APPENDIX 2A

Azeri Chirag Gunashli Production Sharing Agreement Extract

ARTICLE 26 - Environmental Protection and Safety

26.1 Conduct of Operations

Contractor shall conduct the Petroleum Operations in a diligent, safe and efficient manner in accordance with Good International Petroleum Industry Practice and shall take all reasonable actions in accordance with said standards to minimise any potential disturbance to the general environment, including the surface, subsurface, sea, air, lakes, rivers, animal life, plant life, crops, other natural resources and property. The order of priority for actions shall be the protection of life, environment and property.

26.2 Emergencies

In the event of emergency and accidents, including explosions, blow-outs, leaks and other incidents which damage or might damage the environment, Contractor shall promptly notify SOCAR and MENR of such circumstances and of its first steps to remedy this situation and the results of said efforts. Contractor shall use all reasonable endeavours to take immediate steps to bring the emergency situation under control and protect against loss of life and loss of or damage to property and prevent harm to natural resources and to the general environment. Contractor shall also report to SOCAR and appropriate Government authorities on the measures taken

26.3 Compliance

Contractor shall comply with present and future Azerbaijani laws or regulations of general applicability with respect to public health, safety and protection and restoration of the environment, to the extent that such laws and regulations are no more stringent than the then current Good International Petroleum Industry Practice being at the date of execution of this Contract those shown in Appendix 9, with which Contractor shall comply. If Appendix 9 specifies more than one standard with respect to a matter, Contractor will use the standard most appropriate relative to the ecosystem of the Caspian Sea. In the event any regional or multi-governmental authority having jurisdiction enacts or promulgates environmental standards relating to the Contract Area, the Parties will discuss the possible impact thereof on the project. The provisions of Article 23.2 shall apply to any compliance or attempted compliance by Contractor with any such standards, which adversely affect the rights or interests of Contractor hereunder.

26.4 Baseline Study and Ongoing Environmental Monitoring

a) In order to determine the state of the environment in the Contract Area at the Effective Date, Contractor shall cause an environmental base line study to be carried out by a recognized international environmental consulting firm selected by Contractor, and acceptable to SOCAR. SOCAR shall nominate representatives to participate in preparation of the study in collaboration with such firm and Contractor representatives. The costs of such study shall be borne by Contractor, except that SOCAR shall be liable for all costs associated with the representatives nominated by SOCAR. The costs associated with this study shall be subject to Cost Recovery in accordance with Article 11. Contractor shall conduct ongoing environmental monitoring of its operations. Data collected will be evaluated at least annually to determine if any practices and discharge standards need to be revised. The Environmental Strategy included in Appendix 9 outlines the environmental program that Contractor (and SOCAR in the event it carries out operations with or without a Third Party pursuant to Article 15.2(c)) will follow during the course of Petroleum Operations within the Contract Area. The evaluation of data collected during the ongoing monitoring program, together with the baseline study, will provide a basis for determining whether any unacceptable environmental impact has been caused by Contractor in the course of conducting Petroleum Operations and for which Contractor may be liable under Article 20.2, or whether the conditions leading to such impact existed prior to the commencement of Petroleum Operations or otherwise from activities conducted by a party other than Contractor. SOCAR and Contractor shall review the environmental base line study and consult to determine whether any remedial action is warranted to mitigate the effects of any impact which occurs or has occurred from such prior conditions, and if so, whether a programme of remediation could be carried out by Contractor, it being agreed among the Parties that Contractor shall not be liable for any of the expense of such a remedial programme. Any such remedial program undertaken will be considered outside the scope of the Environmental Strategy and will be conducted pursuant to the terms of a separate agreement between SOCAR and Contractor.

b) In the event SOCAR and/or any Third Party operates any facilities with respect to development of Non-Associated Natural Gas pursuant to Article 15.2(c), then in connection with performance of the ongoing monitoring program Contractor shall have the right to make periodic inspections of such facilities and SOCAR's and/or any Third Party's operations with respect thereto, including, but not limited to, the placement of monitoring devices and collection of samples relevant to the monitoring program. Contractor's above referenced inspections, sampling and placement of monitoring devices shall be performed by Contractor in a manner which does not unreasonably interfere with SOCAR's and/or any such Third Party's operations on above referenced facilities.

26.5 Environmental Damage

c) Contractor shall be liable for those direct losses or damages incurred by a Third Party (other than the Government) arising out of any environmental pollution determined by the appropriate court of the Republic of Azerbaijan to have been caused by the fault of Contractor. In the event of any environmental pollution or environmental damage caused by the fault of Contractor, Contractor shall reasonably endeavour, in accordance with Good International Petroleum Industry Practice, to mitigate the effect of any such pollution or damage on the environment.

d) Contractor shall not be responsible and shall bear no cost, expense or liability for claims, damages or losses arising out of or related to any environmental pollution or other environmental damage, condition or problems which it did not cause, including but not limited to those in existence prior to the Effective Date, as well as any environmental pollution or other environmental damage, condition or problems arising out of SOCAR's and/or any Third Party's development of Non-Associated Natural Gas pursuant to Article 15.2(c); and SOCAR shall indemnify and hold harmless Contractor, its Sub-contractors and its and their consultants, agents, employees, officers and directors from any and all costs, expenses and liabilities relating thereto.

e) Any damages, liability, losses, costs and expenses incurred by the Contractor arising out of or related to any claim, demand, action or proceeding brought against Contractor, as well as the costs of any remediation and clean-up work undertaken by Contractor, on account of any environmental pollution or environmental damage (except for such pollution or damage resulting from the Contractor's Wilful Misconduct) caused by the Contractor shall be included in Petroleum Costs.

APPENDIX 9

ENVIRONMENTAL PROTECTION AND SAFETY PRACTICES

I. Environmental Sub-Committee

A. The environmental sub-committee is composed of environmental representatives of Contractor Parties and SOCAR, MENR, Azerbaijan National Academy of Sciences and other research institutes.

B. Responsibilities of the environmental sub-committee

i) - Design Annual Monitoring Program for monitoring of selected environmental parameters
- Coordinate Annual Monitoring Program
- Review results and propose recommendations
- Publish annual report

ii) Select research projects

- Administer environmental protection research projects
- Allocate funding as designated for this purpose in any Annual Work Programme and Budget
- Review progress
- Publish results

II. II. Environmental Strategy

The environmental strategy to be pursued pursuant to Article 26.4 shall be as follows:

A. Baseline Data

1. Literature review
2. International standards review
3. Audit of existing operations and practices
4. Environmental data collection
   - Atmospheric
   - Water Quality
   - Benthic
   - Flora and Fauna
   - Meteorological and Oceanographic
   - Sediment
   - Background Radiation

B. Environmental Impact Assessment (existing facilities, exploration and production activities and new facilities)

1. Project description
2. Environment description
3. Technology assessment
4. Air emission inventory

- Dispersion modelling
- Impact evaluation

5. Water discharge inventory

   - Fate and effects modelling
   - Impact evaluation
   - Treat and discharge offshore
   - Treat onshore and discharge
   - Injection onshore or offshore

6. Waste Inventory

   - Disposal options
   - Impact evaluation
   - Offshore treatment and disposal
   - Transportation and onshore disposal

7. Abandonment studies

   - Disposal options
   - Impact evaluation

8. Cost benefit analysis
9. Environment statement of preferred options

The entry into this Contract shall not affect the validity or effectiveness of any ESIAs relating in whole or in part to the subject matter of the ACG PSA and made prior to the Amendment Effective Date.

C. Oil Spill Response Planning

1. Sensitivity mapping

   - Habitats
   - Fisheries
   - Birds
   - Animals
   - Benthic organisms
   - Marine flora

2. Risk Assessment
3. Prediction modelling
4. Equipment and material resourcing
5. Evaluation of chemical treatments
6. Response organizations
7. Treatment and disposal of oil and chemical contaminated material

III. Effluent Guidelines

The following are general and specific guidelines relating to discharges associated with oil and natural gas exploration and production activities.

A. General Guidelines

1. There shall be no discharge of waste oil, produced water and sand, drilling fluids, drill cuttings or other wastes from exploration and production sites except in accordance with the following guidelines.
2. There shall be no unauthorized discharges directly to the surface of the sea. All discharges authorized by these guidelines shall be controlled by discharging into a caisson whose open end is submerged, at all times, a minimum of sixty (60) centimetres below the surface of the sea.

B. Discharge Guidelines and Monitoring

1. Produced Water

a) Contractor will endeavor to utilize produced water for reservoir pressure maintenance if, through standard compatibility testing with Caspian Sea water, no damage to the reservoir resulting in a reduction in overall hydrocarbon recovery would occur by mixing the two water streams. In the event that the two water streams are compatible, Contractor may only discharge a volume of produced water after treatment to the Caspian Sea that exceeds the total volume required for reservoir pressure maintenance or in the event of an emergency, accident or mechanical failure. In the event that the two water streams are not compatible, Contractor may discharge produced water to the Caspian Sea after treatment. Treatment of produced water will result in an oil and grease concentration that does not exceed 72 mg/l on a daily basis or 48 mg/l on a monthly average. The gravimetric (extraction) test method EPA 413.1 (79) shall be used to measure the oil and grease concentration.

2. Drill Cuttings and Drilling Fluids

a) There shall be no discharge of oil based drilling fluids, other than low toxicity and biodegradable drilling fluids.
b) There shall be no discharge of drill cuttings generated in association with the use of oil based drilling fluids, invert emulsion drilling fluids, or drilling fluids that contain waste engine oil, cooling oil, gear oil, or other oil based lubricants, other than cuttings generated in association with the use of low toxicity and biodegradable drilling fluids.
c) There shall be no discharge of drill cuttings or drilling fluids if the maximum chloride concentration of the drilling fluid system is greater than four (4) times the ambient concentration of the receiving water.
d) Prior to the start of the drilling programme, a drilling mud system will be designed and laboratory tested under the U.S. EPA, 96-hour acute toxicity test using mycid shrimp. Those muds that achieve an LC50 value in concentrations of more than 30,000 ppm will be authorised for discharge during the drilling programme.
e) During drilling operations, mud samples will be collected periodically to determine toxicity using procedures established for the Caspian Sea.
f) The composition of the mud system may be altered as necessary to meet changes in the drilling operations. The modified mud system may be discharged if it has been shown to meet the above limits on oil, salinity and toxicity.

3. Other Wastes

a) Sanitary waste may be discharged from a U.S. Coast Guard certified or equivalent Marine Sanitation Device (MSD) with total residual chlorine content greater than 0.5 mg/l but less than 2.0 mg/l as long as no floating solids are observable. The Hach method CN-66-DPD test shall be used to measure the residual chlorine.
b) Domestic wastes and gray water may be discharged as long as no floating solids are observable.

c) Monitoring of floating solids shall be accomplished during daylight by visual observation of the surface of the receiving water in the vicinity of the sanitary and domestic waste outfalls. Observations shall be made following either the morning or midday meals and at a time during daylight and maximum estimated discharge.

d) Desalinization unit wastes shall be discharged.

e) Deck drainage and wash water may be discharged as long as no visible sheen is observable.

f) Trash shall not be discharged offshore. Trash shall be transported to an appropriate land-based disposal facility.

4. Monitoring

a) Produced water

1. The volume of produced water discharged and concentration of oil and grease contained in the discharge will be monitored daily.
2. The daily maximum and monthly average oil and grease concentration will be reported monthly.

b) Drill Cuttings and Drilling Fluids

1. An inventory of drilling fluids additives and their volumes or mass added to the drilling fluid system will be maintained for each well.
2. Drilling fluid properties, including volume percent oil and concentration of chlorides, will be monitored daily for each well.
3. The estimated volume of drill cuttings and drilling fluids discharged shall be recorded daily and reported monthly.

c) Other Wastes

1. The estimated volume of other wastes discharged shall be recorded daily and reported monthly to include:

i) Sanitary waste
ii) Domestic waste
iii) Deck drainage and wash water

IV. <u>Air Emission Guidelines and Monitoring</u>

Contractor is authorized to discharge air emissions. Such discharges will be limited and monitored as follows:

A. Any building, structure, facility, or installation that emits or may emit nitrogen oxides (NOx), sulphur dioxides (SOx), carbon monoxide (CO), volatile organic compounds (VOCs), or particulate (PT) in an amount equal to or greater than 227 metric tons per year (MTPY) per individual pollutant (250 short tons per year) shall install the best available control technology on all equipment creating the emissions suitable for the equipment creating the emissions and its location. If the source is above 227 MTPY, screening modelling will be conducted to determine potential impacts on sensitive receptors. This trigger amount may be less in cases where sensitive receptors are in close proximity to the source. (NOTE: Any individual item of equipment emitting less than 23 MTPY (25 short TPY) or IC engines/turbines below 500 break horsepower would be exempt from this requirement.) Emergency flares on facilities will be designed to operate smokeless and with continuous pilots or equivalent ignition systems.

B. Any storage vessel with a capacity greater than 1,590 cubic meters (10,000 Barrels) used for Petroleum or condensate storage shall install necessary control technology to minimise emissions.

C. IC engines/turbines larger than 500 HP should be monitored on an annual basis to assure that the NOx and CO emissions are at the specified levels. Portable analyzers for monitoring the NOx and CO should be calibrated before each test using a known reference gas sample.

All new facilities will comply with the above standards. Existing facilities within the Contract Area being operated by Contractor will be brought into compliance with these standards according to a schedule to be negotiated, taking into account the condition, function and economic viability of the facilities.

V. <u>Safety Guidelines</u>

A. Contractor shall take into account the following international safety and industrial hygiene standards in conducting its Petroleum Operations under the Contract:

B. Oil Industry International Exploration and Production Forum (E&P Forum) Reports - Safety.

C. International Association of Drilling Contractors (IADC) – Drilling Safety Manual.

D. International Association of Geophysical Contractors (IAGC) - Marine Geophysical Safety Manual.

E. Threshold Limited Values for Chemical Substances in the Work Environment - American Conference of Governmental Industrial Hygienists.

APPENDIX 5A

Emissions Estimate Assumptions

CONTENTS

1 Introduction

This Appendix provides supplementary information to the emissions calculations presented in Chapter 5: Project Description and includes pollutant emission factors and the basis of emissions estimates for each Project phase.

Emissions were calculated using internationally accepted emission factors that were calculated based on real time data collected over time. These were obtained from:

- European Environment Agency EMEP/CORINAIR Emission Inventory Guidebook – 2007;
- United States Environmental Protection Agency AP42;
- E&P Forum Report No. 2.59/197 (Methods for Estimating Atmospheric Emissions from E&P Operations, Report No. 2.59/197; The Oil Industry International E&P Forum, September 1994); and
- EEMS Atmospheric Emission Calculations Issue 1.8 (UK Offshore Operators Association Ltd, 2008).

2 Emissions Factors

Table 1 presents emissions factors used to calculate emissions from:

- Stationary combustion emission sources including gas and/ or diesel engines, generators, turbines and heaters;
- Flares; and
- Vessels.

Table 1 Stationary Combustion Source, Flare, Vessel and Helicopter Emission Factors

Type of Source	Fuel	Unit	CO_2	CO	NO_X	SO_X[3]	CH_4	VOC
Engine[1]	Diesel	tonnes emissions/ tonnes of fuel used	3.2	0.0157	0.0594	0.0001	0.00018	0.002
Turbine[1]				0.00092	0.0135		0.0000328	0.000295
Heater[1]				0.00071	0.0028		0.00000705	0.0000282
Engine[1]	Gas		2.86	0.0076	0.0576	0.0000128	0.0198	0.0032
Turbine[1]				0.0030	0.0061		0.00092	0.000036
Heater[1]				0.0006	0.0024		0.000089	0.0000099
Vessel[2]	Diesel		3.2	0.0052	0.0125	0.0001	0.000087	0.0008
Platform Flare[1]	Gas	tonnes emissions/ tonnes of gas flared	2.8	0.0067	0.0012	0.0000128	0.010	0.010

Sources:
[1] EEMS- Atmospheric Emissions Calculations, UK Department of Energy & Climate Change, 2008, Issue 1.810a
[2] E&P Forum - Report No. 2.59/197
[3] Sulphur Dioxide Emission Factor = 2 x weight fraction of sulphur in diesel (0.05wt%)

3 Predrilling

3.1 Methodology

Estimated fuel usage for each emission source was multiplied by the relevant emission factor and the expected duration of the operation to estimate emissions.

3.2 Basis of Estimate

Table 2 sets out the number of vessels planned to be used during predrilling including the estimated duration and diesel consumption of each vessel.

Table 2 Number of Vessels and Estimated Fuel Consumption During Predrilling

Source	No. of Vessels	Duration of Use (days)	Average Fuel Consumption (tonnes/day)
MODU	1	360	13
Support Vessel (cargo vessels)	3	144	10
Stand by vessel	1	360	10
Crew change	1	144	25
Anchor handling tug	1	10	25
MODU	1	360	13

4 Onshore Construction and Commissioning of Offshore Facilities

4.1 Methodology

Emission estimates were calculated based on historic records from the Bayil and BDJF yards where previous ACG jackets and topsides were constructed. Emission estimates for the construction of the subsea infrastructure were calculated based on the historic records from the CPC yard where the COP subsea infrastructure was constructed.

Estimated fuel usage per month for onsite generators and engines was multiplied by the relevant emission factor and duration of the construction periods to estimate emissions.

Emissions during topside commissioning were estimated based on duration of operation and approximate fuel consumption associated with key equipment that will be commissioned onshore; specifically the main platform generator, platform cranes, the emergency generator and the air compressors.

4.2 Basis of Estimate

Table 3 presents estimated fuel usage during construction and commissioning activities at yards and the planned duration of activities.

Table 3 Construction Emission Sources and Associated Estimated Fuel Consumption

Source	Diesel (tonnes)	Gasoline (tonnes)	Duration (months)
Jacket Construction	73	22	24
Topside Construction	157	14	48
Subsea Infrastructure Construction	7	2	15
Notes: Based on average monthly recorded data from fuel consumption within the BOS SHELF and ATA yards during 2011 and 2012 for COP. A review of fuel consumption data from the Bos Shelf yard for the ACG Phase 3 project indicated 55% of diesel use was for engines and 45% for generators. This assumption has been maintained			

Emissions estimates were based on the duration of operation and approximate fuel consumption associated with equipment that will be commissioned onshore which is assumed to include the main generator run for one week consuming 8 tonnes of diesel per hour for 8 hour per day and intermittently over approximately 6 months, two air compressors (assumed 7.5 kW capacity each), two temporary diesel generators (400V15Kva each) and up to eight 1MW temporary generators run intermittently for 8 hours for 9 months. It was also assumed that the firewater pump engines, cranes and emergency generators during commissioning period; a 24 hour period is assumed.

5 Platform Installation, Hook Up and Commissioning

5.1 Methodology

Estimated fuel usage for each vessel planned to be used was multiplied by the expected number of vessels, the relevant emission factor and the expected duration of the activity to estimate emissions.

Emissions associated with commissioning of the platform will arise through the use of the temporary generators. These emissions were calculated by multiplying estimated fuel usage by the relevant emission factor, the load on the generators and the anticipated duration that generators will be used.

Emissions will also be generated due to flaring on the East and West Azeri platform during tie-ins activities. These emissions were calculated by multiplying the anticipated flaring flowrates and the anticipated duration of flaring by the relevant emission factor.

5.2 Basis of Estimate

Table 4 lists the vessels and helicopters that will be used during platform installation, hook up and commissioning activities, the duration of use for each vessel/ helicopter and estimated fuel consumption.

Table 4 Number of Vessels and Helicopters and Estimated Fuel Consumption During Platform Installation, Hook Up and Commissioning

Vessels/ Helicopters	Pin Pile Installation			Jacket Installation			Topside Installation			HUC Support Vessels		
	No.	Duration (days)	Fuel Use (days/ tonnes)	No.	Duration (days)	Fuel Use (days/ tonnes)	No.	Duration (days)	Fuel Use (days/ tonnes)	No.	Duration (days)	Fuel Use (days/ tonnes)
Anchor handling				6	75	10	6	36	10	6	66	10
Crew transfer boats				1	32	2	1	15	2	1	67	2
Crew transfer helicopters				1	5	6	1	3	6	1	11	6
DBA / SCV	1	30	10	1	75	10	1	36	10	1	72	6
STB-1				1	75	6	1	36	6	-	-	-
Pipelay barge				-	-	-	-	-	-	1	66	10
Pipe supply vessels				-	-	-	-	-	-	4	66	2
Large support vessels	3	30	2	-	-	-	-	-	-	4	66	8
Survey vessel (pin pile installation)	1	7	8									
Survey vessel (during pipelay)				-	-	-	-	-	-	1	156	7
Survey vessel (pre-installation survey)										1	14	8
DSV / SCV				-	-	-	-	-	-	1	370	8
MV Citadel / small support vessel	2	1	6	-	-	-	-	-	-	1	11	6

With regard to flaring, as a worse case, it is anticipated flaring may occur for up to 52 days and up to 8 days on the EA and WA platforms respectively during ACE tie-in activities at a flowrate of 120 mmscfd.

With regard to platform commissioning the current base case assumes that power during initial commissioning will be provided by the four 1MW temporary diesel generators, with power subsequently provided from the 33kV subsea power cable from EA. It is estimated that over the 180 day platform commissioning period total diesel consumption of four 1MW temporary diesel generators will be approximately 1600 tonnes.

6 Offshore Operations and Production

6.1 Methodology and Basis of Estimate

Estimated emissions to air were calculated based on a combination of emission forecasting using bespoke software and spreadsheet-based manual calculations.

The emissions forecasting software (developed by PI Ltd.) was used to calculate CO_2 from the input gas composition, with all other pollutants calculated using the forecaster calculated fuel flow for the turbine units and UK EEMS emission factors. The source of the main data inputs were:

- Process data was obtained from the project heat and material balance
- Fuel Gas composition was taken from the project heat & material balance
- Equipment Details were obtained from the:
  - Electrical Load Summary
  - Equipment Lists
  - Equipment Load Profile
  - Electrical Load Profile
  - Electrical Load Lists
- Production Data was obtained from the latest production profile.
- Flaring scenarios (duration, frequency and flowrates) as estimated by the project.

In addition, the volumes of diesel usage over the life of field both by diesel users and the main diesel generator were made based on data provided by the project engineers. The model assumed flash gas compressor shut down for planned maintenance activities for 10 days every two years, one trip occurring once a year for 8 hours and 1 emergency depressurisation event occurring once every 5 years for 2 hours. In each case the associated flaring associated with these events was included within the model.

The model was run at 15°C, in order to simulate average ambient meteorological conditions as the performance of the main emission sources are affected by the ambient air temperature.

The emission modelling was initially carried out using the PI Emissions Forecaster software and subsequently updated to capture changes in the anticipated flare profiles and scenarios. These updates were completed using manual calculations. The design base case assumed the use of SGT-A35 (G62) G62 gas turbines for both power generation and mechanical drive for gas compression with 10% import power via subsea cable.

Table 5 Estimated ACE Offshore Emissions (Combustion Sources) During Operations

Source	CO_2	NO_x	N_2O	SO_2	CO	CH_4	VOC
2023	181,639	913	34	4	137	363	32
2024	253,060	928	35	4	143	379	33
2025	255,521	937	35	4	145	386	34
2026	313,681	1,205	45	5	163	440	37
2027	315,477	1,214	45	5	164	442	37
2028	316,032	1,218	45	5	164	442	37
2029	313,647	1,205	45	5	163	440	37
2030	306,731	1,174	44	5	161	434	37
2031	287,314	1,080	40	4	156	419	36
2032	255,812	933	35	4	147	391	35
2033	256,350	937	35	4	147	392	35
2034	256,423	937	35	4	147	392	35
2035	256,148	933	35	4	148	393	35
2036	255,805	933	35	4	148	393	35
2037	255,958	933	35	4	148	394	35
2038	256,124	933	35	4	149	395	35
2039	256,820	938	35	4	149	397	35
2040	256,789	938	35	4	149	397	35
2041	265,252	973	36	4	152	405	36
2042	256,756	933	35	4	150	399	35
2043	256,320	933	35	4	150	399	35
2044	263,392	964	36	4	152	404	36
2045	273,655	1,013	38	4	154	411	36
2046	299,984	1,138	42	4	160	430	37
2047	305,128	1,165	43	5	161	434	37
2048	272,672	1,013	38	4	152	406	35
2049	252,574	919	34	4	145	386	34
Total	7,295,068	27,340	1,023	114	4,104	10,964	955

Emissions during operations will also arise from:

- Fugitive emissions e.g. from fittings (refer to Annex 1 of this Appendix); and
- Supply and support vessels.

Emissions associated with vessels during offshore operations were estimated based on estimated fuel consumption rates multiplied by the expected number and duration of use for each vessel and applicable emission factors.

Table 6 lists the vessels anticipated to be used during the operations phase, the duration of use for each vessel and estimated fuel consumption.

Table 6 Number of Vessels and Estimated Fuel Consumption During Platform Operations

Vessel	Number of vessels	Average Fuel Consumption (tonnes/day)	Duration (days)	Calculated Fuel Consumption (tonnes)
Crew transfer boats	3	2	1,404	8,424
Supply Vessel	1	6	702	4,212
Stand by vessel	1	7	9,612	67,284
Total Vessel Fuel Consumption				79,920

7 Sangachal Terminal

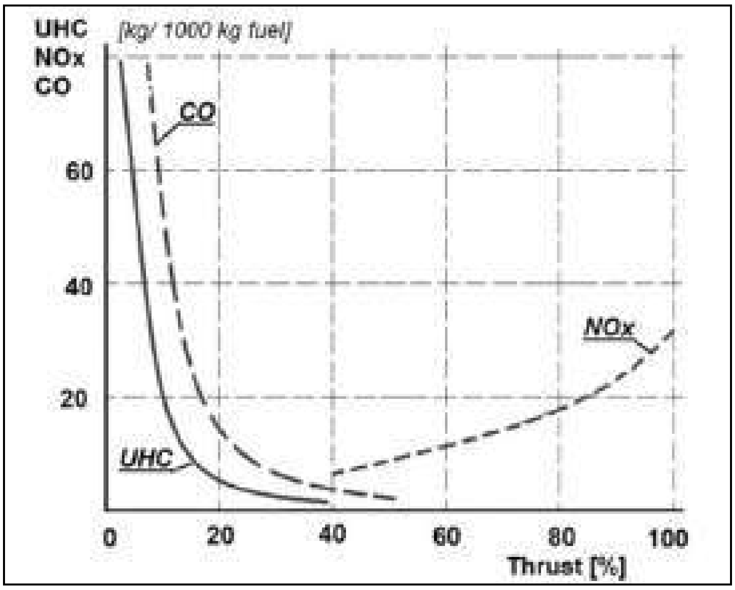
The incremental increase in emissions at the Sangachal Terminal as a result of the ACE Project were calculated based on a review of existing emissions estimates, production throughput and spreadsheet-based manual calculations to estimate the increase due to ACE.

The production volumes, energy consumption and estimated emissions for the ACG facilities at the terminal based on study undertaken in 2013 were used to estimate an estimated volume of CO2 emissions per unit of energy consumption and production. Using this factor the incremental increase in CO_2 emissions due to the ACE Project were derived based on the increase in predicted energy consumption and production for the ACG facilities when ACE is operational.

Unlike CO_2, NOx, N_2O, CO, SO_2, CH_4 and VOCs emissions are highly dependent on the condition and load of the machinery itself.

As shown in the Figure 5A.1, which illustrates a typical gas turbine emissions profile, CH_4 and VOC emissions decrease as load on the turbine increases, therefore it is expected that the additional production throughput at the Sangachal Terminal caused by ACE operations will have no effect on the output of these pollutants.

Figure 5A. 1 Generic Gas Turbine Emissions Profile



For NO_X a linear relationship can be derived between NO_X emissions and generator power. Taking this into account in addition to the characteristics and efficient of the generators associated with the ACG facilities an approximate additional 10% of NO_X emissions are anticipated to be released to the atmosphere over Life of Field once ACE becomes operational.

Annex 1 Fugitive Emissions from Fittings

Offshore:

Table A1 Fugitive Emissions Estimate - Offshore

Component	Emission Rate(kg/ component/year)[1]	Number of Components[2]	Fugitive Emissions (tonnes/year)
Connections	0.946	2506.2	2
Valves	4.52	1429.7	7
Other[3]	60.9	378.6	23
Total Fugitive Emissions (tonnes/year)			**32**

Notes:
1. EEMS- Atmospheric Emissions Calculations, UK Department of Energy & Climate Change, 2008, Issue 1.810a
2. EEMS - Guidelines for the Compilation of an Atmospheric Emissions Inventory, UKOOA, 2002 - number of components for gas platform facility Generic B Gas platform 330 MMSCFD proportioned for ACE production profile of 350 mmscfd.
3. Includes pumps and open-ended fittings.

Table A2 Offshore Fugitive GHG Emissions

Emission Gas	Total Volume (tonnes/year)[1]	GHG (tonnes/year)	Total Volume (over PSA)[1]	GHG (over PSA)
CH_4	26	657	710	17748
VOC	2	-	49	
Total Fugitive Emissions (GHG) tonnes		657		17748

Notes:

Volumes of CH_4 and VOC emissions calculated from total fugitive emissions multiplied by CH4 and VOC factors respectively (derived from Appendix II of EEMS - Guidelines for the Compilation of an Atmospheric Emissions Inventory, UKOOA, 2002)

APPENDIX 5B

Determination of Chemical Hazard Categories

1. CHARM

The Offshore Chemical Notification Scheme (OCNS) conducts hazard assessments on chemical products that are used offshore. The Chemical Hazard Assessment and Risk Management (CHARM) model calculates the ratio of Predicted Effect Concentration against No Effect Concentration (PEC: NEC), and is expressed as a Hazard Quotient (HQ), which is then used to rank the product. The HQ is converted to a colour banding (see Table 1 below), which is then published in the Definitive Ranked Lists of Approved Products, Excel format (ZIP, 437.75 KB, updated 28 May 2018). The PEC is estimated for a standard platform with a standard mixing zone and a standardised estimate of tidal advection. PEC also takes into account standard chemical usage rates and includes an estimate of the fraction released (based on oil-water partitioning data). NEC is derived from the results of standardised acute toxicity tests, using an application factor of 10-1000 (the selection of the application factor is built in to the model and reflects the type and quantity of toxicity data available). Data used in the CHARM assessment include toxicity, biodegradation and bioaccumulation, and the model is divided into 4 main algorithms: Production, Completion / Workover, Drilling and Cementing.

Although the current OCNS is based on hazard assessment, it remains primarily a ranking system; the actual HQ values are dependent on assumptions about the size of the mixing zone and on the rate of dispersion, and these assumptions will not be valid for the Caspian. However, the rankings remain valid for any consistent set of assumptions and will therefore provide a reliable indication of relative environmental effects for all water bodies.

Table 1 The OCNS HQ and Colour Bands

Minimum HQ value	Maximum HQ value	Colour banding	
>0	<1	**Gold**	
≥1	<30	**Silver**	
≥30	<100	**White**	Lowest Hazard
≥100	<300	**Blue**	Highest Hazard
≥300	<1000	**Orange**	
≥1000		**Purple**	

2. Non-CHARM (Old OCNS Ranking)

Products not applicable to CHARM model (i.e. inorganic substances, hydraulic fluids or chemicals used only in pipelines) are assigned an OCNS grouping A – E, with A being the greatest potential environmental hazard and E being the least (see Table 2 below).

This system awards the offshore chemical a letter grouping between A and E. (N.B. care should be taken not to confuse these values with the results of the Netherlands pre-screening scheme). Each individual substance in an offshore chemical should be ranked by applying the OCNS Ranking Scheme. The overall ranking is determined by that substance having the worst case OCNS ranking scheme assignment. The method of assignment of the OCNS letter grouping is described below.

2.1 Initial Grouping

The initial group is determined using Table 2. All submitted toxicity data for the product are compared with the table and the value giving the worst case 'Initial Grouping' (i.e. the test giving the most toxic response) is used as the Initial Group for the substance.

Table 2 Initial OCNS Grouping

Initial Grouping	A	B	C	D	E
Result for Aquatic toxicity data (ppm)	<1	>1-10	>10-100	>100-1,000	>1,000
Result for sediment toxicity data (ppm)	<10	>10-100	>100-1,000	>1,000-10,000	>10,000

- **Aquatic toxicity** refers to the *Skeletonema costatum* EC_{50}[1], *Acartia tonsa* LC_{50}[2], and *Scophthalmus maximus* (juvenile turbot) LC_{50} toxicity tests; and
- **Sediment toxicity** refers to the *Corophium volutator* LC_{50} test.

2.2 Adjustment for Environmental Performance to Determine Final Group

The final grouping is determined using Table 3 as a guide. Select the column that applies to the candidate product and adjust the initial Group accordingly. If the classification should theoretically move beyond Group A or E the product will nevertheless be assigned to that particular Group.

Table 3 Adjustment Criteria for OCNS Grouping

Increase by 2 Groups e.g. From C to E	Increase by 1 Group e.g. from C to D	Do not adjust initial grouping	Decrease by 1 group e.g. From C to B	Decrease by 2 groups e.g. From C to A
Substance is readily biodegradable and is non-bioaccumulative	Substance is inherently biodegradable and is non-bioaccumulative	Substance is not biodegradable and is non-bioaccumulative or	Substance is inherently biodegradable and bioaccumulates	Substance does not biodegrade and bioaccumulates
		Substance is readily biodegradable and bioaccumulates		

Definitions of terms used in the classification table:

- **Readily biodegradable** - Results of >60% biodegradation in 28 days to an OSPAR HOCNF accepted ready biodegradation protocol;

[1] The statistical estimate of the toxicant concentration that has an adverse effect on 50% of the test organisms after a specific exposure time.
[2] Lethal Concentration 50. The concentration of a chemical which kills 50% of a sample population.

- **Inherently biodegradable** - Results of >20% and <60% to an OSPAR HOCNF accepted ready biodegradation protocol or result of >20% by OSPAR accepted Inherent biodegradation study;
- **Not biodegradable** - Results from OSPAR HOCNF accepted ready biodegradation protocol or inherent biodegradation protocol are <20%;
- **Non-bioaccumulative/non-bioaccumulating** - Log Pow <3, or results from a bioaccumulation test (preferably using Mytilus edulis) demonstrates a satisfactory rate of uptake and depuration, or the molecular mass is > 700;
- **Bioaccumulative/Bioaccumulates** - Log Pow >3, or results from a bioaccumulation test (preferably using Mytilus edulis) demonstrates an unsatisfactory rate of uptake and depuration, and the molecular mass is < 700;
- **Aquatic toxicity test result** - LC/EC_{50} data for Skeletonema costatum, Acartia tonsa or Scophthalmus maximus (Juvenile turbot) (units = ppm or mg/litre); and
- **Sediment toxicity test result** - LC_{50} data for Corophium volutator (units = ppm or mg/kg).

APPENDIX 5C

Estimated Usage and Discharge of Cement Chemicals (Predrill Wells)

Table 5C/1: Well Cement Chemicals per Hole Section (Predrill Well)

Additive	Hazard Category[2]	30" Hole Casing		24" Liner		20" Hole Casing		16" Liner		13 3/8" Hole Casing		9 5/8" Liner	
		Estimated Use per Hole (tonnes)[1]	Worst Case Discharged (tonnes)[1]	Estimated Use per Hole (tonnes)[1]	Worst Case Discharged (tonnes)[1]	Estimated Use per Hole (tonnes)[1]	Worst Case Discharged (tonnes)[1]	Estimated Use per Hole (tonnes)[1]	Worst Case Discharged (tonnes)[1]	Estimated Use per Hole (tonnes)[1]	Worst Case Discharged (tonnes)[1]	Estimated Use per Hole (tonnes)[1]	Worst Case Discharged (tonnes)[1]
Cement Class G D907	E	117.00	33.90	20.00	0.00	34.00	0.00	115.00	0.00	148.00	0.00	92	0.00
Litecrete	Gold		0.00	14.00	4.20	24.00	0.00		0.00		0.00		0.00
Antifoam Agent D206	Gold	0.02	0.00	0.04	0.00	0.03	0.00	0.03	0.00	0.03	0.00	0.02	0.00
Silicate Additive D75	E	0.07	0.00		0.00		0.00		0.00		0.00		0.00
Weighting Agent Hematite D076	E		0.00		0.00		0.00		0.00		0.00		0.00
Accelerator D077	E	0.05	0.00	0.04	0.00	0.12	0.00		0.00		0.00		0.00
SALTBOND II Dispersant D080A	*		0.00		0.00		0.00		0.00		0.00		0.00
Low Temperature Retarder D081A	E		0.00		0.00		0.00		0.00	0.02	0.00	0.02	0.00
Cement D095 LCM	E	0.41	0.10	0.16	0.00		0.00		0.00	0.06	0.00		0.00
Losseal D097	E		0.00		0.00	0.27	0.00	0.19	0.00	0.19	0.00	0.19	0.00
Solid Extender D124	E		0.00		0.00		0.00		0.00		0.00		0.00
Dispersant D145A	Gold		0.00		0.00		0.00		0.00		0.00		0.00
D168 Fluid Loss Control	Gold		0.00		0.00		0.00	0.01	0.00	0.01	0.00	0.01	0.00
Mid Temperature Retarder D177	*	0.01	0.00		0.00		0.00	0.10	0.00	0.14	0.00	0.06	0.00
Low Temp Dispersant D185	Gold	0.05	0.00		0.00	0.02	0.00	0.02	0.00	0.02	0.00	0.02	0.00

Additive	Hazard Category[2]	30" Hole Casing		24" Liner		20" Hole Casing		16" Liner		13 3/8" Hole Casing		9 5/8" Liner	
		Estimated Use per Hole (tonnes)[1]	Worst Case Discharged (tonnes)[1]	Estimated Use per Hole (tonnes)[1]	Worst Case Discharged (tonnes)[1]	Estimated Use per Hole (tonnes)[1]	Worst Case Discharged (tonnes)[1]	Estimated Use per Hole (tonnes)[1]	Worst Case Discharged (tonnes)[1]	Estimated Use per Hole (tonnes)[1]	Worst Case Discharged (tonnes)[1]	Estimated Use per Hole (tonnes)[1]	Worst Case Discharged (tonnes)[1]
Accelerator D186 Low Temperature Set	Gold		0.00		0.00		0.00		0.00		0.00		0.00
Solid Extender D188	E		0.00		0.00		0.00		0.00		0.00		0.00
Fluid Loss Agent D193	Gold		0.00		0.00		0.00		0.00		0.00		0.00
AccuSET D197	Gold		0.00		0.00		0.00		0.00		0.00		0.00
Losseal W D199	Gold		0.00		0.00		0.00		0.00		0.00		0.00
D230 Dispersant	Gold	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		0.00		0.00
D231 Solvent	*		0.00		0.00		0.00	0.09	0.00	0.08	0.00	0.06	0.00
D232 Surfactant	Gold		0.00		0.00		0.00	0.07	0.00	0.08	0.00	0.06	0.00
GASBLOK* LT D500	Gold		0.00		0.00	0.21	0.00	0.37	0.00	0.37	0.00	0.37	0.00
D600G GASBLOK*Gas-Migration Control Additive	Gold		0.00		0.00		0.00		0.00	0.03	0.00	0.03	0.00
Mid-Temp Retarder-L D801	E		0.00		0.00		0.00		0.00	0.14	0.00	0.06	0.00
MUDPUSH* II Spacer D182	Gold		0.00	0.01	0.00	0.004	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Ezeflo* F103 Surfactant	Gold		0.00		0.00		0.00	0.07	0.00	0.08	0.00	0.06	0.00
Mutual Solvent U67	*		0.00		0.00		0.00	0.09	0.00	0.08	0.00	0.06	0.00
B038 Extender	*		0.00	0.05	0.00	0.05	0.00	0.27	0.00	0.18	0.00		0.00
Total		**117.61**	**33.90**	**34.29**	**4.20**	**58.71**	**0.00**	**116.30**	**0.00**	**149.49**	**0.00**	**93.03**	**0.00**

[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 17th April 2018.
* Not currently listed in the UK OCNS Ranked Lists of Notified Products

Table 5C/2: Cement Unit Wash Out per Hole Section (Predrill Well)

Additive	Hazard Category[2]	30" Hole Casing	24" Liner	20" Hole Casing)	16" Liner	13 3/8" Hole Casing	9 5/8" Liner
		Worst Case Discharged (tonnes)[1]	Worst Case Discharged (tonnes)[1]	Worst Case Discharged (tonnes)[1]	Worst Case Discharged (tonnes)[1]	Worst Case Discharged (tonnes)[1]	Worst Case Discharged (tonnes)[1]
Cement Class G D907	E	1.200	1.200	1.200	1.000	0.900	1.100
Litecrete	Gold		0.840	0.840			
Antifoam Agent D206	Gold	0.023	0.026	0.022	0.023	0.021	0.023
Silicate Additive D75	E						
Weighting Agent Hematite D076	E						
Accelerator D077	E			0.080			
SALTBOND II Dispersant D080A	*						
Low Temperature Retarder D081A	E						
Cement D095 LCM	E						
Losseal D097	E						
Solid Extender D124	E						
Dispersant D145A	Gold						
D168 Fluid Loss Control	Gold						
Mid Temperature Retarder D177	*	0.126			0.108	0.062	0.062
Low Temp Dispersant D185	Gold			0.007	0.031	0.023	0.023
Accelerator D186 Low Temperature Set	Gold						
Solid Extender D188	E						
Fluid Loss Agent D193	Gold						
AccuSET D197	Gold						
Losseal W D199	Gold						
D230 Dispersant	Gold						
D231 Solvent	*						
D232 Surfactant	Gold						
GASBLOK* LT D500	Gold			0.109	0.389	0.419	0.389
D600G GASBLOK*Gas-Migration Control Additive	Gold						
Mid-Temp Retarder-L D801	E						
MUDPUSH* II Spacer D182	Gold						
Ezeflo* F103 Surfactant	Gold						
Mutual Solvent U67	*						
B038 Extender	*			0.015	0.232	0.210	
Total		**1.349**	**2.066**	**2.272**	**1.784**	**1.636**	**1.598**

[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 17th April 2018.
* Not currently listed in the UK OCNS Ranked Lists of Notified Products

APPENDIX 6A

Bird Report

Appendix 6A

Summary of References and Surveys of Birds of Absheron-Gobustan Coastline of the Caspian Sea in the Azeri Chirag Gunashli (ACG) Contract Area

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1 Introduction

The Absheron-Gobustan coastline of the Caspian Sea has an international and regional importance with different bird species, listed in the Red Book of Azerbaijan, the Red List of the International Union for Conservation of Nature (IUCN), in Ramsar (The Convention on Wetlands), Bern, Bonn, The Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) conventions and in the annexes of The African-Eurasian Migratory Waterbird Agreement (AEWA) agreement, present along the coastline in internationally important numbers during migration, wintering, and nesting periods.

The purpose of this report is to present the latest information on migratory, wintering and nesting bird species present along the Absheron-Gobustan coastline of the Caspian Sea, including information specific to the Azeri Chirag Gunashli (ACG) Contract Area. The report has been prepared using the latest available literature on bird data and the collection and evaluation of survey data in order to identify the species present in the study area and the number of birds recorded within the study area, identify important and sensitive bird areas and the reason for their importance, and confirm key bird migration routes and seasonal variation in their presence.

85 species of waterfowl and coastal birds have been recorded along the Absheron-Gobustan coastline and the ACG Contract Area during the last 17 years (Refs. 6, 8, 11 and 12). Species, numbers and the territorial distribution of birds in the region distinctly differ from each other during migration, wintering and nesting periods.

2 Migratory Bird Species

As shown in Table 6A.1, with the exception of the western swamphen (*porphyrio porphyrio*), 84 bird species of waterfowl and coastal ecological groups recorded in Absheron-Gobustan coastline of the Caspian Sea have migrant populations (Refs. 5, 8, 10 and 11).

Table 6A.1 Species and inhabitation character of waterfowl and coastal birds recorded in 2002-2017 at the Absheron-Gobustan coastline of the Caspian Sea and the relation of international conventions and agreements to them

N	*Name of species*	*Habitat*	*Ecological group*		*Conventions and agreements*				
			Waterfowl	*Coastal*	*Ramsar*	*CITES*	*Bern*	*Bonn*	*AEWA*
	1	2	3	4	5	6	7	8	9
1.	*Podiceps ruficollis*	s,wm	+		+		+		
2.	*P.nigricollis*	wm	+		+		+		
3.	*P.cristatus*	s,wm	+		+		+		
4.	*P.grisegena*	wm	+		+		+	+	+
5.	*Pelicanus crispus*	wm	+		+	+	+	+	+
6.	*P.onocrotalus*	wm	+		+		+	+	+
7.	*Phalacrocorax carbo*	s,wm	+		+		+		
8.	*Ph.pygmaeus*	wm	+		+		+	+	+
9.	*Botaurus stellaris*	it		+	+		+	+	+
10.	*İxobrychus minutus*	it		+	+		+	+	+
11.	*Nycticorax nycticorax*	it		+	+		+		
12.	*Eqretta alba*	wm		+	+		+		
13.	*E.garzetta*	wm		+	+		+		
14.	*Ardea cinerea*	wm		+	+		+		
15.	*A.purpurea*	nm		+	+		+		
16.	*Phoenicopterus roseus*	wm		+	+		+	+	+
17.	*Cygnus olor*	wm	+		+		+	+	+
18.	*C.cygnus*	wm	+		+		+	+	+

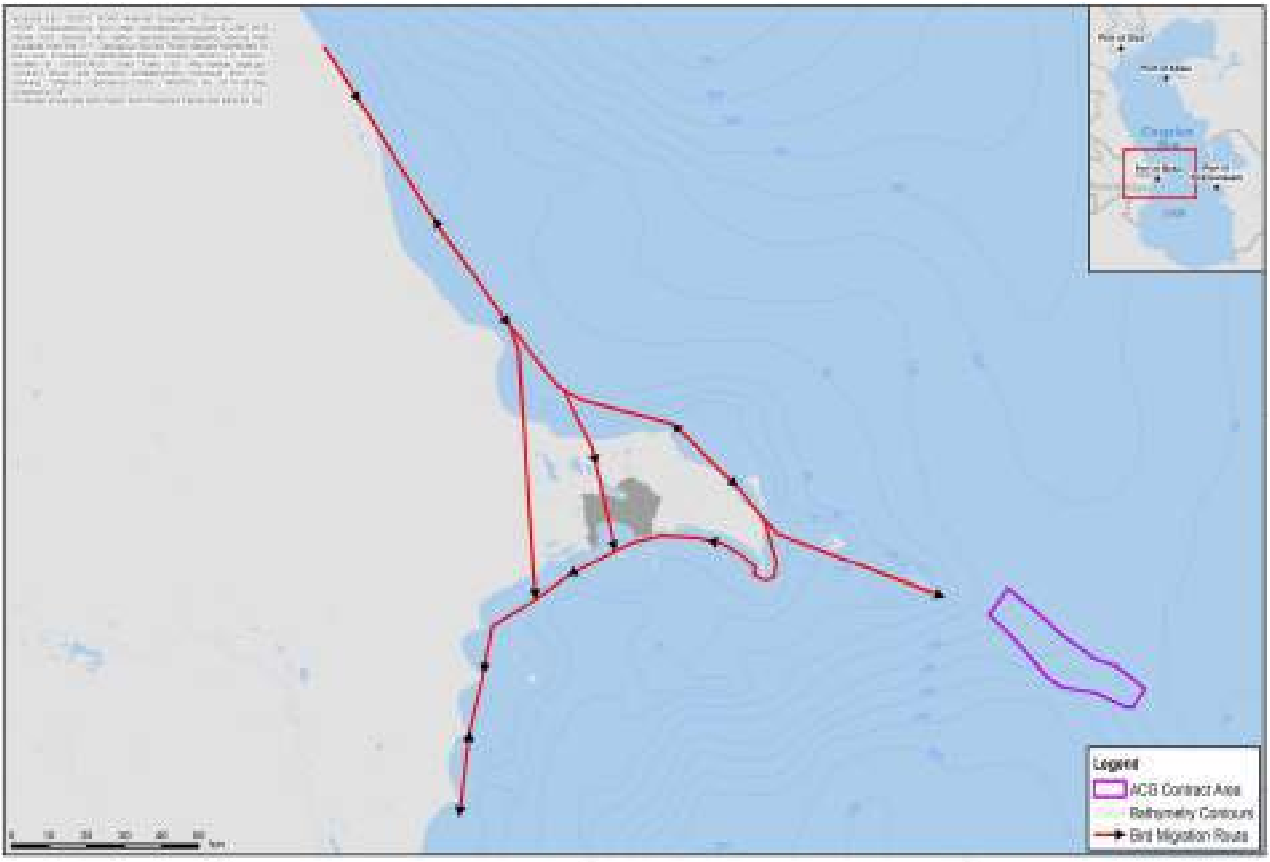
N	Name of species	Habitat	Ecological group		Conventions and agreements				
			Waterfowl	Coastal	Ramsar	CITES	Bern	Bonn	AEWA
	1	2	3	4	5	6	7	8	9
19.	*C.bewickii*	wm	+		+		+	+	+
20.	*Anser anser*	it	+		+		+	+	+
21.	*A.albifrons*	it	+		+		+	+	+
22.	*A.erythropus*	it	+		+		+	+	+
23.	*Tadorna ferruginea*	nm	+		+		+	+	+
24.	*Tadorna tadorna*	wm	+		+		+	+	+
25.	*Anas platyrhynchos*	wm	+		+		+	+	+
26.	*A.penelope*	wm	+		+		+	+	+
27.	*A.crecca*	wm	+		+		+	+	+
28.	*A.clupeata*	wm	+		+		+	+	+
29.	*A.sterepera*	wm	+		+		+	+	+
30.	*A.acuta*	wm	+		+		+	+	+
31.	*A.querquedula*	wm	+		+		+	+	+
32.	*Marmaronetta angustirostris*	wm	+		+		+	+	+
33.	*Netta rufina*	wm	+		+		+	+	+
34.	*Aythya ferina*	wm	+		+		+	+	+
35.	*A.nyroca*	wm	+		+		+	+	+
36.	*A.fuligula*	wm	+		+		+		+
37.	*A.marila*	wm	+		+		+		+
38.	*Bucephala clangula*	wm	+		+		+		+
39.	*Oxyura leucocephala*	wm	+		+	+	+		+
40.	*Merqus merganser*	wm	+		+		+		+
41.	*M.serrator*	wm	+		+		+		+
42.	*M.albellus*	wm	+		+		+		+
43.	*Rallus aquaticus*	s,wm		+	+		+		
44.	*Porphyrio porphyrio*	s		+	+		+		
45.	*Fulica atra*	wm	+		+		+	+	+
46.	*Charadrius hiaticula*	it		+	+		+	+	+
47.	*Ch.leschenaulti*	nm		+	+		+	+	+
48.	*Ch.dubius*	wm		+	+		+	+	+
49.	*Ch.alexandrinus*	nm		+	+		+	+	+
50.	*Ch.asiaticus*	it		+	+		+	+	+
51.	*Vanellus vanellus*	it		+	+		+	+	+
52.	*Himantopus himantopus*	s,wm		+	+		+	+	+
53.	*Recurvirostra avosetta*	s,wm		+	+		+	+	+
54.	*T.glareola*	it		+	+		+	+	+
55.	*T.totanus*	s,wm		+	+		+	+	+
56.	*Actitis hypoleucos*	wm		+	+		+	+	+
57.	*Calidris ferruginea*	it		+	+		+	+	+
58.	*C.alba*	it		+	+		+	+	+
59.	*C.temminckii*	it		+	+		+	+	+
60.	*C.minuta*	it		+	+		+	+	+
61.	*C.albina*	wm		+	+		+	+	+
62.	*Numenius arquata*	it		+	+		+	+	+
63.	*N.phaeopus*	it		+	+		+	+	+
64.	*Arenaria interpres*	it		+	+		+	+	+
65.	*Phalaropus lobatus*	it	+		+		+	+	+
66.	*G.gallinago*	it		+	+		+	+	+
67.	*Limosa limosa*	wm		+	+		+	+	+

N	*Name of species*	*Habitat*	*Ecological group*		*Conventions and agreements*				
			Waterfowl	*Coastal*	*Ramsar*	*CITES*	*Bern*	*Bonn*	*AEWA*
	1	**2**	**3**	**4**	**5**	**6**	7	**8**	**9**
68.	*Scolopax rusticola*	it		+	+		+	+	+
69.	*Glareola pratincola*	it		+	+		+	+	
70.	*Larus argentatus*	wm		+	+		+	+	+
71.	*L.canus*	wm		+	+		+		
72.	*L.melanocephalus*	nm		+	+		+	+	+
73.	*L.genei*	nm		+	+		+	+	+
74.	*L.ichthyaetus*	wm		+	+		+	+	+
75.	*L.cachinnans*	s		+	+		+		
76.	*L.ridibundus*	wm		+	+		+		
77.	*L.minutus*	it		+	+		+		
78.	*Chlidonias hybrida*	nm		+	+		+		
79.	*Ch.leucopterus*	nm		+	+		+		
80.	*Ch.niger*	it		+	+		+	+	+
81.	*Gelochelidon nilotica*	it		+	+		+	+	+
82.	*Sterna hirundo*	nm		+	+		+	+	+
83.	*S.albifrons*	nm		+	+		+	+	+
84.	*S.sandvicensis*	nm		+	+		+	+	+
85.	*Hydroprogne caspia*	nm		+	+		+	+	+
	Total Species per Category		**36**	**49**	**85**	**2**	**85**	**61**	**67**

Notes:
s - sedentary
s, wmp – sedentary, has wintering migratory populations
wm - wintering migratory
nm - nesting migratory
it – in transit

Birds nesting in the European part of the Russia, Western Siberia, and north-western part of Kazakhstan fly to the south of the Caspian Sea, south-western Asia countries, and Africa during autumn migration for wintering, but they fly back to north during spring migration period. Birds' autumn migration starts mainly from the second half of August and lasts until the second half of December. In case of severe winter conditions in Russia, this migration continues until mid-January. The most active period of migration is November. The spring migration of birds starts in the second half of February and finishes in April with March being the most active period (Refs. 9, 11 and 12). During the autumn migration, 51.43% of birds fly along the Caspian coast to the south, 36.64% fly to the southwest, while 11.93% of the birds fly from the Pirallahi-Shahdili coastline to the southeast of the Caspian coast near Turkmenistan (Ref. 9) (Figure 6A.1).

Figure 6A.1 Migration routes of waterfowl and coastal birds along Absheron-Gobustan coastal line. ↑ to North, ↓ to South, → to South-East



Surveys conducted by the Azerbaijan National Academy of Sciences (ANAS) and observations from workers on the platforms in the Caspian Sea have confirmed that there have been no noticeable changes in birds' seasonal migration routes or periods. The majority of the waterfowl birds observed during the migration period consist of ducks of the genus Anas (falcated duck, wigeon), northern pintail, whistling duck, red-crested pochard, ducks of the genus Aythya (common pochard and tufted duck), coots, seagulls (genus Laridae) (silver, gray, brown, common, pigmy) (Refs. 7, 8, 10 and 11).

The mass spring migration of Anas, Pochard and Aythya ducks starts in March and the autumn migration lasts from November to the first half of the December. Other duck species are also present but are not abundant. Their migration coincides with the departure and arrival times of the Anas and Aythya ducks.

Spring and autumn migration of three types of (Anser) geese (greater white-fronted goose, lesser white-fronted goose and greylag) are observed along the Absheron-Gobustan coastline with mass flight occurring in March and November. Three types of swans (mute swan, whooper swan and tundra swan) are observed in winter and during migration. Their mass spring migration starts in the second half of February and autumn migration starts in December. Mute and whooped swan is especially abundant during this period, while the tundra swan is rare in the region. In the north, the arrival of swans continues until mid-January depending on the temperature (Refs. 5, 8, 10 and 11).

Waterfowl are mainly observed within the coastal zone of the sea (5-6 km from the coastline) while coastal birds (with the exception of seagulls) are mainly observed in low numbers along the shoreline (in a strip of approximately 30m width) in damp sands, along the water edge and within stands of reeds. Seagulls are mainly seen in islands, on the water surface while resting and in flight. Their autumn migration mainly occurs in August-November, and spring migration is observed in March-May (Refs. 5, 8, 10 and 11).

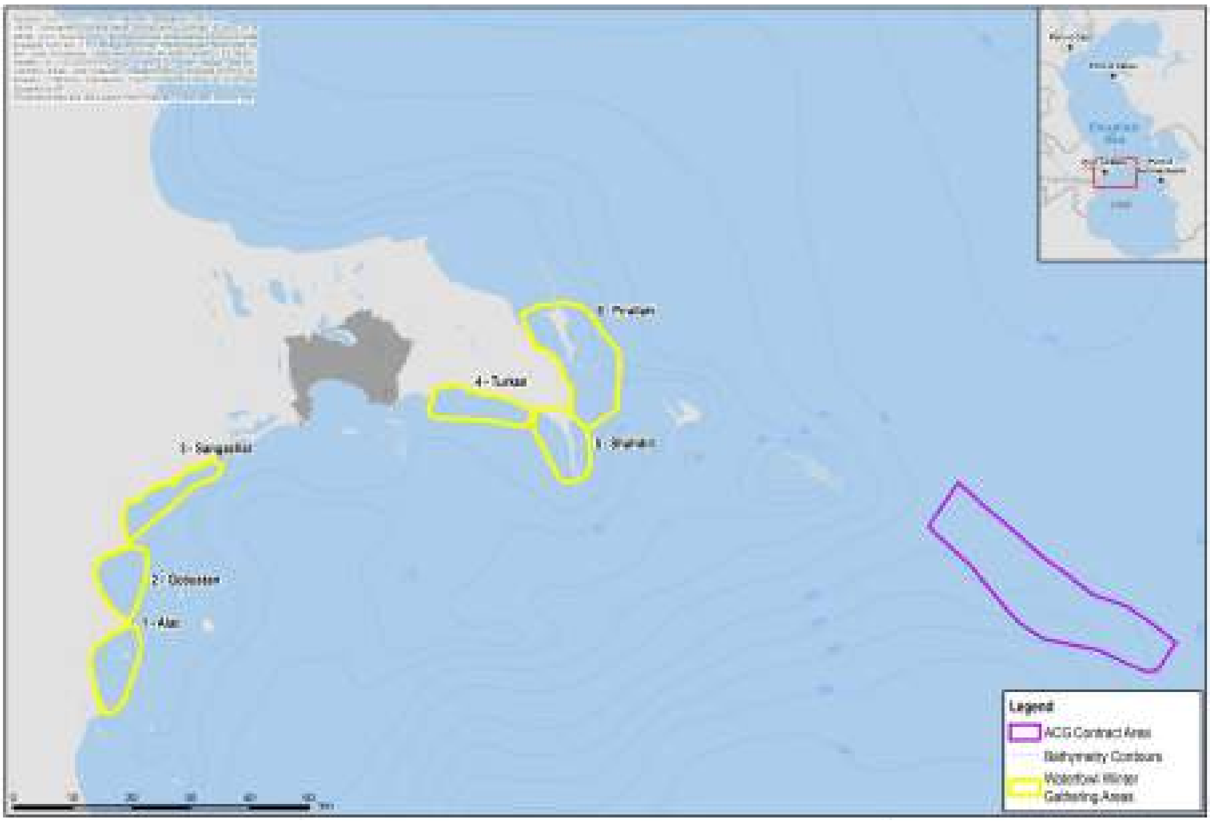
3 Wintering Bird Species and their Gathering Sites

36 species of waterfowl birds were registered wintering in Absheron-Gobustan coastal area of the Caspian Sea. 28 of them are wintering migratory, 3 are resident, 1 is nesting migratory, 4 are passage migratory (Table 6A.1).

The majority of the wintering birds are coots and ducks of the genus Anas, Netta and Aythya. Surveys undertaken across the years taking into account key indicators have established which areas constitute internationally important wintering sites for birds (Ref. 9). Based on the 2002-2006 surveys these were the food-rich areas of Pirallahi island, Shahdili, Turkan, Zigh, Puta (including the lagoons near Baku Deep Water Jackets Factory), Sangachal, Gobustan and Alat coastline and the Red Lake (Figure 6B.2), (Ref. 7). The number (individual) waterfowl species present exceeded the international indicator (1% limit) established for the provision of RAMSAR status for grebe (100 species), tufted duck (2000 species), common pochard (3500 species) in Pirallahi island, tufted duck in Shahdili and Turkan, grebe black-necked grebe (250 species), tufted ducks in Zigh, tufted ducks in Girmizigol, red-crested pochard (2500 species), tufted ducks, European coot (20000 species) in Puta bay. However, the only areas where total number of waterfowl of any species exceeded the RAMSAR criterion of regularly holding 20000 or more were Pirallahi, Shahdili and Puta areas (Refs. 7).

The surveys completed between 2014-2016 identified that the areas of international importance, based on key indicators, were Pirallahi, Shahdili, Turkan, Sangachal, Gobustan and Alat (Figure 6B.2), (Ref. 3). The number (individuals) of waterfowl species present at the Zigh, Puta (including lagoons located within the Baku Deep Water Jackets Factory area) and Red Lake areas were no longer found to exceed the international indicator of 1% limit. Total number of waterfowl of any species in these areas did not exceed the Ramsar criterion of regularly holding 20000 individuals (Refs. 3 and 4). This is thought to be due to the intensive development of the coastline in these areas over the past 10-15 years.

Figure 6A.2 Highly sensitive internationally important winter gathering places of waterfowl in Absheron-Gobustan coastline of the Caspian Sea (2013-2016)



For the most recent surveys (2014-2017), the importance and vulnerability of each area was assessed using the definitions and criteria set out in Sections 7 and 8 of this report.

In the Pirallahi area (Figure 6A.2), two species (tufted and red-crested pochard) were recorded in internationally significant numbers i.e. exceeded 1% limit, one species (whooping swan) recorded is included in the Red Book of Azerbaijan and one species (Dalmatian pelican) recorded is included both in the Red Book of Azerbaijan and IUCN Red List. The vulnerability of the area is therefore considered to be high.

Three species of birds recorded in the Shahdili area (tufted and red crested pochard, grebe) have international importance (i.e. exceeded 1% limit), five species recorded (whooping swan, great white pelican, greater flamingo, western swamphen, Mediterranean gull) are included in the Red Book of Azerbaijan and two species recorded (ferruginous duck, white-headed duck) are included both in the Red Book of Azerbaijan and IUCN Red List. According to the specified indicators, the vulnerability of the area is therefore considered high.

In the Turkan area, the only species recorded that is included in the Red Book of Azerbaijan is the whooping swan. The mallard is among the recorded waterfowl exceeding the Ramsar 1% limit (8000 species). For this reason, the area is considered to be of international importance. The area vulnerability is considered high.

Three species (whooping swan, red-crested grebe, Mediterranean seagull) recorded inhabiting the Sangachal area are included in the Red Book of Azerbaijan. The number of mallards recorded in this area exceeded the 1% species number limit giving the area Ramsar status. It is therefore considered to be of high sensitivity.

Two species of swans recorded inhabiting the Gobustan area (whooping swan, tundra swan) and Mediterranean seagull are included in the Red Book of Azerbaijan, four species (black-tailed godwit, red-crested geese, northern lapwing, Eurasian curlew) are included in the IUCN Red List and a single species (red-crested pochard) has international importance due to the significant numbers recorded in this area. It is therefore considered that the Gobustan area is of high vulnerability.

Two species (greater flamingo, Mediterranean seagull) recorded inhabiting the Alat area are included in the Red Book of Azerbaijan and the number of Mallards recorded exceeded the 1% species number limit giving the area Ramsar status. As such the Alat area is considered to be of high vulnerability.

The most recent surveys conducted by the ANAS between 2014-2017 have identified a sharp decrease in the number of coastal birds' habitats (open wetlands, small lakes, reed beds etc.) along the Absheron-Gobustan coastal area since the earlier surveys in 2002-2006. Reasons for this include the rapidly increasing development of Baku and surrounding area and development along the coastal zone of the sea which is subject to the expansion of the oil and gas production industry, transportation operations and the construction of various industrial, tourism facilities and individual residential houses, etc. (Refs. 3 and 4).

With regard to the areas that are no longer of international importance, the Zigh area is considered to be of low vulnerability as there have been no bird species included in the Red Book of Azerbaijan recorded in this area in recent years or recorded number of birds considered to have regional importance.

The Puta area (near Baku Deep Water Jackets Factory) is considered to be of medium vulnerability as the number of waterfowl inhabiting here has neither international, nor regional importance and there has been only a single species (whooping swan) that is included in the Red Book of Azerbaijan observed in this area.

4 Nesting Bird Species and their Vulnerable Gathering Places

Key nesting areas along the Absheron-Gobustan coastline of the Caspian Sea are generally limited to Shahdili Spit, Dash Zira and Gil islands (Ref. 2) (Figure 6A.3). Generally significantly fewer resting and flying coastal birds are observed in other islands (such as Khanlar, Boyuk Zira, Gum Zira and Tava islands which are located to the immediate south of Baku) and along the Absheron-Gobustan coastline of the Caspian Sea.

The key nesting areas around Absheron Peninsula were identified through a survey conducted by ANAS in June 2017 and included:

- **Shahdili Spit and adjacent islands.** The Spit and the adjacent islands are located within the boundary of the Absheron National Park. Nesting biotopes of birds consist of open dry lands, wet sandy areas, piled shells and open swamps.
- **Gil Island.** This island is a State Nature Reserve. Nesting biotopes of birds consist of open dry lands, rocks, piled of shells and wet sandy areas and 3m wide, 60-70m long reed bushes.
- **Dash Zira Island**. ANAS surveys conducted in June 2017 recorded a total 469 specimens of eight species (Little ringed plover, Kentish plover, Black-winged stilt, collared pratincole, Caspian Gull Larus, Sandwich tern, lesser crested tern, common tern). The main reason for the rich ornithological fauna here is the biotope diversity of the birds and absence of the discomfort factors. The habitat biotopes of the birds consist of 2 – 5 cm deep shallow shore water, 5 - 10m wide wet sands, 100 – 150 square metre (m^2) small lakes located in the depressed areas of the island, open swamps extending in narrow strips around the lakes, reed bushes and vegetation covering most part of the island and dry areas rich with the sandy islands. Little ringed plover, Kentish plover, Sandwich tern, lesser crested tern, Caspian Gull Larus nest in sandy areas, while the nests of Black-winged stilt and collared pratincole are observed in open swamps.

The survey also covered the Turkan-Zigh coastal line, Sangachal area, Gobustan coastline, Alat coastline, Puta bay and the lagoons near Baku Deep Water Jackets Factory.

The full list of species recorded during the June 2017 survey conducted by the ANAS is provided in Table 6A.2 below:

Table 6A.2 Species recorded during the June 2017 survey conducted by the ANAS

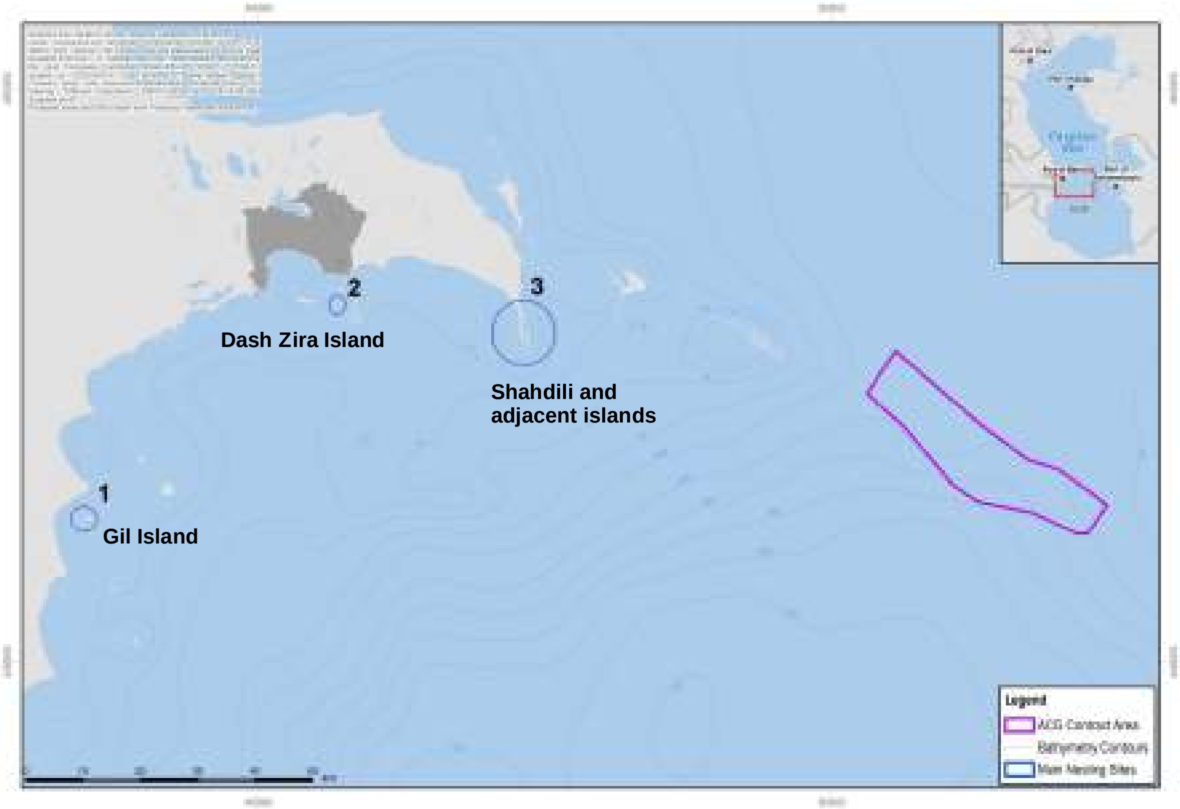
Survey Area	Recorded Species	Number of Individuals Recorded
Shahdili Spit and adjacent islands	Caspian gull larus	360
	Grey heron	8
	Slender-billed gull	41
	Mediterranean seagull	18
	Caspian tern	9
	Lesser crested tern	123
	Cream-colored courser	3
	Sandwich tern	190
	Kentish plover	10
	Little ringed plover	9
	Black-winged stilt	8
	Pied avocet	6
	Greater flamingo	3
	TOTAL:	**788**
Gil Island	Caspian gull larus	240
	Common tern	50
	Sandwich tern	50
	Common black-winged stilt	14
	Common pied avocet	6
	TOTAL:	**360**
Dash Zira Island*	**TOTAL:**	**469**

Survey Area	Recorded Species	Number of Individuals Recorded
Turkan-Zigh coastal line	Caspian gull larus	120
	Slender-billed gull	14
	Common seagull	28
	Sandwich tern	18
	Common tern	28
	Lesser crested tern	24
	Black-winged stilt	7
	Common pied avocet	5
	Kentish plover	4
	Black tern	28
	Whiskered tern	14
	Waterhen	2
	TOTAL:	**292**
Sangachal area	Mediterranean seagull	38
	Caspian gull larus	22
	Sandwich tern	10
	Common tern	14
	Waterhen	2
	TOTAL:	**86**
Gobustan coastal line	Mediterranean seagull	14
	Caspian gull larus	39
	Sandwich tern	14
	Common tern	12
	Waterhen	3
	TOTAL:	**82**
Puta bay and lagoons near Deep Water Jackets Factory	Caspian gull larus	18
	Slender-billed gull	8
	Sandwich tern	6
	Common tern	10
	TOTAL:	**42**
Alat coastal line	Common pied avocet	4
	Black-winged stilt	3
	Caspian gull larus	79
	Sandwich tern	28
	Common tern	31
	Slender-billed gull	14
	TOTAL:	**159**

* Full list of species not available

As shown in Table 6A.2 the number of birds recorded using the Shahdili Spit, Dash Zira and Gil islands was more than 70% of the total number of birds recorded at all locations with Shahdili Spit and adjacent islands used more than any other area.

Figure 6A.3 Key nesting sites of coastal birds in the Absheron-Gobustan coastline



12 species of waterfowl and coastal birds included in the Red Book of Azerbaijan and IUCN Red List were observed during the June 2017 survey at the areas listed above where bird observations were recorded (Table 6A.3), (Refs. 1 and 14).

Table 6A.3 Bird species listed in the "Red Book" of Azerbaijan and the Red List of the International Union for Conservation of Nature at the Absheron-Gobustan coastline of the Caspian Sea and their protection status

N	Species name	Protection status
1	2	3
1	Great white pelican	A
2	Dalmatian pelican	A, I
3	Greater flamingo	A
4	Whooping swan	A
5	Tundra swan	A
6	Marbled duck	A,I
7	White-eyed pochard	A,I
8	Aythya ferina	I
9	White-headed duck	A,I
10	Common swan	A
11	Black-tailed godwit	I
12	Eurasian curlew	I
13	Curlew sandpiper	I
14	Northern lapwing	I
15	Mediterranean gull	A

Notes:
A – Azerbaijan "Red Book"
I - Red List of International Union for Conservation of Nature

Four of the species listed in Table 6A.3 (Dalmatian pelican, marbled duck, white-eyed pochard, white-headed duck) are included both in the Red Book of Azerbaijan and the IUCN Red List; six species (great white pelican, greater flamingo, whooping swan, Tundra swan, common swan, Mediterranean gull) are only in the Red Book of Azerbaijan and five species (Black-tailed godwit, Aythya ferina, Eurasian curlew, Curlew sandpiper, Northern lapwing) are only in the IUCN Red List. Common swan was only observed in the Shahdili location, while the other nine species were observed in various locations along the Absheron-Gobustan coastline of the Caspian Sea in various years.

5 Vulnerability of Birds per Season

The most vulnerable periods for waterfowl and coastal birds throughout the year are November and the first half of December in autumn, January, first half of February in winter and March in spring.

Mass population sites, species, and the number of birds are increased by migratory birds during these periods within the coastal waters of the Caspian Sea. The waterfowl species belonging to the genus ducks, swans, grebes, cormorants, pelicans as well as coots are more vulnerable in winter and migration period, and are particularly vulnerable to any water column contamination or spill because they spend most of their time in the water.

Coastal bird species belonging to plovers, stilts and sandpipers genus feed in small lakes and ponds, sandy areas on the beach, and at the water's edge. They are therefore less vulnerable to water column contamination. The species belonging to gull (laridae) family are largely found in open water areas while looking for food, and in coastline areas and on islands while resting. They spend less time in the water and their potential to be affected by water column contamination is possibility less compared to waterfowl.

Table 6A.4 provides a summary of the vulnerability for each bird species recorded within the latest bird surveys per season.

Table 6A.4 Vulnerability of the Waterfowl and Coastal Birds per season along the Absheron-Gobustan coastline of the Caspian Sea

Species	Vulnerability during migration and wintering	Vulnerability during nesting
1	2	3
Podicipedidae		
Podiceps nigricollis	high	high
P.cristatus	high	high
P.grisegena	high	high
P.(Tachybaptus) ruficollis	high	high
Pelecanidae		
Pelicanus crispus	mid	
P.onocrotalus	mid	
Phalacrocoracidae		
Phalacrocorax carbo	high	high
Ph.pygmaeus	high	high
Ardeidae		
Botaurus stellaris	very low	
Nycticorax nycticorax	very low	
İxobrychus minutus	very low	
Eqretta alba	very low	
E.garzetta	very low	
Ardea cinerea	very low	
A.purpurea	very low	
Phoenicopterus roseus	mid	
Anatidae		
Cygnus olor	high	
C.cygnus	high	
C.bewickii	high	
Anser anser		
A.albifrons		
A.erythropus		
Rusibrenta ruficolis		
Tadorna ferruginea	mid	low
T. tadorna	very high	low
Anas platyrhynchos	very high	low

Species	Vulnerability during migration and wintering	Vulnerability during nesting
1	2	3
A.penelope	very high	
A.crecca	very high	
A.clypeata	very high	
A.sterepera	very high	
A.acuta	very high	
A.querquedula	very high	
Netta rufina	very high	
Aythya ferina	very high	
A.nyroca	very high	
A.fuligula	very high	
A.marila	very high	
Bucephala clangula	very high	
Oxyura leucocephala	very high	
Merqus albellus	very high	
M. mergus	very high	
Rallidae		
Fulica atra	very high	
Porphyrio porphyrio	mid	high
Charadriformes		
Charadrius alexandrinus	low	
Ch.dubius	low	
Himantopus himantopus	low	
Recurvirostra avosetta	low	
Tringo totanus	low	
Actitis hypoleucos	low	
Calidris ferruginea	low	
C.albina	low	
Limosa limosa	low	
Glareola pratincola	low	
Laridae		
Larus ichthyaetus	low	
L.cachinans	low	
L.melanocephalus	low	
L.minutus	low	
L.ridibundus	low	
L.genei	low	
L. argentatus	low	
L. canus	low	
Chlidonias hybrida		high
Ch.leucoptera		high
Hydroprogne tschegrava	low	high
Sterna sandvicensis		high
S.hirundo		high
S.albirfons		high

6 Conclusions

The surveys completed to date have shown that the species present and number of waterfowl and coastal birds along the Absheron-Gobustan coastline changes significantly in days and months during the migration period. The most active migration period for waterfowl is November and first half of December in autumn, and March in spring. Birds can be found all along the coastline through all seasons, peaking during migration periods.

The key vulnerable gathering places for birds in winter are coastal waters of the Caspian Sea at Pirallahi, Shahdili, Turkan, Gobustan and Alat coastline. The areas of Zigh and Puta as well as at the areas around the Red Lake which were previously classified as being of international importance have lost this status. This is thought to be due to large scale construction activities carried out along the coastline in the vicinity of these areas, which has removed habitat and created disturbance.

The key vulnerable gathering place of the nesting birds during nesting period are Shahdili Spit and the small islands nearby, Dash Zira island and Gil island.

7 Glossary

Region – According to the description given on the third edition (13) of the reference book "Waterfowl population assessment", the survey sites along the Caspian Sea are included to the Western Asia and Caspian region.

1% limit – is a criteria defined and widely used in Ramsar convention to indicate the international importance of wetland biotopes. According to Ramsar convention, a wetland is considered internationally important if 1% or more of any waterfowl species dwell there.

Ramsar site – Ramsar is an Iranian city. An international convention on wetlands was signed in this city in 1971. Azerbaijan signed the Ramsar convention on 18th of July, 2001. The sites included into the list of internationally important wetland sites are called "Ramsar sites".

To provide Ramsar status to any wetland, that site must meet the following requirements:

a) 20000 or more waterfowl should exist in the site; or
b) Some group of waterfowl in large number should exist in that wetland biotope showing its importance, productivity, and diversity; or
c) It should support 1% or more of the individuals in a population of one species (subspecies) of waterfowl existing in the region (Refs. 13, 14).

8 Indicators for Definition of the Area Vulnerability

High vulnerability - existence of one or more nesting or transient, protected species of waterfowl population or the population of regional and international importance.

Mid vulnerability - existence of one or more species included in the national or international Red Book.

Low vulnerability - absence of rare waterfowl or waterfowl of regional importance in the area (Ref. 7).

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APPENDIX 6B

Fish and Fishing Report

Appendix 6B

Fish and Fishing Report

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1 Background Information

1.1 Sources of Information

Information presented in this review, prepared by Professor Mehman M. Akhundov (Doctor of Biological Science) in liaison with AECOM, has been taken from the following sources:

- Governmental bodies of the Azerbaijan Republic responsible for the control and regulation of commercial fishing in the Azerbaijan sector of Caspian Sea;
- Fishing fleet of legal entities and individuals carrying out commercial fishing in the Azerbaijan sector of Caspian Sea; and
- Azerbaijan Scientific-Research Institute of fishing industry (AzerNIIRKh) of the Ministry of Ecology and Natural Resources (MENR) of the Azerbaijan Republic.

Additional information relating to small scale coastal fishing has been obtained from interviews with fishermen on behalf of BP in the vicinity of the Sangachal Terminal and along the southern coastline of the Absheron Peninsula as part of the Shah Deniz Stage 2 (SD2) and Shallow Water Absheron Peninsula (SWAP) Projects respectively between 2012 and 2016.

2 Fish Species Present In Azerbaijani Waters

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

- **Migratory species:** this includes sturgeon and shad species whose key spawning grounds are the river Kura in the Southern Caspian and rivers Terek and Samar, which flow into the Central Caspian. These species migrate in waters between 50 and 100 metres (m) deep. Some species of sturgeon (i.e. Beluga) spend the spring and summer mostly in the Northern and Central Caspian and in autumn migrate southwards for wintering[1];
- **Other species (semi-migratory):** this includes kilka (herring family), the most abundant fish in the Caspian. Kilka are widely distributed in the Caspian and are important prey for other species such as sturgeon, salmon and the Caspian seal. Mullet were introduced from the Black Sea in the 1930s and normally overwinter in the southern Caspian. They migrate in the spring to feeding grounds in the Central and Northern Caspian. The key spawning period takes place between late August and early September in water depths typically between 300 and 600m; and
- **Resident species:** several non-commercial species such as gobies are found in all regions of the Caspian Sea, predominantly in shallower areas (up to 30-70m in spring and summer, migrating to greater depths in winter). Gobies are second only to kilka in terms of the number of species present in the Caspian Sea.

In general, the main distribution of fish species in the Azerbaijani waters 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, with only seasonal migrations into deeper water. Some fish overwinter in the warmer waters of the southern Caspian and migrate to the nutrient rich shallow areas of the north or river deltas in the spring/summer for spawning and feeding[2].

The coastal region is important for non-migratory (resident) species providing breeding and

[1] Gesner, J., Chebanov, M. & Freyhof, J. 2010. *Huso huso*. The IUCN Red List of Threatened Species 2010: e.T10269A3187455. Available at: http://dx.doi.org/10.2305/IUCN.UK.2010-1.RLTS.T10269A3187455.en [Assessed 07/11/16]

[2] Lovetskaya, 1941; Derjavin, 1956; Mahmudbekov, Doroshkov, 1956; Kazancheev, 1981; Rahimov, 1982; Belyayeva, Kazancheev, 1989; Akhumdov, 2000; Guseinova, Akhundov, 2011; Ivanov, Komarova, 2012; Red Book of the Azerbaijan Republic, 2013

nursery habitats for a number of species during spring, summer and autumn. The area to the south of the Absheron Peninsula is an important as a nursery area for almost all commercial fish species. This area is particularly sensitive in early spring, summer and autumn, when resident species are spawning.

Annex A of this report presents the fish known to be present in the Azerbaijan waters of the Caspian, their protection status, hearing sensitivity, the estimated water depth they are present per season and location where spawning takes place. Annex B provides figures showing the migration routes for key migratory species.

3 Commercial Offshore and Small Scale Coastal Fishing

3.1 Fishing Regulation and Licensing

3.1.1 Fisheries Regulation

Legislation Regulating Fishing Activity in the Republic of Azerbaijan

Fishing activity is regulated through legislation, and respective rules and regulations.

Legal basis for fishing organization, management, development, usage and protection of the fish resources in the Azerbaijan Republic is regulated by the Azerbaijan Republic Law “On Fishing” adopted in 1998 (No 457-IQ, 27.03.1998).

The Cabinet of Ministers of the Azerbaijan Republic adopted number of new Regulations prepared by the Ministry of the Ecology and Natural Resources with reference to clauses 2.3-2.11 of the Resolution of the Cabinet of Ministers of the Azerbaijan Republic No 262s, dated 18 August 2014 in order to ensure the enforcement of the Decree of the President of the Azerbaijan Republic No 243, dated 11 August 2014 “On implementation of the Azerbaijan Republic Law No 1015-IVQD, dated 27 June 2014 “On changes to the Azerbaijan Republic Law “On Fishing”. Moreover, Resolution “On approval of the “Regulations for fishing and hunting of other water bioresources” No 243, dated 2 June 2017 was adopted.

Coastal fishing is regulated by the “*Rules for state registration of small tonnage vessels, approved pursuant to Resolution 97 (dated 23 April 2008) of the Cabinet of Ministers of the Republic of Azerbaijan“.*The “*Classification of small tonnage vessels sailing under the state flag of the Republic of Azerbaijan”,* Order 073 issued by the Ministry of Emergency Situations on 16 June 2007 and Ministry of Justice Certificate 3350 on 26 June 2007 stipulate that the region in which small-tonnage vessels can fish is limited to 2-3 miles from the coastline.

According to *“Regulations for fishing and hunting of other water bioresources"* approved by the Decree of the Cabinet of Ministers of the Azerbaijan Republic No 243, dated 2 June 2017 *fish and other water bioresources may be hunted during the below periods using appropriate hunting means*:

- Scaly fish nets – from 1st January to 1st April and from 1st September to 31st December;
- Fish nets for kilka – from 1st February to 1st May;
- Fish nets for mullet – from 1st January to 1st May and from 1st September to 31st December;
- Seine nets – from 1st January to 1st May and from 1st September to 31st December;
- Karava and other traps – from 1st January to 1st May and from 1st September to 31st December;
- Cone nets and pumps – from 1st January to 1st May and from 1st June to 31st December.

Pursuant to Appendix 1 of the "Regulations for fishing and hunting of other water bioresources" approved by the Decree of the Cabinet of Ministers of the Azerbaijan Republic No 243, dated 2 June 2017, the following fishing equipment is used in the Caspian Sea:

- Scaly fish nets (length 18-25m, width 3m, mesh size 40-55mm);
- Fish nets for kilka (length 18-25 m, width 3 m, mesh size 24-44 mm);
- Fish nets for mullet (length 351.5 m, width 3 m, mesh size 32-44 mm);
- Seine nets (length up to 1000 m from the shore, width 5 m, mesh size 30-44 mm);
- Karavas and other traps (length up to 20 m from the shore, width 1.5 m, mesh size 30-44 mm); and
- Cone nets (length 5.5 m, diameter 1.5-2 m, mesh size 6.5 mm).

3.1.2 Regulatory Bodies and Licensing

The following are regulatory governmental bodies of the Azerbaijan Republic that control commercial fishing activity in the Azerbaijan sector of the Caspian Sea:

- State Marine Administration (SMA);
- Ministry of Emergency Situations (MES);
- Department on Protection and Reproduction of Bioresources in Water Basins (DPRAB) of the Ministry of Ecology and Natural Resources (MENR);
- Water Transport Police (WTP) under the Ministry of Internal Affairs (MIA); and
- State Border Service (SBS).

Functions of regulatory governmental bodies are outlined in Table 1.

Table 1 Functions of Regulatory Government Bodies

Regulatory Government Body	Function
SMA	Issue documents identifying the vessel owner, crew members of the vessel and the country where the vessel is formally registered.
MES	Inspects the technical condition of the vessel and issues a certificate of seaworthiness. Technical certificates for large vessels are issued by the Baku representative office of the Russian Maritime Register of Shipping.
DPRAB-MENR	For vessels holding respective documents issued by SMA and MES, DPRAB - MENR shall: • Issue formal permission to specific vessels to fish and determine the catch quotas for biological marine products; and • Conduct inspections to approve that the volume and species of the biological marine products caught by the vessels is in accordance with licence conditions.
WTP-MIA	For vessels holding respective documents issued by SMA, MES and DPRAB, WTP-MIA shall: • Inspect the vessel appropriate documents; • Confirm whether the vessel is designed for fishing or other purposes such as transporting dry cargo; and • Verify and confirm that the vessel holds the relevant DPRAB MENR-issued formal documentation and shall not allow the vessel to head for sea without the correct documents.
SBS	For vessels holding the respective documents issued by SMA, MES and DPRAB-MENR documents, SBS shall: • Inspect to check the purpose of a vessel's journey out to sea; and • Not allow a vessel to head to the sea for catching fishery products within the economic zone on 10-nautical mile territory, unless it has the correct documentation.

3.1.3 Fishing Licence Requirements

To obtain a license for catching fish and other water bioresources (i.e. a fishing passport) legal entities or individuals need to apply to the DPRAB of the MENR with the following documents:

- A copy of the relevant by-law;
- Registration certificate;
- Certificate issued by tax inspection;
- Documents specifying vessel's owner (legal entity or individual); and
- Technical documentation regarding vessel condition (register).

An application for a fishing passport should specify:

- Vessel name;
- Proposed quota and fish species composition (kilka, grey mullet, herring, roach and ordinary/small fish[3]); and
- Area (including coordinates) of planned activities.

3.1.4 Commercial Fishing Licence Requirements and Reporting

To control commercial fishing[4], DPRAB-MENR issue a fishing passport. The fishing passports are issued to entities (stating the name of the captain) and individual fishermen, and specify the number of fishermen in the crew and their names, the area the fishermen are permitted to fish (i.e. fishing area), and the fishing quota per species per fishing area authorized for the licensed period of one year. Fishing passports are also issued for the fishing vessels and boats.

The permit and fishing passport is issued after the legal entity or individual (i.e. the applicant) has paid a fee to a DPRAB dedicated account intended to provide compensation for the use of biological resources. At the end of each year, these funds will be transferred from the special account of DPRAB to the Environment Protection Fund at the MENR opened pursuant to the "Regulations on development, restoration and protection fund of the water bioresources" approved by the Resolution of the Azerbaijan Republic President No 962, dated 23 June 2016. Permit and fishing passport are issued to the applicant for a period from the day of his application by DPRAB-MENR to the end of the current calendar year. These documents authorise the applicant to carry out fishing in accordance with the fishing passport conditions. DPRAB also issues official notification to the Agency for the Protection of Aqueous Bioresources (a Department of DPRAB), and copy of this notification is provided to the successful applicant.

At the end of each month, the legal entity/individual is required to submit a report detailing the results of their fishing activities to DPRAB. According to the Law of the Azerbaijan Republic on fishing (1998), representatives of DPRAB have the right to be present during fishing and to check relevant documents.

3.1.5 Sturgeon Fishing Licensing

Starting from 2011, the Caspian States including Azerbaijan stopped commercial fishing for sturgeon. Before adoption of the generalised five-party Agreement on interstate moratorium on commercial sturgeon fishing in the Caspian Sea, the Caspian states were following the technical moratorium for sturgeon set individually for each country.

Within Azerbaijan fishing passports for catching sturgeon (*Acipenseridae*) are only issued for scientific-research activities (where a quota applies), as well as for the artificial reproduction for sturgeon breeding plants. The scientific-research vessel (SRV) "Alif Gadzhiyev" is used for catching sturgeon, with numbers limited by the scientific quota. Every year, two Caspian expeditions are carried out to assess sturgeon populations using this vessel (during summer and winter). These two scientific research expeditions are organized by the Azerbaijan Scientific-Research Institute of Fishing Industry (AzerSRIFI) to assess:

[3] The main focus of commercial fishing is kilka
[4] Includes fish and other biological marine products

- Population numbers (i.e. abundance);
- Field reserves and distribution of sturgeons in the Azerbaijan waters of Caspian Sea, changes in distribution; and
- Ratio of various sturgeon populations in Azerbaijani waters of the Caspian Sea.

In addition to the fishing passport for sturgeon, fishing associated with scientific-research purposes, fishing passport is also granted by AzerSRIFI for fishing at two nearshore observation stations during the year at Nabran (Yalama-6, Middle Caspian) and Narimanabad (Southern Caspian, Small Gizilagaj). Fishing passports are also issued every year in March-April, to legal entities or individuals for the purpose of artificial reproduction of sturgeons so that sturgeon breeding plants have an adequate quantity of sturgeon breeding stock.

3.2 Commercial Offshore Fishing Activity in the Azerbaijan Sector of the Caspian Sea

3.2.1 Offshore Commercial Fishing Entities and Vessels

Currently the following legal entities and individuals carry out commercial fishing in the Southern Caspian including the Azeri-Chirag-Gunashli (ACG) and Shah Deniz (SD) Contract Areas, which are located within the western section of the Southern Caspian:

- Closed joint-stock company (ZAP) “Khazarbalig” (“Khazarbalig” MMM); and
- Closed joint-stock company “Caspian Fish Co Azerbaijan”.

Currently, in accordance with the permits issued by regulatory bodies discussed in Section 3.1 above, 10 vessels registered in Azerbaijan carry out commercial fishing in the Southern Caspian including the ACG and SD Contract Areas. These vessels all operate under annual permits (fishing passports) issued from the beginning of the calendar year, and all fish for kilka. Their technical specifications are listed in Table 2.

Table 2 Specifications for National Fishing Vessels Having Permit for Commercial Fishing in the Southern Caspian (Including the ACG and SD Contract Areas), 2016 Data[1]

Legal Entity/Individual	Vessel Type and Name[2]	Vessel Displacement (Tonnes)	Powerplant output (kWt)	Deadweight (Tonnes)	Fishing Equipment Used
"Khazarbalig" Closed Joint Stock Company (CSJC)[3]	LTV "Shay-1"	86.01	165	57	Cone-shaped net
	LTV "Shay-2"	86.01	165	54	Cone-shaped net
	LTV "Shay-3"	86.01	165	54.08	Cone-shaped net
	LTV "Shay-5"	86.01	165	54	Cone-shaped net
	LTV "Mardakan"	86.01	165	57	Cone-shaped net
	LTV "Tebriz"	86.21	165	56.86	Cone-shaped net
	SB "Akhmedli"	85.04	110	38	Cone-shaped net
	MFT "Lenkoran baligchisi"	723	852	414	Fish pump
	MFT "Namig Hafizoglu"	722	852	414	Fish pump
	LTFV-50 "Antaris"	190	232	70	Cone-shaped net
	LTV -29	81	132	54	Cone-shaped net
	SB "Dolphin"	85.04	110	38	Cone-shaped net
	SB "Shusha"	86.01	166	54	Cone-shaped net
	SB "Fortuna"	85.04	110	38	Cone-shaped net
	LTV "Shans"	86	165	31	Cone-shaped net
	LTV "Dalga"	85.02	166	54	Cone-shaped net
	LTV "Bayaz"	86.01	166	54	Cone-shaped net
ZAO "Caspian Fish Co Azerbaijan"[4]	LTFV-50 "Shahriyar"	189	232	73	Cone-shaped net

Notes:
1 – DPRAB, Closed joint-stock company (ZAP) "Khazarbalig", "Lenkoran fish plant"
2 – Vessel types:
LTV – Lifting Transportation Vessel; LTFV – Lifing Transportation Freezer Vessel; SB – Seine Boat; and MFT – Medium Freezer Trawler
Refer to Section 2.3.1 below for further data regarding vessel types
3 – Areas fished includes water basins of Borisov, Karaqedov, Kalmıçkov, GPB, Kurkamen, Kornilov-Pavlov, Andreyev and Makarov banks
4 – Areas fished includes around water basins of Makarov, Andreyev, Kornilov-Pavlov, Kalmichkov, GPB and Karaqedov banks

Cone-shaped nets on the vessels detailed in Table 2 are used at a maximum depth of 25-80m from the sea surface, and fish pumps are used at a maximum depth of 50-120m.

As it can be seen from Table 2, in 2016 the Azerbaijan Republic had 10 fishing vessels equipped with the gear necessary for fishing of valuable species and sailing under the Azerbaijan flag. All 9 (nine) vessels of "Khazarbalig" CJSC are homeported in Lankaran city, while 1 (one) vessel of "Caspian Fish Co Azerbaijan" CJSC, previously moored in Pirallahi island, was moved to the Bibiheybat port of Baku city.

In 2009 25 out of the 44 fishing vessels that were registered had the appropriate permissions for fishing. It is understood that since 2009 most of these vessels have fallen into disrepair. Hence in 2016, only 10 fishing vessels are still operating and there are no moored vessels recorded without fishing passports.

3.2.2 Fish Caught by Licensed Commercial Offshore Fishing Entities

Fishing vessels that have obtained fishing passports are required to maintain a logbook where coordinates of the region they have fished are registered. Information about volumes and species composition of fish caught is also documented in the log. Vessel owners/operators have the right to sell caught fish.

In 2016 those legal entities and individuals who obtained fishing passports in the Azerbaijan Republic were only permitted to catch kilka and caught 315.6 tonnes of kilka. The volumes caught by each legal entity/individual are set out in Table 3.

Table 3 Fish Caught by Each Legal Entity and Individual in 2016

Legal Entities and Individuals	Volume of Fish Caught (kilka, tonnes)
“Khazarbalig” CJSC	288.4
“Caspian Fish Co Azerbaijan” CJSC	27.2
Total:	**315.6**

The vessels belonging to the legal entities listed in Table 3 deliver the caught fish (kilka) to “Caspian Fish Co Azerbaijan” CJSC fish processing plant and the processed fish is sold via the internal market i.e. none is exported.

3.3 Small Scale Coastal Fishing in the Azerbaijani Sector of the Caspian Sea

Small scale coastal fishing is generally undertaken using medium-sized small tonnage vessels made of Duraluminium or wood and of approximately 4.8m (duraluminium boat) and 5.5m (wooden boat) length and 1.8m width under licenses (fishing passports) issued by the MENR. These fishing passports permit small scale coastal fishing within 3 nautical miles from the shoreline. The fishing areas where small scale fishermen are authorised to fish is specified in fishing licences, with coastal fishing areas typically named after the adjacent coastal town or settlement. Table 4 presents a summary of commercial fishing data available for small scale coastal fishing along the Azerbaijani coastline based on license data available.

Table 4 Summary of Commercial Fishing Licencing Data 2016 (Small Scale Coastal Fishing)

MENR Data 2016	
Fishing Areas For Which Licenses Have Been Granted[5]	Zira; Novkhani; Buzovna; Hovsan; Shuvalen; Shikh; 29th km; Bayil; Zygh; Sangachal-Gobustan; Shykhlar; BilgahTurkan; Pirshaghi Around Oily Rocks and Chilov island
Species of Importance to Commercial Fishing	o Sprat (i.e. Caspian kilka) – *Clupeonella delicatula caspia Svetovidov* o Sprat anchovy (i.e. anchovy kilka)– *Clupeonella engrauliformis* (Borodin) o Caspian shad – *Alosa caspia caspia* (Eichwald) o Brazhnikov’s shad – *Alosa brashnikovi* (Borodin) o Blackback shad – *Alosa kessleri kessleri* (Grimm) o Roach – *Rutilus rutilus caspicus* Berg o Black sea roach – *Rutilus frisii kutum* (Kamensky) o Danubian bleak – *Chalkarburnus chalcoides* (Guldenstadt) o Zahrte or bream – *Vimba vimba persa* (Pallas) o Common carp – *Cyprinus carpio Linne* o Golden grey mullet – *Liza auratus Riss*
Species for Which Quotas are Specified (by common name)	o Sprat o Shad o Black sea roach o Kulma o Common carp o Bream o Grey mullet o Zahrte
Species That Cannot Be Fished Under Azerbaijani Fishing Regulations (as per 2016 License)	o Beluga – *Huso huso* (Linnaeus) o Ship sturgeon – *Acipenser nudiventis,* Lovetsky. o Russian sturgeon – *Acipencer guldenstadti* Brandt o Kura sturgeon – *Acipenser persicus Borodin* o Sturgeon – *Acipenser stellatus Pallas* o Caspian trout – *Salmo trutta caspius Kessler* o Zander – *Sander marinus Cuvier*

Figure 1 shows the licenced coastal fishing areas and communities where licensed fishermen live along the coastline of the Absheron Region based on data collected in 2015[6].

[5] Permits are also issued for the following offshore areas for commercial fishing: water basins of Borisov, Karagedov, Kalmichkov, GPB, Kurkamen, Kornilov-Pavlov, Andreyev and Makarov banks
[6] MENR Letter, 3 July 2015. Response to a Request for Information from BP. Ref. 4/1009-6

Small scale fishing is undertaken using both active and passive fishing methods. Active methods involve use of nets that are launched and collected from the boat whilst passive methods are primarily represented by the use of stationary fish traps. The following gear is typically used by small scale fishermen along the coastline of the Absheron Region:

- **Hanging fish nets:** Scale and seine nets are mainly set at a depth of 2-3m. Nets are placed at different depths ranging from 5 to 8m. The length of the nets is 18-25m and do not lie on the seabed.
- **Stationary seines:** Stationary seine nets are normally no longer than 1km and typically start from the shoreline with posts placed directly on the seabed. The posts are placed at various depths ranging from 1.5 to 2.5m. One end of the net is placed at the seabed at different water depths and the other end can normally be seen from the surface.
- **Karavas and trap-type nets:** This type of net is normally 20m long and start at the shore with posts placed on the seabed at water depths ranging between 1.5 and 2.5m.

The high seasons for small scale fishing is reportedly January to April[7] and September to December with fishermen questioned during the SD2 and 3D Seismic SWAP Projects stating that they fish either every day, or up to 3-4 days a week. High winds restrict fishing activities and dull days are preferable to sunny conditions. Almost all small scale fishermen undertake fishing for commercial purposes with catch sold to market or to entities such the Caspian Fish Co Azerbaijan CJSC.

3.4 Estimate of the Scale and Nature of Unregulated Fishing

Unlicensed fishing activity relates to both fish catch exceeding the quota and species authorised by the regulatory authorities, as well as fishing without any license (fishing passport), i.e. unlicensed vessels or unlicensed fishermen.

Unauthorised equipment, boats, vessels or species is prohibited and is otherwise confiscated by the authorities. There is evidence of violations of fishery protection legislation every year as well as instances of fishing gear and catch being confiscated.

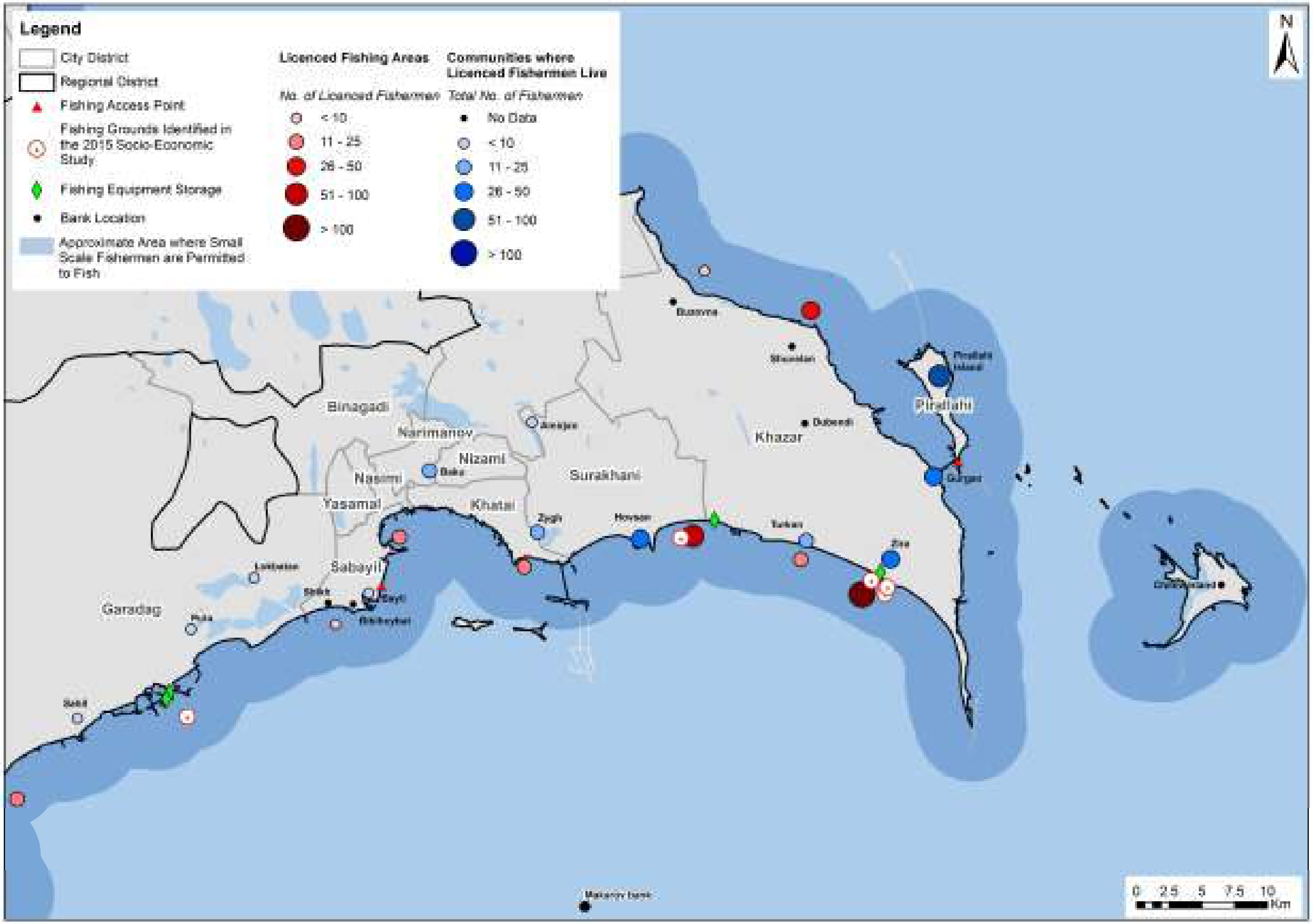
Table 5 presents a summary of the fisheries protection violations data collected for 2016 and 2017. For 2017, there were 272 cases of law violations and 122 persons were subjected to administrative and criminal charges. 100 protocols and 172 citations were prepared. 6 cases were forwarded to the district courts, while 85 cases were heard by legal enforcement authorities due to the criminal nature. 10 cases were reviewed in administrative court. The following equipment of violators was confiscated: 57 boats, 91 oars, 10 outboard motors, 1074 illegal hunting tools, 21 pairs of coveralls, 3 dip-nets, 3 batteries, 4 transformers, 1 flash light, 5 fuel cans, 79 sets - 5550 automatic fishing rods, 3042 various species of fish. The total amount of claims raised for damages caused to biological resources was 51229 AZN manat.

Table 5 Summary of Fisheries Protection Violations, Confiscations and Fines, 2016-2017

Parameter	Unit	Year	
		2016	2017
Number of violations of fishing legislation	each	246	272
Number of prosecuted people	persons	103	122
Number of confiscated boats	each	44	57
Number of confiscated illegal fishing tools	each	363	5550
Number of confiscated various species of fish	each	2954	3042
Amount of raised claims (1$=1.70AZN)	AZN	40667	51229

[7] January to March (scaly fish), February to April (herring), January to April (grey mullet)

Figure 1 Licenced Coastal Fishing Areas and Communities Where Licensed Fishermen Live Along Coastline of the Absheron Region (2015)



4 Commercial Fishing Methods and Equipment

4.1 Commercial Fish Species

Catch records show that kilka is the predominately caught species of fish, accounting for about 50% of total fish catch in 2016 in the Caspian and in estuaries of the rivers flowing into the Caspian. At present, kilka is most abundant fish present (in terms of biomass) in the Caspian and associated river estuaries with sturgeon (white sturgeon, Russian sturgeon, Kura (Persian) sturgeon, Fringebarbel sturgeon and starred sturgeon) as the second most predominate. Fishing in Azerbaijan is carried out mainly in the Caspian Sea, Kura River and inland water reservoirs. Commercial fishing in the Kura River and Caspian Sea includes over 20 fish species.

From 2011, the Caspian States including Azerbaijan stopped commercial fishing for sturgeon. Fishing of sturgeon is performed only for breeding in fisheries and for scientific studies. Before the adoption of the generalised five-party moratorium Agreement on commercial sturgeon fishing in the Caspian Sea, the Caspian States were following the technical moratorium for sturgeon set individually for each country. Within Azerbaijan fishing for sturgeon species for the purpose of fish breeding, is carried out mainly in the Kura River, and in the mouth of the Kura estuary. Foraging schools of sturgeon species dwell on the western shelf of the Middle Caspian (refer to Figure 2), in the territorial waters of the Azerbaijan Republic. Breeding sturgeon species located here are at the II and II-III stages of maturity[8]. To the south of the Kura estuary, breeding sturgeon species are at the III and III-IV stages of maturity.

Currently, when legal entities and individuals apply for a fishing passport, only kilka is specified in the documents as the objective for large-capacity fishing deep waters, but fishing passports can be obtained for other fish species including grey mullet and herring. Kilka, which is a key object for commercial fishing, comprises three species:

- Ordinary;
- Anchovy; and
- Big-eyed.

Besides its commercial value, kilka is the main food source for sturgeon species, Caspian salmon, herring and other predatory fish, as well as for the Caspian seal.

4.2 Locations of Commercial Activity of Fish Vessels

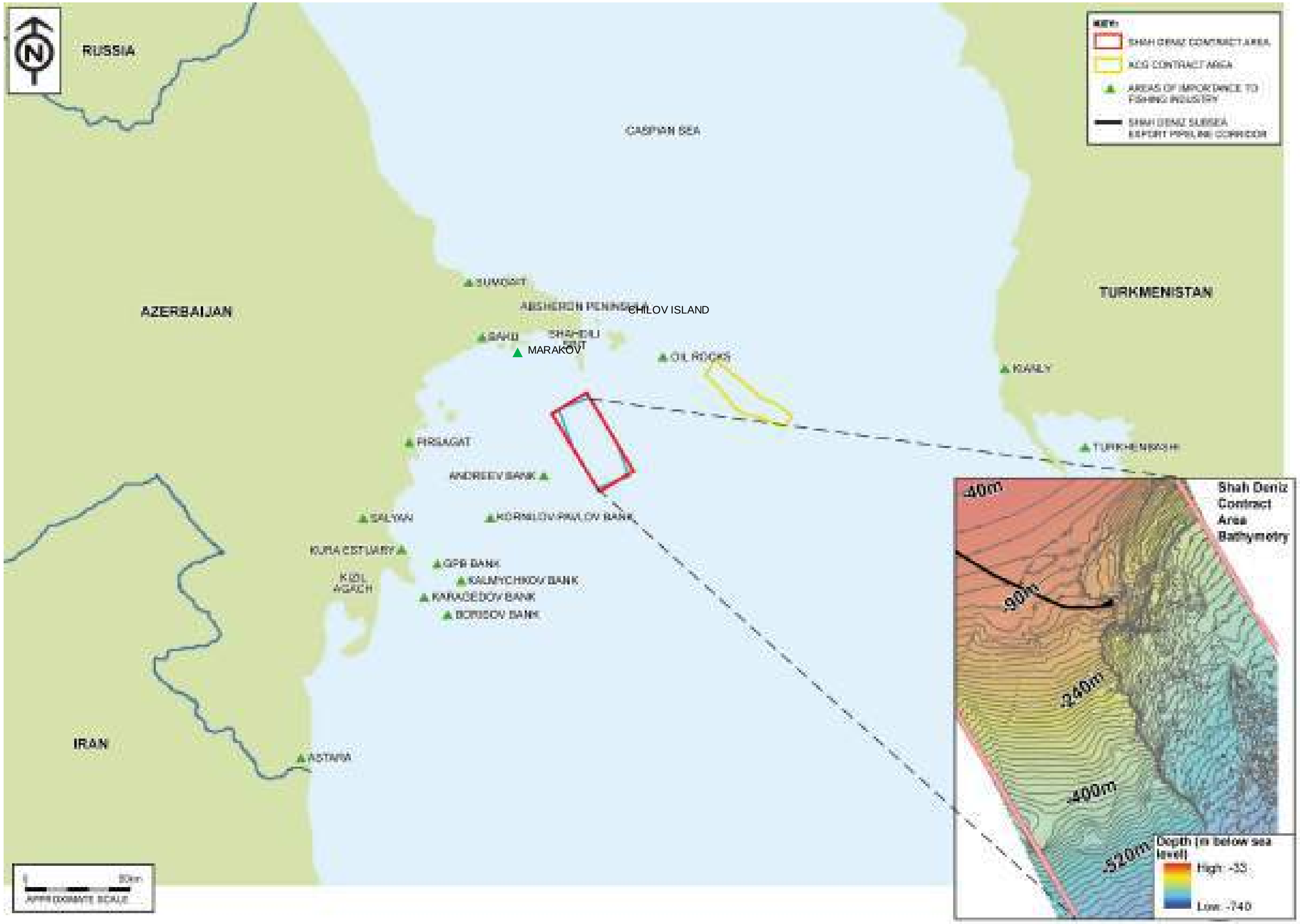
As mentioned above, kilka is main object of commercial fishing for vessels in the Caspian Sea, including Azerbaijani waters. Figure 2 shows the main areas where kilka are fished. The main accumulations of kilka were registered in the offshore areas of Southern Caspian from Oil Rocks and Chilov island towards Makarov bank and south to Borisov bank. In this area ordinary kilka are found between 20 and 40m below sea level, anchovy kilka between 100 and 300m below sea level and big eyed kilka between 130 and 450m below sea level. However, the densest accumulations have been

[8] Sturgeon species undergo 5 (five) stages of maturity of reproductive glands (GMS), namely:
I – Immature (indifferent period);
II – Developing (cytoplasmic growth of oocytes)
III – Developed (oocytes trophoplasmic growth period)
IV – Embryos fully formed and developed for reproduction; and
V – Mature.
Stages I-IV of reproductive gland maturity takes place at sea. The last stage (V) is observed in mature individuals during spawning in the rivers. Various species of sturgeon living in the Caspian Sea reach these stages of maturity at different ages and body mass. Sturgeon mature and are ready for spawning (stage V) at the following ages:
Starry sturgeon – males 7-8, females 9-11 years of age;
Russian sturgeon males 10-12, females 12-14 years of age;
Persian sturgeon males 8-10, females 10-12 years of age;
Fringebarbel sturgeon – males 8-11, females 11-14 years of age; and
White sturgeon – males 12-15, females 15-18 years of age.
.

found in the nearshore zone up to 50m below sea level. Commercial fishing for kilka is carried out in the vicinity of the following:

- Makarov bank;
- Andreev bank;
- Kornilov-Pavlov bank;
- GPB bank;
- Kalmichkov bank;
- Karagedov bank;
- Borisov bank;
- Kurkamen; and
- The mouth of the Kura estuary.

Figure 2 Main Offshore Fishing Ground Within Azerbaijani Sector of the Caspian Sea and Areas of Importance to Fishing Industry



Depending on the season, a maximum of 10 fishing vessels commercially fish in the Southern Caspian at any one time on the route from Oil Rocks and Chilov island towards Makarov bank and south to Borisov bank. Fishing is carried out during the whole year with the exception the period between April and August when kilka are spawning and migrate to the Northern and Middle Caspian. During this period anchovy and big-eyed kilka do not shoal and therefore fishing is not productive. During the winter, commercial fishing is carried out at a depth of 50-80m below sea level, and in the summer at a depth of 25-40m below sea level. At these depths, the main fish caught are ordinary kilka species.

Anchovy and big-eyed kilka stay in the Southern Caspian, mainly during winter. During autumn-winter months a relationship can be seen between the distribution of herring and kilka, (food source for herring) and the distribution of zooplankton (food source for kilka). Herring spend winter in the Southern Caspian, from Chilov Island to Astara, mainly near the western shores and southern slopes of the Absheron sill[9]. Herring and kilka in the ACG and SD Contract Areas are generally found mainly in winter, at depths up to 50-100m, but can sometimes be found at depths of 130-300m below sea level. However, vessels equipped with cone shaped nets predominately fish from 25-80m below sea level, while vessels equipped with fish pumps catch fish at 50-120m below sea level.

The reduction of kilka species landed over the past 10-15 years can be attributed, at least in part, to the adverse impact of the invasive plankton-feeding comb jelly *Mnemiopsis leidyi*, which is especially evident since 2001[10]. The effect of the *Mnemiopsis leidyi* comb jelly in the Caspian ecosystem is to reduce the food source for kilka and other organisms which feed on zooplankton and throughout the food chain. The appearance of *Mnemiopsis leidyi* in the Caspian Sea has resulted in a reduction of the kilka stock and fishing. Thus, catches have reduced from 271,000 tonnes in 1999, to 316 tonnes in 2016. Recently kilka began feeding on zooplankton *Acartia*. Predominance of *Acartia (clausi+tonsa)* within the structure of modern zooplankton instead of *Eurythemora, Limnocalanus and Calanipeda*, leads to a change of biochemical composition of food consumed by Caspian kilka (mainly the anchovy kilka).

During recent years, the distribution and abundance of kilka has changed; while they can be found throughout the Azerbaijan sector of the Caspian Sea their concentrations have reduced due to the *Mnemiopsis* invasion. Prior to the last 6 to 7 years the average volume caught by the cone-shaped nets of the Azeri commercial fleet was 4.3kg and 11.5kg per hoist in the Middle Caspian and Southern Caspian, respectively. From 2002 to 2005 the majority of fish caught was the anchovy kilka representing 71.2-83.5%, the share of ordinary kilka was 14.6-28.6% and that of big-eyed kilka 0.2-2.8%. However, during the last 10 years (Table 6), compared to the previous years, the percentage amount of ordinary kilka caught increased significantly (4-5 times) (up to 93.7% in 2016), whilst big-eyed kilka practically disappeared from the catch (0.4% in 2016). Major accumulations of kilka were observed in the Southern Caspian from Oil Rocks and Chilov island to Borisov bank, whereas most dense accumulations were observed in the nearshore zone (at depths up to 50m).

Table 6 Change of the Ratio of Various Kilka Species (%) Caught in the Azerbaijan Sector of Caspian Sea in 2002-2016[1]

Year	Species of Kilka (% Caught)		
	Anchovy	Ordinary	Big-eyed
2002	83.5	14.6	1.9
2003	80.4	19.1	0.5
2004	71.2	28.6	0.2
2005	75.2	22.0	2.8
2006	63.4	36.2	0.35
2007	23.5	75.6	0.9
2008	34.1	65.3	0.6
2009	20.9	78.3	0.8
2010	28.5	70,7	0.8
2011	20.2	79.1	0.7
2012	20.0	79.5	0.5

[9] Kazancheev, 1981
[10] Sedov et al., 2004

Year	Species of Kilka (% Caught)		
	Anchovy	Ordinary	Big-eyed
2013	9.5	90,0	0.5
2014	12.3	86.5	1.2
2015	9.7	89.3	1.0
2016	5.9	93.7	0.4
Notes: 1 Data source: DPRAB			

Thus, commercial fishing from vessels in the Azerbaijan sector of Southern Caspian during the last 10 years has changed as follows:

1. There has been a reduction in the abundance of anchovy kilka (which is now found at relatively shallow depths – up to 50m during the summer months, whereas previously it was caught at a depth 80-120m), and a corresponding reduction of caught fish volumes; and
2. Fishing vessels have become more active at relatively shallow sea depths (25-40m), which results in increased catch volumes of ordinary kilka (which usually stays at relatively shallow depths and is also called "nearshore kilka").

Recently, in connection with the invasion of comb jelly *Mnemiopsis leidyi* and changes in the trophic structure of Caspian Sea, adult fish dominate within the catch and the proportion of young fish is very small. Commercial fishing for kilka is currently carried out predominantly in the areas of Oil Rocks and Chilov island, Borisov, Karaqedov, Kalmıçkov, GPB, Kurkamen, Kornilov-Pavlov, Andreyev and Makarov banks, sea area near Kura river estuary. Results from recent analysis at Borisov, Karagedov banks and Oil Rocks show that fishing at depths of not more than 50-80m shows that the anchovy kilka caught most recently have been mainly adults and in larger size groups. Young kilka were rare or frequently absent from the catch. This trend has become especially evident since 2001. Shortages of young kilka within the fish catch indicate that from 2001 to present, reproduction of kilka has been low. The appearance of the invader, comb jelly *Mnemiopsis leidyi* in the Caspian Sea during 1997-1998, which eats kilka roe, was one of the reasons attributed to the reduction of the proportion of young kilka in the catch. While the main cause in the reduction of kilka has been the result of comb jelly *Mnemiopsis leidyi*, excessive fishing (over fishing) also negatively affects kilka reproduction.

4.3 Fishing Techniques and Equipment Used in the Azerbaijan Sector of the Caspian Sea

Almost all fishing vessels of the Azerbaijan commercial fishing fleet use cone-shaped nets and fish pump (LTV, LTRV and SB type vessels). Two vessels use fish pumps (MFT "Lenkoran baligchisi" and MFT "Namig Hafizoglu"). An overview of the fishing equipment used on the vessels in the Southern Caspian Sea is provided below. Annex C provides further details.

The Azerbaijani fishing fleet is of high importance in the national fish industry. Fish caught from vessels is processed on board and transported to the shore. The vessels are designed for commercial fishing and there are many types of commercial fishing vessels including trawlers and seine boats. Typically, offshore commercial vessels are of heavy tonnage constructed of steel, approximately 30m length and 5m width and typically equipped with onboard ice preservation techniques.

4.3.1 Fishing Vessel Types

Fish Trawlers

Fish trawlers are designed for offshore fishing, mainly with the use of trawls, however occasionally drift nets or similar are used. No trawler vessels permitted to fish commercially for kilka in Azerbaijani waters employ the use of trawl fishing techniques. The use of trawl fishing methods is employed by scientific research vessels only. Several types of fish trawlers exist: large fish trawlers (BRT), medium fish trawlers (CRT) and small fish trawlers (MRT).

Seine Boats

Seine boats are also used in the Caspian Sea. Seine boats are designed for purse-seine (seine-net) fishing, however when necessary, they can be used for other types of fishing.

The following methods of commercial fishing are currently used:

- Fish entanglement within the net – line meshing fishing gear;
- Fish filtering from water – fish trawling gear (trawler nets);
- Trays and pickups;
- Fishing with the use of traps – fixed fishing gear;
- Fishing with the use of hooks – fishing hooks/tackle; and
- Special fishing methods – electric fishing, fish pumps, fishing wheels, etc.

Annex C provides figures showing both trawler and seine fishing vessels.

4.3.2 Historical Fishing Methods

In earlier years herring drift nets were used in the Southern Caspian (the hanging net length was 30m, hanging net heights were 6.55 and 4.15m, respectively). The main target for drift fishing was herring. Drift fishing for herring was used in the Caspian Sea in the 1940s and 1950s. Depending on the arrangement, stationary nets can be bottom and pelagic nets. In terms of design, there could be ordinary single-walled nets, nets with vertical walls, frame nets, double-walled nets, triple-walled nets and combined gill (rough) nets. However, due to a large inadvertent catch (known as a by-catch) of young sturgeons and following the recommendations of scientists, drift fishing in the Caspian was banned in 1962.

4.3.3 Current Fishing Methods

Currently most fishing vessels in the Azerbaijan sector of the Southern Caspian use cone-shaped nets for kilka fishing with the use of electric light. Electric fishing is widely used and was developed by Professor P.G. Borisov. Later, developing this method further, I.V. Nikonorov and others used fish pumps, attracting fish with electric light. The high efficiency of new fishing methods has resulted in significant improvements in the volume of fish caught and the proportion of kilka caught within a haul with the use of electric light reaches up to 80%. Fishing for kilka in the Caspian Sea with the use of subsea electric light is most important as kilka are attracted to the light and gather near the catching devise. Later, centrifugal fish pumps and then airlifts were used for fishing. All three types of fishing are used on the Caspian i.e.:

- Cone-shaped purse nets;
- Centrifugal fish pumps; and
- Airlift.

Light attracts all three species of kilka; however anchovy kilka makes up the major share of commercial catches when fishing in water depths of 80-120m below sea level. Anchovy kilka lives in the open water of the Middle and Southern Caspian, avoiding low salinity water, while ordinary kilka are found in shallower nearshore waters (25-50m). In summer commercial populations of kilka are found all along the western and eastern coast of Caspian Sea, up to the Northern Caspian. The largest commercial populations of ordinary kilka can be found from the Mangyshlak peninsular to Kenderli Bay in the east and in the area of Makhachkala in the west. Regions especially rich with ordinary kilka in the southern part of the sea are Kianly-Turkmenbashi on the eastern coast, southwards from Salyan – Pirsagat on the western coast (Azerbaijan territorial waters). In these areas kilka is found in large quantities in winter as well.

Fishing for kilka is carried out the year round (with the exception of May and June) from seine boats PC-300, specially re-equipped for kilka fishing in the Caspian Sea. Earlier commercial fishing was carried out mainly from refrigerator vessels such as “Druzhba” and “Zelenodolsk”. Vessels of “Druzhba” type are 57.2m long, 9m wide, displacement 850 ton and deadweight 180 ton. They operate with the use of two diesel-generators, 300 horsepower (hp) each, their cruising capacity is 20 days. These vessels were gradually replaced by vessels of “Zelenodolsk” type, which are 55.35m long, 9.5m wide, displacement 985 ton and deadweight 305 ton. They are operated with the use of two diesel-generators, 400 hp each. The vessel is intended for fishing and fish freezing. Later this business was supported with the introduction of new vessels of “Caspian” type. To attract kilka to fishing gear 500-1000 watt electric lamps are used, providing ordinary white (colourless) light. These lamps have well insulated special sockets, preventing water entry to their bases. Lamps are fixed to the fishing gear with their bulbs being oriented upwards. When fishing from PC-300 type vessels, cone pickups are used, and vessels of “Druzhba” and “Zelenodolsk” type are equipped with fish pumps and airlift.

Cone Shaped Nets

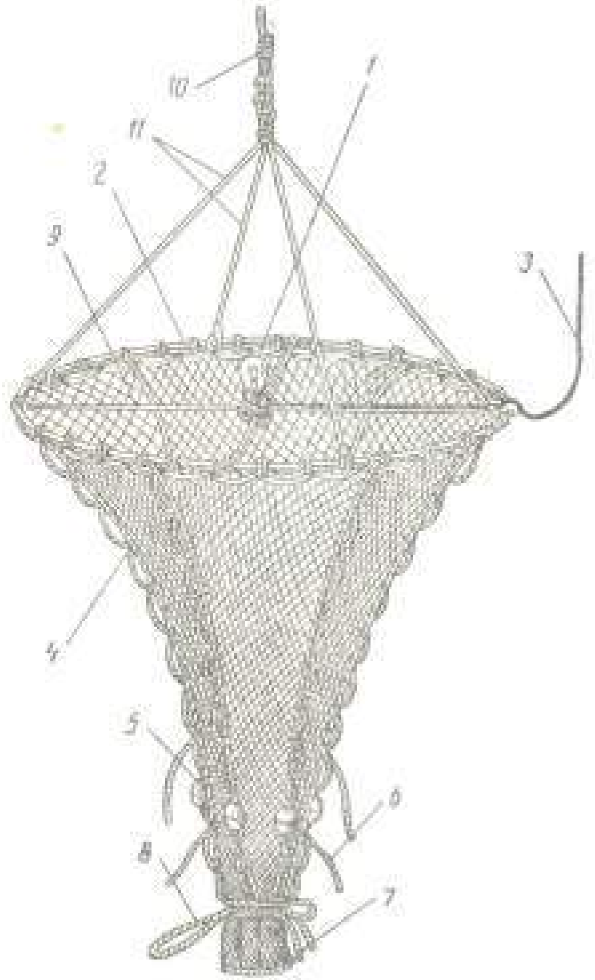
All cone-shaped nets comprise six net trapeziums. The cone-shaped net for Caspian kilka consists of webbing of two kinds: in the upper part webbing is made of 20/12 thread with 30 millimetre (mm) net-mesh, the bottom part is made of 34/9 thread, with 8mm net-mesh. The ferrule (i.e. hoop) diameter is usually 2.5m. The general appearance of cone-shaped nets is shown in Figure 3. Fishing is carried out with two nets, alternately from two sides of the vessel. The nets remain at the fishing depth horizon for 0.5-10 minutes depending on the concentration of fish populations. The rate the net is pulled out of water is typically 0.3-0.4 metres per second (m/s). As stated above cone shaped nets are used at a maximum depth of 20 to 90m below the sea surface.

Fish Pumps and Airlift

In 1948 N.S. Fershtut suggested using fish pumps for Caspian kilka fishing. This method was improved by I.V. Nikonorov. For this technique one or two fish pumps of HP-150 type are installed on the vessel. A vacuum (suction) hose is used which corresponds in length to the desired depth at the fishing location. Two strong lamps are attached at the end of the suction hose, on its side. After the underwater electric lights are switched on, the kilka approach the hose and are sucked into it and delivered to the deck of the vessel. Fishing is undertaken without the participation of fishermen and is quite efficient if the concentrations of fish populations are high enough. Fish pump units RBU-100, RBU-150 and RBU-200 are used for kilka fishing (the code numbers indicate the suction hose diameter in mm).

The pump or pumps are installed on the vessel deck and the suction hose is thrown overboard and lowered into water in a place where kilka are concentrated. Rubber hoses are usually used, which are smooth inside and corrugated outside. They can be lowered to any depth up to 150m. The end of the suction hose is turned upwards and is equipped with a catching device, consisting of a suction nozzle with a guarding ferrule (hoop). Slings are connected the ferrule and to a hoist rope and winch. Electric lamps (usually white light) are fixed to the sides of suction nozzle. Lamp capacity is 1.0–1.5 kilowatts (kWt). When the lamps are switched on, kilka will approach the catching device and are sucked in by the pump and delivered to the deck. This process is continuous and does not require pulling and lowering of fishing gear. Fishing efficiency is 50-60% higher than when cone-shaped nets are used. At the same time the cost of production is reduced and working conditions improved. Commercial fishing for kilka using fish pumps began in 1955. In the 1970s production of kilka in the Caspian Sea reached 423 thousand tonnes, and 80% were caught with the use of fish pumps. However, a major disadvantage of kilka fishing with the use of fish pumps and light is that large quantities of fish damaged by rotating parts of equipment. To address this, special pumps were introduced known as airlifts. Airlifts include a corrugated hose, which is lowered from the vessel to a depth where kilka are concentrated. The technique used and organization of fishing with the use of airlifts is the same as with the centrifugal fish pumps. The advantage of this method is that the kilka is not damaged as lift pumps are used at relatively shallow depths (20-40m) and a lower level of pressure is required. Therefore, the majority can be used for preservation. Fish pumps can be used up to a maximum depth of 100-120m.

Figure 3 Cone-Shaped Net – Key Features



1 – Electric lamp; 2 – Ferrule (hoop); 3 – Electric cable; 4 – Wale;
5 – Weight; 6 – Lead; 7 – Metal rings; 8 – Tightening rope;
9 – Cross-piece; 10 – Hoist rope; 11 – Slings.

4.3.4 Scientific Research Using Trawl Fishing

Trawl fishing in the Caspian Sea is used for scientific-research purposes only (twice in a year – in winter and summer) to assess abundance and distribution of sturgeon and other fish. Depending on the purpose of the study, variable-depth and variable size trawls are used. A 9m trawl surveys at depths of up to 10m while the 24.7m Mikhov's trawl is used for depths in excess of 10m below sea level. Both the 9m trawl and 24.7m Mikhov's trawl are used in the Northern and Middle Caspian. As the Southern Caspian sampling stations are located at larger depths the 24.7m trawl is used.

Scientific Investigations are carried out using following vessels:

- "Issledovatel Kaspiya"; and
- "Alif Gadzhiyev".

Investigations are carried out from the vessel “Issledovatel Kaspiya” belonging to Russian Federation. Trawl surveys using the 24.7m bottom trawl of the vessel “Issledovatel Kaspiya” are carried out outside the 12-mile zone of the Turkmenistan and Kazakhstan sectors of the Caspian Sea, and also in the Northern Caspian, in the territorial waters of the Russian Federation. In 2007-2017, using a permit issued by the Ministry of Foreign Affairs of the Azerbaijan Republic, the “Issledovatel Kaspiya” was used in the Azerbaijani sector of the Caspian Sea.

Since 2002, Azerbaijan annually undertakes two offshore expeditions (summer and winter) in the Middle and Southern Caspian with the purpose of assessing the following with regard to sturgeon:

- Abundance;
- Commercial reserves and distribution of sturgeon;
- Species composition and the abundance of the biomass of plankton and macrozoobethos; and
- Identification of changes in distribution and proportion of population of various species of sturgeons.

Trawl surveys are carried out on 11 sections each comprising 5 sampling stations. In total there are 55 sampling stations in the nearshore sea zones, at 10, 25, 50, 75 and 100m depths below sea level. Investigations are carried out on the scientific-research vessel “Alif Gadzhiyev” (Figure 4). The DPRAB approved network of sampling stations, follow the sections perpendicular to the shoreline. The technical parameters of the vessel “Alif Gadzhiyev” and equipment installed on board are presented in Table 7.

Table 7 Technical Parameters of Scientific-Research Vessel “Alif Gadzhiyev” and Equipment (instruments) On Board

Name of Equipment (Instrument)	Grade, Specification of Equipment (Instrument)	Country, Year of Production
Scientific-research vessel “Alif Gadzhiyev”	Type: ocean-sea-river Model: 655 (research); IMO № 8422462; displacement: 693 ton; deadweight: 207 ton; length: 45.6m; width: 10.0m; maximum draft: 3.6m; vessel anchoring depth: 175m; POB (persons on board): 23 persons; powerplant output: 985 kWt, 1340 hp; vessel speed: 12.0 ± 0.2 knots; cruising radius: 10 000 miles; cruising capacity: 35 days;	Finland, Turku, 1987
Device for determination of direction and velocity of sea currents up to a depth 1000m	2D-ACM	USA, 2006
Bottom grab (sampler) for taking samples of bottom sediments	Van-Veen, sampling area 0.2 m^2	UK, 2007
Bathometer - sea water sampling device	Niskin, volume 10 litre	France, 2004; UK, 2004
Field trawl for ichthyologic studies	24.7m (Mikhov’s design)	Russia, 2013
Fry (beam) trawl for ichthyologic studies	9m	Russia, 2013

For a 24.7m trawl at depth over 10m the direct distance between the front edges of the wings (edges of the net) is 17m and 5m on vertical opening (refer to Figure C2). Catching efficiency at depths over 10m for all sturgeon species is taken as 0.1 (i.e. 10% efficiency). Fishing with trawls is not carried out in areas with a rocky sea bottom and where there are other underwater obstructions as this would be dangerous and may result in the inadvertent loss of the trawler.

Coordinates of sections and trawl sampling stations in the Southern Caspian are presented in Table 8 below and illustrated in Figure 5.

Table 8 Coordinates of Sections and Trawl Sampling Stations in the Southern Caspian

ID	Section	Coordinates	Depth (m) Below Sea Level
1A	Pirsagat Cape	$39^0 54' – 49^0 30'$	-10
1B		$39^0 54' – 49^0 49'$	-25
1C		$39^0 54' – 50^0 09'$	-50
1D		$39^0 54' – 50^0 11'$	-75
1E		$39^0 53' – 50^0 13'$	-100
2A	Byandovan Cape	39^0 42 – 49^0 32/	-10
2B		39^0 42/ – 49^0 41/	-25
2C		39^0 42/ – 49^0 46/	-50
2D		39^0 42/ – 50^0 02/	-75
2E		39^0 42/ – 50^0 03/	-100
3A	North-eastwardly Kultuk	$39^0 33' – 49^0 21'$	-10
3B		$39^0 33' – 49^0 37'$	-25
3C		$39^0 33' – 49^0 48'$	-50
3D		$39^0 33' – 49^0 51'$	-75
3E		$39^0 33' – 49^0 52'$	-100
4A	South-eastwardly Kultuk	$39^0 06' – 49^0 15'$	-10
4B		$39^0 06' – 49^0 21'$	-25
4C		$39^0 06' – 49^0 25'$	-50
4D		$39^0 06' – 49^0 28'$	-75
4E		$39^0 06' – 49^0 31'$	-100
5A	Kurinskaya spit	$38^0 55' – 49^0 09'$	-10
5B		$38^0 55' – 49^0 16'$	-25
5C		$38^0 55' – 49^0 20'$	-50
5D		$38^0 55' – 49^0 22'$	-75
5E		$38^0 55' – 49^0 25'$	-100
6A	Lenkoran	$38^0 45' – 48^0 54'$	-10
6B		$38^0 45' – 49^0 06'$	-25
6C		$38^0 45' – 49^0 11'$	-50
6D		$38^0 45' – 49^0 15'$	-75
6E		$38^0 45' – 49^0 17'$	-100
7A	Shahagach	$38^0 35' – 48^0 54'$	-10
7B		$38^0 35' – 49^0 02'$	-25
7C		$38^0 35' – 49^0 05'$	-50
7D		$38^0 35' – 49^0 06'$	-75
7E		$38^0 35' – 49^0 14'$	-100

Figure 4 Scientific Research Vessel "Alif Gadzhiyev"

Each survey station, located at 10, 25, 50, 75 and 100m depth, is positioned in accordance with earlier established coordinates. Work on each station begins with recording depth (i.e. bathymetry readings), after that standard hydrochemical parameters are determined:

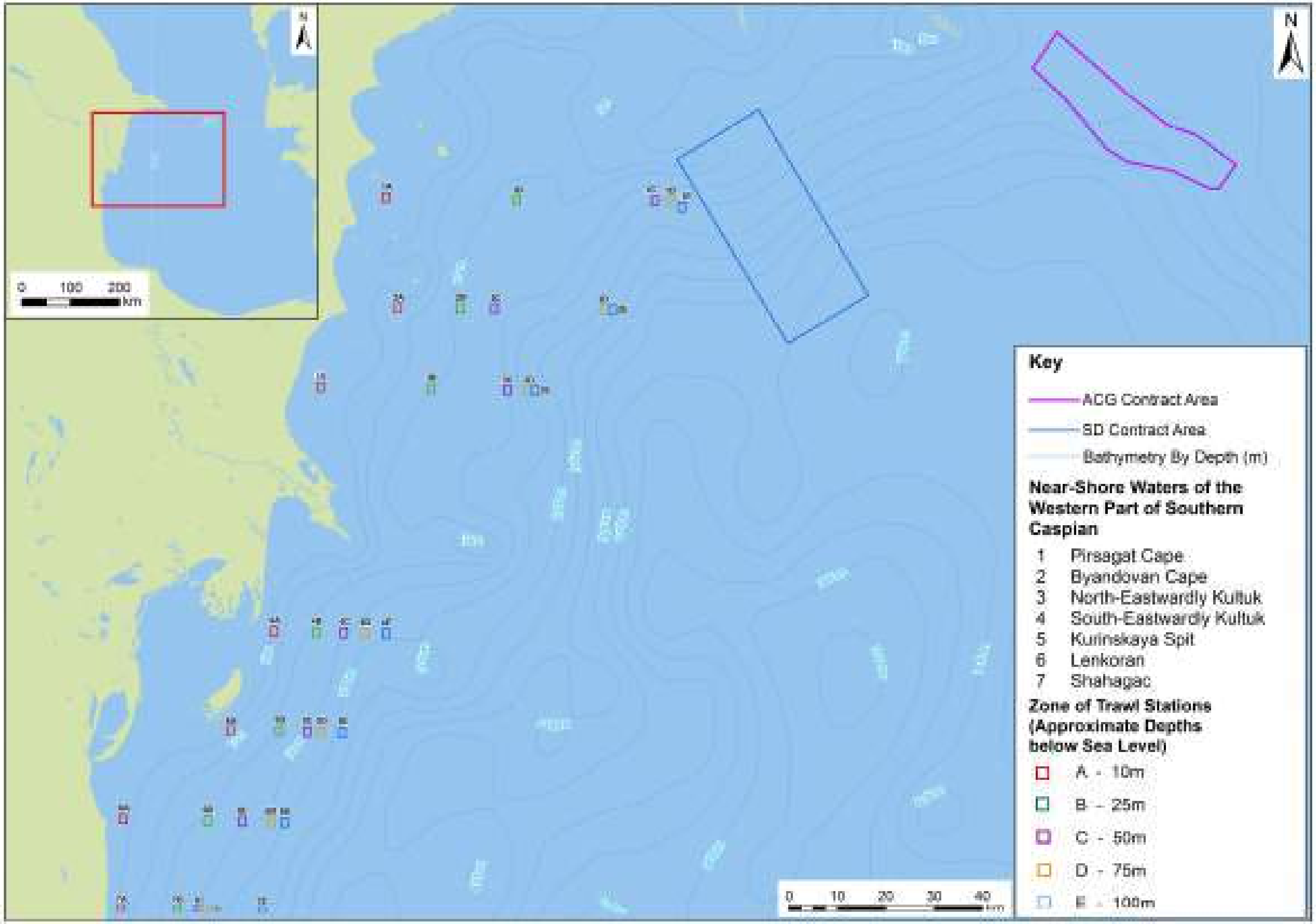
- Water temperature (surface and near-bottom);
- Salinity;
- pH;
- Dissolved oxygen content; and
- Transparency.

Zooplankton samples are then taken with the use of a Juday plankton net, and samples of the comb jelly *Mnemiopsis* are obtained using a special net. Samples are taken from the bottom to the surface, one at each station. The nets are pulled in at a speed of 0.3m/s. Samples of bottom sediments are taken with the use of Van-Veen bottom samplers to obtain macrozoobenthos samples. After washing, samples are preserved in 4% formaldehyde (formalin) solution coloured with special dye "Rose-Bengale". After the completion of zooplankton sampling, *Mnemiopsis* and macrozoobenthos trawling of ichthyofauna begins. In the Middle Caspian, trawling is carried out across 4 sections, including 20 stations, and in the Southern Caspian – across 7 sections, including 35 trawling stations. The standard 24.7 bottom trawl of Mikhov design is used. The speed of bottom trawling is 2.5 knots, giving a trawling exposure at each station of 30 minutes.

In addition to the zooplankton samples taken using a Juday plankton net, water samples are taken using Niskin a bathometer, at a distance 3-5m from the bottom of the sea, avoiding contact with the sea floor. By contrast, the Van-Veen bottom sampler reaches the bottom and takes benthic samples from the sea floor. In accordance with the method of investigation, three replicate samples of macrozoobenthos are taken at each station.

It should be noted that the current location of stations 1D and 1E are the result of correspondence between, BP, the Azerbaijan Fisheries Research Institute and MENR, where it was agreed that 1D and 1E would be moved from 1 January 2015 for an indefinite period because of the location of subsea equipment associated with the SD2 Project. Figure 5 and Table 8 include the current location of these stations.

Figure 5 Location of Sampling Stations



5 Social and Economic Advantages

5.1 Total Economic Value of Fishing Activities

5.1.1 Operating Costs and Gains from Fishing Vessels

Maintenance and operation costs for each of the 10 currently active commercial fishing vessels with the required permits for fishing (listed above in Table 2, Section 3.2.1) is, on average, about 90000 AZN (manat) in a year, i.e. approximately 53000 USD (without seamen wages) meaning that the total costs of maintenance and activity of all 10 commercial vessels were 900000 AZN, approximately 530000 USD (without seamen wages). Both legal entities and individuals would not provide information about their revenues from fishing activity. However, it is clear that revenues from fishing will be the difference between the sum of the profit obtained from the sale of caught fish and the vessel maintenance costs and wages paid to seamen and fishermen.

For small scale fishing vessels, maintenance and operational costs such as fuel and nets (excluding wages) was approximately 2250 AZN per month from 1st September to 1st May 2016 (total 8 months), which equates to 18000 AZN per year. From May to August (inclusive) vessels remain idle and there are no costs associated with this period.

5.1.2 Value and Species of Fish Delivered to the Shore

Commercial fishing vessels mentioned above (Section 3.2.1) fish predominately only for kilka. A total 315.6 tonnes of kilka was caught and sold to the retail trade market in 2016.

The amount of the fish (herring, roach, carp, small fry, bream, grey mullet, shemaya, vimba) caught in 2016 is given in Table 9.

Table 9 Statistical information about species and weight of the fish caught in 2016 in the Azerbaijan Republic sector of the Caspian Sea, internal water basins and Kura River (tonnes)

Fish species	2016	
	Kura River	Caspian Sea
White sturgeon *	--	0.30
Sturgeon *	0.15	0.84
Starred sturgeon *	0.19	0.32
Herring	--	86.1
Kilka	--	315.6
Roach	--	92.5
Carp	3.1	15.8
Small fry	11.4	38.5
Bream	24	3.3
Asp	1.7	--
Perch	3	--
Grey mullet	--	67.7
Shemaya	2.1	2.2
Catfish	7.3	--
Pike	--	--
Crusian carp	7.3	--
Vimba	--	3.2
Silver carp	--	--
TOTAL:	**60.24**	**626.46**

Note: * - Sturgeon species caught only for breeding in fisheries and for scientific studies.

5.1.3 Level and Importance of Employment on Fishing Fleet

The fishing vessel crew consists of the following number of fishermen depending on the vessel type: lifting and transportation vessel (LTV) – 4 persons; lifting and transportation refrigerator vessel (LTRV) – 5 persons; medium freezer trawler (MFT) – 8 persons. Boats engaged in small scale fishing have 3 crew members. Table 10 describes the number of fishing vessels, boats and fishermen in 2016.

Table 10 Number of commercial fishing watercraft and fishermen in Azerbaijan sector of the Caspian Sea in 2016

Watercraft indicators	2016
Number of watercraft	
Boats	628
Vessels	10
Total:	**638**
Number of fishermen	
In boats	1944
In vessels	45
Total:	**1989**

For each of the 10 mentioned commercial fishing vessels that are involved in commercial fishing (Table 2, Section 3.2.1) an average of 4-5 people are employed with 45 people employed in total on the 10 vessels. The average annual wages in 2016 of one person was reportedly 2500 AZN manat, including the two month downtime from 1 April to 1 June or from 15 April to 15 June. Therefore, based on 45 persons commercial fishing generates 112500 AZN in a year, i.e. 66180 USD (1$=1.70AZN). In 2016 there were no fishing vessels docked due to the absence of the commercial fishing passports.

In 2016 there were 1944 fishermen employed in small scale fishing and the average wages of a crew member on a small scale fishing vessel was estimated to be approximately 250 AZN manat per month, which equates to an annual salary of 2000AZN manat per year based on an 8 month working period (from 1 September to 1 May).

5.1.4 Level and Importance of the Onshore Markets and Sales Process

In 2016 legal entities and individuals that obtained a permit for fishing in the Azerbaijan Republic were fishing predominately only for kilka. In 2016 legal entities and individuals caught 315.6 tonnes of kilka (see Table 3, Section 3.2.2).

At present, due to significant reduction of the volume, the caught fish is processed by only one entity - “Caspian Fish Co Azerbaijan” CJSC. Fish (kilka) caught by commercial entities like “Khazar-Shay Company” CJSC, “Baku Daniz Balig Limanı” CJSC, “Qlobus-5” “Khazarbalig” CSJC and “Caspian Fish Co Azerbaijan” CSJC (Table 3) is delivered to the fish processing plant of the “Caspian Fish Co Azerbaijan” CJSC and from here the processed fish is delivered to only internal markets i.e. not exported.

The fishing products are delivered to the markets by the small scale fishermen directly or by their distributors. There are wholesale fishing product collection and distribution markets in Azerbaijan. Therefore, the fishermen or their distributors deliver the fish to the markets themselves. Table 11 presents the retail prices for the commercial fish species caught when sold in markets.

Table 11 Retail price of Commercial Fishery Species Caught by Licensed Fishermen in 2016-2017

Fish species	Retail price per kilogram (AZN manat)
Herring	4
Grey mullet	5 (10-12)
Small fry	4
Roach	6 (18-20)
Carp	6-8 (10-12)
Vimba	6-8 (10-12)
Bream	6
Shamaya	8 (13-15)
Kilka*	2
Asp	14 (25)

Note: *Kilka is caught from fishing vessels;
Figures in brackets are the prices when demand is high and supply lower, for example, during holidays

It must be noted that the retail prices do not reflect the wholesale price of caught products charged by the legal entities and individuals delivering the fish to the market. According to unofficial data, the retail prices are typically about 10% higher than the wholesale prices. Legal entities and individuals chose not to provide information about the income of large-capacity commercial fishing vessels and boats associated with small scale fishing. However, it is clear that the income from the operations of the commercial fishing vessels and from small scale fishing will be defined based on the difference between the total amount of wholesale trade of fishing products and the expenses required for maintenance of the fishing fleet and fishermen's salary.

5.1.5 Level and Importance of Offshore Employment

In 2016, approximately 80 people were reportedly employed at the fish-processing enterprise ZAO "Caspian Fish Co Azerbaijan" which includes a fish splitting department, fish-flour and fish oil producing department and a roe department. The fish processing plant can process up to 300 tonnes of raw fish per day and produce more than 50 different fish products from 30 fish species. Of the 80 people employed on a contractual basis 75% are women. In spring (March-April) the number of people employed may increase by 1.5 times with the employment of temporary workers to cater for the increase in workload. The average annual salary for employees of the fish processing plant is 3600AZN per year.

While in previous years ZAO "Caspian Fish Co Azerbaijan" exported part of their products, since 2010 until present, due to decline of fish catch, all products of ZAO are sold within Azerbaijan and not exported.

5.1.6 Economic Value of Fishing Activities within and Adjacent to the ACG Contract Area

While fishing vessels of legal entities and individuals change their locations depending on the dynamics of kilka populations in the Southern Caspian, which are currently distributed around various offshore banks and other areas as described in Section 4.2 above, no fishing is undertaken within the Contract Area itself. In winter fishing is carried out at depths of 50-80m below sea level, and in summer at 25-40m depths below sea level, in locations which are at a substantial distance from the ACG Contract Area and the adjoining parts of the sea including pipeline routes. As such it is considered that the impact of any activities within the Contract Area on the social-economic indices associated with fishing in the Azerbaijan sector of the Caspian Sea will be negligible.

5.1.7 Seasonality and Alternative Activities

The seasonal variation in offshore commercial fishing as well as small scale coastal activity within the Azerbaijan sector of the Caspian Sea is summarised below:

- **December to February** – mid to low season due to unfavourable winter weather conditions. Typically fishing undertaken by 50% of the commercial fishing fleet or less;
- **March to April** – high season with fishing particularly favourable during dull, cloudy weather conditions when electric lighting to attract fish is particularly effective;
- **1 May to 1 June** – during this season when kilka species are spawning and migrate to the Northern and Central Caspian Sea fishing is prohibited;
- **July to August** – mid - low season due to sunny and cloudless weather; and
- **September to November** – high season with fishing particularly favourable during dull, cloudy weather conditions when electric lighting to attract fish is particularly effective.

Generally heavy tonnage fishing vessels, as well as smaller coastal fishing boats stay relatively idle during May- September, as well as during short-term demurrage (several days) in winter (December-March) due to varying weather conditions. Small scale fishermen interviewed reported high and low seasons consistent with the above; however, they reported carrying out fishing activities all year round. It was reported that windy days would be the only days small scale fishermen would stop their activity.

During low season, alternative economic activities undertaken by fishermen to support their socio-economic status and household income include the following[11]:

- Maintenance or overhaul of vessels;
- Repair or construction of fishing gear;
- Selling fishing equipment;
- Finding temporary work as labourers in the construction sector; and
- Small scale private businesses selling (trading) foodstuff and agricultural products.

5.2 Fisheries Organisation

Fishermen organisations in Azerbaijan tend to be privately managed.

By the Decree of the President of the Azerbaijan Republic No 243 dated 11 August 2014 “On implementation of the Azerbaijan Republic Law No 1015-IVQD dated 27 June 2014 “On changes to the Azerbaijan Republic Law “On Fishing” and by the Decree of the President of the Azerbaijan Republic No 445 dated 2 February 2015 on changes to the Decree of the President of the Azerbaijan Republic No 722 dated 13 June 1998 “On implementation of the Azerbaijan Republic Law “On Fishing” the Ministry of Ecology and Natural Resources of the Azerbaijan Republic is authorised to oversee the development, strengthening of legal and institutional basis of the fishing industry and aquaculture in Azerbaijan and to perform other respective executive powers. According to *“Regulations for fishing and hunting of other water bioresources"* approved by the Decree of the Cabinet of Ministers of the Azerbaijan Republic No 243 dated 2 June 2017, the DPRAB of the MENR is the state authority regulating the activity of the fishing entities.

However, the fishermen organisations do not take part in the process of decision-making by the State with regards to the fishery sector. Cooperation between various fishermen organisations is carried out on the economic level; however, these organisations do not receive any subsidies, support or tax incentives from the State. Some of the fishermen interviewed during the socio-economic survey are members of an organisation called the Hunter and Fisherman Society of Azerbaijan.

[11] Data from the Azerbaijan Fisheries Research Institute, 2015.

5.3 Fishing Trends

Historically, kilka has been the main commercial species caught in Azerbaijan - being 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 MENR where both the number of issued licences (fishing passports) and the number of the larger kilka fishing vessels has decreased. In parallel, the number of licences issued for other (scaly) fish species and for small boats has increased.

Azerbaijan has also observed a reduction in the number of recorded violations of fish protection legislation. The likely reason for this change is decreased activity of the DPRAB of MENR during the last 5-7 years by prosecuting violation, and 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.

Lately (2011-2016) the number of passports issued for fishing has increased as compared to 2005-2010. However, this increase is due to the increasing number of licences issued for small fish (herring, roach, carp, small fry, bream, grey mullet, shemaya, vimba) and increased number of licences for small-capacity fleet (boats). The reduced volume of the caught commercial species of fish, which is a common tendency for the entire Caspian Sea lately is due to the reduced amount of kilka. The reduced amount of kilka and decreased catch is getting more significant, while the amount of caught small fish is increasing. Thus, as compared to 2005-2010, the tendency of recent years (2011-2016) indicates retargeting of commercial fishing from kilka to small fish. Due to decreased amount of kilka, the number of fishing passports issued to large-capacity kilka vessels has reduced, while the number of passports issued for small fish harvesting and for small-capacity vessels (boats) has increased.

Considering the recent changes in development of fishing and the factors causing such changes, it is assumed that this trend will be maintained and continued in near future. The general trend in the development of fishing will be mainly connected with the general degradation observed within the Caspian Sea biota. In future, intensive kilka harvesting in shallow waters is expected to negatively impact its reproduction and reduce the catch in the near future. The trends observed suggest that commercial kilka fishing may potentially cease in near future due to its economical unprofitability, while the small fish harvesting increasing year over year may cause the excessive exploitation and reduction of the natural resources of the small fish.

One more forecasting factor of possible reduction of the fishing activity in Azerbaijan in near future may be expected intensive growth of aquaculture. In summer 2014 the Milli Majlis adopted the changes and improvements to the Law of the Azerbaijan Republic “On Fishing” (No 1015-IVQD dated 27 June 2014), which was approved by the President. The previous Law “On Fishing” (No 457-IQ, dated 27.03.1998) did not cover legal and political aspects of the rapidly developing private sector of the aquaculture. Therefore, the improved Law included new provisions on aquaculture management rules. In summer 2017 the Cabinet of Ministers adopted the Resolution on “Aquaculture management rules” (No 256, dated 14 June 2017). This is intended to support the stable development of the aquaculture in rural areas, to establish alternative income sources and to increase the health and welfare of the coastal population of the country. The development of the aquaculture in Azerbaijan in the near future will allow the population engaged in aquaculture to develop aquaculture farms in internal basins as a new venture. This will assist in decreasing illegal fishing and improve the ecological condition of the Caspian Sea as well as establishing legal and socio-economic conditions for re-orientation of the activity of the coastal population, which will be retargeted from fishing to the breeding of commercial fish species (including, marine culture - marine aquaculture). The reduction in human pressure on natural fish populations (especially, sturgeon) will help to contribute to the environmental protection and maintenance of the biodiversity.

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Annex A
Seasonal Presence of Fish Species across the Azerbaijani Sector of the Caspian Sea

Table A1 Summary of the 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	EN[#]	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[#]		
Asipenser 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 sires 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	

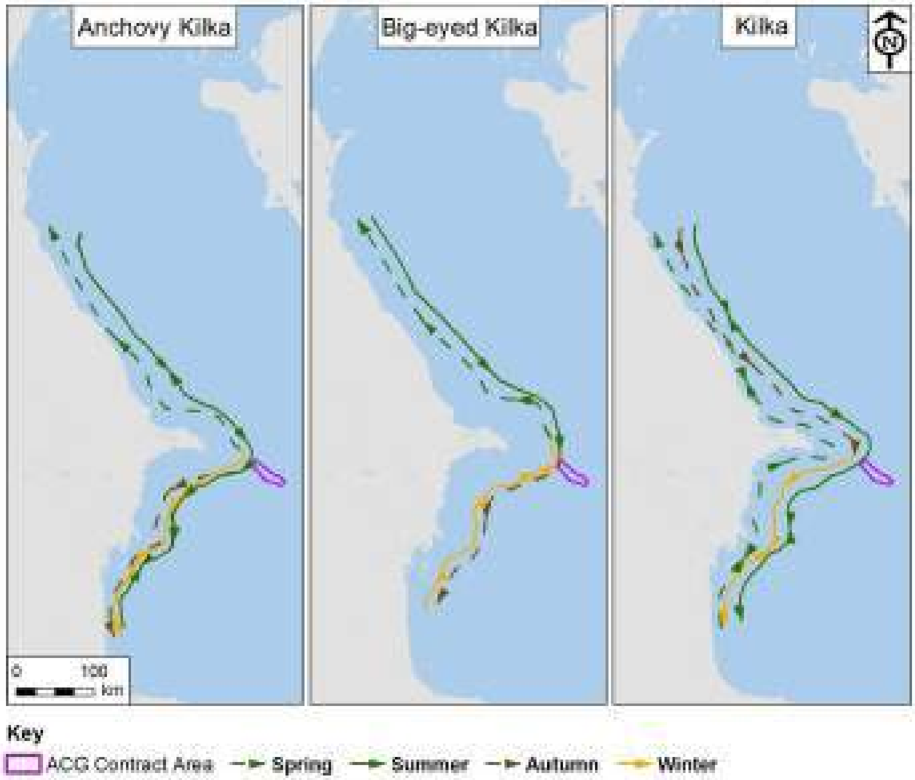
Name of Species	Common Name	Hearing Group	IUCN Red List Status	Spawning Location	Reason for Presence in Southern Caspian (south of Absheron Ridge)
				opposite side of Volga and Ural River mouth.	
CARP (family Cyprinidae)					
Rutilus frisii kutum	Kutum/Black Sea Roach	SB	LC	Kura and Terek Rivers, rivers of the western coast of the Southern Caspian, Small Gizilagaj Bay	Spring migration to spawning areas. Spring/Autumn feeding route. 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 month. 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.

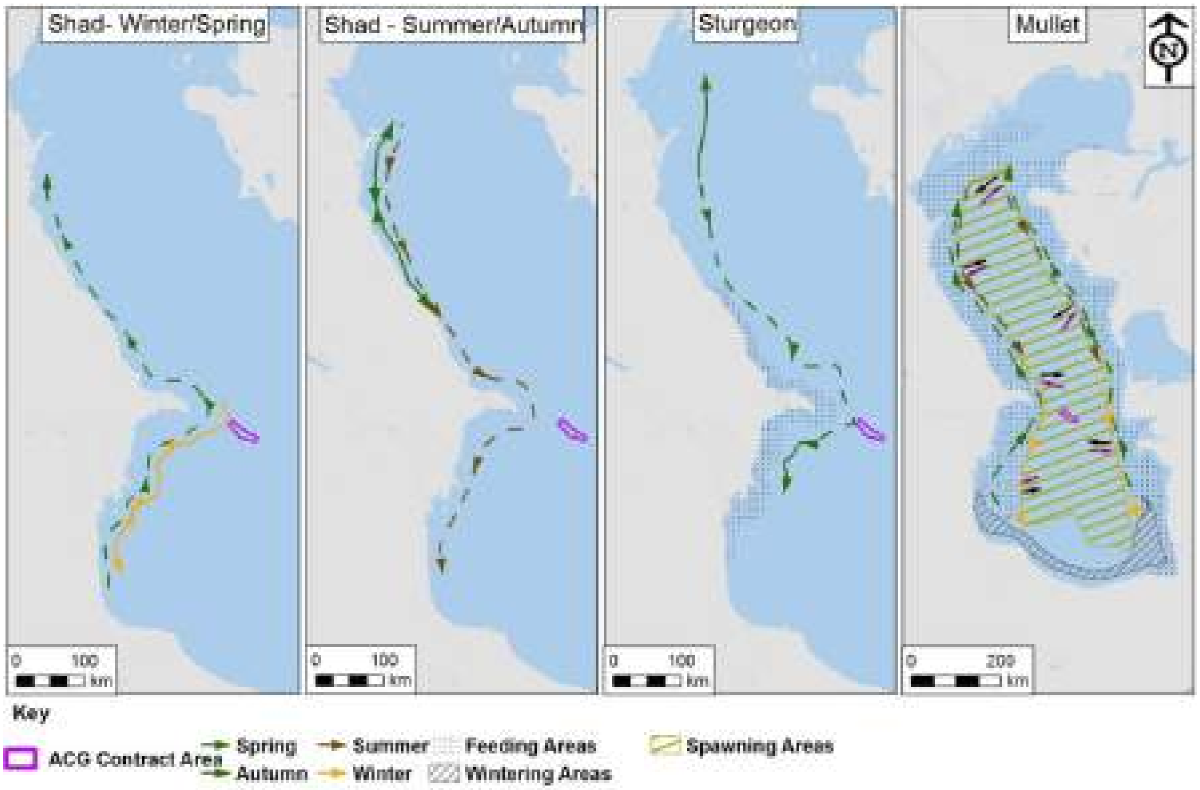
Name of Species	Common Name	Hearing Group	IUCN Red List Status	Spawning Location	Reason for Presence in Southern Caspian (south of Absheron Ridge)
Cyprinus carpio Linnaeus	Carp	SB	LC	Volga, Ural and Terek rivers as well as the Small Gizilagaj Bay, the Kura River and rivers of the southern coast	Spring migration to spawning areas. North-south migration for feeding along the shore during the whole year. Wintering areas in winter. Typically found at depths of up to 8-20m throughout the year
MULLET (family Mugilidae)					
Lisa 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.
Lisa 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.
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.
Stenodus leucichthys	White trout	SB	EN[#]	Volga river, in rare occasions Ural River	Feeding and breeding in the sea feeding areas in spring/summer. 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

Name of Species	Common Name	Hearing Group	IUCN Red List Status	Spawning Location	Reason for Presence in Southern Caspian (south of Absheron Ridge)
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 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 also 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		
Neogobius melanostomus affinis	Round goby	No SB	LC		
Neogobius syrman eurystomus	Caspian syrman goby	No SB	LC		

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: EN – Endangered; LV – Low Vulnerability; LC – Least Concern, # also included in CITES Appendix II.
*Also, known as Atherina boyeri caspia.

Annex B
Figures Showing Fish Migration Routes



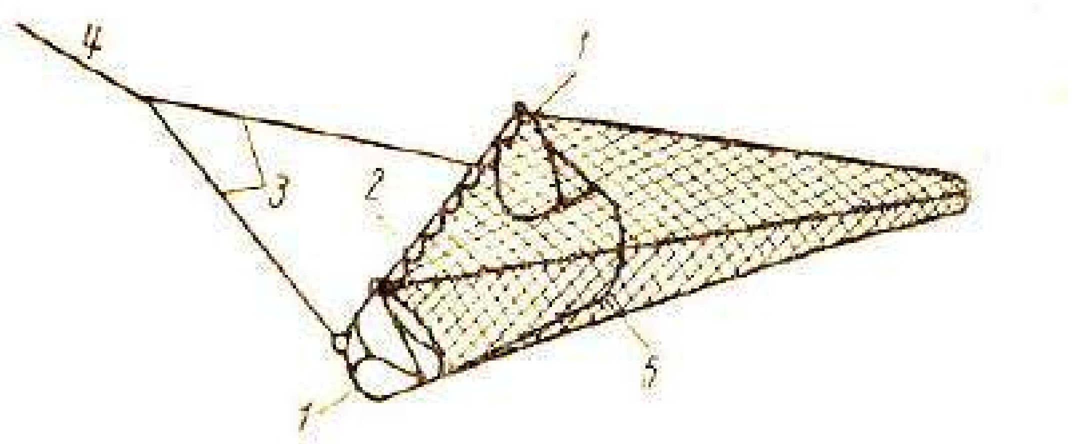


Annex C Trawl Fishing

The principle of trawl fishing is that one or two vessels tow special fishing gear along the bottom of the water body or within the water column, and this fishing gear collects fish as it progresses. If fishing is carried out from two vessels it is called pair trawling. When fishing from one vessel the fishing gear is called a trawl, and the fishing is known as trawl fishing. Trawls include bottom trawls and variable-depth (floating) trawls. The principle of operation of pair trawl fishing gear involves a net bag of a special design which is towed through the water body by two identical twin vessels, catching fish as they progress. This type of fishing was used in the 1930s in the Northern Caspian and Azov Sea using seine (purse) nets, was quite successful, and became a major business on the Caspian. However, as a result of the decrease in stocks both in the Caspian and Azov seas, trawl fishing was banned in these regions.

Another type of trawl, spacer trawls, are trawls that are opened horizontally with the use of otter boards attached to the front side of the trawl, at an angle to its direction of movement. These boards expand wings and open the trawl. In terms of horizontal opening trawls, these are sub divided into beam trawls and otter trawls. A beam trawl is shown in Figure C1.

Figure C1 Beam Trawl



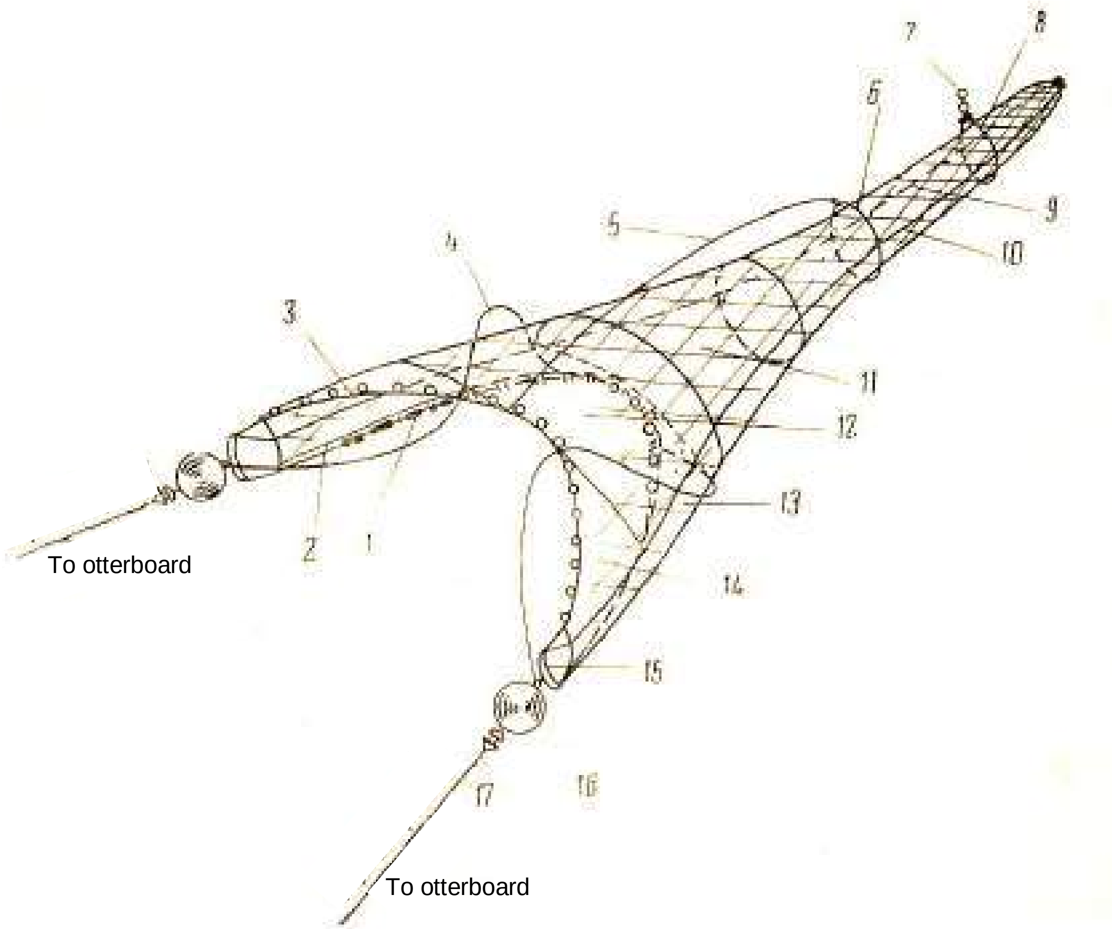
1 – Cradle; 2 – Beam; 3 – Bridle; 4 – Wire (drag rope); 5 – Guard rope.

The base of a beam trawl is a solid wooden block with the beam up to 20m long with diameter about 30cm. The average length of the beam is 15-16m. Due to disadvantages associated with beam trawl operation related to the bulkiness of its frame it was necessary to search for more efficient solutions. As a result the so called brace trawl, or otter trawl, appeared.

In practice bottom trawls and variable-depth (floating) trawls are used. Bottom trawls are intended for catching fish that spend the major part of their life cycle at the bottom of the sea or directly near it. Bottom sweep is a variety of bottom trawl and is used mainly for fishing of seed-herring that stays at some distance from the bottom. Variable-depth (floating) or pelagic trawls have been used for fish, which stay within the water column (herring, pilchard/sardine, kilka, etc.). The design of the variable-depth trawl incorporates the absence of square (pocket park) and ground ropes.

Numerous designs of trawls exist that vary in size, cut, accessories etc. The trawl designed by F.M. Mikhov in the beginning of the 1950s has been used most frequently from the vessels of beam (side) trawling and stern trawling. The length of a Mikhov trawl is 24.7m. In 1959 this trawl was upgraded and is currently used on most vessels of beam (side) trawling and stern trawling. All parts of the trawl are made of kapron webbing with 3mm mesh. Cones of the upper and lower wings are made of two-part strand webbing.

Figure C2 General View of Mikhov's Bottom Trawl



1 – Ground rope; 2 – Lower guard rope; 3 – Upper guard rope; 4 – Quarter-rope; 5 – Jamming rope line; 6 – Jamming rope; 7 – Kukhtyl (ball float); 8 – Special "delezhny" sling; 9 – Cod end; 10 – Belly line; 11 – Pocket (purse); 12 – Square; 13 – Lower wing; 14 – Upper wing; 15 – Moth; 16 – Dan leno; 17 – Cable.

Some models of fish trawlers and seine boats are shown in Figures C3 - C7.

Figure C3 Medium-size fish trawler CRT-400

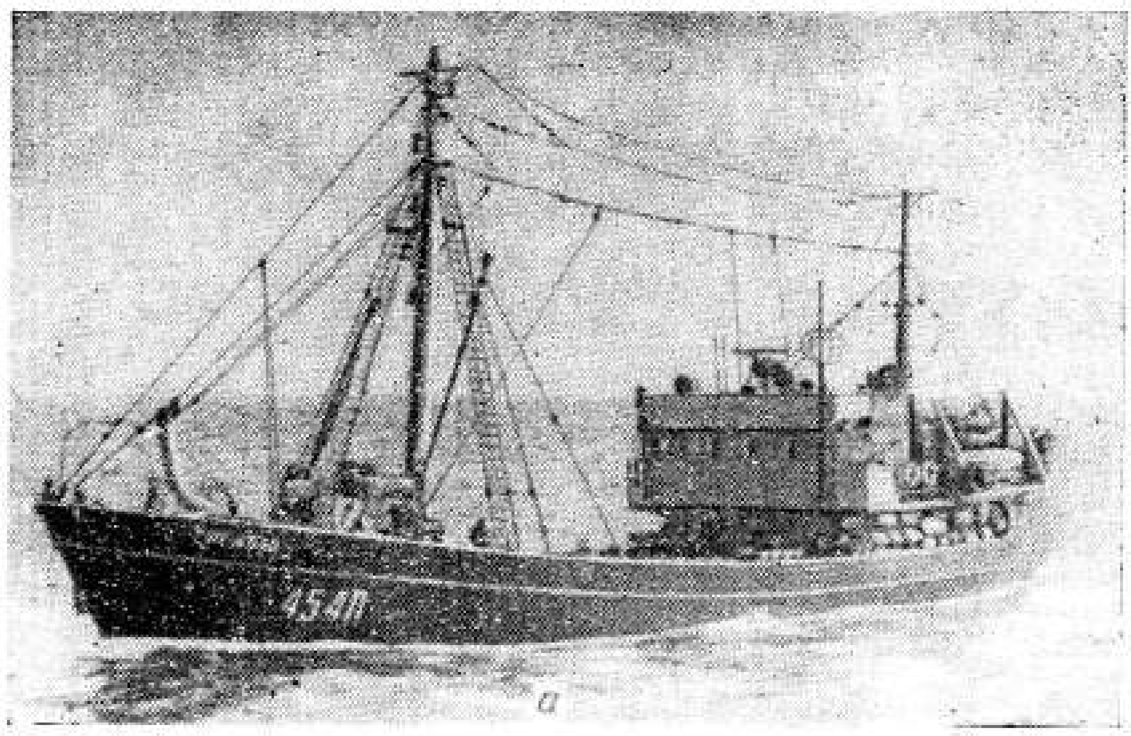


Figure C4 Medium-size fish trawler CRTR

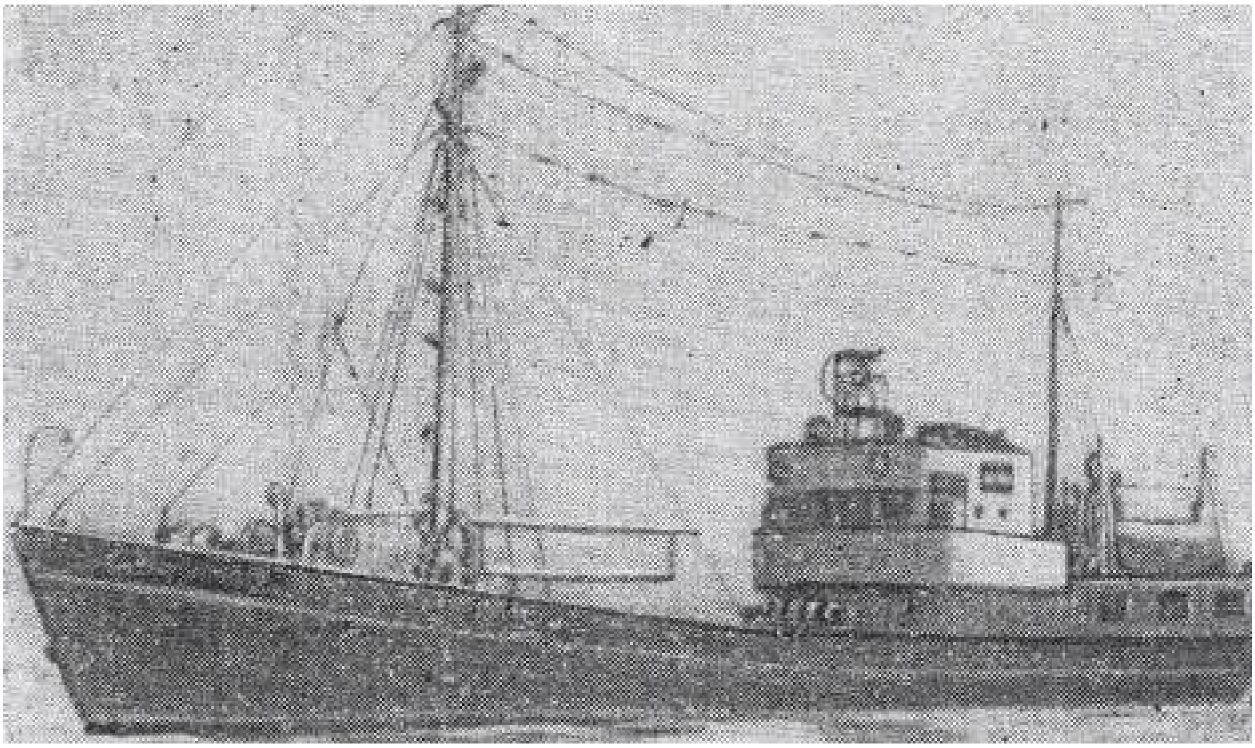


Figure C5 Seine boat CO-300

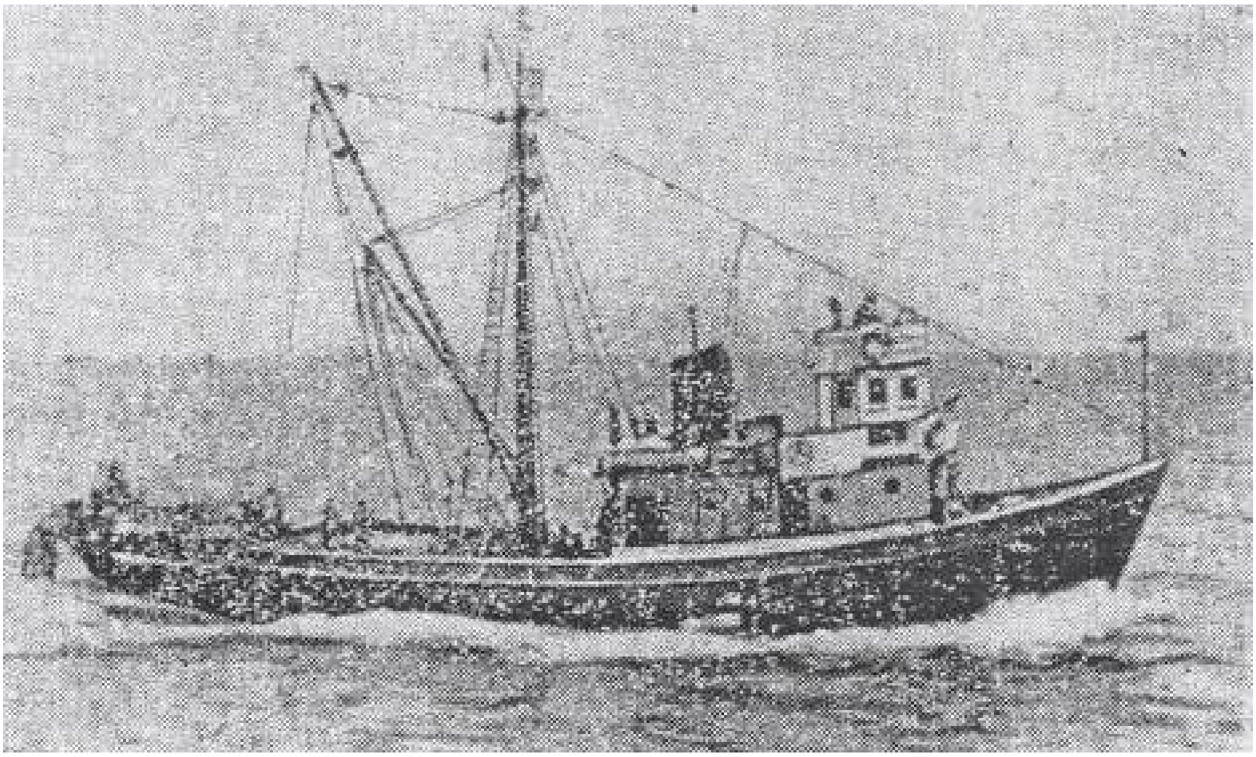


Figure C6 Seine boat PC-300

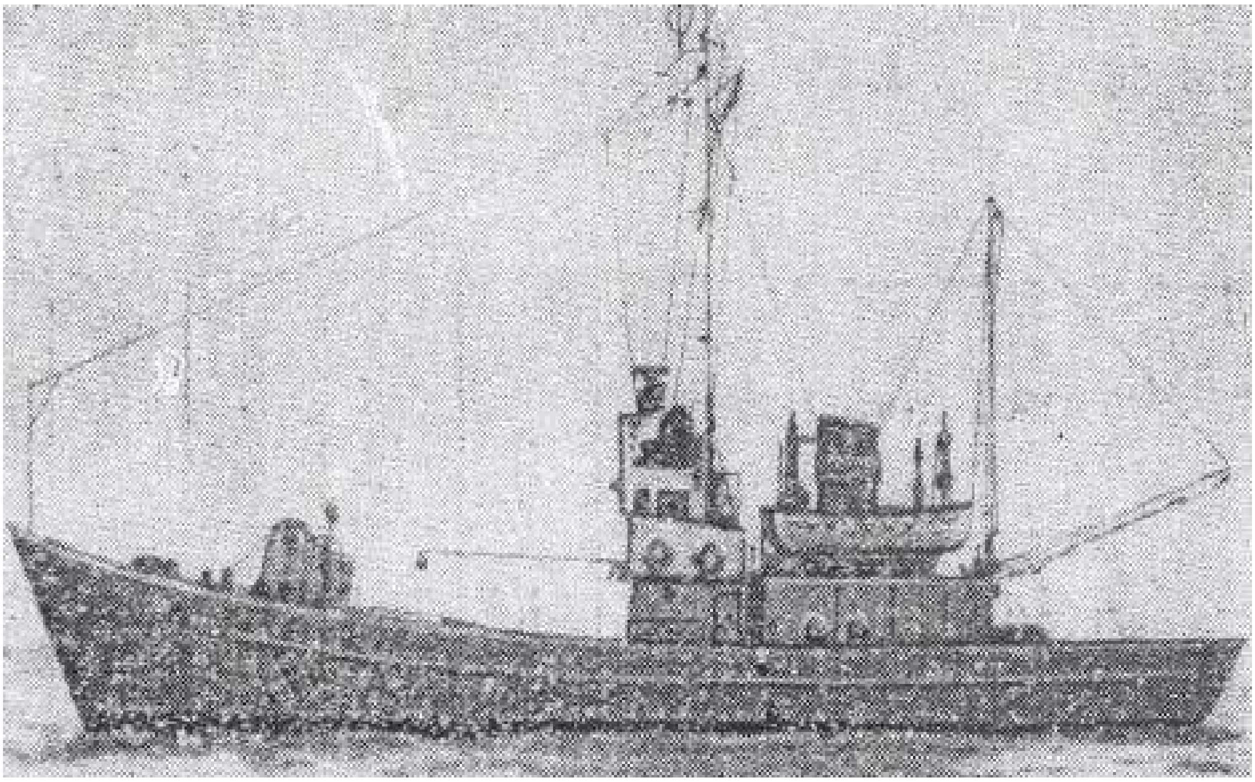
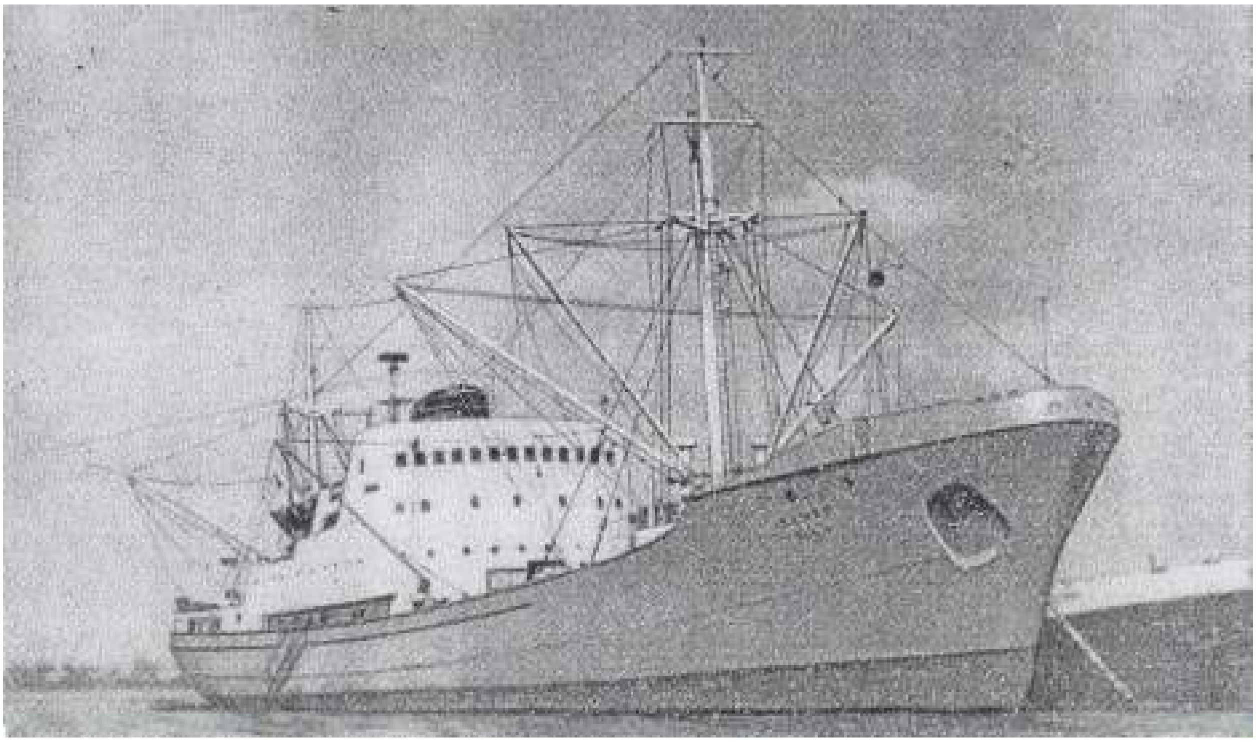


Figure C7 Freezer vessel



Appendix 6C

Caspian Seal Report

Appendix 6C

Caspian Seal Report

T.M.Eybatov, Natural History Museum, named after Hasan Bey Zardabi

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1 Introduction

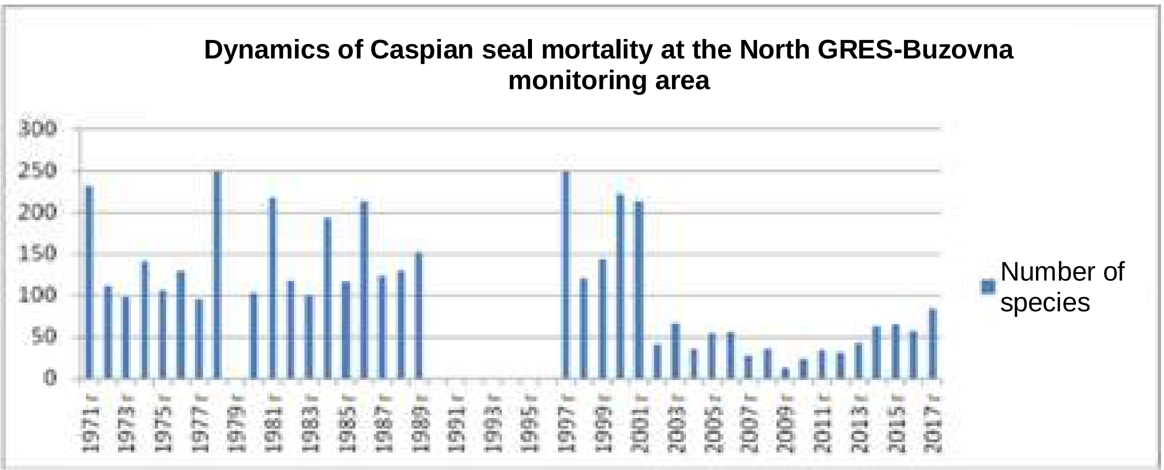
The Caspian seal (*Phoca caspica*) is the only marine mammal present in the Caspian Sea. The species is endemic to the Caspian Sea and has been listed on the International Union for Conservation of Nature (IUCN) Red List of Threatened Species[1] as 'Endangered' since October 2008. The population has been in decline since the start of the 20th Century and has decreased by up to 90%[2]. Recent estimates for the number of seals in the Caspian Sea vary between 100,000 and 170,000 seals. A study in 2012 based on analysis of historical hunting records and 2005 sea ice surveys estimated the population to be 104,000[3] and data from aerial records in Kazakstan and other regions was analysed in 2017 resulting in an estimate of between 100,000 and 170,000 seals[4].

Data on the behaviour and wellbeing of the seals is limited; however, there have been a number of key research programmes in recent decades that are summarised below:

- **1980–present**: Opportunistic monitoring of dead seals and confirmation of seal sightings by fishermen and helicopter pilots in the region of the Absheron Peninsula. Records were submitted only when detecting seals.

  Monitoring of the dynamics of dead Caspian seals found on the northern coast of Absheron has been carried out regularly since 1971 – usually with weekly intervals although in peak periods this has been every day (Figure 6C.1) with regular monitoring not undertaken during the 1990s. Individual surveys were undertaken, usually in spring and in the autumn. Information was submitted only when detecting seals. Individual seal surveys were also undertaken jointly with BP staff and individual specialists from the UK (Callan Duck, Sue Wilson), the Netherlands and Japan (PADECO).

Figure 6C.1 Dynamics of Caspian Seal Mortality on the Northern Coast of Absheron



- **2005-2012**: Annual aerial surveys (undertaken over a 2 week period between 4 February and 2 March) of the breeding population on the winter ice-field in the Northern Caspian to estimate the overall breeding distribution[5];
- **2006–2012**: Behaviour breeding surveys, where 518 mother and pup pairs and 210 lone pups were observed over 34 trips[6]; and

[1] MENR, Azerbaijan Red Data Book (2015). Available at: http://www.redbook.az. Accessed December 2015.

[2] http://www.caspianseal.org/info/caspian-seal. Accessed 10th March 2017.

[3] T. Harkonen, K.C. Harding, S. Wilson, M. Baimukanov, L. Dmitrieva, C.J. Svensson, S.J. Goodman, Collapse of a marine mammal species driven by human impacts, PLOS One 7 (9) (2012) 1–9, http://dx.doi.org/10.1371/journal.pone.0043130.

[4] Arziqulov, J.A. et al, 2017, News of the National Academy of Sciences of The Republic Of Kazakhstan of the Institute of Plant Biology and Biotechnology, Biological and Medical Series Volume 6 (324), ISSN 2518-1629

[5] Dmitrieva, L., Härkönen, T., Baimukanov, M., Bignert, A., Jüssi, I., Jüssi, M., Kasimbekov, Y., Verevkin, M., Vysotskiy, V., Wilson, S. & Goodman, S.J.2015. Inter-year variation in pup production of Caspian seals (*Pusa caspica*) 2005-2012 determined from aerial surveys. Endangered Species Research 28: 209-223.

- **2009-2012**: Telemetry tagging survey, where 75 seals were tagged and their movements across the Caspian Sea tracked. Data collection included recording dive depths[7].

The results of these research programmes and their relevant scientific studies and papers are discussed in this Report.

2 Breeding Behaviour

The Caspian seal is a small bodied, ice-breeding species with an average adult body length of approximately 129 centimetres (cm) and a maximum of 140cm[8]. The life expectancy of the Caspian seal is up to 50 years with maturity reached in females between 7 and 8 years. Females are reported to usually become pregnant for the first time at 7 years old and give birth to a single pup each year thereafter[9]. Fertility of Caspian seals declines with age and by an animal's 20th year it is understood to be low[10]. A decline in the overall fertility of the Caspian seal (of all ages) has been recorded since 1964 and while the cause is unconfirmed, it is thought pollution (in particular organochlorines) may play a role[11] (refer to Section 5.4). The male seal matures between 8 and 9 years of age. Signs of aging in both male and female animals (e.g. osteochondrosis, osteoporosis, deforming arthrosis, root fragmentation in teeth) occur at 28-32 years of age[12].

Seal pups are born after an 11-month gestation period, during January and February in the northern Caspian, either on land or on drift ice at least 20 cm thick overlying water 3 to 5 metre (m) deep. However, a number of pups are born on sandy beaches of islands, such as Ogurchinsky Island in Turkmenistan[2].

Mothers nurse the newborn pups for a period of two to four weeks; the duration will depend on when the pups are born as seals born in late February tend to be nursed for a shorter period. The fur of neo-natal pups has a yellowish tinge, left from residual birthing fluids, which wears off leaving white fur; this explains why they are known as 'white pups' ("belyok"). The white pups weigh around 5 kilograms (kg) and gain between 0.5 and 0.8 kg per day. The white fur moults and is replaced with a new coat, which is pale grey on the back of the seals and white on the stomach. Following weaning the seals are fully independent of their mothers[3].

Soon after female seals have finished nursing pups, breeding will usually occur on the ice. Following the mating season, the older seals begin to moult their old fur for a new coat; this process takes approximately one month. The seals remain on the ice during moulting.

Between 2005 and 2012, an aerial survey of winter ice fields was undertaken to analyse the breeding population of Caspian seals[5]. The surveys were undertaken on an annual basis for a two week period in February and were based on strip transects. Due to the extended pupping period of Caspian seals, some unknown portion of pup production may have been missed during the surveys, e.g. pups which are born and moulted before the survey or pups that are born after the survey. Therefore, the original estimates presented in the paper have been updated using a correction factor based on new analysis and calculations of detection bias associated with aerial transect survey methodology.

[6] Wilson S, Dolgova E, Trukhanova I, Dmitrieva L, Crawford I, Baimukanov M and Goodman, S. . 2017. Breeding behavior and pup development of the Caspian seal, *Pusa caspica*. Journal of Mammalogy (2017) 98 (1): 143-153

[7] Dmitrieva, L., Jüssi, M., Jüssi, I., Kasimbekov, Y., Verevkin, M., Baimukanov, M., Wilson, S. & Goodman, S.J. 2016. Individual variation in seasonal movements and foraging strategies of a land-locked, ice-breeding pinniped. Marine Ecology Progress Series 554: 241‑256.

[8] Wilson SC, Eybatov TM, Amano M, Jepson PD, Goodman SJ (2014) The Role of Canine Distemper Virus and Persistent Organic Pollutants in Mortality Patterns of Caspian Seals (*Pusa caspica*).

[9] Harkonen T, Harding KC, Wilson S, Baimukanov M, Dmitrieva L, Svensson CJ, et al. (2012) Collapse of a Marine Mammal Species Driven by Human Impacts

[10] http://www.iucnredlist.org/details/41669/0. Accessed 10th March 2017.

[11] Eybatov T, Asadi H, Erokhin P, Kuiken T, Jepson P, et al. (2002) Caspian seal (*Phoca caspica*) mortality. Ecotox Final Report, Appendix A2. World Bank

[12] Hajiyev, D, Eybatov, T (1995) Гаджиев Д.В., Эйбатов Т.М. «Морфология зубного аппарата ластоногих» Баку – «Элм» 1995. -173 с.

Analysis of the survey results found that there were considerable variations in the number of seals and pups present on the ice fields from 2005 to 2012 (Table 6C.1). The results show year-on-year fluctuations of ± 65 to 70% in the number of pups observed. Declines were observed in 2007, 2008 and 2010, with the lowest number observed in 2008 (6,254 pups). The highest number of pups observed was approximately 25,000 in 2005. In 2012, the last survey, approximately 22,000 pups were observed and approximately 66,000 adult seals were seen.

The annual variation in the number of seals observed on the ice fields has been attributed to several reasons, including fecundity of the seals, the timing of the surveys and weather conditions (during windy periods seals often move into the water or shelter under ice ridges). While there was no significant correlation between ice parameters and pup production, negative associations with ice conditions were noted. For example, in 2007 there was poor ice coverage and a significant decline in pup productions. However, pup numbers were also low in 2008 and 2010 when ice conditions were normal. Mild winter conditions were attributed to the low numbers of pups present in 2007 as it was noted that a large proportion might have died due to unstable ice floes being swept out to sea.

Table 6C.1 Caspian Seal Observations from Aerial Survey 2005 to 2012[5]

Year	Survey Dates	No. of All Pups	No. of Mother-Pup Pairs	No. of Lone Pups	No. of Single Adults	No. of Eagles
2005	23−28 Feb	25,086	22,750	2,336	23,776	3,144
2006	21−25 Feb	19,437	15,037	4,400	12,123	2,073
2007	24−27 Feb	7,147	4,298	2,849	27,245	680
2008	13 Feb−2 Mar	6,254	5,115	1,139	17,514	1,268
2009	4−20 Feb	19,501	14,874	4,627	33,878	1,120
2010	7−19 Feb	6,697	3,465	3,232	5,552	456
2011	8−20 Feb	21,940	14,413	7,527	19,514	1,831
2012	11−21 Feb	22,292	15,077	7,215	43,980	2,469

The impact of predators is not thought to be a key driver in the variation of pup numbers. During observations made from icebreaking vessels (2006 to 2012), no attacks by eagles were witnessed, although they were sometimes seen feeding on pups. Wolf tracks were only occasionally seen[6].

3 Population and Distribution

At the end of the 19th century the Caspian seal population was estimated to be between one and two million, decreasing to around one million at the beginning of the 20th century. A major contributing factor to this decline in numbers was the hunting of pups for their fur. It is estimated that at the beginning of the 20th century up to 115,000 seals were hunted per year. This increased to an annual average of 160,000 in the 1930s and subsequently declined to between 85,000 and 100,000 by 1960[13].

In 1989, the seal population was estimated to be approximately 128,000 and by 2005 this figure had further declined to 104,000[9]. It is estimated that the Caspian seal population is currently reducing by at least 3–4% per year[14], due to a number of factors, which are discussed in Section 5 below.

Two international workshops were held in 2009 and 2015 to discuss the issues surrounding the Caspian Seal including population and distribution. The 2009 workshop, entitled, ‘Threats to Existence of Caspian Seals: Obtained Data, Required Investigations and Mitigation Measures’ was held in Atyrau, Kazakhstan. The workshop was organised by the Caspian International Seal Survey group (CISS); AGIP KCO and the Darwin Caspian Seal Project research group. The 2015 workshop was entitled “The Caspian Sea: Current Status and Problems of Conservation and Use”.

[13] Caspian Sea. Ichthyofauna and commercial resources. / V.N. Belyaeva, Ye.N. Kazancheev, V.M. Raspopov et al. Moscow, "Nauka" - 1989. 236 p.

[14] Härkönen, T., Jüssi, M., Baimukanov, M., Bignert, A., Dmitrieva, L., Kasimbekov, Y., Verevkin, M., Wilson, S. & Goodman, S. J. (2008) Pup production and breeding distribution of the Caspian seal (*Phoca caspica*) in relation to human impacts. Ambio 37, 356-361.

Annex B presents a summary of the 2015 workshop. A number of the academic papers presented in this Report were discussed at these workshops, which were attended by key academic experts.

4 Migration

The historical understanding of the migration and distribution of Caspian seals has been led by a research group, which includes anthropologist D.V. Gadzhiyev and T.M. Eybatov. Data has been collected for over 35 years and until 1997 was based on observations on the northern shores of Absheron Peninsula, on Shahdili (Shakhova) Spit and Chilov Island and interviews with fishermen. Since 1997, this data has been supplemented with observations from helicopter pilots and oil and gas offshore platform workers. A summary of the most recent recorded sightings is presented in Annex A.

Ad-hoc monitoring conducted since 2005 has shown that there are no permanent rookeries (breeding sites) in Azerbaijan. Temporary haul-out sites were only observed during the spring migration from the north to the south (from April until May), and during autumn migration from the south to the north. These temporary haul-out sites were only found on the Southern spit and Urunos on Chilov Island, as well as on small islands between Pirallahi and Chilov islands (Kichik Tava Island, Boyuk Tava Island, Tava Alti Island and Dardanella, Koltush, Garabatdag etc.). There are now no haul-out sites or rookeries on the Shahdili Spit[4,5]. It is understood that the absence of permanent rookeries is the result of urbanisation and development along the Azerbaijani coastline and a sharp increase in the number of vessels operating in Azerbaijani waters due to the development of the oil and gas industry.

Analysis of observation data collected from helicopter pilots, fishermen and onshore sightings in Azerbaijan have noted recent changes in the migration pattern. Historically, seals appeared in the area of the Absheron archipelago at the end of April, but in 2011 and 2014 seals were observed in late March. A potential trigger for this change is the early melting of the ice-fields in the north causing earlier southwards migration. Changes in the timing of the autumn migration were also noted, with the seals migrating northwards as late as mid-December, several weeks later than previously observed.

Until recently it was generally understood that when the ice melted, seals followed well defined migration paths to feeding grounds in the south: the majority travelling along the east coast of the Caspian and a smaller percentage down the west coast. Recorded observations have shown that seals were seen in Azerbaijani waters in late April to early May, depending on weather and pupping. However, analysis of telemetry tagging survey results has shown that seals do not follow such a prescribed route[5]. Section 4.1 below summarises the research and the results of this survey.

4.1 Telemetry Tagging Research (2009 to 2012)

A three-year research programme between 2009 and 2012, using satellite tracking (telemetry) studies, involving the tagging of 75 seals (both male and female), was conducted in order to study the seals' behaviour and migration patterns[7]. During winter in all years studied most individuals were mobile within the icepack, making repeated trips into open water outside the ice field, with only brief stationary periods that may have been related to breeding activity.

A total of 11.5 months was the longest period of transmission for two seals and the longest track recorded was approximately 14,400 km. The results of this research programme have dispelled the previous understanding of the migration routes as discussed above although it should be noted that this is based on a limited sample of 75 seals. Based on the most recent and historical research Figure 6C.2 illustrates the current understanding on indicative migration routes of the seals.

Analysis of the results has shown that the spring migration route (north to south) is much wider than previously thought, extending into the central area of the Caspian Sea. It was found that while seals migrated to the ice field in the Northern Caspian during autumn-winter months (depending on changeable metocean conditions) for breeding, 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', primarily foraging around the inflow of Volga and Ural rivers. The remaining 60% of the seals migrated to the Central and Southern Caspian in the spring for foraging and the routes taken were not restricted to proximity to haul out sites. Also, whilst most of the migrating seals travelled to the east and southeast, to Turkmenistan and Iranian waters, a significant number of seals remained northwards of the Absheron Peninsula.

Spring migration took place between April to May and autumn migration between October to December, although some did migrate north as early as August. During spring, it was noted that some groups of seals migrated to the south along the shallow near-shore zone through Shirvan and Gizilagach National Reserves. Small groups also moved to the deeper areas of the Caspian. In the summer months a large number of seals remain in the northern part of Azerbaijani waters, and to a lesser degree were also found in the deeper southern waters of the Azerbaijan Republic. The autumn migration, in the reverse direction, includes seals migrating along the western shores for wintering both in Russian and Kazakhstan waters.

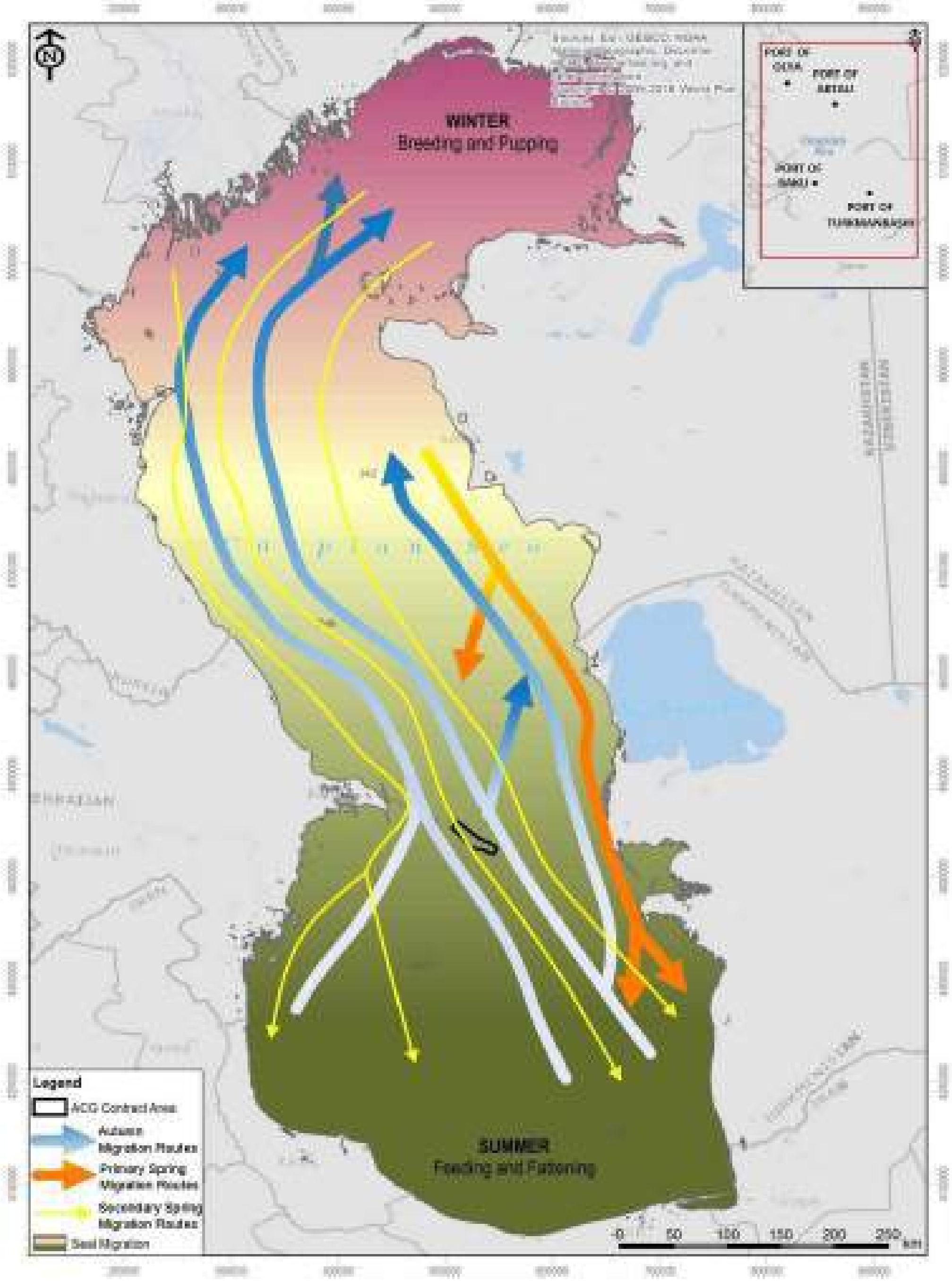
Little hauling out was recorded following moulting (May to December), which corresponds with the research conducted by T.M. Eybatov (Section 4). It was found that some seals remained at sea for more than 6 months. The longest dry days (where the percentage of time spent on land in a 24-hour period is more than 80%), were only seen around small islands and in shallow coastal areas of the north Caspian. Based on limited hauling out, it was concluded that the seals are not restricted to foraging in areas in close proximity to haul-out sites and were observed during fieldwork to sleep and rest on the sea surface.

Tagging of seals has demonstrated that migrations also take place across the central part of the Caspian which is believed to be related to the nature of migration of fish shoals. In summer many seals remain in the northern part of Azerbaijan waters, and their number is less in the deep-water southern part of Azerbaijan waters.

Little is known about the current diet of the Caspian seal and it is thought to vary yearly and depending on the area and season. In the north it is understood the seals forage for Caspian roach (vobla) (*Rutilus caspicus*), common roach (*Rutilus rutilus*), gobies, juvenile bream, common bream (*Abramis brama*) and crustaceans, while in the Middle and South Caspian the forage for oil-rich fish such as kilka (*Clupeonella*) (i.e. deep water anchovy-sprats) and also *Atherina* and gobies. Maximum dive depths exceeded 200 m, and maximum duration of underwater stay was greater than 20 min, however 80% of dives were shallower than 15 m and shorter than 5 min.

The foraging grounds are likely to overlap with commercial fishing trawlers targeting kilka in the South Caspian and there are likely to be interactions between seal and humans.

Figure 6C.2 Spring and Autumn Migration Routes of the Caspian Sea



4.2 Recent Seal Observations (2016 and 2017)

4.2.1 Results of Monitoring of Caspian Seals in 2016

Seal monitoring studies during seismic surveys were carried out in 2016 on the shores of Absheron Peninsula (northern and southern and on Shakhova spit, and on the islands of Absheron archipelago (Pirallahi, Koltush, Boyuk Tava, Kichik Tava, Podplitochny, Dardanella, Chilov (Southern spit and Urunos), Garabatag, Yal, Churka, Kamni Grigorenko.

During the period 1 October to 15 December 2016 a group of Caspian seal experts (T.M. Eybatov, T.Ya.Suleimanov and I.M. Mustafayev) carried out monitoring of marine mammals during a seismic survey (BP SWAP 3D Seismic Survey), during both soft-starts and survey operations, in the shallow water area of Caspian to the east and south-east from the Absheron Peninsula. Autumn monitoring was typically carried out from the vessel SK 152. Vessels Vifi -5051 and TZ - 402 were also used. The survey was carried out with the use of binoculars and a high-quality photo-camera Nikon D5300 (high-speed photography in a sport mode); the Lumix Panasonic FZ38 camera was also used. Coordinates were registered from the vessel, with the photo-camera and a Garmin GPS navigator.

Monitoring consisted of two phases:

- 1 October - 27 October, 2016 in the area of the Absheron archipelago.
- 15 November – 15 December, 2016 – in the western part of Shakhova spit.

Due to early melting of ice in the Northern Caspian the first groups of seals appeared in Azerbaijan waters in March as observed in the records collected by fishermen and helicopter pilots.

For the first time during many years of research, there were no mass accumulations of seals observed in the area of islands of the Absheron archipelago. Also, no seal bodies were recorded during the spring in the monitoring zone. However, a small number of dead seals washed ashore were registered in the summer and autumn periods. Altogether 57 dead seals were found in the monitoring zone in various conditions, most found during autumn migration.

In October and November 156 Caspian seals were observed (and photographed) on the islands of Absheron archipelago, most of them were in a very good condition - i.e. well nourished. Only one dead animal was observed in the water during this survey.

The nature of seals' appearance near the islands of the Absheron archipelago depends on the season, i.e. on the timing of spring and autumn migrations, the migration of fish shoals and on water levels in the Caspian. Depending on the rise or lowering of the water level the exposure of the islands change, new rookeries appear and old ones disappear.

Seals are very cautious animals; they usually choose gentle, flat areas with sandy soil, so that in case of danger they can rapidly escape to sea. On land, seals are quite clumsy and slow moving, compared to in the water where they can move very quickly. Therefore, seal numbers on the islands depend on the availability of sites with the suitable gentle relief on the shores. Unfortunately, there are precipitous cliffs at most islands of the Absheron archipelago, thus large haul-out sites are not available at these islands.

Monitoring clearly demonstrated that many seals stay as individuals at smaller sites, at the extreme ends of islands, on the sunken rocks (Photo 6C.1).

Photo 6C.1 Dardanella island, 6 October 2016

Table 6C.2 Summary Table of Monitoring of Caspian Seal in October 2016

Date	Number of seals observed	Expert observer	Vessel
01.10.2016	3	T.M. Eybatov, T.Ya. Suleimanov, I.M. Mustafayev	SK 152
03.10.2016	17	I.M. Mustafayev	SK 152
04.10.2016	3	I.M. Mustafayev	SK 152
05.10.2016	10	T.Ya. Suleimanov	SK 152
06.10.2016	52	I.M. Mustafayev	SK 152
07.10.2016	50	T.Ya. Suleimanov	SK 152
08.10.2016	9	T.Ya. Suleimanov	SK 152
09.10.2016	6	T.M. Eybatov	SK 152
21.10.2016	0	T.Ya. Suleimanov, I.M. Mustafayev	Vifi -5051
22.10.2016	6	T.Ya. Suleimanov, I.M. Mustafayev	SK 152; TZ -402; SK 152
23.10.2016	0	T.M. Eybatov, T.Ya. Suleimanov	SK 152
27.10.2016	0	I.M. Mustafayev	SK 152
Total	**156**		
Notes: Seals monitoring was not completed on 02/10/2016, between 10/10/2016 and 17/10/2016 due to unfavourable weather conditions and between 18/10/2016 and 20/10/2016 due to survey vessel repair works.			

Table 6C.3 Distribution of Seals by the Islands

Location seals observed	Number of seals
Dardanella Island	72
Koltush Island	32
Yal Island	33
Kichik Tava Island	15
Churka Island	2
Garabatag Island	1
Urunos Island/ Peninsula	1
Total	**156**

Table 6C.4 Number of Seals Observed by Date and Island Location

Date	Dardanella	Yal	Koltush	Kichik Tava
01.10.2016	2		1	
03.10.2016	1		1	15
04.10.2016			1	
05.10.2016	5	5		
06.10.2016	28	7	17	
07.10.2016	30	8	12	
08.10.2016	1	7		
09.10.2016		6		
22.10.2016	5			
Total	**72**	**33**	**32**	**15**

Figure 6C.3 Number of Seals Observed by Date during SWAP Seismic Survey Monitoring in October 2016

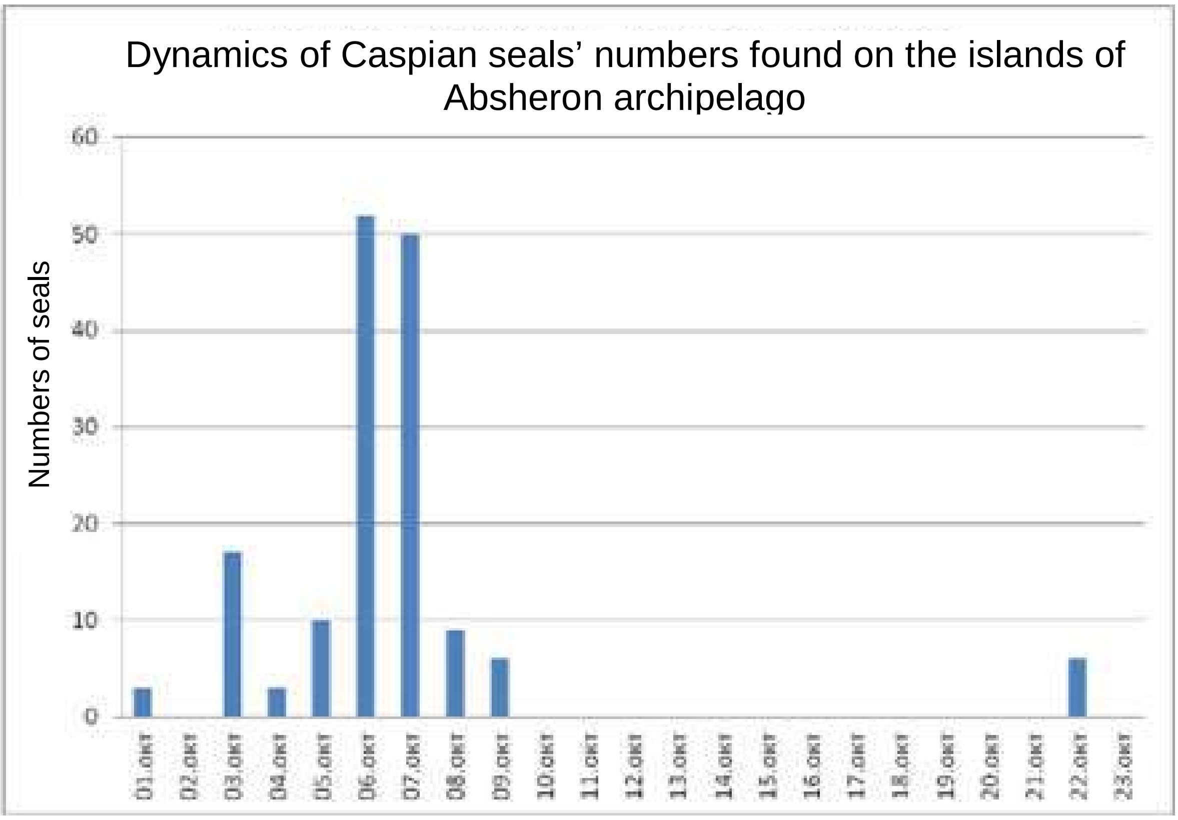


Photo 6C.2 12 October, Dardanella island – eastern part. Most seals are males

Photo 6C.3 Dead body of Caspian seal found near Baklanyi island

As a result of the monitoring carried out, one can provisionally note the unusual character of the autumn migration of seals in the area surveyed. Whilst in previous years the number of seals gradually increased during October-November, during the 2016 survey the dynamic was more irregular with the number of seals on the islands occasionally increased or decreased (see Figure 6C.3).

During this period seals are usually observed both in the open sea and on the islands. However this year they were seen mainly on the islands or near the islands. It should be noted that this year spring migration was also unusual. There were practically no mass accumulations of seals in the Contract area, as characteristic for previous years.

Conclusions:

As a result of monitoring, we can conclude that:

1. Autumn migration of seals was sluggish. The number of seals in the survey area was not increasing gradually.

2. Although the seismic survey could be a factor with regard to disturbance of the Caspian seals, it was carried out in October, during the period of sluggish migration, therefore negative impact was considered minimal and it should have affected a change in population of Caspian seals and nature of their migration.

3. An important aspect for the minimisation of negative impact of the seismic survey is that seismologists followed the recommendations and reduced the intensity of acoustic impact before the start of seismic survey, allowing seals to leave the zone of the seismic survey and escape to the islands. They could also migrate, bypassing the seismic survey area.

4. The maximum number of seals on the islands was observed on 6-7 October. There was no wind on those days (absolutely calm sea), the weather was warm and sunny, so seals could stay on the islands and form rookeries there. On other days, in stormy weather or during strong wind and waves, the seals could not stay on the islands due to the impact of waves, and on such days seals try to escape to deep-water areas of the Caspian, where wave action is not so strong.

4.2.2 Results of Monitoring of Caspian Seals in 2017

In 2017 the first seals in Azerbaijani waters appeared at the end of April, beginning of May. Like 2016, migration in 2017 was unusual. There were no mass accumulations of seals observed on the islands of the Absheron archipelago; small groups of seals usually appeared on individual islands during the daytime and disappeared in the evening. Fishermen traditionally relate this process with migration of herrings. This year the catch of this species of fish was very low. By mid-May there were no reported observations of seals on the islands. Only small groups of seals were observed in the area of Oil Rocks. The number of dead seals washed ashore on the northern coast was not significant; with only 14 dead animals recorded, 5 times less than in the autumn of the same year, although this was similar to the number of registered dead seals in previous years. This may probably be related to large scale poaching activities in Dagestan.

Small groups of seals (2-3 individuals) were found in the summer on the islands of the Absheron archipelago (Dardanella and Koltush). Two dead animals in poor condition were registered in the monitoring zone Buzovna-Severnaya GRES.

In the autumn, monitoring was carried out on the northern coast of the Absheron Peninsula and on the islands of the Absheron archipelago. Small groups of seals were periodically observed on the islands. The number of dead seals found in the monitoring zone increased sharply in the autumn. Overall, 23 dead animals were found on the beach of Shuvelyan settlement, in a 3 km coastal zone, in varying states of decay. Altogether 68 dead seals were recorded in the autumn within the 10 km monitoring zone. One female seal was found with an embryo. Most dead animals were in poor condition. The stomachs of some dead animals were empty, however most stomachs were full with the remains of fish skeletons, especially those of herring. One young female was in a very good condition, without any damages, presumably it got caught in a fishing net (Photo 6C.4).

Photo 6C.4 Completely fresh Caspian seal female

No seals were recorded in winter.

4.3 Earlier Seal Observations (2000 and 2014)

On 17-19 September 2009 an International Workshop was held in Atyrau city (Kazakhstan) on Caspian Seals: "Threats to existence of Caspian Seals. Obtained data, required investigations and mitigation measures". The workshop was organised by the Caspian International Seal Survey group (CISS); oil company Agip KCO jointly with the Darwin Caspian Seal Project research groups, and representatives of the Caspian states involved in Caspian seal monitoring[15]. Results of the monitoring studies of the Caspian seal in Azerbaijan were presented by the leader of the Caspian Seal research group within the framework of the Darwin Initiative project for the Azerbaijan waters of the Caspian, T. Eybatov.

Studies within the framework of the Darwin Initiative project began on 1 July 2006 and were completed on 1 July 2010. Results of this project were partly published (Eybatov T., 2010) (Wilson S., Eybatov T., 2014), and were also published in the scientific literature[16].

The studies conducted during the previous years identified the following:

1. The aerial survey conducted in the North Caspian in winter, during the pupping of seals at the ice rookeries, from 2005 until present, showed that the total abundance of pregnant females and, accordingly, pups, had reduced by a factor of four, compared with 1990; at present it is 20,000 individuals. Thus, the abundance of the Caspian seal population at present is 100,000-110,000 individuals[17].
2. It was also found that during the last three years from 2006 to 2009 pup production declined by 60%, notwithstanding the general decline of the seal population, the birth rate has declined more rapidly[16];
3. It was also found that in recent years there is a steady tendency for a reduction of the ice area whereon pupping takes place, hence the decline of the seals population (presentation of L. Dmitrieva, Meeting in Moscow, 12-13 March, 2015 “Caspian seal: current status and challenges of preservation and use”).
4. Special attention is paid to mass mortality of seals in fishing nets from illegal or legal fishing, and to mitigation measures. Currently net fishing is regarded as the main cause of seals mortality in the Caspian. Practically at all meetings, death of seals caught in nets was discussed. After the collapse of the USSR illegal fishing took place in all Caspian littoral states due to the absence of adequate control over fishing.[10,11,12,23,27 and 28]

[15] Badamshin BI (1961) Caspian seal resources and the ways of their rational usage, Moscow, Russia. 12: 170–179. Translated by M. Slessers, ed. K. Hollingshead, U.S Naval Oceanographic Office, Washington D.C. 20390; 1970. Electronic ed. M. Uhen & M. Kwon, Smithsonian Inst., 2007. http://www.paleoglot.org/files/Badamshin%2061.pdf.
[16] Lilia Dmitrieva et al (2016), Individual variation in seasonal movements and foraging strategies of a land-locked, ice-breeding pinniped,Marine Ecology Progress Series, 554: 241-256.
[17] Caspian Seal Project website - http://www.caspianseal.org/

5. It was established that illegal hunting for seals took place in practically all Caspian littoral states. For the first time it was reported at the meeting that in the Russian sector of the Caspian Sea (in Dagestan) in addition to licensed commercial fishing, illegal fishing and commercial processing of seals also took place[18,19]. This information was confirmed in 2015 by Ilya Ermolin and Linas Svolkinas. Russian research group led by A.Kondakov also initiated monitoring of dead seal bodies found on the Russian coast of the Caspian Sea as part of their seal survey programme, enabling comparison of similar data collected in Azerbaijan and Iran[18].
6. A group of Iranian researchers presented the results of their project associated with measures promoted in Iran to minimise seal mortality due to fishing nets. The project was focused on educating and raising awareness of fishermen and the local population on the issue[28]. The experience of European countries where nets safe for seals were designed was also discussed at the seminar.

Table 6C.5 The Sex Composition of Dead Seals and Percentage of Pregnant Females with Embryos Recorded at the Northern Coast of Absheron Peninsula

Year	Number of seals	% male	% female	% embryos
2000	221	57.5%	42.5%	2.7%
2001	214	63.5%	36.5%	0.5%
2002	41	41.5%	58.5%	2.4%
2003	67	31.3%	68.7%	6%
2004	35	42.8%	57.2%	2.8%
2005	54	51.5%	48.5%	3.7%
2006	56	32%	68%	8.9%
2007	27	40.7%	59.3%	11.1%
2008	36	38.9%	61.1%	16.6%
2009	13	38.5%	61.5%	7.7%
2010	23	52.2%	47.8%	13%
2011	34	58.8%	41.2%	11.8%
2012	31	48.4%	51.6%	9.7%
2013	42	42.5%	57.5%	11.9%
2014	63	55.5%	44.5%	6.3%

5 Threats to the Caspian Seal

The threats faced by the population of Caspian seals are numerous and no single reason can be attributed to their decline. Sections 5.1 to 5.5 present an overview of the threats. A summary of an academic paper prepared by T.M. Eybatov in 2010 regarding the threats to the Caspian seal is provided in Annex C.

5.1 Fisheries

The by-catch of seals in fisheries is identified as a critical threat to the Caspian Seal population due to the overlap of fishing activity and seal habitat within the Caspian Sea[9.] By-catch, primarily in illegal sturgeon fisheries has been identified as a major cause of seal mortality, amounting to several thousand seals per year in recent years[19]. The large, static fishing nets commonly used by both legal and illegal fisheries within the Caspian Sea pose a serious threat of entanglement and accidental drowning to the Caspian Seal, and fishermen regularly sell skins and blubber from by-caught seals[10].

Based on semi-structured interviews conducted in fishing communities from Dagestan (Russia), Astrakhan region (Russia) and Atyrau region (Kazakhstan), Dmitrieva et al. (2013) documented a minimum by-catch of 1,215 seals during the 2008-2009 fishing season, 93% of which occurred in

[18] Ilya Ermolin and Linas Svolkinas (2018), Assessment of the sturgeon catches and seal bycatches in an IUU fishery in the Caspian Sea, Marine Policy Volume 87, Pages 284-290
[19] Dmitrieva L, Kondakov AA, Oleynikov E, Kydyrmanov A, Karamendin K, Kasimbekov Y, et al. (2013) Assessment of Caspian Seal Bycatch in an Illegal Fishery using an Interview Based Approach

illegal sturgeon fisheries. Due to the illegal nature of the fishery, accurately quantifying the total fishing effort is problematic and the sample is likely to represent less than 10% of the poaching activity in the north Caspian Sea. Strukova and Guchgeldiyev (2010) cite 2,130 illegal boats operating in Russia in 2007, although the Federal Fisheries Agencies in Russia and Kazakhstan reported that this had fallen to around 400 by 2009 when the survey was undertaken[20]. Total annual by-catch is however, likely to be significantly greater than the minimum documented by the survey, and could exceed the Potential Biological Removal[21] level for the Caspian Seal population[22]. The survey also did not cover fisheries in the middle and southern Caspian, including Azerbaijan, Iran, and areas of Turkmenistan and Kazakhstan; therefore the total fisheries related mortality could be several times higher than the minimum reported value (for example, a previous study by Eybatov et al. (2002) reported that Iranian commercial fisheries caused an estimated mortality of 500 Seals annually[23]). The documented minimum by-catch mortality could therefore account for 5 to 19% of annual pup production, which has ranged between 6,250 and 25,100 for 2005–2011 as estimated from aerial surveys[5]. Such high rates of by-catch could imply catastrophic rates of decline, greater than the 3–4% decline per year estimated by Härkönen et al. (2012)[11].

The presence of high by-catch rates was supported by independent evidence of net entanglement of seal carcasses during a mass stranding on the Kazakh coast in May 2009. Approximately 10% of the 312 carcasses showed direct evidence of entanglement in large mesh net remnants[12]. As most of the carcasses were highly decomposed Dmitrieva et al. (2013) state that this should be treated as a minimum estimate, since the decomposition could obscure evidence of entanglement in other carcasses.

Sturgeon poaching not only represents a serious threat to Caspian sturgeon populations, but may also be having broader impacts on the Caspian Sea ecosystem by contributing to a decline in the ecosystem's key predator. Further work will be required to fully quantify by-catch rates throughout the Caspian Sea, and the implications for the population demography of the Caspian Seal.

5.2 Hunting

Historically, the principal threat to the Caspian Seal population was intensive and unsustainable commercial hunting which took place through most of the 20th century[2]. The Soviet Union, which included four of the five countries surrounding the Caspian (Russia, Kazakhstan, Turkmenistan and Azerbaijan), considered the Caspian seal to be a 'harvested species', and hunting records show both pups and adult seals were killed in their tens of thousands every year on the ice-breeding grounds[24]. Seals were primarily hunted for their blubber, which was rendered into oil and more recently for the fur of seal pups. The distribution of the Caspian seal in a completely closed ecosystem, from which individuals cannot disperse to or from adjacent habitats, makes it extremely vulnerable to hunting.

Large-scale commercial hunting began in the mid-18th Century, with average annual harvests of 160,000 seals prior to 1803[25]. An average annual catch of 104,651 per year is reported from 1824–1867, with a maximum of 290,000 in 1844. Accurate hunting records for Caspian seals since 1867 enable a more thorough analysis. Initially, the numbers of seals killed annually varied from approximately 30,000 to 110,000, about half of which were pups[20]. The annual kill fell around 1920, rose again to about 100,000 around 1940, followed by a decline to around 40,000 seals per year.

Hunting records showed that for 8 years (1933–1940), catches of females and pups averaged more than 160,000, and increased to more than 220,000 annually, and it is this hunting strategy

[20] Strukova E, Guchgeldiyev O (2010) Study of the economics of bioresources utilization in the Caspian. Caspian Environment Programme, World Bank. http://www.caspianenvironment.org/LibRep/Insert/View/MoreInfo.asp?ID=1020 .

[21] The maximum number of individuals, not including natural mortalities, that may be removed from a marine mammal stock while allowing that stock to reach or maintain its optimum sustainable population.

[22] Wade, P (1998) Calculating limits to the allowable human caused mortality of cetaceans and pinnipeds. Sci 14: 1–37.

[23] Eybatov T, Asadi H, Erokhin P, Kuiken T, Jepson P, et al. (2002) Caspian seal (*Phoca caspica*) mortality. Ecotox Final Report, Appendix A2. World Bank. http://www.caspianenvironment.org/ecotoxreport.htm .

[24] http://www.pinnipeds.org/seal-information/species-information-pages/the-phocid-seals/caspian-seal

[25] Sklabinskij N (1891) Information on seal hunting industry in the Caspian Sea for the last 25 years, Rybnoe delo, N6 (November 1891) (special edition annex to the Astrakhan fisheries data sheet).

that is believed to have been the main cause of the population decline[26]. From 1941, catches were less than 100,000 annually, and after 1965, the annual hunt was focussed only on pups. Analysis of the hunting records show that numbers of breeding females decreased from a minimum of 245,800 in 1867 to around 21,000 in 2005, a decrease by at least 90%[11].

From the 1960s the annual kill on the ice-field was limited to pups, and the reported kill fell steadily until the end of the 20th century[27]. Commercial hunting ceased briefly around 1996 as it was considered economically unviable, though smaller-scale hunting has continued.

Official hunting is conducted under a quota system administered by an inter-governmental body, the Caspian Bioresources Commission, for scientific purposes[23]. Russia is the only country to take up its quota of 8,000 seals per year (out of 18,000 allocated for the Caspian states), Small-scale, opportunistic hunting also continues in other parts of the Caspian.

It is understood that the region of Dagestan is known for illegal seal hunting and there is a commercial seal skin processing facility present. Seals from the north Caspian (from by-catch and illegal hunting) are thought to be sent to this facility in Dagestan where, in addition to using the skin, the blubber is used as crayfish bait or is boiled down for use as medicinal oil. The signal from two of five tagged juvenile seals (as part of the telemetry survey[7]) was detected in 2008 at a terrestrial location in Dagestan, understood to be this facility[28].

5.3 Canine Distemper Virus

Between 1997 and 2001, Caspian seals suffered a series of mass mortality events throughout the Caspian Sea (Azerbaijan, Kazakhstan, Russia and Turkmenistan), affecting thousands of animals. These events raised international concern both about the status of the Caspian seal as a species and the broader Caspian Sea ecosystem[29]. Investigation of the mass mortalities determined Canine Distemper Virus (CDV) as the cause[30], with a previously unknown strain of CDV identified from a dead seal in the 1997 mortality[31].

A mass die-off of Caspian seals in April 2000 was first observed near the mouth of the Ural River in Kazakhstan, spreading south to the Mangistau region. By the end of May, more than 10,000 seals along the Kazakhstan coast had died[32]. High death rates were also recorded in May and June 2000 along the Absheron Peninsula of Azerbaijan and the Turkmenistan coast. Clinical signs of infected seals included debilitation, muscle spasms, ocular and nasal exudation and sneezing. Necropsies performed on eight Azerbaijan seals in June 2000 revealed microscopic lesions characteristic of distemper in both terrestrial and aquatic mammals[33].

Since the identification of CDV in Caspian seals, one important question has been whether the virus was endemic and caused mortalities prior to the first reported outbreak in 1997. Antibodies to CDV have been detected in archive serum taken from seals in 1993, 1997 and 1998[34].

[26] Badamshin BI (1961) Caspian seal resources and the ways of their rational usage, Moscow, Russia. 12: 170–179. Translated by M. Slessers, ed. K. Hollingshead, U.S Naval Oceanographic Office, Washington D.C. 20390; 1970. Electronic ed. M. Uhen & M. Kwon, Smithsonian Inst., 2007. http://www.paleoglot.org/files/Badamshin%2061.pdf.

[27] Igor S. Zonn, Aleksey N Kosarev, Michael H. Glantz, Andrey G. Kostianoy (2010) The Caspian Sea Encyclopaedia.

[28] Wilson, S, Goodman, S, Timirkhanov S and Tleulenov, Z (2012), Seal Special Protected Area Scoping and Inception Plan Final Report. http://www.darwininitiative.org.uk/documents/15024/22941/15-024%20SSPA%20Scoping%20and%20Inception%20Plan%20with%20annexes.pdf Accessed April 2017.

[29] Harkonen T (2008) Pusa caspica. IUCN 2013 Red List of Threatened Species Version 20132: IUCN.

[30] Forsyth M.A.. Kennedy S., Wilson S., Eybatov T.M., Barret T. " Canine distemper virus in a Caspian seal" Veterinari Rekord (1998) 143., P.662-664

[31] Kuiken T, Kennedy S, Barrett T, Van de Bildt MWG, Borgsteede FH, et al. (2006) The 2000 canine distemper epidemic in Caspian seals (*Phoca caspica*): Pathology and analysis of contributory factors. Veterinary Pathology 43: 321–338.

[32] Eybatov T.M. Caspian seal mortality in Azerbaijan. Caspian environment program. Proceedings from the first bio-network workshop. Bordeaux, November 1997. – P 95-101.

[33] Kennedy S, Kuiken T, Jepson PD, Deaville R, Forsyth M, et al. (2000) Mass dieoff of Caspian seals caused by canine distemper virus. Emerging Infectious Diseases 6: 637–639.

[34] Ohashi K, Miyazaki N, Tanabe S, Nakata H, Miura R, et al. (2001) Seroepidemiological survey of distemper virus infection in the Caspian Sea and in Lake Baikal. Veterinary Microbiology 82: 203–210.

Morbilliviruses typically cause epizootics with a periodic build-up of susceptible individuals[35]. Therefore, past Caspian CDV epizootics may have caused periodic mortality peaks in the long term monitoring data, for instance a notable peak in spring mortality was recorded in 1971.

Since 2002, there has been a significant fall in carcases in the Absheron monitoring zone, decreasing to one third the pre-1990 average[8]. However, rather than indicating a decrease in mortality, this may reflect decreased use of the waters around the Peninsula due to disturbance from offshore oil infrastructure and industrial shipping, increased coastal urban development and increases in fishing activity. As noted in Section 4, from 2006, haul-out sites on the Absheron Peninsula, historically used by many hundreds to thousands of seals have been abandoned, despite the site being designated as a National Park.

The origin of the epizootic CDV strain in Caspian seals is still unknown, with no exact match to known strains in either pinnipeds or terrestrial carnivores[27]. Studies have also shown that there is little evidence to suggest that persistent organic pollutants (POPs) such as organochlorines were a significant factor[32]. One theory is that the unusually mild winter that preceded the die-off in 2000 may have contributed to the CDV epizootics through increased ambient air pressure and accelerated disappearance of ice cover at the breeding areas in the northern Caspian Sea[27]. The current trend toward a warming climate has been associated with a worldwide increase in reports of diseases affecting marine organisms[36]. For five mass mortality events of pinnipeds with available data, mean monthly temperatures preceding the mortalities were higher than the 10-year average[37]. However, the mechanism by which this warm winter might have increased mortality from CDV is unknown. Kuiken et al. (2006)[27] suggests that the unusually early disappearance of ice cover in the northern Caspian Sea in spring 2000 could have decreased the available area for hauling out, concentrating seals at fewer haul-out sites, with a resultant increase in the spread of CDV. The early loss of ice cover may also have shortened the suckling period, resulting in reduced body weight of juveniles at weaning and decreased resistance to disease.

It remains to be determined if the current seal population size and contact rates are sufficient to maintain endemic circulation of CDV, or whether future CDV epizootics would require introduction of the virus from an adjacent terrestrial reservoir such as dogs, jackals or wolves. Virological surveys of canids around the Caspian should be a priority to determine if such species were indeed the historical source and whether they could act as reservoirs for future outbreaks[32].

5.4 Pollution

Persistent organic pollutants (POPs) are a particular concern for species occupying high trophic levels since the concentration can accumulate up the food chain. The presence of POPs can cause immune-suppression and impair reproduction[32]. For example, according to Kajiwara et al. (2002)[38], an important threat to the Caspian seal population is organochlorine (OC) contamination of the food chain (particularly from dichlorodiphenyl (DDTs)), which is known to cause infertility in older females.

Kajiwara et al. (2002) proposed that OCs consumed by seals eating contaminated fish could compromise immune system function, making them more susceptible to disease, such as the CDV mass mortality events that occurred between 1997 and 2001. The study also found that OC levels in Caspian seals were high enough to impair fertility, as has been suggested for other marine mammal species[39]. However, Wilson et al. (2014) concluded that although the Caspian is a major oil producing region, hydrocarbon pollution appears to be an unlikely contributory factor to the CDV

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[35] Harding K, Harkonen T, Caswell H (2002) The 2002 European seal plague: epidemiology and population consequences. Ecology Letters 5: 727–732.

[36] Harvell CD, Kim K, Burkholder JM, Colwell RR, Epstein PR, Grimes DJ, Hofmann EE, Lipp EK, Osterhaus ADME, Overstreet RM, Porter JW, Smith GW, Vasta GR: Emerging marine diseases: climate links and anthropogenic factors. Science 285:1505–1510, 1999

[37] Lavigne DM, Schmitz OJ: Global warming and increasing population densities: a prescription for seal plagues. Mar Pollut Bull 21:280–284, 1990

[38] Kajiwara N, Niimi S, Watanabe M, Ito Y, Takahashi S, et al. (2002) Organochlorine and organotin compounds in Caspian seals collected during an unusual mortality event in the Caspian Sea in 2000. Environmental Pollution 117: 391–402.

[39] Reijnders PJH (2003) Reproductive and developmental effects of environmental organochlorines on marine mammals. In: Vos JG, Bossart GD, Fournier M, O'Shea TJ, editors. Toxicology of Marine Mammals. 55–66.

epizootics, since levels were found to be undetectable in adult seals during the 1997 event[32]. Both seals and fish are capable of metabolising hydrocarbons[40] and metabolic indices indicate a relatively high degradation capacity for hydrocarbons in Caspian seals and this might reflect this species' history of living in waters contaminated by oil naturally through seepage over evolutionary timescales[41]. Trace metals in animals from the 2000 mortality event were not significantly elevated, with the exception of zinc (Zn) and iron (Fe) in some seals, which were attributed to a metabolic disorder and redistribution of trace metals in diseased animals[42].

A previous study by Krylov et al. (1990)[43] showed that pollution could cause infertility of female seals, with the ratio of females not participating in reproduction up to 80 per cent. According to the study, mercury (Hg) levels in the liver of pups and immature seals vary in the range of 1.84-4.52 mg/kg. High Hg content was noted in female seals that miscarried during the study, but less often in pregnant females. Increasing Hg contamination within the Caspian basin is therefore likely to have had a negative impact on the reproduction and population of Caspian seals in recent years.

Toxicity studies carried out within the framework of the ECOTOX program (2002) found concentrations of 15 microelements (V, Mn, Fe, Cr, Co, Cu, Zn, As, Se, Mo, Ag, Cd, Tl, Hg, Pb) and organic mercury (Org-Hg) in the liver, kidneys and muscles of Caspian seals[44.] According to Krylov et al. (1990), the levels of DDT in Caspian seal blubber have been relatively high, and are seen as the likely cause of low female fertility, which has been as low as 20-30% during the past decade[2]. The concentration of accumulated DDT in fat tissue varied in the range of 6.05-64.3 mg/kg of tissue mass, depending on the age, sex and capture location.

According to the ECOTOX program (2002, 2008[45]), polychlorinated biphenyls, dibenzo-p-dioxins and dibenzofurans, organochlorinated pesticides and organo-tin compounds were found in the liver of Caspian seals washed up on Caspian shores during the mass mortality events in 2000 and 2001. DDT contaminants, with concentrations from 3-560 mg/kg lipid dominated among the investigated OC compounds. The concentration of OC residues in stranded seals from different regions of the Caspian Sea were compared to understand the spatial distribution of these compounds[38]. A significant negative correlation was observed between OC levels and blubber thickness. This suggests that when the blubber store was low, as observed in the Azerbaijan seals, OCs were concentrated in the remaining lipid reserves. The authors also found that Caspian seals were exposed to OCs throughout the Caspian Sea during their seasonal migration, and the OC residues did not reflect local pollution sources.

Seasonal variation of blubber thickness was also evident, as this layer reduces after the feeding and the moulting season. Consequently, seals may be subjected to a higher risk in the spring, due to the impact of higher concentrations of OCs in the reduced level of blubber.

Levels of OC compounds found in Caspian seals in 2000 and 2001 were comparable to the levels of OC compounds in other marine mammals that have suffered from epizootics. Concentrations of dibenzo-p-dioxins in sick Caspian seals were lower than concentrations in seals from other regions, indicating that the toxic effects of these contaminants were considered weaker, and were not related to the mass mortality of seals. Although levels of toxic equivalent (TE) in seals were relatively low, the current status of contamination with polychlorinated biphenyls and OCs identified in Caspian seals poses a risk of immune-suppression[32].

[40] Law RJ, Biscaya JL (1994) Polycyclic aromatic-hydrocarbons (PAH) – problems and progress in sampling, analysis and interpretation. Marine Pollution Bulletin 29: 235–241.

[41] Watanabe M, Tanabe S, Tatsukawa R, Amano M, Miyazaki N, et al. (1999) Contamination levels and specific accumulation of persistent organochlorines in Caspian seal (*Phoca caspica*) from the Caspian Sea, Russia. Archives of Environmental Contamination and Toxicology 37: 396–407.

[42] Anan Y, Kunito T, Ikemoto T, Kubota R, Watanabe I, et al. (2002) Elevated concentrations of trace elements in Caspian seals (*Phoca caspica*) found stranded during the mass mortality events in 2000. Archives of Environmental Contamination and Toxicology 42: 354–362.

[43] Krylov VI (1990) Ecology of the Caspian seal. Finnish Game Research 47: 32–36.

[44] Kajiwara N., Watanabe M., Wilson S., Eybatov T., Mitrofanov I., Aubrey D., Khuraskin L., Miyazaki N., Shinsuke Tanabe S. (2008) POPs in Caspian seals of unusual mortality event during 2000 & 2001. Environmental Pollution Vol.152. №2

[45] World Bank, (2002) Ecotoxicological Study: Investigation into Toxic Contaminant Accumulation and Related Pathology in the Caspian Sturgeon, Seal and Bony Fish (ECOTOX Study) – Final Workshop Report.

Concentration of butylin compounds in the livers of seals ranged from 0.49-17 ng/g on a wet-weight basis, and octyltin compounds were below the limit of detection in all analysed samples, suggesting less contamination with organo-tin compounds in the Caspian sea[32].

5.5 Decrease in Kilka Fish Stocks

One of the main food sources of the Caspian seal is kilka, a small and highly abundant fish. The decrease in kilka fish stocks is identified as an important threat to the Caspian seal population. Disruption of the Caspian Sea food chain due to overfishing, and wider ecosystem changes, have resulted in reduced prey availability for seals. For example, during the last decade the stock of kilka has reduced significantly for various reasons, including increased harvesting in 2001-2004[46], and the invasion of comb jelly fish (*Mnemiopsis leidyi)*[47].

The comb jelly fish, native to the north-west Atlantic, has managed to invade new waters via ship's ballast water. It is an actively hunting carnivore feeding on zooplankton (including the larvae of benthic animals), fish eggs and fish larvae. This has resulted in the decline of pelagic fish stocks, caused by both the elimination of the zooplankton, the normal food of pelagic fish, and direct predation on floating fish eggs and early larvae. By the 1990s *Mnemiopsis* was already notorious for its devastating invasion of the Black Sea, and predictably reached the Caspian by the late 1990s[2], presumably via ships' ballast travelling through the Volga-Don canal. It is believed to be having a severe effect in the south Caspian region, where, in combination with intensive fisheries, it has reduced the stocks of kilka (sprat) and other small pelagic fish.

Another cause of kilka reduction in the Caspian Sea is believed to be an earthquake that happened in 2001 in the Central section of the Caspian Sea which resulted in large volumes of poisonous gases released into the water from below the ground. These gasses caused mass deaths of Kilka. A dramatic decrease of kilka as a result of this earthquake was registered in Azerbaijan as well as in Russia and Kazakhstan. The earthquake occurred during the breeding period of kilka, which made the impact even more significant. It is assumed that almost half of the Kilka population of the Caspian Sea was killed as a result of this earthquake.

5.6 Summary

Based on the historical decline in the population, and the ongoing nature of a number of different threats, the Caspian seal is now classified as Endangered on the IUCN red list of species threatened with extinction. This reflects the very high risk that the species could become extinct unless conservation measures are implemented urgently.

As described above, the principal reason for the decline was unsustainable commercial hunting throughout most of the 20th century. Although active hunting has now reduced, Russia still considers the seal to be a 'harvested species' and continues to operate a commercial hunt of a few thousand seals, mostly pups every year. Small-scale, opportunistic hunting also continues in other parts of the Caspian.

Other important threats to the Caspian seal include deliberate killing by fishermen around fishing operations, accidental drowning (by-catch) in fishing nets, disease (CDV), organochlorine contamination of the food chain (particularly from DDT) causing infertility in older females, disruption of the Caspian Sea food chain causing reduced prey availability for seals due to overfishing and invasion by the comb jelly, and loss of habitat. In the future climate change may also become an important issue if this leads to reduction or instability of the winter ice fields used for breeding.

[46] Daskalov GM, Mamedov EV (2007) Integrated fisheries assessment and possible causes for the collapse of anchovy kilka in the Caspian Sea. ICES J Mar Sci 64: 503−511

[47] Huraskin L, Zakharova N (2001) Monitoring populjacii kaspijskogo tjulenja. Rybn hozjajstvo 4: 30−31

6 Sensitivity of the Caspian Seal

6.1 Seasonal Sensitivity

The most sensitive period for Caspian seals is in the spring, and late autumn for pregnant females in particular. In winter, sensitivity may be explained by the fact that seals stay on ice and might be killed by icebreaker ships; they could also be attacked by preying animals and birds. They can also fall victim to commercial hunting, which has not taken place in recent years, however many seals are killed by poachers in Dagestan (up to 10-12 thousand/year).

The spring period of high sensitivity is primarily related to pupping, feeding of pups and moulting, which takes place in winter-spring season. During this time seals do not eat, using up reserves of fat accumulated during summer fattening. During the period of milk feeding the young female seals lose more than 90% of fat reserves in subcutaneous tissue, which can concentrate poisonous substances received by the animals via the food chain. They, in turn, receive these substances from a highly contaminated water basin. After the birthing of pups' and their feeding, seals mate. Moulting then takes place and after that begins the migration of seals to the southern regions of the Caspian for fattening. Unfortunately, fish reserves in the northern Caspian are limited, and only a small portion of the seal population remains in this zone.

On migration southwards sensitivity is primarily related to a reduction of swimming capability because of winter fasting, hence ravenous animals have to move along the coast. At night, they occasionally come ashore or lie on the islands. New born seals are even more sensitive during this period as their subcutaneous tissue is usually thin, which affects swimming capability. These juveniles cannot remain in the water for a long time and must come ashore. Their chances to outlive the first year are low, occasionally 2-3 year old animals are found which are the size of a normal 1 year old animal. On emergence to dry land most seals are killed by fishermen and local citizens. Commercial activity in the Shah Deniz and Azeri Chirag Gunashli (ACG) Contract Areas, is located relatively far from the coastline and islands, to a lesser extent influences sensitivity of the seals, however – being an area of spring-summer-autumn fattening of these animals could negatively affect their numbers, if mitigation measures against disturbance are not taken.

The most sensitive period for pregnant females is autumn migration from the south to the north. Although mating of seals usually takes place in the period between the end of February and the beginning of March, development of the embryo begins only at the end of August or beginning of September. Only in October and November does its weight exceed 1-2 kg. Research over many years has shown (Gadzhiyev, Eybatov, 1995) that most dead seals are females at the age of 8 to 18 years.

6.2 Regional and Local Sensitivities across the Caspian Sea

Russian Federation
The death of seals is frequently caused by wolves and birds of prey in the north-western part of Caspian during winter pupping. The movement of icebreakers in winter is also a factor. The disturbance of seals on the islands in Russian waters of the Caspian and illegal fishing in Dagestan also affects seal numbers. Every year up to 10-12 thousands seals are caught from multi-engine poacher sea boats. The items made from seal fur are manufactured on a commercial scale and sold in many regions of Russia (Ermolin, Svolkinas, 2018). Seal oil is also very popular. Numerous seals die in nets used for the illegal fishing of ordinary fish and sturgeons. In this context information often comes from Dagestan about large numbers of dead seals washed ashore in Dagestan. In the 20th century, there were a few such washaways (B. Badamshin, 1971[48]).

Republic of Kazakhstan
The coastline of Kazakhstan is the longest in the Caspian Sea, and there is large number of towns and settlements on the eastern coast. A large number of winter rookeries can be seen in Kazakhstan waters of the Caspian. During the Soviet time in Kazakhstan and Dagestan, collective

[48] Badamshin B.I. "Mass mortality of Caspian seal", 1971. Proceedings of CASNIIRKh, vol. 26, p.261-264.

farms (kolkhozes) for the commercial catch of Caspian seals were organised. Currently these collective farms have been closed and official hunting for seals is absent (since 2006).

Nonetheless, the number of dead seal bodies washed ashore increased sharply (Baimukanov, 2017). In the first place, this is related to illegal fishing, i.e. the cause of most deaths of seals is fishing with nets. Commercial activities in the shelf zone and active navigation also affects life and activity of seals.

Turkmenistan
In the coastal area of Turkmenistan, large towns and settlements are practically absent, thus there is no anthropogenic impact. Fishermen and groups of poachers that are hunting for seals on Ogurchinski island represent the main threat for seals. Seal fat is in high demand in Ashkhabad markets.

Iran
In the territory of Iran there is no commercial or known illegal hunting for seals. Seals mainly die in fishing nets, however local authorities established centres for rescue of seals, and regularly organise workshops and training for fishermen and explain how to minimise seals' mortality (Ashayeri, 2009, 2015).

Azerbaijan
There are numerous cities, settlements and villages along the coast of the Azerbaijani Republic and the capital city of Baku is located near the sea. The coastal area is densely populated and the attitude of people to seals is not generally positive. Thus, during the last 30-40 years seals did not come ashore and to the coastal rocks. Since 2005 all earlier densely populated rookeries on the territory of the Azerbaijani Republic disappeared. Primarily this is due to the appearance of a large number of vessels and a sharp increase of navigation in the areas where seals are staying. A significant number of seals die in fishing nets. Cases of poaching by local people were registered on Chilov island (Eibatov, 1997, 2010). Seal fat is also in high demand.

7 Distribution of Caspian Seals in the Azeri Chirag Gunashli Contract Area

The ACG Contract Area is approximately 48 km in length, 5km width km, covering a total area of approximately 432 km^2. The Contract Area is located in the zone of most intensive movements of seals in spring-summer-autumn periods of activity (Dmitriyeva et al., 2016). The Contract Area is approximately 100km north west of Ogurchinski island (Turkmenistan) where most seals remain at winter rookeries and where some pupping takes place (Krylov, 1989; Yerokhin, 2016).

Table 6C.6 Caspian Seal Sensitivity per Season within the ACG Contract Area

Jan	Feb	March	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec
	Least sensitive period – few number of seals or they are absent										
	Most sensitive period / period of spring and autumn migration / maximum number										
	Seals are distributed as groups according to migration flows of food components										

Table 6C.7 Expected Maximum Number of Seals, which Potentially May be Present or Migrate Across the ACG Contract Area

Jan	Feb	March	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec
30	30	50	3000	3000	900	900	900	1000	3000	3000	200

2018	Jan	Feb	March	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec
	Period of the least presence of seals in the contract zone – seals may be absent, however – according to the results of seals' tagging, even in winter a large number of seals (in the first place males and immature animals) actively and in various directions move across the territory of the northern and central Caspian. Small groups of seals (1-3 individuals) might be found on the islands of the Absheron archipelago. Also small groups of young seals can be found far from the coast, in deep-water areas in the Azerbaijan sector of the Caspian.											
	Period of active fattening. During this period small groups of seals will migrate across the contract zone. The total number of seals in the contract zone may reach 3000 animals.											
	Period of maximum seals' presence – spring and autumn migration. The number of seals that could migrate across the contract zone varies from 8 to 12 thousand animals, whilst the spring migration of seals through this zone will take place both from Russian territory, and the territory of Kazakhstan. Many seals could get into this zone also from the territory of Turkmenistan (Dmitriyeva et al., 2016). During autumn migration a large number of seals might migrate from Iranian and Turkmenistan waters.											

As the Contract Area is located far from the coast and islands of Baku and the Absheron archipelagos, activities within the Contract Area would be expected to have a minimal impact. When carrying out operations in this zone potentially seals could be warned away using low intensity explosions or signals, and the use of lighting devices at night should be minimised, as they can attract seals hoping to forage on kilka, which move towards the surface at night.

ANNEX A: SUMMARY OF OBSERVATIONS

Year	Spring	Summer	Autumn	Winter
2010	Seals appeared in the area of Pirallahi island/ Chilov island/ Oil Rocks at the end of April. In this year unusual (diffuse) spring migration was observed. Seals arrived in small groups - 3-5 individuals in a group and distributed evenly in the aquatic area up to Oil Rocks. There were no seal accumulations at the island haul-out sites.	Small groups of seals - 2 to 10 individuals swim along the shores of aquatic area of Azerbaijan, from Yalama to Lankaran, at approximately 1 km from the shore.	In this year also very unusual autumn migration took place - no accumulations. At all sites of monitoring (about 20 altogether) 2-3 seals swam.	On 5.12.2010 analyses were done on two seal bodies in the monitoring zone Buzovna - North Power Station: female with embryo and male individual with GPS coordinates. In January and February no seals were observed on the islands; in December seals were observed on the Southern spit, Chilov island and Tava Alti (2-3 individuals at each site).
2011	Early migration, 1 April. Concentration of seals again is related to migration of herring. The first large shoal of seals (200 – 400 individuals) was registered on 1 April in the area of Southern spit and islands between Pirallahi island and Chilov (Kichik Tava, Boyuk Tava, Tava Alti, and Dardanella). According to fishermen, at that time mass migration of small herrings took place. At the end of April - beginning of May seals moved to the sea area between Chilov island and Shahdili Spit. Small groups of seals were also observed by oilmen at Oil Rocks. The first seals appeared in the Iranian waters in the beginning of June.	Small groups of seals (2-3-7 individuals) swim in the area of Oil Rocks between Chilov and Pirallahi islands. Small groups of seals accompany ships that service offshore platforms.	Significant accumulations of seals on the islands between Pirallahi and Chilov islands began appearing at the end of October, beginning of November. To the end of November practically all seals disappeared.	Fishermen or helicopter pilots did not see seals during this period.
2012	Helicopter pilots informed that seals came to the islands between Pirallahi and Chilov at the end of April, and disappeared one week later. In some places occasionally individual seals can be seen. Migration of seals was related to migration of kilka, then migration of Black sea roach (small kutum) began, and only now - migration of grey mullet. Diffuse migration in the beginning of May.	Seals are distributed evenly as small groups all across Azerbaijani waters.	Seal migration without large accumulations on the islands of Absheron archipelago.	Individual seals on the Urunos, Southern spit and 2-3 individuals on Garabatdag island.
2013	Migration began in mid-April. Significant accumulations were observed westward from Chilov island. Large group of seals swam in waters of Gugushu island, which seals usually do not visit	Small groups of seals swam to the south from Shahdili Spit and in the east between Chilov island and Oil Rocks	Shoals of several hundred seals around the islands of Absheron archipelago	Small groups of seals (2-5 individuals) on Dardanella island, Kichik Tava and Tava Alti. One seal lies on the Southern spit of Chilov island.

Year	Spring	Summer	Autumn	Winter
2014	1 April - early migration was observed. Namely, seals appeared in the Azerbaijan waters, in the area of Yalama seashore at the end of March. Usually one week prior to appearance on the islands of Absheron archipelago. In the recent years migration of seals in the first place was related to migration of shoals of herring. Fishermen complain that seals eat out fish in the nets.	Seals are distributed evenly, as small groups in the aquatic area, at significant distance from the coast - 1-2 km. Groups of 7-15 seals periodically appeared in the area of Oil Rocks. In dark hours also small groups of seals swam around the brightly illuminated ships.	Small groups of seals around Shahdili Spit and also numerous groups of seals to the south from Shahdili Spit at the level of Sangachal terminal. There are numerous seals in the area of Gizilagach National Reserve and Shirvan National Reserve.	Individual seals (1-2) on the Southern spit, 2-3 seals on Urunos. Groups of seals - 1-3 animals swim between Chilov island and Oil Rocks.
2015	Mass spring migration in the area between Pirallahi and Chilov islands was observed on 19-20 April. The largest number of seals was observed near Garabatdag and Urunos islands.	Seals are evenly distributed in small groups within the waters at a considerable distance from the shore. Small seal groups of 2-3 individuals on Chilov and other islands located between Pirallahi and Chilov islands.	Small groups of seals moving to the North in regular and periodical intervals.	2-5 individuals on the Shahdili Spit and Urunos (Chilov island). Small groups of 2-3 individuals move between Chilov and Oil Rocks.
2016	For the first time in many years there was no mass spring migration of seals. The ice melted earlier in the northern Caspian Sea and small groups of seals started migration to the southern regions in March. Aggregations of seals on the islands of the Absheron archipelago were observed in the spring. Fishermen also noted that there were no spring herring migrations in this region. Also on the north coast of the Absheron Peninsula there were no seal corpses washed up onto the coast, commonly observed here each year.	During summer months, seals were not observed. Dramatically reduced number of corpses, washed up onto the coast in the summer.	In October and November 156 Caspian seals were found and their photos taken, most of them in a very good condition, i.e. well nourished; only one dead animal was found in sea water.	Neither live, nor dead seals were recorded.

Year	Spring	Summer	Autumn	Winter
2017	The first seals in the Azerbaijan waters appeared, as usual, in the end of April, beginning of May. Like 2016, migration in 2017 was unusual. There were no mass accumulations of seals on the islands of Absheron archipelago; small groups of seals usually appeared on individual islands during daytime and disappeared in the evening. Fishermen traditionally relate this process with migration of herrings. This year the catch of this fish species was very low. Up to mid-May nobody saw seals on the islands. Only small groups of seals were observed in the vicinity of Oil Rocks. Number of dead seals washed ashore on the northern coast was not significant; they represented just one third of the autumn wash-away index, although in previous years their numbers coincided.	Small groups of seals (2-3 individuals) were found on the islands of Absheron archipelago (Dardanella and Koltush). Two dead animals in poor condition were found in the monitoring zone Buzovna-Severnaya GRES.	In autumn monitoring was carried out on the northern coast of Absheron Peninsula and on the islands of Absheron archipelago. Small groups of seals were periodically seen on the islands. Number of dead seals found in the monitoring zone increased sharply. In total 23 dead animals were found at the beach of Shuvelyan settlement, in the 3-km coastal zone, in varying condition. In total 68 dead seals were recorded in the autumn. One female was found with an embryo. Most dead animals were in poor condition. In some dead bodies stomachs were empty, however most stomachs were full with remains of fish skeletons, especially herrings. One young female was in a very good condition, without any damage; presumably it got caught in a fishing net. It was taxidermised.	Neither live, nor dead seals were recorded in winter.

ANNEX B: 2015 INTERNATIONAL WORKSHOP

A workshop was held in Moscow on the 13th and 14th March 2015, to discuss the current state of the Caspian Seal for the period 2010-2015. Details of the meeting are provided below:

- **Title of Workshop:** The Caspian Seal : Current Status and Problems of Conservation and Use
- **Organisers:** IEE RAS; Marine Mammal Council; Russian Theriological Society; United Nations Development Programme and University of Leeds.
- **Venue of the workshop:** Severtsov Institute of Ecology; Evolution RAS (IPEE RAS), 33 Leninski prosp. Moscow, 119071, Russia.

Two presentations were conducted by Tariel Eybatov (Figure 1):

1. The current state of Caspian seals in Azerbaijan. Conservation of the seal habitats - status and prospects; and
2. Caspian seal mortality in Azerbaijan – causes and solutions.

Other presentations included:

1. Liliya Dmitriyeva "*By-catches and mortality of Caspian seals in the North Caspian*"; and
2. Hamed Moshiri & Amir Shirazi "*Interaction of seals and fishermen in Iran and Turkmenistan - causes and ways of solving*".

Figure 1: Images of Presentations Conducted by Tariel Eybatov, 13-14th March 2015, Moscow

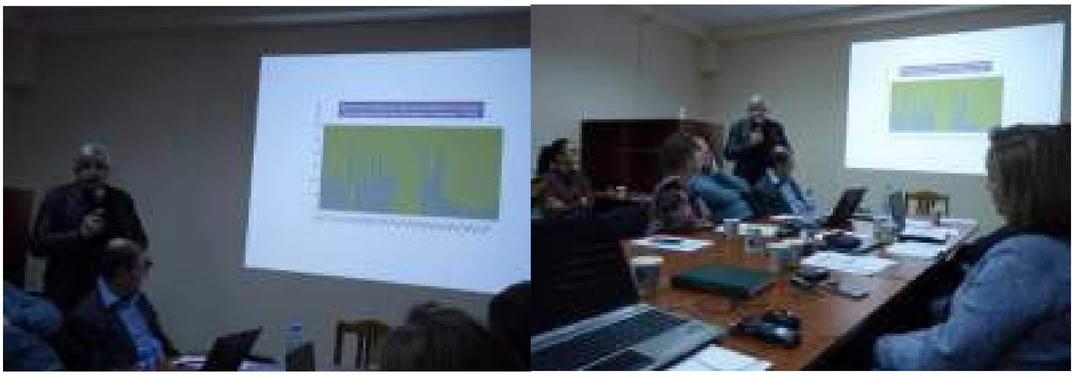
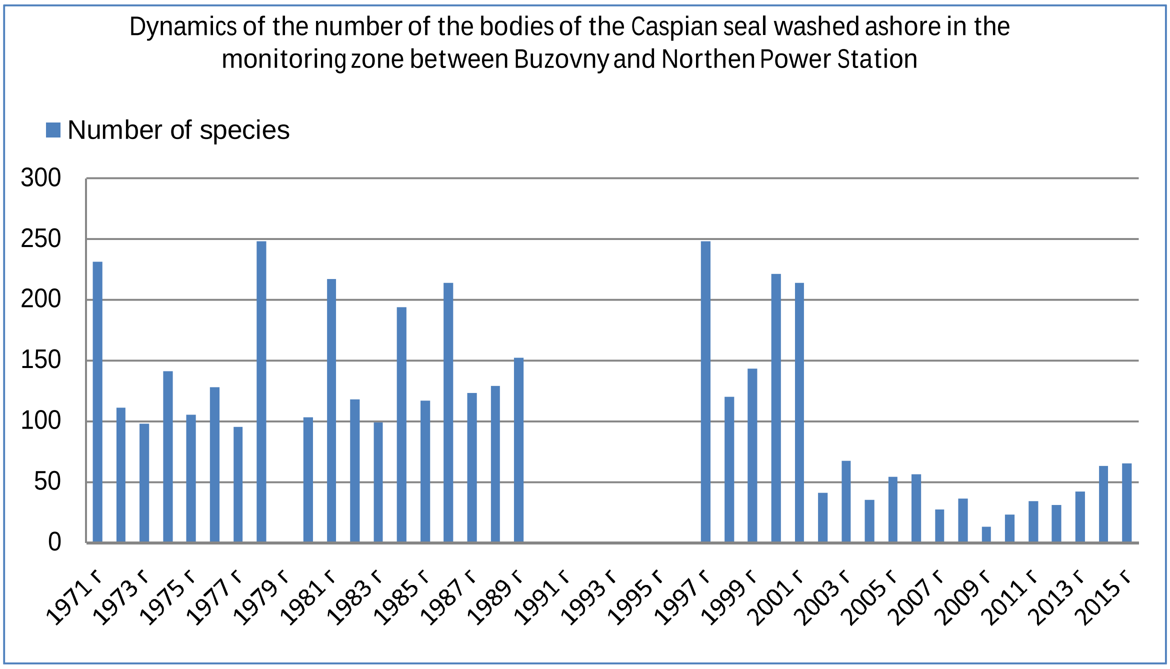


Table 1: Sex Composition of the Bodies Washed Ashore and the Ratio of Pregnant Females in the North Coast of the Absheron Peninsula

Sex composition of the bodies washed ashore and the ratio of pregnant females in the North coast of the Absheron Peninsula				
Years	**∑ specimen**	**% ♂ male**	**% female**	**% with embryos**
2000	221	57,5%	42,5%	2,7 %
2001	214	63,5%	36,5%	0,5%
2002	41	41,5%	58,5%	2,4%
2003	67	31,3%	68,7%	6%
2004	35	42,8 %	57,2%	2,8%
2005	54	51,5 %	48,5%	3,7%
2006	56	32%	68%	8,9%
2007	27	40,7%	59,3%	11,1%
2008	36	38,9%	61,1%	16,6%
2009	13	38,5%	61,5%	7,7 %
2010	23	52,2%	47,8%	13%
2011	34	58,8%	41,2%	11,8%
2012	31	48,4%	51,6%	9,7%
2013	42	42,5%	57,5%	11.9%
2014	63	55,5%	44,5%	6,3%

Figure 2: The Total Abundance of Seals in the Caspian, According to the Last Meeting on the Caspian Seal which was Held in Moscow on the 13th-14th March 2015



At present (2015), the total population of seals in the Caspian is identified at approximately 100,000-105,000. The abundance was identified on the basis of aerial surveys made in the North Caspian during 10 years by CISS (the Darwin Initiative project) (L. Dmitriyeva, 2015)[3]. As part of the workshop, Russian scientists tried to oppose this data stating that the abundance of seals is much higher, somewhere between 400,000 and 450,000, and that there is evidence that the population has not changed in the last 20 years. This conclusion was based on a thermal aerial survey in the Russian sector of the Caspian undertaken by Chernook et al. (2015). However, this study was only undertaken in one year and on Russian territory, at a period when most seals were breeding within the territory of Kazakhstan. Within Russian territory, breeding usually takes place only in mild winters, in harsh winters it only occurs on the eastern shores of Kazakhstan.

As Figure 2 shows, the abrupt reduction of the number of seals commenced in the early 21st century. Significant mortality of seals in 2000 and 2001 resulted in the abundance of seals not exceeding 100,000-105,000 from 2002 onwards, and this trend continued until 2009. In 2009 the number of bodies washed ashore was the lowest (13 specimens) recorded since 1971. In the following years the number of bodies washed ashore remained low; however, their number tended to increase slowly, as did the abundance of seals in the Caspian. In 2014, the number of bodies washed ashore in the North Absheron increased significantly although not in the monitored area between Buzovna and North Power Station, but in the villages of Nardaran, Pirshagi, Novkhani and the city of Sumgait. It is too early to talk about the stabilisation of the seal population in the Caspian but there are two possible interpretations of the increased number of bodies washed ashore: either the abundance of seals is slowly increasing, or the number of bodies washed ashore in 2014 increased due to an increase in poaching. The animals found onshore were not skinny or sick. They were all well-nourished and had enough subcutaneous blubber fat.

The early appearance of seals in the Azerbaijani sector of the sea (March/April) began in 2009, and has continued since then. Table 1 provides details of seal presence and activity between 2010 and 2016 in the vicinity of the Absheron Peninsula. The earlier appearance of seals is most likely connected with the reduction of the area of ice in the North Caspian and early melting of the ice, which has led to seals migrating, south earlier. At the 2015 meeting in Moscow L. Dmitriyeva also discussed the reduction of the area of ice in the North Caspian during the past years.

ANNEX C: EXTRACT OF ACEDEMIC PAPER PREPARED BY T.M. EYBATOV

Part of Published article:

T.M. Eybatov. **Caspian seal (*Pusa Caspica Gmel*.) - endemic of Caspian**. News of the Azerbaijan National Academy of Sciences, Geosciences, № 4, 2010, p. 151-169.

Dead seal bodies washed ashore on the Caspian coast ("drifts")

The first comprehensive study of dead seals found on the shores was carried out by K.K. Chapski (1932), who investigated an issue of the appearance of dead seals drifting in water. The author noticed the regular appearance of dead seals in the autumn. Dead seals are found on the shores of Dagestan from the end of August and till the freeze-up near Chechen island. Distribution of dead seal bodies in this area is not even: most dead seals are found on Uch spit, where Chapski investigated up to 30 dead seals washed ashore. Their age composition was the following: of breeding age 6, adults 13, old 3, male 10, female 12 (only one female was with an embryo). It was difficult to investigate all seal bodies due to strong deterioration of some of them. The author did not make any well-founded conclusions about the causes of seals' death. Investigation of this issue is a matter for the future (S.I. Ognev, 1935). Ognev (1935) writes: "Drifts. After the Caspian opening in spring in some years large number of dead seals appear, locally referred to as "plavun" ("drifts"). It is possible that those are animals that accidentally suffocated under the ice, as they could not get out (because of the frozen holes, collision of big ice fields, etc.) page 559. S.V. Dorofeev and S.Yu. Freyman (cited from Badamshin, 1971) noted cases of dead seals found on the coast; however, they did not try to explain the cause of their death.

They began talking about the dead seals washed ashore since 1875, however only S.I. Ognev (1935) assumed that the main cause of the appearance of dead seals was their death under the ice and collision and overlapping of the blocks of ice. K.K. Chapski (1930-1932) investigated dead seal bodies on the western shore, mainly on the territory of Dagestan, however he did not interpret the reasons because of the poor knowledge of the process. B.I. Badamshin was the first who attempted to explain the cause of mass appearance of dead seals on the shore (1971). According to Badamshin, the main cause of mass deaths of seals is related to late hunting, i.e. during the period when most ice has been melted, half of the wounded seals sink under their own weight and only after a certain time they rise to the surface and move southwards (before Badamshin some researchers thought that seals died of diseases, another that they suffocated under the ice, however without any strong arguments). Seals lie at the edge of the ice shelf, usually with the head towards water. Hunters on small boats swim to the shoals of seals, at 30-40 m distance and begin shooting. They rarely manage to make more than two shots, as the seals hearing noise leave the resting place. Fatally wounded animals very often jump into the sea and immediately sink. The same fate befalls seals killed while swimming. As a result hunters get a maximum of 4-5 killed or heavily wounded. Considering that during the spring hunt the catch was up to 30 thousand animals and more, losses were significant: "Sunken dead bodies had no time to decompose underwater; with the accumulation of gases in the gastrointestinal system they rise to the surface and under the action of wind and currents are washed ashore. In cold spring water dead seals probably remain under water for quite a long time, however in summer, as is evident from the tagged bodies (investigation in 1968) they rise to the surface within 1-3 days.

Unlike dead seals found during spring-summer, which usually takes place in the North Caspian and partly on the western shore of the Middle Caspian, where dead bodies are brought by the western branch of permanent circular current, at the end of 1955 and beginning of 1956 masses of dead seals were found on both shores of the Middle and South Caspian. This was not observed earlier.

During 3 to 12 March 1956 Badamshin surveyed the shores, from Chechen island and to Pervomaiski fish processing plant. Along the overall length of survey (260 km) he discovered 108 dead seals. Whilst moving from the north to the south the number of "plavuns" increases. Most dead animals were mature. Of the 108 seals 31 females were with embryo.

According to B.I. Badamshin, based on the size of embryos, dead seals found on the shore died at the end of October - beginning of November.

Previous researchers stated that the main cause of dead bodies found ashore was hunting and explosive works during prospecting for oil and gas.

Our studies demonstrated (my researches since 1971 and earlier researches by D.V. Gadzhiyev, since 1961) that there are many causes of seals mortality:

Hunting for seals, its shortcomings and inefficiency: in the first place incorrect quotas for shooting, and low efficiency when about 50-60% of hunted seals are lost.

Poaching: earlier it was shooting of seals using shotguns (in our collection there are dozens of seals' skeletons with shots). Illegal fishing for sturgeons using self-made devices "kaladas" (sets of large hooks). In our collection twenty dead seals found on the shore had kalada hooks in their mouths. In recent years, as a result of mass poaching - illegal fishing for sturgeons using nets - a large number of seals died: on average 5 seals/year per net, both coarse and fine-meshed (photo № 15 and photo №16) - three seals get ensnared in one of the nets, and were washed ashore together with the net in highly macerated form. A certain share of seals are killed by oilmen on Oil Rocks and individual offshore platforms: during the spring-summer fattening period seals often interfere with fishing, so oilmen try to shoot them. Besides, recently the local population has used seals caught in the nets for food: mainly liver and fat, skins are used by some people for manufacturing fur hats. The fat of seals is especially valued by the local population (it is considered healing and is used as ointment). Hunting for seals reached special scope island: here you could always buy both fat and liver of seals; most locals on the island wear hats of seal skins, despite the fact that just two rookeries remain in the Azerbaijan waters - Shahdili Spit and Chilov island. A minority of seals occasionally rest on Kichik Tava and Tava Alti islands. Surveys show that the islands of Baku archipelago, beginning from 1997, are no longer used as rookeries. Even during the period of mass spring migration southwards seals recently avoid this group of islands (to our mind, due to permanent disturbances, dirty water, reduction of fish population in this region because of intensive multiple net fishing).

Urbanization - in recent years the number of built-up beaches increased sharply, they cover the Absheron coast all along the perimeter: maintenance facilities & personnel are permanently at the coast and frighten away seals, especially during spring migration, when hungry animals, in particular young pups need to come ashore. The same picture is observed across the whole Caspian. In the first place this concerns fishermen - earlier a major part of the nearshore zone and islands in the Caspian were uninhabited and seals during the mass migration periods could rest on the shore and sea cliffs. Now fishery cooperative associations are located compactly all along the coast.

Owing to our long-term surveys and statements in the 70s-80s and in the beginning of 90s during spring migrations and in the summer seals often come ashore to the Absheron beaches and to the sea cliffs. As for the recent years (1997-2002), such cases were practically not observed. Only in 2000, in the area of Sumgait city local citizens caught sivar (seal's pup eye-witnesses, after the first change of coat) and kept it on the sunken ship. Besides, only occasionally one can see swimming seals in the aquatic area of Absheron and on surrounding territories.

Killing seals onshore: only in 2001 in the monitoring zone Buzovna- North Power Station we found three dead seals with broken skulls recently killed by people. According to eye-witnesses, one of the seals was caught by local people in the evening in the area of the North Power Station. They tied him with a rope to a stone. Early in the morning vacationers going to the beach broke the skull of the live animal with a stone. The same attitude is observed in other regions. Fishermen are against Caspian seals, as they regard them as a competitor and guilty of driving away fish shoals and eating fish out of the nets. That is why when possible they kill seals. Residents of coastal zones are frightened by the cases of seals attacking people (which is highly exaggerated) and kill seals where possible.

Natural enemies: occasionally wolves, foxes, racoon dogs, white-tailed eagles and earlier very large beluga.

PARASITES OF CASPIAN SEAL

A large number of helminths was found in the organism of the Caspian seal (currently more than 28 species are described pertaining to 5 classes: cestodes (tapeworm), nematodes (roundworms), trematodes (flat worms), acantocephala (thorn-headed worms) and proboscis worms:

Helminth fauna of Caspian seal:

Trematodes: according to the data of V.N. Popov and M.Taikov (1982, 1986, 1990), 13 trematode species were registered in Caspian seals:

- *Bolbophorus cinfusus*
- *Hysteromorpha triloba*
- *Tylodelphys podicipina*
- *Mesorchis advena*
- *Cryptocotyle lingua*
- *Parascocotyle sinoecum*
- *Pigidiopsis genata*
- *Miritrema sobolevi*
- *Opishorchis felineus*
- *Pseudavphistomm truncatum*
- *Ciureana badamschini*
- *Cyatocotylidae gen. sp.*
- *Paracoenogonivus ovatus*

Nematodes:

- *Anisakis schupakovi Mosgovoy, 1951*
- *Parafilaroides caspicus Kurotsckin et Zablozky, 1958*
- *Eustrongylides excisus Jagerskiold, 1908*
- *Nematoda gen sp. (Larva)*
- *Dioctophyme sp.*
- *Contracoecum sp.*
- *Dioctophyme renale*

Cestodes:

- *Diphyllobothrium phocarum*
- *Cestoda gen. sp.*

Proboscis worms:

- *Acantocephala Corynosoma strumosum (Rudolphi, 1802)*
- *Corynosoma caspicum*

Some of them should be particularly mentioned as major impact sources: mass infection with helminths and their large numbers in the animals' organisms also may result in death of seals. Of this number only 13 trematode species, 3 nematode species: Anisakis schupakovi, the seal is an accidental (optional) host for nematods Eustrongylides excisus Jagerskiold, 1908 (Yu.V. Kurochkin, 1961). From proboscis worms Corynosoma strumosum was registered. The third species of nematodes found in Caspian seals is Parafilaroides caspicus Kurochkin et Zablozky, 1958; the fourth nematode (Kurochkin, 1961) has not been defined to species.

Ectoparasites in Caspian seals are represented by seal louse Echinophtirius horridus.

Of virus infections only *morbilli* virus giving rise to canine distemper was found.

Of bacterial infections currently only diplococcoid infection induced by diplococcus *Badamschini caspii* (Vilegzhanin), red staphylococcus and salmonella have been confirmed. This shows that virus and bacterial infections of the Caspian seal are not studied well enough: there cannot be so little micro-infections. Initially the number of helminths in the Caspian seal was also estimated as 6, however later more than 27 species were defined.

So, 28 various forms of helminths were established in the Caspian seal, 18 of them were identified to a species.

Also, it should be noted that not all helminths are equally dangerous, many of them use the Caspian seal as a transition form and are not so dangerous for health.

According to data of S.L. Delyamure (1961) 174 kinds of helminths parasitizing in various organs of pinnipeds and cetaecean have been described up to 1961. Delyamure wrote about this with certain purpose: some researchers (other than helminthologists) working with marine mammals were mistaken stating that helminths were parasitizing only within the intestines of these animals. However, this was not so: the following parasites are found in the blood circulatory system: Tictyocaulides, Pseudoaliides, Filariides, Setariides (Nematodes), in the lungs and nasal cavities - Dictyocaulides, Philarioidides, Pseudoaliides, in the hearing organs - Pseudoaliides, in the intestines - Campulides, Echinostomatides, Galactosamatides, Heterophyides, Opisthorchid flukes, Browniides, Notocotylidae, Pholetereides (Trematodes), Tetrabotriides, Difillobotriides (Cestodes), Anisakides, Ancylostomatides /hookworm (Nematodes), Polymorphids (proboscis worms), in the liver - Campulidae, Opisthorchidae, Radziidae (Trematodes), occasionally Diphyllobothriides, in the urinary system - Krassicaudides (Nematodes), in skin and blubber - larvae of phyllobothriides (Cestodes). Thus, the idea that helminths in marine mammals infect only the stomach and intestines is outdated and must be rejected.

Contaminations of Caspian basin

Heavy metals. According to data obtained by Krylov et al. (1990) the level of mercury accumulated in this year's young and impuberal animals in the liver varies within the range 1.84-4.52 mg/kg. A high content of mercury was also established in dry and miscarried, more rarely in pregnant females. Strong contamination of the Caspian basin has an adverse effect on the reproduction and population of the Caspian seal: in recent years eildness of females varies from 39.8-59.8%. Toxicity studies carried out within the framework of the Ecotox program demonstrated (Tanabe et al., 2002) concentrations of 15 microelements (V, Mn, Fe, Cr, Co, Zn, As, Se, Mo, Ar, Cd, Tl, Hg, Pb) and organic mercury (OrgHg) in the liver, kidneys and muscles of the Caspian seal. The highest concentration of these elements was observed in the liver, then in kidneys and muscles. In 2000 and 2001 concentrations of toxic elements (As, Ag, Cd, Tl, Hg, Pb and organic Hg) that were equal or less than concentrations of the same elements in Caspian seals in 1993, and seals from other regions, meaning that these elements may not be the specific cause of mortality of Caspian seals. Alternatively, the concentration of Zn and Fe in infected Caspian seal presumably was higher than that registered in seals from other regions. This indicates a violation of homeostatic control and content of vital important elements in food of the Caspian seal.

Chloroorganic and organophosphorous poisonous compounds. According to of Krylov et al. (1990), accumulation of pesticides (DDT and its metabolites, α and γ-hexachlorocyclohexane) in fat tissue varies from 6.05 to 64.3 mg/kg of mass of tissue, depending on the age, sex and place of catch. According to Sh.Tanabe and N. Kajivara (Ecotox, 2002, 2008), polychlorinated biphenyls (PXB_1) dibenzo-p-dioxins ($PXDD_1$) and dibenzofurans ($PXDF_1$), chloroorganic pesticides and organo-tin compounds were found in the liver fat of Caspian seals on the shores of the Caspian during unusually frequent mass mortality cases in 2000 and 2001. Lipidic-weight investigation showed that DDT contaminants were predominant among the investigated chloroorganic compounds with concentrations 3.1 to 560 ng/g. Content of chloroorganic compounds in the organisms of Caspian seals found on the shores of Iran was less than in other regions. However adipose (fatty) layer in seals found ashore in Iran was significantly thicker, and a negative relationship between the concentration of contaminants and adipose layer was observed in Caspian seals.

Seasonal change of the adipose layer was obvious as this layer is thinning after the season of fattening and change of coat. Consequently, seals could be subject to a higher risk in spring under the impact of chloroorganic compounds. The levels of chloroorganic compounds established in Caspian seals in 2000 and 2001 were comparable with the levels of chloroorganic compounds established in other mammals suffering from epizootic diseases. Concentrations of PXDD/F in ill Caspian seals were lower than concentrations of these compounds in seals from other regions, which means that the toxic effect of these contaminants is weak and they are not responsible for mass mortality of seals. Although the level of TE (toxic equivalent) in seals was relatively low, the current status of infection with polychlorbiphenyls and chloroorganic pecticides found in Caspian seals is dangerous in terms of immunodepression. The concentration of botulinum toxin in the liver of seals varies in the range of 0.49 to 17 ng/g of wet weight, and compounds of octyltyne were below the detection level in all studied samples, which indicates a lower level of contamination with organostannum compounds in the Caspian Sea.

Factors influencing seals' mortality:

- Drilling mud;
- Formation water;
- Corrosion-preventive chemical reagents;
- Black water;
- Radioactive elements used in drilling;
- Household wastes;
- Radioactive contamination related to the washaway of eastern shores of Caspian;
- Discharges of hydrogen sulphide in Kazakhstan;
- Introduction - invasion of comb jelly fish - *Mnemiopsis leidyi* to the Caspian;
- Seismic survey; methods, scale and intensity of shooting;
- Rock outbursts while drilling;
- Oil discharges;
- Paraffinic wastes;
- Ethyleneglycol, sludge;
- Permanent disturbance (stress for young animals);
- Commercial fishing; and
- Natural mortality because of age: in average about 8% from total number of found dead seals.

Recommendations for Preservation of Caspian Seal

1. General prohibition on hunting for the Caspian seal.
2. Strengthening of control and elimination of illegal fishing for sturgeon and small fish.
3. Coordination of investigations all across the aquatic area of the Caspian agreed with all littoral states: Russia, Kazakhstan, Turkmenistan, Iran, Azerbaijan and international environmental organisations.
4. Apply to law enforcement agencies in order to stop killing of seals on Chilov island and introduce fines for those hunting for seals on Oil Rocks and in other oil production areas.
5. Ban on fishing in the areas of mass migration and accumulation of seals.
6. Organise TV broadcasting and attract other mass media, as well as NGOs and educational organisations for the promotion of measures for the protection and preservation of Caspian seals.
7. Strengthen control over discharges of various toxic chemicals (mainly DDT) and toxic metals into rivers, sewage systems and the sea.
8. Develop various vaccination schemes against infections, in the first place against *morbilli* virus.
9. Improve control over the oil-producing companies in the Caspian through the Ministry of Ecology, so that they carry out seismic surveys, drilling and operations accounting for the specifics of seals' migration.

APPENDIX 6D

East Azeri and Central Azeri Platform Monitoring Results Summary

1 CA Platform Location

Sediment sampling surveys have been conducted in the vicinity of the Central Azeri (CA) platform location in 1998 (baseline survey), 2001, 2004, 2006, 2008, 2010, 2012, 2014 and 2016. Surveys from 2004 onwards have used the Environmental Monitoring Programme (EMP) standardised methods. The 1998 baseline survey and the 2001 survey used different arrays of stations, and the analytical methods in 1998 were not consistent with later surveys. A total of 15 stations were sampled in water depths ranging from 127 to 140m during the 2016 survey. The survey locations are shown in Figure 6.11 within Chapter 6 of the Azeri Central East (ACE) Environmental and Social Impact Assessment (ESIA).

1.1 Physical and Chemical Composition of Seabed Sediments

1.1.1 Physical Properties of Sediments

For the 2016 survey the mean particle diameter of sediments ranged from 15 to 721 micrometres (µm), with a mean value of 372µm. The physical compositions of sediments were very similar at the majority of sample stations. Sediments were characterised as being dominated by coarser grained fractions over the finer silt/clay fractions. The coarsest sediments were present at stations along the southern and western edge of the survey area. In the northern half of the survey area there was a general gradient present of sediments reducing in coarseness from west to east, with the finest sediments being present at stations in the north east corner of the survey area. The results from 2016 are similar to those observed on previous surveys and no clear trends have been identified within the 2016 survey area over the survey period.

1.1.2 Hydrocarbon Concentrations

The Total Hydrocarbon Content (THC) concentrations observed during 2016 survey were generally low throughout the survey area and were similar to the levels observed on previous surveys, ranging from 18 to 61 micrograms per gram (µg/g), with a mean value of 40µg/g (refer to Table 6D/1). The lowest THC concentrations were present in the northeast and southeast corners of the survey area, while the highest concentrations were present at stations in the northwest quadrant of the survey area and station 9 directly to the northeast of the platform. The composition of aliphatic and aromatic hydrocarbons throughout the survey area were indicative of weathered material, with no evidence of recent inputs of THC or polycyclic aromatic hydrocarbons (PAH) being identified at any sample station.

Low concentrations of hydrocarbon based drilling fluids Linear Alpha Olefin (LAO) and Low Toxicity Oil Based Mud (LTOBM) were detected at 8 and 4 stations respectively; the concentrations present were low or very low. These materials are not intentionally discharged at Central Azeri as part of the drilling programme and the low concentrations present are likely the result of a historical spill of LAO in 2002 and more recent small spills of LTOBM.

Other than the low concentrations of hydrocarbon based drilling fluids at stations to the northeast, south and southwest of the platform, there is no evidence to suggest that operations at CA are influencing the hydrocarbon concentrations of sediments within the survey area.

Table 6D/1 CA Platform Location Hydrocarbon Sampling Results (2004-2016)

	THC (µg/g)			TPH (µg/g) (Less LAO & LTOBM)			LAO (µg/g)			LTOBM (µg/g)		
	Min	**Mean**	Max	Min	**Mean**	Max	Min	**Mean**	Max	Min	**Mean**	Max
2004	8	35	92	8	29	54	1.0	20.2	49.0	NC	NC	NC
2006	14	39	106	12	32	62	0.5	8.0	44.5	NC	NC	NC
2008	10	18	49	8	16	36	1.0	6.4	13.0	NC	NC	NC
2010	10	21	51	10	19	41	0.5	5.6	18.5	NC	NC	NC
2012	16	32	62	16	31	61	1.2	1.9	2.8	NC	NC	NC
2014	16	37	68	16	37	67	1.1	1.4	1.7	NC	NC	NC
2016	19	40	61	19	38	54	1.5	3.2	9.3	2	4	11
	%UCM			Total 2-6 ring PAH (ng/g)			%NPD			Total EPA 16 PAH (ng/g)		
	Min	**Mean**	Max	Min	**Mean**	Max	Min	**Mean**	Max	Min	**Mean**	Max
2004	50	66	74	47	153	280	52	57	63	9	30	67
2006	37	63	78	81	299	1206	38	49	62	15	88	650
2008	48	67	75	96	198	427	27	45	51	16	46	190
2010	63	73	77	74	132	340	41	45	49	10	20	42
2012	77	82	87	83	162	295	33	50	55	19	37	83
2014	83	87	89	84	139	185	49	55	61	18	30	55
2016	86	87	89	75	139	202	53	59	64	14	26	43

NC – Not Calculated

1.1.3 Heavy Metal Concentrations

As observed on previous surveys at CA, a moderate to strong positive inter-correlation was present between copper, chromium, iron, manganese and zinc. The distribution of these metals was similar to sediment silt and clay content, with higher concentrations of these metals present at stations where silt and clay content was highest. The distribution of all other metals were found to be independent, with patchy distributions being observed for cadmium, arsenic and mercury, the distributions of which were unrelated to operational activities at CA.

Previous surveys have identified a footprint of elevated barium concentrations around the platform which indicate the presence of discharged water based mud (WBM)/WBM drilled cuttings. Although the area of elevated concentrations remains present, the range, mean, and variability of total barium concentrations across the survey area are slightly lower in 2016 than those reported in 2010 to 2014 (refer to Table 6D/2). The most notable change in the concentration of barium between 2014 and 2016 are reductions at stations 15, 14 and 18, and an increase at station 17. The concentrations at the remaining stations have remained relatively unchanged between 2014 and 2016.

Table 6D/2 Statistical Summary of Sediment Heavy Metal Concentrations at the CA Platform Location (2004-2016)[1]

	As			Ba HNO_3			Ba Fusion		
	Min	Mean	Max	Min	Mean	Max	Min	Mean	Max
2004	6.4	10.8	19.2	2451	7445	20966	2870	11031	26600
2006	5.3	12.0	17.3	2725	10049	24050	2850	11484	29050
2008	6.8	9.9	21.2	2515	7348	18600	3145	10109	25100
2010	4.9	13.1	18.4	3454	7943	24141	4397	12015	40601
2012	7.6	10.2	16.6	2548	7078	12206	3034	13052	42080
2014	7.3	10.2	15.5	1294	6435	12673	1708	12573	42500
2016	6.9	9.7	16.5	2210	6613	10790	3843	10797	30505
	Cd			Cr			Cu		
	Min	Mean	Max	Min	Mean	Max	Min	Mean	Max
2004	0.120	0.175	0.220	26.5	35.3	43.3	11.2	19.4	27.2
2006	0.221	0.441	0.765	31.7	42.2	54.4	17.6	22.3	27.6
2008	0.201	0.388	0.705	39.7	49.0	64.0	18.2	23.6	28.6
2010	0.361	0.979	2.432	35.3	46.4	60.1	17.2	23.4	27.0
2012	0.150	0.197	0.236	34.3	41.7	56.5	18.9	23.3	28.8
2014	0.153	0.200	0.237	29.4	35.8	46.2	17.5	21.3	24.7
2016	0.129	0.167	0.197	26.1	41.3	63.1	12.0	16.9	21.9
	Fe			Hg			Mn		
	Min	Mean	Max	Min	Mean	Max	Min	Mean	Max
2004	16260	19681	24927	0.055	0.156	0.273	NM	NM	NM
2006	22100	26414	30600	0.016	0.035	0.063	332	387	512
2008	22700	27400	33100	0.023	0.033	0.052	373	416	493
2010	19761	24678	30369	0.027	0.056	0.121	353	411	518
2012	19683	23413	29475	0.021	0.027	0.044	359	419	560
2014	18302	21710	26886	0.022	0.031	0.041	315	384	477
2016	17599	20505	25200	0.007	0.010	0.013	285	374	540
	Pb			Zn					
	Min	Mean	Max	Min	Mean	Max			
2004	10.3	17.3	25.1	46.1	53.1	63.7			
2006	12.8	17.4	24.9	42.8	51.0	60.2			
2008	14.6	20.0	28.5	55.1	63.4	71.9			
2010	11.4	15.3	25.3	42.5	55.5	70.1			
2012	11.8	13.7	17.5	50.5	61.8	73.9			
2014	11.2	13.0	15.9	45.8	54.8	75.9			
2016	8.3	10.8	13.0	40.7	49.6	60.0			

1.2 Biological Characteristics of Seabed Sediments

A total of 63 macrobenthic taxa were identified in samples from the 15 stations sampled during the 2016 survey. Of these 63 taxa, 30 were amphipods (accounting for 81% of the total abundance), 15 were gastropod molluscs, while cumaceans and annelid worms were represented by 6 taxa each. There were four species of bivalve mollusc, and isopods and insects were represented by one species each. The 2016 macrobenthic community was abundant and species rich and was very similar to the communities present on previous years, particularly 2012 and 2014. As observed on previous years (refer to Table 6D/3), the community structure was generally related to sediment physical properties, with more abundant and species rich communities present in areas where sediments have a higher proportion of coarse grained particle size fractions.

[1] Based on station average sample values for stations common to the 2016 survey.

Table 6D/3 Summary of Major Taxonomic Groups Species Richness and Average Abundance – CA Platform (2004-2016)[1]

Taxonomic Group		2004	2006	2008	2010	2012	2014	2016
Polychaeta	No. of Species	6	6	7	7	6	4	3
	Abundance (n/m^2)	280	101	343	634	418	187	506
Oligochaeta	No. of Species	3	3	3	3	3	3	3
	Abundance (n/m^2)	454	185	302	1212	208	262	361
Cumacea	No. of Species	6	6	6	8	6	6	6
	Abundance (n/m^2)	86	73	48	82	137	88	53
Amphipoda	No. of Species	16	12	28	26	27	28	29
	Abundance (n/m^2)	1805	581	871	2197	1961	3964	4803
Isopoda	No. of Species	2	2	2	2	1	1	1
	Abundance (n/m^2)	15	14	3	11	3	3	4
Insecta	Abundance (n/m^2)	101	18	3	6	5	29	13
Gastropoda	No. of Species	14	4	7	10	15	13	15
	Abundance (n/m^2)	122	10	5	22	100	69	68
Bivalvia	No. of Species	3	2	2	6	3	3	4
	Abundance (n/m^2)	956	425	18	218	107	128	94

Analysis of the 2016 macrobenthic data identified a group of stations in the centre of the survey area surrounding the platform which are located within the elevated barium footprint. The communities at stations surrounding the platform (in an area of elevated barium footprint) was numerically dominated by amphipods, species rich and with a high overall abundance, however the community was slightly different to that present at the surrounding stations with a higher abundance of annelids and a number of species present in low numbers elsewhere, were absent. As this group of stations were located within the discharge footprint, it is possible that the community within this localised area may have been affected by disturbance from operational discharges, resulting in the slightly different community structure. It should be noted, however, that there was no notable difference between years at stations within and outside the elevated barium footprint.

Overall, the macrobenthic community is species rich, abundant and representative the wider area. Other than the slightly different community structure at stations surrounding the platform, there does not appear to be any negative impacts on the macrobenthic community from operational activities at CA.

2 EA Platform Location

Sediment sampling surveys have been conducted in the vicinity of the East Azeri (EA) platform location in 2002, 2006, 2008, 2010, 2012, 2014 and 2016. Surveys from 2006 onwards have used the EMP standardised methods and the 2002 survey used similar methods. A total of 15 stations were sampled in water depths ranging from 150 to 173m during the 2016 survey. The survey locations are shown in Figure 6.11 within Chapter 6 of the ACE ESIA.

2.1 Physical and Chemical Composition of Seabed Sediments

2.1.1 Physical Properties of Sediments

For the 2016 survey the mean particle diameter of sediments ranged from 9 to 390µm, with a mean value of 125µm. Sediments within the survey area were heterogeneous with a wide range of particle sizes present in most samples. There are two distinct main groups with regard to sediment physical composition within the survey area. Sediments at stations within the centre, eastern flank and northeast corner of the survey area were dominated by the finest silt and clay particle size fractions, while sediments at stations within the northwest corner and along the western flank were co-dominated by the silt and clay fractions and the coarsest particle size fractions. The physical characteristics at station 15, located on the centre of the southern flank, were unique within the survey area. The silt/clay content was the lowest recorded within the survey area and the sediment structure was dominated by mid-range sand fractions and large proportions of bivalve shell fragments.

The general spatial distribution within the survey area has remained fairly constant over recent surveys. Finer sediments with lower carbonate content are present at stations in the centre of the survey area to the southwest of the platform, and on the eastern and north-eastern flank of the survey area.

2.1.2 Hydrocarbon Concentrations

2016 THC concentrations were generally low throughout the survey area and were similar to the levels observed on previous surveys, ranging from 5 to 57µg/g, with a mean value of 29µg/g (refer to Table 6D/4). The highest average Total Petroleum Hydrocarbons (TPH) (which exclude hydrocarbon drilling fluid compounds) concentrations were present at contiguous stations 1 and 4 in the northern central part of the survey area. The concentration of TPH was generally higher at stations within the northern third and eastern half of the survey area and reduced in a northeast-southwest. The lowest concentration was recorded at station 11 in the southwest corner of the survey area. Hydrocarbon compounds present in sediments were generally low in concentration and similar in composition to weathered background material. TPH and PAH concentrations were similar to those recorded on previous surveys and were consistent with background levels recorded elsewhere within the Azeri–Chirag–Gunashli (ACG) Contract Area.

Low concentrations of hydrocarbon drilling fluid compounds have been detected in a number of samples on each survey from 2006 to 2016. As hydrocarbon based drilling fluids are not discharged as part of the drilling program at EA, the presence of these compounds is likely the result of a pre-2006 discharge, but may also include material related to the discharge of 20 barrels of cement contaminated with LTOBM, which occurred in 2015. Where present, the concentrations of hydrocarbon drilling fluid compounds in 2016 samples were low/very low ranging from <1µg/g in seven samples to 29µg/g in a single sample at station 5.

Other than the low concentrations of hydrocarbon based drilling fluids at stations to the northeast of the platform, there is no evidence to suggest that operations at EA are influencing the hydrocarbon composition of sediments within the survey area.

Table 6D/4 EA Platform Location Hydrocarbon Sampling Results (2006-2016)

	THC (µg/g)			TPH (µg/g) (THC Less Hydrocarbon Drill Fluid)			%UCM			Hydrocarbon Drill Fluids (µg/g)		
	Min	Mean	Max	Min	Mean	Max	Min	Mean	Max	Min	Mean	Max
2006	4	32	108	4	24	62	10	55	65	3	21	87
2008	3	14	27	3	12	26	33	65	74	2	8	15
2010	4	20	47	4	18	44	53	63	70	1	5	9
2012	2	16	39	2	15	28	62	73	79	1	4	11
2014	10	32	62	10	32	59	80	85	88	1	1	3
2016	5	29	77	5	25	46	75	80	84	1	5	18
	Total 2-6 ring PAH (ng/g)			%NPD			Total EPA 16 PAH (ng/g)					
	Min	Mean	Max	Min	Mean	Max	Min	Mean	Max			
2006	28	128	295	44	49	59	5	27	66			
2008	33	72	122	38	42	49	6	14	28			
2010	18	72	171	38	45	52	2	14	36			
2012	29	79	121	45	56	70	6	20	37			
2014	34	82	139	54	58	65	7	21	35			
2016	19	79	143	54	61	71	3	15	23			

THC – Total Hydrocarbon

2.1.3 Heavy Metal Concentrations

As observed on previous surveys at the EA platform, a moderate to strong positive inter-correlation was present between copper, chromium, iron, manganese and zinc in 2016. The distributions of these metals were correlated to sediment silt and clay content. The distribution of cadmium, arsenic and mercury were found to be independent and unrelated to operational activities at the EA platform.

Previous surveys have identified a footprint of elevated barium concentrations to the northeast and southeast of the platform which indicate the presence of discharged WBM/WBM drilled cuttings. Although the area of elevated concentrations remains present, the range, mean, and variability of total barium concentrations within this area are slightly lower in 2016 than those reported in 2010 to 2014. The most notable changes in the concentration of barium between 2014 and 2016 are the reductions at stations 5, 13 and 14, where the highest concentrations were recorded in 2014 and increases recorded at stations 4 and 15. The increase at these positions will likely be the result of the redistribution of previously contaminated surface sediments by currents at or near the seabed.

Table 6D/5 Statistical Summary of Sediment Heavy Metal Concentrations at the EA Platform Location (2006-2016)[1]

	As			Ba HNO_3			Ba Fusion		
	Min	Mean	Max	Min	Mean	Max	Min	Mean	Max
2006	5.0	10.4	24.9	571	5960	15400	718	7449	16685
2008	4.3	7.5	12.0	920	3624	11450	1040	4290	14130
2010	9.9	12.5	18.8	1756	3438	6700	2481	4773	9846
2012	6.5	9.2	14.1	1619	4217	8117	1857	5977	19664
2014	5.7	9.2	16.2	1675	3962	8257	1903	6557	22817
2016	4.9	7.1	15.0	649	3352	8069	1283	4993	11780
	Cd			Cr			Cu		
	Min	Mean	Max	Min	Mean	Max	Min	Mean	Max
2006	0.14	0.35	0.73	25.7	43.2	55.1	17.5	32.0	38.0
2008	0.19	0.31	0.53	41.4	50.1	59.1	23.4	29.9	39.2
2010	0.29	0.59	1.17	30.4	40.7	55.0	18.7	25.4	32.2
2012	0.17	0.20	0.22	34.7	47.1	55.7	21.4	27.6	33.1
2014	0.15	0.18	0.21	31.4	45.2	55.4	21.2	28.5	40.7
2016	0.13	0.16	0.21	12.9	36.5	52.5	6.4	18.8	24.3
	Fe			Hg			Mn		
	Min	Mean	Max	Min	Mean	Max	Min	Mean	Max
2006	14370	21345	30200	0.01	0.02	0.03	360	470.4	616
2008	18400	23632	29150	0.022	0.03	0.047	361	461	554
2010	15287	18825	27544	0.017	0.026	0.034	317	382	512
2012	19186	23202	28775	0.020	0.025	0.030	372	468	553
2014	18662	23232	28888	<0.02	NC	0.030	368	460	524
2016	11109	17090	26528	<0.007	NC	0.008	223	359	531
	Pb			Zn					
	Min	Mean	Max	Min	Mean	Max			
2006	8.4	12.2	15.3	31.3	46.8	54.3			
2008	8.2	11.0	13.7	48.6	56.3	67.0			
2010	9.1	11.8	21.3	38.9	49.7	61.8			
2012	11.4	13.0	15.2	48.3	59.9	66.3			
2014	10.1	12.0	14.1	45.4	61.5	75.4			
2016	8.5	10.8	12.4	22.0	41.7	58.3			

NC – Not Calculated

2.2 Biological Characteristics of Seabed Sediments

A total of 46 macrobenthic taxa were identified in samples from the 15 stations sampled during the 2016 survey. Of these 46 taxa, 26 were amphipods (accounting for 77% of the total abundance), 7 were gastropod molluscs, 6 were annelid worms while cumaceans were represented by 4 taxa. Bivalve mollusc, isopods and insects were represented by one species each. Abundance and species richness were highest at stations along the western and southern edges of the survey area, while the lowest abundance and taxonomic richness was observed at stations within the north-eastern quadrant of the survey area. The distributions of the main taxonomic groups displayed this general spatial pattern. The only exception was cumacea, which was more abundant at stations to the north of the survey area.

When compared to previous EA survey data (refer to Table 6D/6), the 2016 community was found to be very similar in composition and distribution to the communities present in 2012 and 2014. On average, the abundance of amphipods, cumacea and annelids have increased from the numbers present in 2012 and 2014. The increase in amphipod abundance was observed at all stations in 2016, including the stations within the drilling discharge footprints. While the changes in abundance of the other taxonomic groups was more variable, increases in abundance were recorded at stations within the discharge footprint including stations 4 and 15 where barium concentrations increased from 2014 levels, and stations 1 and 4 where the highest hydrocarbon concentrations were recorded in 2016. As observed on previous surveys, the community structure was related to sediment physical properties, with more abundant and species rich communities present in areas where sediments have a higher proportion of coarse grained particle size fractions.

Table 6D/6 Summary of Major Taxonomic Groups Species Richness and Average Abundance – EA Platform (2006-2016)[1]

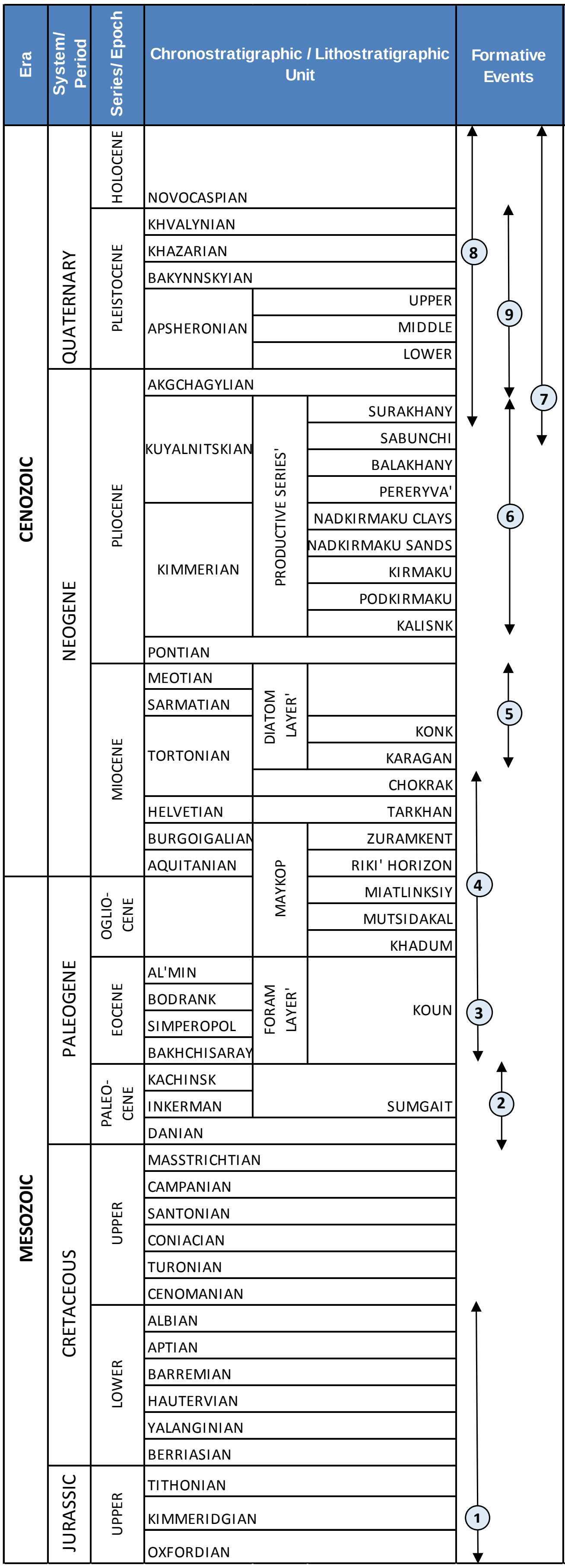
Taxonomic Group		2006	2008	2010	2012	2014	2016
Polychaeta	No. of Species	2	7	7	4	4	3
	Abundance (n/m^2)	119	26	208	83	24	105
Oligochaeta	No. of Species	3	3	3	3	3	3
	Abundance (n/m^2)	308	140	401	119	99	131
Cumacea	No. of Species	5	4	4	4	5	4
	Abundance (n/m^2)	100	10	84	65	132	153
Amphipoda	No. of Species	13	18	17	21	21	26
	Abundance (n/m^2)	309	157	416	378	767	1307
Isopoda	No. of Species	11	3	6	4	4	4
	Abundance (n/m^2)	10	9	14	7	8	11
Insecta	Abundance (n/m^2)	20	1	0	0	3	2
Gastropoda	No. of Species	5	6	8	11	9	7
	Abundance (n/m^2)	6	3	6	12	9	6
Bivalvia	No. of Species	2	3	3	1	1	1
	Abundance (n/m^2)	29	1	1	0	0	0

In summary, the macrobenthic community varied in abundance and taxonomic richness over the survey area in the 2016 survey. There was no evidence to suggest that operations at EA have negatively affected the benthic macrofauna within the survey area.

APPENDIX 6E

Supplementary Geology and Seismicity Data

Figure 6E.1 Summary Stratigraphic Column for the South Caspian Basin (Ref.1)



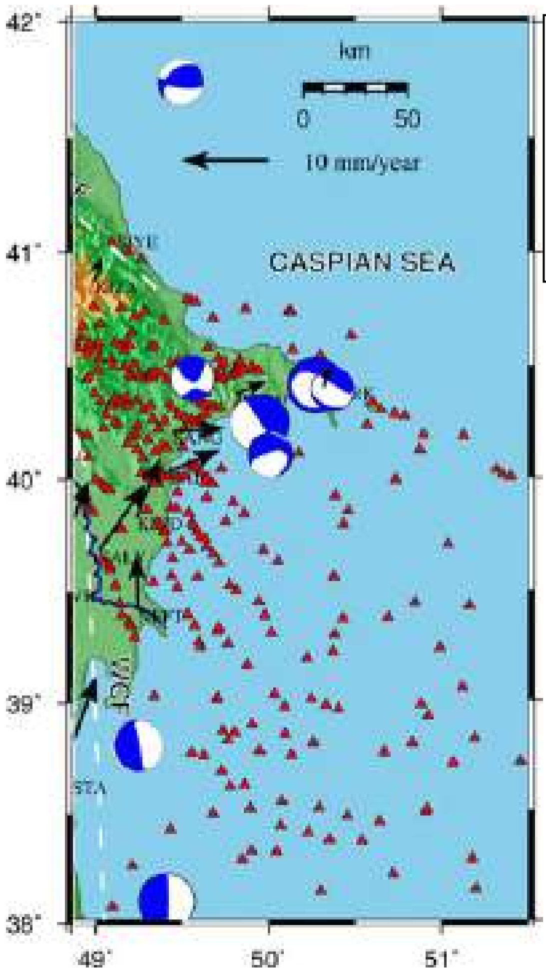
Formative Events (based on the summary provided in Ref. 2)

1. Extension led to inland rifting to the north of the Tethys Ocean and initiated the formation of the Paratethys Sea (combination of the black Sea and Caspian Sea basins, among others);
2. Maximum extent of the Paratethys is reached. The resulting sea occupies an area 900km wide and 3,000km long;
3. Convergence between the Arabian and Eurasian plates resulted in uplift in the Caucasus region and Elburz region. this resulted in the break-up of the Paratethys Sea into the increasingly isolated basins of the Black Sea and Caspian Sea;
4. Further uplift in the Caucasus region caused the Black Sea and Caspian Sea to become isolated from each other. This ultimately resulted in anaerobic conditions that led to the deposition of the organic-rich Maykop sequence;
5. The diatom suite was deposited during a period of connection between the Caspian Sea and the Mediterranean. This was the last connection between the two seas. By early Pliocene time the Caspian was completely isolated from marine water (including the Black Sea);
6. The palaeodelta of the Volga River deposited a thick sequence of fluvial and deltaic sediments across the western end of the Apsheron-Pribalkhan Zone. By the Quaternary period, tectonic influences and rise in sea level within the Caspian had led to the northward retreat of the Volga delta;
7. Mud volcanism in the South Caspian basin started during the Sabunchi-Surakhany time, spreading from south to north across the basin and occurring in increasing frequency throughout the Quaternary (Ref. 3);
8. Convergence between the Arabian and Eurasian plates continues to the present day. This has resulted in the synchronous growth of numerous anticlinal folds across the South Caspian basin while Pleistocene sediments were deposited. Regionally an unconformity marks the base if the Pleistocene sediments along the Apsheron-Pribalkhan ridge. Within the Azeri Area, sediment accumulation was out-paced by the growth of the anticlinal fold during the Apsheronian; this resulted in relatively low sediment accumulation above the fold-crest and the formation of further unconformities in the Apsheron formation in the Azeri Area. Post-Apsheronian sediment accumulation has out-paced the growth of the fold within the Azeri Area;
9. Sediment input from the Volga Delta reduced as tectonic influences and rising water level in the Caspian Sea, as a result of increased fresh water input, caused it to retreat northward.

Table 6E.1 Summary of Main Soil Units Present in the Top 150m of Soils Below the Seabed Surface within the Azeri Area (Ref. 4)

Soil Unit	Description
Soil Unit A	Soil Unit A is characterised by largely homogenous hemipelagic clay in the upper part, which overlies rhythmic deposits of hemipelagic clay with closely spaced organic laminae and partings of silt and strong soil fabric. The soils are locally interbedded by landslide deposits and subdivided into five conformable subunits (A1, A2, A3, A4 and A5). A very thin bed of tephra (fragments of rock that are ejected from a volcano) is present around the same depth of the A500 horizon at geohazard locations. The tephra is described as fine to medium sand where the sand comprises angular fragments of vesicular volcanic glass; locally pockets of the sand are weakly cemented by marcasite (a form of iron sulphide).
Soil Unit 1	Low plasticity calcareous clay with inclusions of laminations of organic clay, and pockets and laminations of silt and fine sand.
Soil Unit 2	High plasticity clay with laminations of organic clay (and locally with laminations of silt).
Soil Unit 3	A thin unit very similar to that of Soil Unit 2, with high plasticity between that off Soil Units 2 and 4, with laminations of organic clay (and locally with laminations of silt).
Soil Unit 4	Sediments are identified as clay with alternations in the plasticity index. This unit has high plasticity and liquid limit.
Soil Unit 5	Sediments are identified as clay with alternations in the plasticity index. This unit has lower plasticity and liquid limit compared to that of Soil Units 4, 6 and 8.
Soil Unit 6	Sediments are identified as clay with alternations in the plasticity index. This unit has high plasticity and liquid limit.
Soil Unit 7	Sediments are identified as clay with alternations in the plasticity index. This unit has lower plasticity and liquid limit compared to that of Soil Units 4, 6 and 8.
Soil Unit 8	Sediments are identified as clay with alternations in the plasticity index. This unit has high plasticity and liquid limit.
Apsheron	Described as claystone or siltstone with interlaminations of fine sand and/or silt.

Figure 6E.2 Overview of the Tectonics and Mud Volcano Locations of Azerbaijan (Ref. 5)



Key

Mud Volcano

Global Positioning System (GPS) Velocities Relative to Eurasia from Reilinger et al. (2006) (Ref. 6).

Focal Mechanisms of Earthquakes with Magnitudes Larger than 5

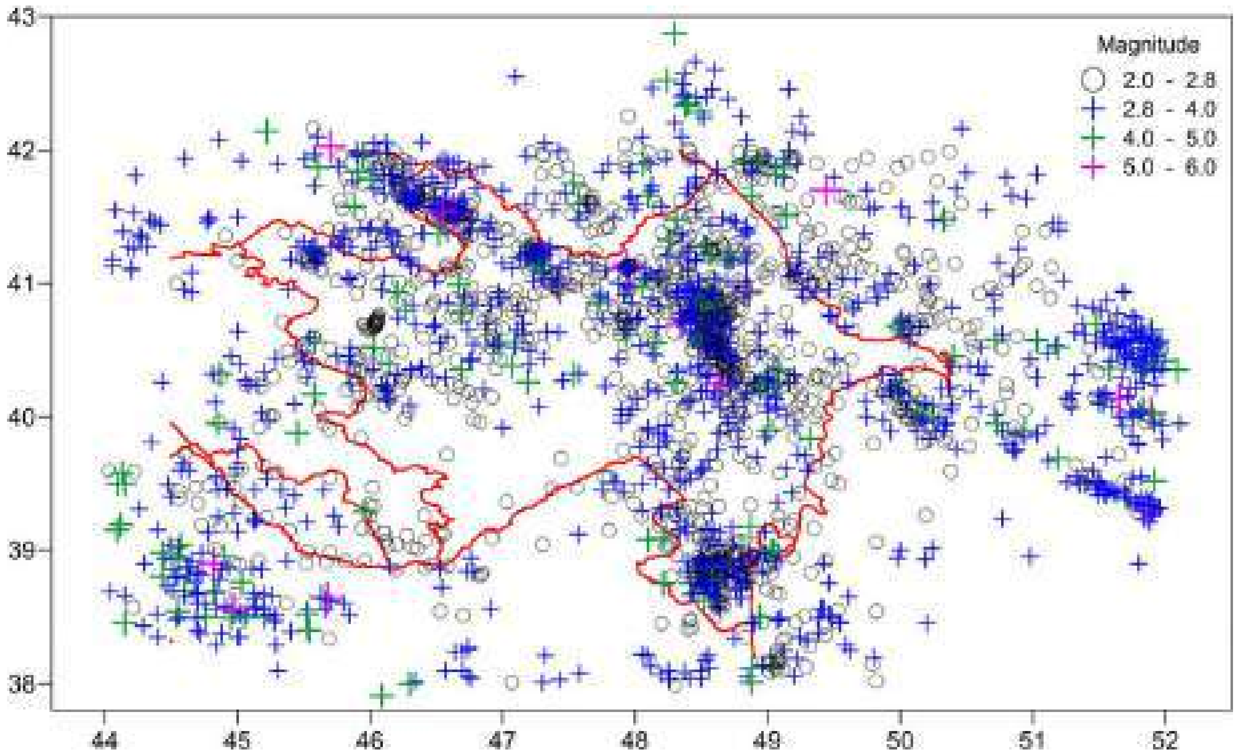
WCF West Caspian Fault

Note: Figure derived from Telesca et al. (2016) (Ref. 5).

Table 6E.2 Summary of Earthquakes With Magnitude >5 Recorded in Azerbaijan (2000-2018) (Ref. 7)

Date	Location		Location	Depth (km)	Magnitude
	Latitude	Longitude			
2018-06-05	41.5263	46.7857	Onshore Azerbaijan	22.65	5.3
2018-08-28	38.8209	48.8124	Onshore Azerbaijan	10	5.0
2017-11-15	40.30.82	47.3317	Onshore Azerbaijan	22.13	5.2
2017-05-11	39.8156	48.5695	Onshore Azerbaijan	62.93	5.1
2016-08-01	39.9542	47.976	Onshore Azerbaijan	16	5.0
2015-09-04	40.9329	47.5328	Onshore Azerbaijan	13.96	5.4
2015-01-26	41.2918	48.8748	Onshore Azerbaijan	50.12	5.0
2014-06-29	41.6028	46.6653	Onshore Azerbaijan	33.59	5.0
2014-06-07	40.3731	51.5739	Onshore Azerbaijan	30.51	5.5
2014-02-10	40.288	48.8033	Onshore Azerbaijan	65.66	5.4
2012-10-04	41.825	46.405	Onshore Azerbaijan	10	5.5
2012-10-07	40.747	48.437	Onshore Azerbaijan	17.4	5.4
2012-05-18	41.439	46.789	Onshore Azerbaijan	18.1	5.1
2012-05-07	41.553	46.719	Onshore Azerbaijan	11.9	5.3
2012-05-07	41.549	46.789	Onshore Azerbaijan	11	5.6
2007-07-11	38.751	48.598	Onshore Azerbaijan	25.6	5.2
2002-02-11	40.102	50.211	Caspian Sea, Offshore Azerbaijan	54.2	5.0
2001-01-07	40.171	50.143	Caspian Sea, Offshore Azerbaijan	33	5.2
2000-11-29	39.856	50.209	Caspian Sea, Offshore Azerbaijan	33	5.0
2000-11-25	40.167	49.954	Caspian Sea, Offshore Azerbaijan	33	6.5
2000-11-25	40.245	49.946	Caspian Sea, Offshore Azerbaijan	50.4	6.8
2000-03-21	39.949	48.23	Onshore Azerbaijan	59.7	5.2

Figure 6E.3 Spatial distribution of Seismicity in Azerbaijan and Surrounding Regions from 2003 to 2016 (Ref. 5)



Notes:
1. The sizes of the crosses are proportional to the magnitude of the events.
2. Figure Source: Telesca et al. (2016) (Ref. 5).

References

Ref. No.	Title
1	BP Upstream Engineering Centre, 2016. *ACG Future Development Integrated Ground Model and Geohazard Reference Report*.
2	Smith-Rouch, L.S., 2006. *Oligocene–Miocene Maykop/Diatom Total Petroleum System of the South Caspian Basin Province, Azerbaijan, Iran and Turkmenistan*. U.S. Geological Survey Bulletin. 2201(I), p.26.
3	Yusifov, M. and Rabinnowitz, P.D., 2004. *Classification of Mud Volcanoes in the South Caspian Basin, Offshore Azerbaijan.* Marine and Petroleum Geology. 21, pp.965-975.
4	Fugro Geoconsulting Limited, 2015. *Azeri Area Soil Model and Soil Parameters Report.*
5	Telesca, L., Kadirov, F., Yetirmishli, G., Safarov, R., Babayev, G. & Ismaylova, S. (2016). *Statistical Analysis of the 2003–2016 Seismicity of Azerbaijan and Surrounding Areas*. J Seismol (2017) 21:1467–1485 DOI 10.1007/s10950-017-9677-x
6	Reilinger R., McClusky S., Vernant P., Lawrence S., Ergintav S., Cakmak R., Ozener H., Kadirov F., Guliev I., Stepanyan R., Nadariya M., Hahubia G., Mahmoud S., Sakr K., ArRajehi A., Paradissis D., Al-Aydrus A., Prilepin M., Guseva T., Evren E., Dmitrotsa A., Filikov S.V., Gomez F., Al-Ghazzi R., Karam, G., 2006. *GPS constraints on continental deformation in the Africa–Arabia–Eurasia continental collision zone and implications for the dynamics of plate interactions.* Geophys Res, Volume 111, Issue B5. doi:10.1029/2005JB004051
7	United States Geological Survey. Earthquake Catalog. Online. Available at: https://earthquake.usgs.gov/earthquakes/search/ [Accessed 4 January 2019]

APPENDIX 8A

Scoping Consultation Presentations and Meeting Minutes

BP – ACE Project

Subject: ESIA SCOPING MEETING WITH MENR

Date: 19/02/18	**Time: 10:00**	**Location: BP XAZAR CENTER, floor 6 MR 30**

Attendees			
BP		**MENR**	
Kelly Goddard	GPO E&S Manager		
Maria Scarlett	GPO Azerbaijan, E&S Lead	Khatira Abbasova	Senior expert of Expertise department, MENR
Saadat Gaffarova	BP AGTR Regulatory Compliance and Environment team, Regulations and permitting adviser	Following people provided their comments to Khatira A. and did not participate due to another urgent subject requested to follow up by MENR management	
Nargiz Mustafayeva	BP Regulatory Compliance and Environment team, Compliance, Advocacy and Permitting Team Lead	Zohrab Rahimov	Head of Offshore Environmental monitoring sector
Nargiz Garajayeva	BP Regulatory Compliance and Environment Team, Environmental Monitoring Adviser	Mehman Akhundov	Head of Fishery Institute
Guivami Rahimli	BP Communications and External Affairs, Community Relations Adviser		
Robert Waterston	ACE ESIA Lead (AECOM)		
Mark Broadbent (by Phone)	BP Engineering ACG Projects	BP provided translator	Kamran Akhmedov
Mehriban Gahramanova	BP Regulatory Compliance and Environment team, Wells and Offshore Operations Environmental Team Lead		
Presentation pack used during the meeting is available			

No.	Discussion
1.	**Opening and objective of Meeting** After safety briefing parties represented introduced themselves and included the BP Global Projects Team, BP Regulatory Compliance and Environment team, BP Communications and External Affairs representative, ACE ESIA project representative (AECOM) and representative from the MENR. MENR representative informed that two more reps were nominated to participate in the meeting, fishery and offshore monitoring specialists, but they were called by MENR management for another urgent business issue and apologized for given inconvenience. However, Khatira A. gathered their comments to share the meeting. The aim of the meeting was presented to the Ministry of Ecology and Natural Resources (MENR) as: • Provide an overview of the proposed ACE Project. • Set out the proposed scope of the proposed ACE Project Environmental and Social Impact Assessment (ESIA). MB outlined the context, objectives and location of the proposed ACE Project (refer to embedded presentation for detail). - Access to the reservoir at other points. - Bring the schedule forward for delivery. - Provides both gas and water injection into the reservoir. - ACE designed to produce up to 100 mbd oil and 350 MMscfd gas. ACE similar to in principle to other platforms such as COP, however the design has been optimised. Key points noted: • Water will not be separated from the oil at the platform. The comingled oil and produced water will be exported back through a 30 inch pipeline to Sangchal terminal via a tie-in to the existing 30 inch oil / water export pipeline between CA and EA platforms. • Clarification asked from KA from MENR on produced water from ACE platform. MB clarified that usually BP 3-phase separation (oil, gas and water), but ACE will have 2-phase separation (gas from liquids), so no offshore produced water will be directly reinjected, liquid (comingled oil and water) will go to Sangachal where it will be treated and sent offshore for reinjection. • Export line for gas back to Central Azeri, so in the event that the ACE gas injection system is down or there is spare gas, the gas can be sent to CA for reinjection from CA or exported to Sangachal terminal, which reduces the need for flaring ACE. • MB clarified that ACE will be supplied with injection water in from a tie-in to the existing CA-EA water injection line near EA, which provides seawater processed from central Azeri. Backup power supply will be provided via a cable from East Azeri. • Brownfield modifications on East Azeri (to facilitate a power supply and telecommunications cable connection to ACE) and Central Azeri (to increase gas handling capacity to receive gas from ACE) are necessary. • Schematic shown of ACE Project layout. Clarification given by MB on MENR query – dotted blue line represents the new water injection (not produced water) line between EA and ACE. The dotted red line is for gas and dotted green line is the oil / produced water line, shown exporting to a tie-in with the existing 30inch oil export pipeline connecting CA and EA (solid blue line). MB stated that the route of the ACE oil / produced water line may move closer to Central Azeri, but it will connect to existing infrastructure. • Confirmed again that comingled oil and water from ACE is separated at Sangachal terminal. • KA – dotted blue line query. MB clarified – The dotted blue line is treated seawater processed on Central Azeri and piped through existing pipeline from CA to EA. The injection water from CA is sent to ACE via the dotted green line

	from a connection near EA to ACE. • Schedule – BP Project stages and sanction gates at the top the schedule. MB discussed key project activities: • Onshore construction and commissioning of the jacket and topside. • Platform, jacket and subsea infrastructure installation. • Subsea tie-ins at central and east Azeri pipelines. • Brownfield work and tie-ins at EA and CA platforms. • Pre-drilling in 2020. • Operations. • No modifications required for Sangachal terminal.
2	**ESIA approach** RW outlined the key ESIA stages illustrated in the ESIA flowchart shown in the presentation slides. Currently at scoping stage which is undertaken to identify the likely key environmental and socio-economic issues and type of assessments to be completed and reported in the ESIA. Scoping process also focuses on identifying any gaps within baseline and project data and the actions necessary to address the gaps. Draft ESIA document will be submitted to MENR and disclosed to the public. After the disclosure period, project will update the ESIA with any feedback received from MENR and the public before final submission to MENR for approval.
3	**Key Environmental Sensitivities** **Water Column** • The results for the 2017 ACE Environmental Baseline Survey (EBS) were not presented on the slides as the draft survey report has just been issued, however, RW presented comments during the presentation on the key results. • Recent ACG Contract Area regional plankton surveys (2014) show plankton communities have remained similar to previous results and dominated by Diatom species. • 4 water column samples taken at ACE as part of the EBS. Results show similar composition of species to previous ACG Contract Area region survey results. • Notable observations from the ACE EBS are the higher no. of dinoflagellate species recorded at ACE, and lower no. of zooplankton species recorded. Likely a lower no. recorded due to less samples and a smaller sample area compared to the regional surveys. • Recent ACG regional survey water column sampling found metal and hydrocarbon concentrations to be low and there was no evidence of recent contamination found in the area. • Water quality at ACE sample locations are similar to the wider ACG contract area and the concentrations of all metals are within the maximum allowable concentrations for Azerbaijan fisheries waters. **Sediment – benthic communities and physical characteristics** • RW referred to the slide showing the sediment sample locations for the CA and EA platform surveys undertaken in 2016 and the ACE EBS conducted in 2017. • Since 2008 the benthic communities at the CA and EA platforms survey locations have been very consistent each year. • Results for recent ACE survey show no populations or species of importance identified. The benthic communities at ACE in 2017 and CA in 2016 exhibit a high degree of similarity. • Overall the physical and chemical composition of sediments within the ACE survey area were comparable to the results observed at the adjacent CA and EA survey areas and were typical of the regional background. **Fish** • Approximately 150 species of fish are estimated to be found in the Caspian, 54 of which are endemic to the Caspian.

	• Fish tend to concentrate in shallow water areas in depths ranging from 50-75m. Proposed ACE platform is located at a greater water depth of 137m. • Professor Ahkundov from the Azerbaijan National Academy of Sciences (ANAS) has been appointed to provide updated baseline information on fish, particularly in relation to spawning, and migration routes and the likely presence of fish species in the ACG Contract Area and specifically in the vicinity of the ACE platform. MENR comment presented by KA. KA suggested examining the possibility of undertaking baseline surveys and monitoring of fish species in the ACG Contract Area. • NG responded in that the monitoring can be done, however due to the transient nature of fish populations it would require significant survey effort throughout the year over several years for meaningful baseline data to be obtained. • Professor Ahkundov asked KA to raise that there are endemic species known to be resident at greater water depths, such as the depth at which the ACE platform is proposed to be located, which generally are not found in shallower waters. **Caspian Seals** RW outlined current context of the Caspian seal population, its IUCN Endangered status and some of the main causes considered responsible for this decline, which has led to the current estimate of less than 100,000 Caspian seals. • RW advised that Professor Tariel Eybatov (ANAS) has been appointed to update a baseline study prepared for previous SD2 and SWAP ESIAs. Updated data will be gathered on estimated population numbers, migration routes, likely presence in the ACG Contract Area and the results of recent tracking and academic studies. **Protected Areas** • A number of important bird and biodiversity areas IBAs) are present along the coast (not within the ACG Contract Area). The closet protected area to the proposed ACE platform location is the Absheron National Park located approximately 90km away. • RW provided an overview of a slide showing the key indicative bird migration routes. They key routes are mostly parallel to the coastline but there is also a route that heads southeast through the ACG Contract Area, however the route actually goes along the southern edge of the ACG Contract Area to the south of existing facilities. • During normal ACE construction and operation activities, there is unlikely to an impact on birds, however birds present along the coastline may be impacted in the unlikely event of an oil spill (e.g. well blowout). • AECOM have appointed Dr Ilyas Babayev (ANAS) who will provide baseline information on bird activity in the ACG Contract Area and coastal areas. Updated data will be provided on likely bird species present and their seasonality, migration routes, latest population estimates and key sensitive bird areas. **Onshore Sensitivities** Air quality data available from BP at Sangachal and potential construction sites that may be used for the Project. In general, air quality outside of Baku and urban areas along the coast is generally considered good. The construction yards to be used for jackets and topsides construction are yet to be determined. Likely that the same yards as previously used by BP for earlier projects (e.g. BDJF, ATA) will be utilised, however this is subject to final confirmation. **Commercial Shipping** A collision risk assessment for the proposed ACE platform location was undertaken in

	2017. The risk assessment used a combination of global satellite and local Automatic Identification System (AIS) data to track the movements of vessels relevant to the ACE platform location. The AIS tracking data shows the highest density of shipping is to the south of the proposed ACE platform location. **Commercial Fishing** It is understood that there are currently 5 vessels licenced for the commercial fishing of Kilka in the Azerbaijani sector of the Caspian Sea. 4 are based in Lenkoran port (in the south of Azerbaijan) and are unlikely to fish as far north as the ACG Contract Area. The remaining vessel owned by the Caspian Fish Company is based and departs from Pirallahi Island. As part of the ACE collision risk assessment a specific fishing vessel movements review was undertaken over a 12 week period (May – August 2017) which showed that no fishing vessels passed within 10 nautical miles (~16km). RW stated that as part of the baseline fish study, Professor Akhundov will also gather latest available data in terms of the number of licensed fishing vessels, fishing methods, catch statistics, fishing locations and the economic value of fishing in the region to local economy. **Employment and Livelihoods** • O&G key sector for employment. Followed by agriculture, including fisheries. • Do not anticipate impacts to coastal fishery communities from ACE Project activities due to the offshore location. No queries or comments on sensitivities were raised during the meeting. **Impact Assessment Methodology** RW provided an overview of the ESIA impact assessment methodology to be used. It was explained that the same assessment methodology used on other recent ESIAs submitted by BP to the MENR (e.g. SD2, SWAP seismic surveys) will be used. No queries or comments were raised during the meeting.
4	**Key Potential Impacts** RW provided an overview of the key potential impacts and activities to be assessed in the ESIA, including: • Contamination of the marine environment from discharges. • Generation of underwater sound (vessel movement, driving of infrastructure into the seabed). • Seabed disturbance (RW stated that subsea project footprint in minor compared to the SD2 Project (infield pipelines only 4-5km in length so no major impacts expected). • Deterioration in air quality (impacts are likely to be minor due to the distance of the platform from onshore receptors). • Potential benefits from the project include employment opportunities and economic flows. • Cumulative (ACE activities and other activities within ACG area) and transboundary impacts will be included (e.g. greenhouse gas emissions). In terms of potential contamination of the marine environment from Project related discharges (listed on the slide) RW stated that it was important to note there are no new discharge events that have not previously been identified and assessed in other recent ESIAs for offshore facilities (e.g. COP and SD2).
5	**Proposed Supporting Studies for Impact** RW provided an overview of some of the modelling studies which will be undertaken to inform the impact assessments presented in the ESIA, including:

	• Air quality modelling of emissions for power generation and flaring. • Drilling discharge modelling will be undertaken to predict the plume and deposition of water based mud and cuttings from the top hole sections onto the seabed. • Underwater sound modelling. • Cooling water system discharges. • Pipeline pre-commissioning test (e.g. hydrotest) discharges. • Hydrocarbon spill modelling (e.g. a subsea blow out of crude oil during drilling or a loss of diesel inventory from the platform. Potential realistic scenarios to be identified by BP. The potential impacts of a spill will be presented in the ESIA and a technical spill modelling report will be included as an appendix to the ESIA. No questions/comments on modelling studies.
6	• **Proposed Content of ESIA** • RW provided an overview of the proposed ESIA Table of Contents. • No questions/comments. • **Schedule for ESIA** • The current schedule plans for the submission of the Draft ESIA to MENR in August, 2018. • Disclosure meetings with MENR and relevant stakeholders are planned for September, 2018. • BP anticipates MENR providing comments on the Draft ESIA and conditional approval in November, 2018. The ESIA will be updated to address MENR and stakeholder comments received with submission of the Final ESIA and MENR approval of the ESIA anticipated in January, 2019. KG stated that in in order to facilitate yard activity to enable the start of the pre-drill wells drilling template, pin piles and associated activities prior to the approval of the ESIA it is currently planned that permission for these activities (due to commence 1Q 2019) will be sought via a separate ETN to be submitted to the MENR in Q3 2018. • KA stated that she did not foresee any issues with MENR working to the ESIA schedule proposed by BP. • KA extended gratitude to BP for scoping meeting. Additional clarification points below: • Talking about ACE platform construction, installation and operation, KA sought to confirm that drilling activities are also included. • *BP confirmed yes.* • KA asked how many wells to be drilled. RW clarified 40 wells are planned to be drilled. The platform will have a 48 slot well bay, however not all of these can be utilised. *MB clarified about no. and type of wells confirmed it is the current basis of design for start of the project. 40 drilling activities confirmed by MB as the reference case.* • KA asked about any further additional work at Sangachal Terminal. *MB confirmed no further physical modifications are necessary as a result of the ACE Project, only some telecommunication modifications to recognise ACE operations*. • KA clarified if the brownfield modifications on CA and EA and will require any additional tanks or fluids / discharges. • *MB said on East Azeri – power upgrades to bring the cable from East to ACE platform. And on Central – 2 scopes – modify internals of the slug catcher to increase (debottleneck) the gas handling capacity. Upgrades to existing produced water system on Central Azeri which has yet to be commissioned. CA*

	has a produced water and sand system, as part of ACG life of field that system will be installed and upgraded to a 3-phase separation system. It is expected that the 3-phase separation on CA will commence operations in 2025. • KA asked if brownfield modifications covered by ESIA. *KG said all brownfield covered by ESIA except for produced water treatment upgrades on CA (ACG life of field) which will be covered by a separate ETN and it will be referenced in the ESIA.* • KA asked if ACE have sewage treatment system on platform. *BP confirmed yes it will have a sewage treatment system.* • KA queried what type of treatment package. *MB said the detailed design will be confirmed in the future but the package will be based on the COP sewage treatment package and work completed and lessons learned from COP and SD2 will be utilised to optimise the design of the system.* • KA queried ESIA will also cover information about drilling fluids and cuttings managed as per requirements. *BP confirmed yes.* • KA asked about cumulative impacts on installation of multiple pipelines, drilling on ACE, drilling on other platforms and other activities*. RW said AECOM will undertake a screening exercise to identify ACE project activities that have the potential to result in cumulative impacts. Cumulative impacts from drill cuttings generated by ACE and other platforms in the ACG contract area are likely to be screened out as the impact of the cuttings is generally quite localised and would not travel as far as the drill cuttings footprint generated by other nearby platforms. RW said AECOM are currently defining the scope of the modelling studies, including the potential requirement for modelling to be undertaken to determine cumulative impacts (e.g. for air quality).* • It was confirmed that the proposed ACE platform is located approximately 3.5km from the EA platform and approximately 4.5km from the CA platform. • KA asked if the modelling studies will be shown in ESIA. *RW confirmed yes, modelling results will be summarised in ESIA and the technical modelling reports will be included in the Appendix.* • KA assumed this project is more interesting than the other project and expects more interesting cumulative studies. • KA queried current status of the ACE Geotechnical surveys and asked that the results could be presented in the ACE ESIA. MS confirmed various activities (seal observation training, review of spill equipment and waste and garbage management plan) and March mobilisation of survey. • *RW confirmed a summary of the ground conditions based on the results of the geotechnical survey can be presented in the ESIA if the results are available in time and any seal observations made during the surveys will be included in the ESIA.*

BP – ACE Project

Subject: ESIA SCOPING MEETING WITH MTAG committee

Date: 20/02/18	Time: 1000	Location: BP XAZAR

Attendees			
BP		MTAG committee	
Kelly Goddard	GPO E&S Manager	Famil Valieyev	Oil & Gas scientific and project institute (SOCAR) (NGETLI)
Maria Scarlett	GPO Azerbaijan, E&S Lead	Aflatun Hasanov	Deputy Director of Ecology department - SOCAR
Saadat Gaffarova	BP AGTR Regulatory Compliance and Environment Team, Regulations and permitting adviser	Zohrab Rahimov	Head of Offshore Environmental monitoring sector
Nargiz Mustafayeva	BP Regulatory Compliance and Environment team, Compliance, Advocacy and Permitting Team Lead	Ayaz Salmanov	Deputy Head of Major Environmental Projects Management Department, SOCAR
Nargiz Garajayeva	BP Regulatory Compliance and Environment team, Environmental Monitoring Adviser	Rufat Mammedov	Institute of Analytics - ANAS
Guivami Rahimli	BP Communications and External Affairs, Community Relations Adviser	Gular Fattayeva	Oil & Gas scientific and project institute (SOCAR) (NGETLI)
Robert Waterston	ACE ESIA Lead (AECOM)	Rauf Qazdagov	ANAS
Mark Broadbent (by Phone)	BP Engineering ACG Projects		
Mehriban Gahramanova	BP Regulatory Compliance and Environment team, Wells and Offshore Operations Environmental Team Lead		
BP provided translator	Kamran Akhmedov		

No.	Discussion
1.	**Objective of Meeting** NG opened the meeting with a safety briefing and parties represented introduced themselves. KG outlined purpose of scoping meeting and encouraged representatives to provide feedback and ask questions to inform the scoping process and assist in the preparation of a comprehensive Project Environmental and Social Impact Assessment (ESIA). Parties represented included the BP Global Projects Team, BP Regional compliance team, BP Communications and External Affairs representative, Azeri Central East (ACE) ESIA project representative (AECOM), representatives from SOCAR and the Azerbaijan National Academy of Sciences (ANAS). KG provided an overview of the Azeri-Chirag-Gunashli (ACG) Production Sharing Agreement (PSA) and the extension signed in 2017 as well as an overview of the phased development of the ACG Contract Area and introduced the proposed ACE Project as the next phase of development. The aim of the meeting was presented to the Monitoring, Technical and Advisory Group (MTAG) committee as: • Provide a technical overview of the proposed ACE Project. • Set out the proposed scope of the proposed ACE Project ESIA. KG outlined the context, objectives and location of the proposed ACE Project (refer to embedded presentation for detail) which include: • Providing a new drilling centre between EA and CA. • Allows major and minor reservoir targets to be accelerated • Easy access to the reservoir at other points. • Provides both gas and water injection into the reservoir. • The ACE platform is designed to produce up to 100 mbd oil and 350 MMscfd gas. Question raised by MTAG SOCAR representative FA about the unit stated for daily oil production. In English the unit is MBD (thousand barrels per day). MB confirmed that the ACE design capacity is 100 MBD or 100 thousand barrels of oil per day. It was noted that the translation was incorrect and RW took note to ensure that future translated ESIA has clear translation of units. MB explained that the ACE Project design is similar in principle to other ACG platforms such as West Chirag (Chirag Oil Project (COP)). The design of ACE platform has been optimised by incorporating lessons learned from other recent project such as COP and SD2. MB provided an overview of some of the key design features of the ACE Project: • Platform will have a 48 well slot bay. • 2 phase separation will take place on platform (gas is separated from liquids, dehydrated and is used for power generation, gas lift and injection and can be exported to CA. Liquids (comingled oil and water) exported to Sangachal Terminal via a tie-in to existing 30in EA-CA oil export line. • No produced water treatment system on ACE. Produced water (comingled with oil) is sent to Sanagchal Terminal for treatment and sent back offshore for re-injection into ACG reservoir. • Option to export gas to CA in the event of excess gas production on ACE or in the event of trips or shutdown. Ability to export gas to CA reduces potential flaring activity. • Power generation on ACE is provided by a single gas turbine generator with back-up power provided by a power cable from the EA platform • ACE living quarters and sewage treatment package is design to accommodate

No.	Discussion
	up to 202 persons on board (POB) although the platform will typically have around 164 POB. Brownfield modifications will be undertaken on EA (to facilitate a power supply and telecommunications cable connection to ACE) and CA (to increase gas handling capacity to receive gas from ACE). Schematic of ACE Project layout was presented in the meeting. MB clarified: • Solid lines are existing pipelines and dotted lines show proposed ACE pipelines. • Dotted blue line represents the proposed imported injection water (seawater processed on CA) line (not produced water) between EA and ACE. • The dotted red line represents the proposed gas export line from ACE to CA. • The dotted green line is the proposed oil / produced water line which ties-in with the existing 30inch oil export pipeline connecting CA and EA (solid blue line). MB stated that the route of the ACE oil / produced water pipeline is currently being optimized and the route may move closer to CA, but it will connect to existing infrastructure. • Comingled oil and water from ACE taken back to Sangachal terminal via the existing 30inch oil export line. MTAG representative asked for clarification on the capacity of the amount of water that will be present in the exported liquids. MB confirmed that the design capacity assumes 100,000 barrels of oil and 60,000 barrels of water per day. MTAG representative queried as to whether the water fraction in the exported liquids is too much for the first phase of production. MB explained that the oil to water ratio is very similar to the design capacities on the other ACG platforms. AS asked for clarification on what components are exported in the oil / produced water pipeline KG clarified that gas is separated from the liquids (oil and produced water) on the platform. This liquid (comingled oil and produced water) is then sent to Sangachal Terminal where oil and water are separated out. MTAG representatives additionally clarified they call this comingled oil and produced water the 'liquid phase' which is what they call the oil and water after gas is separated out. MB discussed key project activities: • Construction of the facility and commissioning of the offshore platform. ZR made a comment that they wish for the new ACE platform to be more environmentally friendly than the existing platforms. KG asked for clarification on what was meant by environmentally friendly. ZR responded that he hoped that the ACE platform will have a better sewage treatment system than other Azeri facilities. KG stated BP have used lessons learned from existing operational sewage treatment packages (e.g. COP and SD2) and will apply this knowledge to the design (and ultimately operation) of the ACE sewage treatment package. MB continued: • Platform, jacket and subsea infrastructure installation. • Subsea tie-ins at central and east Azeri pipelines. • Brownfield work at EA and CA platforms. • Operational drilling and pre-drill activity using MODU ahead of installation. • No modifications required for Sangachal terminal or onshore facilities for ACE. MTAG representative asked for confirmation that there will be a sewage treatment plant on the ACE platform. KG confirmed there will be a sewage treatment package on ACE. However, produced water is not treated on ACE.

No.	Discussion
2	**ESIA approach** RW outlined the key ESIA stages for the ACE Project and explained that the approach is similar to that used for the ESIAs prepared for the COP and SD2 projects. The process was illustrated in the ESIA flowchart shown in the presentation slides. RW explained that an environmental and screening exercise was undertaken during the concept phase of the project. The ACE project is currently at the ESIA scoping stage which is undertaken to identify the likely key environmental and socio-economic issues and the level and type of assessments to be completed for the ESIA. The other key activity during the scoping process is to identify any gaps within the baseline and project data necessary to undertake the ESIA and the actions necessary to address the gaps. RW stated the Draft ESIA document will be submitted to MENR and disclosed to the public. After the disclosure period, AECOM will update the ESIA with any feedback received from the MENR, public and any other stakeholders before final submission to MENR for approval.
3	**Key Environmental Sensitivities** RW stated that the slides on environmental sensitivities are mostly focussed on the offshore environment due to the location of the Project and the limited onshore activities. RW stated the water column and sediment survey data presented in the slides is taken from the 2014 ACG Regional Water Colum Survey and 2016 CA and EA sediment surveys. An Environmental Baseline Survey (EBS) was carried out at the proposed ACE platform location in 2017 however the draft survey report has only just been issued and is not presented in the slides. NG said the ACE EBS Interpretive Report will be submitted to MTAG in a month's time and a meeting will be set up with the MTAG committee to review the results. **Water Column** • Recent ACG Contract Area regional plankton surveys show phytoplankton communities have remained broadly similar to previous results since 2004. AH asked if it was believed there really had been no change over the years. RW commented there have been fluctuations year to year but the general results and trends have remained similar. ZR stated he would not say the baseline has not changed. RW clarified that the English version of the presentation states 'remains broadly similar', however it was established that the Azerbaijani versions says 'remains the same' ('<u>exactly</u>' the same). All noted that this was just a translation issue and RW took a note to review the translation. • RW stated that four water column samples were taken at the proposed ACE platform location as part of the EBS. Results show similar composition of phytoplankton species to previous ACG Contract Area regional survey results. • Notable observations from the ACE EBS are the higher number of dinoflagellate (phytoplankton) species recorded at ACE, and lower number of zooplankton species recorded. Likely a lower number recorded due to less samples and a smaller sample area compared to the regional surveys. • Water quality at the ACE sample locations are similar to the wider ACG contract area and the concentrations of all metals are within the maximum allowable concentrations for Azerbaijan fisheries waters. • MTAG representative asked if the 2014 [ACG regional water column] and 2016 [CA and EA platform sediment] survey results presented in the slides will be used as the baseline data in the ESIA as we are now into 2018. RW clarified that the ESIA will use the ACE 2017 EBS results to form the baseline. However, RW stated that the previous ACG regional surveys and the CA and EA survey results provide useful data to ascertain current conditions in the

No.	Discussion
	wider area and allow baseline conditions at the proposed ACE platform location to be compared. **Sediment – benthic communities and physical characteristics** • RW referred to the slide showing the sediment sample locations for the CA and EA platform surveys undertaken in 2016 and the ACE EBS conducted in 2017. • RW stated that ACE EBS survey results showed the macrofaunal communities at ACE in 2017 and CA in 2016 had a high degree (~80%) of similarity. • ACE EBS identified no populations or species of importance and the macrofaunal community structure was related to the sediment physical properties, with more abundant and species rich communities present in locations where sediments has a higher proportion of coarse grained particle size fractions as observed on previous surveys within the ACG Contract Area. • Sediments within the area surveyed are heterogeneous with a wide range of particle sizes present in most samples. • Overall the physical and chemical composition of sediments within the ACE survey area were comparable to the results observed at the adjacent CA and EA survey areas and were typical of the regional background. • Sediments within the ACE EBS survey area are largely heterogeneous with a wide range of particle size present in most samples taken. **Fish** • Approximately 150 species of fish are estimated to be found in the Caspian, 54 of which are endemic to the Caspian sea. • It is understood that fish tend to concentrate in water depths ranging from 50-75m however some fish species are resident and pass through deeper waters. Proposed ACE platform is located at a water depth of 137m. • In order to ensure that the ESIA is using the most updated baseline information Professor Akhundov from the Azerbaijan National Academy of Sciences (ANAS) has been appointed to provide updated baseline information on fish particularly in relation to spawning, and migration routes and the likely presence of fish species in the ACG Contract Area and specifically in the vicinity of the ACE platform. **Caspian Seals** RW outlined current context of the Caspian seal population, its IUCN Endangered status and some of the main causes considered responsible for this decline, which has led to the current estimate of less than 100,000 Caspian seals. AH asked where this figure of less than 100,000 seals had come from. He mentioned that SOCAR have approximately 50 individuals monitoring regularly for seals and they have not observed a single seal in the past year. RW discussed that the Caspian seals generally migrate south for feeding in the spring time from the breeding and pupping grounds in the northern Caspian to the feeding grounds in the central and southern Caspian. RW explained that current scientific opinion is that seals are showing signs of adaptation to anthropogenic disturbances and the latest research has shown that it is not possible to assume that seals will always follow the previously defined migratory paths. This has been demonstrated by using satellite tracking of seal movements. • RW advised that Professor Tariel Eybatov (ANAS) has been appointed to update a Caspian seal baseline study. Updated data will be gathered on estimated population numbers, migration routes, likely presence in the ACG Contract Area and the results of recent tracking and academic studies.

No.	Discussion
	AH asked how Professor Eybatov intends to provide updated baseline information. RW clarified that Professor Eybatov originally prepared a Caspian seal study for the COP ESIA which was subsequently updated for the SD2 Project ESIA. This baseline information will be updated with recent information and research for the ACE ESIA. AH commented that Professor Eybatov is not the only expert but there are other scientists who have been dealing with the Caspian seals. He suggested that Professor Eybatov should potentially involve other scientists during the preparation of the updated report. RW clarified who they would like to see involved. AH said he is interested to know how Professor Eybatov has estimated the population of Caspian seals and what devices and technology was used. KG and RW clarified that Professor Eybatov is not conducting his own study but is effectively carrying out a literature review of all the existing scientific data and survey results available coupled with Caspian seal observation data provided from BP from observations made from their facilities and operations. RW also stated that the earlier version of the Caspian Seal report prepared by Professor Eybatov for the SD2 Project ESIA was peer reviewed by Dr Simon Goodman from the Faculty of Biological Sciences at the University of Leeds in the UK who is an expert on Caspian seals. AH commented that if Professor Eybatov's report was only based on a literature review and didn't use practical work how could his estimates be correct. RW added that the literature review included review of academic studies into population estimates and migration routes using satellite tracking and identification technology. NG added that Professor Eybatov also conducted Caspian seal monitoring around the islands of Absheron Peninsula during implementation of BP SWAP seismic survey in autumn 2016. KG also added that the Seal report considers studies undertaken in other Caspian Sea countries such as Kazakhstan and Turkmenistan, etc. to inform his report. AH stated that SOCAR have not had any recent recorded sighting of seals off their platforms and want to know what devices BP use to observe seals. BP clarified methodology will be provided as part of the process. **Action:** BP to provide methodology for Caspian seal baseline observations. During SWAP seismic surveys, one of MENR permit condition was to make visual observation of seals and submit report to MENR. SG stated that in the daily reports received from the teams, there are records of seals observed offshore. RQ stated that drones are a useful method for undertaking visual observations and can be used for other types of monitoring (e.g. monitoring suspended particles in the water). KG stated that although the use of a drone is a great idea in principle, their use has been examined before and there are many levels of approvals due to security concerns which limits the opportunity to use them. MS queried if they have existing monitoring programmes using drones. He replied only at draft level. A proposal for shoreline monitoring has been submitted to the Board of ANAS for funding approval and it is expected that this will be approved within 3 months. RQ stated that ANAS have drone factory for the production of pilot drones. He stated that an ambient monitoring programme using drones commenced in May, 2017. The drones are used to monitor the Absheron shoreline and islands where there are mud volcanoes. The drones fly at an altitude of 4km and are equipped with high resolution cameras. The cameras can operate within a radius of 40km and can spot items of 3cm and can resist wind up to 18m /sec.

No.	Discussion
	RW asked what they are monitoring. RQ clarified that they are monitoring for mud volcano activity and tectonic faults, and seismic tension. **Protected Areas** A number of important bird and biodiversity areas (IBAs) are present along the coast (not within the ACG Contract Area). Not expecting any impact on protected areas from the ACE Project. AECOM have appointed Dr Ilyas Babeyev (ANAS) who will provide updated baseline information on bird activity in the ACG Contract Area and coastal areas. Updated information will be provided on likely bird species present and their seasonality, migration routes, latest population estimates and key sensitive bird areas. The closet protected area to the proposed ACE platform location is the Absheron National Park located approximately 90km away. RW provided an overview of a slide showing the key indicative bird migration routes. **Onshore Sensitivities** As project is located offshore, there will be minimal impacts to onshore receptors. Likely that the same yards as previously used by BP for earlier projects (e.g. BDJF, ATA) for jackets and topsides construction will be utilised, however this is subject to final confirmation. **Commercial Shipping** A collision risk assessment for the proposed ACE platform location was undertaken in 2017. The risk assessment used a combination of global satellite and local Automatic Identification System (AIS) data to track the movements of vessels relevant to the ACE platform location. The AIS tracking data shows the highest density of shipping is to the south of the proposed ACE platform location. **Commercial Fishing** It is understood that there are currently 5 vessels licenced for the commercial fishing of Kilka in the Azerbaijani sector of the Caspian Sea. 4 are based in Lenkoran port (in the south of Azerbaijan) and are unlikely to fish as far north as the ACG Contract Area. The remaining vessel owned by the Caspian Fish Company is based and departs from Pirallahi Island. As part of the ACE collision risk assessment a specific fishing vessel movements review was undertaken over a 12 week period (May – August 2017) which showed that no fishing vessels passed within 10 nautical miles (~16km) of the proposed platform. RW stated that as part of the baseline fish study, Professor Akhundov will also gather latest available data in terms of commercial fishing activity, including the number of licensed fishing vessels, fishing methods, catch statistics, fishing locations and the economic value of fishing in the region to local economy. **Impact Assessment Methodology** RW provided an overview of the ESIA impact assessment methodology to be used. It was explained that the same assessment methodology used on other recent ESIAs submitted by BP to the MENR (e.g. SD2, SWAP seismic surveys) will be used. No queries or comments were raised during the meeting.
4	**Key Potential Impacts** RW provided an overview of the key potential impacts and activities to be assessed in the ESIA, including for example:

No.	Discussion
	• Contamination of the marine environment from discharges. • Impacts to seals and fish from the generation of underwater sound. • Seabed disturbance from drilling activities and the installation of the jacket and subsea infrastructure. • Deterioration in air quality from atmospheric emissions associated with power generation and flaring. • There will also be an assessment of cumulative (ACE activities in combination and other activities within ACG area) and transboundary impacts will be included. No queries or comments were raised during the meeting.
5	**Proposed Supporting Studies for Impact** RW provided an overview of some of the modelling studies which will be undertaken to inform the impact assessments which will be presented in the ESIA, including: • Air quality modelling of emissions for power generation and flaring. • Drilling discharge modelling will be undertaken to predict the re plume and deposition of water based mud and cuttings from the tophole sections onto the seabed • Underwater sound modelling. • Cooling water system discharges. • Pipeline pre-commissioning test (e.g. hydrotest) discharges. • Hydrocarbon spill modelling (e.g. a subsea blow out of crude oil during drilling or a and loss of diesel inventory from the platform) The results of the modelling results will be summarised in the ESIA and the technical reports will be included as an appendix to the ESIA. No questions/comments on modelling studies.
6	**Schedule for ESIA** The current schedule plans for the submission of the Draft ESIA to MENR in August, 2018. Disclosure meetings with MENR and relevant stakeholders are planned for September, 2018. BP anticipates MENR providing comments on the Draft ESIA and conditional approval in November, 2018. The ESIA will be updated to address comments received with submission of the Final ESIA and MENR approval of the ESIA anticipated in January, 2019. Questions raised by MTAG representative AH: 1. Question: How produced sand and clay generated by drilling activities will be handled as this was not included in the presentation. MB confirmed there will be sand generated during drilling and the ACE platform design incorporates sand separation and treatment equipment. MB clarified that produced sand will be contained on the platform and shipped to shore for disposal. 2. Question: 60,000 barrels of water per day will be sent to Sangachal terminal for treatment. Does the terminal have the capacity to handle this volume or will the terminal require modifications? MB confirmed there is no need for new infrastructure or upgrades at the terminal as there is sufficient capacity for treatment and transfer of the produced water offshore for re-injection. Comment by MTAG representative GF:

No.	Discussion
	3. We heard the comments of no upgrades, but taking into account how much water will be generated, hence the questions above. Questions and comments raised by MTAG representative RM from ANAS: *4.* We don't have many questions at this stage, but the recommendation will be on the ESIA document itself and content and structure of the document. It is important to have the baseline information in the ESIA to be able to compare monitoring results in the future with the baseline. I have a question because I have not seen the part dedicated to the geology of the ACE location as this information was not presented in the slides. Will the ESIA include data on tectonic and mud volcano activity? This area has been studied many times and was reported in the early ACG development ESIAs including the Early Oil Project (EOP) ESIA which I was involved in. We can argue saying this data has not changed much and this data can be used for this ESIA. In principle I agree with this, however there are some parameters that need to be confirmed annually and updated annually. One of the parameters is the changing seismic data and volcanic activity. The ACG Contract Area has 5 or 6 subsea mud volcanoes and I believe that updated data is available on this. Recently as an expert I had a situation with another company who had prepared an ESIA I reviewed who had used 2010 data on mud volcanoes that had been sourced from a website rather than scientific or engineering study. Maps of seismicity of the earth are updated annually and it is quite easy to find this information. SG queried where to find the information. I suggest that a geological specialist is consulted to provide information. One of the specialists in this field from ANAS can be engaged (he can provide a name). In December 2017, a book dedicated to the mud volcanoes of the world was published in Italy. It was prepared by experts from ANAS and includes information on Azerbaijan mud volcanoes. It is a good source of information for the ESIA which should include a section on geology and seismic matters. RM also asked if the ESIA will include data on sea currents. BP confirmed that we would first look at the publicly available data and then decide the need for potential next steps. *RW confirmed that metocean data (e.g. waves, currents, etc.) will be described in the ESIA.* 5. Question as to whether any seismic survey or imaging around this platform will be undertaken either for the ESIA or in the future. *MB confirmed he was not aware of any seismic work but a Geohazard Survey Report was prepared for ACE in 2017.* ***Action:*** *MB to provide report to AECOM*. 6. AH stated that geohazards/seismic events result in changes every year and as a result data on this should be recorded every year. 7. AH stated that he has been involved in drafting 23 ESIAs. 8. He asked about BP's plans for any 2D and 3D imaging in the future. ANAS have a committee in charge of geological imaging that can undertake this work. *BP confirmed no plans.* 9. Advised that the book on mud volcanoes of the world is available in three languages and consists of three volumes of seismic/geology information. Advised that this book costs $450 and it is quite difficult to obtain a copy. However, they are happy to assist with providing a copy for purchase if desired. Meeting was then closed as no further questions or comments.

Azeri Central East (ACE) Project ESIA
MENR Scoping Meeting

19 February 2018

Background and Purpose

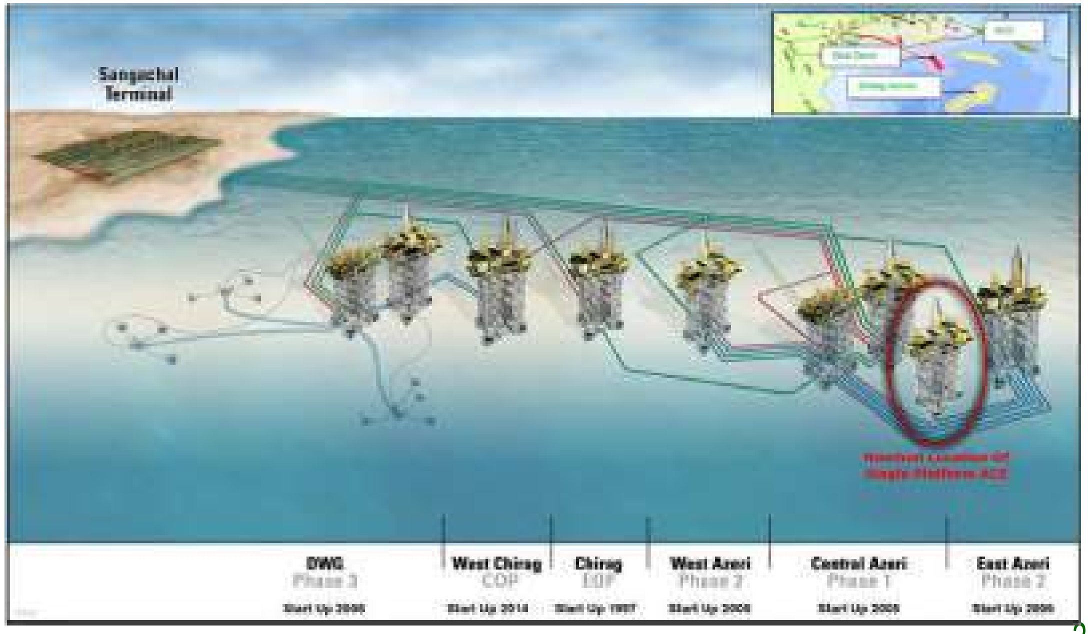
- September 1994 – The Azeri-Chirag-Gunashli (ACG) Production Sharing Agreement (PSA) was signed between the State Oil Company of the Azerbaijan Republic (SOCAR) and a consortium of Foreign Oil Companies.
- The PSA passed into the Azerbaijan law in December 1994 and grants the consortium the rights to develop and manage hydrocarbon reserves within the "Contract Area" of the ACG Field over a period of 30 years.
- An amended and restated PSA effective until the end of 2049 was signed on 14 September 2017.
- The ACG Contract Area is being developed in phases. The potential next phase of development comprises the Azeri Central East (ACE) Project.
- The purpose of this presentation is to:
    - Provide an overview of the proposed ACE Project
    - Set out the proposed scope of the ACE Project Environmental and Social Impact Assessment (ESIA)

ACE Project Objectives

Existing Challenge: Significant distance between the existing Central Azeri platform and the East Azeri platform leaves multiple targets (producers and water injectors) in a large area accessible only via extended reach drilling.

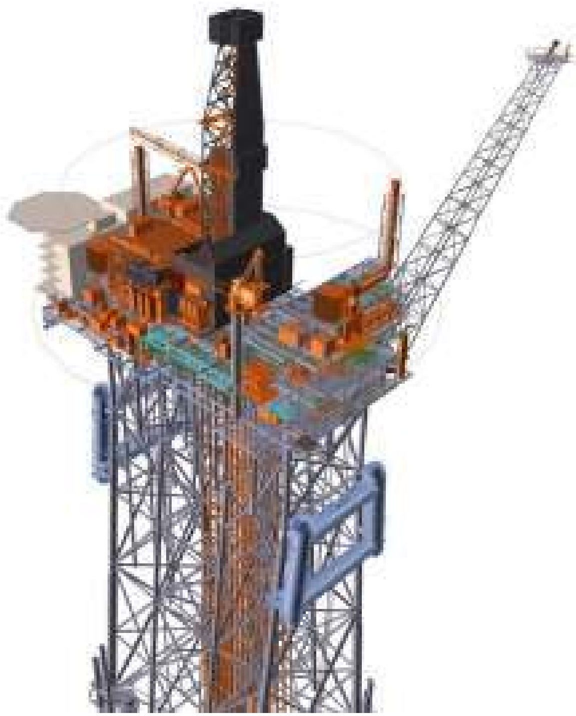
Objectives of ACE Project

- Provide a new drilling centre between EA and CA - simplifies ACG New Wells Delivery and makes drilling operations simpler and more efficient.
- Allows major and minor reservoir targets to be accelerated.
- Slot constraints on the existing platforms in the ACG field reduced significantly as a result of the additional slots provided by ACE.
- As many of the extended reach drilling targets are water injectors on the south flank of the field; the ACE Facility is an important component to developing an efficient water injection scheme by making these wells easier to reach.
- ACE will also enable gas injection to east flank of the Contract Area (the EA crest)
- ACE designed to produce up to 100 mbd oil and 350 MMscfd gas



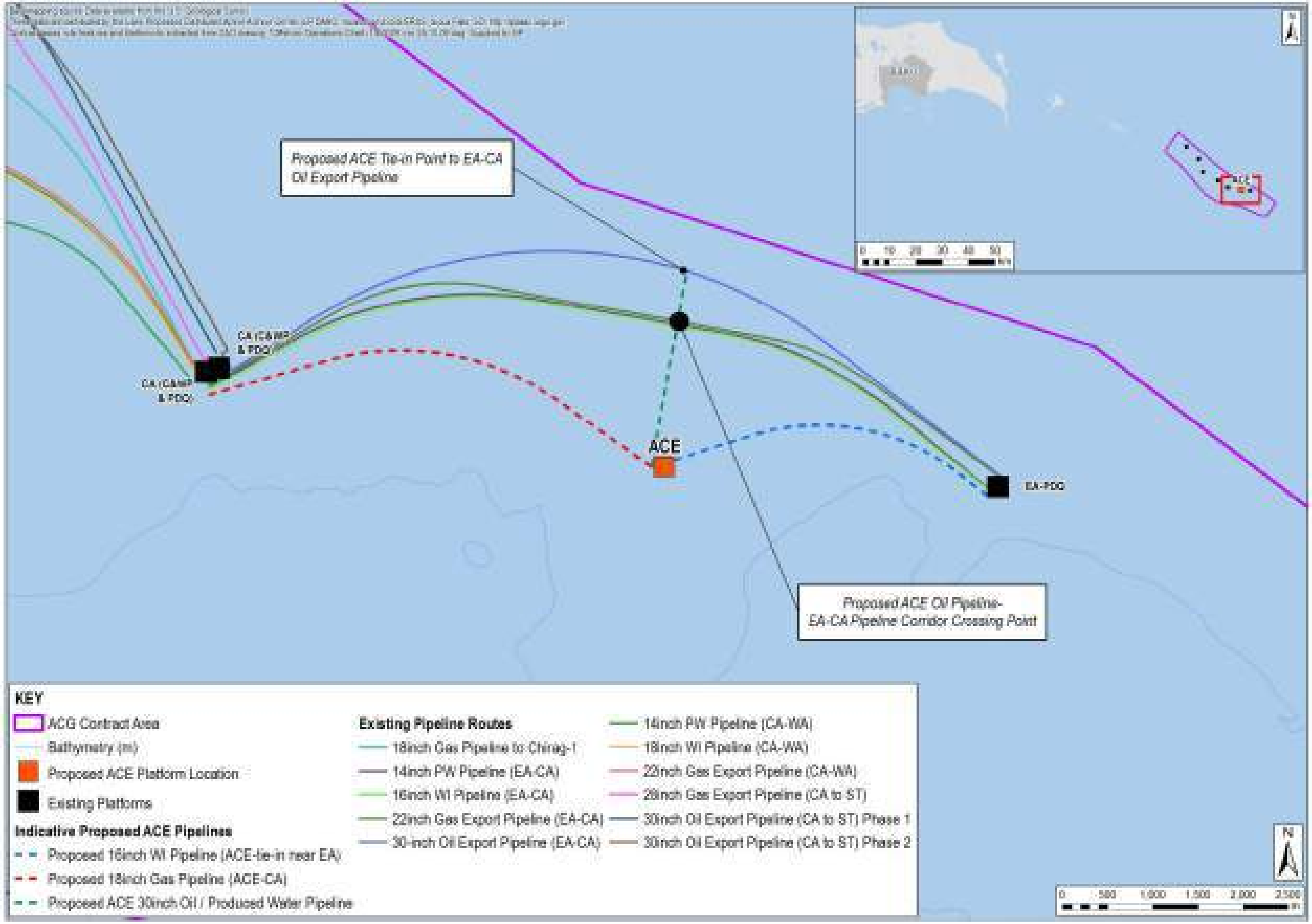
ACE Project Overview

Proposed ACE Production, Drilling and Quarters (PDQ) Platform

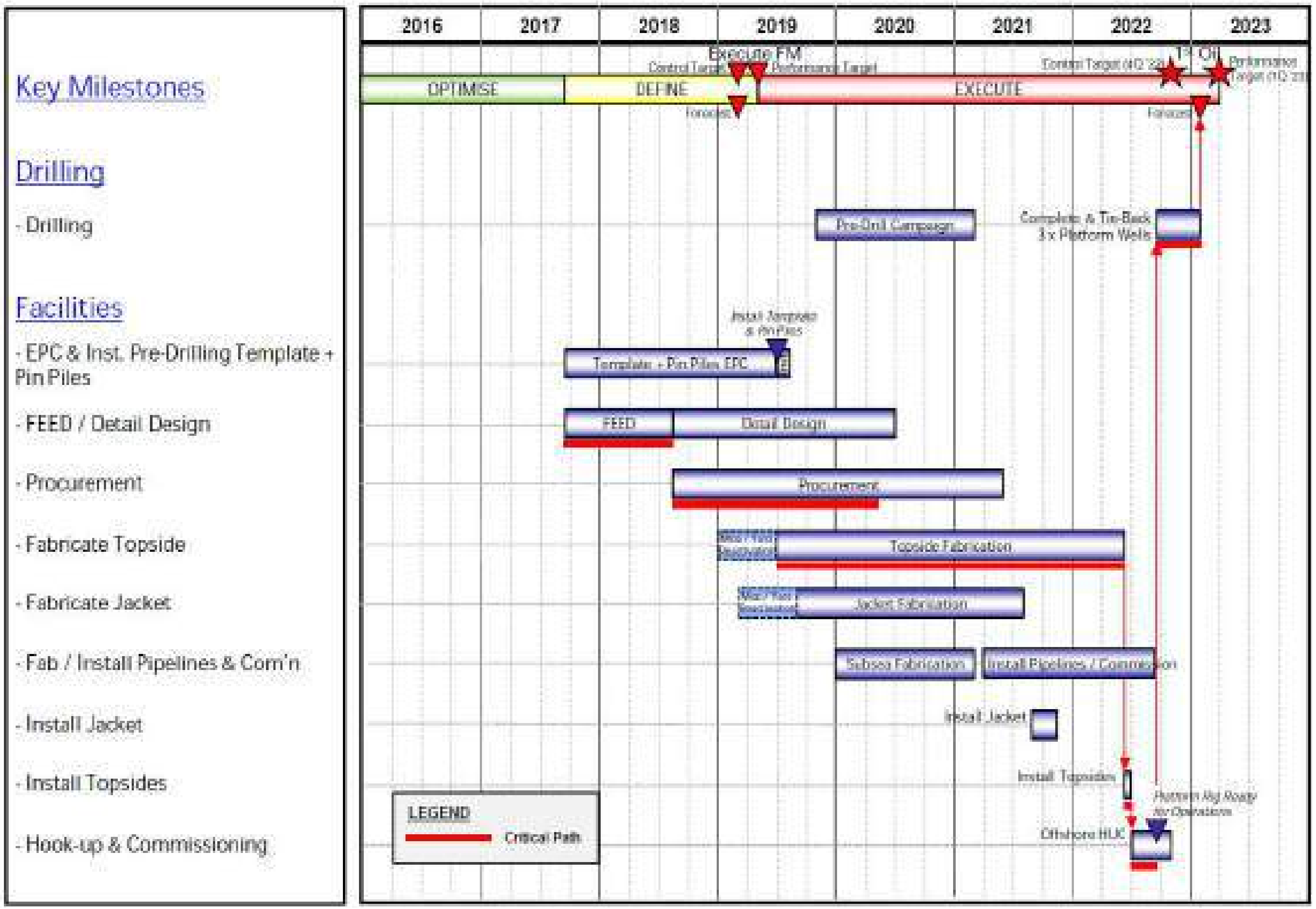


- Single platform equipped with 48 slot well bay. Current base case: 26 production wells; 5 water injection (WI) wells; 7 gas injection wells and 2 CRI wells. There is an option for a number of wells to be predrilled using MODU.
- Designed for 2 phase separation:
  - Oil comingled with produced water sent to Sangachal Terminal via tie-in to existing 30” subsea oil pipeline (new subsea wye spool connection)
  - Gas dehydrated and compressed to provide lift gas for injection to EA crest
  - Gas not required for EA crest gas injection exported to Central Azeri Compressor and Water Injection Platform (CA-CWP) via new 18” infield subsea gas pipeline for gas reinjection or export to Sangachal Terminal
- Injection water provided to ACE via new 16” WI pipeline from a tie-in near EA platform
- 1x100% Gas Turbine Generator (GTG) to meet ACE power demand. Back-up power imported via a combined telecommunications and power cable (CTPC) from EA
- Living quarters and sewage treatment package sized to accommodate up to 202 POB (normal 164 POB)
- Brownfield modifications on CA-CWP to handle the increased gas flowrates associated with ACE and on EA-PDQ associated with CTPC tie-ins
- Produced water will be treated at Sangachal Terminal and sent back offshore for reinjection

ACE Project Layout



ACE Project Schedule



Project Activities

The main ACE Project phases include:

- Onshore construction and commissioning of offshore and subsea facilities (at existing construction yards)
- Platform installation , hook up and commissioning (HUC)
- Installation, tie-in and HUC of ACE infield subsea pipelines and associated subsea infrastructure
- Brownfield works on the EA and CA platforms
- Offshore drilling which might include MODU pre-drilling activities
- Offshore operations and production

The project does not involve any modifications at Sangachal Terminal – there is sufficient capacity within the existing onshore ACG facilities to accommodate ACE

ESIA Approach

Screening and Scoping
Type/level of assessment to be conducted
Initial appraisal of likely key issues
Targeted stakeholder engagement

Project Alternatives
Analysis of viable alternatives to base case design

Base Case Design
Gather and review design information

Existing Conditions
Baseline environmental and socio-economic conditions

Environmental and Socio-Economic Interactions
Determine project activities – receptor interactions

Transboundary and Cumulative Impacts
Assessment of transboundary and cumulative Impacts

Impact Assessment
Determine activity event magnitudes
Determine receptor sensitivities
Identify existing controls and base case mitigation
Determine impact significance

Residual Impacts
Undertake residual impact assessment and determine any additional mitigation measures required

Disclosure and Consultation
Communicate draft findings and recommendations to stakeholders for comment
Finalise ESIA and submit for approval to authorities

Monitoring and Mitigation
Development of management plans and procedures as part of AGT HSSE Management System

Key Environmental Sensitivities – Water Column

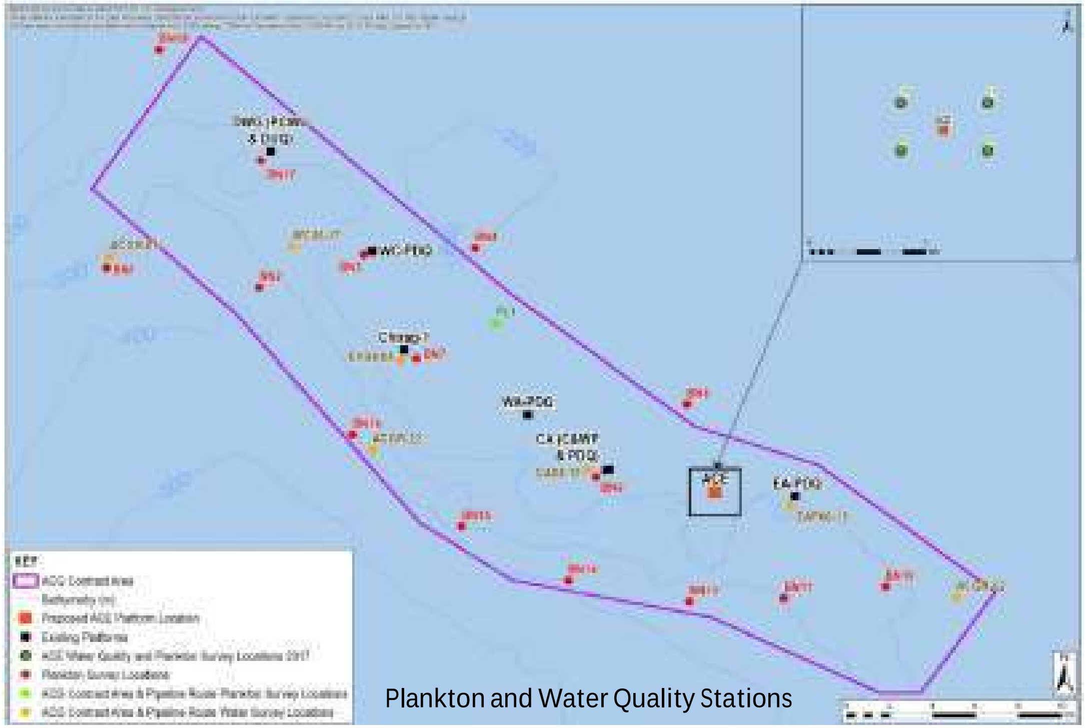
Based on the results of the latest ACG regional sediment and water column surveys (2014) and Central Azeri and West Azeri platforms sediment surveys (2016):

Plankton

- The 2014 results show the composition of the phytoplankton communities have remained broadly similar since 2004. The community is dominated by diatom and dinophyte species in all surveys, particularly the non-native diatom Pseudosolenia calcar-avis
- 2014 results show the zooplankton community is dominated by the invasive copepod Acartia tonsa, but the endemic copepod Eurytemora minor is showing signs of recovery

Water Quality

- Metal and hydrocarbons concentrations reported in 2014 found to be generally low and do not indicate recent contamination
- In general the water quality within the ACG Contract Area and in the ACE location is considered good.



Plankton and Water Quality Stations

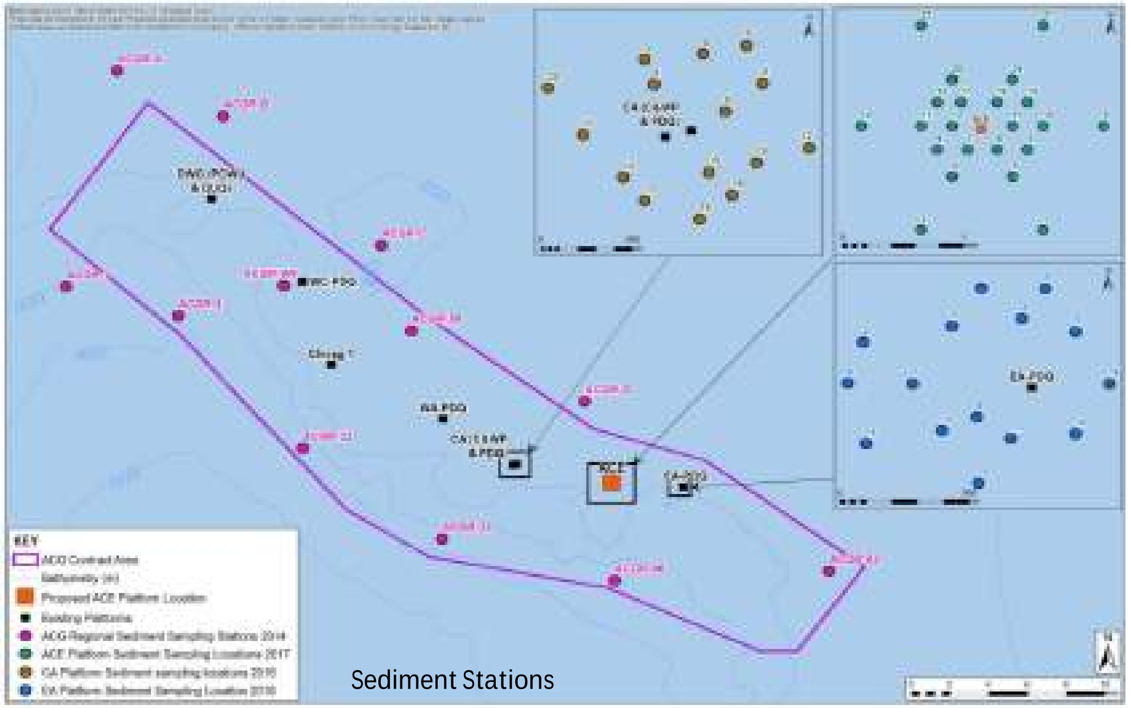
Key Environmental Sensitivities – Sediment

Benthic

- While the benthic community across the ACG Contract Area saw substantial changes from 2004 to 2008, the community has been fairly stable since this time. Amphipods found to be the dominant group throughout the ACG Contract Area. It is expected that benthic species richness at ACE will be relatively low, and dominated by a small number of ubiquitous taxa.

Sediment

- CA and EA surveys show that the physical characteristics and spatial distribution of sediments has been fairly consistent with the exceptions of a small number of stations which have seen changes in the silt/clay content. Hydrocarbon concentrations were generally low throughout the survey area at both platforms and there is no evidence to suggest that operations at EA and CA are influencing the hydrocarbon composition of sediments within the survey area.

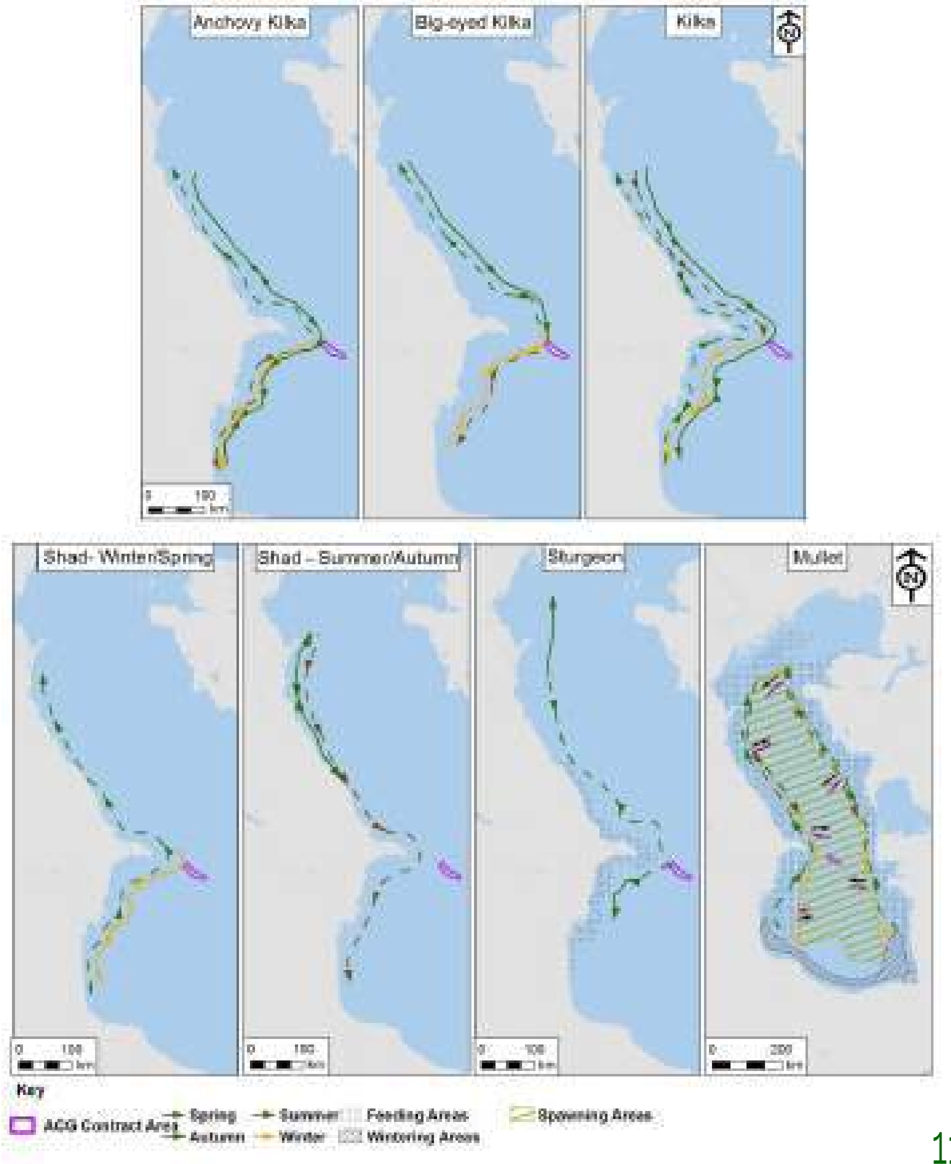


Sediment Stations

- A sediment and water column survey specific to the ACE location has been undertaken. A draft of the report is currently being reviewed and the results will be included in the ESIA.

Key Environmental Sensitivities - Fish

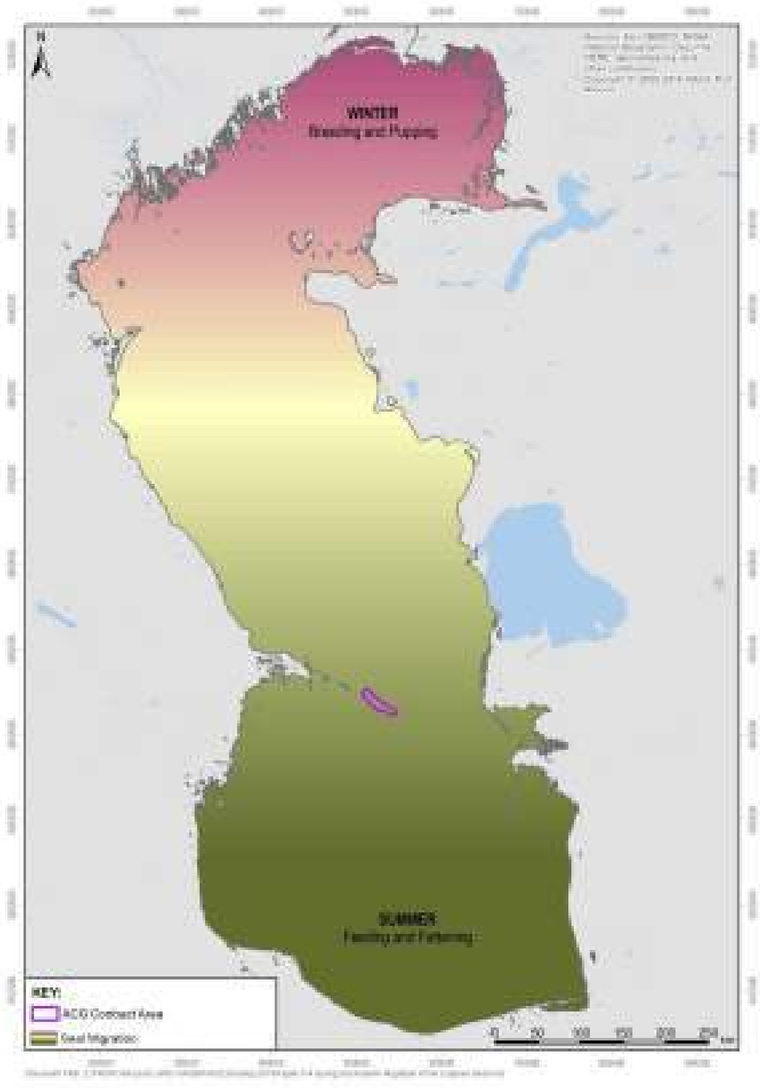
- 150 species and subspecies of fish found in the Caspian Sea; approximately 54 endemic species
- Typically classified as migratory, semi migratory and resident
- Fish tend to concentrate within the shallow water shelf areas. Maximum concentrations of fish are typically found at depths ranging between 50 to 75m but common for Caspian fish species to migrate to greater depths for overwintering and spawning
- The most common species of fish in the Caspian Sea are kilka – important as commercial catch and prey for Caspian seals. Typically overwinter in the southern Caspian, migrating north in spring
- No species is exclusively found in the ACG Contract Area
- Fish are sensitive to underwater sound (specifically those with swimbladders) and contamination in the water column



Key Environmental Sensitivities – Caspian Seal

- IUCN Red List as ‘Endangered’
- Present across the Caspian Sea in numbers of < 100,000
- Key migration periods (may shift by a month):
  - Spring (from north to south following pupping): April-May
  - Autumn (from south to north): October-December
- Seals’ main prey is kilka hence migration patterns have typically been similar to kilka. Also seals have typically remained close to shore, migrating through the waters surrounding the Absheron Peninsula. However latest research has shown that a proportion of seals do not follow a defined migratory pattern
- Possible a number of seals may be present at any time of year and migrate through in the ACG Contract Area – latest data to be compiled for the ACE ESIA
- The ACG Contract Area is not known to be exclusively used by the seals
- Seals are sensitive to human disturbance, underwater sound and contamination in the water column

Source: Dr. Tariel Eybatov



Key Environmental Sensitivities – Protected Areas

Important Bird and Biodiversity Areas (IBAs)

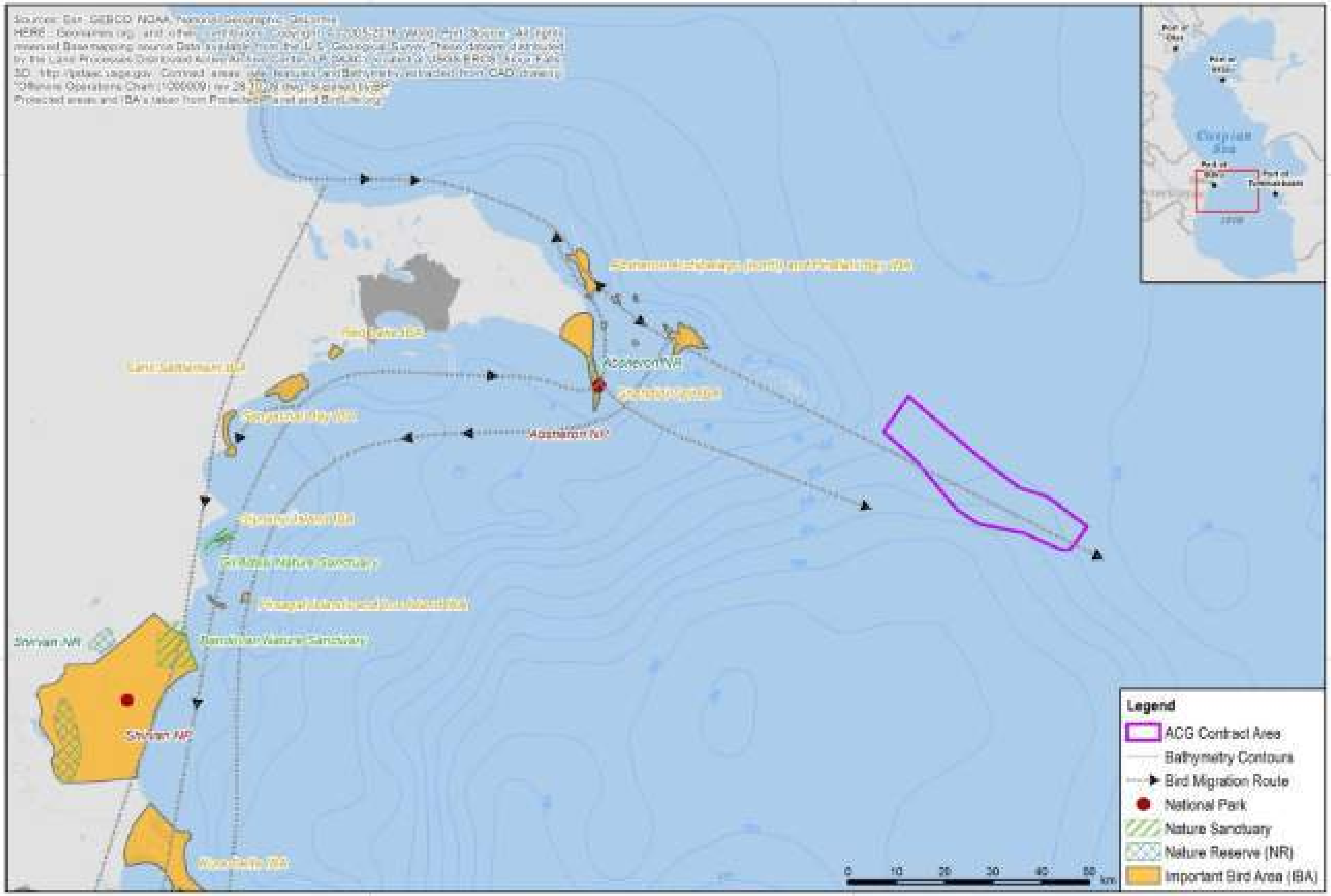
- Important Bird and Biodiversity Areas (IBAs) are found along the coast in Azerbaijan
- The coastal region from the Absheron Peninsula to Gobustan, to the south and west of the Study Area, is of international and regional importance, providing habitat for breeding, nesting, migratory and overwintering birds
- 21 species commonly present are included in the AzRDB and the IUCN Red List of Threatened Species
- The major flyway for migrating waterfowl and coastal birds, which is most active during March and November, passes between the ACG Contract Area and the Azerbaijani coastline.
- Most recent secondary data available on numbers of birds and presence within IBAs to be collected for the ACE ESIA

Absheron National Park

- Located along the Shahdili Spit (approximately 90km from proposed ACE platform location). Total area of 783 hectares
- Internationally protected under International Union for Conservation of Nature (Category II)
- Presence of species listed with IUCN and Azerbaijani Red Data Book (AzRDB) listed protected species

Protected areas sensitive to potential impacts from disturbance and particularly from accidental offshore spills that reach the shoreline

Key Environmental Sensitivities – Protected Areas and Bird Migration Routes



Key Environmental and Social Sensitivities – Coastal

Air Quality

- Air quality within coastal communities varies with higher pollutant concentrations recorded in cities (such as Baku).
- NO_2 concentrations (which give a key indicator of air quality) recorded levels of between 10 and 11 $\mu g/m^3$ around Sangachal Terminal , between 25$\mu g/m^3$ and 50$\mu g/m^3$ in the vicinity of Bibiheybat and up to 120 $\mu g/m^3$ within Baku itself.
- In general coastal air quality is variable with air quality in urban and industrial areas affected primarily by local industry and transport related emissions.

Construction Yards

- Construction yards to be used for ACE are yet to be confirmed however it is likely the same yards are used as for previous ACG and SD developments i.e.
  - Baku Deep Water Jacket Factory Yard, approximately 6km north east from Sahil
  - Amec-Tekfen-Azfen (ATA) Yard and South Dock, immediately adjacent to Bibiheybat (although no residential premises are located within close proximity to the yard)
- The yards are located in established industrial areas, located between the main Baku-Salyan Highway and the Caspian Sea
- Known to be a source of employment and training for people in the local area and wider region

Key Sensitivities - Socio-Economic

Commercial Shipping

- 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 commercial trade, passenger, scientific and supply vessel operations to the offshore oil and gas industry including supply vessels to the ACG platforms
- There is no main shipping route through the ACG Contract Area

Commercial Fisheries

- It is understood there are five commercial vessels currently operating in the Azerbaijani sector of the Caspian Sea which fish for kilka - four of these vessels are based and depart from Lenkoran port (in the south of Azerbaijan). The remaining vessel owned by the Caspian Fish Company is based and departs from Pirallahi Island
- Latest data to be collected to confirm location of important fishing grounds relative to ACE platform location (understood to be at least 50km away) and latest fisheries data (in terms of catch)

Employment and Livelihoods

- Oil and Gas sector plays an important role in the national and regional economy, followed by agricultural sector (which includes fisheries)
- Earlier BP projects have boosted local and regional employment and provided important training opportunities and there is likely to be workforce available with relevant technical skills and experience
- Coastal fishing known to be relied on for livelihoods for small number of people in coastal locations

Overview of Impact Assessment Methodology

- Environmental impact significance criteria is based on Event Magnitude and Receptor Sensitivity:
  - Event Magnitude - Extent / Scale; Frequency; Duration and Intensity
  - Receptor Sensitivity - Presence and Resilience

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

- Socio-economic impact assessment uses a semi-qualitative assessment approach based on Event Magnitude and Receptor Sensitivity
- Same impact assessment methodology used for COP, SD2, SWAP and D230 ESIAs
- Cumulative, transboundary and accidental events assessed quantitatively

Key Potential Impacts

Potential Impact	Activity to be Assessed within ESIA
Contamination of marine environment affecting water quality, plankton, sediment, benthos, seals and fish	• Discharges to sea including: • Discharge of water based mud (WBM) and cuttings to seabed and water column during drilling of the conductor and tophole sections of the pre-drill wells and tophole sections of the platform wells and residual WBM at the end of top hole section drilling • Cement discharges to seabed during cementing of all the hole sections, discharge of washout cement from the MODU and platform during cement washout following completion of cementing activities and grouting of jacket sleeves • Blowout Preventer (BOP) discharges of control fluid during BOP testing during pre-drilling • MODU and platform cooling water system discharge • MODU and platform treated black water and grey water, macerated food waste and drainage • Oil and gas pipelines pre-commissioning discharges (comprising treated seawater) • Subsea infrastructure installation discharges (e.g. MEG discharges of pre-filled subsea infrastructure (e.g. Subsea Safety Isolation Valves (SSIVs)) and trace hydrocarbons during oil pipeline wye installation)
Generation of underwater sound affecting seals and fish	• Underwater sound generated by • MODU and support vessels movements and MODU drilling activities • Driving the jacket and SSIV foundation piles • Operational activities including vessel movements, hydraulic hammering of the conductor well sections and drilling of the wells
Seabed Disturbance	• Disturbance and physical loss of seabed habitat during placement of MODU anchors and chains, drilling and pipelay of oil, gas and water injection infield pipelines and subsea infrastructure

Key Potential Impacts

Potential Impact	Activity to be Assessed within ESIA
Deterioration in air quality (construction yard vicinity)	• Emissions generated by use of construction plant and vehicles and onshore commissioning of platform generator and topside utilities
Deterioration in air quality (coastal communities)	• Emissions generated by: • MODU power generation during pre-drilling • Routine and non routine offshore operations (e.g. associated with platform power generation, pilot/purge flaring, flaring associated with plant trips and ESD) • Use of vessels during pre-drilling, platform and pipeline installation and HUC and operations
Employment and Training	• Jobs and training opportunities created by the project (local and regional)
Increased Economic Flows	• Direct and indirect economic flows created by demand for local goods and services
Disturbance to community wellbeing (construction yard vicinity)	• Noise generated by use of construction plant and vehicles and onshore commissioning of platform generator and topside utilities • Increased traffic flows associated with ACE construction activities on local road network

Cumulative and Transboundary Impacts

- Cumulative impacts to be assessed for potential synergetic or additive effects
  - Between separate ACE project impacts (e.g. potential for overlap of separate discharge plumes)
  - Between other offshore projects in the ACE Project vicinity (e.g. potential for additive air quality impact)

Transboundary impacts to be assessed associated with emissions of greenhouse and non greenhouse gases

Accidental Events

- Impacts to the marine environment to be assessed in the event of an accidental event. Assessment focused on potential hydrocarbon release (e.g. due to well blowout or a platform diesel inventory loss)

Proposed Supporting Studies for Impact Assessment

Study	Overview
Air quality (offshore)	Atmospheric dispersion modelling to predict the potential increases in nitrogen dioxide, sulphur dioxide, carbon monoxide and particulate matter for offshore activities including MODU power generation and routine offshore operations (e.g. power generation, pilot/purge flaring) and non-routine offshore emissions from flaring (e.g. associated with trips and emergencies)
Air quality screening assessment (onshore construction yards)	Air quality screening assessment to confirm extent of air quality impacts associated with construction yard plant and onshore commissioning of main platform generator and topside utilities
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Underwater sound assessment	Underwater sound modelling will be undertaken for activities including vessel movements, MODU and platform drilling, jacket and SSIV foundation piles and the hydraulic hammering of the conductor well sections drilled from the platform to confirm extent of impact within the water column
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BOP control fluid discharges during predrilling	DREAM modelling software will also be utilised to model anticipated BOP control fluid discharges during pre-drilling which occur when the BOP undergoes testing to confirm the extent of impact within the water column
Cooling water system discharges	Cooling water discharges from the MODU and ACE platform will be modelled to confirm the extent of the temperature plume within the water column and the extent of the plume associated with any treatment chemicals added to the cooling water
Infield pipeline installation & pre-commissioning discharges	DREAM modelling software will also be utilised to model infield pipeline pre-commissioning discharges and subsea discharges during infield pipeline & associated infrastructure installation to confirm the extent of impacts of the discharges (including chemicals (e.g. MEG) and/or trace hydrocarbons)
Spill modelling (subsea well blowout of crude oil and platform diesel inventory loss scenarios)	The latest version of the Oil Spill Contingency and Response Model (OSCAR) will be used to predict the transport and behaviour of accidental releases of diesel and crude oil associated with the Project. OSCAR consists of a dispersion model based on 2D wind and 3D current data and a component-specific fate model whereby the physical-chemical, toxicity and biodegradation properties of the components of a discharge are modelled. The model estimates the distribution of contaminants on the water surface, on shorelines, in the water column, and in sediments.

Proposed ESIA Table of Contents

<table>
<tr><th>Chapter</th><th>Overview</th></tr>
<tr><td>Introduction</td><td>Presents an overview and rationale for the Project; introduces proponent; details background information, objectives of the ESIA study and structure of the ESIA Report.</td></tr>
<tr><td>Policy, Regulatory and Administrative Framework</td><td>Describes applicable legal and administrative framework; relevant national, international and corporate (BP) standards and guidelines, as well as best industry practices.</td></tr>
<tr><td>Impact Assessment Methodology</td><td>Description of assessment methodology, approach to defining significance, approach to mitigation and summary of scoping.</td></tr>
<tr><td>Options Assessed</td><td>A summary of the initiatives and options assessed to date to avoid or reduce significant impacts will be presented.</td></tr>
<tr><td>Project Description</td><td>A description of the ACE Project Base Case Design will be presented and include details associated with main components and projects phases.</td></tr>
<tr><td>Environmental Description</td><td>A description of environmental conditions will be provided.</td></tr>
<tr><td>Socio-economic Description</td><td>A description of socio-economic conditions will be provided.</td></tr>
<tr><td>Consultation and Disclosure</td><td>A summary of consultation and disclosure activities undertaken during the scoping phase and during preparation and review of the ESIA Report.</td></tr>
<tr><td>Pre-Drill Environmental Impact Assessment, Monitoring and Mitigation</td><td rowspan="3">A concise evaluation of environmental impacts associated with each phase of the Project based on receptor sensitivity and project interaction. Where necessary, modelling assessments will be undertaken to inform specific parts of the impact assessment.
Impacts will be evaluated taking into account the existence and effectiveness of existing controls and mitigation measures including those implemented for the previous ACG / COP / SD2 projects, where considered to be effective and relevant.</td></tr>
<tr><td>Construction, Installation and HUC Environmental Impact Assessment, Monitoring and Mitigation</td></tr>
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<tr><td>Socio-Economic Impact Assessment, Monitoring and Mitigation</td><td>Socio-economic impacts will be assessed for each phase of the ACE Project based on receptor sensitivity.</td></tr>
<tr><td>Cumulative, Transboundary and Accidental Events</td><td>An assessment of potential cumulative and transboundary impacts and accidental events associated with the ACE Project Activities. Where necessary, modelling assessments will be undertaken to inform specific parts of the impact assessment.</td></tr>
<tr><td>Environmental and Social Management</td><td>A description of the environmental and social management system associated with the ACE project activities during construction and operations.</td></tr>
<tr><td>Residual Impacts and Conclusions</td><td>A summary of the residual impacts and conclusions arising from the ESIA process.</td></tr>
</table>

Indicative ACE Timetable

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Submission of Draft ACE ESIA to the MENR	August 2018
ESIA Disclosure Including Meeting with the MENR	September 2018
ACE ESIA MENR Comments/Conditional Approval Anticipated	November 2018
Submit Final ESIA to MENR	January 2019

Thank You

Azeri Central East (ACE) Project ESIA Scoping Meeting

20 February 2018

Background and Purpose

- September 1994 – The Azeri-Chirag-Gunashli (ACG) Production Sharing Agreement (PSA) was signed between the State Oil Company of the Azerbaijan Republic (SOCAR) and a consortium of Foreign Oil Companies. An amended and restated PSA effective until the end of 2049 was signed on 14 September 2017.
- The ACG Contract Area is being developed in phases. The potential next phase of development comprises the Azeri Central East (ACE) Project.
- The purpose of this presentation is to:
  - Provide an overview of the proposed ACE Project
  - Set out the proposed scope of the ACE Project Environmental and Social Impact Assessment (ESIA)

Objectives of ACE Project

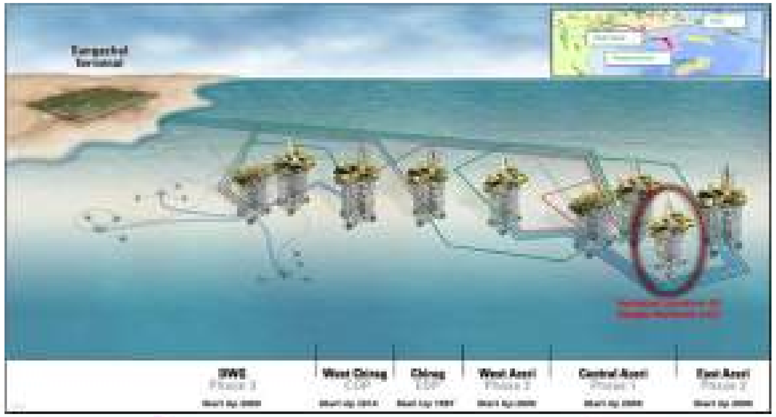
- Provide a new drilling centre between EA and CA - simplifies ACG New Wells Delivery and makes drilling operations simpler and more efficient
- Allows major and minor reservoir targets to be accelerated
- Will enable gas injection to east flank of the Contract Area (the EA crest)
- ACE designed to produce up to 100 mbd oil and 350 MMscfd gas

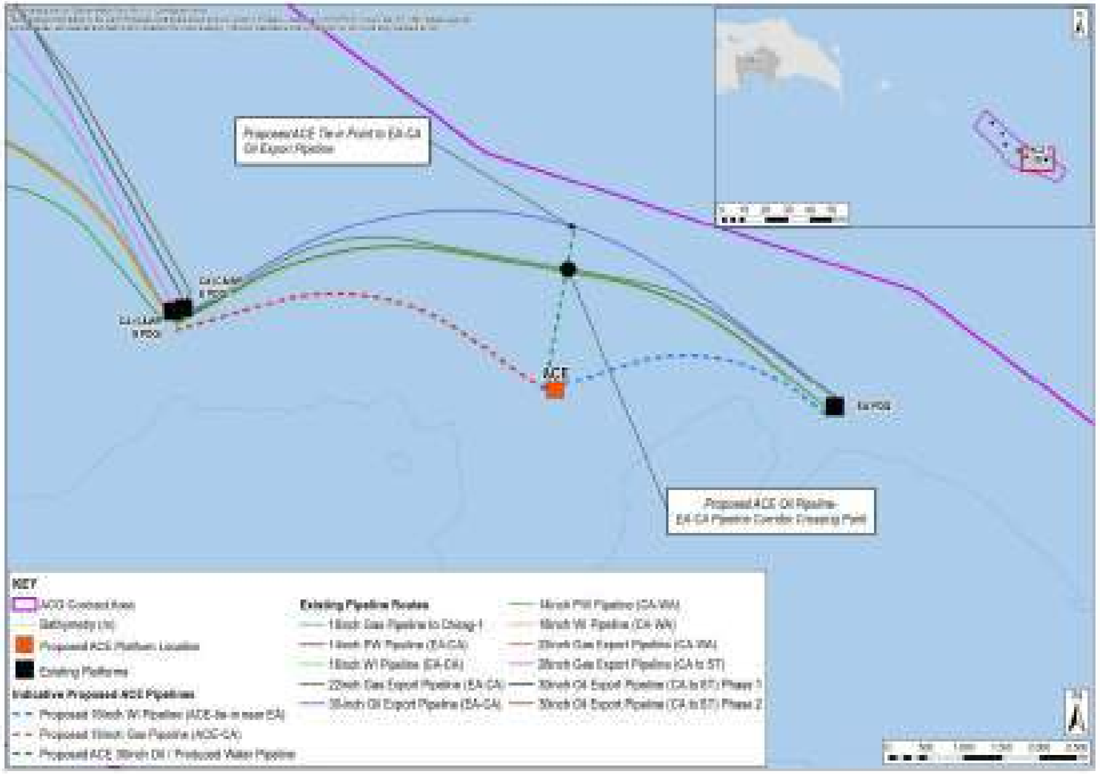
ACE Project Objectives and Project Overview

Proposed ACE Production, Drilling and Quarters (PDQ) Platform

- Single platform equipped with 48 slot well bay. Current base case: 26 production wells; 5 water injection (WI) wells; 7 gas injection wells and 2 CRI wells. There is an option for a number of wells to be predrilled using MODU
- Designed for 2 phase separation: oil comingled with produced water sent to Sangachal Terminal via tie-in to existing 30" subsea oil pipeline
- Gas dehydrated and compressed to provide lift gas for injection to EA crest. Gas not required for gas injection exported to CA via new 18" infield subsea gas pipeline for gas reinjection or export to Sangachal Terminal
- 1x100% Gas Turbine Generator (GTG) to meet ACE power demand. Back-up power imported via a combined telecommunications and power cable (CTPC) from EA
- Living quarters and sewage treatment package sized to accommodate up to 202 POB (normal 164 POB)
- Brownfield modifications on CA-CWP to handle the increased gas flowrates associated with ACE and on EA-PDQ associated with CTPC tie-ins
- Produced water will be treated at Sangachal Terminal and sent back offshore for reinjection

ACE Project Location and Layout





Project Activities

The main ACE Project phases include:

- Onshore construction and commissioning of offshore and subsea facilities (at existing construction yards)
- Platform installation , hook up and commissioning (HUC)
- Installation, tie-in and HUC of ACE infield subsea pipelines and associated subsea infrastructure
- Brownfield works on the EA and CA platforms
- Offshore drilling which might include MODU pre-drilling activities
- Offshore operations and production

The project does not involve any modifications at Sangachal Terminal – there is sufficient capacity within the existing onshore ACG facilities to accommodate ACE

ESIA Approach

Screening and Scoping
Type/level of assessment to be conducted
Initial appraisal of likely key issues
Targeted stakeholder engagement

Project Alternatives
Analysis of viable alternatives to base case design

Base Case Design
Gather and review design information

Existing Conditions
Baseline environmental and socio-economic conditions

Environmental and Socio-Economic Interactions
Determine project activities – receptor interactions

Transboundary and Cumulative Impacts
Assessment of transboundary and cumulative Impacts

Impact Assessment
Determine activity event magnitudes
Determine receptor sensitivities
Identify existing controls and base case mitigation
Determine impact significance

Residual Impacts
Undertake residual impact assessment and determine any additional mitigation measures required

Disclosure and Consultation
Communicate draft findings and recommendations to stakeholders for comment
Finalise ESIA and submit for approval to authorities

Monitoring and Mitigation
Development of management plans and procedures as part of AGT HSSE Management System

Key Environmental Sensitivities – Water Column

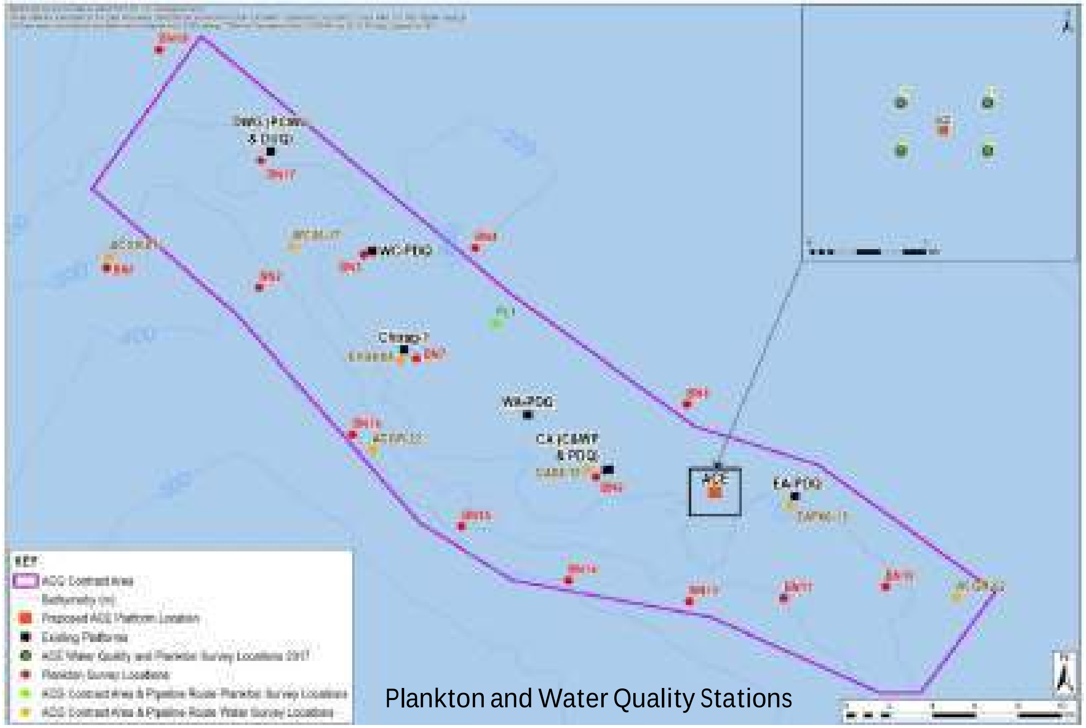
Based on the results of the latest ACG regional sediment and water column surveys (2014) and Central Azeri and West Azeri platforms sediment surveys (2016):

Plankton

- The 2014 results show the composition of the phytoplankton communities have remained broadly similar since 2004. The community is dominated by diatom and dinophyte species in all surveys, particularly the non-native diatom Pseudosolenia calcar-avis
- 2014 results show the zooplankton community is dominated by the invasive copepod Acartia tonsa, but the endemic copepod Eurytemora minor is showing signs of recovery

Water Quality

- Metal and hydrocarbons concentrations reported in 2014 found to be generally low and do not indicate recent contamination
- In general the water quality within the ACG Contract Area and in the ACE location is considered good.



Plankton and Water Quality Stations

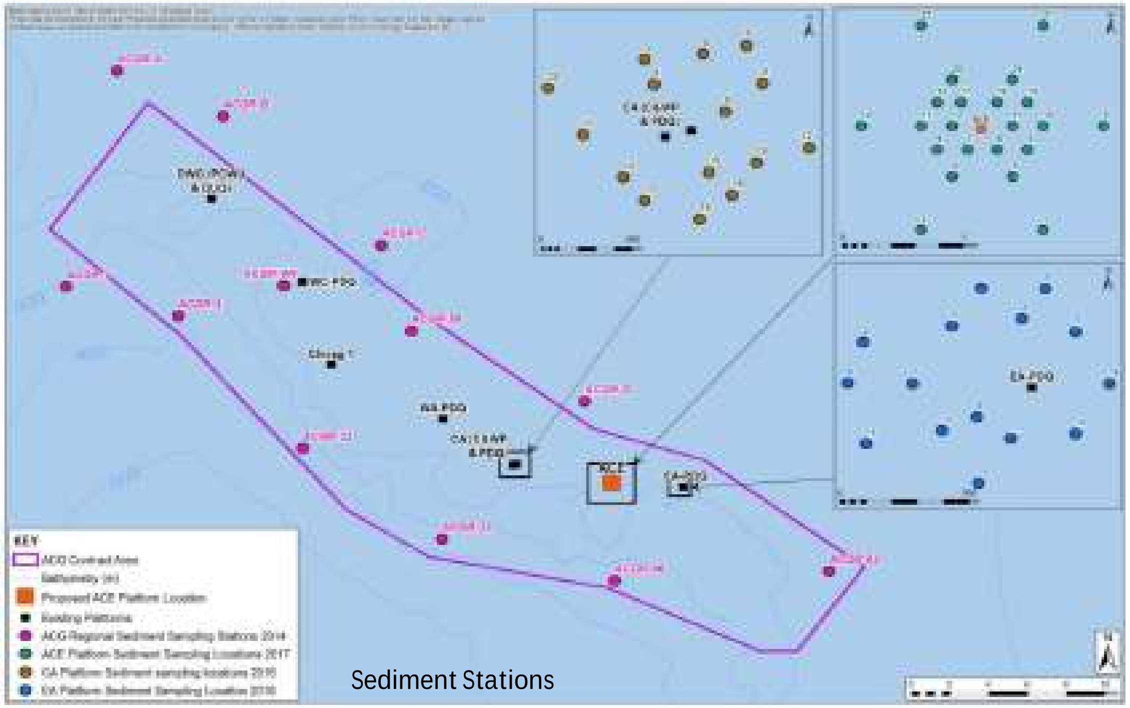
Key Environmental Sensitivities – Sediment

Benthic

- While the benthic community across the ACG Contract Area saw substantial changes from 2004 to 2008, the community has been fairly stable since this time. Amphipods found to be the dominant group throughout the ACG Contract Area. It is expected that benthic species richness at ACE will be relatively low, and dominated by a small number of ubiquitous taxa.

Sediment

- CA and EA surveys show that the physical characteristics and spatial distribution of sediments has been fairly consistent with the exceptions of a small number of stations which have seen changes in the silt/clay content. Hydrocarbon concentrations were generally low throughout the survey area at both platforms and there is no evidence to suggest that operations at EA and CA are influencing the hydrocarbon composition of sediments within the survey area.

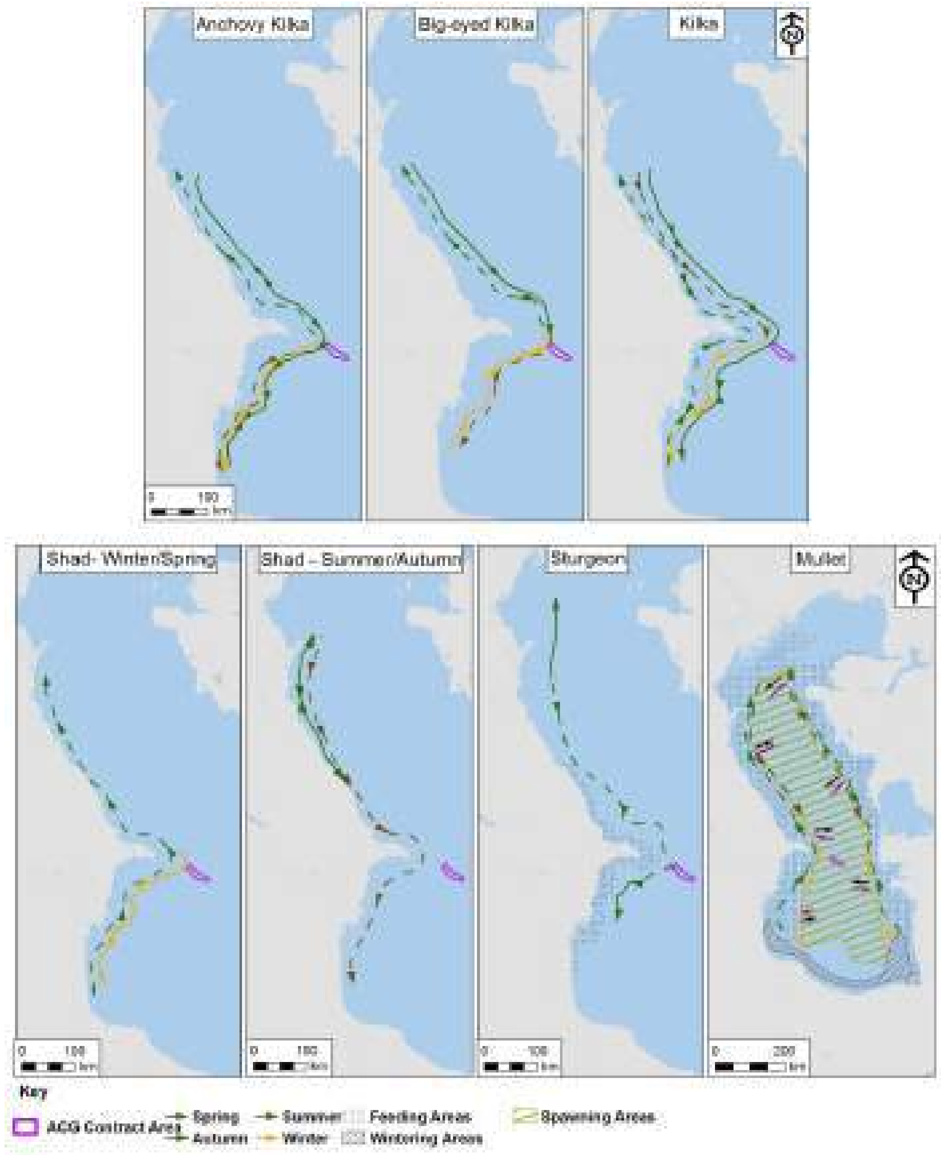


Sediment Stations

- A sediment and water column survey specific to the ACE location has been undertaken. A draft of the report is currently being reviewed and the results will be included in the ESIA. The interpretative report will be issued to MTAG for review and a review meeting will be arranged.

Key Environmental Sensitivities - Fish

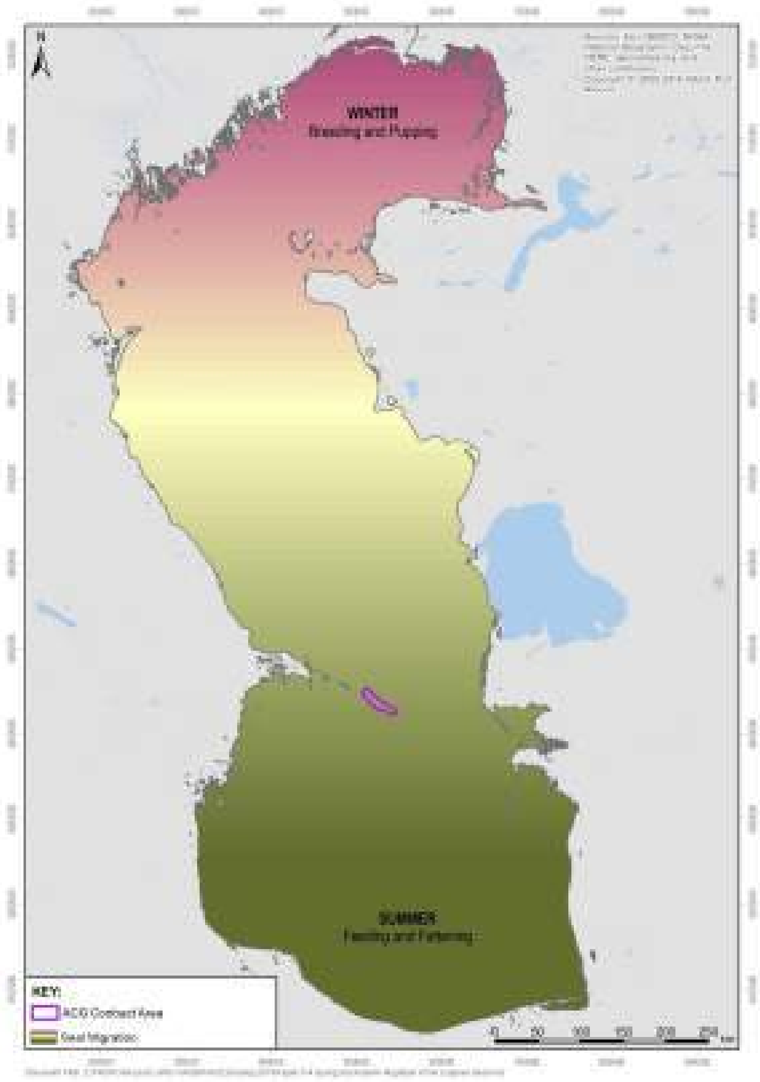
- 150 species and subspecies of fish found in the Caspian Sea; approximately 54 endemic species
- Typically classified as migratory, semi migratory and resident
- Fish tend to concentrate within the shallow water shelf areas. Maximum concentrations of fish are typically found at depths ranging between 50 to 75m but common for Caspian fish species to migrate to greater depths for overwintering and spawning
- The most common species of fish in the Caspian Sea are kilka – important as commercial catch and prey for Caspian seals. Typically overwinter in the southern Caspian, migrating north in spring
- No species is exclusively found in the ACG Contract Area
- Fish are sensitive to underwater sound (specifically those with swimbladders) and contamination in the water column



Key Environmental Sensitivities – Caspian Seal

- IUCN Red List as 'Endangered'
- Present across the Caspian Sea in numbers of < 100,000
- Key migration periods (may shift by a month):
  - Spring (from north to south following pupping): April-May
  - Autumn (from south to north): October-December
- Seals' main prey is kilka hence migration patterns have typically been similar to kilka. Also seals have typically remained close to shore, migrating through the waters surrounding the Absheron Peninsula. However latest research has shown that a proportion of seals do not follow a defined migratory pattern
- Possible a number of seals may be present at any time of year and migrate through in the ACG Contract Area – latest data to be compiled for the ACE ESIA
- The ACG Contract Area is not known to be exclusively used by the seals
- Seals are sensitive to human disturbance, underwater sound and contamination in the water column


Source: Dr. Tariel Eybatov



Key Environmental Sensitivities – Protected Areas

Important Bird and Biodiversity Areas (IBAs)

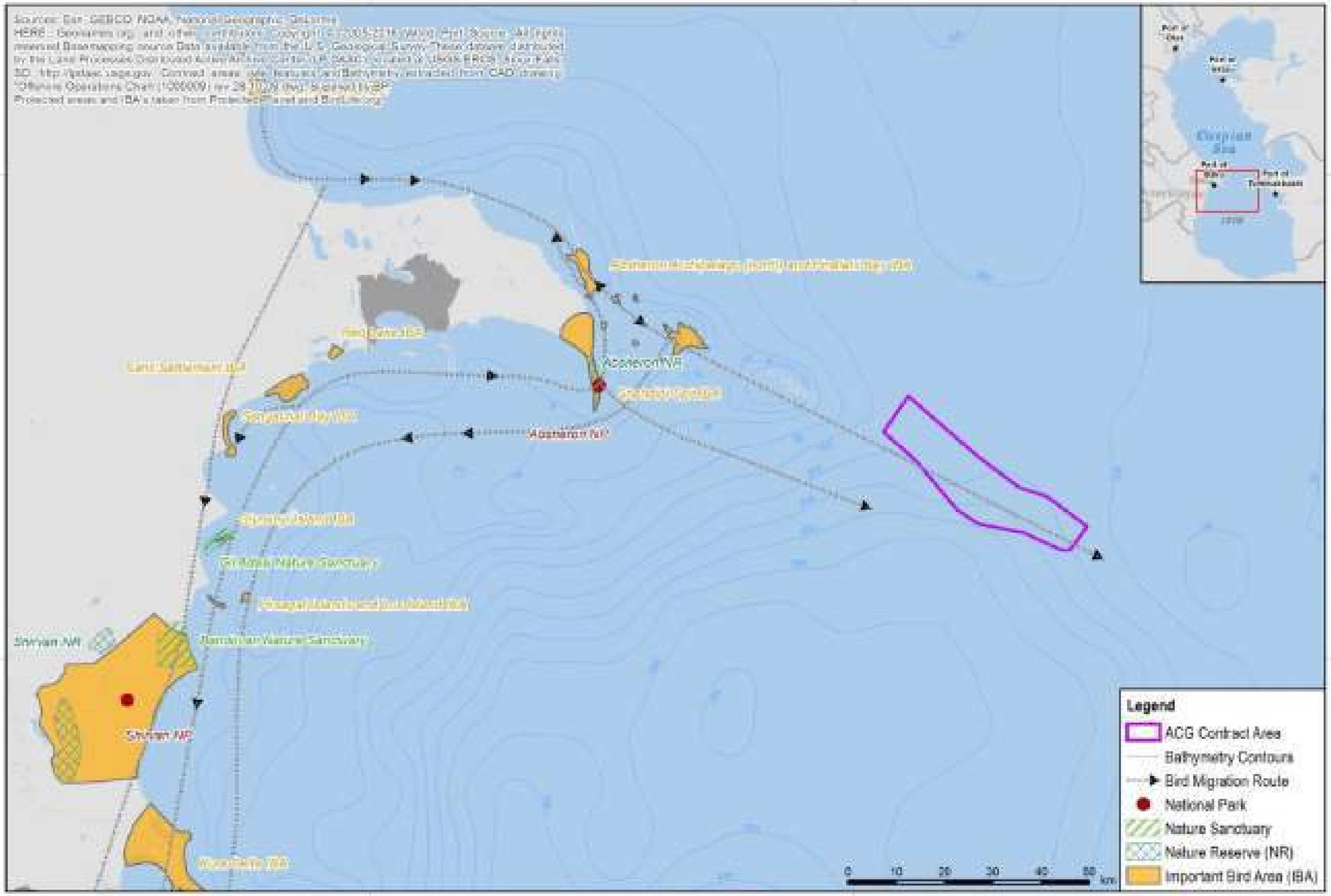
- Important Bird and Biodiversity Areas (IBAs) are found along the coast in Azerbaijan
- The coastal region from the Absheron Peninsula to Gobustan, to the south and west of the Study Area, is of international and regional importance, providing habitat for breeding, nesting, migratory and overwintering birds
- 21 species commonly present are included in the AzRDB and the IUCN Red List of Threatened Species
- The major flyway for migrating waterfowl and coastal birds, which is most active during March and November, passes between the ACG Contract Area and the Azerbaijani coastline.
- Most recent secondary data available on numbers of birds and presence within IBAs to be collected for the ACE ESIA

Absheron National Park

- Located along the Shahdili Spit. (approximately 90km from proposed ACE platform location). Total area of 783 hectares
- Internationally protected under International Union for Conservation of Nature (Category II)
- Presence of species listed with IUCN and Azerbaijani Red Data Book (AzRDB) listed protected species

Protected areas sensitive to potential impacts from disturbance and particularly from accidental offshore spills that reach the shoreline

Key Environmental Sensitivities – Protected Areas and Bird Migration Routes



Key Environmental and Social Sensitivities – Coastal

Air Quality

- Air quality within coastal communities varies with higher pollutant concentrations recorded in cities (such as Baku).
- NO_2 concentrations (which give a key indicator of air quality) recorded levels of between 10 and 11 µg/m^3 around Sangachal Terminal , between 25µg/m^3 and 50µg/m^3 in the vicinity of Bibiheybat and up to 120 µg/m^3 within Baku itself.
- In general coastal air quality is variable with air quality in urban and industrial areas affected primarily by local industry and transport related emissions.

Construction Yards

- Construction yards to be used for ACE are yet to be confirmed however it is likely the same yards are used as for previous ACG and SD developments i.e.
  - Baku Deep Water Jacket Factory Yard, approximately 6km north east from Sahil
  - Amec-Tekfen-Azfen (ATA) Yard and South Dock, immediately adjacent to Bibiheybat (although no residential premises are located within close proximity to the yard)
- The yards are located in established industrial areas, located between the main Baku-Salyan Highway and the Caspian Sea
- Known to be a source of employment and training for people in the local area and wider region

Key Sensitivities - Socio-Economic

Commercial Shipping

- 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 commercial trade, passenger, scientific and supply vessel operations to the offshore oil and gas industry including supply vessels to the ACG platforms
- There is no main shipping route through the ACG Contract Area

Commercial Fisheries

- It is understood there are five commercial vessels currently operating in the Azerbaijani sector of the Caspian Sea which fish for kilka - four of these vessels are based and depart from Lenkoran port (in the south of Azerbaijan). The remaining vessel owned by the Caspian Fish Company is based and departs from Pirallahi Island.
- Latest data to be collected to confirm location of important fishing grounds relative to ACE platform location (understood to be at least 50km away) and latest fisheries data (in terms of catch)

Employment and Livelihoods

- Oil and Gas sector plays an important role in the national and regional economy, followed by agricultural sector (which includes fisheries)
- Earlier BP projects have boosted local and regional employment and provided important training opportunities and there is likely to be workforce available with relevant technical skills and experience
- Coastal fishing known to be relied on for livelihoods for small number of people in coastal locations

Overview of Impact Assessment Methodology

- Environmental impact significance criteria is based on Event Magnitude and Receptor Sensitivity:
  - Event Magnitude - Extent / Scale; Frequency; Duration and Intensity
  - Receptor Sensitivity - Presence and Resilience

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

- Socio-economic impact assessment uses a semi-qualitative assessment approach based on Event Magnitude and Receptor Sensitivity
- Same impact assessment methodology used for COP, SD2 and SWAP ESIAs
- Cumulative, transboundary and accidental events assessed quantitatively

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The proposed ACE Project is designed such that all discharges meet applicable project standards (including relevant PSA requirements) and chemicals selected for use will be the same specification and environmental performance as for existing ACG facilities

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Thank You

APPENDIX 8B

Disclosure Consultation Presentations and Meeting Minutes

Azeri Central East (ACE) Project Environmental & Social Impact Assessment (ESIA) Disclosure Meeting

Date: 30/10/18	Time: 10:00	Location: BP XAZAR CENTER, Floor 6 MR 21/22

Attendees			
BP		**Ministry of Ecology and Natural Resources (MENR)**	
Kelly Goddard	BP Global Project Organisation (GPO) Environmental & Social (E&S) Manager	Khatira Abbasova	Senior Expert of Expertise Department, MENR
Maria Scarlett	GPO Azerbaijan, E&S Lead	Islam Mammadov	Chief Consultant to MENR of Environmental, Engineering and Consulting
Sabina Huseynova	GPO Azerbaijan, E&S Advisor	Zohrab Rahimov	Chief Consultant to MENR of Offshore Environmental Monitoring Sector
Saadat Gaffarova	BP Azerbaijan Georgia Turkey (AGT) Region Regulatory Compliance and Environment (RC&E),Regulatory Compliance and Permitting Team Acting Leader		
Zaur Hasanov	BP AGT Region RC&E, Lead Environmental Advisor (EIA)		
Colin Simpson	BP ACE Project Topside Delivery Manager		
Robert Waterston	ACE ESIA Lead (AECOM)		
Hikmat Abdullayev	ESIA Specialist (AECOM)		
BP provided translator	Kamran Akhmedov		
Presentation pack used during the meeting is available			

No.	Discussion
1.	**Introductions and Purpose of Meeting** Saadat Gaffarova (BP) welcomed attendees and provided a brief overview of the purpose of the meeting. Attendees introduced themselves. Saadat explained that the meeting would involve a presentation and then a question and answer session. Khatira Abbasova (MENR) stated that she had brought along a list of comments from MENR on the ESIA but their comments during the meeting would focus on some of the key issues only due to time constraints.
2.	**Overview of the ACE Project and ESIA Process and Findings** A presentation was provided to MENR covering the following sections: • Overview and Purpose – Sabina Huseynova (BP) • ACE Project Overview – Colin Simpson (BP) • Legal Framework and ESIA Process – Sabina Huseynova (BP) • Environmental and Social Baseline – Sabina Huseynova (BP) • Impact Assessment – Robert Waterston and Hikmat Abdullayev (AECOM) • Employment and Training – Sabina Huseynova (BP) • Cumulative Impacts and Accidental Events – Sabina Huseynova (BP) • Environmental and Social Management – Sabina Huseynova (BP)

3. **Question and Answer Session**

The following questions and comments were raised during this meeting:

Question (Islam Mammadov, MENR): When compared to the monitoring results presented in earlier ESIAs it can be seen that the barium concentrations around the platforms such as CA have increased as a result of the discharge of water based mud and cuttings. How far does the barium travel? 2-3 km?

Response (Saadat Gaffarova, BP): The parameters are being checked as part of the Regional Environmental Monitoring Program (EMP).

Response (Robert Waterston, AECOM): Robert referred back to the presentation which showed that a 1mm thickness of WBM drill cuttings is not anticipated to extend more than 60m from the wellhead. Robert acknowledged that smaller particles, which could include barium, could potentially travel further than this. Robert also stated that BP's monitoring surveys at drill sites in the ACG Contract Area conducted as part of the EMP have found 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 250m from the platforms.

Question (Zohrab Rahimov, MENR): The oil spill scenarios from the platform and pipeline. The ESIA references that oil may travel 400-500km. This distance is a bit confusing as the Caspian is not wide enough to travel that far. Can you clarify this? Can you also explain what Caspian Sea parameters have been used in this model as this model may not be suitable for use in the Caspian. Also, what ACE specific details have been used to estimate these spill volumes and has Caspian specific oil been taken into account.

Response (Robert Waterston, AECOM): The modelling predicts that in the event of a blowout, crude oil on the sea surface could travel around 400-500km from the spill location, however the thickness of oil would be very thin at these distances. The direction the oil travels depends on the sea and wind conditions at the time of the spill and the oil can potentially travel in all directions. This means that the oil could reach shore in a number of locations. The modelling was undertaken using the Oil Spill Contingency and Response Model (OSCAR), which is the industry leading modelling software used across the world. The model has used Caspian-specific metocean data, which includes three-dimensional water column current and two-dimensional wind data which was generated by the Space and Atmospheric Physics Group at Imperial College, London and provided by BP for a period covering 2006-2009. For the blowout scenario modelled, the key characteristics of the spill (i.e. flow rates, temperature, etc.) were estimated by BP's reservoir engineers. In terms of the oil type used in the modelling, it has been assumed that the oil produced at ACE will be similar in nature to the oil produced at the Central Azeri (CA) platform. Therefore, the modelling has incorporated the results of an oil weathering study undertaken on CA oil which provides key oil characteristics such as pour point, viscosity and wax content. A summary of the input data is provided in the Oil Spill Modelling Report included as an appendix to the ESIA.

Question (Zohrab Rahimov, MENR): Why has the spill modelling only considered winter and summer conditions. Why were autumn and spring not considered?

Response (Robert Waterston, AECOM): Summer and winter conditions were presented as these provide the two extremes for potential conditions. *ACTION: If not mentioned in the ESIA, provide description of why spills were modelled under summer and winter conditions.*

Question (Zohrab Rahimov, MENR): I would expect the ESIA to include a description of the alternative options considered for the location of the platform. Alternative platform locations only describe locations between CA and EA platforms. Why was a new platform needed. Why couldn't' extended reach drilling (ERD) from existing platforms be used. Was there a feasibility study carried out?

Response (Colin Simpson, BP): This is a good question. If you recall from the early slides in the presentation part of the need for ACE is due to slot constraints on existing platforms. Without ACE we would have to wait for the wells on existing platforms to end production before sidetracks could be drilled to access other reservoir targets. Economically speaking, we cannot wait this long to access the reserves.

Question (Zohrab Rahimov, MENR): Are there not free slots on the EA platform that could be used as I understand there are reserve slots available.

Response (Colin Simpson, BP): An economic comparison was undertaken to compare ACE against drilling from EA, which showed that it is better to have ACE to ensure economic delivery from the wells.

Response (Kelly Goddard, BP): These are good questions and we can update the ESIA to provide an overview of the issues you have raised. *ACTION: Options Assessed chapter of the ESIA to be updated to provide greater description of why the proposed ACE platform location in the southeast of the ACG Contract Area between the CA and EA platforms was selected over other areas of the Azeri field and why a new platform was selected over the use of ERD wells from existing platforms.*

Question (Zohrab Rahimov, MENR): The ESIA makes some references to MARPOL standards. Azerbaijan has not ratified MARPOL as it is landlocked. MENR are using the European Standard of 25 for Biological Oxygen Demand (BOD).

Response (Robert Waterston, AECOM): The MARPOL standards stated in the ESIA are with regard to the vessels.

Response (Saadat Gaffarova, BP): MARPOL standards do not apply to the platforms. Standards for the platform sewage treatment plant (STP) are based on United States Coast Guard Type II discharge standards in accordance with the requirements of the PSA.

Response (Kelly Goddard, BP): BP to confirm back to MENR and update the ESIA to provide clarification. *ACTION: Kelly Goddard (BP) to review discharge standards and AECOM to ensure the applicable discharge standards are made clear in the ESIA.*

Question (Islam Mammadov, MENR): The ESIA is an extensive document with 441 pages. It does not seem written for a single project is quite long. A lot of the information in the chapters is familiar and includes results of surveys back to 1995. The ESIA has used modelling to evaluate impacts from underwater sound, drilling discharges etc. What modelling software has been used.

Response (Robert Waterston, AECOM): The ESIA has used a number of modelling software programmes. The ESIA appendices provide a description of the modelling packages.

Statement (Khatira Abbasova, MENR): The ESIA appendices were not provided to Islam Mammadov. I will send these to him.

Question (Khatira Abbasova, MENR): The ESIA should make reference to the new Azerbaijan EIA Law. MENR is in the process of implementing protocols for the new EIA law.

Response (Saadat Gaffarova, BP): BP has been in contact with MENR on this subject. With regard to the ACE ESIA the requirement for certification of ESIA specialists is out of scope as the ESIA process commenced before the law was introduced. We understand that the MENR is still preparing the rules on how the new law will be implemented. We can make reference to the new law. What else should be included?

Response (Zohrab Rahimov, MENR): They want the ESIA to recognise the law but understand it may not all be applicable.

Response (Kelly Goddard, BP): We will consider their comments and will liaise with the legal team and RC&E. *ACTION: Kelly Goddard (BP) to liaise with the BP legal team and RC&E to confirm what elements of the new EIA Law need to be reflected in the ACE Project ESIA.*

Question (Islam Mammadov, MENR): Are there any works to be conducted at Sangachal or close to it? Is there a need to consider social receptors at Sangachal? What about fishing near Sangachal and the area near the Baku Deep Water Jackets (BDJF) yard? How will the project impact these areas.

Response (Robert Waterston, AECOM): There will be no new infrastructure constructed at Sangachal or works conducted in Sangachal Bay for the ACE Project. The only minor modifications at Sangachal Terminal are within existing buildings to incorporate the ACE platform into the existing telecommunications system.

Response (Colin Simpson, BP): There will be more throughput at the Terminal from ACE produced oil but the existing facilities have the capacity to process this oil.

Response (Robert Waterston, AECOM): The ESIA includes as estimate of the additional emissions at the Terminal associated with the processing of oil produced by the ACE platform.

Question (Islam Mammadov, MENR): Somewhere in the ESIA it is mentioned that 0.5% of the produced gas will be flared during operations. Why is it such a low volume?

Response (Colin Simpson, BP): Gas will be used for power on the platform as well as gas lift and gas injection to enhance oil recovery. Gas will only be sent to the flare for safety or maintenance reasons.

Response (Robert Waterston, AECOM): In the event that the gas compression facilities on the platform are unavailable, rather than sending the gas to flare, the gas can be exported to the CA platform where it can be used for gas injection or if there is not a requirement for the gas on CA it can be transported to the Terminal.

Statement (Khatira Abbasova, MENR): Here is a list of our comments to be considered. Some of these have been addressed today and we can send through an updated version.

Saadat Gaffarova (BP) concluded the meeting by thanking MENR for a useful meeting. A formal response to the comments will be issued and the ESIA document updated accordingly.

4. **Summary of Actions**

Who:	Action:	When by:
RW (AECOM)	If not mentioned in the ESIA, provide description of why spills were modelled under summer and winter conditions.	In final version of the ESIA - to be released in February 2019.
KG (BP) & RW (AECOM)	Options Assessed chapter of the ESIA to be updated to provide greater description of why the proposed ACE platform location in the southeast of the ACG Contract Area between the CA and EA platforms was selected over other areas of the Azeri field and why a new platform was selected over the use of ERD wells from existing platforms.	In final version of the ESIA - to be released in February 2019.
KG (BP) & RW (AECOM)	Kelly Goddard (BP) to clarify discharge standards and AECOM to ensure the applicable discharge standards are made clear in the ESIA.	Kelly Goddard (BP) to undertake review of discharge standards with legal and provide feedback to AECOM by 23 November 2018. Updates in final version of the ESIA - to be released in February 2019.
KG (BP)	Kelly Goddard (BP) to liaise with the BP legal team and RC&E to confirm what elements of the new EIA Law need to be reflected in the ACE Project ESIA.	23 November 2018.

Azeri Central East (ACE) Project Environmental & Social Impact Assessment (ESIA) Disclosure Meeting

Date: 30/10/18	Time: 14:00	Location: BP XAZAR CENTER, Floor 6 MR 21/22

Attendees			
BP		**Monitoring Technical Advisory Group (MTAG)**	
Kelly Goddard	BP Global Project Organisation (GPO) Environmental & Social (E&S) Manager	Aflatun Hasanov	Deputy Director of Ecology Department – State oil Company of the Azerbaijan Republic (SOCAR)
Maria Scarlett	GPO Azerbaijan, E&S Lead	Famil Valiyev	Oil & Gas Scientific and Project Institute (SOCAR) OilGas Scientific Research Project Institute
Sabina Huseynova	GPO Azerbaijan, E&S Advisor	Valeh Karimov	Lead Expert of Offshore Monitoring Administration – Ministry of Ecology and Natural Resources (MENR)
Saadat Gaffarova	BP Azerbaijan Georgia Turkey (AGT) Region Regulatory Compliance and Environment (RC&E), Regulatory Compliance and Permitting Team Acting Leader	Rufat Mammadov	Institute of Geology – ANAS
Nijat Hasanov	BP AGT Region RC&E, Sangachal Terminal and Export Pipelines Environmental Team Leader	Rauf Gardashov	Institute of Geography, ANAS
Gunesh Aliyeva	BP AGT Region Communications & External Affairs (C&EA), Government Affairs Manager		
Colin Simpson	BP ACE Project Topside Delivery Manager		
Robert Waterston	ACE ESIA Project Manager (AECOM)		
Hikmat Abdullayev	ESIA Specialist (AECOM)		
BP provided translator	Kamran Akhmedov		
Presentation pack used during the meeting is available			

No.	Discussion
1.	**Introductions and Purpose of Meeting** Saadat Gaffarova (BP) welcomed attendees and provided a brief overview of the purpose of the meeting. Attendees introduced themselves. Saadat explained that the meeting would involve a presentation and then a question and answer session.
2.	**Overview of the ACE Project and ESIA Process and Findings** A presentation was provided to MTAG covering the following sections:

	• Overview and Purpose – Sabina Huseynova (BP) • ACE Project Overview – Colin Simpson (BP) • Legal Framework and ESIA Process – Sabina Huseynova (BP) • Environmental and Social Baseline – Sabina Huseynova (BP) • Impact Assessment – Robert Waterston and Hikmat Abdullayev (AECOM) • Cumulative Impacts and Accidental Events – Sabina Huseynova (BP) • Environmental and Social Management – Sabina Huseynova (BP) • Monitoring Overview – Nijat Hasanov (BP)
3.	**Question and Answer Session** The following questions and comments were raised during this meeting: **Question (Rauf Gardashov, MTAG):** With regard to the modelling nitrogen oxide (NOx). You said you undertook modelling of the worst case scenario. But I think the worst scenario would be in a strong wind that is blowing from the west directly to the shore as this would result in the most NOx reaching the shoreline. **Response (Nijat Hasanov, BP):** I would like to answer this question as I coordinate the ambient air quality monitoring around the Sangachal Terminal. Firstly, the winds from the north and south are the pre-dominat and most common wind directions throughout the year in the Absheron peninsula and Caspian Sea. Secondly, the modelling under worst case scenario considers the peak emissions and the average of annual weather conditions. **Response (Robert Waterston, AECOM):** The air quality modelling program uses an annual 12 month met file which includes 1 hour sequential met data i.e. 8760 hours of data. This includes wind, humidity, rainfall data etc. Data for the last three years was reviewed for the purposes of the modelling. For NOx, the ESIA presents results for both 1 hour peak emissions and the annual average over 12 months. **Question (Rauf Gardashov, MTAG):** I think you should consider modelling using a worst case wind direction towards the shoreline and I don't think the annual emissions figure is representative of worst case. **Response (Nijat Hasanov, BP):** BP will consider your comments and respond accordingly. **Question (Rauf Gardashov, MTAG):** I'm also not sure that the ESIA has modelled the worst case for underwater sound impacts. Has the modelling considered the different water depths and frequencies of sound and their impacts on fish and seals. Also, there are certain channels in the water where sound can travel further and louder. Has this been considered? Lastly, I don't think you have included all the sensitivities in the presentation. **Response (Nijat Hasanov, BP):** The presentation is only a high level snapshot of the key information. The ESIA presents the detailed results of the sensitivities and likely impacts. **Response (Robert Waterston, AECOM):** The ESIA has predicted the distances at which potential impacts from underwater sound to seals and fish may occur from a range of project activities, such as vessel movements and piling. As a worst case, the highest sound source levels have been used in the assessment. As mentioned during the presentation the thresholds for impact have been established through various scientific studies. **Response (Kelly Goddard, BP):** We will consider these comments and whether any updates are necessary to the ESIA and will respond accordingly. *ACTION: Take comments on modelling worst case scenarios for air quality and underwater sound into account when updating the ESIA document.* **Question (Aflatun Hasanov, MTAG):** During piling activities the ESIA states that the sound impact can change depending on the rock type, etc. and the diameter of the pile. I think there is some inconsistency in the ESIA between the diameter of the pile and the corresponding decibel level produced. **Response (Robert Waterston, AECOM):** Thank you for pointing this out. There are three different types of piles described in the ESIA such as skirt piles and pin piles for the installation of the jacket. The pin piles have the greatest diameter and therefore it was the underwater sound generated by installation of the pin piles that is presented in the ESIA as this is considered to be the worst case.

Response (Kelly Goddard, BP): We will check the document and the translation to ensure that the description of the piling is clear. *ACTION: Review both the English and Azeri versions of the ESIA to ensure that the description of the piling activities and modelling undertaken is clear. Make any necessary changes when updating the ESIA document.*

Statement (Aflatun Hasanov, MTAG): I have noticed a few errors in translation. For instance the Feedback Form says Azeri Central North rather than East.

Response (Sabina Huseynova, BP): Thanks for pointing this out. I will have the forms updated for the Public Meeting. *ACTION: Update the Feedback Forms to ensure that reference is made to Azeri Central East not Azeri Central North.*

Question (Aflatun Hasanov, MTAG): In the slides you mention ACE having lots of objectives. How can you have so many objectives and targets. There should be a single overall objective.

Response (Kelly Goddard, BP): These are overall ACE Project objectives and are not relevant to today's discussion on the ESIA.

Question (Famil Valiyev, MTAG): You mention in the presentation that water based mud and cuttings will be discharged to the seabed during drilling. The WBM consists of approximately 30% chemicals. Why can you not transport them to shore and dispose of them there?

Response (Nijat Hasanov, BP): This is a question for BP not AECOM. The practice of discharging WBM and cuttings from the upper well sections drilling is aligned with international practice and has been agreed with the Government. This is the practice we are keeping to although in future this may be investigated by BP again.

Response (Saadat Gaffarova, BP): BP have previously tested WBM cuttings disposal options and the Government accepted that WBM with cuttings, which meet the relevant Production Sharing Agreement (PSA) standards, would be discharged to the marine environment based on low level of environmental toxicity established through testing done in accordance with Caspian Specific Ecotoxicity Testing Procedure.

Question (Valeh Karimov, MTAG): The discharge of cuttings creates a layer on the seabed where organisms live and this will cause impacts.

Response (Nijat Hasanov, BP): There are business priorities and every operation cause a certain impact. It's impossible to eliminate all impacts although we work to minimise these as far as possible. BP considers all aspects of its operations such as cost and technical feasibility as well as environmental.

Question (Valeh Karimov, MTAG): We understand that this is in line with current operations but new proposals for the future could be considered.

Response (Nijat Hasanov, BP): This comment as well as all other proposals can be taken into account for future consideration. I can re-confirm this with Nargiz Garajayeva (BP AGT Region Offshore Monitoring Specialist Advisor) that drilling activities (particularly discharge of WBM) are fully agreed with the Government and in line with the PSA and international practice. *ACTION: Re-check with Nargiz Garajayeva with regard to monitoring studies of the impacts from the discharge of WBM cuttings.*

Question (Rufat Mammadov, MTAG): The ESIA document is very good despite some deficiencies to be addressed which we have discussed today. Will there be any exploration activities carried out for the ACE Project, such as seismic surveys or explosions? I am a member of the committee that approves seismic work/exploration for ANAS.

Response (Nijat Hasanov, BP): No. Seismic surveys and exploration activities have been undertaken previously during earlier investigations of the ACG field.

Response (Kelly Goddard, BP): The Project will move straight to drilling and production.

Question (Rufat Mammadov, MTAG): In Chapter 6.3 Physical and Geophysical Environment there is reference to geology data acquired in 1995. In the scoping meeting I made reference to this. New schemes and maps have been acquired during the last 15 years. Therefore, I would recommend updating the map shown in the ESIA.

Response (Robert Waterston, AECOM): We have presented an updated figure of geohazards relevant to the ACE platform location, such as mud volcanoes, in the ESIA which has used the latest information from BP's internal data sets built up over a number of years from various surveys and studies.

Question (Rufat Mammadov, MTAG): There are some new mud volcanos in the area and I recommend that you add this information. You can use the Mud Volcano Atlas, a book dedicated to the mud volcanoes of the world which was prepared by experts from ANAS and includes information on Azerbaijan mud volcanoes. It is a good source of information for the ESIA which should include a section on geology and seismic matters. The ESIA also uses old seismicity data. The last 18 years have witnessed a lot of seismic activity which is not reflected in the document. Tables and maps of offshore earthquakes that have occurred should be used.

Question (Robert Waterston, AECOM): Do we have permission to use this data in the ESIA?

Response (Rufat Mammadov, MTAG): You can use the data in the Mud Volcano Atlas but it only exists in hard copy, there is no electronic version. The book can be purchased from ANAS. We can also provide consultancy services and could update the geology section of the ESIA for you. Geology information is also available in journals but you would have to apply to use this data. If you want my support as MTAG member I can direct you to the right specialists to obtain all the updated baseline information.

Response (Kelly Goddard, BP): Thank you for the information. We will discuss as a team how we will address your recommendations. *ACTION: BP and AECOM to discuss the approach to update the geology baseline section of the ESIA and make relevant updates to the ESIA document.*

Saadat Gaffarova (BP) concluded the meeting by thanking MTAG members for a useful meeting and their questions and comments. A formal response to the comments will be issued and the ESIA document updated accordingly.

4. **Summary of Actions**

Who:	**Action:**	**When by:**
KG (BP) & RW (AECOM)	Take comments on modelling worst case scenarios for air quality and underwater sound into account when updating the ESIA document.	In final version of the ESIA - to be released in February 2019.
RW & HA (AECOM)	Review both the English and Azeri versions of the ESIA to ensure that the description of the piling activities and modelling undertaken is clear. Make any necessary changes when updating the ESIA document.	In final version of the ESIA - to be released in February 2019.
SH (BP)	Update the Feedback Forms to ensure that reference is made to Azeri Central East not Azeri Central North.	31 October 2018.
NH (BP)	Speak with Nargiz Garajayeva with regard to monitoring studies of impacts associated with the discharge of WBM cuttings.	30 November 2018.
KG (BP) & RW (AECOM)	BP and AECOM to discuss the approach to update the geology baseline section of the ESIA and make relevant updates to the ESIA document.	Approach to be agreed by 23 November 2018 and updates in final version of the ESIA - to be released in February 2019.

Azeri Central East (ACE) Project Environmental & Social Impact Assessment (ESIA) Public Disclosure Meeting

Date: 31/10/2018	Time: 10.00	Location: Holiday Inn, Baku

Attendees:

No.	Name	Organisation
1.	Taleh Musayidov	TREND
2.	Saadat Gaffarova	BP Azerbaijan Georgia Turkey (AGT) Region – Regulatory Compliance and Environment (RC&E)
3.	Mirivari Gahramanli	International Oil Workers
4.	Tamam Bayatly	BP AGT Region – Communications and External Affairs (C&EA)
5.	Babek Hamidov	BP, C&EA
6.	Aliya Gaisimova	Institute of Toxicology and Physiology Laboratory
7.	Rovshan Akhundov	Institute of Toxicology and Physiology Laboratory
8.	Rauf Qurdashov	Azerbaijan National Academy of Sciences (ANAS)
9.	Gunel Abbasova	News Reporter
10.	Lada Yevgreshkova	ASTRA
11.	Rena Kashkay	Institute of Geography
12.	N. Ismaylov	Independent Consultant, ANAS
13.	Movsumov Shamil	Independent Consultant
14.	Nabizade Z.O	Ruzgar
15.	Arif Mekhdiyev	Institute of Toxicology and Physiology Laboratory
16.	Grigoriy Polatnikov	Institute of Toxicology and Physiology Laboratory
17.	Guivami Rahimli	BP AGT Region – C&EA
18.	Elnara Mamedova	BP AGT Region – C&EA
19.	Islam Mammadov	Sulaco Ltd
20.	Elmara Aliyeva	CBC TV
21.	Javid Gadirov	CBC TV
22.	Nihad Babayev	Azertac
23.	Qoshqar Mammadov	ANAS
24.	Davud Rahimli	Union for Organization of the Disabled
25.	Khatira Abbasova	Ministry of Ecology and Natural Resources (MENR)
26.	Narmin Babayeva	Real TV
27.	Farkhad Rustamov	ANAS
28.	Ilyas Babayev	Institute of Zoology
29.	Emil Rzayev	Real TV
30.	Qiyas Quliyev	Institute of Zoology
31.	Telman Mammadli	ITV
32.	Ilgar Abdullayev	ITV
33.	Flora Sadigova	-
34	Natavan Tagiyeva	Equinor
35.	Ibrahim Hashimov	Khazar TV
36.	Fagan Aliyev	Khazar TV

Attendees:		
No.	**Name**	**Organisation**
37.	Valeh Karimov	MENR
38.	Vugar Hasanov	MENR
39.	Marat Huseynov	GPNC
40.	Tatyana Javanshir	Independent Expert
41.	Sohrab Rahimov	Independent Expert
42.	Emil Hajiyev	“Shaffaf Idarachilik”
43.	Sabit baghirov	EDF
44.	Farah Isayeva	Equinor
45.	Asiman Aslanov	AzTV
46.	Ilham Mammadov	AzTV
47.	Akbar Askarov	MENR
48.	Sabah Nasirov	“IID” Social Union
49.	Rufat Shikhiyev	“IID” Social Union
50.	Sadig Hasan	-
51.	Ilham Shabanov	Caspian Barrel
52.	Chimnaz Shabanova	Eco Scope
53.	Haydar Mammadov	Social Organisation
54.	Vusal Babayev	Reuters
55.	Aytan Abbaszade	BP
56.	Farida Huseynova	Chairman of the Green Movement of Azerbaijan
57.	Rufat Mammadov	ANAS
58.	Kelly Goddard	BP Global Project Organisation (GPO) – Environmental & Social Manager
59.	Colin Simpson	BP – ACE Project Topside Delivery Manager
60.	Sabina Huseynova	BP GPO Azerbaijan – Environmental & Social Advisor
61.	Maria Scarlett	BP GPO Azerbaijan – Environmental & Social Lead
62.	Robert Waterston	AECOM – ACE Project ESIA Project Manager
63.	Hikmat Abdullayev	AECOM – ESIA Specialist
64.	Kamran Akhmedov	Translator

No.	Discussion
1.	**Introductions and Purpose of Meeting** Tamam Bayatly (BP) welcomed attendees and provided a brief overview of the purpose of the meeting. Tamam Bayatly (BP) then provided an overview of the recently completed Shah Deniz Stage 2 (SD2) Project which was delivered on time and to the highest environmental standards. Tamam Bayatly (BP) provided an overview of the history of the development of the Azeri Chirag Gunashli (ACG) which started with the signing of the ACG Production Sharing Agreement (PSA) in 1994. Tamam Bayatly (BP) explained that the ACG Contract Area has been developed in stages and now that an extension to the PSA was signed in 2017 that BP are prepared to invest in the next stage of development – the Azeri Central East (ACE) Project. Tamam Bayatly (BP) explained that although the Final Investment Decision on ACE will not be made until March 2019 the ESIA has been prepared, as has been the case for previous projects. Tamam Bayatly (BP) encouraged attendees to make comments on the ESIA during the Question and Answer Session to be held following a presentation from BP and their independent ESIA consultants AECOM.
2.	**Safety Induction** A representative from the Holiday Inn welcomed everyone to their hotel and provided a safety induction to explain the fire alarm system and evacuation procedures in the event of an emergency.
3.	**Overview of the ACE Project and ESIA Process and Findings** A presentation was provided to covering the following sections: • Agenda and Purpose of the Meeting – Sabina Huseynova (BP) • ACE Project Overview – Colin Simpson (BP) • Legal Framework and ESIA Process – Sabina Huseynova (BP) • Environmental Surveys – Sabina Huseynova (BP) • Impact Assessment – Hikmat Abdullayev (AECOM) • Accidental Events – Hikmat Abdullayev (AECOM) • Employment and Social Investment – Tamam Bayatly (BP) • Environmental and Social Management – Sabina Huseynova (BP) Following the presentation Tamam Bayatly (BP) welcomed questions from the attendees.
4.	**Mirivari Gahramanli, International Oil Workers** Thank you for the presentations. I have three questions: **Question 1:** Question for Hikmat. When you prepared the assessment, did you compare the ESIA of the ACG Full Field Development (FFD) to the ACE ESIA? We send requests annually to the Ministry of Ecology and Natural Resources (MENR) about what the impact of pollution from the oil and gas companies is to the Caspian. In last 5 years, the BP company has been penalized for the amount of more than 1.2 million Azerbaijan Manats (AZN). The penalties issued to BP in 2016 totaled for 174k AZN and 184k AZN in 2017. The increase in penalties means that something in BP's operations is not right and that environmental commitments are not being fulfilled appropriately. Therefore it is suggested to undertake a benchmark or a comparison study to understand why penalties for discharges are increasing and to prevent and minimize these discharges in future. I will send this comment in writing. Who pays the fines – BP or AIOC? The fines demonstrate that there are some problems with discharges, How are you making sure that the same events will not take place again at the new project? **Response (Hikmat Abduallayev, AECOM):** We have reviewed all of the historical monitoring studies undertaken by BP and compared the results with the latest survey findings, including at the proposed ACE platform location, within the ESIA. **Response (Saadat Gaffarova, BP):** Regarding the history of the fines, BP works in accordance with the PSA. If there is an unplanned spill we have to report to the state. In consultation with the MENR it was decided that even if 1 litre (L) is spilled without permission we should inform the state. If there is a spill over 50L we inform the state immediately verbally and then in writing within 3 days. BP and the MENR agreed on a framework to pay compensation for spills and unplanned discharges of materials to the environment. Protocol on compensation calculation mechanism was worked out together with MENR and signed between BP and MENR. The compensation is paid to the State Environment Protection Fund at the Finance Ministry. We are using this mechanism now. Penalties and compensation is based on the volume, persistence, location and

	hazard of the spilled material. Using these criteria, the compensation is agreed with the Government once the list of reported unplanned releases is submitted. This year penalties from spills have been very low as BP have made great reductions in untreated sewage discharges and unplanned discharges of produced water (PW). All spills are investigated and modifications and remediations made and lessons learned are incorporated into future processes to avoid these types of events in future. **Question 2:** Social investments. We have benefited from this. The social investment programme. BP has partnered with the Heyder Aliyev foundation. What about the civil society – in Garadagh region where there are a lot of NGOs. **Response (Tamam Bayatly, BP):** Previously I spoke about social investment with BP and its partners. BP works with the Government to sponsor cultural events and also has 100% BP funded sponsorship. We are happy to say that we participated in the 100-year anniversary with the funding of a book which details all the founders of Azerbaijan. The second project involved working with the Baku Media Center where we sponsored the movie which depicted the time full of tragedy from the 28 April 1918 when Azerbaijan Republic Government was forced to resign and the country surrounded by the Bolsheviks. BP also sponsors sporting events such as the European games and the Islamic games and athletes such as Ilham Zakiyev. You can see posters of this athlete in London. We decided to sign a Memorandum of Understanding (MOU) with Heyder Aliyev Fund (HAF) to hold some big exhibitions together and if they have some proposals we will review and consider them. In terms of social investment with the partners we will continue these projects. **Question 3:** Is SOCAR-KBR? BP pays better compensation when workers are made redundant. What are the jobs given to Expats? How BP makes sure that there is no discrimination in the employment process within their contractors? In the contractor companies, we have nepotism when people bring their own relatives. Does BP pay attention to this? For the sake of our work we need the best workers and to ensure that the law is followed with all contractors. We have a court case with one contractor company. **Response (Tamam Bayatly, BP):** The ACE Project will employ approximately 3,700 and will target 90-95% of employment to come from local communities. Workers from these communities are attractive to BP because they have the necessary skills and are lower cost with regard to BP's permanent staff in Azerbaijan; by 2018 we had a plan that 90% of BP staff will be Azerbaijan nationals. We achieved this in July this year. We have Azerbaijani Vice Presidents who are managing Sangachal and platform managers as well. We will try not to bring expats from outside Azerbaijan when it is not necessary. We work with state immigration service who oversees us very closely and we try not to bring in expats where we have national skillsets in Azerbaijan. In regard to contractor companies – we try to select contractors that comply with our standards. We have three key criteria on choosing contractors: can they meet the schedule, is their price competitive and can they meet BP standards. If a company can meet these three criteria we will also look at their code of conduct and ethical standards and if there are issues with this, we will not work with them. Occupational safety rules are also important and if a company does not follow these rules, we will not work with them. However, we cannot interfere with the internal HR issues within the companies. They are independent entities even if they are working for BP.
5.	**Arif Mekhtiev, Head of Department of Physiology, Azerbaijan National Academy of Science (ANAS)** **Question:** Professor Mekhman Akhundov and the Scientific Research Institute of Fishing Industry who contributed to the ESIA does not have the facilities to say that there will be no impacts to fish. With my colleagues we have tried to evaluate the physiological impacts of BP activities on fish and other living organisms that consume the fish. The ESIA does not include any information on the physiological impact, including chronic impacts. However, they could not conduct the full study of little effects of small organisms. This needs techniques which do not exist in these institutions. This study focused mainly on the acute effects and these are long standing effects as well as cross generational effects. There is not enough capacity in the Institute to provide a proper study and specific analysis. **Response (Robert Waterston, AECOM):** Thank you for your comments and for helping me by asking your question in English. As you point out the ESIA does not focus of the potential physiological impact to fish as a result of activities. The ACE activities are based approximately 90km offshore and due to the migratory nature of fish and lack of indicator species offshore it is not considered credible to conduct surveys as it would be difficult to attribute the causes of any abnormal results found. However, BP have carried out fish surveys in Sangachal Bay where there are indicator species that live in this area permanently which makes the surveys

	and analysis a useful indicator of fish health. However, further offshore this is more difficult to measure so we can't provide the specifics for that region. **Response (Saadat Gaffarova, BP):** We have a robust Environmental Monitoring Programme (EMP). As mentioned we have done fish surveys in Sangachal Bay within the SD2 Project framework. The report which was prepared by local scientists did not show issues. We have not done offshore surveys for fish as this would not make sense due to the very wide migration of fish. If you have publications, please share and we will consider them.
6.	**Shamil Movsumov, Independent Expert** **Question 1:** I would like to understand if during the first ESIA process conducted for the ACG Contract Area, did BP analyse the results of the monitoring conducted by other companies in that area. For the ACE Project, did BP compare the results of the first surveys conducted in the ACG Contract Area during and prior to ACG Phase 1, 2 and 3 to now? Was there a comparison study conducted to understand the changes in the ACG Contract Area since the installation and operation of the BP platforms. **Response (Robert Waterston, AECOM):** We have considered all available data in terms of monitoring that BP has undertaken in the region as well as all other studies in the public domain (ESIAs, etc.). The comparison of results show that although there have been fluctuations in results of monitoring, in the past 3-4 years the results have been fairly consistent. The results of surveys undertaken at the proposed ACE platform location show that seabed and water column conditions are very similar to conditions at the Central Azeri platform. The baseline study at ACE will allow us to monitor the impact of BP operations at ACE going forward and compare this to the results of other areas monitored in the ACG Contract Area. **Question 2:** Second question on oil spill modelling. In terms of the ACE Project what are the chances of oil to reach the shoreline in case of an oil spill and what would be the impact. **Response (Robert Waterston, AECOM):** We assessed three different scenarios. First was a spill of diesel that is stored on the platform. The modelling showed that the diesel would not travel very far due to evaporation and dispersion and the impacts would be limited with no diesel reaching the shore. The second scenario was a potential pipeline rupture of the new oil pipeline between ACE and CA platforms. This scenario may result in a very small quantity of oil reaching the shore in Azerbaijan. The third scenario modelled was a potential well blowout during drilling at the ACE platform location. The potential worst case blowout scenario information was identified by BP's specialist reservoir and drilling engineering teams. The modelling assumed an absolute worst case that the blowout would last 90 days as this is the maximum time it would take to drill a relief well to stop the blowout. In the event of a blowout the oil would reach a number of areas along the Azerbaijan coastline. Please note that the spill modelling figures presented in the ESIA have assumed an absolute worst case with no mitigation or response measures implemented. BP have an comprehensive Oil Spill Contingency Plan which has been developed in conjunction with partners and approved by relevant Government agencies which would be implemented to limit the spread of oil and any associated impacts of the spill.
7.	**Sadiq Hasanov, Independent Expert** **Question 1:** The presentation stated that the volume of greenhouse gases (GHG) generated by BP activities in Azerbaijan will increase by 8% due to ACE platform operations and then presentation provided information on impacts of nitrogen oxide (NO_X). Presentation did not provide information on volumes of the carbon dioxide (CO_2) or methane (CO_4) so what will be the increase? **Response (Robert Waterston, AECOM):** We have presented some of the key results of the air quality modelling for NO_X in the presentation as this is the key pollutant with regards to human health. With regard to CO_2 and CH_4, we have included estimates for these gases for each phase of the project in the ESIA. The ESIA also provides estimates for emissions of sulphur dioxide (SO_2) and volatile organic compounds (VOCs). **Question 2:** Will you use diesel fuel or petrol? Will it be SOCAR produced or imported? What about the sulphur content? **Response (Robert Waterston, AECOM):** Diesel will be used for a number of activities during construction and by vessels. Although the construction yards will use power from the grid there will also be a number of

	mobile diesel powered generators and commissioning activities that will use diesel. Diesel for vessels contracted by BP will use low sulphur diesel from BP's diesel tank farm, which monitors the sulphur content of the diesel to ensure it meets BP's low sulphur content requirements. During operations offshore the platform will be powered using gas produced from the wells and will also have a power cable from the EA platform. Gas is a much cleaner fuel than diesel. The only times the platform would be powered by diesel would be if there is an issue with the gas supply then the power turbine could be run on diesel. This event would not often occur and would likely only be for a short time. **Question 2:** According to Azerbaijani legislation, noise levels caused by industrial activities shall not pass 90-95 dB at the residential locations. The presentation stated that you have applied 65 decibel (dB) noise limit for onshore construction activities. Need to be more realistic as this limit of 65 dB does not seem to be possible to meet considering the scope of construction activities expected to be required for the ACE Project. **Response (Hikmat Abdullayev, AECOM):** 65dB is the day time noise limit, which is aligned with international standards. The presentation shows that this limit will be complied with at 500m distance from the noise source located within the construction yard. Therefore, due to the distance of the closest receptors (residential area) from the construction yards used for the ACE Project, there is no impact predicted to be generated by the ACE construction noise.
8.	**Rena Qashkay, Department of Geology (ANAS)** **Question:** Can I please be provided with a copy of the presentation? **Response (Tamam Bayatly, BP):** Yes, a copy can be provided after the meeting.
9.	**Representative from Hayajan Environmental Organisation** **Question 1:** In 2012 on Chirag platform there was a constant flaring. There were articles in the press regarding continues flaring activities at the Chirag platform which was even discussed in some conferences held in Geneva. Now is the bird migration month. When gas is flared on the platforms, birds fly into the flare and die. Are there any biotechnical facilities planned to be installed to reduce this impact at the new platform? In previous facilities nothing was installed. There should be artificial islands created which birds could sit on as opposed to the platforms. Hundreds of dead birds have been found around the platforms. Have you ever gathered the dead birds and carried out research on them? **Response (Hikmat Abdullayev, AECOM):** We work with local bird specialists such as Ilyas Babayev to obtain the latest information on birds with the aim of examining ways to reduce impacts. **Question from Ilyas Babayev (author of ACE ESIA Bird Report, Lead Scientist of Institute of Zoology, ANAS):** Where did you find these hundreds of dead birds and when? We have undertaken monitoring for the past six years and we have found one dead bird during our monitoring activities, which did not have to do with oil and gas activities. When gas is flared, they do not approach the flare. Birds mostly fly within 10km of the shoreline and do not regularly fly to the ACG Contract Area. **Response (Saadat Gaffarova, BP):** Regarding flaring and climate change. This is a big focus for our company and the region. A lot of work has been carried out since BP operations started in Azerbaijan to minimize flaring on all platforms. One of the obligations is to minimize routine flaring to almost zero. However, for safety or maintenance reasons flaring must occasionally be undertaken. BP has a 5-year flaring reduction plan. Modifications will be carried out and we will reduce the volumes of flaring as much as possible. **Response (Tamam Bayatly, BP):** Regarding Chirag, we implemented a programme with SOCAR to reduce flaring on Chirag. SOCAR upgraded their equipment and can accept our associated gas which has hugely reduced the volumes of gas that are flared. The World Bank rewarded us and SOCAR for this project so we consider that this is no longer an issue at Chirag.
10.	**Person did not introduce their name or organization** **Question 1:** Terminal Flaring – I have noticed that the flare stack at Sangachal Terminal seems to get higher and flaring seems to be more frequent. I assumed that there will be more associated gas coming onshore due to ACE Project. Can you confirm that existing facilities at the Sangachal Terminal have the capacity to accept the additional gas? Can you install generators to use this gas instead?

	Response (Tamam Bayatly, BP): We will clarify the reasons for the increased flaring at the terminal. As you are aware, for the SD2 Project, we have made modifications to the terminal. Merging the existing facilities with SD2 facilities could have led to the flaring you have witnessed. **Response (Saadat Gaffarova, BP):** The merging of the facilities should reduce routine flaring to almost zero but for emergency or certain other types of cases we do have to flare occasionally.
11.	**Rovshan Abbasov, Independent Expert to MENR** **Question 1:** I have made 52 questions which I have submitted to you for consideration on behalf of MENR. There are some issues I have identified, for example sewage treatment issues and the venting of CO_2 with no mitigations planned. With regards to GHG emissions we understand that all emissions mitigation measures will be included in the 10 years reduction programme for flaring. There is also a comment that microbes (bacteria) will eat the diesel. This is not the case. Why did you write that in the ESIA? We expect the answers to these questions. Please review in detail. **Response (Tamam Bayatly, BP):** Yes, we will review these questions in detail and respond.
12.	**Shaban Nasirov, Public Participation Support Social Union** **Question 1:** I work and live on the shoreline. For the past 3-4 years we have not seen any dead seals. This is surprising. A programme I saw on TV also showed no life on the seabed. What about the chemicals released from the wells? I'm surprised your presentation stated that there will be no impact from BP's discharges to the Caspian. Can BP provide some results of the underwater monitoring – perhaps underwater filming of underwater fauna? Did BP consider any oil cleaning initiatives on the sea? **Response (Saadat Gaffarova, BP):** Regarding underwater filming, we did this from the monitoring point of view for sediments, flora and fauna change. If you have information on flora and fauna change, please share with us. On seals, we have done seismic survey monitoring work before and we have an idea to publish a book on seals. **Statement (Mirivari Gahrammamli, International Oil Workers):** I have visited BP platforms and couldn't see any oil around them. BP's impacts are very small compared to others. Have a look at the Oil Rocks and SOCAR platforms on the Caspian Sea, which discharge a lot of material to the sea. **Question 2:** Second question is regarding social investment. We have not seen these details? Which projects and is this information on your website? What educational activities have you provided that you can describe? **Response (Saadat Gaffarova, BP):** If you have a proposal please submit them to Tamam's team for evaluation. **Response (Tamam Bayatly, BP):** Regarding Education. Our support starts from kindergartens to secondary schools and contributed millions of dollars on laboratories. Faculties opened where previously students had to go abroad and now we have faculties now working (QAFQAZ) so students do not have to go abroad. This as well as labs. Most well-known publications in field of economics abroad are used to teach and we have invested in translating well known books and literature so Azerbaijani students can learn using these books. We have also invested millions of dollars in the data management which can be used at the space centers (ADA University). Highly specialized computers. We are sponsoring the masters degree so that Azerbaijani students can obtain these. We have established the Project Management School. This was done by a foreign company and we put a condition to develop locals and this now has been transferred to national university to lead. In addition, we told to the Ministry that we can support IT skills. We have identified 25 pilot schools. Two IT teachers will be trained. IT skills are so important for the future. If it is successful, this will be included in the school curriculums. In Sangachal and Garadagh Region, we select very skillful students and we support them for one year so they don't have to pay for tuition as they are generally poor families in these areas. We also support a lot of proposals for kindergartens. We have done a lot of work in the field of education and work with the Ministry of Education and the institutions. We expect to support very big projects which will make great changes in the field of education. **Question 3:** Third question: If there has been an oil spill, can BP donate vehicles to assist with cleaning-up

	the beach for example? Odour is coming from platforms and spreads in kilometers, the fishermen know that it comes from the platforms. Has BP cleaned up some polluted areas? As citizens we are interested. **Response (Tamam Bayatly, BP):** Small fishing boats are not in the Contract Area as they only fish within 5-10km. I have been on the platforms and you can see the water from the platform but not the sediment. The SD2 platform is in 500m deep water. When we install the platforms the divers have filmed fish and seals around the platforms.
13.	**Farida Huseynova, Chairman of the Green Movement of Azerbaijan** **Question 1:** During the discussions so far, I was able to get some answers to my questions. The situation is the following: Flaring at Sangachal and on the platforms. We discussed this in 2012 and later I applied to BP to look at other ways to use associated gas. Now you can transport some of the gas to SOCAR but flaring is still being conducted for emergency reasons and more gases will be release to atmosphere. And the flare will be increased with the new project proposed. I have had a proposal for the emergency gas to create a big reservoir at Sangachal and those gases can be collected by compression and sent away by gas pipelines until the emergency is finished. Doing so will stop flaring and polluting the air. In 2012 or 2013 BP joined the World Bank flaring programme which said zero flaring. BP justifies flaring for emergencies but this does not sound credible and if you had such reservoirs and dispose of associated gas it would be better. Saadat mentioned that there is a 10 year programme somewhere on the website – we would like to review these and see why these programmes are not working. It is good that BP got a prize from the World Bank for the flare initiative however, the flare is still there are should be alternatives to the flare. The population can still see flaring and it cannot be visually detected that flaring has been reduced. **Response (Saadat Gaffarova, BP):** The company has commitment to reduce the routine flaring. However, capturing all gas is not possible depending on gas fraction and for safety reasons flaring has to happen. As for the plan, there is the company five year Routine Flaring Reduction Plan and ten years GHG Sustainable Emission Reduction Plan. We have the annual sustainability report with reflects on progress of the plans which is placed on the website. If you want to get to get information on what we have done you can find it there. **Question 2:** I get a copy of the report at oil and gas conference every year. It would be better to get them before they are issued so we can have some comments on it. **Response (Saadat Gaffarova, BP):** Yes, we present this at the annual Caspian Ecology Exhibition. You can come and get information there. The next Environmental Exhibition is to be on November 14-16. **Question 3:** You [Tamam Bayatly, BP] mentioned ADA university for big data and that BP provided super computers but why do diplomats need this? They are diplomats/humanitarians. Could you not have given these to an Industrial University or Baku State University as this would have been more useful. For the future, please think about other universities. **Response (Tamam Bayatly, BP):** BP do not approach the university, they apply and provide very good proposals. We have selection criteria. One of those criteria is that projects must be sustainable and that they must be able to continue once BP stops funding. If they cannot sustain a project and the computers will rust, we will not support these investments. We will invest in projects which bring change. E.g. The movie, the Last Meeting. They came to us and proposed the script. It is history. We will consider in investing in projects that meet our criteria. **Question 4:** I work at the ANAS as lead scientific researcher. At ANAS we have Masters, Bachelors, Doctorship courses. I would suggest for BP to look to the existing educational courses at the ANAS and include these courses to BP's education support programme. ANAS graduates are ultimately the people that BP will be using in future as local specialists and expert, so it would be only in BP's interest to invest into the educational programmes provided by the ANAS.
14.	**Grigoriy Polatnikov, Institute of Toxicology and Physiology Laboratory** **Question 1:** Our laboratory has been working for the last 40 years and has gained recognition by number of local and international organisations that we worked with. I'm surprised to hear that Professor M. Akhundov said that BP's oil and gas activities do not have impact on the physiology of fish. Our laboratory did the

	monitoring of Sangachal Bay and Akhundov's role was to supply the live fish for our analysis. We established zones where impact was high and impact was low. Monitoring was conducted from 1996-2006 before being stopped. These surveys showed the difference in fish health between clean and polluted areas and that there was an impact. Then a round of monitoring was conducted from 2012-2013 and since then no monitoring as done. However, it would be good to see how different the condition of the Bay now. We are working on the Governmental monitoring program now (it is related to the recent announcement on the Caspian Sea division between the neighboring States: Russia/Iran). As Russian and Kazakhstan have been doing their monitoring for number of years, I presume that Azerbaijan will need to start the program very soon to avoid criticism from the other countries. I advise that monitoring at Sangachal and wide areas of shoreline is started again. If it is Professor Akhundov who made the monitoring for your program, then I wouldn't trust his works. **Response (Saadat Gaffarova, BP):** Did you share your results with us? The last monitoring in Sangachal Bay which was carried out for the SD2 Project was conducted in 2015. This examined concentrations of various chemicals on the tissues of fish and was submitted to MENR. Based on the results, there is no problem as far as I know. **Question 2:** We did not provide the results of our work. Who sent the results? No one in our team was consulted on these results. Our monitoring results show differently. **Response (Saadat Gaffarova, BP):** Unfortunately, our Offshore Monitoring Representative Nargiz Garajayeva is ill and could not attend today. We will come back to you on monitoring after consulting with Nargiz. Perhaps we can set up a meeting to discuss both sets of results. *ACTION: Saadat Gaffarova to speak with Nargiz Garajayeva about setting up a meeting with Grigoriy Palotnikov (Institute of Toxicology and Physiology Laboratory) to discuss the results of fish monitoring results and potential future monitoring.* **Question 3:** We do not agree with how Professor Akhundov's has interpreted the monitoring results. **Response (Hikmat Abdullayev, AECOM):** Can I please clarify that Professor Akhmundov's provided information on fish species and their locations and migration patterns, not on toxicology or impacts from oil and gas activities. It was not his scope of work to interpret potential impacts on fish from ACE Project activities. The ACE Project is over 100km from Sangachal Bay and the results of surveys undertaken there are not relevant to this Project. Based on the information we have been provided and the location of the Project the potential impact of project activities on fish and fishing was evaluated as minor. **Question 4:** Based on our ecological assessment of Sangachal Bay, cats and dogs will not eat the fish from there. **Response (Tamam Bayatly, BP):** You can contact Nargiz from our offshore monitoring division. We have not seen any concerns. As a company working offshore, we do the monitoring of the area we are operating in.
15.	**Sadig Bagirov, Representative from the Entrepreneur Fund** **Question 1:** I don't have a question but some proposals: 1) You mentioned three criteria on the selection of contractors. Can you please include another – transparency of beneficiaries who would benefit if contractor was selected. 2) Jobs – when people are unemployed it adds some stress. Prior to demobilization, can you offer some training to teach them how to move on after they have been redundant, how to find a new job or maybe start their own business. 3) I'm thankful for the movie and publication for the 100 years of democratic republic book – can you please publish the video on YouTube and on your website. **Response (Tamam Bayatly, BP):** The Azerbaijani version is on YouTube already. We will also place the English version on YouTube in the future.
16.	**Tatyana Javanhsir, Independent Expert (former MENR)** **Question 1:** Can I propose that BP organize a public meeting dedicated to all BP operations as a lot of the questions today are not specifically about this Project? The meeting would be useful to cover questions on monitoring, cumulative impacts, etc. **Response (Tamam Bayatly, BP):** Yes we can consider organize such a meeting. *ACTION: Tamam Bayatly to discuss with BP AGT Region colleagues the possibility of setting up a Public Meeting to discuss wider*

	environmental issues associated with BP's operations in the region.
17.	**Chimnaz Shabanova, Non-Governmental Organization (NGO)** **Question 1:** In the ESIA report, you mentioned the European Union (EU). Does the EU coordinate you? Are you in line with the latest trends and EU programmes? **Response (Hikmat Abdullayev, AECOM):** EU conventions which Azerbaijan ratified apply. **Question 2:** In accordance with the EU there are different goals e.g. by 2021 single use of plastics should be eliminated. What does BP do about sustainable production? **Question 3:** You involve contractors for disposal of waste. You mentioned before that there is big corporation and about 10000 jobs. Some of the workforce will use rubber gloves which after use should be disposed. Which company does this and how do they do this? According to my information, these previously were burned and this produces dioxin emissions which is very hazardous pollutant. **Response (Hikmat Abdullayev, AECOM):** There are number of control measures applied in the waste management processes carried out by BP in Azerbaijan. Each hazardous waste stream generated by BP activities is provided by a Waste Passport issued by the MENR. Depending on the type of waste it will be sent to different disposal facilities which are agreed and approved by BP and the MENR. Each facility will have a valid operating license issued by the MENR and MES. **Statement (Tatyana Javanhsir, Independent Expert (former MENR)):** You should have raised this question when the waste processing facility was constructed. Emissions of dioxides are minimal when you follow the correct treatment process (incineration). **Response (Saadat Gaffarova, BP):** As part of BP's waste management system the waste is segregated by categories. Contractors are selected to dispose of waste. BP are not a waste disposal company. We are dealing with oil and gas and have contractors to deal with the disposal in accordance with the BP Plans and Procedures. **Question 3:** Who have you chosen as your contractor for the disposal of gloves? **Response (Tamam Bayatly, BP):** This question is not relevant to this report. **Response (Saadat Gaffarova, BP):** Waste is segregated at source at BP's facilities and final disposal/treatment destination for each waste stream is identified through a tender process. There are a number of waste streams generated by BP facilities and number of licensed sub-contractors that BP uses on daily basis for waste management processes, therefore it is difficult to point out who exactly deals with the rubber gloves and the disposal route of this waste stream. We will confirm this with the AGT Region Waste Management Team and will get back to you. *ACTION: Saadat Gaffarova (BP) to contact AGT Region Waste Management Team to obtain details on the waste management and disposal of rubber gloves. Saadat Gaffarova (BP) to share this information with Chimnaz Shabanova (NGO).*
18.	**Davud Rahimli, Union for Organization of the Disabled** **Question 1:** Thank you for your presentation. You mentioned BP sponsorship of disabled sports people and we are proud of Zakiyev. I have a proposal. You mentioned that you mainly support education and culture. In addition, it would be great if you could support disabled people in the regions with training and finding employment. You know according to national legislation; a Company has to follow a quota to have a certain number of disabled workers. I want BP to support this. Also, occupational safety at some contractor sites is not good and people have become injured or disabled. Please do what you can these sites safe and pay attention to these companies. **Response (Tamam Bayatly, BP):** We have such a programme that supports employment of the disabled which we sponsor but we could look to make it more sustainable. More than 100 have been involved. In addition to this, those who work with the organizations can employ those persons. In the committee we have skills in IT area. We had the programme which has run for the last year. We have disabled persons in our staff. There are disabled working at BP and we want the other organizations to join this initiative. Babek is managing this project. Let them join us. It is not just training, we also create contacts between disabled

<table>
<tr><td></td><td colspan="3">people and organizations and identify roles for disabled people. We have supported a project to identify children who are disabled or have potential. Contact with Babek and he can provide context. We work with the Ministry of Labor and representatives participate. I want to make a presentation for the trainees and involve public associations. We want all organizations joined to this initiative. There are disabled people who have a good brain and may have minor physical disabilities. So, BP is working with the Ministry of Labour so that children with minor deficiencies can attend the same school as non-disable children. One such story relates to a child who had a problem with their fingers, but their intelligence level was just as good as other children their age. With help measures were taken for this child to attend a normal school.

Question 2: Can I please ask you to use these terms everywhere – with disability and without disability. Thank you.</td></tr>
<tr><td>19.</td><td colspan="3">Jamil Hajiyev, Transparent Governance

Question 1: Does BP have any plans to incorporate new technologies such as low energy lighting of new systems or hydrotechnical energy (renewables).

Response (Robert Waterston, AECOM): BP have considered the use of renewable energy technologies such as solar and wind power for offshore facilities previously during earlier phases of development in the ACG Contract Area. To date it has not been found to be feasible due to technical and operational limitations and constraints, however renewable energy technology is improving all the time and their use as part of an integrated power source offshore could be revisited and re-examined in the future.

Question 2: It is important to protect the environment such as birds, fish etc., but the people of Azerbaijan are more important. There are 3 million people who live in the central lowlands who use dirty water. Problems in regions with clean water supply. Use water from dirty river. It has been confirmed by the MENR they cannot use the water from the Kura River and use artesian water. Can BP support projects to help with the water supply?

Response (Tamam Bayatly, BP): We have not received such requests before. We believe you, and your monitoring. We do visit villages and meet with communities to understand their needs and assist with training and skills. For example, if we receive a request from a certain community asking us to help them to repair the main road that passes their village, we cannot ignore their request and sponsor the projects that we think are more important for them. BP has a process in place which helps to assess and evaluate the situation based on the most crucial issues that communities faces and help them with these issues first. This process involves surveys, interviews and data collection from the communities and etc. We have a social investment budget. We have people who work across the communities and pipelines. Every day they meet with communities. We supported a new project on bee keeping and honey production. Training and equipment was supplied and the most prominent textbook was translated for them. This has been very successful. For the building of equipment and facilities I think should apply to State agencies to help these villages. You are welcome to submit a relevant proposal.</td></tr>
<tr><td>20.</td><td colspan="3">Meeting Close
Tamam, Bayatly (BP) thanked everyone for their participation and questions and reminded them that if they had any further questions or comments there was still time to submit these.</td></tr>
<tr><td rowspan="5">21.</td><td colspan="3">Summary of Actions</td></tr>
<tr><td>Who:</td><td>Action:</td><td>When by:</td></tr>
<tr><td>Saadat Gaffarova (BP)</td><td>Speak with Nargiz Garajayeva about setting up a meeting with Grigoriy Polatnikov (Institute of Toxicology and Physiology Laboratory) to discuss the results of fish monitoring results and potential future monitoring.</td><td>30 November 2018.</td></tr>
<tr><td>Tamam Bayatly (BP)</td><td>Discuss with BP AGT Region colleagues the possibility of setting up a Public Meeting to discuss wider environmental issues associated with BP's operations in the region.</td><td>30 November 2018.</td></tr>
<tr><td>Saadat Gaffarova (BP)</td><td>Contact AGT Region Waste Management Team to obtain details on the waste management and disposal of rubber gloves. Saadat Gaffarova (BP) to share this information with Chimnaz Shabanova (NGO).</td><td>30 November 2018.</td></tr>
</table>

Azeri Central East (ACE) Project

Environmental and Social Impact Assessment

30th October 2018

Overview and Purpose

Overview

- The Azeri-Chirag-Gunashli (ACG) Production Sharing Agreement (PSA) passed into law in December 1994 and grants the consortium the rights to develop and manage hydrocarbon reserves within the "Contract Area" of the ACG Field over a period of 30 years.
- Amended and restated PSA effective until the end of 2049 signed on 14 September 2017.
- The ACG Contract Area is being developed in phases. The proposed next phase of development comprises the Azeri Central East (ACE) Project.
- An Environmental and Social Impact Assessment (ESIA) Report was prepared for the ACE Project and submitted to the Ministry of Ecology and Natural Resources of the Republic of Azerbaijan on 13th September 2018.

Purpose

- The purpose of this presentation is to:
    - Provide an overview of the ACE Project
    - Summarise the Project ESIA Report
    - Provide an overview of identified potential impacts and mitigation and management measures.

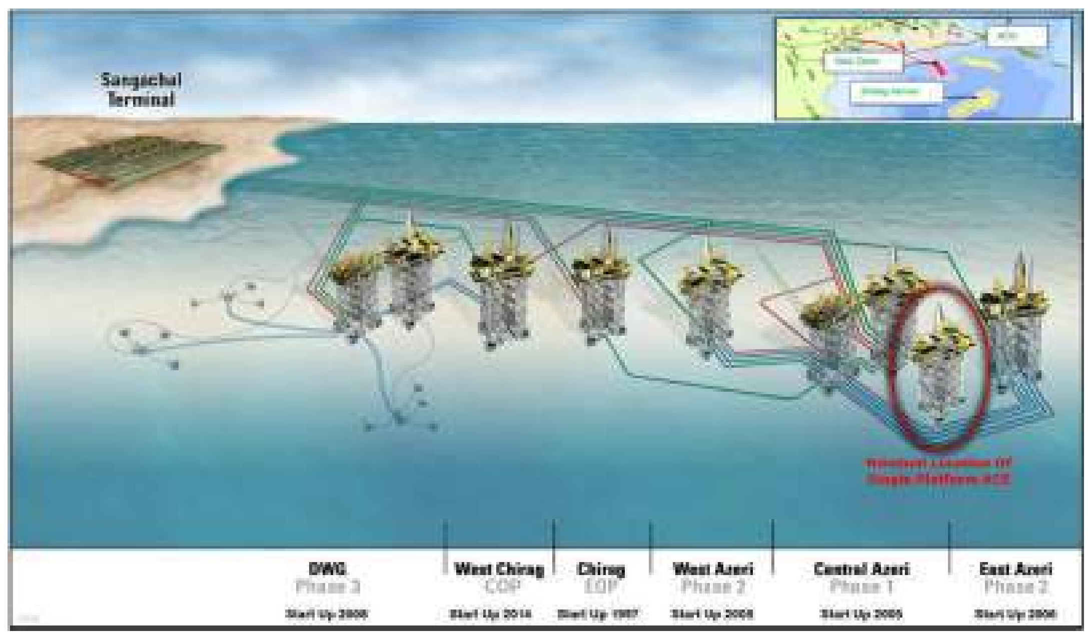
ACE PROJECT OVERVIEW

ACE Project Objectives

Existing Challenge: Significant distance between the existing Central Azeri (CA) platform and the East Azeri (EA) platform leaves multiple targets (producers and water injectors) in a large area accessible only via extended reach drilling.

Objectives of ACE Project

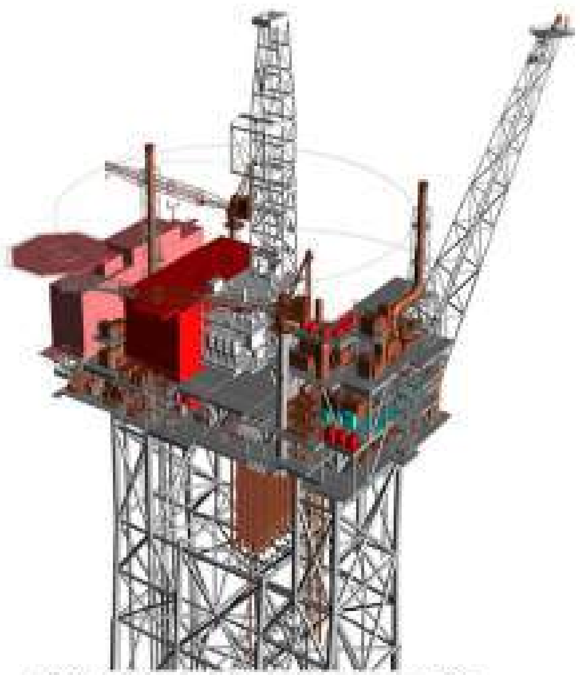
- Provide a new drilling centre between EA and CA - simplifies New ACG Wells Delivery and makes drilling operations simpler and more efficient
- Allows major and minor reservoir targets to be accelerated
- Slot constraints on the existing platforms in the ACG field reduced significantly as a result of the additional slots provided by ACE
- As many of the extended reach drilling targets are water injectors on the south flank of the field; the ACE Facility is an important component to developing an efficient water injection scheme by making these wells easier to reach
- ACE will also enable gas injection to east flank of the Contract Area (the EA crest)
- ACE designed to produce up to 100 mbd oil and 350 MMscfd gas.



ACE Project Description

ACE Production, Drilling and Quarters (PDQ) Platform

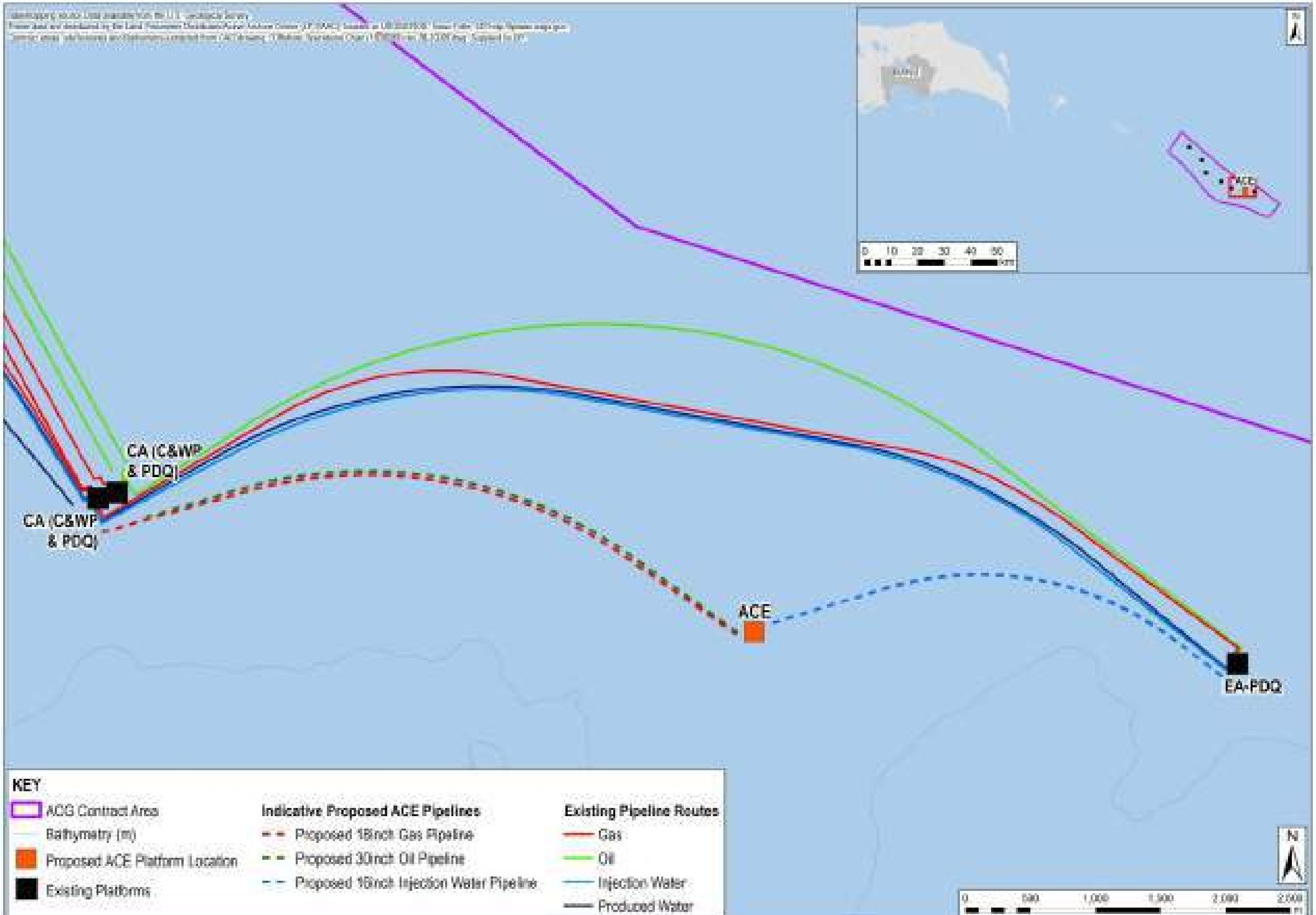
- Facility will have a Modular Drilling Support Module (MDSM), Drilling Derrick and Drilling Equipment Set (DES) with a 48 slot well bay.
- Potential for up to 6 wells to be predrilled using a Mobile Offshore Drilling Unit (MODU).
- Designed for 2 phase separation:
    - Oil comingled with produced water sent to Sangachal Terminal via tie-in to existing 30" subsea oil pipeline adjacent to the Central Azeri - Production, drilling and Quarters Platform (CA-PDQ)
    - Gas dehydrated and compressed providing gas lift and gas injection to the EA crest or exported to CA-Compression and Water Injection Platform (CA-CWP) via new 18" infield subsea gas pipeline for gas reinjection or exported to Sangachal Terminal



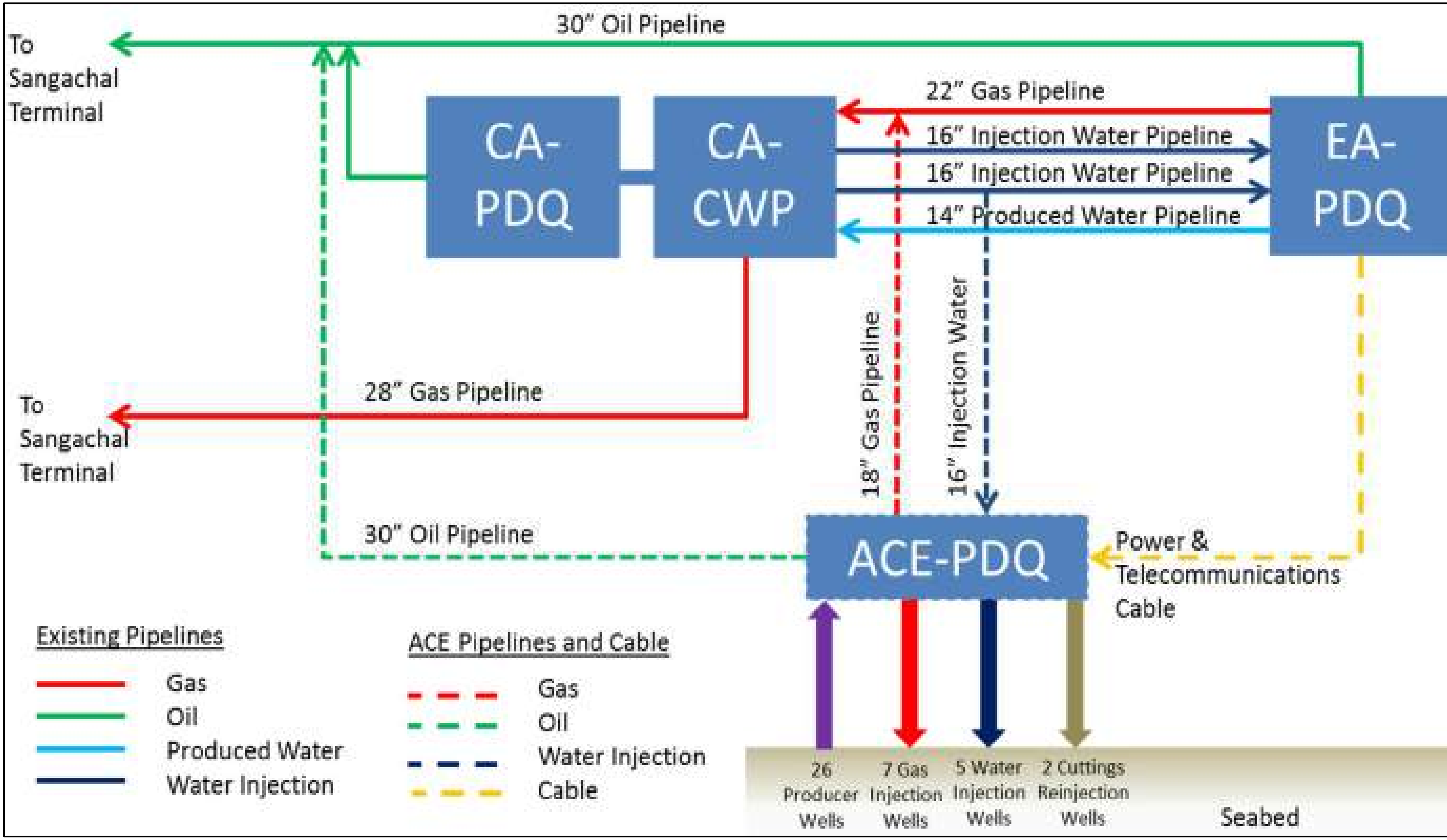
ACE- PDQ Rendered Schematic

- Injection water provided to ACE via new 16" WI pipeline from a tie-in near EA platform.
- 1x100% Gas Turbine Generator (GTG) to meet ACE power demand. Back-up power is imported via a combined brownfield telecommunications and power cable (CTPC) connection on EA.
- Living quarters and sewage treatment package sized to accommodate up to 202 persons on board.
- Brownfield modifications on CA-CWP to handle the increased gas flowrates associated with ACE and on EA-PDQ associated with CTPC tie-ins.
- Produced water will be treated at Sangachal Terminal and sent back offshore for reinjection.

ACE Project Layout



Scope of ACE Project



Legend

CA-PDQ – Central Azeri Production, Drilling and Quarters Platform

EA-PDQ – East Azeri Production, Drilling and Quarters Platform Platform

CA-CWP – Compression and Water Injection platform

ACE–PDQ – Azeri Central East Production, Drilling and Quarters

ACE Project Schedule

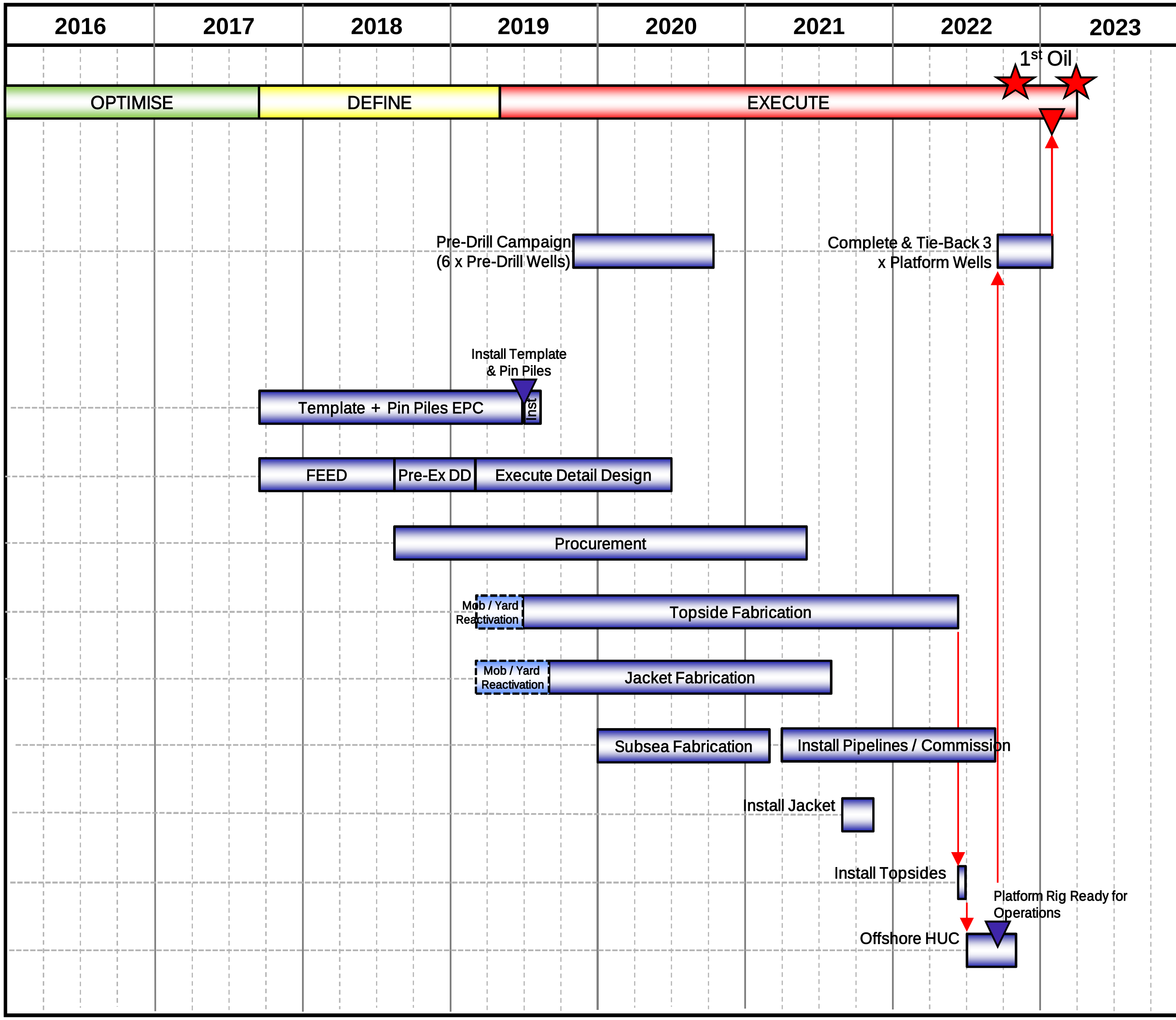
Key Milestones

Drilling

- Drilling

Facilities

- EPC & Inst. Pre-Drilling Template + Pin Piles
- FEED / Detail Design
- Procurement
- Fabricate Topside
- Fabricate Jacket
- Fab / Install Pipelines & Com'n
- Install Jacket
- Install Topsides
- Hook-up & Commissioning



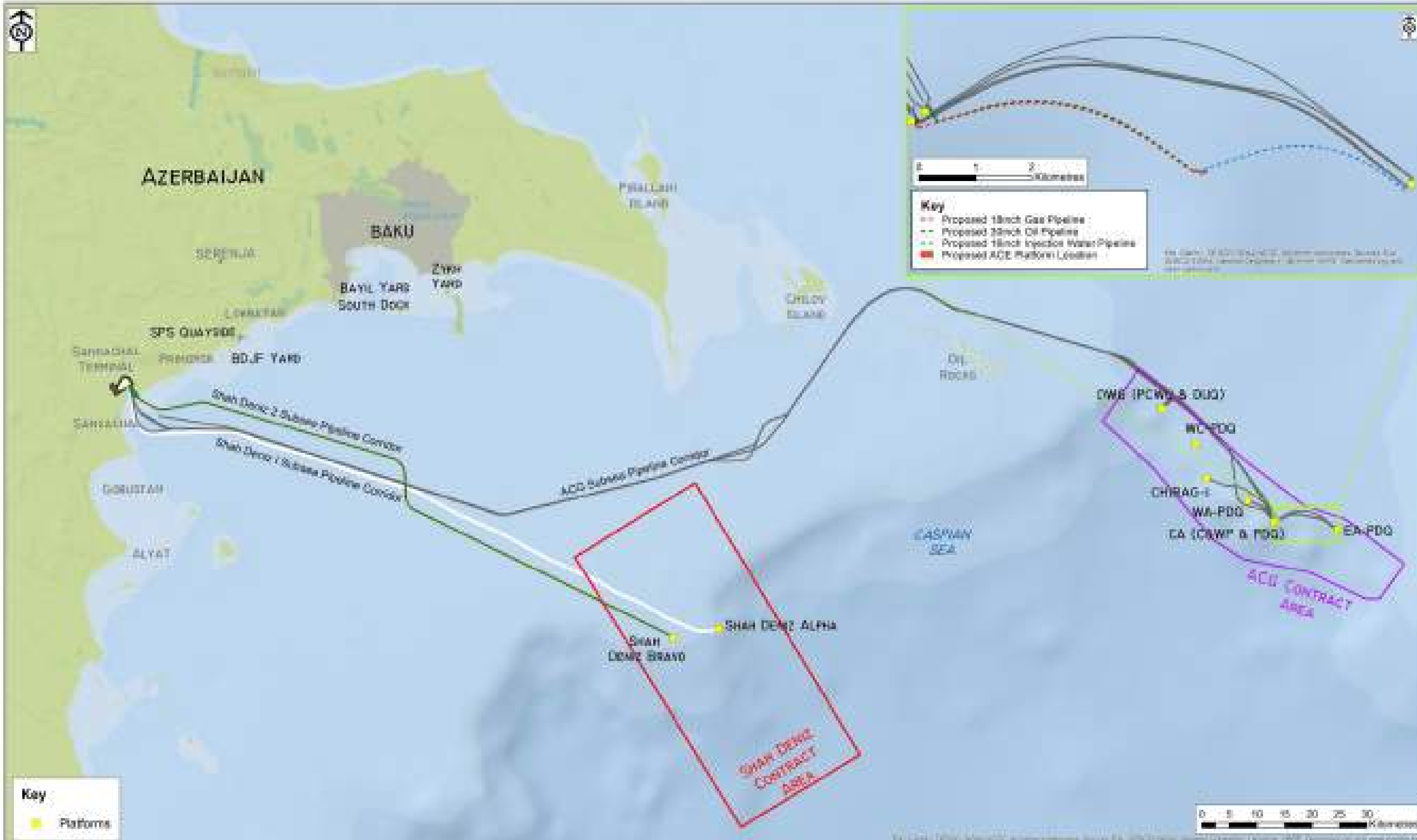
ACE Project Phases

The main ACE Project phases include:

- MODU pre-drilling activities (Potentially up to 6 pre-drill wells)
- Onshore construction and commissioning of offshore and subsea facilities (at existing construction yards)
- Platform installation , hook up and commissioning (HUC)
- Installation, tie-in and HUC of ACE infield subsea pipelines and associated subsea infrastructure
- Brownfield works on the EA and CA platforms
- Offshore drilling
- Offshore operations and production
- Decommissioning – Abandonment Plan to be in place by 2026

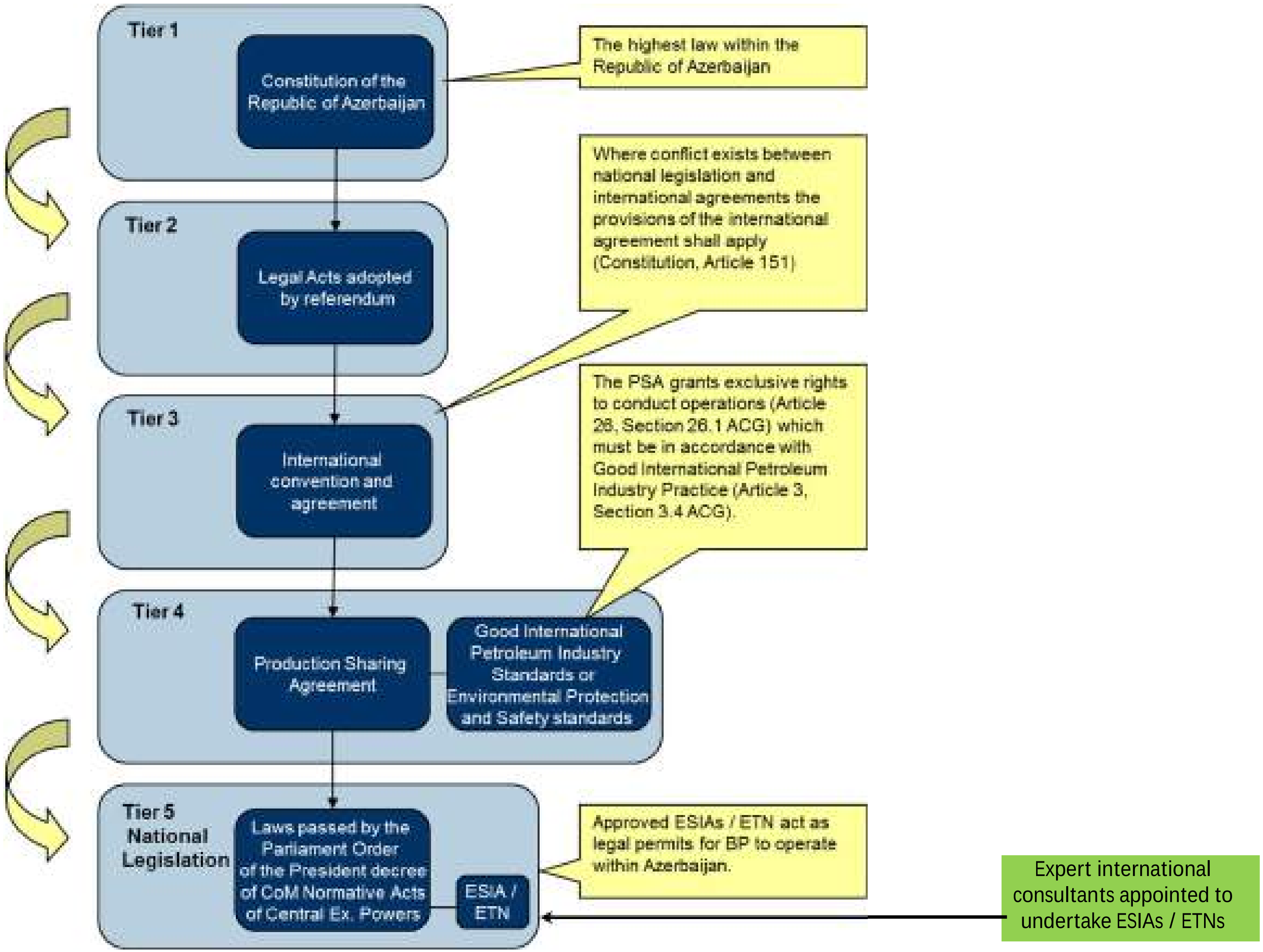
The project does not involve any modifications at Sangachal Terminal (other than minor telecommunication modifications)– there is sufficient capacity within the existing onshore ACG facilities to accommodate ACE.

ACE Project – Key Onshore & Offshore Locations



LEGAL FRAMEWORK & ESIA PROCESS

Policy, Regulatory and Administrative Framework



ESIA Approach

Screening and Scoping
Type/level of assessment to be conducted
Initial appraisal of likely key issues
Targeted stakeholder engagement

Project Alternatives
Analysis of viable alternatives to base case design

Base Case Design
Gather and review design information

Existing Conditions
Baseline environmental and social conditions

Environmental and Social Interactions
Determine project activities – receptor interactions

Accidental, Transboundary and Cumulative Impacts
Assessment of accidental, transboundary and cumulative Impacts

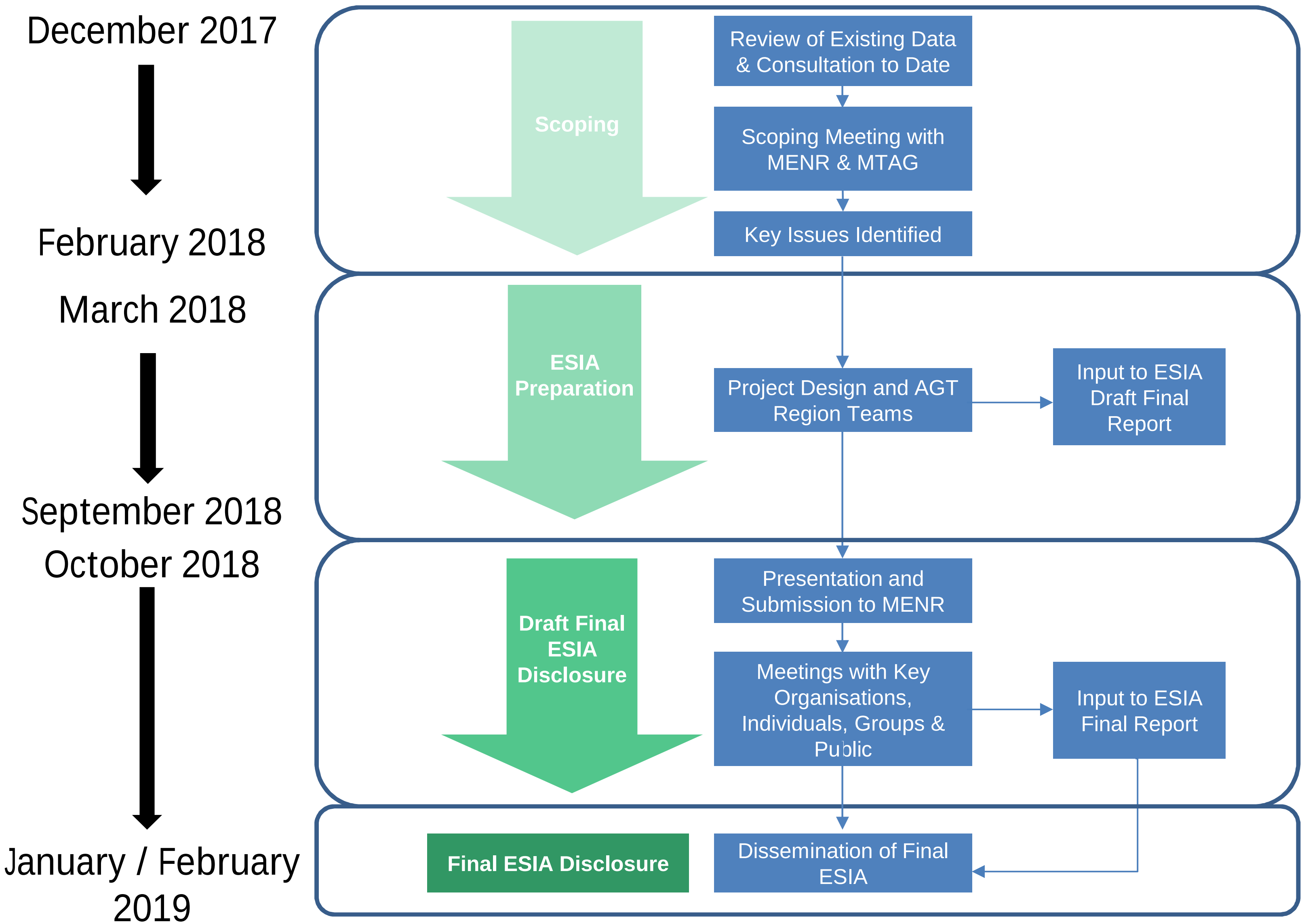
Impact Assessment
Determine activity event magnitudes
Determine receptor sensitivities
Identify existing controls and base case mitigation
Determine impact significance

Residual Impacts
Undertake residual impact assessment and determine any additional mitigation measures required

Disclosure and Consultation
Communicate draft ESIA findings and recommendations to stakeholders for comment
Finalise ESIA and submit for approval to authorities

Monitoring and Mitigation
Development of management plans and procedures as part of AGT Region HSSE Management System

ESIA Consultation and Disclosure Process



ENVIRONMENTAL & SOCIAL BASELINE

Summary of BP Environmental Surveys Relevant to the ACE Project

Offshore Environmental Surveys Relevant to the ACE Project (1992 – 2017)

Date	Title of Survey
Offshore Surveys	
2017	ACE Environmental Baseline Survey
2016	East Azeri Benthic Survey
2016	Central Azeri Benthic Survey
2015	ACG Regional Benthic Survey
2014	ACG Regional and Pipeline Route Water Column and Plankton Communities Survey
2014	East Azeri Benthic Survey
2014	Central Azeri Benthic Survey
2012	ACG Regional and Pipeline Route Water and Plankton Survey
2012	ACG Regional Benthic Survey
2012	East Azeri Benthic Survey
2012	Central Azeri Benthic Survey
2010	ACG Regional Water Quality Survey
2010	ACG Regional Benthic Survey
2010	East Azeri Benthic Survey
2010	Central Azeri Benthic Survey
2008	ACG Regional Plankton Survey
2008	ACG Regional Water Quality Survey
2008	East Azeri Benthic Survey
2008	ACG Regional Benthic Survey
2008	Central Azeri Benthic Survey
2006	East Azeri Post-installation Benthic Survey
2006	East Azeri Post-installation Benthic Survey
2006	ACG Regional Survey (Benthic, Plankton, Water Quality)

Date	Title of Survey
Offshore Surveys	
2006	Central Azeri Benthic Survey
2005	ACG Regional Plankton Survey
2005	ACG Regional Benthic Survey
2005	Central Azeri Post well Survey
2004	ACG Regional Benthic and Plankton Survey
2004	Central Azeri Benthic Survey
2002	ACG Phase 2 Environmental Baseline Survey (East Azeri and West Azeri)
2001	ACG Phase 1 ESIA Baseline Survey (Central Azeri)
2000	Chirag - Sangachal Sub-sea Pipeline Survey
2000	GCA 5 and 6 Post Well Survey
2000	Chirag 1 Post Saraline Survey
1999-2001	Gunashli Field Fisheries Surveys
1998	Phase 1 Platform 1a and 1b Environmental Baseline Surveys
1998	AIOC Chirag 1 Mid Drilling Environmental Survey
1997	AIOC Appraisal Well GCA No. 3 GCA No. 4, Post Appraisal Drilling Surveys
1997	AIOC Appraisal Well 1 Pre and Post Appraisal Drilling Seabed Environmental Survey
1996	AIOC Appraisal Well 1 Pre and Post Appraisal Drilling Seabed Environmental Survey
1996	AIOC Contract Area Long Term Monitoring Stations
1995	AIOC Offshore Environmental Baseline Survey 1995, September and December
1992	Pilot Environmental Survey, Chirag oilfield

Terrestrial / Coastal Surveys Relevant to the ACE Project

Date	Title of Survey
Relevant Terrestrial / Coastal Surveys	
2006	Winter Waterfowl Monitoring Study, Absheron to Kura
2005	Winter Waterfowl Monitoring Study, Absheron to Kura
2004	Overwintering Bird Survey, Absheron to Kura
2004	Winter Waterfowl Monitoring Study, Absheron to Kura
2003	Overwintering Bird Survey, Absheron to Kura
2002	Winter Waterfowl Monitoring Study, Absheron to Kura
1996	Sangachal Coastal Environmental Survey

Onshore - Baseline

Potential Construction Yards

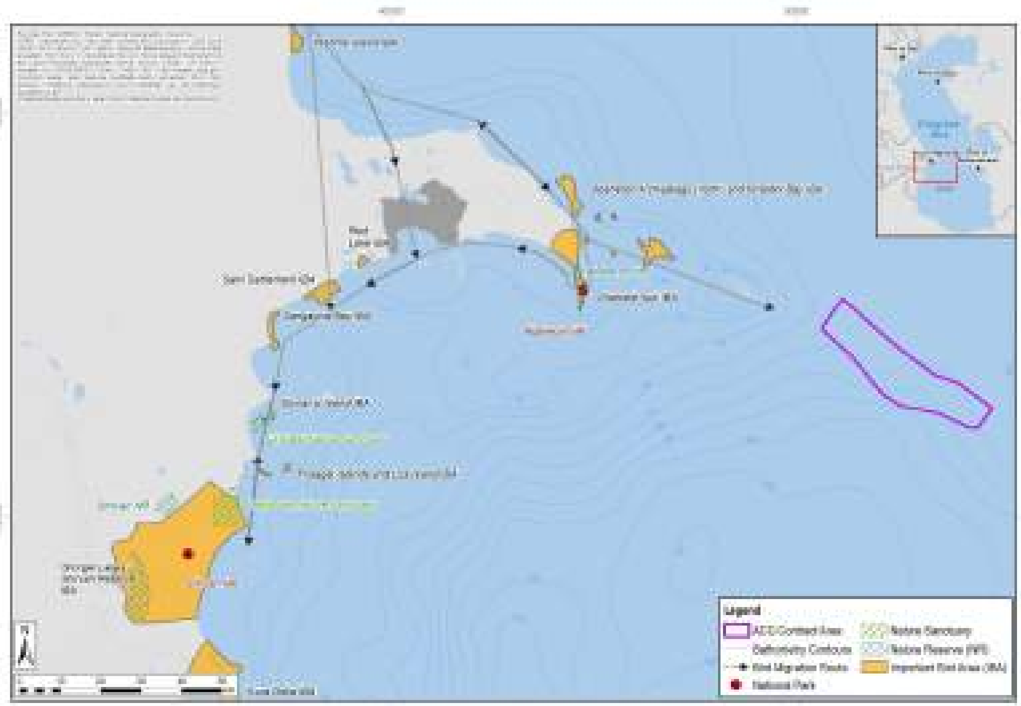
- Bayil Yard (formerly the ATA Yard), South Dock and Baku Deepwater Jacket Factory (BDJF) Yard.
- Each yard is operational and is used for oil and gas industry related construction, including previous BP projects.
- With the exception of the Bibiheybat settlement located approximately 1km to the west of the Bayil Yard boundary, there are no residential receptors in close proximity to the yards.
- Baseline ambient noise surveys undertaken in the vicinity of the Bayil Yard and South Dock in 2015 recorded noise levels which are considered to be typical of industrial environment, with dominant noise coming from nearby road traffic.
- Yards are located within an industrial setting and air quality in these locations is expected to be consistent with areas of an industrial nature as reflected by the NO_2 concentrations recorded in the vicinity of Bibiheybat.

Sangachal Terminal

- The ACE Project will make use of existing capacity/ullage within the Sangachal Terminal processing facilities and no new infrastructure or expansion will be required (other than minor telecommunication modifications).

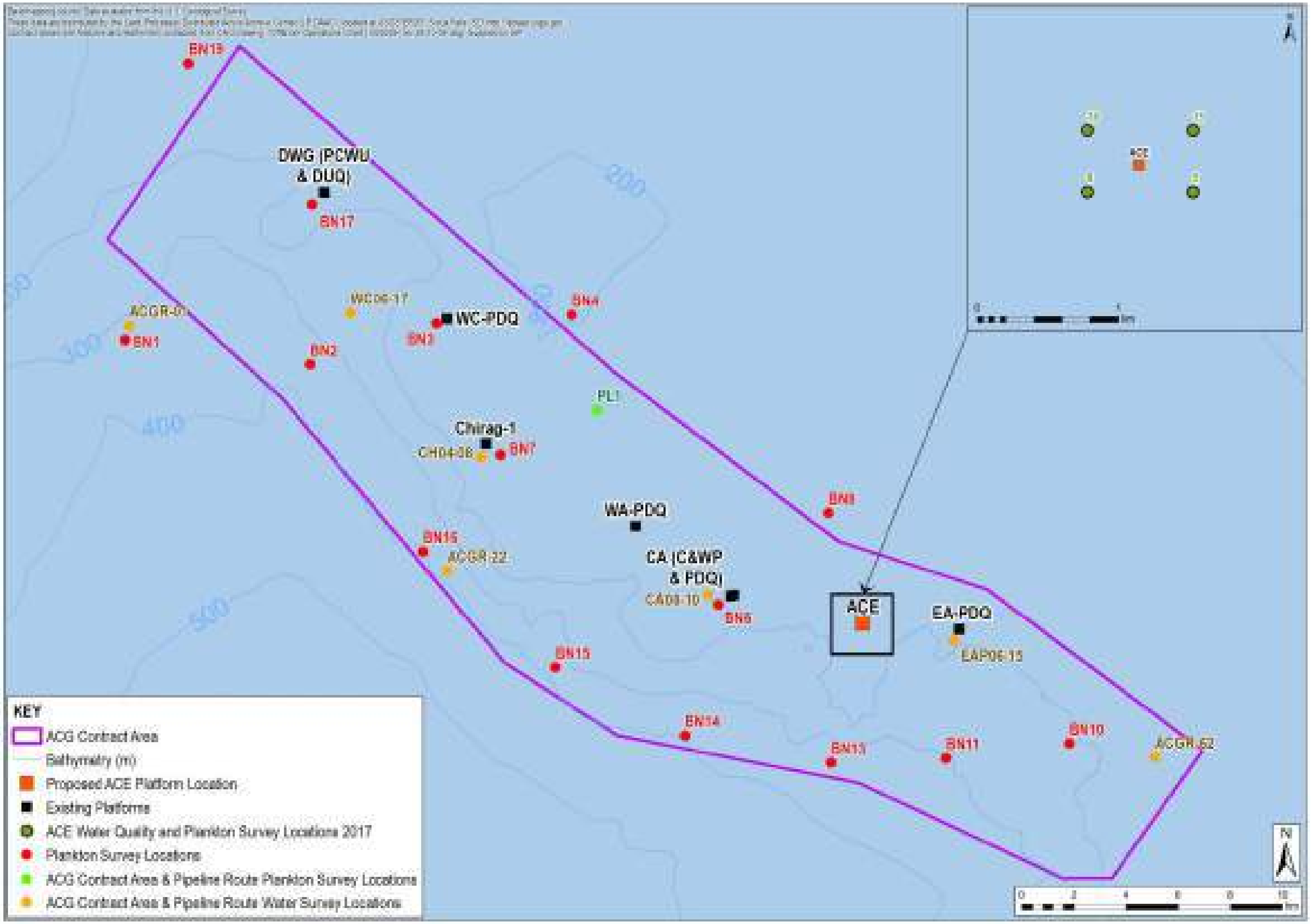
Birds & Protected Areas - Baseline

- An estimated 85 species of waterfowl and coastal birds have been recorded between Absheron and Neftchala since 2002.
- There are 15 species of birds of conservation importance (included in the IUCN Red List or listed in the AzRDB).
- In total there are eight National Parks, 11 State Nature Reserves and 24 Sanctuaries designated within Azerbaijan primarily for the protection of wildlife.
- Important Bird and Biodiversity Areas (IBAs) are located along the coastline from the Absheron Peninsula to the Kura Delta.
- Birds can be categorised into three distinctive groups:
  - Overwintering: most active between December and February
  - Migratory: most active between September/October and December and between March and April)
  - Nesting: most active between May and August.



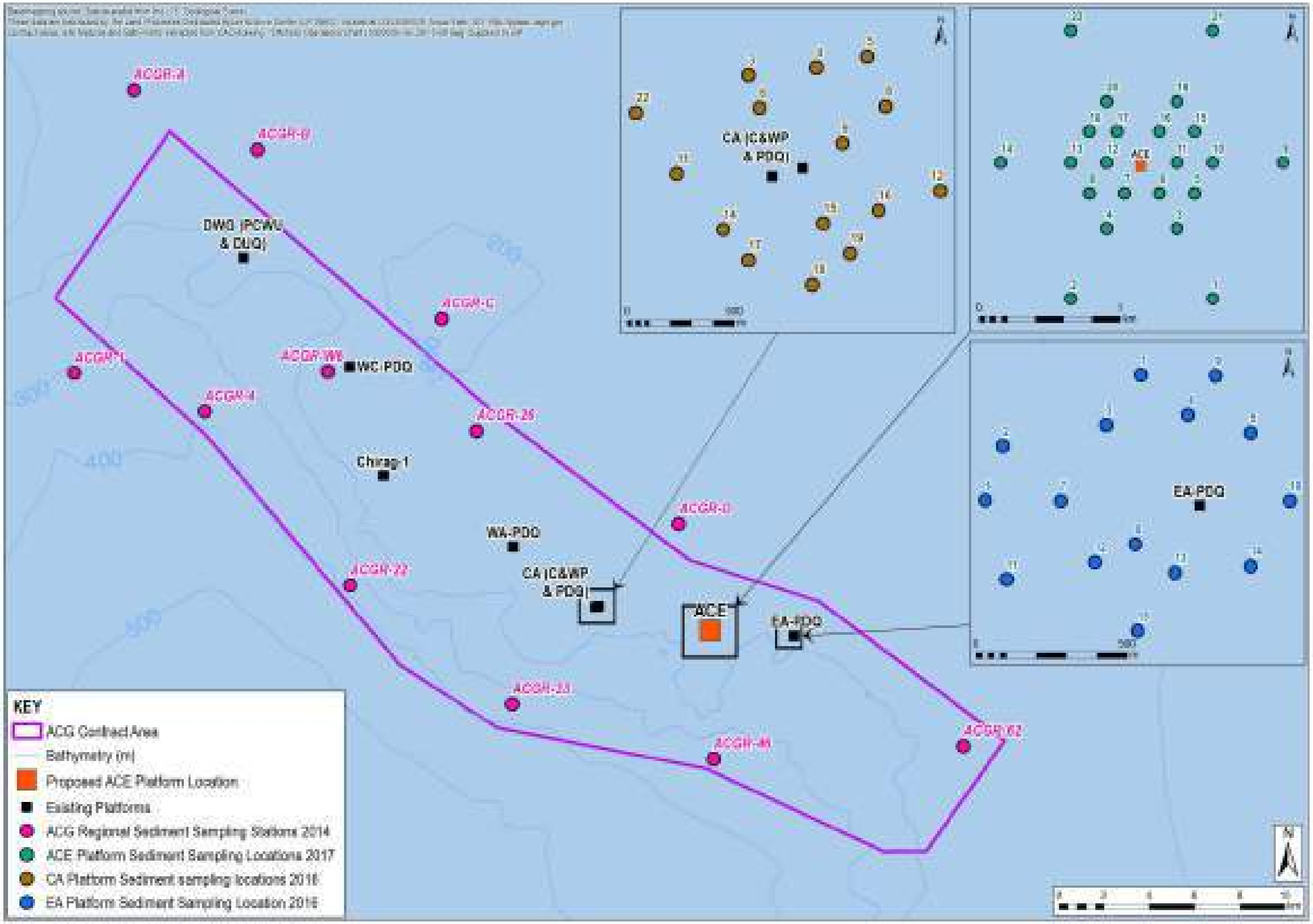
Offshore Baseline – Plankton & Water Quality

ACG Regional and ACE Water Sample Stations



Offshore Baseline – Sediment Physical, Chemical and Biological Characteristics

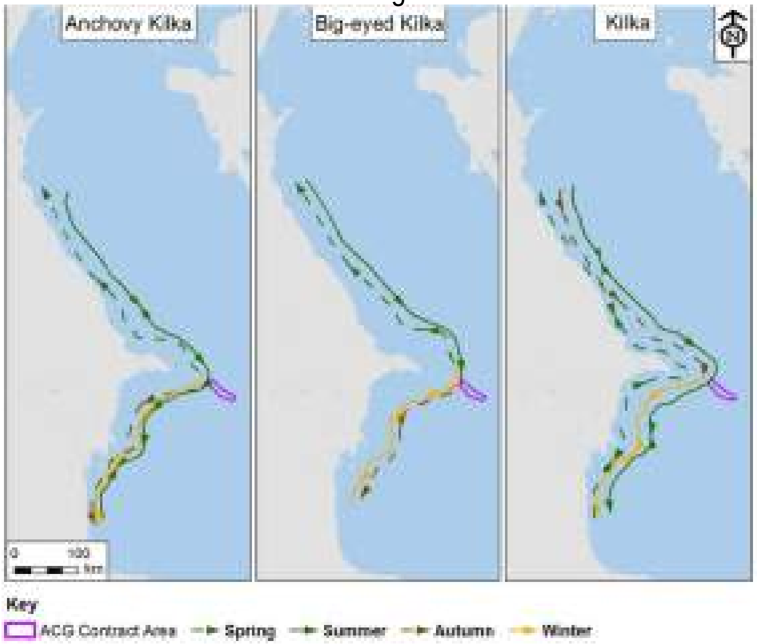
ACE, EA and CA Sediment Sample Stations



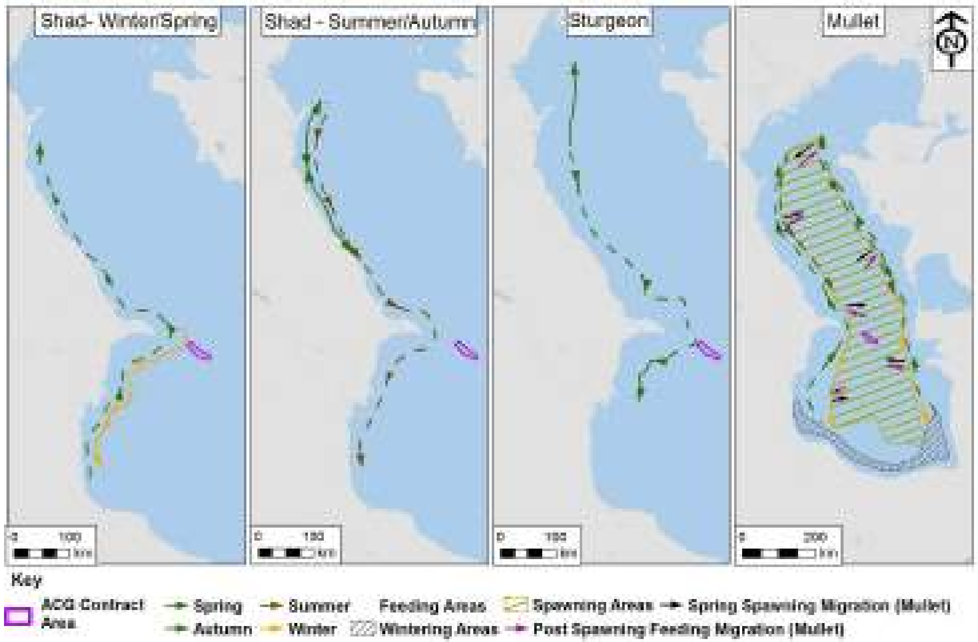
Offshore Baseline – Fish

- Approximately 151 species and subspecies of fish can be found in the Caspian and associated river deltas, while 54 of these are classified as endemic.
- Typically classified as migratory, semi migratory and resident.
- Main distribution of fish species in the Caspian Sea is generally within the shallow water shelf areas.
- Common threats to fish populations are over fishing, high levels of pollution (from both man-made and natural events) and habitat loss.
- In general fish species are not known to migrate through the ACG Contract Area, preferring to remain within the shallower waters between the shore and the Contract Area.
- Herring and kilka in the ACG Contract Area are generally found mainly in winter, at depths up to 50-100m.
- The area south of the Absheron Peninsula is a known nursery area for the main commercial fish species.

Kilka Migration Routes



Shad, Sturgeon and Mullet Migration Routes



Caspian Seals – Baseline

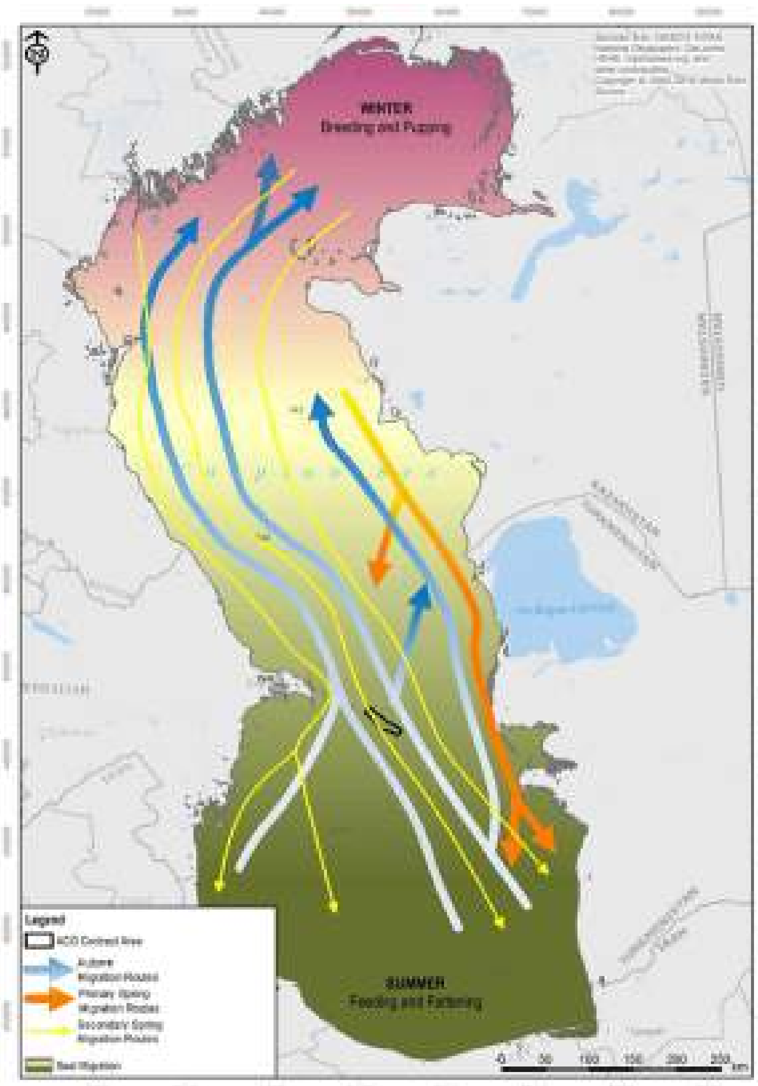
- IUCN Red list as “Endangered”
- Caspian seal distribution is dictated by migration. Main source of food is kilka, thus migration patterns follow similar trends.
- However, latest research has shown it is not possible to assume the seals will always follow the previously defined migratory paths close to the east and west coastline and may travel through the centre of the Caspian.
- Caspian seals may be present in the ACG Contract Area at any time of year but with an increased likelihood during the spring migration, during the summer months and, to a lesser extent, during autumn migration.
- Seal monitoring undertaken during the ACE geotechnical survey at the proposed ACE platform location recorded five seal sightings between the 18th and 23rd April 2018.

Seasonal Sensitivity of Caspian Seal Relative to ACG Contract Area

Sensitivity Relative to ACG Contract Area	Month											
	J	F	M	A	M	J	J	A	S	O	N	D
Least Sensitive Period/Not Present - Winter	(purple)	(purple)	(purple)									(purple)
Least Sensitive Period - Autumn										(green)	(green)	(green)
Most Sensitive Period - Spring				(green)	(green)							
Distribution Influenced by Food Source						(orange)	(orange)	(orange)	(orange)	(orange)		

Key:

Fewer numbers of seals/absent as they move to Northern Caspian for winter. (purple)	Individuals distributed as groups according to migration flows of food components. (orange)	Individuals present during the spring and autumn migrations. (green)



IMPACT ASSESSMENT

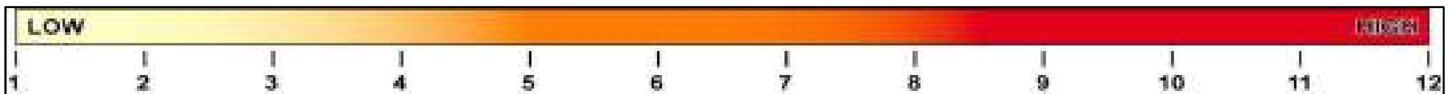
ACE ESIA – Impact Assessment Process

- Continual assessment of the potential environmental and social impacts, which has supported ACE Project decisions.
- Analysis of viable alternatives to the base case design:
  - The selection of a suitable location within the ACG Contract Area to site the offshore facilities
  - Platform design and the extent of integration with existing ACG offshore facilities
- Within the ESIA the environmental impact assessment methodology is based on:
  - The results of modelling work (i.e. air quality dispersion modelling, drilling discharges (drill cuttings and cement discharges), pre-commissioning pipeline discharges, cooling water discharges and oil spill modelling)
  - Laboratory studies.
- Monitoring and historic data:
  - Provided from BP arranged surveys and on-going monitoring work
  - Surveys/data provided by national institutes.

Overview of Impact Assessment Methodology

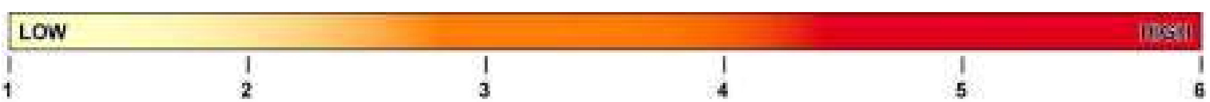
Step 1: Magnitude assessment

- Based on four criteria which are each scored from 1 to 3:
  - Extent/Scale i.e. distance/area affected by the event
  - Frequency i.e. how often does the event occur
  - Duration i.e. the time each event lasts
  - Intensity i.e. how persistent or permanent the event is, how do emission/discharge concentrations compare to relevant standards
- Event magnitude then scored from 4-12 by summing the scores from each criteria



Step 2: Sensitivity assessment

- Identify receptors potentially affected by the event. Categories include Biological/Ecological and Human
- Determine receptor sensitivity: Based on two criteria which are each scored from 1 to 3
  - Presence: Value of the receptor e.g. protected species/ monument and the likelihood of its presence in the area of impact.
  - Resilience: Sensitivity of the receptor to change from the identified stressor e.g. hydrotest discharge
- Receptor sensitivity then scored from 2-6 by summing the scores for presence and resilience



Step 3: Determine impact significance

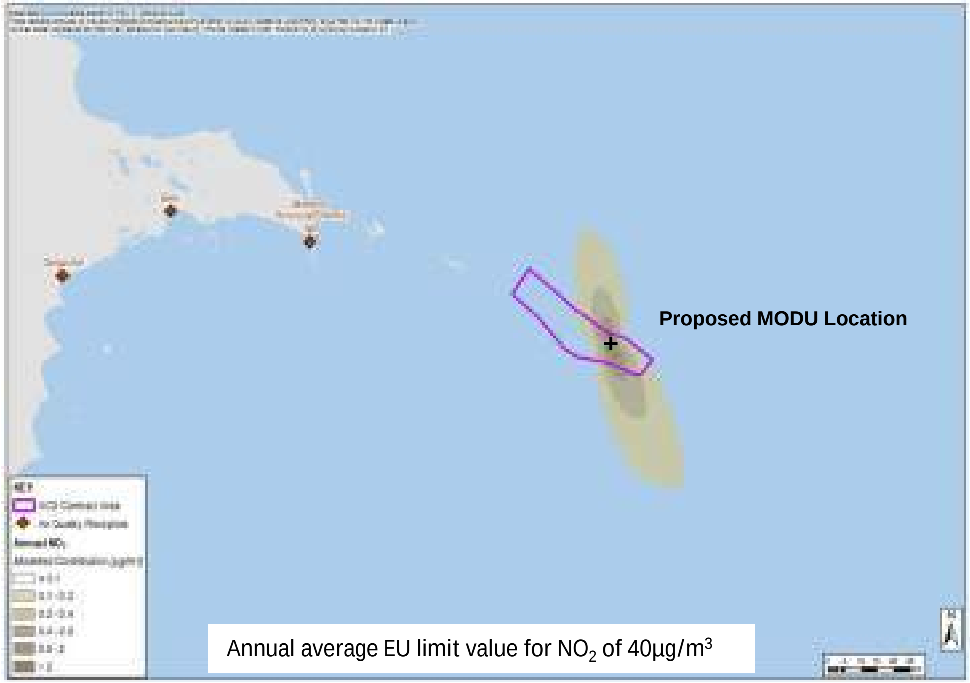
		Receptor Sensitivity		
		Low (2)	Medium (3-4)	High (5-6)
Event Magnitude	Low (4)	Negligible	Minor	Moderate
	Medium (5-8)	Minor	Moderate	Major
	High (9-12)	Moderate	Major	Major

- Any impact classified as "major" is considered significant and requires additional mitigation.

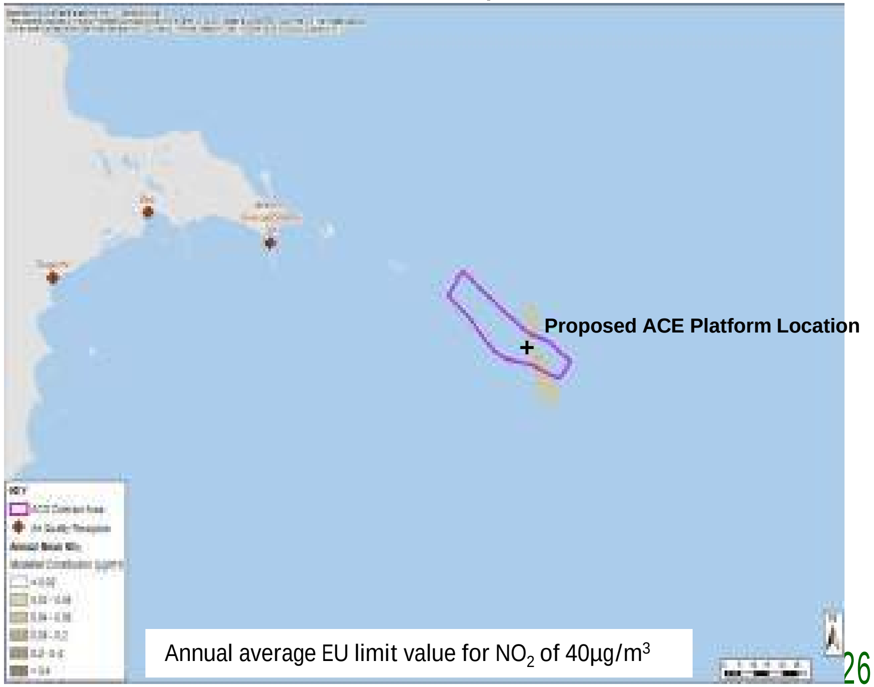
ACE ESIA – Atmospheric Emissions: Offshore

- Air dispersion modelling completed for the key emissions sources associated with predrilling, construction and operation phases.
- The modelling focuses on NOX (which comprises nitrogen oxide (NO) and nitrogen dioxide (NO2)) as 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 hydrocarbons) and its potential to impact upon human health and the environment.
- Results show no predicted exceedances of the relevant long term NOx standard at onshore receptors.

Modelled Mean Annual NO_2 Contributions Due to MODU Power Generation



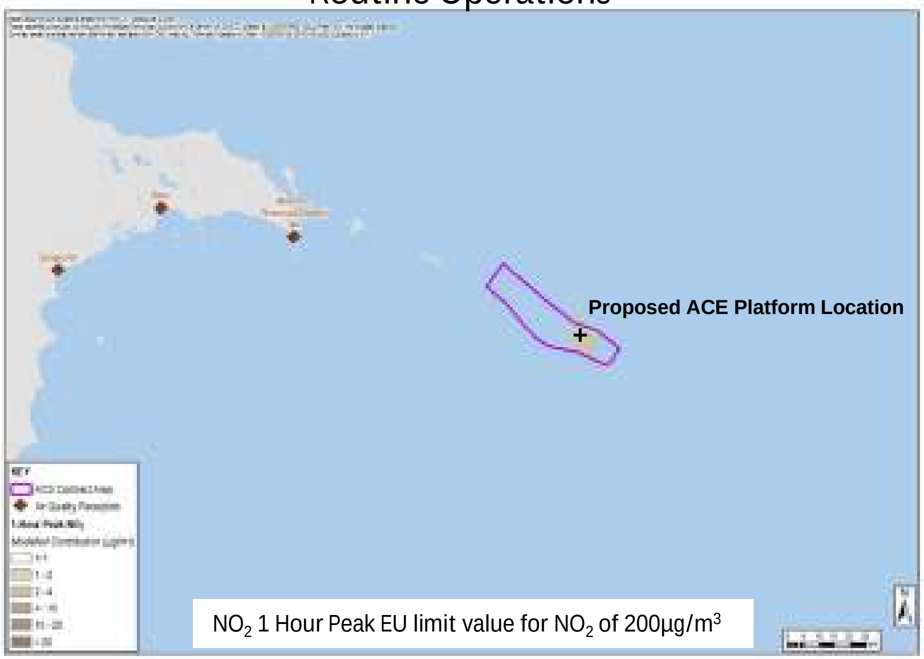
Modelled Mean Annual NO_2 Contributions Due to Routine Offshore Operations



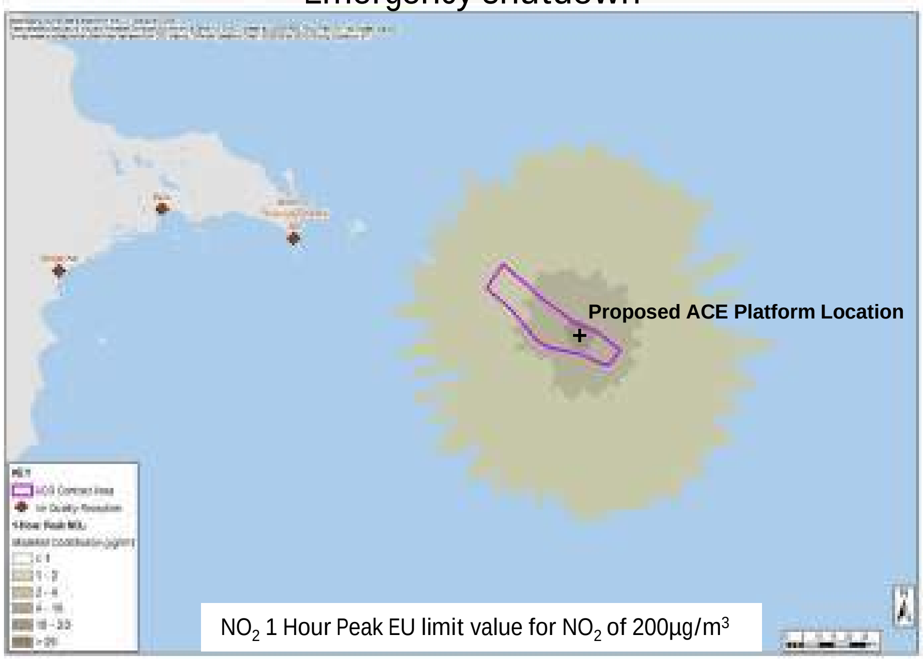
ACE ESIA – Atmospheric Emissions: Offshore

- Offshore modelling undertaken for non routine operations including maintenance downtime of the compression turbine and offshore flaring associated with emergency shutdown.
- Results show no predicted exceedances of the relevant short term (1 hour peak) NO_x standard at onshore receptors.
- For the short term it is assumed that 50% of NO_X converts to NO_2 in the atmosphere.

Modelled 1 Hour Maximum NO_2 Contribution Due to Non Routine Operations



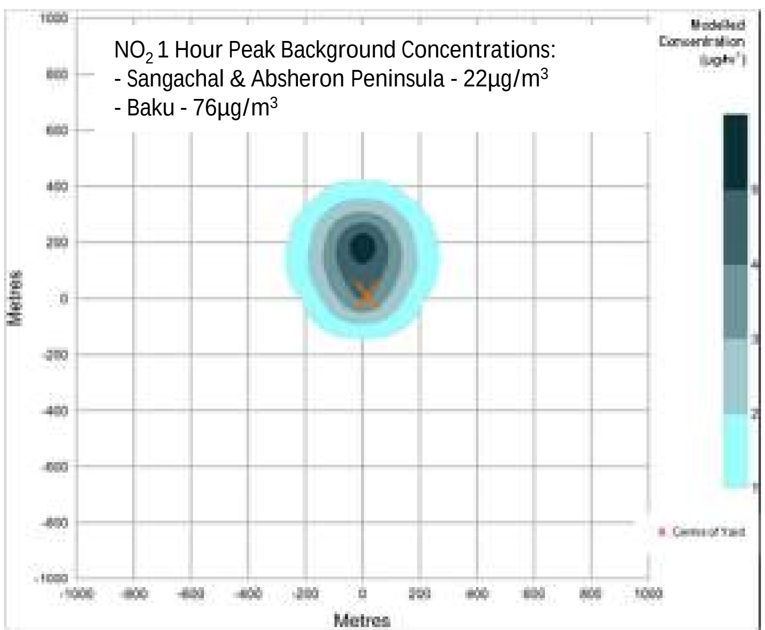
Modelled 1 Hour Maximum NO_2 Contribution Due to Emergency Shutdown



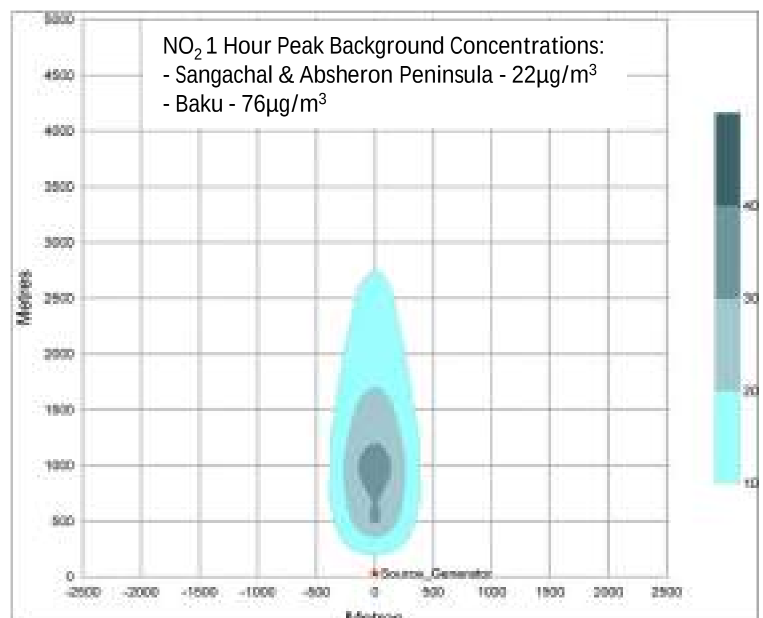
ACE ESIA – Atmospheric Emissions: Onshore

- Dispersion modelling screening assessment undertaken to assess the potential magnitude of impacts from the construction yard emissions to nearby receptors.
- Assessment considered NO2 emissions, comparing the short term and long term average modelled concentrations at ground level to the long term and short term standards for NO_2 (40 and 200 µg/m^3).
- Modelling screening assessment considered emissions from construction yard plant and vehicles and the onshore commissioning of the main ACE platform generators and topside utilities.
- Under all conditions modelled, potential impacts to nearby onshore receptors were minor and additional mitigation was not required.

Ground Level 1-Hour NO_X Contribution from Onsite Construction Yard Plant in 15 m/s Wind



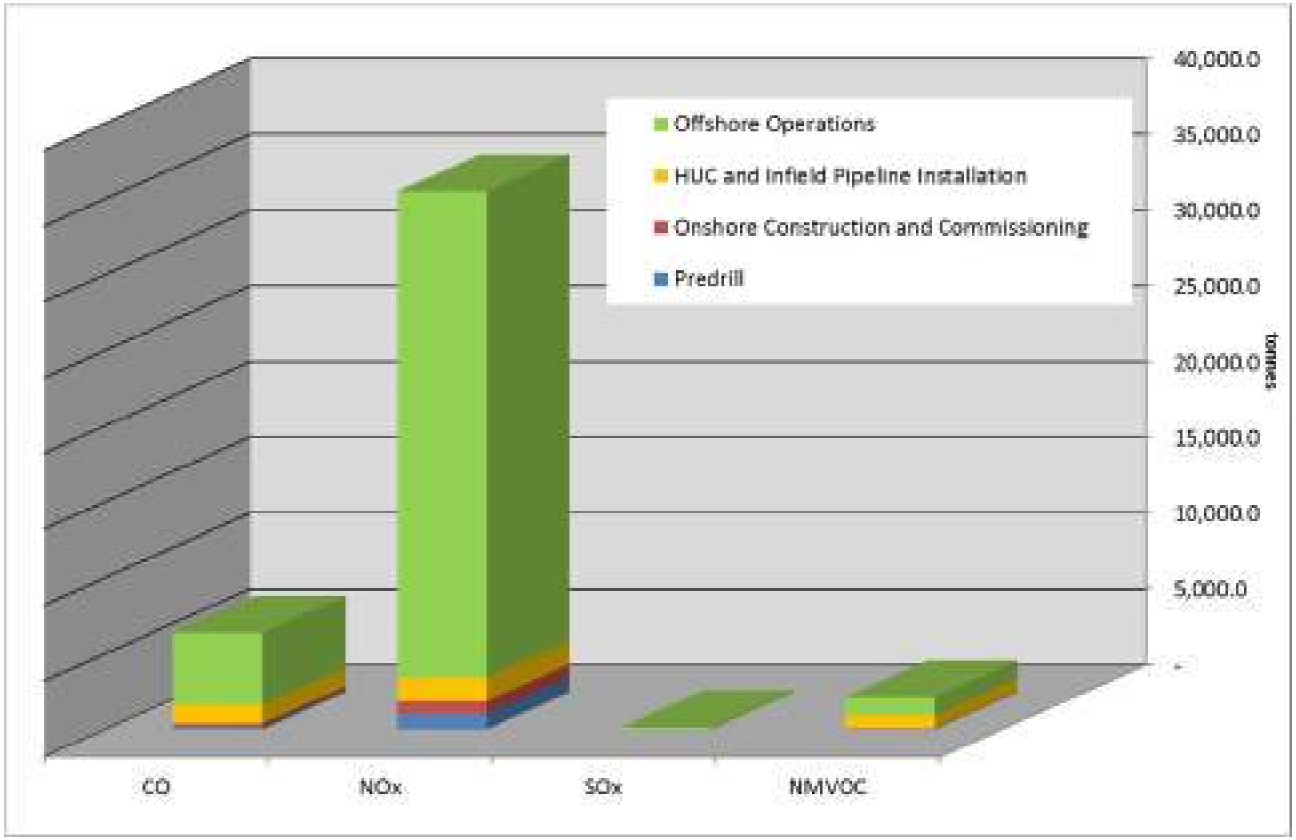
Ground Level 1-Hour NO_X Process Contribution from Platform Generator during Commissioning in 15m/s Wind



ACE ESIA – Summary of Non-GHG Emissions per Project Phase

Atmospheric emissions will be generated from the each ACE Project phase due to:

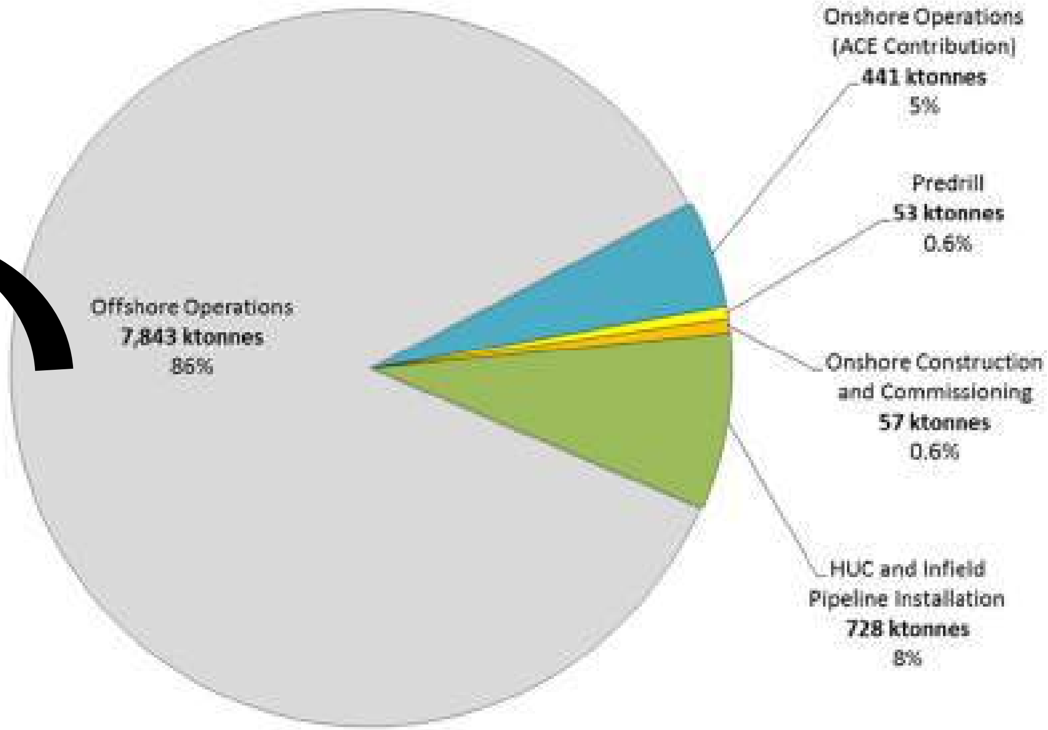
- Operation of combustion plant (during construction and operations)
- Operation of vessels (including a mobile drilling rig)
- Flaring (during brownfield tie-in activities and during operations)
- Fugitive emissions.



ACE ESIA – Summary of GHG Emissions

- The majority (86%) of ACE GHG emissions are predicted to result from offshore activities during the ACE Project operations phase.
- Main source of emissions is power generation and gas compression.

Offshore GHG Emissions per Source		
Source	**Ktonnes**	%
Power Generation	4,112	52
Diesel Users	43	1
Flaring	1,156	15
Gas Compression	2,258	29
Fugitive Emissions	18	0
Vessels	256	3
Total	**7,843**	**100**



ACE ESIA – Underwater Sound

- Underwater sound generated through project activities including drilling, vessel movements and piling.
- Has the potential to impact biological/ecological receptors (specifically seals and fish) in the marine environment.
- Propagation of underwater sound calculated using a simplified geometric spreading model – standard approach across the industry.
- Results are compared to threshold criteria from literature established for;
  - Physiological damage – potential permanent and temporary effects on hearing with these defined as permanent threshold shift (PTS) and temporary threshold shift (TTS)
  - Behavioural reactions – 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 whether it is continuous or intermittent, governs how the receptor may respond.
- Calculated noise levels compared to PTS, TTS and behavioural thresholds for pinnipeds (seals) and fish (either hearing generalist or hearing specialist) to determine distance at which threshold is met and hence extent of underwater sound impacts and requirement for mitigation;

ACE ESIA – Underwater Sound

Underwater sound assessment indicated:

Drilling:

- Extent of underwater sound impacts limited. For seals the injury threshold is predicted to be met within 2m of the source and no observable reaction threshold predicted to be met within 25m.

Vessels and Pipe-lay Barge:

- Calculations completed for range of vessels to be used for the project. Based on the vessel with greatest sound source (pipe-lay barge) PTS may arise in seals at distances up to 2km from the vessel over an exposure duration of 1 hour while moderate behavioural impacts may be seen over significant distances - in excess of 98km.
- Assumed seals are habituated to vessel noise associated with routine commercial traffic and vessels associated with the oil & gas industry, and will take action to avoid the associated sound from this activity so only minor impact expected.

Piling:

- Calculations completed for the use of a hydraulically powered hammer to install pile. Based on a conservative assessment approach, for seals PTS could occur at distances up to 2.3km from the piling while TTS may arise up to 23.5km both for a 1 hour exposure.
- Guidance produced by UK based JNCC, an international authority on guidance for marine mammals, states that the installation of driven piles in the marine environment without mitigation is likely to produce noise levels capable of causing injury and disturbance to marine mammals.

ACE ESIA – Underwater Sound

Existing control measures associated with underwater noise and vibration from piling and vessels include:

- For the vessels undertaking piling activities, the relevant nominated vessel crew will be trained in marine mammal observations (MMOs).
- The Project will establish a Mitigation Buffer Zone of 500m from the centre of the piling sound sources for visual observations of Caspian seals during daylight hours.
- When the piling vessel is on site, the MMO observer will begin seal observations during the period when the pile is being prepared. An Acoustic Deterrent Device (ADD) (specifically set for the hearing range of pinniped seals) will be activated, gradually increasing to full intensity to allow any nearby seals to exit the Mitigation Buffer Zone, 30 minutes prior to the start of the impact piling. When piling starts the ADD should be turned off. The MMO should continue observations for the entire piling period to ensure accurate records are maintained.
- If piling activity stops for less than 30 minutes for any reason the ADD should be immediately activated. For planned pauses of greater than 30 minutes the device shall be switched on 30 minutes prior to re-commencement of piling as outlined above to allow any nearby seals to exit the Mitigation Buffer Zone. The ADD is to be stopped once piling re-commences.
- When piling during daylight hours, trained vessel crew will conduct ongoing visual observations of Caspian seal in the vicinity of the vessel undertaking piling activities. All observations will be logged including location of sighting and number of individuals seen. Daily and final summary reports will be prepared.
- No project vessels will intentionally approach seals for the purposes of casual (recreational) marine mammal viewing which may result in disturbance.

ACE ESIA – Construction Noise (Terrestrial)

- Noise at the selected construction yard(s) during the construction and commissioning phase will arise from the use of plant and machinery to undertake steel rolling, cutting and shaping, welding, grit blasting and the movement of materials around the site(s) by vehicles/cranes
- Noise screening modelling assessment was undertaken to determine potential impacts from onshore construction noise and operation of the main platform generator during commissioning at to any nearby receptors.

Construction Yard Plant and Vehicles

- Modelling demonstrated that, the daytime limit of 65dB will be met at 40m from the noise source and at 400m, the night time limit of 45dB LAeq will be met.

Onshore Commissioning of Main Platform Generators and Topside Utilities

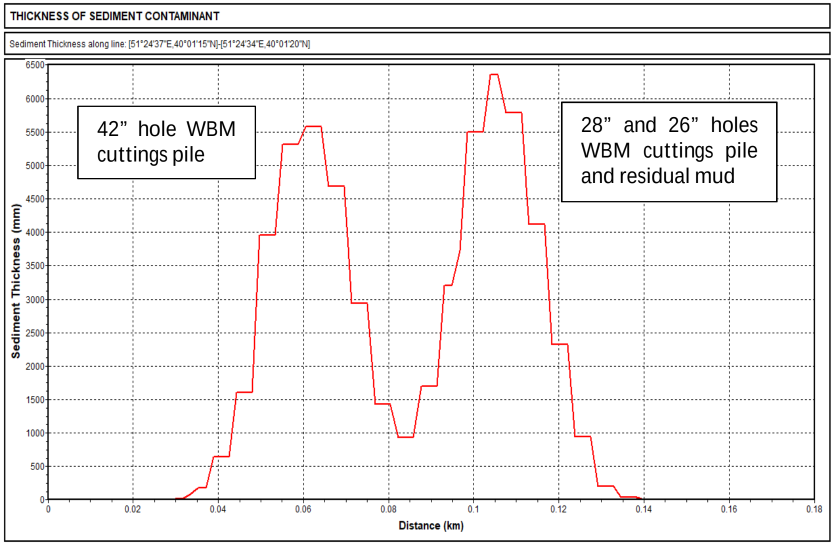
- Worst case impacts were considered based on the operation of the main dual fuel generator running for 8 hours.
- The results demonstrated that predicted noise levels will meet the most stringent limit (night time limit of 45dB LAeq) at distances greater than 500m.

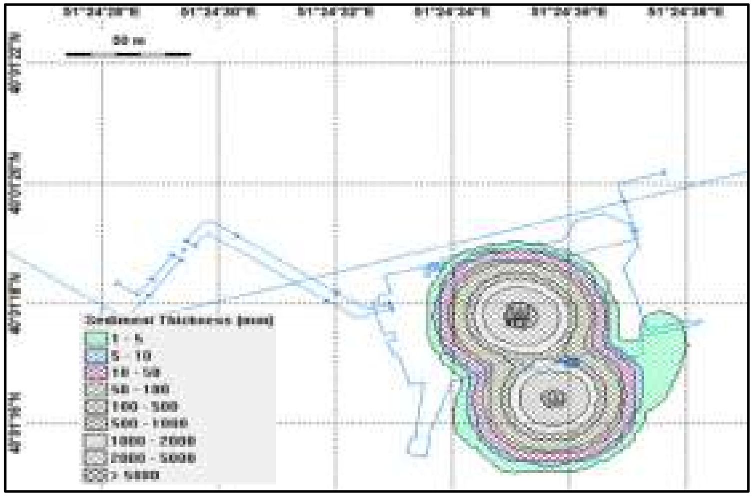
ACE ESIA – Offshore Drilling Discharges (MODU Drilling)

Offshore drilling discharges:

- Only water based mud (WBM) will be discharged from the top hole sections in accordance with PSA requirements.
- Low toxicity WBM of the same specification and environmental performance as used for previous ACG wells will be used (UK Offshore Chemical Notification Scheme (OCNS) “Gold” and “E” category or equivalent toxicity).
- Discharge modelling completed to support post drilling survey results.
- Deposition to 1mm depth area ranges from 8650m^2 (summer conditions), to 10450m^2 (winter conditions).
- Lower hole well sections will be drilled using a Synthetic Oil Based Mud (SOBM) or Low Toxic Mineral Oil Based Mud (LTMOBM). It is not planned to release any SOBM/LTMOBM or associated cuttings into the marine environment.

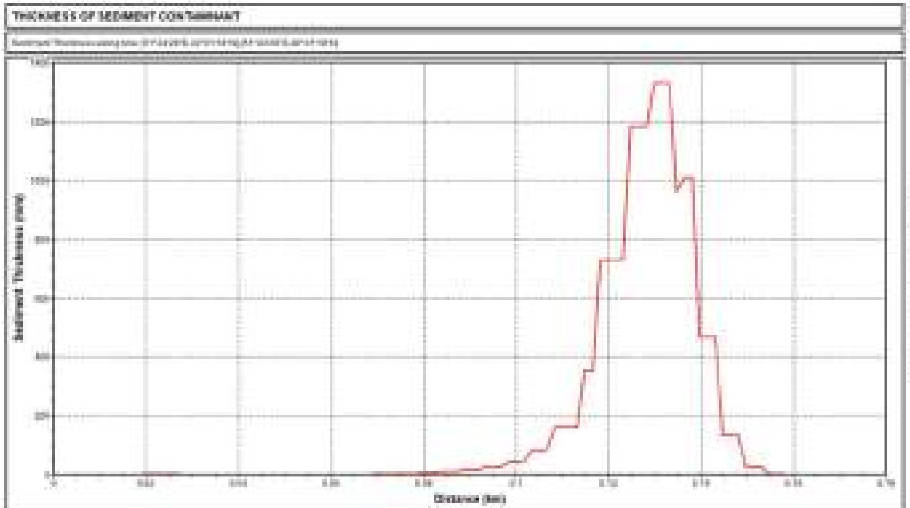
WBM Cuttings Discharged to the Seabed during Drilling of Upper 42”, 28” and 26” Hole Sections (6 Predrill Wells - Winter)



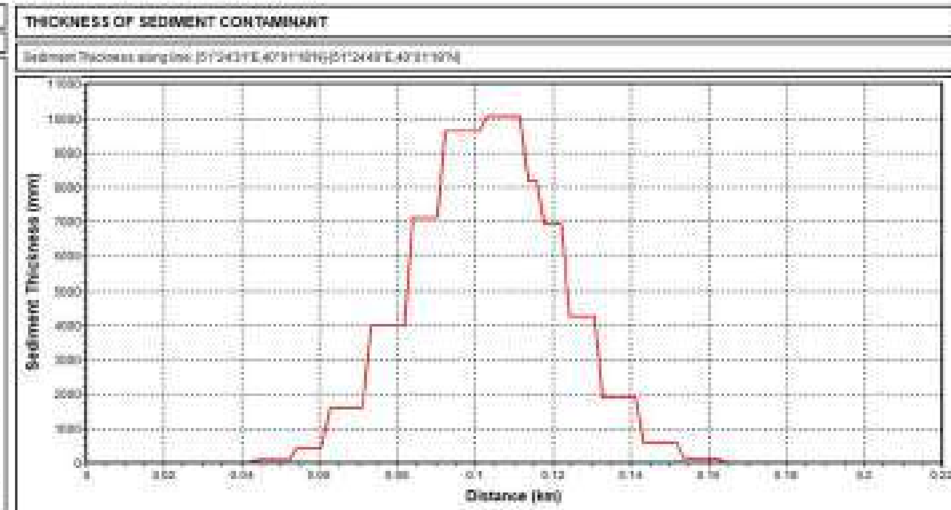


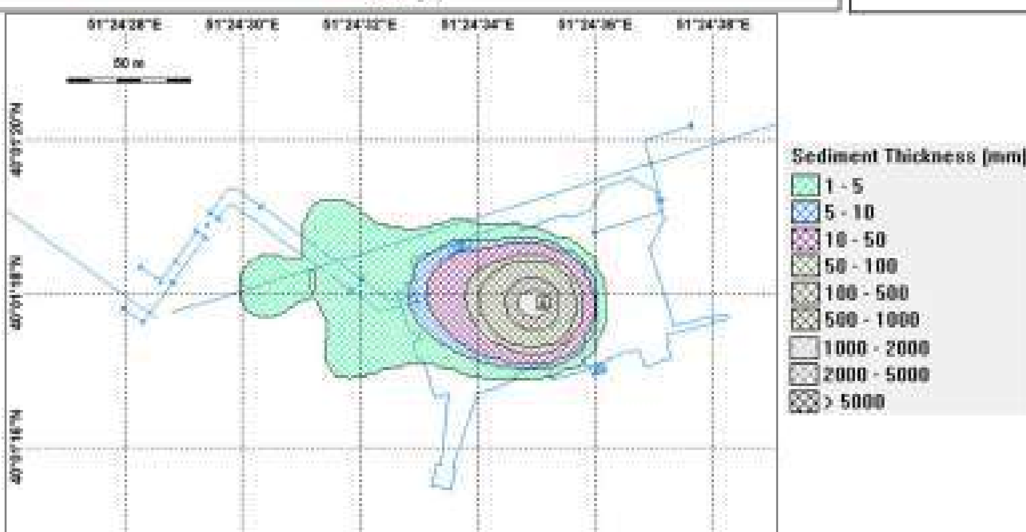
ACE ESIA – Offshore Drilling Discharges (Platform Drilling)

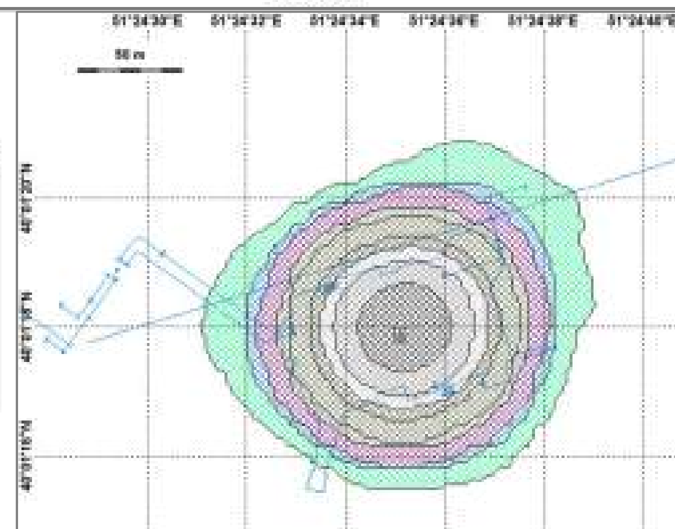
- WBM Cuttings Discharged to the Seabed during Drilling of Upper 30 and 26” Hole Sections (1 Platform Well – Winter)



- WBM Cuttings Discharged to the Seabed during Drilling of Upper 30 and 26” Hole Sections (38 Platform Wells)



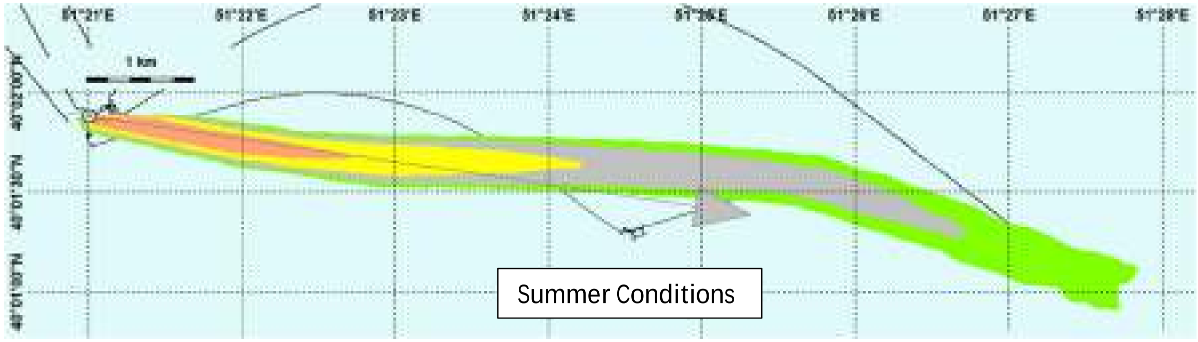


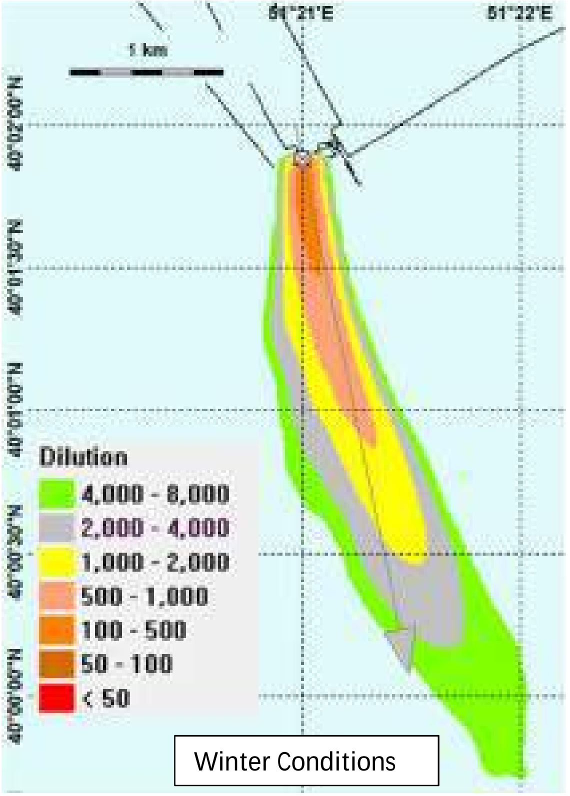


ACE ESIA – Pipeline and Subsea Infrastructure Hook-Up And Commissioning Discharges

- Hydrotesting is a critical activity to ensure the pipelines and flow line integrity and as seawater is used additives are necessary to prevent bacterial growth that can lead to corrosion of the pipe wall
- Screening assessment completed to select hydrotest additives included toxicity testing of candidate additives
- Highest environmental performing additives selected from North Sea/OSPAR certification schemes
- Discharges are not continuous and will occur as the pipelines are installed
- Discharges occur at water depths > 44 metres
- Potential environmental impact of the treated seawater (including preservation chemicals) discharges was assessed by conducting dispersion modelling (DREAM (Dose-related Risk Effects Assessment Model)) on a range of scenarios representing the range and type of discharges.
- Discharge modelling assumed the following Base Case chemicals are added to the pipelines at the indicated dosage rates:
  - 1000 parts per million (ppm) Hydrosure HD5000 (combined biocide, corrosion inhibitor and oxygen scavenger); and
  - 100ppm Tros Seadye (dye).

Dewatering Existing 22" Gas Pipeline EA to CA-CWP





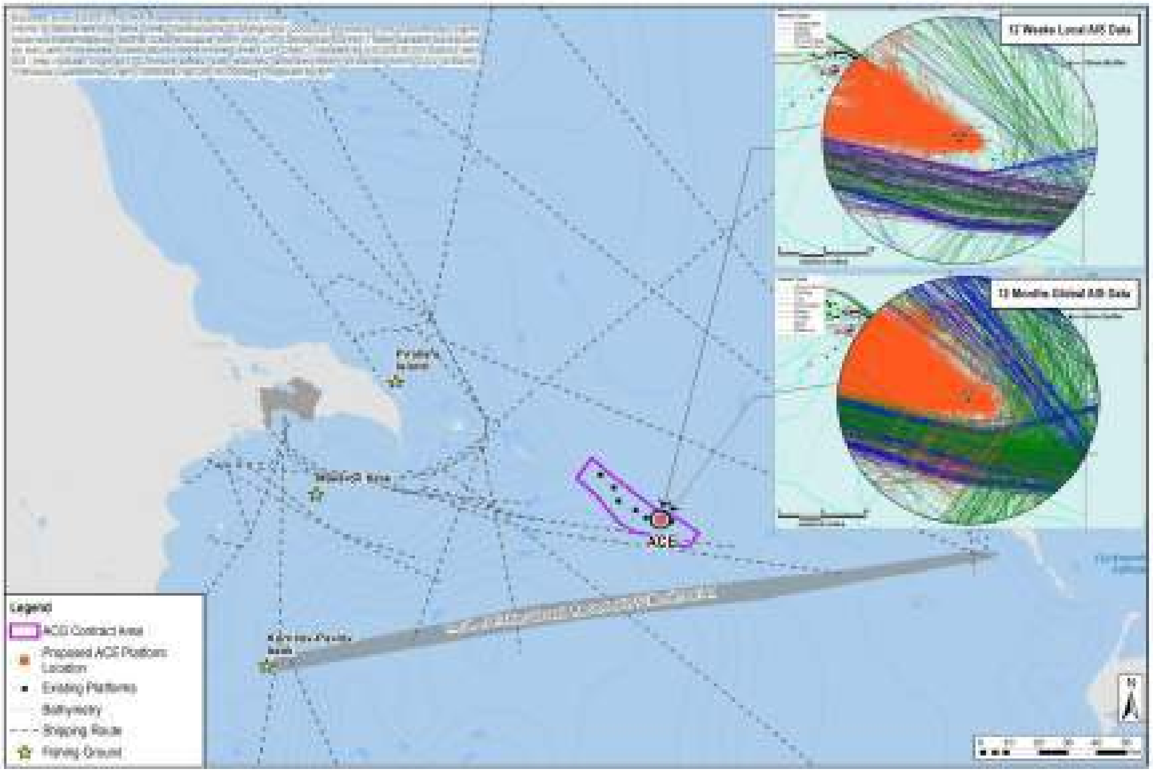
Commercial Shipping and Fishing

Commercial Shipping

- Two main shipping routes that pass through the ACG Contract Area.
- A vessel tracking study undertaken in 2017 to monitor vessel movements in the vicinity of the proposed ACE platform location showed the highest density of shipping is to the south of the proposed ACE platform location.
- The ACE Platform and its exclusion zone are unlikely to cause disruption to commercial shipping activities in this area.

Fishing Operations

- Commercial fishing is not routinely undertaken within the ACG Contract Area and only two legal entities and individuals licensed to carry out commercial fishing in the Southern Caspian.
- Commercial catch of anchovy kilka has gradually decreased during the last 12-15 years due to the reduction of kilka reserves since 2001.
- In recent years the number of licences issued for fishing has increased as fishing effort has moved to catching smaller fish species using small-capacity boats. No predicted impact from Project activities.



EMPLOYMENT & SOCIAL INVESTMENT

Employment and Training

Employment

- ACE Project will generate a number of employment opportunities over the Project duration.
- It is anticipated that the main construction yard contractors will potentially employ at peak 3,700 people, and there will be limited employment opportunities at other times during construction and commissioning.
- During the operational phase, over 100 potential permanent jobs may be created offshore by the ACE Project.
- Main construction and installation contractors and their sub-contractors will actively design and implement training and skills development programmes for their national staff.

BP Social Investment Programmes and Local Content Development Initiatives

BP Social Investment Programmes

- BP and its co-ventures support a variety of community and sustainable development initiatives to improve local education, build community-based skills and capabilities, and provide training that local enterprises need in order to grow.

Local Content Development Initiatives

- BP and its co-venturers launched the enterprise development and training programme in 2007 to identify and support local companies with strong business potential to enable them to meet international standards and enhance their competitiveness.
- Programme has helped local companies to secure contracts with BP in Azerbaijan worth $93 million in 2017.
- BP Azerbaijan has a five-year nationalisation plan for increasing the share of national staff - ultimate target of reaching 90% by the end of 2018. In 2017, 89% of BP Azerbaijan's professional workforce was national citizens.

CUMULATIVE IMPACT & ACCIDENTAL EVENTS

Cumulative Impacts

Marine Discharges

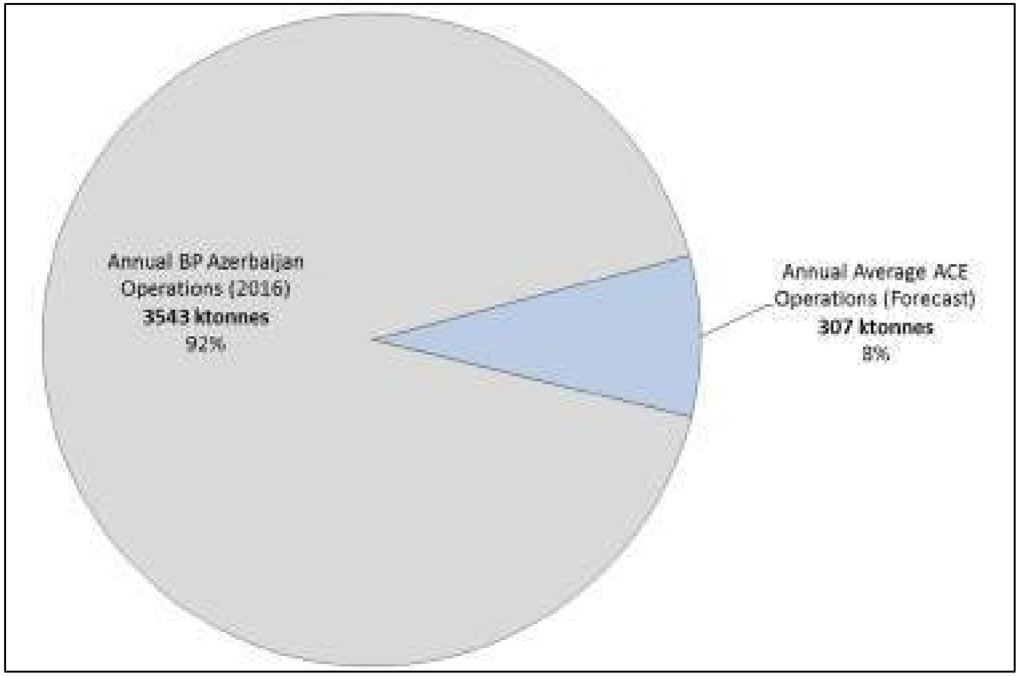
- All of the discharges associated with construction, installation, HUC and operation, have been assessed, and it is concluded that there will be no cumulative or additive interactions between the impacts.
- Discharge assessments concluded that discharges are separated in time and space and will rapidly disperse in the marine environment. Potential for cumulative or additive interactions between impacts considered to be insignificant.

Atmospheric Emissions

- Modelling has been completed to estimate the cumulative effect from non GHG emissions due to the operation of the SD2 platform complex and ACE platform on NO_2 concentrations on onshore receptors.
- Emissions associated with the ACE Project activities alone and emissions from worst-case cumulative SD2 Project offshore activities are not expected to result in any discernible changes in NO2 concentrations at onshore receptors.

Greenhouse Gases Emissions

- Principal sources of GHG emissions from the ACE Project are associated with power generation, gas compression and non-routine flaring of gas (required to maintain the safety of the facilities and operational workforce).
- ACE Project will contribute approximately 8% of the annual operational GHG emissions from BP's activities in Azerbaijan based on GHG emissions data from 2016.



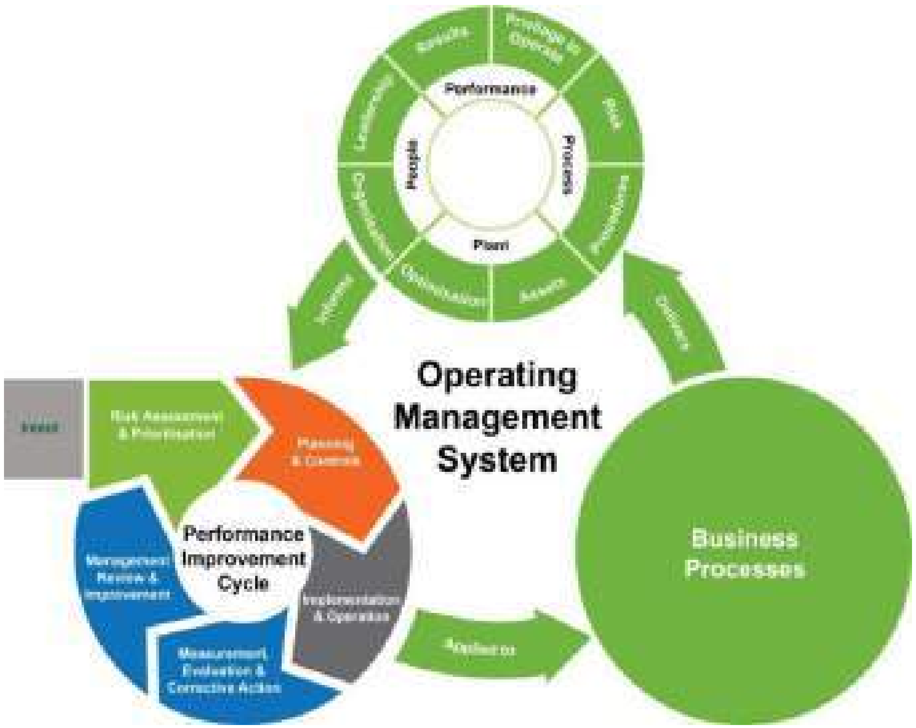
Accidental Events – Oil Spill Modelling

- The following Spill Modelling scenarios were modelled using SINTEF's Oil Spill Contingency and Response (OSCAR) modelling software.
- Three scenarios were modelled.
- Mitigations are in place to prevent these scenarios from occurring. Modelling has not taken into account any response mitigation measures such as dispersant application, containment or recovery. Results provide an indication of theoretical spill consequences without implementation of the oil spill mitigations.
- An Offshore Facilities Oil Spill Contingency Plan (OSCP) has been developed, which provides guidance and actions to be taken during a hydrocarbon spill incident associated with all ACG and SD offshore operations including MODUs, platforms, subsea pipelines and marine vessels.
- 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.

ENVIRONMENTAL & SOCIAL MANAGEMENT

Environmental and Social Management

- The BP Azerbaijan Georgia Turkey (AGT) Region have an established Operating Management System (OMS), which covers environmental performance.
- An ACE Project Construction Phase Environmental and Social Management System (ESMS) will be developed and implemented by BP.
- BP will have overall responsibility for managing the ACE Project and will monitor and audit the technical, environmental and social performance of its contractors.
- A transition plan will be developed to support the movement of ACE from the Construction to the Operations Phase EMS. This will include integration of ACE into the scope of AGT Region wide EMS and its existing processes.



- BP will prepare an Environmental and Social Management and Monitoring Plan (ESMMP) which will be supported by a suite of environmental and social management plans prepared by BP and the main construction contractors.
- Waste generated during the ACE Project will be managed in accordance with the existing BP AGT Region management plans and procedures.
- BP's AGT Region Environmental Monitoring Programme (EMP), which is designed to provide a consistent, long-term set of data, will be expanded for the ACE Project.

ACE ESIA – Environmental Monitoring

- BP's AGT Region Environmental Monitoring Programme (EMP), which is designed to provide a consistent, long-term set of data, will be expanded for the ACE Project.
- Throughout the construction and operations phases environmental monitoring work will continue:
  - Offshore:
    - Seabed sediment (physical, chemical and biological analysis)
    - Water quality (chemical and biological analysis
    - Caspian seal monitoring during piling activities
  - Onshore:
    - Noise
    - Dust
    - Air quality
    - Soil/surface water/ground water quality
- Operational monitoring programmes will also be undertaken to manage:
  - Pipeline and subsea infrastructure pre-commissioning discharges
  - Drill cuttings
  - Drainage
  - Sewage treatment plant performance monitoring
  - Diesel fuel use, flare volumes and exhaust stack emissions monitoring and ambient air quality

ESIA Management of Change (MOC)

- During the Design, Construction and Operations stages of the ACE Project, there may be a need to change a design element or a process.
- The ACE Project intends to implement an ESIA Management of Change process (MOC) to manage and track any 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.

Thank You

Azeri Central East (ACE) Project

Environmental and Social Impact Assessment

Public Disclosure 31st October 2018

Agenda and Purpose of Meeting

Agenda

Start	Finish	Presentation
10:00	10:15	Chair - welcome and agenda
10:15	11:15	ACE Project and ESIA overview
11:15	12:00	Question and Answers

Purpose

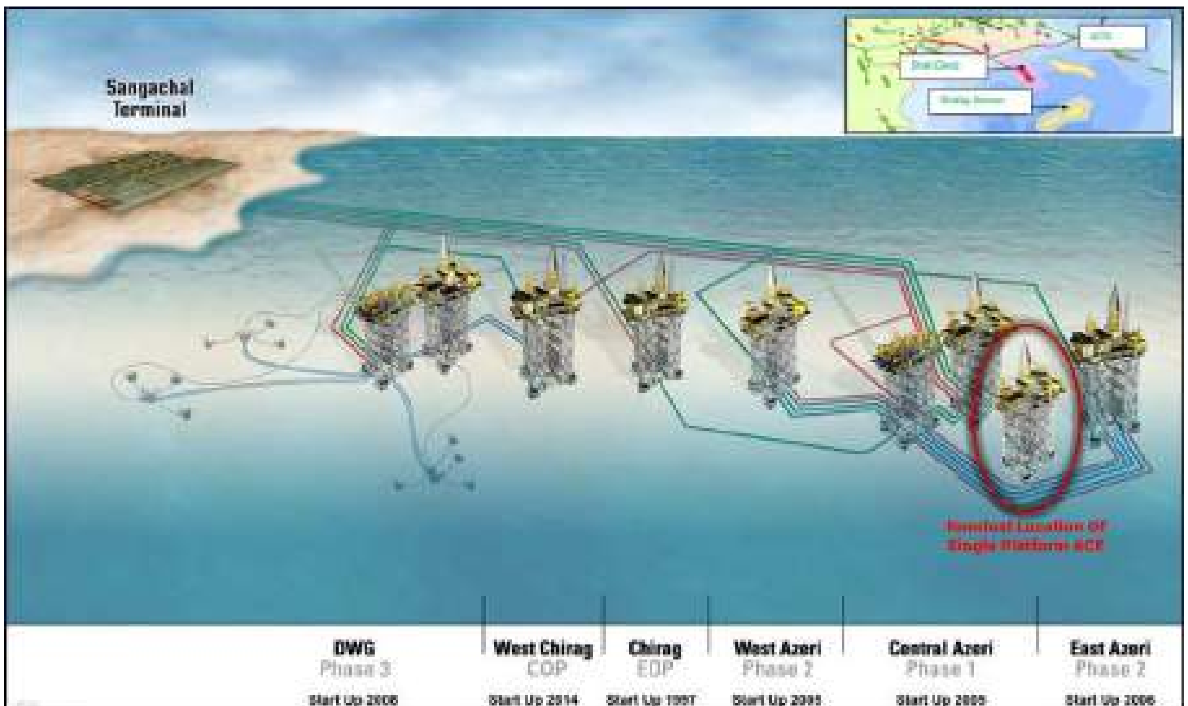
- The Azeri-Chirag-Gunashli (ACG) Contract Area is being developed in phases. The potential next phase of development comprises the Azeri Central East (ACE) Project.
- An Environmental and Social Impact Assessment (ESIA) Report was prepared for the ACE Project and submitted to the Ministry of Ecology and Natural Resources of the Republic of Azerbaijan on 13th September 2018 to seek permission to construct and operate the ACE Project.
- This presentation summarises the ESIA Report and provides an overview of identified potential impacts

ACE PROJECT OVERVIEW

ACE Project Concept

Objectives of ACE Project

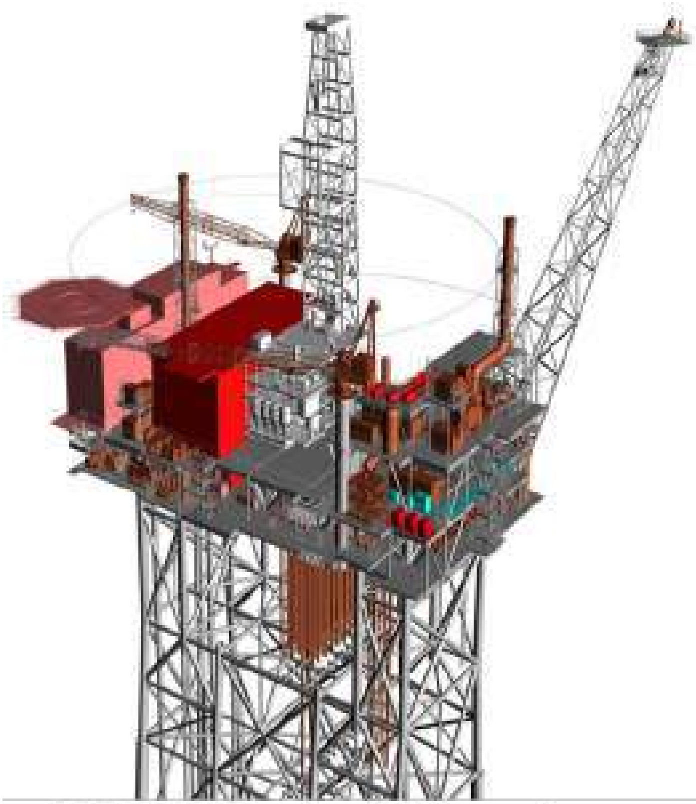
- The ACE platform will be located mid-way between Central Azeri (CA) and East Azeri (EA) platforms.
- The ACE Project comprises the topsides of the Production, Compression, Drilling and Quarters (ACE-PDQ) offshore platform along with associated jackets, piles and risers
- ACE will provide additional oil production and gas and water injection facilities to complement existing Azeri facilities.



ACE Project Overview

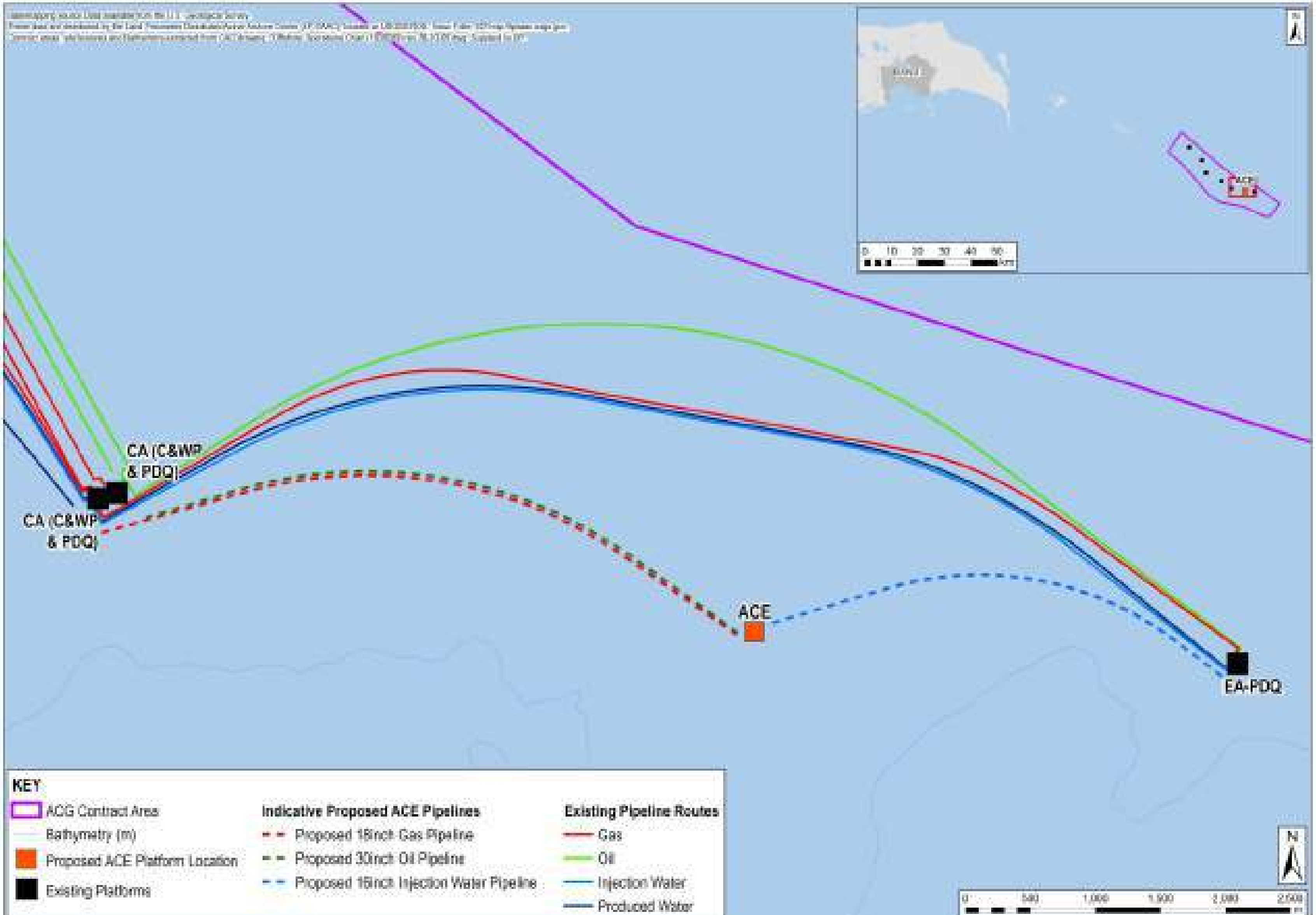
ACE Production, Drilling and Quarters (PDQ) Platform

- Oil and water is exported into the existing oil pipeline to the Sangachal Terminal, via a new pipeline.
- Produced water will be treated at Sangachal Terminal and sent back offshore for reinjection.
- Gas is dehydrated and compressed providing gas lift and gas injection into the reservoirs at EA and CA or is exported to Sangachal Terminal.
- High pressure water for water injection into the reservoirs will be supplied to ACE via a new pipeline that connects into the existing CA-EA WI pipeline.
- The power is provided via 1x100% Gas Turbine Generator on ACE and back-up power is imported via a cable from a brown field connection on EA.
- The Platform contains living quarters and sewage treatment package sized to accommodate up to 202 POB.



ACE- PDQ Rendered Schematic

ACE Project Layout

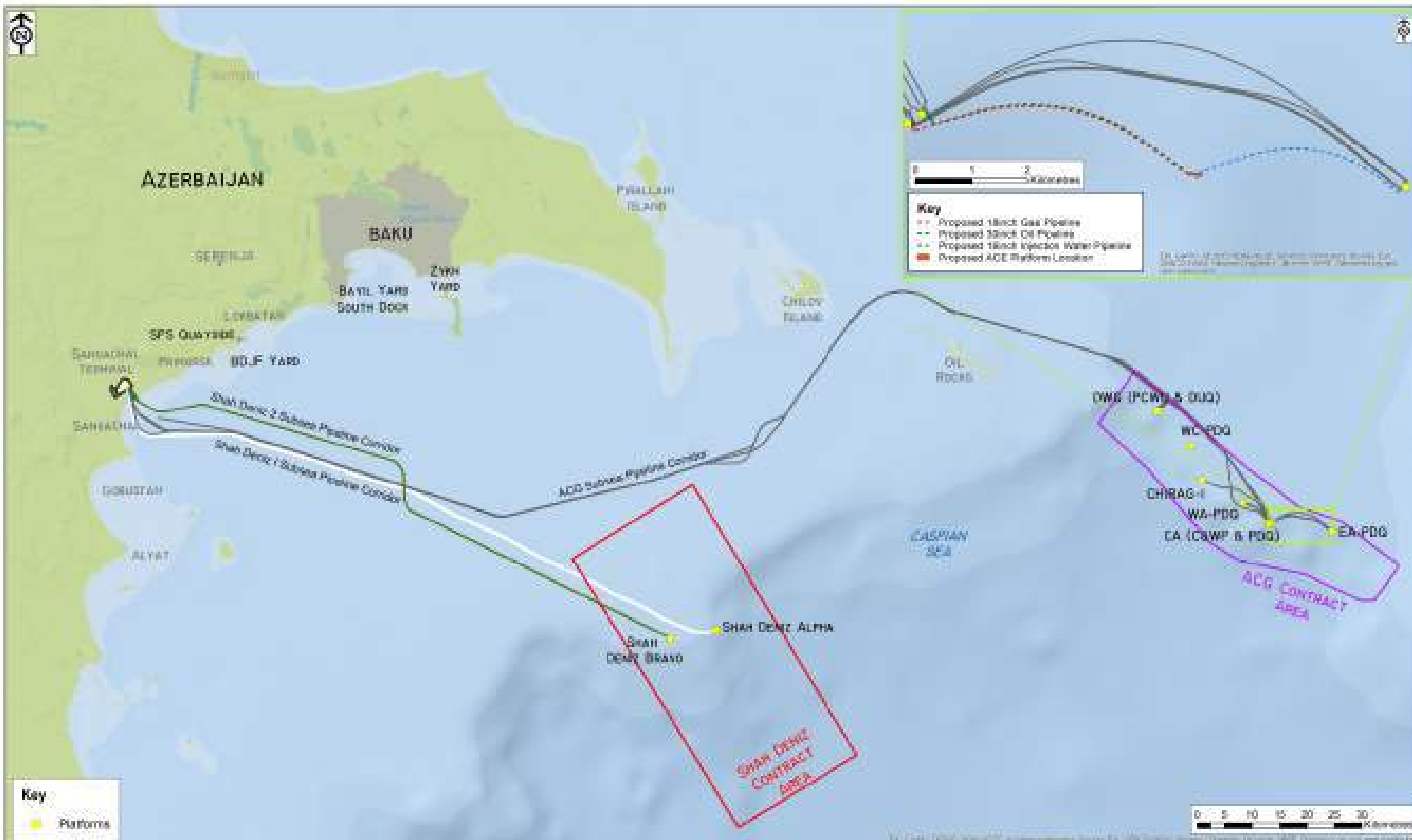


Project Activities

- The main ACE Project phases include:
  - Onshore construction and commissioning of offshore and subsea facilities (at existing construction yards)
  - Platform installation , hook up and commissioning (HUC)
  - Installation, tie-in and HUC of ACE infield subsea pipelines and associated subsea infrastructure
  - Brownfield works on the EA and CA platforms
  - Offshore drilling
  - Offshore operations and production
- The project does not involve any modifications at Sangachal Terminal (other than minor telecommunication modifications) – there is sufficient capacity within the existing onshore ACG facilities to accommodate ACE.

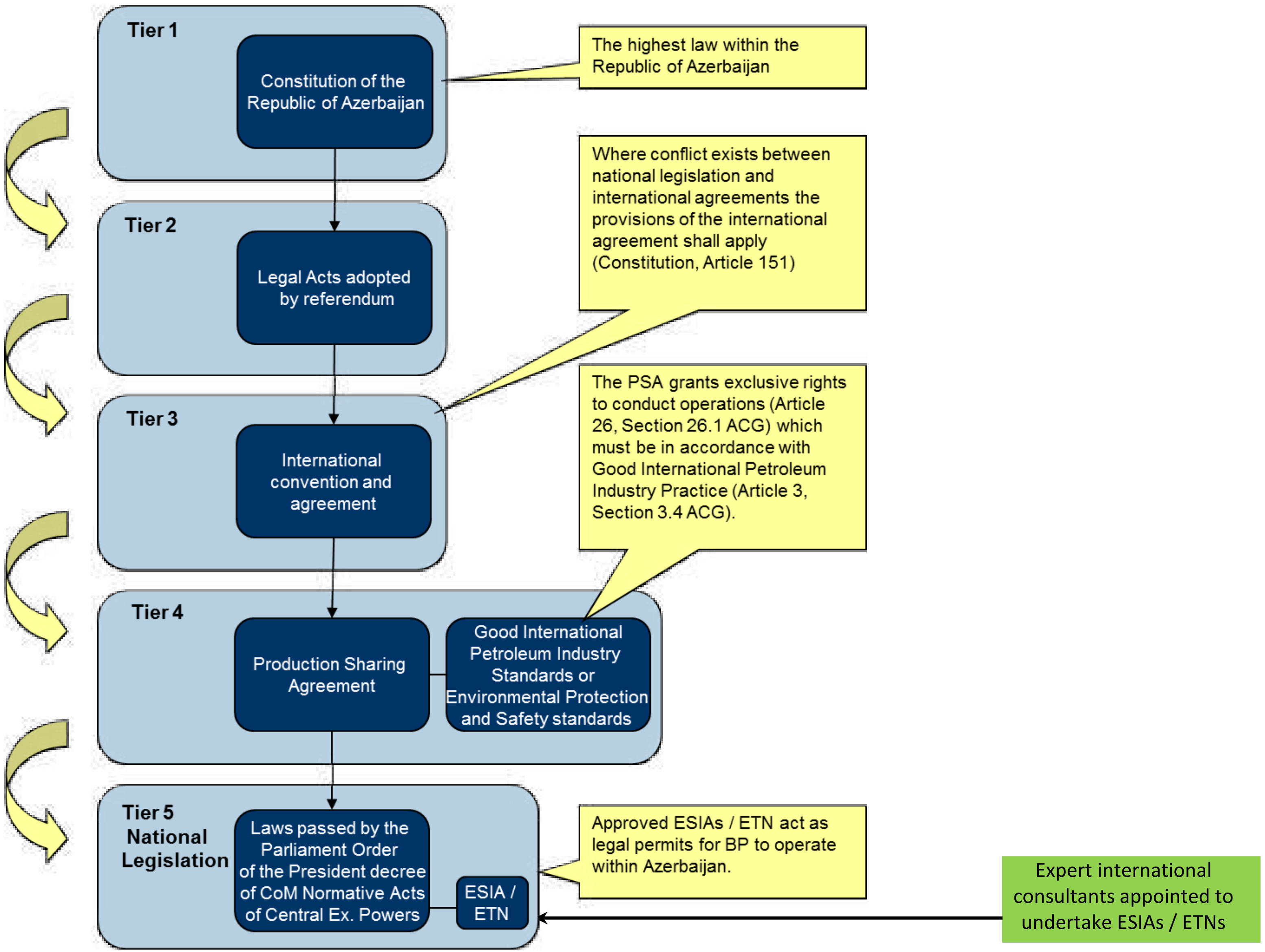


ACE ESIA – Key Onshore & Offshore Locations Associated with the ACE Project

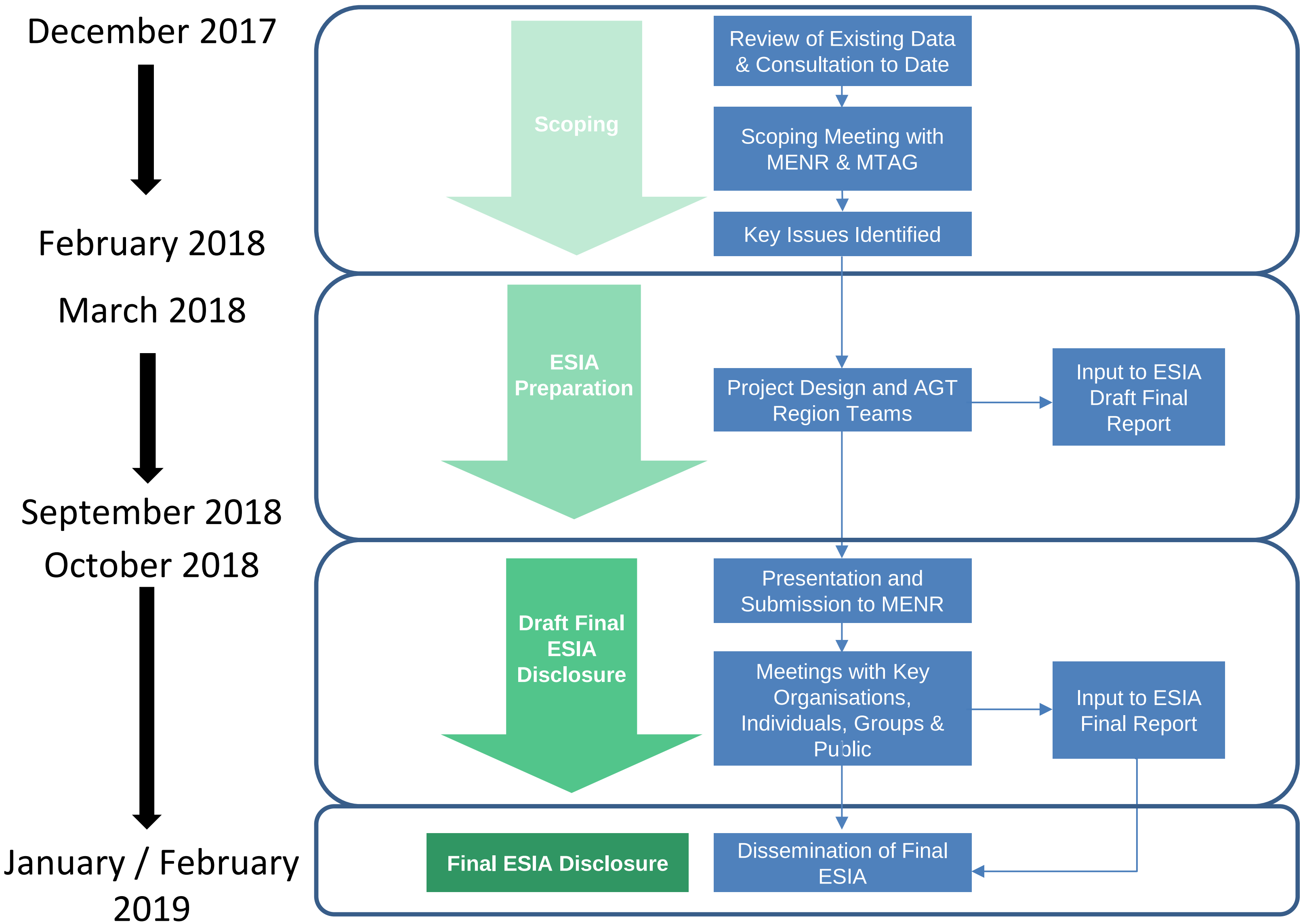


LEGAL FRAMEWORK & ESIA PROCESS

Policy, Regulatory and Administrative Framework



ESIA Consultation and Disclosure Process



ACE ESIA Feedback

- If you have any comments on the draft ESIA, please complete the feedback forms and submit today or alternatively send them to:

  BP Azerbaijan

  BP Xazar Centre,

  153 Neftchilar Avenue

  Baku

  Azerbaijan AZ1010

- or by email to:

  esiafeedback@bp.com

- or by phone call to:
  - Telephone number: 0552259013
- The comments received will be submitted to the team implementing the ESIA, which will address any outstanding issues in the final ESIA.
- All comments must be submitted before end of November, 2018.
- The NTS, ESIA and feedback forms are available at:

  www.bp.com/caspian

ENVIRONMENTAL SURVEYS

ESIA Inputs: Overview of Baseline Data Sources and Surveys

Environmental Surveys	
Operations Offshore Environmental Monitoring Programme Datasets Reviewed: (1992 – 2016) ACG Contract Area and Pipeline Corridor Regional Surveys and East and Central Azeri platform monitoring surveys	
ESIA	
Terrestrial/Coastal Surveys (1996, 2002-2006)	**Offshore Environmental Surveys (2017)**
Winter Waterfowl Monitoring Study, Absheron to Kura (2002, 2004-2006)	Sediment Surveys (benthic, chemical and physical)
Overwintering Bird Survey, Absheron to Kura (2003, 2004)	Plankton Survey
Sangachal Coastal Environmental Survey (1996)	Water Quality

IMPACT ASSESSMENT

ACE ESIA – Impact Assessment Process

- Within the ESIA, the environmental impact assessment process is based on:
  - The results of modelling work (i.e. air quality dispersion modelling, drilling discharges (drill cuttings and cement discharges), pre-commissioning pipeline discharges, cooling water discharges and oil spill modelling)
  - Laboratory studies.
- Monitoring and historic data:
  - Provided from BP arranged surveys and on-going monitoring work
  - Surveys/data provided by national institutes.
- The ESIA process considers the Event Magnitude and the likely Receptor (e.g. human, fish, seal) Sensitivity to predict the Significance of the impact of Project Activities.
- The process takes into account:
  - The existing controls and mitigation, and determines impact significance; and
  - Any further controls and mitigations identified.

		Receptor Sensitivity		
		Low (2)	**Medium (3-4)**	**High (5-6)**
Event Magnitude	**Low (4)**	Negligible	Minor	Moderate
	Medium (5-8)	Minor	Moderate	Major
	High (9-12)	Moderate	Major	Major

Air Quality – Onshore Emissions

- In order to minimise impacts to air quality the construction plant and vehicles will be well maintained, mains electricity will be used instead of mobile generators where possible and the construction plant and vehicles will use low sulphur fuel.
- Under all conditions modelled, concentrations of NO_2 are not expected to exceed the applicable short term standard for NO2 of $200 \mu g/m^3$.

ACE ESIA – Summary of Non-GHG and GHG Emissions

Non-GHG Gases

Atmospheric emissions will be generated from the each ACE Project phase due to:

- Operation of combustion plant (during construction and operations)
- Operation of vessels (including a mobile drilling rig)
- Flaring (during brownfield tie-in activities and during operations)
- Fugitive emissions.

Greenhouse Gases

- Principal sources of GHG emissions from the ACE Project are associated with power generation, gas compression and non-routine flaring of gas which is required to maintain the safety of the facilities and operational workforce.
- ACE Project will contribute approximately 8% of the annual operational GHG emissions from BP's activities in Azerbaijan based on GHG emissions data from 2016.

Construction Noise (Terrestrial)

- Noise at the selected construction yard(s) during the construction and commissioning phase will arise from the use of plant and machinery.
- Noise screening modelling assessment was undertaken to determine potential impacts to any nearby receptors.

Construction Yard Plant and Vehicles

- Modelling demonstrated that, the daytime limit of 65dB will be met at 40m from the noise source and at 400m, the night time limit of 45dB LAeq will be met.

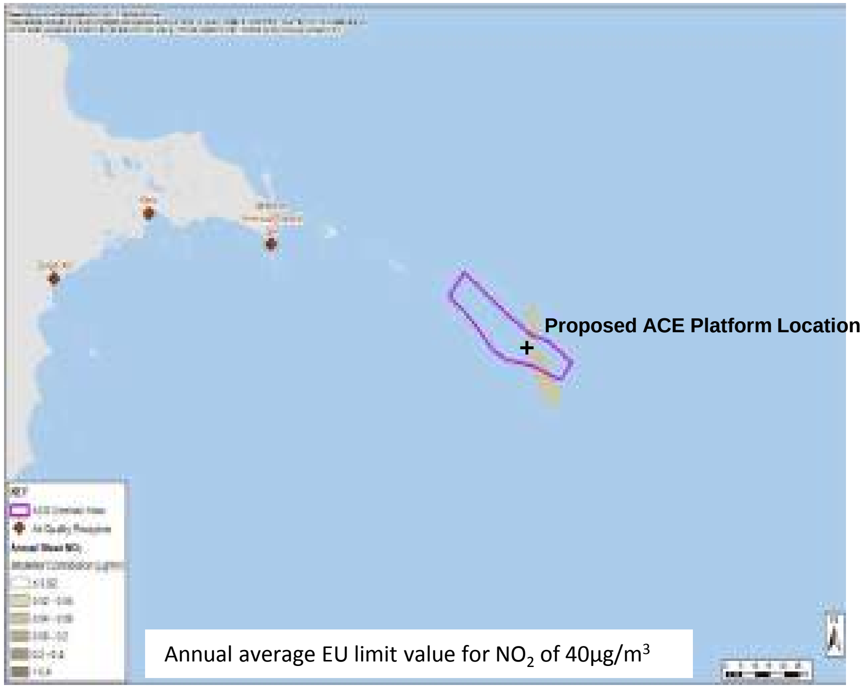
Onshore Commissioning of Main Platform Generators and Topside Utilities

- Worst case impacts were considered based on the operation of the main dual fuel generator running for 8 hours.
- The results demonstrated that predicted noise levels will meet the most stringent limit (night time limit of 45dB LAeq) at distances greater than 500m.

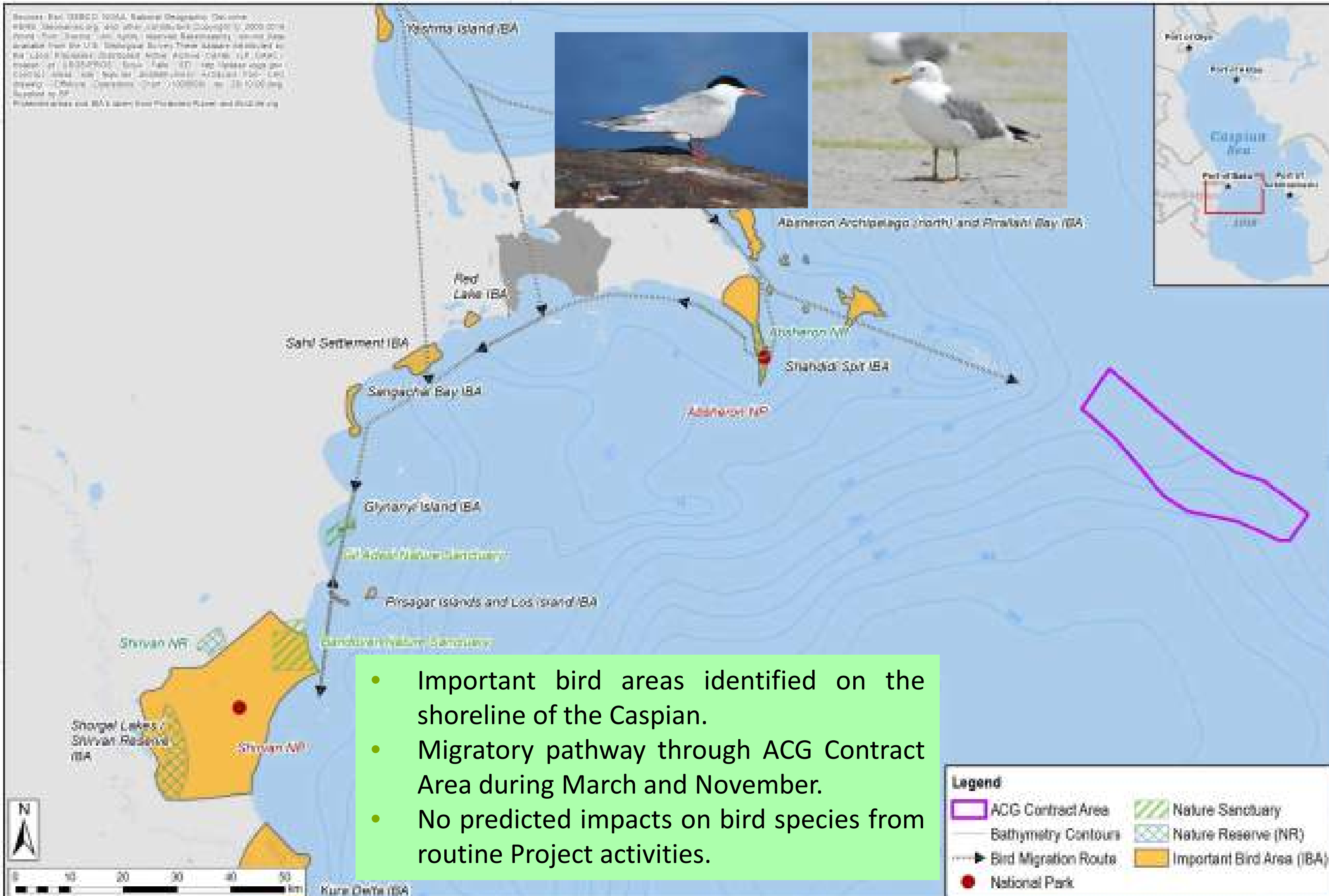
Air Quality – Offshore Emissions

- Project will employ various control measures to minimise emissions, including planned use of low sulphur fuel, planned maintenance of equipment, minimising flaring on the platform and undertaking exhaust emissions testing.
- Air dispersion modelling completed for the key emissions sources associated with predrilling, construction and operation phases.
- Results show no predicted exceedances of the relevant long term NOx standard at onshore receptors.

Modelled Mean Annual NO_2 Contributions Due to Routine Offshore Operations



Birds & Protected Areas

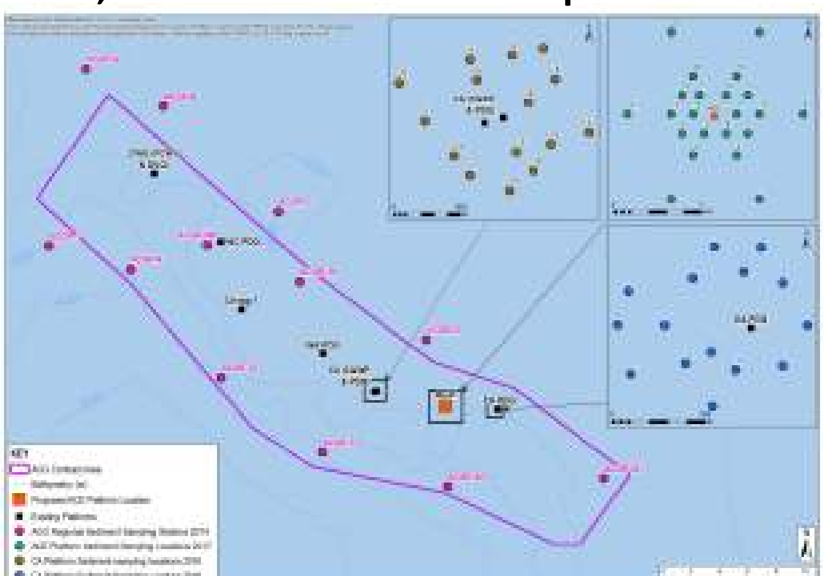


- Important bird areas identified on the shoreline of the Caspian.
- Migratory pathway through ACG Contract Area during March and November.
- No predicted impacts on bird species from routine Project activities.

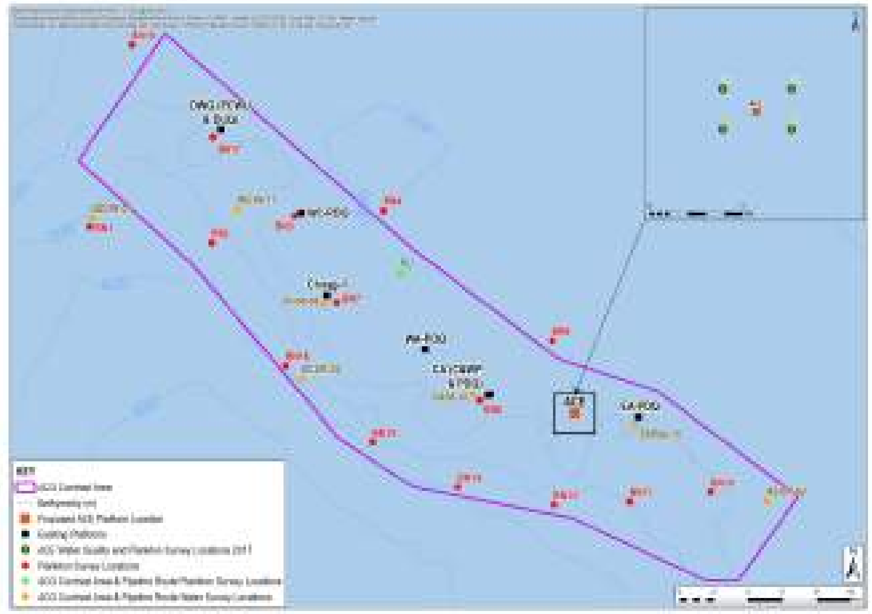
Offshore – Sediment, Water Quality, Plankton

- Environmental monitoring data has been collected by BP across the ACG field for over 25 years.
- Environmental Baseline Survey carried out at the proposed ACE platform location in 2017.
- Key Project controls and mitigation measures to reduce impacts include the use of highest environmental performance chemicals, minimising the volumes of discharges and only discharging water based drilling muds.

ACE, EA and CA Sediment Sample Stations



ACG Regional and ACE Water Sample Stations



- Modelling undertaken to predict impacts of discharges to sea such as drill cuttings, cooling water and pipeline hydrotesting discharges.
- Minor negative impacts predicted on sensitive receptors such as plankton, benthic communities, fish and Caspian Seals.

Discharge Modelling

- Only water based mud will be discharged from the top hole sections in accordance with PSA requirements - Highest environmental performing additives selected from OSPAR certification schemes.

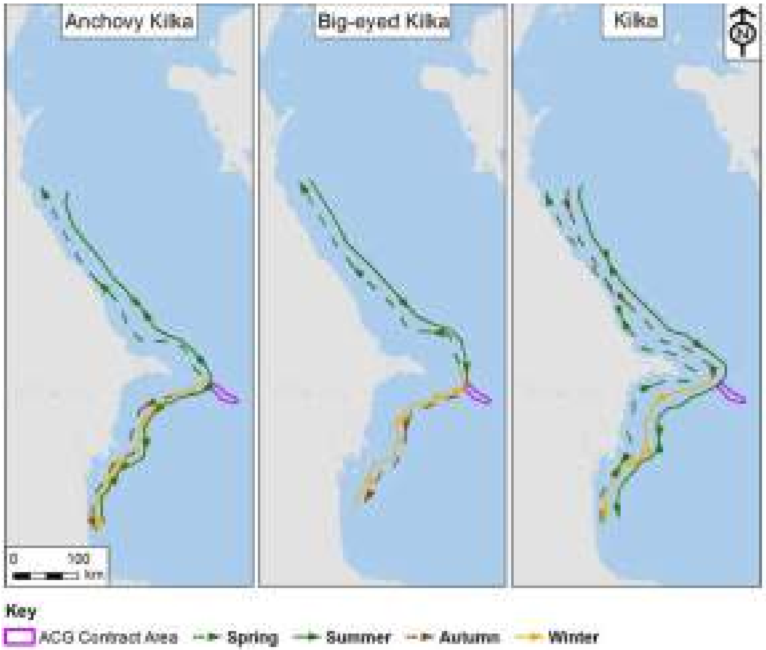
- Pre-commissioning pipeline discharge assessments concluded that discharges are separated in time and space and will rapidly disperse in the marine environment.

Offshore – Fish

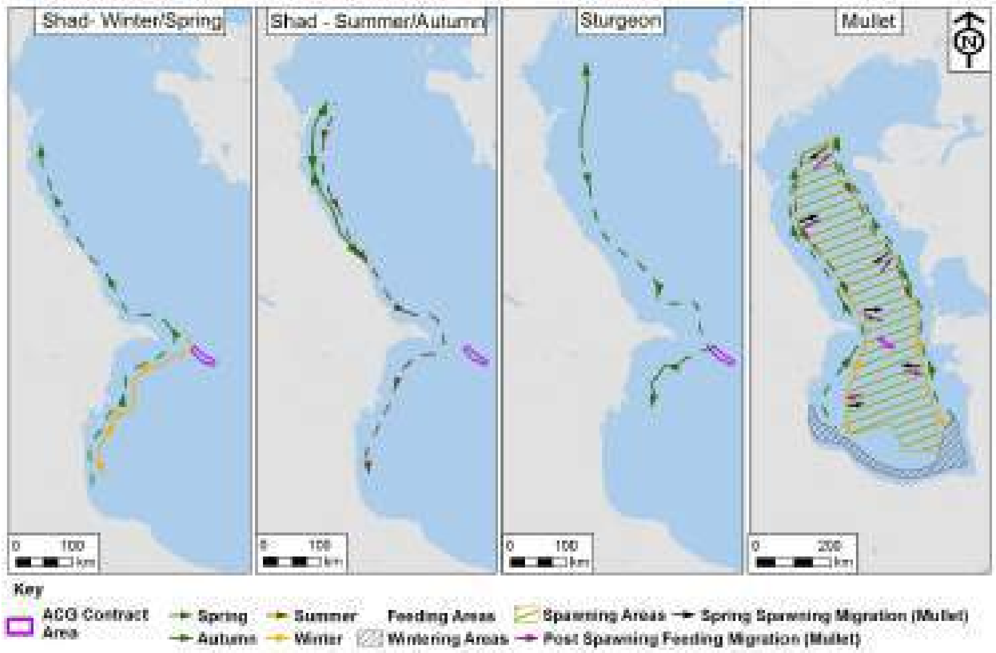
- Approximately 151 species and subspecies of fish can be found in the Caspian and associated river deltas; 54 classified as local to the area.
- In general fish species are not known to migrate through the ACG Contract Area, preferring to remain within the shallower waters between the shore and the Contract Area.
- Common threats to fish populations are over fishing, high levels of pollution (from both man-made and natural events) and habitat loss.

- Potential impacts on fish from underwater sound and marine discharges are predicted to result in a Minor Negative Impact with the implementation of Project control and mitigation measures proposed in the ESIA.

Kilka Migration Routes



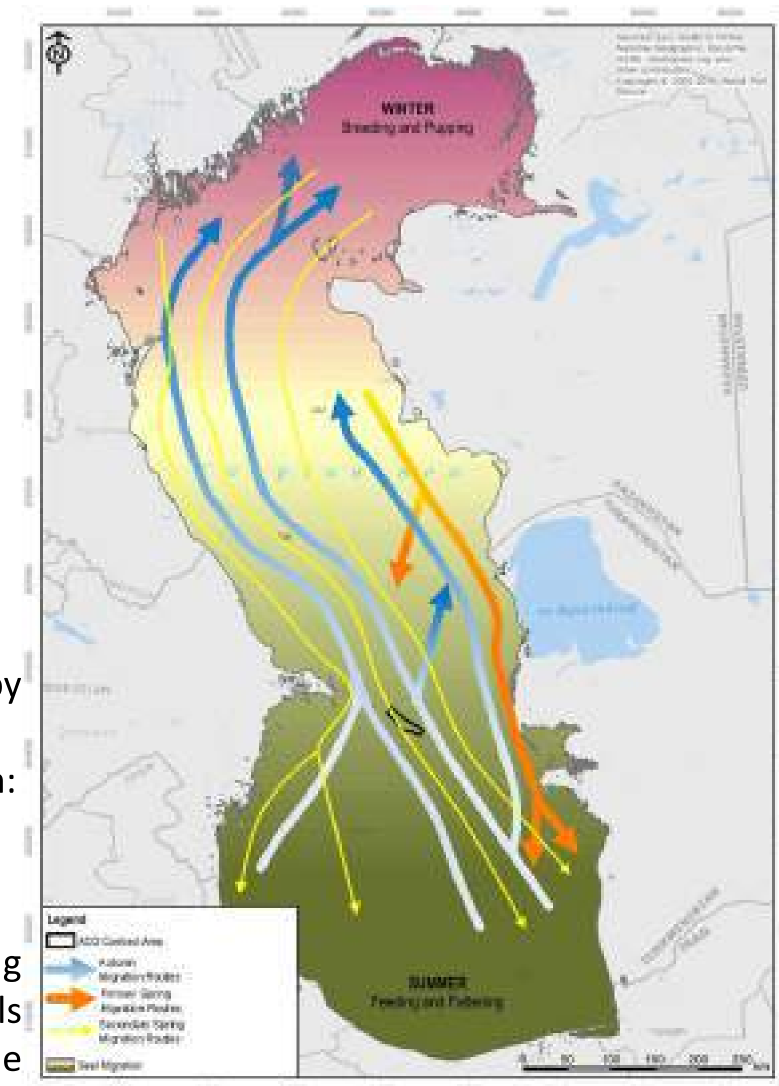
Shad, Sturgeon and Mullet Migration Routes



Caspian Seals

- IUCN Red list as "Endangered."
- Distribution is dictated by migration. Main source of food is kilka, thus migration patterns follow similar trends.
- May be present in the ACG Contract Area at any time of year: increased likelihood during the spring migration and summer.
- Seal monitoring undertaken during the ACE geotechnical survey at the proposed ACE platform location recorded five seal sightings in April 2018.

- Key potential impact is from underwater sound generated by Project activities.
- Underwater sound modelling was used to predict impacts from:
    - Vessel movements – Minor Adverse Impact predicted
    - Drilling – Minor Adverse Impact predicted
    - Piling – Moderate Adverse Impact predicted
- Key Project control and mitigation measures during piling include the training of vessel crews in marine mammals observations, establishment of a 500m Mitigation Buffer Zone for visual observations and the use of a Acoustic Deterrent Device



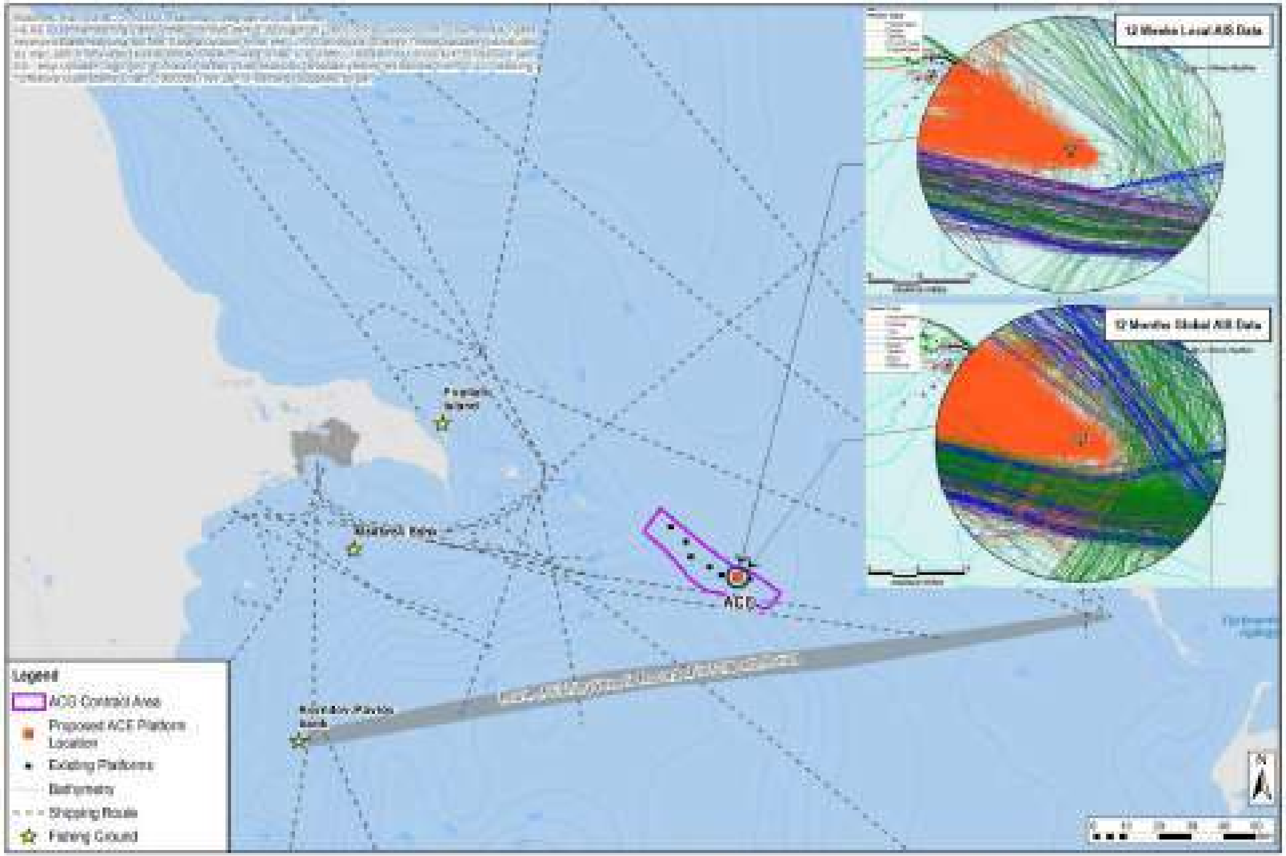
Commercial Shipping and Fishing

Commercial Shipping

- Two main shipping routes that pass through the ACG Contract Area.
- A vessel tracking study undertaken in 2017.
- Exclusion zones enforced during the installation and operation of the ACE facilities are not predicted to cause disruption to commercial shipping activities in this area.

Fishing Operations

- Commercial fishing is not routinely undertaken within the ACG Contract Area and only two legal entities and individuals licensed to carry out commercial fishing in the Southern Caspian.
- Commercial catch of anchovy kilka has gradually decreased during the last 12-15 years due to the reduction of kilka reserves since 2001.
- With the implementation of Project control and mitigation measures there are no predicted impacts from Project activities



ACCIDENTAL EVENTS

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.
- Three hydrocarbon spill scenarios were modelled for the ESIA.
- Impacts from accidental events are unlikely to occur as high operational performance and compliance with good industry practices will be maintained at all times by BP and their contractors.

EMPLOYMENT & SOCIAL INVESTMENT

Employment and Training

Employment

- ACE Project will generate a number of employment opportunities over the Project duration.
- It is anticipated that the main construction yard contractors will potentially employ at peak 3,700 people, and there will be limited employment opportunities at other times during construction and commissioning.
- During the operational phase, over 100 potential permanent jobs may be created offshore by the ACE Project.
- Main construction and installation contractors and their sub-contractors will implement training and skills development programmes for their national staff.

BP Social Investment Programmes and Local Content Development Initiatives

BP Social Investment Programmes

- BP and its co-ventures support a variety of community and sustainable development initiatives to improve local education, build community-based skills and capabilities, and provide training that local enterprises need in order to grow.

Local Content Development Initiatives

- BP and its co-venturers launched the enterprise development and training programme in 2007 to identify and support local companies with strong business potential to enable them to meet international standards and enhance their competitiveness.
- Programme has helped local companies to secure international contracts with BP in Azerbaijan worth $93 million in 2017.
- BP Azerbaijan has a five-year nationalisation plan for increasing the share of national staff - ultimate target of reaching 90% by the end of 2018. In 2017, 89% of BP Azerbaijan’s professional workforce was national citizens.

ENVIRONMENTAL & SOCIAL MANAGEMENT

Environmental and Social Management

- BP will have overall responsibility for managing the ACE Project and will monitor and audit the technical, environmental and social performance of its contractors.
- All ACE Project controls and mitigation measures have been included in the ESIA and will be managed during the Construction Phase Environmental and Social Management System (ESMS).
- To support the ESMS, BP will prepare an Environmental and Social Management and Monitoring Plan (ESMMP) which will be supported by a suite of environmental and social management plans prepared by BP and the main construction contractors.

- Waste generated during the ACE Project will be managed in accordance with the existing BP AGT Region management plans and procedures.
- BP's AGT Region Environmental Monitoring Programme (EMP), which is designed to provide a consistent, long-term set of data, will be expanded for the ACE Project.

Summary and Conclusions

- BP plans to construct, install and operate a PDQ platform, to be located mid-way between the CA and EA platforms in the ACG Contract Area in a water depth of approximately 137m.
- ACE will provide additional oil production and gas and water injection facilities to complement existing Azeri facilities.
- The draft ESIA Report has been submitted to MENR (September 2018).
- Activities associated with the ACE Project have been assessed for all project phases.
- Residual environmental and social impacts identified have been of negligible, minor or moderate adverse significance with positive impacts arising from employment, training and skills development and through procurement of goods and services.
- The monitoring and mitigation plans and procedures proposed in the ESIA are sufficient to ensure the sound management of impacts throughout the duration of the ACE Project.

ACE ESIA Feedback Reminder

- If you have any comments on the draft ESIA, please complete the feedback forms and submit today or alternatively send them to:

  BP Azerbaijan

  BP Xazar Centre,

  153 Neftchilar Avenue

  Baku

  Azerbaijan AZ1010

- or by email to:

  esiafeedback@bp.com

- or by phone call to:
  - Telephone number: 0552259013
- The comments received will be submitted to the team implementing the ESIA, which will address any outstanding issues in the final ESIA.
- All comments must be submitted before end of November, 2018.
- The NTS, ESIA and feedback forms are available at:

  www.bp.com/caspian

Thank You

APPENDIX 9A

Azeri Central East Project Predrill Activities and Events

ACTIVITY/INTERACTIONS

ID (R=Routine, NR= Non-Routine)	Activity	Ref.	Scoped In/Out	Event	Event Category
Predrilling					
Pre-R1	Tow out and positioning of Mobile Offshore Drilling Unit (MODU)	5.3.1.1	✓	Other discharges to sea	Ballast Water Treated Black Water Grey Water Drainage
				Underwater noise and vibration	Underwater Noise and Vibration
				Emissions to atmosphere (non GHG)	MODU Power Generation Support Vessels
Pre-R2	Seabed disturbance associated with MODU anchoring	5.3.1.1	×	Seabed disturbance	Anchoring of MODU
Pre-R3	Vessel support including supply to MODU and backload to shore	5.3.1.2 Table 5.1	✓	Other discharges to sea	Ballast Water Treated Black Water Grey Water Drainage
				Underwater noise and vibration	Underwater Noise and Vibration
				Emissions to atmosphere (non GHG)	MODU Power Generation Support Vessels
Pre-R4	Emissions and noise associated with crew change operations	Table 5.1	×	Emissions to atmosphere (non GHG)	Support Vessels
				Noise	Support Vessels
Pre-R5	MODU power generation	5.3.1.2 Table 5.2	✓	Emissions to atmosphere (non GHG)	MODU Power Generation
Pre-R6	MODU treated black water/ grey water/ drainage discharges	5.3.1.2 Table 5.2	✓	Other discharges to sea	Ballast Water Treated Black Water Grey Water Drainage
Pre-R7	MODU Seawater / Cooling Water Systems	5.3.1.2 Table 5.2	✓	Water intake / entrainment	Cooling Water Intake and Discharge
				Cooling water discharge to sea	Cooling Water Intake and Discharge
Pre-R8	Drilling with seawater/PHB sweeps or water based mud (WBM) (upper 42”, 28” and 26” hole sections)	5.3.2.3	✓	Underwater noise and vibration	Underwater Noise and Vibration
				Drilling discharges to sea	Drilling Discharges to Sea
Pre-R9	Discharge of residual WBM (after 26” hole section drilling)	5.3.2.3	✓	Drilling discharges to sea	Drilling Discharges to Sea
Pre-R10	Discharge from 28” or 26” hole sections due to Mud Recovery pumping System (MRS) failure	5.3.2.3	✓	Drilling discharges to sea	Drilling Discharges to Sea
Pre-R11	Drilling with non-WBM (lower 20”, 17” and 13 ½” hole sections)	5.3.2.3	✓	Underwater noise and vibration	Underwater Noise and Vibration
			×	Generation of hazardous and non-hazardous waste	Waste Generation
Pre-R12	Cementing discharges to seabed (from cementing casings)	5.3.2.5	✓	Cement discharges to sea	Cement Discharges to Sea
Pre-R13	Discharge of cement system washout to sea via cement unit hose	5.3.2.5	✓	Cement discharges to sea	Cement Discharges to Sea
Pre-R14	Blowout Preventer (BOP) testing	5.3.4.1	✓	Discharge of BOP control fluid to sea	Discharge of BOP Control Fluid to Sea
Pre-R15	Waste generation	5.3.6.3	×	Generation of hazardous and non-hazardous waste	Waste Generation
Pre-R16	Fugitive emissions from dry bulk transfer	5.3.2.5	×	Emissions to atmosphere (non GHG)	Transfer of Dry Bulk from Support Vessels to MODU Silos

Appendix 9B

Azeri Central East Predrill Air Quality Modelling Assessment

ACE Predrill Air Quality Modelling Assessment

ACE Project ESIA

Project reference: ACE Project ESIA
Project number: PR-245517

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Figures

Tables

Units and Abbreviations

Unit	Description
°C	Degrees Celsius
g/s	Grams per Second
K	Degrees Kelvin
kg/hr	Kilograms per Hour
Km	Kilometre
lb/MMBTu	Pounds per Million British Thermal Units
M	Meters
m/s	Meters per Second
m^3	Cubic Metres
m^3/day	Cubic Metres per Day
mg/Nm^3	Micrograms per Standardised Meter Cubed of Air
MMscf	Million Standard Cubic Feet
MW	Mega Watts

Abbreviation/ Acronym	Description
ACG	Azeri Chirag Gunashli
ADMS	Atmospheric Dispersal Modelling System
CO	Carbon monoxide
ESD	Emergency Shutdown Depressurisation
EU	European Union
GHG	Greenhouse Gas
IFC	International Finance Corporation
MODU	Mobile Offshore Drilling Unit
NO	Nitric oxide
NO_2	Nitrogen dioxide
NO_X	Oxides of nitrogen
PM	Particulate matter
SO_2	Sulphur dioxide
UK	United Kingdom
US	United States
US EPA	United States Environmental Protection Agency
VOC	Volatile Organic Compounds
WHO	World Health Organisation

Executive Summary

The Azeri Central East (ACE) Project represents the next stage of development in the Azeri Chirag Gunashli (ACG) field. The project comprises a new offshore production, drilling and quarters (PDQ) platform, to be located mid-way between the Central Azeri (CA) and East Azeri (EA) platforms, with associated infield pipelines to tie-in the platform to the existing ACG oil and gas export pipelines and to supply injection water to the platform.

An air dispersion modelling study for the offshore predrilling activities associated with the ACE platform for the purpose of the Environmental and Social Impact Assessment (ESIA) has been undertaken.

The scope of the modelling study was to estimate any changes in ambient atmospheric pollutant concentrations attributed to the offshore predrilling activities. Pollutant species and corresponding averaging periods have been based on the applicable ambient air quality limit values, set for the protection of human health, and modelled at discrete onshore receptors.

As for the other platforms in the ACG Contract Area prior to the installation of the platform it is planned to predrill a number of wells using a Mobile Offshore Drilling Unit (MODU). The MODU programme is expected to last approximately 12 months and one of the MODUs located in the Caspian Sea used for previous predrilling campaigns will be used to drill the wells.

The modelling assessment has conservatively assumed:

- The Istiglal MODU will be used for the predrilling programme. The Istiglal is equipped with four 3,480 Kilowatts diesel engines; and
- The MODU engines will be operating continuously at full capacity for the duration of the drilling programme.

Atmospheric dispersion modelling was completed for pollutant species nitrogen dioxide (NO_2), sulphur dioxide (SO_2), carbon monoxide (CO) and particulate matter measuring 10 micrometres (µm) or less in diameter (PM_{10}). Results have been presented as modelled contributions and in combination with background concentrations, for three selected onshore coastal receptor locations; Absheron Peninsula, Baku and Sangachal.

The modelled NO_2 contributions at Absheron Peninsula, Baku and Sangachal were predicted to be no more than 0.1 micrograms per cubic metre ($\mu g/m^3$) and $1.8 \mu g/m^3$ for the long term and short term averaging periods respectively. Taking into account the background concentrations, the predicted concentrations were predicted to comply with the long-term and short-term limit values of NO_2.

The modelled SO_2 contributions at Absheron Peninsula, Baku and Sangachal were predicted to be less than $0.1 \mu g/m^3$. Taking into account the background concentrations, the predicted concentrations easily comply with the long-term and short-term limit values for SO_2.

The modelled PM_{10} contributions were predicted to be no more than $0.3 \mu g/m^3$ for the short-term and less than $0.1 \mu g/m^3$ over the long-term. For PM_{10}, background concentrations already exceed limit values. This can be attributed to the natural occurrence of particulate matter in the local environment reflecting the high particulate concentrations associated with dry arid region (for example soil particles becoming airborne through wind entrainment). The contribution of ACE predrilling activities to increases in PM_{10} concentrations at onshore receptors is insignificant.

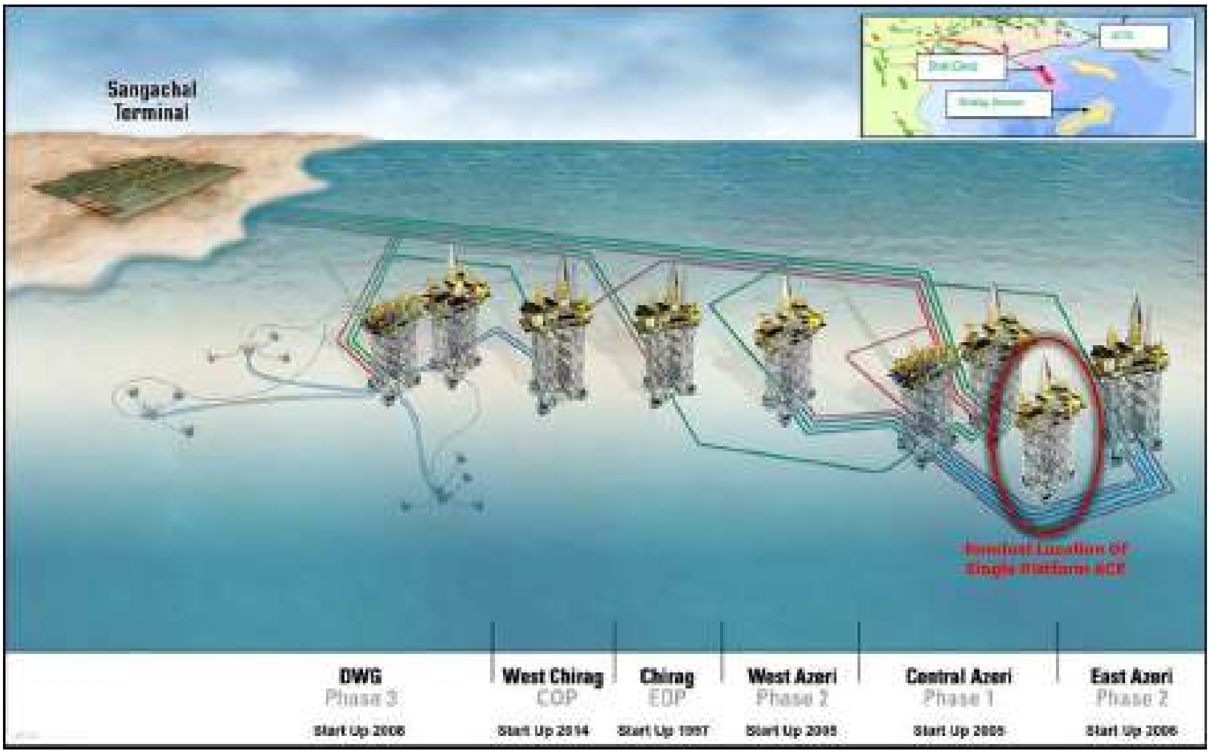
In summary, it is not expected that the ACE predrilling activities will cause the applicable air quality limit values to be exceeded where concentrations currently comply with the limit values, and the contribution of ACE predrilling emissions to concentrations of pollutant at onshore receptors is estimated to be very small and likely to be indiscernible.

1. Introduction

The Azeri Chirag Gunashli (ACG) field is the largest oilfield in the Azerbaijan sector of the Caspian Sea, covering approximately 432 square kilometres (km2) and is located approximately 120 kilometres (km) east of Baku. Development of the field, which is operated by BP on behalf of the Azerbaijan International Operating Company (AIOC) under a Production Sharing Agreement (PSA), is being pursued in phases. Operations within the ACG field under the PSA started in November 1997 with the start-up of production from the Chirag-1 platform (under the initial phase of development, the Early Oil Project). The Central, West and East Azeri facilities were developed under Phases 1 and 2 and Deepwater Gunashli (DWG) portion was developed under Phase 3. The West Chirag (WC) platform, the most recent ACG offshore facility, was completed and commenced production in 2014 under the Chirag Oil Project (COP).

The Azeri Central East (ACE) Project represents the next stage of development in the ACG field. The project comprises a new offshore production, drilling and quarters (PDQ) platform, to be located mid-way between the Central Azeri (CA) and East Azeri (EA) platforms in a water depth of approximately 137m, with tie-ins to the existing ACG subsea export pipelines for export of oil to the Sangachal Terminal with transfer of gas not used for injection on ACE to CA and injection water from a tie-in near the EA platform via infield pipelines.

Figure 1. Location of ACG Field Layout Including Proposed ACE Platform



2. Purpose and Scope

The purpose of this report is to present the air dispersion modelling study for the predrilling activities associated with the ACE Project. The scope of the modelling study is to estimate the changes in ambient atmospheric pollutant concentrations attributed to the predrilling activities. The results are presented as modelled contribution isopleths across the offshore domain and at selected onshore locations. Pollutant species and averaging periods have been based on the applicable ambient air quality limit values, set for the protection of human health.

3. Methodology

The following steps have been followed to undertake the assessment:

1. Define applicable air quality limit values and associated averaging periods;
2. Select a suitable atmospheric dispersion model;
3. Define the modelling scenarios;
4. Determine the model input parameters,
5. Define dimensions of modelling grid and location of sensitive onshore receptors;
6. Define background pollutant concentrations at onshore receptors;

7. Undertake the air dispersion modelling for the defined scenarios; and
8. Compare the modelled pollutant concentrations (including background concentrations) against the applicable air quality limit values to identify potential air quality impacts.

3.1 Air Quality Limits

Ambient air quality limit values are defined with the aim of avoiding, preventing or reducing harmful effects to human health and/or the environment as a whole.

Each limit value is presented for a given averaging period, based on scientific knowledge of known toxicity to human health. Certain limit values are allowed a certain number of exceedances per calendar year, which corresponds to a particular 'percentile'.

Table 1 summarises the ambient air quality limits and averaging periods as provided by:

- World Health Organisation (WHO) Guidelines (Ref. 1);
- International Finance Corporation (IFC) General Environmental, Health and Safety (EHS) Guidelines (Ref. 2);
- World Bank Pollution, Prevention and Abatement Handbook (now superseded by IFC Guidelines) (Ref. 3);
- European Union (EU) Guidelines on Air Quality (Ref. 4), and
- Traditional Azeri air quality limit.

The limits that have been adopted by the ACE Project are shaded in grey.

Table 1. Ambient Air Quality Limit Values

Pollutant	Averaging period	Ambient Air Quality Limit Values (µg/m3)				
		WHO	IFC	Former World Bank	EU	Azeri Limit
NO_2	1 hour	200	200	400	200 (99.8th %ile)	85+
	8 hour	-	-	-	-	-
	24 hour	-	-	150	-	40
	Annual	40	40	100	40	-
CO	1 hour	-	-	-	-	5,000[b]
	8 hour	-	-	-	10,000 (100th %ile)	-
	24 hour	-	-	-	-	3,000
SO_2	10 minute	500	500	-	-	500[b]
	1 hour	-	-	350	350 (99.7th %ile)	-
	24 hour	125[a]	125[a]	125	125 (99.2%ile)	50
	Annual	-	-	50	-	-
PM_{10}	1 hour	-	-	-	-	500[b]
	24 hour	50 (99th %ile)	50 (99th %ile)	125	50 (90.4th %ile)	150
	Annual	20	20	50	40	-

Notes:
[a] Interim target
[b] Maximum Permissible Concentration, taken to be for a 1 hour averaging period (except for SO2 where a 10 minute averaging period is used by WHO and IFC)

These limit values apply to locations where members of the public are expected to be normally present (e.g. residential areas, schools, hospitals). They do not apply to work premises such as the offshore platforms, which are subject to less stringent workplace limits. Occupational, workplace exposure is not assessed within this report.

The study pollutants are described, as follows:

- **Nitrogen dioxide:** Oxides of nitrogen (NO_X) are formed as a by-product of the high temperature combustion of fossil fuels (such as natural gas) by the oxidation of nitrogen in the air. NO_X primarily comprises of nitrogen oxide (NO), but also contains NO_2; once emitted the former can be oxidised in the atmosphere to produce further NO_2. It is the NO_2 that is associated with the health impacts; at high concentrations it can affect lung function and airway responsiveness, and enhances asthma and mortality. The rate of conversion of NO_X to NO_2 in the atmosphere is discussed in Section 3.3.2 of this report.

- **Sulphur dioxide:** SO_2 is a colourless gas that is readily soluble in water. It is formed through the combustion of sulphur containing fossil fuels and is a major air pollutant in many parts of the world. Excessive exposure to SO_2 (above the limit values) may cause discomfort in the eye, lung and throat.

- **Particulate matter**: Health based assessment criteria focuses on the fine 'PM_{10}' size fractions, which are predominately generated through the combustion of fossil fuels. PM_{10} is defined as particulate matter with an aerodynamic diameter of less than 10 microns. Exposure to increased levels are consistently associated with respiratory and cardiovascular illness and mortality.

- **Carbon monoxide:** CO is formed by the incomplete combustion of carbon containing fuels such as natural gas. Exposure to high concentrations causes carboxyhaemoglobin, which substantially reduces the capacity of the blood to carry oxygen.

The modelling results are therefore presented for against the following pollutants and averaging periods:

- NO_2 1 hour peak (project limit value)
- NO_2 annual average (project limit value)
- SO_2 annual average (project limit value)
- SO_2 24 hour average (project & Azeri limit value)
- SO_2 1 hour peak (project limit value)
- PM_{10} annual average (project limit value)
- PM_{10} 24 hour average (project & Azeri limit value)

Additional, Azeri limit values are presented in Annex A, but not discussed within the details of this report:

- NO_2 24 hour average (Azeri limit value)
- PM_{10} 1 hour peak (Azeri limit value)
- CO 1 hour peak (Azeri limit value)
- CO 24 hour average (Azeri limit value)

3.2 Model Selection

A range of models are available for atmospheric dispersion modelling including Offshore and Coastal Dispersion model (OCD), National Radiological Protection Board (NRPB-91), Industrial Source Complex Short Term (ISCST), American Meteorological Society/Environmental Protection Agency Regulatory Model (AERMOD) and Atmospheric Dispersion Modelling System (ADMS).

This assessment has been undertaken using the UK Atmospheric Dispersion Modelling System, ADMS5.

ADMS 5 (and previous) versions have been extensively validated for industrial sources by the model developers Cambridge Environmental Research Consultants (CERC). Details on model validity are available from their library of validation reports available at http://www.cerc.co.uk/environmental-software/model-validation.html

The resources available at this website also explain in detail the approach used to model the dispersion of emissions to the atmosphere in three dimensions and the manner in which surface parameters are taken into account.

Reasons for selection of ADMS5 are given as follows:

- Many regulatory authorities explicitly endorse or accept the use of ADMS5. In the UK the Environment Agency (EA) does not formally "approve" any model. However, ADMS is routinely used and approved by the EA, Scottish Environmental Protection Agency, and the Department of the Environment in Northern Ireland. ADMS is also routinely used on behalf of Defra, the UK Government Department for the Environment;

- ADMS is included in the United States Environmental Protection Agency's (US EPA) List of Alternative Models, and is also approved for all types of environmental impact assessment in China. ADMS is also an approved model in France, Italy, the Netherlands, Ireland, the Baltic States, South Africa, Hungary and Thailand and was used by the California Department of Health. The models are also used in Spain, Portugal, Sweden, Cyprus, Austria, United Arab Emirates, Sudan, Saudi Arabia, Tunisia, Slovenia, Poland, New Zealand, Korea, Japan, India, Canada and Australia;

- ADMS has been rigorously validated by its developers (CERC) against existing monitoring data and alternative models that are available. For the validation studies that applied simple terrain (which is considered to be the most similar to offshore conditions), ADMS outperformed other models (such as the US regulatory model AERMOD) and demonstrated a model accuracy of within ±10% of the actual monitoring findings;
- ADMS 5 incorporates a superior basis for dispersion modelling, based on the Monin-Obhukov length parameter, rather than the Pasquill stability classes/Gaussian profiles which was used in earlier models such as OCD, NRPB-91 and ISCST. The systems, in practice, give similar results for stable and neutral atmospheric stability conditions, however, under unstable conditions, the predictions of models incorporating the Monin-Obhukov length are regarded as superior;
- The ADMS 5 model incorporates an integrated plume rise module, rather than the simple empirical formula used in ISCST and the basic AERMOD model. The empirical approach is known to give poor predictions of emissions from small stacks or high-momentum releases as the equations were established primarily from the observations of large power station plumes. A version of the NRPB-91 model is available, called RAMPART, which incorporates the integrated plume rise approach but lacks a Monin-Obhukov based dispersion model;
- ADMS 5 also introduces a marine boundary layer option which is specifically designed to model offshore sites. The ability to model the changing offshore marine boundary layer provides a more realistic representation of the meteorological conditions, such as lapse rates, encountered offshore; and
- The model uses hourly sequential meteorological data to enable a realistic assessment of dispersion from point sources to be conducted for weather conditions that are directly applicable to the site.

3.3 Model Scenarios

As for the other platforms in the ACG Contract Area prior to the installation of the platform it is planned to predrill a number of wells using a Mobile Offshore Drilling Unit (MODU). The MODU programme is expected to last approximately 12 months. The selection of the rig is yet to be determined however, for the purpose of the air dispersion modelling, the study has assumed conservatively the Istiglal MODU, which is one of the MODUs potentially to be used for the ACE Project.

The modelling assessment has been carried out based on the following:

- MODU engines will be operational for 300 out of 365 days of the year.
- Air quality limits apply to locations where members of the public are expected to be normally present (e.g. residential areas, schools, hospitals) i.e. onshore.
- It has been conservatively assumed that the MODU will be operating at full capacity during the entirety of the programme.

3.3.1 Model Input Parameters

The parameters required by the ADMS5 model to calculate the predicted concentrations associated with the MODU combustion plant are presented in Table 2.

Table 2. MODU Combustion Plant Parameters

Parameter	Istiglal MODU
Type of plant	Wartsila W6L32E
Fuel type	Diesel
No. units / flues	4
Power output (Maximum Rating) (kW)	3,480
Height of release point above sea level (m)	54.5
Internal stack diameter per unit (m)	0.7
Exit gas velocity (m/s)	14.2
Exit gas temperature (°C)	400.0
Exit gas volumetric flow rate per unit (m3/s)	5.5

Parameter	Istiglal MODU
Maximum NO_X emission rate per unit (g/s)	9.47
Maximum CO emission rate per unit (g/s)	0.54
Maximum SO_2 emission rate per unit (g/s)	0.093
Maximum PM_{10} emission rate per unit (g/s)	0.327

3.3.2 Conversion of NOx to NO_2

At the point of release (from a combustion activity) NO_X emissions predominantly comprise nitrous oxide (NO). However, NO converts to NO_2 in the free troposphere under influences of other gases such as ozone (O_3) and hydroxyl (OH) compounds in the presence of UV radiation (sunlight). This process can be significant in locations over 5km downwind of large combustion sources.

Since the focus of human health criteria is on NO_2 rather than NO_X, it is important to determine a rate of conversion in the atmosphere, in order to calculate the ground level impact of NO_2.

The EA's Horizontal Guidance Note (H1) on Assessment and Appraisal Best Available Technology (Ref. 5) presents preferred conversion rates for NO_X to NO_2. It assumes, conservatively, that 100% of NO_X converts to NO_2 in the long term (i.e. annual average), and 35% NO_X for short term averaging periods (such as 1 hour and 24 hour).

Similarly, the US EPA recommends (in the absence of accurate monitoring data) a tiered approach for modelling NO_2 impacts (Ref.6). The second tier uses the 'Ambient Ratio Method (ARM)', which assumes that 75% of NO_X is converted to NO_2 for the long term averaging period.

The ADMS 5 model includes an atmospheric chemistry module to calculate the rate of NO_X to NO_2 conversion. However, it requires accurate hourly background NO_2 and O_3 concentrations in order to produce reliable results.

In the absence of background monitoring data for O_3, and only limited data for NO_2, the most conservative assumption mentioned above has been applied to the model output i.e. 100% of NO_X converts to NO_2 for long term averages, and 50% for the short term.

3.3.3 Meteorology

The dispersion of emissions from a point source is largely dependent on atmospheric stability and turbulent mixing in the atmosphere, which, in turn, are dependent on wind speed and direction, ambient temperature, cloud cover and the friction created by local terrain.

Meteorological parameters are recorded at offshore ACG locations since 2005. Sea surface temperature and cloud cover, required for offshore modelling, are however not recorded at these locations. Previous air quality modelling (Chirag Oil Project) used a dataset from an ACG location, which is more than 10 years old, and may not reflect up-to-date meteorological conditions.

To provide a complete set of data required for the dispersion modelling, recent metrological data was sourced from World Meteorological Observation (WMO) station 'HEYDAR ALIYEV' airport, located on the Absheron Peninsula. Data was acquired for the latest years (2015 – 2017).

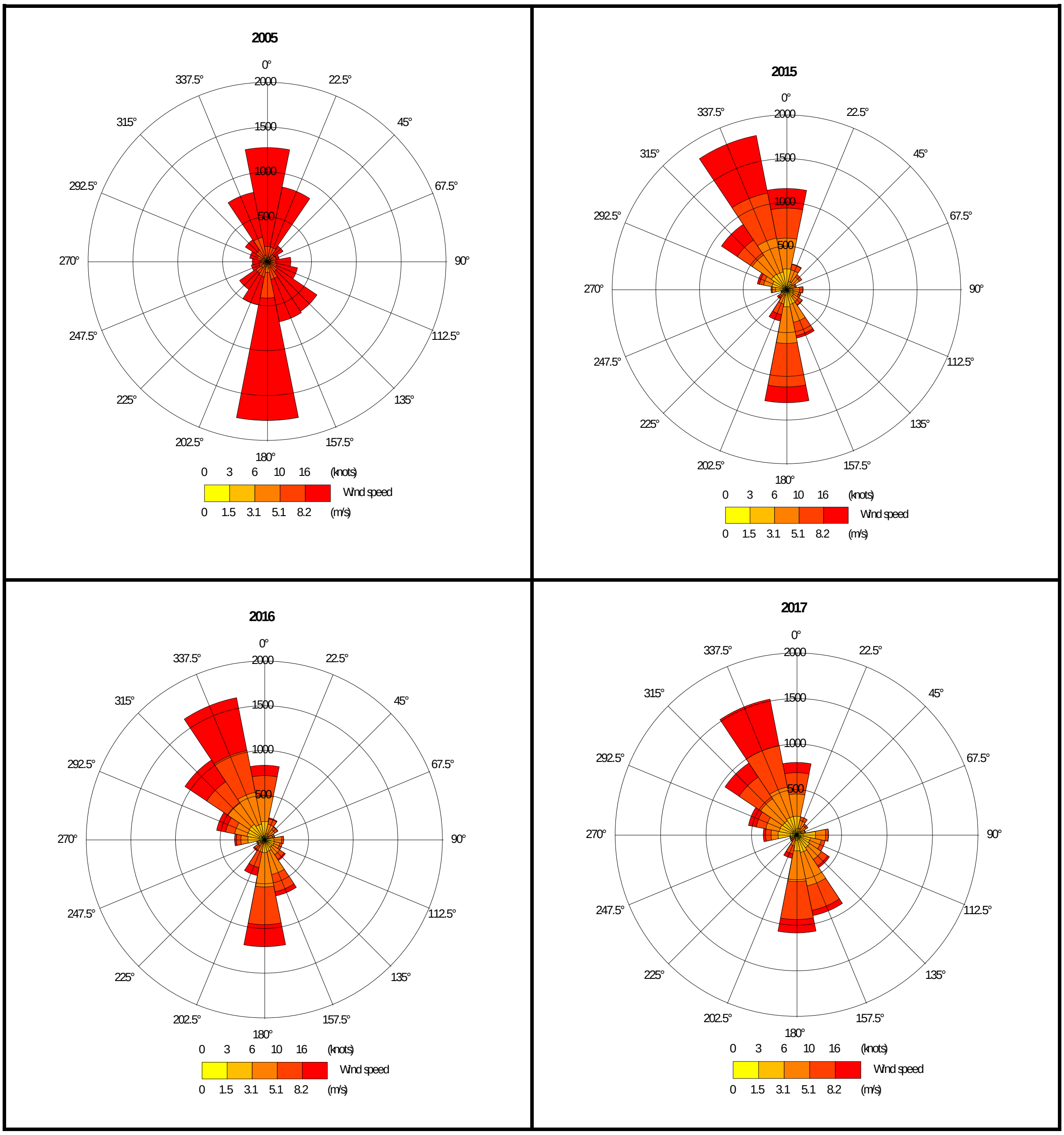
The WMO location records the key modelling parameter of 'cloud cover', although as the location is coastal and not offshore, sea surface temperature is not recorded. Without sea surface temperature the coastline option in ADMS5, which accounts for land/sea diurnal stability changes, cannot be used; the marine boundary option in the model cannot be used either. Because of this lack of sea surface temperature the 2015-2017 WMO data cannot be used with confidence without comparison sensitivity testing.

Testing of the meteorological data was carried out to identify the worst case meteorological dataset. The 2015-2017 and 2005 dataset from the offshore ACG facilities (which includes sea surface temperature) were compared. Figure 2 presents the wind roses for the meteorological datasets used in the ADMS5 model comparative testing.

The 2005 data set included a marine boundary layer file which assumes a default Charnock parameter[1] of 0.018 and that the boundary layer is not neutral. The 2015-2017 data was set to include the surface roughness for the sea set to the default 'sea' value of 0.0001m for the dispersion site, while the recorded location site was set to 'open grassland' which has a roughness of 0.02m. It can also be observed that the wind is more north-west to south-east from the onshore WMO station (2015, 2016, 2017) in comparison to a very north-south bearing for the 2005 offshore data.

The highest modelled contributions were predicted using the 2017 meteorological data. As such, the results presented in this report are all from the model run using 2017 meteorological data.

Figure 2. Wind-Roses Derived from 2005, 2015, 2016, 2017 Meteorological Datasets



[1] Used for calculating aerodynamic roughness length over the sea, accounting for increased roughness as wave heights grow due to increased surface stress.

3.4 Model Domain and Specified Receptors

The Central Caspian region was modelled using a two dimensional Cartesian grid system based on the 'Pulkovo 1942' coordinate system using the 'Krasovsky 1940 spheroid'. The modelling used a 200km by 200km grid, centred on the ACE platform location with spacing set at maximum resolution, resulting in a modelled concentration every 2km.

It is acknowledged that ADMS5 specialises in short range dispersion modelling and is considered to be reliable only up to 60km downwind of the source (but still provides useful, indicative information up to 100 km downwind of the source). Sensitivity testing however, demonstrated that modelled concentrations were not noticeably different between 100km and 200km from the source (though this may have been a function of the relatively small concentrations being calculated by the model at these distances).

In addition to the grid domain, specified receptor points can be chosen in the model at which ground level pollutant concentrations are then calculated. Air quality limit values do not apply to workplaces, and there are not expected to be members of the public offshore.

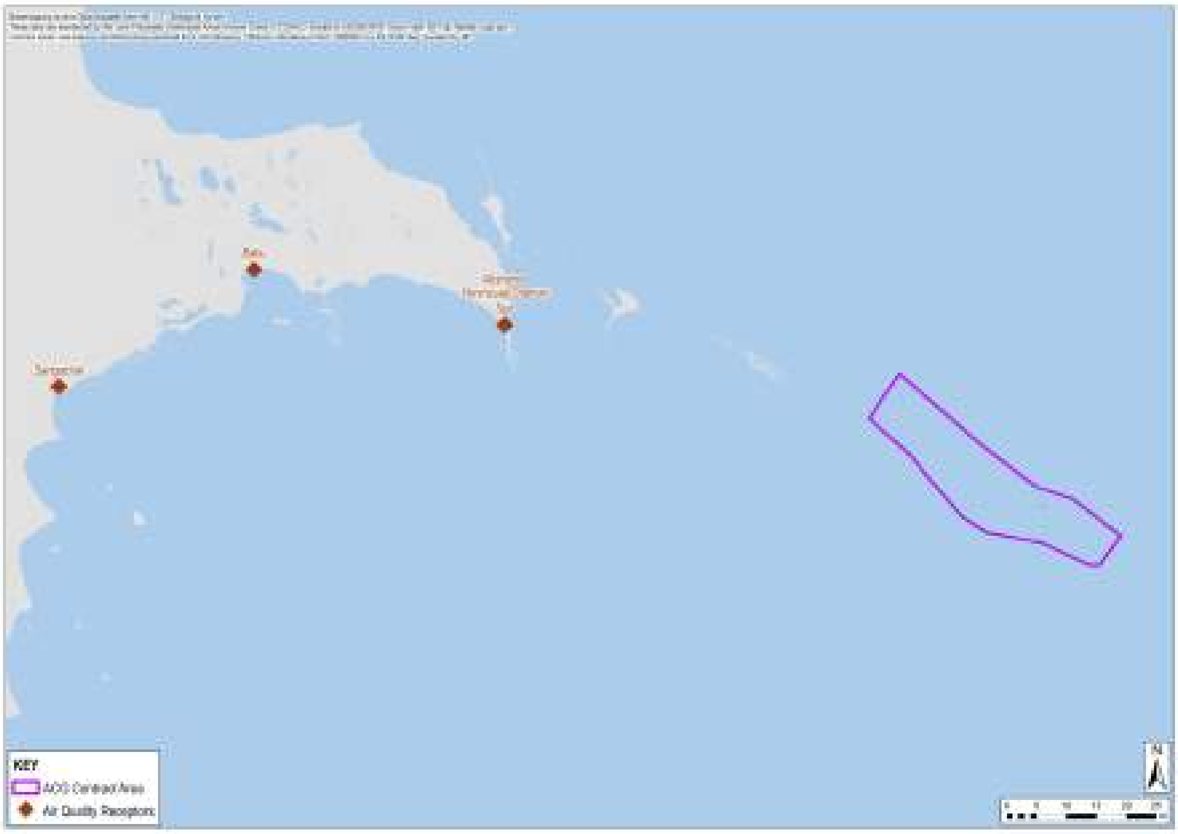
It is difficult to represent large urban areas with a single receptor point. Therefore it was considered suitable to focus on where any modelled plume occurred over landfall, mainly along the southern coastline of the Absheron Peninsula and along the coastline to Sangachal.

Modelled specified receptors are presented in Table 3 and Figure 3.

Table 3. Modelled Receptors

Receptors	Northing	Easting
Absheron Peninsula/Shahdili Spit	445300	4462400
Baku	403500	4471600
Sangachal	370900	4452100

Figure 3. Receptor Locations



4. Background Ambient Concentrations

Ambient air quality monitoring of SO_2, benzene, VOC and NO_2 has been undertaken around the Terminal since 1997. The monitoring locations, parameters recorded and analytical methodology used has varied across the monitoring surveys. The most recent air quality monitoring survey results available are from 2014 and 2016. While specific background data is not available for the southern coastline of the Abershon Peninsula, it has been considered representative to use the background concentrations recorded at Sangachal as the environments are similar in terms of the mix of local sources (e.g. industrial facilities, roads etc). Within Baku, there are a number of air quality monitoring stations across the city. The results from these stations were made publically available within the Draft National Strategy on AQAM (Ref.7).

Surveys have not been completed for CO and therefore a typical, rural background concentration was used based on satellite monitoring data.

In the absence of a large hourly dataset it is not possible to derive accurate short term baseline concentrations; therefore a multiple of the annual average background concentration has instead been used. The approach suggested by EA's Horizontal Guidance Note (H1) (Ref.5) is to double the annual average background concentration. This approach has been adopted for short-term averaging periods assessed in this report.

The background concentrations used for the purposes of modelling and assessment presented in Table 4 are considered to represent typical background concentrations for the onshore receptors.

Table 4. Average Background Concentrations

Pollutant	Averaging Period	Limit Value	Average Background Concentration (Sangachal & Absheron Peninsula)[1] ($\mu g/m^3$)	Average Background Concentration (Baku)[2] ($\mu g/m^3$)
NO_2	1 hour	200	24	76
NO_2	Annual	40	12	38
CO	1 hour	3	200	200
CO	24 hour	3	200	200
SO_2	10 minute	500	2	22
SO_2	1 hour	350	2	22
SO_2	24 hour	125	2	22
SO_2	Annual	50	<2	11
PM_{10}	24 hour	50	184	480
PM_{10}	Annual	20	92	240

1. Based on Sangachal Terminal air quality survey results. NO_2, and SO_2 values using 2016 annual averaged monitoring results from 18 long-term passive samplers in Sangachal region. PM_{10} data using annual averaged data from real-time monitoring station (RTMS from 2014[2]) In the absence of data and given the rural nature of the location the same concentrations are assumed for the Absheron Peninsula

2. Baku concentration taken from: MWH, 2014, Air Quality Governance in the ENPI East Countries National Pilot Project – Azerbaijan "Improvement of Legislation on Assessment and Management of Ambient Air" - Draft National Strategy on AQAM, report funded by the European Union (Ref. 7)

3. CO included to assess modelled concentrations against Azeri limit values

[2] 2016 PM_{10} concentrations from the RTMS were abnormally low and the reason for this is not known. Therefore 2014 data, which is similar to previous years, is used.

5. Modelled Contributions

Tables 5, 6 and 7 below present the modelled concentrations of NO_2, SO_2 and PM_{10} at the selected onshore receptors.

Results are presented in terms of:

- Modelled Contribution: The model output predicted at ground level, considering the specified modelled sources only.
- Predicted Concentration: The model output predicted at ground level, taking into account background concentrations (refer to Section 4).
- Predicted Concentration as Percentage of Limit Value: the Predicted Concentration expressed as a percentage of the ambient limit values.

Table 5. Modelled NO_2 Contributions

Receptor Name	NO_2 Annual Average (µg/m^3)				NO_2 1 Hour Peak (µg/m^3)			
	Limit Value	Modelled Contribution	Predicted Concentration	Predicted Concentration as % Limit Value	Limit Value	Modelled Contribution	Predicted Concentration	Predicted Concentration as % Limit Value
Absheron Peninsula	40	< 0.1	12.0	30.0%	200	1.8	25.8	12.9%
Baku		< 0.1	38.0	95.0%		1.1	77.1	38.6%
Sangachal		< 0.1	12.0	30.0%		1.2	25.2	12.6%
Note Assumed conversion of NOx to NO_2, 100% for Annual Average and 50% for 1 Hour Peak.								

Table 6. Modelled SO_2 Contributions

Receptor Name	SO_2 24 Hour Peak (µg/m^3)				SO_2 1 Hour Peak (µg/m^3)			
	Limit Value	Modelled Contribution	Predicted Concentration	Predicted Concentration as % Limit Value	Limit Value	Modelled Contribution	Predicted Concentration	Predicted Concentration as % Limit Value
Absheron Peninsula	125	< 0.1	2.0	1.6%	350	< 0.1	2.0	0.6%
Baku		< 0.1	22.0	17.6%		< 0.1	22.0	6.3%
Sangachal		< 0.1	2.0	1.6%		< 0.1	2.0	0.6%

Table 7. Modelled PM_{10} Contributions

Receptor Name	PM_{10} Annual Average ($\mu g/m^3$)				PM_{10} 24 Hour Peak ($\mu g/m^3$)			
	Limit Value	Modelled Contribution	Predicted Concentration	Predicted Concentration as % Limit Value	Limit Value	Modelled Contribution	Predicted Concentration	Predicted Concentration as % Limit Value
Absheron Peninsula	20	< 0.1	92.0	460.0%	50	< 0.1	184.0	368.0%
Baku		< 0.1	240.0	1200.0%		< 0.1	480.0	960.0%
Sangachal		< 0.1	92.0	460.0%		< 0.1	184.0	368.0%

Table 5 shows the modelled long term (annual average) NO_2 contributions at Absheron Peninsula, Baku and Sangachal are less than 0.1µg/m^3. The maximum modelled short term NO_2 contribution at any of the onshore receptors is no more 1.8µg/m^3. This increase is less than 1% of the short term limit value and occurs along the Absheron Peninsula. When combined with the background concentration of 25.8µg/m^3, the overall predicted concentration is 12.9% of the 200µg/m^3 limit value. The modelled contribution around Baku is anticipated to be no more than 1.1µg/m^3, although as the background concentration is anticipated to be higher the overall prediction concentration is predicted to be 38.6% of the limit value.

The modelled 24 and 1 hour SO_2 contributions at Absheron Peninsula, Baku and Sangachal presented in Table 6 are predicted to be less than 0.1µg/m^3. Taking into account the background concentrations, the predicted concentrations easily comply with the short-term limit values of SO_2.

As shown in Table 7, the modelled PM_{10} contributions are predicted to be less than 0.1µg/m^3 for both the short-term and the long-term (annual average) concentrations. Background concentrations however already exceed limit values. This can be attributed to the natural occurrence of particulate matter in the local environment reflecting the high particulate concentrations associated with dry arid region (for example soil particles becoming airborne through wind entrainment). The contribution of ACE predrilling activities to increases in PM_{10} concentrations at onshore receptors is insignificant.

Figures 4-9 present the modelled contributions (without background concentrations) as isopleths for long term and short term emissions of NO_2, SO_2 and PM_{10}. Additional modelled contributions for Azeri limit values are provided in Annex A of this report.

The figures show that modelled maximum offshore contribution of NO_2 is 2µg/m^3 and 40µg/m^3 for the annual average and 1 hour averaging periods, respectively.

With respect to SO_2 emissions; maximum offshore contribution of is less than 0.1µg/m^3 and 1.7 µg/m^3 for the 1 and 24 hour averaging periods, respectively. While PM_{10} emissions are modelled to less than 0.1µg/m^3 and less than 0.5µg/m^3 over an annual average and 24 hour averaging period, respectively.

All maximum contributions occur within a few kilometres of the MODU drilling activities, over 100km offshore.

Figure 4. Modelled Mean Annual NO_X Contribution

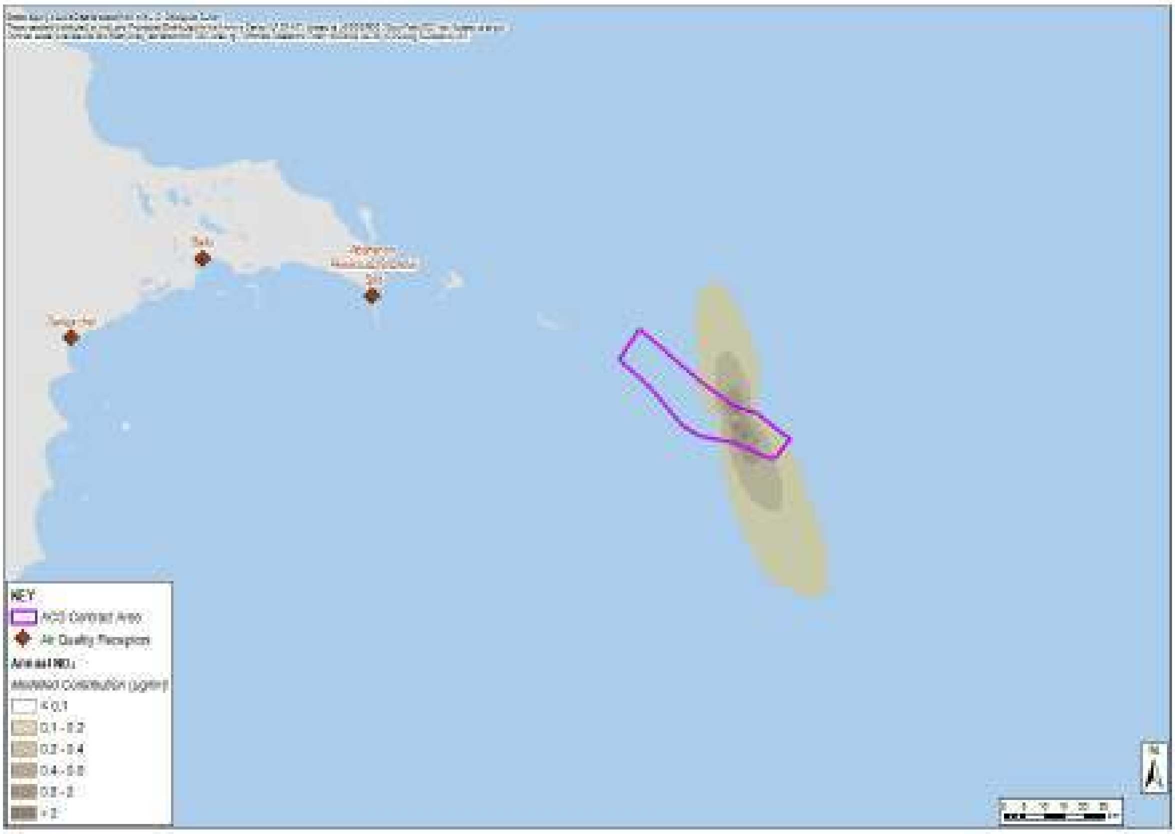


Figure 5. Modelled 1 Hour Maximum NO_X Contribution

Figure 6. Modelled 24 Hour Maximum SO_2 Contribution

Figure 7. Modelled 1 Hour Maximum SO_2 Contribution

Figure 8. Modelled Annual Average PM_{10} Contribution

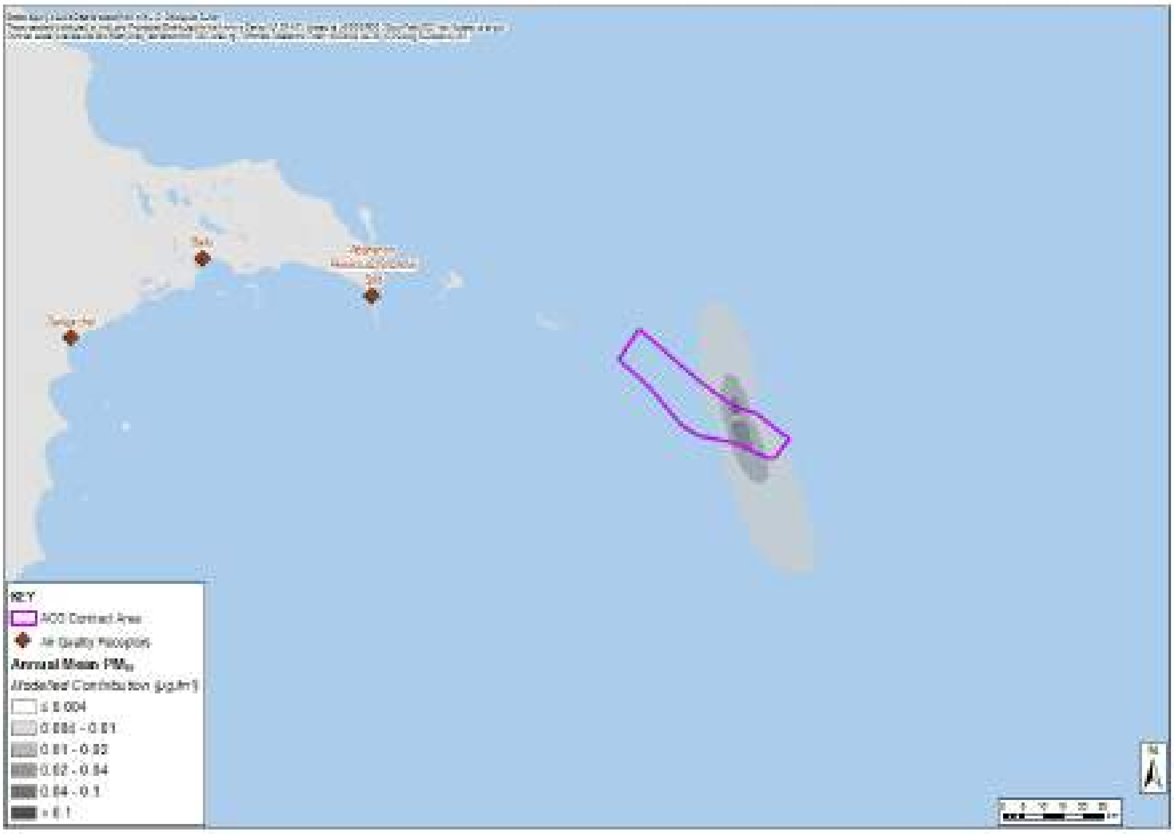
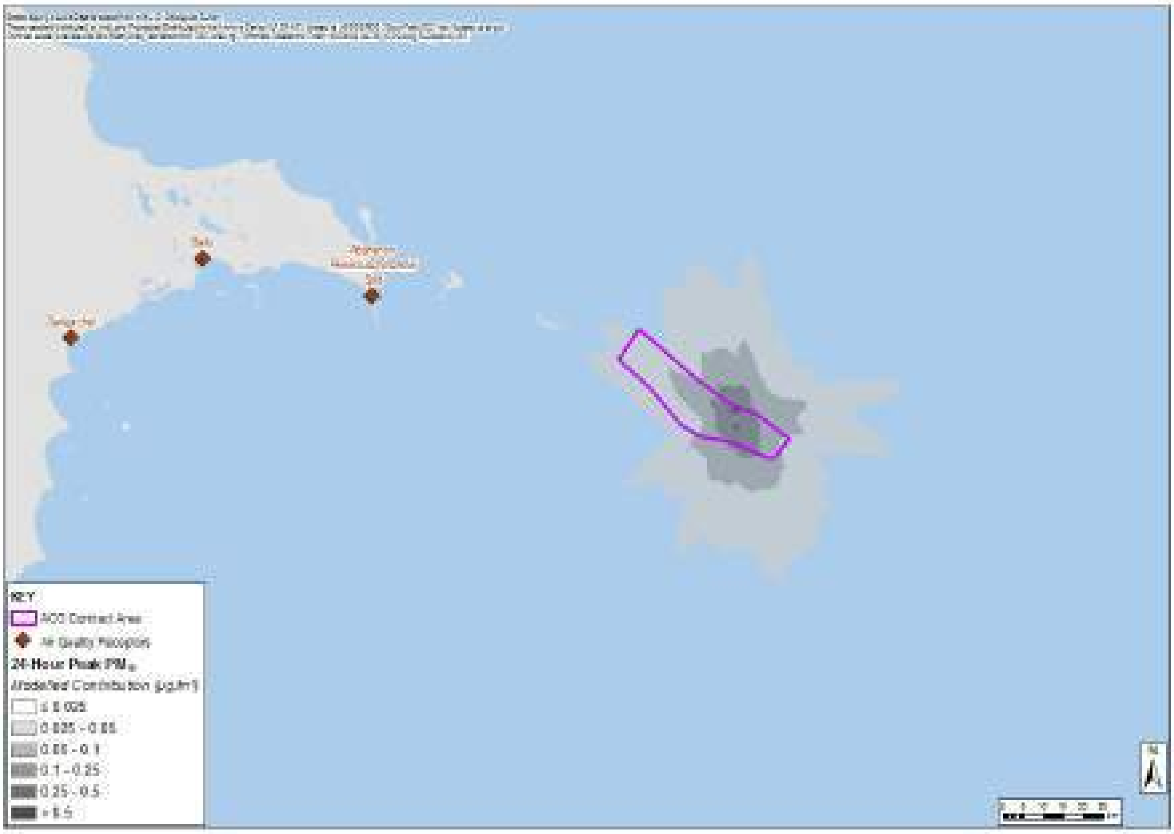


Figure 9. Modelled 24 Hour Maximum PM_{10} Contribution



6. Conclusion

The conclusions of this air dispersion modelling assessment for the ACE predrill activities are:

- The modelled contributions are predicted to lead to no discernible impact on air quality concentrations onshore, and will not lead to any increase above air quality limit values;
- When taking account of the existing background concentrations the predicted concentrations comply with the air quality limit values, with the exception of PM_{10}. This is because PM_{10} background concentrations already exceed the limit values before considering any existing or proposed combustion emission sources - this is a consequence of the dusty nature of the region rather than the predrilling activities at ACE or other combustion activities in the area.

In summary, it is not expected that the ACE predrilling activities will cause the applicable air quality limit values to be exceeded where concentrations currently comply with the limit values.

7. References

Ref. 1 World Health Organisation (2005); Air quality guidelines - global update 2005 Guidelines

Ref. 2 International Finance Corporation (2007); General Environmental, Health and Safety (EHS) Guidelines

Ref. 3 World Bank (1998); Pollution, Prevention and Abatement Handbook. http://smap.ew.eea.europa.eu/test1/fol083237/poll_abatement_hanbook.pdf/

Ref. 4 European Parliament and of the Council (2008); Directive 2008/50/EC on ambient air quality and cleaner air for Europe

Ref.5 Environment Agency (2010); Horizontal Guidance Note H1 – Environmental Risk Assessment for Permits. http://www.environment-agency.gov.uk/business/topics/permitting/36414.aspx

Ref.6 United States Environmental Protection Agency (US EPA) Applicability of Appendix W Modeling Guidance for the 1-hour NO2 National Ambient Air Quality Standard. http://www.epa.gov/ttn/scram/ClarificationMemo_AppendixW_Hourly-NO2-NAAQS_FINAL_06-28-2010.pdf

Ref 7 AZERBAIJAN BRANCH OFFICE OF REC CAUCASUS (March 2014) Air Quality Governance in the ENPI East Countries, National Pilot Project – Azerbaijan, “Improvement of Legislation on Assessment and Management of Ambient Air” Draft National Strategy on AQAM

Annex A Modelled Contributions (Azeri Limit Values)

Receptor Name	NO_2 1 Hour Peak (µg/m³)				NO_2 24 Hour Peak (µg/m³)			
	Limit Value	Modelled Contribution	Predicted Concentration	Predicted Concentration as % Limit Value	Limit Value	Modelled Contribution	Predicted Concentration	Predicted Concentration as % Limit Value
Absheron Peninsula	85	1.8	25.8	30.4%	40	0.3	24.3	60.8%
Baku		1.1	77.1	90.7%		0.2	76.2	190.4%
Sangachal		1.2	25.2	29.6%		0.1	24.1	60.8%
**Note Assumed conversion of NOx to NO_2, 100% for 24 Hour Peak and 50% for 1 Hour Peak.*								

Receptor Name	PM_{10} 24 Hour Peak (µg/m³)				PM_{10} 1 Hour Peak (µg/m³)			
	Limit Value	Modelled Contribution	Predicted Concentration	Predicted Concentration as % Limit Value	Limit Value	Modelled Contribution	Predicted Concentration	Predicted Concentration as % Limit Value
Absheron Peninsula	150	<0.1	184.0	122.7%	500	0.1	184.1	36.8%
Baku		<0.1	480.0	320.0%		0.1	480.1	96.0%
Sangachal		<0.1	184.0	122.7%		0.1	184.1	36.8%

Receptor Name	CO 24 Hour Peak (µg/m³)				CO 1 Hour Peak (µg/m³)			
	Limit Value	Modelled Contribution	Predicted Concentration	Predicted Concentration as % Limit Value	Limit Value	Modelled Contribution	Predicted Concentration	Predicted Concentration as % Limit Value
Absheron Peninsula	3000	<0.1	200.0	6.7%	5000	0.2	200.2	4.0%
Baku		<0.1	200.0	6.7%		0.1	200.1	4.0%
Sangachal		<0.1	200.0	6.7%		0.1	200.1	4.0%

APPENDIX 10A

Azeri Central East Project Construction, Installation and HUC Activities and Events

ACTIVITY/INTERACTIONS				
ID (R=Routine, NR= Non-Routine)	**Activity**	**Scoped In/Out**	**Event**	**Event Category**
C-R1	Use of yard plant (generators and engines) during jacket, topside and subsea equipment fabrication and commissioning	✓	Emissions to atmosphere (non GHG)	Construction yard emissions
		✓	Generation of onshore noise	Construction yard noise
C-R2	Grit blasting / welding and painting of jacket components, piles and pipework	×	Emissions to atmosphere (non GHG)	Construction yard emissions
		×	Generation of onshore noise	Construction yard noise
C-R3	Use of treated freshwater to sterilise topside freshwater system	×	Discharge of freshwater dosed with sodium hypochlorite and then neutralised to sea	Treated waste water discharge
C-R4	Use of temporary yard cooling water system during platform commissioning	✓	Discharge of cooling water to sea from the quayside	Cooling water discharge
C-R5	Commissioning of main platform generator and topside utilities onshore	✓	Emissions to atmosphere (non GHG)	Construction yard emissions
			Generation of onshore noise	Construction yard noise
C-R6	Construction yard utilities (drainage / sewage)	×	Other discharges to sea	Drainage Treated black water
C-R7	Use of vessels for jacket and topside installation e.g. DBA, STB-01 Barge	✓	Emissions to atmosphere (non GHG)	Atmospheric emissions (Support vessels)
			Generation of underwater sound	Underwater sound
			Other discharges to sea	Ballast water Treated black water Grey water Drainage
C-R8	Installation of jacket pin and skirt piles and grouting	✓	Seabed disturbance – benthos	Seabed disturbance
			Generation of underwater sound	Underwater sound
C-R9	Jacket buoyancy tank dewatering	×	Discharge into the marine environment	Seawater discharge (untreated)
C-R10	Offshore commissioning of the platform foam system	×	Discharge of fire fighting foam during testing	Fire fighting foam discharge
C-R11	Offshore commissioning of the platform deluge system	×	Discharge into the marine environment	Treated seawater discharge
C-R12	Use of temporary generators during offshore commissioning and start up	×	Emissions to atmosphere (non GHG)	Atmospheric emissions
C-R13	Use of installation and hook up and commissioning (HUC) vessels and platform installation (seabed disturbance)	✓	Discharge into the marine environment	Discharge of treated black and grey water to sea
				Other discharges to sea
			Emissions to atmosphere (non GHG)	Atmospheric emissions (Support vessels)
C-R14	Installation and tie-in of spools and subsea infrastructure	✓	Discharge of chemically treated seawater to sea	Treated seawater discharge
C-R15	Cleaning and pre-commissioning associated with new infield pipelines	✓	Discharge of chemicals (e.g. MEG) to sea	Chemical discharge
			Discharge of chemically treated seawater to sea (dosed)	Treated seawater discharge
C-R16	Permanent presence of the new infield pipelines and the subsea infrastructure	×	Physical presence	Removal of seabed habitat
C-R17	Topside flaring on East Azeri (EA) and West Azeri (WA) platforms during pipeline installation and tie-in	×	Atmospheric emissions due to flaring	Atmospheric emissions
C-R18	Use of vessels during brownfield modifications	✓	Emissions to atmosphere (non GHG)	Atmospheric emissions (Support vessels)
			Generation of underwater sound	Underwater sound
			Other discharges	Ballast water Treated black water Grey water Drainage
C-R19	Emptying and flushing EA J-tube	×	Discharge of chemically treated seawater to sea (dosed)	Treated seawater discharge (flush)
C-R20	Cleaning of existing water injection pipeline between EA and Central Azeri (CA) CA platforms	×	Discharge of chemically treated seawater to sea (dosed)	Treated seawater discharge (scale inhibitor)
All-CR1	Waste Generation	×	Generation of hazardous and non-hazardous waste	Waste generation

APPENDIX 10B

Air Quality Screening Assessment (Yards)

ACE Onshore Construction and Commissioning (Yards)

Air Quality Screening Assessment
ACE Project ESIA

Project reference: ACE Project ESIA
Project number: PR-245517

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Units and Abbreviations

Unit	Description
°C	Degrees Celsius
g/s	Grams per Second
M	Meters
m/s	Meters per Second
M^3	Cubic Metres
M^3/day	Cubic Metres per Day
mg/Nm^3	Micrograms per Standardised Meter Cubed of Air
MW	Mega Watts

Abbreviation/ Acronym	Description
ACG	Azeri Chirag Gunashli
ADMS	Atmospheric Dispersal Modelling System
CO	Carbon monoxide
EU	European Union
IFC	International Finance Corporation
MODU	Mobile Offshore Drilling Unit
NO	Nitric oxide
NO_2	Nitrogen dioxide
NO_X	Oxides of nitrogen
PM	Particulate matter
SO_2	Sulphur dioxide
UK	United Kingdom
US	United States
US EPA	United States Environmental Protection Agency
WHO	World Health Organisation

Executive Summary

The Azeri Central East (ACE) Project represents the next stage of development in the Azeri Chirag Gunashli (ACG) field. The project comprises a new offshore production, drilling and quarters (PDQ) platform, to be located mid-way between the Central Azeri (CA) and East Azeri (EA) platforms with associated infield pipelines to tie-in the platform to the existing ACG oil and gas export pipelines and to supply injection water to the platform.

A screening modelling study for the onshore construction and commissioning activities at the construction yards associated with the ACE platform for the purpose of the project Environmental and Social Impact Assessment (ESIA) has been undertaken.

The scope of the modelling study was to estimate the changes in ambient atmospheric pollutant concentrations associated with:

- Use of construction plant and equipment; and
- Onshore topside commissioning.

Taking into account that the yard selection process has not yet commenced, an assessment of the predicted increase in concentrations from these activities was undertaken assuming a generic yard and focused on the increases in pollutant concentrations at distance from the source.

With regard to construction yard plant and vehicles it was assumed up to 20 units of diesel powered plant (e.g. trucks, cranes) would be operating simultaneously, evenly distributed across a construction yard of 9 hectares (ha) in area.

Commissioning of the topside is anticipated to include the main platform SGT-A35 (G62) dual fuel generator, run intermittently on diesel for a week, for up to 8 hours a day at a maximum load of approximately 26% and then intermittently for approximately 6 months, in addition to the use of diesel generators to support topside commissioning and running the compression generator will be run intermittently over an approximate 2-3 week period for up to an hour.

The screening assessment considered three wind speed scenarios:

- Wind speed of 15 metres per second (m/s);
- Wind speed of 5m/s; and
- Wind speed of 1m/s.

The modelling studies focused on nitrogen dioxide (NO_2) with the modelling considering the short term averaging periods and the associated ambient air quality limit value, set for the protection of human health. This is due to the short duration of the activities within the yards.

Background concentrations of NO_2 were based on the most recent and relevant air quality monitoring data available for the areas along the Azerbaijan coastline where the candidate construction yards are located.

The screening assessment showed that construction yard plant emissions are predicted to generate a maximum short term ground level NO_2 contribution of 3 micrograms per cubic metre (µg/m^3) extending up to a distance of 200 metres (m) away from the emission source, reducing to 1.5µg/m^3 at 250m and returning to background concentrations at over 400m.

The main generator commissioning was predicted to result in a worst-case 1-hour NO_2 contribution of 15-20µg/m^3 located approximately 500m to 1.5 kilometres (km) from the emission source.

The modelling results show that, when taking background concentrations into account and the locations of nearest community receptors to the yards (typically more than 1km away from the yard boundary), the relevant air quality guideline levels were predicted to be met.

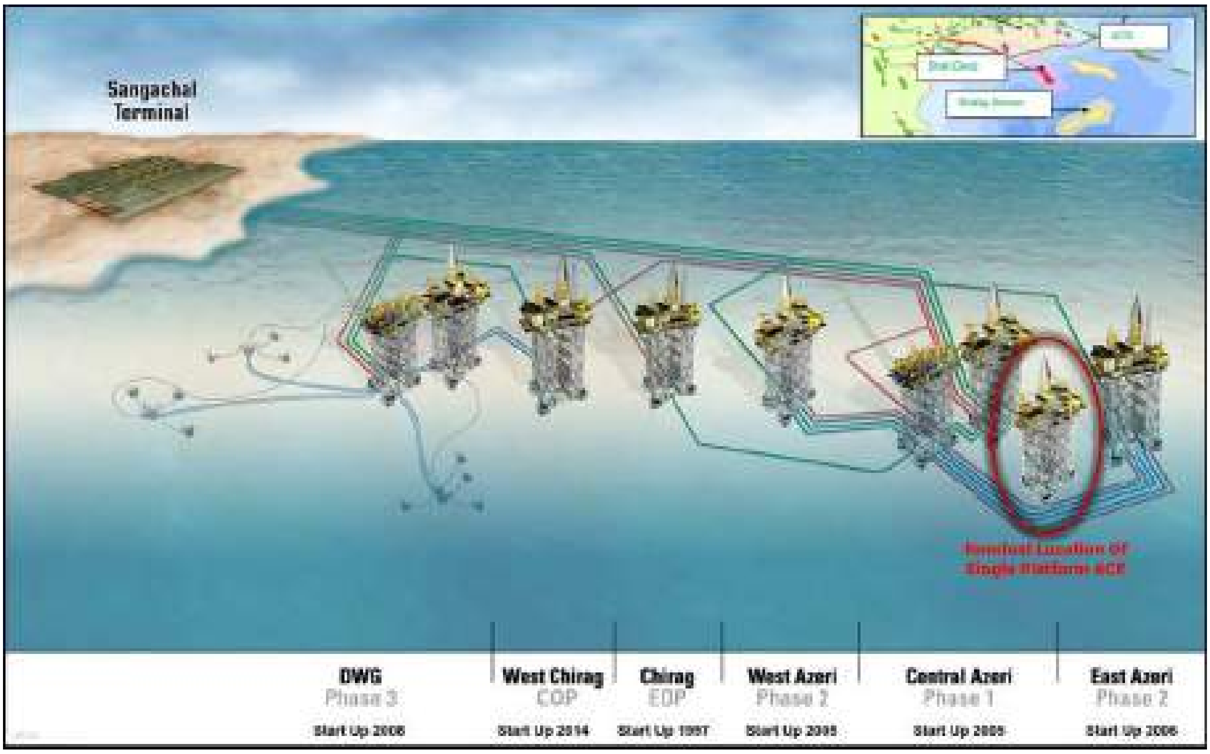
In summary, it is not expected that the platform construction and commissioning activities will cause the applicable air quality limit values to be exceeded. It is anticipated that the contribution of ACE onshore yard construction and commissioning emissions to concentrations of pollutants at onshore receptors is likely to be indiscernible.

1. Introduction

The Azeri Chirag Gunashli (ACG) field is the largest oilfield in the Azerbaijan sector of the Caspian Sea, covering approximately 432 square kilometres (km^2) and is located approximately 120 kilometres (km) east of Baku. Development of the field, which is operated by BP on behalf of the Azerbaijan International Operating Company (AIOC) under a Production Sharing Agreement (PSA), is being pursued in phases. Operations within the ACG field under the PSA started in November 1997 with the start-up of production from the Chirag-1 platform (under the initial phase of development, the Early Oil Project). The Central, West and East Azeri facilities were developed under Phases 1 and 2 and the Deepwater Gunashli (DWG) portion was developed under Phase 3. The West Chirag (WC) platform, the most recent ACG offshore facility, was completed and commenced production in 2014 under the Chirag Oil Project (COP).

The Azeri Central East (ACE) Project represents the next stage of development in the ACG field. The project comprises a new offshore production, drilling and quarters (PDQ) platform, to be located mid-way between the Central Azeri (CA) and East Azeri (EA) platforms in a water depth of approximately 137m, with tie-ins to the existing ACG subsea export pipelines for export of oil to the Sangachal Terminal with transfer of gas not used for injection on ACE to the CA platform and injection water from a tie-in near the EA platform via infield pipelines.

Figure 1 Location of ACG Field Layout Including Proposed ACE Platform



2. Purpose and Scope

The purpose of this document is to present the findings of a screening assessment completed to assess the potential increases in air quality concentrations due to construction and commissioning activities at the construction yards associated with the ACE platform for the purpose of the project Environmental and Social Impact Assessment.

The scope of the screening study is to estimate any changes in ambient atmospheric pollutant concentrations attributed to the construction and commissioning activities, in particular emissions related to:

- Use of construction plant and onsite vehicle emissions at the construction yard; and
- Topside commissioning.

It is planned to undertake fabrication of the ACE jacket and topside as well as elements of the subsea infrastructure in Azerbaijan. The tender process for the selection of the construction contractors is planned for completion by the first quarter of 2019. It has been assumed for the purposes of the ESIA, that a combination of the following construction yards may be used:

- Baku Deep Water Jacket Factory (BDJF) yard[1]: Used extensively during the ACG Projects. It is planned that the jackets and elements of the subsea equipment will be constructed at the BDJF yard;
- Construction yards located on the western fringe of the Bibiheybat oil field: Either in the South Dock[2] or the Bayil yard[3] previously used to construct the ACG DWG-PCWU, CA Compression and Water Injection (CA-CWP), West Chirag (WC) and Shah Deniz Stage 2 (SD2) offshore facilities; and
- Pipe coating and storage yard.

These construction yards are all located in industrial areas with the nearest community receptors at distances of 1km or more from the boundaries of the yards. No major upgrades or modifications at the potential construction yards to be used for the ACE Project have been identified.

3. Methodology

The following steps have been followed to undertake the assessment:

1. Define applicable air quality limit values and associated averaging periods;
2. Select a suitable screening model;
3. Define the modelling scenarios;
4. Determine the model input parameters,
5. Define dimensions of modelling grid;
6. Define background pollutant concentrations;
7. Undertake the screening modelling for the defined scenarios; and
8. Compare the modelled pollutant concentrations (including background concentrations) against the applicable air quality limit values to identify potential air quality impacts.

3.1 Air Quality Limits

Ambient air quality limit values are with the aim of avoiding, preventing or reducing harmful effects to human health and/or the environment as a whole.

Each limit value is presented for a given averaging period, based on scientific knowledge of known toxicity to human health. Certain limit values are allowed a certain number of exceedances per calendar year, which corresponds to a particular ‘percentile’.

Table 1 summarises the ambient air quality limits and averaging periods as provided by:

- World Health Organisation (WHO) Guidelines (Ref. 1);
- International Finance Corporation (IFC) General Environmental, Health and Safety (EHS) Guidelines (Ref. 2);
- World Bank Pollution, Prevention and Abatement Handbook (now superseded by IFC Guidelines) (Ref. 3);
- European Union (EU) Guidelines on Air Quality (Ref. 4), and
- Traditional Azeri air quality limits.

The limits that have been adopted by the ACE Project are shaded in grey.

Table 1 Ambient Air Quality Limit Values

Pollutant	Averaging period	Ambient Air Quality Limit Values (µg/m3)				
		WHO	IFC	Former World Bank	EU	Azeri Limit
NO_2	1 hour	200	200	400	200 (99.8th %ile)	85+
	8 hour	-	-	-	-	-
	24 hour	-	-	150	-	40
	Annual	40	40	100	40	-
CO	1 hour	-	-	-	-	5,000[b]
	8 hour	-	-	-	10,000 (100th %ile)	-
	24 hour	-	-	-	-	3,000
SO_2	10 minute	500	500	-	-	500[b]
	1 hour	-	-	350	350 (99.7th %ile)	-
	24 hour	125[a]	125[a]	125	125 (99.2%ile)	50

[1] Referred to in previous ACG Project ESIAs as Shelfprojectsroi (SPS).
[2] Operated by the Caspian Shipyard Company (CSC).
[3] Formally known as the Amec-Tekfen-Azfen (ATA) yard.

Pollutant	Averaging period	Ambient Air Quality Limit Values (µg/m3)				
		WHO	IFC	Former World Bank	EU	Azeri Limit
	Annual	-	-	50	-	-
PM_{10}	1 hour	-	-	-	-	500[b]
	24 hour	50 (99th %ile)	50 (99th %ile)	125	50 (90.4th %ile)	150
	Annual	20	20	50	40	-

Notes:
[a] Interim target
[b] Maximum Permissible Concentration, taken to be for a 1 hour averaging period (except for SO_2 where a 10 minute averaging period is used by WHO and IFC)

These limit values apply to locations where members of the public are expected to be normally present (e.g. residential areas, schools, hospitals). They do not apply to work premises such as the offshore platforms, which are subject to less stringent workplace limits. Occupational, workplace exposure is not assessed within this report.

The study pollutants are described, as follows:

- **Nitrogen dioxide:** Oxides of nitrogen (NO_X) are formed as a by-product of the high temperature combustion of fossil fuels (such as natural gas) by the oxidation of nitrogen in the air. NO_X primarily comprises of nitrogen oxide (NO), but also contains nitrogen dioxide (NO_2); once emitted the former can be oxidised in the atmosphere to produce further NO_2. It is the NO_2 that is associated with the health impacts; at high concentrations it can affect lung function and airway responsiveness, and enhances asthma and mortality. The rate of conversion of NO_X to NO_2 in the atmosphere is discussed later in this report;
- **Particulate matter**: Health based assessment criteria focuses on the fine 'PM_{10}' size fractions, which are predominately generated through the combustion of fossil fuels. PM_{10} is defined as particulate matter with an aerodynamic diameter of less than 10 microns. Exposure to increased levels are consistently associated with respiratory and cardiovascular illness and mortality;
- **Carbon monoxide:** CO is formed by the incomplete combustion of carbon containing fuels such as natural gas. Exposure to high concentrations causes carboxyhaemoglobin, which substantially reduces the capacity of the blood to carry oxygen; and
- **Sulphur dioxide:** SO_2 is a colourless gas that is readily soluble in water. It is formed through the combustion of sulphur containing fossil fuels and is a major air pollutant in many parts of the world. Excessive exposure to SO_2 (above the limit values) may cause discomfort in the eye, lung and throat. Sulphur content of gas combusted is anticipated to be less than 0.1% and therefore is not considered for modelling purposes. In addition diesel fuel (i.e. site plant or offsite road traffic) in Azerbaijan currently has to comply with the EN 590/GOST R 52368-2005 standards which requires a maximum sulphur content of 0.1% (10ppm).

Based on the use of good quality fuel low sulphur fuel, it is not considered necessary to model SO_2 and PM_{10} concentrations. In addition increases in CO concentrations were shown to be below the accuracy limitations of the model and were therefore screened out of the assessment.

Given the short duration of the planned activities, the modelling undertaken focuses on assessing the increase in short term (i.e. 1 hour) concentrations. The modelling results are therefore presented for the following pollutants and averaging periods:

- NO_2 1 hour peak (project limit value); and
- NO_2 1 hour peak (Azeri limit value).

3.2 Model Selection

A range of models are available for atmospheric dispersion modelling including Offshore and Coastal Dispersion model (OCD), National Radiological Protection Board (NRPB-91), Industrial Source Complex Short Term (ISCST), American Meteorological Society/Environmental Protection Agency Regulatory Model (AERMOD) and Atmospheric Dispersion Modelling System (ADMS).

This assessment has been undertaken using the UK Atmospheric Dispersion Modelling System, ADMS 5.

ADMS 5 (and previous) versions have been extensively validated for industrial sources by the model developers Cambridge Environmental Research Consultants (CERC). Details on model validity are available from their library of validation reports available at http://www.cerc.co.uk/environmental-software/model-validation.html.

The resources available at this website also explain in detail the approach used to model the dispersion of emissions to the atmosphere in three dimensions and the manner in which surface parameters are taken into account.

Reasons for selection of ADMS 5 are given as follows:

- Many regulatory authorities explicitly endorse or accept the use of ADMS 5. In the UK the Environment Agency (EA) does not formally "approve" any model. However, ADMS is routinely used and approved by the EA, Scottish Environmental Protection Agency, and the Department of the Environment in Northern Ireland. ADMS is also routinely used on behalf of Defra, the UK Government Department for the Environment;

- ADMS is included in the United States Environmental Protection Agency's (US EPA) List of Alternative Models, and is also approved for all types of environmental impact assessment in China. ADMS is also an approved model in France, Italy, the Netherlands, Ireland, the Baltic States, South Africa, Hungary and Thailand and was used by the California Department of Health. The models are also used in Spain, Portugal, Sweden, Cyprus, Austria, United Arab Emirates, Sudan, Saudi Arabia, Tunisia, Slovenia, Poland, New Zealand, Korea, Japan, India, Canada and Australia;

- ADMS has been rigorously validated by its developers (CERC) against existing monitoring data and alternative models that are available. For the validation studies that applied simple terrain (which is considered to be the most similar to offshore conditions), ADMS outperformed other models (such as the US regulatory model AERMOD) and demonstrated a model accuracy of within ±10% of the actual monitoring findings;

- ADMS 5 incorporates a superior basis for dispersion modelling, based on the Monin-Obhukov length parameter, rather than the Pasquill stability classes/Gaussian profiles which was used in earlier models such as OCD, NRPB-91 and ISCST. The systems in practice give similar results for stable and neutral atmospheric stability conditions, however, under unstable conditions, the predictions of models incorporating the Monin-Obhukov length are regarded as superior; and

- The ADMS 5 model incorporates an integrated plume rise module, rather than the simple empirical formula used in ISCST and the basic AERMOD model. The empirical approach is known to give poor predictions of emissions from small stacks or high-momentum releases as the equations were established primarily from the observations of large power station plumes. A version of the NRPB-91 model is available, called RAMPART, which incorporates the integrated plume rise approach but lacks a Monin-Obhukov based dispersion model.

3.3 Model Scenarios

The activities within the construction yards that will result in emissions to atmosphere comprise:

- Onsite construction plant within the yard(s) – modelled based on a number of assumptions and typical parameters for similar activities; and
- Topside commissioning – modelled based on data provided by the project for the anticipated commissioning activities.

Three wind speed scenarios have been modelled:

- Wind speed of 15 metres per second (m/s);
- Wind speed of 1m/s; and
- Wind speed of 5m/s.

The modelling of the onsite construction plant within the yard(s) has assumed all of the plant is operational at the same time, which is unlikely but provides a worst case assessment.

3.4 Model Input Parameters

3.4.1 Construction Yard Plant Assessment Input

Input data for a generic construction yard has been derived assuming peak activity and that all of the plant will be in operation simultaneously for up to 10 hours a day. This is likely to lead to an overestimate of the impacts to air quality.

Emissions will be associated with construction plant and vehicles on site. In the absence of specific project data, it has been assumed that the equivalent of 20 units of plant will be operating simultaneously at any one time on site and are evenly distributed across a 9 ha construction yard (approximately 300x300m). This estimate aligns with actual diesel usage data for one of the construction yards used for previous ACG activities; typically 8.5 tonnes per month.

An emission rate of 2.25 grams per second (g/s) NO_X was derived from an emission factor of 14.4 grams per kilowatt-hour (g/KW-hour) from the EMEP/CORINAIR Emission Inventory Guidebook (Ref. 5) for uncontrolled diesel powered site plant, and subsequently modelled as an area source using ADMS 5 as approximately 0.000025 grams per second per square metre (g/s/m^2) of NO_X, with a release height of 2m above ground level.

3.4.2 Commissioning Generator Emissions

All topside utilities will be fully commissioned at the construction yard over an approximate 12 month period. Onshore commissioning of powered equipment using diesel is planned to include:

- The main platform SGT-A35 (G62) dual fuel generator, run intermittently for a week, for up to 8 hours a day at a maximum load of approximately 26%, intermittently for approximately 6 months.
- Running the compression generator intermittently over an approximate 2-3 week period for up to an hour.
- Use of eight 1MW temporary diesel generators operational during commissioning of the topside for up to 9 months.
- The diesel powered emergency generator, firewater pump engines and platform pedestal cranes.

The main platform generator is by far the largest combustion source and hence has the greatest potential to contribute to short term increases in NO_2 concentrations during commissioning activities. The impact associated with this emission source has therefore been assessed using dispersion modelling. Table 2 presents the typical modelled parameters for a similar but slightly larger (in terms of power) generator.

Table 2 Generator Model Parameters

Parameter	Typical values
Anticipated Release Height	22 m
Anticipated Stack Diameter	1.1 m
Anticipated Stack Velocity	62 m/s
Anticipated Release Temperature	719 Deg C
Typical NO_X Exhaust Gas Concentrations	660 mg/Nm^3*
NO_X Emission Rate (Diesel Fuel)	10.3 g/s
Anticipated Release Height	22 m
**Normalised conditions at reference conditions of 0 Deg C and 1 atmosphere.*	

3.4.3 Conversion of NO_X to NO_2

At the point of release (from a combustion activity) NO_X emissions predominantly comprise nitrous oxide (NO). However, NO converts to NO_2 in the free troposphere under influences of other gases such as ozone (O_3) and hydroxyl (OH) compounds in the presence of UV radiation (sunlight). This process can be significant in locations over 5km downwind of large combustion sources.

Since the focus of human health criteria is on NO_2 rather than NO_X, it is important to determine a rate of conversion in the atmosphere, in order to calculate the ground level impact of NO_2.

The UK EA's Horizontal Guidance Note (H1) on Assessment and Appraisal Best Available Technology (Ref. 6) presents preferred conversion rates for NO_X to NO_2. It assumes, conservatively, that 100% of NO_X converts to NO_2 in the long term (i.e. annual average), and 35% NO_X for short term averaging periods (such as 1 hour and 24 hour).

Similarly, the US EPA recommends (in the absence of accurate monitoring data) a tiered approach for modelling NO_2 impacts (Ref. 7). The second tier uses the 'Ambient Ratio Method (ARM)', which assumes that 75% of NO_X is converted to NO_2 for the long term averaging period.

The ADMS 5 model includes an atmospheric chemistry module to calculate the rate of NO_X to NO_2 conversion. However, it requires accurate hourly background NO_2 and O_3 concentrations in order to produce reliable results. In the absence of any background monitoring data for O_3, and only limited data for NO_2, the most conservative assumption mentioned above has been applied to the model output; it has been assumed therefore that 100% of NO_X converts to NO_2 for long term averages, and 50% for the short term.

3.4.4 Meteorology

The dispersion of emissions from a point source is largely dependent on atmospheric stability and turbulent mixing in the atmosphere, which in turn are dependent on wind speed and direction, ambient temperature, cloud cover and the friction created by local terrain.

For the screening assessment the ADMS model was run for a single 1-hour period, based on a wind bearing from 180° (to represent a southerly wind). It was not deemed necessary to analyse the effect of north westerly winds, which would cause emissions to blow from land to sea (where no sensitive receptors are known to exist).

Model runs were undertaken with varying wind speeds of 1, 5 and 15 meters per second (m/s) to represent low, average and high wind speeds respectively. This was assumed to represent various atmospheric conditions in order to identify the potential impacts associated with a range of meteorological conditions.

3.5 Model Domain and Specified Receptors

As the location of the construction yard(s) where the topside and jacket have yet to be determined, a generic grid domain was used in the assessment with size varying between 5km and 14km. A grid resolution of between 50-100m was also used. In addition to the grid domain, specified receptor points can be chosen in the model at which ground level pollutant concentrations are then calculated.

4. Background Ambient Concentrations

Ambient air quality monitoring of SO_2, benzene, VOC and NO_2 has been undertaken around the Terminal since 1997. The monitoring locations, parameters recorded and analytical methodology used has varied across the monitoring surveys. The most recent air quality monitoring surveys were undertaken during 2014, the data from these surveys shall be used as background pollutant concentrations for this assessment.

While specific background data is not available for the southern coastline of the Absheron Peninsula, it has been considered representative to use the background concentrations recorded in 2014 at Sangachal as the environments are similar in terms of the mix of local sources (e.g. industrial facilities, roads etc.). Within Baku, there are a number of air quality monitoring stations across the city. The results from these stations were made publically available within the Draft National Strategy on AQAM (Ref. 8).

In the absence of a large hourly dataset it is not possible to derive accurate short term baselines concentrations; therefore a multiple of the annual average background concentration has instead been used. The approach suggested by EA's Horizontal Guidance Note (H1) is to double the annual average background concentration. This approach has been adopted for short-term averaging periods assessed in this report.

The background concentrations used for the purposes of modelling and assessment presented in Table 3 are considered to represent typical background concentrations for the onshore receptors.

Table 3 Average Background Concentrations (µg/m^3)

Pollutant	Averaging Period	Limit Value	Average Background Concentration (Sangachal & Absheron Peninsula)[1]	Average Background Concentration (Baku)[2]
NO_2	1 hour	200	24	76
NO_2	Annual	40	12	38

[1.] Based on 2016 Sangachal Terminal air quality survey. In the absence of data and given the rural nature of the location the same concentrations are assumed for the Absheron Peninsula
[2.] Baku concentration taken from: MWH, 2014, Air Quality Governance in the ENPI East Countries National Pilot Project – Azerbaijan "Improvement of Legislation on Assessment and Management of Ambient Air" - Draft National Strategy on AQAM, report funded by the European Union.

5. Modelled Contributions

This section presents the modelling results as modelled contribution for each of the dispersion modelling scenarios; i.e. the model output concentrations predicted at ground level without background concentrations.

5.1 Construction Yard Plant Emissions

Figures 2 to 4 present the modelled contributions of NOx (without background concentrations) as isopleths for the three wind speed screening scenarios.

Figure 2 shows that emissions from construction plant at the yard are predicted to generate a maximum short term ground level NO_X contribution of 6µg/m^3 extending up to a distance of 200m away from the emission source, reducing to 3µg/m^3 at 250 m and returning to background concentrations at over 400m, under high wind speeds (15m/s).

Under low wind speed (1m/s) (Figure 3) there is predicted to be no noticeable increase in NO_X concentrations beyond a distance of 200m from the centre of the construction site.

Typical wind speeds conditions (5m/s) (Figure 4) are predicted to result in an increase of NO_X concentrations of approximately 6µg/m^3 up to 30m from the centre of the site, reducing to background concentrations at a distance over 200m.

Figure 2 Ground Level 1-Hour NO_X Contribution from Onsite Construction Yard Plant in 15 m/s Wind

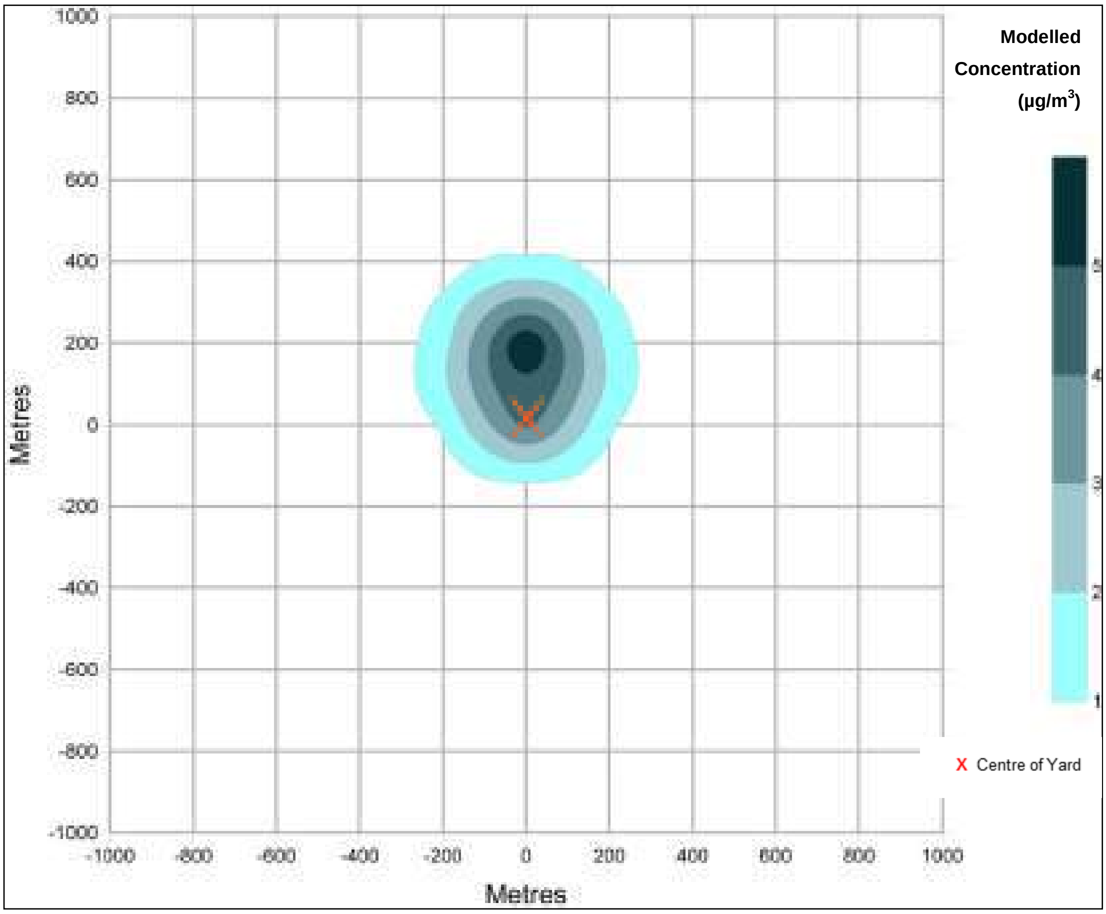


Figure 3 Ground Level 1-Hour NO_X Contribution from Onsite Construction Yard Plant in 1 m/s Winds

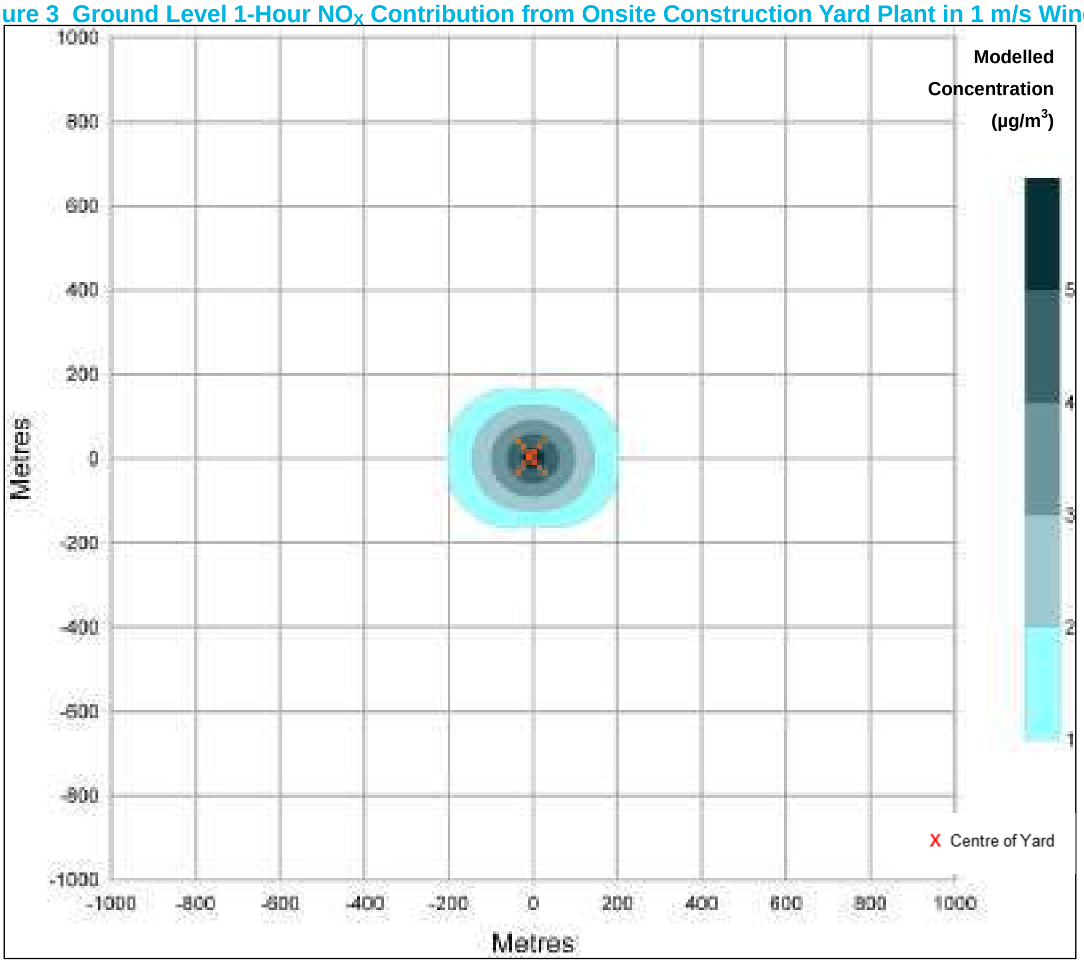
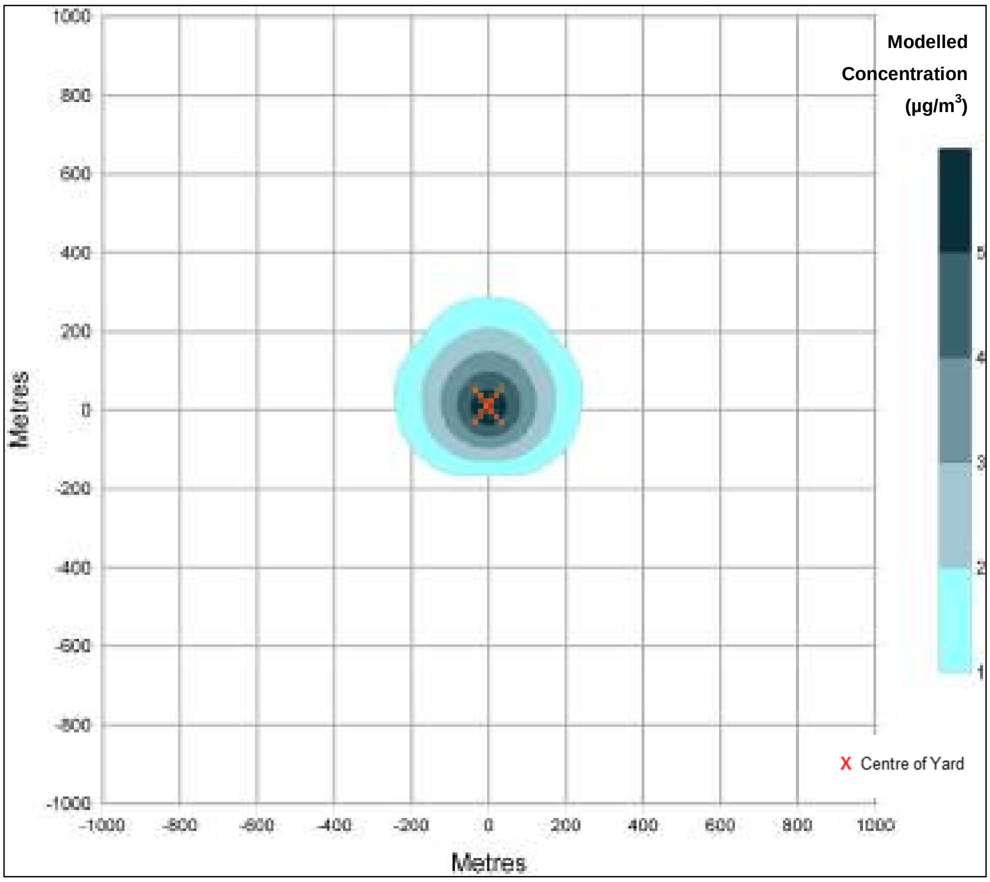


Figure 4 Ground Level Short Term NO_X Contribution from Onsite Construction Yard Plant Considering Average Winds (5 m/s)



5.1.1 Generator Commissioning Emissions

Figure 5 to 7 present the modelled contributions of NOx (without background concentrations) as isopleths for the three wind speed screening scenarios for the generator emissions during commissioning

Figure 5 presents the model results for the ground level NO_X process contribution under the high wind speed scenario (15m/s). The maximum ground level process contribution is predicted to be between 30-40µg/m^3, located approximately 500m to 1.5km from the emission source. Assuming that 50% of short term NO_X is converted into NO_2, emissions from the generator is predicted to lead to a maximum increase in 1 hour ground level NO_2 concentration of 15-20µg/m^3.

Figure 6 presents the model results for the low wind speed scenario (1 m/s). The maximum ground level NO_X process contribution in this case is predicted to be 2-3µg/m^3, located approximately 4-6km away from the emission source. Again, assuming that 50% of short term NO_X is converted into NO_2 emissions from the generators are predicted to lead to a maximum increase in mean 1 hour level NO_2 concentration of 1-1.5µg/m^3.

Figure 7 presents the model results for the average wind speed scenario (5m/s). The maximum ground level NO_X process contribution in this case is predicted to be 20-30µg/m^3, located approximately 500 m to 1.5 km away from the emission source. Again, assuming that 50% of short term NO_X is converted into NO_2, emissions from the generator is predicted to lead to a maximum increase in mean 1 hour level NO_2 concentration of 10-15µg/m^3.

The worst-case 1-hour NO_2 process contribution is expected to increase background concentrations by 30-40 µg/m^3, from 15 µg/m^3 to 55 µg/m^3, which represents approximately 25% of the short-term ambient NO_2 limit (of 200 µg/m^3) and approximately 80% of the short-term ambient Azeri NO_2 limit (of 85 µg/m^3).

Figure 5 Ground Level 1-Hour NO_X Process Contribution from Platform Generator during Commissioning in 15 m/s Winds

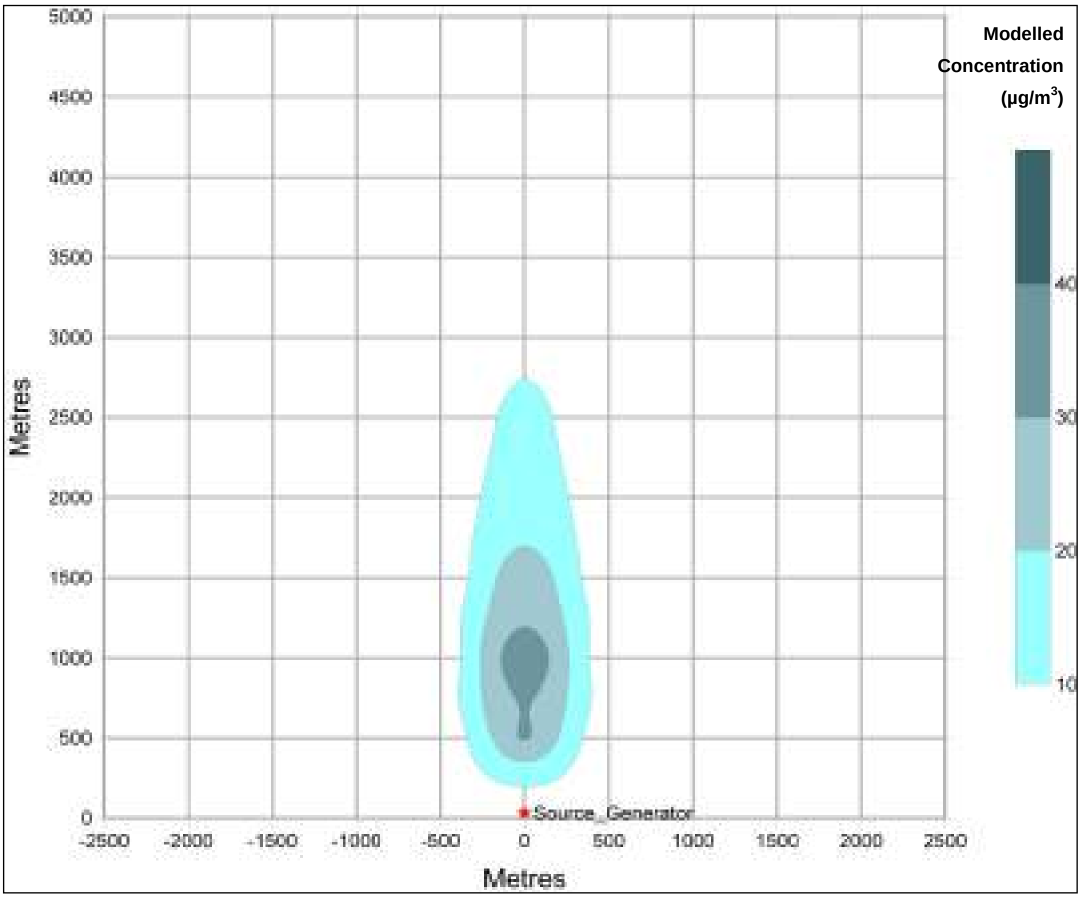


Figure 6 Ground Level 1-Hour NO_X Process Contribution from Platform Generators during Commissioning in 1 m/s Winds

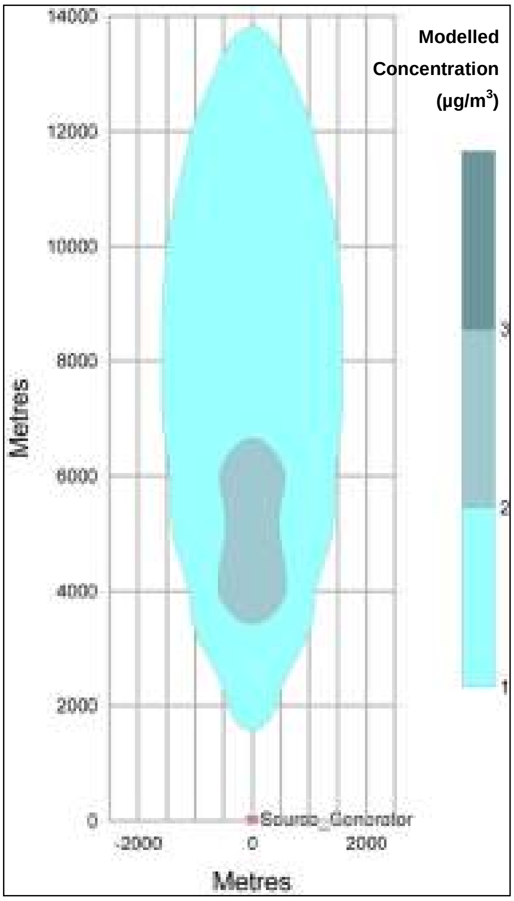
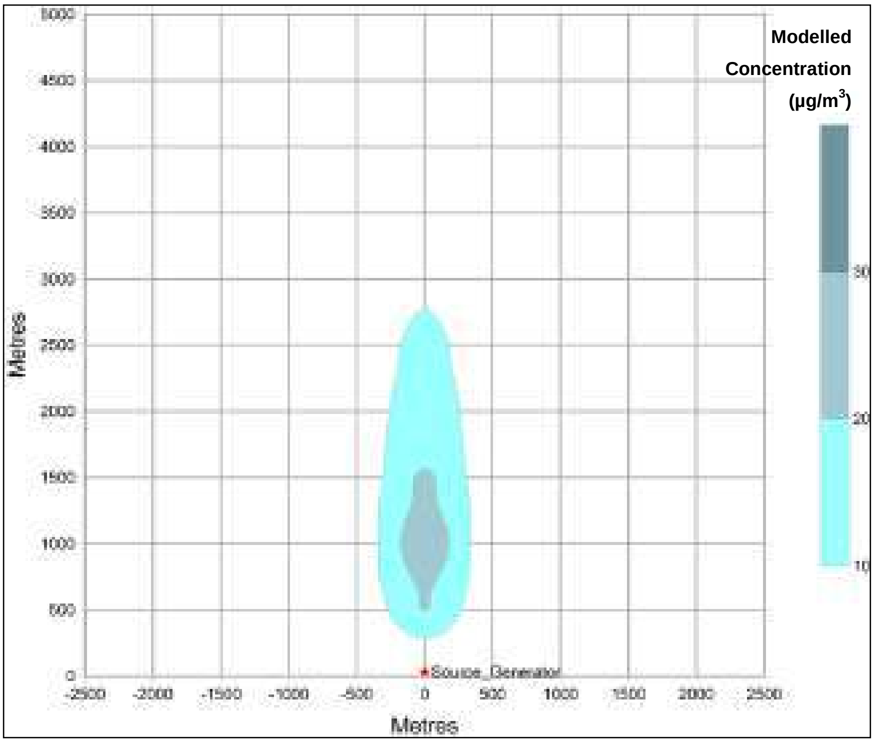


Figure 7 Ground Level Short Term NO_X Process Contribution from Platform Generators Considering Average Winds (5 m/s)



6. Conclusion

The findings of the screening assessment demonstrate construction yard plant emissions and exhaust emissions during topside commissioning are unlikely to cause discernible impacts on local air quality at sensitive receptors.

Construction yard plant emissions are predicted to generate a maximum short term ground level NO_2 contribution of 3µg/m^3 extending up to a distance of 200m away from the emission source, reducing to 1.5µg/m^3 at 250m and returning to background concentrations at over 400 m.

The main generator commissioning would result in a worst-case 1-hour NO_2 contribution of 15-20µg/m^3 located approximately 500m to 1.5km from the emission source.

When taking background concentrations into account, and the locations of nearest community receptors to the yards (typically more than 1km away from the yard boundary), the relevant air quality guideline levels are predicted to be met.

In summary, it is not expected that the platform construction at a specified yard will cause any air quality limit values to be exceeded where concentrations currently comply with the limit values.

7. References

Ref. 1 World Health Organisation (2005); Air quality guidelines - global update 2005 Guidelines

Ref. 2 International Finance Corporation (2007); General Environmental, Health and Safety (EHS) Guidelines

Ref. 3 World Bank (1998); Pollution, Prevention and Abatement Handbook. http://smap.ew.eea.europa.eu/test1/fol083237/poll_abatement_hanbook.pdf/

Ref.4 European Parliament and of the Council (2008); Directive 2008/50/EC on ambient air quality and cleaner air for Europe

Ref.5 European Environment Agency (2007); EMEP/CORINAIR Emissions Inventory Guidebook 2007, http://reports.eea.europa.eu/EMEPCORINAIR5/en/B111vs3.1.pdf, table 24.

Ref. 6 Environment Agency (2010); Horizontal Guidance Note H1 – Environmental Risk Assessment for Permits. http://www.environment-agency.gov.uk/business/topics/permitting/36414.aspx

Ref. 7 United States Environmental Protection Agency (US EPA) Applicability of Appendix W Modeling Guidance for the 1-hour NO2 National Ambient Air Quality Standard. http://www.epa.gov/ttn/scram/ClarificationMemo_AppendixW_Hourly-NO2-NAAQS_FINAL_06-28-2010.pdf

Ref. 8 AZERBAIJAN BRANCH OFFICE OF REC CAUCASUS (March 2014) Air Quality Governance in the ENPI East Countries, National Pilot Project – Azerbaijan, “Improvement of Legislation on Assessment and Management of Ambient Air” Draft National Strategy on AQAM

Appendix 10C

Noise Screening Assessment (Yards)

ACE Onshore Construction and Commissioning (Yards)

Noise Screening Assessment
ACE Project ESIA

Project reference: ACE Project ESIA
Project number: PR-245517

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Units and Abbreviations

Unit	Description
dB	Decibel, unit of sound
dB(A)	A-weighted sound pressure level in decibels
km	Kilometre
LAeq	The equivalent continuous A-weighted sound pressure level over a specific time period.
LA10	The noise level exceeded for 10% of the time, and normally attributable to a series of higher noise events such as road traffic.
LA90	The noise level exceeded for 90% of time. Often referred to as the “background level” this value, particularly in the case of a steady continuous noise source (such as the terminal) can be used to indicate the steady noise level emitted by that source.
LwA	The A weighted sound power level associated with a specific item of machinery or plant.
LpA	The A weighted sound pressure level at a specified distance from the noise source in question.
m	Metres

Executive Summary

The Azeri Central East (ACE) Project represents the next stage of development in the Azeri Chirag Gunashli (ACG) field. The project comprises a new offshore production, drilling and quarters (PDQ) platform, to be located mid-way between the Central Azeri (CA) and East Azeri (EA) platforms, with associated infield pipelines to tie-in the platform to the existing ACG oil and gas export pipelines and to supply injection water to the platform.

A noise screening modelling study for the construction and commissioning activities at the onshore construction yards associated with the ACE platform for the purpose of the Environmental and Social Impact Assessment (ESIA) has been undertaken.

The screening study was designed to estimate the noise levels generated by the following construction and commissioning activities:

- Use of construction plant and equipment; and
- Onshore topside commissioning.

Taking into account that the yard selection process has not yet commenced, an assessment of the predicted noise levels from activities was undertaken at increasing distances from the activity, with the predicted noise levels compared to noise limits for sensitive receptors (e.g. communities) relevant to construction activity. These are taken from British Standard BS5228:2009+ A1:2014 Code of practice for noise and vibration control on construction and open sites Part 1 - Noise (Ref. 1).

As described within BS5228:2009+ A1:2014, typically baseline data is used to determine applicable limits. In the absence of location specific baseline noise data to determine the relevant noise limits, the lowest construction noise thresholds of 65 LAeq dB and 45 LAeq dB have been assumed for the day time and night time periods respectively, which represent the most stringent criteria.

The majority of equipment at the yards to be used for construction will be mains powered but mobile plant and vehicles will be used throughout the construction period at all yards where ACE construction activities will be undertaken.

Commissioning of the topside is anticipated to include the main platform dual fuel generator, run intermittently on diesel for a week, for up to 8 hours a day at a maximum load of approximately 26% and then intermittently for approximately 6 months, in addition to the use of diesel generators to support topside commissioning and running the compression generator will be run intermittently over an approximate 2-3 week period for up to an hour.

The assessment of noise generated by construction activities, taking into account the typical plant and equipment to be used, indicated that noise levels that the 45dB night time criterion would be met at distances of 400m or more from the noise source.

The assessment of noise generated by commissioning activities focused on the main platform generator, which is the most significant noise source. This assessment indicated that noise levels that the 45dB night time criterion would be met at distances of 500m or more from the noise source.

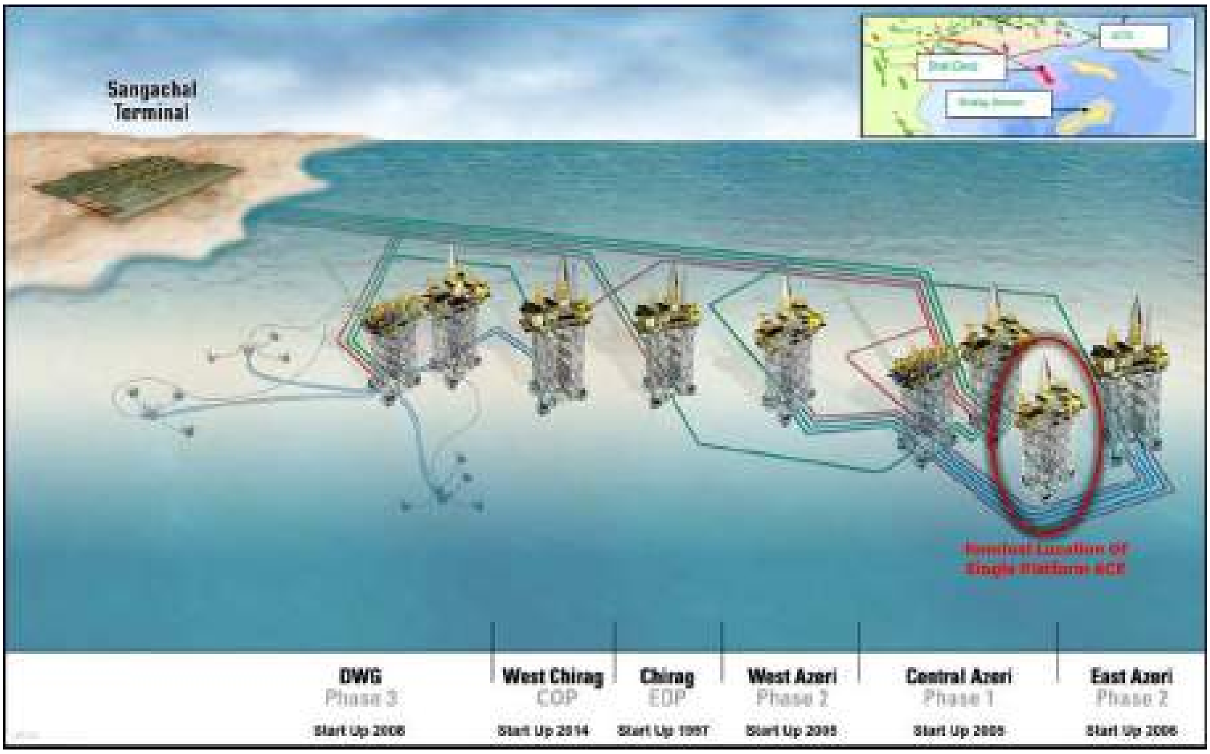
It is understood that the candidate construction yards are generally within industrial areas and the nearest sensitive receptors (i.e. communities) are more than 1km from the yard boundaries. As such it is not expected that the platform construction or commissioning activities at a specified yard will cause any noise threshold values to be exceeded at sensitive receptors.

1. Introduction

The Azeri Chirag Gunashli (ACG) field is the largest oilfield in the Azerbaijan sector of the Caspian Sea, covering approximately 432 square kilometres (km^2) and is located approximately 120 kilometres (km) east of Baku. Development of the field, which is operated by BP on behalf of the Azerbaijan International Operating Company (AIOC) under a Production Sharing Agreement (PSA), is being pursued in phases. Operations within the ACG field under the PSA started in November 1997 with the start-up of production from the Chirag-1 platform (under the initial phase of development, the Early Oil Project). The Central, West and East Azeri facilities were developed under Phases 1 and 2 and the Deepwater Gunashli (DWG) portion was developed under Phase 3. The West Chirag (WC) platform, the most recent ACG offshore facility, was completed and commenced production in 2014 under the Chirag Oil Project (COP).

The Azeri Central East (ACE) Project represents the next stage of development in the ACG field. The project comprises a new offshore production, drilling and quarters (PDQ) platform, to be located mid-way between the Central Azeri (CA) and East Azeri (EA) platforms in a water depth of approximately 137m, with tie-ins to the existing ACG subsea export pipelines for export of oil to the Sangachal Terminal with transfer of gas not used for injection on ACE to the CA platform and injection water from a tie-in near the EA platform via infield pipelines.

Figure 1 Location of ACG Field Layout Including Proposed ACE Platform



2. Purpose and Scope

The purpose of this report is to present the findings of a screening assessment, completed to predict noise generated by ACE construction and commissioning activities associated with the ACE platform at increasing distance from the source and compare these to relevant noise limits.

The screening study estimates the noise levels at generated by the following construction and commissioning activities:

- Use of construction plant at the construction yard; and
- Topside commissioning at the construction yards.

3. Methodology

The following steps have been followed to undertake the assessment:

1. Review of applicable project standards and assessment criteria for noise associated with construction;
2. Prepare a construction propagation modelling spreadsheet that predicts construction plant and commissioning source noise levels at increasing distance from the source;
3. Determine the model input parameters which are;
   - The types and numbers of construction plant used and their associated noise generation levels from routine use;
   - Specification of the topside plant to be used in the yard during commissioning;
   - The correction to be applied to reflect the presence of buildings (referred to as the façade correction factor);
4. Establish assessment scenarios;
5. Identify the contribution of noise from the on-site construction plant and topside plant being commissioned at increasing distance from source; and
6. Compare predicted noise levels at increasing distance to the relevant noise limits to establish the distance at which the noise limit would be met.

4. Sensitive Receptors

It is planned to undertake fabrication of the ACE jacket and topside as well as elements of the subsea infrastructure in Azerbaijan. The tender process for the selection of the construction contractors is planned for completion by the first quarter of 2019. It has been assumed for the purposes of the ESIA, that a combination of the following construction yards may be used:

- Baku Deep Water Jacket Factory (BDJF) yard[1]: Used extensively during the ACG Projects. It is planned that the jackets and elements of the subsea equipment will be constructed at the BDJF yard;
- Construction yards located on the western fringe of the Bibiheybat oil field: Either in the South Dock[2] or the Bayil Yard[3] previously used to construct the ACG DWG-PCWU, Central Azeri Compression and Water Injection (CA-CWP), West Chirag (WC) and Shah Deniz Stage 2 (SD2) offshore facilities ; and
- Pipe coating and storage yard.

These construction yards are all located in industrial areas with the nearest community receptors at distances of 1km or more from the boundaries of the yards. No major upgrades or modifications at the potential construction yards to be used for the ACE Project have been identified.

5. Applicable Standards

The assessment of construction and commissioning noise is based on the guidance provided within British Standard BS5228:2009+ A1:2014 Code of practice for noise and vibration control on construction and open sites. Part 1 - Noise (Ref. 1).

BS5228:2009+A1:2014 provides a number of methods to assess significance of construction noise. For this assessment the 'ABC' method has been adopted, which determines the potential acceptability of predicted noise levels based on absolute threshold values, and takes into account the existing ambient noise levels. This is achieved by establishing different categories as follows:

- Category A - noise thresholds – relevant when ambient noise levels (rounded to the nearest 5 dB) are less than the threshold values;
- Category B - relevant when ambient noise levels (rounded to the nearest 5 dB) are the same as the Category A noise thresholds; and
- Category C - relevant when ambient noise levels (rounded to the nearest 5 dB) are greater than the Category A noise thresholds.

These relevant noise limits are provided in Table 1 below.

1 Referred to in previous ACG Project ESIAs as Shelfprojectsroi (SPS).
2 Operated by the Caspian Shipyard Company (CSC).
3 Formally known as the Amec-Tekfen-Azfen (ATA) yard.

Table 1 BS5228:2009+A1:2014 ABC Method Construction Noise Threshold Values

Period	Category A LAeq (dB)	Category B LAeq (dB)	Category C LAeq (dB)
Night-time (23:00 to 07:00)	45	50	55
Evening and weekends	55	60	65
Daytime (07:00 to 19:00) and Saturday (07:00 to 13:00)	65	70	75
Category A –when ambient noise levels are less than these values *Category B –when ambient noise levels are the same as category A* *Category C –when ambient noise levels are higher than category A values*			

Construction working hours are assumed to be between 07:00 to 19:00 Monday to Saturday.

In the absence of location specific baseline noise data, the lowest construction noise thresholds of 65dB LAeq and 45dB LAeq have been assumed for the day time and night time periods respectively to represent the most stringent criteria.

6. Screening Assessment

6.1 Construction Yard Plant Assessment Input Parameters

Activities associated with the fabrication of the topside and jacket are likely to include the following:

- Jackets and Piles – The jacket and associated pin and foundation piles will be fabricated within one or more of the proposed yards. This process will involve assembly, inspection, testing, grit blasting and painting.
- Topside – The topside fabrication will involve grit blasting, painting, and the use of cranes to move relevant equipment and modules. The deck frame and components will be tested with non-destructive techniques.

The majority of fabrication works in the yards (e.g. steel shaping etc.) will be generally undertaken within workshop areas and as such any noise from these activities will be attenuated by the workshop building fabric. Typically the plant and vehicle used in the yard are small and low powered e.g. forklifts. The key plant that is larger and has the potential to generate more significant noise levels are detailed in Table 2.

Table 2 Key "Noisy" Construction Equipment within the Yards

Plant Item	LAeq (dB) at 10m	Reference from BS5228:2009+A1:2014 Part 1
Road Lorry (full)	80	C.6-21
Tower Crane	77	C.4-49

6.2 Topside Commissioning Assessment Input Parameters

All topside utilities will be fully commissioned at the construction yard over an approximate 12 month period. Onshore commissioning of powered equipment using diesel is planned to include:

- The main platform dual fuel generator, run intermittently for a week, for up to 8 hours a day at a maximum load of approximately 26%, intermittently for approximately 6 months.
- Running the compression generator intermittently over an approximate 2-3 week period for up to an hour.
- Use of eight 1MW temporary diesel generators operational during commissioning of the topside for 9 months.
- The diesel powered emergency generator, firewater pump engines and platform pedestal cranes.

The most dominant in terms of noise output is the main platform generator, which is assumed to have a sound power level of 112 dB LwA, based on typical manufacturer's data. The level includes the use of inlet and exhaust silencers as provided by the manufacturer as part of the unit.

7. Screening Assessment Results

7.1 Construction Yard Plant Assessment Results

As the location(s) of the construction yards is yet to be finalised, the assessment of the noise levels has been undertaken for varying distances from the activities. Noise levels have been predicted following guidance from BS5228:2009+A1:2014 and has assumed partial screening by intervening site hoardings and building structures.

Table 3 summarises the calculation and results, which predicted that noise levels will meet the daytime noise threshold at distances greater than approximately 40m and will meet the night-time threshold at distances greater than 400m.

Table 3 Predicted Noise Levels from Construction Yard Activities

Distance (m)	Distance Attenuation (dB)	Screening (dB)	Predicted Noise Level dB LAeq	Daytime Threshold dB LAeq	Night-time Threshold dB LAeq
1	20.0	-5.0	98.8	65.0	45.0
25	-8.0	-5.0	70.8	65.0	45.0
50	-14.0	-5.0	64.7	65.0	45.0
100	-20.0	-5.0	58.6	65.0	45.0
200	-26.0	-5.0	52.3	65.0	45.0
400	-32.0	-5.0	45.9	65.0	45.0
800	-38.1	-5.0	39.1	65.0	45.0
1200	-41.6	-5.0	34.8	65.0	45.0

7.2 Topside Commissioning Assessment Results

Table 4 details the predicted noise levels at different distances from the generator commissioning activities. Noise levels have been predicted following guidance from BS5228:2009+A1:2014 and has assumed partial screening by intervening site hoardings and building structures.

The results demonstrate that predicted noise levels will meet the daytime noise threshold at distances greater than approximately 50m and will meet the night-time threshold at distances greater than 500m.

Table 4 Predicted Noise Levels During Onshore Commissioning of the Main Topside Generator

Distance (m)	Distance Attenuation (dB)	Screening (dB)	Predicted Noise Level dB LAeq	Daytime Threshold dB LAeq	Night-time Threshold dB LAeq
1000	-68.0	-5.0	39.0	65.0	45.0
2000	-74.0	-5.0	31.0	65.0	45.0
3000	-77.5	-5.0	25.5	65.0	45.0
4000	-80.0	-5.0	21.0	65.0	45.0
5000	-82.0	-5.0	17.0	65.0	45.0
6000	-83.6	-5.0	13.4	65.0	45.0
7000	-84.9	-5.0	10.1	65.0	45.0
8000	-86.1	-5.0	6.9	65.0	45.0
9000	-87.1	-5.0	3.9	65.0	45.0
10000	-88.0	-5.0	1.0	65.0	45.0

8. Conclusion

A preliminary assessment of the potential noise impact from construction and commissioning activities associated with the ACE Project has been undertaken.

Noise levels arising from platform construction activities within the construction yards (yet to be selected) have been predicted at a range of distances from the noise source. This has demonstrated that noise levels will not exceed the night time criterion for sensitive properties located more than 400m from the noise source.

As the yard location(s) has yet to be finalised, noise levels arising from the commissioning of the main platform generators have been predicted at increasing distances from the noise source to determine at what distance noise threshold would be met. This assessment concludes that general night-time noise criterion would be met at a distance of 500m or more from the noise source.

In summary, it is not expected that the platform construction at a specified yard will cause any noise threshold values to be exceeded at sensitive receptors where work concentrations also currently comply with the threshold values.

9. References

Ref. 1 British Standards Institute (BSi), (2009 with 2014 amendments): 'BS5228 - Noise and Vibration Control on Construction and Open Sites', BSi, London.

APPENDIX 11A

Azeri Central East Project Operations Activities and Events

ACTIVITY/INTERACTIONS				
ID (R=Routine, NR= Non-Routine)	**Activity**	**Scoped In/Out**	**Event**	**Event Category**
Platform Drilling				
O-R1	Installation of conductor section using hydraulic hammer	✓	Underwater sound and vibration	Underwater Sound and Vibration
O-R2	Suspension fluids from predrill well tie-in and re-entry	×	Suspension fluids discharges	Drilling Discharges to Sea
O-R3	30" and 26" upper hole section drilling	✓	Drilling discharges to sea	Drilling Discharges to Sea
			Underwater sound and vibration	Underwater Sound and Vibration
O-R4	30" and 26" hole upper hole section drilling - residual water based mud (WBM) recover to shore or sent to CRI (base case). Residual WBM that cannot be recovered discharged to sea when CRI well not available	×	Excess WBM sent to CRI well	-
		✓	Drilling discharges to sea	Drilling Discharges to Sea
O-R5	20", 17" and 13 ½" lower hole section drilling - Synthetic Oil Based Mud (SOBM) or Low Toxic Mineral Oil Based Mud (LTMOBM) sent to CRI (base case) or, if not available, sent to shore.	×	SOBM/LTMOBM sent to CRI well	-
		✓	Underwater sound and vibration	Underwater Sound and Vibration
O-NR6	Fugitive emission of dry cement	×	Cement discharges to sea	Cement Discharges to Sea
O-R7	Discharge of cement system washout to sea via the platform cuttings caisson	✓	Cement discharges to sea	Cement Discharges to Sea
Offshore Operations and Production				
O-R8	Operation of offshore combustion sources under routine conditions	✓	Atmospheric emissions due to power generation	Offshore Operations (Routine Operations)
O-NR1	Operation of offshore combustion sources under non-routine or emergency depressurisation conditions	✓	Emissions to atmosphere (non GHG)	Offshore Operations (Non Routine Operations - Flaring)
O-R9	Cooling water system intake and discharge	✓	Water intake/entrainment	Water Intake/Entrainment and Cooling Water Discharge
			Cooling water discharge to sea	Water Intake/Entrainment and Cooling Water Discharge
O-NR2	Fire system operation and tests	×	Other discharges to sea	Discharge of treated seawater
				Discharge of fire fighting foam
O-R10	Platform drainage systems	✓	Other discharges to sea	Deck Drainage
O-R11	Saline effluent from freshwater maker	✓		Saline Discharge
O-R12	Treated black water discharge	✓		Treated Black Water
O-R13	Grey water discharges	✓		Grey Water
O-R14	Galley waste discharges	✓		Organic Food Waste
O-R15	Pipeline operations and maintenance – pigging of ACE oil and gas infield pipelines	×	Generation of hazardous and non-hazardous waste	Waste Generation
O-R16	Pipeline operations and maintenance – pigging of water injection pipeline	✓	Pigging discharge to sea	Pigging Discharge
		×	Generation of hazardous and non-hazardous waste	Waste Generation
O-R17	Supply vessel operations (non GHG emissions to atmosphere)	×	Emissions to atmosphere (non GHG)	Supply Vessels
		×	Underwater sound and vibration	Supply Vessels
O-R18	Crew change operations (non GHG emissions to atmosphere)	×	Emissions to atmosphere (non GHG)	Support Vessels
		×	Underwater sound and vibration	Support Vessels
Sangachal Terminal Activities				
Ter-R1	Use of existing processing and storage facilities (Non GHG emissions to atmosphere)	×	Emissions to atmosphere (non GHG)	Onshore Operations (Routine Operations)
All Operations				
All-R1	Waste Management	×	Waste Generation	Waste Generation

APPENDIX 11B

Azeri Central East Offshore Operations Air Quality Assessment

ACE Offshore Operations Air Quality Modelling Assessment

ACE Project ESIA

Project reference: ACE Project ESIA
Project number: PR-245517

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Units and Abbreviations

Unit	Description
°C	Degrees Celsius
g/s	Grams per Second
K	Degrees Kelvin
kg/hr	Kilograms per Hour
Km	Kilometre
lb/MMBTu	Pounds per Million British Thermal Units
M	Meters
m/s	Meters per Second
M3	Cubic Metres
M3/day	Cubic Metres per Day
mg/Nm3	Micrograms per Standardised Meter Cubed of Air
MMscfd	Million Standard Cubic Feet per Day
MW	Mega Watts

Abbreviation/ Acronym	Description
ACG	Azeri Chirag Gunashli
ADMS	Atmospheric Dispersal Modelling System
CO	Carbon monoxide
ESD	Emergency Shutdown Depressurisation
EU	European Union
GHG	Greenhouse Gas
IFC	International Finance Corporation
NO	Nitric oxide
NO_2	Nitrogen dioxide
NO_X	Oxides of nitrogen
PM	Particulate matter
SO_2	Sulphur dioxide
UK	United Kingdom
US	United States
US EPA	United States Environmental Protection Agency
VOC	Volatile Organic Compounds
WHO	World Health Organisation

Executive Summary

The Azeri Central East (ACE) Project represents the next stage of development in the Azeri Chirag Gunashli (ACG) field. The Project comprises a new offshore production, drilling and quarters (PDQ) platform, to be located mid-way between the Central Azeri (CA) and East Azeri (EA) platforms, with associated infield pipelines to tie-in the platform to the existing ACG oil and gas export pipelines and to supply injection water to the platform.

An air dispersion modelling study for the offshore operational activities associated with the ACE platform for the purpose of the project Environmental and Social Impact Assessment (ESIA) has been undertaken.

The scope of the modelling study was to estimate any changes in ambient atmospheric pollutant concentrations attributed to the offshore operational activities. Pollutant species and corresponding averaging periods have been based on the applicable ambient air quality limit values, set for the protection of human health, and modelled at discrete onshore receptors.

The assessment considered the following emissions sources:

- 1 No. 27.5 Mega Watt (MW) dual fuel turbine for power generation (SGT-A35-G62);
- 1 No. 29.1 MW gas turbine for gas compression (SGT-A35(G62)); and
- Flare system, comprising HP and LP flares

The assessment considered the following modelling scenarios:

- Scenario 1 – ACE Routine Operation represents the ACE facilities operating under routine conditions with power generation, gas compression running at 100% load and flare system operating in pilot/purge mode (minimum safe operation).
- Scenario 2 – ACE Non-Routine Scenario represents the ACE facilities operating under non routine conditions with power generation running at 100% load, and gas compression in maintenance leading to HP flare non-routine flaring at 80 million standard cubic feet per day (MMscfd).
- Scenario 3 – ACE Emergency Shutdown (ESD) represents the ACE facilities operating under non routine conditions with power generation running at 100% using diesel, and HP flare ESD flaring at 333MMscfd.
- Scenario 4 – Cumulative Routine represents the ACE facilities operating under routine conditions (Scenario 1), plus the Shah Deniz 2(SD2) offshore emission sources under routine operation.
- Scenario 5 – Cumulative ESD represents the ACE facilities emergency shutdown (Scenario 3), plus the SD2 offshore emission sources under non-routine operation

Atmospheric dispersion modelling was completed for pollutant species nitrogen dioxide (NO_2), carbon monoxide (CO) and particulate matter measuring 10 microns (µm) or less in diameter (PM_{10}). Results have been presented as modelled contributions and in combination with anticipated background concentrations, presented at the closest onshore receptor locations; Absheron Peninsula, Baku and Sangachal.

The highest modelled contribution occurred from Scenario 5. The maximum ground level annual average NO_2 contribution was predicted to be less than 0.1 micrograms per cubic metre (µg/m^3). The maximum predicted ground level short term NO_2 contribution was predicted to be 1.5µg/m^3. The maximum modelled annual average PM_{10} contribution, at the worst-affected receptor, was predicted to be less than 0.2µg/m^3. The maximum short term PM_{10} contribution was predicted to be 1.7µg/m^3. The modelled contributions associated with all Scenarios were not predicted to lead to any discernible impact on air quality concentrations onshore.

When taking account of the existing background concentrations the predicted concentrations easily comply with the air quality limit values, with the exception of PM_{10}. This can be attributed to the natural occurrence of particulate matter in the local environment reflecting the high particulate concentrations associated with dry arid region (for example soil particles becoming airborne through wind entrainment). The contribution of ACE offshore activities to increases in PM_{10} concentrations at onshore receptors is insignificant.

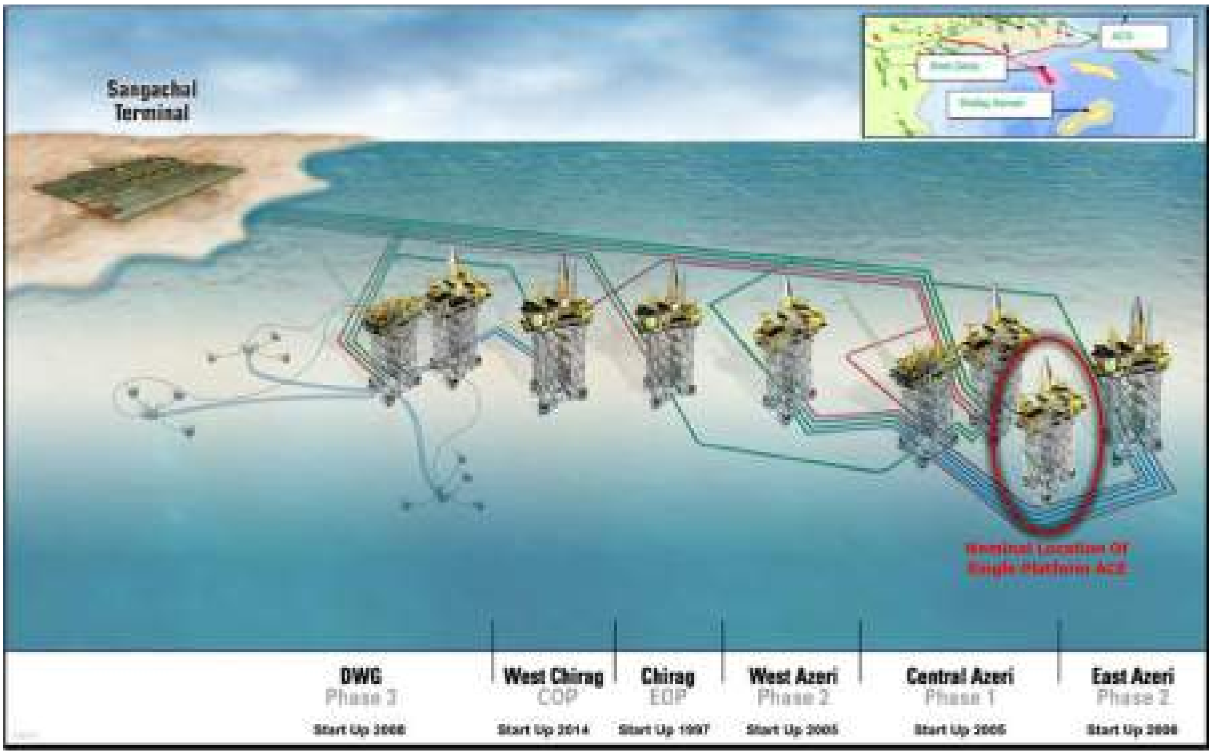
In summary, it is not expected that ACE offshore operational activities will cause the applicable air quality limit values to be exceeded at onshore locations, where concentrations currently comply with the limit values and the contribution of ACE offshore operational emissions to concentrations of pollutant at onshore receptors is estimated to be very small and likely to be indiscernible.

1. Introduction

The Azeri Chirag Gunashli (ACG) field is the largest oilfield in the Azerbaijan sector of the Caspian Sea, covering approximately 432 square kilometres (km2) and is located approximately 120 kilometres (km) east of Baku. Development of the field, which is operated by BP on behalf of the Azerbaijan International Operating Company (AIOC) under a Production Sharing Agreement (PSA), is being pursued in phases. Operations within the ACG field under the PSA started in November 1997 with the start-up of production from the Chirag-1 platform (under the initial phase of development, the Early Oil Project). The Central, West and East Azeri facilities were developed under Phases 1 and 2 and Deepwater Gunashli (DWG) portion was developed under Phase 3. The West Chirag (WC) platform, the most recent ACG offshore facility, was completed and commenced production in 2014 under the Chirag Oil Project (COP).

The Azeri Central East (ACE) Project represents the next stage of development in the ACG field. The project comprises a new offshore production, drilling and quarters (PDQ) platform, to be located mid-way between the Central Azeri (CA) and East Azeri (EA) platforms in a water depth of approximately 137m, with tie-ins to the existing ACG subsea export pipelines for export of oil to the Sangachal Terminal with transfer of gas not used for injection on ACE to CA and injection water from a tie-in near the EA platform via infield pipelines.

Figure 1. Location of ACG Field Layout Including Proposed ACE Platform



2. Purpose and Scope

The purpose of this report is to present the air dispersion modelling study for the offshore operational activities associated with the ACE Project. The scope of the modelling study is to estimate any changes in ambient atmospheric pollutant concentrations attributed to the operational activities. The results are presented as modelled contribution isopleths across the offshore domain and at selected onshore locations. Pollutant species and averaging periods have been based on the applicable ambient air quality limit values, set for the protection of human health.

3. Methodology

The following steps have been followed to undertake the assessment:

1. Define applicable air quality limit values and associated averaging periods;
2. Select a suitable atmospheric dispersion model;
3. Define the modelling scenarios;
4. Determine the model input parameters,
5. Define dimensions of modelling grid and location of sensitive onshore receptors;
6. Define background pollutant concentrations at onshore receptors;

7. Undertake the air dispersion modelling for the defined scenarios; and
8. Compare the modelled pollutant concentrations (including background concentrations) against the applicable air quality limit values to identify potential air quality impacts.

3.1 Air Quality Limits

Ambient air quality limit values are defined with the aim of avoiding, preventing or reducing harmful effects to human health and/or the environment as a whole.

Each limit value is presented for a given averaging period, based on scientific knowledge of known toxicity to human health. Certain limit values are allowed a certain number of exceedances per calendar year, which corresponds to a particular 'percentile'.

Table 1 summarises the ambient air quality limits and averaging periods as provided by:

- World Health Organisation (WHO) Guidelines (Ref. 1);
- International Finance Corporation (IFC) General Environmental, Health and Safety (EHS) Guidelines (Ref. 2);
- World Bank Pollution, Prevention and Abatement Handbook (now superseded by IFC Guidelines) (Ref. 3);
- European Union (EU) Guidelines on Air Quality (Ref. 4), and
- Traditional Azeri air quality limit.

The limits that have been adopted by the ACE Project are shaded in grey.

Table 1. Ambient Air Quality Limit Values

Pollutant	Averaging period	Ambient Air Quality Limit Values (µg/m3)				
		WHO	IFC	Former World Bank	EU	Azeri Limit
NO_2	1 hour	200	200	400	200 (99.8th %ile)	85+
	8 hour	-	-	-	-	-
	24 hour	-	-	150	-	40
	Annual	40	40	100	40	-
CO	1 hour	-	-	-	-	5,000[b]
	8 hour	-	-	-	10,000 (100th %ile)	-
	24 hour	-	-	-	-	3,000
SO_2	10 minute	500	500	-	-	500[b]
	1 hour	-	-	350	350 (99.7th %ile)	-
	24 hour	125[a]	125[a]	125	125 (99.2%ile)	50
	Annual	-	-	50	-	-
PM_{10}	1 hour	-	-	-	-	500[b]
	24 hour	50 (99th %ile)	50 (99th %ile)	125	50 (90.4th %ile)	150
	Annual	20	20	50	40	-

Notes:
[a] Interim target
[b] Maximum Permissible Concentration, taken to be for a 1 hour averaging period (except for SO_2 where a 10 minute averaging period is used by WHO and IFC)

These limit values apply to locations where members of the public are expected to be normally present (e.g. residential areas, schools, hospitals). They do not apply to work premises such as the offshore platforms, which are subject to less stringent workplace limits. Occupational, workplace exposure is not assessed within this report.

The study pollutants are described, as follows:
- **Nitrogen dioxide:** Oxides of nitrogen (NO_X) are formed as a by-product of the high temperature combustion of fossil fuels (such as natural gas) by the oxidation of nitrogen in the air. NO_X primarily

comprises of nitrogen oxide (NO), but also contains NO_2; once emitted the former can be oxidised in the atmosphere to produce further NO_2. It is the NO_2 that is associated with the health impacts; at high concentrations it can affect lung function and airway responsiveness, and enhances asthma and mortality. The rate of conversion of NO_X to NO_2 in the atmosphere is discussed in Section 3.3.2 of this report;

- **Sulphur dioxide:** SO_2 is a colourless gas that is readily soluble in water. It is formed through the combustion of sulphur containing fossil fuels and is a major air pollutant in many parts of the world. Excessive exposure to SO_2 (above the limit values) may cause discomfort in the eye, lung and throat.

- **Particulate matter**: Health based assessment criteria focuses on the fine 'PM_{10}' size fractions, which are predominately generated through the combustion of fossil fuels. PM_{10} is defined as particulate matter with an aerodynamic diameter of less than 10 microns. Exposure to increased levels are consistently associated with respiratory and cardiovascular illness and mortality;

- **Carbon monoxide:** CO is formed by the incomplete combustion of carbon containing fuels such as natural gas. Exposure to high concentrations causes carboxyhaemoglobin, which substantially reduces the capacity of the blood to carry oxygen.

The modelling results are therefore presented for against the following pollutants and averaging periods:

- NO_2 1 hour peak (project limit value)
- NO_2 annual average (project limit value)
- SO_2 annual average (project limit value)
- SO_2 24 hour average (project & Azeri limit value)
- SO_2 1 hour peak (project limit value)
- PM_{10} annual average (project limit value)
- PM_{10} 24 hour average (project & Azeri limit value)

Additional, Azeri limit values are presented in Annex A, but not discussed within the details of this report:

- NO_2 24 hour average (Azeri limit value)
- PM_{10} 1 hour peak (Azeri limit value)
- CO 1 hour peak (Azeri limit value)
- CO 24 hour average (Azeri limit value)

3.2 Model Selection

A range of models are available for atmospheric dispersion modelling including Offshore and Coastal Dispersion model (OCD), National Radiological Protection Board (NRPB-91), Industrial Source Complex Short Term (ISCST), American Meteorological Society/Environmental Protection Agency Regulatory Model (AERMOD) and Atmospheric Dispersion Modelling System (ADMS).

This assessment has been undertaken using the UK Atmospheric Dispersion Modelling System, ADMS5.

ADMS 5 (and previous) versions have been extensively validated for industrial sources by the model developers Cambridge Environmental Research Consultants (CERC). Details on model validity are available from their library of validation reports available at http://www.cerc.co.uk/environmental-software/model-validation.html

The resources available at this website also explain in detail the approach used to model the dispersion of emissions to the atmosphere in three dimensions and the manner in which surface parameters are taken into account.

Reasons for selection of ADMS5 are given as follows:

- Many regulatory authorities explicitly endorse or accept the use of ADMS 5. In the UK the Environment Agency (EA) does not formally "approve" any model. However, ADMS is routinely used and approved by the EA, Scottish Environmental Protection Agency, and the Department of the Environment in Northern Ireland. ADMS is also routinely used on behalf of Defra, the UK Government Department for the Environment;

- ADMS is included in the United States Environmental Protection Agency's (US EPA) List of Alternative Models, and is also approved for all types of environmental impact assessment in China. ADMS is also an approved model in France, Italy, the Netherlands, Ireland, the Baltic States, South Africa, Hungary and Thailand and was used by the California Department of Health. The models are also used in Spain, Portugal, Sweden, Cyprus, Austria, United Arab Emirates, Sudan, Saudi Arabia, Tunisia, Slovenia, Poland, New Zealand, Korea, Japan, India, Canada and Australia;

- ADMS has been rigorously validated by its developers (CERC) against existing monitoring data and alternative models that are available. For the validation studies that applied simple terrain (which is considered to be the most similar to offshore conditions), ADMS outperformed other models (such as the US regulatory model AERMOD) and demonstrated a model accuracy of within ±10% of the actual monitoring findings;

- ADMS 5 incorporates a superior basis for dispersion modelling, based on the Monin-Obhukov length parameter, rather than the Pasquill stability classes/Gaussian profiles which was used in earlier models such as OCD, NRPB-91 and ISCST. The systems in practice give similar results for stable and neutral atmospheric stability conditions, however, under unstable conditions, the predictions of models incorporating the Monin-Obhukov length are regarded as superior; and

- The ADMS 5 model incorporates an integrated plume rise module, rather than the simple empirical formula used in ISCST and the basic AERMOD model. The empirical approach is known to give poor predictions of emissions from small stacks or high-momentum releases as the equations were established primarily from the observations of large power station plumes. A version of the NRPB-91 model is available, called RAMPART, which incorporates the integrated plume rise approach but lacks a Monin-Obhukov based dispersion model.

3.3 Model Scenarios

The main ACE Project emissions sources comprise:

- 1 No. 27.5 MW dual fuel turbine for power generation (SGT-A35-G62);
- 1 No. 29.1 MW gas turbine for gas compression (SGT-A35(G62)); and
- Flare system, comprising High Pressure (HP) and Low Pressure (LP) flares.

The modelling scenarios selected for assessment are:

- Scenario 1 – ACE Routine Operation represents the ACE facilities operating under routine conditions with power generation, gas compression running at 100% load and flare system operating in pilot/purge mode (minimum safe operation).
- Scenario 2 – ACE Non-Routine Scenario represents the ACE facilities operating under non routine conditions with power generation running at 100% load, but gas compression in maintenance leading to HP flare non-routine flaring at 80 million standard cubic feet per day (MMscfd).
- Scenario 3 – ACE Emergency Shutdown (ESD) represents the ACE facilities operating under non routine conditions with power generation running at 100% using diesel, but HP flare ESD flaring at 333MMscfd.
- Scenario 4 – Cumulative Routine represents the ACE facilities operating under routine conditions (Scenario 1), plus Shah Deniz 2 (SD2) offshore emission sources under routine operation.
- Scenario 5 – Cumulative ESD represents the ACE facilities emergency shutdown (Scenario 3), plus SD2 emission sources under routine operation.

The modelling scenarios including the sources modelled are summarised within Table 2.

Table 2. Modelling Scenarios

Scenario	Description	ACE Power SGT-A35-G62	ACE Gas Compression SGT-A30RB-GT62	ACE LP flare	ACE HP flare	SD2 Platform Routine Ops
1	Routine Operations	✓	✓	✓[2]	✓[2]	×
2	Flash Gas compressor maintenance	✓	×	×	✓[3]	×
3	ESD	✓□	×	×	✓[4]	×
4	Cumulative Routine	✓	✓	✓[2]	✓[2]	✓
5	Cumulative ESD	✓[5]	×	×	✓[4]	✓

Notes:
1. It is assumed that the ACE power and gas compression gas turbines (GT) operate at 100% load for all scenarios modelled.
2. Purge pilot flaring: LP 0.8MMscfd HP 0.1MMscfd
3. Flash Gas compressor planned maintenance: HP flare 80MMscfd for up to 5 days every 2-3 years
4. ESD: HP flare 333MMscfd for up to 2 hours per event occurring once every 5 years
5. Turbine operating on back up liquid fuel (diesel)

Scenarios 4 and 5 include the offshore emissions sources associated with SD2 Project which commenced operation in 4Q 2018. SD2 Project emissions are therefore not included in the background ambient concentrations described in Section 4 below. SD2 sources comprise:

- Gas turbines. These are assumed to be operating at 100% load in both Scenarios 4 and 5;
- Elevated flare system. Scenario 5 takes into account anticipated flaring as a result of an SD2 compressor trip.

The parameters used for these cumulative sources are provided in Annex B of this report.

3.3.1 Model Input Parameters

The parameters required by the ADMS5 model to calculate the predicted concentrations associated with the emissions are presented in Table 3 and

Table 4.

Table 3. Gas Turbine Emissions Parameters

Parameter	ACE Power	ACE Power during ESD	ACE Gas Compression
Model	SGT-A35-G62		SGT-A30-GT62
Fuel Type	Gas[1]	Diesel[2]	Gas
No. units/Flues	1	1	1
Power output (kW)	27,500	27,500	27,500
Height of release point above sea level (m)	68.7	68.7	68.7
Mass flux rate (kg/s)	92.5	90.6	95.0
Internal stack diameter per unit (m)	1.98	1.98	1.98
Exit gas temperature (°C)	504	509	494
Exit gas mass flow rate per unit (kg/s)	92.5	90.6	95.0
Maximum NOX emission rate per unit (g/s)	3.75	30.2	3.84
Maximum CO emission rate per unit (g/s)	0.375	0.113	0.384
Maximum SO2 emission rate per unit (g/s)	0.0219	3.52	0.0225
Maximum PM10 emission rate per unit (g/s)	0.0156	0.148	0.0160

Emission derived from emissions factors from EMEP/EEA air pollutant emission inventory guidebook – 2016, Tier 2 emissions factors for source category 1.A01.a,

1. Gas turbines using gaseous fuel
2. Gas turbines using diesel (note SO_2 based on a sulphur content of 1%, although diesel used for ACE is anticipated be 0.05% Sulphur).

Flares are treated in a similar way to point sources (e.g. emissions from stacks) in ADMS5, except that there are buoyancy flux adjustments associated with radiative heat and heat losses. The thermal effects of the flame require an ‘effective stack height’ and ‘effective stack diameter’ to be calculated (i.e. the combustion gases are emitted from the top of the flame, not the flare tip), assuming the exit temperature is 1000°C, and the exit velocity is 20 g/s in accordance with USEPA’s guidance. The parameters required by the ADMS model to calculate the emissions associated with an Emergency Depressurisation (ESD) and maintenance flaring event are presented in Table 4.

Table 4. Flare Emissions Parameters

Parameter	ACE High Pressure Flare (Flash Gas Compressor Maintenance)	ACE High Pressure Flare (ESD)
Fuel Rate (MMscfd)	80	333
Stack height (m)	94.6	94.6
Effective stack diameter (m)	9.8	19.9
Exit gas velocity (m/s)	20	20
Exit gas temperature (°C)	1000	1000
Maximum NOX emission rate per unit (g/s)	29.9	124
Maximum CO emission rate per unit (g/s)	134	559
Maximum SO_2 emission rate per unit (g/s)	48.7	203
Maximum PM_{10} emission rate per unit (g/s)	55.5	231

3.3.2 Conversion of NOx to NO_2

At the point of release (from a combustion activity) NO_X emissions predominantly comprise nitrous oxide (NO). However, NO converts to NO_2 in the free troposphere under influences of other gases such as ozone (O_3) and hydroxyl (OH) compounds in the presence of UV radiation (sunlight). This process can be significant in locations over 5km downwind of large combustion sources.

Since the focus of human health criteria is on NO_2 rather than NO_X, it is important to determine a rate of conversion in the atmosphere, in order to calculate the ground level impact of NO_2.

The EA's Horizontal Guidance Note (H1) on Assessment and Appraisal Best Available Technology (Ref. 5) presents preferred conversion rates for NO_X to NO_2. It assumes, conservatively, that 100% of NO_X converts to NO_2 in the long term (i.e. annual average), and 35% NO_X for short term averaging periods (such as 1 hour and 24 hour).

Similarly, the US EPA recommends (in the absence of accurate monitoring data) a tiered approach for modelling NO_2 impacts (Ref.6). The second tier uses the 'Ambient Ratio Method (ARM)', which assumes that 75% of NO_X is converted to NO_2 for the long term averaging period.

The ADMS 5 model includes an atmospheric chemistry module to calculate the rate of NO_X to NO_2 conversion. However, it requires accurate hourly background NO_2 and O_3 concentrations in order to produce reliable results.

In the absence of background monitoring data for O_3, and only limited data for NO_2, the most conservative assumption mentioned above has been applied to the model output i.e. 100% of NO_X converts to NO_2 for long term averages, and 50% for the short term.

3.3.3 Meteorology

The dispersion of emissions from a point source is largely dependent on atmospheric stability and turbulent mixing in the atmosphere, which, in turn, are dependent on wind speed and direction, ambient temperature, cloud cover and the friction created by local terrain.

Meteorological parameters are recorded at offshore ACG locations since 2005. Sea surface temperature and cloud cover, required for offshore modelling, are however not recorded at these locations. Previous air quality modelling (Chirag Oil Project) used a dataset from an ACG location, which is more than 10 years old, and may not reflect up-to-date meteorological conditions.

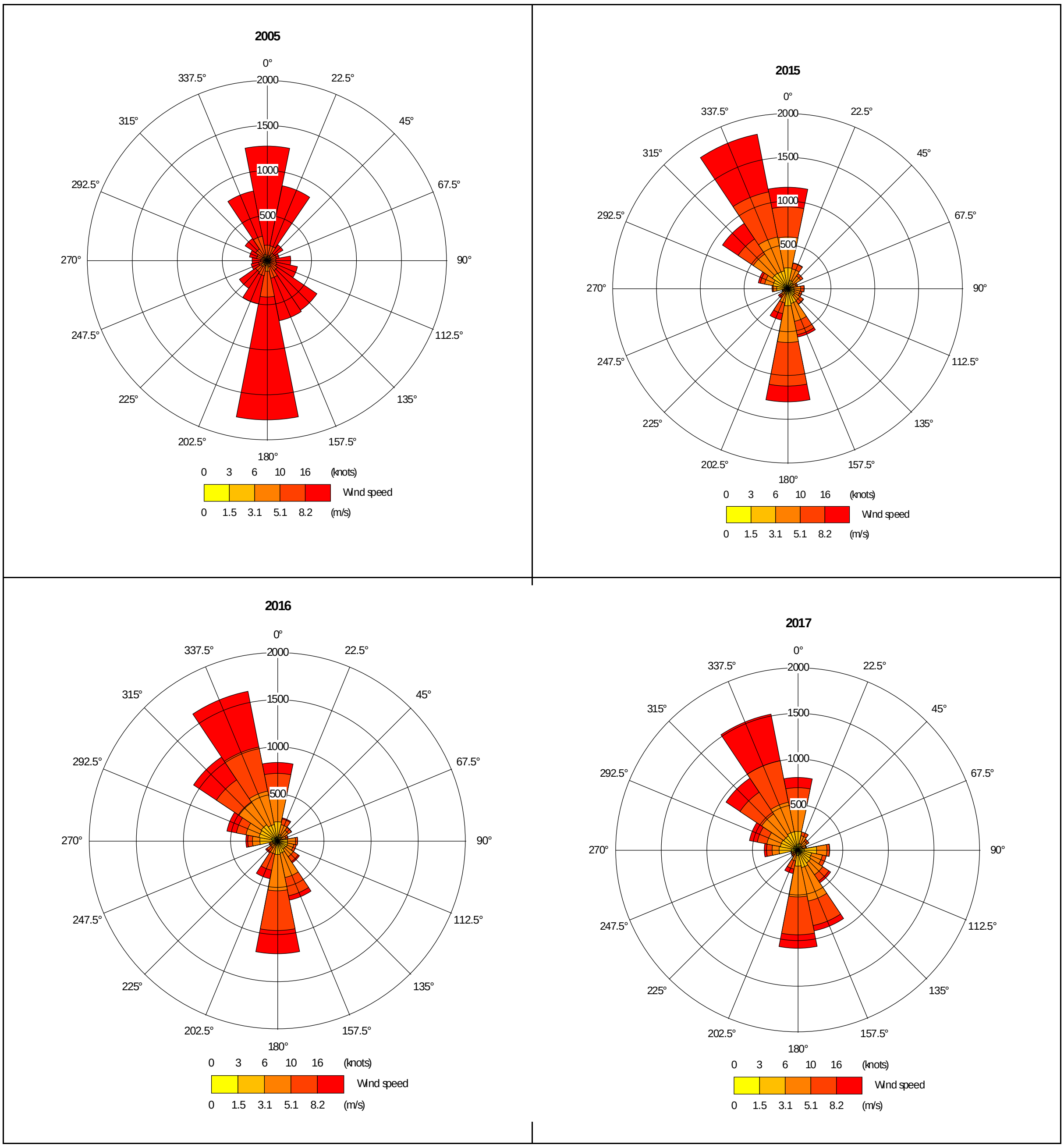
To provide a complete set of data required for the dispersion modelling, recent metrological data was sourced from World Meteorological Observation (WMO) station 'HEYDAR ALIYEV' airport, located on the Absheron Peninsula. Data was acquired for the latest years (2015 – 2017).

The WMO location records the key modelling parameter of 'cloud cover', although as the location is coastal and not offshore, sea surface temperature is not recorded. Without sea surface temperature the coastline option in ADMS5, which accounts for land/sea diurnal stability changes, cannot be used; the marine boundary option in the model cannot be used either. Because of this lack of sea surface temperature the 2015-2017 WMO data cannot be used with confidence without comparison sensitivity testing.

Testing of the meteorological data was carried out, with unchanged emission sources, to find the worst case meteorological dataset. The 2015-2017 and 2005 dataset from the offshore ACG facilities (which includes sea surface temperature) were compared. Figure 2 presents the wind roses for the meteorological datasets used in the ADMS5 model comparative testing.

The 2005 data set included a marine boundary layer file which assumes a default Charnock parameter[1] of 0.018 and that the boundary layer is not neutral. The 2015-2017 data was set to include the surface roughness for the sea set to the default 'sea' value of 0.0001m for the dispersion site, while the recorded location site was set to 'open grassland' which has a roughness of 0.02m. It can also be observed that the wind is more north-west to south-east from the onshore WMO station (2015, 2016, 2017) in comparison to a very north-south bearing for the 2005 offshore data. The highest modelled contributions were predicted using the 2017 meteorological data. As such, the results presented in this report are all from the model run using 2017 meteorological data.

Figure 2. Wind-Roses Derived from 2005, 2015, 2016, 2017 Meteorological Datasets



[1] Used for calculating aerodynamic roughness length over the sea, accounting for increased roughness as wave heights grow due to increased surface stress.

3.4 Model Domain and Specified Receptors

The Central Caspian region was modelled using a two dimensional Cartesian grid system based on the 'Pulkovo 1942' coordinate system using the 'Krasovsky 1940 spheroid'. The modelling used a 200km by 200km grid, centred on the ACE Contract Area with spacing set at maximum resolution, resulting in a modelled concentration every 2km.

It is acknowledged that ADMS5 specialises in short range dispersion modelling and is considered to be reliable only up to 60km downwind of the source (but still provides useful, indicative information up to 100km downwind of the source). Sensitivity testing however, demonstrated that modelled concentrations were not noticeably different between 100km and 200km from the source (though this may have been a function of the relatively small concentrations being calculated by the model at these distances).

In addition to the grid domain, specified receptor points can be chosen in the model at which ground level pollutant concentrations are then calculated. Air quality limit values do not apply to workplaces, and there are not expected to be members of the public offshore.

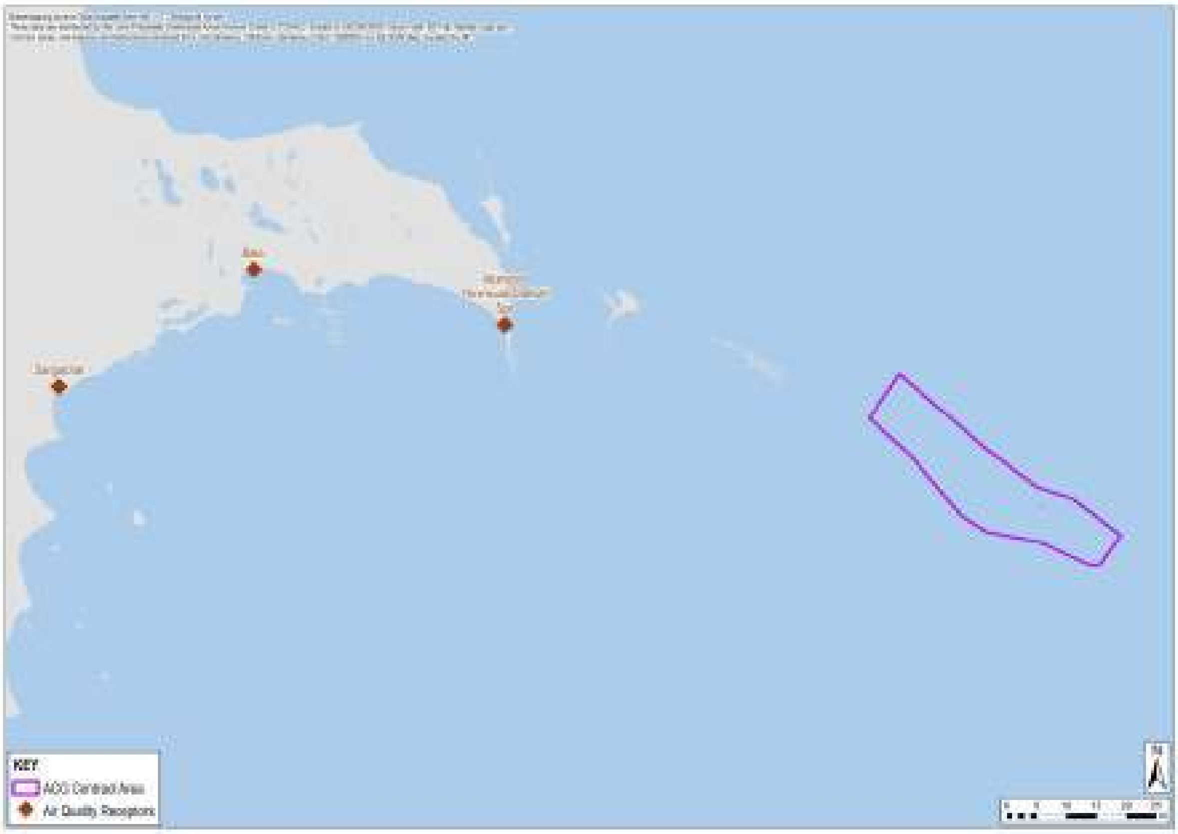
It is difficult to represent large urban areas with a single receptor point. Therefore it was considered suitable to focus on where any modelled plume occurred over landfall, mainly along the southern coastline of the Abershon peninsula. Concentrations at the Sangachal are also reported.

Modelled specified receptors are presented in Table 5 and Figure 3.

Table 5. Modelled Receptors

Receptors	Northing	Easting
Absheron Peninsula/Shahdili Spit	445300	4462400
Baku	403500	4471600
Sangachal	370900	4452100

Figure 3. Receptor Locations



4. Background Ambient Concentrations

Ambient air quality monitoring of SO_2, benzene, VOC and NO_2 has been undertaken around the Terminal since 1997. The monitoring locations, parameters recorded and analytical methodology used has varied across the monitoring surveys. The most recent air quality monitoring survey results available are from 2014 and 2016. While specific background data is not available for the southern coastline of the Abershon Peninsula, it has been considered representative to use the background concentrations recorded at Sangachal as the environments are similar in terms of the mix of local sources (e.g. industrial facilities, roads etc.). Within Baku, there are a number of air quality monitoring stations across the city. The results from these stations were made publically available within the Draft National Strategy on AQAM (Ref.11).

Surveys have not been completed for CO and therefore a typical, rural background concentration was used based on satellite monitoring data.

In the absence of a large hourly dataset it is not possible to derive accurate short term baseline concentrations; therefore a multiple of the annual average background concentration has instead been used. The approach suggested by EA's Horizontal Guidance Note (H1) (Ref.7) is to double the annual average background concentration. This approach has been adopted for short-term averaging periods assessed in this report.

The background concentrations used for the purposes of modelling and assessment presented in Table 6 are considered to represent typical background concentrations for the onshore receptors.

Table 6. Average Background Concentrations

Pollutant	Averaging Period	Limit Value	Average Background Concentration (Sangachal & Absheron Peninsula)[1] ($\mu g/m^3$)	Average Background Concentration (Baku)[2] ($\mu g/m^3$)
NO_2	1 hour	200	24	76
NO_2	Annual	40	12	38
CO	1 hour	3	200	200
CO	24 hour	3	200	200
SO_2	10 minute	500	2	22
SO_2	1 hour	350	2	22
SO_2	24 hour	125	2	22
SO_2	Annual	50	<2	11
PM_{10}	24 hour	50	184	480
PM_{10}	Annual	20	92	240

1. Based on Sangachal Terminal air quality survey. NO_2, and SO_2 values using 2016 annual averaged monitoring results from 18 long-term passive samplers in Sangachal region. PM_{10} data using annual averaged data from real-time monitoring station (RTMS from 2014[2]). In the absence of data and given the rural nature of the location the same concentrations are assumed for the Absheron Peninsula

2. Baku concentration taken from: MWH, 2014, Air Quality Governance in the ENPI East Countries National Pilot Project – Azerbaijan "Improvement of Legislation on Assessment and Management of Ambient Air" - Draft National Strategy on AQAM, report funded by the European Union (Ref. 11)

3. CO included to assess modelled concentrations against Azeri limit values

[2] 2016 PM_{10} concentrations from the RTMS were abnormally low and the reason for this is not known. Therefore 2014 data, which is similar to previous years, is used.

5. Modelled Contributions

This section presents the modelling results as modelled contribution for each of the dispersion modelling scenarios.

Results are presented in terms of:

- Modelled Contribution: The model output predicted at ground level, considering the specified modelled sources only.
- Predicted Concentration: The model output predicted at ground level, taking into account background concentrations (refer to Section 4).
- Predicted Concentration as Percentage of Limit Value: the Predicted Concentration expressed as a percentage of the ambient limit values.

5.1 Scenario 1 (Routine Operations)

Table 7 and Table 8 present the modelled contributions for NO_2 and PM_{10}., expressed as a percentage of limit value and overall predicted concentrations at receptors for Scenario 1 (ACE routine operations, power generation and gas compression turbines are running at 100% load).

Table 7. Scenario 1 Modelled NO_2 Contributions

Receptor Name	NO_2 Annual Average (µg/m^3)				NO_2 1 Hour Peak (µg/m^3)			
	Limit Value	Modelled Contribution	Predicted Concentration	Predicted Concentration as % Limit Value	Limit Value	Modelled Contribution	Predicted Concentration	Predicted Concentration as % Limit Value
Absheron Peninsula	40	< 0.1	12.0	30.0%	200	0.1	24.1	12.1%
Baku		< 0.1	38.0	95.0%		0.1	76.1	38.1%
Sangachal		< 0.1	12.0	30.0%		0.1	24.1	12.1%
Note Assumed conversion of NOx to NO_2, 100% for Annual Average and 50% for 1 Hour Peak.								

Table 8. Scenario 1 Modelled PM_{10} Contribution

Receptor Name	PM_{10} Annual Average (µg/m^3)				PM_{10} 24 Hour Peak (µg/m^3)			
	Limit Value	Modelled Contribution	Predicted Concentration	Predicted Concentration as % Limit Value	Limit Value	Modelled Contribution	Predicted Concentration	Predicted Concentration as % Limit Value
Absheron Peninsula	20	< 0.1	92.0	460.0%	50	< 0.1	184.0	368.0%
Baku		< 0.1	240.0	1200.0%		< 0.1	480.0	960.0%
Sangachal		< 0.1	92.0	460.0%		< 0.1	184.0	368.0%

The modelled maximum ground level annual average NO_2 contribution, at the worst-affected receptor, is predicted to be less than 0.1 g/m^3. The maximum predicted ground level 1 hour (short term) NO_2 contribution is predicted to be 0.1µg/m^3.

The maximum modelled annual average PM_{10} contribution, at the worst-affected receptor, is predicted to be less than 0.1µg/m^3. The maximum 24 hour (short term) PM_{10} contribution is predicted to be less than 0.1µg/m^3.

Considering the existing baseline concentrations the modelling predicts that all NO_2 air quality limit values are predicted to be met at all the modelled receptors for Scenario 1. For PM_{10}, the mean annual and short term background concentrations already exceed limit values. This can be attributed to the natural occurrence of particulate matter in the local environment reflecting the high particulate concentrations associated with dry arid region (for example soil particles becoming airborne through wind entrainment). The contribution of ACE offshore operations activities to increases in PM_{10} concentrations at onshore receptors is insignificant.

Figure 4 to Figure 7 present the modelled contributions (without background concentrations) as isopleths for NO_2 and PM_{10} over long and short term averaging periods. Additional modelled contributions for Azeri limit values are provided in Annex A of this report.

The figures show that maximum offshore contributions of NO_2 for the annual average and 1 hour averaging periods are predicted to be 0.08µg/m^3 and 2µg/m^3, respectively.

With respect to PM_{10} emissions; the maximum offshore contributions for the annual average and 24 hour averaging periods are predicted to be less than 0.01µg/m^3 and 0.1µg/m^3, respectively.

All maximum contributions occur within a few kilometres of the ACE platform activities, over 100km offshore.

Figure 4. Modelled Mean Annual NO_2 Contribution for Scenario 1

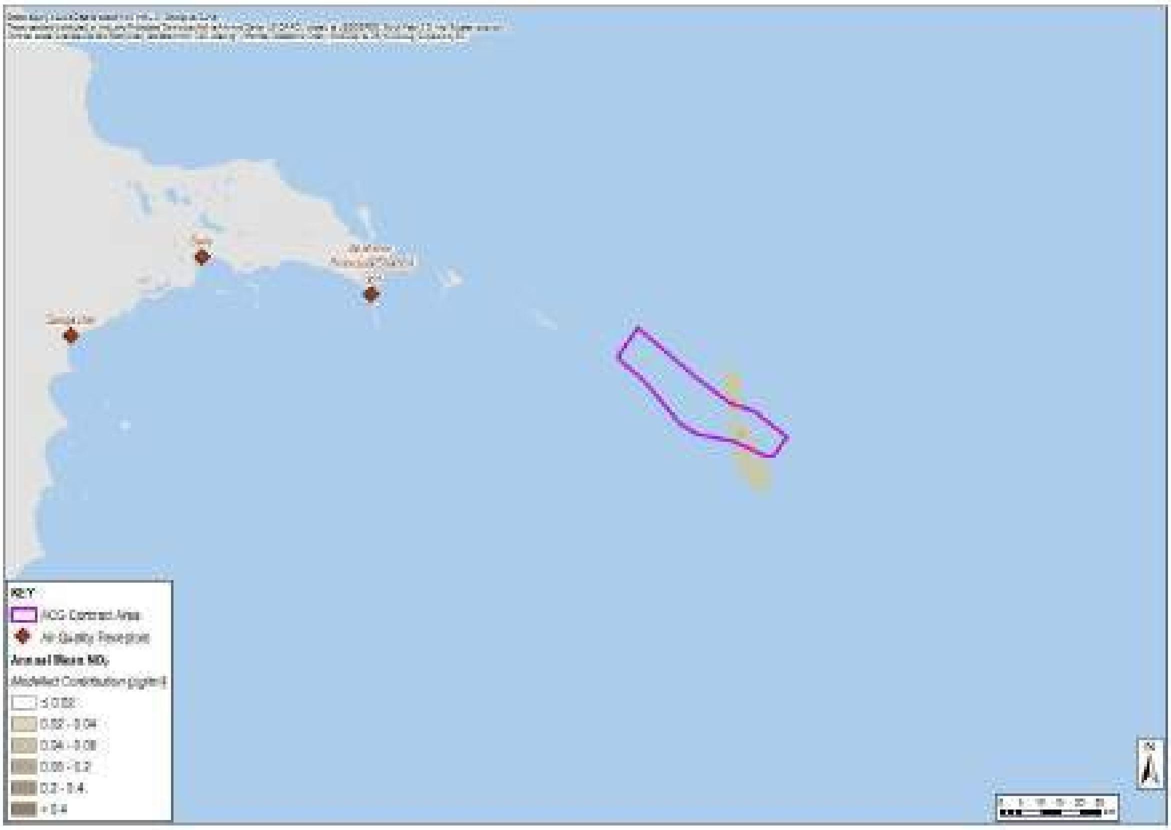


Figure 5. Modelled 1 Hour Maximum NO_2 Contribution for Scenario 1

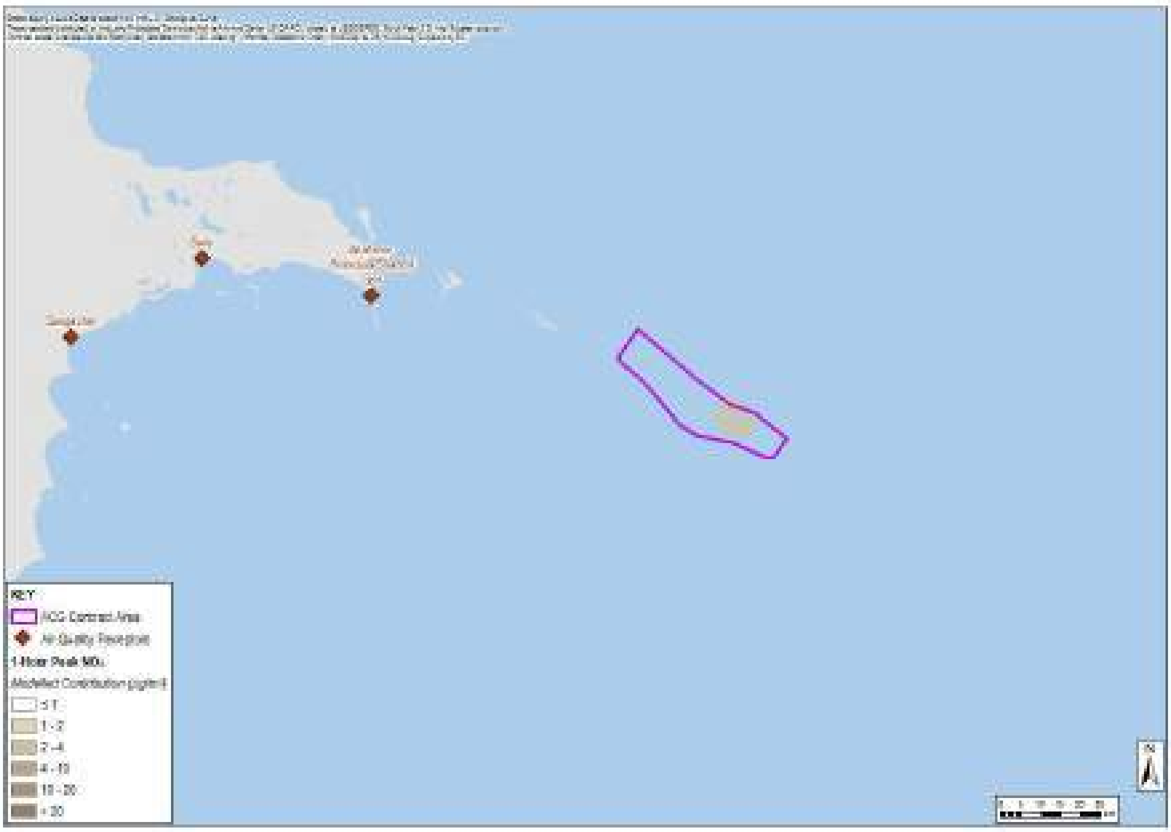


Figure 6. Modelled Annual Average PM_{10} Contribution for Scenario 1

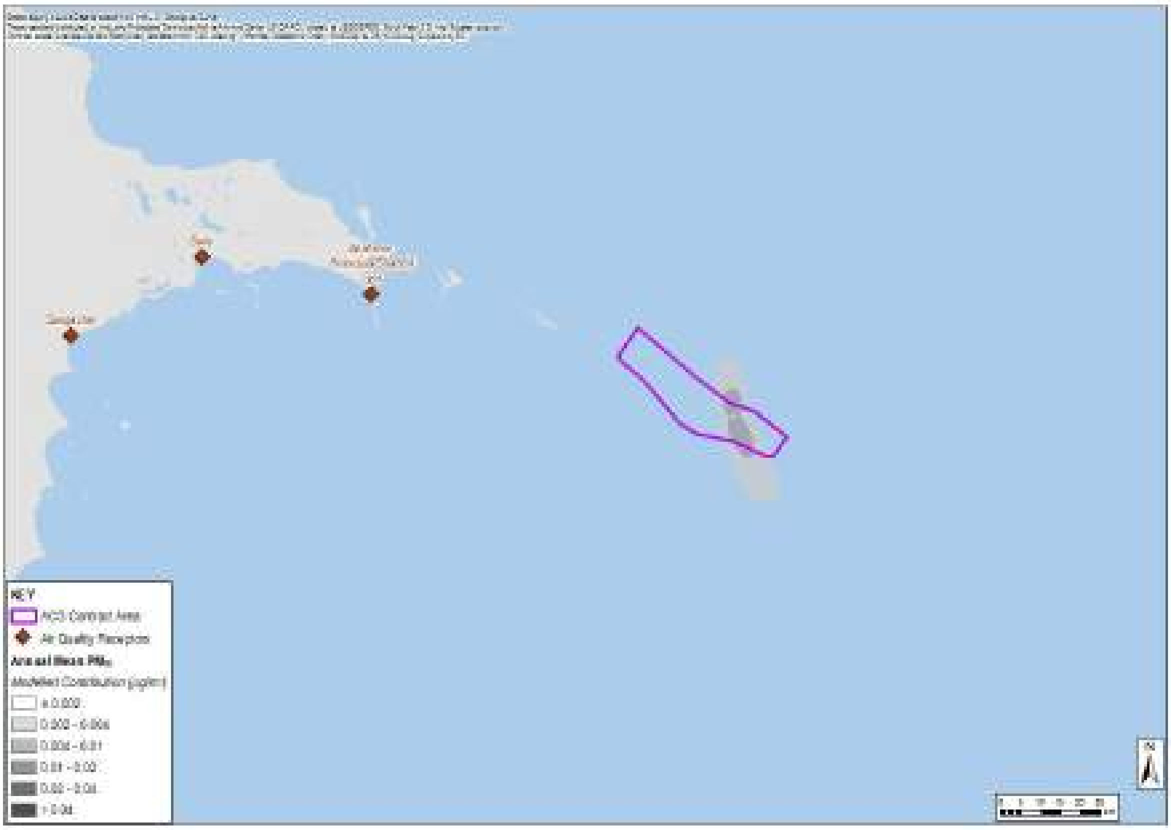
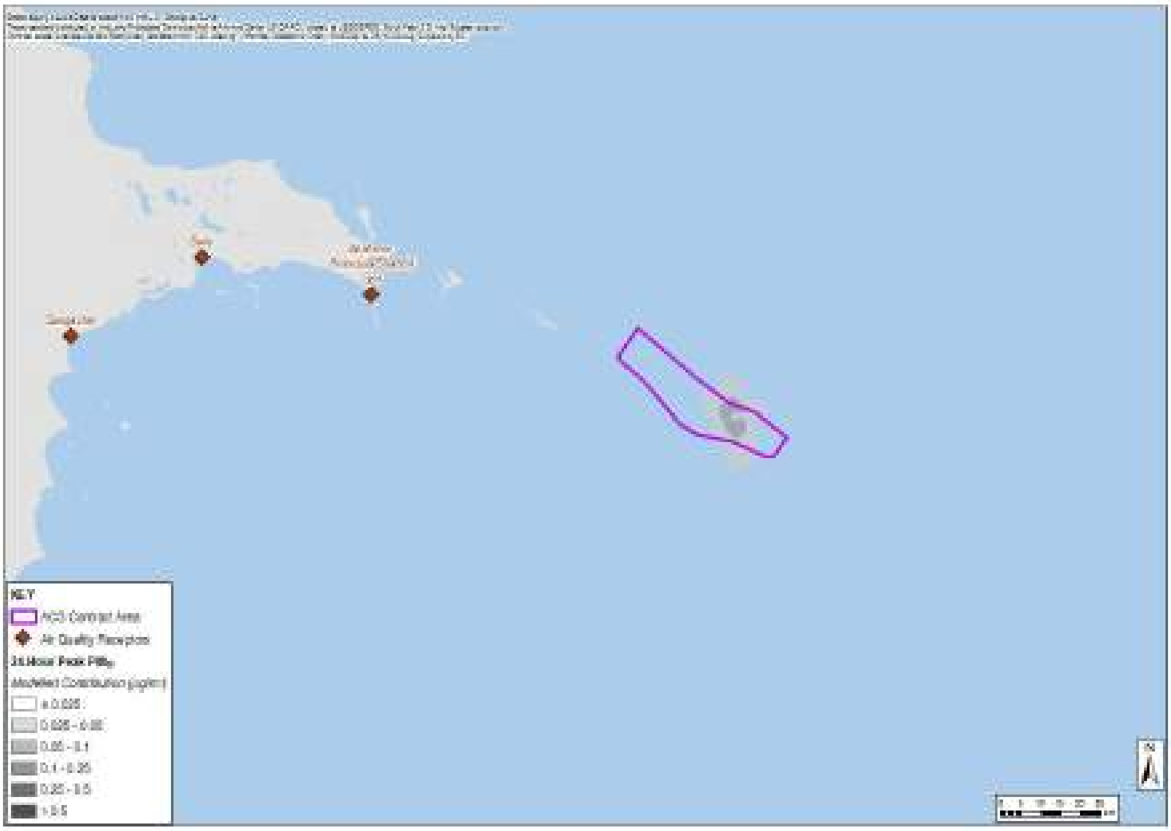


Figure 7. Modelled 24 Hour Maximum PM_{10} Contribution for Scenario 1



5.2 Scenario 2 (Non Routine Operation)

Table 9 and Table 10 present the modelled contributions NO_2 and PM_{10}, expressed as a percentage of limit value and overall predicted concentrations at receptors, for Scenario 2 (ACE non routine operations, power generation gas turbine at 100% load, gas compression turbine under maintenance and flaring at a rate of 80MMscfd).

Table 9. Scenario 2 Modelled NO_2 Contributions

Receptor Name	NO_2 Annual Average (µg/m^3)				NO_2 1 Hour Peak (µg/m^3)			
	Limit Value	Modelled Contribution	Predicted Concentration	Predicted Concentration as % Limit Value	Limit Value	Modelled Contribution	Predicted Concentration	Predicted Concentration as % Limit Value
Absheron Peninsula	40	< 0.1	12	30%	200	0.2	24.2	12.1%
Baku		< 0.1	38	95.0%		0.2	76.2	38.1%
Sangachal		< 0.1	12	30%		0.1	24.2	12.1%
**Note Assumed conversion of NOx to NO_2, 100% for Annual Average and 50% for 1 Hour Peak.*								

Table 10. Scenario 2 Modelled PM_{10} Contributions

Receptor Name	PM_{10} Annual Average (µg/m^3)				PM_{10} 24 Hour Peak (µg/m^3)			
	Limit Value	Modelled Contribution	Predicted Concentration	Predicted Concentration as % Limit Value	Limit Value	Modelled Contribution	Predicted Concentration	Predicted Concentration as % Limit Value
Absheron Peninsula	20	< 0.1	92.0	460.0%	50	0.1	184.1	368.1%
Baku		< 0.1	240.0	1200.0%		< 0.1	480.0	960.1%
Sangachal		< 0.1	92.0	460.0%		< 0.1	184.0	368.1%

The modelled maximum ground level annual average NO_2 contribution, at the worst-affected receptor, is predicted to be less than 0.1µg/m^3. The maximum predicted ground level 1 hour (short term) NO_2 contribution is predicted to be 0.2µg/m^3.

The maximum modelled annual average PM_{10} contribution, at the worst-affected receptor, is predicted to be less than 0.1µg/m^3. The maximum 24 hour (short term) PM_{10} contribution is predicted to be 0.1µg/m^3.

Figure 8 to Figure 11 present the modelled contributions (without background concentrations) as isopleths for NO_2 and PM_{10} over long and short term averaging periods. Additional modelled contributions for Azeri limit values are provided in Annex A of this report.

The figures show that maximum offshore contributions of NO_2 for the annual average and 1 hour averaging periods are predicted to be 0.04µg/m^3 and 2µg/m^3 respectively.

With respect to PM_{10} emissions; the maximum offshore contribution for the annual average and 24 hour averaging periods are predicted to be less 0.04µg/m^3 and 1.0µg/m^3 respectively.

All maximum contributions occur within a few kilometres of the ACE platform activities, over 100km offshore.

Figure 8. Modelled Mean Annual NO_2 Contribution for Scenario 2

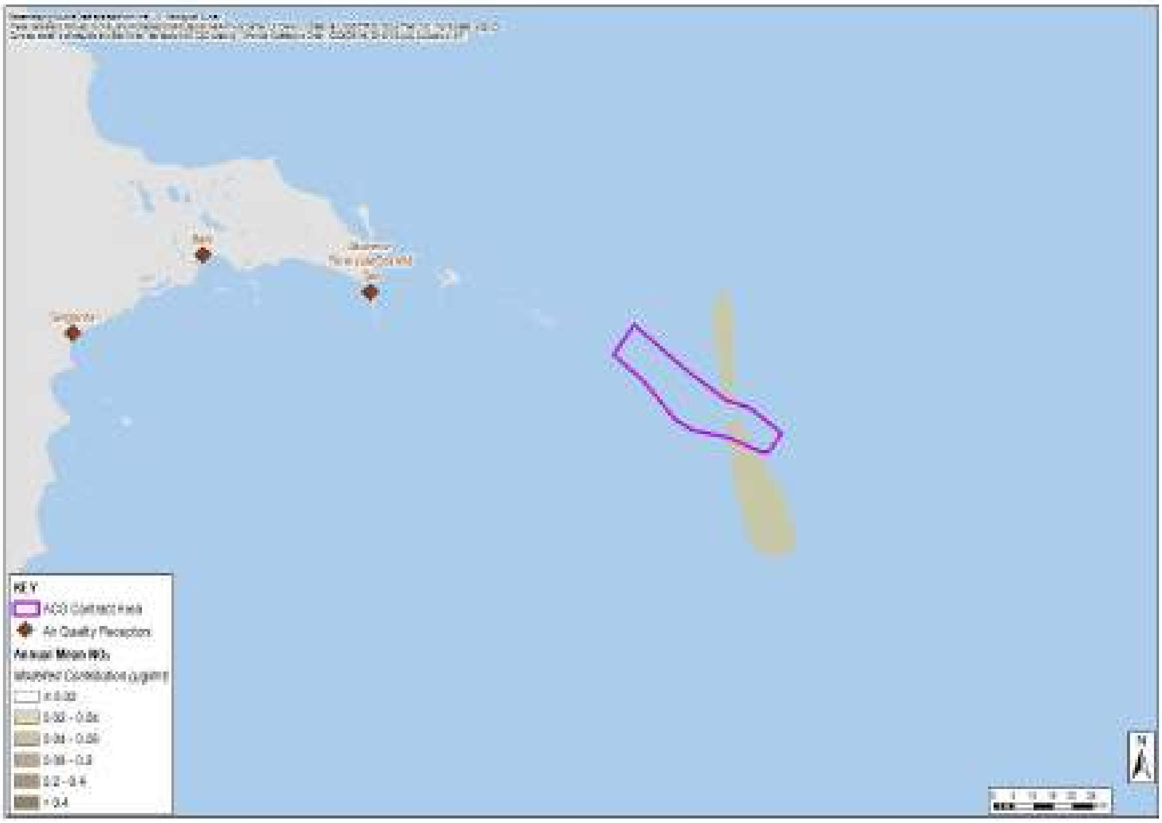


Figure 9. Modelled 1 Hour Maximum NO_2 Contribution for Scenario 2

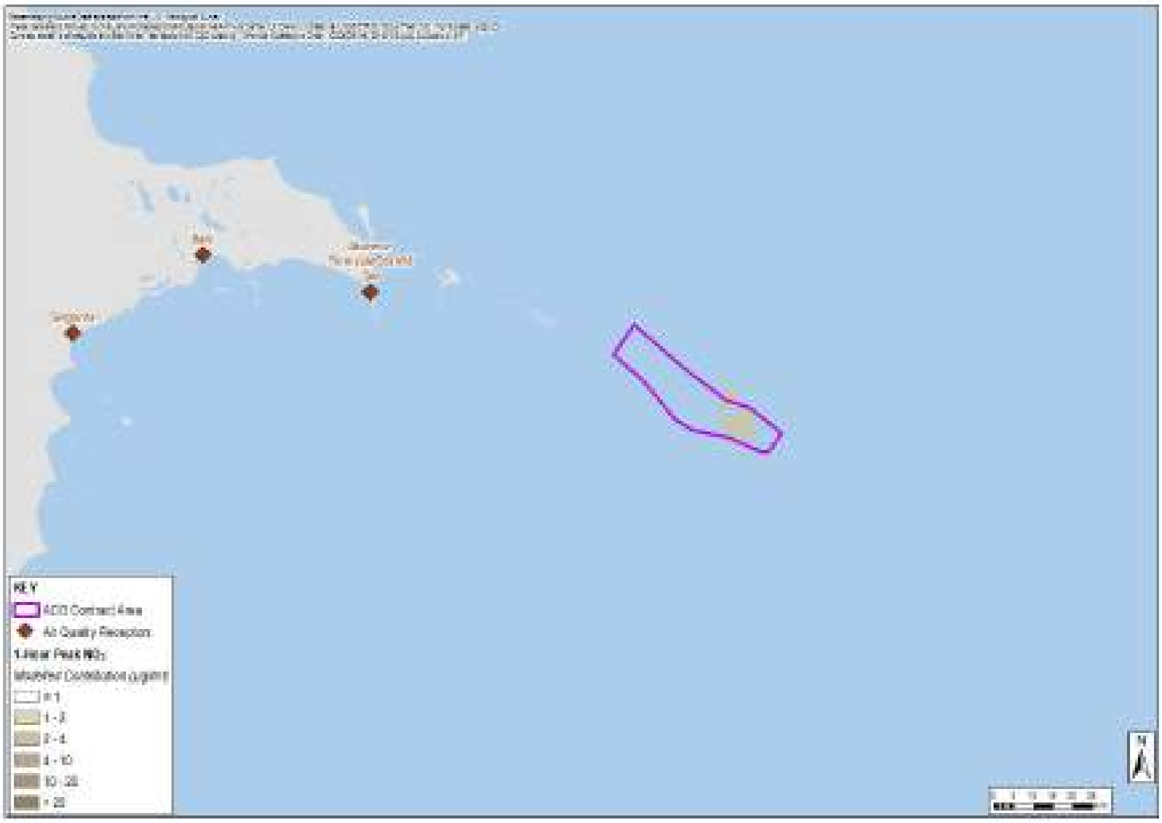


Figure 10. Modelled Annual Average PM_{10} Contribution for Scenario 2

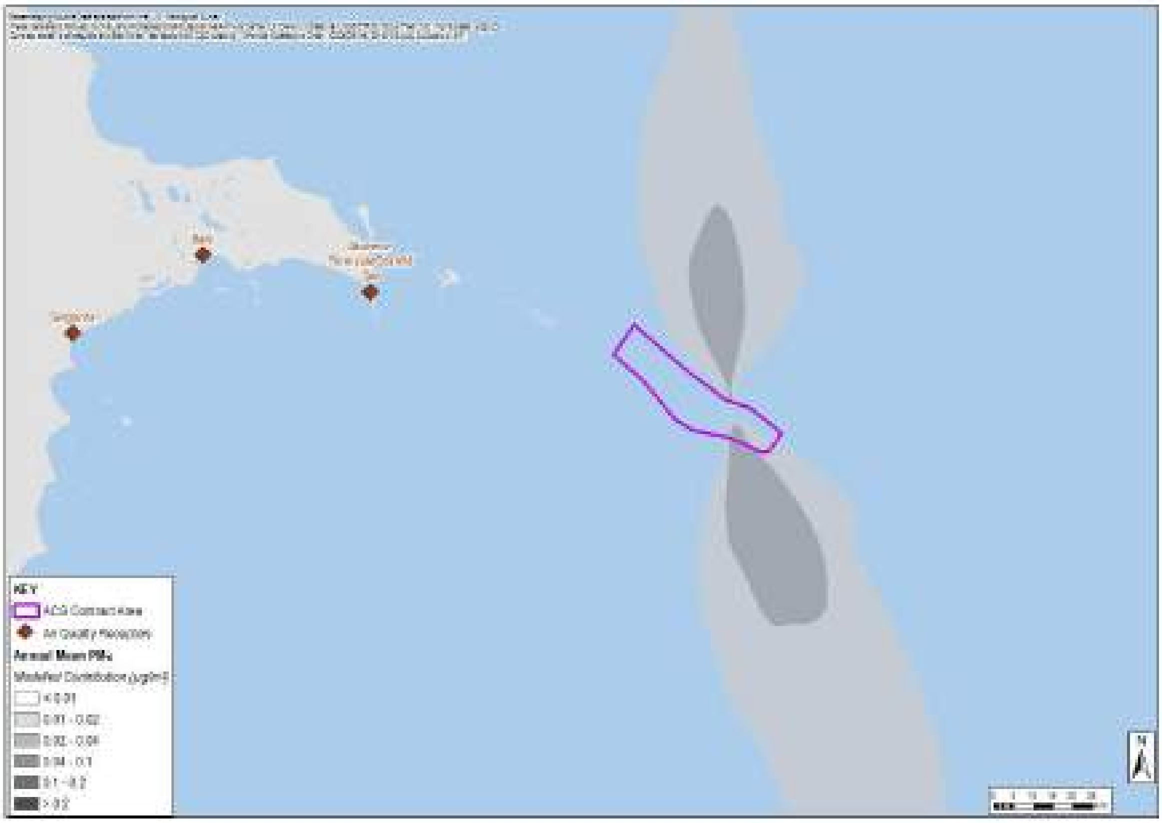
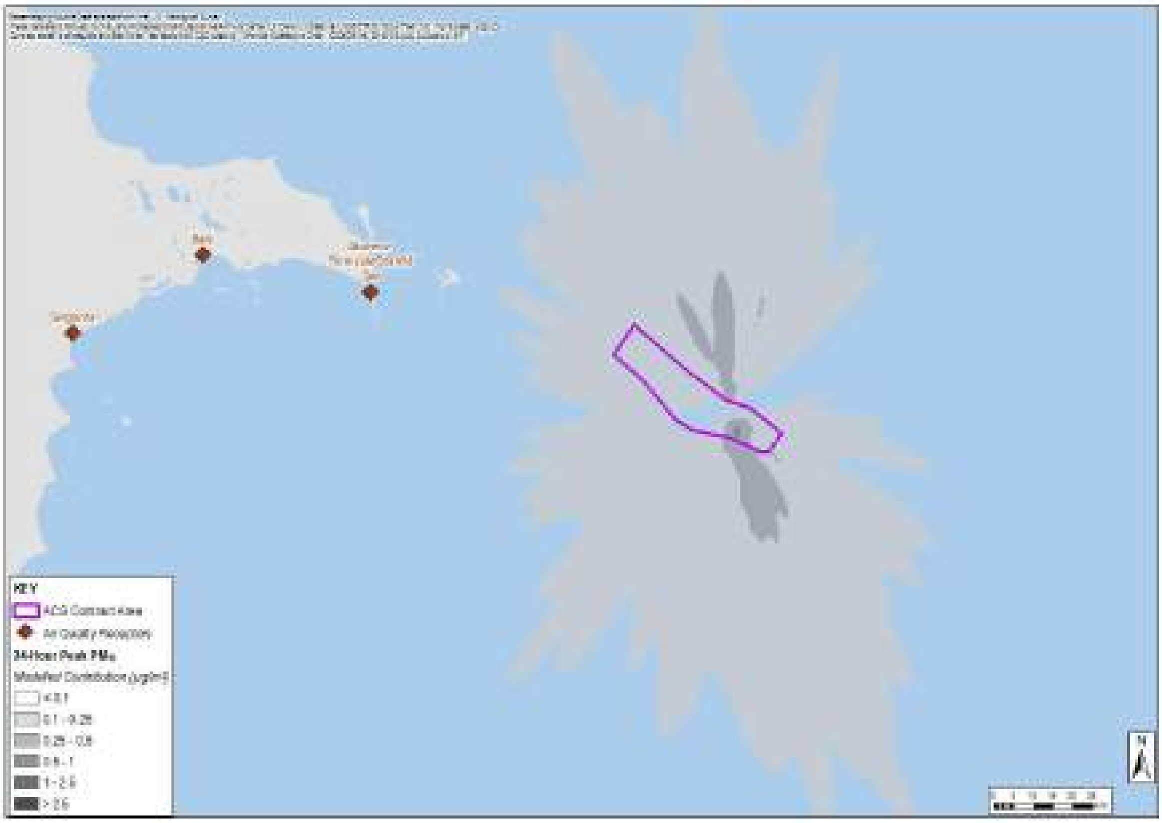


Figure 11. Modelled 24 Hour Maximum PM_{10} Contribution for Scenario 2



5.3 Scenario 3 (Non-Routine Operation ESD Event)

Table 11, Table 12 and Table 13 present the modelled contributions for NO_2 and PM_{10}.and SO_2, expressed as a percentage of limit value and overall predicted concentrations at receptors for Scenario 3 (ACE power generation turbine at 100% load operating on back up diesel, gas compression turbine not in operation and ESD flaring at flow rate of 333MMscfd).

Table 11. Scenario 3 Modelled NO_2 Contributions

Receptor Name	NO_2 Annual Average (µg/m^3)				NO_2 1 Hour Peak (µg/m^3)			
	Limit Value	Modelled Contribution	Predicted Concentration	Predicted Concentration as % Limit Value	Limit Value	Modelled Contribution	Predicted Concentration	Predicted Concentration as % Limit Value
Absheron Peninsula	40	< 0.1	12	30%	200	0.6	24.6	12.3%
Baku		< 0.1	38	95.0%		0.4	76.4	38.2%
Sangachal		< 0.1	12	30%		0.4	24.4	12.2%
**Note Assumed conversion of NOx to NO₂, 100% Annual Average and 50% 1 hour.*								

Table 12. Scenario 3 Modelled PM_{10} Contributions

Receptor Name	PM_{10} Annual Average (µg/m^3)				PM_{10} 1 Hour Peak (µg/m^3)			
	Limit Value	Modelled Contribution	Predicted Concentration	Predicted Concentration as % Limit Value	Limit Value	Modelled Contribution	Predicted Concentration	Predicted Concentration as % Limit Value
Absheron Peninsula	20	< 0.1	92	460.0%	50	0.1	184.1	368.2%
Baku		< 0.1	240	1200.0%		0.1	480.1	960.2%
Sangachal		< 0.1	92	460.0%		0.1	184.1	368.1%

Table 13. Scenario 3 Modelled SO_2 Contributions

Receptor Name	SO_2 24 Hour Peak (µg/m3)				SO_2 1 Hour Peak (µg/m3)			
	Limit Value	Modelled Contribution	Predicted Concentration	Predicted Concentration as % Limit Value	Limit Value	Modelled Contribution	Predicted Concentration	Predicted Concentration as % Limit Value
Absheron Peninsula	125	0.1	2.1	1.7%	350	1.5	3.5	1.0%
Baku		0.1	22.1	17.7%		1.1	23.1	6.6%
Sangachal		0.1	2.1	1.6%		1.0	3.0	0.8%

The modelled maximum ground level annual average NO_2 contribution, at the worst-affected receptor, is predicted to be less than 0.1µg/m^3. The maximum predicted ground level 1 hour (short term) NO_2 contribution is predicted to be 0.6µg/m^3.

The maximum modelled annual average PM_{10} contribution, at the worst-affected receptor, is predicted to be less than 0.1µg/m^3. The maximum 24 hour (short term) PM_{10} contribution is predicted to be 0.1µg/m^3.

The maximum modelled 24 hour SO_2 contribution, at the worst-affected receptor, is predicted to be no greater than 0.1µg/m^3. The maximum 1 hour (short term) SO_2 contribution is predicted to be 1.5µg/m^3 or 1% of the limit value. Figure 12 to Figure 15 present the modelled contributions (without background concentrations) as isopleths for NO_2 and PM_{10} over long and short term averaging periods. Additional modelled contributions for Azeri limit values are provided in Annex A of this report.

The figures show that maximum offshore contribution of NO_2 for the annual average and 1 hour averaging periods are predicted to be 0.2µg/m^3 and 10.0µg/m^3 respectively.

With respect to PM_{10} emissions; the maximum offshore contribution for the annual average and 24 hour averaging periods are predicted to be less than 0.1µg/m^3 and 1.0µg/m^3 respectively.

All maximum contributions occur within a few kilometres of the ACE platform activities, over 100km offshore.

Figure 12. Modelled Mean Annual NO_2 Contribution for Scenario 3

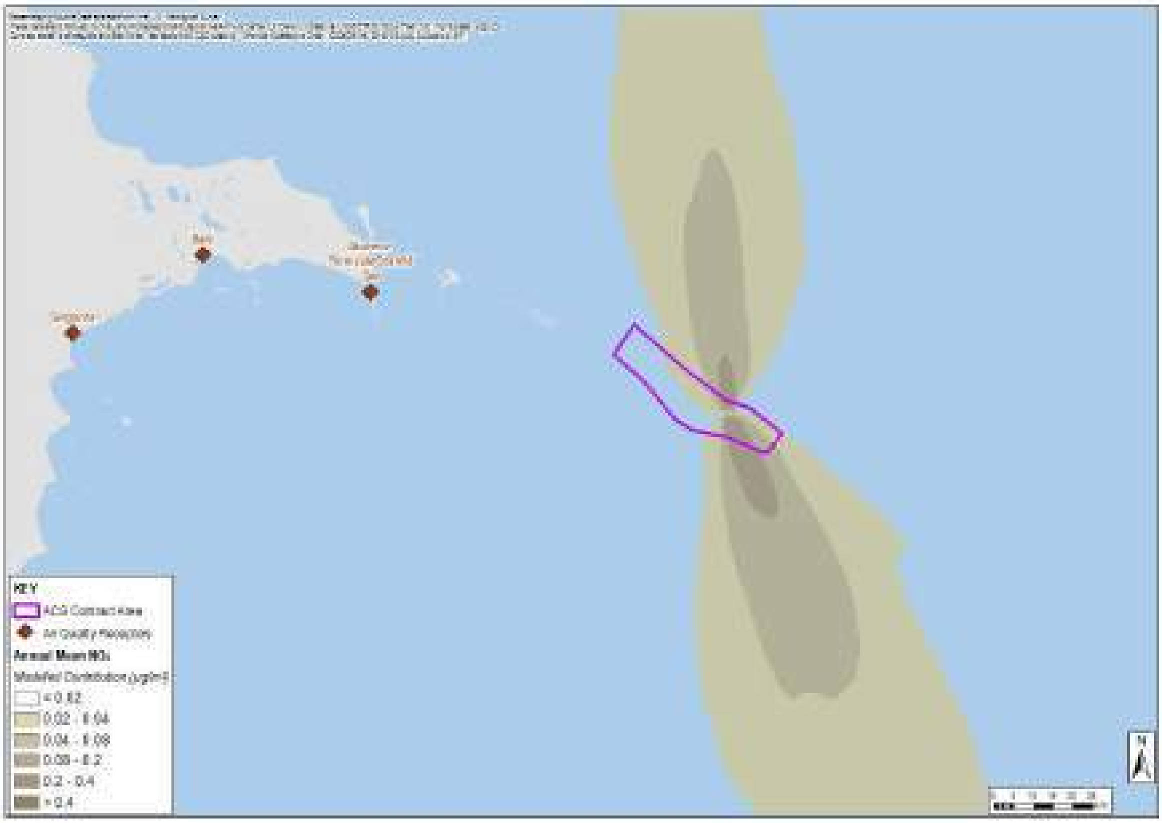


Figure 13. Modelled 1 Hour Maximum NO_2 Contribution for Scenario 3

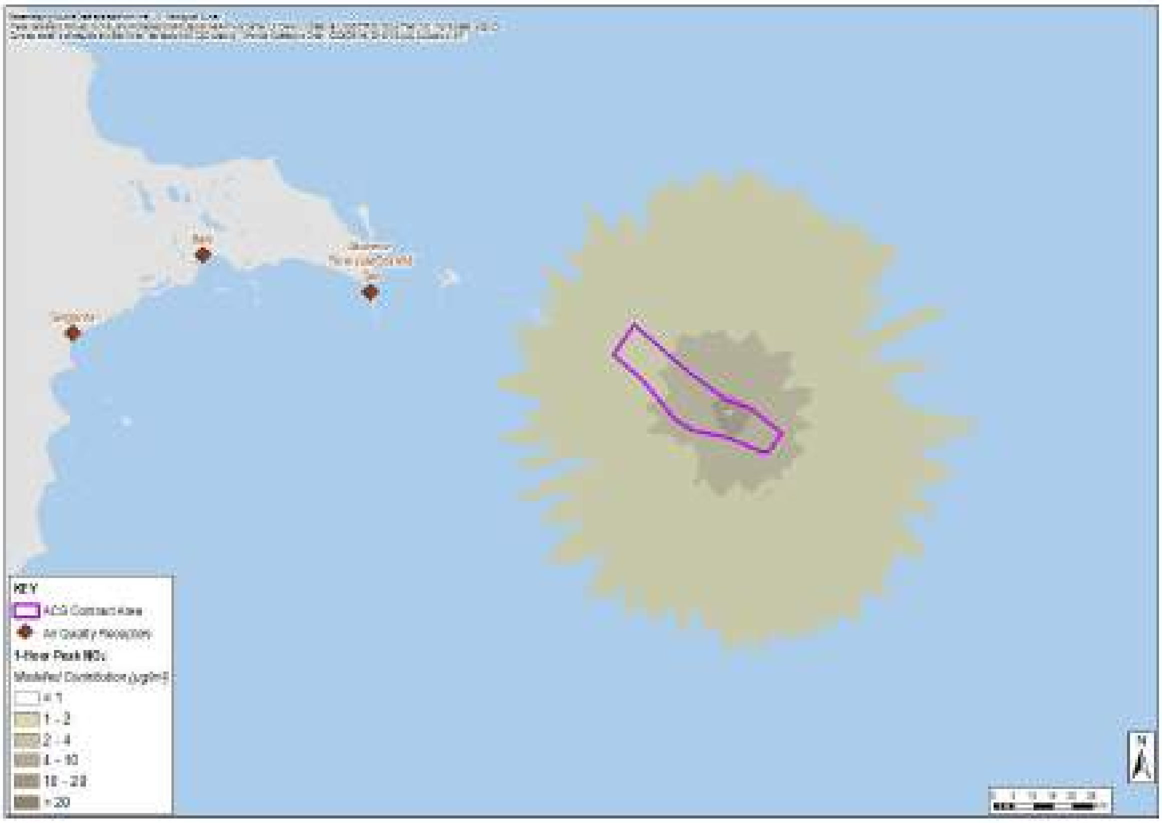


Figure 14. Modelled Annual Average PM_{10} Contribution for Scenario 3

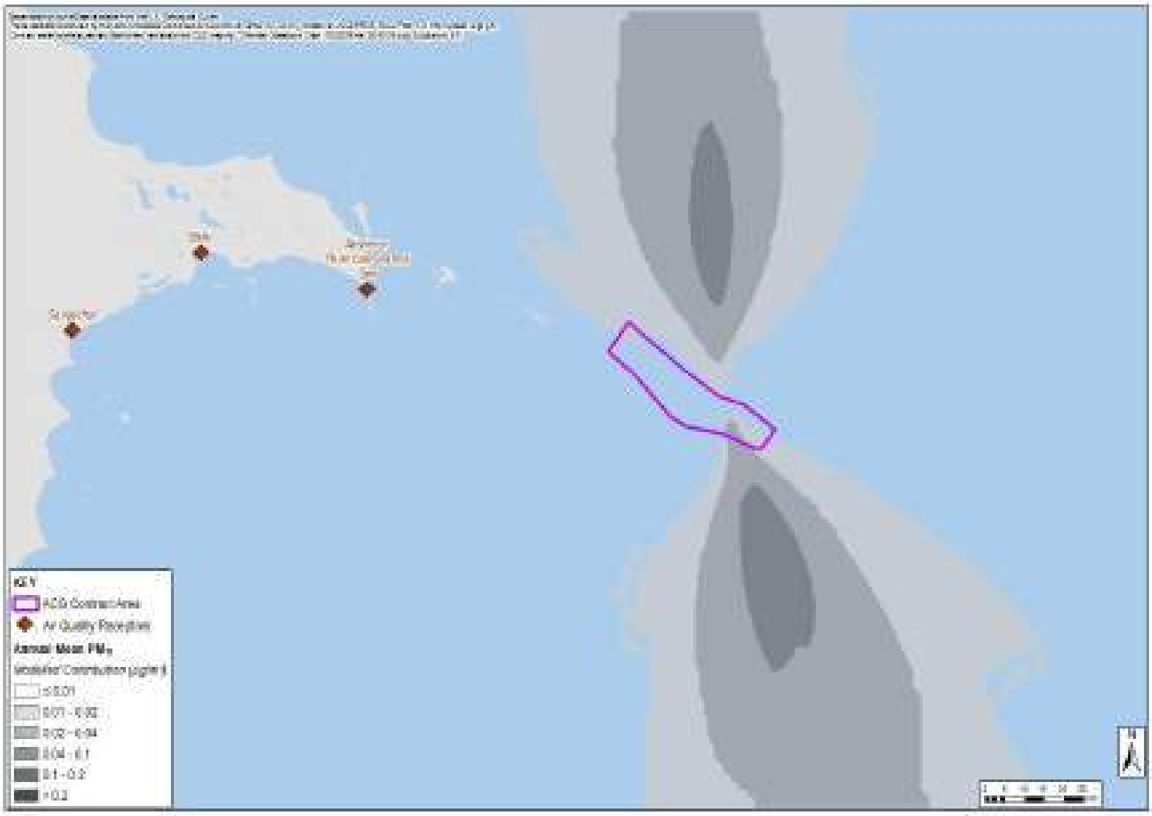
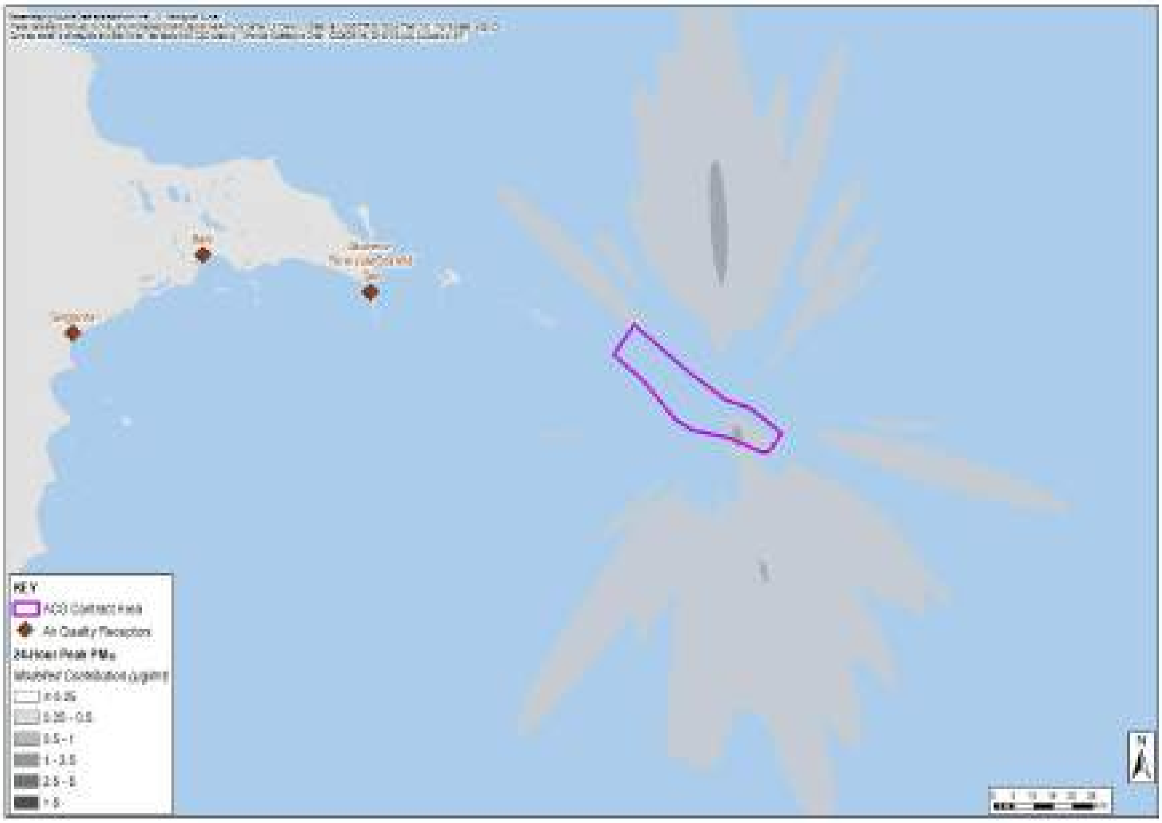


Figure 15. Modelled 24 Hour Maximum PM_{10} Contribution for Scenario 3



5.4 Scenario 4 (Cumulative Routine Operations)

Table 14 and Table 15 present the modelled contributions for NO_2 and PM_{10}., expressed as a percentage of limit value and overall predicted concentrations at receptors for Scenario 4 (ACE routine operations, power generation and gas compression gas turbines are running at 100% load and routine operation of the proposed SD2 emission sources).

Table 14. Scenario 4 Modelled NO_2 Contributions

Receptor Name	NO_2 Annual Average (µg/m^3)				NO_2 1 Hour Peak (µg/m^3)			
	Limit Value	Modelled Contribution	Predicted Concentration	Predicted Concentration as % Limit Value	Limit Value	Modelled Contribution	Predicted Concentration	Predicted Concentration as % Limit Value
Absheron Peninsula	40	< 0.1	12.0	30%	200	1.5	25.5	12.8%
Baku		< 0.1	38.0	95.0%		0.9	76.9	38.5%
Sangachal		< 0.1	12.0	30%		1.0	25.0	12.5%
Note Assumed conversion of NOx to NO_2, 100% Annual Average and 50% 1 hour.								

Table 15. Scenario 4 Modelled PM_{10} Contributions

Receptor Name	PM_{10} Annual Average (µg/m^3)				PM_{10} 24 Hour Peak (µg/m^3)			
	Limit Value	Modelled Contribution	Predicted Concentration	Predicted Concentration as % Limit Value	Limit Value	Modelled Contribution	Predicted Concentration	Predicted Concentration as % Limit Value
Absheron Peninsula	20	< 0.1	92.0	460.0%	50	< 0.1	184.0	368.0%
Baku		< 0.1	240.0	1200.0%		< 0.1	480.0	960.0%
Sangachal		< 0.1	92.0	460.0%		< 0.1	184.0	368.0%

The modelled maximum ground level annual average NO_2 contribution, at the worst-affected receptor, is predicted to be less than 0.1µg/m^3. The maximum predicted ground level short term NO_2 contribution is predicted to be 1.5µg/m^3.

The maximum modelled annual average PM_{10} contribution, at the worst-affected receptor, is predicted to be less than 0.1µg/m^3. The maximum short term PM_{10} contribution is predicted to be less than 0.1µg/m^3.

Figure 16 to Figure 19 present the modelled contributions (without background concentrations) as isopleths for NO_2 and PM_{10} over long and short term averaging periods. Additional modelled contributions for Azeri limit values are provided in Annex A of this report.

The figures show that modelled maximum offshore contributions of NO_2 for the annual average and 1 hour averaging periods are predicted to be 0.4µg/m^3 and 20µg/m^3 respectively.

With respect to PM_{10} emissions; maximum offshore contributions for the annual average and 24 hour averaging periods are predicted to be less than 0.01µg/m^3 and 0.1µg/m^3 respectively.

Figure 16. Modelled Mean Annual NO_2 Contribution for Scenario 4

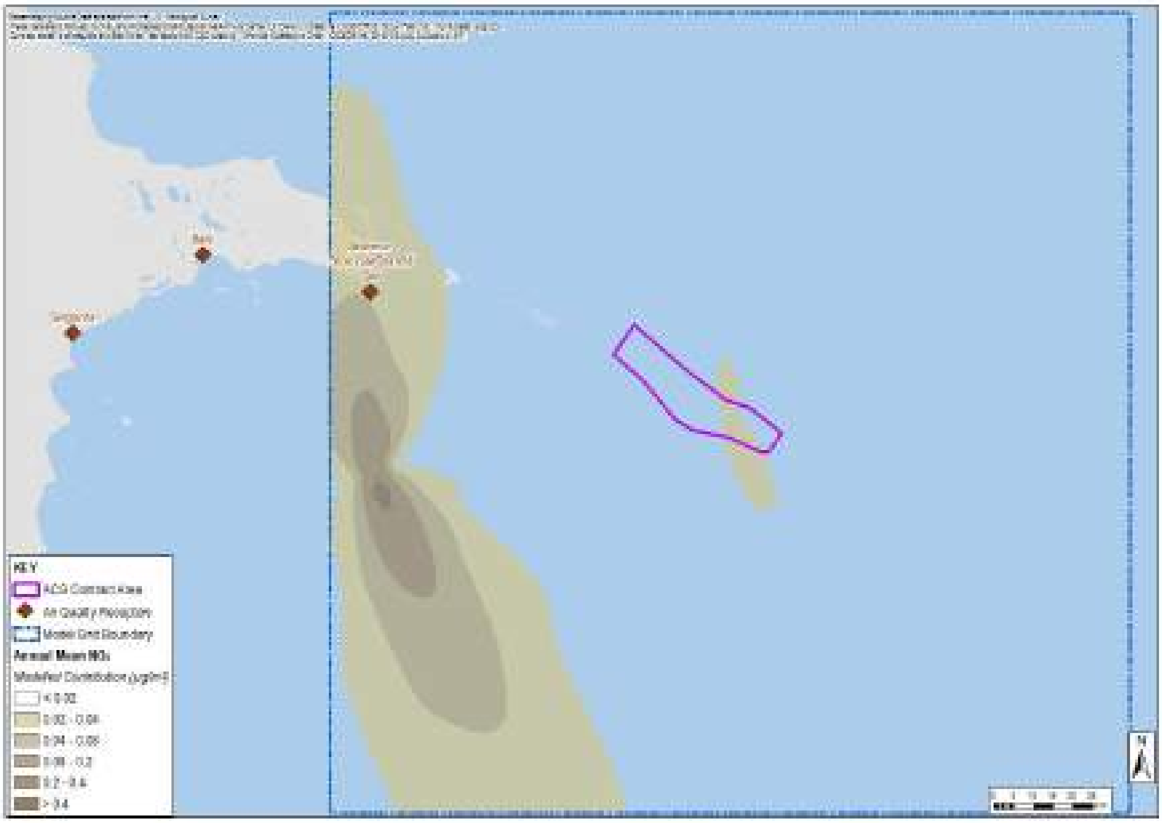


Figure 17. Modelled 1 Hour Maximum NO_2 Contribution for Scenario 4

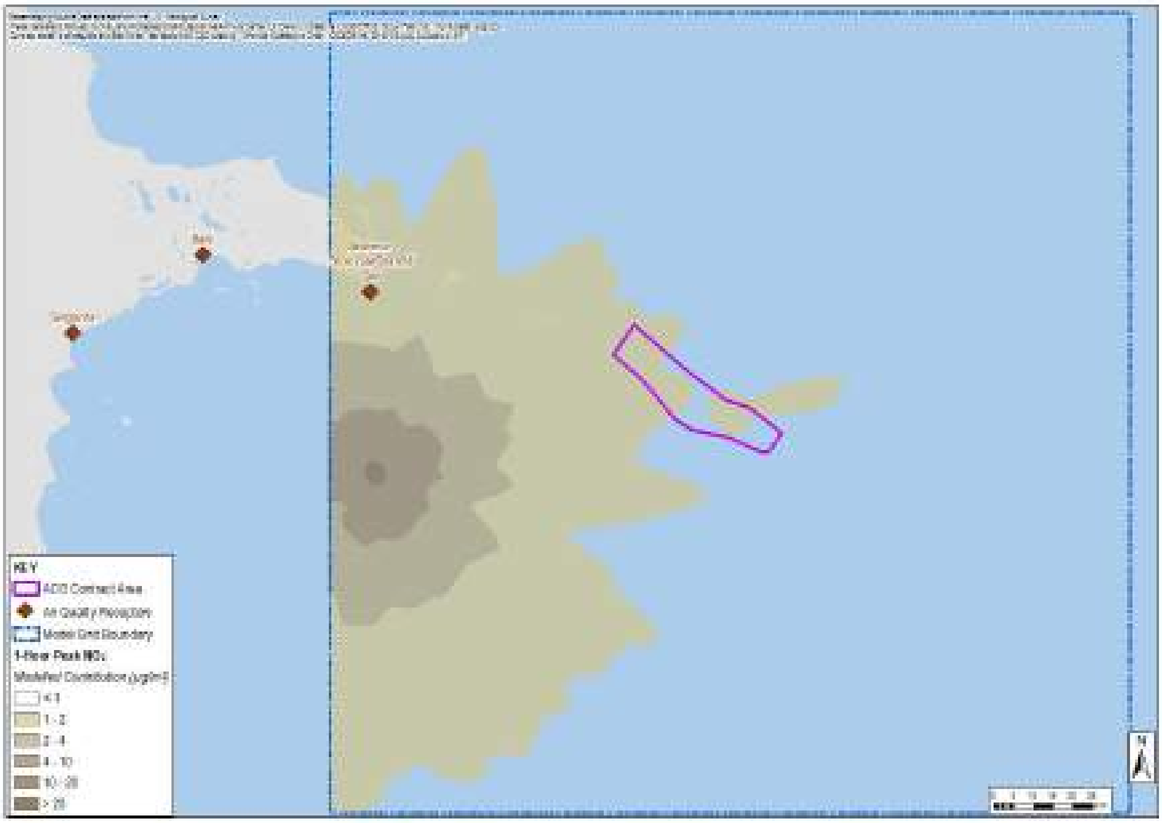


Figure 18. Modelled Annual Average PM_{10} Contribution for Scenario 4

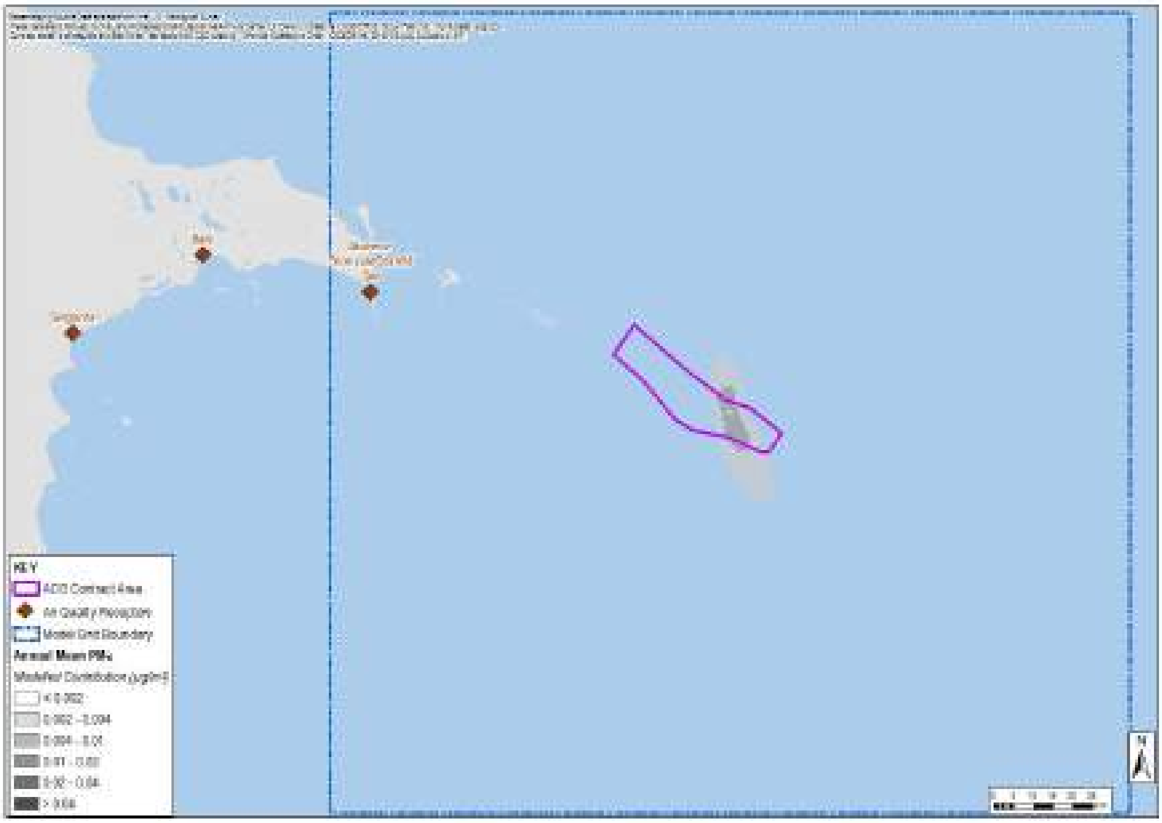
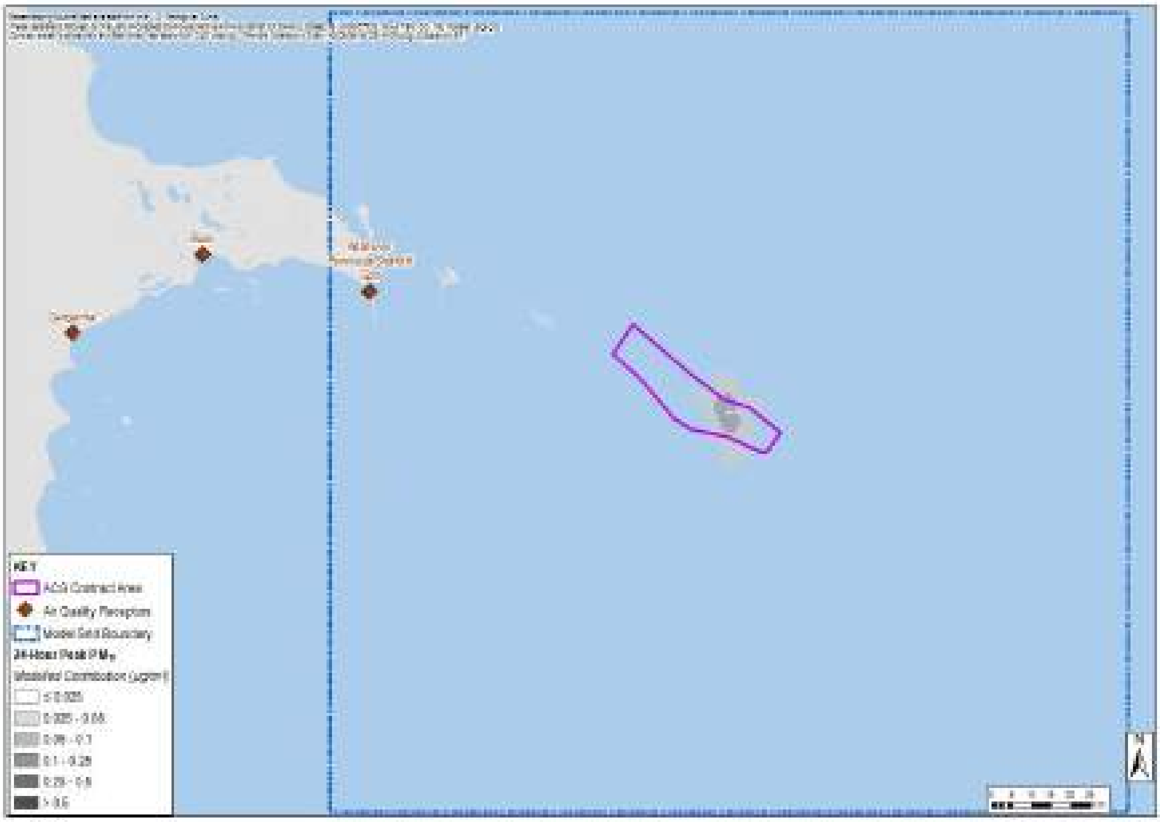


Figure 19. Modelled 24 Hour Maximum PM_{10} Contribution for Scenario 4



5.5 Scenario 5 (Cumulative ESD Event)

Table 16 and Table 17 present the modelled contributions NO_2 and PM_{10}, expressed as a percentage of limit value and overall predicted concentrations at receptors, for Scenario 5 (ACE power generation turbine at 100% load operating on back up diesel, gas compression turbine not in operation and ESD flaring at flow rate of 333MMmscfd and non-routine operation of SD2 platform with flaring occurring due to a compressor trip).

Table 16. Scenario 5 Modelled NO_2 Contributions

Receptor Name	NO_2 Annual Average (µg/m^3)				NO_2 1 Hour Peak (µg/m^3)			
	Limit Value	Modelled Contribution	Predicted Concentration	Predicted Concentration as % Limit Value	Limit Value	Modelled Contribution	Predicted Concentration	Predicted Concentration as % Limit Value
Absheron Peninsula	40	< 0.1	12.0	30%	200	1.5	25.5	12.8%
Baku		< 0.1	38.0	95.0%		0.9	76.9	38.5%
Sangachal		< 0.1	12.0	30%		1.0	25.0	12.5%
**Note Assumed conversion of NOx to NO_2, 100% Annual Average and 50% 1 hour.*								

Table 17. Scenario 5 Modelled PM_{10} Contributions

Receptor Name	PM_{10} Annual Average (µg/m^3)				PM_{10} 24 Hour Peak (µg/m^3)			
	Limit Value	Modelled Contribution	Predicted Concentration	Predicted Concentration as % Limit Value	Limit Value	Modelled Contribution	Predicted Concentration	Predicted Concentration as % Limit Value
Absheron Peninsula	20	0.2	92.2	461.0%	**50**	1.7	185.7	371.3%
Baku		< 0.1	240.0	1200.2%		0.9	480.9	961.9%
Sangachal		< 0.1	92.0	460.1%		0.6	184.6	369.2%

Table 18. Scenario 5 Modelled SO_2 Contributions

Receptor Name	SO_2 24 Hour Peak (µg/m^3)				SO_2 1 Hour Peak (µg/m^3)			
	Limit Value	Modelled Contribution	Predicted Concentration	Predicted Concentration as % Limit Value	Limit Value	Modelled Contribution	Predicted Concentration	Predicted Concentration as % Limit Value
Absheron Peninsula	**125**	0.1	2.1	1.7%	**350**	1.5	3.5	1.0%
Baku		0.1	22.1	17.7%		1.1	23.1	6.6%
Sangachal		0.1	2.1	1.6%		1.0	3.0	0.8%

The maximum ground level annual average NO_2 contribution, at the worst-affected receptor, is predicted to be less than 0.1µg/m^3. The maximum predicted ground level short term NO_2 contribution is predicted to be 1.5µg/m^3.

The maximum modelled annual average PM_{10} contribution, at the worst-affected receptor, is predicted to be 0.2µg/m^3. The maximum short term PM_{10} contribution is predicted to be 1.7µg/m^3.

The maximum modelled 24 hour SO_2 contribution, at the worst-affected receptor, is predicted to be no greater than 0.1µg/m^3. The maximum 1 hour (short term) SO_2 contribution is predicted to be 1.5µg/m^3 or 1% of the limit value.

Figure 20 to 24 present the modelled contributions (without background concentrations) as isopleths for NO_2 and PM_{10} over long and short term averaging periods. Additional modelled contributions for Azeri limit values are provided in Annex A of this report.

The figures show that modelled maximum offshore contributions of NO_2 for the annual average and 1 hour averaging periods are predicted to be 0.4µg/m^3 and 20µg/m^3 respectively.

With respect to PM_{10} emissions; maximum offshore contributions for the annual average and 24 hour averaging periods are predicted to be 0.4µg/m^3 and 5.0µg/m^3 respectively.

Figure 20. Modelled Mean Annual NO_2 Contribution for Scenario 5

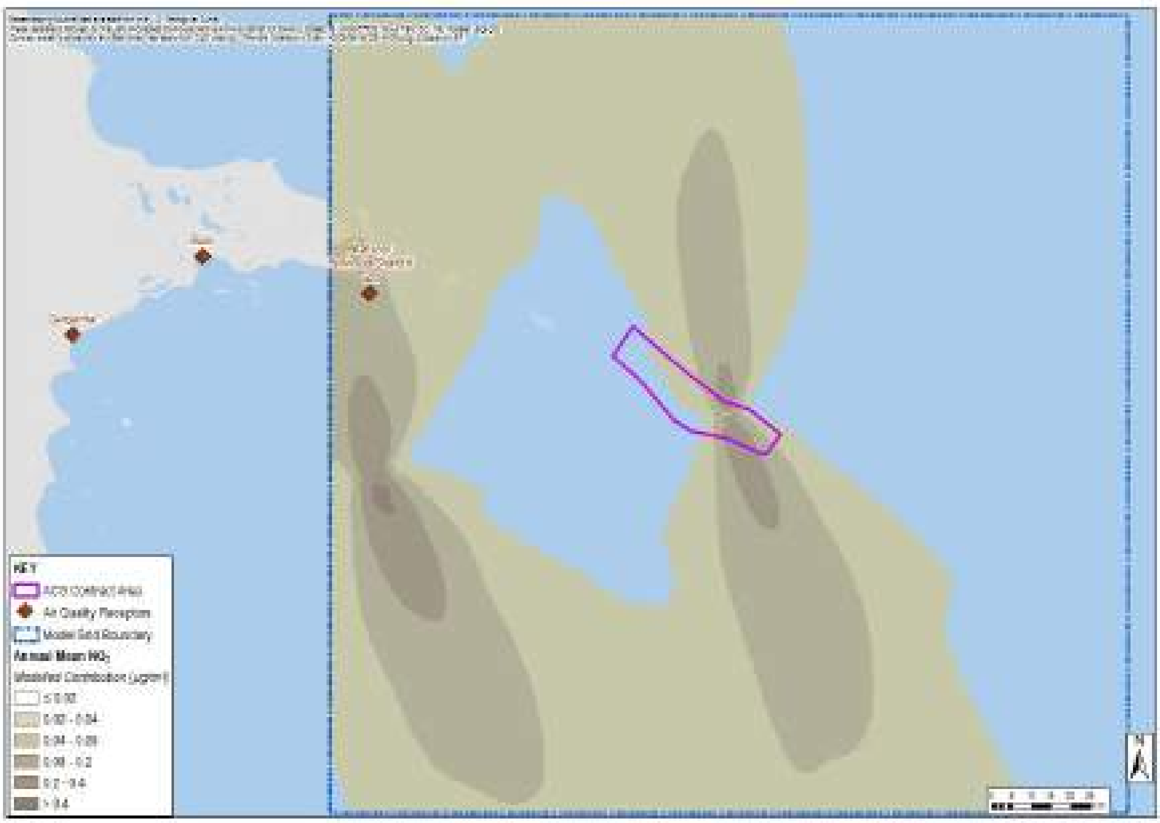


Figure 21. Modelled 1 Hour Maximum NO_2 Contribution for Scenario 5

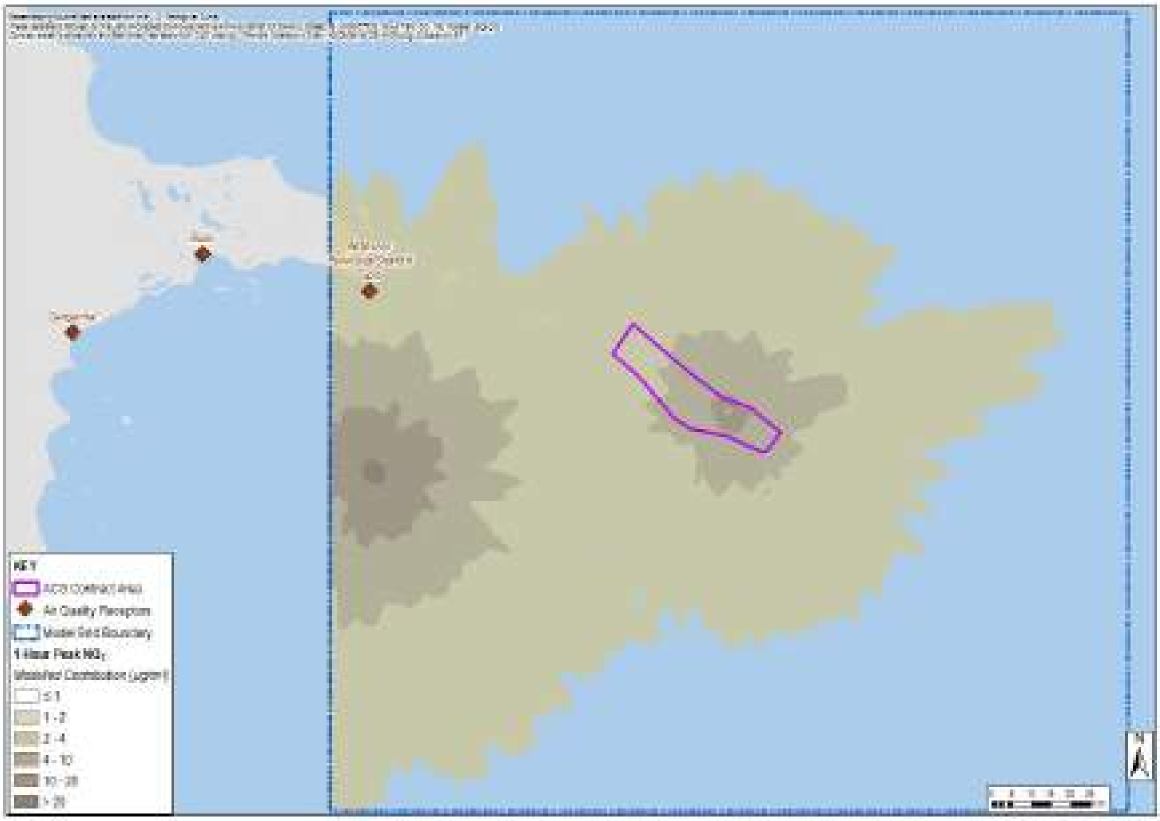


Figure 22. Modelled Annual Average PM_{10} Contribution for Scenario 5

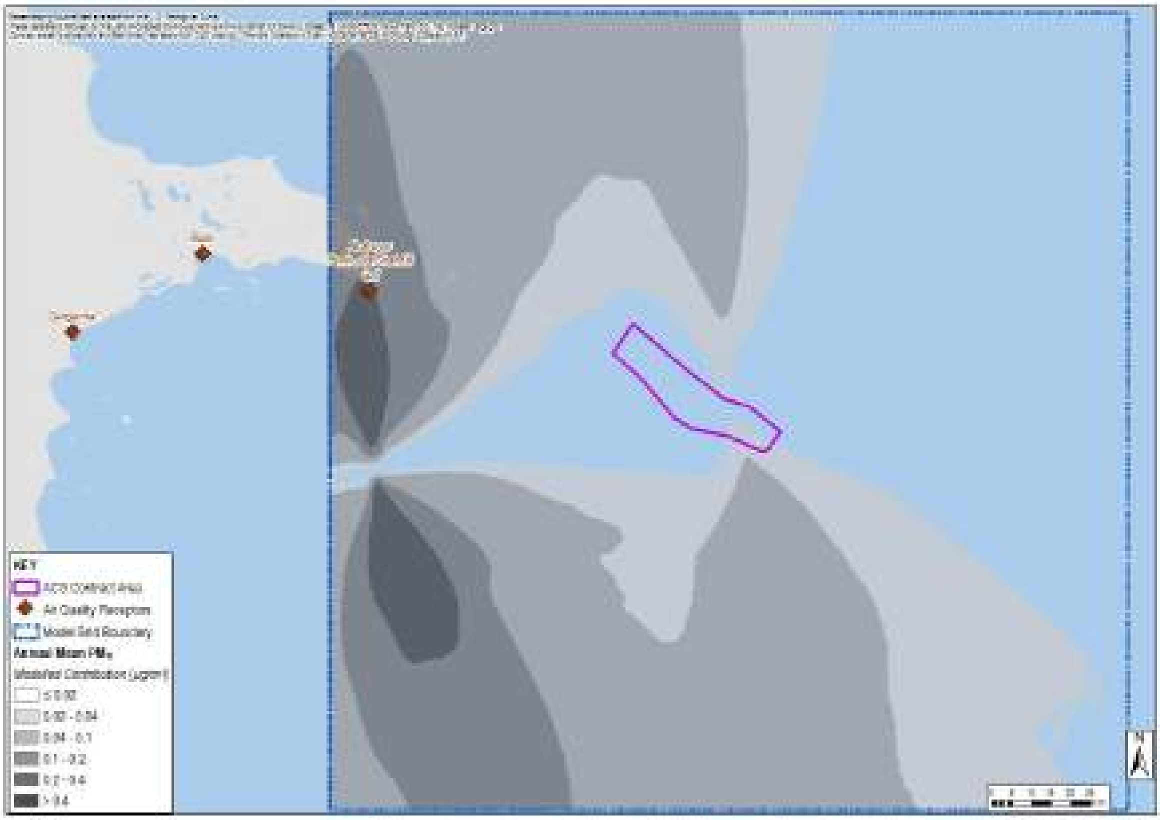
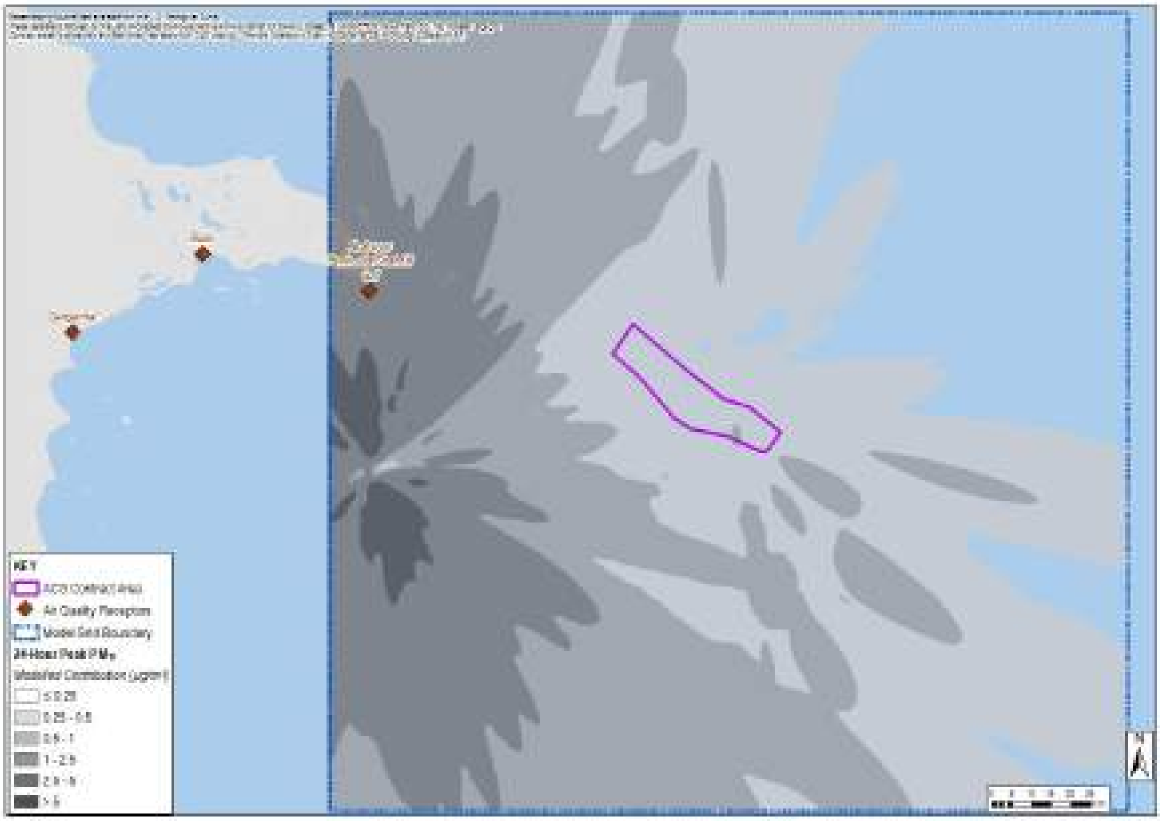


Figure 23. Modelled 24 Hour Maximum PM_{10} Contribution for Scenario 5



6. Conclusion

Atmospheric dispersion modelling was completed for pollutant species NO_2 and PM_{10} with the results presented at the closest onshore receptor locations for comparison to applicable air quality limits.

The modelled contributions associated with all scenarios are not predicted to lead to any discernible impact on air quality concentrations onshore.

When taking account of the existing background concentrations the predicted concentrations easily comply with the air quality limit values, with the exception of PM_{10}. This can be attributed to the natural occurrence of particulate matter in the local environment reflecting the high particulate concentrations associated with dry arid region (for example soil particles becoming airborne through wind entrainment). The contribution of ACE offshore operations activities to increases in PM_{10} concentrations at onshore receptors is insignificant.

In summary, it is not expected that ACE offshore operational activities will cause the applicable air quality limit values to be exceeded at onshore locations, where concentrations currently comply with the limit values.

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Ref. 2 Heydar Aliyev Drilling. http://www.Heydar Aliyev-drilling.com/fleet/drilling_rigs/FleetItem.aspx?fid=23&cid=4

Ref. 3 World Health Organisation (2005); Air quality guidelines - global update 2005 Guidelines

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Ref. 5 World Bank (1998); Pollution, Prevention and Abatement Handbook. http://smap.ew.eea.europa.eu/test1/fol083237/poll_abatement_hanbook.pdf/

Ref. 6 European Parliament and of the Council (2008); Directive 2008/50/EC on ambient air quality and cleaner air for Europe

Ref. 7 Environment Agency (2010); Horizontal Guidance Note H1 – Environmental Risk Assessment for Permits. http://www.environment-agency.gov.uk/business/topics/permitting/36414.aspx

Ref. 8 United States Environmental Protection Agency (US EPA) Applicability of Appendix W Modeling Guidance for the 1-hour NO2 National Ambient Air Quality Standard. http://www.epa.gov/ttn/scram/ClarificationMemo_AppendixW_Hourly-NO2-NAAQS_FINAL_06-28-2010.pdf

Ref. 9 Sangachal Ambient Air Quality Monitoring Programme 2010, Final Report, AmC Report 10709-R1

Ref. 10 Worden, H. M, Deeter, M. N, Edwards, D.P. Gille, J.C., Drummond, J.R and Nedelec, P. 'Observations of near surface carbon monoxide from space using MOPITT multispectral retrievals, J. Geophys. Re., 115, D18314, doi:10.1029/2010JD14242, 2010

Ref 11 AZERBAIJAN BRANCH OFFICE OF REC CAUCASUS (March 2014) Air Quality Governance in the ENPI East Countries, National Pilot Project – Azerbaijan, "Improvement of Legislation on Assessment and Management of Ambient Air" Draft National Strategy on AQAM

Annex A Modelled Contributions (Azeri Limit Values)

Scenario 1

Receptor Name	NO_2 1 Hour Peak (µg/m³)				NO_2 24 Hour Peak (µg/m³)			
	Limit Value	Modelled Contribution	Predicted Concentration	Predicted Concentration as % Limit Value	Limit Value	Modelled Contribution	Predicted Concentration	Predicted Concentration as % Limit Value
Absheron Peninsula	85	0.1	24.1	28.4%	40	< 0.1	24.0	60.0%
Baku		0.1	76.1	89.5%		< 0.1	76.0	190.0%
Sangachal		0.1	24.1	28.4%		< 0.1	24.0	60.0%
**Note Assumed conversion of NOx to NO_2, 100% for 24 Hour Peak and 50% for 1 Hour Peak.*								

Receptor Name	PM_{10} 24 Hour Peak (µg/m³)				PM_{10} 1 Hour Peak (µg/m³)			
	Limit Value	Modelled Contribution	Predicted Concentration	Predicted Concentration as % Limit Value	Limit Value	Modelled Contribution	Predicted Concentration	Predicted Concentration as % Limit Value
Absheron Peninsula	150	< 0.1	184.0	122.7%	500	< 0.1	184.0	36.8%
Baku		< 0.1	480.0	320.0%		< 0.1	480.0	96.0%
Sangachal		< 0.1	184.0	122.7%		< 0.1	184.0	36.8%

Receptor Name	CO 24 Hour Peak (µg/m³)				CO 1 Hour Peak (µg/m³)			
	Limit Value	Modelled Contribution	Predicted Concentration	Predicted Concentration as % Limit Value	Limit Value	Modelled Contribution	Predicted Concentration	Predicted Concentration as % Limit Value
Absheron Peninsula	3000	< 0.1	200.0	6.7%	5000	0.1	200.1	4.0%
Baku		< 0.1	200.0	6.7%		0.1	200.1	4.0%
Sangachal		< 0.1	200.0	6.7%		0.1	200.1	4.0%

Scenario 2

Receptor Name	NO_2 1 Hour Peak (µg/m^3)				NO_2 24 Hour Peak (µg/m^3)			
	Limit Value	Modelled Contribution	Predicted Concentration	Predicted Concentration as % Limit Value	Limit Value	Modelled Contribution	Predicted Concentration	Predicted Concentration as % Limit Value
Absheron Peninsula	85	0.2	24.2	28.5%	40	< 0.1	24.0	60.0%
Baku		0.2	76.2	89.6%		< 0.1	76.0	190.1%
Sangachal		0.1	24.1	28.4%		< 0.1	24.0	60.0%
*Note Assumed conversion of NOx to NO_2, 100% for 24 Hour Peak and 50% for 1 Hour Peak.								

Receptor Name	PM_{10} 24 Hour Peak (µg/m^3)				PM_{10} 1 Hour Peak (µg/m^3)			
	Limit Value	Modelled Contribution	Predicted Concentration	Predicted Concentration as % Limit Value	Limit Value	Modelled Contribution	Predicted Concentration	Predicted Concentration as % Limit Value
Absheron Peninsula	150	0.1	184.1	122.7%	500	0.7	184.7	36.9%
Baku		< 0.1	480.0	320.0%		0.5	480.5	96.1%
Sangachal		< 0.1	184.0	122.7%		0.4	184.4	36.9%

Receptor Name	CO 24 Hour Peak (µg/m^3)				CO 1 Hour Peak (µg/m^3)			
	Limit Value	Modelled Contribution	Predicted Concentration	Predicted Concentration as % Limit Value	Limit Value	Modelled Contribution	Predicted Concentration	Predicted Concentration as % Limit Value
Absheron Peninsula	3000	0.1	200.1	6.7%	5000	1.7	201.7	4.0%
Baku		0.1	200.1	6.7%		1.3	201.3	4.0%
Sangachal		0.1	200.1	6.7%		1.1	201.1	4.0%

Scenario 3

Receptor Name	NO_2 1 Hour Peak (µg/m^3)				NO_2 24 Hour Peak (µg/m^3)			
	Limit Value	Modelled Contribution	Predicted Concentration	Predicted Concentration as % Limit Value	Limit Value	Modelled Contribution	Predicted Concentration	Predicted Concentration as % Limit Value
Absheron Peninsula	85	0.6	24.6	29.0%	40	0.1	24.1	60.3%
Baku		0.4	76.4	89.9%		0.1	76.1	190.2%
Sangachal		0.4	24.4	28.7%		0.1	24.1	60.3%

**Note Assumed conversion of NOx to NO_2, 100% for 24 Hour Peak and 50% for 1 Hour Peak.*

Receptor Name	PM_{10} 24 Hour Peak (µg/m^3)				PM_{10} 1 Hour Peak (µg/m^3)			
	Limit Value	Modelled Contribution	Predicted Concentration	Predicted Concentration as % Limit Value	Limit Value	Modelled Contribution	Predicted Concentration	Predicted Concentration as % Limit Value
Absheron Peninsula	150	0.1	184.1	122.7%	500	1.7	185.7	37.1%
Baku		0.1	480.1	320.1%		1.2	481.2	96.2%
Sangachal		0.1	184.1	122.7%		1.1	185.1	37.0%

Receptor Name	CO 24 Hour Peak (µg/m^3)				CO 1 Hour Peak (µg/m^3)			
	Limit Value	Modelled Contribution	Predicted Concentration	Predicted Concentration as % Limit Value	Limit Value	Modelled Contribution	Predicted Concentration	Predicted Concentration as % Limit Value
Absheron Peninsula	3000	0.3	200.3	6.7%	5000	4.1	204.1	4.1%
Baku		0.2	200.2	6.7%		3.0	203.0	4.1%
Sangachal		0.2	200.2	6.7%		2.6	202.6	4.1%

Scenario 4

Receptor Name	NO_2 1 Hour Peak (µg/m^3)				NO_2 24 Hour Peak (µg/m^3)			
	Limit Value	Modelled Contribution	Predicted Concentration	Predicted Concentration as % Limit Value	Limit Value	Modelled Contribution	Predicted Concentration	Predicted Concentration as % Limit Value
Absheron Peninsula	85	1.5	25.5	30%	40	0.4	24.4	61.0%
Baku		0.9	76.9	90.5%		0.1	76.1	190.4%
Sangachal		1.0	25.0	29.4%		0.1	24.1	60.3%

**Note Assumed conversion of NOx to NO_2, 100% for 24 Hour Peak and 50% for 1 Hour Peak.*

Receptor Name	PM_{10} 24 Hour Peak (µg/m^3)				PM_{10} 1 Hour Peak (µg/m^3)			
	Limit Value	Modelled Contribution	Predicted Concentration	Predicted Concentration as % Limit Value	Limit Value	Modelled Contribution	Predicted Concentration	Predicted Concentration as % Limit Value
Absheron Peninsula	150	< 0.1	184.0	122.7%	500	< 0.1	184.0	36.8%
Baku		< 0.1	480.0	320.0%		< 0.1	480.0	96.0%
Sangachal		< 0.1	184.0	122.7%		< 0.1	184.0	36.8%

Receptor Name	CO 24 Hour Peak (µg/m^3)				CO 1 Hour Peak (µg/m^3)			
	Limit Value	Modelled Contribution	Predicted Concentration	Predicted Concentration as % Limit Value	Limit Value	Modelled Contribution	Predicted Concentration	Predicted Concentration as % Limit Value
Absheron Peninsula	3000	< 0.1	200.0	6.7%	5000	0.4	200.4	4.0%
Baku		< 0.1	200.0	6.7%		0.2	200.2	4.0%
Sangachal		< 0.1	200.0	6.7%		0.3	200.3	4.0%

Scenario 5

Receptor Name	NO_2 1 Hour Peak (µg/m^3)				NO_2 24 Hour Peak (µg/m^3)			
	Limit Value	Modelled Contribution	Predicted Concentration	Predicted Concentration as % Limit Value	Limit Value	Modelled Contribution	Predicted Concentration	Predicted Concentration as % Limit Value
Absheron Peninsula	85	1.5	25.5	30%	40	0.4	24.4	61.0%
Baku		0.9	76.9	90.5%		0.2	76.2	190.4%
Sangachal		1	25.0	29.4%		0.1	24.1	60.3%
**Note Assumed conversion of NOx to NO_2, 100% for 24 Hour Peak and 50% for 1 Hour Peak.*								

Receptor Name	PM_{10} 24 Hour Peak (µg/m^3)				PM_{10} 1 Hour Peak (µg/m^3)			
	Limit Value	Modelled Contribution	Predicted Concentration	Predicted Concentration as % Limit Value	Limit Value	Modelled Contribution	Predicted Concentration	Predicted Concentration as % Limit Value
Absheron Peninsula	150	1.7	185.7	123.8%	500	14.7	198.7	39.7%
Baku		0.9	480.9	320.6%		9.7	489.7	97.9%
Sangachal		0.6	184.6	123.1%		8.2	192.2	38.4%

Receptor Name	CO 24 Hour Peak (µg/m^3)				CO 1 Hour Peak (µg/m^3)			
	Limit Value	Modelled Contribution	Predicted Concentration	Predicted Concentration as % Limit Value	Limit Value	Modelled Contribution	Predicted Concentration	Predicted Concentration as % Limit Value
Absheron Peninsula	3000	0.5	200.5	6.7%	5000	4.1	204.1	4.1%
Baku		0.2	200.2	6.7%		3.0	203.0	4.1%
Sangachal		0.2	200.2	6.7%		2.6	202.6	4.1%

Annex B Cumulative Source Data

Source name	Height(m)	Location X	Location Y	Diameter (m)	Efflux type	Velocity (m/s)	Temp (°C)	NOx (g/s)	SO2 (g/s)	PM10 (g/s)	CO (g/s)
SD2_Titan_1_100%	67	446200	4417050	1.95	Vel	38.8	489	21.7	0	0.160	2.64
SD2_Titan_2_100%	67	446200	4417050	1.95	Vel	38.8	489	21.7	0	0.160	2.64
SD2_Flare CompTrip	145	446100	4417050	7.4	Vel	20	1000	15.95	0	498	86.8

APPENDIX 11C

Marine Discharges Modelling

AECOM

Azeri Central East Marine Discharges Modelling

A Report Produced By

More Energy Ltd

Contents

Figures & Tables

Figures

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1 Introduction

1.1 The project

AECOM has commissioned More Energy Ltd on behalf of BP Exploration (Caspian Sea) Ltd to undertake a marine discharges modelling study to establish the expected extent of the impacts associated with the following discharges to sea anticipated during the pre-drilling, construction and installation and operational phases of the Azeri Central East (ACE) Project in the Caspian Sea (Figure 1).

- Discharge of water based mud (WBM) drill cuttings and residual mud from the mobile offshore drilling unit (MODU) during pre-drilling (multiple wells) and from the ACE platform during operations (single well and multiple wells scenario);
- Discharge of residual cement (washout) from the MODU (pre-drilling) and the ACE platform (operations) at the end of cementing casing sections;
- Discharge of blowout preventer (BOP) fluids during BOP testing events;
- Discharge during pipeline pre-commissioning and subsea infrastructure installation; and
- Discharge of cooling water from the MODU (pre-drilling) and the ACE platform (operations).

The scenarios have been identified in conjunction with the BP ACE Project team.

This report presents the results of work undertaken to model these discharges, and determine their extent.

The above discharges, with the exception of cooling water, have been modelled using the Dose-Related Risk and Effect Assessment Model (DREAM) published by SINTEF (v9.01). This incorporates the ParTrack sub-model used for modelling the dispersion and settlement of solids. The software is developed by SINTEF (Stiftelsen for industriell og teknisk forskning - The Foundation for Scientific and Industrial Research) in Norway. DREAM/ParTrack consists of a dispersion model based on 2D wind and 3D current data and a component-specific fate model whereby the physical-chemical, toxicity and biodegradation properties of the components of a discharge are modelled.

Cooling water discharges were modelled using the Cornell Mixing Zone Expert System (CORMIX) model (version 11.0GT) published by MixZon Inc and developed with funding from the United States Environmental Protection Agency (USEPA) for the analysis, prediction and design of aqueous toxic or conventional pollutant discharges into diverse water bodies.

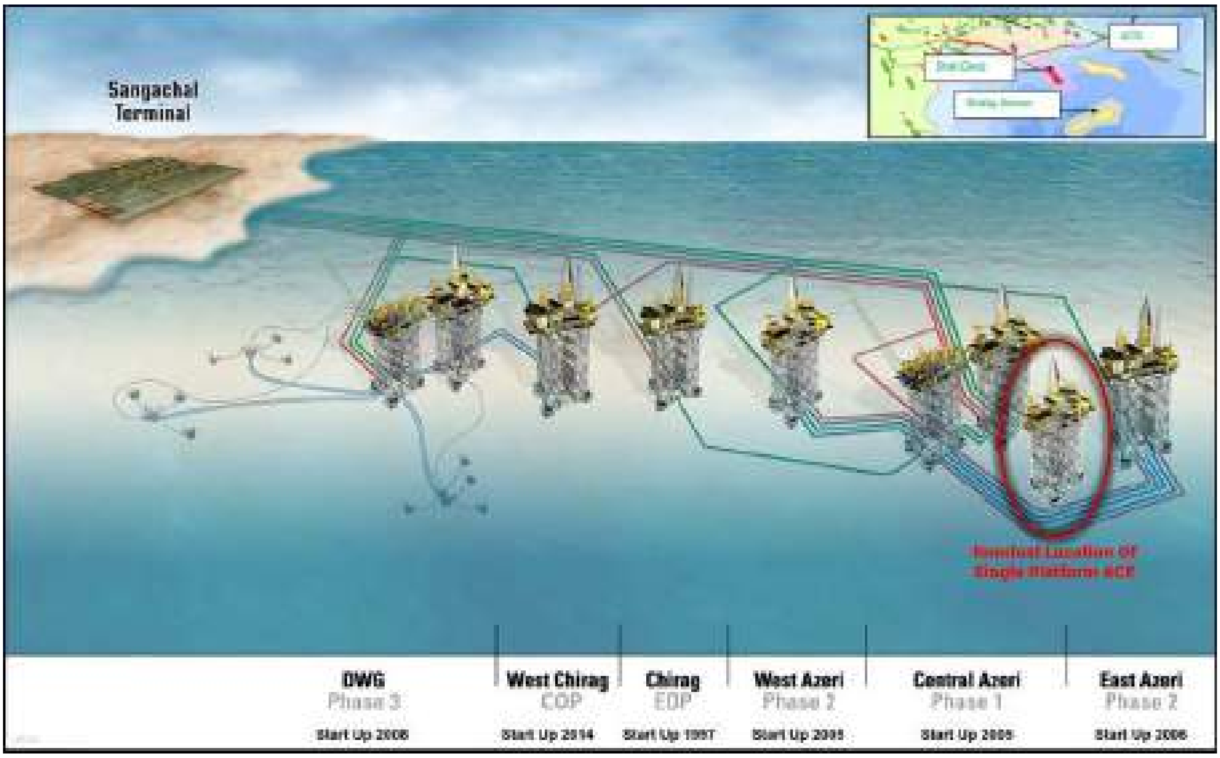


Figure 1: Azeri-Chirag Gunashli (ACG) field layout including proposed Azeri Central East (ACE) platform

1.2 Scope of work

The scope of work was to model discharges resulting from the pre-drilling, construction and installation and operational phases of the ACE Project and to determine their extent.

Modelling is undertaken using the particle dispersion model DREAM 9.01 written by SINTEF using 3D metocean data and discharge parameters provided by BP that are specific to the Caspian Sea operations. Agreed scenarios have been modelled relating to different locations and discharge scenarios for:

- Drill cuttings and mud;
- Pipeline pre-commissioning and hydrotest discharges;
- BOP discharges; and
- Cement washout discharges;

Cooling water modelling is undertaken using CORMIX, a USEPA-supported mixing zone model and decision support system for environmental impact assessment of regulatory mixing zones resulting from continuous point source discharges. This model is used for

- Cooling water discharges from the mobile offshore drilling rig (MODU) and platform operations.

2 Introduction to the models utilised

2.1 Dose-Related Risk and Effect Assessment Model (DREAM)

With the exception of cooling water, the discharges were modelled using DREAM published by SINTEF. The model predicts the fate of materials discharged to the marine environment (their dispersion and physico-chemical composition over time) and can also calculate an estimate of risk to the environment using a metric known as the Environmental Impact Factor (EIF). DREAM/ParTrack is part of a suite of models within the Marine Environmental Modelling Workbench (MEMW) developed by SINTEF.

The DREAM model underwent significant development in the late 1990s and 2000s including its use in the Environmental Risk Management System joint industry project. Model details and development can be found in the technical reports at www.sintef.no/erms/reports as well as papers such as Reed *et al.* (2001) and Reed and Hetland (2002). The model has been validated in field trials relating to produced water plumes including Durell (2006) and Niu and Lee (2013), which found "*The DREAM model was also compared with field data … The results indicated that DREAM predicted both the dilution and trajectory very well*". The physics of the model shares many aspects with the related ParTrack model for solids including drill cuttings and with the Oil Spill Contingency and Response (OSCAR) model, both of which also have field validation e.g. the DEEPSPILL joint industry project (Johansen *et al.*, 2001) and simulated deposition of drill cuttings deposition on the sea floor at the Trolla Field (Rye H. and Furuholt, 2010; Jødestøl & Furuholt, 2010) and at the Murchison Field (Hayes and Galley, 2013), where reasonably good correspondence was obtained between measured and modelled results. The models continue to evolve and improve and are overseen by an international users' group.

The model has been developed to predict the dispersion of chemical plumes in the water column along with a variety of other physico-chemical processes such as evaporation, biodegradation, transition from droplet to dissolved states to adsorbed into sediments, and the dynamic equilibrium of these states dependent on local environmental conditions. The calculations are based on a Lagrangian 'particle' approach using a cloud of individual particles to represent the components of the discharge, combined with a near field plume model including advection by density, thermal and momentum forces and a far-field model for subsequent horizontal and vertical dispersion of particles. The plume model takes into account effects from water stratification on the near-field mixing and geometrical configuration of the outlet. Once the plume has been trapped by the prevailing structure of the water column, dissolved particles undergo ongoing horizontal and vertical dispersion while solids or droplets can continue to fall or rise in the water column and potentially deposit on the seabed or reach the surface and, in the case of oil droplets, form a sheen. Wave turbulence driven by wind speed and fetch is also incorporated into the surface layers of the water column.

This report uses DREAM as a dispersion model and for simplicity it treats the discharge as 'conservative' i.e. there is no degradation of the release over time. This slightly overestimates the extent of the resulting plumes, since some biodegradation of the discharge is to be expected, but allows a dilution approach to be taken which is easily understood.

2.2 Introduction to the ParTrack model

The cuttings discharges were modelled using DREAM published by SINTEF (v9.01), which incorporates the ParTrack sub-model used for modelling the dispersion and settlement of solids. The model predicts the fate of materials discharged to the marine environment including their settlement, dispersion and physico-chemical composition over time. DREAM/ParTrack is part of a suite of models within the Marine Environmental Modelling Workbench (MEMW) developed by SINTEF.

The ParTrack model underwent significant development in the Environmental Risk Management System (ERMS) joint industry project. Model development, including field trials and cross-validation can be found in the technical reports at www.sintef.no/erms/reports and include approaches to environmental risk calculation e.g. as described in Trannum (2004) and Kjeilen-Eilertsen et al. (2004).

The model has been developed to calculate the spreading and deposition on the seabed of drilling mud and cuttings as well as the dispersion of chemicals throughout the water column. The calculations are based on the 'particle' approach, combined with a near field plume model and the application of external current fields for the horizontal advection of the particles. The model consists of a plume mode and a far-field mode. The plume mode takes into account effects from water stratification on the near-field mixing, ambient currents and geometrical configuration of the outlet. Once the plume has been trapped in the water masses, particles are free to fall out of the plume and deposit on the seabed. Downwards (or rise) velocity of the particles is dependent on size and particle density. The far-field model includes the downstream transport and spreading of particles and dissolved matter, once the plume mode is terminated. The processes involved are illustrated in Figure 2.

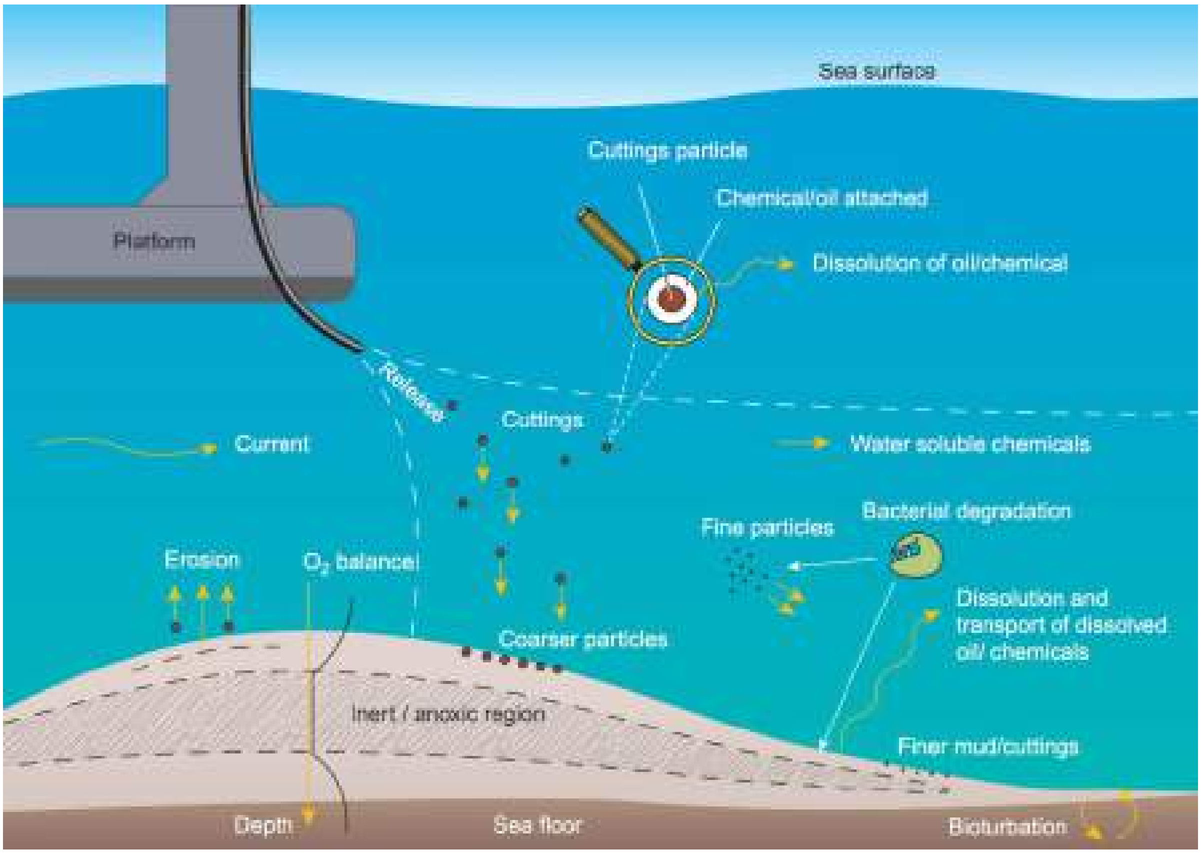


Figure 2: Processes involved in the ParTrack model

This approach is discussed in more detail in Rye *et al.* (2006), together with laboratory and field research supporting and validating the approach listed at www.sintef.no/erms/reports. Initial plume formation, is an important element in determining the fate of the release. These are key features of the underlying model (Reed & Hetland, 2002) which depend on the *in situ* release conditions. The model uses the in-built PLUME3D sub-model to calculate theoretical initial plume conditions where buoyancy and momentum advection are taking place.

Model predictions were validated through field measurements at the Trolla Field in 265 m water depth in the Norwegian Sea, where reasonably good correspondence was obtained between measured and simulated deposition of the cuttings on the sea floor (Rye & Furuholt, 2010; Jødestøl & Furuholt, 2010). The observed deposition thickness was lower than was predicted by the ParTrack model which suggests that the modelling results are conservative.

Using ParTrack to model a historic cuttings pile in the North Sea where WBM discharges were undertaken also gave a good correlation between modelled and observed deposition patterns and oil concentrations (Hayes and Galley, 2013).

2.3 Cornell Mixing Zone Expert System (CORMIX)

Cooling water discharges were modelled using CORMIX model (version 11.0GT) published by MixZon Inc and developed with funding from the USEPA for the analysis, prediction and design of aqueous toxic or conventional pollutant discharges into diverse water bodies. The model was designed to provide safe and reliable mixing zone analysis for conventional and toxic discharges in oceans, rivers, lakes, and estuaries and has been recognized by a range of regulatory authorities in all continents for environmental impact assessment of point source mixing analysis.

CORMIX emphasizes the role of boundary interaction to predict steady-state mixing behaviour and plume geometry. CORMIX consists of a series of software systems for the analysis, prediction, and design of discharges into watercourses or the atmosphere, with emphasis on steady-state values for the geometry and dilution characteristics of the mixing zone. It can also be applied across a broad range of ambient conditions ranging from estuaries, deep oceans, swift shallow rivers, to density stratified reservoirs and lakes.

Its application here is specifically for thermal plumes, which tend to be very local in nature and are highly dependent on the near field behaviour of the plume, and for which there are international standards for what is normally acceptable such as the Environmental, Health and Safety (EHS) Guidelines (International Finance Corporation and World Bank Group, 2007), which state "*Temperature of wastewater prior to discharge does not result in an increase greater than 3°C of ambient temperature at the edge of a scientifically established mixing zone which takes into account ambient water quality, receiving water use and assimilative capacity among other considerations.*" This mixing zone is often taken as the transition point between rapid advective mixing and much slower, more passive mixing that occurs when momentum and temperature buoyancy effects are no longer significant. This can occur, for example, at the edge of a 'surface boil' for a buoyant pollutant in shallow water, and it can be determined using tools such as CORMIX to identify the change in flow class, whether at the surface or within the water column.

While DREAM has a near field plume algorithm, CORMIX has over 100 that are chosen dependent on many different parameters relating to the ambient conditions and the characteristics of the discharge. It also gives a clear indication of the extent of the initial mixing zone to allow comparison with international standards. It is limited in terms of showing a time-series of results in dynamic conditions, so extremes of current and temperature are instead investigated independently.

3 Scenarios and model input data

3.1 Drill cuttings and mud discharge scenarios

Table 1 presents the modelling scenarios which were provided by BP. In advance of platform installation, drilling of up to 6 pre-drill wells is planned to occur from a MODU. The 'worst case' deposition is assumed to arise when a hose discharging at 25 m above the seabed is used to move cuttings away from the proposed platform jacket location for WBM sections after the 42" tophole section has been drilled and discharged at the seabed. For simplicity, the cumulative deposition arising from drilling 6 consecutive wells was considered.

Up to 38 platform wells may be drilled at some point over the operational life of the ACE platform, therefore the deposition pattern of solids on the seabed for a typical ACE well design was investigated, in summer and in winter metocean conditions. The cumulative deposition arising from drilling 38 wells consecutively was also considered.

Particle size distribution for the cuttings was provided by BP based on realistic regional data. The barite content of the mud was modelled along with cuttings volumes. The quantity of bentonite in the spud mud was based on a typical 10 pounds per gallon of spud mud.

Table 1: Modelling scenarios for drill cuttings and water based mud

Discharge scenario	Hole size (drill bit diameter)	Estimated Fluids Discharged (tonnes)	Estimated Cuttings Discharged (tonnes)	Drilling Fluid/Mud System	Cuttings and Mud disposal	Duration of discharge (hours)**
WBM and cuttings from MODU cuttings chute (six well)*	42"	42	730	Seawater & gel sweeps	At seabed	8
	28"	550	306	WBM	To sea via hose	35
	26"	550	306	WBM		35
	Residual WBM discharge	239	N/A	WBM		12
WBM and cuttings from ACE platform cuttings caisson (one well)*	30"	81	164	WBM	To sea via ACE cuttings caisson	24
	26"	169	466	WBM		48
	Residual WBM discharge	8	N/A	WBM		12
WBM and cuttings from ACE platform (38 wells)	30"	81	164	WBM	To sea via ACE cuttings caisson	24
	26"	169	466	WBM		48
	Residual WBM discharge	8	N/A	WBM		12

* Conducted for both summer and winter conditions
** It is understood that the discharges may be intermittent, but for the purposes of modelling, the dispersion is essentially unaffected by a small number of gaps in the discharge, and 'gaps' to run casing etc. are not included in the model timescale. Further, the modelling is undertaken during a period of representative currents and will vary slightly depending on the currents at the time of drilling, and the timing is therefore always an approximation. It is assumed that the discharge takes place at the same rate as the cuttings are generated according to the rate of progress.

3.2 Pipeline pre-commissioning and hydrotest discharge scenarios

Modelling is undertaken to determine the typical worst-case trajectory and extent of the discharge plumes to the point at which the discharges are diluted to a predicted no-effect concentration (PNEC). In this case only the physical dispersion of the plume has been modelled, which is conservative. The PNEC is derived by the application of an assessment factor to relevant aquatic toxicity data. The determination of appropriate dilutions has been undertaken by others and concludes that a dilution factor of 8,000 is relevant to the assessment. Because the discharges could happen at any time of year, each scenario has been modelled under both summer and winter metocean conditions.

Discharges will take place at the locations shown in Table 2. Each of the discharges will occur separately and therefore there will be no additive effects from discharges in the receiving body of water.

The discharge scenarios are summarised in Table 2. The scenarios have been selected to represent the full range of discharge operations and pipeline/flowline characteristics. Discharge volumes, duration port diameters, orientation, depths, locations and discharge temperatures are based on data provided by the ACE Project design team.

Table 2: Modelling scenarios for pipeline pre-commissioning and hydrotest discharges

Pipeline	Scenario	Discharge Volume per Discharge (m^3)	Duration per discharge (hr)	Port diameter (m)	Location of discharge
Existing 22" Gas Export Pipeline - East Azeri (EA) to Central Azeri Compression & Water Injection Platform (CA-CWP)	Leak test EA to CA-CWP via Wye - Treated seawater	11	2.65	1.1	EA seawater discharge caisson
	Dewatering EA to CA-CWP - Treated line length slug	2545	2.70	1.5	CA-CWP seawater discharge caisson
New 18" ACE Gas Export Pipeline	Dewatering Wye to ACE – Treated seawater line length slug	830	2.02	1.1	ACE seawater discharge caisson
New 30" ACE Oil Pipeline	Flood, Clean & Gauge ACE, 20% Line length overfill	530	0.72	0.1	ACE seabed
	Flood, Clean & Gauge ACE (100% Contingency with chemicals)	2244	2.77	0.1	ACE seabed
	Dewater 90% pipeline volume to ACE	1836	1.25	1.1	ACE seawater discharge caisson
Existing 16" Water Injection Pipeline	Clean & Gauge, CA-CWP to EA, 20% Line length overfill	937	2.62	1.1	EA seawater discharge caisson
	EA Water Injection Riser flush	20	0.13	0.1	EA seabed
16" Water Injection Pipeline (Existing and New)	Water Replacement CA-CWP to ACE	1322	3.68	1.5	ACE seawater discharge caisson
	Dewatering Wye to ACE (MEG slug)	10	2.65	1.5	CA-CWP seawater discharge caisson
Spool connections and subsea infrastructure	4 x Spools Tie-in at CA-PDQ	16	3.60	0.2	CA-PDQ seabed

3.3 Blowout preventer (BOP) discharge scenarios

The BOP has a routine testing cycle that involves discharges of control fluid from a number of operations. The sequence and discharge volume are shown in Table 3. Based on a composition of 70% water, 2% ethylene glycol and 4% control fluid chemical, a specific gravity of 1.0086 is calculated. Temperature is assumed to be slightly above ambient (+0.5°C), on the assumption that the liquids will have equalised to ambient temperature with minor heating from the equipment actuations.

Table 3: Modelling scenarios for BOP discharges

Description of release	Volume (litres)	Duration (mins)	Rate l/s	Start (mins)	Diameter (mm)
Upper Annular	654	3	3.63	0	25
Lower Annular	644	3	3.58	3	25
Upper Pipe Ram	260	1.16	3.74	6	25
Middle Pipe Ram	264	1.16	3.79	7.16	25
Lower Pipe Ram	70	1.16	1.01	8.32	25
Upper Outer Choke (U.O.C) line	20	0.57	0.58	9.48	25
Upper Inner Choke (U.I.C) line	20	0.57	0.58	10.05	25
Lower Outer Choke (L.O.C) line	20	0.57	0.58	10.62	25
Lower Inner Choke (L.I.C) line	20	0.57	0.58	11.19	25
Upper Outer Choke (U.O.K) line	20	0.57	0.58	11.76	25
Upper Inner Kill (U.I.K) line	20	0.5	0.67	12.33	25
Lower Outer Kill (L.O.K) line	20	0.5	0.67	12.83	25
Lower Inner Kill (L.I.K) line	20	0.5	0.67	13.33	25
	Season	**Discharge temperature °C**		**Ambient temperature °C**	
	Summer	7.4		6.9	
	Winter	6.8		6.3	

3.4 Cement washout discharge scenarios

During the installation of a well, casings are inserted into the wellbore and cement slurry is pumped in behind the casing. After each well section is drilled and the casing cemented in place, the cement remaining in the cement unit will be slurrified with water and washed out.

To model the dispersion of the cement during the wash out events, the following assumptions were made:

- Cement discharge volumes and durations as shown in Table 4;
- Discharge depth of 11 m for MODU discharges and 104 m for Platform discharges;
- Discharge diameter of 0.28 m vertically downwards;
- Rate of discharge: 1.3 m^3 of slurry per minute (22 l/s);
- 10% potable water by mass in the cement mix;
- 10:1 seawater dilution when washing out the cement;
- Cement density 3.15 s.g. taken from standard specifications e.g. Lafarge datasheet; and
- Particle size distribution taken from Stark and Mueller (2003) 'Very high early strength cement' - noting that PSD does not alter appreciably on mixture/reaction with water.

The volumes of cement, potable water and seawater discharged per wash out event are summarised in Table 4. For the MODU cement discharges, cement masses have been provided by BP and include Class G Portland cement and Lightcrete with a total of 8.28 tonnes of cement per well, which are used to model the cement suspended solids in DREAM. Other cementing additives included in the cement mixture are assumed to be dissolved or finely mixed into the mix water, and are represented by assuming a specific gravity of 1.1 in the added water content in the discharge. For the Platform cement discharges, cement masses have been inferred from total cement volume and density figures provided by BP using the respective specific gravities of the components, with a total of 13.12 tonnes of cement per well, and additives in the mix water have been included as for the MODU discharges.

Table 4: Modelling scenarios for cement washout discharges

Parameter	MODU cement discharges					
	42" Hole Section	28" Hole Section	26" Hole Section	20" Hole Section	17½" Hole Section	13½" Hole Section
Total cement (tonnes)	1.2	2.04	2.04	1	0.9	1.1
Diluted volume cement + water (m^3)	11.81	20.08	20.08	9.84	8.86	10.83
Discharge duration (hours)	0.151	0.257	0.257	0.126	0.114	0.139
Parameter	**Platform cement discharges**					
	30" Hole Section	**26" Hole Section**	**20" Hole Section**	**17½" Hole Section**	**13½" Hole Section**	
Total cement (tonnes)	2.62	2.62	2.62	2.62	2.62	
Diluted volume cement + water (m^3)	25.82	25.82	25.82	25.82	25.82	
Discharge duration (hours)	0.331	0.331	0.331	0.331	0.331	

3.5 Cooling water discharge scenarios

Cooling water discharge scenarios are summarised in Table 5. The pre-drill discharges differ to the operational discharges principally in being a lower flow rate, a shallower discharge depth and a slightly warmer discharge. Each discharge variation is tested at two current speeds reflecting the observed range of currents.

Table 5: Modelling scenarios for cooling water discharges

Project stage	Discharge flowrate (m^3/s)	Pipe internal diameter (mm)	Discharge depth (m)	Season	Discharge Temperature °C	Ambient Temperature at release point °C	Current velocity (m/s)
Pre-drilling	0.4444	1000	11.5	Summer	30	25.54	0.2
							0.8
				Winter	22.3	9.59	0.2
							0.8
Operations	0.9472	1400	46	Summer	29.2	8.89	0.2
							0.8
				Winter	21.5	8.53	0.2
							0.8

3.6 Metocean data

Three-dimensional water column current and two-dimensional wind data were generated by the Space and Atmospheric Physics Group at Imperial College and provided by BP for a period covering 2006-2009. A snapshot of currents in the Caspian region can be seen in Figure 3 for the surface layer (which includes wind-driven currents) and also the layer closest to the seabed.

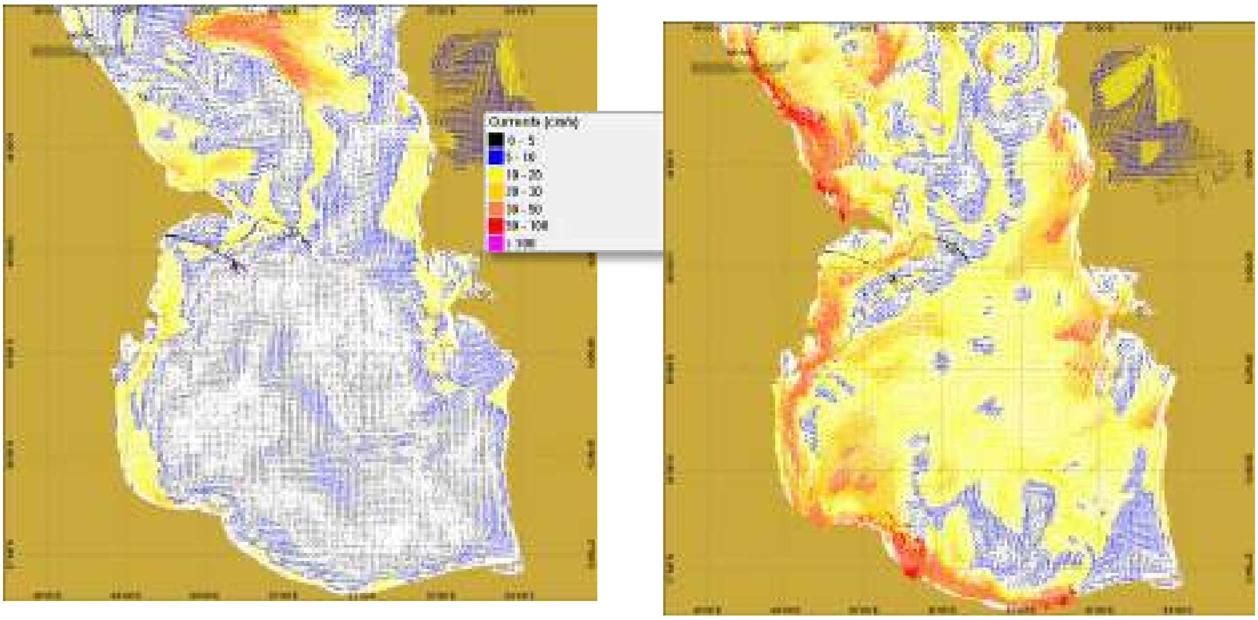


Figure 3: Example of instantaneous surface currents (left, seabed; right, sea surface)

Typical surface air temperatures and water column salinity averages were taken from Siamak *et al.* (2010) and AETC (2011) and are summarised in Table 6 .

The seawater temperature-depth profiles used in the modelling are shown in Figure 4. The values were taken from a BP Shah Deniz site survey (*per. comm*. 2013) and Kosarev (1974).

Table 6: Ambient conditions

Parameter	Summer	Winter
Surface air temperature (°C)	25	0
Salinity average (mg/l)	12.5	12.5

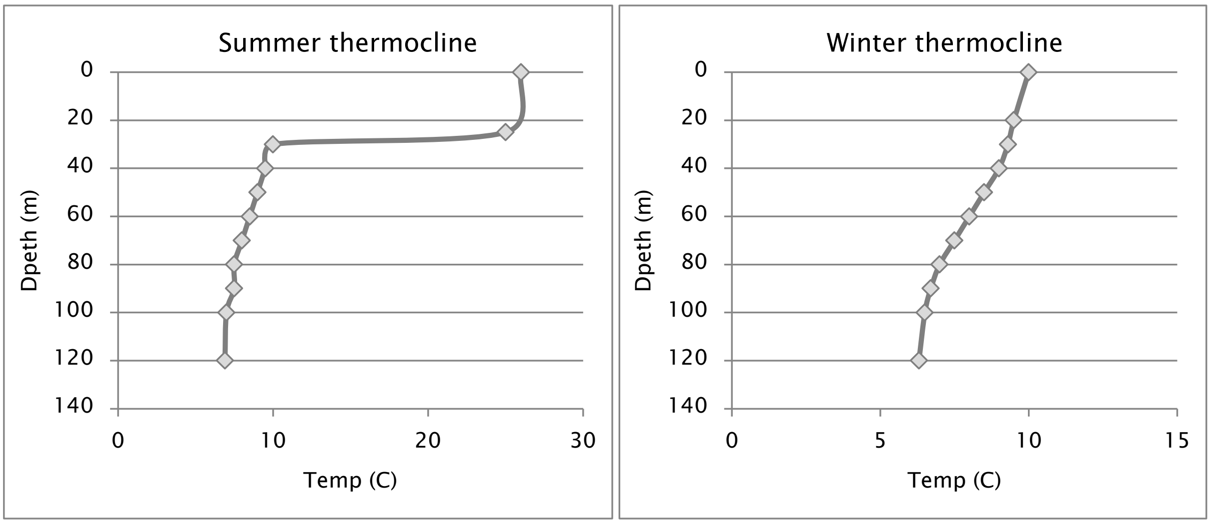


Figure 4: Summer and winter temperature-depth profiles

3.7 Bathymetry data

Bathymetry data is taken from the General Bathymetric Chart of the Oceans (GEBCO) '08' 30-arc-second grid, which has been translated into MEMW format. In turn, bathymetric grids for the Caspian Sea region were provided to GEBCO by Dr. John Hall, Geological Survey of Israel, based on bathymetric soundings digitised from Russian hydrographic charts (Hall, 2002). This differs to more recent survey data collected via ongoing projects, by around 10% in depth in places. Currently, it is problematic to merge localised survey data with the wider GEBCO data, and since the results are not significantly affected by depth differences in the order of 10%, the prevailing GEBCO data has been used in the model.

The bathymetry data used in the modelling is represented in Figure 5.

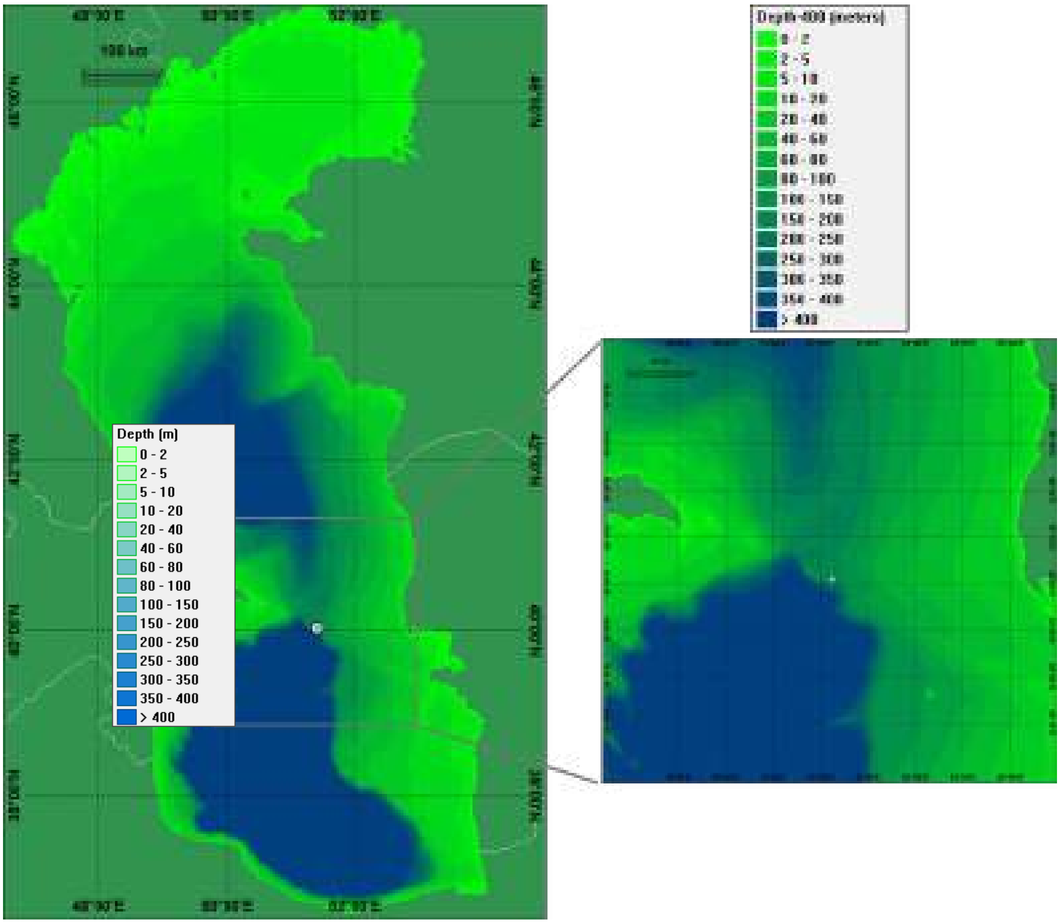


Figure 5: Regional bathymetry data used in model

3.8 Model setup

3.8.1 Drilling discharges

Key model parameters are shown in Table 7 . These are chosen using experienced judgment from training received from SINTEF, the software User Guide, experience of using the model over 10 years and direct dialogue with SINTEF software developers.

Table 7: Key model settings: drilling discharges

Model parameter	Setting used	Notes
Grid size	5 m by 5 m in X and Y direction 10 m by 10 m in X and Y direction	Tested to ensure results are not sensitive to change
Model time step	Computational time step: 2 minutes Output time step: 12 hours	Short enough to describe early stages of dispersion and ensure particles maintain continuous deposition
Number of particles	Solid/Droplet particles Dissolved particles	Maximum recommended number of particles is 30,000 per category
Sediment re-deposition	Turned on	Sediment transferred to neighbour cells when critical angle of repose exceeded. Avoids unrealistically large buildup of sediment in small areas
Modelling period	1 day post release	Model particles have deposited or left the grid area by this time

3.8.2 Pipeline discharges

DREAM model settings have been applied based on the MEMW User Guide, training received from SINTEF and from experience. Key settings are shown in Table 8.

3.8.3 BOP discharges

DREAM model settings have been applied based on the MEMW User Guide, training received from SINTEF and from experience. Key settings are shown in Table 9.

3.8.4 Cement discharges

DREAM model settings have been applied based on the MEMW User Guide, training received from SINTEF and from experience. Key settings are shown in Table 10.

3.8.5 Cooling water discharges

CORMIX model settings for the cooling water discharges are shown in Table 11 and Table 12 and detailed below. Density of effluents and ambient seawater were calculated based on the temperatures provided in Section 3.5. Based on the difference in effluent temperature during operations between summer (29.2°C) and winter (21.5°C), the effluent temperature in pre-drilling winter scenarios was calculated at 22.3°C assuming an equal temperature gain to cool machinery. The internal diameter of the discharge pipe for the pre-drilling project stage scenarios was assumed to be 1 m.

Across all scenarios, the cross section was assumed to be unbounded (i.e. away from the influence of a shoreline or bank) and the average depth, 144 m.

The ambient velocity at discharge was assumed to be 0.8 m/s (fast) and 0.2 m/s (slow) – a fast and slow scenario was modelled for each discharge both summer and winter.

To represent the roughness of the seabed, a Manning's coefficient of 0.015 was assumed representing a smooth seabed. It was assumed that the wind velocity was 0 m/s.

A single port was assumed with the nearest bank being on the left at a distance of 30 000 m (i.e. very far and not influencing the plume). The vertical discharge angle was assumed to be -90 degrees and the horizontal 0 degrees. The surface heat exchange coefficient was set to 6 W/m^2 based on guidance in Jirak *et al.* (1996). The port cross sectional area for the pre-drill discharge point was 0.7854 m^2 and for operations 1.4957 m^2. The discharge velocity was 0.57 m/s for the pre-drilling scenario and 0.63 m/s for operational discharge with an associated flowrate of 0.44 m^3/s and 0.9472 m^3/s respectively.

Table 8: Key model settings: pipeline discharges

Model parameter	Setting used	Notes
Grid size	50 m by 50 m horizontally and 5 m depth	Finer cell size than recommended in 'EIF Computational Guidelines' (NOGA, 2003), captures main features of plume adequately and avoids non-continuous plume problems
Model time step	1 minute	Short enough to describe early stages of dispersion and ensure particles maintain a continuous plume
PLUME 3D	On, set to caisson vertically downwards	Creates accurate initial dynamic plume
Tracer properties	Neutrally buoyant, non-degradable, non-evaporative, completely soluble.	The plume is modelled using an inert tracer in the flow. It does not decay, evaporate or interact with the seabed. Dose rate 1000 ppm
Number of particles	Dissolved particles 30,000.	Maximum recommended value, avoids false plume 'detachment' issues
Wind forcing	Turned off	Built into metocean current data and should not be applied 'twice'. Wind data is still attached to the model to generate realistic wave turbulence
Distance to nearest neighbour	Turned on	A continuous plume is expected and this feature helps to preserve plume continuity

Table 9: Key model settings: BOP discharges

Model parameter	Setting used	Notes
Grid size	1 m by 1 m horizontally and 0.75 m depth	Fine cell size to capture small and rapidly dispersing plume
Model time step	2 seconds	Short enough to describe early stages of dispersion and ensure particles maintain a continuous plume
PLUME 3D	On, set to vertically upwards	Creates representative initial dynamic plume
Tracer properties	Neutrally buoyant, non-degradable, non-evaporative, completely soluble.	The plume is modelled using an inert tracer in the flow. It does not decay, evaporate or interact with the seabed. Dose rate 1000 ppm
Number of particles	Dissolved particles 100,000.	Greater than maximum recommended value in order to maintain a continuous plume in a fine grid and avoid false plume 'detachment' issues
Distance to nearest neighbour	Turned on	A continuous plume is expected and this feature helps to preserve plume continuity

Table 10: Key model settings: cement discharges

Model parameter	Setting used	Notes
Grid size	2 m by 2 m horizontally and 3 m depth	Adequate cell size to capture size and dispersion of the plume
Model time step	5 minutes	Short enough to ensure particles maintain a continuous plume
PLUME 3D	On, set to vertically downwards	Creates representative initial dynamic plume
Release properties	Actual cement density used for solids fraction, no degradation	The cement particles can settle out through the water column as governed by the particle size distribution
Number of particles	Dissolved particles 30,000.	The maximum recommended value in order to maintain a continuous plume and avoid false plume 'detachment' issues
Distance to nearest neighbour	Turned on	A continuous plume is expected and this feature helps to preserve plume continuity

Table 11: Ambient parameters for cooling water discharge models in CORMIX

Ambient parameters	Project stage	Pre-drilling				Operations			
	Season	Summer		Winter		Summer		Winter	
	Units | Current	Fast	Slow	Fast	Slow	Fast	Slow	Fast	Slow
Ambient velocity	m/s	0.8	0.2	0.8	0.2	0.8	0.2	0.8	0.2
Stratification Type	NA	B*	B*	A*	A*	A*	A*	A*	A*
Surface temperature	°C	26	26	10	10	10.58**	10.58**	10	10
Bottom temperature	°C	5.31	5.31	5.04	5.04	5.31	5.31	5.04	5.04
Below thermocline temperature	°C	5.31	5.31	NA	NA	NA	NA	NA	NA
Stratification height	M	116.5	116.5	NA	NA	NA	NA	NA	NA
Surface water density	kg/m³	996.7843	996.7843	999.7019	999.7019	999.6486	999.6486	999.7019	999.7019
Bottom water density	kg/m³	999.9610	999.9610	999.9661	999.9661	999.9610	999.9610	999.9661	999.9661
Density below pycnocline	kg/m³	999.9610	999.9610	NA	NA	NA	NA	NA	NA

* A=linear stratification, B=Two layer stratification. See Jirka *et al.* (1996), Figure 4.4 for further explanation.

** This has been adjusted to better represent the pycnocline in the vicinity of the discharge depth using a linear interpolation and represents the upper water column below the pycnocline.

Table 12: Discharge parameters for cooling water discharge models in CORMIX.

Discharge parameters	Project stage	Pre-drilling				Operations			
	Season	Summer		Winter		Summer		Winter	
	Units | Current	Fast	Slow	Fast	Slow	Fast	Slow	Fast	Slow
Port diameter	m	1	1	1	1	1.38	1.38	1.38	1.38
Port cross-sectional area	m²	0.7854	0.7854	0.7854	0.7854	1.4957	1.4957	1.4957	1.4957
Discharge velocity	m/s	0.57	0.57	0.57	0.57	0.63	0.63	0.63	0.63
Discharge flowrate	m³/s	0.4444	0.4444	0.4444	0.4444	0.9472	0.9472	0.9472	0.9472
Discharge port height	m	132.5	132.5	132.5	132.5	98	98	98	98

4 Results

A deterministic analysis was carried out on specific sets of metocean conditions. In order to identify the least dispersive conditions, a test discharge was run through 6 months of summer 2006 and 6 months of winter 2006/07. By looking at regional weather charts it appears that temperatures rise and fall significantly in approximately mid-April and mid-October, and therefore these have been used as cut-offs for winter and summer metocean conditions. It was found that February and August appear to be the least dispersive months. Subsequently further analysis was conducted to identify the least dispersive, i.e. "worst case" dispersive periods during these times.

4.1 Selection of worst case conditions for summer and winter

In order to determine the metocean conditions that would lead to the worst (i.e. largest) volume of water to be affected, a continuous release of an inert and neutrally buoyant tracer at 1000 parts per million (ppm) was modelled. An example output is shown in Figure 6 and Figure 7.

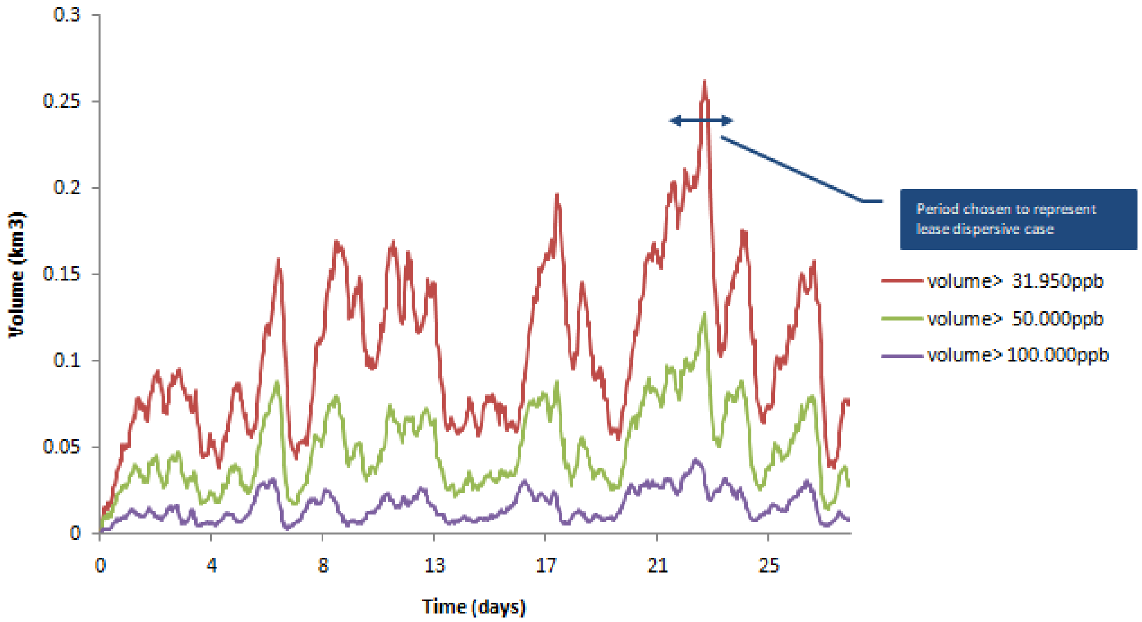


Figure 6: Winter volume of water affected above specific concentrations for continuous release

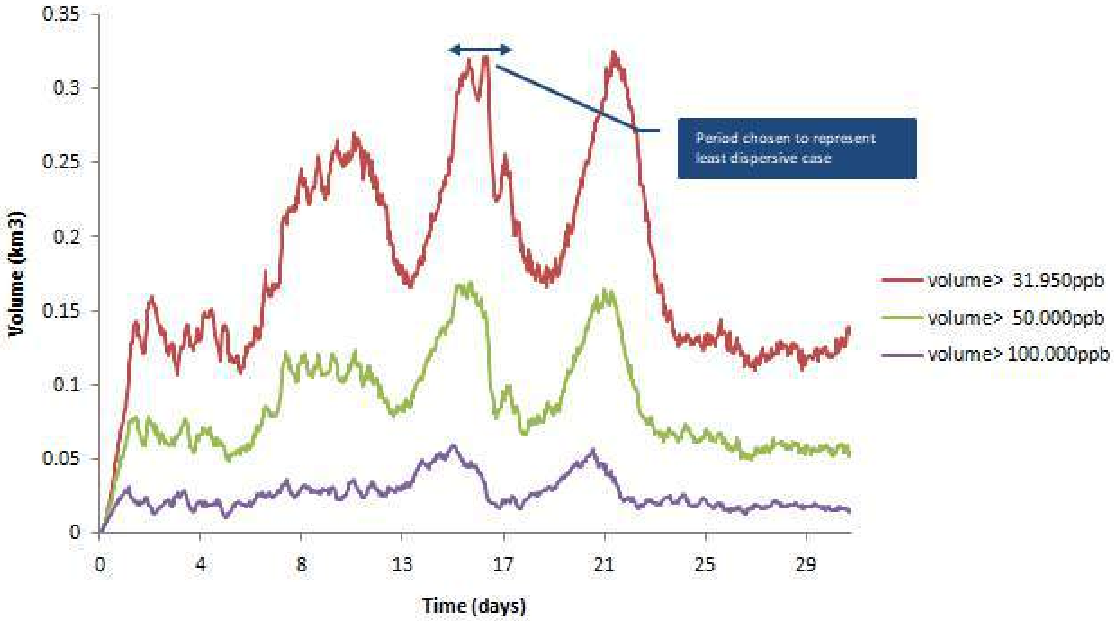


Figure 7: Summer volume of water affected above specific concentrations for continuous release

4.2 Summary: Drill cuttings and mud discharges

The following sections detail a representation of the distribution of deposition thickness and a cross section through the main area of deposition.

4.2.1 MODU drilling: discharge of WBM and cuttings (six wells)

Deposition in drilling occurring during summer is shown in Figure 8 and Table 13. Peak thickness is predicted to be around 6.4 m. Although the model averages the results over 5 m and there may be local variations in thickness, approximately 8,650 m² of seabed is covered by over 1 mm thick of deposits. The particle size distribution is relatively coarse, retaining a large fraction of the cuttings within 50 m of each drill centre.

Figure 9 and Table 13 shows deposition from drilling during winter. Peak thickness is also predicted to be around 6.4 m with approximately 10,450 m² of seabed being covered by over 1 mm thickness of deposits. It is concluded that the results do not vary significantly between summer and winter – any observed differences are variability caused by the specific timing of discharges.

Table 13: Approximate Extent of WBM Cuttings Deposition to 1mm Depth and Maximum Depth of Deposition for ACE MODU Drilling Discharges (6 Wells)

Season	Water Depth	Approximate Extent of Cuttings Deposition to 1mm Depth	Maximum Depth of Deposition
Winter	137m	8,650 m²	6.36 m
Summer		10,450 m²	6.37 m

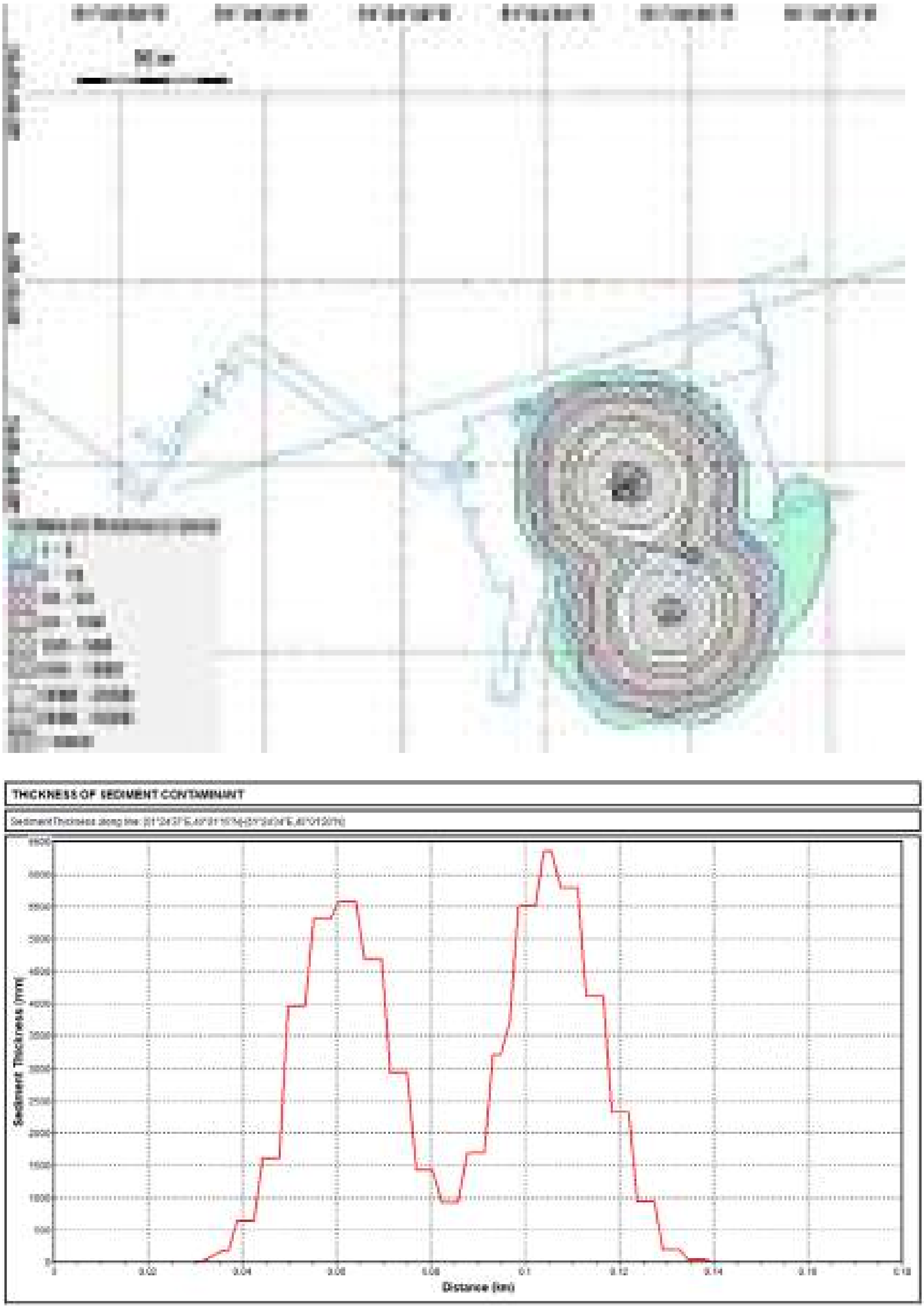


Figure 8: Drilling deposition distribution, 6 pre-drill wells (winter)

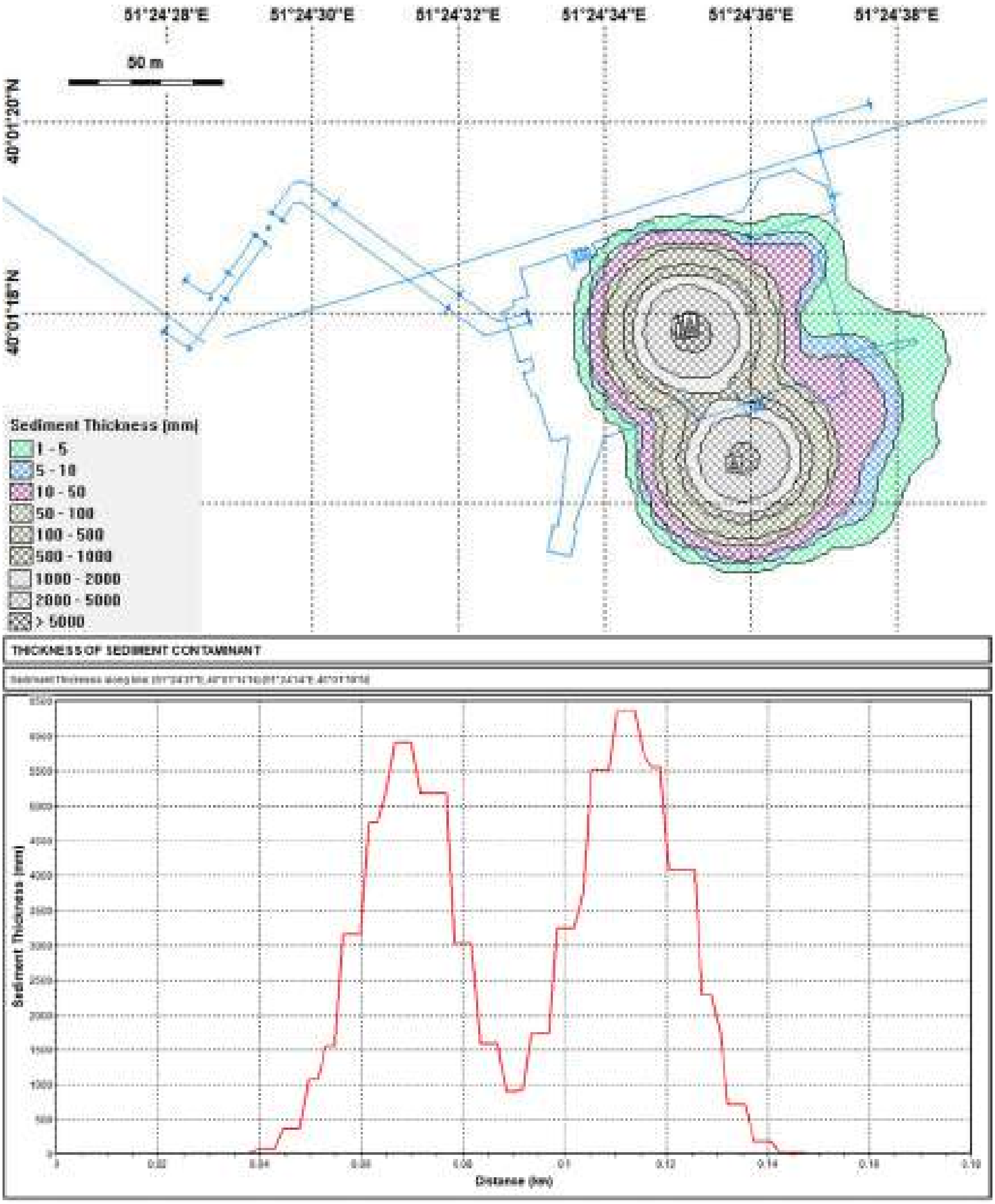


Figure 9: Drilling deposition distribution, 6 pre-drill wells (summer)

4.2.2 Platform drilling: discharge of WBM and cuttings from ACE cuttings caisson (one well)

Deposition during drilling assumed to occur in the winter is shown in Figure 10. Peak thickness is predicted to be around 1.4 m. Approximately 7,350 m^2 of seabed will be covered in deposition of a depth greater than 1 mm thickness, however due to metocean conditions at the time of discharge, approximately half of this area is covered by deposition of a thickness between 1 and 5 mm.

Figure 11 shows the summer output which has a maximum deposition thickness of 1.4 m with an area of approximately 4,350 m^2 covered by deposits greater than 1 mm thick.

It can be seen from the Figures that the results do not vary significantly between summer and winter – any observed differences are variability caused by the specific timing of discharges

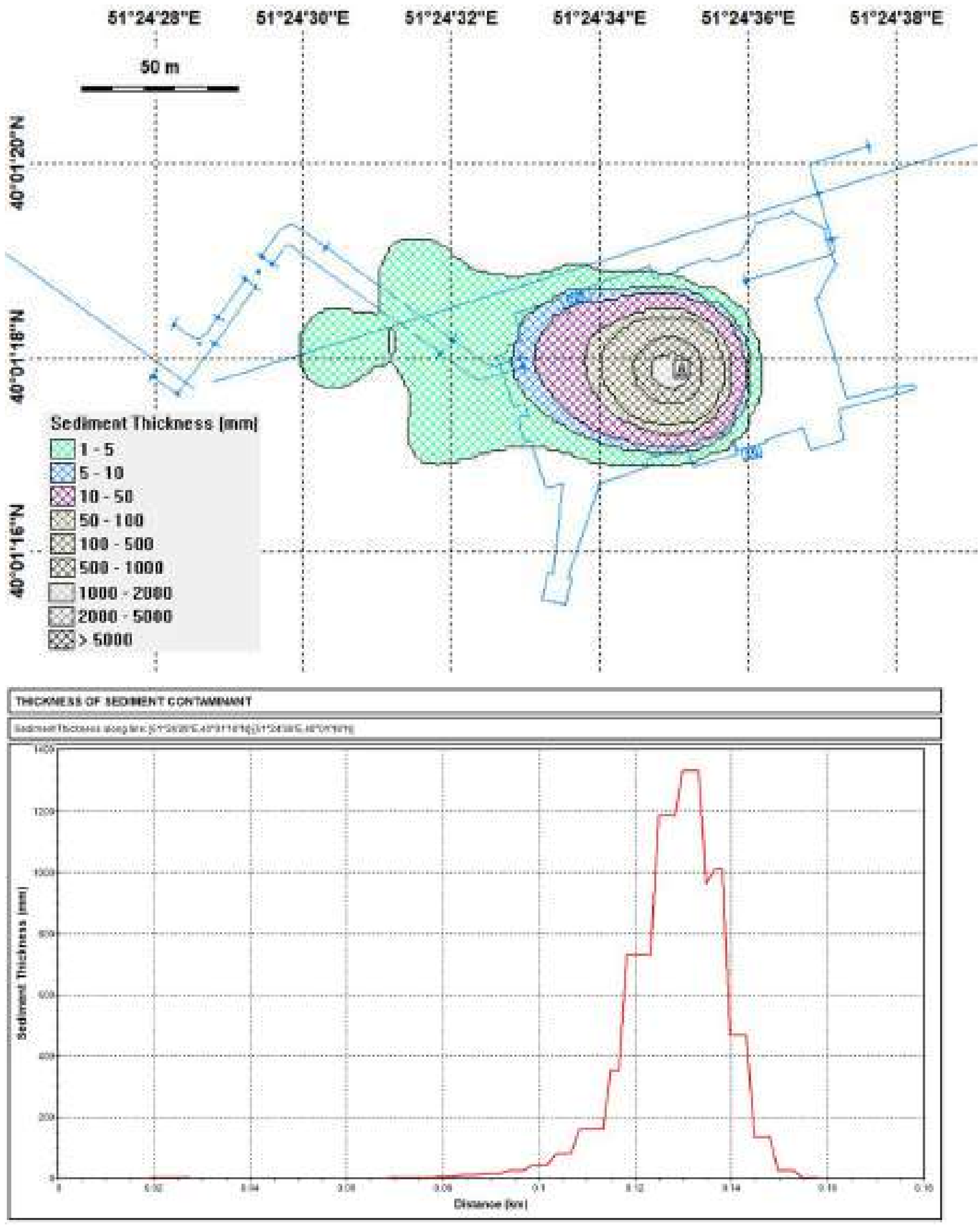
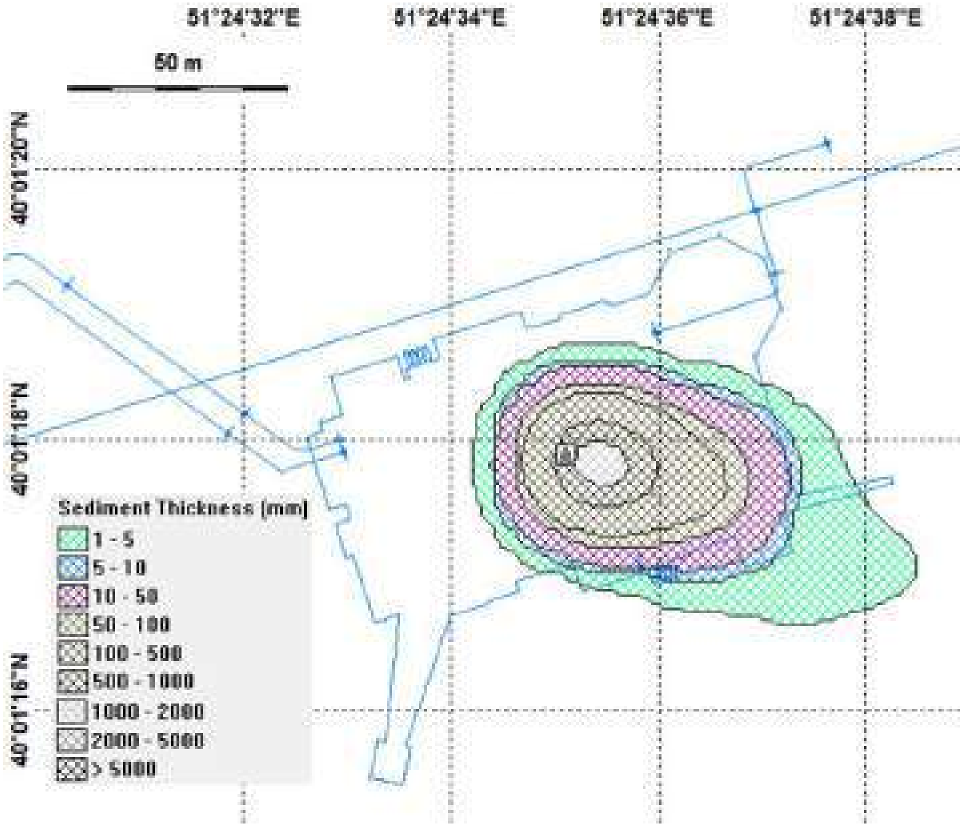


Figure 10: Drilling deposition distribution, 1 platform well (winter)



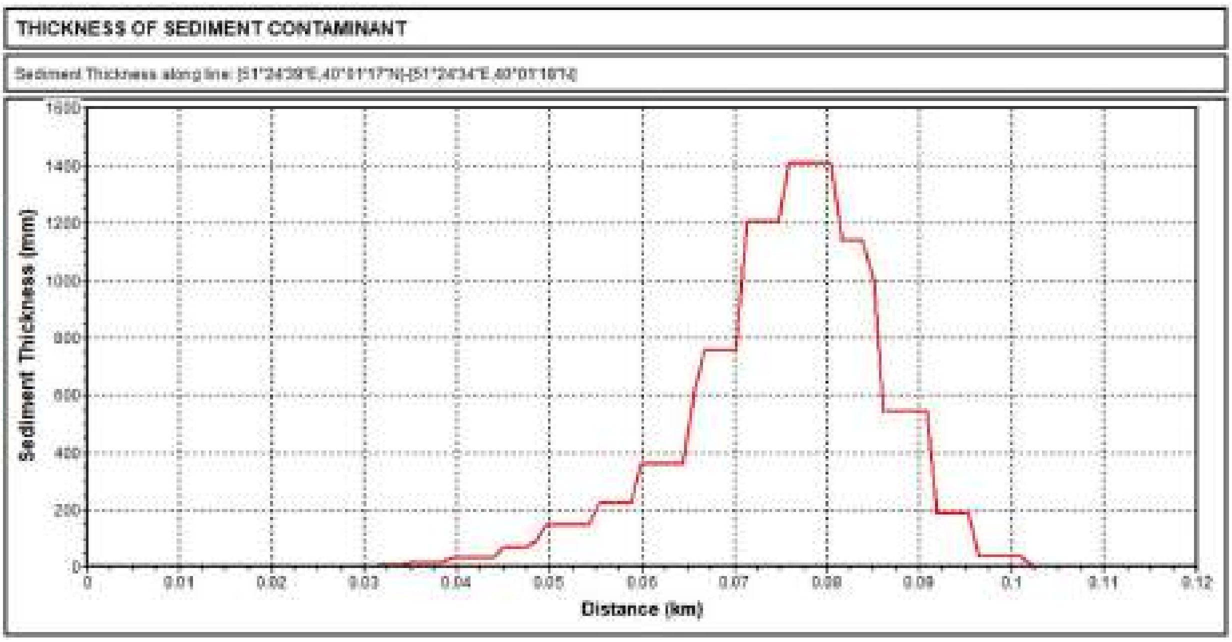


Figure 11: Drilling deposition distribution, 1 platform well (summer)

4.2.3 Platform drilling: Cumulative discharges of WBM & cuttings from ACE (multiple wells)

Deposition thicknesses are shown in Figure 12. Peak thickness is predicted to be around 10.1 m. The model averages the results over 10 m and although there may be local variations in thickness, a total of 22,400 m² of seabed is modelled to be covered in deposition greater than 1 mm. The particle size distribution is relatively coarse, retaining a large fraction of the cuttings within 100 m of the drill centre.

The duration of the discharges are such that they are spread over a longer period of metocean data and therefore the modelling is not repeated for summer and winter.

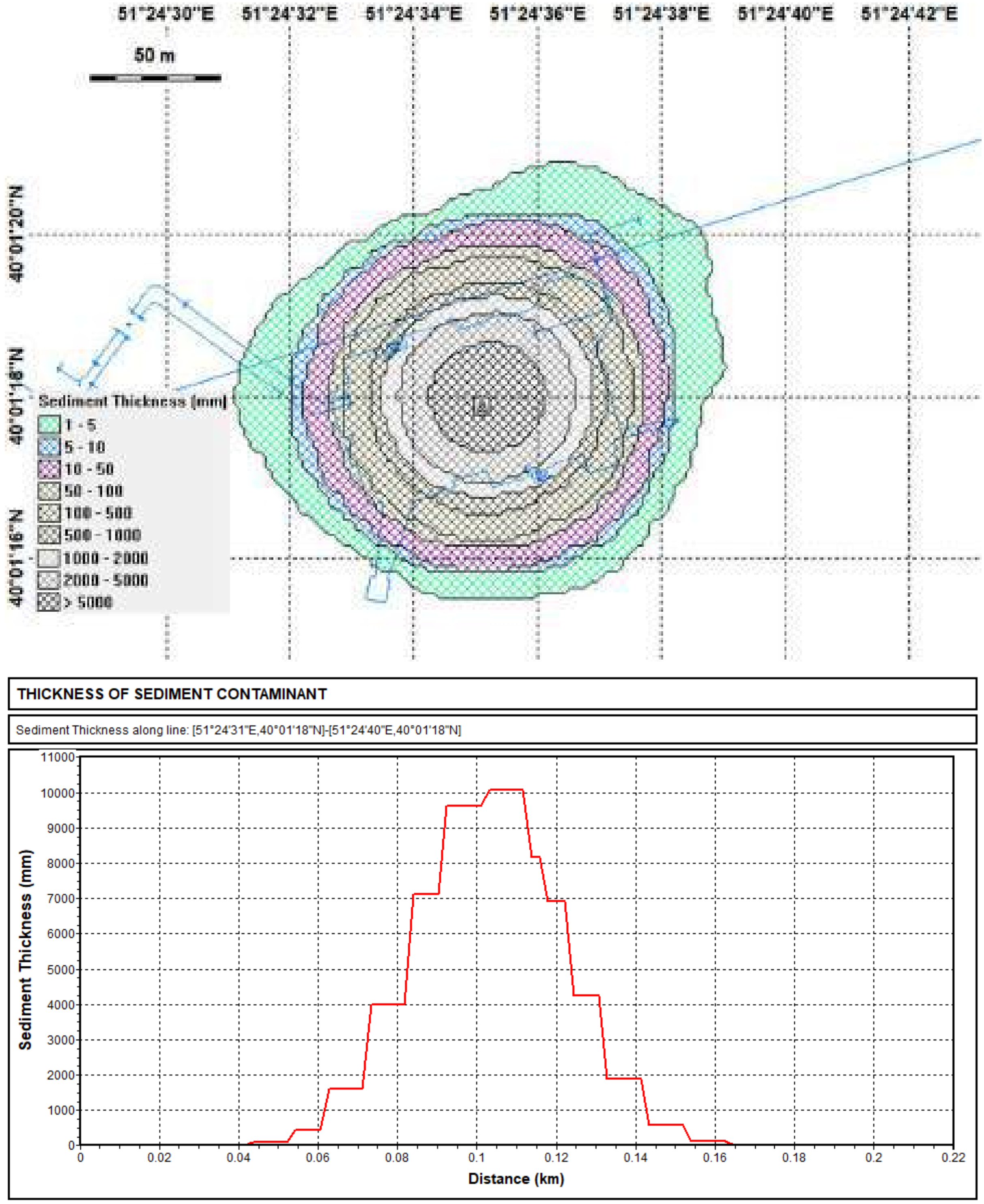


Figure 12: Drilling deposition distribution, 38 platform wells

4.3 Summary: Pipeline pre-commissioning and hydrotest discharges

For each scenario, the times and distances that are required to reach a dilution of at least 8,000 are shown in Table 14. All scenarios reach this point in 29 hours or less, and within 10.5 km.

Table 14: Summary of results for pipeline pre-commissioning and hydrotest discharges

Activity	Scenario	Discharge Volume per discharge (m^3)	Time Plume Takes to Reach 1/8,000 Dilution from Start of First Discharge (hr)		Maximum Distance from Release Location Where Water Column Below 1/8,000 Dilution (km)	
			Summer	Winter	Summer	Winter
Leak test EA to CA-CWP via Wye - Treated seawater	1	11	Instantaneous	Instantaneous	Negligible	Negligible
Dewatering EA to CA-CWP - Treated seawater line length slug	2	2545	23.34	28.0	10.1	4.3
Dewatering Wye to ACE - Treated line length slug	3	830	13.3	17.0	5.2	1.5
Flood, Clean & Gauge ACE, 20% Line length overfill	4	530	11.3	14.7	4.3	1.8
Flood, Clean & Gauge ACE (100% Contingency with chemicals)	5	2244	14.7	29.0	4.0	3.6
Dewater 90% pipeline volume to ACE	6	1836	18.0	24.3	5.7	3.1
Clean & Gauge, CA-CWP to EA, 20% Line length overfill	7	937	18.3	18.7	5.2	2.3
EA Water Injection Riser flush	8	20	4.3	5.0	0.4	0.3
Water Replacement CA-CWP to ACE	9	1322	17.0	22.0	4.9	1.6
Dewatering Wye to ACE (MEG slug)	10	10	Instantaneous	Instantaneous	Negligible	Negligible
4 x Spools at CA-PDQ	11	16	Instantaneous	0.24	Negligible	Negligible

It can be seen that the release from Scenario 1, the leak test consisting of 11 m^3 discharge of treated seawater at the EA platform seawater discharge caisson dispersed instantaneously during summer and winter conditions. A similar result occurred for the discharge of 10 m^3 of monoethylene glycol (MEG) at the CA-CWP seawater discharge caisson (Scenario 10) and 16 m³ discharge of treated seawater at the CA-PDQ location (Scenario 11).

4.3.1 Dewatering EA to CA-CWP (Scenario 2)

The maximum volume of water column affected for this scenario is shown in plan and cross section in Figure 13 (winter) and Figure 14 (summer).

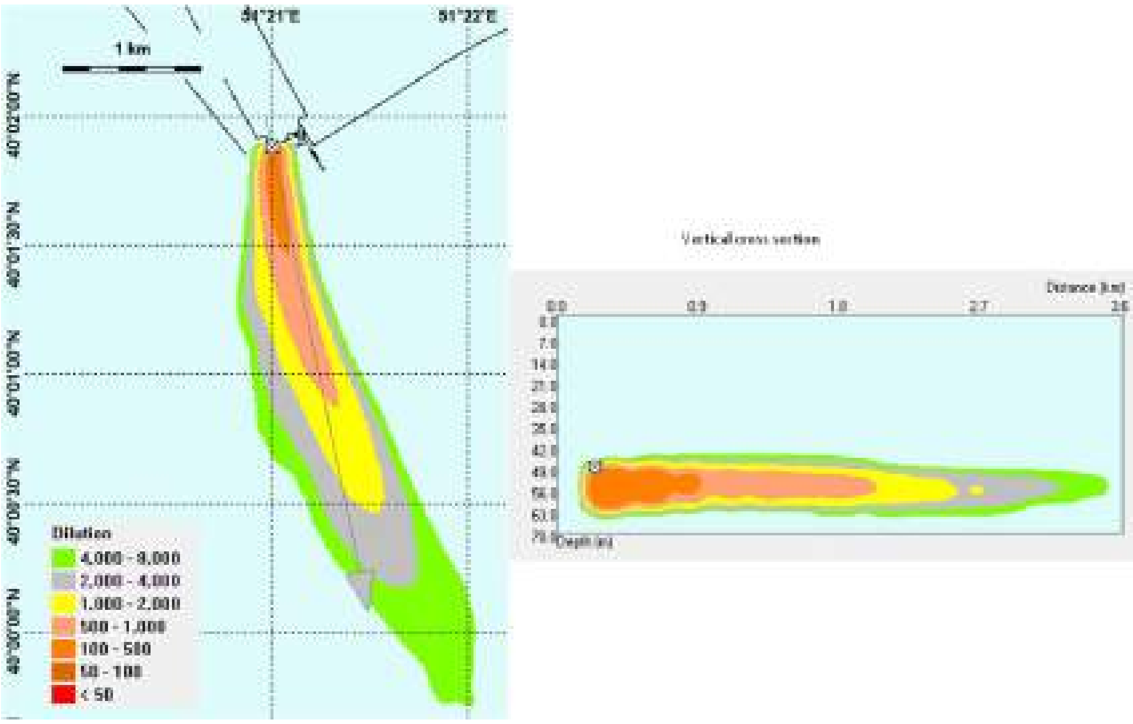


Figure 13: Dewatering EA to CA-CWP, overview and cross section of minimum dilution - winter

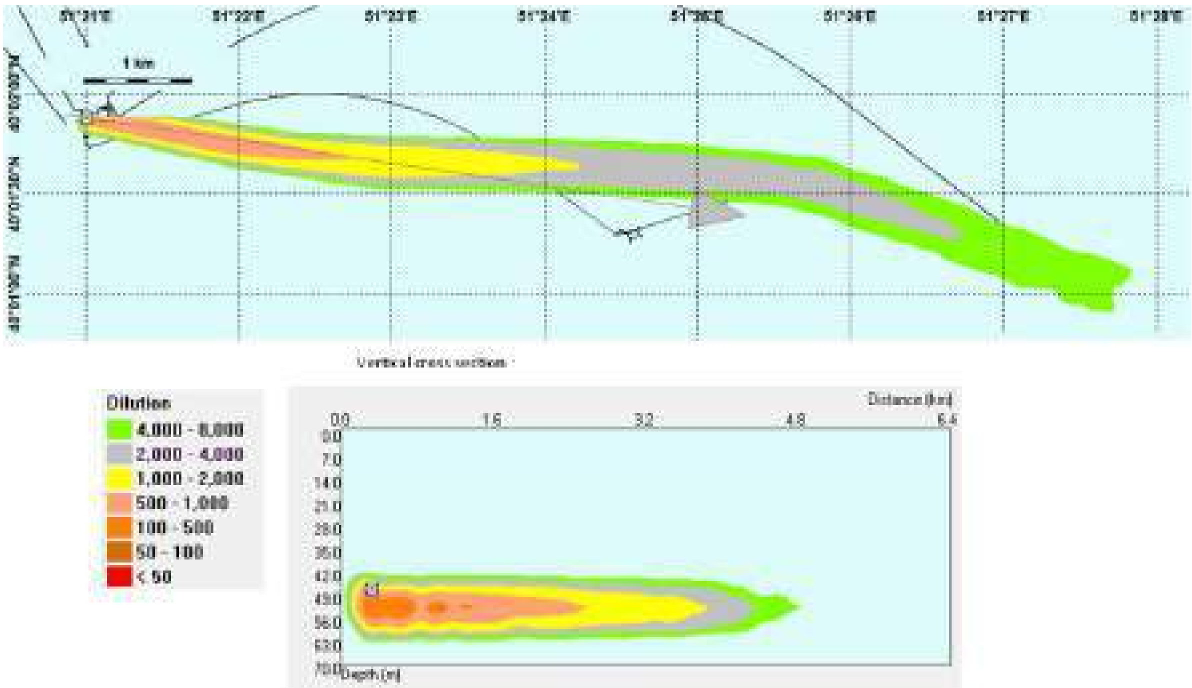


Figure 14: Dewatering EA to CA-CWP, overview and cross section of minimum dilution – summer

4.3.2 Dewatering Wye to ACE (Scenario 3)

The maximum volume of water column affected for this scenario is shown in plan and cross section in Figure 15 (winter) and Figure 16 (summer).

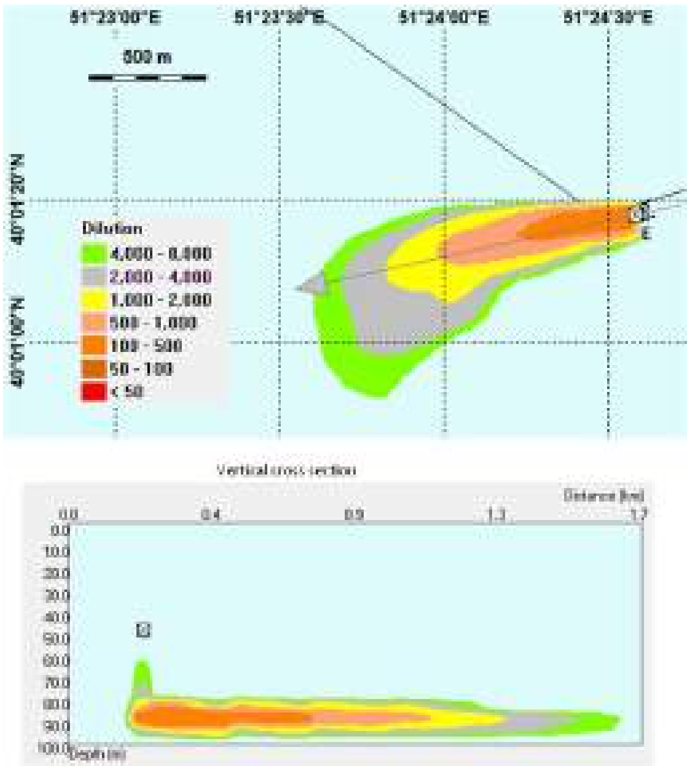


Figure 15: Dewatering Wye to ACE, overview and cross section of minimum dilution - winter

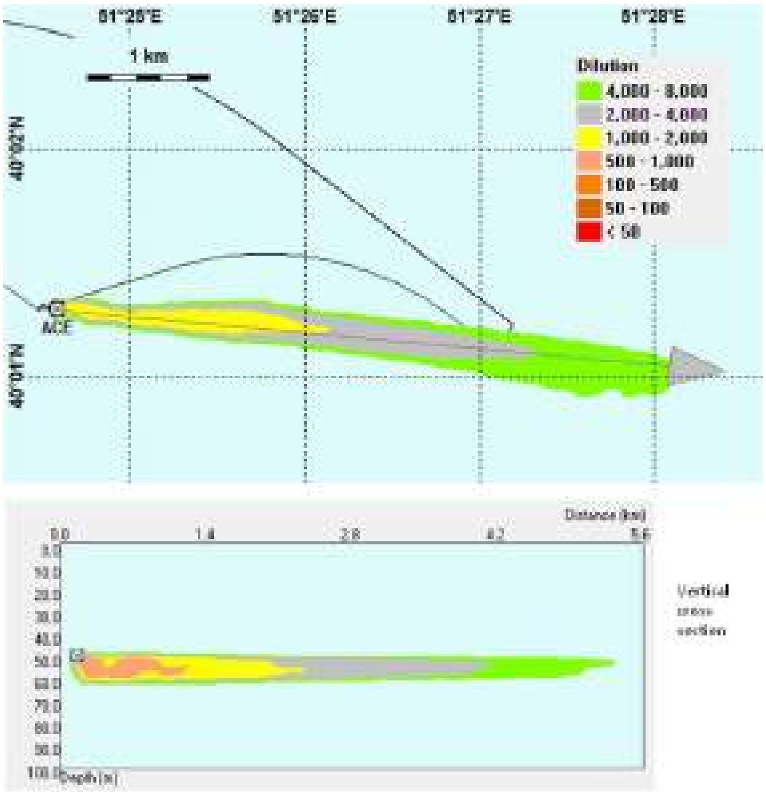


Figure 16: Dewatering Wye to ACE, overview and cross section of minimum dilution - summer

4.3.3 Flood, Clean & Gauge ACE (20 % overfill) (Scenario 4)

The maximum volume of water column affected for this scenario is shown in plan and cross section in Figure 17 (winter) and Figure 18 (summer).

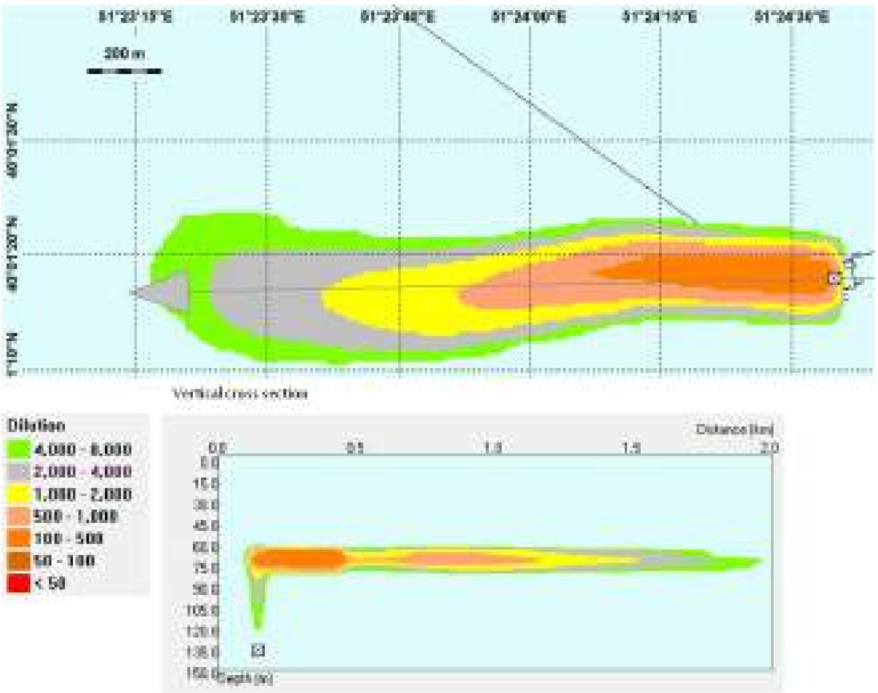


Figure 17: Flood, Clean & Gauge ACE, overview and cross section of minimum dilution - winter

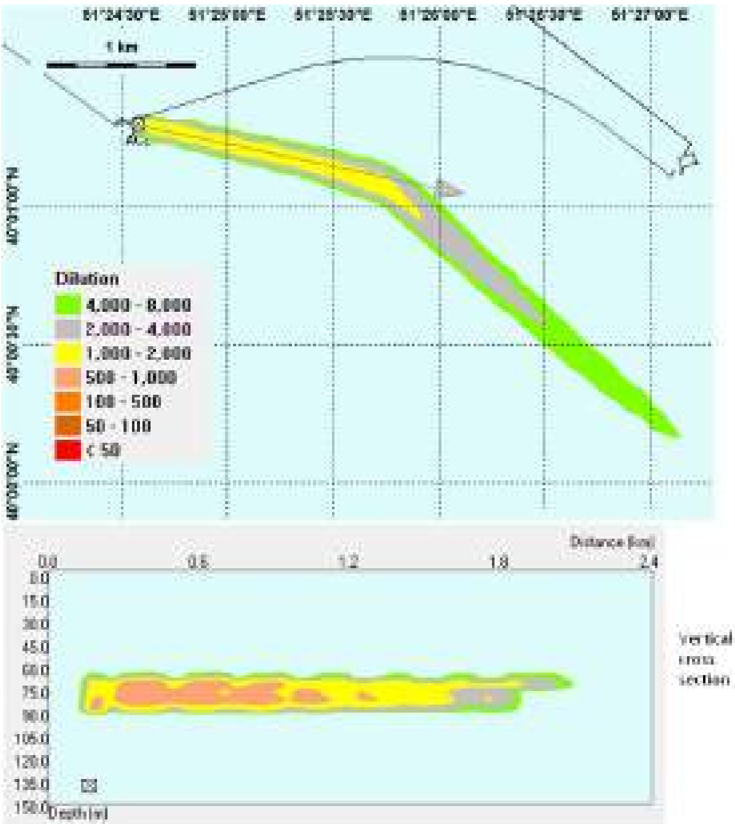


Figure 18: Flood, Clean & Gauge ACE, overview and cross section of minimum dilution - summer

4.3.4 Flood, Clean & Gauge ACE (100 % overfill) (Scenario 5)

The maximum volume of water column affected for this scenario is shown in plan and cross section in Figure 19 (winter) and Figure 20 (summer).

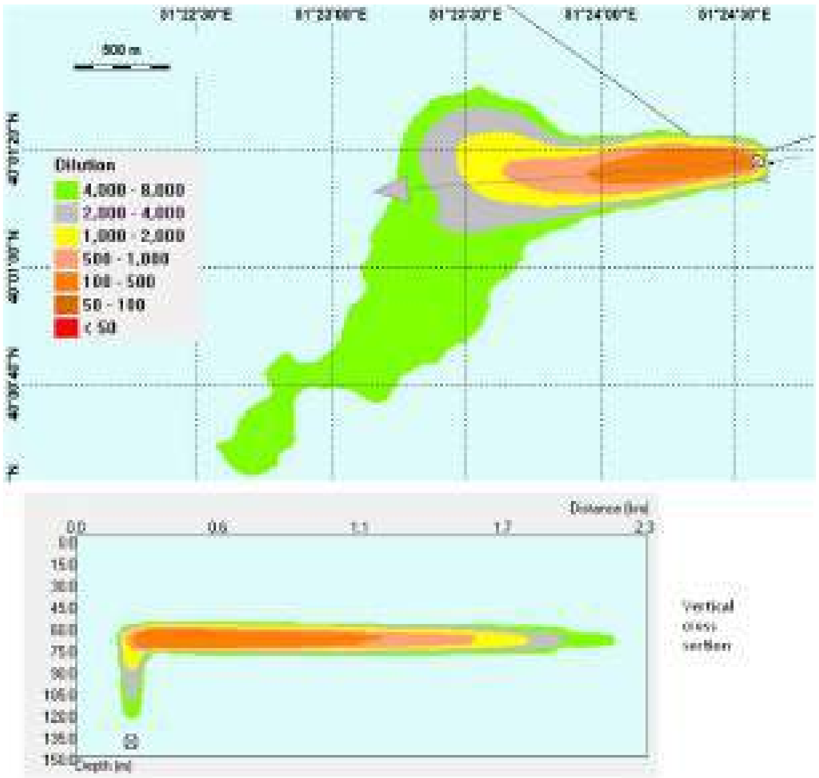


Figure 19: Flood, Clean & Gauge ACE, overview and cross section of minimum dilution - winter

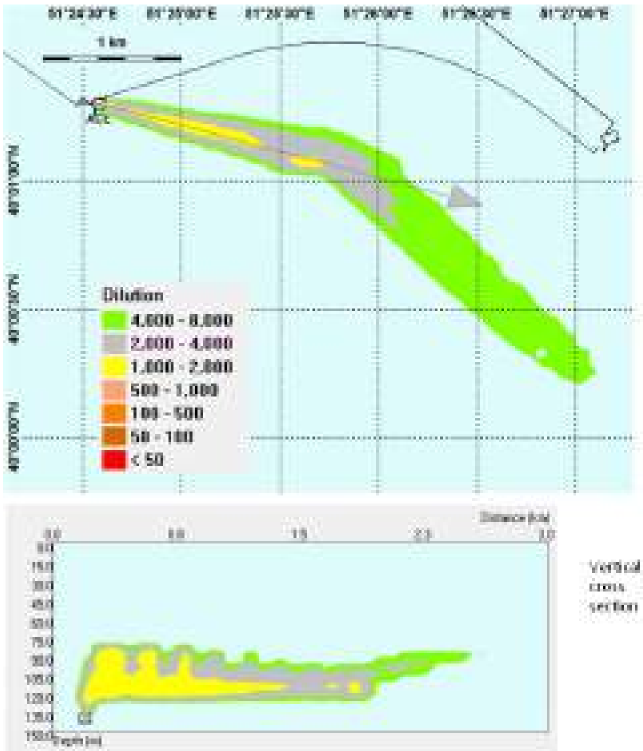


Figure 20: Flood, Clean & Gauge ACE, overview and cross section of minimum dilution - summer

4.3.5 Dewater 90% pipeline volume to ACE (Scenario 6)

The maximum volume of water column affected for this scenario is shown in plan and cross section in Figure 21 (winter) and Figure 22 (summer).

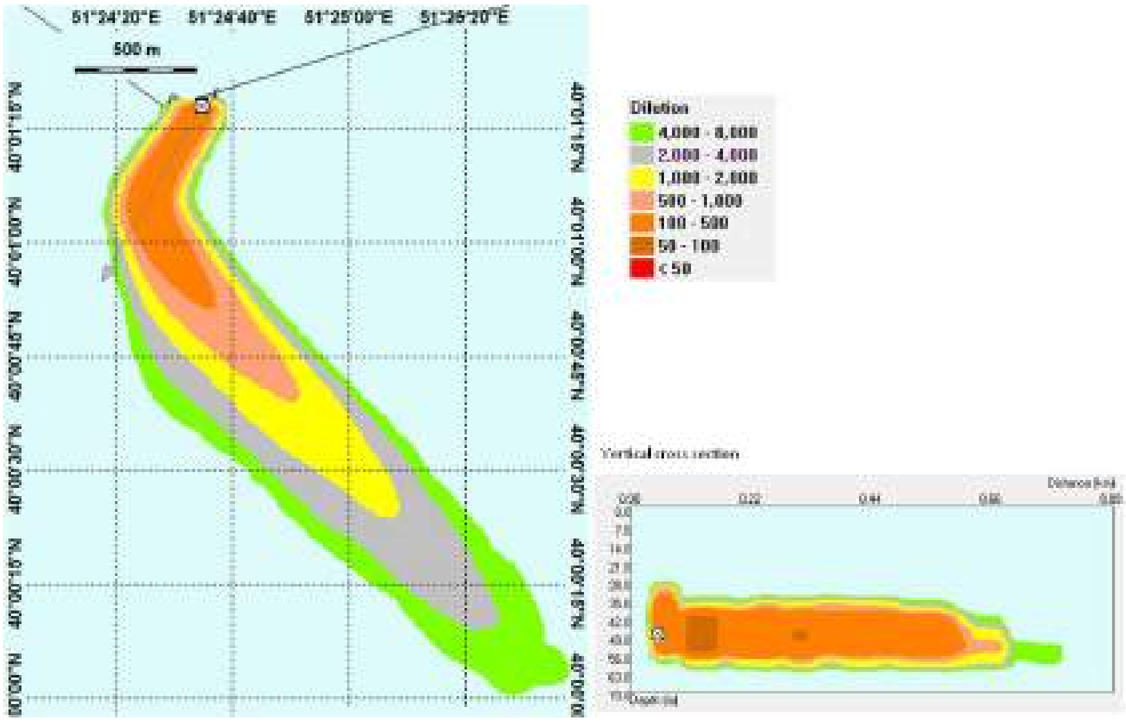


Figure 21: Dewater 90% pipeline volume to ACE - overview and cross section of minimum dilution - winter

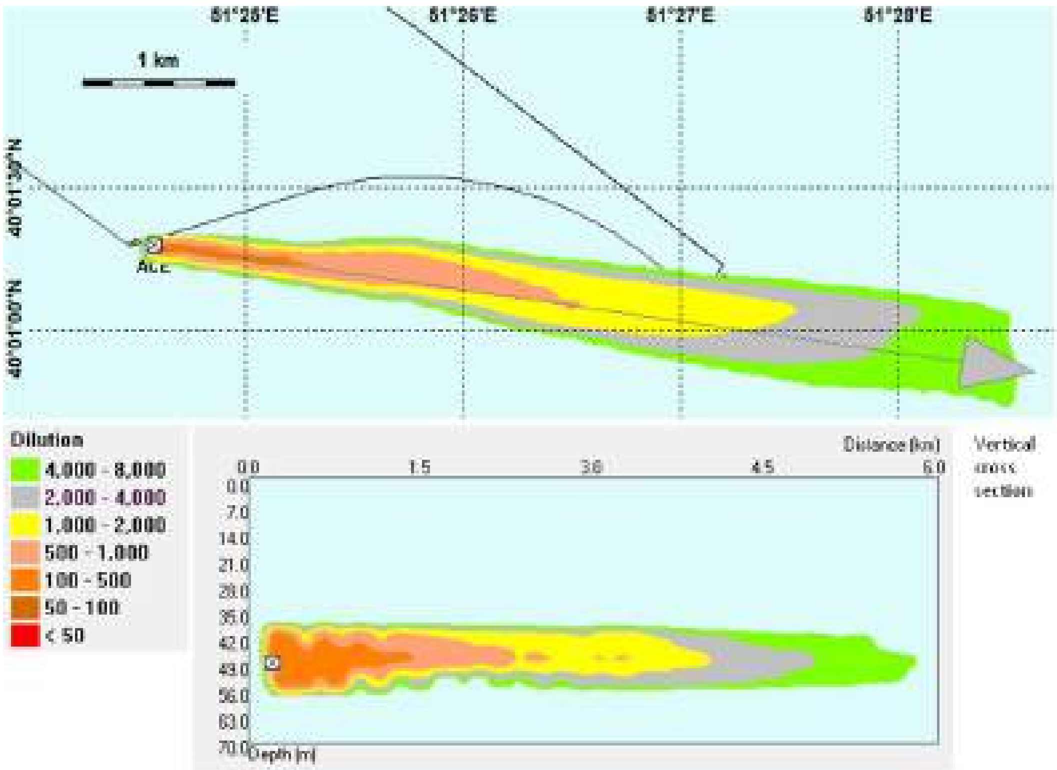


Figure 22: Dewater 90% pipeline volume to ACE - overview and cross section of minimum dilution - summer

4.3.6 Clean & Gauge, CA-CWP to EA (Scenario 7)

The maximum volume of water column affected for this scenario is shown in plan and cross section in Figure 23 (winter) and Figure 24 (summer).

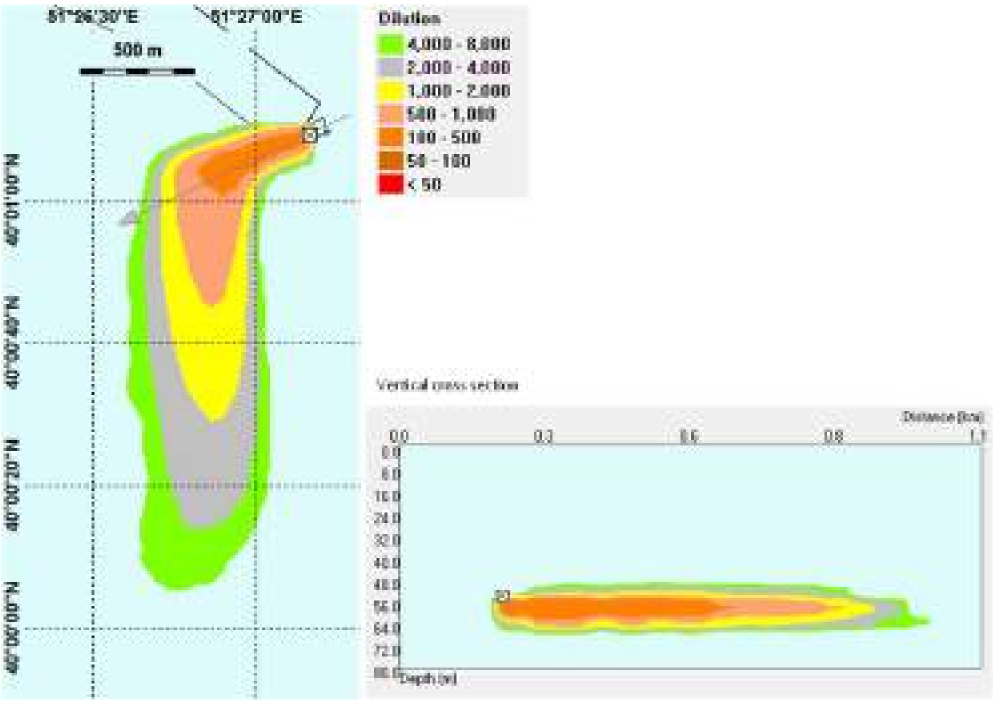


Figure 23: Clean & Gauge, overview and cross section of minimum dilution - winter

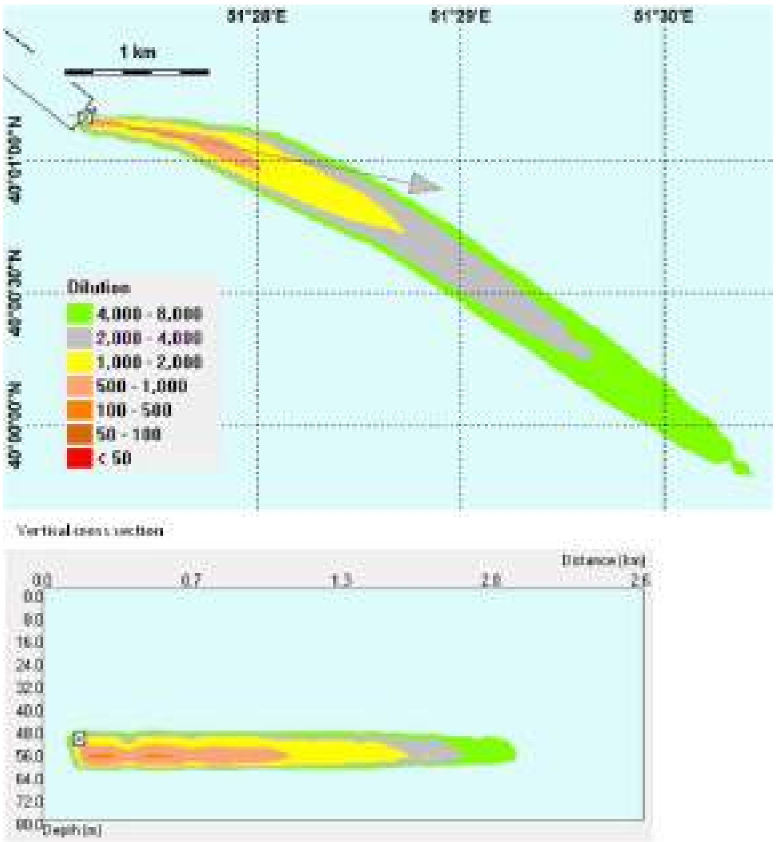


Figure 24: Clean & Gauge, overview and cross section of minimum dilution – summer

4.3.7 EA Water Injection Riser flush (Scenario 8)

The maximum volume of water column affected for this scenario is shown in plan and cross section in Figure 25 (winter) and Figure 26 (summer).

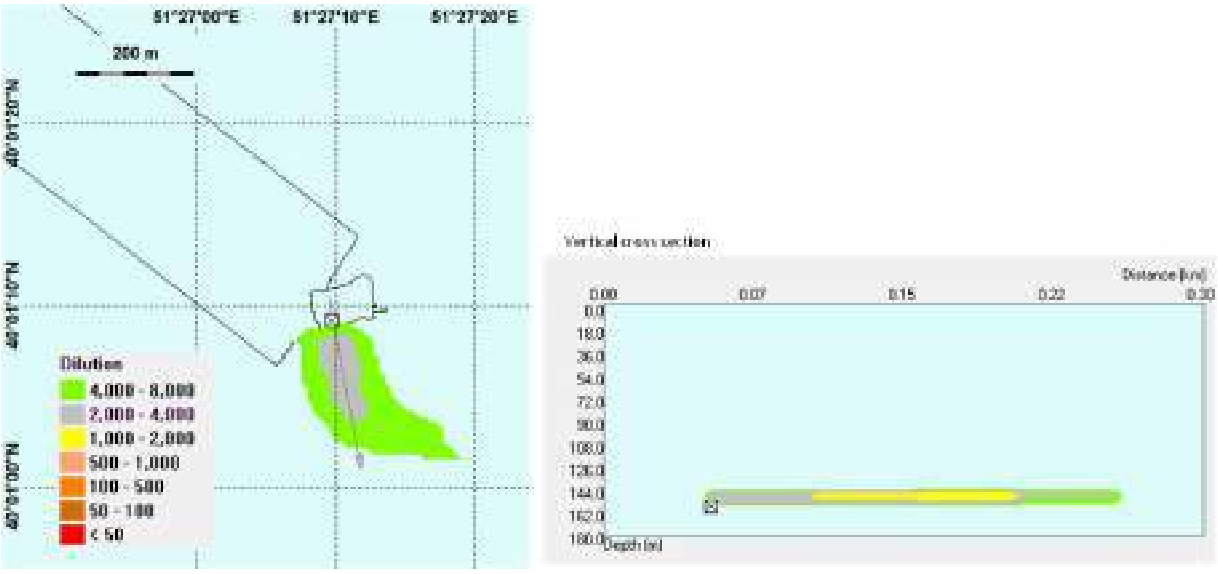


Figure 25: EA water injection riser flush, overview and cross section of minimum dilution - winter

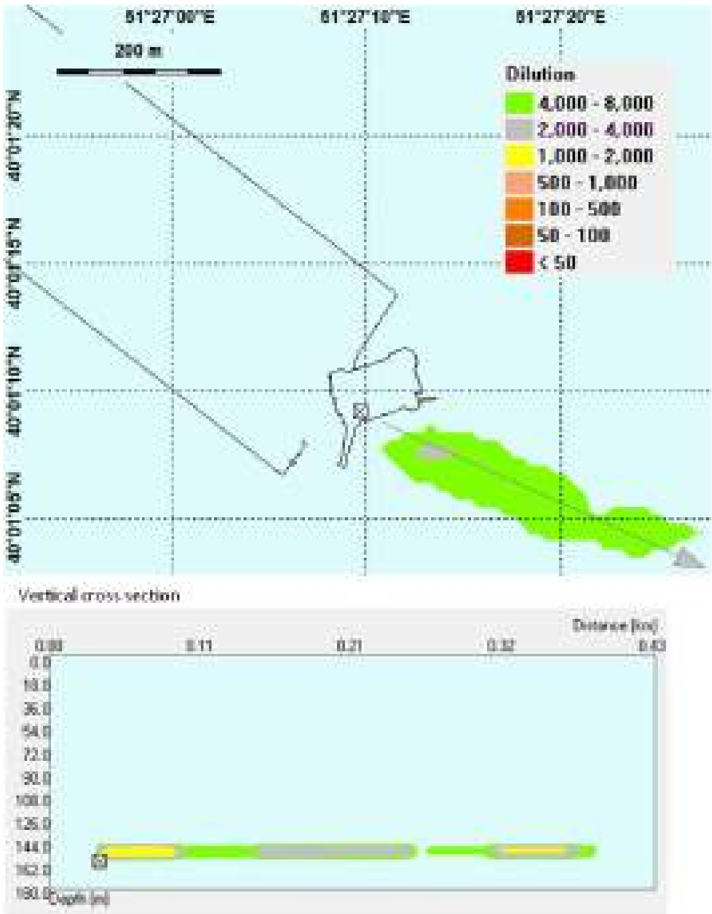


Figure 26: EA water injection riser flush, overview and cross section of minimum dilution - summer

4.3.8 Water Replacement CA-CWP to ACE (Scenario 9)

The maximum volume of water column affected for this scenario is shown in plan and cross section in Figure 27 (winter) and Figure 28 (summer).

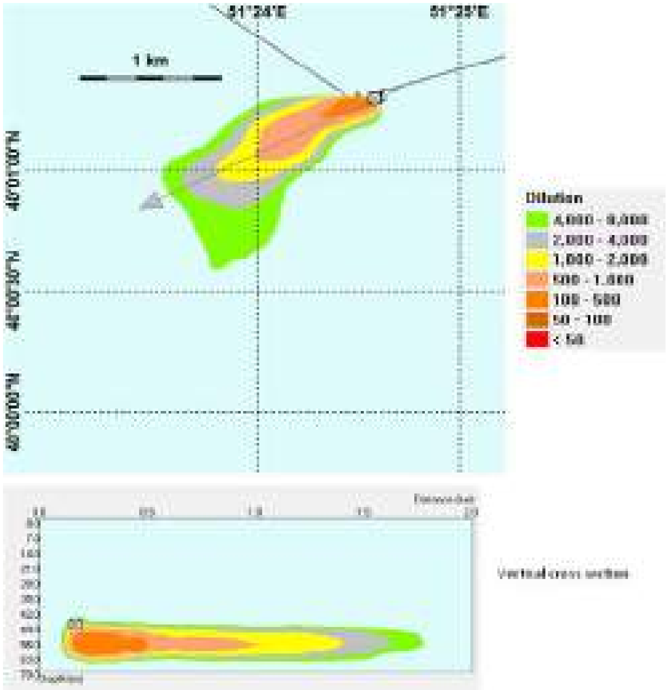


Figure 27: Water Replacement CA, overview and cross section of minimum dilution - winter

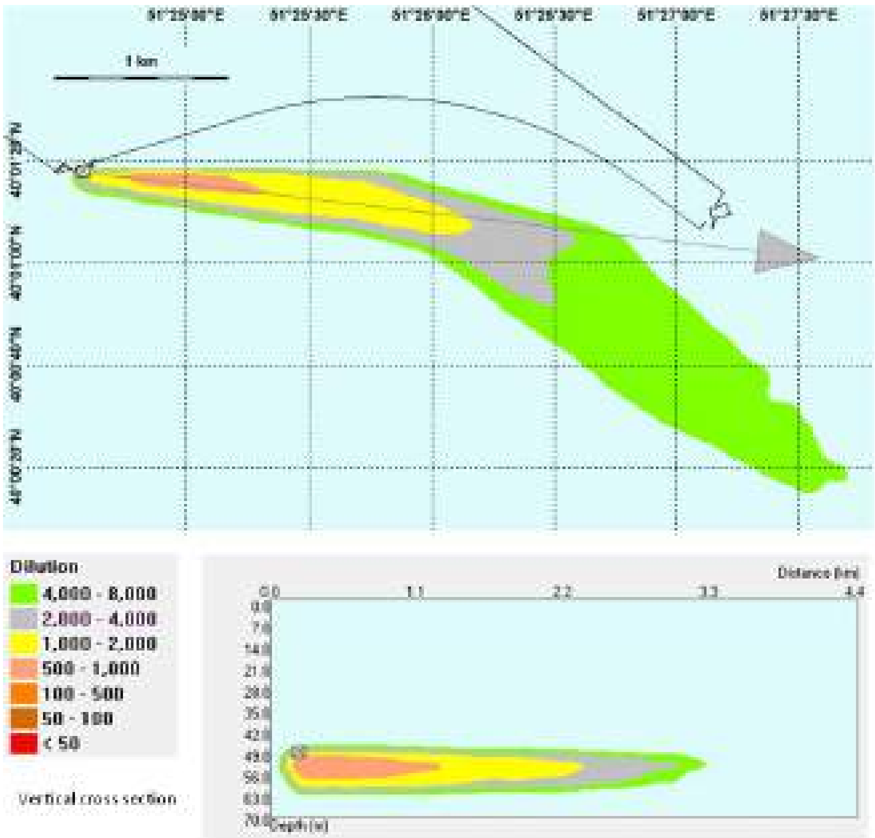


Figure 28: Water Replacement CA, overview and cross section of minimum dilution – summer

4.4 Summary: BOP discharges

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 simulation contains a wide range of BOP discharges and the plume shown is cumulative. 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 dilution factor of 500 with a slightly higher rise in winter due to the different ambient temperature profile. The exact orientation and geometry of discharges will depend on the design of the BOP, but the results are believed to be representative in terms of the area and volumes affected under the relatively poor dispersion conditions selected from the metocean data. The plume is completely dispersed to below a dilution 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 dilution factor of 500.

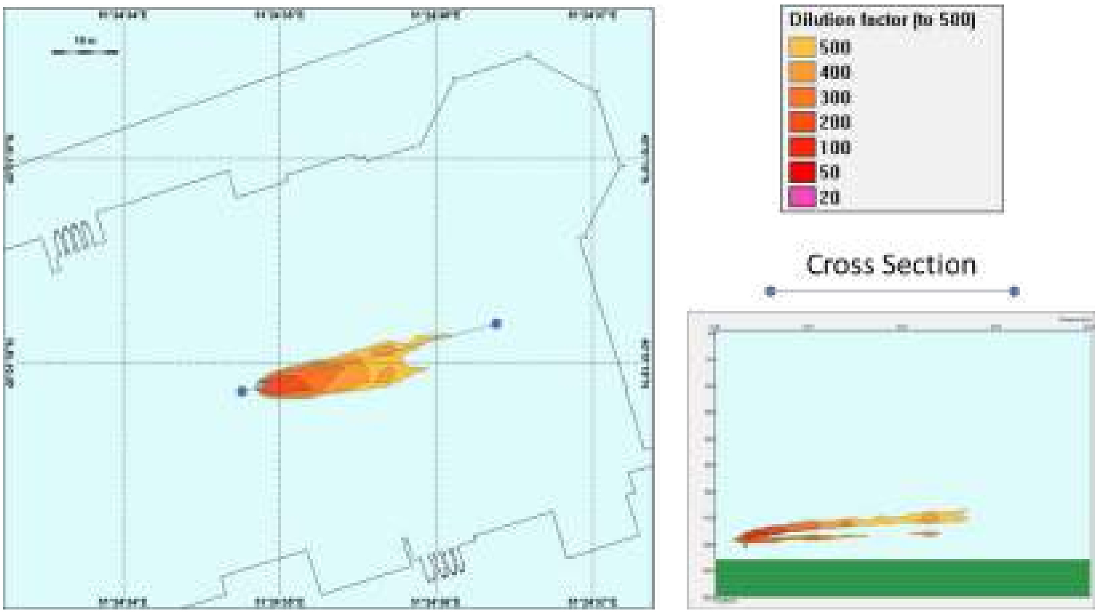


Figure 29: Dilution of BOP discharges - summer

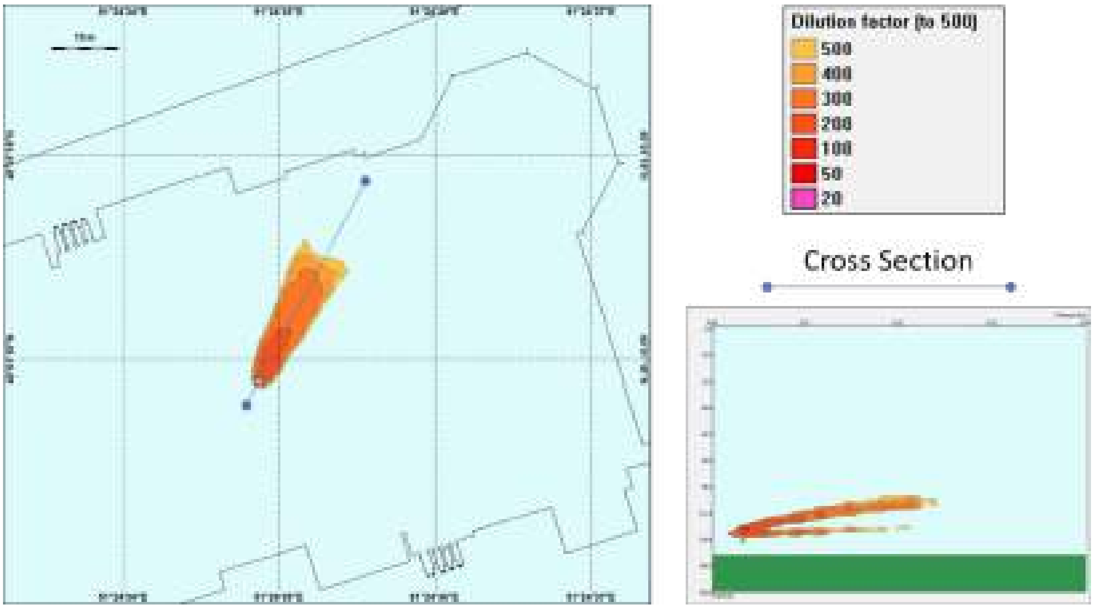


Figure 30: Dilution of BOP discharges - winter

4.5 Summary: Cement washout discharges

4.5.1 MODU cement washout discharges

The cement washout discharge modelling predicts that the cement concentration drops below 5 ppm (considered to represent background) after 3.5 hours (summer) and 3.5 hours also in winter and within a distance of 0.97 km (summer) and 0.60 km (winter). The modelling also indicates that less than 0.05% of the cement solids would be deposited on the seabed within 2.5 km of the point of discharge (summer) and approximately 0.1% in winter.

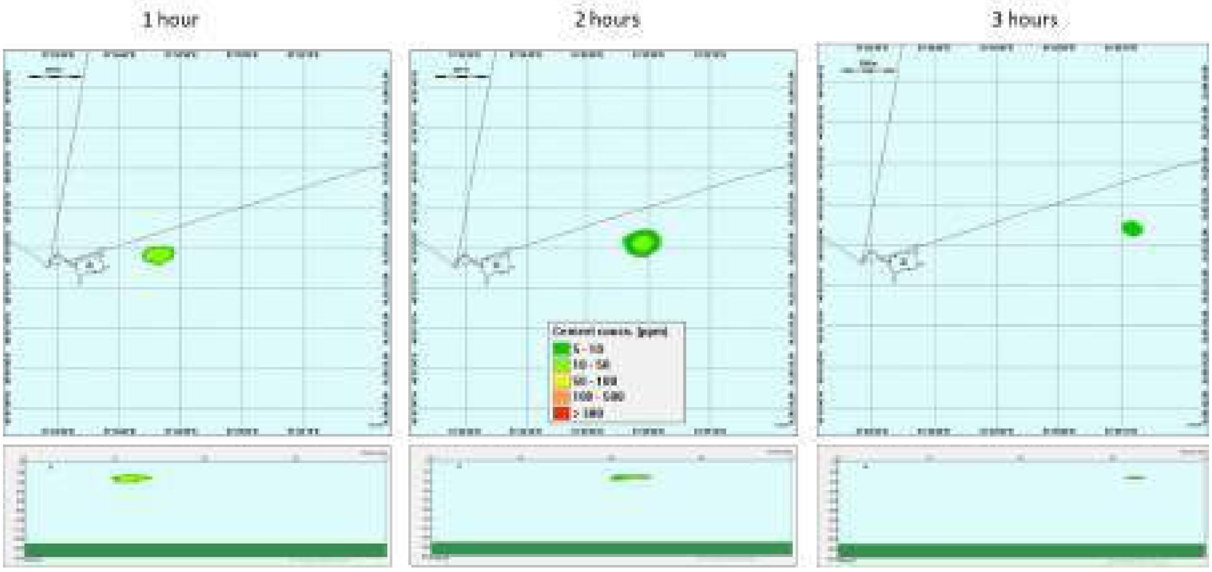


Figure 31: Water column dispersion of MODU cement washout discharges - summer

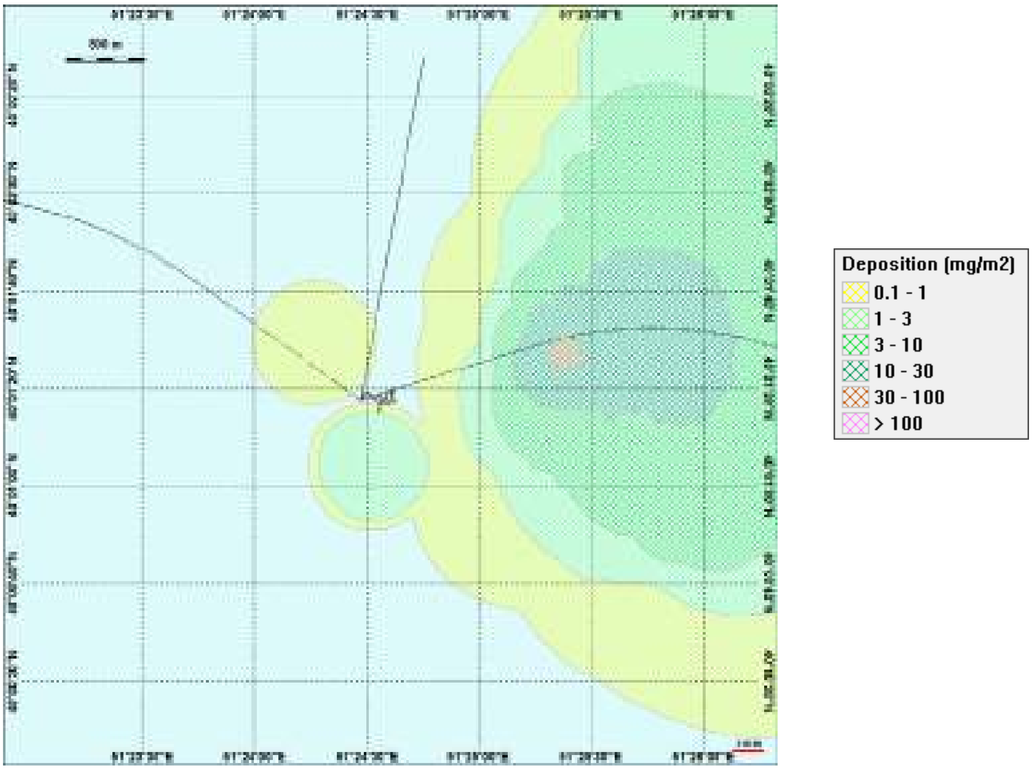


Figure 32: Seabed deposition of MODU cement washout discharges (one well) - summer

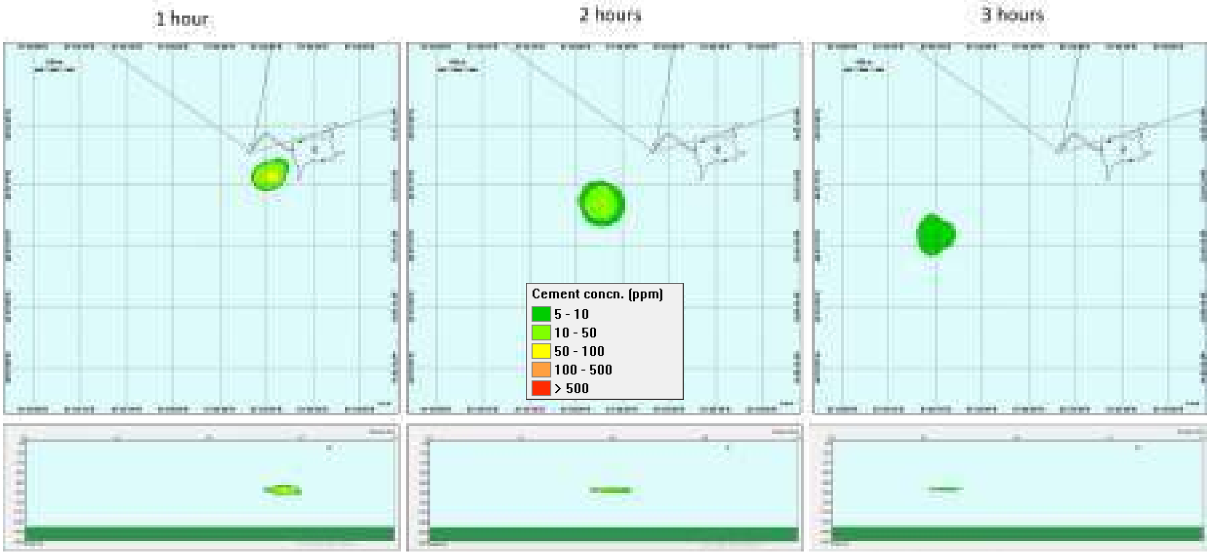


Figure 33: Water column dispersion of MODU cement washout discharges - winter

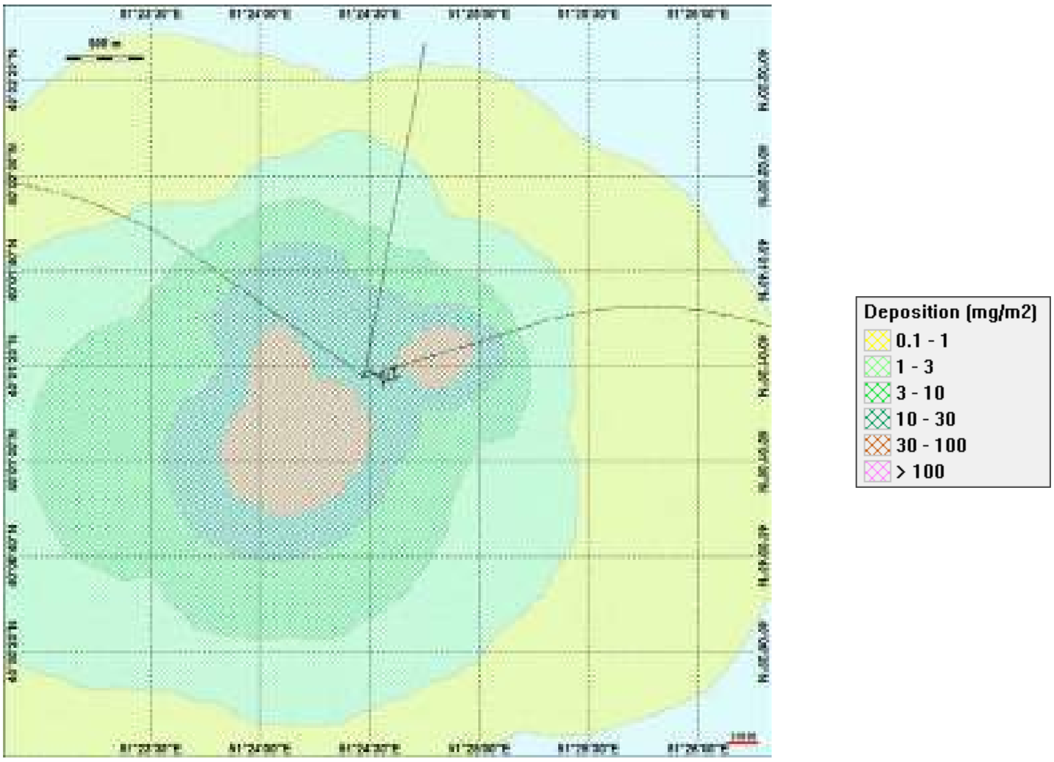


Figure 34: Seabed deposition of MODU cement washout discharges - winter

4.5.2 Platform cement discharges

The cement washout discharge modelling predicts that the cement concentration drops below 5 ppm (considered to represent background) after 5.5 hours (summer) and 5.5 hours (winter) and within a distance of 1.40 km (summer) and 0.78 km (winter). The modelling also indicates that approximately 2.0% of the cement solids would be deposited on the seabed within 2.5 km of the point of discharge (summer) and approximately 3.3% in winter.

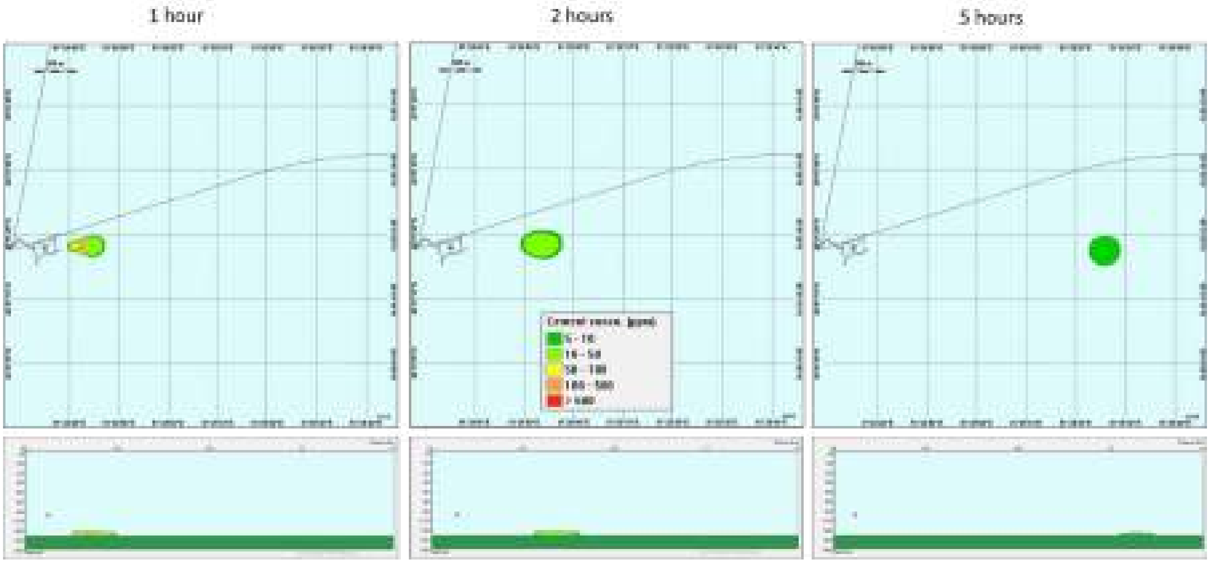


Figure 35: Water column dispersion of Platform cement washout discharges - summer

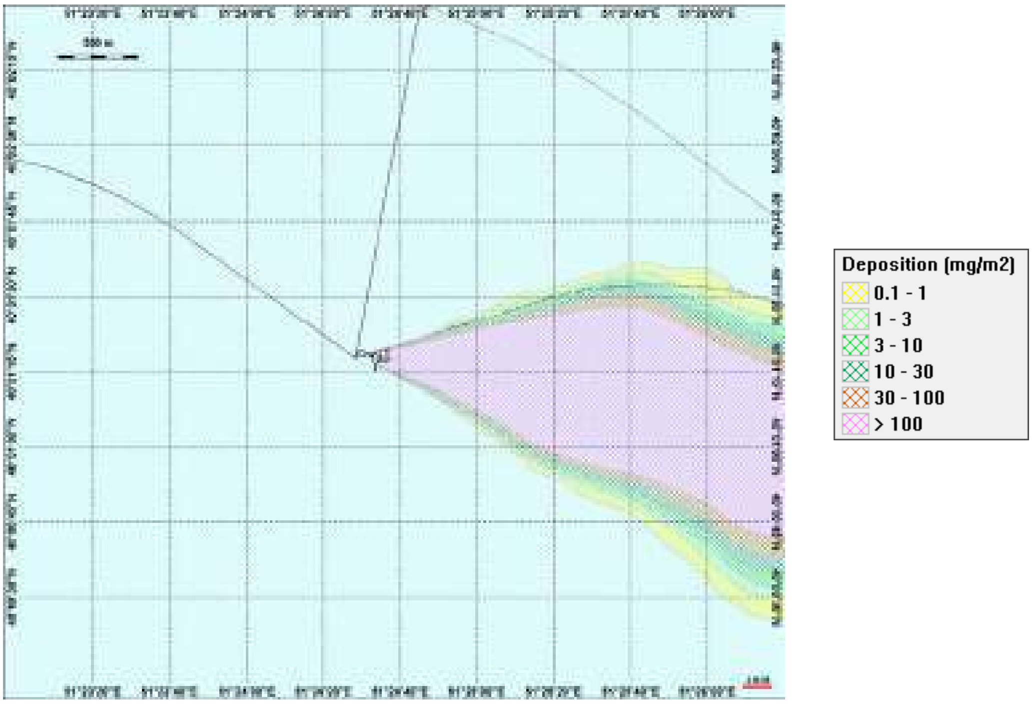


Figure 36: Seabed deposition of Platform cement washout discharges - summer

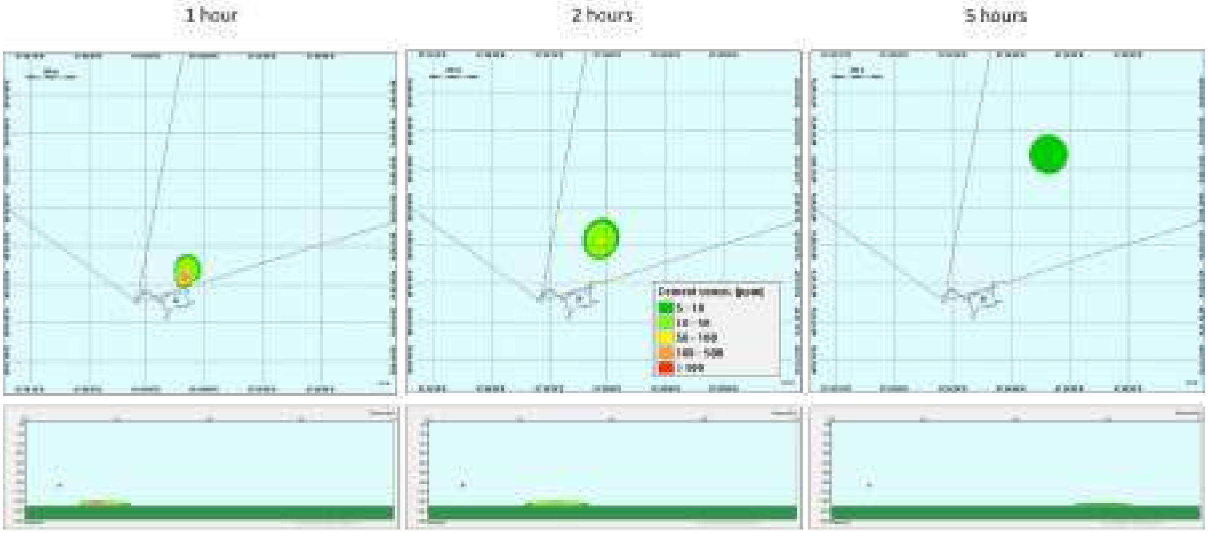


Figure 37: Water column dispersion of Platform cement washout discharges - winter

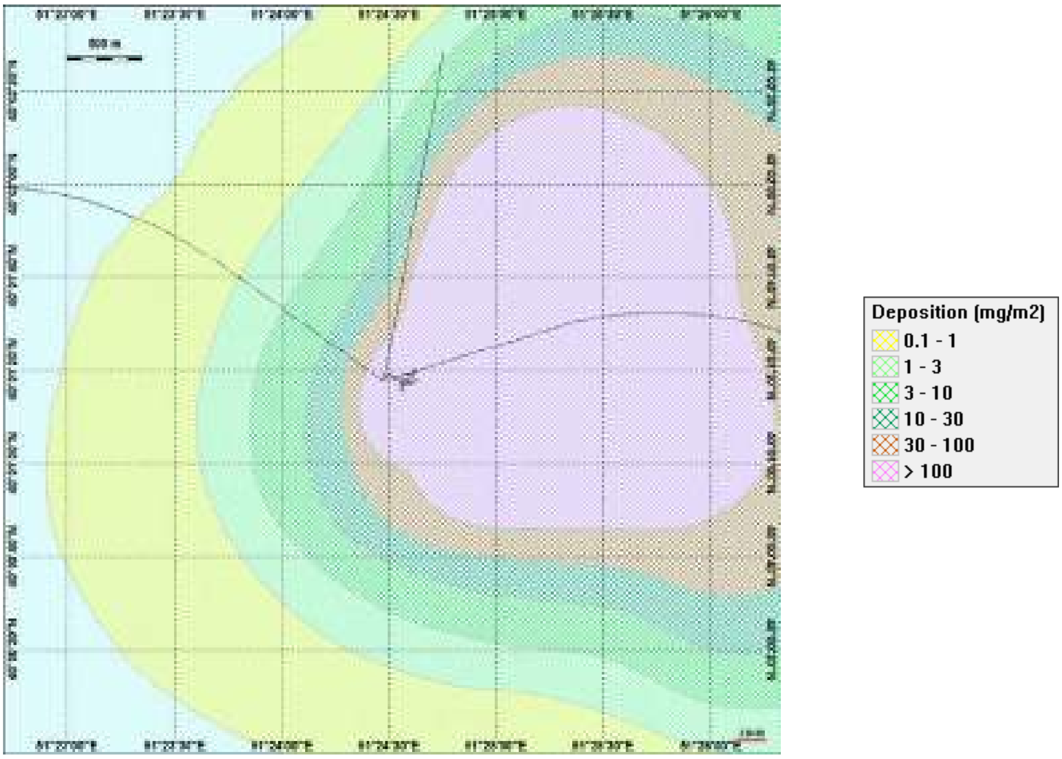


Figure 38: Seabed deposition of Platform cement washout discharges - winter

4.6 Summary: Cooling water discharges

The multiple combinations of pre-drilling/operations, summer/winter and low/high currents are shown graphically in Figure 40 to Figure 47. The first picture in each figure is a three-dimensional representation of the plume, and the second picture is a plan view of the 3°C isotherm, i.e. the point at which the temperature difference equals the World Bank standard (i.e. *"Temperature of wastewater prior to discharge does not result in an increase greater than 3°C of ambient temperature at the edge of a scientifically established mixing zone..."*).

A summary and comparison of the maximum ranges at which the 3°C isotherm is reached is shown in Figure 39. This shows that in all cases the range is 12 metres or less. All the cases terminate with the mixing zone - called the 'near field region' - of the plume in the water column, i.e. the mixing zone is not curtained by reaching the sea surface nor does it reach the seabed. In the three-dimensional representations, the near field region is in all cases significantly further away from the release than the 3°C isotherm, i.e. the temperature difference at the edge of the mixing zone is always less than 3°C.

In the light of the short distances to the 3°C isotherm and the fact that the mixing zone continues to extend beyond these distances, it is concluded that under no circumstances is the 3°C criterion exceeded at the edge of a scientifically established mixing zone.

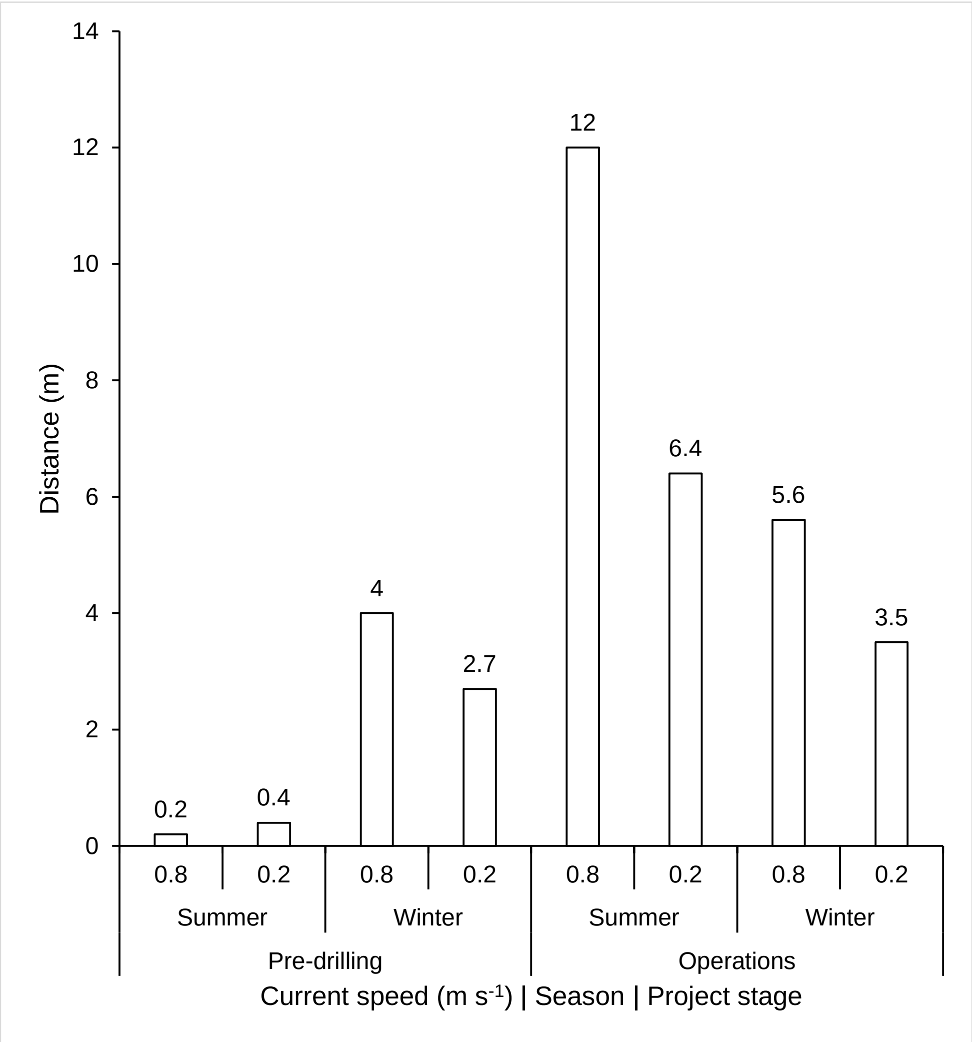


Figure 39: Maximum distance from discharge at which the temperature difference between the effluent and the ambient water is >3°C (m) in all discharge scenarios considered.

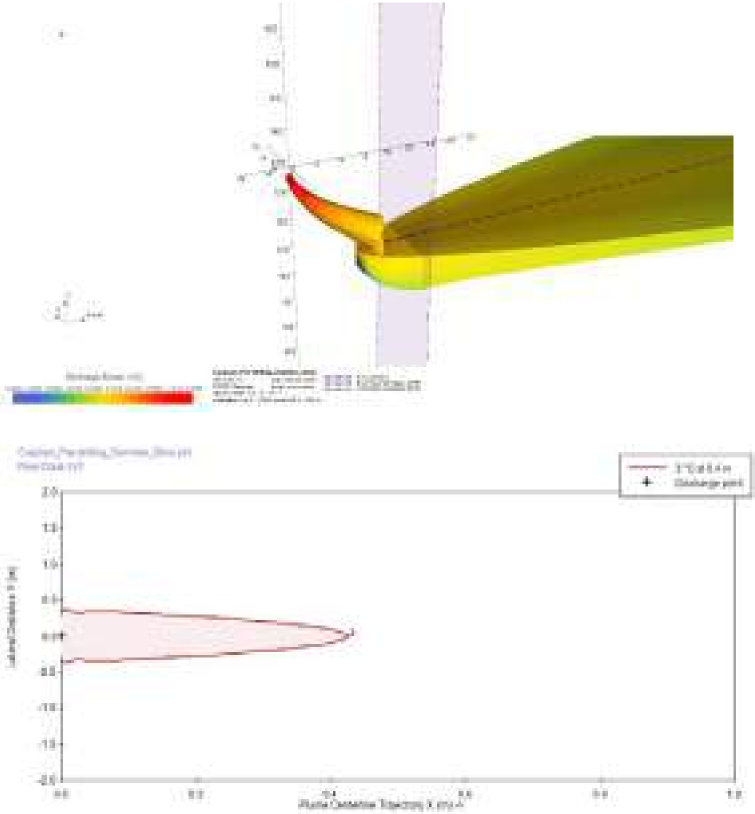


Figure 40: 3D representation of temperature excess in cooling water plume and plan view of 3°C isotherm - pre-drilling, summer, low current

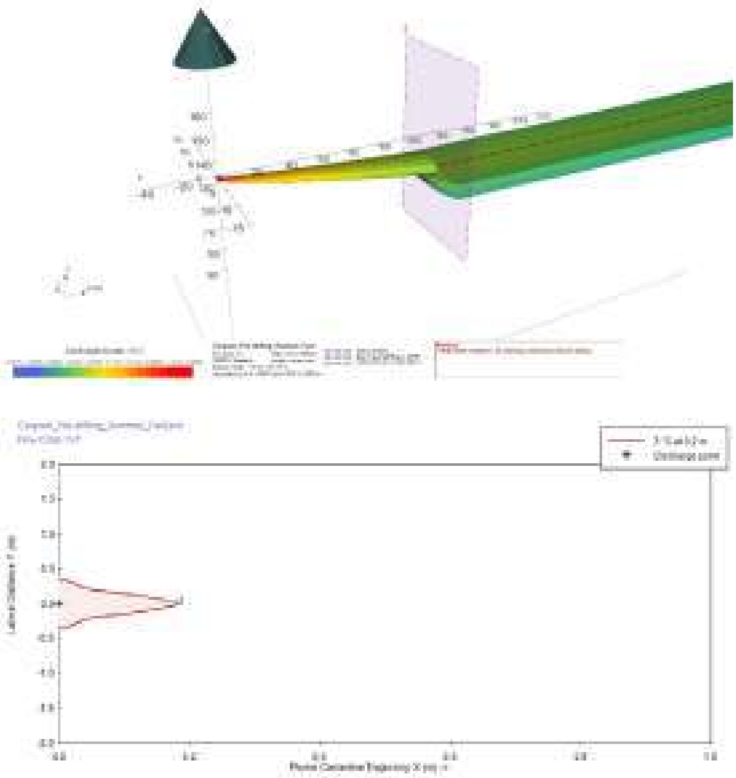


Figure 41: 3D representation of temperature excess in cooling water plume and plan view of 3°C isotherm - pre-drilling, summer, high current

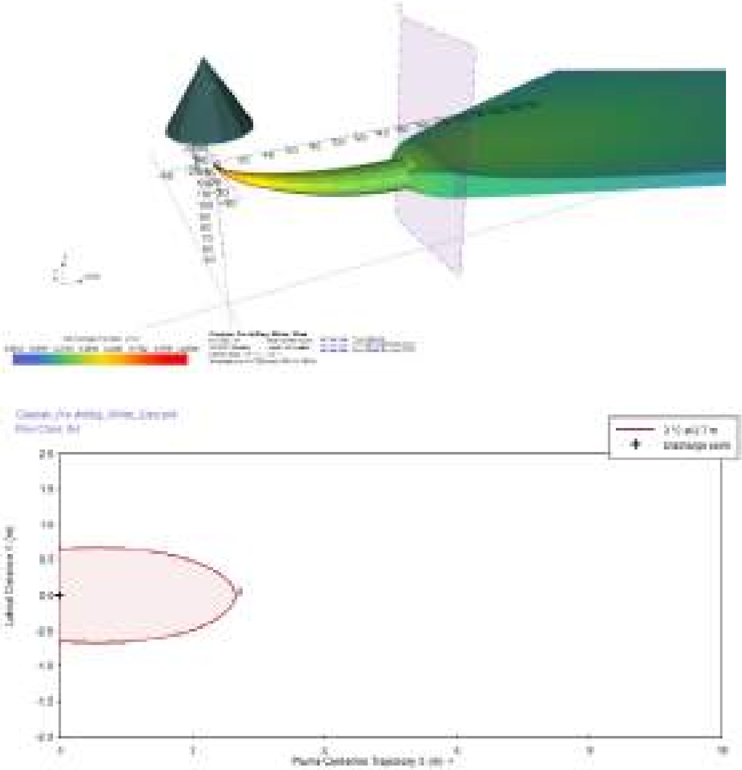


Figure 42: 3D representation of temperature excess in cooling water plume and plan view of 3°C isotherm - pre-drilling, winter, low current

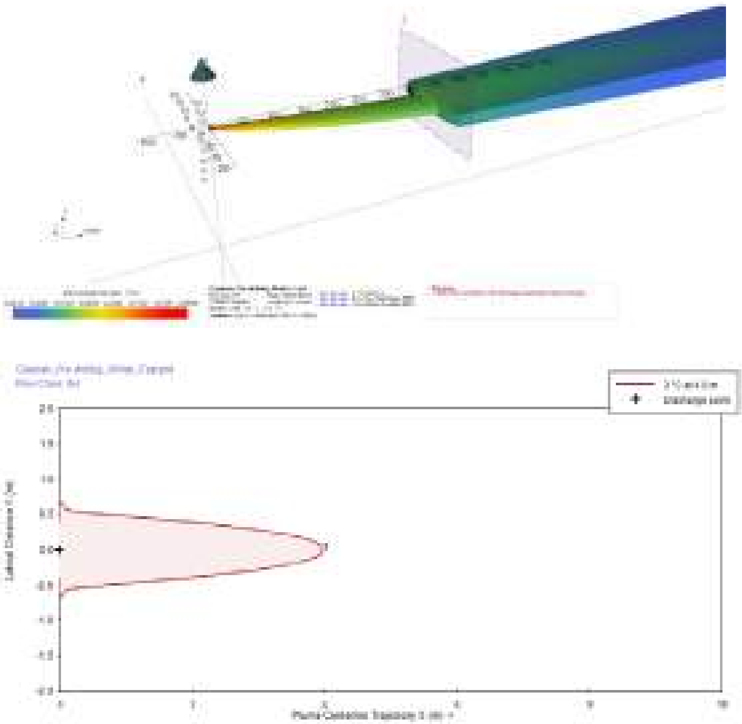


Figure 43: 3D representation of temperature excess in cooling water plume and plan view of 3°C isotherm - pre-drilling, winter, high current

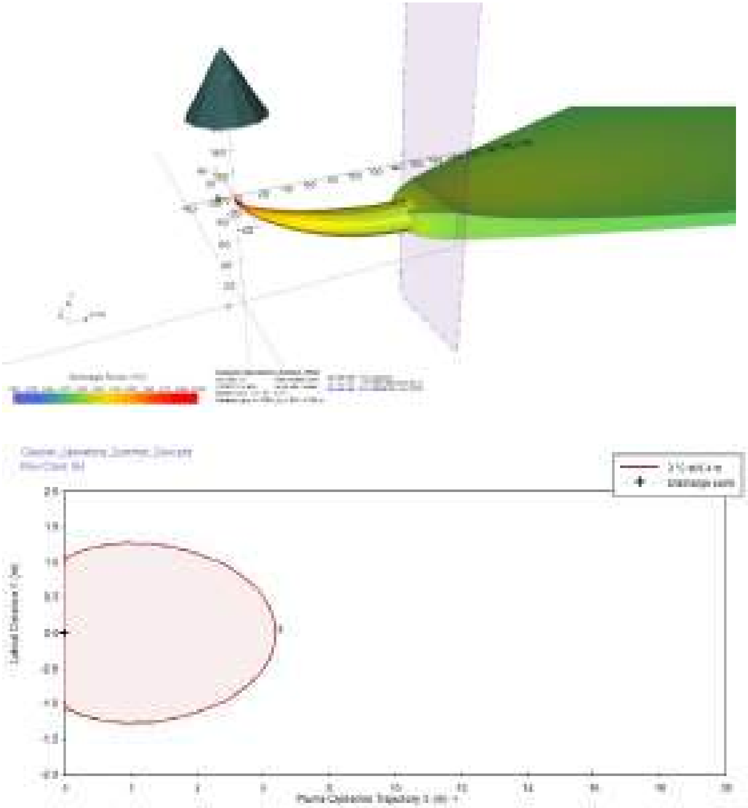


Figure 44: 3D representation of temperature excess in cooling water plume and plan view of 3°C isotherm - operations, summer, low current

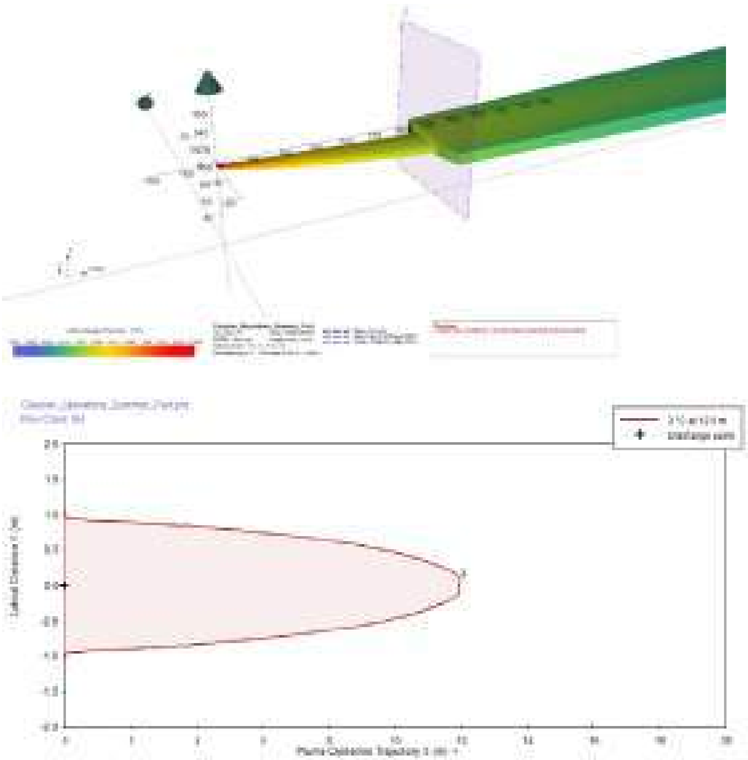


Figure 45: 3D representation of temperature excess in cooling water plume and plan view of 3°C isotherm - operations, summer, high current

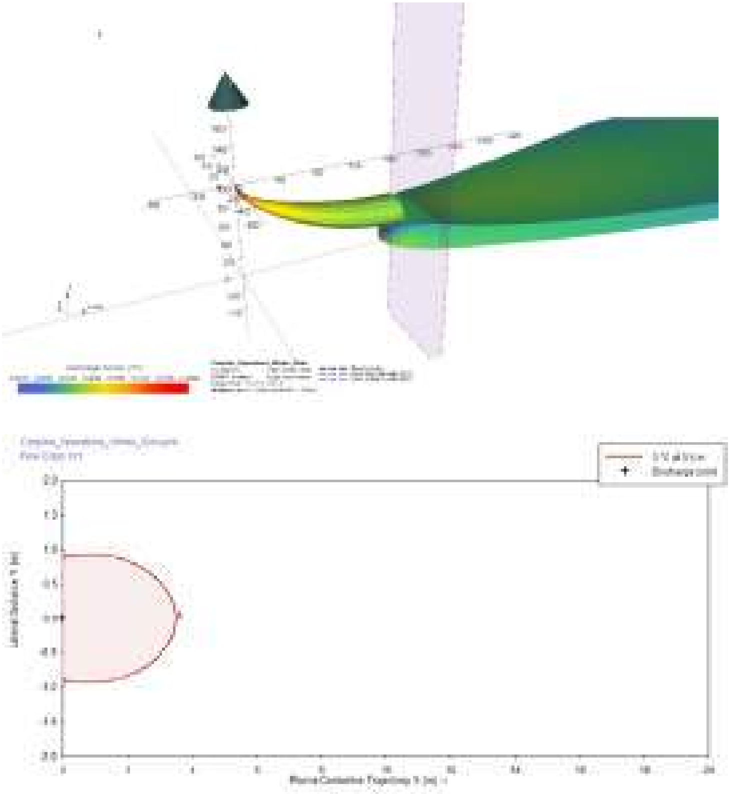


Figure 46: 3D representation of temperature excess in cooling water plume and plan view of 3°C isotherm - operations, winter, low current

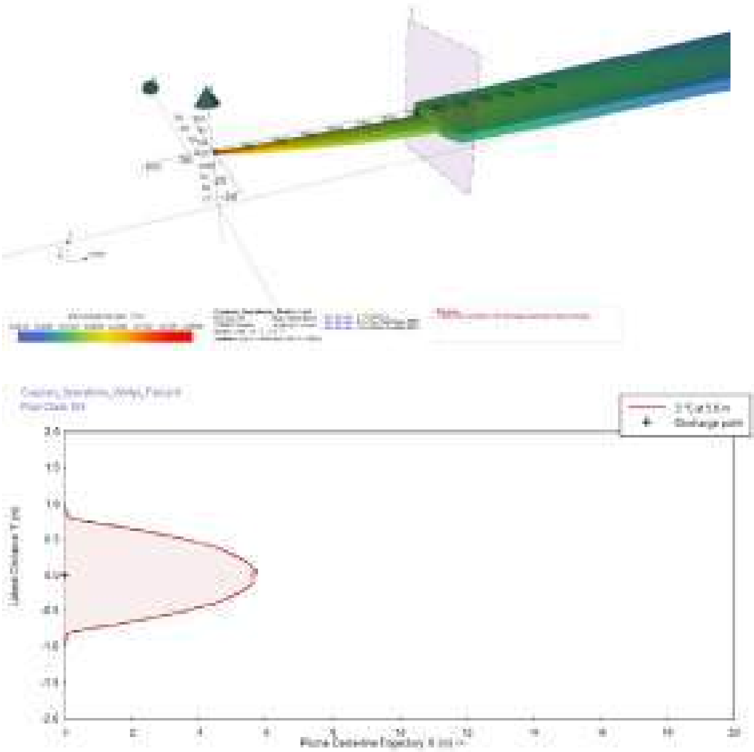


Figure 47: 3D representation of temperature excess in cooling water plume and plan view of 3°C isotherm - operations, winter, high current

5 Uncertainties

5.1 Drilling discharges

5.1.1 Release volumes

Discharges from drilling operations are closely linked to well design and are therefore quite predictable. A contingency has been applied in the form of washout/overdrill to account for uncertainties in the amount of cuttings predicted and for variability between individual wells.

5.1.2 Characterisation of the release

Barite is a well-defined and specified material whose properties are well known. Cuttings themselves can vary in particle size distribution between different geologies and drilling bit designs but this is not thought to significantly affect the deposition pattern, and the source used by the model uses real-world size distribution that give model results that correlate with observations in the field.

5.2 Uncertainties: pipeline discharges

5.2.1 Release geometry

The release geometry is fixed and not a significant uncertainty.

5.2.2 Release volumes and rates

There may be some uncertainty regarding the exact duration and flowrates. It is understood that high estimate flow rates and short durations have been selected based on the specific plant installed and mode of operation to give a conservative estimate of the most acute discharge.

5.2.3 Fluid properties

The temperature of the fluids discharged has been supplied by BP and is expected to be reasonably stable over the short term as it arises from subsurface.

5.3 BOP discharges

Discharges from BOP testing are run consecutively from a single discharge point, and cumulative areas affected are presented. If these were more spaced out either in time, or spatially, the discharge would be more diluted. BOP designs vary between manufacturers but share common overall geometries and modes of operation.

5.4 Cement discharges

The volumes and timings of cement discharges are estimates based on operational practices and typical cement unit sizings. The modelling suggests that a very small fraction of the cement reaches the seabed, and that the vast majority descends a short distance before being carried for many kilometres by prevailing currents, during which time it disperses. These overall conclusions are unlikely to change should the actual discharges be different, and the use of low-dispersion summer and winter conditions means that the predictions of areas affected are unlikely to be exceeded.

5.5 Cooling water discharges

The temperature and rate of cooling water discharges reflects directly on the rate of excess heat generation that needs to be absorbed from machinery, and this is a predictable property. It is possible that the cooling water system could operate at a different balance water rate and temperature (lower flow, larger temperature difference or higher flow, lower temperature difference) but this would nevertheless contribute heat at the same rate into the receiving water. Given that the discharges are into the water column and they are not restricted by the water surface or seabed, and given that the heat reaches near to ambient temperatures within tens of metres under a wide range of conditions, the conclusions of the cooling water modelling are considered robust.

CORMIX outputs include statement that the model is reliable in most cases and can have an associated error of ±50% (standard deviation). Additionally, the cross-section of the water body is modelled as a straight, uniform channel and ambient velocity is assumed to be uniform over time. These factors would not affect the overall conclusions of the modelling in terms of rapid heat dispersion in a relatively small mixing zone.

5.6 Common uncertainties

5.6.1 Metocean data

Seasonal variations in temperature occur, mainly in top tens of metres of the water column. To show the effect of summer and winter conditions, separate modelling runs have been undertaken in February and August.

For the pipeline discharges, the metocean dataset is limited by the short duration of the discharge. To overcome this, a continuous discharge has been modelled over the whole of each month to identify conditions where the largest volumes of the water column might be affected.

Seasonal variations in salinity are not expected.

The densities of cooling water discharges consisting of treated seawater are calculated using the UNESCO equation with temperature and salinity inputs the temperature (data provided by the client). This is not considered a significant source of uncertainty.

Bottom temperatures (for 144 m) have been modelled for all scenarios using linear regression due to the temperature data available reaching 120 m. Surface temperatures for operational project stage discharges were calculated using linear regressions due to the temperature stratification being assumed to be linear at the discharge depth below the pycnocline and minimise any distortion in the results of the discharge models.

6 Conclusions

The modelling of marine discharges associated with the ACE Project predicted the following.

Drilling discharges:

1. For pre-drill wells, the most significant accumulations of drill cuttings are predicted within 50 m of the drilling template with a peak thickness of around 6.4 m. Approximately 9,000 - 10,500 m^2 of seabed is predicted to be covered by 1 mm or more thickness of deposits.

2. For the drilling of 38 operational wells, accumulations of drill cuttings are predicted to be around a maximum of 10.1 m thick. Approximately 22,400 m^2 of seabed is predicted to be covered by 1 mm or more thickness of deposits.

Pipeline discharges:

3. Discharges from pipeline pre-commissioning and hydrotest discharges result in plumes in the water column that reach a dilution of at least 8,000 in 29 hours or less, and within 10.1 km of the release.

4. Discharges remain in the main water column and are not predicted to impinge on the water surface or the seabed.

BOP discharges:

5. The plume from BOP actuation discharges extends approximately 25-30m in summer and winter in the lower water column before dispersing to below a factor of 500 within two minutes after the end of the discharge.

Cement discharges:

6. The cement discharge modelling predicts that the cement concentration drops below 5 ppm (considered to represent background) within 5.5 hours of the release and within a distance of 1.40 km in all scenarios modelled. The discharged cement is widely dispersed in the water column with no more than 0.1% of the solids being deposited on the seabed within 2.5 km of the release for releases from the MODU at 11 m depth, and up to 3.0% being deposited on the seabed within 2.5 km of the release for releases at 104 m depth from the ACE platform.

Cooling water discharges:

7. In all cases of cooling water discharges, the range at which the 3°C isotherm is reached is 12 metres or less. The 3°C criterion is not exceeded at the edge of a scientifically established mixing zone under any conditions.

7 References

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APPENDIX 12A

Azeri Central East Social Activities and Events

ACTIVITY/INTERACTIONS

ID (R=Routine)	Activity	Scoped In/Out	Event	Event Category
S1-R	Temporary employment through procurement of contractors (predrilling, construction and installation)	✓	Extension of existing employment workforce contracts	Employment
			Competition for jobs (perceived and actual) creating tension	Social Conflict
S2-R	Procurement of goods and services by large contractors	✓	Increased economic flows	Increased Economic Flows
S3-R	Enforcement of marine exclusion zones during vessel activities and around platform	×	Disruption to third-party vessels e.g. commercial shipping	Commercial Shipping and Fishing Operations
			Disruption to small scale and commercial fishing	
S4-R	Use of construction yards to construct and commission offshore and subsea facilities	×	Generation of noise, air emissions and dust at construction yards	Community Disturbance from Construction Yards/Community Health & Safety
S5-R	Use of road network to transport equipment, goods and materials to construction yards	×	Disruption of road users	Construction Traffic
S6-R	Demanning following construction works	✓	Reduction in workforce and end of contracts	Demanning
S7-R	The creation of employment for the platform operational workforce	✓	Creation of permanent job opportunities	Employment

APPENDIX 13A

Oil Spill Modelling Report

AECOM

Azeri Central East Oil Spill Modelling

A Report Produced By

More Energy Ltd

Figures & Tables

Figures

Tables

1 Introduction

1.1 The project

AECOM has commissioned More Energy Ltd on behalf of BP Exploration (Caspian Sea) Ltd to undertake an oil spill modelling study to establish the expected extent of the impacts associated with the following releases to sea. These are the worst-case releases that could be associated with the pre-drilling, construction and installation and operational phases of the proposed Azeri Central East (ACE) Project in the Caspian Sea (Figure 1).

The objective of the modelling is to establish the expected extent of the impacts associated with a release of hydrocarbons by establishing:

- Where hydrocarbons are likely to travel;
- How the oil and diesel is likely to disperse over time (both on the sea surface and in the water column);
- Expected behaviour of oil and diesel sheens on the surface;
- The extent to which oil is likely to arrive on the shoreline; and
- Where hydrocarbon concentrations could exceed certain thresholds in the water column.

The scenarios have been identified in conjunction with the BP project team.

This report presents the results of work undertaken to model these releases, and determine their extent.

The OSCAR (Oil Spill Contingency and Response) model from SINTEF (Stiftelsen for industriell og teknisk forskning) was used to model the crude oil and marine diesel release scenarios. OSCAR computes surface and subsurface transport, behaviour, weathering and fate of oil using a Lagrangian (particle tracking) approach, enabling explicit tracking of each particle's location and behaviour through time.

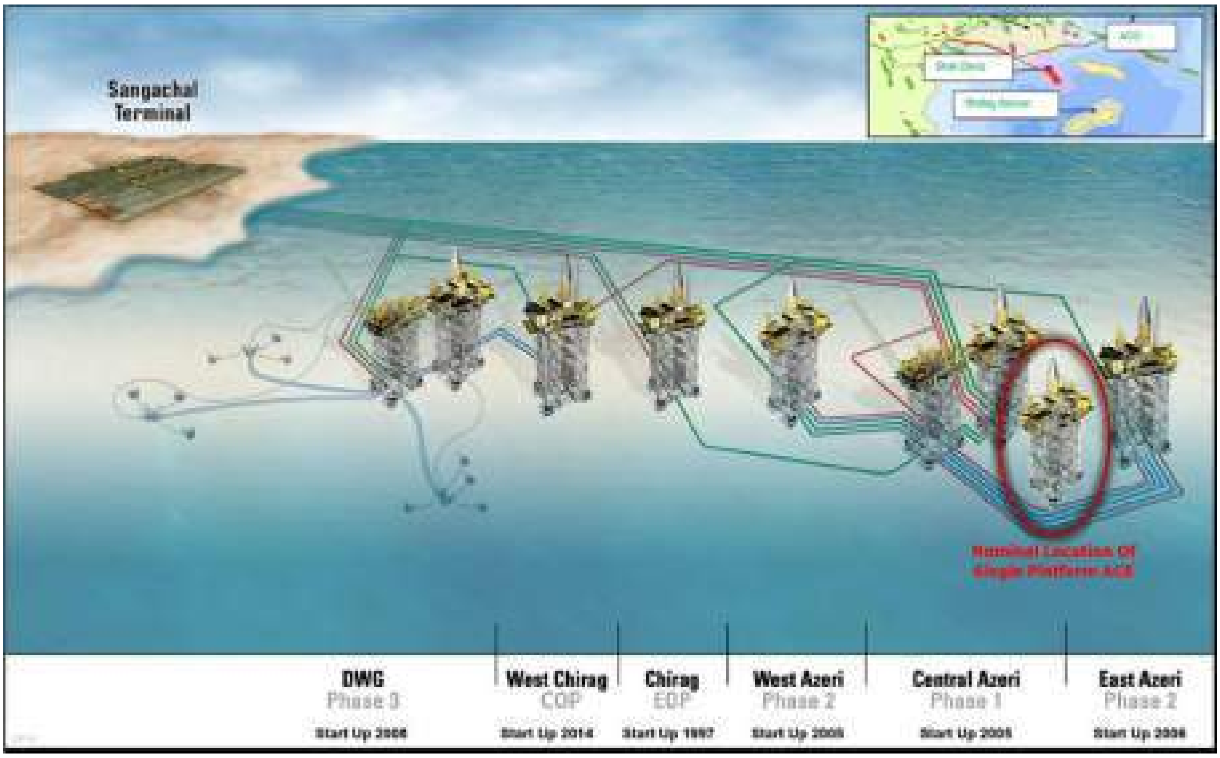

Figure 1: Azeri Chirag Gunashli (ACG) field layout including proposed Azeri Central East (ACE) platform

1.2 Scope of work

The scope of work was to model oil spills resulting from the predrilling, construction and installation and operational phases of the ACE Project and to determine their extent.

Modelling is undertaken using the oil weathering and dispersion model OSCAR 9.01 written by SINTEF using 3D metocean data and discharge parameters provided by BP that are specific to the Caspian Sea operations. Agreed scenarios have been modelled relating to different locations and discharge scenarios for:

- Scenario 1: Diesel release;
- Scenario 2: Seabed blowout of crude oil; and
- Scenario 3: Infield oil / produced water pipeline rupture.

Stochastic modelling of each scenario is undertaken demonstrating how the behaviour of the oil changes in variable metocean conditions, including typical summer and winter conditions.

Stochastic analysis of >100 runs:

- Probability of predicted visible slick above threshold;
- Profile of beaching times;
- Profile of mass accumulated onshore;
- Averaged mass balance statistics over model duration;
- Maximum exposure times of oil on surface and in water column; and
- Minimum arrival times of oil on surface and at shoreline.

For the worst scenarios of hydrocarbons reaching the shoreline in summer and winter periods, deterministic modelling is undertaken to predict the mass balance fate of the oil as it disperses over time, typical development and appearance of the surface slick and the typical behaviour of oil in the water column.

Deterministic model for worst case beaching (largest volume):

- Maximum surface extent and thickness of sheen;
- Distribution and density of oil reaching shore;
- Maximum water column concentrations over time;
- Time profile (mass balance) for surface oil, water column oil, shoreline oil, evaporation, biodegradation;
- Areas of surface affected over time and volumes of water column affected over time to certain concentrations or dilutions; and
- Deposition pattern and concentration in sediments.

Preferred thresholds for surface oil, shoreline and water column concentrations based on good international industry practice were agreed with BP on 17/04/18.

2 The Oil Spill Contingency and Response Model (OSCAR)

2.1 Introduction to the OSCAR model

The SINTEF OSCAR software is a sophisticated multifunction model that incorporates models of plume behaviour, oceanic dispersion, wind forcing, wave turbulence, oil weathering and behaviour including physical and chemical processes, environmental interaction, ecological impact and spill response. The model has been developed over 30 years and is the subject of verification and calibration by numerous field experiments both on surface spills and subsea releases e.g. as described in Reed et al. (1995 and 1996) and Johansen et al. (2001) as well as operational experience. It shares dispersion mathematics with sister models Dose-related Risk and Effect Assessment Model (DREAM) and ParTrack which have also been validated e.g. Niu and Lee (2013) and Durell et al. (2006). The weathering of oil and its physical state are computed using the embedded Oil Weathering Model developed by the SINTEF oil weathering laboratories in Trondheim, supported by decades of research into oil chemistry and behaviour.

The model calculates and records transport and distribution of a contaminant in three physical dimensions plus time, on the water surface, along shorelines, in the water column, and in sediments, along with losses to atmosphere and by biodegradation. For subsurface releases the near field part of the simulation is conducted with a multi-component integral plume model that is embedded in OSCAR. The near field model accounts for buoyancy effects of oil and gas, as well as effects of ambient stratification and cross flow on the dilution and rise time of the plume.

Single oil spill scenarios can be completed for a specified meteorological period (deterministic modelling), or multiple scenarios with varying start times can be compiled to calculate statistics such as the probability of some event e.g. oil reaching shore or the fastest time of arrival (stochastic modelling). These releases can be set as single static, multiple or moving sites.

Relevant parameters are chosen based on recommendations from SINTEF via the model documentation, training courses and dialogue. Outputs are generated by collating particle properties over a grid, set to capture the main areas of interest as the plume develops and disperses. Various model parameters can affect the quality of outputs including the metocean data used, the number of particles chosen and the size of the grid applied and a balance is struck between model complexity, the output required and practical run times. All such inherent uncertainties require conclusions to be drawn carefully and using experience.

The model is capable of evaluating the effectiveness of oil spill response strategies and allows the assignment of specific operational tactics for simulated containment, storage, booming, skimming and dispersant operations. This can be coupled with biological impacts on plankton and fish to support net environmental benefit analysis.

OSCAR has been used in the report to understand:

- Surface sheen probability, arrival time, thickness and persistence;
- Shoreline oiling probability, arrival time and density;
- The characteristics of the hydrocarbon plume in the water column;
- The fate of the hydrocarbons in terms of the relative amounts evaporated, on surface, dispersed, biodegraded, deposited in sediments and beached calculated independently for each of the 25 hydrocarbon components used to represent the oil; and
- The overall regional transport characteristics of oil at sea in terms of density, direction and time including the countries whose waters and/or coastlines may be most affected.

2.2 Types of analysis

For each Scenario, the following analyses were undertaken. OSCAR is an extremely capable model that can offer many different statistics on any particular spill, and the analyses given below are judged to be the most useful in understanding potential environmental impact.

Stochastic simulation:

- Probability of oil on surface at any time;
- Minimum arrival time of oil;
- Probability of oil on shoreline at any time;
- Maximum mass of oil on shoreline (and distribution of outcomes);
- Minimum arrival time of oil on shoreline (and distribution of outcomes); and
- Density of oil on shoreline.

From the stochastic analysis, a 'worst case' of metocean conditions is identified that causes the maximum amount of oil to reach shorelines (or a typical case if no oil reaches shore, in the case of a diesel release).

Deterministic simulation:

- Mass balance plot for evaporation, dissolved, dispersed, sediment, shoreline, biodegraded and outside grid; and
- 'Swept area' of individual spill on surface and water column.

2.3 Modelling Region

Since the Caspian Sea is a closed waterbody, the model boundary never extends beyond the physical shorelines. Metocean data is also available for the whole area. Consequently, the size of the model boundary can be as large as necessary to encompass the entire dispersion of the release within the modelling period. For

3D current data and 2D wind data was obtained for the period 2006 - 2009 covering this area and imported into the model. Using this area, all oil is accounted for.

In common with other areas of the world with strong currents, it is not efficient to capture all oil particles indefinitely as some may persist for many months, and the metocean/model area is chosen to maximise accuracy in the area of greatest significant impacts. Model accuracy also decreases as distance increases as uncertainties accumulate and any wider scale results should be treated as being more indicative further from the source. Consequently, low concentrations of dispersed oil are observed leaving the grid at a point where they are forming intermittent and light sheens that disappear quickly during higher sea states, and re-emerge during calm conditions. Potential impacts can be assessed from this information, and may be compared with background levels of oil in the environment.

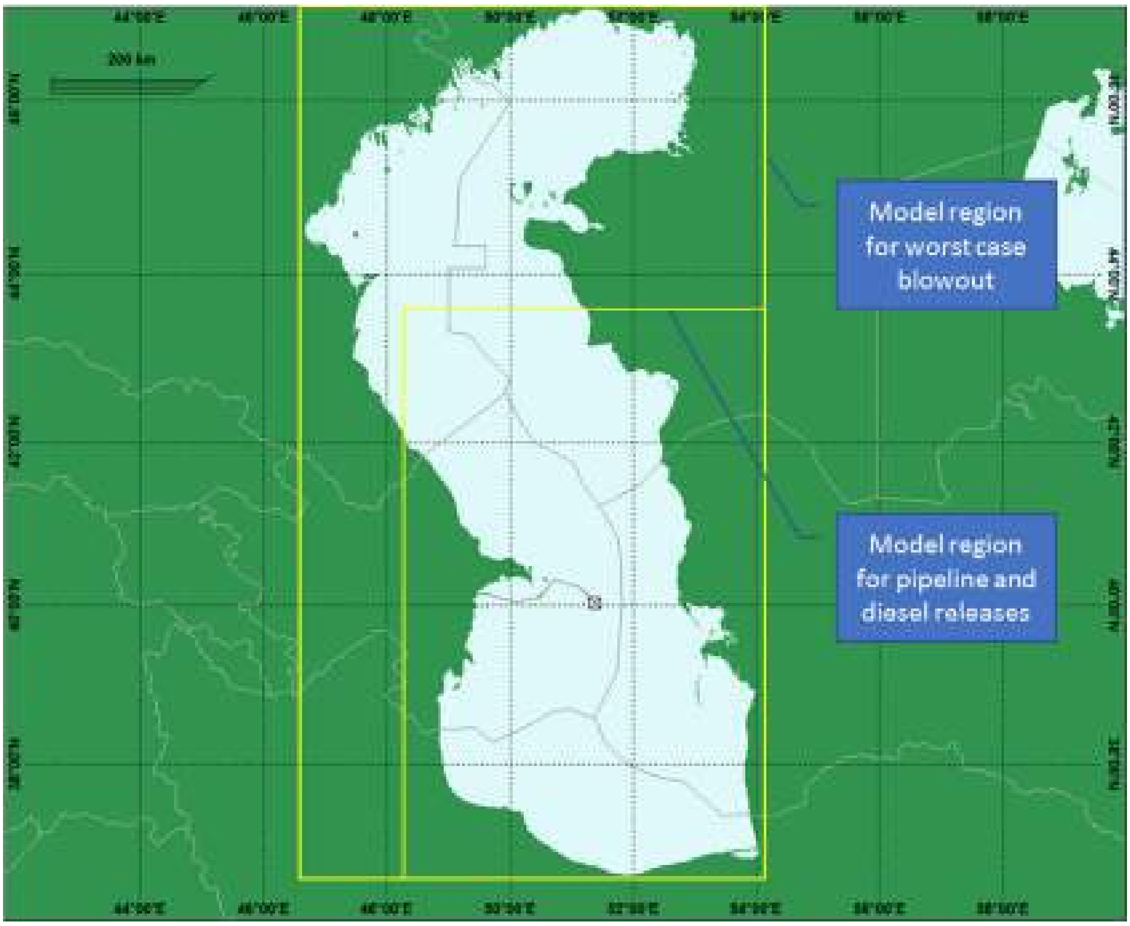

Figure 2: Modelling regions used

2.4 Environmental thresholds

Sophisticated models such as OSCAR are capable of tracking the fate of oil in increasingly smaller and smaller concentrations and masses, beyond the point at which oil presents a significant risk or is even detectable against background levels. In order to ensure the model outputs reflect the risks, while still retaining a precautionary approach, thresholds are normally applied to thicknesses of surface oil, concentrations in the water column and densities of shoreline oiling.

The thresholds adopted in this study are described in Table 1 for:

- Shoreline oiling;
- Thickness of surface sheen; and
- Total oil in the water column.

Table 1: Thresholds for oil significance adopted

Category	Threshold	Justification
Shorelines	100 ml/m² (approx. equal to 86 g/m²).	The International Tank Owners Pollution Federation (ITOPF) guidelines for the recognition of oil on shorelines (ITOPF, 2011) include shoreline oil density. The definition for 'light oiling' is selected as the most appropriate threshold and is described in the guidelines as equivalent to a volume threshold of 0.1 litre/m², or less than 0.2 litres of oil per metre strip along a 2m deep beach which is assumed in the model. The 0.1 litre/m² threshold (considered a 'stain' or 'film') is assumed as the lethal threshold for invertebrates on hard substrates and sediments (mud, silt, sand, gravel) in intertidal habitats based on Owens & Sergy (1994) and French-McCay (2009). This would be enough to coat the animal and likely impact its survival and reproductive capacity, while stain <0.1 litre/m²) would be less likely to have an effect (French-McCay, 2009). Values have also been adopted for 'Moderate oiling' of 1 litre/m², and 'Heavy oiling' of 10 litre/m², also derived from ITOPF.
Sea Surface	0.04 µm (microns) silvery grey - rainbow sheen	Interpretations of significance of surface oil thickness vary widely. The presence of a visible sheen is likely to interfere with other users of the sea such as fishing operations and a visible sheen can occur between 0.04 and 0.3 µm as identified by the Bonn Agreement Oil Appearance Code (BAOAC). This is highly dependent on weather conditions, and the lower level of 0.04 µm is only visible under ideal conditions. Tests performed by O'Hara and Morandin (2010) indicated that significant changes in feather structure did not necessarily occur at a thickness of 0.04 µm, but began to be visible at 0.1 µm. Oil spill response in the form of containment or dispersant use is normally not attempted when oil is below a thickness of 5 µm.
Water Column	58 ppb (parts per billion) (total oil)	Research completed by Statoil (2006) and Det Norsk Veritas (2008) resulted in the development of species sensitivity dose-response curves to assess the impact to organisms from different water column hydrocarbon concentrations. A 5th percentile LC_{50}[1] for total hydrocarbon concentrations was found to be 58 ppb. This value of 58 ppb is used within this modelling as the lower threshold for potential acute toxicological responses and concentrations below this threshold are not reported from OSCAR. 58 ppb is a conservative lethal exposure value for marine fauna as it is below the LC_{50} for 95% of species and is lower than the OSPAR recommended predicted no-effect concentration of 70 ppb (OSPAR, 2014). At this concentration mortality is highly unlikely however toxicological effects may be both short and long-term.

[1] Lethal Concentration 50%. The concentration of a chemical which kills 50% of a sample population

3 Model input data

3.1 Metocean data

Three-dimensional water column current and two-dimensional wind data were generated by the Space and Atmospheric Physics Group at Imperial College and provided by BP for a period covering 2006-2009. A snapshot of currents in the Caspian region can be seen in Figure 3 for the surface layer (which includes wind-driven currents) and a snapshot of two-dimensional winds is shown in Figure 4.

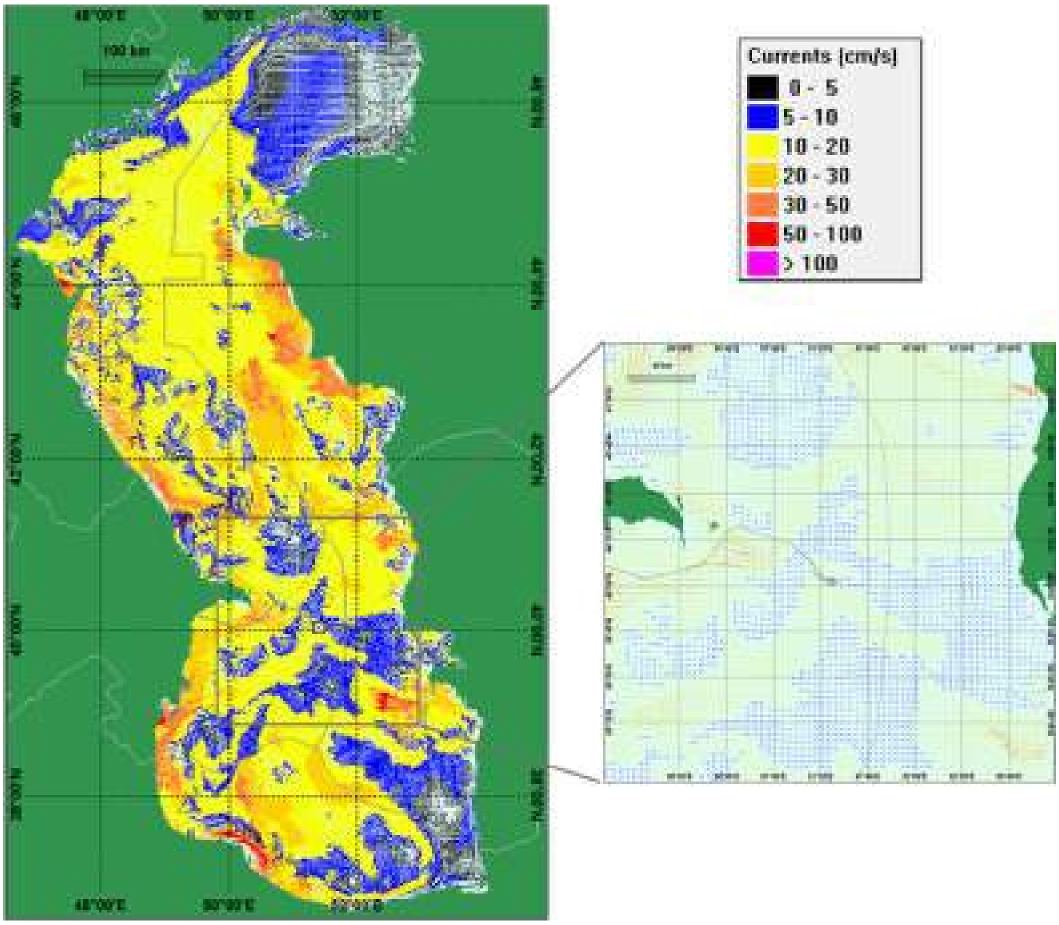

Figure 3: Example of instantaneous surface currents

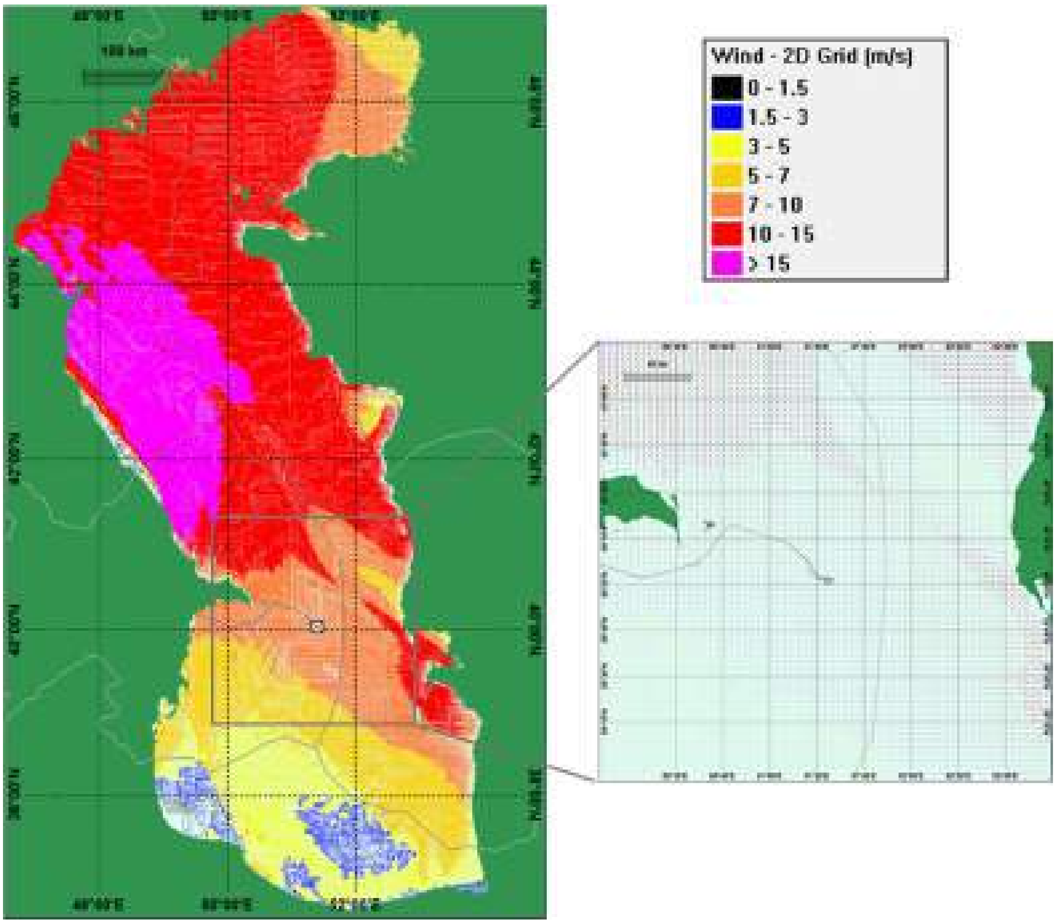

Figure 4: Example of instantaneous winds

Typical surface air temperatures and water column salinity averages were taken from Siamak et al. (2010) and AETC (2011) and are summarised in Table 2 .

The seawater temperature-depth profiles used in the modelling are shown in Figure 5. The values were taken from a BP Shah Deniz site survey (per. comm. 2013) and Kosarev (1974).

Table 2: Ambient conditions

Parameter	Summer	Winter
Surface air temperature (°C)	25	0
Salinity average (mg/l)	12.5	12.5

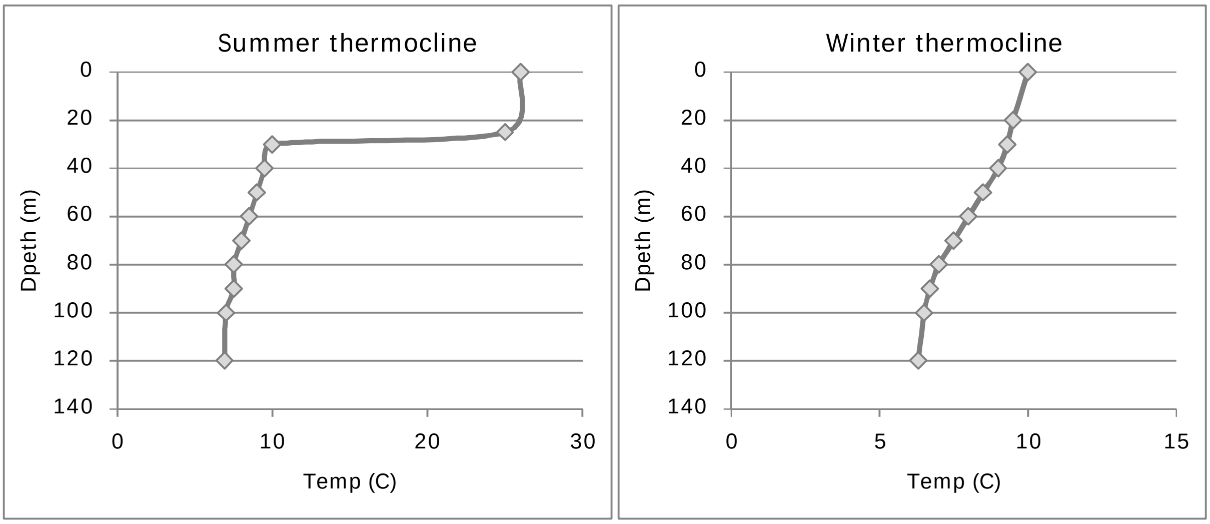

Figure 5: Summer and winter temperature-depth profiles

3.2 Bathymetry data

Bathymetry data is taken from the General Bathymetric Chart of the Oceans (GEBCO) '08' 30-arc-second grid, which has been translated into MEMW format. In turn, bathymetric grids for the Caspian Sea region were provided to GEBCO by Dr. John Hall, Geological Survey of Israel, based on bathymetric soundings digitised from Russian hydrographic charts (Hall, 2002). This differs to more recent survey data collected via ongoing projects. Currently, it is problematic to merge localised survey data with the wider GEBCO data, and changes in bathymetry would also require re-running of a hydrodynamic model to provide accurate currents. It is therefore preferable to retain the coupled bathymetry and currents even if there are some discrepancies, than attempt to merge different datasets. Oil movement largely depends on near-surface currents, which are affected little by such changes in bathymetry and the prevailing GEBCO data has been used in the model.

The bathymetry data used in the modelling is represented in Figure 6.

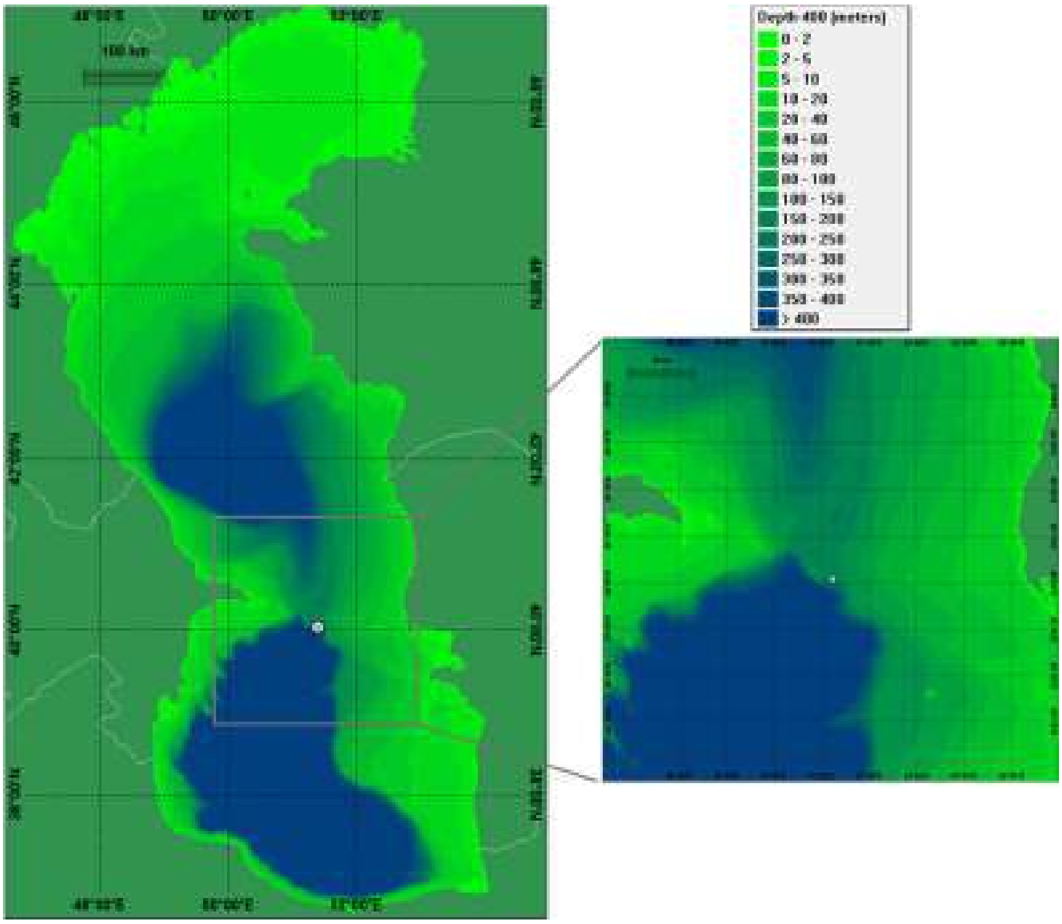

Figure 6: Regional bathymetry data used in model

3.3 Model parameters

Key model parameters are shown in Table 3. These are chosen using experienced judgment from training received from SINTEF, the software User Guide, experience of using the model over 15 years and direct dialogue with SINTEF software developers.

3.4 Oil characterisation

The oil type present is identified as matching the ACG field Central Azeri crude oil type. Analysis of this oil type for physical, weathering and dispersibility properties has been undertaken amongst a group of seven Azeri oils by CEDRE (2012). This has been interpreted by SINTEF and entered into the OSCAR database.

Table 3: Key model settings

Model parameter	Setting used	Notes
Grid size	Blowout: 1500 m in X and Y direction, 10 m in Z direction Pipeline & Diesel Spill: 1000 m in X and Y direction, 10 m in Z direction	Tested to ensure results are not sensitive to change
Model time step	Computational time step: 20 minutes Output time step: 1 hour	Short enough to describe early stages of dispersion and ensure particles maintain continuous deposition
Number of particles	Solid/Droplet particles 20,000 Dissolved particles 10,000	Maximum recommended number of particles is 30,000 per category. Dissolved particles remain in a more homogenous pattern and fewer particles are required for equivalent accuracy.
Modelling period	Blowout: 120 days (30 days post-release) Pipeline: 40 days (39.5 days post-release) Diesel spill: 30 days (30 days post-release)	The vast majority of model particles have deposited, evaporated or left the grid area by this time. Significant environmental impacts are expected to have manifested in this time.

Table 4: Main oil properties

Property	Value	Notes
Name of oil type	Central Azeri 8C	Oil type identified by BP as a match for the ACE Project
Specific gravity	0.849 (0.849)	Oil is buoyant and classed as Group II by ITOPF
Pour Point	6 °C (9 - 15 °C)	Oil is liquid above the pour point. Although the quoted range is fairly large, the oil is likely to be initially liquid at ambient Caspian Sea surface temperatures, and initially spreads on the sea surface.
Viscosity	32.4 (32) centipoise at 8 °C 9.5 (10) centipoise at 25 °C	Oil is initially relatively low viscosity and flows readily
Asphaltene content	0.3% (0.3%)	The oil has potential initially to form an emulsion. The emulsion is not stable and breaks down according to CEDRE (2012).
Wax content	9.6% (10.2%)	Moderate amount of wax which is more persistent

Note: numbers refer to SINTEF OSCAR database values while the values in brackets refer directly to test results in CEDRE (2012).

4 Scenarios modelled

Table 5 presents the modelling scenarios which were provided by BP.

This includes the following.

1. A release of diesel from the ACE platform crane pedestal storage tank, representing the largest credible spill of diesel. This is represented by the Marine Diesel oil type in the OSCAR model. A discharge duration of 1 hour is assumed to represent a puncturing of the tank.

2. A worst-case blowout. This is assumed to occur near the seabed e.g. after drilling the 13.5" reservoir section, and includes a mixture of oil and associated gas being released in a subsea plume. The maximum flow rate is modelled over a period of 90 days, which is the length of time calculated by BP to drill a relief well and arrest the blowout. In reality, it is extremely rare for blowouts to continue for this long, and BP has calculated that the flow rate may decrease by 10-30% over this time period, so the results are conservative.

3. A worst-case pipeline release. The pipeline network has been simulated using the Pipeline Oil Spill Volume Calculation Method (POSVCM) by SINTEF (2003) for the US Minerals Management Service. This allows the complex interaction of shutdown of interconnected facilities, depressurisation of the pipeline and changes in pressure and temperature to calculate the volumes of oil and gas released at seabed (Figure 7). This method has been validated against six real pipeline releases that have occurred worldwide (SINTEF, 2003). The pipeline rupture uses flow data from the point of maximum oil production for the group of fields (2024 projected flow conditions). It assumes a first stage release during depressurisation (a) fast phase and (b) slow phase, until pipeline pressure drops to ambient hydrostatic pressure; then a release due to subsequent seawater ingress displacing some of the remaining oil until water-accessible lengths of the pipeline are filled.

Table 5: Oil spill modelling scenarios

<table>
<tr><th>Scenario ID</th><th>Spill Site</th><th>Spill Event</th><th>Oil Type</th><th colspan="2">Spill Rate</th><th>Spill Duration</th><th>Total Spilled Volume</th></tr>
<tr><td>1</td><td>ACE-PDQ Platform</td><td>Surface release of diesel fuel from crane pedestal diesel storage tank</td><td>Diesel</td><td colspan="2">92 m^3/hr</td><td>1 hour</td><td>92 m^3</td></tr>
<tr><td rowspan="3">2</td><td rowspan="3">ACE-PDQ Platform Well Location</td><td rowspan="3">Subsea well blowout - worst case release rate</td><td rowspan="3">Central Azeri Crude</td><td>Oil</td><td>35,500 bbl/day</td><td rowspan="3">90 days (time to drill relief well)</td><td rowspan="3">507,686 m^3</td></tr>
<tr><td>Gas</td><td>35.5 MMscf/day</td></tr>
<tr><td>Water</td><td>0 bbl/day (dry well)</td></tr>
<tr><td>3</td><td>30" oil / PW pipeline (mid-way between ACE and CA platforms)</td><td>Full bore pipeline rupture, depressurisation and seawater ingress</td><td>Multiple Crudes[1]</td><td colspan="2">1,360 m^3/hr (initially higher, declining rapidly)</td><td>Approx. 50 minutes</td><td>1,133 m^3</td></tr>
</table>

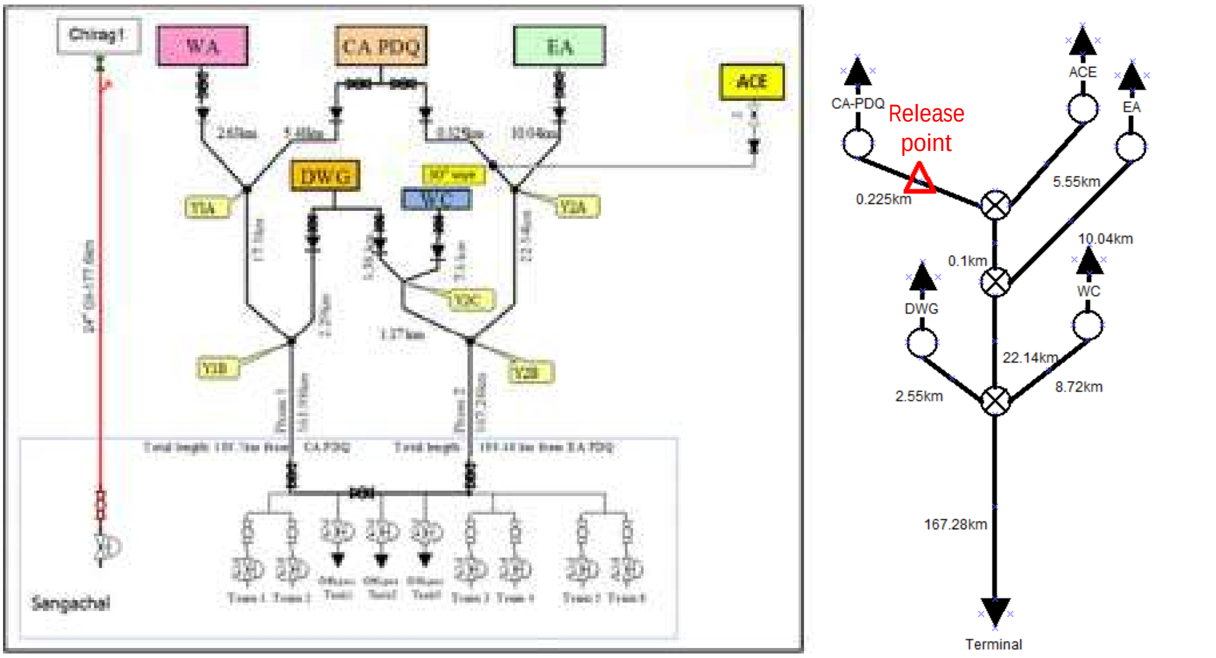

Figure 7: Schematics of pipeline network (a) Left - actual network (b) Right - representation in POSVCM to model outflow at the release point

5 Results

Key outputs from the deterministic modelling are shown in Table 6. Following the stochastic modelling which is presented below, selected deterministic runs were conducted and an overview of the results is shown in Table 6 and discussed further in this section. Note that the 'summer' scenario releases begin and end between April - September inclusive, and the 'winter' scenario releases begin and end between October - March inclusive. This captures the worst case release, which occurs in summer.

Table 6: Deterministic results summary for oil release scenarios

Scenario	Release location	Maximum surface extent of sheen above 0.04 µm (km)		Minimum time to beaching (days)		Time until water column dissolved concentration <58 ppb (days)[1]		Maximum mass onshore (tonnes)	
		Summer	Winter	Summer	Winter	Summer	Winter	Summer	Winter
Blowout	ACE platform wells	509	406	6.5	8.1	> 120	> 120	18,295	9,823
Pipeline release	Mid-pipeline ACE-CA platforms	312	339	8.3	6.0	9	6	28	3
Diesel	ACE platform	20.1	52.3	-	-	1.4	0.9	0	0

Notes: 1. Time from start of release

5.1 Scenario 1 - Diesel spill results

5.1.1 Overall description of oil behaviour from stochastic and deterministic modelling

The OSCAR model tracks the fate of oil through the simulation as shown in Figure 8, which represents the summer conditions, but which is generally representative of the fate of oil released at any point in the year.

Initially the majority of the diesel is present on the sea surface, and over the first two days around 60% evaporates and 10% 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 15 m. Biodegradation also progresses relatively quickly such that a very small fraction of oil in the water column is left after 30 days. Ultimately 64% evaporates, 33% is biodegraded, 1% remains in the water column and 2% is deposited in sediments.

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.

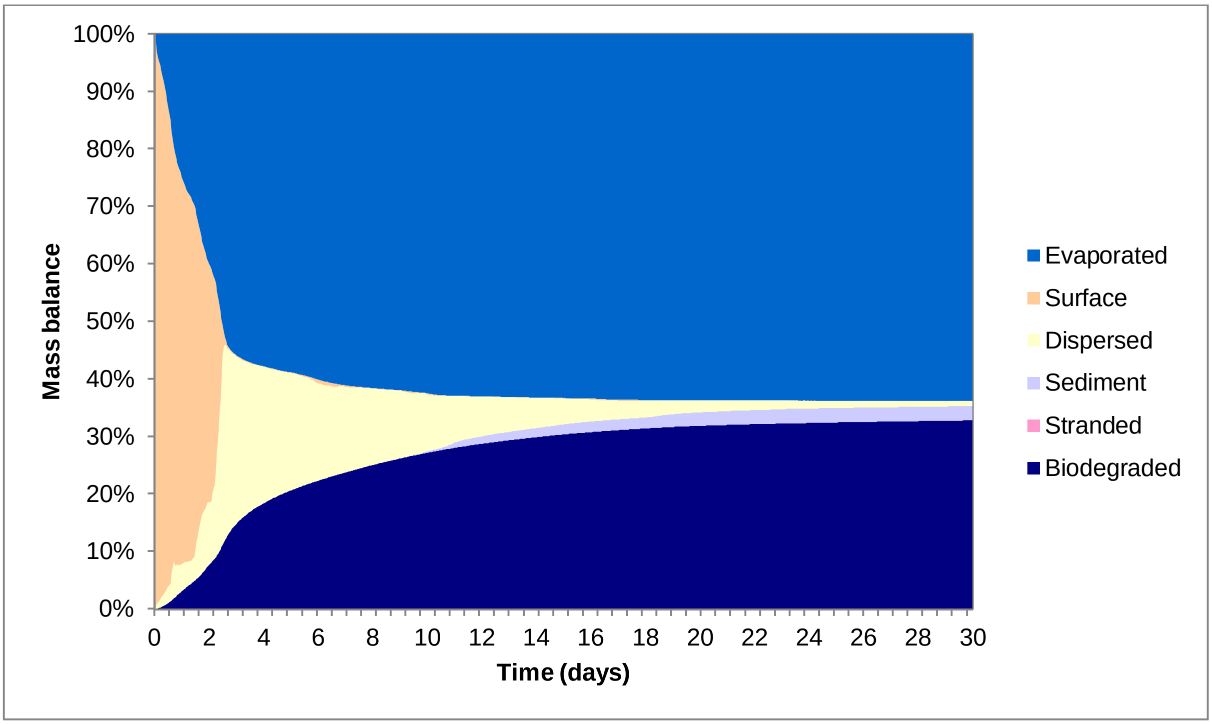

Figure 8: Diesel spill: Fate of oil during modelling period

5.1.2 Stochastic modelling

Stochastic simulations were generated encompassing year-round varying metocean data for the 92 m^3 diesel spill scenario using 102 model runs evenly spaced through the three years' data. From these results, the worst weather periods were chosen to run deterministic scenarios under summer and winter conditions.

Table 7 summarises the findings for time to reach shore and oil on shore, but no oil was found to reach shore in any of the runs, and therefore no seasonality was observed in the degree of shoreline oiling.

Table 7: Stochastic results summary

Scenario	Percentile	Minimum time to beaching (hours)	Mass of emulsion accumulated onshore (tonnes)
Diesel spill	All scenarios	Oil does not reach shore	Oil does not reach shore

OSCAR statistical outputs are shown as follows:

- Probability of oil on the surface above the threshold of 0.04 µm (Figure 9);
- Minimum arrival time of oil on the surface (no threshold) (Figure 10);
- Probability of oil on the shoreline above the threshold of 100 ml/m^2 (Figure 11); and
- Probability of oil in the water column above the threshold of 58 ppb (Figure 12).

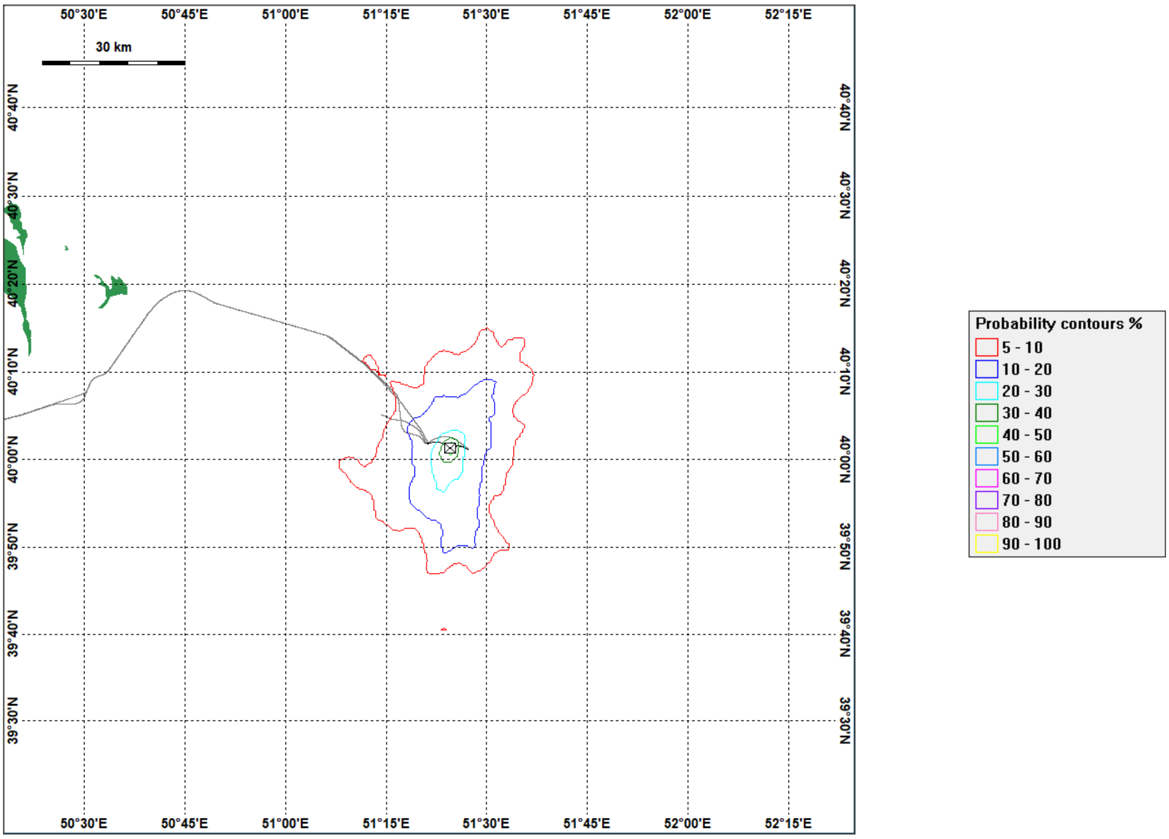

Figure 9: Diesel spill: Probability of surface oil above threshold of 0.04 µm

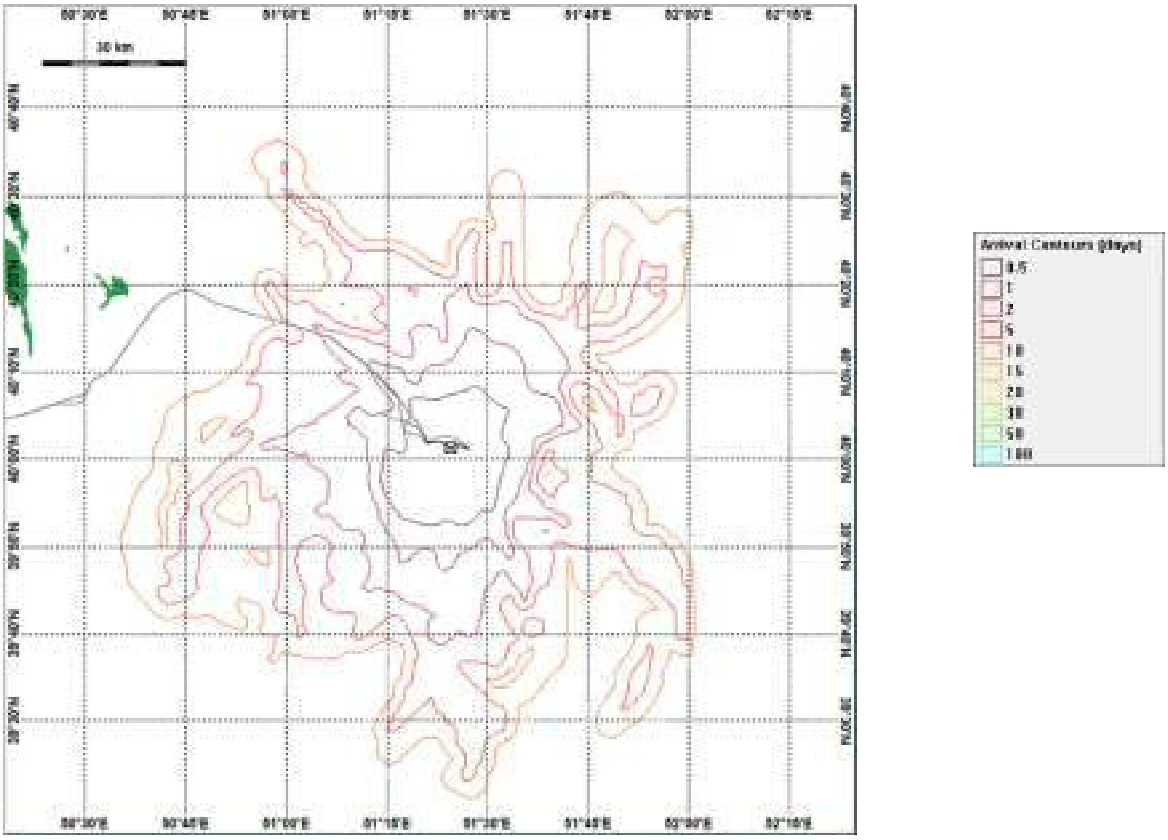

Figure 10: Diesel spill: Minimum arrival time of oil on surface

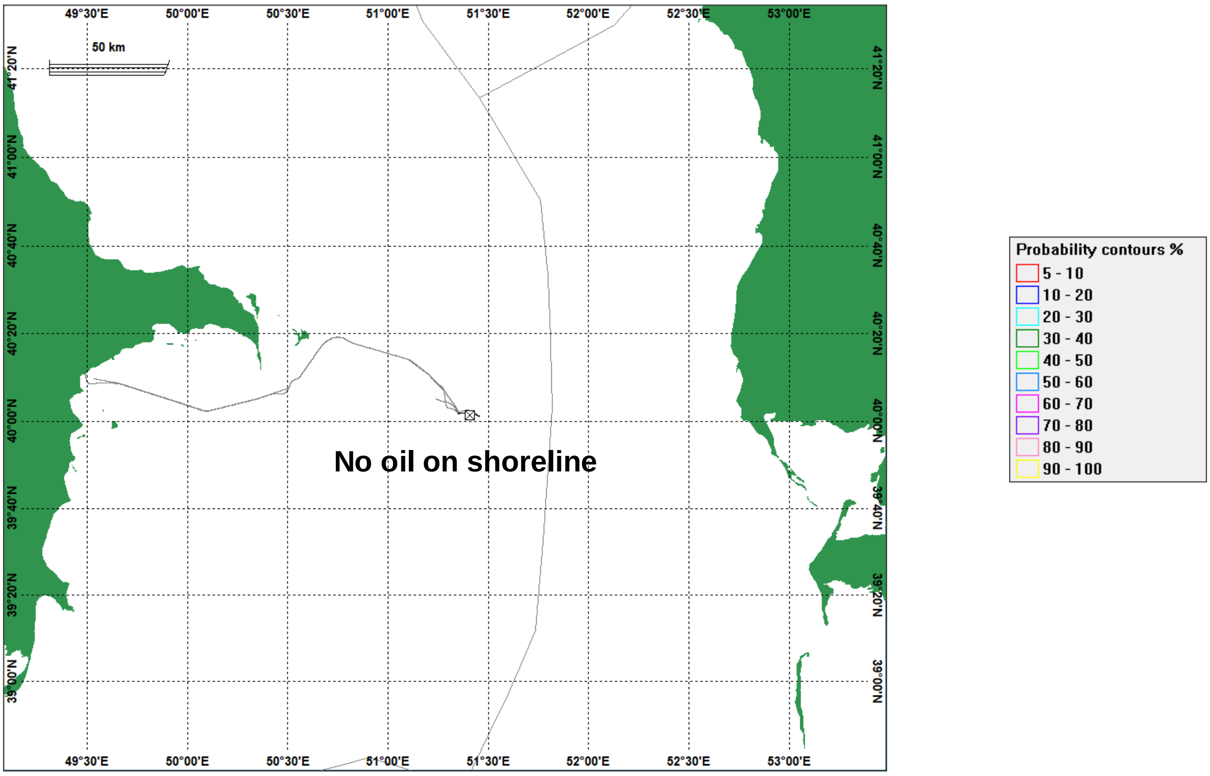

Figure 11: Diesel spill: Probability of oil on shoreline above threshold of 100 ml/m2

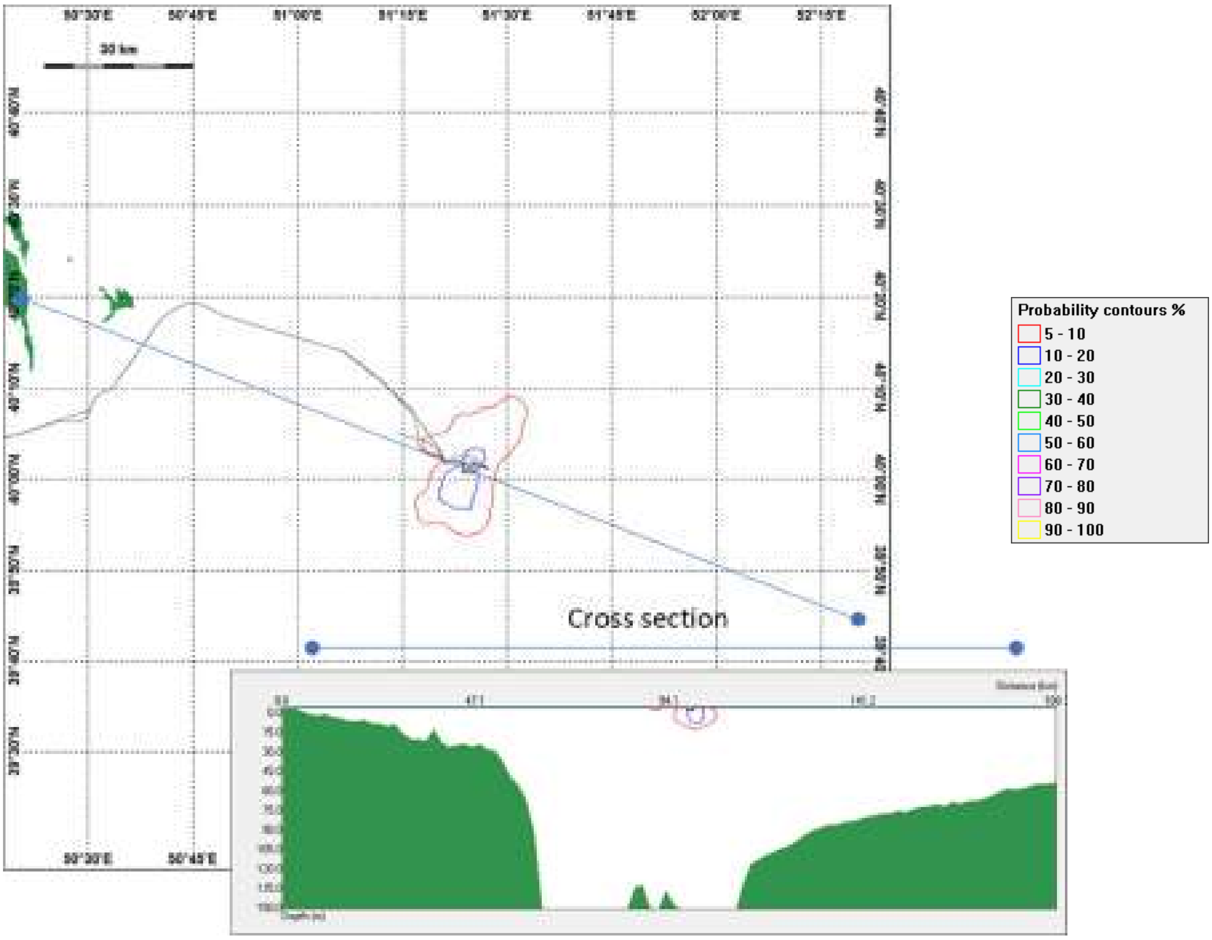

Figure 12: Diesel spill: Probability of oil in water column above threshold of 58 ppb

5.1.3 Deterministic modelling

Key outputs from the deterministic modelling are shown in Table 8.

Table 8: Deterministic results summary for diesel spill scenario

Scenario	Release location	Maximum surface extent of sheen above 0.04 µm (km)		Time until water column dissolved concentration <58 ppb (days)	
		Summer	Winter	Summer	Winter
Diesel spill 92 m^3	ACE platform	20.1	52.3	1.4	0.9

Since no oil reaches shore in summer or winter, the timing of the summer and winter deterministic scenarios is chosen to match the timings of the worst case blowout scenario.

5.1.3.1 Oil on surface

Diesel on the sea surface is predicted to travel less than 20 km in these two sets of conditions before it drops below the lowest recognised visible thickness under ideal viewing conditions (Figure 13 and Figure 14). In winter, the break between two areas of sheen is a result of a change in wind and wave conditions that disperse oil briefly and then allow it to re-emerge and form a new sheen separate to the first area.

Thicker areas of oil that are more likely to be associated with environmental impacts are restricted to a small radius around the spill.

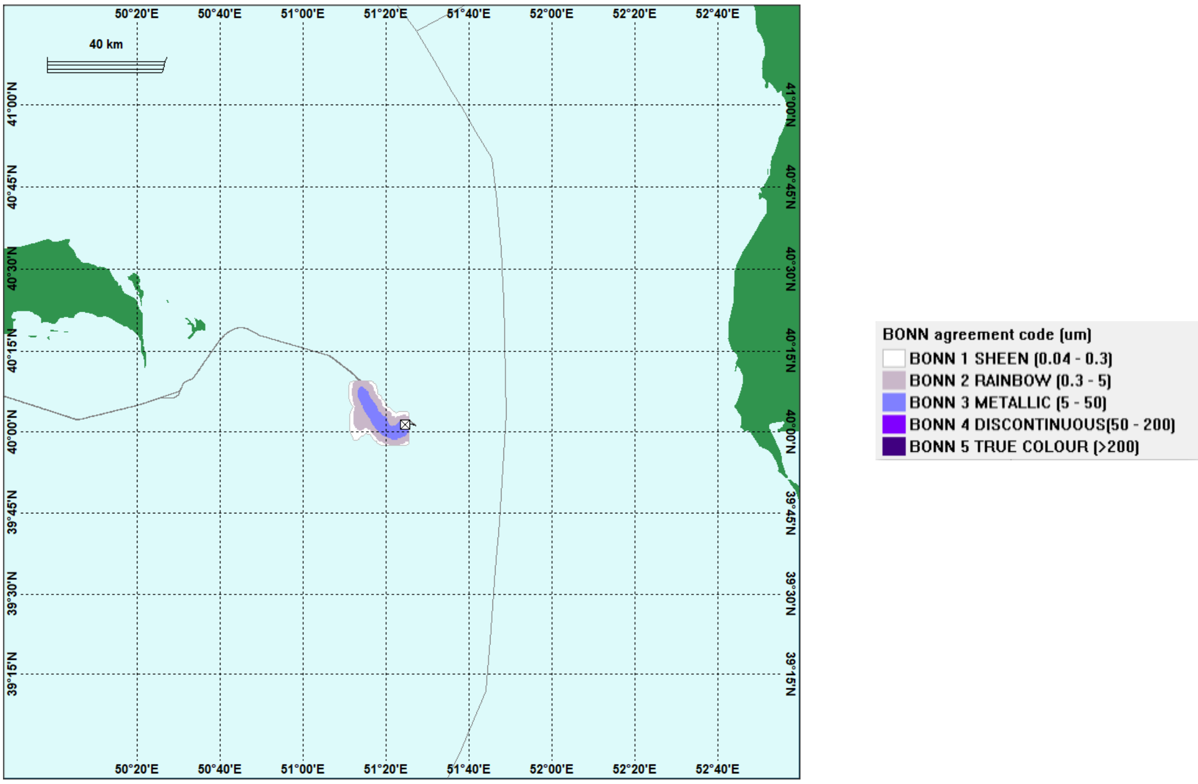

Figure 13: Diesel spill: Cumulative area of surface sheen - summer

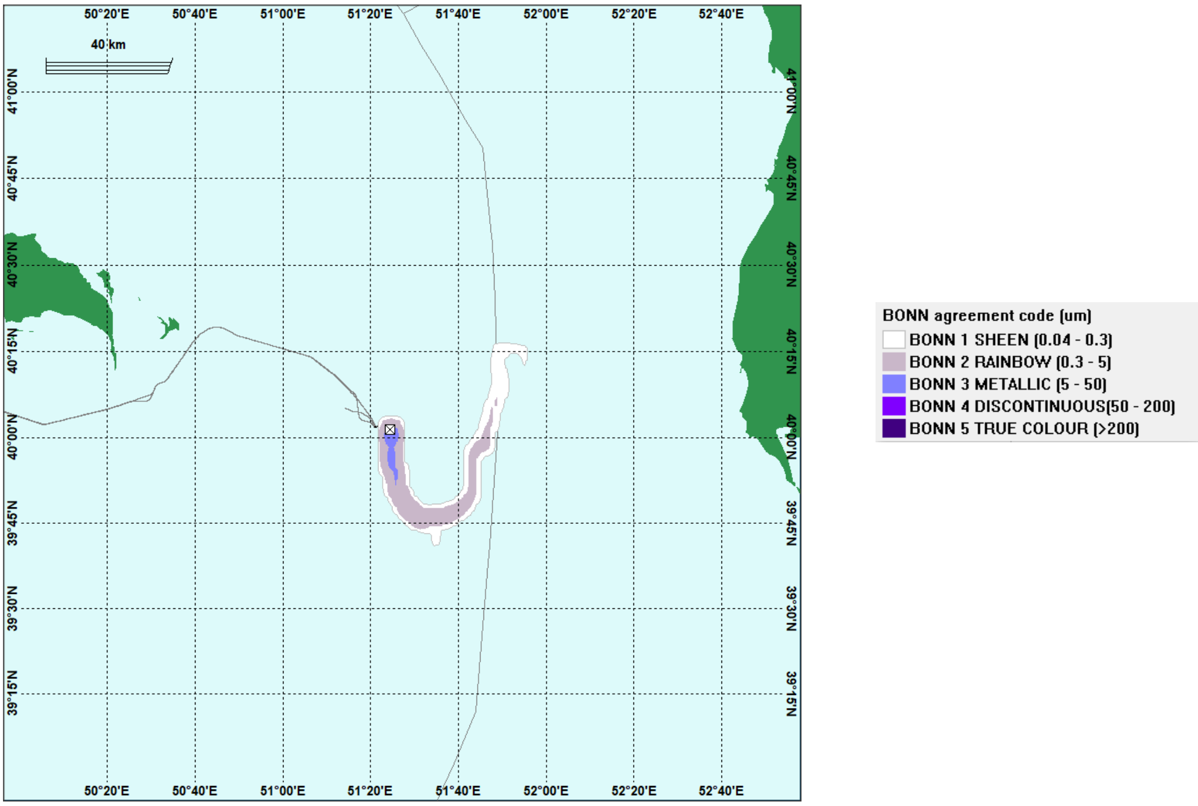

Figure 14: Diesel spill: Cumulative area of surface sheen - winter

5.1.3.2 Oil on shore

No oil from the diesel spill reaches shore in summer or winter conditions.

5.1.3.3 Oil in the water column

The extent of oil in the water column is confined to a few kilometres of the release and tracks the path of the surface release. The area is affected for approximately 1.4 days after the release before the oil disperses below the threshold levels, as shown in Figure 15 and Figure 16 representing the deterministic cases run in summer and winter. In each figure, the output is a 'snapshot' at the time where the largest area is affected, which is at approximately 15 hours after the start of the release, where the oil has moved away from the release location.

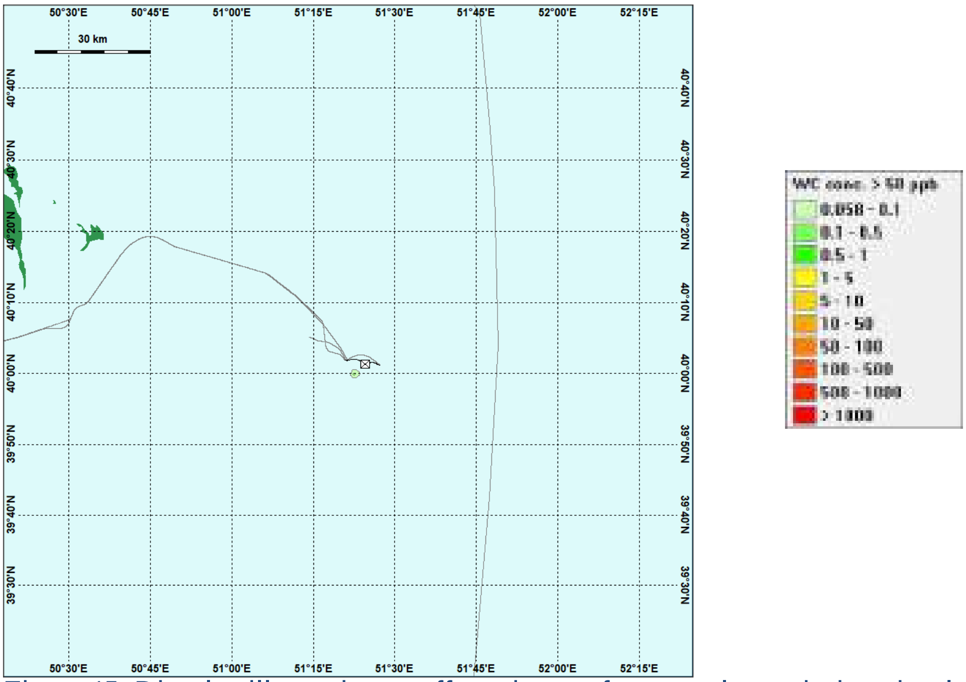

Figure 15: Diesel spill: maximum affected area of water column during simulation - summer

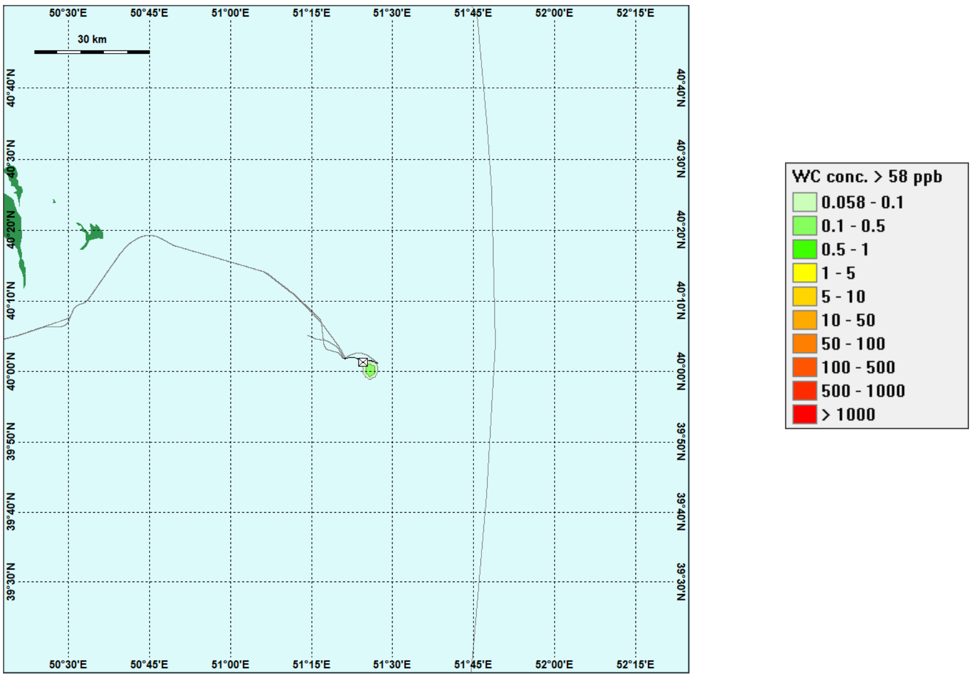

Figure 16: Diesel spill: maximum affected area of water column during simulation - winter

5.2 Scenario 2 - Worst-case blowout results

5.2.1 Overall description of oil behaviour from stochastic and deterministic modelling

The OSCAR model tracks the fate of oil through the simulation as shown in Figure 17, which represents the summer conditions, but which is generally representative of the fate of oil released at any point in the year.

Initially the majority of the oil is present on the sea surface, while 15% evaporates almost immediately and 5% is dispersed into the water column. Oil travels through the water column and takes just under two minutes to reach the surface, and in the initial 48 hours is predominantly within the upper 15 m of the water column. During the blowout period of 90 days, oil is continually supplied to the sea surface, and oil on the surface remains significant until after the end of the 90-day period. Dependent on the wind and waves, it can be mixed into the water column and some oil can subsequently re-surface during calmer periods. After around 18 days, oil has moved into shallower waters and begins to deposit in sediments, eventually accounting for around 15% of the oil at the end of the simulation. In this example, which represents the case with the maximum amount of oil on shore, oil reaches the shore at day 23 in southern Azerbaijan and Iran, although the fraction on shore does not exceed 1% of the total until day 32.

The amount of evaporation stabilises at just over 30% while the amount biodegraded rises steadily to 38% by the end of the simulation. Ultimately 32% evaporates, 38% is biodegraded, 13% remains in the water column and 15% is deposited in sediments and approximately 2% is on the shoreline, with less than 1% remaining on the surface.

In this example, the majority of oil moves southwest towards southern Azerbaijan and then circulates south along the coast towards northern Iran and the southern Caspian Sea shoreline. After day 50, however, the winds and currents shift and oil is moved towards the Absheron peninsula and then northwards into the northern Caspian, where it tends to remain away from the coast with little further shoreline oiling. Although the precise movement of the surface oil is dependent on the exact metocean conditions at the time, the analysis of over 100 different sets of metocean data suggest that these two directions are dominant, and that the most likely locations to receive oil on shore are southern Azerbaijan, northern Iran and the tip of the Absheron peninsula.

The area of water column affected tends to track the surface oil location and is predominantly mixed within the upper 30 m of the water depth over the course of the scenario, although transient concentrations above the threshold may occur down to 80 m depth over a wide area. 20 days after the release has ended, the areas affected above the 58 ppb threshold have become patchy and transient.

Oil can reach shore in as little as 6.5 days, although the 50th percentile value is 19.4 days, and it can take around 30 days for substantial amounts of oil to reach shore.

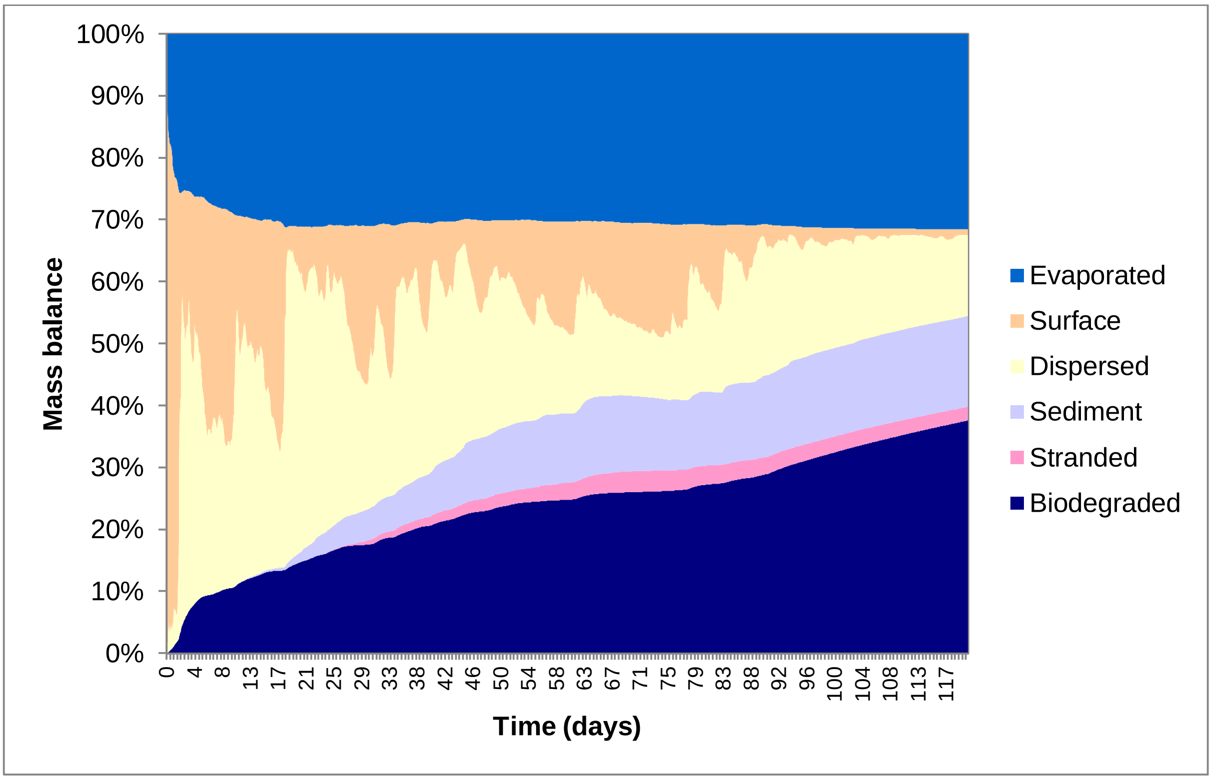

Figure 17: Worst case blowout: Fate of oil during modelling period

5.2.2 Stochastic modelling

Stochastic simulations were generated encompassing year-round varying metocean data for the worst case blowout scenario of 507,686 m^3 of crude oil using 102 model runs evenly spaced through the three years' data. From these results, the worst weather periods were chosen to run deterministic scenarios under summer and winter conditions.

The results for shoreline oiling for each of these simulations are represented in Figure 18 and statistics summarised in Table 9. There is a clear seasonal bias to the results, showing blowout start times of February - May (assuming an average of 20 days for oil to reach shore) are likely to result in much larger volumes of oil arriving than at other times of the year. Between September and December, the likely amounts of oil reaching shore are far lower.

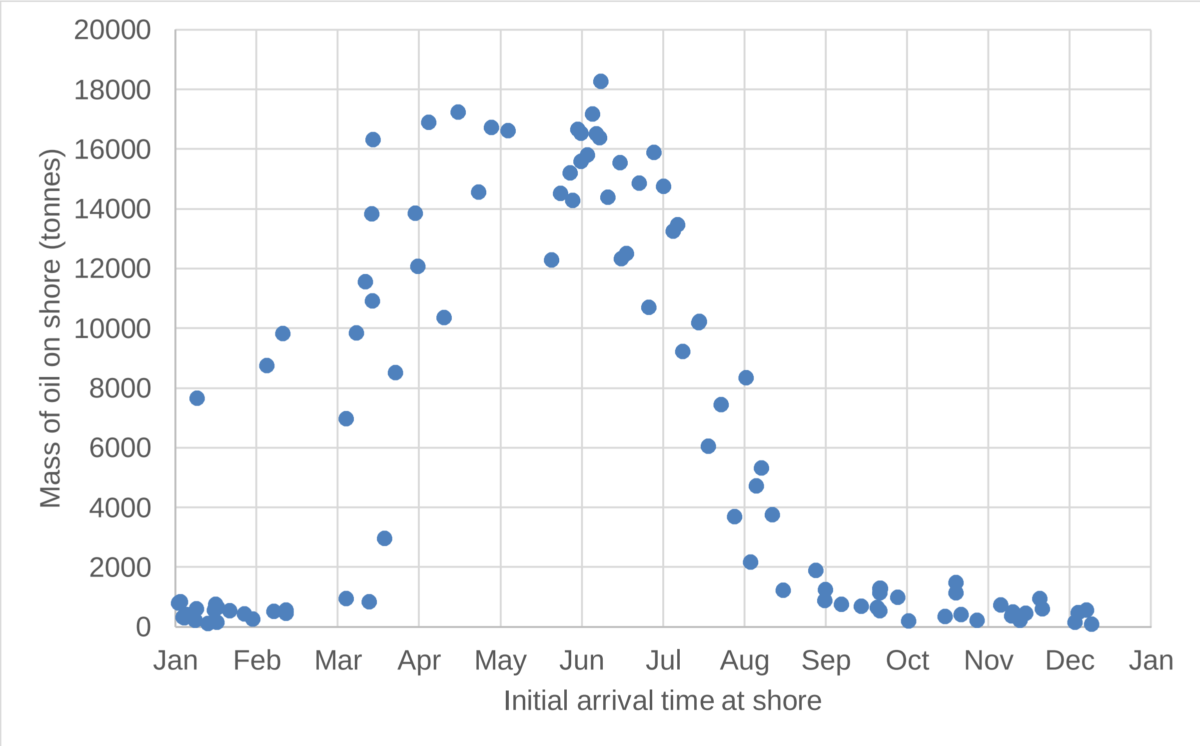

Figure 18: Seasonal distribution of oil on shore from stochastic analysis

Table 9: Stochastic results summary

Scenario	Percentile	Minimum time to beaching (days)	Mass of emulsion accumulated onshore (tonnes)
Worst case blowout	P10	10.4	341
	P50	19.4	2,591
	P90	36.8	16,299
	Worst	6.5	18,295

OSCAR statistical outputs are shown as follows:

- Probability of oil on the surface above the threshold of 0.04 µm (Figure 19);
- Minimum arrival time of oil on the surface (no threshold) (Figure 20);
- Probability of oil on the shoreline above the threshold of 100 ml/m² (Figure 21);
- Minimum arrival time of oil on the shoreline (no threshold) (Figure 22); and
- Probability of oil in the water column above the threshold of 58 ppb (Figure 23).

Note that the arrival time of oil at the shoreline above the threshold may be different to the arrival time on the adjacent sea surface above threshold, although any differences are usually small.

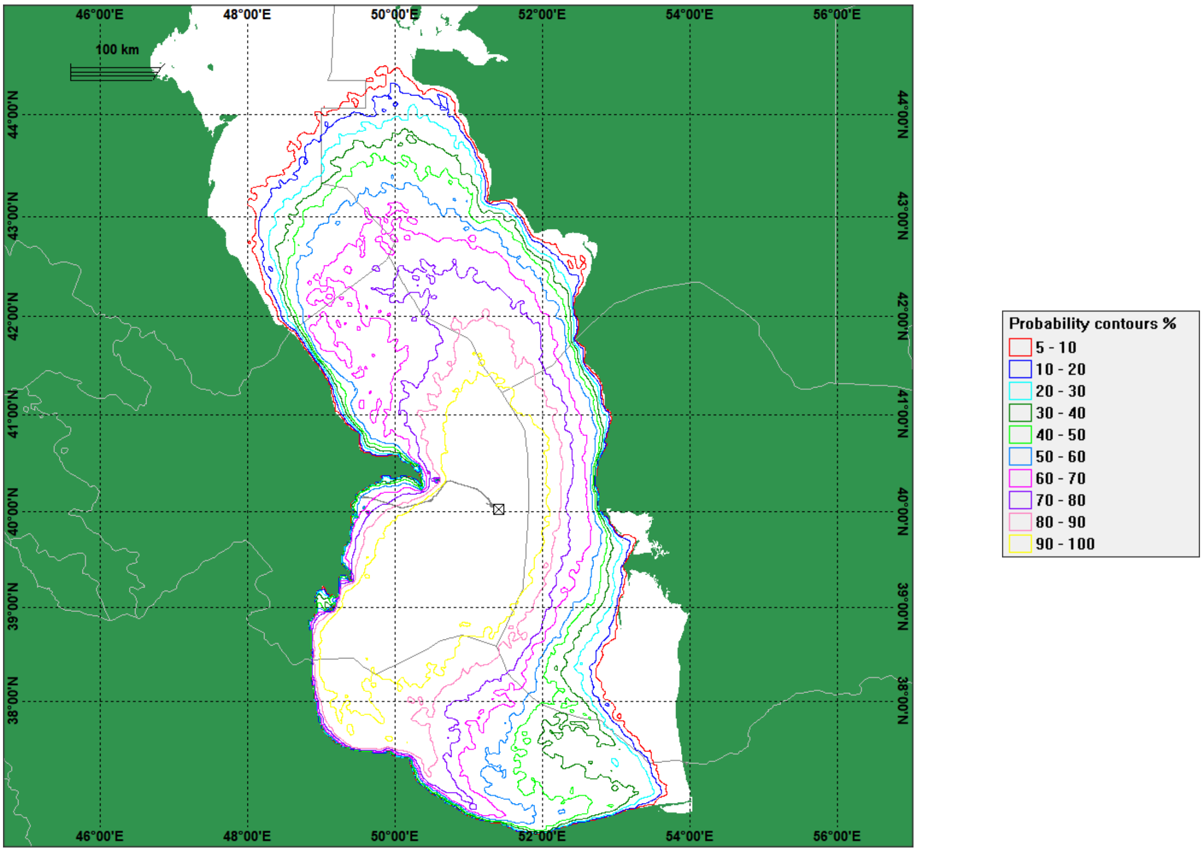

Figure 19: Worst case blowout: Probability of surface oil above threshold of 0.04 µm

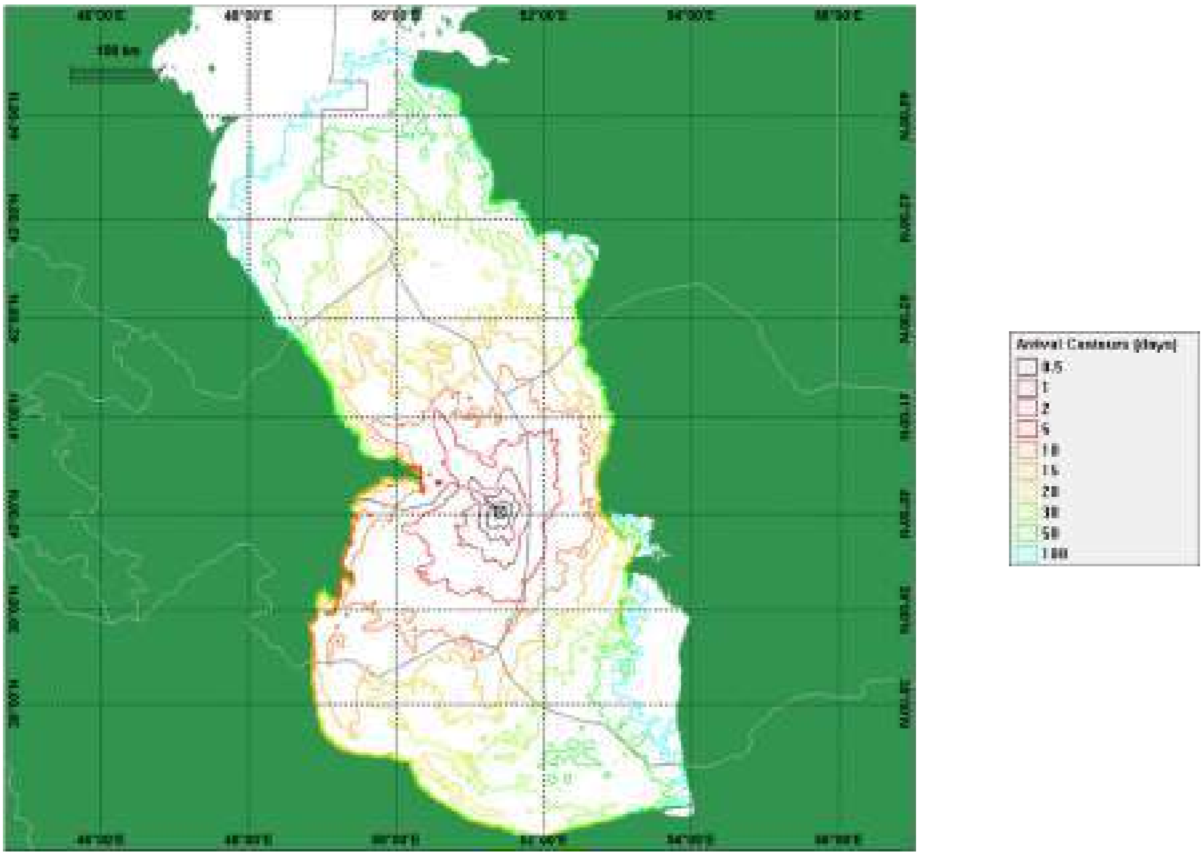

Figure 20: Worst case blowout: Minimum arrival time of oil on surface

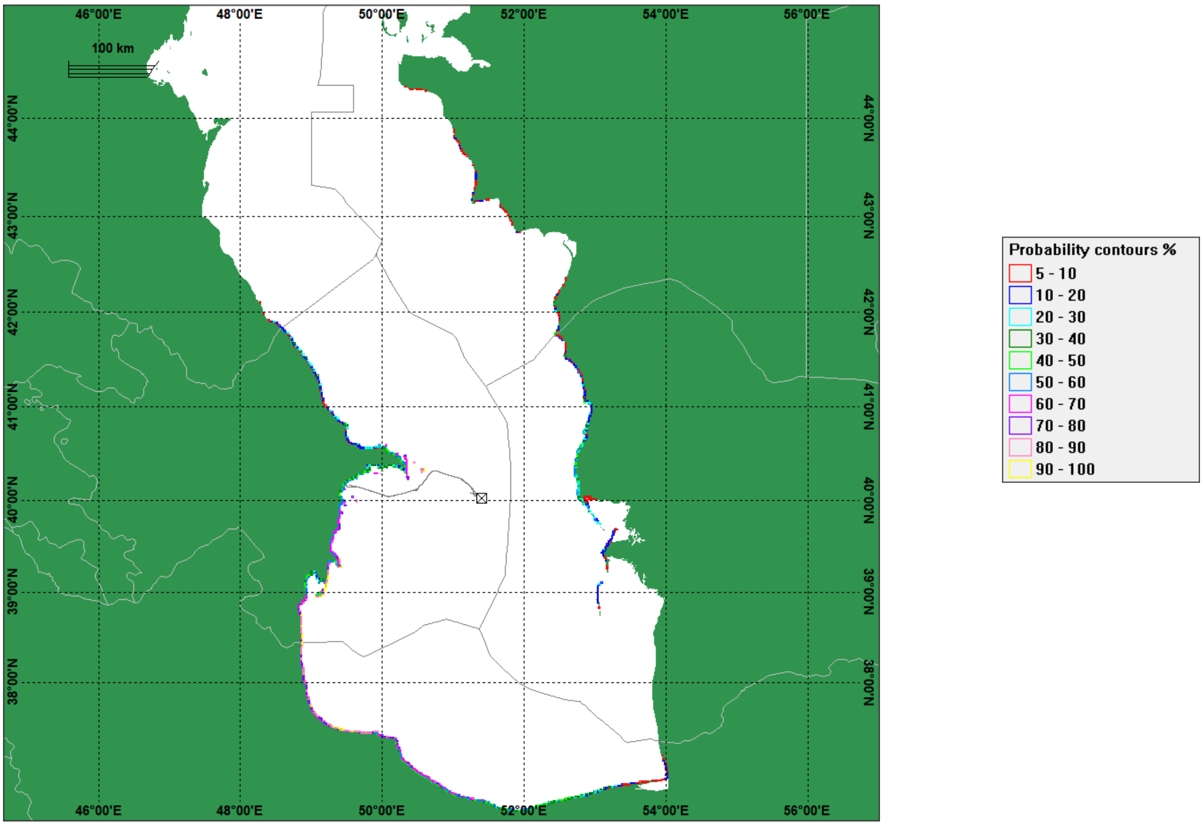

Figure 21: Worst case blowout: Probability of oil on shoreline above threshold of 100 ml / m^2

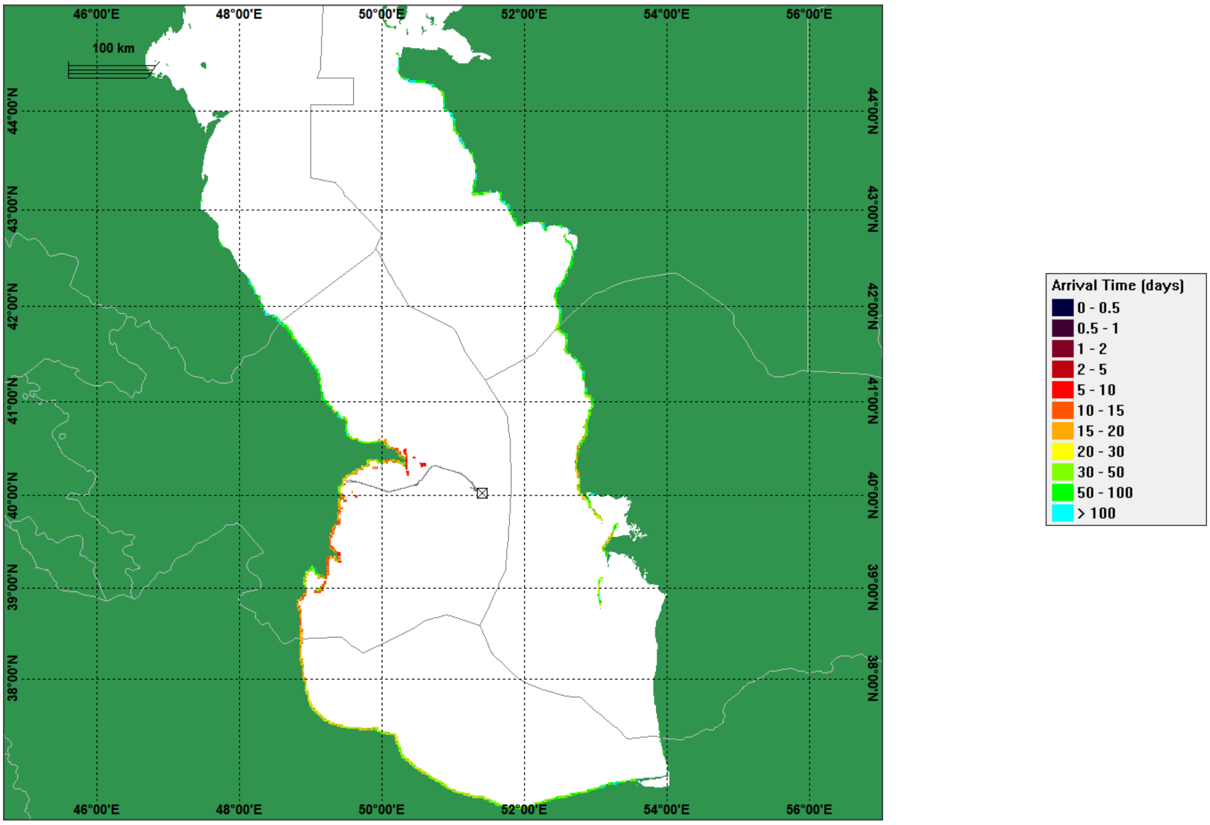

Figure 22: Worst case blowout: Minimum arrival time of oil on shoreline

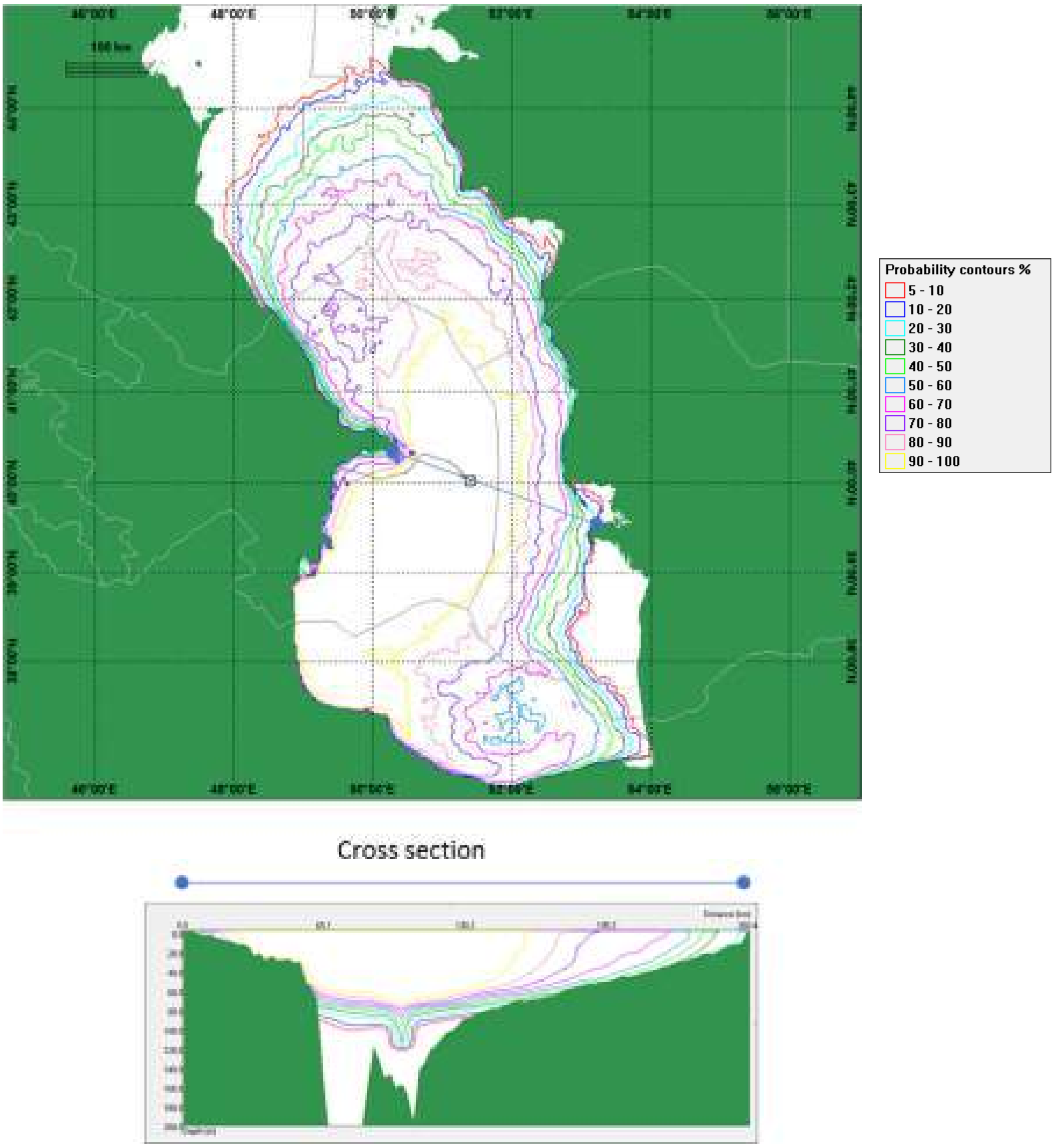

Figure 23: Worst case blowout: Probability of oil in water column above threshold of 58 ppb

5.2.4 Deterministic modelling

Key outputs from the deterministic modelling are shown in Table 10.

Table 10: Deterministic results summary for worst case blowout

Scenario	Release location	Maximum surface extent of sheen above 0.04 µm (km)		Time until water column dissolved concentration <58 ppb (days)	
		Summer	Winter	Summer	Winter
Worst case blowout 507,686 m^3	ACE platform	509	406	> 120	> 120

The timing of the summer and winter deterministic scenarios is chosen to match the cases with the maximum mass of oil reaching shore in each season.

5.2.4.1 Oil on surface

Crude oil on the sea surface is predicted to travel around 400-500 km in these two sets of conditions before it drops below the lowest recognised visible thickness under ideal viewing conditions (Figure 24 and Figure 25). There is a distinct difference in oil movement between summer and winter as shown in the figures. In the summer, oil 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 oil (> 0.2 mm) are present within 100 km of the well and sometimes further. These areas are likely to be associated with the most significant environmental impacts for animals and birds using the sea surface.

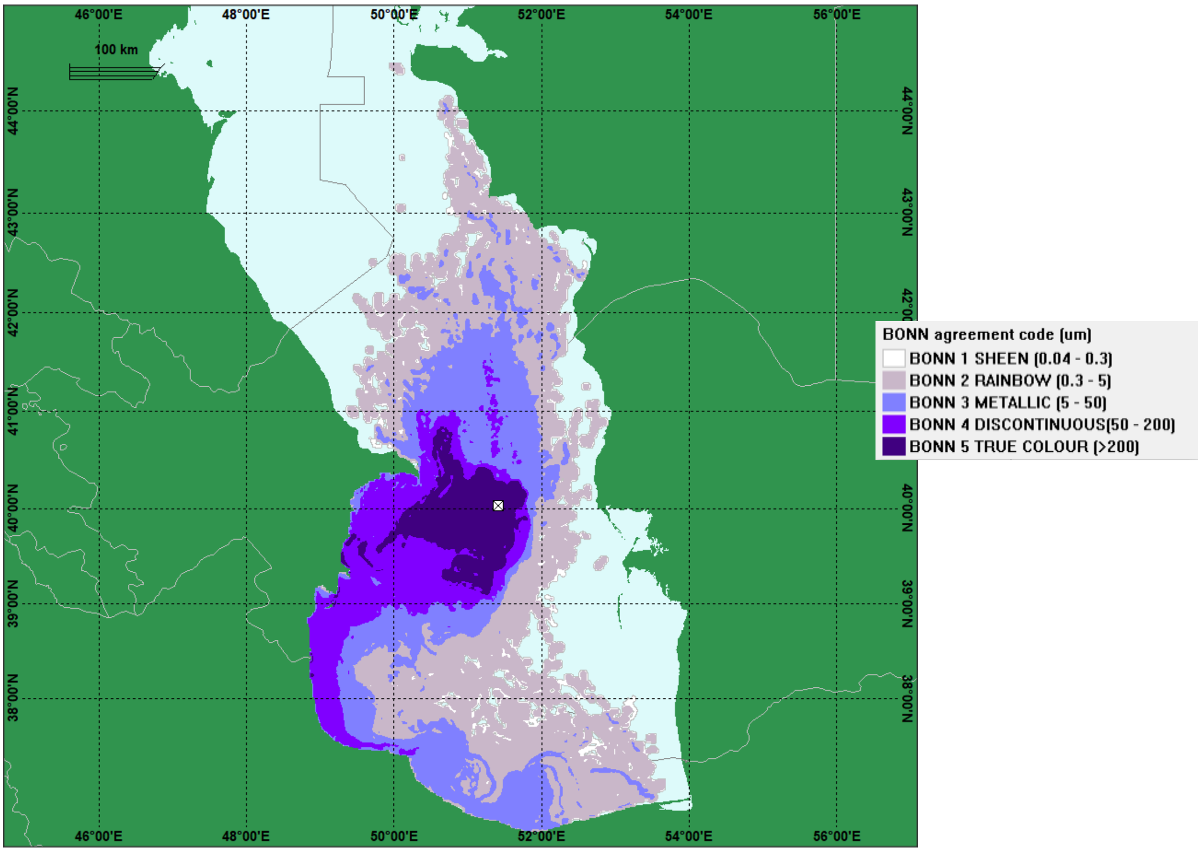

Figure 24: Worst case blowout: Cumulative area of surface sheen - summer

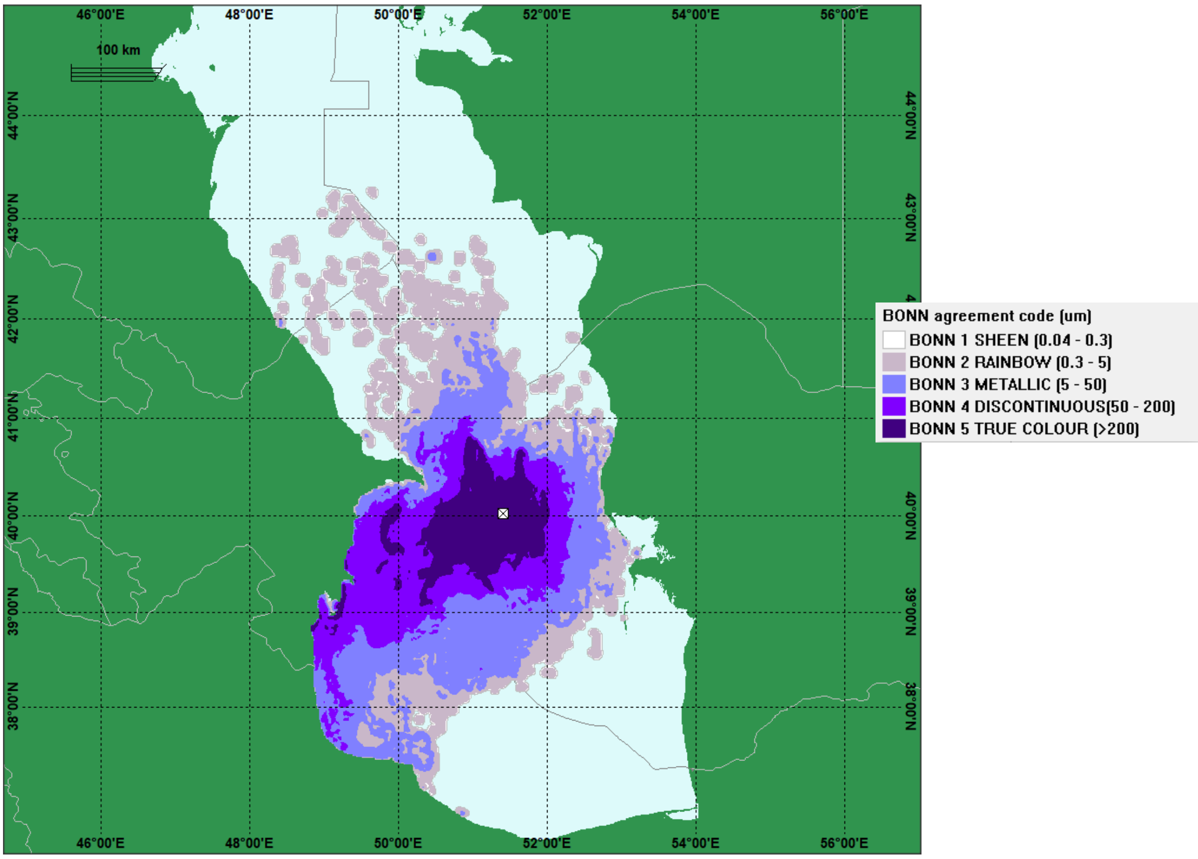

Figure 25: Worst case blowout: Cumulative area of surface sheen - winter

5.2.4.2 Oil on shore

Oil accumulation on shore for summer deterministic case is shown in Figure 26 and the winter deterministic case is shown in Figure 27.

The summer case results in oil mainly reaching three areas; southern Azerbaijan, northern Iran and the Absheron peninsula. The eastern coastline is unaffected. A mixture of areas of very light, light, moderate and heavy oil deposition are present.

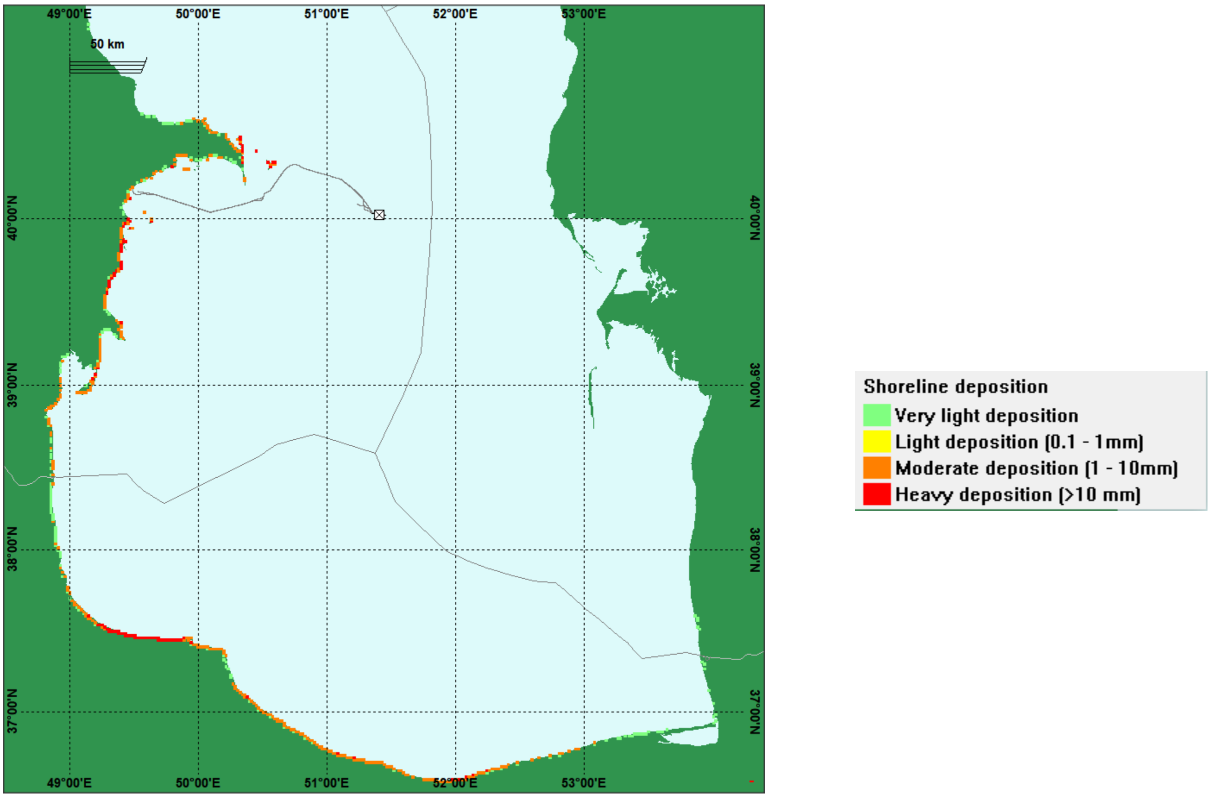

Figure 26: Worst case blowout: Oil on shore - summer

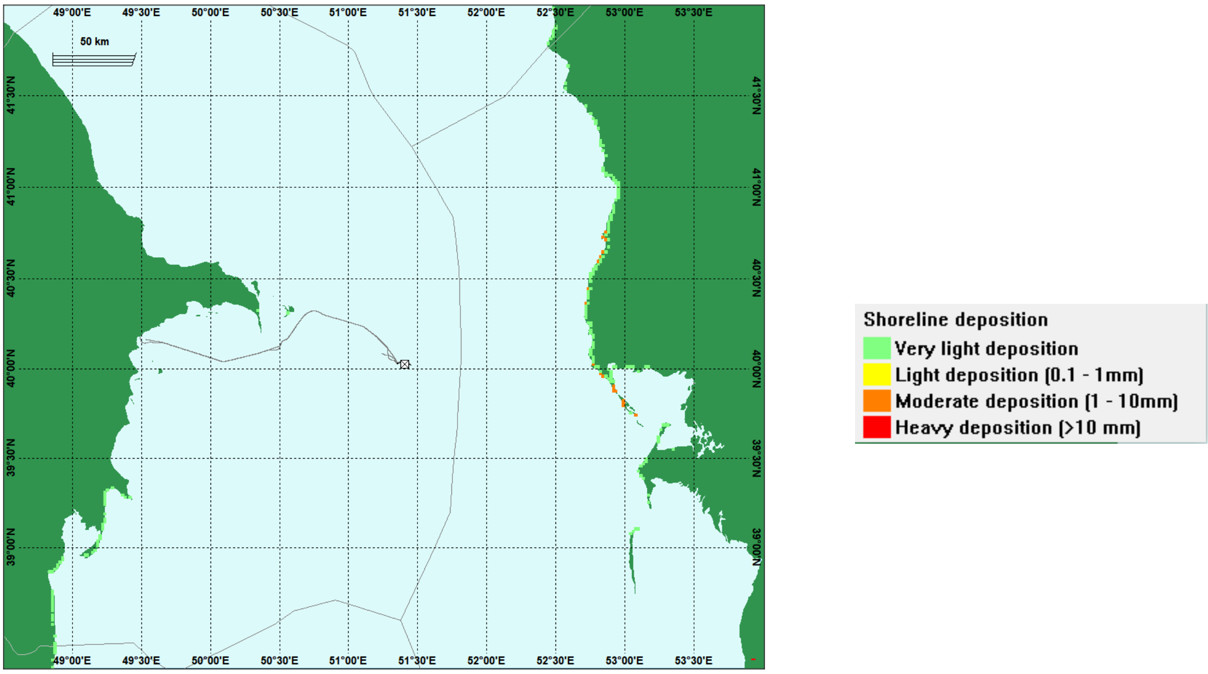

Figure 27: Worst case blowout: Oil on shore - winter

5.2.4.3 Oil in the water column

The extent of oil in the water column above the threshold tracks the path of the surface release and can extend over 200 km from the source as shown in Figure 28 and Figure 29 representing the deterministic cases run in summer and winter, where (for each season respectively) the maximum oil reaches the shore. In each figure, the output is a ‘snapshot’ at the time where the largest area is affected, which is at approximately 60 days after the start of the release. Some areas continue to be affected 30 days after the end of the release although they are patchy and transient by this time. The upper 30 m of the water column is most affected, although some oil above the threshold is also predicted temporarily at depths of up to 80 m, and in the plume directly above the blowout.

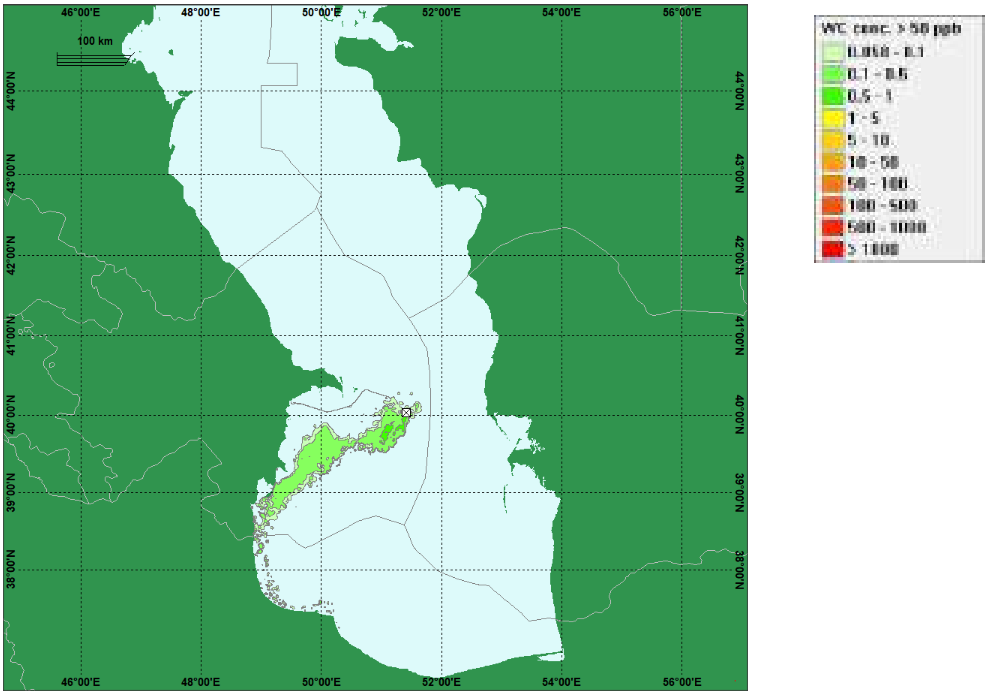

Figure 28: Worst case blowout: maximum affected area of water column during simulation

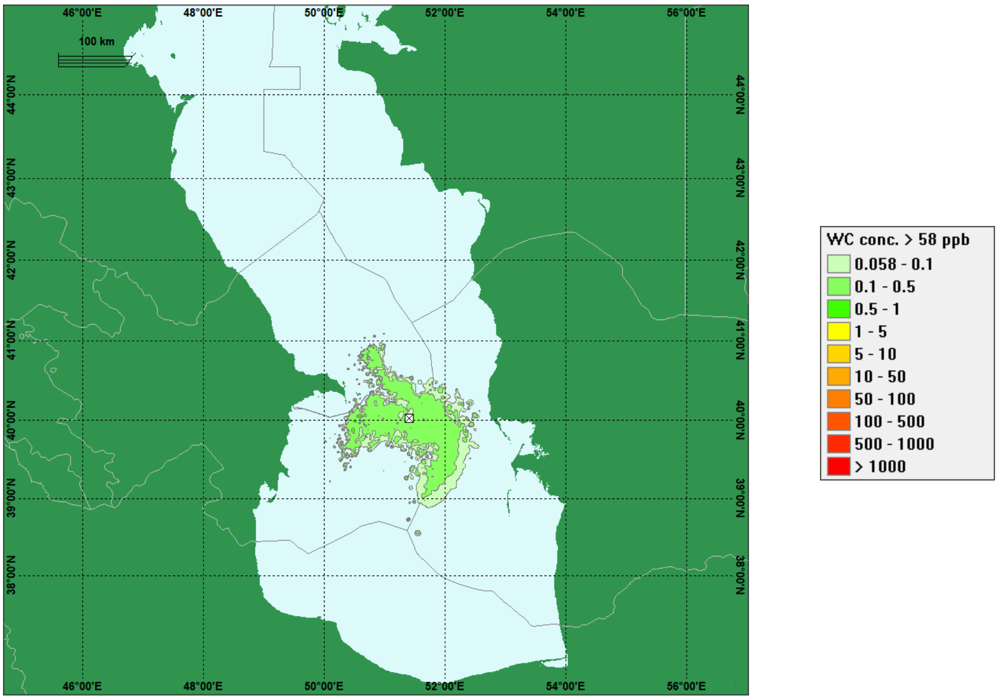

Figure 29: Worst case blowout: maximum affected area of water column during simulation

The typical development of the subsea plume is shown in Figure 30, which illustrates the oil in the water column (note: oil on the surface has been omitted for clarity). This shows the ascent of the oil and gas plume 2 hours after the start of the blowout, when the plume to the surface has reached stable conditions and oil has travelled around 2 km from the source. Although summer conditions are shown, this initial development of the plume is similar in summer and winter. The sea currents at this time are relatively quiescent, so the plume appears vertical, although at other times it will be deflected off-vertical. Oil is predicted to appear on the surface approximately 100 seconds after the start of the release.

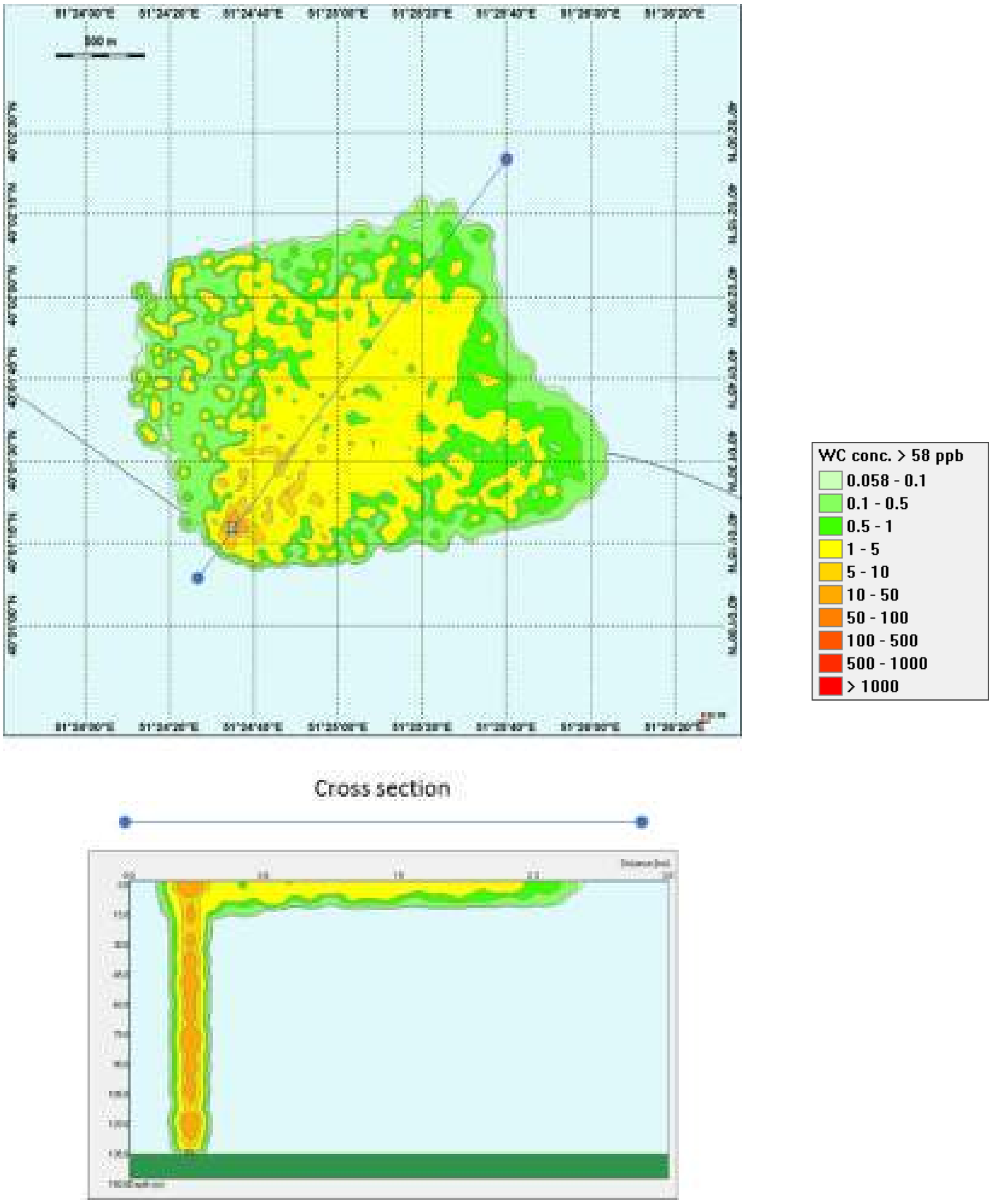

Figure 30: Worst case blowout: Development of subsea plume

5.3 Scenario 3 - Pipeline release

5.3.1 Overall description of oil behaviour from stochastic and deterministic modelling

The OSCAR model tracks the fate of oil through the simulation as shown in Figure 31, which represents the summer conditions, but which is generally representative of the fate of oil released at any point in the year.

Initially the majority of the oil is present on the sea surface, while 10% evaporates almost immediately and 15% is dispersed into the water column. Oil travels through the water column and takes just under two minutes to reach the surface. In the initial 48 hours oil is predominantly within the upper 15 m of the water column, although in the first few hours, a secondary plume is also observed near the seabed resulting from initial high turbulence conditions that create neutrally buoyant oil droplets and promote dissolution. Oil on the surface diminishes rapidly after two days by mixing into the water column under the action of wind and waves, although some oil can subsequently re-surface during calmer periods. After around 6 days, oil has moved into shallower waters and begins to deposit in sediments, eventually accounting for around 24% of the oil at the end of the simulation. In this example, which represents the case with the maximum amount of oil on shore, oil reaches the shore at day 10 in southern Azerbaijan, and the fraction on shore does not exceed 2.6% of the total at the end of 40 days.

The amount of evaporation stabilises at around 30-35% while the amount biodegraded rises steadily to 29% by the end of the simulation. Ultimately 36% evaporates, 29% is biodegraded, 7.5% remains in the water column, 24% is deposited in sediments, approximately 2.5% respectively is on the shoreline and less than 1% remains on the sea surface.

In this example, the majority of oil moves southwest towards southern Azerbaijan and then circulates south along the coast towards northern Iran and the southern Caspian Sea shoreline. In the winter, oil transport is more likely to be to the north, tending to avoid the coastline. Although the precise movement of the surface oil is dependent on the exact metocean conditions at the time, the analysis of over 100 different sets of metocean data suggest that these two directions are dominant, and that the most likely locations to receive oil on shore are southern Azerbaijan, northern Iran and the tip of the Absheron peninsula.

The area of water column affected is relatively small, partly because of the size of the release, the low gas content and the low energy conditions towards the end of the release which mean that the oil droplets formed are relatively large and do not spend long in the water column. The location of water column oil tends to track the surface oil location and is predominantly within the upper 20 m of the water depth, although the water column directly above the release is obviously affected in the short period as oil rises to the surface. Nine days after the release has ended, no areas of the water column remain above the 58 ppb threshold.

Oil can reach shore in as little as 6.0 days, although the 50th percentile value is 14.0 days, and it can often take around 30 days for oil ashore to reach a number of tonnes.

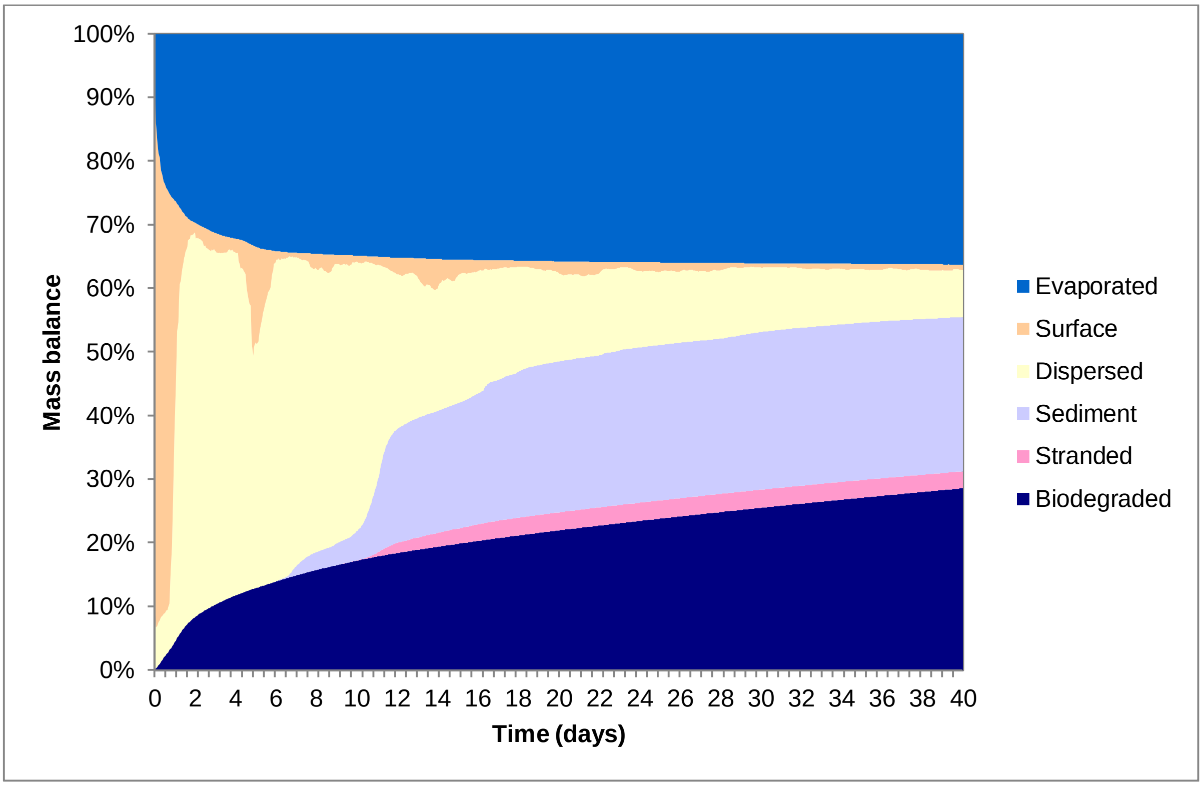

Figure 31: Fate of oil during modelling period

5.3.2 Stochastic modelling

Stochastic simulations were generated encompassing year-round varying metocean data for the pipeline release scenario of 1,133 m^3 of crude oil using 102 model runs evenly spaced through the three years' data. From these results, the worst weather periods were chosen to run deterministic scenarios under summer and winter conditions.

The results for shoreline oiling for each of these simulations are represented in Figure 32 and statistics summarised in Table 11. There is a clear seasonal bias to the results, showing that if oil arrives in May - August, it can reach tens of tonnes which is a much larger volume than if oil were to arrive at other times of the year. Given around 30 days on average for oil to reach shore, this corresponds to release start times of March - July. Between September and April, the likely amounts of oil reaching shore are far lower than at other times - less than 5 tonnes. In 30% of cases, no oil at all reaches the shoreline in the simulations.

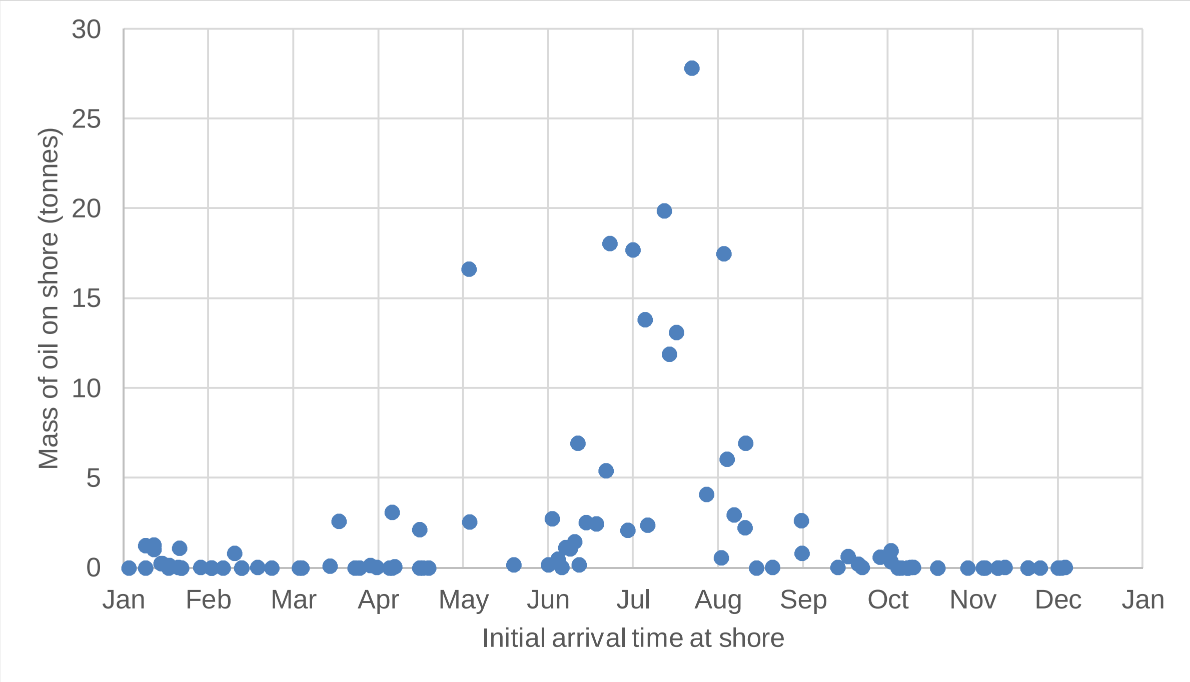

Figure 32: Seasonal distribution of oil on shore from stochastic analysis

Table 11: Stochastic results summary

Scenario	Percentile	Minimum time to beaching (days)	Mass of emulsion accumulated onshore (tonnes)
Pipeline release	P10	-	0
	P50	14.0	0.1
	P90	31.2	7
	Worst	6.0	28

OSCAR statistical outputs are shown as follows:

- Probability of oil on the surface above the threshold of 0.04 µm (Figure 33);
- Minimum arrival time of oil on the surface (no threshold) (Figure 34);
- Probability of oil on the shoreline above the threshold of 100 ml/m^2 (Figure 35);
- Minimum arrival time of oil on the shoreline (no threshold) (Figure 36); and
- Probability of oil in the water column above the threshold of 58 ppb (Figure 37).

Note that the arrival time of oil at the shoreline above the threshold may be different to the arrival time on the adjacent sea surface above threshold, although any differences are usually small.

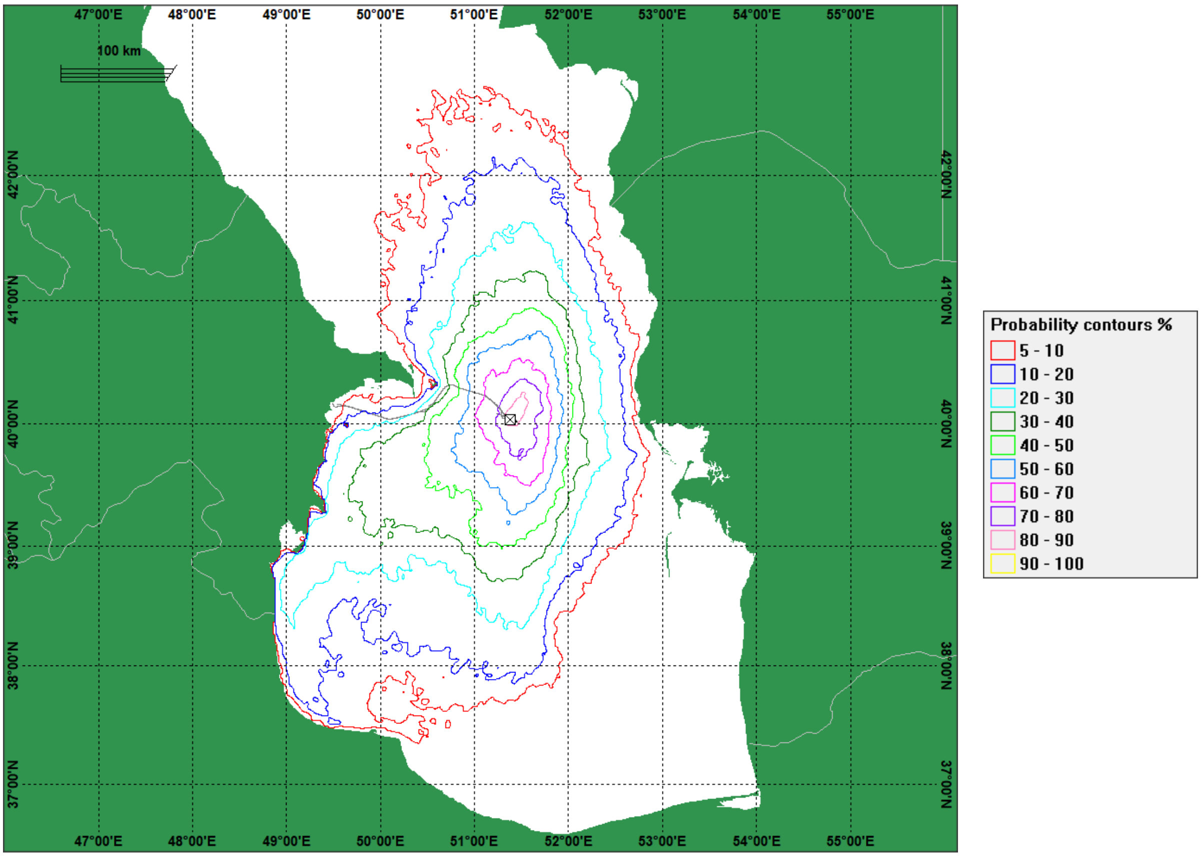

Figure 33: Pipeline release: Probability of surface oil above threshold of 0.04 µm

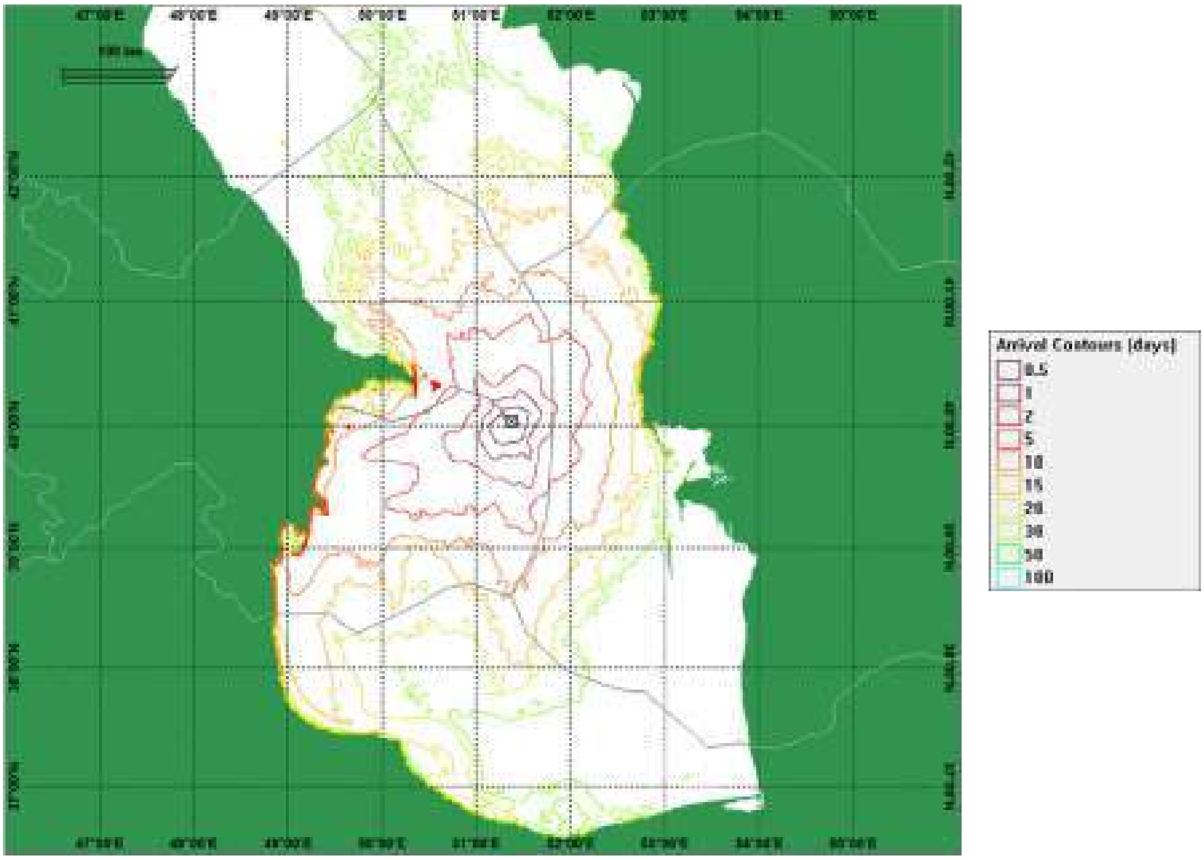

Figure 34: Pipeline release: Minimum arrival time of oil on surface

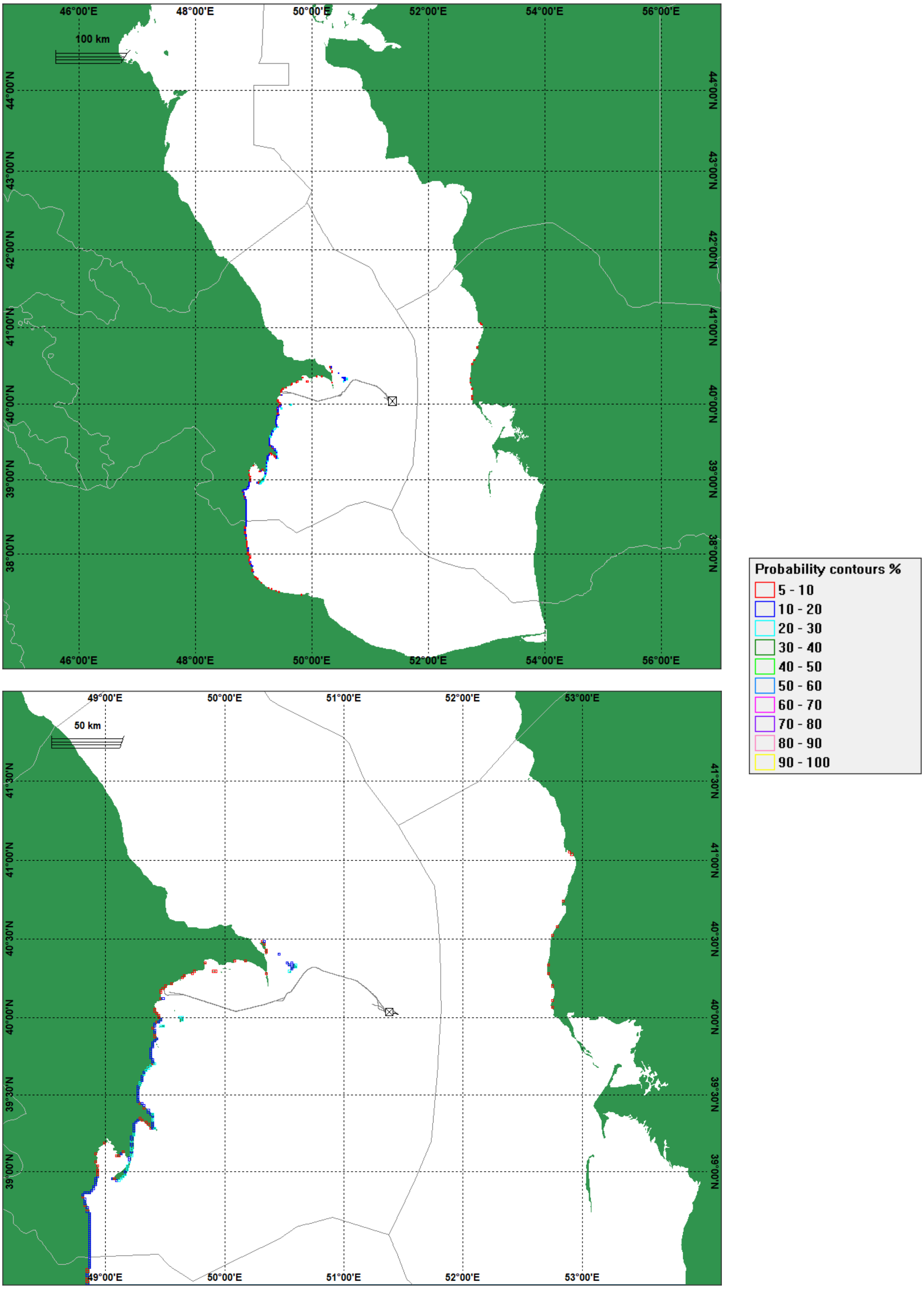

Figure 35: Pipeline release: Probability of oil on shoreline above threshold of 100 ml / m², with enlargement of key areas

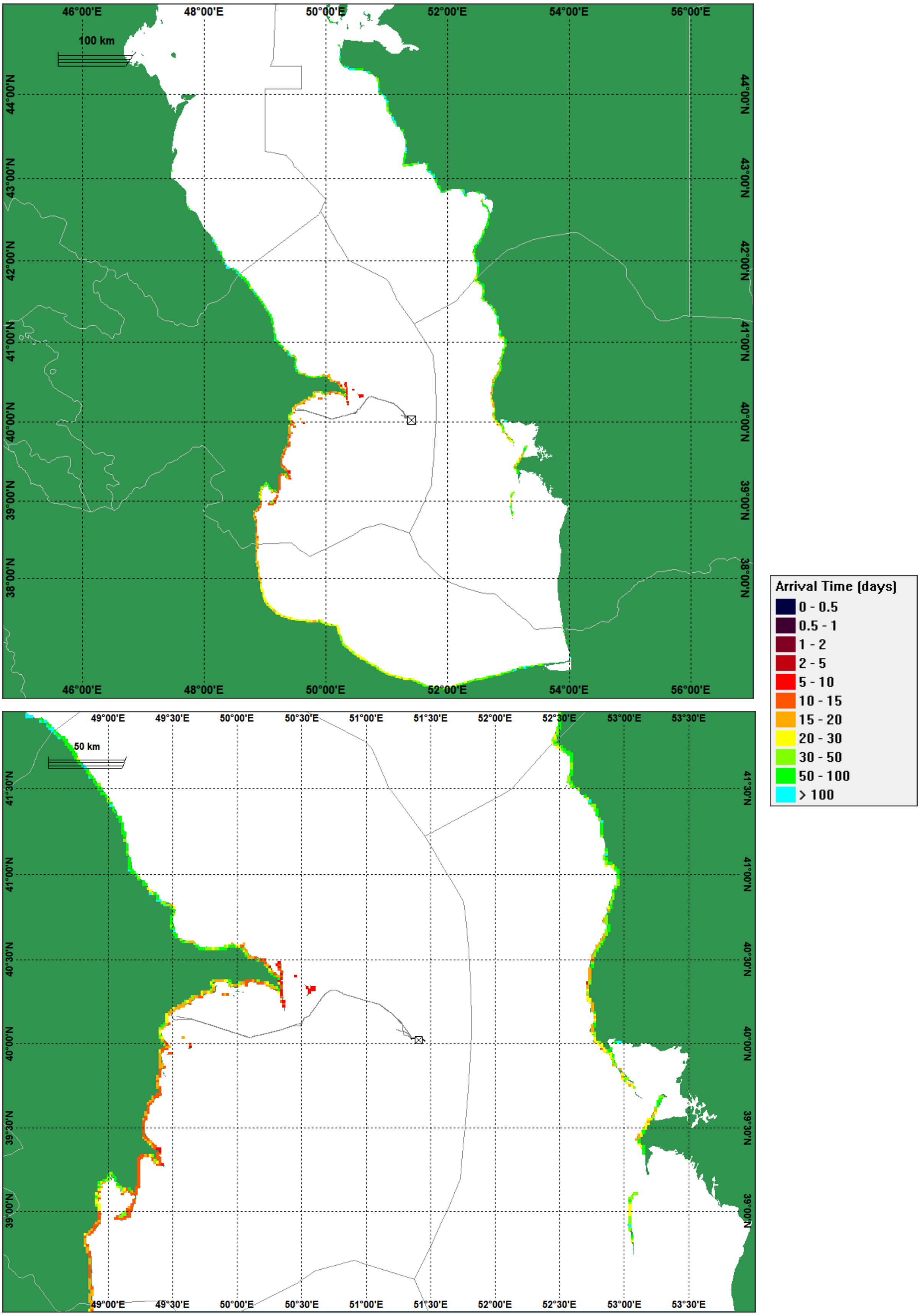

Figure 36: Pipeline release: Minimum arrival time of oil on shoreline, with enlargement of key areas

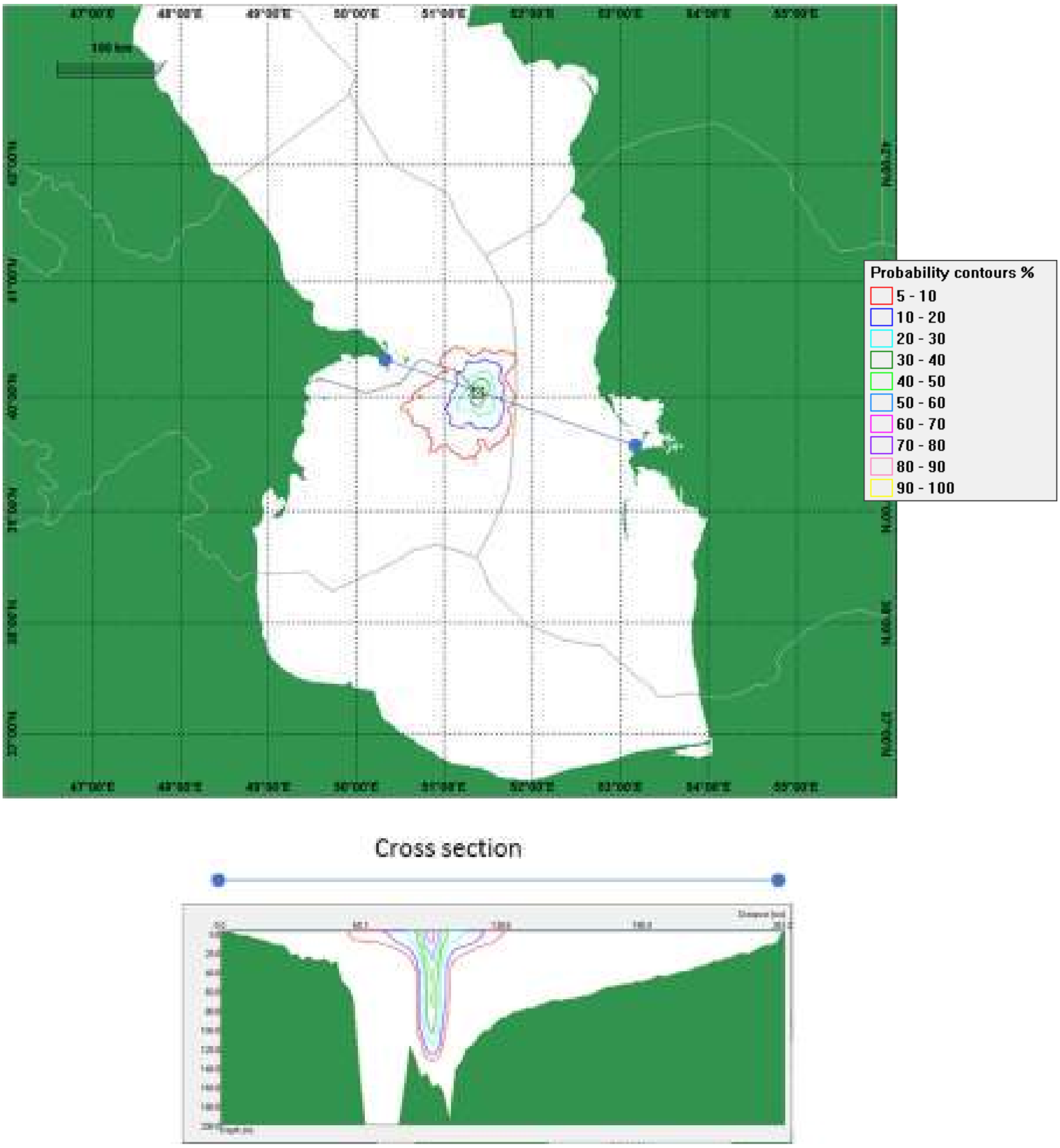

Figure 37: Pipeline release: Probability of oil in water column above threshold of 58 ppb

5.3.3 Deterministic modelling

Key outputs from the deterministic modelling are shown in Table 12.

Table 12: Deterministic results summary for pipeline release scenario

Scenario	Release location	Maximum surface extent of sheen above 0.04 µm (km)		Time until water column dissolved concentration <58 ppb (days)	
		Summer	Winter	Summer	Winter
Pipeline release 1,133 m^3	30" oil / PW pipeline (mid-way between ACE and CA platforms)	312	339	9	6

The timing of the summer and winter deterministic scenarios is chosen to match the cases with the maximum mass of oil reaching shore in each season.

5.3.3.1 Oil on surface

Crude oil on the sea surface is predicted to travel up to 340 km in these two sets of conditions before it drops below the lowest recognised visible thickness under ideal viewing conditions (Figure 38 and Figure 39), although the sheen is very thin and broken up at far smaller distances. The oil droplets initially produced are larger than in the blowout scenario as there is little associated gas and the release conditions are lower energy, which means that although the release if far smaller, the surface sheen can still be somewhat persistent over distance where the wax content has a bearing in keeping the oil stable for longer. There is a distinct difference in oil movement between summer and winter as shown in the figures. In the summer, oil 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 oil (> 0.2 mm) are present within around 10-20 km of the release but are short term (lasting up to 2 days) and occupying an area of up to 2 km^2. These areas are likely to be associated with the most significant environmental impacts for animals and birds using the sea surface.

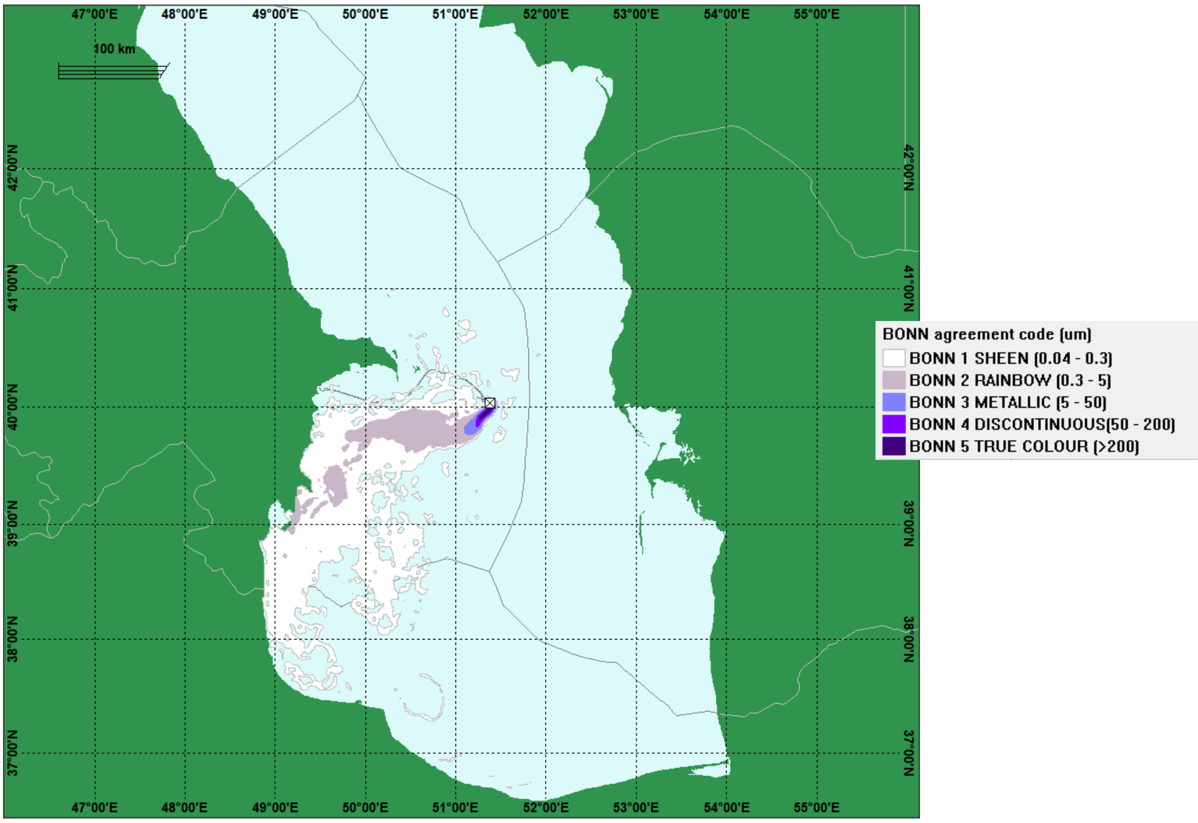

Figure 38: Pipeline release: Cumulative area of surface sheen - summer

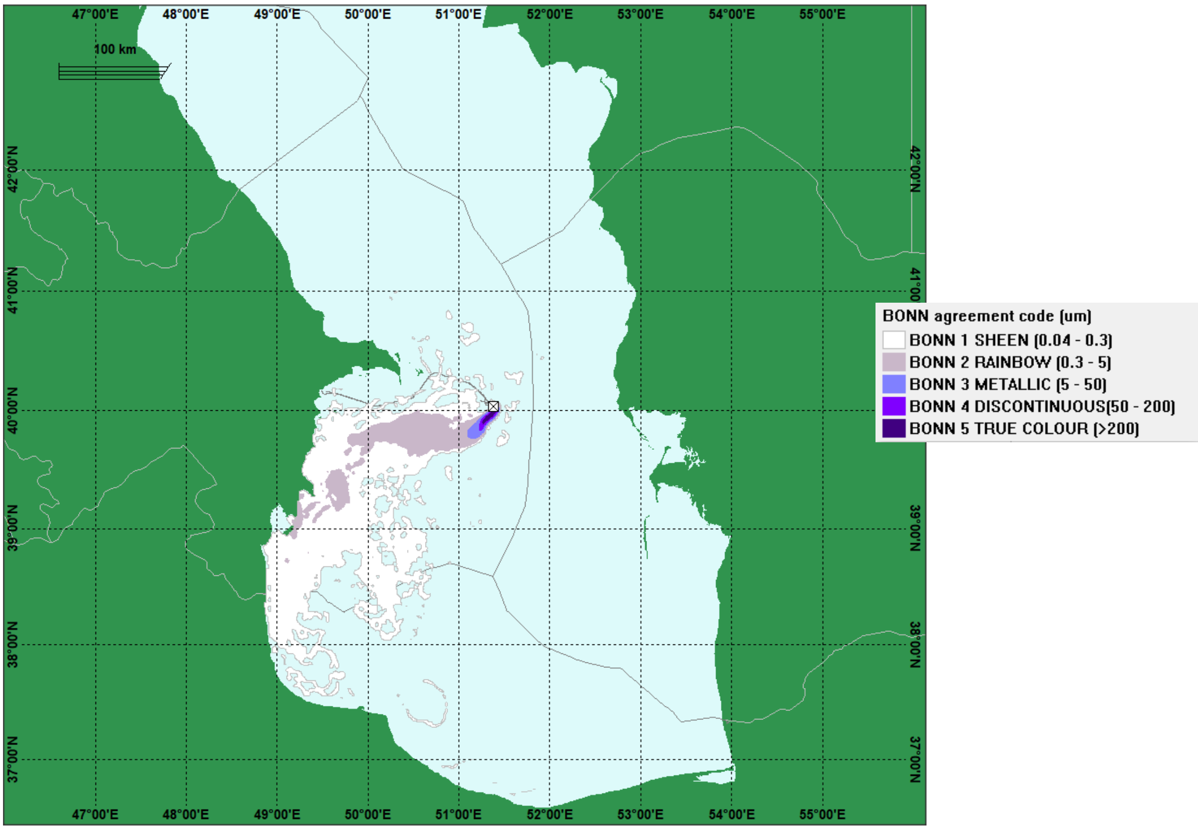

Figure 39: Pipeline release: Cumulative area of surface sheen - winter

5.3.3.2 Oil on shore

Oil accumulation on shore for summer deterministic case is shown in Figure 40 and the winter deterministic case is shown in Figure 41. Oil deposition is spread out given the distance and time separating the source from the shore, and the mass of oil involved are relatively small.

The summer case results in oil mainly reaching three areas; southern Azerbaijan, northern Iran and Turkmenistan. A mixture of areas of very light and light oil deposition are present.

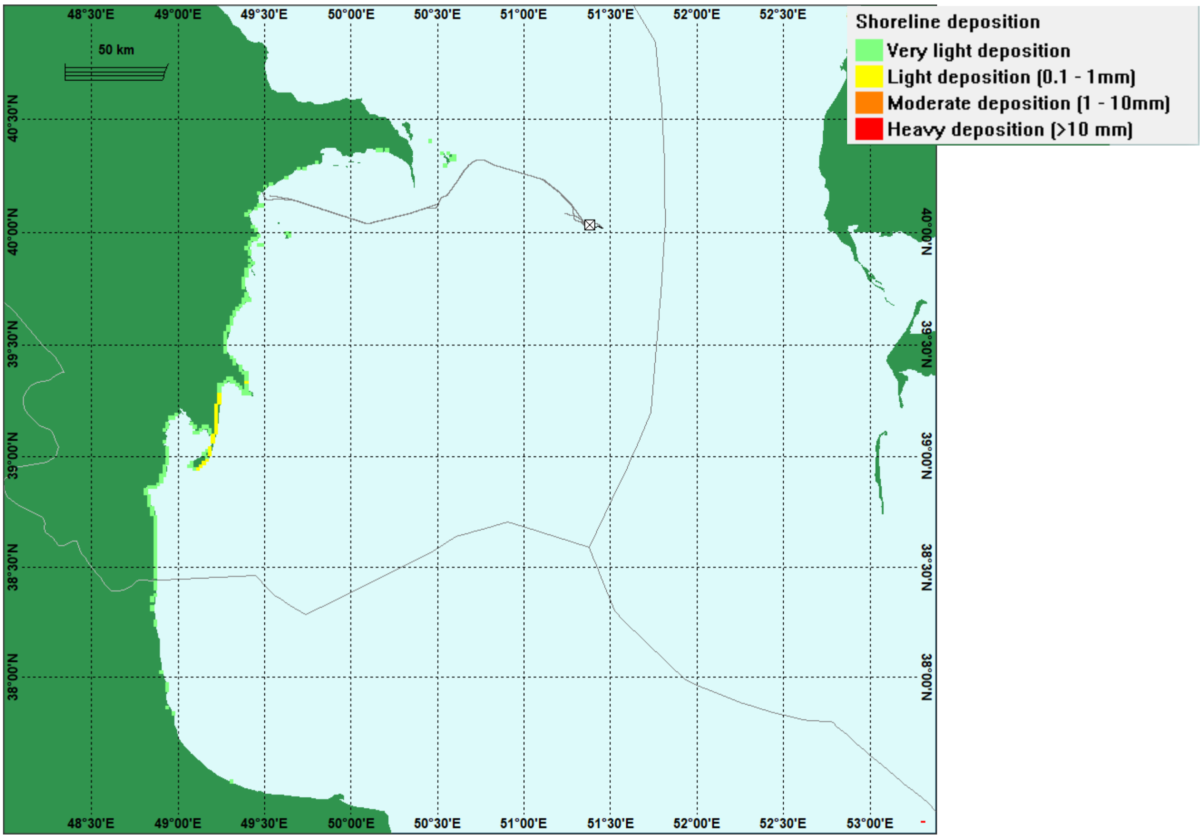

Figure 40: Pipeline release: Oil on shore - summer

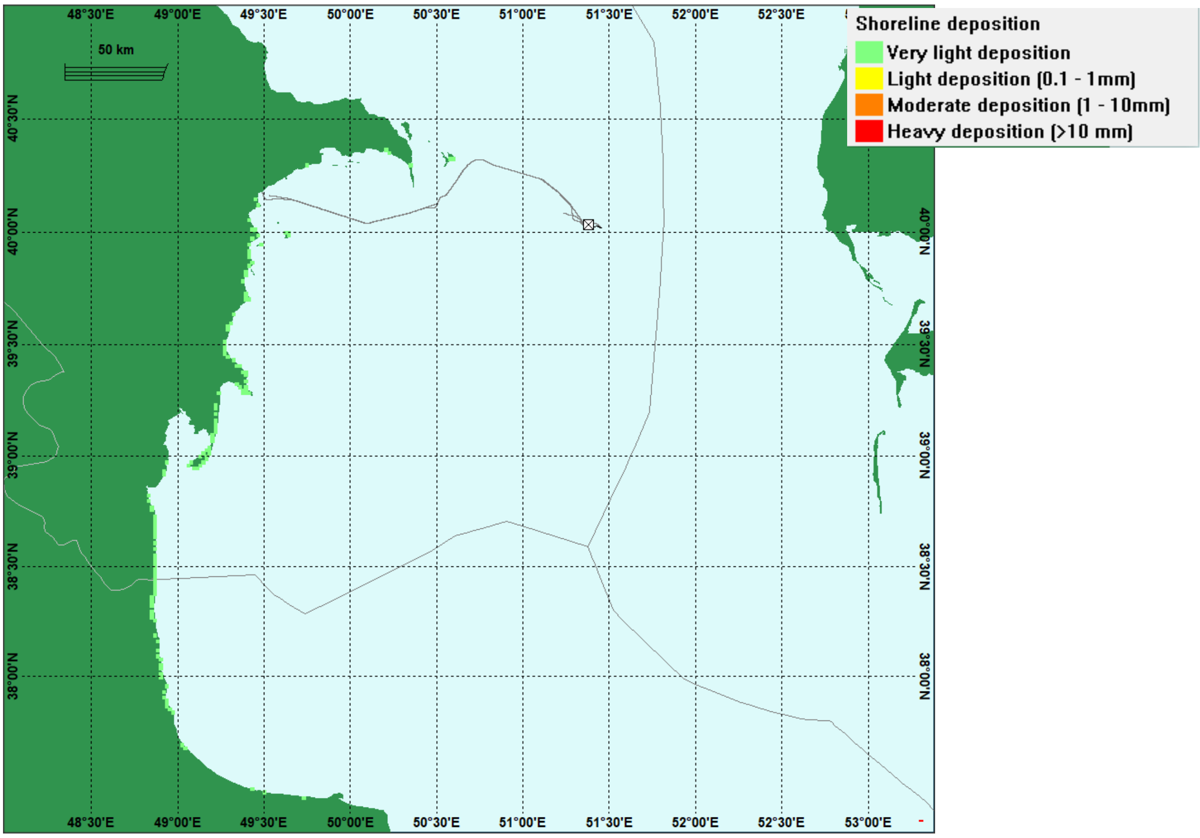

Figure 41: Pipeline release: Oil on shore - winter

5.3.3.3 Oil in the water column

The extent of oil in the water column above the threshold tracks the path of the surface release and can extend around 30-40 km from the source as shown in Figure 42 and Figure 43 representing the deterministic cases run in summer and winter, where (for each season respectively) the maximum oil reaches the shore. In each figure, the output is a 'snapshot' at the time where the largest area is affected, which is at approximately one day after the start of the release, when the oil has moved away from the release point. Some affected areas continue to be present up to 4 days after the end of the release in these examples although they are patchy by this time. The upper 20 m of the water column is most affected, although some oil above the threshold is also predicted in the plume directly above the release point.

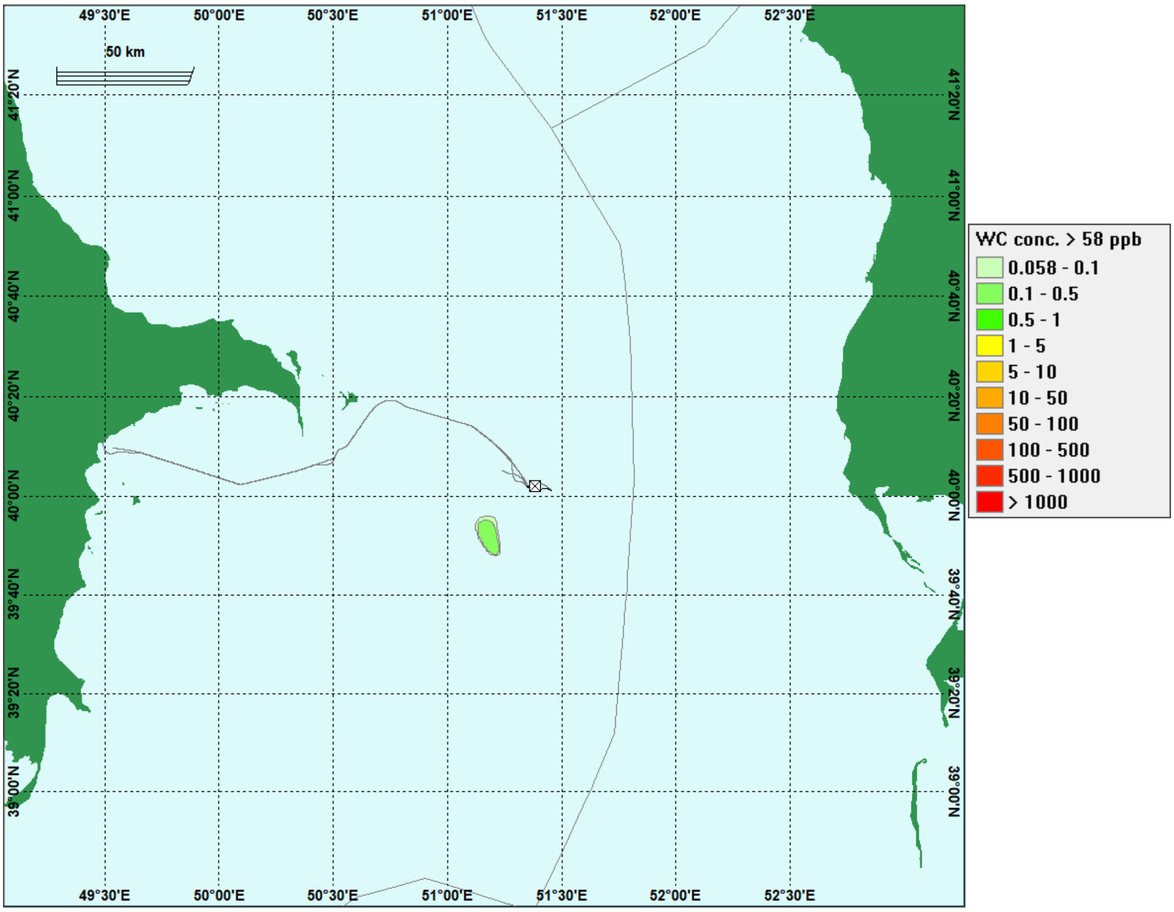

Figure 42: Pipeline release: maximum affected area of water column during simulation - summer

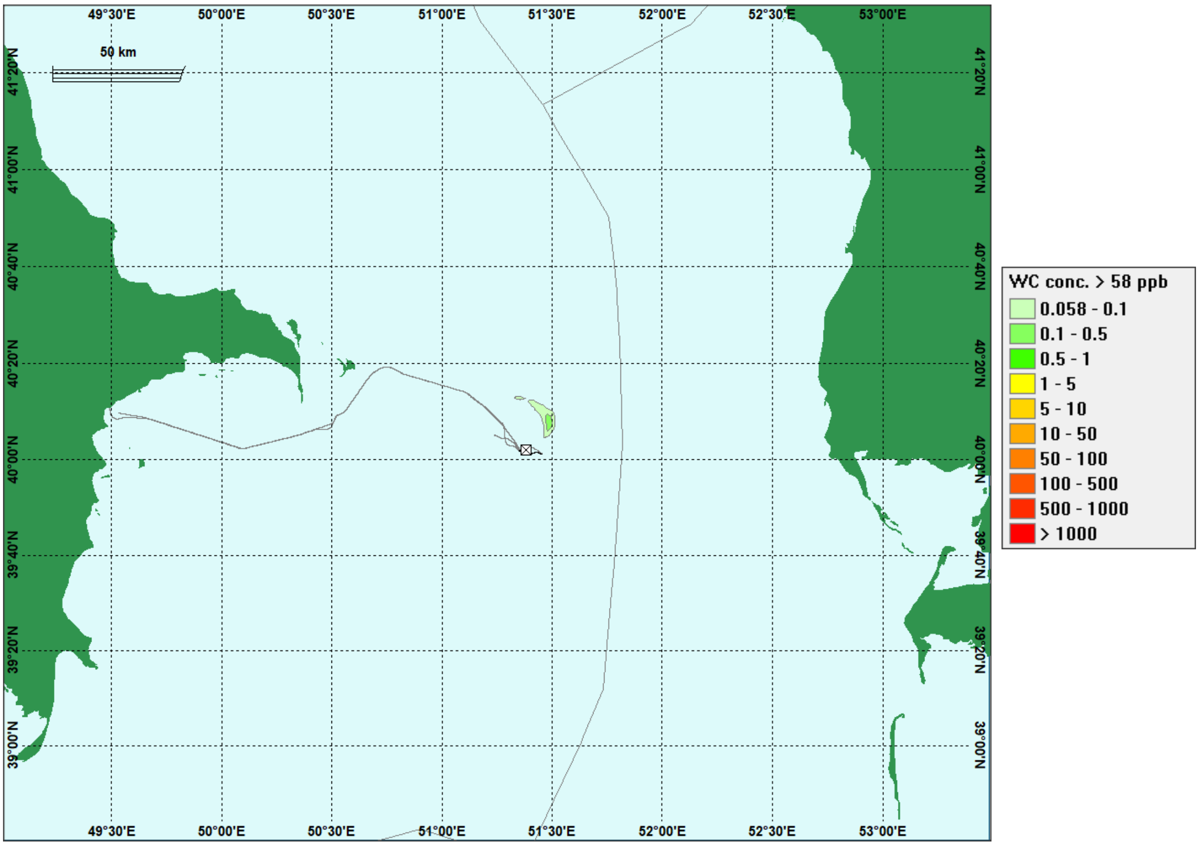

Figure 43: Pipeline release: maximum affected area of water column during simulation - winter

The development of the subsea plume is shown in Figure 44 which illustrates the oil in the water column (note: oil on the surface has been omitted for clarity). Although summer conditions are shown, this initial development of the plume is similar in summer and winter. The release period is relatively short (up to 50 minutes) and the developed plume is shown at 60 minutes after the start of the release i.e. 10 minutes after it has ended, when oil is still ascending through the water column. At this time, oil has travelled around 1 km from the source. The sea currents at this time are relatively quiescent, so the plume appears close to vertical, although at other times it will be more deflected. Some oil is also present near the seabed resulting from the very initial stage of the release when the highest energy is present, resulting from high energy turbulence creating small, neutrally buoyant droplets. Oil is predicted to reach the sea surface less than 90 seconds after the start of the release.

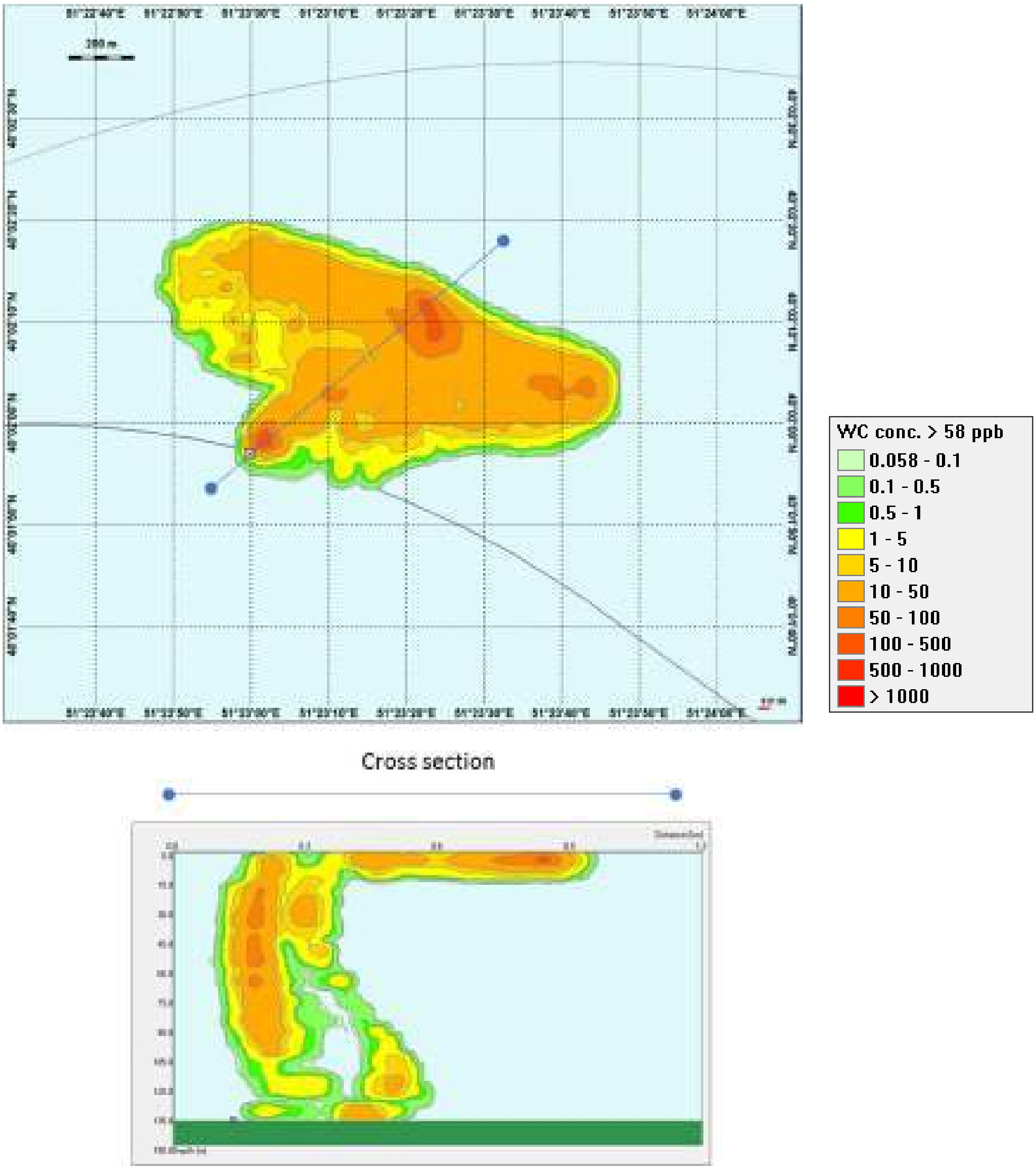

Figure 44: Pipeline release: Development of subsea plume

6 Uncertainties

6.1 Characterisation of the release

6.1.1 Release volumes

Diesel volumes are based on known tank sizes and are well defined. Release rates depend on the means of discharge e.g. a perforation. Assuming this volume leaks in one hour appears a reasonably conservative estimate, and is a small proportion of the time taken for the release to mainly disappear from the surface (48 hours).

6.1.2 Release geometry

The release geometry for diesel is onto the water surface. An underwater release would reduce the diesel on the surface and increase the diesel in the water column, by a small margin. A smaller release would result in a thinner sheen that would evaporate more quickly.

The release geometry for the worst case blowout is fixed by the well design and not a significant uncertainty. There are many other potential geometries of the release, such as having the opening obstructed, or a release topsides, but these will tend to reduce the flow of oil into the sea and would therefore not be worst case, while the time to arrest the blowout by a relief well remains the same.

The pipeline release is modelled as full bore, and any orifice smaller than this would slow the release rate and create more energetic turbulence that would reduce the surface slick and increase the amount of oil in the water column.

6.1.3 Oil properties

The oil properties are well understood from internationally recognised laboratory testing. It is possible that the mix of oils in the blowout and pipeline release scenarios differs from the Central Azeri oil type, but the ACG group of reservoirs have similar properties, including some that are more fluid and more evaporative, so overall impacts would be expected to be within the envelope of those predicted.

6.2 Metocean data

Seasonal variations in temperature occur, mainly in top tens of metres of the water column. To show the effect of summer and winter conditions, separate modelling runs have been undertaken in February and August. Seasonal variations in salinity are not expected.

The main uncertainty arising is that of differences between actual bathymetry data and that observed through recent surveys, which can be 10-15%. This will have some effect on the hydrodynamic model although it is not expected to be as high as 10-15% as the changes are spread over wide areas. The decision has been taken to retain the GEBCO bathymetry data in the model as the most representative, uniform source, rather than try to load in small patches of new data, which would create anomalies in the seabed and mean that releases were not depth-proportional to the profile of currents. It is unlikely that overall regional circulation is altered by this new information, but local effects may be noticeably changed. The effects on oil movement are limited since oil is buoyant and quickly reaches the sea surface layers.

6.3 Model capabilities

The OSCAR model has a long pedigree of development coupled with testing that gives confidence in surface and water column outputs. Recent validation by BP has also given confidence to shoreline statistics (de Susanne et al., 2015). Predictions for sediment, however, are based on very simple partitioning calculations, and may have a large margin of variability. Additionally, shoreline types have been mapped as sandy beach, and precise local shorelines will show a greater or lesser affinity for oil.

7 Conclusions

The modelling of oil releases associated with the ACE Project predicted the following key outcomes. Note that comments are restricted to the behaviour of the oil rather than interpretation of impacts.

1. Diesel release. A diesel release of 92 m^3 would create a sheen that would occupy a relatively small area of the Caspian Sea for a period of up to 2 days, after which it would be relatively insubstantial. The majority if the diesel would be lost to the atmosphere and/or biodegraded, with a residual component in the water column. Diesel does not reach the shoreline.

2. Well blowout. A worst-case well blowout would create a thick oil slick extending up to 400 - 500 km at its maximum. During the blowout period of 90 days, oil is continually supplied to the sea surface, and oil on the surface remains significant until after the end of the 90 day period. Oil could reach shore in 6.5 days although 19.4 days is the typical arrival time. The thickest areas of oil (> 0.2 mm) are present within 100 km of the well and sometimes further. The most likely locations to receive oil on shore are southern Azerbaijan, northern Iran and the tip of the Absheron peninsula, and up to 18,295 tonnes is predicted to be on the shoreline (2,591 tonnes typically) with the majority evaporated and/or biodegraded plus a significant proportion deposited in sediments. A blowout in the summer months is much more likely to result in shoreline oiling.
3. Pipeline release. A full-bore pipeline release at maximum production rates followed by a shut-down would result in 1,133 m^3 of oil being released. Oil on the surface diminishes rapidly after two days by mixing into the water column under the action of wind and waves. Evaporation and biodegradation account for the majority of the oil and there would be fractions in sediment, with less than 0.5% reaching shore, and with no shoreline oiling in 30% of cases. The most likely locations to receive oil on shore are southern Azerbaijan, northern Iran and the tip of the Absheron peninsula with a maximum mass on shore of 28 tonnes. Oil can reach shore in as little as 6.0 days (typically 14.0 days), and it can take around 30 days for oil ashore to reach a number of tonnes.

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