DANUBE POLLUTION REDUCTION PROGRAMME

NATIONAL REVIEWS 1998
MOLDOVA

TECHNICAL REPORTS

Part C: **Water Quality**

Part D: **Water Environmental Engineering**

NATIONAL ACADEMY OF ECOLOGICAL SCIENCES

in cooperation with the

Programme Coordination Unit
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Preface

The National Reviews were designed to produce basic data and information for the elaboration of the Pollution Reduction Programme (PRP), the Transboundary Analysis and the revision of the Strategic Action Plan of the International Commission for the Protection of the Danube River (ICPDR). Particular attention was also given to collect data and information for specific purposes concerning the development of the Danube Water Quality Model, the identification and evaluation of hot spots, the analysis of social and economic factors, the preparation of an investment portfolio and the development of financing mechanisms for the implementation of the ICPDR Action Plan.

For the elaboration of the National Reviews, a team of national experts was recruited in each of the participating countries for a period of one to four months covering the following positions:

- Socio-economist with knowledge in population studies,
- Financial expert (preferably from the Ministry of Finance),
- Water Quality Data expert/information specialist,
- Water Engineering expert with knowledge in project development.

Each of the experts had to organize his or her work under the supervision of the respective Country Programme Coordinator and with the guidance of a team of International Consultants. The tasks were laid out in specific Terms of Reference.

At a Regional Workshop in Budapest from 27 to 29 January 1998, the national teams and the group of international consultants discussed in detail the methodological approach and the content of the National Reviews to assure coherence of results. Practical work at the national level started in March/April 1998 and results were submitted between May and October 1998. After revision by the international expert team, the different reports have been finalized and are now presented in the following volumes:

Volume 1:	Summary Report
Volume 2:	Project Files
Volume 3 and 4:	Technical reports containing: - Part A : Social and Economic Analysis - Part B : Financing Mechanisms - Part C : Water Quality - Part D : Water Environmental Engineering

In the frame of national planning activities of the Pollution Reduction Programme, the results of the National Reviews provided adequate documentation for the conducting of National Planning Workshops and actually constitute a base of information for the national planning and decision making process.

Further, the basic data, as collected and analyzed in the frame of the National Reviews, will be compiled and integrated into the ICPDR Information System, which should be operational by the end of 1999. This will improve the ability to further update and access National Reviews data which are expected to be collected periodically by the participating countries, thereby constituting a consistently updated planning and decision making tool for the ICPDR.

UNDP/GEF provided technical and financial support to elaborate the National Reviews. Governments of participating Countries in the Danube River basin have actively participated with professional expertise, compiling and analyzing essential data and information, and by providing financial contributions to reach the achieved results.

The National Reviews Reports were prepared under the guidance of the UNDP/GEF team of experts and consultants of the Danube Programme Coordination Unit (DPCU) in Vienna, Austria. The conceptual preparation and organization of activities was carried out by **Mr. Joachim Bendow**, UNDP/GEF Project Manager, and special tasks were assigned to the following staff members:

- Social and Economic Analysis and Financing Mechanisms: **Reinhard Wanninger**, Consultant
- Water Quality Data: **Donald Graybill**, Consultant,
- Water Engineering and Project Files: **Rolf Niemeyer**, Consultant
- Coordination and follow up: **Andy Garner**, UNDP/GEF Environmental Specialist

The **Moldavian National Reviews** were prepared under the supervision of the Country Programme Coordinator, **Mr. Ion Ilie Dediu**. The authors of the respective parts of the report are:

- Part A: Social and Economic Analysis: **Ms. Tatiana Belous**
- Part B: Financing Mechanisms: **Ms. Tatyana Lariusin**
- Part C: Water Quality: **Mr. Dumitru Drumea**
- Part D: Water Environmental Engineering: **Mr. Alexander Yakirevich**

The National Academy of Ecological Sciences and the Parliament of Moldova

The UNDP/GEF Danube Pollution Reduction Programme,
Danube Programme Coordination Unit (DPCU)
P.O.Box 500, 1400 Vienna – Austria
Tel: +43 1 26060 5610
Fax: +43 1 26060 5837

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Part C

Water Quality

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LIST OF ABBREVIATIONS

a.c	active compounds
ML	million liters
70-s; 80-s; etc.	1970; 1980 etc.
NN	order number

1. Summary

1.1. Updating, Evaluation and Ranking of Hot Spots

Previous evaluation of the Hot Spots in the Moldavian part of the Danube River basin was made in 1993. The data used for it had a target year 1991 - 1992. No significant changes in the economy and population distribution have happened for the period from 1992 till recent time.

In accordance with statistical data the amount of Gross National Product in Moldova strongly reduced and actually presents only 40% of that at the beginning of the 90-s. Energy consumption also strongly decreased and water supply is available for some hours per day only (in rural area and small towns). Due to this fact the amount of the wastewater in the Moldavian part of the Danube River basin decreased by 40 - 50% compared to the beginning of 90th.

Recent Hot Spots actually influence mainly the small rivers, which are tributaries of the Prut River. Some WWTPs facilities are overloaded, but due to the financial crisis no investments are made for the connection of additional population to the centralized water treatment.

One of key issues from the former agricultural practice in Moldova is the deposits of the manure of big animal farms near Cahul and Edineti, which affect mainly shallow and ground waters. Industrial activity has a temporary character and is arranged mainly during the harvest gathering in 3-4 months in autumn time. Even in this period the amounts of pollutant loads cannot strongly affect Prut River water quality. At the same time water quality of the small rivers (receiving waters) is affected by food industry enterprises.

Recent Hot Spots in Moldova, like food industry center in the northern part of the country (Cupcini), have restarted their operation only 2 years ago. At the same time it should be mentioned that there are some projects aimed at the recovering of some industrial and agricultural enterprises in the Moldavian part of the Danube River basin and one can expect the increase of the pollution loads on environment in the nearest future.

A special Hot Spot, whose influence on environment has never been studied, is the pesticide dump in the southern part of the country. Respective estimations in official data are much less then real ones. Taking into account the location of the dump (14 km from the Danube bank and short distance from the Danube Delta) it can be estimated as a very high priority Hot Spot, which needs to be studied for the development of the concrete action Programme for the reduction of possible negative effect of this Hot Spot on the state of environment in this very sensitive area of the Danube basin.

1.2. Updating, Analysis and Validation of Water Quality Data

There are not any integrated water quality classification schemes adopted in the Republic of Moldova. The evaluation of water quality is accomplished on the base of Maximal Admissible Concentration (MAC) for each contaminant. There are two different kinds of MACs in use. One MAC level is for the water bodies, which are used for domestic purposes (human health oriented, sanitary MAC), and another - for the water bodies, which are used for fish farming purposes (ecologically oriented, environmental MAC). In case of complex usage of a water body (for drinking water supply and for fish farming) the quality of water can be evaluated on the base of both schemes separately. In many cases, the environmentally oriented water quality standards are stricter in comparison with sanitary ones. In addition, the quality of water can be evaluated for irrigation purposes by means of specific water compound norms.

The standards and ecological norms of the former USSR currently are applied in Moldova. Their validity was prolonged by decision of the Moldavian Standards Board until the formulation of corresponding national standards. Actually, water quality can be monitored for 1373 substances, for which the Ministry of Health has set MACs, and 972 substances, for which MACs have been set by the Ministry of Fisheries of the former USSR.

National and regional water quality goals

There are not developed strategic water quality and water protection programmes in Moldova. Currently, the economic difficulties of the transition period force the Authorities responsible for environment to amend the regulations they apply and make corresponding changes in their institutional structure, so that to review and expand the methods applied (including penalties, environmental charges, economical stimuli), reinforce monitoring systems and develop appropriate tools and instruments for this. Hence the task of the environmental Authorities is, the first and foremost, to direct economic reforms towards the attainment of environmental goals. The key steps are to improve environmental protection legislation, including new standards, to switch the responsibilities from central bodies towards the local administration.

In general the strategy for natural resource exploitation and environmental protection in the past was based on rendering emissions and wastewater harmless after the production cycle rather than avoiding inappropriate uses of water and reducing the amount of waste generated by the technologies in use. Thus the capacity of effluent treatment stations grew year by year. At present the wastewater treatment facilities make up the bulk (about 88%) of total country's environmental protection assets. Keeping these assets in working order takes more funds and human resource every year. From 1980 to the end of 1992, the proportion of current expenditure and outlays on capital repairs to total outlays on environmental protection rose from 50% to 58%, while the efficiency of the assets (the differences between the damages averted and the costs incurred as a proportion of the value of the assets) fell from 20% to 2.5%. The remaining funds were mainly used for maintaining existing environmental protection operational infrastructure.

In 1987 the Long-term Comprehensive Programme on Environmental Protection and Rational Use of Natural Resources up to the Year 2000 was adopted by Parliament. A Comprehensive Territorial Nature Protection Scheme was drawn up in 1990 in furtherance of the Programme. The key provisions were formulated in the light of a shift towards intensive methods of economic management and efficient, resource-saving technologies. The Programme called for water protection zones and shoreline strips to be established along small rivers, for the release of untreated wastewater into rivers and lakes to cease. The economic crisis and changing management conditions over the recent years have virtually brought the Programme to a halt.

Priorities and new avenues in environmental protection policy during the transition to market economy relations are set in the National Strategic Action Plan for Environmental Protection (1995). The main target goals are aimed at water resource (quantity aspects) management. Regarding the quality context it was planned to reduce the amount of pollutants in discharges of wastewater, to improve the sanitary regime by 20% and to implement new water quality standards system.

The National Environmental Action Plan, which was elaborated in 1995, is setting up new priorities in economic, fiscal and environmental policy, institutional changes and sectoral recommendation. Water relating issues (water resources, water quality and pollution, water supply, irrigation water, monitoring, etc.) are mentioned as high priority actions for short-term implementation.

Characterization of water quality

The registered yearly average concentrations of $N\text{-}NH_4$, $N\text{-}NO_2$, $N\text{-}NO_3$, P-total in the Prut River during last 15 years are presented in the text. The data were obtained through monitoring programme by Hydrometeo Service.

Surface water quality

The following brief description of water quality was made on the base of data, which were used for creation of the Comprehensive Territorial Nature Protection Scheme (1991). According to this estimation the water of the Prut River corresponds to drinking quality standards (GOST-2874-82 "Drinking water") in terms of mineralization, pH, DO, chlorine, sulfates, oil compounds, N-nitrite and N-nitrate, silicon, copper. At the same time, in many cases, the concentrations of some components were higher then adopted limits. The exceeding concentration rates (indicated in brackets) were indicated for sodium (1,2 - 2,0 times), BOD (1,1 - 2,5), phenols (4 - 9), organochlorine pesticides, NH_4 (1,3 - 1,5), copper (6 - 7), zinc (8 - 12). The water of the Ciugur River (tributary of Prut with monitoring sampling site) did not correspond to drinking water standard in terms of BOD (1,3 times), phenols (12,0), copper (8,0) and zinc (11,0).

The running surface water in the Danubian lakes basin is extremely polluted and could not be used for drinking purposes. Exceeding concentrations of BOD (1,9 - 2,5 times), oil (1,1 - 2,2), phenols (9,0), NH4 (2,4 - 2,6), copper (10), zinc (8 - 13) are detected.

According to the multi-annual statistics the average concentrations of SS in the Prut River are fluctuating mainly in limits 490 - 670 mg/l (in some years the average annual concentration of SS can reach 900 - 1000 mg/l), in the Prut tributaries - 170 - 525 mg/l (800 - 1300 mg/l), in the Danubian lakes region - 2500 - 5000 mg/l (9800 - 11000 mg/l).

The surface water in reservoirs located in the northern part of the Prut basin is limited for drinking purposes by sodium (1,4 - 3,1 times) and pesticides contamination. In central part of the Prut basin the water of reservoirs is polluted by sulfates (1,1 - 2,8 times for drinking standard), sodium (5,6 - 18,9) ions and total mineralization (1,3 - 3,9). For reservoirs located in the southern part of the Prut and the Danubian lakes basins the exceeding of standards was indicated for chlorine (up to 1,7 times for drinking), sulfates (up to 3,1), sodium (up to 14,1) and mineralization (up to 3,2).

2. Updating of Hot Spots

Previous list of hot spots prepared for the SAP was developed at the end of 1993. Data used for Moldavian National Review referred to the 1991 and first half of 1992. Actually many of industrial and agricultural enterprises, which played an important role in national economy at the end of the eighties - beginning of the nineties, are not working at all or only partially.

Transition period in the development of national economy and cooperation with different partners from the European Union, USA, different international Institutions etc. caused appearance in Moldova of new economical units and new technologies. That is why, some other Hot Spots, often not traditional for the country, have appeared for last 2 - 3 years.

At the same time it should be mentioned, that Danube part of the country is mainly agricultural area with strong predominance of rural population. Industrial enterprises are presented mainly by food, tobacco industry. All these factories are not big water consumers and water consumption is relatively small even in comparison with the eastern part of the country.

2.1. General Approach and Methodology

The different human activities and environmental conditions in the Moldavian part of the Danube River basin influenced each other and nature form functions, which have to be taken into account for the development of the Pollution Reduction Programme. Functions to be considered for the Moldavian part of the Danube River basin are:

- agriculture (irrigation, use of pesticides, mineral and organic fertilizers, animal farms etc.)
- municipalities
- fisheries
- recreation
- drinking water supply
- wetlands, natural reservations
- underground and surface water use
- hydraulic structures

The study is based on main issues that might have effect on the state of environment in the Moldavian part of the Danube River basin. They are:

- eutrophication
- pollution with nutrients, toxic and hazardous substances
- disposal of wastes
- sewerage
- pollution of soils, sediments and groundwater
- erosion
- deforestation

Based on the analysis of main issues, which cause environmental pollution, next target groups can be identified for the description and evaluation of the Hot Spots in the Moldavian part of the Danube River basin:

- agriculture
- food industry
- population
- environmental data and trends in the economical development
- transboundary effects

2.1.1. Evaluation of the Existing Hot Spots

Due to the traditional features of the national economy and existing sewer system all Hot Spot in the Moldavian part of the Danube River basin can be divided in the following groups:

- Municipal (industrial wastewater is treated together with the municipal ones)
- Agricultural
- Dumps of industrial, agricultural and municipal wastes

2.1.1.1. Municipal Hot Spots

The communal central systems of water supply are exploited in 56 settlements. The total capacity of water pumping of these systems is 1075 thousands m^3/day. Towns Cahul, Leova, Ungeni, Cantemir consume together 44,1 thousands m^3 per day.

The annual water supply for different purposes from the Prut River is 59 mln.m^3 (domestic, industrial, agricultural and other needs), which is distributed through pipelines. Average water consumption in Moldova (from distribution network, including industrial, agricultural and other needs) is 310 l/day per capita. WWTPs of main towns in the Moldavian part of the Danube catchment area treat 26,9 thousands m^3/day. The volume of treated waters constitutes 94% of all water consumption from the *distribution network* in the Moldavian part of the Danube basin. Emissions from WWTPs in the Prut River are around 30 mln.m^3 per year and the rest is generated in the basins of small rivers Yalpugh and Cahul. The volume of untreated waters is 14% and the common length of sewer system (collectors) in the Moldavian part of the Danube River basin is 2200 km. Irreversible losses and leakage in the distribution network constitutes 30-40% of all water consumption.

The conditions of emissions of sewage waters are determined by regulations on using and protecting of water resources on the base of Maximal Admissible Emission (MAE). These MAEs are confirmed by SS and BOD from 3 to 5 mg/l. Other ingredients normally correspond to the State standard 2874-82 (see Annex 2.1.1.1).

Actual practice of collecting of the wastewater presumes that majority of agricultural and industrial discharges are treated together with municipal ones. Industry in the Moldavian part of the Danube River basin is mainly presented by the food one and that is why list of pollutants is very similar to the list of wastewater dischargers from population. Agricultural emissions treated at the municipal treatment facilities are coming mainly from animal farms (many of them are not working from 1993-94). That is why main pollutants originating from WWTPs are presented by organic substances, nitrogen, phosphorus, BOD etc.

2.1.1.2. Agricultural Hot Spots

Main part of pollutants originating from agriculture refers to the application of organic and mineral fertilizers, pesticides and wastes from animal farms. In comparison with the end of the eighties - beginning of the nineties, when the average use of mineral fertilizers was on the level of 220 kg/ha of a.c. (active component) for N and P, now actual average use is on the level of 10 kg of N and 1 kg of P per ha. Amount of organic fertilizers has also strongly reduced and consists actually of 0,3 tones per ha annually (6-8 tones at the end of the 80-s).

Agricultural sources of pollution are mainly represented by the diffuse sources, where any treatment is impossible. Main point sources of pollution from agriculture are animal farms, which actually are not working, but manure accumulated for many years is a significant source of pollution especially for underground aquifers.

Another pollutant originating from agriculture is pesticides. Actually the amount of pesticide application is on the level of 3-4 kg/ha and half of this amount is presented by copper sulfate (at the end of in the 80-s pesticide application was on the level of 10-12 kg of a.c/ha).

On the base of the results obtained from material accounting for the Nutrient balances study for the Moldavian part of the Danube River basin, actually the most important source of nitrogen and phosphorus for Moldova is erosion. In accordance with estimations it gives 2000 - 2300 tons of N and 130 - 200 tons of P.

Actually due to the structural changes in agricultural practice, approximately the same amount of animals is growing up in the households, without any treatment or deposited facilities. Recently private households have become main producers of meat in Moldova. Treatment facilities at the private households are absent and produced manure is not treated. It is stored directly near the settlement or is used on the adjacent to the house cultivated area. Thus rural settlement can be estimated as a diffuse source of pollution especially for nutrients, BOD, bacteria and viruses.

2.1.1.3. Dumps of Industrial, Agricultural and Municipal Wastes

Each town and big settlement in the Moldavian part of the Danube River basin has its own solid waste disposal sites. In addition to them there is a pesticide dump near the Danube bank (14 km). All these dumps and waste sites including the landfills can be estimated as Hot Spots.

Unfortunately there are no analytical data concerning the chemical composition of solid waste. Therefore it is possible to assess, that they can have influence on the quality of surface and especially underground water quality. Nevertheless, due to the absence of especially hazardous enterprises in the Moldavian part of the Danube River basin and main features of national economy one can admit that chemical composition of these sites can consist mainly of nutrients, BOD, some heavy metals like Cu, Zn, Pb and Cr.

2.1.1.4. Priority Pollutants

An estimation of priority pollutants in the Moldavian part of the Danube River basin was made on the basis of data obtained from the Hydrometeo Service, Statistical data from relevant Ministries and Departments, scientific reports and other sources. These calculations were compared with the water quality standards used in Moldova. The results are presented in Table 2.1.1.4.1.

Table 2.1.1.4.1. Identified priority pollutants and their effects on the water quality

Pollutants	Ranking level of pollution	River basin	Hot Spots
1. Total N	Minor/Moderate	All Danube catchment area	
2. Total P	Severe	All Danube catchment area	
3. Oil	Minor	Lower Prut and Danube	Cahul
4. Metals	Minor	All Danube catchment area	
5. Micropollutants			
5.2. PCBs	Minor	All Danube catchment area	
5.3. Phenols	n.d.		
6.Pathogenic	Severe(*)	Upper Prut	Costesti
bacteria+viruses	Minor/locally(**)	Prut river	Costesti, Cahul
7.Biologically degradable matter (BOD)	Moderate/Severe	Prut river	Leova, Cantemir Cahul

(*) - In accordance with the Pre-investment study for the Prut River basin (Alexander Gibb, UK, 1994) high level of phenols can originate from the wood factory in Colomyia and WWTP in Cernouti (Ukraine), where wood industry is well developed.

(**) - Lactosopositive intestinal bacilli were found in the Costesti reservoir (70 MAL) and near Cahul (2400 MAL) in the summer period.

Ranking: Level ratio "ingredient concentration/standard"

Minor - < 0,2
locally - minor except Hot Spots
Restricted - 0,2 - 0,5
Moderate - 0,5 - 1,0
Severe - > 1,0

Prut River basin, which presents around 80% of the Moldavian part of the Danube River basin is a boundary river, whose quality is affected by transboundary pollution from neighboring countries (Romania and Ukraine), whose contribution to the pollution can be calculated and identified only having the whole picture of this basin. Nevertheless on the basis of the data presented in the Table 2.1.1.4.1, one can emphasize main pollutants for the Moldavian part of the Danube River basin: nutrients, BOD, phenols.

The highest level of the above mentioned ingredients has been registered in the lower part of the Prut River basin (Leova, Cahul) and lower part of small Danubian lakes' tributaries. Thus it is possible to identify this part of the basin as a Hot Spot. List of the main municipal + industrial (industrial and municipal waste waters are treated together at the same facilities) Hot Spots in the Moldavian part of the Danube River basin is presented in the Annex 2.1.1.4.1 and Vulcanesti dump in Annex 2.1.1.4.2.

3. Updating and Validation of Water Quality Data

3.1. Index of Water Quality Monitoring Records

Moldavian part of the Danube River basin is presented by the basin of the Prut River (in Moldova) - 8300 km^2, Yalpugh and Cahul Rivers (in Moldova) - 4300 km^2 (lower Danubian lakes basins). Actually Prut River is monitored at the 6 stations (see Table 3.1.1.). Half of them are part of the TNMN. Sampling is held one time per month and 38 ingredients are monitored (Table 3.1.1.).

Table 3.1.1. Sampling stations in the Moldavian part of Danube River basin

No	Sampling station (distance from the mouth of the river)	Water quality measurements		Hydrological measurements		Biological sampling
		yes/no	frequency	yes/no	category (1 or 2)*	yes/no
1	Sireuti (660 km)	+	monthly	+	1	+
2	Corpaci	+	quarterly	+	2	+
3	Costesti (536 km)	+	monthly	+	2	+
4	Braniste (546 km)	+	monthly	-		+
5	Sculeni (395 km)	+	monthly	-		-
6	Ungheni (376 km)	+	monthly	+	1	+
7	Valea Mare (353 km)	+	monthly	-		+
8	Leuseni (292 km)	+	quarterly	+	2	+
9	Leova (216 km)	+	monthly	+	1	+
10	Stoianovca (152 km)	+	quarterly	-		-
11	Cahul (78 km)	+	monthly	-		+
12	Brinza (45 km)	+	monthly	+	2	-
13	Giurgiulesti (1 km)	+	monthly	+	2	+
14	Birladeni	+	quarterly	+	2	+
15	Ciadir-Lunga	+	monthly	+	2	+

*Note: * - hydrological stations of category 1 are measuring river flow, water level, temperature, turbidity and other parameters, stations of category 2 - only water level (twice a day)*

The network for the water quality and quantity sampling was created at the beginning of the seventies. Danube part (Prut River) of the country was the border of the former Soviet Union with a strict regime and access to the river, even for sampling was very difficult. That is why data about quality of this river are rather poor. Data on the Prut water quality in this time were not transparent for public and were published only in special editions.

Yalpugh River was studied in the mid of the seventies in the frame of the hydrotechnical constructions, which had been finished at the beginning of the eighties by the desiccation of the river valley and construction of the channel, which had to provide artificial water bodies, where TDS was 2,5 - 3 g/l with the Danube water, where TDS was 0,5 g/l. The results of the channel exploitation caused increasing TDS in the transported Danube water up to 2-2,5 g/l (during transportation Danube water was saturating with the salts from rocks, evaporation etc.). It made impossible irrigation in the southern part of the country and actually artificial water bodies are used only for fishing and recreation. The process of siltation is very strong and it is expected that in the nearest time (10 - 12 years), these lakes will disappear.

3.2. Data Quality Control and Quality Assurance

3.2.1. Characterization of Monitoring Programmes

The environmental monitoring in the Republic of Moldova is carried out by different State Institutions.

The following Institutions are responsible for monitoring of water resources (Capcelea, 1995):

- Department for Environmental Protection
  - Service "Hydrometeo" (Hydrological Department) - surface water quantity
  - Service "Hydrometeo" (Pollution Control Center) - surface water quality
  - State Inspectorate of Environmental Quality (Regional Ecological Agencies) - surface water quality, waste water
- Ministry of Health
  - Sanitary-Hygienic Republican Center (Districts sanitary-hygienic services) - surface waters and shallow groundwater quality
- Ministry of Agriculture and Food
  - State Water Management Consortium "Apele Moldovei" - surface water quantity
  - Agency of Geology of Moldova "AGeoM" - groundwater quantity and quality

Each organization follows its specific goals and operates according to specific monitoring programmes (concerning sampling sites, sampling frequency, analytical equipment and methods). At present time, these programmes are not sufficiently coordinated. There is no systematic information exchange between Ministries and data information network.

The Ministry of Health is responsible for the quality control of drinking water by chemical and bacteriological parameters. The samples of surface water and water from shallow wells are analyzed by Districts Sanitary-Hygienic Services and/or on the base of central analytical laboratory.

The control of the quality of wastewater and its treatment is the obligation of Ministry of Municipal Services and Housing.

The Ministry for Environmental Protection, the main responsible Authority in the fields of environmental protection, carries out surface water quality monitoring via Pollution Control Center in Kishinev. The samples are collected during field expeditions and analyzed in central laboratory. The details of hydrological, hydrochemical and hydrobiological monitoring programme, including analytical methods are reflected in Tables 3.2.1. and 3.3.1. At present time there are 13 sampling sites on the Prut River and 2 sampling stations on small internal rivers (Ciuhur, a tributary to the Prut River, and Lunga, a tributary to one of the Danubian lakes). The water quality measurements include about 30 hydrochemical and 5 biological determinants. Biological samples are taken simultaneously with water quality samples during joint expeditions. Saprobic indexes are calculated and information on phytoplankton, zooplankton, zoobenthos, periphyton and bacterioplankton is used for the data interpretation. The analytical possibilities of Regional Ecological Agencies are extremely limited.

As a rule sampling is held by the 2-3 people from the laboratory staff. There were no special training courses for the sampling procedure and staff training. First training in this direction had taken place in 1996 in the frame of the Danube Environmental Programme and 8 people participated in that activity. On the base of this training there was developed a guide for sampling and 2 trained people were selected as responsible persons for the sampling in the Hydrometeo Laboratory.

Another important part of the training activity in the frame of the Danube programme was analytical training in different Institutions in the EU and CEE countries (8 people participated in this training) in 1996. One of the drawbacks of the training was that delivering of the equipment would start probably at the end of 1998 - beginning 1999 and it seems to be useful to repeat some training issues like GC, AAS and data handling. In accordance with the contract between the TACIS and Ministry of Environmental Protection of Moldova (National Institute of Ecology and Hydrometeo service) Moldavian Laboratories will be provided with modern analytical equipment - AAS, GC with computer terminals, consumable, glassware etc. for 450000 ECU. It will strongly improve Moldavian capacities in the frame of the TNMN, local monitoring network and will allow to analyze ingredients, which are not analyzed now.

There are several types of quality control practice in Moldavian laboratories

- *Internal control.* This control is held between laboratories on the base of analyses of the same sample and then results are being compared.
- *International cooperation.* Moldavian laboratories, especially those working within international agreements, participate in the interlaboratory studies and international projects such as QualcoDanube and EQUATE. The results obtained in the frame of these projects showed good compatibility especially for nutrients (more than 90% of tested samples) and fragmentary results on Cu and Zn. Unfortunately actual technical facilities do not allow to analyze heavy metals and some organic substances with instrumental tectonics. Analyses, which were held, were made by using calorimetric method, which does not allow to make mass analyses and takes much time.
- *Technical facilities for the quality assurance.* It is one of the most acute issues in Moldova, because the standards used for calibration of equipment are very old and often inaccurate (on the base of discussion and analytical tests around 50% of standards, received from the former USSR are not pure enough). International cooperation in the frame of such projects allowed to calibrate present equipment and to obtain relevant results especially for nutrients.
- *Quantitative capabilities of equipment.* So as equipment used in Moldova is mainly from the former USSR time, it is very difficult to maintain it and that is why, it often does not work or its efficiency is low. One of the main problems caused by it, is small amount of samples, which does not allow to monitor all hot spots due to very long procedure for analyses and often quality losses in analyses.
- *Internal control of assurance in laboratory management.* The subjects for control are the results of measurements obtained in the frame of methodologically accredited and standard methodologies. Internal control is monitored by head of laboratory. This activity consists from two parts:
- *Preventive control for avoiding of rough error.* This control must be made in the laboratories, where that random error was found, the sample must not depend on the interference components, which must not exceed 1/3. Such control includes in itself operative control of the results on the measurements of rough error and control of the stability of calibrations. Operative control must be held before current measurements of any ingredient. This control is made on the base of standards, which do not have any interference compounds, influenced the results of calibration, and the concentration of measured component must be within working limits. The results are presented in Table 3.2.1.

Table 3.2.1. Parameters used for the estimation of quality control (content developed in the former USSR in 1988)

Date of analyses	Name employee	The content of measured ingredient in solution	The result of control measurement	The normative of operational control of rough error	Estimation of quality of measurement (satisfactory or not)	The causes of rough error and measures undertaken
1	2	3	4	5	6	7

If the number of results, having rough error exceeds 20% or occur 3 times, the causes of this phenomena must be analyzed and responsible persons (mainly head of laboratory) have to develop plan of actions to avoiding them with the nomination of responsible people and dates.

- *Statistical control of measurements*. This activity is held with the standard solutions and tested liquids. Statistical control is held during all control period. The results are summarized in the next format:

Sample nr.	Date of analyses	The result of measurement X	$X - C$ (C-given concentration in the standard solution)	Results of calculation
1	2	3	4	5

Recent laboratory management and analyses are made in conformity with methodology presumed in the ISO standards. Quality assurance is developed among laboratories by analyzing of the same samples and by analyzing of the standards obtained from authorized Institutions. The results are presented to the state Institutions, which are responsible for the accreditation and control of the qualitative laboratory practice. In case of necessity, they provide technical and methodological assistance (very limited) for the improvement of quality parameters in the day to day activity.

Sediment discharges are not measured in the routine monitoring and during the flow measurements. that is why it is really difficult to estimate pollutant loads, which can be contained in them. Due to the insufficiency of financial resources, the processes of siltation were measured last time at the beginning of 90th. All reservoirs on the small rivers where built on the base of 20-30 years functioning.

Statistical procedure is carrying for the next issues of statistical calculations:

- limits of permitted errors for each analysis
- calculation of the parameter of rightness
- control of stability of graduate characteristic (calibration curves)
- statistical control of reproductivity of current analyses (each analyses is carried out in 3 repetitions if results are compatible and more repetitions till the level of reproductive results)

Problems for Moldavian Laboratories involved in the routine monitoring analyses are:

- old equipment
- standards obtained from available sources are polluted
- incompatibilities among laboratories (facilities, chemicals, management etc.)
- low awareness of state authorities to the environmental issues and state of environment
- lack of training programmes for different categories of the laboratory staff

Ways of quality assurance improvement are:

- strengthening of interlaboratory cooperation, exchange of samples, standards, experienced staff, training programmes, obtained results, etc.
- to improve institutional structure in quality assurance practice
- to propose legislative acts and new standards for quality assurance
- to hold permanent training courses for different levels of laboratory staff
- to develop institutional structure for the strengthening of qualitative capacities of the organizations involved in the environmental monitoring

3.3. Data Consistency, Compatibility and Transparency

All analyses held in the Moldavian laboratories are filtered before analyzing. The aim of the filtration is to separate Suspended solids, which are not analyzed in the routine monitoring. Suspended solids are measured, but without analyzing of nutrients and pollutants contained in them. The standard filter is used (around 45 nm.). Methodology used for analysis is presented in the Table 3.3.1.).

Table 3.3.1. Main methods of determination of hydrochemical parameters in the frame of the routine monitoring programme in Moldova

Monitored parameter	Method of determination	Sensitivity
temperature	thermo-metria	0,1 C
pH	pH-metria	
mineralization	calculating, gravimetrically	
suspended solids	gravimetrically	
CO_2	volumetrically	1 mg/l
O_2	volumetrically (Vinkler)	0,05 mg/l
BOD	volumetrically (Vinkler)	0,05 mg/l
COD	volumetrically ($K_2Cr_2O_3$)	5 - 50 mg/l
% of saturation	calculating	
HCO_3	potentiometrically	0,5 mg/l
SO_4	volumetrically (Pb(NO3)2)	1 mg/l
Cl	(Moor reaction)	1 mg/l
Ca	volumetrically (EDTA)	0,5 mg/l
Mg	calculating	
Na	photometrically	1 mg/l
K	photometrically	1 mg/l
hardness	complexonometrically (EDTA)	0,5 mmol/l
phenol	(amidopirinum)	0,001 mg/l
oil products	fluorimetrically	0,02 mg/l
detergents	(blue methylene)	0,015 mg/l
tar and asphalt compounds	fluorimetrically	
organochlorine pesticides (a,b,d,c-HCH, DDT, DDE, DDD)	gas chromatography	
$N\text{-}NH_4$	(Nestler reaction)	0,002 mg/l
$N\text{-}NO_2$	(Gris reaction)	0,007 mg/l
$N\text{-}NO_3$	photometrically	0,01 mg/l
$P\text{-}PO_4$	photometrically	0,005 mg/l
P-total	photometrically	0,005 mg/l
copper	photometrically	0,02 mg/l
silicon	photometrically	0,5 mg/l
cooper	photometrically	0,002 mg/l
zinc	photometrically	0,002 mg/l

In the of leakage, alarm situations etc. analyses are made due to necessity, which is determined depending on current conditions of accidents. In case of high water no special sampling activity is presumed. Sediment discharges have not been measured in Moldova. Some fragmentary studies were held for Dnister River (not part of the Danube basin) in the 70th. Main attention was paid to the studying of siltation processes in water bodies.

Data storage has been made on the paper and published as annual reports (qualitative and quantitative parameters) till the beginning of 90th. These reports could be used only for service purposes without free access to them. Actually new data are also storied on paper or in PC without being included in the informational network. Data obtained in the last 5-7 years are not published at all, but in accordance with legislation everybody can have free access to them. Unfortunately, local authorities often charge financial resources for the using (coping) of the raw data.

3.4. River Channel Characteristics

3.4.1. Network

Moldavian part of the Danube River basin consists of the basins of the Prut, Yalpugh and Cahul Rivers. Last two ones discharge into the lower Danubian lakes situated in Ukraine. These rivers have network of tributaries presented on the Figure 3.4.1.1.

Northern part of Danube basin in Moldova has river density network >0,4 km of rivers per km^2. This area is spread till the confluence of Ciugur and Prut Rivers. Further to the south the rivers' network density varies from 0,3 to 0,4 km per km^2. This zone spreads till the confluence of the Prut and Camenca Rivers (see Figure 3.4.1.1.). Next part of the Danube basin from Camenca River till Lapusna has river density 0,2 - 0,3 km per km^2. Basins of the small rivers, discharging into the lower Danubian lakes have rivers network density 0,2 - 0,3 km per km^2. Lower from the Lapusna River the density if the rivers network becomes 0,1 - 0,2 km per km^2. Watercourses of these rivers are temporarily dry in the summer period. It is a wetland area, which was desiccated in the middle of the 70-s. The lowest part of the Prut basin from the village Valeni has river density network < 0,1 km per km^2.

3.4.2. Channel Cross Section

Prut River has 6 main cross-sections, which differ from each other by character of slopes, width of the floodplains, meanders etc.

First cross-section is from the border with Ukraine and town Lipcani - 665 km from, outfall (see Figure 3.4.2.1). Average width of the Prut River valley here is 2,5 - 3 km. Riverbed is strongly meandered.

Section Lipcani-Costesti - 665 - 536 km from outfall. Prut River valley becomes very narrow and crosses reefed zone. The width of the valley is 200 - 400 m. This segment of river flow is presented by the rocks of carbon, torton and sarmate, age is presented by the carbonates and marl. Recently this area is watered by the Costesti-Stanca water body.

Section Costesti-Pruteni 536 - 430 km from outfall. In this section Prut River valley becomes much larger - 5,0-5,5 km. with big forests areas and wetlands, which were desiccated at the middle of the 70-s. The rocks are presented by alluvial material with strong clay compound.

Section Pruteni-Nemteni 430 - 300 km from outfall. This is also wetland area, desiccated 25 years ago. Its width is around 7,5 km and rocks are very similar with ones from the previous section.

Section Nemteni-New Stoianvca 300 - 152 km from outfall. Prut River valley has symmetric character with small meanders, lakes and old river's beds. Width of the valley is 3 - 5,5 km.

Section down to the New Stoianovca (152 - 0 km from outfall) is much larger than other sections. Its width is till 10 km. Rather big lakes with volume 1-2 million m^3 are located there. It is zone of permanent wetlands, which have been also desiccated in the middle of the 70-s.

Yalpugh River and its tributaries valleys have usually symmetric character with the width 0,5 - 1 km. In the confluence area Yalpugh River valley becomes much larger - 4 -5 km. with the width of the river bed 10-15 m. Before the beginning of 80th it was also wetland area, desiccated for the agricultural needs. Main rocks in the riverbed are sands in the lower part they are presented by clay material.

Cahul River valley has the features, which are very close to the Yalpugh River with the width of the valley in the downstream till 2-3 km.

Schemes for the cross sections are not presented, because of raw data for it were not available from the relevant responsible Institution.

3.4.3. Gradients

On the entering of the Prut River on Moldavian territory the elevation of riverbed is 100,4 m, which declines till 60,6 m till the Costesti-Stanca dam. After it river basin and banks are presented by clay and loamy rocks of different ages and consistency. River elevation is presented on the Figure 3.4.4.1. Yalpugh River begins in the southern part of the country on the elevation of 80,0 m and leaves the territory of Moldova (3 km from outfall) on the elevation of 2,3 m.

3.4.4. Flood Plains

Actually flood plains in the Moldavian part of the Danube River basin are presented by territories, which were flooded during fulfilling of the water bodies. According to data search there were not significant flooding events in Moldova for last 20 years. The most important events were before construction of the Costesti-Stanca barrage and had place in 1955 and 1969, when water level had risen for 7 m. Heavy rainfall in 1991 affected 2000 km^2 in the Lapusna River basin.

Main flood areas are presented on the Figure 3.4.4.1.

3.4.5. Wetlands

Wetland areas in the Moldavian part of the Danube River basin were desiccated in the mid of the 70-s. At the same time, some areas (mainly protected ones) remained in the southern and central part of the Prut River basin and in the downstream of Yalpugh. It should be mentioned, that due to the financial difficulties farmers can not use significant part of desiccated wetland areas and rehabilitation processes have taken place. No special studies were held in the frame of wetland restoration. Normally wetland areas are covered by waters with 0,5 - 1 m for period not more than 1 - 1,5 months. In case of desiccated areas water is pumped and flooding mainly does not have place. Normal water level in the channels of desiccated areas is around 0,5-1 m.

3.4.6. Erosion and Degradation

Average bank erosion of main rivers in the Moldavian part of the Danube River basin is 20-30 cm per year. In some places, due to the natural conditions like confluence with the tributaries, landslides etc. bank erosion can increase till 1 m per year. Due to the absence of navigation, channels etc. bank erosion is not a priority in Moldova.

3.4.7. Dams and Reservoirs

There is only one water body on the Prut River, which was constructed in 1976. Its dam has 30 m height and 10 m width on the top built from the beton. All others are built on the small rivers. Water bodies indicated on the map present those exceeding 1.000.000 m^3. Dams of the water bodies constructed on the small rivers, whose volume is some millions m^3 are mainly built form clay and loamy material aggregated in the wet consistency by bulldozers and planted by grass. Usually theirs volume is 30-50.000 m^3, width 3-5 m and height - 5-7 m. The general characteristics of main natural lakes and artificial water reservoirs in the Prut river basin are presented in Table 3.4.7.1.

Table 3.4.7.1. General characteristics of main natural lakes and artificial water reservoirs in the Prut River basin

Lake	Type	River associated	Year of creation	Using
Costesti-Stanca	reservoir	Prut - riverbed	1978	irrigation, energy, flood control, water supply, fish farming
Beleu	natural lake	Prut - river corridor	-	natural protected area
Manta lakes	natural lakes	Prut - river corridor	-	fish-farming
Calicauti	reservoir	Dradiste - riverbed	1982	irrigation, fish-farming
Tirnovo	reservoir	Racovet - riverbed	1972	irrigation, fish-farming, recreation
Cupcini	reservoir	Chugur - riverbed	1962	industry water supply, fish farming, recreation
Sturzeni	reservoir	Camenka - riverbed	1955/57	irrigation, recreation
Danu	reservoir	Galdarusa - riverbed	1954/75	industry water supply, irrigation
Viisoara	reservoir		1930/70	irrigation, recreation
Limbeni-nou	reservoir	Shoveti - riverbed	1956	irrigation
Limbeni-veci	reservoir	Shoveti-mare - riverbed	1960	irrigation, fish-farming
Sarata-nou	reservoir	Girlo-mare - riverbed	1955/56	irrigation
Scumpia	reservoir		1953	irrigation, fish farming, recreation
Choropcani-nou	reservoir		1984	irrigation
Zagoranca	reservoir	Vladnic - riverbed	1959	irrigation
Ungeni	reservoir	Delia - riverbed	1962/74	irrigation, recreation
Milesti	reservoir	Bratuleni - riverbed	1953	irrigation, fish farming
Bratuleni	reservoir		1953/75	irrigation, fish farming
Lapusna	reservoir	Lapusna - riverbed	1966	irrigation, fish farming, recreation
Carpineni	reservoir		1960	irrigation, fish farming, recreation
Kneazevka	reservoir	Sarata -riverbed	1967/68	irrigation, fish farming, recreation
Sarata-nou	reservoir		1967	irrigation, fish farming, recreation
N 1 Cahul	reservoir	Prut - river corridor	1972	fish-farming, fish-reproduction
N 2 Cahul	reservoir		1972	same as above
N 3 Cahul	reservoir		1973	same as above
N 4 Cahul	reservoir		1973	same as above
N 5 Cahul	reservoir		1976	same as above
N 6 Cahul	reservoir		1976	same as above
N 8 Cahul	reservoir		1974	same as above

The general characteristics of the main lakes and artificial water reservoirs in the Danubian lakes basin are presented in table 3.4.7.2.

Table 3.4.7.2. General characteristics of the main lakes and artificial water reservoirs in the Danubian lakes basin

Lake	Type	River associated	Year of creation	Using
Comrat	reservoir	Ialpuh - riverbed	1957	irrigation, fish-farming, recreation
Congaz	reservoir		1961	irrigation, fish-farming, recreation
Dezgingea	reservoir		1981	run off control, irrigation, fish-farming, recreation
Taraclia	reservoir		1980	irrigation, water supply, fish-farming, recreation
Cahul*	natural lake	Cahul – riverbed	-	irrigation, fish-farming
Vulcanesti	reservoir		1977	irrigation, fish-farming
Cirsovo	reservoir	Cirsovo channel - riverbed	1952/67	irrigation, fish-farming, recreation
Vishneovca	reservoir	Sasucel channel - riverbed	1971	irrigation, industry water supply
Sadic	reservoir	Ialpujeli - riverbed	1975	erosion control, fish-farming, recreation
Cotovskoe	reservoir		1978	irrigation
Ciriet-Lunga	reservoir	Lunga - riverbed	1954	irrigation, fish-farming, recreation
Chioc-Maidan	reservoir	Lunguta - riverbed	1978	irrigation, fish-farming, recreation
Tomai	reservoir		1945/74	irrigation, fish-farming, recreation
Chiriutnea	reservoir		1966	irrigation, fish-farming, recreation
Salcia	reservoir	Salcia - riverbed	1971	irrigation, fish-farming, recreation
Valea-Perjei	reservoir	Perjei channel - riverbed		irrigation, fish-farming, recreation

** - the main part of the water body is out of the territory of Moldova*

The morphometric characteristic of the main natural lakes and water reservoirs in the Prut river basin are presented in Table 3.4.7.3.

Table 3.4.7.3. Morphometric characteristic of the main natural lakes and water reservoirs in the Prut River basin

Lake	Area, km^2	Volume, mln m^3	Length, km	Average width, m	Average depth, m	Maximal depth, m
Costesti-Stanca	59	1085	70-90	840	12,5	34,2
Beleu						
Manta lakes						
Calicauti	0,79	2,04	1,64	300	2,6	5,5
Tirnovo	1,02	1,87	2,6	390	1,8	4
Cupcini	0,82	1,27	2,4	110	1,6	2,6
Sturzeni	0,54	1,1	3,35	160	2	3,9
Danu	0,65	1,17	2,78	230	1,8	3,3
Viisioara	1,25	2,54	3,2	390	2	4,5
Limbeni-nou	0,93	1,18	2,85	330	1,3	1,9
Limbeni-veci	1,31	1,43	3,35	390	1,1	3,2
Sarata-nou	0,8	1,03	2,48	320	1,3	1,9
Scumpia	1,12	1,02	4,34	260	0,9	2,1
Chioropcani-nou	0,35	1,63	1,74	200	4,7	8
Zagoranca	0,63	1,1	2,9	220	1,7	3,5
Ungeni	1,24	1,79	3,21	390	1,4	3
Milesti	0,67	1,28	2,17	410	1,3	3,4
Bratuleni	0,9	1,19	2,7	330	1,3	2,5
Lapusna	0,72	2,12	2,15	340	3	5,5
Caprineni	0,6	1,04	1,2	500	1,7	2,8
Kneazevka	0,95	2,8	2,5	380	3	5,9
Sarata-nou	1,54	2,28	2,5	620	1,5	2,6
N 1 Cahul	1,28	1,54	1,6	800	1,2	2,2
N 2 Cahul	1,28	1,54	1,7	750	1,2	3
N 3 Cahul	1,3	1,56	1,7	760	1,2	2,9
N 4 Cahul	1,3	1,69	1,7	760	1,3	3
N 5 Cahul	1,74	2,09	1,6	1 100	1,2	2,8
N 6 Cahul	2,15	5,58	1,8	1 200	1,2	2,4
N 7 Cahul	1,32	1,52	1,3	1 000	1,2	2,3
N 8 Cahul	1,18	1,36	1,2	1 000	1,2	2,4

The morphometric characteristics of the main natural lakes and water reservoirs in the Danubian lakes basin are presented in Table 3.4.7.4.

Table 3.4.7.4. Morphometric characteristics of the main natural lakes and water reservoirs in the Danubian lakes basin

Lake	Area, km^2	Volume, mln m^3	Length, km	Average width, m	Average depth, m	Maximal depth, m
Taraclia	15,10	62,00	8,5	1 800	4,1	
Congaz	3,08	5,07	5	620	1,7	3,4
Comrat	1,52	2,60	2,85	460	1,7	2,6
Cahul	90,00		25	1000 - 9000	2,0	7,0
Vulcanesti	0,93	2,01	2,82	330	2,2	3,3
Destinjea	0,47	1,18	2,18	220	2,5	3,8
Cirsovo	0,67	1,36	2,6	260	2,0	2,5
Visniovca	0,62	1,69	2,1	300	2,7	5,6
Sadic	0,82	2,30	3	270	2,8	6,3
Kotovskoe	0,94	1,64	3,03	310	1,7	3,4
Chiriet-Lunga	0,43	1,47	0,98	440	3,4	6,0
Cioc-Maidan	0,59	1,52	2,3	260	2,6	4,6
Tomai	0,98	1,70	2,16	450	1,7	3,0
Chiriutnea	1,10	1,58	2,47	440	1,4	3,9
Salcia	0,77	1,44	2,2	350	1,9	3,2
Valea-Rerjei	0,61	1,10	1,38	440	1,8	3,1

Figure 3.4.1.1.

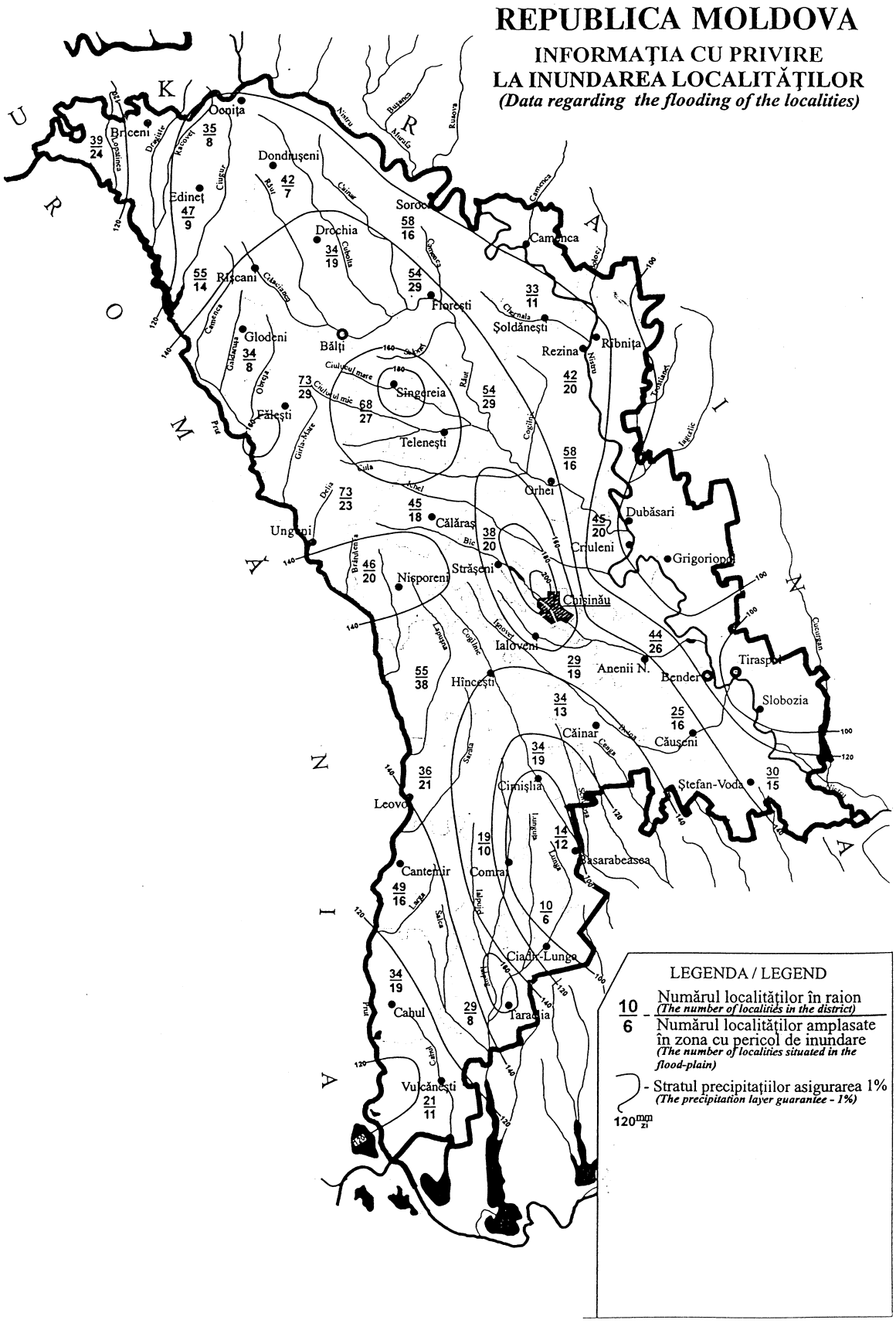
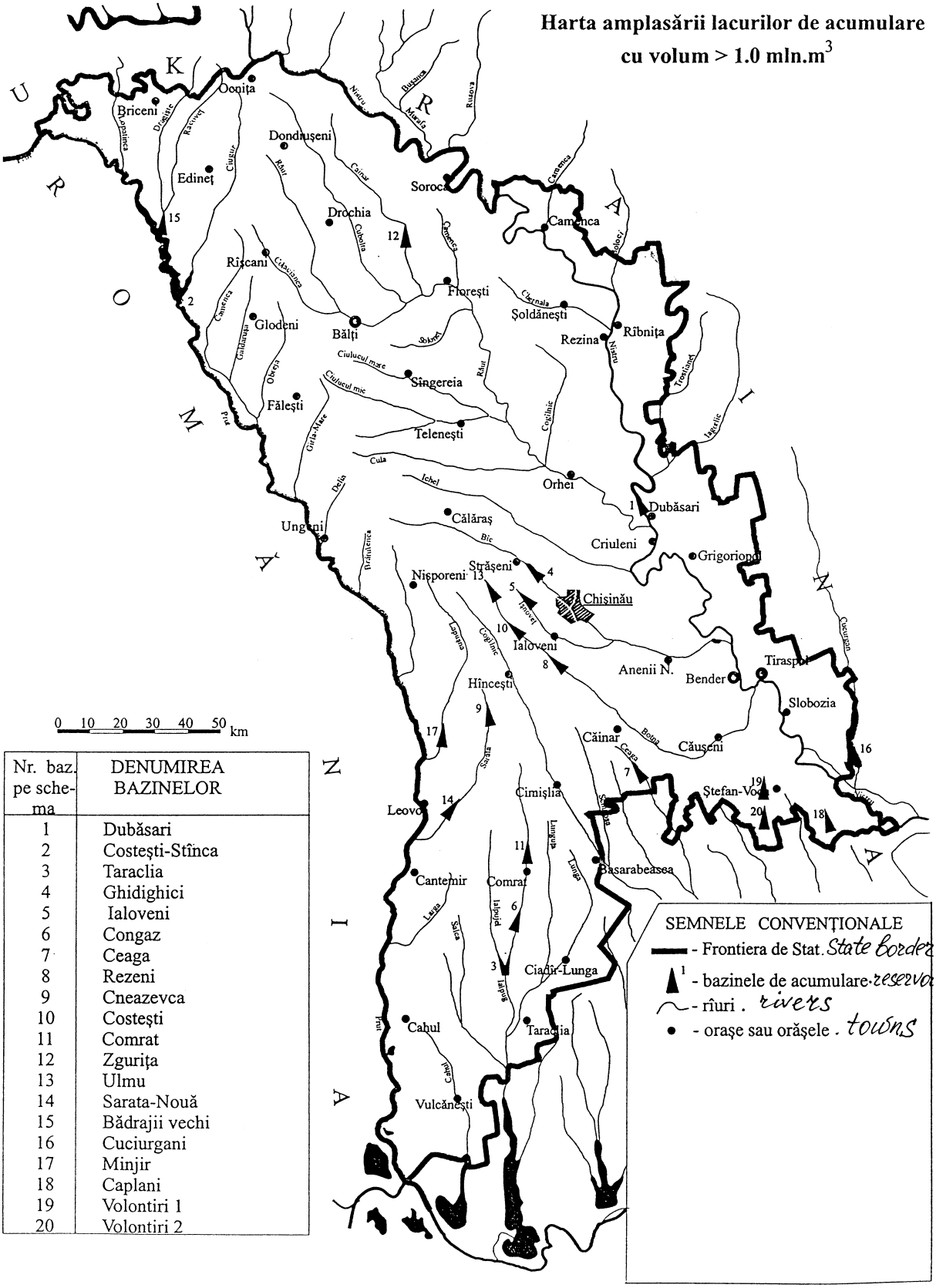

REPUBLICA MOLDOVA
INFORMAŢIA CU PRIVIRE
LA INUNDAREA LOCALITĂŢILOR
(Data regarding the flooding of the localities)
Oniţa
Briceni
Dondruşeni
Edineţ
Drochia
Soroca
Camenca
Rîşcani
Floreşti
Şoldăneşti
Glodeni
Bălţi
Rezina
Rîbniţa
Făleşti
Singereia
Teleneşti
Orhei
Dubăsari
Călăraş
Ungheni
Cruleni
Grigoriopol
Străşeni
Nisporeni
Chişinău
Ialoveni
Anenii N.
Bender
Tiraspol
Hînceşti
Slobozia
Căinar
Căuşeni
Cimişlia
Ştefan-Voda
Leova
Basarabeasca
Cantemir
Comrat
Ciadîr-Lunga
Cahul
Taraclia
Vulcăneşti
LEGENDA / LEGEND
Numărul localităţilor în raion
(The number of localities in the district)
Numărul localităţilor amplasate în zona cu pericol de inundare
(The number of localities situated in the flood-plain)
- Stratul precipitaţiilor asigurarea 1%
(The precipitation layer guarantee - 1%)
120 mm/zi

Figure 3.4.4.1.



Nr. baz. pe schema	DENUMIREA BAZINELOR
1	Dubăsari
2	Costeşti-Stînca
3	Taraclia
4	Ghidighici
5	Ialoveni
6	Congaz
7	Ceaga
8	Rezeni
9	Cneazevca
10	Costeşti
11	Comrat
12	Zguriţa
13	Ulmu
14	Sarata-Nouă
15	Bădrajii vechi
16	Cuciurgani
17	Minjir
18	Caplani
19	Volontiri 1
20	Volontiri 2

3.5. Other Major Structures and Encroachments

There are not any significant industrial enterprises or any other important objects, which could be affected by bank erosion in the Moldavian part of the Danube basin or cause construction of any specific structures and encroachments. Bank protecting constructions have local importance and are located near roads, houses and dams mainly for avoiding of the erosion.

3.6. Major Water Transfers

The artificial water transfer network is not developed in the Moldavian part of the Danube River basin. The channel in the Yalpugh River valley, built at the beginning of 80th (Taraclia channel with the length 130 km and bed width 7m) does not work. Nevertheless there are plans for the construction of the distribution network for the improvement of the drinking water supply network in the south of Moldova (water will be pumped from Danube) and northern part of Moldova (water will be pumped from Prut), but due to the lack of finance these projects were stopped.

3.7. Preferred Sampling Stations and Data Sets

Analyzing of the Hot Spots location and recent volumes of the mineral, organic fertilizers and pesticides use in the Moldavian part of the Danube River basin, we should assume that actual monitoring network for the routine analyses is sufficient and covers main pollutant sources. At the same time, it should be mentioned, that level of water discharges measurement is on the very insufficient level (Moldavian Institutions do not measure river flow in the downstream), which does not allow to combine quantitative and qualitative data. Monitoring network for flow measurements should be added. The most preferable stations (on the Prut River) for such records could be:

- Branesti (546 km from outfall). This is the first monitoring station after the Costesti-Stanca waterbody. It is the area of confluence of some small rivers, which serve as recipients for the discharges from Cupcini food industry center.
- Leova (216 km from outfall). This is the area of confluence of the Prut River with the Gigia (coming from Romania). Area drained by Gigia River is industrial one and after the confluence, Prut River quality becomes 4 class quality (2 class before).
- Cahul (78 km from outfall). Lower Prut area, with desiccated wetlands. Monitoring stations for water discharges from the Moldavian part are absent now. Installation of such station here will allow to estimate water discharges and pollution loads for all Prut River basin.

Small rivers were sampled till the beginning of 90th and actually are not measured at all and it seems reasonable to install measuring stations in the downstream of their basins (2-3) km from outfall.

So as main branches of Moldavian economy and distribution of population do not cause any significant variations in the water discharges and use, actual monitoring network in the Moldavian part of the Danube River basin suits the recent necessities. The frequency of sampling and location of sampling stations allow to obtain results, which satisfy necessities in information on the water quality on the ingredients, which are measured. At the same time it should be mentioned, that many parameters like heavy metals, oil products, organic substances and some others are not monitored due to the lack of relevant analytical equipment, trained staff etc. Interlaboratory studies held in the frame of different projects, showed that obtained results in analyzing of these ingredients are not sufficient and performance must be improved.

Another gap in Moldavian monitoring network is lack of the sediment measurements. Such measurements should be held simultaneously with the recording of rivers discharges and hydrochemical analyses.

The hydrochemical characteristics of main natural lakes and artificial water reservoirs in the Danube River basin (in territory of Moldova) are presented in Table 3.7.1.

Table 3.7.1. Hydrochemical characteristics on main natural lakes and artificial water reservoirs in the Danube River basin

Lake	Parameter										mineralization, mg/l	pH
	K+Na	Ca	Mg	SO4	Cl	HCO3	NH_4	NO_3	NO_2	PO_4		
Costesti -Stinca*	32 - 50	53 -73	9 - 23	69 -125	45 - 75	128-318		2,4		0,09	270-520	7,8
Comrat	533	56,5	83,3	620	398	488		8,7		0,12	2167	8,6
Congaz	588	58,4	94,5	580	412	473		9,4		0,12	2446	9,2
Cahul	41,8	57,3	17,9	65	56,4	198		5,8		0,13	457	8,2
Cupcini	110	36,1	58,4	151	49,6	415*	1,07-2,61	0,68-1,13		0,03-0,26	820	7,5
Danu	140	28	48,6	160	35,5	390*					802	8,3
Tirnovo	62	24	34	72,4	28,4	268*					489	8,2
Viisoara	253	28	60,8	336	21,3	597*					1301	8,3
Navirnet	426	44,1	82,7	724	70,9	610*					1957	8,4
Limbenii-nou	409	44	80,3	703	71	560*					1868	8,7
Limbenii-veci	563	38,8	90	803	116	837*					2448	8,3
Ungeni	563	52,1	90	1002	128	536*					2370	8,7
Cioropcani-nou	145	60	53,5	93,8	35,5	646*					1034	7,9
Scumpia	830	44	95	1383	128	730*					3216	8,9
Sarata-nou	850	44	102	1400	114	880*					3390	8,7
Lapusna	100	65,4	84,3	333	73,3	333*					990	7,9
Carpineni	205	74,1	51,9	477	103	366*	0,16	0		0,01-0,1	1302	7,9
Kneazevka	222	84,2	116	612	170	323*					1526	7,8
Sarata-nou	334	62,8	102	682	218	325*					1724	8,2
Tomai	451	152	117	978	411	268*					2376	8,2
Chirsovo	591	116	105	1111	422	306*					2656	7,7
Chiriutnea	462	148	97	1034	126	220*					2090	8,8
Cazaclia	554	140	117	1194	348	366*					2720	7,6
Dezginge	182	108	49	379	206	220*					1142	7,9
Minjir	193	64	109	527	114	378*	0,13-0,16	0,94		0,04-0,05	1385	7,8
Vulcanesti	79	55	33	150	80	220*					613	7,6
Salcia	184	42	66	351	135	263*					1046	7,8
Chioc-Maidan	458	200	272	1551	595	158*					3234	8,3
Taraclia	636	62	90	868	468	317*					2441	9,2
pond Briceni							0	0,19		0,15		8,1
ponds(8) Falesti	260-770	20-70	60-280	490-1210	50-140	480-1220	0-1,82	0-9,9	0-0,4	0-0,81		8,6-9,6

*Note: *- multy annual data (1985-1988), other reservoirs - average annual data (1987). From the beginning of 90th small waterbodies are not monitored*

Average yearly concentrations* (mg/l) of NH4 of the Prut River on the monitoring stations are presented in the Table 3.7.2. Raw water quality data for 1996-1997 are presented in the Table 3.7.2.

Table 3.7.2. Raw water quality data for 1996-1997

Monitoring station (km from outfall)	Year											
	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994
Sireuti	0,71	1,40	0,75	0,68	1,24	0,42	0,64	0,47	0,72	0,58	0,62	0,28
(658)	0,88	1,24	0,78	0,62	1,42	1,07	0,63	1,01	0,49	0,62	0,14	n,d,
Corpaci	0,71	0,73	1,01	0,63	0,75	0,60	0,32	0,30	0,49	0,33	0,34	0,26
Costesti	0,51	0,72	0,67	0,67	0,94	0,49	0,40	0,37	0,34	0,44	0,28	n,d,
(536)	0,52	0,56	0,67	0,66	0,70	0,56	0,36	0,31	0,55	0,42	0,36	0,74
Braniste	n,d,	n,d,	n,d,	n,d,	n,d,	n,d,	n,d,	n,d,	n,d,	1,34	1,32	1,79
(546)	1,42	1,41	2,69	1,87	4,09	2,01	1,24	1,45	1,93	1,75	1,13	n,d,
Ungheni,	1,03	1,34	2,23	2,02	3,51	1,79	1,08	1,11	1,69	1,00	0,79	0,45
us (376)	0,53	0,75	2,73	2,37	3,82	1,76	0,86	1,45	1,99	n,d,	n,d,	n,d,
Ungheni,	n,d,	n,d,	n,d,	n,d,	n,d,	n,d,	n,d,	n,d,	n,d,	0,81	0,97	0,32
ds (353)												
Leova												
(216)												
Cahul (78)												
Brinza												
(45)												
Giurgi-												
ulesti (1)												

Continuation of the table

Monitoring station	1995	1996	1997
Sireuti (660 km)	0,45	0,66	0,38
Corpaci			
Costesti (536 km)			
Braniste (546 km)	0,17	0,17	0,25
Sculeni (395 km)			
Ungheni (376 km)	0,35	0,48	0,33
Valea Mare (353 km)			
Leuseni (292 km)			
Leova (216 km)			
Stoianovca (152 km)	1,73	0,87	0,88
Cahul (78 km)			
Brinza (45 km)			
Giurgiulesti (1 km)	1,03	0,69	0,71
	0,81	0,58	0,57

Table 3.7.3. Average yearly concentrations (mg/l) of NO2

Monitoring station (km from outfall)	Year											
	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994
Sireuti (658)	0,062	0,030	0,040	0,062	0,069	0,025	0,056	0,046	0,076	0,105	0,070	0,070
Corpaci	0,067	0,027	0,052	0,053	0,074	0,030	0,036	0,044	0,054	0,047	0,020	n.d.
Costesti (536)	0,062	0,048	0,078	0,059	0,038	0,028	0,020	0,025	0,082	0,052	0,040	0,090
Braniste (546)	0,029	0,021	0,049	0,042	0,037	0,029	0,020	0,025	0,032	0,045	0,110	n.d.
Ungheni, us (376)	0,040	0,049	0,056	0,034	0,075	0,040	0,024	0,021	0,034	0,023	0,020	0,070
Ungheni, ds (353)	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	0,044	0,110	0,150
Leova (216)	0,061	0,063	0,138	0,108	0,130	0,066	0,116	0,098	0,125	0,162	0,150	n.d.
Cahul (78)	0,063	0,105	0,188	0,110	0,167	0,083	0,116	0,116	0,183	0,128	0,320	0,240
Brinza (45)	0,064	0,009	0,083	0,081	0,140	0,059	0,220	0,084	0,119	n.d.	n.d.	n.d.
Giurgiulesti (1)	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	0,064	0,040	0,220

Continuation of Table 3.7.3.

Monitoring station	1995	1996	1997
Sireuti (660 km)	0,013	0,020	0,0,022
Corpaci			
Costesti (536 km)			
Braniste (546 km)	0,013	0,018	0,030
Sculeni (395 km)			
Ungheni (376 km)	0,016	0,015	0,016
Valea Mare (353 km)			
Leuseni (292 km)			
Leova (216 km)			
Stoianovca (152 km)	0,045	0,11	0,11
Cahul (78 km)			
Brinza (45 km)			
Giurgiulesti (1 km)	n.d	0,040	0,036
	n.d.	0,058	0,027

Table 3.7.4. Average yearly concentrations (mg/l) of NO3

Monitoring station (km from outfall)	Year											
	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994
Sireuti (658)	1,78	1,45	1,00	2,10	2,52	0,84	1,93	0,80	1,77	1,36	2,11	1,03
Corpaci	1,63	1,57	1,20	1,34	2,17	1,25	1,84	2,07	1,22	1,75	1,93	n.d.
Costesti (536)	2,02	1,85	1,89	1,56	1,85	1,16	2,05	1,43	1,14	2,31	2,12	1,79
Braniste (546)	1,95	1,25	1,76	1,85	2,07	1,11	2,01	1,46	1,10	2,10	2,23	n.d.
Ungheni, us (376)	2,06	1,73	2,27	3,08	2,19	1,05	2,36	1,96	1,15	1,40	2,01	1,58
Ungheni, ds (353)	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	1,97	0,97	1,68
Leova (216)	2,38	1,68	1,72	2,33	2,22	1,27	2,14	1,58	1,07	1,91	1,40	n.d.
Cahul (78)	2,35	2,11	2,14	2,39	2,08	1,53	2,70	2,32	1,95	2,90	2,34	1,36
Brinza (45)	2,52	1,07	1,83	1,52	3,09	2,60	3,32	2,29	0,95	n.d.	n.d.	n.d.
Giurgiulesti (1)	n.d.	n.d.	n.d.	n.d.	n.d.	n,d	n.d.	n.d.	n.d.	1,59	2,29	1,33

Continuation of Table 3.7.4.

Monitoring station	1995	1996	1997
Sireuti (660 km)	1,12	1,5	1,13
Corpaci			
Costesti (536 km)			
Braniste (546 km)	2,38	1,36	2,20
Sculeni (395 km)			
Ungheni (376 km)	2,28	1,87	2,13
Valea Mare (353 km)			
Leuseni (292 km)			
Leova (216 km)			
Stoianovca (152 km)	2,45	1,3	1,3
Cahul (78 km)			
Brinza (45 km)			
Giurgiulesti (1 km)	3,95	1,79	n.d
		2,40	3,01

Table 3.7.5. Average yearly concentrations (mg/l) of P-total

Monitoring station (km from outfall)	Year											
	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994
Sireuti (658)	0,099	0,186	0,068	0,091	0,189	0,053	n.d.	n.d.	n.d.	n.d.	n.d.	0,28
Corpaci	0,070	0,054	0,070	0,113	0,120	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.
Costesti (536)	0,088	0,056	0,054	0,082	0,125	0,134	0,169	0,083	0,166	0,166	0,220	0,26
Braniste (546)	0,086	0,053	0,050	0,084	0,159	0,186	0,111	0,086	0,192	0,126	0,180	n.d.
Ungheni, us (376)	0,084	0,090	0,060	0,099	0,136	0,144	0,197	0,151	0,160	0,163	0,180	0,74
Ungheni, ds (353)	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	0,190	0,300	1,79
Leova (216)	0,128	0,147	0,267	0,228	0,250	0,225	0,215	0,246	0,253	0,226	0,290	n.d.
Cahul (78)	0,117	0,120	0,163	0,235	0,232	0,198	0,229	0,237	0,271	0,140	0,250	0,45
Brinza (45)	0,068	0,091	0,143	0,241	0,274	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.
Giurgiulesti (1)	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	0,178	0,320	0,32

Continuation of Table 3.7.5.

Monitoring station	1995	1996	1997
Sireuti (660 km)	0,049	0,083	0,093
Corpaci			
Costesti (536 km)			
Braniste (546 km)	0,122	0,065	0,074
Sculeni (395 km)			
Ungheni (376 km)	0,121	0,029	0,122
Valea Mare (353 km)			
Leuseni (292 km)			
Leova (216 km)			
Stoianovca (152 km)	0,218	0,150	0,092
Cahul (78 km)			
Brinza (45 km)			
Giurgiulesti (1 km)	0,194	0,132	n.d
	0,152	0,111	0,143

Table 3.7.6. Average year concentration of BOD

Average yearly concentrations (mg/l) of BOD monitoring station (km from outfall)	Year				
	1990	1991	1992	1993	1994
Sireuti (658)	3,30	3,42	3,27	2,25	2,99
Costesti (536)	2,23	2,76	2,75	2,28	2,30
Ungheni, us (376)	2,65	3,37	2,73	3,41	3,55
Cahul (78)	3,8	4,60	n.d.	3,04	3,67
Giurgiulesti (1)	n.d.	n.d.	4,19	3,41	6,96

Continuation of Table 3.8.5.

Monitoring station	1995	1996	1997
Sireuti (660 km)	3,65	2,98	2,70
Corpaci			
Costesti (536 km)			
Braniste (546 km)	2,19	2,71	1,94
Sculeni (395 km)			
Ungheni (376 km)	3,56	2,86	2,43
Valea Mare (353 km)			
Leuseni (292 km)			
Leova (216 km)			
Stoianovca (152 km)	n.d.	3,44	3,43
Cahul (78 km)			
Brinza (45 km)			
Giurgiulesti (1 km)	n.d.	3,20	3,16
	n.d.	3,20	2,90

In accordance with the monitoring programme in Moldova, mentioned ingredients are measured monthly and average yearly concentration is based on the monthly analyses per year.

3.8. Water Discharges

Rivers flows in the Moldavian part of the Danube River basin strongly depend on the amount of atmospheric precipitation. That is why variations in the rivers' discharges correlate to the rains and snow melting.

Discharges for Sireuti and Ungeni stations are presented on the Figured 3.8.1. - 3.8.4. *Other stations are not measured by Moldavian Institutions.*

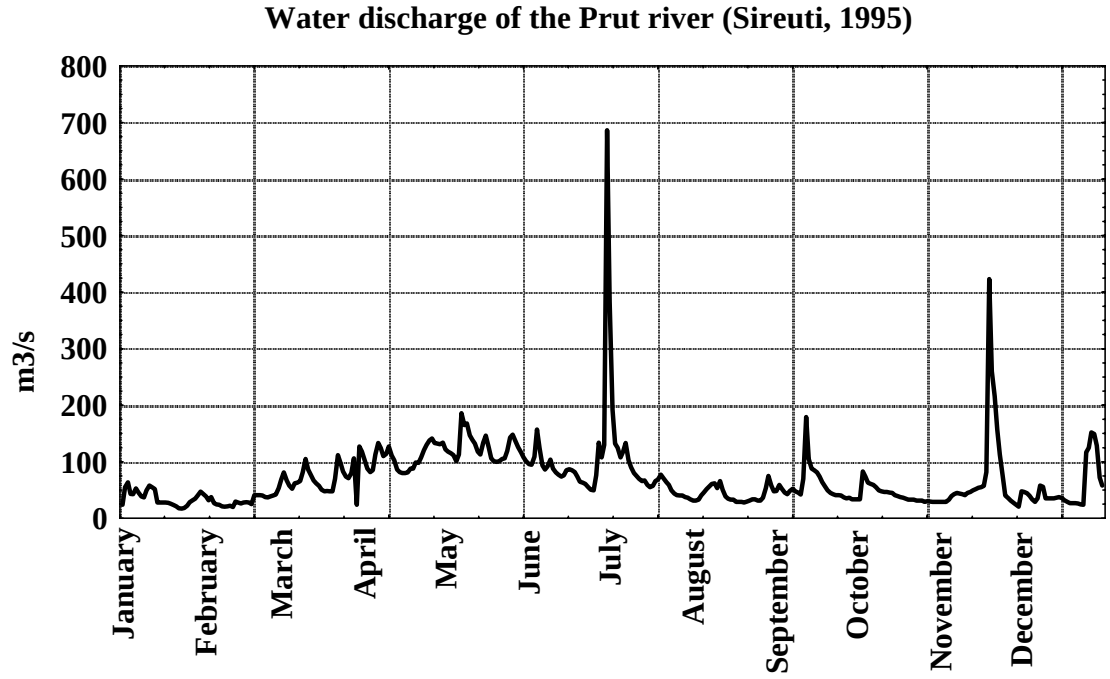


Figure 3.8.1. Water flow of the Prut River (Sireuti, 1995)

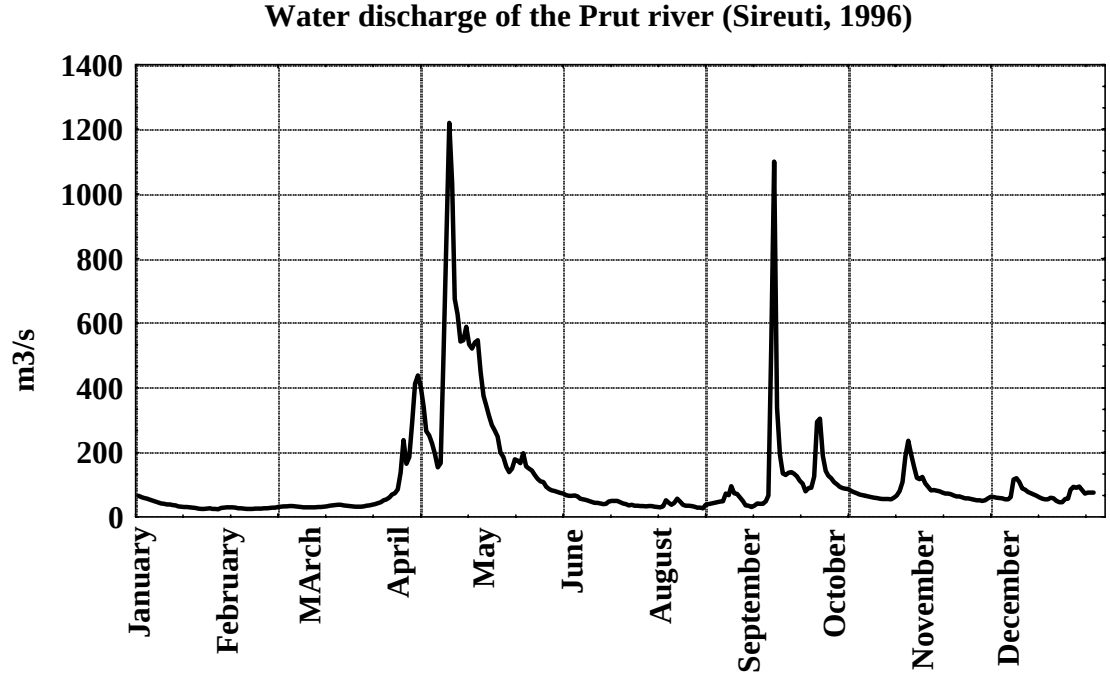


Figure 3.8.2. Water flow of the Prut River (Sireuti, 1996)

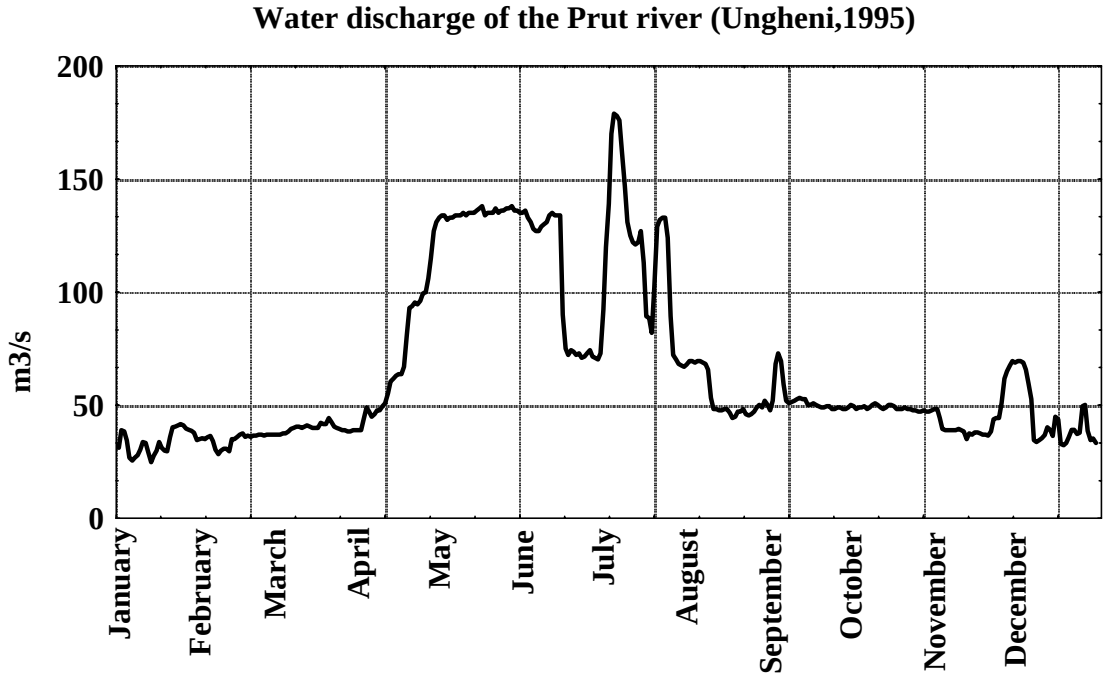


Figure 3.8.3. Water flow of the Prut River (Ungheni, 1995)

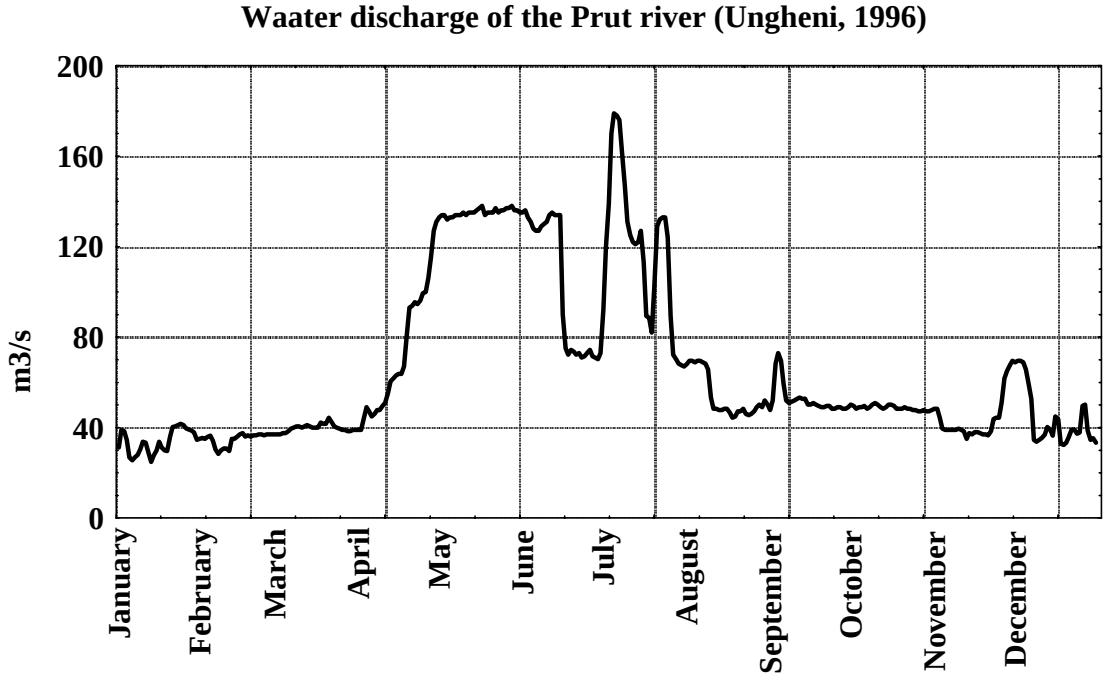


Figure 3.8.4. Water flow of the Prut River (Ungheni, 1996)

3.9. Sediment Discharges

Sediment discharges have not been measured in Moldova.

3.10. Suspended Sediment Concentrations

This ingredient has not been measured in Moldova.

3.11. Water Quality Data

3.11.1.Nitrogen

Actually only mineral forms of nitrogen are analyzed in Moldova. The concentration of all forms of nitrogen grows from upstream to the downstream of the rivers (see fig.3.11.1.1.). Reported average annual concentrations, which are based on monthly measurements, do not exceed MLA (in some cases they are very close to the admissible limits). At the same time it should be mentioned that concentrations of all forms of nitrogen grows after the confluence of the Prut River with the Jijia River coming from Romania.

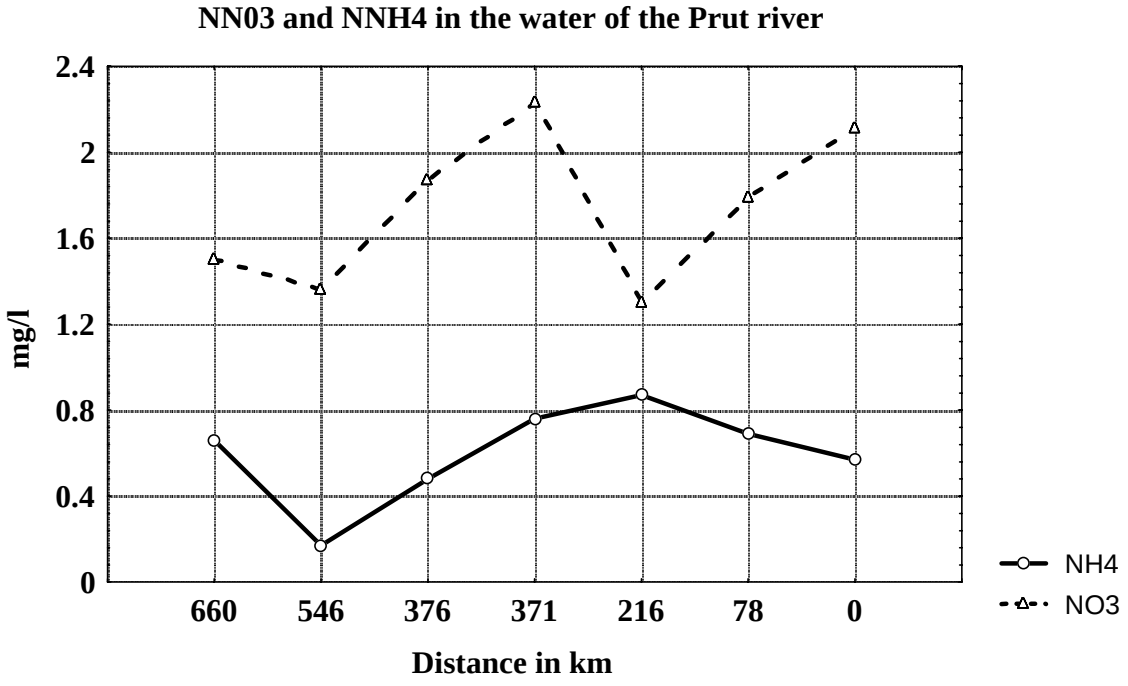


Figure 3.11.1.1. Average annual concentration of the mineral forms of nitrogen in the Prut River

Concentration of the mineral forms of nitrogen in Yalpugh River is higher than in the Prut River. The reasons for it can be low dilution capacity of small rivers, high frequency of water bodies, where the depth is not 2-3 m and erosion of fertile soils from agricultural crops is present. Taking into account that economical activity in the basins of small rivers is approximately the same, density and style of life of population is also very similar from basin to basin, one can assume that water quality in small rivers is close to each other.

Calculations made in the frame of the Nutrient balance study for the Danube River basin show that within total load of nitrogen in the water ecosystems in the Moldavian part of the basin Industry is responsible for 8 t of Nitrogen, mineral fertilizers application 3750 t, organic fertilizers - 1900 t and erosion 12,5 - 20.000 tons.

In accordance with the data obtained from the Hydrometeo service and reports from the National Institute of Ecology one can make a conclusion that concentrations of the mineral forms of nitrogen do not exceed admissible level. According to the standards reported concentrations of $NN0_3$, NNH_4 cannot be limit factor for the water use.

3.11.2.Phosphorus

Moldavian soils have relatively high pH and high content of carbonates near the surface. in these conditions phosphorus compounds have low migration capacity and can be transported mainly with the runoff. Average concentration of this element in waters is normally 10-15 times less then of nitrogen. Concentration of this element also grows from upstream to downstream and after the confluence of the Prut River with Jijia its concentration increases in 1,5 - 2 times (see Figure 3.11.2.1.).

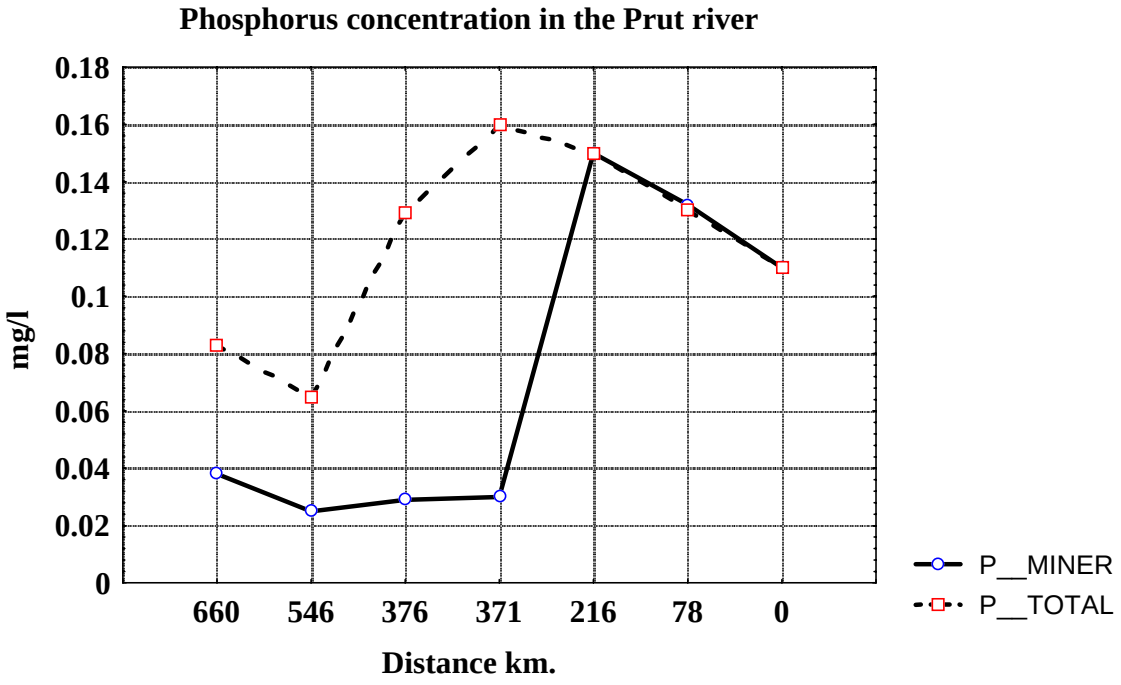


Figure 3.11.2.1. Average annual phosphorus concentration in the Prut River

In accordance with estimations made for the Nutrient balance study industry is responsible for 1 t of phosphorus, mineral and organic fertilizers for 670 tons and erosion for 510 tons.

Phosphorus concentration in small rivers and water bodies is also much higher than in the Prut River. The reasons for it seem to be the same as for nitrogen. Recent standard for phosphorus in Moldova is 3,5 mg/l. Actually environmental and sanitary authorities recognize that it does not reflect real situation and should be revised. Target standard is presumed to be 1 mg/l. The reported concentrations of this element in the rivers of the Moldavian part of the Danube River basin are much lower and cannot limit water use from the rivers. Measurements of total nitrogen and phosphorus are being hold in the Moldavian routine monitoring programme.

3.11.3.BOD and COD

Average concentration of BOD in the Prut River varies from 2,5 till 3,5 mg/l. Significant growing of the concentration of this ingredient takes place after the confluence with the Jijia River (see Figure 3.11.3.1.). Approximately the same picture is for COD, whose level of concentration varies around 20 mg/l (see Figure 3.11.3.2.).

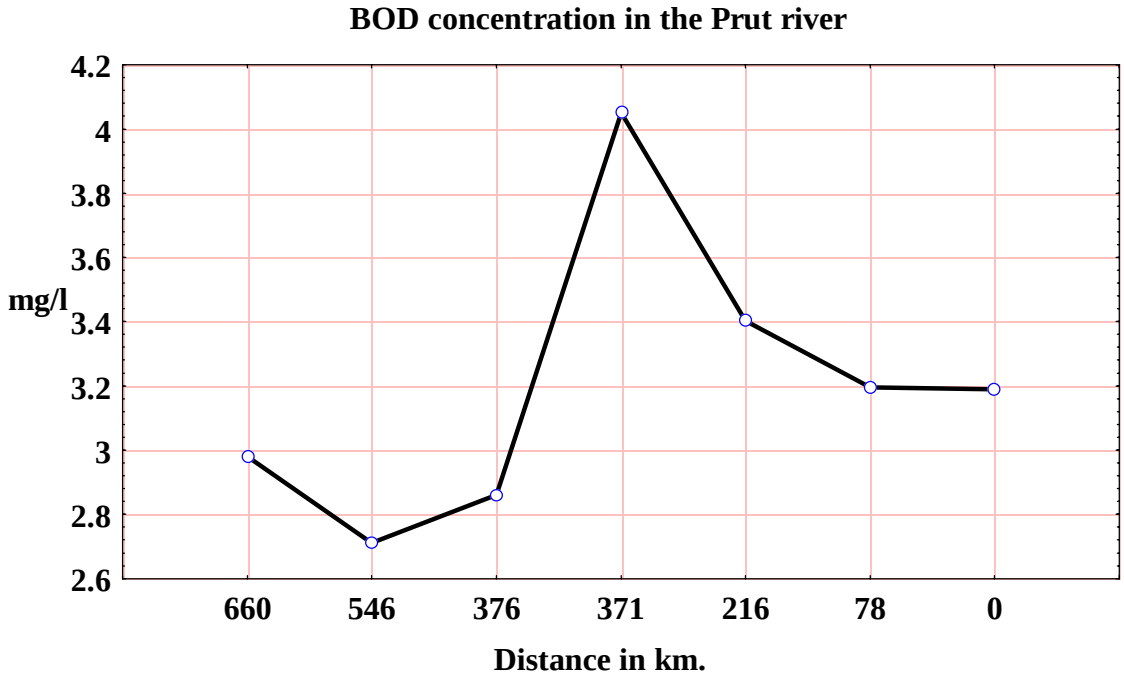


Figure 3.11.3.1. BOD in the Prut River

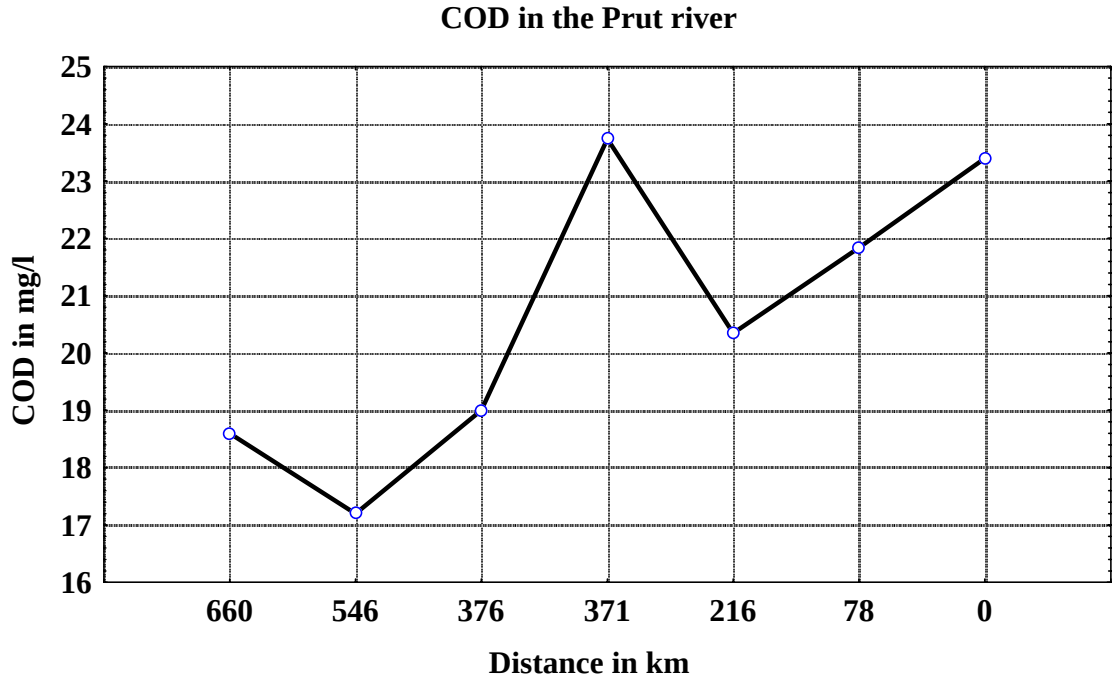


Figure 3.11.3.2. Concentration of COD in the Prut River

3.11.4.Heavy Metals

Only Zn and Cu are included now in the routine monitoring programme in Moldova. The results of analyses show that pollution of water ecosystems with these ingredients does not cause any serious problems and their concentration is much lower than Maximum Admissible Level (see Figure 3.11.4.1.).

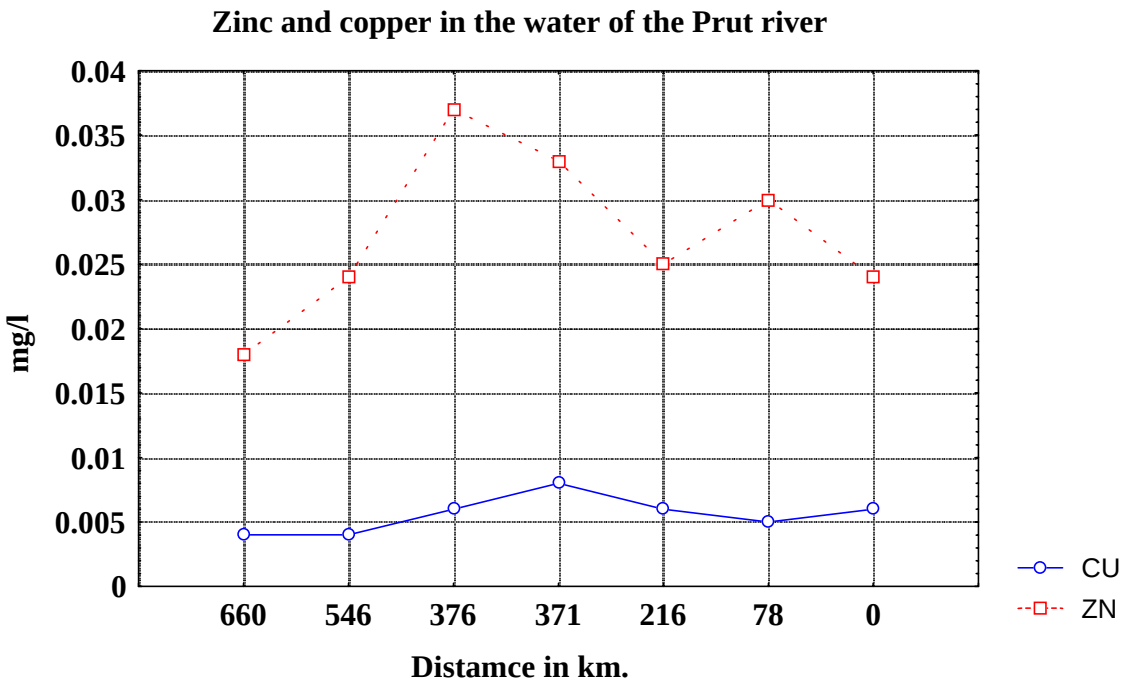


Figure 3.11.4.1. Concentration of Cu and Zn in the water of the Prut River

3.11.5.Oil and Other Toxins

Actual level of routine monitoring of these ingredients does not allow to make any conclusions on the pollution of water with these substances.

4. Brief Overview of Legal and Institutional Framework for Water Quality Control

The legal framework for water resources use, quality control and data report comprises the following laws: The Constitution of the Republic of Moldova, 1994; Forest Code. Law of the Republic of Moldova, 1979; Protection Areas of Rivers and Lakes, 1983; The Law on Environmental Protection, 1993; Water Code of the Republic of Moldova. Law of the Republic of Moldova, 1993; Code on Underground Resources. Law of the Republic of Moldova, 1993; State Ecological Expertise (Environmental Impact Assessment)

In 1993 the Parliament of Moldova made a decision on Adherence of the Republic of Moldova to the International Conventions. Actually, Parliament is discussing ratification of the Danube Convention (ratification will have place probably October-November 1998).

Local authorities have responsibility for quality of environment state including water. Normally they elaborate local programmes for water quality. The local authorities perform on their territory the control over the rational use of natural resources, including water resources, and environmental protection activity; they also are responsible for activity toward soil improving, increasing of green zones and forest zones. Local programmes of environmental rehabilitation and protection are also provided by local authorities according to the decisions of relevant departments.

The system of state ecological control includes Ecological Inspectorate; Ecological Expertise; Ecological Prosecution and Environmental Monitoring.

At present time in Moldova the following institutions realize water quality monitoring and assessment: Ministry for Environment Protection; Ministry of Health; Ministry of Agriculture and Food; Association of Geology of Moldova. Besides, under supervision of the Ministry for Environment Protection are: State Ecological Inspectorate in Kishinev and 5 local agencies (in the Danube part of Moldova). These agencies are provided with equipment, which allows to analyze nutrients and some basic parameters for water quality control and soil.

Hydrometeo Service with central analytical laboratory in Kishinev and countrywide network of regional laboratories analysis the data of 40 hydrological water quality stations and data of number mobile groups of water sampling.

Ministry of Health realizes the control of drinking water on physico-chemical and bacteriological parameters at the stations, where water is pumped for drinking purposes. In addition to it this unit measures boreholes (normally 1 time per month). It involves the main analytical laboratory in Kishinev.

Ministry of Agriculture and Food carriers out the water quality control at fish farms, water bodies through its own laboratories network.

Association of Geology of Moldova explores underground water resources and surveys their quality.

Annexes

Annex 1.

State Standard 2874-82

State Standard 2874-82

Drinking water, hygienic requirements and quality management

Microbiological parameters:

Number of microorganisms in water - 100 per liter
Coli-index - 3 per liter

Concentration of chemical substances in mg/l

Al	- 0,5
Be	- 0,0002
Mo	- 0,25
As	- 0,05
Pb	- 0,03
Se	- 0,001
Sr	- 7,0
Fe	- 0,3
Mn	- 0,1
Cu	- 1,0
Zn	- 5,0
Cd	- 0,01
Sb	- 0,05
Hg	- 0,005
Ti	- 0,1
NO_3 as N	- 10,0
NO_3	- 45,0
NH_4 as N	- 2,0
PO_4	- 3,5 (currently is being revised)
SO_4	- 500
Cl	- 35
DDT	- 0,1
DDD	- 0,4
DDE	- 0,4
Atrazin	- 0,5
Metafos	- 0,02
Detergents	- absence
Oil	- absence
Phenols	- 0,001
Dry residue	- 1000,0
pH	- 6,0 - 9,0
Hardness	- 7,0 mg/equivalent

Annex 2.

Main Hot Spots in the Moldavian Part of the Danube River Basin

Main Hot Spots in the Moldovian Part of the Danube River Basin

Prut and small rivers, which are affected by the "Hot-spots" are not monitored before and after the WWTPs emissions.

NN: 1

District: BRICENI

Treatment Plant: SUGAR PLANT'S TREATMENT PLANT

Water discharge ML (here and further - ML million litters)/year - 2140

Percentage of each stage: Stage 1 - 100%; Stage 2 - 100%, Stage 3 - 0%

Population connected to sewer system (municipal and sugar plant discharges are treated on the same facilities): - 4900

Discharges of main pollutants in tones/year:

Biological Oxygen Demand (BOD)	Suspended solids (SS)	Nitrogen (N)	Phosphorus (P)	Detergents	Petroleum products
54,4	23,8	31,1	4,0	0,46	1,16

Critical emissions. Such emissions happen during maximal working of the sugar plant. This period normally starts at the end of September and lasts for 3-4 months. On the base of interview with municipal authorities and journals of discharges around 80% of all emissions are coming during this period. That is why, it is possible to assume, that 80% of all pollutants loads originate in this period. Thus, in this period of time 43,5 tones of BOD, 19 tones of SS, 24,9 tones of N, 3,2 tones of P, 033 tones of detergents and 0,85 tones of petrol substances are coming to the water ecosystems of the Prut River through the small river (see map), which flow is comparable with the discharges from the plant. Average flow of the Racoveti River (recipient river) is around 2,5 m^3/sec or 86500 m^3/day, these amounts of pollutants are rather significant for the small river and this Hot Spot can be ranked as a **medium priority**.

NN: 2

District: BRICENI

Treatment Plant: Lipcani, TREATMENT PLANT

Water discharge ML/year - 0,40

Percentage of each stage: Stage 1 - 100%; Stage 2 - 100%, Stage 3 - 0%

Population connected to sewer system: - 900

Discharges of main pollutants in tones/year:

BOD	SS	N	P	Detergents	Petrol. prod.
1,0	0,02	0,01	0,001	0,0005	0,0

Amounts of discharges and calculated pollutants loads in comparison with the river flow, which is around 50 m^3/sec, are not significant for Prut, which flow is around 50 m^3/sec and this Hot Spot can be ranked as a **medium priority.**

NN: 3

District: EDINET

Treatment Plant: Cupcini, TREATMENT PLANT

Water discharge ML/year - 3661

Percentage of each stage: Stage 1 - 100%; Stage 2 - 100%, Stage 3 - 0%

Population connected to sewer system: - 8500

Discharges of main pollutants in tones/year:

BOD	SS	N	P	Detergents	Petrol. prod.
20,50	65,9	7,32	6,883	1,32	0,15

The figures from this plant are very similar as for the Briceni sugar plant. The discharges from this WWTP are coming directly to the small river Ciugur (see map), which flow is approximately the same as Racoveti river and this Hot Spot can be identified for this river as **medium priority.**

NN: 4

District: EDINET

Treatment Plant: Pig farm, TREATMENT PLANT

Water discharge ML/year - 0,3

Percentage of each stage: Stage 1 - 100%; Stage 2 - 100%, Stage 3 - 0%

Population connected to sewer system: - 0

Discharges of main pollutants in tones/year:

BOD	SS	N	P	Detergents	Petriol. prod.
0,4	0,3	0,004	0,001	0,001	0,0

The wastes from the pig farm are mainly accumulated in the landfills and are not discharged into the river. Anyway, there can be influence of the pig farm wastes on the groundwater quality. Analyses held by the Sanitary-epidemiological Center showed, that 90% of shallow wells in adjacent area are polluted with nitrates. Exceeding level is 2 - 3 times. That is why, based on the shallow water quality data this Hot Spot can be estimated as a **medium priority.**

NN: 5

District: RISCANI

Treatment Plant: Costesti, TREATMENT PLANT

Water discharge ML/year - 253

Percentage of each stage: Stage 1 - 100%; Stage 2 - 100%, Stage 3 - 0%

Population connected to sewer system: - 1350

Discharges of main pollutants in tones/year:

BOD	SS	N	P	Detergents	Petrol. prod.
1,3	1,85	0,5	0,06	0,055	0,03

Discharges originating from this WWTP are coming directly to the Prut River, which average flow is around 60 m^3/sec. This treatment plant works normally without any seasonal variations. The volume of the residual waters is insignificant in comparison with the main river and that is why this Hot Spot can be identified as a **low priority.**

NN: 6

District: GLODENI

Treatment Plant: Glodeni town, TREATMENT PLANT

Water discharge ML/year - 1887

Percentage of each stage: Stage 1 - 100%; Stage 2 - 100%, Stage 3 - 0%

Population connected to sewer system: - 4500

Discharges of main pollutants in tones/year:

BOD	SS	N	P	Detergents	Petrol. prod.
6,60	9,44	64,1	3,6	0,41	0,22

Discharges from this WWTP come directly to the Prut River. There are no any industrial or agricultural units in this town, which can cause any seasonal variations in wastewater emissions. That is why, taking into account flow of the main river (Prut) with annual discharges from the WWTP (quantitative and qualitative parameters), it is possible to assume that this Hot Spot is **low priority.**

NN: 7

District: FALESTI

Treatment Plant: Town, TREATMENT PLANT

Water discharge ML/year - 825

Percentage of each stage: Stage 1 - 100%; Stage 2 - 100%, Stage 3 - 0%

Population connected to sewer system: - 7220

Discharges of main pollutants in tones/year:

BOD	SS	N	P	Detergents	Petrol. Prod.
3,0	14,9	11,85	1,6	0,18	0,1

Wastewater from this WWTP is discharged to the small river (tributary of the Prut River), which is often dry during the summer period and which flow is very low (>0,5 m^3/s). Taking into account small volumes of discharged waters and absence of seasonal variations of emissions, this Hot Spot can be estimated as a **low priority.**

NN: 8

District: Ungeni

Treatment Plant: Town, TREATMENT PLANT

Water discharge ML/year - 3991

Percentage of each stage: Stage 1 - 100%; Stage 2 - 100%, Stage 3 - 0%

Population connected to sewer system: - 17200

Discharges of main pollutants in tones/year:

BOD	SS	N	P	Detergents	Petrol. prod.
25,2	47,1	122,6	7,5	1,18	0,2

Discharges are going to the Prut River. Industrial enterprises like railway station, carpet plant, food factory, some galvanic facilities etc. work without any seasonal variations and discharge wastewater directly to the municipal sewer system. Analytical equipment of the WWTP does not allow to analyze some ingredients, like heavy metals and some organic pollutants. The type of industries, developed in this town, allows to assume, that these ingredients should be in the wastewater. That is why, this Hot Spot can be ranked as a **high priority.**

NN: 9

District: Ungeni

Treatment Plant: Costesti, TREATMENT PLANT

Water discharge ML/year - 82,5

Percentage of each stage: Stage 1 - 100%; Stage 2 - 100%, Stage 3 - 0%

Population connected to sewer system: - 230

Discharges of main pollutants in tones/year:

BOD	SS	N	P	Detergents	Petrol. prod.
2,6	2,6	1,25	0,16	0,018	0,01

Only municipal discharges, without any seasonal variations and any influence on the water quality of recipient river. **Low priority.**

NN: 10

District: Nisporeni

Treatment Plant: Town, TREATMENT PLANT

Water discharge ML/year - 685

Percentage of each stage: Stage 1 - 100%; Stage 2 - 100%, Stage 3 - 0%

Population connected to sewer system: - 3135

Discharges of main pollutants in tones/year:

BOD	SS	N	P	Detergents	Petrol. prod.
12,25	23,8	9,9	1,3	0,15	0,08

Only municipal discharges without any seasonal variations and influence on the water quality. Discharges are coming to the small river, which is dry during the summer period and often do not reach main river. **Low priority.**

NN: 11

District: Leova

Treatment Plant: Town, TREATMENT PLANT

Water discharge ML/year - 652

Percentage of each stage: Stage 1 - 100%; Stage 2 - 100%, Stage 3 - 0%

Population connected to sewer system: - 4270

Discharges of main pollutants in tones/year:

BOD	SS	N	P	Detergents	Petrol. prod.
2,1	4,4	1,21	1,23	0,15	0,08

There are not any industrial or agricultural units in this town, which can cause seasonal variations. Recipient river is Prut. WWTP in Leova is underloaded (40% of capacities are used now) and are rather new (constructed in 1989). **Low priority.**

NN: 12

District: Cantemir

Treatment Plant: Town, TREATMENT PLANT

Water discharge ML/year - 956

Percentage of each stage: Stage 1 - 100%; Stage 2 - 0%, Stage 3 - 0%

Population connected to sewer system: - 3150

Discharges of main pollutants in tones/year:

BOD	SS	N	P	Detergents	Petrol. prod.
52,6	41,4	13,9	1,8	0,21	0,11

Only mechanical treatment, with seasonal variation September-December (cannery plant). About 80% of all discharges are coming during this period. This region is beginning of the desiccated wetland area, which is only partially used in agriculture. In the nearest future this area can be used for large scale wetland restoration. Water quality of the Prut River in this region is deteriorated. At the same time, water resources from the river are largely used for different purposes, including drinking (towns Cantemir, Cahul some villages). Estimated population using this water is around 70000 inhabitants. Installation of the second stage of treatment is necessary. **High priority.**

NN: 13

District: Cahul

Treatment Plant: Town, TREATMENT PLANT

Water discharge ML/year - 4410

Percentage of each stage: Stage 1 - 100%; Stage 2 - 100%, Stage 3 - 0%

Population connected to sewer system: - 17000

Discharges of main pollutants in tones/year:

BOD	SS	N	P	Detergents	Petrol. prod.
40,10	59,1	20,18	8,3	0,13	0,13

Cannery plant, which also works for 3-4 months and is responsible for 80% of all discharges, causes seasonal variations in emissions discharged to the Prut River. Recently WWTP facilities are underloaded, except for the period of cannery plant working. Water quality of the Prut River is the 3rd class. At the same time pollutants loads are very close to others originating from other Hot Spots and should not cause serious problems for the water quality of the Prut River. That is why it is possible to assume transboundary pollution on this part of the river. **Medium priority.**

NN: 14

District: Comrat

Treatment Plant: Town, TREATMENT PLANT

Water discharge ML/year - 2410

Percentage of each stage: Stage 1 - 100%; Stage 2 - 100%, Stage 3 - 0%

Population connected to sewer system: - 7000

Discharges of main pollutants in tones/year:

BOD	SS	N	P	Detergents	Petrol. prod.
10,10	9,1	2,18	2,3	0,13	0,13

This treatment plant is located in the basin of the small river Yalpugh. Seasonal variations of discharges are insignificant. Due to the types of industry (mainly food industry) municipal wastewater is treated together with municipal ones (common procedure for all WWTPs in Moldova). Due to the small flow of the Yalpugh River (around 4 m^3/s), emissions from this WWTP play an important role for this river and total BOD can give around 0,5% of all BOD in the river. Same picture for nitrogen and phosphorus. That is why this Hot Spot can be ranked as **Medium priority.**

NN: 15

District: Taraclia

Treatment Plant: Town, TREATMENT PLANT

Water discharge ML/year - 1810

Percentage of each stage: Stage 1 - 100%; Stage 2 - 100%, Stage 3 - 0%

Population connected to sewer system: - 4000

Discharges of main pollutants in tones/year:

BOD	SS	N	P	Detergents	Petrol. prod.
5,20	7,1	2,0	0,93	0,12	0,1

This WWTP discharges to the Yalpugh River via another small river Lunguta. Emission volumes are comparable with the Lunguta River flow. There are no seasonal variations in the emissions. Main type of treated wastes is municipal waters. Lunguta river confluence with Yalpugh River is located near the Taraclia water body, which is used for irrigation, fishery farming and recreation. **Medium priority.**

The typical concentrations of influent of WWTPs in the Moldavian part of the Danube river basin are:

BOD - 100 - 150 mg/l
COD (Cr) - 170-250 mg/l
Total N - 15-20 mg/l
Total P - 3-4 mg/l

Effluent

BOD - 10-14 mg/l
COD(Cr) - 25-35 mg/l
Total N - 10-15 mg/l
Total P - 2-2,5 mg/l

Annex 3.

Dumpsite in the District of Vulcanesti

Assortment and amounts (tones) of pesticides, buried in the repository in the district of Vulcanesti

NN	Name	
1	2,4 -D Buthil ether	2,3
2	2,4-D Na	8,6
3	2,4 -DA	148,9
4	2,4-DB	6,2
5	AB preparation	8,4
6	Anabasin sulfate	0,1
7	Anthio	0,4
8	Atrazine	13,0
9	Bensophosphate	0,5
10	Betanal	0,2
11	Calcium arsenate	9,1
12	Carbolineum	23,6
13	Carbophos	1,9
14	Carbothion	124,1
15	Chlorophos 7%	0,6
16	Chlorophos 80%	17,2
17	Chomezin	13,0
18	Copper acetate+arsenate	0,5
19	Copper chlorooxide	2,7
20	Copper naphtenate	24,5
21	Copper sulfate	8,0
22	Cosan	11,1
23	Cupricol	1,2
24	Cupritox	0,7
25	DCU	0,3
26	DDT 15%	3,1
27	DDT 30%	318,9
28	DDT 5,5%	187,7
29	DDT 75%	22,6
30	DDT, technical	107,5
31	DDT, paste	14,3
32	Dalatone	30,7
33	Dendrobacilline	6,4
34	Dicol	5,8
35	Difenamide	8,0
36	Dinitroortocresol	3,8
37	Ditox	27,7
38	Dosanex	0,3
39	Enide	10,9
40	Entobacterine	70,5
41	Ethersulphonate	39,0
42	Fentiuram	0,5
43	Ferrum sulfate	7,3
44	Fundasol	0,1

45	Granosane	11,6
46	HCH 12-25%	96,6
47	HCH 16%	2,1
48	HCH 20%	14,3
49	HCH technical	17,1
50	Hungazine	2,7
51	Isofen	0,5
52	Keltane	12,3
53	Lindane	0,2
54	Linuron	6,8
55	MCPB	1,1
56	Magnesium chlorate	6,6
57	Metabiosulphate	0,1
58	Metaphos	21,0
59	Metathion	0,3
60	Methaldehide	0,3
61	Methyl-parathion	1,0
62	NRV	0,4
63	Naphtaline	2,4
64	Nemagone granulated	294,2
65	Nitrafen	45,3
66	Novozir	8,8
67	Off Shut	1,4
68	Olgin	0,3
69	Pentatiuram	0,9
70	Perosine	17,5
71	Phosalon	0,2
72	Phtalophos	3,6
73	Polycarbacin	0,8
74	Polychlorcamphene	104,4
75	Polychlorpiren	37,1
76	Polychome	0,5
77	Polytriazine	67
78	Preparation 30	39,8
79	Prometrine	0,5
80	Radocor	1,7
81	Ramrod	4,0
82	Redion	1,5
83	Rogor	2,1
84	Rovicurt	1,5
85	Semeron	0,1
86	Sevine	21,5
87	Sulphur 80%	17,6
88	Sulphur colloidal	16,6
89	Sulphur ground	52,1
90	Symazine	31,9
91	TCA Na	5,1
92	TMTD	9,0

93	Tetral	0,2
94	Thiosulphate	1,4
95	Tiason	21,0
96	Tilt	4,2
97	Treflan	0,2
98	Tricholole - 5	10,0
99	Tritox	6,7
100	Tur	10,9
101	Unknown powders	680,5
102	Venzar	0,1
103	Vofatox	29,2
104	Zeapos	0,4
105	Zeazine	6,7
106	Zineb	22,1
107	Ziram	66,0
108	Mixture of ferroconcrete&pesticides (fire remains)	800
	Fumigant G-17 grenades	
109		800 units
		TOTAL: 3937,9 Tones

This Hot Spot was constructed in 1978. Filling of the dump had been going till 1986. Only official figures are presented in this table. At the same time on the base of the interview with the people participated in the construction of this dump the depth of each tank was 7-8 m and pesticides are deposited on the pressed clay surface. The volume of each tank is 8 m depth x 7-8 m width and 22-23 m length or about 1350 m^3. Taking into account that plastic cellars with pesticides were pressed by bulldozers, it is possible to assume that the aggregation of the deposited material was close to the soil and could be on the level of 1,6 - 1,8 t/m^3. Based on it we can assume that there are about 2300 tones of banned material in each tank. As there are 15 tanks, it is possible to assume around 35000-40000 tones of deposited material in this dump (it is only *estimations*, which seem reasonable, but for any estimations for the Pollution Reduction Programme official figures should be used). Adjacent area was also covered by the unauthorized dumping of pesticides. Recently all these plastic or paper cellars are covered by the runoff and are visible only partially.

There had been no special studies aimed at the studying the influence of this dump on the state of environment in this region. At the same time, international expedition held in 1991 on the Danube River (Danube for whom and for what) reported about the detection of DDT and Lindane in the sediments only in this part of the Danube. Underground and shallow waters have not been studied for last 15-17 years and any information on the influence of the dump on the sate of environment is absent. Taking into account amounts, types of the deposited material, ways of deposition and lack of information this Hot Spot can be ranked as a **High priority.**

Annex 4.

Index of Water Quality and Discharge Records

Index of Water Quality and Discharge Records

Sampling station Name & ID	River name	River bank (L or R)	Coordinates or river km	Number of years of records and the latest year of record for each of the categories of parameters						
				Water dis-charge	Sedi ment dis-charge	N	P	BOD	Heavy metals	Other toxics
Sireuti	Prut	L	660 km from outfall	24/97	not detected	24/97	24/97	24/97	24/97 only Cu and Zn	24/97 phenolpes-ticides (DDT and lindan, oil prod (fragmen-tary
Corpaci	Prut	L				24/97	24/97	24/97		24/97 pesticides, oil (frag-ment).
Costesti	Prut	L	536 km from outfall	24/97 water levels	frag-mentary data on silta tion	24/97	24/97	24/97	24/97	24/97 pesti-cides, oil prod.
Branesti	Prut	L	546 km from outfall			24/97	24/97	24/97		
Sculeni	Prut	L	395 km from outfall			24/97	24/97	24/97		
Ungeni	Prut	L	376 km from outfall	24/97		24/97	24/97	24/97	24/97	24/97
Valea Mare	Prut	L	353 km from outfall			24/97	24/97	24/97		
Leuseni	Prut	L	292 km from outfall	24/97 (Wat. level meas-ure-s)		24/97	24/97	24/97		
Cahul	Prut	L	78 km from outfall			24/97	24/97	24/97		
Brinza	Prut	L	45 km from outfall			24/97	24/97	24/97		
Giurgiu-lesti	Prut	L	1 km from outfall			24/97	24/97	24/97		
Birladeni	Yalpugh	middle	1 km from outfall	15/90	some data on siltation on water bodies	15/90	15/90	15/90	frag-ment. data from sci. papers	fragment. data from sci. papers
Ciadir-Lunga	Lunguta (Yalpugh)	middle	middle 0,5 km from outfall			10/90	10/90	10/90		

Part D

Water Environmental Engineering

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1. Summary

Generally, the Moldavian part of the Danube River basin constitutes 12500 km^2 or almost 40% of the whole territory of the country. Main rivers of this area are: Prut (catchment in Moldova constitutes 8300 km^2), which is the last significant Danube tributary, Yalpugh (catchment area - 3300 km^2) and Cahul (catchment area - 900 km^2) entering into the lower Danubian lakes Yalpugh and Cahul situated in Ukraine.

The Prut River is the last significant tributary of the Danube River; it is also the second largest river in Moldova with a network of small rivers, normally drained in summer time. Generally, water of Prut River is moderately polluted. All small rivers - tributaries of the Prut River are extremely polluted. Within last decades river valleys and floodplains have been cultivated to the edge of the river banks; waters are polluted by fertilizers and pesticides residues, in spite of the fact that the application of chemicals means has substantially dropped within last few years; besides, surface water resources are polluted by organic material from cattle-breeding farms, and some toxic and chemicals from industry. The most significant pollution of Prut River water is marked in its middle-stream after discharge of Jijia River from Romanian side near village Nemteni. The groundwater is mostly marked with nitrates pollution.

In Moldova there exist no developed strategic water quality and water protection programmes. However, in spite the difficulties of transition period the ecological authorities are going dramatically to amend the situation in the sphere of applied regulations, including environmental charges, penalties and various economic stimuli; of reinforcing of monitoring systems and developing of tools and instruments. The key issue is to improve ecological legislation, to establish new standards and to transfer some responsibilities from central ecological authorities to local ones.

The state of human health and population welfare depends on water quality. In Moldova the state of population health is rather poor. Besides, because of insufficient water quality, drainage of major part of wetlands, large-scale extraction of river sand, building of hydrotechnical constructions and other anthropogenic causes one can observe direct and indirect destruction of habitats and loss of biodiversity. Water of good quality is essential not only for organisms living in water but for other wildlife depending on this water. The national targets of reduction of water pollution are to maintain human health and eliminate health risk in water resources, to provide sources of nutrition and to maintain and restore biodiversity.

Generally activities on water protection are elaborated with consideration of schemes of complex use and protection of water resources. On the basis of special calculations maximum permissible discharges are determined. Maximum permissible discharge is established for each pollutant separately with consideration of background concentration, the category of water use, the norms of water quality in waterbody, its assimilating capability and optimal distribution water among its users by relative services of Ministry of Health and other Ministries, which are involved in assessment and definition of use for waterbody. Condition of discharge are determined with consideration of dilution degree of wastewater with receiving water in certain waterbody on the stretch from wastewater discharge to the nearest control site; background chemical content of water in waterbody in the sites of wastewater discharge; natural capability for self-purification.

The Ministry for Environment Protection and Sanitary-Epidemiological Service of the Ministry of Health are responsible institutions for the licensing of wastewater discharges into surface water; the duration of such kind of license is a period between 1 and 5 years. According to Water Code the discharge of wastewater is permitted only if: I) it will not result in the exceeding of maximum allowed concentration in receiving water; ii) the users will provide the treatment of wastewater to the degree required by the ecological, water management and sanitary authorities. The base for calculation of fees or charges is wastewater volume-related and pollution load-related. These payments are made to the account of extra-budgetary Ecological Fund and could be used for improving of environmental conditions.

Currently pollution fees and fines and natural resources user charges inadequately reflect the social cost of environmental degradation and do not provide pollution reduction or use of natural resources.

Currently in Moldova next standards of water quality are used - for drinking water; for water used for recreation; for water used as sources a centralized water supply, for irrigation and for wastewater discharge.

Generally, the efficiency of existing system for water quality monitoring is quite poor because its implementation is realized by various institutions and often is not coordinated.

Currently the mechanical and biological purification are the main method applied in purifying of wastewater polluted by organic substances. This kind of treatment includes use of biofilters and aerotanks with further use of biological ponds and microfilters.

In respect of reduction of water pollution from municipalities in the first turn the measures will be concentrated at the bringing and maintaining water treatment efficiency in existing wastewater treatment plants to relevant level; improving of their operations and functioning, and repair of municipal storm run-off canalization system.

In respect of decreasing of impact from livestock husbandry in public sector it is supposed to develop: new possibilities for use the unconventional technologies in wastewater purifying by plants and microorganisms toward reduction of pollution; possibilities of maximum water recycling in animal farms; to elaborate the technology of anaerobic biological purification of liquid wastes from animal farms aimed at their harmlessness and obtaining of biogas and organic fertilizers of high quality; to elaborate the intensive methods of biothermal treatment of solid phase of waste from animal farms aimed at the obtaining of organic fertilizers and some others measures. However, to meet environmental standards the farm management should be focused also on investments in new technologies and currently it is quite difficult because of lack of financial means.

Besides, it should be mentioned that currently the situation with animal farms to some degree has changed; the number of big animal farms has been reduced and a big share of animals are concentrated in the private sector. However, the pollution of water by organic material did not drop significantly, but currently such kind of pollution in some places mostly represents rather diffuse than point source.

Agricultural chemicals are considered a major diffuse source of pollution source. In this connection in the National Strategic Action Plan have been outlined the strategic policies and some measures are to be undertaken: efficient fertilizer application to minimize agro-chemical pollution; soil conservation practice to reduce agricultural run-off; study the possibility for sustainable level of fertilizer application in order not to damage environment.

Unfortunately, currently in Moldova there do not exist any technical projects related to the actions toward improving of self-purification of watercourses. However, some measures aimed at the rehabilitation of wetlands are going to be undertaken. In the first turn it concerns the recently elaborated in Moldova project on wetland restoration.

Despite the fact that more than half of county's industry closed down and the volume of industrial wastewater has strongly declined (around 70%), due to declining functioning of treatment plants the concentration of pollutants per volume in discharging water has increased due to the insufficient treatment, especially during energy disconnection.

Generally the problem of industrial and domestic waste utilization is still remains, in spite of the fact that the volume of their production has decreased in comparison with previous years. Moreover, the volume of accumulated waste is growing because the problem of its utilization has not been solved yet. The Program of Activity of the Government for 1994 -1997 provided for the

developing of a new system for waste collection and utilization. However, details have not been elaborated for the developing of such system. The situation with toxic substances on the Moldavian territory located in the Danube River basin is quite acute, and this fact is mainly due to the lack of specialized dumps and systems for neutralization of such substances. In the majority of the cases the waste is placed on the territory of the enterprises or partly is transported to the municipal dumps. The situation is getting worse because the majority of industrial enterprises are in critical condition and there is no relevant efficient normative basis.

Among the most appropriate policy measures for pollution reduction of water appeared to be improvement of legislation and technical regulation for pollution reduction; strict observance of legislation and technical regulations; developing of new taxes on use mineral fertilizers, pesticides and other agro-chemicals; developing new system of fees and charges for discharges of wastewater reflecting to their real damage to environment and possible cost for its recovery; developing a new system of penalties for exceeding of licensed pollution on the same base; create a system of taxes for withdrawal of raw water from surface and groundwater sources, which would be more adequately reflect the value of fresh water.

2. National Targets and Instruments for Reduction of Water Pollution

2.1. Actual State and Foreseeable Trends in Water Management with Respect to Water Pollution Control

The Prut River is the second largest river in Moldova with a network of small rivers, normally drained in summer time. Generally, water of the Prut River is moderately polluted. All small rivers - tributaries of the Prut River are extremely polluted. The main sources of surface water pollution are next: discharge of untreated and insufficient treated wastewater; animal farms and storm run-off of fertilizers and pesticides, waste disposals, and insufficient sewerage in rural area. Within last decades river valleys and floodplain have been cultivated to the edge of the river banks; waters are polluted by fertilizers and pesticides residues, in spite of the fact that the application of chemicals means have substantially dropped within last few years; besides, surface water resources are polluted by organic material from cattle-breeding farms and some toxic and chemicals from industry. The groundwater is mostly marked with nitrate pollution. There are about 600 big and small municipal and industrial solid waste disposals and special polygons for sanitary treatment of solid waste and a lot of illegal dumps with mixed industrial and municipal waste. Altogether there are about 270 small wastewater treatment plants; from small wastewater treatment plants only about 20% operate on the permanent base. Majority of WWTPs strongly affects water quality; normal methods of treatment are mechanical and biological ones. Besides, the treatment efficiency of existing wastewater treatment plants is very poor due to the insufficient energy supply and the concentration of discharging pollutants does not correspond to permissible meanings. In the populated areas where treatment plants are absent, mostly local systems of wastewater are operated taking their discharges into tanks, ravines etc. It concerns such objects as schools, kindergartens, local enterprises, hospitals and others. Only 50% of urban population and 1,5% of rural population living in the Moldavian part of the Danube River basin are connected to centralized sewerage systems, what represents a significant source of groundwater pollution. The quality of groundwater used for domestic needs is threatened by high levels of nitrates, pesticides, hydrogen sulfides and fluorides. Most of groundwater wells are shallow with average 7 meters depth. The waters of deep wells often contain high levels of fluorides, especially in the northern part of Moldavian part of the Danube River basin. Altogether half of drinking water from groundwater sources in the Prut River basin has increased nitrates level. In fact, in the southern part of Moldavian part of the Danube River basin groundwater could not be used for irrigation as a result of poor water quality. About 20 % of drinking water supplies contained fecal coliforms, what is a major factor in the increasing of hepatitis A cases. Also, monitoring data from natural springs and fountains indicate that about 70% of samples contained exceeding concentrations of nitrates and ammonium. Besides, about 25 % of all samples exceeded biological standards.

The most significant pollution of Prut River water is marked in its middle-stream after discharge of Jijia River from Romanian side near village Nemteni.

Table 2.1. Some indexes of Prut River water quality after discharge of Jijia River

Determands	Index (mg/l)
Odor (force)	3
Color (degree)	50
PH	3,2
suspend solids	16,5
iron	11
manganese	11
hardness	4,5
sulfates	175
chlorides	75
dry residue	572
HCO_3	8,8
Se	11
fluorides	0,29
detergents	11
BOD_5	6,4
BOD_{total}	8,3
COD	22,5
Phenols	0,02
Ammonia	5,0
Nitrites	0,7
Nitrates	0,3
petrol products	11
dissolved oxygen	4,8
Mercury	11
Copper	0,04
Organochlorine pesticides	0,0004
Treflan	11
Organophosphate pesticides	11
Chlorofos	11
Symtriazin	11
Cadmium	11
Lead	11
Zinc	11
Sr	1,2
Be	11
pathogenic microorganisms / l	11
number of coli bacteria/l	240000
fecal contamination/l	2300

(Data are obtained from the State Programme "Drinking Water", Kishinev, 1994)

2.2. National Targets for Water Pollution Reduction

In Moldova there are no developed strategic water quality and water protection programmes. However, in spite the fact that the difficulties of transition period the ecological authorities are going dramatically to amend the situation in the sphere of applied regulations, including environmental charges, penalties and various economic motivation; of reinforcing of monitoring systems and developing of tools and instruments. The key issues are to improve ecological legislation, to establish new standards and to transfer some responsibilities from central ecological authorities to local ones. In the past the strategy for natural resources exploitation and environmental protection mostly were based on rendering emissions and wastewater harmless after the production cycle rather than avoiding inappropriate use of water and reducing the amount of waste originated in the applied technologies. According to estimations made in Nutrient Balance, currently the wastewater treatment facilities constitute about 88% of total environmental protection assets.

Priorities in environment protection policy within transition period have been outlined in National Strategic Action Plan (1995). The basic target goals are concentrated on water resources management. In the respect to water quality aspect the reduction of pollutants in discharging wastewater and establishment of new water quality standard systems are supposed. Also, in the National Strategic Action Plan water related issues, such as water resources, water quality and prevention of its pollution, water supply, quality of irrigation water, monitoring etc. have been nominated as actions of highest priority.

The state of humans health and their welfare depend on water quality. In Moldova the state of population health is rather poor. Besides, because of insufficient water quality, drainage of major part of wetlands, large-scale extraction of river sand, building of hydrotechnical constructions and other anthropogenic causes direct and indirect destruction of habitats and loss of biodiversity are observed. Water of good quality is essential not only for organisms living in water but for other wildlife depending on this water. In this connection currently there is a necessity to realize that rivers, streams, lakes and wetlands are a national treasure, because clean waters support incredible diversity of animal and plant life, support sources of drinking water, use for recreation etc.

So, the national targets of reduction of water pollution are to maintain human health and to eliminate health risk in water resources, to provide sources of nutrition, and to maintain and restore biodiversity. The achievement of these issues relate to solution of such issues as:

- comprehensive evaluation of water resources conditions and elaboration of a concept of protection and rational use of water resources and water-balanced systems based on sustainable development approach
- elaboration of scheme for river basins use directed at the protection of water resources; encouragement of putting into force of watersaving technologies in industry and agriculture
- development of ecological criteria for assessment of permissible loads into surface waters
- developing and putting into force of integrated parameters and criteria for maintaining of ecological balance in waterbodies
- preparation of ground for rehabilitation and maintenance of proper ecological conditions in waterbodies designed for certain uses

The governmental declarations related to water pollution prevention mostly concern the following adopted laws: The Constitution of the Republic of Moldova (1994); Protection Areas of Rivers and Lakes (1983); The Law on Environmental Protection (1993); Water Code of the Republic of Moldova (1993); Code on Underground Resources (1993), Law on Industrial Wastes (1997) and

Law on Toxic Substances (1998). Besides, there are next decisions of the Government of the Republic of Moldova: Fee for Water; Protecting Actions for Prut River; Activity in the Field of Chemical Wastes and Non-Used Pesticides Harmlessness Admitted on the Territory of the Republic of Moldova; Regulation of Water Management. Besides, the Parliament of Moldova has ratified and jointed some international conventions: on Biological Diversity; on Wildlife and Natural Habitats Protection in Europe; Bucharest Declaration; Convention on Transboundary Effects of Industrial Accidents; Danube River Convention (the ratification of this Convention is supposed to be at the end of 1998) and some others.

2.3. Technical Regulations and Guidelines

Altogether activities on water protection are elaborated with consideration of schemes of complex use and protection of water resources.

On the basis of special calculation the maximum permissible discharges are determined. Maximum permissible discharge is established for each pollutant separately with consideration of background concentration, the category of water use, the norms of water quality in waterbody, its assimilating capability and optimal distribution of water among its users by relative services of Ministry of Health and other Ministries, which are involved in assessment and definition of use for waterbody. Condition of discharge are determined with consideration of dilution degree of wastewater with receiving water in certain waterbody on the stretch from wastewater discharge to the nearest control site; background chemical content of water in waterbody in the sites of wastewater discharge; natural capability for self-purification.

In accordance with the Water Code, the responsible institution for water abstraction licensing at the national level is Ministry for Environment Protection jointly with surface water management, geological, sanitary, fishing and other authorities interested in; for monitoring compliance with license is responsible the Ministry for Environment Protection through Ecological Inspectorate. Penalties for license exceeding are paid in progressive ratio. Duration for such kind of license could be permanent; constitutes till 3 years (short-term), or 3-25 years (long-term). Normally in practice the duration of the license varies from 1 to 5 years. The water Code also stipulates that the users must pay for water according to legislation. Actually the charge for the water use is fixed by the governmental decision (1994) and constitutes: from surface water - 0,2% of the minimum salary for 10 m^3 (0,001 USD per m^3); from groundwater - 0,5% of minimum salary for 10 m^3 (0,002 USD per m^3). At the moment the rate of national currency is next - 4,88 Lei is equal to 1 USD; 5,37 Lei is equal to 1 ECU.

For the licensing of wastewater discharges into surface water the responsible institutions are the Department for Environment Protection and Sanitary-Epidemiological Service; the duration of such kind of license is a period between 1 and 5 years. According to Water Code the discharge of waste water is permitted only if: it is not result to exceeding of maximum allowed concentration in receiving water; the users will provide the treatment of wastewater to the degree required by the ecological, water management and sanitary authorities. The base for calculation of fees or charges are wastewater volume-related and pollution load-related. These payments are made to the account of extra-budgetary Ecological Fund and could be used for improving of environmental conditions.

It is necessary to underline, that pollution fees and fines and natural resources user charges inadequately reflect the social cost of environmental degradation and do not provide pollution reduction or use of natural resources more efficiently. Fees, fines and charges are to be raised and indexed to inflation.

Payments for environmental pollution are realized in conformity with relevant Regulations approved by the Ministry for Environment Protection. The decision of the Parliament concerning the putting into force of the Law on State Budget stipulates that the government must set the amount of payments for environmental pollution and establish the mechanism of payment gathering. Generally, the following types of payments have been established:

- for aquatic resources pollution. Its amount depends on the content and level of toxic pollutants in the wastewater discharging in the sewerage systems or in natural waterbodies. In case when discharges exceed the fixed limits the payments are being enhanced in a progressive mode;
- payments for waste dumping are also being counted in dependence on toxicity of waste content and its amount (however, currently payments for waste dumping are not gathered in the Moldova).

The accounting of effluent charges imposed on wastewater depends on such indexes as the quality of pollution, the concentration of pollutants during emissions and quality of surface water. For wastewater discharge in the waterbodies or aquifers fee for pollution is established in accordance with established norms of maximum admissible discharges on indexes of pollutants in the project documentation. Fees for pollutants are realized by water users, which discharge wastewater in the centralized sewerage system. The list of these pollutants and maximum permissible concentrations are established by exploitation services of waste water treatment plants in agreement with environment protection authorities. Fee for discharge of polluted water in fixed norms (maximum admissible concentration, maximum admissible discharge) are determined as a product of tax norm and mass of pollutants. Fee for wastewater discharge exceeding fixed norms of pollutants are determined as a product of tax, pollution volume, and coefficient of exceeding of pollutants above normative concentration. Fee for water discharge on filtration fields is determined as a product of fee norm (0,023 USD) on total discharge volume. Fee for water discharge from fish farms and for agro-industrial run-off is imposed only for exceeding of pollution mass in reference to fixed discharge norms and determined as a product of tax norm, coefficient 5 and index of exceeding.

Anti-pollution charges include payments for pollution of aquatic resources, air basin, waste dumping pollution. All discharges within established limits have to be paid at the ordinary level; all extra dishrags have to be paid multiplying the tax by five.

In respect of municipal, industrial and hazardous waste fee for economic units, placing wastes on their own territory are determined as a product of taxes and volume of wastes in tons. For wastes accumulated until 1998 fee is not imposed. Fee for waste disposals at the special polygons in the fixed limits is determined as a product tax norms and volume of waste in tons. Fee for waste disposals in the quantities exceeding fixed limits is imposed to be 5 times much.

Currently in Moldova next standards of water quality are used - for drinking water; for water used for recreation; for water used as sources of a centralized water supply, for irrigation and for wastewater discharge.

There are 12 sampling stations on Prut River, where regularly surface water quality is monitored on 30 hydrochemical and 5 biological parameters by the Ministry for Environment Protection through Hydrometeo Service.

Quality control of drinking water on main chemical parameters and saprobic indexes is realized by Sanitary-Epidemiological Service of the Ministry of Health in the sites of water abstraction before abstraction; after treatment of raw water the quality of drinking water is assessed by the special service of Ministry of Municipal Service and Housing.

The assessment of water quality is carried out on the basis of maximum admissible concentrations (MAC) for each pollutant. There are two kinds of MACs - MACs for pollutants in waterbodies used for domestic demand and MACs for pollutants in waterbodies used for fish-farming purposes.

Altogether there are nine water abstraction pump stations on Prut River for centralized water supply with total productivity 5,06 m^3/sec in districts Briceni, Cupcini, Glodeni, Ungeni (three stations), Leova, Cahul (two stations). Raw water is undergoing to mechanical and physico-chemical treatment; these activities mostly relate to lighting and disinfecting of water. According to estimation of water supply authorities on these water abstraction stations should be installed extra facilities for purification of surface water from periodically occurring phenols and detergents.

It is necessary to stress, that sanitary zones of water supply sources in majority cases are absent; 56% of existing sources of water supply do not correspond to national standards for drinking water. Only 17% of population in the Moldavian part of the Danube River basin use centralized sources of water supply; altogether there is no achieved hygienic norms of water per capita.

However, in the sites of allocation of pump station for abstraction from the Prut River of raw water used for water supply of population, the quality of water mostly corresponds to national standards for surface water used for centralized water supply. Some indexes of water quality for surface sources used for centralized water supply are listed below. According to standard, concentrations of chemicals in surface water used as source of centralized water supply should not exceed maximum admissible concentrations for drinking water.

Table 2.2. Standards of water quality for surface sources used for centralized water supply

Determands(mg/l)	Indexes of water quality		
	I class	II class	III class
dry residue	< 1000	1000	1500
Chlorides	< 350	350	350
Sulfates	<500	500	500
Hardness	<7	7	10
Turbidity	20	1500	10000
Color (degree)	<35	<120	<200
Odor (force)	<2	<3	<5
PH	6,5-8,5	6,5-8,5	6,5-8,5
Iron	<1	<3	<5
Manganese	<0.1	<1.0	<2.0
Phytoplankton (cells/sm^3)	1000	100000	100000
COD	<7	<15	<20
BOD_{20}	<3	<5	<7
Chemicals	should not exceed MAC		
Number of coli bacteria	1000	10000	50000
Pathogenic microorganisms	absence	Absence	absence

According to the evaluation of the relative service of the Ministry of Health, due to insufficient water quality the state of population health is especially threatened in some districts of the Moldavian part of the Danube River basin. In this connection prime localities with needs in the improvement of water supply have been selected.

Table 2.3. List of localities with needs for improvement of water supply

Districts	Localities
Chiadar-Lunga	Valea Pergei, Joltei, Besh-Gaidar, Baurchi, Ciruitnea
Ungeni	Elisavetovca, Napadeni, Uncesti, Cheteteni, Parlita, Bushila, Chirileni, Bumbata, Cornesti, Sinesti, Bogenii Noi,Condratesti, Manoilesti, Todiresti
Leova	Bauish, Sarma, Tocile-Raducanu, Tomai, Covarlui, Sarata Noua, Tigeni, Yargora
Glodeni	Bolotino, Tomestii Veci, Clocochenii Noi, Cuhnesti, Clocochenii Veci, Cobani, Camenka, Cajba, Chuchuilea, Viisoara
Falesti	Cetrineni, Reutel, Hancesti, Panzareni, Sarata-noua, Chelaceuca vece, Federeu, Chelaceuca, Catranic, Glideni
Cahul	Andrushul de sus, Moskovei, Andrushul de Jos, Bucuria, Tataresti, Crihana vece, Manta
Taraclia	Svetlii, Aldat, Balabani, Biruinta, Musaib, Taraclia, Salta, Barchat
Vulcanesti	Vulcanesti, Colibash, Cuza-Voda, Valeni, Slobodzea Mare, Djurdjulesti, Caslita-Prut, Branza

According to monitoring data of the Ministry of Health, contamination not corresponding to bathing water quality standards is observed virtually along all length of Prut River in the Moldova's boundary.

Table 2.4. National standards for bathing water quality

Determands	Standards (mg/l)
odor (force)	2
PH	6,5-8,5
dry residue	1000
dissolved oxygen	4
iron,	1
manganese	0,1
COD	30,0
BOD	6,0
pathogenic microorganisms	Absence
number of coli bacteria	5000
number of coliform	100
chemicals	Should not exceed MAC

The discharge of wastewater could be realized only on the basis of license obtained from environment protection authorities in accordance with sanitary service. According to Law, the discharge is permitted if it does not lead to increasing of polluting substances above maximum allowed concentrations in waterbody and discharged water is purified conforming permitted license.

Table 2.5. Standards of wastewater quality discharging into surface water
(maximum admissible levels of pollutants in the wastewater)

Ingredient	Admissible level (mg/l)
SS	12
BOD	12,4
TDS	900
Cl	110
$S0_4$	180
$NN0_3$	9
Ammonia	6,87
Cu	0,008
Ni	0,01
Zn	0,035
Fe	0,296
Cr (3)	0,009
Cr (6)	0,001
Lipids	2,8
Detergents	0,13
Phenols	0,0038
oil products	0,134
F	0,75
$P(P0_4)$	1,65 (or 0,54 reported to P)
Hg	0,0003
Cd	0,00001
Pb	0,01
Vi	0,001
CCN	0,0015
Formaldehyde	0,0015
As	0,002
Al	0,224
Co	0,002
$N(N0_2)$	0,3
Sn	0,005
Sr	2,0
Be	0,0001
Se	0,001
Mo	

After emissions there must not be:

- surface covered oil products, lipids etc.
- odor
- water must not change the color
- temperature must not exceed 5 degrees in comparison with natural one
- pH 6,5-8,5
- dissolved oxygen winter - more than 4 mg/l
- dissolved oxygen summer - 6 mg/l
- COD for drinking water supply, fisheries, recreation - 15 mg/l for the water bodies

- COD for the irrigation water, agricultural needs etc.- 30 mg/l
- Lactozapositive bacteria - not more than 10000 per liter for agricultural needs and less than 5000 per liter for the water bodies for drinking water supply, fisheries, recreation
- Coli - 100 per liter for any type of water resources
- Fecal microorganisms - absence

2.4. Expected Impacts of EU-Directives to Water Pollution Control

Current standards for the water quality in Moldova are stricter than in the EU. When there are possibilities to follow them, enterprises do not discharge the amounts of pollutants, which exceed admissible levels. At the same time the situation very often does not allow to follow them. Moreover, when the enterprises are recovering, they do not have enough financial possibilities to invest money in the treatment facilities. That is why it is expected, that in accordance with the realistic situation there should be some directives, which will regulate discharges amount and their quality. The standards for each economical unit will be improved together with the national targets, which are actually being revised.

Generally, it is expected, that the use of the EU directives will improve the control after the water quality and pollution reduction through the directives issued by authorized Institutions. These directives will reflect real situation and penalties included in them would be used for increasing of capacities for the pollution reduction.

So far Moldova has not applied for membership in the European Union, actual EU practice in the use of directives is only on the level of proposal, based on the experience obtained from the seminars on the EU practice in the field of water management, legislation, standards and normative acts held in autumn 1996

2.5. Law and Practice on Water Pollution Control

Generally, the efficiency of existing system for water quality monitoring is quite poor because its implementation is realized by various institutions and often is not coordinated.

In fact, State Ecological Inspectorate in Kishinev and 5 regional agencies with laboratories for water quality control realize monitoring of surface waters. The Republic Hydrometeorological Service analyzes the data of 40 hydrological water quality stations and data of number of mobile groups of water sampling, and also realizes the monitoring of surface waters. The National Scientific and Practical Center of Hygiene and Epidemiology as a subdivision of Ministry of Health carries out the control of drinking water on physico-chemical and bacteriological parameters. It involves the main analytical laboratory in Kishinev; 4 regional laboratories and 45 local laboratories. Ministry of Agriculture and Foodstuff through its subdivisions - state consortium“ Apele Moldovei”, State Chemical Commission, associations “ Prut” - surveys water quality control at fish farms etc. Analytical laboratory of Association of Geology of Moldova (AGeoM) explores the underground water resources and surveys quality of underground waters.

3. Reduction of Water Pollution from Municipalities

3.1. Reduction of Point Sources of Nutrient Discharge (hot spots)

Currently the mechanical purification (first stage) and biological purification (second stage) are the main methods applied in purifying of wastewater polluted by organic substances. This kind of treatment includes use of biofilters and aerotanks with further use of biological ponds and microfilters. Currently the advanced purification is not applied (third stage). The effort toward improving of operation and functioning mostly refer to elaboration and putting into force of technology for intensive anaerobic-aerobic biological purification on the basis of application of microflora.

In respect of reduction of water pollution from municipalities in the first turn the measures will be concentrated at the bringing and maintaining water treatment efficiency in existing wastewater treatment plants (WWTP) on relevant level; improving of their operations and functioning, and repair of municipal storm run-off canalization system.

It is necessary to underlined that all these wastewater treatment plants have been constructed 15-20 years ago and at the moment practically for each WWTP there exists a project for its reconstruction or construction of new one, but they could not be implemented due to lack of financial resources.

There are the following municipal wastewater treatment plants in the Moldavian part of the Danube River catchment area, which represent to a certain extent the sources of surface water pollution.

- District Briceni: sugar wastewater treatment plant (WWTP), small river Racoveti. Water discharge - 2140 ML/year (ML-million litters). Population connected to sewer system (municipal and sugar plant discharges are treated on the same facilities) - 4900. This Hot Spot is of a *medium priority*.
- District Briceni: WWTP of town-type settlement Lipcani, river Prut. Water discharge - 0,40 ML/year. Population connected to sewer system: 900. This Hot Spot is of a *medium priority.*
- District Edineti: WWTP of town-type settlement Cupcini, small river Racoveti. Water discharge - 3661 ML/year. Population connected to sewer system: - 8500. This Hot Spot can be identified for small river Racoveti as a *medium priority*.
- District Riscani: WWTP of town-type settlement Costesti, Prut River. Water discharge - 253 ML/year. Population connected to sewer system: 1350. This Hot Spot can be identified as a *low priority*.
- District Glodeni: WWTP of town Glodeni, small river Galdarusa. Water discharge - 1887 ML/year. Population connected to sewer system: 4500. This Hot Spot is of a l*ow priority.*
- District Falesti: WWTP of town Falesti, small river Girla Mare. Water discharge - 825 ML/year. Population connected to sewer system: 7220. This Hot Spot can be estimated as a *low priority*.
- District Ungeni: WWTP of town Ungeni, river Prut. Water discharge - 3991 ML/year.
- Population connected to sewer system: 17200. This Hot Spot can be ranked as a *high priority.*
- District Ungeni: WWTP of town-type settlement Cornesti, small river Delia. Water discharge - 82,5 ML/year. Population connected to sewer system: 230. *Low priority.*
- District Nisporeni: WWTP of town Nisporeni, small river Lapusna. Water discharge - 685 ML/year. Population connected to sewer system: 3135. *Low priority*.

- District Leova: WWTP of town Leova, river Prut. Water discharge - 652 ML/year. Population connected to sewer system: 4270. This WWTP has been constructed in 1989 and is estimated as a source of water pollution of a *low priority.*
- District Cantemir: WWTP of town Cantemir, river Prut. Water discharge - 956 ML/year. Population connected to sewer system: 3150. Only mechanical treatment, with seasonal variation September-December (cannery plant). About 80% of all discharges are coming during this period. This region is beginning of the desiccated wetland area, which is only partially used in agriculture. In the nearest future this area can be used for large-scale wetland restoration. Water quality of the Prut River in this region has deteriorated. At the same time, water resources from the river are largely used for different purposes, including drinking (towns Cantemir, Cahul and some villages). Approximate population using this water is around 70000 inhabitants. Installation of the second stage of treatment is necessary. *High priority***.**
- District Cahul: WWTP of town Cahul, river Prut. Total water discharge - 4410 ML/year.
- Population connected to sewer system: 17000. WWTP facilities are underloaded, except the period of cannery plant working. Water quality of the Prut River is the 3rd class. At the same time pollutants loads are very close to others originating from other Hot Spots and should not cause serious problems for the water quality of the Prut River. That is why it is possible to assume transboundary pollution on this part of the river. *Medium priority.*
- District Comrat: WWTP of town Comrat, river Yalpugh. Water discharge - 2410 ML/year. Population connected to sewer system: 7000. *Medium priority*.
- District Taraclia: WWTP of town Taraclia, small river Lunguta. Water discharge - 1810 ML/year. Population connected to sewer system: 4000. This WWTP discharges to the Yalpugh River via another small river Lignite. Emission volumes are comparable with the Lignite River flow. There are no seasonal variations in the emissions. Main type of treated wastes is municipal waters. Lignite river confluences with Yalpugh River near the Taraclia reservoir, which is used for irrigation, fish- farming and recreation. *Medium priority*.

3.2. Reduction of Water Pollution from Agriculture

3.2.1. Prevention of Pollution from Agricultural Point Sources

The latest available data on livestock husbandry in the Moldavian part of the Danube catchment area refer to 1992 and they are collected in the "Nutrient Balances" study performed by the expert team from Moldova. Altogether in 1992 in the Moldavian part of the Danube River basin about 1470 animal farms, including 35 big cattle-breeding farms and 8 big pig farms were operating. These farms represented a great source of water pollution.

Table 3.1. Livestock (capita) in the Danube River basin

River basin	Cattle			Pigs		
	Public	private	total	Public	private	total
Prut	170930	76570	247500	240580	108812	339392
Yalpugh and Cahul	79119	10639	88758	151244	41298	192542
Total	250049	87207	336257	381824	150110	531934

Table 3.2. Livestock (capita) in the Danube River basin

River Basin	Horse			Ship, goats		
	public	private	total	Public	private	total
Prut	9853	4476	14329	98680	332082	430762
Yalpugh and Cahul	2781	2181	4962	121987	257592	379579
Total	12634	6657	19291	220667	589674	810341

Table 3.3. Livestock (capita) in the Danube River basin

River Basin	Domestic birds			Rabbits		
	public	private	Total	public	private	total
Prut	2040000	3046200	5086200	6874	61869	68743
Yalpugh and Cahul	1300000	992100	2292100	4214	37930	42144
Total	3340000	4038300	7378300	11088	99799	110887

In Nutrient Balance, performed by the expert team from Moldova a total volume of manure, produced in public and private sectors, has been evaluated. The results of this accounting are presented below.

Table 3.4. Manure produced in public and private sectors (1992)

	Approximate excretion rate (t/cap/per year)	Public sector		Private sector	
		number of animals	manure, tons	Number of animals	manure, tons
Cattle	9	10214	92000	4070	36650
Pigs	1,6	19319	31000	6468	10350
Ships	0,7	12061	8400	38367	26850
Poultry	0,02	82866	1657	129633	2600
Horse	9	425	3800	356	3200
Total			136850		79450

The manure disposal is not only a technical but also and a management problem. It is assumed that manure produced in private sector is being used as organic fertilizers.

In respect to decreasing of impact from livestock husbandry in public sector it is supposed to develop: new possibilities for use of unconventional technologies in wastewater purifying by plants and microorganisms toward reduction of pollution; possibilities of maximum water recycling in animal farms; to elaborate the technology of anaerobic biological purification of liquid wastes from animal farms aimed at their harmlessness and obtaining of biogas and organic fertilizers of high quality; to elaborate the intensive methods of biothermal treatment of solid phase of waste from animal farms aimed at the obtaining of organic fertilizers and some others measures. However, to meet environmental standards the farm management should be focused also on investments in new technologies and currently it is quite difficult because of lack of financial means. Generally there is an elaborated set of measures to be undertaken in order to reduce the organic pollution from animal farms, including such as: building of the extra lagoon systems, maximum use of biogas and others.

Besides, it should be mentioned that currently the situation with animal farms to some degree has changed; the number of big animal farms has been reduced and a big share of animals are concentrated in the private sector. However, the pollution of water by organic material did not drop significantly, but currently such kind of pollution in some places mostly represents rather diffused than point source.

The main agricultural point source of surface water pollution is represented by Edinet pig farm. Wastewater discharge from this pig farm constitutes 0,3 ML/year. There is no population connected to this sewer system. The wastes from the pig farm are mainly accumulated in the landfills and are not discharged into the river. Anyway, there can be influence of the pig farm wastes on the groundwater quality. Analyses held by the Sanitary-epidemiological Center showed that 90% of shallow wells in adjacent area are polluted with nitrates. Exceeding of admissible level constitutes 2-3 times. This Hot Spot can be estimated as a *medium priority.*

3.2.2. Prevention of Pollution Sources from Agricultural Non-Point Sources

Agricultural chemicals are considered a major pollution source. In this connection in the National Strategic Action Plan the strategic policies and have been outlined some measures are to be undertaken: efficient fertilizer application to minimize agro-chemical pollution; soil conservation practice to reduce agricultural run-off; study the possibility for sustainable level of fertilizer application in order not to accumulate persistent pollutants above quality standards; consideration of pollution tax based on economic recovery and higher application rate; to elaborate and introduce a set of programmes for land serving as a buffer strips and buffer zones for protecting of water resources; to develop programmes on afforestation and permanent vegetation cover with would protect watershed.

3.2.3. Reduction of Water Pollution through Improved Land Management

First of all reduction of water pollution through improved land management concerns the restriction of highly eroded lands, what in turn will reduce total agro-chemical application.

Besides, the attention is going to be paid to such issue as inappropriate match between crop, slope and type of soil; excessive large-scale conservation of hilly pasture and meadow lands to annual crops and cultivation of large fields without consideration to slope distribution; tillage system systems, involving excessive field operations without consideration of various forms of conservation tillage etc.

Unfortunately, currently in Moldova there is not any technical projects related to the actions toward improving of self-purification of watercourses. However, some measures aimed at the rehabilitation of wetlands are going to be undertaken. In first turn it concerns the recently elaborated in Moldova project on wetland restoration.

In this respect it is necessary to stress that within 1992-1994 in accordance with essential agrarian reforms the inventory of lands has been accomplished, and the list of persons entitled to the land ownership was outlined; the size of lands to be distributed among people employed in agriculture was established, and the process of land distribution started.

However, among the ecological demands of agrarian reforms, especially in respect of land privatization and the maintenance of natural biocenoses as well as the rational use of biological resources.

The area of Moldavian wetlands was greatly reduced during last 20-30 years due to land reclamation and drainage. In the last decades the water quality of remaining lakes and rivers has deteriorated due to eutrophication. The background for development of this project is

environmental legislation adopted in Moldova, international conventions and great attention to this issue in the USA, European Union and in the CEE countries (Strategic Action Plans of the Danube and Black Sea Environmental Programmes).

As a link between land and water, wetlands play a vital role in water quality management programmes. They are defined as areas that are inundated or saturated by surface or ground water at a frequency and duration to support, and under normal circumstances do support, a prevalence of vegetation typically adapted to life in saturated soil conditions. Wetlands provide a wide array of functions including shoreline stabilization, non-point sources runoff filtration and erosion control, which directly benefit adjacent and downstream waters. In addition, wetlands provide important biological habitat, including nursery areas for aquatic life and wildlife, and other benefits such as groundwater recharge and recreation. Wetlands comprise a wide variety of aquatic vegetated systems, including sloughs, swamps, pot-holes, wet meadows, bogs, fens, vernal pools, marshes and similar areas.

The propagation of aquatic life and wildlife is an attainable use in virtually all wetlands. Aquatic life protection does not refer only to year-round fish and aquatic life. Wetlands often provide valuable seasonal habitat for fish and other aquatic life, amphibians, and migratory bird reproduction and migration.

Normally, water quality standards are being applied to such type of surface waters as rivers, lakes etc., and in this connection it is necessary to stress that similar water quality requirements could be applied to wetlands.

In this respect it is supposed that conservation programmes for natural reserves and wetlands will be established. In particular, it concerns several sites in the Danube catchment areas. Altogether, the Moldavian part of the Danube River basin constitutes 12 500 km^2 or around 40% of the whole territory of the country. In the middle of the seventies wide desiccated works have been held and as a result wetlands were destroyed and recently are used for cultivation of agricultural crops (vegetables, wheat, orchards etc.). Total population in the Moldavian part of the Danube Basin consists 1.070.000 inhabitants. Rural population predominates and constitutes about 90%. So as only 10% of them are connected to the sewer system and taking into account predomination of agricultural activity in the region diffuse sources of pollution are the most important in this area. Different studies show that 90% of all pollution loads (nutrients and pesticides) are originating from agricultural activities.

Generally the types of ecological danger for wetland could be divided into the following categories: i) effect on productive functions, because negative impact of foreign substances can finally lead to reduction of some natural resources; ii) effect on regulative functions, because as a result of anthropogenic impact some regulative processes could be destroyed and iii) effect on secondary functions, such as nature as a basis for human recreation (sport and fishing) and information functions (loss of biodiversity).

Total drainage areas in the Moldavian part of the Danube basin occupy territory 21000 ha. Main part of the desiccated lands belongs to the Prut River basin (80% of all Danube catchment in Moldova) and 20% belong to the basins of two small rivers Yalpugh and Cahul. There is also a channel in the Yalpugh River valley, which connects Danube River (through lower Danube lake Yalpugh) with agricultural areas in Moldova. Total length of this channel is 135 km.

Large desiccation of the wetlands in Moldova was held in the middle of the seventies. These lands have been widely involved in intensive agriculture with irrigation, high mineral (200 kg/ha of a.s. of N and P) and organic fertilizers (8-10 tons per year) and pesticides (mainly copper sulfate 15-16 kg/ha/year) use. Recently due to the financial difficulties around 70% of the deranged channels are silted and these areas are not under intensive agricultural use. Amount of mineral and organic fertilizers and pesticides has also strongly reduced for last 5 - 7 years.

Previous intensive agricultural practice has strongly influenced the state of biodiversity in wetland areas and rivers themselves. Wetlands in the Moldavian part of the Danube River basin practically have not remained. Some small sites suitable for wetland restoration were selected for this project in the central and downstream parts of the Prut and lower Yalpugh River valleys.

Central part of the Prut River and Yalpugh River basins are mainly represented by alluvial-limnological sediments representing different types of clays, sands, sandstone with thin interlayers of lime-stones and conglomerates with *Ervilia dissata* Eichw. For wetland restoration several sites could be used. First of them is allocated in the central part of the Prut River valley near villages Leusheni and Calmatui. This site is located in the confluence area of rivers Camenca and Prut. Recently, rivers are banked, the distance between water and artificial banks varies from 20-30m. to 1,5 km, average 600m. The surface area of this site is 125 ha. It is desiccated area under agricultural use. There are spots with high level of shallow waters, which kept more or less hydrological regime of wetlands in this area. Hydrological regime of the area had been totally changed in the middle of the seventies. The fluctuations of water level in the Prut River are till 6 m. average annual water flow is around 60 - 80 m^3/sec. River Camenca is also banked (near the confluence area) with approximately the same parameters of hydrotechnical constructions. Fluctuations and flow depend on the state of the Prut River. Influenced zone is till 7-10 km.

Before desiccation activity this area was covered by water layer 50 - 60 cm for the period of more than half a year. Deepness of the drainage channels in the valley area is around 1,5 m. About 70% of them is silted. Water layer in the channels is normally 20-30 cm. Drainage water is discharged directly to Prut. Its average discharge is near 6000 m^3/year. Actually site area is widely used for agricultural needs. This area actually is owned by collective farm together with adjacent area. Desiccated wetlands are used for cultivation of agricultural crops, but due to the lack of financial resources drainage channels are silted and agricultural use of area becomes less intensive. It is more and more used as permanent grassland and some typical vegetation for wetlands appeared. Adjacent area is used as arable lands and partially as grasslands. Currently this site is not protected, but on the base of discussions with local authorities and specialists form Ministry "Apele Moldovei" (institution responsible for water management, desiccation, amelioration, etc.) there is a willingness to develop and implement technical project aimed at the restoration of this area. Water Management authorities evaluated that floodplains regime in this area could be reestablished within 3-5 years.

The second place for probable wetland restoration is located in the beginning of the lower part of the Prut River valley (Prut fens), near village Gotesti. The site square is 250 ha. It presents desiccated area under agricultural use. There are some spots with shallow waters near to the surface, with entering on the soil. Such sites kept more or less hydrological regime of wetlands in the area proposed for demonstration project. According to visual estimations they occupy about 5% of the artificially drainage area. Hydrological regime of the area is very close to the previous one and had been also totally changed in the middle of the 70-s. This site is located at the beginning of the lower Prut valley. The fluctuations of water level in main river (Prut) are till 2 m.; average annual water flow of the Prut River is around 80 m^3/sec.

Deepness of the drainage channels in the valley area is around 1,5 m. About 70% of them are silted. Water layer in the channels is normally 20-30 cm. Drainage water is discharged directly to Prut. Average annual discharge of the drainage waters is around 7000 m^3. Actually site area is widely used for agricultural needs, too. This area actually is owned by cooperative farms together with adjacent area and partially is private (till 20%). Desiccated wetlands are used for cultivation of agricultural crops, but due to the lack of financial resources drainage channels are silted and agricultural use of area is becoming less intensive. It is more and more used as permanent grassland and some typical vegetation for wetlands is appearing. Adjacent area is also used as arable lands and partially as grasslands and pasture.

The third site proposed for restoration is situated in the lower Prut River valley (lower Prut lakes) near villages Manta, Valeni, Brinza. The site square is around 367 ha. It consists of water ecosystems of Manta lakes (4 Lakes), which are widely used for industrial fish farming, with total area (including adjacent territories) of 2000 ha, and Beleu lake, which belongs to the international importance reservation area "Prutul de Jos" ("Lower Prut") with total territory 1670 ha. Hydrological regime of this area also had been strongly impacted in the middle of the 70-s, when significant part of the Prut wetland area was desiccated. Only these lakes remained in their initial stage. The water level in these reservoirs strongly depends on the fluctuations of the Prut River. The fluctuations of water level in main river (Prut) are 1,5 - 2 m average annual water flow is around 80 m^3/sec. During high water all adjacent area is under the water. Its layer is till 1 m. Normally adjacent area (till 30% of the lakes surface) is under the water for 3-4 months.

Lake Beleu is connected with the Prut River through a natural channel. During high water in the main river it comes to the lake and during dry season water from the lake goes to Prut. Once per 5-7 years water level in the lake reduces till some cm. The average depth of the lake is 1,7 m.

Total volume of the Beleu Lake is around 1 mln.m^3 with total surface around 800 ha. Lake Beleu and adjacent area as natural reservation are of a state property with a very strict protected regime. This protected area has international importance and was registered according to the international conventions as area registered as a part of national ecological network. As reservation was created only in 1991, there are a lot of problems concerning inventory of species and estimation of their productivity. Research was held in this field, but it has not been finished. Soil studies, GIS were not done. There is a small oil field under Beleu Lake. Several boreholes are leaking and that is why it is strongly affected by oil pollution. Adjacent and protected areas are often used as a pasture grassland and for recreation purposes.

Manta Lakes also have natural stream connecting them with the main river. Their average depth is around 1,7 m. These lakes and adjacent areas have very similar hydrological regime with lake Beleu and strongly depend on the Prut River flow. So as Manta Lakes are used for fish farming, water is pumped from Prut into these lakes in case of necessity. Altogether Manta Lakes have water volume 1,6 mln.m^3 with total surface around 1000 ha. They are highly polluted with nutrients due to the intensive fish farming and recreation. Research activities have a fragmentary character and are held only for clarifying of some issues concerning industrial fisheries. Adjacent area is often used for agricultural use and belongs to private persons (about 20% of the territory) and collective farms.

As a fourth site for wetland restoration lower Yalpugh River valley near villages Aluat and Vinogradnoe could be used. The size of this area is around 300 ha. This area belongs to the Yalpugh River valley. The width of the Yalpugh River valley in this place is around 0,5 km. and length - 1,7 km. This area is located close to the Moldavian - Ukrainian border. This site is adjacent area to the Yalpugh Lake, which belongs to Ukraine (upper part of the lake forms the border between Moldova and Ukraine).

Total length of the Yalpugh River is 142 km. Its average annual flow is 1 m^3/sec. Hydrological regime of the area had been strongly changed in the end of the 70-s as well, when practically all Yalpugh River valley was desiccated and chemically meliorated (bedrocks are very saline and TDS in water is on the level of 2500 mg/l). There are 3 big water bodies on the Yalpugh River with total volume 145 mln.m^3, which are widely used in fish farming, recreation and earlier for irrigation (due to the high concentration of salts irrigation was stopped in the mid of the 80-s). Average depth of water bodies is around 1,7 m and they are strongly silted. Drainage channels are also silted and river valley is used mainly as a pasture. Concentration of TDS in shallow waters exceeds 3000 mg/l.

The territory of site available for wetland restoration and adjacent territory mainly used for agriculture are owned mainly by state. This area can have transboundary importance for wetland restoration. Actually there are no special normative acts and legislation, which could regulate nature protection activity in this region. Hydrochemical studies show strong nutrient pollution in the artificial water bodies and shallow waters. All of these caused strong degradation of water ecosystems of the river.

This area proposed for wetland restoration is typical natural lower wetland area in the steppe area in Moldova. It is located at the beginning of the lower Danube lakes area and repeats all main features of it. That is why this site is supposed to have big international importance for rehabilitation activity in the lower Prut and Danube region and will have positive influence on the improvement of the state of steppe biodiversity in this sensitive area of the Danube basin.

In all areas currently proposed for wetland restoration activities next measures could be undertaken:

- to reduce agricultural activity
- where it is possible to enlarge protected area
- to strength the measures aimed on the stopping of illegal hunting, fisheries, cutting of trees, pasture etc.
- to fulfill detailed inventory of biodiversity
- to finance planting of new forests from native trees and where it is necessary to plant forest belts on the river and artificial lakes banks (50 - 70 m).
- to rise the public and local authorities awareness on the significance of wetland restoration
- to maintain and protect of biodiversity in selected sites
- to elaborate recommendation and proposals for decision-makers

In the implementation of these activities state institutions will be involved: Ministry for Environmental Protection, State Concern “Apele Moldovei”, Ministry of Agriculture, local authorities; NGOs (Ecological Movement of Moldova, National Ecological Academy etc.); Parliament of the Moldova, and International Institutions (World Bank, European Bank of Reconstruction and Development, United Nations Development Programme, World Wild Fund etc.).

3.3. Reduction of Water Pollution from Industries

The polyphenols produced by wine and sugar factories are the cause of major concern. Many agro-industrial plants discharge directly to the rivers, especially to small tributaries of the Prut River; another part of discharge is slightly treated, but this treatment is not sufficient. In the National Environment Action Plan (1995) it is marked that in spite of the fact that the poultry farms and dairies have treatment plants, they are not operational due to lack of resources for repairs and maintenance. Heavy contaminated wastewater mixed with fresh water is used for irrigation what contributes to higher level of nitrates and ammonia in groundwater. Despite th fact that the substantially more than half of county’s industry closed down and the volume of industrial wastewater has declined, because of declining functioning of treatment plants, the pollution concentration per volume of water discharges has increased. The whole amount of wastewater discharged into surface water in the Moldavian part of the Danube River system constituted 36,09 mln.m^3. From this amount 8,8 mln.m^3 was the municipal discharge; 6,39 mln.m^3 - industrial discharge and 20,36 mln.m^3 have been discharged by agricultural units. 4,03 mln.m^3 of these effluents have not been treated at all; the rest part – 31,26 mln.m^3 have been treated biologically. In Moldova, including Prut River basin and Danubian lakes basin, there is no installed advanced

treatment facilities. Practically all industrial enterprises discharge their wastewater into municipal wastewater treatment plants (WWTP) often without any preliminary treatment. In particular, it relates to the next several municipal WWTP:

District Briceni: sugar WWTP; total water discharge constitutes 2140 ML/year; *medium priority.*

District Glodeni: sugar WWTP; total wastewater discharge - 1887 ML/year; l*ow priority.*

District Ungeni: WWTP of town Ungeni, water discharge - 3991 ML/year. Discharges are going to the Prut River. Industrial enterprises like railway station, carpet plant, food factory, some galvanic facilities etc. work without any seasonal variations and discharge wastewater directly to the municipal sewer system. Analytical equipment of the WWTP does not allow to analyze such ingredients, like heavy metals and some organic pollutants. The type of industries, developed in this town, allows to assume, that these ingredients should be in the wastewater. *High priority*.

3.4. Reduction of Water Pollution from Dump Sites

Generally the problem of industrial and domestic waste utilization is still current, in spite of the fact that the volume of their production has decreased in comparison with previous years. Moreover, the volume of accumulated waste is growing because the problem of its utilization has not been solved yet. The Programme of Activity of the Government for 1994-1997 provides the developing of new system for waste collection and utilization, however, details have not been elaborated for the developing of such system. The situation with toxic substances on the Moldavian territory located in the Danube River basin is quite acute, and this fact is mainly due to the lack of specialized dumps and systems for neutralization of such substances. In most cases the waste is deposited on the territory of the enterprises or partly is transported to the municipal dumps. The situation is getting worse because the majority of industrial enterprises are in crisis and there is not the efficient normative basis. In Moldova special normative acts, standards and instructions have not been developed. While the national standards and special normative acts are being elaborated, the normative acts of former Soviet Union are being used. The control system of waste transportation on the territory of Moldova is not finalized yet; there is no programme for dangerous waste reduction in the Republic.

At the same time in order to stimulate toxic waste disposal, the Ministry for Environment Protection passed a motion to amend the Law on Enterprises Profit Tax. The amendments grant tax relieves to enterprises disposing of toxic waste. The control over toxic use realized the Department for Environment Protection, which is empowered, in accordance to the Law on Environment Protection, to issue licenses authorizing the production, transportation and utilization of toxic waste, to enhance state control and to design necessary regulations. The impact of toxic waste on human health is controlled by the Sanitary and Epidemiological Service. The monitoring of toxic waste and applying of preventive measures directed to avoid the negative consequences is performed by the Department for Civil Protection.

There are about 600 old and new municipal and industrial solid waste disposals and special sites for sanitary treatment of solid waste, including 22 big ones, with total volume 8229 thousand m^3 covering 419 ha. Normally big disposals are located within 8-10 km of each district center or town. Besides, in rural area practically near each community is located local solid waster disposal. At least 25% of authorized disposals are currently exceeding capacity, however further construction of new disposals has been stopped because of economic crisis. There is not a single well organized hazardous industrial and chemical waste disposal in Moldavian part of the Danube River basin. Basically, the industrial and hazardous waste are gathered, stored and treated together.

There is a deposit of the expired and banned pesticides in the southern part of Moldova. It is presumed that due to the amounts of deposited wastes (presented in "Water Quality" report), the impact on the state of water ecosystems from this dump can be expected. Unfortunately due to the transition period in Moldavian economy, it is very difficult to expect some financial support for the developing of relevant projects.

Table 3.5. Municipal and industrial solid waste disposals (without dumps)

Districts	Site Area (ha)	authorized (ha)	unauthorized (ha)
Briceni	31,35	-	31,35
Ocnita	34,54	-	34,54
Edineti	34,26	-	34,26
Riscani	15,05	-	15,05
Glodeni	27,7	-	27,7
Falesti	32,92	2,9	30,01
Ungeni	36,3	5,2	31,1
Nisporeni	11,25	11,25	-
Hancesti	13,5	3,8	9,7
Leova	10,2	10,0	0,2
Cantemir	33,0	28,5	4,5
Cahul	29,6	20,1	9,5
Vulcanesti	39,7	28,1	11,6
Chimislia	4,3	1,3	3,0
Comrat	26	26	-
Basarabeasca	2,2	2,0	0,2
Chiadir-Lunga	13,5	9,8	3,7
Taraclia	24,0	13,5	10,5
Total	419,37	152,48	266,9

In the waste management the attention is going to be paid to the financial mechanisms and private sector participation, especially in municipal solid waste disposal issues. Also, focus will be placed on quality of waste collection service and management of landfill sites by raising tariffs and developing direct invoice collection; identifying all site locations of illegal dumping and eliminating these dumping; carrying out a special study to develop a national waste management strategy, including economic and environment cost assessment of various disposal options for landfills, compost plants and incineration; safe storage of toxic pesticides wastes; creating a special sites for long-term storage for industrial wastes, and enforcing regulations on separate disposals of hazardous and industrial wastes.

3.5. Special Policy Measures

Among the most appropriate policy measures the most appropriate for pollution reduction of water appeared to be improvement of legislation and technical regulation for pollution reduction and water management; strict observance of legislation and technical regulations; developing of new taxes on use mineral fertilizers, pesticides and other agro-chemicals; developing new system of fees and charges for discharge of wastewater in accordance with their real damage to environment and reflecting the possible cost for its recovery; developing a new system of penalties for exceeding of licensed pollution on the same base; create a system of taxes for withdrawal of raw water from surface and groundwater sources which would be more adequately reflect the value of fresh water.

Currently the elimination of phosphate containing detergents in washing powder does not represent a problem of high priority in Moldova.

4. Expected Effects of Current and Planned Projects and Policy Measures

4.1. Reduction of Nutrient Emissions

There are no special programmes and projects aimed on the reduction of nutrients emissions in the Moldavian part of the Danube River basin. At the same time there was a pilot project in 1995-1996 sponsored by USAID for the development of organic agriculture. There were selected several farms in the northern part of the Prut River basin (Briceni district). In the frame of the project there were introduced advanced EU technologies for organic farms and organized several workshops for private land owners.

Actually, there is declared the final tender for the TACIS project with total amount of 2,5 mln. ECU, which is aimed at the improvement of water management in the Prut River basin. It presumes reconstruction of some wastewater treatment plants in the Moldavian part of the Danube basin and through it reduction of nutrient and microbiological loads in the water ecosystems. This project will probably start at the end of 1998.

Another project, which is going to be developed with the support from TACIS, is aimed at the wetland restoration on the whole territory of the country and feasibility study for the Vulcanesti dump. This project is on very initial stage. There was only a recognition mission to Moldova and it is expected that it can be approved at the end of 1999.

4.2. Hazardous Substances

There are no special projects aimed on the reduction of the hazardous substances loads in the Moldavian part of the Danube River basin.

4.3. Microbiological Contamination

The TACIS project mentioned in 4.1. is partially aimed on the reduction of microbiological pollution.

4.4. Adverse Environmental Effects

According to different studies held in the framework of the applied research projects of the Danube Environmental Programme, the implementation of these projects can reduce nutrients (main pollutants in the Moldavian part of the Danube River basin) loads originating on the Moldavian territory for 5-7%.

5. Cost Estimation of Programmes and Projects

The short list of running and completed projects in Moldova related to the Pollution Reduction Programme includes:

Creation of National Register for Toxic Waste

The objective of the project is to create the National Register of Toxic Wastes. This will improve the management of toxic wastes in the country.

Total cost: 16.000,00 USD

Integrated Water Management of the Costesti-Stanca Reservoir on the Prut River

The project is intended to elaborate an action plan for the management of water resources in order to ensure a sustainable water use by various users in Romania and Moldova, including the sensitive river ecosystems. Other objectives are to develop a plan for reduction of pollution loads into the reservoir in order to prevent accumulation of micropollutants in sediments and eutrophication and to establish a bi-lateral monitoring programs to control the quality of water and sediments in the reservoir.

Total cost: 300.000,00 USD

Toxic Waste Incineration in Cement Kilns

Presently big amounts of toxic wastes (galvanic sediments, old and banned pesticides) are stored on the territory of industrial and agricultural units. There are no special sites in Moldova, where such wastes can be stored. One of the possible solution is the incineration of some toxic wastes in cement kilns. The costs of the re-construction of cement kiln in order to be used as toxic wastes incinerator constitutes 5% from the cost of a standard commercial incinerator. The requested sum is to be spent for installation of a waste disaster, the procurement of a control system, and the training of the staff.

Total cost: 1.000.000,00 USD

Creation and Maintaining of Environmental Training Center

The main activities of the Center will be the environmental knowledge exchange and spreading of international experience in this field and training of specialists, organizing of environmental regional seminars.

Total cost: 100.000,00 USD

New Technologies for Treatment of Waste and Waste Containing Heavy Metals

The following activities are planned: (1) Evaluation of the total amount of galvanic wastes accumulated in Moldova; (2) Elaboration of new treatment technologies for such wastes.

Total cost: 50.000,00 USD

Creation of the National Environmental Information System

The project is conceived as a three phases process of substitution of existing mode of collecting, analyzing, keeping and transmission of information with electronic information management. NEIS is planned to be a virtual network of interconnected computers distributed territorially among environmental organizations in order to implement modern technology of information management, provide public access to environmental data and facilitate decision making process.

Total cost: 605.000,00 USD

Energy Efficiency Programme

Support to the Energy Efficiency Programme: energy audit, staff training, energy awareness programme. Extension of residential energy saving measures.

Total cost: 0,68 MECU

Development of Energy Conservation Programmes at the National and Local Levels

Development of energy-use statistics; implementation of energy-saving survey; of audits; of a pilot scheme for offices of the NEEO at regional level to provide advice to consumer demonstration of energy efficient technologies; training in energy saving.

Total cost: 1,25 MECU

Improvement of Traffic Flows in Trans-European Network Corridors II and IX

Activities: actions to improve traffic flows on corridors Germany-Russia and Finland-Greece.

Total cost: N/A

Port of Giurgiulesti Oil Terminal

Appraisal study for potential European Bank for Reconstruction and Development (EBRD) financing of Guirgiulesti oil reception facilities to Moldavian Parliament and EBRD approved project.

Total cost: 0,45 MECU

Management Gas and Oil Pipelines Extensions to Ukraine and Moldova

Activities: seminars.

Priority Emergency Investments in Oil and Gas Pipelines

Assistance to improve security of gas pipelines.

Total cost: 6,0 MECU

Regional Seas Programme - Black Sea, Caspian Sea and the Danube River Basin

Funding of selected parts of the Strategic Action Plan Implementation Programme: wetland rehabilitation; pesticides dumps; industrial waste treatment and others.

Total cost: 1 MECU

Prut River Management

Creation of an Environmental Information System; development of river & ground monitoring strategy; development of wastewater management strategy; modernization of monitoring laboratories.

Total cost: 2,5 MECU

Raising Public Awareness, Developing Environmental Media and Resourcing Good Practice

Development of the capacity of the media to report environmental issues; continued support to the CIS Inter-Parliamentary Assembly; building of the Best Practice Resource Center for promotion of Best Practice models; transfer of the resources to the new REC.

Total cost: 2,5 MECU

Widened Environmental Action Programme

Support to the activities of the Regional Environmental Center in project preparation, creation of mechanism for financing feasibility studies, environmental legal advice service; intra-ministerial and intra-NIS environmental cooperation and enhancement of environmental awareness.

Total cost: 6,50 MECU

Development of Common NIS Environmental Policies

Support to the establishment of common national environmental action plans for NIS countries. Colloquia, documentation and training.

Total cost: 4,00 MECU

Environmental Programme for the Danube River Basin

Accident Emergency Warning System and Monitoring, Laboratory and Information Management for Ukrainian and Moldavian part of the Danube Basin (TACIS)

Overall objective: i) To enable Ukraine and Moldova to meet their international obligations under the Danube River Protection Convention in the establishment of the Danube Accident Emergency Warning System and the Danube Trans National Monitoring Network (TNMN); ii) To promote regional (Danube basin-wide) cooperation, investment preparation and the elimination of health risk in water resources, control on water quality and developing proposals for the pollution reduction and pilot projects.

Specific objective: To provide the equipment, training and expert advice required for establishing AEWS and TNMN systems in Ukraine and Moldova.

Total cost: 1,0 MECU

Development of Common Environment Policies in the Newly Independent States (NIS) and Mongolia (completed in June 1998). The main objective of this TACIS-financed project was to assist the NIS countries and Mongolia to develop effective capacity for addressing the serious environmental problems they face. This is being achieved through: (i) providing long term advisers, to be resident in the country for up to one year; (ii) short-term assistance in the areas such as environmental priority setting, cross sectoral environmental issues, environmental legislation, public participation, project preparation, and environmental economics; (iii) organizing training courses and workshops in the key areas at a sub-regional level with a focus on common NEAP frameworks, trans-boundary issues and participation in international conventions.

Building Capacity for the Implementation of the National Environmental Action Plan in Moldova (UNDP, on-going). This project aims to assist the Ministry for Environmental Protection of Moldova by enhancing its capacity to implement the National Environmental Action Plan (NEAP). This will be achieved through the institutional strengthening, support for development of the local environmental action plans and mechanisms of their realization for each of the Regional Ecological Agencies; and the identification and promotion of projects fitting NEAP recommendations.

Raising Environmental Awareness and Developing Environmental Media in the NIS and Mongolia (on-going). The overall objective of this TACIS project is defined as follows: to raise awareness of possible solutions to environmental problems and to build the capacity of selected groups in tackling environmental problems. The programme will work to increase the coverage of environmental problems in the mass media, increase the NGOs' efficiency and work with the Governments of the region to support the environmental legislative process.

Pilot Project on Developing NEAP Environmental Indicators in Moldova (completed). In order to facilitate the evaluation and monitoring of the NEAP implementation process, the Organization of Economic Cooperation and Development supported the development of a set of environmental indicators. This project involved the participation of international consultants and experts from Moldavian institutions responsible for the natural resources management and environment protection.

Environmental Performance Review of Moldova (completed). In the framework of this project the UN/ECE environmental experts reviewed the current environmental policy and the degree of integration of environmental policies into the economic and social ones.

Farm Environmental Management Demonstration Programme (completed). The Environmental Policy and Technology Project, sponsored by the United States Agency for International Development, was facilitating during 1995-1996 the introduction and demonstration of agricultural production techniques and methods that could lead to environmental improvements in Moldova. In cooperation with government agencies, NGOs and the farming community, three locations were selected to introduce there the farming practices and techniques that offered both cost effective and ecological means to advance the agricultural sector of Moldova.

Study on the Quality of Rural Drinking Water (completed). This project was implemented during 1996-1997 by the Department of Environmental Protection with the financial assistance of the World Bank. The overall project objective was to contribute to the implementation of sustainable land-use and water resources management practices in Moldova. Specific objectives of the study were (1) to assess the actual state of groundwater pollution in selected pilot areas, and (2) to develop and introduce concepts on reduction and control of groundwater pollution from anthropogenic sources.

Moldova 21 (recently approved by UNDP). Through this project the global Capacity 21 programme will assist the Republic of Moldova to undertake a series of activities aimed at the development of the Moldova 21 Action Programme, which would focus at: upgrading the existent institutional framework and reviewing the state policy for launching a participatory process for designing a unified vision on Moldova's path to the 21st Century; supporting the cross-sectoral integration of the existing and future economic, social and environmental initiatives in the country; and strengthening the capacities of local and international actors as well as the knowledge of the general public on the key sustainable development issues. The coordination and monitoring of the Moldova 21 project will be assigned to the High Economic Council under the Presidency of the Republic of Moldova.

Small GEF Grants within the Environmental Programme for the Danube River Basin. This regional programme was designed to create a framework for the long-term solution of the problem of pollution in the Danube River Basin. In the framework of this programme, the UNDP office in Moldova supported the participatory development of the Danube Strategic Action Plan with the involvement of Moldavian experts and non-governmental community, as well as assisted Moldavian environmental NGOs in building their capacity to solve problems of a basin-wide character at the local level. The small project component is going to be renewed in the nearest future.

6. Planning and Implementing Capacities

6.1. Planning Capacities

Moldavian Institutions have accumulated a lot of experience in the designing and developing of different projects in cooperation with different international and local institutions.

Institute "CEPROSERVING" participated in the designing and development of the construction project for the oil terminal on the Moldavian part of the Danube bank, oil deposits in Ungeni, railway from the oil terminal to Cahul etc. This Institute has also experience in the designing and development of the construction projects for the WWTPs.

Institute ACWAPROIECT has experience in the designing and construction of the irrigation and drainage systems, channels, drinking water supply network, dams, water bodies etc.

National Institute of Ecology in cooperation with other subdivisions of the Ministry for Environmental Protection in Moldova has accumulated experience in designing of different action programmes, plans etc. Experience accumulated in the Institute was largely used during the development of different impact assessment studies in different parts of the country, development and designing of different environmental standards, normatives etc. Essential part of the activity of the Institute is dissemination of international experience in environmental protection and management in Moldova.

Different workshops, seminars and training courses held in Moldova for last 5 years in the frame of different international activities and projects have strongly increased planning capacities of local authorities and Institutions. According to estimations more than 1500 specialists from different Institutions in Moldova participated and have a beneficiary from such activity.

6.2. Implementing Capacities

6.2.1. Implementing Capacities for Structural Projects

Actual implementing capacities strongly depend on financial situation for the project implementation. Practice shows, that implementation also depends on the training of the staff from implementing agency. Experience accumulated in the construction practice shows (recovering of food industry enterprises, developing of the irrigation system, future recovering of the pig farm in Cahul district etc.) that there were no significant problems in the implementation of the projects developed with the technical assistance and cooperation with international donors.

6.2.2. Implementing Capacities for Non-structural Projects

Moldavian Institutions have been being successfully involved in the implementation of different projects aimed at the pre-investment and feasibility studies aimed at the improvement of the drinking water supply network, quality assurance practice in laboratory management, development of the action programmes etc. These projects have influenced very positive on the improvement of the institutional capacities of Moldavian Institutions and structural changes in Moldavian economy. Generally, Moldavian Institutions have good capacities for the implementation of the non-structural projects.

Annexes

Moldavian Hot Spots

Hot spot name, river and location	Parameters Values which Define the Problem	Ranking of the Problem	Name & Type of Project (Structural or non-structural)	Project Strategy and Targets	Parameters & Values which Define project benefits	Project Beneficiaries
town of Briceni, river Racovet	BOD - 54,4 tons, N - 31,1 tons	Medium	Structural	Installation of the nutrient removal stage. Reduction of nutrients for 40%	Reducing of the BOD and N loads	Local authorities
Town Edinet, river Racovet	P - 6883 tons	Medium	Structural	Installation of the nutrient removal stage. Reduction of nutrients for 40%	Reducing of P- load for 40%	Local authorities
Town Ungeni, Prut river	BOD - 25,2 tons, N - 122,6 tons, P - 7,5 tons	High	Structural	Installation of the nutrient removal stage. Reduction of nutrients for 40%	reduction of BOD, N and P for 40%	Local authorities
Town Cantemir	BOD - 52,6 tons, N - 13,9 tons	High	Structural	Installation of the second stage of treatment and nutrient removal stage	SS, BOD, N removal for 80%	local authorities
District Vulcanesti, pesticide dump, Danube and Prut rivers	out of data pesticides 4000 tons (officially) 40.000 tons (estimations) see part B	High	Structural	Construction of remediation plant or as a first step - improving the protected regime	Reduction of the pesticides loads on groundwater and Danube ecosystems	Danube Delta authorities, local authorities

Note: there are no separated discharges from industry, agriculture and municipalities; all Hot Spots are given together.

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