Shafag-Asiman Exploration Drilling Project (SAX01)

Environmental and Socio-Economic Impact Assessment

October 2019

Final

ACKNOWLEDGEMENTS

This Environmental and Socio-Economic Impact Assessment (ESIA) for the Shafag-Asiman Exploration Drilling was carried out by AECOM on behalf of BP (Operator) and the Shafag-Asiman Contract Area Production Sharing Agreement Contractor Parties.

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Company

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Individual	Expertise
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Azerbaijan Ministry of Ecology and Natural Resources

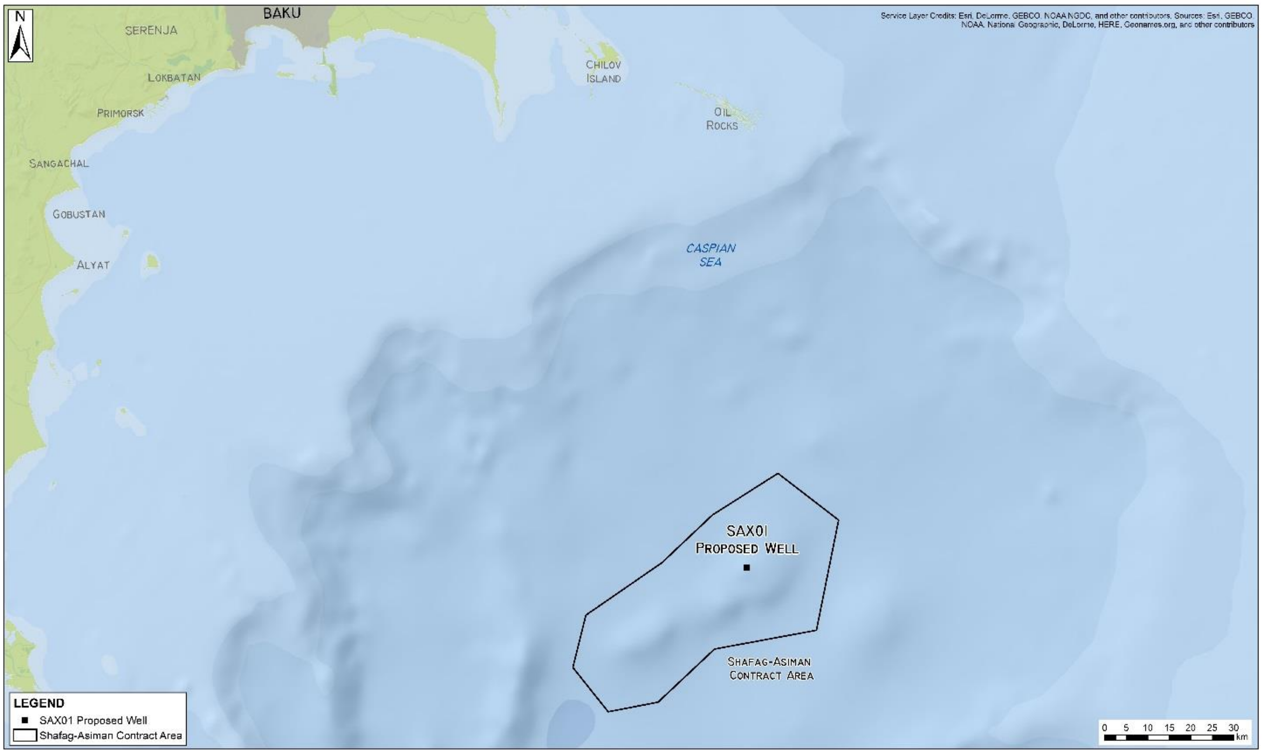
Non-Technical Summary

This Non-Technical Summary (NTS) presents a concise overview of the Environmental and Socio-Economic Impact Assessment (ESIA) prepared for the Shafag-Asiman Exploration Drilling (SAX01) Project to be undertaken in the Shafag-Asiman Contract Area. It is intended to provide a summary of the Project activities, the issues considered in the ESIA and the main conclusions on environmental and socio-economic impacts. Detailed technical description of modelling studies, proposed mitigation measures and monitoring activities are presented in the main sections of the ESIA.

E.1 Introduction

This ESIA has been prepared to identify and assess the potential impacts associated with the drilling activities for the SAX01 exploration well. The indicative location of the Project exploration well is shown in Figure E.1.

Figure E.1 Shafag-Asiman Contract area and Proposed SAX01 Exploration Well Location



E.2 Overview of the Shafag-Asiman Exploration Drilling Project

In 1995 and 1999, 2D seismic surveys were undertaken in Shafag-Asiman Contract Area, followed by a 3D seismic survey in 2012. The seismic, and subsequent geohazard and bathymetry survey results were used to inform the decision making process regarding the exact exploration drilling location. The Shafag-Asiman Contract Area lies approximately 125 km to the south-east of Baku in the Azerbaijan sector of the Caspian Sea, with water depth at SAX01 approximately 624 m. Drilling is expected to commence in Quarter (Q) 4 of 2019 over a period of approximately 440 days. Once drilled it is anticipated the well will be suspended and well testing will be undertaken following a break of between 1 and 3 years due to availability of the well testing rig. As the well test activities are not sufficiently defined at this time they are not included within the Project Base Case and will be considered in a separate permission document to be submitted to the Ministry of Ecology and Natural Resources (MENR) at a later date if it is confirmed that well testing is to be undertaken (based on well logging results).

It is anticipated that the proposed Project exploration well will be drilled using the Heydar Aliyev Mobile Offshore Drilling Unit (MODU).

MODU activities during the Project exploration drilling programme include:

- Preparation of the drilling equipment;
- Drilling of conductor, upper surface and lower well hole section;
- Installing wellhead and cementing casings;
- Well suspension and temporary well abandonment;
- Re-entry and well testing[1]; and
- Well plug and abandonment.

E.3 Alternatives Assessed

A number of alternatives have been evaluated during the project development to inform the base case design, taking into account technical, economic, safety and environmental considerations in addition to lessons learned from BP's extensive experience in exploration well drilling in the Caspian Sea. The proposed Project well location has been selected as having the most promising potential for hydrocarbon discovery following analysis of the 3D seismic data acquired in the Shafag-Asiman Contract Area in 2012. The evaluation of surface, near surface and subsurface hazards to drilling have been considered during the selection of the proposed well location. Alternative locations were therefore discounted as they would not achieve the Project objectives, while possibly leading to a higher risk of experiencing operational problems during drilling.

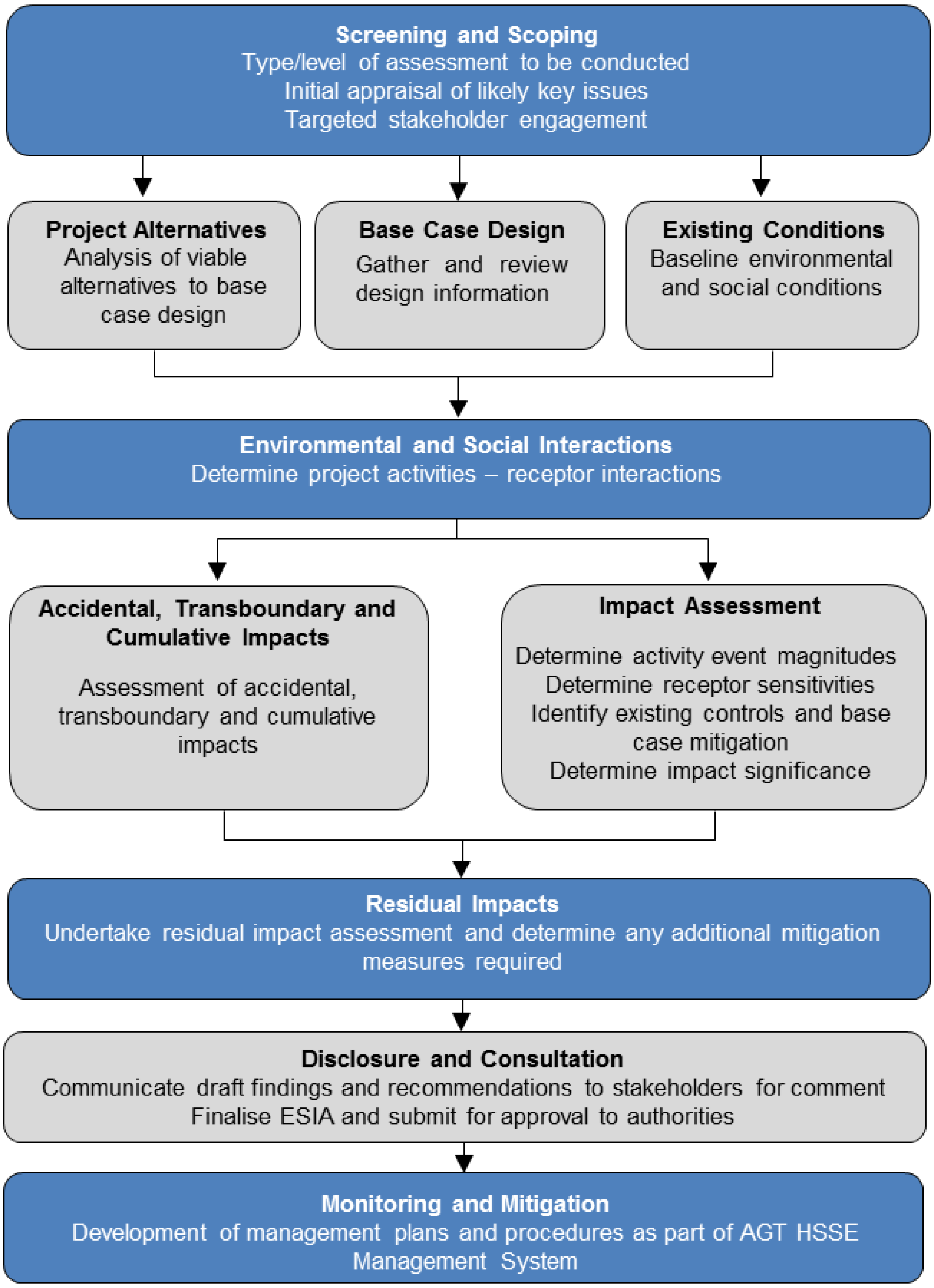
Drilling fluid selection considered two main types of fluids typically used for offshore drilling are water based mud (WBM) and non-water based mud (NWBM). From a technical perspective within the Caspian Sea, WBMs are typically used to drill the top sections of wells, with NWBM more suitable for the lower hole sections. To support the decision for the handling and disposal of WBM and NWBM and cuttings from drilling operations when drilling of wells was initially being planned by BP for the Azeri Chirag Gunashli (ACG) Contract Area a Best Practicable Environmental Option (BPEO) assessment was undertaken. The assessment concluded that the BPEO was that NWBM and cuttings should shipped to shore for disposal, while WBM and cuttings, which meet the relevant project standards, could be discharged to the marine environment. This conclusion was based on the expected low levels of environmental toxicity of the chemicals in the WBM and the localised impact of solids deposition, which will occur near to the discharge point.

E.4 Assessment Methodology

The ESIA has been conducted in accordance with the legal requirements of Azerbaijan. The ESIA process (illustrated in Figure E.2) constitutes a systematic approach to the evaluation of a project and its associated activities throughout the project lifecycle. The overall aim of the ESIA process is to identify, reduce and effectively manage potential negative environmental and socio-economic impacts arising from the Project activities.

[1] Well test activities are not sufficiently defined at this time, are not included within the Project Base Case and will be considered in a separate permission document to be submitted to the MENR at a later date if it is confirmed that well testing is to be undertaken, which will be based on the well logging results.

Figure E.2 The ESIA Process



Assessment of the Project environmental and socio-economic impacts has been undertaken based on identified routine activities and accidental events that have the potential to interact with the environment. The impact significance considers receptor sensitivity and the magnitude of the impact and takes into account existing control measures embedded in the project design.

E.5 Policy, Regulatory and Administrative Framework

The Production Sharing Agreement (PSA) to jointly explore and develop potential prospects in the Shafag-Asiman Contract Area was signed between BP and the State Oil Company of Azerbaijan Republic (SOCAR) in October 2010. 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 Shafag-Asiman Contract Area is set out within the PSA.

The PSA states that the "*Contractor shall conduct the Petroleum Operations in a diligent, safe and efficient manner in accordance with the Environmental Standards and shall take all reasonable actions* *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 and other natural resources and property*".

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 Ministry of Ecology and Natural Resources (MENR). The PSA also makes reference to international petroleum industry standards and practices with which the Project will comply.

E.6 Environmental Impact Assessment

Table E.1 summarises the outcome of impact assessment for the Activities associated with the Project.

Table E.1: Summary of Residual Environmental Impacts Associated with the Project

	Event/ Activity	Overall Score		
		Event Magnitude	Receptor Sensitivity	Impact Significance
Marine Environment	Underwater Sound (MODU Drilling)	Medium	Low	Minor Negative
	Underwater Sound (Vessel Movements)	Medium	Low	Minor Negative
	Drilling Discharges to Sea	Medium	Low	Minor Negative
	Cement Discharges to Seabed	Medium	Low	Minor Negative
	Cement Unit Wash Out Discharges	Medium	Low	Minor Negative
	BOP Testing	Medium	Low	Minor Negative
	MODU Cooling Water Discharges to Sea	Medium	Low	Minor Negative

Underwater Sound

Propagation of underwater sound arising from positioning of the Mobile Offshore Drilling Unit (MODU), drilling the well, and vessel movements were calculated using a simplified geometric spreading model to estimate distances at which various impacts on the marine species known to be present in Caspian Sea may occur. With regards to drilling activities, the modelling results show that permanent threshold shift (PTS) and temporary threshold shift (TTS) may occur in seals if the animals remain within 10 metres (m) of the drilling operations. At distances beyond 10 m the likelihood of any observable reactions quickly falls to insignificant. For fish species it is considered that there is a low risk of mortality and recoverable injury for fish of all hearing abilities and a moderate risk of TTS in hearing generalist fish at short distances from the drilling location.

The calculation showed that, during the mobilisation and demobilisation of the MODU, PTS may occur in seals if they remain within a distance of 10 m from the tugs used to position the MODU for a period of 1 hour. TTS may occur if the seals remain within 109 m of the tug operations for a similar period. At distances beyond 436 m the likelihood of any observable responses to sound is expected to be low. TTS may occur in high sensitivity fish if they remain within 54 m of vessels for a period of 12 hours. Recoverable injury may only occur if they remain in close proximity (within 10 m) to the operations for a period of 48 hours.

In relation to vessel movements during the drilling programme, it was calculated that PTS may occur in seals if they remain within a distance of 506 m of the vessels with the loudest sound source (support vessels) for a period of 1 hour. TTS may occur if the seals remain within 10.9 kilometres (km) from support vessels for a similar period. However, it is expected that seals are likely to move away and are unlikely to remain in the vicinity of the sound long enough to result in PTS or TTS (note however that any movement towards or away from the noise source is context-driven by the seal). Moderate behavioural reactions in seals such as changes in swimming direction and speed may occur at distances up to 116.6 km from support vessels. At distances beyond this the likelihood of any observable responses to sound is low. TTS may occur in fish if they remain within 5.4 km of vessels for a period of 12 hours. Recoverable injury was estimated to potentially occur to high sensitivity fish if they remain in close proximity (within 251 m) to the support vessels for a period of 48 hours; although the likelihood is that they will move away from a disturbing sound source.

Risk of injury or significant behavioural disturbance seals is expected to be very low given the drilling, activities are scheduled to avoid the summer feeding periods when seals are most likely to be present on the area and the control measures that will be established during these activities. Based on the predicted event magnitude, receptor characteristics and observed sensitivities the impact from underwater sound was assessed as being of minor negative significance.

Discharges to Sea

During drilling, the largest discharges to the marine environment by volume are drilling discharges, specifically the discharge of drill cuttings and water based drilling mud, and the discharge of cooling water from the MODU cooling water system. Modelling of the drilling discharges was undertaken to confirm the extent and scale of mud and cuttings predicted to be deposited on the seabed during Project drilling. The modelling has shown that such discharges, which are required to meet applicable standards prior to discharge, have a very limited ecological impact to marine receptors. Based on the predicted event magnitude, receptor characteristics and observed sensitivities the impact significance was assessed as minor negative. Cooling water discharge modelling similarly indicated impacts would be very limited in scale (a few metres) and an impact upon biological receptors in the water column (i.e. zooplankton, phytoplankton, seals and fish) would be of no more than minor negative significance.

Small quantities of excess cement may be discharged to the seabed whilst cementing well casings into place. These will remain close to the wellhead in the same area as drill cuttings are deposited. At the end of well casing cementing activities there will also be small discharges of washout cement from the MODU cement system, which will be diluted with seawater prior to being discharged. Modelling of the cement washout discharges predict that the discharge plume will dilute rapidly and no cement solids would be deposited on the seabed. The impact to benthic invertebrates and seals, fish and plankton, which were evaluated as having a low sensitivity to cement discharges, resulting in a minor negative significance.

During drilling, a blowout preventer (BOP) will be installed on the well to control pressure in the well. The BOP control system uses hydraulic fluids to actuate the BOP valves. Testing of the valves is expected to occur weekly, resulting in discharge of control fluids to sea. Modelling of a similar BOP control fluid discharge conservatively assumed that the discharge would require a dilution of 500-fold to reach the no-effect concentration. The modelling results show that the maximum extent of the 500-fold dilution plume area during summer is approximately 28 m long, 6 m wide and that the plume will completely disperse in the water column to the no-effect concentration within 15 minutes. The impact to benthic invertebrates and seals, fish and plankton, which were evaluated as having a low sensitivity to BOP fluid discharges, was therefore assessed as being of minor negative significance.

For all 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.

E.7 Cumulative, Transboundary and Accidental Events

Potential cumulative and transboundary impacts were assessed taking into account potential for inter project impacts as well as other potentially significant projects where the associated impacts may overlap geographically or temporally with Project impacts. The most significant project where this potential exists is the Shah Deniz Stage 2 (SD2) Project, which achieved first gas during 4Q 2018[2].

With regard to discharges within the water column, the majority of the Project discharges are small, and are comparable to discharges associated with previous MODU drilling activities. There is limited potential for the Project drilling and MODU discharges (e.g. drill cuttings and cooling water discharges) to interact given the temporal and spatial differences between the discharge events and locations. The largest discharges will be confined to a small area of seabed (drilling discharges) or will be short in duration. All of these discharges will be dispersed and diluted to concentrations below the threshold of impact within (at most) a few hundred metres of the source and therefore have no potential for cumulative impacts. All of the discharges associated with the Project have been assessed, and it is concluded that there will be no cumulative or additive interactions between the impacts.

Based on the findings of the SD2 Project ESIA (which predicted minor and localised impacts from discharges to sea with magnitude limited to no more than a few kilometres from the drilling rig, project vessel, platform or subsea installation) it is considered very unlikely there will be cumulative impacts within the marine environment between the Project and SD2 Project planned activities given the scale of the impacts anticipated and the distance between the Project activities and any future development within the SD Contract Area.

It is considered that the potential socio-economic cumulative impacts to other marine users such as fishing and shipping that may arise as a result of the Project in combination with the SD2 Project (where construction and installation activities are largely complete) will be very limited and insignificant. This is due to the short-term duration of the Project activities and that the proposed SAX01 well is not located in an area of importance to small-scale or commercial fishing nor is it located near known major shipping routes.

Greenhouse gases (GHG) have the potential to give rise to transboundary impacts. The estimated GHG emissions associated with Project represent approximately 1.1.% of the annual operational GHG emissions from BP's upstream activities in Azerbaijan based on GHG emissions data from 2018.

To support the assessment of unplanned events, modelling of potential hydrocarbon spill scenarios using Stiftelsen for Industriell og Teknisk Forskning (SINTEF)'s Oil Spill Contingency and Response (OSCAR) modelling software was undertaken to predict the behaviour of the spilled hydrocarbon in the water column and on the sea surface and to estimate where and how much spilled hydrocarbon may come ashore. It must be noted that modelling has not taken into account any response mitigation measures such as dispersant application, containment or recovery, meaning that the results should only be interpreted as indication of theoretical spill consequences without implementation of the oil pollution prevention strategy. The key accidental event scenarios modelled and assessed included:

- Scenario 1: MODU inventory loss of 1500 m^3 of diesel;
- Scenario 2: A blowout of gas / condensate (34816 barrels (bbls/day) over 224 day duration.

The modelling predicts that following the release of 1500 m^3 of diesel it will initially spread across the sea surface, and over the first seven days following the release around 56% of the diesel evaporates and 16% is dispersed into the water column. Dispersion and dissolution into the upper water column takes place very close to the release point to a depth of 40-60 m. Biodegradation also progresses relatively quickly such that only a very small fraction of diesel in the water column is left after 30 days. After 30 days 61% of the diesel evaporates, 30% is biodegraded, 5% remains in the water column, 2% is deposited in sediments and 2% will reach the coastline. The spill modelling indicates that the concentrations of diesel in the water column above the 58 parts per billion (ppb) threshold are limited in extent from the point of release and are not expected to persist for longer than 5 days. The modelling predicts there will only be a very light deposition of diesel where it comes ashore.

[2] While SD2 Project operations and first gas commenced in Q4 2018 the potential effects of the SD2 Project are not captured within the existing baseline conditions described in Chapter 5 against which the Project impacts have been assessed. Therefore, for the purposes of this ESIA, the SD2 Project activities and impacts have been considered within the Project assessment.

Modelling for the blowout event was based on a worst case estimate that the release would continue for an estimated 224 days, based on the anticipated time it would take to drill a relief well. During this time, approximately 34816 bbls/day of condensate would be released per day. The modelling predicts the majority of the condensate is initially present on the sea surface following the release, while 20% evaporates almost immediately and 5% is dispersed into the water column. Throughout the 224 days release period, condensate is continually supplied to the surface. Dependent on the wind and waves, it can continue to be mixed into the water column during rougher weather with some condensate subsequently re-surfacing during calmer periods. After approximately 18 days, condensate has moved into shallower waters along the Azerbaijan coastline and begins to start to deposit in sediments and accounts for 8% of the condensate at the end of the simulation.

Condensate on the sea surface is predicted to travel up to 400-500 km before it drops below the lowest recognised visible thickness under ideal viewing conditions. Although the precise movement of the surface condensate is dependent on the exact metocean conditions at the time, the analysis of over 100 different sets of metocean data suggest that the most likely locations to receive condensate on shore are southern Azerbaijan, northern Iran and the tip of the Absheron Peninsula. The extent of condensate in the water column above the 58 ppb threshold tracks the path of the surface release and can extend over 500 km from the source. The modelling predicts that a blowout under worst case conditions could result in 32198 tonnes of condensate reaching the coastline and that this would mainly impact three areas: southern Azerbaijan, northern Iran and the Absheron Peninsula. The eastern coastline of the Caspian Sea is unaffected. A mixture of areas of very light, light (0.1-1mm), moderate (1-10mm) and heavy (>10mm) condensate deposition are predicted in these areas. 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 higher concentrations. These wax particles may melt in the sun during the day and soak into sandy shoreline substrates.

In the event of a blowout, species in the immediate vicinity of the spill that cannot actively avoid the condensate such as plankton, benthic invertebrates, birds and seals are likely to suffer the greatest impacts. Highly mobile species such as fish are anticipated to largely avoid the spilled oil areas. The modelling of the blowout shows that a number of Important Bird Areas (IBAs) and Key Biodiversity Areas (KBAs), and associated bird species may be exposed to elevated hydrocarbon concentrations as a result of surface or dispersed / dissolved oil beaching on the shoreline. Given the volume of condensate predicted to beach in some IBAs and KBAs the potential impact on IBAs and KBAs (and the birds present there) could be potentially significant, especially if the release occurs during the bird nesting period (April to July).

In the event of a blowout the potential impacts are assumed to be significant for the areas impacted by the spill and it is anticipated that recovery would take a period of time in the medium to long term. However, compared to crude oils, the condensate reaching the shore will contain lower levels of potentially toxic chemical compounds. Therefore, the ecological effects of condensate coming ashore are likely to be much less severe than would be the case for emulsified crude oil coming ashore. The impact on fisheries would be reflected by the impact on fish and the presence of juvenile stages at the time of a spill as they are more susceptible to relatively low levels of oil within the water column and are less likely to be able to move away. Fish can become tainted and contaminated with hydrocarbons. If there are signs of fish oil tainting or contamination as a consequence of a hydrocarbon spill event, any resultant imposed authority restrictions on fishing activities could result in a detrimental financial impact upon local fisheries. Equally, a lack of timely restrictions, or illegal fishing, can create a risk to human health from contaminated product consumption. Therefore, the impact to the commercial fishing industry in the unlikely event of a blowout or pipeline rupture is considered to be potentially significant.

The BP Azerbaijan Georgia Turkey (AGT) Region Offshore Facilities Oil Spill Contingency Plan (OSCP) provides guidance and actions to be taken during a hydrocarbon spill incident associated with all ACG and SD 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. This plan will be updated to include activities within the Shafag-Asiman Contract Area.

E.8 Environmental and Social Management

BP will have overall responsibility for managing the Project activities and will be monitoring and verifying the implementation of environmental and socio-economic mitigation measures detailed in this ESIA.

The Project specific environmental and social management plans will be developed by BP before the Project commences. The plans, procedures and reporting requirements for the MODU and those relevant to drilling activities will be aligned to the existing BP and MODU Operator's Health Safety and Environmental (HSE) Management System (MS), the Health Safety, Security and Environment (HSSE) Bridging Document and the BP MODU Environmental Operating Procedure and associated Environmental Monitoring & Reporting Forms. The plans will cover the following topics:

- Environmental Management;
- Pollution Prevention Management;
- Waste Management; and
- Communication.

The plans will identify key criteria (e.g. waste volumes, discharge parameters, communication frequency, etc.) that will be used to measure environmental and social performance.

BP will verify that mitigation measures and commitments set out in this ESIA are implemented. This will be achieved through periodical environmental checks and reviews, the results of which will be documented within "Site Inspection Reports". An action-tracking system will be maintained to monitor close-out actions and the effectiveness of actions taken in response to findings.

E.9 ESIA Consultation and Disclosure

The scope of the ESIA was agreed with the MENR at a scoping meeting held in 15th January 2019. A public consultation and disclosure meeting was held in Baku on 11th September 2019 and a disclosure meeting with the MENR on 12th September 2019. Where relevant, the issues raised at these meetings have been incorporated into the Final ESIA.

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Appendices

Units and Abbreviations

Units

%	Percent
% vol.	percentage by volume
μg/g	Micrograms per gram
μg/l	Micrograms per litre
$\mu g/m^3$	Micrograms per cubic meter
μm	Micrometer
μPa	Micro Pascal
˚C	Degrees Celsius
˚	Degrees
“	Inches
+/-	Plus/minus
<	Less than
>	Greater than
bbl	Barrel (6.2898 barrels = 1 m3)
cm	Centimetre
cm/year	Centimetres per year
dB	Decibel
dB(A)	A weighted unit of sound intensity weighted in favour of frequencies audible to the human ear
dB L_{AEQ}	Sound pressure level
dBrms	Root mean square sound pressure
g/l	Grams per litre
ha	Hectare
hr	Hour
Hz	Hertz
in	Inches
kg	Kilograms
km	Kilometre
km^2	Square kilometre
Knots	Measurement of wind speed (1 Knot = 0.514 m/s)
kW	Kilowatt
LC_{50}	Lethal Concentration 50. The concentration of a chemical which kills 50% of a sample population.
l/h	Litres per hour
l/MMscfd	Litres per million standard cubic feet per day
l/m^2	Litres/square meter
m	Metres
m^2	Square metres
m^3	Cubic metres
m^3/day	Cubic metres per day
m^3/hr	Cubic metres per hour
m^3/person/day	Cubic metres per person per day
m/s	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)
ml	Millilitres
mm	Millimetres
mm/year	Millimetres per year
MPN	Most Probable Number
MPN/100ml	Most Probable Number per 100 millilitres

ng/g	Nanogram per gram
pH	-log 10 [H+] (Measure of acidity or alkalinity)
PM_{10}	Particulate matter measuring 10µm or less in diameter
ppb	Parts per billion
ppbv	Parts per billion by volume
ppm	Parts per million
ppm/m^3	Parts per million per cubic metre
ppmv	Parts per million by volume
ppmw	Parts per million by weight
PSU	Practical saline unit
dB_{PEAK} re. 1 µPa	Peak decibels relative to one micropascal
dB re. 1 µPa	Decibels relative to one micropascal
2D	Two dimensional
3D	Three dimensional
1Q	Quarter one (of year)
2Q	Quarter two (of year)
3Q	Quarter three (of year)
4Q	Quarter four (of year)

Chemical Elements and Compounds

As	Arsenic
Ba	Barium
BTEX	Benzene, toluene, ethylbenzene, xylene
Cd	Cadmium
CH_4	Methane
Co	Cobalt
CO	Carbon Monoxide
CO_2	Carbon Dioxide
Cr	Chromium
Cu	Copper
H_2S	Hydrogen Sulphide
Hg	Mercury
HNO_3	Nitric Acid
KCl	Potassium Chloride
MEG	Mono Ethylene Glycol
Mn	Manganese
NaCl	Sodium Chloride
Ni	Nickle
NH4	Ammonium
NO	Nitrogen Oxide
NO_2	Nitrogen Dioxide
NO_x	Nitrogen Oxides
NMVOC	Non-methane volatile organic compounds
NPD	Naphthalenes, phenanthrenes and dibenzothiophenes
P	Phosphorous
PAH	Polycyclic aromatic hydrocarbons
Pb	Lead
PCB	Polychlorinated biphenyls
PHB	Pre Hydrated Bentonite
PO4	Phosphates
SiO2	Silicates
SO_2	Sulphur Dioxide
SO_x	Sulphur Oxides
Zn	Zinc

Abbreviations

ACE	Azeri Central East
ACG	Azeri Chirag Gunashli
AGT	Azerbaijan Georgia Turkey
ANAS	Azerbaijan National Academy of Sciences
AzRDB	Azerbaijan Red Data Book
BOD	Biological Oxygen Demand
BOP	Blow Out Preventer
BPEO	Best Practicable Environmental Option
Bpd	Barrels per day
BRT	Below rotary table
BS	British Standard
CDV	Canine Distemper Virus
CEFAS	Centre for Environment, Fisheries and Aquaculture Science
CHARM	Chemical Hazard Assessment and Risk Management
CITES	Convention on International Trade in Endangered Species of Wild Fauna and Flora
CTD	Conductivity Temperature Depth
COD	Chemical Oxygen Demand
DDT	Dichlorodiphenyltrichloroethane
DPRAB	Department on the Protection and Reproduction of Aquatic Bioresources
DREAM	Dose-related Risk Effects Assessment Model
E&P Forum	Exploration and Production Forum
EBS	Environmental Baseline Survey
EIA	Environmental Impact Assessment
EMS	Environmental Management System
EMP	Environment Management Plan
EN	Endangered (IUCN Red List)
ENP	European Neighbourhood Policy
ES	East South
ESIA	Environmental and Social Impact Assessment
ETN	Environmental Technical Note
EU	European Union
GDP	Gross Domestic Product
GHG	Greenhouse Gas
GIWA	Global International Waters Assessment
HOCNF	Harmonised Offshore Chemical Notification Format
HOCNS	Harmonised Offshore Chemical Notification Scheme
HSE	Health, Safety & Environment
HSE MS	Health, Safety & Environmental Management System
HSSE	Health Safety Security and Environment
IADC	International Association of Drilling Contractors
IAGC	International Association of Geophysical Contractors
IBAs	Important Bird Areas
IOGP	International Association of Oil and Gas Producers
IUCN	International Union for the Conservation of Nature
KBAs	Key Biodiversity Areas
LC	Least concern (IUCN Red List)
LCM	Loss Control Materials
LTMOBM	Low Toxic Mineral Oil Based Mud
LV	Low Vulnerability (IUCN Red List)
LWD	Logging While Drilling
MAC	Maximum Allowable Concentration
MEG	Mono Ethylene Glycol
MARPOL	International Convention for the Pollution of Prevention by Ships, 1973, as modified by the Protocol of 1978
MENR	Ministry of Ecology and Natural Resources
MEPC	Marine Environment Protection Committee
MES	Ministry of Emergency Situations

MODU	Mobile Offshore Drilling Unit
MPN	Most Probable Number
MRS	Mud Recovery System
MSDS	Material Safety Data Sheet
N	North
NF	Northern Flank
NGO	Non-Governmental Organisation
NKG	Nad Kirmakinskaya Glinistaya
Non GHG	Non Greenhouse Gas
NOAA	National Oceanic Atmospheric Administration
NP	National Park
NS	Not Significant
NTS	Non-Technical Summary
NWBM	Non-Water Based Mud
OCNS	Offshore Chemical Notification Scheme
OMS	Operating Management System
OSCAR	Oil Spill Contingency and Response
OSCP	Oil Spill Contingency Plan
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 Plan
PCA	EU-Azerbaijan Partnership and Cooperation Agreement
PCDP	Public Consultation and Disclosure Plan
PDF	Potential Dangerous Facilities
PEC	Predicted Environmental Concentration
PHB	Pre Hydrated Bentonite
PNEC	Predicted No-Effect Concentration
POB	Persons On Board
PSA	Production Sharing Agreement
PSU	Practical Saline Unit
RAMSAR	Convention on the, Protection of wetlands of international importance
ROV	Remotely Operated Vehicle
SAX01	Shafag-Asiman Exploration Drilling Proposed Well
SB	Swim Bladder (fish)
SCS	Solids Circulation System
SD	Shah Deniz
SD1	Shah Deniz Stage 1
SD2	Shah Deniz Phase 2
SDB	Shah Deniz Bravo
SEE	State Ecological Expertise
SEL	Sound Exposure Level
SELcum	Cumulative Sound Exposure Level
SINTEF	Stiftelsen for Industriell og Teknisk Forskning
SOBM	Synthetic Oil Based Mud
SOCAR	State Oil Company of Azerbaijan Republic
SOPEP	Ship Oil Pollution Emergency Plans
SPL	Sound Pressure Level
ST	Sangachal Terminal
STP	Sewage Treatment Plant/Package
SWRP	Subsea Well Response Project
SWAP	Shallow Water Absheron Peninsula
TD	Target Depth
THC	Total Hydrocarbon Content
TPH	Total Petroleum Hydrocarbon
TSS	Total Suspended Solids
TTS	Temporary Threshold Shift
TVD	True Vertical Depth
UCM	Unresolved Complex Mixture
UK	United Kingdom

UN	United Nations
UNECE	United Nations Economic Commission for Europe
UNEP	United Nations Environment Programme
UNESCO	United Nations Educational, Scientific and Cultural Organisation
US$	United States Dollars
US$M	United States Dollars (Millions)
V	Vulnerable (IUCN Red List)
VOC	Volatile Organic Compounds
WBM	Water Based Mud
WDPA	World Protected Areas Database
WF	Western Flank
WTNs	Waste Transfer Notes

1 Introduction

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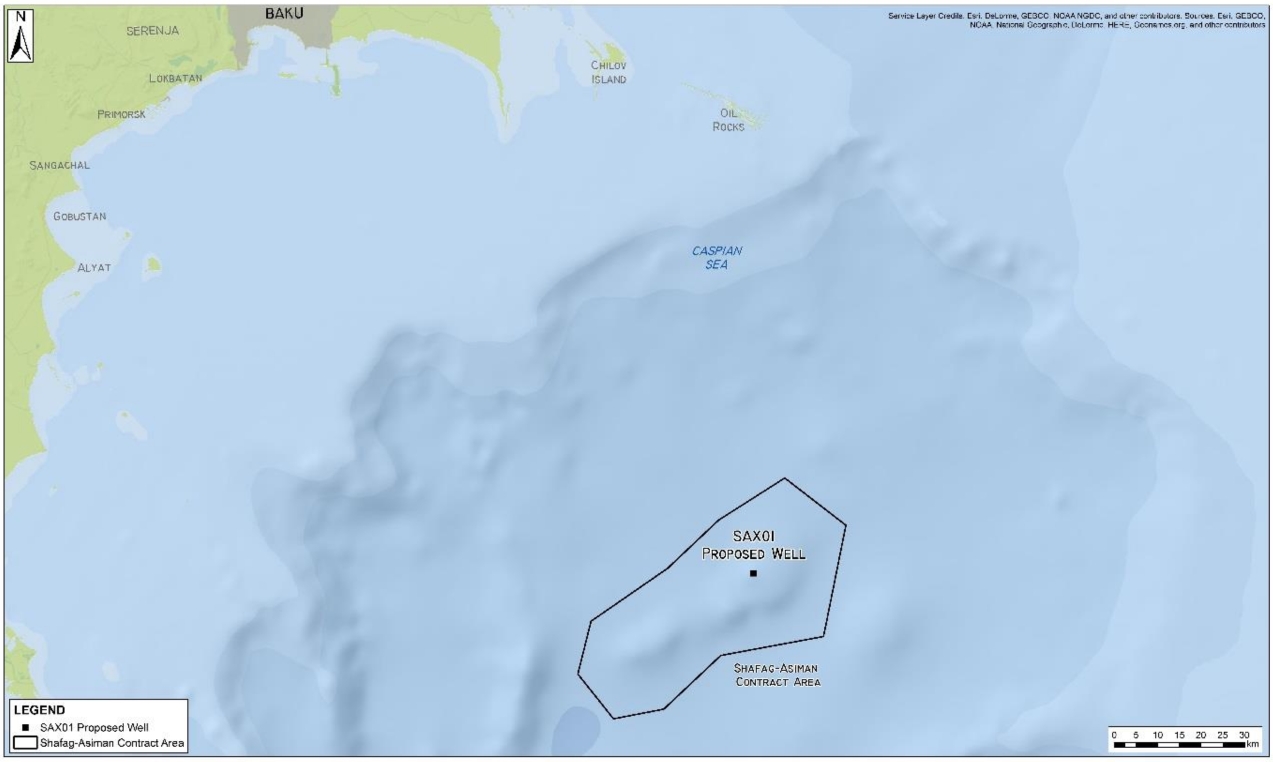
1.1 Introduction

This Environmental and Socio-Economic Impact Assessment (ESIA) has been prepared for the Shafag-Asiman Exploration Drilling Project. The Shafag-Asiman Contract Area lies approximately 125 km to the south-east of Baku in the Azerbaijan sector of the Caspian Sea.

This ESIA Report has been prepared to identify and assess the potential impacts associated with the Shafag-Asiman exploration well (SAX01) drilling activities within the Shafag-Asiman Contract Area. The indicative location of the SAX01 well is shown in Figure 1.1.

Figure 1.1 Shafag-Asiman Contract Area and Proposed SAX01 Exploration Well Location



In October 2010, BP signed a Production Sharing Agreement (PSA)[3] with the State Oil Company of the Azerbaijan Republic (SOCAR) to jointly explore and develop potential prospects in the Shafag-Asiman Contract Area.

1.1.1 Shafag-Asiman Activities Undertaken to Date

Initial geological studies indicated that there are potential hydrocarbon reservoirs within the Shafag-Asiman Contract Area**.** To characterise the subsurface geology and these potential reservoirs within the Contract Area two seismic surveys were undertaken:

- A two dimensional (2D) seismic survey within the deeper waters of the Contract Area and the surrounding areas (undertaken between 1995 and 1999); and
- A three-dimensional (3D) seismic survey within the Shafag-Asiman Contract Area (undertaken in 2012).

Prior to undertaking the 3D survey, an ESIA report (Ref. 1) was prepared to evaluate the survey activities and potential impacts, and provide relevant mitigation and monitoring measures.

[3] Specifically, Agreement on the Exploration, Development And Production Sharing For the Shafag-Asiman Contract Area in the Azerbaijan Sector of the Caspian Sea.

1.1.2 Shafag-Asiman Exploration Drilling Project

The Shafag-Asiman Contract Area is situated in waters approximately 600-800 metres (m) deep with oil reserves located approximately 6000 m to 7000 m below sea-level[4]. It is currently planned to commence drilling the SAX01 exploration well in Q4 2019. Drilling activities are expected to take up to approximately 440 days followed by a potential pause (1-3 years) between the end of drilling activities and the start of well testing (if required) activities. As the well test activities are not sufficiently defined at this time they are not included within the Project Base Case and will be considered in a separate permission document to be submitted to the Ministry of Ecology and Natural Resources (MENR) at a later date if it is confirmed that well testing is to be undertaken.

Drilling of the SAX01 well will be carried out taking into account applicable national and international legal requirements and in accordance with the requirements of the Shafag-Asiman PSA. The key objective of drilling the SAX01 well is to evaluate the gas resource in the Nad Kirmakinskaya Glinistaya (NKG), Fasila and Balakhany reservoirs prior to the potential further future development of the Contract Area.

1.2 Scope of the Shafag-Asiman Exploration Drilling Project ESIA

The overall objective of the Shafag-Asiman Exploration Drilling Project ESIA process is to ensure that any adverse environmental or socio-economic impacts arising from the proposed drilling activities are identified and, where possible, eliminated or minimised through early recognition of, and response to, the issues.

The purpose of the ESIA is to:

- Ensure that environmental and socio-economic considerations are integrated into the Project design and operation;
- Ensure that previous relevant 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 performance is planned and achieved for the project;
- Ensure that applicable legal, operator and PSA requirements and expectations are addressed;
- Consult with project 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, the drilling 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 which form part of the Project design, typically developed from previous drilling projects undertaken by BP in the region.

1.3 Approach to the ESIA and Structure

This ESIA Report, has been prepared by AECOM on behalf of BP for submission to the MENR. Table 1.1 presents a summary of the ESIA Report structure and the anticipated scope of the ESIA Report.

[4] Measured in true vertical depth (TVD) below Mean Caspian Sea Level

Table 1.1 Structure and Content of Shafag-Asiman Exploration Drilling Project ESIA Report

Chapter	Shafag-Asiman Exploration Drilling Project ESIA
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.
Introduction	An overview of Shafag-Asiman Contract Area; background and purpose; the ESIA objectives; details of ESIA team members and ESIA Report structure.
Policy, Regulatory and Administrative Framework	A summary of applicable legislative requirements including those associated with the Shafag-Asiman PSA, ratified international conventions, International Petroleum Industry Standards and Practices and applicable national legislation and guidance.
Impact Assessment Methodology	A description of the methods used to conduct the ESIA and an overview of the consultation undertaken during the ESIA programme.
Project Description	A detailed description of the SAX01 exploration well activities.
Environmental Description	A description of the environmental and socio-economic baseline conditions in the vicinity of the SAX01 exploration well.
Environmental and Socio-economic Impact Assessment, Monitoring and Mitigation	An assessment of the potential environmental and socio-economic impacts associated with the SAX01 exploration well activities, including any necessary mitigation and monitoring.
Cumulative, Transboundary and Accidental Events	An assessment of the potential cumulative and transboundary impacts and accidental events associated with the SAX01 exploration well activities.
Environmental and Socio-Economic Management	A summary of the environmental and social management system associated with the SAX01 exploration well activities.
Residual Impacts and Conclusions	A summary of the residual impacts and conclusions arising from the ESIA process.
Appendices	Supporting technical information.

1.4 ESIA Team

The details of the Shafag-Asiman Exploration Drilling Project ESIA Team are provided in Table 1.2.

Table 1.2 Shafag-Asiman Exploration Drilling Project ESIA Team

Team Member	Role
AECOM	ESIA Project Manager and Lead Authors
	Air Dispersion Assessment
	Noise and Vibration Assessment
	Underwater Sound Assessment
	Marine Ecology Assessment
	Socio-economic Assessment
Mehman M. Akhundov	Local Fish and Fisheries Specialist
Tariel Eybatov	Local Caspian Seal Specialist
Ilyas Babayev	Local Bird Specialist
More Energy	Spill Modelling Specialist
	Discharge Modelling Specialist
BP	Shafag-Asiman Contract Area PSA Technical Operator

1.5 References

Ref.	Title
1	AETC on behalf of BP (2011), Shafag Asiman Offshore Block 3D Seismic Exploration Survey Environmental Impact Assessment

2 Policy, Regulatory and Administrative Framework

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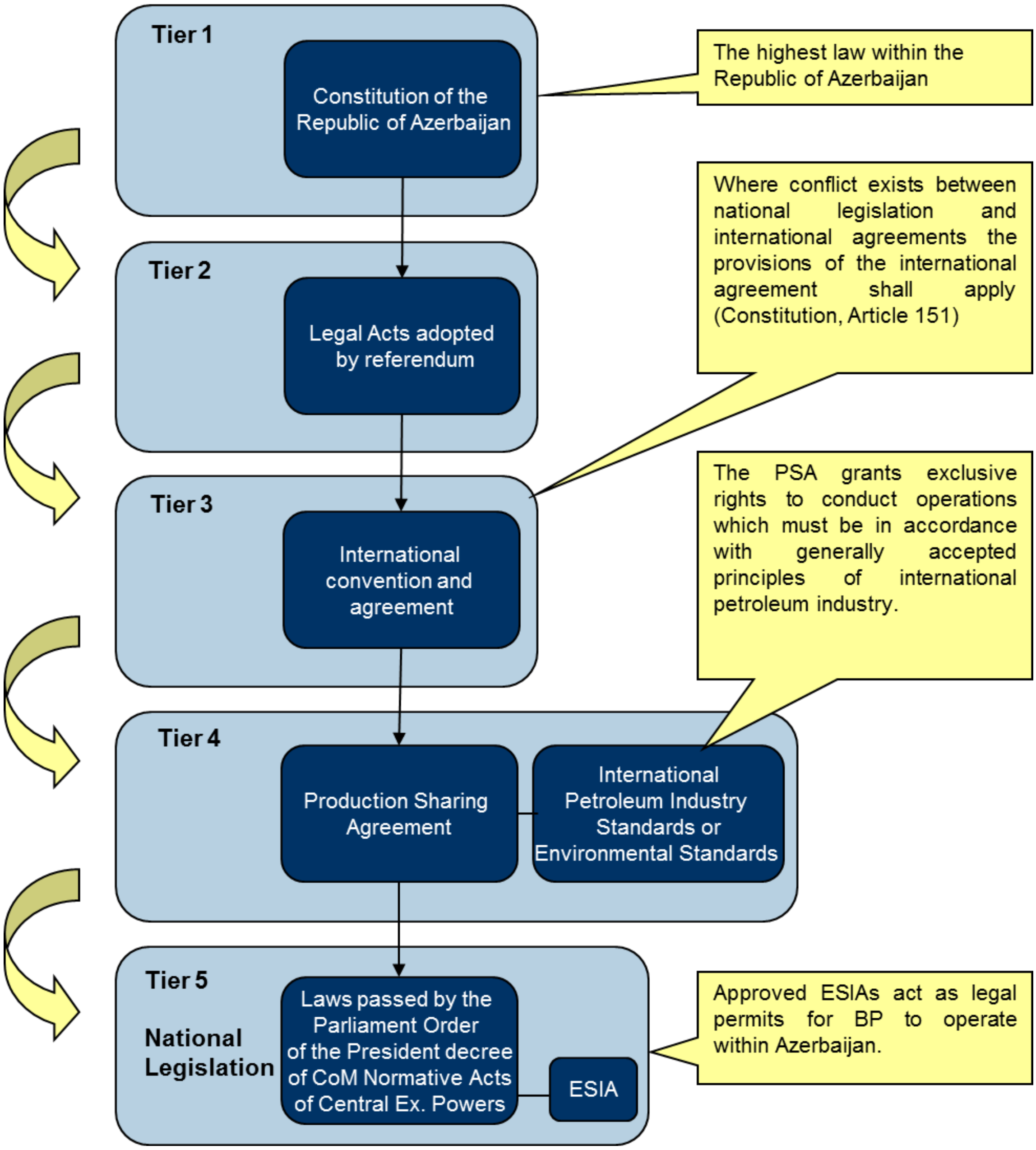
2.1 Introduction

This Chapter of the Environmental and Socio-Economic Impact Assessment (ESIA) provides an overview of the agreements, legislation, standards and guidelines which are applicable to the Shafag-Asiman Exploration Drilling Project including the following:

- Shafag-Asiman Production Sharing Agreement (referred to herein as the “PSA”);
- Applicable national legislation and guidance;
- Applicable requirements of international and regional conventions ratified by the Azerbaijan government;
- Regional processes; and
- International petroleum industry standards and practices.

The legal hierarchy applicable to the Shafag-Asiman Exploration Drilling Project is illustrated in Figure 2.1.

Figure 2.1 Azerbaijan Legal Hierarchy



In addition to the applicable legal requirements, the Shafag-Asiman Exploration Drilling Project will be undertaken, where applicable, in accordance with BP Group, Segment and Regional guidelines.

2.2 Regulatory Agencies

The Ministry of Ecology and Natural Resources (MENR) has primary responsibility for environmental regulation. The MENR's statutes were adopted by presidential decree in 2001, making this body responsible for:

- Development of draft environmental legislation for submission to the Azerbaijan Parliament (Milli Mejlis[5]);
- Implementation of environmental policy;
- Enforcement of standards and requirements for environmental protection;
- Suspension or termination of activities not meeting set standards;
- Advising on environmental issues;
- Expert review and approval of environmental documentation, including Environmental Impact Assessment (EIA) and ESIA; and
- Implementation of the requirements set out in international conventions ratified by the Azerbaijan Republic (within its competence).

Other ministries and committees have functions that relate to environmental regulation including:

- **Ministry of Emergency Situations (MES)** - responsible for the management of natural disasters and industrial accidents and the implementation of safety rules in construction, mining and industry. MES (along with the State Oil Company of the Azerbaijan Republic (SOCAR), MENR and other appropriate Ministries) require prompt notification in the event of an emergency, or accident;
- **Ministry of Health** - state institution controlling the sanitary-epidemiological situation in the country and regulation of health protection in the work place; and
- **Ministry of Energy** - responsible for oil and gas activities, the sale of oil and gas products, and the efficient utilisation of Azerbaijan's energy resources.

2.3 The Constitution

The Constitution is the highest law in the Republic of Azerbaijan and prevails over national legislation and international agreements. The following Articles help determine the applicability of national and international requirements to the proposed Shafag-Asiman Exploration Drilling Project:

- **Article 148.II** - International agreements acceded to by the Republic of Azerbaijan become an integral part of the legislative system of Azerbaijan; and
- **Article 151** - If any conflicts arise between the normative-legal acts which constitute the legislative system of Azerbaijan (except for the Constitution and the acts adopted via referendum) and the international agreements acceded to by the Republic of Azerbaijan, the provisions of the international agreements shall apply.

The Constitution (Article 39) also 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.

2.4 Production Sharing Agreement

The PSA is the legally binding agreement for the joint development of the Shafag-Asiman Exploration Drilling Project in the Azerbaijan sector of the Caspian Sea. It was signed on 7th October 2010 between SOCAR and BP. The proposed Exploration Drilling will be managed by BP as the Contractor under the

[5] Milli Mejlis is the name of the National Parliament of the Republic of Azerbaijan.

PSA. Under the terms of the PSA, Contractor has the right, for the entire term of the PSA, to explore, develop and produce hydrocarbons from the Shafag-Asiman offshore field.

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 and shall take all reasonable actions 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 and other natural resources and property*.

Article 26.1 of the PSA states:

"*Contractor shall develop jointly with SOCAR and the Ministry of Ecology and Natural Resources of the Republic of Azerbaijan ("MENR") safety and environmental protection standards and practices appropriate for the regulation of Petroleum Operations*[6].

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 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 MENR. Such substitution shall take effect following the written agreement between Contractor, SOCAR and MENR on a date agreed between the Parties and MENR and from such date such agreed standards and practices shall have the force of law as if set out in full in the Agreement*."

At the time of writing, Environmental Standards specific to the Shafag-Asiman Contract Area have not been developed. As such the standards and practices set out in part II of Appendix 9 to the PSA shall continue to apply.

Article 26.4 of the PSA requires BP to:

"…*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*"

Appendix 9 of the PSA describes the standards and practices common for international petroleum industry that were in existence when the PSA was signed. Appendix 9 also stipulates the requirement for an environmental impact assessment to be completed for exploration drilling activities.

2.5 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 Shafag-Asiman Exploration Drilling Project are listed in Tables 2.1 and 2.2.

[6] 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, building rail or roads for loading facilities, building connecting entry point to the rail network or to existing pipelines, handling, lifting, transporting Petroleum to the Delivery Point and marketing of Petroleum from, and abandonment operations with respect to the Contract Area*."

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.
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 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.
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.
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.
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

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. Three protocols have been adopted and therefore form the basis for national legislation and regulations. One protocol, namely Environment Impact Assessment in a Transboundary Context, has been drafted and was not adopted at the time of writing.	Convention is ratified, and the following protocols have been adopted: The Protocol Concerning Regional Preparedness, Response and Co-operation in Combating Oil Pollution Incidents ("Aktau Protocol") (August 2011); The Protocol for the Protection of the Caspian Sea against Pollution from Land-based Sources and Activities ("Moscow Protocol") (December 2012); and The Protocol for the Conservation of Biological Diversity ("Ashgabat Protocol") (May 2014).

* 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.

2.6 National Environmental and Social 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 proposed Shafag-Asiman Exploration Drilling Project will comply with the intent of current national legal requirements of general applicability with respect to public health, safety and the protection and restoration of the environment, to the extent that such laws and regulations are no more stringent than the 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.

As of 12th June 2018, Azerbaijan introduced a law on Environmental Impact Assessment which establishes a legal, economic and organisation framework for assessment of impacts on natural environment and human health associated with economic activities proposed by public and private developers (Ref.1). The objectives and principles of this law, and how it interacts with existing guidance are outlined in Section 2.6.1.

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

Table 2.3 Key National Environmental and Social Laws[7]

Subject	Title	Description / Relevance to Shafag-Asiman Exploration Drilling Project
General	Law of Azerbaijan Republic on Environmental Impact Assessment (EIA) No. 1175-VQ.	Determines the legal framework for the Environmental Impact Assessment process in Azerbaijan and outlines the objectives and principles of EIA. It also introduces a list of mandatory activities that require an EIA and identifies the rights and responsibilities of all parties involved in its' preparation, approval and communication.
	Law of Azerbaijan Republic on the Protection of the Environment No. 678-IQ.	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.	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.	Determines the legal basis for protected natural areas and objects in Azerbaijan.
	Law of Azerbaijan Republic on Fauna No. 675-IQ.	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).	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.

[7] This table is compiled from a variety of sources including: Ref.2, Ref.3 and Ref.4

Subject	Title	Description / Relevance to Shafag-Asiman Exploration Drilling Project
	Rules of Referral of Specially Protected Water Objects to Individual Categories, Cabinet of Ministers Decree No. 77.	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).
	Rules for Protection of Surface Waters from Waste Water Pollution, State Committee of Ecology Decree No. 1.	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.	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.	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.	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.	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

Subject	Title	Description / Relevance to Shafag-Asiman Exploration Drilling Project
		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.	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 Azerbaijani Law.
Health & Safety	Law on Sanitary-Epidemiological Services (authorised by Presidential Decree No. 371).	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.	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.
	Law of the Azerbaijan Republic on Public Radiation Safety No. 423-IQ.	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.
	Law of Azerbaijan on Technical Safety - 733-IQ	The current law sets legislative, economic and social basis of PDF (Potential Dangerous Facilities) exploitation.
Liability	Law of the Azerbaijan Republic on Mandatory Environmental Insurance.	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.	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.

2.6.1 National EIA Legislation and Guidance

The mandatory EIA requirements within Azerbaijan are set out within the Law of Azerbaijan Republic on Environmental Impact Assessment ("EIA Law") The purpose of the EIA Law is to give effect to Article 54.2 of the Law on the Protection of the Environment in Azerbaijan, establishing the legal, economic and organisation framework for assessment of impacts on natural environment and human health associated with economic activities proposed by public and private developers.

Under this law, an EIA must be undertaken with reference to the following key principles:

- Based on an analysis of environmental and socio-economic effects of the proposed activity;
- Ensuring accuracy, transparency and reliability of environmental information relevant to the proposed activity;
- Taking into account the requirement for preservation of ecological balance and biodiversity;
- Forecasting all possible environmental impacts and assessment of risk;
- Confirming compliance of the proposed activity with established permissible limits;
- Ensuring public disclosure, consultation and consideration of public representatives in addition to participation of government and municipal bodies, physical and legal entities and non-governmental organisations; and
- Ensuring state control and public transparency of EIA.

The process to be followed to undertake an EIA is provided in Article 4 of the EIA legislation, including the roles and responsibilities of the Developer and Competent Authorities which includes the MENR. A summary of the EIA process, including the mandatory requirements are provided in Table 2.4 below.

Table 2.4 Summary of the EIA Process in Azerbaijan and Mandatory Requirements

Scoping and Requirement for EIA	
Activities Subject to EIA	The categories of economic developments that are subject to mandatory EIA are set out within an Appendix to the EIA Law. These include hydrocarbon exploration, development and extraction.
Scoping	The Developer is required to carry out the EIA of the proposed activity following a preliminary consultation with the Competent Authority (MENR). The preliminary consultation is required to define the content, scope and methodology of the assessment, and to ensure completeness and accuracy of the relevant documentation used in the EIA.
EIA Report	
General	The EIA Report shall be prepared during the project development stage and submitted to the Competent Authority to undertake a review of the EIA report in accordance with the AR Law on Environmental Protection. It shall be written in an understandable style and shall include a description of baseline conditions, potential environmental and public health impacts, mitigation measures and recommendations aimed at minimisation of the negative impacts and shall include introduction and conclusion sections.
Project Description	A full description of the proposed development, its purpose, phases, types of its environmental impacts and methodology used for assessing environmental risks shall be provided
Project Alternatives	An overview of at least two options alternative to the proposal (including zero option), as well as environmental justification for the option of applying the best available technology shall be provided
Legislative Requirements	A summary of the legal framework and references of statutory and normative documentation used in the EIA shall be included.
Environmental and Socio-economic Description	Baseline environmental and socio-economic conditions and sensitivity of the areas affected by the proposed development should be described.

Impact Assessment and Mitigation	All impacts (direct and indirect, onsite and offsite, acute and chronic, one-off and cumulative, emergency and non-routine, transient and irreversible) should be identified and evaluated according to its significance and severity and mitigation measures provided to avoid, reduce, or compensate for these impacts.
Transboundary and Accidental Impacts	Where transboundary impacts are identified, these should be assessed as per the procedure and terms established by the competent authority (Cabinet of Ministers) which are not yet adopted. Prediction of impacts associated with emergency events should be included within the EIA Report.
Environmental Management and Monitoring	An overview of the environmental management system to be adopted for the project through all project phases including relevant management and monitoring plans should be included.
Residual Impacts	A summary of the residual impacts and the prediction of their significance should be included.
EIA Disclosure	
Public Participation	The law requires that the public affected by the planned activities are informed during the EIA process. The developer is expected to involve the affected public in discussions on the proposal.
State Ecological Examination	The review of the EIA report in accordance with the Law on Environmental Protection will be undertaken by the MENR (over a statutory 3 month period), who will prepare an expert opinion. This will be published and made available to the relevant local executive authority where the development is located.

The approval of an EIA by the MENR establishes the compliance framework, including the environmental and social standards that an organisation should adhere to. The law requires that the EIA to be conducted by at least three Environmental Impact Assessors. These will be persons who are appropriately qualified, certified by the MENR and listed within a register. At the time of writing the procedures for certification and registration have yet to be established.

The Handbook for the Environmental Impact Assessment Process in Azerbaijan published in 1996, is aligned to the Law of Azerbaijan Republic on Environmental Impact Assessment and provides additional guidance on the EIA process and ongoing management and monitoring (Ref. 5).

2.7 Regional Processes

2.7.1 European Union

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 (Ref.6). 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 (Ref.7).

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 (Ref.8) 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.).

2.7.2 Environment for Europe

Environment for Europe (Ref.9) 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 2.5.

2.8 International Petroleum Industry Standards and Practices

Shafag-Asiman Exploration Drilling Project activities are required to comply with national legislation where it is no more stringent than "*the Environmental Standards set out in Part II of Appendix 9*" (Shafag-Asiman PSA, Art. 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) are specifically mentioned in the PSA.

The Convention for the Protection of the Marine Environment of the North-East Atlantic (the "OSPAR Convention") is of relevance to Shafag-Asiman Exploration Drilling Project offshore activities and in particular to the regulation of chemicals.

2.9 References

Ref.	Title
1	Law ID 1175-VQ "Ətraf mühitə təsirin qiymətləndirilməsi haqqında", dated 13/07/2018, available at http://www.e-qanun.az/framework/39511
2	United Nations (2004), Environmental Performance Reviews Series No. 19 – Azerbaijan
3	Currie & Brown, (2008), Integrated Solid Waste Management System for the Absheron Peninsula Project
4	Popov (2005), Azerbaijan Urban Environmental Profile (an ADB Publication).
5	Azerbaijan State Committee on Ecology and Control of Natural Resources Utilization and United Nation Development Programme. Handbook for the Environmental Impact Assessment Process in Azerbaijan. Baku, 1996.
6	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.
7	SOFRECO (undated) Support for the Implementation of the PCA between EU-Azerbaijan, Draft Programme of legal Approximation.
8	European Commission, (2007). European Neighbourhood and Partnership Instrument, Azerbaijan National Indicative Programme (NIP).
9	United Nations Economic Commission for Europe UNECE (2008) Environment for Europe. Available at: http://www.unece.org/env/efe/welcome.html Accessed February 2018

3 Impact Assessment Methodology

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3.1 Introduction

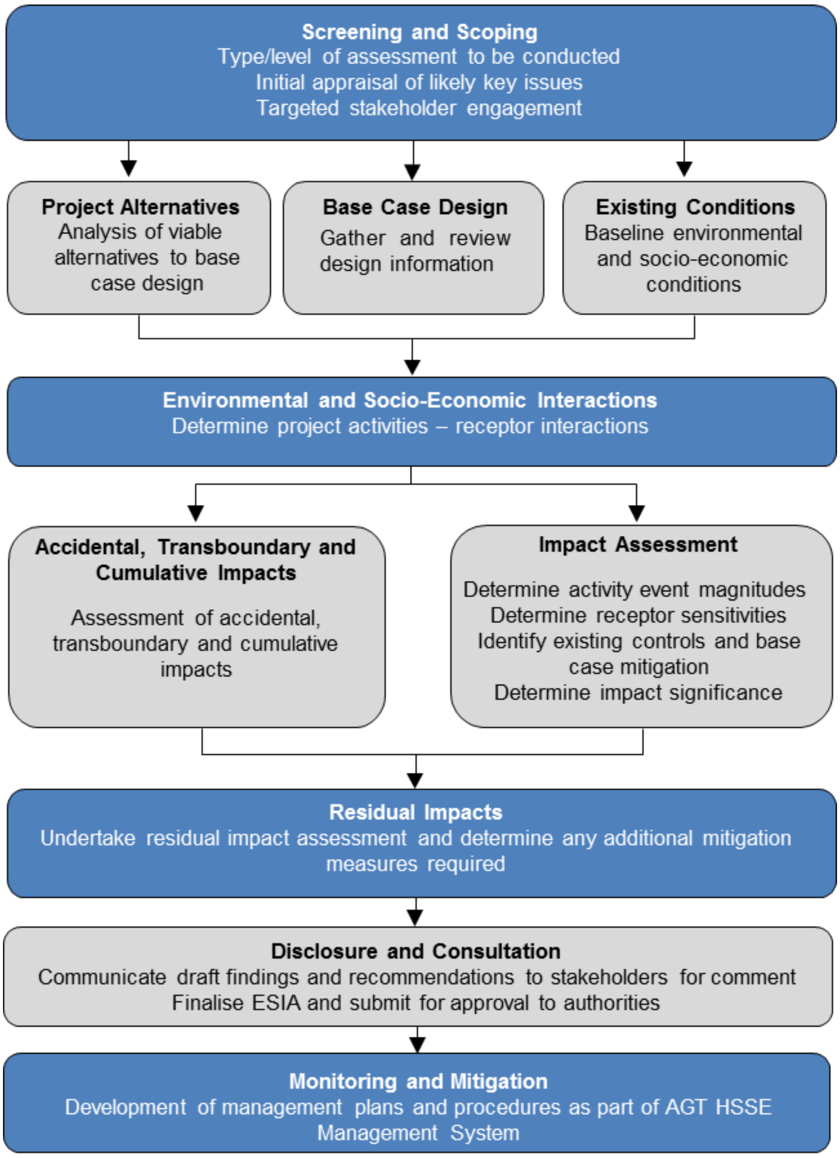
This Chapter presents a description of the Environmental and Socio-Economic Impact Assessment (ESIA) process adopted for the Shafag-Asiman Exploration Drilling Project and the methodology used to assess impact significance.

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
- Monitoring and Mitigation.

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.

Based on the Project location, the scope and the planned activities, it is deemed necessary to undertake an ESIA for the Shafag-Asiman Exploration Drilling Project. The ESIA will take account of applicable national and international legislation and Shafag-Asiman Production Sharing Agreement (PSA) as detailed in Chapter 2: Policy, Regulatory and Administrative Framework. This is consistent with the approach taken for exploration drilling projects completed in the Azeri Chirag Gunashli (ACG) and Shah Deniz (SD) Contract Areas.

The approach and the scope of the ESIA was agreed with the MENR at a scoping meeting held in January 2019.

Scoping is a high level assessment of anticipated **interactions** between **project activities** and **environmental and socio-economic receptors**[8]. 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 discernible 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 Shafag-Asiman Exploration Drilling Project Scoping process has included:

- The review of available environmental and socio-economic data and reports relevant to the area potentially affected by the Shafag-Asiman proposed Exploration Drilling Project activities; and
- Liaison with the Shafag-Asiman Exploration Drilling Project Team to gather data and to formulate an understanding of project activities.

Based on the findings of the review and data gathering, the Shafag-Asiman Exploration Drilling Project ESIA Team identified potential project related environmental and socio-economic impacts based on likely interactions between the proposed Exploration Drilling Project activities and environmental/socio-economic receptors. In addition, the Team identified gaps where the extent, depth and/or quality of available environmental, socio-economic and/or technical data at the scoping stage was insufficient for the Shafag-Asiman Exploration Drilling Project ESIA process.

3.2.2 Impact Significance Assessment

An **impact**, as defined by the international standard ISO 14001:2015 is:

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

Where an **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 sensitivity requires an understanding of the biophysical and human environment.

[8] For the purpose of this assessment, a receptor is considered a component of the existing biophysical and social environment (i.e. air, water, land, sediments, habitats, commercial fishing, etc.) that is affected by or interacts with the project activities.

The approach to evaluating the significance of potential environmental and socio-economic impacts is set out in the sections below. Impacts can be positive or negative depending on whether they result in a beneficial or adverse change when compared to baseline conditions.

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

3.2.3 Environmental Impacts

3.2.3.1 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 where the effect extends across an area:

  1 – Near to the source (e.g. in the range tens to hundreds of metres); to

  2 – At intermediate distance from the source (e.g. in the range hundreds to thousands of metres); to

  3 – At far distance from the source (e.g. in the range thousands of metres and above).

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

  1 – Once or twice; to

  2 - Repeatedly but intermittently (e.g. 10 to 20 times); to

  3 – Frequently and persistently (e.g. more than 20 times).

- **Duration**: Events range from those where effects occur over: :

  1 – Instantaneous/short term (e.g. hours to days); to

  2 - Medium term (e.g. between a week and 3 months); to

  3 – Long term (e.g. more than 3 months to permanent).

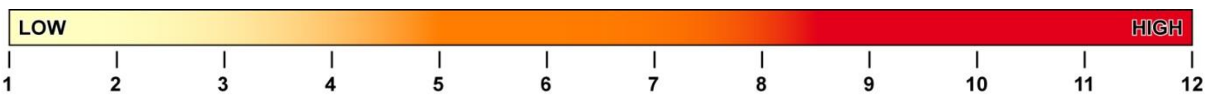
- **Intensity**: Concentration[9] of an emission or discharge with respect to standards of acceptability that include applicable legislation and international guidance, its toxicity or potential for bioaccumulation, and its likely persistence in the environment. Degree/permanence of disturbance or physical impact. 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.

[9] In the case of underwater sound this parameter relates to peak sound pressure level or sound energy level depending on the criteria selected.

Table 3.1 Event Magnitude Rankings

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

3.2.3.2 Method for Determining Receptor Sensitivity

Receptor sensitivity considers the type of receptor (namely, biological/ecological, human and physical receptor/feature); and 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 – Internationally threatened species[10]/protected area within the area impacted by the project activities during period of high sensitivity (e.g. during breeding, spawning or nesting) and during routine or reliably predictable peak presence; to

  2 - Internationally threatened species[4]/protected area within the area impacted by the project activities outside of period of high sensitivity or during routine or reliably predictable peak presence.

  Internationally near threatened species[11] within the area impacted by the project activities during period of high sensitivity (e.g. during breeding, spawning or nesting) and/or during routine or reliably predictable peak presence.

  Nationally protected species and/or species which are of importance to the local and regional ecosystem within the area impacted by the project activities.

  1 – Presence of species which is none of the above.

  Resilience (to the identified stressor) ranges from:

  3 – Species which has little or no capacity to absorb or adapt to change (i.e. little or no capacity to move away from or adapt to the project impact), leading to potential for substantial change of character and/or loss of ecological functionality or population effects.

  2 – Species and/or population which has moderate capacity to absorb or adapt to change (i.e. has capacity to move away from or adapt to the project impact), leading to potential temporary but sustainable effect which does not substantially alter character or result in significant loss of ecological functionality.

  1 – Species and/or population has high capacity to absorb or adapt to change (i.e. has capacity to move away from or adapt to the project impact), and is potentially unaffected or marginally affected.

- Human Receptors:

  Presence ranges from:

  3 – People being permanently present (e.g. residential property) within the area impacted by Project activities; 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.

[10] IUCN Red List Classification of Critically Endangered, Endangered or Vulnerable
[11] IUCN Red List Classification of Near Threatened

Resilience (to the identified stressor) ranges from:

3 – Most vulnerable groups (i.e. ambient conditions such as air quality are at or above adopted standards); to

2 – People being vulnerable to change or disturbance (i.e. ambient conditions such as air quality are below adopted standards); to

1 – People being least vulnerable to change or disturbance (i.e. ambient conditions such as air quality are well below applicable legislation and international guidance).

Overall, receptor sensitivity is then scored on a scale 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

3.2.4 Socio-Economic Impacts

The socio-economic impact assessment uses a semi-qualitative assessment approach to describe and evaluate potential impacts based on the event magnitude and receptor sensitivity rankings set out in Tables 3.3 and 3.4 respectively.

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

Table 3.3 Event Magnitude Rankings

Magnitude	Criteria
Low	Changes in social, economic or cultural dynamics with slight and temporary effect on any given sector performance and/ or population wellbeing. These impacts are unlikely to result in concerns being raised by governmental bodies or stakeholders.
Medium	Changes in social, economic or cultural dynamics with moderate and noticeable adverse effect on any given sector performance and/or population wellbeing. Such impact may result in concerns being raised by governmental bodies or stakeholders.
High	Changes in social, economic or cultural dynamics with major adverse effect on any given sector performance and/or population wellbeing. Such impacts may result in immediate intervention by governmental bodies and stakeholders.

Table 3.4 Receptor Sensitivity Ranking

Sensitivity	Criteria
Low	Receptor sensitivity is considered low when there is a moderate to high capacity and means to adapt to a given change and maintain / improve quality of life.
Medium	Receptor sensitivity is considered medium when there is limited capacity and means to adapt to a given change and maintain / improve quality of life.
High	Receptor sensitivity is considered high in the case of vulnerable receptors, who have little capacity and means to adapt to a given change and maintain / improve quality of life

3.2.5 Environmental and Socio-Economic Impact Significance

For both environmental and socio-economic impacts, impact significance, as a function of event magnitude and receptor sensitivity, is ranked as **Negligible**, **Minor**, **Moderate** or **Major** as presented in Table 3.5.

Table 3.5 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 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.

3.3 Accidental, Transboundary and Cumulative Impacts

In addition to assessing impacts associated with the routine Shafag-Asiman Exploration Drilling Project activities, the following will also be assessed:

- **Impacts from Accidental Events:** Impacts that arise as a result of a technical failure, human error or as a result of natural phenomena such as a seismic event.
- **Transboundary Impacts:** Defined as impacts that occur outside the jurisdictional borders of a project's host country.
- **Cumulative Impacts:** While an impact may be relatively small when considering the project or activity on its own, it may be magnified in combination with impacts from other projects and activities; these combined effects are known as 'cumulative' impacts.

Cumulative impacts may arise from the following:

- 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 within the same area of influence.

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 steps taken to undertake the cumulative impact assessment presented in Chapter 7 comprise the following:

1. Identify other known projects and activities within the vicinity of the Shafag-Asiman Exploration Drilling Project where there is potential for cumulative impacts
2. Define the spatial (i.e. impacts are so close in space that their effects overlap) and temporal (i.e. impacts are so close in time that the effect of one is not dissipated before the next one occurs) scope of the assessment;
3. Assess potential cumulative impacts to the environmental and socio-economic receptors potentially affected by the Shafag-Asiman Exploration Drilling Project and the cumulative projects identified; and
4. Where required, define measures to avoid, reduce, or mitigate any potentially significant cumulative impacts to the extent possible.

Where there is potential for impact interaction, and the Project is sufficiently defined and sufficient data is available, a quantitative assessment will be undertaken. Where insufficient data is available, only a qualitative assessment will be undertaken.

At the time of writing, there is potential for cumulative impacts with the planned production, drilling and incremental tie-in and start up of subsea wells associated with the Shah Deniz 2 (SD2) Project. The platform commenced initial production in 4Q 2018 from wells within two of five flanks associated with the project. Drilling and completion of the remaining wells is expected to continue until 2026.

3.4 Mitigation and Monitoring

The iterative and integrated nature of the ESIA and project planning processes means that the majority of proposed mitigation measures and strategies have been incorporated into the project and integrated into the Base Case design of the proposed Shafag-Asiman Exploration Drilling programme**.** These measures / strategies have included mitigation measures and ongoing commitments as previously adopted by other BP projects (including other exploration projects) in the AGT Region.

The ESIA Report will be submitted for review and comment to the MENR who will have an opportunity to make comments on the findings, including suggestions for additional mitigation measures to those already committed to in this ESIA associated with Project activities. If deemed appropriate, such mitigation measures will be added to the proposed Shafag-Asiman Exploration Drilling programme design and/or management programme.

3.5 ESIA Disclosure and Finalisation

The Draft Final ESIA Report has been disclosed in compliance with Azerbaijani law; enabling project stakeholders to review and comment on identified impacts and the assessment of those impacts, ensuring that appropriate weighting has been given to local priorities and concerns where appropriate. Stakeholders and communities have had the opportunity to assess whether proposed impact mitigation and management strategies adequately achieve these objectives; respond to local needs; are culturally appropriate and technically viable.

As part of the Draft Final ESIA consultation process the following meetings were held:

- Public meeting, Baku 11th September 2019; and
- MENR meeting, Baku 12th September 2019.

Comments and feedback received during the disclosure phase were collated and responses issued where relevant. The ESIA was subsequently revised and finalised for MENR approval.

4 Project Description

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4.1 Introduction

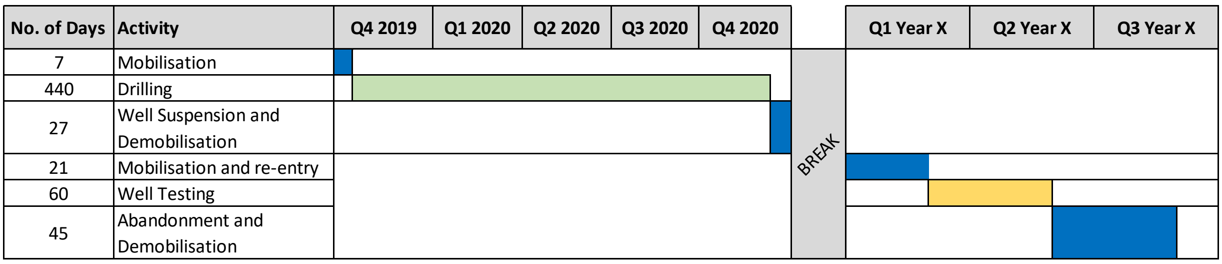
This Chapter of the Environmental and Socio-economic Impact Assessment (ESIA) describes the activities and events associated with the Shafag-Asiman Exploration Drilling (SAX01) Project, henceforth referred to as the Project. The information presented in this Chapter provides the basis for the assessment of environmental and socio-economic impacts presented in Chapter 6 of this document. An overview is also provided outlining the key alternatives and options considered for the Project.

4.2 Drilling Programme

The anticipated drilling programme for the Project exploration well is presented in Figure 4.1, including a breakdown of each activity and expected duration.

Activities will be undertaken in two stages. The first stage, expected to commence in Quarter (Q) 4 of 2019, includes drilling and well suspension. Second stage activities include well testing and well abandonment, which will commence following a break of between 1 and 3 years due to availability of the well testing rig. As the well test activities are not sufficiently defined at this time they are not included within the Project Base Case and will be considered in a separate permission document to be submitted to the Ministry of Ecology and Natural Resources (MENR) at a later date if it is confirmed that well testing is to be undertaken.

Figure 4.1 Shafag-Asiman Exploration Drilling Schedule



*Note: well testing is not currently part of the Project Base Case.

4.3 Project Alternatives

A number of alternatives have been evaluated during the development of the Project to inform the Project Base Case design as described within this Chapter, taking into account technical, economic, safety and environmental considerations in addition to lessons learned from BP's extensive experience in exploration well drilling in the Caspian Sea.

4.3.1 'Do Nothing' Option

Should the Project not be undertaken, the potential environmental and socio-economic impacts associated with the Project will not occur, however the Project objectives would also not be achieved. The prospective hydrocarbon resource identified during the seismic data analysis will not be confirmed and the opportunity for the future development of the Shafag-Asiman Contract Area will not be realised. The subsequent effect could result in a potential loss of revenue and economic development for Azerbaijan associated with hydrocarbon exploitation.

4.3.2 Well Location

The proposed Project exploration well location has been selected as having the most likely potential for hydrocarbon discovery based on evaluation of the 3D seismic data acquired in the Shafag-Asiman Contract Area in 2012. The well location selection process also took into account an evaluation of surface, near surface and subsurface hazards to drilling. Alternative locations were therefore not considered as they would not achieve the Project objectives, while possibly leading to a higher risk of experiencing operational problems during drilling.

4.3.3 Drilling Mud Selection

The two main types of drilling muds typically used for offshore drilling are water based mud (WBM) and non-water based mud (NWBM (including Synthetic Oil Based Mud (SOBM)/ Low Toxicity Mineral Oil Based Mud (LTMOBM)). From a technical perspective, within the Caspian Sea, WBMs are typically used to drill the top hole sections of wells, with NWBM more suitable for the lower hole sections. To inform the decision for the handling and disposal of WBM and NWBM and cuttings from offshore drilling operations a Best Practicable Environmental Option (BPEO) assessment was undertaken during the ACG Phase 1 Project. The BPEO assessment concluded that NWBM and cuttings should be re-injected offshore (for platforms where cutting reinjection wells were feasible) or shipped to shore for disposal. The assessment also concluded that WBM and cuttings, which meet the relevant project standards, could be discharged to the marine environment based on the expected low levels of environmental toxicity of the chemicals and the localised impact of solids deposition at the discharge point. This approach has been consistently utilised across previous ACG and Shah Deniz projects and will be adopted for the Project.

4.4 Mobile Offshore Drilling Unit (MODU) Activities

It is anticipated that the proposed Project exploration well will be drilled using one of the semi-submersible rigs located within the Caspian Sea. For the purpose of this ESIA, it is assumed that the Heydar Aliyev Mobile Offshore Drilling Units (MODU) will be used, with the final rig selection dependant on the rig availability.

4.4.1 MODU Positioning

Support vessels will tow the MODU to the drilling location and move it into position prior to anchoring. The mobilisation, positioning and set-up of the MODU is expected to take 7 days and some further 5 days to demobilise the rig at the end of the drilling programme. A mandatory 500 metre (m) safety exclusion zone will be established around the MODU while drilling is in progress.

4.4.2 MODU and Vessel Logistics and Utilities

In addition to the MODU, vessels will be required throughout the drilling programme to supply consumables such as drilling mud to the MODU and ship solid and liquid waste to shore for treatment and disposal. It is anticipated that consumables such as drilling mud and diesel will be provided to the MODU by vessels from the existing onshore facilities used during previous ACG and SD Contract Area exploration drilling programmes and which also supply the operational ACG and SD platforms. Table 4.1 summarises the estimated number and function of the vessels. Tables 4.2 and 4.3 summarise the MODU and support vessel utilities.

Estimated volumes of waste and greenhouse gas (GHG) and non GHG gas atmospheric emissions generated during the drilling programme are summarised within Section 4.10.1.

Table 4.1 Estimated Number and Function of Vessels

Vessel	Number	Basis of Use	Function	POB	Average Fuel Consumption (tonnes/day)
Heydar Aliyev MODU	1	Continuous through drilling programme	Drilling	160	20
Anchor Handling Tugs / Mobilisation support vessels	3	7 Days for tow out and 5 days for demobilise	Tow out and position MODU and demobilise MODU	17	20
Support Vessels	2	Daily	Supply drilling mud, diesel and other consumables to the MODU Ship solid and liquid wastes to shore	17	10
Standby Vessel	1	Continuous	Back up support for MODU/support vessels	17	10
Crew Change Vessel [1]	1	Weekly	Personnel transfer	16	15
Helicopters	1	5 times/ week	Personnel transfer	10	0.36

Notes: [1] Vessel trips may be shared with other BP Azerbaijan Georgia Turkey (AGT) Region Offshore installations. Helicopters will be used as primary crew change

Table 4.2 Summary of MODU Utilities

Activity	Heydar Aliyev Description
MODU Power Generation	• Main Power provided by 4 Wärtsilä diesel driven generators 4,504 kW. • Emergency diesel generator rated at 1563 kW.
MODU Grey Water and Sanitary Waste	• Grey water will either be sent to the vessel sewage treatment system or 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 sewage treatment system to MARPOL 73/78 Annex IV MEPC. 159 (55) standards[1]. No chlorination of the effluent will be required under routine conditions, however when chlorine is used for disinfectant purposes, the concentration of residual chlorine in the effluent to achieve below 0.5mg/l and discharge to sea. In the event it is not practicable to achieve this concentration, the effluent will be contained and shipped to shore. • Under non routine conditions when the sewage treatment system is not available black water will be managed in accordance with the existing BP AGT Region plans and procedures and reported to the MENR as required. • Sewage sludge will be shipped to shore for disposal in accordance with the existing BP AGT Region waste management plans and procedures.
MODU Galley Waste	• Depending on the availability of the system, galley food waste will either be: - Sent to maceration units designed to treat food wastes to applicable MARPOL 73/78 Annex V: Prevention of Pollution by Garbage from Ships particle size standards2 prior to discharge; or - Contained and shipped to shore for disposal in accordance with the existing BP AGT Region waste management plans and procedures.
MODU Seawater/Cooling Water Systems	• Seawater is used onboard within the engine and compressor systems (for cooling). • Seawater lift pumps designed to uplift up to 2,250 m^3/hr from a depth below sea level of 18 m. • Design incorporates anodic biofouling and corrosion control system. • Cooling system: - Designed to discharge cooling water at a temperature of 2 to 4 degrees greater than the intake temperature. - Cooling system discharge up to 2250 m^3/hr at a depth below sea level of 15 m.
MODU Fresh Water	• Unit produces freshwater from lifted seawater by reverse osmosis for sanitary and galley use.
MODU Desalination Unit	• Designed to produce approximately 55 m^3/day of freshwater for use and discharge approximately 71 m^3/day of saline water to sea.
MODU Drainage	• MODU deck drainage and wash water will be discharged to sea as long as no visible sheen is observable. • In the event of a spill, main MODU deck drainage will be diverted to hazardous drainage tank for spills including SOBM/LTMOBM, oil/diesel/cement and oily water. Contents of hazardous waste tank will be shipped to shore for disposal in accordance with the existing BP AGT Region waste management plans and procedures. • Waste oil collected from the drainage system will be sent to waste oil tank and transported to shore. • Bilge water will be sent to a zero discharge centrifuge to separate oily water. Treated bilge water with an oil content less than 15 ppm will be discharged to sea. If the bilge water separator is not operational on the MODU oily bilge water shall be collected and sent to shore. • 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 15 ppm will be discharged to sea. Separated sludge will be shipped to shore for disposal in accordance with the existing BP AGT Region waste management plans and procedures and separated oil sent to the waste oil tank.
MODU Ballast System	• Ballasting, using untreated seawater, undertaken daily to maintain stability of the MODU for effective drilling. • The ballast system is designed so that oil and chemicals do not come into contact with ballast water.

Notes:

1. Five day Biological Oxygen Demand (BOD) ≤25mg/l, Chemical Oxygen Demand (COD) ≤125 mg/l, total suspended solids ≤35mg/l, pH between 6 and 8.5 and thermotolerant coliform 100MPN (most probable number) per 100ml. Where chlorine is added, residual chlorine in the effluent to achieve below 0.5 mg/l (for sewage treatment systems installed after January 2010).

2. Macerated to particle size less than 25mm.

Table 4.3 Summary of Vessel Utilities

Utility	Description
Sanitary Waste (All Vessels)	• Grey water will either be sent to the vessel sewage treatment system or 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 vessel sewage treatment system to either: - MARPOL 73/78 Annex IV: Prevention of Pollution by Sewage from Ships standards: Five day BOD ≤50mg/l, total suspended solids ≤50mg/l (in lab) or ≤100mg/l (on board) and thermotolerant coliforms ≤250MPN per 100 ml. Residual chlorine as low as practicable where chlorine is added (for vessel sewage treatment systems installed prior to January 2010); or - MARPOL 73/78 Annex IV MEPC. 159 (55) standards: Five day BOD ≤25mg/l, COD ≤125 mg/l, total suspended solids ≤35mg/l, pH between 6 and 8.5 and thermotolerant coliform 100MPN per 100ml. Where chlorine is added, residual chlorine in the effluent to achieve below 0.5 mg/l (for vessels sewage treatment systems installed after January 2010). • Under non routine conditions when the sewage treatment system is not available black water will be managed in accordance with the existing BP AGT Region plans and procedures and reported to the MENR as required. • Sewage sludge will be shipped to shore for disposal in accordance with the existing BP AGT Region waste management plans and procedures.
Galley Waste (All Vessels)	• Depending on the availability of the vessel system, galley food waste will either be: - 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; or - Contained and shipped to shore for disposal in accordance with the existing AGT waste management plans and procedures.
Drainage / Wash Water (All Vessels)	• 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 to sea or contained and shipped to shore for disposal in accordance with the existing BP AGT Region waste management plans and procedures.

4.5 Drilling Operations and Discharges

MODU activities during the Project exploration drilling programme include:

- Preparation of the drilling equipment;
- Drilling of conductor, upper surface and lower well hole section;
- Installing wellhead and cementing casings;
- Well suspension and temporary well abandonment;
- Re-entry and well testing[12]; and
- Well plug and abandonment.

A summary of discharge types and the associated discharge scenarios associated with the drilling, temporary suspension, subsequent re-entry, plugging and abandonment activities is provided in Table 4.4 and illustrated within Figure 4.2.

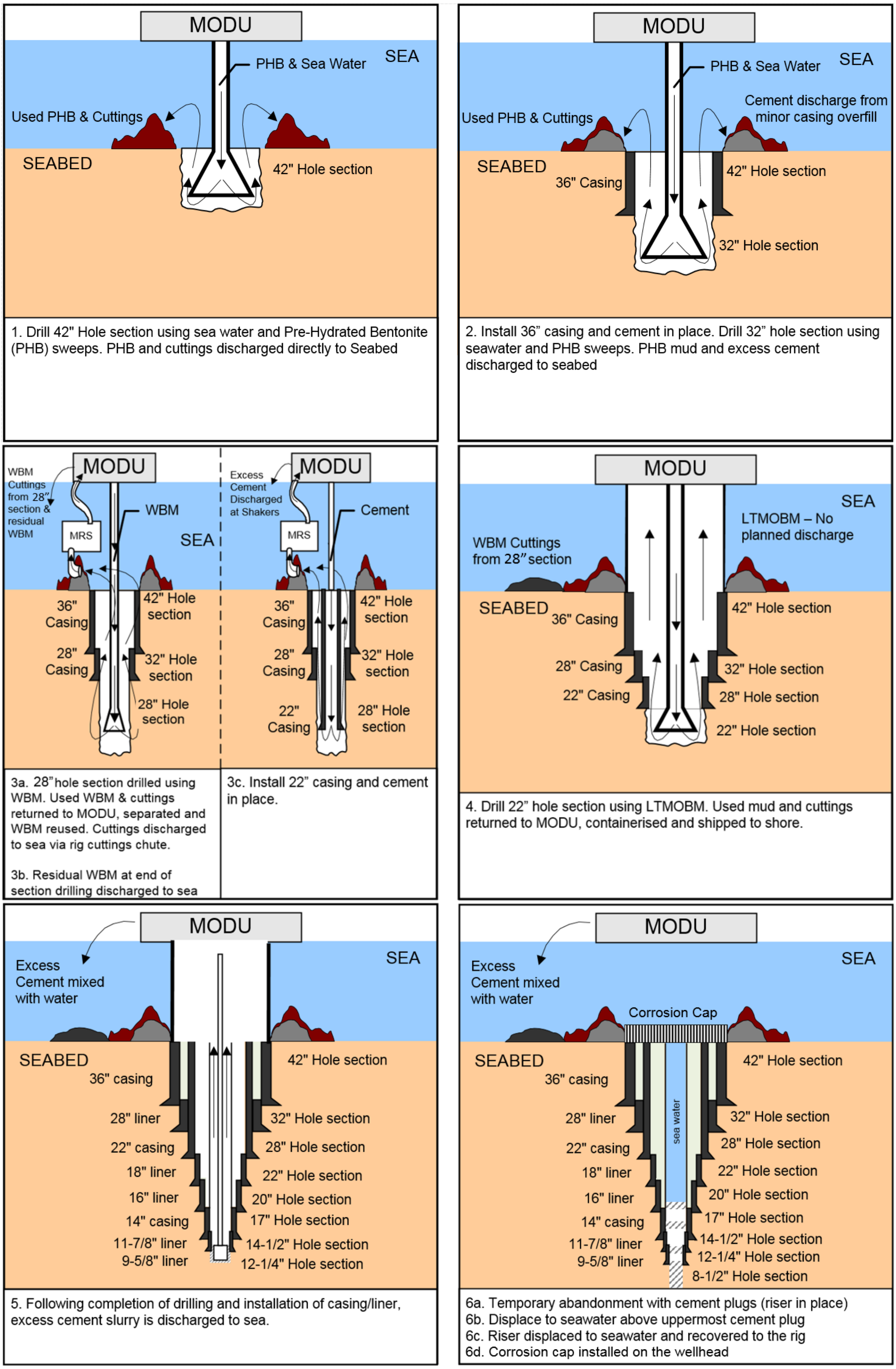
[12] As described in Section 4.2, as the well test activities are not sufficiently defined at this time they are not included within the Project Base Case and will be considered in a separate permission document to be submitted to the MENR at a later date if it is confirmed that well testing is to be undertaken.

Table 4.4 Summary of Drilling Activity and Discharge Scenarios

Step (as per Figure)	Activity	Composition	Discharge Scenario
1 - 3	Application of pipe dope to drilling equipment joints	Pipe dope	Discharge minimal amount of pipe dope while circulating through joints of pipe. Discharge of Seawater/ Pre-Hydrated Bentonite (PHB) sweeps/WBM when drilling prior to riser installation (42", 32" and 28" hole sections).
1 & 2	Drilling of upper hole section (42")	Cuttings and seawater with PHB sweeps	Discharge seawater/PHB sweeps and cuttings directly to seabed.
	Cementing 36" casing	Cement	Discharge of cement, due to slight overfill (required to ensure the casing is fully cemented to the seabed), directly to seabed following cementing of 36" casing.
	Drilling of upper hole section (32")	Cuttings and seawater with PHB sweeps	Discharge seawater/PHB sweeps and cuttings directly to seabed.
	Cementing 28" casing	Cement	Discharge of cement and spacer directly to seabed or to sea via the MODU cuttings chute[2]. Required to ensure casing is cemented securely up to the seabed and formations isolated. This may require use of managed pressure cementing[3].
3a	Drilling of 28" hole section (riserless)	Cuttings with WBM	Return WBM and cuttings to MODU using riserless mud recovery system (MRS). WBM is separated from the cuttings and recovered. Cuttings are treated for discharge and then discharged to sea via the MODU cuttings chute[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 discharged to seabed.
3c	Cementing 22" casing	Cement and spacer	Discharge of cement and spacer directly to seabed or to sea via the MODU cuttings chute[2]. Required to ensure casing is cemented securely up to the seabed and formations isolated. This may require use of managed pressure cementing[3]. WBM on the rig that cannot be recovered can be treated and discharged to sea via the MODU cuttings chute[1,2].
4	Drilling of lower hole sections (with riser)	No planned discharge	
5	Cementing casings and liners of lower sections	Cement	Discharge a small amount of cement to the sea via the MODU cuttings chute[2]. Required to ensure casing top of cement is met. Cement remaining in the surface system after cementing activities cannot be feasibly recovered. It will be mixed with water and discharged to sea via the MODU cuttings chute[2].
1, 2, 3c, 5	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].
7	Re-entry	No Planned Discharge to sea	
8	Well testing[4]		
6a & 9a	Temporary and permanent abandonment	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].

Notes:
[1] PSA Requirement: 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] PSA Requirement: caisson whose open end is submerged, at all times, a minimum of two (2) feet below the surface of the sea.
[3.] Managed pressure cementing uses equipment from the riserless MRS. It may be necessary discharge directly to the seabed (as outlined in Section 4.5.5) to manage pressures and ensure formations are isolated.
[4] Well testing is not part of the Project base case

Figure 4.2 Summary of Drilling Activities and Discharges



1. Drill 42" Hole section using sea water and Pre-Hydrated Bentonite (PHB) sweeps. PHB and cuttings discharged directly to Seabed

2. Install 36" casing and cement in place. Drill 32" hole section using seawater and PHB sweeps. PHB mud and excess cement discharged to seabed

3a. 28" hole section drilled using WBM. Used WBM & cuttings returned to MODU, separated and WBM reused. Cuttings discharged to sea via rig cuttings chute.

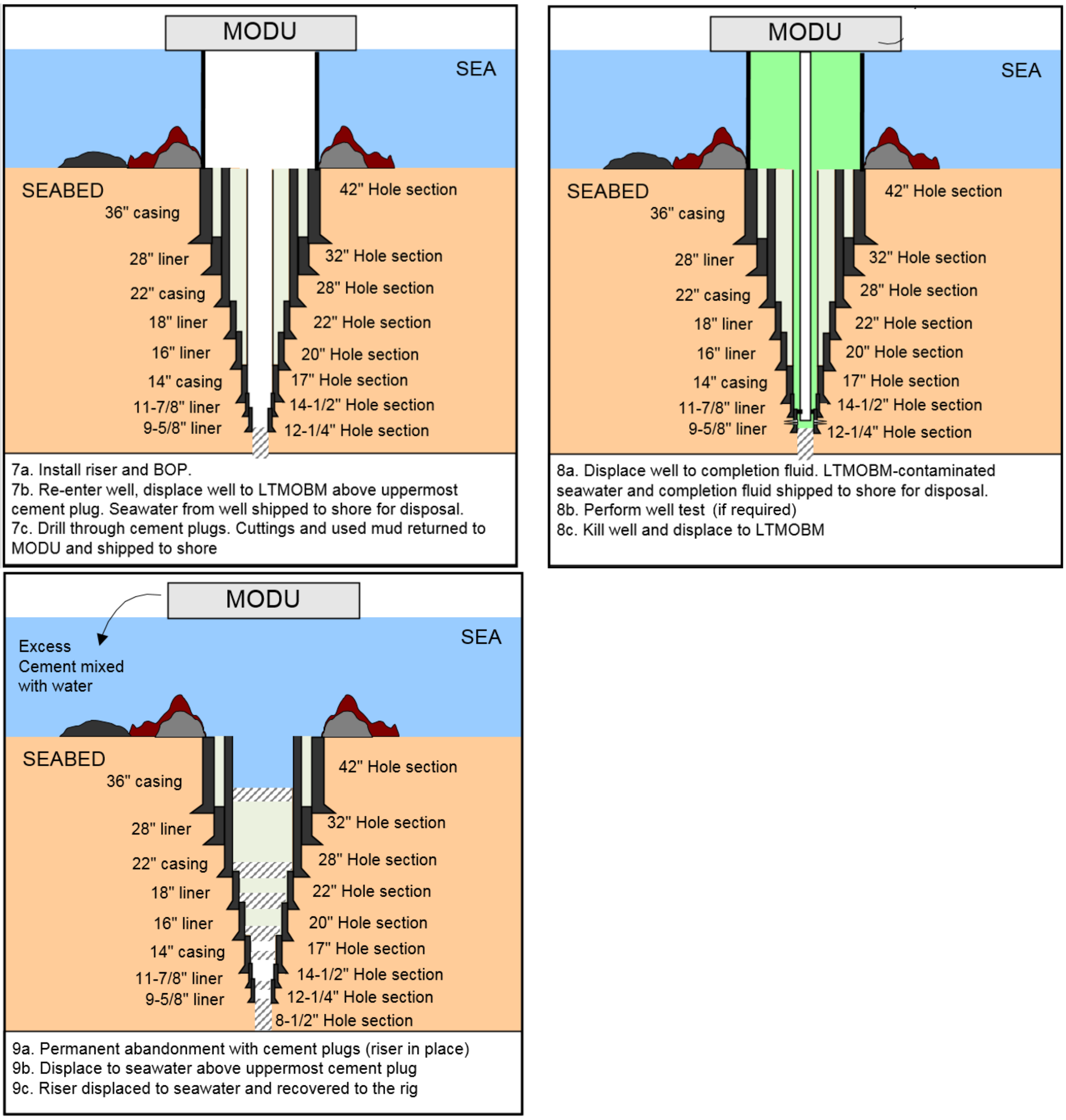
3b. Residual WBM at end of section drilling discharged to sea

3c. Install 22" casing and cement in place.

4. Drill 22" hole section using LTMOBM. Used mud and cuttings returned to MODU, containerised and shipped to shore.

5. Following completion of drilling and installation of casing/liner, excess cement slurry is discharged to sea.

6a. Temporary abandonment with cement plugs (riser in place)
6b. Displace to seawater above uppermost cement plug
6c. Riser displaced to seawater and recovered to the rig
6d. Corrosion cap installed on the wellhead



*Note: well testing is not currently part of the Project base case.

4.5.1 Well Design and Drilling Fluid Types

The well will comprise of a number of hole sections, each section decreasing in diameter as depth increases. 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.

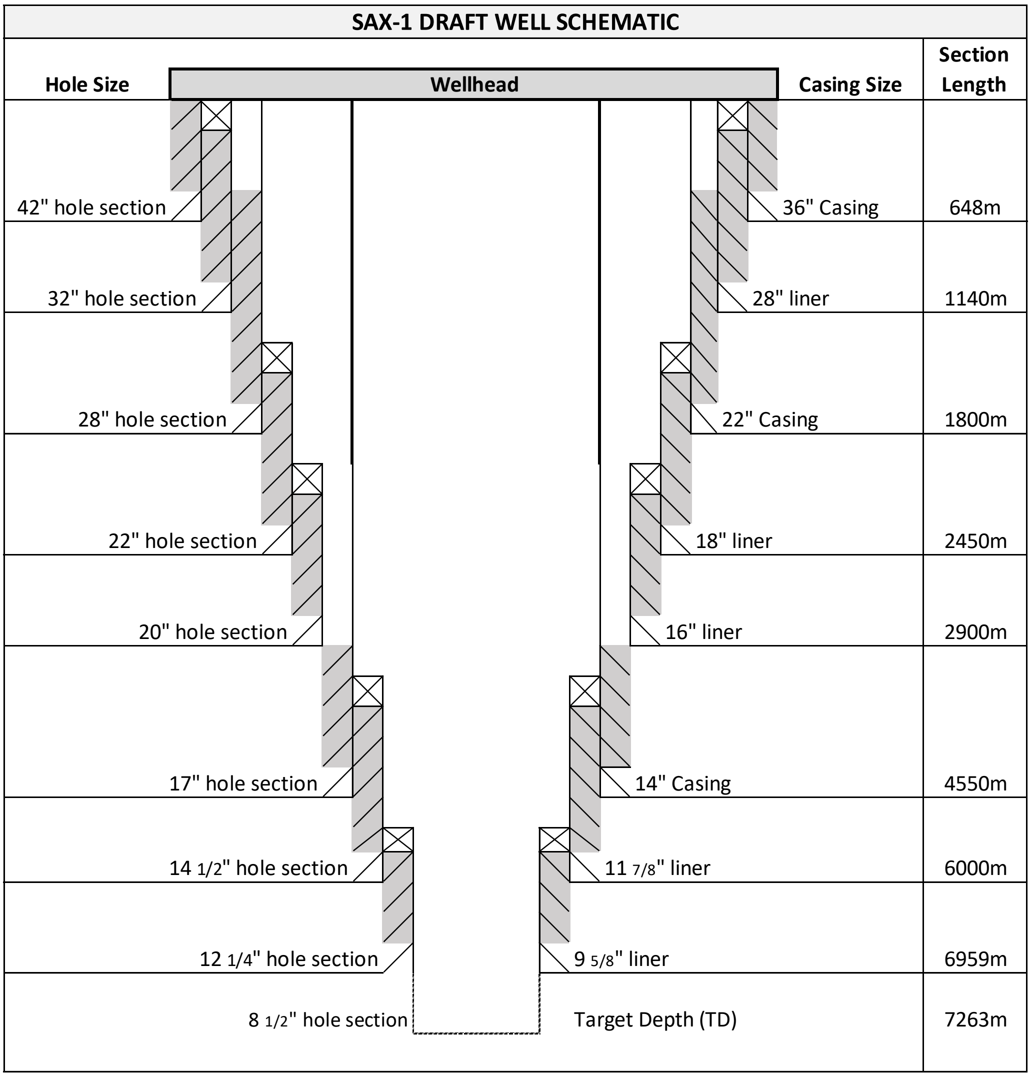
The well design is presented in Table 4.5 and illustrated in Figure 4.3.

Table 4.5 SAX01 Well Design

Casing Size (in)	Hole Size (in)	Section Length (TVD BRT) (m)	Mud System	Disposal Route of Drilling Muds/Cuttings
36	42	648	Seawater PHB Sweeps	Discharge to sea at seabed.
28	32	1140		
22	28	1800	WBM	Discharge to sea via rig cuttings discharge caisson
18	22	2450	SOBM/ LTMOBM	Ship to Shore
16	20	2900		
14	17	4550		
11-7/8	14-1/2	6000		
9-5/8	12-1/4	6959		
7-5/8*	9-1/2	6959		
-	8-1/2"	7263		

Notes: *Contingency

Figure 4.3 SAX01 Draft Well Schematic



4.5.2 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 a heavy metal free dope will be primarily used for this purpose with a small volume of heavy metal dope used for certain operations, including casing connections and associated completions for reliability and safety reasons. Pipe dope of the same or equivalent environmental performance to those currently used and approved within the region will be used for the project. It is expected that trace amounts of pipe dope will be discharged to sea when drilling surface and top hole sections with seawater and PHB sweeps (42” and 32” hole sections) and with WBM cuttings (28” hole section).

4.5.3 Drilling Fluids and Cutting Generation

Drilling fluids comprise a base material (water or non-aqueous drilling fluid) together with multiple additives, combinations of which are designed to avoid chemical reactions at the different well depths, formation pressures and rock types likely to be encountered.

Drilling mud for the Project programme will be routinely prepared onshore and supplied to the MODU via hose connections from supply vessels. Measures to avoid discharges to the marine environment during mud transfer include:

- Appropriate design of the mud pumping system and connections between the MODU and supply vessels;
- Preventative maintenance of transfer equipment; and
- Appropriate training of relevant personnel.

4.5.3.1 Upper Hole Sections

Upper 42”, 32” and 28” Hole Sections

The 42” and 32” hole sections will be drilled using a seawater system (including PHB) that will be pumped down the drill string forcing drilling cuttings discharge directly to the seabed. While drilling, the borehole will be cleaned out using high viscosity sweeps of PHB. The 36” diameter casing will be installed following drilling of the 42” hole section, following which, the 32” hole section will be drilled in the same manner. 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. The 28” liner and 22” casing will be installed after the 32” and 28” hole sections are drilled, respectively.

For 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 ACG and SD wells (see Section 4.3.3 for full details on drilling mud selection). If there is a requirement to change the sweeps/WBM drilling mud composition or to select different drilling fluids for commercial or technical reasons, the ESIA Management of Change Process (see Section 4.11) will be followed.

Table 4.6 presents a summary of the total expected chemical composition of the 42”, 32” and 28” hole section drilling fluids to be used per hole section.

Table 4.6 Estimated Use of WBM Drilling Chemicals – Upper Hole Sections

Chemical	Trade Name	Function	Estimated Use per Hole (tonnes)[1]			Hazard Category[2]
			42”	32”	28”	
Chemicals common to seawater/PHB sweeps and WBM						
Barite	Barium sulphate ore	Weighting agent	170	220	760	E
Bentonite	Clay Ore	Viscosifier and removal of cuttings	20	40		E
Soda Ash	Soda Ash	pH treatment and calcium	1.7	1.9	6.5	E
Magnesium oxide	Magnesium oxide	pH control	2.5	0.5		-
Fluorescent Dye	Fluorescein	Cement tracer	0.1	0.1		GOLD
Chemicals associated with WBM only						
Polypac	Polyanionic cellulose	Water soluble polymer designed to control fluid loss	5.7	6.6	13.7	E
Duovis(xanthan gum)	Bio-polymer	Viscosifier	2.9	3.3	11.4	GOLD
Salts (KCl)	Potassium chloride	Borehole stabiliser / shale inhibitor			290	E
Salts (NaCl)	Sodium Chloride	Borehole stabiliser / shale inhibitor			145	E
Bicarbonate of soda		Calcium sequestor	1.7	1.9	6.5	E
Nut Shells	Nut Plug	LCM/Pipe scouring	0.7	0.7	1.2	E

Chemical	Trade Name	Function	Estimated Use per Hole (tonnes)[1]			Hazard Category[2]
			42"	32"	28"	
Poly Ether Amine/Poly Ether Amine Acetate Blend	Ultrahib	Shale Inhibitor			70	Gold
Aliphatic Terpolymer	Ultracap	Shale Encapsulator			14	Gold
Ester/Alkenes C15-C18 Blend	Ultrafree	Anti-accretion additive			65	Gold
Flotrol	starch	Water soluble polymer designed to control fluid loss			9.2	E

Notes:
[1] Volumes will depend on the actual subsurface conditions encountered as such these volumes are best estimates based on previous experience.
[2] 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 April 2019.

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 (shale shakers, desander and desilter), separating mud from the cuttings onboard the MODU.

Once treated onboard the MODU, WBM cuttings from the 28" hole section will be discharged below the sea surface from the MODU cuttings chute in accordance with applicable PSA requirements[13].

When drilling of the 28" hole section is completed, residual WBM viable for recycling will be recovered and backloaded to shore based storage facilities for reconditioning and future re-use. WBM not viable for shipping to shore upon completion of drilling the 28" hole section will be discharged to sea in accordance with PSA requirements[14]. However, in some cases, mud and 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 drill string 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[15].

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 drill string 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 13-62 m^3.

[13] 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.
[14] 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.
[15] Well control equipment is not installed at this stage to mitigate against weak formation.

4.5.3.2 Lower Hole Sections

Lower 22", 20", 17", 14½", 12¼" and 8½" 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 SOBM/LTMOBM for the 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. The density and chemical composition of the SOBM/LTMOBM will be dependent on the actual well conditions encountered during drilling operations. Table 4.7 presents the typical composition and estimated volumes of SOBM/LTMOBM expected to be used per hole.

Table 4.7 Estimated Use of SOBM/LTMOBM Drilling Chemicals - Lower Hole Sections

Chemical	Trade Name	Function	Estimated Use per Hole (tonnes)[1]	Hazard Category[2]
			All Lower Hole Sections	
Barium sulphate ore	Barite	Weighting agent	3581	E
Calcium chloride	Calcium chloride	Borehole stabiliser	270	E
Polymer	Ecotrol	Fluid loss control and reduces the risk of drill string sticking	5	E
Calcium hydroxide	Lime	Alkalinity, calcium ion treatment	36	E
Emulsifier	Suremul EH	Emulsifier	125	D
Surfactant	Surewet	Wetting agent for drill solids and barite	17	D
Alkenes/Fatty Acid	Rheflat	Rheology modifier	9	D
Oxybisethanol/ Diethylenetriamine	Rhethik	Viscosifier	6	*
Propylene Carbonate	Rhebuild	Temporary viscosity agent	1	C
Base Oil	Escaid 110 base oil	Mineral Oil base fluid	3400	C
Gilsonite/Lignite	Versatrol	Fluid Loss Additive	71	E
Treated Bentonite	VG Plus/ VG Supreme	Viscosifier and removal of cuttings	63	E
Calcium carbonate	Durcal 130	LCM / wellbore strengthening	15	E
Calcium carbonate	Safecarb Z3	LCM / wellbore strengthening	5	E
Calcium carbonate	Safecarb 250	LCM / wellbore strengthening	73	E
Calcium carbonate	Safecarb 600	LCM / wellbore strengthening	52	E
Calcium carbonate	Safecarb 750	LCM / wellbore strengthening	5	E
Calcium carbonate	Safecarb 1400	LCM / wellbore strengthening	7	E
Calcium carbonate	Safecarb Z4	LCM / wellbore strengthening	5	E
Calcium carbonate	Starcarb	LCM / wellbore strengthening	2	E
Loss Control Material (LCM) /Cement scouring pill	Nutplug	LCM / wellbore strengthening	10	E
graphite	Gseal	LCM / wellbore strengthening	61	E
LCM material	Sand Seal	LCM	6	E
Notes as per Table 4.6 * Not currently listed into UK Offshore Chemical Notification Scheme (OCNS) Ranked Lists of Notified				

Used SOBM/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 SOBM/ 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 SOBM/LTMOBM will be reused where practicable, and the remainder returned to shore for disposal. SOBM/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 SOBM/LTMOBM or associated cuttings into the marine environment.

4.5.3.3 Contingency Drilling

The Base Case is to drill one exploration well (SAX01) as part of the Project scope. However, should the MODU encounter borehole stability issues during the drilling of SAX01 well, it will be abandoned in line with procedures outlined in Section 4.9. As such, it may be necessary to drill an additional well (based on the same well design) within approximately 50-70 m from the original SAX01 location. Should the drilling of a second well also encounter stability issues the drilling of further wells will be required. In order to reduce the risk of requiring additional drilling, the well has been designed to set the 22” casing above any potential shallow gas accumulations.

In the event it is necessary to drill an additional well(s), additional discharges to the marine environment will occur. For the purpose of the ESIA, it is assumed that up to two additional wells may be drilled. It is conservatively assumed they are each drilled to their full depth and the estimated discharges and duration for each well will be the same as for the SAX01 Base Case well.

4.5.4 Summary of Mud and Cuttings

Table 4.8 presents the estimated quantities of waste drilling fluids and cuttings for each hole section (based on the experience of the project engineers and the diameter and length of each well section) and the planned disposal route. It should be noted that the volumes presented are per well and the Base Case assumes drilling of a single well with potential for additional wells under contingency conditions only as described in Section 4.5.3.3 above.

Table 4.8 Estimated Well Cuttings and Mud Volumes Per Hole Section (Per Well)

<table>
<tr><th>Hole Size (Drill Bit Diameter)</th><th>Description</th><th>Estimated Fluids Discharged (Tonnes)[1,2]</th><th>Estimated Cuttings Discharged (Tonnes)</th><th>Estimated Cuttings Shipped to Shore (Tonnes)</th><th>Estimated Fluids Shipped to Shore (Tonnes)</th><th>Drilling Fluid / Mud System</th><th>Cuttings and Mud Disposal</th><th>Duration of Discharge (hours)</th></tr>
<tr><td>42”</td><td rowspan="2">Conductor and Surface Holes</td><td>1600</td><td>450</td><td rowspan="3">0</td><td rowspan="3">0</td><td rowspan="2">Seawater / sweeps/ bentonite Pad mud</td><td rowspan="2">At seabed</td><td>30</td></tr>
<tr><td>32”</td><td>1600</td><td>570</td><td>120</td></tr>
<tr><td>28”</td><td>Surface Hole</td><td>2176</td><td>720</td><td>WBM</td><td>To sea via caisson</td><td>168</td></tr>
<tr><td>22”, 20”, 17”, $14^{1}/_{2}$”, $12^{1}/_{4}$ and $8^{1}/_{2}$”</td><td>Lower Holes</td><td colspan="2" rowspan="4">No planned discharge</td><td>3050</td><td>2500[3]</td><td rowspan="4">SOBM/ LTMOBM</td><td rowspan="4">Ship to shore for disposal</td><td rowspan="3">-</td></tr>
<tr><td>Temporary Abandonment</td><td rowspan="3">Post-drilling Activity</td><td>0</td><td>0</td></tr>
<tr><td>Re-entry</td><td>0</td><td>1217</td></tr>
<tr><td>Permanent Abandonment</td><td>0</td><td>1217</td><td></td></tr>
<tr><td colspan="9">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 4.6. This is because allowance is made for mud volumes left behind in casings.
[3] Estimated volume of SOBM/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 SOBM/ LTMOBM returned to shore for reuse on subsequent wells.</td></tr>
</table>

4.5.5 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 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.

During cementing of the casings, some loss of cement to the seafloor usually occurs when completing the casing cementing as a result of needing 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.

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. 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 casing. The discharge of dilute cement slurry is estimated to take approximately an hour at a rate of 78 m^3 per hour. Excess cement from well cementing will be discharged to sea via the cement unit hoses. Dry cement will not be discharged to the marine environment under routine conditions.

Table 4.9 below presents the estimates of the worst-case volume discharged to the seafloor during casing cementing per well and from the drilling rig to sea during wash out of the cement unit. Table 4.10 presents the estimated cement unit washout volumes discharged following the plug and tieback cementing activities during well abandonment activities. A full list of cement chemicals is included in Appendix 4A.

Table 4.9 Estimated Discharge of Well Cement Chemicals During Cementing and Cement Unit Wash Out (Per Well)

Activity	Discharge Route	36" Casing	28" Liner	22" Casing	18" Liner	16" Liner	14" Casing	11-7/8" Liner	10" Liner	7-5/8" Liner
		Estimated Discharge per Casing/Liner (tonnes)								
During casing cementing	To seabed	100.4	66.80	103.0	12.8	12.8	16	12	7.2	4
During cement unit wash out[1]	To sea (via hose)	5.1	4.0	6.8	4.7	4.7	5.9	4.7	3.1	5.1
Note 1. Discharge comprises cement and water at a ratio of approximately 1:10.										

Table 4.10 Estimated Discharge of Well Cement Chemicals During Cement Unit Washout for Temporary and Permanent Well Abandonment (Per Well)

Activity	Discharge Route	8-1/2" Hole Plugback	Temporary Abandonment Plugs	10" Tieback	Permanent Abandonment Plugs
		Estimated Discharge per Casing/Liner (tonnes)			
During cement unit wash out[1]	To sea (via hose)	4.7	4.7	4.7	19.0
Note 1. Discharge comprises cement and water at a ratio of approximately 1:10.					

4.5.6 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 which may pose 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.

Table 4.11 lists the anticipated chemicals per well intended to be stored on the rig, used in the event of contingencies when drilling. By definition the extent of 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 and safety considerations.

Table 4.11 Estimated Usage of Drilling Contingency Chemicals Added to SOBM/LTMOBM (Per Well)

Chemical	Function	Estimated Use (tonnes)[1]	Hazard Category[2]
Contingency chemicals that may added to WBM or SOBM/ LTMOBM			
Citric Acid	Thinner and calcium sequester	1	E
Super sweep	Hole cleaning agent	1	GOLD
Mica F, M, C	LCM	1	E
Contingency chemicals that may be added to SOBM/ LTMOBM only			
Gluteraldehyde 50%	Biocide	1	Gold
Safe - cide	Biocide	0.5	Gold
MI Seal F, M	LCM	4	E
Nut Plug / nutshells	LCM	2	E
Lignites / gilsonite	Organics / Asphalts for lost circulation	5	Gold
Kleen Up	Surfactant and wellbore cleaning agent	5	Gold
Safe Cor (Amine Blend)	Corrosion inhibitor	5	Gold
Sand Seal	LCM	1	E
Cellophanes	LCM	7.5	E
Notes as per Table 4.6			

4.6 Well Displacement

Displacement of the well 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 SOBM/ LTMOBM from the well. Table 4.12 details the chemicals and fluids planned to be stored on the rig and used for well displacement. The ESIA Management of Change Process (Section 4.11) will be followed should alternative chemicals be required.

Table 4.12 Estimated Well Displacement Chemicals (Per Well)

Chemical/Fluid	Function	Estimated Use (tonnes)[1]	Hazard Category[2]
Barite	Weighting agent	750	E
Escaid-110 Base Oil	Base fluid	192	D
DEEPCLEAN	surfactant/solvent	56	GOLD
DEFOAM-A-EH	defoaming agent	2.5	GOLD
DUO-VIS	viscosifier	4	GOLD
SAFE-SCAV HSB	H2S scavenger	7	GOLD
SAFE-SCAV CA	Oxygen scavenger	1	GOLD
Sodium Chloride	Salt	900	E
Monoethylene glycol (MEG)	MEG	14.8	E
Safe Cor (Amine Blend)	Corrosion inhibitor	30	Gold
Gluteraldehyde 50%	Biocide	1	Gold
Notes as per Table 4.6			

It is planned that displacement chemicals will be circulated back to the MODU with the SOBM/LTMOBM and either be reused/recycled or will be shipped to shore for disposal in accordance with the existing BP AGT Region waste management plans and procedures. It is not planned to discharge displacement chemicals or fluids 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 BP AGT Region waste management plans and procedures.

4.7 Blow Out Preventer (BOP) Testing

A blow out preventer (BOP) will be installed on the well after the 22" casing to control pressure in the well. 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), ethylene glycol and water. The active components of Stack Magic ECO Fv2 and the typical proportions of this product, ethylene glycol and water in the BOP fluid as a whole are summarised in Table 4.13.

Table 4.13 Percentage Composition of Stack Magic and BOP Fluid

Control Fluid (Stack Magic)	Percentage (%)	BOP Fluid	Percentage (%)
Ethylene glycol	10-20	Control Fluid	3
2-Aminoethanol	5-10	Ethylene glycol[1]	0-6
Triazine Biocide	2-5	Water	91-97
Water	65-83		
Notes: 1. Only used during winter months – November to March @6%			

It is anticipated that BOP testing will take place weekly from when the BOP is installed to the end of drilling activities). On alternate weeks, either function testing (one pod) or full function/pressure testing (two pods) will be carried out. Table 4.14 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 4.14.

Table 4.14 Summary of BOP Fluid Discharge

BOP Function	Volume (litres)	Depth	Frequency
Upper Annular	617	Approximately 8 m above seabed	Fortnightly – 2 pod test
Lower Annular	597		
Blind sheer rams	664		
ST lock blind shear	40		
Casing sheer rams	892		
Upper Pipe Ram	345		
ST lock UPRs	23		
Middle Pipe Ram	365		
ST Lock MPRs	23		
Lower Pipe Ram	355		
ST Lock LPRs	30		
Upper Outer Choke (U.O.C) line	40		
Upper Inner Choke (U.I.C) line	33		
Lower Outer Choke (L.O.C) line	43		
Lower Inner Choke (L.I.C) line	48		
Upper Outer Kill (U.O.K) line	49		
Upper Inner Kill (U.I.K) line	38		
Lower Outer Kill (L.O.K) line	48		
Lower Inner Kill (L.I.K) line	40		
Outer bleed valve	40		
Inner bleed valve	38		
C&K Line Test Valves	55		
Mud Boost Valve	42		
Diverter	302		
Total	**4767**		

4.8 Well Logging

During the drilling of the well, a number of techniques will be used to determine the well characteristics and evaluate the potential for hydrocarbon reserves. Well logging activities to be undertaken during the drilling of the Project exploration well, include:

- Mud logging;
- Monitoring of well bore parameters;
- Wireline logging to obtain information on the physical properties of the formations, pressures and fluids by means of sensors deployed on logging tools;
- Logging while drilling (LWD) to obtain information on the physical properties of the rock formations and fluids by means of sensor gauges on specially adapted drill collars;
- Potential for side wall coring performed on wireline to assess rock properties; and
- Potential for coring to assess rock properties.

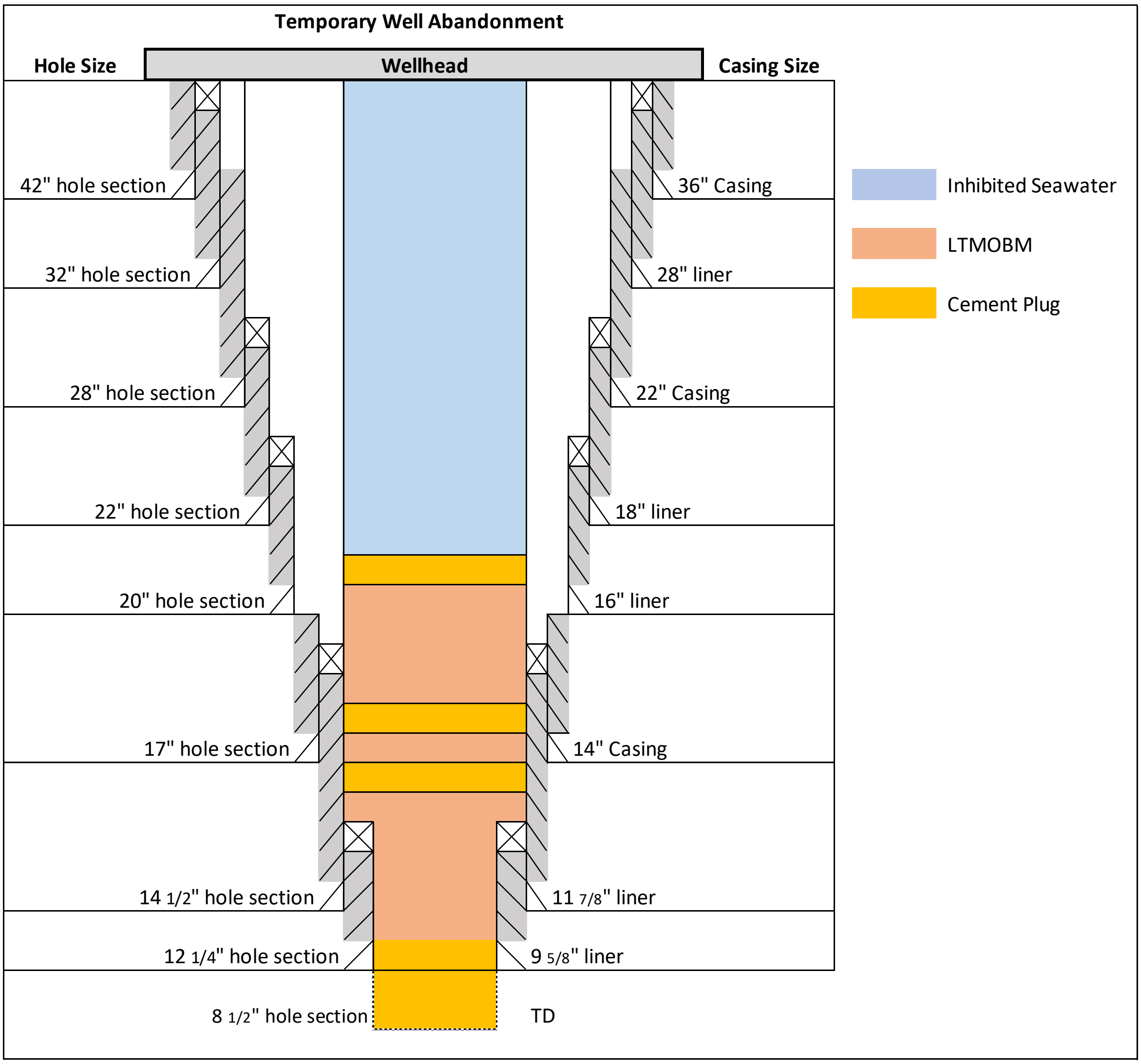
Logging tools are inserted into the well (sensors integrated in drill string) to measure the electrical, acoustic, radioactive, and electromagnetic properties of the subsurface formation. Measured data is collected in real-time and transmitted to the surface.

4.9 Well Suspension and Abandonment

When the target depth (TD) is reached following drilling, casing and cementing activities, if no well test is required, the well will be permanently abandoned at this stage (see Section 4.9.2). If logging of the well shows presence of potential commercial hydrocarbon reserves, the well will be tested.

If a well test is required, it is anticipated that this activity will be undertaken following a break in the drilling programme (refer to Section 4.2). As such the well will be temporarily abandoned. Cement plugs will be introduced into the well and the SOBM/LTMOBM in the lower sections of the well will be retained. The SOBM/LTMOBM present above the uppermost plug will be displaced using inhibited seawater/brine. The SOBM/LTMOBM will be recovered to the MODU and shipped to shore. A corrosion cap will be installed on the wellhead to protect it from corrosion and to seal it. Figure 4.4 shows the temporary well abandonment schematic.

Figure 4.4 Temporary Well Abandonment Schematic



During the preparation of the cement plugs there will be residual cement generated within the MODU cement system. It is anticipated that an estimated 4.7 tonnes of cement mixed with seawater, discharged at a rate of 78 m^3 per hour will occur as described in Section 4.5.5 above during the temporary abandonment activities.

4.9.1 Well Re-entry

In the event that well testing is required the temporarily abandoned well will be re-entered by the MODU that will undertake the well test. The inhibited seawater/ brine will be displaced with SOBM/ LTMOBM with the seawater/ brine sent to the MODU. Downhole tools will be used to remove the cement plugs which will be recovered back to the MODU and fluids circulated to the hole to remove debris. A 10" production tieback will be installed as production casing. The well will be displaced using completion fluid. It is anticipated that either calcium chloride or sodium chloride brine with MEG will be used, depending on the downhole conditions of the well. It is planned to circulate all completion fluids back to the MODU, where they will be contained and shipped to store for disposal. It is not planned to discharge any completion fluids.

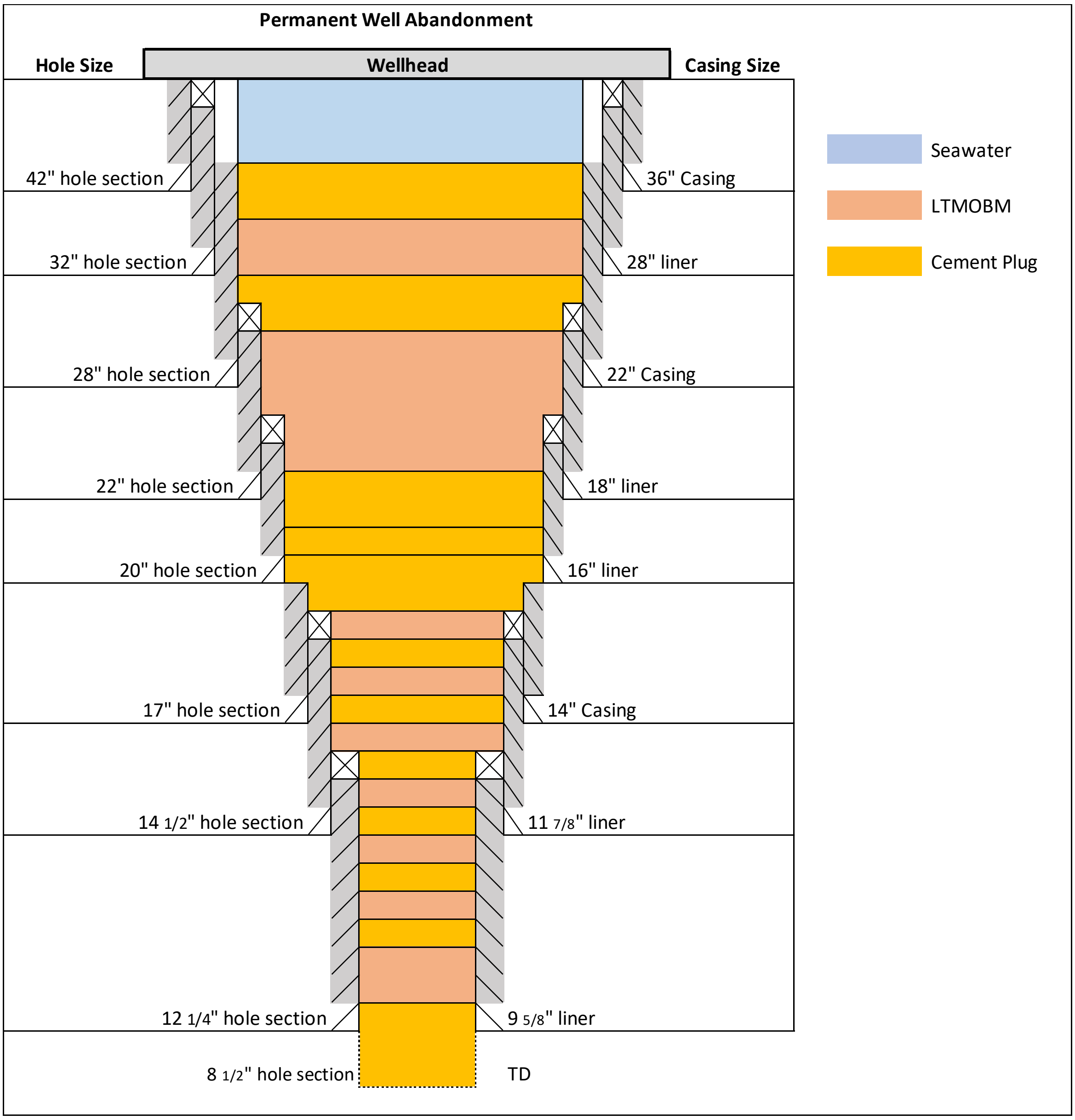
As described in Section 4.2, as the well test activities are not sufficiently defined at this time they are not included within the Project Base Case and will be considered in a separate permission document to be submitted to the MENR at a later date if it is confirmed that well testing is to be undertaken (on the basis of the well logging results). This document will include an environmental assessment of the well testing activities and this is not considered further in this ESIA.

4.9.2 Permanent Well Abandonment

If well testing is not required due to potential commercial hydrocarbon reserves not being detected by well logging activities, or following completion of well test activities, the well will be permanently abandoned. SOBM/ LTMOBM will be introduced to the well, the 10” tieback and 14” casing will be recovered, and cement plugs will be placed at multiple intervals to provide zonal isolation as shown in Figure 4.5. The hole section above the uppermost plug will be displaced to seawater. The wellhead assembly and associated equipment will remain on the sea floor, with the wellhead assembly extending approximately 3.5 m above the seabed.

As for the temporary abandonment activities there will be residual cement remaining within the MODU cement system at the end of cementing activities. It is anticipated that an estimated 19 tonnes of cement mixed with seawater, discharged at a rate of 78 m^3 per hour will occur as described in Section 4.5.5 above during the permanent abandonment activities.

Figure 4.5 Permanent Well Abandonment Schematic



4.10 Emissions, Discharges and Waste Summary

4.10.1 Summary of Emissions to Atmosphere

Emissions to atmosphere from the proposed drilling operations will arise from the following key sources:

- MODU engines and generators;
- MODU support vessels (supply vessels and crew transport) engines and generators; and
- Helicopters (crew transport).

Table 4.15 summarises the GHG (i.e. CO_2 and CH_4[16]) and non GHG emissions predicted for the Project drilling activities per well.

Table 4.15 Estimated GHG and Non GHG Emissions Associated with Drilling Activities (Per Well)

Emission	MODU, Support Vessels & Helicopter Movements
CO_2 (ktonnes)	94
CO (tonnes)	459
NOx (tonnes)	1736
SOx (tonnes)	3
CH_4 (tonnes)	5
NMVOC (tonnes)	58
GHG (ktonnes)	94
Notes: CH4 has a global warming potential of 25 times CO2 therefore GHG emissions = CO2 emissions + (25*CH4 emissions) Estimates assumes all support vessels during drilling programme regardless of shared supply route to other facilities	

4.10.2 Summary of Discharges to Sea

Table 4.16 provides a summary of the total estimated routine and non-routine drilling fluid, cuttings and cement discharges to sea per well across the Project exploration drilling programme associated with planned activities.

Table 4.16 Estimated Drilling Fluids and Cement Discharges to Sea (Per Well)

Discharge	Frequency	Location	Estimated Volume (tonnes)	Discharge Composition
Seawater, PHB sweeps and cuttings	During 42" & 32" hole section drilling	Seabed	1020 cuttings and 3200 drilling fluids	Refer to Table 4.8
WBM and cuttings	During 28" hole section drilling	To sea (via cuttings chute or hose)	720 cuttings and 2176 drilling fluids	Refer to Table 4.8
Cement and cement chemicals	During 36", 28" and 22" casing cementing	Seabed	270.2	Refer to Table 4.9
Residual cement	At the end of each casing section and end of temporary and permanent well abandonment cementing activities	To sea (via cement unit hoses)	44.1	Refer to Table 4.9

Discharges of hydraulic fluids to sea due to testing of the BOP are detailed in Section 4.7 above.

4.10.3 Summary of Hazardous and Non-Hazardous Waste

The estimated quantities of non-hazardous and hazardous waste generated (SAX01 Base Case well) during the Project exploration drilling programme are provided in Table 4.17. Waste quantities have been estimated based on previous exploration drilling programmes in the region.

All waste generated during MODU drilling activities will be managed in accordance with the existing BP AGT Region waste management plans and procedures. The planned destination of each waste stream is also provided within Table 4.17.

[16] To convert to CO_2 equivalent the predicted volume of CH_4 is multiplied by a global warming potential of 25.

Table 4.17 Estimated Hazardous and Non-Hazardous Waste Associated with Drilling Activities (Per Well)

Classification	Physical Form	Waste Stream	Estimated Volume (tonnes)
Non-hazardous	Solid Waste	Metals - scrap	34
		Paper and cardboard	1
		Wood	23
		Cement	105
		Domestic/office wastes	237
	Total Non-hazardous Waste		**400**
Hazardous	Solid Waste	Batteries - dry cell	<1
		Batteries - wet cell	<1
		Clinical waste	<1
		Oily rags	35
		Container - plastic	5.0
		Filter bodies	2.0
		Toner or printer cartridges	2.0
		Container - metal	63
		Lamps/tubes – mercury vapour	<1
		Explosives	<1
	Liquid Wastes	Sewage - untreated	14
		Well suspension fluids	4
		Drilling muds SOBM/LTOBM	5550
		Drilling cuttings SOBM/LTOBM	
		Paints and coatings	1.0
		Water - oily	2,106
		Solvents, degreasers and thinners	7
		Oils - lubricating oil	156
		Bentonite	24
		Drilling muds WBM - contaminated	475
		Drilling cuttings WBM - contaminated	
		Laboratory chemicals and testing reagents	15
		Drilling chemicals	79
	Total Hazardous Waste		**8,538**

4.11 Management of Change Process

During the detailed planning and mobilisation stages of the Project, there may be a need to change a design element or a process. A formal process will be implemented 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 potentially significant environmental or social interactions.

Changes which do not significantly 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 Shafag-Asiman Exploration Drilling Project ESIA;
- Increase the quantity discharged as detailed in the Shafag-Asiman Exploration Drilling Project ESIA by more than 20%[17,18]; or
- Result in the discharge of a chemical not referenced in the Shafag-Asiman Exploration Drilling Project ESIA and not currently approved by the MENR for use in the same application by existing BP AGT Region operations.

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.

[17] 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).
[18] Unless increase is deemed to have no material effect on the associated impact(s).

5 Environmental & Socio-Economic Description

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5.1 Introduction

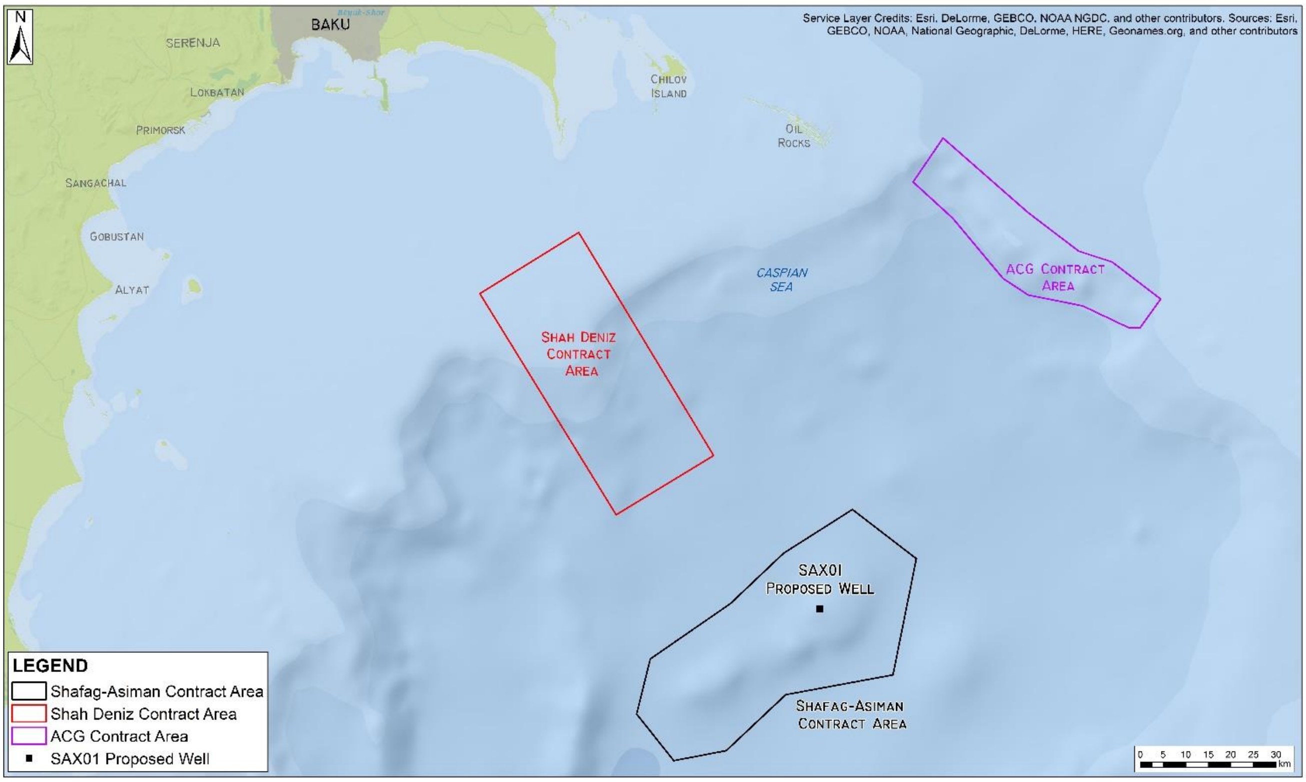
This Chapter describes the environmental and socio-economic baseline conditions relevant to the Shafag-Asiman Exploration Drilling Project. The purpose of the Chapter is to provide sufficient information to allow the potential impacts of the Project activities to be assessed in accordance with the assessment methodology as set out in Chapter 3 of this Environmental and Socio-economic Impact Assessment (ESIA). The scope and content of this Chapter has therefore been determined based on the anticipated environmental interactions identified during the Project scoping process.

This Chapter provides relevant information on the following relating to environmental and socio-economic baseline conditions:

- Physical setting including a summary of seismicity, geology, meteorology and climatic conditions relevant to the Caspian region as a whole (i.e. the entire geographic area in which the Caspian Sea is located);
- A description of the marine environment relevant to the Southern basin of the Caspian Sea including an overview of bathymetry and oceanography;
- A summary of the known presence, behaviour and seasonal sensitivity of fish and Caspian seals within the Shafag-Asiman Contract Area; and
- Specific data relating to the seabed and water column physical, chemical and biological/ecological conditions at the proposed Shafag-Asiman SAX01 well location, including a comparison to regional datasets;
- A summary setting out the importance of the Azerbaijan coastline for birds; and
- A description of the socio-economic baseline conditions relevant to the Shafag-Asiman Contract Area and Project activities.

Figure 5.1 presents the location of Shafag-Asiman Contract Area and Exploration well location in the context of the Southern Caspian Sea.

Figure 5.1 Shafag-Asiman Contract Area and SAX01 Exploration Drilling Location in the Context of the Southern Caspian Sea



5.2 Data Sources

Environmental monitoring data has been collected by BP for over 25 years from the Azeri-Chirag-Gunashli (ACG) and Shah Deniz (SD) Contract Area, with the latter located approximately 30 kilometres (km) north west from the Shafag-Asiman Contract Area. Since 2005, data has been collected under the Environmental Monitoring Programme (EMP) which has developed a reliable, consistent and robust time-series database for each monitoring location within a clearly defined survey area. This design has enabled long-term trends to be identified. Data is collected both at specific platforms locations (benthic only) and at regional stations across each Contract Area (water column and benthic). The regional surveys therefore provide an overview of the background conditions and overall trends recorded at the boundary of the ACG and SD Contract Areas, providing an indication of anticipated regional conditions.

In addition to the ongoing EMP surveys in the region, a specific Environmental Baseline Survey (EBS) at the proposed SAX01 exploration well location was undertaken in 2017 to gather additional environmental data (Ref.1). In total 4 water column and 20 sediment samples were taken and physical, chemical and biological analysis undertaken.

A summary of the baseline and EMP surveys considered to be relevant to the Shafag-Asiman Exploration Drilling Project is provided in Table 5.1.

Table 5.1 Baseline and EMP Surveys Relevant to the Shafag-Asiman Exploration Drilling Project Completed to Date

Date	Title of Survey
Offshore Surveys	
2017	Shafag-Asiman SAX01 Environmental Baseline Survey
Shah Deniz Contract Area	
2015	Shah Deniz Regional Survey
2013	Shah Deniz Regional Survey
2011	Shah Deniz Regional Survey
2009	Shah Deniz Regional Survey
2007	SDX-5 Environmental Baseline Survey
2007	Shah Deniz Regional Survey
2005	Shah Deniz Regional Survey

In addition to the surveys listed above, this chapter has also been prepared based on review of previous relevant BP ESIAs and Environmental Technical Notes (ETN) specifically:

- Shafag-Asiman 3D ESIA (Ref.2): The ESIA was prepared to obtain permission to undertake a 3D seismic survey across the Shafag-Asiman Contract Area;
- Azeri Central East ESIA (Ref.3): An ESIA was prepared to assess the drilling, construction and operational activities associated with the Azeri Central East (ACE) Project, located within the ACG Contract Area. In addition to an offshore environmental baseline survey at the planned platform location, a number of literature reviews were undertaken focused on updating baseline data relevant to Caspian Seal, fish and birds across the Central and Southern Caspian Sea; and
- Shah Deniz Stage 2 (SD2) Project ESIA (Ref.4): An ESIA was prepared to assess the drilling, construction and operational activities associated with the SD2 Project located within the Shah Deniz Contract Area, including the associated subsea export pipelines to the onshore Sangachal Terminal. In addition to numerous onshore surveys, offshore baseline surveys were completed at the proposed platform location and at the five flanks where the project wells will be located in addition to literature surveys focused on Caspian Seal, fish and birds.

Secondary data sources used to inform the environmental baseline include:

- Data collected through consultation with local specialists including:
  - Review of available bird data relevant to the Shafag-Asiman Contract Area completed by Ilyas Babayev of the Institute of Zoology;

  - Review of the most recent available data relating to Caspian Sea fish species and commercial fishing activities relevant to the Shafag-Asiman Contract Area completed by Professor Mekhman Akhundov of the Azerbaijan Fisheries Research Institute; and
  - Review of the most recent available data relating to Caspian seals relevant to the Shafag-Asiman Contract Area completed by Tariel Eybatov of the Natural History Museum.
- Data and literature publicly available on the internet including reports published by International Union for Conservation of Nature (IUCN); United Nations Environment Programme Global International Waters Assessment (UNEP / GIWA), BirdLife International; World Protected Areas Database (WDPA) and Casp Info.

In addition to the sources listed above, socio-economic data presented in this Chapter has been also been sourced from Secondary data and literature publicly available on the internet including data and reports published by The State Statistical Committee of the Republic of Azerbaijan, The Republic of Azerbaijan Ministry of Economy, US Energy Information Administration, United Nations Development Programme and the World Bank.

5.3 Physical and Geophysical Environment

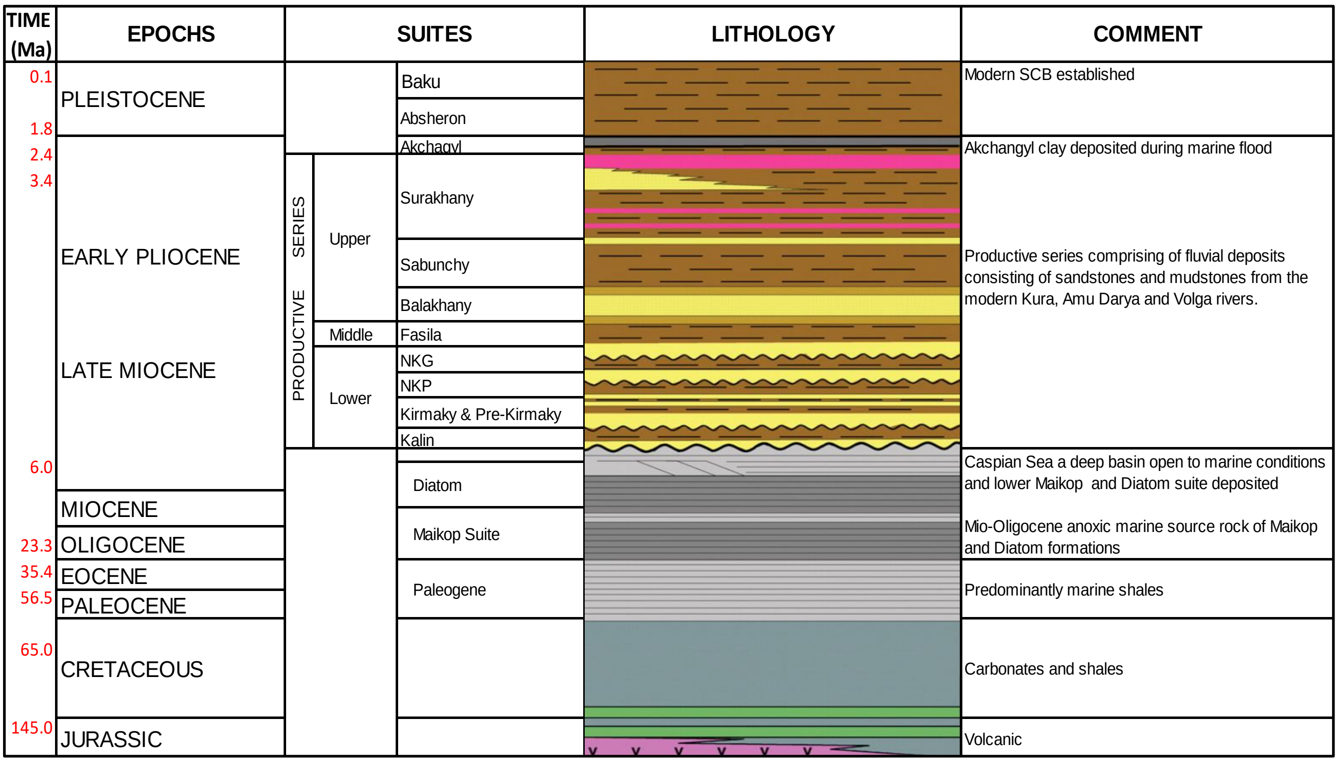
5.3.1 Geology

The Caspian Basin represents one of the largest continental lake systems in the world. The South Caspian Basin is a large intermountain basin situated within the Alpine-Himalayan collision zone and is characterised by deep water on the west and shallow water on the east. It is separated from the Central Caspian Basin by the Caucasus-Kopet-Dagh fault. The South Caspian Basin occupies the southernmost Caspian Sea and includes the Kura Basin in the west and as the West Turkmenistan Basin in the east. The Shafag-Asiman Contract Area lies within the Southern Caspian Basin, approximately 125 kilometres (km) south-east of Baku.

The Caspian region is characterised by the tectonic collision within the Arabia-Eurasia zone which has produced a series of anticlinal (arch-like) upward thrusting folds and exhibits horizontal motion rates of several centimetres per year (Ref.5). The SCB in particular has been affected by a complex tectonic history with several events of rifting and compression (Ref.6).

Within the Southern Caspian Basin several geological units that range from Jurassic-to-Present in age extend for up to 20 km in depth and represents the highest sedimentary package of the Caspian Sea (Ref.7). The sedimentary fill of the Maikop and Diatom Suites (refer to Figure 5.2) in the Southern Caspian Sea is considered young and occurred during the Oligocene and Early Miocene, when the Caspian Sea was a deep marine basin. The Mesozoic era (which incorporates the Jurassic and Cretaceous periods) deposits correspond to approximately 5 km of the sediment fill. During this period, the lower part of the Maikop Suite was deposited (Ref.8). This lower part consists of dark grey, sandy, sub-carbonaceous clays contain the interlayers of consolidated sands and sandstones and thin layers of marl. This is considered to be the main hydrocarbon source of the region. Since the end of the Miocene epoch, these layers were covered by sands originating from major delta systems of the modern Kura, Amu Darya and Volga rivers at exceptionally high rates of up to 4.5 kilometres/million years (Ref.8). This has formed the the main hydrocarbon reservoir within the region. The stratigraphic column for the South Caspian Basin is presented in Figure 5.2 below.

Figure 5.2 Stratigraphy of the Southern Caspian Basin



Roughly half of the sedimentary deposits in the Southern Caspian Basin accumulated in less than a tenth of its history and, as a consequence of this rapid sand deposition, led to an over-pressuring of the underlying muds, resulting in an abundance of mud volcanoes and diapirs (i.e. below surface geological intrusions) in the region.

5.3.1.1 Mud Volcanoes

Approximately half of the world's known mud volcanoes are found within the Southern Caspian Basin (Ref.9). Periodic fluid upwelling from deeper overpressured shales has led to the formation of numerous mud volcanoes and seepage features. This formation occurs through the rapid sedimentation of low permeability clay layers which leads to a thick blanket (>20 km thick) of low density shale containing high excess pore-pressures. These overpressures in the sediments, combined with the vertical and lateral stresses induced by the regional compressive tectonics, are key traits which explain the upward migration of fluids in the near-seabed sediments which result in the numerous mud volcanoes at the seafloor. There are three known prominent mud volcanoes in the Shafag-Asiman Contract Area (Ref.10). The nearest is located approximately 10 to 15km south east of the planned proposed SAX01 exploration well location (Ref.11).

5.3.1.2 Seismicity

The main source of seismic activity within Azerbaijan results from the Caucasian segment of the Alpine-Himalayan (Mediterranean) folded belt, which was generated through the collision between the Eurasian and Afro-Arabian lithospheric plates, which continues to occur. The rate of northward motion of Arabia relative to Eurasia has remained more or less constant at about 2 centimetres per year (cm/year) since the collision began.

The Southern Caspian is defined by the Scythian microplate (regional tectonic block), 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. These convergent plate movements are generally associated with relatively high levels of seismic activity.

Seismic monitoring of the region has been ongoing since early 2000 using modern telemetric stations with satellite communication systems. A seismic assessment (Ref.12) undertaken for the region in 1996 detected 565 earthquakes which occurred from 650 AD to 1996 and included a subset of nine significant (magnitude[19] 6-7.7) historic earthquakes since 1668. Despite its history, the Southern Caspian Basin, has been reported as having ‘relative low’ seismicity as the majority of seismic epicentres have been registered around the margins. Since the 1996 study, there have been a further seven earthquakes with magnitude >5 within Azerbaijan, including a magnitude 6.8 event in 2000 (Ref.13).

5.3.2 Meteorology and Climate

5.3.2.1 Temperature and Precipitation

The Caspian Sea region is climatically diverse and encompasses the basins of the vast semi-arid and hot arid plains of northern Kazakhstan and Turkmenistan in the east, and the humid Caucasus and Elburz Mountains in the south-west. The Caspian plays an important role in atmospheric processes, regional water balance and microclimate. Climate conditions in the Caspian region are linked to the Northern Atlantic Oscillation (fluctuations in atmospheric air pressure) which affects variations in temperatures, humidity and rainfall.

Over the Caspian area, July to August average temperatures vary between 24 and 26°C, with a maximum of 44°C on the eastern shore. Monthly average temperatures during winter range from −10°C in the north to 10°C in the south (Ref.14). In the western part of the Southern Caspian where Azerbaijan is located, annual variations in the temperature regime are considerable, but in general air temperatures below freezing are uncommon.

Extreme air temperatures offshore derived using a combined data set that comprises measurements taken from the platforms in the offshore ACG Contract Area over a total duration of approximately nine years provides estimates of extreme return period values for hundred year values of 40.8°C and -7.3°C for the maxima and minima, respectively. The average air temperatures above the Caspian Sea typically peak at 25.5°C during the summer, and may drop to 0°C for some periods in the winter (Ref.15).

Precipitation is highly variable throughout the Caspian region. The highest levels of precipitation occur between September and April where the monthly average can be up to 35 mm. The driest months, July to August, have monthly average precipitation ranging from 7 to 8 mm (Ref.16). Annual average precipitation in the offshore environment of Azerbaijan is approximately 300 to 400 mm.

5.3.2.2 Wind

The wind conditions found on the Caspian Sea are formed largely as a result of its north to south orientation, the mountain ranges which surround it and the different weather systems converging on this area (Ref.17). The average annual wind speed across the Southern Caspian Sea is around 5 to 6 metres per second (m/s). Strong winds and storms can arise at any time of the year but are more common during the winter months.

5.3.3 Air Quality

At a national level, air quality varies across Azerbaijan with higher pollutant concentrations recorded in cities (such as Baku) due to increased industry and transport emissions than in rural areas. Monitoring of pollution of ambient air in Azerbaijan is undertaken by the Department of National Environmental Monitoring and reported on an annual basis since 2005 at 26 stations in cities across the country, including nine locations within Baku city (Ref.18). Outside of Baku it is understood that air quality in coastal areas is not routinely monitored except in the vicinity of the Sangachal Terminal located approximately 40 km south west of Baku. Between 2012 to 2016 average NO_2 concentrations of between 10.4µg/m^3 and 11.8µg/m^3 were recorded, well below the annual average EU limit value for NO_2 of 40µg/m^3.

Monitoring of dust and particulate levels around the Sangachal Terminal and within Baku indicate average particulate concentrations (as PM_{10}[20]) of between 24.3 and 240µg/m^3 which is 6 times more

[19] The magnitude is a number that characterises the relative size of an earthquake. Magnitude is based on measurement of the maximum motion recorded by a seismograph.
[20] Atmospheric air containing dust having particulates with <10 um diameter aerodynamic size distribution.

than the annual average EU limit value of 40µg/m^3. Windblown dust is a known nuisance issue across the region and within Baku, and considered typical of such an environment.

5.3.4 Marine Setting

5.3.4.1 Bathymetry

The Caspian Sea is the largest landlocked water body on Earth with a surface area of approximately 371,000 km^2. It is fed by numerous rivers, the largest of which is the Volga to the north. The Caspian 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 Central and Southern Basins are separated by the Absheron Sill. The deepest recorded depth is in the Southern Caspian Basin and is just over 1000 m.

The bathymetry of the Shafag-Asiman Contract Area slopes from the north-east to the south-west, with depths ranging from 650 m in the centre of the Contract Area to approximately 950 m in the south-west corner. The depth at which the proposed SAX01 exploration well is 624 m.

5.3.4.2 Sea Level

The Caspian Sea has experienced significant water level fluctuations over the past several hundred years, including changes of several metres within the past few decades. The Caspian Sea and is one of the few water bodies in the world where the water level is lower than the global mean sea level of the world's oceans. The variation in sea level is a result of changes in water inflow from rivers (mainly the Volga which represents 70% of total inflow), precipitation, loss from evaporation and discharge to the Kara-Bogaz-Gol in Turkmenistan. A recent study (Ref.19) found that water levels in the Caspian Sea increased by approximately 12.74 cm/year during the period 1979–1995 and dropped approximately 6.72 cm/year during the period 1996–2015. The study found that increased evaporation rates over the Caspian have significantly contributed to the recent drop in sea level and predicts accumulating evaporation rates over the Caspian Sea for the foreseeable future will lead to further sea level decline. The current Caspian Sea level is approximately 28 m below mean sea level.

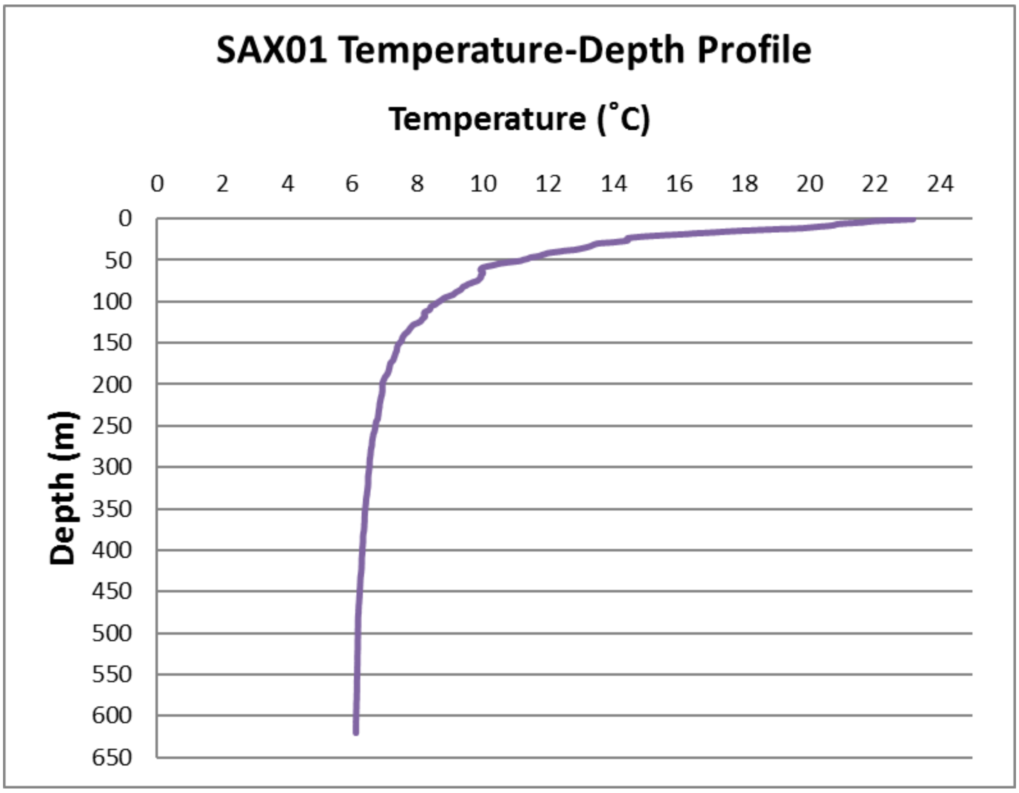
5.3.4.3 Salinity

The salinity in the Caspian Sea is almost three times lower than that of the world oceans (Ref.20). The surface salinity levels vary with water temperature (i.e. evaporation rates), distance to fresh water sources and the riverine input. The salinity of the surface water in the Southern Caspian Basin increases in summer months and can reach up to 11-13 practical saline unit (PSU). The most recent samples taken from the Shafag-Asiman Contract Area in June 2017 recorded salinity values of 10.45 to 11.01 PSU.

5.3.4.4 Water Temperature

As a result of the differential climatic conditions between the Caspian basins, the seabed bathymetry, the current regime and the northern fluvial inputs, sea surface temperatures change significantly across the seasons in the Caspian Sea while the temperature at depth remains constant. The Shafag-Asiman EBS conducted in June 2017 measured the water temperature-depth profile using a submersible Conductivity, Temperature, Depth (CTD) sensor. The survey recorded a major temperature decline of approximately 8.5 °C between 10 and 50 m water depth (refer to Figure 5.3). These marked differences between surface and deeper water temperature result in the formation of a seasonal thermocline (a stable zone within the water column exhibiting a rapid rate of temperature change), which restricts mixing of the upper and lower water layers, thereby stratifying the water column while it persists. This feature is typical of summer months and has been observed on previous surveys carried out in the region.

Figure 5.3 Temperature-Depth Profile Measured at the SAX01 Location (June 2017)



5.3.4.5 Oxygen Regime

The deep-water areas of the Southern Caspian Basin are characterised by lower dissolved oxygen levels compared to the Northern and Central Caspian Basins. This is caused among other factors, by poor penetration of sunlight and reduced photosynthesis activity, the deficiency of large river inflows and the stratification of the water column during the thermocline. Dissolved Oxygen (DO) levels in the Southern Caspian Basin decrease with depth and saturation can reach levels as low as 10% at 600 m depth (Ref.20).

Throughout the year the surface waters of the Southern Caspian Basin are characterised by high oxygenation with high saturation levels occurring in the spring due to phytoplankton activity. During summer, the water column becomes stratified, resulting in decreased oxygen levels below the thermocline.

Sampling conducted as part of the 2017 Shafag-Asiman EBS recorded DO levels of between 6.5 milligrams per litre (mg/l) and 7.5 mg/l at 5m water depth and between 4.7 mg/l and 5.0 mg/l at 150 m water depth. Water quality standards in Azerbaijan for fisheries require DO level in excess of 6 mg/l. The DO levels recorded within the deeper samples collected as part of the EBS were all below 6 mg/l. The decrease in DO levels between shallow and deeper waters is likely to be due to a reduction in photosynthesis at these depths. Also dead biota (mainly plankton) sink towards the seabed using up oxygen during decomposition. Furthermore, during summer months, the thermal layering, as discussed in Section 5.3.3.4 above, prevents mixing within the water column and therefore a reduction in DO levels in deeper waters occurs.

5.3.4.6 Wave and Current Regime

The main distinguishing features of the Caspian Sea are its isolation from the world's oceans and its intracontinental location. The Caspian is non-tidal, with the currents primarily influenced by wind, bathymetry, water density and temperature variations leading to some isolation between the Northern, Central and Southern Caspian areas (Ref.21). The resulting large scale circulation pattern consists of two anti-clockwise currents in the Northern and Central Caspian, and the western anticyclonic and the eastern cyclonic gyres in the Southern Caspian. According to Kosarev and Yablonskaya (Ref.22), in-flowing rivers influence the current regime, creating a southwards flow down the west coast of the Central Caspian and a counter current up the east coast as well as small residual currents in the southwest of the Caspian Sea.

The predominant wave heights in the Caspian Sea are relatively low with a minor build-up of swells, given the sea's land-locked nature and absence of tides. The greatest wave development occurs from the western section of the Central Caspian basin down and across the central section of the Absheron Ridge.

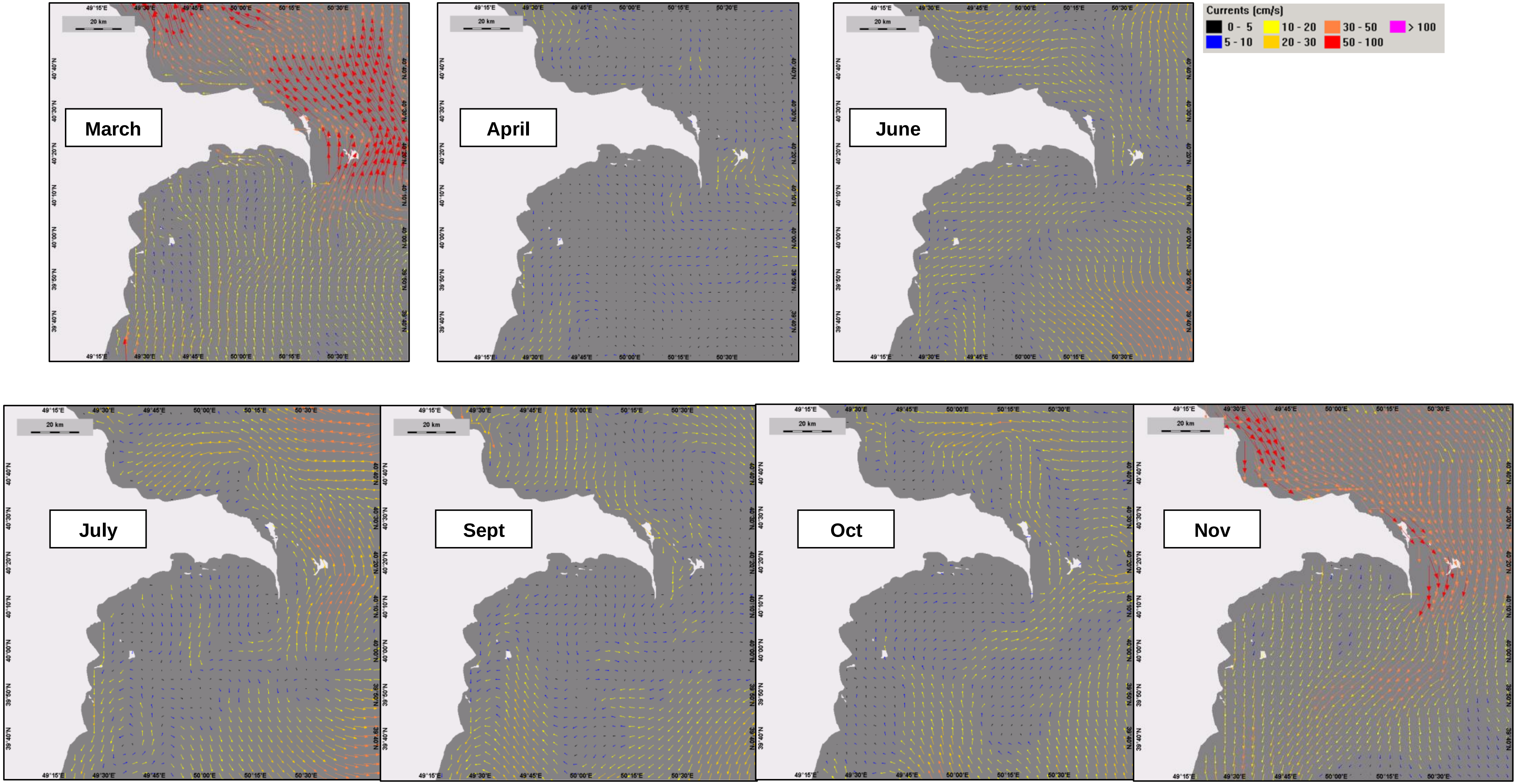
The mechanism that drives the currents can be traced back to the Northern Caspian Basin. Here, very cold winter air temperatures, shallow waters and large fluvial inputs from rivers, lead to rapid ice development and the formation of a reservoir of cold, dense water on the boundary with the Central Caspian Basin. The cold water is transported along the western Central Caspian 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 Caspian Basin where it appears to mix and sink. A counter flow of relatively warm Southern Caspian Basin water along the eastern section of the Absheron sill balances the cold water inflow.

In the vicinity of the proposed SAX01 well location, surface currents vary throughout the year in direction and speed Figure 5.4 shows the expected circulation variation during March, April, June, July, September, October and November (Ref.23). Moderate northward currents can be observed at the beginning of March, later replaced in the summer by smaller anti-clockwise circulation areas. More moderate southwards currents resume in November at the beginning of winter.

5.3.4.7 Storm Surges

Storm surges occur in the Caspian Sea causing temporary rises or falls in sea level. These events are associated with persistent strong winds, particularly the strong prevailing regional winds that blow along the axis of the Caspian Sea, from north and northwest or from the south and southeast. 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. Maximum wave heights and wind velocities over a 20-year period for the central southern Caspian have been recorded as 14 m and 26 ms^{-1} respectively. Northerly waves prevail during the whole year and the largest waves occur during the autumn / winter months with April having the least wave activity (Ref.24).

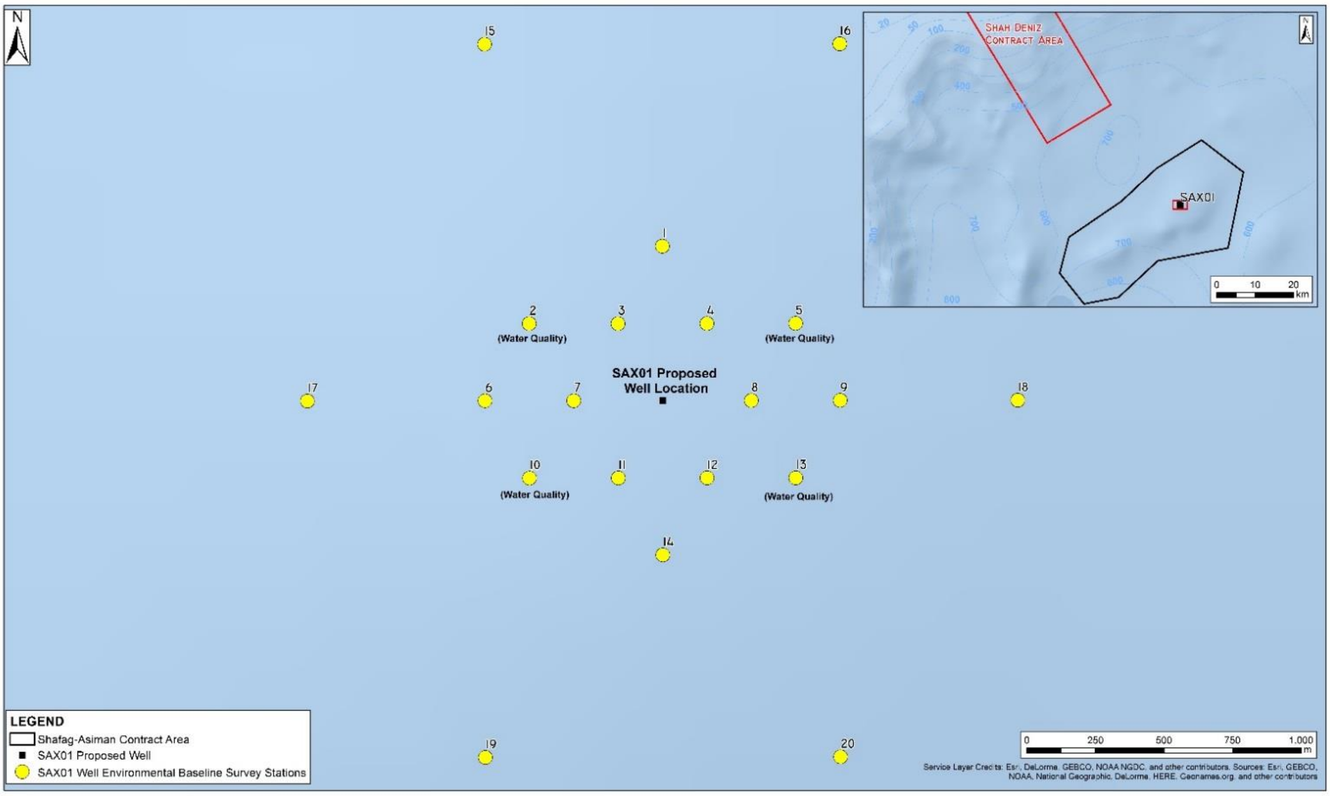
Figure 5.4: Surface Currents Recorded within the South Caspian Sea in March, April, June, July, September, October and November



5.4 Offshore Environment

In June 2017 an EBS was undertaken at the proposed SAX01 exploration well location in the Shafag-Asiman Contract Area. The EBS included sediment sampling at 20 stations and water column sampling at four of the 20 stations (stations 2, 5, 10 and 13). The water depth at the sampling stations ranged between 611 and 687 m. Three replicate seabed samples were collected from each of the 20 monitoring stations, while two samples were collected from the four water quality stations. Figure 5.5 shows the location of the 20 sample stations.

Figure 5.5 Locations of the Shafag-Asiman Contract Area, the Proposed SAX01 Exploration Well and SAX01 EBS Stations



Environmental surveys aimed at identifying seabed and water column characteristics and trends in the region have been undertaken as part of the wider BP EMP since 2005. The nearest EMP surveys have been undertaken in the SD Contract Area (shown in Figure 5.5), where the water depths within the southern section of the SD Contract Area are comparable to those in the Shafag-Asiman Contract Area. A comparison of the SAX01 EBS results and deeper SD Stations is presented in Section 5.4.6.

5.4.1 Physical and Chemical Characteristics of Seabed Sediments

5.4.1.1 Physical Properties

Table 5.2 presents a summary of the physical properties of the sediments recorded across the SAX01 EBS area.

Table 5.2 Summary of Physical Sediment Properties Recorded at SAX01

	Mean Diameter (µm)	Carbonate %	Organics %	Silt/Clay %	Silt %	Clay %	Wentworth Scale*	Sorting Index
Min	4	20	7.3	99	17	71	Clay	Good
Max	5	32	13.5	100	29	83	Very fine silt	Very Good
Median	4	25	9.3	100	20	79		
Mean	4	26	9.4	100	21	79		
* a scale for specifying the sizes (diameters) of sedimentary particles								

The results indicate that sediments across the area surveyed were generally homogenous with a consistent range of particle sizes present in most samples. The sediments at all stations were very well sorted and were classified as very fine silts or clay. All samples were dominated by the <3.9 µm clay fraction, the proportion of which ranged from 71-83%. Carbonate content ranged from 20 to 32% and organic content was generally high, ranging from 7.3 to 13.5%. This is considered typical for depth and location of the survey as finer sediments accumulate to a greater extent in deeper water, where the near-seabed water velocities are lower than in shallow water.

5.4.1.2 Hydrocarbon Concentrations

Table 5.3 summarises the sediment hydrocarbon concentrations recorded in the SAX01 EBS samples.

Table 5.3 Summary of Hydrocarbon Concentrations Recorded at SAX01

	THC (µg/g)	UCM (µg/g)	% UCM	Total 2-6 ring PAH (ng/g)	NPD (ng/g)	% NPD	Total EPA 16 (ng/g)
Min	27	20	60	359	230	58	72
Max	761	484	78	2267	1495	68	267
Median	51	36	71	633	389	62	116
Mean	78	54	71	646	407	63	120

Hydrocarbon concentrations were generally low throughout the EBS area. Aromatic and aliphatic compounds were strongly correlated, and the general composition was indicative of heavily weathered material being present throughout the EBS area. The highest average THC and PAH concentrations were recorded at Station 17 (within replicate sample 2). This was considerably higher than the concentrations recorded in all other samples collected within the EBS area, including the corresponding duplicate sample collected at Station 17 (i.e. replicate sample 1).

There was very little variation in the concentration of THC and PAH at stations within the centre of the survey area. The highest average THC and PAH concentrations were recorded at station 17 in the centre of the western flank, and slightly higher PAH concentrations were recorded at stations directly to the north and west of the proposed well site. Overall, the hydrocarbon concentrations within the SAX01 EBS area were, on average, lower than the levels recorded at comparable sites within the SD Contract Area.

5.4.1.3 Heavy Metal Concentrations

Table 5.4 provides a statistical summary of the concentration of heavy metals recorded in the SAX01 EBS sediment samples.

Table 5.4 Summary of Heavy Metal Concentrations (mg/kg) Recorded at SAX01

	As	Ba HNO_3	Ba Fusion	Cd	Cr	Cu	Hg	Fe	Mn	Pb	Zn
Min	4.5	438	797	0.203	40.4	38.3	0.038	32383	318	9.6	46.4
Max	9.9	654	1023	0.377	65.0	59.2	0.068	45539	1540	14.9	70.8
Median	6.4	512	868	0.276	50.3	46.4	0.049	34040	408	11.5	57.0
Mean	6.5	524	887	0.270	51.8	48.1	0.048	34418	434	11.8	57.5

The highest concentration of barium was found at Station 6, located approximately 500 m to the west of the proposed SAX01 location. Although the variability was low, the concentrations of most metals were highest at stations within the centre and the northern half of the EBS area.

Overall, the 2017 SAX01 sediment metal concentrations were similar to the results observed at comparable monitoring locations within the SD Contract Area and were considered typical for the region.

5.4.2 Biological Characteristics of Seabed Sediments

5.4.2.1 Benthic Communities

As explained above, the 2017 EBS at SAX01 collected three replicate samples from each of the 20 monitoring stations. The samples were analysed to confirm the macrofaunal species composition and abundance across the survey area. Only one taxa, the polychaete *Manayunkia Caspica, was recorded* at a single station (Station 1), represented by a single individual from three grab samples. This suggests that the benthic community across the SAX01 EBS area is almost abiotic (i.e. devoid of life). A comparison between this result and the macrofaunal distribution associated with the SD Contract Area is presented in Section 5.5 .

5.4.3 Chemical Characteristics of the Water Column

Water samples were collected at four stations during the 2017 SAX01 EBS as shown in Figure 5.5. Two samples were taken at each station, one from surface waters (0-2 m) and the second from 150 m below the surface; which is below where the major thermocline occurs.

The results of laboratory analyses for oxygen demand, nutrients and suspended solids are presented in Table 5.5.

Table 5.5 BOD, COD, Nutrients and Suspended Solids in Recorded at SAX01

Station ID	Sample Depth	BOD mg/l	COD mg/l	TSS mg/l	Nitrates NO2+3 –N mg/l	Ammonium NH4-N mg/l	Total N mg/l	Phosphates PO4 -P mg/l	Total P mg/l	Silicates SiO2-Si mg/l
SAX1-02	5	<1	19.5	<2	<0.01	<0.01	0.601	0.0021	0.028	0.022
	150	<1	17.9	<2	0.055	<0.01	0.583	0.0069	0.059	0.7
SAX1-05	5	<1	20.8	<2	<0.01	<0.01	0.508	0.005	0.055	0.015
	150	<1	18.4	<2	0.061	<0.01	0.514	0.006	0.058	0.709
SAX1-10	5	<1	20	<2	<0.01	<0.01	0.495	0.0027	0.049	0.021
	150	<1	18.8	<2	0.068	<0.01	0.505	0.0075	0.05	0.727
SAX1-13	5	<1	21.3	<2	<0.01	<0.01	0.547	0.0027	0.045	0.021
	150	<1	18.9	<2	0.063	<0.01	0.523	0.008	0.075	0.704

As Table 5.5 shows the BOD concentrations were below the detection limit (i.e. less than 1 mg/l) in all samples. COD was found to be slightly lower in those samples collected at 150 m as compared to surface samples. Overall, COD levels were slightly higher than those recorded in previous surveys within the SD Contract Area. The concentrations of total suspended solids (TSS), nitrites and ammonium were below the method detection limit in all samples. While nitrates were recorded below the relevant detection limit at the surface, higher concentrations above the detection limit were detected in samples collected from 150 m. This difference in nitrate concentrations at the surface and at depth was also noted in in previous hydrochemical studies carried out within the deep waters of the Caspian Sea (Ref.40). This difference is most likely due to plankton uptake of nitrogen at the surface layers (Ref.41).

Total nitrogen levels varied between station and depth, whereas total phosphorus (P) and the concentration of phosphate was generally higher in samples collected at 150 m. Silicate levels were also higher in samples collected at 150 m. This is in line with previous surveys within the SD Contract Area which have observed increasing silicate concentrations with increasing depth.

The levels of nutrients recorded in the 2017 SAX01 EBS samples were within the ranges observed in previous surveys conducted within the SD Contract Area. The exception was total phosphorous which was slightly higher in the SAX01 samples.

Table 5.6 presents the results of the heavy metal concentrations in water samples collected during the SAX01 survey.

Table 5.6 Heavy Metal Concentrations in Water Samples Recorded at SAX01 (µg/l)

Station ID	Sample Depth	Cd	Co	Cu	Fe	Ni	Pb	Zn
SAX1-02	5	<0.1	0.045	5.1	6.7	1.09	0.14	11.1
	150	<0.1	0.046	40.7	11.8	1.14	1.39	4.4
SAX1-05	5	<0.1	0.056	28.5	11.5	1.11	1.74	9.8
	150	<0.1	0.029	2.4	6.7	0.94	0.40	5.6
SAX1-10	5	<0.1	0.043	2.7	4.5	0.92	0.37	3.6
	150	<0.1	0.031	2.1	8.5	0.99	0.41	3.2
SAX1-13	5	<0.1	0.042	1.9	6.6	0.90	0.31	4.5
	150	<0.1	0.031	2.2	5.6	1.09	0.40	3.2
MAC		**5**	**10**	**10**	**N/A**	**10**	**100**	**10**

Note: Highlighted cells indicate exceedance of MAC

As Table 5.6 shows the 150 m sample from station 2 and the surface sample from station 5 were distinctive, with higher concentrations of copper, iron, zinc and lead. The concentrations of copper were particularly high, exceeding the MAC for Azerbaijani fisheries waters. The concentration of cadmium was below the method detection limit of 0.01 µg/l in all samples.

The concentrations of all metals varied between stations and depth. Excluding the higher concentration of certain metals observed in Station 2 at 150 m depth and 5 at the surface, the concentration of metals were within the ranges recorded in SD regional surveys, the only exception was zinc, which was slightly higher in SAX01 samples.

With the exception of the copper concentration in the two samples discussed above and the zinc concentration in Station 2 at the surface, the concentrations of all metals in all samples were within the MAC for Azerbaijan fisheries waters. The reasons for recorded concentrations above MAC are unclear.

The water samples collected at the four stations during the 2017 SAX01 EBS were analysed for hydrocarbon concentrations; the analysis recorded concentrations below detectable limits in all samples.

5.4.4 Biological Characteristics of the Water Column

5.4.4.1 Plankton

Plankton samples were collected at four stations during the 2017 SAX01 EBS as shown in Figure 5.5.

Phytoplankton

As shown in Table 5.7, a total of 37 species of phytoplankton were recorded in the samples collected during the EBS. The most abundant phylum were bacillariophyta followed by dinoflagellates, chlorophyta and cyanophyta. The phytoplankton community within the samples was similar in composition to the communities observed on previous surveys carried out within the SD Contract Areas (refer to Section 5.5).

Table 5.7 Composition of Phytoplankton Communities Recorded at SAX01

Phylum	No. of Species
Cyanophyta	3
Bacillariophyta	17
Dinophyta	14
Chlorophyta	3
Total	**37**

Zooplankton

A total of eight zooplankton species were recorded from the 200 µm net samples (refer to Table 5.8) during the 2017 SAX01 EBS. The community was numerically dominated by copepod crustaceans at all stations, with cladoceran crustaceans and planktonic stages of ostracod species also present at a lower density. The most abundant species was the non native copepod *Acartia tonsa*, which accounted for 80% of the individuals present. The non native, predatory ctenophore (comb jelly) *Mnemiopsis leidyi* was present in all samples.

Six zooplankton taxa were recorded from 53 µm net samples, while one taxa (*Keratella sp.*) recorded in the 54 µm nets was not present in the 200 µm net samples at low density.

Table 5.8 Composition of Zooplankton Communities Recorded at SAX01

Group	No. of Species	
	200µm Net	53µm Net
Cladocera	2	
Copepoda	2	2
Ostracoda	1	1
Rotatoria		1
Cirripedia Nauplii	1	1
Mollusc larvae	1	1
Ctenophora	1	
Total	**8**	**6**

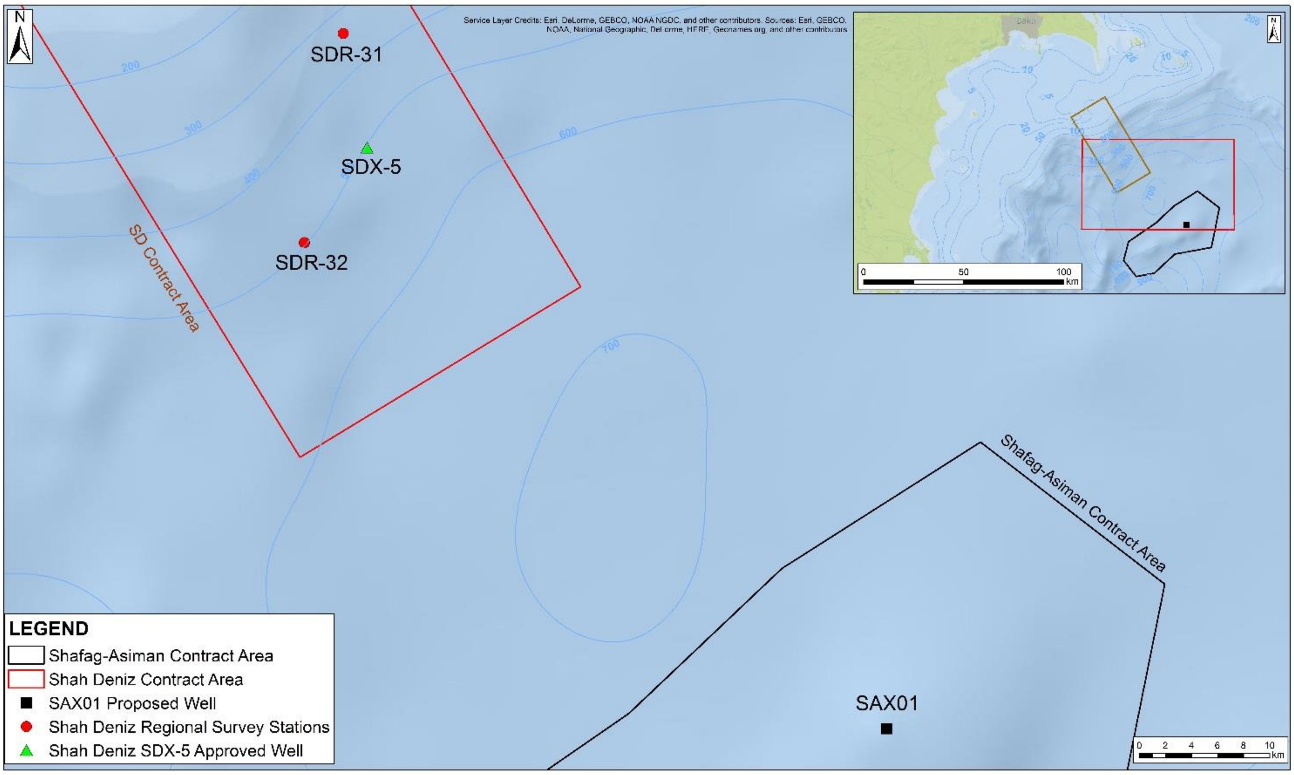
5.4.5 Comparison Between Regional Benthic and Water Column Environment and SAX01

The following sections summarise the physical, chemical and biological characteristics of the sediments based on the SAX01 EBS results and results for comparable deep water survey locations within the SD Contract Area, namely:

- Two of the SD Contract Area regional survey stations; SDR-31 and SDR-32; and
- The 2007 EBS survey at the SDX-5 well location, which comprised 13 stations, in water depths ranging from 530 m to 557 m.

The survey locations are shown in Figure 5.6. Comparison is also made between the plankton survey results obtained from the SAX01 survey and from the SD Contract Area regional surveys between 2005 and 2015.

Figure 5.6 SAX01 and Comparable Deepwater SD Contract Area Survey Locations



5.4.5.1 Physical and Chemical Characteristics of Sediment

As presented in Table 5.9, the SAX01 EBS sediment mean diameter and carbonate content results were comparable to those from the surveys at similar water depths within the SD Contract Area. A greater level of consistency was observed within the results from the SAX01 EBS than those from the SDX-5 survey regarding the proportions of silt and clay. Sediments within the SAX01 EBS area had a higher proportion of clay sediments (<39 µm) and a generally higher amount of organic content; mean of 9% compared to approximately 7% from the SDX-5 survey and approximately 8% at the SDR-31 and SDR-32 D regional stations.

Overall, the physical and chemical characteristics of the sediments within the vicinity of the proposed SAX01 exploration well location are comparable to those at the SDX-5, SDR-31 and SDR-32 locations.

Table 5.9 Summary of Sediment Physical Properties from SAX01, SDR-31, SDR-32 and SDX-5 Surveys

	Mean Diameter (µm)				Silt/Clay %			
	SDR-31	SDR-32	SDX-5	SAX01	SDR-31	SDR-32	SDX-5	SAX01
Min	5	5	5	4	99	99	99	99
Max	5	5	12	5	100	100	100	100
Mean	5	5	6	4	100	100	100	100
	Carbonate %				**Organic %**			
	SDR-31	SDR-32	SDX-5	SAX01	SDR-31	SDR-32	SDX-5	SAX01
Min	20.6	19.9	23	20	7.85	7.34	3	7.3
Max	23.4	35.9	37	32	8.66	8.52	10.1	13.5
Mean	22.2	26.4	30	26	8.32	8.02	6.7	9.4

Table 5.10 presents a summary of the sediment hydrocarbon characteristics recorded from the 2017 SAX01 EBS, alongside those from the 2007 SDX-5 baseline survey and the two comparable SD regional survey stations, SDR-31 and SDR-32.

Table 5.10 Summary of Sediment Hydrocarbon Characteristics from SAX01, SDR-31, SDR-32 and SDX-5 Surveys

	THC (µg/g)				Total 2-6 ring PAH (ng/g)			
	SDR-31	SDR-32	SDX-5	SAX01	SDR-31	SDR-32	SDX-5	SAX01
Min	-	-	109	27	-	-	525	359
Max	-	-	241	761	-	-	1405	2267
Mean	149	224	160	78	1062	1255	994	646
	% UCM of TPH				**% NPD**			
	SDR-31	SDR-32	SDX-5	SAX01	SDR-31	SDR-32	SDX-5	SAX01
Min	-	-	66	60	-	-	43	58
Max	-	-	80	78	-	-	54	68
Mean	83	82	74	71	63	53	50	63
	Total EPA 16 PAH (ng/g)							
	SDR-31	SDR-32	SDX-5	SAX01				
Min	-	-	-	72				
Max	-	-	-	267				
Mean	231	304	-	120				

Table 5.10 shows that on average, the concentrations of THC and PAH were lower within the SAX01 survey area than the comparable survey locations within the SD contract area. As described in Section 5.4.1.3, higher THC concentrations were found in deeper stations of the SD Contract Area, in areas of highly weathered material. Similarly, for SAX01, the general composition was indicative of heavily weathered material being present throughout the SAX01 survey area.

As presented in Table 5.11 below, the concentrations of barium, copper and iron recorded within the SAX01 EBS area were very similar to the results from the comparable deep water survey locations within the SD Contract Area, while the concentrations of arsenic and chromium were slightly lower in the samples from the SAX01 EBS. Mercury and cadmium concentrations exhibited a greater similarity to the concentrations recorded at SDX-5, which were respectively lower and higher than the results from samples collected at SD regional survey stations SDR-31 and SDR-32.

Lower concentrations of manganese, lead and zinc were recorded in samples from the SAX01 survey as compared to those recorded from the three SD surveys. This is most likely due to a change in laboratory contractor between the 2005-2015 SD analysis and the 2017 SAX01 analysis. It is therefore likely that the lower levels of manganese, lead and zinc in the SAX01 samples are the result of analytical variation rather than being representative of a real difference in the concentration within the respective survey areas.

Table 5.11 Summary of Heavy Metal Concentrations from SAX01, SDR-31, SDR-32 and SDX-5 Surveys (mg/l)

	As				Ba HNO3				Ba Fusion			
	SDR-31	SDR-32	SDX-5	SAX01	SDR-31	SDR-32	SDX-5	SAX01	SDR-31	SDR-32	SDX-5	SAX01
Min	-	-	9	5	-	-	446	438	-	-	658	797
Max	-	-	15	10	-	-	643	654	-	-	802	1023
Mean	12	11	11	7	676	668	553	524	784	791	742	887

	Cd				Cr				Cu			
	SDR-31	SDR-32	SDX-5	SAX01	SDR-31	SDR-32	SDX-5	SAX01	SDR-31	SDR-32	SDX-5	SAX01
Min	-	-	0.18	0.20	-	-	52	40	-	-	42	38
Max	-	-	0.27	0.38	-	-	78	65	-	-	47	59
Mean	0.152	0.149	0.24	0.27	73	70	67	52	36	38	44	48

	Fe				Mn				Pb			
	SDR-31	SDR-32	SDX-5	SAX01	SDR-31	SDR-32	SDX-5	SAX01	SDR-31	SDR-32	SDX-5	SAX01
Min	-	-	33021	32383	-	-	777	318	-	-	23	10
Max	-	-	41674	45539	-	-	934	1540	-	-	26	15
Mean	38434	38342	37174	34418	733	839	838	434	24	24	24	12

	Zn			
	SDR-31	SDR-32	SDX-5	SAX01
Min	-	-	76	46
Max	-	-	89	71
Mean	95	95	83	58

Overall, based on the evidence in Table 5.11 above, the 2017 SAX01 baseline sediment metal concentrations were similar to the results observed at comparable SD monitoring locations and were typical of the regional background.

5.4.5.2 Biological Characteristics of Sediment

Table 5.12 presents the macrobenthic species abundance data from the 2017 SAX01 EBS, the 2007 SDX-5 baseline survey and for the two SD Contract Area regional survey stations; SDR31 and SDR32.

Table 5.12 Macrobenthic Species Abundance: SDX-5 Survey (2007) , SD Regional Surveys (2015 – Stations 31 & 32) and SAX01 EBS (2017)

SAX01 2017																				
Taxon / Station	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**	**20**
Class Polychaeta																				
Manayunkia caspica	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

SDX-5 2007													
Taxon / Station	**1**	**2**	**3**	**4**	**6**	**7**	**8**	**9**	**11**	**12**	**13**	**14**	**15**
Class Polychaeta													
Nereis diversicolor	0	0	0	3	0	0	0	0	0	0	3	0	0
Class Oligochaeta													
Isochaetides michaelseni	16	10	23	3	0	27	33	13	0	57	3	3	10
Order Amphipoda													
Niphargoides caspius	0	0	3	0	0	0	0	0	0	0	0	0	0

SD Regional 2015		
Taxon / Station	**31**	**32**
Order Amphipoda		
Corophium spp	0	3

Table 5.12 shows that the communities at these locations were similarly sparse, with very few species being observed at a very low abundance and occurrence.

It is often observed that macrofaunal abundance, species richness and biomass decrease rapidly at water depths greater than 200 metres, and communities at depths beyond 400 m are generally extremely sparse. These trends are thought to be a result of low oxygen availability in deeper waters (Ref.42).

Benthic Sensitivity

The benthic environment within the area defined by SD Contract Area regional surveys and the SAX01 EBS are dominated by amphipods, cumaceans and oligochaetes, the majority of which are native or endemic species. These animals are either deposit or suspension feeders and as a result are potentially sensitive to the following:

- 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) and associated 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 undertaken over a number of years in the vicinity of the 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 eradicated. With shallower deposits (less than 10 cm, 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. Monitoring has shown that, even when high barium concentrations indicate the presence of cuttings, 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 to sea, 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. These organisms have relatively short generation times, thus meaning populations of these animals have the potential to replace losses within months rather than years. 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. Persistent impact is only likely in instances where there is sustained or persistent chemical contamination. Amphipods, for instance, are sensitive to hydrocarbons in sediment, and populations may be reduced for as long as significant contamination is present.

Caspian gastropods are a diverse group, all of which are very small and are surface deposit feeders. Gastropods are primarily vulnerable to surface sediment contamination, and relatively vulnerable to physical smothering.

Bivalves, are either deposit feeders or filter feeders that reproduce and grow relatively slowly. 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 1-2 cm. Bivalves are also relatively vulnerable to water contamination because they filter large volumes of water. Consequently, damage to bivalve populations would take longer to recover from.

5.4.5.3 Biological Characteristics of Water Column

Table 5.13 presents the number of species for each phytoplankton group recorded within the SD Contract Area regional surveys between 2000 and 2015, and the 2017 SAX01 EBS.

Table 5.13 Phytoplankton Communities, SD Regional Plankton Surveys (2005-2015) and SAX01 Survey (2017)

	Shah Deniz Regional Surveys							SAX01
Group / Year	**2000**	**2001**	**2005**	**2009**	**2011**	**2013**	**2015**	**2017**
Cyanophyta	2	4	5	8	6	6	3	3
Bacillariophyta	3	8	7	13	12	9	21	17
Dinophyta	5	9	5	12	14	14	16	14
Chlorophyta			1	1	1	1	2	3
TOTAL :	**10**	**21**	**18**	**34**	**33**	**30**	**42**	**37**

Table 5.13 shows that the 2017 SAX01 phytoplankton community composition exhibited the greatest similarity to the composition recorded from the 2015 SD regional survey, where bacillariophyta were noted as being the most taxonomically rich group. Dinophyta were the numerically dominant group based on cell density for the SAX01 survey, whereas there was a higher density of bacillariophyta recorded during the 2015 SD Contract Area Regional Survey.

Zooplankton taxonomic richness within the SAX01 survey samples analysed was lower than in previous regional surveys carried out within the SD Contract Area (Table 5.14). However, the lower number of species observed in the SAX01 samples is likely to be a consequence of the fewer samples collected on the SAX01 EBS compared to the SD regional surveys. Despite the lower number of species present, the general community structure was comparable to SD regional survey samples.

Table 5.14 Zooplankton Taxonomic Richness, SD Regional Plankton Surveys (2005-2015) and SAX01 (2017)

	Shah Deniz Regional Surveys					SAX01
Net Size	**2005**	**2009**	**2011**	**2013**	**2015**	**2017**
53µm	2	6	9	9	11	6
200µm	6	8	13	13	15	8

Overall, the physical, chemical and biological baseline conditions within the SAX01 EBS area were comparable to those recorded within the nearby SD Contract Area, and were representative of the conditions found at similar depths within the wider region.

Plankton Sensitivity

Phytoplankton and zooplankton are sensitive to chemical contamination at an individual level. However, plankton are not highly sensitive at the population level as populations can grow rapidly from a few individuals (phytoplankton populations can double in 12 hours, copepod zooplankton populations in 2-3 days). Populations can therefore re-establish quickly; and in some instances, rapid growth can offset the effects of chemical contamination.

Being dependent on light to photosynthesise, phytoplankton are confined to the upper layers of the water column. Periods of high turbidity, such as those associated with drill cuttings discharge, can interfere with this process.

Both phytoplankton and zooplankton can be sensitive to aqueous discharges in the water column, such as cooling water which has been treated with corrosion control systems.

5.4.6 Fish

The Caspian Sea's unique geography, climate and hydrological characteristics create a range of different habitats that support a large diversity of fish species. The existence of shallow areas, deep depressions, and a wide range of salinities provide different environmental conditions and habitats favourable for species diversity. According to the latest literature, approximately 151 species and subspecies of fish can be found in the Caspian and associated river deltas (Ref.25). Due to the Caspian Sea's isolation from other water bodies, the sea is characterised by the presence of many endemic species and the presence of 54 endemic fish species (Ref.26).

Fish commonly found in the Southern Caspian Sea can be categorised into the three following types:

- **Migratory species**: such as sturgeon and shad species considering their key spawning grounds are the river Kura. These species are found in various water depths ranging from 50 to 100 m. During the warmer season species of sturgeon (i.e. Beluga) have been found mainly in the Northern and Central Caspian whilst they are found to migrate southwards in the autumn for wintering.
- **Other species (Semi- Migratory)**: The most abundant species of fish in the Caspian Sea is kilka (Herring family) and are important prey for species including sturgeon, salmon and Caspian seal. Mullet are normally found overwinter in the Southern Caspian whilst migrating during the Spring in the Central and Northern Caspian towards their feeding grounds. Their key spawning periods occur during late August and early September between 300 to 600 m. They were introduced from the Black Sea during the 1930s.
- **Resident species**: some resident species include gobies which are found in all regions of the Caspian Sea. They are second to herring in the number of species in the Caspian Sea. They are predominantly found at depths of 30 to 70 m in the spring and summer, although migrate to deeper depths during the winter.

The most common species of fish in the Caspian Sea are kilka. However, in recent years the abundance and distribution of kilka has altered in response to a number of factors including overfishing and the presence of the invasive ctenophore (*Mnemiopsis leidyi*) which feeds on the zooplankton prey of many fish species. In addition, in April and May 2001, a mass mortality of 166,000 tonnes of kilka (mainly anchovy kilka) was recorded in the Central and Southern Caspian Sea. Earthquake data reveals that, in the first quarter of 2001, the local Absheron seismic plate was active, the water and gas systems in the soil were unstable suggesting a series of natural hydro-volcanic events occurred, resulting in the release of significant gas and poisonous substances into the water column. It is thought that this event was a significant contributor to the mass kill (Ref.27).

Data from Department for Reproduction and Protection of Aquatic Bioresources at Reservoirs (DPRAB) indicates that the total quantity of kilka (traditionally the most important species for the fishing industry) landed in the Azerbaijan Sector of the Caspian Sea has reduced by 99% from 1999 (271,000 tonnes) to 2017 (560 tonnes). The reduction in kilka species caught by the commercial fishing fleet over the past 10-15 years is generally attributed to the impact of the increased presence of *M. leidyi*, which is particularly evident since 2001. Recently there is evidence to suggest that kilka have started feeding on zooplankton *Acartia*. The prevalence of *Acartia* (*clause and tonsa*) within the structure of current zooplankton communities instead of *Eurythemora, Limnocalanus* and *Calanipeda*, is leading to a change in composition of the diet of the kilka (mainly the anchovy kilka).

As well as a reduction in catch size, the proportional share of species in catches has changed from being dominated by anchovy kilka (*Clupeonella engrauliformis*) to ordinary Caspian kilka (*Clupeonella cultriventris*). In addition, major aggregations of kilka have been observed in nearshore locations in less than 50m of water, such as at Oil Rocks rather than in deeper waters at the traditional fishing banks further offshore. The most common species of fish in the Caspian Sea after kilka is mullet.

Throughout their lifecycle, fish use spawning, feeding and wintering habitats. For fish species with limited migratory range these three habitats often coincide. Some fish species spend a certain amount of time at sea, but during the wintering and spawning seasons move to rivers. Some marine fish can undertake considerable migrations across the sea, while others inhabit relatively limited areas of the sea. The migration routes and spawning areas of the main fish species passing through the Southern Caspian are shown in Figures 5.7 and 5.8. Table 5.15 presents the fish species known to be present in the Southern Caspian, their protection status, hearing sensitivity, the estimated water depth they are present per season and location where spawning takes place (Ref.28).

Pelagic species such as kilka are typically present in the waters of the Southern Caspian year round, in greatest numbers during the main spawning and migration periods. Typically they are present the shallowest water depths during this period with common kilka (*Clupeonella delicatula caspia*) present in water depths of 20-40 m. During autumn and winter, it is common for anchovy (*Clupeonella engrauliformis*) and big-eyed kilka (*Clupeonella grimmi*) to remain in the Southern Caspian in water depths from 60-100 m in autumn, increasing to up to 450 m in winter.

Goby species are very common and widespread in the Caspian Sea. Many goby species usually stay in shallow waters (up to 20 to 200 m) and some migrate through and into deeper waters during autumn and into winter. There are occasions when they are found at greater depths (between 200-300 m to 500 m depths) but not typically. They are mainly distributed in the Central and Southern Caspian and avoid the coastal areas freshened by river flows. They typically mainly feed on small demersal fish and crustaceans (Ref.29).

Sturgeon species including critically endangered Beluga sturgeon (*Huso huso*) are generally found at water depths of between 50m and 100m. They generally spend spring and summer mostly in the northern and central parts of the Caspian Sea, spawning within riverine environments during spring before migrating southwards in autumn and remaining in the south during winter. The seasonal distribution of most shad species and the water depths they are typically found at is similar to sturgeon species. The exception being big eyed shad (*Alosa brashnikovi autumnalis)* that are known to spawn in the shallowest waters along the coast of the Southern Caspian during spring before moving to greater depths during summer, autumn and winter. Sturgeon and shad species are not expected to be present in the deep waters where the SAX01 well is proposed at any time of year

The species most likely to be present within the deep waters of the Shafag-Asiman Contract Area include gobies and mullet, typically during winter. Based on recent studies conducted by the Azerbaijan Fisheries Research Institute those species most likely to be present include four species of goby (*Knipowitschia iljini, Benthophilus leptocephalus, Benthophilus leptorhynchus* and *Anatirostrum profundurum*) and leaping mullet (*Lisa saliens)* with presence of individuals or low numbers between November and February.

Figure 5.7 Kilka Migration Routes

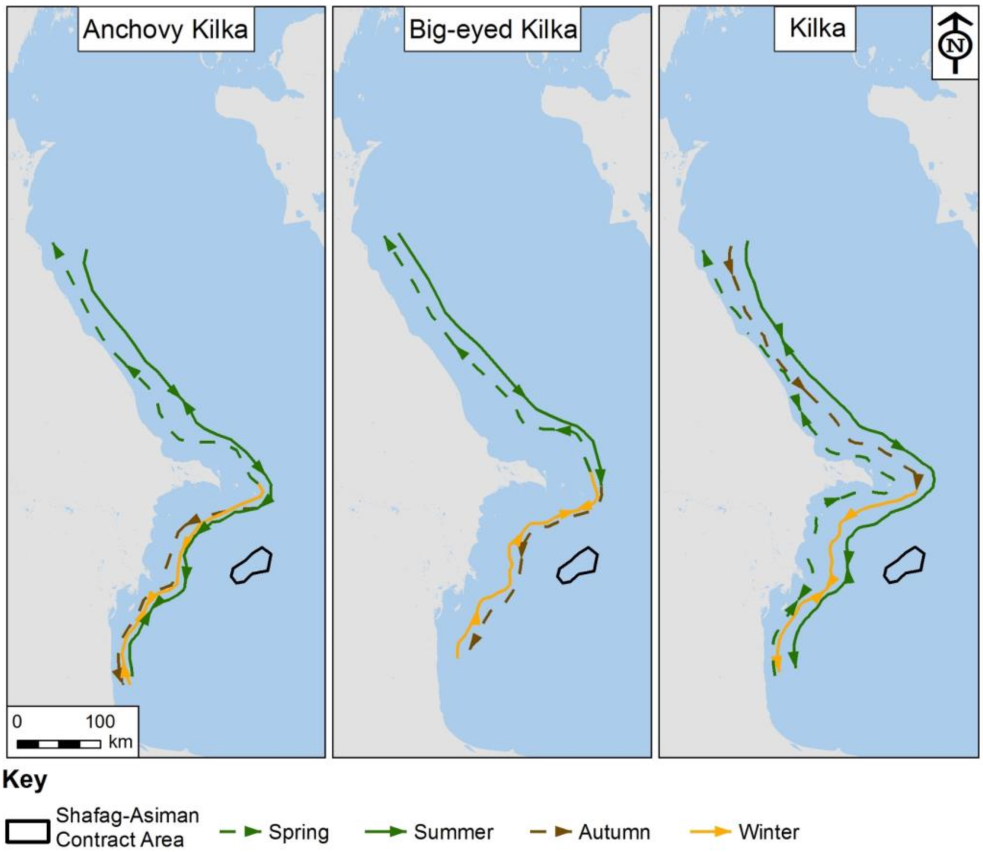


Figure 5.8 Shad, Sturgeon and Mullet Migration Routes

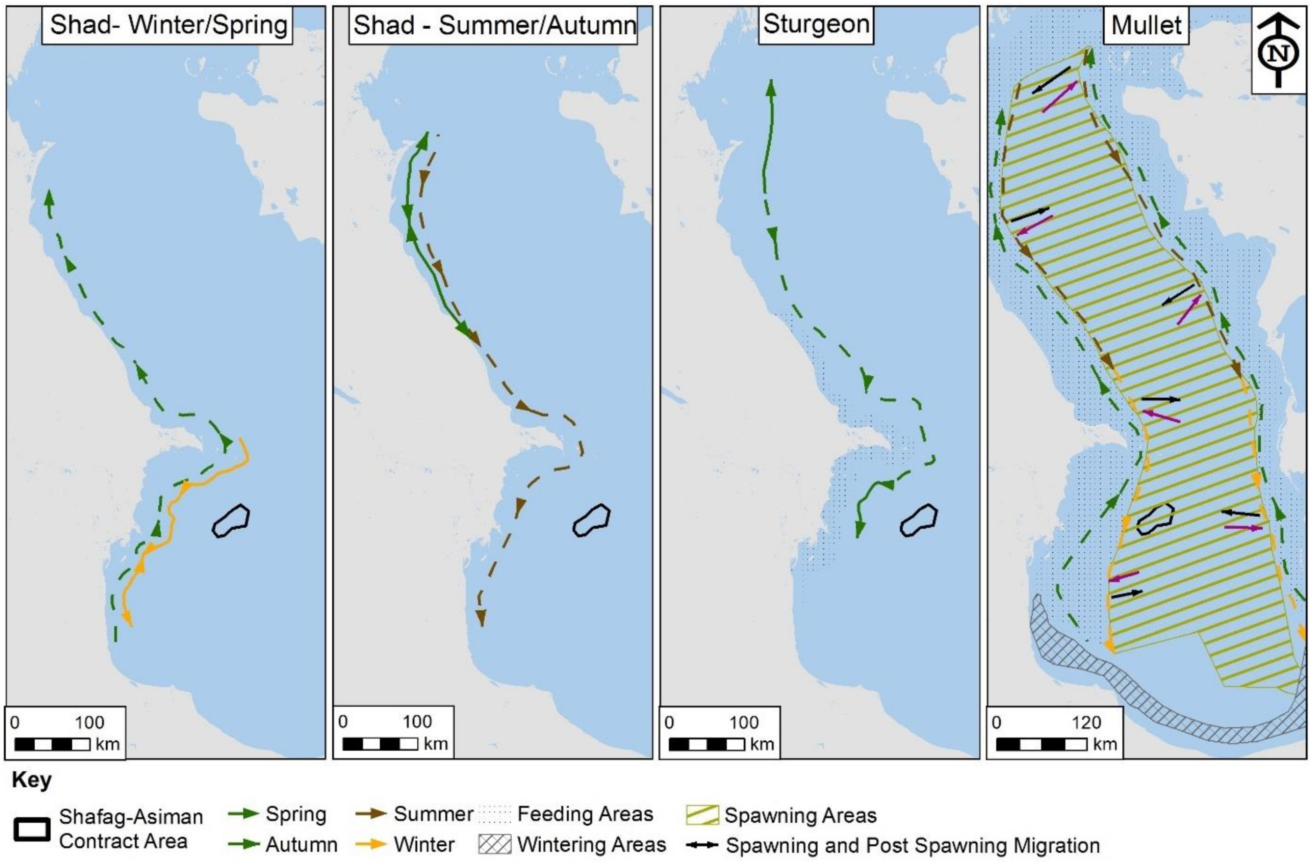


Table 5.15 Summary of Fish Species Expected to Present in the Southern Caspian Sea

Name of Species	Common Name	Hearing Group	IUCN Red List Status	Spawning Location	Reason for Presence in Southern Caspian (south of Absheron Ridge)
STURGEON (Family Acipenseridae)					
Huso huso	Beluga	SB	CR#	River Volga, Ural, Kura, Sefīd-Rūd and sometimes Terek.	Spring migration to spawning areas located in Volga, Ural and Sefīd-Rūd Rivers. Typically found at water depths between 50-70m in spring/summer and 70-100m in autumn/winter. Feeding and breeding in sea feeding sites in spring/summer/ autumn months. Wintering areas in winter.
Acipenser güldenstädtii	Russian sturgeon	SB	EN#	River Volga, Ural, sometimes Terek and Kura.	
Acipenser güldenstädtii persicus natio cyrensis	Kura (Persian) sturgeon	SB	EN#	River Volga, Ural, Kura, Sefīd-Rūd and sometimes Terek.	
Acipenser nudiventris	Kura barbel sturgeon	SB	EN#		
Acipenser stellatus	Kura (South-Caspian) stellate sturgeon	SB	EN#		
KILKA (genus Clupeonella, family Clupeidae – herring)					
Clupeonella engrauliformis	Anchovy kilka	SB/HS	LV	The eastern part of the Central and South Caspian in the area of circular flows at depths of 50 to 200m in the upper layers of water not less than 15 to 20m from the surface.	Spring migration to spawning areas. Feeding and breeding in sea feeding sites in 50-130m depth in spring/summer/autumn months. Autumn migration to the wintering areas in the south. Wintering areas in winter.
Clupeonella grimmi	Big-eyed kilka	SB/HS	LV	The eastern part of the Central and South Caspian in the area of circular flows at depths of 350 to 450m in the upper layers of water not less than 15 to 20m from the surface.	Spring migration to spawning areas. Feeding and breeding in sea feeding sites in 80-450m depth in spring/summer/autumn months. Autumn migration to the wintering areas in the south. Wintering areas in winter.
Clupeonella delicatula caspia	Caspian common kilka	SB/HS	LV	North Caspian in 1-3 m depth, down part of deltas of Volga, on the opposite side of the mouth of the Ural River, Buzachi peninsula, up to 10m depth in shallow waters of the Middle and South Caspian.	Spring migration to spawning areas. Feeding and breeding in sea feeding sites in 20-40m depth in summer/autumn months. Wintering areas in winter.
SHAD (genus Alosa Cuvier, family Clupeidae – herring)					
Alosa caspia caspia	Caspian shad	SB/HS	LC	At a depth of 1 to 3m in Northern Caspian, opposite of Volga and Ural River mouth.	Spring migration to spawning areas. Feeding and breeding in sea feeding sites in 40-100m depth in summer/autumn months. Autumn migration to the wintering areas. Wintering areas in winter.
Alosa brashnikovi autumnalis	Big-eyed shad	SB/HS	LC	At a depth of 2-6m in western and eastern coastal area of the South Caspian.	
Alosa kessleri volgensis	Volga shad	SB/HS	LC	Volga River and in rare cases in Ural and Terek Rivers.	
Alosa kessleri kessleri	Black-backed shad	SB/HS	LC	Volga River and in rare cases in Ural river.	
Alosa braschnikowii braschnikowii	Dolgin shad	SB/HS	LC	At a depth of 1 to 4 m in the Northern Caspian, in the opposite side of Ural River mouth, Buzaji peninsula and around Saridash.	
Alosa saposchnikowii	Big-eyed shad	SB/HS	LC	At a depth of 1 to 6 m in the Northern Caspian, in the opposite side of Volga and Ural River mouth.	
CARP (family Cyprinidae)					
Rutilus frisii kutum	Kutum/Black Sea Roach	SB	LC	Kura and Terek Rivers, rivers of the western coast of the Southern Caspian, Small Gizilagaj Bay.	Spring migration to spawning areas. Spring/Autumn feeding route.

Name of Species	Common Name	Hearing Group	IUCN Red List Status	Spawning Location	Reason for Presence in Southern Caspian (south of Absheron Ridge)
					Wintering areas in winter. Typically found at depths of up to 10-25m throughout the year.
Rutilus rutilus caspicus	Roach	SB	LC	Small Gizilagaj Bay, Kura River, the rivers of the western coast of the Southern Caspian, extremely rarely in the Terek River.	Spring migration to spawning areas. Spring/Autumn feeding route. Wintering areas in winter. Typically found at depths of up to 10-25m throughout the year.
Aspius aspius taeniatus	Asp	SB	LC	Kura River, as well as in the rivers along the western shores of the South Caspian and Small Gizilagaj Bay, very rarely in Terek River.	Autumn/winter/spring migration to spawning areas. Migration for feeding during the whole year. Wintering areas in winter. Typically found at depths of up to 10-25m throughout the year.
Lusibarbus brachycephalus caspius	Caspian barbel	SB	LC	Kura River, as well as in the rivers along the western shores of the South Caspian and Small Gizilagaj Bay, very rarely in Terek River.	Spring/summer migration to spawning areas. Feeding and breeding in spring/summer/autumn months. Wintering areas in winter. Typically found at depths of up to 20-25m throughout the year.
Abramis sapa bergi	White-eye bream	SB	LC	Kura River, as well as in the rivers along the western shores of the South Caspian and Small Gizilagaj Bay, very rarely in Terek River.	Migration to spawning areas in winter and early spring. Southwest migration for feeding along the shore during the whole year. Wintering areas in winter. Typically found at depths of up to 10-25m throughout the year.
Pelecus cultratus	Sabrefish	SB	LC	Rivers Volga, Ural, Kura and Terek as well as in the rivers of the Lankaran coast.	Autumn/winter migration to spawning areas. North-south migration for feeding along the shore during the whole year. Wintering areas in winter. Typically found at depths of up to 10-25m throughout the year.
Abramis brama orientalis	East bream	SB	LC	Rivers Volga, Ural, Kura and Terek, rivers of the Lankaran coast.	Migration to spawning areas in winter and early spring. Southwest migration for feeding along the shore during the whole year. Wintering areas in winter. Typically found at depths of up to 10-25m throughout the year.
Chalcalburnus chalcoides	Danube bleak	SB	LC	Rivers Kura, Terek and other rivers of the western coast of the Central and Southern Caspian, extremely rarely in the Volga and Ural rivers.	Migration to spawning areas throughout the year and mainly end of autumn and winter months. Southwest migration for feeding along the shore during the whole year. Wintering areas in winter. Typically found at depths of up to 20-30m throughout the year.
Vimba vimba persa	Caspian bream	SB	LC	Kura and Terek Rivers, extremely rarely in the Volga River.	Spring migration to spawning areas. North-south migration for feeding along the shore during the whole year. Wintering areas in winter. Typically found at depths of up to 20-25m throughout the year.
Cyprinus carpio Linnaeus	Carp	SB	LC	Volga, Ural and Terek rivers as well as the Small Gizilagaj Bay, the Kura River and rivers of the southern coast.	Spring migration to spawning areas. North-south migration for feeding along the shore during the whole year.

Name of Species	Common Name	Hearing Group	IUCN Red List Status	Spawning Location	Reason for Presence in Southern Caspian (south of Absheron Ridge)
					Wintering areas in winter. Typically found at depths of up to 8-20m throughout the year.
MULLET (family Mugilidae)					
Liza aurata	Golden mullet	SB	LC	Central Caspian (300 to 600m depth).	Spring/summer migration to the Central Caspian for feeding. Autumn/winter migration to wintering areas. Feeding and breeding in the sea feeding areas throughout the year. Typically found at depths of up to 400-500m throughout the year.
Liza saliens	Leaping mullet	SB	LC	South and Central Caspian (5 to 700m depth).	Spring migration for feeding. Spring/summer migration to the spawning places located in deep-water areas of the sea. Autumn/winter migration to wintering areas. Feeding and breeding in the sea feeding areas throughout the year. Typically found at depths of up to 200-300m throughout the year.
GOBY (family Gobiidae)					
Neogobius bathybius	Deepwater goby	No SB	LC	Central and Southern Caspian, west coast, up to 10-20 m, sometimes up to 3-5 m.	Resident species dominate in shallow waters (30-200m in spring/ summer months), but can be also found in deeper areas of the sea in winter months (up to 300m).
Mesogobius nonultimus	Nonultimus goby	SB	LC		
Benthophilus grimmi	Grimms' pugolovka	No SB	LC		
Benthophilus ctenolepidus	Persian goby	No SB	LC		
Benthophilus svetovidovi	Pugolovka svetovidovi	No SB	LC		
Knipowitschia Iljini	Ilyin goby	SB	LC	Central and Southern Caspian, west coast, up to 70-80m, sometimes up to 40-50m.	Resident species dominate in shallow waters (100-300m in spring/ summer), but can be also found in deeper areas of the sea in winter months (300-500m).
Benthophilus leptocephalus	Slender-snouted pugolovka	No SB	LC		
Benthophilus leptorhynchus	Slender-snouted pugolovka	No SB	LC		
Anatrirostrum profundurum	Pugolovka-platypus	SB	LC		
Benthophilus stellatus leobergius Iljin	Caspian tadpole goby	No SB	LC	North, Central and Southern Caspian, west coast, up to 1-10m, included deltas of Volga, Kura, Terek, rivers.	Resident species dominate in shallow waters (1-10m), but can be also found in deeper areas of the sea in winter months (20-50m).
Neogobius fluviatilis	Monkey goby	No SB	LC		
Knipowitschia longicaudata	Knipovich long-tailed goby	SB	LC		
Neogobius kessleri gorlap	Caspian big-headed pugolovka	No SB	LC		
Neogobius ratan goebeli	Ratan Goby	No SB	LC		
Benthophilus macrocephalus Pallas	Big-headed pugolovka	No SB	LC		
Neogobius caspius	Caspian goby	No SB	LC	North, Central and Southern Caspian, west coast, up to 1-10m, included deltas of Volga, Kura, Terek, rivers.	Resident species dominate in shallow waters (1-10m), but can be found in deeper areas of the sea in winter months (60-150m).
Benthophilus granulosus	Granular pugolovka	No SB	LC		
Benthophilus Baeri	Baer pugolovka	No SB	LC		

Name of Species	Common Name	Hearing Group	IUCN Red List Status	Spawning Location	Reason for Presence in Southern Caspian (south of Absheron Ridge)
Neogobius melanostomus affinis	Round goby	No SB	LC		
Neogobius syrman eurystomus	Caspian syrman goby	No SB	LC		
Others					
Salmo trutta caspius	Caspian brown trout	SB	EN#	Kura, Terek, Samur, Keyranchay rivers, small rivers of the western coast of the Central and South Caspian Sea, in rare occasions Volga and Ural rivers.	Autumn/winter migration to the spawning places. Feeding and breeding in the sea feeding areas throughout the year. Typically found at depths of up to 40-50m throughout the year.
*Atherina mochon pontica nation caspia**	Big-scale sandsmelt	SB	V	In all areas of the sea, at the depth of 1.5-2.0m, mainly in the sandy seabed areas, mainly in the Gizilagaj Bay.	Present throughout the year for spawning, feeding and wintering in shallow coastal waters. Typically found at depths of up to 50m.
Gasterosteus aculeatus	Three-spined stickleback	SB	LC	Shallow parts of the rivers flowing into the Caspian Sea (estuaries) Volga, Ural, Kura, Terek rivers and others.	Present throughout the year for spawning, feeding and wintering in shallow coastal waters. Typically found at depths of up to 20m throughout the year.
Syngnathus nigrolineatus caspius	Caspian Pipefish	SB	LC	In all parts of the sea located close to the coast (depth of 1-4m), also in the areas where the Zostera plants grow such as the shallow parts of the rivers flowing into the Caspian.	Present throughout the year for spawning, feeding and wintering in shallow coastal waters. Typically found at depths of up to 10m.
Sander marinus	Sea pikeperch	SB/HS	EN#	Chilov and Pirallahi islands, Baku archipelago, Kurdashi aquatorium of the Central and Southern Caspian at a depth up to 10m in the coastal waters with rocky seabed.	Migration to spawning, feeding and wintering areas throughout the year. Typically found at depths of up to 50-100m.

Key:
Hearing group: SB – fish with swim bladder; V – sometimes does not have swim bladder depending on species; HS – hearing experts with wide hearing frequency rate.
IUCN Red List: CR: Critically Endangered; EN – Endangered; LV – Low Vulnerability; LC – Least Concern, # also included in CITES Appendix II.
*Also, known as *Atherina boyeri caspia*.

5.4.6.1 Fish Sensitivity

The common threats to fish populations are over fishing, high levels of pollution (from both man-made and natural events) and habitat loss. Impacts relating to the oil industry are direct (e.g. accidental spills, noise) and indirect (e.g. fish consuming prey that ingested or had been affected by accidental spills). Fish species are vulnerable to oil and chemical spills, specifically during spawning, and are sensitive to increased turbidity (which can affect the zooplankton they feed on due to reduction in the light level in the water column) and to underwater sound impacts which may discourage them from approaching drilling activities. Those species with swim bladders are most susceptible to underwater sound impacts. The swim-bladder is a gas filled sac found in most bony fishes of the class Osteichthyes. It supports fishes with buoyancy and acts as a lung and as a sound producing organ; thus, can enhance the hearing capability of fish via amplification of underwater sound. Their response to underwater sound is determined by the duration, sound pressure level and frequency; and ranges from changes in behaviour, recoverable injury to, in extreme instances, mortal injury.

With respect to overall ecosystem health, heavy metals are recognised as being toxic to and accumulate in living organisms, and because of this, fish samples are often used worldwide to monitor the quality of ecosystems (Ref.30). Heavy metal concentrations within the Caspian Sea are thought to have accumulated mainly from the Volga River and known elevated concentrations of trace elements have been reported in coastal sediment samples (Ref.31). The most recent published study, however, found that concentrations of heavy metals (chromium, cadmium, cobalt and lead) in the three commercial species of kilka were lower than international standards (Ref.32).

The species of gobies and mullet potentially present within the Shafag-Asiman Contract Area are most sensitive during April to June and June to September respectively when they are breeding. This is outside of the period when they are potentially present within the Shafag-Asiman Contract Area (November to February).

5.4.7 Caspian Seal

The Caspian seal (*Phoca caspica*) is the only marine mammal present in the Caspian Sea. The species is endemic to the Caspian Sea and has been listed on the IUCN Red List of Threatened Species as Endangered since October 2008 and has been included in the AzRDB since 1993 (Ref.33).

The population of Caspian seals has decreased by more than 90% since the start of the 20th century, considered to be due to a combination of commercial hunting, habitat degradation (through introduction of invasive species), disease, industrial development, pollution and fishing operations using nets (Ref.34). The population of seals has been estimated using a number of different methods. A 2012 paper (Ref.35), using an age-structured projection model and the annually recorded seal harvest, between 1867 and 2005 estimated the 2005 population to be 104,000. In comparison, data collected from aerial surveys in Kazakhstan and sea ice surveys resulted in estimates of between 100,000 and 170,000 (Ref.36).

There have been a number of survey/research programmes undertaken to improve understanding of the distribution and population numbers of Caspian seals. Data collection has included the following:

- **1980 – present**: Opportunistic monitoring of dead seals and confirmation of seal sightings by fishermen and helicopter pilots;
- **2005 - 2012**: Annual aerial surveys of the breeding population on the winter ice-field in the Northern Caspian from 18 to 27 February to estimate the overall breeding distribution; and
- **2009 - 2012**: Telemetry tagging survey, where 75 seals were tagged and their movements across the Caspian Sea tracked. Data collection included dive depths.

In addition, seal observations have been undertaken by BP and their contractors during surveys. Most recently these have included the following:

- **2016**: October, November and December: seal observations from vessels during the SWAP seismic surveys; and

- **2018**: Mid-March to late April: seal observations made from vessels at the location of the proposed ACE platform during geotechnical investigation works.

Caspian seals are observed in many regions of the Caspian Sea depending on the season. Until recently it was thought that the Caspian seal population as a whole undertakes annual migrations between breeding locations in the north (where pupping and mating occurs on the ice) to feeding locations in the Central and Southern Caspian during the spring months (Ref.37). The spring southwards migration was understood to take place between April to May and the autumn northwards migration between October to December, although some were thought to migrate north as early as August.

Recent satellite tagging research, conducted between 2009 and 2012 (Ref.38) has shown that this pattern of migration is not as regular or direct as had been previously reported. Data obtained from 75 tagged adult seals, of both sexes, showed that whilst seals migrated to the ice field in the Northern Caspian during autumn-winter months for breeding (the timing depending on changeable metocean conditions), they did not all migrate south in the spring. For example, in 2011 40% of the tagged seals remained in the Northern Caspian and were considered to be ‘non-migratory’. The remaining 60% of the seals migrated to the Central and Southern Caspian in the spring for foraging and the migration routes taken were not restricted to proximity to haul-out sites as had been believed. Both the primary routes followed by the seals during migration and the secondary spring routes as suggested by previous research programmes, the satellite tagging study and also through direct observations (see below) are shown in Figure 5.9.

Assuming the findings of the research are representative of the wider population, there is potential for seals to be present within the Southern Caspian for foraging from May to September with peak numbers in July, returning periodically to their haul-out sites. The Shafag-Asiman Contract Area is likely to be utilised by seals during this feeding period, however the majority of seals will tend to congregate further inshore and further south where the greatest proportions of kilka are concentrated (Ref.2).

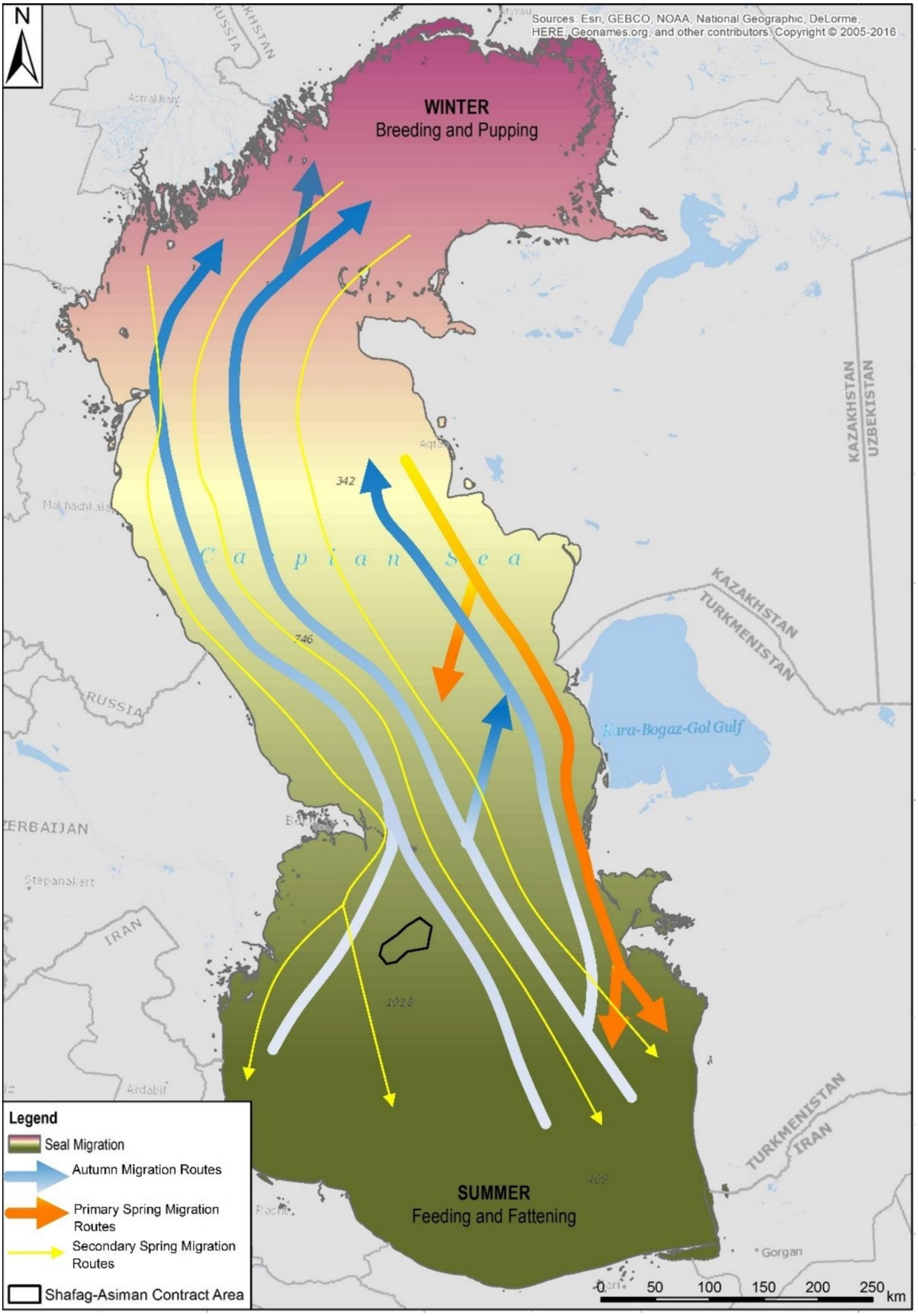
The scientific opinion is that seals are showing signs of adaptation to anthropogenic disturbances (Ref.39). It is understood that, following increased disturbances within the Dagestan coastal area of Russia (including reported mass poaching), seals tended to avoid coastal areas during the autumn and spring migrations and use routes located away from the coast. Thus, the latest research has shown it is not possible to assume the seals will always follow the previously defined migratory paths close to the east and west coastline and may travel through the centre of the Caspian (including potentially through the Shafag-Asiman Contract Area).

Typically seals migrating during spring have been observed in the Southern Caspian, particularly offshore of the Absheron Peninsula, in April and May. When observed earlier than April this has been correlated to the sea ice melting in the Northern Caspian.

While this section presents an overview of expected seasonal distribution of the seals throughout the Caspian Sea, it does not represent a comprehensive understanding. There are a number of limitations in relation to the available data used to determine migration patterns:

- The tagging research programme was based on a 3 year period (2009 to 2012); there is no ongoing survey programme in place to monitor long-term trends of distribution across the Caspian Sea. Prior to 2009, historic distribution data had been based on live seals sightings provided by vessels and helicopter pilots observation, opportunistic recordings which has not been collected as part of an ongoing scientific programme; and
- The research programme tagged 75 seals. This is not considered to be a representative number to enable an accurate conclusion of the distribution of seals across the Caspian Sea (Ref.39).

Figure 5.9 Spring and Autumn Migration Routes of the Caspian Seal



5.4.7.1 Seal Sensitivity

The reasons for the significant decline in the Caspian seal's population in the past century 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 pollution spills (such as oils or chemicals) and ongoing discharges which contribute to contamination over time. 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. Seals are sensitive to underwater sound while diving or swimming and therefore may be susceptible to high levels of underwater sound generated through vessel movements and drilling activities.

As discussed, Caspian seals may be present in the Shafag-Asiman Contract Area during the summer months for feeding and, to a lesser extent, during autumn and spring migration periods.

5.5 Birds

The Azerbaijan coastline of the Caspian Sea is an area of international and regional importance providing habitat for breeding, nesting, migratory and overwintering birds. An estimated 85 species of waterfowl and coastal birds have been recorded in this region over the past 17 years (Refs.43, 44, 45 and 46). Many species of conservation importance, including globally threatened species, species included in Annex I of the EU Birds Directive (2009/147/EC) and birds listed in the Azerbaijan Red Data Book (AzRDB) can be found in this coastal area at some point. Seventeen of these species are included in the AzRDB and the IUCN Red List of Globally Threatened Species. Given Azerbaijan's location within the bird migrating circuit of Europe, Asia and the Middle East a large number of bird species have been recorded, with onshore and offshore areas providing habitats for 348 avifauna species, including 31 species of seabirds (Ref.47).

A literature review was undertaken in March 2018 as part of the ACE Project to obtain the latest information on migratory, wintering and nesting bird species present along the Azerbaijan coastline. This review has been supplemented in December 2018 with additional information and likely species to be present within the Shafag-Asiman Contract Area. The review was prepared using the latest available literature on bird data and the evaluation of coastal survey data from 2002-2017 in order to identify the likely species present, estimated number of birds, identify important and sensitive bird areas and confirm key bird migration routes and seasonal variations in their presence.

5.5.1 Migratory Birds

The distribution and abundance of birds in the coastal region is subject to significant seasonal changes particularly during the spring and autumn migration periods as birds move between feeding, breeding and overwintering grounds. There are a recorded 296 different species of migratory breeds (Ref.48).

The coastlines of Azerbaijan are a major flyway for migrating waterfowl and coastal birds, who nest in the 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 autumn migration begins in the second half of August and continues until mid-December although this may extend into January during years of severe winter in Russia. The most active autumn migration period is November. The spring migration starts in the second half of February and ends in April, with the most active period during March. Table 5.16 below outlines the key migratory periods in the region and the migration routes are illustrated in Figure 5.10.

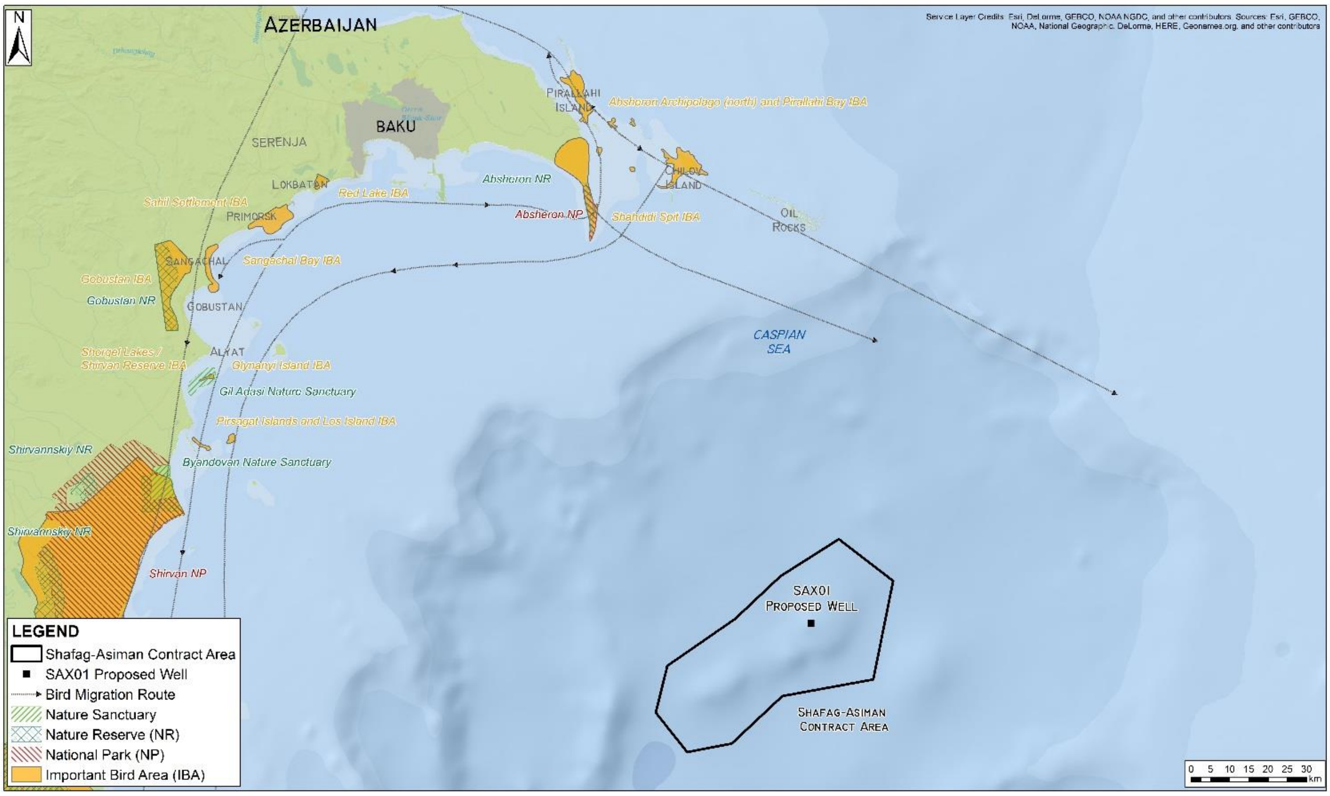
Table 5.16 Key Migration and Active Periods Along the Southwest Caspian Coastline

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec
Overwintering												
Spring Migration												
Nesting / Breeding												
Autumn Migration												

Key:

Overwintering Birds	Nesting Birds	Migrating Birds
Small number present	Small number present	Small number present
Most Active period	Most Active period	Moderate Numbers
		Most Active period

Figure 5.10 Important Ornithological Sites Located on the Southwest Caspian Coastline (Absheron to Neftchala) and Migration Routes



5.5.2 Overwintering Birds

Approximately 36 species of waterfowl and 16 species of coastal migratory birds are reported to overwinter along the coastline from Absheron to the north to Neftchala to the south. The majority of birds to overwinter are ducks (of the genera *Anas, Netta* and *Aythya*) and coot (*Fulica atra*) but migrating herring, common, black-headed and great black-headed gulls (all of the genus *Larus*) also overwinter along the coastline. These particular species will dive in shallow waters to feed on small fish and benthic invertebrates on or near the seabed. Wading birds also feed in coastal waters but, with the exception of the beak, remain above the water during feeding.

5.5.3 Nesting Birds

The breeding and nesting season along the Azerbaijan 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. The coastline is host to a number of important nesting migratory seabirds, in particular the Mediterranean gull (*Larus melanocephalus*) (listed in the AzRDB) and the slender-billed gull (*Larus genei*), and a number of tern species (of the genera *Sterna*, *Chlidonius* and *Hydroprogne*). The most recent surveys undertaken in June 2017 by ANAS indicated three areas of particular importance to nesting birds: Shahdili Spit, Dash Zira and Gil Island, all located over 100 km from the Shafag-Asiman Contract Area.

5.5.4 Bird Sensitivity

The major flyway for migrating waterfowl and coastal birds, which is most active during March and November, crosses the Azerbaijani coastline and offshore. Birds 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.

Bird species at the key ornithological sites along the Azerbaijan coastline, particularly species that spend most of their time in the water (e.g. genera *Aythya, Anas, Cygnus, Bucephala, Mergus, Podiceps, Phalacrocorax, Pelecanus* and *Fulica atra*) will be most vulnerable to potential major spills whereas coastal birds and species belonging to gull are less likely to be affected by water column contamination. A number of overwintering species, particularly ducks, will dive in shallow waters to feed on small fish and benthic invertebrates on or near the seabed. Wading birds will be common only in shallow coastal waters.

There is little baseline information on the migratory route, distribution and abundance of birds in the vicinity of the Shafag-Asiman Contract Area. However it is anticipated that a number of seabirds may be present, albeit likely as individuals, on occasions. A list of the species potentially present is provided within Table 5.17 below. Only 1 of the 12 species (*Larus melanocephalus*) is listed within the AzRDB.

Table 5.17 Bird Species Potentially Present Within the Shafag-Asiman Contract Area

Species	Common Name	Potential Presence (Seasonal)
Gavia stellata	Red-throated Loon	Winter and During Migration
G. arctica	Black-throated Loon	
Podiceps grisegena	Red-necked Grebe	
Phalacrocorax carbo	Great Cormorant	All Seasons
Ph. Pygmaeus	Pygmy Cormorant	
L. cachinnans	Caspian Gull	
L. genei	Slender-billed Gull	
L. melanocephalus	Mediterranean Gull	
Sterna sandvicensis	Sandwich Tern	En-Route to Nesting Sites and During Migration
S. hirundo	Common Tern	
S. albifrons	Little Tern	
Hydroprogne caspia	Caspian Tern	

Given the distance of the Shafag-Asiman Contract Area from the Azerbaijan coast (approximately 125 km), the exposed meteorological and climatic conditions and the lack of shelter and resting locations the numbers of seabirds present on the water surface at any time is expected to be very low.

Overall, the Shafag-Asiman Contract Area has no sensitive habitats for overwintering, nesting or migratory birds. Given the distance of the Shafag-Asiman Contract Area from the Azerbaijan coast (approximately 125 km), the exposed meteorological and climatic conditions and the lack of shelter and resting locations the numbers of seabirds present on the water surface at any time is expected to be very low.

5.6 Socio-Economic Description

5.6.1 National Context

Azerbaijan comprises 77 administrative districts including 11 city districts and 10 economic regions. The majority of Azerbaijan's major settlements are in coastal locations, with 22% of the population resident in Baku (Ref.48). In 2018, the population of Azerbaijan was 9,898,100 with a gender distribution of 49.9% male and 50.1% female (Ref.49).

Azerbaijan's economy is heavily dependent on its energy exports, with more than 90% of total exports accounted for by oil and gas products (Ref.50). After oil and gas, the economy is dominated by the agricultural sector which, alongside fisheries and forestry, represented 5.27% of the Azerbaijan's GDP in 2014. Other important economic sectors include manufacturing and services such as tourism, financial and telecommunications. The overall contribution of the fisheries industry to the Azerbaijani economy and to national food security and poverty reduction is low. However, there are local areas where fisheries are important for the rural economy and the livelihoods of coastal communities (Ref.51).

In recent years, a significant reduction in poverty in Azerbaijan has been achieved (Ref.52) and was accompanied by a rise of 91% in gross national income (GNI) per capita between 2001 and 2013 (Ref.53). This rapid growth was due to the expansion of the oil and gas sector. However, in 2016 the Azerbaijani economy contracted by 3.8% driven by a fall of 5.4% in non-oil sector output. Oil GDP showed no growth in 2016 and oil export fell by 40%(Ref.54).

Improvements in health and education have also been achieved across many parts of Azerbaijan. Basic infrastructure such as accessible roads and sanitation systems are typically lacking in some rural communities; and utility services such as electricity and water are not universally available when compared to the high level of development in the major cities.

Nationally, the level of inequality is high, particularly between rural and urban areas. Inequality is also high within urban areas with reported data showing significant disparities between the rich and the poor with regard to access to services (Ref.55). As in other transition countries economic growth has not had a significant impact on employment, with youth employment is comparatively low at 14 % (2008), having fallen from 42% in 1999 (Ref.56). This is because the growth has not generated a comparatively significant number of jobs nationally, partly as it has not been based on a diversified economy.

5.6.2 Fisheries

5.6.2.1 Fishing and Fishing Trends

Fishing activity is regulated through legislation, and respective rules and regulations. The legal basis for the organisation, management, development, usage and protection of fish resources in the Azerbaijan Republic is regulated by the Azerbaijan Republic Law "On Fishing" adopted in 1998 (No 457-IQ, 27.03.1998). In 2017, the "Regulations for fishing and hunting of other water bioresources" No 243, was adopted to outline the hunting means, including seasonal restrictions and equipment to be used in the Caspian Sea.

Based on the latest fisheries data collected for the ACE Project ESIA (Ref.3) it is understood that historically, kilka has been the main commercial species caught in Azerbaijan. Kilka was the single authorised commercial fishing species until 2012. Commercial catch of anchovy kilka has gradually decreased during the last 12-15 years due to the reduction of kilka reserves since 2001. Due to the reduced reserves of anchovy kilka, there has been a recent change (between 2012-2016) in the commercial fishing licences issued by the MENR (specifically the Department for Reproduction and Protection of Aquatic Bioresources at Reservoirs (DPABR)) where both the number of licences issued and the number of larger kilka fishing vessels has decreased. In parallel, the number of licences issued for other fish species and for small boats has increased.

Azerbaijan has also experienced a reduction in the number of recorded violations of fish protection legislation. The likely reason for this change is decreased activity of the Department of Protection and Reproduction of Bioresources in Water Basins of MENR during the last 5-7 years in the prosecution of violations coupled with the reduction in natural reserves of sturgeon (including beluga, sturgeon, sturgeon stellate, ship sturgeon) and the corresponding reduction of illegal fishing of these prohibited species.

In recent years (2011-2016) the number of licences issued for fishing has increased compared to earlier years (2005-2010). This increase is associated with the additional number of licences issued for catching small fish (herring, roach, carp, small fry, bream, grey mullet, shemaya) and increased number of licences for small-capacity fleet (boats). The reduced weight of the landed commercial species of fish, which is a common trend for the entire Caspian Sea in recent years, is due to the reduced amount of kilka. The decreasing catch volume of kilka is becoming more significant, while the amount of small fish caught is increasing. Thus, as compared to 2005-2010, the trend in recent years (2011-2016) indicates a change in commercial fishing from targeting kilka to other small fish species. Due to the decreased amount of kilka landed, the number of fishing licences issued to large-capacity kilka vessels has reduced, while the number of licences issued for small fish harvesting and for small-capacity vessels (boats) has increased.

5.6.2.2 Small Scale Coastal Fishing

Small scale and coastal fishing is predominantly undertaken using medium sized small tonnage vessels, with fishing taking place within to 2-3 nautical miles from the coastline. Typically, March-April and September-November are the peak seasons for small scale fishing with many of the fish caught being sold to local markets. Areas along the coastline between the Absheron Peninsula and Gobustan where the majority of licences have been issued for small-scale fishing include Zira, Hovsan, Shikh, Bayil, Zygh and Sangachal-Gobustan.

5.6.2.3 Commercial Fishing

The latest review of fishing activity completed for the for the ACE Project ESIA (Ref.3) indicated that commercial fishing is primarily undertaken in shallower coastal waters of the Caspian Sea (up to 50 m depth) where the largest concentrations of kilka (the primary catch) are found. In 2016, only 10 commercial fishing vessels equipped with gear necessary for fishing of commercial species were sailing under the Azerbaijan flag. Nine of these vessels were ported in Lankaran city, while the remaining vessel previously ported in Pirallahi island, was moved to the Bibiheybat port of Baku city.

There are no known fishing grounds either within or in the vicinity of Shafag-Asiman Contract Area and it is not an area where commercial vessels known to operate, given the unfavourable meteorological and climatic conditions in this area as well as the distance from shore.

5.6.3 Shipping, Ports and Existing Offshore Infrastructure

The primary commercial ports of Azerbaijan are situated on the Absheron Peninsula and in the vicinity of Baku. Shipping activities in the waters of the Central and Southern Caspian Sea include cargo shipping, passenger vessels, scientific surveys and other vessel movements supporting the oil and gas industry.

There is a dense network of navigation routes across the Central and Southern Caspian Sea, which are supported by a number of commercial ports, including the Port of Baku, Turkmanbashi (Turkmenistan), Aktau (Kazakhstan) and Olya (Russia). Cargo and passenger ferries operate between Baku/Alat and Aktau and between Baku/Alat and Turkmenbashi; and between Olya and Turkmenbashi. They do not operate under a timetable; operations are dictated by passenger and cargo demand, as well as by the weather (Ref.57). There are no known shipping routes through or in the vicinity of the Shafag-Asiman Contract Area.

5.6.4 Tourism and Recreation

In 2016, the total contribution of tourism activities to the Azerbaijani economy was US$1.4 million or 4.1% of GDP (Ref.58). It is forecast to rise to $US2.9 million (or 5.9% of GDP) by 2027. The tourism sector directly supported around 171,000 jobs in 2016 (~3.7% of total employment), and indirectly around 609,000 jobs (or 13.2% of total employment).

In 2016, Azerbaijan generated US$2.8 million in visitor exports; in 2017, this is expected to grow by 8.1%, and the country is expected to attract 2,758,000 international tourist arrivals; and by 2027, international tourist arrivals are forecast to total 4254,000 (Ref.59).

There are a number of locations along the coast of the Absheron Region and south of Baku city that are used for recreational activities and water sports (including diving, sailing and kite surfing) and are available for beach users, particularly in the beach clubs and hotels. A number of these beach clubs and hotels rely on seasonal income, and offer employment opportunities to the region, particularly during high season (Ref.3).

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6 Environmental and Socio-Economic Impact Assessment

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6.1 Introduction

The activities and events associated with the Shafag-Asiman (SAX01) Exploration Drilling Project (henceforth referred to as the "Project") have been determined based on the activities described within Chapter 4: Project Description; and the potential for interactions with the environment identified.

In accordance with the impact assessment methodology (described in Chapter 3), Environmental and Socio-Economic Impact Assessment (ESIA) Scoping has been undertaken to identify selected activities that may be "scoped out" from the full environmental impact assessment process if the event magnitude is identified to be very low and the receptor interaction predicted to be highly unlikely. In addition, existing controls and mitigation have been identified. These include routine procedures and design measures that will be used to ensure that activities are consistent with environmental expectations.

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, where required, are provided. Assessments of cumulative and transboundary impacts and accidental (unplanned) events have also been undertaken and are provided in Chapter 7 of this ESIA.

6.2 Scoping

The Project activities and associated Events that have been scoped out due to their limited potential to result in discernible environmental or socio-economic impacts are presented in Table 6.1. The scoping process has used judgement based on prior experience of similar Activities and Events. 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 6.1 "Scoped Out" Project Activities

Activity / Event	Justification for "Scoping Out"
Event: Seabed disturbance associated with MODU anchoring	• MODU anchoring will result in disturbance due to positioning of anchors and anchor chains of approximately 13,000 square metres (m^2). • As described in Chapter 5: Section 5.5.2.1 the baseline survey conducted at the proposed SAX01 well location indicated that the benthic community across the SAX01 survey area is almost abiotic (i.e. devoid of life). • The displacement of sediment due to anchoring may result in burying of any benthic organisms present with some potentially buried too deeply to recover to a position near the sediment surface. The majority, however, will be able to re-establish themselves once the anchors and chains have been removed **Conclusion:** It is considered that impacts are minimised as far as practicable and no discernible impact to the marine environment due to seabed disturbance.
Activity: Discharges of treated black water/ grey water/ drainage from MODU and support/supply vessels during drilling activities	• Discharges from the MODU and supply/support vessels will comprise ballast water, grey water, treated black water and deck drainage. • Based on the estimated Persons On Board (POB) and forecasted generation rates of 0.1 cubic metres (m^3)/person/day (black water) and 0.22m^3/person/day (grey water), it is estimated that approximately 16m^3/day of black water and 35.2m^3/day of grey water will be generated by the MODU and support/supply vessels during the Project drilling programme. • Discharges of treated black water, grey water and drainage from the MODU and supply/support vessels will be managed in accordance with the requirements described in Table 4.2 in Chapter 4: Section 4.4.1. Monitoring and reporting requirements associated with these discharges include: • Black Water: - During periods when the MODU/vessel Sewage Treatment Plant (STP) is in use, sewage samples will be taken from the sewage discharge outlet and analysed monthly for relevant parameters to confirm compliance with the applicable MARPOL 73/78 Annex IV[21] or MARPOL 73/78 Annex IV MEPC. 159 (55) standards[22];

[21] Five day BOD ≤50mg/l, total suspended solids ≤50mg/l (in lab) or ≤100mg/l (on board) and thermotolerant coliform ≤250MPN per 100ml. Residual chlorine as low as practicable where chlorine is added (vessels) (for vessel STP plants installed prior to January 2010)

[22] Five day BOD ≤25mg/l, COD ≤125mg/l, total suspended solids ≤35mg/l, pH between 6 and 8.5 and thermotolerant coliform 100MPN per 100ml. Where chlorine is added, residual chlorine in the effluent to achieve below 0.5mg/l (for vessels STP plants installed after January 2010 and Heydar Aliyev MODU)

<table>
<tr><th>Activity / Event</th><th>Justification for "Scoping Out"</th></tr>
<tr><td></td><td>

Daily visual checks will be undertaken when discharging treated black water to confirm no floating solids are observable; and
MODU and support/supply vessels 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 per person per day) will be reported to the Ministry of Ecology and Natural Resources (MENR) upon Project completion.
Grey Water and Drainage (deck drainage and wash water):
Daily visual checks undertaken when discharging grey water, deck drainage and wash water to confirm no visible sheen is observable; and
Daily estimated volumes of grey water discharged from the MODU and support/supply vessels will be recorded monthly and reported to the MENR upon Project completion. Estimates will be based on generation rates of 0.22m^3 per person per day (grey water).

Conclusion: The low volume of these discharges in accordance with the relevant standards over the short duration of the drilling programme is not anticipated to result in any discernible impact to the marine environment.</td></tr>
<tr><td>Activity: Discharge of macerated MODU galley waste</td><td>
Galley food waste generated onboard the MODU and support/supply vessels will be managed in accordance with the requirements described in Table 4.2 in Chapter 4: Section 4.4.1.
Conclusion: The low volume of galley waste discharged in accordance with the relevant standards over the short duration of the drilling programme is not anticipated to result in any discernible impact to the marine environment.</td></tr>
<tr><td>Event: Atmospheric emissions (non GHG) from MODU, support vessels and helicopter power generation during drilling and vessel support activities</td><td>

Emissions of non greenhouse gases (GHG) to atmosphere will arise from the operation of the MODU and support/supply vessel engines.
Nitrogen oxides (NOx) is the main atmospheric pollutant of concern, based on the larger predicted emission volumes as compared to other pollutants (sulphur oxides (SOx), carbon monoxide (CO) and non-methane volatile organic hydrocarbons (NMVOC)) and the potential to impact human health and the environment.
Estimated volumes of non GHG emissions generated by the Project activities over the duration of the drilling programme (for NOx, CO, SOx and NMVOCs) are 1165, 308, 2 and 39 tonnes respectively (refer to Table 4.14 in Chapter 4: Section 4.10.1).
Outside of Baku air quality in coastal areas is not routinely monitored except in the vicinity of the Sangachal Terminal located approximately 40km south west of Baku. Between 2012 to 2016 average NO_2 concentrations of between 10.4 micrograms per cubic metre (µg/m^3) and 11.8µg/m^3 were recorded, well below the annual average EU limit value for NO_2 of 40µg/m^3. Background NO_2 concentrations levels in rural areas along the coastline are likely to be lower due to the rural conditions.
The ACE Project ESIA (Ref.1) presented the results of air quality dispersion modelling undertaken to assess the impacts to air quality onshore due to MODU activities at a distance of approximately 100km offshore.
The modelling focused on NO_X as the main atmospheric pollutant of concern, based on its potential to impact upon human health and the environment. The assessment predicted an increase in annual average NO_2 contributions at onshore receptors (Absheron Peninsula (at Shahdili Spit), Baku and Sangachal) of less than 0.1µg/m^3 with no predicted exceedances of the annual average limit value for NO_2 of 40µg/m^3. Overall it was considered that impacts associated with MODU power generation would not be discernible onshore.
Based on the results of the ACE Project dispersion modelling and the location of the SAX01 well (approximately 150km offshore) it is predicted that no discernible change in pollutant concentrations or exceedances of the annual average air quality standards that could impact human health are likely at onshore receptors due to the MODU activities and emissions would rapidly disperse into the atmosphere before reaching shore.
For support/supply vessels, the low volume of emissions released will be dispersed across the entire vessel route and the wider area across the duration when the drilling activities are planned. Increases in pollutant concentrations will be very small and indistinguishable from existing background concentrations at key receptors (i.e. onshore communities).
MODU and support/supply vessel 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.
Vessels will be well maintained and use good quality, low sulphur fuel.
Monitoring and reporting requirements associated with emissions to the atmosphere during MODU drilling 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 within the Environmental Report completed at the end of drilling:
Volume of fuel used by the MODU (recorded daily in tonnes and reported monthly); and
Estimated volumes of emissions generated as a result of fuel used (calculated using emission factors).
</td></tr>
</table>

Activity / Event	Justification for “Scoping Out”
	Conclusion: Based on the distance of the project activities from onshore communities, the short-term nature of the activities and the control measures listed above, it is considered the potential for adverse impacts from emissions to atmosphere is insignificant.
Event: Waste Generation	• Waste generated during the SAX01 drilling programme will be consistent with the type and quantity that have been routinely generated during previous drilling programmes conducted by BP in the Caspian Sea. • Waste onboard the MODU and support/supply vessels will be segregated at source, stored and transported in fit for purpose containers. • State licensed and approved waste management facilities will be used for disposal of waste during the drilling programme. • All waste generated during MODU drilling activities will be managed in accordance with the existing BP Azerbaijan Georgia Turkey (AGT) Region waste management plans and procedures. • 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 will be managed in accordance with the existing BP AGT Region management plans and procedures and the waste management plans to be developed for the Project. No discernible impacts expected.
Event: Fugitive emissions from dry bulk transfer	• During the transfer dry bulk (primarily cement and barite) from vessels to the MODU silos some losses to the atmosphere of dry bulk may occur through vent lines (the vent lines must be open as part of operational requirements). • Fugitive emissions resulting from dry bulk transfer are expected to be minimal. **Conclusion:** No discernible impact to the marine environment anticipated due to fugitive emissions resulting from dry bulk transfer.
Activity: Physical presence of MODU and support vessels	• A mandatory 500m safety exclusion zone for non-project related vessels will be established around the MODU while drilling is in progress. • There are no known shipping routes passing through or in the vicinity of the Shafag-Asiman Contract Area. • There are no known fishing grounds within or in the vicinity of Shafag-Asiman Contract Area and it is not an area where commercial fishing vessels are known to operate. The nearest fishing ground is the Kornilov-Pavlov Bank, located approximately 80km west of Shafag-Asiman Contract Area. • A Notice to Mariners will be issued in advance of the offshore Project activities to warn mariners of the project including the position/duration of the marine exclusion zone around the MODU. • The location of the SAX01 well will be clearly marked on marine navigation charts provided to the appropriate relevant authorities. • All vessels will operate in compliance with national and international maritime regulations for avoiding collisions at sea, including the use of signals and lights. **Conclusion:** Potential impacts from the physical presence of the MODU and support/supply vessels on shipping and commercial fishing is expected to be insignificant.

Table 6.2 presents the Activities related to the Project activities that have been assessed within this Chapter.

Table 6.2 "Assessed" Routine Project Activities

Activity	Event	Receptor
Tow out and positioning of MODU and vessel support including supply to MODU and backload to shore	Underwater sound	Marine Environment
Discharges from MODU seawater/cooling water systems	Water intake/entrainment	
	Cooling water discharge to sea	
Drilling of 42” and 32” upper hole sections with seawater/ pre-hydrated bentonite (PHB) sweeps, Pad Mud or water based mud (WBM)	Underwater sound	
Discharge of residual WBM (after 28” hole section drilling)	Drilling discharges to sea	
Discharge from 28” hole section due to Mud Recovery pumping System (MRS) failure		
Drilling of lower hole sections	Underwater sound	
Cementing discharges to seabed (from cementing casings)	Cement discharges to sea	
Discharge of cement system washout to sea via cement unit hose		
Blowout Preventer (BOP) testing	Discharge of BOP control fluid to sea	

6.3 Impacts to the Marine Environment

6.3.1 Mitigation

Existing control measures associated with underwater sound from MODU drilling and vessels include:

- Project vessels will not intentionally approach seals for the purposes of casual (recreational) marine mammal viewing which may result in disturbance; and
- Support vessels are subject to periodical performance review, which includes environmental performance. Corrective actions will be undertaken to address any performance gaps.

Existing controls associated with MODU drilling discharges include the following:

- WBM and associated cuttings will be discharged below the sea surface from the MODU cuttings chute or a discharge hose in accordance with PSA requirements[23];
- Synthetic Oil Based Mud (SOBM) / Low Toxic Mineral Oil Based Mud (LTMOBM) and associated cuttings used for lower hole drilling will be returned to the MODU and separated. Separated SOBM/LTMOBM will be reused where practicable, and the remainder returned to shore for disposal. SOBM/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 SOBM/LTMOBM or associated cuttings into the marine environment;
- During MODU drilling activities, WBM will be separated from cuttings as far as practicable and reused;
- WBM additives used during MODU drilling activities will be of low toxicity (UK Offshore Chemical Notification Scheme (OCNS) “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); and
- For the upper sections of the well, it is proposed to use pre-hydrated bentonite (PHB) sweeps or Pad Mud and a WBM of the same specification and environmental performance as used for previous wells drilled in the Shah Deniz (SD) and Azeri Chirag Gunashli (ACG) Contract Areas. If there is a requirement to change the sweeps/pad mud/WBM composition or to select different drilling fluids for commercial or technical reasons, the ESIA Management of Change Process (see Chapter 4: Section 4.11) will be followed.

Existing controls associated with cement during MODU drilling 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; and
- Excess cement at the seabed will be observed and corrective action will be taken, if required, to ensure cement discharges are minimised.

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 100 m from the discharge point) will be no greater than 3 degrees Celsius (°C) above ambient water temperature; and
- The MODU seawater intake design will include the use of a screen mesh to prevent fish entrainment.

[23] 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.

6.3.2 Underwater Sound

6.3.2.1 Event Magnitude

Description

Underwater sound, resulting from the positioning of the MODU using vessels (10 days), drilling of the well (up to 440 days), and associated vessel movements over the same period as described within Chapter 4, has the potential to impact biological/ecological receptors (specifically seals and fish) in the marine environment.

Sound can be described using various acoustic metrics, including sound pressure levels (SPL) and sound exposure levels (SEL). The former is the instantaneous pressure which can be defined as a peak, peak-to-peak, zero-to-peak or RMS (root-mean-square) value while the latter is a measure of received sound energy over some defined period of time. A glossary of acoustic terminology is presented in Section 6.6 of this chapter.

The propagation of sound from these activities has been calculated using a simplified geometric spreading model (Ref.2) to understand the magnitude of potential impacts of underwater sound to the biological receptors in the marine environment (seals and fish). The formula (shown below) accounts for source sound levels and propagation of sound over distance:

- $SPL = SL - N \log_{10}(R)$

where SL is the acoustic source level of the sound under consideration, SPL is the sound pressure level at range R and N is a constant: 20 for spherical spreading and 10 for cylindrical spreading. In a free acoustic field (far-field) without any reflecting boundaries, N=20 as the energy is dispersed over a large area. In shallow water the bottom and water surface will reflect the sound, causing interferences and the transmission loss will be better described by N=10. Attenuation loss due to absorption, scattering and diffraction increases with increasing frequencies and it is dependent on temperature, salinity, depth and the pH value of the water.

Note that use of cylindrical spreading (N=10) is generally suited to shallow-to-mid water depths, and spherical spreading (N=20) is generally applicable to deep water depths. Although the definition of deep vs. shallow is somewhat dependent on wavelength, Richardson *et al.* (Ref.3) suggests that depths <200 m are commonly regarded as “shallow” and >2000 m are commonly regarded as “deep” regardless of source wavelength. Richardson *et al.* (Ref.2) also suggests using N=15 for underwater transmission in water conditions where the depth is greater than 5 times the wavelength.

Water depths at the proposed well site are approximately 624 m and the acoustic energy of drilling and vessel movements is typically concentrated between 250 hertz (Hz) to 2000 Hz. For the purposes of these modelling exercises, and to provide a reasonable estimate of sound propagation, an empirical wave mode coefficient N=15 has been used.

Due to the limitations of a simplified geometric spreading model, transmission losses due to absorption, scattering and diffraction have been excluded from these predictions. Additionally, the effect of the ambient underwater sound environment has not been considered in this assessment.

The modelling has assumed that both sources and receptors are stationary relative to each other, although this will overestimate the received sound levels, as in reality sources will be moving (e.g. vessels moving to/from the MODU location) and receptors would not remain stationary (e.g. species would probably move away from an obtrusive sound event and also move as part of natural foraging and other activities). The distances at which SELcum threshold criteria for marine mammals are met have included consideration of marine mammal auditory weighting functions (‘M-weighting’) and the broadband weighting factor adjustments as set out in Appendix D of NOAA Technical Memorandum NMFS-OPR-59 (Ref.4).

Sound Sources

Drilling

Sound will be generated from the MODU at the drilling location when the drilling programme is in progress. The sound source levels emitted during the drilling programme will consist of drill pipe operation and on board machinery. The sound will be mainly emitted above water, with low transmission into the water from the air, however some sound will be emitted directly into the water.

While a literature review revealed there is limited data on which estimates of source levels for drilling may be established, two references of relevance are available. These reports discuss drilling using, in the first case, a 20 cm diameter drill (Ref.5) and in the second case, a much larger 4.2 m diameter drill (Ref.6). Source noise levels of 135.8 dB re 1 µPa at 1 m and 153.4 dB re 1µPa at 1 m, respectively were given. It is assumed that sound levels vary linearly with drill diameter (although there is insufficient data against which to test this hypothesis) hence the source levels associated with the Project exploration hole was estimated. The source levels estimated varied between 137.1 dB re 1µPa at 1 m ($12^{1}/_{4}$" hole size) and 140.2 dB re 1µPa at 1 m (42" hole size). As there is little variation in source levels the use of a single source level may be used to represent all drilling activities. Therefore, for the purposes of this ESIA, a source level of 140 dB has been used as a worst case for drilling activities.

Vessel Movements

The vessels required throughout the drilling programme to supply consumables such as drilling mud and fuel to the MODU, ship solid and liquid waste to shore for treatment and disposal are presented in Chapter 4: Table 4.1. These will include support vessels and tugs. Sound from vessels is produced by a combination of sources with broadband sound superimposed with tonal sound at specific frequencies corresponding to propeller blade rate, engine cylinder firing and crankshaft rotation.

Example acoustic data (Ref.7) have been used to provide proxy data for the vessels proposed to be deployed on the Project based on vessel power and overall vessel size[24]. Table 6.3 presents the derived source levels for the support vessels proposed to be used during the Project drilling programme.

Table 6.3 Derived Acoustic Source Levels for Support Vessels Anticipated to be used for the Project Drilling Programme

Vessel	Source Level dB re 1µPa @1m
Tug	177
Support Vessel	206
Standby Vessel	197
Crew Change Vessel	197

Sound Threshold Criteria Associated with Potential Impacts to Seals and Fish

Responses of marine mammals and fish to underwater sound have been studied and reported within scientific literature over many years with threshold criteria developed and revised for a number of species and groups of species. Thresholds are usually proposed in terms of one or more different sound level metrics (SPL and SEL) and for different levels of potential impact ranging from mortality, physical injury and hearing impairment through to behavioural reactions denoted by changes in feeding, breeding, respiration or patterns of movement.

Thresholds for hearing impairment consider potential permanent and temporary effects on hearing where animals exposed to sufficiently intense sound exhibit an increased hearing threshold (i.e. poorer sensitivity) for some period of time following exposure. This is called a sound-induced threshold shift and the amount of shift is determined by the distance between a sound and the individual at the time of hearing the sound in combination with the amplitude, duration, frequency content, temporal pattern, and energy distribution of the sound exposure relative to the hearing sensitivity of the species and the

[24] Insufficient vessels of the same or similar class have been categorised based on sound level measurements, hence any detailed relationship between sound emissions and size of vessel is not known.

background sound levels. Hearing threshold shifts may be permanent (PTS) or temporary (TTS) and thus hearing impairment impacts are generally considered at these two levels:

- **Permanent threshold shift (PTS)** is a permanent, irreversible increase in the threshold of audibility at a specified frequency or portion of an individual's hearing range above a previously established reference level. This is considered to be auditory injury.

  Due to the absence of data on permanent injury in marine taxa, PTS thresholds have been extrapolated from observed TTS responses and therefore, there are high levels of uncertainty in the currently available threshold criteria for PTS in marine receptors.

- **Temporary threshold shift (TTS)** is a temporary, reversible increase in the threshold of audibility at a specified frequency or portion of an individual's hearing range above a previously established reference level.

Behavioural thresholds are based on observations of individuals or groups of individuals when exposed to sound at a given level. The sound levels involved are lower than those that would give rise to PTS or TTS. The nature of the sound, in terms of its frequency content as well as its duty cycle, whether continuous (e.g. sound associated with drilling) or intermittent, governs how the receptor may respond. The response of the animal is also often context-dependent (i.e. feeding, breeding, migrating etc.) and may relate to its motivation and previous experience to the perturbing sound.

Where dual metric impact thresholds are available for hearing impairment, the threshold criterion which is exceeded first (i.e. the more precautionary of the two measures) is widely used (Ref.4, 11). In the case of drilling sound (classified as non-pulse sound (Ref.4, 11)), acoustic thresholds for permanent threshold shift (PTS) and temporary threshold shift (TTS) are given in terms of SEL only while thresholds for behavioural reactions are given in terms of SPL_{RMS}.

Thresholds for Seals

Underwater audiograms for Caspian seal do not exist hence the hearing ability of this species remains unknown. Thresholds representing the onset of PTS and TTS must therefore be based on suitable proxy species and for this purpose data from the northern elephant seal and harbour seal are used (Ref.4, 11). A recent study (Ref.12) based on the underwater hearing ability of two captive spotted seals suggested that their hearing ability was similar to harbour seals, and lower than other Arctic species tested (i.e., harp and ringed seals). Taking a precautionary approach, this suggests that harbour seals are an appropriate proxy for other ice seals, such as the Caspian seal for which no specific thresholds exist.

Southall et al. (Ref.11) reviewed published data concerning measurements of SPL and SEL together with data on hearing impacts or behavioural characteristics. The criteria for PTS and TTS were later revised (Ref.4, 13) and it is this later set on which the acoustic impact thresholds for PTS and TTS shown in Table 6.4 below are based.

Southall et al. (Ref.11, 13) states that the effects of non-pulse exposures on pinnipeds are poorly understood. Studies for which data are available involve harbour seals and northern elephant seals and indicate that sound levels between 90 and 140 dB re 1μPa were unlikely to elicit strong behavioural reactions. Further it was noted that the behavioural reactions in the seals were very context-driven varying from no change in behaviour through to moderate changes indicated by changes in speed, direction and/or dive profile; minor changes in group distribution; and moderate changes in vocal behaviour. Therefore, as a precaution, the assessment has considered additional behaviour criteria derived from Southall *et al*. (Ref.11, 13) for non-impulsive sounds, summarised below:

Non-impulsive sound sources:

- Moderate behavioural reactions in pinnipeds exposed to non-pulse sounds - 130 - 140 dB_{rms} re 1μPa; and
- No observable reactions expected in pinnipeds exposed to non-pulse sounds - 120-130 dB_{rms} re 1μPa.

Thresholds for Fish

Limited published information exists for establishing thresholds for PTS and TTS in fish. Popper *et al*. (Ref.14) undertook a review and defined a set of acoustic impact criteria for fish having varying levels of sensitivity to underwater sound[25] (refer to Table 6.4). The PTS thresholds for fish have been developed based on the following functional hearing categories:

- High hearing sensitivity fish, particularly herring and related species (*Clupeidae*), which involve the use of the swim bladder in hearing;
- Medium sensitivity hearing generalist fish such as sturgeon which have a swim bladder but it is not used in hearing; and
- Low sensitivity hearing generalist[26] fish, particularly flatfish, sharks and rays, which do not have any gas filled organs.

TTS has been demonstrated in some fish but there are high levels of variability in the duration and magnitude of the shift depending on many factors, including the intensity and duration of sound exposure, the species and the life stage of fish. There are no reliable thresholds for fish behavioural changes but TTS can be used as an estimate of the point at which a significant behavioural response would be expected to occur. With regards to continuous sound, there are no data on exposure or received levels that enable guideline thresholds to be set.

Assessment

Drilling

Using the geometric spreading model, estimated source levels for drilling and a number of assume exposure durartions (where appropriate), the SPL and SEL at distances from the source were calculated and compared to the applicable threshold levels to confirm at what distance the threshold is met. Sound from drilling will be non-impulsive in nature. The results of the calculations are presented in Table 6.4.

Table 6.4 Threshold Criteria for Seals and Fish and Predicted Distance at which the Criteria is Met (Drilling)

Receptor	Effect	Threshold level		Distance at Which Threshold is Met (m)
Seals	PTS	201	dB SELcum (24hr M-weighted) re. $1\mu Pa^2s$	<10 (1hr exposure)
				<10 (8hr exposure)
		218	dB peak (unweighted) re. $1\mu Pa$	<10
	TTS	181	dB SELcum (24hr M-weighted) re. $1\mu Pa^2s$	<10 (1hr exposure)
				<10 (8hr exposure)
	Moderate behavioural reactions	130-140	dB rms (unweighted) re. $1\mu Pa$	<10
	No observable reactions	120-130	dB rms (unweighted) re. $1\mu Pa$	22
Low & medium sensitivity fish	Mortality/mortal injury	n/a		(N/I/F) Low
	Recoverable injury	n/a		(N/I/F) Low
	TTS	n/a		(N) Moderate; (I/F) Low
	Low level disturbance	n/a		(N) Moderate; (I/F) Low

[25] Note that the data set is limited, as the thresholds identified in Popper *et al.* (Ref. 14) are based on piling driving sound rather than drilling sound sources.

[26] Popper *et al*. (Ref.14) classify fish as being hearing-specialist or hearing-generalist. In the latter case, physiological differences account for the fact that some species of hearing-generalist fish are more audiologically sensitive than other species. In order to differentiate between these two groups, the terms "low sensitivity" and "medium sensitivity" are used. It is acknowledged that the use of this specific terminology is informal and not used widely outside this ESIA. It is nevertheless considered helpful to use these terms from an environmental impact assessment perspective as a range of fish species of varying hearing sensitivity are present in the project area.

Receptor	Effect	Threshold level		Distance at Which Threshold is Met (m)
High sensitivity fish	Mortality/mortal injury	n/a		(N/I/F) Low
	Recoverable injury	170	dB rms (unweighted) re. 1µPa, for 48 hours	<10
	TTS	150	dB rms (unweighted) re. 1µPa, for 12 hours	<10
	Low level disturbance	n/a		(N) High (I) Moderate (F) Low

Notes:
1 – Distances of <10m indicate that effects are unlikely to occur unless receptor is directly adjacent to the sound source.
2 – *Popper et al.* advises that relative risk (high, moderate, low) is given for animals at three distances from the source defined in relative terms as near (N), intermediate (I), and far (F).
3 – *Popper et al.* advises that "near" might be considered to be in the tens of meters from the source, "intermediate" in the hundreds of meters, and "far" in the thousands of meters.

With reference to seals, PTS and TTS may occur if the animals remain within 10 m of the drilling operations. At distances beyond 10 m the likelihood of any observable reactions quickly falls to insignificant. Disturbance and behavioural reactions in seals such as changes in swimming direction and speed may occur at distances up to 10 m from the drilling site. At distances beyond this the likelihood of any observable reactions quickly falls to insignificant.

Popper *et al*. (Ref.11) states that fish of varying hearing sensitivities will respond to sounds but that there are no data on exposure or received levels that enable guideline threshold levels to be set for behavioural response. As such distances at which certain thresholds are met are expressed qualitatively rather than quantitatively. For fish exposed to continuous sounds, there is no data to support the establishment of thresholds for mortality, recoverable injury or TTS. It is considered that there is a low risk of mortality and recoverable injury for fish of all hearing abilities and a moderate risk of TTS in hearing generalist fish at short distances from the drilling location.

The Azerbaijan sector of the Caspian Sea is routinely and regularly crossed by commercial ships, fishing vessels and supply vessels travelling to and from offshore oil and gas facilities and background underwater sound levels would be typical for this type of environment. Measurements made in the coastal North Sea where oil-field related activities predominate recorded background noise levels as high as 130 dB re 1µPa (Ref.15). Background sound levels within the Shafag-Asiman Contract Area are likely to be lower compared to areas such as the SD or ACG Contract Areas as there are no existing oil and gas activities present and as such the volume of vessel traffic, and hence sources of underwater sound, is less. However, it is assumed that marine life will have become largely habituated to noise levels associated with vessel traffic and there would be a minimal relative increase to existing levels of disturbance on pinnipeds and fish species. In comparison to other sound sources, sound emissions from drilling are considered relatively low. The likelihood of any observable effects on marine receptors due to drilling is low.

Support Vessels

Using the geometric spreading model and source levels for anchor handling tugs, support and standby / crew change vessels (Table 6.3) the SPL and SEL at distances from the source were calculated and compared to the applicable threshold levels to confirm at what distance the threshold is met. Sound from vessel movements will be non-impulsive in nature. The results of the modelling are presented in Table 6.5.

Table 6.5 Threshold Criteria for Seals and Fish and Predicted Distance at which the Criteria is Met (Support Vessels)

Receptor	Effect	Threshold Level		Distance at Which Threshold is Met (m)		
				Anchor Handling Tug	Support Vessel	Standby / Crew Change Vessels
Seals	PTS	201	dB SELcum (24hr M-weighted) re. 1μPa^{2}s	<10 (1hr exposure)	506 (1hr exposure)	127 (1hr exposure)
				20 (8hr exposure)	2024 (8hr exposure)	508 (8hr exposure)
		218	dB peak (unweighted) re. 1μPa	<10	<10	<10
	TTS	181	dB SELcum (24hr M-weighted) re. 1μPa^{2}s	109 (1hr exposure)	10903 (1hr exposure)	2739 (1hr exposure)
				436 (8hr exposure)	43611 (8hr exposure)	10955 (8hr exposure)
	Moderate behavioural reactions	130-140	dB rms (unweighted) re. 1μPa	251 - 1166	25119 - 116591	6310 - 29286
	No observable reactions	120-130	dB rms (unweighted) re. 1μPa	1166 - 5412	116591 - 541170	29286 - 135936
Low & medium sensitivity fish	Mortality/mortal injury	n/a		(N/I/F) Low	(N/I/F) Low	(N/I/F) Low
	Recoverable injury	n/a		(N/I/F) Low	(N/I/F) Low	(N/I/F) Low
	TTS	n/a		(N) Moderate; (I/F) Low	(N) Moderate; (I/F) Low	(N) Moderate; (I/F) Low
	Low level disturbance	n/a		(N) Moderate; (I/F) Low	(N) Moderate; (I/F) Low	(N) Moderate; (I/F) Low
High sensitivity fish	Mortality/mortal injury	n/a		(N/I/F) Low	(N/I/F) Low	(N/I/F) Low
	Recoverable injury	170	dB rms (unweighted) re. 1μPa, for 48 hours	<10	251	63
	TTS	150	dB rms (unweighted) re. 1μPa, for 12 hours	54	5412	1359
	Low level disturbance	n/a		(N) High (I) Moderate (F) Low	(N) High (I) Moderate (F) Low	(N) High (I) Moderate (F) Low
Notes as per Table 6.4						

During the mobilisation and demobilisation of the MODU, the calculations indicate PTS may occur in seals if they remain within a distance of 10 m from the anchor handling tugs for a period of 1 hour andTTS may occur if the seals remain within 109 m of the tug operations for a similar period. Moderate behavioural reactions in seals, such as changes in swimming direction and speed, may occur at distances beyond 251 m from the tugs. At distances beyond 1.1 km the likelihood of any observable response to sound is expected to be low. It should also be noted that the lower threshold at which no observable reactions are expected (120 dB re 1μPa rms) is likely to be close to the background underwater sound levels and hence sound associated with vessels may not be audible.

During the drilling programme, the calculations indicate PTS may occur in seals if they remain within a distance of 506 m from support vessel movements or 127 m of standby/crew change vessels for a period of 1 hour and TTS may occur if the seals remain within 10.9 km of support vessel movements or 2.7 km of standby/crew change vessels for a similar period. However, it is expected that seals are likely to move away and are unlikely to remain in the vicinity of the sound long enough to result in PTS or TTS (note however that any movement towards or away from the noise source is context-driven by the seal). Moderate behavioural reactions in seals may occur at distances beyond 25.1 km of support vessel movements or 6.3 km of standby/crew change vessels. At distances beyond 116.6 km of support vessel movements or 29.3 km of standby/crew change vessels the likelihood of any observable responses to sound is expected to be low. However, these distances do not account for the movement of either the vessels or the seal or background noise.

Seals dive to feed on fish and may be vulnerable during feeding. Recent telemetry research shows that although Caspian seals can dive to depths greater than 200 m, with a maximum observed duration over 20 minutes, most dives (80%) were shallower than 15 m and shorter than 5 minutes (Ref.16). Thus, most seals undertaking foraging dives in the vicinity of a support vessel will be able to rapidly return to the surface or move away from the vessel. Seals are likely to be foraging where high abundance of fish will be found and fish are also expected to likely move away from the sound source, thus reducing the potential for seals to be present in the close vicinity of the vessel to feed.

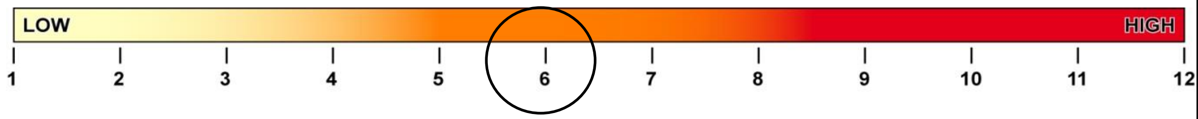
As described above, there is no data to support the establishment of thresholds for mortality, recoverable injury or TTS for fish exposed to continuous sounds. It is considered that when exposed to vessel noise there is a low risk of mortality and recoverable injury for fish of all hearing abilities and a moderate risk of TTS in hearing generalist fish at short distances.

It is considered that the local underwater sound environment would be subject to existing vessel traffic and there would be a minimal relative increase to existing levels of disturbance on pinnipeds and fish species from support vessel movements.

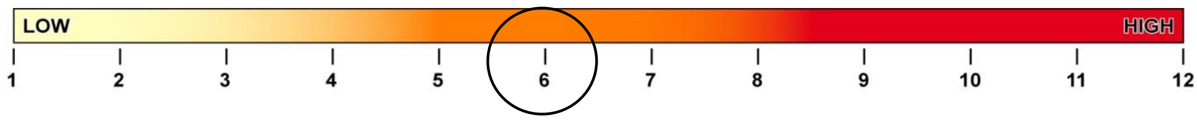
Table 6.6 presents the justification for assigning a score of 6 for MODU drilling and support vessels underwater sound, which represents a Medium Event Magnitude.

Table 6.6 Event Magnitude

Event Parameter	MODU Drilling	Support Vessels
Extent/Scale	1	1
Frequency	1	1
Duration	3	3
Intensity	1	1
Event Magnitude:	**6**	**6**



MODU Drilling



Support Vessels

6.3.2.2 Receptor Sensitivity

Seals

As stated within Chapter 5: Section 5.4.4.3 the Caspian seal population has significantly declined over the 20th Century (by more than 90% since the start of the century) and has continued to decline due to a combination of factors including commercial hunting, habitat degradation (through introduction of invasive species), disease, industrial development, pollution and fishing operations. The seal population is therefore highly vulnerable as reflected by its International Union for Conservation of Nature (IUCN) Red List “Endangered” and Azerbaijan Red Data Book (AzRDB) listed status.

Current information available on seal migration timing and routes are described within Chapter 5: Section 5.4.4.3. There is potential for seals to be present within the Southern Caspian for foraging from May to September with peak numbers in July, returning periodically to their haul-out sites. The Shafag-Asiman Contract Area is likely to be utilised by seals during this feeding period, however the majority of seals will tend to congregate further inshore and further south where the greatest proportions of kilka are concentrated.

The MODU, anchor handling tugs and standby vessel will generally be stationary for the period of the drilling programme and as such are not expected to interfere with the presence of the seals. The support vessels will move between the shore and the Project drill location, but the seals will detect the underwater sound from this source long before the vessel is sufficiently close for the associated sound to result in injury and will temporarily move. Any behavioural disturbance will be very short term, reversible and temporary.

Fish

In general, the main distribution of fish species in the Caspian Sea is within the shallow water shelf areas. Maximum concentrations of fish are typically found at depths of up to 75m for the majority of the year. It is common for Caspian fish species to migrate to warmer southern waters for overwintering and migrate to nutrient rich shallow areas of the north or river deltas in the spring / summer for spawning and feeding.

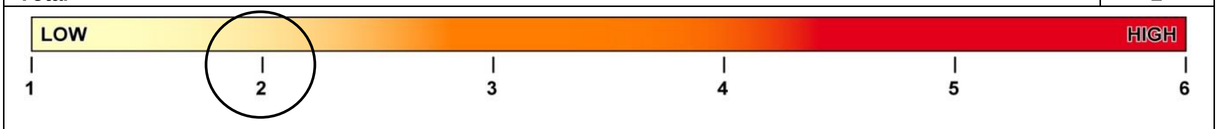
As presented in Chapter 5, Section 5.4.4.2, the species most likely to be present within the deep waters of the Shafag-Asiman Contract Area include gobies and mullet that include some species with moderate sensitivity to underwater sound. However, the species of gobies and mullet potentially present within the Shafag-Asiman Contract Area are most sensitive during April to June and June to September respectively when they are breeding which is outside of the period when they are potentially present within the Shafag-Asiman Contract Area (November to February).

Migratory species such as sturgeon and shad are not expected to be present in the deep waters where the well is located at any time of year. Although pelagic species such as kilka are typically present in the waters of the Southern Caspian year round, they are not generally present in large numbers in water depths greater than 450 m, such as at the Project well location.

Table 6.7 presents the justification for assigning a score of 2 to biological receptors, which represents Low Receptor Sensitivity.

Table 6.7 Receptor Sensitivity (Seals and Fish)

Parameter	Explanation	Rating
Presence	**Fish:** Low numbers of hearing specialist fish are likely to be present for limited periods of time in the vicinity of the proposed Project location. However, these species are widely distributed and do not use this area exclusively. Fish species are able to easily move away from underwater sound before permanent or temporary injury impacts are likely to occur. There may be a change in behaviour but this is expected to be limited to a change in swimming direction and is expected to be short-term. **Seals:** There is potential for low numbers of individual seals to be present at the proposed Project location in the summer months and, to a lesser extent, during spring and autumn migration periods.	1
Resilience	**Fish:** Individual fish are at very low risk of injury or significant behavioural disturbance and therefore the risk to populations is considered to be even lower and ecological functionality will be maintained. **Seals:** Internationally protected Caspian seals may be present in the vicinity of the Project activities during the summer months and possibly during spring/autumn migration periods. However the main migration route is typically offshore of the Absheron Peninsula and along the coast. For Caspian seals that may be present in the vicinity of the Project activities their typical behavioural response is to sense the sound from a distance and adjust their course away accordingly.	1
Total		**2**



6.3.2.3 Impact Significance

Table 6.8 summarises underwater sound impacts to marine biological receptors (seals and fish) associated with MODU drilling and vessel movements.

Table 6.8 Impact Significance

Event	Event Magnitude	Receptor Sensitivity	Impact Significance
MODU Drilling	Medium	(Biological/Ecological) Low	**Minor Negative**
Support Vessels	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 6.3.1) and no additional mitigation is required.

6.3.3 Drilling Discharges

As described in Chapter 4: Section 4.3 it is planned to drill the SAX01 well using a MODU. As outlined in Chapter 4: Section 4.5.3.3, should the MODU encounter borehole stability issues during the drilling of the SAX01 Base Case well, it may be necessary to drill up to two additional wells. Discharges of water based mud (WBM) and cuttings are planned to be consistent with existing SD and ACG drilling practices.

6.3.3.1 Event Magnitude

Description

The anticipated drilling activities resulting in discharges to sea are described within Chapter 4: Section 4.5. The estimated quantities of seawater, PHB sweeps, pad mud, WBM and cuttings discharged in tonnes are provided in Table 6.9. Two types of discharge events are anticipated to occur:

- Seabed discharges during routine drilling of the 42" and 32" holes, residual WBM from 28" hole section and in the event of a failure of the Mud Recovery System (MRS) when drilling the 28" hole; and
- Discharges from the MODU cuttings chute during routine drilling of the 28" hole and during discharge of residual WBM.

Table 6.9 Summary of Drilling Discharges per Hole

Discharge Location	Hole Size	Description	Drilling Fluid/ Mud System	Estimated Fluids Discharged (Tonnes)	Estimated Cuttings Discharged (Tonnes)
Seabed	42"	Conductor and Surface Holes	Seawater/ PHB sweeps/ Pad mud	1600	450
	32"			1600	570
To sea via cuttings chute	28"	Surface Hole	WBM	2176	720
Notes: 1. The volume of WBM discharged includes water.					

The anticipated composition and function of the fluids discharged are provided within Table 6.11 below.

Assessment

SAX01 Base Case Well

The deposition of cuttings discharged directly to the seabed during drilling of the 42" and 32" hole sections using seawater/PHB sweeps/Pad mud and the WBM and cuttings discharged to sea from the MODU during drilling of the 28" hole section has been modelled using Stiftelsen for Industriell og Teknisk Forskning's (SINTEF) DREAM (Dose-related Risk Effects Assessment Model), incorporating the ParTrack model for modelling solids in the water column and sediment. The results of the modelling are summarised below and presented in detail in Appendix 6A.

During drilling of the 42" and 32" hole sections, approximately 3200 tonnes of drilling fluids and 1020 tonnes of cuttings is expected to be discharged directly to the seabed. As described in Chapter 4: Section 4.5.4, the WBM cuttings generated by drilling the 28" hole section will be discharged from the MODU cuttings chute located 0.6 m below the sea surface.

In the event that there is a failure of the MRS, based on the typical chloride concentration within the WBM the 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. The results of the modelling are presented in Figures 6.1 to 6.4 for winter and summer conditions and summarised within Table 6.10.

Table 6.10 Approximate Extent of WBM Cuttings Deposition to 1 mm Depth and Maximum Depth of Deposition for MODU Drilling Discharges (SAX01 Base Case well)

Season	Water Depth	Approximate Extent of Cuttings Deposition to 1mm Depth	Maximum Depth of Deposition
Winter	624m	50,225 m^2	2.21 m
Summer		20,750 m^2	2.51 m

Winter Conditions

As shown in Figure 6.1, under winter conditions it is estimated that the cuttings pile generated by drilling the upper hole sections of the well will reach a maximum height of 2.21 m. The modelling predicts that the maximum estimated area affected by the cuttings deposition to a 1 mm depth from the drilling of the upper hole sections during winter conditions is approximately 50225 m^2 (refer to Figure 6.2).

The area affected is driven by the amount of 42" and 32" hole section cuttings discharged at seabed and also the dispersion of the 28" hole section cuttings over a wide area as they descend to the seabed through over 600 m of water from the MODU. The particle size distribution is relatively coarse, retaining a large fraction of the cuttings within 200 m of the drill centre.

Figure 6.1 Cross Section Showing Depth of Deposition from WBM Cuttings Discharged to the Seabed during Drilling of Upper 42", 32" and 28" Hole Sections (Winter)

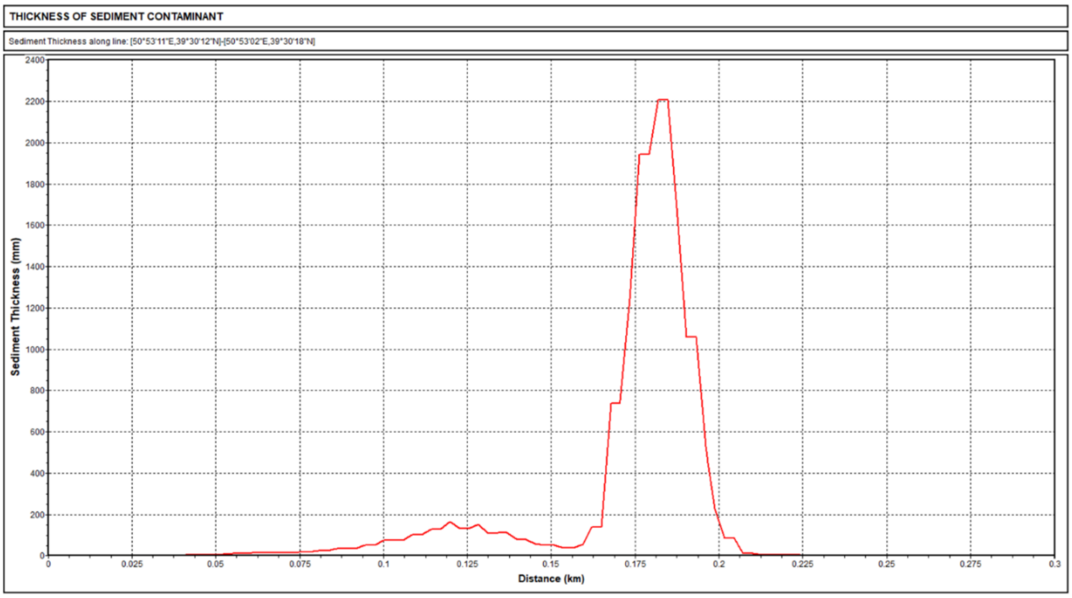
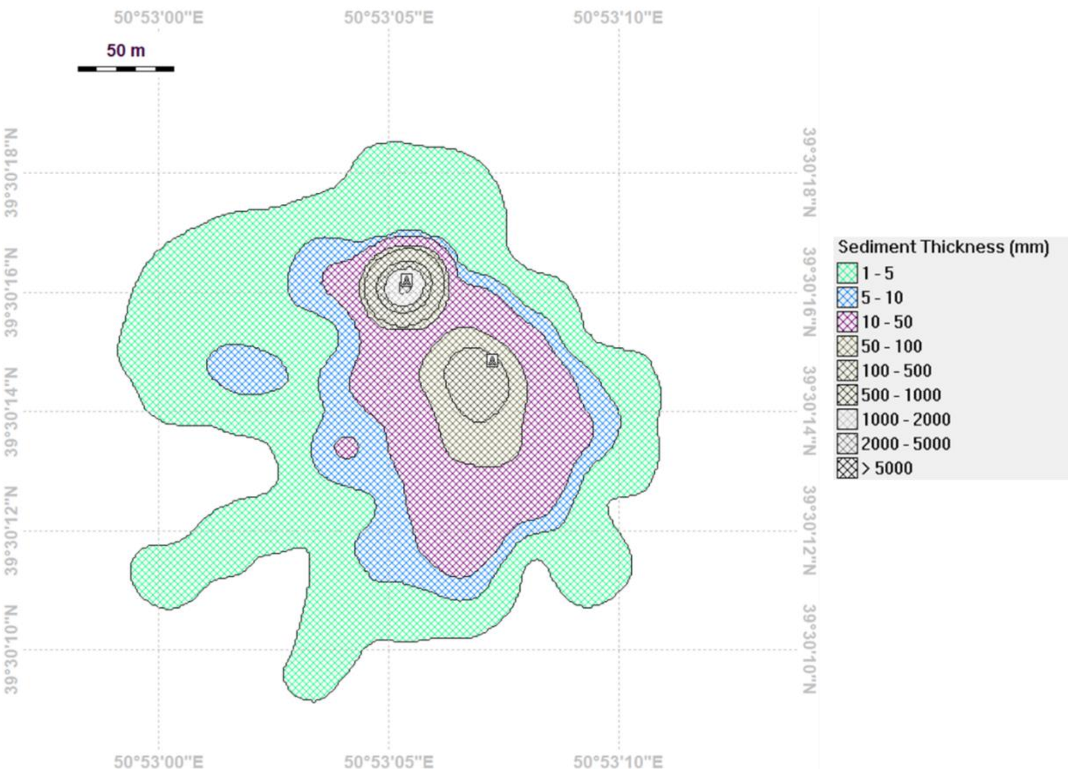


Figure 6.2 Deposition Thickness from MODU Drilling Discharge (Winter)



Summer Conditions

As shown in Figure 6.3, under summer conditions it is estimated that the cuttings pile generated by drilling the upper hole sections of the well will reach a maximum height of 2.51 m. As with the winter conditions modelling results, the height of the cuttings pile on the seabed drops away rapidly with distance from the well, with a height of 1mm reached within a radius of approximately 150-250 m of the well location. The modelling shows that the maximum estimated area affected by the cuttings deposition to a 1mm depth from the drilling of the upper hole sections during summer conditions is approximately 20750 m^2 (refer to Figure 6.4).

Figure 6.3 Cross Section Showing Depth of Deposition from WBM Cuttings Discharged to the Seabed during Drilling of Upper 42”, 32” and 28” Hole Sections (Summer)

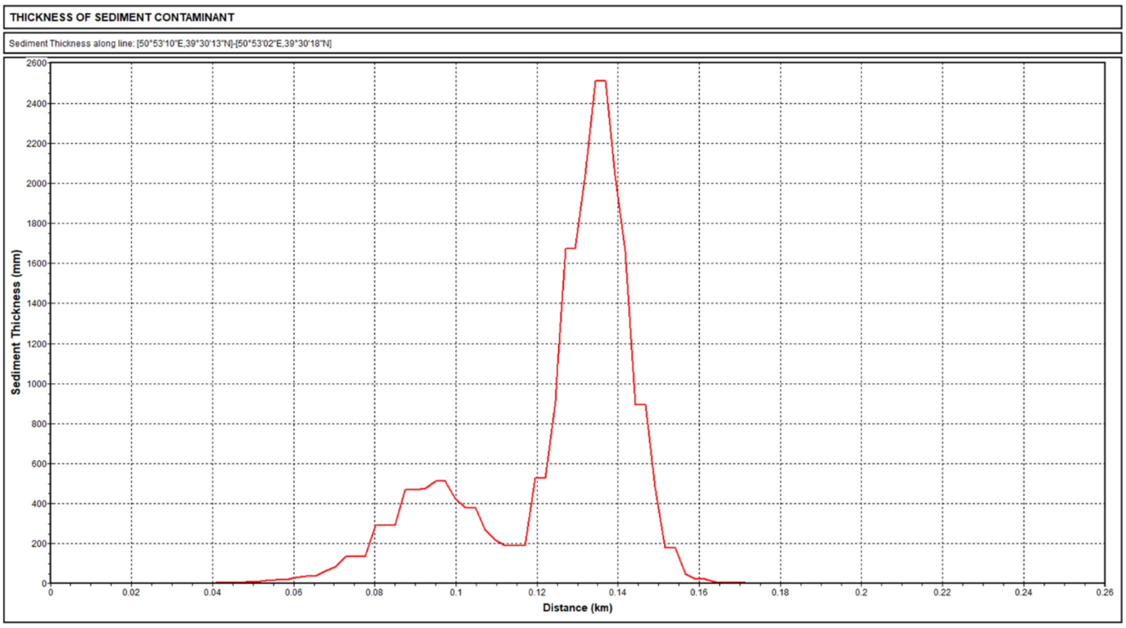
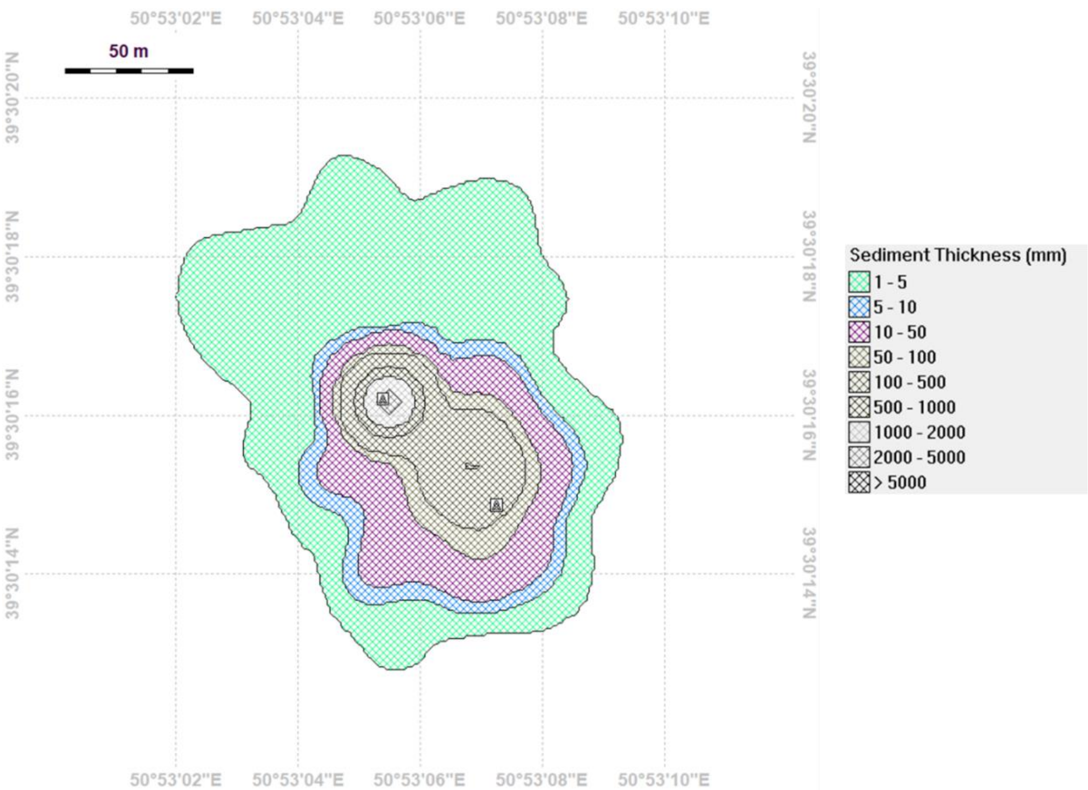


Figure 6.4 Deposition Thickness from MODU Drilling Discharge (Summer)



Contingency Drilling

Modelling has been undertaken to predict the behaviour of the drilling discharges associated with drilling of up to two additional contingency wells, located 50 m to the east and 50 m to the west of the SAX01 Base Case location. For the purpose of the ESIA, the modelling has conservatively assumed each well is drilled to their full depth and the estimated discharges and duration for each contingency well will be the same as for the SAX01 Base Case well. However, in the event the MODU encounters borehole stability issues during drilling it is highly unlikely that the well will be drilled to the full depth before being abandoned and thus the actual volume of drilling discharges is likely to be much lower than has been modelled for the contingency drilling case.

The modelling for the drilling of three wells predicts the most significant accumulations of drill cuttings will be deposited within 200 m of the drill centres with a peak thickness of around 2.6 m. The modelling predicts that a maximum of approximately 47650 m^2 (during summer conditions) and 127225 m^2 (during winter conditions) of seabed may be affected by the cuttings deposition to a 1 mm depth. The overall deposition patterns are reasonably consistent over summer and winter conditions. Detailed modelling results for the three well drilling case are included within Appendix 6A.

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 ACG and SD Contract Areas. These studies provide direct evidence of the environmental effects of discharges arising from the drilling of multiple wells (over 20 in the case of some ACG platforms) at a single location.

In each case, chemical analysis of sediments has shown a detectable barium footprint extending out to approximately 500 m from the wells. This observation is consistent with the modelling predictions taking into account that the barite is predicted to 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 cuttings is not creating any adverse effects on the benthic invertebrate communities at distances of more than 250 m from the platforms (for safety reasons, it is not possible to conduct routine environmental surveys within a 250 m exclusion radius). The monitoring has shown that substantial populations can be found in areas of sediment with high barium concentrations and there is little evidence that the structure of the habitat has been substantially altered.

Drilling discharges are assigned an intensity score of 1 for the following reasons:

- A large proportion (at least 27%) of the discharges consists of inert geological material (the cuttings);
- The drilling fluid components are inert or of low toxicity;
- Only the solid, inert, insoluble components of the drilling mud will settle to the seabed. Low toxicity soluble components, such as potassium chloride and 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 only small effect on the benthos within the 'footprint' of the discharge (up to 500 m 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 Project well(s) and summary of the environmental fate and effects of each component, is summarised in Table 6.11.

Table 6.11 Approximate Composition and Environmental Fate of WBM

Chemical	Function	Hazard Category[1]	Environmental Fate and Effect
Barite	Weighting agent	E	Dense, fine powder. Will settle to seabed. Not considered environmentally hazardous.
Bentonite	Viscosifier and removal of cuttings	E	Inert clay. Not considered environmentally hazardous.
Soda Ash	pH treatment and calcium	E	Water soluble. Will disperse in water column. Not considered harmful.
Magnesium oxide	pH control	E	Natural inorganic substance. Not considered environmentally harmful, will disperse readily in water column.
Fluorescent Dye	Cement tracer	GOLD	UK HOCNS classification of GOLD – low toxicity and low persistence.
Polypac	Water soluble polymer designed to control fluid loss	E	Not classified as environmentally hazardous, is water soluble, biodegradable and does not bioaccumulate.
Duovis (xanthan gum)	Viscosifier	GOLD	UK HOCNS classification of GOLD – low toxicity and low persistence.
Salts (KCl)	Borehole stabiliser / shale inhibitor	E	Natural inorganic substance. Not considered environmentally harmful, will disperse rapidly in water column.
Salts (NaCl)	Borehole stabiliser / shale inhibitor	E	Natural inorganic substance. Not considered environmentally harmful, will disperse rapidly in water column.
Bicarbonate of soda	Calcium sequestor	E	Water soluble. Will disperse in water column. Not considered harmful.
Nut Shells	LCM/Pipe scouring	E	Natural inorganic substance, not considered environmentally harmful. Will settle slowly to seabed, dispersed over wide area.
Poly Ether Amine/Poly Ether Amine Acetate Blend	Shale Inhibitor	Gold	UK HOCNS classification of GOLD – low toxicity and low persistence.
Aliphatic Terpolymer	Shale Encapsulator	Gold	UK HOCNS classification of GOLD – low toxicity and low persistence.
Ester/Alkenes C15-C18 Blend	Anti-accretion additive	Gold	UK HOCNS classification of GOLD – low toxicity and low persistence.
Flotrol	Water soluble polymer designed to control fluid loss	E	Not classified as environmentally hazardous, is water soluble, biodegradable and does not bioaccumulate.
Polyproplene Fibres	Hole cleaning agent	GOLD	UK HOCNS classification of GOLD – low toxicity and low persistence.

Notes: 1. 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.

Toxicity tests are regularly conducted on the proposed WBM formulations using Caspian zooplankton, phytoplankton and sediment-dwelling species. Toxicity was assessed in the water column and sediment[27]. The results from the WBM toxicity testing conducted since 1999 have been reviewed and are summarised in Table 6.12. 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 100-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 6.12 would likely persist only for the duration of each discharge.

[27] The species tested were: Zooplankton: *Calanipeda aquae dulcis*; Phytoplankton: *Chaetoceros tenuissimus* and Sediment: *Pontogammarus maeoticus*.

Table 6.12 Seawater Sweeps and Water Based Mud Toxicity Test Results

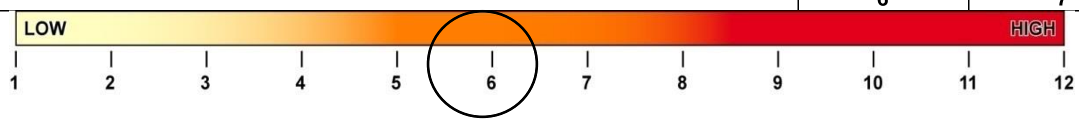
Mud Type	Water Column		Sediment
	Zooplankton 48 hour LC_{50} [1] (mg/l)	Phytoplankton 72 hour EC_{50} [2] (mg/l)	Amphipod 96 hour LC_{50} [1] (mg/kg)
Seawater sweeps (42" & 32" sections)	>32000	>32000	>32000
KCl mud (28" section)	>10000	>32000	>32000
Ultradril WBM (28" & 26" sections)	16568	9868	26270

Notes: 1. LC_{50} - 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. EC_{50} - 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%.

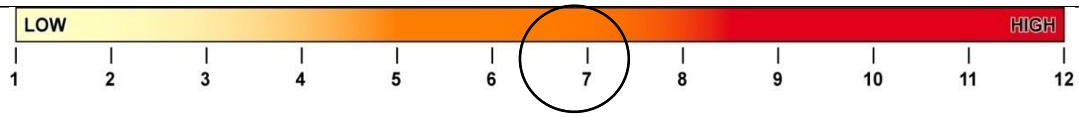
Table 6.13 presents the score justification for the SAX01 Base Case and contingency wells, assigning a score of 6 and 7 respectively. This represents a Medium Event Magnitude in both cases.

Table 6.13 Event Magnitude

Parameter	Explanation	Rating	
		SAX01 Base Case	SAX01 Base Case Well + Contingency Wells
Extent/Scale	Modelling indicates potential for cuttings deposition to over 1mm depth over an area of up to 50225 m^2 associated with drilling the SAX01 Base Case well. This increases to 127225 m^2 should two additional contingency wells be drilled. Overall, deposition patterns on the seabed remain similar and deposition is localised in both the SAX01 Base Case and contingency wells case. Monitoring has shown evidence of barite at distances of up to 500 m from drilling of other ACG/SD wells.	1	2
Frequency	Discharges of WBM and associated cuttings will occur once for each hole section.	2	2
Duration	Total duration of discharge is approximately 318 hours for each well which will take place intermittently over a period of 12 months.	2	2
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	1
Total		**6**	**7**



SAX01 Base Case Well



SAX01 Base Case Well + Contingency Wells

6.3.3.2 Receptor Sensitivity

Seals and Fish

Drilling discharges will generate turbid plumes of limited duration and dimension. Based on BP's Environmental Monitoring Programme (EMP) survey findings, observation and studies relating to similar discharges, these plumes however, are not expected 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 and will not be directly affected by the cuttings deposited at the seabed.

Table 6.14 presents the justification for assigning a score of 2, which represents Low Receptor Sensitivity.

Table 6.14 Receptor Sensitivity (Seals and Fish)

Parameter	Explanation	Rating
Presence	**Fish:** Fish species including gobies and mullet will be present in the Contract Area throughout most of the year with other species occasionally 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. Fish are highly mobile and sensitive and studies (Ref.17) have shown that mobile water column animals, such as fish usually avoid or rapidly move away as soon as they detect the cuttings plume, and so the risk of any impact to fish is low. **Seals:** There is potential for low numbers of individual seals to be present at the proposed Project location throughout the year but with an increased likelihood during the summer feeding season and spring and autumn migration periods. However, the Caspian seal is expected to sense and rapidly move away from any disturbance or from any localised particle plumes associated with drilling discharges, typically following their prey (fish) who will also rapidly move away.	1
Resilience	Marine mammals are occasionally observed in turbid waters offshore, so some tolerance to localised increases due to drilling discharges is likely while most fish species are found in a range of turbidity conditions, such as coastal and riverine locations with much higher sediment loadings. 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
Total		**2**

Plankton

Zooplankton

As for fish and seals, the principal potential interaction of drilling discharges with zooplankton is via the intermittent presence of short-duration turbidity plumes. Discharges from the MODU will normally take place via the cuttings chute (at a depth of approximately 0.5 m below sea level), which is within the zooplankton productive zone present during spring, summer and early autumn.

Much of the particulate matter in the cuttings discharged from the cuttings chute will sink rapidly to the seabed, although smaller particles will remain in the water column creating areas of elevated turbidity. The discharges will be intermittent and of short duration so 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 anticipated to be sufficiently small that the "residence time" of individual organisms within the plume will be too short to cause significant harm.

As described in Chapter 5: Section 5.5.4.1 plankton samples collected as part of the Environmental Baseline Survey (EBS) undertaken at the proposed SAX01 well location in 2017 indicated that the zooplankton community is dominated by two invasive species; the copepod *Acartia tonsa* and the ctenophore *Mnemiopsis sp*. The plankton samples found zooplankton taxonomic richness was lower compared to previous surveys carried out within the SD Contract Area, however the general community structure was similar.

Zooplankton has high reproductive rates during spring, summer and autumn and localised populations tend to develop in patches in response to food availability. These patches then decline as local food resources are depleted. Consequently, zooplankton will be highly resilient to the effects of drilling discharges as populations can re-establish quickly.

Phytoplankton

As presented in Chapter 5: Section 5.5.4.1, a total of thirty seven species of phytoplankton were recorded in the samples taken during the SAX01 EBS. The most abundant phylum were bacillariophyta followed by dinoflagellates, chlorophyta and cyanophyta. The phytoplankton community within the samples was similar in composition to the communities observed in previous surveys carried out within the SD Contract Area.

Being dependent on light to photosynthesise, phytoplankton are confined to the upper layers of the water column. As with zooplankton, phytoplankton populations tend to be patchy. In areas where nutrient levels are temporarily high, growth will be rapid and dense patches can develop. The development of patches is limited both by local nutrient availability and by zooplankton grazing.

Phytoplankton are fast growing, short-lived and respond quickly to changing conditions such as increases in nutrients or changes in light conditions and are therefore well adapted to rapidly changing conditions.

Table 6.15 presents the justification for assigning a score of 2, which represents Low Receptor Sensitivity.

Table 6.15 Receptor Sensitivity

Parameter	Explanation	Rating
Presence	Species not rare or unique on a regional basis. Species are assessed at the community level only. Phytoplankton and zooplankton will be exposed to drilling discharges from the MODU cuttings chute during drilling of the 28” hole section. Discharges to the seabed from drilling of the 42” and 32” hole sections will be below the productive zone.	1
Resilience	Community dominated by widespread and abundant invasive species. Plankton are fast growing, short-lived and respond rapidly to changing conditions.	1
Total		**2**

Benthic Invertebrates

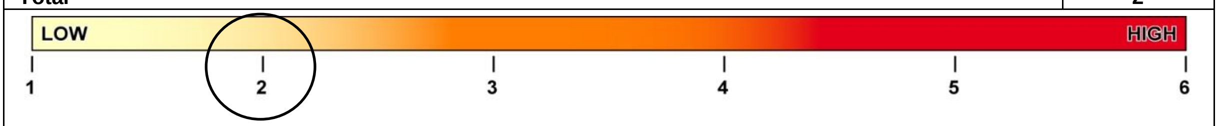
The benthic invertebrate community at the Project location during the 2017 EBS was found to be almost abiotic with only a single individual of one taxa, the polychaete *Manayunkia Caspica,* recorded in three samples. This result was largely comparable to samples recorded at deep water sample stations within the SD Contract Area. Analysis of results from surveys conducted within the SD Contract Area show that macrofaunal abundance, species richness and biomass decrease rapidly at water depths greater than 200 m, and communities at depths beyond 400 m are generally extremely sparse. This trend is thought to be a result of low oxygen availability in deeper waters. Although only a single polychaete was recorded during the SAX01 EBS in 2017, samples taken from deep water stations within the SD Contract Area indicate that there is potential for low numbers of amphipod and oligochaete species to also be present.

The taxa present are deposit feeders which routinely burrow through seabed sediments to a depth of 10 cm or more (this is why field surveys take samples to a depth of 10-15 cm). These are infaunal species capable of burrowing 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 provide 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 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.

Table 6.16 presents the justification for assigning a score of 2, which represents Low Receptor Sensitivity.

Table 6.16 Receptor Sensitivity

Parameter	Explanation	Rating
Presence	Very low number of benthic organisms present. No rare, unique or endangered species present. Species are assessed at the community level only.	1
Resilience	Species or community unaffected or marginally affected.	1
Total		**2**



6.3.3.3 Impact Significance

Table 6.17 summarises impacts to biological/ecological receptors associated with drilling discharges to sea.

Table 6.17 Impact Significance

Event	Event Magnitude	Receptor Sensitivity	Impact Significance
Drilling Discharges to Sea	Medium	(Seals and 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 5 of this ESIA, a limited impact on benthic communities has been observed from existing drilling discharges associated with drilling activities within the Shah Deniz Contract Area.

Monitoring and reporting requirements associated with drilling discharges to the sea during MODU drilling activities include following:

- 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 4: Section 4.11). 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 on completion of drilling activities and monitoring results will be submitted to the MENR; and
- The Environmental Report submitted to the MENR following the completion of the drilling activities 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 MODU HSE MS (Health, Safety & Environmental Management System), which is aligned to the BP AGT Region EMS as described within Chapter 8: Section 8.3 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.

6.3.4 Cement Discharges

As discussed within Chapter 4: Section 4.5.5 it is expected that cement will be discharged to the marine environment during the cementing of the hole sections. In addition, it is expected that excess cement will be discharged from the MODU following the completion of these activities.

6.3.4.1 Event Magnitude

Description

Cementing discharges will occur during drilling from three types of activity:

- During the cementing of successive well casings. Cement discharged from each hole sections will be 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 seawater (approximately 10:1 dilution) and will be discharged from the MODU via a hose located below the sea surface. The discharge of dilute cement slurry is estimated to take approximately an hour at a rate of 78 m^3 per hour.

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*. For the upper hole sections, the principal component (representing between 97 and 99% of the cement by weight) is Class C cement while for the lower hole sections and well abandonment plugs, the principal component (representing between 25 and 85% of the cement by weight) is Class G cement. Both components are an environmentally inert solids. The total quantities of excess cement discharged for each hole section are summarised in Chapter 4: Table 4.9. 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.

Worst case estimates predict approximately 335 tonnes of cement will be discharged directly to the seabed. Although the discharge will occur in separate events for each casing/liner, 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 30 cm deep, then the maximum radius to which the cement would extend would be approximately 10.5 m. Consequently, the impact of seabed cement discharges would therefore be minimal, as this area would lie within the area previously impacted by cuttings discharge from the 42" hole section.

Cement Discharges from Wash Out

As per the cement discharges to seabed described above, the principal component (representing between 92 and 98% of the cement chemicals washout by weight) for the upper holes is Class C cement while for the lower hole sections, the principal component (representing between 25 and 85% of the cement by weight) is Class G cement, which are both environmentally inert solids.

Discharge of slurry at a rate of 1.3m^3 per minute will generate a downward plume, initially at a velocity of 30-40cm/s. The discharge will consist of class C cement (upper hole sections) or class G cement (lower hole sections and well abandonment plugs), mixed with water with a total of 77.3 tonnes discharged. Other cementing additives included in the cement mixture are assumed to be dissolved or finely mixed into the mix water.

The discharges will occur after the cementing of each liner and casing and the installation of the well abandonment plugs. They will last no more than one hour each, and the discharge and dispersion plumes will therefore be completely separated in time.

The cement washout discharges were modelled during summer and winter conditions in order to establish the extent of any turbidity plume. Figures 6.5 illustrates the plan view of a plume from a typical individual washout discharge following the completion of a casing cementing activity 1-hour, 2-hours, 4-hours and 8-hours after the start of the discharge during summer conditions. The maximum dimension of the plume above 5 milligrams per litre (mg/l) (considered to represent background level) is approximately 600 m x 200 m two hours after the start of the discharge. The modelling indicates that the discharge plume will have completely dispersed to particulate concentrations of less than 5 mg/l within 3 hours 30 minutes during both summer and winter conditions and within a distance of 0.97 km (summer) and 0.60 km (winter). The modelling also indicates that no solids would be deposited on the seabed within the area of the model grid (10 km x 10 km).

Figure 6.6 is a cumulative plot showing all the areas affected by the successive cement discharges during summer conditions. In summer, it is predicted that the plume will remain closer to the surface where it is affected by wind effects and will tend to travel longer distances in linear paths. In the winter, the discharge reaches a deeper layer where the currents are much less variable, and a more concentric pattern of dispersion occurs. The area affected is up to approximately 6.7 km from the discharge point in summer and 5.3 km in winter. This is a result of the temperature assumption for the discharge and the prevailing metocean conditions, which show a strong thermocline at the surface in the summer, which together affect the depth at which the plume stabilises as it passes downwards through the water column. Full results of the modelling for discharges under both summer and winter conditions are presented in Appendix 6A.

Figure 6.5 Plan View of Cement Wash Out Dispersion Plume - Time Series of Typical Individual Discharge (Summer)

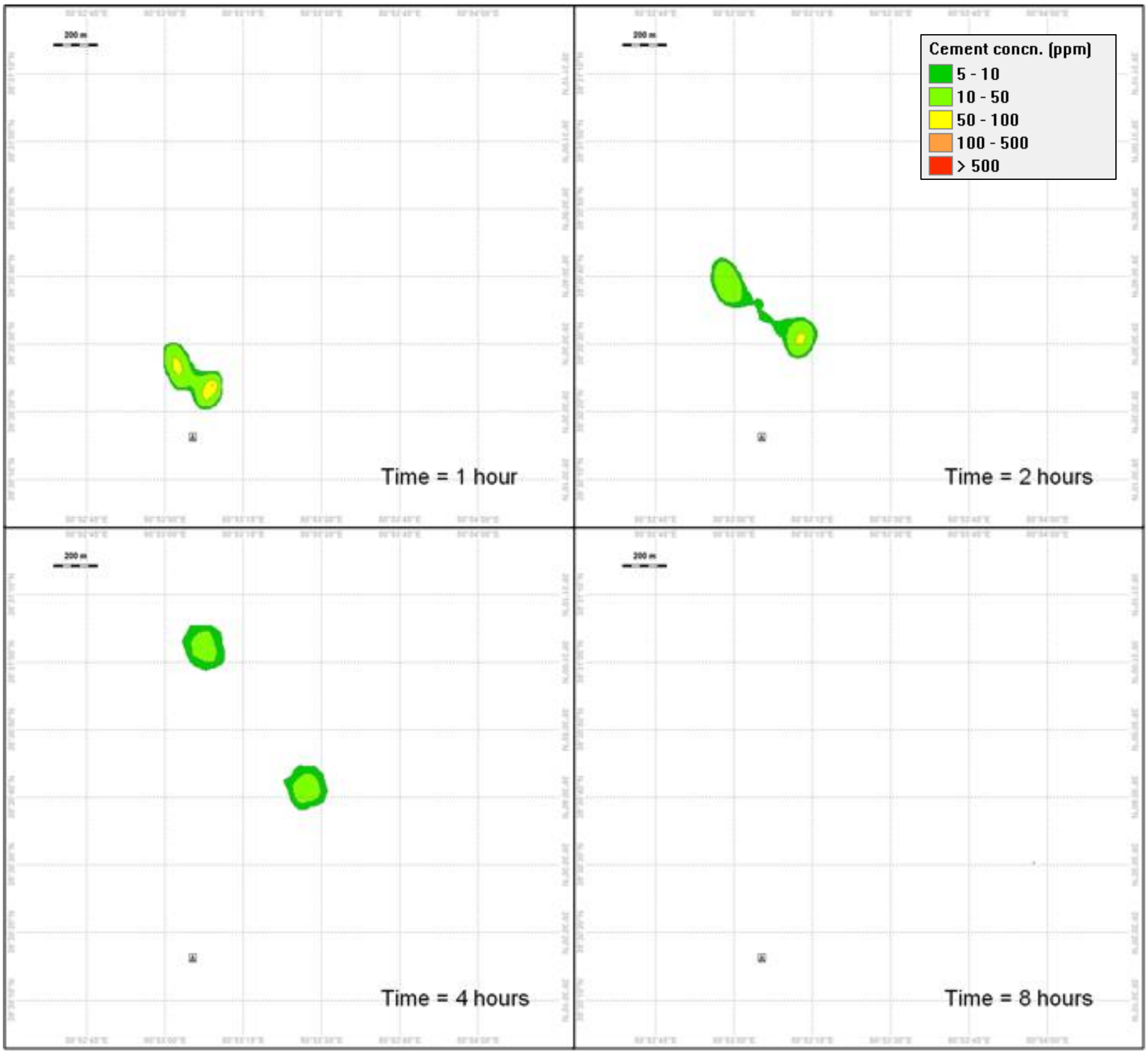


Figure 6.6 Plan View and Cross-Section of Cement Wash Out Dispersion Plume – Cumulative Discharges (Summer)

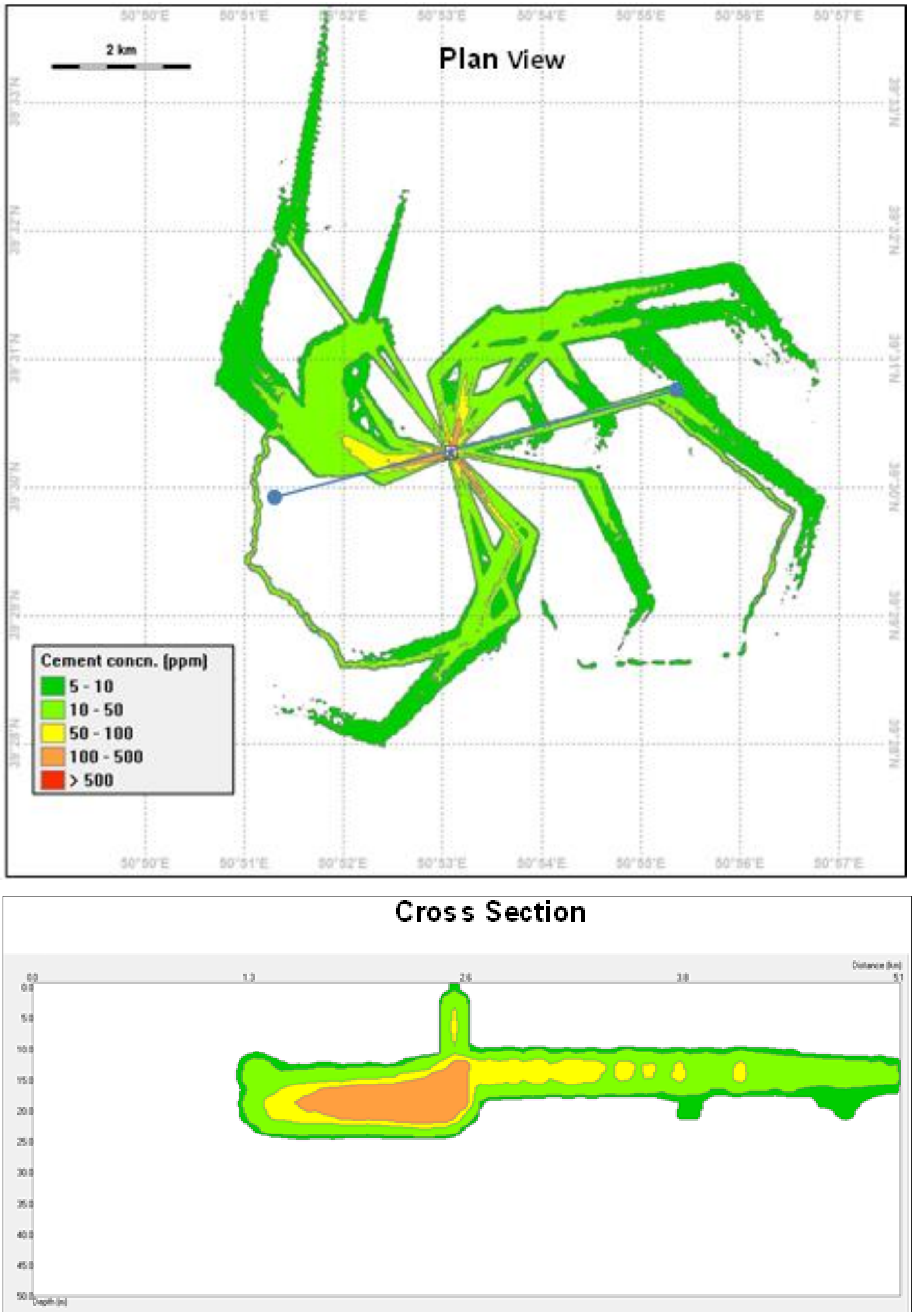
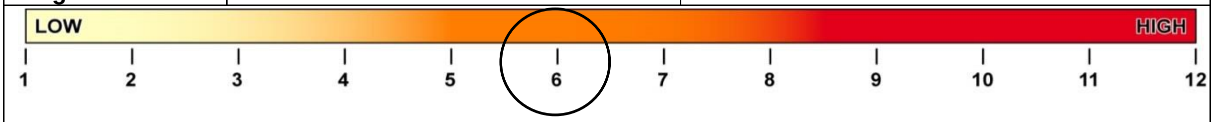


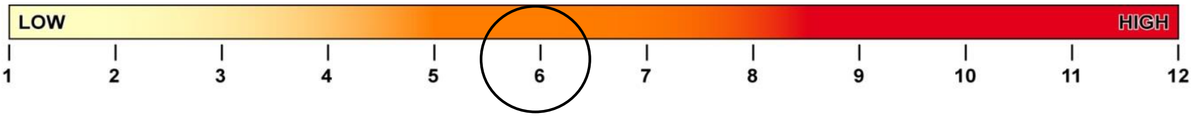
Table 6.18 presents the justification for assigning a score of 6 for cement discharges activities, which represent a Medium Event Magnitude.

Table 6.18 Event Magnitude

Event Parameter	Cement Discharges to Seabed	Cement Unit Wash Out Discharges
Extent/Scale	1	1
Frequency	2	2
Duration	1	1
Intensity	2	2
Event Magnitude:	**6**	**6**



Cement Discharges to Seabed



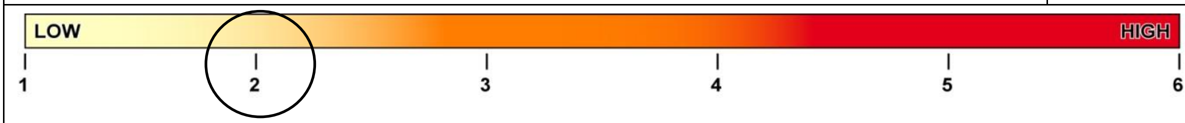
Cement Unit Washout Discharges

6.3.4.2 Receptor Sensitivity

With regard to cement discharges to the seabed, these will be confined to a small area of seabed immediately around the well and no chemical releases are anticipated. Consequently, the only biological receptor is the benthic community, however as described in Section 6.3.3.2 above the benthic invertebrate community at the Project location was found to be almost abiotic during the 2017 EBS. 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 6.19.

Table 6.19 Receptor Sensitivity (Benthic Invertebrates)

Parameter	Explanation	Rating
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 (very low presence of benthic organisms present).	1
Resilience	No rare, unique or endangered species at significant risk of exposure, receptor confined to benthic community close to well.	1
Total		**2**

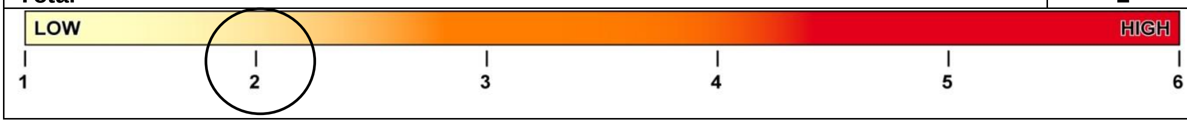


With regard to cement discharges associated with wash out, the discharge will form a limited plume extending no more than 600 m, comprising settling solids and soluble, low-toxicity chemicals. The quantity of solids is low compared to a WBM discharge, and will not cause significant turbidity or deposits 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 6.20 presents the justification for assigning a score of 2, which represents Low Receptor Sensitivity.

Table 6.20 Receptor Sensitivity (Seals and Fish/ Zooplankton/ Phytoplankton)

Parameter	Explanation	Rating
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 size and persistence.	1
Resilience	No rare, unique or endangered species at significant risk of exposure.	1
Total		**2**



6.3.4.3 Impact Significance

Table 6.21 summarises impacts to benthic invertebrates, seals and fish, zooplankton and phytoplankton associated with cement discharges to seabed and associated with the MODU cement unit washout discharges.

Table 6.21 Impact Significance

Event	Event Magnitude	Receptor Sensitivity	Impact Significance
Cement Discharges to Seabed	Medium	(Benthic Invertebrates) Low	**Minor Negative**
Cement Unit Wash Out 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 modelling predicts that no solids would be deposited on the seabed. Effects in the water column will be minor, and will be restricted to within a short distance (less than 1 km) from the point of discharge. Both solids and chemical dispersion plumes will disperse rapidly following cessation of discharge and prior to the commencement of the next washout discharge associated with the subsequent well section or well abandonment plug. Therefore no single discharge event will have a marked impact.

Monitoring and reporting requirements associated with cement discharges to the sea during MODU drilling activities include:

- Monitoring of potential effects on seabed and benthic communities will be carried out on completion of drilling activities and monitoring results will be submitted to the MENR; and
- The volume of cementing chemicals used and discharged will be recorded daily and included within the Environmental Report submitted to the MENR following well drilling and cementing activities.

These requirements are incorporated into the MODU HSE MS, which is aligned to the BP AGT Region EMS as described within Chapter 8: Section 8.3 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.

6.3.5 BOP Discharges

As described with Chapter 4: Section 4.7 a blowout preventer (BOP) will be installed on the well after the 22" casing has been installed to control pressure in the well.

6.3.5.1 Event Magnitude

Description

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 Chapter 4; Table 4.13. The anticipated discharges and duration of each event is detailed within Table 4.14. In total a discharge of 8934 litres of BOP fluid over a period of 16.2 minutes is estimated for each 2 pod test. Single pod testing results in discharges of 4467 litres. Each pod is tested on alternate weeks and two pod tests are undertaken every three weeks through the drilling programme.

The BOP fluid comprises a proprietary control fluid (Stack Magic ECO-F v2), ethylene glycol and water. The active components of Stack Magic ECO-F v2 and the typical proportions of this product, ethylene glycol and water in the BOP fluid as a whole are summarised in Chapter 4: Table 4.13. Since the proportions of components can vary, the impact assessment is based on the highest proportions of each.

Assessment

Toxicity tests were conducted on the proposed BOP fluid in 2014 using Caspian zooplankton, phytoplankton and sediment-dwelling species. Toxicity was assessed in the water column[27]. The results are summarised in Table 6.22.

Table 6.22 BOP Fluid Toxicity Test (2014)

Chemical	Water Column	
	Zooplankton 48h LC50 1 (mg/l)	Phytoplankton 72h EC502 (mg/l)
BOP Fluid (Water, Ethylene Glycol and Stack Magic ECO-F v2)	27060	2170

Notes:
1. LC_{50} - 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. EC_{50} - 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%.

In order to estimate 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). Consequently, the BOP fluid no-effect concentration is estimated to be 2706mg/l. To reach these concentrations, a discharge would require dilution of 380-fold.

For the ACE Project ESIA (Ref.1) the discharge of 2052 litres of BOP fluid to sea over a period of 13.8 minutes was modelled for summer and winter conditions, to enable the dimensions and persistence of the dispersion plumes to be quantified and visualised. The modelling conservatively assumed that the discharge would require a dilution of 500-fold to reach the no-effect concentration.

The modelling results for the ACE Project showed that the maximum extent of the 500-fold dilution plume area is approximately 28m long and 6m wide in summer while the discharge is anticipated to extend up to 20m in vertical height from the point of discharge. During winter conditions the modelling indicated that the plume will reach the 500-fold dilution requirement at approximately 21m from the discharge location with the width of the plume expected to be slightly larger (approximately 8m) than for summer conditions. The plume generated by the release of BOP fluids is assumed to be upwards and at slightly above ambient temperature, causing the plume to rise a short way in the water column. The modelling showed that under the stronger initial discharges the plume rises and extends further than for the weaker, subsequent discharges resulting in two distinct plume shapes appearing in the cross section. The plume extends approximately 25-30m in summer and winter before dispersing to below a factor of 500 with a slightly higher rise in winter due to the different ambient temperature profile. The plume is completely dispersed to below a factor of 500 within two minutes after the end of the discharge, and there is a total period of 15 minutes during which the water column contain BOP fluids diluted by less than a factor of 500.

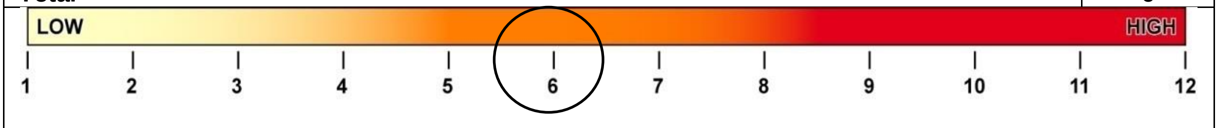
The overall volumes of fluids released by the BOP during the Project drilling programme are similar to those modelled and assessed for the ACE Project ESIA (as described above), and subsea BOP fluids have a relatively standard composition across offshore drilling operations. The majority of the dispersion occurs in the near-field turbulent mixing zone on release from the valve, where the momentum of the release is dissipated and the fluid is rapidly diluted with surrounding seawater. This initial mixing zone depends on the amount of energy in the release which, is strongly related to its exit velocity. By comparing the Project BOP releases with the ACE Project releases modelled, the Project individual releases are slightly larger in volume but also significantly shorter in duration, which means velocities will be higher and the degree of turbulent mixing higher. This will act to balance the additional dilution required to reduce the slightly larger volume to the no-effect level. For both the ACE and Project locations, the seabed currents are low enough to allow a stable dispersion plume to form, and average currents are lower at the Project location due to the much greater water depth (water depths are 137 m at ACE location and 624 m at Project location). This means that the plume will have a longer time to dilute with distance away from the release point at the Project location compared to the ACE location. Given the greater exit velocity and weaker currents, it is therefore anticipated that the areas affected by the release of BOP fluids during the Project BOP testing discharges are no larger than those predicted for the ACE Project, with greater upward motion of the plume away from the seabed.

The components of the BOP control fluid and ethylene glycol are all readily degradable, and the products have been assigned a HOCNS category D and E (rated A-E where E is the least environmental harmful). Taking into account both the limited area of potential impact and the very short duration, BOP fluid discharges is considered to be a low intensity activity.

Table 6.23 presents the justification for assigning a score of 6, which represents a Medium Event Magnitude.

Table 6.23 Event Magnitude

Parameter	Explanation	Rating
Extent/Scale	Affects a small area from source (estimated to be less than 60 m in summer based on modelling conducted for the ACE Project ESIA).	1
Frequency	Discharge will occur weekly for duration of the drilling programme.	3
Duration	Discharge from each weekly test will last for approximately 16.2 minutes.	1
Intensity	Low intensity.	1
Total		**6**



6.3.5.2 Receptor Sensitivity

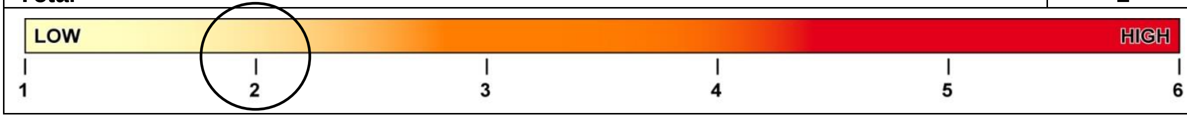
The discharges will take place approximately 8 m above the seabed. Seals are not considered at risk of exposure due to the small size of the area of potential impact and the fact that dermal contact at the dilutions modelled would be very limited. Fish and zooplankton are most likely to be exposed, but 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 given the depth.

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 6.24 presents the justification for assigning a score of 2, which represents Low Receptor Sensitivity.

Table 6.24 Receptor Sensitivity (All Receptors)

Parameter	Explanation	Rating
Presence	Exposure is low and of short duration, so resilience is, in effect, high.	1
Resilience	No significant presence of rare, unique or endangered species.	1
Total		**2**



6.3.5.3 Impact Significance

Table 6.25 summarises the impact of BOP fluid discharge to sea on seals, fish, zooplankton, phytoplankton and benthos.

Table 6.25 Impact Significance

Event	Event Magnitude	Receptor Sensitivity	Impact Significance
BOP 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, phytoplankton and benthos are predicted from BOP fluid discharge during the drilling programme.

Monitoring and reporting requirements associated with BOP discharges include:

- BOP fluid sampling will be undertaken at least once during the drilling programme and ecotoxicity testing, involving phytoplankton and zooplankton, will be implemented.

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.

6.3.6 Cooling Water Intake and Discharge

Cooling water will be continuously uplifted and discharged from the MODU during the drilling activities.

6.3.6.1 Event Magnitude

Description

The Heydar Aliyev MODU is designed to lift seawater at a rate of up to 2250 m^3 per hour (2 pumps operating at a time) with water lifted from a depth of approximately 18 m depending on the draft of the MODU. Cooling water will be discharged at a rate of up to 2250 m^3 per hour via a caisson 15 m below sea level and at a maximum temperature of 29°C (during summer). The system is designed to discharge cooling water at a temperature of 2 to 4°C greater than the intake temperature.

The MODU cooling system is protected by a standard anodic biofouling and corrosion control system These systems typically result in very small concentrations of metal ions (e.g. copper, iron, aluminium) being introduced into the seawater at levels significantly below predicted no effect concentrations.

Assessment

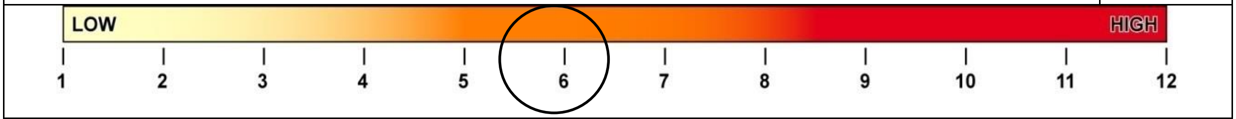
The MODU cooling water intake velocity will be low and screens installed on the cooling water intake will prevent fish entering the cooling water system.

Modelling of the cooling water discharges (refer to Appendix 6A) was undertaken for worst case low and high current velocity cases for both summer and winter conditions to predict plume behaviour under varying metocean conditions. With regard to the extent of the plume the results were reviewed to establish at what distance from the discharge point the temperature at the edge of the plume was less than 3°C of the ambient temperature for summer and winter conditions, under both high and low current conditions. The modelling shows that the majority of the heat loss takes place within a few metres of the discharge with the plume first descending and then rising and there is no point at which there is a zone where the temperature is raised by 3°C in any of the scenarios modelled. The modelling shows that, under high current conditions, the plume predicted is more elongated and shallower than the plume formed during low currents.

Table 6.26 presents the justification for assigning a score of 6, which represents a Medium Event Magnitude.

Table 6.26 Event Magnitude

Parameter	Explanation	Rating
Extent/Scale	There is no point at which there is a zone where the temperature is raised by 3°C.	1
Frequency	Once.	1
Duration	Discharge will occur continuously during drilling activities.	3
Intensity	Low intensity.	1
Total		**6**



6.3.6.2 Receptor Sensitivity

While the MODU cooling water intake will be fitted with a screen to prevent fish entering the cooling water system, plankton will, however, be entrained due to their small size. The area and volume of water within which any potentially harmful exposure might occur is limited to within the first few metres of the intake and hence impacts are expected to be insignificant to the water column.

With regard to the cooling water discharge, the modelling showed that there is no point at which there is a zone where the temperature is raised by 3°C in any of the scenarios modelled and the maximum temperature increase predicted is 1.9°C during summer conditions for the high current velocity case. Therefore, it is considered that the cooling water discharge is not likely to cause harmful exposure to marine organisms although it may provoke an avoidance reaction in fish and seals (although the probability of an encounter with the plume for either group is very low based on their expected presence and the plume dimensions).

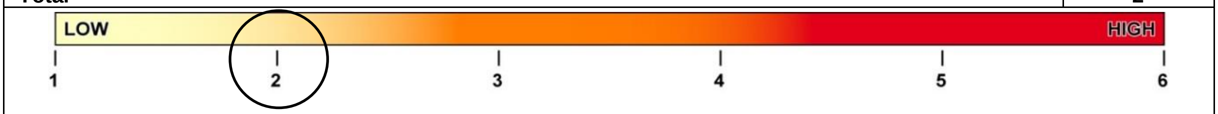
For all plankton, interaction with the discharge plume depends on entrainment from the surrounding water and the process will ensure that individual plankton organisms do not remain in the discharge plume for more than a few tens of seconds.

The cooling water discharge takes place 15 m below the sea surface and therefore does not have the potential to interact with benthic invertebrates.

Table 6.27 presents the justification for assigning a score of 2, which represents Low Receptor Sensitivity.

Table 6.27 Receptor Sensitivity (All Receptors)

Parameter	Explanation	Rating
Presence	Exposure is negligible, so resilience is, in effect, high.	1
Resilience	No significant presence of rare, unique or endangered species.	1
Total		**2**



6.3.6.3 Impact Significance

Table 6.28 summarises the impact of cooling water discharges to sea on seals and fish, zooplankton and phytoplankton.

Table 6.28 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. Therefore, no additional mitigation beyond existing control measures is deemed to be necessary.

6.4 Socio-Economic Impacts

The Project is predominantly an offshore development and all routine support and logistics required for the Project will use existing operational onshore infrastructure capacities. As such, employment opportunities will be lower than those of other oil and gas developments in the region and impacts predicted to marine users are negligible. Table 6.1 provides justification for the scoping out of all potential socio-economic impacts from the full assessment.

6.5 Summary of Environmental and Socio-Economic Impacts

	Event/ Activity	Magnitude				Sensitivity		Overall Score		
		Extent/ Scale	Frequency	Duration	Intensity	Human	Ecological	Event Magnitude	Receptor Sensitivity	Impact Significance
Marine Environment	Underwater Sound (MODU Drilling)	1	1	3	1	-	2	Medium	Low	Minor Negative
	Underwater Sound (Vessel Movements)	1	1	3	1	-	2	Medium	Low	Minor Negative
	Drilling Discharges to Sea	1	2	2	1	-	2	Medium	Low	Minor Negative
	Cement Discharges to Seabed	1	2	1	2	-	2	Medium	Low	Minor Negative
	Cement Unit Wash Out Discharges	1	2	1	2	-	2	Medium	Low	Minor Negative
	BOP Testing	1	3	1	1	-	2	Medium	Low	Minor Negative
	MODU Cooling Water Discharges to Sea	2	1	3	1	-	2	Medium	Low	Minor Negative

6.6 Glossary of Acoustic Terminology

Term	Description
Ambient sound	Background environmental noise not of direct interest during a measurement or observations.
dB	Decibel, unit used in the logarithmic measure of sound strength. The decibel expression for a sound pressure level is = 20 log {p(t)/p0}, where p0 is a reference pressure of 1 µPa (micropascal) and p(t) is the instantaneous pressure at time t .
dBpeak	Peak sound pressure over the measurement period, expressed in dB re 1 µPa.
dBpeak-peak	Minimum to maximum peak sound pressure over the measurement period, expressed in dB re 1 µPa.
dBrms	Root mean square sound pressure over the measurement period, expressed in dB re 1 µPa.
Hz	Hertz. The number of cycles per second and refers to the frequency of the particular sound.
M-weighting	Frequency weightings designed to best reflect the hearing sensitivity of marine mammals, similar to the use of the A-weighting for measuring sound impacts on humans.
PTS	Permanent Threshold Shift. Irreversible and permanent reduction in auditory sensitivity.

Term	Description
SEL	Sound Exposure Level. Sound energy over the measurement period expressed in dB re 1 µPa2s. SEL is commonly used for impulsive underwater sound sources because it allows a comparison of the energy contained in impulsive signals of different duration and peak levels. The measurement period for impulsive signals is usually defined as the time period containing 90% of the sound energy.
SELcum	Cumulative Sound Exposure Level. Summation of the sound energy of multiple impulsive or transient signals over a defined assessment period expressed in dB re 1 µPa2s i.e. SELcum = SEL + 10 log (number of events or time of exposure).
SPL	Sound Pressure Level. The sound pressure averaged over the measurement period, expressed in dB re 1 µPa; applicable to peak, peak-peak and rms sound pressure levels.
SL	Source Level. The intensity of underwater sound sources is compared by their source level, expressed in dB re 1 µPa at 1 m for peak, peak-peak and rms sound pressure levels, and dB re 1 µPa2s for SEL. The source level is defined as the sound pressure (or energy) level that would be measured at 1 metre from an ideal point source radiating the same amount of sound as the actual source being measured. Where a source level is defined, the sound level indicator will be denoted with '-m' i.e. dBrms re. 1µPa-m, dBpeak re. 1µPa-m, or dBSEL re 1µPa2s-m.
TTS	Temporary Threshold Shift. Short-term reversible reduction in auditory sensitivity. TTS will be gradually reversed upon removing exposure to the high sound levels that cause the change in hearing sensitivity.

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7 Cumulative and Transboundary Impacts and Accidental Events

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7.1 Introduction

This Chapter of the Shafag-Asiman (SAX01) Exploration Drilling Project Environmental and Socio-Economic Impact Assessment (ESIA) discusses:

- Cumulative and Transboundary Impacts; and
- Accidental Events that could potentially occur during the Project activities and the control, mitigation and response measures designed to minimise event likelihood and impact.

A detailed assessment of Project environmental and socio-economic impacts, based on expected activities and events, is presented in Chapter 6 of this ESIA.

7.2 Cumulative and Transboundary Impacts

As discussed within Chapter 3, cumulative impacts can arise from:

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

Transboundary impacts are impacts that occur outside the jurisdictional borders of a project's host country.

7.2.1 Approach to the Cumulative Assessment

The approach taken to assessing cumulative impacts between individual Shafag-Asiman (SAX01) Exploration Drilling Project (henceforth referred to as the "Project") impacts focuses on assessing the potential temporal and geographic overlap between environmental impacts based on the current schedule (refer to Chapter 4: Section 4.2) and the results of modelling assessments demonstrating the expected geographic extent of the impacts (refer to Chapter 6).

The cumulative assessment takes into account each activity and the existing controls and additional mitigation measures identified to minimise and manage impacts. An analysis of the potential for these impacts to overlap and result in additive or synergistic effects within the marine environment and socio-economic environment is presented in Sections 7.2.2 and 7.2.3 below with potential cumulative and transboundary impacts associated with emissions to atmosphere discussed in Section 7.2.4.

The potential for cumulative impacts with other planned projects[28] has been determined based on a review of available information and taking into account geographic and temporal scope of the individual project impacts and hence the potential to result in cumulative impacts in combination with the Project impacts.

Due to the location of the proposed SAX01 well and the nature of the Project activities the only project which has been identified as being potentially significant source in terms of giving rise to cumulative impacts is the operation of Shah Deniz Stage 2 (SD2) Project. While SD2 Project operations and first gas commenced in Q4 2018 the potential effects of the SD2 Project are not captured within the existing baseline conditions described in Chapter 5 against which the Project impacts have been assessed. Therefore, for the purposes of this ESIA, the SD2 Project activities and impacts have been considered within the Project assessment.

[28] The cumulative assessment does not take into account projects or facilities that are operational where their effects are captured within the existing baseline against which the Project impacts have been assessed. The assessment is focused on other proposed BP projects within the vicinity of the proposed Project or those not operational when the baseline was established.

7.2.2 Cumulative Impact between Separate Shafag-Asiman Exploration Drilling Project Impacts

Within the water column there is limited potential for the drilling and rig discharges (e.g. drill cuttings and cooling water discharges) to interact given the temporal and spatial differences between the discharge events and locations. As discussed within Chapter 6 Section 6.4 of this ESIA deposition of drill cuttings, seawater, sweeps, WBM and cement washout is predicted to primarily occur within 200m – 1km of the source. Cooling, grey and black water will be discharged continuously throughout the MODU operations, however each discharge will make a small incremental contribution to the overall Project discharge volume. The total volume of discharge represents a very small fraction of the assimilative capacity of the Contract Area. All of these discharges will be dispersed and diluted to concentrations below the threshold of impact within (at most) a few hundred metres of the source and therefore have no potential for cumulative impacts. Control measures to mitigate impacts to the marine environment from discharges associated with drilling the SAX01 well and associated reporting requirements are detailed within Chapter 6 of this ESIA.

Due to the nature of the predicted residual impacts from the Project, the potential for individual Project activities to interact synergistically or in-combination and result in cumulative impacts on the receiving environment is considered very unlikely.

7.2.3 Cumulative Impact with Other Projects

In general, potential impacts from the Project are expected to be of short duration and concentrated mostly within a few hundred metres to a few kilometres of the proposed SAX01 well location. However, the potential for cumulative environmental and socio-economic impacts arising from the Project in combination with the SD2 Project are considered below.

The SD2 Project comprises the fixed Shah Deniz Bravo (SDB) platform complex, drilling and completion of 26 wells, subsea infrastructure tied back to the SDB platform and subsea export pipelines to the Sangachal Terminal. The wells associated with the SD2 Project are located in five clusters around the SD Contract Area and will all be drilled using a Mobile Offshore Drilling Unit (MODU). The wells are tied into a manifold which are tied into the SDB platform complex using flowlines. The SDB platform complex is located approximately 65 km north of the proposed SAX01 well location. The nearest well cluster, east south (ES), is located approximately 50 km from the SAX01 well location.

The SD2 Project construction and installation activities are complete and first gas from the platform commenced in Q4 2018 with wells to date drilled and completed at two well clusters; northern flank (NF) and western flank (WF). Ongoing SD2 Project activities include the drilling and completion of a number of other SD2 wells and installation of remaining subsea infrastructure within the SD Contract Area (including manifolds and flowlines).

Marine Environment

Based on the findings of the SD2 Project ESIA (Ref.1), SD2 offshore activities resulting in potential impacts to water column and seabed, such as the discharge of water based muds (WBM) and cuttings, underwater sound and discharge of cooling water, were predicted to result in minor and localised impacts with magnitude limited to no more than a few kilometres from the drilling rig, project vessel, platform or subsea installation. Given the scale of the impacts anticipated and the distance between the Project activities and any future development within the SD Contract Area, it is considered very unlikely there will be cumulative impacts within the marine environment between the Project and SD2 Project planned activities.

Socio-Economic Environment

It is considered that the potential socio-economic cumulative impacts to other marine users such as fishing and shipping that may arise as a result of the Project in combination with the SD2 Project (where construction and installation activities are largely complete) will be very limited and insignificant. This is due to the short-term duration of the Project activities and that the proposed SAX01 well is not located in an area of importance to small-scale or commercial fishing nor is it located near known major shipping routes.

7.2.4 Transboundary Impacts Associated with Non Greenhouse Gas and Greenhouse Gas Atmospheric Emissions

Transboundary impacts are those that may affect countries other than the country in which a project will be developed. The potential transboundary impacts associated with the Project activities are considered to be limited to emissions, particularly greenhouse (GHG) emissions which contribute to the global greenhouse effect.

7.2.4.1 Non Greenhouse Gas Atmospheric Emissions

The potential for transboundary impacts associated with non GHG emissions are dependent 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 nitrogen dioxide (NO_2). It has been demonstrated that emissions associated with Project activities are not expected to result in any discernible 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.

The volumes of emissions released (including visible particulates) due to the 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 discernible to biological/ecological receptors. Sulphur dioxide (SO_2) emissions will be minimised through the planned use of low sulphur diesel. The contribution of the Project SO_2 emissions to acid rain generation is therefore expected to be insignificant.

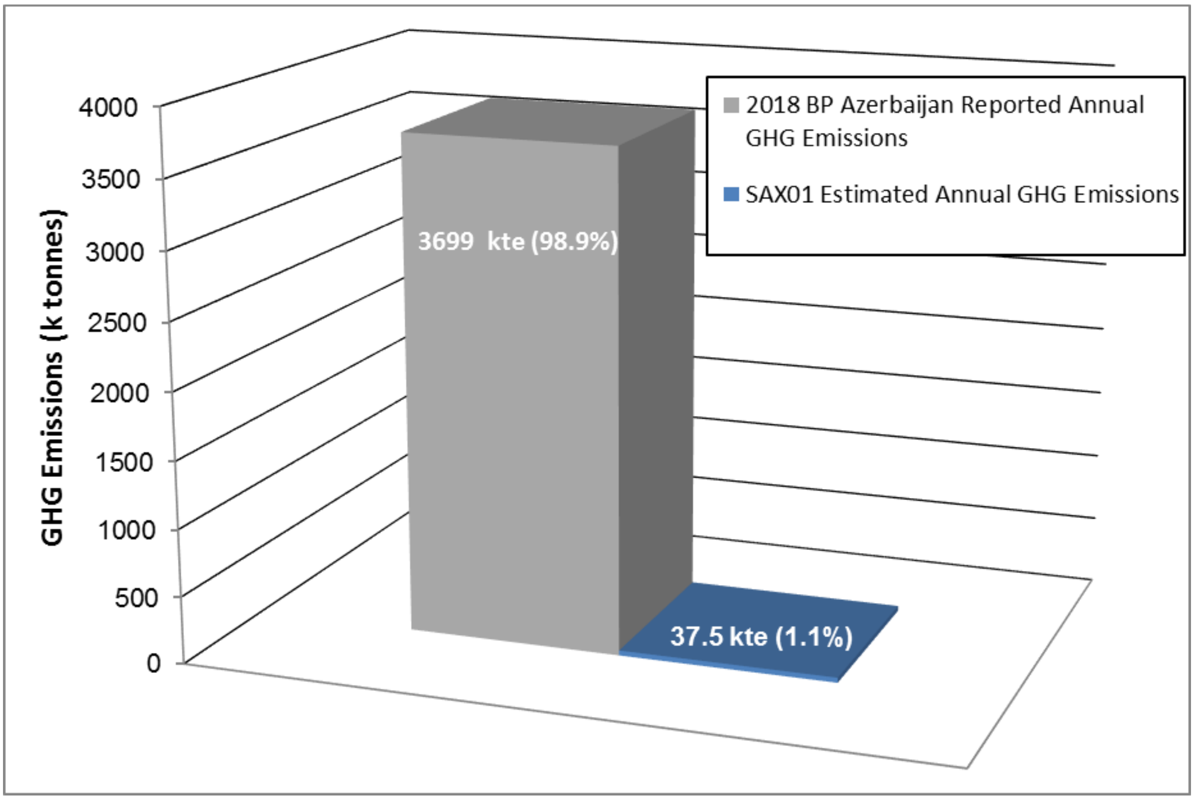
7.2.4.2 Greenhouse Gas Atmospheric Emissions

The estimated volume of GHG emissions (carbon dioxide and methane) generated by the proposed Project activities are presented in Chapter 4: Table 4.15 of this ESIA.

Figure 7.1 presents the estimated volume of the Project activities total GHG emissions compared with the annual BP Azerbaijan operations emissions volumes reported in 2018 (Ref.2). Figure 7.1 demonstrates that the Project will represent approximately 62.8 kilotonnes (ktonnes) (equating to approximately 1.1%) of the annual operational GHG emissions from BP's upstream activities in Azerbaijan (based on 2018 reported GHG emissions data).

The most recently published GHG emissions data for Azerbaijan estimated a total of 61842 ktonnes of GHG emissions were emitted in 2013; 80% of which was estimated to be generated by the energy sector (Ref. 3). As a proportion, the estimated GHG emissions for the Project activities are expected to account for approximately 0.1% of the national total GHG emissions based on the 2013 data.

Figure 7.1 Estimated SAX01 Annual GHG Emissions Compared to Reported 2018 BP Azerbaijan Annual GHG Emissions



7.3 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. High operational performance and compliance with good industry practices will be maintained at all times by BP and their contractors. However, as with most projects of this nature, a low probability of an accidental event does exist.

Potential accidental events that may result in potentially significant environmental impacts during the Project have been identified and include:

- Vessel collision with other marine users;
- Release of chemicals/waste from the Project vessels; and
- Hydrocarbon spills (e.g. small spills resulting from refuelling, large spill of marine diesel resulting from a vessel collision or well blowout of condensate).

7.3.1 Vessel Collision

As described in Chapter 5: Section 5.8.3 the Project is located outside of the main shipping routes. Shipping activities in the waters of the Southern Caspian Sea include some commercial trade, passenger, scientific and supply vessel operations to the offshore oil and gas industry. A range of maritime and navigation safety measures outlined in Chapter 6: Table 6.1 are expected to minimise the risk of collision. The likelihood of a collision between Project and other vessels is considered to be very low given the preventative measures in place. However, in the event of a collision there is the potential for significant impacts on other marine users and infrastructure depending on the scale and nature of the collision.

7.3.2 Release of Chemicals / Waste

A number of chemicals and drilling fluids to support the drilling operation (e.g. drilling mud chemicals) will be stored on board the MODU and transported by the support vessels. In addition, chemicals for cleaning and maintenance purposes, e.g. cleaning fluids, will be used on board the vessels throughout the drilling programme. All chemicals on the vessels will be labelled and stored appropriately in areas with secondary containment. Waste generated during the Project will be managed in accordance with the existing BP AGT Region management plans and procedures.

The likelihood of an accidental release of chemicals or waste to the marine environment is considered to be very low assuming the control mitigation measures are implemented as set out in Chapter 6: Section 6.3. In the unlikely event of loss of containment and release of hazardous substances overboard, the BP AGT Region spill reporting procedures described within Section 7.3.4.3 will be followed.

With regard to drilling fluids, accidental events are limited to potential spills and also potential releases that may occur during drilling as a result of unexpected downhole conditions, for example, in the event displacement of the top hole sections using WBM is deemed necessary should shallow water flows be encountered and the WBM is released to the seabed. The likelihood of these events occurring is low. Any accidental release of drilling fluids (including from unplanned displacement activities) will be reported in accordance with the BP AGT Region spill reporting procedures.

7.3.3 Hydrocarbon Spills and Releases

Potential accidental discharges of hydrocarbons that may lead to pollution of the marine environment during the proposed Project include:

- Spills during vessel collision, fuel tank failure, fire or explosion; and
- Well blowout of condensate following loss of well control.

The resulting potential discharges can be broadly categorised as follows:

- Spill of diesel from the MODU or support vessels; and
- Major spill of condensate from a well blowout.

7.3.3.1 Spill of Marine Diesel

As described in Section 7.3.1 the likelihood of a vessel collision occurring during the Project is considered to be very low. Analysis of water transport accident statistics by the International Association of Oil & Gas Producers (IOGP) (Ref.4) shows that ship to ship collisions represent 12% of total ship losses and that the likelihood of this occurring is extremely low. The likelihood that such an incident would result in a loss of the vessel's fuel inventory is even lower, as a high-energy collision would be required to damage a vessel to such an extent that fuel tank integrity is compromised releasing its content into the sea.

Fuel on vessels is typically stored in a series of small tanks which are double bottomed and connected by valves and it is unlikely that contents of all the tanks would be lost simultaneously in the event of a collision. The MODU will be equipped with diesel tanks to provide fuel for onboard use. As described in Chapter 4: Section 4.4 the MODU to be used to drill the proposed SAX01 exploration well is yet to be confirmed. However, for the purposes of the ESIA the largest MODU diesel tank capacity (Heydar Aliyev) of 1500 cubic metres (m^3) has been assumed. In the unlikely event of a release of the full MODU diesel tank inventory the diesel will spill overboard. A description of the MODU diesel tank spill scenario and the modelling undertaken to predict the potential impact of the spill is presented in Section 7.3.3.6.

7.3.3.2 Well Blowout Scenario

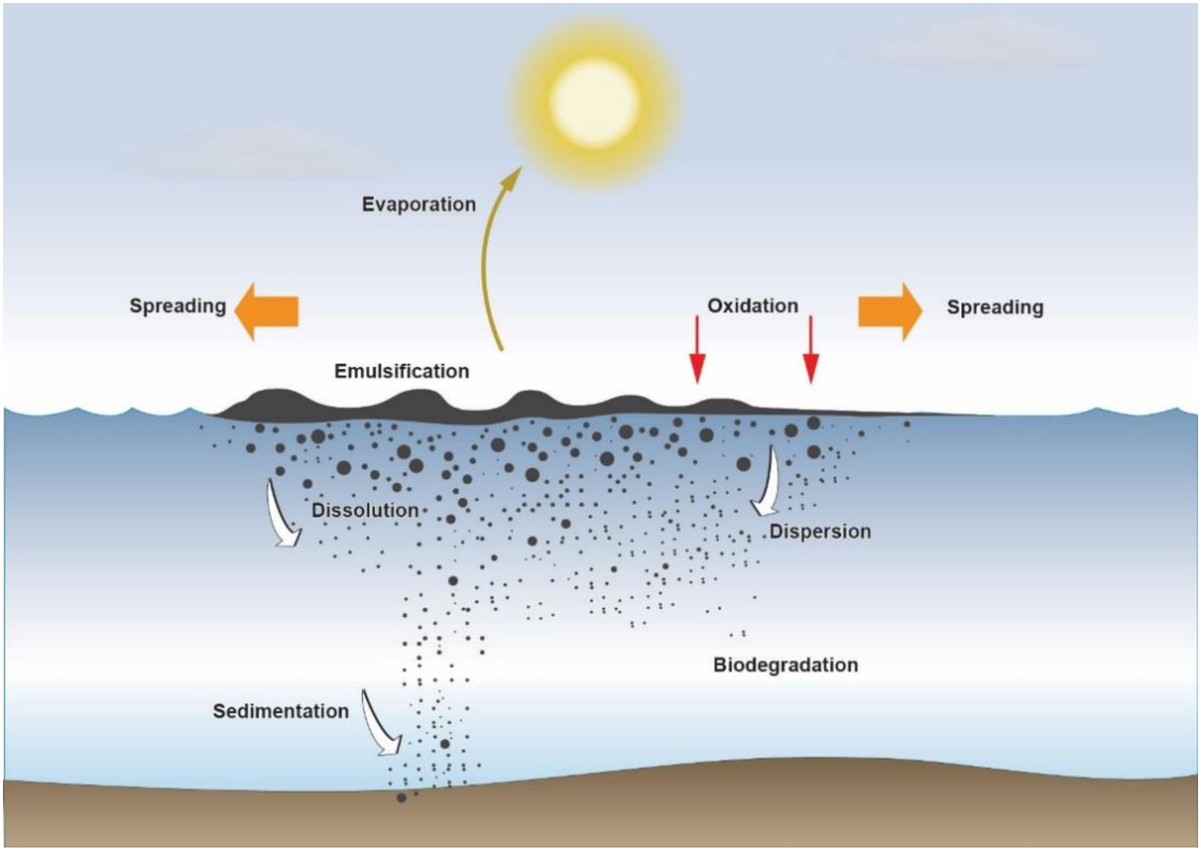
A well blowout, as a consequence of loss of well control, is an uncontrolled influx of liquids or gas from the formation into the wellbore which may result in an uncontrolled release into the environment. This influx can either be oil, gas / condensate, water or a combination of liquids and gas. Well blowout is considered to be the worst case scenario for oil and condensate spills.

Well blowouts are very low probability but high consequence events, which occur where all primary and secondary control failures occur together. A review of wells drilled in the period 2000-2015 in regulated countries across the world found that the probability of a well blowout that would result in a spill of 500 barrels or more of oil is 1 blowout per 3985 wells drilled (0.025% per well drilled) for exploration wells and 1 blowout per 14,444 wells drilled (0.007% per well drilled) for development wells, respectively (Ref.5). Similarly, a review conducted by the International Association of Oil and Gas Producers (IOGP) found a blowout occurs in approximately 1 out of every 4000 exploration wells operated at North Sea standards and 1 out of every 588 exploration wells operated at non-North Sea standards (Ref.6). A description of a potential blowout scenario of the SAX01 exploration well and the modelling undertaken to predict the potential impacts of the blowout is presented in Section 7.3.3.6.

7.3.3.3 Fate of Hydrocarbons in the Marine Environment

The key processes that govern the fate of hydrocarbons at sea are shown in Figure 7.2. When oil and condensate is released into the marine environment it undergoes a number of physical and chemical changes as a result of evaporation, dissolution, dispersion, emulsification, sedimentation, photo-oxidation and bio-degradation processes, collectively known as weathering. These changes are dependent upon the type and volume of hydrocarbons spilt and the prevailing weather and sea conditions.

Figure 7.2 Weathering Processes Acting on Spilled Crude Oil and Condensates



Marine Diesel

Diesel fuel is a light, refined petroleum product, and what is commonly referred to as "marine diesel" is a blend of gasoil and heavy fuel oil with a low viscosity (up to 12 centistokes (cSt)/400°C). When spilled on water, diesel fuel spreads very quickly to a thin film of rainbow and silver sheens, whereas marine diesel may form a thicker film of dull or dark colours and persist on the surface for longer.

Evaporation and dispersion are the two main mechanisms that act to remove diesel type fuels from the sea surface, whilst oxidation and biodegradation break down hydrocarbons into basic elements over a longer time period. Marine diesel is readily dispersed into the water column when wind speeds reach 5 to 7 knots, or the sea state is approximately Force 2 Beaufort scale or higher. It is much lighter than water, therefore it is not possible for the diesel to sink and accumulate on the seabed as pooled or free oil. However, diesel may be physically mixed into the water column by wave action, forming small droplets that are carried and kept in suspension by the currents. Diesel dispersed in the water column can adhere to suspended sediments, which then settle out and are deposited on the seabed. This process is more likely to occur in near shore areas or river estuaries rather than in the open marine environment.

Compared to unrefined crude oils, marine diesel is not sticky or viscous. When stranded on the shoreline, diesel tends to penetrate porous sediments quickly whereas if it is deposited on hard surfaces, it will be quickly washed off by wave action. In terms of toxicity to marine organisms, diesel is considered to be one of the most acutely toxic oil types (Ref.7).

Condensate

The main physical characteristics that affect the behaviour and persistence of an oil and condensate spill at sea includes specific gravity, vapour pressure, distillation characteristics, viscosity and pour point. The chemical composition of the oil or condensate, such as the proportion of volatile components and the content of waxes, will also affect the behaviour of the oil and condensate. Spilled condensates behave in a similar way to spilled crude oils with some exceptions. The major processes contributing to oil and condensate weathering behaviour are:

- **Loss of more volatile oil components by evaporation:** Spilled crude oils and condensates spilled at sea will rapidly spread out to form thin slicks on the sea surface. The more volatile components in the oil/condensate then evaporate at a rate proportional to their individual volatilities (associated to boiling points) and the prevailing water temperature. The loss of these hydrocarbon fractions decreases the volume of oil or condensate that remains on the sea surface. Crude oils with a higher proportion of volatile components will decrease in volume more than crude oils that contain less volatile components. Condensates generally contain a higher proportion of volatile components than most crude oils and therefore lose a greater proportion of their volume by evaporation into the air. Evaporation slows and eventually stops as the volatile components are progressively lost. The residue that remains at sea will have a higher viscosity than the original condensate, because the volatile components that are lost by evaporation are of lower viscosity than the residue that remains on the sea surface.
- **Incorporation of water into the oil to form water-in-oil emulsions:** Condensates do not contain asphaltenes and they will therefore not precipitate and stabilise water-in-oil emulsions. Weak water-in-oil emulsions can be formed by precipitated waxes at low temperatures; however, condensates will spread faster than heavier oils on the sea surface resulting in smaller film thicknesses that retard the formation of water-in-oil emulsions. In addition, thin oil slicks tend to be more rapidly broken down by wave action.
- **Natural dispersion:** Natural dispersion is driven by breaking waves. As a breaking wave crest passes through the oil or condensate slick, the oil or condensate is broken into droplets of various sizes and pushed into the water column. The larger droplets rapidly float back to the surface, but the very smallest oil droplets are retained in the water column by the prevailing turbulence. The rate of natural dispersion is driven by the prevailing sea state and limited by the viscosity of the emulsified oil; rough seas cause a high rate of natural dispersion, but high emulsified oil viscosity resists this process. Condensates that are liquid at the prevailing temperature will form smaller droplets than heavier oils and will be readily dispersed by the action of breaking waves, but the semi-solid, waxy residue that remains after the evaporation of the more volatile components will be more resistant to natural dispersion.

The relative rates of evaporation, water-in-oil emulsification and natural dispersion depend on the prevailing oceanographic conditions (temperature, wind speed and sea state) and on the properties of the spilled oil or condensate (as described by the boiling point curve, density, viscosity and asphaltene content).

7.3.3.4 SAX01 Condensate Properties

Since condensate has yet to be produced from the Shafag Asiman target reservoir locations, no condensate has been available for characterisation. However, the gas/condensate resource targeted is anticipated to be similar to the condensates produced from the various reservoirs discovered at the nearby SD2 Project, as described in the SD2 Project ESIA (Ref.1). The SD2 Project condensates have relatively high wax contents and Pour Points, ranging from +3°C to +12°C.

This condensate can be understood as a mixture of very light, dispersible oil and a much waxier fraction with divergent properties. When released at ambient temperatures, this wax fraction precipitates and separates from the lighter condensate.

Stiftelsen for Industriell og Teknisk Forskning (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. 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.

For the purposes of this ESIA and the modelling results presented in Section 7.3.3.6 below, the SDX-05Y condensate characteristics have been used as an analogue condensate for the SAX01 exploration well. The key characteristics of SDX-05Y condensate based on the results of the SINTEF weathering study are presented in Table 7.1.

Table 7.1 Physical Characterisation of the SDX-05Y Condensate

Property	Value	Notes
Name of oil type	Shah Deniz 2: Wax depleted phase (WD) Wax enriched phase (WE)	Oil type identified by BP as a match for the SAX01 well
Specific gravity	0.811 (WD)0.811 (WE)	Oil is buoyant and classed as Group II by ITOPF
Pour Point	9 °C (WD) 33 °C (WE)	Oil is liquid above the pour point. The oil is likely to be initially liquid at ambient Caspian Sea temperatures, but wax particles will quickly form. The condensate phase will spreads on the sea surface along with associated wax particles.
Viscosity	36 centipoise at 13 °C (WD) >500,000 centipoise at 13 °C	Oil is initially relatively low viscosity and flows readily, although wax particles will quickly form which are solid
Asphaltene content	0.0% (WD) 0.0% (WE)	The oil has potential initially to form an emulsion. The emulsion is not stable and breaks down according to CEDRE (2012).

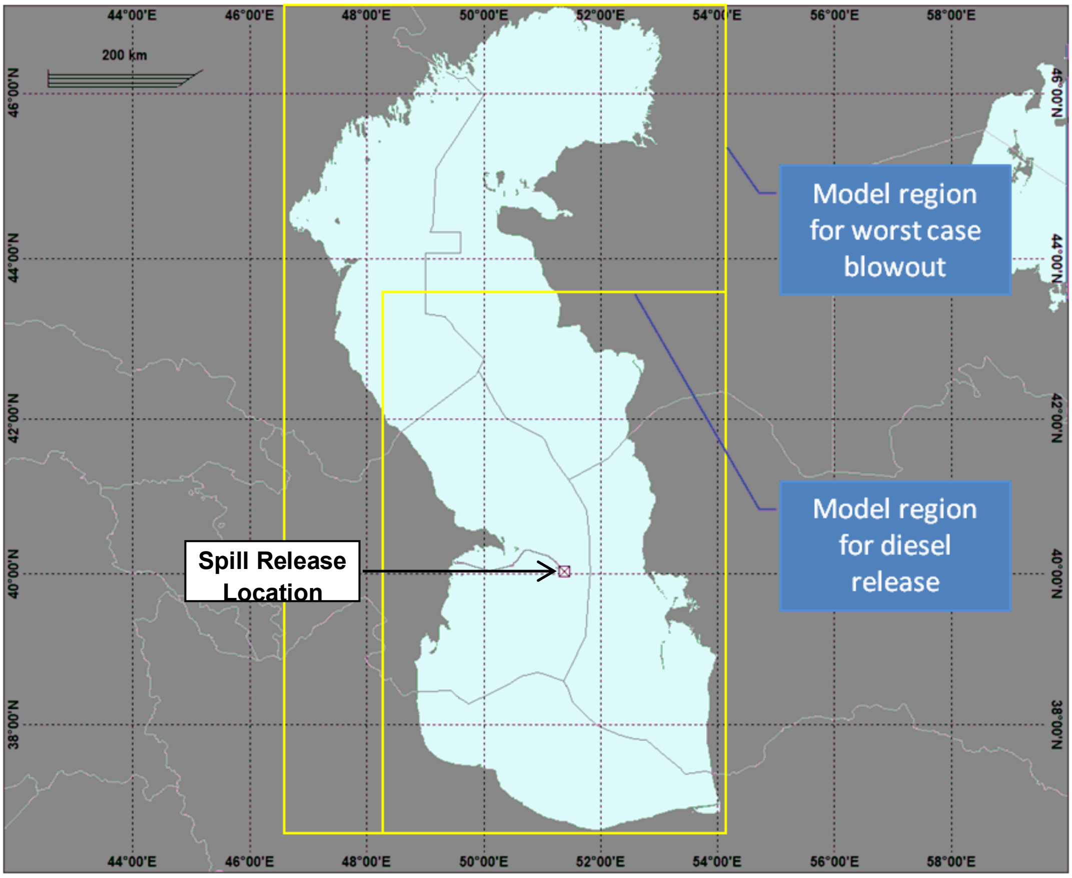
7.3.3.5 Hydrocarbon Spill Modelling

To assess the potential impact of a hydrocarbon release during the Project (i.e. a diesel inventory loss from the MODU and a well blowout), modelling was undertaken using SINTEF's Oil Spill Contingency and Response (OSCAR) modelling software (version 9.0.1). The location of the spill events considered in the modelling assessment is shown in Figure 7.3 i.e. the SAX01 well location.

The following scenarios were modelled (refer to Appendix 7A for full details):

- Scenario 1: MODU inventory loss of 1,500m^3 of diesel;
- Scenario 2: A blowout of gas / condensate (34,816 bbls/day) over 224 day duration.

Figure 7.3 Spill Release Location and Modelling Regions Used Within the Spill Modelling Assessment



Scenario 1 has been modelled assuming loss of 1,500 m^3 from the MODU diesel storage tank. It has been assumed that the diesel would be spilled directly onto the sea surface over a period of one hour i.e. at a rate of 1,500 m^3/hour.

Scenario 2 is the "worst case" estimate for a blowout from the SAX01 well and assumes the blowout would flow for 224 days, based on the anticipated time it would take to drill a relief well. Scenario 2 has assumed a flowrate of 34,816 bbls/day, which is estimated to result in a total spill volume of 7,798,784 bbls (equivalent to 1,239,227 m^3) of condensate. The release includes a mixture of condensate and associated gas, and the well is expected to be dry with no water anticipated to flow. The blowout scenario modelled has assumed, as a worst case, that the volume of condensate spilled each day will continue at the maximum anticipated flow rate for the duration of the blowout. In reality there may be a declining flow rate over the duration of the blowout and the actual total volume of condensate to be spilled is likely to be reduced significantly. The weathering properties of the two condensate phases (refer to Section 7.3.3.4 above) have been entered into the OSCAR model database and the blowout scenario is modelled assuming these two types of condensate are released simultaneously, which allows the model physics to best represent the actual behaviour of the release. The precise behaviour of the condensate released into the sea will depend on the release conditions.

Stochastic (probabilistic) and deterministic (single spill trajectory) modelling was carried out for each spill scenario.

Stochastic modelling is used to predict the probability of sea surface, shoreline or water column contact that may occur following an oil spill event. It accounts for the variability of meteorological and oceanographic conditions in the study area over the anticipated operational period to provide an insight into the probable behavior of the potential spills.

It involves running numerous individual spill trajectory simulations using a range of prevailing wind and current conditions that are historically representative of the location and timeframe during which the spill event may occur. The set of individual simulations may be performed within a specified time period (seasonal single year statistics), or by specifying the number of simulations to be run each year in a specified season (seasonal multiyear statistics). The trajectory results are then combined to produce statistical outputs that include the probability of where oil might travel and the time taken for the oil to reach a given shoreline. The stochastic model output does not represent the extent of any one oil spill event (which would be significantly smaller) but rather provides a summary of the total individual simulations for a given scenario or oil type.

Deterministic modelling (or single spill trajectory analysis) is used to predict the fate (transport and weathering behaviour) of spilled oil over time under predefined hydrodynamic and meteorological conditions.

Stochastic modelling was carried out for both summer and winter seasons, with stochastic outputs generated from the composite of > 100 individual spill trajectories produced during each stochastic simulation.

From the stochastic simulations the worse-case scenarios in terms of shoreline impact (greatest volume of hydrocarbon reaching shoreline) were identified and re-run as single deterministic simulations so that the fate of the release could be analysed in greater detail in terms of surface accumulation, condensate reaching the shore and water column concentrations.

Section 7.3.3.6 provides a summary of the modelling undertaken. Appendix 7A provides a detailed overview of the fate of diesel and condensate in the marine environment as a function of time, probabilities of surface and shoreline oiling and extent of the affected areas. It must be noted that modelling has not taken into account any response mitigation measures such as dispersant application, containment or recovery, meaning that the results should be only interpreted as indication of theoretical spill consequences without an implementation of the pollution prevention strategy. Section 7.3.4 below provides an overview of the spill planning to be adopted for the Project which will outline all necessary preventative and mitigation measures for minimising the consequences of any spills.

7.3.3.6 Spill Modelling Results

Scenario 1 – MODU Inventory Loss of Diesel

The modelling results assuming loss of MODU diesel inventory are summarised in Table 7.2.

Table 7.2 Summary of MODU Diesel Inventory Loss Spill Modelling Results

Release location	Maximum surface extent of sheen above 0.04 µm (km)		Minimum time to beaching (days)[1]		Time until water column concentration[1] <58 ppb (days)[2]		Maximum mass onshore (tonnes)	
	Summer	Winter	Summer	Winter	Summer	Winter	Summer	Winter
SAX01 Well Location	112	68	5.6	7.7	2	4.9	26.5	15.5

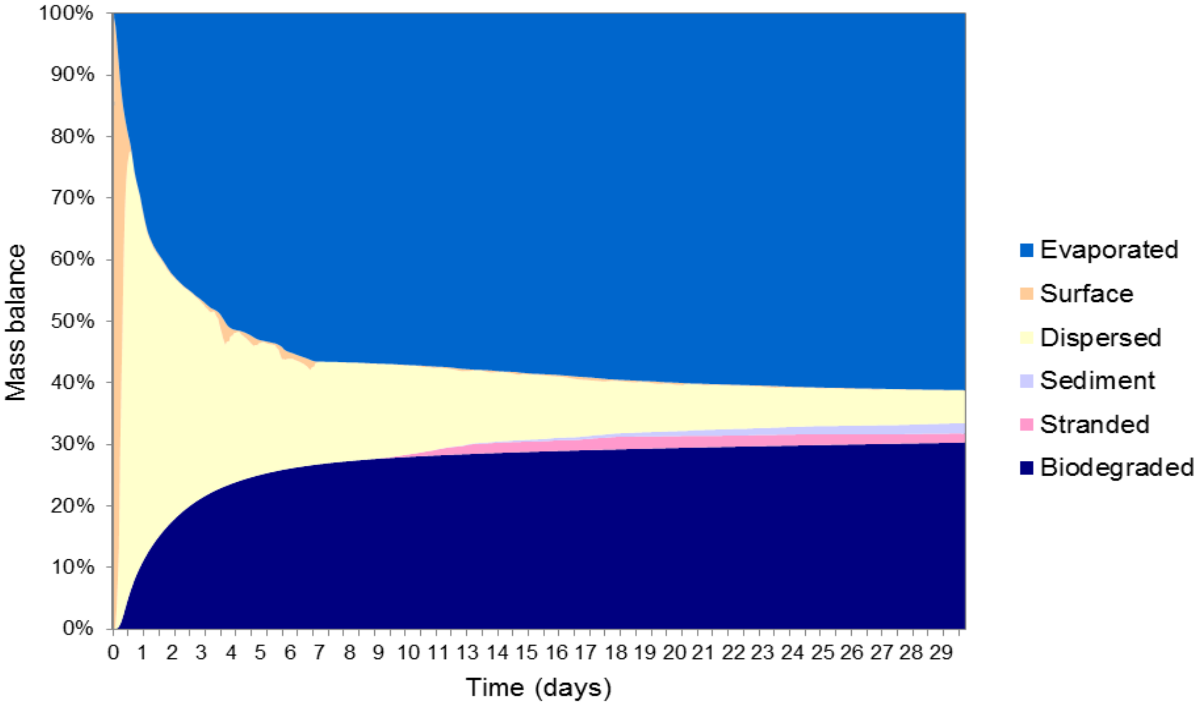
Notes: 1. Dissolved and dispersed oil in water column.
2. Time from start of release.

Figure 7.4 below shows the majority of the spilled diesel is initially present on the sea surface, and over the first seven days following the release around 56% of the diesel evaporates and 16% is dispersed into the water column. Dispersion and dissolution into the upper water column takes place very close to the release point to a depth of 40-60 m. Biodegradation also progresses relatively quickly such that only a very small fraction of diesel in the water column is left after 30 days. After 30 days 61% of the diesel evaporates, 30% is biodegraded, 5% remains in the water column, 2% is deposited in sediments and 2% will reach the coastline.

The resultant slick is relatively small and short-lived. Although it will tend to move in a single direction dependent on the exact metocean conditions at the time, the analysis of over 100 different sets of metocean data suggest that there are no dominant directions. While Figure 7.4 represents the spill during summer conditions, the result is generally representative of the fate of diesel released at any point in the year.

During summer conditions, diesel is predicted to reach the shoreline within six days with up to 26.5 tonnes predicted reach the shoreline, although the 50th percentile value[29] shows no diesel reaching the shoreline.

Figure 7.4 Modelled Fate of MODU Diesel Release (Summer)



Following the release of 1,500 m^3 of diesel the modelling predicts that the released diesel will travel up to 112 km from the point of release location in summer (worst case) before it drops below the lowest recognised visible thickness under ideal viewing conditions of 0.04 micrometres (µm). In winter, diesel is predicted to travel around 68 km from the release location. The spill would create a sheen that would occupy a relatively small area of the Caspian Sea for a period of up to 5 days, after which it would be effectively dissipate. Figures 7.5 and 7.6 present the modelling results for summer and winter, showing thicker areas of diesel are expected to be restricted to a small radius around the spill location.

Figures 7.7 and 7.8 shows the maximum area of the water column where the diesel in water concentration is above the 58 parts per billion (ppb) threshold[30]. The modelling predicts that the area is affected for approximately 5 days in winter and 2 days in summer after the release before the diesel disperses below the 58 ppb threshold levels. Each of the two figures shows the total predicted area the diesel covers as the slick moves away from the release location. The cross section through the water column shows that the release is predicted to remain in the upper sections of the water column.

The probability of diesel reaching the shoreline following the spill (based on the results of stochastic modelling) is presented in Figure 7.9 and the accumulation of diesel predicted to reach the shoreline following the spill under summer conditions is shown in Figure 7.10. Both summer and winter cases result in diesel reaching shoreline along the Azerbaijan coast and the coast of northern Iran. The modelling predicts there will only be a very light deposition of diesel where it comes ashore.

[29] Means that in 50% of scenarios modelled, this value or less would result.
[30] Concentration of total oil (dispersed and dissolved) in the water column above 58ppb threshold.

Figure 7.5 Modelled (Deterministic) Cumulative Area Thickness of Diesel on the Sea Surface (Summer)

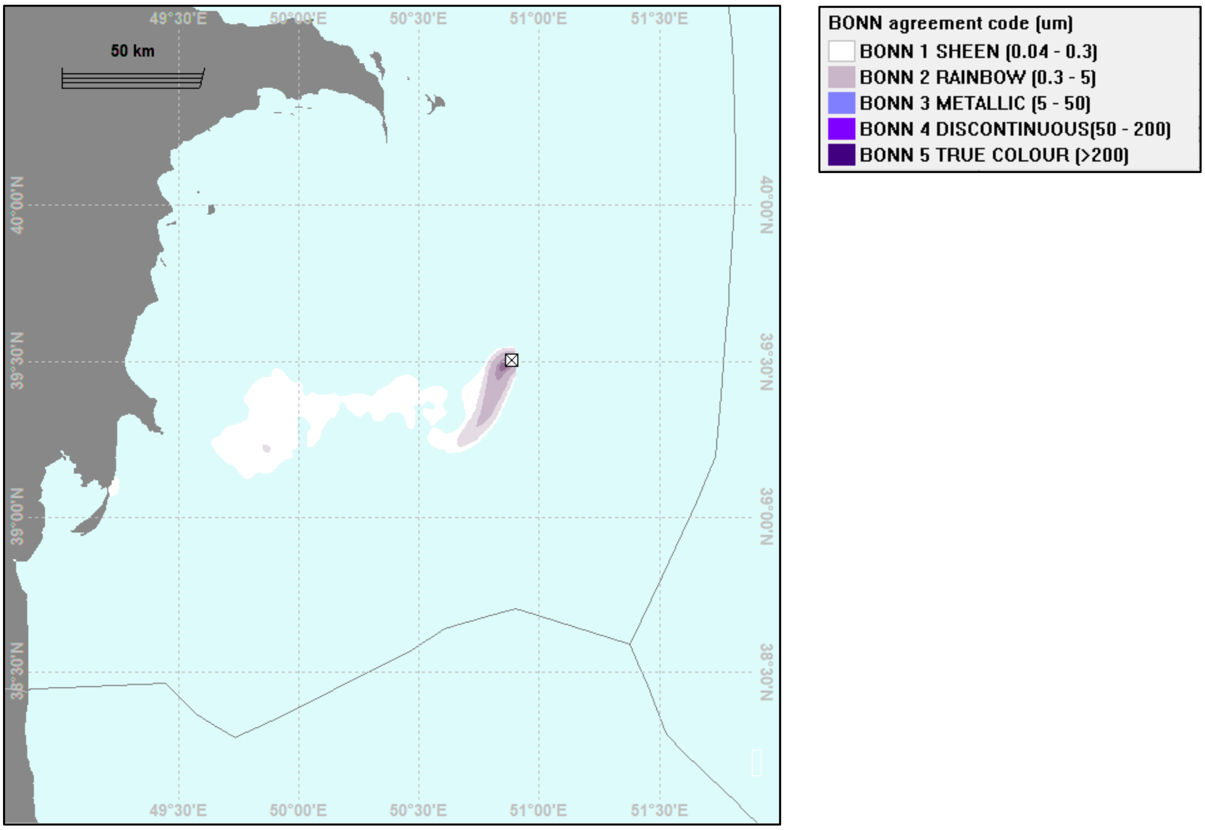


Figure 7.6 Modelled (Deterministic) Cumulative Area Thickness of Diesel on the Sea Surface (Winter)

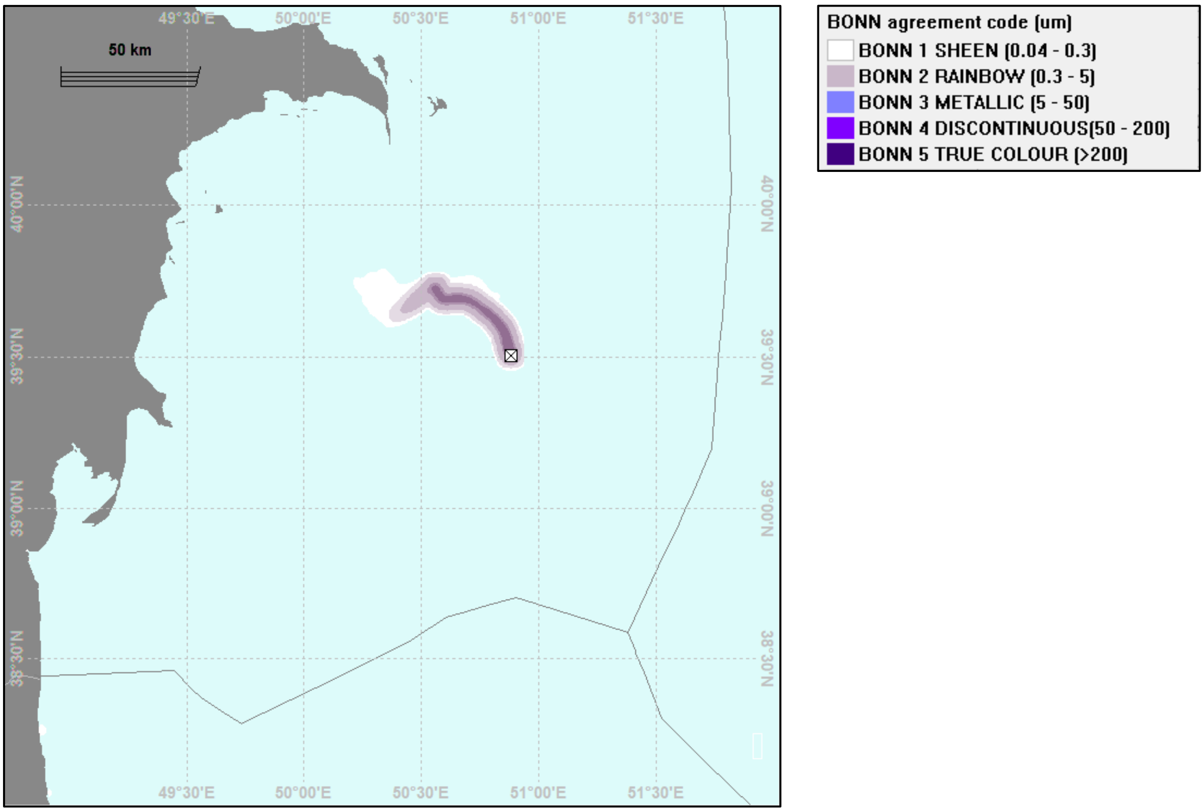


Figure 7.7 Modelled Maximum Affected Area of Water Column[30] for Deterministic Modelling of Diesel Spill Scenario (Summer)

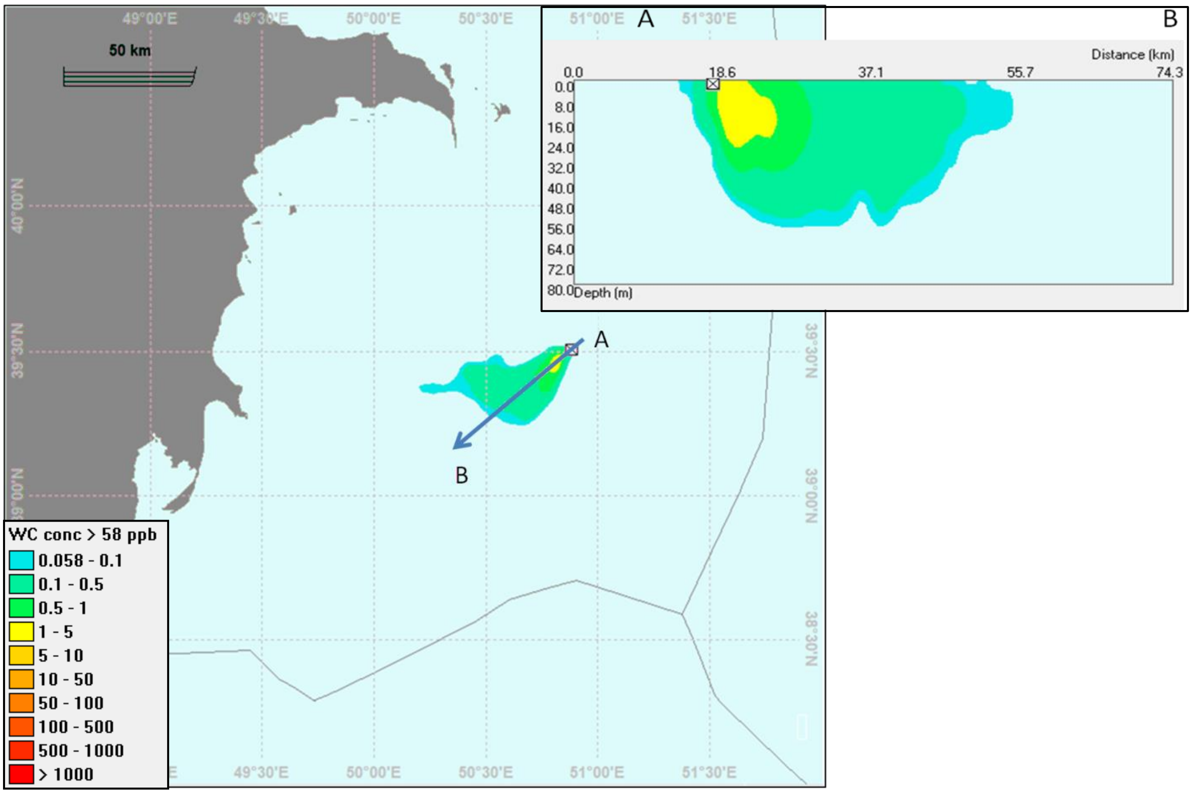


Figure 7.8 Modelled Maximum Affected Area of Water Column[30] for Deterministic Modelling of Diesel Spill Scenario (Winter)

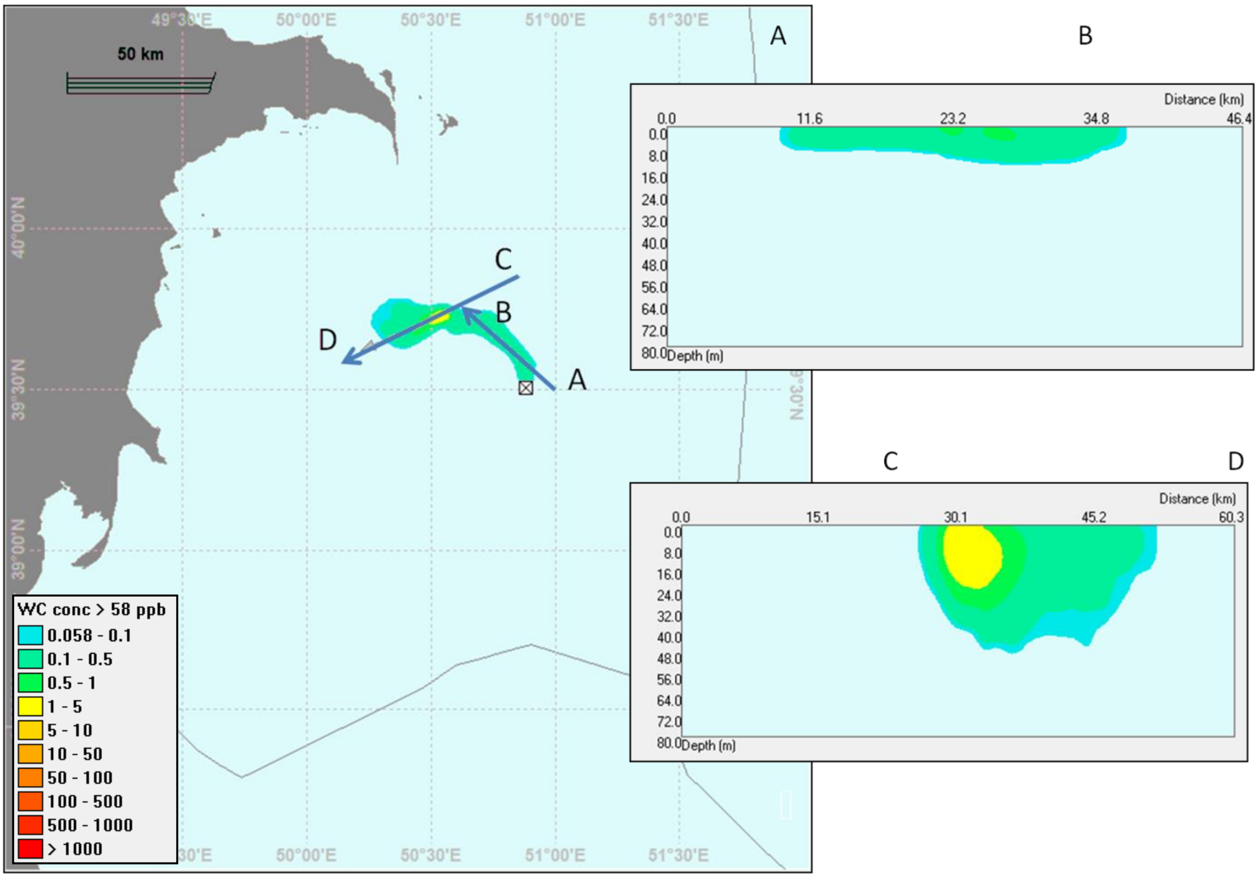


Figure 7.9 Modelled (Stochastic) Probability of Shoreline Oiling Above 0.1 litres/m² for Diesel Spill Scenario

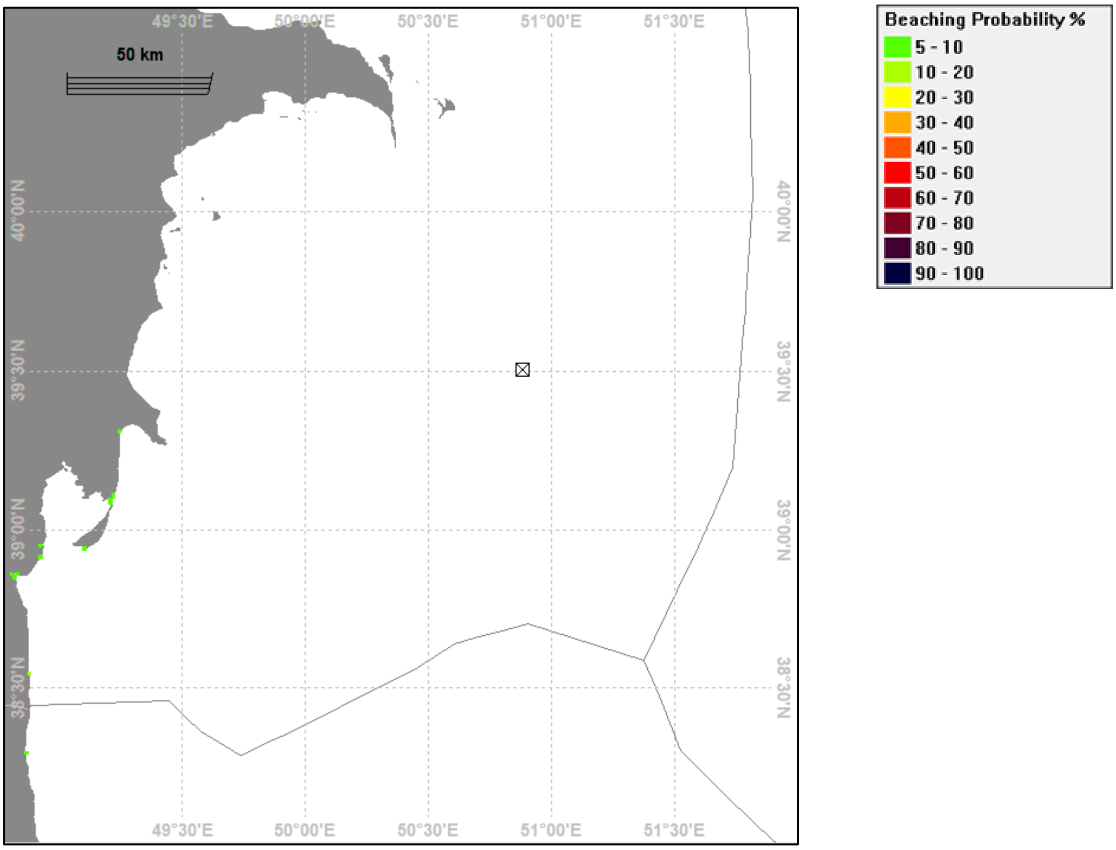
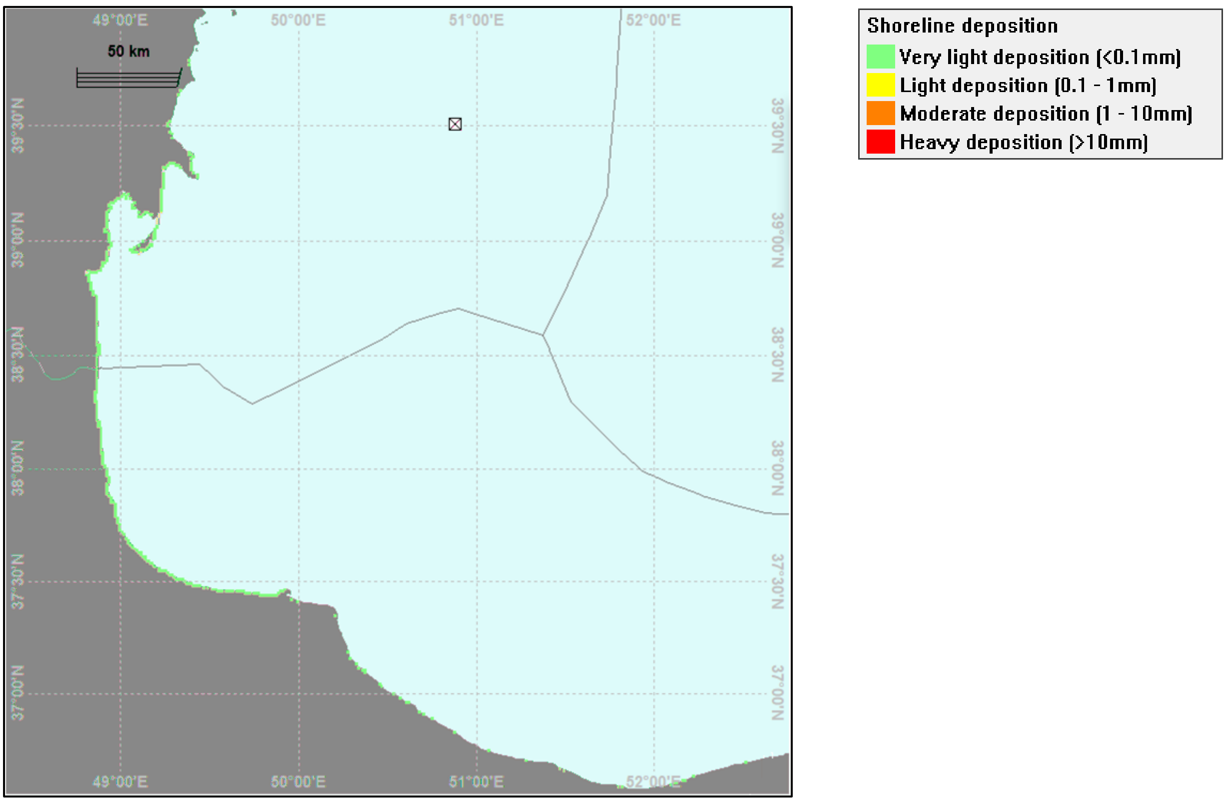


Figure 7.10 Modelled Shoreline Deposition for Deterministic Modelling of Diesel Spill Scenario (Summer)



Scenario 2 – Blowout of Gas Condensate

The modelling results assuming a worst case blowout are summarised in Table 7.3.

Table 7.3 Summary of Deterministic Results for Hydrocarbon Release in Blowout Scenario

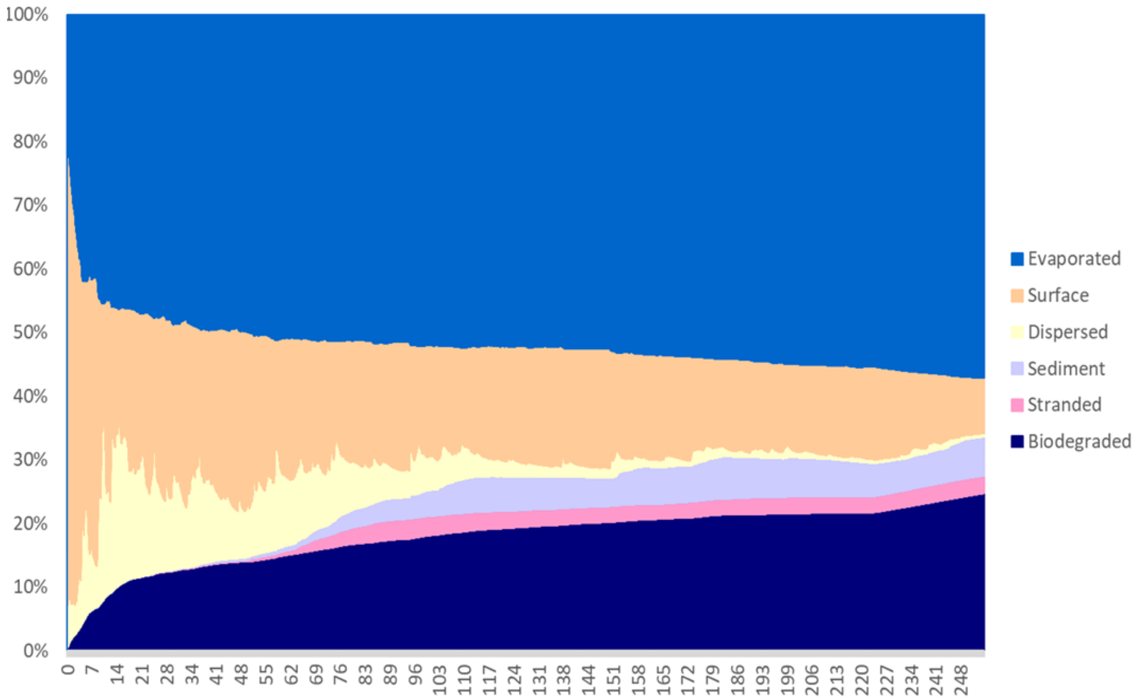
Release location	Maximum surface extent of sheen above 0.04 μm (km^2)		Minimum time to beaching (days)[1]		Time until water column dissolved concentration[1] <58 ppb (days)[2]		Maximum mass onshore (tonnes)	
	Summer	Winter	Summer	Winter	Summer	Winter	Summer	Winter
SAX01 Well Location	597	574	6.1	4.4	> 254	> 254	22,737	32,198

Notes: As per Table 7.2.

The results of the worst case deterministic modelling (Table 7.3) shows that, during winter conditions, condensate is predicted to reach the shoreline within approximately four days and result in up to 32,198 tonnes of condensate reaching the shoreline, although the 50th percentile value[29] is 19,660 tonnes.

As shown in Figure 7.11 below, during winter conditions the majority of the condensate is initially present on the sea surface following the release, while 20% evaporates almost immediately and 5% is dispersed into the water column. Throughout the 224 days release period, condensate is continually supplied to the surface. Dependent on the wind and waves, it can continue to be mixed into the water column during rougher weather with some condensate subsequently re-surfacing during calmer periods. After approximately 18 days, condensate has moved into shallower waters and begins to start to deposit in sediments and accounts for 8% of the condensate at the end of the simulation. In this example, which represents the case with the maximum amount of condensate accumulating on the shoreline, condensate reaches the shore at day 16 in southern Azerbaijan and Iran, although the most substantial deposition takes place between days 65-95. In the summer case, after 250 days around 57% of the condensate evaporates, 25% is biodegraded, 1% remains in the water column, 6% is deposited in sediments and approximately 3% is on the shoreline, with around 8% remaining on the surface as persistent wax particles. In the winter case, there is less evaporation and more condensate remaining on the water surface, in line with colder conditions.

Figure 7.11 Modelled Fate of Condensate From Blowout Scenario (Winter)



Condensate can reach shore in as little as 4.4 days, although the 50^{th} percentile value is 19.4 days, and it can take around 60 days for substantial amounts of condensate to reach shore.

The probability of surface oiling above 0.04 µm threshold is shown in Figure 7.12. The condensate on the sea surface is predicted to travel around 400-500 km before it drops below the lowest recognised visible thickness under ideal viewing conditions. There is a distinct difference in condensate movement between summer and winter. In the summer, condensate is more likely to travel southwest and follow the coast south, while in the winter it is more likely to travel north or south and much less likely to approach the coast. The thickest areas of condensate (>0.2 mm) are present within 100 km of the well and sometimes further. The thickest areas of condensate (>0.2 mm) are predicted to cover a greater area during winter rather than during summer (refer to Figure 7.13). Although the precise movement of the surface condensate is dependent on the exact metocean conditions at the time, the analysis of over 100 different sets of metocean data suggest that the most likely locations to receive condensate on shore are southern Azerbaijan, northern Iran and the tip of the Absheron Peninsula.

The extent of condensate in the water column above the threshold tracks the path of the surface release and can extend over 500 km from the source as shown in Figure 7.14, which represents the deterministic case run in summer, where the maximum condensate reaches the shore. The figure shows the total area the condensate has covered as it has moved away from the release location. The cross section through the water column shows that the release remains in the top 70 m of the water column, and remains closer to the surface for a release in summer compared to a release in winter. The condensate moves outwards and disperses via the action of circulation currents, winds and waves and its presence in the water column is dominated by the presence of the surface slick. Some of the surface condensate dissolves into the upper water column and some disperses in droplet form during stronger wind and wave conditions and can then re-appear on the surface in calmer conditions. Wave mixing and diffusion of the dissolved components gives rise to appreciable concentrations in the upper 20 m of the water column, and occasionally deeper to around 60 m depth (Figure 7.14).

The probability of condensate reaching the shoreline is presented in Figure 7.15 and the accumulation of condensate predicted on shore following the blowout under winter conditions is shown in Figure 7.16. The summer case release results in condensate mainly reaching three areas: southern Azerbaijan, northern Iran and the Absheron Peninsula. The eastern coastline of the Caspian Sea is unaffected. A mixture of areas of very light, light (0.1-1 mm), moderate (1-10 mm) and heavy (>10 mm) condensate deposition are predicted as can be seen in Figure 7.16. 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 higher concentrations. These wax particles may melt in the sun during the day and soak into sandy shoreline substrates.

Figure 7.12 Modelled (Stochastic) Probability of Surface Condensate Thickness Above 0.04µm Threshold for Well Blowout Scenario

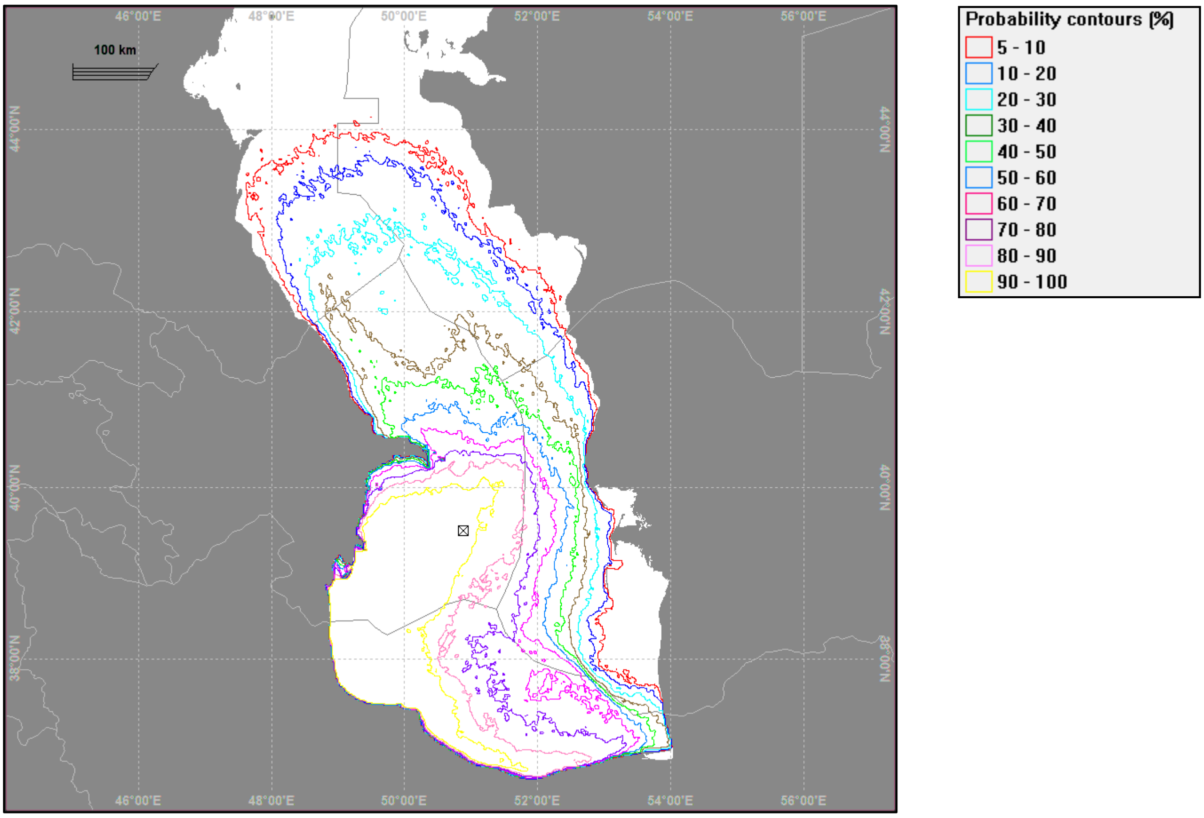


Figure 7.13 Modelled (Deterministic) Cumulative Area Thickness of Condensate on the Sea Surface for Blowout Scenario (Winter)

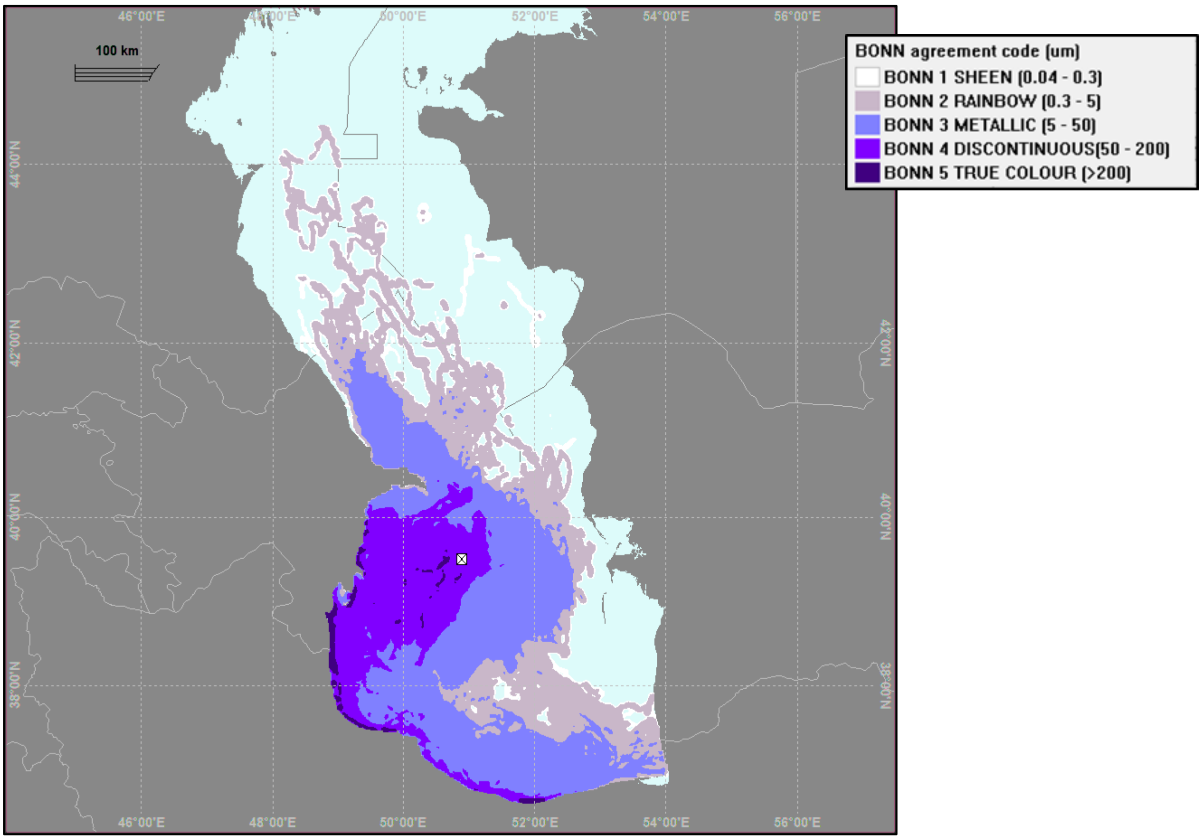


Figure 7.14 Modelled Maximum Affected Area of Water Column for Deterministic Modelling of Blowout Scenario (Summer)

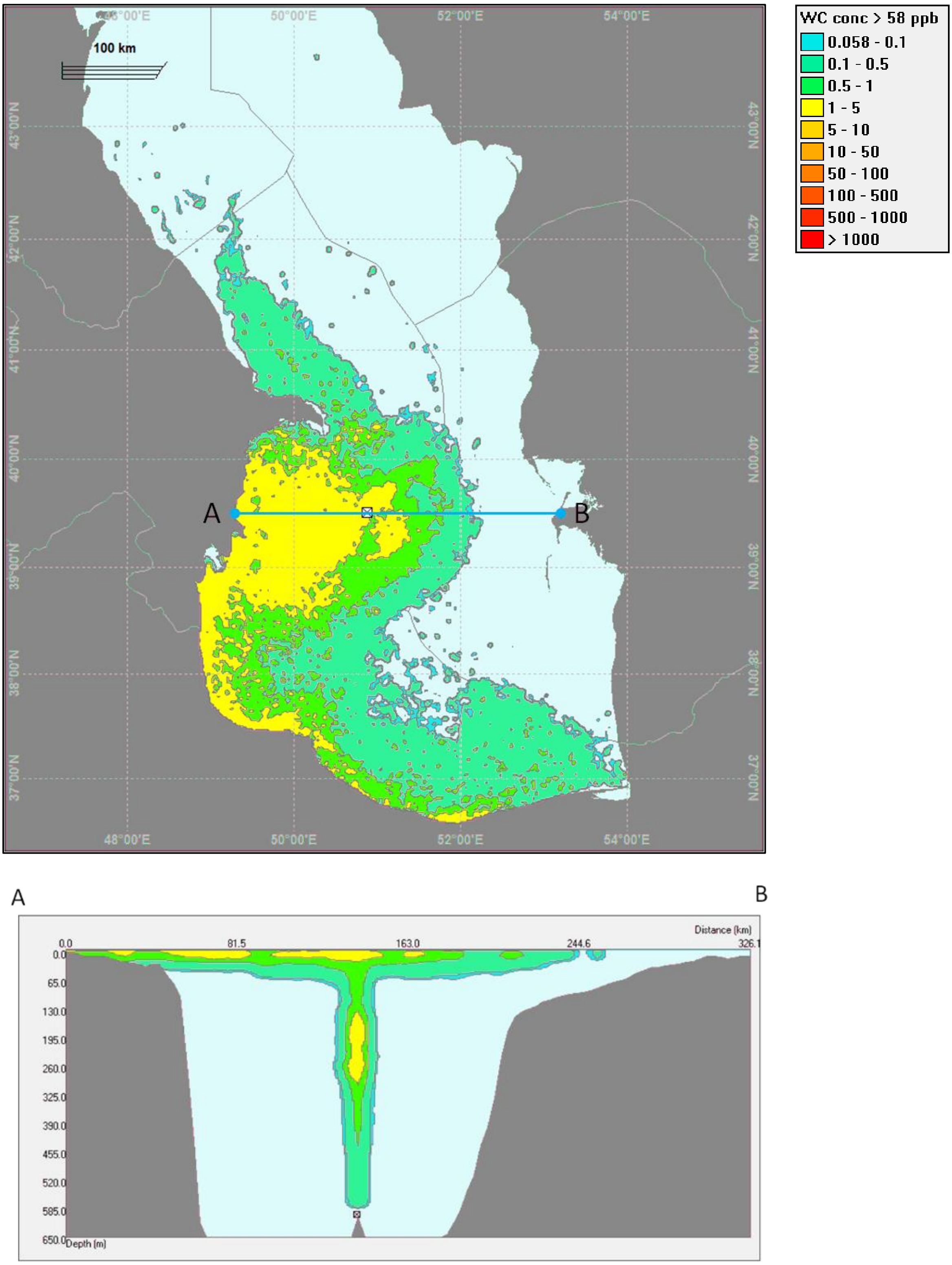


Figure 7.15 Modelled Probability (Stochastic) of Shoreline Oiling Above 0.1 litres/m^2 for Blowout Scenario

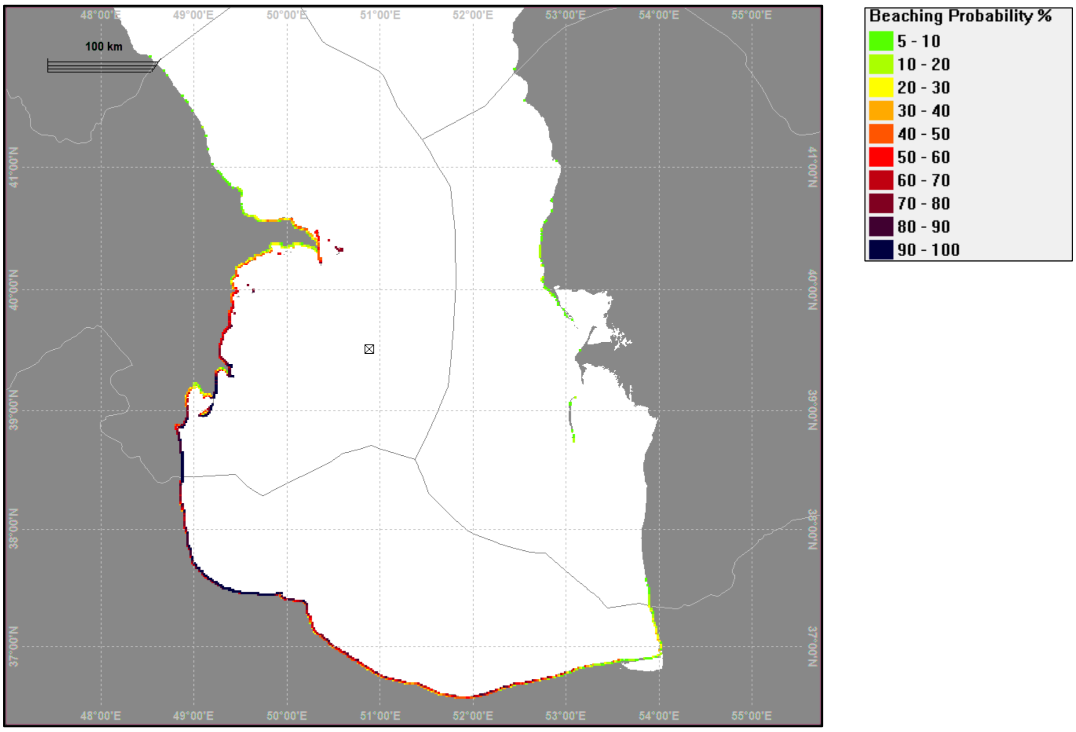
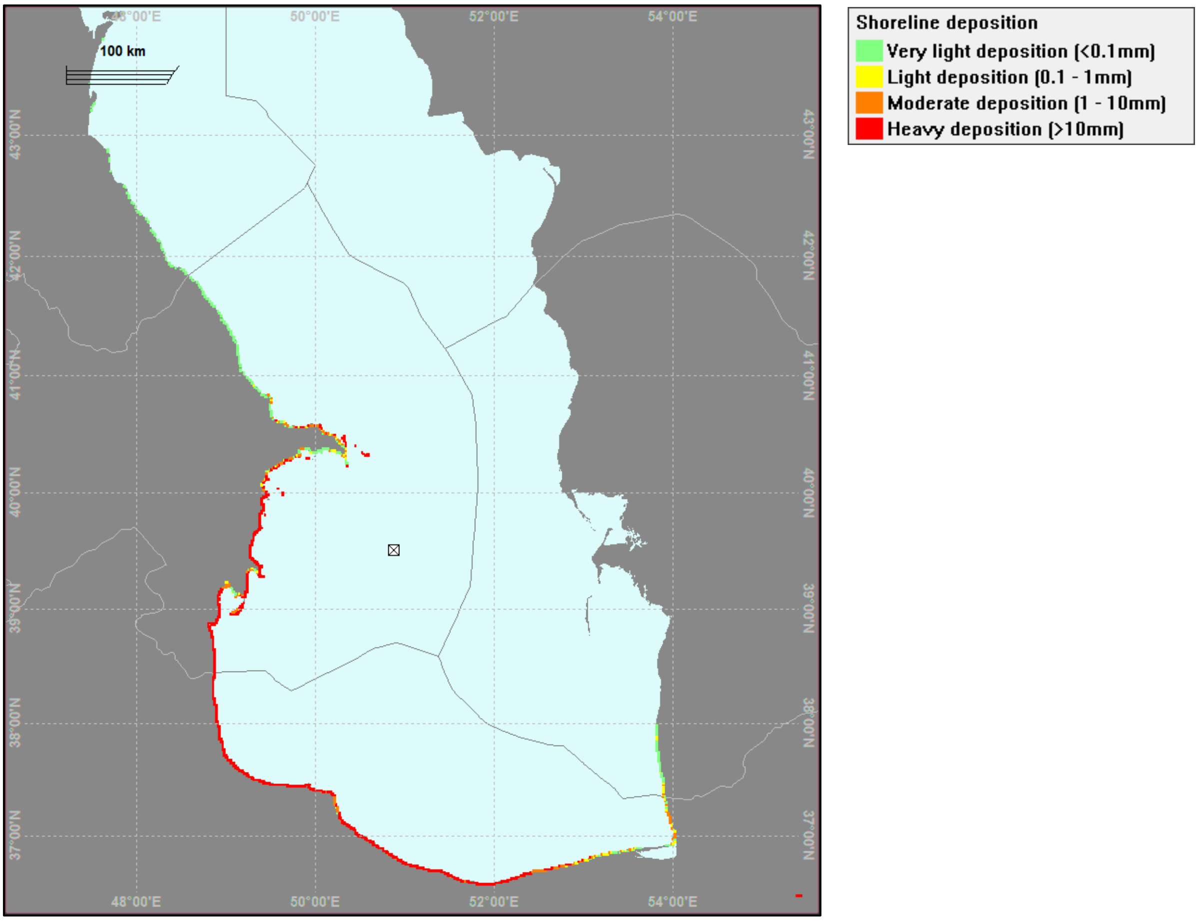


Figure 7.16 Modelled Shoreline Deposition for Deterministic Modelling of Blowout Scenario (Winter)



7.3.3.7 Potential Impact of Hydrocarbon Release

Hydrocarbons have the potential to cause detrimental effects to water and sediment quality, marine and coastal flora and fauna, including plankton, benthic invertebrates, fish, birds and marine mammals that may come into contact with a spill. An impact on fisheries and an indirect impact on human health via the food chain is also possible, depending on the scale of the spill and its proximity to fishing grounds. The vulnerability of marine and coastal receptors to hydrocarbon spills is summarised in Table 7.4 below.

Spilled hydrocarbons undergo a weathering process once they are released into the marine environment. The fate of diesel and condensate in the marine environment is described in Section 7.3.3.3 and Appendix 7A and is dependent on the type and volume of hydrocarbon spilled and the prevailing weather and sea conditions. The spill modelling described above in Section 7.3.3.6 has estimated the trajectory of hydrocarbons in the marine environment for a loss of diesel inventory from the MODU at the proposed SAX01 well location and a well blowout. A brief description of the potential impacts of the spills, taking into account the modelling results on marine and coastal receptors is presented below. Further details on the environmental and socio-economic receptors potentially impacted by a spill are provided in Chapter 5 of this ESIA.

Table 7.4 Vulnerability of Marine and Coastal Receptors to Hydrocarbon Spills

Receptor	Vulnerability to Hydrocarbon Spills
Plankton	• Abundance of phytoplankton may increase after a hydrocarbon spill due to increased nutrient availability, while zooplankton, fish larvae and eggs may suffer increased mortality due to toxicity in the water column, and therefore can affect the food chain of other fish species. • Although localised mortality is likely, the overall effect on plankton communities is not statistically significant and generally short-term. Shallow water areas have been found to have higher concentrations of phytoplankton compared to the open ocean. • Following a spill, plankton biomass may fall, however, after a few weeks, population often returns to baseline levels as a result of high reproductive rates and redistribution of species from outside the affected area.
Benthic Invertebrates	• Effects on the benthos include acute toxicity and organic enrichment. Sub-tidal regions generally have lower hydrocarbon concentrations after a spill than inter-tidal regions as often the hydrocarbon is carried and spread at the sea surface. • Recovery times are variable, and for light hydrocarbons are generally in the region of a few months to a few years. • Impacts can include rapid mortality of sensitive species such as crustaceans and amphipods; a period of reduced species population and abundance; a period of altered community structure with increased abundance of opportunistic species.
Fish	• Evidence suggests that fish are able to detect and avoid hydrocarbon-contaminated waters. This avoidance may cause disruption to migration or spawning patterns. • Hydrocarbon exposure in fish can lead to mortality or sub-lethal impacts on growth, physiology, behaviour and lowered disease resistance. • Fish populations are more sensitive to hydrocarbon pollution in shallow waters than in deep waters, with hydrocarbon concentrations being typically higher in the upper column. • Fish may ingest large amounts of hydrocarbons through their gills. Fish that have been exposed to hydrocarbons may suffer from changes in heart and respiratory rate, enlarged livers, reduced growth, fin erosion and a variety of effects at biochemical and cellular levels. Hydrocarbons toxicity can also affect reproductive capacity negatively and/or result in deformed fry. • Fish eggs and larvae are more vulnerable to hydrocarbon pollution than adults. In many fish species, these stages float to the surface where contact with spilt hydrocarbons is more likely. However, as most fish species have extensive spawning grounds and produce large numbers of eggs, there is unlikely to be any effect on numbers in the adult populations. Stocks may be at risk from a spill if it is large and coincides with spawning periods. • Longer term impacts of a hydrocarbon spill have shown genetic damage, physical deformities, reduced abundance and growth, and compromised survival of some life stages.
Seals	• Seals are very vulnerable to hydrocarbon pollution because they spend much of their time on or near the surface of the water. They need to surface to breathe, and regularly haul out onto beaches. During the course of a hydrocarbon pollution incident, they are at risk both when surfacing and when hauling out. • Seals may be damaged through the ingestion of food contaminated by hydrocarbons or the inhalation of hydrocarbon droplets and vapours. Oil, especially light oils and hydrocarbon vapours, will attack exposed sensitive tissues. These include mucous membranes that surround

Receptor	Vulnerability to Hydrocarbon Spills
	the eyes and line the oral cavity, respiratory surfaces, anal and urogenital orifices. This can cause corneal abrasions, conjunctivitis and ulcers. Consumption of contaminated prey can lead to the accumulation of hydrocarbons in tissues and organs.
Birds	• Spilled hydrocarbons can penetrate into the plumages of sea birds, reducing its insulating ability, and making them more vulnerable to temperature fluctuations and much less buoyant in the water. This can lead to death from hypothermia or drowning. Unlike most crude oils, condensate does not form high-viscosity water-in-oil emulsions that can smother and contaminate seabird's plumage. • In their efforts to clean themselves from hydrocarbons, the birds may inhale or ingest the hydrocarbon. As hydrocarbons are toxic, this may result in serious injuries/health effects such as pneumonia, congested lungs, intestinal or lung haemorrhage, liver and kidney damage. • Hydrocarbons may also affect the reproductive success of the birds as hydrocarbons from feathers of a bird that is laying on eggs may pass through the pores in the eggshells and either kill the embryos or lead to malformations.
Fisheries	• Fish exposed to hydrocarbons may become tainted, defined as giving the product a petroleum taste or smell. Commercial fish species rarely become tainted in open deep waters, as they are able to avoid the affected area. However, major spills can result in loss of fishing days and exclusion zones and bans on certain species lasting for a whole season may be enforced.
Sources: Ref. 8, Ref. 13, Ref. 14, Ref. 15 & Ref. 16	

Plankton

The spill modelling indicates that for a diesel release (Scenario 1) the concentrations of diesel in the water column above the 58 ppb threshold are limited in extent from the point of release and are not expected to persist for longer than 2 days (summer) and 5 days (winter), respectively. The exposure of plankton (excluding fish larvae) to toxic levels of hydrocarbons from these scenarios is therefore expected to be short term and localised. However, the modelling of the well blowout scenario (Scenario 2) estimates the maximum area of water column with a concentration of condensate in the water column above the 58 ppb threshold would be extensive and the concentration would remain above the 58 ppb threshold for greater than 254 days following the release.

Plankton (particularly zooplankton, fish larvae and eggs) are likely to suffer high levels of mortality through exposure to hydrocarbons. However, plankton already experience very high levels of natural mortality, predominantly the result of predation. Plankton are generally short-lived, rapidly reproducing often releasing very high numbers of eggs and/or larvae and are also widely distributed, so that recovery, even from significantly detrimental impacts, can be relatively short (weeks or months) (Ref. 12).

During the peak period of phytoplankton production (spring and autumn) the biomass exposed to a hydrocarbon spill would increase resulting in reduced growth levels and mortality. However, this is not expected to be significant in comparison to the total production level over the long term. Zooplankton may also suffer mortality as a result of a hydrocarbon spill, but the large number of early life stages produced and short reproductive cycles, will act as a buffer for recruitment from areas outside the spill affected region. Thus, plankton concentrations are expected to return to baseline levels after a relatively short period of time. As a result, the overall impact on the plankton communities is not considered to be significant.

Benthic Invertebrates

As detailed in Chapter 5: Sections 5.5.2, the benthic community SAX01 location is considered almost abiotic and does not support any species of conservation significance. Nevertheless, benthic communities in the wider Caspian Sea play an important role in supporting critical functions of the local ecosystem, particularly as prey items for other species, including fish such as sturgeon. There are a number of taxa that are important prey e.g. amphipod crustaceans, which are known to be sensitive to hydrocarbons.

As shown in Figure 7.4, it is predicted that a release of diesel from the MODU (Scenario 1) will result in approximately 2% of the spilled diesel ending up in sediments and thus benthic environments are less likely to suffer the impacts of a surface hydrocarbon spill. The spilled hydrocarbons become mixed into the water column, subsequently combining with suspended sediments. This then sinks to the seabed where its toxic components can be lethal to benthic organisms (Ref. 12). As shown in Figure 7.11, the spill modelling predicts that approximately 6% of the condensate from the blowout scenario will sink to the seabed. Furthermore, the maximum amount of condensate predicted to beach on the shoreline is 32,198 tonnes for the worst case blowout scenario.

Potential impacts to the benthic invertebrates can include: (i) rapid mortality of sensitive species such as crustaceans, amphipods, and bivalves; (ii) a period of reduced species population and abundance and (iii) a period of altered community structure with increased abundance of opportunistic species.

Given the water depths in the vicinity of the proposed SAX01 well location (approximately 624m), it is unlikely a surface spill of diesel would give rise to highly significant effects to benthic invertebrates, particularly as the diesel will rapidly evaporate and disperse in the water column with only approximately 2% of the spilled diesel volume predicted to end up in seabed sediments coupled with the fact that the benthic community at the SAX01 location is abiotic. Furthermore, only a limited area of the coastal zone will potentially be affected by stranded diesel. Given the medium term recovery rates, the overall impact to benthic invertebrates is expected to be low.

In the case of a well blowout, where the hydrocarbon initially disperses and evaporates rapidly, the impact to the benthic environment in the vicinity of the release will be dependent upon weather conditions and levels of suspended sediment within the water column at the time. In this blowout case a significant volume of condensate is anticipated to reach the coastline and the probability of the concentration of condensate in the water column being above the threshold rate of 58 ppb is between 50 and 100% for significant lengths of coastline meaning there is potential to impact benthic species present within the shallow water coastal areas where condensate is predicted to beach. The recovery times for benthos would vary depending on the environmental conditions and species affected. Over time the condensate will biodegrade and the effects of wave action and currents will help to naturally disperse the condensate particularly along rocky and sandy shores, although persistent wax particles remaining on the sea surface may eventually arrive on the shoreline over an extended period. Benthic species present in areas of fine sand or mud may suffer longer term effects as the hydrocarbons that penetrate fine sediments can persist for many years and can often be released back into the water column if disturbed. However, compared to crude oils, the condensate waxy residue reaching the shore will contain lower levels of potentially toxic chemical compounds because the BTEX (Benzene, Toluene, Ethylbenzenes and Xylenes) type compounds will be depleted as they will have already been transferred into the water column.

For a well blowout, although impacts to the benthic community in the immediate vicinity of the well will be relatively minor (due to the abiotic nature of the area) the potential for a large amount of condensate to reach the seabed and beach along a significant length of coastline is expected to lead to a potentially significant impact on benthic species present in areas impacted by the condensate. However, the impacts will be much less severe than would be the case for emulsified crude oil coming ashore.

Fish

As discussed in Chapter 5: Section 5.4.4.2, the species most likely to be present within waters of the Shafag-Asiman Contract Area includes gobies and mullet, typically during winter. Based on recent studies conducted by the Azerbaijan Fisheries Research Institute those species most likely to be present include four species of goby and leaping mullet. These species are most sensitive during April to June and June to September respectively when they are breeding. However, this is outside of the period when they are potentially present within the Shafag-Asiman Contract Area (November to February).

The potential impacts of a condensate spill on fish may include physical damage (e.g. through oiling of gills) and toxic effects (e.g. due to uptake of volatile toxic components of the condensate that have dispersed into the water column). Fish have the ability to detect hydrocarbons in water through olfactory (smell) or gustatory (taste) systems and tend to avoid contaminated areas). Depending on the time of year that a spill was to occur, different groups of fish species may be affected. It can be assumed therefore that the majority of adult fish would avoid the area of a spill, although in very shallow waters fish may be more restricted between the seabed and the hydrocarbons on the sea surface. Spill avoidance behaviour can disrupt migration routes for some fish species. This has the potential to impact the migration of species of sturgeon and shad and semi-migratory species such kilka and mullet should the spill extend into areas where these species migrate through. Where mortalities have been recorded they have generally been associated with high levels of surface oiling in storm conditions when mixing increases the presence of hydrocarbon compounds in the water column. Juveniles and larvae are more vulnerable to hydrocarbon spills as they have limited ability to move away from the contaminated zone, which may have implications for the reproduction of these species. It should be noted that protected sturgeon species do not spawn within waters around the Shafag-Asiman Contract Area and are not expected to be present in these waters at any time of the year.

The spill modelling indicates that diesel concentrations in the water column that have the potential to cause toxic effects on fish are non-persistent, with a large proportion of the diesel evaporating within five days of the release and diesel concentrations within he water column dispersing below the 58 ppb threshold levels within 5 days in winter and 2 days in summer. For the blowout scenario, the probability of the oil in water concentration exceeding the 58 ppb threshold is 90-100% over an extensive area of the south-west part of the Caspian Sea and the modelling predicts it will take more than 254 days for the concentration to fall below 58 ppb in many impacted areas. Although adult fish have the ability to move away from affected areas, juveniles and larvae have limited ability. Coupled with the extensive area impacted by the condensate spill and the duration of contamination there will likely be significant impacts to fish populations in the short to long-term.

Seals

If Caspian seals are within the area of a spill, or if the spill affects any resting or haul out sites, there could be irreversible impacts from a hydrocarbon spill through coating, inhalation and ingestion.

As discussed within Chapter 5: Section 5.4.4.3 there is potential for seals to be present within the Southern Caspian for foraging from May to September with peak numbers in July, returning periodically to their haul-out sites. The Shafag-Asiman Contract Area is likely to be utilised by seals during this feeding period, however the majority of seals will tend to congregate further inshore and further south where the greatest proportions of kilka are concentrated. Seal migration behaviour is discussed within Chapter 5: Section 5.4.3.3. It is understood that, following increased disturbances within the Dagestan coastal area of Russia (including reported mass poaching), seals tended to avoid coastal areas during the autumn and spring migrations and use routes located away from the coast. Thus, the latest research has shown it is not possible to assume the seals will always follow the previously defined migratory paths close to the east and west coastline and may travel through the centre of the Caspian (including potentially through the Shafag-Asiman Contract Area). In addition evidence from a tagging survey has indicated that seals do not always migrate or followed the previously understood routes.

With regard to a release of diesel from the MODU at the proposed SAX01 well location (Scenario 1) the spill modelling confirmed that surface diesel thicknesses will be greatest near the spill location, dispersing and thinning out with distance and time. The duration of diesel remaining on the sea surface in most areas is not predicted to exceed 5 days and there is a low probability (5-10%) of diesel above the 0.1 litres/m^2 threshold accumulating on short sections of shoreline in Azerbaijan and northern Iran. Therefore, any exposure of seals to spilled diesel is likely to be limited.

In the event of a blowout (Scenario 2) there will be a significant volume of condensate released to the sea surface. Over time, the volume of condensate on the surface will reduce through evaporation, dispersion in the water column and biodegradation, however around 8% of the spilled condensate is predicted to remain on the surface as persistent wax particles. Under worst case conditions up to 32,198 m^3 of condensate may reach the shoreline with the first condensate reaching shore within approximately 4.4 days following the blowout. The stochastic modelling indicates that different times of year can make a significant difference to the amount of condensate that reaches the shore with a blowout during the winter months predicted to result in more condensate remaining on the water surface, in line with colder conditions, and ultimately beaching along the coastline. The probability of condensate reaching the Azerbaijan coastline varies from 5-100% with condensate most likely to come ashore from Neftchala southwards to the border with Iran.Caspian seals are an International Union for Conservation of Nature

(IUCN) endangered species and are under pressure from various natural and anthropogenic stressors. Seals are known to be highly sensitive to oiling and are most vulnerable during the breeding season (December to February) and feeding periods (May to November). Therefore, even small-medium scale exposure to toxic effects of diesel, within sensitive areas for seals, could result in a potentially significant impact. The anticipated larger volume of a major spill (i.e. blowout) and relative larger size of slick would increase the potential for contact with seals in the offshore waters and along the coastline meaning a significant impact to seals is highly likely in the event of a blowout. As condensate does not form stable water-in-oil emulsions seals are less likely to become coated with the condensate waxy residue which will be less toxic than oil as the BTEX components will have dissolved into the water column; the effects will still, however, likely be significant.

Protected Areas of Sites of Ornithological Importance

There are a number of Protected Areas (IUCN Categories II and IV), Important Bird and Biodiversity Areas (IBAs), and Key Biodiversity Areas (KBAs) located along the coastline of Azerbaijan.

The shoreline oiling probabilities predicted by modelling in the event of a diesel spill from the MODU at the SAX01 well location (Scenario 1) or a well blowout (Scenario 2) for each of the areas of ornithological importance are summarised in Table 7.5.

Table 7.5 Shoreline Oiling Probabilities for Designated Areas along the Absheron to Gobustan Coastline

Sites of Ornithological Importance	Designation	Probability of Shoreline Oiling Under Worst Case Conditions	
		Diesel Spill (Scenario 1)	Blowout (Scenario 2)
Absheron National Park (including Shahdili Spit and Pirallahi Island)	National Park KBA/IBA IUCN II	None	70 – 80%
Red Lake	KBA/IBA	None	30 – 40%
Sahil Settlement – ‘Shelf Factory’	KBA/IBA	None	30 – 40%
Sangachal Bay	KBA/IBA	None	40 – 50%
Glinyani Island	KBA/IBA IUCN IV	None	50 – 60%
Pirsagat Islands and Los Island	KBA/IBA	None	70 – 80%
Bandovan	State Nature Sanctuary IUCN IV	None	70 – 80%
Shirvan National Park	National Park KBA/IBA IUCN II	None	70 – 80%
Kura Delta	KBA/IBA	5 – 10%	90 – 100%
Gizil Agach	KBA/IBA IUCN Ia Ramsar Site	5 – 10%	90 – 100%
Gizil Agach State Nature Sanctuary	State Nature Sanctuary	5 – 10%	90 – 100%

In the event of a diesel spill (Scenario 1), there is a very low probability (5-10%) of diesel reaching parts of the coastline within the Kura Delta and Gizil Agach KBAs/IBAs. In the event the diesel does reach the coastline the deposition of diesel will only be very light and any impacts would be limited in duration and extent. However, in the event of a blowout (Scenario 2) the modelling predicts a range of probabilities of shoreline oiling for some of the important ornithological areas due to the extensive length of coastline they occupy, therefore the highest probability predicted for any part of the important ornithological area is presented as a worst case. In the case of a blowout (Scenario 2) each of the important ornithological sites listed in Table 7.5 have at least a 40% probability of being impacted by shoreline oiling while for a number of sites including the Kura Delta and Gizil Agach KBAs/IBAs the probability is above 80%. The recovery of different habitats from an oil spill varies but for hydrocarbons such as condensate the recovery typically takes place within a few seasonal cycles for most habitats within one to three years although the recovery in more sheltered areas may take longer. However, compared to crude oils, the condensate waxy residue reaching the shore will contain lower levels of potentially toxic chemical compounds. Therefore, the ecological effects of a waxy condensate residue coming ashore are likely to be much less severe than would be the case for emulsified crude oil coming ashore. Based on this medium to long term recovery and considering international conservation status and ecological importance of these areas, the potential impacts are assumed to be significant.

Birds and Important Bird and Biodiversity Areas

As discussed in Chapter 5: Section 5.7, the Caspian region supports a high diversity of bird species, with a large number of endemic and protected species present. There are 15 birds on the IUCN Red List or in the Azerbaijan Red Data Book (AzRDB) known to be present along the Absheron to Neftchala coastline. The Azerbaijan coastline of the Caspian Sea from the Absheron region moving south is an area of international and regional importance providing habitat for breeding, nesting, migratory and overwintering birds, which is reflected in the designation of a number of IBAs.

The distribution and abundance of birds in the coastal region changes significantly during the migration and overwintering periods. A large number of overwintering and migrating birds will be present offshore and along the Central and Southern Caspian coastline within a number of IBAs identified as areas of potential impact from a hydrocarbon spill (Table 7.5). Bird species that spend most of their time on water are most at risk, including a number of overwintering birds (i.e. ducks) which dive in shallow waters to feed on small fish/ benthic invertebrates.

There are, however, some key periods and areas of higher sensitivity. Ducks and coots are overwintering from December to February and the presence of migrating species peaks in March and November. The IBAs are the key habitats for these groups of birds, particularly for nesting and breeding. The bird nesting season begins at the end of April/beginning May and continues until mid-July. Limited information is available regarding the offshore distribution and abundance of birds in the Southern Caspian; however it is anticipated that there may be small numbers of gulls and birds such as terns that plunge dive to feed. There is little baseline information on the migratory route, distribution and abundance of birds in the vicinity of the Shafag-Asiman Contract Area. However it is anticipated that a number of seabirds may be present, albeit likely as individuals, on occasions.

An accidental release of hydrocarbons, particularly crude oil, can impact birds offshore and in the nearshore / coastal areas. The oiling of their plumage is the most obvious impact although unlike most crude oils, condensate does not from high-viscosity water-in-oil emulsions that smothers and contaminates the plumage of seabirds. When oiling occurs, the important layer of insulation is disrupted, which results in the skin coming into direct contact with the seawater. In this condition birds lose buoyancy and the ability to take off in search of food and/or escape predation. Smothered plumage also leads to loss of body heat putting the birds at risk of hypothermia as fat reserves beneath the skin are depleted during attempts to keep warm. Ultimately, birds that suffer from cold, exhaustion and loss of buoyancy, may drown (Ref.12).

Should the birds return to a nest, this can transfer the hydrocarbons to live young or hatching eggs, which can then suffer eggshell thinning, failure of the egg to hatch and developmental abnormalities. Ingestion of hydrocarbons can lead to congested lungs, intestinal or lung haemorrhages, pneumonia and liver and kidney damage. Birds are likely to ingest hydrocarbons whilst attempting to clean their plumage.

A small spill during breeding seasons could prove more catastrophic for birds than a larger spill at a different time of the year. The modelling of a blowout during both summer and winter conditions shows that a significant volume of condensate will reach the coastline, including areas with IBA status. In some locations the condensate is likely to persist for a number of months exposing birds and their habitats to the impacts of condensate for an extended period. However, as described above, compared to crude oils, the condensate reaching the shore will contain lower levels of potentially toxic chemical compounds. Therefore, the ecological effects of condensate coming ashore are likely to be much less severe than would be the case for emulsified crude oil coming ashore.

It is considered that the impacts to birds and IBAs from a release of diesel from the MODU (Scenario 1) will be minor as the diesel is not expected to reach long stretches of coastline and diesel concentrations in the water column above the 58 ppb threshold will not reach the shallower coastal areas important to birds. In the event of a blowout (Scenario 2), it is considered that the impact of a condensate spill on birds at sea and the IBAs and KBAs could be a significant impact for the reasons mentioned above and due to the spill potentially occurring during the most sensitive time of year for nesting birds in the region.

Fisheries and Other Marine Users

Socio-economic receptors such as fisheries and coastal tourism could be exposed to the risk from an accidental spill. As described above, for Scenario 1, the modelled maximum exposure of the water surface to diesel is generally limited to 1.5 days, and water column exposure to diesel concentrations exceeding the 58 ppb threshold is not expected to reach the shore and will not exceed this concentration for more than 5 days in impacted areas. The probability of condensate from a blowout (Scenario 2) reaching coastal areas or commercial fishing grounds within Azerbaijan varies with some areas around Baku Bay ranging from 20 to 40% while further south near Neftchala and Lankaran the probability is in the range of 50 to 100% (refer to Figure 7.15). Although a large percentage of the spilled hydrocarbons will evaporate, biodegrade or disperse within the water column it is anticipated that up to 26.5 tonnes of diesel or 32,198 tonnes of condensate could reach the shoreline from a blowout during summer and winter conditions respectively. A blowout of condensate will also result in a significant amount of condensate on the sea surface which would slowly reduce over several months although approximately 8% of the spilled condensate is predicted to remain on the surface as persistent wax particles. The concentration of condensate in the water column is expected to remain above the 58 ppb threshold for greater than 254 days for a blowout in some areas impacted by the spill (refer to Figure 7.14).

In the unlikely event of a large spill such as a blowout, in addition to the significant effect on the marine and coastal receptors the negative public perception and media attention can have reputational implications. While offshore condensate will largely evaporate and biodegrade, any condensate wax particles reaching the coastline may remain stranded on the affected recreational beaches, hence potentially having impacts on the recreational businesses within the affected area. Depending on the time of the year the spill takes place the beached wax particles may melt in the sun during the day and soak into sandy shoreline substrates.

Chapter 5: Section 5.8.2.3 describes how there are no known fishing grounds either within or in the vicinity of Shafag-Asiman Contract Area and it is not an area where commercial vessels are known to operate, given the unfavourable meteorological and climatic conditions in this area as well as the distance from shore. However, there is the potential that a worst case spill from a blowout could have much wider impacts on fishing including to important commercial fishing grounds such as the Kornilov-Pavlov Bank and Makarov Bank and smaller scale fishing areas (with fishing taking place within 2-3 nautical miles from the coastline) and landing sites located along the Azerbaijan coastline. The closest commercial fishing ground to the proposed SAX01 well is the Kornilov-Pavlov Bank (located approximately 80km west). Areas along the coastline between the Absheron Peninsula and Gobustan where the majority of licences have been issued for small-scale fishing include Zira, Hovsan, Shikh, Bayil, Zygh and Sangachal-Gobustan. It is understood that the high season for commercial fishing is during March to April whereas the peak fishing period for small scale fishing occurs in March-April and September-November, although fishing takes place throughout the year.

The impact on fisheries would reflect the impact on fish and the presence of juvenile stages at the time of a spill as they are more susceptible to relatively low levels of hydrocarbon concentrations within the water column and are less likely to be able to move away. Any impact on juvenile stages could impact short to medium term recruitment to future stocks. Despite the susceptibility of fish larvae and juveniles to relatively low concentrations of hydrocarbons in the water column, adult free swimming fish and wild stocks of commercially important species are likely to detect and avoid hydrocarbon contaminated areas. Following a spillage, the reproductive success of unaffected fish, as well as the influx of larvae from unaffected areas should lead to the recovery of stock numbers. Given that many marine species produce vast numbers of eggs that are widely distributed by sea currents this means that species can recover from small mortality events relatively quickly.

However, fish can become tainted and contaminated with hydrocarbons. If there are signs of fish hydrocarbon tainting or contamination, in the event of a hydrocarbon spill, any resultant imposed authority restrictions on fishing activities could result in detrimental financial impact upon local fisheries. Equally, a lack of timely restrictions, or illegal fishing, can create a risk to human health from contaminated product consumption. A release of diesel (Scenario 1) is unlikely to have an impact on small scale fishing although in the event of a blowout (Scenario 2) the impact from condensate reaching shallow water in areas of small scale fishing is likely to be significant as fishing represents the primary source of household income for the majority of fishermen. In the case of a diesel spill (Scenario 1) it is highly unlikely that the spill will impact important commercial fishing grounds. However in the case of a blowout (Scenario 2) there is high probability that the spilled condensate will result in the concentration of hydrocarbons in the water column exceeding the 58ppb threshold at important commercial fishing grounds such as Kornilov-Pavlov Bank and Makarov Bank leading to the potential for toxic effects to fish and indirectly on human health that could trigger a temporary fishing ban. Therefore, the impact to the commercial fishing industry in the unlikely event of a blowout is considered to be potentially significant.

In the longer term, fishery products that consumers associate with areas affected by a large spill would become less marketable. This is only likely to occur for more substantial spills that endure over a long period and that receive broad media attention. In an extreme case where there are enduring concerns about food safety there could be restrictions placed by national regulators on all commercial fishing across an affected area.

Summary of Hydrocarbon Spill Impacts

Considering the spill scenarios assessed, the following conclusions can be drawn with regard to the impact of hydrocarbon spills on the marine and coastal environment:

- A spill of diesel from the MODU located at the proposed SAX01 well location will have a limited impact to the marine environment as the diesel evaporates and disperses quickly and the concentrations of diesel in the water column above the 58 ppb threshold are limited in extent from the point of release and are not expected to persist for longer than 5 days. Although a small proportion of the spilled diesel may ultimately reach the shoreline it will be below concentrations harmful to the environment.
- A major spill from a well blowout has the greatest potential for impact in terms of volume of hydrocarbons discharged into the marine environment. For the blowout scenario, species in the immediate vicinity of the spill that cannot actively avoid the condensate such as plankton, benthic invertebrates, birds and seals are likely to suffer the greatest impacts. Highly mobile species such as fish are anticipated to largely avoid the spilled areas. The modelling of the blowout shows that a number of IBAs and KBAs, and associated bird species, may be exposed to elevated hydrocarbon concentrations as a result of surface or dispersed / dissolved condensate beaching on the shoreline following a blowout. Given the volume of condensate predicted to beach in some IBAs and KBAs and high water-in-oil concentrations in the shallow waters along the coastline in these areas, the potential impact on IBAs and KBAs (and the birds present there) could potentially be significant, especially if the release occurs during the bird nesting period (April to July). The blowout scenario may also affect small scale fishing grounds along the coast, and commercial fishing.

7.3.4 Spill Prevention and Emergency Response Planning

7.3.4.1 Oil Spill Contingency Planning - Azerbaijan Offshore

The BP AGT Region Offshore Facilities Oil Spill Contingency Plan (OSCP) provides guidance and actions to be taken during a hydrocarbon spill incident associated with all BP AGT Region offshore operations, which include mobile offshore drilling units, platforms, subsea pipelines and marine vessels. It is valid for spills that may occur during all project phases including commissioning, operation, and decommissioning including break periods during periods (e.g. as is potentially the case for the SAX01 well where a break will occur between well suspension and well testing). This plan will be updated to include the planned activities within the Shafag-Asiman Contract Area.

The OSCP 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 platform 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.

Under the BP AGT Region spill procedures, spill incidents are categorised according to the level of resource required to mitigate them. BP has adopted the internationally recognised tiered response concept to oil spill response as shown in Table 7.6.

Table 7.6 Oil Spill Response Tiers

Tier 1	Tier 1 spills are defined as small operational spills that can be can be handled immediately by on-site personnel. In most cases, the response would be to clean up using on site resources.
Tier 2	Tier 2 spills are defined as spills that require additional local (in-country) resources and manpower that are not available on the site that the spill occurs. The site response team would carry out cleanup, aided by the dedicated Tier 2 oil spill contractor.
Tier 3	Tier 3 spills are very large, possibly ongoing spills, which will require additional resources from outside the country of spill origin and is likely to impact the community for an extended period and may arouse national or international media interest. Such spills are very rare and would only occur through events such as a well blowout. All available spill contractors (from within and outside Azerbaijan) would carry out the physical response, with extensive support from the BP Incident Management Team and the Business Support Team.

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. BP also have Tier 2 oil spill response capability in Georgia and Turkey 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 (MES). The OSCP describes how BP will utilise these resources to protect the environment in which it resides.

7.3.4.2 BP Capping Resources - Azerbaijan Offshore

In addition to oil spill response capability, BP also has access to subsea capping equipment, riser adapters, debris removal equipment and Remotely Operated Vehicle (ROV) tooling systems available through subscription to the Subsea Well Response Project (SWRP). OSRL manages and maintains this SWRP equipment, including, four capping stacks which are stored at bases in Norway, Brazil, Singapore and South Africa. In the event of a capping stack being required in the BP AGT Region, the capping stacks in Norway and Brazil are the primary and back-up options. Both capping stacks would be mobilised, by air to Baku, in the case of an incident and plans are in place as to how these would be mobilised and deployed to the Caspian. Detailed plans are in place for the mobilisation and deployment of this equipment, if required.

High flow-rate gas wells with the potential for gas plumes in the Caspian in combination with shallow water may limit vertical access to a failed blow out preventer (BOP) in the event of a subsea capping requirement. In response to this BP also has access to the OSRL provided Offset Installation System, through the SWRP. This equipment allows the deployment of a capping stack without the need to position a vessel directly above the incident site.

As well as planning for subsea capping stack availability, mobilisation and deployment to the well site, BP has also developed procedures and capabilities to allow ROV intervention on the MODU BOP systems to facilitate secondary control in the event of a loss of primary (rig-based) control.

7.3.4.3 Reporting

Under the BP AGT Region spill reporting procedures, all accidental and non-authorised releases (liquids, gases or solids), including releases exceeding approved limits or specified conditions during all phases of the Project, will be internally reported and investigated. Existing external notification requirements agreed with the Ministry of Ecology and Natural Resources (MENR) will be adopted for the Project which are:

- For liquid releases to the environment exceeding a volume of 50 litres, 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 50 litres, 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.

It will be the responsibility of BP to report any spills that occur from vessels used for Project related activities to the MENR. BP will then proceed through their notification process to the MENR to report any unplanned releases.

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.

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8 Environmental and Social Management

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8.1 Introduction

Under the Shafag-Asiman Contract Area Production Sharing Agreement (PSA), BP as Operator, is responsible for the environmental and social management of all Shafag-Asiman exploration drilling activities, to ensure that Project commitments are implemented, and conform to applicable environmental and social legal, regulatory and corporate requirements. This Chapter of the Environmental and Socio-Economic Impact Assessment (ESIA) provides an overview of the system that will be used to manage the environmental and social issues associated with the Shafag-Asiman Exploration Drilling Project (SAX01), henceforth referred to as the “Project”.

8.1.1 Overview of BP AGT Region Operating Management System

BP have an established Operating Management System (OMS) that provides a single framework for operations, people, plant and performance. This system forms BP requirements on health, safety, security, environment, social responsibility and operational reliability etc. into a common management system. The requirements address eight focus areas – the Elements of Operating – under people, plant, process and performance. OMS also provides a process for improving the quality of operating activities – the Performance Improvement Cycle. The structured framework of BP Operating Management System is set out in Figure 8.1.

Figure 8.1 BP Operating Management System Framework

8.2 Implementation

The Mobile Offshore Drilling Unit (MODU) to be used to drill the Project exploration well will be operated by a MODU Operator who has their own independent Health, Safety & Environmental (HSE) Management System (MS) already in place. BP will have overall responsibility for managing the Project activities and will be monitoring and verifying the implementation of environmental and socio-economic mitigation measures detailed in this ESIA.

Separate from the MODU operations, vessel activities will be managed in accordance with the existing relevant BP AGT Region HSE MS requirements as part of BP AGT Region's OMS.

8.2.1 HSSE Bridging Document

Alignment of the plans, procedures and reporting requirements between the MODU Operator's HSE MS and the BP AGT Region HSE MS is currently and will be achieved through the implementation of the Health, Safety, Security and Environment (HSSE) Bridging Document. The purpose of the HSSE Bridging Document is to provide an interface between the two companies HSSE management systems and to ensure that the MODUs Operator implement the activities in conformance with the BP AGT Region HSSE requirements. The aim of the HSSE Bridging Document is to ensure that both the BP AGT Region and the MODU Operator's HSE MS do not result in any of the following, which is reflected in the BP OMS policy:

- Accidents;
- Harm to people; and
- Harm to the environment.

The HSSE Bridging Document is a live document and is reviewed on a regular basis. Both BP's HSE MS and the MODU Operator's HSE MS monitor the same targets and objectives which are separately audited as part of their internal review process. Communications lines are established to ensure the effective sharing of the findings and action lists.

8.2.2 Roles and Responsibilities

The MODU Operator will be responsible for performing the Project activities under their own HSE MS, the BP AGT Region HSE MS (through the implementation of the HSSE Bridging Document) and in accordance with the requirements of this ESIA. The latter will be achieved through the implementation of a number of environmental and social management plans developed for the Project (refer to Section 8.3).

A summary of the key roles and responsibilities for BP and the MODU Operator with regard to the development and implementation of these plans is provided below:

BP

- Development of the management plans for the Project;
- Ensure compliance with applicable environmental legislation;
- Ensure systems are in place to enable compliance with the plans to be achieved;
- Provide support to the MODU Operator in the implementation of the plans;
- Provide environmental and social awareness training to MODU personnel; and
- Ensure all environmental incidents are reported, investigated, root cause identified and action plan developed.

MODU Operator

- Implement the procedures set out within the plans relevant to the MODU activities;
- Ensure MODU personnel have sufficient training to implement the requirements of the plans;
- Report any environmental incidents; and
- Undertake monitoring and reporting relevant to the MODU activities as set out within Section 8.2.5.

8.2.3 Training

Training is fundamental to the successful delivery of environmental and socio-economic aspects of the Project. The Project activities 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 MODU and vessel crews will be capable to undertake drilling operations in compliance with national and international requirements. All training material under the BP and MODU HSE MS will be reviewed by BP and any gaps specific to the Project identified.. Any identified gaps in training will be provided by BP, to raise the environmental and social awareness of the MODU Operator's personnel in areas such ecological and social sensitivities, waste management, hazardous materials management handling, spill prevention and recording and reporting requirements.

8.2.4 Audit and Review

Both the BP and the MODU Operator have systems in place to audit their respective HSE MS. 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 BP and the MODU Operator have systems in place to control communication, tracking and follow up of audit and review recommendations.

In addition to the routine audits undertaken under the BP and MODU HSE MS, BP will undertake periodical environmental checks and reviews specific to this project to ensure compliance with the commitments of this ESIA.

8.2.5 Monitoring and Reporting

Monitoring and reporting will be undertaken in accordance with the requirements as set out within the environmental and social management plans developed for the Project. These plans will be developed in alignment with the BP MODU 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;
- Wastes shipped to shore;
- Drilling/cementing/testing chemicals;
- Mud sampling;
- Rig chemical inventory;
- Use of new or substituted chemicals not included on an approved list;
- Seabed Remotely Operated Underwater Vehicle (ROV) monitoring;
- Material release reporting; and
- Environmental drilling report.

It will be the responsibility of BP to report any material release to the Ministry of Ecology and Natural Resources (MENR). Other external reporting requirements and responsibilities will be set out within the management plans.

8.3 Project Environmental and Social Management Framework

Environmental and socio-economic mitigation and management measures discussed in this ESIA will form the Environmental and Social Management Framework for managing socio-economic and environmental issues throughout the duration of the Project.

8.3.1 Management Plans

The Project specific environmental and social management plans will be developed by BP before the Project commences. The plans, procedures and reporting requirements for the MODU and those relevant to drilling activities will be aligned to the existing BP and MODU Operator's HSE MS, the HSSE Bridging Document and the BP MODU Environmental Operating Procedure and associated Environmental Monitoring & Reporting Forms. The plans will cover the following topics:

- Environmental Management;
- Pollution Prevention Management;
- Waste Management; and
- Communication.

The plans will identify key criteria (e.g. waste volumes, discharge parameters, communication frequency, etc.) that will be used to measure environmental and social performance.

BP will verify that mitigation measures and commitments set out in this ESIA are implemented. This will be achieved through periodical environmental checks and reviews, the results of which will be documented within "Site Inspection Reports". An action-tracking system will be maintained to monitor close-out actions and the effectiveness of actions taken in response to findings.

The sections below provide an overview of the environmental and social management plans, which will be developed specifically for the Project. A summary of the key design controls and mitigation measures set out in Chapters 4, 6 and 7 and 8 of this ESIA are presented in Tables 8.1 to 8.3, which also include references to the location of these measures within this document.

8.3.1.1 Environmental Management Plan

A Project specific Environmental Management Plan will set out the necessary measures (presented in this ESIA, and summarised in Table 8.1) to prevent pollution and limit impacts to the marine environment.

8.3.1.2 Pollution Prevention Management Plan

A Pollution Prevention Management Plan will cover issues such as sewage treatment and disposal, chemical selection management, spill response and notification procedures and monitoring and reporting and will include the measures outlined in Chapters 6 and 7 of this ESIA, as briefly summarised in Table 8.1.

The MODU and support vessels will have Ship Oil Pollution Emergency Plans (SOPEP) detailing response resources and action required to manage fuel spills and to minimise associated impacts on the marine environment.

Offshore Facilities Oil Spill Contingency Plan

As described in Chapter 7: Section 7.3.4.1 the BP AGT Region Offshore Facilities Oil Spill Contingency Plan (OSCP), which provides guidance and actions to be taken during a hydrocarbon spill incident associated with all BP offshore operations will be updated to include the planned activities within the Shafag-Asiman Contract Area.

8.3.1.3 Waste Management Plan

The Waste Management Plan (aligned to applicable national regulatory requirements, good international industry practices, existing BP HSE MS and MODU Operator HSE MS and the associated HSSE Bridging Document) will address the anticipated waste streams, likely quantities, disposal routes and any special handling requirements as presented in this ESIA and set out in Table 8.2.

Key aspects of the Plan will include the following points:

- Waste will only be routed to those waste disposal facilities that have been approved for use by the BP AGT Region.
- Non-hazardous waste generated offshore will be segregated, compacted and stored on-board the MODU and vessels, and then transferred to shore to BP approved waste management facilities for disposal or recycling.
- Hazardous waste streams will be segregated and stored separately to prevent contact between incompatible waste streams. Hazardous waste generated offshore will be stored on board the MODU and vessels in fit for purpose containers and in designated areas and transferred onshore to BP approved waste facilities for treatment and disposal.
- All waste generated offshore will be tracked and controlled. Waste Transfer Notes (WTNs) will be completed for every waste shipment to shore from MODU and vessels. The WTNs will detail 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 sign-off and uplift. All parties involved in transporting wastes will retain a copy of the waste transfer documentation.

8.3.1.4 Communication Management Plan

A Communication Management Plan will set out the communication protocols and key requirements as presented in this ESIA (Chapters 4 and 6) and set out in Table 8.3 below. This includes communicating the drilling programme to the relevant authorities and stakeholders both prior to and during the drilling programme.

Table 8.1 Summary of Key Design Controls, Mitigation Measures, Monitoring and Reporting Requirements for Environmental Management and Pollution Prevention

Reference	Summary of Key Measures Outlined in ESIA Report	Applicable to MODU and/or Support Vessels	Execution Stage[31]
Chapter 4: Section 4.4.1 Mobile Offshore Drilling Unit (MODU) Activities Chapter 6: Table 6.1 Key “Scoped Out” Project Activities (physical presence of MODU and support vessels)	A mandatory 500 m safety exclusion zone (for non-project vessels) will be established around the MODU while drilling is in progress.	MODU	DD
Chapter 4: Table 4.2 Summary of MODU Utilities Chapter 4: Table 4.3 Summary of Vessel Utilities	Grey water will either be sent to the vessel sewage treatment system or discharged to sea (without treatment) as long as no floating matter or visible sheen is observable.	MODU and Support Vessels	Pre-D, DD, PD
	• Under routine conditions black water will be treated within the sewage treatment system to applicable MARPOL 73/78 Annex IV MEPC. 159 (55)[32]. No chlorination of the effluent will be required under routine conditions, however when chlorine is used for disinfectant purposes, the concentration of residual chlorine in the effluent to achieve below 0.5mg/l and discharge to sea. In the event it is not practicable to achieve this concentration, the effluent will be contained and shipped to shore.	MODU	DD
	Under non routine conditions when the sewage treatment system is not available black water will be managed in accordance with the existing BP AGT Region plans and procedures and reported to the MENR as required.	MODU and Support Vessels	DD
	• MODU deck drainage and wash water will be discharged to sea as long as no visible sheen is observable.	MODU	DD
	In the event of a spill, main MODU deck drainage will be diverted to hazardous drainage tank for spills including Synthetic Oil Based Mud (SOBM)/ Low Toxicity Mineral Oil Based Mud (LTMOBM), oil/diesel/cement and oily water. Contents of hazardous waste tank will be shipped to shore for disposal in accordance with the existing BP AGT Region waste management plans and procedures.	MODU	DD

[31] Pre-Drilling (Pre-D), During Drilling (DD), and Post Drilling (PD)

[32] Five day BOD ≤50mg/l, total suspended solids ≤50mg/l (in lab) or ≤100mg/l (on board) and thermotolerant coliform ≤250MPN per 100ml. Residual chlorine as low as practicable where chlorine is added (vessels) or below 0.5mg/l for Istiglal (for sewage treatment systems installed prior to January 2010)

Reference	Summary of Key Measures Outlined in ESIA Report	Applicable to MODU and/or Support Vessels	Execution Stage[31]
	• Bilge water will be sent to a zero discharge centrifuge to separate oily water. Treated bilge water with an oil content less than 15 ppm will be discharged to sea. If the bilge water separator is not operational on the MODU oily bilge water shall be collected and sent to shore; • 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 15 ppm will be discharged to sea.	MODU	DD
	The ballast system is designed so that oil and chemicals do not come into contact with ballast water.	MODU	DD
Chapter 4: Table 4.3 Summary of Vessel Utilities	• Under routine conditions black water will be treated within the vessel sewage treatment system to either: - MARPOL 73/78 Annex IV: Prevention of Pollution by Sewage from Ships standards: Five day BOD ≤50mg/l, total suspended solids ≤50mg/l (in lab) or ≤100mg/l (on board) and thermotolerant coliforms ≤250MPN per 100 ml. Residual chlorine as low as practicable where chlorine is added (for vessel sewage treatment systems installed prior to January 2010); or - MARPOL 73/78 Annex IV MEPC. 159 (55) standards: Five day BOD ≤25mg/l, COD ≤125 mg/l, total suspended solids ≤35mg/l, pH between 6 and 8.5 and thermotolerant coliform 100MPN per 100ml. Where chlorine is added, residual chlorine in the effluent to achieve below 0.5 mg/l (for vessels sewage treatment systems installed after January 2010).	Support Vessels	Pre-D, DD, PD
	Drainage: • 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 to sea or contained and shipped to shore for disposal in accordance with the existing BP AGT Region waste management plans and procedures.	Support Vessels	Pre-D, DD, PD

Reference	Summary of Key Measures Outlined in ESIA Report	Applicable to MODU and/or Support Vessels	Execution Stage[31]
Chapter 6: Table 6.1 Key "Scoped Out" Project Activities	Sampling and Monitoring Black Water: • During periods when the MODU/vessel Sewage Treatment Plant (STP) is in use, sewage samples will be taken from the sewage discharge outlet and analysed monthly for relevant parameters to confirm compliance with the applicable MARPOL 73/78 Annex IV or MARPOL 73/78 Annex IV MEPC. 159 (55) standards; • Daily visual checks will be undertaken when discharging treated black water to confirm no floating solids are observable; and • MODU and support/supply vessels 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 per person per day) will be reported to the Ministry of Ecology and Natural Resources (MENR) upon Project completion. Grey Water and Drainage: • Daily visual checks undertaken when discharging grey water, deck drainage and wash water to confirm no visible sheen is observable; and • Daily estimated volumes of grey water discharged from the MODU and support/supply vessels will be recorded monthly and reported to the MENR upon Project completion. Estimates will be based on generation rates of 0.22m^3 per person per day (grey water).	MODU and Support Vessels	Pre-D, DD, PD
Chapter 4: Section 4.5.2 Drilling String Lubrication	It is anticipated that a heavy metal free dope will be primarily used for this purpose with a small volume of heavy metal dope used for certain operations, including casing connections and associated completions for reliability and safety reasons. Pipe dope of the same or equivalent environmental performance to those currently used and approved within the region will be used for the project.	MODU	DD
Chapter 4: Section 4.5.3 Drilling Fluids and Cutting Generation	Drilling mud for the Project will be routinely prepared on shore and supplied to the MODU via hose connections from supply vessels.	MODU	DD
	Measures to avoid discharges to the marine environment during mud transfer include: • Appropriate design of the mud pumping system and connections between the MODU and supply vessels; • Preventative maintenance of transfer equipment; and • Appropriate training of relevant personnel.	MODU	DD
Chapter 4: Section 4.5.3.1 Upper Hole Sections	Used WBM and cuttings from the 28" hole section will be returned to the MODU via a riserless Mud Recovery System (MRS).	MODU	DD
	• For the 28" hole section, WBM cuttings will be discharged below the sea surface from the MODU cuttings chute in accordance with applicable PSA requirements[33].	MODU	DD

[33] 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.

Reference	Summary of Key Measures Outlined in ESIA Report	Applicable to MODU and/or Support Vessels	Execution Stage[31]
	When drilling of the 28" hole section is completed residual mud will be discharged to sea in accordance with PSA requirements[34].	MODU	DD
Chapter 4: Section 4.5.3.1 Upper Hole Sections Chapter 4: Section 4.5.3.2 Lower Hole Sections Chapter 6: Section 6.3.1 Mitigation [drilling discharges]	The controls associated with MODU drilling discharges to be implemented include the following: • WBM and associated cuttings will be discharged below the sea surface from the MODU cuttings chute or a discharge hose in accordance with PSA requirements[34]; • Synthetic Oil Based Mud (SOBM)/ Low Toxic Mineral Oil Based Mud (LTMOBM) and associated cuttings used for lower hole drilling will be returned to the MODU and separated. Separated SOBM/ LTMOBM will be reused where practicable, and the remainder returned to shore for disposal. SOBM/ 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 SOBM/ LTMOBM or associated cuttings into the marine environment; • During MODU drilling activities, WBM will be separated from cuttings as far as practicable and reused; • WBM additives used during MODU drilling activities will be of low toxicity (UK Offshore Chemical Notification Scheme (OCNS) "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); and • For the upper sections of the well, it is proposed to use pre-hydrated bentonite (PHB) sweeps and a WBM of the same specification and environmental performance as used for previous wells drilled in the Shah Deniz (SD) and Azeri Chirag Gunashli (ACG) Contract Areas. If there is a requirement to change the sweeps/WBM composition or to select different drilling fluids for commercial or technical reasons, the ESIA Management of Change Process (see Chapter 4: Section 4.11) will be followed.	MODU	DD
Chapter 6: Section 6.3.3 Drilling Discharges	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 4: Section 4.11). 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.	MODU	DD
	Each batch of barite supplied for use in WBM will be tested by the supplier to confirm cadmium and mercury content.	MODU	PD
	When WBM and cuttings are discharged from the MODU the chloride concentrations will be analysed twice a day.	MODU	DD

[34] 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.

Reference	Summary of Key Measures Outlined in ESIA Report	Applicable to MODU and/or Support Vessels	Execution Stage[31]
	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.	MODU	DD
	Monitoring of potential effects on seabed and benthic communities will be carried out on completion of drilling activities and monitoring results will be submitted to the MENR	N/A	Annual Report
	An Environmental Report will be submitted to the MENR following the completion of the drilling activities and 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.	MODU	PD
Chapter 4: Section 4.5.5 Casing and Cementing	Dry cement will not be discharged to the marine environment under routine conditions.	MODU	DD
Chapter 6: Section 6.3.1 Mitigation [cement discharges]	Existing controls associated with cement discharges during MODU drilling 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; and • Excess cement at the seabed will be observed and corrective action will be taken to ensure cement discharges are minimised.	MODU	DD
Chapter 6: Section 6.4 Impacts to the Marine Environment (Cementing Discharges)	The volume of cementing chemicals used and discharged will be recorded daily and included within the Environmental Report submitted to the MENR following well drilling and cementing activities.	MODU	DD
Chapter 4: Section 4.6 Well Displacement	The Shafag-Asiman Management of Change Process (Section 4.11) will be followed should alternative well displacement chemicals to those listed in Table 4.12 be required.	MODU	DD

Reference	Summary of Key Measures Outlined in ESIA Report	Applicable to MODU and/or Support Vessels	Execution Stage[31]
	It is not planned to discharge displacement chemicals or fluids to the marine environment under routine conditions.	MODU	DD
Chapter 6: Table 6.1 Key “Scoped Out” Project Activities (Atmospheric emissions (non GHG) from MODU and support vessels power generation during drilling and vessel support activities)	• The following measures will be in place to minimise atmospheric emissions: • MODU and support/supply vessel 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. • Vessels will be well maintained and use good quality, and low sulphur fuel.	MODU and Support Vessels	Pre-D, DD
	• Monitoring and reporting requirements associated with emissions to the atmosphere during MODU drilling 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 within the Environmental Report completed at the end of drilling: - Volume of fuel used by the MODU (recorded daily in tonnes and reported monthly); and - Estimated volumes of emissions generated as a result of fuel used (calculated using emission factors).	MODU	DD, PD
Chapter 6: Section 6.3.1 Mitigation [Underwater sound from MODU drilling and vessels]	To minimise disturbance due to underwater sound, the following measures will be in place: • Project vessels will not intentionally approach seals for the purposes of casual (recreational) marine mammal viewing which may result in disturbance • Support vessels are subject to periodical performance review which includes environmental performance. Corrective actions will be undertaken to address any performance gaps.	Support Vessels	Pre-D, DD, PD
Chapter 6: Section 6.3.5.3 Impact Significance (BOP Fluid Testing Discharges)	BOP fluid sampling will be undertaken at least once during the drilling programme and ecotoxicity testing, involving phytoplankton and zooplankton, will be implemented .	MODU	DD
Chapter 6: Section 6.3.6.1 Event Magnitude (MODU Cooling Water Intake and Discharge)	The MODU cooling water intake design will include the use of a screen mesh to prevent fish entrainment.	MODU	DD,PD
Chapter 7: Section 7.3.2 Release of Chemicals / Waste	All chemicals on the vessels will be labelled and stored appropriately in areas with secondary containment.	Support Vessels	Pre-D, DD

Reference	Summary of Key Measures Outlined in ESIA Report	Applicable to MODU and/or Support Vessels	Execution Stage[31]
Chapter 7: Section 7.3.4.1 7.3.4.1 Oil Spill Contingency Planning - Azerbaijan Offshore Chapter 8: Section 8.3.1.2 Pollution Prevention Management Plan	The BP AGT Region Offshore Facilities Oil Spill Contingency Plan (OSCP) will be updated to include the planned activities within the Shafag-Asiman Contract Area.	-	-
Chapter 8: Section 8.2 Implementation	vessel activities will be managed in accordance with the existing relevant BP AGT Region HSE MS requirements.	Support Vessels	Pre-D, DD, PD
	Alignment of the plans, procedures and reporting requirements of the MODU Operator's HSE MS and the BP AGT Region's HSE MS is currently and will be achieved through the implementation of the Health, Safety, Security and Environment (HSSE) Bridging Document developed by BP and aligned with the MODU Operator's HSE MS.	MODU	Pre-D
	The HSSE Bridging Document is a live document and will be reviewed on a regular basis.	MODU	Pre-D, DD, PD
Chapter 8: Section 8.2.2 Roles and Responsibilities	The MODU Operator will be responsible for performing the Project activities under their own HSE MS, the BP AGT Region HSE MS (through the implementation of the HSSE Bridging Document) and in accordance with the requirements of this ESIA.	MODU	DD
Chapter 8: Section 8.2.3 Training	All training material under the BP and MODU HSE MS will be reviewed by BP and any gaps specific to the Project identified.. Any identified gaps in training will be provided by BP, to raise the environmental and social awareness of the MODU Operator's personnel in areas such ecological and social sensitivities, waste management, hazardous materials management handling, spill prevention and recording and reporting requirements.	MODU	Pre-D
Chapter 8: Section 8.2.4 Audit and Review	Monitoring and reporting will be undertaken in accordance with the requirements as set out within the environmental and social management plans developed for the Project. These plans will be developed in alignment with the BP MODU 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;	MODU	DD, PD

Reference	Summary of Key Measures Outlined in ESIA Report	Applicable to MODU and/or Support Vessels	Execution Stage[31]
	• Volume of drilling fluids and cuttings discharged; • Wastes shipped to shore; • Drilling/cementing/testing chemicals; • Mud sampling; • Rig chemical inventory; • Use of new or substituted chemicals not included on an approved list; • Seabed Remotely Operated Underwater Vehicle (ROV) monitoring; • Material release reporting; and • Environmental drilling report.		
	It will be the responsibility of BP to report any material release to the Ministry of Ecology and Natural Resources (MENR). Other external reporting requirements and responsibilities will be set out within the management plans.	MODU	DD
Chapter 8: Section 8.3.1.1 Environmental Management Plan	A Project specific Environmental Management Plan will be developed and will set out the necessary measures (presented in this ESIA) to prevent pollution and limit impacts to the marine environment.	MODU	Pre-D
Chapter 8: Section 8.3.1.2 Pollution Prevention Management Plan	A Pollution Prevention Management Plan will cover issues such as sewage treatment and disposal, chemical selection management, spill response and notification procedures and monitoring and reporting and will include the measures outlined in Chapters 6 and 7 of the ESIA.	MODU	Pre-D, DD
	The MODU and support vessels will have Ship Oil Pollution Emergency Plans (SOPEP) detailing response resources and action required to manage fuel spills and to minimise associated impacts on the marine environment.	MODU and Support Vessels	Pre-D, DD, PD

Table 8.2 Summary of Key Design Controls, Mitigation Measures, Monitoring and Reporting Requirements for Waste Management

Reference	Summary of Key Measures Outlined in ESIA Report	Applicable to MODU and/or Support Vessels	Execution Stage[31]
Chapter 4: Table 4.2 Summary of MODU Utilities Chapter 4: Table 4.3 Summary of Vessels Utilities	Sewage sludge will be shipped to shore for disposal in accordance with the existing BP AGT Region waste management plans and procedures.	MODU and Support Vessels	Pre-D, DD, PD
	Contents of hazardous waste tank will be shipped to shore for disposal in accordance with the existing BP AGT Region waste management plans and procedures.	MODU	DD
	Waste oil collected from the drainage system will be sent to waste oil tank and transported to shore.	MODU	DD
	Depending on the availability of the system, galley food waste will either be: • 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[35] prior to discharge; or • Contained and shipped to shore for disposal in accordance with the existing BP AGT Region waste management plans and procedures.	MODU and Support Vessels	DD
Chapter 4: Section 4.5.3.2 Lower Hole Sections	Separated SOBM/ LTMOBM will be reused where practicable, and the remainder returned to shore for disposal.	MODU	DD
	SOBM/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 SOBM/LTMOBM or associated cuttings into the marine environment.	MODU	DD
Chapter 4: Section 4.6 Well Displacement	It is planned that displacement chemicals will be circulated back to the MODU with the SOBM/ LTMOBM and either be reused/recycled or will be shipped to shore for disposal in accordance with the existing BP AGT Region waste management plans and procedures.	MODU	DD
Chapter 4: Section 4.9 Well Suspension and Abandonment	During well suspension activities as part of the temporary well abandonment, the SOBM /LTMOBM present above the uppermost plug will be displaced using inhibited seawater/brine. The SOBM/LTMOBM will be recovered to the MODU and shipped to shore.	MODU	DD

[35] Applicability of MARPOL parameters can differ depending on type of vessel. Discharge requirements to be determined when vessel fleet is confirmed

Reference	Summary of Key Measures Outlined in ESIA Report	Applicable to MODU and/or Support Vessels	Execution Stage[31]
Chapter 4: Section 4.10.3 Summary of Hazardous and Non-Hazardous Waste Chapter 7: Section 7.3.2 Release of Chemicals / Waste Chapter 6: Section 6.2 Scoping, Table 6.1 Key "Scoped Out" Project Activities (Waste Generation)	All waste generated during MODU drilling activities will be managed in accordance with the existing BP AGT Region waste management plans and procedures.	MODU	Pre-D, DD,PD
	Waste onboard the MODU and support/supply vessels will be segregated at source, stored and transported in fit for purpose containers.	MODU and Support Vessels	Pre-D, DD,PD
	State licensed and approved waste management facilities will be used for disposal of waste during the drilling programme.	MODU and Support Vessels	
	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.	MODU	
Chapter 8: Environmental and Social Management Section 8.3.1.3 Waste Management Plan	The Waste Management Plan (aligned to applicable national regulatory requirements, good international industry practices, existing BP AGT Region management plans and the existing MODU HSE MS and the associated HSSE Bridging Document) will address the anticipated waste streams, likely quantities, disposal routes and any special handling requirements. Key aspects of the Plan include the following points: • Waste will only be routed to those waste disposal facilities that have been approved for use by the AGT Region. • Non-hazardous waste generated offshore will be segregated, compacted and stored on-board the MODU and vessels, and then transferred to shore to BP approved waste management facilities for disposal or recycling. • Hazardous waste streams will be segregated and stored separately to prevent contact between incompatible waste streams. Hazardous waste generated offshore will be stored on board the MODU and vessels in fit for purpose containers and in designated areas and transferred onshore to BP approved waste facilities for treatment and disposal. • All waste generated offshore will be tracked and controlled. Waste Transfer Notes (WTNs) will be completed for every waste shipment to shore from MODU and vessels. The WTNs will detail 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 sign-off and uplift. All parties involved in transporting wastes will retain a copy of the waste transfer documentation.	MODU	DD

Table 8.3 Summary of Key Design Controls, Mitigation Measures, Monitoring and Reporting Requirements for Communication

Reference	Summary of Key Measures Outlined in ESIA Report	Applicable to MODU and/or Support Vessels	Execution Stage[31]
Chapter 4: Section 4.11 Management of Change Process	During the detailed planning and mobilisation stages of the Project, there may be a need to change a design element or a process. A formal process will be implemented 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.	MODU and Support Vessels	Pre-D, DD, PD
	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 potentially significant environmental or social interactions.	MODU and Support Vessels	Pre-D, DD, PD
	Changes which do not significantly 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.	MODU and Support Vessels	Pre-D, DD, PD
	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.	MODU and Support Vessels	Pre-D, DD, PD
	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 Project ESIA; • Increase the quantity discharged as detailed in the Project ESIA by more than 20%[36][37]; or • Result in the discharge of a chemical not referenced in the Project ESIA and not currently approved by the MENR for use in the same application by existing BP AGT Region operations.	MODU and Support Vessels	Pre-D, DD, PD

[36] 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).

[37] Unless increase is deemed to have no material effect on the associated impact(s).

Reference	Summary of Key Measures Outlined in ESIA Report	Applicable to MODU and/or Support Vessels	Execution Stage[31]
	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.	MODU and Support Vessels	Pre-D, DD, PD
Chapter 6: Section 6.2 Scoping, Table 6.1 Key "Scoped Out" Project Activities (physical presence of MODU and support vessels)	A Notice to Mariners will be issued in advance of the offshore Project activities to warn mariners of the Project including the position/duration of marine exclusion zone around the MODU.	MODU	PD, DD
	The location of the SAX01 well will be clearly marked on marine navigation charts provided to the appropriate relevant authorities	N/A	PD, DD
	All vessels will operate in compliance with national and international maritime regulations for avoiding collisions at sea, including the use of signals and lights.	MODU and Support Vessels	PD, DD
Chapter 7: Section 7.3.4.3 Reporting	Under the BP AGT Region spill reporting procedures, all accidental and non-authorised releases (liquids, gases or solids), including releases exceeding approved limits or specified conditions during all phases of the Project, will be internally reported and investigated.	MODU and Support Vessels	Pre-D, DD, PD
	Existing external notification requirements agreed with the Ministry of Ecology and Natural Resources (MENR) will be adopted for the Project which are: • For liquid releases to the environment exceeding a volume of 50 litres, 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 50 litres, 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.	MODU	Pre-D, DD, PD
	It will be the responsibility of BP to report any spills that occur from vessels used for Project related activities to the MENR.	MODU and Support Vessels	Pre-D, DD, PD

Reference	Summary of Key Measures Outlined in ESIA Report	Applicable to MODU and/or Support Vessels	Execution Stage[31]
Chapter 8: Section 8.3.1.4 Communication Management Plan	A Communication Management Plan will be developed to communicate the drilling programme to the relevant authorities and stakeholders both prior to and during the drilling programme.	MODU and Support Vessels	Pre-D, DD

9 Conclusions

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9.1 Introduction

This Chapter of the Environmental and Socio-Economic Impact Assessment (ESIA) summarises the residual impacts and conclusions of the Shafag-Asiman Exploration Drilling Project (SAX01) (henceforth referred to as the 'Project') ESIA.

9.2 Residual Impacts

Table 9.1 summarises the outcome of impact assessment for the Activities associated with the Project as described in Chapter 6 Environmental and Socio-Economic Impact Assessment.

Table 9.1 Summary of Residual Environmental Impacts for Shafag-Asiman Exploration Drilling Activities

	Event/ Activity	Magnitude				Sensitivity		Overall Score		
		Extent/ Scale	Frequency	Duration	Intensity	Human	Ecological	Event Magnitude	Receptor Sensitivity	Impact Significance
Marine Environment	Underwater Sound (MODU Drilling)	1	1	3	1	-	2	Medium	Low	Minor Negative
	Underwater Sound (Vessel Movements)	1	1	3	1	-	2	Medium	Low	Minor Negative
	Drilling Discharges to Sea	1	2	2	1	-	2	Medium	Low	Minor Negative
	Cement Discharges to Seabed	1	2	1	2	-	2	Medium	Low	Minor Negative
	Cement Unit Wash Out Discharges	1	2	1	2	-	2	Medium	Low	Minor Negative
	BOP Testing	1	3	1	1	-	2	Medium	Low	Minor Negative
	MODU Cooling Water Discharges to Sea	2	1	3	1	-	2	Medium	Low	Minor Negative

Propagation of underwater sound arising from positioning of the Mobile Offshore Drilling Unit (MODU), drilling the well, and vessel movements were calculated using a simplified geometric spreading model to estimate distances at which various impacts on the marine species known to be present in Caspian Sea may occur. With regards to drilling activities, the modelling results show that permanent threshold shift (PTS) and temporary threshold shift (TTS) may occur in seals if the animals remain within 10 metres (m) of the drilling operations. At distances beyond 10 m the likelihood of any observable reactions quickly falls to insignificant. For fish species it is considered that there is a low risk of mortality and recoverable injury for fish of all hearing abilities and a moderate risk of TTS in hearing generalist fish at short distances from the drilling location.

The calculation showed that, during the mobilisation and demobilisation of the MODU, PTS may occur in seals if they remain within a distance of 10 m from the tugs used to position the MODU for a period of 1 hour. TTS may occur if the seals remain within 109 m of the tug operations for a similar period. At distances beyond 436 m the likelihood of any observable responses to sound is expected to be low. TTS may occur in high sensitivity fish if they remain within 54 m of vessels for a period of 12 hours. Recoverable injury may only occur if they remain in close proximity (within 10 m) to the operations for a period of 48 hours.

In relation to vessel movements during the drilling programme, it was calculated that PTS may occur in seals if they remain within a distance of 506 m of the vessels with the loudest sound source (support vessels) for a period of 1 hour. TTS may occur if the seals remain within 10.9 kilometres (km) from support vessels for a similar period. However, it is expected that seals are likely to move away and are unlikely to remain in the vicinity of the sound long enough to result in PTS or TTS (note however that any movement towards or away from the noise source is context-driven by the seal). Moderate behavioural reactions in seals such as changes in swimming direction and speed may occur at distances up to 116.6 km from support vessels. At distances beyond this the likelihood of any observable responses to sound is low. TTS may occur in fish if they remain within 5.4 km of vessels for a period of 12 hours. Recoverable injury was estimated to potentially occur to high sensitivity fish if they remain in close proximity (within 251 m) to the support vessels for a period of 48 hours; although the likelihood is that they will move away from a disturbing sound source.

Risk of injury or significant behavioural disturbance seals is expected to be very low given the drilling, activities are scheduled to avoid the summer feeding periods when seals are most likely to be present on the area and the control measures that will be established during these activities. Based on the predicted event magnitude, receptor characteristics and observed sensitivities the impact from underwater sound was assessed as being of minor negative significance.

During drilling, the largest discharges to the marine environment by volume are drilling discharges, specifically the discharge of drill cuttings and water based drilling mud, and the discharge of cooling water from the MODU cooling water system. Modelling of the drilling discharges was undertaken to confirm the extent and scale of mud and cuttings predicted to be deposited on the seabed during Project drilling. The modelling has shown that such discharges, which are required to meet applicable standards prior to discharge, have a very limited ecological impact to marine receptors. Based on the predicted event magnitude, receptor characteristics and observed sensitivities the impact significance was assessed as minor negative. Cooling water discharge modelling similarly indicated impacts would be very limited in scale (a few metres) and an impact upon biological receptors in the water column (i.e. zooplankton, phytoplankton, seals and fish) would be of no more than minor negative significance.

Small quantities of excess cement may be discharged to the seabed whilst cementing well casings into place. These will remain close to the wellhead in the same area as drill cuttings are deposited. At the end of well casing cementing activities there will also be small discharges of washout cement from the MODU cement system, which will be diluted with seawater prior to being discharged. Modelling of the cement washout discharges predict that the discharge plume will dilute rapidly and no cement solids would be deposited on the seabed. The impact to benthic invertebrates and seals, fish and plankton, which were evaluated as having a low sensitivity to cement discharges, resulting in a minor negative significance.

During drilling, a blowout preventer (BOP) will be installed on the well to control pressure in the well. The BOP control system uses hydraulic fluids to actuate the BOP valves. Testing of the valves is expected to occur weekly, resulting in discharge of control fluids to sea. Modelling of a similar BOP control fluid discharge conservatively assumed that the discharge would require a dilution of 500-fold to reach the no-effect concentration. The modelling results show that the maximum extent of the 500-fold dilution plume area during summer is approximately 28 m long, 6 m wide and that the plume will completely disperse in the water column to the no-effect concentration within 15 minutes. The impact to benthic invertebrates and seals, fish and plankton, which were evaluated as having a low sensitivity to BOP fluid discharges, was therefore assessed as being of minor negative significance.

For all 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.

9.3 Cumulative, Transboundary and Accidental Events

Potential cumulative and transboundary impacts were assessed taking into account potential for inter project impacts as well as other potentially significant projects where the associated impacts may overlap geographically or temporally with Project impacts. The most significant project where this potential exists is the Shah Deniz Stage 2 (SD2) Project, which achieved first gas during 4Q 2018[38].

With regard to discharges within the water column, the majority of the Project discharges are small, and are comparable to discharges associated with previous MODU drilling activities. There is limited potential for the Project drilling and MODU discharges (e.g. drill cuttings and cooling water discharges) to interact given the temporal and spatial differences between the discharge events and locations. The largest discharges will be confined to a small area of seabed (drilling discharges) or will be short in

[38] While SD2 Project operations and first gas commenced in Q4 2018 the potential effects of the SD2 Project are not captured within the existing baseline conditions described in Chapter 5 against which the Project impacts have been assessed. Therefore, for the purposes of this ESIA, the SD2 Project activities and impacts have been considered within the Project assessment.

duration. All of these discharges will be dispersed and diluted to concentrations below the threshold of impact within (at most) a few hundred metres of the source and therefore have no potential for cumulative impacts. All of the discharges associated with the Project have been assessed, and it is concluded that there will be no cumulative or additive interactions between the impacts.

Based on the findings of the SD2 Project ESIA (which predicted minor and localised impacts from discharges to sea with magnitude limited to no more than a few kilometres from the drilling rig, project vessel, platform or subsea installation) it is considered very unlikely there will be cumulative impacts within the marine environment between the Project and SD2 Project planned activities given the scale of the impacts anticipated and the distance between the Project activities and any future development within the SD Contract Area.

It is considered that the potential socio-economic cumulative impacts to other marine users such as fishing and shipping that may arise as a result of the Project in combination with the SD2 Project (where construction and installation activities are largely complete) will be very limited and insignificant. This is due to the short-term duration of the Project activities and that the proposed SAX01 well is not located in an area of importance to small-scale or commercial fishing nor is it located near known major shipping routes.

Greenhouse gases (GHG) have the potential to give rise to transboundary impacts. The estimated GHG emissions associated with Project represent approximately 1.1.% of the annual operational GHG emissions from BP's upstream activities in Azerbaijan based on GHG emissions data from 2018.

To support the assessment of unplanned events, modelling of potential hydrocarbon spill scenarios using Stiftelsen for Industriell og Teknisk Forskning (SINTEF)'s Oil Spill Contingency and Response (OSCAR) modelling software was undertaken to predict the behaviour of the spilled hydrocarbon in the water column and on the sea surface and to estimate where and how much spilled hydrocarbon may come ashore. It must be noted that modelling has not taken into account any response mitigation measures such as dispersant application, containment or recovery, meaning that the results should only be interpreted as indication of theoretical spill consequences without implementation of the oil pollution prevention strategy. The key accidental event scenarios modelled and assessed included:

- Scenario 1: MODU inventory loss of 1500 m^3 of diesel;
- Scenario 2: A blowout of gas / condensate (34816 barrels (bbls/day) over 224 day duration.

The modelling predicts that following the release of 1500 m^3 of diesel it will initially spread across the sea surface, and over the first seven days following the release around 56% of the diesel evaporates and 16% is dispersed into the water column. Dispersion and dissolution into the upper water column takes place very close to the release point to a depth of 40-60 m. Biodegradation also progresses relatively quickly such that only a very small fraction of diesel in the water column is left after 30 days. After 30 days 61% of the diesel evaporates, 30% is biodegraded, 5% remains in the water column, 2% is deposited in sediments and 2% will reach the coastline. The spill modelling indicates that the concentrations of diesel in the water column above the 58 parts per billion (ppb) threshold are limited in extent from the point of release and are not expected to persist for longer than 5 days. The modelling predicts there will only be a very light deposition of diesel where it comes ashore.

Modelling for the blowout event was based on a worst case estimate that the release would continue for an estimated 224 days, based on the anticipated time it would take to drill a relief well. During this time, approximately 34816 bbls/day of condensate would be released per day. The modelling predicts the majority of the condensate is initially present on the sea surface following the release, while 20% evaporates almost immediately and 5% is dispersed into the water column. Throughout the 224 days release period, condensate is continually supplied to the surface. Dependent on the wind and waves, it can continue to be mixed into the water column during rougher weather with some condensate subsequently re-surfacing during calmer periods. After approximately 18 days, condensate has moved into shallower waters along the Azerbaijan coastline and begins to start to deposit in sediments and accounts for 8% of the condensate at the end of the simulation.

Condensate on the sea surface is predicted to travel up to 400-500 km before it drops below the lowest recognised visible thickness under ideal viewing conditions. Although the precise movement of the surface condensate is dependent on the exact metocean conditions at the time, the analysis of over

100 different sets of metocean data suggest that the most likely locations to receive condensate on shore are southern Azerbaijan, northern Iran and the tip of the Absheron Peninsula. The extent of condensate in the water column above the 58 ppb threshold tracks the path of the surface release and can extend over 500 km from the source. The modelling predicts that a blowout under worst case conditions could result in 32198 tonnes of condensate reaching the coastline and that this would mainly impact three areas: southern Azerbaijan, northern Iran and the Absheron Peninsula. The eastern coastline of the Caspian Sea is unaffected. A mixture of areas of very light, light (0.1-1mm), moderate (1-10mm) and heavy (>10mm) condensate deposition are predicted in these areas. 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 higher concentrations. These wax particles may melt in the sun during the day and soak into sandy shoreline substrates.

In the event of a blowout, species in the immediate vicinity of the spill that cannot actively avoid the condensate such as plankton, benthic invertebrates, birds and seals are likely to suffer the greatest impacts. Highly mobile species such as fish are anticipated to largely avoid the spilled oil areas. The modelling of the blowout shows that a number of Important Bird Areas (IBAs) and Key Biodiversity Areas (KBAs), and associated bird species may be exposed to elevated hydrocarbon concentrations as a result of surface or dispersed / dissolved oil beaching on the shoreline. Given the volume of condensate predicted to beach in some IBAs and KBAs the potential impact on IBAs and KBAs (and the birds present there) could be potentially significant, especially if the release occurs during the bird nesting period (April to July).

In the event of a blowout the potential impacts are assumed to be significant for the areas impacted by the spill and it is anticipated that recovery would take a period of time in the medium to long term. However, compared to crude oils, the condensate reaching the shore will contain lower levels of potentially toxic chemical compounds. Therefore, the ecological effects of condensate coming ashore are likely to be much less severe than would be the case for emulsified crude oil coming ashore. The impact on fisheries would be reflected by the impact on fish and the presence of juvenile stages at the time of a spill as they are more susceptible to relatively low levels of oil within the water column and are less likely to be able to move away. Fish can become tainted and contaminated with hydrocarbons. If there are signs of fish oil tainting or contamination as a consequence of a hydrocarbon spill event, any resultant imposed authority restrictions on fishing activities could result in a detrimental financial impact upon local fisheries. Equally, a lack of timely restrictions, or illegal fishing, can create a risk to human health from contaminated product consumption. Therefore, the impact to the commercial fishing industry in the unlikely event of a blowout or pipeline rupture is considered to be potentially significant.

The BP Azerbaijan Georgia Turkey (AGT) Region Offshore Facilities Oil Spill Contingency Plan (OSCP) provides guidance and actions to be taken during a hydrocarbon spill incident associated with all ACG and SD 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. This plan will be updated to include activities within the Shafag-Asiman Contract Area.

9.4 Environmental and Social Management

BP will have overall responsibility for managing the Project activities and will be monitoring and verifying the implementation of environmental and socio-economic mitigation measures detailed in this ESIA.

The Project specific environmental and social management plans will be developed by BP before the Project commences. The plans, procedures and reporting requirements for the MODU and those relevant to drilling activities will be aligned to the existing BP and MODU Operator's Health Safety and Environmental (HSE) Management System (MS), the Health Safety, Security and Environment (HSSE) Bridging Document and the BP MODU Environmental Operating Procedure and associated Environmental Monitoring & Reporting Forms. The plans will cover the following topics:

- Environmental Management;
- Pollution Prevention Management;
- Waste Management; and
- Communication.

The plans will identify key criteria (e.g. waste volumes, discharge parameters, communication frequency, etc.) that will be used to measure environmental and social performance.

BP will verify that mitigation measures and commitments set out in this ESIA are implemented. This will be achieved through periodical environmental checks and reviews, the results of which will be documented within “Site Inspection Reports”. An action-tracking system will be maintained to monitor close-out actions and the effectiveness of actions taken in response to findings.

9.5 Conclusions

Activities associated with the Project have been assessed and residual environmental and socio-economic impacts identified have been of negligible or minor adverse in significance.

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 duration of the Project.

Appendices

APPENDIX 4A
Cement Chemicals

Table 4A.1 Estimated Volume of Cement Chemicals Used and Worst Case Discharged – Top Hole Sections

Chemicals	Hazard Category	36" Conductor		28" Liner		22" Casing	
		Estimated Use per Hole (tonnes)	Worst Case Discharged (tonnes)	Estimated Use per Hole (tonnes)	Worst Case Discharged (tonnes)	Estimated Use per Hole (tonnes)	Worst Case Discharged (tonnes)
D907 - CLASS G CEMENT	E	0.000	0.000	0.000	0.000	0.000	0.000
D903 - CLASS C CEMENT	E	200.000	100.000	150.000	65.000	250.000	100.000
D076 - HEMATITE WEIGHTING AGENT	E	0.000	0.000	0.000	0.000	0.000	0.000
D222 - MICROMAX	E	0.000	0.000	0.000	0.000	0.000	0.000
D066 - SILICA FLOUR	E	0.000	0.000	0.000	0.000	0.000	0.000
D174 - EXPANDING CEMENT LT	E	0.000	0.000	0.000	0.000	0.000	0.000
D206 - ANTIFOAMING AGENT	Gold	0.379	0.030	0.644	0.644	0.984	0.984
D182 - MUDPUSH II	Gold	0.000	0.000	0.408	0.408	0.454	0.454
F103 - EZEFLO* SURFACTANT	Gold	0.000	0.000	0.000	0.000	0.000	0.000
U066 - MUTUAL SOLVENT	Gold	0.000	0.000	0.000	0.000	0.000	0.000
U067 - MUTUAL SOLVENT	Not currently listed in UK OCNS Lists of Notified and Ranked Products	0.000	0.000	0.000	0.000	0.000	0.000
D231 - CEMPRIME	Not currently listed in UK OCNS Lists of Notified and Ranked Products	0.000	0.000	0.000	0.000	0.000	0.000
D232 - CEMPRIME	Gold	0.000	0.000	0.000	0.000	0.000	0.000
D075 - SODIUM SILICATE EXTENDER	E	1.842	0.147	0.000	0.000	0.000	0.000
D077 - LIQUID ACCELERATOR	E	1.567	0.125	0.000	0.000	0.000	0.000

Chemicals	Hazard Category	36" Conductor		28" Liner		22" Casing	
		Estimated Use per Hole (tonnes)	Worst Case Discharged (tonnes)	Estimated Use per Hole (tonnes)	Worst Case Discharged (tonnes)	Estimated Use per Hole (tonnes)	Worst Case Discharged (tonnes)
B038 - LT LIQUID EXTENDER	Not currently listed in UK OCNS Lists of Notified and Ranked Products	0.000	0.000	2.271	0.182	5.905	0.472
D257 - LIQUID ANTISETTLING AGENT	Gold	0.000	0.000	0.000	0.000	0.000	0.000
D185 - DISPERSANT LOW TEMP (LIQUID)	Not currently listed in UK OCNS Lists of Notified and Ranked Products	0.390	0.031	0.390	0.031	0.390	0.031
D153A - SOLID ANTISETTLING AGENT	E	0.000	0.000	0.000	0.000	0.000	0.000
D230 - DISPERSANT,LOW TEMP	Gold	0.390	0.031	0.390	0.031	0.390	0.031
D240 - DISPERSANT,MED TEMP	E	0.000	0.000	0.000	0.000	0.000	0.000
D500 - LOW TEMP. GASBLOK	Gold	0.000	0.000	5.735	0.459	8.411	0.673
D600G - GASBLOK ADDITIVE	Gold	0.000	0.000	0.000	0.000	0.000	0.000
D700 - GASBLOK HIGH TEMPERATURE ADDITIVE	Gold	0.000	0.000	0.000	0.000	0.000	0.000
D168 - FLUID LOSS ADDITIVE	Gold	0.000	0.000	0.000	0.000	0.000	0.000
D256 - FLUID LOSS ADDITIVE	Gold	0.000	0.000	0.000	0.000	0.000	0.000
D081 - LIQUID RETARDER	E	0.000	0.000	0.000	0.000	2.385	0.191
D177 - RETARDER ADDITIVE	Not currently listed in UK OCNS Lists of Notified and Ranked Products (former B)	0.000	0.000	0.416	0.033	2.082	0.167
D801 - LIQUID RETARDER	E	0.000	0.000	0.000	0.000	0.000	0.000

Chemicals	Hazard Category	36" Conductor		28" Liner		22" Casing	
		Estimated Use per Hole (tonnes)	Worst Case Discharged (tonnes)	Estimated Use per Hole (tonnes)	Worst Case Discharged (tonnes)	Estimated Use per Hole (tonnes)	Worst Case Discharged (tonnes)
D110 - HIGH TEMP. LIQUID RETARDER	Gold	0.000	0.000	0.000	0.000	0.000	0.000
D095 - CEMNET ADDITIVE	E	0.227	0.018	0.000	0.000	0.000	0.000
D097 - LOSSEAL MICROFRACTURE	E	0.000	0.000	0.136	0.011	0.227	0.018
D259 - CEMPRIME SCRUB	Gold	0.000	0.000	0.000	0.000	0.000	0.000

Table 4A.2 Estimated Volume of Cement Chemicals Used and Worst Case Discharged - Lower Hole Sections (18" Liner to 7 $^5/_8$" Liner)

Chemicals	Hazard Category	18" Liner		16" Liner		14" Casing		11 7/8" Liner		10" Liner		7 5/8" Liner	
		Estimated Use per Hole (tonnes)	Worst Case Discharged (tonnes)	Estimated Use per Hole (tonnes)	Worst Case Discharged (tonnes)	Estimated Use per Hole (tonnes)	Worst Case Discharged (tonnes)	Estimated Use per Hole (tonnes)	Worst Case Discharged (tonnes)	Estimated Use per Hole (tonnes)	Worst Case Discharged (tonnes)	Estimated Use per Hole (tonnes)	Worst Case Discharged (tonnes)
D907 - CLASS G CEMENT	E	160.000	12.800	160.000	12.800	200.000	16.000	150.000	12.000	90.000	7.200	50.000	4.000
D903 - CLASS C CEMENT	E	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
D076 - HEMATITE WEIGHTING AGENT	E	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	50.000	4.000
D222 - MICROMAX	E	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	50.000	4.000
D066 - SILICA FLOUR	E	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	17.500	1.400
D174 - EXPANDING CEMENT LT	E	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000

Chemicals	Hazard Category	18" Liner		16" Liner		14" Casing		11 7/8" Liner		10" Liner		7 5/8" Liner	
		Estimated Use per Hole (tonnes)	Worst Case Discharged (tonnes)	Estimated Use per Hole (tonnes)	Worst Case Discharged (tonnes)	Estimated Use per Hole (tonnes)	Worst Case Discharged (tonnes)	Estimated Use per Hole (tonnes)	Worst Case Discharged (tonnes)	Estimated Use per Hole (tonnes)	Worst Case Discharged (tonnes)	Estimated Use per Hole (tonnes)	Worst Case Discharged (tonnes)
D206 - ANTIFOAMING AGENT	Gold	0.568	0.045	0.568	0.045	0.568	0.045	0.568	0.045	0.454	0.036	0.454	0.036
D182 - MUDPUSH II	Gold	0.544	0.044	0.544	0.044	0.680	0.054	0.544	0.044	0.408	0.033	0.408	0.033
F103 - EZEFLO* SURFACTANT	Gold	1.281	0.102	1.281	0.102	2.135	0.171	1.744	0.139	1.744	0.139	1.744	0.139
U066 - MUTUAL SOLVENT	Gold	1.226	0.098	1.226	0.098	2.044	0.164	1.669	0.134	1.669	0.134	1.669	0.134
U067 - MUTUAL SOLVENT	Not currently listed in UK OCNS Lists of Notified and Ranked Products	1.295	0.104	1.295	0.104	2.158	0.173	1.762	0.141	1.762	0.141	1.762	0.141
D231 - CEMPRIME	Not currently listed in UK OCNS Lists of Notified and Ranked Products	1.458	0.117	1.458	0.117	2.430	0.194	1.985	0.159	1.985	0.159	1.985	0.159
D232 - CEMPRIME	Gold	1.417	0.113	1.417	0.113	2.362	0.189	1.929	0.154	1.929	0.154	1.929	0.154
D075 - SODIUM SILICATE EXTENDER	E	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
D077 - LIQUID ACCELERATOR	E	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000

Chemicals	Hazard Category	18" Liner		16" Liner		14" Casing		11 7/8" Liner		10" Liner		7 5/8" Liner	
		Estimated Use per Hole (tonnes)	Worst Case Discharged (tonnes)	Estimated Use per Hole (tonnes)	Worst Case Discharged (tonnes)	Estimated Use per Hole (tonnes)	Worst Case Discharged (tonnes)	Estimated Use per Hole (tonnes)	Worst Case Discharged (tonnes)	Estimated Use per Hole (tonnes)	Worst Case Discharged (tonnes)	Estimated Use per Hole (tonnes)	Worst Case Discharged (tonnes)
B038 - LT LIQUID EXTENDER	Not currently listed in UK OCNS Lists of Notified and Ranked Products	5.905	0.472	5.905	0.472	2.271	0.182	0.227	0.018	0.136	0.011	0.136	0.011
D257 - LIQUID ANTISETTLING AGENT	Gold	0.439	0.035	0.439	0.035	1.317	0.105	0.220	0.018	0.132	0.011	0.132	0.011
D185 - DISPERSANT LOW TEMP (LIQUID)	Not currently listed in UK OCNS Lists of Notified and Ranked Products	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
D153A - SOLID ANTISETTLING AGENT	E	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.544	0.044
D230 - DISPERSANT,LOW TEMP	Gold	0.390	0.031	0.390	0.031	0.390	0.031	0.000	0.000	0.000	0.000	0.000	0.000
D240 - DISPERSANT,MED TEMP	E	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.428	0.034	0.428	0.034
D500 - LOW TEMP. GASBLOK	Gold	8.411	0.673	8.411	0.673	11.470	0.918	0.000	0.000	0.000	0.000	0.000	0.000
D600G - GASBLOK ADDITIVE	Gold	0.000	0.000	0.000	0.000	0.000	0.000	11.583	0.927	6.950	0.556	6.950	0.556
D700 - GASBLOK HIGH	Gold	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	6.950	0.556	6.950	0.556

Chemicals	Hazard Category	18” Liner		16” Liner		14” Casing		11 7/8” Liner		10” Liner		7 5/8” Liner	
		Estimated Use per Hole (tonnes)	Worst Case Discharged (tonnes)	Estimated Use per Hole (tonnes)	Worst Case Discharged (tonnes)	Estimated Use per Hole (tonnes)	Worst Case Discharged (tonnes)	Estimated Use per Hole (tonnes)	Worst Case Discharged (tonnes)	Estimated Use per Hole (tonnes)	Worst Case Discharged (tonnes)	Estimated Use per Hole (tonnes)	Worst Case Discharged (tonnes)
TEMPERATURE ADDITIVE													
D168 - FLUID LOSS ADDITIVE	Gold	0.000	0.000	0.000	0.000	0.000	0.000	4.906	0.392	3.271	0.262	3.271	0.262
D256 - FLUID LOSS ADDITIVE	Gold	0.000	0.000	0.000	0.000	0.000	0.000	4.270	0.342	2.847	0.228	2.847	0.228
D081 - LIQUID RETARDER	E	2.385	0.191	2.385	0.191	4.770	0.382	0.000	0.000	0.000	0.000	0.000	0.000
D177 - RETARDER ADDITIVE	Not currently listed in UK OCNS Lists of Notified and Ranked Products (former B)	2.082	0.167	2.082	0.167	4.164	0.333	0.000	0.000	0.000	0.000	0.000	0.000
D801 - LIQUID RETARDER	E	0.000	0.000	0.000	0.000	0.000	0.000	5.360	0.429	3.216	0.257	3.216	0.257
D110 - HIGH TEMP. LIQUID RETARDER	Gold	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
D095 - CEMNET ADDITIVE	E	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
D097 - LOSSEAL MICROFRACTURE	E	0.136	0.011	0.136	0.011	0.136	0.011	0.136	0.011	0.091	0.007	0.091	0.007
D259 - CEMPRIME SCRUB	Gold	0.000	0.000	0.000	0.000	0.295	0.024	0.000	0.000	0.000	0.000	0.000	0.000

Table 4A.3 Estimated Volume of Cement Chemicals Used and Worst Case Discharged Estimate Chemicals - Lowest Hole Sections and Plugs(

Chemicals	Hazard Category	8-1/2" hole plug back		T.A. plugs		10" tieback		P.A. plugs	
		Estimated Use per Hole (tonnes)	Worst Case Discharged (tonnes)	Estimated Use per Hole (tonnes)	Worst Case Discharged (tonnes)	Estimated Use per Hole (tonnes)	Worst Case Discharged (tonnes)	Estimated Use per Hole (tonnes)	Worst Case Discharged (tonnes)
D907 - CLASS G CEMENT	E	50.000	4.000	50.000	4.000	50.000	4.000	300.000	16.000
D903 - CLASS C CEMENT	E	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
D076 - HEMATITE WEIGHTING AGENT	E	50.000	4.000	50.000	4.000	50.000	4.000	150.000	8.000
D222 - MICROMAX	E	50.000	4.000	50.000	4.000	50.000	4.000	150.000	8.000
D066 - SILICA FLOUR	E	17.500	1.400	17.500	1.400	17.500	1.400	75.000	4.000
D174 - EXPANDING CEMENT LT	E	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
D206 - ANTIFOAMING AGENT	Gold	0.454	0.036	0.454	0.036	0.454	0.036	1.817	0.097
D182 - MUDPUSH II	Gold	0.408	0.033	0.408	0.033	0.408	0.033	2.041	0.109
F103 - EZEFLO* SURFACTANT	Gold	1.744	0.139	1.744	0.139	1.744	0.139	8.006	0.427
U066 - MUTUAL SOLVENT	Gold	1.669	0.134	1.669	0.134	1.669	0.134	7.665	0.409
U067 - MUTUAL SOLVENT	Not currently listed in UK OCNS Lists of Notified and Ranked Products	1.762	0.141	1.762	0.141	1.762	0.141	8.091	0.432
D231 - CEMPRIME	Not currently listed in UK OCNS Lists of Notified and Ranked Products	1.985	0.159	1.985	0.159	1.985	0.159	9.113	0.486
D232 - CEMPRIME	Gold	1.929	0.154	1.929	0.154	1.929	0.154	8.858	0.472

Chemicals	Hazard Category	8-1/2" hole plug back		T.A. plugs		10" tieback		P.A. plugs	
		Estimated Use per Hole (tonnes)	Worst Case Discharged (tonnes)	Estimated Use per Hole (tonnes)	Worst Case Discharged (tonnes)	Estimated Use per Hole (tonnes)	Worst Case Discharged (tonnes)	Estimated Use per Hole (tonnes)	Worst Case Discharged (tonnes)
D075 - SODIUM SILICATE EXTENDER	E	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
D077 - LIQUID ACCELERATOR	E	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
B038 - LT LIQUID EXTENDER	Not currently listed in UK OCNS Lists of Notified and Ranked Products	0.000	0.000	0.000	0.000	1.363	0.109	6.814	0.363
D257 - LIQUID ANTISETTLING AGENT	Gold	0.220	0.018	0.220	0.018	0.220	0.018	1.581	0.084
D185 - DISPERSANT LOW TEMP (LIQUID)	Not currently listed in UK OCNS Lists of Notified and Ranked Products	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
D153A - SOLID ANTISETTLING AGENT	E	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
D230 - DISPERSANT,LOW TEMP	Gold	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
D240 - DISPERSANT,MED TEMP	E	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
D500 - LOW TEMP. GASBLOK	Gold	0.000	0.000	0.000	0.000	0.000	0.000	4.588	0.245
D600G - GASBLOK ADDITIVE	Gold	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
D700 - GASBLOK HIGH TEMPERATURE ADDITIVE	Gold	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000

Chemicals	Hazard Category	8-1/2" hole plug back		T.A. plugs		10" tieback		P.A. plugs	
		Estimated Use per Hole (tonnes)	Worst Case Discharged (tonnes)	Estimated Use per Hole (tonnes)	Worst Case Discharged (tonnes)	Estimated Use per Hole (tonnes)	Worst Case Discharged (tonnes)	Estimated Use per Hole (tonnes)	Worst Case Discharged (tonnes)
D168 - FLUID LOSS ADDITIVE	Gold	3.271	0.262	3.271	0.262	3.271	0.262	7.359	0.392
D256 - FLUID LOSS ADDITIVE	Gold	2.847	0.228	2.847	0.228	2.847	0.228	6.405	0.342
D081 - LIQUID RETARDER	E	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
D177 - RETARDER ADDITIVE	Not currently listed in UK OCNS Lists of Notified and Ranked Products (former B)	0.000	0.000	0.000	0.000	0.000	0.000	3.123	0.167
D801 - LIQUID RETARDER	E	3.573	0.286	3.573	0.286	3.573	0.286	5.360	0.286
D110 - HIGH TEMP. LIQUID RETARDER	Gold	2.567	0.205	2.567	0.205	2.567	0.205	5.133	0.274
D095 - CEMNET ADDITIVE	E	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
D097 - LOSSEAL MICROFRACTURE	E	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
D259 - CEMPRIME SCRUB	Gold	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000

APPENDIX 6A
Shafag-Asiman Marine Discharges Modelling Report

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APPENDIX 7A
Shafag-Asiman Oil Spill Modelling Report

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