bp EXPLORATION (Shah Deniz) Ltd

Shah Deniz Compression Project

Environmental & Social Impact Assessment – Volume 2

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CONTENTS

APPENDIX 5A - AIR EMISSION ESTIMATE ASSUMPTIONS

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:

- EMEP/EEA Air Pollutant Emission Inventory Guidebook (European Environment Agency, 2023)
- AP-42 Compilation of Air Pollutant Emission Factors, Volume 1: Stationary and Point Emission Sources (U.S. Environmental Protection Agency, 1995)
- E&P Forum Report No. 2.59/197 Methods for Estimating Atmospheric Emissions from E&P Operations (Oil Industry International E&P Forum, September 1994)
- EEMS Atmospheric Emission Calculations Issue 1.8 (UK Offshore Operators Association Ltd, 2008).

Emission Factors

Vessels and helicopters

Table 5A.1 presents emissions factors used to calculate emissions from vessels and helicopters. Sources are provided in the table.

Table 5A.1: Emission factors for vessels and helicopters

Type of source	Fuel	Unit	CO_2	CO	NO_x	SO_x	CH_4	NMVOC
Vessel	Diesel	Tonnes emissions / tonnes of fuel used	3.2	0.0052	0.0125	0.0001	0.00087	0.0008
Helicopter				0.008	0.059		0.00027	0.0024
Sources: E&P Forum - Report No. 2.59/197 Sulphur dioxide emission factor = 2 x weight fraction of sulphur in diesel (0.05 wt%)								

Construction plant

Table 5A.2 presents emission factors used to calculate emissions forecasts from construction plant including cranes, forklifts, etc. These factors have been taken from USEPA WebFire Emission Factor Database for Diesel Industrial Engines (AP-42 Compilation of Air Pollutant Emission Factors, Volume 1: Stationary and Point Emission Sources).

Table 5A.2: Emission factors construction plant

Pollutant	Emission factor (lb/1000Gal)
CO_2	22600
CO	130
NOx	604
SO_2	39.70
CH_4	N/A
NMVOC	N/A

There are minimal emissions of CH_4 and NMVOCs from construction plant. Emission factors for these were not available in USEPA WebFire Emission Factor Database for Diesel Industrial Engines, therefore, these have not been calculated.

Construction vehicles

Table 5A.3 presents emission factors used to calculate emissions forecasts from construction vehicles including trucks, trailers etc. These factors have been taken from EMEP/EEA Air Pollutant Emission Inventory Guidebook 2023 for Diesel Heavy Duty Vehicles (assumed >32 t - Euro VI).

Table 5A.3: Emission factors construction vehicles

Pollutant	Emission factor (g/km)
CO_2	0.486
CO	0.121
NOx	0.507
SO_2	N/A
CH_4	0.001187
NMVOC	0.012
PM2.5	0.0013

Note: There are minimal emissions of SO_2 from construction vehicles. The emission factors for these were not available in EMEP/EEA Air Pollutant Emission Inventory Guidebook 2023 for Diesel Heavy Duty Vehicles, therefore, these have not been calculated.

Diesel generators

Table 5A.4 presents emission factors used to calculate emissions forecasts from generators. These factors have been taken from AP 42 Vol 1 (3.4) for Large Stationary Diesel And All Stationary Dual-fuel Engines (https://www3.epa.gov/ttnchie1/ap42/ch03/final/c03s04.pdf). The emission factor varies with the load in case of generators.

Table 5A.4: Emission factors for diesel generators

Pollutant	Emission factor (tonnes per day) full load	Emission factor (tonnes per day) half load
NOx	0.28512	0.14256
SO_2	0.00048	0.00024
CO	0.07536	0.03768
PM	0.00927	0.00464
NMVOC	0.00761	0.00380
CH_4	0.00075	0.0004
CO_2	15.3252	7.6626

Paint

Table 5A.5 presents emission factors used to estimate VOC emissions from paints and coatings used on the jacket and topsides. VOC emission factors for top coat (assumed polyurethane stain), mid coat (assumed latex paint), and undercoat (assumed primer) have been taken from research paper https://doi.org/10.5194/acp-21-6005-2021.

Table 5A.5: VOC emission factors for coating and painting

Pollutant	Emission factor (g/kg)
Top coat (assumed polyurethane stain)	495
Mid coat (assumed latex paint)	43.1
Undercoat (assumed primer)	2.84

Greenhouse gases (GHGs)

GHG emissions were calculated by adding the CO_2 emissions and CH_4 emissions multiplied by their global warming potential, as specified in the IPCC AR6 GWP values, see below:

CO_2 = 1

CH_4 = 29.8

Methodology

Onshore construction (yards)

Estimated fuel usage for each vehicle or piece of plant (based on fuel consumption and operational period) was multiplied by the relevant emission factor (see Tables 5A.2, 5A.3 and 5A.4).

The estimated number of key construction plant and vehicles expected to be used onsite at the construction yards is provided in Tables 5A.6 and 5A.7.

Table 5A.6: Predicted plant and vehicles use at BDJF yard

Plant	Number	Fuel consumption (diesel)	Operational period
Crawler cranes	8	60 litres per hour	9 hrs working, 6 days a week, 24 months
Forklift	7	3 litres per hour	9 hrs working, 6 days a week, 24 months
Generators	2	220 litres per hour	Used for backup power (0.8 MW at full load – see Annex 1). Assumed operational for 2 hours per week for 24 months.
Compressors	11	3 litres per hour	9 hrs working, 6 days a week, 24 months
Welding machines	44	-	Mains electricity
Electrode ovens	86	-	Mains electricity
Trailers	4	3 litres per 10 km	6 hrs working, 3 days a week, 24 months. Assumed 30 km travelled per day.
Winches	20	5 litres per hour	9 hrs working, 2 days a week, 24 months
Onsite vehicles and trucks	20	3 litres per 10 km	9 hours working, 6 days a week, 24 months. Assumed 30 km travelled per day.
Cherry pickers	3	3 litres per hour	9 hours working, 6 days a week, 24 months
Rolling machines	5	3 litres per hour	9 hours working, 6 days a week, 24 months

Table 5A.7: Predicted plant and vehicles use at Bayil yard

Plant	Number	Fuel consumption (diesel)	Operational period
Generators	2	259 litres per hour	Used for backup power (1 MW at full load – see Annex 1). Assumed operational for 2 hours per week for 32 months to include construction and commissioning period.
600 t cranes	2	60 litres per hour	6 hrs working, 6 days a week, 24 months
400 t cranes	2	40 litres per hour	6 hrs working, 6 days a week, 24 months
220 t cranes	2	20 litres per hour	7 hrs working, 6 days a week, 28 months
Small cranes	13	10 litres per hour	8 hrs working, 6 days a week, 30 months

Plant	Number	Fuel consumption (diesel)	Operational period
Forklifts	18	3 litres per hour	8 hrs working, 6 days a week, 30 months
HIABs	6	3 litres per hour	8 hrs working, 6 days a week, 30 months
Low beds and trucks	15	3 litres per 10 km	8 hrs working, 6 days a week, 30 months. Assumed 20 km travelled per day.
Compressors	15	3 litres per hour	8 hrs working, 6 days a week, 24 months
Tractors	5	3 litres per 10 km	8 hrs working, 6 days a week, 30 months. Assumed 20 km travelled per day.
Welding machines	300	-	8 hrs working, 6 days a week, 28 months

VOC emissions from painting and coating were estimated using the anticipated paint use quantities in Table 5A.8 and the emissions factors in Table 5A.5.

Table 5A.8 Anticipated paint use quantities

Item	Area	Undercoat (litres)	Topcoat (litres)	
Jacket (BDJF yard)				
Jacket	Below splash zone	15,000	15,000	
	Within splash zone	1,500	1,500	
Risers	External	400	400	
Caisson and J-tube	External	600	600	
Caisson	Internal	150	150	
Skirt piles		180	700	
Item	**Area**	**Primer (litres)**	**Midcoat (litres)**	**Topcoat (litres)**
Topsides (Bayil yard)				
Structural	Sub under deck	1,970	1,100	1,100
	Under deck	14,960	8,200	8,200
	Main deck	25,253	13,900	13,900
	Electrical room	3,565	1,960	1,960
	Cooler structure	2,695	1,480	1,480
Passive fire protection	Vent stack	392	170	170
	Under deck	2,630	470	470
Piping spools	Topsides	6,542	3,500	3,500
Pipe supports	Topsides	8,800	4,800	4,800

Offshore Installation and HUC

Estimated fuel usage for each vessel / helicopter (based on fuel consumption and operational period) was multiplied by the relevant emission factor (see Table 5A.1).

Table 5A.9 lists the vessels and helicopters that will be used during platform installation, hook up and commissioning activities.

Table 5A.9: Predicted vessel and helicopter use for offshore installation & HUC (fuel use in tonnes)

	Pin piles			Jacket			Topside			Pipeline and subsea		
	No	Days	Fuel use	No	Days	Fuel use	No	Days	Fuel use	No	Days	Fuel use
Anchor handling tug (AHT)				3	19	10	3	18	10	4	80	10
Crew transfer helicopters				1	5	6	1	3	6	1	11	6
DBA / SCV	1	54	22.5	1	106	22.5	1	18	22.5	1	439	22.5
STB-1				1	123	6	1	168	6			
Pipelay barge										1	131	10
Large support vessel	1	24	2	1	59	2	1	18	2	2	80	8
Survey vessel										1	182	7
Floatel							1	178	13			
Pipe supply vessels										4	80	2

Note: The number of AHTs and pipe supply vessels for infield pipeline and subsea installation are likely to be reduced to 3 of each, however, 4 of each have been allowed for in the air emission calculations to represent the worst case scenario.

Topsides commissioning

Prior to tie-in of the PFOCs to the SDC platform, emissions will arise through the use of a temporary generator for a short period during topsides commissioning. Emissions have been based on the use of a 1 MW generator operating at a low load (50%) for a period of 2 months (diesel consumption of 130 litres / hour – see Annex 1) and emission factors in Table 5A.4.

Onshore, Nearshore and Offshore Installation of Power & Fibre Optic Cable (PFOC)

Onshore PFOC

Estimated fuel usage for each vehicle or piece of plant (based on fuel consumption and operational period) was multiplied by the relevant emission factor (see Tables 5A.2 and 5A.3).

The estimated number of key construction plant and vehicles expected to be used along the onshore PFOC installation route is provided in Tables 5A.10.

Table 5A.10: Predicted plant and vehicles use for onshore PFOC installation

Plant	Number	Fuel consumption (diesel)	Operational period
Excavators (onshore activities and construction of finger piers in nearshore)	2	3 litres per hour	8 hrs working, 6 days a week, 20 months
Construction and testing trucks	5	3 litres per 10 km	8 hrs working, 6 days a week, 20 months. Assumed to travel 40km travel per day.
100 t cranes	1	20 litres per hour	7 hrs working, 6 days a week, 15 months
Small cranes	5	10 litres per hour	8 hrs working, 6 days a week, 20 months
Horizontal drilling equipment	1	3 litres per hour	8 hrs working, 6 days a week, 1 month

Nearshore PFOC

Estimated fuel usage for each piece of plant (based on fuel consumption and operational period) and vessel was multiplied by the relevant emission factor (see Tables 5A.1 and 5A.2).

The estimated number of key construction plant and vessels expected to be used along the nearshore PFOC installation route is provided in Tables 5A.11.

Table 5A.11: Predicted plant and vehicles use for nearshore PFOC installation

Plant	Number	Fuel consumption (diesel)	Operational period
Excavator on barge	1	3 litres per hour	9 hrs working, 6 days a week, 2 months
Cable lay vessel SCV Khankendi	1	22.5 tonnes per day	35 days
Survey vessel (geotechnical survey)	1	6 tonnes per day	14 days
Anchor handling tug (AHT)	2	10 tonnes per day	35 days

Note: It is proposed that a jack-up barge will be used in the nearshore zone that will not require anchor handling tugs, however, 2 AHTs have been allowed for in the air emission calculations to represent the worst case scenario.

Offshore PFOC

Estimated fuel usage for each vessel (based on fuel consumption and operational period) was multiplied by the relevant emission factor (see Table 5A.1).

The estimated number of vessels expected to be used along the offshore PFOC installation is provided in Table 5A.12.

Table 5A.12: Predicted vessels use offshore PFOC installation

Plant	Number	Fuel consumption (diesel)	Operational period
Cable lay vessel SCV Khankendi	1	22.5 tonnes per day	60 days

Offshore operations (Scope 1)

Offshore Scope 1 emissions during operations phase include the following:

- Emissions from maintenance vessel visits to the SDC platform
- Intermittent venting during maintenance
- Fugitive emissions.

Maintenance vessel visits

Estimated fuel usage for the maintenance vessel (based on fuel consumption and operational period) was multiplied by the relevant emission factor (see Table 5A.1).

Information on the maintenance vessel to be used during the SDC operational phase is provided in Table 5A.13.

Table 5A.13: Predicted vessel use for offshore operations phase

	No	Fuel use	Days
Walk to work maintenance vessel	1	8 tonnes / day	1,064 (total)*
* A 10-14 day maintenance campaign is planned each quarter = 56 days / year. 19 years of operation 2029 to 2048. 1,064 days in total for lifetime of facility.			

Intermittent venting and fugitives

Intermittent venting and fugitive emissions calculations for SDC operational phase were sourced from 'Shah Deniz Compression Energy Usage and Air Emission Forecast Report (including atmospheric emissions modelling and GHG emissions forecast) (SJ-CPZZZZ-EV-REP-0006-000-D02)' document dated 25/09/24.

Offshore operations (Scope 2)

Scope 2 emissions associated with the import of electricity to power the SDC platform were sourced from 'Shah Deniz Compression Energy Usage and Air Emission Forecast Report (including atmospheric emissions modelling and GHG emissions forecast) (SJ-CPZZZZ-EV-REP-0006-000-D02)' document dated 25/09/24.

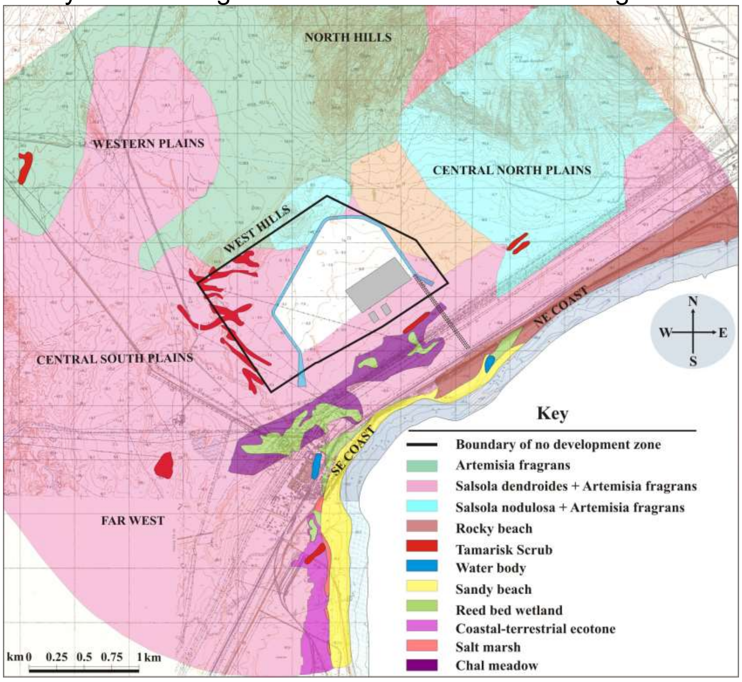
Annex 1 – Generator size and approximate diesel fuel consumption

Generator Size	Approximate Diesel Fuel Consumption			
	¼ Load (litres/hr)	½ Load (litres/hr)	¾ Load (litres/hr)	Full Load (litres/hr)
8kW / 10kVA	1	1	2	3
10kW / 12kVA	1	2	3	4
12kW / 15kVA	1	2	3	4
16kW / 20kVA	1	3	4	5
20kW / 25kVA	2	3	5	6
24kW / 30kVA	2	4	5	7
32kW / 40kVA	3	5	8	10
40kW / 50kVA	3	6	9	12
60kW / 75kVA	5	9	14	19
80kW / 100kVA	7	12	18	25
120kW / 150kVA	8	16	24	32
160kW / 200kVA	10	20	30	40
200kW / 250kVA	13	25	38	50
280kW / 350kVA	19	38	56	75
400kW / 500kVA	27	53	80	106
640kW / 800kVA	43	86	129	172
800kW / 1000kVA	60	110	170	220
1000kW / 1250kVA	65	130	194	259

APPENDIX 6A – BIRDS LITERATURE REVIEW

Answers to questions

Question	Response
1. How many species of birds migrate along the Azerbaijan coastline according to the latest migratory bird monitoring? Please state year of monitoring.	According to latest survey data there are 360 species migrating along the Azerbaijan coastline. Migration surveys conducted annually since 2011 year by international group of ornithologist. The results of surveys up to 2023 can be observed at https://www.trektellen.org/ Among them: 185 species are non-passerine; 50 have protection status (both international (IUCN Red List) and local AzRDB, 2023); 129 species are waterfowl and shore birds; and 33 raptors. The list of non-passerine species with results of migration counts and conservation status can be observed in Table 1.
2. Have there been any changes to bird migratory routes or periods in recent years (since 2019)? If yes, please describe	There has been no change in migratory routes int last 10 years.
3. According to the latest monitoring data which areas along the Azerbaijan coast are most important for overwintering birds? (e.g. which exceed the international indicator of 1% of population, or > 20,000 individuals.	The most important areas along the Azerbaijan coast are the Gizilagach Nature Reserve (up 1,000,000 water birds), Absheron National Park (up to 150,000 birds), Alat –Gobustan bays (80,000 – 90,000 birds) , Pirallahi Island (up to 70,000 birds) and Kura delta (up to 40,000 birds). At the same time it is necessary to take into account that due to sharp decrease of Caspian Sea level within last several years, distribution of birds along the coastal zone has changed. Thus number of wintering birds in Gizil Agach Nature Reserve and around Kura River Delta significantly declined and at Absheron National Park and Pirallahi Island increased significantly.
4. Please provide the latest bird monitoring data for Sangachal Bay during the overwintering period (species and number of birds). State year of monitoring.	Monitoring of wintering population of water birds along the entire sea coast within Azerbaijan border had been conducted by Ministry of Ecology and Natural Resources during last three (3) years January 2022 – January 2024. The previous data had been received during winter counts conducted by consultant group in 2004-2005. The results for Sangachal can be observed in Table 2.
5. Please provide the latest bird monitoring data for Sangachal Bay during the migratory period (species and number of birds). State year of monitoring.	Sangachal bay is under strict control of governmental security organisations as well as personal security of BP as area of governmental importance. Thus any works since 2000 only within request and permission of BP. The most detailed investigation of migratory birds within Sangachal Bay had been conducted in autumn 1996 (the results can be observed at Table 3). A one-time count of migratory species was then conducted in September 2004. The count was carried out exclusively along the coastline and did not include terrestrial species. The result of that survey are present in Table 4. No later monitoring of migration birds was carried out within Sangachal Bay.

Question	Response
6. Please provide the latest bird monitoring data for Sangachal area during the nesting period (species and number of birds)? State year of monitoring.	Similar situation as with migrating birds. Most detailed study had been conducted at the end of May 2001 by Dames & Moor Company and then in June 2004 by URS Company. The results of both surveys could be observed at Tables 5 & 6. Surveyed area had been divided to several zones that could be observed on the map below. No later surveys of breeding birds was carried out within Sangachal area. 
7. Please provide the latest bird monitoring data for Puta area, near Baku Deep Water Jackets Factory (species and number of birds)? Please provide data for overwintering, migratory and nesting periods if available. State year of monitoring.	The latest bird monitoring at Puta area, near Baku Deep Water Jackets Factory was conducted in January 2022 – 2024 (this data could be observed in Table 8). This area was regularly studied earlier in wintering season however other seasons were sporadically investigated in separate years (this information present in the Table 7). One important note: small artificial islands located in 50-200 m from the coastline was used by some species as nesting habitat for several years (2004-2007). Thus huge colony of sandwich terns (about 700 pairs) regularly nested here. Later, during construction works, islands was destroyed and colony has gone. 

<table>
<tr><th>Question</th><th>Response</th></tr>
<tr><td>8. According to the latest monitoring data, which are the key nesting areas along the Absheron-Gobustan coastline of the Caspian? Please provide species and numbers of individuals found in these areas? State year of monitoring.</td><td>Nesting population of Absheron-Gobustan coastline is not very rich during the breeding season. Previously lagoons along the Caspian, covered with reed or open sand beaches, kept some populations of small nesting birds such as little grebe, little bittern, marsh harrier, moorhen, purple swamphen, black-winged stilt, kentish plover, little ringed plover, common tern, little tern, kingfisher and different passerines. However, with development of tourism, most part of coastline around Baku and Sumgait cities had been occupied by construction of private houses, hotels, guest houses etc. Also, a sharp decrease in the level of the Caspian Sea led to the drying out of many lagoons previously used for nesting by the listed bird species. Thus, even those sites along the coast that previously supported small breeding colonies and individual pairs of breeding birds now appear to have lost their value. An exception may be the Absheron National Park and certain protected areas with limited human activity. However, studies during the nesting period along the Absheron-Gobustan coast have not been carried out in the last 20 years, and therefore there is no data on nesting.

Key nesting sites have been and remain uninhabited islands located along the Caspian coast. The latest studies of nesting colonies on the Caspian islands along the Azerbaijani coast were carried out in 2007 by consultants from the Professor Succow Foundation (Greifswald University). The research results are presented in Table 9.</td></tr>
<tr><td>9. What bird species are likely to be present offshore in the Shah Deniz Contract Area? Any seasonal differences in species present?</td><td>Azerbaijan is located on a great migration route in Western Palearctic. As stated above there are at least 360 species of birds migrating along the Azerbaijan coast of Caspian Sea and this number increasing every year. Described species can be present offshore in the Shah Deniz Contract Area as according to reports of the scientists working offshore for sea mammals studies, a lot of terrestrial birds observed over the sea during migration period.

Similar picture could be observed in winter season as real wintering period is quite short and autumn migration continues up to mid of December and some of wintering birds start their spring movement to the north already at the end of January. Spring migration continuing up to end of May and already in August numerous passerine species as well as some waders starting migration south.

There is big seasonal difference in species list and number of birds at the Project area. Biggest number of birds is present in winter season and some days of migration time. As described above some coastal areas within contract zone hold up to 150,000 birds in winter season. These are mainly waterfowl, shore birds (herons, egrets, rails, waders</td></tr>
</table>

Question	Response
	and gulls) and some raptors (for details please, see tables above). Number of birds is much smaller during breeding season and mainly concentrated around the islands and some protected areas. The species are mainly gulls (mainly yellow legged gull) and terns, some waders and few ducks (mainly shelduck and ruddy shelduck). The key nesting areas can be observed on the map below.
10. Have any bird species been removed / added to the 2023 Red Data Book?	There is some difference between Red Book of Azerbaijan edited in 2013 and 2023. Comparison can be observed in Table 10.

Table 1: List of non-passerine birds migrating along the Azerbaijan coast of Caspian Sea

No.	Species	Individuals	Date	Protection Status	
				IUCN	Local
1	Red-throated Loon	2	15 October 2007		
		3	1 November 2017		
		1	8 November 2017		
		1	17 November 2017		
2	Arctic Loon	1	24 October 2019		
		3	24 November 2018		
		2	2 December 2018		
		1	11 October 2007		
		1	9 November 2017		
3	Pygmy Cormorant	1	17 September 2018		
		770	7 November 2014		
		754	19 November 2018		
		5910	18 November 2018		
		4914	18 November 2017		
4	Cormorant	23882	6 November 2014		
		20050	17 November 2017		
		19066	3 November 2019		
		17386	17 November 2018		
		13197	1 November 2022		
5	Dalmatian Pelican	32	9 November 2023	NT	VU
		1038	4 March 2012		
		701	9 November 2011		
		667	26 March 2012		
		601	20 November 2019		
6	Great White Pelican	18	6 September 2023	LC	EN
		60	27 October 2014		
		58	18 October 2014		
		49	21 October 2023		
		38	30 October 2017		
7	Little Grebe	104	13 October 2022		
		1	2 April 2012		
		1	6 September 2018		
		1	16 October 2018		
8	Red-necked Grebe	1	27 October 2023		
		7	21 October 2007		
		4	2 October 2007		
		4	5 October 2007		

No.	Species	Individuals	Date	Protection Status	
				IUCN	Local
		2	10 October 2007		
9	Great Crested Grebe	2	7 November 2017		
		1218	2 December 2018		
		749	5 December 2018		
		576	7 December 2018		
		138	16 November 2018		
10	Horned Grebe	90	20 November 2018		
		2	11 November 2011		
		2	30 November 2018		
		2	21 October 2023		
		1	13 October 2014		
11	Eared Grebe	1	3 November 2018		
		17	16 November 2018		
		15	15 November 2018		
		10	13 September 2022		
		9	9 October 2011		
12	Greater Flamingo	2	19 October 2007	LC	VU (breeding); NT (wintering)
		441	14 November 2018		
		339	13 November 2018		
		271	28 October 2014		
		250	20 October 2007		
13	Black Stork	1	4 November 2022	LC	EN
		7	19 October 2017		
		7	14 October 2022		
		6	24 October 2011		
		6	28 October 2011		
14	White Stork	6	26 October 2018		
		9	14 September 2023		
		7	27 October 2022		
		3	1 November 2023		
		1	6 October 2011		
15	Glossy Ibis	13197	18 November 2017		
		798	9 September 2022		
		310	2 September 2011		
		256	24 August 2011		
		248	15 August 2011		

No.	Species	Individuals	Date	Protection Status	
				IUCN	Local
16	Spoonbill	154	22 September 2022	LC	B2; C2
		1440	30 September 2018		
		923	24 September 2018		
		760	22 September 2016		
		703	5 October 2022		
17	Bittern	536	20 September 2018		
		93	9 November 2011		
		61	29 March 2012		
		53	10 November 2011		
		42	30 March 2012		
18	Little Bittern	41	18 October 2011		
		317	6 September 2011		
		129	1 October 2011		
		104	26 May 2012		
		98	3 August 2011		
19	Black-crowned Night-Heron	94	27 September 2011		
		130	19 September 2018		
		94	8 October 2018		
		47	14 September 2011		
		44	4 October 2011		
20	Squacco Heron	39	6 September 2011		
		5	25 September 2022		
		2	15 September 2016		
		2	8 October 2018		
		2	26 September 2022		
21	Cattle Egret	1	23 September 2018		
		52	10 September 2023		
		31	18 September 2023		
		17	6 September 2023		
		16	16 September 2017		
		249	11 September 2018		
		3281	3 November 2014		
		2868	4 November 2022		
		2373	16 November 2022		
		2028	19 November 2018		
22	Grey Heron	16	17 September 2023		
		3991	10 September 2023		
		3133	22 September 2022		

No.	Species	Individuals	Date	Protection Status	
				IUCN	Local
		1824	23 September 2022		
		1239	18 September 2018		
23	Purple Heron	1099	24 September 2022		
		1457	10 September 2023		
		1199	8 October 2018		
		757	21 September 2018		
		250	14 September 2011		
24	Little Egret	271	21 September 2018		
		902	11 September 2011		
		562	10 September 2023		
		417	16 September 2023		
		381	18 September 2018		
25	Red-breasted Goose	4	24 November 2018	EN	CR
26	Greylag Goose	2064	24 November 2018		
		1165	6 December 2022		
		697	7 December 2022		
		623	3 November 2014		
27	Tundra Bean Goose	5645	7 December 2022		
28	Greater White-fronted Goose	17	30 October 2022		
		852	1 November 2018		
		726	28 October 2014		
		347	26 October 2014		
		203	3 November 2014		
29	Lesser White-fronted Goose	8	4 November 2019	VU	VU
		70	29 October 2014		
		34	28 October 2017		
		18	1 November 2017		
		14	2 November 2017		
30	Mute Swan	14	10 November 2017	LC	CR (breeding); NT (wintering)
		52	2 March 2012		
		49	14 April 2012		
		40	1 March 2012		
		28	8 March 2012		
31	Bewick's Swan	10	20 May 2012	LC	VU
		103	26 October 2014		
		66	18 November 2018		

No.	Species	Individuals	Date	Protection Status	
				IUCN	Local
		50	29 November 2022		
		46	6 December 2022		
32	Whooper Swan	179	7 December 2022		
		75	7 March 2012		
		70	1 March 2012		
		70	6 December 2022		
33	Shelduck	13	3 November 2014		
		2744	2 December 2018		
		1899	7 December 2022		
		1508	6 December 2022		
		829	5 December 2022		
34	Ruddy Shelduck	553	8 December 2022		
		1202	22 November 2019		
		784	30 November 2022		
		562	3 December 2022		
		549	14 November 2018		
35	Garganey	497	15 November 2022		
		27851	2 September 2018		
		4530	25 September 2018		
		4214	11 September 2022		
		3918	3 September 2018		
36	Northern Shoveler	3834	21 September 2016		
		4669	24 November 2023		
		2675	15 November 2018		
		1963	7 November 2017		
		1613	29 November 2022		
37	Gadwall	1552	30 November 2022		
		4749	7 December 2022		
		2242	16 November 2022		
		1966	5 December 2022		
		1897	16 November 2018		
38	Eurasian Wigeon	1897	2 December 2022		
		5023	1 December 2018		
		4762	7 December 2022		
		4466	15 November 2018		
		2616	16 November 2018		
39	Mallard	2214	5 December 2022		
		9215	7 December 2022		

No.	Species	Individuals	Date	Protection Status	
				IUCN	Local
		6369	15 November 2018		
		5982	13 November 2018		
		5546	5 December 2022		
40	Northern Pintail	5285	2 November 2018		
		6713	16 November 2022		
		6618	4 December 2022		
		5658	7 November 2017		
		5413	5 December 2022		
41	Eurasian Teal	4232	24 November 2023		
		14153	13 November 2018		
		10558	16 November 2022		
		4803	24 November 2023		
		3916	3 October 2007		
42	Red-crested Pochard	477	25 September 2023		
		503	1 December 2018		
		485	4 December 2022		
		411	20 November 2018		
		330	5 December 2022		
43	Pochard	320	18 November 2017	VU	NT
		3136	24 November 2018		
		3000	15 November 2018		
		2209	16 November 2018		
		2110	20 November 2018		
44	Ferruginous Duck	27	2 November 2018	NT	VU
		26	12 September 2018		
		25	6 September 2018		
		11	24 November 2018		
		5	2 September 2011		
45	Tufted Duck	5	13 November 2018		
		1568	4 December 2022		
		1036	30 November 2022		
		826	5 December 2022		
		619	20 November 2018		
46	Greater Scaup	453	19 November 2018		
		12	15 November 2018		
		12	7 December 2022		
		10	16 November 2018		
		8	3 October 2007		

No.	Species	Individuals	Date	Protection Status	
				IUCN	Local
47	Velvet Scoter	408	7 November 2022	VU	CR
		7	27 October 2014		
		2	8 November 2011		
48	Common Scoter	2	30 November 2018		
49	Long-tailed Duck	1	15 November 2018	VU	CR
50	Common Goldeneye	2	1 November 2018		
		2	9 December 2022		
		426	7 December 2022		
		65	5 December 2022		
		28	8 December 2022		
		27	24 November 2023		
51	Smew	223	10 December 2022		
		100	7 December 2022		
		9	5 December 2022		
		9	6 December 2022		
		4	9 December 2022		
52	Common Merganser	2	19 November 2022		
		4	15 November 2018		
		3	16 November 2018		
		3	25 November 2018		
		3	3 December 2018		
53	Red-breasted Merganser	3	22 November 2019		
		107	15 November 2018		
		100	16 November 2018		
		75	7 November 2017		
		56	5 December 2022		
54	Osprey	22	19 October 2022	LC	CR
		5	13 October 2022		
		4	19 September 2018		
		3	24 September 2018		
		3	12 October 2018		
55	Egyptian Vulture	3	11 October 2022	EN	EN
		7	9 May 2012		
		4	21 April 2012		
		4	13 September 2023		
		3	15 April 2012		
56	Eurasian Griffon Vulture	7	25 September 2016	LC	VU
		56	16 October 2022		

No.	Species	Individuals	Date	Protection Status	
				IUCN	Local
		52	26 October 2019		
		43	28 October 2019		
		38	27 October 2018		
57	Cinereous Vulture	31	14 October 2022	NT	EN
		24	24 October 2019		
		24	27 October 2019		
		20	14 September 2023		
		15	26 October 2019		
58	Honey Buzzard	1	7 September 2011	LC	CR
		10	25 May 2012		
		10	12 September 2018		
		9	21 September 2018		
		8	19 May 2012		
59	Short-toed Snake-Eagle	14	28 October 2019	LC	EN
		1	14 October 2022		
		4	6 October 2018		
		2	7 September 2011		
		2	30 September 2011		
60	Lesser Spotted Eagle	2	18 September 2016		
		3	18 September 2016		
		2	18 April 2012		
		2	19 September 2018		
		2	21 September 2018		
61	Greater Spotted Eagle	2	21 October 2023	VU	CR
		4	4 October 2017		
		4	14 October 2018		
		2	1 November 2017		
		1	7 November 2011		
62	Booted Eagle	2	12 September 2018	LC	EN
		5	4 October 2017		
		3	27 September 2017		
		3	10 September 2018		
		3	19 September 2018		
63	Steppe Eagle	3	8 September 2022	EN	EN
		304	16 October 2022		
		205	14 October 2022		
		125	15 October 2022		
		124	28 October 2011		

No.	Species	Individuals	Date	Protection Status	
				IUCN	Local
64	Imperial Eagle	96	18 April 2012	VU	EN
		20	28 October 2011		
		11	30 October 2014		
		11	28 October 2019		
		9	5 November 2022		
65	Golden Eagle	7	8 November 2017	LC	VU
		3	28 August 2011		
		2	28 October 2011		
66	Levant Sparrowhawk	4	5 October 2023		
		5	11 September 2023		
		3	11 September 2022		
		3	13 September 2022		
		3	10 September 2023		
67	Sparrowhawk	3	14 September 2023		
		271	28 October 2022		
		179	5 November 2014		
		179	30 October 2017		
		161	23 October 2017		
68	European Goshawk	2	21 September 2023	LC	VU
		2	9 November 2011		
		1	12 October 2007		
		1	15 October 2007		
		1	15 October 2011		
69	Marsh Harrier	1	30 October 2011		
		1394	24 November 2018		
		523	21 November 2018		
		515	4 November 2014		
		483	25 November 2018		
70	Hen Harrier	400	6 November 2018		
		198	30 October 2017		
		190	4 November 2014		
		71	24 October 2011		
		70	3 November 2014		
71	Pallid Harrier	67	13 October 2014	NT	VU
		23	18 September 2011		
		16	27 September 2017		
		15	25 March 2012		
		13	26 October 2014		

No.	Species	Individuals	Date	Protection Status	
				IUCN	Local
72	Montagu's Harrier	13	4 October 2017		
		24	2 May 2012		
		23	10 September 2023		
		21	18 September 2011		
		12	10 April 2012		
73	Black Kite	6	2 May 2012	LC	VU (breeding); CR (wintering)
		60	4 October 2017		
		51	6 October 2017		
		50	26 August 2011		
		40	8 October 2018		
74	White-tailed Sea Eagle	26	15 September 2018	LC	CR
		9	26 November 2018		
		7	21 November 2018		
		7	5 December 2018		
		5	23 November 2019		
75	Rough-legged Buzzard	5	5 December 2022		
		7	5 November 2017		
		3	6 November 2014		
		2	30 October 2017		
		2	6 November 2017		
76	Long-legged Buzzard	2	24 November 2018		
		6	24 October 2017		
		5	6 October 2017		
		4	5 November 2017		
		4	14 October 2022		
77	Common Buzzard	3	2 October 2023		
		1	10 November 2017		
		1	1 November 2018		
		1	31 October 2019		
		1	5 November 2019		
78	Steppe Buzzard	1	10 September 2023		
		648	19 May 2012		
		569	9 May 2012		
		205	25 May 2012		
		195	21 April 2012		

No.	Species	Individuals	Date	Protection Status	
				IUCN	Local
79	Lesser Kestrel	3	September 2023		
		60	22 September 2011		
		33	27 September 2017		
		17	18 September 2011		
		17	26 September 2011		
80	Eurasian Kestrel	15	30 September 2011		
		6	3 April 2012		
		6	23 October 2017		
		6	17 October 2022		
		5	7 October 2022		
81	Red-footed Falcon	20	24 September 2022	VU	CR
		1	11 October 2011		
82	Merlin	1	24 October 2018		
		16	17 October 2022		
		15	25 October 2018		
		14	16 November 2017		
		12	15 November 2017		
83	Hobby	11	11 November 2017	LC	VU
		24	17 September 2018		
		19	18 September 2018		
		14	21 April 2012		
		13	19 September 2018		
84	Lanner Falcon	1	27 September 2022	LC	CR
		1	28 October 2011		
		1	20 October 2014		
		1	12 September 2018		
85	Saker Falcon	1	13 September 2018	EN	CR
		2	26 October 2017		
		1	12 October 2007		
		1	28 August 2011		
		1	29 October 2011		
86	Peregrine Falcon	1	21 April 2012	LC	EN
		2	19 October 2014		
		2	17 October 2022		
		2	20 September 2023		
		2	26 October 2023		
87	Quail	1	6 November 2017		
		32	26 April 2012		

No.	Species	Individuals	Date	Protection Status	
				IUCN	Local
		25	4 May 2012		
		15	2 May 2012		
		4	19 April 2012		
88	Water Rail	2	16 November 2017		
		8	19 May 2012		
		5	29 May 2012		
		4	2 April 2012		
		3	26 March 2012		
89	Corncrake	3	12 April 2012		
90	Spotted Crake	2	8 May 2012		
		12	12 April 2012		
		8	17 April 2012		
		8	20 April 2012		
		8	4 May 2012		
91	Moorhen	7	21 April 2012		
		27	20 April 2012		
		25	10 April 2012		
		20	21 April 2012		
		16	17 April 2012		
92	Coot	11	12 April 2012		
		17	26 March 2012		
		9	10 April 2012		
		8	6 March 2012		
		8	17 April 2012		
93	Western Swamphen	8	20 April 2012	LC	VU
		16	26 May 2012		
		2	18 April 2012		
		2	25 May 2012		
		1	10 April 2012		
94	Baillon's Crake	1	11 April 2012		
		2	12 April 2012		
		1	29 August 2011		
		1	15 April 2012		
		1	17 April 2012		
95	Demoiselle Crane	1	20 April 2012	LC	NT
		17	20 August 2011		
		3	16 May 2012		
		2	25 September 2018		

No.	Species	Individuals	Date	Protection Status	
				IUCN	Local
		1	30 March 2012		
96	Crane	1	1 May 2012	LC	CR (wintering); NT (migration)
		780	24 October 2011		
		342	28 October 2011		
		204	23 October 2022		
		144	1 November 2022		
97	Macqueen's Bustard	1	31 October 2023	VU	CR
98	Little Bustard	1	30 October 2018	NT	NT
		82048	7 November 2011		
		11926	15 November 2022		
		11569	6 November 2022		
		11537	8 November 2011		
99	Stone Curlew	209	16 November 2022		
		16	4 October 2011		
		14	12 April 2012		
		13	10 April 2012		
		12	15 September 2011		
100	Oystercatcher	9	8 October 2018	NT	CR
		21	2 September 2022		
		20	15 August 2011		
		20	21 August 2011		
		11	6 August 2011		
101	Black-winged Stilt	8	23 August 2011		
		360	3 August 2011		
		223	9 August 2011		
		107	5 August 2011		
		90	10 August 2011		
102	Avocet	75	8 September 2023		
		1409	2 September 2018		
		410	4 September 2022		
		383	16 November 2022		
		317	18 November 2017		
103	Northern Lapwing	266	23 September 2018	NT	EN
		2891	3 November 2014		
		1168	7 November 2011		
		1154	26 October 2014		

No.	Species	Individuals	Date	Protection Status	
				IUCN	Local
		949	13 October 2017		
104	Sociable Plover	926	5 October 2023	CR	EN
		26	18 September 2011		
		13	2 April 2012		
		11	15 September 2016		
		5	4 April 2012		
105	White-tailed Plover	3	26 September 2011	LC	VU
		8	20 September 2022		
106	European Golden-Plover	1	30 May 2012		
		121	3 November 2019		
		87	9 September 2018		
		36	2 November 2019		
		35	22 November 2018		
107	Pacific Golden Plover	33	4 November 2019		
108	Black-bellied Plover	1	24 September 2023		
		20	30 September 2007		
		15	16 October 2018		
		12	24 September 2023		
		10	10 October 2022		
109	Ringed Plover	7	21 September 2011		
		262	20 September 2022		
		182	31 August 2011		
		164	4 September 2023		
		156	21 September 2016		
110	Little Ringed Plover	127	3 September 2011		
		48	3 August 2011		
		19	5 August 2011		
		16	9 August 2011		
		16	6 September 2011		
111	Kentish Plover	12	7 August 2011		
		8	3 September 2022		
		6	24 September 2023		
		5	24 August 2011		
		3	11 September 2022		
112	Caspian Plover	3	20 September 2022		
		3	21 September 2016		
		1	22 April 2012		

No.	Species	Individuals	Date	Protection Status	
				IUCN	Local
113	Dotterel	1	27 October 2014		
		23	8 November 2011		
		17	10 November 2011		
		10	9 November 2011		
		5	24 October 2011		
114	Whimbrel	3	13 May 2012		
		50	17 August 2011		
		35	12 August 2011		
		18	2 September 2022		
		18	6 September 2023		
115	Curlew	11	9 September 2018	NT	VU
		22	20 September 2022		
		13	1 September 2018		
		12	18 October 2014		
		12	2 September 2022		
116	Bar-tailed Godwit	1	11 October 2007		
		8	21 September 2016		
		1	3 September 2022		
117	Black-tailed Godwit	1	20 September 2022	NT	VU
		160	4 September 2022		
		113	11 September 2018		
		92	6 September 2023		
		91	8 October 2022		
118	Ruddy Turnstone	7	3 September 2023		
		9	27 August 2011		
		5	31 August 2011		
		5	17 September 2016		
		5	2 September 2022		
119	Red Knot	5	11 September 2022		
		4	10 November 2017		
120	Ruff	1	1 November 2011		
		1290	2 September 2018		
		796	3 September 2018		
		586	17 September 2016		
		555	9 September 2023		
121	Broad-billed Sandpiper	499	18 September 2016		
		3	3 September 2018		

No.	Species	Individuals	Date	Protection Status	
				IUCN	Local
122	Curlew Sandpiper	125	4 September 2022	NT	NT
		42	21 August 2011		
		20	21 September 2022		
		19	3 September 2018		
		15	27 August 2011		
123	Temminck's Stint	13	20 September 2022		
		4	24 August 2011		
		3	23 September 2018		
		1	6 September 2022		
124	Sanderling	1	8 September 2023		
		132	20 September 2016		
		75	17 September 2016		
		57	21 September 2016		
		44	24 September 2023		
125	Dunlin	31	18 September 2016		
		1341	21 September 2016		
		465	15 November 2018		
		272	16 November 2018		
		203	24 September 2023		
126	Little Stint	198	2 September 2022		
		184	31 August 2011		
		179	11 September 2022		
		164	24 August 2011		
		118	21 September 2016		
127	Eurasian Woodcock	91	21 September 2016		
		4	6 November 2017		
		2	30 October 2018		
		1	6 October 2007		
		1	22 October 2014		
128	Jack Snipe	1	4 November 2017		
		3	12 November 2017		
		1	22 October 2011		
		1	21 October 2018		
		1	30 October 2018		
129	Snipe	1	1 October 2022		
		154	3 September 2018		
		133	25 September 2023		
		83	21 September 2016		

No.	Species	Individuals	Date	Protection Status	
				IUCN	Local
		71	22 November 2019		
130	Terek Sandpiper	57	23 September 2022		
		17	6 August 2011		
		14	17 April 2012		
		8	21 August 2011		
		2	27 August 2011		
131	Red-necked Phalarope	1	2 August 2011		
		7	16 September 2018		
		3	24 August 2011		
		3	4 September 2022		
132	Common Sandpiper	1	23 September 2018		
		145	2 August 2011		
		27	6 August 2011		
		25	15 August 2011		
		22	5 August 2011		
133	Green Sandpiper	21	11 August 2011		
		68	12 April 2012		
		55	19 April 2012		
		46	15 April 2012		
		42	17 April 2012		
134	Redshank	39	11 April 2012		
		68	9 August 2011		
		35	3 August 2011		
		17	23 September 2018		
		10	2 August 2011		
135	Marsh Sandpiper	10	27 March 2012		
		22	2 September 2018		
		20	13 August 2011		
		5	15 August 2011		
		5	18 September 2017		
136	Wood Sandpiper	3	21 August 2011		
		154	9 August 2011		
		126	5 September 2018		
		106	9 September 2023		
		103	11 September 2022		
137	Spotted Redshank	68	8 May 2012		
		5	16 September 2017		
		4	1 October 2011		

No.	Species	Individuals	Date	Protection Status	
				IUCN	Local
		1	27 March 2012		
		1	14 October 2014		
138	Greenshank	1	17 September 2016		
		25	3 September 2022		
		19	9 September 2022		
		12	21 August 2011		
		7	12 September 2023		
139	Collared Pratincole	30	2 September 2011		
		38	27 September 2017		
		33	22 April 2017		
		8	25 April 2012		
		6	22 April 2012		
140	Black-winged Pratincole	4	23 April 2017	NT	NT
		6488	14 September 2023		
		3991	18 September 2011		
		2428	20 September 2022		
		1978	16 September 2023		
141	Black-legged Kittiwake	231	23 April 2012		
		5	13 November 2018		
		2	19 November 2017		
		1	12 November 2017		
		1	17 November 2017		
142	Slender-billed Gull	1	30 October 2018		
		372	30 September 2023		
		253	11 September 2018		
		241	3 November 2023		
		231	4 September 2022		
143	Black-headed Gull	4272	9 November 2023		
		19829	17 November 2018		
		18346	16 November 2022		
		13162	17 November 2017		
		12525	27 October 2014		
144	Little Gull	11	28 September 2023		
		851	19 September 2016		
		789	7 September 2018		
		716	18 November 2018		
		571	5 October 2007		

No.	Species	Individuals	Date	Protection Status	
				IUCN	Local
145	Mediterranean Gull	479	31 October 2022	LC	VU
		82	25 April 2012		
		19	9 August 2011		
		15	12 August 2011		
		8	16 September 2018		
146	Great Black-headed Gull	7	26 October 2022		
		626	7 December 2022		
		631	10 December 2022		
		250	11 December 2022		
		182	8 December 2022		
147	Mew Gull (European)	164	15 March 2012		
		183	22 November 2018		
		176	29 November 2018		
		155	15 March 2012		
		152	21 November 2018		
148	Caspian Gull	144	17 March 2012		
		1533	6 November 2018		
		1455	26 October 2018		
		1349	27 October 2018		
		977	8 October 2018		
149	Armenian Gull	890	16 November 2018		
		2	24 October 2023		
		1	25 October 2023		
150	Lesser Black-backed Gull	1	27 October 2023		
		77	4 October 2007		
		64	3 September 2018		
		40	3 October 2007		
		23	5 October 2007		
151	Heuglin's Gull	20	7 October 2007		
		48	8 October 2018		
		19	10 October 2022		
		16	3 October 2018		
		12	27 September 2018		
152	Larus fuscus fuscus	11	8 October 2022		
		2	8 October 2022		
		1	6 September 2018		
153	Larus intermedius	1	24 September 2023		
		1	23 September 2018		

No.	Species	Individuals	Date	Protection Status	
				IUCN	Local
		1	24 September 2018		
		1	27 September 2018		
		1	30 September 2018		
154	Gull-billed Tern	31	7 October 2007		
		875	15 September 2016		
		398	8 September 2023		
		276	11 September 2018		
		251	10 September 2018		
155	Caspian Tern	189	3 September 2011		
		219	2 September 2018		
		195	1 September 2018		
		119	15 September 2016		
		101	1 October 2023		
156	Sandwich Tern	96	30 September 2023		
		2469	24 September 2018		
		936	25 September 2018		
		680	7 October 2011		
		563	29 September 2007		
157	Little Tern	433	5 October 2022		
		13	21 August 2011		
		11	7 May 2012		
		9	4 May 2012		
		8	18 May 2012		
158	Common Tern	6	2 September 2011		
		3329	14 September 2022		
		2745	5 September 2018		
		2588	6 September 2018		
		1748	7 September 2018		
159	Whiskered Tern	140	17 September 2018		
		1625	4 September 2018		
		1208	5 September 2018		
		1109	6 September 2018		
		873	11 September 2011		
160	White-winged Tern	758	11 September 2022		
		5472	9 September 2023		
		5183	2 September 2018		
		5062	21 August 2011		
		3250	3 September 2018		

No.	Species	Individuals	Date	Protection Status	
				IUCN	Local
161	Black Tern	2923	11 September 2011		
		184	17 September 2018		
		43	10 September 2018		
		20	23 September 2018		
		7	8 September 2016		
162	Pomarine Jaeger	434	21 August 2011		
		2	20 October 2018		
163	Parasitic Jaeger	1	10 October 2007		
		29	5 September 2018		
		17	18 May 2012		
		17	8 September 2018		
		9	9 September 2018		
164	Black-bellied Sandgrouse	1	8 May 2012	LC	VU
		58	24 October 2011		
		21	5 November 2014		
		20	5 November 2019		
		10	5 December 2018		
165	Rock Dove	9	2 November 2017		
		115	14 November 2017		
		112	23 October 2019		
		109	16 November 2017		
		84	13 October 2018		
166	Feral Pigeon	75	21 October 2019		
		516	23 September 2023		
		358	24 September 2023		
		210	3 October 2023		
		204	12 November 2023		
167	Stock Dove	184	25 September 2023		
		2786	31 October 2022		
		2708	27 October 2022		
		2167	19 October 2022		
		1923	24 October 2022		
168	Woodpigeon	1773	21 October 2022	LC	VU
		715	5 November 2019		
		695	21 November 2018		
		375	5 November 2014		
		369	5 November 2023		

No.	Species	Individuals	Date	Protection Status	
				IUCN	Local
169	Turtle Dove	95	9 October 2023	VU	EN
		50	26 August 2011		
		24	3 October 2023		
		10	16 August 2011		
		10	14 May 2012		
170	Oriental Turtle-Dove	7	1 September 2023		
		1	7 November 2017		
171	Eurasian Collared-Dove	1	8 November 2022		
		170	27 October 2022		
		118	19 October 2019		
		108	6 October 2023		
		99	19 October 2022		
172	Laughing Dove	94	31 October 2022		
		4	10 October 2023		
		3	11 November 2017		
		3	3 September 2018		
		3	31 October 2023		
173	Cuckoo	8413	24 November 2018		
		2	17 May 2012		
		2	1 October 2023		
		1	18 September 2011		
		1	1 October 2011		
174	Scops Owl	2	16 October 2007		
175	Long-eared Owl	1	17 September 2023		
		1	19 October 2007		
		1	14 October 2017		
		1	4 November 2017		
176	Short-eared Owl	1	16 November 2022		
		20	7 November 2017		
		14	14 October 2011		
		12	18 October 2011		
		10	9 October 2011		
177	Nightjar	4	21 May 2012		
		2	6 September 2011		
		2	7 October 2011		
		2	18 September 2023		
		1	23 September 2011		

No.	Species	Individuals	Date	Protection Status	
				IUCN	Local
178	Alpine Swift	1	4 May 2012		
		2	12 April 2012		
		1	28 August 2011		
		1	23 March 2012		
179	Swift	1	6 May 2012		
		264	19 August 2011		
		264	22 August 2011		
		126	19 April 2012		
		59	23 August 2011		
180	Pallid Swift	51	24 April 2012		
181	Hoopoe	1	6 November 2017		
		48	30 March 2012		
		26	2 April 2012		
		15	4 April 2012		
		13	1 April 2012		
182	European Roller	7	10 April 2012		
		73	13 August 2011		
		56	5 May 2012		
		42	1 May 2012		
		29	4 September 2018		
183	Kingfisher	27	23 August 2011		
		1	21 August 2011		
184	Blue-cheeked Bee-eater	1	6 October 2011		
		1315	9 September 2023		
		1030	18 September 2016		
		1022	17 September 2016		
		806	18 September 2011		
185	European Bee-eater	673	21 September 2011		
		1253	10 September 2023		
		1118	9 September 2023		
		270	23 August 2011		
		267	20 August 2011		

Table 2: Wintering birds along Sangachal Bay

Species	Years				
	2004	2005	2022	2023	2024
Podiceps cristatus Great Crested Grebe	34	19	2	4	2
Podiceps nigricollis Black-necked Grebe	17	38	2	8	6
Phalacrocorax carbo Great Cormorant	4	2			2
Phalacrocorax pygmaeus Pygmy Cormorant		5		13	1
Ardea cinerea Grey Heron		2			
Egretta garzetta Little Egret	4		1	3	
Cygnus olor Mute Swan	1			8	2
Anas penelope Eurasian Wigeon	2	3		12	
Anas crecca Common Teal				52	43
Anas platyrhynchos Mallard	70	132	25	215	59
Anas clypeata Shoveler		1			
Netta rufina Red-crested Pochard	12	310			
Aythya ferina Pochard	755	420	60	2520	613
Aythya fuligula Tufted Duck	3695	1526		1497	1837
Aythya marila Greater Scaup	9	1			
Bucephala clangula Goldeneye	4	7	1		
Mergus serrator Red-breasted Merganser	3	4	11	16	13
Circus aeruginosus Marsh Harrier				1	
Fulica atra Common Coot	213	1159		680	
Charadrius alexandrines Kentish Plover		3			
Tringa totanus Redshank		4		30	
Tringa sp.				4	
Unidentified waders			30		
Larus cacchinans Yellow-Legged Gull		21	18	35	6
Larus genei Slender-billed Gull				1	
Larus ridibundus Black Headed Gull		1			
Larus canus Common Gull		3			
Alcedo athis Kingfisher		1			
Total	**1739**	**3663**	**150**	**5099**	**2584**

Table 3: Monitoring of autumn migratory birds Sangachal

No	Species/ Dates	September 1996						October 1996									November 1996									December 1996				Total
		10	14	17	21	24	28	1	5	9	12	15	19	22	26	29	2	5	9	12	16	19	23	26	30	3	7	10	14	
1	Great-crested Grebe	41		3		5			26	39	8	22	49	34	45	1804	27	130	17	36	11	9	15	19	9	18	16	3	5	**2391**
2	Red-necked Grebe	8		31		2	128	3		3	3	11		2	1	90	2	2		1										**287**
3	Black-necked Grebe							1	7	20	17	25	19	15	8	23	2	16	4	8	5	9	8	1	11	18	16	18	49	**300**
4	Little Grebe						4			3		3	1	2	4	1	3	2		10	1	3	2	4	2	5		4		**54**
	Grebe sp.		2		45													12					250							**309**
5	Great Cormorant	21	21	19	33	22	47	26	21	36	28	33	22	52	25	45	18	23	18	14	27	31	13	29	15	11	14	1	18	**683**
6	Pygmy Cormorant					1		1						1												1			2	**6**
7	Little Bittern																	1												**1**
8	Night Heron					1	5						1	1																**8**
9	Great White Egret			3		1															3		2	1		1				**11**
10	Little Egret	2		2		1	8				1			4	1	2		3		2				1						**27**
11	Grey Heron	1	1		2	3		1	4		1	1	3	2	1	3		3	2	2	3	1	3	4	2	2	5			**50**
12	Purple Heron		1	4	92		8		2						3															**110**
13	Geese sp.																							2						**2**
14	Shelduck							1	1			2																		**4**
15	Mallard			1			2							2					8			23			10	1	4		19	**70**
16	Gadwall																										1			**1**
17	Teal	13																									6		2	**21**
18	Garganey					7		13	13	7	17	3	10	13			1		3											**87**
19	Shoveler																							7						**7**
20	Red-crested Pochard																					8								**8**
21	Tufted Duck							1																				1	3	**5**
22	Scaup															1		1												**2**
23	Pochard										1										2									**3**
24	Common Merganser																										1			**1**
25	Red-breasted Merganser																			1										**1**
	Ducks sp.										10		3		15				8			42		185	1	80				**344**
26	Egyptian Vulture	2																												**2**
27	March Harrier									1					1					1										**3**
28	Hen Harrier															1						1						1		**3**
29	Common Merganser																		1											**1**
30	Long-legged Buzzard												2																	**2**
31	Common Kestrel		1		2			2	1	5	2		1				1				3	1	2					1	1	**23**
32	Lesser Kestrel										1																			**1**
33	Kestrel sp		1												2															**3**
	Raptor sp.												1				1													**2**
34	Water Rail					1		4	1	2	1	1				2	2	1	1	2						2				**20**
35	Moorhen		1			4		8	3	9	5	3	8	3	3	9	4	11	15	14	14	14	2	4	13	19	15	9	29	**219**

36	Purple Swamp-hen		5	1	6			4		4	7	4	1	1							1	2	1		2		2			**41**
37	Coot		1						3		2	2				1	1	1		2	86	123		350	260	519	253	337	338	**2279**
38	Little Bustard																			3										**3**
39	Black Winged Stilt	2		1		1											1													**5**
40	Collared Pratincole				11																									**11**
41	Little Ringed Plover	34																										3		**37**
42	Ringed Plover	10	7			1																							3	**21**
43	Kentish Plover	50		12	10	25	40	3					4		3	14														**161**
44	Greater Sand Plover	6																												**6**
45	Lapwing														1															**1**
46	Dunlin	6																												**6**
47	Curlew Sandpiper									2																				**2**
48	Sanderling			1				39											3		8	2	3					3		**59**
49	Little Stint					28				76	32	38	7	25	50			25	28							12		3		**324**
50	Stint sp.							15																						**15**
51	Snipe					2	4		8	2	1		2	4				3	1	4		5			1	6	6	1	5	**55**
52	Bar-tailed Godwit	1																												**1**
53	Redshank				2	3		9				1	27	12		9	8	17		13	27						25	29	26	**208**
54	Wood Sandpiper						12																							**12**
55	Green Sandpiper	7	1	3		5	7	1	6	19	3		4			2			6	6	2	3		5	4	2	2	2	1	**91**
56	Common Sandpiper	2						1																						**3**
57	Turnstone		10	1		1																								**12**
58	Red-necked Phalarope	1																												**1**
	Waders sp												35																	**35**
59	Yellow-legged Gul	36	8	26	16	33	50	28	13	15	40	18	34	37	21	202	6	15	3	4	8	6	5	10	6	11	17	2	14	**684**
60	Black-headed Gull																			2										**2**
61	Little Gull								1															1						**2**
62	Mediterranean Gull																					2								**2**
63	Common Gul																					2	1		1	2				**6**
64	Common Tern	6	9	7	17	39	60		5	17		5																		**165**
65	Little Tern									1																				**1**
66	Sandwich Tern							7	1	1	29	8	29	34	24		29		36	12	8	22	26	1						**267**
67	White-winged Black Tern					1																								**1**
	Terns sp.								12						2					5										**19**
68	Rock Dove	11	2	1		3	14	4	7								24	4			7		9				3		5	**94**
69	Dove sp.					1																								**1**
70	Kingfisher					2	1	1		1	1	1			1				1	1	1	1	1				1			**14**
71	Hoopoe				2																									**2**
72	European Bee-eater	2				1																								**3**

73	Blue-cheeked Bee-eater		1																										**1**
74	Crested Lark	22	8	18	12	15	39	9	12	8	6	9	21	1	11	10	5	8	18	23	17	18		6		16	6	8	2	**328**
75	Tawny Pipit																		12		20	5								**37**
76	Meadow Pipit																									3				**3**
77	Pipit sp.																										120		4	**124**
78	House Martin										50																			**50**
79	Swallow	9		2		27			6		60		1	2	1															**108**
80	Sand Martin					10																								**10**
81	Pied Wagtail	12	2	14		10	20	6	12	5	5	2	3	3	2			4		5	1	1				4	1	2	2	**116**
82	Yellow Wagtail	2									4													1		1		1		**9**
83	Grey Wagtail														1															**1**
84	Red-backed Shrike		1																											**1**
85	Great Grey Shrike					1																								**1**
86	Whinchat																	1												**1**
87	Cpommon Wheatear						4				2					3														**9**
88	Isabelline Wheatear	2	5	2	2	1	6	11		2	1	1	1	2			1			7	1			1						**46**
89	Finsch's Wheatear																		3		2		1							**6**
90	Pied Wheatear			1		7			9		2		9	1	3	5				2								1		**40**
91	Great Reed Warbler	1	1			7						1																		**10**
92	Reed Warbler					3													1											**4**
93	Sedge Warbler sp.																	1												**1**
95	Icterine Warbler					1			1																					**2**
96	Olivaceous Warbler						1																							**1**
97	Bearded Tit																1		10		1									**12**
98	Wren																				2									**2**
99	Corn Bunting					1			40										5							88		80	48	**262**
100	Reed Bunting										2				2				7		2		1			3		2		**19**
101	Chaffinch																										55			**55**
102	Goldfinch					8																								**8**
103	Siskin	3																												**3**
104	House Sparrow									1	1		80	260	42	23	5	20	39	17										**488**
105	Tree Sparrow		20			48			1	6	35			5						160					15					**290**
106	Starling								2				5				2		212	20			18			164				**423**
107	Hooded Crow		2			1			5	2	3	2		2		2		5		5	8	3	5					2		**47**
108	Rook														1				55	10	12	15	9			5		4		**111**
109	Magpie															4		2	4											**10**
	Passerine sp.														22			15				10	13							**60**
	Total	**313**	**111**	**153**	**252**	**334**	**460**	**199**	**223**	**287**	**381**	**196**	**383**	**520**	**296**	**2256**	**144**	**326**	**521**	**392**	**283**	**362**	**390**	**632**	**352**	**994**	**569**	**518**	**576**	**12423**
	%	2.52	0.89	1.23	2.03	2.69	3.7	1.6	1.8	2.31	3.07	1.578	3.08	4.19	2.38	18.2	1.16	2.62	4.19	3.16	2.28	2.91	3.14	5.09	2.83	8	4.58	4.17	4.64	

Table 4: Migrating birds count Sangachal, September 2004

Species	Latin name	Sangachal Bay	Sangachal Cape
Black-necked Grebe	*Podiceps nigricollis*	3	9
Great-crested Grebe	*P. cristatus*	129	39
Great Cormorant	*Phalacrocorax carbo*	55	63
Little Egret	*Egretta garzetta*		2
Mallard	*A. platyrhynchos*	3	4
Pochard	*Aythya ferina*		28
Tufted Duck	*A. fuligula*	2	15
Ringed Plover	*C. hiaticula*	2	5
Kentish Plover	*C. alexandrinus*	7	
Grey Plover	*P. squatarola*	1	
Lapwing	*V. vanellus*	3	
Little Stint	*C. minuta*	1	
Sanderling	*C. alba*	20	
Redshank	*T. totanus*	46	
Greenshank	*T. nebularia*	1	
Green Sandpiper	*T. ochropus*	1	
Terek Sandpiper	*Xenus cinereus*	2	
Slender-billed Gull	*L. genei*	6	
Herring Gull	*L. cachinnans*	26	23
Little Gull	*L. minutus*	2	
Sandwich Tern	*S. sandvicensis*	4	10
Marsh Harrier	*Circus aeruginosus*		1
Total		**314**	**199**

Table 5: Breeding birds at Sangachal Bay and surrounding areas, May 2001

No.	Species	May 28, 2001			May 29, 2001		May 30, 2001		May 31, 2001	
		Southern Lagoon	Sangachal-chay River delta	Semi-desert behind terminal up to hills	Northern Lagoon	Semi-desert in front of terminal	Semi-desert to the south from terminal	Semi-desert to the north from terminal	Semi-desert up to hills	Semi-desert on hills
1	Great Crested Grebe				4					
2	Great Cormorant				2					
3	Purple Heron	1								
4	Little Bittern		1							
5	Glossy Ibis						1			
6	Shelduck				3				3	
7	Mallard				3					
8	Wigeon				1					
9	Egyptian Vulture									1
10	Honney Buzzard						15		3	
11	Common Buzzard						1			
12	Long-legged Buzzard						1	1		
13	Common Kestrel		1	1			1		1	
14	Lesser Kestrel						2			
15	Chukar			5						5
16	Stone Curlew							2		
17	Black-winged Stilt	2					2	4		
18	Collared Pratincole	2	10							
19	Greater Sand Plover		1		21					
20	Caspian Plover				4					

No.	Species	May 28, 2001			May 29, 2001		May 30, 2001		May 31, 2001	
		Southern Lagoon	Sangachal-chay River delta	Semi-desert behind terminal up to hills	Northern Lagoon	Semi-desert in front of terminal	Semi-desert to the south from terminal	Semi-desert to the north from terminal	Semi-desert up to hills	Semi-desert on hills
21	Kentish Plover	4			1			2		
22	Little Ringed Plover							1		
23	Wood Sandpiper		1							
24	Yellow Legged Gull	2			common					
25	Slender-billed Gull				2					
26	Sandwich Tern				2					
27	Common Tern		1		19					
28	Little Tern				8					
29	Whiskered Tern		7							
30	Black-bellied Sandgrouse								3	
31	Rock Dove		1		1					
32	Little Owl			1						
33	Swift	common			common				common	
34	Hoopoe		8							
35	European Bee-eater						6		4	
36	Crested Lark	common			common			common		
37	Short-toed Lark						1		1	
38	Sand Martin	common				common				
39	Swallow	common				common		5		
40	House Martin					common				
41	Red-throated Pipit						1			
42	Pied Wagtail						1			

No.	Species	May 28, 2001			May 29, 2001		May 30, 2001		May 31, 2001	
		Southern Lagoon	Sangachal-chay River delta	Semi-desert behind terminal up to hills	Northern Lagoon	Semi-desert in front of terminal	Semi-desert to the south from terminal	Semi-desert to the north from terminal	Semi-desert up to hills	Semi-desert on hills
43	Northern Yellow Wagtail						2	3		
44	Black-headed Yellow Wagtail	1	1					1		
45	Rufous Bush Robin					common	common			
46	Isabelline Weatear					1			6	
47	Pied Wheatear									1
48	Finsch's Wheatear		1	common					2	3
49	Great Reed Warbler		common				1			
50	Reed Warbler				common	common				
51	Sedge Warbler				1	1				
52	Moustached Warbler					common	1			
53	Booted Warbler					1	common			
54	Menetries's Warbler					4				
55	Rock Nuthatch									3
56	Red-backed Shrike						1			
57	House Sparrow	common					common			
58	Starling	60				6	common			
59	Chough			8					7	
60	Hooded Crow							1	2	
Total		**72**	**33**	**15**	**72**	**13**	**37**	**20**	**32**	**13**

Table 6: Breeding birds at Sangachal Bay and surrounding areas, June 2004

No.	Species	Location							
		SE Coast	NE Coast	North Hill	Central Plain south	Central Plain north	West Hills	Western Plains	Far West
		June 9, 2004	June 9, 2004	June 10, 2004	June 10, 2004	June 8, 2004	June 9, 2004	June 11, 2004	June 12, 2004
1	Purple Heron				1 dead				
2	Long-legged Buzzard			1					
3	Kestrel	1		1	2+	1	2	1	
4	Chukar			1+			1+		
5	Black-winged Stilt	2	9						
6	Little Ringed Plover	2	1			1			
7	Kentish Plover	6	28						
8	Greater Sand Plover	(2)				1			1
9	Common Tern	(7)	19						
10	Little Tern	(3)	29						
11	Black-bellied Sandgrouse*			1		3	3	2	(1)
12	Rock Dove						(5)		
13	Cuckoo	1			3				
14	Little Owl						2		
15	European Bee-eater	(4)			6		(20+)	(2)	(3)
16	Hoopoe	2	2	1	2	7	2		2
17	Short-toed Lark			3	10	62	37		40
18	Crested Lark	3	20	9	24	44	50		14
19	Black-headed Wagtail	2				4			

No.	Species	Location							
		SE Coast	NE Coast	North Hill	Central Plain south	Central Plain north	West Hills	Western Plains	Far West
		June 9, 2004	June 9, 2004	June 10, 2004	June 10, 2004	June 8, 2004	June 9, 2004	June 11, 2004	June 12, 2004
20	White Wagtail	2				2			(1)
21	Rufous Bush Robin	2			30+	5	5	3	1
22	Isabelline Wheatear		6	3	8	15	29	18	13
23	Finsch’s Wheatear			5	1	3	15		3
24	Reed Warbler	7			7	1			
25	Great Reed Warbler	1	1		10				
26	Booted Warbler				20	3			

Table 7: Puta/Shelf surveys conducted in different years

No.	Species	Date				
		25.09.2001	09.12.2001	22.02.2003	30.09.2004	29.06.2005
1	Tachybaptus ruficollis Little Grebe	1		20	1	
2	Podiceps cristatus Great Crested Grebe	1		4	129	6
3	Podiceps nigricollis Black-necked Grebe	10		12	17	
4	Phalacrocorax carbo Great Cormorant	23		6	155	8
5	Phalacrocorax pygmaeus Pygmy Cormorant			50		
6	Ardea cinerea Grey Heron				9	
7	Casmerodius albus Great White Egret	11				
8	Egretta garzetta Little Egret				30	
9	Cygnus cygnus Whooper Swan			2		
10	Cygnus olor Mute Swan			50		
11	Anas platyrhynchos Mallard				31	
12	Anas querquedula Garganey				4	
13	Netta rufina Red-crested Pochard			109		
14	Aythya ferina Pochard		160	322	9	
15	Aythya fuligula Tufted Duck			370	6	
16	Aythya sp.		4800			
17	Bucephala clangula Goldeneye			1		
18	Mergellus albellus Smew			21		
19	Anatinae spp. unidentified ducks		840			
20	Fulica atra Common Coot		16390	8400	11684	2
21	Glareola pratincola Collared Pratincole					14
22	Pluvialis squatarola Grey Plover			2		
23	Charadrius hiaticula Ringed Plover			2		
24	Charadrius alexandrinus Kentish Plover					4
25	Tringa totanus Redshank	1		5		
26	Gallinago gallinago Common Snipe			2		
27	Calidris alpina Dunlin			3		
28	Larus canus Common Gull			1		

No.	Species	Date				
		25.09.2001	09.12.2001	22.02.2003	30.09.2004	29.06.2005
29	Larus cachinnans Yellow-legged Gull	291		4		15
30	Larus ichthyaetus Great Black-headed Gull			4		
31	Larus ridibundus Black-headed Gull			2		
32	Larus minutus Little Gull			2		
33	Mediterranean Gull Larus melanocephalus			1		
34	Sterna sandvicensis Sandwich Tern					1400
35	Sterna hirundo Common Tern					8
36	Marsh Harrier Circus aeruginisus			4		

Tabel 8: Puta/Shelf winter counts for the last 3 years

No.	Species	January 2022	January 2023	January 2024
1	Podiceps nigricollis Black-necked Grebe	10	41	31
2	Phalacrocorax carbo Great Cormorant			2
3	Phalacrocorax pygmaeus Pygmy Cormorant	23	214	2
4	Ardea cinerea Grey Heron	4	5	1
5	Egretta garzetta Little Egret	1	1	
6	Phoenicopterus ruber roseus Greater Flamingo	90	1	50
7	Anser anser Greylag Goose			12
8	Cygnus cygnus Whooper Swan	70	55	5
9	Cygnus olor Mute Swan	64	64	
10	Cygnus spp. unidentified swans			16
11	Tadorna tadorna Shelduck		6	
12	Anas penelope Eurasian Wigeon		650	
13	Anas crecca Common Teal	200	205	35
14	Anas platyrhynchos Mallard	408	1100	423
15	Anas clypeata Northern Shoveler		40	
16	Netta rufina Red-crested Pochard	6400	5000	6
17	Aythya ferina Pochard	9590	9008	6328
18	Aythya fuligula Tufted Duck	3310	4170	2406
19	Bucephala clangula Goldeneye		2	
20	Mergus serrator Red-breasted Merganser			11
21	Anatinae spp. unidentified ducks	5000		
22	Fulica atra Common Coot	4750	6430	5990
23	Recurvirostra avosetta Avocet	105		12
24	Charadrius hiaticula Ringed Plover		2	
25	Charadrius alexandrinus Kentish Plover		4	
26	Tringa totanus Redshank	26	6	4
27	Tringa sp.			20
28	Unidentified waders	900		
29	Circus aeruginosus Marsh Harrier		1	6
	TOTAL	**30951**	**27005**	**15360**

Table 9: Monitoring of breeding birds on Islands: Absheron Archipelago

SPECIES	Islands of Absheron Archipelago													Islands of Baku Archipelago							Deserted Oil Platform around islands of Baku Archipelago												Kur Dili	Islands of Kura Delta	
	Boyuk Tava	Rocks between Boyuk and Kichik Tava	Kichik Tava	Podplitochniy	Suiti (Absheron NP)	Gu	Garabattag	Deserted Oil Platform (near Garabattag)	Jilov	Yal	Dardanelly	Koltish	Artificial Islands in lagoons of Shelf Factory	Babur rocky islands	Hara Zira	Dashlar (3 rocky Islands)	Zenbil	Gutan	Garasu	Sangi Mugan	1	2	3	4	5	6	7	8	9	10	11	12		South	North
Date of study	02/06/07	02/06/07	02/06/07	02/06/07	03/06/07	16/06/07	16/06/07	16/06/07	16/06/07	16/06/07	16/06/07	16/06/07	15/06/07	08/06/07	12/06/07	12/06/07 & 27/06/07	27/06/07	28/06/07	28/06/07	28/06/07	28/06/07												3-5/07/07	25/07/07	26/07/07
Great Crested Grebe				1		c										2	2																60		
Black-Necked Grebe						o										5	18																		
Little Grebe						m																													10
Great Cormorant	62	10	65	7	18	p	70	50	2	18		16		106	9	3 4	4	16		2	12	46	23	8	0	6	28	27	3	2	74	8	18	8	
Pygmy Cormorant						l																											31		27
Grey Heron						e							3																				8	4	2
Purple Heron						t																													32
Great White Egret						e																											26		8
Little White Egret						l																												10	19
Cattle Egret						y																													80
Squacco Heron																																			1
Night Heron						u																													40
Glossy Ibis						n							1																						13
Common Shelduck						d								1																					
Ruddy Shelduck	2	3	3			e		2						2	1		1																		
Mallard				1		r						14																					2		
Common Teal				1																															
Red-Crested Pochard																	2																		
Ducks sp.																	6																		
Marsh Harrier					2	w									1																		20		
Common Kestrel						a									1														1		1				1
Black Francolin						t																											22		11
Common Coot						e							6		1 dead	97	250																		20
Purple Swamphen						r							1																				17		24
Moorhen																																			20
Black-Winged Stilt																																			6
Collared Pratincole													30	27					4														7		18
Kentish Plover					4	c			1																								5	11	14
Little Ringed Plover					8	o								1																				5	9
Dunlin					6	m																													
Little Stint					3	p																												30	
Black-Tailed Godwit						l																													18
Curlew						e																											1		
Redshank					28	t																											224	40	280
Greenshank					1	e																											1		
Green Sandpiper						l																											5		1

Terek Sandpiper					2	y																												14	
Common Sandpiper																																		19	8
Turnstone						u																												6	
Red Necked Phalarope					16	n																													
Great Black Headed Gull	1		1			d																													
Yellow Legged Gull	750	75	820	150	48	e	20	14	5	20	40	46		110	18	1	600	100	1500	3	3	4	2		0	3		2					2	265	
Mediterranean Gull						r																												8	
Little Gull																																		12	
Common Tern	4		3	4	20	w			4				60	57	1						2	1		1	0		1				2		30	42	
Little Tern					18	a																												105	
Gull Billed Tern	4			5	3	t																													
Sandwich Tern					100	e										2																		680	
White-Winged Black Tern						r																											148	15	285
Black Tern																																			12
Whiskered Tern																																			14
Rock Dove	4		2	2			2							2							4				0				3	2	8	1			
Cuckoo						c																													1
Swift						o									1																				
Kingfisher						m																													1
Hoopoe						p																											5		
Blue-Cheeked Bee-Eater						l																													100
Crested Lark						e									2																		1		
Lesser Short Toed Lark						t			1						5																		3		
Short Toed Lark						e			2																										
Calandra Lark						l																											12		
Swallow						y														4													100		50
Sand Martin																																			150
Pied Wagtail						u																									3				
Yellow Wagtail						n																													1
Isabelline Wheatear						d									2																				
Great Reed Warbler						e							2																				12		20
Reed Warbler						r																													10
Bearded Tit																																			40
Long-Tailed Tit						w																												1	
Red-Backed Shrike						a																											2		
Hooded Crow						t									1																		20		
Starling						e									6					2											6	2	100		
House Sparrow						r														10													80		
TOTAL breeding pairs	760	78	829	156	198	0	22	0	3	20	40	0	99	200	16	0	601	100	1504	16	21	5	25	1	0	9	1	29	7	2	94	11	273	1059	964
TOTAL non-breeding ind.	67	10	65	14	79	0	70	66	11	18	0	76	4	106	32	4	2	16	0	9	0	46	0	8	0	0	28	0	0	2	0	0	689	216	328
TOTAL dead individuals	0	0	1	0	0	0	0	0	0	0	0	0	0	0	1	108	282	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
147 - breeding pairs 50 - individuals (do not breed) 57 - dead individuals + - rare ++ - common +++ - abundant																																			

Table 10: Comparison of species included in the Red Book 2013 and 2023

No.	Species	2013	2023	
			IUCN	AZ
1	*Pelecanus onocrotalus* White Pelican	LC	LC	EN
2	*Pelecanus crispus* Dalmatian Pelican	VU	NT	VU
3	*Ardea purpurea* Purple Heron	LC		
4	*Ciconia nigra* Black Stork	LC	LC	EN
5	*Platalea leucorodia* Spoonbill	LC	LC	B2
6	*Phoenicopterus ruber roseus* Greater Flamingo	LC	LC	VU breeding; NT wintering
7	*Anser erythropus* Lesser White-fronted Goose	VU	VU	VU
8	*Branta ruficollis* Red-breasted Goose	EN	EN	CR
9	*Cygnus (columbianus) bewickii* Bewick's Swan	LC	LC	VU
10	*Cygnus olor* Mute Swan	LC	LC	CR breeding; NT wintering
11	*Marmaronetta angustirostris* Marbled Teal	VU	NT	VU
12	*Aythya ferina* Pochard		VU	NT
13	*Aythya nyroca* Ferruginous Duck	NT	NT	VU
14	*Clangula hyemalis* Long-tailed Duck		VU	CR
15	*Melanitta fusca* Velvet Scoter	LC	VU	CR
16	*Oxyura leucocephala* White-headed Duck	EN	EN	VU
17	*Pandion haliaetus* Osprey	LC	LC	CR
18	*Pernis apivorus* Honney Buzzard	LC	LC	CR
19	*Milvus migrans* Black Kite	LC	VU	CR
20	*Milvus milvus* Red Kite	LC	LC	DD
21	*Circus macrourus* Pallid Harrier	NT	NT	VU
22	*Accipiter gentilis* Goshawk	LC	LC	VU
23	*Accipiter brevipes* Levant Sparrowhawk	VU		
24	*Accipiter badius* Shikra	CR		
25	*Buteo rufinus* Long-legged Buzzard	EN		
26	*Circaetus gallicus* Short-toed Eagle	LC	LC	EN
27	*Hieraaetus pennatus* Booted Eagle	LC	LC	EN
28	*Aquila nipalensis* Steppe Eagle	LC	EN	EN
29	*Aquila clanga* Spotted Eagle	VU	VU	CR
30	*Aquila heliaca* Imperial Eagle	VU	VU	EN
31	*Aquila chysaetos* Golden Eagle	LC	LC	VU
32	*Haliaeetus albicilla* White-tailed Sea Eagle	LC	LC	CR
33	*Gypaetus barbatus* Lammergeier	LC	NT	EN

No.	Species	2013	2023	
			IUCN	AZ
34	*Neophron percnopterus* Egyptian Vulture	VU	EN	EN
35	*Aegypius monachus* Cinereous Vulture	NT	NT	EN
36	*Gyps fulvus* Griffon Vulture	LC	LC	VU
37	*Flaco cherrug* Saker	EN	EN	CR
38	*Falco biarmicus* Lanner	LC	LC	CR
39	*Falco peregrinus* Peregrine Falcon	EN	LC	EN
40	*Falco subbuteo* Hobby	LC	LC	VU
41	*Falco columbarius* Merlin	LC		
42	*Falco naumanni* Lesser Kestrel	LC		
43	*Falco vespertinus* Red-footed Flacon	NT	VU	CR
44	*Lyrurus mlokosiewiczi* Caucasian Black Grouse	DD	NT	VU
45	*Tetraogallus caucasicus* Caucasian Snowcock	LC	LC	VU
46	*Tetraogallus caspius* Caspian Snowcock	LC	LC	VU
47	*Francolinus francolinus* Black Francolin	LC	LC	NT
48	*Perdix perdix* Grey Partridge	LC	LC	VU
49	*Phasianus colchicus* Pheasant	LC	LC	CR
50	*Ammoperdix griseogularis* See-see Partridge	LC	LC	EN
51	*Grus grus* Common Crane	LC	LC	NT
52	*Grus leucogeranus* Siberian Crane	CR	CR	CR
53	*Anthropoides virgo* Demoiselle Crane	LC	LC	NT
54	*Crex crex* Corncrake	LC		
55	*Porphyrio porphyrio* Purple Swamphen	LC	LC	VU
56	*Otis tarda* Great Bustard	VU	VU	CR
57	*Tetrax tetrax* Little Bustard	NT	NT	NT
58	*Chlamydotis undulata* Houbara	VU	VU	CR
59	*Haematopus ostralegus* Eurasian Oystercatcher		NT	CR
60	*Recurvirostra avosetta* Avocet	LC		
61	*Glareola nordmanni* Black-winged Pratincole	NT	NT	NT
62	*Vanellus vanellus* Northern Lapwing		NT	EN
63	*Vanellus gregarius* Sociable Plover	CR	CR	EN
64	*Vanellus leucurus* White-tailed Plover	LC	LC	VU
65	*Charadrius leschenaultii* Greater Sandplover	LC	LC	VU
66	*Limosa limosa* Black-tailed Godwit		NT	VU
67	*Numenius tenuirostris* Slender-billed Curlew	CR	CR	CR
68	*Numenius arquata* Eurasian Curlew		NT	VU
69	*Calidris ferruginea* Curlew Sandpiper		NT	NT
70	*Larus melanocephalus* Mediterranean Gull	LC	LC	VU
71	*Pterocles orientalis* Black-bellied Sandgrouse	LC	LC	VU

No.	Species	2013	2023	
			IUCN	AZ
72	*Pterocles alchata* Pin-tailed Sandgrouse		LC	EN
73	*Columba palumbus* Woodpigeon		LC	VU
74	*Streptopelia turtur* Turtle Dove		VU	EN
75	*Irania gutturalis* White-throated Robin	LC	LC	CR
76	*Prunella ocularis* Radde's Accentor		LC	CR
77	*Hippolais languida* Upcher's Warbler		LC	EN
78	*Turdus iliacus* Redwing		NT	NT
79	*Oenanthe xanthoprymna* Red-tailed Wheatear	LC		
80	*Carpospiza brachydactyla* Pale Rock Sparrow		LC	CR
81	*Rhodospiza obsoleta* Desert Finch		LC	VU
82	*Bucanetes githagineus* Trumpeter Finch	LC	LC	EN
83	*Rhodopechys sanguinea* Crimson-winged Finch	LC	LC	VU
84	*Bucanetes mongolicus* Mongolian Finch	LC	LC	CR
85	*Emberiza buchanani* Grey-necked Bunting	LC	LC	EN
86	*Melanocorypha bimaculata* Bimaculated Lark	LC	LC	VU
87	*Sitta tephronota* Eastern Rock Nuthatch	LC	LC	VU

APPENDIX 6B – FISH LITERATURE REVIEW

Fish Species

The Shah Deniz Compressor Project Contract Area covers sea depths of up to 40 meters, almost adjoining the Shah Deniz Contract Area to the east and the Makarov Bank to the north. In this part of the sea, there are muddy-sandy, sandy-silt, muddy-shell, pebble and stony soils in water depths of up to 40 meters.

The coastal areas of the Caspian Sea, mainly up to a depth of 100 meters, have always been a traditional fishing area in the South Caspian Sea. About 32 fish species can be found in these areas during different seasons of the year (Table 1): those inhabiting the coastal waters at depths not exceeding 50-75 m (gobies), migrating through this area during spring (March-April) and fall (October-November) seasons, or wintering near the western shores (herring, sprat).

Based on the results of recent surveys, as well as information from amateurs fishermen and representatives of the MENR Fisheries Protection Service, the following fish species comprise the ichthyofauna of the Shah Deniz Compressor Project Contract Area (Table 1).

Table 1: Ichthyofauna composition in BP Shah Deniz Compressor Project of the Caspian Sea

No.	Species		
	Azərbaijani	English	Latin
	Nərəkimilər fəsiləsi	Sturgeons	Acipenseridae
1	Bölgə	Beluga	Huso huso (Linnaeus)
2	Kür (fars) nərəsi	Kura (Persian) sturgeon	Acipenser persicus Borodin
3	Qaya balığı (Kələmo)	Ship sturgeon	Acipenser nudiventris Lovetsky
4	Uzunburun nərə	Kura sturgeon	Asipenser stellatus Pallas
	Qızılbalıqkimilər fəsiləsi	Salmon	Salmonidae
5	Xəzər qızılbalığı (kumja)	Caspian salmon	Salmo trutta caspius Kessler
	Siyənəkkimilər fəsiləsi	Herring	*Clupeidae*
6	Xəzər kilkəsi (adi kilkə)	Caspian trout	*Clupeonella delicatula caspia* Stetovidov, 1941
7	İrigöz siyənək	Shad	*Alosa brashnikovi autumnalis* (Berg, 1913)
8	Xəzər şişqarını	Caspian shad	*Alosa caspia* (Eichwald)
9	Volqa siyənəyi	Volga shad	*Alosa kessleri volgensis* (Berg)
10	Qarabel siyənək	Black-back shad	*Alosa kessleri* (Grimm)
11	İrigöz şişqarın	Big-eye shad	*Alosa saposchnikowii* (Grimm)
12	Dolgin siyənəyi	Dolginka shad	*Alosa braschnikowii braschnikowii* (Borodin)
	Çəkikimilər fəsiləsi	Carp	*Cyprinidae*
13	Kütüm (Ziyad)	Black Sea roach	*Rutilus frisii kutum* (Kamensky)

No.	Species		
	Azerbaijani	**English**	**Latin**
14	Xəzər qarasolu	Zahrte	*Vimba vimba persa* (Pallas, 1774)
15	Külmə	Roach	*Rutilus rutilus caspicus* (Jakovlev, 1870)
16	Çəki	Common carp	*Cyprinus carpio* Linnaeus, 1758
17	Şərq çapağı	Caspian bream	*Abramis brama orientalis* Berg, 1949
	Aterinkimilər fəsiləsi	Sand smelt	*Atheriniformis*
18	Xəzər aterinası	Caspian sand smelt	*Atherina boyeri caspia* (Eichwald)
	İynəbalığıkimilər dəstəsi	Acerate	*Syngnathiformis*
19	Xəzər iynəbalığı iynəbalığı	Caspian pipe fish	*Syngnathus nigrolineatus caspius* (Eichwald)
	Tikanbalığıkimilər dəstəsi	Stickleback	*Gasterosteiformis*
20	Üçtikanlı tikanbalığı	Three-spined stickleback	*Gasterosteus aculeatus* (Linnaeus)
	Kefalkimilər fəsiləsi	Mullets	*Mugilidae*
21	Sivriburun kefal	Leaping grey	*Lisa saliens* (Risso, 1810)
	Xulkimilər fəsiləsi	Goby	*Gobiidae*
22	Qumluq xulu	Goby	*Neogobius fluviatilis* (Pallas)
23	Xəzər iribaş xulu	Caspian goby	*Neogobius gorlap* (Iljin)
24	Xval xulu	Khvaly goby	*Neogobius caspius* (Eichwald)
25	Girdə xul	Round goby	*Neogobius melanostomus affinis* (Pallas)
26	Şirman xulu	Goby	*Neogobius syrman eurystomus* (Nordmann)
27	Ziyilli çömçə xul	Goby	*Benthophilus granulosus* Kessler
28	Ber çömçə xul	Goby	*Benthophilus Baeri* Kessler
29	Nordman xulu	Goby	*Neogobius ratan goebeli* (Kessler)
No.	**Species**		
	Azerbaijani	**English**	**Latin**
30	İribaş çömçə xulu	Caspian goby	*Benthophilus macrocephalus* Pallas
31	Uzunquyruq Knipoviç xulu	Long-tailed goby	Knipowitschia longicaudata (Kessler)
32	Xəzər ulduzlu çömçə xulu	Caspian goby stellate	*Benthophilus stellatus leobergius Iljin*

Thus, according to data for recent years, about 32 fish species are observed around the Shah Deniz Compressor Project area. The species encountered include both pelagic fish (e.g., herring, beluga, salmon, atherium, needlefish, sticklefish) and near-bottom fish (sturgeon, spike, starred sturgeon, kutum, mullet, and all gobies). During spring and fall, the area to the northeast of Contract Area contains migration routes of producers of anadromous and semi-anadromous fish ready for reproduction (sturgeon, herring, salmon, carp). This area is particularly important during the spring-summer period and to a lesser extent during the fall period.

Consequently, half (17) of the observed number (32) of fish species come here during seasonal migrations and occur here relatively rarely (April-May, September-October). These migratory species are: all the above-mentioned sturgeons (beluga, Persian sturgeon, spike, starred sturgeon), herrings (bigeye herring, Caspian herring, Volga herring, blackback herring, Dolginsky herring), Caspian salmon and carps (mainly kutum). Apart from sturgeon and Caspian salmon, all of the listed herring and carp (mainly kutum) are commercial fish species. However, even during spring migrations these listed species are relatively rare (especially sturgeons and Caspian salmon), as this water area is the most extreme, coastal (up to 10-20 m) and shallow part of their migration route, covering depths of up to 50 meters, mainly 20-50 m. As these migrations are mainly observed in spring, the main season for the presence of these fish in the Shah deniz Compressor Project Contract Area is spring (March-May) and, to a relatively lesser extent, fall (September-October).

The main objects in the Contract Area are sprat, herring, mullet, kutum, and roach (Table 2). In contrast, carp, bream and redfish occur sporadically (occasionally) in these water areas, and only their individual (sporadic) migrations are noted. The main habitats of these fish species are confined to the western coast and spawning grounds in the rivers of the South Caspian Sea are located much further south - in water areas adjacent to the mouth of the Kura River, the Great and Small Gizilaghaj Bays, and the Lankaran coast.

In contrast to migratory fish species, there are species whose life cycle is associated with shallow water areas of the sea and these are relatively more observed around the Shah Deniz Compressor Project contract area: pelagic - atherium, needlefish, sticklefish; near-bottom - gobies and mullet. All these fish species, with the exception of mullet, have no commercial importance. However, leaping grey mullet inhabits these places all year round, especially during spawning migration in spring-summer when it approaches coastal water areas with depths of 5-10 meters.

In contrast to gobies and mullet, pelagic fish species are recorded in minimal numbers in summer and winter. In contrast, gobies (11 species, Table 1) occur here all year round, are relatively permanent residents of the area and lead a benthic lifestyle.

Table 2 summarises the main water areas and habitat depths for commercial fisheries in the Contract Area.

Table 2: Places and depths of fish species caught by commercial fisheries in the Shah Deniz Compressor Project water area (m)

No.	Area of water	Sprat	Shad	Black Sea Roach	Roach	Common Carp	Bream	Mullet	Zahrte
1	Garadagh district	3-25	4-16	9-24	2-9	-	-	10-25	-
2	Sangachal settlement	3-25	4-16	9-24	2-9	-	-	10-25	-
3	Makarov bank	20-25	16-20	20-24	-	-	-	20-25	-

Is the Shah Deniz Compressor Project Contract Area used for fish spawning? Here are the names of fish species, their spawning periods and locations used in this area.

Of the 33 fish species noted, the following fish species spawn in the Contract Area:

- of pelagic fish - needlefish (at depths up to 4 meters), Atherina (at depths up to 2 m) and three-spined stickleback (at depths up to 10 m),
- of benthic fish - all 11 species of gobies (spawning on the seabed at depths up to 10 m) and mullet (pelagic spawning above depths of 5-10 m).

Atherina lives everywhere in the Contract Area, mainly in shallow coastal waters at depths up to 2 m, spawning in areas of rich bottom vegetation at depths up to 2 m. Spawning takes place in May-June, spawning is portioned and may extend from May to August, eggs are attached to bottom vegetation with the help of filamentous outgrowths.

Needlefish live everywhere in the waters of the Contract Area, mainly in the areas of Zostera marina L. algae distribution. It spawns in the same areas in May-July at depths of up to 4 m.

Gobies are seen everywhere in the Contract Area, mainly in near-shore areas at depths of up to 10 m, partly in areas of rich benthic vegetation, but they prefer sandy-shell, pebble and rocky areas. Gobies spawn on gravel and stony ground at depths of up to 10 m, mainly in April-May, spawning is portioned and may extend from April to September.

Three-spined stickleback inhabits and feeds all year round throughout the Contract Area, mainly in shallow coastal waters at depths of up to 10 m. it spawns all year round and spawning is portioned.

Leaping grey mullet lives all year round and everywhere in the Contract Area at depths from 5 to 700 m, especially in spring-summer. During the spawning migration, it approaches coastal water areas up to 50 m, pelagic spawning spawning occurs above depths of 5-10 m, in autumn-winter there is a reverse migration to wintering grounds with a widespread distribution at depths from 5 to 700 m.

Therefore, of the 33 fish species occurring in the Shah Deniz Compressor Project Contract Area, only relatively permanent resident species (Atherina, needlefish, gobies, three-spined stickleback, leaping grey) only 15 species spawn. Spawning of these species in the Contract Area is observed only at depths up to 10 meters, mainly up to 2-4 meters. It starts in spring and extends until the beginning of autumn, from April to September.

The water area of the Sangachal Bay and the shallow waters of the Sangachal coastal area are inhabited by atherina, gobies, common sprat, sprat, roach, Black Sea roach, mullet, Caspian shad, needlefish and sticklefish for most of the year.

According to the studies carried out in the Sangachal Bay near the oil terminal in recent years, from nine to 11 fish species are present in different seasons of the year (Table 3). The species composition of ichthyofauna is dominated by *Atherina boyeri caspia* and gobies *Neogobius sp*. Also the following species are characterized by 100% occurrence in trawls: roach *Rutilus rutilus caspicus* (Jakovlev), mullet *Liza saliens* (Risso), Caspian shad *Alosa caspia* (Eichwald), Caspian needlefish *Syngnathus nigrolineatus caspius* (Eichwald), small South Caspian stickleback, nine-spined stickleback *Pungitius platygaster* (Kessler), and Black Sea roach (Kamensky).

Table 3: Composition of ichthyofauna in Sangachal Bay

No.	Species		
	Azərbaycan dilində	English	Latın dilində
	Siyənəkkimilər fəsiləsi	Herrings	*Clupeidae*
1	Xəzər kilkəsi (adi kilkə)	Caspian kilka	*Clupeonella delicatula caspia* Stetovidov, 1941
2	Xəzər şişqarını	Caspian shad	*Alosa caspia* (Eichwald)
	Çəkikimilər fəsiləsi	Carps	Cyprinidae
3	Kütüm (Ziyad)	Black Sea roach	*Rutilus frisii kutum* (Kamensky)
4	Külmə	North Caspian roach	*Rutilus rutilus caspicus* (Jakovlev, 1870)
	Aterinkimilər fəsiləsi	Atherina	*Atheriniformis*
5	Xəzər aterinası	Caspian atherina	*Atherina boyeri caspia* (Eichwald)
	İynəbalığıkimilər dəstəsi	Needlefish	*Syngnathiformis*
6	Xəzər iynəbalığı iynəbalığı	Caspian pipe fish	*Syngnathus nigrolineatus caspius* (Eichwald)
	Tikanbalığıkimilər dəstəsi	Sicklebacks	*Gasterosteiformis*
7	Kiçik cənub tikanbalığı	Small South Caspian stickleback	*Pungitius platygaster* (Kessler)
	Kefalkimilər fəsiləsi	Mullets	*Mugilidae*
8	Sivriburun kefal	Leaping grey	*Lisa saliens* (Risso, 1810)
	Xulkimilər fəsiləsi	Gobies	*Gobiidae*
9	Qumluq xulu	Goby	*Neogobius fluviatilis* (Pallas)
10	Xəzər iribaş xulu	Goby	*Neogobius gorlap* (Iljin)
11	Girdə xul	Goby	*Neogobius melanostomus affinis* (Pallas)

Of the 11 fish species, spawing in the littoral zone of the Sangachal Bay are:

- of pelagic fish – pipe fish (at depths up to 4 m), Atherina (at depths up to 2 m) and Small South Caspian stickleback (at depths up to 10 m),
- of benthic fish - all 3 species of gobies (spawning on the seabed at depths up to 10 m) and leaping grey (pelagic spawning above depths of 5-10 m).

Atherina lives everywhere in the waters of the Sangachal Bay, mainly in the shallow coastal part at depths up to 2 m, spawning in areas of rich bottom vegetation at depths up to 2 m. Spawning takes place in May-June and may be portioned and extend into May-August. Eggs are attached to bottom vegetation with the help of filamentous outgrowths.

Pipe fish lives everywhere in the waters of the Sangachal Bay, mainly in the areas where the alga Zostera marina L. is distributed, spawning in the same areas in May-July at a depth of up to 4 m.

The gobies live everywhere in the waters of the Sangachal Bay, mainly in coastal areas at depths up to 10 m, partly in areas of rich bottom vegetation, but prefer areas of sandy-shell, pebble and stony ground. Gobies spawn on pebble and stony ground at depths of up to 10 m, mainly in April-May, spawning is portioned and may extend from April to September.

The small South Caspian stickleback inhabits and feeds all year round, everywhere in the entire water area of the Sangachal Bay, mainly in the shallow coastal part at a depth of up to 10 m, spawns all year round. The spawning is portioned.

Leaping grey lives all year round and everywhere in the waters of the Sangachal Bay. In spring-summer, during spawning migration, it approaches coastal waters up to 10 m, pelagic spawning occurs above depths of 5-10 m.

Thus, of the 11 fish species found in the waters of the Sangachal Bay, only relatively permanent species (Atherina, pipe fish, gobies, stickleback and leaping grey) spawn – seven species in total. Spawning of these species in the waters of the Sangachal Bay is observed only at depths up to 10 meters, mainly up to 2-4 meters. It starts in spring and extends until the beginning of autumn, from April to September.

Protected Fish Species

Of the mentioned fish species (Table 1) observed in the Shah Deniz Compressor Project Contract Area, Caspian salmon (*Salmo trutta caspius* Kessler) and Ship (*Acipenser nudiventris* Lovetsky) are included in the Red Book of Azerbaijan (2023).

Most of the noted fish species are endemic to the Caspian Sea, i.e. they are not found anywhere else in any other marine area of the world, e.g. the mentioned species of herring, carp, goby.

The fish species inhabiting the waters of the Sangachal Bay (Table 3) are not included in the Red Book of Azerbaijan (2023). The names of 11 (eleven) fish species were included in the third edition (2023) of the “Red Book of the Republic of Azerbaijan”. Of these, 2 fish species are new: Kura and Volga herring.

Table 4: Names of fish species included in the third edition (2023) of the "Red Book of the Republic of Azerbaijan"

No.	Elmi (Latın dilində) adı	Azərbaycan dilində adı	English
1	*Acipenser nudiventris* Lovetsky, 1828	Qaya balığı (kələmo)	Ship sturgeon
2	*Salmo trutta fario* Linneus, 1758	Çay qızılxallısı	River rainbow trout
3	*Salmo trutta caspius* Kessler, 1870	Xəzər qızılbalığı (kumja)	Caspian trout
4	*Pseudophoxinus atropatenus* (Derjavin, 1937)	Şirvan külməsi	Azerbaijani (Shirvan) Spring Roach
5	*Luciobarbus capito* (Güldenstaedt, 1773)	Zərdəpər	Bulatmai barbel
6	*Luciobarbus caspius* (Berg, 1914)	Xəzər şirbiti	Caspian barbel
7	*Ballerus sapa* (Pallas, 1814)	Cənubi Xəzər porusu	White-eye bream
8	*Pelecus cultratus* (Linnaeus, 1758)	Qılıncbalıq	Sabrefish/Sichel
9	*Sander marinus* Cuvier, 1828	Dəniz sıfı	Zander
10	*Alosa curensis Suworow, 1907*	Kür siyənəyi	Kura shad
11	*Alosa volgensis Berg, 1915*	Volqa siyənəyi	Volga shad

Trawl Fishing

Trawl fishing in the Caspian Sea is used only for scientific research purposes (once a year in summer) to assess the abundance and distribution of sturgeon and other types of fish. Since the sampling stations in the South Caspian basin are located at greater depths (more than 10 meters), a 24.7 m trawl is used.

Until 2012, trawl surveys were conducted in 11 study sections, each consisting of five sampling stations. In total, there were 55 sampling stations at depths of 10, 25, 50, 75 and 100 meters in coastal zones. Researches were carried out from "Alif Hajiyev" scientific-research vessel of MENR.

The coordinates of sea transects and trawl sampling stations in the South Caspian basin are presented in Table 3 below and illustrated in Figure 1.

In the South Caspian basin, none of the seven research sea sections where deep trawling was carried out coincided with pipeline routes from the ACG or SD Contract Areas to the Sangachal Bay. The survey section (up to 100 m in depth) extending eastward from Cape Pirsaat is the survey section closest to the pipeline routes to the Sangachal terminal and the SD Contract Area. However, as shown in Table 3 and Figure 1, trawl stations "1E" and "1D" are located close to the main SD1 pipeline. Trawl station “1E” is located approximately 2-3 km to the north of the pipeline and trawl station “1D” is located approximately 5-6 km to the south.

Therefore, it was agreed through further negotiations involving BP, the Azerbaijan Scientific-Research Institute of Fisheries and MENR that trawl operations in “1D” and “1E” would be suspended from January 1, 2015 for an indefinite period. Under the agreement, starting in 2012, these two test trawl locations were also moved further west outside the SD Contract Area. With an indefinite postponement from January 1, 2015, the relocation of test trawl stations was agreed as follows:

- “1D” trawl station: old coordinates – latitude 390 54/ 00// , longitude 500 17/ 37//, new coordinates – latitude 390 54/ 00//, longitude 500 11/ 18//;
- “1E” trawl station: old coordinates – latitude 390 54/ 00//, longitude 500 25/ 44//, new coordinates – latitude 390 53/ 24//, longitude 500 13/ 00//.

However, the MENR decided to abandon scientific-research trawling work in this area of the Pirsaat Cape and Bandovan Cape of the Caspian Sea starting from 2015 and up to the present time due to ongoing oil and gas operations in this part of the sea.

Therefore, since scientific-research trawling work was not carried out in the sea area closest to the Shah Deniz Contract Area and the Sangachal Bay in the last 10 years, there is no information about the abundance of sturgeons on the Pirsaat Cape and Bandovan Cape sections.

The water area of the Sangachal Bay and the shallow waters of the Sangachal coastal area are inhabited by atherina, gobies, common sprat, sprat, roach, Black Sea roach, mullet, Caspian shad, needlefish and sticklefish for most of the year.

According to the studies carried out in the Sangachal Bay near the oil terminal in recent years, from nine to 11 fish species are present in different seasons of the year (Table 4). The species composition of ichthyofauna is dominated by Atherina boyeri caspia and gobies Neogobius sp. Also the following species are characterized by 100% occurrence in trawls: roach Rutilus rutilus caspicus (Jakovlev), mullet Liza saliens (Risso), Caspian shad Alosa caspia (Eichwald), Caspian needlefish Syngnathus nigrolineatus caspius (Eichwald), small South Caspian stickleback, nine-spined stickleback Pungitius platygaster (Kessler), and Black Sea roach (Kamensky).

Table 5: Coordinates of Sections and Trawl Sampling Stations in the South Caspian Basin

ID.	Research sections	Coordinates (Lat / Long)	Water depth (m)
1A	Pirsaat 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 17$^/$	-75
1E		39^0 54$^/$ – 50^0 25$^/$	-100
2A	Bandovan 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-east section	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-east section	390 06/ – 490 15/	-10
4B		390 06/ – 490 21/	-25
4C		390 06/ – 490 25/	-50
4D		390 06/ – 490 28/	-75
4E		390 06/ – 490 31/	-100
5A	Kura section	380 55/ – 490 09/	-10
5B		380 55/ – 490 16/	-25
5C		380 55/ – 490 20/	-50
5D		380 55/ – 490 22/	-75
5E		380 55/ – 490 25/	-100
6A	Lankaran	380 45/ – 480 54/	-10
6B		380 45/ – 490 06/	-25
6C		380 45/ – 490 11/	-50
6D		380 45/ – 490 15/	-75
6E		380 45/ – 490 17/	-100
7A	Shahaghaj	380 35/ – 480 54/	-10
7B		380 35/ – 490 02/	-25
7C		380 35/ – 490 05/	-50
7D		380 35/ – 490 06/	-75
7E		380 35/ – 490 14/	-100

Figure 1: Sea transects and trawl sampling stations

APPENDIX 6C - FISH PHYSIOLOGY LITERATURE REVIEW

Fish populations in the Caspian Sea

A brief overview of the current abundance, diversity and health status of fish populations in the Caspian Sea, in particular around the proposed location of the SDC platform in the Shah Deniz Contract Area and the Sangachal Bay.

The Caspian Sea is currently home to 1,809 species and subspecies of animals, including 415 vertebrate species.

There are 150 species and subspecies in the ichthyofauna of the Caspian Sea, which belong to 15 orders and 22 families.

There are 171 species of phytoplankton (algae), 40 species of zooplankton, 258 species of phytobenthos, 91 species of macro zoobenthos, 80 species and subspecies of fish from 14 families in the Azerbaijani sector of the sea.

In terms of the number of fish species, the majority are carps - 42 species, sprat - 17, salmon - 2, sturgeons include 5 species. Of the ichthyofauna of the Caspian Sea, 4 breeds, 31 species and 45 subspecies are endemic [RESEARCH OF THE MODERN STATE OF ICHTHYOFAUNA OF THE CASPIAN SEA // Eurasian Union of Scientists - publication of research papers in the monthly scientific journal. Biological Sciences].

The main pollutant of the sea is undoubtedly oil. Oil pollution suppresses the development of phytobenthos and phytoplankton of the Caspian Sea, represented by blue-green and diatom algae, and reduces oxygen production.

Increased pollution also negatively affects heat, gas and moisture exchange between the water surface and the atmosphere. Due to the spread of oil film over large areas, the evaporation rate decreases several times.

Pollution of the Caspian Sea leads to the death of a huge number of rare fish and other living organisms. The impact of oil pollution is most clearly seen in waterfowl. Sturgeon stocks are steadily decreasing.

Fishing within the Azerbaijani zone of the Caspian Sea is extremely affected by pollution from petroleum hydrocarbons. Despite the efficient operation of fish breeding plants, sturgeon catches have decreased almost 15 times. As a consequence of sea pollution, the state of Caspian herring stocks was catastrophic, as oil extraction is taking place in the vital areas of the sea. The pollution has also reduced mullet stocks. Crayfish, which used to be caught in large quantities south of the Absheron Peninsula, have disappeared.

The pollution of the Caspian Sea has had a negative impact on all links of the trophic chain. A deterioration of the fish food base has been noted and its species composition has sharply decreased. The biomass of amphipods and cumaceans, which have poor resistance to oil pollution, has decreased dozens of times in comparison with clean areas of the sea. Ten-legged crayfish are much more resistant to the impact of oil pollution, but their abundance has also decreased.

Petroleum products destroy spawning grounds and food base of fish, which causes a sharp decrease in their numbers. There are known facts of growth rate suppression of commercial species associated with polluted areas of the sea. The average size and weight of sturgeon fish also tends to decrease.

In some areas of extreme petroleum product pollution sharp pathological changes in fish have been noted. In the mid-1980s, signs of a severe sturgeon disease were detected, which particularly affected the Russian sturgeon. Many fish died, and those that survived often had pathologies.

Among the endangered fish included in the Red Book of the Republic of Azerbaijan are the Caspian lamprey, spotted fish, South Caspian porus (white-eye), chekhon, and sea whitefish. In recent years, the Caspian salmon, white salmon, temmura, and shamaika have become endangered.

Such valuable species as the spike sturgeon and beluga are on the verge of extinction - the population of sturgeon in the Caspian Sea has fallen threefold, beluga 10 times, and starred sturgeon seven times. In 2002, these species were included in the Red Book. Every year, millions of fry are released into the Caspian from fish breeding enterprises, but only hundreds survive in the wild [116].

Today, the average concentration of petroleum hydrocarbons in Caspian water exceeds maximum allowable concentrations (MAC) by 1.5-2 times, and in places of intensive offshore oil production - by tens and hundreds of times. The waters adjacent to the Oil Rocks have long turned into a dead zone [SA CHERKASHIN. Some aspects of the influence of oil hydrocarbons on fish and crustaceans // Vestnik DVO RAN. 2005. No. 3 p. 83 - 91].

The average content of oil hydrocarbons in the Southern and Middle Caspian exceeds the MAC 7-10 times, and in oil and gas producing areas 30-100 times. In the Middle and South Caspian, there are huge nomadic oil fields, in which it is impossible to carry out fish production, in particular, sprats. At present, there is such a mass death of the sprat that it is already possible to talk about the cessation of its commercial fishing.

The consequences of the negative influence of oil products on the inhabitants of the sea are perfectly visible from the experience of years of operation of wells on the coast of Azerbaijan. The sad result of exploration and offshore oil production has been the complete loss of the fishing value of the sea sections from Cape Bandovan to the Absheron Peninsula. Previously, it served as a pasture for feeding young Caspian salmon, Kura small fish, and a place for fishing for kutum and Caspian herring. Under the influence of oil pollution, sea pike and crayfish, which used to live around Zhiloy Island and Oil Rocks and whose catches reached 25,000-30,000 quintals per year before the start of offshore oil production, completely disappeared.

During an offshore expedition of the Ministry of Ecology of Azerbaijan in the summer of 2022, during an analysis of water samples taken from different horizons, among the heavy metals at the Shah Deniz deposit, iron was 1.02-1.2 times and nickel was 2.2-3, 9 times above MAC [Ecological problems of the Caspian Sea // Presidential Secretariat, Presidential Library https://files.preslib.az/projects/eco/ru/eco_m2_3.pdf].

Monitoring of the abundance, diversity and health of fish populations in the Caspian Sea around the proposed location of the SDC platform on Shah Deniz Contract Area and in the Sangachal Bay is prohibited because trawling of these territories may damage pipelines and electric cables on the bottom of this territory. During the offshore expedition conducted jointly with the Ministry of Ecology of Azerbaijan, it was possible to take only water samples around the Shah Deniz platform.

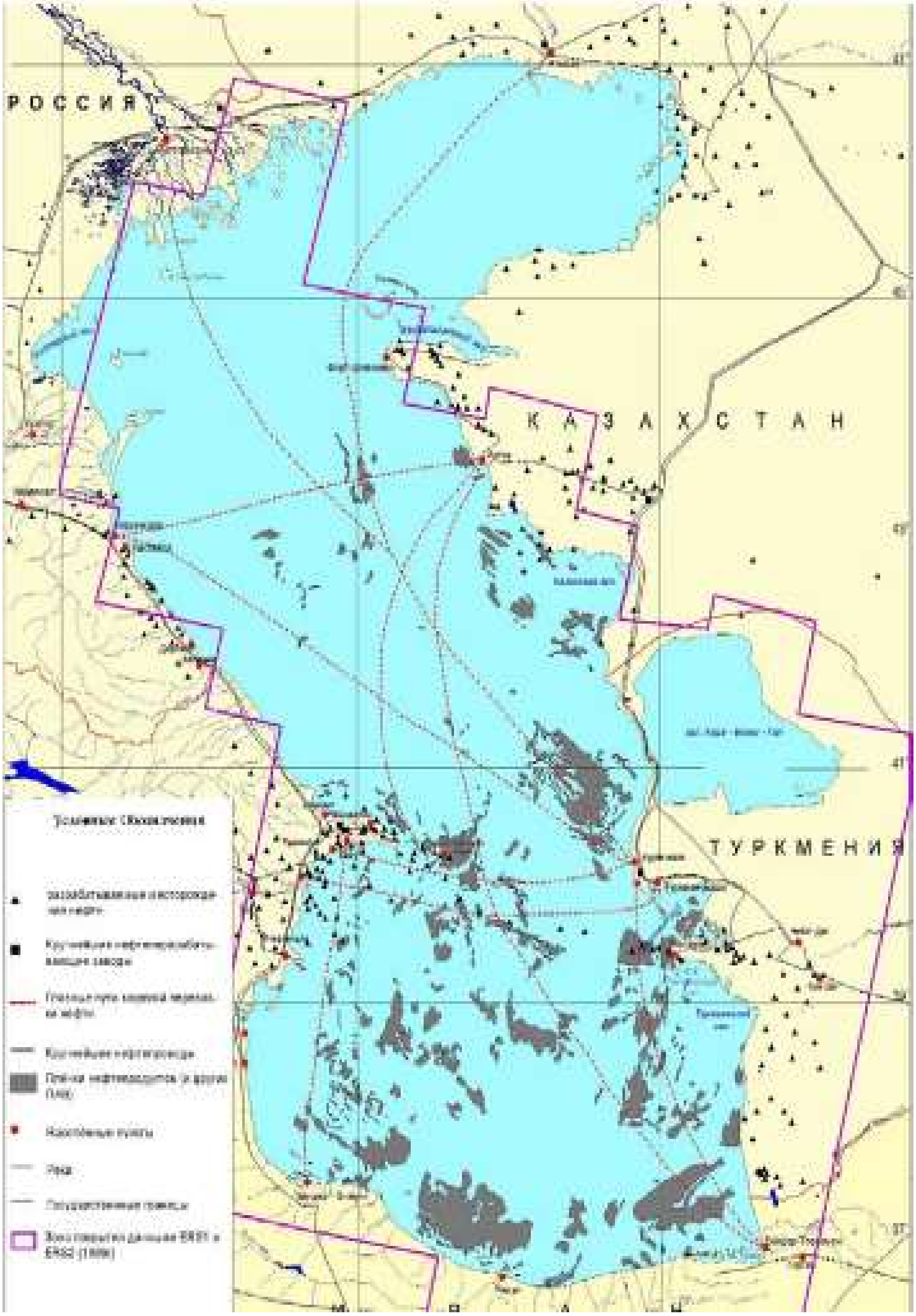


Figure 1: Location map (open source)

Каспийское море: загрязнение донных отложений

Источник: Интерпретация данных относительно донных отложений Каспийского моря, Каспийская экологическая программа, 2002, 2007, 2009

Figure 2: Sampling locations demonstrating heavy metal pollution (As, Ni, Cd). Source: Interpretation of data on bottom sediments of the Caspian Sea, Caspian Environmental Program, 2002, 2007, 2009

Результат аналитических анализов. Пробы морской воды, взятые в районе платформы «Шах Дениз».

Индикаторы	Единицы измерения	Допустимая концентрация	Север N 39°56'5" E 50°25'9"		Восток N 39°54'1" E 50°29'9"			Запад N 39°53'1" E 50°19'1"		Юго-Запад N 39°51'4" E 50°19'9"		
			глубина səth	глубина 20 m	поверхность	глубина 100 m	глубина 200 m	глубина səth	глубина 50 m	поверхность	глубина 50 m	глубина 100 m
pH	-	6,5-8,5	8,49	8,49	8,48	8,34	8,31	8,48	8,4	8,5	8,44	8,31
Соленость	‰	-	10,8	10,8	10,8	10,8	10,7	10,7	10,7	10,7	10,7	10,8
Растворенный кислород	mq/l	4-6	6,06	6,54	6,25	8,75	7,02	6,47	6,98	6,37	6,66	7,9
Температура	°C	-	19,4	19,3	19,3	10,2	10,1	19,3	15,1	18,9	16,7	10,6
Ион аммония (NH4)(NH_4)	mq/l	0,5	0	0	0	0	0	0	0	0	0	0
Нитриты (NO_2)	mq/l	0,08	0	0	0	0	0	0	0	0	0	0
Нитраты (NO_3)	mq/l	45,0	0,15	0,2	0,11	0,12	0,11	0,13	0,2	0,10	0,11	0,10
Фосфаты (PO_4)	mq/l	3,5	0,16	0,16	0,15	0,16	0,16	0,17	0,17	0,17	0,16	0,17
Синтетические поверхностно-активные вещества(SSAM)	mq/l	0,5	0,3	0,35	0,35	0,35	0,3	0,3	0,3	0,35	0,3	0,3
Химическая потребность в кислороде(OKT)	mq/l	10,0	7,0	6,2	7,0	7,0	7,0	6,2	6,2	7,0	7,0	6,2
Нефтепродукты	mq/l	0,05	0	-	0,01	-	-	0	-	0	-	-
Хлориды	mq/l	11900	5672,0	5672,0	5672,0	5672,0	5672,0	5672,0	5672,0	5672,0	5494,7	5672,0
Сульфаты	mq/l	3500	2800	2800	2800	2850	2800	2700	2700	2650	2710	2800
Жесткость	mqekv/l	80-100	74,0	74,0	74,0	74,0	74,0	74,0	74,0	73,0	74,0	74,0

Laboratoriya Mərkəzində su nümunələri üzərində aparılan ağır metalların təhlili

S/S	Nümunənin götürüldüyü yer	Koordinatlar	Ağır metallar, (mkq/l)							
			Dəmir, Fe	Xrom, Cr	Nikel, Ni	Kadmium, Cd	Manqan, Mn	Sink, Zn	Qurğuşun, Pb	Mis, Cu
			YVQH-50,0	-	YVQH-10,0	YVQH-5,0	YVQH-100,0	YVQH-10,0	YVQH-100,0	YVQH-10,0
1	"Ümid-Babək" platforması - qərb	N 39°42'1" E 49°53'1"	34,9	8,54	35,7	0,61	4,51	2,57	0,9	<LOD
2	"Ümid-Babək" platforması - şimal	N 39°44'0" E 49°55'4"	29,1	10,2	35,9	0,48	8,11	4,87	4,97	1,59
3	"Ümid-Babək" platforması - şərq	N 39°42'1" E 49°58'8"	28,4	7,64	36,1	0,58	5,41	3,19	3,19	2.67
4	"Ümid-Babək" platforması - cənub	N 39°40'4" E 49°55'0"	28,5	10,2	22,5	0,11	3,51	1,24	0,16	0,69
5	"Abşeron" yatağı (Jocap ƏŞ)-qərb	N 39°56'0" E 50°51'08"	31,5	10,2	12,1	<LOD	3,54	2,51	0,58	<LOD
6	"Abşeron" yatağı (Jocap ƏŞ)-cənub	N 39°51'6" E 50°52'0"	39,6	7,24	33,7	0,84	5,08	5,12	3,19	0,84
7	"Abşeron" yatağı (Jocap ƏŞ)-şərq	N 39°56'0" E 50°54'4"	38,7	9,31	21,4	0,99	1,98	2.17	4,06	<LOD
8	"Abşeron" yatağı (Jocap ƏŞ)-şimal	N 39°57'3" E 50°52'6"	28.5	7,14	63.4	0,15	3,18	1,87	0,58	0.25
9	"Şahdəniz" platforması-şimal	N 39°56'5" E 50°25'9"	39,6	28,1	21,5	0,71	3.54	1,19	0.67	1.18
10	"Şahdəniz" platforması-şərq	N 39°54'1" E 50°29'9"	58,9	37,4	22,4	0,41	6,57	4,23	0,96	0,78
11	"Şahdəniz" platforması-qərb	N 39°53'1" E 50°19'1"	39,7	29,11	28,1	0,94	7,11	2,57	1,93	0,67
12	"Şahdəniz" platforması-cənub qərb	N 39°51'4" E 50°19'9"	49,8	18,5	24,5	0,12	3,99	5,67	1,64	0,29

Figure 3: Information regarding an expedition held on November 12th-16th, 2020 using 'Alif Hajiyev' scientific research vessel in Baku

Status of fish populations around the Sangachal terminal in October 2014

Histopathology of Fish

Histopathological analyses were carried out on the gill and liver tissue of two species of fish caught at 6 stations in Sangachal Bay and 2 control stations - "clean station" in Neftchala district and "contaminated station" in the village of Zykh.

The report consists of a description and a quantitative assessment of various morphological parameters related to the structure of liver and liver cells. Only 15 individual fish of each species at each station were used in the analyses. In total, 8x15X2=240 individual fish were analyzed. Detailed presentation by views and stations is given below in the text. Histological material is presented in Tables 3 and 4, detailed description is given in the text.

- Report on gill tissue

The gill tissue represents two rows of gill lobes attached to the convex side of the gill arch. On the surface of these petals (lamellas of the first order) there are gill petals (lamellas of the second order). These lamellae of the second order represent a functional respiratory surface.

The following changes in the gill tissue were revealed in the studied fish:

- Hyperplasia of the respiratory epithelium of the lamellae of the second order (tissue growth as a result of an increase in the number of cells) and as the resulting fusion of the lamellae
- Terminal thickening of lamellae of the second order (growth of the respiratory epithelium of the apical part of the lamellae of the second order)
- Hyperplasia of interlamellar epithelium
- Bending of second-order lamellae
- Defoliation of the respiratory epithelium from the surface of the lamellae of the second order
- Aneurysm
- Telangiectasia
- Tearing of the respiratory epithelium and its exfoliation
- Uncontrolled hyperplasia of interlamellar epithelium

Station 1

Examination of the gill tissue of the Caspian sandsmelt showed that, although the tissue was normal (Fig. 1.3.1), almost all individuals had mildly expressed hyperplasia of the respiratory epithelium, terminal thickening of the lamellae of the second order (Fig. 1.3.2) and their curvature (Fig. 1.3.3). Defoliation of the respiratory epithelium was found in 5 individuals (Fig. 1.3.4). In 3 individuals, the fusion of the end sections of the lamellae of the second order was also recorded (Fig. 1.3.5). The thickness of normal lamellae of the second order was within 4.2-6.8 μm. The thickness of interlamellar epithelium is 5.2-7.2μm. With hyperplasia of lamellae of the second order, their thickness was 10.8-13.6 μm. The thickness of the end thickening was 14.- 25.6 μm.

In general, the gill tissue of gobies was normal (Fig. 1.3.6). However, some histopathological changes in the gills of gobies bore a common character with those of the Caspian sandsmelt. This is hyperplasia of lamellae of the second order (fig. 1.3.7), curvature and terminal thickening of lamellae of the second order (fig. 1.3.8). In 2 individuals, internal telangiectasia was diagnosed

(Fig. 1.3.9). The thickness of normal lamellae of the second order was 5.2-8.8 µm. The thickness of the interlamellar epithelium is 5.2 -8.4 µm. In hyperplasia, the thickness of second-order lamellae was 9.6-17.2 µm. The size of the final thickening of the secondary lamellae reached 29.2 µm.

Station 2

The gill tissue of the Caspian sandsmelt shows a normal structure, but it also had such deviations as hyperplasia of the lamellae of the second order, their terminal thickening, fusion and curvature (Fig. 1.3.10). These changes are present in almost all studied fish. The fact of exfoliation of the respiratory epithelium was revealed in 6 individuals. The thickness of normal lamellae of the second order fluctuated between 4.0-6.2 microns, interlamellar epithelium 5.2-7.2 microns. With hyperplasia of the respiratory epithelium, the thickness of the lamellae was within 9.2-15.2 µm.

In contrast to the Caspian sandsmelt, changes in the gill tissue of gobies are present in greater numbers. However, the gill tissue of gobies, in general, preserved its normal structure. The gills of gobies are characterized by the presence of hyperplasia of the respiratory epithelium and terminal thickening of lamellae in varying degrees of severity (Fig. 1.3.11). Telangiectasia was found in 4 individuals. Uncontrollable hyperplasia of the interlamellar epithelium (Fig. 1.3.12), aneurysm (Fig. 1.3.13) and telangiectasia (Fig. 1.3.14) are simultaneously noted in one and the same individual. The thickness of normal lamellae of the second order was 5.2 -7.2 µm. The thickness of interlamellar epithelium was 5.2-8.4 µm. With hyperplasia, the thickness of the lamellae of the second order fluctuated between 11.2 and 17.6 microns.

Station 3

The gill tissue of the Caspian sandsmelt was in normal condition. Such deviations as hyperplasia of lamellae of the second order and their terminal part are observed rarely and are weakly expressed. Fusion of the end sections of the secondary lamellae is revealed (fig. 1.3.15). The thickness of normal lamellae was 4.8-7.8 µm. The thickness of interlamellar epithelium is 4.0-8.4 µm.

The gill tissue of gobies, as well as the Caspian sandsmelt, was normal (Fig. 1.3.16). There is rare and mildly expressed hyperplasia of lamellae of the second order and their end section. The width of normal lamellae of the second order is 4.6 - 8.0 µm. The thickness of interlamellar epithelium was 5.2-8.0 µm.

Station 4

The study showed that the gill tissue of the Caspian sandsmelt is mostly normal. Along with that, a characteristic deviation for all fish of this group is a different degree of hyperplasia of the lamellae of the second order, in particular its apical part (fig. 1.3.17), the thickness of which reaches 41.6 µm. The thickness of lamellae of the second order in hyperplasia is within 10.6-15.8 microns, and normally 4.4-7.8 microns. The thickness of interlamellar thickening is 4,4 -7,8 µm.

The gill tissue of gobies, as well as the Caspian sandsmelt, is characterized by a normal structure. In addition to hyperplasia of lamellae of the second order and their apical part, revealed in almost all individuals, in one case a rupture and desquamation of the respiratory epithelium was detected (Fig. 1.3.18). In 6 individuals, exfoliation of the respiratory epithelium (Fig. 1.3.19) was noted, and in one of them, exfoliation of the respiratory epithelium and telangiectasia (Fig. 1.3.20) were observed simultaneously. The thickness of lamellae of the second order in hyperplasia was in the range of 10.2-25.4 microns, while normally it is 4.8-7.8 microns. The thickness of the interlamellar epithelium is 5.6 -8.8 µm.

Station 5

In all Caspian sandsmelts caught from this station, the gill tissue has a normal structure, except for the presence of mildly expressed hyperplasia of individual lamellae of the second order. The thickness of normal lamellae of the second order was 5.2-8.2 µm. The size of the end thickening was in the range of 17.2 -22.8 µm. The thickness of interlamellar epithelium is 5.6-7.6 µm.

A picture similar to the Caspian sandsmelts is also observed in gobies. In contrast to Caspian sandsmelts, hyperplasia of lamellae of the second order and their terminal areas is more pronounced in gobies (Fig. 1.3.21). Exfoliation of the respiratory epithelium was revealed in the gills of 5 individuals (Fig. 1.3.22). The thickness of the lamellae of the second order is 4.6-8.8 µm. Different degrees of lamellar hyperplasia are reflected in fluctuations in its thickness - 12.0-26.8 µm. The thickness of interlamellar thickening was 4.8 -7.8 µm.

Station 6

Gill tissue is generally normal in all Caspian sandsmelts. However, there are first and second order lamellae in different quantities, which have undergone hyperplasia. Normally, the thickness of lamellae of the second order is 4.8-9.6 µm, the interlamellar epithelium is 5.8-9.8 µm. With hyperplasia of the lamellae of the first and second order, their thickness varies from 12.0 to 15.2 and from 15.2 to 17.4 µm, respectively. The thickness of the apical part of the lamellae of the second order when they are thickened is within 12.4-24.6 µm. Defoliation of the respiratory epithelium was found in 4 individuals (Fig. 1.3.23).

The gill tissue of the majority of gobies, as well as Caspian sandsmelts, is characterized, along with the normal structure, by the presence of hyperplasia of primary (fig. 1.3.24) and secondary lamellae of varying degrees of expression (fig. 1.3.25). In 5 cases, the fact of exfoliation of the respiratory epithelium was noted. The thickness of normal lamellae of the second order is 5.4-8.8 µm, with hyperplasia it was 12.0-16.8 µm. The thickness of interlamellar epithelium is 7.2-8.8 µm, with hyperplasia -13.2-37.6 µm. The thickness of the apical part of the lamellae of the second order varies between 13.2 and 27.2 µm when they are thickened.

Station 7

In the gill tissue of Caspian sandsmelts from this station, along with the normal organized structure, lamellae of the first and second, subjected to hyperplasia to varying degrees, are observed. There is a fusion of lamellae of the second order (fig. 1.3.26). The thickness of the end section of lamellae of the second order in hyperplasia is 12.4-16.8 µm . The thickness of normal lamellae of the second order is within 5.2-8.6 µm. With hyperplasia from 12.0 to 17.6 µm. The thickness of the interlamellar epithelium is 5.2-8.4 µm, with hyperplasia from 16.0 to 21.6 µm. In 5 individuals, exfoliation of the respiratory epithelium is observed. Multiple aneurysms were noted in 1 person (Fig. 1.3.27). In 2 individuals, rupture and desquamation of the respiratory epithelium was detected.

The picture of the state of the gills is similar to that of the gobies. Here, as in Caspian sandsmelts from this station, hyperplasia of lamellae of the first and second order is found (Fig. 1.3.28). The curvature and terminal thickening of the lamellae of the second order are noted (Fig. 1.3.29). In 1 individual, the bifurcation of the terminal part of the lamella of the second order was detected (Fig. 1.3.30). Defoliation of the respiratory epithelium is observed in 6 individuals (Fig. 1.3.31). Normally, the thickness of lamellae of the second order is 6.0-8.2 µm. With hyperplasia, these values fluctuate within 10.8-19.6 µm. The thickness of interlamellar thickening is 5.8-8.2 µm, with hyperplasia 13.2-23.4 µm.

Station 8

The gill tissue is normal in Caspian sandsmelts caught from 8 stations. The thickness of the lamellae of the second order is 4.0 -7.2 μm. The thickness of interlamellar epithelium is 5.2 -8.6 μm. Endless thickening of secondary lamellae is rare.

In gobies, as in Caspian sandsmelts, the gill tissue is normal. The thickness of the lamellae of the second order is 5.6 - 8.6 μm. The thickness of interlamellar thickening is 5.6-8.8μm. Terminal thickening in gobies, as well as in Caspian sandsmelts, is rarely found (Fig. 1.3.32).

So, as a result of the research, the following morphological changes were revealed in the gill tissue of Caspian sandsmelts and gobies. Hyperplasia of lamellae of the second order and their apical part, curvature of lamellae of the second order, exfoliation of the respiratory epithelium and telangiectasia were found in fish caught from station 1. In Caspian sandsmelts and gobies from station 2, apart from hyperplasia of lamellae of the second order, their terminal thickening and curvature, exfoliation of respiratory epithelium, telangiectasia, aneurysm, uncontrolled hyperplasia of interlamellar epithelium were observed. In the gill tissue of fish with station 3, in general, apart from the rare terminal thickened lamellae of the second order, there were no morphological shifts. In gobies from station 4, in addition to hyperplasia of lamellae of the second order and their terminal thickening, which also occurred in Caspian sandsmelts, exfoliation of the respiratory epithelium, rupture of the respiratory epithelium and its exfoliation, telangiectasia were found. Hyperplasia of lamellae of the second order and their apical part, exfoliation of the respiratory epithelium were observed in gobies from station 5. Morphological shifts were absent in the gills of the Caspian sandsmelts from this station, except for the terminal thickening of the petals. Epithelial lamellae of the first and second order were subject to hyperplasia in arteries and gobies from station 6. In addition, exfoliation of the respiratory epithelium was noted in both species. Hyperplasia of the epithelium of lamellae of the first and second order was common for Caspian sandsmelts and gobies from the 7th (contaminated) station. In addition, rupture and desquamation of the respiratory epithelium and aneurysm were noted in Caspian sandsmelts, and exfoliation of the respiratory epithelium in gobies. In the gill tissue of fish from the 8th station, which was the control station, no morphological changes were detected, except for the rare terminal thickening of the lamellae of the second order.

A comparative analysis of the condition of the gills of Caspian sandsmelts and gobies allowed us to establish that the revealed morphological shifts vary in frequency of occurrence and degree of damage. The most frequently encountered changes were proliferative type changes, such as hyperplasia of the respiratory epithelium and the epithelium of the lamellae of the first order. A critical assessment of the gill tissue will be conducted based on the condition of the gill epithelium and the number of identified abnormalities.

The gill epithelium of Caspian sandsmelts and gobies caught from station 3 and 8 (control station) was in normal condition.

In the gill tissue of Caspian sandsmelts and gobies from stations 1, 2, 4 and 5, only respiratory epithelium hyperplasia was revealed, which was weakly expressed in Caspian sandsmelts. The degree of manifestation of morphological shifts varied depending on the species and the place of capture. Thus, in gobies from stations 1, 2 and 4, the largest number of disorders was found: thickening of the apical part of lamellae of the second order, their curvature, exfoliation of the respiratory epithelium, rupture and desquamation of the respiratory epithelium, aneurysm, telangiectasia and uncontrolled hyperplasia of the epithelium of the lamellae of the first order, while in Caspian sandsmelts only thickening of the apical part of lamellae of the second order, their curvature and exfoliation of the respiratory epithelium were recorded. It should be noted that in

Caspian sandsmelts from station 5 the state of the gill epithelium was normal, and in gobies, in addition to hyperplasia of lamellae of the second order, there was only thickening terminal section of the lamellae and exfoliation of the respiratory epithelium.

Proliferative changes affect the epithelium of lamellae of the first and second order in Caspian sandsmelts and gobies caught from the 6th and 7th (contaminated) stations. The thickness of their interlamellar epithelium with hyperplasia is 2-3 times greater than the thickness of normal epithelium. In addition, detachment of the respiratory epithelium was found in fish from these stations, and rupture and exfoliation of the respiratory epithelium and aneurism in the Caspian sandsmelts from station 7.

Thus, on the basis of the research, it can be concluded that the histological picture of the gills of Caspian sandsmelts and gobies from the 3rd station is normal and corresponds to that of the Caspian sandsmelts and gobies from the 8th station, where the cleanest part of the sea is located. The nature and quantity of morphological shifts in the gill tissue of Caspian sandsmelts and gobies from stations 1, 2, 4 and 7 indicate water pollution with which the gills of the fish under study were in constant contact. The condition of the gill tissue of Caspian sandsmelts and gobies from stations 5 and 6 indicates that there are pollutants in their environment, however, the gills of these fish were exposed to their negative influence to a lesser extent.

It is known that changes of the proliferative type, as well as exfoliation of the respiratory epithelium, are a response based on compensatory and protective mechanisms. These changes are reversible. In the absence of adverse environmental factors, the gill tissue is restored to its initial state. Reversible, but serious in nature are rupture and desquamation of the respiratory epithelium, uncontrolled hyperplasia of the primary epithelium. Changes related to the circulatory system, some of which are aneurysm and telangiectasia, are also serious but reversible disorders. Restoration of structure and function is possible, but much more difficult than after damage to the epithelium.

Table 1: Average values of the morphometric parameters of the gills at the norm and with hyperplasia (M±m) Stations 1 – 6 Sangachal bay; St. 7 – contaminated; St. 8 – clean

Station	1	2	3	4	5	6	7	8
Respiratory epithelium	5.7±1.1 n = 5	5.4±0.6 n = 8	6.0±0.4 n = 15	5.9±1.0 n = 6	6.4±0.5 n = 15	6.6±0.8 n = 9	6.8±0.8 n = 8	6.2±0.1 n = 15
Hyperplasia respiratory epithelium	10.6±1.0 n = 10 ***	10.5±1.4 n = 7 **		11.8±1.5 n = 9 ***		13±0.6 n = 5 ***	13.7±1.9 n = 7 ***	
Epithelium interlamellar space	7.1±0.5 n = 15	6.4±0.4 n = 15	6.3±0.5 n=15	6.5±0.5 n=15	6.9±0.5 n=15	7.8±0.7 n = 11	7.0±2.4 n = 9	7.1±0.5 n=15
Hyperplasia epithelium space						16.6±4.2 n = 4 ***	18.3±2.9 n = 6 ***	

Table 2: Mean values of the morphometric parameters of the gills of gobies in normal conditions and with hyperplasia (M±m)

Station	1	2	3	4	5	6	7	8
Respiratory epithelium	6.3±0.7 n = 5	6.1±0.3 n = 8	6.5±0.3 n = 15	6.2±0.6 n = 4	6.4±0.5 n = 9	6.6±0.4 n = 8	7.4±0.4 n = 6	7.2±0.3 n = 15
Hyperplasia respiratory epithelium	14.7±1.4 n = 10 ***	14.4±0.8 n = 7 ***		16.4±1.9 n = 11 ***	17.9±2.3 n = 6 ***	14.0±0.6 n = 7 ***	15±1.0 n = 9 ***	
Epithelium interlamellar space	7.2±0.3 n = 15	7.1±0.3 n = 15	6.6±0.3 n = 15	6.7±0.2 n = 15	6.7±0.3 n = 15	7.5±0.4 n = 7	8.0±0.2 n = 6	6.8±0.3 n = 15
Hyperplasia epithelium space						22.6±2.7 n = 8 ***	17.3±1.2 n = 9 ***	
Note: *** - p < 0.001 Values are significantly different from the control station (station 8)								

Table 3: Photos

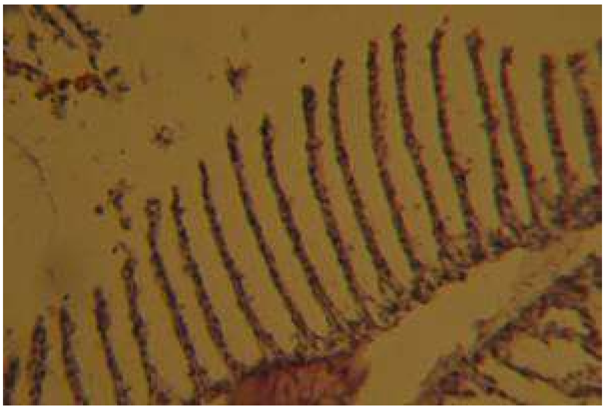
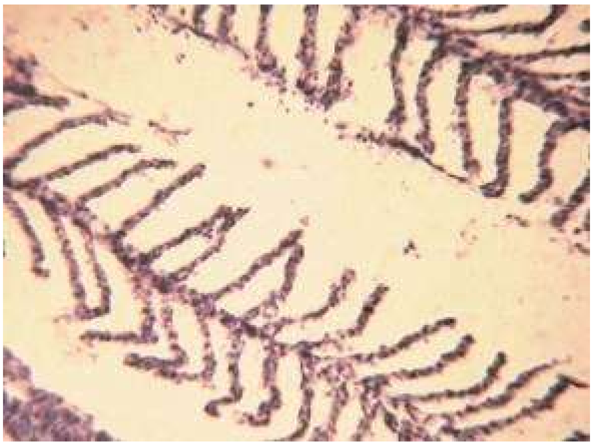
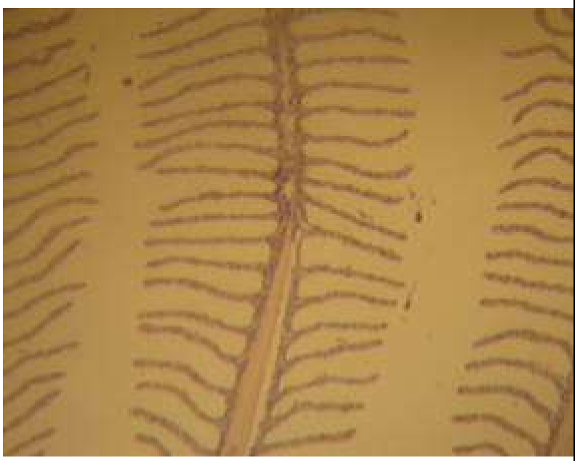
 Fig. 1.3.1 Gill tissue of the Caspian sandsmelt is normal (x 312.5)	 Fig. 1.3.2 Weak hyperplasia of secondary lamellae and their terminal thickening in Caspian sandsmelt (x 625)
 Fig. 1.3.3 And the curvature of the secondary lamellae of the Caspian sandsmelt (x 625)	 Fig. 1.3. 4 Defoliation of the respiratory epithelium of the Caspian sandsmelt (x625)
 Fig. 1.3.5 Terminal thickening of lamellae of the second order and their fusion of the Caspian sandsmelt (x312,5)	 Fig. 1.3.6 Gill tissue of a goby is normal (x125)

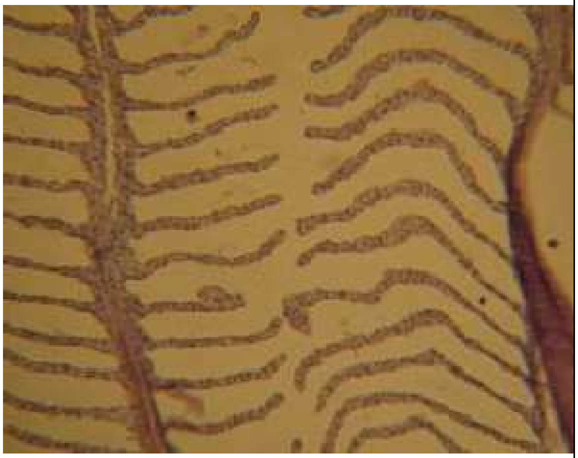
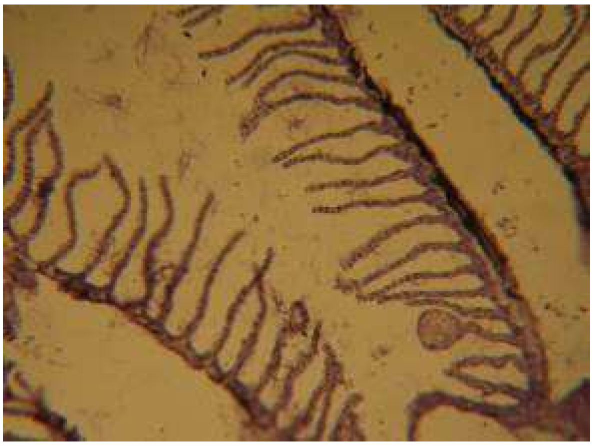
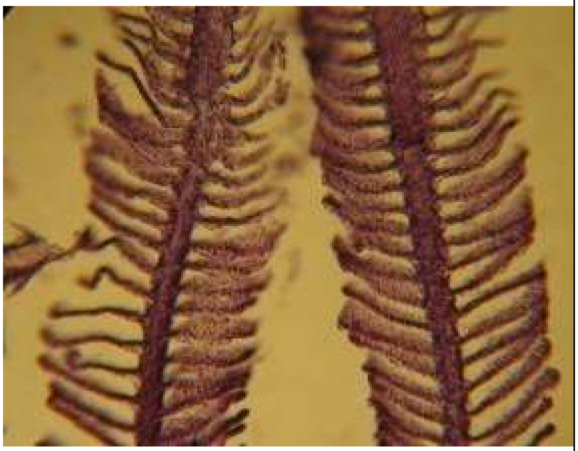
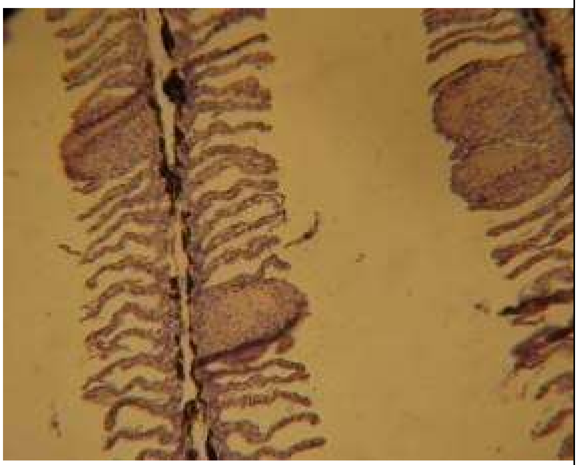
 Fig. 1.3.7 Hyperplasia of lamellae of the second order in a goby (x625)	 Fig. 1.3.8 Hyperplasia, terminal thickening and curvature of lamellae of the second order in a goby (x312.5)
 Fig. 1.3.9 Telangiectasia in a goby (x312.5)	 Fig. 1.3. 10 Hyperplasia, terminal thickening and curvature of lamellae of the second order of the Caspian sandsmelt (x 312.5)
 Fig. 1.3. 11. Hyperplasia of lamellae of the second order in a goby (x 625)	 Fig. 1.3. 12. Uncontrolled hyperplasia of the interlamellar epithelium in a goby (x 312.5)

	
Fig. 1.3. 13. Aneurysm in a goby (x 625)	Fig. 1.3. 14 Telangiectasia and uncontrolled hyperplasia of the interlamellar epithelium in a goby (x 625)

Liver Tissue Report

Hepatic tissue is mainly represented by hepatocytes-parenchymatous cells of the liver. Almost all the various physiological functions of the liver are performed by these cells. Hepatocyte is a polygonal liver cell with a round nucleus. Binuclear cells are occasionally found. The sizes of liver cells, as is known, vary widely depending on the function. Also, their cores have a large variation in size.

The following disorders were found in the liver tissue:

- Accumulation of formed blood elements in the vessels of the liver (blood stagnation in the liver).
- The presence of melanomacrophage centers in the liver tissue. The frequency of occurrence and the size of macrophages are directly proportional to the severity of liver tissue changes.
- Vacuolization of hepatocytes by degree of severity is ranked as follows: insignificant vacuolization of hepatocytes, hydropic vacuolization and a more severe form - fatty dystrophy of the liver.

The detected violations were grouped as follows:

- Reversible minor violations. Stagnation of blood, the presence of single macrophages, insignificant and hydropic vacuolization of hepatocytes.
- Serious violations. The presence of a large number of macrophages, fatty dystrophy of the liver.

Station 1

Liver tissue of all Caspian sandsmelts preserves the normal structure, although nuclear polymorphism is generally observed (Fig. 2.3.1). The presence of melanomacrophage centers was noted in 7 individuals (Fig. 2.3.2). Insignificant cytoplasmic vacuolization occurs in 6 individuals (Fig. 2.3.3). The size of the nuclei was in the range of 3.6-7.8 µm, and the size of the hepatocytes was from 8 to 18 µm.

Liver tissue of all studied gobies preserves normal structure (fig. 2.3.4). Accumulation of formed elements of the blood in the vessels of the liver is observed in almost half of the individuals (Fig. 2.3.5). In 5 studied gobies, slight vacuolization of the cytoplasm was noted (Fig. 2.3.6), and in 6 individuals – hydropic vacuolization of the tissue (Fig. 2.3.7). Fat degeneration of the liver is noted in two cases (Fig. 2.3.8). The sizes of the nuclei of hepatocytes ranged from 3.2 to 6.8 μm, and the sizes of the hepatocytes themselves ranged from 9.8 to 16.2 μm.

Station 2

The presence of vacuoles is noted in the liver tissue of all *Caspian sandsmelts* (Fig. 2.3.9). A slight vacuolization of hepatocytes is observed in 4 individuals (Fig. 2.3.10). The size of the nuclei was between 3.8 and 8.2 μm, and the size of the hepatocytes was between 9.6 and 18.2 μm.

Hydropic vacuolization is noted in the liver tissue of almost half of the gobies. A stronger form of this pathology was found in 6 individuals - fatty degeneration of liver tissue (fig. 2.3.11). Melanomacrophages were noted in 7 individuals. In general, the liver tissue of all fish preserves its normal structure. The sizes of the nuclei of hepatocytes ranged from 3.2 to 7.2 μm, and the sizes of the hepatocytes themselves ranged from 12.2 to 20.6 μm.

Station 3

Liver tissue of all Caspian sandsmelts preserves its normal structure. Only in two cases there is the accumulation of a large number of macrophages (fig. 2.3.12) and in 4 individuals blood stagnation in vessels (fig. 2.3.13). The sizes of the nuclei varied between 3.2 -7.2, and the bodies themselves from 8.2 to 16.6 μm.

Hydropic vacuolization of hepatocytes is noted in the liver tissue of only 2 gobies. Blood stagnation in vessels occurs in 5 individuals. The size of nuclei is 3.6-6 μm, hepatocytes are 10.8-16.2 μm.

Station 4

In the majority of Caspian sandsmelts, insignificant vacuolization of hepatocytes is observed in the liver tissue. In two cases, the presence of single macrophages (fig. 2.3.14) and stagnation of blood cells in the vessels of the liver is noted. The size of nuclei is 3.2-7.8 μm, hepatocytes are 10.2-18.8 μm.

In the liver tissue of most gobies, a stronger form of this pathology was observed in 4 individuals - hydropic vacuolization. Half of the individuals had blood stagnation in the vessels of the liver. The sizes of the nuclei varied between 3.8 and 6.2, and the bodies themselves from 8.8 to 16 μm.

Station 5

Weak vacuolization of hepatocytes with preservation of the normal structure of the liver tissue is noted in all Caspian sandsmelts (Fig. 2.3.15). Single melanomacrophages were detected in two individuals. In one case, the accumulation of a large number of macrophages was noted. Blood stagnation in the vessels of the liver is noted in 4 individuals. The sizes of nuclei were within 2.4-7.8 μm, and hepatocytes from 10 to 20.8 μm.

In half of the gobies, small or large vacuoles were found in the hepatocytes, in one individual - insignificant cytoplasmic vacuolization. Blood stagnation in the vessels of the liver was found in 5 fish (fig. 2.3.16). The sizes of the nuclei varied between 2.8 -7.2, and the bodies themselves from 8.2 to 16 μm.

Station 6

The liver tissue of all Caspian sandsmelts has a normal structure, sometimes small cytoplasmic vacuoles are noted. Single melanomacrophages are found in only two individuals and blood stagnation in four individuals. Nuclei were in the range of 2.8-8 μm, hepatocytes – 8-18 μm.

Large or small cytoplasmic vacuoles were observed in the cytoplasm of the liver tissue of the majority of gobies (fig. 2.3.17). Hydropic vacuolization was noted in 4 individuals and blood cell stagnation in vessels in 6 individuals. Overall the issue has a normal structure. Nuclei were from 2.8 to 8 μm, hepatocytes from 8.2 to 18 μm.

Station 7

The presence of melanomacrophage centers (fig. 2.3.18) and blood stagnation in 5 individuals is noted in the liver tissue of 8 Caspian sandsmelts. Hypertrophied nuclei (up to 12 μm) and hepatocytes (up to 30 μm) are found in most fish. In general, the size of nuclei fluctuated between 4.2-8.2 μm, and hepatocytes from 9.2 to 20.4 μm.

In 8 gobies (fig. 2.3.19), a stronger form of this pathological fatty degeneration of liver tissue is observed in two individuals. Blood stagnation in the vessels of the liver is noted in 10 individuals (Fig. 2.3.20). The size of nuclei varied between 3.2-6.2 μm, the size of hepatocytes from 7.2 to 18 μm.

Station 8

In general, the liver tissue of all Caspian sandsmelts had a structure corresponding to the norm (Fig. 2.3.21). Blood stagnation in liver vessels was noted in 4 individuals and macrophages were detected in only one case. The sizes of nuclei were within 3.2-8 μm, hepatocytes 9.2-18 μm.

Hydropic vacuolization was found in the liver tissue of 2 gobies and accumulation of blood cells in the vessels of the liver in 5 individuals (Fig. 2.3.22). In general, the liver tissue of all gobies preserved its normal structure. The sizes of nuclei were from 2.8 to 6 μm, the sizes of hepatocytes from 9 to 14 μm.

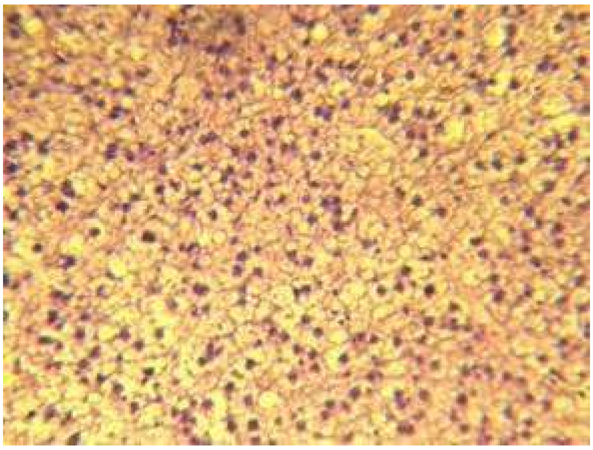
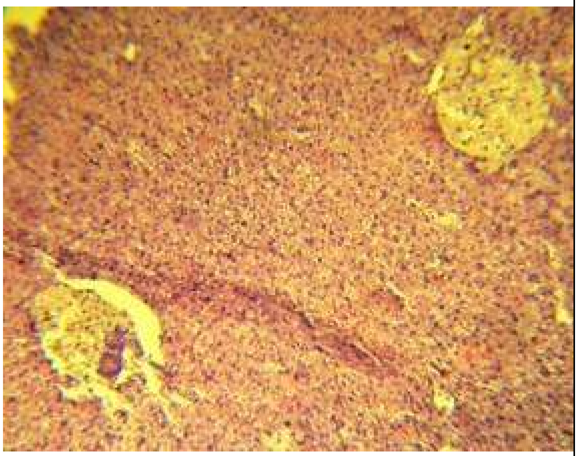
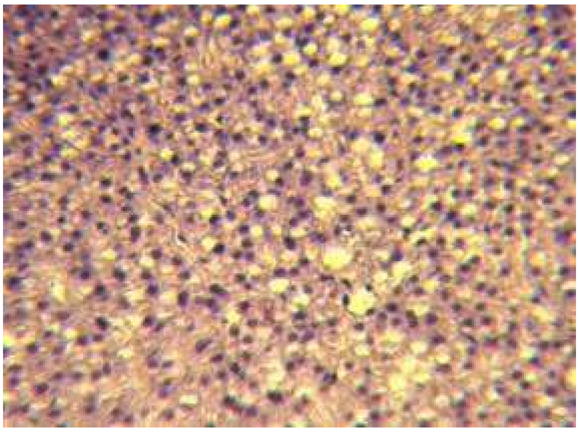
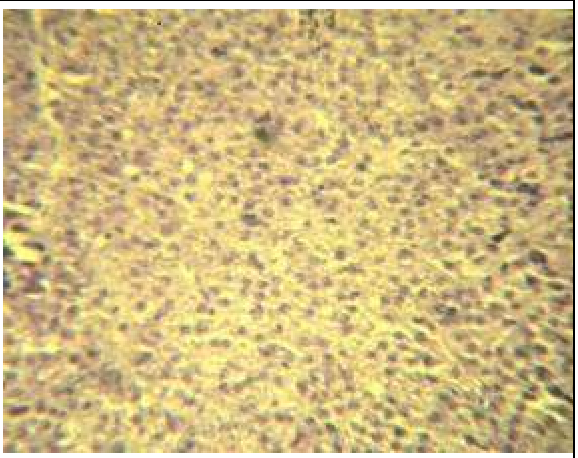
The following histological changes were used as criteria for comparative assessment of liver tissue of fish caught from 8 stations: stagnation of formed blood elements in liver vessels, presence of melanomacrophages, vacuolization of cytoplasm (insignificant, hydropic) and fatty tissue degeneration.

The highest occurrence of accumulation of blood cells in the vessels of the liver was in fish caught from stations I, II, IV, VI and VII. It should be noted that when comparing the revealed shifts of the liver tissue, the species specificity of the fish can be traced. Thus, melanomacrophage centers are most often found in Caspian sandsmelts from stations I, II and VII, although single macrophages in the liver tissue are noted in gobies caught from the same stations. For gobies, the most characteristic pathology is vacuolization of hepatocytes of a small or large degree. Negligible vacuolization of hepatocytes marked in gobies from stations I and V, and in Caspian sandsmelts from stations I, II and IV. A more serious form of vacuolization - hydropic vacuolization occurs in gobies from stations I, II, IV, VI and VII. In other individuals, the indicated changes are observed in isolated cases.

Fatty degeneration of liver tissue (the most severe of the pathologies identified) was detected in gobies caught from stations I, II and VII. But in fish from stations I and VII, this pathology does not have a mass character, and only in gobies from station II, fatty dystrophy of the liver is observed in almost half of the gobies.

Analyzing the data, the following conclusions can be drawn. The largest changes in liver tissue were observed in fish caught from stations I, II and VII. At the same time, in fish caught from station II, serious liver disorders are found in a larger number of individuals (fatty dystrophy is noted in almost half of gobies). Relatively less histological changes are observed in the liver tissue of fish from stations IV and VI. The lowest number of pathologies is noted in the liver tissue of fish caught from stations III, V and VIII. It should be noted that, in general, the liver of all studied fish preserves the normal trabecular structure and all the detected changes in the liver tissue are reversible and have a protective-adaptive nature.

Table 4: Photos

 Fig. 2.3.1 The liver of the Caspian sandsmelt is normal (x625)	 Fig. 2.3.2. Macrophages in the liver of Caspian sandsmelt (x312.5)
 Fig. 2.3.3. Negligible vacuolization in Caspian sandsmelt's liver (x625)	 Fig. 2.3.4 Normal goby liver (x625)

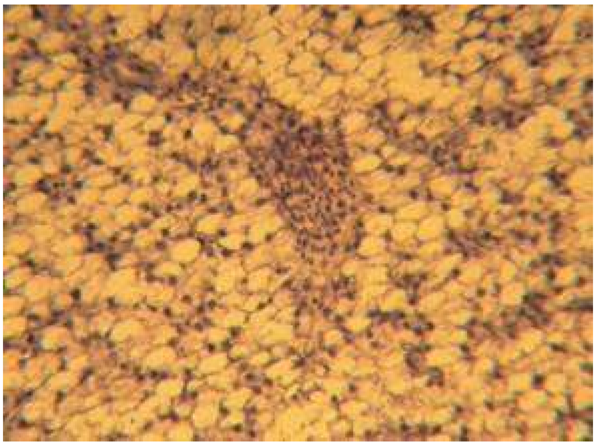


Fig. 2.3.5. Stasis of blood in the vessels of the liver of gobies (x625)

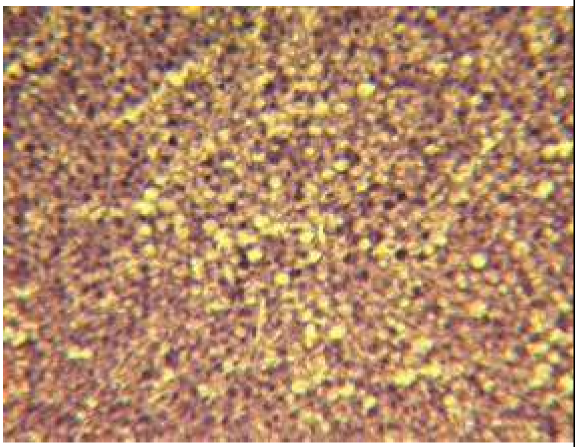


Fig. 2.3.6. Insignificant vacuolization in the liver of gobies (x625)

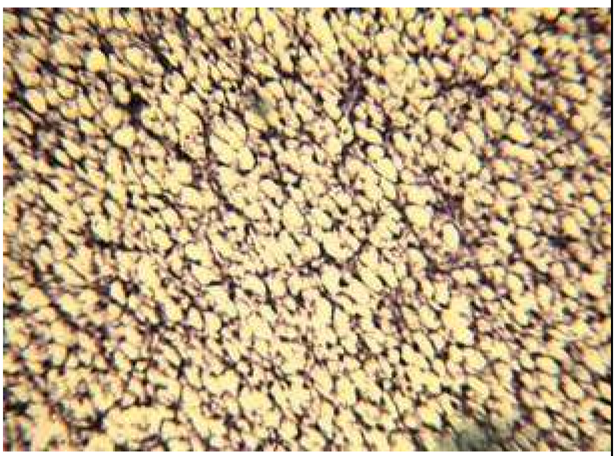


Fig. 2.3.7. Hydropic vacuolization in the liver of gobies (x625)

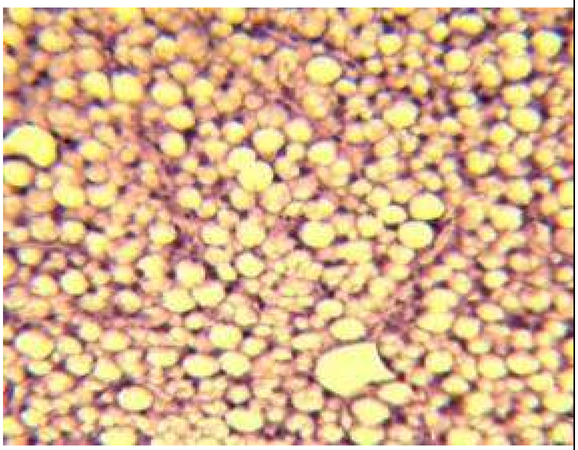


Fig. 2.3.8. Adipose regeneration of hepatocytes in gobies (x625)

Genotoxic studies. Micronucleus test

The micronucleus test is a mutagenicity test system used to detect chemicals that induce the formation of such small cytoplasmic DNA fragments as micronuclei in the cytoplasm of cells.

Micronuclei are markers of the genotoxic effect of various substances, as well as indicators of chromosomal instability, since the frequency of micronuclei is higher in tumor cells and cells with a defective DNA damage repair system or destruction of the cell cycle checkpoint mechanism.

The relevance of studies, including the identification and registration of cells that have micronuclei in their composition, is explained by the fact that these structures are often found in various diseases, and as a result of changing the conditions of the organism's existence. The micronucleus test is very much in demand, as it allows you to determine the ability of a chemical substance to induce chromosomal damage. Registration of cells containing micronuclei and other pathological nuclei is a practically significant and highly informative diagnostic indicator of genetic abnormalities.

The popularity of the micronuclear test can be explained by the fact that it is non-invasive, quick, easy to perform and store biomaterial.

Micronuclei (MN) are acentric chromosomal fragments and separate whole chromosomes "lost" during mitosis. These "losses" may be the result of cell apoptosis and nuclear destruction. They may also occur when the cell is freed from excess chromatin, formed after the mutation effect.

MN occur in the studied cells not only after a negative impact on the body, but also in healthy individuals. Normally, such pathological formations make up no more than **5%.** In pathological conditions, the level of MN increases. Usually, most researchers look at 500 to 2000 cells.

In addition to MN, this test allows you to detect other structural changes in cells:

- Chromatinolysis – leaching of chromatin;
- Karyolysis – dissolving part of the nucleus;
- Karyorrhexis - the breakdown of chromatin in the nucleus into fragments when preserving the nuclear envelope;
- Hypochromasia – destruction of hemoglobin in erythrocytes.

Such disturbances in the structure of the cell as condensation of the nucleus (karyopyknosis) with its subsequent dissolution (karyolysis) or disintegration into condensed lumps (karyorrhexis) can be considered as stages preceding apoptosis (destruction) of cells. Normally, the amount of such pathologies in the body should not exceed 5%.

Micronuclei were practically not detected during microscopy of the obtained preparations, all pathologies were of a more serious nature: karyorrhexis, chromatinolysis, hypochromasia, deformation of nuclei. As you know, the more cells with such damage, the less cells with micronuclei. After statistical data processing, the obtained results were summarised in the table.

Table 5: Percentage of micronuclei and other pathologies per 1000 erythrocytes. Fish monitoring in Sangachal Bay, October 2014

Fish	Average amount of micronuclei and other pathologies per 1000 erythrocytes															
	Station number															
	St.1		St.2		St.3		St.4		St.5		St.6		St.7		St.8	
	м/я	п/я	м/я	п/я	м/я	п/я	м/я	п/я	м/я	п/я	м/я	п/я	м/я	п/я	м/я	п/я
Caspian sand-smelt	0	20.5	0	33.6	2.1	10.3	0	19.14	3.1	18.2	1.0	9.05	0.3	33.61	2.87	0.5
% Pathology	**20.5±1.27**		**33.6±7.83**		**12.42±2.17**		**19.14±1.37**		**21.28±3.41**		**10.05±0.57**		**33.91±6.4**		**3.37±0.29**	
Gobies	3.0	13.3	3.87	6.5	1.0	13.6	1.68	6.97	0	47.2	0	40.88	0	48.06	2.15	0
% pathology	16.26±2.63		10.34±0.94		14.55±2.03		8.85±1.26		47.18±3.02		40.88±2.57		48.06±3.87		2.15±0.46	

Caspian sandsmelt

General levels of nuclear pathology at the Sangachal stations ranged from 9.05 (station 6) to 33.6 (station 2) units per 100 erythrocytes, averaging 18.46. This indicator turned out to be lower than that of fish from the "contaminated station" in Zykh settlement (33.61). The lowest level of nuclear pathologies was observed in ethers from the "clean station" in Neftchala (0.5).

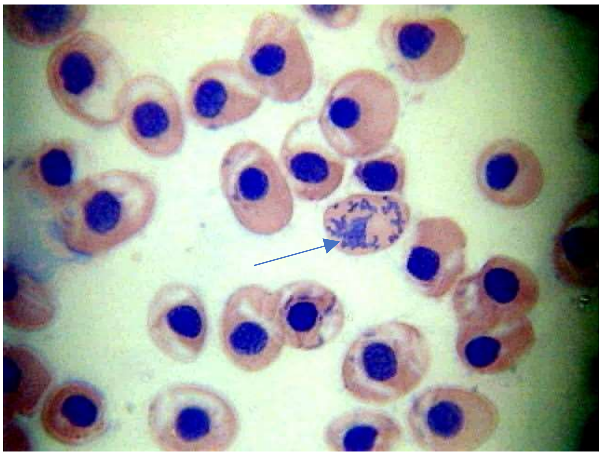
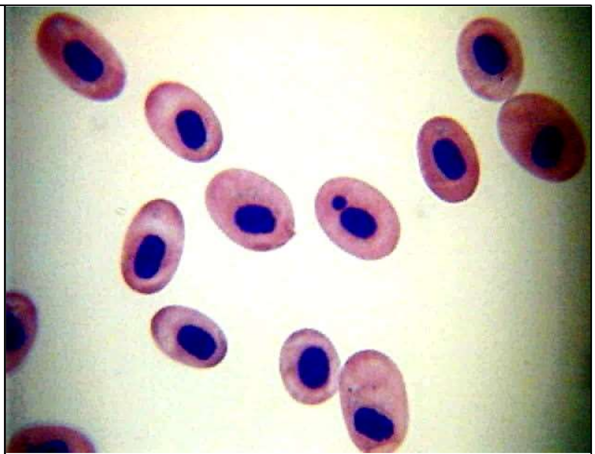
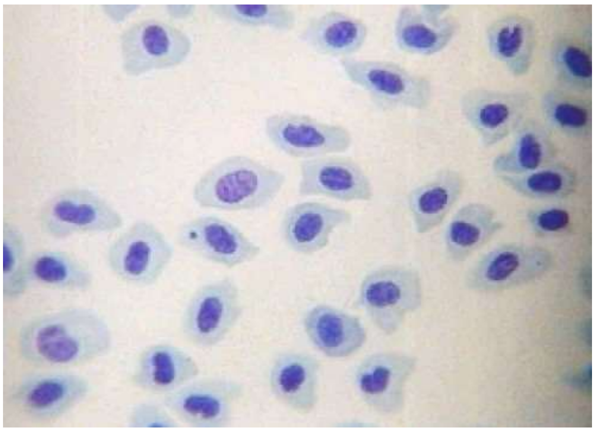
The total number of micronuclei and nuclear pathologies in Caspian sandsmelts at the Sangachal stations ranged from 10.05 (station 6) to 33.6 (station 2) units per 100 erythrocytes, averaging 19.50. This indicator turned out to be lower than that of fish from the "contaminated station" in Zykh settlement (33.91). The lowest level of nuclear pathologies was observed in ethers from the "clean station" in Neftchala (3.37).

The observed indicators of the levels of micronuclei and pathologies of the nuclei in Caspian sandsmelts were higher than the corresponding values obtained during the study of the Sangachal Bay in the fall of 2008.

Gobies

The average values of the number of micronuclei determined on gobies at Sangachal stations ranged from 0 to 3.87 units per 100 erythrocytes, averaging 1.59. Compared to stations 3, 5 and 6, the highest values were calculated for fish from stations 1 (3.0), 2 - (3.87), 4 - (1.68). The average levels measured on fish from the "clean station" in Neftchala were higher (2.15), and on the contrary, they were lower (0.0) for fish from the "polluted station" in Zykh compared to the values of some Sangachal stations.

Table 6: Pathology of nuclear and erythrocyte cells

 Goby. Disintegration of the nucleus and hemoglobin.	 Goby. Micronucleus, breakdown of hemoglobin and displacement of the nucleus.
 Caspian sandsmelt. Micronucleus, nucleus decay, cell shape change.	 Caspian sandsmelt. Intussusception.

List of Ecotoxicology Laboratory works on the influence of pollution on Aquatic organisms

1. Kasimov R.Yu., Rustamova Sh.A., Dzhafarov A.I., Perelygin V.V., Gasanov G.I. Changes in physical and chemical parameters and some physiological indicators of sturgeon larvae and juveniles in different conditions of oil pollution. // В сб. “Biophys. aspects of pollution of the biosphere”. Moscow, publishing house "Nauka", 1973, p. 43-45.

2. Kasimov R.Yu., Rustamova Sh.A., Perelygin V.V. Influence of chemical reagents used in the oil industry on some biophysical parameters of sturgeon juveniles. // В сб. “Biophys. aspects of pollution of the biosphere”. Moscow, publishing house "Nauka", 1973, p. 129 -132.

3. Kasimov R.Yu., Rustamova Sh.A., Vodovozova M.A. Influence of different oil concentrations on hematological indicators of young sturgeons. // В "Problems of water toxicology". Petrozavodsk, 1975. Vol. 2, p. 113-114.

4. Kasimov R.Yu. Experimental data on the effect of oil on the hypothalamic-pituitary system of young sturgeon. // В "Problems of water toxicology". Petrozavodsk, 1975. Vol. 2, p. 119-122.

5. Kasimov R.Yu. Modification of conditional reflex activity of young sturgeon fish under the influence of various types of oil. // Quick. XII Vs. Physiologist at the congress. I.P. Pavlov Society, Tbilisi, 1974. Vol. 3. p. 285 – 286.

6. Kasimov R.Yu. The influence of oil pollution on the most important physiological functions of fish. // Izvestiya AS AzSSR, series of biological sciences. 1977. No. 3, p. 105-110.

7. Kasimov R.Yu., Abbasov R.Yu., Palatnikov G.M., Ismailov A.A. The influence of petroleum toxicants on the functional activity of the visual analyzer and some physiological and biochemical indicators of the blood of fish. // Astrakhan, 1979. vol. 1, p. 18 – 20.

8. Kasimov R.Yu., Huseynov T.I., Rustamova Sh.A., Efendiev N.G. Studying the harmless concentration of oil-containing stratified sand of marine deposits of the Caspian Sea for fish and feed organisms. // Izvestiya AS AzSSR, series of biological sciences. 1979. No. 4. p. 31-38.

9. Kasimov R.Yu., Ismailov A.A., Tagiyev Sh.K. Electrophysiological characteristics of the visual and olfactory systems of fish depending on the time spent in a polluted oil environment. // Izvestiya AS AzSSR, series of biological sciences. 1980. No. 6, p. 42-46.

10. Kasimov R.Yu., Suleymanov A.B. Methodical guidelines for determining sources, estimating the amount and composition of pollutants in the water environment in the oil and gas fields of the Caspian Sea and methods of their cleaning. // Baku. 1981. p. 103.

11. Kasimov R.Yu. The influence of drilling mud before and after its thermal treatment on the most important physiological functions of fish. // Izvestiya AS AzSSR, series of biological sciences. 1982. No. 4. p. 107-113.

12. Suleimanov A.B., Kasimov R.Yu. Ways of reducing the toxicity of drilling mud and its influence on fish and invertebrates. // Proceedings of the State Oceanographic Institute. M., 1983. issue 167, p. 70-78.

13. Kasimov R.Yu., Kryuchkov V.I., Gireev N.M. Study of the influence of КССБ and Окзиза on the life of hydrobionts with the aim of establishing the PDC. // Сб. "MAN and BIOSPHERE" (MaB UNESCO) Azerbaijan National Committee Proceedings. 1986. p. 116-124.

14. Kasimov R.Yu., Kryuchkov V.I., Dzhabarov M.I. Influence of oil of different concentration on ECG, breathing and amino acid composition of muscles of thorn and carp. // Izvestiya AS AzSSR, series of biological sciences, Baku. 1988, No. 3, p. 84-94.

15. Kasimov R.Yu., Palatnikov G.M. Study of the influence of various pollutants of the aquatic environment on ichthyofauna using methods of neurophysiology. // 1st International scientific and technical conference. "Modern problems of ecology, methods and means of their solutions".

Baku, 1994. p. 170.

16. Palatnikov G.M., Raghimova N.G. Kasimov R.Yu. Rustamov E.K. Abbasov R.Yu. Influence of oil pollution on olfactory behavior and morphofunctional characteristics of the olfactory bulb of sturgeon. // 2nd Russian meeting on the problems of fish. Borok. 1996 p. 81.

17. Palatnikov GM, Ragimova NG Rustamov EK Changes of smell sensitivities and olfactory bulb structures of sturgeons under the influence of crude oil.// ISOT XII AchemS XIX San Diego, USA, 1997. p. 80.

18. Bickham JW, Palatnikov GM, Mekhtiev AA, Row G., Rogers J., Kasimov R. Acute and genotoxic effects of Baku harbor sediment on Russian Sturgeon, *Acipenser gueldenstaedti //* Bull. Environmental Contamination and Toxicology, (1998), vol. 61, p. 512-518.

19. Kasimov R.Yu., Raghimova N.G., Rustamov E.K. Influence of oil pollution on the fish of the Caspian Sea. I. Early stages of development. Izvestiya AS AzSSR, series of biological sciences, 2000, No. 5-6, p. 138-151

20. Rustamov E.K., Kasimov R.Yu., Raghimova N.G. Influence of oil pollution on the fish of the Caspian Sea. II. Later stages of development. Izvestiya AS AzSSR, series of biological sciences, 2000, No. 5-6, p. 183-191

21. Bickham JW, Matson CW, Islamzadey A., Row GT, Donnelly RC, Swartz CD, Rogers WJ, Autenrieth RL, McDonald TJ, Palatnikov GM, Politov D., Wickliffe JK, Mekhtiev AA, Kasimov R. Editorial: The unknown. environmental tragedy in Sumgait, Azerbaijan. // Ecotoxicology, (2003), No. 12, p. 507-510.

22. Swartz CD, Donnelly RC, Palatnikov GM, Islamzadey A., Row GT, Rogers WJ, Kasimov R.Yu., McDonald TJ, Wickliffe JK, Bickham JW Chemical contaminants and their effects in fish and wildlife from the industrial zone of Sumgait , Republic of Azerbaijan.// Ecotoxicology, (2003), №12, p. 511-523.

23. Mekhtiev AA, Gaisina AA, Palatnikov GM, Kasimov R.Yu. Serotonin-Modulating Protein Content as a Biomarker of Environmental Pollution // Soil & Sediment Contamination, 2005, vol. 14, p. 115-121.

24. CW Matson, Palatnikov GM PATTERNS of genotoxicity and contaminant exposure: evidence of genomic instability in the marsh frogs (*R ana ridibunda*) of Sumgayit, Azerbaijan // TOXICOLOGY and CHEMISTRY, 2005, vol. 24, NO. 8, P. 2055-2064.

25. CW Matson, GM Palatnikov, G. McDonald, R.L. Autenrieth, K.C. Donnelly, T.A. Anderson, A. Islamzadeh, J.W. Bickham. Chromosomal Damage in Two Species of Aquatic Turtles (Emys orbicularis and Mauremys caspica) Inhabiting Contaminated Sites in Azerbaijan// Ecotoxicology, 2005. P. 513-525.

26. Palatnikov G.M. Genotoxic condition of the populations of Kutuma on the Apsheron coast. // Research of the Institute of Physiology named after A.I. Garayev, NAS Azerbaijan, 2006, p. XXIV.

27. Palatnikov G.M. Kasimov R.Yu., Matson CW, Bickham J.W. Genotoxic analysis of industrial zone of Sumgayt (Azerbaijan) // "MAN and BIOSPHERE" (MaB UNESCO) Azerbaijan National Committee Proceedings. 2009. vol. 5, p. 56-63.

28. Palatnikov G.M. Kasimov R.Yu. Influence of used auto tires on behavior, fertilization and development of fertilized roe of Russian sturgeon // "MAN and BIOSPHERE" (MaB UNESCO) Azerbaijan National Committee Proceedings. 2010. p. 205 – 211.

29. Abdulkerimova S.L., Rustamov E.K., Akhundov A.H. Dynamics of changes in COE indicators of fish blood under the influence of oil pollution // Compendium of scientific works of the Institute of Physiology named after A.I Garayev of ANAS and the Society of Physiologists of Azerbaijan. Volume XXVII, Baku-2010, p. 137-141.

30. Abdulkerimova S.L. Changes in the indicators of hemoglobin and the value of motor activity of young carp under the influence of crude oil // Human and biosphere (MaB, UNESCO) works of Azerbaijan National Committee. Baku, 2010, c. 6, p. 218-224.

31. Palatnikov G.M., Vagabova G.R., Abdurakhmanova R.Ю. Genotoxic influence of used auto tires on the young of South-Caspian sturgeon (*Acipenser guldenstadti persicus, nation kurensis)//* Mat. According to water toxicology. 24-29 September 2011. vol. 1, p. 181-184.

32. Palatnikov G.M., Kasimov R.Yu. Absolute olfactory sensitivity of Russian sturgeon (*Acipenser guldenstadti* Brandt) to water-soluble fractions of oil // "MAN and BIOSPHERE" (MaB UNESCO) Azerbaijan National Committee Proceedings. 2011. vol. 7, p. 333-340.

33. Abdulkerimova C.L. , Rustamov E.K. Changes in the hematological age of crucian carp under the influence of crude oil from the "Azeri" site // Works of the Society of Zoologists of Azerbaijan, Baku, 2011, v.3, p. 320-329.

34. Abdulkerimova S.L. Histopathological changes in the liver of a carp caused by exposure to crude oil from the "Azeri" field // Compendium of scientific works of the Institute of Physiology named after A.I. Garayev of ANAS and the Society of Physiologists of Azerbaijan. Volume XXX, Baku-2012, p. 153-156.

35. Abdulkerimova S.L. Histopathological changes in the gill tissue of fish under the influence of "Azeri" crude oil // All-Russian scientific conference "Animals: ecology, biology and protection", Saransk, 2012, p. 3-5.

36. Abdulkerimova S.L. Effect of crude oil from “Oil Rocks” on the muscle tissue of carp // Materials of "III Republican Innovative Ideas Fair of Young Scientists", 2013, p. 65.

37. Abdulkerimova S.L. Estimation of histological shifts of muscle tissue of carp at the initial stages of exposure to crude oil from the Azeri field // Works of young scientists, 2013, No. 8, p. 168-171.

38. Abdulkerimova S.L. Changes in the behavioral reactions of carp under the influence of crude oil from the “Oil Rocks” field // Third National Congress of Physiologists of Georgia dedicated to I. Beritashvili, Tbilisi, 2013, p. 116-117.

39. Abdulkerimova S.L. Influence of crude oil on the gill tissue of carp: early stages of influence // Vestnik of the Moscow State University, “Natural Sciences” series, 2014, No. 2, p. 6-10.

40. Safikhanova Kh.M., Kasimov R.Yu., Rustamov E.K. Influence of experimental oil pollution on the blood of a carp // Izvestiya AS of Azerbaijan, series of biological siences, 2014, No. 1, p. 60-65.

41. Palatnikov G.M. Teratogenic influence on fertilization and fertilized eggs, genotoxic and behavioral reaction of young Russian sturgeon to the presence of used car tires in water. // 5th All-Russian Conference on aquatic ecotoxicology, Borok, 2014, p. 128-132.

42. Palatnikov G.M., Raghimova N.G., Vagabova G.R., Gasanova M.R. Cytotoxic effects of sublethal concentrations of the neonicotinoid insecticide Acenamiprid on young carp // "MAN and BIOSPHERE" (MaB UNESCO) Azerbaijan National Committee Proceeding. 2016, vol. 12. p. 171-178.

43. Mamedov Ch.A., Palatnikov G.M., Mehdiyev A.A., Guliyeva G.G. Criteria for evaluating physiological readiness and reproductive features of sturgeon producers (Acipenseridae) in modern ecological conditions. // Advances in Biology & Earth Sciences 2017. Vol. 2, p. 45-51.

44. Alizadeh M.H., Palatnikov G.M., Mamedova R. *И*. Cytotoxic effect of minimal concentrations of used machine oils (OMM) on young carp *(*Cyprinus carpio). "MAN and BIOSPHERE" (MaB UNESCO) Azerbaijan National Committee Proceeding. 2019.

45. Yusifova S.L., Raghimova N.G., Palatnikov G.M. Some features of the morphological and functional state of fish during the early stages of exposure to crude oil // International Conference "Problems of preserving the Caspian ecosystem in the conditions of development of oil and gas fields", Astrakhan, 2021, pp. 309-316.

APPENDIX 6D – SEALS LITERATURE REVIEW

Table 1: Answers to questions

Question	Answer
1. Please provide any updated data on the number of seals in the Caspian Sea (after 2017).	The situation with the number of Caspian seals in the Caspian Sea is complicated. The reasons for this are different methods of counting and methods of determining the number of individuals. In some cases the number of individuals on ice rookeries was determined by visual method (2006-2012 - the method of counting strips was used), in others Russian and Kazakh specialists used thermal imagers (2021, 2022). Disputes continue to this day. Population calculations are usually based only on the number of females on ice rookeries during the breeding season. Unfortunately, the age structure of the population is not properly used in determining the numbers. The period of puberty is not taken into account. Even Wikipedia states that the age of puberty of the Caspian seal is 5 years. This is completely wrong. Studies we have conducted for 52 years on more than 10,000 individuals have established that puberty in males and females occurs at the age of 8-9 years (Hajiyev, Eybatov 1995), physical maturity (synostosis) occurs at 20-22 and the climacteric period at 28-30 years of age. Therefore, individuals under 8 years and after 28-30 years of age will not be found on the flocks. In addition, the authors of such calculations groundlessly believe that females give birth once in three years and according to their calculations the number of sexually mature females on the ice is three times less than their total number. In addition, a large percentage of yawl (non-pregnant) females is indicated. In the early 20th century, the number of seals in the Caspian Sea was approximately 1 million. In the 1980s, V. Krylov (1989), who conducted aerial surveys in the northern Caspian Sea and used our determinations of the age composition of the population, established the number of seals at 400,000-450,000. In 2005-2012, an international team of Caspian seal researchers determined the number of seals to be 100,000-110,000 as a result of aerial surveys (UK Government Darwin Initiative Project). Current population estimates range from 168,000 to 168,000 individuals. This figure is indicated in the report of the International Caspian Seal Study Group (CISS) at the seminar on the Caspian seal (November 3, 2016) in Astrakhan entitled “Problems of conservation of the Caspian and other seals in landlocked water bodies" (S. Goodman) The dynamics of seal mortality on the territory of Azerbaijan fully confirms this figure. According to the All-Russian Research Institute of Fisheries and Oceanography (VNIRO), as of 2019, there are 43,000-66,000 Caspian seals left in the world, the population of which has decreased by 77.5 percent since the beginning of the 20th century. As of 2021, as a result of aerial surveys conducted by Russia and Kazakhstan, the number of seals was determined as 311,000 individuals and in 2022 at 258,000. Such a difference indicates an erroneous methodology for determining the number of seals. In one year, the number of seals could not decrease by more than 50,000. Besides, the number of cadavers on the coast of Dagestan does not indicate large-scale mortality along the entire Caspian coast. In Kazakhstan, they were not more than 200 and in Azerbaijan, on the northern Absheron (the main cemetery of the Caspian seal), they were very few in comparison with the previous years - only 480-610 individuals Today the population of Caspian seals is about 311,000 individuals. In November 2023, during a scientific conference in Astrakhan, Vyacheslav Bizikov, deputy director for scientific work at the All-Russian Research Institute of Fisheries and Oceanography, confirmed the natural causes of the mass death of red-book seals on the Caspian coast in December 2022. According to the data obtained during the aerial survey in the winter of 2023, the total number of seals in the Russian-Kazakh part of the Caspian Sea in 2023 amounted to 259,852 individuals, which is 51,000 less than in 2022.

Question	Answer
	Thus, it can be stated that the population of the Caspian seal has not been reliably determined and estimates vary from 43,000 to 311,000. Based on the dynamics of beached cadavers and general assessments, the number of seals can be determined by averaging 170,000, i.e. at present there is a stabilization of the number of seals at this level. Only the increase in the number of cadavers on the Dagestan coast is of concern.
2. Please provide any updated data on seal mortality in the Caspian Sea (after 2017).	The problem of population reduction, i.e. death of the Caspian seal, is still topical and insufficiently studied. There are many reasons, but there is no comprehensive approach to this problem. Usually these studies are conducted after mass beaching of seal cadavers on the coasts of neighboring countries. Unfortunately, studies of the dynamics of seal beaching are rather chaotic, not regular and occur only in certain years of mass beaching. Therefore, the assessments are quite conditional. Systematic studies, i.e. almost weekly studies of the dynamics of seal beaching on the northern coast of the Absheron Peninsula (100 km long) and partially on the whole of Azerbaijani sector of the Caspian Sea were conducted by D. Hajiyev from 1958 and by T. Eybatov since 1971. The main monitoring zone of 10 km, Buzovna-Northern GRES, has been investigated in detail (see the graph of seal beaching at the end of the report*). Many years of studies in the northern coast of the Absheron Peninsula have confirmed that the indicators of the monitoring zone are averaged data on the number of cadavers on the entire northern coast. From the data in the table, we can determine the maximum and minimum number of cadavers for the whole period of monitoring. The maximum number of seals detected is 2,480 and the minimum is 130. *A brief history of the study of beached seal cadavers on the Caspian coast by T. Eybatov (2010) is provided at the end of the report. The analysis of beached cadavers on the Caspian coast in recent years (after 2017) shows that all along the coast the beaching of dead seals (the only exception is the beaching of cadavers on the Dagestan coast in the fall of 2022 of 2,500 seals) is normal, not catastrophic. The point is that the beaching of seals on the coasts of Russia, Kazakhstan and Turkmenistan, as well as Iran for the first time, have been of interest to environmental organizations only in recent years. Therefore, they perceive any amount as catastrophic. Only the beaching of dead seals in Dagestan in 2022 are rather unusual. Many reasons have been provided: methane gas, viral infections, pneumonia. None of the arguments proved convincing. No serious research has been done. Most of the seals were in a decomposed state and were quickly buried. The last time we discussed this problem was at a webinar in Makhachkala (IV International Webinar. State of the Caspian seal population - present and future. Makhachkala 16 -09 -23. Presentation by T. Eybatov) None of the webinar participants agreed with Dagestani and Kazakhstani specialists. The reason, in our opinion, is technogenic: either military or poaching. It has been established that for 10 years poachers have been harvesting 10,000-15,000 seals in Dagestan annually. Industrial processing and sale of seal skin and fat has been established (I. Yermolin and L. Svolkinas -2018, 2019, 2020) Ilya Yermolin and Linas Svolkinas provided materials on the illegal commercial capture of seals on the Dagestan coast of the Caspian Sea. According to them, poachers from Dagestan annually kill at least 10,000 seals. There are regions of Dagestan where skin is processed and products are made from it (mainly the Dargin mountainous region). The routes for marketing these products in the Russian Federation have also been traced.

Question	Answer
	Information about the beaching of dead seals in recent years TASS Science The eared seals died at least two weeks ago and were washed ashore by a storm, the conservation centre concluded. The centre's specialists found no signs of violent death or remains of fishing nets. On 3 December 2022, the Russian Fishing department reported that dead seals were found on the shore of the Caspian Sea in Makhachkala. On 5 December 2022, the department specified that specialists counted 2,500 dead animals. A little later, the bodies of animals appeared in the Azerbaijani sector of the Caspian Sea. According to the Ministry of Natural Resources of Dagestan, the mass death of seals occurred due to natural causes. Four more dead seals were found on the Azerbaijani coast of the Caspian Sea - PHOTO by Oxu.az Monitoring continues in the Azerbaijani sector of the sea in connection with the detection of cases of mass death of seals on the Dagestan coast of the Caspian Sea, the Ministry of Ecology and Natural Resources (MENR) of Azerbaijan reported. The head of the Biodiversity Protection Service of MENR, Firuddin Aliyev, said that during the monitoring conducted by specialists of the Department, as well as the Agrarian Services Agency under the Ministry of Agriculture and Food Safety Agency on 9 December 2022, four dead seals were found on the Caspian Sea coast in Novkhani, Goradil and Shuvalan. According to F. Aliyev, in order to establish the cause of death of the animals, the specialists took samples and the public will be provided with additional information about the results of the analysis. Hundreds of dead seals found on Turkmen coast of Caspian Sea 9 December 2022, 09:00 The seals died at least two weeks ago and were washed ashore by a storm, the environmental centre concluded. The centre's specialists found no signs of violent death or remains of fishing nets. --- Dead seals found on the shore of the Caspian Sea in Dagestan - VIDEO 17 January 2023 15:56 --- Dead seals were found on the shore of the Caspian Sea near Makhachkala, Dagestan, in Russia. 17 January 2023. More than 50 animal carcasses were found after a powerful storm that lasted for three days. Specialists from Russian Fishing and the Ministry of Natural Resources and Ecology of Dagestan went to the site. They found that the dead animals were Caspian seals, which belong to the endemic species of Caspian seals listed in the Red Book and are considered endangered species.

Question	Answer
	Water samples were taken for analysis to establish the causes and time of the seal deaths. The cause of death of seals found on the shore of the Caspian Sea has been established. ---- Source: Izvestia (Russia) More than 50 dead seals found on Caspian shore - VIDEO https://baku.tv/dunyaa/xezer-sahilinde-yeniden-suitilerin-kutlevi-olumu-askarlanib 21 January 2023 15:07 On the shore of the Caspian Sea, in Dagestan (Russia), the carcasses of red seals have been found again. Over the course of several days, nature protection specialists have found more than 50 dead Caspian seals. According to preliminary data, the animals died about two weeks ago. Biologists cannot yet say for sure what caused their death. It may be due to infectious disease and viruses. At the same time, scientists assess the ecological state of the Caspian Sea as unfavourable. “Against the background of a depressive environment, animals, just like people, experience a drop in immunity, as a result of which they quickly pick up infection or disease and, unfortunately, die,” Alimurad Hajiyev, the director of the Institute of Ecology and Sustainable Development of Dagestan, says. In December, more than 2,500 dead seals were found on the shore of the Caspian Sea in Dagestan. It is not yet clear why the mass deaths occurred. But the main theory of the deaths is believed to be natural factors. Source: MIR 24 -- Dead seals have been spotted again on the shore of the Caspian Sea January 28, 2023 21:07 Dead seals have been spotted again on the shore of the Caspian Sea in Dagestan. So far it has been possible to count eight animals, which were thrown on the beach in Makhachkala. Specialists remind that Caspian seals are listed in the Red Book and are now under the threat of total extinction. We recall that in December last year almost 700 dead seals were found in Dagestan, and the exact cause of their death is still unknown. Source: Telegram channel “Lenta Dnya” --- Feb. 8, 2023. 12:39

Question	Answer
	The cause of death of seals on the shore of the Caspian Sea was a viral disease, the press service of the Fisheries Committee of the Ministry of Ecology and Natural Resources of Kazakhstan reports. The working group concluded that the main cause of death of most Caspian seals was virus-associated acute pneumonia - an outbreak of mixed influenza and morbillivirus infection during the fall concentration of animals in the Kazakh part of the sea. "Chronic poisoning of marine animals with immunotoxic elements and compounds contributes to their increased susceptibility to infectious diseases due to decreased immunity and general body resistance. Thus, the cause of death of Caspian seals was pneumonia, aggravated due to viral infections and caused by decreased immunity of animals, including the pollution of their habitat," the report says. To find out the reasons for the death of seals, the committee has attracted specialists from the Centre for the Study and Rehabilitation of Caspian seals, the Institute of Hydrobiology and Ecology, the Research and Production Centre of Microbiology and Virology, the Kazakhstan Agency for Applied Ecology, as well as the Department of Ecology of Mangistau region, territorial departments of the Committee of Veterinary Control and Supervision of the Ministry of Agriculture of the Republic of Kazakhstan. We recall that in early December, about 700 dead seals were found on the shore of the Caspian Sea in Dagestan (RF). The next day the number increased to 2,500. The Ministry of Natural Resources and Environment of the region added that this is the biggest mass death of Caspian seals in the last 10 years. Source: informburo.kz -- About 130 dead seals found on the Dagestan coast of the Caspian Sea Dec 19, 2023 22:51 The commission has found about 130 dead seals listed in the Red Book of Russia during the monitoring of the Caspian Sea coast in Dagestan, says a report of the press service of the regional Ministry of Natural Resources and Environment. “About 130 cadavers were recorded on the coast this weekend. Most of them were decomposed, they could have died not only off the coast of Russia, but also off the coasts of Azerbaijan and Iran. The exact cause has not yet been determined," the agency said. Causes of mass deaths of Caspian seals are being investigated in Kazakhstan WORLD, May 9, 2023 17:48 (UTC +04:00) 15 dead seals have been found on the coast of the Caspian Sea. As Day.Az reports, this is stated in the information of the press service of the Ministry of Ecology of Kazakhstan. During the monitoring by state inspectors from the Department of Fishery Inspection in Mangistau region of Zhaiyk-Caspian interregional basin on May 6, 2023, carcasses of 15 seals were found on the Caspian Sea coast of Tupkaragan district, Bautino village. Day az

Question	Answer
	--- Apr 26, 2024 12:57 Dozens of seal cadavers were washed ashore in the Caspian Sea after a storm in the Mangistau region of Kazakhstan, says a report by the Department of Fisheries Inspection. In Tupkaragan district on April 25, 12 cadavers of seals were found during monitoring the Caspian coast. “The discovered dead seals were in a highly decomposed state, which suggests that their deaths occurred during the winter period and they were in the water all this time. They were carried ashore as a result of the westerly gale wind, which began on April 23 and is still continuing," the report says. At the same time, 67 dead seals were found on April 23-24, also in a decomposed state. Specialists managed to take several samples to find out the possible cause of the animals' death. Thus, 79 dead Caspian seals were washed ashore. The animals are listed in the Red Book of Kazakhstan. A total of 182 dead seals were found on the Caspian coast in Mangistau from March 29 to April 25. Source: "Vesti Kavkaza" --- 67 seals were found by officers of the Border Service of the NSC of the RK from poachers in the waters of the Caspian Sea, Tengrinews.kz correspondent reports. June 08, 2024 13:14 From April 1 to May 31 this year, the KNB Border Guard Service in Atyrau, Mangistau and West Kazakhstan regions and adjacent territorial waters in the Caspian Sea held a fish protection action "Bekire-2024". As a result, 90 violators of the regime of territorial and internal waters, 72 violators of the border regime and 69 watercraft were detained. A large number of poaching tools, including more than 263 kilometers of nets and 20 thousand hooks”, have been seized, says a report of the press service of the KNB RK.

Question	Answer
3. Please provide any updated data on the results of aerial seal surveys or tagging surveys (after 2012).	As of 2021, as a result of aerial surveys conducted by Russia and Kazakhstan, the number of seals was determined to be 311,000 and in 2022 – 258,000. New data on the nature of Caspian seal migrations, which were obtained as a result of seal tagging and the use of telemetry tags, were published in 2016 (Dmitrieva L., Jüssi M., Jüssi I., Kasymbekov Y., Verevkin M., Baimukanov M., Wilson S., Simon J. Goodman S.J. Individual variation in seasonal movements and foraging strategies of a land-locked, ice-breeding pinniped. Marine Ecology Progress Series 554: 241–256 (2016). **Video is available.** Aerial survey or tagging of seals was conducted in 2021-2023. Research was conducted through companies in Russia and Kazakhstan. As a result of the use of aerial photography and thermal imaging, the number of seals in 2021 was 311,000 and in 2022 - 258,000. The study of seals by tagging was carried out in the north (in Kazakhstan and Russian waters) in 2021-2022. During this time, 40 seals were tagged. The results have not been officially published yet.
4. Please provide any information on Caspian seal seminars organized after 2015.	Astrakhan, Russia November 3-8, 2016. MARINE MAMMALS OF THE HOLARCTIC COLLECTION OF RESEARCH PAPERS VOLUME 1 Materials of the Ninth International Conference Astrakhan October 31 - November 05, 2016 Baimukanova A.M., Zhdanko L.A., Baimukanov T.T., Baimukanov M.T. Results of a survey of Caspian seals (Pusa caspica) in Kendirli Bay in spring and fall 2015 Volodina V.V. On the role of Caspian seals (Phoca caspica Gmelin, 1788) in the circulation of natural foci of infestation Goodman S.J., Clark L., Jackson E., Brooke T., Stennaus E., Statozschulu M., Kydymanov A., Karamendin K., Baimukanov M. Assessment of genetic variability, population structure and demographic history of the Caspian seal (Pusa caspica) based on analysis of microsatellite loci and variation of mitochondrial DNA nucleotide sequences. Russia, Arkhangelsk October 29 - November 2, 2018 Marine Mammals of the Holarctic. Collection of research papers on the materials of the Ninth International Conference Year of publication: 2018 Volume: 2 Russia, Moscow, online 1-5 March 2021

Question	Answer
	 Marine mammals of the Holarctic: collection of research papers: the materials of the Ninth International Conference, online, March 01-05, 2021 / Marine Mammal Council; compiled by V. N. Burkanov [et al.]. - Moscow, 2023. - 360 p., Russian, English. – Bibliography at the end of the article - ISBN 978-5-9904294-8-2. --- AGENDA International Webinar "Status of the Caspian Seal (Pusa caspica) Population - Present and Future" August 8-9, 2023 --- Fourth International Webinar. State of the Caspian seal population - present and future. Makhachkala 16 -09 -23. Presentation.

<table>
<tr><th>Question</th><th>Answer</th></tr>
<tr><td>5. Please provide the locations of any seal coming ashore on the Absheron Peninsula / Cape Shahdili (provide a map).</td><td>Since 2005, no living seals have been found in Cape Shahdili. Only their cadavers are visible. A one-year-old seal was discovered on the coast of Bilgah and Nardaran on the Absheron Peninsula on February 22. Video available. In 2024, in the middle of May, a large sick seal was found alive on the coast of Nabran. Video available.</td></tr>
<tr><td>6. Please update the seal sensitivity table for the Shah Deniz Contract Area.</td><td>
<table>
<tr><td>Jan</td><td>Feb</td><td>Mar</td><td>Apr</td><td>May</td><td>Jun</td><td>Jul</td><td>Aug</td><td>Sept</td><td>Oct</td><td>Nov</td><td>Dec</td></tr>
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<tr><td>20</td><td>20</td><td>200</td><td>4000</td><td>4000</td><td>1200</td><td>1200</td><td>1200</td><td>1500</td><td>4000</td><td>4000</td><td>300</td></tr>
</table>
Green – least sensitivity, few or no seals
Blue – distribution of seals in groups according to migration flows or food components
Red – most sensitive, spring and fall migration, maximum number passing through the area

Clarification email from Dr Tariel Eybatov (02/12/24):
Tagging of seals (carried out twice by L. Dmitrieva (2011-2012) and P. Shibanova (2021-2022) showed that seals migrate across the entire width of the central Caspian and move chaotically following schools of fish. These 4,000 thousand individuals are not constantly in this zone, but migrate through it.
Due to the difficult ice conditions in recent years, seals appear in the waters of Azerbaijan in March from the early melting of ice. In addition, only young inexperienced individuals move along the coast, and adults actively move in the deeper-water part where schools of kilka migrate.</td></tr>
</table>

Question	Answer
7. Please provide information about the ice cover of the Caspian Sea in 2023 and the times of sighting of seals in Azerbaijan's waters of the Caspian Sea and the Absheron Archipelago in 2023.	A comparative analysis of ice condition maps compiled using satellite data in 2022 and the first ten days of January 2023 shows that the Caspian Sea ice cover in 2023 was 20%, which is 12% more than the same period of last year. Since February 15, ice has been restored in the entire water area of the North Caspian Sea. The original types of ice and dark nilas reappeared in the northwest of the sea, along the western part of the Volga delta, from the east, in some places on the Volga, gray and gray-white sliding ice. About 5 cm thick ice formed again, the same ice formed in the northern part of the Volga-Caspian Sea Shipping canal. In the northeast of the Caspian Sea, polynyas are covered with primary ice and dark nila, in places approaching Atyrau the width of ice doubled, and its thickness reached 23-25 cm. Ice formation resumes in the Northern Caspian Sea Marine News of Russia https://morvesti.ru ' news Thus, the freezing began in the second half of December 2023. Today, the area of ice in the northern waters of the Caspian Sea reaches 67% (in 2023 it was from 98% to 100%). The thickness of the ice cover is uneven: the thickness of the northern and northeastern parts is up to 10-15 centimeters, and in the areas of the formed edge, the ice is variable and reaches 5-10 centimeters. From December 1, 2023 to January 13, 2024, the air temperature in the Mangistau region varied between -3 and +10 degrees. In the same period of 2022-2023, the winter was colder, the temperature varied between 0 and -10-15 degrees. At the same time, according to Kazgidromet, from January 20 to February 20, 2024, hot weather was expected up to +11 degrees. This warming can reduce the area of the ice field by 20-40%, the committee said. On February 20, most of the primary ice melted in the northwestern part of the sea, the fast ice in the Volga-Caspian Sea Shipping canal partially disintegrated, and in the approaches there were sliding ices compressed to the east of the Volga-Caspian Sea Shipping canal. Intensive ice formation continues in the North Caspian Sea 31/01/2024. https://morvesti.ru › news Spring migration was observed at the end of March. The map of ice conditions in winter 2022-2023 and 2023-2024 is shown below **
8. Please provide any information on seal monitoring in Azerbaijani waters for the spring, summer, fall and winter months of 2018-2023 (use the table below).	

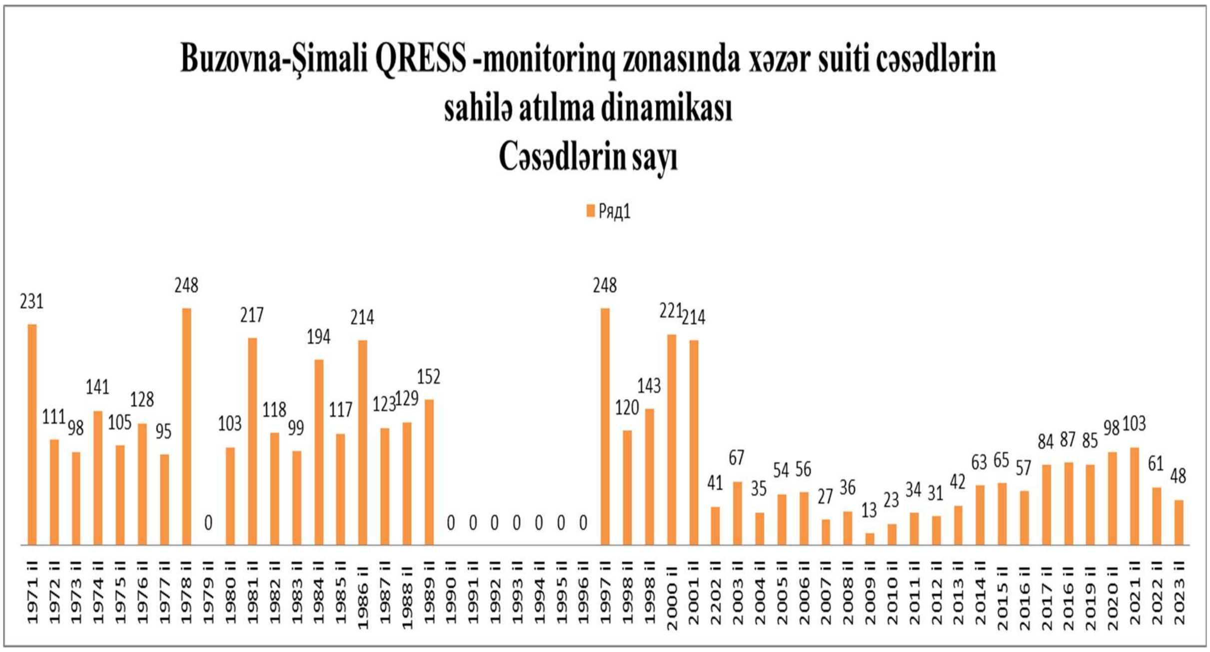


Figure 1: Dynamics of Caspian seal cadavers washed ashore in the Buzovna-Northern GRES monitoring zone

Table 2: Seasonal observations between 2017 and 2024

Year	Spring	Summer	Fall	Winter
2017	The first seals are usually observed in the waters of Azerbaijan in late April, early May. As in 2016, migration in 2017 was unusual. On the islands of the Absheron archipelago, no mass gathering of seals was found; small groups of seals were usually found on individual islands during the day and they left the islands at night. Fishermen usually associate this process with herring migration. This year, the catch of this fish species was very low. No seals were observed on the islands until mid-May. Only small groups of seals were observed near the Oil Rocks. The number of dead seals washed ashore by the waves was not significant. Although the numbers coincided with previous years, it was only one third of the number of dead seals washed ashore by the waves in the autumn season.	Small groups of seals (2-3 individuals) were found on the islands of the Absheron archipelago (Dardanella and Koltush). In the monitoring zone of Buzovna-Northern GRES, two dead seals were found. In the summer months, 9 cadavers were found in the monitoring zone, of which 5 were male and 4 female.	Autumn monitoring was carried out on the northern shores of the Absheron peninsula and the islands of the Absheron archipelago. Small groups of seals were observed on the islands from time to time. The number of seals detected in the monitoring area has suddenly increased. In general, 23 bodies of seals were found in different condition on the beach of Shuvalan settlement, 3 km from the coastal zone. Overall, 68 dead seals were recorded in fall. A female seal was found with a fetus. Most of the dead animals were in bad condition. Although some of the cadavers had empty stomachs, most of them were full of remains of fish, especially herring bones. One young female seal was found to be in very good condition with no visible injuries. It is believed to have fallen into a fishing net. The body was taxidermied.	Neither live nor dead seals were recorded during the winter season.

Year	Spring	Summer	Fall	Winter
2018	Seals were first discovered in the Azerbaijani waters on April 22 and gathered around the Absheron Peninsula at the beginning of May (May 1). From April 21 to 30, monitoring was carried out around the Absheron peninsula and islands of the Absheron archipelago using the "Gizgalasi" commissioned by Socar-Fugro. This time, seals were not detected in the area, their spring migration from the northern part of the Caspian Sea to the south slowed down this year. Seals usually migrate to the Azerbaijani waters at the end of March and beginning of April. During 2018, Caspian seal mortality was monitored on the northern and southern shores of the Absheron peninsula and the Absheron archipelago. During the year, 84 cadavers (46 males and 38 females) were detected in the main monitoring zone of Buzovna-Northern GRES, and after morphological examination the cadavers were dissected, examined and tissue samples were taken. Most of them had died in the north 1-2 weeks earlier, their skin was freed of hair and torn apart by dogs. It was noted that most of the seals died while falling into fishing nets. Signs of disease (inflammation, pneumonia and helminthosis) were found in some of the animals. The stomachs of some of were full of fish remains, while the stomachs of others were empty.	In the summer, 9 cadavers were found in the monitoring zone, 5 of them were male and 4 were female. In the summer, fishermen observed 17 live seals in the Absheron Strait. 1-5 seals were observed around SOCAR and BP oil platforms, which were well lit in the evening.	Fall migration started in the territory of Azerbaijan at the end of October and ended in December. The conducted research confirm that the Caspian seal is in a stable condition in the Azerbaijani aquaria. 46 bodies were found in fall (23 females, 19 males)	4 dead seals were discovered during the winter season (4 males)

Year	Spring	Summer	Fall	Winter
	In summer, 29 cadavers were found in the monitoring zone (18 males, 11 females). AECOM August 17 - Block D230, monitoring by "Gizgalasi" vessel.			
2019	In 2019, as a result of rapid melting of the glaciers in the north due to weather conditions, seals entered the territory of Azerbaijan in early March, and groups of 5-12 individuals were observed on the islands of the Absheron archipelago in mid-March. Research confirms that the Caspian seal (population) is in a stable condition in Azerbaijan's waters. In summer months, 9 cadavers were discovered and examined in the monitoring zone of Northern GRES - Buzovna. Out of 9 individuals, 5 were male and 4 female. Young individuals predominate.	As a result of monitoring carried out on the coast in the summer months (June, July, August), 17 dead seals found, 10 of which were male and 7 female. Most of them were caught in nets. Around the small islands of the Absheron archipelago, fishermen saw 23 live seals	Fall monitoring is carried out both at sea (by Gilavar ship in September-October) and on the northern shores of the Absheron peninsula. Research at sea is mainly carried out in the Ashrafi-Dan-Ulduzu-Aypara (ADUA) contract areas in the northern part of Azerbaijan's water area. From September 15 to mid-October, 43 seals were recorded around the ship. Most seals move alone. Sometimes 2-3 individuals, only 5 individuals were observed in one group. From November 16 to 23, monitoring was carried out on the Alpha platform of Shah Deniz by Socar-Fugro organization. This time, seals were not detected. In fall, 47 cadavers were found in the Buzovna-Northern GRES monitoring zone, and forensic studies were conducted on them.	Neither live nor dead seals were recorded during the winter season.

Year	Spring	Summer	Fall	Winter
			Most of the bodies were females (29 individuals), fetuses were found in 4. Monitoring was carried out by Gilavar, Tsvetlogor 2 and Turkan vessels. The survey was conducted by Caspian Geo on board Gilavar motoring vessel from September 16 to December 21, 2019 for Equinor. Monitoring area: Ashrafi-Dan Ulduzu-Aypara Between 14-09-2019 and 16-10-2019, 34 seals were found during the day and 1 at night. Night Camera Operators: Shift I: Dorota Iwanowska, Paulina Szmidt Shift II: Grigorii Kornilov, Teymur Suleymanov During the survey, ADUA visual inspection in the Caspian Sea was carried out for a total of 862 hours and CMS monitoring was performed for a total of 102 hours and 33 minutes. The source ran for a total of 797 hours and 30 minutes, including 43 hours and 8 minutes of soft start and 14 hours and 43 minutes of	

Year	Spring	Summer	Fall	Winter
			source testing. 122 soft starts were performed. There were 34 visual observations and one night observation of marine mammals during the survey, resulting in one mitigation measure. On board the vessel there were two trained Marine Mammal Observers (MMOs) equipped with an IR night vision camera and Night Binocular Operators (NBOs) to ensure proper mitigation measures were followed during the seismic survey. The ADUA 2D/2.5D/3D seismic survey is an area located approximately 50 km from Baku, about 14 km from the Absheron Peninsula, at least 7 km east of the Pirallahi Island in Azerbaijan and Chilov Island in the Caspian Sea. Caspian Geo carried out a combination of 2D, 2.5D (837 km2) and 3D surveys on an area of 695 km2 (total area).	

Year	Spring	Summer	Fall	Winter
2020	In 2020, seals entered the northern waters of Azerbaijan on March 27, and groups of small individuals were observed around the Absheron archipelago on April On the islands of the Absheron archipelago, the first seals migrating from north to south were discovered by helicopter.	In the summer, 9 bodies (5 of them female) were found on the beach.	In autumn, 62 bodies (38 females and 3 embryos) were found. During the year, 98 bodies were found in the monitoring zone. Most are individuals caught in fishing nets.	Neither live nor dead seals were recorded during the winter season.
2021	During the year: 103 bodies were found in Buzovna-Northern GRES monitoring zone. Most are individuals caught in fishing nets. In mid-April to early May, the first seals migrating from north to south (spring migration) were spotted by helicopter on the islands of the Absheron archipelago. During the spring migration, 36 cadavers were found in the monitoring coastal zone of Buzovna-Northern GRES, and studies were carried out on them. Most of the bodies were male (23 individuals).	11 seals were found on the beach in summer (6 of them females)	The autumn migration started at the beginning of October. 56 cadavers in fall (37 of them females) September 27 - one of the main objectives of the monitoring studies of the Caspian seal mammals is to carry out in mitigation measures order to minimize the impact of seismic surveys in the Caspian Sea. During the study, 23 Caspian seal mammals were recorded.	Neither live nor dead seals were recorded during the winter season.
2022	During the year, 64 bodies were found in Buzovna-Northern GRES monitoring coastal zone. Most were individuals caught in fishing nets. Spring migration (for the first time) was observed at the end of February, live seals and cadavers were found on the shore.	8 seals were found on the beach during the summer months (5 of them females)	In October and November, 37 seals were recorded in small groups by helicopter on the islands of the Absheron archipelago. The fall migration started at the beginning of October. 35 cadavers were found in fall (21 of them females)	On February 22, a 1-year-old seal was discovered on the coast of Bilgah-Nardaran. Video available.

Year	Spring	Summer	Fall	Winter
	They were found in groups (4-5 seals) on Yal and Koltush islands in early April by helicopter. During the spring migration, 21 cadavers were found in the monitoring coastal zone of Buzovna-Northern GRES, and studies were conducted on them. Most of the bodies are male (13 individuals). Platform Garabattak April-May - no seal detected Azecolab IE UK LTD			
2023	During the year, 48 bodies were found in Buzovna-Northern GRES monitoring coastal zone. Most were caught in fishing nets. Spring migration was observed at the end of March During the spring migration, 16 cadavers were found in the Buzovna-Northern GRES monitoring coastal zone, and studies were conducted on them. Most of the bodies were male (10 individuals) March 28 - Platform Garabattag	6 seals were found on the beach in summer (4 of them females) 22 live seals were discovered in the Shah Deniz contract area at the beginning of August (1-9). See the table below. ****	The fall migration started at the beginning of October. 26 cadavers were found in fall (17 of them females) Most of them died a few weeks earlier.	Neither live nor dead seals were recorded during the winter season.
2024			In mid-May, a large sick seal was found alive on the coast of Nabran. Video available.	Bogoslovsky interiew. February 25, 2024. “Caspian” newspaper talks to Vasily Bogoslovsky, Director General of the “Clean Seas” Environmental Foundation, head of the Caspian seal research project “Soul of the Caspian” and one of the authors of the public initiative to implement the "Green Standard of the Caspian":

Year	Spring	Summer	Fall	Winter
				After the mass beaching of Caspian seals on the Dagestan coast of the Caspian Sea in 2022, studies showed that the cause of death was not viruses, not man-made impact, but natural phenomena. Which ones remains to be found out. We have to admit that over the last year the number of seals has decreased by 16.5%. On the Russian and Kazakhstani coasts, there are about 260 thousand of them left, and some 100 years ago there were almost 1 million. So far, scientists' forecasts are quite disappointing. The Caspian seal breeds only in ice, and due to climate warming, there are fewer and fewer places for that.

**Question 7. Please provide information about the ice cover of the Caspian Sea in 2023 and the times of sighting of seals in Azerbaijan's waters of the North Caspian Sea and in the Absheron Archipelago in 2023.

*** UNIFIED STATE SYSTEM OF INFORMATION ON THE SITUATION IN THE WORLD OCEAN

ESIMO OPERATING MODULE

Ice conditions in the Caspian Sea, 2022-2023

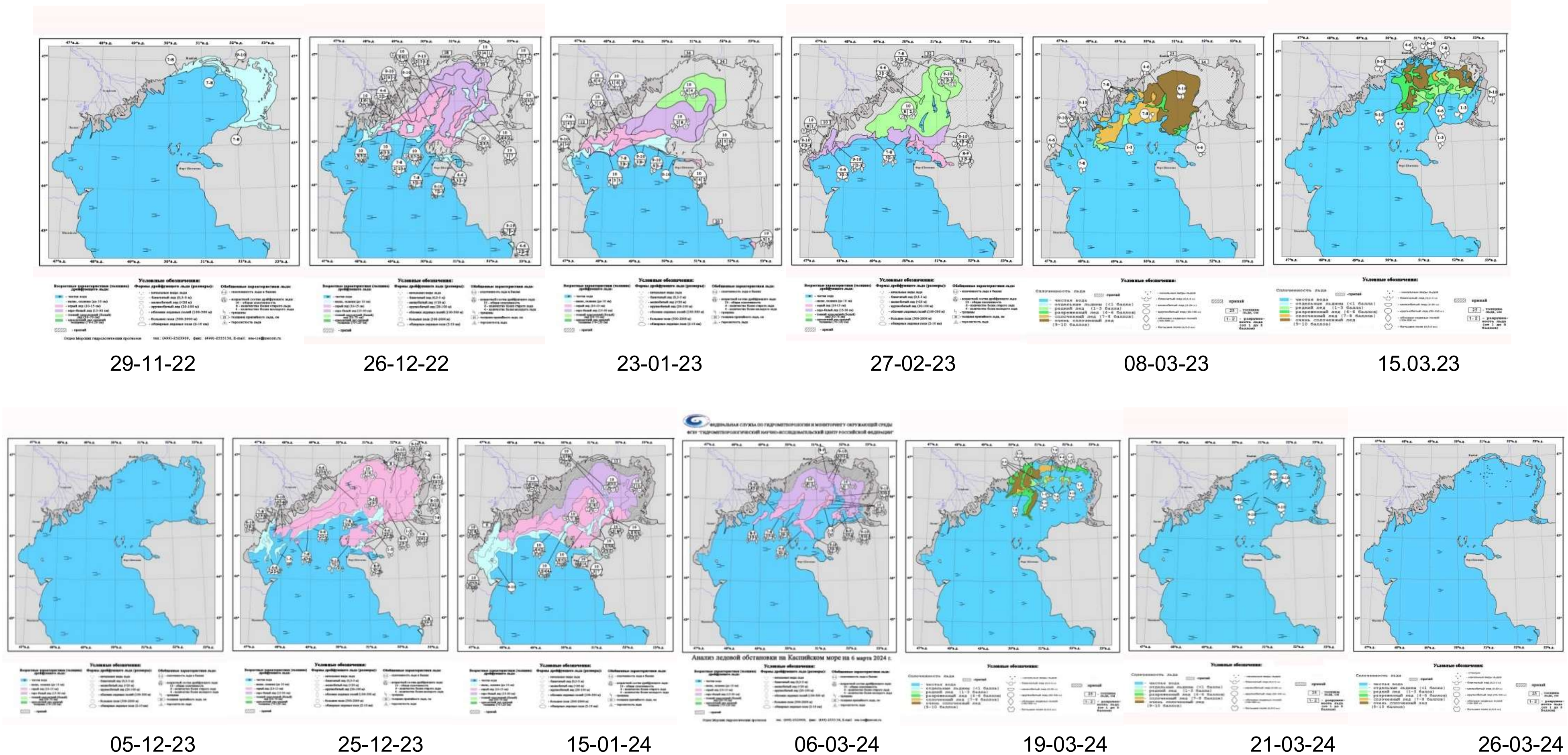
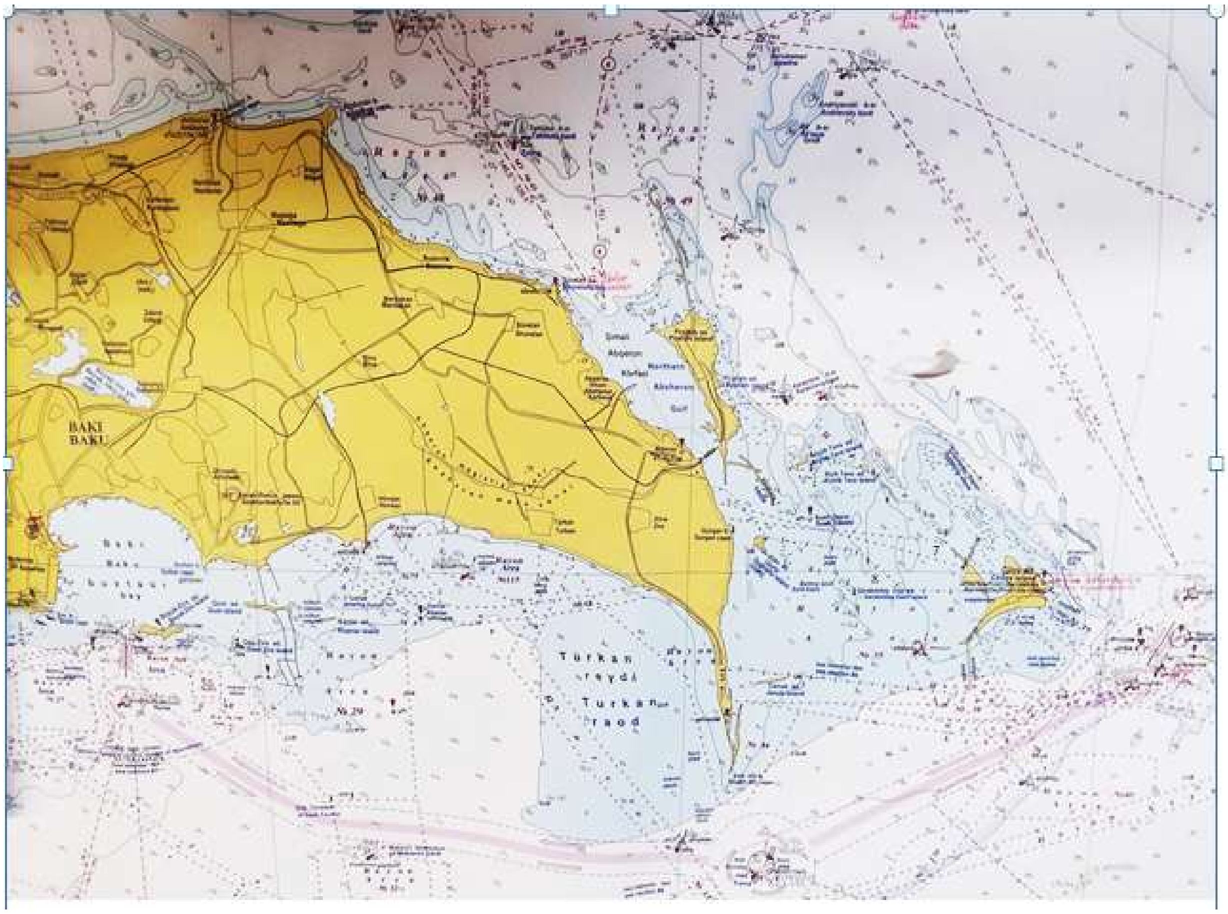


Figure 2: Ice conditions in the Caspian Sea, 2022-2024



***Islands of the Absheron archipelago located between Pirallahi Island and Chilov Island. Usual places of annual landings of the Caspian seal.

On the map they are marked with numbers.

1. Böyük tava 2. Kiçik Tava 3. Tava altı 4. Koltuş 5. Çurka 6. Dardanel 7. Yal 8. Qarabatdağ

A better map could not be found.

Table 3: Sighting rates per day for Caspian seals during different SWH of Caspian Sea and visibility during the 2023 2DUHR seismic survey

2023 Date	Significance Wave Height	Visibility in kilometers	Number of Caspian seals
01 August	3	0.5	0
02 August	2	1	1
03- 06 August	1	5	21
07 August	4	0.5	0
08- 09 August	2	2	0

Brief history of the study of seals washing ashore on the Caspian coast

***Beaching of seal cadavers on the Caspian coast (floaters). (E.M. Eybatov) Caspian seal (Pusa Caspica Gmel.) - endemic of the Caspian Sea. AMEA Xəbərləri, Yer Elmləri, No. 4, 2010 pp. 151-169

The first comprehensive research on Caspian seal beaching and floaters belongs to K.K. Chapsky (1932). The author notes regular fall appearance of floaters. The season of dead seal beaching on the Dagestan coast starts at the end of August and continues until ice-freezing near Chechen Island. The distribution of beaching in this area is far from uniform: the largest number of cadavers is ejected on the Uch Spit, where K.K.Chapsky studied up to 30 cadavers. The age composition was as follows: 6 semi-aged, 13 adults, 3 old, 10 males, 12 females (only one of them pregnant). It was difficult to examine all the cadavers due to severe deterioration of some of them. The author does not make any substantive conclusions about the reasons of the deaths. The study of this question is a matter for the future (quoted from S.I. Ognev, 1935). S.I. Ognev (1935) points out: "Floaters. After the opening of the Caspian Sea in spring, in some years there a large number of seal cadavers, locally called "floaters". It is likely that these are individuals that were suffocated by accidental conditions under the ice they could not swim out of (due to freezing of the lagoons, collision of large ice fields, etc.). p. 559. S.V. Dorofeev and S.Y. Freiman (cited in Badamshin, 1971) noted cases of seals being washed ashore but did not try to explain the cause of their deaths.

The talk of seals washed ashore started in 1875, but only S.I. Ognev (1935) suggested that the main reason for the appearance of floaters is the freezing of seals under the ice and ice floes. K.K. Chapsky (1930-1932) investigated cadavers on the West Coast, mainly in Dagestan, but did not interpret the cause of their beaching because of the poorly studied process. B.I. Badamshin was the first to try to substantiate the cause of mass beaching of seals on the coast in 1971. In his opinion (and before him some people believed that seals died of diseases, others simply suffocated under the ice, but did not give convincing arguments in their favor), the main cause is connected with the prolonged fishing, i.e. during the period when the majority of the seals were killed. during the period when most of the ice melted, due to their high specific weight during this period they sank, then surfaced after some time and moved to the south. Seals lie on the edge of the ice, usually with their heads pointed towards the water. Poachers on buoys approach the cluster of animals by 30-40 meters and start shooting, but they rarely manage to make more than two shots: hearing the noise, seals leave the rookery. Very often, the mortally wounded animals manage to jump into the water and immediately go to the bottom. The same fate befalls, in most cases, the animals the industrialists kill while they are afloat, hoping to catch them in the stage of agony. As a result, out of 4-5 seals killed or seriously wounded, the poachers get at best 2-3 animals. Since during the spring fishing up to 30,000 and more seals were harvested per season in the past, the loss was undoubtedly significant: Sunken cadavers do not have time to decompose under water. As gases accumulate in the gastrointestinal system, they float to the surface and, driven by wind and current, are thrown ashore. In cold water in spring, the cadavers may remain submerged, probably for quite a long time, but in summer, as our experiments on 20 labeled cadavers in 1968 showed, they floated for 1 to 3 days.

In contrast to the usual spring-summer ejection of floaters, which usually occurs within the Northern Caspian and partly on the western coast of the Middle Caspian, where dead seals are carried by the western branch of the constant circular current, in late 1955 and early 1956 a mass ejection of floaters was observed on both shores of the Middle and Southern Caspian, which has never been observed before.

From March 3 to 12, 1956, Badamshin surveyed the coast from Chechen Island to the Pervomayskiy fish factory, a total length of about 260 km, and found 108 cadavers. It turned out that the number of dead animals became larger as they moved from north to south. Most of the dead animals were sexually mature individuals. Out of 108 seals, 31 females were pregnant.

According to B.I. Badamshin, based on the size of embryos, the animals dumped on the coast died in late October - early November.

Thus, in the opinion of previous authors, the main cause of seal ejections is the peculiarities of fishing and blasting operations during oil and gas exploration.

Our studies (conducted since 1971 (by me) and earlier since 1961 by D.V. Hajiyev) that there are many reasons for the death of seals:

Seal fishing, its shortcomings and irrationality: first of all, wrong quotas for shooting, as well as low efficiency, in which about 50-60% of all harvested seals are lost.

Poaching: in the past, this involved shooting of seals with shotguns. We have dozens of seals in our collection whose skeletons were shot through with shotgun shells. Illegal fishing of sturgeons with homemade kalads (a huge set of large hooks). In our collection, 20 seals had hooks sticking out of their mouths when they were found on shore. In recent years, as a result of mass poaching and illegal catching of sturgeon with nets, a huge number of seals have been killed: on average, up to 5 seals per net per year, and the nets are both large-mesh and small-mesh. Three seals got entangled in one of the nets and were thrown to the shore in a highly demacerated form together with the net. A certain part of seals are also killed by the hands of oilmen on oil rocks and drilling platforms: in spring-summer, seals often prevent oilmen from fishing and therefore they try to shoot these seals. Besides, in recent years, the seals caught in nets are used by local residents for food: mainly liver and fat, and the pelts are used for making fur hats. Seal fat is particularly valued among the local population (it is considered medicinal and is used for external rubbing). The killing of seals has reached high proportions on Zhilov Island, where it was always possible to buy both seal fat and liver. Besides, a significant part of the population of the island walks in seal hats, and this is despite the fact that there were only two rookeries of Caspian seals in Azerbaijan: Shakhova Spit and Zhilov Island. Only an insignificant part of the seals can sometimes be found on the islands of Malaya Plate and Podplitnoe. The islands of the Baku archipelago, as studies have shown, have not been used as rookeries since 1997, Even during the period of mass spring migration to the south, seals in recent years avoided this group of islands (in our opinion, this is due to constant disturbance, dirty water, decrease in the number of fish in this region due to intensive multi-row net fishing).

Urbanization - in recent years there has been a sharp increase in the number of built-up beaches, which cover the entire perimeter of the Absheron peninsula: service stations are constantly on the coast and with their year-round presence scare away the seals, especially during spring migrations, when hungry and emaciated animals need to go ashore. It is the same all over the Caspian Sea. This is especially true for fishermen. Previously most of the coastal zone and islands of the Caspian Sea were deserted and seals had the opportunity to rest on the shore and coastal rocks during mass migrations. Now fishing enterprises are densely distributed along the entire coast.

Thanks to our long-term observations, as well as according to eyewitnesses, in the 1970-80 and, during spring migration and in summer, seals often came to the beaches of Absheron and coastal rocks. As for recent years, such cases are observed very rarely. Besides, it is a much rarer occasion to see seals in the water area of Absheron and adjacent territories.

Destruction of animals on shore: in 2001 alone, in the Buzovna-Northern GRES monitoring area we found three dead seals with broken skulls, which had been killed by people only recently. According to eyewitnesses, one of the seals in the area of the Northern GRES came ashore in the evening and was caught by local residents and tied to a rock with a rope. Early in the morning, beachgoers passing by broke the skull of a live seal with a stone. The same picture is observed in other regions. First of all, fishermen have a prejudice against Caspian seals, considering it as a competitor and a culprit in dispersing fish schools and eating fish caught in nets. This is why they kills the seals at the first opportunity. The same applies to coastal zone inhabitants, who are frightened by cases of seal attacks on people (and the number of these attacks is sharply exaggerated) and also kill seals at the first opportunity.

APPENDIX 7A – FISHERIES LITERATURE REVIEW

Additions and Changes to the Legislation on Fisheries Introduced in 2019-2023

Additions and amendments to the Law of the Republic of Azerbaijan “On Fishing” (1998):

The implementation of state environmental expertise of objects that can affect the state of fishing bodies, the preparation of environmental impact assessment (EIA) documents in accordance with the Law of the Republic of Azerbaijan “On Environmental Impact Assessment”, as well as cases when environmental impact assessment is not required but there are conditions for conducting state environmental expertise of projects have been determined.

The Law of the Republic of Azerbaijan "On Food Safety" and relevant regulatory acts adopted on the basis of this law are part of the legislation on fisheries.

To issue a fishing ticket, a state duty in the amount determined in accordance with the Law of the Republic of Azerbaijan "On State Duties" is charged.

It has been established that state control in the field of fishing is exercised in accordance with the requirements of the Law of the Republic of Azerbaijan “On the regulation of inspections in the field of entrepreneurship and protection of the interests of entrepreneurs”.

Additions and amendments to the "Types, rates, rules of application of payments for the use of fish and other aquatic bio-resources and penalties for illegal catching of fish and other aquatic bioresources" approved by Resolution No. 146 of the Cabinet of Ministers of the Republic of Azerbaijan dated September 6, 1999:

Additions and amendments to the permissible norms of harmful effects on water bodies, as well as the norms for the release of new, unknown or previously not discharged harmful substances into fishing bodies, are to be agreed with the Ministry of Science and Education of the Republic of Azerbaijan.

The amount of damage to a single fish, aquatic animal and invertebrate, regardless of size and weight, has been approved.

Additions and amendments to the "Procedure for catching fish and other aquatic bioresources" approved by Resolution No. 243 of the Cabinet of Ministers of the Republic of Azerbaijan dated June 2, 2017:

Taking into account Decree No. 476 of the President of the Republic of Azerbaijan dated January 16, 2019 “On measures related to the improvement of the structure and management of the Ministry of Ecology and Natural Resources of the Republic of Azerbaijan”, the name of the Biological Diversity Protection Service under the Ministry of Ecology and Natural Resources was included in the relevant document.

The names of some hunting tools used for hunting fish and other aquatic bioresources have been changed.

The number of documents required in the applications related to the allocation of quotas for catching fish and other aquatic bioresources and the issuance of fishing tickets has been reduced and the deadline for submission applications has been extended by 4 (four) months.

It has been established that the single register of fishing tickets shall be maintained in accordance with the Law of the Republic of Azerbaijan "On Licenses and Permits".

It has been established that quotas should not be allocated if reports on the results of industrial catching of fish and other aquatic bioresources are not submitted.

According to the new conditions and rules for the industrial hunting of fish and other aquatic bioresources, the dimensions of the hunting tools allowed to be used, as well as the places and periods of sport and amateur hunting of fish and other aquatic bioresources, have been clarified.

Local Fishing Vessels

Table 1: List of local fishing vessels (vessels and small boats) authorized to fish commercially in the South Caspian Sea (2024)

Legal entity	Vessel type	Vessel tonnage	Equipment used	Registration port
1. "X.B.İmport" LLC	"SRTM-Lankaran fisherman" "Hazar-10" "Hazar-2"	722 ton 187 ton 86 ton	Pump Pelagic trawl Conic net	Garadagh district
2. "A.Kur Fish" LLC	PTR "Hazar-12" SRTM "Araz-357" PTR "Araz" PTR "Morion"	190 ton 740 ton 187 ton 226 ton	Pelagic trawl Pelagic trawl Conic net Pelagic trawl	Garadagh district
3. "Azbioresurs" LLC	"Sea Star"	398 ton	Pelagic trawl	Garadagh district
4. "Gold Alko" LLC	Wooden boat AMA 5329, ABA 1216 Progress-4AMA 5080, 5179	0.4 ton 0.4 ton	Carp net-20, Shad net -20, seine-6	Salyan district Khidirli village
5. Rustamov Elvin Alibaba	Wooden boat-AMA 5496, 5006	0.8 ton	Seine-8	Salyan district Khidirli village
6. Mustafayev Mammad Zaman	Wooden boat-AMA 5601, progress-4 AMA 5149	0.3 ton 0.4 ton	Carp net-10, seine-4	Salyan district Khidirli village
7. Babayev Rauf Atamali	Wooden boat AMA 5399	0.2 ton	Carp net 5, Shad net 5	Garadagh district
8. Huseynzada Elmar Elman	Ribber boat - ABB 1192	0.2 ton	Carp net-10, Shad net 5	Garadagh district
9. Zulfugarov İmran Mammad	Wooden boat-ACA 4149	0.3 ton	Carp net 5, Shad net 5	Alat settlement
10. Farzaliyev Elchin Yusif	Wooden boat-ABB 1453	0.2 ton	Carp net 5, Shad net 5	Garadagh district

Legal entity	Vessel type	Vessel tonnage	Equipment used	Registration port
11. Garayev Khangulu Imangulu	Wooden boat-ABB 1705	0.3 ton	Seine-2	Alat settlement
12. Aliyev Elman Bilal	Wooden boat-ABA 1603	0.3 ton	Carp net 5, Shad net 5	Garadagh district
13. Bagirov Elchin Abdulmanaf	Wooden boat-ACA 4300	0.5 ton	Venter-5	Alat settlement
14. Hajikhanov Gulverdi Sadig	Wooden boat-ABB 1333	0.3 ton	Seine-2	Alat settlement
15. Huseynova Gulara Gasim	Wooden boat-ABA 1437	0.4 ton	Carp net 5, Shad net 5	Garadagh district
16. Orujaliyev Galib Rustam	Wooden boat-ABB 1328	0.3 ton	Carp net 5, Shad net 5	Alat settlement
17. Bagirov Zulfiyar Abdulali	Wooden boat-67, Progress-4- 34, Progress-2-8, Amur- 4, Voronezh-1, Kazanka-2	Total weight 46.4 ton	Carp net-1115, Shad net-560	Neftchala district
18. Taghiyev Vagif Rza	Wooden boat-79, Progress-4- 57, Progress-2-4, Amur- 7, Yuzhanka-4, Kazanka-4, Dnepr-1	Total weight 75.2 ton	Carp net-1230, Shad net-1230, Seine-15	Lankaran and Astara districts
19. "Azproduct" LLC	2 Wooden boats AMA 5167,5168	0.6 ton	Shad net-5, Seine-4	Neftchala district

Fishing Quota

Table 2: Fishing quota allocated to fisheries (2024)

Legal entity	Fishing volume	Species
A.Kur.Fish MMC	1050 ton	Sprat
XB.İmport MMC	220 ton	Sprat
Rustamov Elvin Alibaba	1.5 ton	Shad, Black Sea roach, leaping grey, roach, common carp, bream
Baghirov Zulfiyar Abdulali	73.58 ton	Shad, Black Sea roach, leaping grey, roach, common carp, bream, sprat
Taghiyev Vagif Rza	62.93 ton	Shad, Black Sea roach, leaping grey, roach, common carp, bream, sprat
Aghayev Miraskar Mirhuseyn	0.3 ton	Shrimp
Orujaliyev Galib Rustam	0.5 ton	Shad, Black Sea roach, leaping grey, roach, common carp, bream
Hajaliyeva Maya Sabirovna	1.5 ton	Shad, Black Sea roach, leaping grey, roach, common carp, bream, Zahrte
Aliyev Rahib Suleyman	0.6 ton	Shad, Black Sea roach, leaping grey, roach, common carp, bream
Balakishiyev Javad Hagverdi	0.55 ton	Shad, Black Sea roach, leaping grey, roach, common carp
Isgandarov Tabriz Saleh	2.5 ton	Shad, Black Sea roach, leaping grey, roach, common carp, bream
Huseynov Parviz Kitabir	0.75 ton	Shad, Black Sea roach, leaping grey, roach, crayfish, shrimp
Amrahov Mammad Ali	0.45 ton	Shad, Black Sea roach, leaping grey, roach
Safarov Rasim Nadir	0.9 ton	Shad, Black Sea roach, leaping grey, roach, common carp, bream, Zahrte
Abdullayev Rashad Arif	1.8 ton	Shad, Black Sea roach, leaping grey, roach, common carp
Gafarov Ruslan Ogtay	1.3 ton	Shad, Black Sea roach, leaping grey, roach, common carp, Danubian bleak
Valiyev Sakit Maharram	0.45 ton	Shad, Black Sea roach, leaping grey, roach
Maharramov Shirali Galib	0.5 ton	Shad, Black Sea roach, leaping grey, roach
Mustafayev Mammad Zaman	1.5 ton	Shad, Black Sea roach, leaping grey, roach, common carp, bream
Mirzayev Ali Maharram	0.7 ton	Shad, Black Sea roach, leaping grey, roach
Guliyev Faig İbad	0.2 ton	Shad, Black Sea roach, leaping grey
Huseynova Gulara Gasim	0.8 ton	Shad, Black Sea roach, leaping grey, roach, common carp, shrimp
Goychayev Hashim Akif	0.8 ton	Shad, Black Sea roach, leaping grey, roach, common carp, Zahrte
Damirov Rahib Anvar	0.75 ton	Shad, Black Sea roach, leaping grey, roach, common carp
Yariyev Anar Sarkhan	0.7 ton	Shad, Black Sea roach, leaping grey, roach

Legal entity	Fishing volume	Species
Pashayev Asif Ashraf	0.6 ton	Shad, Black Sea roach, leaping grey, roach, Zahrte
Muradov Elchin Atamali	0.75 ton	Shad, Black Sea roach, leaping grey, roach, common carp
Aliyev Fazil Asafovich	0.55 ton	Shad, Black Sea roach, leaping grey, roach
Majidov Vugar Yashar	0.9 ton	Shad, Black Sea roach, leaping grey, roach
Gasimov Zaur Aladdin	0.9 ton	Shad, Black Sea roach, leaping grey, roach
İmanov Arif Farrukh	0.6 ton	Shad, Black Sea roach, leaping grey, roach
Maharramov İlham Ahmad	0.55 ton	Shad, Black Sea roach, leaping grey, roach
Hamzayev Gabil Kamil	0.69 ton	Shad, Black Sea roach, leaping grey, roach
İsmayilov Kanan Musa	0.55 ton	Shad, Black Sea roach, leaping grey, roach, common carp
Bakhshiyev Eynulla Rafig	0.3 ton	Shad, Black Sea roach, leaping grey, roach
Jabrayilov Mansur Jabrayil	0.5 ton	Shad, Black Sea roach, leaping grey, roach
Abdullayev Anar Abdulla	1.5 ton	Shad, Black Sea roach, leaping grey, roach
Ashrafov Azar Garib	0.55 ton	Shad, Black Sea roach, leaping grey, roach
Aliyev Zohrab Aghalar	0.55 ton	Shad, Black Sea roach, leaping grey, roach
Kalbikhanov Takhir Kalbikhan	1.5 ton	Shad, Black Sea roach, leaping grey, roach, Danubian bleak
Guliyev Hidayat Sabir	0.2 ton	Shad, Black Sea roach, leaping grey, roach
Babayev Rauf Atamali	0.6 ton	Shad, Black Sea roach, leaping grey, roach, common carp
Mayilov Guloghlan Akbar	0.5 ton	Shad, Black Sea roach, leaping grey, roach, common carp
Babayev Anar Absaladdin	0.6 ton	Shad, Black Sea roach, leaping grey, roach, common carp
Vahabov Alasgar Vahab	0.4 ton	Shad, Black Sea roach, leaping grey, roach
Zulfgarov İmran Alimammad	0.45 ton	Shad, Black Sea roach, leaping grey, roach, common carp
Mammadov Nizami Sayad	0.7 ton	Shad, Black Sea roach, leaping grey, roach, common carp
GOLD ALKO MMC	3.3 ton	Shad, Black Sea roach, leaping grey, roach, common carp, sprat
AZPRODUCT MMC	21.8 ton	Shad, Black Sea roach, leaping grey, roach, common carp, sprat
AZBİORESURS MMC	1000 ton	Sprat
Malikov Malik Mirzammad	0.65 ton	Shad, Black Sea roach, leaping grey, roach
Farhadov Telman Yashar	1.5 ton	Shad, Black Sea roach, leaping grey, roach, bream
Mammadov Faig Aghaqulu	0.45 ton	Shad, Black Sea roach, leaping grey, roach, bream
Suleymanov Ahmad Huseynkhan	0.3 ton	Shad, Black Sea roach, leaping grey, roach
Babakishiyev Tofig Babakishi	0.5 ton	Shad, Black Sea roach, leaping grey, roach
Niftaliyev Vugar Allahverdi	0.4 ton	Shad, Black Sea roach, leaping grey, roach

Legal entity	Fishing volume	Species
Bakhishov Shahverdi Aliagha	0.4 ton	Shad, Black Sea roach, leaping grey, roach, common carp
Mammadov Aghaali Oruj	0.8 ton	Shad, Black Sea roach, leaping grey, roach, bream
Mammadov Khoshbakht Zulfugar	4.7 ton	Shad, Black Sea roach, leaping grey, roach, common carp
Guliyev Rasim Eynulla	0.45 ton	Shad, Black Sea roach, leaping grey, roach, Zahrte
Aliyev Samir Sardar	0.35 ton	Shad, Black Sea roach, leaping grey, roach
Hasanov Nacaf Qulu Hasan Abdul	0.6 ton	Shad, Black Sea roach, leaping grey, roach
Aliyev Azizagha Abdul	1.25 ton	Shad, Black Sea roach, leaping grey, common carp, Danubian bleak
Nabizada Vagif Vahid	0.55 ton	Shad, Black Sea roach, leaping grey, roach, Zahrte
Musayev Abulfat Ali	0.4 ton	Shad, Black Sea roach, leaping grey, roach, Zahrte
Aliyev Elmaddin Alixan	0.65 ton	Shad, Black Sea roach, leaping grey, roach, Zahrte
Gurbanov Alimirza Ogtay	0.65 ton	Shad, Black Sea roach, leaping grey, roach
Rasulov Zabil Aziz	1.05 ton	Shad, Black Sea roach, leaping grey, roach, common carp
Aliaskarov Samir Arif	0.7 ton	Shad, Black Sea roach, leaping grey, roach, Zahrte
Babayev Sahib Sofi	0.35 ton	Shad, Black Sea roach, leaping grey, roach
Huseynov Kamran Muslum	0.65 ton	Shad, Black Sea roach, leaping grey, roach
Balakhayev Gabil Kamal	1.35 ton	Shad, Black Sea roach, leaping grey, common carp, Danubian bleak
Shoshanov İntiqam Kamil	0.5 ton	Shad, Black Sea roach, leaping grey, roach
Majidov İsmayil Ahmad	0.7 ton	Shad, Black Sea roach, leaping grey, roach
Babayev Yashar Mahid	0.7 ton	Shad, Black Sea roach, leaping grey, roach, common carp
Tahirov Jamil Soltan	0.35 ton	Shad, Black Sea roach, leaping grey, roach
Muradov Ramin Tahir	1.26	Shad, Black Sea roach, leaping grey, roach
Jabrayilov Bahram Jabrayil	0.4 ton	Shad, Black Sea roach, leaping grey, roach, common carp
Jafarov Elshan Firdovsi	0.75 ton	Shad, Black Sea roach, leaping grey, roach, common carp
Malikov Elshan Alish	0.7 ton	Shad, Black Sea roach, leaping grey, roach
Rajabov Seyfulla Amirulla	5.06 ton	Shad, Black Sea roach, leaping grey, roach, Zahrte
Ganiyev Abas Umudali	0.45 ton	Shad, Black Sea roach, leaping grey, roach
Movsumov Zaur Kanal	0.6 ton	Shad, Black Sea roach, leaping grey, roach
Almammadov Emin Khagani	1.5 ton	Shad, Black Sea roach, leaping grey, roach
Azayev Tahir Balaoghlan	1.3 ton	Shad, Black Sea roach, leaping grey, roach

Legal entity	Fishing volume	Species
Azayev Seymur Aflatun	0.55 ton	Shad, Black Sea roach, leaping grey, roach, common carp, bream
Taghiyev Kichibay Gasimovich	1.1 ton	Shad, Black Sea roach, leaping grey, roach, Danubian bleak
Malikov Bayram Abdulfaz	0.45 ton	Shad, Black Sea roach, leaping grey, roach
Yusibov Sarkhan Amirkhan	0.7 ton	Shad, Black Sea roach, leaping grey, roach
Gurbanov Eldar Meybulla	0.7 ton	Shad, Black Sea roach, leaping grey, roach
Huseynzada Elmar Elman	0.6 ton	Shad, Black Sea roach, leaping grey, roach
Osmanov Gahil Ramiz	1.1 ton	Shad, Black Sea roach, leaping grey, roach
Maharramov Rafig Adil	0.65 ton	Shad, Black Sea roach, leaping grey, roach
Baluyev Oleq Nikolayevich	0.8 ton	Shad, Black Sea roach, leaping grey, roach, common carp
Shirinov Mail Najmaddin	0.5 ton	Shad, Black Sea roach, leaping grey, roach
Mirzayev Bakhtiyar Aligaib	0.6 ton	Shad, Black Sea roach, leaping grey, roach, Zahrte
Mirzayev Ramil Aligaib	0.9 ton	Shad, Black Sea roach, leaping grey, roach, Zahrte
Madatov İlgar Mildan	1.4 ton	Shad, Black Sea roach, leaping grey, roach, common carp
Aliyev Abdulla Balagardashevich	0.6 ton	Shad, Black Sea roach, leaping grey, roach
Yusifov Tahir İman	0.5 ton	Shad, Black Sea roach, leaping grey, roach, Zahrte
Alasgarov Ali Alasgar	0.7 ton	Shad, Black Sea roach, leaping grey, roach, common carp
Mitrofanov Yevqeniy Anatolyevich	0.5 ton	Shad, Black Sea roach, leaping grey, roach
Ahmadov Ziyad Alikarim	0.4 ton	Shad, Black Sea roach, leaping grey, roach
Azizova Samira Fakhraddin	0.65 ton	Shad, Black Sea roach, leaping grey, Danubian bleak
Gulmaliyev Tural Sahib	0.7 ton	Shad, Black Sea roach, leaping grey, roach, Danubian bleak
Akbarov Yahya Shafaqat	0.35 ton	Shad, Black Sea roach, leaping grey, roach, common carp
Asgarov Asad Balakishi	0.4 ton	Shad, Black Sea roach, leaping grey, roach
Mammadov Rafael Ogtay	0.4 ton	Shad, Black Sea roach, leaping grey, roach
Abdullayev Elman Alas	0.65 ton	Shad, Black Sea roach, leaping grey, roach
Akbarov Yahya Ehtibar	0.4 ton	Shad, Black Sea roach, leaping grey, roach
Taghiyev Balabay Aghami	0.8 ton	Shad, Black Sea roach, leaping grey, roach, Zahrte
Zakizada Asif Zakariyya	0.8 ton	Shad, Black Sea roach, leaping grey, roach, Zahrte, Danubian bleak
Musayev Oktay Novruz	0.65 ton	Shad, Black Sea roach, leaping grey, roach
Najafov Elnur Muzaffar	0.6 ton	Shad, Black Sea roach, leaping grey, roach
Aghayev Galib Hashim	1.15 ton	Shad, Black Sea roach, leaping grey, roach
Aliyev Elman Bilal	0.45 ton	Shad, Black Sea roach, leaping grey, roach

Legal entity	Fishing volume	Species
Garayev Khanqulu İmangulu	0.75 ton	Shad, Black Sea roach, leaping grey, roach
Pashayev Rauf Hasanagha	0.6 ton	Shad, Black Sea roach, leaping grey, roach
Mammadov Azar Nuru	1.2 ton	Shad, Black Sea roach, leaping grey, roach, common carp, bream
Pashayev Adil Hasanagha	0.4 ton	Shad, Black Sea roach, leaping grey, roach, common carp
Azimov Telman İmran	0.5 ton	Shad, Black Sea roach, leaping grey, roach, common carp
Aliyev Shakir Nushravan	0.35 ton	Shad, Black Sea roach, leaping grey, roach
Mehdiyev Kamal Miryavar	1.85 ton	Shad, Black Sea roach, leaping grey, roach
Hasanov İsmayil Ehtibar	1.5 ton	Shad, Black Sea roach, leaping grey, roach
Aghayev Mammadagha Aghaverdi	1.25 ton	Shad, Black Sea roach, leaping grey, roach, common carp
Javadov Vidadi Hasan	0.45 ton	Shad, Black Sea roach, leaping grey, roach
Farzaliyev Elchin Yusif	0.7 ton	Shad, Black Sea roach, leaping grey, roach
Karimova Elnara Shamsaddin	0.6 ton	Shad, Black Sea roach, leaping grey, roach, Danubian bleak
Sharifov İlqar Elshad	0.35 ton	Shad, Black Sea roach, leaping grey, roach, Danubian bleak, common carp
Sharifov Ahmadxan Shafi	1.05 ton	Shad, Black Sea roach, leaping grey, roach
Ahmadov Aslan Rza	0.4 ton	Shad, Black Sea roach, leaping grey, roach
Bayramov Yusif Gulbala	0.4 ton	Shad, Black Sea roach, leaping grey, roach
Akbarov Akbar Ehtibar	1.05 ton	Shad, Black Sea roach, leaping grey, roach, Danubian bleak
Rustamov Akbar Habib	0.8 ton	Shad, Black Sea roach, leaping grey, roach, common carp, shrimp
Abdullayev Rashad Arif	0.8 ton	Shad, Black Sea roach, leaping grey, roach, common carp
Guliyev Shamil Gurban	0.5 ton	Shad, Black Sea roach, leaping grey, roach, common carp
Hummatov Amil Gojabay	1.3 ton	Shad, Black Sea roach, leaping grey, roach
Eyvazov Royal Kazim	0.5 ton	Shad, Black Sea roach, leaping grey, roach
Huseynov Bahruz Kamil	0.45 ton	Shad, Black Sea roach, leaping grey, roach
Safarov Zamin Alif	0.65 ton	Shad, Black Sea roach, leaping grey, roach
Yusubov Shahin Yusif	0.1 ton	Shrimp
Amiraslanov Jabrayil Elbadi	0.65 ton	Shad, Black Sea roach, leaping grey, roach
Gurbanov Aflatun Gurban	0.7 ton	Shad, Black Sea roach, leaping grey, roach
Zeynalov Jabbar Gulam	0.65 ton	Shad, Black Sea roach, leaping grey, roach
Najafov Aman Najafali	1.95 ton	Shad, Black Sea roach, leaping grey, roach
Mammadov Parviz Mammadagha	0.55 ton	Shad, Black Sea roach, leaping grey, roach, common carp, bream
Gurbanov Agha Aghadayi	0.4 ton	Shad, Black Sea roach, leaping grey, roach

Legal entity	Fishing volume	Species
Gurbanov Rashad Aghaali	1.1 ton	Shad, Black Sea roach, leaping grey, roach, common carp
Aliyev Sabir Ramazan	0.65 ton	Shad, Black Sea roach, leaping grey, roach
Abdullayev Fursant Xanbala	0.65 ton	Shad, Black Sea roach, leaping grey, roach
Mammadov Saleh Anvar	0.7 ton	Shad, Black Sea roach, leaping grey, roach
Gurbanov Nazim Kasir	0.7 ton	Shad, Black Sea roach, leaping grey, roach
Shahbazov Faxraddin Shirali	1.4 ton	Shad, Black Sea roach, leaping grey, roach
Karimov Zahid Namaz	0.38 ton	Shad, Black Sea roach, leaping grey, roach
Huseynov Aghalar Suleyman	1.1 ton	Shad, Black Sea roach, leaping grey, roach
Guliyev Nizami Farhad	1.3 ton	Shad, Black Sea roach, leaping grey, roach
Abdullayev Elnur Abit	0.95 ton	Shad, Black Sea roach, leaping grey, roach
Guluzada Alakbar Malik	0.65 ton	Shad, Black Sea roach, leaping grey, roach
Eyvazov Farhad Shirinbala	0.2 ton	Black Sea roach, leaping grey
İmanov Vusal Mahammad	1.95 ton	Shad, Black Sea roach, leaping grey, roach
Aliyev Farhad Camal	0.4 ton	Shad, Black Sea roach, leaping grey, roach, common carp
Jabiyev Nizami Gardashagha	0.7 ton	Shad, Black Sea roach, leaping grey, roach, common carp
Shikhaliyev Jeyhun Suleyman	2.1 ton	Shad, Black Sea roach, leaping grey, roach, bream
Abbasov Taghi Tarlan	0.85 ton	Shad, Black Sea roach, leaping grey, roach, common carp
Madatov Samin Nuragha	0.45 ton	Shad, Black Sea roach, leaping grey, roach
Abdullayev Fikrat Soltanahmad	0.35 ton	Shad, Black Sea roach, leaping grey, roach
Huseynov Amiraslan Muxtar	0.8 ton	Shad, Black Sea roach, leaping grey, roach, common carp
Guliyev Zahid Qulu	0.6 ton	Shad, Black Sea roach, leaping grey, roach
Nasirov Nasir Mammad	0.45 ton	Shad, Black Sea roach, leaping grey, roach
Aghayev Miraskar Mirhuseyn	0.45 ton	Shad, Black Sea roach, leaping grey, roach
Mammadov Pasha Nuru	0.55 ton	Shad, Black Sea roach, leaping grey, roach
İmanov Adgozal Alimirza	0.4 ton	Shad, Black Sea roach, leaping grey, roach
Azimov Namiq Yahya	0.6 ton	Shad, Black Sea roach, leaping grey, roach
Karimov Tarlan Muxtar	0.35 ton	Shad, Black Sea roach, leaping grey, roach
Heydarov Nofal Nariman	0.1 ton	shrimp
Aliyev Emil Aliniyyat	0.4 ton	Shad, Black Sea roach, leaping grey, roach
Shahbazov Fakhraddin Shirali	0.7 ton	Shad, Black Sea roach, leaping grey, roach, bream
Mikayilov Tarlan İsag	1.95 ton	Shad, Black Sea roach, leaping grey, roach
Farhadov Aghami Shirin	2 ton	Shad, Black Sea roach, leaping grey, roach
Safarov Elmar Garibshah	0.4 ton	Shad, Black Sea roach, leaping grey, roach
Ganiyev Namig Ali	0.85 ton	Shad, Black Sea roach, leaping grey, roach, common carp

Legal entity	Fishing volume	Species
Azizov Gudrat Ayaddin	0.75 ton	Shad, Black Sea roach, leaping grey, roach
Sultanov Aleksandr Vahidinovich	0.35 ton	Shad, Black Sea roach, leaping grey, roach
Abdulrahimov Emil Yaqub	0.5 ton	Shad, Black Sea roach, leaping grey, roach
Fedorishov Anar Borisovich	1.2 ton	Shad, Black Sea roach, leaping grey, roach
Huseynaliyev Mehman Pasha	0.6 ton	Shad, Black Sea roach, leaping grey, roach, Zahrte
Mammadov Mahir Nuru	0.45 ton	Shad, Black Sea roach, leaping grey, roach, common carp, bream
Huseynov Vagif Asgar	0.15 ton	Shrimp
Baghirov Aqil Afsar	0.1 ton	Shrimp
Mammadov Garib Anvar	0.25 ton	Shad, Black Sea roach, leaping grey, roach
Alakbarov Raji Alikiram	0.6 ton	Shad, Black Sea roach, leaping grey, roach
Nahirmanov Ehtiram Eynulla	0.65 ton	Shad, Black Sea roach, leaping grey, roach
Baghirov Elchin Abdulmanaf	0.1 ton	Shrimp
Naghiyev Bahruz Balaoghlan	1.4 ton	Shad, Black Sea roach, leaping grey, roach
Hagverdiyev Sahil İgid	0.45 ton	Shad, Black Sea roach, leaping grey, roach
Hajikhanov Gulverdi Aghasadig	0.55 ton	Shad, Black Sea roach, leaping grey, roach, common carp, bream
İsmayilov Bahram Mammadali	0.65 ton	Shad, Black Sea roach, leaping grey, roach, common carp
Mammadov Mubariz Mammadtaghi	1.1 ton	Shad, Black Sea roach, leaping grey, roach, common carp
Aliyev Alisan Alidadash	1.4 ton	Shad, Black Sea roach, leaping grey, roach, common carp
Mammadov Khanlar Shaban	0.69 ton	Shad, Black Sea roach, leaping grey, roach
Gurbanov Ramil Vasif	0.65 ton	Shad, Black Sea roach, leaping grey, roach, common carp
Amiraslanov Tural Bulud	1.35 ton	Shad, Black Sea roach, leaping grey, roach, common carp

Aquatic Catch in the Caspian Sea

Table 3: Fish and other aquatic bioresource caught in the Caspian Sea in 2023

Species	Fishing volume (ton)
1. Sprat	2300
2. Shad	79.12
3. Black Sea roach	84.07
4. Roach	40
5. Common carp	19.17
6. Bream	2.9
7. Zahrte	2.05
8. Danubian bleak	1
9. Leaping grey	73.66
10. Crayfish	0.5
11. Shrimp	1.2

Azerbaijan Sector of the Caspian Sea

Table 4: Number of fisheries and vessels in the Azerbaijan sector of the Caspian Sea (2024)

Number of fisheries	Vessels	Small boats
209	8	668

Legislation Violations

Table 5: Republic of Azerbaijan data on the protection of aquatic bioresources: Number of violations of legislation on fisheries (2023)

Results of measures to protect aquatic bioresources	Unit of measure	Year: 2023
Number of violations of legislation on fisheries	Number	223
Number of people held accountable	People	217
Number of confiscated boats	Number	26
Number of confiscated illegal fishing gear	Number	Nets – 893 40,118 meters in length
Number of fish species confiscated	Number	32
Amount of claims filed ($1=AZN 1.7)	AZN	AZN 161,012 = $94,713.00

Commercial Fishing

Table 6: Commercial fishing locations

Place	Number of vessels	Number of small boats
1. Pirallahi settlement		21
2. Turkan settlement		6
3. Gurgan settlement		8
4. Buzovna settlement		4
5. Bilgah settlement		8
6. Mardakan settlement		2
7. Pirshaghi settlement		5
8. Zira settlement		7
9. Hovsan settlement		11
10. Sabayil district		4
11. Lokbatan settlement		2
12. Alat settlement	8	16
13. Sangachal settlement		1
14. Salyan district		12
15. Neftchala district		137
16. Lankaran-Astara district		156
Total	8	390

Makarov Bank is the closest fishing area to the propose cable route from SD compressor platform to the Sangachal Terminal. Licensed fishing in the Makarov Bank area is not carried out, as this area is located at a distance beyond the permit for fishing by small-sized fleet (boats) and is not accessible. With the help of small-sized fleet (boats) coastal (small-scale) fishing is carried out – catch of particle fish (herring, mullet, roach, bream, Black Sea roach, carp, redfish, Danubian bleak) only within a 2-3-mile zone from the coastline. Beyond this line fishing is not allowed. Therefore, the Makarov Bank area is legally inaccessible for fishing by small vessels (boats). Large-capacity vessels (deep-sea fishing), which are only licensed to catch sprat, have not carried out fishing in the Makarov Bank in recent years either. Until 2017, commercial fishing of common (inshore) sprat was carried out from October through March south and southwest of Zhiloy Island to Makarov Bank (at depths of 20-40 m) by a large-capacity vessel “Shakhriyar” owned by Caspian Fish Co. Azerbaijan”. At present, there is no fishing in the Makarov Bank area by large-capacity vessels. Since this water area of the Southern Caspian is no longer important for commercial fishing, the stocks of fish species occurring here are recorded in sporadic quantities and have no commercial value. In addition, in the last 10-15 years, due to a significant decline in commercial stocks of anchovy sprat (by 10 times), commercial fishing has been specialized on common (coastal) sprat in shallow waters of 30-40 meters, maximum 60-70 meters, mainly in the area of Andreyev, Kornilov-Pavlov and Karagedov banks. These waters are located at a distance of 100-120 km west-southwest of the Contract Area. Thus, no small fishing fleet (boats) or large fishing vessels (deep-sea fishing) are used or encountered in Makarov Bank.

Table 7: Fishing entities awarded licences for commercial fishing in Sangachal-Gobustan area alongside specific fishing quotas in the area (2024)

Name	Quota for fish species
1. Babayev Rauf Atamali oglu	Shad – 1.1 ton; Black Sea roach – 1.4 ton; Leaping grey – 1.4 ton; Roach – 0.4 ton; Common carp – 0.5 ton; Bream – 0.3 ton; Shrimp – 0.45 ton;
2. Huseynzada Elmar Elman oglu	
3. Zulfuqarov İmran Mammad oglu	
4. Farzaliyev Elchin Yusif oglu	
5. Garayev Khangulu Imangulu oglu	
6. Aliyev Elman Bilal oglu	
7. Baghirov Elchin Abdulmanaf oglu	
8. Hajikhanov Gulverdi Sadig oglu	
9. Huseynova Gulara Gasim gizi	
10. Orujaliyev Galib Rustam oglu	
11. Baghirov Agil Afsar oglu	
12. Huseynov Vagif Asgar oglu	

The preferred fish species are Black Sea roach, leaping grey, shad and roach.

According to the legislation on fisheries, a ban on industrial fishing (on quota) is applied in the Caspian Sea from May 1 to September 1. During the rest of the year, approximately 70-80% of the quota is taken in autumn (September-October) and spring (March-April).

Recreational Fishing

According to the country's fishing legislation, from May 1 to June 30, there is a ban on sport and recreational fishing in the Caspian Sea, including the waters of the Sangachal Bay. During the legal fishing period, the greatest sport and recreational fishing activity (hook and spinning) is observed in September-October and March-April. The main objects of fishing (fish species) are mullet, roach, bream, Black Sea roach, carp, redfish and Danubian bleak. Sport and recreational fishing (hook and spinning) in the water area of Sangachal Bay is carried out from the seashore to the north of the cave about 1 km and above. This type of fishing is also carried out from inflatable boats (length up to 3-4 meters) equipped with a motor. Permission for these boats to go out to sea is issued by representatives of the Border Guard Service (berth No. 37) within a 2-mile zone from the shoreline. One to four inflatable boats with a motor can go out daily for the purpose of sport and recreational fishing in different seasons of the year, mainly in September-October and March-April.

APPENDIX 8A - SCOPING CONSULTATION PRESENTATION & MEETING MINUTES

SHAH DENIZ COMPRESSION PROJECT

Environmental and Socio-economic Impact Assessment (ESIA) Scoping Meeting with MENR

Date: 3 June 2024	**Time**: 15:00 – 17:00	**Venue**: Expertise Department of MENR

Attendees:

BP	MENR
Bagir Akhundov, Project Manager	Mirsalam Ganbarov, Chairman of the Board of the State Environmental Expertise Agency
Saadat Gaffarova, Sr E&S Advisor	Mubariz Aliyev, Head of Project and environmental-normative documents expertise sector of the State Environmental Expertise Agency of the Ministry of Ecology and Natural Resources of the Republic of Azerbaijan
Zaur Hasanov, Projects E&S Lead	Konul Ahmadsoy, Project and environmental-normative documents expertise sector of the State Environmental Expertise Agency of the Ministry of Ecology and Natural Resources of the Republic of Azerbaijan, senior specialist
Eldar Alakbarov, Projects E&S Advisor	Valeh Karimov, Specialist from Offshore Monitoring Department
RSK	Ramila Butayeva, Project and environmental-normative documents expertise sector of the State Environmental Expertise Agency of the Ministry of Ecology and Natural Resources of the Republic of Azerbaijan, specialist
Ulviyya Seidmamedova, E&S consultant	

Summary of the discussion:

The ESIA scoping meeting started with introduction of participants and followed with a presentation of ESIA scoping approach suggested by BP. Attached presentation pack was used during the meeting. MENR representatives asked questions and provided comments as presentation progressed. Below is the summary of the discussion:
Questions and Answers:
<u>MENR Q1:</u> Please explain how compression will work on this project? What will be its function and benefits? <u>BP Response</u>: *Since the start of production from the Shah Deniz field the pressure has been naturally dropping in the reservoir. Gas compression has been widely adopted by the petroleum industry and is validated as a reliable method for improving reserves base. As depletion drive gas fields mature, their reservoir pressure declines with an associated reduction in gas production rates. This phenomenon is even more pronounced in fields where aquifer water breaks through and results in rapidly falling well head pressures which naturally result in reduced reserves recovery over the producing life of the field. Compression platform near producing platform elongates well and field life resulting in tapping additional reserves, which may be left behind in case surface compression facilities are not put in place in a timely and phased manner.* *Availability of compression facility aids consolidation of large gas volumes produced via SDA and SDB wellheads at lower pressures into a high-pressure stream. This is done by eliminating pressure barrier in the production system or, in other words, dropping backpressure in the system. Compressor stations are built in intervals along the pipeline route (e.g. number of compressor stations on the South Caucasian Pipeline (SCP)) to keep the gas moving toward its ultimate destination. SDC Platform is literally introducing another station closer to the producing asset, and provides the driving force to keep the gas moving down the line.* **<u>MENR Q2:</u> Venting is area of concern. Can venting be avoided? What are the periods of venting, its duration and estimated volumes. Why not to burn emitted gases?** <u>BP Response:</u> *The process facility on SDC platform are being designed to minimise cold venting requirements. Cold vent system will only be in operation during planned maintenance campaigns when breaking of containment is needed and local isolations are introduced. Introducing fully rated flare relief system will compromise the concept of unattended installation as it would naturally introduce higher maintenance regime for associated systems. Additionally, fully rated flare relief system to stay compliant with minimal emissions agenda will need to be N2 purged resulting in higher energy consumption and continuous flare pilots to operate.* **<u>MENR Q3:</u> Confirm if the cable route onshore will also be following the existing pipelines corridor.** <u>BP Response:</u> *Current arrangement is that cable lay activities will be conducted within existing SD pipeline corridor.*

MENR Q4: Will biocides be discharged as part of project activities?

BP Response: *No biocide discharge to environment is planned during onshore commissioning phase of the project. Hydrotest water containing biocide in it will be collected and taken off site to an approved third-party disposal facility. All waste water shipments will be documented.*

MENR Q5: How the platform will be accessed? Will there be helipad? How platform will be accessed if incident happens?

BP Response: *Access to the platform during commissioning hook-up and operate stages will be with use of marine vessels only. Helideck is not provided. The nature of the eNUI facility is such that it envisages only planned maintenance campaigns on a pre-defined periods and will be limited to a series of daily trips to the offshore installation. The platform will be fully controlled and monitored remotely from Sangachal terminal. To enable flexibility in access – the project will provide at least 2 locations for both boat landing platforms and 2 ampelmann v-docks. AGT Regional Emergency Response plan will be updated to consider specifics of eNUI operation towards the end of Define stage.*

MENR Q6: Will there be a finger piers to lay the cable in nearshore? If yes, how soil will be managed?

BP Response: *Design of the finger piers including related dimensions and volumes of the soil is currently under development. All works will be arranged and conducted in line with similar arrangement made for previous projects with a minimum impact to marine flora and fauna.*

MENR Q7: What sources bp used to inform about the ESIA? Only literature review or any site surveys are also planned?

BP Response: *As part of Project ESIA development, BP initiated focused literature review by local experts to provide latest information and status on ornithology, fish and fisheries and Caspian seal. This was complimented by information available in open sources as well as obtained during the progression of past projects were used to inform the ESIA. Moreover, bp completed offshore environmental survey at and around the proposed platform location. There will also be modelling studies such as: onshore air quality, terrestrial noise, underwater sound, infield pipeline installation and pre-commissioning discharges.*

Shah Deniz Compression (SDC) Project ESIA

Scoping Meeting

June 2024

P&O
production & operations

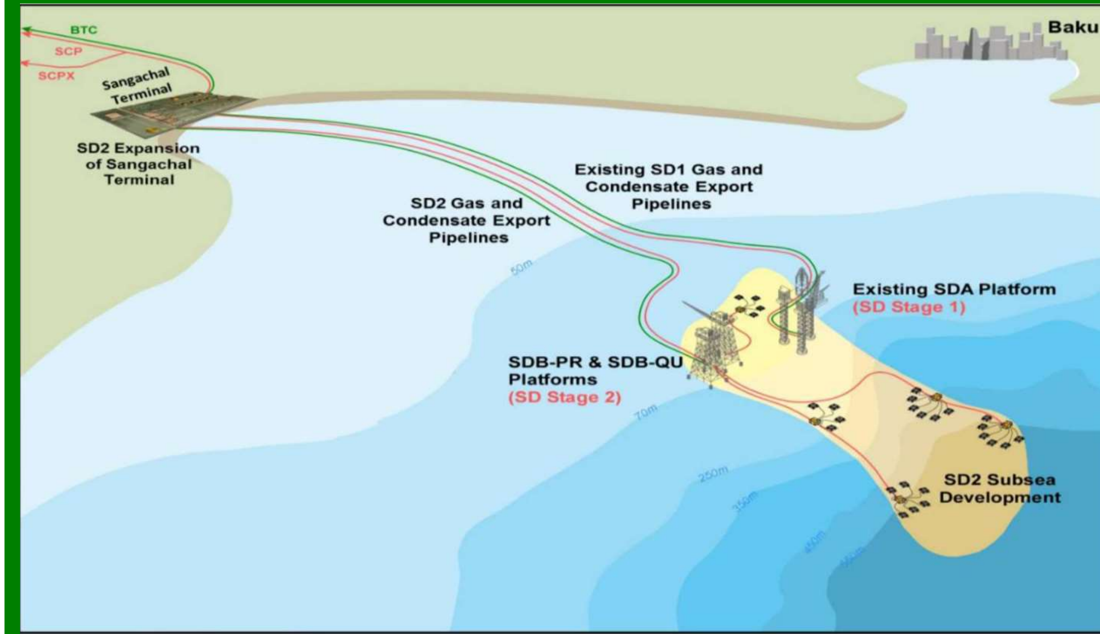
Background

The Shah Deniz Production Sharing Agreement was signed in October 1996 between a consortium of foreign oil companies (with BP as operator) and SOCAR.

The PSA passed into Azerbaijan law and grants the consortium the rights to develop and manage hydrocarbon reserves within the Shah Deniz Contract Area.

The Contract Area has been developed in phases, with Shah Deniz Stage 1 and Shah Deniz Stage 2 now both producing gas and condensate from the Shah Deniz Alpha and Shah Deniz Bravo platforms.

The Shah Deniz Compression project follows on from previous phases and involves the installation of an offshore compression platform and associated facilities, to enable further gas to be extracted and processed from the field.



Existing Shah Deniz facilities and infrastructure

P&O

Purpose

The purpose of this scoping meeting is to:

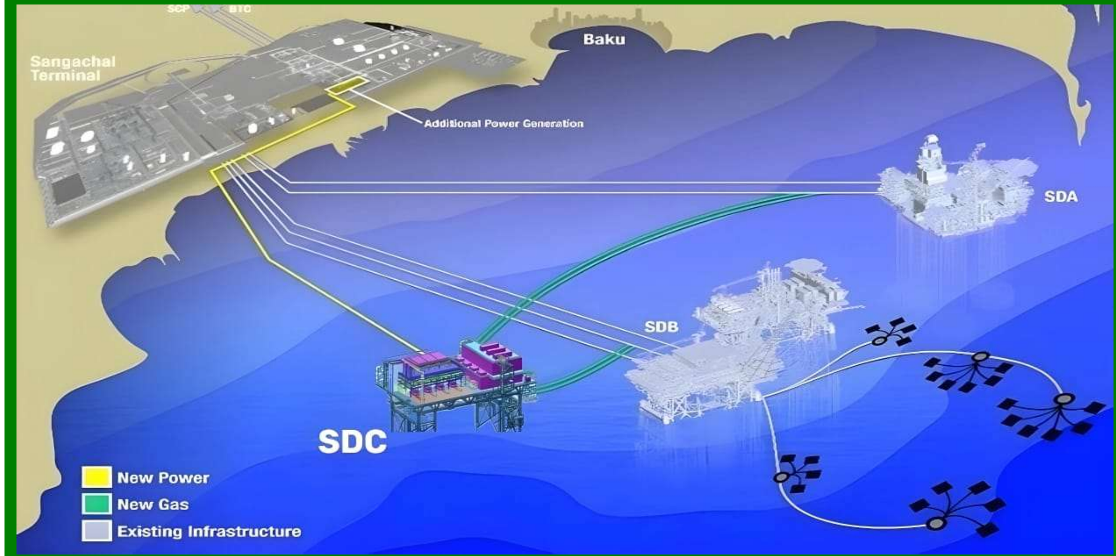
- Provide an overview of the proposed SDC project
- Present an overview of the environmental and socio-economic baseline within the project area based on a review of available sources of information
- Set out the proposed scope of the SDC project Environmental and Socio-economic Impact Assessment (ESIA).

P&O

Overview

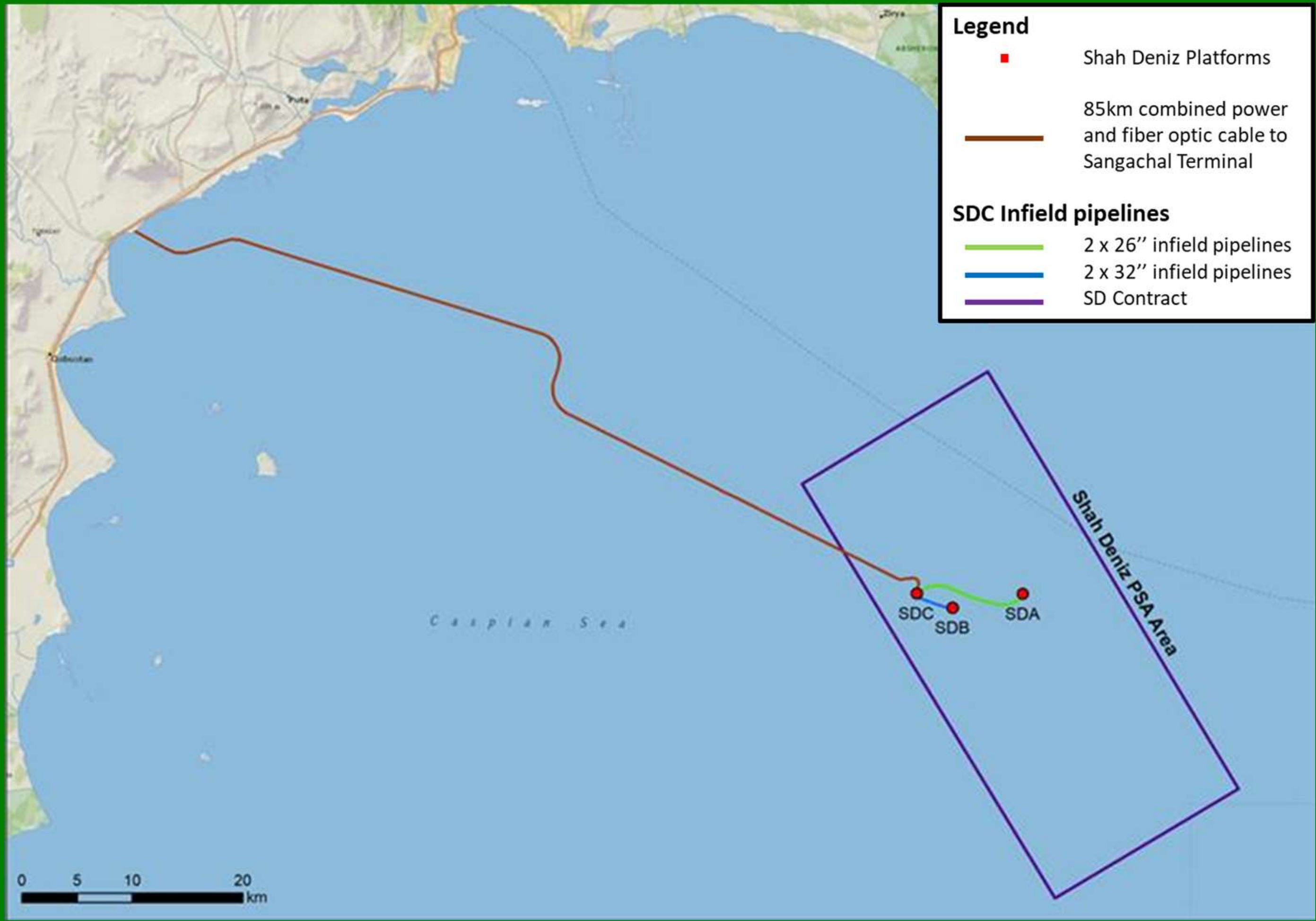
The SDC project comprises:

- An electrically powered Normally Unattended Installation (eNUI) offshore compression platform (Shah Deniz Compression)
- Infield subsea gas pipelines to / from the existing SDA and SDB gas export lines (along with associated spools / structures for pigging, bypass and isolation, and control umbilicals)
- A combined power and fibre optic cable (PFOC) from the SDC platform to Sangachal Terminal (prime source of energy will come from Azerenergy using existing 110 kV overhead lines) with the aim to maximise flow of 'green' electrons



The objective of the SDC project is to enable BP to access and produce low pressure gas reserves in the SD Contract Area and maximize recovery of resources.

Proposed SDC Facilities



NB: SDA platform and SDB platform already in existence, SDC platform proposed.
Combined power and fibre optic cable will landfall in Sangachal Bay.

Project Activities

The main SDC project activities include:

Onshore construction and commissioning of offshore and subsea facilities (at existing construction yards)

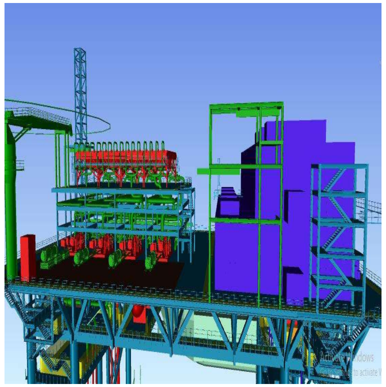
Platform installation, hook up and commissioning (HUC)

Installation, tie-in and HUC of SDC infield pipelines and associated infrastructure

Installation of SDC power cable to shore

Brownfield works at SDA and SDB to remove bottlenecks
Brownfield works at ST to implement power from shore supply scheme and remote control from ST

Offshore operations and maintenance



SDC Platform – Offshore Operations

Key operational activities:

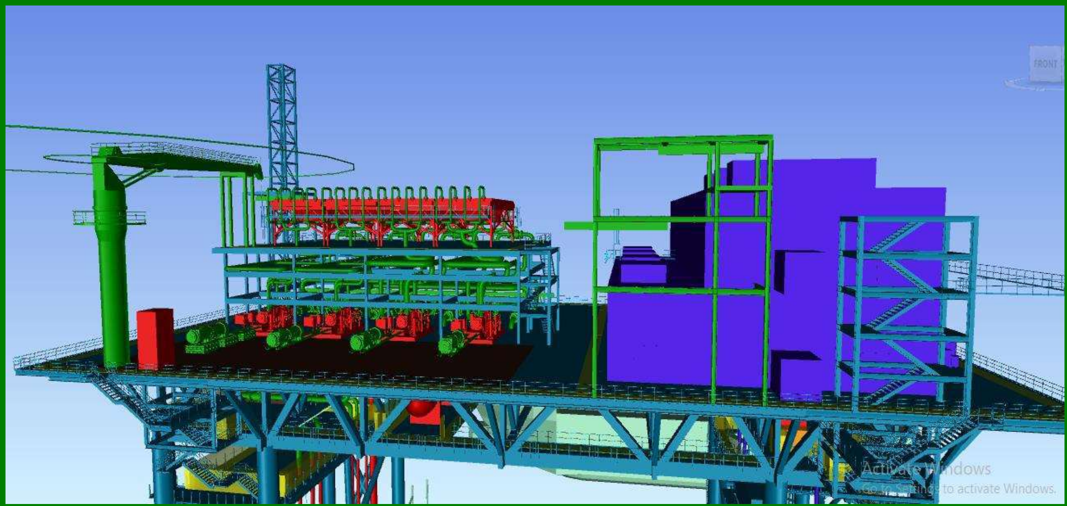
- Receipt of gas from the SDA and SDB platforms
- Compression of gas (using four electrically driven 11 MW compressors)
- Routing of compressed gas back to Sangachal Terminal through infield pipeline connections to existing export pipelines.

Other systems on SDC platform include:

- Cold vent and closed drain system – vent is for depressurisation during maintenance
- Open drains system - for rainwater collection
- Heating, ventilation and air conditioning (HVAC) system
- Material and mechanical handling devices
- Electrical, safety and telecom systems.

bp

The eNUI platform will be controlled remotely and powered from Sangachal Terminal.



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ESIA Process

bp

Scoping
Initial appraisal of key issues
Scoping meeting with MENR

Project description
Gather and review information on base case design

Project Alternatives
Consideration of viable alternatives to base case design

Existing Conditions
Baseline environmental and socio-economic conditions

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

Impact Assessment
Determine magnitude of effect
Determine receptor sensitivities
Identify existing controls
Determine impact significance

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

Residual Impacts
Assess residual impacts and determine any additional mitigation measures required

Monitoring and Mitigation
Development management and management framework plan

Key Sensitivities – Offshore Baseline

Sediment

- Surface sediments across majority of survey area dominated by finest silt and clay fractions and small amounts of coarser gravel and sand fractions. Sediments comparable to those present at SD regional stations, but finer than those present at SDA and SDB.
- Hydrocarbon concentrations typical of those recorded at neighbouring survey sites and indicative of heavily weathered material being present throughout survey area.
- Baseline sediment metal concentrations typical of sediment type and location. Sediments with a higher proportion of finest silt and clay fractions generally had higher concentrations of metals.

Macrobenthos

- Benthic community at 17 of the 18 sample stations was sparse and dominated numerically by the polychaete *Spionidea spp*, the oligochaete *Isochaetides michaelseni* and the insect *Chironomus aldibus*. A more taxonomically rich community was present at station 18 where sediments were slightly coarser.

Water Quality

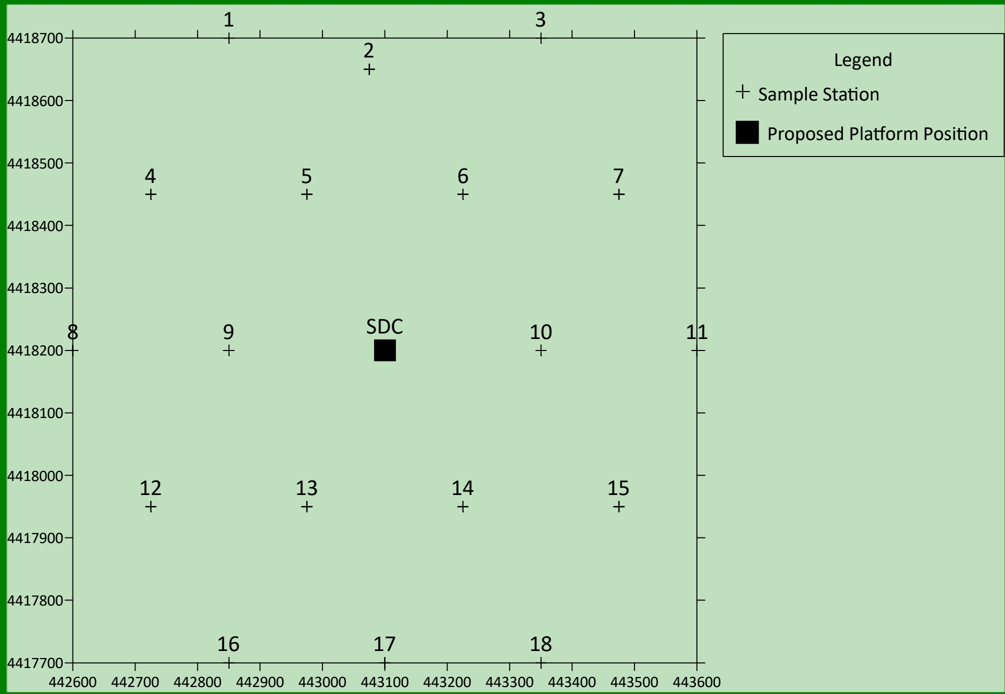
- Water analyses generally showed the water column to be characteristic of uncontaminated offshore waters in the middle Caspian.

Plankton

- Phytoplankton community was numerically dominated by chlorophyta (mainly *Binuclearia*) which represented 99% of abundance, suggesting sampling coincided with a bloom. Zooplankton community was consistent with previous surveys and numerically dominated by non-native copepod *Acartia tonsa*.

bp

An offshore environmental baseline survey was undertaken at the proposed SDC platform location in August 2023.



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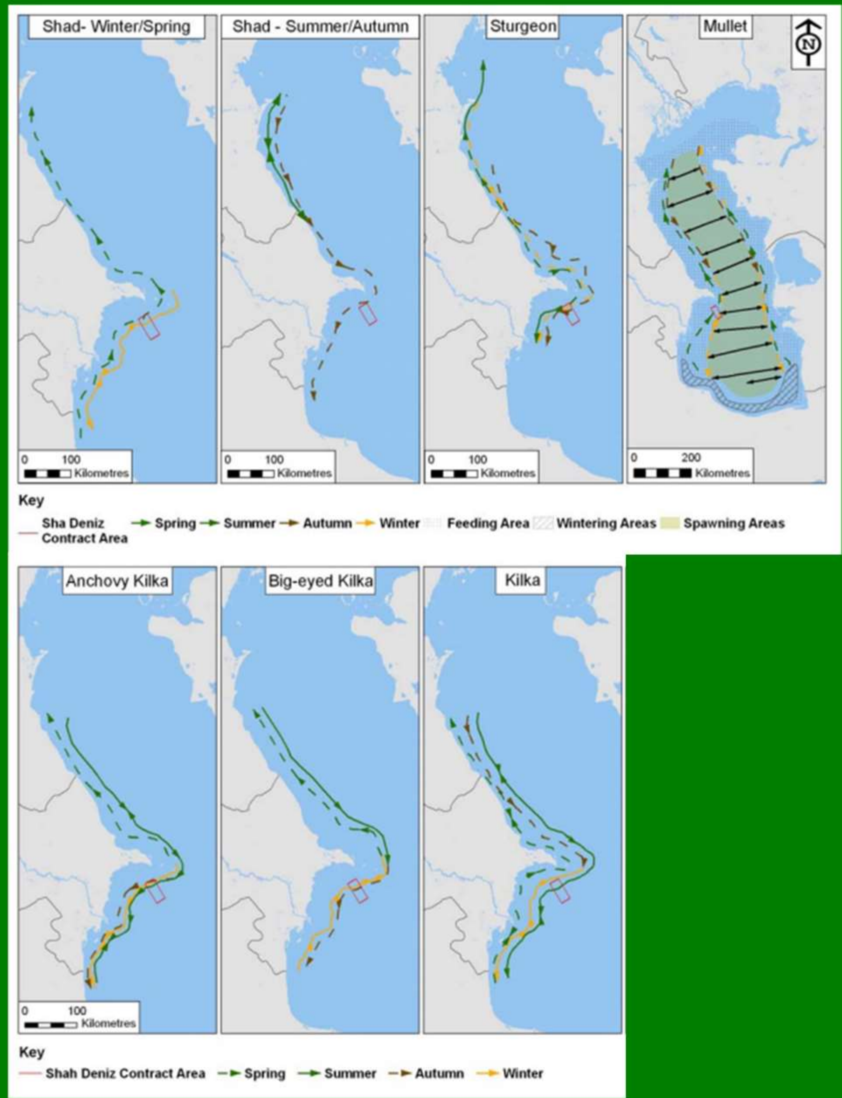
Key Sensitivities – Fish

- 151 species and subspecies of fish found in the Caspian Sea and associated river deltas. Due to the Caspian's isolation from other water bodies some endemic species.
- Main distribution of fish species within shallow water shelf areas. Max. concentrations of fish are typically found at depths up to 75 m for majority of the year, but it is common for some species to migrate to deeper, warmer waters for overwintering and to migrate to nutrient rich shallow areas of the north or river deltas in the spring / summer for spawning and feeding.
- 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.
- The Caspian Sea is an important habitat for a number of sturgeon species, five of which have an IUCN Red List status of Critically Endangered.
- Fish are sensitive to underwater sound (specifically those with swimbladders) and contamination in the water column.



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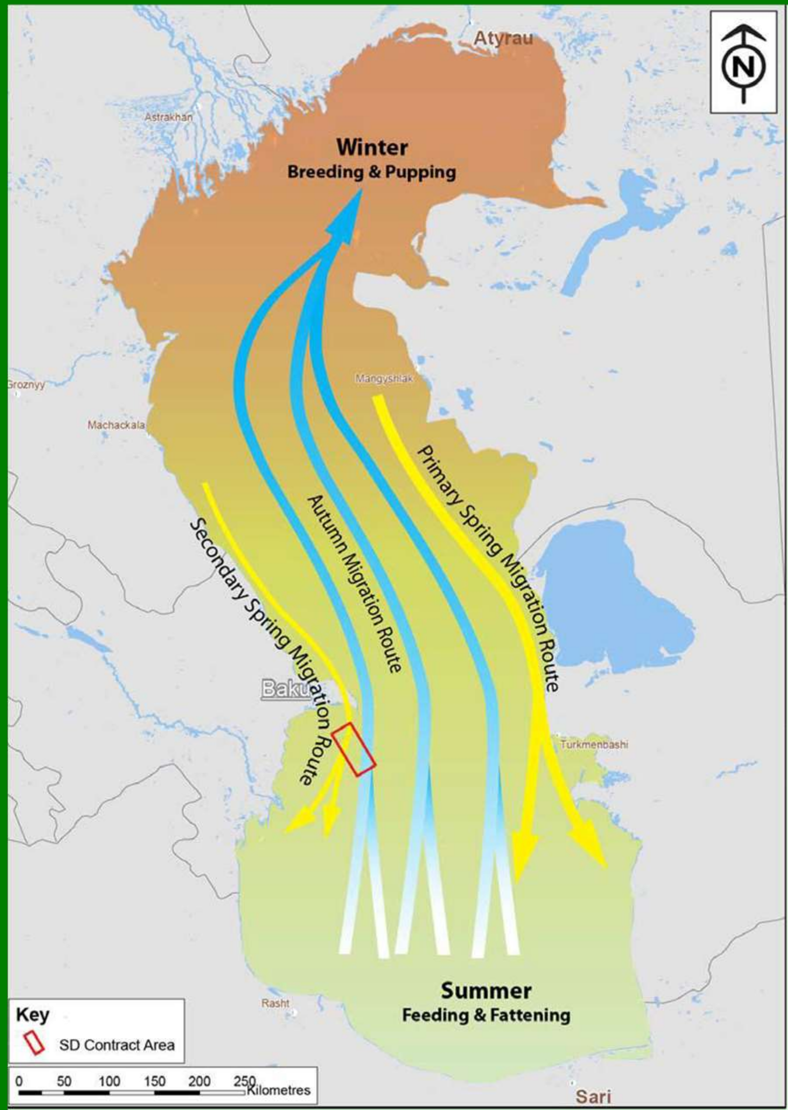
Key Sensitivities – Caspian Seal

- IUCN Red List 'Endangered'
- Present across the Caspian Sea in numbers of 100,000 – 170,000
- Key migration periods (may shift by a month):
  - Spring (from north to south following breeding and pupping on ice in northern Caspian): April-May
  - Autumn (from south to north): October-December
- During the summer months the seals move into the deeper waters of the southern Caspian where the kilka populations are concentrated.
- May be present at any time of the year in SD Contract Area, however most likely to be present during spring and autumn migration and during summer months.
- Seals are sensitive to underwater sound, human disturbance and contamination in the water column.



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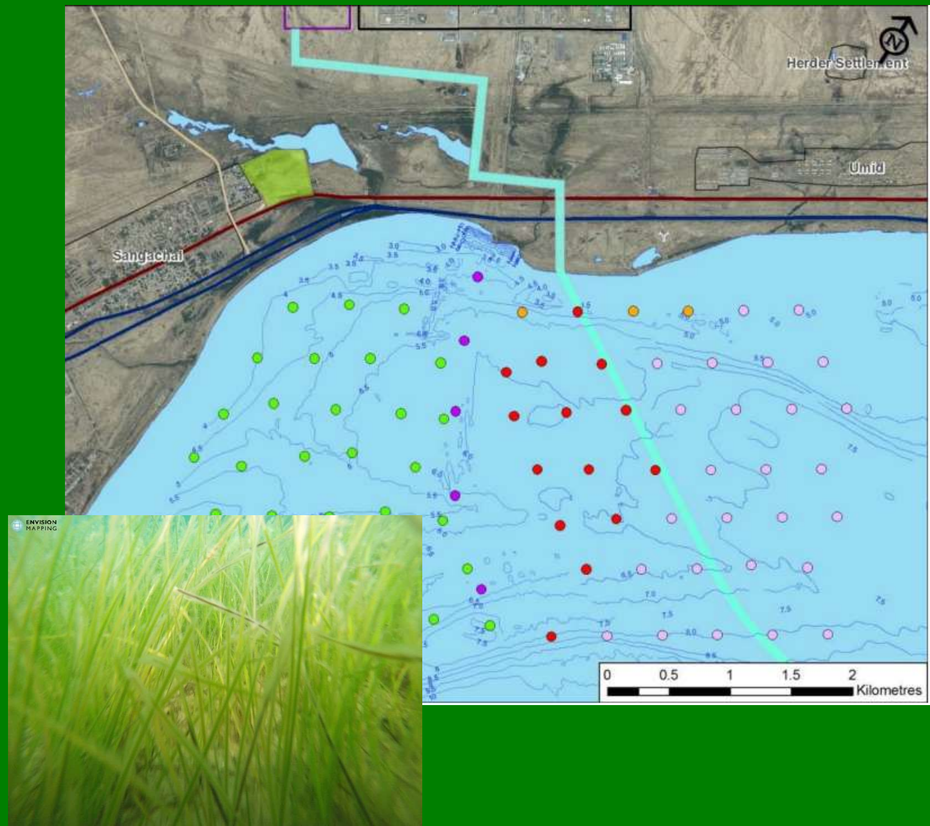
Key Sensitivities – Coastal (Sangachal Bay)

- **Sediments** - Results similar to previous studies within the bay. Physical composition of sediments varied across the survey area from silt / clay to gravel sediments. The composition of hydrocarbon compounds in sediments were typical of the site and indicative of weathered material (no evidence of recent inputs of hydrocarbons).
- **Macrobenthos** - communities highly variable across survey area. *Tanais dulongii* was recorded for the first time (assumed transported into Caspian via vessel ballast water or fouling).
- **Marine flora** – Drop down video surveys in 2014, 2016 and 2018 for SD2 suggest that Sangachal Bay has become less influenced by silt since 2016 and there has been an increase in seagrass, with 2 additional stations found to have seagrass present in 2018.
- **Water quality** – Results similar to previous studies within the bay and representative of uncontaminated inshore waters.
- **Plankton** – 70 species of phytoplankton recorded. Bacillariophyta (diatoms) most species rich and abundant. Zooplankton was similar in abundance and richness to previous surveys. Non-native species of copepod *Acartia tonsa* and ctenophore *Mnemiopsis leidyi* numerically dominant.

Most recent environmental survey in Sangachal Bay conducted in 2019.



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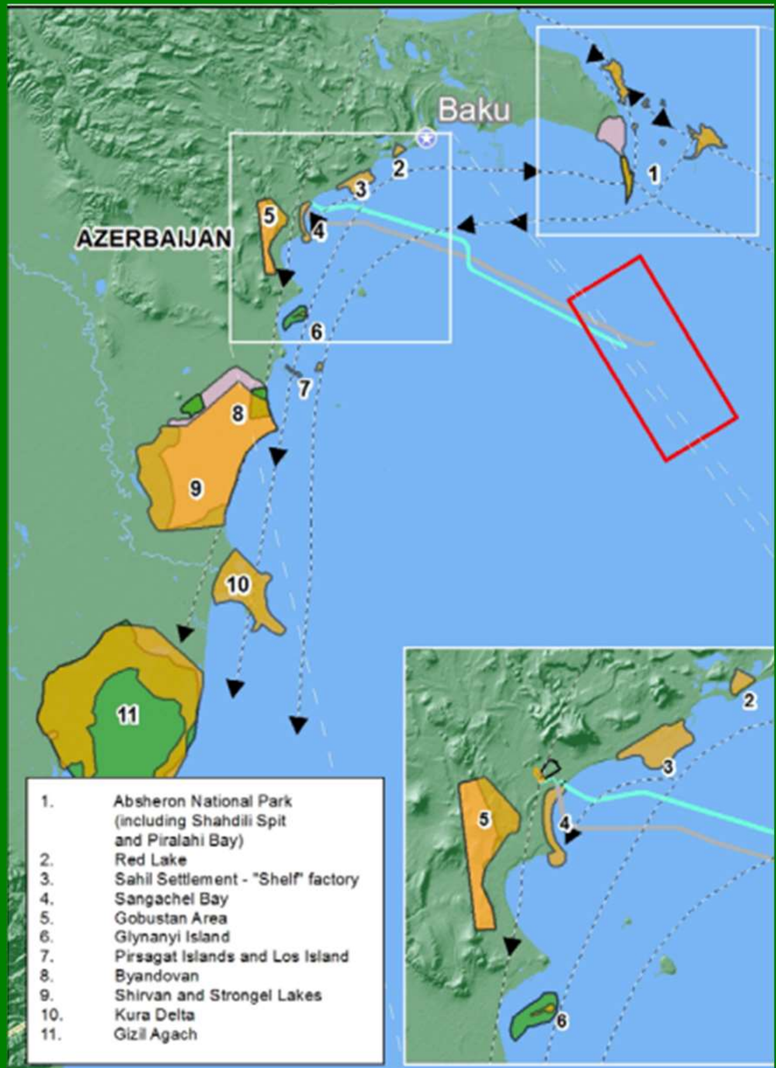
Key Sensitivities – Birds

- Coastline of Azerbaijan is on a major flyway for waterfowl and coastal birds. During winter and migration periods, it holds internationally important numbers of visiting waterfowl. There are 17 species of conservation importance (included in the IUCN Red List or listed in the AzRDB).
- Sangachal Bay (where the SDC power cable comes ashore) is an Important Bird Area (IBA) notable for migrating and wintering waterbirds. Numbers of winter birds can reach 25,000 individuals. At least 20,000 diving ducks and 30,000 coot stage here every autumn (BirdLife International, 2024).
- Birds found along the coastline 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.



Important conservation / ornithological sites

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Key Sensitivities – Onshore

- Soil and vegetation; wetlands; birds; mammals and herpetofauna all regularly surveyed in the vicinity of Sangachal Terminal since 2011 as part of BP's Environmental Monitoring Programme. Most recent surveys conducted in 2022.
- Findings of these surveys will be incorporated into the ESIA. However, important to note that onshore power cable route will follow that of the Shah Deniz 2 gas export pipelines within an existing fenced 'controlled area' for the majority of the route (sections crossing highway and railway not fenced).

Proposed onshore SDC power cable route

Key Sensitivities – Socio-economic

Construction Yards

Construction yards to be used for the SDC project are yet to be confirmed, however, it is likely the same yards will be used as for previous SD and ACG projects, namely:

- Baku Deepwater Jacket Factory (BDJF) – operational yard used previously for SD and ACG jackets. Located ~ 20 km southwest of Baku. No residential receptors located in close proximity to the yard.
- Bayil Yard – operational yard used extensively for oil and gas industry related construction. Located ~ 8 km from Baku. Settlement of Bibiheybat approx. 1 km away.

The yards are in established industrial areas, located between the main Baku-Salyan Highway and the Caspian Sea in Garadagh District.

Construction yards known to be a source of employment and training for people in the local area and wider region.

Location of proposed onshore construction yards

Key Sensitivities – Socio-economic

Air Quality

- Air quality within coastal communities varies with higher pollutant concentrations recorded in cities (such as Baku).
- NO_2 concentrations (which are a key indicator of air quality) have been recorded at levels of between 10 - 21 µg/m^3 around Sangachal Terminal , between 25 - 50µg/m^3 in the vicinity of Bibiheybat (near Bayil Yard), and up to 120 µg/m^3 within Baku itself.

Noise

- Baseline ambient noise surveys undertaken near Bayil Yard in 2015 recorded average daytime noise levels of 63-65 dB (LAeq), which are typical of industrial environments and considered to be due to industrial activities and road traffic noise primarily from the Baku-Salyan Highway.

Commercial Shipping

- The primary commercial ports of Azerbaijan are situated on the Absheron Peninsula and in the vicinity of Baku.
- No commercial shipping lanes pass through the SD Contract Area. The SDC power cable route to shore crosses two recommended shipping routes (No. 24 and 35), one restricted area (No. 23), and two prohibited areas (No. 67 and 133).

Commercial Fisheries

- According to the latest fisheries literature review, no commercial fishing is carried out within the SD Contract Area. The closest offshore kilka fishing area is Makarov Bank. It is understood that small-scale coastal fishing in Sangachal Bay is no longer conducted as fishermen were relocated to another area as part of the SD2 project.

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.

Principle offshore commercial fishing grounds

Overview of Impact Assessment Methodology

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- 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 ACE ESIAs
- Cumulative, transboundary and accidental events assessed quantitatively (accidental impact assessment takes into account likelihood of accidental event scenario occurring).

Scoped Out Activities and Justification - Environment

Activity / event	Justification for 'scoping out'
Transport of SDC materials/equipment to construction yards	• Potential construction yards located in close proximity to Baku-Salyan Highway which will be the primary route used for transport of construction materials and workforce. A Transportation and Traffic Management Plan will be developed and implemented by construction yard contractors. • Construction yards will have controls and plans in place to manage health and safety risks and interaction with local community.
Grit blasting / welding and painting of jacket, piles, topsides and pipework	• Majority of activities undertaken in a paint shops with fume extraction and grit recovery. Activities conducted outside (too large to be accommodated in paint shop) undertaken within a temporary enclosure. Inert, non-hazardous material used for grit blasting.
Onshore hydrotesting of topsides piping and spools, etc at construction yard	• No discharge to environment. Where untreated demineralised water used for hydrotesting, waste hydrotest water discharged to yard grey water system. Where biocides used in hydrotest water, waste hydrotest water will be taken off site by third party for treatment / disposal.

Scoped Out Activities and Justification - Environment

Activity / event	Justification for 'scoping out'
Construction yard utilities (sewage / drainage)	• Sewage will either be treated by a STP at the construction yard or collected onsite and transferred by road tanker or sewer to an MENR approved STP for treatment and disposal. • Contaminated drainage water will be collected and delivered to an appropriate licensed waste management contractor in accordance with existing AGT management plans and procedures. Only uncontaminated rainwater will be discharged directly to the onshore/marine environment.
Jacket buoyancy tank dewatering	• Will result in discharge of untreated seawater, no discernible impact on the marine environment expected.
Sand jack ops during topside installation	• Will result in discharge of small volume of clean sand (~35m^3), no discernible impact on the marine environment expected.

Scoped Out Activities and Justification - Environment

Activity / event	Justification for 'scoping out'
Waste generation	• Waste generated during the SDC project will be consistent with type and quantity routinely generated on previous SD and ACG projects • Waste will be segregated at source, stored and transported in fit for purpose containers • Waste generated will be managed in accordance with existing BP AGT Region management plans and procedures - Waste Minimisation and Management Plans will be established, and all waste transfers controlled and documented • No discernible impacts anticipated.
Brownfield modifications	• Equipment modifications at SDA and SDB will not result in any discharges to sea and minimal atmospheric emissions • Installation of power receiving and transfer kit at Sangachal Terminal will not result in any discharges and minimal atmospheric emissions.

Scoped Out Activities and Justification - Environment

Activity / event	Justification for 'scoping out'
Emissions and discharges from SDC maintenance vessel during operations	• Maintenance visits to SDC platform only anticipated once a quarter for a small number of days • Emissions and discharges from vessel will be managed in accordance with MARPOL 73/78 (Annex I-VI) standards. Low sulphur fuel used < 0.05% weight.
Use of existing processing and storage facilities at ST	• Sufficient capacity at Sangachal Terminal therefore no additional facilities, upgrades or improvements are required for onshore processing of the compressed gas. Contribution of SDC project to onshore SD production anticipated to have no discernible impact on air quality.

P&O
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Key Potential Impacts - Environment

Potential impact	Activity to be assessed in ESIA
Discharges to marine environment (affecting water quality, sediment, plankton, benthos, fish and seals)	Discharges to sea during installation and commissioning including: • Infield pipeline pre-commissioning discharges (treated seawater and small quantities of MEG) • Subsea structure and spool installation discharges (treated seawater) • J-tube cable tie-in discharges (treated seawater) • Installation and support vessel discharges.
Generation of UW sound (affecting seals and fish)	Underwater sound generated during installation and commissioning by: • Installation of jacket pin and skirt piles and piling of SSIV foundations • Installation and support vessel movements.
Seabed disturbance (affecting benthic communities)	Disturbance and physical loss of seabed habitat from: • Installation of SDC jacket and infield pipelines / subsea infrastructure • Installation of SDC power cable (particularly in coastal zone where cable trenched to 1 m out to 12.5 m water depth using excavators on temporary finger piers and on flat-bottom barge). Associated effects include physical disturbance and smothering of marine flora (seagrass) and benthic fauna from trenching activities. Potential changes to coastal erosion processes from presence of finger piers.

Key Potential Impacts - Environment

Potential impact	Activity to be assessed in ESIA
Onshore soil disturbance (affecting flora and fauna, potentially CH)	Disturbance and temporary loss of habitat from: • Onshore trenching of SDC power cable, and installation of cable transition joint pit and temporary access road and parking. Associated effects include: • Physical disturbance of flora and fauna • Potential disturbance of unknown cultural heritage artefacts.
Deterioration in air quality (onshore)	Emissions generated during installation and commissioning including: • Emissions from plant and vehicles at construction yards • Emissions from construction plant and vehicles in area of onshore power cable installation and dust generation from cable trenching.
Deterioration in air quality (offshore)	Emissions generated during installation and commissioning from: • Tie-in venting at SDA and tie-in flaring at SDB platform • Installation and support vessel engines. Emissions generated during operations phase from: • Intermittent venting (small volumes) during SDC plant maintenance and fugitive emissions from valves, vents, seals, etc.

P&O
production & operations

Scoped Out Activities and Justification – Socio-economic

Activity / event	Justification for 'scoping out'
Community disturbance from construction yards	• No major upgrades or modifications at the potential construction yards to be used for the SDC Project have been identified • All potential yards are within existing industrial sites with few residential premises in near proximity to site boundaries • Air and noise quality screening / assessment will be conducted to confirm justification for scoping out (if results do not justify scoping out, this parameter will be fully assessed in the ESIA).
Community health and safety	• SDC onshore activities will be carried out within existing construction yards • As these yards have been used for previous BP projects plans have been developed to meet BP's HSSE project requirements.
Construction traffic	• Each of the potential construction yards is located in close proximity to the main Baku-Salyan Highway • BP and its main construction contractors have implemented successful driving and vehicle management plans during the previous SD and ACG projects. To ensure that any disruption to road users is minimised from increases in traffic and transport of oversized loads a Transportation and Traffic Management Plan will be developed and implemented by each of the yard's main construction contractors.

Key Potential Impacts – Socio-economic

Potential impact	Activity to be assessed in ESIA
Disruption to marine and coastal users	• Restricted access in vessel construction spread area (marine exclusion zone round installation works) • Restricted access to SDC power cable landfall in Sangachal Bay • NB: It is assumed that cable crossings of road and rail in coastal zone will be carried out by HD to minimise disruption.
Employment and training	• Jobs and opportunities created by project (local and regional)
Increased economic flows	• Direct and indirect economic flows created by demand for local goods and services

Cumulative, Transboundary & Accidental Impacts

Cumulative impacts will be assessed to determine potential synergetic or additive effects:

- Between separate SDC project impacts (e.g. a receptor being affected by more than one project impact such as physical disturbance and discharges to sea)
- Between SDC and other offshore projects in the vicinity of SDC (e.g. potential for additive air quality impacts).

Transboundary impacts will be assessed - anticipated to be limited to those associated with emissions of greenhouse gases.

Accidental impacts will be assessed - scenarios limited to installation/support vessel diesel spills (due to limited hydrocarbon inventory on the SDC platform).

Proposed Supporting Studies for ESIA

Topic	Study Overview
Onshore air quality	• Air quality screening and assessment to confirm extent of air quality impacts associated with construction yard activities and onshore power cable installation activities
Terrestrial noise	• Noise screening and assessment to confirm extent of noise impacts associated with construction yard activities and onshore power cable installation activities
Underwater sound	• Underwater sound modelling and assessment to determine impacts on fish and seals from jacket and SSIV piling, and installation / support vessel movements
Infield pipeline installation and pre-commissioning discharges	• CORMIX modelling software utilised to confirm extent of impacts of discharges (including chemicals, MEG, etc)
Literature reviews	• Literature reviews commissioned from local specialists on the topics of fish, birds and Caspian seals

Proposed ESIA Table of Contents

Chapter title	Content
Executive Summary	• Concise summary of ESIA findings
1. Introduction	• Overview of SD field development, proposed SDC project, ESIA objectives, ESIA team and ESIA report structure
2. Policy, Regulatory and Administrative Framework	• Summary of applicable requirements from national E&S legislation, the SD PSA, ratified regional / international conventions and agreements, and international petroleum industry standards / practices
3. IA Methodology	• Description of process and methodology used for the impact assessment
4. Options Assessed	• Description of alternative concept options assessed for SDC project
5. Project Description	• Detailed description of the SDC project
6. Environmental Description	• Description of existing offshore, nearshore and onshore environmental conditions potentially affected by SDC project
7. Social Description	• Description of existing offshore, nearshore and onshore social conditions potentially affected by the SDC project
8. Consultation and Disclosure	• Overview of consultation and disclosure activities undertaken during the ESIA, and the issues and concerns raised
9. Construction, Installation and HUC EIA	• Assessment of potential environmental impacts associated with offshore, nearshore and onshore SDC project construction, installation and HUC, including any necessary mitigation and monitoring
10. Operations EIA	• Assessment of potential environmental impacts associated with the operations phase of the SDC project, including any necessary mitigation and monitoring
11. Social Impact Assessment	• Assessment of potential social impacts associated with SDC project activities, including any necessary mitigation and monitoring
12. Cumulative and Transboundary Impacts and Accidental Events	• Assessment of potential cumulative and transboundary impacts associated with the SDC project activities, and an assessment of potential accidental event scenarios
13. Environmental and Social Management	• Summary of the E&S management system associated with the SDC project activities
14. Residual Impacts and Conclusion	• Summary of the residual impacts and conclusions of the assessment

SDC Project ESIA - Timeline & Consultation / Disclosure

1
Scoping
June 2024

Scoping meeting with MENR

Agreement on ESIA scope and content and identification of key issues

2
ESIA Preparation
June – October 2024

Consultation with local experts from academic institutions

Consultation with BP project design teams

Development of Draft ESIA report

3
Disclosure of Draft Final ESIA
Mid Oct – Mid Dec 2024

Presentation and submission of Draft Final ESIA to MENR

Hard copy made publicly available and soft copy on BP website

Public consultation meeting in Baku

Incorporation of stakeholder feedback into ESIA document

4
Submission of Final ESIA
Jan-Feb 2025

Final ESIA submitted to MENR for approval

Soft copy made publicly available on BP website

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APPENDIX 9A – SDC CONSTRUCTION, INSTALLATION AND HUC ACTIVITIES / INTERACTIONS

Table 9A.1: SDC construction installation and HUC activities / interactions

ID	Activity	Scoped in	Event	Receptor
Onshore construction and commissioning of offshore facilities				
C-R1	Use of yard plant (generators and engines) during jacket, topside and subsea equipment fabrication and commissioning	Y	Emissions to atmosphere	Atmosphere
		Y	Generation of onshore noise	Terrestrial environment
C-R2	Grit blasting / welding and painting of jacket components, piles, topsides and pipework	N	Emissions to atmosphere	Atmosphere
		N	Generation of onshore noise	Terrestrial environment
C-R3	Construction yard utilities (drainage / sewage)	N	Discharges to marine environment	Marine environment
CR-4	Onshore hydrotesting of risers, spools / structures, and topsides piping at construction yards	N	Discharges to marine environment via grey water system (only for topsides piping and if demineralised water used with no chemicals)	Marine environment
Offshore platform installation, hook-up and commissioning				
C-R5	Use of vessels for jacket and topside installation e.g. STB-1 Barge, DBA / SCV Khankendi, support vessels	Y	Emissions to atmosphere	Atmosphere
		Y	Generation of underwater sound	Marine environment
		Y	Vessel operational discharges to marine environment	Marine environment
C-R6	Installation of jacket, pin piles, skirt piles and grouting	N	Seabed disturbance – benthos	Marine environment
		Y	Generation of underwater sound	Marine environment
		Y	Discharge of cement grout	Marine environment
C-R7	Jacket buoyancy tank dewatering and topsides sand jacks operation	N	Discharge to marine environment	Marine environment
C-R8	Discharge from J-tubes during PFOC hook up	N	Discharge to marine environment	Marine environment
C-R9	Brownfield works at SDA and SDB platforms	N	Emissions to atmosphere	Atmosphere
Infield pipeline and subsea infrastructure installation, tie-in and commissioning				
C-R10	Use of vessels for infield pipeline installation, e.g.	Y	Emissions to atmosphere	Atmosphere
		Y	Generation of underwater sound	Marine environment

ID	Activity	Scoped in	Event	Receptor
	Pipelay barge, SCV Khankhendi, support vessels	Y	Vessel operational discharges to marine environment	Marine environment
C-R11	Cleaning, testing and dewatering of infield pipelines (and PLM controls commissioning)	Y	Discharge to marine environment	Marine environment
Installation of PFOC nearshore				
C-R12	Geotechnical survey of PFOC route	N	Discharges to marine environment	Marine environment
C-R13	Installation of finger piers	Y	Coastal erosion	Marine environment
		Y	Seabed disturbance – benthos	Marine environment
C-R14	Trenching (from coastline to 12.5 m water depth) and installation of PFOC	Y	Coastal erosion	Marine environment
		Y	Seabed disturbance – benthos	Marine environment
		Y	Potential disturbance / damage to cultural heritage	Marine environment
C-R15	Use of vehicles and vessels during nearshore trenching and cable lay	Y	Emissions to atmosphere	Atmosphere
		Y	Generation of underwater sound	Marine environment
		Y	Vessel operational discharges to marine environment	Marine environment
Installation of PFOC onshore				
CR-16	Use of plant and vehicles during PFOC installation	Y	Emissions to atmosphere	Atmosphere
		Y	Onshore noise	Terrestrial environment
C-R17	Removal and storage of surface soil layer and vegetation along cable route and at cable transition joint pit	Y	Direct / indirect effects to wildlife	Terrestrial environment
		Y	Loss of habitat	Terrestrial environment
C-R18	Cable trenching including movement, temporary storage of excess spoil	Y	Potential mobilisation of contamination	Terrestrial environment
		Y	Potential disturbance / damage to cultural heritage	Terrestrial environment
CR-19	Construction of cable transition joint pit and temporary vehicle access, parking and construction site facilities	Y	Disturbance / indirect effects to wildlife	Terrestrial environment
		Y	Loss of habitat	Terrestrial environment
		Y	Potential disturbance / damage to cultural heritage	Terrestrial environment
General – all phases				
C-R20	Waste generation	N	Generation of hazardous and non-hazardous waste	Waste generation

Notes:

C – construction; R – routine activity

APPENDIX 9B -
AIR QUALITY SCREENING ASSESSMENT

bp Exploration (Shah Deniz) Ltd

Shah Deniz Compression Project

Air Quality Screening Assessment

Report No.: 445957-00 (01)

OCTOBER 2024

RSK air quality
MODELLING · MONITORING · PERMITTING

RSK GENERAL NOTES

Project No.: 445957-00 (01)

Title: Shah Deniz Compression Project – Air Quality Screening Assessment

Client: BP Exploration (Shah Deniz) Ltd

Date: 14th October 2024

Office: Hemel

Status: Rev01

Author	Dr Aastha Dhingra Senior Air Quality Consultant	**Technical reviewer**	Dr Srinivas Srimath Director, Air Quality
Signature		Signature	
Date:	17th October 2024	Date:	17th October 2024

Author	Charles Kwok Senior Air Quality Consultant
Signature	
Date:	17th October 2024

RSK Environment Ltd (RSK) has prepared this report for the sole use of the client, showing reasonable skill and care, for the intended purposes as stated in the agreement under which this work was completed. The report may not be relied upon by any other party without the express agreement of the client and RSK. No other warranty, expressed or implied, is made as to the professional advice included in this report.

Where any data supplied by the client or from other sources have been used, it has been assumed that the information is correct. No responsibility can be accepted by RSK for inaccuracies in the data supplied by any other party. The conclusions and recommendations in this report are based on the assumption that all relevant information has been supplied by those bodies from whom it was requested.

No part of this report may be copied or duplicated without the express permission of RSK and the party for whom it was prepared.

Where field investigations have been carried out, these have been restricted to a level of detail required to achieve the stated objectives of the work.

This work has been undertaken in accordance with the quality management system of RSK Group Limited.

EXECUTIVE SUMMARY

RSK Environment Limited (RSK) has been commissioned by bp Exploration (Shah Deniz) Ltd, to undertake an air quality screening assessment for the Shah Deniz Compression project.

The air quality screening study includes the onshore construction and commissioning elements of the project, which comprises the following main elements at three different locations:

- jacket construction at the Baku Deepwater Jacket Factory yard
- topsides construction and commissioning at AzFen Bayil yard
- installation of the onshore section of the SDC power and fibre optic cable (PFOC) between the landfall in Sangachal Bay and Sangachal Terminal.

The construction equipment used at the construction yards and along PFOC cable route (along with diesel consumption and operating hours) were provided by the client to calculate the emissions of the pollutants.

This air quality assessment has sought to assess the potential air quality impacts of activities at the proposed construction yards and along the onshore PFOC cable route on human receptors.

The screening study focuses on emissions nitrogen dioxide (NO_2), sulphur dioxide (SO_2), carbon monoxide (CO), non-methane volatile organic compounds (NMVOCs), and particulate matter (PM_{10}), considering the short term averaging periods and the associated ambient air quality limit value, set for the protection of human health.

The screening assessment showed that emissions from the construction yards, and from cable installation activities along the PFOC route, are predicted to be below the assessment criteria.

In summary, it is not expected that the construction and commissioning activities will result in any significant impact on local air quality and at sensitive receptor locations.

CONTENTS

1 INTRODUCTION

1.1 Background

RSK Environment has been commissioned by bp Exploration (Shah Deniz) Ltd, to undertake an air quality screening assessment for the Shah Deniz Compression (SDC) project, south of Baku, Azerbaijan.

The Shah Deniz field was discovered in 1999 and is one of the world's largest gas-condensate fields. The key objective of the SDC project is to install compression facilities offshore on a platform (downstream of existing facilities) to pressurise the gas and enable further hydrocarbons to be extracted and processed from the Shah Deniz field.

The SDC project comprises:

- the construction and installation of an electrically powered Normally Unattended Installation (eNUI)[1] (Shah Deniz Compression platform)
- infield subsea gas pipelines to/from the existing SDA and SDB gas export lines
- a combined power and fibre optic cable (PFOC) from Sangachal Terminal to the SDC platform.

1.2 Site Description and Location

This air quality screening assessment considers the onshore construction elements of the project only, which comprises of the following three main activities at three different locations:

- jacket construction at the Baku Deepwater Jacket Factory (BDJF) yard
- topsides construction and commissioning at AzFen Bayil yard
- installation of the onshore section of the PFOC between the landfall in Sangachal Bay and Sangachal Terminal.

Figure 1.1 shows the location of both the BDFJ and the AzFen Bayil yards.

1.2.1 BDJF yard

The BDJF yard lies approximately 20 km southwest of Baku on the western coastline of the Caspian Sea within a mostly industrial and commercial area. The site is bound to the east by vacant land, to the southeast by the Caspian Sea and to the north by the Baku-Salyan Highway. The site is located on a coastal plain backed by steep hills that form a ridgeline running approximately parallel to the coast. The coastal area in the vicinity of the yard also includes a number of shallow lagoons, particularly to the west of the yard.

The nearest human receptors to the BDJF yard are located approximately 3.5 km north of the centre of the yard, in the settlement of Puta. There are also some individual dwellings 1 km northwest from the centre of the yard. The BDJF fabrication area is shown in the Figure 1.2.

[1] The concept of an eNUI platform is new to the region.

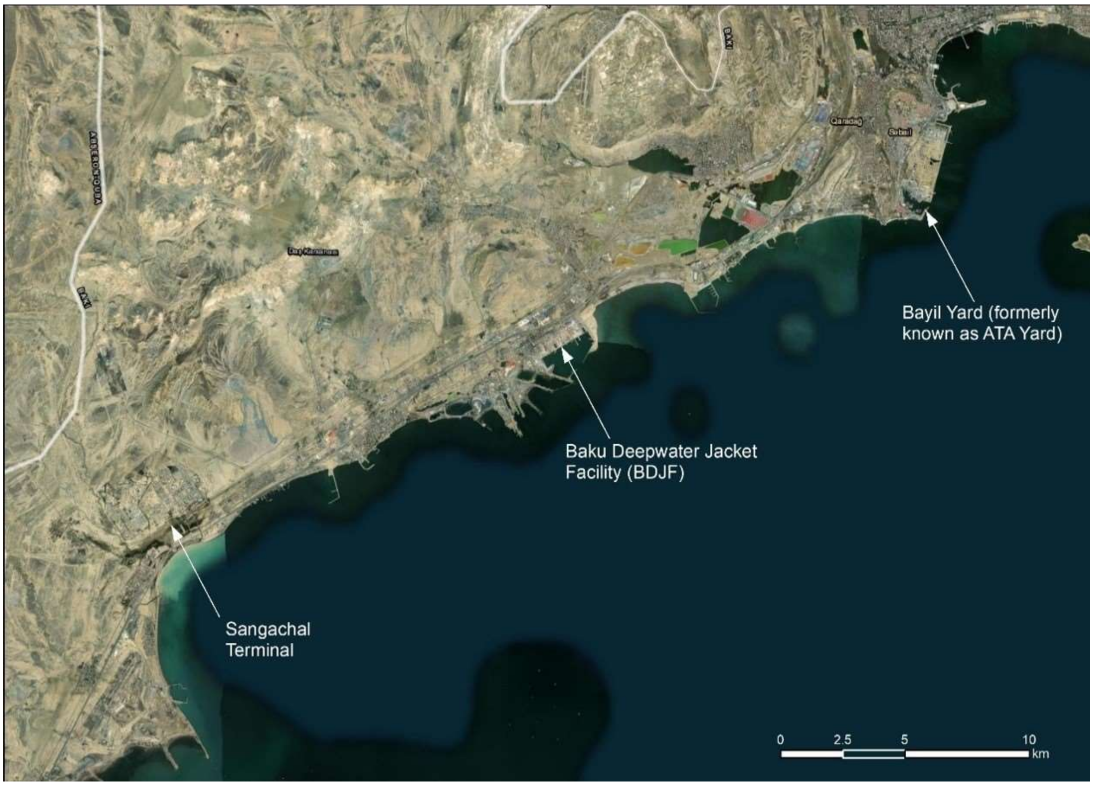


Figure 1.1: Location of BDFJ and AzFen Bayil yards

Figure 1.2: BDJF yard fabrication area

Yard fabrication area red boundary; human receptors blue boundary

1.2.2 AzFen Bayil yard

The AzFen Bayil yard is an operational yard used extensively for oil and gas industry related construction. It is located approximately 8 km south of Baku and is bound to the east and south by the Caspian Sea. Land to the west of the yard is mostly a mix of industrial sheds and storage yards with the settlement of Bibiheybat located approximately 1 km away.

The Bayil yard fabrication area is shown in Figure 1.3.

Figure 1.3: Azfen Bayil yard fabrication area (red boundary)

Yard fabrication area red boundary; human receptors blue boundary

1.2.3 Sangachal Bay - Sangachal Terminal (PFOC route)

Installation of the onshore section of the SDC PFOC will take place along a 4.2 km route that follows the existing route of the Shah Deniz 2 gas export pipelines between the landfall in Sangachal Bay and Sangachal Terminal. The whole cable route in shown in Figure 1.4 in red. It should be noted that that the cable route inside the ST new security fence is outside of scope (shown in black boundary) and therefore, not included in the assessment.

The nearest human receptors along the 4.2 km onshore PFOC route between Sangachal Bay and Sangachal Terminal are located approximately 1 km east of the route in the settlement of Umid, and approximately 1.5 km south of the terminal connection in the settlement of Sangachal, see Figure 1.4.

Figure 1.4: Proposed onshore PFOC route

1.3 Proposed Activities

1.3.1 BDJF yard

The activities related to the jacket construction taking place at BDJF will take place between February 2026 and January 2028. Most of the activities will take place during the daytime only, with some activities expected to be undertaken 24 hours per day for a limited period of time.

1.3.2 AzFen Bayil yard

The activities related to the topside fabrication and commissioning at AzFen Bayil yard will take place between July 2026 and January 2029. Most of the activities will take place during the daytime only for up to 8 hours per day.

1.3.3 PFOC route

Installation of the onshore section of the PFOC between the Sangachal Bay landfall and Sangachal Terminal will involve open-cut trenching techniques, with horizontal drilling for crossings of roads and railways. The activities have the potential to be undertaken during both the daytime and night-time.

1.4 Scope of Report

The purpose of this document is to present the findings of a screening assessment completed to assess the potential increase in air quality concentrations due to onshore construction and commissioning activities associated with the SDC project.

The objective of the screening study is to estimate any changes in ambient atmospheric pollutant concentrations from the proposed activities related to:

- use of construction plant, generators and onsite vehicles at the construction yards
- construction activities along the proposed PFOC route.

2 AIR QUALITY LEGISLATION AND GUIDANCE

2.1 Air quality assessment objectives

The aim of ambient air quality objective values is the prevention or reduction of detrimental effects to human health and/or the environment.

The objectives presented for each respective long term and short term averaging period allows for a certain number of exceedances per calendar year, which corresponds to a particular ‘percentile’.

2.1.1 World Health Organisation (WHO) Air Quality Guidelines, 2000 & 2005

The WHO Air Quality Guidelines (AQGs) have been widely used as a reference tool to assist decision makers around the world in setting air quality standards and goals. The WHO Air Quality Guidelines Global Update, 2005 provides global recommendations on important air contaminants that pose health concerns, including thresholds and restrictions.

The Guidelines apply worldwide to both outdoor and indoor environments and are based on expert evaluation of current scientific evidence.

2.1.2 WHO Guidelines 2021

WHO published revised air quality guidelines for pollutants in ambient air in September 2021. The new AQGs for particulate matter (PM) and nitrogen dioxide (NO_2) are substantially lower than the previous (2005) guidelines and are widely exceeded in many urban and other locations around the world. Interim targets are provided as achievable ‘milestones’ on the journey to meeting the guidelines.

2.1.3 International Finance Corporation (IFC) General Environmental, Health and Safety (EHS) Guidelines

The World Bank Group Environmental, Health and Safety Guidelines (EHS Guidelines) are technical reference documents with general and industry-specific examples of good international industry practice. The General EHS Guideline contains information on cross-cutting environmental, health, and safety issues potentially applicable to all industry sectors.

The IFC Environmental, Health, and Safety (EHS) General Guidelines reproduce the 2005 WHO Guidelines as recommended criteria for air quality, in the absence of national standards.

2.1.4 European Union (EU) Air Quality Guidelines 2008

Directive 2008/50/EC of the European Parliament and of the Council on ambient air quality and cleaner air for Europe. This Directive defines objectives for ambient air quality designed to avoid, prevent or reduce harmful effects on human health and the environment as a whole.

2.1.5 Azerbaijan, "Improvement of Legislation on Assessment and Management of Ambient Air" Draft National Strategy

The aim of the Draft National Strategy "Improvement of Legislation on Assessment and Management of Ambient Air" is to implement the improved and sustainable national air quality assessment and management system of the country in line with the European air quality management related legislation, ensuring reduced effects of air pollution and climate change.

2.1.6 Azerbaijan, "Law of Azerbaijan Republic on Air Protection"

Air quality in Azerbaijan is also regulated by the Law of Azerbaijan Republic on Air Protection No. 109-IIQ of 2001 which is composed of seven sections: 1) general provisions; 2) state regulation in the field of atmosphere protection; 3) programs and measures on the protection of the atmospheric air; 4) state monitoring; 5) control measures for the atmospheric pollution; 6) liability; and 7) international cooperation.

2.2 Derivation of the Project Assessment Criteria

A comparison of the Azerbaijan Air Quality Standards, EU Guidelines on Air Quality and WHO Guidelines is presented in Table 2.1. The Azerbaijan standards are used to derive the project assessment criteria. Where an Azerbaijan standard is not available for a particular pollutant and averaging period, guidelines from the EU and WHO are used to include in the project assessment criteria.

These standards apply to locations where members of the public are expected to be normally present (e.g. residential areas, schools, hospitals).

Table 2.1: Project Assessment Criteria Derived from National and International Standards / Guidelines

Pollutant	Averaging period	Air quality standard - ambient air concentration, µg/m³			Air standards used in assessment
		WHO	EU	Azerbaijan	Project assessment criteria
			Guidelines on air quality	Air quality limits	
Nitrogen dioxide, NO_2 / Oxides of nitrogen, NOx (as NO_2)	Annual	10 µg/m³	40 µg/m³	-	40 µg/m³
	24 hr	25 µg/m³	-	40 µg/m³	40 µg/m³
	8 hr	-	-	-	-
	1 hr	200 µg/m³	200 µg/m³ (99.8th %ile)	-	200 µg/m³
Carbon monoxide, CO (mg/m³)	8 hr	10,000 µg/m³	10,000 µg/m³ (100th %ile)	-	10,000 µg/m³
	1 hr	30,000 µg/m³	-	5,000 µg/m³	5,000 µg/m³
	24 hr	4000 µg/m³	-	3,000 µg/m³	3,000 µg/m³
	15 min	-	-	-	-
Particulate matter, PM_{10}	Annual	15 µg/m³	40 µg/m³	-	40 µg/m³
	24 hr	45 µg/m³ (99th %ile)	50 µg/m³ (99th %ile)	150 µg/m³	50 µg/m³
Fine particulate matter, $PM_{2.5}$	Annual	5 µg/m³	25 µg/m³	-	25 µg/m³
	24 hr	15 µg/m³	-	-	15 µg/m³
Sulphur oxides, SO_2	Hourly (10 min)	500 µg/m³	-		500 µg/m³
	24 hr	40 µg/m³	125 µg/m³ (99.2th%ile)	50 µg/m³	50 µg/m³
	1 hour	-	350 µg/m³ (99.7th %ile)	-	350 µg/m³
Benzene	Annual	-	5 µg/m³	-	5 µg/m³

3 BASELINE AIR QUALITY

Ambient air quality monitoring of SO_2, benzene, total volatile organic compounds (TVOC) and NO_2 has been undertaken around Sangachal 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 February and September 2023, the data from these surveys shall be used as background pollutant concentrations for this assessment.

While this data is representative of the onshore PFOC location, specific background data is not available for the construction yards.

The outcomes of the Sangachal air quality monitoring study (between 5th June 2023 and 5th July 2023) for NO_2, SO_2, benzene and TVOC undertaken at 18 locations are shown in the Table 3.1 and Figure 3.1.

Table 3.1 Sampling locations – Sangachal Terminal

ID	NAME	Easting	Northing
1	AAQ6	8880751	4458795
2	AAQ7	8880468	4458227
3	AAQ8	8881032	4456210
4	AAQ9	8884398	4461788
5	AAQ10	8884741	4461983
6	AAQ11	8877376	4460214
7	AAQ12	8882176	4461844
8	AAQ13	8880908	4460356
9	AAQ14	8880006	4459635
10	AAQ15	8879737	4461958
11	AAQ16	8881445	4463445
12	AAQ17	8883024	4462418
13	AAQ18	8882682	4460654
14	AAQ19	8883024	4463444
15	AAQ20	8881446	4460655
16	AAQ21	8880952	4455411
17	AAQ22	8880415	4458211
18	AAQ23	8880868	4458519

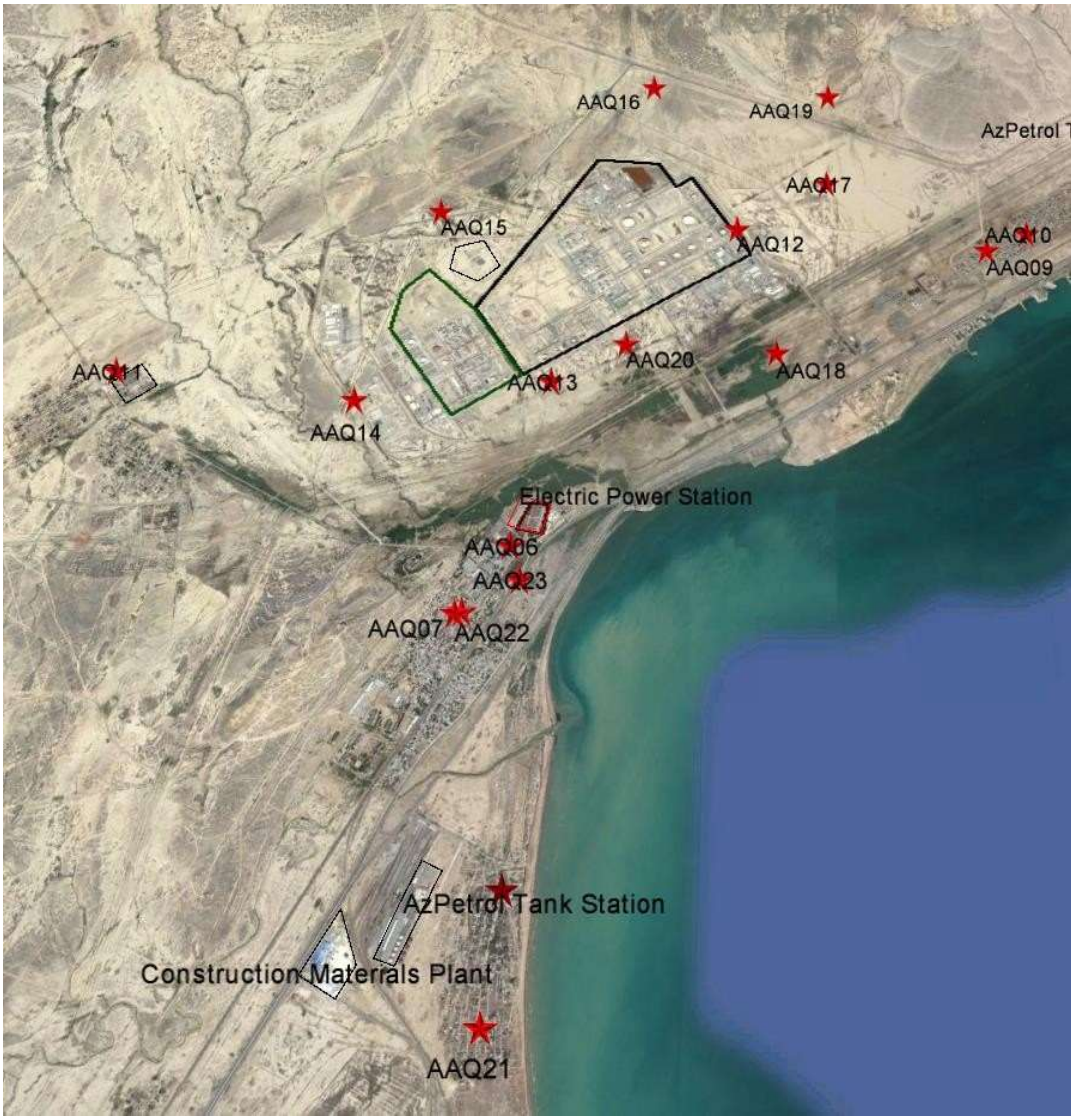


Figure 3.1: Sampling locations – Sangachal Terminal

The background concentrations of NO_2, SO_2, benzene and TVOC presented in Table 3.1 are considered to represent typical background concentrations for the onshore receptors.

Table 3.1: Monitored concentrations (µg/m^3) of the pollutants in 2023

Station ID	Sampling period		Parameters			
	Date installed	Date reinstalled	NO_2 µg/m^3	SO_2 µg/m^3	TVOC µg/m^3	Benzene µg/m^3
AAQ06	05/06/23	05/07/23	11.8	<2	48.4	0.5
AAQ07	05/06/23	05/07/23	13.2	<2	44.8	0.4
AAQ08	05/06/23	05/07/23	9.42	<2	52.6	0.4
AAQ09	05/06/23	05/07/23	9.35	<2	49.5	0.5
AAQ10	05/06/23	05/07/23	10.2	<2	55.6	0.5
AAQ11	05/06/23	05/07/23	6.18	<2	39.3	0.4
AAQ11D	05/06/23	05/07/23	5.56	<2	40.8	0.5
AAQ12	05/06/23	05/07/23	7.65	<2	63.5	0.9
AAQ13	06/06/23	05/07/23	7.39	<2	47.6	0.3
AAQ14	06/06/23	05/07/23	11	<2	37.2	0.4
AAQ15	06/06/23	05/07/23	5.42	<2	28.9	0.4
AAQ16	06/06/23	06/07/23	5.79	<2	48.7	0.4
AAQ17	06/06/23	06/07/23	6.05	<2	34.6	1.7
AAQ18	06/06/23	05/07/23	8.37	<2	55.2	0.4
AAQ19	06/06/23	06/07/23	5.75	<2	67.5	0.4
AAQ20	06/06/23	05/07/23	7.41	<2	28.3	0.4
AAQ21	05/06/23	05/07/23	10.2	<2	42.8	0.5
AAQ22	05/06/23	06/07/23	12.2	<2	30.4	0.7
AAQ23	05/06/23	05/07/23	17	<2	58.7	0.7
AAQ23D	05/06/23	05/07/23	16.7	<2	56.3	0.7
Project Assessment Criteria			**40**	**50**	**-**	**5**

Note: The maximum TVOC is recorded in the table out of the two filters. The SO_2 air quality standard refers to 24-hour average concentration, and that for NO2 and benzene refer to annual average concentration.

The particulate monitoring data was not available for 2023 but the monitoring data for 2022 (November- December, 2022) is presented in Table 3.2.

Table 3.2: Monitored PM_{10} concentrations (μg/m^3) in 2022

Station ID	Sampling/test date	Parameters
		PM_{10}, ug/m^3
AAQ06	11/11/22	34
AAQ07	11/11/22	27
AAQ08	12/11/22	21
AAQ09	11/11/22	28
AAQ10	11/11/22	19
AAQ11	11/11/22	17
AAQ12	11/11/22	14
AAQ13	12/11/22	12
AAQ14	12/11/22	25
AAQ15	12/11/22	16
AAQ16	09/12/22	28
AAQ17	08/12/22	24
AAQ18	09/12/22	16
AAQ19	08/12/22	38
AAQ20	09/12/22	24
AAQ21	09/12/22	27
AAQ22	09/12/22	44
AAQ23	09/12/22	31
24-hour average PM_{10} project assessment criteria		**50**

The monitoring data suggests that ambient air conditions did not exceed the project assessment criteria for air quality average annual standards for nitrogen dioxide and average daily standard for sulphur dioxide. The concentration reported for SO_2 is less than 2 μg/m^3 at all locations.

The monitoring results for PM_{10} suggests that ambient air conditions did not exceed the project assessment criteria.

4 METHODOLOGY

The following steps have been undertaken for the assessment:

- selection of a suitable screening model; determination of the model input parameters, and definition of the dimensions of modelling grid
- desk study review to confirm the location of nearby existing receptors that may be sensitive to changes in airborne pollutant concentrations as a result of emissions arising from the onshore construction activities
- dispersion modelling to predict the impact of emissions to air from onshore construction activities on local air quality and the identified sensitive receptors
- comparison of the predicted pollutant concentrations against the project assessment criteria.

4.1 Model Selection

This assessment has been undertaken using the UK Atmospheric Dispersion Modelling System, ADMS 6.

ADMS has been extensively validated for industrial sources by the model developers Cambridge Environmental Research Consultants (CERC). Many regulatory authorities explicitly endorse or accept the use of ADMS. ADMS is routinely used and approved by the UK Environment Agency (EA) and used widely in Europe.

4.2 Emission Sources

The following will result in emissions to atmosphere:

- onsite construction plant and vehicles within the yard(s) – modelled based on a number of assumptions and typical parameters for similar activities
- onshore construction plant and vehicles along the PFOC route – modelled based on a number of assumptions and typical parameters for similar activities.

The details of number of emission sources in each yard and along the PFOC route, their operation, fuel consumption etc are provided in Appendix A.

4.3 Modelling Scenarios

Two model scenarios are set up for each location. One scenario is set at the long term emission rate while the other scenario is set at the short-term emission rate.

4.4 Air Dispersion Model Set up and the Coordinate System

The coordinate system used in the current study is WGS 84.

4.5 Meteorological Data

Hourly sequential meteorological data measured between 2019 and 2023 at the Heydar Aliyev International Airport weather station has been employed in the assessment. This meteorological station is located approximately 25 km northeast of the Bayil yard and is considered to be representative of site conditions.

The maximum predicted pollutant concentrations for each of the five years have been reported. The windroses for the station are presented in Appendix C.

A surface roughness length of 0.3 m was used in the dispersion modelling study for the dispersion site. This value is considered appropriate for the morphology of the assessment area and is suggested within ADMS 6 as being suitable for 'agricultural areas (max)'. A roughness length of 0.5 m was considered appropriate for the morphology of the meteorological station and is suggested within ADMS 6 as being suitable for 'Parkland, open suburban'.

Digital terrain data was included in the assessment to account for topographical features (slopes that are greater than 1:10) of the land covering the model domain.

4.6 Monin-Obukhov Length

The Monin-Obukhov length provides a measure of the stability of the atmosphere. A minimum Monin-Obukhov length of 10 m was used in the dispersion modelling for the study area and the meteorological station.

4.7 Discrete Receptors and Modelled Domain

Human receptors

Following a review of the local area, representative worst case location sensitive human receptors have been selected and considered in the assessment. Furthermore, for the purpose of considering potential impacts at a greater number of locations by producing isopleths (pollution concentration contours), for the predicted annual concentrations, hypothetical grid receptors spaced at 50 m covering approximately a domain of 5 x 5 km have also been included.

Details of all discrete human receptors included in the modelling study are summarised in Tables 4.1 to 4.3 for the two construction yards and PFOC onshore route. The location of receptors are shown in Figures 4.1 to 4.3. Each discrete human receptor was assumed to be 1.5 m above ground level (i.e. close to 'breathing height').

Table 4.1: Human receptors included in the dispersion modelling assessment for BDJF yard

Receptor ID	Type of receptors	Grid reference	
		X	Y
Long-term (LR) receptors: residential units (1-hour & annual mean NO_2 , 8-hour CO AQS apply)			
R1	Residential receptor	5528437	4908150
R2	Residential receptor	5519995	4899998
Short-term (SR) receptors: warehouse units, industrial and education centre (1-hour mean NO_2 , 8-hour CO AQS apply)			
R3	Industrial receptor	5529990	4903805
R4	Industrial receptor	5528417	4904125
R5	Industrial receptor	5527839	4903901
R6	Industrial receptor	5527249	4903739
R7	Industrial receptor	5526639	4903106
R8	Industrial receptor	5526772	4902959
R9	Industrial receptor	5526990	4902467
R10	Industrial receptor	5525354	4902857
R11	Supermarket	5525510	4903666
R12	Industrial receptor	5530283	4906268

Table 4.2: Human receptors included in the dispersion modelling assessment for Azfen Bayil yard

Receptor ID	Type of receptors	Grid reference	
		X	Y
Long-term (LR) receptors: residential units (1-hour & annual mean NO_2 , 8-hour CO AQS apply)			
R1	Residential receptor	5545612	4911918
R2	Residential receptor	5545893	4912114
R3	Residential receptor	5545838	4912396
R4	Residential receptor	5546007	4912630
R5	Residential receptor	5546150	4912982
R6	Residential receptor	5547057	4913402
R7	Residential receptor	5546062	4910808
R8	Residential receptor	5546471	4910560
R9	Residential receptor	5546812	4910333
Short-term (SR) receptors: warehouse units, industrial and education centre (1-hour mean NO_2 , 8-hour CO AQS apply)			
R10	School	5546786	4912405
R11	Industrial receptor	5546152	4911500
R12	Industrial receptor	5546746	4911487
R13	Industrial receptor	5546383	4911964
R14	Industrial receptor	5546569	4911726

Table 4.3: Human receptors included in the dispersion modelling assessment for onshore PFOC route

Receptor ID	Type of receptors	Grid reference	
		X	Y
Long-term (LR) receptors: residential units (1-hour & annual mean NO_2 , 8-hour CO AQS apply)			
R1	Residential receptor	5506822	4891645
R2	Residential receptor	5510707	4894333
R3	Residential receptor	5510470	4894655
Short-term (SR) receptors: warehouse units, industrial and education centre (1-hour mean NO_2 , 8-hour CO AQS apply)			
R4	Industrial receptor	5509114	4894750
R5	Industrial receptor	5507683	4894182
R6	Industrial receptor	5507580	4894357
R7	Industrial receptor	5508764	4894719
R8	Industrial receptor	5509939	4894011
R9	Industrial receptor	5507034	4892160

Figure 4.1: Location of receptors at BDJF yard

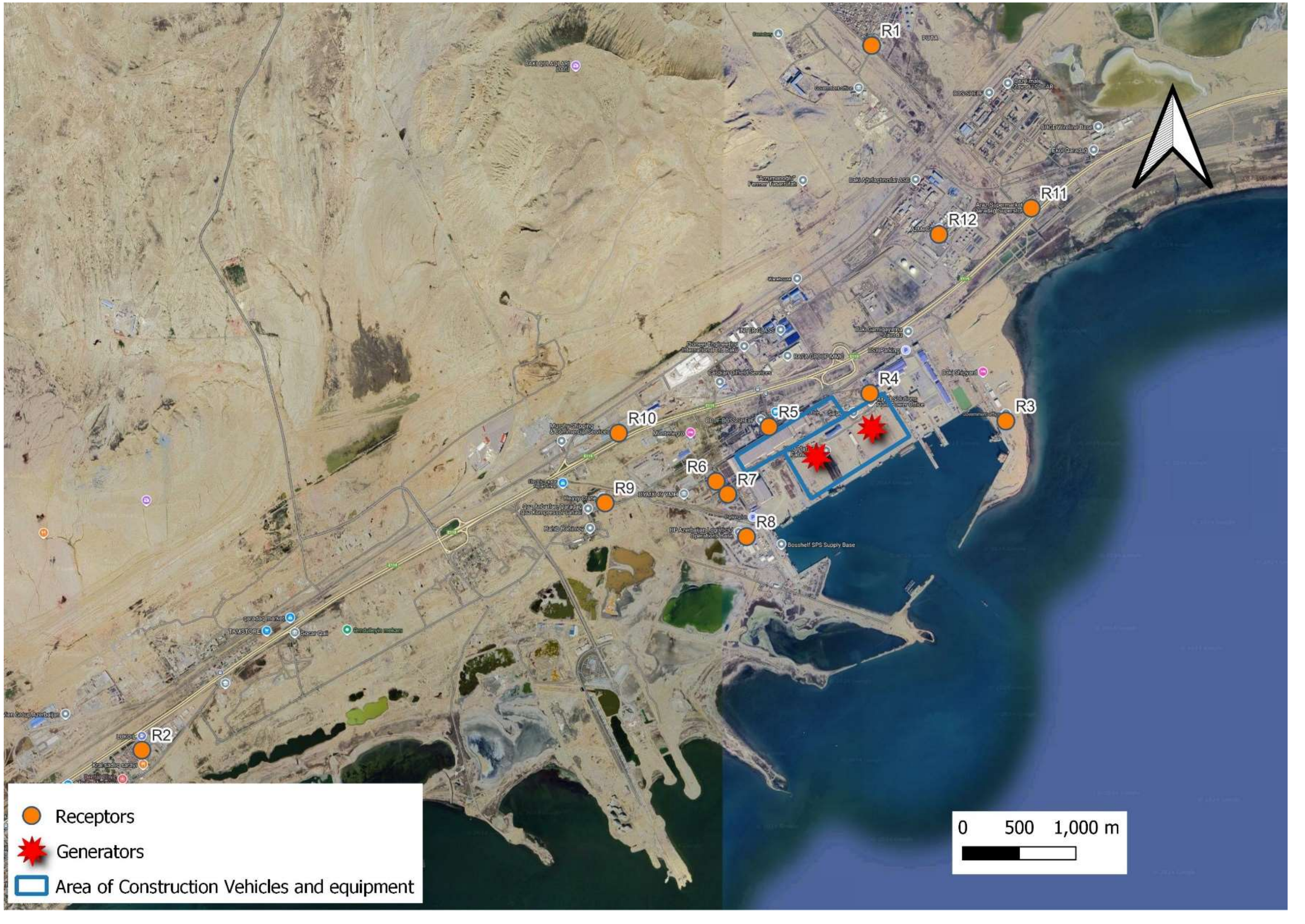


Figure 4.2: Location of receptors at Azfen Bayil yard

Figure 4.3: Location of receptors onshore PFOC route

4.8 Input Parameters

Input data for the construction yards has been derived assuming that all of the plant will be in operation simultaneously for up to 8 hours a day. This will lead to an over estimation of the impacts to air quality. Emissions will be associated with construction plant, generators and vehicles on site.

Emission rates for NOx, PM, CO and SO_x were derived from emission factors from AP-42 Chapter 3.3 Gasoline and Diesel Industrial Engines for industrial applications of both gasoline and diesel internal combustion engines for construction equipment, from AP-42 Chapter 3.4 Large Stationary Diesel And All Stationary Dual-fuel Engines for generators, and from European Environment Agency EMEP/CORINAIR Emission Inventory Guidebook – 2023 for construction vehicles.

The NMVOC emission rate was calculated using emission factors for top coat (assumed polyurethane stain), mid coat (assumed latex paint) and undercoat (assumed primer) from a research paper (https://doi.org/10.5194/acp-21-6005-2021). The detailed emission estimation method and assumptions are detailed in Appendix B.

The construction yards and PFOC route have been modelled as an area source using ADMS 6 and the emission rates and other modelling inputs in Tables 4.4 to 4.8.

Table 4.4: Modelling inputs for construction equipment and vehicles BDJF yard

Construction equipment and vehicles					
Parameter	**NOx**	**SOx**	**CO**	**PM**	**NMVOC**
ER Short term	1.33E+01	8.70E-01	2.85E+00	3.66E-01	1.71E+01
ER long term	3.86E+00	3.93E-01	8.32E-01	1.07E-01	4.97E+00
Area 1 (m)	473314				
Area 2 (m)	190100				
Short Term (Area 1) ($g/m^2/s$)	2.8000E-05	1.8387E-06	6.0272E-06	7.7334E-07	3.6040E-05
Long Term (Area 1) ($g/m^2/s$)	8.1655E-06	8.3070E-07	1.7574E-06	2.2552E-07	1.0510E-05
Short Term (Area 2) ($g/m^2/s$)	6.9716E-05	4.5779E-06	1.5007E-05	1.9255E-06	8.9734E-05
Long Term (Area 2) ($g/m^2/s$)	2.0331E-05	2.0683E-06	4.3757E-06	5.6150E-07	2.6168E-05
Release height	1m				
Operating profile	Continuous operation. No profile.				
Exhaust temperature	300 deg C				
Exhaust velocity	20 m/s				

Table 4.5: Modelling inputs for diesel generators for BDJF yard

Generators 2 X 0.8 MWe					
Parameter	**NOx**	**SOx**	**CO**	**PM**	**NMVOC**
ER Short term g/s	5.28E+00	7.68E-04	1.40E+00	1.72E-01	1.41E-01
ER long term g/s	6.36E-02	1.07E-04	1.68E-02	1.63E-03	1.70E-03
No of generators	2				
Operating Profile	Continuous operation. No profile.				
Co-ordinate of Gen 1	5528440.42, 4903720.93				
Co-ordinate of Gen 2	5527798.05, 4903389.81				
Stack height (m)	3				
Dia (m)	0.3				
Stack temperature	474 deg C				
Velocity	31.3 m/s				

Table 4.6: Modelling inputs for construction equipment and vehicles for AzFen Bayil yard

Total equipment plus vehicles					
Parameter	**NOx**	**SOx**	**CO**	**PM**	**NMVOC**
ER Short term	9.81E+00	6.44E-01	2.11E+00	2.71E-01	1.26E+01
ER long term	2.51E+00	1.65E-01	5.40E-01	6.93E-02	3.23E+00
Area	193368				
Short Term ($g/m^2/s$)	5.0714E-05	3.3310E-06	1.0916E-05	1.4010E-06	6.5291E-05
Long Term ($g/m^2/s$)	1.2977E-05	8.5229E-07	2.7934E-06	3.5847E-07	1.6706E-05
Release height	1m				
Operating profile	Continuous operation. No profile.				
Exhaust temperature	300 deg C				
Exhaust velocity	20 m/s				

Table 4.7: Modelling inputs for Diesel Generators for AzFen Bayil yard

Generators 2 X 1 MWe					
Parameter	**NOx**	**SOx**	**CO**	**PM**	**NMVOC**
ER Short term g/s	6.60E+00	9.60E-04	1.74E+00	2.15E-01	1.76E-01
ER long term g/s	7.84E-02	1.14E-05	2.07E-02	2.55E-03	2.12E-03
No of generators	2				
Operating Profile	Continuous operation. No profile				
Co-ordinate of Gen 1	5547657.21, 4911564.33				
Co-ordinate of Gen 2	5547383.87, 4911627.99				
Stack height (m)	3				
Dia (m)	0.3				
Stack temperature	474 deg C				
Velocity	39.1 m/s				

Table 4.8: Modelling inputs for construction equipment and vehicles for PFOC onshore route

Construction equipment and vehicles					
Parameter	NOx	SOx	CO	PM	NMVOC
ER Short term	1.59E+00	1.01E-01	3.43E-01	4.40E-02	2.05E+00
ER long term	4.45E-01	2.80E-02	9.58E-02	1.23E-02	5.73E-01
Area of Cable 1	195395 m^2				
Area of Cable 2	117562 m^2				
Area of Cable 3	186844 m^2				
Short Term (Cable 1) ($g/m^2/s$)	8.15356E-06	5.144E-07	1.755E-06	2.249E-07	1.05E-05
Long Term (Cable 1) ($g/m^2/s$)	2.27759E-06	1.435E-07	4.903E-07	6.283E-08	2.934E-06
Short Term (Cable 2) ($g/m^2/s$)	1.35517E-05	8.55E-07	2.917E-06	3.739E-07	1.746E-05
Long Term (Cable 2) ($g/m^2/s$)	3.78549E-06	2.385E-07	8.15E-07	1.044E-07	4.877E-06
Short Term (Cable 3) ($g/m^2/s$)	8.52671E-06	5.38E-07	1.836E-06	2.352E-07	1.099E-05
Long Term (Cable 3) ($g/m^2/s$)	2.38183E-06	1.501E-07	5.128E-07	6.57E-08	3.069E-06
Release height	1m				
Operating profile	Continuous operation. No profile.				
Exhaust temperature	300 deg C				
Exhaust velocity	20 m/s				

4.9 Uncertainties and Assumptions

The following uncertainties and assumptions have been made in the air quality assessment:

- There will be uncertainties introduced because the modelling has simplified real-world processes into a series of algorithms. Furthermore, it has been assumed that the subsequent dispersion of emitted pollutants will conform to a Gaussian distribution in order to simplify the real-world dilution and dispersion conditions.
- There is an element of uncertainty in all modelled data. All values presented in this report are considered reasonable estimates. Where estimations in emissions are made, these are overestimated and hence the impacts on local air quality reported are considered to be conservative in nature.
- For modelling purposes, in BDJF yard and AzFen Bayil yard, locations of the emission sources are assumed at fixed locations. In reality, emission source location might change as demanded by the construction requirements.
- For modelling purposes, it is assumed that all NMVOC will be assessed as benzene which is a very conservative assumption and will result in overprediction of impacts in terms of benzene impacts.

5 ASSESSMENT RESULTS

5.1 Predicted Air Pollutant Concentrations

The following sections identify the maximum predicted air pollutant concentrations at the identified sensitive receptor locations. In the absence of baseline concentrations at relevant locations and averaging periods, only process contributions are compared with the project assessment criteria.

5.1.1 BDJF yard

The highest predicted process contribution pollutant concentrations are presented in Tables 5.1 to 5.5. These are compared with the assessment criteria.

Table 5.1: Predicted highest NO_2 concentrations - BDJF yard

Receptor ID (Type)	X (Easting)	Y (Northing)	Highest concentration (µg/m³)	Assessment criteria (µg/m³)	% of assessment criteria
NO_2 1-hour maximum concentration					
R1 (Residential)	5528437	4908150	19.42	200	9.7%
R2 (Residential)	5519995	4899998	6.69	200	3.3%
R3 (Industrial)	5529990	4903805	25.95	200	13.0%
R4 (Industrial)	5528417	4904125	73.63	200	36.8%
R5 (Industrial)	5527839	4903902	67.90	200	34.0%
R6 (Industrial)	5526639	4903106	37.72	200	18.9%
R7 (Industrial)	5526773	4902959	37.43	200	18.7%
R8 (Industrial)	5526990	4902467	31.63	200	15.8%
R9 (Industrial)	5525355	4902858	21.38	200	10.7%
R10 (Industrial)	5525510	4903666	23.79	200	11.9%
R11 (Commercial)	5530284	4906268	17.20	200	8.6%
R12 (Industrial)	5529216	4905963	24.43	200	12.2%
NO_2 24-hour maximum concentration					
R1 (Residential)	5528437	4908150	2.40	40	6.0%
R2 (Residential)	5519995	4899998	0.55	40	1.4%
R3 (Industrial)	5529990	4903805	2.98	40	7.5%
R4 (Industrial)	5528417	4904125	26.29	40	65.7%
R5 (Industrial)	5527839	4903902	17.77	40	44.4%
R6 (Industrial)	5526639	4903106	9.75	40	24.4%
R7 (Industrial)	5526773	4902959	9.01	40	22.5%
R8 (Industrial)	5526990	4902467	5.38	40	13.4%
R9 (Industrial)	5525355	4902858	3.37	40	8.4%
R10 (Industrial)	5525510	4903666	3.68	40	9.2%
R11 (Commercial)	5530284	4906268	1.92	40	4.8%
R12 (Industrial)	5529216	4905963	1.91	40	4.8%

Receptor ID (Type)	X (Easting)	Y (Northing)	Highest concentration (μg/m³)	Assessment criteria (μg/m³)	% of assessment criteria
NO_2 annual average concentration					
R1 (Residential)	5528437	4908150	0.005	40	0.01%
R2 (Residential)	5519995	4899998	0.001	40	<0.01%
R3 (Industrial)	5529990	4903805	0.004	40	0.01%
R4 (Industrial)	5528417	4904125	0.118	40	0.29%
R5 (Industrial)	5527839	4903902	0.629	40	1.57%
R6 (Industrial)	5526639	4903106	0.011	40	0.03%
R7 (Industrial)	5526773	4902959	0.012	40	0.03%
R8 (Industrial)	5526990	4902467	0.009	40	0.02%
R9 (Industrial)	5525355	4902858	0.004	40	0.01%
R10 (Industrial)	5525510	4903666	0.004	40	0.01%
R11 (Commercial)	5530284	4906268	0.002	40	<0.01%
R12 (Industrial)	5529216	4905963	0.004	40	0.01%

Table 5.2: Predicted highest CO concentrations - BDJF yard

Receptor ID (Type)	X (Easting)	Y (Northing)	Highest concentration (μg/m³)	Assessment criteria (μg/m³)	% of assessment Criteria
CO 15-min maximum concentration					
R1 (Residential)	5528437	4908150	14.67	3000	0.5%
R2 (Residential)	5519995	4899998	5.05	3000	0.2%
R3 (Industrial)	5529990	4903805	19.60	3000	0.7%
R4 (Industrial)	5528417	4904125	55.61	3000	1.9%
R5 (Industrial)	5527839	4903902	47.95	3000	1.6%
R6 (Industrial)	5526639	4903106	28.48	3000	0.9%
R7 (Industrial)	5526773	4902959	28.26	3000	0.9%
R8 (Industrial)	5526990	4902467	23.89	3000	0.8%
R9 (Industrial)	5525355	4902858	16.15	3000	0.5%
R10 (Industrial)	5525510	4903666	17.96	3000	0.6%
R11 (Commercial)	5530284	4906268	12.99	3000	0.4%
R12 (Industrial)	5529216	4905963	18.45	3000	0.6%

Receptor ID (Type)	X (Easting)	Y (Northing)	Highest concentration (µg/m³)	Assessment criteria (µg/m³)	% of assessment Criteria
CO 1-hour maximum concentration					
R1 (Residential)	5528437	4908150	2.83	5000	0.1%
R2 (Residential)	5519995	4899998	0.89	5000	<0.1%
R3 (Industrial)	5529990	4903805	5.79	5000	0.1%
R4 (Industrial)	5528417	4904125	26.33	5000	0.5%
R5 (Industrial)	5527839	4903902	18.07	5000	0.4%
R6 (Industrial)	5526639	4903106	8.78	5000	0.2%
R7 (Industrial)	5526773	4902959	9.73	5000	0.2%
R8 (Industrial)	5526990	4902467	6.98	5000	0.1%
R9 (Industrial)	5525355	4902858	4.59	5000	0.1%
R10 (Industrial)	5525510	4903666	5.30	5000	0.1%
R11 (Commercial)	5530284	4906268	4.12	5000	0.1%
R12 (Industrial)	5529216	4905963	3.70	5000	0.1%
CO 24-hour maximum concentration					
R1 (Residential)	5528437	4908150	1.81	10000	0.02%
R2 (Residential)	5519995	4899998	0.41	10000	<0.01%
R3 (Industrial)	5529990	4903805	2.25	10000	0.02%
R4 (Industrial)	5528417	4904125	19.85	10000	0.20%
R5 (Industrial)	5527839	4903902	13.19	10000	0.13%
R6 (Industrial)	5526639	4903106	7.36	10000	0.07%
R7 (Industrial)	5526773	4902959	6.80	10000	0.07%
R8 (Industrial)	5526990	4902467	4.06	10000	0.04%
R9 (Industrial)	5525355	4902858	2.54	10000	0.03%
R10 (Industrial)	5525510	4903666	2.78	10000	0.03%
R11 (Commercial)	5530284	4906268	1.45	10000	0.01%
R12 (Industrial)	5529216	4905963	1.44	10000	0.01%

Table 5.3: Predicted highest PM_{10} concentrations - BDJF yard

Receptor ID (Type)	X (Easting)	Y (Northing)	Highest concentration (µg/m³)	Assessment criteria (µg/m³)	% of assessment Criteria
PM_{10} 24-hour 99th Percentile Concentration					
R1 (Residential)	5528437	4908150	0.15	50	0.3%
R2 (Residential)	5519995	4899998	0.04	50	0.1%
R3 (Residential)	5529990	4903805	0.18	50	0.4%
R4 (Residential)	5528417	4904125	2.27	50	4.5%
R5 (Residential)	5527839	4903902	1.34	50	2.7%
R6 (Residential)	5526639	4903106	0.62	50	1.2%
R7 (Residential)	5526773	4902959	0.62	50	1.2%
R8 (Residential)	5526990	4902467	0.37	50	0.7%
R9 (Residential)	5525355	4902858	0.24	50	0.5%
R10 (School)	5525510	4903666	0.24	50	0.5%
R11 (Industrial)	5530284	4906268	0.08	50	0.2%
R12 (Industrial)	5529216	4905963	0.17	50	0.3%
PM_{10} annual average concentration					
R1 (Residential)	5528437	4908150	1.47E-05	40	<0.1%
R2 (Residential)	5519995	4899998	4.81E-06	40	<0.1%
R3 (Industrial)	5529990	4903805	9.38E-06	40	<0.1%
R4 (Industrial)	5528417	4904125	2.84E-04	40	<0.1%
R5 (Industrial)	5527839	4903902	8.22E-02	40	<0.1%
R6 (Industrial)	5526639	4903106	2.73E-05	40	<0.1%
R7 (Industrial)	5526773	4902959	3.07E-05	40	<0.1%
R8 (Industrial)	5526990	4902467	2.38E-05	40	<0.1%
R9 (Industrial)	5525355	4902858	9.87E-06	40	<0.1%
R10 (Industrial)	5525510	4903666	1.05E-05	40	<0.1%
R11 (Commercial)	5530284	4906268	4.73E-06	40	<0.1%
R12 (Industrial)	5529216	4905963	1.05E-05	40	<0.1%

Table 5.4: Predicted highest SO_2 concentrations - BDJF yard

Receptor ID (Type)	X (Easting)	Y (Northing)	Highest concentration (µg/m^3)	Assessment criteria (µg/m^3)	% of assessment criteria
SO_2 10-min maximum concentration					
R1 (Residential)	5528437	4908150	0.02	500	<0.01%
R2 (Residential)	5519995	4899998	0.01	500	<0.01%
R3 (Industrial)	5529990	4903805	0.02	500	<0.01%
R4 (Industrial)	5528417	4904125	0.05	500	0.01%
R5 (Industrial)	5527839	4903902	6.88	500	1.38%
R6 (Industrial)	5526639	4903106	0.03	500	0.01%
R7 (Industrial)	5526773	4902959	0.03	500	0.01%
R8 (Industrial)	5526990	4902467	0.02	500	<0.01%
R9 (Industrial)	5525355	4902858	0.02	500	<0.01%
R10 (Industrial)	5525510	4903666	0.01	500	<0.01%
R11 (Commercial)	5530284	4906268	0.01	500	<0.01%
R12 (Industrial)	5529216	4905963	0.01	500	<0.01%
SO_2 1-hour 99.7th percentile concentration					
R1 (Residential)	5528437	4908150	0.01	350	<0.01%
R2 (Residential)	5519995	4899998	<0.01	350	<0.01%
R3 (Industrial)	5529990	4903805	0.01	350	<0.01%
R4 (Industrial)	5528417	4904125	0.02	350	0.01%
R5 (Industrial)	5527839	4903902	4.76	350	1.36%
R6 (Industrial)	5526639	4903106	0.01	350	<0.01%
R7 (Industrial)	5526773	4902959	0.01	350	<0.01%
R8 (Industrial)	5526990	4902467	0.01	350	<0.01%
R9 (Industrial)	5525355	4902858	<0.01	350	<0.01%
R10 (Industrial)	5525510	4903666	<0.01	350	<0.01%
R11 (Commercial)	5530284	4906268	<0.01	350	<0.01%
R12 (Industrial)	5529216	4905963	<0.01	350	<0.01%
SO_2 24-hour maximum concentration					
R1 (Residential)	5528437	4908150	1.01E-03	50	<0.01%
R2 (Residential)	5519995	4899998	4.01E-04	50	<0.01%
R3 (Industrial)	5529990	4903805	1.24E-03	50	<0.01%
R4 (Industrial)	5528417	4904125	1.09E-02	50	0.02%
R5 (Industrial)	5527839	4903902	8.30E-01	50	1.66%
R6 (Industrial)	5526639	4903106	4.05E-03	50	0.01%
R7 (Industrial)	5526773	4902959	3.74E-03	50	0.01%
R8 (Industrial)	5526990	4902467	2.24E-03	50	<0.01%
R9 (Industrial)	5525355	4902858	1.41E-03	50	<0.01%
R10 (Industrial)	5525510	4903666	1.54E-03	50	<0.01%
R11 (Commercial)	5530284	4906268	8.01E-04	50	<0.01%
R12 (Industrial)	5529216	4905963	8.00E-04	50	<0.01%

Table 5.5: Predicted highest benzene concentrations - BDJF yard

Receptor ID (Type)	X (Easting)	Y (Northing)	Highest concentration ($\mu g/m^3$)	Assessment criteria ($\mu g/m^3$)	% of assessment criteria
Benzene annual average concentration					
R1 (Residential)	5528437	4908150	0.0002	5	<0.01%
R2 (Residential)	5519995	4899998	0.0001	5	<0.01%
R3 (Industrial)	5529990	4903805	0.0001	5	<0.01%
R4 (Industrial)	5528417	4904125	0.0045	5	0.09%
R5 (Industrial)	5527839	4903902	1.0406	5	20.81%
R6 (Industrial)	5526639	4903106	0.0004	5	0.01%
R7 (Industrial)	5526773	4902959	0.0005	5	0.01%
R8 (Industrial)	5526990	4902467	0.0004	5	0.01%
R9 (Industrial)	5525355	4902858	0.0002	5	<0.01%
R10 (Industrial)	5525510	4903666	0.0002	5	<0.01%
R11 (Commercial)	5530284	4906268	0.0001	5	<0.01%
R12 (Industrial)	5529216	4905963	0.0002	5	<0.01%

Tables 5.1 to 5.5 show that no exceedance of the assessment criteria is predicted at receptors in the vicinity of BDJF yard and the short-term and long-term process contribution concentrations of all pollutants are well below the assessment criteria.

5.1.2 Azfen Bayil yard

The highest predicted process contribution pollutant concentrations are presented in Tables 5.6 to 5.10. These are compared with the assessment criteria.

Table 5.6: Predicted highest NO_2 concentrations - Azfen Bayil yard

Receptor ID (Type)	X (Easting)	Y (Northing)	Highest concentration(µg/m^3)	Assessment criteria (µg/m^3)	% of assessment criteria
NO_2 1-hour maximum concentration					
R1 (Residential)	5545612	4911918	42.41	200	21.2%
R2 (Residential)	5545893	4912114	47.56	200	23.8%
R3 (Residential)	5545838	4912396	55.49	200	27.7%
R4 (Residential)	5546008	4912631	48.73	200	24.4%
R5 (Residential)	5546150	4912982	41.20	200	20.6%
R6 (Residential)	5547057	4913402	39.96	200	20.0%
R7 (Residential)	5546062	4910808	28.63	200	14.3%
R8 (Residential)	5546471	4910560	33.98	200	17.0%
R9 (Residential)	5546812	4910333	33.98	200	17.0%
R10 (School)	5546786	4912405	68.16	200	34.1%
R11 (Industrial)	5546152	4911501	51.60	200	25.8%
R12 (Industrial)	5546746	4911487	91.28	200	45.6%
R13 (Industrial)	5546384	4911965	68.29	200	34.1%
R14 (Industrial)	5546570	4911726	83.39	200	41.7%
NO_2 24-hour maximum concentration					
R1 (Residential)	5545612	4911918	4.16	40	10.4%
R2 (Residential)	5545893	4912114	4.82	40	12.0%
R3 (Residential)	5545838	4912396	3.93	40	9.8%
R4 (Residential)	5546008	4912631	5.58	40	14.0%
R5 (Residential)	5546150	4912982	5.38	40	13.4%
R6 (Residential)	5547057	4913402	5.80	40	14.5%
R7 (Residential)	5546062	4910808	6.51	40	16.3%
R8 (Residential)	5546471	4910560	6.96	40	17.4%
R9 (Residential)	5546812	4910333	7.53	40	18.8%
R10 (School)	5546786	4912405	14.57	40	36.4%
R11 (Industrial)	5546152	4911501	11.36	40	28.4%
R12 (Industrial)	5546746	4911487	23.61	40	59.0%
R13 (Industrial)	5546384	4911965	8.06	40	20.1%
R14 (Industrial)	5546570	4911726	13.90	40	34.8%

Receptor ID (Type)	X (Easting)	Y (Northing)	Highest concentration(μg/m^3)	Assessment criteria (μg/m^3)	% of assessment criteria
NO_2 annual average concentration					
R1 (Residential)	5545612	4911918	0.01	40	0.02%
R2 (Residential)	5545893	4912114	0.01	40	0.02%
R3 (Residential)	5545838	4912396	0.01	40	0.02%
R4 (Residential)	5546008	4912631	0.01	40	0.02%
R5 (Residential)	5546150	4912982	0.01	40	0.03%
R6 (Residential)	5547057	4913402	0.02	40	0.06%
R7 (Residential)	5546062	4910808	0.01	40	0.02%
R8 (Residential)	5546471	4910560	0.01	40	0.03%
R9 (Residential)	5546812	4910333	0.01	40	0.03%
R10 (School)	5546786	4912405	0.03	40	0.07%
R11 (Industrial)	5546152	4911501	0.01	40	0.03%
R12 (Industrial)	5546746	4911487	0.03	40	0.07%
R13 (Industrial)	5546384	4911965	0.01	40	0.04%
R14 (Industrial)	5546570	4911726	0.02	40	0.05%

Table 5.7: Predicted highest CO concentrations - Azfen Bayil yard

Receptor ID (Type)	X (Easting)	Y (Northing)	Highest concentration (μg/m^3)	Assessment criteria (μg/m^3)	% of assessment criteria
CO 15-min maximum concentration					
R1 (Residential)	5545612	4911918	32.03	3000	1.1%
R2 (Residential)	5545893	4912114	35.92	3000	1.2%
R3 (Residential)	5545838	4912396	41.90	3000	1.4%
R4 (Residential)	5546008	4912631	36.80	3000	1.2%
R5 (Residential)	5546150	4912982	31.12	3000	1.0%
R6 (Residential)	5547057	4913402	30.18	3000	1.0%
R7 (Residential)	5546062	4910808	21.62	3000	0.7%
R8 (Residential)	5546471	4910560	25.66	3000	0.9%
R9 (Residential)	5546812	4910333	25.66	3000	0.9%
R10 (School)	5546786	4912405	51.48	3000	1.7%
R11 (Industrial)	5546152	4911501	38.96	3000	1.3%
R12 (Industrial)	5546746	4911487	68.94	3000	2.3%
R13 (Industrial)	5546384	4911965	51.57	3000	1.7%
R14 (Industrial)	5546570	4911726	62.97	3000	2.1%

Receptor ID (Type)	X (Easting)	Y (Northing)	Highest concentration (µg/m³)	Assessment criteria (µg/m³)	% of assessment criteria
CO 1-hour maximum concentration					
R1 (Residential)	5545612	4911918	8.94	5000	0.2%
R2 (Residential)	5545893	4912114	8.52	5000	0.2%
R3 (Residential)	5545838	4912396	6.98	5000	0.1%
R4 (Residential)	5546008	4912631	8.45	5000	0.2%
R5 (Residential)	5546150	4912982	8.02	5000	0.2%
R6 (Residential)	5547057	4913402	10.81	5000	0.2%
R7 (Residential)	5546062	4910808	8.12	5000	0.2%
R8 (Residential)	5546471	4910560	7.15	5000	0.1%
R9 (Residential)	5546812	4910333	7.48	5000	0.1%
R10 (School)	5546786	4912405	17.63	5000	0.4%
R11 (Industrial)	5546152	4911501	13.17	5000	0.3%
R12 (Industrial)	5546746	4911487	24.28	5000	0.5%
R13 (Industrial)	5546384	4911965	13.97	5000	0.3%
R14 (Industrial)	5546570	4911726	16.98	5000	0.3%
CO 24-hour maximum concentration					
R1 (Residential)	5545612	4911918	3.14	10000	0.03%
R2 (Residential)	5545893	4912114	3.64	10000	0.04%
R3 (Residential)	5545838	4912396	2.97	10000	0.03%
R4 (Residential)	5546008	4912631	4.22	10000	0.04%
R5 (Residential)	5546150	4912982	4.06	10000	0.04%
R6 (Residential)	5547057	4913402	4.38	10000	0.04%
R7 (Residential)	5546062	4910808	4.92	10000	0.05%
R8 (Residential)	5546471	4910560	5.26	10000	0.05%
R9 (Residential)	5546812	4910333	5.68	10000	0.06%
R10 (School)	5546786	4912405	11.00	10000	0.11%
R11 (Industrial)	5546152	4911501	8.58	10000	0.09%
R12 (Industrial)	5546746	4911487	17.83	10000	0.18%
R13 (Industrial)	5546384	4911965	6.09	10000	0.06%
R14 (Industrial)	5546570	4911726	10.50	10000	0.10%

Table 5.8: Predicted highest PM_{10} concentrations - Azfen Bayil yard

Receptor ID (Type)	X (Easting)	Y (Northing)	Highest concentration (µg/m³)	Assessment criteria (µg/m³)	% of assessment criteria
PM_{10} 24-hour 99th percentile concentration					
R1 (Residential)	5545612	4911918	0.32	50	0.6%
R2 (Residential)	5545893	4912114	0.37	50	0.7%
R3 (Residential)	5545838	4912396	0.28	50	0.6%
R4 (Residential)	5546008	4912631	0.31	50	0.6%
R5 (Residential)	5546150	4912982	0.38	50	0.8%
R6 (Residential)	5547057	4913402	0.48	50	1.0%
R7 (Residential)	5546062	4910808	0.49	50	1.0%
R8 (Residential)	5546471	4910560	0.51	50	1.0%
R9 (Residential)	5546812	4910333	0.46	50	0.9%
R10 (School)	5546786	4912405	1.06	50	2.1%
R11 (Industrial)	5546152	4911501	0.85	50	1.7%
R12 (Industrial)	5546746	4911487	1.91	50	3.8%
R13 (Industrial)	5546384	4911965	0.73	50	1.5%
R14 (Industrial)	5546570	4911726	1.11	50	2.2%
PM_{10} annual average concentration					
R1 (Residential)	5545612	4911918	1.41E-06	40	<0.1%
R2 (Residential)	5545893	4912114	1.76E-06	40	<0.1%
R3 (Residential)	5545838	4912396	1.58E-06	40	<0.1%
R4 (Residential)	5546008	4912631	1.96E-06	40	<0.1%
R5 (Residential)	5546150	4912982	2.26E-06	40	<0.1%
R6 (Residential)	5547057	4913402	5.96E-06	40	<0.1%
R7 (Residential)	5546062	4910808	1.98E-06	40	<0.1%
R8 (Residential)	5546471	4910560	2.22E-06	40	<0.1%
R9 (Residential)	5546812	4910333	3.13E-06	40	<0.1%
R10 (School)	5546786	4912405	6.37E-06	40	<0.1%
R11 (Industrial)	5546152	4911501	2.19E-06	40	<0.1%
R12 (Industrial)	5546746	4911487	5.84E-06	40	<0.1%
R13 (Industrial)	5546384	4911965	3.20E-06	40	<0.1%
R14 (Industrial)	5546570	4911726	4.10E-06	40	<0.1%

Table 5.9: Predicted highest SO_2 concentrations - Azfen Bayil yard

Receptor ID (Type)	X (Easting)	Y (Northing)	Highest concentration (μg/m³)	Assessment criteria (μg/m³)	% of assessment criteria
SO_2 10-min maximum concentration					
R1 (Residential)	5545612	4911918	0.03	500	0.01%
R2 (Residential)	5545893	4912114	0.03	500	0.01%
R3 (Residential)	5545838	4912396	0.03	500	0.01%
R4 (Residential)	5546008	4912631	0.03	500	0.01%
R5 (Residential)	5546150	4912982	0.03	500	0.01%
R6 (Residential)	5547057	4913402	0.02	500	<0.01%
R7 (Residential)	5546062	4910808	0.02	500	<0.01%
R8 (Residential)	5546471	4910560	0.02	500	<0.01%
R9 (Residential)	5546812	4910333	0.02	500	<0.01%
R10 (School)	5546786	4912405	0.04	500	0.01%
R11 (Industrial)	5546152	4911501	0.04	500	0.01%
R12 (Industrial)	5546746	4911487	0.05	500	0.01%
R13 (Industrial)	5546384	4911965	0.05	500	0.01%
R14 (Industrial)	5546570	4911726	0.06	500	0.01%
SO_2 1-hour 99.7th percentile concentration					
R1 (Residential)	5545612	4911918	0.01	350	<0.01%
R2 (Residential)	5545893	4912114	0.01	350	<0.01%
R3 (Residential)	5545838	4912396	0.01	350	<0.01%
R4 (Residential)	5546008	4912631	0.01	350	<0.01%
R5 (Residential)	5546150	4912982	0.01	350	<0.01%
R6 (Residential)	5547057	4913402	0.01	350	<0.01%
R7 (Residential)	5546062	4910808	0.01	350	<0.01%
R8 (Residential)	5546471	4910560	0.01	350	<0.01%
R9 (Residential)	5546812	4910333	0.01	350	<0.01%
R10 (School)	5546786	4912405	0.02	350	0.01%
R11 (Industrial)	5546152	4911501	0.01	350	<0.01%
R12 (Industrial)	5546746	4911487	0.02	350	<0.01%
R13 (Industrial)	5546384	4911965	0.01	350	<0.01%
R14 (Industrial)	5546570	4911726	0.02	350	<0.01%

Receptor ID (Type)	X (Easting)	Y (Northing)	Highest concentration (μg/m³)	Assessment criteria (μg/m³)	% of assessment criteria
SO_2 24-hour maximum concentration					
R1 (Residential)	5545612	4911918	1.73E-03	50	<0.01%
R2 (Residential)	5545893	4912114	2.00E-03	50	<0.01%
R3 (Residential)	5545838	4912396	1.63E-03	50	<0.01%
R4 (Residential)	5546008	4912631	2.32E-03	50	<0.01%
R5 (Residential)	5546150	4912982	2.24E-03	50	<0.01%
R6 (Residential)	5547057	4913402	2.41E-03	50	<0.01%
R7 (Residential)	5546062	4910808	2.71E-03	50	0.01%
R8 (Residential)	5546471	4910560	2.90E-03	50	0.01%
R9 (Residential)	5546812	4910333	3.14E-03	50	0.01%
R10 (School)	5546786	4912405	6.06E-03	50	0.01%
R11 (Industrial)	5546152	4911501	4.73E-03	50	0.01%
R12 (Industrial)	5546746	4911487	9.81E-03	50	0.02%
R13 (Industrial)	5546384	4911965	3.36E-03	50	0.01%
R14 (Industrial)	5546570	4911726	5.78E-03	50	0.01%

Table 5.10: Predicted Highest Benzene Concentrations at Azfen Bayil yard

Receptor ID (Type)	X (Easting)	Y (Northing)	Highest concentration (μg/m³)	Assessment criteria (μg/m³)	% of assessment criteria
Benzene annual average concentration					
R1 (Residential)	5545612	4911918	0.0002	5	<0.01%
R2 (Residential)	5545893	4912114	0.0003	5	0.01%
R3 (Residential)	5545838	4912396	0.0003	5	0.01%
R4 (Residential)	5546008	4912631	0.0003	5	0.01%
R5 (Residential)	5546150	4912982	0.0004	5	0.01%
R6 (Residential)	5547057	4913402	0.0010	5	0.02%
R7 (Residential)	5546062	4910808	0.0004	5	0.01%
R8 (Residential)	5546471	4910560	0.0004	5	0.01%
R9 (Residential)	5546812	4910333	0.0005	5	0.01%
R10 (School)	5546786	4912405	0.0011	5	0.02%
R11 (Industrial)	5546152	4911501	0.0004	5	0.01%
R12 (Industrial)	5546746	4911487	0.0011	5	0.02%
R13 (Industrial)	5546384	4911965	0.0006	5	0.01%
R14 (Industrial)	5546570	4911726	0.0007	5	0.01%

Tables 5.6 to 5.10 show that no exceedance of the assessment criteria is predicted at receptors in the vicinity of Bayil yard and the short-term and long-term process contribution concentrations of all pollutants are well below the assessment criteria.

5.1.3 PFOC onshore route

The highest predicted process contribution pollutant concentrations are presented in Tables 5.11 to 5.15. These are compared with the assessment criteria.

Table 5.11: Predicted highest NO_2 concentrations - PFOC onshore route

Receptor ID (Type)	X (Easting)	Y (Northing)	Highest concentration (µg/m³)	Assessment criteria (µg/m³)	% of assessment criteria
NO_2 1-hour maximum concentration					
R1 (Residential)	5506822	4891645	9.84E-05	200	<0.01%
R2 (Residential)	5510708	4894333	4.88E-04	200	<0.01%
R3 (Residential)	5510470	4894655	8.51E-04	200	<0.01%
R4 (Industrial)	5509114	4894750	1.74E-03	200	<0.01%
R5 (Industrial)	5507683	4894182	2.48E-04	200	<0.01%
R6 (Industrial)	5507581	4894357	2.55E-04	200	<0.01%
R7 (Industrial)	5508764	4894719	2.23E-03	200	<0.01%
R8 (Industrial)	5509940	4894011	2.49E-03	200	<0.01%
R9 (Industrial)	5507035	4892161	1.06E-04	200	<0.01%
NO_2 24-hour maximum concentration					
R1 (Residential)	5506822	4891645	1.97E-05	40	<0.01%
R2 (Residential)	5510708	4894333	3.37E-05	40	<0.01%
R3 (Residential)	5510470	4894655	4.80E-05	40	<0.01%
R4 (Industrial)	5509114	4894750	4.77E-04	40	<0.01%
R5 (Industrial)	5507683	4894182	3.97E-05	40	<0.01%
R6 (Industrial)	5507581	4894357	4.12E-05	40	<0.01%
R7 (Industrial)	5508764	4894719	5.53E-04	40	<0.01%
R8 (Industrial)	5509940	4894011	3.14E-04	40	<0.01%
R9 (Industrial)	5507035	4892161	2.30E-05	40	<0.01%

Receptor ID (Type)	X (Easting)	Y (Northing)	Highest concentration (μg/m³)	Assessment criteria (μg/m³)	% of assessment criteria
NO_2 annual average concentration					
R1 (Residential)	5506822	4891645	5.83E-07	40	<0.01%
R2 (Residential)	5510708	4894333	6.82E-07	40	<0.01%
R3 (Residential)	5510470	4894655	1.18E-06	40	<0.01%
R4 (Industrial)	5509114	4894750	7.73E-06	40	<0.01%
R5 (Industrial)	5507683	4894182	1.08E-06	40	<0.01%
R6 (Industrial)	5507581	4894357	1.08E-06	40	<0.01%
R7 (Industrial)	5508764	4894719	8.87E-06	40	<0.01%
R8 (Industrial)	5509940	4894011	4.62E-06	40	<0.01%
R9 (Industrial)	5507035	4892161	5.30E-07	40	<0.01%

Table 5.12: Predicted highest CO concentrations - PFOC onshore route

Receptor ID (Type)	X (Easting)	Y (Northing)	Highest concentration (μg/m³)	Assessment criteria (μg/m³)	% of assessment criteria
CO 15-min maximum concentration					
R1 (Residential)	5506822	4891645	6.05E-05	3000	<0.01%
R2 (Residential)	5510708	4894333	3.00E-04	3000	<0.01%
R3 (Residential)	5510470	4894655	5.23E-04	3000	<0.01%
R4 (Industrial)	5509114	4894750	1.07E-03	3000	<0.01%
R5 (Industrial)	5507683	4894182	1.53E-04	3000	<0.01%
R6 (Industrial)	5507581	4894357	1.57E-04	3000	<0.01%
R7 (Industrial)	5508764	4894719	1.37E-03	3000	<0.01%
R8 (Industrial)	5509940	4894011	1.53E-03	3000	<0.01%
R9 (Industrial)	5507035	4892161	6.53E-05	3000	<0.01%
CO 1-hour maximum concentration					
R1 (Residential)	5506822	4891645	2.86E-05	5000	<0.01%
R2 (Residential)	5510708	4894333	5.87E-05	5000	<0.01%
R3 (Residential)	5510470	4894655	1.18E-04	5000	<0.01%
R4 (Industrial)	5509114	4894750	4.80E-04	5000	<0.01%
R5 (Industrial)	5507683	4894182	8.49E-05	5000	<0.01%
R6 (Industrial)	5507581	4894357	9.11E-05	5000	<0.01%
R7 (Industrial)	5508764	4894719	5.96E-04	5000	<0.01%
R8 (Industrial)	5509940	4894011	4.60E-04	5000	<0.01%
R9 (Industrial)	5507035	4892161	2.58E-05	5000	<0.01%

Receptor ID (Type)	X (Easting)	Y (Northing)	Highest concentration (μg/m³)	Assessment criteria (μg/m³)	% of assessment criteria
CO 24-hour maximum concentration					
R1 (Residential)	5506822	4891645	1.21E-05	10000	<0.01%
R2 (Residential)	5510708	4894333	2.07E-05	10000	<0.01%
R3 (Residential)	5510470	4894655	2.95E-05	10000	<0.01%
R4 (Industrial)	5509114	4894750	2.93E-04	10000	<0.01%
R5 (Industrial)	5507683	4894182	2.44E-05	10000	<0.01%
R6 (Industrial)	5507581	4894357	2.53E-05	10000	<0.01%
R7 (Industrial)	5508764	4894719	3.40E-04	10000	<0.01%
R8 (Industrial)	5509940	4894011	1.93E-04	10000	<0.01%
R9 (Industrial)	5507035	4892161	1.42E-05	10000	<0.01%

Table 5.13: Predicted highest PM_{10} concentrations - PFOC onshore route

Receptor ID (Type)	X (Easting)	Y (Northing)	Highest concentration (μg/m³)	Assessment criteria (μg/m³)	% of Assessment criteria
PM_{10} 24-hour 99th percentile concentration					
R1 (Residential)	5506822	4891645	1.27E-06	50	<0.01%
R2 (Residential)	5510708	4894333	1.64E-06	50	<0.01%
R3 (Residential)	5510470	4894655	2.93E-06	50	<0.01%
R4 (Industrial)	5509114	4894750	1.83E-05	50	<0.01%
R5 (Industrial)	5507683	4894182	2.77E-06	50	<0.01%
R6 (Industrial)	5507581	4894357	2.56E-06	50	<0.01%
R7 (Industrial)	5508764	4894719	2.16E-05	50	<0.01%
R8 (Industrial)	5509940	4894011	1.56E-05	50	<0.01%
R9 (Industrial)	5507035	4892161	9.80E-07	50	<0.01%
PM_{10} annual average concentration					
R1 (Residential)	5506822	4891645	5.24E-08	40	<0.01%
R2 (Residential)	5510708	4894333	6.14E-08	40	<0.01%
R3 (Residential)	5510470	4894655	1.06E-07	40	<0.01%
R4 (Industrial)	5509114	4894750	6.96E-07	40	<0.01%
R5 (Industrial)	5507683	4894182	9.74E-08	40	<0.01%
R6 (Industrial)	5507581	4894357	9.71E-08	40	<0.01%
R7 (Industrial)	5508764	4894719	7.99E-07	40	<0.01%
R8 (Industrial)	5509940	4894011	4.16E-07	40	<0.01%
R9 (Industrial)	5507035	4892161	4.77E-08	40	<0.01%

Table 5.14: Predicted highest SO_2 concentrations - PFOC onshore route

Receptor ID (Type)	X (Easting)	Y (Northing)	Highest concentration (µg/m³)	Assessment criteria (µg/m³)	% of assessment criteria
SO_2 10-min maximum concentration					
R1 (Residential)	5506822	4891645	1.78E-05	500	<0.01%
R2 (Residential)	5510708	4894333	8.79E-05	500	<0.01%
R3 (Residential)	5510470	4894655	1.52E-04	500	<0.01%
R4 (Industrial)	5509114	4894750	3.12E-04	500	<0.01%
R5 (Industrial)	5507683	4894182	4.50E-05	500	<0.01%
R6 (Industrial)	5507581	4894357	4.62E-05	500	<0.01%
R7 (Industrial)	5508764	4894719	4.02E-04	500	<0.01%
R8 (Industrial)	5509940	4894011	4.47E-04	500	<0.01%
R9 (Industrial)	5507035	4892161	1.90E-05	500	<0.01%
SO_2 1-hour 99.7th percentile concentration					
R1 (Residential)	5506822	4891645	6.88E-06	350	<0.01%
R2 (Residential)	5510708	4894333	1.19E-05	350	<0.01%
R3 (Residential)	5510470	4894655	1.81E-05	350	<0.01%
R4 (Industrial)	5509114	4894750	1.08E-04	350	<0.01%
R5 (Industrial)	5507683	4894182	1.60E-05	350	<0.01%
R6 (Industrial)	5507581	4894357	1.78E-05	350	<0.01%
R7 (Industrial)	5508764	4894719	1.39E-04	350	<0.01%
R8 (Industrial)	5509940	4894011	8.99E-05	350	<0.01%
R9 (Industrial)	5507035	4892161	6.99E-06	350	<0.01%
SO_2 24-hour maximum concentration					
R1 (Residential)	5506822	4891645	3.55E-06	50	<0.01%
R2 (Residential)	5510708	4894333	6.08E-06	50	<0.01%
R3 (Residential)	5510470	4894655	8.65E-06	50	<0.01%
R4 (Industrial)	5509114	4894750	8.60E-05	50	<0.01%
R5 (Industrial)	5507683	4894182	7.16E-06	50	<0.01%
R6 (Industrial)	5507581	4894357	7.43E-06	50	<0.01%
R7 (Industrial)	5508764	4894719	9.98E-05	50	<0.01%
R8 (Industrial)	5509940	4894011	5.66E-05	50	<0.01%
R9 (Industrial)	5507035	4892161	4.15E-06	50	<0.01%

Table 5.15: Predicted highest benzene concentrations - PFOC onshore route

Receptor ID (Type)	X (Easting)	Y (Northing)	Highest concentration (μg/m³)	Assessment criteria (μg/m³)	% of assessment criteria
Benzene annual average concentration					
R1 (Residential)	5506822	4891645	1.07E-06	5	<0.01%
R2 (Residential)	5510708	4894333	1.25E-06	5	<0.01%
R3 (Residential)	5510470	4894655	2.18E-06	5	<0.01%
R4 (Industrial)	5509114	4894750	1.42E-05	5	<0.01%
R5 (Industrial)	5507683	4894182	1.99E-06	5	<0.01%
R6 (Industrial)	5507581	4894357	1.98E-06	5	<0.01%
R7 (Industrial)	5508764	4894719	1.63E-05	5	<0.01%
R8 (Industrial)	5509940	4894011	8.51E-06	5	<0.01%
R9 (Industrial)	5507035	4892161	9.76E-07	5	<0.01%

Tables 5.11 to 5.15 show that no exceedance of the assessment criteria is predicted at receptors in the vicinity of the onshore PFOC route and the short-term and long-term process contribution concentrations of all pollutants are well below the assessment criteria.

5.2 Contour Plots

The primary atmospheric pollutant of concern is NO_x, which comprises nitrogen dioxide (NO_2) and nitrous oxide (NO). This is based on the larger predicted emission volumes as compared to other pollutants and the potential to impact human health. Moreover, the predicted concentration of other pollutants modelled was extremely low, well below the air quality assessment criteria.

Contour plots illustrating the dispersion profiles of NO_x (NO_2) released to the atmosphere are provided in Appendix D.

6 CONCLUSIONS

RSK Environment has been commissioned by bp Exploration (Shah Deniz) Ltd to undertake an air quality screening assessment for the Shah Deniz Compression (SDC) project, south of Baku, Azerbaijan.

The air quality screening assessment includes the onshore construction and commissioning elements of the project, which comprises the following main elements at three different locations:

- jacket construction at the Baku Deepwater Jacket Factory yard
- topsides construction and commissioning at AzFen Bayil yard
- installation of the onshore section of the SDC PFOC between the landfall in Sangachal Bay and Sangachal Terminal.

The potential air emission impacts associated with the two construction yards and onshore PFOC route have been assessed using an advanced air dispersion model, ADMS 6.

The key pollutants considered in this assessment are nitrogen dioxide, sulphur dioxide, particulate matter, carbon monoxide and VOCs (benzene). The assessment demonstrates that the process contributions resulting from the onshore construction and commissioning activities are well within the project assessment criteria derived from national and international standards / guidelines.

In summary, it is not anticipated that the onshore construction and commissioning activities will result in any significant impact on local air quality at sensitive receptor locations.

APPENDIX A: DETAILS OF EMISSION SOURCES

The estimated number of typical key construction plant and vehicles expected to be used onsite at the construction yards is provided in Tables A.1 and A.2. The estimated quantity of paint use at these sites is shown in Table A.3.

The estimated number of typical key construction plant and vehicles expected to be used along the PFOC onshore installation route is provided in Table A.4.

Table A.1: Predicted plant and vehicles in operation at BDJF yard

Plant	Number	Fuel consumption (diesel)	Operational period
Crawler cranes	8	60 litres per hour	9 hrs working, 6 days a week, 24 months
Forklift	7	3 litres per hour	9 hrs working, 6 days a week, 24 months
Generators	2	220 litres per hour	Used for backup power (0.8 MW at full load – see Annex 1). Assumed operational for 2 hours per week for 24 months.
Compressors	11	3 litres per hour	9 hrs working, 6 days a week, 24 months
Welding machines	44	-	Mains electricity
Electrode ovens	86	-	Mains electricity
Trailers	4	3 litres per 10 km	6 hrs working, 3 days a week, 24 months. Assumed 30 km travelled per day.
Winches	20	5 litres per hour	6 hrs working, 2 days a week, 24 months
Onsite vehicles and trucks	20	3 litres per 10 km	9 hours working, 6 days a week, 24 months. Assumed 30 km travelled per day.
Cherry pickers	3	3 litres per hour	9 hours working, 6 days a week, 24 months
Rolling machines	5	3 litres per hour	9 hours working, 6 days a week, 24 months

Table A.2: Predicted plant and vehicles in operation at Bayil yard

Plant	Number	Fuel consumption (diesel)	Operational period
Generators	2	259 litres per hour	Used for backup power (1 MW at full load – see Annex 1). Assumed operational for 2 hours per week for 32 months to include construction and commissioning period.
600 t cranes	2	60 litres per hour	6 hrs working, 6 days a week, 24 months
400 t cranes	2	40 litres per hour	6 hrs working, 6 days a week, 24 months
220 t cranes	2	20 litres per hour	7 hrs working, 6 days a week, 28 months
Small cranes	13	10 litres per hour	8 hrs working, 6 days a week, 30 months
Forklifts	18	3 litres per hour	8 hrs working, 6 days a week, 30 months

Plant	Number	Fuel consumption (diesel)	Operational period
HIABs	6	3 litres per hour	8 hrs working, 6 days a week, 30 months
Low beds and trucks	15	3 litres per 10 km	8 hrs working, 6 days a week, 30 months. Assumed 20 km travelled per day.
Compressors	15	3 litres per hour	8 hrs working, 6 days a week, 24 months
Tractors	5	3 litres per 10 km	8 hrs working, 6 days a week, 30 months. Assumed 20 km travelled per day.
Welding machines	300	-	8 hrs working, 6 days a week, 28 months

Table A.3 Anticipated paint use quantities

Item	Area	Undercoat (litres)		Topcoat (litres)
Jacket (BDJF yard)				
Jacket	Below splash zone	15,000		15,000
	Within splash zone	1,500		1,500
Risers	External	400		400
Caisson and J-tube	External	600		600
Caisson	Internal	150		150
Skirt piles		180		700
Item	**Area**	**Primer (litres)**	**Midcoat (litres)**	**Topcoat (litres)**
Topsides (Bayil yard)				
Structural	Sub under deck	1,970	1,100	1,100
	Under deck	14,960	8,200	8,200
	Main deck	25,253	13,900	13,900
	Electrical room	3,565	1,960	1,960
	Cooler structure	2,695	1,480	1,480
Passive fire protection	Vent stack	392	170	170
	Under deck	2,630	470	470
Piping spools	Topsides	6,542	3,500	3,500
Pipe supports	Topsides	8,800	4,800	4,800

Table A.4: Predicted plant and vehicles onshore installation of PFOC

Plant	Number	Fuel consumption (diesel)	Operational period
Excavators (onshore activities and construction of finger piers in nearshore)	2	3 litres per hour	8 hrs working, 6 days a week, 20 months
Construction and testing trucks	5	3 litres per 10 km	8 hrs working, 6 days a week, 20 months. Assumed to travel 40km travel per day.
100 t cranes	1	20 litres per hour	9 hrs working, 6 days a week, 15 months
Small cranes	5	10 litres per hour	8 hrs working, 6 days a week, 20 months
Horizontal drilling equipment	1	3 litres per hour	8 hrs working, 6 days a week, 1 month

APPENDIX B: EMISSION ESTIMATION METHOD AND ASSUMPTIONS

Emissions were calculated using internationally accepted emission factors, these were obtained from:

- EMEP/EEA Air Pollutant Emission Inventory Guidebook (European Environment Agency, 2023)
- AP-42 Compilation of Air Pollutant Emission Factors, Volume 1: Stationary and Point Emission Sources (U.S. Environmental Protection Agency, 1995)
- E&P Forum Report No. 2.59/197 Methods for Estimating Atmospheric Emissions from E&P Operations (Oil Industry International E&P Forum, September 1994)
- EEMS Atmospheric Emission Calculations Issue 1.8 (UK Offshore Operators Association Ltd, 2008).

Emission Factors

Construction plant

Table B.1 presents emission factors used to calculate emissions forecasts from construction plant including cranes, forklifts, etc. These factors have been taken from USEPA WebFire Emission Factor Database for Diesel Industrial Engines (AP-42 Compilation of Air Pollutant Emission Factors, Volume 1: Stationary and Point Emission Sources).

Table B.1: Emission factors construction plant

Pollutant	Emission Factor (lb/1000Gal)
CO_2	22600
CO	130
NO_x	604
SO_2	39.70
CH_4	NA
NMVOC	NA

There are minimal emissions of CH_4 and NMVOCs from construction plant. Emission factors for these were not available in USEPA WebFire Emission Factor Database for Diesel Industrial Engines, therefore, these have not been calculated.

Construction vehicles

Table B.2 presents emission factors used to calculate emissions forecasts from construction vehicles including trucks, trailers etc. These factors have been taken from EMEP/EEA air pollutant emission inventory guidebook 2023 for Diesel Heavy Duty Vehicles (assumed >32 t - Euro VI).

Table B.2: Emission factors construction vehicles

Pollutant	Emission Factor (g/km)
CO_2	0.486
CO	0.121
NO_x	0.507
SO_2	N/A
CH_4	0.001187
NMVOC	0.012
$PM_{2.5}$	0.0013

Note: There are minimal emissions of SO_2 from construction vehicles. The emission factors for these were not available in EMEP/EEA air pollutant emission inventory guidebook 2023 for Diesel Heavy Duty Vehicles. Therefore, these have not been calculated.

Diesel generators

Table B.3 presents emission factors used to calculate emissions forecasts from generators. These factors have been taken from AP 42 Vol 1 (3.4) for Large Stationary Diesel And All Stationary Dual-fuel Engines (https://www3.epa.gov/ttnchie1/ap42/ch03/final/c03s04.pdf). The emission factor varies with the load in case of generators.

Table B.3: Emission factors for diesel generators

Pollutant	Emission factor (tonnes per day) full load	Emission factor (tonnes per day) half load
NOx	0.28512	0.14256
SO_2	0.00048	0.00024
CO	0.07536	0.03768
PM	0.00927	0.00464
NMVOC	0.00761	0.00380
CH_4	0.00075	0.0004
CO_2	15.3252	7.6626

Paint

Table B.4 presents emission factors used to estimate VOC emissions from paints and coatings used on the jacket and topsides. VOC emission factors for top coat (assumed polyurethane stain), mid coat (assumed latex paint), and undercoat (assumed primer) have been taken from research paper https://doi.org/10.5194/acp-21-6005-2021.

Table B.4: VOC emission factors for coating and painting

Pollutant	Emission factor (g/kg)
Top coat (assumed polyurethane stain)	495
Mid coat (assumed latex paint)	43.1
Undercoat (assumed primer)	2.84

APPENDIX C: WINDROSES

Figure C.1: 2019 Windrose at Heydar Aliyev International Airport weather station

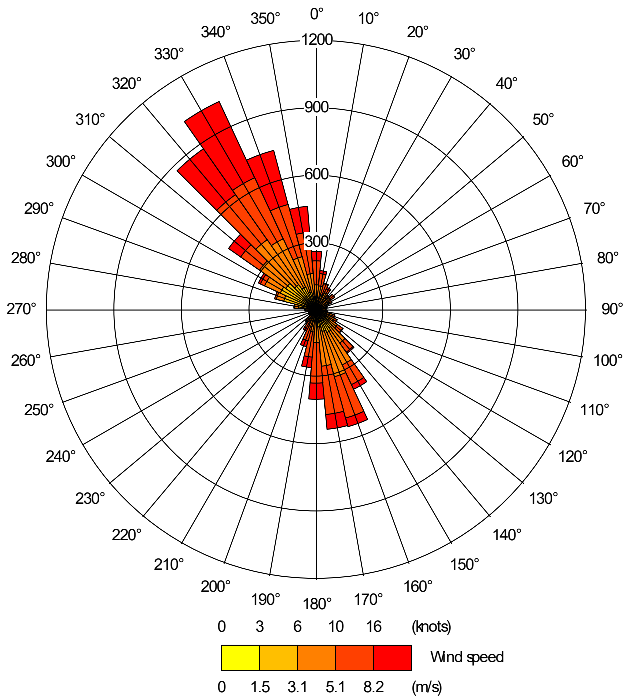


Figure C.2: 2020 Windrose at Heydar Aliyev International Airport weather station

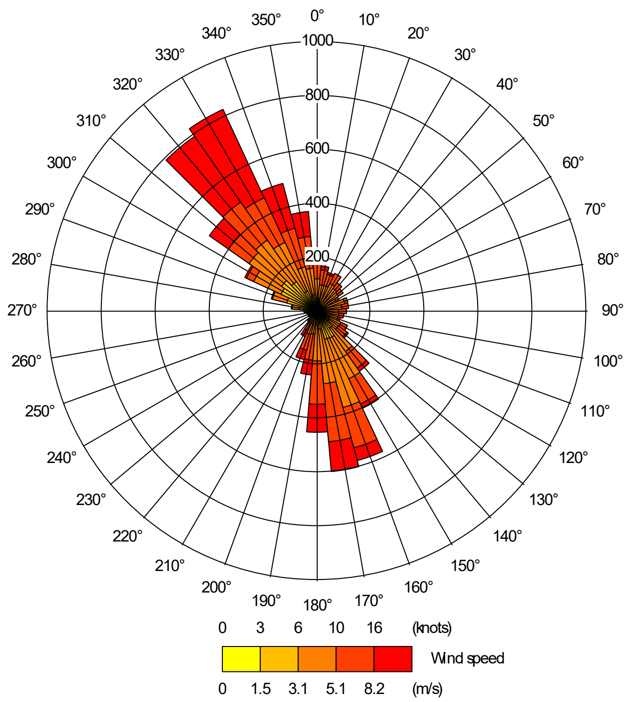


Figure C.3: 2021 Windrose at Heydar Aliyev International Airport weather station

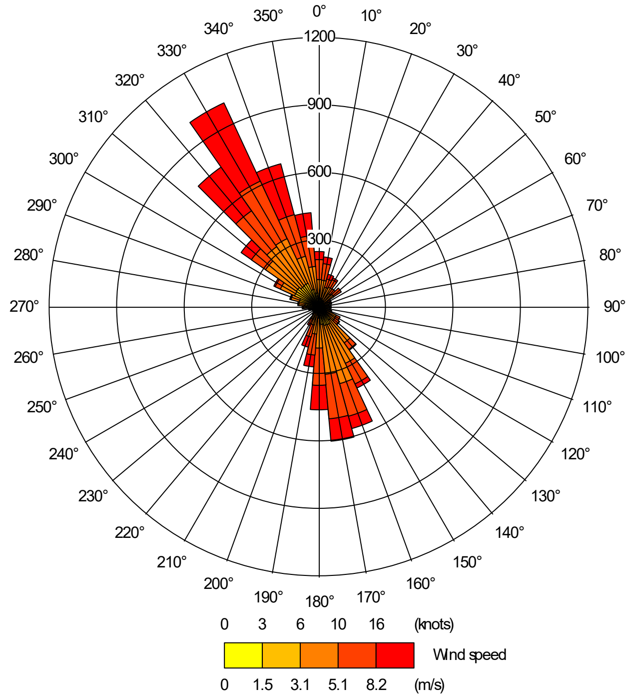


Figure C.4: 2022 Windrose at Heydar Aliyev International Airport weather station

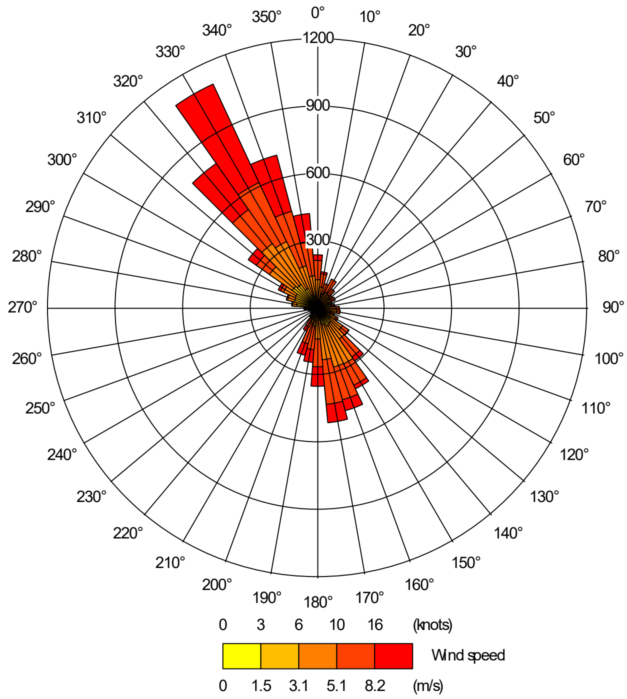
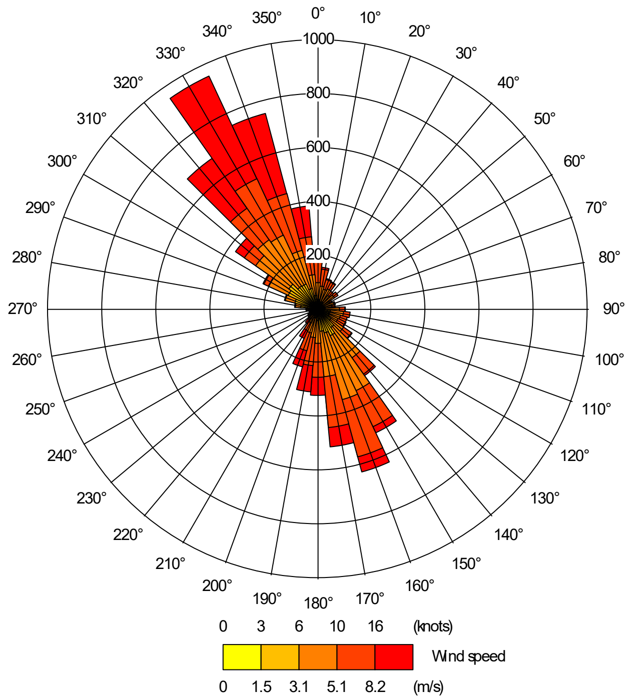


Figure C.5: 2023 Windrose at Heydar Aliyev International Airport weather station



APPENDIX D: CONTOUR PLOTS

Contour plots showing the dispersion and dilution profiles of NO_x (NO_2) are included in this appendix.

These refer to the predicted process contributions using 2021 meteorological datasets for BDJF yard, 2023 for Azfen Bayil yard, and 2020 for the PFOC onshore route as datasets for the stated years predicted the worst case scenario.

Figure D.1: Contour plot annual average NO_2 concentrations - BDJF yard (using 2021 meteorological dataset)

Figure D.2: Contour plot hourly maximum NO_2 concentrations - BDJF yard (using 2021 meteorological dataset)

Figure D.3: Contour plot annual average NO_2 concentrations - Azfen Bayil yard (using 2023 meteorological dataset)

Figure D.4: Contour plot hourly maximum NO_2 concentrations - Azfen Bayil yard (using 2023 meteorological dataset)

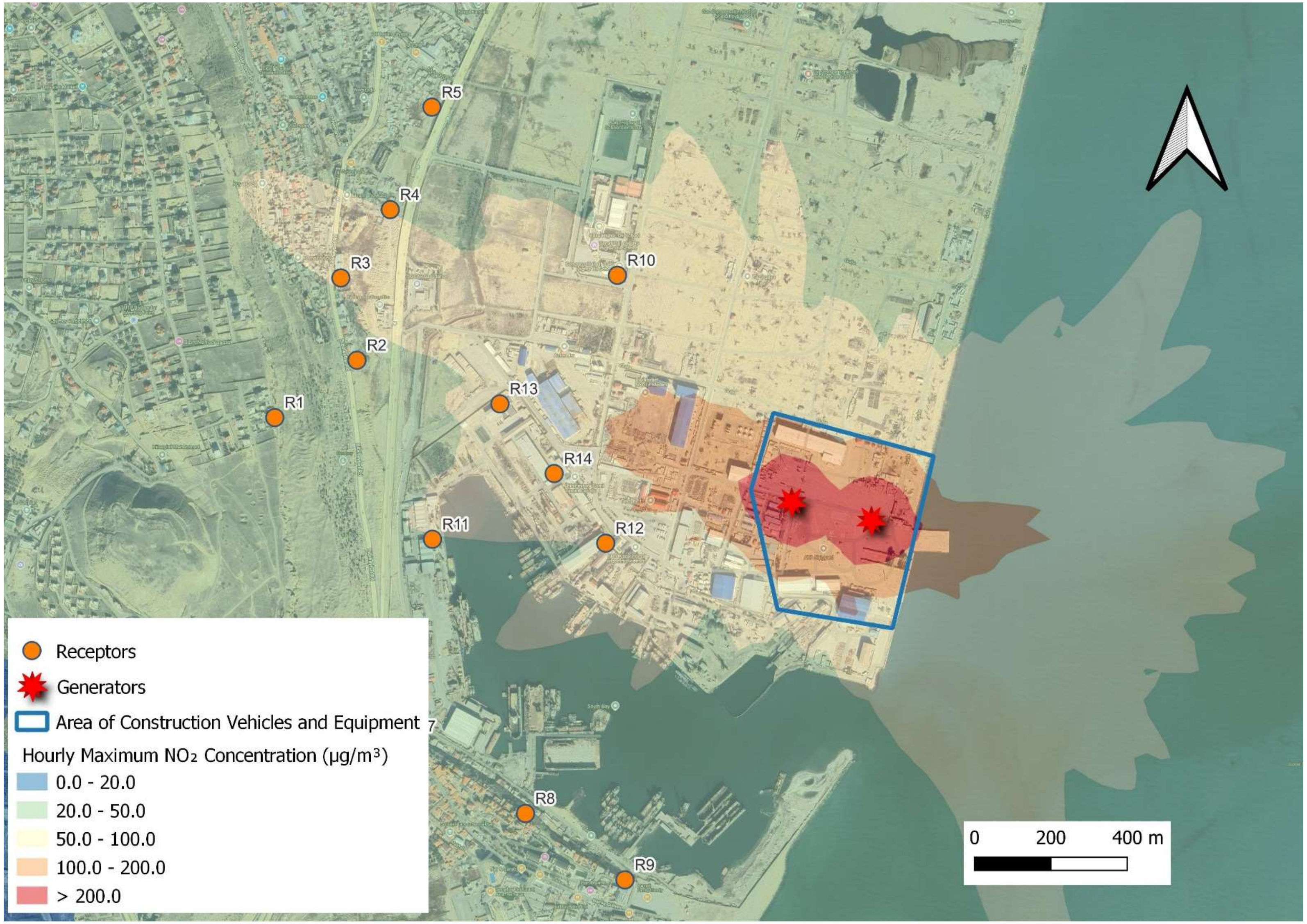
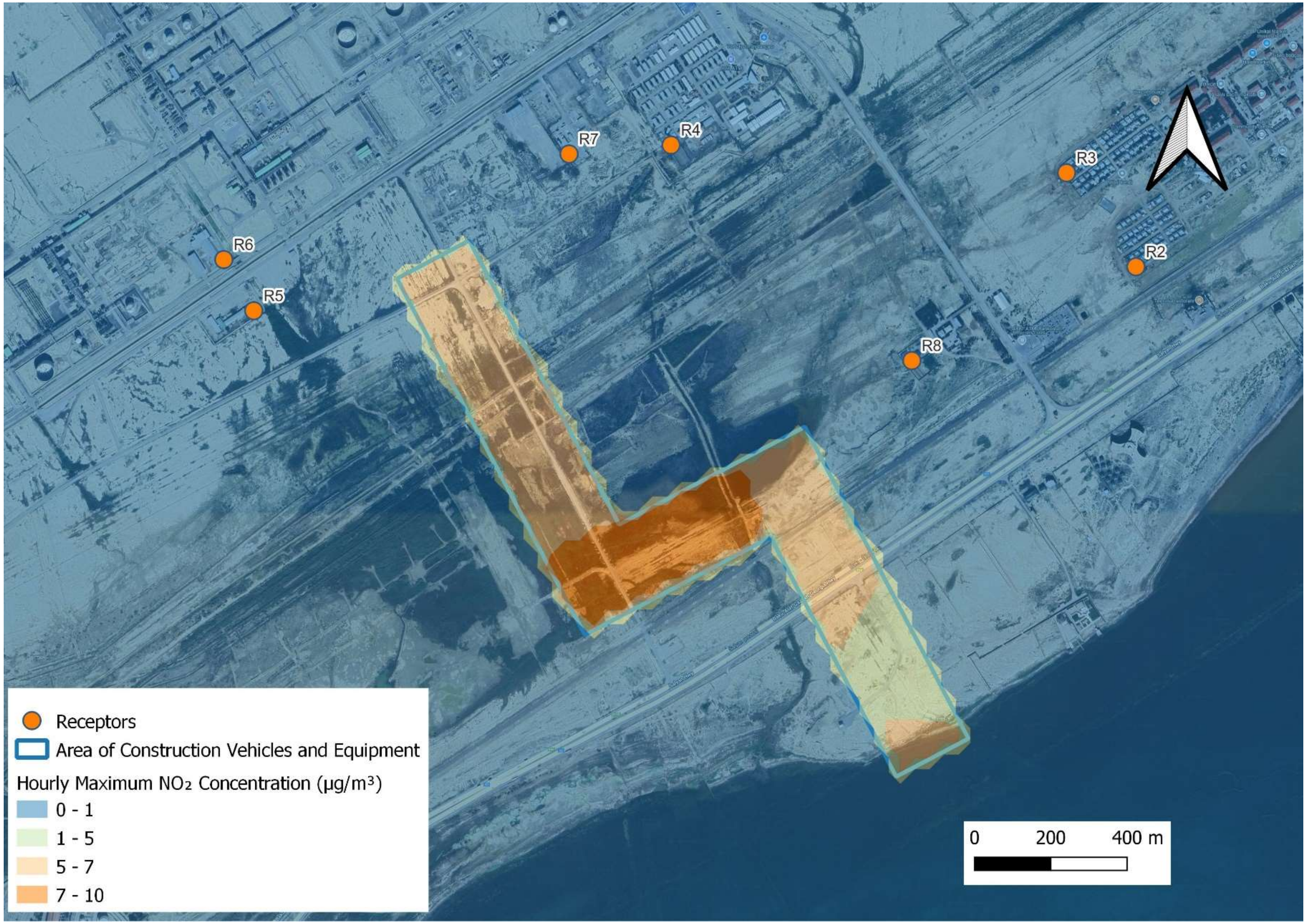


Figure D.5: Contour plot annual average NO_2 concentrations - onshore PFOC route (using 2020 meteorological dataset)

Figure D.6: Contour plot hourly maximum NO_2 concentrations – onshore PFOC route (using 2020 meteorological dataset)



APPENDIX 9C - NOISE SCREENING ASSESSMENT

bp Exploration (Shah Deniz) Ltd

Shah Deniz Compression Project

Noise Screening Assessment

2062147

OCTOBER 2024

RSK

RSK GENERAL NOTES

Project No.: 2062147

Title: Shah Deniz Compression Project – Noise Screening Assessment

Client: BP Exploration (Shah Deniz) Ltd

Date: 14 October 2024

Office: Bristol

Status: Rev03

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EXECUTIVE / NON-TECHNICAL SUMMARY

RSK Acoustics Limited (RSKA) has been commissioned by RSK Environment, on behalf of bp Exploration (Shah Deniz) Ltd, to undertake a noise screening assessment for the Shah Deniz Compression project.

The noise screening assessment includes the onshore construction and commissioning elements of the project, which comprises of the following three main activities at three different locations:

- jacket construction at the Baku Deepwater Jacket Factory yard
- topsides construction and commissioning at AzFen Bayil yard
- installation of the onshore section of the SDC power and fibre optic cable between the landfall in Sangachal Bay and Sangachal Terminal.

The assessment of noise from onshore operations has been scoped out as there will be no significant noise sources during the operational phase.

Due to the large distances between the construction activities and the nearest receptors (>500 m) the assessment of vibration has also been scoped out.

In the absence of specific local standards / guidance on noise, the assessment of construction and commissioning noise has been based on the guidance contained within British Standard 5228-1:2009+A1:2014 '*Code of Practice for Noise and Vibration Control on Construction and Open Sites*'.

Existing survey data has been used to derive appropriate noise criteria. Based on the survey data provided, the lowest construction noise thresholds of 65 dB $L_{Aeq,T}$, 55 dB $L_{Aeq,T}$ and 45 dB $L_{Aeq,T}$ have been assumed for the day, evening and night-time periods respectively to represent the most stringent criteria.

Calculations, based on data provided by the project team and from data taken from BS5228, show that noise from the construction and commissioning activities is considered not significant during both the daytime and night-time at all identified receptors.

CONTENTS

TABLES

FIGURES

1 INTRODUCTION

1.1 Background

RSK Acoustics Limited (RSKA) has been commissioned by RSK Environment, on behalf of bp Exploration (Shah Deniz) Ltd, to undertake a noise screening assessment for the Shah Deniz Compression (SDC) project, south of Baku, Azerbaijan.

The Shah Deniz field was discovered in 1999 and is one of the world's largest gas-condensate fields. The key objective of the SDC project is to install compression facilities offshore on a platform (downstream of existing facilities) to pressurise the gas and enable further hydrocarbons to be extracted and processed from the Shah Deniz field.

The SDC project comprises:

- the construction and installation of an electrically powered Normally Unattended Installation (eNUI)[1] (Shah Deniz Compression platform)
- infield subsea gas pipelines to/from the existing SDA and SDB gas export lines
- a combined power and fibre optic cable (PFOC) from Sangachal Terminal to the SDC platform (and an interconnector PFOC from SDB to SDC platform).

A glossary of acoustic terminology is presented in Appendix A.

1.2 Site Description and Location

This noise screening assessment considers the onshore construction elements of the SDC project only, which comprises of the following three main activities at three different locations:

- jacket construction at the Baku Deepwater Jacket Factory (BDJF) yard
- topsides construction and commissioning at AzFen Bayil yard
- installation of the onshore section of the PFOC between the landfall in Sangachal Bay and Sangachal Terminal.

1.2.1 BDJF yard

The BDJF yard lies approximately 20 km southwest of Baku on the western coastline of the Caspian Sea within a mostly industrial and commercial area. The site is approximately 1.5 km^2 in area and bound to the east by vacant land, to the southeast by the Caspian Sea and to the north by the Baku-Salyan Highway. The site is located on a coastal plain backed by steep hills that form a ridgeline running approximately parallel to the coast. The coastal area in the vicinity of the yard also includes a number of shallow lagoons, particularly to the west of the yard. The settlement of Puta is located approximately 3 km north of the yard.

1.2.2 AzFen Bayil yard

The AzFen Bayil yard is an operational yard used extensively for oil and gas industry related construction. It is located approximately 8 km south of Baku and is bound to the

[1] The concept of an eNUI platform is new to the region.

east and south by the Caspian Sea. Land to the west of the yard is mostly a mix of industrial sheds and storage yards with the settlement of Bibiheybat located approximately 1 km away. To the north is the Bibiheybat oil field. The yard extends over an area of approximately 1 km^2.

Figure 1.1 shows the location of both the BDFJ and the AzFen Bayil yards.

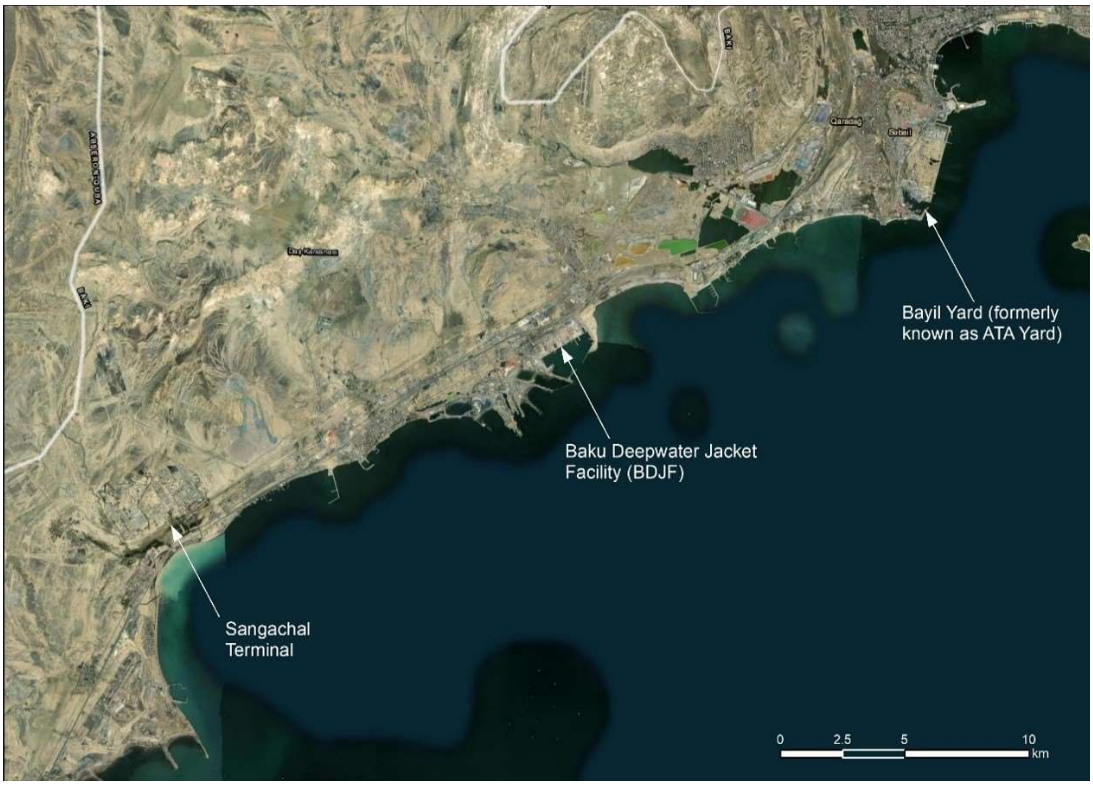

Figure 1.1: Location of BDFJ and AzFen Bayil yards

1.2.3 Sangachal Bay - Sangachal Terminal

The route of the onshore section of the Sangachal to SDC PFOC runs approximately 1 km west-southwest of the settlement of Umid (at its closest point) and just over 1 km north of the settlement of Sangachal (at its closest point), see Figure 1.2.

Installation of the onshore section of the SDC PFOC will take place along a 4.2 km route (only 2.2 km of which are outside the existing terminal boundary) that follows the route of the existing Shah Deniz 2 gas export pipelines between the landfall in Sangachal Bay and Sangachal Terminal.

Figure 1.2: Proposed onshore PFOC route

1.3 Proposed Activities

1.3.1 BDJF yard

The activities related to the jacket construction taking place at the BDJF will take place between February 2026 and January 2028. Most of the activities will take place during the daytime only, with some activities expected to be undertaken 24 hours per day for a limited period of overall project duration.

1.3.2 AzFen Bayil yard

The activities related to the topside fabrication and commissioning taking place at the AzFen Bayil yard will take place between July 2026 and January 2029. Most of the activities will take place during the daytime only, with some activities expected to be undertaken 24 hours per day. The 24-hour activities will take place between July 2026 and December 2027.

1.3.3 Sangachal Bay - Sangachal Terminal

Installation of the onshore section of the PFOC between the Sangachal Bay landfall and Sangachal Terminal will involve open-cut trenching techniques, with horizontal drilling for crossings of roads and railways. The activities have the potential to be undertaken during both the daytime and night-time.

1.4 Scope of Report

The objectives of this report are to:

- present the results of noise surveys undertaken in the vicinity of the proposed work locations.

- detail appropriate assessment criteria derived from local and international guidelines and from the survey data.
- calculate the noise impact at the nearest human receptors from the proposed SDC project construction activities and compare these to the relevant noise criteria.
- outline mitigation measures as necessary.

It should be noted that the assessment of noise from onshore operations has been scoped out as there will be no significant noise sources introduced during this phase.

Due to the large distances between the construction activities and the nearest human receptors (>500 m) the assessment of vibration has also been scoped out.

2 SENSITIVE RECEPTORS

2.1 BDJF Yard

The nearest human receptors to the BDJF yard are located approximately 3.5 km north of the centre of the yard, in the settlement of Puta, see Figure 2.1. There are also some individual dwellings 1 km northwest from the centre of the yard.

Figure 2.1: Location of sensitive receptors in the vicinity of BDJF yard

2.2 AzFen Bayil Yard

The nearest receptors to the Bayil yard are located approximately 1 km south, in the settlement of Bibiheybat, see Figure 2.2.

Figure 2.2: Location of sensitive receptors in vicinity of Azfen Bayil yard

2.3 Sangachal Bay - Sangachal Terminal

The nearest human receptors to the onshore PFOC route between Sangachal Bay and Sangachal Terminal are located approximately 1 km east of the route in the settlement of Umid, and approximately 1.5 km south of the terminal connection in the settlement of Sangachal, see

Figure 2.3. There are also some individual dwellings along the coast, approximately 350 m from the cable route.

Figure 2.3: Location of sensitive receptors in vicinity of onshore PFOC route

3 BASELINE SURVEY DATA

Baseline survey data has been collected at two of the work locations. The data was collected in 2015 around AzFen Bayil Yard and in 2024 around Sangachal Bay over 5-minute periods by surveyors outside of RSK. Due to the short measurement periods, and the age of some of the measurements, the data has been presented below for illustrative and contextual purposes only.

3.1 BDJF Yard

There is no noise monitoring data available at this location.

3.2 AzFen Bayil Yard

An ambient noise monitoring survey was undertaken between 11th and 14th November 2015 in order to identify the existing levels across the area.

The details of the survey methodology can be found in Section 5.4.5 of "*Shallow Water Absheron Peninsula 3D Seismic Survey Environmental and Socio-Economic Impact Assessment*" undertaken by AECOM in 2015.

Results show that the $L_{Aeq,5min}$, measured during the daytime, were between 63 and 65 dB at a location representative of the nearest noise sensitive receptors, in the settlement of Bibiheybat.

3.3 Sangachal Bay - Sangachal Terminal

Noise monitoring is periodically carried out in the vicinity of Sangachal Terminal, with the latest carried out in September 2024.

The details of the survey methodology can be found in document reference "*Environmental Noise Monitoring Report № 001 – 2024*" prepared by bp.

The results are presented in Table 3.1.

Table 3.1: Sangachal Terminal noise survey results

Survey Location	Survey results, $L_{Aeq,5min}$ dB	
	Daytime	Night-time
Sangachal settlement	48	47
Umid settlement	50	41

4 APPLIED CRITERIA

In the absence of specific local standards / guidance, the assessment of construction and commissioning noise has been based on the guidance contained within British Standard (BS) 5228-1:2009+A1:2014 '*Code of Practice for Noise and Vibration Control on Construction and Open Sites*', see Table 4.1.

Table 4.1: Construction criteria

Assessment category and threshold value period	Threshold value, $L_{Aeq,T}$ (dB)		
	Category A [A]	Category B [B]	Category C [C]
Night-time (23:00-07:00)	45	50	55
Evening and weekends	55	60	65
Daytime (07:00-19:00) and Saturdays (07:00-13:00)	65	70	75

[A] Category A used when ambient noise levels (when rounded to the nearest 5 dB(A)) are less than these values.

[B] Category B used when ambient noise levels (when rounded to the nearest 5 dB) are the same as the category A values.

[C] Category C used when the ambient noise levels (when rounded to the nearest 5 dB) are higher than category A values.

The lowest Category A construction noise thresholds of 65 dB $L_{Aeq,T}$, 55 dB $L_{Aeq,T}$ and 45 dB $L_{Aeq,T}$ have been used for the assessment for the day time, evening time, and night time periods respectively to represent the most stringent criteria.

This is in line with the survey results, presented in Section 3, for AzFen Bayil yard and Sangachal Bay - Sangachal Terminal.

In the absence of location specific baseline noise data at the BDJF yard, the lowest Category A construction noise thresholds has also been used for the assessment at the location.

A potential significant effect is indicated if the $L_{Aeq,T}$ noise level arising from the construction site exceeds the defined threshold criteria.

5 SCREENING ASSESSMENT

5.1 Calculation Assumptions

Noise predictions have been undertaken based on the methodology contained within BS 5228-1:2009+A1:2014. The noise predictions have been used to determine whether the construction phase activities have the potential to result in significant adverse effects at the surrounding noise sensitive receptors. The prediction method considers the type and quantity of plant items, the noise emission levels of the plant, typical operating times and the separation distance between the source and the receptor.

For the purpose of the assessment, the following assumptions have been made:

- there is no acoustic screening from intervening topography, or attenuation due to absorptive ground.
- a 10 dB acoustic attenuation has been applied to activities taking place in the BDJF and AzFen Bayil yards, due to screening from surrounding buildings. This attenuation applies to all activities but the welding.
- welding activities at BDJF and AzFen Bayil yards will take place inside workshops and a 20 dB attenuation has been applied.
- all activities have the potential to take place during both daytime and night-time periods.
- all yard activities have been assumed to be located in a single point located in the centre of the yard.
- the percentage on-time of each plant item has been based on professional experience on similar projects.
- as a worst-case assessment, it has been assumed that all activities will happen simultaneously during the full duration of the project.

5.2 Construction Plant List

The anticipated plant items and resultant sound pressure levels for the construction phase activities are presented in Table 5.1.

The list of plant for each construction activity has been provided by the BP Project Team. The sound pressure levels for each plant have been taken from BS 5228-1:2009+A1:2014, or from data provided by the BP Project Team.

Table 5.1: Construction plant list

Construction activity	Plant	Reference	Noise at 10 m, dB(A)	% on-time	No. of items	Total noise at 10 m, dB(A)
Jacket construction at BDJF yard	Crawler cranes	BS5228 C4:50	71	50	8	79
	Forklifts	BS5228 C2:35	71	80	7	
	Back-up generators	BS5228 C4:86	65	100	16	
	Compressors	BS5228 C5:5	65	30	11	
	Welding machines and grinders	BS5228 C4:93	80	25	44	
	Electrode ovens	Project Team	52	50	86	
	Trailers	Project Team	62	20	4	
	Winches	Project Team	62	40	20	
	On site vehicles and trucks	BS5228 C2:34	80	20	20	
	Cherry pickers	BS5228 C4:59	78	50	3	
	Paint / blast	Project Team	72	60	1	
	Rolling machines	Project Team	42	80	5	
Topsides construction and commissioning at AzFen Bayil yard	Back-up generators	BS5228 C4:86	65	100	6	80
	Cranes	BS5228 C4:50	71	50	19	
	Forklifts	BS5228 C2:35	71	80	18	
	Cherry pickers	BS5228 C4:59	78	50	6	
	Low bed trucks / trailers	BS5228 C2:34	80	20	15	

Construction activity	Plant	Reference	Noise at 10 m, dB(A)	% on-time	No. of items	Total noise at 10 m, dB(A)
	Compressors	BS5228 C5:5	65	30	15	
	Tractors for compressor transport	BS5228 C4:74	80	10	5	
	Welding machines	BS5228 C3:31	73	25	150	
	Commissioning - Compressor testing[1]	Project Team	80[2]	66	2	
	Commissioning - Vent testing	Project Team	46[3]	10	1	
Installation of onshore section of PFOC	Excavators	BS5228 C5:35	74	50	2	78
	Low beds and trucks	BS5228 C2:34	80	30	5	
	100 t Crane	BS5228 C4:41	71	30	1	
	Cranes	BS5228 C4:46	67	50	5	
	Horizontal drilling equipment	BS5228 C3:16	79	25	1	

[1] Dynamic testing of the compressors will be carried out 2 compressors at a time.

[2] Has been based on a point source attenuation from 108 dB L_W, as presented in document "PRELIMINARY NOISE DATASHEETS (incl VSDS) SDA" reference 10004205885_001.

[3] Has been based on a point source attenuation from 66 dB at 1 m, as presented in Table 5.1 of report "Shah Deniz Compression Project Vent Network Hydraulic Study Report" reference SJ-CPZZZZ-PR-REP-0019-000_D01.

5.3 Results

Calculations have been undertaken to predict the noise levels at the nearest human receptors from the proposed works. The results are presented in Table 5.2.

Table 5.2: Predicted noise levels at human receptors

Construction activity	Receptors	Predicted noise levels, in dB(A)
Jacket construction at BDJF yard	Puta settlement	28
	Individual dwellings	39
Topsides construction and commissioning at AzFen Bayil yard	Bibiheybat settlement	40
Installation of onshore section of PFOC	Umid settlement	38
	Sangachal settlement	35
	Individual dwellings	47

Calculations show that noise from all construction activities are likely to be below the proposed criteria during the daytime (65 dB $L_{Aeq,T}$) at all identified receptors.

Calculations show that noise from construction activities at the BDJF and AzFen Bayil yards are likely to be below the proposed criterion during the night-time (45 dB $L_{Aeq,T}$) at all identified receptors. However, it is possible that noise from the PFOC laying activities may be above the night-time criterion at the nearest receptors (individual dwellings) along the coast when working near the landfall part of the route. It should be noted, however, that there is a 3 m high brick wall running adjacent to the cable lay route separating the construction corridor from residential areas that has not been taken into account in the noise calculations. The brick wall is likely to bring the predicted noise levels down, at the receptors, by around 5 to 10 dB, which would be below the proposed night-time criterion.

Based on the results of the recent surveys undertaken around the Sangachal Terminal, reported in Table 3.1, it is possible that the noise from the PFOC laying activities would be below the current ambient noise levels which are mainly affected by traffic noise from the Baku-Alat Highway.

The works associated with the PFOC laying activity will be transitory and therefore elevated noise levels experienced by individual receptors located close to the works will only occur for a limited time period. The contractor undertaking the works will adopt industry best practice control measures to reduce the noise levels throughout the construction works, with specific emphasis on works which are taking place close to sensitive receptors. These include the following:

- switching off engines of plant, equipment and vehicles when idle or not in use
- ensuring quieter equipment is selected over noisier alternatives during vendor selection, or when purchasing equipment

- using silencers or mufflers for high noise generating equipment
- utilising barrier protection to limit noise impacts to sensitive environmental and social receptors
- regularly servicing and maintaining all plant, equipment and vehicles in accordance with manufacturer's specifications
- scheduling activities and establishing a noise perimeter zone to minimise noise impacts to sensitive environmental and social receptors.

As a result of the limited time period that receptors will be subjected to noise from the transient construction works, the resultant noise levels are not considered to be significant.

6 CONCLUSIONS

RSK Acoustics Limited (RSKA) has been commissioned by RSK Environment, on behalf of bp Exploration (Shah Deniz) Ltd, to undertake a noise screening assessment for the Shah Deniz Compression project, south of Baku, Azerbaijan.

The noise screening assessment includes the onshore construction and commissioning elements of the project, which comprises of the following three main activities at three different locations:

- jacket construction at the Baku Deepwater Jacket Factory yard
- topsides construction and commissioning at AzFen Bayil yard
- installation of the onshore section of the SDC PFOC between the landfall in Sangachal Bay and Sangachal Terminal.

Calculations show that noise from the construction activities at the construction yards will be below the proposed criteria during both the daytime and night-time at all identified receptors.

Noise from the PFOC laying activities are likely to be below the daytime criterion at all receptors, but may be above the night-time criterion at the nearest receptors (individual dwellings) along the coast. Due to the transitory nature of the work and the limited time period that receptors will be subjected to noise from the works, the resultant noise levels are not considered to be significant.

APPENDIX A: GLOSSARY OF ACOUSTIC TERMINOLOGY

Term	Definition
Ambient sound	The total sound at a given place, usually a composite of sounds from many sources near and far.
dB	Decibel. Scale for expressing sound pressure level. It is defined as 20 times the logarithm of the ratio between the root mean square pressure of the sound field and a reference pressure i.e. $2x10^{-5}$ Pascal.
dB(A)	A-weighted decibel. This provides a measure of the overall level of sound across the audible spectrum with a frequency weighting to compensate for the varying sensitivity of the human ear to sound at different frequencies. Example sound levels include: 140 dB(A) Threshold of pain 120 dB(A) Threshold of feeling 100 dB(A) Loud nightclub 80 dB(A) Traffic at busy roadside 60 dB(A) Normal speech level at 1m 40 dB(A) Quiet office 20 dB(A) Broadcasting studio 0 dB(A) Median hearing threshold (1000 Hz)
Frequency	The repetition rate of a sound wave. The subjective equivalent in music is pitch. The unit of frequency is the Hertz (Hz), which is identical to cycles per second. A thousand hertz is often denoted as kHz, e.g. 2 kHz = 2000 Hz. Human hearing ranges approximately from 20 Hz to 20 kHz.
$L_{Aeq,T}$	This is defined as the notional steady sound level over a stated period of time (T), would contain the same amount of acoustical energy as the A-weighted fluctuating sound measured over that period.
Sound absorption	Process whereby sound energy is converted in to heat. Sound absorption properties is expressed as the sound absorption coefficient α or the sound absorption class (A-E).
Sound insulation	The reduction or attenuation of airborne sound by a solid element between source and receiver.

APPENDIX 9D - INFIELD PIPELINE AND SUBSEA INFRASTRUCTURE PRE-COMMISSIONING AND COMMISSIONING DISCHARGE MODELLING

RSK Environment Limited

Discharge Modelling for Shah Deniz Compression (SDC) Project

Modelling Report

ASSIGNMENT L303706-S00
DOCUMENT L-303706-S00-A-REPT-001

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REVISIONS & APPROVALS

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CONTENTS

ABBREVIATIONS

Bstb	Billion Stock Tank Barrels
Cefas	Centre for Environment, Fisheries and Aquaculture Science
EPA	Environmental Protection Agency
FCG	Flooding, Cleaning and Gauging
HMCS	Harmonised Mandatory Control Scheme
km	Kilometre
LAT	Lowest Astronomical Tide
MEG	Mono-Ethylene Glycol
m	Metre
NFR	Near-field Region
OSPAR	Oslo and Paris Conventions
PLONOR	Pose Little Or No Risk
PLM	Product Lifecycle Management
PNEC	Predicted No Effect Concentration
SD	Shah Deniz
SDA	Shah Deniz Alpha
SDB	Shah Deniz Bravo
SDC	Shah Deniz Compression
SSIV	Subsea Intervention Valve
Tcf	Trillion cubic feet
US	Unites States

EXECUTIVE SUMMARY

This study aimed to assess the potential environmental impact of aqueous discharges from infield pipeline and subsea infrastructure pre-commissioning and commissioning operations associated with the Shah Deniz Compression (SDC) project in the Shah Deniz (SD) Contract Area, in Azerbaijani waters. The modelling described in this report was conducted to evaluate the dispersion of the worst-case discharge from this program of work. Modelling was conducted using MixZon Inc's. CORMIX GTS v12.0.1 GTS software.

Four worst-case discharge scenarios were selected for modelling from the pre-commissioning and commissioning programme. These scenarios assess the largest discharge port size and the longest duration of discharge. All other discharges in this work package will be of much shorter duration; with seven discharge scenarios lasting less than an hour and the next longest discharge being less than a third of the duration of the modelled scenarios.

The modelled scenarios were:

- Scenario 1a: Infield flooding, cleaning and gauging (FCG) of the 32″ gas export pipelines (x2) with dyed, chemically treated, filtered seawater;
- Scenario 1b: Infield FCG of the 26″ gas export pipelines (x2) with dyed, chemically treated, filtered seawater;
- Scenario 2: Dewatering, 32″ gas export pipeline with chemically treated, filtered seawater; potable water; dyed MEG; and chemical sticks; and
- Scenario 3: Dewatering, 26″ gas export pipeline with chemically treated, filtered seawater; potable water; dyed MEG; and chemical sticks.

The infield pipeline FCG operation involves introducing treated dyed seawater into the pipelines, removing construction debris from inside, and ensuring there are no internal deformations or intrusions. These three operations will be performed using a combined pig train. The slugs separating the pigs (including any entrained construction debris) along with the lubrication slug (treated unfiltered seawater) and 20% overfill contingency will be discharged to the environment.

The entire pipeline system will be dewatered, desalinated, and Mono-Ethylene Glycol (MEG) swabbed by reversing the intervention pig train towards the platform, using hydrocarbon gas to propel it. The contents, including treated dyed seawater, desalination slug (potable water), MEG slug, and nitrogen slug, will be discharged subsea via temporary platform pipework, while the hydrocarbon gas will be routed to the platform process pipework for further processing.

In order to prevent corrosion and inhibit bacteria growth, the seawater used for these applications will be chemically treated.

The ambient current speed can greatly influence the near-field dilution of an effluent. Therefore, the modelling study considered four current speed ranges to understanding how the dilution changes with varying currents. When assessing an offshore discharge, the dilution factor at 500 m is the metric referenced when considering whether it will cause harm to the environment. The dilution factors at 500 m vary across different scenarios as shown in Table 1.1.

For Scenario 1a, the dilution factor was 2,800, resulting in an effluent concentration of 0.036% at 500 m. In Scenario 1b, the dilution factor increased to 4,250, reducing the effluent concentration to 0.024%. Scenario 2 exhibited the lowest dilution factor at 500 m, at 2,740, leading to an effluent concentration of 0.037%. Conversely, Scenario 3 had a dilution factor of 4,210, with an effluent concentration of 0.024% at the same distance. However, all discharges will be indistinguishable from the ambient environment.

The water in the pipeline will be treated with Hydrosure HD-5000 is a Gold category chemical. In all four scenarios Hydrosure HD-5000 is applied at 1000 ppm concentration, and the fluorescein dye; Preservan 2140 will be added to the water at 100 ppm. Additionally, in Scenarios 2 and 3, the fluorescent tracer; Roemex RX-9022 at 100 ppm will also be included. The dilution required for the chemicals to reach their respective Predicted No Effect Concentrations (PNECs) will depend on the concentration of the chemicals discharged, which in turn will be dependent on the quantity of each chemical used in achieving its primary function in the hydrotest process. The assessment considered chemical discharges at 100%[1] and at 20% of the concentration applied to the pipeline. For the less toxic components (dyes; Roemex RX-9022 and Preservan 2140) PNECs were achieved within 1 m for both the 100% and 20% discharge concentrations (Table 1.1).

The highest average plume area is predicted to occur 500 m from the discharge location in Scenario 1a. In this scenario, the plume is expected to have a cross-sectional area of 634 m^2. In Scenario 1b, the plume is predicted to have a cross-sectional area of 453 m^2 at 500 m. Scenario 2 forecasts a plume with a cross-sectional area of 571 m^2 at 500 m. In Scenario 3, the plume is anticipated to have a cross-sectional area of 422 m^2 at 500 m. Notably, the worst-case plume cross-sectional area of 633.5 m^2 in Scenario 1a at 500 m would occupy less than 1% of the water column at this distance.

For Scenario 1a, the flow-weighted average edge concentration varies from 0.017 mg/l at 30 m to 0.003 mg/l at 500 m. In Scenario 1b, it ranges from 0.020 mg/l at 30 m to 0.002 mg/l at 500 m. For Scenario 2, the flow-weighted average edge concentration varies from 0.035 mg/l at 30 m to 0.003 mg/l at 500 m. In Scenario 3, it ranges from 0.030 mg/l at 30 m to 0.002 mg/l at 500 m. Under typical use and discharge conditions of the pipeline chemicals it is expected that the discharge plume will occupy a very small volume of the available water column at the discharge location and will rapidly achieve dilution of the hydrotest chemicals to below toxic concentrations. The duration of the discharge will also be short and therefore there will not be sufficient exposure of any extant water column organisms to toxic concentration of chemicals in the cocktail to cause a discernible toxic impact. Furthermore, larger marine animals, such as the Caspian seal (*Pusa caspica*), are expected to actively avoid chemically contaminated areas of the water column which in turn would reduce exposure.

[1] *It should be considered that 100% chemical concentration within the discharge is extremely unlikely as the chemicals will be used within their functions. It has only been presented to provide the theoretical maximum worst-case.*

Table 1.1 Flow-weighted average dilution and concentration

SCENARIO	Flow-Weighted Average Dilution			Flow-weight average distance to achieve dilution to achieve PNEC (m)					
	30 m	100 m	500m	100% concentration at discharge			20% concentration at discharge		
				Roemex RX-9022	Preservan 2140	Hydrosure HD-5000	Roemex RX-9022	Preservan 2140	Hydrosure HD-5000
Scenario 1a	315	1,020	2,800	-	-	1,330	-	-	231
Scenario 1b	344	1,130	4,250	-	-	919	-	-	168
Scenario 2	233	816	2,740	0.12	-	1,350	-	-	251
Scenario 3	267	1,020	4,210	0.17	-	922	-	-	183

1 INTRODUCTION

1.1 Background

The Shah Deniz (SD) development is located on the deep-water shelf of the Caspian Sea, approximately 90 km south-east of Baku, in water depths ranging from 75 to 550 m. Discovered in 1999, it is one of the largest gas-condensate fields in the world and represents the largest gas discovery ever made by bp, with an estimated 30 Trillion cubic feet (Tcf) Gas Initially In Place and 2 Billion stock tank barrels (Bstb) of Condensate Initially In Place.

The Shah Deniz Compression (SDC) platform will serve as a host facility for Shah Deniz Alpha (SDA) and Shah Deniz Bravo (SDB) fields gas export compression. SDC is a normally unattended facility, which is remotely controlled and will be located 3 km from SDB in approximately 85 m of water.

The SDC platform will have separate compression trains for SDA and SDB, designed to match their gas capacities and deliver to processing plants at specific pressures. No spare compressors are provided, with bypass systems used if needed. Wet gas pipelines from both fields are treated with Mono Ethylene Glycol (MEG) to prevent hydrate formation, and liquids are managed through a bypass during abnormal operations.

The overall Shah Deniz field development including SDC is shown in Figure 1.1.

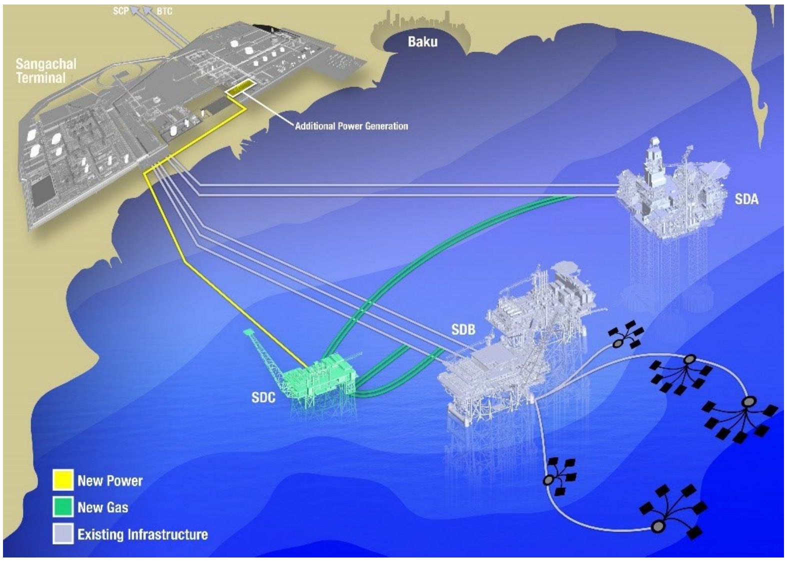

Figure 1.1 - Shah Deniz Field Development

1.2 Overview of Pre-commissioning and Commissioning Discharges

The pre-commissioning and commissioning operations consist of a number of steps, detailed below. To prevent corrosion and inhibit bacteria growth, the seawater used for these applications will be chemically treated.

Infield pipeline flooding, cleaning and gauging (FCG): The operation involves introducing treated, dyed seawater into the pipelines, removing construction debris from inside, and ensuring there are no internal deformations or intrusions. These three operations will be performed using a combined pig train. The slugs separating the pigs (including any entrained construction debris) along with the lubrication slug (treated unfiltered seawater) and 20% overfill contingency will be discharged to the environment.

Infield pipeline hydrostatic strength testing: The pipeline systems will be pressurised to 1.25 times design pressure. Upon completion, the seawater volume used to pressurise is discharged to the surrounding environment.

Intervention pig train launch operation: Prior to any diver subsea intervention at the Subsea Intervention Valve (SSIV) locations, each gas pipeline will be prepared using an intervention pig train that includes bi-directional pigs separated by slugs of nitrogen, dyed MEG, potable water, and treated filtered seawater. The intervention pig train is designed to replace hydrocarbon gas with treated seawater to aid diver activities and, after subsea tie-ins and leak tests, to dewater and condition the pipeline using hydrocarbon gas for start-up.

Subsea spool tie-ins: Each subsea spool will be pre-loaded with chemical sticks (biocide, oxygen scavenger, corrosion inhibitor) onshore and free flooded during deployment. Additional sticks will be added during diver tie-ins to maintain preservation and aid leak detection, with minimal chemical dispersion expected subsea. The dissolved contents will be discharged during dewatering.

System integrity pressure testing: The complete piggable pipeline systems, excluding unpiggable SDC risers, will be topped up and hydrostatically pressure tested to 1.1 times the design pressure. After the test, the pressurising volume will be discharged to the environment through SDA and SDB platform pipework.

Dewatering and MEG swabbing: The entire pipeline system will be dewatered, desalinated, and MEG swabbed by reversing the intervention pig train towards the platform, using hydrocarbon gas to propel it. The contents, including treated dyed seawater, desalination slug, potable water, MEG slug, and nitrogen slug, will be discharged subsea via temporary platform pipework, while the hydrocarbon gas will be routed to the platform process pipework for further processing.

SDC riser MEG displacement: The treated dyed seawater in the SDC risers, subsea spools, and Product Lifecycle Management (PLM) pipework sections will be drained subsea using a MEG gel interface followed by liquid MEG. After MEG displacement, the SDC risers will have a sufficient MEG concentration for hydrate inhibition, with some MEG discharge expected. The risers will be pressurised with MEG to equalise the pressure across pigging module branch valves. If the MEG content in the SDC risers is insufficient for hydrate inhibition after displacement, additional flushing will be necessary, resulting in the discharge of diluted MEG mixed with fresh MEG.

Whilst there are a number of discharges resulting from these activities, the majority are small volumes occurring over a very short period of time. In particular, the MEG discharges are not of a concern as MEG is a low toxicity readily biodegradable substance which under the OSPAR Harmonised Mandatory Control Scheme is considered to "Pose Little or No Risk" (PLONOR) to the Marine Environment. As such, MEG discharges have not been considered further. The four scenarios selected for study are presented in Table 2.1 and represent various discharge configurations of large volumes of seawater treated with typical pipeline protection chemicals. The primary function of these chemicals is to protect the pipeline from corrosion and biological growth, therefore requiring it to be highly toxic to be effective.

2 METHODOLOGY

2.1 Dilution and Dispersion of Effluent Modelling with CORMIX GTS

The software used for this study was MixZon Inc's. CORMIX GTS v12.0.1[2]. This software was developed by the United States (US) Environmental Protection Agency (EPA) to assess the mixing zone of discharges to the aqueous environment. It has been widely used around the world for this purpose in a variety of industries including oil and gas exploration and production.

Four worst-case discharge scenarios (FCG and dewatering scenarios) were modelled the details of which are presented in Section 2.1.1. The local current speeds were taken from project data[3].

2.1.1 Model Inputs

Four discharge scenarios were selected for modelling due to presenting the worst-case discharges from the Shah Deniz field. The modelled scenarios are as follows:

- Scenario 1a: Infield FCG of the 32″ gas export pipelines (x2) with dyed, chemically treated, filtered seawater;
- Scenario 1b: Infield FCG of the 26″ gas export pipelines (x2) with dyed, chemically treated, filtered seawater;
- Scenario 2: Dewatering, 32″ gas export pipeline with chemically treated, filtered seawater; potable water; dyed MEG; and chemical sticks; and
- Scenario 3: Dewatering, 26″ gas export pipeline with chemically treated, filtered seawater; potable water; dyed MEG; and chemical sticks.

The CORMIX model was used to predict the dispersion and dilution characteristics of the chemically treated seawater discharged during the FCG and pipeline dewatering. A summary of the parameters used to configure the model is presented in Table 2.1.

[2] *http://www.cormix.info/cormix-gts.php*
[3] *bp, 2009*

Table 2.1 - Model parameters (input data provided by the client)

Parameter Set	Parameters	Scenario 1a	Scenario 1b	Scenario 2	Scenario 3
Effluent Discharge	Flow rate (m^3/hour)	504	324	504	324
	Flow velocity (m/s)	17.03	11.07	1.55	1.01
	Discharge volume (m^3)	782.20	1630.57	2828.30	6415.74
	Density (kg/m^3)	1012			
	Port Orientation	Vertically Upwards			
	Port Internal diameter (m)	0.1016	0.1016	0.337	0.337
	Height of discharge	2 m above seabed			
Environmental conditions	Depth of water column at location below Lowest Astronomical Tide (LAT) (m)	96			
	Current speed	Table 2.3			
	Seawater density (kg/m^3)	1012			

Scenarios 2 and 3 involved the discharge of additional chemicals from Hydrosure Biocide Sticks, Oxygen Scavenger Sticks, Corrosion Inhibitor Sticks, and Fluorodye Sticks used to treat the seawater in the spool when they are tied-in. The concentration at which the chemical sticks were applied to the spools is shown in Table 2.2. These were excluded from the modelling because their concentrations would be significantly diluted by the seawater throughout the entire pipeline, rendering their concentrations in the ambient environment negligible.

Scenarios 2 and 3 include the discharge of the MEG swab during dewatering operations. MEG is a low toxicity highly biodegradable substance that is classified as a "Pose Little or No Risk" (PLONOR) substance as defined by The Convention for the Protection of the Marine Environment of the North-East Atlantic (OSPAR) Harmonised Mandatory Control Scheme (HMCS). MEG is not expected to cause an impact to the marine environment and has therefore been excluded from the modelling.

Table 2.2 - Proposed chemical package for SDC subsea spools

Chemical	Function	Dosage per stick (ppm/m^3)	Maximum dosage (ppm/m^3)
Hydrosure TM biocide stick	Biocide	50	200
Hydrosure TM corrosion inhibitor stick	Corrosion inhibitor	30	120
Hydrosure TM oxygen scavenger E2 stick	Oxygen scavenger	40	80
Fluorodye UC	Dye	12.5	37.5

2.1.2 Ambient Current Speed

The Caspian Sea, the world's largest enclosed inland body of water, experiences unique tidal dynamics. Unlike open oceans, the Caspian Sea's tides are primarily influenced by direct tidal forces rather than tidal waves from adjacent seas. The semi-diurnal tides, which occur twice daily, dominate the Caspian Sea, with the largest amplitude reaching up to 6 cm in Turkmen Bay (Copernicus, 2020). The tidal range can vary, with the maximum observed range being around 21 cm (Frontiers, 2016). These tides are relatively small compared to oceanic tides.

The currents in the Caspian Sea are complex and can be strong during the winter months, both at the surface and near the seabed. The predominant direction of the strong currents is from the Northeast. The currents may act from surface to seabed, or surface flows may be de-coupled from the deepwater flows and the strong current act in either layer. The currents may be driven directly by local weather events or by distant forcing mechanisms. In the latter case the currents may occur during periods of unremarkable local weather, and if focused at depth, may go unnoticed by operators on the platforms (bp, 2006).

Current speed is a very important variable affecting effluent dilution. Table 2.3 presents information about the most frequent current speeds, and their direction, in the vicinity of Shah Deniz Platform. The data concerns surface currents, with the most frequent current speeds ranging from 0 to 0.05 m/s. The most frequent current flows are observed in a westerly direction. Whilst discharges will occur near the seabed, they will be discharged vertically upwards and interact with the sea surface. As such the use of the surface currents, in what is a predominantly a low current velocity system, was considered to be valid in determining the likely dilution behaviour of these discrete batch discharges.

The wind regimes of the Caspian Sea are influenced by its large meridional extent and diverse coastal physiographic conditions. The region experiences significant seasonal variations, with relatively stable wind directions during winter and summer. The southern Caspian Sea, where the project is located, generally has weaker winds, with mean speeds of 3-4 m/s (Masoud & Pawlowicz, 2021). Wind-induced surges can lead to significant changes in sea level, affecting coastal flooding and navigation. Additionally, the wind power density in the Caspian Sea has shown a decreasing trend over recent decades, influenced by regional climate change (Rahimi et al., 2022).

Table 2.3 - Current frequency data (bp, 2009)

Current bins (m/s)	Direction (towards)								
	N	NE	E	SE	S	SW	W	NW	Total
0.00 – 0.05	33.6	50.4	40.4	27.9	20.5	29.8	50.9	43.3	296.8
0.05 – 0.10	19.8	98.6	53	11.2	3.7	14.2	96.9	29.9	327.3
0.10 – 0.15	2.5	66.4	47.5	3.4	0.3	2.3	48.5	7.3	178.2
0.15 – 0.20	0.6	48.7	24.3	4.2	0	0.1	5.7	1.2	84.8
0.02 – 0.40	0	58.3	37	1.7	0	0	5.2	0	102.2
0.40 – 0.70	0	5.7	4.7	0	0	0	0	0	10.4
Total	56.5	328.1	206.9	48.4	24.5	46.4	207.2	81.7	1000.0[4]

[4] *All numbers in the table have been rounded to one decimal place. The "Total" figure has been rounded up from 999.7.*

3 RESULTS AND DISCUSSION

3.1 Flow-Weighted-Average Calculations

The flow-weighted-average dilution is calculated from the dilution (as determined by CORMIX) at each current speed and the frequency of these currents at the discharge location. This value represents the average dilution that may occur for a discharge.

Table 3.1 and Figure 3.1 present the results of the flow-weighted-average dilution values for the four discharge scenarios. The calculations indicate that a narrower discharge port and a lower flow rate result in greater dilution. The reduced flow rate decreases the initial velocity of the discharge, allowing for a more controlled and steady entry into the water column. Additionally, the narrower port increases the discharge's velocity due to the constriction, enhancing its momentum. This combination allows the discharge to penetrate higher into the water column, promoting more extensive lateral diffusion by the current over a longer path to the surface.

When assessing an offshore discharge, the dilution factor at 500 m is the value that is commonly referenced when considering whether a discharge will cause harm to the environment. As illustrated in Table 3.1, the dilution factors at 500 m vary across the different scenarios (Table 3.1). For Scenario 1a, the dilution factor was 2,800, resulting in an effluent concentration of 0.036% at 500 m. In Scenario 1b, the dilution factor increased to 4,250, reducing the effluent concentration to 0.024%. Scenario 2 exhibited the lowest dilution factor at 500 m, at 2,740, leading to an effluent concentration of 0.037%. Conversely, Scenario 3 had a dilution factor of 4,210, with an effluent concentration of 0.024% at the same distance. However, all scenarios would be indistinguishable from the ambient environment at 500 m.

Table 3.1 - Flow-weighted average dilution calculations

Scenario	Flow-Weighted Average Dilution at Defined Distances		
	30 m	100 m	500 m
Scenario 1a	315	1,020	2,800
Scenario 1b	344	1,130	4,250
Scenario 2	233	816	2,740
Scenario 3	267	1,020	4,210

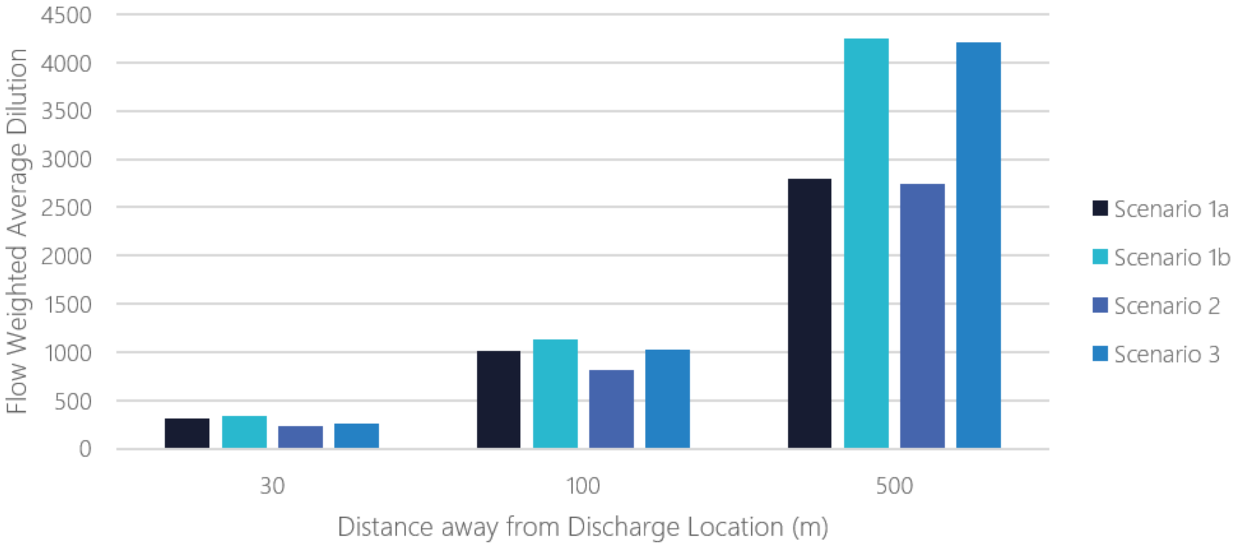

Figure 3.1 - A graphical representation of the flow -weighted average dilution calculations (note NFR dilution is presented at 0 m away from the discharge)

After discharge, the momentum and buoyancy of the effluent carries it upwards through the water column before it is laterally displaced by the current eventually impinging with the sea surface. The majority of current velocities at the project location are relatively weak and therefore lateral displacement is limited.

3.2 Chemical Composition

Hydrosure HD-5000 is a biocide which is required to prevent corrosion and inhibit bacteria growth. Although the Cefas registered function is a biocide, it is a 'one-can' cocktail product which contains biocidal, oxygen scavenging and corrosion prevention functionality and will reduce the integrity threat. The active component in Hydrosure HD-5000 is a quaternary ammonium salt. The activity of these salts is reduced by high chloride concentrations of oil and other organic foulants, and by accumulation of sludge in the system. However, without an exact determination the reduction in activity cannot be accurately estimated. Hydrosure HD-5000 is a Gold category chemical. In all four scenarios Hydrosure HD-5000 is applied in 1000 ppm concentration.

The water in the pipelines in all four scenarios is also treated with a fluorescein dye; Preservan 2140 at 100 ppm, which enables the remote detection of leaks and seeps from the pipeline. In Scenarios 2 and 3, the seawater in the pipelines is also treated with the fluorescent tracer (dye); Roemex RX-9022 at 100 ppm to detect potential leaks.

In Scenarios 2 and 3, Hydrosure Biocide Stick at 200 ppm, Hydrosure Oxygen Scavenger Stick at 80 ppm, Hydrosure Corrosion Inhibitor Stick at 120 ppm, and Hydrosure Flurodye UC at 37.5 ppm were added to the spool during tie-in to treat the seawater that will free-flood the spools during deployment. These spools are then connected to the gas export lines, allowing the chemicals to freely mix with the total volume of seawater in the gas export lines. As the volume of the spools is significantly lower than that of the gas export lines, their contents will be significantly diluted when mixed. Due to this significant dilution, these chemicals were not included in the modelling. In addition, the subsea diver insertion of the sticks will result in a loss of chemicals from the sticks before they are contained within the spools. This would further reduce the concentration of stick chemicals initially present in the lines.

Discharge of treated water present in the various new development pipelines will occur at a range of locations during pre-commissioning and commissioning. The discharges are very short lived and generally of very small volumes of treated water. In general terms the worst-case discharges that are expected to occur are those to dewater the pipelines. In addition, FCG discharges for SD also have an appreciable volume and have a different discharge port configuration and discharge rate compared to the dewatering discharges. Even these worst-case discharges of the treated water are a one-off short duration event (hours) and have far less potential to cause a long-term impact to the environment than a long-term continuous discharge. The consequence of not using and discharging these chemicals is that the pipeline could be at increased risk of failing due to corrosion, potentially resulting in a hydrocarbon spill of much greater environmental consequence than the use and discharge of this cocktail.

Oxygen scavengers, biocides and corrosion inhibitors are all used up in protecting the pipeline, particularly if the pipeline is stored wet for a longer time, thus whilst it is possible to determine the concentration of chemicals applied to the water in the line, it is not possible to precisely determine the discharge concentration. Initial concentrations for each of the scenarios are presented in Table 3.2.

Table 3.2 - Applied hydrotest chemicals with toxicity values

Chemical	Applied Concentration (ppm)				Worst-case Marine Toxicity (mg/l)
	Scenario 1a	Scenario 1b	Scenario 2	Scenario 3	
Hydrosure HD-5000	1000	1000	1000	1000	0.1349
Preservan 2140	100	100	100	100	2024.11
Roemex RX-9022	-	-	100	100	55.8

Within the pipeline the seawater would become anaerobic rapidly with any anaerobic microbes present being removed by the biocide thus suppressing the biodegradation of the added chemicals. However, it is clear from the available data that, if discharged, all the organic substances present are biodegradable in the marine environment and would not be persistent.

PNEC value is calculated by the lowest toxicity for a substance divided by an assessment factor taken from regulatory guidance. Hydrotest discharges are short duration one off discharges for which it is appropriate to use an assessment factor of 100 to calculate the PNEC based on the worst OSPAR HCMS toxicity data.

Table 3.3 presents the PNEC values for the 3 chemicals in the treated seawater assuming an assessment factor of 100. Whilst Table 3.4 presents the variation in dilution required to achieve these PNEC values depending upon the proportion of the applied chemicals that are in the discharge (i.e., those chemicals which have not been used up in protecting the pipeline).

Table 3.3 - Aquatic Toxicity

SUBSTANCE	PNEC (mg/L)
Hydrosure HD-5000	0.1349
Preservan 2140	2024.11
Roemex RX-9022	55.8

Table 3.4 - Dilution[3] (fold) required to achieve PNEC

Proportion of applied cocktail in discharge	100%	50%	40%	30%	20%	10%
Hydrosure HD-5000	7,410	3,710	2,970	2,220	1,480	741
Roemex RX-9022	1.790	0.896	0.717	0.538	0.358	0.179
Preservan 2140	0.049	0.025	0.020	0.015	0.010	0.005

Table 3.5 presents the flow-weighted-average distance from the discharge location required for each chemical to reach their PNECs, assuming either 100% or 20% of chemicals in the discharge. It should be considered that 100% chemical concentration within the discharge is extremely unlikely as the chemicals will be used within their functions. It has only been presented to provide the theoretical maximum worst-case.

The results show that for the less toxic substances (dyes; Roemex RX-9022 and Preservan 2140), their PNECs are reached in less than 1 m when at a concentration of 100%.

Table 3.5 - Flow-weighted average distance (m) to achieve dilution (fold) required to achieve PNEC for the four scenarios

	ROEMEX RX-9022		PRESERVAN 2140		HYDROSURE HD-5000	
	100%	20%	100%	20%	100%[5]	20%
Scenario 1a	-	-	-	-	1,330	231
Scenario 1b	-	-	-	-	919	168
Scenario 2	0.144	-	-	-	1,350	252
Scenario 3	0.167	-	-	-	924	184

The more toxic chemical, Hydrosure HD-5000, does not achieve PNEC values of less than 1 in the near-field, at both a discharge concentration of 100% and 20% of the hydrotest water. The flow-weighted discharge concentrations required to reach the PNEC values (assuming a discharge concentration of 100%) at distances of 30, 100 and 500 m away from the discharge point are presented in Table 3.6.

Table 3.6 - Flow-weighted discharge concentration required for PNEC to be achieved for the Hydrosure HD-5000 for the 100% chemical package

	Flow-weighted discharge concentration required for PNEC to be achieved at the following distances (mg/l)		
	Hydrosure HD-5000		
	30 m	100 m	500 m
Scenario 1a	42.5	137	378
Scenario 1b	46.4	153	574
Scenario 2	31.4	110	369
Scenario 3	36.1	138	568

Pipeline dewatering discharges are short duration discharges that do not re-occur after commissioning of the pipeline has been completed. The FCG and dewatering chemicals that are added to the pipeline are intended to prevent microbes and oxidants in the seawater causing corrosion of the pipeline that could reduce the service life of the

[5] *Hydrosure HD-5000 will be used up in its function, it will not be discharged at 100% however it has been presented to provide the theoretical maximum worst-case.*

pipeline and potentially lead to a catastrophic failure of the pipeline. Some of the added chemicals are toxic in the marine environment; however, these chemicals are used up in providing protection to the pipeline (oxygen scavenger, biocide, corrosion inhibitor) and therefore their discharge concentration is lower than the concentration of chemicals added to the pipeline. It is not possible to determine the concentration of the chemicals that will be discharged and therefore an assessment needs to be formulated on the maximum added concentration even though this will not be the discharge concentration. On discharge the plume has a circular cross-section, which increases in size and deflected by ambient currents in the water column as ambient waters are taken into the plume and dilute the chemicals present. Interaction with the sea surface results in the discharge spreading widely across the sea surface, with ambient diffusing becoming the primary mixing mechanism at this stage. The plume takes up only a small proportion of the water column and is only present for a limited period. When the discharge is completed, the plume will be dissipated into the environment. During discharge any mobile organisms in the water are able to move away from the plume if they encounter it and find conditions unfavourable. In addition, water column organisms are unlikely on a behaviour basis to remain static in the water column and therefore are unlikely to experience a prolonged exposure to the hydrotest chemicals.

As the discharge concentration will be less than the amount of chemicals added to the pipeline, the discharge will occur over a relatively short period of time and occupy only a very limited volume of the water column, it is not anticipated that any ecotoxic effects would be seen because of the discharge of the hydrotest water.

3.3 Plume Analysis

The flow-weighted average plume area at 30 m, 100 m and 500 m away from the discharge location for the four scenarios are presented in Table 3.7 and Figure 3.2 - A graphical representation of discharge distance against plume cross-sectional area for the four discharge scenarios. The greatest average plume area is predicted to occur 500 m from the discharge location in Scenario 1a. In this scenario, the plume is expected to have a cross-sectional area of 633.5 m^2. In Scenario 1b, the plume is predicted to have a cross-sectional area of 453.0 m^2 at 500 m. Scenario 2 forecasts a plume with a cross-sectional area of 571.3 m^2 at 500 m. In Scenario 3, the plume is anticipated to have a cross-sectional area of 421.6 m^2 at 500 m. Notably, the worst-case plume cross-sectional area of 633.5 m^2 in Scenario 1a at 500 m would occupy less than 1% of the water column at this distance. This suggests that mobile marine organisms, such as fish and the Caspian seal would actively avoid contact with the plume.

Table 3.7 - Flow-weighted average plume cross-sectional area at 30 m, 100 m and 500 m away from the discharge location

SCENARIO	30m from discharge	100m from discharge	500m from discharge
	Average plume cross-sectional area (m^2)	Average plume cross-sectional area (m^2)	Average plume cross-sectional area (m^2)
Scenario 1a	151.2	386.8	633.5
Scenario 1b	168.1	516.8	453.0
Scenario 2	163.5	316.8	571.3

SCENARIO	30m from discharge	100m from discharge	500m from discharge
	Average plume cross-sectional area (m^2)	Average plume cross-sectional area (m^2)	Average plume cross-sectional area (m^2)
Scenario 3	131.9	462.8	421.6

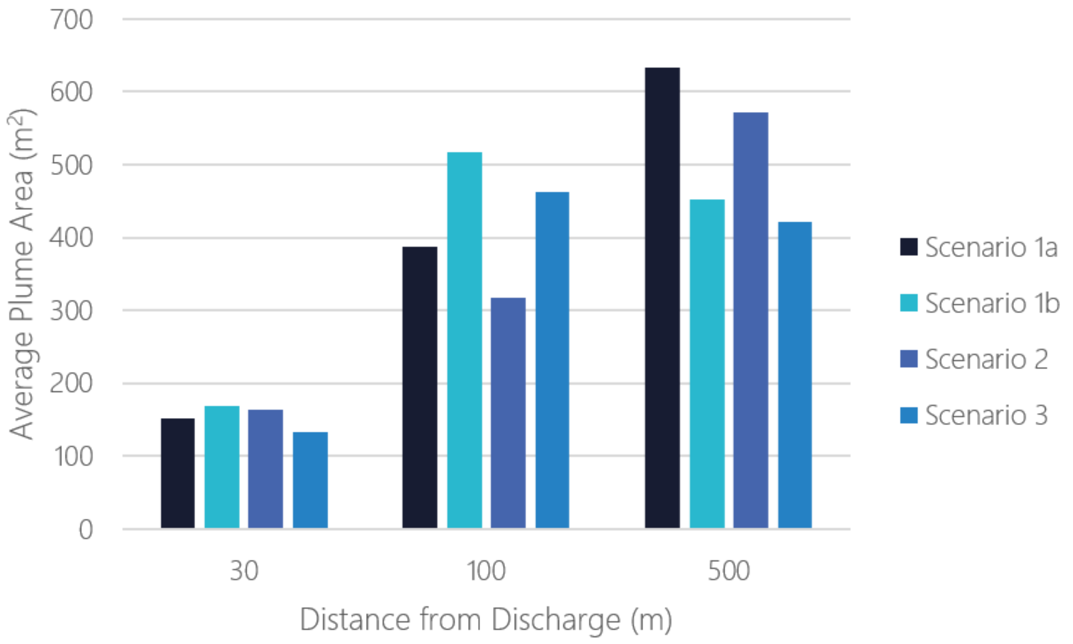

Figure 3.2 - A graphical representation of discharge distance against plume cross-sectional area for the four discharge scenarios

For the near-field jet / plume phase of the discharge the variation in concentration across the plume can be calculated using a Gaussian profile. This profile predicts that, in the jet/plume phase, the edge concentration is 0.37. After interaction with the sea surface the plume behaviour transitions to a plume diffusion stage, with the edge concentration of 0.46 of the centreline concentration. The flow-weighted average edge concentrations at 30 m, 100 m, and 500 m for all scenarios are presented in Table 3.8.

For Scenario 1a, the flow-weighted average edge concentration varies from 0.017 mg/l at 30 m to 0.003 mg/l at 500 m. In Scenario 1b, it ranges from 0.020 mg/l at 30 m to 0.002 mg/l at 500 m. For Scenario 2, the flow-weighted average edge concentration varies from 0.035 mg/l at 30 m to 0.003 mg/l at 500 m. In Scenario 3, it ranges from 0.030 mg/l at 30 m to 0.002 mg/l at 500 m. Since the edge concentration is a fraction of the centreline concentration, the chemical discharge will have higher dilution and thus lower toxicity. This indicates that the potential impact on marine life is minimised as the plume disperses.

Table 3.8 - Flow-weighted average edge concentration at 30 m, 100 m and 500 m away from the discharge location

SCENARIO	Edge concentration 30 m from discharge (ppm)	Edge concentration 100 m from discharge (ppm)	Edge concentration 500 m from discharge (ppm)
Scenario 1a	0.017	0.006	0.003
Scenario 1b	0.020	0.005	0.002
Scenario 2	0.035	0.009	0.003
Scenario 3	0.030	0.007	0.002

The generalised behaviour of the plume within 500 m of the point of discharge is presented graphically in Figure 3.3. The lateral displacement is primarily affected by the strength of the current. Dotted lines represent the upper and lower boundary of the circular cross section plume.

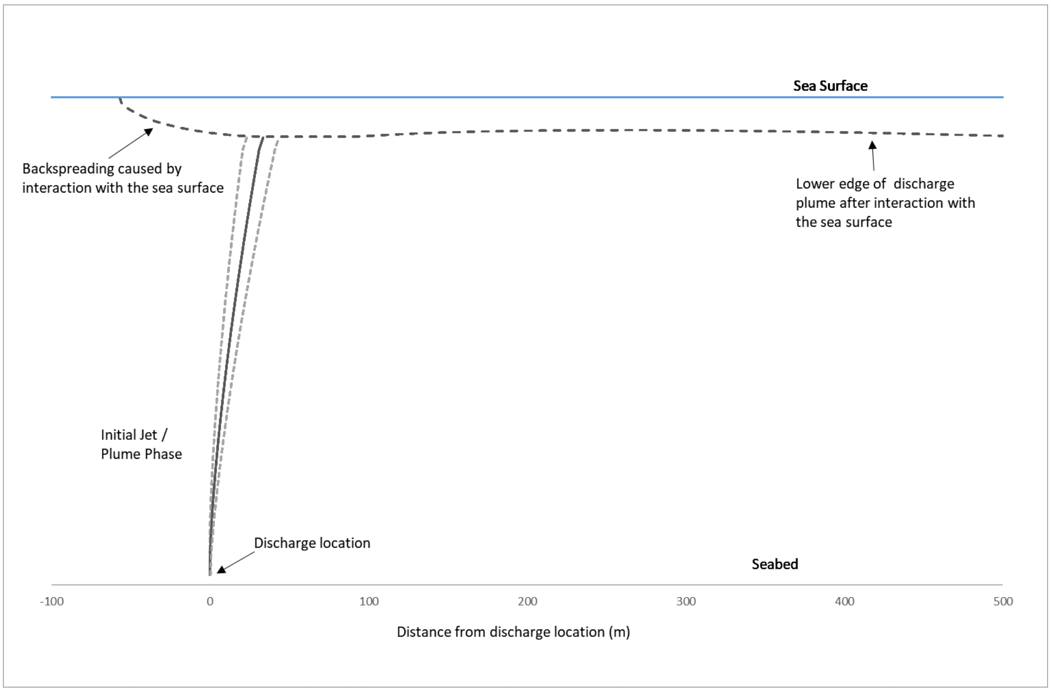

Figure 3.3 - Plume Behaviour within 500 m of Discharge

4 CONCLUSION

Four worst-case FCG and dewatering discharge scenarios were modelled associated with SDC project infield pipeline and subsea infrastructure pre-commissioning and commissioning activities. The differences between the scenarios was in the internal diameter of the discharge point, the flow rate of the discharge, and the chemicals discharged. The discharge was conducted at a water depth of 96 m, 2 m above the sea floor, with the discharge point positioned vertically upright.

When assessing an offshore discharge, the dilution factor at 500 m is the value that is commonly analysed when considering whether a discharge will cause harm to the environment. As illustrated in Table 3.1, the dilution factors at 500 m vary across different scenarios. For Scenario 1a, the dilution factor was 2,800, resulting in an effluent concentration of 0.036% at 500 m. In Scenario 1b, the dilution factor increased to 4,250, reducing the effluent concentration to 0.024%. Scenario 2 exhibited the lowest dilution factor at 500 m, at 2,740-fold, leading to an effluent concentration of 0.037%. Conversely, Scenario 3 had a dilution factor of 4,210, with an effluent concentration of 0.024% at the same distance. Notably, Scenario 2's effluent concentration of 0.037% at 500 m would be indistinguishable from the ambient environment, implying that the discharges from the other three scenarios would also be undetectable.

The pipeline hydrotest fluids in all four scenarios will be treated with Hydrosure HD-5000 at an initial application rate of 1000 ppm, and Preservan 2140 at a rate of 100 ppm. In Scenarios 2 and 3 the fluorescent tracer (dye); Roemex RX-9022 is also added to the pipelines at a concentration of 100 ppm. The dilution required for each chemical to reach their respective PNECs will depend on the actual concentration of the chemicals discharged, which in turn is dependent on how much of each chemical is used up in achieving its primary function in the hydrotest cocktail. An assessment was made for a discharge of the cocktail at 100% and an arbitrary 20% of the initially applied concentration. For the less toxic components (Roemex RX-9022 and Preservan 2140 dyes) PNECs were achieved within 1 m for 100% cocktail concentration.

The greatest average plume area is predicted to occur 500 m from the discharge location in Scenario 1a. In this scenario, the plume is expected to have a cross-sectional area of 633.5 m^2. In Scenario 1b, the plume is predicted to have a cross-sectional area of 453.0 m^2 at 500 m. Scenario 2 forecasts a plume with a cross-sectional area of 571.3 m^2 at 500 m. In Scenario 3, the plume is anticipated to have a cross-sectional area of 421.6 m^2 at 500 m.

For Scenario 1a, the flow-weighted average edge concentration varies from 0.017 mg/l at 30 m to 0.003 mg/l at 500 m. In Scenario 1b, it ranges from 0.020 mg/l at 30 m to 0.002 mg/l at 500 m. For Scenario 2, the flow-weighted average edge concentration varies from 0.035 mg/l at 30 m to 0.003 mg/l at 500 m. In Scenario 3, it ranges from 0.030 mg/l at 30 m to 0.002 mg/l at 500 m.

Under typical use and discharge conditions of the hydrotest chemicals it is expected that the discharge plume will occupy a very small volume of the available water column at the discharge location and will rapidly achieve dilution of the hydrotest chemicals to below toxic concentrations. The duration of the discharge will also be short and therefore there will not be sufficient exposure of any extant water column organisms to toxic concentration of chemicals to cause a discernible toxic impact. Furthermore, larger marine animals, such as the Caspian seal, are expected to actively avoid chemically contaminated areas of the water column which in turn would reduce exposure.

5 REFERENCES

Ghaffari, P., Karami, H., and Etemad-Shahidi, A., 2016. Wind regimes of the Caspian Sea. Frontiers in Marine Science, 3, p.46. Available at: https://www.frontiersin.org/articles/10.3389/fmars.2016.00046/full [Accessed 10 October 2024].

Medvedev, I.P., Kulikov, E.A., and Rabinovich, A.B. (2021) 'Sea breeze system and its impact on currents in the southern Caspian Sea', Ocean Science, 17(1), pp. 1-27. https://doi.org/10.5194/os-2021-57Rahimi, M., Gholamalifard, M., Rashidi,

A., Ahmadi, B., Kostianoy, A.G. and Semenov, A.V., 2022. Spatio-Temporal Variability of Wind Energy in the Caspian Sea: An Ecosystem Service Modeling Approach. Remote Sensing, 14(6263). doi:10.3390/rs14246263.

Terziev, F.S., 2020. Wind regimes of the Caspian Sea. Ocean Science, 16(1), pp.209-223. Available at: https://os.copernicus.org/articles/16/209/2020/ [Accessed 10 October 2024].

APPENDIX 10A – SHAH DENIZ GAS COMPOSITION

Table 10A.1: Shah Deniz vent gas composition

Component	SDC alpha train mass fraction	SDC bravo train mass fraction
Carbon dioxide	0.0036	0.0043
Nitrogen	0.0055	0.0055
Methane	0.8435	0.8438
Ethane	0.0567	0.0592
Propane	0.0305	0.0322
Butane	0.0224	0.0233
Pentane	0.0130	0.0126
C6+*	0.0245	0.0188
Water	0.0003	0.0003
Total	**1.0000**	**1.0000**

* All hydrocarbons from hexanes upwards

APPENDIX 11A – SDC PROJECT SOCIO-ECONOMIC ACTIVITIES / INTERACTIONS

Table 11A.1: SDC project social activities / interactions

ID	Activity	Scoped in?	Event	Receptor
Onshore construction and commissioning of SDC facilities at construction yards				
S-R1	Use of construction yards to construct and commission offshore and subsea facilities	N	Generation of noise and air emissions at construction yards	Community disturbance / community health & safety
S-R2	Transport of materials / equipment to construction yards	N	Increased traffic on roads	Disruption to road and rail users / community health and safety
			Movement of oversized / heavy loads	
			Deterioration of public roads	
S-R3	Creation of employment for onshore construction workforce	Y	Extension of existing employment workforce contracts	Employment
			Creation of new job opportunities	
S-R4	Demanning of workforce following completion of works	Y	Reduction in workforce and end of contracts	Demanning
S-R5	Procurement of goods and services by large contractors	Indirect impact	Increased economic flows	Increased economic flows
S-R6	Competition for jobs	Indirect impact	Competition for jobs (perceived and actual) creating tension	Social conflict
Onshore installation of PFOC				
S-R7	Use of plant and vehicles to install onshore cable	N	Generation of noise and air emissions along cable route	Community disturbance / community health & safety

ID	Activity	Scoped in?	Event	Receptor
S-R8	Cable installation works	N	Excavation of trench for onshore cable installation Crossing of roads and railways Access restrictions to shoreline	Community health and safety / disruption to road and rail users / access restrictions
S-R9	Transport of materials / equipment to PFOC installation site	N	Increased traffic on roads Movement of oversized / heavy loads Deterioration of public roads	Disruption to road and rail users / community health and safety
S-R10	Creation of employment for PFOC installation workforce	Y	Creation of new job opportunities	Employment
S-R11	Demanning of PFOC installation workforce following completion of works	Y	Reduction in workforce and end of contracts	Demanning
S-R12	Procurement of goods and services by large contractors	Indirect impact	Increased economic flows	Increased economic flows
S-R13	Competition for jobs	Indirect impact	Competition for jobs (perceived and actual) creating tension	Social conflict
Offshore and nearshore installation, commissioning and HUC				
SR-14	Offshore and nearshore installation activities and enforcement of marine exclusion zones	N	Disruption to third-party vessels	Disruption to commercial shipping and fishing operations
S-R15	Procurement of vessel operator contractors	Y	Extension of existing workforce employment contracts	Employment
S-R16	Procurement of goods and services by large contractors	Indirect impact	Increased economic flows	Increased economic flows

Notes:

S – social

R – routine activity