JAPAN INTERNATIONAL COOPERATION AGENCY
MINISTRY OF ENVIRONMENT
THE REPUBLIC OF LITHUANIA

STUDY ON THE SEWERAGE SYSTEM IMPROVEMENT OF BIRZAI AND SKUODAS TOWN IN THE REPUBLIC OF LITHUANIA

FINAL REPORT

VOLUME I

SUMMARY REPORT

FEBRUARY 1999

NIPPON JOGESUIDO SEKKEI CO., LTD.

EXCHANGE RATE

US$ 1.0 = Litas 3.99 = Yen 117.71

(As of February 1999)

JAPAN INTERNATIONAL COOPERATION AGENCY
MINISTRY OF ENVIRONMENT
THE REPUBLIC OF LITHUANIA

STUDY
ON
THE SEWERAGE SYSTEM IMPROVEMENT
OF
BIRZAI AND SKUODAS TOWN
IN
THE REPUBLIC OF LITHUANIA

FINAL REPORT

VOLUME I

SUMMARY REPORT

FEBRUARY 1999

NIPPON JOGESUIDO SEKKEI CO., LTD.

PREFACE

In response to a request from the Government of the Republic of Lithuania, the Government of Japan decided to conduct a feasibility study on the Sewerage System Improvement of Birzai and Skuodas Town in the Republic of Lithuania and entrusted to the study to the Japan International Cooperation Agency (JICA).

JICA selected and dispatched a study team headed by Mr. Kuniaki Onishi of the Nippon Jogesuido Sekkei Co., Ltd. to Lithuania, two times between May and December 1998. In addition, JICA set up an advisory committee headed by Mr. Yoshio Oshima, Director of Research Section, New Sewerage Technology Promotion Organization between March 1998 and February 1999, which examined the study from specialist and technical points of view.

The team held discussions with the officials concerned of the Government of Lithuania, and conducted field surveys at the study area. Upon returning to Japan, the team conducted further studies and prepared this final report.

I hope that this report will contribute to the promotion of the project and to the enhancement of friendly relationship between our two countries.

Finally, I wish to express my sincere appreciation to the officials concerned of the Government of Lithuania for their close cooperation extended to the study.

February, 1999

Kimio Fujita
President
Japan International Cooperation Agency

February 1999

Mr. Kimio Fujita
President
Japan International Cooperation Agency
Japan

Dear Sir,

Letter of Transmittal

We are pleased to submit herewith the final report for the Study on the Sewerage System Improvement of Birzai and Skuodas Town.

The Study was completed through the discussions with the Lithuanian Government officials and the field investigation during two visits from May to December 1998 and the home work thereafter.

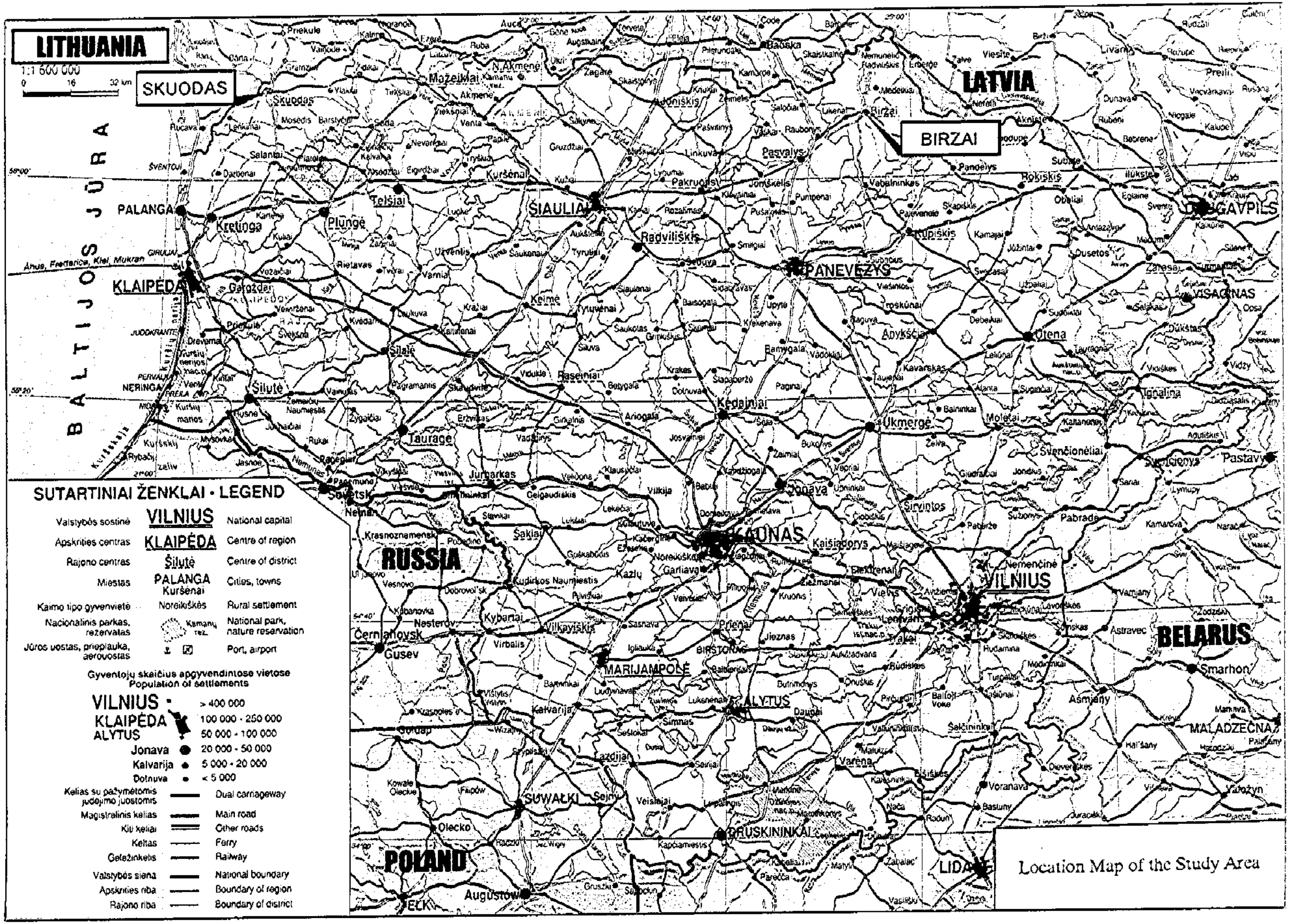
The Final Report consists of 13 volumes consolidating the interim report and draft final report. 13 volumes can be divided into Japanese Summary (one volume), English Reports (five volumes), Sewage Treatment Plant Preliminary Design Drawings (two volumes) and Lithuanian Reports (five volumes): Japanese Summary and English Report Volume I - Summary Report which succinctly describes the study and recommendations; Volume II - Main Report (Birzai and Skuodas Town : two volumes), which conduct the feasibility study on sewerage system improvement plan with target year of 2010. Volume III - Supporting Report (Birzai and Skuodas Town : two volumes) including detailed engineering analysis and relevant information with reference to Volume II. Volume IV – Preliminary Design Drawings (Birzai and Skuodas Town : two volume) contain structural drawings of the proposed sewage treatment plant for each town. Contents of Lithuanian Reports are corresponding to English ones.

We hope that the implementation of the proposed projects would greatly contribute to the improvement of water quality of public water bodies, and sanitary conditions in the study area.

We wish to take this opportunity to express our sincere gratitude to the officials of your Agency, the Ministry of Foreign Affairs, the Ministry of Construction and the Overseas Economic Cooperation Fund for their kind support and advice. We also would like to show our appreciation to the officials of the Ministry of Environment, Birzai Town, Skuodas Town, the Embassy of Japan in Lithuania and in Denmark for their kind cooperation and assistance throughout our field survey.

Very truly yours,

Kuniaki Onishi
Team Leader
Study Team for the Study on the
Sewerage System Improvement of
Birzai and Skuodas Town



Location Map of the Study Area

STUDY ON
THE SEWERAGE SYSTEM IMPROVEMENT
OF
BIRZAI AND SKUODAS TOWN
IN
THE REPUBLIC OF LITHUANIA

FINAL REPORT

VOLUME I – SUMMARY REPORT

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

CURRENCY EXCHANGE RATE

US$1.00 = Litas 3.99

LIST OF ABBREVIATIONS

BOD	-	Biochemical Oxygen Demand
COD	-	Chemical Oxygen Demand
EBRD	-	European Bank for Reconstruction and Development
EU	-	European Union
JICA	-	Japan International Cooperation Agency
LTL.	-	Lithuanian Litas (currency)
MOE	-	Ministry of Environment
N	-	Nitrogen
OD	-	Oxidation Ditch
P	-	Phosphorus
PHARE	-	Poland and Hungary Aid Restructuring Economy
SBR	-	Sequencing Batch Reactor
SS	-	Suspended Solids
STP	-	Sewage Treatment Plant
WB	-	World Bank

EXECUTIVE SUMMARY

Nippon Jogesuido Sekkei Co., Ltd.
Tokyo, Japan

EXECUTIVE SUMMARY

1 PROPOSED PROJECT

BIRZAI SEWERAGE SYSTEM IMPROVEMENT PROJECT

(1) Rationale of the Project

Implementation of the proposed project is considered essential for protecting the water environment in the Birzai Region in particular for prevention of pollution, and to maintain the quality of both the surface water and groundwater in the karst zone. The implementation of the project will further contribute to the preservation of the natural resources in the region.

(2) Projection of Population and Amount of Sewage

Year	1997	2000	2005	2010
Population in the town area	16,183	16,176	16,445	16,742
Population served	8,240	8,900	10,280	11,720
Amount of sewage (m^3/day)				
daily average	3,100	3,600	3,900	4,200
daily maximum	3,500	4,200	4,600	5,000
hourly peak	4,300	5,300	6,100	6,930

(3) Design Year = 2010

(4) Planned Study Area = Inside the urban area equal to 1,783 ha

(5) Present Population in the Study Area = 16,183

(6) Proposed Sewerage System Improvement

1. Sewage Collection System Improvement

- Water Company must make an effort to prevent stormwater from intruding in the sewers;
- Investigation of the infiltration of groundwater into the sewers is recommended. Budget may need to be allotted for this purpose.

2. Sewage Treatment System

For the two options proposed, the Miuistry of Environment and Birzai Municipality will implement Option 1 because of its greater advantage of smaller cost in both construction and operation.

- Construct a new treatment plant at the fornerly proposed site outside the town boundary;
- Abandon the existing treatment plant upon completion of the new treatment plant;
- New treatment plant will be designed to treat 5,000 m^3/day sewage as a daily maximum flow. The plant will employ the previously designed treatment method that is a so called anaerobic-anoxic-aeration (A2O) method for secondary treatment;

- Excess sludge will be treated by gravity thickening and mechanical dewatering using a centrifuge;
- For emergency case if the dewatering machine breaks down, a sludge lagoon having one month storage will be provided; and
- Dewatered sludge will be transported outside the plant for composing.
- Treated effluent will be discharged to the Juodupe River that flows to the Tatula River by gravity through a 3.2 km long discharge pipe made of reinforced concrete;
- A tertiary treatment process using a biological membrane filter will be used for the secondary effluent to meet the special requirement for the effluent discharged to the Tatula River.
- Construction of the tertiary treatment process may be excluded from the first phase construction subject to evaluation of the effluent quality of the secondary treatment process and reconsideration by the Ministry of Environment of the special effluent standard for the Tatula River.

(7) Project Cost

Investment Cost (1998 base cost)

Option 1

Construction cost	=	LTL. 10.17 million
Engineering cost (10%)	=	LTL. 1.02 million
Contingency (5%)	=	LTL. 0.56 million
Total Project Cost	=	LTL. 11.75 million

Operation Cost of the proposed treatment plant (for 2010 demand in 1998 base cost)

(with the Tertiary Treatment)

Power cost	=	LTL. 106,900/year
Chemical cost	=	LTL. 71,000/year
Fuel & consumable	=	LTL. 89,000/year
Total Operation Cost	=	LTL. 266,900/year

(without the Tertiary Treatment)

Power cost	=	LTL. 85,250/year
Chemical cost	=	LTL. 71,000/year
Fuel & consumable	=	LTL. 73,250/year
Total Operation Cost	=	LTL. 229,500/year

(8) Financial Program and Water Tariff

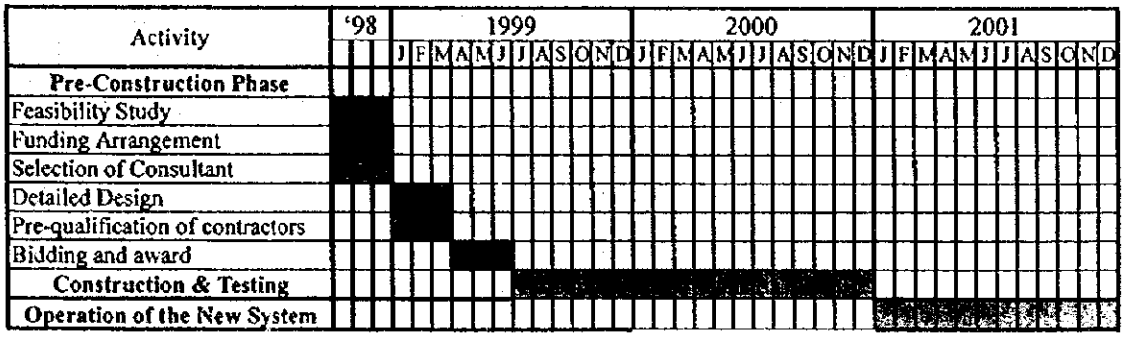
A tariff schedule is calculated with assumptions for a financial arrangement to achieve an FIRR of 5 percent, as a hurdle value. Schedule of tariffs is summarized for various loan interests as follows:

Interest Rate of Loan (%)	Tariff (L.U/m^3)		
	First Year	10th year	25th year
(Option 1) 5	1.65	2.19	3.53
7	1.74	2.31	3.72
9	1.83	2.43	3.92

Assumption:
- Loan finance for 50% of the investment (25-year return period, 10-year grace period)
- State subsidy/grant for 50 % of the project cost
- FIRR = 5 % as a hurdle value

(9) Implementation Program

It is assumed that the proposed project will be implemented as follows:



SKUODAS SEWERAGE SYSTEM IMPROVEMENT PROJECT

(1) Rationale of the Project

Construction of the proposed sewage treatment plant will effectively contribute to the environmental protection in the Bartuve River Basin that is also requested by Latvia. Implementation of the project should therefore be given a high priority considering the present discharge of poorly treated effluent from the existing treatment plants in Skuodas.

(2) Projection of Population and Amount of Sewage

Year	1997	2000	2005	2010
Population in the town area	8,974	8,970	9,119	9,284
Population served	6,731	7,000	7,660	8,340
Amount of sewage (m^3/day)				
daily average	760	867	1,057	1,270
daily maximum	950	1,100	1,340	1,600
hourly peak	1,900	2,200	2,680	3,200

(3) Design Year = 2010

(4) Planned Study Area = Inside the urban area equal to 596 ha

(5) Present Population in the Study Area = 8,974

(6) Proposed Sewerage System Improvement

- Construct a new treatment plant at the previously proposed site outside the town boundary;
- The new treatment plant is designed for the daily maximum flow. Proposed sewage treatment method is using an oxidation ditch;
- Treated effluent is to be discharged into the Bartuva River;
- Excess sludge is to be dried by gravity thickening and mechanical dewatering using a centrifuge;
- Dewatered sludge (3.0 m^3/day) is to be treated by a mounting composting method and used for low-level fertilizer or soil conditioner for agriculture;
- For emergency use in case the dewatering machine is not in operation, a sludge lagoon having a volume of one month storage is to be provided;
- Abandon the two existing treatment plants upon completion of the proposed treatment plant;

(7) Project Cost

Investment Cost (1998 base cost)

Construction cost	=	LTL. 6.74 million
Engineering cost (10%)	=	LTL. 0.67 million
Contingency (5%)	=	LTL. 0.37 million
Total Project Cost	=	LTL. 7.78 million

Operation Cost of the proposed treatment plant (for 2010 demand in 1998 base cost)

Power cost	=	LTL. 36,000/year
Chemical cost	=	LTL. 52,000/year
Fuel & consumable	=	LTL. 48,000/year
Total Operation Cost	=	LTL. 136,000/year

(8) Financial Program and Water Tariff

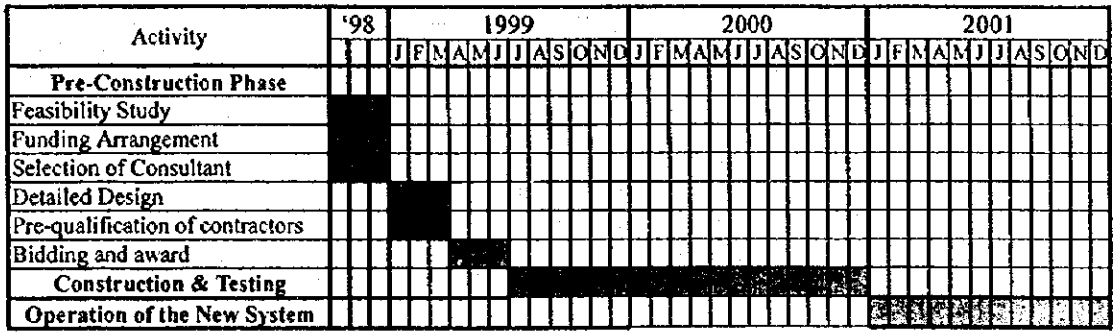
A tariff schedule is calculated with some assumptions for a financial arrangement to achieve an FIRR of 5 percent as a hurdle value. Schedule of tariffs is summarized for various loan interests as follows:

Interest Rate of Loan (%)	Tariff (Lt/m^3)		
	First Year	10th year	25th year
5	2.12	2.83	4.55
7	2.27	3.02	4.86
9	2.42	3.22	5.18

Assumption:
Loan finance for 50% of the investment (25-year return period, 10-year grace period)
State subsidy/grant for 50 % of the project cost
FIRR = 5 % as a hurdle value

(9) Implementation Program

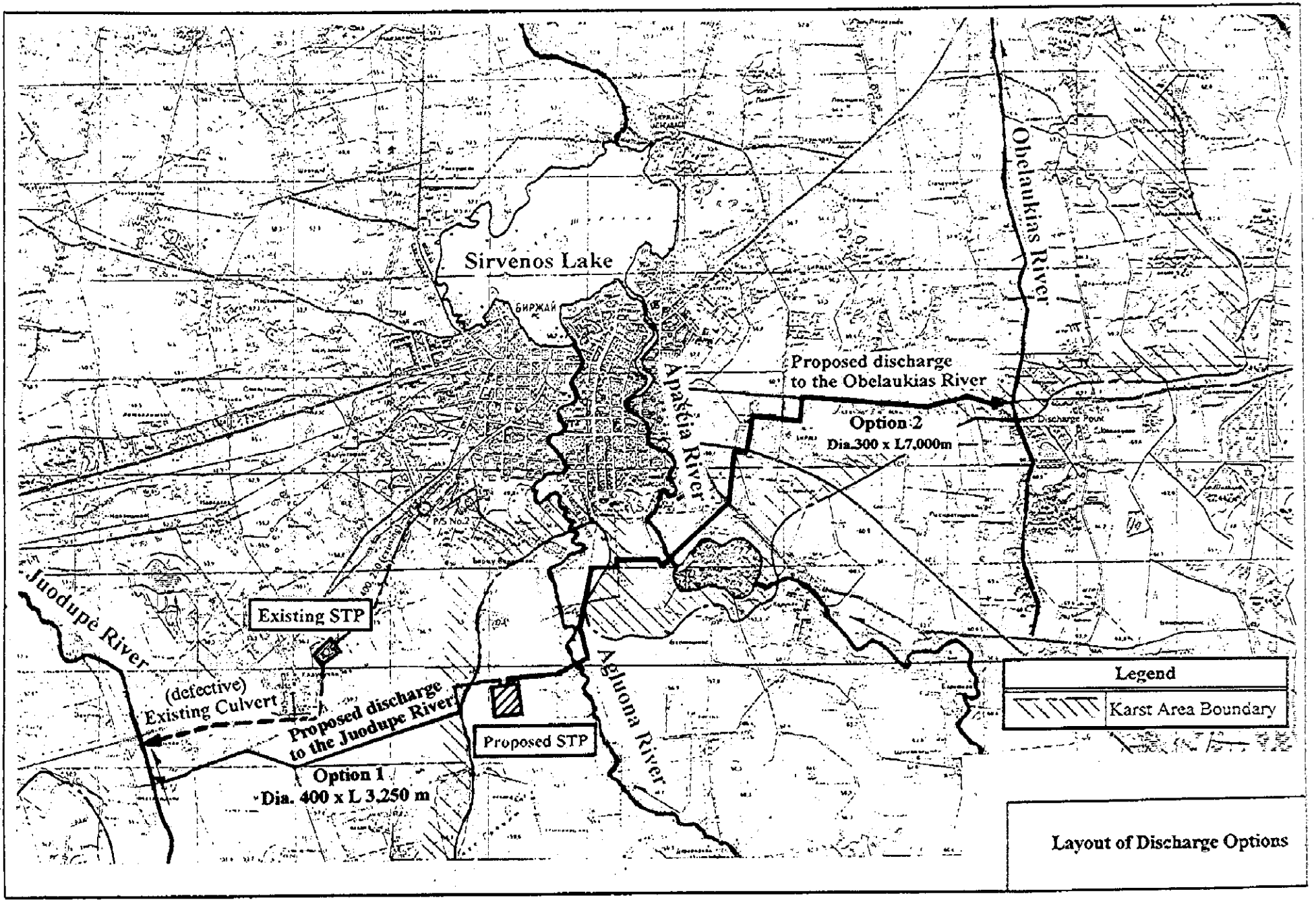
It is assumed that the proposed project will be implemented as follows:

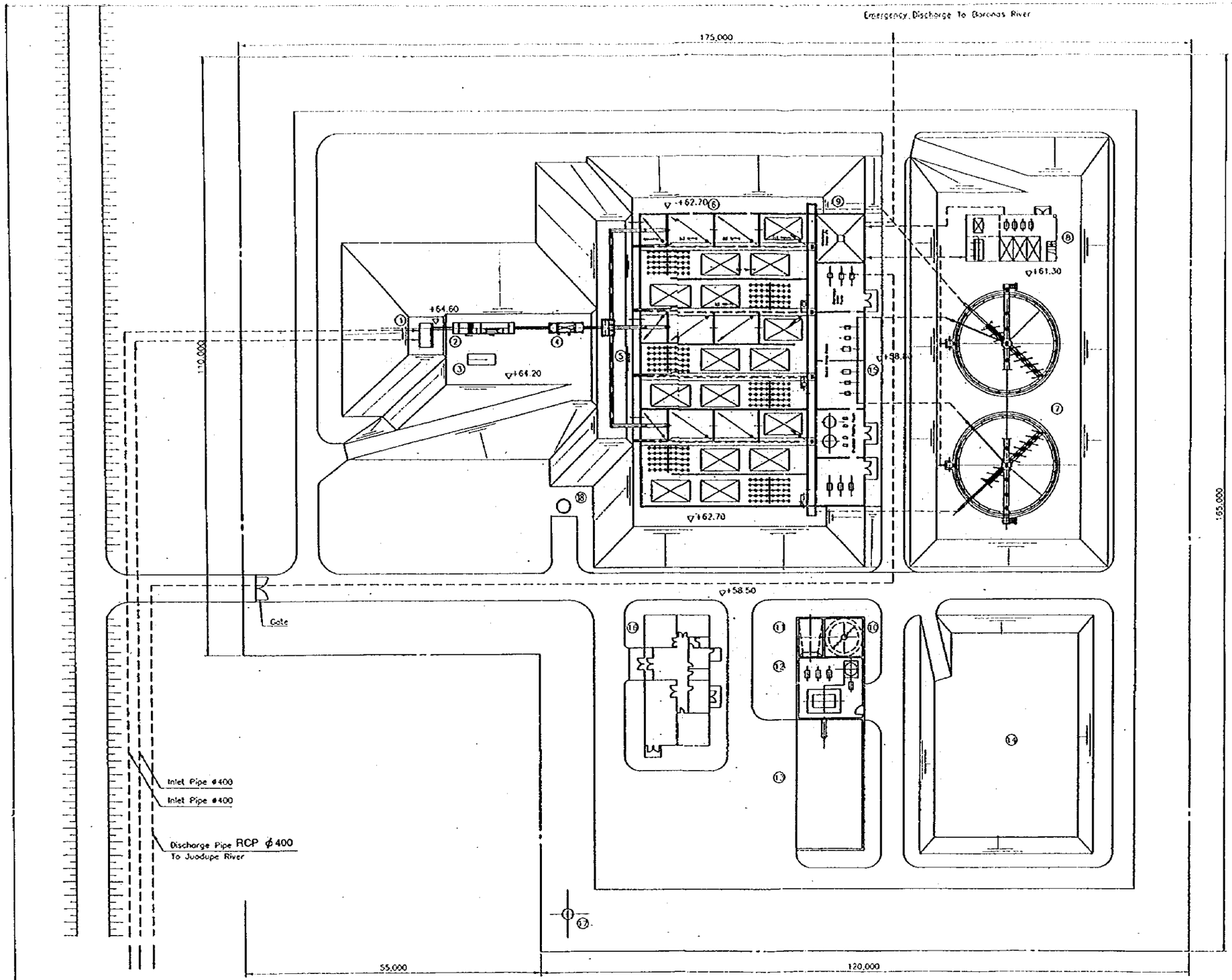


2 ENVIRONMENTAL IMPACT ASSESSMENT

The Study Team conducted an environmental impact assessment for the two proposed projects at Birzai and Skuodas. The results are presented in Chapter 6 in detail.

The EIA concluded that no significant adverse impacts are expected on the environment from implementation of the proposed two projects.


Sirvenos Lake
Obelaukias River
Apaščia River
Proposed discharge
to the Obelaukias River
Option 2
Dia.300 x L7,000m
Juodupė River
Existing STP
(defective)
Existing Culvert
Proposed discharge
to the Juodupe River
Option 1
Dia. 400 x L 3,250 m
Proposed STP
Agluona River
Legend
Karst Area Boundary
Layout of Discharge Options



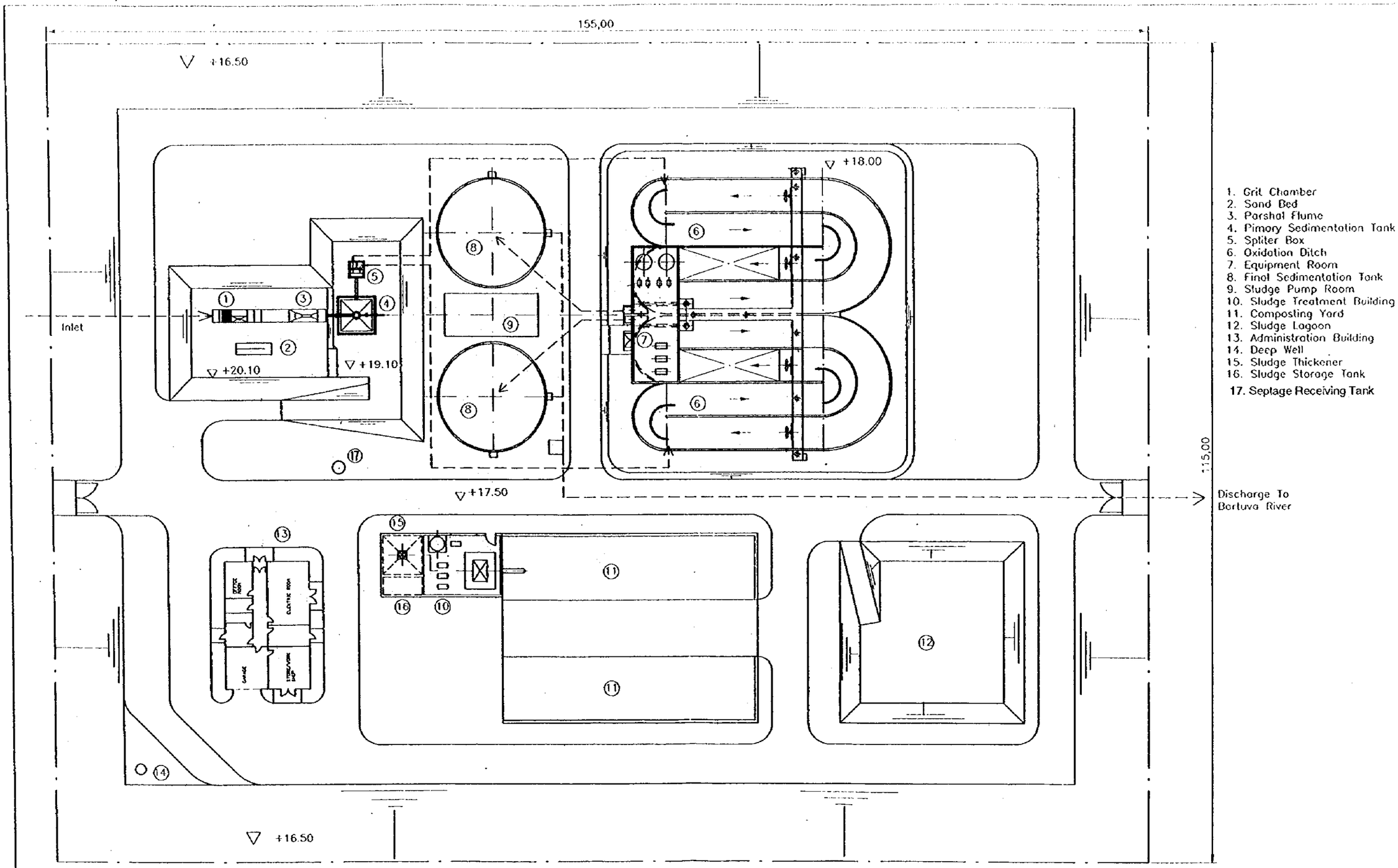
Item_Of_Facility

1. Receiving Well
2. Grit Chamber
3. Sand Bed
4. Parshal Flume
5. Spliter Box
6. Reaction Tank
7. Final Sedimentation Tank
8. Biological Membrane Filter (Option 1 only)
9. Discharge Pump Pit
10. Sludge Thickener
11. Sludge Storage Tank
12. Sludge Treatment Building
13. Sludge Stock Yard
14. Sludge Lagoon
15. Equipment Room
16. Administration Building
17. Deep Well
18. Septage Receiving Tank

General Plan S=1/500

Study on the Sewerage System Improvement of Birżai and Skuodas Town in the Republic of Lithuania

Layout of the Birzai Treatment Plant



1. Grit Chamber
2. Sand Bed
3. Parshal Flume
4. Pimary Sedimentation Tank
5. Spliter Box
6. Oxidation Ditch
7. Equipment Room
8. Final Sedimentation Tank
9. Sludge Pump Room
10. Sludge Treatment Building
11. Composting Yard
12. Sludge Lagoon
13. Administration Building
14. Deep Well
15. Sludge Thickener
16. Sludge Storage Tank
17. Septage Receiving Tank

General Plan S=1/500

Study on the Sewerege System Improvement of Biržai and Skuodas Town in the Republic of Lithuania

Layout of the Skuodas Treatment Plant

CHAPTER 1

INTRODUCTION

1 INTRODUCTION

1.1 BACKGROUND

The towns of Birzai and Skuodas are located in the north and northeastern parts of Lithuania, respectively. Both towns face the country border with Latvia. The districts of Birzai and Skuodas have populations of 38,500 and 27,800, respectively. The sewerage facilities of these towns were developed in 1960's, an outline of which is shown below:

Table 1.1 Existing Sewerage Facilities in Birzai and Skuodas

Sewerage Facility	Birzai Town	Skuodas Town
Total Sewer Length	27 km	23 km
Pumping Station	3 nos.	4 nos.
Sewage Treatment Plant	1 no.	2 nos.

As these facilities are old and do not functioning well, they have been creating environmental problems which lead to water pollution in the receiving water bodies. In Birzai particularly, effluent causes groundwater contamination in the karst formation which has a high permeability. As well as other domestic problems, pollution is becoming an international issue with Latvia, which is complaining about pollution in the river flowing from Lithuania.

To cope with this situation, these towns have each prepared a rehabilitation plan for a sewage treatment system. Birzai started construction in 1995 based on the plan, but suspended it after a part of the structures had been constructed. The construction work was suspended since the subsidy from the central government ceased due to financial constraints. In 1995, the government requested the government of Japan to provide a loan for rehabilitation of the sewerage facility in the two towns. The government of Japan, however, evaluated the application and determined it as lacking essential information such as a basis of definition of major design criteria, service areas and treated sewage quality, and institutional and managerial improvement for operation of the Water Company (Vandenys). To meet the requirements for securing financial aid, an additional study was needed immediately.

Under these circumstances, the government of Lithuania requested the government of Japan, in May 1997, to conduct a feasibility study on the sewerage system improvements for Birzai and Skuodas Towns.

In response to this request, the government of Japan dispatched a preparatory study team and signed the scope of work for this project in January, 1998. The study team, consisting of engineers and specialists, was formulated by the Japan International Cooperation Agency (JICA) and commenced the study work in May 1998.

1.2 OBJECTIVES OF THE STUDY

Objectives of the study are defined as follows:

1. To conduct a feasibility study for improvement of the sewerage system that will contribute to the upgrading of sanitary and environmental conditions in Birzai and Skuodas towns for the target year of 2010 after reviewing current existing plans; and
2. To transfer technology on planning methods and skills to counterpart personnel during the course of study.

1.3 STUDY AREA AND DESIGN YEAR

The study covers the extent of the town area within the districts of Birzai and Skuodas as follows:

Birzai Town:	Area 1,783ha
Skuodas Town :	Area 596ha

The feasibility study will be prepared for the design year 2010.

1.4 SCOPE OF WORK OF THE STUDY

The scope of work to be covered by the study is shown below:

1. Review present plans
2. Prepare preliminary designs for the proposed facilities
3. Formulate construction plans
4. Formulate operation and maintenance plans
5. Formulate organizational, institutional and human resource development plans
6. Prepare cost estimates
7. Formulate financial plans
8. Conduct an environmental impact assessment
9. Conduct comprehensive project evaluations
10. Formulate implementation plans

Extent of the study is as follows:

1. The karst area in Birzai will not be included in the scope of work.
2. The study will cover both the domestic and industrial wastewater discharges.
3. Stormwater drainage will not be included in the scope of work.
4. The feasibility study will cover the following items:
   a. Construction plans for new sewage treatment plant
   b. Construction plans for the discharge pipelines
   c. Institutional and management (including billing and collection system) strengthening plan and a practical finance plan.

1.5 FORMATION OF THE STUDY TEAM

The Study Team and JICA Advisory Committee consisted of the following members:

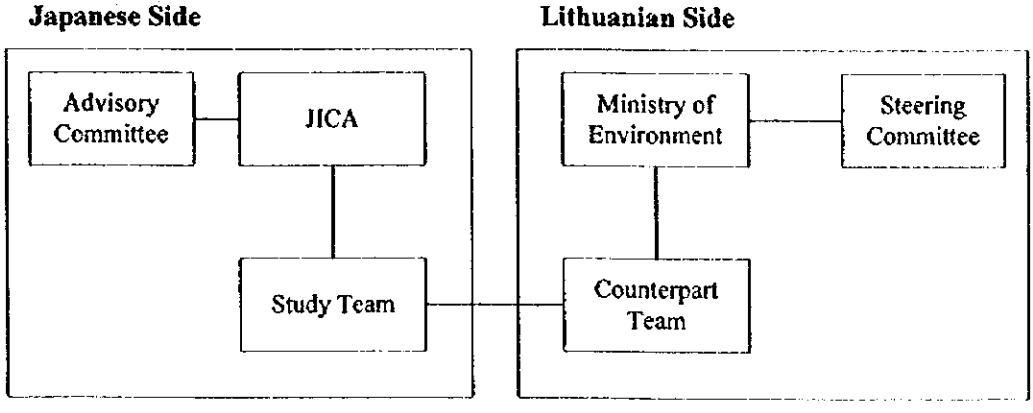
Study Team

Kuniaki Onishi	Team Leader, Sewerage Planning
Takashi Watanabe	Sewerage Facility Design (1), Survey Supervision
Raymond Merritt	Sewerage Facility Design (2), Survey Supervision
Naoji Kumagai	Economic and Financial Analysis
Taku Ogata	Institutional and Financial Planning
Richard Deussen	Construction Planning and Cost Estimates
Satoshi Shibasaki	Operation and Maintenance Planning
Hiroshi Okada	Water Quality and Environment
Hiroki Fujiwara	Equipment Planning

JICA Advisory Committee

Yoshio Oshima	Chairman, Sewerage New Technology Promotion Organization
Kazumi Suzuki	Member, Sewerage Operation Management Center
Hiroyuki Mori	Member, Overseas Economic Cooperation Fund of Japan (OECF)

An organization diagram showing the relationships between the Lithuanian side, JICA and the Study Team is presented in Figure 1.1.



JICA: Japan International Cooperation Agency

Figure 1.1 Organization Set-up of the Study

1.6 FORMATION OF THE LITHUANIAN SIDE

The organization of the Lithuanian side consists of the counterpart team of the Ministry of Environment, and Steering Committee as follows:

Counterpart Team

Ministry of Environment

Mr.A. Dragūnas	Director of the Environmental Strategy Department
Mr.V.Bernadišius	Deputy Director of the Environmental Strategy Department
Mr.R.Sakalauskas	Head of the Water Division
Mr.S.Ulinskas	Chief Economist
Mrs.E.Levulienė	Sr. Engineer of the Water Division
Mr.K.Mastauskas	Head of the Economic Division
Ms.A Plančiūnaitė	MOE Panevėžys Regional Department
Mr.V.Balionis	MOE Klaipėda Regional Department
Birzai Municipality	
Mr.B.Zurba	Mayor of Birzai Municipality
Mr.R.Šaltauskas	Administrator
Mr.P.Januškevičius	Head of the Local Economy Division
Mr.B.Klastauskas	Director of the Stock Company "Birzai Vandenys"
Skuodas Municipality	
Mr.L.Žukauskas	Mayor of Skuodas Municipality
Mr.K.Viršilas	Vice Mayor
Mr.A.Paulikas	Administrator
Mrs.J.Joskaudienė	Head of the Local Economy Department
Ms.L.Jurevičiūtė	Head of the Financial Division
Mr.R.Kungys	Director of the Stock Company "Skuodas Vandenys"
Mr.R.Polikas	Chief Engineer of the "Skuodas Vandenys"
Mr.A.Ciunka	Stock Company the "Skuodas Vandenys"

Steering Committee

Chairman	
Mr.A.Daubaras	Vice Minister of Environment
Vice Chairman	
Mr.V. Bernadišius	Deputy Director of the Environmental Strategy Department
Ministry of Environment:	
Mr.K. Mastauskas	Head of the Environmental Strategy and Investment Unit
Mr.G. Tiškus	Director, Territorial Planning Department
Mrs.E. Levulienė	Chief Engineer of the Water Division
Ms.A. Plančiūnaitė	Deputy Director, MOE Panevėžys Regional Department
Municipalities of Birzai	
Mr.B. Zurba	Mayor of Biržai Municipality
Mr.B. Klastauskas	Director of the Biržai Water Company
Municipalities of Skuodas	
Mr.L. Žukauskas	Mayor of Skuodas Municipality

1.7 ORGANIZATION OF THE REPORT

The Final Report consists of three volumes, as follows:

Volume I. Summary Report

Volume II. Main Report (Birzai)

Main Report (Skuodas)

Volume III. Supporting Report (Birzai)

Supporting Report (Skuodas)

Volume IV Preliminary Design Drawings (Birzai)

Preliminary Design Drawings (Skuodas)

CHAPTER 2

DESCRIPTION OF THE COUNTRY

2 DESCRIPTION OF THE COUNTRY

2.1 HISTORY IN BRIEF

Lithuania was first mentioned in recorded history in the 13th Century. In the 15th Century, the Lithuanian lands extended from the Baltic Sea to the Black Sea. Lithuania lost its independence from 1940 to 1990 under the Nazi, followed by the Soviet Union, regimes. On March 11, 1990, the Supreme Council declared Lithuanian's independence restored. The United Nations admitted the three Baltic countries in 1991. Lithuania joined the Council of Europe in May 1993 followed by withdraw of the last former Soviet military unit in September 1993.

In 1995, Lithuania signed an association agreement with the European Union and the European Treaty between the European Community and Lithuania. The Lithuanian Parliament ratified the European Agreement that is expected to bring the country one step closer to becoming a member of the European Union.

2.2 NATURAL CONDITIONS

2.2.1 General

Lithuania is located in the Baltic Sea region at latitudes from N-54°00' to N-56°15' and longitudes from E-21°00' to E-27°00'.

The language is Lithuanian, of the Indo-European family, and is said to be as ancient as Sanskrit in its grammatical forms. More than 90 percent of the population are Roman Catholics.

2.2.2 Topography and Geology

Lithuania lies on the East European Plain in the middle and lower basin of the Nemunas River. The relief is a meridian-oriented alternation of lowland plains and hilly uplands. Rivers and lakes are dispersed almost all over the country.

Lithuania lies in one of Europe's most abundant lake districts. There are 2,833 lakes exceeding 0.5 ha. They occupy an area of 876 km^2 (1.5 percent of the country's territory).

Groundwater yields are very high throughout Lithuania. Groundwater is found at a depth of 1-15 m, while the aqueous horizon is 10-60 m deep. Underground fresh-water also lies at a depth of 300-400 m with an estimated potential resource of 3.2 million m^3 per day.

2.2.3 Meteorology

The climate of Lithuania changes from maritime to continental. Average monthly temperatures range between 20°C in summer and -5°C in winter. In Vilnius, the recorded annual average temperature is 6.3°C, the annual highest temperature is +31.0°C, and the annual lowest temperature is -28.8°C. Average monthly temperatures in Vilnius in 1997 are as follows:

January	-0.7°C	February	0.2°C
March	-0.6°C	April	3.7°C
May	11.5°C	June	15.9°C
July	18.0°C	August	18.8°C
September	11.4°C	October	5.1°C
November	1.7°C	December	-4.3°C

2.2.4 Land Use

Of a total land area of 65,300 km^2, about 35,000 km^2 is agricultural land. The amounts of warmth and humidity are sufficient for growing corn, potatoes, sugar beet, flax and maize of medium-early sort (for silage). Lithuanian soils have a very diverse pattern. The farmland consists of 25 percent sand, 33 percent sandy loam, 34 percent clay loam, 2 percent clay, and 6 percent turf. The majority of the farming land is formed from natural wood soils. The most fertile soils are in the middle Lowland.

2.3 SOCIO-ECONOMIC CONDITIONS

2.3.1 Political System

The Republic of Lithuania is a sovereign democratic state. State power is exercised by the President, the Seimas (Parliament), the Government, and the Court. The President is the highest state official and represents the Republic of Lithuania in international relations. The Seimas appoints the Prime Minister on the nomination of the President. Ministers are appointed by the President on nomination by the Prime Minister. Local self-government is organized on the basis of the administrative-territorial division of Lithuania. Administratively, Lithuania is divided into 44 districts which, in their turn, are divided into 423 areas with 11 cities of national jurisdiction.

2.3.2 Administrative Structure

2.3.2.1 Central Government

In May 1998, there was a reorganization of the central government of Lithuania. After the reorganization, government consists of 12 Ministries, one Department, and nine state authorities as follows:

Ministry of Agriculture and Forestry
Ministry of Culture
Ministry of Economics
Ministry of Education and Science
Ministry of Environment
Ministry of Finance
Ministry of Foreign Affairs
Ministry of Health Care
Ministry of Justice
Ministry of National Defense
Ministry of Social Security and Labor Protection

Ministry of Transport

Department of Statistics

State Control of Competition and Consumer Rights
State Energy Control Committee
State Nuclear Power Safety Inspection
State Land Cadastre and Register
State Inventory Bureau
State Patent Bureau
State Privatization Agency
State Council of Youth Affairs
State Tourist Board

2.3.2.2 Local Government

The local government system consists of the following hierarchy:

District (apskritis): The Country is divided into ten districts. Each district has an administrative body.

City : There are 11 cities in Lithuania. Cities are not subordinate to the districts, but are independent administrative bodies at the same level as the districts. The leader of each city is a mayor who is selected by election.

Region/Municipality (rajonai): Administrative bodies other than the City are defined as Region or Municipality. Presently there are 44 regional governments. Head of the municipality is also a mayor and is selected by election.

Town (misestai): Each Region/Municipality has a number of towns in its territory. These towns are populated areas, in the Region and have designated boundaries.

2.3.3 Population

2.3.3.1 Historical Population

In 1997, Lithuania had a population of 3.70 million broken down to 2.53 million and 1.17 million in urban and rural areas, respectively. Ethnic composition of the population is as follows:

Lithuanians	81.3 %
Russians	8.4 %
Poles	7.0 %
Byelorussians	1.5 %
Ukrainians	1.0 %
Others	0.8 %

Populations of urban and rural areas in the past 15 years are tabulated as follows:

Table 2.1 Population in Lithuania

Year	Total Population	Urban Population	Rural Population
1983	3,470,700	2,211,200	1,259,500
1984	3,499,700	2,256,100	1,243,600
1985	3,528,700	2,298,400	1,230,300
1986	3,560,400	2,341,600	1,218,800
1987	3,597,400	2,390,400	1,207,000
1988	3,635,300	2,440,200	1,195,100
1989	3,647,800	2,486,800	1,188,000
1990	3,708,200	2,526,900	1,181,300
1991	3,736,500	2,549,000	1,187,500
1992	3,746,900	2,568,200	1,178,700
1993	3,736,500	2,549,000	11,87,500
1994	3,724,000	2,533,400	1,190,600
1995	3,717,700	2,526,400	1,191,300
1996	3,711,900	2,518,400	1,193,500
1997	3,707,200	2,543,500	1,172,700

Source: Department of Statistics

2.3.3.2 Population in Future

The latest projection of the future population was prepared and issued in June 1998 by the Department of Statistics. The projection was made in five scenarios; namely, the optimistic scenario, three medium scenarios and a pessimistic one. Total populations projected under these five scenarios are presented in Table 2.2.

Table 2.2 Projection of Country's Total Population

	Optimistic	Medium-3	Medium-2	Medium-1	Pessimistic
1997	3,707,200	3,707,200	3,707,200	3,707,200	3,707,200
2000	3,713,000	3,704,490	3,700,809	3,700,379	3,697,000
2001	3,719,000	3,707,951	3,700,090	3,699,336	3,692,000
2002	3,728,000	3,713,904	3,700,139	3,698,905	3,687,000
2003	3,740,000	3,720,803	3,700,910	3,699,034	3,682,000
2004	3,753,000	3,728,681	3,702,495	3,699,827	3,676,000
2005	3,767,000	3,737,656	3,705,026	3,701,384	3,670,000
2006	3,782,000	3,747,785	3,708,615	3,703,767	3,664,000
2007	3,797,000	3,757,392	3,713,317	3,706,030	3,657,000
2008	3,813,000	3,766,524	3,717,855	3,708,206	3,650,000
2009	3,828,000	3,775,140	3,722,210	3,710,217	3,643,000
2010	3,843,000	3,783,704	3,726,272	3,711,964	3,635,000

2.3.4 Economy

2.3.4.1 Current Status and Trend (Successful Market Oriented Reform)

(1) Economic Growth

Lithuania's economy recovered in 1995 with an increase in GDP of 3.3 percent, in constant prices, and recorded an increase of 4.7 percent in 1996 and 5.7 percent in 1997.

The recovery has been brought about by the pro-market policy and programs. Export industries in fields such as machinery and mechanical equipment, textiles and mineral products have expanded over the past three years.

(2) Inflation

The CPI (Consumer Price Index) reached 1,162.6 percent by the end of 1992 mainly from an increase in fuel prices. However, the CPI fell to 45.1 percent in 1994, 35.7 percent in 1995, 13.1 percent in 1996, and 8.4 percent in 1997. The decline of the CPI is due to the adherence to the currency board arrangement that fixed the value of the Litas at LTL. 4.00 = US$1.00 and the strict fiscal policy followed by the Republic. The year on year CPI in April 1998 was 6.9 percent.

(3) Current Account

The current account deficit increased from US$896.20 mil (9.2% of GDP) in 1996 to US$1,147.49 mil (10.3% of GDP) in 1997 because of an increase in imports due to strong consumer demands and increasing investments, similar to other countries in transition.

(4) National Budget

The national budget deficit decreased from 883.8 million litas (2.8 percent of GDP) in 1996 to 430.4 million litas (1.1 percent of GDP) in 1997. This improvement was achieved by tightening revenue collection, widening the tax bases on the consumer taxes (including VAT and excises) and cutting expenditures.

(5) Foreign Debt

The Government's guideline in setting the annual ceiling for foreign disbursement is a maximum of 25 percent of revenue, as approved in the National Budget.

Foreign debt increased to US$1,407 million as of 31 December 1997 and its percentage of GDP increased to 14.7 percent. In addition to direct foreign debt, the Republic extends guarantees for foreign loans raised by state enterprises in cases where it deems such guarantees to be in the national interest.

Lithuania's scheduled direct debt service is modest by international standards. External direct debt service for the year ended 31 December 1997 accounted for approximately 5 percent of the Republic's exports of goods, services and net transfers for the year. It is said that there may be no concern about debt service in the future because of the strong economic recovery.

(6) Industry and Trade

Lithuania's GDP is mainly created in the services and industries sectors (utilities, mining and manufacturing) which account for 81.5 percent of the GDP in 1996.

Refined petroleum products, food products and beverages, chemicals, textiles and apparel are the main industrial products which account for more than 70 percent of the industrial production. Some manufacturing industries such as textiles, apparel, food, wood and wood products have been recovering faster since the restoration of independence.

Main export products are mineral products, textiles and machinery which, respectively, accounted for 17.8 percent, 16.3 percent, and 12.2 percent of exports in 1997. Main import products are machinery, mineral products and transport equipment which respectively accounts for 18.4 percent, 18.2 percent, and 11.4 percent of the import.

2.3.5 Infrastructures

2.3.5.1 Electric Power Supply

Lithuania is the most nuclear-dependent country in the world. Approximately 83 percent of the total power demand is supplied by a nuclear power plant located in Ignalina some 120 km north of Vilnius. The power plant works at only about 86 percent of capacity and generates 14 billion kWh of power per year.

2.3.5.2 Transportation

In 1997, Lithuania had a total of 4,853 km of roads, of which 3,478 km are paved. The national highway network connect the major cities with first class highways. The main route is Highway A1 which runs 330 km from east to west connecting Vilnius and Klaipėda.

Secondary national roads are well developed and maintained to provide access to municipalities in all districts.

2.3.5.3 Water Supply and Sewerage

In Lithuania, most of the urban population has access to safe drinking water supplied by the Water Companies. Water Companies, called "Vandenys" in Lithuanian, are formulated as joint stock companies with the municipality as a major shareholder.

Generally, groundwater is the source of water in Lithuania where aquifers with high yields are common. Groundwater, however, often contains iron and requires treatment for iron removal.

Water supply in the country and major cities is summarized Table 2.3.

Sewage treatment is not sufficient to prevent pollution caused by wastewater. Table 2.4 presents an overview of sewerage services for the major cities in Lithuania.

Table 2.3 Water Supply Service in Lithuania

	Total Length of one direction street water supply lines (km)	Water Supply Amount ('000 m^3/day)		
		Amount directly into the Systems	Amount through Treatment	Domestic Use
Country Total	5,265.8	283,557	84,436	195,101
Major Cities				
Vilnius	588.4	60,885	7,641	59,278
Kaunas	449.0	45,914	1,490	27,288
Klaipėda	220.5	27,680	13,644	17,718
Šiauliai	204.0	9,330	0	5,918
Panevėžys	194.1	10,732	10,671	5,211

Table 2.4 Sewerage Service in Lithuania

	Total Length of one direction street sewer pipes (km)	Amount of Sewage ('000 m^3/day)			
		Discharge of Wastewater	Discharge of Wastewater through Treatment Facilities		Through Biological Treatment
			Total Amount	% of Total Wastewater discharged	
Country Total	2,765.8	248,565	181,223	73%	107,978
Major Cities					
Vilnius	355.5	55,009	54,633	99%	26,825
Kaunas	290.0	32,955	0	0%	0
Klaipėda	149.3	47,451	25,584	54%	0
Šiauliai	135.0	7,569	7,550	100%	6,795
Panevėžys	98.1	12,498	12,296	98%	12,261

2.3.5.4 Solid Waste Management

Solid waste collection and disposal is under the responsibility of each municipality. Municipal solid wastes are collected by each municipality and disposed of at waste disposal sites that are normally located far from the urban area. Dumping sites consist of either sanitary landfills or open dumping. No incineration is practiced.

2.3.5.5 Community Heating

In Lithuania, hot water heating services are operated by private companies at each city. These companies own the facilities for water storage, heating, and distribution that are separated from the public water supply system for drinking water. Hot water is used not only for heating but also for domestic use such as bathing, washing etc.

Normally, the source of hot water is the public water supply which complies with the drinking water standard. Hot water companies buy water from a water supply company and sell it adding the cost of heating and distribution.

Most of the households in the cities and towns have hot water services but some individual houses have their own heating and hot water systems.

CHAPTER 3

SEWERAGE IN LITHUANIA

3 SEWERAGE IN LITHUANIA

3.1 GENERAL

Construction of sewerage facilities in Lithuania commenced in the 1960's. In the early phase, pipeline facilities were constructed and connected to each house and building. As of 1997, a total of 2,765 km of sewers have been laid.

The existing sewage treatment facilities are not adequate to treat the wastewater discharged from domestic and industrial sources. Approximately 43 percent of wastewater is treated by a biological treatment method that can remove organic matter. Other fractions of the wastewater are discharged to the environment without removal of the organic matter. Such wastewater causes the pollution of water and soil systems in the country.

Many industries are connected to the sewer network, and currently discharge wastewater without proper pre-treatment. This is because there are no proper standards in Lithuania to control discharge of industrial wastewater. Only a limited number of factories have pre-treatment facilities to reduce the pollution load before discharge to the sewers. The industrial sector is required to pay a pollution charge based upon the quantity and quality of wastewater discharged.

3.2 ORGANIZATION AND LEGISLATION

3.2.1 Ministry of Environment

Environmental protection in Lithuania started with formation of the Nature Protection Committee in 1957. The Department of Environmental Protection was formed under the Seimas (Lithuanian Parliament) in 1992. The Ministry of Environmental Protection (MEP) was then established on June 15, 1994 replacing the Department of Environmental Protection. The MEP is authorized as the main organization responsible for environmental management and use of natural resources.

In the re-organization of the government in May 1998, the MEP merged with the Ministry of Construction and Urban Development, and was named the Ministry of Environment (MOE). The new organization of the MOE consists of 11 departments as shown in Figure 3.1.

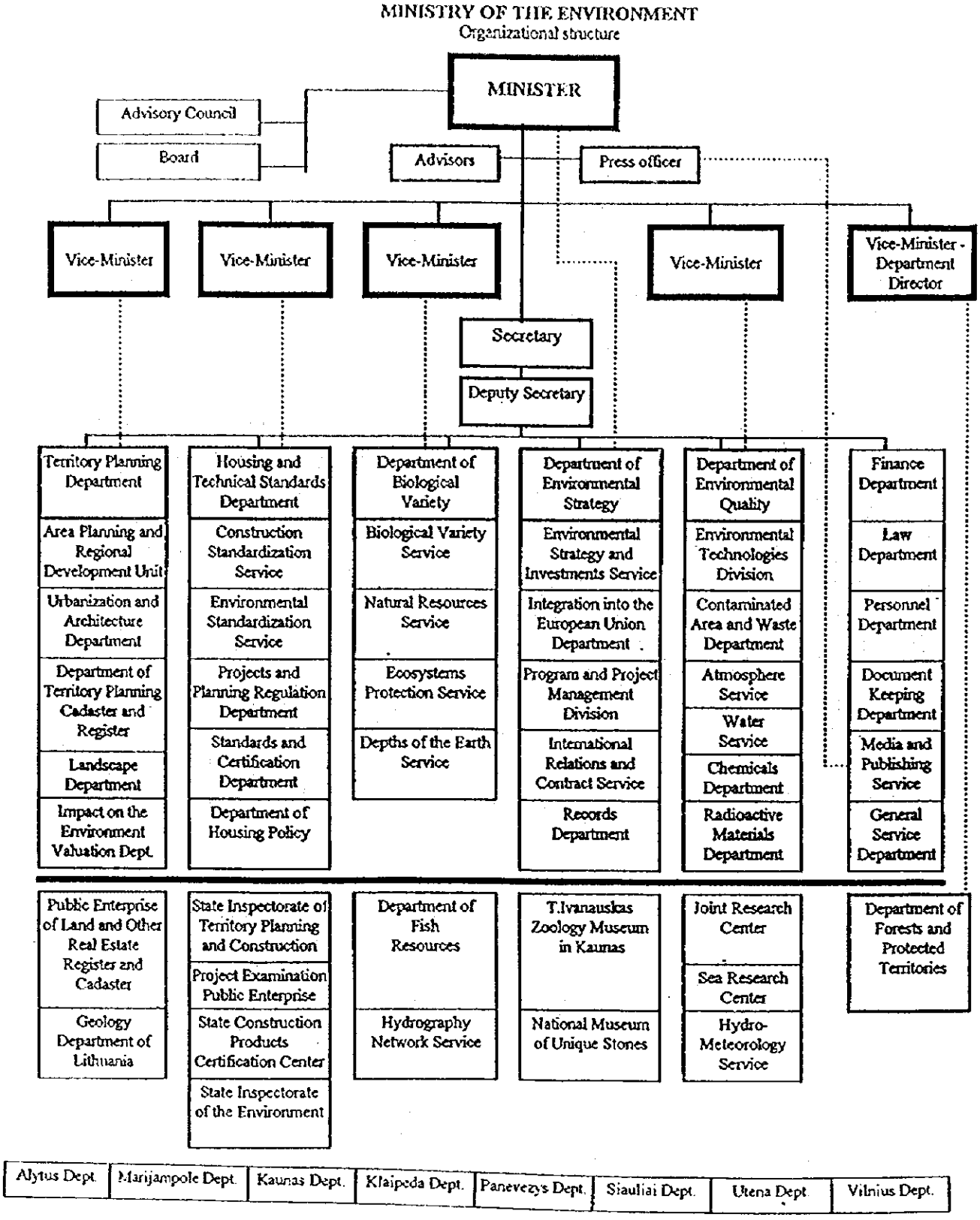


Figure 3.1 Organization of the Ministry of Environment

3.2.2 Water Company

Before independence in 1991, water supply and sewerage service were managed by each Municipality. After 1991, at each city and municipality, water supply and sewerage services are managed, and operated by a Water Company that is a joint stock company, called "Vandenys" in Lithuanian. In 1992, fourteen large Water Companies started the service as joint stock companies. Since then, these large Water Companies have split into smaller companies for each City and Municipality.

The Water Company is an organization responsible for planning, construction, operation and maintenance of the water supply and sewerage works. The Water Company is operated on an equity contribution from municipality, revenue from the tariff collections, loans from various funding sources and subsidy from the central government, etc. The major shareholder of most of the Water Companies is the local Municipality.

3.2.3 Legislation Related to Water and Sewerage

Laws and regulations of Lithuania related to the water and sewerage management are listed as follows:

Laws related to the Water Management

- Environmental Protection Law, 1996
- Law on Water, 1997
- Law on Underground Resources (Entails of the Earth), 1995
- Law on Protected Areas, 1993
- Marine Protection Law, 1997
- Law on Monitoring, 1997
- Law on Taxes on State Owned Natural Resources, 1991
- Law on Pollution Tax, 1991 (revision under through Parliament)

Regulations related to the Water Management

- Ministry Order: Wastewater effluent standards, 1997 (LAND 10-96)
- Ministry Order: Standard of Usage of Sewage Sludge, 1997 (LAND 20-96)
- Ministry Order: Regulations for the obtaining of permits for use of material resources and emissions (air, water, waste), 1994
- Ministry Order: Regulations on the establishment of rain water collection systems and discharge standards, application of taxes for rainwater discharge and laboratory monitors, 1995 (LAND 3-95)
- Ministry Order: Regulations on use and maintenance of water reservoirs, 1995 (LAND 4-95)

- Ministry Order: Directions for the construction and sealing of individual wells, 1995 (LAND 4-95)
- Ministry Order: Water use estimates for different activities, 1991 (RSN 26-90)
- Regulations on the scaling of regulations temporary closing of wells, 1996 (LAND 17-96)
- Regulations for the maintenance, first time dredging and river bed maintenance of inland waterways of state importance, 1996 (LAND 13-95)
- Regulation on protection of surface water against pollution by effluents, 1975 (valid until 2000)
- Government Order: Special conditions for land and forest use, 1996

3.3 ENVIRONMENTAL STRATEGY AND POLICY

3.3.1 Environmental Strategy and Action Program

The Lithuanian Environmental Protection Program was developed in 1992. The program included all major environmental problems, and established implementation priorities. Since then, most of the measures proposed in the program have been implemented while others are still underway.

Further, to include the national economic and development policies and to address urgently some environmental problems, the Ministry of Environmental Protection developed a new Environmental Protection Program in 1995. The program was approved by Parliament in September 1996. This program presented a long-term strategy, as well as short and medium-term action programs related to environmental protection. Recommendations were also made for funding of environmental protection in the program.

3.3.2 Environmental Protection Goals

The 1995 program sets environmental protection goals in two major categories: (1) Environmental Quality Protection, and (2) Protection of Natural Resources, Landscape and Biodiversity. More specific goals have been established for each category as follows:

Environmental Quality Protection by Sector

Water Protection

- reduction of surface water pollution from municipal and smaller settlements wastewater;
- reduction of pollution from industrial and agro-industrial wastewater;
- reduction of groundwater pollution;
- reduction of non-point source pollution to water bodies;
- reduction of pollution from surface (storm water) run-off;
- reduction of pollution loads into the sea;

- reduction of seawater pollution from oil products transportation; and
- reduction of polluted water crossing the borders from other countries.

Air Pollution

- reduction of pollution from transport exhaust gases;
- reduction of volatile organic compounds emissions from point sources;
- reduction of the use of ozone depleting substances and their emissions;
- reduction of pollution with suspended solids; and
- reduction of SO_2 and NOx long-range transboundary pollution.

Protection of Soil from Pollution

- reduction of soil pollution from organic and mineral fertilizers and other agricultural chemicals;
- reduction of soil pollution from oil products;
- reduction of soil pollution from cities and industrial areas; and
- reduction of soil pollution with heavy metals.

Waste Management

- waste management system creation;
- reduction of environmental contamination from industrial and hazardous wastes;
- reduction of pollution from domestic wastes;
- eliminating prohibited and old pesticides; and
- regulation of radioactive wastes.

Protection from Physical Pollution

- reduction of noise levels in cities;
- prevention of radioactive releases posed by Ignalina Nuclear Power Plant; and
- reduction of radioactive environmental pollution.

<u>Protection of Natural Resources, Landscape and Biodiversity</u>

Land Use Structure Formation

- optimization of the general land use structure;
- prevention of further natural landscape degradation in nature from other territories and those under protection, in cities and towns;
- prevention of depletion of the soil layer structure;
- prevention of further karst region and wetland landscape degradation; and
- optimization of protected areas network.

Biota Protection

- prevention of further plant, animal and fungi species and populations degradation;

- optimization of forest structure;
- optimization of the use of wildlife resources; and
- prevention of further degradation of river valleys and lakes as well as marine biocenoeses.

Protection of Recreational Environment

- prevention of further degradation of recreational agrarian environment;
- prevention of further sea beaches and sand dunes degradation; and
- prevention of further urban development in the most picturesque natural areas, primary construction activities in the coastal zone, namely, along beaches, dune chain, or on the front and back lines of the dunes and the cliffs.

Lithosphere Protection

- re-naturalization of used quarries;
- reduction of a negative impact upon the environment from oil extraction, from transportation of oil and oil products and their sales;
- prevention of a negative impact upon the environment from the use of geothermal energy; and
- prevention of a negative impact upon the environment from the exploitation of other mineral resources.

Water Resources Protection

- protection of fresh resources from over-use while extracting water from in-take sites; and
- prevention of further changes of the natural hydrographic network structure.

3.3.3 Priority of Wastewater Projects

Out of the environmental protection goals listed above, the Environmental Protection Program established the priority in implementation of various schemes. The highest priority was given to the following three subjects:

- Water and air quality
- Waste management
- Preservation of natural resources, landscape and biological diversity.

Wastewater treatment and reduction of discharge is given the highest priority in the program; in allocation of investments, particularly for funds from the State budget, and loans and subsidies received by the State. The program also encourages restructuring the financial mechanism for the wastewater sector by introducing the "polluter/consumer pays" principle and development of water protection laws.

3.3.4 Environmental Policies Principles

The Environmental Protection Program takes into consideration the importance of the principles in implementing the action programs and in achieving the environmental protection goals. The principles of environmental protection policies in the Program are as follows:

- Sustainable Development
- Consistent development
- Environmental policy integration
- Precautionary principle
- Polluter/User pays principle
- Prevention
- Use of best available technology not entailing excessive costs
- Subsidiarity principle
- Partnership and sharing of responsibilities
- Information availability
- Assessment of sustainable development

3.4 STANDARDS RELATED TO SEWERAGE SYSTEM

3.4.1 Laws and Regulations for Effluent and Environmental Standards

3.4.1.1 Effluent Standards

In Lithuania, the standards applied to sewage are set in the "Sewage Pollution Norms LAND 10-96". Effluent standards are specified (1) for effluent discharged into surface waters, and (2) for effluent discharged into public sewerage systems. Norms abstracted from the LAND 10-96 documents are as follows:

Table 3.1 Principal Pollution Norms of Sewage discharged into Surface Waters (1/2)

Pollutants	Permissible Concentration (mg/l)	
	Average annual concentration (Cave)	Maximum instantaneous concentration (Cmax)
BOD_7[2]		
< 5 m^3/day	30[1]	50
5 m^3/day – 5,000 PE[3]	25[1]	40
5,000 – 10,000 PE	20[1]	30
>10,000 PE	15[1]	25
COD		
< 10,000 PE	100[1]	150
≥10,000 PE	75[1]	120
Total-P		
≥10,000 PE	1.5[1]	2.5
Total-N		
10,000 – 100,000 PE	20[1]	35
≥100,000 PE	15[1]	25

Table 3.1 Principal Pollution Norms of Sewage discharged into Surface Waters (1/2)

(continued)

Pollutants	Permissible Concentration (mg/l)	
	Average annual concentration (Cave)	Maximum instantaneous concentration (Cmax)
Suspended Solid		
<100,000 PE	30[1)]	45
≥100,000 PE	25[1)]	35

1) If the factual average concentration of pollutants (Cave) from a treatment facility, or the average concentrations of pollutants (Cave) of the treatment facility that is under design is less than the values established by these norms, to calculate Cave concentration for maximum permissible pollution shall be taken in accordance with a project that has been approved or in accordance with the data of laboratory research, whereas the maximum instantaneous concentration (Cmax) shall be taken in accordance with Table 3.1 and Table 3.2.
2) $BOD_7 = 1.15 \times BOD_5$
3) PE (population equivalent): the relative number of population calculated according to the amount of pollutants in sewage (70g-BOD_5/cap/day, 70g-SS/cap/day, 12g-N/cap/day, 2.7g-P/cap/day)

Table 3.2 Principal Pollution Norms of Sewage discharged into Surface Waters (2/2)

Pollutants	Concentration in mg/l
Biological	
Nitrites-N[2)]	1 [1)]
Ammonium-N[2)]	5 [1)]
Non-Organic	
Cadmium, Cd	0.04 [3)]
Chromium, Cr	0.5 [3)]
Chromium, Cr^{6+}	0.1 [3)]
Copper, Cu	0.1 [3)]
Mercury, Hg	0.002 [3)]
Nickel, Ni	0.2 [3)]
Lead, Pb	0.1 [3)]
Manganese, Mn	1 [3)]
Tin	1 [3)]
Vanadium, V	2 [3)]
Zinc, Zn	0.3 [3)]
Aluminum, Al	0.5 [3)]
Cyanides, Cn	0.1 [3)]
Active Chlorine, Cl	0.6 [3)]
Chlorides	500 [4)]
Fluorides	8 [4)]
Sulphides	0.5 [4)]
Sulphates	300 [4)]
Arsenic, As	0.05 [4)]
Organic	
Synthetic active surface substances (detergents)	
anionic	1.5 [4)]
non-ionic	2 [4)]
Oil products	1 [3)]
Phenols	0.2 [4)]
Fats	1 [3)]

1) Permissible average annual concentration.
2) Applies for wastewater amount of 1,000m^3/day or more.
3) Maximum spot sample concentration.

4) Permissible concentration of 24-hour composite sample. In case of absence of automatic sampling, maximum spot sample concentration shall be applied.

Table 3.3 Principal Pollution Norms of Sewage discharged into Sewerage System*

Pollutants	Concentration in mg/l
General	
COD/BOD,**	<2.5
pH	6.5 - 9
Non-Organic	
Cadmium, Cd	0.1 [1]
Chromium, Cr	1 [1]
Chromium, Cr^{6+}	0.2 [1]
Copper, Cu	1 [1]
Mercury, Hg	0.01 [1]
Nickel, Ni	0.5 [1]
Lead, Pb	0.5 [1]
Manganese, Mn	10 [1]
Tin	2 [1]
Zinc, Zn	1 [1]
Cyanides, Cn	0.5 [1]
Active Chlorine, Cl	0.6 [1]
Fluorides	10 [1]
Sulphides	2 [1]
Arsenic, As	0.1 [1]
Organic	
Absorbing organic halogens	0.1 [1]
Synthetic active surface substances (detergents)	
anionic	10 [1]
non-ionic	15 [1]
Oil products	5 [1]
Phenols	3 [1]

1) Permissible concentration of 24-hour composite sample. In case of absence of automatic sampling, maximum spot sample concentration shall be applied.
2) Permissible average annual concentration.
* If the sludge formed in treatment facility does not meet the requirements for use, the Ministry of Environment may establish more stringent standards.
** $BOD_7 = 1.15 \times BOD_5$

3.4.1.2 Standard for Sludge Disposal

The Ministry of Environment has a national standard named "LAND 20-96 Standard of Usage of Sewerage Sludge" that has been prepared in compliance with the EU standard 86/278/EEC. This standard shall be applied to the sludge from domestic and combined sewage treatment plants. Before use, all sludge shall receive treatment by biological, chemical, thermal, or composting method to reduce microbiological and parasitological pollution.

LAND 20-96 defines the categories and classes of the sludge produced in a sewage treatment plant as follows:

Table 3.4 Sludge Category by Heavy Metal Contents

Sludge category	Amount of heavy metals (mg/kg)						
	Pb	Cd	Cr	Cu	Ni	Zn	Hg
I	≤60	≤1.0	≤60	≤60	≤45	≤200	≤0.8
II	61-165	1.1-2.0	61-130	61-200	45-100	201-660	0.8-2.0
III	166-250	2.0-3.0	201-300	201-300	101-150	661-1000	2.0-3.0
IV	251-500	3.0-6.0	301-600	301-600	151-300	1001-2000	3.0-6.0
V	>500	>6.0	>600	>600	>300	>2000	>6.0

Table 3.5 Sludge Category by Pathogenic Organisms

Sludge class	Escherichia coli (no./g)	Clostridium perfringens (amount/g)	Helminth eggs and larvae (amount/g)	Pathogenic enterobacteria (amount/g)
A	≤1 000	≤100 000	0	0
B	1 001-100 000	100 001-10 000 000	1-100	0
C	>100 000	>10 000 000	>100	>1

With the category and class of sludge above, various restrictions are set for use of sludge as summarized below.

Table 3.6 Restriction for Use of Sludge

Sludge category class	fertilize fields and re-cultivate quarries	fertilize vegetable	fertilize sensitive areas[1]	fertilizing intensive karst area
I	O	X	X	O
II	O	X	X	X
III	O	X	X	X
IV	O	X	X	X
V	X	X	X	X
A	O	O	X	X
B	O	X	X	X
C	X	X	X	X

1. Sensitive area = sensitive zones designated in Lithuanian hygienic standard 'the standards and regulations of design and supervision of a sanitary protection zone of underground water (HN 44-1993).'

3.5 PRESENT STATUS OF THE SEWERAGE SYSTEMS

As briefly noted in Chapter 2, approximately 249 million m^3/year (682,000 m^3/day) of domestic wastewater is discharged into surface water. Out of this amount, 73 percent is receiving some kind of treatment. Biological treatment is applied to only 108 million m^3/year or 43 percent of the total amount of domestic wastewater.

In 1997, some 84 cities and municipalities have a treatment facility in operation. The Ministry of Environment is implementing construction projects for sewage treatment plants and sewerage systems in the major cities and municipalities. As of 1998, there are various sewerage

projects under implementation with financial assistance from foreign or international donor agencies as follows:

Table3.7 Ongoing Sewerage Projects

	City	City Population	Project Cost	Local Budget	Donor	Foreign Finance	
						Grant	Loan
A	Vilnius	580,099	11,232		PHARE	732	
					Denmark		10,500
A	*Kaunas*	418,707	98,850	67,550	EBRD	0	14,800
					NEFCO	0	3,000
					Sweden	3,800	0
					Finland	1,700	0
					PHARE	8,000	0
A	*Klaipėda*	203,269	23,100	7,213	World Bank	0	7,000
					PHARE	887	0
					Finland	3,000	0
					Sweden	5,000	0
A	*Šiauliai*	146,996	22,850	8,000	World Bank	0	6,200
					Sweden	2,100	0
					Norway	1,500	0
					Sweden	4,650	0
					Other	400	0
C	Kelmė	43,296	2,043	765	Denmark	0	1,278
C	Lazdijai	32,817	1,484	720	Denmark	0	764
C	Molėtai	26,640	1,482	735	Denmark	0	747
C	Pakruojis	30,992	1,802	830	Denmark	0	972
C	Raseiniai	46,674	2,293	755	Denmark	0	1,538
C	Šilalė	33,303	1,567	720	Denmark	0	847
C	Anykščiai	38,031	2,120	620	Denmark	0	1,500
B	Alytus	77,362	3,120	620	Denmark	0	2,500
C	Širvintos	21,716	1,840	640	Denmark	0	1,200
B	Ukmergė	51,453	3,010	10	Denmark	0	2,500
B	Utena	53,981	3,040	540	Denmark	0	2,500
C	Vilkaviškis	53,117	950	450	Denmark	0	500
A	Panevėžys	133,347			Denmark	0	313
A	Panevėžys	133,347			Denmark	0	195
A	Šiauliai	146,996			Denmark	0	173
C	Anykščiai	38,031			Denmark	0	2,400
B	Tauragė	56,088			Denmark	0	352
B	*Palanga*	19,716			PHARE	1,625	0
B	Pavojingu				PHARE	1,375	0
	Total					34,769	61,779

unit: thousand US $
city in Italic: Project of the highest national priority
A: Large scale Water Company
B: Medium scale Water Company
C: Small scale Water Company

3.6 FINANCE FOR SEWERAGE DEVELOPMENT

3.6.1 Public Investment Program of the Government

Each year, the Ministry of Finance develops an annual budget and the Ministry of Economy plans and revises the three-year investment projects to fit within the annual budget, under the title

"Public Investment Program" (including projects of more than 3 million litas). All ministries, and some municipalities, request budgets for their projects from the Ministry of Economy. The Ministry of Economy prioritizes the projects from the viewpoints of national importance and necessity. Water and sewerage projects are part of the Public Investment Program.

Almost all water and sewerage Public Investment Program projects are based on the National Environment Program. Wastewater treatment projects are a top priority in this program. The Ministry of Environment makes comments on the projects from the viewpoint of environmental protection to the Ministry of Economy. Projects are then finally determined by the Ministry of Economy together with the Ministry of Environment.

3.6.2 Financial System for the Sewerage Projects

Finance sources for projects are the state government budget, the municipality budget (small), profits of the water companies (many of them unprofitable), grants and/or loans from foreign countries and international financial institutions like the World Bank, EBRD, etc. The Ministry of Finance, in some cases, acts as a borrower to the World Bank, Nordic Investment Bank (NIB), European Investment Bank (EIB) and the EBRD, and can guarantee loans from foreign countries for the borrowers, if requested.

The Ministry of Environment and municipalities have environment protection funds, which are used for the protection of the rivers, sea and forests. These funds are not sufficient to cover sewerage projects in every district. Many water and sewerage projects are presently financed by foreign countries. All of them are guaranteed or funded by the Government. All important projects must be included in the Public Investment Program if they wish to be included in the state budget, or receive a state guarantee. According to the list of environmental projects prepared by the Ministry of Environment, there are 23 projects, which used, are using, or planning to use foreign grants or loans in the near future.

These projects are financed by the EBRD loans of 14.8 million US dollar, NEFCO loans of 3 million US dollar, Swedish Government grants of 3.8 million US dollar, Finnish Government grants of 1.7 million US dollar, and PHARE grants of 8.0 million US dollar. These account for 32 percent of the total project costs of 98.85 million US dollar. The remainder was financed by the budget of the State Government (48.3%), the municipality (8.3%) and the Water Company (11.4%). Budgets and grants account for about 70 percent of the total project costs. The Danish Government is very active in supporting sewerage projects through export credit loans. The Molėtai plant is already working, and 11 other plants are under construction.

CHAPTER 4

BIRZAI TOWN SEWERAGE SYSTEM IMPROVEMENT PLAN

4 BIRZAI TOWN - SEWERAGE SYSTEM IMPROVEMENT PLAN

4.1 DESCRIPTION OF THE STUDY AREA

4.1.1 General

Birzai is located 210 km north of Vilnius and 20 km from the Lithuanian-Latvian border. Birzai was first mentioned as a settlement in 1455, and has been a frontier town of Lithuania. In the late 16th century, Birzai was granted the right to force all merchants en route to Riga in Latvia, to stop first in Birzai. Birzai was then an important town on the main trading route in the Baltic Sea region.

4.1.2 Natural Conditions

4.1.2.1 Topography, Geology and Hydrogeology

Birzai is located on relatively flat land with an elevation between 55 to 65 m above sea level. Ground slopes gently downward from south to north.

Birzai is surrounded by a large karst geological area that extends to southern Latvia over an area of about 1,000 km^2. This area is referred to as the Gypsum Karst Region as it is formed with mature gypsum karst at the land surface and the subsurface.

4.1.2.2 Meteorology

Temperature and precipitation in the Birzai area are shown below:

Table 4.1 Temperature and Precipitation in Birzai

Month	Temperature (°C)			Precipitation (mm)		
	Minimum	Average	Maximum	Minimum	Average	Maximum
January	-35.1	-5.7	8.4	9	32	80
February	-35.5	-5.2	13.0	6	24	69
March	-29.5	-1.2	18.8	4	34	87
April	-16.7	5.5	26.1	6	40	102
May	-4.1	12.1	30.7	14	52	150
June	0.1	15.7	33.3	21	58	197
July	3.5	16.7	33.7	25	77	183
August	0.4	15.9	33.3	15	71	220
September	-5.3	11.4	28.9	0	64	157
October	-10.8	6.7	22.7	4	55	136
November	-20.4	1.5	16.2	8	52	135
December	-31.4	-3.2	10.5	9	46	90
		5.9		434*	609	921**

source: Meteorology Station

* : minimum annual total precipitation (1928)

** : maximum annual total precipitation (1975)

4.1.2.3 Surface Waters

Birzai has a big manmade lake just north of town. The dam was constructed in the 16th century. The area of the lake is 340 ha. In the Municipality area, there are four major rivers, all of which flow from south to north. The rivers Tatula and Obelaukias bypass the town to the west and east respectively, while the Apascia and Agluona Rivers flow through the town into the lake.

4.1.3 Socio-economic Conditions

4.1.3.1 Administrative Territory and Population

Birzai Municipality has a total area of 1,476 km^2 including the town of Birzai (urban area) as the capital of the Municipality. The town of Birzai has an area of 1,783 ha. The Municipality is governed by the council and mayor. The Administrator is assigned for management of the administrative works. The administrative structure of the Municipality includes eight local authorities (towns), 12 Departments/Bureaus/Offices and advisors.

Population of Birzai is shown in the table below:

Table 4.2 Population of Birzai

Year	Municipality Population	Population in Birzai Town (urban area)
1991	38,301	16,373
1992	38,520	16,349
1993	38,701	16,308
1994	38,772	16,364
1995	38,991	16,252
1996	38,933	16,326
1997	38,908	16,183

As shown above, the population of the town has been decreasing slightly while that of the municipality has been almost stable. There has been limited migration in and out of the municipality.

4.1.3.2 Economy

Commercial and Industry

The main industry in the Birzai Municipality is agriculture similar to the other local areas in Lithuania. In Birzai town, there are also several factories producing food, beer, and textiles.

Local Investment

Recently, a Swedish company announced a plan to invest in a famous beer brewery factory in Birzai Town.

Employment

Statistics Department shows the unemployment in Birzai Municipality as follows

Table 4.3 Unemployment Rate in Birzai

Year	Birzai	Lithuania
1993	8.1 %	4.4 %
1994	3.6 %	3.8 %
1995	5.0 %	6.1 %
1996	5.1 %	7.1 %
1997		

Unemployment in Birzai is relatively low except for 1993 compared with the overall country's average figure.

4.1.3.3 Public Investment Program

As of the beginning of 1998, the sewerage system improvement project is the only program for Birzai Municipality proposed in the Public Investment Program of the Government.

4.1.4 Land Use

4.1.4.1 Present Land Use

There is no clear data for the land use of the Birzai Municipality. Most of the town area is however designated as a developed area which consists of residential, public, and industrial areas, and parks. Agricultural land use is minimal within the town area.

4.1.4.2 Development Plan for Future Land Use

Currently there is no definite plan to develop or expand the present urban area.

4.2 WATER COMPANY (VANDENYS)

4.2.1 History

Birzai Water Company was established in 1994 as a joint stock company from the former Panevėžys Water Supply Department. Shareholders of the Water Company are the Municipality (90.6 %) and an oil company (9.4 %). The oil company invested in the Water Company when the Water Company became a joint stock company separated from one division of the Municipality.

4.2.2 Organizational Structure and Responsibility

In 1997, Birzai Water Company had a total of 52 employees in its organization. Organization of the Water Company and the number of staff of each division are shown in Figure 4.1.

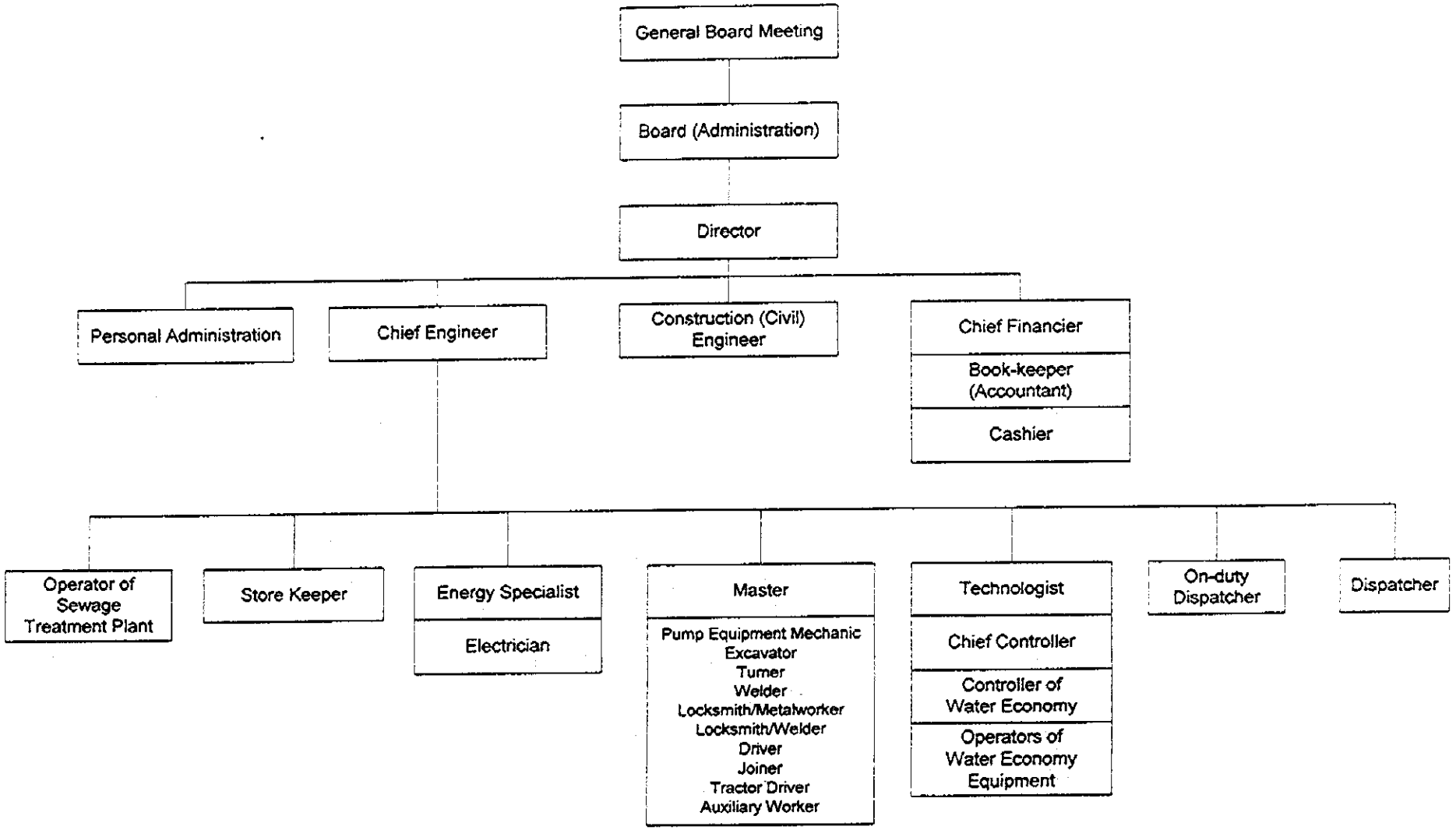


Figure 4.1 Organization of Birzai Water Company

4.2.3 Service Area and Population Served

Populations served in 1996 and 1997 are tabulated as follows:

Table 4.4 Population Served – Water Supply and Sewerage

Year	Water Supply	Sewerage
1996	7,570	8,280
1997	7,400	8,240

4.2.4 Tariff Structure

Tariffs for water supply and sewerage are set up as follows:

Table 4.5 Tariff Schedule

User Type	Water Supply	Sewerage
Residential use	1.46 Lt/m^3	1.37 Lt/m^3
Enterprise	2.54 Lt/m^3	1.38 Lt/m^3

4.2.5 Financial Performance

The Birzai Water Company made losses both in 1996 and in 1997. Operating losses against sales increased from -5.8 percent in 1996 to -9.2 percent in 1997. Current losses to sales increased from -4.2 percent in 1996 to -5.7 percent in 1997.

4.3 EXISTING SEWERAGE SYSTEM

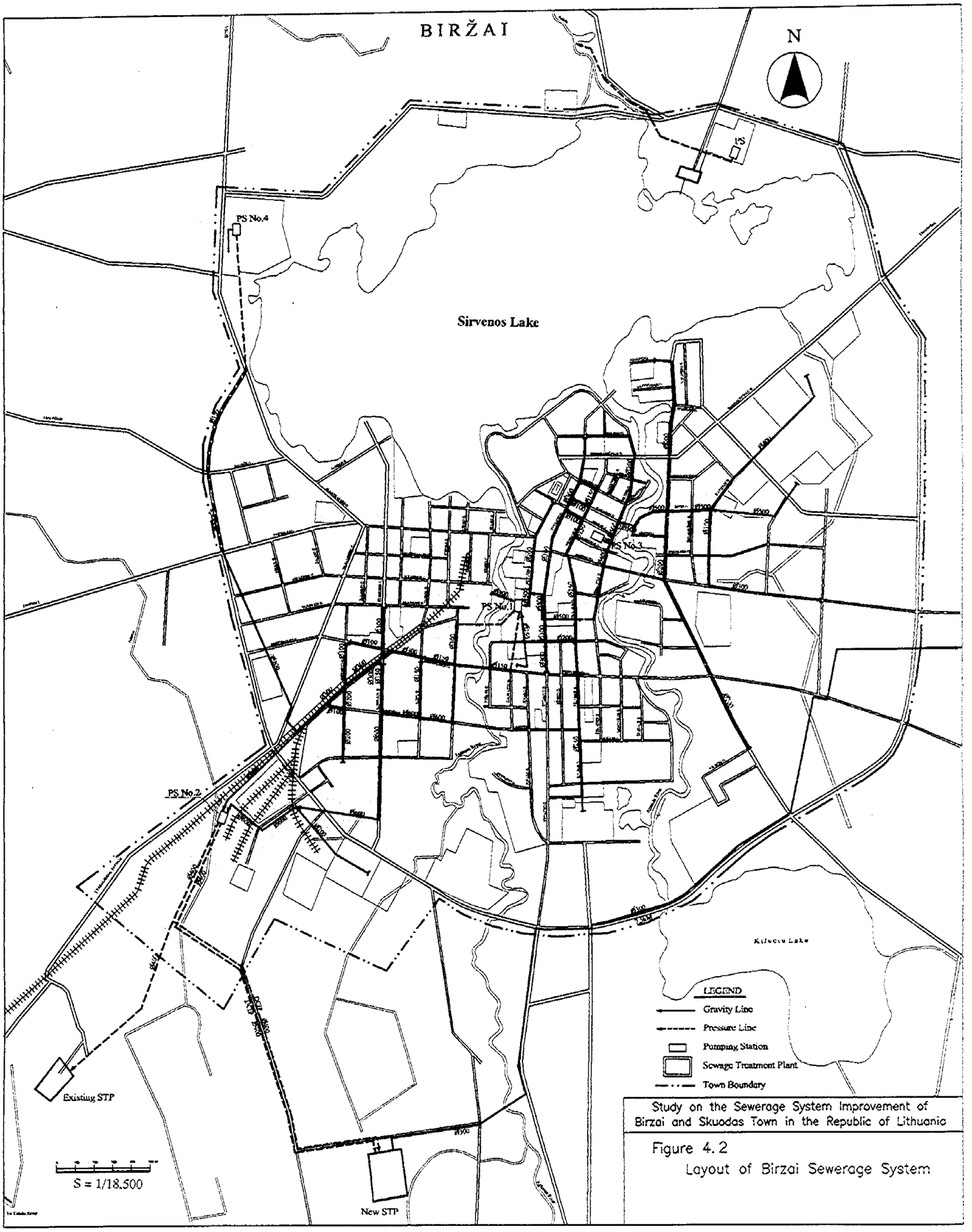
4.3.1 Existing Facilities

4.3.1.1 General

The sewerage system of Birzai has been developed since the 1960's to collect, transfer and treat the sewage discharged in the town proper. The existing system consisting of pipelines, pump stations, and a treatment plant was completed in 1962. Currently, the existing system collects sewage totaling about 2,200 m^3/day. The layout of the existing sewerage system is presented in Figure 4.2.

4.3.1.2 Sewage Collection

The sewage collection system of Birzai is a separate system in which only sewage is collected. Rainwater is drained into the rivers or the lake through open channels. The sewerage collection system consists of sewer pipelines and pump stations. The total length of sewers is 28,070 m with diameters ranging 100 to 600 mm.



Study on the Sewerage System Improvement of Birzai and Skuodas Town in the Republic of Lithuania

Figure 4.2
Layout of Birzai Sewerage System

4.3.1.3 Sewage Treatment

Existing Treatment Plant under Operation

The existing treatment plant is located about 2 km southwest of the town boundary. It is estimated that the plant has a treatment capacity of approximately 2,600 m^3/day. The plant receives sewage from Pump Station No.2. Layout of the existing treatment plant is presented in Figure 4.3.

New Treatment Plant partly constructed

The treatment plant was designed in 1994 by a local consulting firm "UAB Ekoprojektas". The process design included nutrient removal using the A2/O system (anaerobic-anoxic-oxidation) in which the removal of organic matter and nutrients occur in a single basin activated sludge system.

Construction work was commenced in 1995 but ceased in 1997. At present, only the base slabs and walls of the reaction tank have been built. Concrete wall design used pre-cast concrete panels, a normal practice in Lithuania.

4.3.1.4 Sludge Disposal

At present, sludge is stored in two ponds in the treatment plant site. Since the sludge is in liquid state due to absence of the dewatering devices, reuse for agricultural use is almost impossible. Because use of sludge for fertilizing the agricultural land is prohibited in the karst geological area, final disposal is a problem.

4.3.1.5 Discharge of Effluent from the Treatment Plant

Effluent from the stabilization pond is discharged, as the final effluent, into a drainage/irrigation canal that flows to one of the tributaries of the Tatula River after about 5km. This tributary flows into the Tatula River after approximately 3 km.

4.3.2 Characteristics of Sewage and Plant Performance

4.3.2.1 Existing Data of the Sewage Characteristics

The Water Company conducts a water sampling and quality analysis in a manner as follows:

Frequency: once a month

Sampling points: inlet and outlet of the treatment plant

For BOD_7 of the raw water, there is one extraordinary high value (3,360 mg/l) for November 1996. Other parameters of the same date also show high values, but are not so remarkable when compared with normal values. This high BOD should be taken as a special irregular value, probably caused by either error in the analysis or by dumping of unusual wastewater into the sewer on that day.

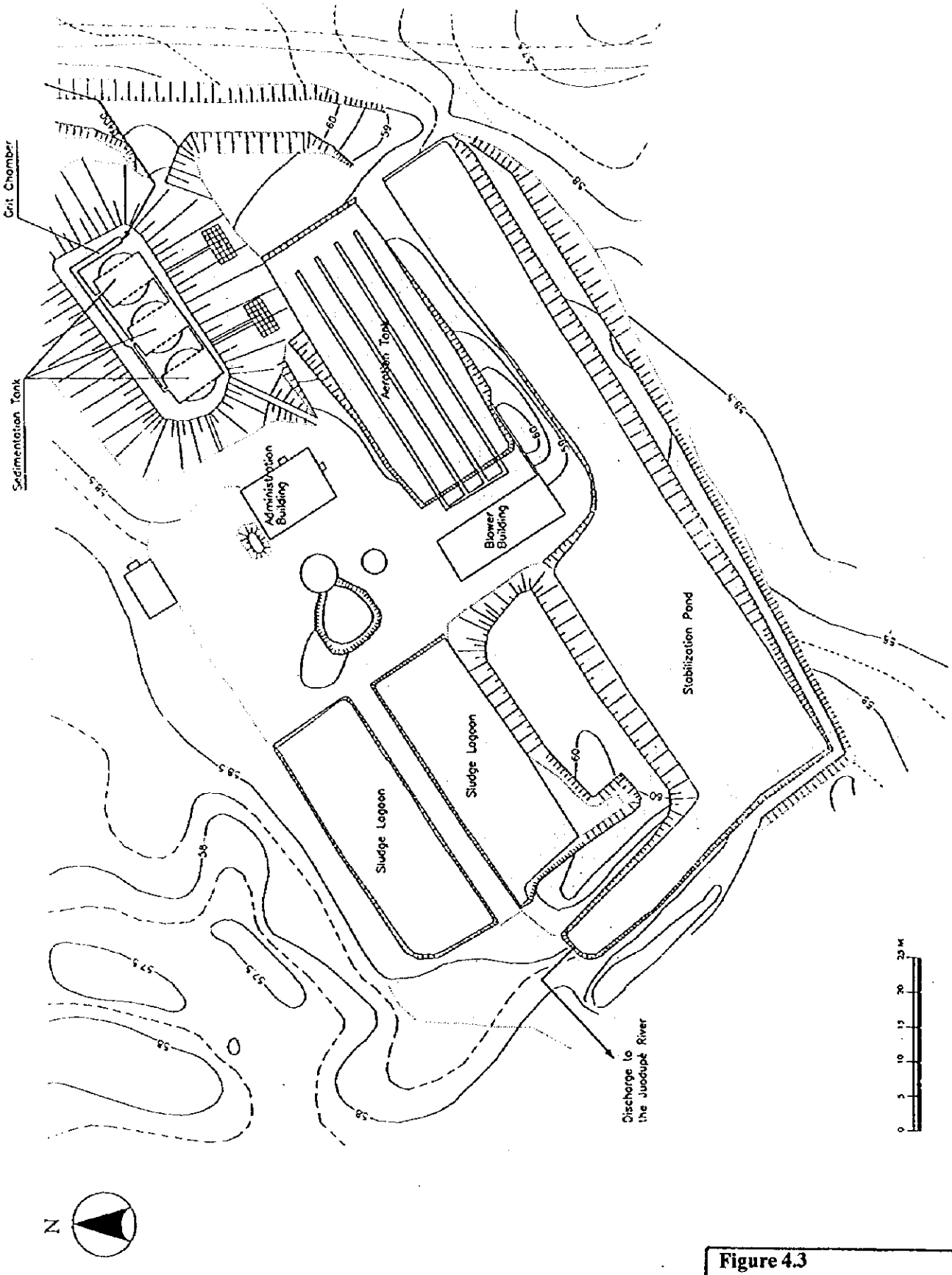


Figure 4.3
Layout of
the Existing Treatment Plant

4.3.2.2 Performance of the Existing Treatment Plant

The existing treatment plant does not satisfy the national effluent standards. The summary of the influent and effluent are shown below.

Table 4.6 Summary of Performance of the Treatment Plant

	BOD_7		SS		Total-N		Total-P		Oil	
	Inf.	Eff.	Inf.	Eff.	Inf.	Eff.	Inf.	Eff.	Inf.	Eff.
Maximum	3,360	630	1,037	236	152	67	12.0	9.0	1.8	1.0
Minimum	123	70	43	19	13	8	0.9	1.2	0.7	0.6
Average	513	187	240	62	44	32	5.0	3.9	1.1	0.8
Effluent Standard	20 (ave.) 30 (max.)		30 (ave.) 45 (max.)		NA		NA		1	
Average of Removal Ratio	44%		59%		18%		27%		17%	

Effluent standard: for <10,000 p.e.

BOD_7 and suspended solids far exceed the maximum values set in the standards while oil is within the acceptable range of the standards. This failure is easily explained from the design of the treatment process that does not have sufficient capacity of biological treatment.

4.3.2.3 Industrial Wastewater

In Birzai, there are several business entities, institutions, and industries that are discharging wastewater to the sewer system. Some of them have their own wells as a water source at their premises. Daily average water consumption of these facilities is 596 m^3/day in total. The Water Company supplies 155 m^3/day, while the reminder is taken from the deep wells of each user.

4.3.2.4 Results of the Water Sampling and Water Quality Analysis

The JICA Study Team conducted a water sampling and water quality analysis to supplement the data for sewage and industrial wastewater. Water samples were taken at the points and with a frequency as follows:

Raw Sewage

From the inlet channel of the treatment plant

4 days x 13 samples/day (every 2 hours for 24 hours)

= 52 samples

Industrial Wastewater

From the discharge at the dairy

4 days x 5 samples/day (every 2 hours from 8:00 to 16:00 hours)

= 20 samples

From the discharge at the beer brewery

4 days x 5 samples/day (every 2 hours from 8:00 to 16:00 hours)

= 20 samples

As well as water sampling, flow rate measurements were conducted at each sampling time. Samples were analyzed at the Victa Laboratory in Vilnius. Results of the sampling are summarized in Table 4.7.

Table 4.7 Results of Water Quality Analysis

item	unit	sampling date			
		Jul 28-29	Aug 06-07	Aug 13-14	Aug 20-21
Sewage Flow	m^3/day	2,920	2,770	3,050	1,790
SS	mg/l	255	163	286	229
BOD_7	mg/l	217	229	365	335
Soluble BOD_7	mg/l	94	98	158	175
COD	mg/l	430	486	690	676
Total-N	mg/l	23	36	31	33
Total-P	mg/l	8.1	5.7	8.0	6.0
Note: Concentrations are calculated as a weighted average of the concentrations and flow-rates of the 12 samples taken every 2 hours during 24 hours. Details are presented in Appendix 4.					

4.4 EXISTING CONSTRAINTS FOR SEWERAGE SYSTEM

4.4.1 Technical Aspects

4.4.1.1 Collection system

Infiltration

A remarkable deficiency of the sewage collection system of Birzai is a huge amount of infiltration. In 1998, about half of the inflow is infiltration of the groundwater. This deficiency results in the large power consumption in pump operation.

Stormwater Intrusion

According to the Water Company, the sewage flow substantially increases during rainy weather. This is apparently caused by intrusion of the rain water into the sewer system.

4.4.1.2 Sewage treatment plant

The existing sewage treatment plant was designed to remove suspended solid and organic substances using sedimentation and biological filtration. Removal of nitrogen and phosphorous was not considered in the plant design. The plant is also hydraulically overloaded and not functioning properly. Treatment capacity of the sedimentation tank is estimated at 2,600 m^3/day from its surface area while the capacity of the biological filter is estimated at only 1,300 m^3/day.

4.4.1.3 Industrial wastewater

From the data of water quality and water consumption, BOD_7 load of the wastewater from three major factories is estimated at about 35 percent of the total load incoming to the treatment

plant. Reducing the organic load in the industrial wastewater will therefore also reduce the load at the sewage treatment plant.

4.4.2 Managerial Aspects

4.4.2.1 Collecting Incorrect Charges from Collective Housing

It has been reported that some residents tried to manipulate meter reading to reduce the consumption by use of a magnet or by releasing water in so small amount that it cannot be detected by the presently used water meters. This problem may however be more or less overcome by replacing the existing meters with ones sensitive enough to detect small flow.

Some flats do not have meters. If so, they pay charges based on a norm, which is a standard usage of volume for those who have no meters. The company has not been collecting the correct charges from residents in collective housing because residents not having meters use more water than the norm. It is estimated that the company has been losing 10 to15 percent of the correct charge.

4.4.2.2 Expansion of the Coverage Area

Since 1996, the Birzai Water Company has provided services to three sub-regions, Papilys, N.Radviliskis and Vabalninkas in addition to the Birzai region. The number of employees was approximately 25 in 1995 and is 53 in 1998. The company provides support for three sub-regions and manages three sub-region offices. This may cause management problems, such as inefficiency due to duplicated management staff members and communication gaps, lack of control due to differences of management history, policy and practices among regions and unfamiliarity with management of plural regions, etc.

4.4.2.3 Possible Redundancy in Some Business Units

Business units have responsibility for operation of divisions but the number of employees in some divisions may be more than strictly necessary for management because of the expanding coverage area and other reasons.

4.4.2.4 Short of Periodic Performance Evaluations

All employees reportedly do their best in order to maintain their job stability. The Water Company has not conducted periodic performance evaluations for employees using clearly written requirements to meet and goals to perform. Employees may reduce costs and increase revenues by performing more active work to meet their goals.

4.4.2.5 Lack of Integrated Management Information System

A computerized information system is installed in a controller room to manage billing and collection of the water and sewerage fees. Computerized information systems are also installed in

water and sewerage equipment rooms to monitor operations. There are no information systems for the management functions. This lack of information systems causes inefficiency in gathering correct information and inability to provide speedy action when required.

4.4.2.6 Process of a Self Supporting Management System

The Water Company manages itself on a self-supporting accounting system and also follows policies concerning tariff and costs of the municipality. Because of this dual responsibility, the company does not have autonomous management. The company should be more commercialized to cover costs because the state and municipality budgets are strictly regulated.

4.4.2.7 Unwillingness for Payment

Eighteen people out of fifty samples answered that they do not want to pay for fees of sewerage services and eight people think that fees should be shouldered by the government.

4.4.3 Financial Aspects

4.4.3.1 Unclear Business Units

Financial analysis is based on the sharing of assumed indirect costs between the water and sewerage division. The cost sharing system for some business units that work for both the water and sewerage divisions, administration, and some of the other operational expenses need to be clearly defined.

4.4.3.2 Increase in Sales and Loss

Because the year 1997 was the only full accounting year since separation from the regional Water Company, exact comparison is not possible. But the sales of 1997 increased by 186 percent from the half year of 1996, mostly due to the increase of tariff and areas of service. The losses of 1997 increased by 352 percent from the half year of 1996 because the company has had to cover three sub-regions besides Birzai region, since 1996.

4.4.3.3 Profits of the Sewerage Division and Losses of the Water Division

In the Birzai area, some users, particularly industrial users, use a well for their supply of water. In this case, the user does not pay for the water used, but only pays for the charge for sewerage service. That is why the company had 58 percent of its sales from the sewerage division. The sewerage division made a profit on the operating basis while the water division had a large loss on the operating basis based on an assumption of sharing indirect costs between the water and sewerage division. The sewerage division has enough sales, almost 30 percent more than the breakeven point. The water division has to increase the sales by 52 percent to reach the breakeven point by the increase of the tariff.

4.5 FUTURE DEMAND FOR THE SEWERAGE SYSTEM

4.5.1 Design Year

The design year is set at the year 2010. This target is 12 years from the planning stage and considered suitable for the design horizon of the new facilities.

4.5.2 Service Area

The entire urban area is set as the service area for the proposed improvement plan of the sewerage system.

4.5.3 Planned Population and Sewage Amount

4.5.3.1 Population

Future population of the urban area of Birzai is projected using the growth ratio applied in the projection of country's population prepared by the Department of Statistics. Of three medium scenarios, the medium-3 scenario (medium-high) is adopted since it has a slight increase in the country's population and is on the safe side in the projection of the amount of sewage. Yearly growth rates of population are tabulated as follows:

Table 4.8 Yearly Population Growth Rate and Urban Population

Year	Country Total (% / year)	Urban Area (% / year)	Urban Population
1997-2000	-0.02%	-0.05%	16,176
2001	0.09%	0.24%	16,215
2002	0.16%	0.32%	16,266
2003	0.19%	0.34%	16,321
2004	0.21%	0.37%	16,381
2005	0.24%	0.39%	16,445
2006	0.27%	0.42%	16,514
2007	0.26%	0.39%	16,578
2008	0.24%	0.35%	16,637
2009	0.23%	0.32%	16,691
2010	0.23%	0.31%	16,742

Calculated from Population Projections of Lithuania (Medium-3), Department of Statistics, 1998

4.5.3.2 Service Ratio and Population Served

As of 1997, the service ratio of water supply and sewerage expressed in population is 45.7 percent and 50.9 percent, respectively. The Water Company expects these figures to increase to 70 percent by 2010. Therefore, the population served by the water supply and sewerage would increase as calculated in table below.

Table 4.9 Projection of Population Served

Year	Water Supply		Sewerage	
	population served	service ratio	population served	service ratio
1997	7,400	45.7%	8,240	50.9%
2000	8,088	50%	8,897	55%
2005	9,867	60%	10,278	63%
2010	11,719	70%	11,719	70%

Population served = urban population x service ratio

4.5.3.3 Sewage Amount

Domestic Sewage

For the projection of water consumption, increase in per capita consumption is set at 160 and 180 l/cap/day for 2000 and 2010, respectively. It is assumed that 90 percent of the amount consumed is discharged into the sewers.

Water consumption at households not connected to the water supply system is considered the same as the figures above as such households have deep wells as a reliable source. Using the population served and unit water consumption, the amount of domestic sewage is calculated as follows:

Table 4.10 Projection of Domestic Sewage

Year	Population served	Per capita water consumption (l/cap/day)	Domestic Sewage (m^3/day)
1997	8,240	158	1,172
2000	8,897	160	1,281
2005	10,278	170	1,573
2010	11,719	180	1,900

domestic sewage = population served x per capita consumption x 90%

Industrial Wastewater

The present amount of industrial wastewater is 498 m^3/day. It is assumed that the amount of industrial wastewater will increase to about 565 m^3/day by 2010. For the purpose of projection, 600 m^3/day is adopted as a rounded figure for industrial contribution of wastewater.

Infiltration

There is a substantial amount of infiltration that is estimated at approximately 1,500 to 1,700 m^3/day. Considering that no measure will be taken for reducing the infiltration, 1,700 m^3/day is accounted for infiltration for projection.

Projected Amount of Sewage

From the discussion above, the amount of sewage is calculated as follows:

Table 4.11 Projection of Amount of Sewage (Daily Average Flow)

unit: m^3/day

Year	Domestic sewage	Industrial wastewater	Infiltration	Total Amount
2000	1,281	600	1,700	3,581
2005	1,573	600	1,700	3,873
2010	1,900	600	1,700	4,200

4.6 SEWERAGE SYSTEM IMPROVEMENT PLAN

4.6.1 Design Flow

The design of the sewerage facility also needs to incorporate the variation in sewage flow such as average daily flow, maximum daily flow, and peak hourly flow.

These design flows are then summarized in Table 4.12.

Table 4.12 Design Flow

	daily average flow Qda (m^3/day)	daily max flow Qdm (m^3/day)	hourly peak flow Qhp (m^3/day)
Domestic/Industrial sewage	2,400	3,200	5,130
Infiltration	1,800	1,800	1,800
Total	4,200	5,000	6,930
Ratio to daily average	1.00	1.20	1.65
Ratio to daily maximum	0.83	1.00	1.38

Qdm = Qda x 1.35 (for domestic sewage and industrial wastewater only)
Qhp = Qdm x 2.0 (for domestic sewage only)

4.6.2 Characteristics of Sewage and Population Equivalent

With the projected sewage amount and pollution load, characteristics of sewage is calculated using the per capita unit load (70 g-BOD_7/cap/day) as follows:

Table 4.13 Calculated BOD Load and Concentration

	Amount (m^3/day)	Population served	BOD_7 Load unit load (g/cap/day)	BOD_7 Load Total Load (kg/day)	BOD_7 (mg/l)	Population equivalent
Domestic Sewage	1,900	11,719	70	820		11,719
Industrial Wastewater						
Brewery Factory	100			70	700	1,000
Dairy Factory	300			150	500	2,143
Canned Food Factory	100			50	500	714
Other Industry	100			25	250	357
Infiltration	1,700			-	-	-
Total	4,200			1,115	260	15,933

Using the population equivalent calculated above, other pollution loads are calculated as follows:

Table 4.14 Calculated SS, Total-N and Total-P Loads and Concentrations

	SS	Total-N	Total-P
population equivalent	15,933	15,933	15,933
unit load (g/p.e./day)	70	12	2.7
total load (kg/day)	1,115	191	43
concentration (mg/l)	265	45	10.0

4.6.3 Effluent Standards to be Applied

The effluent standard shall be as follows:

Table 4.15 Effluent Standard for Sewage Treatment

Pollutants	Permissible Concentration (mg/l)	
	Average annual concentration (Cave)	Maximum instantaneous concentration (Cmax)
BOD_5 (>10,000 PE)	15	25
COD (≥10,000 PE)	75	120
Total-P (≥10,000 PE)	1.5	2.5
Total-N (10,000 – 100,000 PE)	20	35
Suspended Solid (<100,000 PE)	30	45

In addition to these standards, a special requirement must be applied when the effluent is discharged into the Tatula River as shown in Table 4.16.

Table 4.16 Special Standard for Effluent Discharged to the Tatula River

Pollutants	Permissible Concentration (mg/l)	
	Average annual concentration (Cave)	Maximum instantaneous concentration (Cmax)
BOD_5	4	8
Total-N	8	14
Total-P	1.0	1.5

4.6.4 Improvement Plan for the Sewage Collection System

As the capacity of each pump station is sufficient for pumping the amount of sewage, no major improvement will be required. Only improvements needed are as follows:

- To expand the existing monitoring system (for Pump Stations No.2 and No.4) to cover Pump Stations No.1 and No.3.
- To repair the leaks in the walls of each Pump Station.

4.6.5 Improvement Plan for the Treatment System

4.6.5.1 Discharge Point Alternatives

(1) Consideration

Effluent may be discharged to the following surface waters:

- Tatula River (through the Juodupe River)
- Obelaukias River
- Agluona River
- Apascia River

The Obelaukias River is a small tributary of the Roveja River. It flows bypassing the Birzai Town to the east. The 1994 design of Ekoprojektas is based on the discharge into the Obelaukias River. A 7km long transmission pipeline was proposed to discharge the effluent into the Obelaukias River by pumping. This option seems to have been selected as a reasonable option with the least impact on the karst area.

Both the Agluona River and Apascia River flow down through the Birzai Town into the Sirvenos Lake that is located less than 4 km from the treatment plant site No.2. Discharge of the effluent into these two rivers will therefore mean the discharge of effluent into the lake. The environmental impact will be serious if the effluent is discharged into these rivers since the downstream lake is a sensitive area and must be free from risk of eutrophication. A high level of treatment will likely be required if the effluent flows into the lake.

(2) Conclusion for Alternatives

Two alternatives are acceptable in terms of technical aspects, and are proposed as Options 1 and 2 as follows:

Option 1: Effluent to be discharged to the Juodupe River after treatment by a tertiary treatment process.

Option 2: Effluent to be discharged to the Obelaukias River after treatment by secondary treatment process.

Detailed comparison between these options is discussed in Section 4.6.6.

4.6.5.2 Discharge Pipe Routing for Options 1 and 2

For Option 1, a new discharge pipe is proposed to be laid from the new treatment plant to the Juodupe River. Proposed routing of the discharge pipe is shown in Figure 4.4. The route of the pipeline was chosen along the existing road except for a river crossing and about 400 m that passes through agricultural land.

For Option 2, a detailed design was prepared in 1994 for a 7 km discharge pipeline.

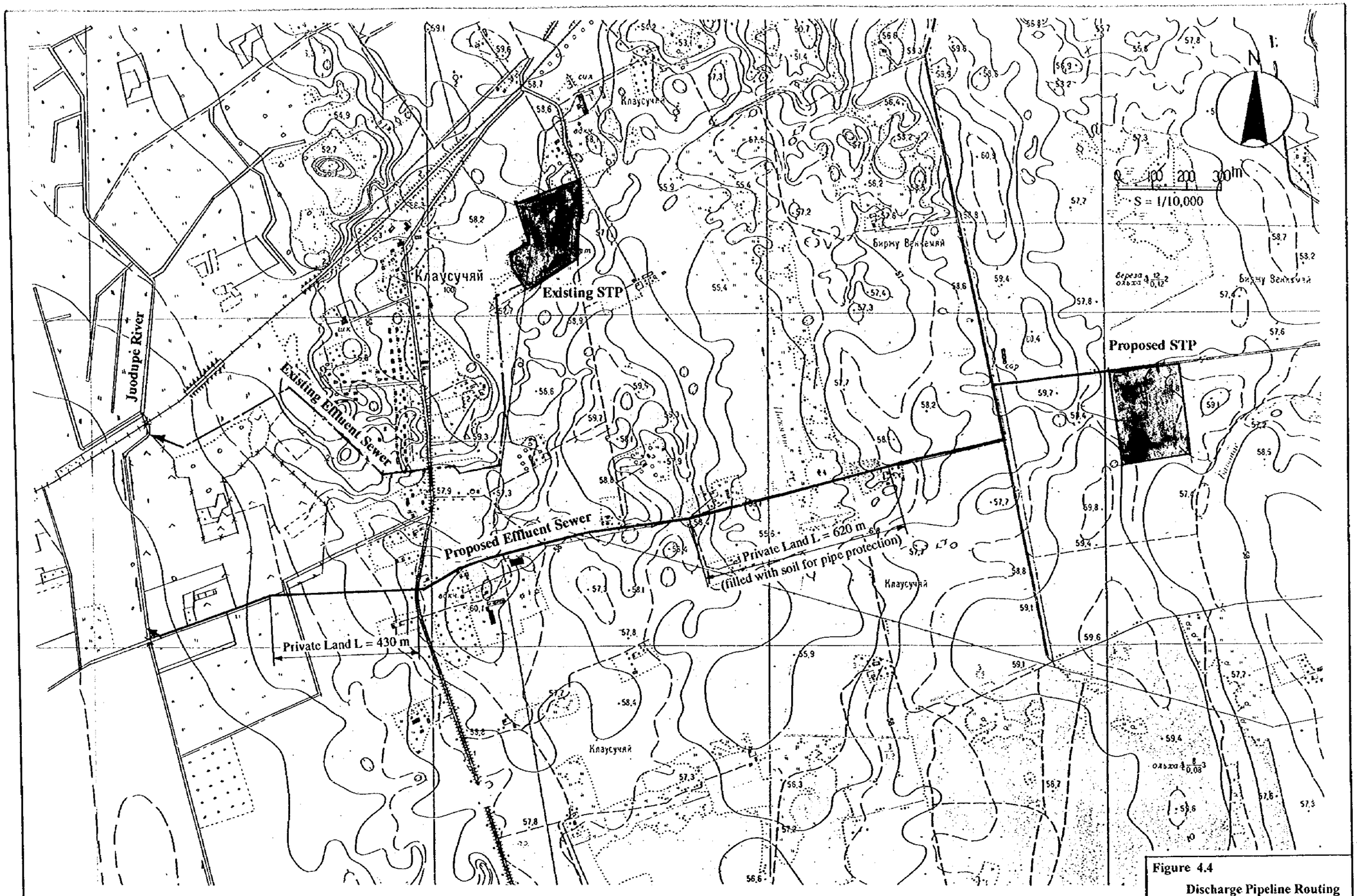


Figure 4.4
Discharge Pipeline Routing for Option 1

4.6.5.3 Sewage Treatment Method

Secondary Treatment

To complete the existing structures and use them for the originally designed system with necessary modifications.

Tertiary Treatment

To meet the requirement of the BOD level, the biological membrane filter is recommended.

4.6.5.4 Sludge Treatment and Disposal

The Water Company intended to process the sludge by a composting method using a composting machine purchased by a private company in Birzai. In such a case, it is speculated that the sludge could be transferred after composting, to outside the karst area for fertilizing the agricultural area. The composting machine has a treatment capacity of 14 m^3/day that is sufficient to treat the sludge produced in the proposed treatment plant.

In the new treatment plant, it is proposed that a mechanical dewatering machine be provided to reduce the water content in sludge below 85 percent so that transportation will be easier. A decanter (centrifuge) type dewatering is selected as a suitable method due to its high efficiency and ease of operation. Prior to dewatering, a gravity thickening process will be provided to reduce the water contents from about 99.4 percent to 98 percent.

4.6.6 Comparison of Options

Options 1 and 2 are compared taking into account the construction and operation costs. Layout and profiles for the two options are shown in Figure 4.5 to Figure 4.7. Results of the comparison are summarized in the table below:

Option 1 is more economical than Option 2 in terms of both the construction and operation costs as shown above. Option 1 however needs careful operation of the tertiary treatment process to meet the special requirement for the Tatula River. In terms of operation of the treatment plant, Option 2 will be less sensitive because of its simplicity of treatment process and less strict effluent standard.

Option 1 is recommended for its economical advantage provided that the Water Company is confident to operate the tertiary treatment system. Option 2 is still considered as a possible option due to ease of operation in case that the financial disadvantage can be overcome. These two schemes are proposed as possible options so that the Water Company and Ministry of Environment will make a final decision including the review of the special effluent standard for the Tatula River.

Table 4.17 Summary of Detailed Comparison

OPTION	1 (Tatula via Juodupe)	2 (Obelaukias)
Receiving Water	Tatula (via Juodupe)	Obelaukias
Location of Treatment Plant	No.2 (at the New Treatment Plant Site)	
Effluent Standard as Annual Average (mg/l)		
BOD_7	4	15
SS	30	30
COD	75	75
Total-N	8	20
Total-P	1.0	1.5
Treatment Facility		
Secondary treatment	A2O	A2O
Tertiary treatment	Biological Membrane Filter	N/A
Sludge Treatment	thickening, dewatering, storage	
Expected Effluent Quality at the Best Operation Practice		
BOD7	3 – 6	7 - 10
Total-N	4 – 9	5 - 10
Total-P	< 1.0*	< 1.0*
Discharge pipe		
pipe material	reinforced concrete	ductile iron
length (m)	3,250	7,000
dia. (mm)	400	300
Discharge pump	no	yes
Economic Comparison		
Construction Cost ('000 litas)	9,964	15,111
secondary treatment	7,689	7,689
tertiary treatment	1,300	-
influent transmission pipe	-	-
discharge pipe	975	7,325
discharge pump	-	97
Operation Cost ('000 litas/year)	178	212
secondary treatment	156	156
tertiary treatment	22	-
discharge pumping	-	56
Total Cost in NPV** ('000 litas)	11,215	16,303

* Phosphorous removal is achieved by chemical coagulation.

** NPV: Net Present Value for 25 years operation, discount rate = 5 %/year

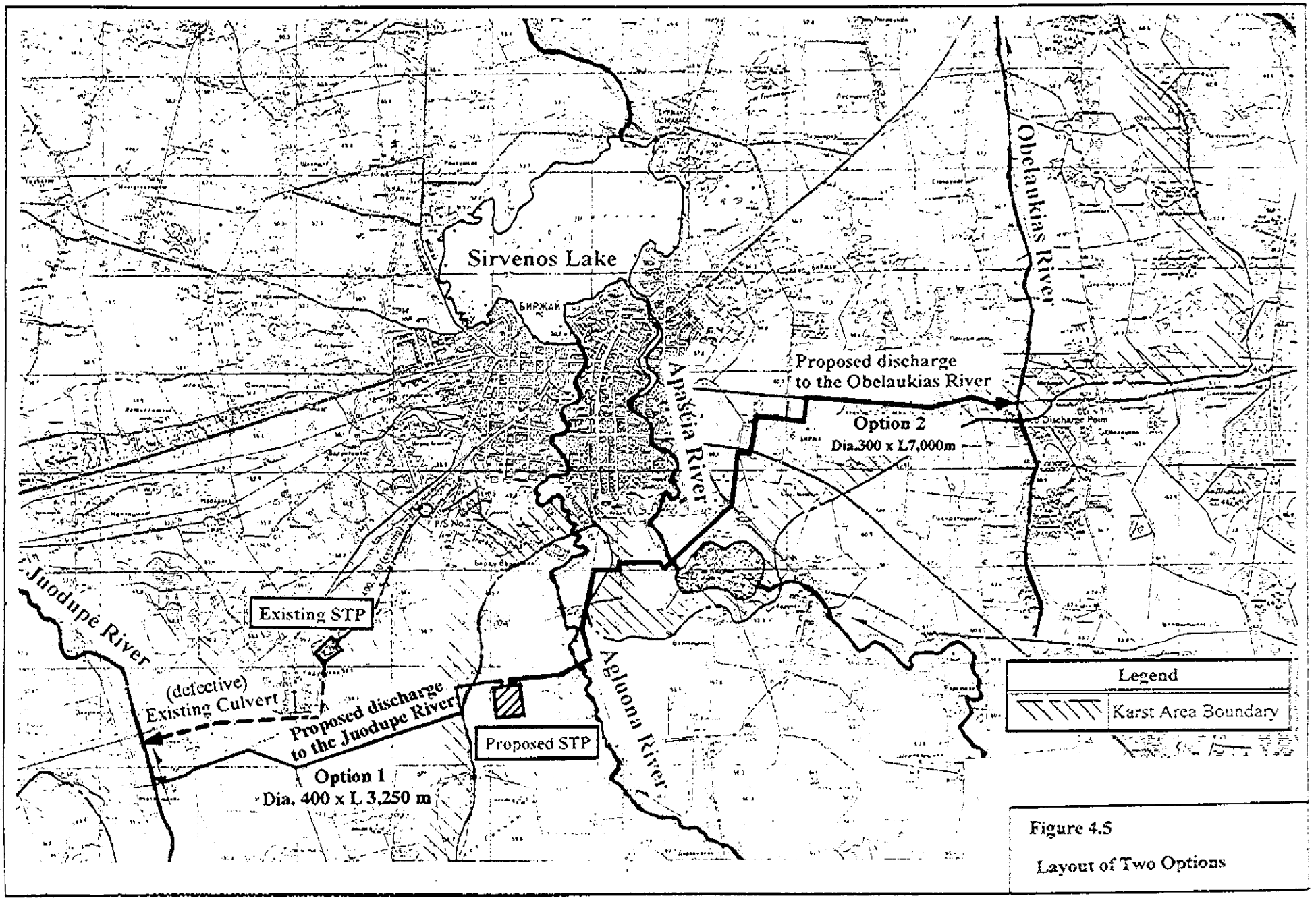


Figure 4.5

Layout of Two Options

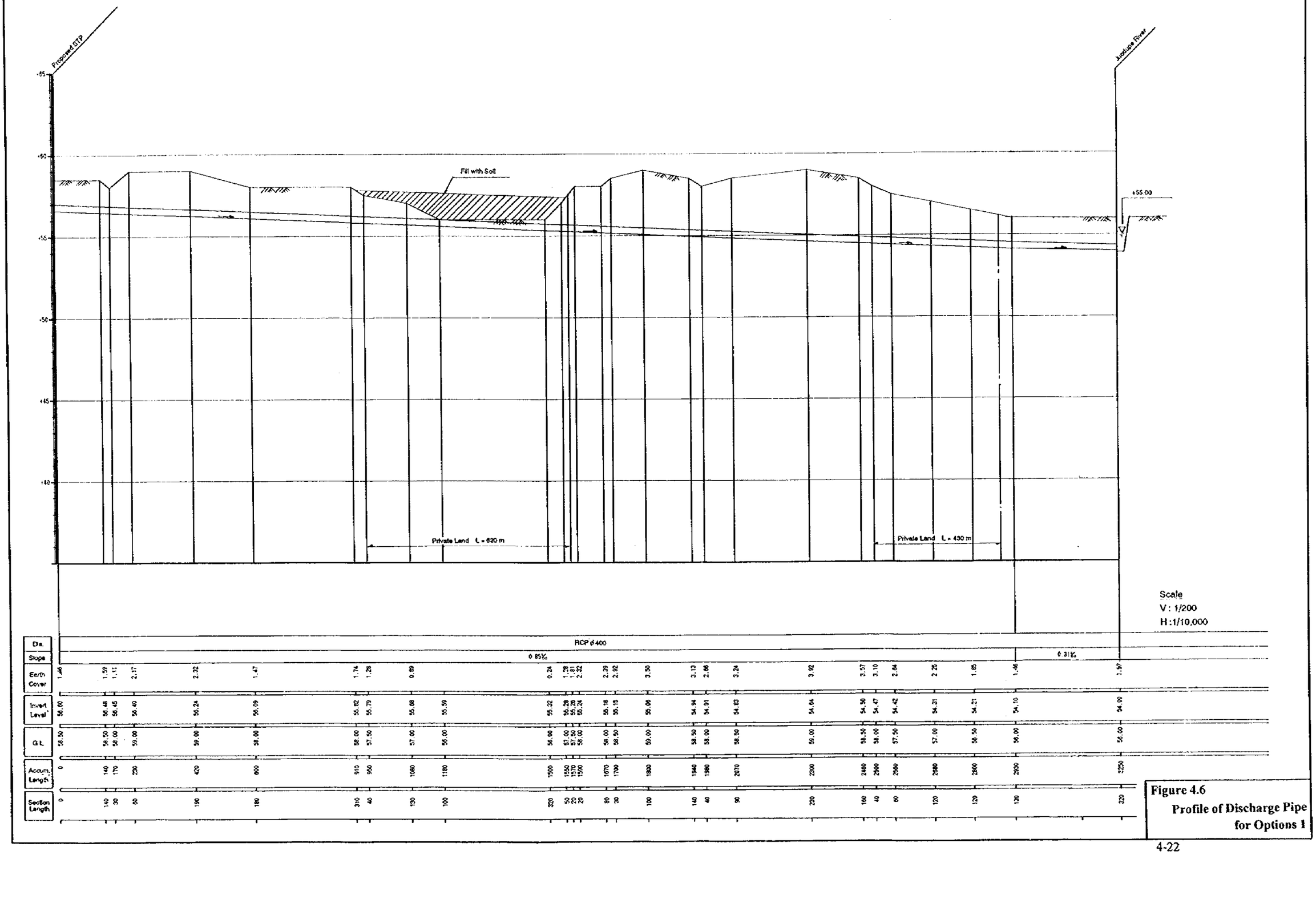
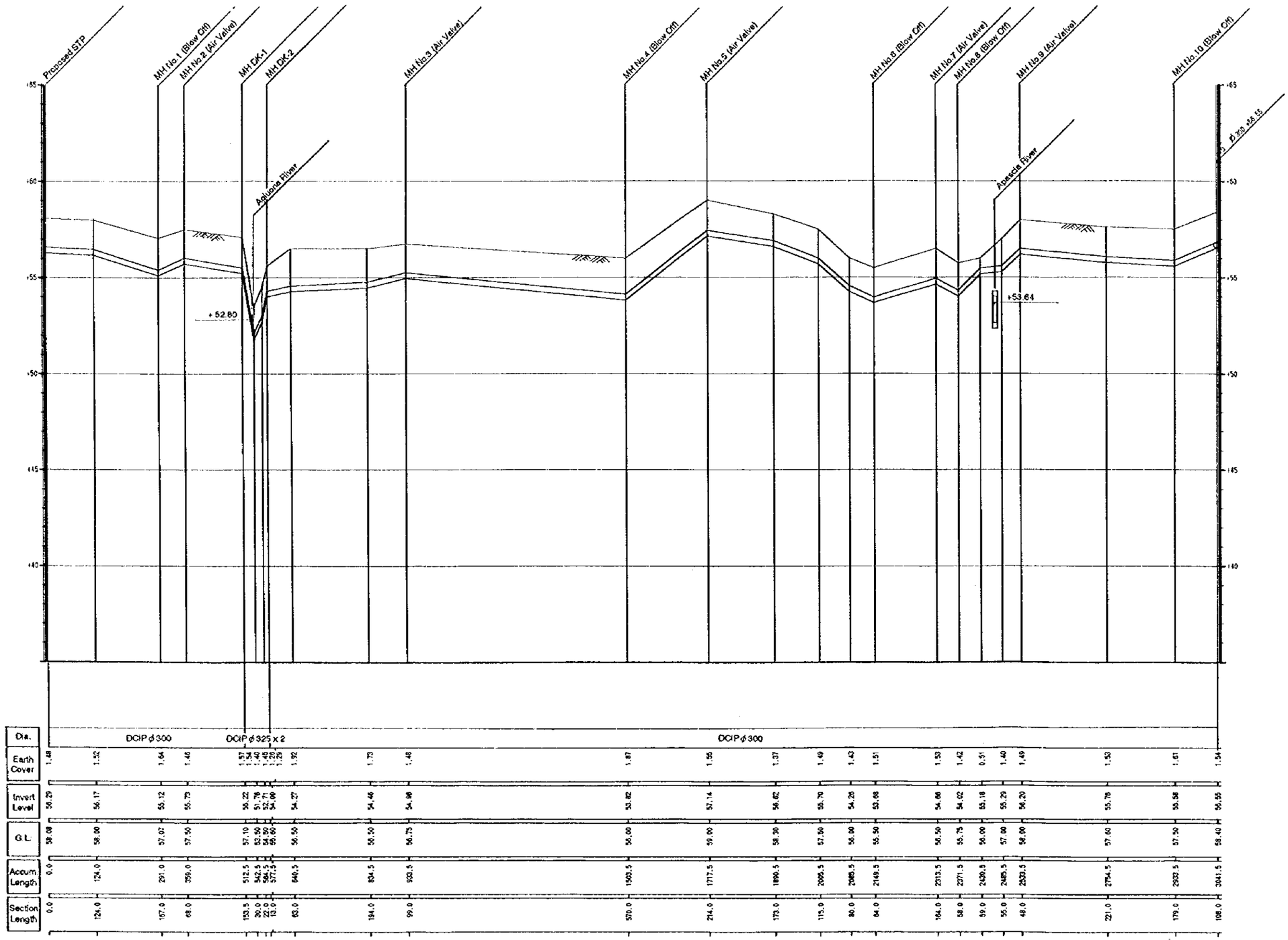
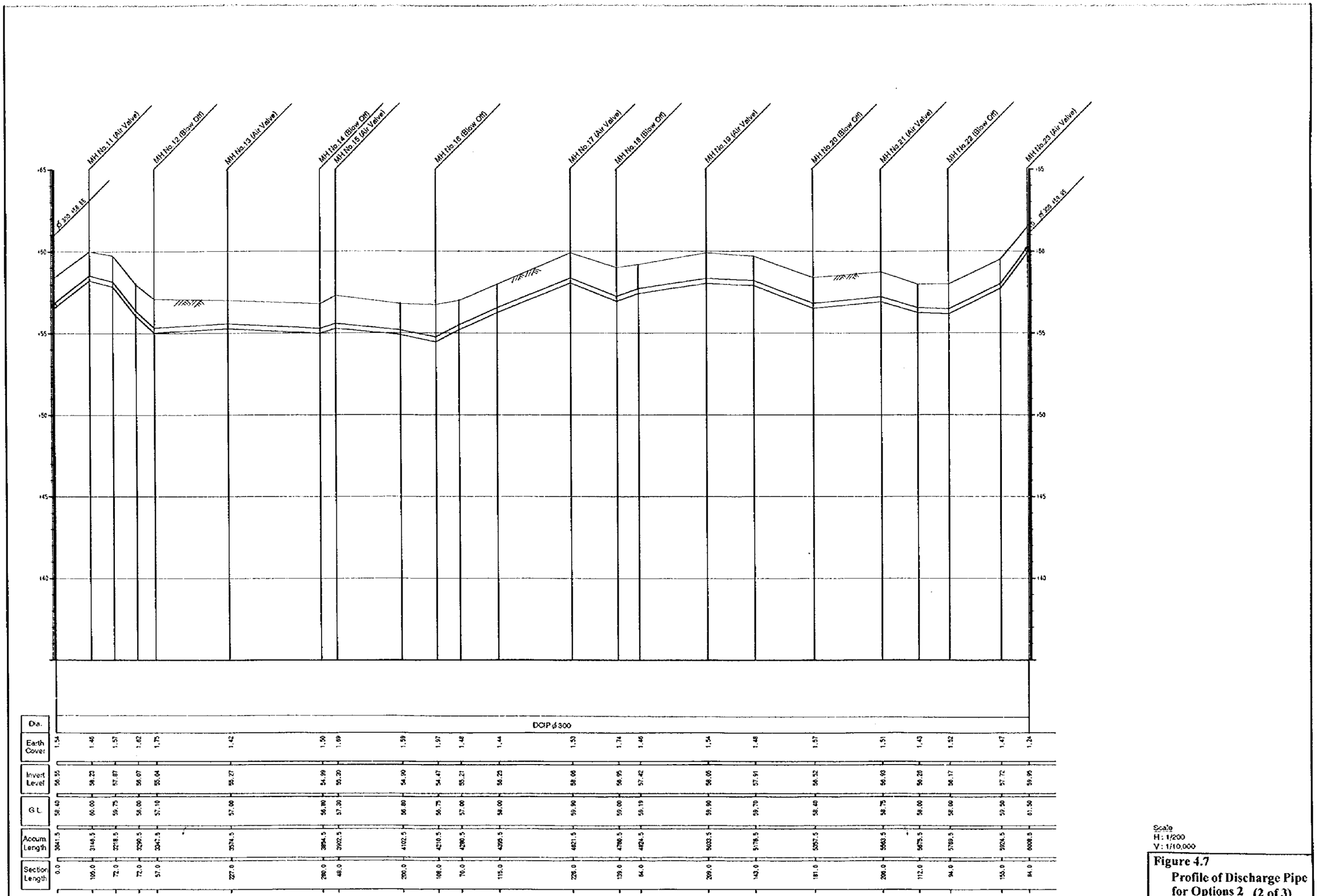


Figure 4.6
Profile of Discharge Pipe for Options 1



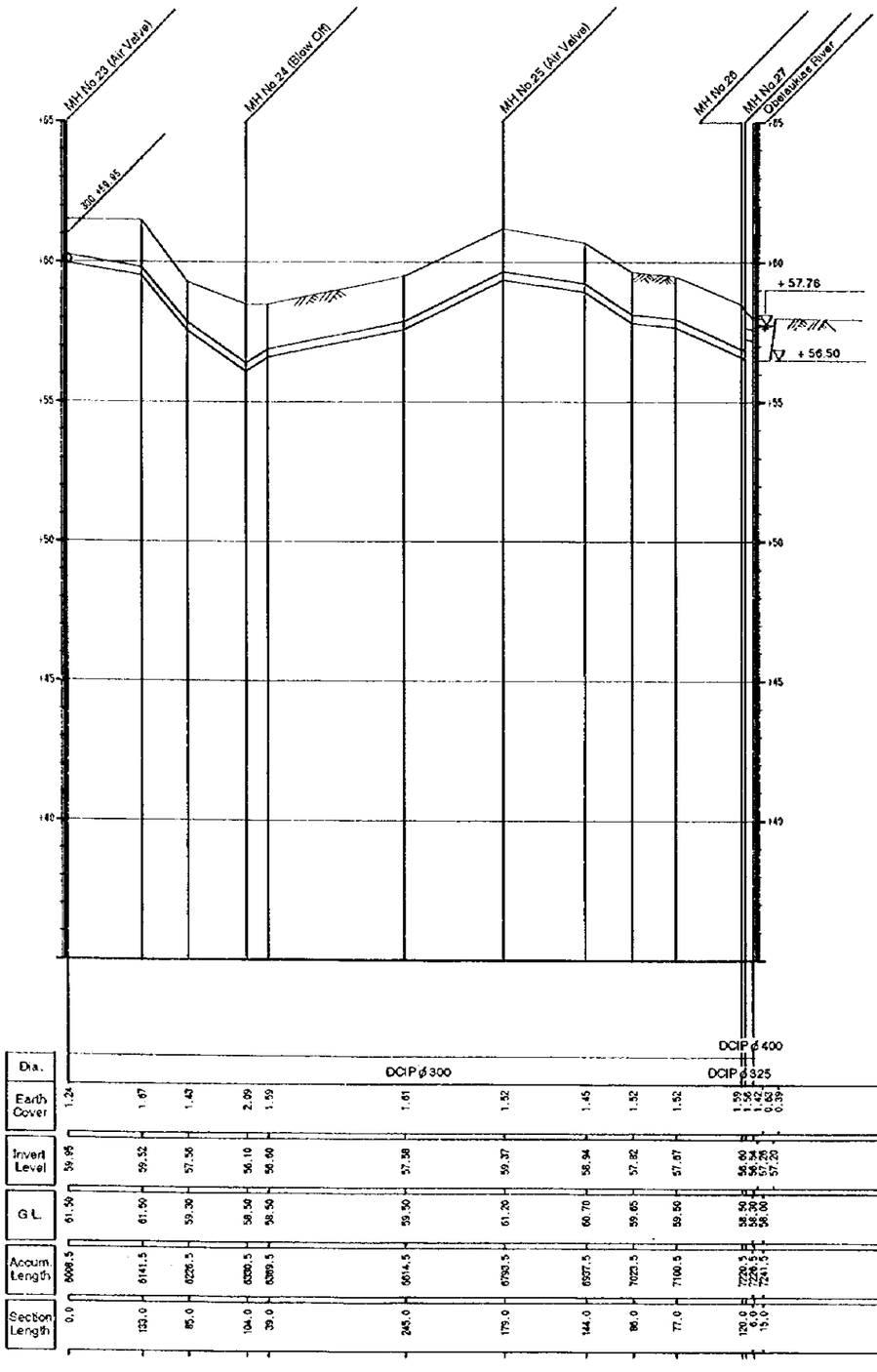
Scale
H : 1/200
V : 1/10,000

Figure 4.7
Profile of Discharge Pipe for Options 2 (1of 3)



Scale
H: 1/200
V: 1/10,000

Figure 4.7
Profile of Discharge Pipe for Options 2 (2 of 3)



Scale
H: 1/200
V: 1/10,000

Figure 4.7

Profile of Discharge Pipe for Options 2 (3 of 3)