DRAINAGE BASIN OF THE CASPIAN SEA

This chapter deals with major transboundary rivers discharging into the Caspian Sea and their major transboundary tributaries. It also includes lakes located within the basin of the Caspian Sea.

TRANSBOUNDARY WATERS IN THE BASIN OF THE CASPIAN SEA[1]

Basin/sub-basin(s)	Total area (km²)	Recipient	Riparian countries	Lakes in the basin
Ural	231,000	Caspian Sea	KZ, RU	…
- Ilek	…	Ural	KZ, RU	…
Atrek	27,300	Caspian Sea	IR, TM	…
Astara Chay	*242*	*Caspian Sea*	*AZ, IR*	…
Kura	188,000	Caspian Sea	AM, AZ, GE, IR, TR	Lake Jandari, *Lake Kartsakhi, Araks Arpachay Baraji reservoir, Araks Govsaghynyn reservoir*
- Iori	5,255	Kura	AZ, GE	
- Alazani	11,455	Kura	AZ, GE	
- Debet	4,100	Kura	AM, GE	
- Agstev	2,500	Kura	AM, GE	
- Potskhovi	1,840	Kura	GE, TR	
- Ktsia-Khrami	8,340	Kura	AM, GE	
- Araks	102,000	Kura	AM, AZ, IR, TR	
-- Akhuryan	9,700	Araks	AM, TR	
-- Arpa	2,630	Araks	AM, AZ	
-- Vorotan (Bargushad)	5,650	Araks	AM, AZ	
-- Voghji	1,175	Araks	AM, AZ	
-- *Kotur (Qotur)*	…	*Araks*	*IR, TR*	
Samur	7,330	Caspian Sea	AZ, RU	…
Sulak	15,200	Caspian Sea	GE, RU	…
- Andis-Koisu	4,810	Sulak	GE, RU	…
Terek	43,200	Caspian Sea	GE, RU	…
Malyi Uzen	13,200	Kamysh-Samarsk Lakes	KZ, RU	*Lakes of Kamysh-Samarsk*
Bolshoy Uzen	14,300	Kamysh-Samarsk Lakes	KZ, RU	

[1] The assessment of water bodies in italics was not included in the present publication.

URAL RIVER BASIN [1]

Hydrology

The Ural River, which forms part of the traditional boundary between Europe and Asia, rises in the South-eastern slopes of the Ural Mountains (Russian Federation). 72% of its total runoff is formed in the Russian part of the basin. There are remarkable water level and water discharge fluctuations throughout the year; the share of spring floods amounts to some 65-70%.

The total length of the river is 2,428 km, from which 1,082 km are in Kazakhstan. In the basin, there are some 240 lakes and one man-made multipurpose reservoir, the Iriklin reservoir, with a total storage capacity of 3,260 km^3 and a surface of 260 km^2.

Pressure factors

On the territory of the Russian Federation, major pollution sources are the industrial enterprises in Magnitogorsk and the Orenburg oblasts. In Kazakhstan, the cities of Uralsk and Atyrau discharge municipal wastewaters with nutrients and organic substances into the Ural River. Other pollution sources include surface water runoff, particularly during flood periods,

URAL RIVER

The Ural River basin is shared by the Russian Federation (upstream country) and Kazakhstan (downstream country).

Basin of the Ural River			
Area	**Country**	**Country's share**	
231,000 km^2	Russian Federation	83,200 km^2	36%
	Kazakhstan	147,800 km^2	64%

Source: Ministry of Environment Protection of Kazakhstan.[2]

Discharge characteristics of the Ural River downstream of the border with theRussian Federation	
Q_{av}	2.82 km^3/a
Q_{max}	7.82 km^3/a
Q_{min}	1.0 km^3/a

Source: Ministry of Environment Protection, Kazakhstan.

[1] Based on information provided by the Federal Water Agency, Russian Federation and the Ministry of Environment Protection, Kazakhstan.
[2] Other sources report a size of the basin ranging from 231,000 km^2 to 311,000 km^2.

carrying away pollutants from sewage infiltration fields, as well as seepage from sewage ponds. Surface runoff from the oil extraction sites on the Caspian coast (Tengiz, Prorva, Martyshi, Kalamkas, Karazhmbas) introduces oil products into the Ural river.

Transboundary impact

Phenols, heavy metals and oil products are the principal pollutants in the Ural basin.[3] Data from 1990 to 1999 show that on the Russian-Kazakhstan border (village of Yanvartsevo) the concentration of copper and phenol in the Ural River exceeded the maximum allowable concentration (MAC) by a factor of 10 to 12, whereas the concentrations for hexachlorane and lindan were 1 to 18 times higher than the allowable concentrations. For the same period of time, inputs of phosphorus and lindan from sources in Kazakhstan increased the pollution load by 13% and 30%, respectively, compared to the measurement at the Russian-Kazakhstan border.

Water pollution at the Russian-Kazakhstan border (village of Yanvartsevo)

Determinands and the corresponding MAC in mg/l		1990	1995	1999	2001	2002	2003	2004
Copper	0.001	0.012	0.0006	0.00	…	…	…	…
Zinc	0.01	0.037	0.004	…	0.021	…	…	…
Chromium	0.001	0.0016	0.002	0.00	…	…	…	…
Manganese	0.01	0.009	0.016	0.00	…	…	…	…
Oil products	0.05	0.039	0.071	0.0031	…	…	…	…
Phenols	0.001	0.001	0.001	0.00	0.001	0.002	0.002	0.001

Source: Ministry of Environment Protection, Kazakhstan.

Despite the negative impact of floods (see above), the diluting effects of huge spring floods temporarily decrease water pollution in the river itself and allow for some self-purification of the river system. These effects are particularly visible in the lower parts of the basin and in the delta (see the table below). Nevertheless, data from the second half of the 1990s show a general increase in the content of nitrogen compounds (by 3 times) and boron (by 7 times).

Water pollution index[4] at two stations in Kazakhstan

Measuring station	1994	1995	1996	…	2001	2002	2003	2004
Uralsk (KZ)	1.55	1.68	3.03	…	2.78	1.18	1.21	1.42
Atyrau (KZ)	0.96	1.04	1.01	…	…	…	…	…

Source: Ministry of Environment Protection, Kazakhstan.

Trends

As indicated by the water pollution index, an increase of the overall pollution in the 1990s seems to be followed by a slight decrease of pollution from 2000 onwards and the upgrading from water quality class 4 (polluted) to class 3 (moderately polluted). For individual substance, a trend cannot be detected, as the factor by which the maximum allowable concentration is exceeded considerably changes from year to year.

ILEK RIVER

The river Ilek, also shared by Kazakhstan and the Russian Federation, is a transboundary tributary to the Ural River. The Ilek carries boron and chromium into the Ural River, originating from the tailing ponds of former chemical plants via groundwater. The water-quality class of Ilek River varies between 4 (polluted) to 6 (very polluted).[5]

[3] Environmental Performance Review, Kazakhstan, UNECE, 2000.
[4] The water pollution index is defined on the basis of the ratios of measured values and the maximum allowable concentration of the water-quality determinands.
[5] Water Resources of Kazakhstan in the New Millennium, Water Resources Committee of the Republic of Kazakhstan, 2002.

ATREK RIVER BASIN[6]

Hydrology

The basin of the Atrek River, with a total area of 26,720 km², is shared by the Islamic Republic of Iran and Turkmenistan. The 530 km long river (635 km with its tributaries) rises in the Islamic Republic of Iran, forms for some length the border between the Islamic Republic of Iran and Turkmenistan, and ends up in the Caspian Sea. The Atrek carries high amounts of suspended solids, sometimes 14,000-35,000 mg/l.

The long-term mean annual discharge of the river in Turkmenistan is 100 million m³. Following a bilateral agreement between the riparian countries, the river's water resources are equally shared between the Islamic Republic of Iran and Turkmenistan.

Pressure factors

Irrigated agriculture is the predominant water user in the basin. Of the total area of fertile land in the basin, only 25% can be irrigated due to lacking water resources.

The return waters (surface runoff and groundwater flow) from the irrigated land heavily influence the river's water quality: its mineral salt content reaches 1,800 mg/l. According to the 2006 measurements in Turkmenistan, the oxygen content was "satisfactory" and COD with 20-30 mg O_2/l was "not high". The mean annual concentration of nitrogen compounds did not exceed the MAC values and their maximum values exceeded the MAC values only by a factor of 3. The maximum values for phenols, oil products and sulphates, however, exceeded the MAC values by a factor of 11, 12 and 10, respectively.

KURA RIVER BASIN[7]

[6] Based on information by the Ministry of Nature Protection of Turkmenistan.
[7] Based on information provided by the Ministry of Nature Protection of Armenia, the Ministry of Ecology and Natural Resources of Azerbaijan and the Ministry of Environment Protection and Natural Resources of Georgia.

KURA RIVER

Armenia, Azerbaijan, Georgia, the Islamic Republic of Iran and Turkey share the Kura basin, which has a total area of 188.000 km^2. The Russian Federation is usually not considered as a basin country, as its territory in the basin is far below 1% of the total basin area.

Basin of the Kura River [8]			
Area	**Country**	**Country's share**	
188,000 km^2	Armenia	29,743 km^2	15.8%
	Azerbaijan	57,831 km^2	30.7%
	Georgia	29,741 km^2	15.8%
	the Islamic Republic of Iran	…	…
	Turkey	…	…

Source: UNECE Environmental Performance Review (EPR) programme; Ministry of Nature Protection of Armenia, Ministry of Ecology and Natural Resources of Azerbaijan and Ministry of Environment Protection and Natural Resources of Georgia.

Hydrology

The Kura, takes off in Turkey on the east slope of the mount Kyzil-Gyadik at the height of 2742 m. The total length of the river is 1364 km (185 km in Turkey, 390 km in Georgia and 789 km in Azerbaijan). The basin includes the whole territory of Armenia, the eastern part of Georgia, some 80% of Azerbaijan as well as parts of Turkey and the Islamic Republic of Iran. In previous times, the Kura was even navigable up to Tbilisi (Georgia); after the construction of dams for hydropower generation, the river became much shallower.

Among the Kura tributaries, there are a number of major transboundary tributaries, including the rivers Araks, Iori, Alazani, Debet, Agstev, Potskhovi and Ktsia-Khrami. Major transboundary tributaries to the Araks River include the rivers Akhuryan, Agstev, Arpa, Kotur, Voghji and Vorotan.

Flash floods are frequent (see also the assessment of the first and second order tributaries below). Reservoir and dam construction also served flood regulation. On the Kura, the Mingechevir reservoir has improved the situation in this respect in the lowlands of the river. Downstream of the confluence of the Araks River, however, floods frequently occur due to a combination of increased water level in the Caspian Sea and sedimentation in the riverbed. Emergency work on the Kura dykes in 2003 mitigated the impact of flooding in the Salyan and Nefchala areas.

[8] There are some differences regarding the total area of the basin (ranging from 188,000 km^2 to 193,200 km^2) and the countries' shares. For example, the 2004 GIWA Regional Assessment 23 "Caspian Sea" gives the following figures: Total basin area 193,200 km^2 from which 18% in AM, 29% in AZ, 18% in GE, 21% in IR, 14% in TR and <<1% in RU). The figures used here are those reported by the countries under the UNECE Environmental Performance Review programme, supplemented by data from the Water Convention's pilot project on monitoring and assessment of transboundary waters, i.e. the TACIS Project "Joint River Management Programme", 2003. Data on Turkey and on the Islamic Republic of Iran were not gathered under this activity and is therefore not included in the table.

Discharge characteristics of the Kura at gauging stations in Georgia and Azerbaijan		
Khertvisi (Georgia, downstream of the border with Turkey): latitude: 41° 29′; longitude: 43°17′		
Q_{av}	33.0 m^3/s	1936-1990
Q_{max}	56.0 m^3/s	1936-1990
Q_{min}	18.0 m^3/s	1936-1990
$Q_{absolute\ max}$	742 m^3/s	18 April 1968
$Q_{absolute\ min}$	5.5 m^3/s	16 January 1941
Tbilisi city (Georgia): latitude: 41° 44′; longitude: 44° 47′		
Q_{av}	204.0 m^3/s	1936-1990
Q_{max}	325.0 m^3/s	1936-1990
Q_{min}	133.0 m^3/s	1936-1990
$Q_{absolute\ max}$	2450 m^3/s	19 April 1968
$Q_{absolute\ min}$	12 m^3/s	12 February 1961
Kyragkesaman (Azerbaijan, on the border with Georgia): latitude: 41° 00′; longitude: 46° 10′		
Q_{av}	270.0 m^3/s	1953-1958, 1986-2006
Q_{max}	4,460 m^3/s	1953-1958, 1986-2006
Q_{min}	188.0 m^3/s	1953-1958, 1986-2006
$Q_{absolute\ max}$	2,720.0 m^3/s	May 1968
$Q_{absolute\ min}$	47.0 m^3/s	August 2000
Saljany (Azerbaijan): latitude: 48° 59′; longitude: 39° 36′		
Q_{av}	446.0 m^3/s	1953-2006
Q_{max}	6,570 m^3/s	1953-2006
Q_{min}	269.0 m^3/s	1953-2006
$Q_{absolute\ max}$	2,350 m^3/s	11 May 1969
$Q_{absolute\ min}$	82 m^3/s	4 July 1971

Pressure factors

The Kura river system is organically and bacteriologically polluted by the discharge of poorly treated or untreated wastewater from the 11 million people[9] living in the catchment area. Wastewater discharges from households, not connected to sewage systems, into surface waters and groundwaters (particularly on the countryside) which also increases the potential of water-related diseases.

Due to the collapse of many industries in the early 1990s, industrial pollution has decreased considerably. A number of polluting activities, however, still exist, notably mining, metallurgical and chemical industries. The major pollutants are heavy metals (Cu, Zn, Cd) from mining and the leather industry, and ammonia and nitrates from the fertilizer industry. Up to now, concentrations of heavy metals exceed norms up to nine times, phenols up to six times and mineral oil, two to three times. The point source discharges from industries are very irregular (often during night-time) and difficult to detect due to the high speed in most of the rivers. In Georgia, pollution load estimates are therefore based on production figures, rather than measurements.

Irrigated agriculture is another source of pollution. In Azerbaijan alone, some 745,000 ha are used for this purpose, including 300,000 ha in the Azerbaijan part of the Araks sub-basin.

[9] Environmental Performance Review Azerbaijan, UNECE, 2004.

Manure and pesticides (including leakages from old stock of DDT or use of illegally produced or imported products) and viniculture are additional pollution sources. As roads are often close to the riverbanks, there is also a fair impact from oil products, residues and lead, mostly from badly functioning cars.

Deforestation in the upper part of the basin has led to poor soil protection with damaging mud slides as a result. Moreover, deforestation and overgrazing have led to erosion causing high turbidity of river water. The Araks River is claimed to be one of the most turbid in the world, and its high turbidity and pollution load increases the cost of drinking-water production in Azerbaijan.

Transboundary impact

On the territory of Georgia, industrial enterprises discharged in 2004: $9.945 \cdot 10^6$ kg surface active synthetic substances, $2 \cdot 10^3$ kg sulfate, $72 \cdot 10^3$ kg chloride, $46.839 \cdot 10^6$ kg ammonium-nitrogen, $23 \cdot 10^3$ kg nitrate, $159 \cdot 10^3$ kg iron, $37.005 \cdot 10^3$ kg total inorganic nitrogen, $600 \cdot 10^3$ kg BOD and 4,958 t suspended solids.[10] These data are calculated values based on production figures.

Following measurements by Azerbaijan, the maximum allowable concentration (MAC) for a number of substances are exceeded at the Georgian-Azerbaijan border (station Shikhli-2), for example, 8-12 times for phenols, 2-3 times for oil products, 8-14 times for metals, and 1-2 times for sulphates.

There are no significant pollution sources in the section from the Georgian-Azerbaijan border to the Mengechevir reservoir (Azerbaijan); due to self-purification capacity of the Kura, the concentration of polluting substances decreases in this section by 30-55%.

Trends

The Ministry of Environment of Georgia assesses the Kura river's ecological and chemical status (from its source in Turkey until the border between Georgia and Azerbaijan) as moderate. There are no major improvements in water quality to be expected over the next years. Spring floods will continue causing damage in parts of the basin.

IORI RIVER

Georgia (upstream country) and Azerbaijan (downstream country) share the catchment area of the Iori River, a left-hand side (northern) tributary to the Kura, as follows:

Sub-basin of the Iori River[11]			
Area	**Country**	**Country's share**	
5,255 km²	Georgia	4,645 km²	88,4 %
	Azerbaijan	610 km²	11,6 %

Source: Ministry of Environment Protection and Natural Resources of Georgia for the area in Georgia; Ministry of Ecology and Natural Resources of Azerbaijan for the area in Azerbaijan.

Hydrology

The Iori River takes off on the southern slope of the Main Caucasian Range at the height of 2600 m, flows from Georgia to Azerbaijan and falls into the Mingechevir reservoir. The river has a length of 320 km (313 km in Georgia and 7 km in Azerbaijan). In Georgia, the river system is made up of 509 smaller rivers with an overall length of 1,777 km. The density of river network is 0.38 km/km².

The hydrological regime of the river is characterized by spring floods, summer/autumn high waters and steady low-water levels in winter. The increase of water levels in the period of spring floods caused by melting of snow and rainfalls usually starts in March (in the second half of February in the lower reaches of the river) and reaches its maximum in May-June. The dropping of water levels continues till the end of July. The summer/autumn season floods, caused by intensive rainfalls, reoccur every year for 3-6 times a season with a duration of 2 to 10 days. By height, water levels often reach the maximums of spring

[10] These data are estimates, based on production figures and not on monitoring.
[11] Both countries gave a different size for the total area.

floods. In winter, variations of low-water levels do not exceed 0.1 m, and in some years the water level even stays on the same mark for 10-30 days.

In Georgia, there are three large irrigation reservoirs on the Iori River, the Sioni reservoir (325 million m³) used for irrigation, hydropower generation and water supply; the Tbilisi reservoir (308 million m³) used for irrigation and water supply; and the Dalimta reservoir (180 million m³) used for irrigation. The construction of the Sioni reservoir in the 1950's also served flow regulation.

Pressure factors

Diffuse pollution from agriculture (94,006 hectares are used for irrigated agriculture) and municipal wastewaters are the main anthropogenic pollution sources in Georgia. In Azerbaijan, 1,522 ha are used for irrigated agriculture.

Transboundary impact

On the territory of Georgia, the following substances were discharged in 2004 into the Iori River: surface active substances $5.85 \cdot 10^6$ kg, oil products 1,000 kg, BOD $111 \cdot 10^3$ kg and suspended solids 176 t. These data are calculated values, based on production figures. The Ministry of Environment of Georgia assesses the river's ecological and chemical status as "good".

Azerbaijan confirms that there is little human impact on the river. Downstream of the Georgian-Azerbaijan border, the maximum allowable concentration (MAC) for phenols and metals are exceeded by a factor of 2-3, the MAC values for oil products and sulphates are exceeded by a factor of two.

Trends

Georgia assesses that the river system's ecological and chemical status will remain in a good status.

ALAZANI RIVER

Georgia (upstream country) and Azerbaijan (downstream country) share the catchment area of the Alazani River. The total length of the river is 391 km (104 km in Georgia, 282 km common border between Georgia and Azerbaijan, 5 km in Azerbaijan).

Sub-basin of the Alazani River			
Area	**Country**	**Country's share**	
11,455 km²	Georgia	6,700 km²	58,5
	Azerbaijan	4,755 km²	41,5%

Source: Ministry of Environment Protection and Natural Resources of Georgia for the area in Georgia; Ministry of Ecology and Natural Resources of Azerbaijan for the area in Azerbaijan.

Hydrology

The Alazani River, the second largest river in Eastern Georgia, is formed at the junction of two mountain rivers, which flow from the southern slopes of the Main Caucasus Mountain Range. The river crosses an inter-mountainous depression, streams along the Georgian-Azerbaijan border and flows into Mingachevir reservoir in Azerbaijan. In Georgia, the river system is made up of 1,803 smaller rivers with an overall length of 6,851 km (1,701 rivers with a length below 10 km).

Spring floods caused by melting of seasonal snows and rainfalls usually starts in March in the upper reaches, and end of February in the lower reaches of the river. Typically, the maximum is achieved in May-June. Caused by rainfalls (from the beginning or middle of April), some sharp but usually low peaks are observed with a duration of 2 to 15 days. The dropping of floods continues till the end of July. At this time, usually 2-3 short rain peaks take place. The rainy days in summer/autumn reoccur typically 2-6 times per season with the duration of 2 to 20 days. They are especially intensive and prolonged in the lower reaches of the river. There, water levels often reach the maximum of spring floods, and in some years even surpass them.

The winter low-water level is nearly steady, the daily range of level fluctuations does not exceed 0.2 m, and in some winters, the same water level persists during 25-30 days.

In several winter seasons, sudden increase of level has occurred caused by rains and thaws.

Discharge characteristics at the Agrichai gauging station (Azerbaijan) latitude: 41° 16′; longitude: 46° 43′		
Q_{av}	110 m^3/s	1950–2006
Q_{max}	192 m^3/s	1950–2006
Q_{min}	69.5 m^3/s	1950–2006
$Q_{absolute\ max}$	742 m^3/s	27 August 1983
$Q_{absolute\ min}$	2.40 m^3/s	8 October 1988

Source: Ministry of Ecology and Natural Resources, Azerbaijan.

Pressure factors

Diffuse pollution from agriculture and viniculture as well as municipal wastewaters are the main anthropogenic pollution sources in Georgia.

Transboundary impact

On the territory of Georgia, the following substances were discharged from industries in 2004: oil products 2,000 kg, BOD $66{\cdot}10^3$ kg and suspended solids 216 t. These data are calculated values based on production figures. There are no data for agricultural and municipal pollution.

The Ministry of Environment of Georgia assesses the river's ecological and chemical status as "good".

Following measurements by Azerbaijan, the MAC values for phenols are exceeded 5-7 times, for metals 6-8 times, and for oil products 2-3 times.

Trends

Georgia assesses that the river system's ecological and chemical status will remain good.

DEBET RIVER

Armenia (upstream country) and Georgia (downstream country) share the catchment area of the Debet River, a right-hand side (southern) tributary to the Kura, as follows:

Sub-basin of the Debet River			
Area	**Country**	**Country's share**	
4,100 km^2	Armenia	3,790 km^2	92.4%
	Georgia	310 km^2	7.6%

Sources: Ministry of Environment Protection and Natural Resources of Georgia and L.A. Chilingarjan et al. "Geography of rivers and lakes in Armenia", Institute of hydro-technology and water problems, Armenia.

Hydrology

The Debet River rises at 2100 m above sea level and flows through a deep valley. From its total length of 176 km, 154 km are in Armenia. There are two reservoirs in the Armenian part of the catchment area, one on the river Dzoraget (0.27 million km^3), which is a (non-transboundary) tributary to the Debet, and the other on the river Tashir (5.4 million km^3), a non-transboundary tributary to the river Dzoraget. The lake percentage is 0.01%.

Discharge characteristics at gauging stations on the Debet River		
Discharge characteristics at the Sadaghlo gauging station at the Georgian-Armenian border		
Q_{av}	29.2 m^3/s	1936–1990
Q_{max}	48.5 m^3/s	1936–1990
Q_{min}	13.0 m^3/s	…
$Q_{absolute\ max}$	479 m^3/s	19 May 1959
$Q_{absolute\ min}$	1.56 m^3/s	12 July 1961
Discharge characteristics at the Airum gauging station (Armenia) upstream of the border with Georgia		
Q_{av}	38.1 m^3/s	Long-term average
Q_{max}	242 m^3/s	Long-term average
$Q_{absolute\ max}$	759 m^3/s	19 May 1959
Q_{min}	10.6 m^3/s	For 95% of time

Source: L.A. Chilingaryan et al. "Geography of rivers and lakes in Armenia", Institute of hydro-technology and water problems, Armenia.

Pressure factors

In the Armenian part of the sub-basin, the Debet experiences background pollution from hydrochemical processes in ore deposits, which leads to increased concentrations of heavy metals (V, Mn, Cu, Fe). These concentrations already exceed in the upper parts of the sub-basin the maximum allowable concentration (MAC)[12] values for aquatic life.

Wastewater from the ore enrichment and processing industry, wastewater from municipal sources (some 110 human settlements in the Armenian part), and diffuse pollution from agriculture (51% of the Armenian agriculture uses water from the sub-basin of the Debet) are the main anthropogenic pollution sources.

Transboundary impact

In the period 2004–2006, the average mineral content at the border between Armenia and Georgia was 392 mg/l and the maximum value was 438 mg/l.

Trends

In Armenia, the closure of the Vanadzorsk chemical factory (1989) and the installations of closed water systems in the Alaverdinsk copper melting factory (2005) and in the Achtalinsk ore processing factory (2006) considerably decreased water pollution.

However, natural background pollution, leakages from a tailing dam that stores wastes from the Achtalinsk factory, and pollution from agriculture will remain as pollution problems. Spring floods will continue causing damage in the lower part of the basin.

Currently, the chemical and ecological status of the water system is not satisfactory for the maintenance of aquatic life, but meets the requirements for municipal, agricultural, industrial and other uses.

[12] In Armenia, water classification is based on MAC values for maintenance of aquatic life, which have been used in former Soviet Union, and which are more stringent than the MAC values for other uses.

AGSTEV RIVER

Armenia (upstream country) and Azerbaijan (downstream country) share the sub-basin of the Agstev River.

Sub-basin of the Agstev River			
Area	**Country**	**Country's share**	
2,500 km^2	Armenia	1,730 km^2	69.2%
	Georgia	770 km^2	30.8%

Sources: Ministry of Environment Protection and Natural Resources of Georgia and L.A. Chilingarjan et al. "Geography of rivers and lakes in Armenia", Institute of hydro-technology and water problems, Armenia.

The Agstev River has its source at 3,000 m above sea level. Its total length is 121 km; 81 km of which are in Armenia. The river has two main transboundary tributaries: the 58 km long Getik River (586 km^2) and the 58 km long Voskepar River (510 km^2).

Discharge characteristics of the Agstev River at the Idshevan gauging station (Armenia) upstream of the border with Azerbaijan		
Q_{av}	9.07 m^3/s	Long-term average
Q_{max}	75.3 m^3/s	Long-term average
$Q_{absolute\ max}$	177 m^3/s	29 August 1990
Q_{min}	1.78 m^3/s	During 95% of the year

Source: L.A. Chilingaryan et al. "Geography of rivers and lakes in Armenia", Institute of hydro-technology and water problems, Armenia.

Pressure factors

The main anthropogenic pollution of the river on Armenian territory stems from household and municipal wastewaters. The high concentration of heavy metals (Fe, Cu, Mn) is mainly due to natural background pollution, which was proved through measurements in the upstream stretches of the river.

Transboundary impact

Following Armenian data, the concentration of heavy metals exceeds the MAC value by a factor of 2–6. Sulphates did never exceed these norms. From 2005 onwards, the measurements of oil products ceased temporarily for technical reasons. In the long run, the phenol concentrations never exceeded the MAC norm. Water pollution, exceeded MAC values for drinking water, was not observed. Unfortunately there were no joint measurements with Azerbaijan at the border section, thus it is difficult to explain differences in measurements by both countries. Following information by Azerbaijan, the maximum allowable concentrations are exceeded for phenols by a factor of 9, for metals by a factor of 5–8, for oil products by a factor of 3–4, and for sulphates by a factor of 2. In the period 2004–2006, the average mineral content at the border was 559 mg/l and the maximum 600 mg/l. Currently, the ecological and chemical status is satisfactory for aquatic life as well as municipal, industrial and other uses.

POTSKHOVI RIVER

Turkey (upstream country) and Georgia (downstream country) share the catchment area of the Potskhovi River, a left-hand side tributary to the Kura.

Sub-basin of the Potskhovi River			
Area	**Country**	**Country's share**	
1,840 km²	Turkey	509 km²	27.7%
	Georgia	1,331 km²	72.3%

Source: Ministry of Environment Protection and Natural Resources of Georgia.

Hydrology

The Potskhovi River originates in Turkey on the southern slope of the Arsiani range 1.2 km east of the mountain Arsian-dag at a height of 2720 m. The length of the river is 64 km, from which 35 km are in Georgia. In the Georgian part of the catchment area, there are 521 rivers with a total length of 1,198 km. Floods mostly occur in the middle or end of March and reach their maximum in April, sometimes in May; the average increase of water levels is in the order of 0.8-1.2 m. There are altogether 11 lakes with a total area of 0.14 km².

Pressure factors, transboundary impact and trends

Above 2000 m, there are alpine meadows utilized as pastures and hayfields. Below, there are mixed forests. Further downhill, the land is used by agriculture. Georgia assesses that the river system's chemical status is moderate.

Discharge characteristics at the gauging station "Skhvilisi" in Georgia (10 km upstream of the river mouth): latitude: 41° 38′; longitude: 42° 56′		
Q_{av}	21.3 m³/s	1936-1990
Q_{av}	13.6 m³/s	During 97% of the year
Q_{max}	31.7 m³/s	1936-1990
Q_{min}	11.7 m³/s	1936-1990
$Q_{absolute\ max}$	581 m³/s	18 April 1968
$Q_{absolute\ min}$	1.0 m³/s	13 August 1955

KTSIA-KHRAMI RIVER

Armenia, Azerbaijan and Georgia share the catchment area of the Ktsia-Khrami River, a right-hand side tributary to the Kura.

Sub-basin of the Ktsia-Khrami River			
Area	**Country**	**Country's share**	
8,340 km²	Armenia	3,790 km²	45.4%
	Georgia	4,470 km²	53.5%
	Azerbaijan	80 km²	1.1%

Source: Ministry of Environment Protection and Natural Resources of Georgia.

Hydrology

The Ktsia-Khrami River takes off from a spring on the southern slope of the Trialeti range 2.4 km eastwards from the mountain Karakaya at the height of 2,422 m, falls into the river Kura from the right bank at 820 km above the riverhead. The length of the river is 201 km. There are 2,234 rivers in the catchment area with a total length of 6,471 km.

The hydrological regime is characterized by one significant spring flood. In other periods of the year, the water level is mostly low occasionally disrupted by summer/autumn high waters.

Pressure factors, transboundary impact and trends

Pastures, meadows, forests and agriculture are the main form of land use. Given data from 1980-1993, NH_4, Cu and Zn exceeded the MAC. Georgia assesses that the river system's chemical status will remain in a moderate status.

Discharge characteristics at the transboundary gauging station "Red bridge": latitude: 41° 20′; longitude: 45° 06′		
Q_{av}	51.7 m^3/s	1928-1990
Q_{av}	32.5 m^3/s	During 99% of the year
Q_{max}	90.1 m^3/s	1928-1990
Q_{min}	29.3 m^3/s	1928-1990
$Q_{absolute\ max}$	1,260 m^3/s	16 May 1966
$Q_{absolute\ min}$	3.95 m^3/s	26 February 1961

ARAKS RIVER

Hydrology

Armenia, Azerbaijan, the Islamic Republic of Iran and Turkey share the sub-basin of the Araks River with a total area of 102,000 km^2.

The 1,072 km long Araks has its source at 2,200–2,700 m above sea level. The Araks crosses the Armenian border twice: at 364 km and 746 km from its source. In Armenia, the river flows for 192 km and drains an area of 22,560 km^2.

Sub-basin of the Araks River and average discharge for the last 30 year				
Country	Area		Discharge	
	In km^2	In %	In km^3	In %
All countries	102,000	100	9.37	100
Armenia	22,560	22	5.01	53.5
Turkey	19,500	19	2.46	26.2
The Islamic Republic of Iran	41,800	41	0.81	8.5
Azerbaijan	18,140	18	1.09	11.7

Source: L.A. Chilingaryan et al. "Geography of rivers and lakes in Armenia", Institute of hydro-technology and water problems, Armenia.

Pressure factors and transboundary impact

The Araks is of particular importance for Armenia, which is the reason for extensive measurements. Following Armenian data, the pollution originates from household waters and municipal wastewaters. The impact of natural hydrochemical processes, which are responsible for the increased concentration of heavy metals in the river water, has also been observed. The concentration of nitrite is 2–4 times above the MAC for aquatic life (MAC = 0.024 mg/l) and 3–6 times above the MAC for heavy metals; which is a general feature for Armenia. On the border between Turkey and Armenia, heavy metals exceed the MAC for aquatic life by a factor of 2–8. However, concentrations exceeding the MAC for drinking water and municipal uses have not been observed.

From 2005 onwards, the measurements of oil products ceased temporarily for technical reasons. In the long run, the phenol concentrations never exceeded the MAC norm; therefore, phenol measurements are not any more carried out.

At the Turkish-Armenian border, the average mineral content for the period 2004–2006 was 368 mg/l with a maximum at 678 mg/l. At the border between Armenia and the Islamic Republic of Iran, joint measurements of both countries showed an average mineral content of 673 mg/l with a maximum at 746 mg/l.

Currently, the ecological and chemical status is satisfactory for aquatic life, municipal and industrial uses, and other uses.

AKHURYAN RIVER

Armenia and Turkey share the sub-basin of the Akhuryan River, a tributary to the Araks.

Sub-basin of the Ahuryan River			
Area	**Country**	**Country's share**	
9,700 km²	Armenia	2,784 km²	28.7%
	Turkey	6,916 km²	71.3%

Source: L.A. Chilingarjan et al. "Geography of rivers and lakes in Armenia", Institute of hydro-technology and water problems, Armenia.

Hydrology

The 186 km long river has its source at 2,017 m above sea level; its most important tributary in Armenia is the Karkachun River. There are two reservoirs on the Akhuryan River, the Arpilich reservoir close to the river's source and the Achurnsk reservoir in the middle stretch.

Pressure factors and transboundary impact

Main pressure factors arise from municipal sources and agriculture as well as natural chemical processes.

According to Armenian measurements in the lower part of the sub-basin, the concentration of nitrites exceeds the MAC norms by a factor of 2–6; the concentration of heavy metals is 3–8 times higher than the corresponding MAC. For copper, the concentration exceeds the MAC value for aquatic life (0.001 mg/l) by a factor of 10–18 in the upper part and by a factor of 5–12 in the lower part. However, concentrations exceeding the MAC for drinking water and municipal uses have not been observed.

From 2005 onwards, the measurements of oil products ceased temporarily for technical reasons. In the long run, the phenol concentrations never exceeded the MAC norm; therefore, phenol measurements are not any more carried out.

The average mineral content at the border is 223 mg/l with a maximum at 285 mg/l (period 2004–2006).

Currently, the ecological and chemical status is "satisfactory".

ARPA RIVER

Armenia and Azerbaijan share the sub-basin of the Arpa River, a tributary to the Araks.

Sub-basin of the Arpa River			
Area	**Country**	**Country's share**	
2,630 km²	Armenia	2,080 km²	79%
	Azerbaijan	550 km²	21%

Source: L.A. Chilingarjan et al. "Geography of rivers and lakes in Armenia", Institute of hydro-technology and water problems, Armenia.

Hydrology

The total length of the river is 128 km of which 92 km are in Armenia. In the Armenian part, three rivers join the Arpa: the Elegis (47 km long; 526 km^2), the Gerger (28 km; 174 km^2) and the Darb (22 km; 164 km^2).

Discharge characteristics of the Arpa River at the Areni gauging station (Armenia) upstream of the border with Azerbaijan		
Q_{av}	23.2 m^3/s	Long-term average
Q_{max}	146 m^3/s	Long-term average
$Q_{absolute\ max}$	280 m^3/s	12 May 1960
Q_{min}	4.36 m^3/s	During 95% of the year

Source: L.A. Chilingaryan et al. "Geography of rivers and lakes in Armenia", Institute of hydro-technology and water problems, Armenia.

Pressure factors and transboundary impact

The river is very clean. There is almost no human impact; however, natural hydrochemical processes influence the quality of the river's water.

From source to mouth, the concentration of V and Cu is 2–3 times higher than the MAC norms for aquatic life, which is typical for Armenian rivers. The MAC values for other uses are not being exceeded.

The average mineral content on the border is 315 mg/l with a maximum of 439 mg/l (period 2004–2006).

Currently, the ecological and chemical status is "normal and close to natural conditions".

VOROTAN (BARGUSHAD) RIVER

Armenia and Azerbaijan share the sub-basin of the Vorotan River, a tributary to the Araks.

Sub-basin of the Vorotan River			
Area	**Country**	**Country's share**	
5,650 km^2	Armenia	2,030 km^2	36%
	Azerbaijan	3,620 km^2	64%

Source: L.A. Chilingarjan et al. "Geography of rivers and lakes in Armenia", Institute of hydro-technology and water problems, Armenia.

Hydrology

The total length of the river is 178 km. In the Armenian part, two rivers join the Vorotan: the Sisian (33 km long; 395 km^2) and the Gorisget (25 km; 146 km^2).

Discharge characteristics of the Vorotan River at the Vorotan gauging station (Armenia) upstream of the border with Azerbaijan		
Q_{av}	21.8 m^3/s	Long-term average
Q_{max}	101 m^3/s	Long-term average
$Q_{absolute\ max}$	1,140 m^3/s	18 April 1959
Q_{min}	2.82 m^3/s	During 95% of the year

Source: L.A. Chilingaryan et al. "Geography of rivers and lakes in Armenia", Institute of hydro-technology and water problems, Armenia.

Pressure factors and transboundary impact

There is almost no human impact on the river. Natural hydrochemical processes cause an increase of the vanadium concentration.

Given Armenian measurements, an increase in nitrites' concentration (MAC for aquatic life exceeded by a factor of 2) and vanadium concentration (MAC for aquatic life exceeded by a factor of 6, which signals background pollution) appears in the central part of the river's sub-basin. On the border, no measurements of nitrites were carried out. Except for aquatic life, the MAC values for other uses are not exceeded.

The average mineral content at the border is 199 mg/l with a maximum of 260 mg/l (period 2004–2006).

Currently, the ecological and chemical status is "normal and close to natural conditions".

VOGHJI RIVER

Armenia and Azerbaijan share the sub-basin of the Voghji River, a tributary to the Araks.

Sub-basin of the Voghji River			
Area	**Country**	**Country's share**	
1,175 km^2	Armenia	788 km^2	67%
	Azerbaijan	387 km^2	33%

Source: L.A. Chilingarjan et al. "Geography of rivers and lakes in Armenia", Institute of hydro-technology and water problems, Armenia.

Hydrology

Of the river's total length of 82 km, 43 km are in Armenia.
The Gechi is the most important tributary.

Discharge characteristics of the Voghji River at the Kapan gauging station (Armenia) upstream of the border with Azerbaijan		
Q_{av}	11.6 m^3/s	Long-term average
Q_{max}	68.1 m^3/s	Long-term average
$Q_{absolute\ max}$	118 m^3/s	20 May 1976
Q_{min}	2.72 m^3/s	During 95% of the year

Source: L.A. Chilingaryan et al. "Geography of rivers and lakes in Armenia", Institute of hydro-technology and water problems, Armenia.

Pressure factors and transboundary impact

Industrial activities are the main pressure factor. Natural hydrochemical processes in the areas of ore deposits also affect water quality.

According to Armenian data, the concentration of nitrites in the lower area of the sub-basin exceeds the MAC for aquatic life by a factor of 2. The MAC values for metals (Cu, Zn, Mn, Cr, V) are also exceeded, caused by hydrochemical processes in the sub-basin and, partly, by human activity.

In the period 2004–2006, the average mineral content was 296 mg/l with a maximum of 456 mg/l.

Currently, the ecological and chemical status of the river system is "not satisfactory for aquatic life", but appropriate for other uses.

LAKE JANDARI

Lake Jandari covers an area of 12.5 km², and the lake basin's area is 102 km². Some 67% of the basin is located on Georgian territory and 33% in Azerbaijan. Water comes mainly through the Gardaban water canal from the Kura River. The maximum capacity of the canal is 15 m³/s.

Pollution originates from various anthropogenic sources. Wastes from industry, residential areas and agriculture pollute water coming into the reservoir from the Kura River. The total population in the lake basin is 14,000–15,000 (some 140–150 inhabitants/km²). The lake is used for fishing.

In the nineteenth century, the shallow and salty lake often dried out during the summer. Later, in order to provide water for irrigation, an additional water supply canal (the Gardaban canal) was constructed. As a result, the lake was filled and turned into a water reservoir. Another canal, which starts from the Tbilisi (Samgori) water reservoir, also feeds Lake Jandari.

Lake Jandari does not currently have a good ecological or chemical status. Increased pollution from the Kura River and from reservoirs is increasing levels of pollution in the lake. Moreover, expansion of irrigated land in both countries and uncoordinated use of water by various users are decreasing the water level.

SAMUR RIVER BASIN[13]

The basin of the Samur River is shared by the Russian Federation and Azerbaijan, as indicated in the following table.

Basin of the Samur River			
Area*	**Country**	**Country's share**	
7,330 km²	Azerbaijan	340 km²	4.6%
	Russian Federation	6,990 km²	95.4%

Source: Federal Agency for Water Resources (Russian Federation).
* Including the tributary Giolgerykhay.

Hydrology

The river rises in Dagestan (Russian Federation). The common border on the river between the Russian Federation and Azerbaijan is 38 km long. Before flowing into the Caspian Sea, the river divides into several branches, located both in Azerbaijan and the Russian Federation. 96% of the river flow originates on Russian territory.

Pressure factors

Use of the water for irrigation (currently some 90,000 ha in Azerbaijan and 62,000 ha in the Russian Federation)[14] and to supply drinking water to the cities of Baku and Sumgait in Azerbaijan (up to 400 million m³/a) and settlements in Dagestan (Russian Federation) has led to pressure on water resources.

Transboundary impact

The Russian Federation carries out monitoring close to the mouth of the river.

Average pollution level near to the mouth of the Samur River (Russian Federation)	
Determinands	**Measured concentration, compared to MAC**
BOD_5	0.7–1.7 times MAC
Ammonia	0.4 times MAC
Nitrites	0.6 times MAC
Iron	0.4–3.0 times MAC

[13] Ministry of Ecology and Natural Resources, Azerbaijan and the Federal Water Agency, Russian Federation.
[14] The countries' irrigation inventory indicates 210,000 ha for Azerbaijan and 155,700 ha for the Russian Federation.

Average pollution level near to the mouth of the Samur River (Russian Federation)	
Sulphates	0.4–4.5 times MAC
Copper	0.5–1.2 times MAC
Manganese	Up to 5 times MAC
Oil products	0.2–3.2 times MAC
Phenols	0.03 times MAC

Source: Federal Agency for Water Resources (Russian Federation).

Thus, the river is classified as "moderately polluted".

The total water demand of both countries considerably exceeds the available resources. For six month, there is almost no water flow downstream the hydrotechnical installation at Samursk. The considerable decrease of water flow from source to mouth and the absence of any flow downstream Samursk has caused a drop in the groundwater table, which also has ecological and other consequences for the relic forest in the Samur Valley and nature conservation areas in the delta.

Trends

Over a period of time, pollution problems and adverse impact of overuse will remain. The drawing up of a bilateral agreement is of utmost importance in order to ensure that the transboundary waters of the Samur are used in a reasonable and equitable way and to guarantee the ecological minimum flow in the delta region.

SULAK RIVER BASIN[15]

The basin of the Sulak River is shared by Georgia and the Russian Federation. The total basin area, including all tributaries, is 15,200 km^2.

Hydrology

The confluence of the Avarsk-Koisu (Russian Federation; 7,660 km^2) and Andis-Koisu (transboundary river shared by Georgia and the Russian Federation; 4,810 km^2) rivers is taken as the source of the Sulak. The Sulak River itself flows entirely in the Russian Federation.

Sub-basin of the Andis-Koisu River			
Area	**Country**	**Country's share**	
4,810 km^2	Georgia	869 km^2	18%
	Russian Federation	3,941 km^2	82%

Source: Ministry of Environment Protection and Natural Resources (Georgia) and Federal Agency for Water Resources (Russian Federation).

Pressure factors and transboundary impact in the sub-basin of the Andis-Koisu River

Irrigation and human settlements constitute the main pressure factors. The transboundary impact is insignificant. The transboundary Andis-Koisu River is in a good ecological and chemical status.

Trends

There are no pressure factors, which would significantly affect this good status in the near future. However, there are plans to construct a number of hydropower stations in the Russian part of the sub-basin.

[15] Based on information provided by the Ministry of Environment Protection and Natural Resources, Georgia and the Federal Water Agency, Russian Federation.

Measurements at Agvali (Russian Federation, 75 km upstream of the confluence with the Sulak)	
Determinands	**Measured concentration, compared to MAC**
BOD_5	0.9 times MAC
Iron	0.5–2.1 times MAC
Nitrites	0.8–4.6 times MAC
Ammonia	0.2–0.6 times MAC
Oil products	0.2–0.6 times MAC
Mineral content	Does not exceed 300 mg/l

Source: Federal Agency for Water Resources (Russian Federation).

TEREK RIVER BASIN[16]

Georgia (upstream country) and the Russian Federation (downstream country) share the basin of the Terek River. The river is a key natural asset in the Caucasus region.

Basin of the Terek River			
Area	**Country**	**Country's share**	
43,200 km²	Georgia	869 km²	18%
	Russian Federation	3,941 km²	82%

Source: Ministry of Environment Protection and Natural Resources (Georgia) and Federal Agency for Water Resources (Russian Federation).

Discharge characteristics at the Kazbeki gauging station (Georgia): latitude: 44° 38′ 24″; longitude: 42° 39′ 32″		
Q_{av}	24.1 m³/s	1928–1990
Q_{max}	30.4 m³/s	1928–1990
Q_{min}	18.6 m³/s	1928–1990
$Q_{absolute\ max}$	481 m³/s	6 August 1967
$Q_{absolute\ min}$	1.0 m³/s	27 February 1938

Source: Ministry of Environment Protection and Natural Resources of Georgia.

Hydrology

The Terek rises in Georgia on the slopes of Mount Kazbek. After some 61 km, the river crosses the Georgian-Russian border and flows through North Ossetia/Alania, Kabardino-Balkaria, the Stavropol Kraj, Chechnya and Dagestan (Russian Federation).

The river is 623 km long. Usually, inventories quote 43,200 km² as the size of the hydrographic basin. However, the area which is directly and indirectly influenced by the Terek's water management is larger and counts for 90,000 km².

The water resources of the Terek (in the hydrographic basin) are 11.0 km³/a in an average year, 10.1 km³/a in an average dry year and 9.0 km³/a in a dry year (figures for the Stepnoye station). The period of high water levels in spring-summer is very long (end of March to September), which is characteristic for rivers fed by glaciers and rainwater.

Spring floods cause damage, particularly in the Russian part of the basin.

Pressure factors

Irrigational water use and human settlements are the main pressure factors in the Georgian part of the basin. In the Russian part of the basin, pressure arises from irrigation (>700,000 ha), industry, aquaculture/fisheries and human settlements.

[16] Based on information provided by the Ministry of Environment Protection and Natural Resources, Georgia and the Federal Water Agency, Russian Federation.

Transboundary impact

Based on Georgian estimates, 17·10³ kg BOD and 41 t suspended solids were discharged in 2004 into the Georgian part of the basin. Measurements are carried out by the Russian Federation downstream the border (see table below).

Trends

At the border, the river has a good ecological and chemical status. High metal concentrations, exceeding the MAC values, are of natural origin. There are no real threats, which would decrease the status of the river in the near future.

Measurements upstream of the village Lars (Russian Federation, 1 km downstream the border with Georgia, 560 km upstream of mouth)	
Determinands	**Measured concentration, compared to MAC**
BOD_5	0.9 times MAC
Iron	3.2 times MAC
Aluminium	8.9
Manganese	1.8
Copper	Up to 2
Oil products	0.22–0.84 times MAC

Source: Federal Agency for Water Resources (Russian Federation).

MALYI UZEN RIVER BASIN[17]

The Russian Federation (upstream country) and Kazakhstan (downstream country) share the basin of the Malyi Uzen River.

Basin of the Malyi Uzen River			
Area	**Country**	**Country's share**	
13,200 km²	Russian Federation	5,980 km²	45.3%
	Kazakhstan	7,220 km²	54.7%

Source: ТОО «Уралводпроект» «Водохозяйственный баланс бассейнов рек Малый и Большой Узены», заказ № 02.044, Книга 1 (Water management balance of the Malyi and Bolshoy Uzen River basins, TOO Uralvodproject).

Hydrology

The river's source is the Syrt chain of hills (Saratov Oblast, Russian Federation). It discharges into Lake Sorajdyn, which belongs to the Kamysh-Samarsk lakes (Kazakhstan). The river's total length is 638 km (374 km in the Russian Federation, 264 km in Kazakhstan). The mean annual discharge at the Malyi Uzen station is 8.54 m³/s. The population density is 28.4 persons/km².

Pressure factors and transboundary impact

The main pressure on water resources comes from irrigated agriculture. Downstream the border between the Russian Federation and Kazakhstan, irrigated agriculture is the main form of land use. The share of land that requires irrigation strongly depends on the actual river's water availability (depending on hydrometeorological conditions) and varies between 1,961 ha in wet years and 45,979 ha in dry years. The biggest reservoirs on the Russian side are the Upper Perekopnovsk (65.4 million m³), Molouzensk (18.0 million m³) and Varfolomejevsk (26.5 million m³) reservoirs and several artificial lakes (87.33 million m³). Reservoirs in Kazakhstan include: the Kaztalovsk-I (7.20 million m³), the Kaztalovsk-II (3.55 million m³) and the Mamajevsk (3.50 million m³) reservoirs and several artificial lakes (4.83 million m³).

Most recently (2005), water construction works to increase water protection in the basin were carried out in the Russian part of the basin.

Water quality problems are also caused by wastewater discharges, surface run-off from the basin's surface area, sediments and erosion of riverbanks. A significant problem is that economic and other activities in water protection zones next to the water bodies do not respect established environmental standards. Reconstruction works (buildings, installations, communications and other works), which are not approved by the relevant water authorities, have a

[17] Based on information provided by the Ministry of Environment Protection, Kazakhstan and the Federal Water Agency, Russian Federation.

negative effect on surface water quality, and consequently on the drinking water supplied to local populations.

According to the 2005 measurements in the Russian part of the basin, water quality falls into class 3, which means "moderately polluted". It is worth mentioning that both countries have agreed on a schedule for joint sampling of water at the border of the river.

Average water quality characteristics of the Malyi Uzen River in the Russian part of the basin	
Determinands	**Mean values**
Dissolved oxygen	12.24 mg/l
Oxygen saturation	101%
Nitrates	0.194 mg/l
Nitrites	0.033 mg/l
Ammonia	0.25 mg/l
Chlorides	131.8 mg/l
Phosphates	0.236 mg/l
Chromium	0.003 mg/l
Iron	0.18 mg/l
Zinc	0.002 mg/l
COD	30.3 mg/l
Suspended solids	43.0 mg/l
Sulphates	20.0 mg/l
Calcium	56.5 mg/l

Source: Federal Agency for Water Resources (Russian Federation).

Water quality and water quantity at the border between the two countries respect the Agreement between the Russian Federation and Kazakhstan on the joint use and protection of transboundary waters (27 August 1992). Water transfer, including transfer from the Volga basin, is subject to annual agreements between both countries. A minimum of 17.1 million m^3 shall pass the Russian-Kazakhstan border; this amount was increased in 2006 at the request of Kazakhstan (to 19.2 million m^3) following very dry weather conditions and low water flow in the river.

Taking into account that water resources in the Russian part of the basin are mainly used for agricultural purposes and that the population density is relatively small, the status of the watercourses is assessed as "stable".

BOLSHOY UZEN RIVER BASIN[18]

The Russian Federation (upstream country) and Kazakhstan (downstream country) share the basin of the Bolshoy Uzen River.

Basin of the Bolshoy Uzen River			
Area	**Country**	**Country's share**	
14,300 km^2	Russian Federation	9,660 km^2	67.6%
	Kazakhstan	4,640 km^2	32.4%

Source: ТОО «Уралводпроект» «Водохозяйственный баланс бассейнов рек Малый и Большой Узены», заказ № 02.044, Книга 1 (Water management balance of the Malyi and Bolshoy Uzen River basins, TOO Uralvodproject).

Hydrology

The river's source is the Syrt chain of hills (Saratov Oblast, Russian Federation). It discharges into Lake Ajden, which belongs to the Kamysh-Samarsk lakes (Kazakhstan).

[18] Based on information provided by the Ministry of Environment Protection and Natural Resources, Georgia and the Federal Water Agency, Russian Federation.

The river's total length is 650 km (397 km in the Russian Federation, 253 km in Kazakhstan). The mean annual discharge at the Novouzensk station is 11.1 m^3/s.

The population density is 27.9 persons/km^2.

Pressure factors and transboundary impact

The main pressure on water resources comes from irrigated agriculture. Downstream from the border between the Russian Federation and Kazakhstan, irrigated agriculture is the main form of land use. The share of land requiring irrigation depends greatly on the actual hydrometeorological conditions and varies between 1,200 ha in wet years and 27,000 ha in dry years.

The biggest reservoirs on the Russian side are the Nepokojevsk (48.75 million m^3) and Orlovogajsk (5.4 million m^3) reservoirs and several artificial lakes (183.67 million m^3). Three reservoirs are in Kazakhstan: the Sarychganaksk (46.85 million m^3), the Ajdarchansk (52.3 million m^3) and the Rybnyj Sakryl (97 million m^3) reservoirs.

Most recently (2005), water construction works to increase water protection in the basin were carried out in the Russian part of the basin, following decisions of the joint Russian-Kazakhstan Commission for the joint use and protection of transboundary waters.

Water quality problems are also caused by wastewater discharges, surface run-off from the basin's surface area, sediments and erosion of riverbanks. A significant problem is that economic and other activities in water protection zones next to the water bodies do not respect general environmental standards. Reconstruction works (buildings, installations, communications and other works), which are not approved by the relevant water authorities, have a negative effect on surface water quality, and consequently on the drinking water supplied to local populations.

According to the 2005 measurements in the Russian part of the basin, water quality falls into class 3, which means "moderately polluted". It is worth mentioning that both countries have agreed on a schedule for joint sampling of water at the border of the river.

Average water quality characteristics of the Bolshoy Uzen River in the Russian part of the basin

Determinands	Mean values
Dissolved oxygen	10.34 mg/l
Oxygen saturation	83%
Nitrates	0.161 mg/l
Nitrites	0.02 mg/l
Ammonia	0.32 mg/l
Chlorides	369.9 mg/l
Phosphates	0.195 mg/l
Chromium	0.001 mg/l
Iron	0.33 mg/l
COD	39.7 mg/l
Suspended solids	38.0 mg/l
Sulphates	30.3 mg/l
Calcium	84.6 mg/l

Source: Federal Agency for Water Resources (Russian Federation).

Water quality and water quantity at the border between both countries respects the Agreement between the Russian Federation and Kazakhstan on the joint use and protection of transboundary waters (27 August 1992). Water transfer, including transfer from the Volga basin, is subject to annual agreements between both countries. At minimum 17.1 million m^3 shall pass the Russian-Kazakhstan border.

Taking into account that water resources in the Russian part of the basin are mainly used for agricultural purposes and that the population density is relatively small, the status of the watercourses are assessed as "stable".