CHAPTER IV LEGAL, INSTITUTIONAL AND EDUCATIONAL ASPECTS

4.1 Legislative Framework

4.1.1 General

The most important laws stipulating the policies and activities for promotion of water environment management are the Environment Protection Law (Law 137/1995) and the Water Law (Law 107/1996). The Environment Protection Law gives a general framework for environmental protection. The Water Law provides all the provisions necessary for integrated water management including quantity and quality.

Under these two (2) fundamental Laws, subordinate legislation are issued in the form of Government Decisions or MWFEP Orders, classified as:

(1) Legislation providing for organization and functions of the government entities; in this case, MWFEP, Romanian Waters and the Agency for Environmental Protection

(2) Legislation providing for regulatory procedures.

4.1.2 Environmental Protection Law

The objective of the Law is to regulate environmental protection on the basis of the principles and strategic elements leading to the sustainable development of society. In the transitory provisions, the Law stipulates the fields to be regulated through special/revised/new laws, where "water and aquatic ecosystems management" is nominated. The specific regulation related to water resources is placed under the Water Law provisions. The Environmental Protection Law gives a general framework of the environmental protection that contains water quality protection as a part.

The Law involves 89 articles divided into 6 chapters. The following are the significant provisions related to the Project.

(1) General Principles and Strategic Elements

(2) Jurisdictions in the Environmental Protection

(3) Regulation of Economic and Social Activities having an Environmental Impact

   (a) The environmental protection authorities (Agency for Environmental Protection) shall conduct the permitting and licensing procedure and shall issue the environmental permit and the environmental license.

   (b) The environmental permit application is compulsory for new investments, for modification of the existing ones, and for activities listed in Appendix No. II in the Law. The environmental license application is also compulsory for putting into operation the objectives that have an environmental permit and for the existing activities.

(4) Protection of Waters and Aquatic Ecosystems

(5) Protection of Human Settlements

4.1.3 Water Law

The Water Law aims at conservation, development and protection of water resources by applying a unified, rational and complex water management in the respective river basins. To effectuate this primary objective, 112 articles are provided in 7 chapters. Hereafter outlined are the significant provisions of the Water Law that are closely related to the Project, categorized by subject matter.

(1) General Provisions

(a) Public Ownership of Water : The surface water and groundwater shall be owned by the public in principle.

(b) Jurisdictions in Water Use Regulation : The establishment of water use regulation is an exclusive right of the Government, to be exerted through MWFEP in principle. Romanian Waters shall administer public-owned waters.

(c) Jurisdictions Relating to Water Management : The MWFEP shall carry out the elaboration of the national water management strategy and policy, and shall ensure the coordination and control in applying the internal and international regulations. The Romanian Waters shall carry out the quantitative and qualitative water management, operation of water management structures, and the implementation of the national water management strategy and policy.

(2) Regulation of Water Use

(a) Authorization of Water Use and Discharge : The right to use surface and ground water shall be established by the water management license except minor use. The right also includes the discharge of wastewater, after being used.

(b) Priority on Drinking Water Supply

(c) Water Quality Standards : Water quality standards and drinking water quality standards shall be approved, on the proposal of MWFEP and of the Ministry of Health, respectively. The effluent limits of pollutants in wastewater discharge shall be approved by the Government Decision, on the proposal of the above two (2) Ministries. The effluent limits provided in the water management permit/license are the maximum allowable limits.

(d) Forbidden Activities to Protect Water Resources : The increase of wastewater pollution contents caused by (i) setting into operation new economic units, (ii) developing and introducing modified production technologies in the existing economic units, and (iii) setting into place new human settlements, is forbidden, without setting into operation sewerage networks/wastewater treatment plants, or without carrying out works/measures to ensure the effluent limits stipulated in the water management license.

(e) Wastewater Discharge into Sewerage System : The wastewater discharge into sewerage network may be admitted, only with the agreement of and in compliance with the conditions established by the network holder, and only if the wastewater treatment plant has the necessary technological profile and the available capacities. Pre-treatment of wastewater by the water users is mandatory, in all cases.

(f) Obligations of Operators of Wastewater Treatment Plants : Continuous monitoring of functioning of wastewater treatment plants, through laboratory analysis. Book-keeping of records with analysis results. Putting the data at the disposal of the inspection and control personnel of Romanian Waters, and others.

(g) Mining/Industrial Wastewater Discharge : The mining wastewater may be discharged into surface water bodies, only after the proper treatment.

(h) Accidental Water Pollution : The Romanian Waters shall organize the activities to prevent the accidental water pollution. Water users are obliged to prepare and apply their own plans, in accordance with the frame-methodology of MWFEP. In case of pollution occurrence, Romanian Waters shall immediately warn water users and local public administration authorities downstream to take water protection and damage-elimination measures.

(3) Regulation of River and River-bed Use

(4) Protection Measures for Riverbeds, Banks and Hydraulic Structures

(5) Water Management

(a) Establishment of National Water Management Database

(b) Formulation of the Water Cadastre

(c) Establishment of Water Management Frame Scheme and Development Program

(d) Organization of Basin Committee

(6) Regulation Prescription for Works Built on or Related to Waters

(7) Prevention and Control of Floods, Hazardous Meteorological Phenomena and Hydraulic Structure's Accidents

(8) Participation of the Public

(9) Inspection of Water Management Activity

(a) State Inspectorate of Water :

Within the MWFEP, the State Inspectorate of Water is functioning with the duties of inspection and control of the implementation of the provisions of the Law.

(b) The Right of the Water Management (Romanian Waters) Personnel :

(i) to access water for ascertaining the compliance with the regulations and implementation of the water management measures;

(ii) to inspect the water-related works, constructions, installations or activities, and to check up if all these are realized and exploited according to the specific legal provisions and in compliance with the provisions of the water management permits/licenses;

(iii) to check up the flow measurement installations, to take water samples, and to examine any data/documents necessary for the inspection;

(iv) to identify the actions constituting infringements and infractions in the water management field, and to conclude the documents.

(10) Water Economic Mechanism

(a) Specific Economic Mechanism to Include Payment System : For the quantitative and qualitative water management, the specific economic mechanism shall include the payment system, allowances and penalties as part of the financing practice of the water management system development and of ensuring the functioning of Romanian Waters based on economic principles. The payment system is based on "beneficiary pay" principle, according to the services provided, and the services related to the rational use of water resources.

(b) Allowances and Penalties : The allowance shall be granted to the water users who demonstrate a permanent concern for the rational use and for protection of water quality, discharging the treated wastewater in quality and in quantity smaller than those stipulated in the water management license. The penalties shall be applied to the water users for exceeding both permitted quantity in the water extraction, and permitted quality/quantity in the wastewater discharge. Romanian Waters is the only authority entitled to identify the cases to grant allowances and to apply penalties. The allowances shall be granted with the approval of MWFEP.

(c) Water Fund (see, the following Subsection 4.1.7)

(d) Financing of Investment in Water Management

4.1.4 Water Quality Standards and Effluent Limits

(1) Water Quality Standards for Surface Waters

The standards was established by the Romanian Standard STAS 4706/88 of the Romanian Institute for Standardization, coming into force in November 1988. The category and technical quality conditions of surface water are stipulated depending upon the scope of water use. For the water quality standards and scope of water uses by category, see Chapter III, Subsection 3.4.1. For details, see Appendix G, Table G.2.4.

(2) Drinking Water Quality Standards

The drinking water quality standards established by STAS 1342-91 have been effective since June 1991. Although this standards do not cover all the parameters included in those of EU, it is observed that both standards are almost at the same level except for some toxic substances. For the comparison with EU standards, see Appendix G, Table G.2.5.

(3) Effluent Limits for Wastewater Discharge

In November 1997, Romanian Standard NTPA-001 was approved by the Government Decision HG 730/1997, stipulating the effluent limits of pollutants in wastewater discharge into surface water. Simultaneously, MWFEP Order 645/1997 came into force, providing for Romanian Standard NTPA-002 regarding the effluent limits into the sewerage systems. The new standards stipulate a constant effluent limit of parameters, being different from the previous ones of 1979 in the regulatory concepts on wastewater discharge. For the effluent limits of wastewater discharge stipulated in NTPA-001 and NTPA-002, see Appendix G, Table G 2.6.

However, the effluent limits are not always constant throughout the country, since they shall be reduced according to the dilution degree of the receiving surface water. The maximum permissible limits of quality parameter in Table G.2.6 are applicable to surface waters having the standard flow rate (a yearly minimum monthly mean discharge with a probability of 95%) bigger than three (3) times the wastewater flow discharging into the surface water, except for the Danube River. For the surface water with a dilution degree smaller than three (3), the limit values in Table G.2.6 shall be proportionally reduced to secure at least the water quality of Category II in STAS 4706/88.

4.1.5 Regulatory Legislation

Under the Water Law, the water management permit and the water management license application is obligatory to all the water users and for works on water or related to water, except for those meeting the household needs on the small-scale. For issuing water management permits/licenses, promulgated are:

MWFEP Order 148/1997	:	regarding procedures and competence to issue water management permits/licenses
MWFEP Order 277/1997	:	regarding technical documentation required for obtaining water management permits/licenses

Prior to the promulgation of the Water Law, the Government Decision HG 1001/1990 has been in force, providing for a unitary payment system of water management products and services. It should be noticed as semi-regulatory.

HG 1001/1990	:	regarding a unitary payment system for water management products and services
MWFEP Order 242/1990	:	regarding technical instructions to apply HG 1001/1990

Under the Environmental Protection Law, the environmental permit and environmental license applications are obligatory to all the economic and social activities having environmental impacts. The issuance of the environmental permit/license shall follow:

MWFEP Order 125/1996 : regarding regulatory procedures for the economic and social activities having environmental impact

4.1.6 Regulatory Procedures Related to the Project

(1) Authorization of Water Management

The authorization of water management is made through the issuance of the water management permit and the water management license.

The Water Law provides: "The water management permit is required for the water users to carry out the works built on or related to water, for the investment documentation. To set into motion or to put into operation the works shall be made only on the basis of the water management license."

The Water Law also stipulates: "The right to use the surface or ground waters, including the artesian wells, is established by the water management license. Such right also includes the discharge into water resources, of wastewater, drainage water, meteoric water, mine or deposit water, after being used."

Romanian Waters and its river basin branches issue the water management permit and the water management license. To obtain the water management permit, the technical documentation with a copy of letter to inform the public of the intentions, etc., shall be sent in a prescribed manner to Romanian Waters. In issuing the water management license, an elaborated technical documentation is required, following the normative contents.

The water management license does not exclude the obligation of applying and obtaining of the environmental license.

The water management permit and the water management license contain almost the same items relating to water use, but the items for wastewater discharge are not included in the water management permit.

Items included in the water management license are as follows:

1	Cadastral Parameters	Registration No. in County, Intake/Discharge Registration No. etc.
2	Water Intake	Water Source and Intake Flow Rate, Total Authorized Intake Volume, Water Intake Facilities, Treatment Facilities, Distribution and Storing Facilities
3	Water Use Instructions	Total Water Consumption Volume, Total Water Intake Volume, Level of Recycle Water Use
4	Standard Water Use Rate	
5	Wastewater Discharge	Water Category, Authorized Receiver, Total Discharge Volume
6	Wastewater Treatment	
7	Wastewater Quality	Water Category, Parameter, Permitted Value
8	Wastewater Quality Measurement	Frequency and Person in Charge

To monitor compliance to the stipulations, Romanian Waters conducts inspection works, mainly on wastewater discharge to the surface water bodies. The inspection consists of a visual examination of the discharge outlets, taking a sample for laboratory analysis, and the completion of the inspection report. The samples are usually taken in duplicate or triplicate in the presence of the water user. One of the duplicate samples is analyzed by the water user, and another by the Romanian Waters laboratory. When the analytical results differ by 20% or less, the average of the two (2) values is considered as the correct results. If the difference is greater than 20%, the Romanian Waters value is considered to be the correct one.

(2) Unitary Payment System for Water Management Products and Services

As stipulated in the Water Law, only the Romanian Waters is supplier of surface water and groundwater. They have the right to directly manage waters; therefore, exclusively entitled to receive the payment for water. The payment includes the following price, tariff and penalty.

(a) Raw Water Prices : Raw water extraction prices of surface and ground water for various water uses.

(b) Tariffs for Water Management Services : Including (i) the tariffs for the pollution loads discharged into surface water within the permitted limits (ii) tariffs for water use for hydropower generation.

(c) Penalties for Violating the Standards : Including the penalties for (i) exceeding the permitted intake volume of surface and ground water, (ii) using water for the purposes other than permitted one, (iii) exceeding the permitted water quality values in wastewater discharge, (iv) discharge of highly toxic substances forbidden by the Law, etc.

The unitary payment system has furnished Romanian Waters with its financial basis for autonomous operation. On the basis of the water management license issued, Romanian Waters concludes a commercial contract with the water user, and collects the revenue from the sales of water management products and from rendering water management services.

The Competition Bureau, Ministry of Finance, shall first approve the price of raw water, tariff of water management services and penalties, based on the proposal of the Romanian Waters, exclusive of VAT. Based on the approved price and tariff, the

Romanian Waters Headquarters establishes the standard price/tariff applicable nationwide.

The current prices of raw water and tariffs for water management services as of August 31, 1998 are shown below.

Category	Type of Water/Service	Unit	Unit Price/Tariff	Unit Price/Tariff
I.	Raw Water		Surface Water	Groundwater
	Industrial Use	Lei/1,000 m^3	67,721	83,358
	Domestic Use	Lei/1,000 m^3	67,721	19,015
	Irrigation/Fishery Use	Lei/1,000 m^3	901	3,280
	Stock-breeding	Lei/1,000 m^3	67,721	25,243
II.	Pollution Load Discharge			
	SS	Lei/ton	24,395	
	BOD	Lei/ton	98,658	
III.	Hydropower Use		Capacity < 4 MW	Capacity > 4 MW
	Mean Head	Lei/m	442,028	732,414
	Turbine Water Use	Lei/1,000 m^3	900	1,988

The Romanian Waters Basin Branches establish the price of treated water within their respective areas of authority, by adding the cost of water intake, treatment, transport cost and a 10% of profits to the basic price of raw water.

The penalties under the unitary payment system, stipulated in the Water Law, shall be assessed by the inspection of Romanian Waters personnel. In 1997, the Prahova Office staff carried out inspections 320 times resulting in assessing the total penalty amount of 2.8 million lei in four (4) cases, and the fines of 11 million lei, also in four (4) cases. The fines are imposed due to the infringement of the Water Law provisions, different from the penalties under the unitary payment system. Due to non-payment of the water users, only 5 million lei had been collected out of the total assessment value of fines.

4.1.7 Water and Environmental Fund

(1) Water Fund

The Water Fund was first established by HG 1001/1990 in 1990. This is a special fund not included in the state budget. Thereafter, its functions were revised and upgraded by the Water Law promulgated in 1996.

The purpose of the Water Fund is to participate in the financing of investment for works with a significant contribution to the improvement of the water supply sources, to the water quality protection, as well as of the expenditures required for studies and applicable researches in the water field.

The Water Fund is managed by Romanian Waters and is used, together with other sources, for the financial support of various activities in the water field. The activities closely related to the Project are as follows.

(a) Strengthening of water quantity/quality monitoring system including laboratories.

(b) Participation in installation and modernization of the wastewater treatment plants in order to improve the surface water quality.

(c) Studies for the development and management of water resources in quantity and quality.

(d) Granting of allowance to those with significant results in the protection of water environment.

However, the financial sources of the Water Fund are limited to (i) fees collected in water management permit and license issuance (including VAT) and (ii) penalties under the unitary payment system. The performance of the Fund has been poor due to the insufficient fund sources.

(2) Environmental Fund

Recently, the Environmental Protection Department of the MWFEP has prepared a Draft Environmental Fund Law, which is now under deliberation by the Chamber of Deputies of the Romanian Parliament. The objective of the Fund is to improve the environmental quality by encouraging the investment for the following technologies and activities:

(a) To replace the polluting substances in the manufacturing process.

(b) To reduce the negative impact upon the environment.

(c) To take special measures for protection, preservation of biodiversity and ecological reconstruction, and for developing scientific, educational and information field regarding environmental protection.

The proposed major financial sources are:

(a) Direct taxes and tariffs for the use of either the natural resources or the natural capacity of emissions and waste assimilation.

(b) Indirect taxes and tariffs for commercial use of the products having an impact upon the environment.

4.2 Institutional Set-up

4.2.1 MWFEP and the Water Department

The MWFEP is a central public administration body to apply the government strategies for water management, forest management, and environmental protection. It has three (3) Departments; namely, Water, Forestry and Environmental Protection. The Water Department is directly responsible for the water management. Its main tasks are to substantiate and promote the measures for water resources protection, conservation and rational management. Its specific functions include:

(1) Strategic planning and coordination in water management;

(2) Allocation and management of state budget for water management;

(3) Preparation and management of legislative and policy initiatives, and administrative processes for the regulation of water resources use;

(4) Preparation of legislation and policy;

(5) Provision of guidance and technical assistance to other institutions in water management;

(6) Control and monitoring of compliance with national standards, policies and regulations concerning water management; and

(7) Coordination and control in applying the internal and international regulations.

4.2.2 Self-managed Public Company, Romanian Waters

(1) Headquarters and River Basin Branches

The Romanian Waters is an actual operational agent of the MWFEP in the field of water management, directly falling under the Secretary of State, Water Department. The Romanian Waters is charged with the implementation of the national water management strategy (quality and quantity); and in its capacity, the general responsibilities include:

(a) To administer the water resources of the country;

(b) To promote rational use of water resources;

(c) To protect water resources against pollution;

(d) To prevent over-use and exhaustion of water resources;

(e) To control destructive effects of the waters;

(f) To coordinate reservoirs operation; and

(g) To develop new water management works.

Organizationally, Romanian Waters is composed of a headquarters and 12 basin branches. The specific responsibilities of the basin branches include:

(a) Preparation of river basin management and investment plans in accordance with the strategies issued by the MWFEP;

(b) Administration of investment funds supported by the fees collected and used to provide economic incentives in the financing of the investments under the plans;

(c) Operation and maintenance of the monitoring system of the hydrological and water-related information in support of a better understandings in the basin.

(2) Romanian Waters – Prahova Office

The Prahova Office comes under the Basin Branch, Buzau in the organizational settings of Romanian Waters. It is in charge of the implementation of the strategy in quality and quantity management of surface and ground water in the Prahova River Basin. For the set-up of the Prahova Office, see Appendix G, Fig. G.3.3.

The Prahova Office administers 1,786 km of watercourses, 2 multi-purpose reservoirs (Paltinu and Maneciu), 24.15 km of dikes, 190 km of riverbed stabilization works, 49 km of riverbank consolidation, 4 water intake facilities, 3 water treatment plants, 1 groundwater intake facility with 40 wells, 170 km of pipeline for water transportation, and others.

The currently carried-out major activities of the Prahova Office are:

(a) Operation of 2 multi-purpose reservoirs and the respective dams;

(b) Operation of 3 water treatment plants; Paltinu, Maneciu and Valenii de Munte;

(c) Transporting of the treated water, through pipe-lines, directly to water users, and to the storage/distribution facility at Moara Vulpii and then to water users;

(d) Sales of untreated water;

(e) Water management authorization through issuing the water management permits and licenses;

(f) Inspections towards compliance with the provisions of water management permits and licenses;

(g) Surveillance and monitoring of water resources conditions, through hydrological and hydrogeological measurements;

(h) Flood defense (only at the time of occurrence) and the related survey; and

(i) Collection of water tariff, discharge tariff, permit and license fees, and penalties for excessive effluent discharge.

4.2.3 Agency for Environmental Protection, Ploiesti

The Agency for Environmental Protection, Ploiesti is in charge of the implementation of the environment protection strategy in the Prahova County. It is one of the 42 branch agencies having an office at each County plus the one at Bucharest. The Agency is subordinate to the MWFEP, directly under the Secretary of State, Environmental Protection Department. Three (3) Services: Inspection, Advisory and Monitoring, are functioning inside the Agency. Tasks being performed by each Service are:

(1) Advisory Service : issuing the environmental permits/licenses in accordance with the Environmental Protection Law and regulations;

(2) Inspection Service : control of the economic/social units such as industrial plants, agricultural farms, and public utilities authorized under the environmental permits/licenses;

(3) Monitoring Service : surveillance of quality of environmental factors: air, water, and others, to report the monitored data to the MWFEP.

4.2.4 Local Public Administration Authorities

The Prahova County Council is the primary administration authority in Prahova County, overseeing the lower level Local Council established at each municipality. The County Council, headed by a President, is composed of a number of Counselors elected from among the people of Prahova County. The technical staff is functioning to conduct the actual administration works under the Counselors. Organization of technical staff is frequently changing due to internal shuffling; however, the major components are four (4) divisions as follows:

(1) Administration Staff

(2) Legal Staff

(3) Financial Staff

(4) Infrastructure Staff

These County Council staff maintains a close coordination with the representatives of the governmental departments stationed in the Prahova County. In some occasions, joint-committees of the County Council staff and the departmental representatives are formed to discuss the specific subjects in the County such as infrastructure development.

At the municipality level, the Local Councils are constituted to conduct the administrative matters in the locality. The head of the Local Council is the Mayor, who is elected by the people of the municipality. In the Prahova County, 100 Local Councils have been set up, in total: 2 Cities, 12 Towns and 86 Communes. The Local Council may propose certain investment programs of the municipality to the County Council for the purpose of appraisal. In case of infrastructure investment, the County Council may arrange the funding measures with the Ministry of Public Works and Land Development after the appraisal.

For the above-mentioned situations relating to the local public administration authorities, see Appendix G, Fig. G.3.5.

4.2.5 Local Public Services Companies

The drinking water supply, sewerage, solid waste disposal, central heating network, real estate and housing, street maintenance are the responsibility of the local public services companies set up at each Local Council area. These are mostly autonomous bodies established by the Local Councils to provide the public services as enumerated above.

In the Prahova River Basin, established and operating are the following:

Municipality	Organization	Management Type	Provided Services
Predeal	S.C. Apevita S.A. Predeal	Pure Private	Water Supply, Sewerage, Solid Waste
Azuga	S.G.O. Azuga	Town Department	Water Supply, Sewerage
Busteni	G.O. Busteni	Town Department	Water Supply, Sewerage
Sinaia	A.D.P.P. Sinaia	Town Department	Water Supply, Sewerage, Solid Waste
Comarnic	D.A.D.P.P. Comarnic	Town Department	Water Supply, Solid Waste
Breaza	S.C. Civitas S.A. Breaza	State Company	Water Supply, Sewerage, Solid Waste
Campina	R.A.G.C. Campina	Self-management Company	Water Supply, Sewerage
Baicoi	S.C.G.L. Baicoi	State Company	Water Supply, Sewerage, Solid Waste, Heating
Plopeni	S.C.G.C.L. Plopeni	State Company	Water Supply, Sewerage, Heating
Slanic	S.C. Goscom S.A. Slanic	State Company	Water Supply, Sewerage, Solid Waste, Heating
Valenii de Munte	S.P.S. Valenii de Munte	Town Department	Water Supply, Sewerage, Solid Waste, Heating
Boldesti Scaieni	S.C.G.C.L. Boldesti Scaieni	State Company	Water Supply, Sewerage
Urlati	A.D.P. Urlati	Town Department	Water Supply, Sewerage, Solid Waste, Heating
Ploiesti	R.A.A.C.F.L. Ploiesti	Self-management Company	Water Supply, Sewerage

4.3 Environmental Education, Public Awareness and Training

4.3.1 General

Environmental problems are locally oriented. Even global environmental problems such as ozone depletion cannot be solved without local initiative. Through education, public awareness activities, and training, local residents will become more aware of their living environment and more responsible for the consequences of their own action toward the environment. Promotion of public awareness in environmental protection is crucial to the success of an environmental regulatory system.

In the Basin, approximately 200 major point pollution sources exist. In addition to the point sources, there are non-point sources that consist of approximately 40% of the total pollution load in the River. Further, the River has suffered from major water pollution accidents 18 times since 1989. Systematic public participation in water environment management is considered essentially necessary to attain a satisfactory control of these many and complicated water pollution sources and problems.

This section reviews the current efforts in environmental education, public awareness and training at both national and local level, and assesses the present level of environmental awareness of the public on the Prahova River. Further, this section identifies legal and administrative bases on which public participation should be promoted.

4.3.2 Current Efforts in Environmental Education, Public Awareness and Training

(1) Initiative at the National Level

(a) Ministry of Waters, Forest and Environmental Protection (MWFEP)

The Directorate for International Relations under the Minister is responsible for disseminating information. The responsibilities include preparation of annual

environmental report and of educational material on environmental protection, and consultation with NGOs as well as other civil society.

The Ministry publishes a monthly journal "Jurnalul Naturii" and distributes 1,100 copies to the Council of Europe, schools, universities, NGOs and others. An information database on environment has been under development on the Internet.

The relationship between the MWFEP and Non-Governmental Organizations (NGOs) has greatly improved for the past four (4) years. The MWFEP currently has a financial difficulty in supporting NGOs. The creation of the Environmental Fund has been under consideration to satisfy such financial needs.

(b) Ministry of National Education (MNE)

The Institute of Educational Sciences, an independent institution under the MNE is responsible for developing school curriculum as well as textbooks including sub-textbooks.

Currently, 3rd and 4th grades in primary school have a couple of hours of inter-disciplinary science program a week. In secondary schools, environmental education is generally incorporated into biology, chemistry, geography or physics classes. The new subject "Geoecology" is about to be introduced at high schools. Certain high schools have optional courses on environment.

The Institute occasionally offers training courses for teachers and seminars for students on environmental issues.

(c) Romanian Waters Bucharest Headquarter

The International Relation Department is responsible for public relations.

In 1995, the headquarters organized the National Clean Water Campaign and distributed 20,000 copies of fliers and posters to the public through the regional offices. The flier contained the device on how to reduce pollutants and how to detect polluted water. The flier also encouraged the public to inform the Romanian Waters of any change in water conditions through local government, police department, medical unit, school, church, etc.

The Romanian Waters and the Romanian Association for Hydrological Science are jointly preparing for a new campaign.

(d) National Center for Sustainable Development (NCSD)

The NCSD, a UNDP project, was launched in June 1997. It functions as a think tank to advise Romanian Government and other bodies on sustainable development issues.

The NCSD started its preparation for Romanian "Agenda 21" (National Strategy for Sustainable Development) in April 1998. It will also include the strategies on environmental education, public awareness and training.

(c) Non-Governmental Organizations (NGOs)

About 300 environmental NGOs currently exist in Romania of which nearly 90% focuses on environmental education and training. NGOs in Romania have taken a leading role in environmental education and training. It appears that the government realizes the NGOs' advantages in the field of environmental education.

(2) Activities in Prahova County

(a) Environmental Protection Agency (EPA) Ploiesti Office

The EPA Ploiesti Office, regional office of MWFEP, acts as a coordinator among businesses, central and local organizations regarding general environmental protection, especially on soil and air quality protection (Romanian Waters is responsible for water quality and "Romsilva" is for forest and protected area).

Some of the responsibilities of this office are to carry out public consultation on permit application, to initiate educational activities and to support NGOs. At this office, 4 to 5 staff is engaged in public awareness activities. Table 4.1 shows the public awareness activities in which the office has been engaged.

(b) Romanian Waters Prahova Office

The Romanian Waters Prahova Office organized an information workshop, "Each household – A Step Against Pollution" in late July 1998 assisted by the JICA Study Team. The workshop intended to convey the message that each household can make a difference in the reduction of water pollution. This was the first workshop organized by the Romanian Waters Prahova Office.

(c) Inter-Organizational Initiative

(i) Local Agenda 21 Prahova

The Rio Declaration on Environment and Development (Agenda 21) of the United Nations Conference on Environment and Development (1992) includes local authorities' initiatives in support of Agenda 21 (Chapter 28) and promoting education, public awareness and training (Chapter 36). Based on these Chapters, the planning on how to implement the Local Agenda 21 Prahova (Agenda Locala 21 Prahova) has just started. The seminar on "Local Implementation of Agenda 21" was held in mid-July 1998 in Ploiesti organized by the NCSD, Environmental Know How Fund (United Kingdom) and the local NGO.

At the above seminar, the Romanian version of "Guide to Environmental Management for Local Authorities in Central and Eastern Europe" adopted by the International Council for Local Environmental Initiative was officially launched under the auspices of the Mayor of Ploiesti.

(ii) Pilot Project for Ploiesti City and Prahova County

In late July 1998, the EPA Ploiesti Office, Prahova County, INCERP-Ploiesti (Research Institute for Petroleum Processing and Petrochemistry), and the local NGO officially proposed that Prahova County become a pilot center for projects whose objectives are to improve the used oil management in Romania and to ease the environmental degradation, including the reduction of surface water pollution of the Prahova River Basin.

(d) Civil Society

There are 13 environmental NGOs in Prahova County; six (6) in Ploiesti, three (3) in Cimpina, two (2) in Busteni, and one (1) each in Sinaia and Azuga. Generally, the membership is diverse from pupils at secondary schools to specialists like biochemist, biologist, etc. Some local NGOs are part of international networks. The names and main activities of the local NGOs are shown in Table 4.2.

The other civil societies working for environmental education, public awareness and training include Childens' Club-Ploiesti, Boys and Girls Scout Association Sinaia, Prahova Women's Association and PTA (Parents and Teachers Association).

(e) Media

Both local governments and NGOs use the media for disseminating information. Thus, their success in public awareness activities much depends on the media attention.

There are seven (7) local radio stations, four (4) local TV stations and seven (7) local newspapers in Prahova County. The 1996 county data shows that about one (1) out of five (5) in the County is a TV receiver and about one (1) out of six (6) is a radio receiver.

4.3.3 Present Level of Public Awareness on the Prahova River

The JICA Study Team conducted a questionnaire survey in mid-July 1998 with cooperation of Romanian Waters Prahova Office and Prahova Women's Association in order to assess the present level of public awareness on the Prahova River. The survey made it clear that:

(1) People enjoy easy access to the river for leisure such as sunbathing (33%), trips/picnics (24%), etc.

(2) Twenty percent (20%) of the respondents did not know the source of their tap water.

(3) People are aware of the water pollution problems in some areas of the River, the cause of pollution and the regulations.

(4) Approximately 80% of the respondents knew that factories need a legal permit to discharge wastewater to the river. About 70% of the respondents who recognized the legal responsibility of factory thought that factories are not complying with the legal permit. In fact, most of the factories in the Basin discharge wastewater beyond their legal limits or without a legal permit.

(5) The media, especially radio and TV were acknowledged as important information sources for the public. Ninety percent (90%) of the information on water pollution of the River comes from the media.

(6) Fifty-five percent (55%) of the respondents was not satisfied with the existing conditions of the River. They want to see improvement in the future.

(7) People are willing to act more for improvement of the water quality of the River. Approximately 60% of the respondents answered that they would try to reduce household wastewater or to participate in environmental activities. About 50% have already been involved in such activities.

4.3.4 Legal and Administrative Bases for Public Participation

(1) Legal Bases

The following laws and order require public participation in environmental decision-making and implementation.

(a) Environmental Protection Law 137/95

"Setting up of a framework for the participation of NGOs and of the population in the decision-making and implementation" (Article 3) is one of the strategic elements to assure sustainable development – general principles and provisions.

The ways of implementing the principles and strategic elements include "training and education of the population as well as the participation of the NGOs in the decision-making and implementation" (Article 4) – general principles and provisions.

The local public administration authorities shall have the following prerogatives and responsibilities "to promote an appropriate behavior of the communities with respect to the importance of the environmental protection" (Article 76).

(b) Water Law 107/96

The water management shall be based on the principle of human solidarity and common interest through the close, all-level collaboration and cooperation of the public administration, water users, representatives of the local communities and population, in order to obtain the maximum social benefit (Article 6).

Water Law has a section 6 "Participation of the Public." The Law requires public consultation of water users, riverside residents and the public before decisions-making (Article 77). Other provisions also require public consultation (Article-42).

The information necessary to establish the water management frame schemes and the development programs shall be mandatorily provided for the MWFEP and Romanian Waters by .....(with omission) and the main water users, as well as by other NGOs interested in the river basins development (Article 44).

A Basin Committee shall be organized including one representative elected by NGOs and three water users' representatives (Article 47).

(c) MWFEP Order 194/96

The Ministry Order is summarized as follows. The EPA approves the activities of NGO members on environmental protection, of students in ecology and environment sciences, and of the people retired from the governmental bodies such as MWFEP, MNE, Ministry of Culture and Youth, Ministry of Health, Ministry of National Security, Ministry of Internal Affairs and public administration. The EPA shall initiate the cooperation and organize the training and activities for the people who can become authorized agents. The environmental violation detected by the authorized agents shall be penalized in accordance with Environmental Protection Law.

(2) Administrative Bases

The purposes of the Local Agenda 21 Prahova are: (i) to make suggestions on a series of actions for sustainable development; and (ii) to establish the cooperative relationship between local institutions and organizations or groups that are interested in taking necessary actions.

The "Local Agenda 21 Prahova" identified the following sectors for which an action should be planned to systematize their voices: local administrations; youth; labor unions; scientists; businesses; women; and agriculturists. Under the Agenda 21 Prahova, local NGOs are anticipated to act as intermediaries for local administrations and local communities, and help build trust among them.

CHAPTER V WATER DEMAND AND RIVER WATER BALANCE

5.1 Projected Future Water Demand

The future domestic, industrial and agricultural water demands in the year 2015 are estimated. The water demand is estimated by municipality and by hydrological simulation block (see Fig. 3.1) in the same way as the existing water use.

5.1.1 Domestic Water

(1) Assumptions for Water Demand Estimate

(a) Served Population

(i) Annual Growth Rate of Population

As discussed in Chapter II, the population of the Basin is assumed to increase in the future at annual growth rates of 0.0% until 2000 and 0.5% during 2001-2015. The annual growth rate of each municipality is also assumed to be the same as that of the total basin. Then, the population of each municipality in 2015 comes to 1.08 times the existing one.

(ii) Increase of Piped Water Served Population

In accordance with the recommendation of EPA, all the people will be served by piped water in the future. Individual shallow wells will be replaced by piped water with surface or ground water sources, resulting in increase of per capita water consumption.

Romanian Waters is constructing a new transmission main between Valenii de Munte and Movila Vulpii to supply water to the 29 municipalities located outside the Basin. The served population in these municipalities is included in the estimation of future water demand, because the source of this new water supply is the river water of Teleajen.

(b) Per Capita Gross Domestic Water

The per capita gross domestic water (including net domestic, small industries, shops/restaurants, offices, public facilities, etc.) is assumed to increase at annual growth rates of 0.0% until 2000 and 1.0% during 2001–2015, referring to the actual growth rate during the recent 10 years in Japan. Then, it comes to 1.16 times the existing one in 2015.

The per capita gross domestic water in 2015 is shown below, compared with the average existing one.

(unit: l/day/person)

Category	Municipality	Existing Facility	Existing	Yr.2015
1	City	Piped Water	370	430
2	Towns	Piped Water	280	320
3	Communes	Piped Water	180	210
4	Communes	Shallow Well	50	150

In the above table, it is assumed that all the existing shallow well water will be converted to piped water by the year 2015 and the per capita water consumption will increase up to 150 l/day/person of the Romanian minimum standard.

(c) Water Loss

As discussed in Chapter III, Subsection 3.2.3, the water loss in the domestic water supply networks in the municipalities is not significant except some cities/towns. In general, detection of water leakage locations is not easy and reduction of water loss will take a long time. Therefore, reduction of the existing water loss in the municipal water supply networks is not considered in this study for safety factor.

On the other hand, the loss in the water transmission mains of Romanian Waters is large and location of the water leakage can be detected by some detailed surveys. Rehabilitation and replacement of part of the transmission mains will be able to resolve this water leakage problem. Hence, it is assumed in this study that this existing water loss will be solved completely by the year 2015.

(d) Water Sources

The final objective of projection of the future water demand is to estimate the change of the river flow rate in the future. Hence, the future water demand is allocated for the surface and ground water sources based on the following assumptions.

(i) In the areas where surface water and/or network water (supplied from surface water source) is supplied at present, additional water demand is met by only surface water and/or network water. No groundwater development is considered. Ratio of the surface water and network water in the future is the same as the existing one.

(ii) In the areas where only groundwater is supplied at present, additional water demand is met by only groundwater development.

(2) Future Water Demand

The total domestic water demand of the Basin will increase to 126.2 million m^3/year in 2015 from 89.3 million m^3/year in 1997. This future water demand includes 4.5 million m^3/year in the municipalities located outside the Basin as mentioned in Item (1) above.

The breakdown by area and by water source is shown below. Ploiesti and its surrounding areas are the largest water demand area, sharing 54.8% of the total demand.

(unit: 1000 m³/year)

Area	Served Population	Network Water	Ground-water	Surface Water	Total
Ploiesti City & Surroundings	341,029	41,706	24,993	0	66,700
Floresti	8244	718	0	0	718
Cimpina City	44,176	3,944	0	5,300	9245
Prahova Valley	93,309	6,833	2,067	4,373	13,273
Others	338,015	19,334	10,769	1,665	31,768
Outside of Basin	48195	4,458			4,458
Total	872,969	76,994	37,830	11,338	126,162

Note : 1) Ploiesti and Surroundings include Aricesti Rahtivani, Barcanesti, Berceni, Blejoi, Brazi, Bucov, Paulesti, Targsoru Vechi communes.
2) Prahova Valley includes the upstream area of Cimpina City

For the future water demand by municipality and by water quality simulation block (same as water quality simulation block), see Appendix B, Table B.2.12.

5.1.2 Industrial Water

(1) Assumptions for Water Demand Estimate

(a) Growth Rate of Industrial Water Demand

Industrial water demand consists of reuse water demand and supplied water demand. Generally, unit supplied water demand will gradually decrease according to the promotion of water reuse although total unit water demand for industrial production is constant by each industrial category.

However, the reuse rate of industrial water in the Basin has already reached 85.7% on average and further promotion of the recycle use is considered not easy. (see, Chapter III, 3.2.2). In this study, the reuse rate of each industrial establishment in the future is assumed to be the same as the existing one.

Hence, the industrial water demand in the Basin is assumed to increase in direct proportion to the growth rate of industrial production.

As predicted in Chapter II, the annual growth rates of industrial production including tourism industry in the future are assumed as follows.

Category	Until 2000	2001-2015
General Industry	0.0 %	3.5 %
Tourism Industry	0.0 %	5.0 %

Then, the water demands of general industry and tourism industry in 2015 come to 1.68 times and 2.08 times of the existing ones, respectively.

(b) Water Sources

Similarly to the domestic water sources,

(i) The existing groundwater extraction does not change in the future for the industrial establishments which can use other water sources than ground water. The additional water demand is allocated to the surface water,

drinking net work water (surface water source) and industrial network water (surface water source) in proportion to the existing ratios of the above three (3) sources.

(ii) For the industrial establishments of which water source is limited to groundwater, the groundwater extraction will be increased to meet the future demand.

(2) Future Water Demand

The total industrial water demand of the Basin will increase to 1,388.1 million m^3/year in 2015 from 829.4 million m^3/year in 1997. This future water demand includes a reuse water demand of 1,190.4 million m^3/year; then, the supplied water demand (real water demand) is 197.7 million m^3/year.

The breakdown by area and by water source is shown below. Ploiesti and its surrounding areas are the largest water demand area, sharing 88.8% of the total demand on gross demand basis and 68.2% on real demand basis.

(unit: 1000 m^3/year)

Area	Network Water (Drinking)	Ground -water	Surface Water	Network Water (Industrial)	Reuse	Total Water Use	
Ploiesti City & Surroundings	67,808	37,369	118	29,518	1,098,028	1,232,841	(134,813)
Floresti	6,241	3,787	0	0	22,543	32,571	(10,028)
Cimpina City	11,176	0	684	30	19,216	31,106	(11,890)
Prahova Valley	4,483	1,952	10,392	0	14,379	31,207	(16,828)
Others	7,362	12,231	3,207	1,394	36,200	60,395	(24,195)
Total	97,070	55,340	14,401	30,942	1,190,366	1,388,119	(197,753)

Note : 1) Ploiesti and Surroundings include Aricesti Rahtivani, Barcanesti, Berceni, Blejoi, Brazi, Bucov, Paulesti, Targsoru Vechi communes.
2) Prahova Valley includes the upstream area of Cimpina City
3) with parentheses are real water use

For the future water demand by hydrological simulation block (same as water quality simulation block), see Appendix B, Table B.2.13.

5.1.3 Agricultural Water

(1) Assumptions of Water Demand Estimate

The existing agricultural water users will not increase their water requirement in consideration of the future economic growth of the agricultural sector. The water demand in 2015 is assumed to be the same as the existing one. For the existing agricultural water uses, see Chapter III, Subsection 3.2.2.

However, the rehabilitation of the irrigation system is an important policy in the agricultural sector to recover the agricultural production. There are five (5) irrigation systems in the Basin but they are not functioning well due to damage of the intakes and/or irrigation canals. These irrigation systems will be rehabilitated to fully function by the year of 2015, resulting in increase of irrigation water demand.

(2) Future Water Demand

In addition to the existing agricultural water demand of 13.5 million m^3/year, an additional irrigation water of 3.2 million m^3/year will be required in 2015 for the five (5) irrigation systems as shown below.

Irrigation System	District	Irrigation Area (ha)	Water Demand (1,000 m^3/yr.)	Intake
Iazul Morilor Prahova	Outside of Basin (right side of Prahova)	1,094	437.6	Floresti, Prahova Main
Canal Leaot	Ploiesti & Surroundings (left side of Prahova)	3,700	1,480.0	Nedelea, Prahova Main
Buda	Ploiesti & Surroundings (left side of Prahova)	1,650	660.0	-ditto-
Iazul Morilor Teleajen	Others (left side of Teleajen)	870	348.0	Magurele, Teleajen
I.C.V.V. Valea Calugareasca	Others (left side of Teleajen)	614	245.6	-ditto-
Total		7,928	3,171.2	

5.1.4 Total Water Demand

The total gross water demand (including water reuse) of the Basin will increase to 1,531.0 million m^3/year in 2015 from 923.1 million m^3/year in 1997. While, the total real water demand (excluding water reuse) will increase from 212.5 million m^3/year in 1997 to 340.6 million m^3/year in 2015.

The breakdown by area and by water source is shown below. Ploiesti and its surroundings is the largest water demand area, sharing 85.2% of the total demand on gross demand basis and 60.5% on real demand basis.

(unit: 1000 m^3/year)

Area	Domestic	Industry	Agriculture	Total
Ploiesti & surroundings	66,700	1,232,841 (134,813)	4,481	1,304,022 (205,994)
Floresti	718	32,571 (10,028)	0	33,289 (10,746)
Cimpina City	9245	31,106 (11,890)	0	40,351 (21,135)
Prahova Valley	13,273	31,207 (16,828)	7,540	52,020 (37,641)
Others	31,768	60,395 (24,195)	4,230	96,393 (60,193)
Outside of Basin	4,458	-	438	4,896 (4,896)
Total	126,162	1,388,119 (197,753)	16,689	1,530,533 (340,605)

Note : 1) Ploiesti and Surroundings include Aricesti Rahtivani, Barcanesti, Berceni, Blejoi, Brazi, Bucov, Paulesti, Targsoru Vechi communes.
2) Prahova Valley includes the upstream area of Cimpina City
3) with parentheses are real water use

5.1.5 Increase of Water Demand

The balance of the total real water demand (excluding water reuse) in 1997 and 2015 is estimated at 128.2 million m^3/year. The breakdown by area and by water use is shown below.

(unit: 1000 m³/year)

Area	Domestic	Industry	Agriculture	Total
Ploiesti & surroundings	16,557	54,784	2,140	73,481
Floresti	527	4,059	0	4,586
Cimpina City	2,294	4,831	0	7,125
Prahova Valley	4,430	7,503	0	11,933
Others	17,769	7,768	594	26,131
Outside of Basin	4,458	-	438	4,896
Total	46,035	78,945	3,172	128,152

Note : 1) Ploiesti and Surroundings include Aricesti Rahtivani, Barcanesti, Berceni, Blejoi, Brazi, Bucov, Paulesti, Targsoru Vechi communes.
2) Prahova Valley includes the upstream area of Cimpina City

5.2 River Water Balance

5.2.1 Additional Surface Water Extraction in the Future

The above water demand balance of 128.2 million m³/year will be met by the developments of surface water, groundwater and network water (of surface water and/or groundwater sources). Out of 128.2 million m³/year, 111.4 million m³/year must be supplied directly from surface water and through network water (surface water source).

On the other hand, the Voila and Valenii de Munte intakes extract a total surface water of 106,581 million m³/year at present of which 32.0 million m³/year (30 %) is leaked from the transmission mains connecting both intakes with Ploiesti City and two (2) large factories (see, Chapter III, Subsection 3.2.3). In this study, it is assumed that this water loss will be saved completely in the future. Then, the required additional surface water extraction will be reduced to 79.4 million m³/year as shown below.

(unit: 1,000 m³/year)

Water Use	Surface Water	Network Water	Loss Reduction	Total
Domestic	4,189	35,556		
Industrial	4,417	64,083		
Sub-total	8,606	99,639	- 31,974	76,271
Agricultural	3,171	-	-	3,171
Total	11,777	99,639	- 31,974	79,442

Out of the total additional surface water extraction (79.4 million m³/year), 47.0 million m³/year depends on the intake water of Voila and Valenii de Munte. Therefore, the additional water demand for both intakes is properly allocated as shown below, considering the river flow rates, existing extraction volumes, and capacity of transmission mains of both intakes.

(unit: 1,000 million m³/year)

Surface Water Source	Existing	Additional	Total	Transmission Capacity
Voila Intake	68,424	10,287	78,711	108,799 (3,450 l/s)
Valenii de Munte Intake	38,157	36,686	74,843	75,686 (2,400 l/s) *
Others	53,367	32,469	85,836	
Basin Total	159,948	79,442	239,390	

*: including a transmission main under construction

The required additional surface water in the future by each water user and by water source is shown in Table 5.1 along with the existing one.

5.2.2 Water Supply Development of Existing Reservoir

(1) General

According to the Romanian water supply standards, the domestic and industrial water supply must be assured for the design river flow rate with a 95% probability. However, the existing surplus river flow rate may not be able to meet the above-mentioned additional surface water demand at a time of the design drought. On the other hand, the reservoir capacity of the Paltinu and Maneciu dams are not fully employed at present and have some allowance. In this Section, the potential water supply development of both dams/reservoirs is discussed.

(2) Estimated Development Potential

The development potential of both dams/reservoirs is estimated under the following conditions.

(a) The active storage capacity of each dam is 53.7 million m^3 for Paltinu Dam and 50.0 million m^3 for Maneciu Dam.

(b) The required storage capacity is estimated so that water can be fully supplied even at the design drought with a 95% probability (driest year during the recent 20 years).

(c) Priority of the reservoir operation is given to water supply purpose rather than hydropower generation. Hence, any impact on the hydropower generation is not considered in this study.

The development potential for additional water supply is estimated to be 1.13 m^3/s (35.6 million m^3/year) for Paltinu reservoir and 2.84 m^3/s (89.6 million m^3/year) for Maneciu reservoir. The required storage capacity corresponding to the new development discharge for both dams/reservoirs is shown below.

Paltinu Reservoir	New Development Discharge (m^3/s)				
	0.0	0.5	0.7	0.9	1.13
Required Storage Vol. (1000 m^3)	19,508	29,847	34,165	38,485	53,121
Date of Lowest W.L Occurrence	Mar-93	Mar-93	Mar-93	Mar-93	Mar-91

Maneciu Reservoir	New Development Discharge (m^3/s)				
	0.00	2.00	2.75	2.84	3.00
Required Storage Vol. (1000 m^3)	1,650	28,746	44,670	49,987	62,904
Date of Lowest W.L Occurrence	Feb-87	Mar-93	Mar-93	Mar-91	Mar-91

(3) Conclusion

The water supply development potentials of the Paltinu and Maneciu reservoirs are large enough to meet the additional surface water demands at the Voila and Valenii de Munte intakes, respectively, as compared below.

(unit: 1,000 million m³/year)

Reservoir	Additional Water Demand	Development Potential
Paltinu	10,287	35,636
Maneciu	36,686	89,562

Although the Paltinu and Maneciu reservoirs can meet the water demand in the middle and downstream areas of the Basin, they cannot supply water to the Prahova valley area due to the large head difference.

5.2.3 Change of River Flow Regime

The above mentioned additional surface water extraction (see Table 5.1) will decrease the river flow rate in the downstream sections in the future. However, all the additionally extracted water is not consumed but a considerable portion will return to the river in the downstream. In this study, the return rate is assumed as follows.

Water Use	Return Rate
Domestic	80 %
Industrial	90 %
Agricultural	Negligible

On the other hand, the development of the existing dams/reservoirs will mitigate the decrease of river flow rate. Hence, the probable river flow rate in the future is simulated for the two (2) cases of without dam development and with dam development. The simulated probable future river flow rates are shown below, compared with the existing ones.

(unit: m³/s)

Station (model point.)		Existing			2015 w/o Dam Dev.			2015 with Dam Dev.		
		50 %	75 %	95 %	50 %	75 %	95 %	50 %	75 %	95 %
Cimpina	(200)	5.26	3.65	2.55	5.35	3.73	2.63	5.35	3.73	2.63
Doftana	(C)	0.83	0.39	0.01	0.44	0.01	- 0.38	0.44	0.01	0.00
Nedelea	(217)	7.11	4.65	2.91	6.54	4.09	2.34	6.54	4.09	2.72
Prahova	(200)	7.28	5.42	4.26	7.50	5.64	4.48	7.50	5.64	4.86
Valenii	(240)	2.28	1.24	0.70	1.15	0.11	- 0.42	1.15	0.11	0.08
Moara	(260)	6.93	5.38	4.52	7.29	5.74	4.88	7.29	5.74	5.38
Ciorani	(280)	0.85	0.56	0.35	0.96	0.67	0.46	0.96	0.67	0.46
Adincata	(H)	18.46	14.31	11.67	19.26	15.11	12.48	19.26	15.11	13.36

For details, see Table 5.2.

CHAPTER VI PROJECTION OF RIVER WATER POLLUTION

6.1 Basic Assumptions for Projection of River Water Pollution

The future baseline pollution load generation and river water quality are projected for the target year 2015, under the following basic assumptions and conditions:

(1) The future baseline projection is defined as the future projection without project. Hence, no projects concerning wastewater treatment improvement are considered.

(2) The pollution load generation will increase in direct proportion to the increase of population and industrial production. The pollution load effluent to river is estimated considering the runoff ratio of the generated pollution load.

(3) The average annual growth rates of the population and industrial production in the Basin are assumed as follows.

Item	Up to 2000	2001 – 2015	2015/Existing
Population	0.0 %	0.5 %	1.08 times
General Industry	0.0 %	3.5 %	1.68 times
Tourism Industry	0.0 %	5.0 %	2.08 times
Livestock	0.0 %	0.0 %	1.00 times

(4) The pollution load generation and river quality are estimated in terms of BOD. The river water quality is estimated for the proposed standard river flow rate (mean daily flow rate of 50% or 183 days flow rate of average flow regime).

(5) The standard river flow rate is estimated, taking into consideration the future increase of river water extraction from the upstream and return water discharge to the downstream.

6.2 Projection of Future Baseline Pollution Load Effluent

6.2.1 Domestic Sewerage Effluent

(1) Sewerage Discharge

The sewerage discharge in the Basin consists of the three (3) components of major industrial wastewater, gross domestic wastewater and groundwater infiltration.

(a) Major Industrial Wastewater

As discussed in Chapter V, Subsection 5.1.2, the industrial water demand (real water demand excluding reuse) is assumed to increase in direct proportion to the growth of the industrial production. Accordingly, the industrial wastewater discharge is also assumed to increase in direct proportion to the growth of the industrial production.

Then, the future wastewater discharge to sewerage system of general industry, tourism industry and livestock industry in 2015 come to 1.68 times, 2.08 times and 1.00 times of the existing ones, respectively.

For the future wastewater discharge to sewerage system of each major industrial establishment, see Appendix D, Table D.2.6.

(b) Gross Domestic Wastewater

The future sewerage served population of each municipality is assumed to grow at the same rate of the total population of the County. Then, the sewerage served population of each municipality in 2015 is assumed to increase to 1.08 times of the existing one.

On the other hand, the annual growth rate of per capita gross domestic water consumption is assumed to be 0.0% until 2000 and 1.0% for 2001-2015 in Chapter V, 5.1.1. Then, per capita gross domestic wastewater discharge in 2015 becomes as follows.

Municipality	Per Capita Discharge (l/d/person)
Ploiesti/Cimpina	370 x 1.16 = 430
11 towns	280 x 1.16 = 320
2 communes	180 x 1.16 = 210

(c) Groundwater Infiltration

The future groundwater infiltration is assumed to be the same as the existing one since no sewerage networks are extended.

The future baseline sewerage discharge of each municipality including major industrial wastewater, gross domestic wastewater and groundwater infiltration is shown in Table 6.1.

(2) Sewerage Quality

(a) General

The treatment methods of the existing 15 sewerage systems in the Basin are classified as follows.

Treatment Method	Municipality
Activated Sludge	Predeal, Sinaia, Breaza, Cimpina, Baicoi, Plopeni, Slanic, Valenii de Munte, Boldesti Scaieni, Urlati, Floresti, Maneciu
Sedimentation Only	Ploiesti
No Treatment	Azuga, Busteni

BOD removal efficiency of the existing treatment plants will decrease in the future according to the increase of sewerage influent discharge. The reduction of the BOD removal efficiency varies depending on the treatment method as described below.

(i) Estimate of Future BOD Removal by Activated Sludge Treatment

BOD removal rate of activated sludge treatment method is generally expressed by the following equation when sewage stream in the aeration tank is assumed to be a completely mixed flow.

$$Ce/Ci = 1/(1+K \cdot M \cdot T) \quad (1)$$

Where,
Ce : BOD concentration of sewerage effluent (mg/l)
Ci : BOD concentration of sewerage influent (mg/l)
K : BOD removal speed constant (l/mg·hr)
M : Concentration of biomass in aeration tank (MLSS : mg/l)
T : Retention time (hr)

If sewerage discharge increases to μ times of existing discharge in the future, the future retention time becomes T/μ. Then, the future BOD concentration of sewerage effluent is obtained from the following relationship.

$$Ce'/Ci' = 1/(1+K \cdot M \cdot T') = 1/(1+1/\mu \cdot K \cdot M \cdot T) = \mu/(\mu - 1 + Ci/Ce) \quad (2)$$

Where,
Ce' : Future sewerage effluent BOD (mg/l)
Ci' : Future sewerage influent BOD (mg/l)
T' : Future retention time (hr)

(ii) Estimate of Future BOD Removal by Sedimentation Treatment

BOD contained in suspended solids is removed when suspended solids settle in the sedimentation tank. In this study, the BOD removal rate by sedimentation treatment is assumed to be the same as the removal rate of suspended solids (SS).

The SS removal rate is generally determined by the ratio of settling velocity of particles to sewage water overflow velocity. Based on this principle, the future SS effluent concentration is obtained from the following equation when the sewerage discharge increases to μ times of the existing one and the SS influent concentration is constant (For details, see Appendix D, Chapter II, Subsection 2.2.2).

$$Se' = (Si - Se) \cdot (1 - 1/\mu) + Se$$

Where,
Si : Existing influent SS (mg/l)
Se : Existing effluent SS (mg/l)
Se' : Future effluent SS (mg/l)

If the SS influent concentration also changes in the future, the future effluent SS is assumed to proportionally vary as follows.

$$Se' = Si'/Si \cdot \{(Si - Se) \cdot (1 - 1/\mu) + Se\}$$

Where,
Si' : Future influent SS (mg/l)

Similarly, the future effluent BOD concentration is expressed as follows when sewerage discharge increases to μ times of the existing one and the influent BOD concentration changes in the future.

$$Ce' = Ci'/Ci \cdot \{(Ci - Ce) \cdot (1 - 1/\mu) + Ce\} \quad (3)$$

Where,
Ci : Existing influent BOD (mg/l)
Ci' : Future influent BOD (mg/l)
Ce : Existing effluent BOD (mg/l)
Ce' : Future effluent BOD (mg/l)

(b) Influent Quality

(i) Major Industrial Wastewater

The wastewater of the major industrial establishments except 10 ones is pre-treated by either activated sludge method or coagulation settling method before discharging to the sewerage system. The 10 industrial establishments are not provided with treatment plants. However, no data of influent quality to the above pre-treatment plants are available.

The existing industrial categories in the Basin are classified by treatment method as follows.

Treatment Method	Industrial Category
Activated Sludge	food/beverage, textile, whole sale, health/social work, petroleum, construction material, hotel/restaurant
Coagulation Settling	non-metallic mineral, machinery/equipment, mining/quarrying, land transport, metal products, electrical, crude oil extraction, chemical products, wood, rubber/plastic, furniture, leather, basic metals

The future effluent quality of major industrial wastewater to the sewerage system (effluent quality of pre-treatment plant) is estimated as follows.

(Case of Activated Sludge Pre-treatment)

In the case of activated sludge pre-treatment, the future effluent quality of pre-treatment is obtained from the existing effluent quality by assuming the values of K, M and T and further by assuming that the influent quality to the pre-treatment plant does not change even in the future (Ci' = Ci). The following equation is obtained from equations (1) and (2) for the calculation of future effluent quality.

$$Ce'/Ce = \mu (1 + K \cdot M^{-T}) / (\mu + K \cdot M^{-T}) \quad (4)$$

BOD removal speed constant (K) of the existing pre-treatment plants in the Basin is estimated from equation (1), based on the sampling observation of inflow wastewater quality (Ci), outflow wastewater quality (Ce) and

wastewater quantity (accordingly, retention time T) of the representative factories. From the above survey, the average values of K, M and T of the representative factories were estimated to be K=2.4x10^{-4} l/mg·hr, M=2,000 mg/l, T=23 hours.

Then, the design ratio between future BOD effluent and existing BOD effluent (Ce'/Ce) are obtained from equation (4) as follows.

Case	Q'/Q	Ce'/Ce
General Industry	μ = 1.68	1.6
Tourism Industry	μ = 2.08	1.9
Livestock Industry	μ = 1.00	1.0
Without Treatment		1.0

For details, see Appendix D, Chapter II, 2.2.2.

(Case of Coagulation Settling Pre-treatment)

Only a few data are available concerning the BOD removal efficiency of coagulation settling treatment in the Basin. Hence, the future BOD effluent from the treatment plant of coagulation settling type is estimated, referring to the two (2) sampling data in the Basin and the typical data in Japan.

The ratio between future effluent BOD and existing effluent BOD is obtained from equation (3) by assuming that the influent BOD does not change even in the future (Ci' = Ci) as follows.

$$R = Ce'/Ce = \{(Ci - Ce)\cdot(1 - 1/\mu) + Ce\} / Ce \qquad (5)$$

The coagulation settling treatment is applied only for general industry. The design ratio between future effluent BOD and existing effluent BOD is assumed as follows.

Case	Q'/Q	Ce'/Ce
General Industry	μ = 1.68	1.6
Without Treatment		1.0

For details, see Appendix D, Chapter II, 2.2.2.

For the future effluent quality (BOD) of each major industrial establishment to the sewerage system, see Appendix D, Table D.2.6.

(ii) Gross Domestic Wastewater

Per capita water consumption quantity will increase in the future according to the improvement of living standards. Per capita BOD pollution load generation will also increase according to the improvement of diet. Therefore, the influent quality to the sewerage treatment plant is assumed to be the same as the existing one (BOD: 200 mg/l).

(iii) Groundwater Infiltration

No BOD load is assumed.

The estimated average sewerage influent quality of each municipality including major industrial wastewater, gross domestic wastewater and ground infiltration is shown in Table 6.1. The sewerage influent BOD load of each municipality is also shown in the same table.

(c) Effluent Quality

The future baseline sewerage effluent quality of the activated sludge treatment plant is calculated by using equation (2) for the following municipalities.

- Predeal, Sinaia, Breaza, Cimpina, Baicoi, Plopeni, Slanic, Valenii de Munte, Boldesti Scaieni, Urlati, Floresti and Maneciu

On the other hand, the future baseline sewerage effluent quality of the sedimentation treatment plant is calculated by using equation (3) for Ploiesti.

The estimated future baseline effluent qualities (BOD) of the above sewerage systems are shown along with effluent BOD load in Table 6.1.

(3) Future Baseline Sewerage Effluent Load

The total future baseline sewerage discharge in the Basin will increase to 2,780.9 l/s in 2015 or 1.27 times of the existing one of 2,191.1 l/s. On the other hand, the total future baseline effluent BOD load will increase to 15,726 kg/d in 2015 or 1.79 times of the existing one of 8,808 kg/l.

The future baseline effluent BOD load is broken down by area as follows in comparison with the existing one.

Area	Existing		Future		Ratio
	BOD Load (kg/d)	(%)	BOD Load (kg/d)	(%)	
Ploiesti City	6,466	73.4	11,603	73.8	1.79
Cimpina City	521	5.9	1,102	7.0	2.11
Prahova Valley	1,108	12.6	1,836	11.7	1.66
Other Area	714	8.1	1,185	7.5	1.66
Total	8,808	100.0	15,726	100.0	1.79

Note : Prahova Valley includes Predeal, Azuga, Busteni, Sinaia, Breaza.

6.2.2 Industrial Wastewater

(1) Wastewater Discharge

Number of the industrial wastewater effluent channels to river (excluding 2 fish farming) is 84 of which 73 effluents are provided with treatment, while 11 effluents have no treatment plants.

The industrial wastewater discharge is assumed to increase in direct proportion to the growth of the industrial production as discussed in the previous Subsection 6.2.1 (1)(a). Then, the future wastewater discharge to river of each industrial establishment in 2015

comes to 1.68 times in general industry, 2.08 times in tourism industry and 1.00 times in livestock industry of the existing one.

The future baseline industrial wastewater discharge to river of each industrial establishment is shown in Table 6.2. In this estimation, S.C. Romfosfochim SA. (code: 4117) is excluded since it was closed in August 1997.

(2) Wastewater Quality

The treatment methods of the 73 effluents are classified into two (2) types of activated sludge and coagulation settling methods depending on the industrial categories as shown below.

Treatment Method	Industrial Category
Activated Sludge	Livestock, food/beverage, textile, paper, petroleum, construction, hotel/restaurant, public administration, health/social work, , education, post/telecommunication
Coagulation Settling	Mining/quarrying, wood, non-metallic mineral, chemical products, rubber/plastic, basic metal, machinery/equipment, electrical machinery, electricity supply, land transport

BOD removal efficiency of the existing treatment plants will decrease in the future according to the increase of wastewater discharge. The reduction of the BOD removal efficiency varies depending on the treatment method as discussed in the previous Subsection 6.2.1. As mentioned in the previous subsection, the future BOD concentration of industrial wastewater can be estimated from the existing BOD concentration. Ratio of both BOD concentrations are summarized below.

Treatment Method	Discharge Ratio (Q'/Q)	BOD Content Ratio (Ce'/Ce)
Activated Sludge		
General Industry	1.68	1.6
Tourism Industry	2.08	1.9
Livestock Industry	1.00	1.0
Coagulation Settling		
General Industry	1.68	1.6
Without Treatment		1.0

Note : 1) Q and Q' are existing and future wastewater discharge respectively
2) Ce and Ce' are existing and future BOD content of wastewater effluent respectively

The future baseline industrial wastewater effluent quality (BOD) of each pollutant source is shown in Table 6.2.

(3) Future Baseline Wastewater Effluent Load

The future baseline wastewater effluent load of the Basin is estimated on the basis of the existing baseline effluent.

The total future baseline industrial wastewater discharge to river will increase to 3,004.5 l/s in 2015 or 1.68 times of the existing baseline discharge of 1,793.7 l/s. On the other hand, the total future baseline effluent BOD load will increase to 25,183 kg/d in 2015 or 2.50 times of the existing baseline load of 10,062 kg/l. The future baseline effluent BOD load is broken down by area as follows, compared with the existing baseline one.

Area	Existing		Future		Ratio
	BOD Load (kg/d)	(%)	BOD Load (kg/d)	(%)	
Ploiesti City & Surroundings	8,908	88.5	22,206	88.2	2.49
Cimpina City	537	5.3	1,442	5.7	2.69
Prahova Valley	268	2.7	747	3.0	2.79
Other Area	349	3.5	788	3.1	2.26
Total	10,062	100.0	25,183	100.0	2.50

Note: 1) Ploiesti Surroundings include Aricesti Rahtivani, Barcanesti, Berceni, Blejoi, Brazi, Bucov, Paulesti, Targsoru Vechi communes.
2) Prahova Valley includes the upstream area of Cimpina City

6.3 Projected Future Baseline River Water Quality

The future baseline river water quality is projected by using the simulation model constructed in Chapter III, Subsection 3.5.2.

(1) Pollution Load Generation and Effluent

The pollution load generation of the point sources is estimated in the previous section. Almost all of the entire generated load enter the main river.

The non-point pollution load generation of households will increase according to the population growth. The load will become 1.08 times of the existing one in 2015. However, non-point livestock and land pollution load generations are the same as the existing ones.

The runoff coefficients of the non-point pollution loads are also the same as the existing ones.

The total future baseline pollution load generation of the Basin is estimated at 130.4 ton/day. Breakdown by major sub-basin and by pollutant source is shown below.

(unit: kg/day)

Source	Prahova Main	Dimbu	Teleajen	Cricovul Sarat	Total	(%)
Point (sewerage)	3,045	11,990	695	86	15,726	12.1
Point (industry)*	15,303	5,517	4,352	3	25,176	19.3
Sub-total	18,348	17,417	5,048	89	40,902	31.4
Non-point (household)	5,662	2,237	5,628	2,387	15,914	12.2
Non-point (livestock)	26,750	3,395	18,324	7,958	56,426	43.3
Non-point (land)	8,023	1,807	4,829	2,453	17,112	13.1
Sub-total	40,435	7,439	28,781	12,798	89,452	68.6
Total	58,783	24,855	33,829	12,887	130,354	100.0

*: including factories, major livestock farms and other industrial activities

The total future baseline pollution load effluent to the main river is estimated to be 55.2 ton/day. Breakdown by major sub-basin and by pollutant source is shown below.

(unit: kg/day)

Source	Prahova Main	Dimbu	Teleajen	Cricovul Sarat	Total	(%)
Point (sewerage)	3,045	11,900	695	86	15,723	28.5
Point (industry)*	15,278	5,517	4,345	3	25,148	45.5
Sub-total	18,323	17,417	5,037	89	40,866	74.0
Non-point (household)	1,690	1,082	1,522	542	4,835	8.8
Non-point (livestock)	2,496	338	1,752	761	5,347	9.7
Non-point (land)	1,864	676	1,144	498	4,180	7.5
Sub-total	6,050	2,096	4,418	1,801	14,362	26.0
Total	24,373	19,512	9,454	1,890	55,229	100.0

*: including factories, major livestock farms and other industrial activities

(2) Simulation of Future Baseline River Water Quality

The future baseline river water quality of the Basin is simulated for the 23 river stations under the proposed standard river flow rate.

The simulated future baseline river water quality at principal stations is shown below.

Code No.	Station Name	Location of Station	Future Standard Flow Rate (m^3/s)*	Future Baseline BOD (mg/l)
200	Cimpina	Exit of Prahova Valley	5.35	6.2
217	Nedelea	Upstream of Nedelea Weir	6.54	12.4
220	Prahova	Prahova Main Downstream	7.50	29.6
260	Moara	Teleajen Downstream	7.29	30.1
280	Ciorani	Cricovul Sarat Downstream	0.96	10.6
H	Adincata	Upstream of Ialomita Junction	19.26	23.5

*: Future standard river flow rate at water quality simulation point which is estimated, considering the effects of river water extraction and return flow in the future.

Longitudinal profiles of the future baseline river water quality in the respective rivers are shown in Fig. 3.6, compared with the existing ones.

CHAPTER VII PROPOSED MASTER PLAN

7.1 Objective

The existing river water quality (BOD) at the principal locations under the proposed standard river flow rate (mean daily flow rate of 50% or 183 days flow rate of average flow regime) is assessed as below.

(unit: BOD mg/l)

St. No.	Station Name	Station Location	Existing Baseline	Future Baseline
200	Cimpina	Exit of Prahova Valley	4.3	6.2
217	Nedelea	Upstream of Nedelea Weir	7.4	12.4
220	Prahova	Prahova Main Downstream	15.2	29.6
260	Moara	Teleajen Downstream	18.2	30.1
280	Ciorani	Cricovul Sarat Downstream	11.0	10.6
H	Adincata	Upstream of Ialomita Junction	14.2	23.5

The river water quality is predicted to become worse in the year of 2015 if no water pollution control measures are taken as shown also in the above table.

A master plan of structural measures is proposed to alleviate the future river water quality up to the target level. The structural measures include the development of domestic and industrial wastewater treatment. Further, non-structural measures are also recommended to facilitate functions of the proposed structural measures. The non-structural measures include strengthening of the monitoring and accidental pollution prevention system, recommendations for improvement of the legal and institutional system, and promotion of environmental education and public awareness.

7.2 Planning Target

7.2.1 Target Year

The proposed master plan is targeted for the year 2015.

7.2.2 Target River Water Quality

Domestic and industrial water is mostly extracted from Doftana River and upper Teleajen River (upstream of Valenii de Munte) and Azuga River. Such river water will have no pollution problems even in the future. Other river water uses are for industrial, irrigation and miscellaneous purposes in the middle and downstream reaches of Prahova Main, Teleajen and Cricovul Sarat rivers. Further, the water pollution of the Prahova River affects the irrigation water use in the Ialomiata River that is located just downstream of the confluence with the Prahova River.

In consideration of the existing water use situation of the Prahova River, the target river water quality is determined for the following six (6) principal stations based on the national standards of surface water quality stipulated in STAS 4706/88.

(1) Prahova Main River : Cimpina (200), Nedelea (217), Prahova (220)

(2) Teleajen River : Moara (260)

(3) Cricovul Sarat River : Ciorani (280)

(4) Prahova River : Adincata (H)

The water quality at Cimpina Station represents the quality in the Prahova valley. Water quality shall be below 5 mg/l in BOD for water contact recreation use in the Prahova valley (Category I).

Industrial water of S.C. Petrobrazi S.A. and F.E. Ploiesti is taken from the Nedelea Weir in the middle reaches of the Prahova Main River in addition to irrigation water. Hence, the river water quality at Nedelea shall meet the requirement of industrial water use of which BOD limit is 7 mg/l (Category II). Further, the river water quality at Prahova Station represents that of the middle and downstream reaches in Prahova Main where irrigation and other miscellaneous water uses exist, then, the water quality shall be below 12 mg/l (Category III).

In the middle and downstream reaches of Teleajen River, only irrigation and other miscellaneous water are extracted. Accordingly, the water quality at Moara shall be below 12 mg/l in BOD (Category III).

The river water quality at Ciorani represents that of the middle and downstream reaches of the Cricovul Sarat where some irrigation and miscellaneous water is taken. The river water quality shall be below 12 mg/l in BOD (Category III).

The river water quality at Adincata shall be below 12 mg/l in BOD to meet the requirement of irrigation and other miscellaneous water uses in the Ialomita River (Category III).

The target river water quality of the above six (6) stations is summarized in the following table.

St. No.	St. Name	Station Location	Water Use	Category	BOD (mg/l)
200	Cimpina	Exit of Prahova Valley	Water Contact Recreation	I	< 5
217	Nedelea	Upstream of Nedelea Weir	Industry/Irrigation	II	< 7
220	Prahova	Downstream of Nedelea Weir	Irrigation/Miscellaneous	III	< 12
260	Moara	Teleajen Downstream	Irrigation/Miscellaneous	III	< 12
280	Ciorani	Cricovul Sarat Downstream	Irrigation/Miscellaneous	III	< 12
H	Adincata	Upstream of Ialomita Junction	Irrigation/Miscellaneous	III	< 12

7.2.3 Target of Pollution Load Control

To attain the above target river water quality at principal stations, the wastewater effluent quality of all sewerage systems and industrial establishments should be controlled below BOD 20 mg/l as regulated in the Government Decision NTPA-001. However, pollution load reduction of the non-point sources is not considered since there are no practical control measures for the non-point sources.

7.3 Development of Sewerage System

7.3.1 Basic Plan

(1) General

As shown in Chapter VI, Table 6.1, the treated wastewater quality of the existing plants will much exceed the permissible quality of BOD 20 mg/l in 2015 except Predeal and Breaza due to shortage of the plant capacity. In addition, most of the existing plants do not function well due to the damage of mechanical equipment and insufficient operation/maintenance.

Rehabilitation of the existing plants, and development of new plants will be necessary to meet the treatment requirement in 2015. Extension of the existing sewer networks may also be necessary for reduction of the pollution load effluents to the rivers and for improvement of the community's sanitary environments.

In this Section 7.3, two (2) alternative developments of sewerage system, (a) without extension of sewer networks and (b) with extension of sewer networks, are discussed.

The above studies are conducted for the major sewerage systems of 14 cities and towns including Comarnic. For the sewerage systems of two (2) communes (Floresti, Maneciu), only the required costs are roughly estimated since they are less important compared to those of the 14 cities and towns.

(2) Extension of Sewer Networks

The land use plan of municipal urban area is available for the respective cities and towns. The land use is classified into the following five (5) zones: (a) residential area, (b) central/commercial area, (c) open space/sport/recreation area, (d) industrial area, and (e) tourism area. For the land use zoning of the cities and towns, see Appendix D, Fig. D.3.2.

The extension area of the sewer networks was selected based on the above land use map and field survey. The sewer network extension concentrates in the residential area since the central/commercial area is already covered by the existing networks.

The future sewerage service ratio of each municipality in case of with sewer network extension is determined in consideration of the existing population density of dwelling area and existing service ratio, as shown below.

Category	Existing Population Density (person/ha)	Existing Service Ratio (%)	Future Service Ratio (%)
I	above 45	above 60	90
II	30 - 45	40 - 60	60
III	below 30	below 40	40

In this study, extension of the sewer networks is not considered for the two (2) communal sewerage systems since the densely populated area of the two (2) communes is already covered by the existing networks.

The future sewerage served population and service ratio of each municipality are shown in Table 7.1, compared with the existing ones.

(3) Future Sewerage Influent Discharge and Quality

At present, 82 industrial establishments discharge their wastewater to the domestic sewerage systems. In this study, it is assumed that no additional industrial establishments discharge wastewater to the sewerage systems until 2015 even if factories are located in the new extension areas of sewer networks.

The above 82 industrial establishments discharge wastewater to the sewerage system mostly after pre-treatment. According to the Government Decision NTPA-002, their wastewater quality to the sewerage system must be below 300 mg/l in BOD. The future wastewater quality to the sewerage system is mostly below 300 mg/l even without development of the existing pre-treatment system. Only nine (9) establishments will exceed the BOD limit as shown below (see Appendix D, Table D 2.6).

Sewerage	Code	Establishment Name	Future without Project		Future with Project	
			Q (l/s)	BOD (mg/l)	Q (l/s)	BOD (mg/l)
Sinaia	4020	Salsi Sinaia	6.18	749.3	6.18	300
Cimpina	4554	Electroutilaj	10.92	1,555.2	10.92	300
Urlati	4217	Videlmar Sediu	2.08	749.3	2.08	300
Ploiesti	4094	Prola-Ploiesti	10.87	749.3	10.87	300
- ditto -	4136	S.C. Vinalcool S.A Prahova	3.51	749.3	3.51	300
- ditto -	4139	Extrapan Sediu	1.86	749.3	1.86	300
- ditto -	4143	I.N.C.A.F Ploiesti	10.38	1,011.2	10.38	300
- ditto -	4311	Coca Cola Ploiesti	11.73	487.2	11.73	300
- ditto -	4350	Agrocom Ploiesti	1.50	749.3	1.50	300

The wastewater of the above establishments will be treated up to 300 mg/l in BOD before discharging to the sewerage system also as shown in the above table. This improvement of the pre-treatment will decrease the influent wastewater quality of the above four (4) sewerage systems.

On the other hand, the extension of the sewer networks increases the gross domestic wastewater discharge and groundwater infiltration.

The future sewerage influent discharge and quality for the two (2) alternative cases (without extension and with extension of sewer networks) are estimated, as shown in Table 7.2 and Table 7.3.

7.3.2 Preliminary Design

(1) Design Discharge and Quality

The design mean discharge and influent quality of the sewerage plant are determined, as shown in Table 7.2 and Table 7.3. The design effluent quality is set at 20mg/l in BOD according to the NTPA – 001.

The sewerage facilities are designed for the following three (3) kinds of discharge: maximum daily discharge, mean daily discharge and hourly maximum discharge. Maximum daily discharge is used for the design of aeration and sedimentation tanks,

mean daily discharge is for sludge treatment facilities and hourly maximum discharge is for grit chamber and pump facilities.

(2) Sewer Pipe

The sewer pipes are extended to increase the sewerage service area in all the objective municipalities. The existing sewer networks of 14 cities and towns are separate type or combined one. The sewer pipe extension in each municipality is planned, conforming to the existing sewer type.

In Azuga and Busteni towns, there is no treatment plant and the wastewater is discharged to the river at several locations at present. Then, the construction of interceptors and transmission mains is necessary. Comarnic town has no sewerage system at present and then, construction of a new sewer network is necessary.

The sewer pipes are generally planned so that the wastewater can be collected by gravity to the treatment plant as far as possible. In this study, no additional pumping station is proposed by exploiting the topographical advantages in the objective cities and towns to the maximum extent.

In this study, main sewer (diameter: larger than 200mm) and secondary sewer (diameter: 100-250 mm) are designed. Tertiary sewer is not included.

(3) Treatment Plant

(a) Site

The required open space for expansion of the existing treatment plant and sludge drying bed is considered available within the existing plant site or its neighboring land, judging from the results of field survey although the land ownership is not clear.

In Azuga, Busteni and Comarnic towns, their new plant sites are selected in due consideration of the availability of open space and topographical advantages in collecting wastewater.

(b) Sewerage Treatment Process

The existing facilities are employed to the maximum extent with necessary rehabilitation. However, some of the existing treatment processes are changed to the standard activated sludge treatment type in order to raise the treatment efficiency and decrease the operation/maintenance problems when designing the expansion of the existing plants (installation of additional plants).

(c) Sludge Disposal

Sludge from the sedimentation tank is directly discharged to the sludge drying bed with neither mechanical dewatering nor digestion processes except Cimpina and Ploiesti cities. In these two (2) cities, thickeners are proposed to decrease the sludge volume since direct discharge of the sludge requires a large space of sludge drying bed.

(4) Proposed Sewerage Facilities

In addition to the necessary rehabilitation of the existing facilities, extension of sewer pipes, expansion of the existing plants and construction of new plants are proposed.

Salient features of the proposed additional sewer pipes and treatment facilities (primary sedimentation tank, aeration tank and secondary sedimentation tank) for 14 cities and towns are shown in Table 7.4. For the structural design and layout of the proposed sewerage facilities, see Appendix D, Fig. D.3.1 to Fig. D.3.3.

7.3.3 Project Cost

(1) Rehabilitation and Construction Cost

The rehabilitation and construction costs are estimated based on the following conditions and assumptions.

(a) The required materials and equipment are mostly domestic products.

(b) The rehabilitation and construction costs consist of direct cost, indirect cost and value added tax (22%).

(c) Currency conversion rate: 1 US$ = 141.5 Yen = 8,800 Lei prevailing in August 1998.

The total rehabilitation and construction costs for the sewerage development of the 16 cities/towns/communes are estimated to be US$ 36.6 million for the case without sewer extension and US$ 46.7 million for the case with sewer extension with the following breakdown.

(unit: US$ 1,000)

Item	Without Extension	With Extension
Rehabilitation	6,024	6,024
Construction	30,533	40,636
Plant	29,487	32,512
Sewer	1,046	8,124
Total	36,557	46,660

For the breakdown by each municipality, see Table 7.5.

(2) O&M Cost

The O&M cost of treatment plant consists of manpower cost, electricity cost and chemical cost. It is estimated based on the market prices. The O&M cost of sewer pipes is assumed to be 10% of that of treatment plant.

The total annual O&M cost of all the sewerage systems (16 systems) at the full operation time after 2016 is estimated to be US$2,420 thousand for the case without sewer extension and US$2,639 thousand for the case with sewer extension, as shown below.

(unit: US$ 1,000)

Item	Without Extension	With Extension
Plant	2,178	2,375
Sewer	242	264
Total	2,420	2,639

For the breakdown by each municipality, see Table 7.5.

7.3.4 Optimum Sewerage Development

The above sewer network extension will increase the served population of the Basin by 46,500 persons and upgrade the service ratio by 9.3%, compared with the case without extension.

The effect of the sewer network extension on the river water quality improvement is small. The reduction of pollution load effluent to the river is estimated at 1-2% of the total pollution load effluent to the river in 2015. However, the sewer network extension is considered to contribute much to the sanitary improvement of the communities and cost saving in the on-site wastewater treatment at a reasonable sewerage cost increase. Hence, the case with sewer network extension is adopted.

7.4 Development of Industrial Wastewater Treatment

7.4.1 Planning Approach

(1) Selection of Objective Industrial Establishments

There are 189 industrial pollutant sources in the Basin. Among them, 14 sources are small and discharged into underground, seven (7) are discharged to industrial sewerage for which treatment is unnecessary, two (2) are fish farming and one (1); S.A. Romfosfochim S.C., is not operated. These 24 pollutants do not need to be treated. Hence, the remaining 165 pollutant sources (mostly factories) are studied.

Wastewater of the 165 pollutant sources is discharged into river or domestic sewerage. For the list of the pollutant sources including industrial activity and wastewater receiving body, see Appendix E, Table E.3.1.

The wastewater problems of the industrial establishments in the Basin are identified in the quality parameters of BOD, SS, COD, Oil, CN, Phenol and Cd. On the other hand, the Government Decisions; NTPA-001 and NTPA-002 stipulate the permissible industrial wastewater quality to river and to domestic sewerage as shown below.

(mg/l)

Receiving Body	BOD	SS	COD	Oil	CN	Phenol	Cd
River	20	60	40 (Mn)	5	0.05	0.05	0.1
Domestic Sewerage	300	300	500 (Cr)	20	0.5	30	0.1

As discussed in Chapter VI, 6.2.2, the future wastewater effluent quality (BOD) will become worse, compared to the existing one as follows if no development of the existing plants is undertaken.

Treatment Method	BOD Ratio (Future/Existing)
Activated Sludge	
General Industry	1.6
Tourism Industry	1.9
Livestock Industry	1.0
Coagulation Settling	
General Industry	1.6
Without Treatment	1.0

In this study, it is assumed that the above ratios of future and existing wastewater quality are also applicable for the other six (6) quality parameters.

The future wastewater quality (above 7 parameters) without project was estimated from the existing wastewater quality by using the above ratios for all the industrial pollutant sources in the Basin. Seventy-nine (79) effluents of 75 industrial establishments will exceed the water quality limits in at least one of the above parameters in 2015. Finally, these 79 effluents were selected as the objective ones. The list of the selected industrial establishments is shown in Table 7.6 along with the future wastewater quantity/quality, existing treatment system and wastewater receiving body. For these industrial establishments, wastewater treatment development is planned.

(2) Classification of Objective Industrial Establishments

The above 79 effluents are classified into the following 23 industrial activities.

Activity	Nos.	Activity	Nos.	Activity	Nos.
Basic Metals	1	Health/Social Work	7	Paper/Paper Products	2
Chemical/Chemical	1	Hotel/Restaurant	4	Petroleum Refinery	8
Products		Land transport	1	Post/Telecommunication	1
Construction Material	7	Livestock Farm	5	Public Administration	1
Education	3	Machinery/Equipment	8	Rubber/Plastic Products	1
Electrical Machinery	2	Metal Products Fabricated	2	Tanning Leather	1
Electricity/Gas Supply	1	Mining/Quarrying	1	Textiles	1
Food/Beverage	13	Non-metallic Mineral	3	Wood	5
				Total	79

(3) Identification of Development Measures of Wastewater Treatment

It is difficult to design the development of wastewater treatment plant of all industrial establishments one by one. Hence, the development of the wastewater treatment plants of the representative 16 factories are designed and the wastewater treatment methods of the remaining 63 effluents are determined, referring to the design of the representative factories.

The representative 16 factories are shown below.

Activity	Name of Factory
Petroleum Refinery	Steaua Romana (4035 A), Petrobrazi (4051A), Vega (4137A), Petrotel (4148A), Astra Romana (4158A)
Food/Beverage	Bere Azuga (4006A), I.N.C.A.F. Ploiesti (4143B), Coca Cola Ploiesti (4311A)
Electrical Machinery	Electroutilaj (4554A)
Tanning/Leather	Prahoveana Ploiesti (4318A)
Construction Material	Matizol (4150A)
Paper/Paper Products	Hartia Busteni (4014 A), Cahiro (4102A)
Rubber/Plastic Products	Progresul Ploiesti (4138A)
Textiles	Postav Azuga (4007A)
Health/Social Work	Spitalul Azuga (4010A)

7.4.2 Preliminary Design

(1) Petroleum Refinery

The wastewater includes a high concentrated Oil and SS, and a medium concentrated BOD. It sometimes includes Phenol. The prevailing treatment process in this industry is a combination of oil removal and activated sludge.

(a) S.C. Steaua Romana (4035A)

The existing treatment plant is provided with only oil removal facilities and a lagoon with no aeration. A new treatment plant of activated sludge should be constructed in addition to necessary rehabilitation of the existing mechanical equipment. The required capacity of the new aeration tank is 6,550 m^3. For layout of the new plant, see Appendix E, Fig. 4.1.

(b) S.C. Petrobrazi (4051A)

The existing treatment system consists of three (3) series of treatment plants of activated sludge method. The total aeration tank capacity is 74,124 m^3 (equivalent to 29.5 hr detention time for the future wastewater discharge). This capacity can meet the future requirement in 2015. However, only two (2) series of plants are working at present. Rehabilitation of the existing mechanical equipment is necessary.

(c) S.C. Vega S.A. (4137A)

The existing treatment system is activated sludge one with a very small aeration tank capacity. Installation of a new treatment plant of activated sludge method is necessary. The required aeration tank capacity is 1,350 m^3. For layout of the new plant, see Appendix E, Fig. E.4.2.

(d) S.C. Petrotel S.A. Ploiesti (4148A)

The existing treatment plant of activated sludge method is provided with an aeration tank capacity of 10,240 m^3 (equivalent to 6.1 hr detention time for the future wastewater discharge). The existing capacity is not enough to meet the future requirement. A new treatment plant with an aeration tank capacity of 10,000 m^3 should be installed. For layout of the new plant, see Appendix E, Fig. E.4.3.

(e) S.C. Astra Romana S.A. (4158 A)

The existing treatment plant of activated sludge method has an aeration tank capacity of 16,707 m^3 (equivalent to 12.3 hr detention time for the future wastewater discharge). The existing plant has a sufficient capacity to meet the future requirement. However, rehabilitation of the existing mechanical equipment is necessary.

(f) Remaining Three (3) Effluents

BODs of S.C. Chimfotex Bucov (4091A) and Petrotrans Ploiesti (4149 B) much exceed the standards in the future. Installation of new plants of activated sludge method is necessary for both effluents in addition to rehabilitation of the existing mechanical equipment.

Victoria Floresti (4039 A) exceeds the standard in only SS. For this effluent, only rehabilitation of the existing mechanical equipment is necessary.

(2) Food/Beverage

The wastewater contains a high concentration of BOD in general. However, it is easily decomposed. Activated sludge process is applicable for the treatment of this wastewater.

(a) Bere Azuga (4006A)

The existing treatment system of activated sludge method has a sufficient aeration tank capacity of 1,716 m^3 (equivalent to detention time of 18.7 hr for the future wastewater discharge). However, rehabilitation of the existing mechanical equipment is necessary.

(b) I.N.C.A.F. Ploiesti (4143B)

The existing treatment system has only a pre-treatment process consisting of oil separator and sedimentation tank. It discharges the wastewater with a high concentration of BOD (1,011 mg/l), SS (1,246 mg/l) into Ploiesti domestic sewerage, exceeding the standards due to the mechanical troubles and insufficient operation/maintenance.

The factory produces processed meat and this high BOD is mostly derived from the high SS. Therefore, most of the BOD and SS can be removed by recovering the function of the existing sedimentation tank. Rehabilitation of the existing mechanical equipment is necessary.

(c) Coca-Cola Ploiesti (4311A)

The existing treatment system of activated sludge method has a sufficient aeration tank capacity of 844 m^3 (equivalent to detention time of 18.7 hr for the future wastewater discharge). However, rehabilitation of the existing mechanical equipment is necessary.

(d) Remaining 10 Effluents

Four (4) effluents discharge the wastewater into the river with activated sludge process and six (6) effluents discharge the wastewater into the domestic sewer system with activated sludge/coagulation treatment process. Installation of new plants of activated sludge method is necessary for all the effluents except Vinalcool (4136B). The excess BOD of Vinacool is not high, so that the wastewater of this effluent could be treated by sand filter method.

(3) Machinery/Equipment

The wastewater contains more inorganic materials than organic ones. Chemical/physical treatment is recommendable for this industry.

There are eight (8) effluents in this category. Among them, six (6) effluents other than U.M. Plopeni (4100B) and 24 Ianuarie (4141A) are provided with the treatment plants of coagulation settling method at present. BOD does not exceed much the standard in the six (6) effluents.

Only rehabilitation of the existing facilities is necessary for the six (6) effluents. Construction of new plants of sand filter is planned for U.M. Plopeni and 24 Ianurie since they have no treatment plants at present and the wastewater exceeds the standard in only Oil.

(4) Construction Material

The wastewater includes more inorganic material than organic material. Such physical treatment as sedimentation and sand filter is efficient in this industry.

There are seven (7) effluents in this category. Among them, four (4) effluents are treated by activated sludge, while the remaining three (3) effluents have no treatment plant at present. The wastewater quality exceeds a little in BOD and Oil.

Only rehabilitation of the existing facilities is planned for the four (4) effluents. New plants of sand filter should be constructed for the three (3) effluents.

(5) Wood

Chips produced in this activity contain organic material like lignin which is hard to decompose. The activated sludge process with a large capacity of aeration tank is recommendable.

There are five (5) effluents in this category. All the effluents discharge the wastewater into river with treatment of coagulation settling method. The future wastewater quality of the effluents without project is estimated to be worse than 220 mg/l except Gas Scaieni (4101A).

New treatment plants of activated sludge method should be constructed for all the effluents except Gas Scaieni (4101A) in addition to rehabilitation of the existing mechanical equipment. Only rehabilitation of the existing mechanical equipment is necessary for Gas Scaieni since the wastewater of this effluent exceeds the standard only in SS.

(6) Education, Health/Social Work and Hotel/Restaurant

The wastewater is the same as the domestic one. The most typical treatment is activated sludge process.

There are three (3) effluents in education, seven (7) in health/social work and four (4) in hotel/restaurant. All the effluents discharge the wastewater into river with treatment of simple activated sludge method (Imhoff tank) except two (2) effluents (with no treatment). Their future wastewater quality without project is estimated to be in the range of 43 mg/l and 265 mg/l, mostly higher than 150 mg/l. Hence, new treatment plants of activated sludge method should be installed for all effluents. For the standard layout of the proposed treatment plant, see Appendix E, Fig. E.4.4.

(7) Livestock

The wastewater contains a very high BOD. The activated sludge process is effective in this activity.

There are five (5) livestock farms in this category. They all discharge the wastewater into river with treatment of simple activated sludge method. Their future wastewater quality without project is estimated to be in the range of 285 mg/l and 1,249 mg/l. New treatment plants of activated sludge should be constructed for all the livestock farms. For the standard layout of the proposed treatment plant, see Appendix E, Fig. E.4.5.

(8) Other Industrial Activities

There are 19 effluents in the other categories including basic metals, chemical/chemical products, electrical machinery, electricity/gas supply, land transport, metal products fabricated, mining/quarrying, non-metallic mineral products, paper/paper products, post/telecommunication, public administration/defense, rubber/plastic products, tanning/dressing leather, textiles. The treatment systems of these effluents are determined, referring to the representative factories and estimated future wastewater quality. The following development measures of the wastewater treatment are proposed.

Development Measures	Nos. of Effluent
New Plant Installation (Activated Sludge)	3
New Plant Installation (Floatation)	2
New Plant Installation (Sand Filter)	1
Rehabilitation Only	13
Total	19

For details, see Appendix E, Chapter IV, Subsection 4.2.

7.4.3 Project Cost

(1) Rehabilitation and Construction Costs

The rehabilitation and construction costs are estimated based on the same conditions and assumptions as the development of the sewerage system.

The total rehabilitation and construction costs for the wastewater treatment development of the 79 effluents in 75 industrial establishments is estimated to be US$49.8 million with the following breakdown.

(US$ 1,000)

Item/Receiving Body	River	Domestic Sewer	Total
Rehabilitation	5,560	525	6,084
Construction	37,296	6,381	43,677
Total	42,855	6,906	49,761

For the breakdown by each effluent, see Table 7.6.

(2) O&M Cost

The O&M cost of treatment plant consists of manpower cost, electricity cost and chemical cost. It is estimated based on the market prices. The total annual O&M cost of all the industrial effluents (179) in the Basin at the full operation time after 2016 is estimated to be US$14,463 thousand with the breakdown of US$12,956 for the effluents to river and US$1,507 for the effluents to domestic sewer.

For the breakdown by each industrial effluent, see Appendix E, Table E. 4.3.

7.5 Improvement of River Water Quality

The above sewerage and industrial wastewater developments will alleviate the river water pollution in the future up to the satisfactory level. The estimated river quality at the principal locations in 2015 is shown below, compared to the existing and future baseline (without project) river water quality.

(unit: BOD mg/l)

St. No.	Station Name	Station Location	Existing Baseline	Future Baseline	Future With Project	Target
200	Cimpina	Exit of Prahova Valley	4.3	6.2	3.6	5
217	Nedelea	Upstream of Nedelea Weir	7.4	12.4	7.4	7
220	Prahova	Prahova Main Downstream	15.2	29.6	9.9	12
260	Moara	Teleajen Downstream	18.2	30.1	12.4	12
280	Ciorani	Cricovul Sarat Downstream	11.0	10.6	10.3	12
H	Adincata	Upstream of Ialomita Junction	14.2	23.5	10.1	12

Longitudinal profiles of the future river water quality with project in the respective rivers are shown in Fig. 7.1.

7.6 Strengthening of Monitoring System and Prevention of Accidental Water Pollution

7.6.1 Strengthening of Monitoring System

(1) Surface Water

The water quality of the Prahova River is monitored at 16 stations at present. They cover all the important river sections for which river water quality should be assessed. However, the water quality parameters in the existing monitoring program are not

sufficient. Number of the monitoring parameters should be increased to 51 in accordance with STAS 4706/88 and observation frequency should be once a month for all the stations.

Further, the water quality monitoring in the Paltinu and Manecin reservoirs should be strengthened in the same manner as the river although the existing monitoring locations are adequate.

(2) Wastewater

There are 15 sewerage effluents and 168 major industrial effluents in the Basin at present. All sewerage effluents are discharged into the river. Among 168 industrial effluents, 86 effluents are discharged into the river and the remaining 82 are discharged into domestic sewerage systems. All the effluents should be monitored once a month. The monitoring parameters of the industrial wastewater discharging to river and domestic sewerage should be determined by industrial activity considering the pollutant characteristics. The proposed monitoring parameters of the industrial wastewater discharging to river and domestic sewerage by industrial activity are shown in Table 7.7.

The sewerage systems in the Basin receive some industrial wastewater in addition to human waste. Then, the necessary monitoring parameters of the sewerage effluents vary depending on the industrial activities covered by the sewerage system. The monitoring parameters of the sewerage effluents are obtained by combining the parameters of the industrial groups given in Table 7.7. The proposed combination of parameter groups for each sewerage is shown below.

Sewerage	Combination of Group No.	Sewerage	Combination of Group No.
Predeal	5	Slanic.	5
Azuga	4, 5	Valenii de Munte	2, 5
Busteni	5	Boldesti Scaieni	2, 4, 5
Sinaia	2, 3, 5	Urlati	3, 4, 5
Breaza	2, 5	Ploiesti	2, 3, 4, 5
Cimpina	2, 4, 5	Floresti	2, 5
Baicoi	2, 4, 5	Manecin	5
Ploperi	2, 5		

(3) Laboratory

The capacity of the existing laboratory at Romanian Waters Prahova Office is not sufficient to meet the above-mentioned monitoring program. Construction of a new laboratory with an area of 1,000 m^2 is recommended. The proposed plan includes construction of a building, and procurement of laboratory equipment, furniture, office equipment and vehicles.

For details, see Appendix F, Table F.2.3.

(4) Estimated Cost

The total required cost for the construction of building and procurement of equipment is estimated at US$1,823 thousand with the following breakdown.

Item	Quantity	US$ (1,000)
Construction of Building	1,000 m^2	468
Procurement		1,355
Laboratory Equipment	35 items	1,130
Furniture	1 L.S.	48
Office Equipment	1 L.S.	71
Vehicle	3	106
Total		1,823

Further, total annual O&M cost of US$95 thousand is required for sampling and laboratory analysis.

For details, see Appendix F, Table F.2.3.

7.6.2 Prevention of Accidental Water Pollution

There are a considerable number of factories that deal with oil and toxic materials in the Basin. Fortunately, they are all located in the downstream of the drinking water intakes and then, they do not directly affect the health of the people in the Basin.

Only oil leakage of the pipeline of Petrotrans in the upstream of the Voila Intake in the Doftana River causes a direct danger on the health of the people. Oil leakage occurs from small corroded holes of the pipeline in the entire distance in the upstream of Voila Intake (Voila Intake – watershed). Frequency of the oil leakage will further increase in the future as the pipeline becomes older. The leaked oil first infiltrates underground and thereafter, it runs off from underground to the river. Hence, immediate detection of the oil leakage is difficult although the inspection team of the company is patrolling the route of the pipeline everyday.

Once oil is leaked at a location between Voila Intake and Paltinu Dam, it is difficult to completely prevent the oil from entering the water purification plant. On the other hand, the oil leakage in the upstream of Paltinu Dam will give some allowance time for the preparedness of water pollution accident since the oil retards floating on the surface of the reservoir.

Hence, immediate replacement of the existing pipeline between the Voila Intake and Paltinu Dam is recommended.

Installation of an oil detector (oil sensor) in the river or at the Voila Intake is another measure to prevent the oil from entering the purification plant. However, reliability of the oil detector is low in such a case since the oil layer on the surface water is very thin. Hence, the oil sensor should be used as a supplementary measure in this project. For the drawing of the oil detector, see Appendix F, Fig. F 3.3.

The total replacement cost of the existing oil pipeline (15.7 km) between the Voila Intake and the upper end of Paltinu Reservoir is roughly estimated at US$4,701 thousand.

7.7 Legal and Institutional Recommendations

(1) Revision of NTPA-001

NTPA-001 stipulates the allowable quality limit of wastewater discharged into the river. It further prescribes that:

(a) The maximum allowable limits of wastewater quality parameters are applicable for surface water of which designated standard river flow rate (a yearly minimum monthly mean discharge with a probability of 95%) is at least three (3) times bigger than the flow rate of wastewater discharge into the river.

(b) For the surface water with a dilution degree below three (3), the maximum allowable limits of wastewater quality parameters shall be proportionally decreased.

As discussed in Chapter III, Subsection 3.5.3, application of this standard river flow rate is not practicable. The yearly minimum monthly mean discharge with a probability of 95% should be replaced by the river flow rate with a lower probability.

(2) Increase of Inspection Personnel and Laboratory Analysts in the Romanian Waters Prahova Office

To attain a satisfactory water quality management of the Basin, the monitoring location, frequency and parameters for rivers and wastewater effluents should be much increased.

In addition to the increase of water quality sampling and laboratory analysis, the licensing procedures, inspection on wastewater discharge, wastewater quality assessment, penalty assessment and accident preparedness should be more active to cope with the existing and future increasing water pollution problems.

For the strengthening of monitoring operations, Romanian Waters Prahova Office will have to man as follows in addition to the existing personnel.

Personnel	Existing	Additional	Total
Inspection Personnel	10	5	15
Laboratory Analysts	15	10	25

(3) Establishment of New Laboratory under the Joint Cooperation between Romanian Waters and the Municipality

The Water Law provides for the obligations of a title-holder of wastewater treatment plants for operation and maintenance by monitoring their functioning through laboratory analysis. The local public services companies, now in charge of the municipal sewerage systems shall, therefore, be provided with necessary laboratory. However, the local public services company has insufficient laboratory or no laboratory at present due to lack of manpower and financial resources. For the existing laboratory conditions of the local public services companies, see, Appendix F, Table F.1.9.

Due to the high-level requirement in water quality analysis such as for oil, a large cost and advanced expertise will be necessary in each municipality. The municipalities may not be able to afford the laboratory establishment as required.

On the other hand, the Project proposes a new laboratory to accommodate the increasing requirement of laboratory analysis of Romanian Waters. For the proposed laboratory, see the previous Section 7.6.

It is advisable to avoid unnecessary overlapping of investment. The new laboratory shall serve not only Romanian Waters but also the municipalities in the Basin under joint

cooperation. If required, the laboratory analysis for the industrial units might be entrusted on payment basis to the new laboratory.

(4) Financial Arrangements for the Improvement of Sewerage System and Industrial Wastewater Treatment

(a) Improvement of Sewerage System:

In usual cases, these shall be done with the annual state budget in the accounts of the Ministry of Public Works and Land Development. The County Council administers the fund to be allocated to each municipality, through appraisal and prioritization.

(b) Improvement of Industrial Wastewater Treatment

The industrial unit itself undertakes this and, sometimes, improvement funds are subsidized from the Ecological Direction, Ministry of Industry and Commerce, after the appraisal and prioritization based on the improvement proposals.

Fund allocation to meet the proposals of the Project shall follow these ordinary procedures, from the viewpoint of smooth implementation in the present administration system.

(5) Expansion of Sources and Role of the Water Fund

The performance of the existing Water Fund is poor, because of the limitation of constituting sources of permit/license fees and penalties. Majority of the Fund accrues from the water management permit/license fees. The penalties under the unitary payment system are difficult to be collected.

The sources other than those stipulated in the Water Law should be added to expand the Fund. The constituting sources shall include credits and government subsidy for the specific technological development. The foreign loans or domestic bonds shall be guaranteed by the MWFEP with the consent of the Ministry of Finance. The beneficiaries are obligated for the amortization of these credits; for instance, the Romanian Waters with its revenue from water sales and the municipalities with their revenues from water supply/sewerage services.

Afterwards, the Water Fund might be used for the following:

(a) Study and development of advanced monitoring equipment such as oil detector and toxic substance detector.

(b) Study and development of the technologies for energy-saving wastewater treatment and wastewater recycle use; if required, installation of model plants or model projects.

7.8 Promotion of Public Participation in Water Environment Management

7.8.1 Necessity and Benefits of Public Participation

The Romanian Waters' task includes public consultation which is required by the Water Law. At

the Romanian Waters Prahova Office, no specific staff is in charge of this task. In reality, public consultation is carried out on an ad hoc basis.

As the Romanian Waters Prahova Office has occasionally experienced, an information from the public on water conditions helps the Romanian Waters perform its responsibility more effectively. The information voluntarily provided by the public can complement the information regularly collected by the Romanian Waters.

As mentioned before, there are a number of point pollutant sources in the Prahova River. In addition to the point sources, there are non-point sources that consist of approximately 40% of the total pollution load in the River. There were also many water pollution accidents in the past. The existing point sources are too many for the Romanian Waters to keep their eyes on. Also, non-point sources are generally out of reach of the Romanian Waters' regular monitoring activities. Furthermore, riverside residents can notice water pollution accidents earlier than anyone else.

Therefore, the systemized public participation in water environment management can supplement scarce governmental resources on monitoring, inspection and enforcement, which will eventually save governmental costs. The communication between the public and the Romanian Waters should be extended and strengthened in both directions.

7.8.2 Proposed Promotion Methods for Public Participation

(1) General

As presented in Chapter IV, Subsection 4.3.2(2), there have been many initiatives and activities in Prahova County in recent years, most of which were initiated or organized by local NGOs or were the joint efforts between local NGOs and local governmental organizations. Local NGOs will be able to contribute more to the public awareness of water environment management. Moreover, there are legal bases of NGO participation as an information provider or authorized representative in the Water Law.

In order to maximize these existing opportunities and to establish a partnership between local NGOs and the Romanian Waters, a constructive approach is recommended as follows.

(2) Creation of Communication Officer

A position of "communication officer" should be created in each basin branch/office of the Romanian Waters. A communication officer can assist the Director in media relations as a media specialist, and can also act as an NGO coordinator to form a stronger relationship with local NGOs and other civil societies.

(3) Target Groups of Communication

The communication officer at the Romanian Waters basin branches/offices should strengthen the communication line with the regional EPA, Soil Survey and Agrochemical Office, Health Directorate, Culture and Education Department, and local public authorities.

The communication officer should develop and maintain contact with the external target groups: local NGOs, schools, children's clubs, universities, research institutes, and other

civil societies, businesses, and the media. These contacts should be coordinated for public awareness activities.

(4) Methods of Communication

In the water environment management context of the Basin, the following methods of communication and their combination are highly recommended in order to reach the general public.

(a) Water Reports

Currently, the key data and information on water quality are not provided to the public on a regular basis. The "Water Report" on the Basin should be prepared on a regular basis (i.e., annually). The report should contain the data on river water quality, underground water quality, pollutant, water usage, and the record of water pollution accidents. The report should be distributed to the general public through local government and civil society.

(b) Exhibitions

The place where people have easy access for free can be used for the "Water Exhibition." The permanent exhibition is ideal, but exhibitions for a certain period would be also effective.

(c) Workshops and Training

The strength of the civil society in Prahova County is the existence of 13 environmental NGOs that have considerable experiences on public awareness activities. Some local NGOs have a strong institutional capacity, national and international network, and access to external funding.

Thus, Romanian Waters can jointly organize workshops and training courses with the NGOs. Training could be organized for specific target groups: youth, women, environmental journalists, NGOs, civic leaders, community leaders, etc.

(d) Media

As the results of the questionnaire survey show, the media is the major information sources (90%) for people on the water pollution in the Prahova River. Among the media, radio is relatively inexpensive compared with the TV and newspapers when putting a public campaign advertisement. In the County, about one (1) out of six (6) is a radio receiver. Therefore, the local radio is the best media option for the County.

(e) Educational Kits

The results of the questionnaire survey show that people in the County are willing to act more for environmental improvement. Such people may need more comprehensive information on environmental activities in which the public can voluntarily participate.

(f) Water Month Campaign

The above-mentioned methods will be more effective if combined for a public awareness campaign. For example, the "Water Month" can be organized in a certain month. In the Water Month, there should be exhibitions, radio and/or newspaper advertisement, and workshops as well as posters, fliers and stickers.

(5) Required Cost

The total annual required cost for the above communication activities in the Basin is estimated at approximately US$23,000 with the following breakdown.

Communication Method	Cost (US$)
Water Report	1,500
Publicity by Media	750
Educational Kids	3,500
Exhibitions	150
Workshop/Training	17,400
Total	23,300

For details, see Appendix H, Table H.2.3.

The total required office equipment cost for the communication activities in Romanian Waters Prahova Office is estimated at US$7,000 including copier (US$1,200), computer and printer (US$1,500), video camera (US$1,000), slide projector (US$2,400), and others (US$900).

CHAPTER VIII PHASING AND EVALUATION OF THE MASTER PLAN

8.1 Phased Program

The proposed developments of the sewerage system, industrial wastewater treatment, water quality monitoring system and accidental water pollution control will be implemented in three (3) phases: first phase (2001-2005), second phase (2006-2010) and third phase (2011-2015), based on the following policies.

8.1.1 Sewerage System

(1) The sewerage wastewater control of the Basin will be leveled up step by step, reaching the target in 2015. All the wastewater will be treated up to 20 mg/l in BOD by 2015. Oil and other pollutants will be treated along with BOD to meet their standards by 2015.

(2) The implementation program is prepared in due consideration of the financial capability of the local governments. The financial capability is assumed to increase in proportion to the growth of GDP in the Basin.

(3) The all rehabilitation of the existing treatment plants will be completed by 2005.

(4) The Ploiesti sewerage is the largest polluter of the Basin. It discharges a BOD load of 6.5 ton/day or 73% of the total sewerage BOD load effluent in the Basin at present. Hence, the development of Ploiesti treatment plant is given the highest priority and the plant will be developed in stages during 15 years from 2001 to 2015.

(5) The extension of Cimpina treatment plant and construction of the new treatment plants in Azuga, Busteni and Comarnic are given the second highest priority. Pollution load of Cimpina gives a significant impact on the water use in the middle reaches of the Prahova Main River. Pollution load effluents from the sewerage networks of Azuga and Busteni give large adverse effects on the water quality of the Prahova valley since the existing sewerage systems are provided with no treatment plant. Comarnic town has no sewerage system at present.

The new treatment plants of Azuga, Busteni and Comarnic will be constructed during five (5) years from 2006 to 2010. The treatment plant of Cimpina will be extended in stages during 10 years from 2006 to 2015.

(6) The extension of the other treatment plants will be implemented during 2011-2015.

(7) The extension of the sewerage networks will be implemented step by step during 10 years from 2006 to 2015.

The phased program of the total sewerage BOD load reduction in the Basin is shown below.

Item		Existing	2005	2010	2015
Discharge	(l/s)	2,191.1	2,455.0	2,735.5	3,007.8
Influent BOD Load	(kg/d)	8,088	11,566	14,576	17,460
Cut BOD Load	(kg/d)	-	3,793	8,064	12,331
Effluent BOD Load	(kg/d)	8,088	7,774	6,512	5,129
Ave. Effluent BOD Content	(mg/l)	46.5	36.7	27.6	19.7

For the phased program of BOD load reduction by each municipality, see Appendix D, Table D.4.2.

The phased program of the total sewerage investment and O&M costs in the Basin is shown below.

(US$ 1,000)

Item	2001-2005	2006-2010	2011-2015	Total	Annual O&M Cost (2016 -)*
Investment Cost	12,714	15,910	18,036	46,661	-
O&M Cost	5,892	7,661	9,742	23,295	2,641

Note: 1) Investment and annual O&M costs are those during each phase.
2) Exchange rate: 1 US$=141.5 Yen=8,800 Lei
3) Annual O&M cost at the full operation time after 2016
*: US$ 1,000/year

The phased program of investment and O&M costs by each municipality are shown in Table 8.1. For details, see Appendix D, Table D.4.3.

8.1.2 Industrial Wastewater Treatment

(1) The industrial wastewater control of the Basin will be leveled up step by step, reaching the target in 2015. All the industrial wastewater will be treated up to 20 mg/l in BOD by 2015. Oil and other pollutants will be treated along with BOD to meet their standards by 2015.

(2) The implementation program is prepared in due consideration of the financial capability of the industrial establishments. The financial capability is assumed to increase in proportion to the growth of the industrial production in the Basin.

(3) The petroleum industry is the largest polluter of the Basin. It discharges a BOD load of 7.9 ton/day or 78% of the total industrial BOD load effluent in the Basin at present. The wastewater will be treated up to 20 mg/l by 2005 and maintained below 20 mg/l until 2015 in BOD. The treatment plants will be rehabilitated and or extended in stages according to the increase of wastewater during 2001-2015.

(4) All the establishments of the health/social work, hotel/restaurant, livestock farm, land transport and wood industries except a few ones discharge wastewater with a high BOD concentration. Further, the wastewater of the electrical machinery is also high due to the livestock breeding inside the factories. The baseline average BOD concentration of the above industries in 2005, 2010 and 2015 is estimated as shown below.

Industrial Activity	Existing BOD (mg/l)	2005 BOD (mg/l)	2010 BOD (mg/l)	2015 BOD (mg/l)
Electrical Machinery	972	1,248	1,402	1,555
Health/Social Work	87	107	121	131
Hotel/Restaurant	100	130	160	190
Land Transport	224	269	314	358
Livestock Farm	983	983	983	983
Wood	104	134	155	171

All the wastewater of the above industrial categories will be treated up to 100 mg/l by 2010 and treated up to 20 mg/l by 2015 in BOD. The treatment plants will be rehabilitated and or developed in stages to satisfy the above mentioned target treatment levels during 2006-2015.

(5) The wastewater of the electric supply and paper industries is large in quantity but not so high in quality. The wastewater of the other industries is comparatively small in quantity and low in quality. The other industrial wastewater than those of the petroleum, electrical machinery, health/social work, hotel/restaurant, land transport, livestock farm and wood industries will be treated up to 20 mg/l in BOD by 2015. The treatment plant will be improved during 2011-2015.

(6) The industrial wastewater discharging to the sewerage system will be given the lowest priority and treated up to 300 mg/l in BOD by 2015. The pre-treatment plants will be improved during 2011-2015.

The phased program of the total industrial BOD load reduction to river in the Basin is shown below.

Item		Existing	2005	2010	2015
Discharge	(l/s)	1,793.7	2,197.4	2,601.0	3,004.5
Influent BOD Load	(kg/d)	10,063	15,100	20,138	25,177
Cut BOD Load	(kg/d)	-	9,818	15,121	20,067
Effluent BOD Load	(kg/d)	10,063	5,279	5,016	5,110
Ave. Effluent BOD Content	(mg/l)	64.9	27.8	22.3	19.7

For the phased program of BOD load reduction to river by each industrial effluent, see Appendix E, Table E.5.2.

The phased program of the investment and O&M costs of the total industrial wastewater treatment in the Basin are shown below.

(US$ 1,000)

Item	2001-2005	2006-2010	2011-2015	Total	Annual O&M Cost (2016 -)*
Investment Cost	9,616	13,738	26,407	49,761	
O&M Cost	48,793	56,514	68,445	173,752	14,463

Note: 1) Investment and annual O&M costs are those during each phase.
2) Exchange rate: 1 US$=141.5 Yen=8,800 Lei
3) Annual O&M cost at the full operation time after 2016
*: US$ 1,000/year

The phased program of the investment and O&M costs by industrial category are shown in Table 8.2. For the phased program of the investment and O&M costs by each industrial effluent,

see Appendix E, Table E.5.4 and Table E. 5.5.

8.1.3 Monitoring System and Accidental Water Pollution

(1) The existing laboratory of Romanian Waters Prahova Office will be reconstructed in during 2001-2005 in view of the urgent necessity of strengthening the existing monitoring system. Further, the monitoring activities including water quality sampling, laboratory analysis, licensing, inspection, wastewater discharge/quality assessment and penalty assessment will be strengthened in an early stage.

(2) Oil had leaked from the pipeline of Petrotrans Oil Company running along the Doftana River eight (8) times in the recent 10 years, causing serious damages on the drinking water of the downstream people. Replacement of this old pipeline is the only reliable prevention measure. In view of this fact, replacement of the pipeline should be completed by 2005.

The phased program of the monitoring system strengthening and the accidental water pollution prevention are summarized below.

(US$ 1,000)

Item	2001-2005	2006-2010	2011-2015	Annual Monitoring Cost*
Monitoring System				
Laboratory Re-construction.	1,823	-	-	-
Monitoring Cost	475	475	475	95
Accidental Water Pollution				
Pipeline Replacement Cost	4,701	-	-	-

*: US$ 1,000/year
Exchange rate: 1 US$=141.5 Yen=8,800 Lei

8.2 Improvement of River Water Quality

The above phased program of the sewerage and industrial wastewater developments will gradually improve the water quality of the Prahova River, attaining the target quality in 2015. The river water quality (BOD) at the principal stations of the Basin in 2005, 2010 and 2015 is estimated as follows.

(unit: BOD mg/l)

St. No.	Station Name	Station Location	Existing	2005	2010	2015
200	Cimpina	Exit of Prahova Valley	4.3	4.8	4.2	3.6
217	Nedelea	Upstream of Nedelea Weir	7.4	8.3	7.9	7.4
220	Prahova	Prahova Main Downstream	15.2	11.3	10.2	9.9
260	Moara	Teleajen Downstream	18.2	13.8	13.4	12.4
280	Ciorani	Cricovul Sarat Downstream	11.0	10.6	10.7	10.3
H	Adincata	Upstream of Ialomita Junction	14.2	11.2	10.7	10.1

8.3 Economic Benefits

(1) General

Beneficial effects of a water pollution control project are mostly intangible and it is generally difficult to estimate the benefits in monetary term. However, the Study Team

tried to estimate the benefits of the proposed project in monetary term to the possible extent. The Team estimated the following economic benefits in monetary term in due consideration of the existing water uses and predicted future river water quality

(a) Recovery of water environmental losses

(b) Prevention of tourism income loss

(c) Cost saving of industrial water use

(d) Prevention of agricultural production loss.

(2) Recovery of Water Environmental Losses

Many environmental losses are generated by the river water pollution at present. They include outbreak of waterborne disease, decrease or extinct of aquatic lives, loss of recreational value, emission of foul smell, reduction of water and land use potential, etc. These losses are all intangible. Hence, the losses were estimated as a whole through questionnaire to the residents in this study. The questionnaire survey was made in the form of asking the amount of willingness to pay to recover the river water quality up to a desired level.

The average willingness to pay per month of the questionnaire respondents was 10,199 lei/month, equivalent to 0.83% of the average income of the respondents (1.23 million lei/month).

On the other hand, the entire population of the Basin is not a beneficiary of the water environment resources. The beneficiaries are assumed to be limited to the residents of the 30 riverine municipalities of the Prahova River. Further, the beneficial population is assumed also to be limited to the adult population since only adult people earn the above-mentioned income. Then, the number of beneficiaries comes to 285,500.

The total benefit is estimated at 34,946 million lei/year (US$4,016 thousand/year).

(3) Prevention of Tourism Income Loss

The Prahova valley is blessed with abundant tourism resources composed of forest, river, fresh air, snow, historical assets, etc. The value of these tourism resources will decrease if the river water quality becomes worse in the future. This will result in loss of the tourism income in the valley. The proposed project will prevent this income loss in the tourism industry.

The Study Team estimated the beneficial effects of the river water quality improvement on the tourism industry through the interview survey with the tourists. The results show that:

(a) The respondents gave a weight of 14% of the total tourism resources on the river and water.

(b) Thirty-four percent (34%) of the respondents answered that they would not come again if the river water pollution goes on in the future.

In 1996, approximately 295,000 tourists (person x day) visited the Prahova valley. Number of tourists is projected to grow up to 612,000 in 2015 (see, Chapter II, Subsection 2.2.3).

On the other hand, the average daily tourist expenditure was obtained to be 182,600 lei/day/person through the interview survey. This daily tourist expenditure is assumed to grow in direct proportion to the growth of GDP in the Basin, reaching 338,500 lei/day/person in 2015. (For the annual growth rate of GDP, see Chapter II, 2.2.3).

From the above discussions, the economic benefit of tourism industry in 2015 is estimated at 9,930 million lei/year (US$1,128 thousand/year).

(4) Cost Saving of Industrial Water Use

S.C. Petrobrazi S.A. and F.E. Ploiesti extract the industrial water from the Nedelea Weir in the middle reaches of the Prahova Main River. The total industrial water extraction is projected to increase from 15,145,000 m^3/year in 1997 to 29,518,000 m^3/year in 2015.

On the other hand, the river water quality at Nedelea is predicted to become worse from 7 mg/l in 1997 to 12 mg/l in 2015 in terms of BOD if no water pollution control measures are taken. In such case, both factories must shift the water source from Nedelea to Voila in Doftana River or Valenii de Munte in Teleajen River, resulting in increase of water supply cost. This cost increase can be saved by the proposed project. In fact, the proposed project will control the future water quality below 7 mg/l in BOD which is suitable for industrial use.

The present unit water supply cost is 142,607 lei/1,000 m^3 for Nedelea and 414,758 lei/1,000 m^3 for Voila and Valenii de Munte.

From the above discussions, the cost saving of the industrial water use in 2015 is estimated at 8,033 million lei/year (US$913 thousand/year).

(5) Prevention of Agricultural Production Loss

There are four (4) irrigation intakes commanding a total farmland of 7,928 ha in the Prahova River including the future rehabilitation plans. However, all the irrigation intakes are located in the middle reaches of the Prahova Main and Teleajen rivers. The future river water quality at the irrigation intake sites is estimated below 12 mg/l in BOD even if no water pollution control measures are taken.

The beneficial effects of the proposed project are accrued only from the irrigation water use in the Ialomita River. The river water quality at the confluence to the Ialomita River (at Adincata) is predicted to become worse from 14mg/l in 1997 to 24 mg/l in 2015 in terms of BOD if no water pollution control measures are taken. While, the proposed project will control the future river water quality below 12 mg/l in BOD.

In the Ialomita River, river water is used to irrigate a farmland of 900 ha at present. The future water pollution without project will lose all the agricultural production of this farmland. The proposed project will prevent this production loss. Hence, the existing agricultural production profit is counted as the benefit of the proposed project.

The benefit is estimated at 473 million lei/year (US$54 thousand/year) under the following assumptions.

Crop	: Wheat
Annual Production	: 2,700 ton
Unit Sales Price	: 1,000 lei/kg
Profit Rate	: 17.5 %

(6) Total Economic Benefit

The total annual economic benefit of the proposed project in 2015 is estimated at US$6.1 million with the following breakdown.

Item	(US$ 1,000/year)
Recovery of Water Environmental Loss	4,016
Prevention of Tourism Income Loss	1,128
Cost Saving of Industrial Water Use	913
Prevention of Agricultural Production Loss	54
Total	6,111

The project may produce a lot of benefits other than the above ones. However, they are all intangible.

8.4 Financial Analysis

8.4.1 Development of Sewerage System

(1) Existing Sewerage Charge

The sewerage systems in the Basin receive the domestic wastewater (including offices, shops, restaurants, public facilities, etc.) and industrial wastewater with different unit service charges, respectively. The existing wastewater quantity and unit service charges (as of January 1998) of 13 major sewerage systems are shown below.

	Quantity (1,000 m^3/year)		Unit Charge (lei/m^3)	
	Domestic	Industrial	Domestic	Industrial
Predeal	602.3	0.0	120	0
Azuga	542.4	15.8	125	275
Busteni	741.1	116.7	90	160
Sinai	1,226.8	1,100.6	140	405
Breaza	920.9	611.8	170	270
Cimpina	3,544.6	2,245.4	110	125
Baicoi	495.1	394.2	70	70
Plopeni	829.4	1,510.6	95	165
Slanic	246.0	0.0	290	490
Valenii de Munte	324.8	18.9	130	245
Boldesti Scaieni	375.3	321.7	155	245
Urlati	510.9	78.8	195	270
Ploiesti	29,710.1	5,313.8	120	120

The above unit service charges were determined to cover the required O&M cost with permission of the price control office of the central government in principle.

The weighted average unit sewerage charge of all sewerage systems is calculated to be 122 lei/m^3 for domestic waste and 165 lei/m^3 for industrial waste.

In the above sewerage systems, Azuga and Busteni have no treatment plant and Ploiesti has a low-level treatment plant consisting of only sedimentation process. Hence, the weighted average unit sewerage charge of the complete sewerage system is calculated by excluding these three (3) municipalities. The average unit sewerage charge of the Basin for the complete sewerage system is estimated at 129 lei/m^3 for domestic waste and 203 lei/m^3 for industrial waste. These unit sewerage charges are used as the bases for calculating the affordable sewerage charge of the Basin in this study.

(2) Affordable Sewerage Charge under Existing Economic Situation

(a) Domestic Waste

The affordable sewerage charge for domestic waste is estimated, comparing to the existing unit sewerage charge and the results of willingness to pay survey.

(i) Based on Existing Unit Charge

The above 13 sewerage systems treat a total domestic wastewater volume of 40,070,000 m^3/year, serving 312,880 persons at present. The charged domestic wastewater per capita comes to 10.67 m^3/month/person. Then, the average monthly sewerage charge per household is estimated at 4,268 lei/month by assuming the average family size of the Basin as 3.1 persons/household.

On the other hand, the average household income in the Basin is estimated at 1,811,576 lei/month as of December 1997.

The existing monthly sewerage charge is equivalent to 0.24% of the monthly income.

(ii) Based on Willingness to Pay

According to the willingness to pay survey, adult questionnaire respondents answered that they would pay 0.83% of their income for the water quality improvement of the Prahova River at the maximum. This rate becomes 0.54% when the rate of the questionnaire survey is converted into the rate for a household income.

From the above discussions, the affordable sewerage charge of a household is assumed to be 0.4% of the household income by averaging the above two (2) cases. Then, the affordable unit sewerage charge of domestic waste comes to 219 lei/m^3 (=1,811,576 lei/month x 0.004÷10.67 m^3/month/person÷3.1 person).

(b) Industrial Waste

The affordable unit sewerage charge of industrial waste is obtained by multiplying the proposed unit charge of domestic waste by the ratio between actual domestic and industrial unit charges. The affordable unit sewerage charge of industrial waste is calculated to be 344 lei/m^3 (=219 x 203 / 129).

(3) Affordable Sewerage Charge under Future Economic Situation

The future affordable unit sewerage charge for domestic waste is assumed to increase in proportion to the growth of per capita GDP. GDP of the Basin is predicted to increase at an annual rate of 4.2% (0.0% until 2000, 4.2% for 2001-2015), while, the population growth is assumed to be 0.5% per annum (0.0% until 2000, 0.5% for 2001-2015). Then, per capita GDP will increase at an annual rate of 3.68% (0.0% until 2000, 3.68% for 2001-2015).

The future affordable unit sewerage charge for industrial waste is assumed to increase, maintaining the same rate to the domestic waste under the present economic situation.

(4) Financial Evaluation

(a) Sewerage Revenue and Cost Disbursement

In the Basin, there are two (2) communal sewerage systems other than the above 13 sewerage systems at present. Further, Comarnic town will construct a new sewerage system in the future. Then, the total charged sewerage wastewater volume is estimated at 52,539,000 m^3/year at present (1997-2000) and 77,434,000 m^3/year in 2015. The wastewater volume is assumed to proportionally increase during 2000-2015 and thereafter, constant.

The expected annual sewerage revenue in the future is estimated below by applying the above-mentioned affordable sewerage unit charges.

Year	Unit Charge (lei/m^3)		Volume (10^3 m^3/yr.)		Annual Revenue	
	Domestic	Industry	Domestic	Industry	(million lei/yr.)	(US$ 10^3/yr.)
- 2000	219	344	40,659	11,880	12,994	1,477
2005	262	412	46,170	14,668	18,176	2,065
2010	314	494	51,680	17,455	24,888	2,828
2015	377	592	57,191	20,243	33,545	3,812
2016 -	377	592	57,191	20,243	33,545	3,812

Exchange rate: 1 US$=8,800 lei

On the other hand, the disbursement schedule of the sewerage development cost and annual O&M cost are summarized below.

Year	Development Cost (US$ 1,000)	Ave. Annual O&M Cost (US$ 1,000/yr.)
- 2000	-	-
2001 - 2005	12,714	1,178
2006 - 2010	15,910	1,532
2011 - 2015	18,036	1,948
2016 -	-	2,641

(b) Financial Internal Rate of Return

The sewerage development of the Basin is evaluated in terms of financial internal rate of return (FIRR). As known from the above tables, the annual O&M cost is sufficiently covered by the expected annual revenue. Then, the FIRR is calculated for the following four (4) cases.

Cost Coverage	FIRR (%)
(1) All development cost and O&M cost	0.19
(2) 50 % of development cost and O&M cost	5.77
(3) 40 % of development cost and O&M cost	8.57
(4) 30 % of development cost and O&M cost	14.13

For the cash flow, see Appendix I, Table I.2.1.

When the marginal efficiency of the project is assumed to be FIRR=10%, the beneficiaries can bear one-third of the development cost and all the O&M cost. The remaining development cost must be borne by the central and local governments.

8.4.2 Development of Industrial Wastewater Treatment

(1) Affordable Treatment Cost

Generally, it is difficult to make a correct estimation of the affordable cost of the factories to spend in wastewater treatment. However, the Study Team roughly estimated the cost through a questionnaire survey with the representative factories. Questionnaires were sent to 20 factories of which six (6) responded. The percentage of the actual treatment cost to the sales amount at present and the affordable percentage of treatment cost to sales amount in the future are summarized below.

Code	Factory	Actual Percentage at Present (%)	Affordable Percentage In Future (%)
4311	Coca Cola Ploiesti	0.12	Less than 1 %
4006	Bere Azuga	1.15	Less than 1 %
4014	Hartia Busteni	1.4	N.A.
4051	S.C. Petrobrazi S.A.	Less than 1 %	N.A.
4559	Neptun Campina	Less than 1 %	Less than 1 %
4150	Matizol	Less than 1 %	Less than 1 %

N.A.: no answer

Based on the above survey, the average affordable percentage of treatment cost to sales amount in the Basin is roughly assumed to be 0.7%.

(2) Financial Evaluation

The total industrial production in the Prahova County was 10,696 billion lei (US$1,492 million) in 1997, almost all of which was produced in the Basin. It is projected to increase to 17,917 billion lei (US$2,499 million) in 2015 with an annual growth rate of 0.0% until 2000 and 3.5% during 2001-2015.

Accordingly, the total affordable treatment cost of the Basin in the future is estimated as shown below.

Year	Annual Affordable Cost (US$ million/yr.)
- 2000	10.44
2005	12.41
2010	14.73
2015	17.50
2016 -	17.50

Exchange rate: 1 US$=8,800 lei

On the other hand, the proposed disbursement schedule of the total development and O&M costs for the industrial wastewater treatment in the Basin are shown below.

Year	Development Cost (US$ million)	Ave. Annual O&M Cost (US$ million/yr.)
- 2000	-	-
2001 – 2005	9.62	9.70
2006 – 2010	13.74	11.26
2011 – 2015	26.41	13.68
2016 -		14.46

FIRR of the industrial wastewater treatment project is calculated at 12.35% by regarding the annual affordable cost as the revenue accrued from the project. For the cash flow, see Appendix I, Table I.2.2.

When the marginal efficiency of the project is assumed to be FIRR=10%, the industrial sector of the Basin should annually appropriate 0.7% of the sales amount for the development, and operation and maintenance of the industrial wastewater treatment.

8.5 Impact of Economic Growth Change on River Water Quality

(1) Change of Economic Growth Rate

The major pollution sources of the Basin are domestic wastewater and industrial wastewater including those of general industry, tourism industry and livestock industry. Their future pollution load effluents are estimated by assuming the population and industrial production growths in the future respectively.

In the proposed master plan, the following annual growth rates are assumed based on the projections of the governments, discussions with the governmental officials concerned and JICA judgement.

Item	Until 2000	2000-2015	2015/Present
Population	0.0 %	0.5 %	1.08 time
General Industry	0.0 %	3.5 %	1.68 time
Tourism Industry	0.0 %	5.0 %	2.08 time
Livestock Industry	0.0 %	0.0 %	1.00 time

The predicted future river water quality and as a result, required water pollution control cost varies depending on the projection of the socio-economic growth rates. In this Section, variation of the future river water quality and the required water pollution control cost are examined by assuming different socio-economic growth rates.

Among the above assumed socio-economic growth rates, those of the general industry and tourism industry may vary to some extent, however, the variation range of the population and livestock growth rates is considered small. On the other hand, the tourism industry discharges only 1.4% of the total industrial wastewater in BOD load at present. Hence, different growth rates are assumed for only general industry.

The National Commission for Economic Forecasting has predicted that the annual industrial growth rate of the country will reach 2.7% at the minimum and 4.3% at the maximum, averaging 3.5% in 2000. Based on this prediction, two (2) different cases of low growth (2.7%) and high growth (4.3%) are assumed for the general industry of the Basin during 2001-2015 to assess the variation of the projected river water quality and as a result, change of the required water pollution control cost.

(2) Change of River Water Quality

The pollution load generation of the Basin varies according to the change of the industrial growth rates. The total future baseline pollution load effluents (BOD) to the river in 2015 are estimated as follows for the cases of low and high industrial growth rates in comparison with the proposed ones.

(unit: kg/day)

Source	Proposed	Low Growth		High Growth	
	Load (1)	Load (2)	(2)/(1)	Load (3)	(3)/(1)
Point (sewerage)	15,723	14,928	0.95	16,659	1.06
Point (industry)	25,143	20,440	0.81	31,223	1.24
Sub-total	40,866	35,369	0.87	47,882	1.17
Non-point	14,362	14,362	1.00	14,362	1.00
Total	55,229	49,732	0.90	62,245	1.13

Note: Sewerage load varies according to the change of industrial wastewater influent to sewerage

The future baseline river water quality (BOD) at the principal stations in 2015 of the two (2) cases is estimated as follows. The future river water quality (BOD) in 2015 when the sewerage and industrial wastewater are treated up to 20 mg/l is also estimated in the following table.

(BOD: mg/l)

St. Name	Location of Station	Proposed		Low Growth		High Growth	
		Baseline	With	Baseline	With	Baseline	With
Cimpina	Exit of Prahova Valley	6.2	3.6	5.9	3.4	6.6	3.7
Nedelea	Upstream of Nedelea Weir	12.4	7.4	11.1	7.0	14.1	8.0
Prahova	Prahova Main Downstream	29.6	9.9	25.5	9.3	34.9	10.4
Moara	Teleajen Downstream	30.1	12.4	27.3	12.2	33.9	12.8
Ciorani	Cricovul Sarat Downstream	10.6	10.3	10.5	10.3	10.6	10.3
Adincata	Upstream of Ialomita Junction	23.5	10.1	21.1	9.9	26.8	10.5

Note: With: with project

The river water quality in case of high growth exceeds the target river water quality at Nedelea and Moara. However, the excess is negligible.

(3) Change of Required Costs

The required costs for the sewerage and industrial wastewater tre.

(3) Change of Required Costs

The required costs for the sewerage and industrial wastewater treatment developments to attain the target river water quality are estimated for the cases of low and high growth rates as follows in comparison with the proposed ones.

(US$ 1,000)

Item	Proposed	Low Growth	High Growth
Sewerage System			
Rehabilitation	6,023	6,023	6,023
Construction	40,636	39,960	41,407
Plant	32,513	31,835	33,282
Sewer	8,125	8,125	8,125
Sub-total	46,661	45,983	47,430
Industrial Treatment Plant			
Rehabilitation	6,084	5,561	6,527
Construction	43,677	40,962	46,676
Sub-total	49,761	46,523	53,726
Total	96,422	92,506	101,156

The required annual O&M cost at the full operation time is also compared as follows.

(US$ 1,000/year)

Item	Proposed	Low Growth	High Growth
Sewerage System	2,639	2,581	2,703
Industrial Treatment Plant	14,463	12,990	16,023
Total	17,102	15,571	18,726

(4) Conclusion

The river water quality in both cases scarcely differs from that of the proposed one. The change of the required cost is also small. It is less than 5%.

Hence, the proposed master plan is considered reasonable although the assumed economic growth rates have some uncertain factors.

CHAPTER IX RECOMMENDATIONS

9.1 Strengthening of Monitoring System

There are a number of point pollutant sources consisting of sewerage, factories and other industrial establishments in the Basin. The wastewater treatment of these sources should be leveled up to meet the new standards regulated in the Government Decision at an early stage. The Romanian Waters should perform more intensive monitoring on the quality of the wastewater effluents as well as river water to attain a satisfactory water environmental management of the Basin according to the Water Law.

However, the existing monitoring capacity of the Romanian Waters Prahova Office is insufficient in manpower and laboratory equipment. In addition to the manpower increase, urgent improvement of the laboratory is necessary to meet the increasing analytical works of water quality.

The municipalities in the Basin are also obligated to monitor the quality of sewerage effluents to maintain proper operation of their treatment plants according to the Water Law. The existing capacity of their laboratories is insufficient as well due to the financial and manpower constraints.

Integration of the existing laboratories of the Romanian Waters and related municipalities under joint cooperation may also be necessary to meet the current requirement of high-level water quality analysis such as for oil and toxic substances, and to avoid unnecessary overlapping of investment.

9.2 Project Implementation and Feasibility Study

(1) Water Management Project

As mentioned before, early establishment of an integrated advanced laboratory is essentially necessary for strengthening of the water quality monitoring system in the Basin.

Oil leakage from the old pipeline of the Petrotrans company running along the Doftana River causes serious damage on the drinking water use in the downstream. Urgent replacement of the pipeline is necessary.

Further, the water transmission mains of Romanian Waters connecting Voila and Valenii de Munte with Ploiesti is presumed to cause a large quantity of water leakage. Prevention of this water loss is economically important.

Feasibility of the above-mentioned projects should be studied immediately for promotion of the water management of the Basin.

(2) Ploiesti Sewerage Treatment

Ploiesti sewerage system discharges 73% of the total sewerage pollution loads or 34% of the total sewerage and industrial pollution loads of the Basin in BOD. A local consultant has completed the feasibility study on the development of the existing treatment plant. Early financial arrangements for the detailed design including review of the feasibility study and for construction are recommended.

(3) Wastewater Treatment of Petroleum Industry

The petroleum industry is the largest pollution source in the Basin, discharging 73% of the total industrial pollution loads or 39% of the total sewerage and industrial pollution loads of the Basin in BOD. The existing treatment plants have a comparatively large capacity but they must be rehabilitated. Then, the required additional development cost is considered moderate. Early development of the wastewater treatment plants is necessary. Prior to the development, an elaborate feasibility study is recommended.

(4) Sewerage Treatment of Cimpina and Prahova Valley

The sewerage effluents from the Prahova valley and Cimpina City affects the recreational water use in the valley, and industrial and irrigation water uses in the middle reaches of the Prahova Main River. Feasibility study on the sewerage developments in the valley and City is necessary.

The feasibility study should include rehabilitation of the Sinaia treatment plant, installation of new treatment plants in Azuga, Busteni and Comarnic towns, and rehabilitation and extension of the Cimpina treatment plant. The study should focus on the development of energy-saving and simple operating treatment system because almost all of the existing sewerage treatment plants in the Basin are not fully operated due to the high electricity cost.