PART II-4: BASIC STUDY FOR FOUR CITIES

CHAPTER 1 EXISTING CONDITIONS

1.1 CALARASI

1.1.1 GENERAL

Calarasi City is in the south-east of Romania, which is located about 100 km east from Bucharest. The city locates at 44°20' north latitude and 27° east longitude, and lies on the left bank of the Bratul Borcea River which is a tributary of the Danube River. There are ferry boat services crossing the Danube River from the Calarasi City to the Ostrov City in Bulgaria. The general map of the city is shown in *Figure II.1.1.*

Calarasi town was established around 400 years ago. The population was less than 20,000 before 1979 when a steel factory was constructed. The construction and operation of the steel factory was based on an Eastern Europe policy to supply steel materials to the Eastern European countries such as Hungary, Poland, Czech Slovakia and so on. Some other industries were also developed so that the population of the city was increased rapidly with the industrial developments. The present population of the city in 1998 is about 80,000.

After the year of 1989 when the period of communist party was ended, trades in the Eastern Europe have been changed drastically by the introduction of free market system. The former Eastern European countries such as Hungary now import steel materials from Germany but not from Romania, because they give priorities on the quality of products. Since the Romanian product is cheap but lower in quality, the exports have been shrunk. The steel factory has survived even though a drastic decrease in the production by receiving supports from the Romanian Government. The shrunken export of the products consequently drives the factory into a corner.

1.1.2 NATURAL CONDITIONS

(1) Topography

The Calarasi county is located in the south – eastern part of Romanian Meadow and includes different types of relief: meadow covered by loess, Baragan type, fragmented meadow burnas type, deltaic meadow or terminal covered by loess, alluvial plain, muskeg type plain, wide valleys and terraces (the county presents four terraces levels).

Calarasi City belongs to the first terrace level, formed during inferior Holocene, of 3 - 7 m, and covered by a thick layer of gravel.

Calarasi City is located in Danube alluvial plain, more precisely in subdivision Calarasi alluvial plain, which is developed only on the Danube left bank. The Calarasi alluvial plain is not equal as width. It is wider at west of Calarasi, where it is about 14 km. Between Mostistea river and Calarasi exists high grinds. Starting with the southern part of Calarasi, the Borcea arm is shoved off, which follows the left bank.

The city is on terrace of the river and the terrace is about 4-5 m above the river surface.

(2) Climate, Temperature and Wind

The territory of the Calarasi county belongs entirely of the continental climate sector. In the southern part, where Calarasi City is situated, it is about a specific microclimate of the Danube alluvial plain, with warm summers and gentle winters. The annual solar radiation has values between 125 kcal/cm^2 and more than 127.5 kcal/cm^2.

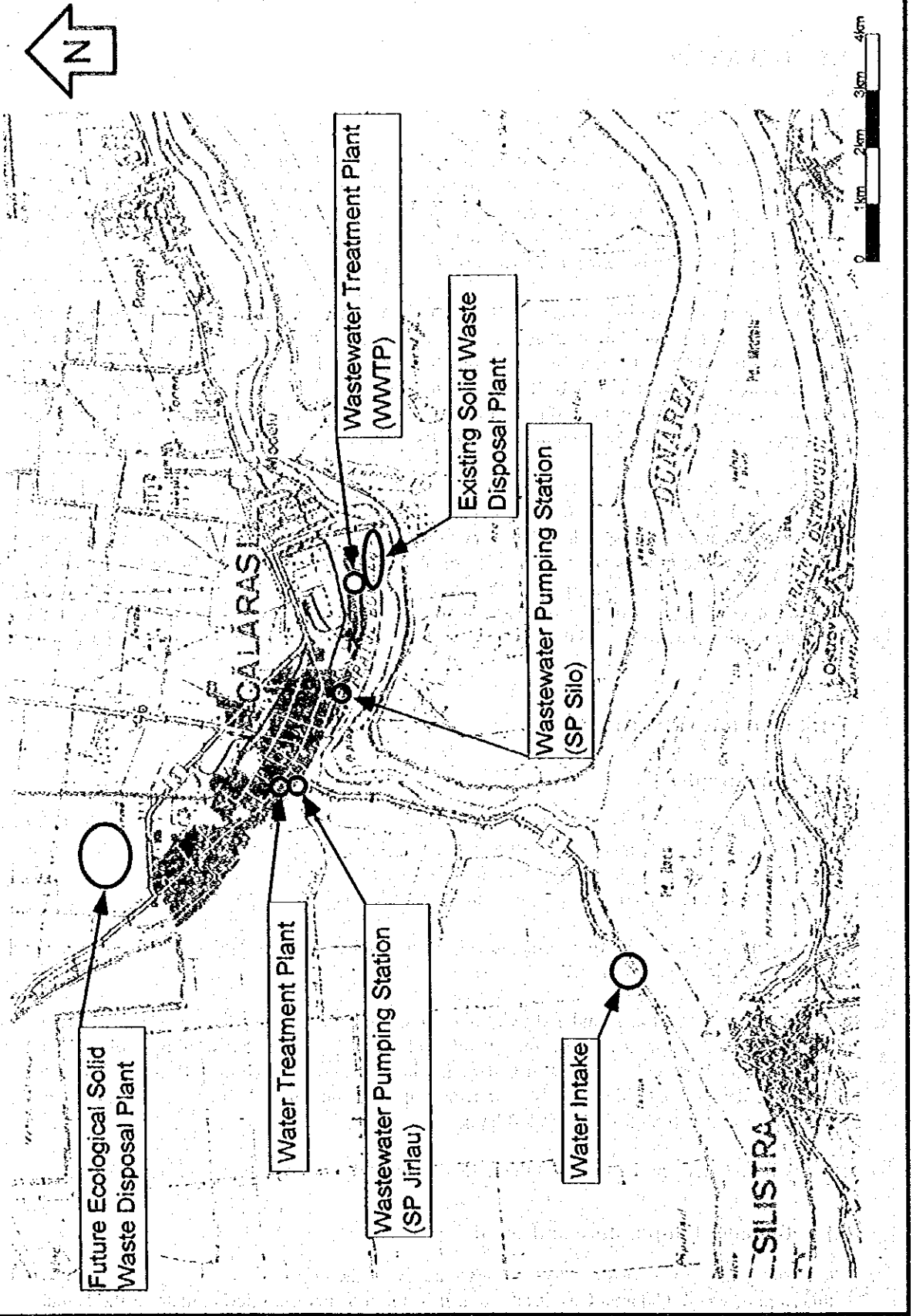


Figure II.1.1 General Map of Calarasi City

The annual average temperature is 11.3 °C, with the highest monthly average of 23.1°C in July and the lowest monthly average of -2 °C in January. The highest and lowest ever recorded are 41.4 °C on August 10 in 1951 and -30 °C on January 9 in 1938, respectively.

Prevailing wind directions are north and north-east, with a frequency of 10.9 %. The frequency of winds having the speed is less than 0.5 m/s is 17.2 %. The average wind speed at ground level is 2.3 m/s for the prevailing wind directions.

(3) Precipitation

The annual average precipitation is 504 mm and the monthly average precipitation is in the highest of 72 mm in June and lowest of 31 mm in February. The maximum 24 hours rainfall ever recorded is 149.4 mm, which was occurred on July 4 in 1915.

(4) River Information

The water level of the Danube River in the Calarasi City is available only for high water level (HWL) of 6 m and low water level (LWL) of -2 m.

1.1.3 Socio-economic Conditions

(1) Population

As shown in the following table, during the 7 years 1992 to 1998 the population of Calarasi maintained the 77,000 to 78,000 level without any noticeable decline or growth. The population of the city stood at 77,666 as of 1998. Its future projection is not immediately available. It is crucial to make a reasonable projection of the population since it forms the very basis on which to plan and design the future sewage treatment plant. The number of houses was 25,018 in 1998, the number of persons per house being calculated at 3.10, while the number of households was 23,535, the number of members per household working out to 3.30.

Table II.1.1 Total Population of Calarasi

Year	1992	1993	1994	1995	1996	1997	1998
Population	78,179	78,540	78,874	78,637	77,856	77,906	77,666

Source : Caralasi City

(2) Industries

The number of employees totaled 28,658 in 1997 as shown in the following table. It appears to be on the downward trend these years. Out of it, the primary, secondary and tertiary sectors accounted for 6.7%, 49.7% and 43.5% respectively. The predominance of the secondary sector is to be noted. Especially, the number of workers in the manufacturing industry reached 9,851, occupying 34.4% of the entire workforce.

Table II.1.2 Number of Employees by Type of Industrial Activities

Type of Industrial Activities	1992	%	1997	%
Primary Industry	2,946	8.1	1,928	6.7
Secondary Industry	19,404	53.6	14,250	49.7
Mining	26	0.1	103	0.4
Manufacturing	13,372	36.9	9,851	34.4
Electricity, Water, etc.	1,114	3.1	1,540	5.4
Construction	4,892	13.5	2,756	9.6
Tertiary Industry	13,881	38.3	12,480	43.5
Total	36,231	100.0	28,658	100.0

Source : Caralasi City

(3) Organization

The organization chart of Calarasi City office is shown in *Figure II.1.2.*

Sewerage service is operated by S.C. APA-CANAL S.A. S.C APA-CANAL S.A. is a commercialized company and the local council of Calarasi is the only shareholder. S.C. APA-CANAL S.A has 333 personnel in total and operates water supply and sewerage services. Technical part of the company consists of following sections.

- Water section with 131 personnel, and
- Sewerage section with 106 personnel.

The organization chart of S.C. APA-CANAL S.A is shown in *Figure II.1.3.*

(4) Financial Conditions of the City

As shown in the table below, during 7 years 1993 to 1999, the local budget of Calarasi grew 19 times from ROL 2,879 million to ROL 56,033 million. Its average annual growth rate is calculated at 64.0%. During the same period, prices increased at the average annual rate of 62.4%. That is to say, the local budget increased in real terms by 1.0% per year on average.

Table II.1.3 Total Amount of Local Budget

1993	1994	1995	1996	1997	1998	1999
2,878,952	9,725,124	17,534,507	22,988,371	43,248,447	37,576,296	56,032,892

Source : Caralasi City Unit : 1000 ROL

The local budget of Calarasi for 1999 totals ROL 56,033 million, which is by 49.1% greater compared with the budget for 1998, ROL 37,576 million.

Because of the new local finance law which was put into force in January, 1999, there is no subsidy from the central government any longer. Under the law, 31.5% of the tax on salaries goes directly to the local government. Also, 45% of this tax is allocated for the state income budget, of which a part is transferred to the local government through the county as the quota. This quata is different from the direct transfer from the state, but by nature is an addition to the above direct local tax on salaries. It occupies the majority of the transfer from the state income budget. That is, in principle almost all the income of the local budget now derives from its own sources. It in turn gives freedom to the local authorities to use the income in whatever way they deem proper.

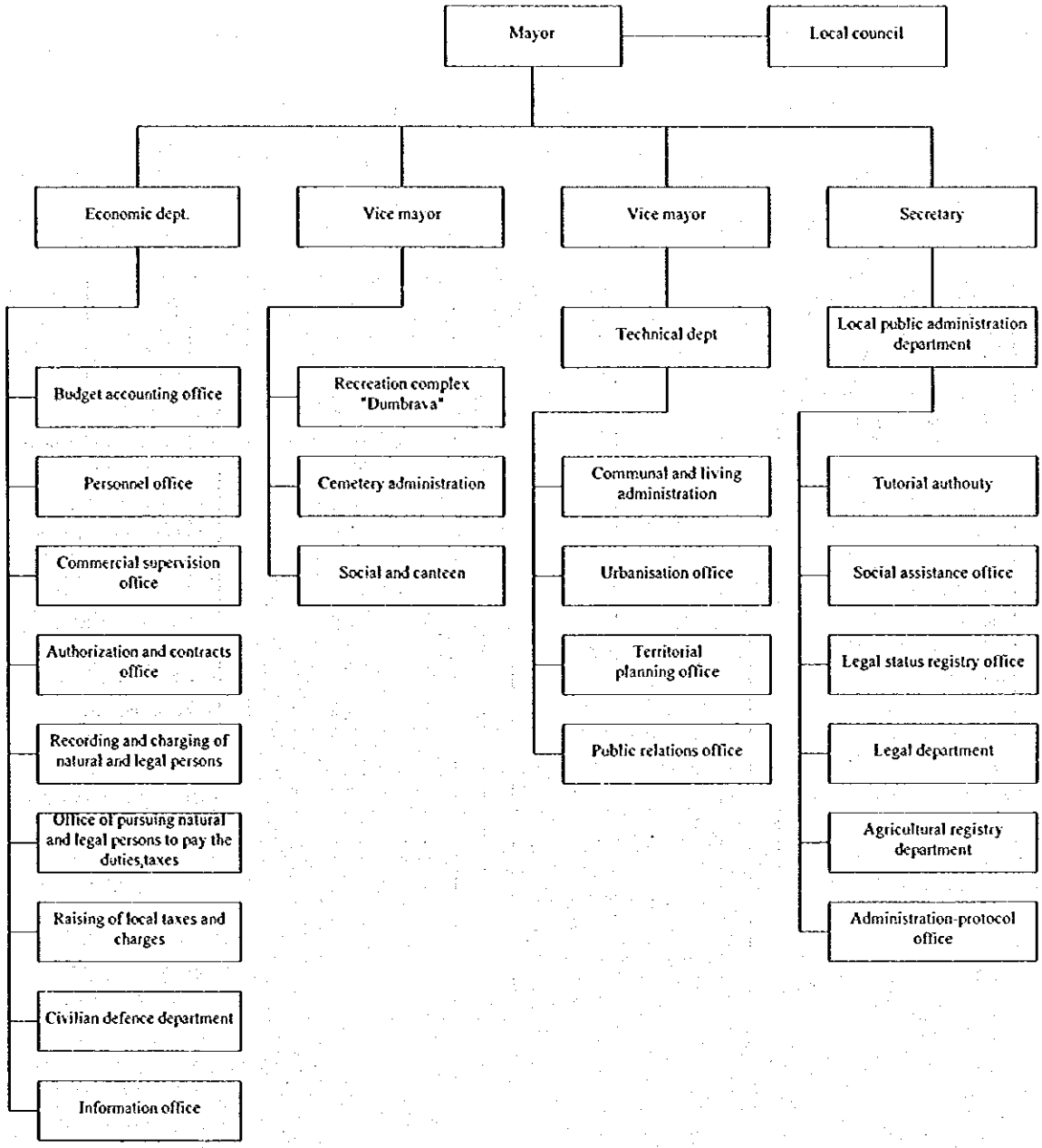


Figure II.1.2 | **Organization Chart of Calarasi City Office**

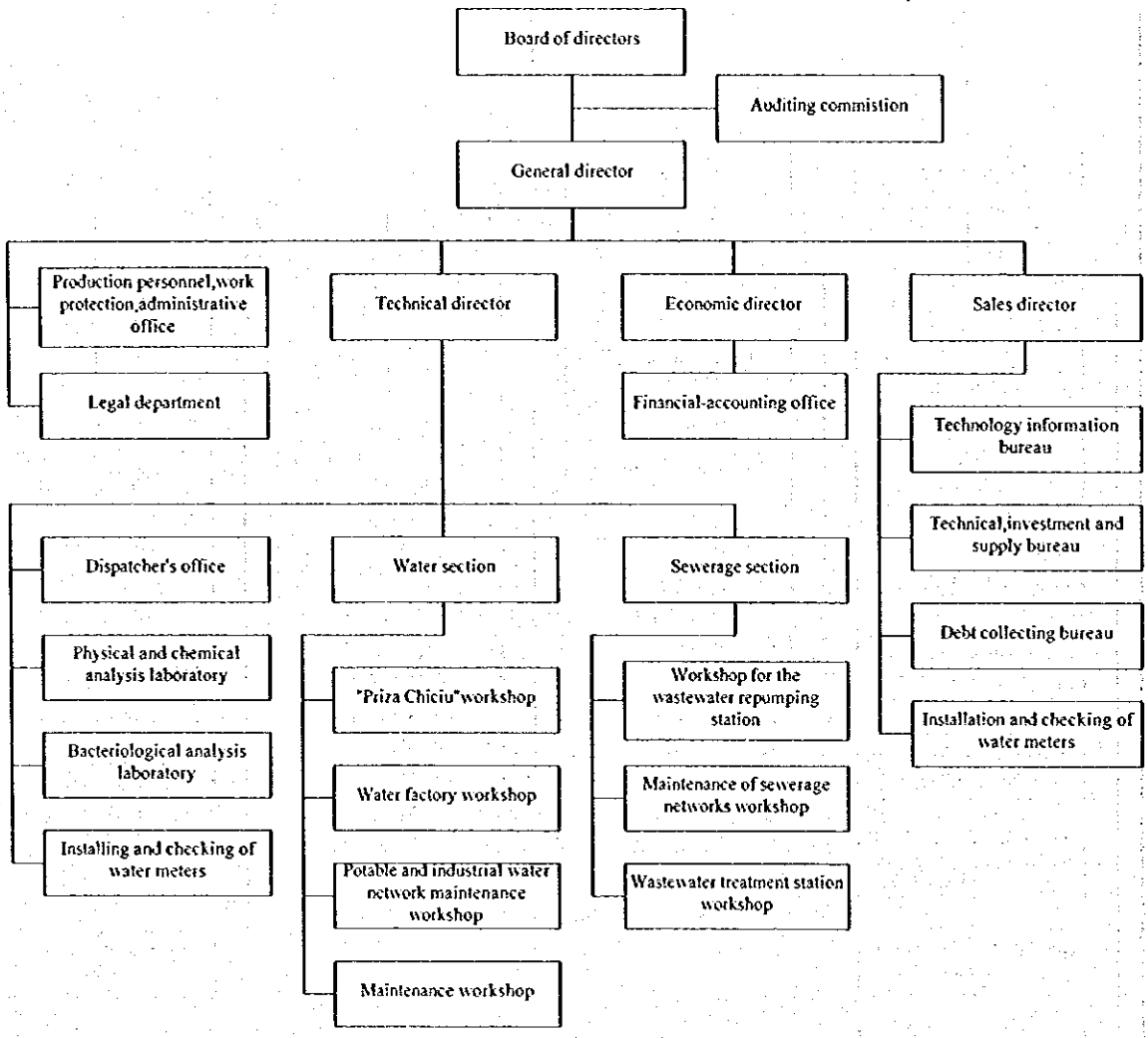


Figure II.1.3 | **Organization Chart of S.C. APA-CANAL S.A.**

As shown in the table below, out of the city's total income budget of ROL 56,033 million in 1999, 55.1% came from its own sources and the balance of 44.9% was the transfer from the central government (most of which consists of the above-mentioned quota).

Regarding the expenditure budget, capital expenditure, which is spent for the economic development of the city accounted for 18.9%.

57.2% or the majority of the expenditure budget went to "Services and Public Development, Dwellings, Environment and Water" which includes the sewerage sector. 27.5% was allocated for "Social-Cultural".

Table II.1.4 Breakdown of Local Budget for 1999

Item	Amount	Ratio (%)
Total Income	56,032,892	100.0
1. Own Income	30,883,698	55.1
2. Money from State Income Budget	25,149,194	44.9
3. Subsidy	0	0.0
Total Expenditure	56,032,892	100.0
1. Current Expenditure	45,227,771	80.7
1) Personnel	4,873,954	8.7
2) Services and Materials	30,189,339	53.8
3) Subsidies	9,394,214	16.8
4) Transfer	733,690	1.3
5) Interest	36,574	0.1
2. Capital Expenditure	10,605,121	18.9
3. Financial Operations	200,000	0.4
4. Reserves	0	0.0

Source: Calarasi City (Unit: 1,000 ROL)

Table II.1.5 Breakdown of Local Expenditure for 1999

Item	Amount	Ratio (%)
Total Expenditure	56,032,892	100.0
1. General Public Services	5,184,428	9.2
2. Social-Cultural	15,392,500	27.5
3. Services and Public Development, Dwellings, Environment and Water	32,024,335	57.2
4. Economic Activities	2,945,055	5.2
5. Other Activities	250,000	0.4
6. Guarantee and Redistribution Funds	0	0.0
7. Transfer	0	0.0
8. Loans Granted	0	0.0
9. Payment of Interest	36,574	0.1
10. Repayment of Loans	200,000	0.4
11. Reserve Funds	0	0.0
12. Special Destination Expenditure	0	0.0
13. Surplus/Deficit	0	0.0

Source: Calarasi City (Unit: 1,000 ROL)

(5) Financial Conditions of S.C. APA CANAL S.A.

S.C. APA CANAL S.A. provides water supply and sewerage services to the citizens of Calarasi.

The existing tariffs of sewerage services are ROL 665/m³ for both domestic and industrial customers. The tariffs of sewerage services are about one third of those of water supply.

Table II.1.6 Tariff for Water Supply and Sewerage Services

Period	Water		Sewerage	
	Domestic	Economic	Domestic	Economic
1 Jan. '98 ~ 31 Jan. '98	990	2,330	505	505
1 Feb. '98 ~ 31 Mar. '98	1,080	2,540	550	550
1 Apr. '98 ~ 24 May '98	1,175	2,765	600	600
25 May '98 ~ 19 Jun. '98	1,620	2,665	600	600
20 Jun. '98 ~ 26 Oct. '98	1,900	2,100	630	630
27 Oct. '98 ~ 31 Dec. '98	2,037	2,100	665	665

Source: S.C. APA CANAL S.A. Unit : ROL/m^3

The total volume of wastewater discharged into sewerage was 6,582,000 m^3 in 1998. It occupied 73.0% of the total volume of water supply. The income from sewerage services came to ROL 3,920 million in the same year. It corresponded to about one fourth of the income from water supply.

Table II.1.7 Income from Water Supply and Sewerage Services in 1998

Services	Total Volume (1,000m^3/year)	Total Income (1,000 ROL)
Water	9,013	15,895,387
Sewerage	6,582	3,920,350

Source: S.C. APA CANAL S.A.

The total volume of wastewater discharged into sewerage was 2,896,000 m^3 in the 1st half of 1999. The volume of sewage was 72.5% of that of water in the same period. The income from sewerage services came to ROL 1,953 million. It corresponded to about one fourth of the income from water supply.

Table II.1.8 Income from Water Supply and Sewerage Services for 1st Half of 1999

Item	Total Volume (1,000 m^3/year)	Total Income (1,000 ROL)
Water	3,996	8,131,263
Sewerage	2,896	1,952,930

Source: S.C. APA CANAL S.A.

Table II.1.9 Financial Performance of S.C. APA CANAL S.A.

Item		1996	1997	1998	1st Half of 1999
Water Supply	Income	3,271,366	9,204,157	15,895,387	8,131,263
	Expenditure	4,049,070	10,534,347	13,845,944	7,511,452
	Profit	-777,704	-1,330,190	2,049,443	619,811
	Profit Rate (%)	-23.8	-14.5	12.9	7.6
Sewerage	Income	1,136,937	2,334,340	3,920,350	1,952,930
	Expenditure	932,469	2,357,873	4,285,914	1,946,790
	Profit	204,468	-23,533	-365,564	6,140
	Profit Rate (%)	18.0	-1.0	-9.3	0.3
Total	Income	4,408,303	11,538,497	19,815,737	10,084,193
	Expenditure	4,981,539	12,892,220	18,131,858	9,458,242
	Profit	-573,236	-1,353,723	1,683,879	625,951
	Profit Rate (%)	-13.0	-11.7	8.5	6.2

Source: S.C. APA CANAL S.A. (Unit: 1,000 ROL)

Table II.1.19 shows that S.C. APA CANAL S.A. earned ROL 1,953 million, while it spent ROL 1,947 million, begetting a slight surplus of 0.3% in sewerage services in the 1st half of 1999. Combined with water supply, it gained a profit of 6.2%. In 1998 it run into the loss of 9.3% in sewerage services, which was covered by a substantial surplus in water supply, resulting in the

overall profit of 8.5%.

The cost of sewerage services per m³ of sewage was ROL 651 in 1998 and ROL 672 in 1st half of 1999. Personnel, energy and depreciation appear to be the major three cost components. In water supply, there seems to be four important cost items, namely energy, personnel, materials and depreciation.

Table II.1.10 Unit Expenditure for Water Supply and Sewerage Services

Item	1998		1st Half of 1999	
	Water	Sewerage	Water	Sewerage
Raw Materials and Other Materials	202	16	192	46
Combustibles	23	2	34	3
Electricity and Water	574	206	475	59
Depreciation	154	71	127	66
Tests	56	5	44	7
Repairs	40	3	122	10
Salaries	281	228	490	293
Insurance and Social Protection	97	76	205	122
Others	109	44	191	66
Total	1,536	651	1,880	672

Source: S.C. APA CANAL S.A. Unit : ROL/m³

During the three years 1996 to 1998 the combined income of water supply and sewerage services of S.C. APA CANAL S.A. grew 4.5 times from ROL 4,408 million to ROL 19,816 million at the average annual rate of 112.0%. It succeeded in earning a surplus of 8.5% across the two sectors last year. Also, it budgeted a surplus of 5.2% for the 1st half of 1999. However, it consecutively lost in 1996 and 1997. The collection efficiency of the 50% level might have been responsible for it.

Table II.1.11 Planned Budget for Water Supply and Sewerage Services

Item	1996	1997	1998	1st Half of 1999
Total Income	4,408,303	11,538,497	19,815,737	13,974,000
Total Expenditure	4,981,539	12,892,220	18,131,858	13,247,000
Raw Materials and Other Materials	538,504	1,393,895	1,931,198	1,799,000
Combustibles	64,760	167,850	225,530	185,000
Electricity and Water	1,970,197	5,099,400	6,522,805	3,588,000
Depreciation	599,777	1,552,670	1,866,627	1,152,000
Works done by Other Companies	139,483	361,050	608,906	400,400
Repairs	81,199	210,630	377,466	850,600
Salaries	1,011,751	2,617,907	4,038,004	3,276,000
Insurance and Social Protection	317,822	822,784	1,396,721	1,116,000
Others (incl. Duty and Tax)	258,046	666,034	1,164,601	880,000
Profit	-573,236	-1,353,723	1,683,879	727,000
Profit Rate	-13.0	-11.7	8.5	5.2

Source: S.C. APA CANAL S.A. Unit : ROL/m³

The efficiency of the collection of water and sewerage charges in recent years was 55% to 69.8%, as shown below.

Table II.1.12 Collection Efficiency of Water and Sewerage Charges

	1996	1997	1998	1999
Collection Rate	58 %	59 %	55 %	69.8 %

Source: S.C. APA CANAL S.A.

The following things are essential to work out a sustainable financial plan on sewerage services.

- Estimation of the willingness and affordability of the households to pay sewerage charge to clarify the extent and limit of household income allocable to it.
- Incorporation of the actual collection efficiency in formulating income budget and cost analysis to realize proper level of cost per unit volume of sewage.
- Preparation of funds statement and balance sheet besides income statement in order to assure a long term profitability and solvency.

1.1.4 WATER SUPPLY

(1) General

About 59,860 of population corresponding to 75% of the present total population of 80,000 is served by the municipal water supply system. The remaining 25% of the people have their own wells or have an access to some groundwater sources. The number of service population categorized by the residential type and water supply system is as follows:

- Population in flats with house connection 49,340
- Population in individual houses with house connection 3,641
- Population in individual houses with yard tap 6,552
- Population with communal tap 327

The municipal water supply service areas at present is 11,990 ha out of the total administrative area of 13,322 ha, thus the service area coverage now reaches at 90 %. Concerning residential areas, the area of about 584 ha is covered by the municipal water supply and in the future the area will be expanded to 604 ha.

Amount of water distributed to the consumers is summarized in the table below. Average of domestic water distributed per capita can be estimated as 306 lcd based on the water distributed volume of 18,290 m^3/d divided by the service population of 59,860.

Table II.1.13 Annual Water Distribution Records

	Annual Supply (m3/yr)	Daily Supply (m3/d)	Remarks
Domestic Water	6,674,983	18,290	212 L/s
Metered	3,537,741	9,690	
Non-metered	3,137,242	8,600	
Institutional Water	740,650	2,030	23 L/s
Metered	0	0	
Non-metered	740,650	2,030	
Industrial Water	1,729,179	4,740	55 L/s
Metered	1,382,543	3,790	
Non-metered	346,636	950	
Total	9,144,812	25,050	290 L/s
Metered	4,920,284	13,480	
Non-metered	4,442,528	11,570	

The water source for the public water supply system relies on the surface water of the Danube River. Qualities of raw water from Danube River and treated water are shown in *Table II.1.14*.

Table II.1.14 Quality of Intake Water and Treated Water in Calarasi

No.	Item	unit	22 Jul. 1998		15 Sep. 1998		19 Feb. 1999		10 Mar. 1998	
			Intake Water	Treated Wate	Intake Water	Treated Wate	Intake Water	Treated Wate	Intake Water	Treated Water
1	Alkalinity (P)	mg/l	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2	Alkalinity (M)	mg/l	3.0	2.6	3.0	2.5	3.8	3.5	3.2	2.8
3	Carbonates	mg/l	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
4	Bicarbonates	mg/l	183.0	158.6	183.0	152.5	231.8	213.5	195.2	170.8
5	Total Hardness	degree	9.0	9.0	9.5	9.2	12.3	12.3	11.2	11.2
6	Temporary Hardness	degree	8.4	7.3	8.4	7.0	10.6	9.8	9.0	7.8
7	Permanent Hardness	degree	0.6	1.7	1.1	2.2	1.7	2.5	2.2	3.4
8	Organic Matter	mg/l	13.2	7.0	9.0	5.4	11.1	8.2	10.4	7.6
9	pH	-	8.0	7.0	7.8	7.0	8.0	7.0	7.5	7.0
10	Calcium	mg/l	44.0	26.0	44.0	40.0	78.0	74.0	66.0	58.0
11	Magnesium	mg/l	12.2	23.1	14.6	15.8	6.1	8.5	8.5	13.4
12	Silicium	mg/l	4.5	4.3	3.0	2.2	7.8	7.2	5.0	5.7
13	Chloride	mg/l	31.8	30.1	31.8	31.5	39.0	41.5	39.0	40.8
14	Sulfate	mg/l	53.8	27.8	61.4	40.5	62.4	54.7	67.2	54.7
15	Salinity	mg/l	258.5	216.5	276.3	229.5	333.2	309.7	301.4	266.2
16	Ammonium	mg/l	0.10	0.00	0.10	0.00	0.15	0.00	0.15	0.00
17	Nitrite	mg/l	0.10	0.00	0.10	0.00	0.20	0.00	0.05	0.00
18	Temperature	°C	27.0	24.5	21.5	20.5	4.5	5.0	7.5	8.5
19	Total Dissolved Solid	mg/l	342.4	276.9	352.4	287.5	442.7	407.6	397.1	350.9
20	Total Suspended Solid	mg/l	152.0	4.0	113.0	3.0	101.0	-	89.0	6.0
21	Aluminum	mg/l	0.0	0.2	0.0	0.1	0.0	0.2	-	0.4

Source : Calarasi City

(2) Existing Facility

Location of main facilities of the water supply system such as intake, pre-treatment plant and water treatment plant is shown in *Figure II.1.1.*

The surface water of Danube is taken by pumps and treated by clarifiers installed at pre-treatment plant, and then pumped up about 7 km to the water purification plant (rapid sand filtration), which is located in the city center for the final treatment of water. The treated water is distributed to consumers directly by pumps installed in the water purification plant.

The intake site is about 7 km far from the city center and is situated at the upstream of Danube River where the Bratul Borcea River joins the Danube. The water is taken up by pumps, then treated at pre-treatment facilities, and finally transmitted to the water purification plant by pumps though dual pre-treated water mains made of steel having 1,000mm in diameter and about 6.5 km in length. The following figure shows schematic components of the intake and pre-treatment facilities.

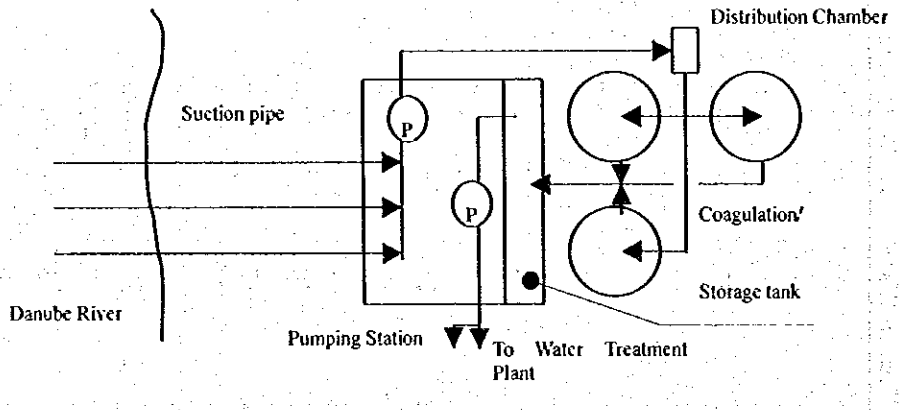


Figure II.1.4 Intake and Pre-treatment Facilities

The table below shows main features of the facilities.

Table II.1.15 Main Features of Intake and Pre-treatment Facilities

Facility	Main Features	No. of unit	Remark
Suction Pipe from the intake to pre-treatment facility	Dia. 1,000 mm	3 pipes	Each suction pipe has 2 inlets, one is fixed type and the other is floating type, which can move 7m in vertical direction.
Pumping Station (Taken water to Pre-treatment plant)	18 NDS, 110 kW, 420 l/s, Hp=18	6 pumps	2 pumps are operated under normal conditions.
Distribution Chamber		1 tank	Aluminum sulfate is dosed as coagulants
Coagulation/Clarifier	Dia. 35m	3 tanks	A type of suspended solid contact reactor
Storage Tank/Chlorination			
Pumping Station (Pre-treated water to WTP)	18 NDS, 132 kW, 420 l/s, Hp=22	6 pumps	3 pumps are operated under normal conditions.
Pre-treated Water Main from the Pre-treatment Plant to WTP	Dia. 1,000 mm, steel pipe, L = 6.5 km	2 pipe lines	

Source : S.C. APA CANAL S.A.

The pre-treated water transmitted from the pre-treatment plant is further treated at the water treatment plant located at the center of the city. The plant consists of rapid sand filters, post-chlorination equipment, treated water reservoir and pumping station. The treated water is once kept at the treated water reservoirs and distributed by pumps installed at the water treatment plant directly to the consumers. The outline of facilities at water treatment plant is as follows.

Table II.1.16 Outline of Facilities at Water Treatment Plant

Facility	Main Features	No. of Unit	Remarks
Rapid Sand Filter, 1st stage construction	55 m^2 (surface area)	6 filters	One is out of order
Rapid Sand Filter, 2nd stage construction	19.5 m^2 (surface area)	12 filters	
Post-chlorination Equipment			
Treated Water Reservoir, 1st stage const.	10,000 m^3	2 tanks	
Treated Water Reservoir, 2nd stage const.	3,000 m^3	1 tank	
Pumping Station	Head = 25-35m		Directly supplied to consumers.

Source : S.C. APA CANAL S.A.

The water mains and distribution pipes are made of cast iron, RC and asbestos cement ranging from 100 to 800 mm in diameters. The total length of laying pipes is about 176.3 km.

(3) Future Improvement Plan

The city has a plan to implement rehabilitation and expansion works of water distribution networks in the near future. About 3,000 of population will be connected to public water supply system by the end of 1999. In addition, the city has a water supply improvement plan to provide better services not only in quantity but also in quality. The daily average supply volume is planned to increase 45 %, from 290 L/s (250,050 m^3/d) to 422 L/s (36,460 m^3/d). In detail, the domestic water supply increases from 212 L/s to 303 L/s, and for non-domestic water supply increased from 78 L/s to 119 L/s. The domestic water supply volume required in the future is estimated as 1.2 times as the present requirement.

The Romanian standards STAS categorize water bodies as follows:

Table II.1.17 Category Defined in STAS

Category	Area classified by water/heated water distribution and sewage system
1	Water distributed by communal taps
2	Water distributed by yard taps
3	Water distributed with house connections and discharge to public system
4	The same as the above category 3, but the distributed water is heated locally by an in-house heater
5	Heated water is also distributed by the public central system

The category is set by considering what kind of water distribution system is used, whether sewerage system is provided, and whether a central heated water supply system is provided. The present domestic water supply requirement is estimated as shown in the table below:

Table II.1.18 Future Requirement of Domestic Water Supply Volume

Item	STAS Category		Total
	2	4	
Population	16,784	45,044	61,828
Surface Area (ha)	432	173	605
Population Density (capita/ha)	39	260	103
Per Capita Supply (lcd)	130	400	
Coefficient, Kp	1.10	1.10	
Coefficient, Ks	1.10	1.10	
Daily Average Flow (m^3/d)	2,640	21,800	24,440
Coefficient, Kzi	1.2	1.1	
Daily Maximum Flow (m^3/d)	3,170	23,980	27,150
Coefficient, Ko	1.239	1.239	
Hourly Maximum Flow (m^3/d)	3,930	29,710	33,640

Source: Calarasi City / S.C. APA CANAL S.A.
Note) Daily Average Flow, Qda = Kp x Ks x Population x Per Capita Supply; Daily Maximum Flow, Qdm = Kzi x Qda and Hourly Maximum Flow, Qhm = Ko x Qdm

Since the surface water of the Danube River is recently deteriorated or contaminated by an increase of nutrients, pesticides, phenol, algae etc., from various pollution sources. The municipal water supply system is required to increase chlorine dosage for safety, but this may cause taste and odor problems. To solve the problems, an alternative study was conducted in 1996; one alternative is to introduce a new advanced treatment system comprised with ozone and activated carbon filtration processes after the existing rapid sand filtration system, and the other is to change the water source from the surface water of Danube River to groundwater. The final decision to select the best alternative has not been made yet.

In the alternative study, groundwater source development was planned as presented in the following table. Two wells proposed were dug and their water quality was tested to show a good quality for drinking purposes. According to the study, the construction costs estimated for both alternatives were in the same level or magnitude.

Table II.1.19 Groundwater Sources Development Plan

Construction Stage	Capacity Increase	No. of Wells	Depth of Well
1st Stage	400 l/s/stage	45 wells	110 m
2nd Stage	200 l/s/stage	5 wells	500 m
3rd Stage	200 l/s/stage	5 wells	500 m

Source: Calarasi City / S.C. APA CANAL S.A.

1.1.5 SEWERAGE SYSTEM

(1) General

In 1970's the city decided to apply a separate sewer system to manage wastewater and storm-water with different sewer networks. The wastewater management system was composed of sanitary sewers, two (2) pumping stations and Imhoff tank.

From 1980 to 1986, the wastewater treatment plant was improved and the following facilities were commissioned in 1986; grit chamber, Parshall flume, oil separator, chemical treatment, 2 units of circular sedimentation tanks, sludge thickener, pH control chamber, sludge drying beds, administration building and laboratory. Additional one circular sedimentation tank is still under construction and be completed by August 1999. The Imhoff tank was abandoned after the commission of new treatment facilities.

Due to some financial constrains and/or a mismatch of construction period, it was difficult to construct both sanitary sewers and storm-water sewers simultaneously. In some residential areas where only storm-water sewers were constructed, the domestic wastewater generated has been discharged to the storm-water sewers. Therefore, the storm-water sewers convey wastewater only in dry weather conditions and covey wastewater and storm-water in wet weather conditions as if they were combined sewers. The wastewater conveyed by the storm-water sewers is discharged directly to the Danube River through four outfalls without any treatment.

The Environmental Protection Agency (EPA) of Caralasi county asked the city to take any measures/actions urgently to improve the environmentally bad situation. In response to the request of EPA, the city conducted a study and constructed four flow regulating structures in 1998. The structure has the same function of Combined Sewer Overflow (CSO) regulator, by which in dry weather conditions the wastewater is discharged or drained to sanitary sewer mains, while in wet weather conditions only intercepted wastewater (dry weather flowrate only) is discharged to sanitary sewer mains but the overflows are discharged to the Danube through the existing outfall sewers. Additional CSO regulator is planned to install to the remained one outfall in the near future. The following schematic drawing illustrates a concept of CSO.

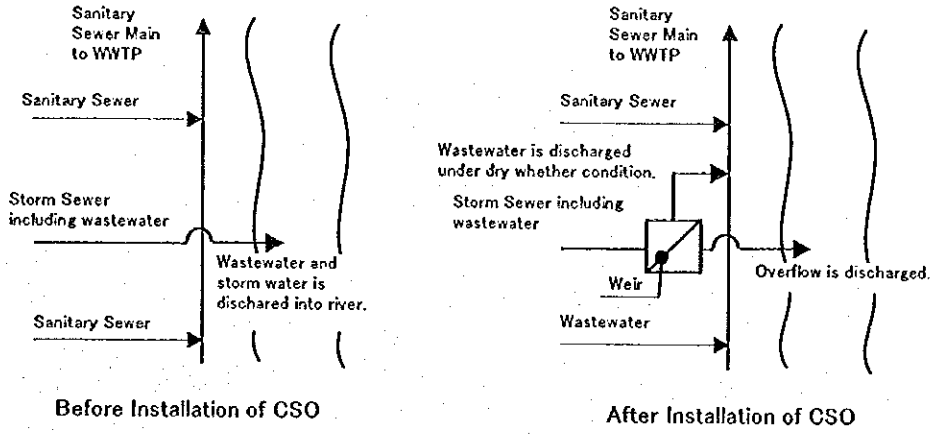


Figure II.1.5 Concept of CSO

The present population served by the sewerage system is about 50,000 and the total population in the city is 77,666 as of January in 1998, thus, the present population coverage is about 64 %.

(2) Existing Sewerage Facilities

Existing sewerage system of Calarasi is schematically shown in the figure below. Main components are CSO regulators, pumping stations, sanitary sewer mains, outfalls, and a WWTP.

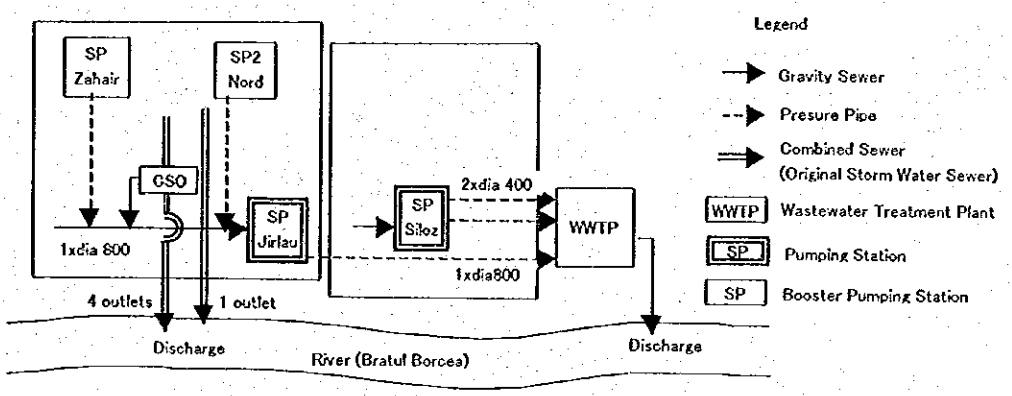


Figure II.1.6 Existing Sewerage System of Calarasi

Total length of sanitary sewer networks is 56 km and that of stormwater sewer network is 28 km, respectively. Existing sewer network is as shown in *Figures II.1.7 and II.1.8.* There are two pumping stations, namely "Jirlau" and "Siloz" and two booster pumping stations, namely "Zahair" and "SP2 Nord", as shown in *Table II.1.20.* "Zahair" receives wastewater from a sugar factory and "SP2 Nord" receives both domestic wastewater and industrial water.

Table II.1.20 Outline of Wastewater Pumping Stations at Calarasi City

No.	Station	Pumps	Q'ty	Flow	Head	Suction	Outlet	r.p.m.	Motor Power
1	SP.Jirlau	MV 253	1	600 m^3/h	38 m	400 mm	300 mm	1500	110 kW
		MV 402	2	1400 m^3/h	36 m	600 mm	400 mm	1500	200 kW
2	SP. Siloz	MV 401	1	1400 m^3/h	32 m	600 mm	400 mm	1500	110 kW
		ACVD 150	5	210 m^3/h	32 m	300 mm	250 mm	1500	55 kW
3	SP2 Nord	ACVD 150	1	210 m^3/h	32 m	300 mm	250 mm	1500	55 kW
		ACV 100	3	135 m^3/h	15 m	250 mm	150 mm	1500	15 kW
4	SP. Zahair	ACVD 150	5	210 m^3/h	32 m	300 mm	250 mm	1500	55 kW

Source: S.C. APA CANAL S.A.

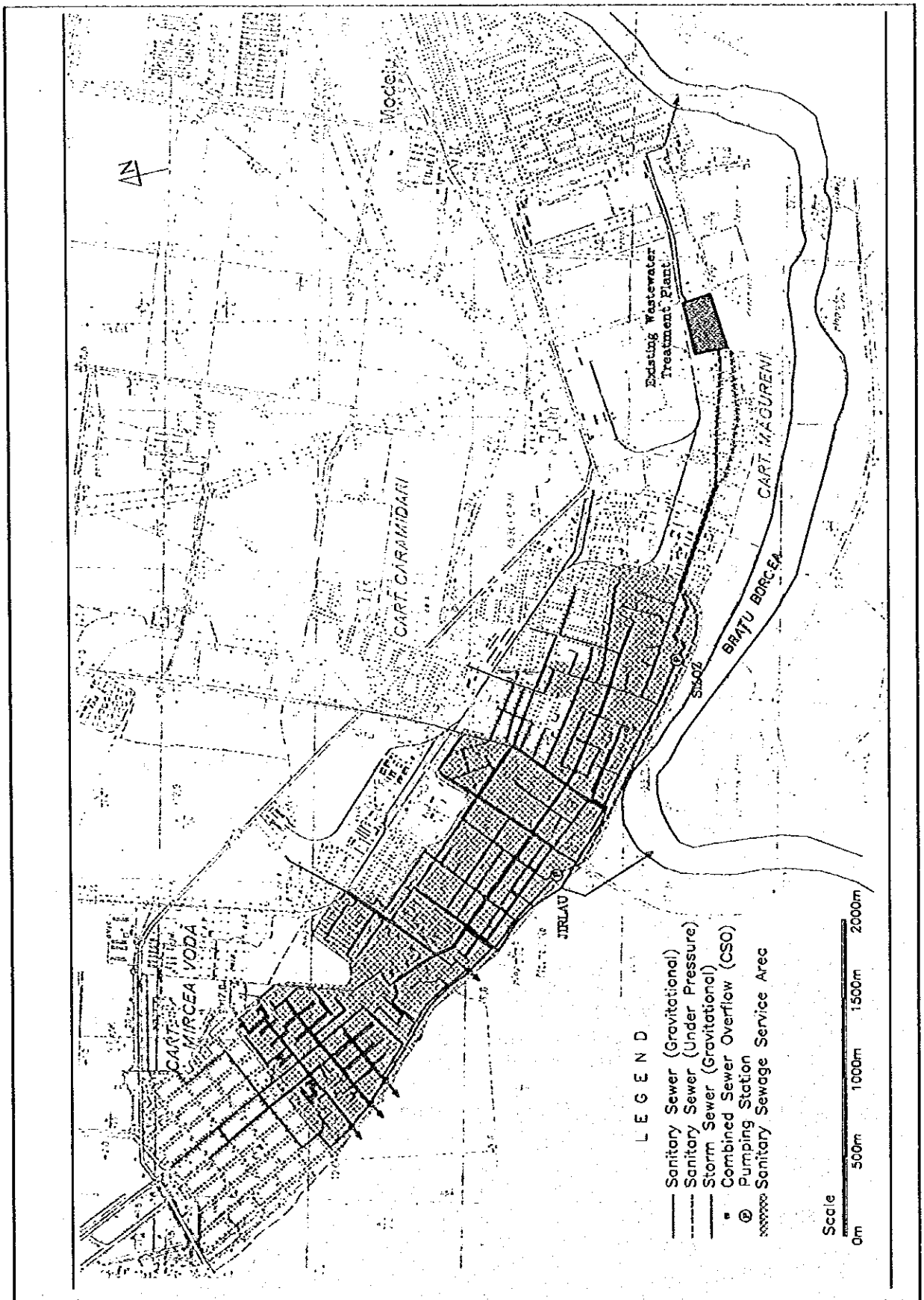


Figure II.1.7	Existing Sewerage Network of Calarasi

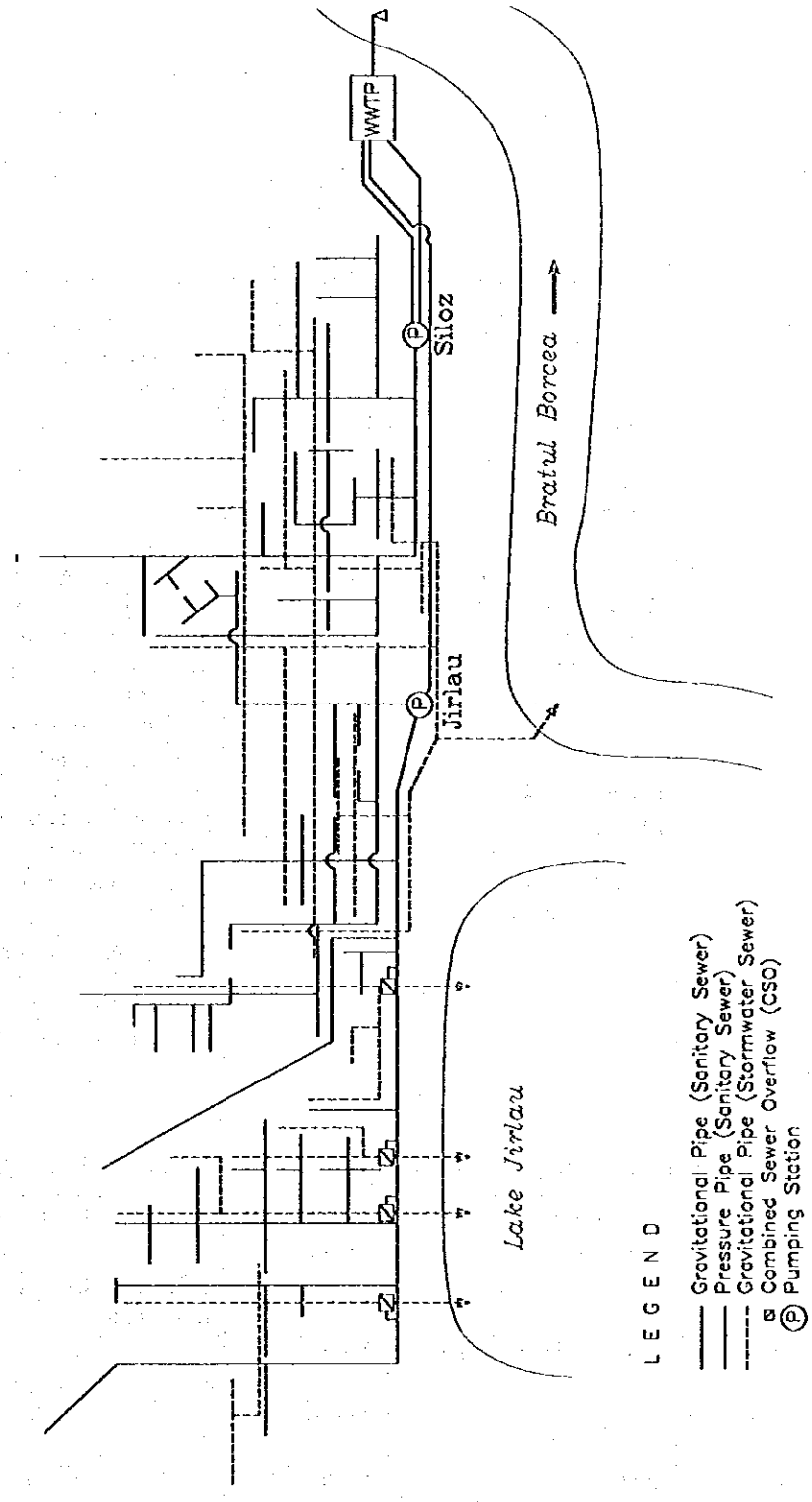


Figure II.1.8 | **Schematic Representation of Calarasi Sewerage System**

The Calarasi WWTP is situated at Magureni district, in the eastern outskirts of the city. The total area of the WWTP site is about 6.3 ha. It is surrounded by Calarasi Pulp and Paper Mill (CCH) to the north, cemetery to the west, an area for agriculture to the east, and solid wastes disposal site to the south.

Wastewater conveyed by two pumping stations, Jirlau and Siloz, received once by a chamber and is treated by the preliminary and primary treatment facilities as shown in *Figure II.1.9*.

The treatment capacity of the existing WWTP is about 645 l/sec, 55,700 m^3/day. Outline of the existing treatment facilities is as shown in *Tables II.1.21* and *II.1.22*.

Table II.1.21 Outline of Existing Wastewater Treatment Facilities at Calarasi WWTP

Facilities	Main Features	Number	Remarks
Grit Chamber	Wide: 1.45 m, Length: 19.25 m	3 units	No bypass for the grit chamber.
Parshall Flume	Upper width:1.35 m Bottom width: 0.565 m Depth: 1.50 m Length: upstream 13.50 m and downstream 8.75 m	1 units with three chambers	
Skimming Tank / Oil Separator	Upper width: 4.10 m, Bottom width: 1.10 m, Depth: 2.60 m Length: 15.0 m	2 units	Aerated by Arcuda Plats, made by gravel and sand together with resin. But the aeration is not properly operated due to the malfanction of blows
Chemical Treatment Tank	Wide: 9.56 m, Length: 19.34 m, Effective depth: 2.75 m	2 units	Lime is dosed for pH adjustment. Mixing is provided by pressured air by local blowers
Distribution Tank	Outer Dia 6.0 m Inner Dia: 4.7 m	1 tank	It has one inlet and 4 outlets.
Primary (Circular) Sedimentation Tank	Dia. : 35 m	3 tanks	Two tanks are operated. One tank is still under construction but be completed by Aug. 1999.
Chlorine Contact Tank			

Table II.1.22 Outline of Existing Sludge Treatment Facilities at Calarasi WWTP

Facilities	Main Features	Number	Remarks
Thickener	Dia. : 20 m	1 tank	
pH Controller		1 tank	HCL was used but stopped its operation
Pumps for thickened sludge	Horizontal axis pumps	2 units	
Pumps for supernatant in thickener	AVC pumps	2 units	
Sludge Drying Bed	Wide: 10 m, Length: 50 m,	4 + 8 = 12 beds	Total surface is about 16,350m^2. *1) Sludge is removed with two years interval.

Source: Calarasi City
*1) : According to the water company.

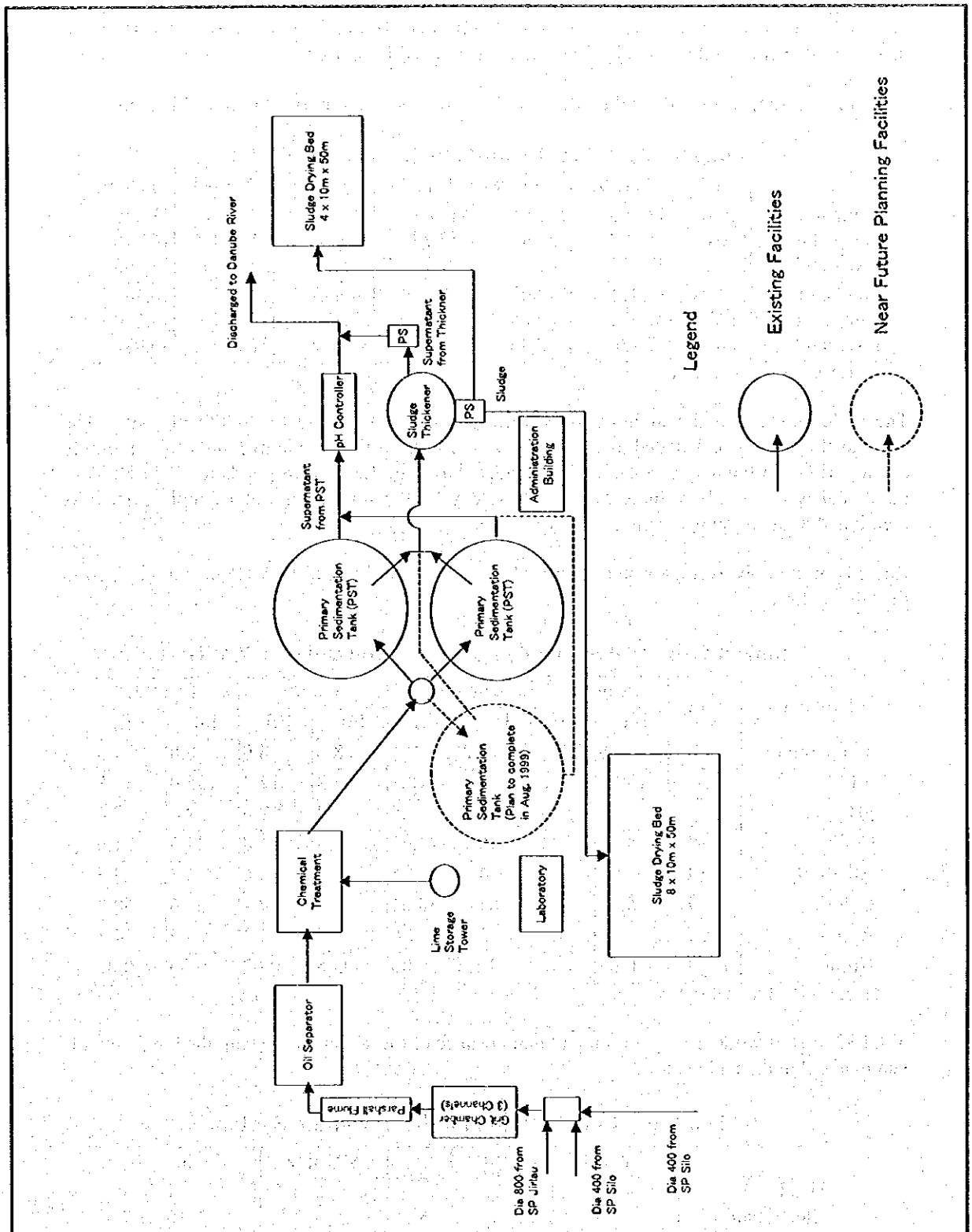


Figure II.1.9	Flow Chart of Existing WWTP in Calarasi

The primary sludge is thickened and then dried at sludge drying beds. The dried sludge is disposed of at final disposal site, which located only about 100 m from the wastewater treatment plant. Only very small amount of dried sludge is utilized for agriculture.

Recent monthly flow records of the inflow to the WWTP are summarized in the table below.

Table II.1.23 Inflow Records to the Calarasi WWTP

	unit	June-98	July-98	Aug.-98	Dec.-98	Jan.-99	Feb.-99
Minimum Flow	L/sec	137.66	136.65	113.06	167.17	141.41	119.76
Average Flow	L/sec	251.09	232.47	252.79	316.36	214.63	165.16
Maximum Flow	L/sec	372.52	361.53	392.7	385.98	373.75	347.65
Minimum Flow	m^3/day	11,894	11,807	9,768	14,443	12,218	10,347
Average Flow	m^3/day	21,694	20,085	21,841	27,334	18,544	14,270
Maximum Flow	m^3/day	32,186	31,236	33,929	33,349	32,292	30,037

Source: S.C. APA CANAL S.A.

The table shows that the monthly flow varies from about 10,000 to 34,000 m^3/day. The average flow can be calculated as about 20,630 m^3/da from the simple average of the monthly average flows in the above table. The calculated average flow corresponds to about 82 % of the actual water supply volume of 25,050 m3/day by the municipal water supply system as mentioned in the previous section.

Records of monthly average water quality of influent and effluent at WWTP are summarized in the table below.

Table II.1.24 Water Quality Records at the Calarasi WWTP

Parameter	unit	Aug-98		Sep-98		Jan-99		Feb-99	
		Inf.	Eff.	Inf.	Eff.	Inf.	Eff.	Inf.	Eff.
Temperature	°C	24.8	25.3	19.2	19.1	8.3	8.0	8.0	7.8
SS	mg/L	130.5	11.5	137.9	12.1	142.3	12.4	135.0	11.8
pH		7.4	7.6	7.4	7.6	7.4	7.6	7.4	7.6
COD	mg/L	43.2	22.3	46.1	23.02	43.5	21.8	43.3	21.6
Alkalinity	mg/L	4.1	4.4	4.2	4.5	4.3	4.6	4.3	4.5
Chlorine	mg/L	63.8	59.6	64.0	58.61	65.4	59.1	65.6	60.7
Ammonia	mg/L	3.2	4.5	3.6	4.6	3.4	4.3	3.4	4.1
Nitrate	mg/L	0.04	0.01	0.12	0.06	0.08	0.02	0.06	0.02

Source: S.C. APA CANAL S.A.

Total 37 of staff works for operation and maintenance of the sewerage system, the breakdown is summarized in the table below.

Table II.1.25 Staff Working for the Sewerage System

	WWTP	SP Jirlau	SP Siloz	Total
Head	1	-	-	1
Electrician	5	5	-	10
Mechanics	11	5	5	21
Laboratory	5 (one chief)	-	-	5
Total	22	10	5	37

Souce: Calarasi City

The five (5) electricians working at SP Jirlau also work for operation and maintenance of other pumping stations including two (2) pumping stations.

(3) Sewerage System Improvement Plan

In order to improve the situations of wastewater management, a F/S on the sewerage system improvement was conducted in 1995. The F/S has proposed two targets, one is rearrangement of the sanitary and storm-water sewer networks and the other is improvement of wastewater treatment level.

1) Rearrangement of sewer networks

As mentioned in the previous sub-section, the existing storm-water sewers are used like sanitary sewers in the area where only storm-water sewers are installed. Based on the results of field surveys and existing design materials, the capacity of existing sewers was examined taking into account of the future flow linked with the future water demand and a comprehensive plan of strengthening the sewer networks was prepared. It is planned a new installation of sanitary sewers and of storm-water sewers. Some storm-water sewers is being used as sanitary sewers, which will be also used as sanitary sewers or will be used as a storm-water sewer and a new sanitary sewer will be installed in the vicinity. It is proposed that the rearrangement of sewer networks be implemented in three stages.

2) Improvement of wastewater treatment plant

A discharge of treated wastewater from WWTP should comply with a national regulation. The discharge to a receiving water body of "Borcea Arm" from Calarasi WWTP is regulated by an Agreement between National Water Company Constata Office and Calarasi City. The agreement No. 35/04 Oct. 1995 – National Water Company Constanta Office is shown in the table below.

Table II.1.26 WWTP Effluent Quality and Quantity Agreement

Treated Wastewater Quality		Discharge Rate	
pH	6.5 to 8.5	Daily Maximum Flow	320 L/s
SS	25 mg/L		27,700 m^3/d
BOD_5	15 mg/L	Daily Average Flow	272 L/s
TDS (105°C)	1,200 mg/L		23,600 m^3/d
Ammonia	0.5 mg/L	Annual Discharge	8,750,000 m^3/d
Ammonium	10 mg/L		
Oil or Grease	0.1 mg/L		
Chlorides	300 mg/L		
Biodegradable anionic detergents	0.5 mg/L		

Source: S.C. APA CANAL S.A.

The present WWTP does not comply with the agreement. The National Water Company and the city have carried out some water quality surveys on the treated wastewater. The results of the surveys pointed out that some quality parameters such as BOD_5 and SS exceeded the regulated and agreed values.

To comply with the agreement based on national regulations, the upgrade of Calarasi WWTP was urgently required. In 1995, a feasibility study on the WWTP improvement was conducted.

The flowrate for the design of WWTP was set in the F/S as shown in the table below. The design daily average flow, Qd ave., is about twice of the present flow of about 21,000 m^3/day, and the design daily average flow, Qd max., is 1.73 times of the present flow of about 32,200 m^3/day.

Table II.1.27 Design Flow of Calarasi WWTP

Design Flow	L/s	m^3/day
Q average daily	493	42,595
Q maximum daily	645	55,728
Q maximum hourly	775	66,960

Source: S.C. APA CANAL S.A.

The quality of influent and effluent set for the design in the F/S is as shown in the table below.

Table II.1.28 Design Wastewater Quality for Calarasi WWTP

Parameter	Influent	Effluent	Remarks
BOD_5	230 mg/L	15 mg/L	Removal rate 93 %
SS	210 mg/L	25 mg/L	Removal rate 88 %

Source: S.C. APA CANAL S.A.

The proposed plan is to provide a necessary rehabilitation or extension works for primary treatment facilities and equipment, and to introduce biological secondary treatment facilities and necessary sludge treatment facilities. A conventional activated sludge process is selected as the biological secondary treatment method. For a sludge treatment, an anaerobic digestion followed by mechanical dewatering of filter press is selected. The dewatered sludge is planned to be kept in there for five years, and conveyed to solid wastes dumping site for final disposal.

The layout plan of the future WWTP is presented in *Figure II.1.10* and the outline of biological secondary treatment facilities and sludge treatment facilities is shown in the table below.

Table II.1.29 Outline of Proposed Treatment Facilities for Calarasi WWTP

Facilities	Main Features	Q'ty	Remarks
Wastewater Treatment			
Aeration Tanks	Wide: 6.0 m, Water Depth:5 m Length: 50 m, Total Effective Volume: 12,000 m^3	8	Qd max
Distribution Chamber for Final Sedimentation Tanks	Dia.: 2.0 m	1	Qd max
Final Sedimentation Tank	Dia.: 45 m, Water Depth: 3.9 m	2	1.24 Qd max
Sludge Treatment			
Gravity Thickener for primary and excess sludges	Dia.: 20 m Volume: 1,050 m^3	1	One existing thickener also used. Q=680 m^3/d
Anaerobic Digester	Volume: 4,000 m^3, with electrical heating and recycling system	2	Digested Sludge, Q=525 m^3/d
Gravity Thickener for digested sludge	Dia.: 16 m, Volume: 660 m^3	1	
Mechanical Sludge Dewatering	Filter Press	3	Thickened Sludge, Q=369 m^3/d
Gas Storage Tank	Volume: 1,000 m^3	1	
Treated Sludge Stock Facility	Area: 6,000 m^2, Height: 6.5 m	-	5 years stock
Equipment			
Blower	Q: 5,000 m^3/h, H: 5.5 m, P: 132 kw	4	
Return Sludge Pump	Q: 610 m^3/h, H: 7 m, P: 22 kw	3 + 1	0.8 Qd max
Thickened Sludge Pump	Q: 37.5 m^3/h, H: 32 m, P: 18.5 kw	2 + 1	
Digested Sludge Pump	Q: 12 m^3/h, H: 10 m, P: 7.5 kw	2 + 1	

Source: S.C. APA CANAL S.A.

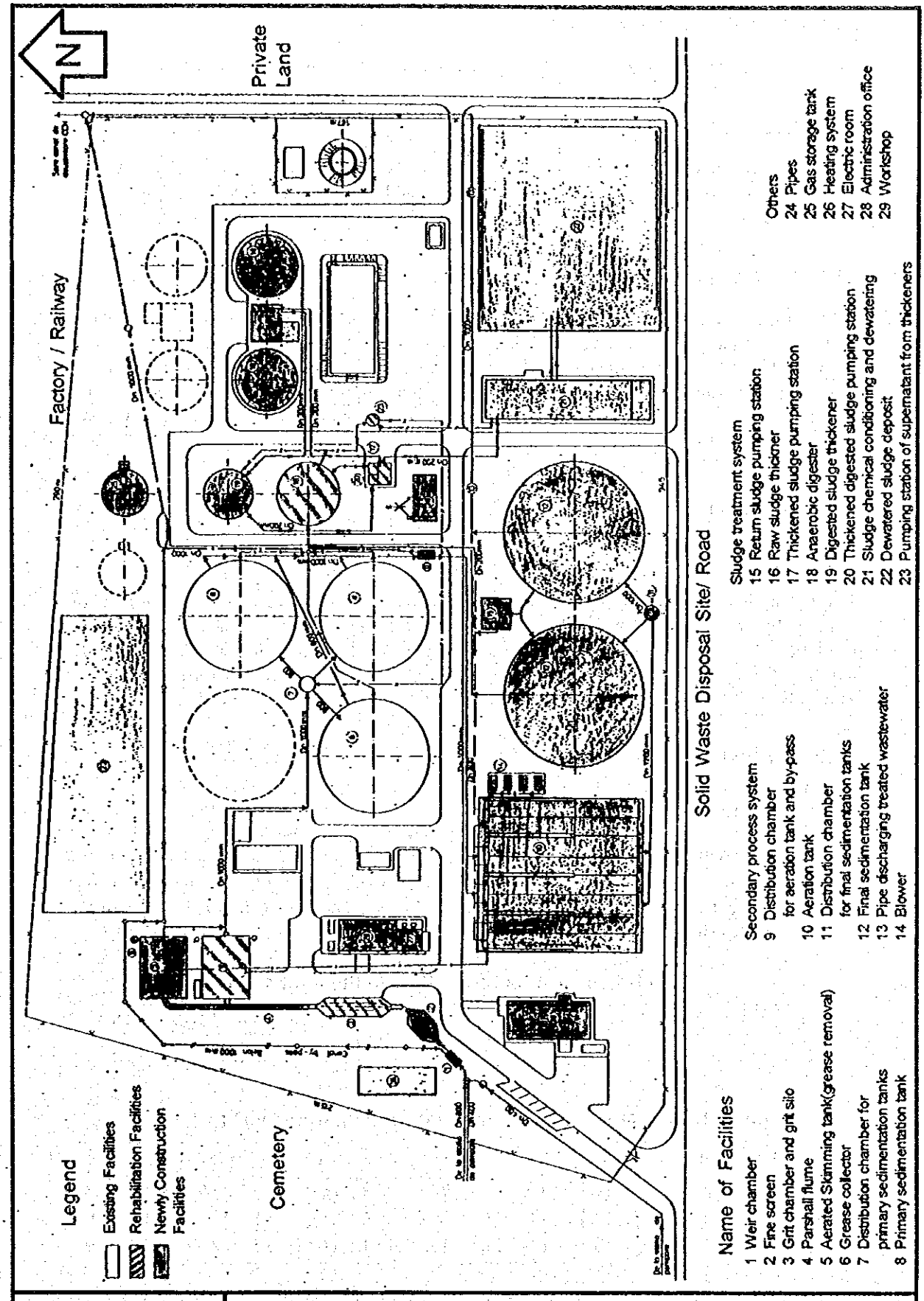


Figure II.1.10 WWTP Layout Plan Prepared by Calarasi City

1.1.6 ON-SITE SANITATION

Septic tank is generally used for wastewater management in areas without sewerage system.

1.1.7 INDUSTRIAL WASTEWATER

Major industries in the city are steel, pulp and paper and construction materials such as RC pipe or bricks. Most of the factories use the water provided by the municipal water supply system. Only the factory producing construction materials gets water by its own water source.

1.1.8 SOLID WASTE

The service of solid waste management is provided by "Salubritate", a pubic corporation related to the city. Since any separated collection system is not applied, all solid waste collected is transported to the existing final disposal site located along the Bratul Borcea River in the vicinity of the wastewater treatment plant. The disposal site is almost full and therefore, by the end of this year, a new ecological solid waste disposal plant will be constructed at the site shown in *Figure II.1.1*.

1.2 GIURGIU

1.2.1 GENERAL

Giurgiu City is located 60 km south from the capital city of Bucharest. The city is bordered on Bulgaria by the Danube River. The area of district is about 352,600 ha and the present population is estimated about 302,000. The city is an important traffic point for trade, industries and tourism. Because there is an important bridge constructed in 1954, crossing the Danube River by railways and roads. The general map of the city is shown in *Figure II.1.11*.

1.2.2 NATURAL CONDITIONS

(1) Temperature

The annual average temperature is 11.2℃, and the monthly average temperature in summer season and winter season is 22.9℃ and -2.6℃, respectively. The highest and lowest ever recorded are 42.41℃ on July 25 in 1987 and -30.2℃ on February 6 in 1954, respectively. The below tables show the monthly average temperature in 1998 and the data for 1901-1994.

Table II.1.30 Temperature Data in the Year 1998

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1.8	3.8	6.3	16.3	19.1	24.8	27.0	26.5	----	12.2	4.3	-4.0

Unit : ℃

Table II.1.31 Multi-annual Temperature Data from 1901 to 1994

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Ave.
Ave.	-2.6	-0.1	5.2	11.9	17.3	21.0	22.9	22.2	18.0	11.7	5.9	0.5	11.2
Max.	1.2	4.3	10.7	17.5	24.0	27.5	29.8	29.6	25.6	18.8	10.9	4.1	17.0
Min.	-6.1	-4.0	0.3	6.2	11.0	14.5	16.0	15.1	11.3	6.5	2.3	-2.5	5.9

Source : Giurgiu City

Unit : ℃

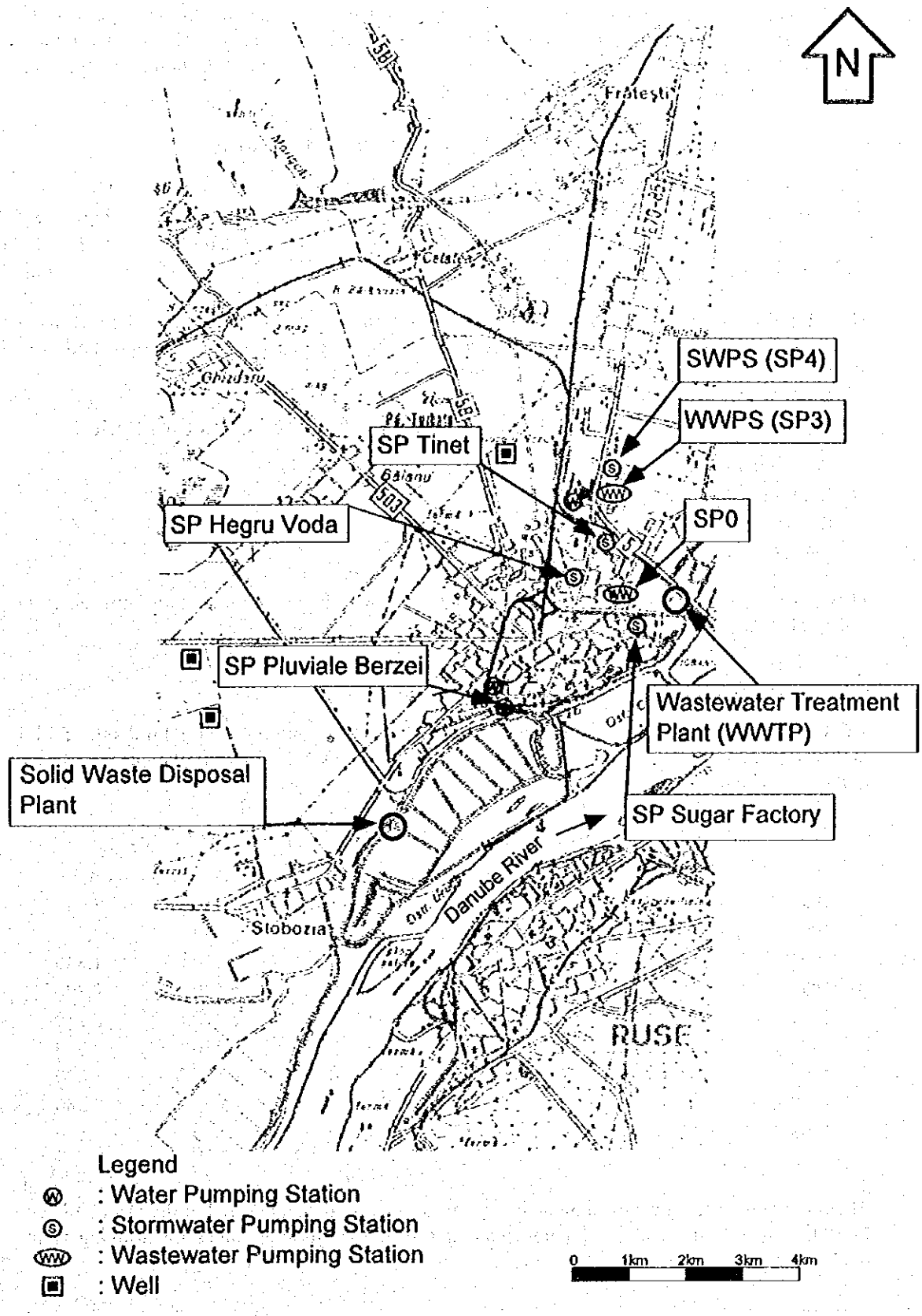


Figure II.1.11	General Map of Giurgiu City

(2) Precipitation

The average annual precipitation is about 575 mm. Regarding to the monthly average records, the highest one is 79.8 mm in June and the lowest is 31.9 mm in February. The following table shows that the monthly average precipitation and monthly maximum of 24 hours-precipitation in the period between 1901 and 1994, respectively.

Table II.1.32 Precipitation Data from 1901 to 1994

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	annual
Ave.	39.0	31.9	36.1	47.6	66.4	79.8	60.0	47.2	41.2	40.3	43.3	42.6	575.4
Max	36.5	53.4	54.1	53.7	70.5	91.0	96.6	96.2	76.5	118.0	41.9	47.1	118.0

Source : Giurgiu City Unit mm

The rainfall intensity calculated on probability and return periods are as shown in the following table. In case that the event happens once a five years, (five years of return periods and 20% of probability), the rainfall intensity is 64 mm.

Table II.1.33 Rainfall Intensity based on Probability and Return Period

Probability (%)	1	2	5	10	20
Return Period (Year)	100	50	20	10	5
Rainfall Intensity (mm)	120	104	89	77	64

Source : Giurgiu City

They have snowfalls during from November 29 to March 19 based on the records between 1904 and 1994. Accumulated snow depth happened once a five years is 45 cm.

(3) River Condition (Flow, HWL, LWL, other)

The Danube River along the city has the width of about 800m and the maximum depth of 14.5 m. The annual water level and flow rates recorded at the Danube River in the city are shown in the following table.

Table II.1.34 Information on the Danube River in Giurgiu City.

year	Hmax (m)	Hmed (m)	Hmin (m)	Qmax (m^3/s)	Qmed (m^3/s)	Qmin (m^3/s)
1990	15.83	13.87	11.80	7,000	4,110	2,040
1991	18.51	14.96	12.58	10,500	5,530	2,750
1992	18.19	14.60	11.82	10,100	5,060	1,840
1993	17.46	14.17	12.26	9,370	4,540	2,390
1994	18.27	14.71	12.20	11,000	5,390	2,230
1995	17.96	15.37	12.83	9,900	6,120	2,840
1996	18.58	15.74	12.85	11,300	6,520	3,000
1997	17.86	15.42	12.92	10,000	6,070	2,580
1998	18.62	15.52	12.72	11,800	6,000	2,550

Source : Giurgiu City

The following table shows the annual average water quality data measured in the Danube River in 1995. It indicates that some parameters exceed the permissible values for drinking water quality standards STAS 4706/88.

Table II.1.35 Water Quality Data of Danube River in 1995

Parameters	Unit	Annual Mean Value	Permissible Value
pH		7.6	7.5
Alkalinity "M"	mg/L	4.1	3.5
Hardness	mg/L	13	13
TSS	mg/L	98.7	178
COD	mg/L	3.95	3.82
Fixed residence	mg/L	299	283.9
Cl^-	mg/L	72.8	38.4
SO_4^{2-}	mg/L	82	45
HCO_3^-	mg/L	250.1	213.5
Ca	mg/L	62.8	51.3
Mg	mg/L	29.5	21.5
DO	mg/L	7.0	6.9
NH_4^+	mg/L	1.2	1.9
NO_2^-	mg/L	0.098	0.072
NO_3^-	mg/L	11.2	16.2
PO_4^{3-}	mg/L	0.42	0.375
Cyanide	mg/L	Not detective	Not detective
Phenol	mg/L	Not detective	Not detective
Iron	mg/L	0.075	0.175

Source : Giurgiu City

1.2.3 Socio-economic Conditions

(1) Population

As shown in the following table, the population of Giurgiu slightly decreased from the 74,000 level to the 72,000 level during the 6 years from 1993 to 1998.

Table II.1.36 Total Population of Giurgiu

1993	1994	1995	1996	1997	1998
74,060	73,997	73,967	73,347	73,586	72,995

Source : Giurgiu City

The population of the city stood at 72,995 as of 1998. It is projected to grow to 83,000 in the target year of 2010. It means that it will grow from now on at the average annual rate of 1.1%.

It is crucial to make a reasonable projection of the population since it forms the very basis on which to plan and design the future sewage treatment plant. The number of households was 23,321 in 1998, the number of members per household being calculated at 3.13.

(2) Industries

The number of employees totaled 33,900 in 1992. Out of it, the primary, secondary and tertiary sectors accounted for 3.3%, 58.4% and 38.2% respectively. The predominance of the secondary sector is to be noted. Especially, the number of workers in the manufacturing industry reached 16,313, occupying 48.1% of the entire workforce.

Table II.1.37 Number of Workers by Type of Activities (1992)

Type of Activities	Workers	%
Primary Industry	1,107	3.3
Secondary Industry	19,800	58.4
Mining	65	0.2
Manufacturing	16,313	48.1
Electricity	1,167	3.4
Construction	2,255	6.7
Tertiary Industry	12,933	38.2
Total	33,900	100.0

Source : Giurgiu City

"Transport Means" accounted for 31.0% of the workforce in the major manufacturing industry in 1997, followed by "Chemicals" with 19.9%, "Food" with 12.0%, "Cakes" with 11.6%, "Machines and Equipment" with 7.4%, etc. Summing up, machines, food and chemicals can be said to occupy a principal place in the manufacturing industry of the city.

(3) Organization

The organization chart of Giurgiu city office is shown in *Figure II.1.12*.

Sewerage service is operated by S.C. AQUA TERM S.A. S.C AQUA TERM S.A. is a commercialized company and the local council of Giurgiu is the only shareholder. S.C. AQUA TERM S.A has 568 personnel in total and operates water supply, sewerage, and district heating services. Technical part of the company consists of following sections.

- Water supply section with 180 personnel,
- Sewerage section with 80 personnel, and
- District heating section with 191 personnel.

The organization chart of S.C. AQUA TERM S.A is shown in *Figure II.1.13*.

(4) Financial Conditions of the City

As shown in the table below, during 6 years 1994 to 1999, the local budget of Giurgiu grew 6.1 times from ROL 6,924 million to ROL 42,218 million. Its average annual growth rate is calculated at 43.6%. During the same period, prices increased at the average annual rate of 62.5%. That is to say, the local budget decreased in real terms by 11.6% per year on average.

Table II.1.38 Total Amount of Income Budget

1994	1995	1996	1997	1998	1999
6,924,131	13,048,377	16,983,420	27,570,247	32,749,146	42,218,000

Source : Giurgiu City Unit: 1,000 ROL

The budget of Giurgiu for 1999 totals ROL 42,218 million, which is by 28.9% greater compared with the budget for 1998, ROL 32,749 million.

Because of the new local finance law which was put into force in January, 1999, there is no subsidy from the central government any longer. Under the law, 31.5% of the tax on salaries goes directly to the local government. Also, 45% of this tax is allocated for the state income budget, of which a part is transferred to the local government through the county as the quota. This quota is different from the direct transfer from the state, but by nature is an addition to the above direct local tax on salaries. It occupies the majority of the transfer from the state income budget. That is, in principle almost all the income of the local budget now derives from its own sources. It in turn gives freedom to the local authorities to use the income in whatever way they deem proper.

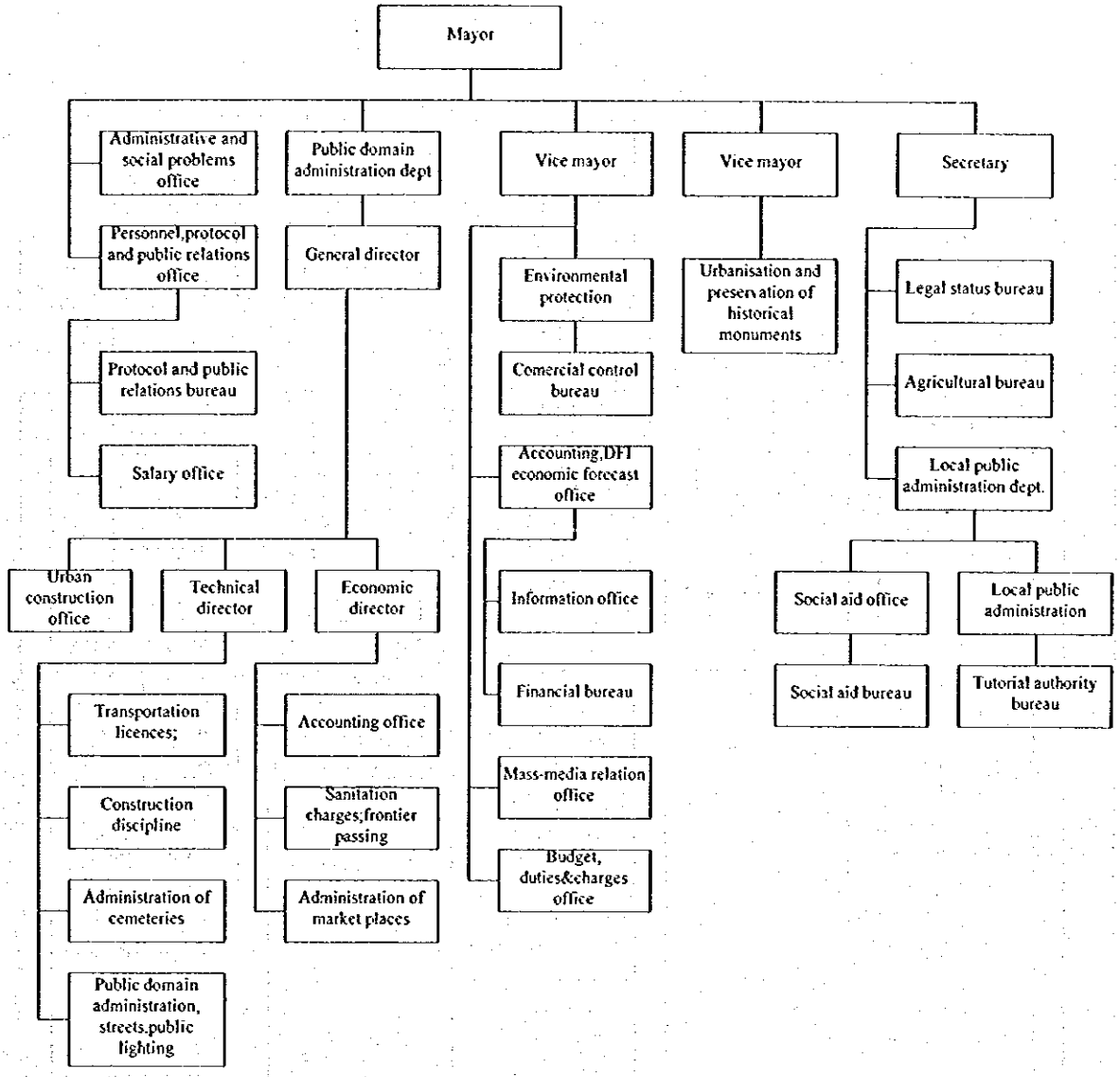


Figure II.1.12 | **Organization Chart of Giurgiu City Office**

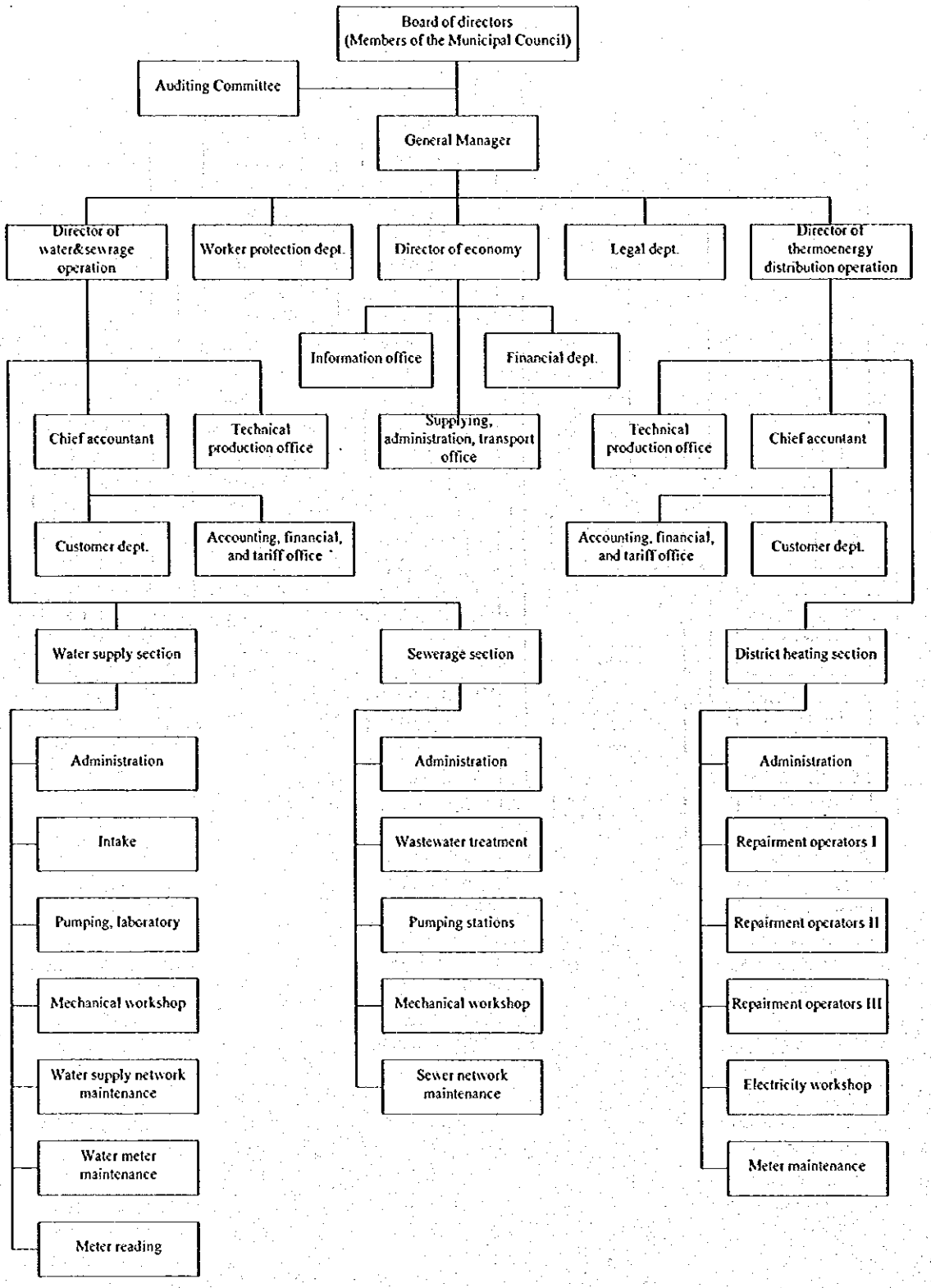


Figure II.1.13 | **Organization Chart of S.C. AQUA TERM S.A.**

As shown in the table below, out of the city's total income budget of ROL 42,218 million in 1999, 58.3% came from its own sources and the balance of 41.7% was the transfer from the central government (most of which consists of the above-mentioned quota).

Regarding the expenditure budget, capital expenditure, which is spent for the economic development of the city accounted for 21.4%.

35.9% of the expenditure budget went to "Services and Public Development, Dwellings, Environment and Water" which includes the sewerage sector, followed by "Social-Cultural" with 31.2%.

Table II.1.39 Breakdown of Local Budget for 1999

Item	Amount	Ratio (%)
Total Income	42,218,000	100.0
1. Own Income	24,625,696	58.3
2. Money from State Income Budget	17,592,304	41.7
3. Subsidy	0	0.0
Total Expenditure	42,218,000	100.0
1. Current Expenditure	32,790,919	77.7
1) Personnel	4,704,871	11.1
2) Services and Materials	15,019,727	35.6
3) Subsidies	11,484,599	27.2
4) Transfer	1,581,322	3.8
5) Interest	400	0.0
2. Capital Expenditure	9,047,000	21.4
3. Financial Operations	17,600	0.0
4. Reserves	362,481	0.9

Source: Giurgiu City (Unit: 1,000 ROL)

Table II.1.40 Breakdown of Local Expenditure for 1999

Item	Amount	Ratio (%)
Total Expenditure	42,218,000	100.0
1. General Public Services	7,035,972	16.7
2. Social-Cultural	13,168,289	31.2
3. Services and Public Development, Dwell ings, Environment and Water	15,153,493	35.9
4. Economic Activities	4,700,000	11.1
5. Other Activities	1,779,765	4.2
6. Guarantee and Redistribution Funds	0	0.0
7. Transfer	0	0.0
8. Loans Granted	0	0.0
9. Payment of Interest	400	0.0
10. Repayment of Loans	17,600	0.0
11. Reserve Funds	362,481	0.9
12. Special Destination Expenditure	0	0.0
13. Surplus/Deficit	0	0.0

Source: Giurgiu City (Unit: 1,000 ROL)

(5) Financial Conditions of S.C. AQUA TERM S.A.

S.C. AQUA TERM S.A. provides water supply, sewerage services and steam to the citizens.

Since the beginning of 1998 up to now water and sewerage tariffs were revised 7 times, as shown in *Table II.1.41*. It may show how hard S.C. AQUA TERM S.A. has been trying to make both ends meet. As economic tariffs stay static, domestic tariffs are increasingly approaching their levels.

As of May 6, 1999 the sewerage charges for domestic and industrial customers are ROL 605 and ROL 855 respectively. Water tariffs are 2 to 3 times greater than sewerage tariffs.

Table II.1.41 Water and Sewerage Tariff

Item	Water Supply		Sewerage	
	Domestic	Economic	Domestic	Economic
Jan. 1, 1998	710	1,545	270	720
Feb. 1, 1998	775	1,685	295	785
Apr.1, 1998	845	1,835	320	855
Jun. 19, 1998	900	1,956	320	855
Oct. 21, 1998	985	1,956	361	855
Feb.8, 1999	1,053	1,956	385	855
Mar. 10, 1999	1,451	1,956	538	855
May 6, 1999	1,677	1,956	605	855

Source: S.C. AQUA TERM S.A. (Unit: ROL/m^3)

The total volume of wastewater discharged into sewerage was 7,317,000 m^3 in 1998. It occupied 65.9% of the total volume of water supply. The income from sewerage services came to ROL 3,156 million in the same year. It corresponded to about one fourth of the income from water supply.

Table II.1.42 Income from Water Supply and Sewerage Service for 1998

	Total Volume (1,000 m^3)	Total Income (1,000 ROL)
Water	11,101	12,287,779
Sewerage	7,317	3,155,545

Source : S.C. AQUA TERM S.A.

The total volume of wastewater discharged into sewerage was 3,659,000 m^3 in the 1st half of 1999. The volume of sewage was 71.1% of that of water in the same period. The income from sewerage services came to ROL 2,055 million. It corresponded to 27.5% of the income from water supply.

Table II.1.43 Income from Water Supply and Sewerage Services for 1st Half of 1999

Item	Total Volume (1,000 m^3/year)	Total Income (1,000 ROL)
Water	5,148	7,482,663
Sewerage	3,659	2,054,502

Source: S.C. AQUA TERM S.A.

S.C. AQUA TERM S.A. earned ROL 2,055 million, while it spent ROL 1,999 million, begetting a surplus of 2.7% in sewerage services in the 1st half of 1999. It also obtained a surplus of 10.1% in water supply, combinedly making a substantial profit of 8.5%.

It earned ROL 3,156 million, while it spent ROL 3,423 million, suffering a loss of 8.5% in sewerage services in 1998. It also showed a deficit of 5.8% and 7.4% in 1996 and 1997.

Table II.1.44 Financial Performance of Water Supply and Sewerage Services

Item		1996	1997	1998	1st Half of 1999
Water Supply	Income	3,622,157	8,679,672	12,287,779	7,482,663
	Expenditure	3,907,991	9,633,584	13,684,842	6,728,684
	Profit	-285,834	-1,253,912	-1,397,063	753,979
	Profit Rate (%)	-7.9	-14.4	-11.4	10.1
Sewerage	Income	995,658	2,354,723	3,155,545	2,054,502
	Expenditure	1,069,460	2,491,460	3,422,578	1,998,894
	Profit	-73,802	-136,737	-267,033	55,608
	Profit Rate (%)	-7.4	-5.8	-8.5	2.7
Total	Income	4,617,815	11,034,395	15,443,324	9,537,165
	Expenditure	4,977,451	12,125,044	17,107,420	8,727,578
	Profit	-359,636	-1,090,649	-1,664,096	809,587
	Profit Rate (%)	-7.8	-9.9	-10.8	8.5

Source: S.C. AQUA TERM S.A. (Unit: 1,000 ROL)

The cost of sewerage services per m³ of sewage was ROL 468 in 1998. Out of it, "Personnel" and "Electricity" accounted for 43.2% and 28.8% respectively. They were followed by "Depeciation" with 8.3% and "Materials" with 7.1%. Personnel, energy and depreciation appear to be the major three cost components. In water supply, three important cost items seem to be energy, personnel and materials.

The cost of sewerage services per m³ of sewage was ROL 559 in the 1st half of 1999. Out of it, "Personnel" and "Electricity" accounted for 49.7% and 25.4% respectively. They were followed by "Depeciation" with 10.6% and "Materials" with 7.3%. Personnel, energy and depreciation appear to be the major three cost components. In water supply, three important cost items seem to be energy, personnel and materials.

Table II.1.45 Unit Expenditure for Water Supply and Sewerage Services

Item	1998		1st Half of 1999	
	Water	Sewerage	Water	Sewerage
Materials	113	33	161	41
Electricity	537	135	592	142
Duties and Taxes	6	6	67	13
Personnel	307	202	460	278
Payment for Services by Other Companies	48	6	106	7
Depreciation	37	39	60	59
Others	185	49	38	19
Total	1,233	468	1,484	559

Source : S.C. AQUA TERM S.A. Unit: 1,000 ROL/ m³

During the three years 1996 to 1998 the total income of S.C. AQUA TERM S.A. grew 2.9 times from ROL 11,013 million to ROL 32,094 million at the average annual rate of 70.7%. It ran into a deficit of 27.1% across the three sectors last year. Also, it consecutively lost in the preceding two years. The collection efficiency of the 60% level might be responsible for it.

Table II.1.46 Planned Budget of S.C. AQUA TERM S.A. for Last 3 Years

Item	1996	1997	1998	%
Total Income	11,013,417	20,429,363	32,093,766	100.0
Total Expenditure	11,798,775	26,932,847	40,803,156	127.1
Materials	954,678	1,946,151	3,330,864	10.4
Energy	6,709,658	17,004,488	23,398,013	72.9
Depreciation	663,260	1,329,812	1,386,747	4.3
Works done by Other Companies	75,255	164,452	165,028	0.5
Salaries	3,144,808	6,306,740	8,335,329	26.0
Insurance and Social Protection	10,323	78,039	144,927	0.5
Others	240,793	103,165	4,042,248	12.6
Profit	-785,358	-6,503,484	-8,709,350	-27.1
Profit Rate	-7.1	-31.8	-27.1	

Source : S.C. AQUA TERM S.A. Unit: 1,000 ROL

The efficiency of the collection of water and sewerage charges in recent years was 58% to 69.46%, as shown below.

Table II.1.47 Waster and Sewerage Charges Collection Efficiency

Item	1996	1997	1998	1st Half of 1999
Collection Rate	69.46 %	60.51 %	62.29 %	58 %

Source: S.C. AQUA TERM S.A.

The following things are essential to work out a sustainable financial plan on sewerage services.

- Estimation of the willingness and affordability of the households to pay sewerage charge to clarify the extent and limit of household income allocable to it.
- Incorporation of the actual collection efficiency in formulating income budget and cost analysis to realize proper level of cost per unit volume of sewage.
- Preparation of funds statement and balance sheet besides income statement in order to assure a long term profitability and solvency.

1.2.4 WATER SUPPLY

The total population of the city is about 73,260 in 1998. The population served by the municipal water supply is 52,925, thus its population coverage ratio is about 72 %. The remaining 20,335 of dwellers live in individual houses have their own wells. The service of supplying both water and heated water is provided by Water Corporation, called S.C. Aquaterm S.A.

Annual water supply volume is 15,026,400 m³/year in 1998, thus the daily average supply volume is estimated about 41,170 m³/day. The breakdown is as follows:

- Domestic water for flats; 7,323,492 m³/year (20,070 m³/day)
- Domestic water for individual houses; 900,165 m³/year (2,470 m³/day)
- Industrial water; 2,877,368 m³/year (7,880 m³/day)
- Un-accounted water loss and Leakage; 3,925,375 m³/year (10,750 m³/day)

Water source for the public water supply system is groundwater only. There are existing 57 wells located 5 - 9 km far from the city. 19 wells are deep-wells having depth of 600 m to 800 m but only 15 deep-wells are operating because the production of four wells is decreased and the water consumption is also not increased. The remained 38 wells are shallow wells having depth of 18 to 30 m.

The original design water capacity of water supply system was 3,319 m³/h (79,700m³/day), but actually the operational capacity was only 41,200 m³/day. And after German pumps were introduced, the water supply capacity was increased to 2,610 m³/day (62,640 m³/day).

The water is distributed to the consumer directly by two pumping stations. One is called "Pump station I" is located near the separation point of the railways in the north of urban area, and the other is called "Pump Station II" is located in the west of urban area. According to the interview conducted on March 1999, the total capacity of the pumping stations is 5,120 m³/h (122,880 m³/day).

The water mains and distribution pipes are made of steel ranging from 100 to 500 mm in diameters, cast iron ranging from 200 to 350 mm in diameters, and asbestos cement ranging from 350 to 400 mm in diameters. The steel pipes are mostly used and then cast iron and asbestos cement pipes are also used.

Currently, there is no available future plan of water supply system.

1.2.5 SEWERAGE SYSTEM

The city has developed a separate sewerage system since 1952. The main components of system are as shown in *Figure II.1.11*.

Wastewater generated is collected by sanitary sewers, conveyed by trunk sewers through two pumping stations and finally treated at a WWTP. The first trunk sanitary sewer having diameter of 1200 mm to 1500 mm was constructed in 1955.

Wastewater treatment plant was originally constructed by a textile company in 1970, and then the plant was transferred to the Public Water Corporation, called AQUA TERM, in 1974. The following primary wastewater and sludge treatment facilities were designed in 1974 and constructed between 1974 and 1979: one unit of primary sedimentation tank (30 m in diameter), two units of anaerobic digesters (500 m³ x 2 units), one unit of gas storage tank, 10 units of sludge drying beds and an administration building. But the anaerobic digesters and the gas holder have never been used, because it was found that the digesters were not airtight enough to operate properly due to poor construction.

The expansion of WWTP was planned and the plan was prepared by PROED in 1982. The following facilities were constructed between 1982 and 1984 and commissioned in 1984: screening with mechanical screens removal equipment, grit chamber, distribution chamber, one unit of primary sedimentation tank (30 m in diameter), one unit of anaerobic digester having volume of 1,500 m³ and six units of sludge drying beds. But since the operation of grit removal equipment was completely stopped due to the mechanical trouble. The sludge was drawn from the sedimentation tanks and dewatered at sludge drying beds directly without any digestion. The additional anaerobic digester had never been used after the construction due to the same reasons for the first anaerobic digester.

Regarding storm-water management, the city developed storm-water sewers simultaneously with the construction of sanitary sewers. Therefore, the storm-water is collected by the storm-sewers and kept at storage ponds and finally discharged to the Danube River by pumps installed at the storage ponds. There are five storage ponds equipped with pumps in the city as follows: SP4 (constructed in 1970), Tineret (1970), Fabrica de Zahar (1976), Berzei (1976) and Negru Voda (1978). The city had an experience of floods in 1942 and 1954, but it has never experienced floods after a dam was constructed in the upstream.

The locations of existing two pumping stations for wastewater, five storm-water storage ponds with pump equipment and WWTP are shown in *Figure II.1.11*.

(1) Present Wastewater Management

The existing sewerage system is shown in *Figures II.1.14 and II.1.15*. The diameter of sewers ranges from 200 to 1,400 mm but the maximum diameter of circular pipe is 800 mm. The collected wastewater is conveyed by two pumping stations to WWTP and is treated at primary level.

The pumping station named "SP3" receives the wastewater generated in a low lying area and pumps it up to the next pumping station, SP0, with a pressure main having diameter of 400 mm and length of 9.5 km. The SP3 was constructed in 1975 near the storm-water pumping station of SP4. Four (4) umps are installed in a dry well, each pump has capacity of 250 m³/h and total head of 35 m. Because the pumps installed have enough capacity, only one pump is operated intermittently depending on the flowrates of incoming wastewater.

Another pumping station, SP0 receives about 70 to 80 % of wastewater generated in the city and pumps it up to the WWTP with a pressure main having diameter of 600 mm and length of 1.1 km. The following figure shows the plan of pump facilities installed in three separated pump houses.

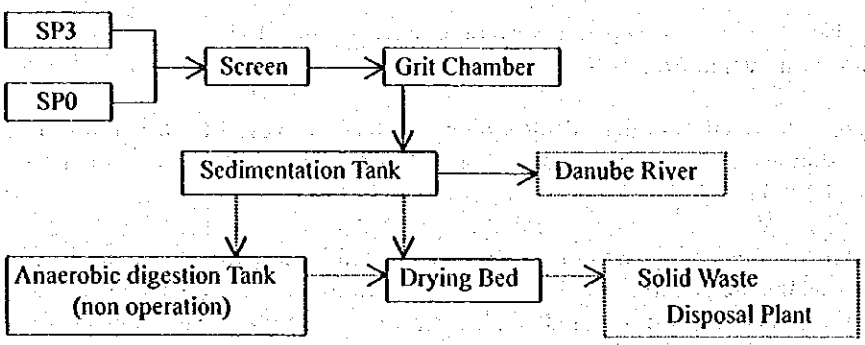


Figure II.1.16 Plan of Pumping Facilities

Firstly, three pumps having each capacity of 250 m³/h and total head of 35 m were installed in 1963, but now these pumps are not operated due to some problems in pipes. Other two pumps having each capacity of 700 m³/h and total head of 35 m were installed in 1986. One of the two pumps is operated continuously, and the other starts its operation when the wastewater level at the wet well exceeds a set level. The wastewater level is monitored manually and the second pump is also controlled manually. In addition, the following pumps are in progress to install by the end of this year: two pumps having each capacity of 600 m³/h and total head of 35 m and one pump having capacity of 400 m³/h and total head of 35 m.

The WWTP is located in the eastern part of the city and is surrounded by both a railway and a road connected to the bridge crossing the Danube River to Ruse city in Bulgaria. The layout of the existing facilities is presented in *Figure II.1.17*. The design capacity of the plant is 0.5 m³/s (43,200 m³/day) and actual treatment is about 25,000 m³/day in average. The WWTP has the area of 30.3 ha.

The existing facilities are composed of screening with mechanical screens removal equipment, grit chamber with mechanical sand removal equipment, distribution chamber, two unit of primary sedimentation tank having 30 m in diameter, anaerobic digesters; two units having volume of 500 m³ each and one unit having volume of 1,500 m³, and sixteen units of sludge drying beds. But the operation of equipment of screen and grit removal was completely stopped due to the mechanical trouble. Since the anaerobic digesters have never been used after construction due to poor construction, the primary sludge generated from the sedimentation tanks is only dewatered at sludge drying beds and finally disposed of at solid waste dumping site.

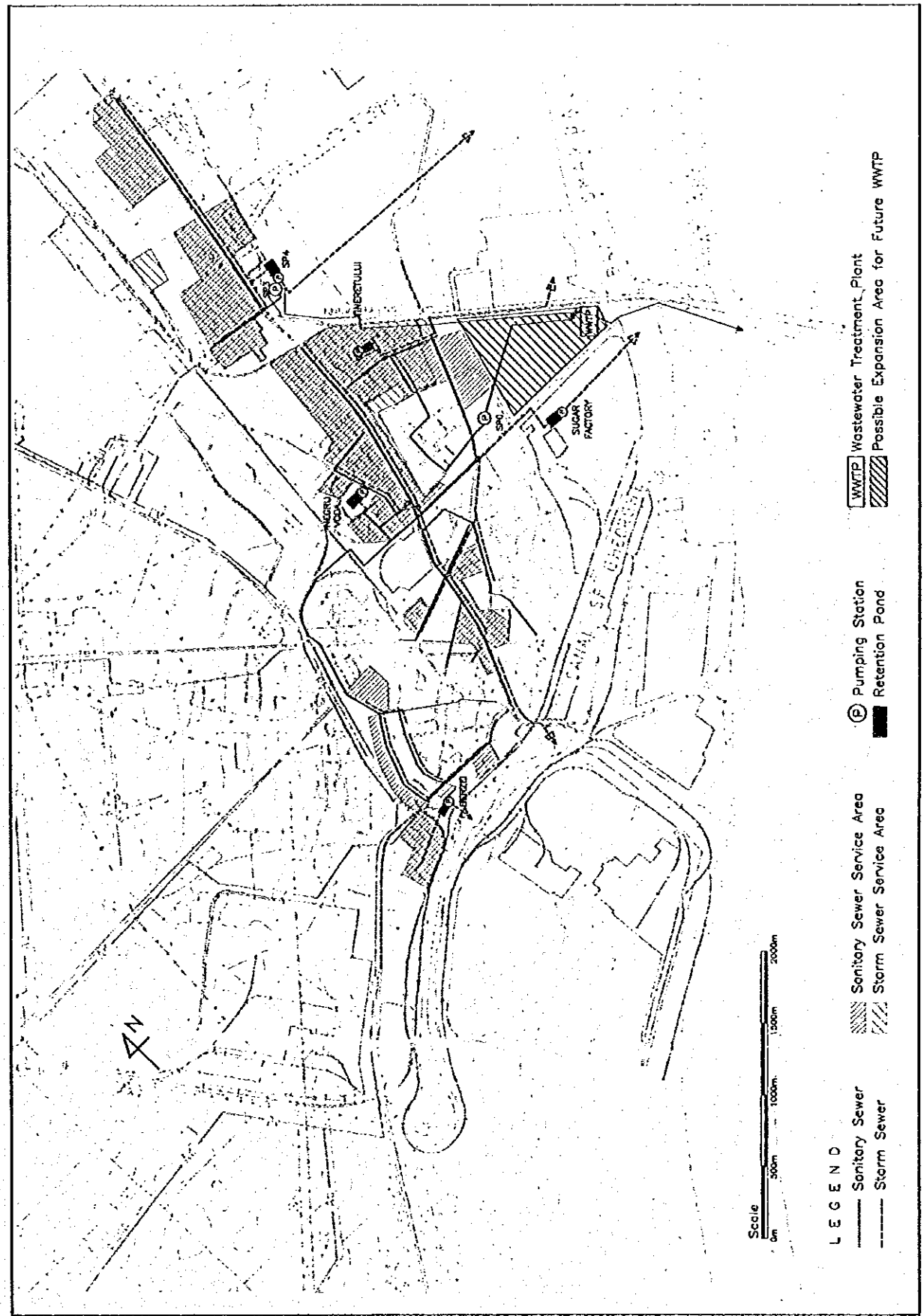


Figure II.1.14	Existing Sewerage System of Giurgiu

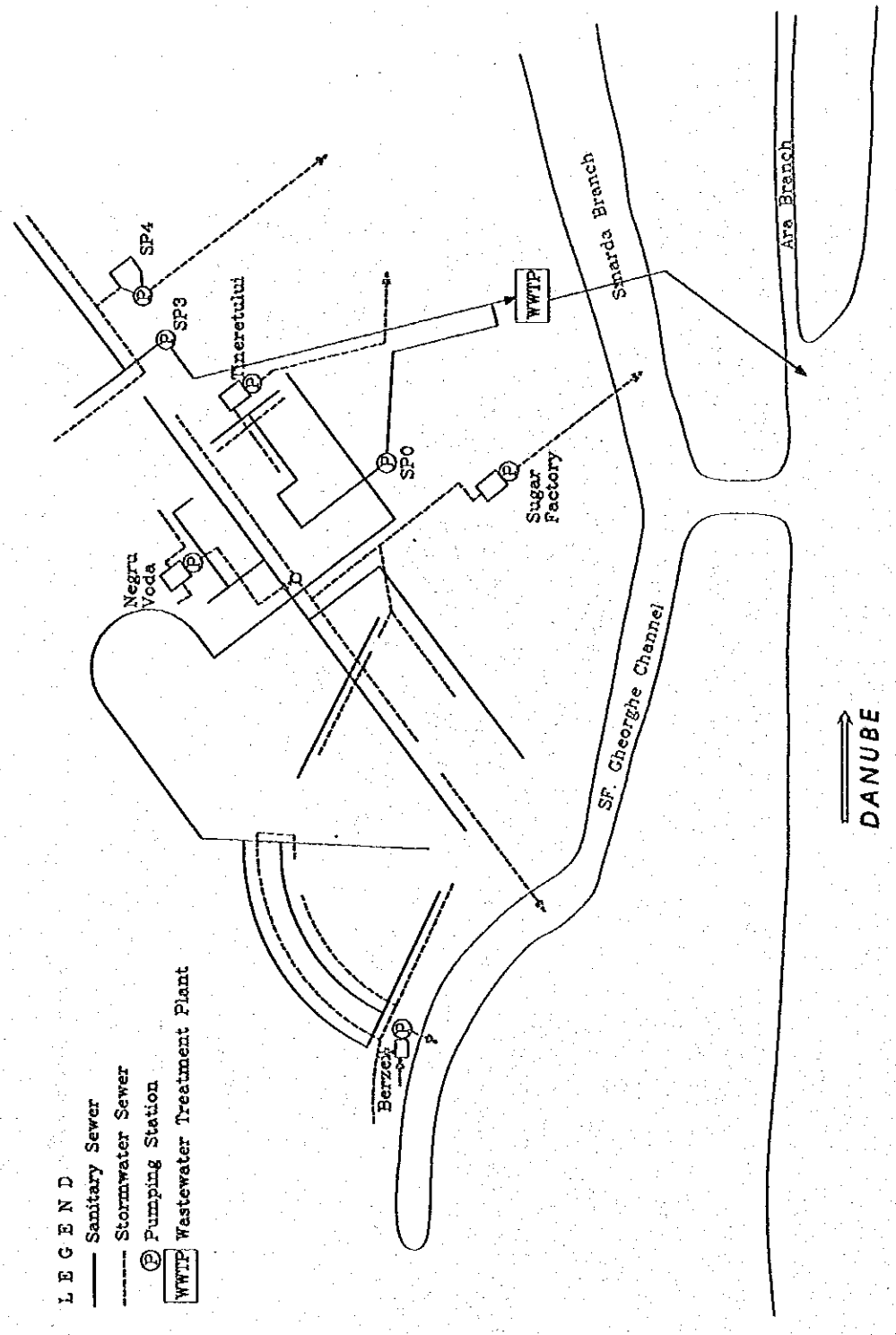
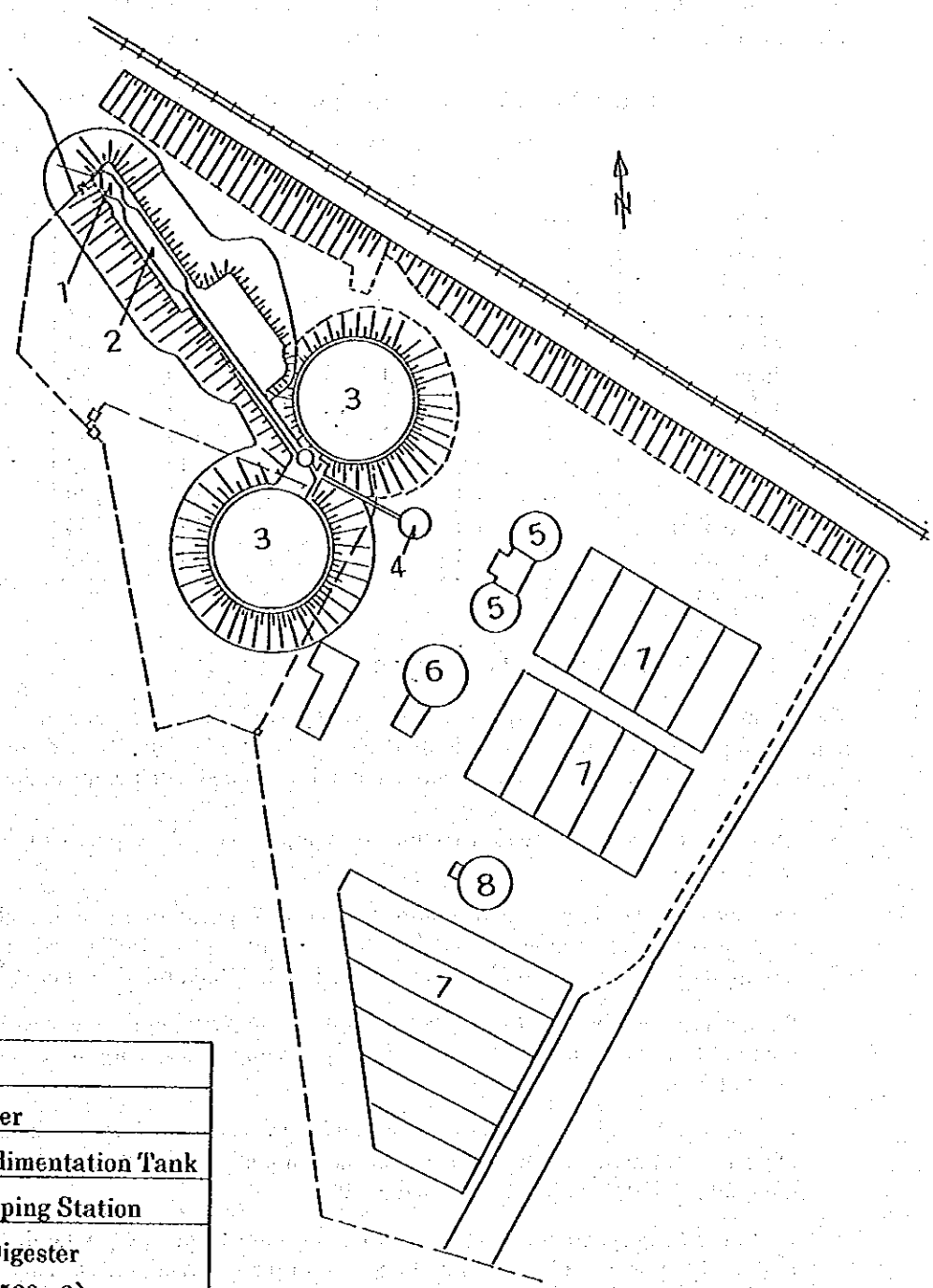


Figure II.1.15	Schematic Representation of Giurgiu Sewerage System



1	Screening
2	Grit Chamber
3	Primary Sedimentation Tank
4	Sludge Pumping Station
5	Anaerobic Digester (Volume : 500m3)
6	Anaerobic Digester (Volume : 1,500m3) no operation
7	Drying Bed
8	Gas Tank

Figure II.1.17 Layout of Existing WWTP in Giurgiu

The water quality records of influent and effluent at the WWTP are summarized in the following table. It shows that BOD_5 in the raw wastewater is very low as 15 to 30 mg/L.

Table II.1.48 Water Quality Records at the WWTP in 1998

	pH		BOD5 (mg/L)		SS (mg/L)		Flowrate
	Inf.	Eff.	Inf.	Eff.	Inf.	Eff.	(m^3/s)
January	8.0	7.4	16	13	99	74	0.45
February	7.5	7.3	17	12	107	75	0.45
March	7.5	7.2	15	12	111	80	0.47
April	7.0	7.2	17	12	118	87	0.52
May	8.0	7.3	14	11	113	83	0.50
June	7.5	7.2	15	11	120	86	0.50
July	3.0	7.2	14	12	114	84	0.50
August	3.1	7.3	17	12	119	87	0.52
September	3.8	2.8	16	13	147	113	0.53
October	3.6	7.3	18	15	170	129	0.55
November	5.1	7.3	27	21	159	144	0.48
December	5.2	7.5	31	27	295	180	0.47

Source : S.C. AQUA TERM S.A.

(2) Present Storm-water Management

The storm-water is collected by the storm-sewers having diameters ranging from 300 to 1400 mm and kept at storage ponds and finally discharged to the Danube River by pumps installed at the storage ponds. There are five (5) storage ponds equipped with pumps in the city as follows:

- PS 4; commissioned in 1975, two units of pumps having the capacity of 700m^3/h and total head of 15m.
- PS Negru Vorda; three units of pumps having the capacity of 150m^3/h each and total head of 25m (two units commissioned in 1986 and one unit in 1999), and one unit of pump having the capacity of 250m^3/h and total head of 35m (commissioned in 1984).
- PS Tineret: commissioned in 1972; one unit of pump having the capacity of 150 m^3/h and the total head of 25 m and two units of pumps having the capacity of 700 m^3/h and the total head of 25 m.
- PS Pluviale Berzei: two units of pumps having the capacity of 150 m^3/h and the total head of 25 m (commissioned in 1989) and one unit of pump having the capacity of 250 m^3/h and the total head of 35 m (commissioned in 1991).
- PS Sugar Factory: commissioned in 1987; two units of pumps having the capacity of 150 m^3/h and the total head of 25 m and one unit of pump having the capacity of 700 m^3/h and the total head of 25 m.

(3) Operation and Maintenance

The sewerage system including storm-water management is operated and maintained by 80 staff in total as follows: one (1) engineer, two (2) chief, and 77 workers including eight (8) mechanics. In detailed, for sewer networks, 29 persons, for mechanical workshop, eight (8) persons, for pumping Station, SP0; 15 persons, and for WWTP, 16 persons; one (1) Chief, six (6) mechanics, one (1) electrician, four (4) water quality analysts, and four (4) laborers.

(4) Present Problem

The influent BOD_5 concentration is very low as 15 to 30 mg/L, so that the treatment of

wastewater must be very difficult with the ordinary suspended solid type biological wastewater treatment processes. The reasons of the low BOD_5 should be assessed and identified and then counter-measures should be considered.

It was observed that some domestic and industrial wastewaters are discharged to the storm-sewer and finally reached to the storage ponds for storm-water management even though under dry weather conditions. The storage ponds are contaminated heavily and become anaerobic conditions. The pollutants at the storage ponds are flushed out to the receiving water bodies finally during wet weather conditions. In case of SP4, one storm-water pump operates four or five hours a day to discharge the wastewater even if under dry weather conditions, and wastewater including some oil is also reached to the storage ponds.

Anaerobic digesters constructed in the WWTP have never been used due to the poor construction. Equipment for removing screens and grits is also left without repairs. To operate the facilities properly and maintain the original functions, it is required urgently to rehabilitate or renew the wastewater treatment facilities.

(5) Future Plan

The future expansion of sewerage system was planned and a F/S report was prepared by PROED in 1993. The design flowrate is 82,000 m^3/day as of daily maximum flow and 98,500 m^3/day as of hourly maximum flow. The influent (raw wastewater) quality for the design purpose is set at 237 mg/L as of BOD_5 and 256 mg/L as SS. The target value of treated wastewater quality is 60 mg/L as of BOD_5 and 100 mg/L as of SS to comply the regulation of STAS 5180/88. To comply with the treated wastewater, a secondary wastewater treatment is needed. The planned wastewater treatment method is a conventional activated sludge process with the sludge anaerobic digestion processes. The outline of treatment facilities proposed is summarized in the table below.

Table II.1.49 Outline of Proposed Facilities at Giurgiu WWTP

Facilities	Main Features	Number	Remarks
Wastewater Treatment			
Screening	Wide: 1.6m, Length: 4.0m	3 units	With mechanical cleaning equipment
Grit Chamber	Wide: 1.45m, Depth: 2.5m,	2 units	
Skimming tank for grease removal		1 unit	With aeration
Primary Sedimentation Tank	Dia: 35m, Volume:5,060m3	3 tanks	
Aeration Tank	Volume: 11,340m3	10 tanks	Axial aerator, 3.3hr
Secondary Sedimentation Tank	Dia: 45m,	2 tanks	Retention time: 2.18 hr
Sludge Treatment			
Gravity Thickener	Dia: 25 m	1 tank	
Anaerobic Digester	Volume: 15 m3	2 units	Retention time: 20 days
Mechanical Dewatering	Filter Press	5+1 units	
Sludge Pumps		2+1 pumps	

Source: F/S Report in Dec. 1993

1.2.6 SANITATION CONDITION

The wastewater generated in the area where no provision of public sewerage service is managed by on-site sanitation systems. The black water is mainly treated by septic tank system having the tank volume of 4 to 8 m^3. The septage is collected once every two months by vacuum tracks running by S.C. AQUA TERM S.A. The collected septage is disposed of into the sewer near the pumping station SP0, then finally treated at the wastewater treatment plant. In case of

wastewater generated in small factories, the wastewater is treated by the septic tank system and then the septage is also collected and disposed of to the sewerage system.

Three (3) vacuum trucks (2 trucks having capacity of 8 m³ each and one truck having capacity of 4m³) collect and transport the septage. Total 10 staff is working for the septage service; three staff is drivers and seven staff is workers. The present tariff for collection of septage as of February 1999 is set as follows: domestic purpose; 28,500 ROL/m³, commercial and industrial purposes; 38,830 ROL/m³, and public purposes such as hospitals and schools; 38,830 ROL/ m³. These charges are exclusive of VAT.

1.2.7 SOLID WASTE

The solid wastes are collected and finally disposed at dumping site. The management is carried out by the public corporation called "S.C. Salubris S.A." It owns the following vehicles to collect and transport the wastes: four special trucks (three trucks having the capacity of 12m³ and one truck having the capacity of 8 m³), four trucks having the capacity of 4 m³, and eleven tractors having the capacity of 4 m³. The working staff is 98 in total including 13 drivers and workers at solid wastes disposal site. The present tariff for collection of solid wastes as of February 1999 is set as follows: domestic purpose; 4,500 ROL/capita/month for residents living in flats and 6,650 ROL/capita/month for residents living in individual houses, commercial and industrial purposes; 91,225 ROL/m³, and small farms, 17,650 ROL/head/month for cow, ox and horse, 4,500 ROL/head/month for pig and 3,550 ROL/head/month for sheep and goat. These charges are exclusive of VAT.

1.3 TURNU MAGURELE

1.3.1 GENERAL

Turnu Magurele City is located in the southern part of Romania, and bordered on Bulgaria by the Danube River. It is about 130 km southwest from Bucharest. The Olt River flows into the Danube River at the city. The general map of the city is shown in *Figure II.1.18*.

The city was established 120 years ago and the present administrative area is about 1,123 ha. The population is about 37,000 at present and is projected about 50,000 in the year of 2010.

Main industries are chemistry, electric devices, textile, furniture, food processing, commercial activities and agriculture. About 60 to 70% of the population work for these industries.

1.3.2 NATURAL CONDITIONS

(1) Climate and Temperature

The city belongs to a continental temperate zone. The main features of this climate are as follows: long daylight hours, large difference in temperature, showers in summer season, low precipitation, and low humidity throughout the year.

Annual precipitation is about 500 to 600 mm, and the monthly average is ranging from 36.6 mm in January to 69.7 mm in June. Average numbers of day of snow are 23 days a year.

Prevailing wind direction is from west to east. The average wind velocity is about from 3.5 to 4.6 m/s, while that from the east is about 2.7 to 4.5 m/s.

Annual average temperature is 11.2 °C, and the highest monthly average is 23.2 °C in July and the lowest monthly average is - 2.5 °C in January.

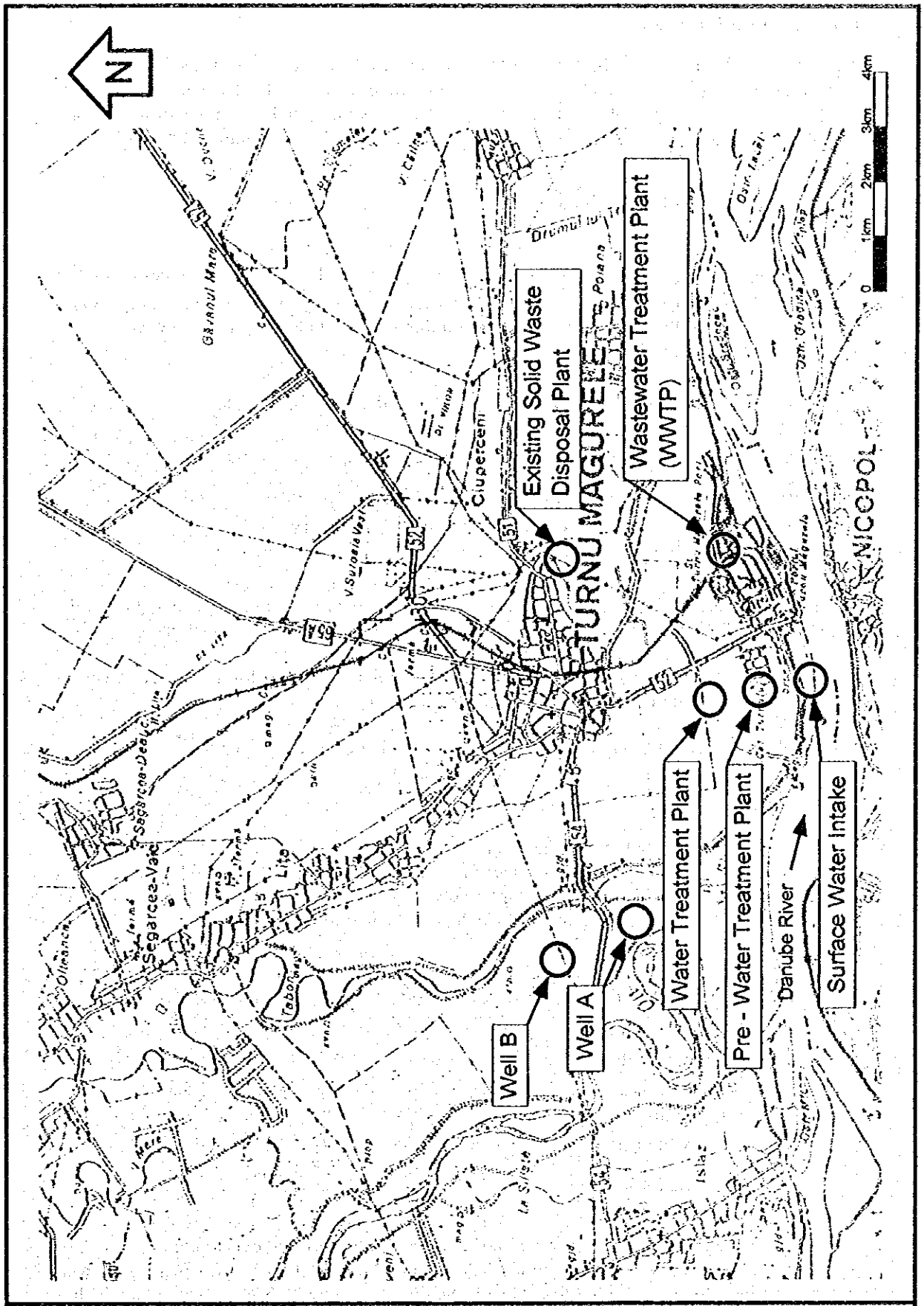


Figure II.1.18	General Map of Turnu Magurele City

(2) River Information

The water levels of the Danube River at the city are as follows: the high water level (HWL), 21.60 m; mean water level (MWL), 20.66 m; and low water level (LWL), 18.56 m. These water levels are above the mean of Black Sea Level. The maximum and minimum flow rates are 12,000 m^3/s and 5,500 m^3/s, respectively. The velocity is usually in the range of 0.5 to 2.1 m/s.

1.3.3 Socio-economic Conditions

(1) Population

As shown in the table below, the population of Turnu Magurele grew from 32,969 to 35,372 during the 8 years from 1982 to 1989, at the average annual rate of 1.0%. Since 1990, however, it has virtually stopped growing, maintaining the 36,000 level. These few years there seems to be a hint of a little growth.

Table II.1.50 Total Population of Turnu Magurele

1982	1983	1984	1985	1986	1987	1988	1989	1990
32,969	33,145	33,250	33,618	33,900	35,100	35,360	35,372	36,150
1991	1992	1993	1994	1995	1996	1997	1998	
36,492	36,587	36,596	36,401	36,334	36,580	36,725	37,122	

Source: Turnu Magurele City

The population of the city stood at 37,122 as of 1998. It is projected to grow to 47,000 in the target year of 2010. It means that it will grow from now on at the average annual rate of 2.0%.

It is crucial to make a reasonable projection of the population since it forms the very basis on which to plan and design the future sewage treatment plant.

The number of houses was 11,396 in 1998, with the number of members per house at 3.26.

(2) Industries

As shown in the following table, the number of workers in major fields totaled 8,680 in 1998. It is on a downward trend these years. Out of it, the primary, secondary and tertiary sectors accounted for 5.5%, 52.5% and 42.4% respectively. The predominance of the secondary sector is to be noted. Especially, the number of workers in the manufacturing industry reached 4,191, occupying 48.3% of the entire workforce.

Table II.1.51 Number of Workers in Major Fields by Type of Activities

Type of Activities	1995	1996	1997	1998	%
Primary Industry	620	560	500	480	5.5
Manufacturing	5,301	5,033	4,048	4,191	48.3
Construction	330	229	329	329	3.8
Tertiary Industry	2,656	2,635	3,830	3,680	42.4
Total	8,907	8,457	8,707	8,680	100.0

Source: Turnu Magurele City

As shown in the table below, "Chemical Industry" accounted for the overwhelming 59.5% of the workforce in the major manufacturing industry in 1998, followed by "Canned Food" with 14.3%, "Electric Engines" with 7.6%, "Textile Manufacturing" with 7.2%, "Bakery and Mills" with 6.7% and "Furniture" with 4.8%.

Table II.1.52 Number of Industrial Workers in Major Fields by Type of Industry

	1995	1996	1997	1998	%
Chemical Industry	3,200	3,100	2,106	2,492	59.5
Electric Engines	420	385	342	319	7.6
Textile Manufacturing	362	347	325	300	7.2
Furniture	390	386	395	200	4.8
Canned Food	651	532	600	600	14.3
Bakery and Mills	278	283	280	280	6.7
Total	5,301	5,033	4,048	4,191	100.0

Source: Turnu Magurele City

(3) Organization

The organization chart of Turnu Magurele city office is shown in *Figure II.1.19*.

Sewerage service is operated by R.A. SAGO. R.A. SAGO is a Regia Autonoma. R.A. SAGO has 385 personnel in total and operates water supply, sewerage, district heating, and garbage collection services. Technical part of the company consists of following sections.

- Water-sewerage section with 88 personnel,
- District heating section with 95 personnel, and
- Service section including garbage collections service with 65 personnel.

Among 88 personnel of water-sewerage section, 25 employees are working at wastewater treatment station and seven (7) employees are engaged in maintenance of sewer network.

The organization chart of R.A. SAGO is shown in *Figure II.1.20*.

(4) Financial Conditions of the City

As shown in the table below, during 6 years 1993 to 1999, the local budget of Turnu Magurele grew 31.8 times from ROL 706 million to ROL 22,485 million. Its average annual growth rate is calculated at 78.0%. During the same period, prices increased at the average annual rate of 62.4%. That is to say, the local budget increased in real terms by 9.6% per year on average. It is to be noted that the budget is decreasing these three years.

Table II.1.53 Total Amount of Budget

1993	1994	1995	1996	1997	1998	1999
706,417	1,719,679	5,876,180	7,382,508	30,236,258	27,237,842	22,485,059

Source: Turnu Magurele City Unit : 1,000 ROL

The local budget of Turnu Magurele for 1999 totals ROL 22,485 million, which is by 17.4% less compared with the budget for 1998, ROL 27,238 million.

Because of the new local finance law which was put into force in January, 1999, there is no subsidy from the central government any longer. Under the law, 31.5% of the tax on salaries goes directly to the local government. Also, 45% of this tax is allocated for the state income budget, of which a part is transferred to the local government through the county as the quota. This quota is different from the direct transfer from the state, but by nature is an addition to the above direct local tax on salaries. It occupies the majority of the transfer from the state income budget. That is, in principle almost all the income of the local budget now derives from its own sources. It in turn gives freedom to the local authorities to use the income in whatever way they deem proper.

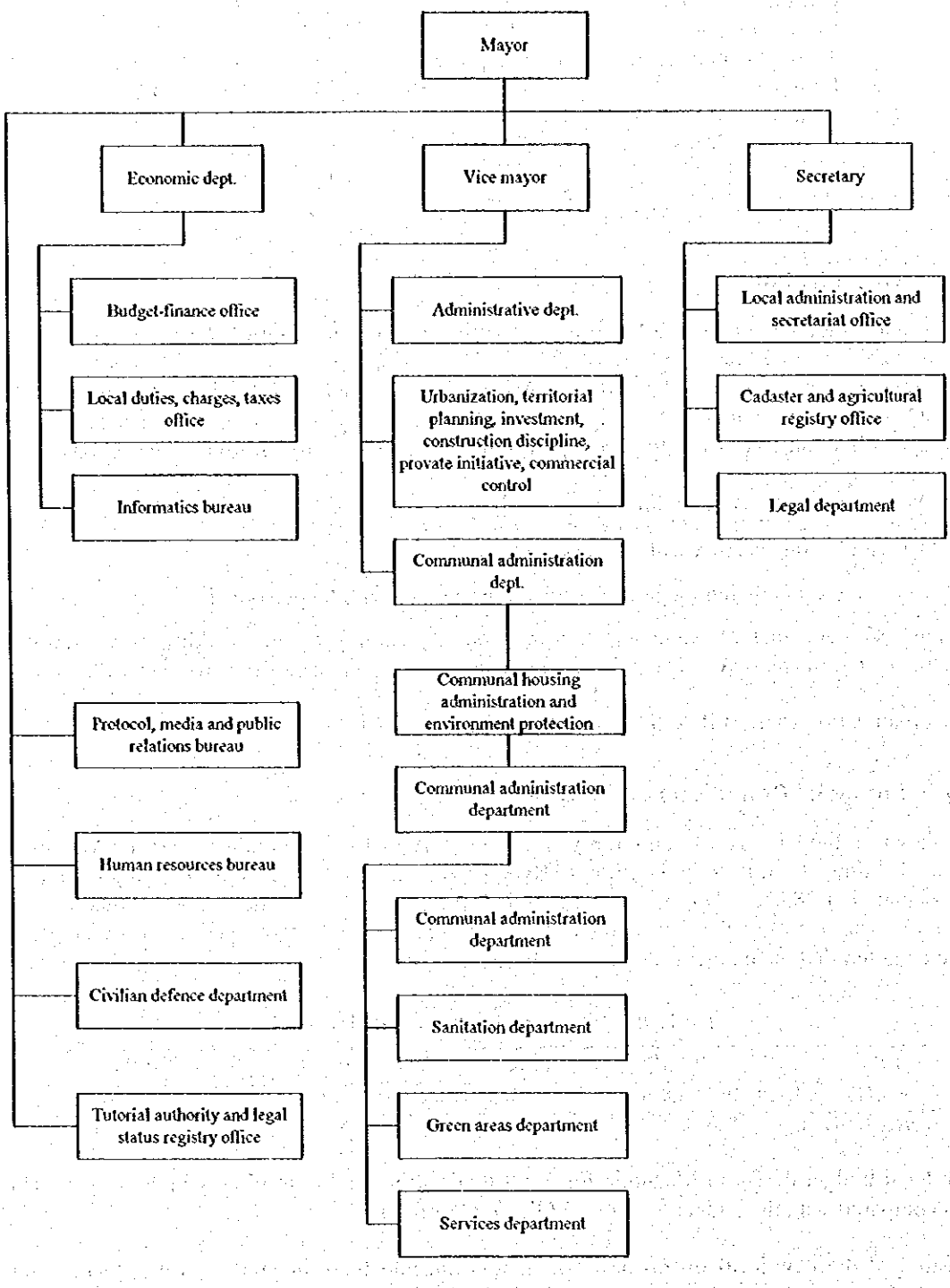


Figure II.1.19 **Organization Chart of Turnu Magurele City Office**

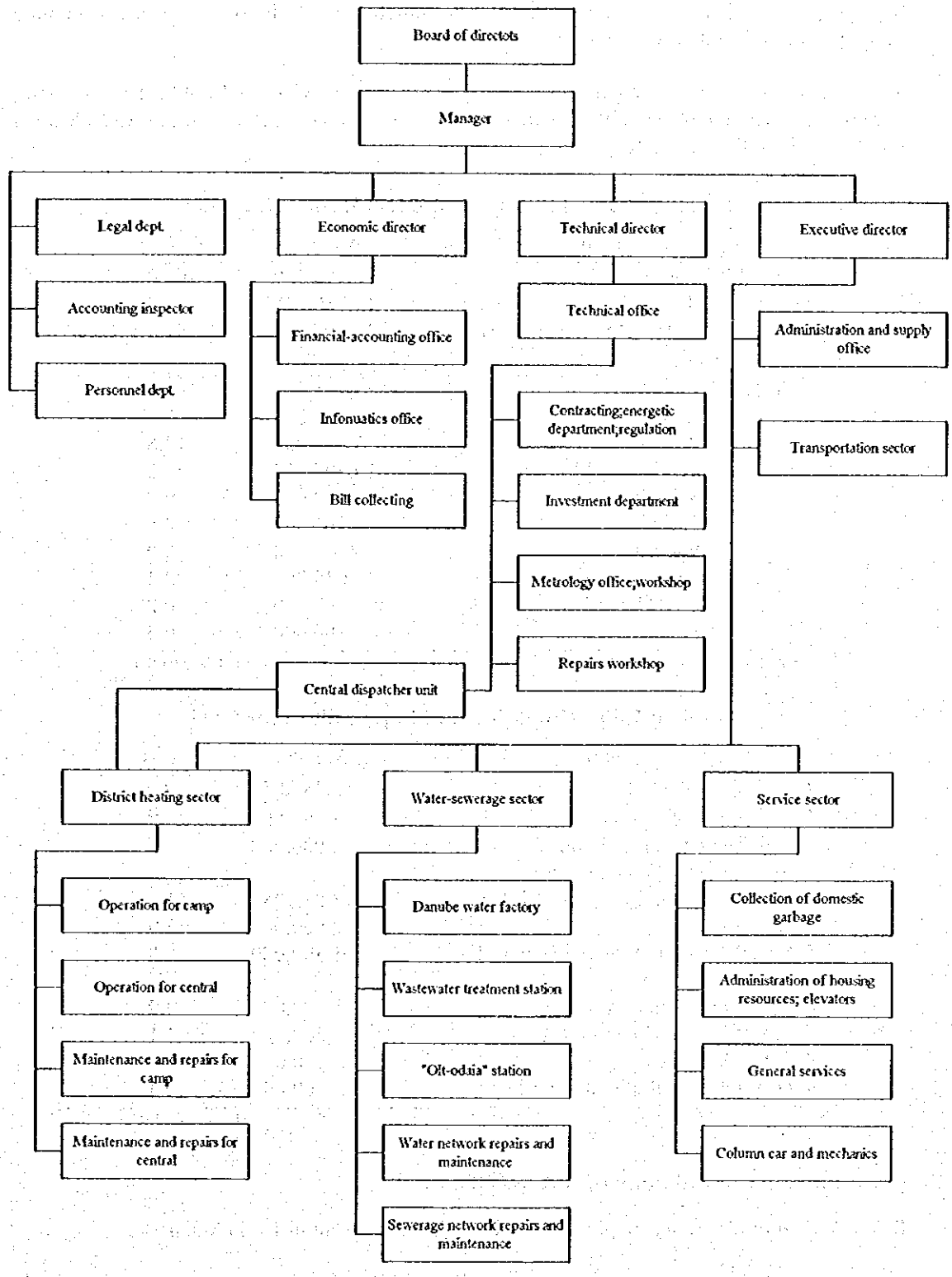


Figure II.1.20 | **Organization Chart of R.A. SAGO**

As shown in the table below, out of the city's total income budget of ROL 22,485 million in 1999, 52.8% came from its own sources, and the balance of 47.2% was the transfer from the central government (most of which consists of the above-mentioned quota).

Regarding the expenditure budget, capital expenditure, which is spent for the economic development of the city accounted for 22.4%.

61.5% or the majority of the expenditure budget went to "Services and Public Development, Dwellings, Environment and Water" which includes the sewerage sector. 16.9% was allocated for "General Public Services".

Table II.1.54 Breakdown of Local Budget for 1999

Item	Amount	Ratio (%)
Total Income	22,485,059	100.0
1. Own Income	11,880,348	52.8
2. Money from State Income Budget	10,604,711	47.2
3. Subsidy	0	0.0
Total Expenditure	22,485,059	100.0
1. Current Expenditure	17,350,059	77.2
1) Personnel	3,998,000	17.8
2) Services and Materials	10,597,059	47.2
3) Subsidies	2,190,000	9.7
4) Transfer	565,000	2.5
5) Interest	0	0.0
2. Capital Expenditure	5,035,000	22.4
3. Financial Operations	0	0.0
4. Reserves	100,000	0.4

Source: Turnu Magurele City (Unit: 1,000 ROL)

Table II.1.55 Breakdown of Expenditure for 1999

Item	Amount	Ratio (%)
Total Expenditure	22,485,059	100.0
1. General Public Services	3,790,000	16.9
2. Culture, Art and Religion	900,000	4.0
3. Services and Public Development, Dwell ings, Environment and Water	13,835,059	61.5
4. Education	2,000,000	8.9
5. Social Assistance, Social Benefit Fund and Indemnity	1,300,000	5.8
6. Agriculture and Forestry	200,000	0.9
7. Transport and Communications	250,000	1.1
8. Other Activities	110,000	0.5
9. Guaranty and Redistribution Fund	100,000	0.4

Source: Turnu Magurele City (Unit: 1,000 ROL)

(5) Financial Conditions of R.A. SAGO

R.A. SAGO provides water supply, sewerage services and steam in Turnu Magurele.

The existing tariffs of sewerage services are ROL 320/m³ for domestic customers and ROL 610/m³ for industrial customers. It is to be noted that the tariff for households is more than a half of that for establishments. The tariffs of sewerage services are about one third to one fourth of those of water supply.

Table II.1.56 Sewerage and Water Charges

Item	Domestic	Industrial
Water Charges (ROL/m³)	1,060	2,590
Sewerage Charges (ROL/m³)	320	610

Source: R.A. SAGO

As shown below, the total volume of wastewater discharged into sewerage was 4,234,000 m³ in 1998. It was slightly greater than the total volume of water supplied. It was due to an addition from industrial wastewater and rainwater. The income from sewerage services came to ROL 1,865 million in the same year. It corresponded to more than one third of the income from water supply.

Table II.1.57 Income from Water Supply and Sewerage Services for 1998

Year	Total Volume (1,000 m³)	Total Income (1,000 ROL)
Water	4,223	5,971,925
Sewerage	4,234	1,864,888

Source: R.A. SAGO

As shown in *Table II.1.58*, R.A. SAGO budgeted to earn ROL 1,865 million and to spend ROL 1,686 million, begetting a surplus of 9.6% in sewerage services last year. It also budgeted to make a profit of 14.8% and 3.4% in 1996 and 1997 respectively. Likewise, a certain extent of surplus was envisaged in water supply these three years.

Table II.1.58 Financial Performances of Water Supply and Sewerage Services

Item		1996	1997	1998
Water Supply	Income	1,402,731	4,147,130	5,971,925
	Expenditure	1,285,524	4,061,342	5,767,862
	Profit	117,207	85,788	204,063
	Profit Rate (%)	8.4	2.1	3.4
Sewerage Services	Income	539,516	1,327,933	1,864,888
	Expenditure	521,324	1,131,728	1,685,679
	Profit	18,192	196,205	179,209
	Profit Rate (%)	3.4	14.8	9.6
Total	Income	1,942,247	5,475,063	7,836,813
	Expenditure	1,806,848	5,193,070	7,453,541
	Profit	135,399	281,993	383,272
	Profit Rate (%)	7.0	5.2	4.9

Source: R.A. SAGO Unit: 1,000 ROL

The cost of sewerage services per m³ of sewage was budgeted to be ROL 398 in 1998, as shown in *Table II.1.59*. Out of it, "Personnel" and "Materials" accounted for 35.2% and 32.2% respectively. These two items combinedly accounted for more than two thirds of the total cost. In water supply, three important cost items seem to be energy, personnel and materials.

Table II.1.59 Unit Expenditure for Water Supply and Sewerage Services (1998)

Item	Water	Sewerage
Materials	156	128
Electricity	613	9
Duties and Taxes	8	0
Personnel	295	140
Payment for Services by Other Companies	44	2
Depreciation	72	15
Others	177	104
Total	1,365	398

Source: R.A. SAGO Unit: ROL/ m^3

During the three years 1996 to 1998 the total income of R.A. SAGO was budgeted to grow 2.7 times from ROL 10,083 million to ROL 27,568 million at the average annual rate of 65.3%. It planned to have a little surplus each year. The collection efficiency of the 40% to 50% level might have presented a major hurdle in attaining the budgeted target.

Table II.1.60 Budget for Water Supply and Sewerage Services for Last 3 Years

Item	1996	1997	1998
Total Income	10,083,093	25,490,050	27,567,504
Total Expenditure	10,071,408	25,378,698	27,171,565
Materials	549,639	8,947,497	4,657,102
Energy	6,718,734	10,300,274	11,830,600
Depreciation	349,206	400,250	1,044,367
Works done by Other Companies	106,187	350,040	919,575
Salaries	1,704,742	3,839,858	6,122,600
Insurance and Social Protection	528,946	1,190,356	2,096,990
Others	113,954	350,423	500,330
Profit	11,685	111,352	395,939
Profit Rate (%)	0.1	0.4	1.4

Source: R.A. SAGO Unit: 1,000 ROL

The efficiency of the collection of water and sewerage charges in recent years was 41.85% to 52.13 %, as shown below.

Table II.1.61 Water and Sewerage Charges Collection Efficiency

Item	1996	1997	1998
Collection Rate	52.13 %	48.70 %	41.85 %

Source: R.A. SAGO

The following things are essential to work out a sustainable financial plan on sewerage services.

- Estimation of the willingness and affordability of the households to pay sewerage charge to clarify the extent and limit of household income allocable to it.
- Incorporation of the actual collection efficiency in formulating income budget and cost analysis to realize proper level of cost per unit volume of sewage.
- Preparation of funds statement and balance sheet besides income statement in order to assure a long term profitability and solvency.

1.3.4 WATER SUPPLY

(1) General

The total population served by the municipal water supply system is about 21,500 which is equivalent to 58% of the total population of 37,000. The remaining 15,500 of population have their own wells or have an access to some groundwater sources. The administrative area of the city is 1,123 ha and the water service area is 618 ha. Therefore, the service area coverage is 55 % at present.

About 17,000 residents are living in flats, which are equivalent to about 80% of service population. About 60 % of the residents (about 10,200 residents) are measured by block (bulk) water meters. The remained 4,500 people is living in individual houses, but the water supplied is not measured. Heated water is also supplied by central heating system running by the corporation, the service is provided for 15 hours in summer season and 10 hours in winter season.

Per capita water supply volume is estimated for the metered population of about 10,200 living in flats as follows: 15 to 16 m^3/capita/month (500 to 530 L/capita/d), of which 11 to 12 m^3/capita/month (330 to 370 L/capita/d) is water and 5 m^3/capita/month (167 L/capita/d) is heated water from the municipal central system.

While the per capita water supply volume of non-metered service population is also estimated by the water corporation as follows: 13 m^3/capita/month (433 L/capita/d), of which 8 m^3/capita/month (267 L/capita/d) is water and 5 m^3/capita/month (167 L/capita/d) is heated water from the municipal central system.

The city has two water sources, one is the surface water of the Danube River and the other is groundwater. The surface water is the main water sources for the municipal water supply system, because the groundwater contains high concentration of iron and manganese. Therefore, the groundwater is considered as a emergency water source.

Maximum intake capacity from the surface water is 270 L/s (23,330 m^3/d). The daily water supply volume is 200 to 220 L/s (17,280 to 19,010 m^3/d) which is equivalent to about 75 to 80 % of maximum capacity. Domestic water supply volume is from 150 to 165 L/s (12,960 to 14,260 m^3/d) which is equivalent to 75% of the total supply volume. The non-domestic water supply volume is from 50 to 55 L/s (4,320 to 4,750 m^3/d) which is equivalent to 25 % of the total supply volume.

There are 26 wells at the western side of the city and the maximum intake capacity is 180 L/s (15,550 m^3/d). But the water volume taken from the wells have been reduced because the water demand of factories has been decreased due to economic recession. Therefore, three wells have not been operated for three years.

(2) Existing Facility

The water supply system from the intake to the treated water reservoir is illustrated as shown in *Figure II.1.21*. The water taken from the Danube River is conveyed to a pre-treatment plant first, where water is separated to convey to water treatment plant or to a chemical factory. At the water treatment plant, the water is treated by a rapid sand filtration method, comprised with pre-chlorination, coagulation, flocculation, sedimentation, rapid sand filtration, and post chlorination. The treated water is kept reservoir and finally distributed to each user by gravity flow through water distribution networks.

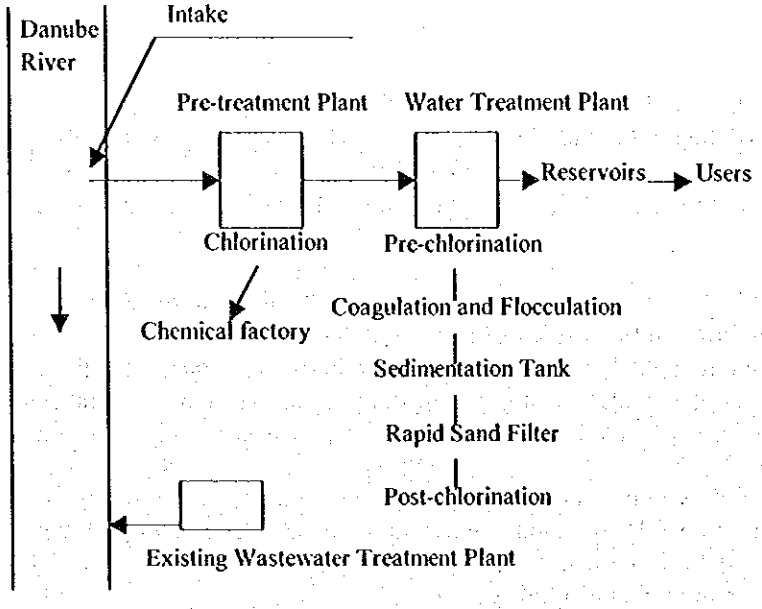


Figure II.1.21 Schematic Drawing of Existing Water Supply System

There are three distribution reservoirs in the city: two reservoirs having capacity of 3,000 m^3 and one elevated tank having the capacity of 750 m^3.

The water distribution pipes have been constructed since 1916, of which 75 % of the pipes made of cast iron. Since some of pipes have been used for more than 80 years, water leakage is increasing.

The present service charge for water supply is 1,060 ROL/m^3 for domestic purpose and 2,590 ROL/m^3 for industrial (non-domestic) purpose.

(3) Future Improvement Plan

It is understood that the rehabilitation and expansion of water pipe lines are required urgently. To this end, the city has a plan to conduct a study for the water supply improvements and is asking some supports to the Central government for arrangement of the cooperation of Austrian Government.

1.3.5 SEWERAGE SYSTEM

(1) General

The city of Turnu Magurele has developed a combined sewer system. Both wastewater and storm-water is collected and conveyed by gravity flow, so that there are no pumping stations for sewer networks.

Total sewerage service population is 19,500 at present, and thus the population coverage is about 53% of total population of 37,000. Among the service population, 17,000 people are living in flats and 2,500 people are living in individual houses.

Wastewater collection system was constructed from 1916 to 1985. The plan of WWTP was prepared in 1966. The following facilities were constructed from 1968 to 1969 by a chemical company: screening, pumping station (4 vertical pumps), vertical grit chamber, Imhoff tank and

five (5) sludge drying beds. These facilities were transferred to the public corporation called "S.A.G.O." in 1970.

A rehabilitation and expansion of the wastewater treatment plant was planned in 1976 and an implementation plan was prepared by PROED. Following facilities and equipment are constructed or replaced from 1978 to 1992: new construction/installation of Parshall flume, distribution chamber, circular sedimentation tank, four sludge drying beds and three pumps; replacement of four pumps and of vertical grit chamber with horizontal type.

(2) Existing Sewerage Facilities

Secondary collectors are 58.9 km in total length and have diameter ranging from 200 to 1,500 mm. Main interceptor is 1,200 mm in diameter and 6.5km in length. The shape of combined sewers is circular type or egg shape type. Total length of streets installed with sewer network is 42.6 km. The existing sewerage system is shown in *Figure II.1.22.*

There are two combined sewer overflow (CSO) structures in the sewer network as shown in the above figure. The CSO-1 was originally planned for discharging overflows to an irrigation system. But the overflows have been polluted gradually these days, the EPA recommended the city not to use the CSO. Now the CSO-1 is abandoned, so that all wastewater and storm-water is conveyed to the next CSO-2. All the combined overflows is conveyed by gravity to a storage pond having volume of 2,500m^3 (dimension: Width 30 m, Length: 80 m and Water Depth: 1.5m). Then they are discharged to a nearby irrigation channel by pumps installed in the pond, or some portion of the combined overflows are pumped up to the interceptor and finally treated at the wastewater treatment plant. The installed pump is one horizontal electric pump having capacity of 540 m^3/h, total head of 12 m, and motor power of 45 kw. The maximum capacity of interceptor is 1,000 L/s (86,400 m^3/d).

The wastewater treatment plant is located in the south of the city and is closed to the Danube River as shown in *Figure II.1.18.* The WWTP has an area of about 3.0 ha. The design hourly maximum flow is 290 L/s (25,000 m^3/d) under dry weather conditions and 580 L/s (50,000 m^3/day) under the wet weather conditions.

A treatment flow is schematically presented in *Figure II.1.23.* About 40 % of influent is treated by the Imhoff tanks. And the remaining 60 % of influent is treated by circular primary sedimentation tanks. The treated wastewater from Imhoff tanks and circular sedimentation tanks is discharged through a 1,200 mm concrete conduit which joins a discharge channel of C.I.C. factory and disposed of to the Danube River.

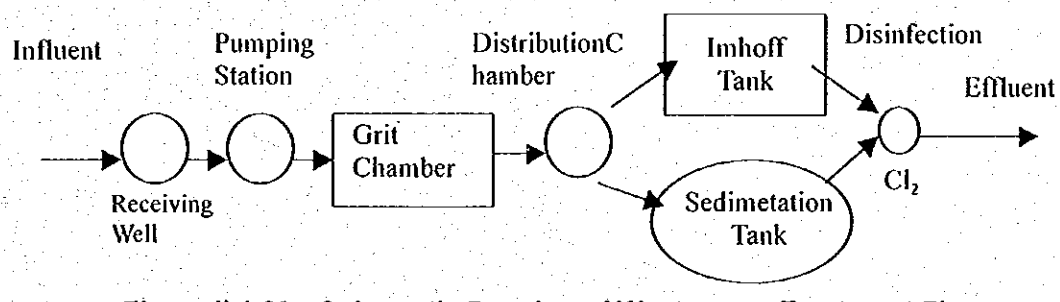


Figure II.1.23 Schematic Drawing of Wastewater Treatment Flow

The main features of the existing treatment facilities are summarized in *Table II.1.62.* Plan and section of wastewater treatment plant are shown in *Figures II.1.24 and II.1.25.*

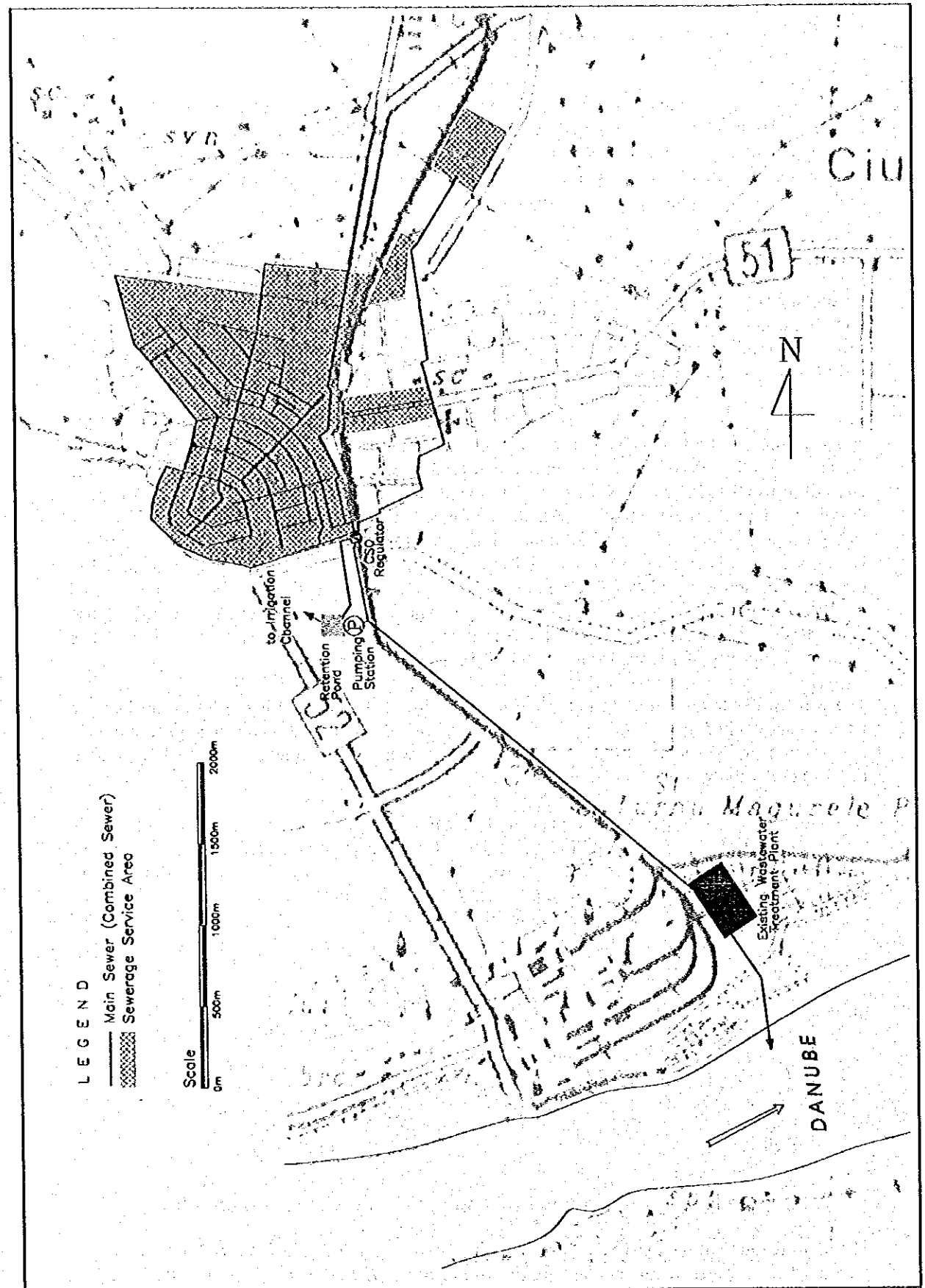


Figure II.1.22	Existing Sewerage System of Turnu Magurele

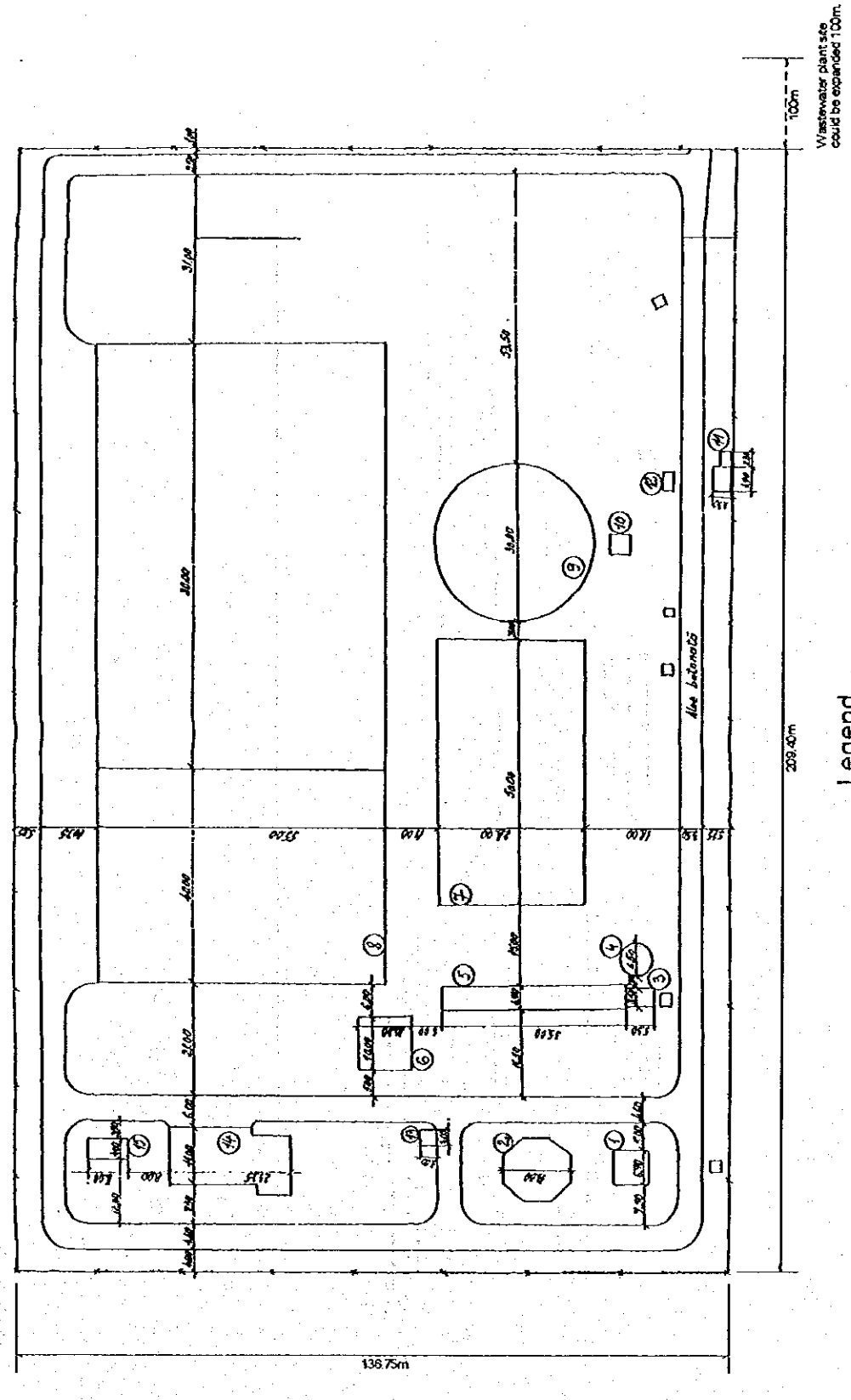


Figure II.1.24	Layout of Existing WWTP in Turnu Magurele

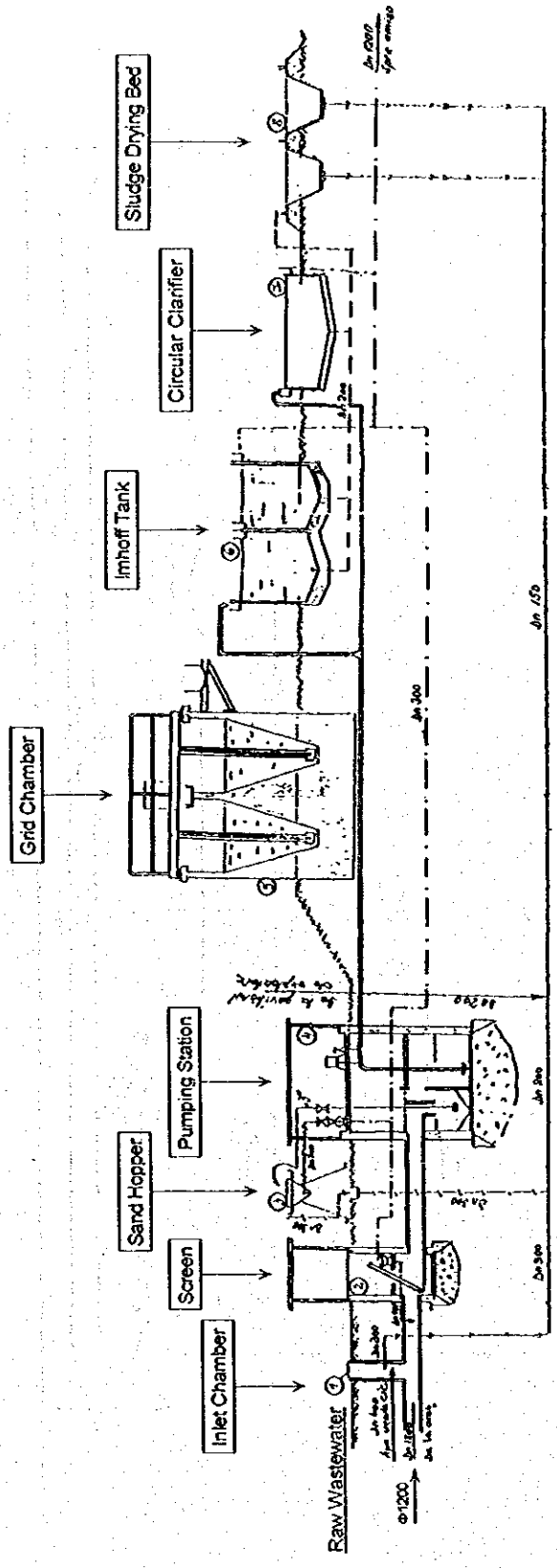


Figure II.1.25	Profile of Existing WWTP in Turnu Magurele

Table II.1.62 Outline of Existing Treatment Facilities at Turnu Magurele WWTP

Facilities	Main Features	Number	Remarks
Wastewater Treatment			
Screening	Width: 6.0 m, Depth:4.5 m, Spacing:20 mm	1 unit	Two mechanical screen removal equipment
Pumping Station	Capacity: 540 m3/h, Head:14 m, Motor power: 45 kw	7 units (2 standby)	Pump house: Diameter 13 m, Volume: 800 m^3
Grit Chamber	Width: 4.15 m, Length: 22.85 m, Depth: 2.5 m Each channel: Top width, 1.80 m; Bottom width, 0.7 m; Water depth, 1.20 m		Horizontal type, two electrical pumps, capacity of 0.08 m^3/s (4.80 m^3/min), with one blower SRD-20, Capacity of 180 m^3/h, 5.50 kw
Parshall Flume	Type MARCHI – 570 mm.		Section: 3 Hmax = Q; Qmax = 1,000 L/s; Hmax = 1,260 mm.
Imhoff Tank	Volume: 960 m^3, Surface: 780 m^2, Length: 25.00 m, Width: 2.60 m, Depth: 2.10 m, Total Width: 11.00 m, Total Depth: 6.50 m		Retention time: 1.50 h, mean cell residence time: 120 days Pump: APT - 45 kw, capacity:250 m^3/h
Primary Sedimentation Tank	Dia.: 30 m, Volume: 1,390 m^3, Surface: 695 m^2, Effective Water Depth: 2.00 m Diameter of inverted cone: 3.60 m, length of triangular steel weir: 88.00 m. Scrapper: 15.10 m		Retention time: 0.76 h, Two electrical pumps N90S – 0.37 kw, 2 reducing gears 3BH x 40, peripheral speed: 2.40 m/min, one complete rotation at every 40 minutes.
Chlorine Contact	Two devices provide 1.85 kg Cl_2/h each.	2 units	Liquid chlorine stored in 1,000 kg container.
Sludge Treatment			
Sludge Drying Bed		9 beds	Total area: 0.63 ha
Equipment			
Sludge Pumping Station	Length: 3.50 m, Height: 2.00 m, Depth: 3.00 m Horizontal electric pump, capacity of 325 m^3/h		Operation: 2 times a day. Also be used for emptying the circular sedimentation tanks

Source: R.A. SAGO

The following table shows the monthly records of wastewater flowrate at the existing WWTP. Based on the records, the monthly average flow is 372,617 m^3/month (12,420 m^3/d). According to the flow records of July in 1998, the daily maximum, average and minimum flows were 173 L/s (14,950 m^3/d), 144 L/s (12,440 m^3/d), 79 L/s (6,830 m^3/d), respectively.

Table II.1.63 Wastewater Flowrate Records at WWTP in 1998

Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Flow Records (1,000 m^3/month)	360.6	287.5	399.5	310.0	330.5	314.9	394.6	398.5	398.8	441.9	411.8	422.6	4,471.4

Source: R.A. SAGO

Wastewater quality is measured at the existing treatment plant. Measured influent and effluent qualities are presented in *Tables II.1.64* and *II.1.65*, respectively. The influent records indicate

that the concentrations of SS and BOD are low, especially the BOD concentrations are very low as 31 to 45 mg/L.

Table II.1.64 Influent Quality Records at WWTP in 1998

Month	Temp (℃)	pH	SS (mg/L)	COD (mg/L)	BOD (mg/L)	NH_4-N (mg/L)	NH_3-N (mg/L)	NO_2-N (mg/L)
January	12.4	7.0	88	17	31	30.6	0.15	0.50
February	12.7	7.0	79	17	32	33.0	0.16	0.50
March	13.7	7.0	99	21	40	35.6	0.17	0.55
April	14.6	7.0	92	19	35	32.8	0.16	0.60
May	18.5	7.0	96	19	31	37.7	0.13	0.70
June	24.4	7.0	114	20	37	30.0	0.17	0.60
July	25.4	7.0	107	20	37	28.2	0.13	0.60
August	25.4	7.0	102	21	45	27.6	0.14	0.60
September	23.0	7.0	103	20	34	28.9	0.15	0.60
October	19.6	7.0	98	18	34	33.4	0.14	0.60
November	15.7	7.0	103	23	42	28.9	0.13	0.60
December	11.0	7.0	83	21	38	28.2	0.14	0.60
Total average	18.0	7.0	97	20	36	31.2	0.15	0.59

Source: R.A. SAGO

Table II.1.65 Effluent Quality Records at WWTP in 1998

Month	Temp (℃)	pH	SS (mg/L)	COD (mg/L)	BOD (mg/L)	NH_4-N (mg/L)	NH_3-N (mg/L)	NO_2-N (mg/L)
January	13.0	7.0	58	12	22	25.4	0.12	0.60
February	12.4	7.0	62	13	25	28.2	0.13	0.40
March	13.2	7.0	64	14	25	27.1	0.13	0.50
April	14.1	7.0	55	12	22	24.8	0.11	0.45
May	18.0	7.0	61	11	20	22.3	0.10	0.50
June	24.0	7.0	86	14	29	21.8	0.10	0.50
July	25.0	7.0	66	17	32	21.5	0.09	0.50
August	25.1	7.0	56	17	39	19.6	0.08	0.50
September	22.7	7.0	63	15	27	20.1	0.09	0.50
October	19.2	7.0	62	13	24	20.5	0.10	0.50
November	15.3	7.0	66	15	28	20.9	0.10	0.50
December	10.8	7.0	42	15	27	21.4	0.09	0.40
Total average	17.7	7.0	62	14	27	22.8	0.10	0.49

Source: R.A. SAGO

The performance of the primary treatment facilities is as summarized in *Table II.1.66.*

Table II.1.66 Performance of WWTP

Month	SS			BOD			Inorganic Nitrogen		
	Inf. (mg/L)	Eff. (mg/L)	Reduction (%)	Inf. (mg/L)	Eff. (mg/L)	Reduction (%)	Inf. (mg/L)	Eff. (mg/L)	Reduction (%)
January	88	58	34	31	22	29	31.3	26.1	17
February	79	62	22	32	25	22	33.7	28.7	15
March	99	64	35	40	25	38	36.3	27.3	25
April	92	55	40	35	22	37	33.6	25.4	19
May	96	61	36	31	20	35	38.5	22.9	41
June	114	86	25	37	29	22	30.8	22.4	27
July	107	66	38	37	32	14	28.9	22.1	24
August	102	56	45	45	39	13	28.3	20.2	29
September	103	63	39	34	27	21	29.7	20.7	30
October	98	62	37	34	24	29	34.1	21.1	38
November	103	66	36	42	28	33	29.6	21.5	27
December	83	42	49	38	27	29	28.9	21.9	24
Average	97	62	36	36	27	25	31.9	23.4	27

Source: R.A. SAGO

Total 27 staff works for operations and maintenance of the existing wastewater treatment plant. The breakdown is as follows: chief 1, mechanics 6, electrician 5, operator 2, and chemist at the laboratory 4, and general labors 9. The operations and maintenance of the plant is being done 24 hours by two shifts: 17 staff works during day time and 10 staff works during night time. The laboratory is operated by an eight-hour shift. Wastewater quality of 13 items is measured six times a day.

Dewatered sludge by sludge drying beds is transported to a solid wastes disposal site twice a year, where is located 5 km from the wastewater treatment plant. R.A. SAGO is requesting EPA to construct a new sludge disposal site near the wastewater treatment plant, because the existing disposal site is far from the city and the transportation costs of sludge are high.

(3) Future Plan

The city does not have any specific expansion plan of the sewerage system. When a secondary biological treatment process is required to treat the wastewater to comply with regulations, the WWTP should be expanded. The available area for expansion is about 1.4 ha (100 m x 140 m) at the south of the present WWTP site, as shown in *Figure II.1.26.*

1.3.6 SANITATION SYSTEM

As mentioned in the previous sub-section, more than half, about 53 % of the total population of the city is served by the sewerage system, the remaining 47 % of the people use some on-site sanitation system. It is said that about only 5% of total population use a septic tank system and the remaining 42 % use pit latrines.

The public corporation, R.A. SAGO. is a responsible agency to provide the desludging service of septic tank system. It has only one vacuum track having $10m^3$ and two persons including one driver are in charge for collecting the septage from the septic tanks and transporting it to disposal site. The service is provided once a year for individual houses and three or four times a year for public facilities.

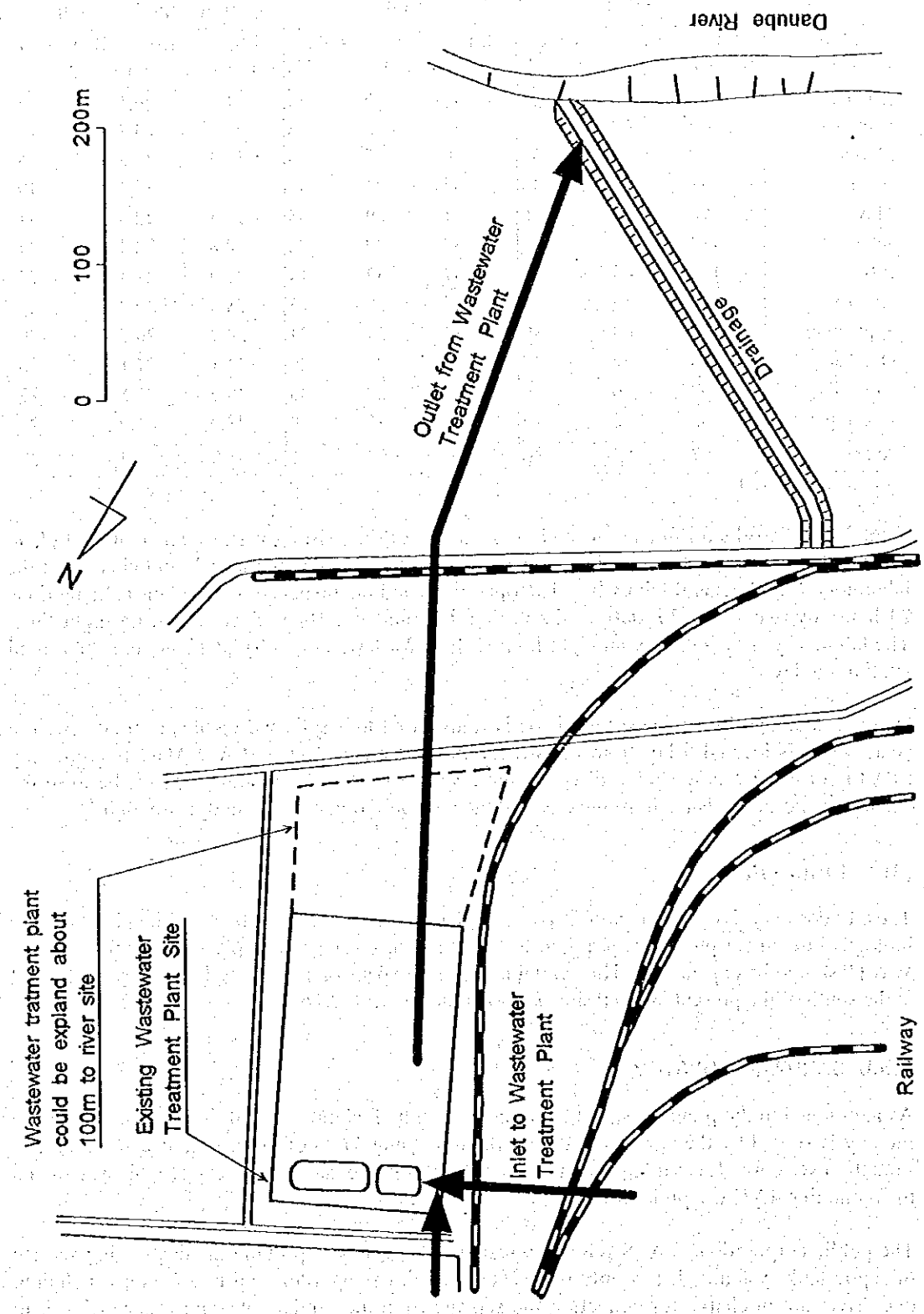


Figure II.1.26	Existing WWTP Site and Potential Extension Area in Turnu Magurele