Annex 3

BRIEF DESCRIPTION OF CONDITION AND KEY PROBLEMS OF WATER AND WASTEWATER SECTOR IN THE REPUBLIC OF ARMENIA

1. WATER SUPPLY

The distinctive feature of water supply in Armenia is that 95.5 % of water is abstracted from groundwater sources with stable composition and good water quality, and which at the intakes corresponds to organoleptic, toxicological and microbiological norms and standards established locally and by the World Health Organization (WHO). Ground water in Armenia is characterized by softness, low mineralization, constant chemical composition, low fluorine content. But there are deviation of hardness parameters for some water sources (basically in the Ararat Valley). Groundwater is usually pumped into the distribution networks without any treatment or disinfection (*e.g.* chlorine). In many cases, the quality of the raw resource permits to supply water without preliminary treatment. Nevertheless, some settlements face problems related to the lack of water disinfection.

The main concern comes from the fact that a number of settlements located above a drinking water source lack wastewater collection systems, and thus the discharge of wastewater endangers the sources of drinking water supply (in some sources, non-compliance with colon bacillus index was detected).

The table below shows water abstraction and water consumption volumes in the largest settlements of Armenia, water abstraction volumes from surface and groundwater sources, and its further use in various sectors of the economy, including domestic water supply.

Table1.1 Main water bodies in Armenia (annual water abstraction and consumption volumes, th. m^3)[1]

Water basin	Number of consumers	Water abstraction	Water consumption	HCS	Industry	Irrigation	Agriculture	Other
Araks	0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
Akhuryan	0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
Sevdzhur-Kasakh	1	25484,0	14092,5	0,0	13398,9	693,6	0,0	0,0
Razdan	1	1154,6	1116,7	0,0	1036,7	80,0	0,0	0,0
Azat	1	783,2	783,2	0,0	783,2	0,0	0,0	0,0
Vedi	0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
Arpa	6	410,9	410,9	0,0	322,1	88,8	0,0	0,0
Vorotan	0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
Vokhchi	2	13475,3	13475,3	1,5	13473,8	0,0	0,0	0,0

[1] All data of tables of the Annex 3 have been presented by the Armenian experts of the Working Group.

Water basin	Number of consumers	Water abstraction	Water consumption	HCS	Industry	Irrigation	Agriculture	Other
Megri	0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
The Kura River Basin	0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
Pambazh-Debed	1	15,0	15,0	0,0	15,0	0,0	0,0	0,0
Agstev	3	9,0	0,6	0,0	0,6	0,0	0,0	0,0
The Sevan Lake Basin	0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
Gavaraget	0	0,0	0,0	0,0	0,0	0,0	0,0	0,0

Table1.2 Annual water abstraction and consumption (by sectors in the economy, th.m3)

City	Population (Number of persons)	Number of water consumers	Water abstraction	Water consumption	HCS	Industry	Irrigation	Agricul-ture	Other
Yerevan	1103491	325	454936,7	145913,6	46329,8	36368,9	22879	40335,0	0,9
Aragatsotn oblast		8	187384,3	103861,7	2460,3	365,4	99858,0	1178,0	0,0
Ashtarac	20639	4	184387,7	101829,1	1791,1	124,1	99858,0	180,0	0,0
Aparan	6614	1	1014,7	497,2	497,2	88,8	0,0	0,0	0,0
Talin	5614	1	1141,9	639,9	172,0	122,6	0,0	467,9	0,0
Ararat oblast		101	280437,8	192988,5	4707,8	4582,6	172596,4	5164,6	5937,0
Ararat	20480	11	253315,4	173228,9	581,7	1685,9	172585,1	0,0	62,1
Vedi	12963	9	3160,8	1837,1	491,2	166,6	0,0	1345,9	0,0
Artashat	25066	24	9603,4	4500,2	1599,9	430,1	0,0	2900,0	0,3
Masis	21376	14	6434,9	2956,1	2026,1	262,0	11,3	918,8	0,0
Armavir oblast		32	503784,8	353763,3	7858,3	17015,6	325390,6	3498,8	0,0
Armavir	32034	8	449049,5	327005,7	2246,7	506,8	324697,0	62,0	0,0
Metsamor	9870	3	37467,5	3459,3	2765,7	13690,8	693,6	0,0	0,0
Echmiadzin	56390	10	15144,3	6282,7	2845,9	694,6	0,0	3436,8	0,0
Gegarkunic oblast		41	31466,7	20107,5	5333,7	1195,8	12070,0	1508,0	0,0
Gavar	26621	4	21044,5	14924,4	2252,6	660,6	12070,0	601,8	0,0
Martuni	11756	1	1263,0	812,1	697,8	79,9	0,0	114,3	0,0
Sevan	21422	25	7568,3	2304,6	1512,7	159,8	0,0	791,9	0,0
Verdenis	12757	1	1088,7	674,8	674,8	72,9	0,0	0,0	0,0
Lori oblast		65	27609,4	16177,5	8103,6	3094,3	3507,0	1472,6	0,0
Alaverdi	16641	5	5361,8	1218,1	748,1	130,7	0,0	470,0	0,0
Spitak	14984	2	1299,0	804,6	673,8	6,2	0,0	130,8	0,0
Stepanavan	16302	6	2220,3	926,9	775,7	8,6	0,0	151,2	0,0
Vanadzor	107402	32	17496,8	9652,8	5475,2	2859,4	3507,0	670,6	0,0
Kortaik oblast		72	108274,8	71992,6	9113,2	5180,2	56517,4	1181,8	0,0
Abovyan	44570	25	81272,0	59115,2	2538,9	342,4	56479,0	97,3	0,0
Razdan	52816	6	19044,5	3842,0	3803,6	4209,7	38,4	0,0	0,0
Charentsavan	25056	4	3651,5	1822,7	1194,2	175,9	0,0	628,5	0,0
Tsakhkadzor	1618	2	1596,9	359,1	190,9	288,7	0,0	168,2	0,0
Yegvard	11627	4	1738,5	1089,5	931,7	124,0	0,0	157,8	0,0
Nor-Adzhn	10168	3	0	0	0,0	0,0	0,0	0,0	0,0
Shirak oblast		62	48808,8	32648,2	8539,1	821,1	21029,0	2259,0	0,0
Marapic	5782	1	827,0	391,0	331,0	15,0	0,0	60,0	0,0
Artic	17564	7	3501,2	2020,5	1220,5	216,1	0,0	800,0	0,0
Gyumri	150949	45	41483,0	27753,0	6724,0	560,0	21029,0	0,0	0,0
Syunik oblast		11	47782,4	36719,9	4925,4	22266,6	8744,6	783,3	0,0
Goris	23261	2	12098,8	9473,6	911,4	242,1	7929,0	633,2	0,0
Kapan	45711	5	6059,8	2646,0	2546,0	1986,8	0,0	100,0	0,0
Kadzharan	8439	1	19883,4	0,0	0,0	19883,4	0,0	0,0	0,0

City	Population (Number of persons)	Number of water consumers	Water abstraction	Water consumption	HCS	Industry	Irrigation	Agricul-ture	Other
Megri	4805	1	1913,0	1363,5	547,9	0,0	815,6	0,0	0,0
Sisian	16843	1	1837,0	970,2	920,1	154,3	0,0	50,1	0,0
Vayotz-Dzor		24	23563,1	19454,2	1502,6	2515,6	15312,8	123,2	0,0
Yegegnadzor	8188	6	20085,1	16263,8	827,8	59,0	15312,8	123,2	0,0
Vaik	6024	8	750,0	240,0	240,0	373,3	0,0	0,0	0,0
Djermuk	5394	4	2720,9	434,8	434,8	2076,2	0,0	0,0	0,0
Tavush oblast		38	11644,9	9369,6	1971,4	454,6	6722,5	221,1	0,0
Idzevan	20223	14	9392,3	7613,2	891,9	260,0	6721,4	0,0	0,0
Noemberyan	5486	4	699,3	414,4	193,3	7,7	0,0	221,1	0,0
Dilijan	16202	9	1120,1	634,5	634,5	117,5	0,0	0,0	0,0
TOTAL		779	1725693,7	1039365,5	100845,1	93860,7	744627,8	57725,5	5937,9

2. WASTEWATER COLLECTION AND TREATMENT

2.1 Wastewater collection system

All cities and about 20% of villages are served by the wastewater collection system in Armenia. The effluent in these settlements is discharged to open water bodies, except several cities having biological ponds.

The total length of sewer pipes is about 2800 km, the sewerage mains are 860 km long.

The municipal wastewater networks and sewers are basically of gravity type, except some wastewater systems *e.g.* in Sevan (3 municipal pumping stations), Masis (municipal pumping station), which require replacement of pumping equipment (see figure 2.1).

Figure 2.1 Sewerage pump. Municipal pumping station. Masis city.

Based on geographical situation, the inter-district gravity sewers are constructed in order to collect wastewater from a number of settlements and further treat it at the united wastewater treatment facilities. For instance, Sevan – Razdan sewer collects wastewaters from cities of Sevan, Tsakhkadsor, Razdan, adjacent villages and Ankavan recreation area, and transports them to WWTP at Kakhsi village, and Charentsavan – Yerevan sewer collects wastewaters from the cities of Abovyan, Byuregavan, Nor-Achin, Yegvard and adjacent villages and sites, and further transports them to WWTP in Yerevan. Besides, the Spitak – Vanadzor sewer for wastewater discharge to WWTP of Vanadzor are planned to be constructed.

In some parts of the cities, due to a lack of wastewater networks and sewers, a part of wastewater is discharged untreated to open water bodies. For instance, one of the residential districts in Yerevan is connected to the wastewater collection system, but the sewer doesn't reach the municipal WWTP and the collected untreated wastewater is discharged into the river.

63% of the networks and sewers constructed more than 20 years ago are in emergency condition. 2,5 accidents occur annually per 1 km of the network. As the water is supplied according to the schedule, the sewers and networks are increasingly being clogged up.

Improvement of wastewater discharge system requires capital repair of the most outdated and worn out sections (more than 3 accidents per 1 km/year), design and stage-by-stage construction and rehabilitation of the networks and sewers, purchase of special machinery and equipment providing normal conditions for the networks and sewers operation.

Storm water sewerage system

There are no data on availability and length of storm sewers and pipelines, on design and capacity of storm water treatment facilities, and on approximate storm water volumes collected to storm and domestic sewerage system in Armenia.

2.2. Wastewater treatment

18 of 20 existing wastewater treatment plants (WWTP) are under responsibility of Armvodocanal CJSC, Yerevan aeration plant (EAP) is operated by CJSC Yervodocanal, and WWTP of Kadzharan City is a local self-governed institution. 14 cities in Armenia have no WWTP.

Only 45-50% of the total wastewater volume is exposed to nominal mechanical treatment. The rest is discharged untreated.

Almost all WWTP are equipped with mechanical and biological treatment facilities, which include disinfection units and sludge treatment facilities.

The mechanical treatment facilities of relatively large WWTP include:

- Screens with mechanical rakes,

Figure 2.2 Screens building, Echmiadzin city

Figure 2.3 Screens with mechanical rakes, Vanadzor city

- Horizontal sand traps with water circulation,

Figure 2.4 Tangential sand trap, Echmiadzin city

- Primary sedimentation tanks with relevant equipment.

Figure 2.5 Primary sedimentation tanks, Masis city

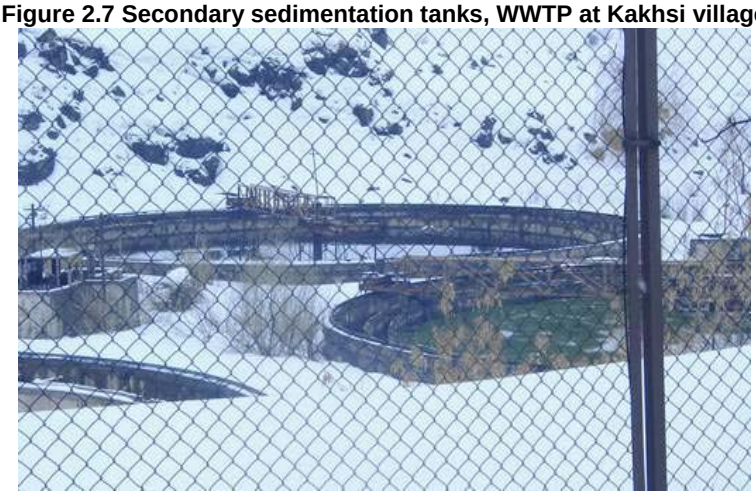
Biological treatment facilities include:

- aerotanks,

Figure 2.6 Aerotanks, Masis city

- secondary radial sedimentation tanks,

Figure 2.7 Secondary sedimentation tanks, WWTP at Kakhsi village



- building with air blowers and pumping equipment,

Figure 2.8 Air blowers, Aparan city

- contact tank with chlorinating unit.

Figure 2.9 The Chlorinating unit, Aparan city

Sludge treatment facilities usually include:

- anaerobic digesters

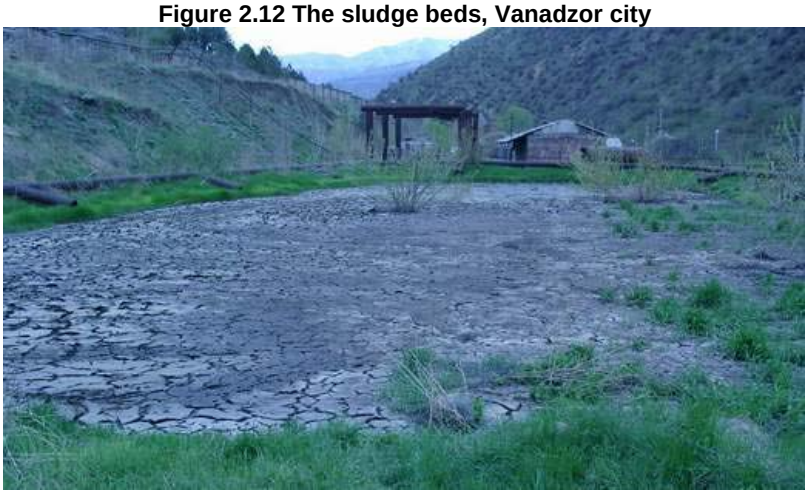
Figure 2.10 The anaerobic digester, Yerevan city

- sludge mechanical dewatering plant

Figure 2.11 The sludge mechanical dewatering plant, vacuum-filter, Yerevan city

- sludge beds.

Figure 2.12 The sludge beds, Vanadzor city



Some WWTPs, *e.g.* in Ashtarak, Aparan, Dilizhan, Sisian, are equipped with combined treatment facilities (primary and secondary sedimentation tanks, aerotanks, contact reservoirs and sludge stabilizers in one block).

Figure 2.13 The combined treatment facilities, Ashtarak city

The social and economic situation developed in Armenia during 1989-1999 resulted in very bad condition of wastewater treatment plants, sewers and sewerage networks, as it can be seen from the above photos.

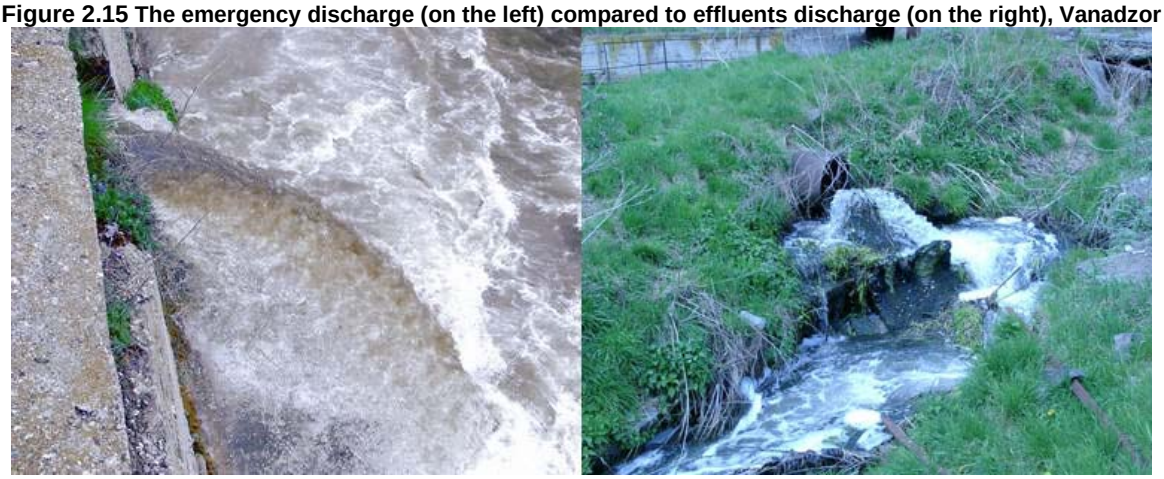
Some WWTP have not been operating after construction for various reasons. For instance, the construction of the main sewer at WWTP of Dilizhan city was not completed, WWTP of Aparan city required the installations reinforcement after the earthquake.

Construction of WWTP is not completed in several cities – in Sisian (about 80% available), Vanadzor (about 75% available), Stepanavan (about 70% available).

Figure 2.14 Uncompleted construction of the treatment facilities (the second stage), Vanadzor

The installations, technological pipelines, mechanisms, valves and equipment of the operating WWTP have almost similar level of deterioration. The wastewater often passes through emergency outlets, having no possibility to let wastewater pass through concrete-made facilities even for maintaining them from destruction.

Figure 2.15 The emergency discharge (on the left) compared to effluents discharge (on the right), Vanadzor

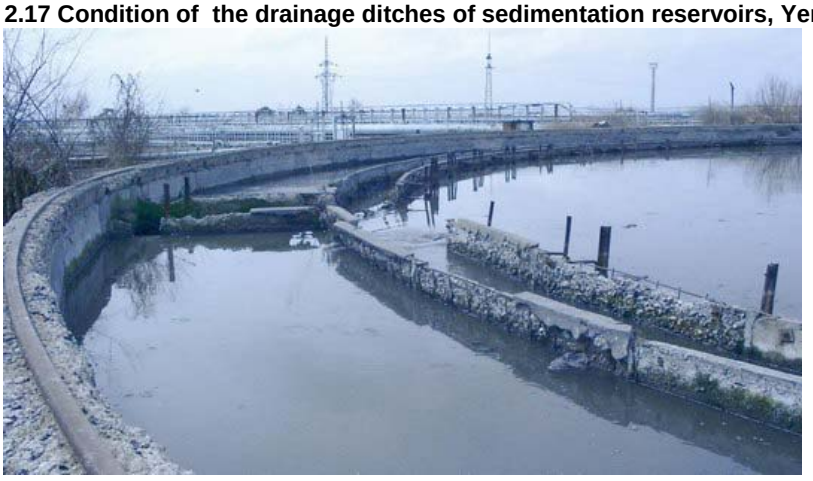


The equipment (screens, sludge scrapers, sludge pumps, valves, hydroelevators etc.) installed in open facilities are completely worn out. The reinforced concrete constructions unsealed,….

Figure 2.16 Sedimentation reservoir's seal failure, Vanadzor

…trays and channels are partly destroyed, …

Figure 2.17 Condition of the drainage ditches of sedimentation reservoirs, Yerevan.



… the same concerns hanging constructions and reservoirs. Electric and automatic equipment is completely deteriorated.

Figure 2.18 Internal premises, power-generating sets and elements of automated mechanisms Pumping station, Yerevan

Lack of necessary capital investments and funds for capital repair and maintenance have caused collapse of technological installations and equipment.

Figure 2.19 Uncompleted reconstruction of sludge beds, Yerevan

The 1992—1994 energy crisis had an extremely negative effect on performance of almost all Armenian WWTP. Treatment processes were interrupted; the pipelines were clogged up. Lack of funds for WWTP reconstruction resulted in complete shutdown of most of the existing treatment facilities. Only some WWTP carry out mechanical treatment (WWTP in Kakhsi village, cities of Vanadzor, Ashtarak, Echmiadzin).

2.3. Basic pollutants discharge volumes

Tables 2.1-2.4. show some key pollutants load in the wastewater discharged to sewerage system and water bodies.

Table 2.1 Key pollutants load in the wastewater delivered to the sewerage system

Basin	Waste water volumes (th. мм^3)	BOD, t	Suspended solids, t	Oil products t	Ammonia nitrogen, t	Phosphorous, total, t	Chlorides, t	Sulphates, t	Nitrates, t	Nitrites, t	Copper, kg	Zinc, kg	Iron, kg	Nickel, kg	Chrome, kg
Araks	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Akhuryan	21	15	0	4	0	21	19	0	0	0	0	0	0	0	0
Sevdzhur-Kasakh	2	4	0	0	0	1	0	0	0	0	0	0	0	0	0
Razdan	934	753	15	2	0	176	106	4	0	16	35	375	0	28	0
Azat	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Vedi	2	1	0	1	0	2	1	0	0	0	0	0	0	0	0
Arpa	51	45	11	0	0	12	5	0	0	0	0	0	0	0	0
Vorotan	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Vokhchi	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Megri	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
The Kura River Basin	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Pambak-Debed	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Agstev	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0
The Sevan Lake Basin	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Gavareget	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a

Table 2.2 Composition of the wastewater collected through the centralised system

City	Waste water volumes (th. мм^3)	BOD, t	Suspended solids, t	Oil products t	Ammonia nitrogen, t	Phosphorous, total, t	Chlorides, t	Sulphates, t	Nitrates, t	Nitrites, t	Copper, kg	Zinc, kg	Iron, kg	Nickel, kg	Chrome, kg
Yerevan	956	782	17	0	0	1044	977	1	0	10	0	93	0	28	0
Aragotsotn oblast	134	98	0	5	0	53	46	4	1	12	16	397	0	0	0
Ashtarak	73	48	0	2	0	30	26	2	0	8	10	259	0	0	0
Aparan	36	31	0	1	0	18	14	1	0	4	6	59	0	0	0
Talin	25	20	0	2	0	5	6	0	1	0	0	68	0	0	0
Ararat oblast	402	381	0	12	0	188	131	12	1	156	54	972	0	0	0
Ararat	65	59	0	2	0	33	23	2	0	4	10	207	0	0	0
Vedi	38	35	0	1	0	19	14	1	0	2	6	118	0	0	0
Artashat	124	145	0	3	0	56	43	4	0	7	22	288	0	0	0
Masis	175	141	0	6	0	80	51	4	1	142	16	360	0	0	0
Armavir oblast	934	909	1	22	0	472	330	16	6	100	124	1829	0	0	0

Table 2.3 Pollutants content in the wastewater discharged to the basins of main rivers of Armenia

Basin	Wastewater volumes (th. мм^3)	BOD, t	Suspended solids, t	Oil products t	Ammonia nitrogen, t	Phosphorous, total, t	Chlorides, t	Sulphates, t	Nitrates, t	Nitrites, t	Copper, kg	Zinc, kg	Iron, kg	Nickel, kg	Chrome, kg
Araks	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Akhuryan	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Sevdjur-Kasakh	11	20	1	0	0	12	192	0	0	54	0	0	0	0	0
Razdan	151	325	0	0	0	1536	1737	2	0	2	2	25	0	0	0
Azat	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Vedi	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Arpa	2	0	0	0	0	1	2	3	3	0	0	0	0	0	0
Vorotan	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Vokhchi	15	32	0	0	3	0	213	0	0	10	0	0	0	0	0
Megri	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Koura river	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Pambak-Debed	4	39	0	0	0	0	0	0	0	0	0	0	0	6	0
Agstev	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
The Sevan Lake	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Gavaraget	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a

Table 2.4 Key pollutants load in wastewater discharged to open water bodies in the main Armenian cities

City	Wastewater volumes (th. мм^3)	BOD5, t	Suspended solids, t	Oil products t	Ammonia nitrogen, t	Phosphorous, total, t	Chlorides, t	Sulphates, t	Nitrates, t	Nitrites, t	Copper, kg	Zink, kg	Iron, kg	Nickel, kg
Yerevan	5466	7046	0	0	29	18595	18460	2	62	14604	2	22005	0	0
Aragatsotn oblast	3	3	0	0	0	0	0	0	0	0	0	0	0	0
Ashtarak	3	3	0	0	0	0	0	0	0	0	0	0	0	0
Aparan	No surface water reservoirs													
Talin	No surface water reservoirs													
Ararat oblast	24	20	0	3	0	28	24	30	0	0	0	0	0	0
Ararat	1	3	0	0	0	0	0	30	0	0	0	0	0	0
Vedi	0	1	0	0	0	0	0	0	0	0	0	0	0	0
Artashat	1	1	0	0	0	1	1	0	0	0	0	0	0	0
Masis	2	1	0	0	0	2	1	0	0	0	0	0	0	0
Armavir oblast	61	69	1	1	0	69	258	0	0	54	0	0	0	0
Armavir	2	10	0	0	0	2	16	0	0	0	0	0	0	0
Metsamor	10	19	1	0	0	12	192	0	0	54	0	0	0	0
Echmiadzin	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Gegarkunic oblast	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Gavar	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Martuni	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Sevan	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Vardenis	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Lori oblast	5	44	0	0	0	0	0	0	0	0	0	0	0	6
Alaverdi	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Spitak	0	1	0	0	0	0	0	0	0	0	0	0	0	0
Stepanavan	0	1	0	0	0	0	0	0	0	0	0	0	0	0
Vanadzor	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Kotaik oblast	24	44	0	0	0	6	191	36	0	0	0	4	0	30
Abovyan	No surface water reservoirs													
Razdan	21	40	0	0	0	3	23	36	0	0	0	0	0	0
Charentsavan	No surface water reservoirs													
Tsakhkadzo	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a

City	Wastewater volumes (th. мм^3)	BOD5, t	Suspended solids, t	Oil products t	Ammonia nitrogen, t	Phosphorous, total, t	Chlorides, t	Sulphates, t	Nitrates, t	Nitrites, t	Copper, kg	Zink, kg	Iron, kg	Nickel, kg
r														
Egcard	No surface water reservoirs													
Hor-Ajin	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Shirak oblast	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Maralic	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Artic	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Gumri	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Syunik oblast	120	1856	0	0	3	95	2188	0	0	3646	90	3649	0	0
Goris	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Kapan	25	34	0	0	3	0	633	0	0	1320	90	2486	0	0
Kajaran	96	1822	0	0	0	95	1556	0	0	2326	0	1163	0	0
Megri	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Sisian	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Vayots-Tzor oblast	13	20	0	0	0	2	3	4	5	0	0	0	0	0
Yegegnadzor	3	1	0	0	0	0	0	0	1	0	0	0	0	0
Vike	2	0	0	0	0	1	2	3	3	0	0	0	0	0
Jermuk	5	18	0	0	0	0	0	0	1	0	0	0	0	0
Tavush oblast	0	1	0	0	0	0	0	0	0	0	0	0	0	0
Ijevan	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Noemberyan	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Dilidjan	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
TOTAL	5716	9103	2	5	32	18796	21124	71	67	18303	92	25658	0	36

Note: no data on chrome discharges

n/a- data is not available

Concentrations (g/m^3) of two pollutants in the effluents (BOD, suspended solids) are presented below.

Table 2.5 Effluents quality

City	Water Basin	BOD (gO_2/m^3)	Suspended solids (g/m^3)
Yerevan*	The Razdan River	70,5	80,6
Ashtarak	The Kassakh River	120,0	105,0
Aparan*	The Kassakh River	80,2	45,0
Tsakhkaovit	The Kassakh River	60,5	58,0
Artashat*	The Araks River	135,0	120,0
Ararat*	The Araks River	92,0	85,0
Vedi	The Araks River	90,0	82,5
Masis*	The Razdan River	132,5	90,3
Armavir*	The Sevjur River	112,0	100,5
Echmiadzin*	The Sevjur River	120,0	110,0
Vanadzor*	The Pambak River	150,0	142,0
Spitak*	The Pambak River	81,4	75,5
Tashir	The Tashir River	79,0	70,2
Alaverdi*	The Debed River	114,2	100,5
Akhtala	The Debed River	80,5	78,2
Toumanyan	The Debed River	82,0	75,1
Stepanavan	The Dzoraged River	102,5	99,0
Gavar	р. Гавараєт	115,2	102,0
Sevan	The Razdan River	95,4	90,5
Vardenis*	The Masrik River	85,0	82,6

Chambarak	The Getik River	70,2	60,9
Martuni*	The Martuni River	95,1	90,4
Razdan*	The Razdan River	128,9	110,5
Tsakhadzor	The Razdan River	68,4	61,8
Gyumri*	The Akhuryan River	159,8	135,8
Yegegnadzor	The Arpa River	98,4	89,7
Vike	The Arpa River	88,5	82,6
Jermuk	The Arpa River	71,0	60,8
Kapan*	The Vokhchi River	139,4	120,5
Sisian*	The Vorotan River	120,5	104,7
Goris	The Goris River	118,9	100,4
Megri	The Megri River	99,5	97,4
Ijevan	The Agstev River	120,2	98,2
Dilijan*	The Agstev River	105,7	95,8
Berd*	The Tavush River	90,6	95,8
Noemberyan	The Kokhb River	88,9	81,9

*) these settlements have biological wastewater treatment plants, but their effective performance require reconstruction, restoration and re-equipping.

2.4. Needs for rehabilitating of wastewater collection and treatment infrastructure

Most of the wastewater treatment facilities were constructed in the beginning of 60-ies based on inadequate technologies and without compliance with the construction standards and norms. Given the existing condition of the facilities (see table 2.6), costs for repair and reconstruction of some WWTP (Martuni, Verdenis, Kapan, Berd, Ararat etc.) apparently might exceed the cost for new construction. Taking into account stringent financial constraints, rehabilitation of sewerage networks, sewers, WWTP, as well as construction of new WWTP should be carried out by stages depending on the national significance of a water body.

Table 2.6 Technical condition and need for rehabilitation, modernization and construction of WWTP in Armenia

Priority	WWTP	City served	WWTP capacity (th. m^3/day)	Technical condition of WWTP and required improvements	Treatment method	Discharge point
I	WWTP Martuni	Martuni	4,0	The existing WWTP doesn't operate and is not subjected to rehabilitation. A New plant needs to be contracted	–	The Martuni River, the Sevan Lake
I	WWTP Vardenis	Vardenis	4,0	The existing WWTP doesn't operate and is not subjected to rehabilitation. A New plant needs to be contracted		The Masrik River, the Sevan Lake
I	WWTP Gavar	Gavar	10,6	No WWTP constructed	_	The Gavaraget River, the Sevan Lake
II	WWTP at Kakhsi village	Sevan, Tsakhkadzor, Razdan	64,0	Requires capital repair and complete replacement of the equipment	Mechanical treatment	The Razdan River
II	WWTP Alaverdi	Alaverdi	16,3	Doesn't operate, requires capital repair of the head sewer, WWTP and complete replacement of the equipment		The Debed River
II	WWTP Vanadzor	Vanadzor	28,8	Requires capital repair and complete replacement of the equipment. Construction of new	Mechanical treatment	The Pambak River

Priority	WWTP	City served	WWTP capacity (th. m^3/day)	Technical condition of WWTP and required improvements	Treatment method	Discharge point
				WWTP is not completed (128 th.m3/day capacity)		
II	WWTP Spitak	Spitak	0,7	Doesn't operate, requires rehabilitation and construction of new WWTP	Mechanical treatment	The Pambak River
II	WWTP Stepanavan	Stepanavan	5,0	Construction WWTP and SPS with sewer is not completed. New WWTP should be constructed	_	The Dzoraget River
III	WWTP Ashtarak	Ashtarak	10.0	Requires capital repair and complete replacement of the equipment	Mechanical treatment	The Kasakh River
III	WWTP Echmiandzin	Echmiandzin	32.2	Requires capital repair and complete replacement of the equipment	Mechanical treatment	The Sevjur River
III	WWTP Aparan	Aparan	7,3	Doesn't operate, requires rehabilitation with installations reinforcement		The Kasakh Lake
III	WWTP Jermuk	Jermuk	2,3	No WWTP constructed		The Arpa River
IV	WWTP Masis	Masis	53,0	Requires rehabilitation and replacement of the equipment	Mechanical treatment	The Razdan River
IV	WWTP Ararat	Ararat and Vedi	28,2	WWTP requires rehabilitation, the head sewer requires capital repair, the equipment should be completely replaced.		Drainage canal, the Araks River
IV	WWTP Dilijan	Dilijan	18,0	Require capital repair, replacement of the equipment, the sewers' construction should be completed.		The Agstev River
IV	WWTP Berd	Berd	5,2	Requires rehabilitation with equipment replacement		The Tavush River
IV	WWTP Idjevan	Idjevan	4,7	No WWTP constructed		The Agstev River
IV	WWTP Sisian	Sisian	17,0	Requires rehabilitation with equipment replacement		Teh Vorotan River
IV	WWTP Metsamor	Armavir and Metsamor	24,0	Doesn't operate, requires rehabilitation with complete equipment replacement		The Sevjur River
V	WWTP Gyumri	Gyumri	76.0	Doesn't operate, requires rehabilitation with complete equipment replacement		The Akhurn River
V	WWTP Kapan	Kapan	25,0	Ruined after bombing, requires rehabilitation with complete equipment replacement		The Vokhchi River
V	WWTP Artashat	Artashat	17,0	Bioponds don't function. New WWTP should be constructed		The Arake River
VI	WWTP Megri	Megri	1,3	No WWTP constructed		The Megri River
VI	WWTP Agarak	Agarak	4.0	No WWTP constructed		The Arake River
VI	WWTP Goris	Goris	7.0	No WWTP constructed		The Goris River
VI	WWTP Noyemberyan	Noyemberyan	1.5	No WWTP constructed		The Kokhb River
VII	WWTP Tashir	Tashir	2.0	No WWTP constructed		The Tashir River
VII	WWTP Talin	Talin	1,5	No WWTP constructed		The Soukhodoyi River
VII	WWTP Akhtala	Akhtala	0,9	No WWTP constructed		The Debed River
VII	WWTP Vike	Vike	1,4	No WWTP constructed		The Arpa River
VII	WWTP Ekhegnadzor	Ekhegnadzor	2,5	No WWTP constructed		The Arga River

Before the decision on WWTP rehabilitation is made, it is necessary to carry out comprehensive investigation of the existing facilities and pipelines, and constructions in progress, as well as to prepare feasibility study. This would be the basis for making a decision on technical and economic feasibility and financial viability of the available options.

3. Sanitary and epidemiological condition of the sector

Bad condition of the water supply networks and considerable deterioration of the water pipelines often result in secondary contamination of water; e.g. 98-99% of samples not complying with the relevant GOST requirements for drinking water by microbiological indicators are taken from the distribution network, which indicates the secondary water contamination in the water supply network. There is a clear trend for worsening of sanitary and technical condition of water pipelines from year to year: in 1990, 21% of water distribution networks did not comply with sanitary norms, 39,3% in 1993, 57% in 2000. Thus, number of incompatible samples (by microbiological indicators) has increased from 9,4% in 1990 up to 11,6% in 2000. Until 1992, there were no water related acute enteric infections; but they have been being regularly registered since.

The «scheduled» water supply leads to a number of additional problems, including:

- Increased maintenance cost and shortened service life of water mains, distribution network and valves; this results from frequent water hammers ("hydraulic blows") and accelerated corrosion processes;
- An increased risk for microbiological contamination and for the intrusion of polluted ground water into the network; this comes from the existence of areas of low pressure and water stagnation in the pipelines; the risk is even higher when there is no disinfection of the water pumped into the system.

During 1992-2001, there were 52 episodes of acute enteric infections affected 15,508 people (see table 3.1). The most frequent are bacterial dysentery and ADI, in rear cases salmonellosis, enteric fever, gastroenterocolitis and viral hepatitis are registered.

Table 3.1 Data on water related acute enteric infections in Armenia during 1992-2002

	Year	Location	Number of persons infected	Ethiology
1	1992	Yerevan, Mashtotsky district	200	Bacteriological dysentery, salmonellosis Enteric infection with unclear ethiology
		Zvartnots Airport	15	Enteric fever
		Ashtarak	486	Bacteriological dysentery, salmonellosis Enteric infection with unclear ethiology
		Aintap, Massisky district	38	Bacteriological dysentery
		Yerevan, Arabkirsky district	520	Bacteriological dysentery, salmonellosis Enteric infection with unclear ethiology
		Vanadzor	455	Bacteriological dysentery Enteric infection with unclear ethiology
		Total	**1714**	
2	1993	Artashtsky region, Arevshatm Berkanush, Azatan villages	24	Bacteriological dysentery
		Artashtsky region, Gegavan village	47	Bacteriological dysentery
		Abovyan	15	Enteric fever
		Naiiryisky region	65	Bacteriological dysentery Enteric infection with unclear ethiology
		Goris	925	Bacteriological dysentery Enteric infection with unclear ethiology
		Kotaisky region Charentsavan	67	Bacteriological dysentery
		Kapan	219	Bacteriological dysentery Enteric infection with unclear ethiology
		Total	**1336**	

	Year	Location	Number of persons infected	Ethiology
3	1994	Yerevan, Shengavitsky district	502	Bacteriological dysentery, salmonellosis
4	1995	Yerevan, Shaumyansky district	402	Bacteriological dysentery, salmonellosis Enteric infection with unclear ethiology
5	1996	Yerevan, Sovyetsky district (Zeitun)	594	Bacteriological dysentery Enteric infection with unclear ethiology
		Vanadzor, micro quarter	41	Enteric fever
		Ashtaraksky region, Parpi, Oganavan villages	197	Bacteriological dysentery Enteric infection with unclear ethiology
		Yerevan, Myasnikyansky district	32	Viral hepatitis “A”
		Total	**1264**	
6	1997	Yerevan, Sovyetsky district	119	Viral hepatitis “A”
		Yerevan, Arabkirsky district	299	Bacteriological dysentery Enteric infection with unclear ethiology
		Dilidjan city and Izhdevansky region	184	Bacteriological dysentery Enteric infection with unclear ethiology
		Yerevan, Shaumyansky district	131	Enteric infection with unclear ethiology
		Stepanavan	80	Enteric infection with unclear ethiology
		Akhuryan	30	Enteric infection with unclear ethiology
		Total	**843**	
7	1998	Aparan	114	Enteric infection with unclear ethiology
		Ashtaraksky region, Sasunic village	118	Enteric infection with unclear ethiology
		Ashtaraksky region Byurakan village	63	Enteric infection with unclear ethiology
		Gavarsky region Karmir village	40	Enteric infection with unclear ethiology
		Razdansky region Kakavadzor village	25	Viral hepatitis “A”
		Nairiysky region Buzhakan village	62	Enteric infection with unclear ethiology
		Nairiysky region Buzhakan village	34	Viral hepatitis “A”
		Vanadzor	10	Enteric fever
		Armavirsky region, Zartonk village	229	Cholera
		Abovyansky region Karamis village	32	Viral hepatitis “A”
		Total	**727**	
8	1999	Kotaisky region Abouvyan	4910	Enteric infection with unclear ethiology
		Vanadzor	11	Enteric fever
		Aniysky region Saraland, Gegamit	7	Enteric fever
		Aniysky region Norashen village	6	Enteric fever
		Aparansky region Kouchak village	98	Bacteriological dysentery Enteric infection with unclear ethiology
		Aparansky region Aragats village	80	Bacteriological dysentery Enteric infection with unclear ethiology
		Martuninsky region, Vardenik village	54	Viral hepatitis “A”
		Ashtapaksky region Voskevaz village	16	Viral hepatitis “A”
		Araratsky region Zangatun village	21	Bacteriological dysentery Enteric infection with unclear ethiology
		Amasiysky region Megrashat village	27	Bacteriological dysentery Enteric infection with unclear ethiology
		Tavushsky region, Avan Berd Artsvaberd	89	Bacteriological dysentery Enteric infection with unclear ethiology
		Total	**5319**	

	Year	Location	Number of persons infected	Ethiology
9	2000	Artashtsky region Mrgavan village	41	Enteric infection with unclear ethiology
		Yekhegnadzor city, Areni village	18	Enteric infection with unclear ethiology
		Vanadzor city and Gugarsky region	87	Viral hepatitis “A”
		Marz Lori, Stepanavan city	157	Enteric infection with unclear ethiology
		Total	**303**	
10	2001	Syuniksky Marz Goris	31	Viral hepatitis “A”
		Gavar	49	Bacteriological dysentery
11	2002	Sevan	19	

For a more comprehensive presentation of the condition of the water supply system, sanitary and epidemiological surveillance service data for sanitary protection zones (SPZ) for 2001 are presented below, on disinfecting facilities, and on chemical and bacteriological analyses. Please note a possible discrepancy with data presented by the water supply enterprises regarding number and condition of water supply networks and SPZ.

Table 3.2 Data on compliance of water supply systems with the established sanitary norms and rules

Location	Number of water supply facilities	Water supply facilities not complying with sanitary norms			Laboratory analyses					
		Total	Incl. due to the absence of		Sanitary – chemical indicators				Bacteriological indicators	
			SPZ	Disinfecting facilities	Samples analysed	Including incompatible	Residual chlorine		Samples analysed	Including incompatible
							Including incompatible	Including incompatible		
Aragatzotn	72	30	27	22	1560	125	1538	125	3679	578
Ashtarak	19	6	5	1	222	38	200	38	725	204
Aragats	16	3	3	2					492	8
Aparan	20	19	17	19	72	30	72	30	681	274
Talin	17	2	2		1266	57	1266	57	1781	87
Ararat	63	53	37	46	1642	216	987	175	2471	599
Artashat	25	23	7	16	853	88	723	60	1211	223
Ararat city					124	52	124	52	258	103
Vedy	10	5	5	5	105	39	72	29	454	270
Masis	28	25	25	25	380	37	68	34	548	3
Armavir city	100	88	40	62	792	164	578	147	3349	336
APP	1				305		230		93	
Echmiadzin	28	22	22		285	130	252	130	602	82
Armavir	67	65	18	61	106	12	48	10	2039	231
Bagramyan	4	1		1	96	22	48	7	615	23
Gegarkunic	88	48	34	45	605	45	348	41	3102	289
Martuni	22	2	1	2	182	1	2	1	983	133
Sevan	14	5	3	2	32	3	10	3	458	50
Gavar	9	2	2	2	243	16	231	16	353	22
Jambarakк	21	20	9	20	85	20	85	20	518	30
Vardenis	22	19	19	19	63	5	20	1	790	54
Lory	134	61	43	51	3962	487	3197	443	4454	957
Tashir	19	7	5	2	99	18	94	18	309	93
Stapanavan	7	5	5	5	138	74	138	74	313	106
Spitak	44	38	31	35	387	136	378	136	980	126
Toumanyan	16	2		2	1886	117	1197	99	1142	98
Gugark	40	5		5	44	18	17	7	175	30
Kotaik	52	16	12	9	1062	115	846	106	2184	205
Kotaik	16	7	5		308	14	241	14	572	16
Charentsavan	12	8	6	8	282	66	233	57	454	140
Razdan	17				340		240		687	13
Nairi	7	1	1	1	132	35	132	35	516	36

Location	Number of water supply facilities	Water supply facilities not complying with sanitary norms			Laboratory analyses					
		Total	Incl. due to the absence of		Sanitary – chemical indicators			Bacteriological indicators		
			SPZ	Disinfecting facilities	Samples analysed	Including incompatible	Residual chlorine		Samples analysed	Including incompatible
							Including incompatible	Including incompatible		
Shirak	84	33	27	23	8214	117	8198	117	7646	228
Gyumri	4				5718	6	5709	6	5040	2
Artik	8	7	3	6	510	25	510	25	293	71
Akhuryan	19	15	15	15	1072	31	1065	31	784	11
Ani	7	4	2	2	914	55	914	55	596	108
Ashotsk	26	2	2						399	8
Amasiya	20	5	5						534	28
Syunik	127	84	44	79	1185	202	1025	186	3552	474
Kapan	45	32		32	515	36	482	36	650	104
Goris	19	17	17	17	445	109	398	102	962	132
Sisian	47	19	11	18	148	14	92	8	1797	115
Megry	16	16	16	12	77	43	53	40	143	123
Vayots Dzor	56	43	18	33	460	211	214	203	1396	218
Jermuk	5	4		4					114	14
Vike	18	17	10	17	80	80	80	80	481	33
Yekhegnadzor	33	22	8	12	380	131	134	123	801	171
Taush	87	48	7	47	1099	229	874	146	1187	423
Idjevan	24	16		16	745	189	630	118	396	6104
Dilizhan	13	7	7	7	201	33	144	25	222	148
Noyemberyan	15	14		14					115	108
Taush	35	11		10	153	7	100	3	354	63
Yerevan	15	3	3		2835	259	1626	240	8360	508
Shemgavit	2				342	44	264	44	1433	89
Myasnikyan	1				254	73	190	73	1441	162
Erebuni					976	45	131	37	1067	56
Sovetsky	2				308	23	142	23	703	31
Spandaryan	2	2	2		55	3	45	3	519	30
Arabkir	2				161	12	144	12	980	43
Shaumyan	2	1	1		211	54	200	43	852	16
Mashtots	2				510	5	510	5	1133	65
Aviation	2				18				232	16
TskiPZ										
TOTAL	878	507	292	417	23236	2170	19431	1929	41380	4815