No.

MINISTRY OF ENVIRONMENTAL PROTECTION
THE REPUBLIC OF KAZAKHSTAN

THE STUDY ON CAPACITY DEVELOPMENT ON POLLUTION PREVENTION AND CONTROL IN THE PETROLEUM INDUSTRY IN THE CASPIAN SEA AND ITS COASTAL AREAS IN THE REPUBLIC OF KAZAKHSTAN

FINAL REPORT

Volume II : Main Report

August 2007

JAPAN INTERNATIONAL COOPERATION AGENCY
NIPPON KOEI CO., LTD.
JAPAN OIL ENGINEERING CO., LTD.

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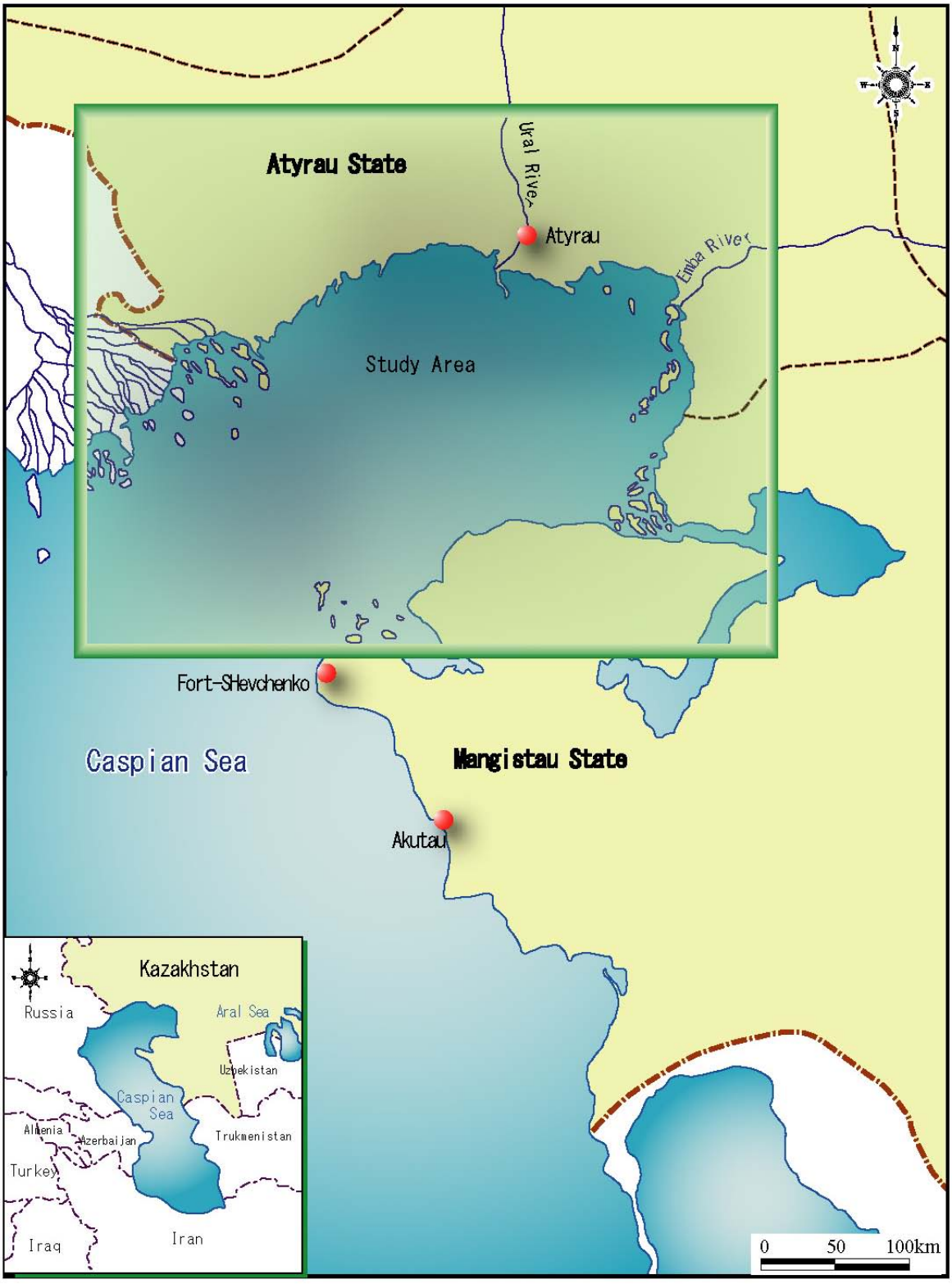


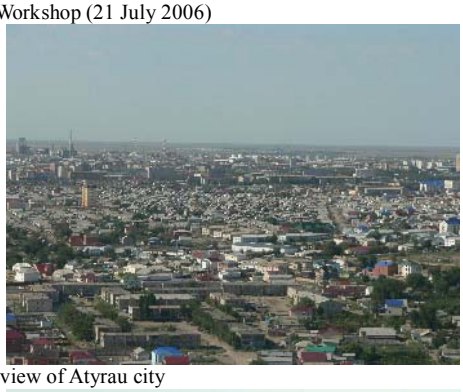
Location Map of Study Area

Str/C meeting on Inception Report (19 April 2006)

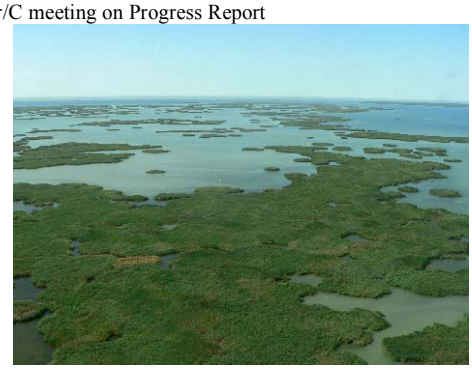
1st Workshop (26 April 2006)

2nd Workshop (21 July 2006)

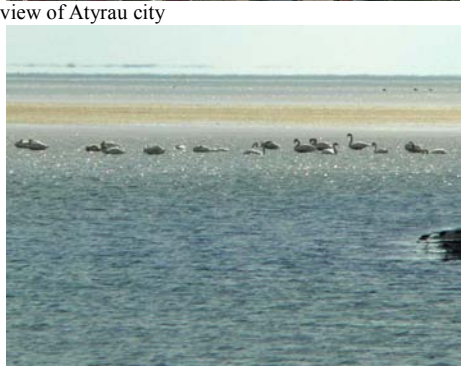
Str/C meeting on Progress Report



Overview of Atyrau city



Coastal area of the Northern Caspian Sea



Swans in the Northern Caspian Sea

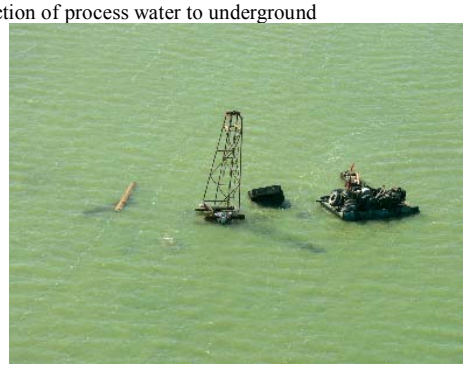
Condition of terrestrial oil field

Desulfurizing facility in Atyrau oil refinery

Soil pollution in the oil field

Injection of process water to underground

Condition of flare



Shut-off works for underwater abandoned well

Construction of an industrial waste disposal facility

Construction of oil pipeline from Kashagan oil field

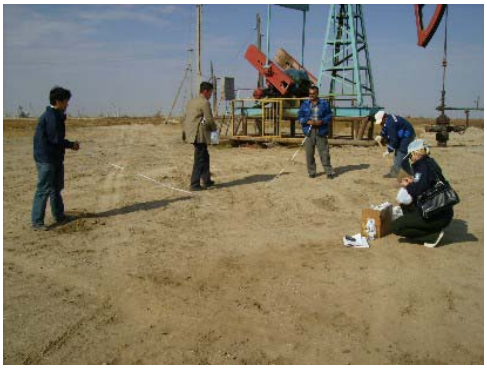
Storage condition of surplus sulfur

Atyrau HYDROMET Center

Analytical equipment in Atyrau HYDROMET Center

Water sampling and filed measurement in the Caspian Sea (pilot project)

Air quality monitoring (pilot project)



Soil sampling in the oil filed (pilot project)

Analytical training using certified materials

Training on remote sensing analysis

Bird view of coatsal area of the Northern Caspian Sea

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FINAL REPORT

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Abbreviations

Abbreviation	Term
AAS	Atomic Absorption Spectrophotometer
API	Air Pollution Index
BAT	Best Available Techniques
BOD	Biochemical Oxygen Demand
BTX	Benzene, Toluene and Xylene
CACILM	Central Asian Countries Initiative for Land Management
CEP	Caspian Environment Programme
CEP-SAP	Caspian Environment Programme - Strategic Action Program
CIS	Commonwealth of Independent States
CITES	Convention on International Trade in Endangered Species of Wild Fauna and Flora(Washington Convention)
COD	Chemical Oxygen Demand
CPC	Caspian Pipeline Consortium
CRS	Congressional Research Service
DEA	Di-Ethanol Amine
DFID	Department for International Development
DO	Dissolved Oxygen
DUCER	Department of Use and Control of Environmental Resources
EBRD	European Bank for Reconstruction and Development
EIA	Environmental Impact Assessment
EIMS	Environmental Information Management System
ELV	Emission Limit Value
EMS	Environmental Management System
EQO	Environmental Quality Objective
ERA	Emergency Response Agency
ERD	Extended Reach Drilling
EU	European Union
EU-TACIS	European Union Technical Assistance to the Commonwealth of Independent States
FCO	Foreign & Commonwealth Office
FRG	Federal Republic of Germany
FRT	Floating Roof Tank
FT-IR	Fourier Transform Infrared Spectroscopy
GDP	Gross Domestic Product
GEF	Global Environment Facility
GC-FID	Gas Chromatograph-Flame Ionization Detector
GTZ	Gesellschaft für Technische Zusammenarbeit
GGFR	Global Gas Flaring Reduction
GIS	Geographic Information System
GNP	Gross National Product
GPS	Global Positioning System
GRDP	Gross Regional Domestic Product

HSE-MS	Health, Safety, and Environmental Management System
IARC	International Agency for Research on Cancer
IPIECA	International Petroleum Industry Environmental Conservation Association
IPPC	Integrated Pollution Prevention and Control
ISO	International Organization for Standardization
IUCN	International Union for Conservation of Nature and Natural Resources
JBIC	Japan Bank for International Cooperation
JICA	Japan International Cooperation Agency
KCT	KaraChanganak
KTO	KazTransOil
KZT	Kazakhstan Tenge
M/M	Minutes of Meeting
MCSST	Multi Channel Sea Surface Temperature
MDEA	Methyl Di-Ethanol Amine
MEA	Multilateral Environmental Agreement
MMS	Minerals Management Service
MEMR	Ministry of Energy and Mineral Resources
MoA	Ministry of Agriculture
MoE	Ministry of Energy
MoEP	Ministry of Environmental Protection
MoT	Ministry of Transport
MPC	Maximum Permissible Concentration
MPD	Maximum Permissible Discharge
MPE	Maximum Permissible Emission
NAP	National Programme
NEAP	National Environmental Action Plan
NGO	Non Governmental Organization
NIS	New Independent States
NNR	National Nature Reserve
NOAA	National Oceanic and Atmospheric Administration
NOSRP	National Oil Spill Response Plan
NRMP	Natural Resources Management Program
OECD	Organisation for Economic Co-operation and Development
OHSAS	Occupational Health and Safety Standard
OJT	On the Job Training
OSCE	Organization for Security and Co-operation in Europe
OSCP	Oil Spill Contingency Plan
OSRL	Oil Spill Response Ltd
PAH	Polycyclic Aromatic Hydrocarbon
PCU	Programme Co-ordination Unit
PEL	Probable Effects Level
PM	Particulate Matter
POPs	Persistent Organic Pollutants
PSA	Production Sharing Agreement
QA	Quality Assurance
QC	Quality Control

RPMP	Regional Pollution Monitoring Program
SCEM	Social Capacity for Environmental Management
SPZ	Sanitary Protection Zone
SER	State Environmental Review
TACIS	Technical Assistance to the Commonwealth of Independent States
TCO	TengizChevrOil
TPH	Total Petroleum Hydrocarbon
UNDP	United Nations Development Program
UNECE	United Nations Economic Commission for Europe
UNEP	United Nations Environment Program
USAID	United States Agency for International Development
USEPA	United States Environmental Protection Agency
USMS EMR	Unified State Monitoring System of Environment and Natural Resources
VOC	Volatile Organic Compounds
WB	World Bank
WPI	Water Pollution Index
WWF	World Wildlife Fund

PART 1

PRESENT CONDITIONS
OF
THE STUDY AREA
AND
POLLUTION CONTROL SYSTEMS

CHAPTER 1 INTRODUCTION

1.1 Background

The Caspian Sea and its coast with Kazakhstan are endowed with oil resources, and about 47% of the resources in the country are concentrated in the coastal states (oblasts) of Atyrau and Mangystau. With the development of offshore wells, oil and gas production in the area is expected to increase significantly in the next few decades. However, development of an environmental management system in the area is still lagging behind, and degradation of air, soil and water quality is becoming a concern. Among the major environmental problems are oil pollution around abandoned and/or inundated wells, discharge of wastewater from production facilities, air pollution associated with produced gas, disposal of a large amount of sulphur and oil spill accidents during transport. Such problems might affect environmental conditions of the northern Caspian Sea, which is famous for its rich biodiversity and fishery resources. In order to deal with such environmental issues, the Government of Kazakhstan in 2003 requested that the Government of Japan implement a development study with the aim to build local capacity to manage the environment in the region. In response, the Government of Japan sent preparatory missions, and both sides agreed on the Scope of the Work for this study in November 2005.

1.2 Objectives and Study Area

1.2.1 Objectives

The objective of the study is to develop capacity and capability in environmental management to mitigate the environmental degradation caused by petroleum industrial activities in the Caspian Sea and its coastal area.

1.2.2 Study Area

The study area is illustrated by the frontispiece of this report. It is the shallow and ecologically important north-eastern Caspian Sea and its coast, covering the Atyrau oblast and the northern part of the Mangistau oblast.

1.3 Participating Organizations

The study was implemented jointly by Kazakh organizations and the JICA Study Team dispatched by JICA (Japan International Cooperation Agency).

1.3.1 Counterpart Organizations

The main counterpart organizations of the study were the Ministry of Environmental Protection (MoEP) and KAZHYDROMET under MoEP.

1.3.2 Steering Committee

Because environmental issues related to the petroleum industry involve various stakeholders, the following organizations became the members of the steering committee for the study: the Ministry of Environmental Protection, KAZHYDROMET, Ministry of Energy and Mineral Resources, Ministry of Emergency Response, Ministry of Agriculture, and Ministry of Economy and Budget Planning. The members of the Steering Committee are shown below:

Table 1.3.1 Members of Steering Committee

-	Name	Title
Ministry of Environmental Protection		
1	Braliev Algan	Vice-Minister of Environmental Protection
2	Bekniyazov Bolat	Director, Department of Environmental Issues / Science / Monitoring
3	Temirhanov Kenes	Deputy Director, Department of Environmental Protection and Management
4	Bragin Aleksandr	Director, Department of Legal, Policy and International Cooperation
5	Karibganova Galia	Chief, Section of International Cooperation
6	Zeinullin Talgat	Director, KAZHYDROMET
7	Tultabaev Muhtar	Head, Environmental Monitoring Center, KAZHYDROMET
8	Suvorova Olga	Chief, Section of Environmental Monitoring
9	Abdrakhmanov Marat	Director, Atyrau Office of Ministry of Environmental Protection
10	Shankieva Kuralai	Deputy Director, Atyrau Office of Ministry of Environmental Protection
11	Bauzhan Takishev	Director, Atyrau HYDROMET
12	Akhmetov Serik	Coordinator of Caspian Environment Programme
Other Ministries		
13	Ongarbaeva Oliga	Senior Expert, Monitoring and Technical Standard Policy, Department of Oil Industry, Ministry of Energy and Mineral Resources
14	Latfullin Ladus	Atyrau Office, Ministry of Emergency Response
15	Uknova Elena	Senior Expert, Section of Fishery Development, Ministry of Agriculture
16	Maserbaeva Bibigul	Expert, Ministry of Economy, Budget Planning and Investment

1.3.3 Other Kazakh Organizations

In addition to the organizations mentioned above, the Atyrau oblast, the geology committee of the Ministry Energy and Mineral Resources, various oil companies and local laboratories have participated in the study.

1.3.4 JICA Study Team

JICA dispatched the JICA Study Team, a team of 12 international experts, to Kazakhstan (hereinafter called the JICA Study Team or the team). The names and the positions of the team members are listed in the table below.

Table 1.3.2 Names and Positions of the JICA Study Team Members

No.	Name	Position
1	Dr. Itaru Okuda	Team Leader/Capacity Development
2	Dr. Paul Driver	Environmental Administration/Environmental Planning
3	Mr. Yoshihiro Miyabuchi	Pollution Control/Environmental Audit
4	Mr. Makoto Fuyumuro	Oil Pollution Control Technology
5	Mr. Kengo Naganuma	Monitoring of Water/Soil/Sediment & Analysis of Heavy Metals and Inorganics
6	Mr. Shinichiro Tanimoto	Water Monitoring (2)/Natural Environment/Coordinator
7	Mr. Shinsuke Sato	Analysis of Organics
8	Mr. Michinobu Aoyama	Air Monitoring/Clean Development Mechanism
9	Mr. Hiroshi Hyodo	Remote Sensing/GIS Database
10	Mr. Shinichiro Kageyama	Remote Sensing/GIS Database (2)
11	Mr. Alex Nikolaev	Interpreter (1)
12	Ms. Makiko Uehara	Interpreter (2)

1.4 Implementation of the Study

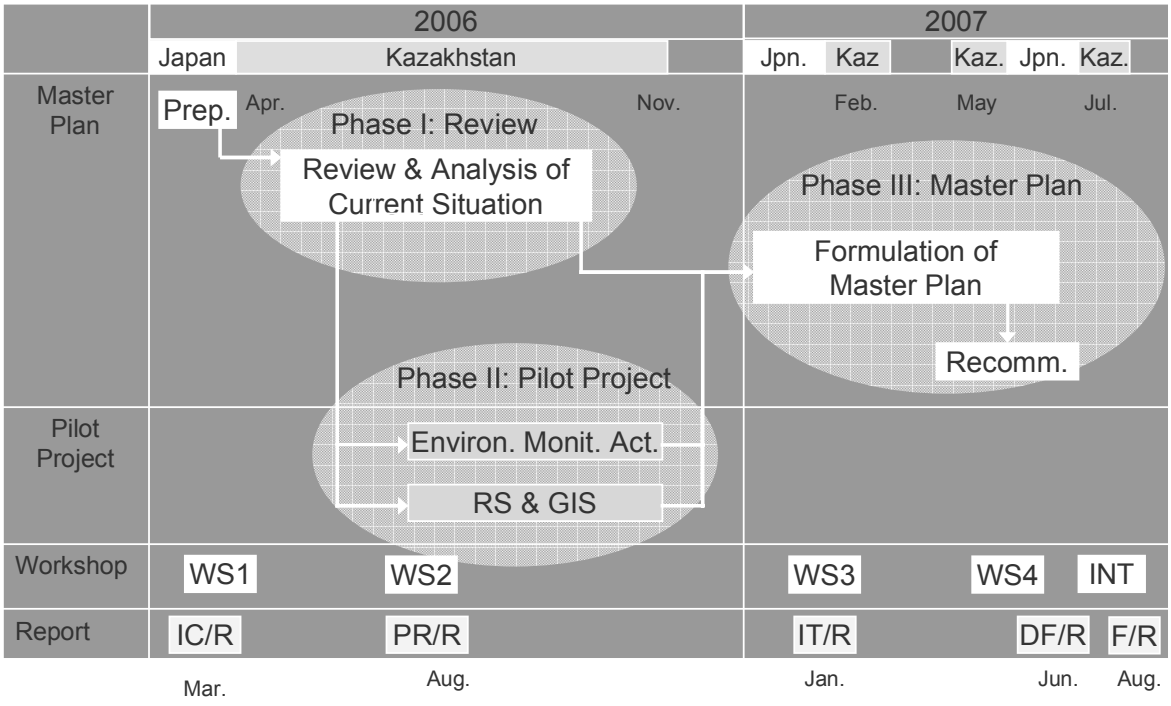
Figure 1.4.1 shows the general flow of the study. The study has the following three phases:

- Analysis of the current situation (Phase 1)
- Implementation of the Pilot Project (Phase 2), and
- Development of the Master Plan (Phase 3).

The reports prepared and the workshops held in the study are shown in Table 1.4.1. The Minutes of Meetings of the Steering Committee meetings are shown in the Appendix.

Table 1.4.1 Report Prepared and Workshop Held in the Study

Year and Month	Report	Workshop / Steering Committee Meeting
March 2006	Inception Report	-
19th April 2006	-	1st Workshop in Astana / Steering Committee Meeting
26th April 2006	-	1st Workshop in Atyrau
July 2006	Progress Report	-
21st July 2006	-	2nd Workshop in Atyrau
26th July 2006	-	2nd Steering Committee Meeting
February 2007	Interim Report	-
16th February 2007	-	3rd Workshop in Atyrau
19th February 2007	-	3rd Steering Committee Meeting
11th May 2007	-	4th Workshop in Atyrau
July 2007	Draft Final Report	-
12th July 2007		5th Workshop in Atyrau
17th July 2007		4th Steering Committee Meeting
18th July 2007		International Seminar in Astana
August 2007	Final Report	-



Note: WS: workshop, INT: international seminar, IC/R: Inception Report, PR/R: Progress Report, IT/R: Interim Report, DF/R: Draft Final Report, F/R: Final Report

Figure 1.4.1 Overall Flow of the Study

1.5 Adoption of the Master Plan

This study revealed that the Kazakh government and the oil and gas industry are making substantial efforts to develop pollution control and environmental risk management systems. However, the oil and gas sector is growing rapidly, possibly even faster than the speed of development of environmental management systems, and the risk of an environmental disaster is increasing. The team hopes the Kazakhstan government, after thorough review, will adopt the activities and the recommendations of this Master Plan, and effectively prevent environmental degradations in the Caspian region.

CHAPTER 2 PRESENT CONDITIONS OF THE STUDY AREA

2.1 Introduction

This Chapter describes the environmental and socio-economic conditions in the northeast Caspian Sea region. The data and information, which are largely cited from EIA reports recently prepared by an oil industry[1], reports of the Caspian Environment Programme (CEP), and data of KAZHYDROMET, etc., became the basis for our work in Phase 2 (capacity development) and Phase 3 (master plan development).

2.2 Environmental Conditions

Oil industries in the study area are located onshore and offshore of the northeastern Caspian Sea. Therefore this section summarizes environmental conditions in both the northeastern Caspian Sea and its coastal area.

2.2.1 Caspian Sea

The Caspian Sea is the world's largest natural lake that spreads from southern Russia to northern Iran. It is a salt lake of 1,200 km north-south and 300 km east-west on average, and the area is 371,000 km^2. The Volga River and Ural River flow from the north into the Caspian Sea. Although the depth of water exceeds 200 m in the central and southern areas, it is shallower than 20 m in the north (Figure 2.2.1). Especially in the northeastern region, where the average water depth is merely 2 to 5 meters, and the coastal inclination is very gentle both onshore and underwater over almost all the area, typically less than 2m change in water depth over a distance of 50 km.

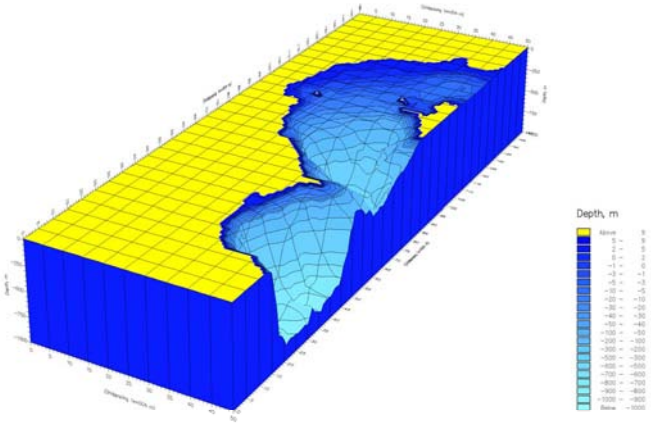


Figure 2.2.1 Longitudinal Section of the Caspian Sea
Source: KAZHYDROMET

The present conditions of the northeastern Caspian Sea are described below with respect to climate, water level fluctuation, currents, ice, water/sediment quality, ecosystem and protected areas.

(1) Climate

Climate of the Kazakhstan coast of the North Caspian is continental with a hot dry summer and a cold winter with low snow precipitation and significant amplitudes of seasonal and daily temperature.

1) Wind

The annual wind speed at the eastern coast of the North Caspian averages 4-6 m/s. Strong winds are most probable in March-April and least probable in July-August. The highest recorded wind speed for the last 16 years was 34 m/s. The strongest winds over the sea surface

[1] Agip, Kashagan Field Experimental Program, Facilities Construction Project, Book 5, Vol. 2, 2004; Agip, Kashagan Experimental Program, Technical Substantiation for Selection of Construction Options, Volume 4, Preliminary Environmental Impact Assessment, 2002; Caspian Environment Programme, Coastal Profile of the Kazakhstan part of the Caspian Sea, 2000.

in the North Caspian are typically easterly winds. In 71% of the cases, strong winds and storms in the Caspian Sea are related to anticyclonic circulation of air masses.

2) Temperature

An analysis of mean monthly air temperature variations at the northeast Caspian Sea coast indicates that the coldest months are January-February and the warmest month is July (Table 2.2.1). The below zero air temperatures above the sea in the winter months result in the presence of ice cover in this area with developed forms of land-fast ice.

Table 2.2.1 Average Monthly Air Temperature

unit : °C

Observation station	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
Atyrau	-6.2	-6.7	0.4	11.5	17.9	24.7	26.4	24.2	17.3	9.3	0.5	-4.4	9.5
Peshnoi	-5.9	-6.8	-0.1	10.9	17.5	23.6	25.3	23.2	16.8	9.2	0.8	-4.1	9.2
Kulaly Lsland	-1.7	-2.5	2.7	11.7	17.2	23.9	26.2	25.3	18.7	11.3	3.6	-0.5	12
Fort-Shevchenko	-0.5	-0.8	4.1	11.8	17.4	23.8	26.1	24.8	19.6	12.9	5.5	1.3	12.3

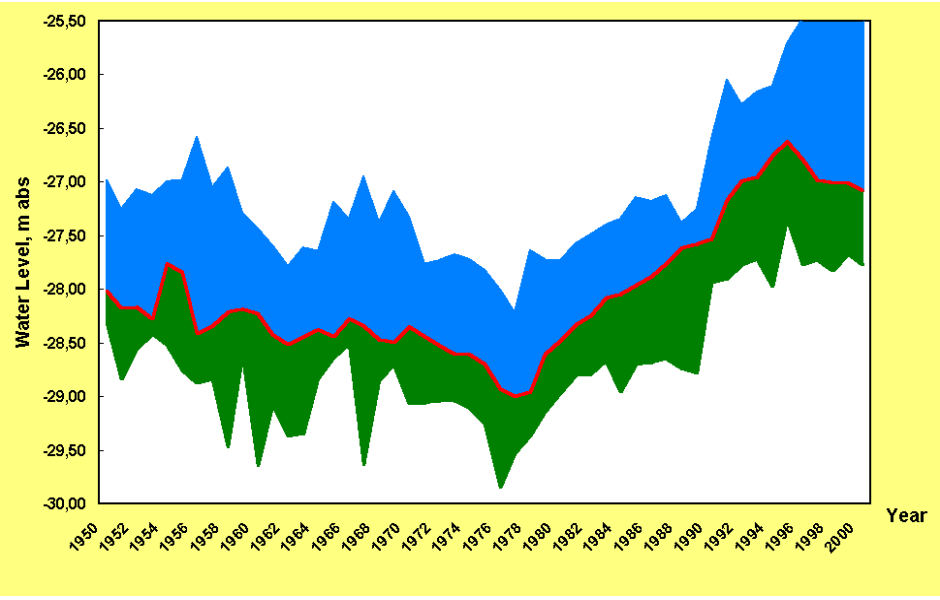
Source: KAZHYDROMET

3) Precipitation

The mean annual precipitation in Atyrau is 206mm. Further seaward, the quantity of precipitation is less than 150 mm.

(2) Water level fluctuation

Figure 2.2.2 shows the fluctuation of the water level in the Caspian Sea. The recent intense rise of the Caspian Sea level began in 1978 and continued for 18 years (1978-1996). During the period, the sea water level has increased by 2.4m, and since 1996, the water level has been stable at approximately ASL-27m. The very slight bottom slope in the coastal zone within Kazakhstan is the reason for flooding of vast territories by even a small sea level rise. At a sea level rise of 1m an area of up to 10-17 thousand km^2 is flooded.



Source: KAZHYDROMET

Figure 2.2.2 Fluctuation of the Caspian Sea Level (Island Peshnoy Station)

The duration of surges caused by storms varies over a wide range from several hours to several days. The average surge height varies from 51-53 cm (August and January) to 67-68 cm (October and April) based on multiyear data. The highest surges of rare frequency typical occur in spring and autumn. Over the period 1960 to 2000, 15 surges had heights of 100cm and more. In recent years, surges greater than 200 cm occurred in spring of 2000.

(3) Currents

Currents are influenced by wind, runoff of the Volga and Ural Rivers and the water density distribution. They also depend on the bottom depth and relief, underwater vegetation and coastline configuration. The river runoff and the density distribution determine the constant outflow currents.

In the area with a depth up to 2-5 m, the prevailing currents are in two directions, west to southwest and northeast to east. The average speed of the current is 15 cm/s. The maximum current speeds can be 70-90 cm/s. Near the eastern coast of the north Caspian, currents with northwest and south to southwest directions predominate. Near the shore, the current is directed onshore (eastward) during the surge water level rise. The highest current speeds are usually observed with winds parallel to the shore.

(4) Ice formation

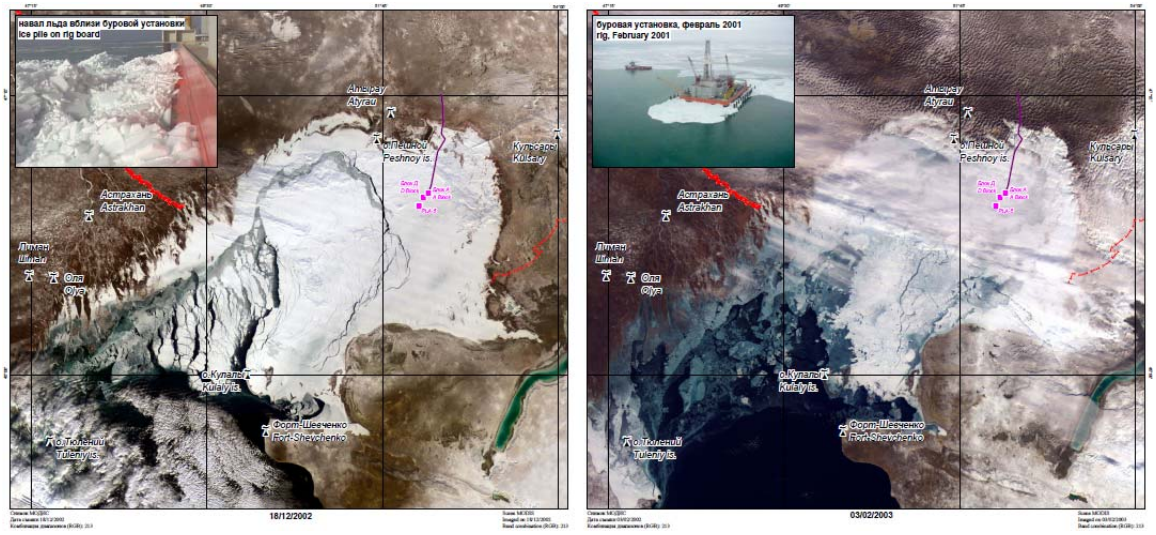
Usually, the northeast part of Caspian Sea is entirely covered with ice in winter. In a cold winter, the first ice is formed in the marginal northeastern part of the sea in early November, although during a warm winter the first ice can be formed in the estuary of the Ural River, in early December.

The average long-term ice thickness in the northeast Caspian varies from 25-60 cm. Some of the records of ice thickness were from 80 to 100cm or more (1936-37, 1950-51, 1953-54, and 1956). During severe winters it can reach 130 cm at certain places, and thickness of rafted ice reaches 2-3 m. In the northeast Caspian Sea, a ridging process results in appearance of ice ridges parallel to its contour near the land. The average height of ridges is 1.5-2.0 m, but it can reach 5-6 m.

During a surge, the ice moves westward and southwestward. The land-fast ice breaks during a surge, and cracks and patches of ice-free water are formed. This results in erosion of the seabed by the friction between the drifting ice and seabed. Agip KCO's surveys have revealed cases of seabed scouring up to 0.3m, with the direction of the furrows being mostly from SSW to ENE.

Ice crushing starts in the second half of February. The open areas of the north Caspian are cleared first, then its northeast area. The sea becomes completely free from ice in late March – early April.

The ice cover in the northeast Caspian Sea lasts for 3-4 months during winters of average severity.



Source: Kashagan Field Experimental Program Facilities Construction Project Book5 Vol.2

Figure 2.2.3 Ice Cover of the Northeast Caspian Sea

(5) Water/sediment Quality

1) Water Quality

KAZHYDROMET revised its water quality monitoring plan in 2004. The frequency is supposed to be four-times per year; the sampling stations are shown in Figure 2.2.4 (A1-E9). However, so far water monitoring has been carried out only once in February 2005 near the shore because of problems with the sampling boat. The average values of water quality parameters at A4, A6, A8 and A10 in February 2005, are shown in Table 2.2.2.

Figure 2.2.4 Location of Sampling Stations

pH was 7.3, Dissolved Oxygen (DO) was 6.9 mg/L, Biochemical Oxygen Demand (BOD_5) was 1.7 mgO_2/L, sulphate was 496 mg/L. Oil products was 0.054 mg/L and it exceeded the Maximum Permissible Concentration (MPC) slightly. Heavy metals tend to exceed MPCs. These are 0.038 mg/L of lead, 0.019 mg/L of arsenic, 0.0065mg/L of hexavalent chromium and so on. However, the MPCs that were compared with the data are the (deep) seawater standard, and if the analysed values were compared with the MPCs for river water, the values for heavy metals would not exceed the MPCs. The northeast Caspian Sea has low salinity (approximately 3‰) and is a relatively closed water area. Therefore, the fact that some parameters exceed the MPCs for deep seawater[2] does not necessarily mean that the water is contaminated.

As KAZHYDROMET could not carry out water quality surveys in the sea, they conducted water quality surveys at the Ural delta and coast in July, August and December in 2005. According to the results, total nitrogen showed high values (0.5-1.0 mg/L). It is equivalent to the Level III seawater quality standard in Japan. BOD_5 recorded more than 5 mg O_2/L in July. Based on these results, it is estimated that eutrophication occurs at the Ural delta and coast.

[2] MPCs for seawater in Kazakhstan are similar to those of the USEPA standard for seawater.

Oil products slightly exceeded the MPC[3] at most stations, and this seems to indicate the occurrences of oil pollution.

Furthermore in June 2006, a non-regular water quality survey was conducted at 7 points (W1-W7) in the northeast Caspian Sea by KAZHYDROMET. The survey points are close to the innundated abandoned oil wells (W2-W7) and an oil well under construction (W1). The results are presented in Table 2.2.3.

pH was 7.5 - 9.1, temperature was 23.0-27.0 ^{o}C, DO was 8.75-9.39 mg/L, and suspended solid (SS) was 10.0-15.0 mg/L. Total nitrogen was 0.87-1.01 mg/L, phosphate was 0.021-0.030 mg/L, sulphate was 1,590-2,210 mg/L, salinity was 3,120-3,660 mg/L, and sodium+potassium was 1,830-2,030 mg/L. Phenolic compounds were less than 0.0005 mg/L and oil products were 0.031 to 0.087. These are less than the MPCs. As the value for oil products generally detected was less than the MPC level, it is assumed that there is not a high concentration of oil products, unless sampling is conducted at the location of an oil spill.

Table 2.2.2 Water Quality Survey Result in February 2005 (Average among A4, A6, A8 and A10)

Parameter	Temperature	pH	SS	DO	BOD_5	NO_3	Salinity	SO_4	Ca	Mg	Phosphate	Fe
-	°C	-	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
USEPA		6.5-8.5										0.3
MPC	-	-	-	6	3	40	11900	3500	610	940		0.1
Result	0.1	7.3	3.75	6.9	1.675	0.97	800	495	99.5	346.1	0.04	0.29
Year	Phenolic compounds	Oil Products	Mn	Hg	As	Cr6+	Cu	Zn	Pb	Cd	Ni	Na+K
-	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
USEPA			0.05	0.00094	0.0036	0.005	0.0031	0.081	0.0081	0.0088	0.0082	
MPC	0.001	0.05	0.05	0.001	0.01	0.001	0.005	0.05	0.01	0.005	0.01	7100
2005	0.0006	0.054	0.029	ud	0.019	0.006	0.0097	0.108	0.038	0.002	0.0237	488

Source: KAZHYDROMET

Table 2.2.3 Water Quality Survey Result in June 2006

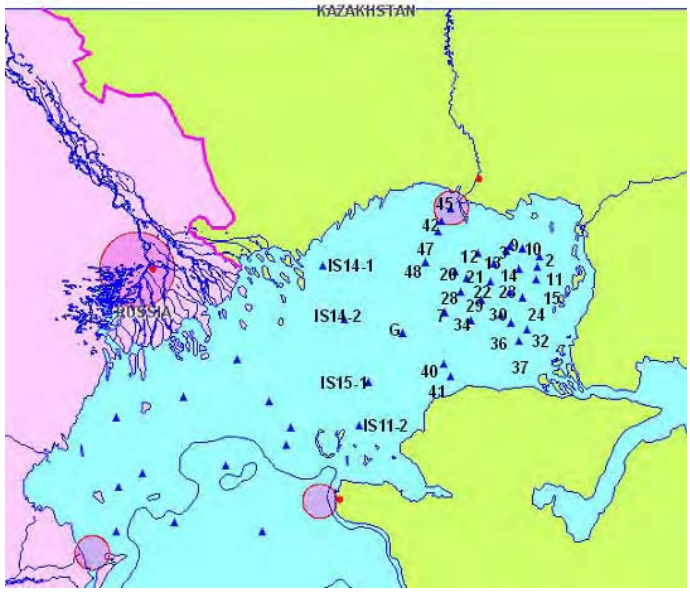
Station	Date	Temperature	pH	SS	DO	Total Nitrogen	Salinity	Sulphate	Ca	Mg	Phosphate	Fe
-	-	°C	-	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
MPC	-	-	-	-	6		11900		610	940		0.1
W1	31/5/2006	23	7.8	13	9.15	0.87	3264	1729	200	480	0.03	0.38
W2	1/6/2006	25	9.1	10	8.95	1.01	3424	1681	240	456	0.022	0.35
W3	1/6/2006	25	9	11	8.93	0.91	3344	1585	220	468	0.022	0.63
W4	1/6/2006	25	9.1	13	8.75	0.92	3185	1729	200	480	0.021	0.4
W5	1/6/2006	25	7.5	11	9.38	1	3504	1729	220	480	0.029	0.31
W6	2/6/2006	27	8.1	13	8.97	0.87	3121	1921	240	504	0.022	0.31
W7	2/6/2006	27	8.8	15	9.12	0.96	3663	2209	260	576	0.033	0.49
Station	Phenolic compounds	Oil Products	Mn	Na+K								
-	mg/L	g/L	mg/L	mg/L								
MPC	0.001	0.05	0.05	7100								
W1	<0.0005	0.031	0.026	1898								
W2	<0.0005	0.036	0.021	1925								
W3	<0.0005	0.028	0.026	1865								
W4	<0.0005	0.041	0.029	1831								
W5	<0.0005	0.033	0.021	2029								
W6	<0.0005	0.044	0.032	1803								
W7	<0.0005	0.018	0.036	2109								

Source: KAZHYDROMET

[3] The Japanese standard requires “oil products are not detected”.

2) Sediment Quality

Sediment quality is a good indicator of environmental conditions because pollutants are usually accumulated in sediment. A sediment quality survey was conducted by CEP in 2001 and 2005. The sampling stations and results of the survey in 2001 are shown in Figure 2.2.5 and Table 2.2.4. Overall, the results did not reveal any serious pollution. All parameters were below the PELs (Probable Effects Level) of National Oceanic and Atmospheric Administration (NOAA-USA).



Source: http://www.caspianenvironment.org/newsite/Data-MAP_GIS.htm#

Figure 2.2.5 Location of Sampling Stations

Another bottom sediment quality survey was conducted by KAZHYDROMET in June 2006 at the same stations as the water quality. The results are shown in Table 2.2.5. pH was 7.5-9.1 and oil products was 0.079 to 0.280 g/kg. Regarding heavy metals, cadmium was 0.053-0.623 mg/kg, lead was 1.77-3.26 mg/kg, and nickel was 1.77-6.79 mg/kg.

These results are generally consistent with the results of the sediment survey conducted in this study (see Chapters 7 and 8 on Pilot Project). Judging from these results, the sediment of northern Caspian Sea has not been seriously contaminated. This appears to be because pollution sources in the area are sparsely located in a wide area, and most on-shore pollution sources use evaporation ponds and do not discharge wastewaters to the Caspian Sea.

Table 2.2.4 Sediment Analytical Results

Station Code	Sampling Date	Depth	Longitude Latitude	Analytical Results										
				Total Hydrocarbons	Lindane	Total PAHs	Total HCHs	Total DDTs	Total PCBs	TOC	Cr	Cu	Hg	Pb
				(ug/g)	(pg/g)	(ng/g)	(pg/g)	(pg/g)	(pg/g)	(%)	(ug/g)	(ug/g)	(ug/g)	(ug/g)
2	25 Sep 2001	2.8	52^0 63' 33" 46^0 46' 67"	2.3	1.0	10.775	11.0	19.0	68.6	0.350	26.3	6.79	0.0200	6.09
3	25 Sep 2001	3.8	52^0 23' 33" 46^0 51' 67"	11.0	1.5	14.265	13	44.5	74.4	0.330	31.7	4.24	0.0020	5.85
7	22 Sep 2001	6.2	51^0 50' 00" 46^0 01' 67"	20.1	7.0	24.268	30.0	70.5	178.1	2.510	40.9	9.52	0.0400	6.04
9	25 Sep 2001	3.2	52^0 28' 33" 46^0 55' 00"	10.1	1.5	15.241	15.1	23.0	81.7	0.360	41.8	5.64	0.0080	6.87
10	25 Sep 2001	3.2	52^0 43' 33" 46^0 53' 33"	8.3	0.6	8.88	9.1	53.5	38.3	0.240	56.5	4.39	0.0010	8.31
11	24 Sep 2001	3.3	52^0 60' 00" 46^0 38' 33"	8.0	3.5	8.76	10.8	13.5	63.3	0.220	42.7	4.23	0.0150	6.71
12	25 Sep 2001	3.5	51^0 90' 00" 46^0 50' 00"	-	-	-	-	-	-	-	3.81	1.69	0.0040	1.43
13	25 Sep 2001	3.8	52^0 08' 33" 46^0 41' 67"	9.1	1.0	12.19	8.0	19.0	71.5	0.260	25.2	3.41	0.0190	5.18
14	24 Sep 2001	3.5	52^0 38' 33" 46^0 36' 67"	24.1	3.0	11.829	12.5	19.0	88.2	0.360	29.3	4.11	0.0010	7.15
15	24 Sep 2001	2.5	52^0 58' 33" 46^0 28' 33"	16.0	0.6	11.274	12.1	19.0	59.9	0.430	35	5.27	0.0050	6.84
20	26 Sep 2001	6.2	51^0 63' 33" 46^0 35' 00"	5.4	8.0	170.140	28.0	40.0	126.3	0.600	41	7.81	0.0120	6.29
21	24 Sep 2001	5.8	51^0 76' 67" 46^0 30' 00"	9.7	1.5	12.259	18.5	34.0	216.7	0.530	32.5	6.63	0.0150	5.98
22	24 Sep 2001	4.0	52^0 05' 00" 46^0 26' 67"	11.2	2.5	11.314	9.0	11.5	42.5	0.210	20.3	3.24	0.0050	4.12
23	24 Sep 2001	3.5	52^0 26' 67" 46^0 18' 33"	7.1	0.6	9.701	5.9	12.8	49.6	0.260	24.7	3.64	0.0070	5.71
24	24 Sep 2001	2.8	52^0 41' 67" 46^0 13' 33"	7.0	0.6	6.71	4.7	11.8	48.0	0.180	14.4	2.59	0.0020	4.20
28	24 Sep 2001	5.4	51^0 70' 00" 46^0 18' 33"	30.0	1.0	15.977	11	27.5	132.4	0.860	15.6	4.17	0.0120	3.87
29	23 Sep 2001	4.8	51^0 93' 33" 46^0 11' 67"	9.5	1.0	22.197	11.5	21.5	59.4	0.390	28.68	6.36	0.0280	5.46
30	23 Sep 2001	3.3	52^0 16' 67" 46^0 00' 00"	6.5	0.6	9.352	4.6	12.0	44.3	0.390	4.9	1.32	0.0010	3.61
32	23 Sep 2001	2.0	52^0 46' 67" 45^0 86' 67"	2.8	0.8	12.615	13.3	21.8	57.2	0.180	19.0	4.88	0.0190	5.37
34	23 Sep 2001	5.0	51^0 81' 67" 45^0 95' 00"	21.7	4.0	26.37	21.0	33.0	117.9	0.370	1.9	1.20	0.0040	1.51
36	23 Sep 2001	3.0	52^0 28' 33" 45^0 93' 33"	8.2	0.6	12.242	5.2	14.8	34.8	0.220	19.1	2.99	0.0090	4.86
37	23 Sep 2001	2.5	52^0 36' 67" 45^0 78' 33"	10.0	2.0	13.402	16.0	25.8	56.1	0.450	24.0	5.64	0.0200	5.44
40	22 Sep 2001	4.5	51^0 48' 33" 45^0 60' 00"	12.0	11.0	8.948	43.6	30.5	57.6	2.080	29.2	3.68	0.0140	4.72
40	22 Sep 2001	2.4	51^0 56' 67" 45^0 50' 00"	8.6	1.0	14.210	4.0	14.8	38.8	0.080	39.7	2.10	0.0020	4.97
42	27 Sep 2001	3.6	51^0 46' 67" 46^0 76' 67"	9.1	2.0	20.327	22.5	38.0	91.0	0.510	56.9	10.4	0.0260	8.21
45	27 Sep 2001	2.4	51^0 58' 33" 46^0 86' 67"	21.0	2.0	195.3	25.0	84	128.7	0.330	103	19.2	0.0020	14.6
47	26 Sep 2001	4.5	51^0 43' 33" 46^0 68' 33"	9.5	0.6	0.000	11.6	20.5	64.9	0.430	50.7	4.61	0.0010	6.59
48	26 Sep 2001	5.3	51^0 28' 33" 46^0 43' 33"	-	-	-	-	-	-	-	2.39	1.38	0.0100	3.54
G	21 Sep 2001	10.6	51^0 01' 67" 45^0 85' 33"	20.0	4.5	23.506	19.0	33.0	111.6	1.340	28.0	9.17	0.0280	4.83
IS11-2	21 Sep 2001	1.8	50^0 51' 67" 45^0 10' 00"	13.7	2.0	14.995	13.5	21.5	69.8	0.380	37.3	4.40	0.0110	4.10
IS14-1	20 Sep 2001	1.8	50^0 06' 67" 46^0 40' 00"	4.7	0.8	6.085	4.8	12.8	55.4	0.120	21.7	3.14	0.0160	5.74
IS14-2	20 Sep 2001	4.2	50^0 33' 33" 45^0 96' 67"	7.0	1.0	0.000	7.5	14.0	39.0	0.210	31.1	2.84	0.0140	5.18
IS15-1	21 Sep 2001	8.0	50^0 61' 67" 45^0 45' 00"	14.7	2.5	21.210	19.0	33.5	95.6	0.620	32.6	8.48	0.0260	5.58
Threshold Effects Level (TEL		-	-	-	320	1,684	-	3,890	21,550	-	52	19	0.1300	30
PEL (Probable Effect Level)		-	-	-	990	16,770	-	51,700	189,000	-	160	108	0.6960	112

Source : http://www.caspianenvironment.org/newsite/Data-MAP_GIS.htm#

Table 2.2.5 Bottom Sediment Quality Survey Result in June 2006

Station	Date	Temperature	pH	Oil Products	Cd	Pb	Cu	Ni	Zn
-	-	℃	-	g/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
W1	31/5/2006	23	7.87	0.097	0.1788	1.7715	1.6967	1.7715	2.6121
W2	1/6/2006	25	9.1	0.282	0.1434	2.6674	3.0109	5.5688	7.4641
W3	1/6/2006	25	9	0.256	0.1814	3.2631	3.6798	6.484	8.8594
W4	1/6/2006	25	9.1	0.102	0.6229	1.9258	2.1527	2.2262	6.0474
W5	1/6/2006	25	7.5	0.079	0.0533	1.8535	2.8343	4.9523	4.3609
W6	2/6/2006	27	8.1	0.049	0.0316	2.0339	2.9873	6.7943	7.0362
W7	2/6/2006	27	8.8	0.075	0.0466	2.0061	2.8701	6.6161	6.8363

Source: KAZHYDROMET

(6) Ecosystem

1) Marine vegetation

The ecological study of the water area and the transition zone of the Volga-Ural interfluve conducted by CEP in 2002 showed that the species composition of aquatic plants in the Kazakhstan Caspian Sea sector comprises of 59 species from 30 genera and 27 families. Vegetation distribution is of zonal nature and depends on the habitat conditions, including relief, bottom sediments characteristics, depth, turbidity, water salinity nutrients, etc.

The plant communities are represented by open communities of pondweed and eelgrass (Potamogeton pectinatus and Zostera marina) with the clasping-leaved pondweed (Potamogeton perfoliatus) and pondweed with participation of P. perfoliatus, Myriophyllum verticillatum and Ceratophyllum demersum. Quite frequently the communities of the red alga polisifonia (Polisifonia sertularioides) can be observed, and significant areas of bottom surface are completely devoid of any vegetation.

No vegetation was observed at any of the 7 stations on the bottom surface within the Kashagan's offshore pipeline sector. Wave activities, under influence of south, southeast and east winds, may prevent the plants from rooting.

The transit zone is represented by reed islands and their ring-form chains. Reed communities cover not only the water edge, but also the areas considered to be the old coastline before the water level rose. Macrophytes communities are represented by vascular aquatic vegetation, with green filamentous algae, and red algae grow in the water column between islands.

2) Marine Phytoplankton

One hundred fifty five species and varieties of algae have been recorded in the northeast Caspian Sea during the second half of the 1990s. The taxonomic divisions are represented by: 107 species and forms of diatoms, 22 blue-green algae, 15 green algae, 8 pyrophyte, 2 euglena and 1 yellow-green. The most diverse within the diatoms were 20 varieties of Genera Nitzschia, 14 of Navicula, 8 of Cymbella, 3 each of Gleocapsa and Merismopedia.

The distribution of algae over northeast Caspian area is non-uniform. In spring, the maximum concentration of cells was observed at a depth of 3-5 m exceeding 3 times the cells of the community in the coastal zone (1996). The highest productivity of cenosis in autumn was observed in 7-9 m depth.

The main mass – 65% of the annual primary production is created in the North Caspian in the summer and autumn months. The productions of phytoplanktons in spring and winter are 25% and less than 10% of the annual production respectively. Taking into account this data as well as the diversity of algae species, the period May to October is the period of the highest ecological sensitivity for the communities in the North Caspian Sea.

3) Marine Zooplankton

Caspian zooplanktons are not diverse, though, they are unique due to low sea salinity and long isolation from the ocean. Along with the Caspian species, immigrants of Arctic, Mediterranean and freshwater origin are also recorded. About 120 species and forms of zooplankton are known such as rotifers, cladocers and copepods as well as 70 infusorians species. In addition, larvae of bottom dwelling organisms are present. There are many endemics, particularly 16 species and 1 subspecies of cladocers. Overall, 27 endemic taxa of zoo planktons can be identified. At the same time, the invasion of migrants continues.

In the northeast Caspian Sea, throughout the 1990's, 73 zooplankton taxa were recorded, they were 2 of jelly-fishes, 25 of rotifers, 20 of cladocers, 8 of copepods and 8 of other facultative forms. One third of species, mainly freshwater rotifers, are indicators of water pollution. Species pointing to slight pollution (35% of all indicators) or lack of pollution prevail.

Plankton is non-uniformly distributed in the water area of the northeast part of the sea. In spring and autumn, shallow water areas are poor in zooplankton. With depth increasing below two meters, numbers of individuals in May increased ten-fold, and the biomass increased to 3-4 times. These figures are based on Calanipeda; however, the numbers of Shychaeta and Podonevadne in the pelagic zone also increase. In autumn, at the depth of 4-5 m, only mature copepods concentrate. Their biomass is several times higher than that in spring. In spring and autumn, the most sensitive habitats of zooplankton are at depths with the maximum density of individuals. Low figures of summer zooplankton are related to intense consumption by fish.

4) Marine Macrozoobenthos

Species composition of benthic fauna in the North Caspian is much poorer than in the Middle and South Caspian and comprises 234 taxa. Macrozoobenthos is dominated by species of the autochthonous assemblage, which are mostly endemic for the Caspian. These are sponges Spongia, Turbellaria, gastrotricha of Pyrgula genus, some Polychaeta, Oligochaeta, Hirudinca, most of crustaceans of Amphipoda, Mysidacea and Bryozoa.

Depending on the salinity, benthic fauna of the Caspian is classified under 5 groups: freshwater, dwelling under salinity 0-2‰, slightly brackish of 2-7‰, brackish of 7-11‰, and marine of over 10‰. Rising Caspian Sea level in the last decades resulted in intensified development of organisms belonging to freshwater and brackish water assemblages and displacement of salt-loving species. At present, molluscs – brackish water Didacna trigonoides, Hypanis angusticostata and Dreissena polymorpha andrusovia are rare.

During the year, numbers and biomass of most bottom dwellers increases from April to June. It is during this period that organisms are breeding, which results in an intense increase in the density of individuals in the population. In July-August, the numbers and biomass of benthic fauna decrease at the expense of active consumption by fish. By autumn, with the decreasing feeding rate and fish migration to river deltas and southern areas of Caspian, the benthic biomass increases again. Also, the mass increases at the expense of growing young organisms that are rarely consumed.

Distribution of numbers and biomass of certain benthic faunal groups in the northeast Caspian is determined by relations of these organisms with depth, salinity and character of soils. The highest biomass values of benthic invertebrates (30-100 g/m^2) were recorded in May in the central part of northeast Caspian.

5) Ichthyofauna

a) Distribution of Caspian Fish

On the basis of ecological features, fish of the Caspian Sea are classified into 4 groups:

- River fish is represented by 42 species and subspecies, and accounts for 34.4% of ichthyofauna. Throughout their lifetime, they dwell in fresh water in the lower courses of rivers and delta water bodies.
- Diadromous fish comprises 18 species and subspecies (14.7%). Prior to becoming sexually mature they dwell in the sea, migrating to rivers for breeding, far away from the mouths using certain areas of riverbed and floodplain for spawning.
- Semianadromous fish is represented by 9 species and subspecies (7.4%). These fish feed in fresh water areas and breeds in water bodies of river deltas during high water periods.
- Sea fish is most abundant in respect to species composition. 53 species and subspecies (43.5% of ichthyofauna composition) inhabit the region. These fish spend their entire life cycle in the sea.

Due to disappearance of reeds and eutrophication, particularly in delta areas of the Volga, Ural and the interfluve, extensive hypoxia zones form in the summer period having a negative effect on production processes. Nevertheless, the shallow water zone is characterized by a higher concentration of fish.

b) Caspian Sea Fish Resources

Ichthyo-resources of the Caspian Sea are at least 2.9 million tons, and their commercial value is assessed at 5-6 billion US dollars a year. Reserves of valuable commercial fish in the north Caspian exceed 1 million tons, which amounts to about 1 billion dollars.

The Kazakhstan part of the Caspian Sea contains 24-26% of the herring and sturgeon reserves in the Caspian Sea.

During the period of the Caspian Sea level lowering, there occurred a marked reduction in small fish catches (vobla, sazan, bream, zherekh, pike perch, etc.). The reserves of these species have increased significantly recently due to sea freshening, and expanding fattening and spawning grounds. However, they are commercially overexploited, particularly during the sea period of their life cycle.

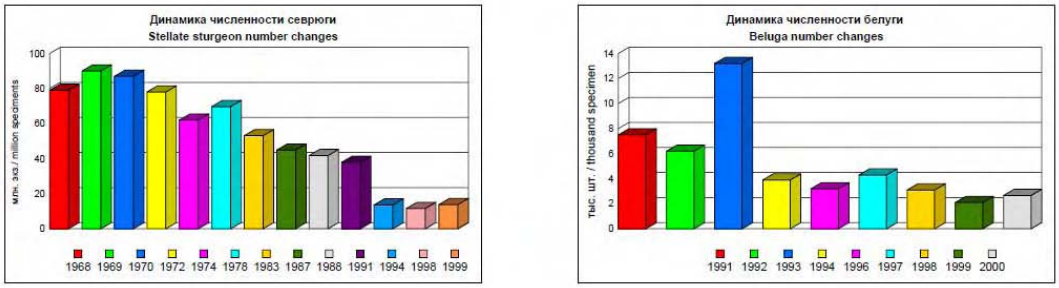
c) Sturgeons

Caviar-producing sturgeons are one of the world's most valuable wildlife resources, and it is vital to the people of the Caspian Sea region. Revenue from exporting sturgeon caviar by Kazakhstan in 1994 (26.5 ton), at an average price of 500 dollars/kg, reached 14 million dollars.

However, according to a program established by the World Wide Fund for Nature (WWF) and the World Conservation Union (IUCN) to monitor wildlife trade, the amount of recorded sturgeon catches in the Caspian Sea plummeted from 22,000 tons in the late 1979's to 1,100 tons in the late 1990's.

In response to the situation, the Conference of the Parties to the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) decided to make all species of sturgeon, as of April 1998, subject to strict CITES provisions requiring, among other things, strict permits for export and specific labelling. Export permits are to be granted only if it can be shown that the trade is not detrimental to the long-term survival of the species. In June 2001, CITES halted the caviar trade by Azerbaijan, Kazakhstan, Turkmenistan, and Russia. The four states established a long-term survey programme and CITES accepted the proposal for a 2002 Caspian-wide quota of some 142 tons of caviar from five sturgeon species. This is 9.6% below the 2001 quota levels. The export quota for Kazakhstan was 23,500 kg. A certain quota had ensured until 2005, however, CITES has permitted no quota for the four states because they have not submitted the necessary information to CITES.

Sturgeon catches in Kazakhstan dropped since the 1970's from 8 thousand ton to 0.4 thousand ton. Factors contributing to the decline include reduced river flow, the destruction of spawning sites, official corruption, poaching, and illicit trade. Sturgeon reserves suffer great losses due to illegal catches, particularly in the sea, which became quite common after disintegration of the single state.



Source: Kashagan Field Experimental Program Facilities Construction Project Book5 Vol.2

Figure 2.2.6 Dynamics of Beluga and Satellite Sturgeon in the North Caspian Sea

d) Fish Histopathology

Analysis of Caspian fish for hydrocarbons and heavy metal contamination has been carried out in the framework of baseline surveys and monitoring environmental status in the area of exploration drilling since 1996 (CSC, 1997, NCPT, 1998, OKIOC,1999, etc.). Similarly a number of academic studies have been carried out on accumulation of toxic substances in fish in the region (Anan et al., 2005[4]). While some of these studies speculate that the concentrations of toxic substances in fish are of critical level, it is still premature to draw conclusions, and further studies are needed.

6) Avifauna

There are 242 bird species known in the northeast Caspian region. Of these species, 51 species nest, 34 species winter and 157 species are encountered only during migration. These birds include rare species recorded in the Red Book of Kazakhstan, as well as a number of species of a wetland complex that are prey of amateur hunting.

More than 70 bird species migrate over 20-60 km across the open areas of the northeast Caspian, remote from the shore. The species in the shallow sea areas comprised 10 species including 4 species recorded in mass concentration on coquina islands. On the coast, the density is higher than the sea area, and up to 470 birds/km. The main direction of migration in this region is southwest where up to 88% of the total number of birds migrate.

On the coast and flooded islands, nesting of not more than 25 species is possible. Here, in the reed thickets on Shalygi, nesting of 4 species of ducks is possible (Gadwall, Garganey, Shoveler and Redcrested pochard), Marsh harrier coot, 3 species of terns (Whiskered, Common and Little terns), Cuckoo, 5 species of warbler, and in the coastal zone – 3 species of waders –Kentish, Black-winged stilt and Avocet. The density of bird nesting in this part of the northeast Caspian coast is not high both from data of route census and air surveys comprising, on average, up to 50 individuals per km^2. During migration (April-May and August-October), the number of migrants reaches 250 individuals/km in spring and up to 930 individuals/km in autumn.

[4] Anan, Y., et al., Trace element accumulation in fishes collected from coastal waters of the Caspian Sea, Marine Pollution Bulletin, 51:882-888, 2005.

In September-October 2000 the major proportion of the birds was concentrated in the corridor from the eastern extremity of the Ural River delta towards Emba River delta. The population of birds in other areas was 2-30 times smaller.

In coastal shallows the number of birds depends more upon feeding capability than on nesting possibilities. With the gradual increase in the depth and the flat sea bottom surface, nearly all the birds gather in the areas with depths from 10 to 35 cm. In Aktota and Kairan areas, which has 50 cm deep micro-depressions areas left flooded after the sea retreats, the greatest number of birds is observed in 2-3 km belt along the seashore.

During the observation period in August 2001, on the sites in the area of the Kairan and Aktota and Shalygi of the northeast Caspian coast, 29 wetland bird species were noted. Of rare birds, quite numerous are the greater flamingo (2,531) and White pelican (342 birds). Similar, both to baseline stations and Shalygi of the northeast Caspian coast, the Mute swans, Shelduck, Teals, Black-headed and Herring gulls and Waders were common during this period of the year.

The high numbers of birds during the period of seasonal migrations are primarily due to the fact that the fall migration routes of waterfowl and water-side birds from the vast territories of North Kazakhstan and West Siberia through the Caspian Sea and the spring routes from the Caspian-Iranian and Mediterranean-African wintering grounds to the nesting places pass through the study area.

Special attention should be paid to no less than 30 species of rare birds of the Red Book of Kazakhstan in the northeast Caspian region. Most of them are inhabitants of wetland grounds (white and Dalmatian pelicans, squacco and little egrets, Eurasian spoonbill, glossy ibis, greater flamingo, whooper swan, Bewick's swan, red-breasted goose, marbled teal, white-headed duck, Siberian white crane, purple gallinule, great black-headed gull, osprey and white-tailed sea eagle) that are sometimes observed on the marine oil pipeline segment of the Kashagan field during the period of migrations.

Eighty little egrets were observed at one station in 2000. In spring in the areas adjacent to the Ural River deltas and the Emba River delta, about 20-30 pelicans were recorded. In spring, a large number of rare birds can be seen at the areas adjacent to the Ural River delta (Figure 2.2.7).

Source: Kashagan Field Experimental Program Facilities Construction Project Book5 Vol.2

Figure 2.2.7 Nestling Places of rare Birds Species and Summer Concentration of Waterfowls on Moulting Places in the North Caspian Sea

7) Caspian Seal

The Caspian seal (*Phoca caspia*) is an endemic species and the only representative of mammals in the Caspian Sea fauna. This seal inhabits virtually the entire sea area, periodically appearing in the deltas of the Volga and Ural Rivers. Significant concentrations of seal during the autumn period are known on coquina islands in the northeast Caspian and on sand spits of the South Caspian. However, the greatest concentration of the Caspian seals is observed in the wintertime (January-March) on ice of the North Caspian during breeding and moulting.

The numbers of the Caspian seal population in the early 20th century was estimated at about 1 million heads. In the 1960s-1970s, it decreased to 520-560 thousands. Based on aerial photography surveys in the 1980s, the further decrease of the seal numbers in the North

Caspian was noted. In 1999, the total seal number was estimated at 415-435 thousand individuals.

The facts of the death of seals in Mangystau and Atyrau regions have been known from 1968. In 1968, more than 2000 individuals perished, in 1971, 200 were dead after wintering, in 1978, 207 after wintering, as well as 815 in autumn and in 1985, more than 100 in the wintertime.

In 1997, a mass death of seal (up to 6000 head) was recorded on the Apsheron Peninsula. A high level of DDT and the indications of distemper of carnivores were reportedly detected in the dead animals, however, without laboratory confirmation.

In April-August 2000, a mass death of the Caspian seal was recorded in the North Caspian and then in the western area of the Middle and the South Caspian. Dead seals were noted on islands, in the water area of the North Caspian, in the coastal band of Kazakhstan, the Russian Federation and Azerbaijan. During this period, the death of seals in the Kazakhstan part of the Caspian was about 11,000 individuals recorded in the official data.

In May 2006, mass deaths of the Caspian seal (337 head as of 2nd June) and sturgeon were recorded at Kalamkas. Many newspapers reported the incidence, however, the cause is not clear.

These deaths may be attributed to either chemicals or infection. Poisoning by hydrogen sulphide (H_2S) from wells in the northeast Caspian or the Tengiz area is a possibility of the first type. Hydrogen sulphide is highly toxic gas and can cause an impact upon any organism nearby, if the concentration of H_2S is high. Hence, H_2S poisoning should affect not only seals but also other animals. It is true that a significant number of dead fish is often found, including sturgeon. However, the number of dead birds is often insignificant. Bacteria and viruses are also considered a probable cause of seal deaths, however, there has been no evidence to explain the cause of the mass death of Caspian seal. Further studies are needed to elucidate the cause of these mass deaths.

(7) Protected areas

1) National Protected Areas

Kazakhstan adapted “Law on Specially Protected Natural Territories” in 1997, and areas that have special environmental, scientific, and/or cultural value have been designated as protected areas, and economic activities are restricted. The total area of the Specially Protected Natural Territories is 2,892,600 ha in 2004.

The Specially Protected Natural Territories are categorized to the following main types:

- State wildlife areas
- State natural game reserves
- State national park
- State nature monuments

Novinsky (Atyrau) and Aktau-Buzachinsky (Mangistau) are state natural game reserves on the northeast Caspian Sea coast. The main wildlife that inhabits these reserves is as follows:

Table 2.2.6 Main Wildlife that Characterize State Natural Game Reserves

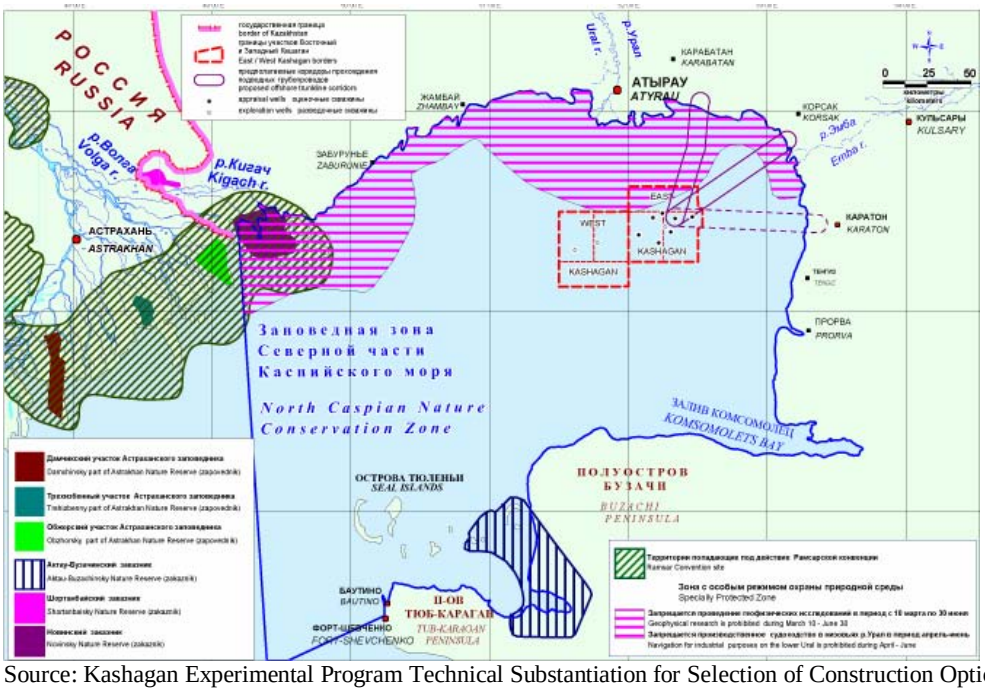
Name of Reserve	Main Wildlife
Novinskii	The Russian desman, Beaver, Brandt's hedgehog, Eastern white and dalmatian pelicans, Flamingo, Whooper swan, Little egret
Aktau-Buzachin	The ustirt moufflon, Persian gazelle, Brandt's hedgehog, Caracal, Pallas's cat, Caspian seal, Flamingo, Whooper swan, Eastern white and dalmatian pelicans

Source: Objects of Ecological Tourism of Kazakhstan, 2001

In addition, the area from Volga to Ural River delta of the North Caspian Sea coast is known at a world level for its rich natural conditions. The area has a specific significance as a breeding ground for birds and other animals, and as specially protected zones the following activities are prohibited:

- Geophysical research is prohibited during March 10 – June 30
- Navigation for industrial purposes on the lower Ural is prohibited during April - June

The locations of these territories within the Northeast Caspian region are shown in Figure 2.2.8. Currently UNDP is implementing a project to establish a nature reserve in the Ural delta region (see section on international environmental cooperation). A project to establish a new sanctuary "Ak-Zhaiyk" was approved in May 2007.



Source: Kashagan Experimental Program Technical Substantiation for Selection of Construction Options Volume 4 Preliminary Environmental Impact Assessment, 2002

Figure 2.2.8 Specially Protected Natural Territories in the Northeast Caspian Region

2) Wetland of International Importance

The Volga delta has been listed as a Ramsar site in the 1970s. However, the status of this wetland became unclear after the collapse of the USSR. By Resolution of the Government of Russian Federation of 1994 No.1050, Russia re-designated the Russian territory of the wetland in the lower Volga River delta as a Ramsar site known as "Volga Delta" wetlands. Kazakhstan follows the

Figure 2.2.9 Migratory Birds in Northeast Caspian Coast

same management principles as this international document. In 2005, Kazakhstan ratified the Ramsar Convention and is preparing the national action plan at present. Kourgaldzhinand Tengiz Lake has been listed as a Ramsar site by the former USSR. However, it is recommended that the Ural River delta and contiguous Caspian coast be listed as Ramsar sites.

2.2.2 Coastal Area

(1) Water quality of Ural River

According to the water quality survey conducted by KAZHYDROMET in 2005, the average values of water quality parameters were as follows:

pH was 7.87, dissolved oxygen (DO) was 8.12 mg/L, and BOD_5 was 5.0 mg O_2/L, sulphate was 114 mg/L, salinity was 120.34 mg/L, magnesium was 33.83 mg/L, sodium+potassium was 104.1 mg/L, nitrate was 0.87 mg/L, nitrite was 0.01 mg/L, phenolic compounds were 0.000865 mg/L, and oil products were 0.053 mg/L. The oil products value is slightly higher than the MPC.

As for the heavy metals, concentrations of iron, nickel and hexavalent chromium were above the MPCs, although with the exception of iron, the values were not particularly high compared with the MPCs. The concentrations of mercury, copper, manganese, arsenic, zinc, cadmium and lead were below the MPC.

(2) Air Pollution

Air pollution sources in the northeast Caspian Sea are mainly oil and gas production enterprises, and energy enterprises. The following tables summarize pollutant emissions in Atyrau.

Table 2.2.7 Pollutants Emissions in 2004 and 2005

Unit : thousand ton

Category	2004	2005	Validation
Stationary sources	93	91	-2
Mobile sources	26.8	27	0.2

Source : Environmental Condition in Atyrau, 2005

Table 2.2.8 Pollutants Emissions from Major Enterprises in 2005

Unit : ton

Enterprises	Pollutants					
	SO_2	NO_2	CH_4	CO	H_2S	Others
Tengizchevroil	15,635	6,012	15,616	16,314	41	74
Atyrau Power Plant	73	1,473	5	1,035	-	0
Embamumaigas	1,389	680	3,865	2,596	2	17
Atyrau Oil Pipeline	0	146	1,205	83	0	0
Atyrau Refinery	3,549	193	1,084	648	0	1
Agip KCO	101	598	218	494	-	9

Source : Environmental Condition in Atyrau, 2005

Table 2.2.9 Pollutants Emissions from Transport in 2005

Unit : ton

Pollutants	SO_2	NO_2	CH_4	CO	Aldehyde	Benzo-pyrene	PM	Pb (compound)	Others
Emission	565	6,144	4,232	16,006	190	0	510	0	0

Source : Environmental Condition in Atyrau, 2005

To assess air pollution levels in Kazakhstan, an indicator known as "Atmospheric Pollution Index" (API)[5], which is calculated from the concentrations of priority pollutants (PM, SO_2, CO, NO_2, H_2S), is often used. According to the observed data during the period from 1990 through 2002 in Atyrau, the API decreased from 3.3-4.6 in 1990-1991 to 2.5-1.8 in 2000-2002 indicating the air quality is getting better. The results are the lowest values for API in Kazkhstan cities where air quality monitoring is conducted.

According to the air quality survey conducted by KAZHYDROMET in 2005, the average values of air pollutants in Atyrau are as shown in Table 2.2.10.

Table 2.2.10 Air Quality Survey Result in 2005

Unit : mg/m^3

Parameter	PM	SO_2	CO	NO_2	H_2S	Ammonia
MPC (24 hours ave.)	0.15	0.05	3	0.04	-	0.04
MPC (20 minutes max)	0.5	0.5	5	0.85	0.008	0.2
Average concentration	0.162	0.0043	0.91	0.02	0.006	0.0088
Maximum concentration	0.8	0.009	3	0.07	0.004	0.03

Note : PM means particulate matter analyzed by RD 52.04.186-89
Source : KAZHYDROMET

Both average and maximum values were below the MPCs except for PM (Particulate Matter), although the exceeding level of PM was slight.

(3) Soil Condition

A brief overview of the soil distribution over the study area reveals that young, slightly differentiated soils of the modern marine plain predominate in the area. Fully developed soils are typical only of the northern territory and the Mangyshlak plateau. All soils are distinguished by thin humic horizon, low content of nutrients, and a high salinization degree. Soils are characterized by a high carbonate content and alkalinity as well as by a non-uniform grain-size composition.

In addition, there are several points in which soil is black near the east coast of northeast Caspian Sea according to the satellite image in 2002. These soils may be polluted by spilled oil.

(4) Ecosystem

1) Land Ecology

a) Vegetation

The specific features of the territory are low diversity and peculiar structure of vegetation cover. Arid climate, salinization of soils, saline groundwater close to the surface, accumulation of salt on the surface, and redistribution of salts in soils resulted in predominant development of halophytic vegetation.

Overall, 957 vascular plant species assigned to 371 genera and 88 families are recorded throughout the Atyrau region, of which 357 of them occur in the coastal zone. Most abundant species are the families Chenopodiaceae - 42 species, Asteraceae – 15 species, and Poaceae – 13 species. Other families (Plumbagenaceae, Boragenaceae, Cyperaceae, Caryophyllaceae,

[5] API is the air pollution index in Kazakhstan, which has been utilized since the former Soviet Union period. Average concentration of five parameters (PM, SO2, CO, NO2, and NH4) are devided by MPCs and multiplied by coefficients respectively. API is shown by the sum of five calculated values. The situation where the API is estimated to be more than 5 is considered to have a significant pollution level.

Umbeliferae, Tamaricaceae, ephedraceae, Levuminosae, Liliaceae, Amaranthaceae, orobanchthaceae, Zygophyllaceae) are represented by 1-3 species.

Around inhabited localities, developed oil fields and other economic areas, the natural vegetative cover is strongly transformed. One might expect the formation of secondary weed communities here, similar to the surrounding areas. On sands, there are the communities of Peganum harmala and Ceratocarpus, on zonal brown soils, of *Alhagi pseudalhagi* (Camel's-thorn) and Ceratocarpus, and on saline soils, of annual weed saltworts. Recovery of natural communities is impossible without special phytomeliorative measures, since the territories have lost their ecological and resource potential.

b) Invertebrates

Over 2,000 insect species were recorded in the region: Odonata (12), Phasmoptera (1), Mantoptera (3), Orthoptera (about 100), homoptera (about 400), Heteroptera (about 300), Coleoptera (about 600), Lepidoptera (about 300), Hymenoptera (about 200), and Diptera (about 150). Beetles are most abundant among the insects: Carabidae, Staphylinidae, Scarabaeidae, Cerambycidae, Buprestidae, Coccinellidae, Chrysomelidae, Curculionidae, Tenebrionidae and other families. There is no information on other orders of insects inhabiting deserts, semi-deserts and intrazonal biotopes of the Caspian area.

c) Amphibians and Reptiles

Fauna of amphibians and reptiles in deserts of the northeast Caspian area is relatively poor, which is due to environmental conditions. Strong salinization of soils, a large network of saline soils with depauperate vegetation, markedly continental climate, and levelled relief intensify the severity of the climate, particularly during wintering in winters with little snow.

Amphibians in the area are represented only by 2 species, green toad and marsh frog. The ability of the green toad to endure significant air dryness, night mode of living and use of temporary brackish water bodies for egg-laying allow it to populate territories that are remote from constant water bodies. Marsh frog is rather numerous in the Emba and Ural floodplains.

Reptiles are represented with 16 species (32.7% of total composition of herpetofauna of Kazakhstan). The basis of reptile fauna is made up of the desert assemblage, 10 species. Other species have an extensive occurrence. Such diversity of reptile fauna is due to several reasons, primarily, Caspian Sea level fluctuations and specific features of ecosystem development on plain coastal territories.

The rarest snake species, *Elaphe quatuerlineata*, listed in the Red Book of the Kazakhstan is recorded within the area. *Elaphe quatuerlineata* is a rare species with decreasing numbers; it dwells in different landscapes, sometimes in construction sites. It is recorded from April to September, its numbers are very low except for sandy masses in the Emba floodplain, where up to 2 individuals per 1 hectare were recorded.

d) Avifauna

Avifauna of desert landscape is relatively limited and represented only by 200 species. However, due to the complicated wetland conditions, the qualitative and quantitative composition of avifauna is much richer than in typical desert areas.

Generally, the area can be subdivided into three main habitats of animals; Caspian coast, floodplains of rivers and coastal salt plain. Among these, the Caspian coast and Emba and Ural floodplains are most densely populated. Here, the highest diversity of the animal species is also recorded.

The most valuable habitat of birds is the Ural River floodplain (including delta), where over 250 bird species are recorded, among which 70 species are nesting. Over 50 bird species are

nesting in the Ural River floodplain, most characteristic and background among them being penduline tit, tree sparrow, redstart, lesser whitethroat, hooded crow, magpie, rook, starling, golden oriole, red-headed bunting, grey shrike and others.

In the Emba floodbpain, 146 bird species are recorded; about 60 of them are nesting. 17 species dwell in shrub and reed growths. 25 species dwell in areas of nearbed tall grasses. On steep slopes, 11 species are nesting.

Special emphasis should be placed on rare and threatened birds listed in the Red Book of Kazakhstan. At least 30 species occur on the sea area of the Kashagan's oil pileline route and in Kairan and Aktota fields area (see Section 2.2.1). Species diversity of birds associated with desert and steppe landscapes is slightly lower. From this group of birds, only steppe eagle, black-bellied sand grouse, Pallas sand grouse and eagle owl are nesting on land areas, whereas other species are recorded in small numbers during the period of flying in April and September - October.

e) Mammals

Mammal fauna on the northeast coast of the Caspian Sea is represented by 49 species (27.5% of total composition of mammals of Kazakhstan) among which 2 species (*Eptesicus bobrinskoi* and marbled polecat) are categorized as rare and disappearing species in the Red Book of Kazakhstan. In quantitative terms, the group of rodents is most broadly represented (23 species), among which 8 species are carriers of dangerous infections for man and domestic animals.

The most diverse species composition and the numbers of animals are noted at the Caspian coast (in the marine oil pipeline area) and in the Emba and Ural floodplains. However, unsuitable habitat passes along the solonchak maritime plain, which is subjected to periodic flooding during surge phenomena due to transgression of the Caspian Sea where the numbers of many groups of animals (except for the wetland complex birds) are very low. In this territory, reptiles and small mammals have to settle on the elevated segments (road embankments, dams, quarry dumps and oil pipeline embankment) and more frequently in transformed habitats.

2) Ecological Sensitivity

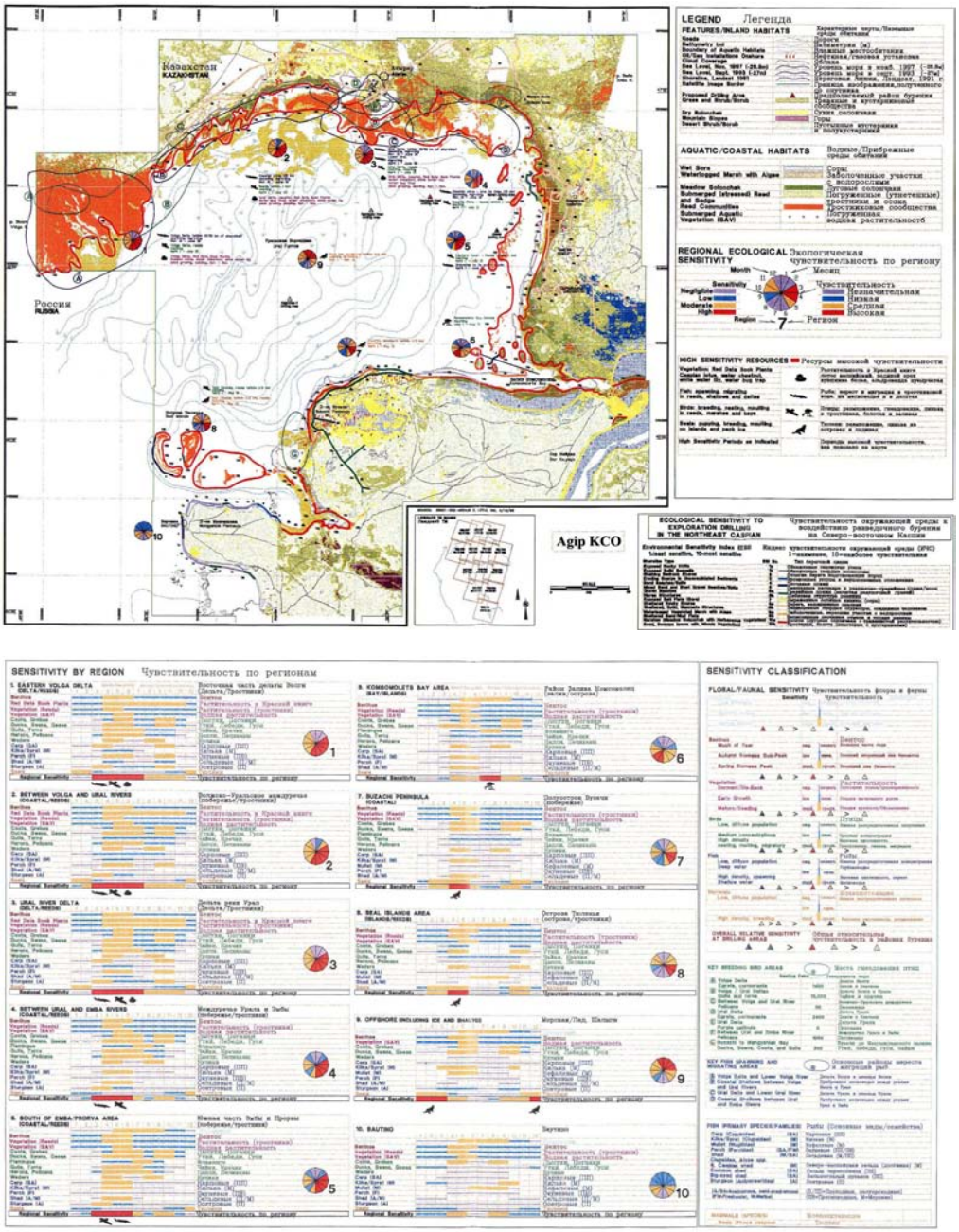
The northeast Caspian Sea is an important habitat for Caspian seal and sturgeons, and also the seasonal migration route of various species of fish. Furthermore the coast is the nesting and resting areas of migratory birds. For these reasons, the northeast Caspian region is environmentally a highly-sensitive area among the Caspian Sea areas.

Environmental sensitivity is reflected by the distribution of the animals and plants mentioned above, distribution of ecologically unstable areas like wetlands, distribution of environmentally polluted areas, etc. Such information may be integrated into an environmental sensitivity index map, which shows information such as coastal area, biological resources and social facilities that may be greatly influenced by oil pollution. The map provides information for quickly examining areas prone to significant environmental damage by an oil spill event, so that one can be prepared for such event, and contain the damage before it spreads out.

There have been a number of attempts to produce an ecological sensitivity map of the area. For example, CEP has carried out a number of technical studies on environmental sensitivity in the area (Caspian National Thematic Center on Emergency Response, 2001[6]; Mitrofanov,

[6] Caspian National Thematic Center on Emergency Response, 2001, Report on acquisition of information related to sensitive points as part of national and regional Action Plan on Oil Spill Response, GEF-UNDP.

2001[7]). Based on these studies, Forestry, Fishing and Hunting Committee of the Ministry MoA has established a working group and is going to implement a detailed study. Agip KCO (Agip KCO, 2002[8]) has developed an environmental sensitivity index map of the Northeast Caspian Sea in the EIA study of the Kashagan oil development project (Figure 2.2.10).



Source: Kashagan Experimental Program Technical Substantiation for Selection of Construction Options Volume 4 Preliminary Environmental Impact Assessment, 2002

Figure 2.2.10 Ecological Sensitivity in the Northern Caspian Region

[7] Mitrofanov, I. V., 2001, Review and Evaluation of Impact on fauna of invertebrates, fish, birds and marine mammals of Kazakhstan Part of the Caspian Sea by Heavy Metals, Pesticides and Hydrocarbons, Caspian Environment Programme.

[8] Agip KCO, 2002, Kashagan Experimental Program Technical Substantiation for Selection of Construction Options Volume 4 Preliminary Environmental Impact Assessment.

(5) Public Health Problem

The most frequently registered diseases are respiratory diseases, infections diseases and cutaneous diseases. The incidence of tuberculosis in Atyrau is twice the Kazakhstan average. The main reason is poor living conditions. Atyrau and Mangistau have been the areas with the highest incidence of tuberculosis. In 1996 Atyrau was the number one area in Kazakhstan as far as the rate of tuberculosis cases is concerned. Mangistau oblast was the fifth. The tendency for uncontrolled growth of tuberculosis incidence is due to the drop in the population covered by preventive examinations, especially in the rural areas.

Growth of tuberculosis is the scourge of the area. The threat becomes even greater with the significant inflow of workforce to the unfavourable areas upon commencement of large-scale oil production operations.

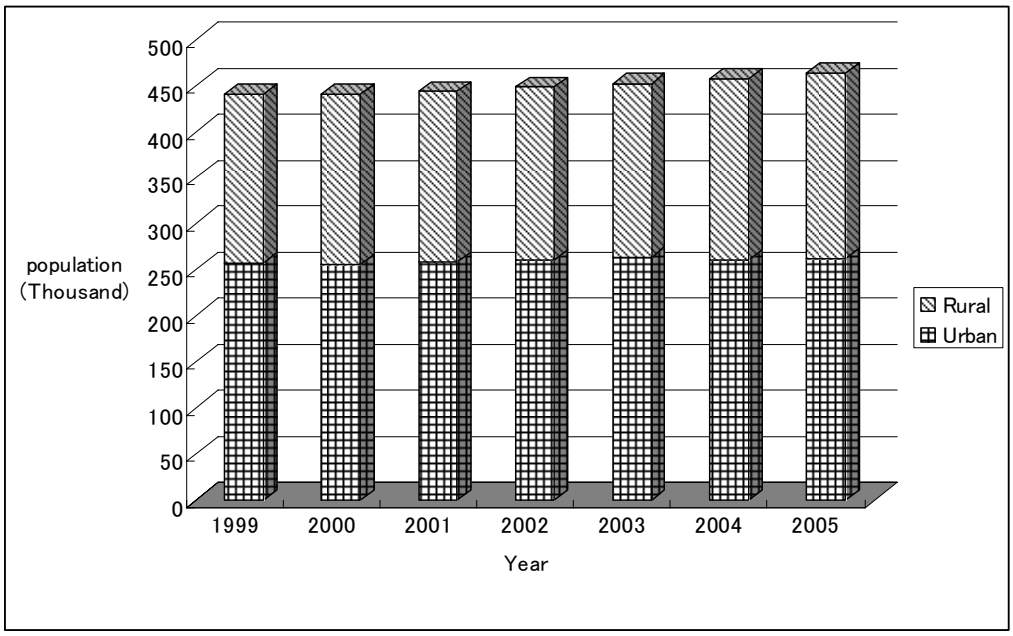
2.3 Socio-Economy

2.3.1 Population

The total population of Atyrau oblast on January 1, 2005 was 463.5 thousand people, and the average population density of the Atyrau oblast is 3.9 persons per km2. The population of Atyrau city on January 1, 2005 was 198.5 thousand people, which was 42.8% of the total population of the oblast.

The total population of Mangistau oblast on January 1, 2000 was 317.1 thousand people, and the average population density is considered the lowest in Kazakhstan, 1.9 persons per km2. Population of Aktau city on January 1, 2000 was 157.3 thousand people, which was 49.4% of the total population of the oblast.

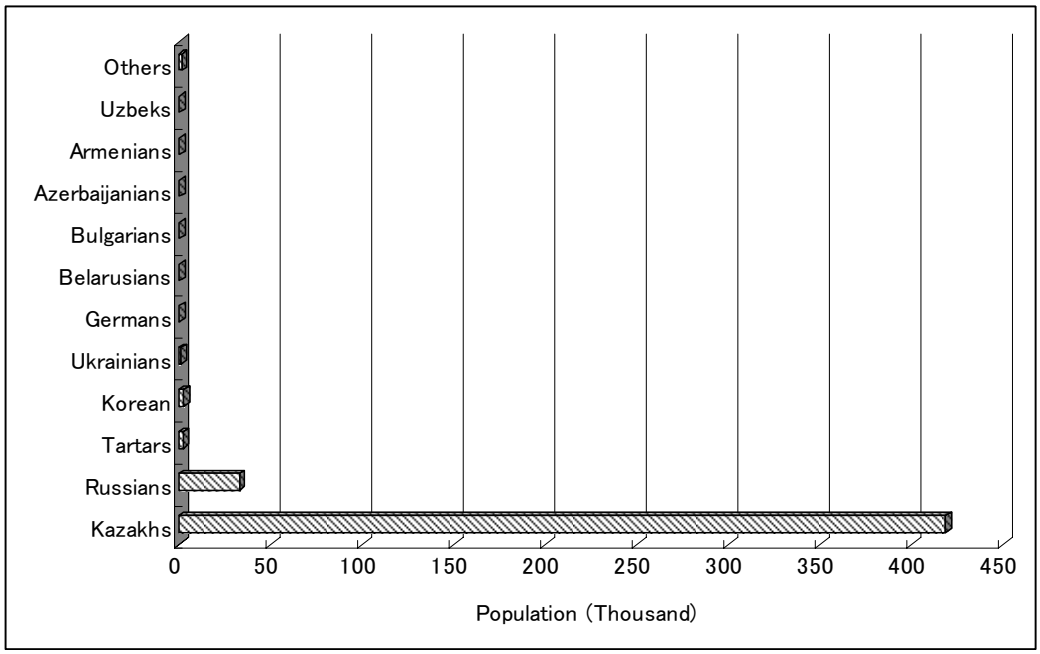
The recent population trend in Atyrau is shown in Figure 2.3.1. The population is gradually increasing in the rural area.



Source: Demographic Annual Report of Atyrau Oblast 2005

Figure 2.3.1 Trend of Population in Atyrau

The ethnic composition of population of Atyrau is diverse (Figure 2.3.2). However, the rate of Kazakhs is dominant, at 90.6%.

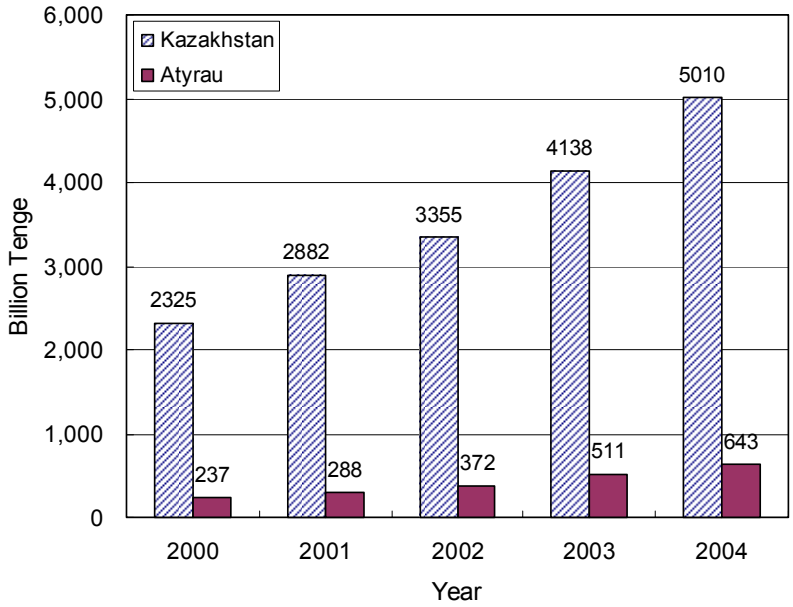


Source: Demographic Annual Report of Atyrau Oblast 2005

Figure 2.3.2 Ethnic Composition of Population in Atyrau

2.3.2 Economy

Gross Domestic Product (GDP) of Kazakhstan and Gross Regional Domestic Product (GRDP) of Atyrau are shown in Figure 2.3.3. They have increased more than twice over the last 5 years. Especially GRDP of Atyrau has increased almost three times. GDP and GRDP per capita are KZT 333,700 for Kazakhstan and KZT 1,396,300 for Atyrau respectively in 2004.



Source: Finances of Atyrau Oblast 2000-2004

Figure 2.3.3 Change of GDP-GRDP from 2000 to 2004

In 2000 the average monthly salary per employee was KZT 32,490 in Atyrau and KZT 32,097 in Mangistau. The average monthly salary in Atyrau and Mangistau is more than two times higher than Kazakhstan's average monthly salary rate, leading other oblasts in Kazakhstan.

The higher salary in Atyrau and Mangistau oblasts is mainly due to the high salary of employees engaged in oil and gas production and banking. The average monthly salary in rural area of Atyrau did not exceed KZT 4,100 and KZT 7,300 in Mangistau.

In December 2000, the number of population working for wage totalled 98.7 thousand people in Atyrau and 85.8 thousand people in Mangistau. Industries employ the higher proportion of workforce in both oblasts. 50% of total industrial employees in Atyrau and 55% in Mangistau are engaged in gas-and-oil producing industry. Only 3.7% and 2.6% of total employees in Atyrau and Mangystau are engaged in agriculture, 9.7% and 4.6% in construction, 12% and 11.2% in transport and communication sectors, 4.1% and 0.6% in fishing industry and pisciculture, 15.1% and 9.8% in education.

2.3.3 Public Administration

(1) Ministries

Republic of Kazakhstan is a democratic country with a presidential system. There are the following administrative agencies in Kazakhstan:

- Government of Republic of Kazakhstan,
- Ministry of Agriculture,
- Ministry of Culture, Information and Sports,
- Ministry of Defence,
- Ministry of Economy and budget Planning,
- Ministry of Education and Science,
- Ministry of Emergency Situations,
- Ministry of Energy and Mineral Resources,
- Ministry of Environmental Protection,
- Ministry of Finance,
- Ministry of Foreign Affairs,
- Ministry of Internal Affairs,
- Ministry of Justice,
- Ministry of Labour and Social Security,
- Ministry of Public Health,
- Ministry of Transport and Communication,
- National Bank of Kazakhstan,
- Chamber of Commerce and Industry, and
- Agency of Statistics of the Republic of Kazakhstan.

Among the above agencies, the Ministry of Environmental Protection (MoEP) is the main counterpart organization for this study.

(2) Local Administration

Kazakhstan is divided into 14 oblasts. Each oblast has an oblast government and is headed by an Akim (provincial governor) appointed by the president. Five deputy Akims are appointed under the Akim in Atyrau, and they take charge of different portfolios, such as economy, agriculture, environment, resident life, and education, respectively. Each deputy Akim has a

managing organization that is constituted by a department with sections and offices. The department of use and control of environmental resources takes charge of environmental problems, and collection of environmental charges from enterprises, environmental monitoring, etc..

2.3.4 Development Plan

In 1998 the government of Kazakhstan approved the Strategy of Kazakhstan Development till 2030. The strategy formulated the goals to be achieved by the end of the first third of the 21 century. On August 15, 2003 the president of Kazakhstan accepted the decree "On further measures on implementation of the Strategy of Kazakhstan Development till 2030". The main objective of the program is to improve living standards in all regions of the country on the basis of socio-political stability, sustainable socio-economic development, strengthening economic and environmental safety, reduction of system risks and development of international cooperation.

2.3.5 Environmental Management

Subject to the Decree of the President of the Republic of Kazakhstan of 29 August 2002, the Ministry of Natural Resources and Environmental Protection transferred its functions on natural resources management to other ministries, and MoEP was created. The strategic objectives of the MoEP (http://www.nature.kz) are:

- To reduce the deficit of water resources and increase the level of water supply;
- To improve the existing legislation and develop international cooperation;
- To optimize the system of nature use and environmental protection;
- To increase the level of waste use;
- To secure environmental awareness.

The organization charts of the MoEP are given in Chapter 4. The functions required of MoEP are:

- To prepare policies and enforce laws and international agreements for sustainable development;
- To set maximum allowable discharge to air, water and soil environment, and establish and enforce penalty system on illegal discharge of pollutants;
- To prepare budgetary plan for sustainable development and pollution control;
- To execute environmental control activities such as reviewing of EIA reports prepared by natural resources users, issue of the permission for usage of natural resources, preparation and enforcement of legislation for pollution control;
- To formulate Unified State Monitoring system for Environment and Natural Resources (USMS ENR);
- To promote environmental awareness activity.

There is the branch office of MoEP in Atyrau, Atyrau region territorial department (Atyrau MoEP), and the environmental inspections of enterprises are implemented. There is also the branch office of KAZHYDROMET, which is the organization within the MoEP that carries out environmental monitoring of water, air, soil and bottom sediment.

The strategic plan pays special attention to the environmental protection and preservation of natural resources. In December 2003, "the concept of the environment safety of Kazakhstan for 2004-2015" was issued as a middle-term strategy. On this basic philosophy, oil resource

development was positioned as a potential threat against environmental security, and requiring the following measures for environmental protection:

- Environmental standard that should be applied for the Caspian Sea
- Estimate the level of oil production activity that does not significantly affect the ecosystem of the Caspian Sea
- Measures for controlling oil spills from abandoned oil wells
- Control of flaring of oil associated gas
- Control of unapproved burying of oil pipes contaminated with radioactive materials

Moreover, the MoEP decided upon the "National Action Programme on Enhancement of the Environment of the Caspian Sea 2003-2012" in 2003 as the framework for a Caspian Sea environmental program. This action program indicates the status of the environment of the Caspian Sea coast and the present data analysis about society, the directivity of program implementation, the source of revenue, and the outcomes expected. Because the Framework Convention for the Protection of the Marine Environment of the Caspian Sea has entered into force in 2006, it is required that this action programme is officially approved by the Kazakh government in order to develop and reinforce environmental management activities in the Northern Caspian Sea.

Atyrau oblast has established "Program for Environmental Protection and Improvement of Environmental Situation in Atyrau Oblast, 2006-2008". This program has been approved by Akim and the assembly. However, it has not been approved by the MoEP, as of June 2006.