JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)

MINISTRY OF TRANSPORT AND COMMUNICATIONS
MINISTRY OF ENVIRONMENT AND PHYSICAL PLANNING
CITY OF SKOPJE
PUBLIC ENTERPRISE "WATER SUPPLY AND SEWERAGE" SKOPJE

THE STUDY ON WASTEWATER MANAGEMENT IN SKOPJE IN FORMER YUGOSLAV REPUBLIC OF MACEDONIA

FINAL REPORT

SUMMARY

JUNE 2009

TOKYO ENGINEERING CONSULTANTS CO., LTD. (TEC)
In Association with
CTI ENGINEERING INTERNATIONAL CO., LTD. (CTII)

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THE STUDY
ON
WASTEWATER MANAGEMENT
IN
SKOPJE
IN
FORMER YUGOSLAV
REPUBLIC OF MACEDONIA

FINAL REPORT

CONSTITUENT VOLUMES

SUMMARY

MAIN REPORT

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APPENDIX (2)

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PREFACE

In response to a request from the Government of Former Yugoslav Republic of Macedonia, the Government of Japan decided to conduct a study on Wastewater Management in Skopje in Former Yugoslav Republic of Macedonia and entrusted to the study to the Japan International Cooperation Agency (JICA).

JICA selected and dispatched a study team headed by Mr. Kazufumi Momose of Tokyo Engineering Consultants Co., LTD. and consists of Tokyo Engineering Consultants Co., LTD. and CTI Engineering International Co., Ltd. between September, 2007 and June, 2009. In addition, JICA set up an advisory committee supported by Mr. Wataru Fukatani, Ministry of Land, Infrastructure, Transport and Tourism and Ms. Hiroko Kamata, Senior Advisor, JICA, which examined the study from specialist and technical points of view.

The team held discussions with the officials concerned of the Government of Former Yugoslav Republic of Macedonia 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 this 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 Former Yugoslav Republic of Macedonia for their close cooperation extended to the study.

June 2009

Ariyuki Matsumoto
Vice-President
Japan International Cooperation Agency

Mr. Akiyuki Matsumoto
Vice-President
Japan International Cooperation Agency

June 2009

LETTER OF TRANSMITTAL

Dear Sir,

We are pleased to submit you the final report entitled "The Study on Wastewater Management in Skopje in Former Yugoslav Republic of Macedonia". This report has been prepared by the Study Team in accordance with the contracts signed on 14th September 2007, between Japan International Cooperation Agency and Tokyo Engineering Consultants Co., Ltd. in association with CTI Engineering International Co., Ltd..

The report examines the existing conditions concerning sewerage system of the Skopje City and presents the basic plan and feasibility study on priority project selected from the basic plan.

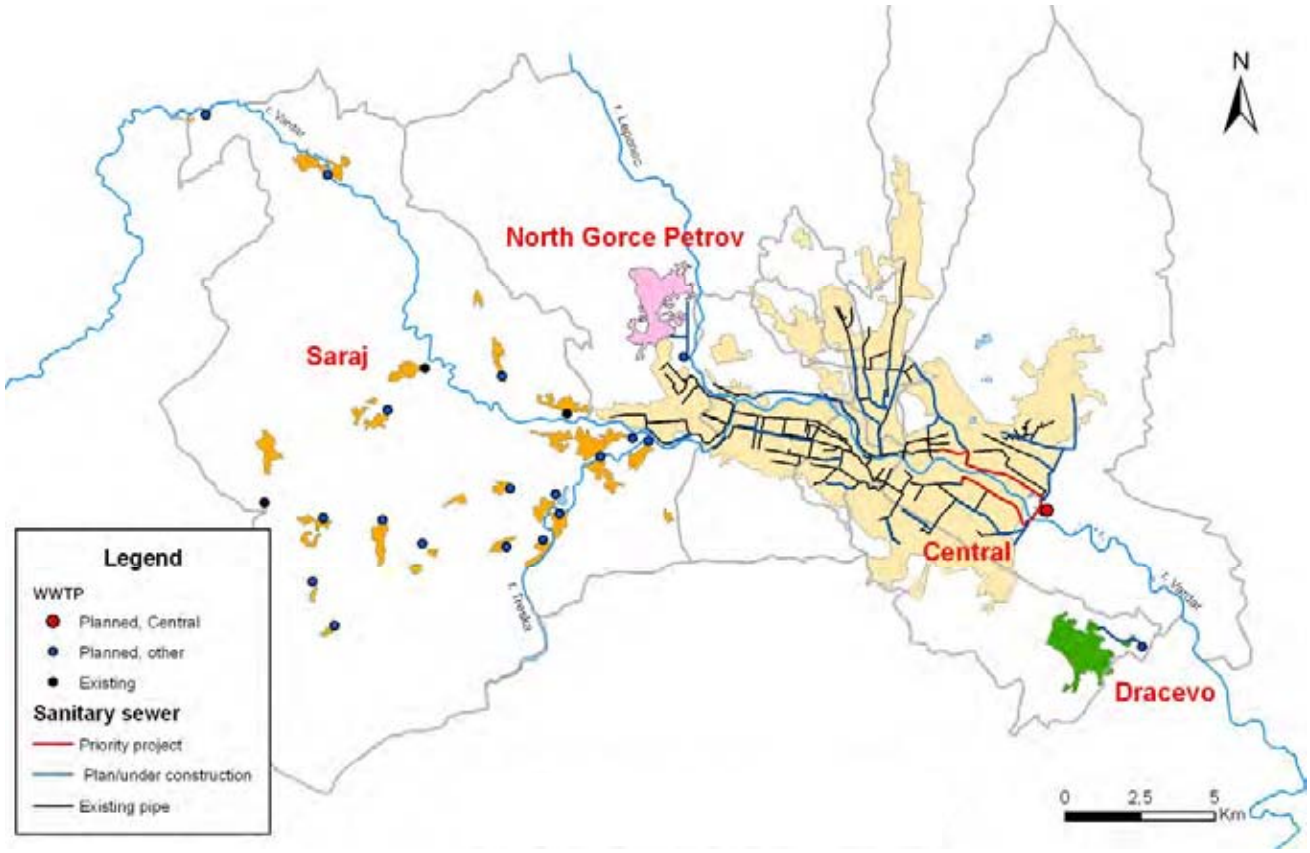
This study aimed to improve the water quality of the Vardar River. We are sure that the recommendations made in the report shall contribute to improving the water quality of the Vardar River and the sewerage system in Skopje City.

All the members of the Study Team wish to acknowledge gratefully to the personnel of your Agency, Ministry of Foreign Affairs, JICA Balkan Office, and also to the officials and individuals of the Government of Former Yugoslav Republic of Macedonia for their assistance extended to the study team.

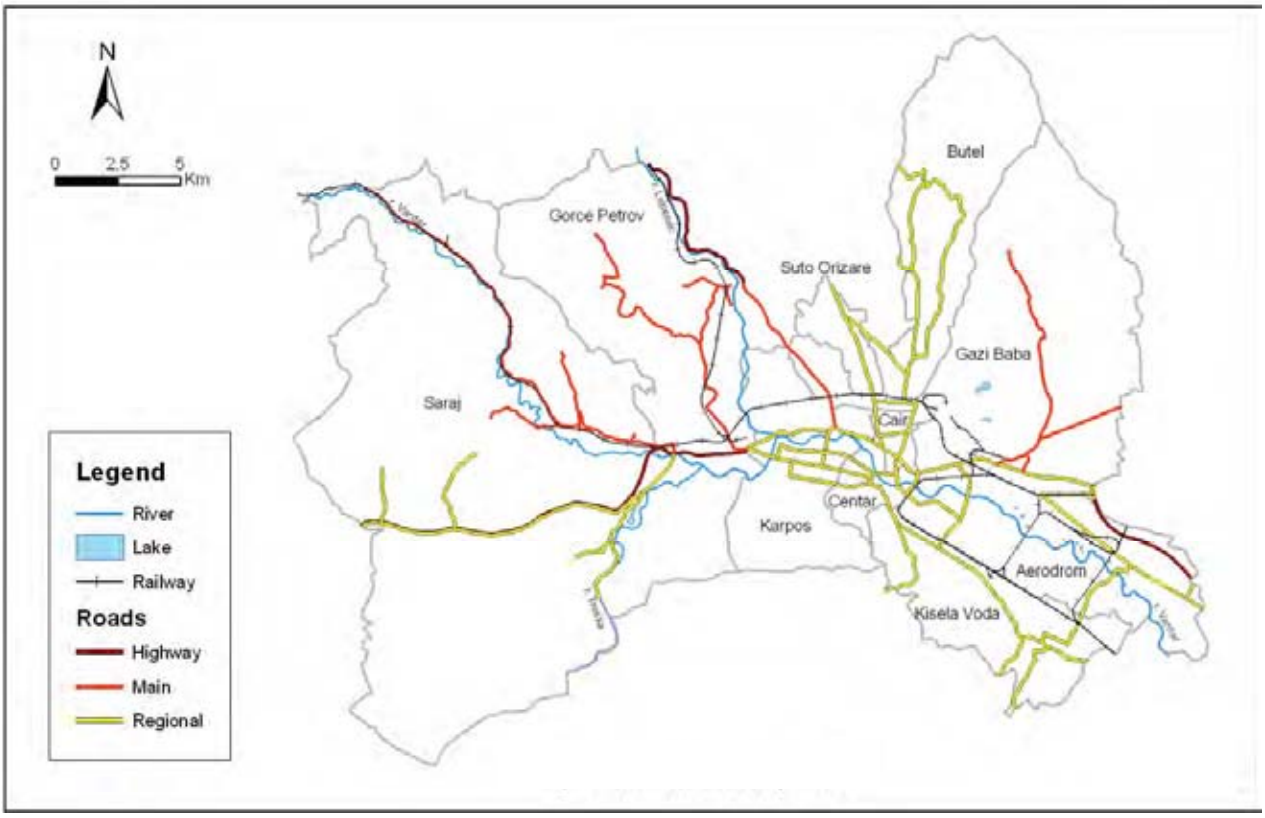
Yours faithfully,

Kazufumi MOMOSE
Team Leader

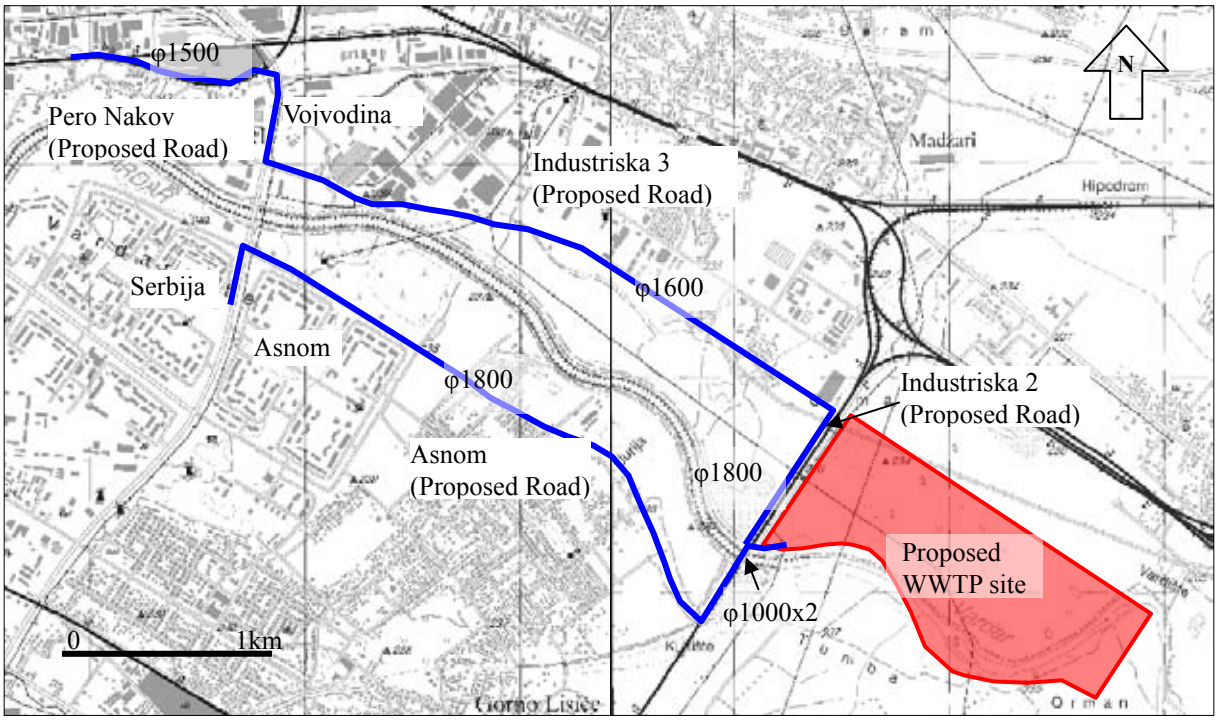
LOCATION MAP OF
FORMER YUGOSLAV REPUBLIC OF MACEDONIA



BASIC PLAN FOR SEWERAGE DEVELOPMENT IN SKOPJE



General View of Study Area



Scope of Priority Project

The Study on Wastewater Management in Skopje
in Former Yugoslav Republic of Macedonia

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Abbreviations

AA	Atomic absorption Analyzer
AP	Adjustment Plan
A/P	Action Plan
ASRT	Aerobic Solid Retention Time
BAT	Best Available Techniques
BOD	Bio-chemical Oxygen Demand
BREF	BAT Reference
B/P	Basic Plan
CA	Capacity Assessment
CARDS	Community Assistance for Reconstruction, Development and Stability in Balkans.
CASP	Conventional Activated Sludge Process
CD	Capacity Development
CHPI	City Health Protection Institute
COD	Chemical Oxygen Demand
CP	Cleaner Production
C/P	Counterpart
DB	Data Base
DF/R	Draft Final Report
DO	Dissolved Oxygen
D/D	Detail Design
EAP	Environmental Action Plan
EC	European Commission
EC	Electric Conductivity
EIA	Environmental Impact Assessment
EIB	European Investment Bank
EU	European Union
F.C.	Foreign Currency portion
F/R	Final Report
F/S	Feasibility Study
GC-mass	Gas Chromatography-mass spectrometry
GHG	Green House Gasses
GUP	General Urban Plan 2002 City of Skopje
g/c/d	Gram Capita per day
HRT	Hydraulic Retention Time
HMI	Hydro Meteorological Institute
ICP	Inductivity-Coupled Plasma
IC/R	Inception Report
IEE	Initial Environmental Examination
IEP	Integrated Environmental Permit
IPA	Instruments for Pre-Accession
ISIC	International Standard of Industrial Classification
IUCN	International Union for the Conservation of Nature and Natural Resources
IPPC	Integrated Pollution Prevention and Control
IT	Information Technology
IT/R	Interim Report
JBIC	Japan Bank for International Cooperation
JICA	Japan International Cooperation Agency
KfW	Kreditanstalt fur Wiederaufbau
kg/d	Kilogram per Day
L.C.	local currency portion
lpcd	liter per capita per day
L.W.L.	Low Water Level
m^3	Cubic meters
MAFWE	Ministry of Agriculture, Forestry and Water Economy
Max	Maximum
MEPP	Ministry of Environment and Physical Planning

MF	Ministry of Finance
Mg/l	Milligram per liter
Min	Minimum
MKD	Macedonian Denar
MOE	Ministry of Economy
MOH	Ministry of Health
MLSS	Mixed Liquor Suspended Solid
Sewerage M/P 99	Sewerage Master Plan prepared in 1999 by Kruger
MTC	Ministry of Transport and Communication
NACE	Nomenclature des Activities Economiques
NDP	National Development Plan
NEAP	National Environmental Action Plan
NGO	Non Governmental Organization
NRW	None-revenue Water
OJT	On the Job Training
O&M	Operation and Maintenance
PAPs	Project Affected Peoples
PE	Population Equivalent
PHARE	Poland and Hungary Assistance for Reconstruction of Economy.
PR/R	Progress Report
PV	Present Value
R.C.	Reinforced Concrete
SCADA	Supervisory Control and Data Acquisition
SME	Small and Medium sized Enterprise
SRT	Sludge Retention Time
SS	Suspended Solids
S/W	Scope of Work
TDS	Total Dissolved Solids
TOC	Total Organic Carbon
TOR	Terms of Reference
USEPA	United States Environmental Protection Agency
VAT	Value Added Tax
Vodovod	Public Enterprise “Water Supply and Sewerage” Skopje
WB	World Bank
WWTP	Wastewater Treatment Plant

PART I: BASIC PLAN

1. INTRODUCTION

1.1 Objectives of the Study

The main aim of the Study is water quality improvement in the Vardar River flowing through the center of Skopje City in Former Yugoslav Republic of Macedonia ("Macedonia") and to achieve this target, this Study is undertaken with the following objectives.

Figure I. 1 Location of the Vardar River

(1) To formulate a Basic Plan (B/P) in order to control pollution due to domestic and industrial wastewater.
(2) To conduct a Feasibility Study (F/S)on the sewerage projects selected from the B/P.
(3) To formulate an Action Plan (A/P) for improvement of organizational, institutional and financial aspects.
(4) To formulate an A/P pertaining to industrial wastewater management and water quality monitoring system.

1.2 Study Flow

The study was commenced in September 2007 and is scheduled to complete in June 2009. It is implemented in two phases: Phase 1 was completed in March 2008, and is followed by phase 2 study. The study result of Phase 1 is compiled in this Report which contains sewerage basic plan and wastewater management in domestic and industrial sectors. This report also includes selected priority projects and capacity assessment on institutional, financial aspects of Public Enterprise "Water Supply and Sewerage" Skopje (hereinafter referred to as "Vodovod"), industrial wastewater management and water quality monitoring. This result leads to identification of the project and A/P and CD (Capacity Development) on which F/S was conducted. Study schedule is presented in Figure I. 2.

It is emphasized here that the B/P is conducted only for selection of the priority projects. The depth in a B/P is different from that in a Master Plan study. Accordingly, the study in Saraj, North Gorce Petrov and Dracevo is not so comprehensive but limited only for selection of priority projects in Skopje city.

Items of survey	2007 (First year)							2008 (Second year)											2009		
	Phase 1							Phase 2											Phase 3		
	9	10	11	12	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4	5	6
1.Investigation on existing condition																						
2.Model Development for Pollution Analysis																						
3.Alternatives / sewerage facilities / industrial wastewater management																						
4.Expected water quality with/without alternatives																						
5.Basic plan on industrial wastewater management																						
6.Basic plan on sewerage development																						
7.Selection of priority projects on sewerage development																						
8.Preparation of Action Plan																						
9.Selection of Capacity Development Project																						
10.Conducting capacity development																						
11.Conducting feasibility study																						
Report		IC/R					PR/R						IT/R				DF/R					F/R

Figure I. 2 Study Schedule

1.3 Study Area

The study area covers entire Skopje city as indicated in the "General Urban Plan 2002 (Target year 2020) (hereinafter referred to as "GUP")".

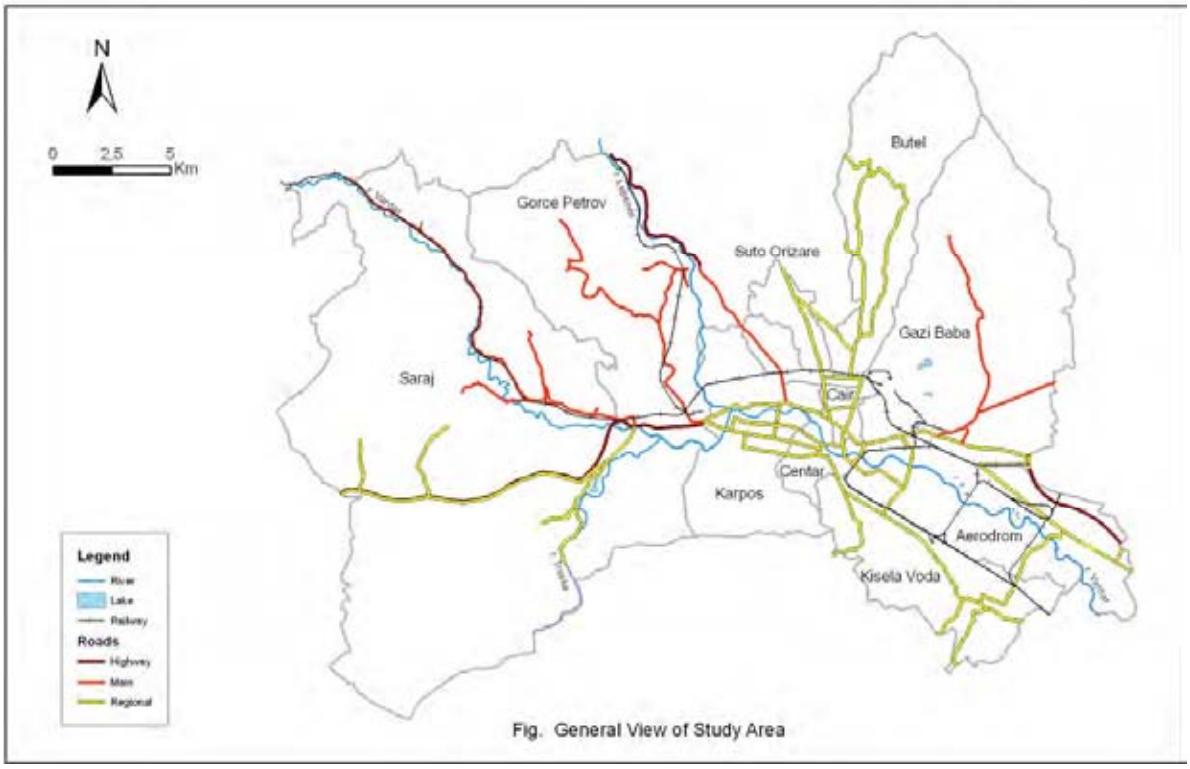


Figure I. 3 Study Area

1.4 Counterpart Agency in Macedonia

Counterpart agencies for the Project include:

(1) Ministry of Transport and Communication (MTC)
(2) Ministry of Environment and Physical Planning (MEPP)
(3) Skopje City

(4) Public Enterprise "Water Supply and Sewerage" Skopje (Vodovod)

The members of Steering Committee (S/C) are from above four agencies and Ministry of Agriculture, Forestry and Water Economy (MAFWE) (see Appendix 1.1, Part I (B/P)).

1.5 Assistance for the Project Realization

In the list of the National Development Plan (NDP) 2007 – 2009, "Construction of the wastewater collection and treatment for Skopje" together with "rehabilitation and water supply improvement" is included as one of the 2009 projects. The required investment costs are estimated as 104 million Euros for sewerage and water supply sector in Macedonia during 2007 and 2009. The Project cost for Skopje is estimated as around 95 million Euros by the Study Team.

The Second National Environmental Action Plan (NEAP), on the other hand, says that the volume of required investment to comply with the EU Urban Waste Water Directive is 230 million Euros. As the NEAP says, external financial sources are needed to cover the required volume. IPA (Instrument for Pre-Accession) fund is a possible promising external financial resource. According to its scheme of the Multi-annual Fund, 8 to 12 million Euros for the year 2007 to 2009 will be allocated to environmental sector. It was allocated to the sewerage project in Prilep city. The second Fund starting from the year 2010 will be allocated to a part of the sewerage project in Skopje.

There are several potential international donor agencies of the capital required for the Project implementation. EIB[1] is a possible donor agency and the JICA with very low-interest rate and long-term repayment period is also one of the potential donor agencies. Although request for JICA loan is usually made based on F/S results, assistance even during the study process to the counterparts to accelerate placement of JICA request is one of the items in the study. It is found out that the request can be made only after decision of the Government (Ministers), who can decide based on the results of F/S. Therefore, the earliest request can be made is at the end of 2008 when a substantial result will be available through the F/S report.

1.6 Investor

"Who can be an investor, as defined in the EIA procedure, on the Project" is the next issue. The city and all 84 municipalities (10 municipalities constitute the Skopje City) are responsible, among others, for collection and treatment of wastewater according to the Law on local self-government, 2005. Based on this, the City of Skopje as an investor hosted a stakeholder meeting on environmental and social issues in November 2007.

On the other hand, their financial base is still not strong enough to finance the Project, although financial base has started strengthening. The Project can be financed either by the subsidy from the central government or through external loan. As mentioned earlier, in addition to the domestic budget, external loan is essentially needed for the Project realization.

Direct external borrowing by a city or municipality became legitimate in June 2007. The government, however, shall not approve such borrowing to be practiced by a city or municipality unless it realizes a sound financial position of the city or municipality with sufficient surplus for at least a couple of consecutive years. As of beginning of 2008, only 8 municipalities are observed to be financially sound local self-government unit and are allowed to borrow external loan by the MF. City of Skopje is not included among these 8 municipalities. A city or municipality can also be the borrower after building up a satisfactory financial position. Even in such cases, the municipality should be backed up by the government as guarantor.

[1] EIB plans to provide 8.7 billion Euros for 7 years covering 2007 to 2013 to Croatia, Turkey and the western Balkan countries.

Assuming that the project is financed by a loan from an external lending agency, the MTC (or the MEPP) shall be the executing agency as a tradition. It is understood that the MTC (or the MEPP), guaranteed by the MF, has been borrower in past for such projects and could be a loan borrower, namely as an investor. However, the agency that will be assigned as borrower can be decided by the Government (Ministers) only when a loan is requested. In case of the Zletovica multi-purpose phase 1, a new law was formulated defining that the Ministry of Agriculture, Forest and Water Economy be a borrower and the MF is a guarantor. In the Zletovica case, the loan is to be paid back by the users' fee. Similarly, the loan is assumed to be paid back users' charge in the wastewater project.

During the course of Study, possibility of setting up P.E. Skopje wastewater treatment plant by the central government was raised. However, it is told that this matter is decided by the cabinet meeting so that this possibility is not dealt in the Study.

1.7 Regulation on Environment and Water

Macedonia obtained the EU candidate status in December 2005. Even though it is stressed that significant efforts will be needed to ensure the implementation and enforcement of the legislation (EU Enlargement Strategy and Main Challenges 2006-2007), progress on approximation process to EC "acquis communautaire" has been made in the environmental and water sectors.

(1) Law on Environment, Official Gazette No. 53/05, 81/05, 24/07
Law on Environment was enacted in June 2005. It encompasses right and duty of the state, municipality, and individuals on environmental conservation. It incorporates EC acquis communautaire and includes Integrated Pollution Prevention and Control, Environmental Impact Assessment, Public Access to Environmental Information, etc.

(2) National Environmental Action Plan
The (second) National Environmental Action Plan was formulated in 2006. It is a guideline for six years up to 2011.

(3) Law on Waters, Official Gazette No. 4/98, 19/00, 42/05, and Revised Law on Waters (87/08)
The law on Waters is revised in August 2008. A comprehensive law of EU Water Framework Directives is incorporated fully into the revised law. It defines standard, principle, duty and right of the state, municipality, and individuals. According to this, water is to be managed by 4 river basins of Vardar, Crn Drim, Strumica and Juzna Morava. It defines rational and effective water use, sustainable water resources development, and action and procedures of water pollution prevention. Main implementation agency will be the Ministry of Environment and Physical Planning. Effluent standard bylaws will be defined based on the revised law.

(4) Urban Wastewater
Currently, wastewater facilities are financed either by the Ministry of Transport and Communication or by the Ministry of Environment and Physical Planning. On the other hand, according to the law on the local self-government, local self-government units should construct, operate and maintain wastewater facilities. However, their financial base is not strong enough to do it. Their total budget was small, equal to only 3% of the state budget in 2007. It increased to 7% equivalent in 2008. Their own income sources are 3% of income tax and value added tax but their largest income is transfer from the central government. The capital grant from the Ministry of Transport and Communication can be used for sewerage facilities construction.

The local self-government can now obtain internal and external loans according to the new law. However, only a few financially-sound municipalities can get loan as of 2008, based on the clearance of some conditions imposed by the MF. City of Skopje has not cleared such condition yet and its local self-government is not permitted to obtain loan.

Ten municipalities which constitute the City of Skopje, have same legal status as some other municipalities in Macedonia and the City of Skopje according to the Law. Hence they can construct wastewater facilities on their own. Surrounding municipalities of Saraj, Gorce Petrov and Kisela Voda are planning or constructing wastewater facilities. On the other hand, communal works including wastewater facilities which can not be separated or divided are to be constructed and managed by the City of Skopje. However, there is no definition of "separation" or "division".

Public enterprises established by the local self-government are controlled by the MTC which has a sector of the communal works.

Ordinances or sub-laws will be formulated gradually based on the (new) Law on Waters. Effluent standard will be formulated complying with EU Directives 271/91/EEC. Industrial effluent standard as well as pre-treatment standard for facilities which discharge to sewer will also be formulated.

2. PRESENT CONDITION OF THE VARDAR RIVER AND TASKS FOR WATER QUALITY IMPROVEMENT

2.1 Condition of the Vardar River

The Vardar River is the largest river in the Macedonia in terms of its catchment area and length of water course. The Vardar River is an international river which flows into Aegean Sea via Greece. The Lepenec River which joins the Vardar River within the study area is coming from Serbia. The Vardar River within the Study area is one tenth of total length and located in the upper stretch. The up- and middle-streams of the river in Skopje have been improved with normal and flood flow cross sections. The width is about 50 m and the depth ranges from 1 to 2 m. The downstream remains a natural cross section with about 35 m width and maximum depth of 4 m.

2.2 Flow Rate of the Vardar River

2.2.1 Precipitation in Skopje City

The average precipitation is high in May and December, with 50 to 60 mm of monthly total precipitation. Average precipitation is low in February and August, with 30 mm of monthly precipitation approximately.

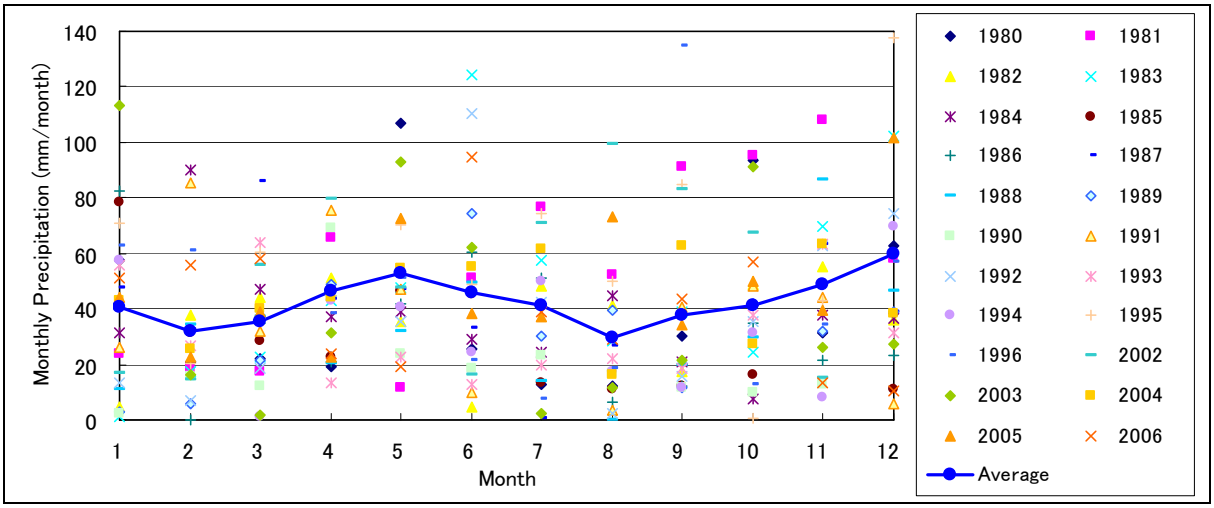


Figure I. 4 Variation of Monthly Precipitation in Skopje City

2.2.2 Flow Rate in Rivers

Tendency of flow rate is very similar to those of precipitation, which increases in May and December,

and decreases in August.

Using the collected data from 1991 to 2005, high-water flow (95 days flow rate), average-water flow (185 days flow rate), low-water flow (275 days flow rate), and draught flow rate (355 days flow rate) in the Vardar River have been calculated. Low water flow rate is used for a water quality simulation. It is essential to keep the water qualities under the designated environmental standard at least for 275 days in a year. Low water flow rate is calculated as 19.6 m^3/s at the upstream, 25.7 m^3/s at the city center, and 29.8 m^3/s at the downstream. Low water flow in tributaries of the Vardar River is 8.4 m^3/s in the Treska River, and 2.5 m^3/s in the Lepenec River.

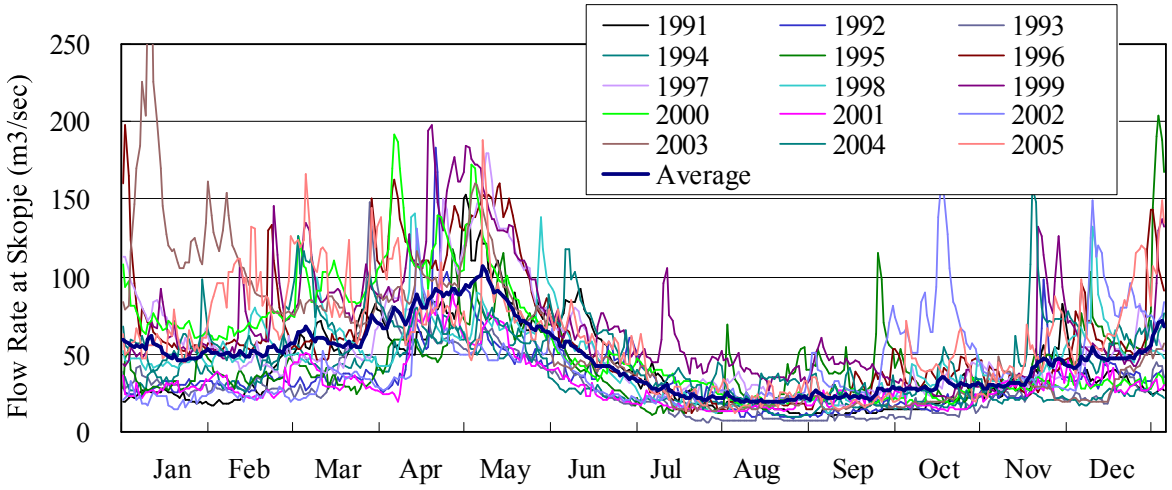


Figure I. 5 Flow Rate at Middle of the Vardar River (Skopje Z.Most)

2.3 Water Quality in the Vardar River

2.3.1 Regulation for Classification of Water

Generally, the entire Vardar River is classified as class II except at downstream of the large cities like Skopje and Veles. Classes II and III are separated in Skopje in sewer outlet from the main right bank sewer, 20 m downstream of the Serbia bridge. The Treska and Lepenec Rivers flowing into the Vardar River are also under the class II, similar to the upstream section of the Vardar River.

- Class 1 This is a very clean, oligotrophic water, which in its natural state or with possible disinfection can be used for drinking, production and processing of food product, and for breeding and raising of noble types of fish – salmonids.
- Class 2 This is a very clean, mesotrophic water, which in its natural state can be used for bathing and recreation, water sports, production of other types of fish, or which can be used – after usual methods of purification / coagulation, filtration, disinfection etc./–for drinking and production and processing of food products.
- Class 3 This class includes moderately eutrophic water, which in its natural state can be used for irrigation, and after usual purification methods (conditioning) for industries which do not need drinking water quality.
- Class 4 This is strongly eutrophic, polluted water, which in its natural state can be used for other purposes only after certain process of treatment.
- Class 5 This is much polluted, hypertrophic water, which in its natural state can be used only for other purposes.

Water quality standards of BOD, SS etc. for different classes are shown below.

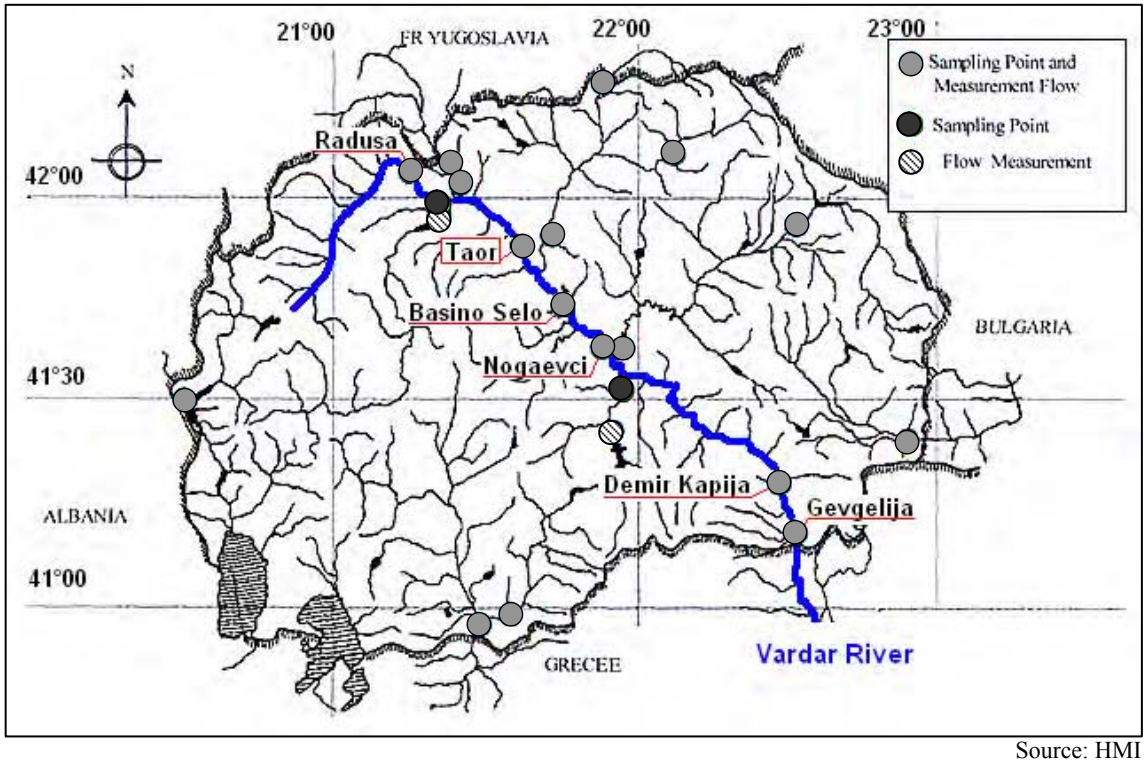
Table I. 1 Water Quality Standards

	Class I	Class II	Class III	Class IV	Class V
BOD (mg/l)	≤ 2.00	2.01 ~ 4.00	4.01 ~ 7.00	7.01 ~ 15	> 15
SS (mg/l)	≤ 10	10 ~ 30	30 ~ 60	60 ~ 100	> 100
Cyanide (µg)	1	1	100	100	> 100
Nitrite (µg)	10	10	500	500	> 500
Chromium (6) (µg/l)	10	10	0	50	> 50
Phenols (µg/l)	1	1	50	50	> 50

Source: Regulation for Classification of Water (Official Gazette No. 18/99)

2.3.2 Water Quality of the Vardar River

Monitoring locations by HMI along the main stream of the Vardar River are Radusa, Taor, Basino Selo, Nogaevci, Demir Kapija and Gevgelija. Monitoring locations near Skopje City are Radusa at the upstream, and Taor at the downstream at about 15 km from Skopje City. The BOD levels ranged from 6 to 7 mg/l and SS ranged from 35 to 55 mg/l in 2006, both falling in the class III.



Source: HMI

Figure I. 6 Water Quality Measuring Points in Macedonia

Table I. 2 Water Quality in the Vardar River – BOD and SS

	Designated Class	BOD (mg/l)			SS (mg/l)		
		Average	Min	Max	Average	Min	Max
Taor	III	6.1	3.1	9.8	46.3	10.0	144.0
Basino Selo	II	6.9	4.7	9.0	42.1	8.0	180.0
Nogaevci	III	6.4	3.0	7.8	37.0	10.0	110.0
Demir Kapija	II	6.8	3.2	11.3	53.7	10.0	148.0
Gevgelija	II	6.6	3.4	10.4	50.1	8.0	120.0

Note: The figures are average from February to December 2006
Source: MEPP

2.3.3 River Water Quality in Study Area – BOD

Most of the BOD in the Vardar River along its upstream to middle reach within the study area is about 2 mg/l, but it occasionally increases to 4 mg/l. Water quality in the Vardar River along its middle to downstream reach within the study area is observed to deteriorate compared to upstream reaches

because lots of houses and industry are located around the middle reach and often untreated wastewaters are discharged to the Vardar River. Values of BOD along this stretch vary from 2 to 7 mg/l and existing water quality for this stretch falls in Class III on average. BOD values along tributaries of the Vardar River, i.e. the Treska River and the Lepenec River, are observed to be same as in case of upstream stretch of the Vardar River, which are about 2 mg/l and fall in Class II.

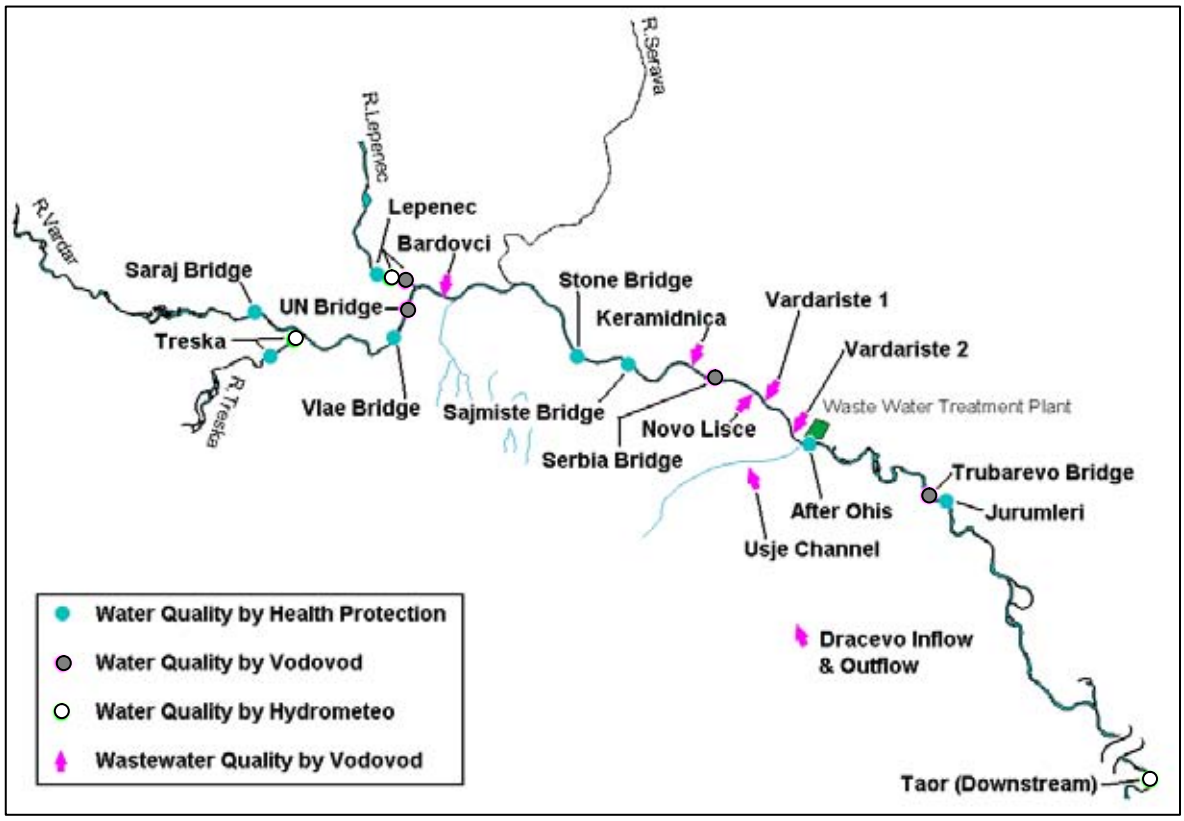


Figure I. 7 Locations of River Water and Wastewater Monitoring Station

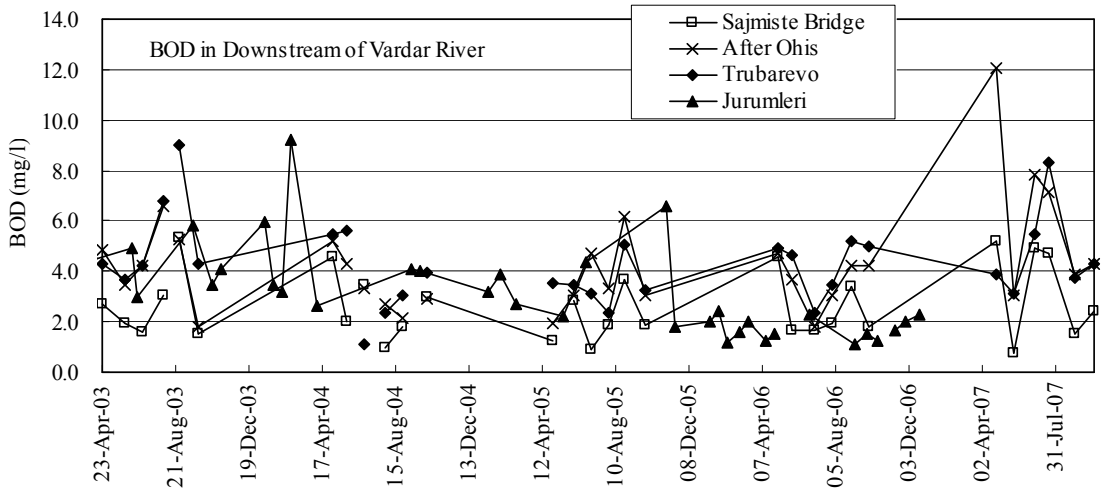


Figure I. 8 BOD in Downstream of the Vardar River

2.3.4 River Water Quality in Study Area– SS

SS value along upstream stretch of the Vardar River within the study area ranges from 20 to 60 mg/l, which is 30 mg/l in average, and could be said to fall in Class III. It was expected that turbid water from the Lepenec River would influence the quality in the Vardar River, but there is no significant difference between SS values at Vlae Bridge and Stone Bridge which are located before and after the

confluence, respectively. The SS values along the downstream stretch of the Vardar River within the study area range from 10 to 100 mg/l, and the average is 35 mg/l that falls in Class III. Large number of houses and industries are located in the middle of Skopje City and wastewaters from these houses and industries lead to deterioration of the water quality along the downstream of the Vardar River.

2.3.5 River Water Quality in Study Area– Others

Based on the presence of Cyanide and Nitrites as Nitrogen, river water quality falls in Class III or IV in the entire study area, and in terms of Chromium $^{6+}$ and Phenols categorization could be made as Class III or IV along some part of the Vardar River within the study area. In terms of other parameters, river water quality falls in Class I or II in the entire study area.

2.4 Existing Condition of Waterworks

In Skopje, the population served by water supply is as high as 96% of the total population. However, the ratio of revenue water is as low as 42%. After year 2000, the supplied water volume has increased by 10%. On the other hand, the ratio of revenue water has been decreasing, which is acknowledged as a severe issue on waterworks in Skopje.

2.5 Existing Condition of Sewerage Works

2.5.1 Sewerage

The sewerage system in Skopje was started as a separate system. Sanitary sewer construction started in the first half of 1960s followed by construction of storm sewer in the second half of 1960s. The service population is estimated to be more or less 80%. However, storm sewer network is not complete; therefore, some stormwater is connected to the sanitary sewer.

The outline of existing sewerage facilities is described in the following Table. In addition, the following figures show the pipe networks together with pumping stations. There are no WWTPs in operation.

Table I. 3 Outline of Existing Sewerage Facilities

Sanitary Sewerage service area		6,074 ha
Sewer	Sanitary	539,900 m
	Stormwater	206,700 m
	Total	746,600 m
Constructed Year	Before Year 1966 (Old)	294,500 m
	Year 2002-2006 (New)	34,200 m
	Others (1967-2001)	417,900 m
Number of Pump Station		11
	Sanitary	8
	Stormwater	3
Number of WWTP		3 (2 in Saraj, 1 in Dracevo)

Source: Vodovod

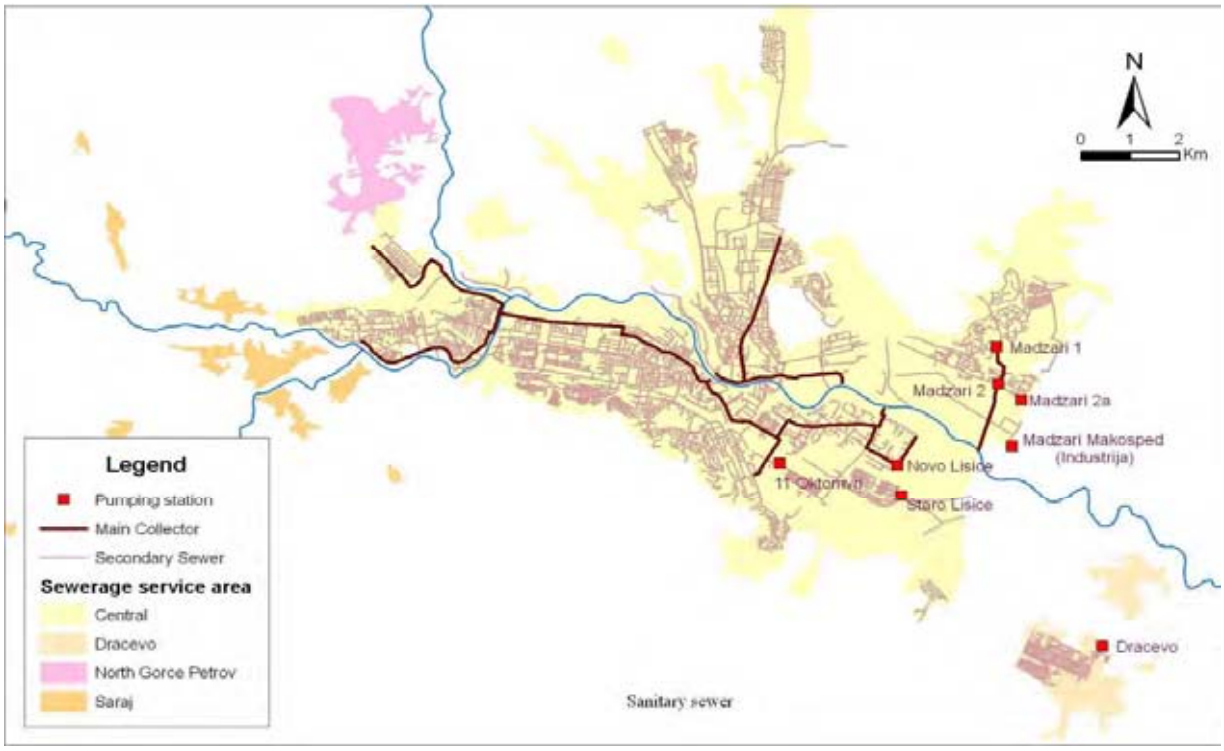


Figure I. 9 Existing Main Sewerage Facilities with Pumping Stations

2.5.2 Existing Condition of Stormwater Drainage Facilities

Stormwater in Skopje City is drained to the Vardar River through storm sewers or canals. The storm sewer network is shown in Figure I. 10. The existing storm sewers, shown in green color, are laid in the city area, and canals are mainly dug on the hillside. Existing storm sewers were installed after the huge earthquake in 1961. Currently, the storm sewers cover 25% of Skopje City's population, i.e., more than 50% of the residential area. In order to extend the coverage, a D/D on the storm sewer network development plan under GUP has been completed. As soon as the budget is prepared, the project will be commenced. After the project is completed, storm sewer network will cover almost all the residential area in Skopje.

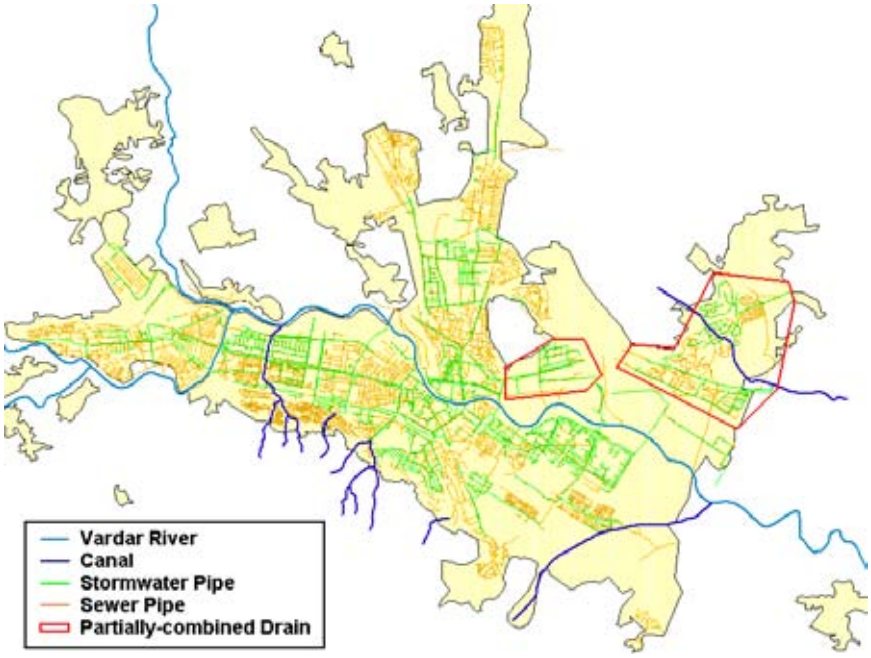


Figure I. 10 Area drained through both Sanitary Sewers and Storm Sewers

2.6 Status Quo and Capacity Assessment

2.6.1 Financial and Institutional Status of Vodovod

For 2002 to 2004 the balance of operating revenue and expenses resulted in surplus ranging from 10.0 million MKD to 67.7 million MKD. In 2005 and 2006 large deficits of 138 million MKD and 173 million MKD were experienced. The balance is turning to surplus in 2007 owing to a large (98%) rate hike made in 2007. The total annual revenue amounts to approximately 699 million MKD to 1,219 million MKD, 92% of which is the revenue generated from water and sewer service sales. The total expenditure amounts to 715 million MKD to 1,144 million MKD. The largest expenditure item is salaries and wages, which averaged 330 million MKD or 42% of the total expenditure. (See Table 2.25 in Chapter2, Part I (B/P).

Vodovod prepares financial tables. However, The Study Team experienced difficulty in finding sources and uses of funds since the style of cash flow statement is different from the standard one. According to Vodovod, they keep a large book which records all the transactions including not only operating expenses but also capital investments. This practice appears to be different from the internationally standardized practices. Operating expenses and capital expenditures should be logged on separate books. A table in the financial report to the City council is filled out by hand, which is one of the examples for required improvement.

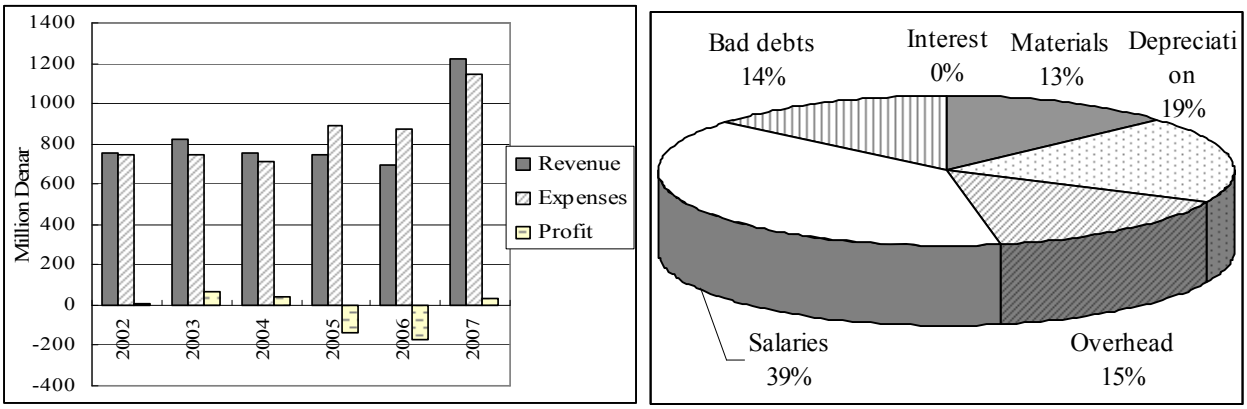


Figure I. 11 Financial Status and Expenditure Item of Vodovod

2.6.2 Organizational Structure

Vodovod is an independent organization with 1,120 staff members (as of March 2008). A General Director heads up Vodovod with a Deputy General Director, two Assistant General Directors and a Consultant. For decision-making the General Director consults with a Management Board and a Control (Audit) Board. There are eight Sectors and two centers, which handle day-to-day activities of Vodovod (See Figure I. 12). The names of Sectors are listed below together with their terms of reference:

1) Sector Water Supply (Total No. of staff members: 181)
   (i) Maintenance of distribution mains, (ii) Replacement of old mains, (iii) Repair of leaks, (iv) Operation of meter repair shop etc.
2) Sector Sewerage (Total No. of staff members: 122)
   (i) Maintenance and repair of sewers, (ii) Installation of service connections and so forth.
3) Sector Mechanical (Total No. of staff members: 111)
   (i) Purchase, storage, upkeep and deployment of construction and transport machinery etc.
4) Sector Technical Affairs & Development (Total No. of staff members: 40)
   (i) Design of minor construction schemes, (ii) Installation of services (connections)
5) Sector Exploitation, Maintenance of Facilities (Sector O&M) (Total No. of staff members: 282)
   (i) O&M of water intake, chlorination, pumping (water intake and sewage) facilities, (ii) Upkeep

of buildings, (iii) Development and operation of SCADA etc.
6) Sector Accounting, Finance & Commerce (Total No. of staff members: 246)
(i) General accounting, (ii) Budget planning and control, (iii) Meter reading, billing etc.
7) Sector Legal, Personnel & General Affairs (Total No. of staff members: 64)
(i) Prosecution of long-time default customers, (ii) Personnel management etc.
8) Sector IT (Total No. of staff members: 26)
(i) Management of operational information, (ii) Data processing, analysis for database etc.
9) Emergency and Information Center (Total No. of staff members: 26)
(i) Emergency repair, (ii) Leak detection on water mains, (iii) Inspection of sewers etc.
10) Center for Sanitary Control (Total No. of staff members: 17)
(i) Safety control of drinking water, (ii) Monitoring of sewage at its discharge points

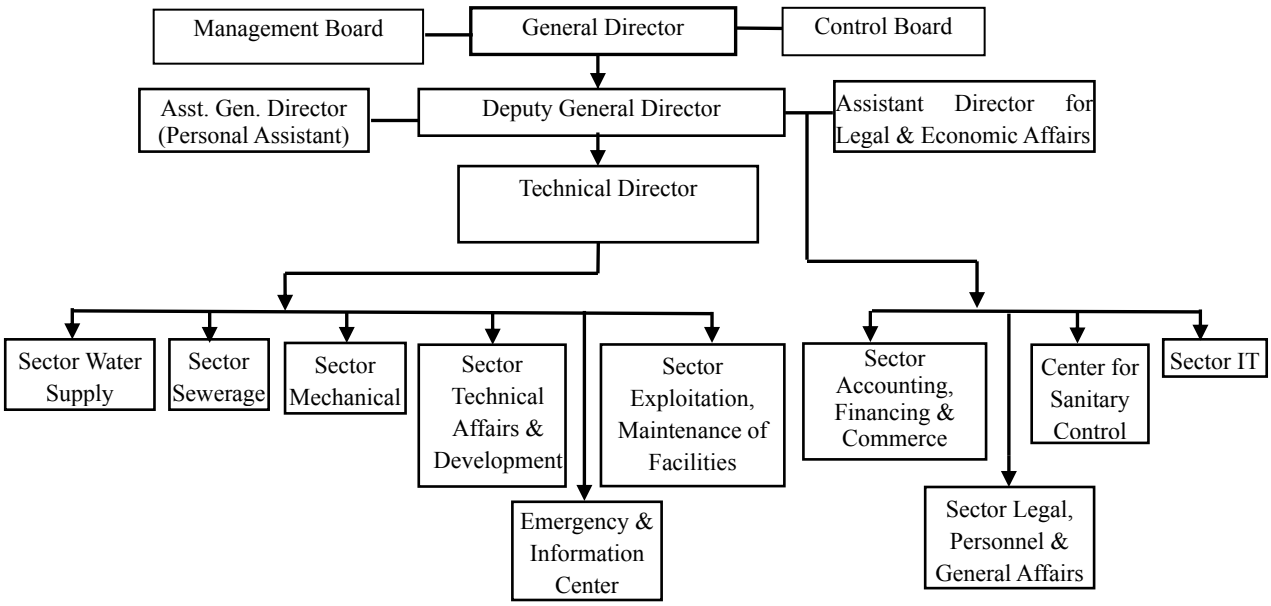


Figure I. 12 Organization of Vodovod

2.7 Current Law System of Industrial Wastewater Management and Issues

Basic laws related to environment including industrial wastewater management have been prepared by EU's assistance. Related sub-laws and regulations are under preparation one after another. Application of operation permit under IPPC (Integrated pollution prevention and control) system, which is deeply related to industrial wastewater management, has been started and the first permission was issued in early 2008. The next challenge is how to secure proper implementation and technical improvement.

2.7.1 IPPC system and Implementation

It is clearly described in Chapter XII (Integrated Environmental Permits for Operation of Installations with an Environmental Impact) of Law on Environment which was enacted in 2005, that operation of installation is required the permit based on IPPC system with EIA. The industrial units which discharge toxic substance to environment are required the introduction of EU's IPPC Directive (Council Directive 96/61/EC). According to the Directive, large scale or highly toxic substances handling industrial units are recognized as A classification and are supervised by MEPP and other middle to small sized units and handling less toxic substances are recognized as B classification and are supervised by the municipality.

IPPC system is introduced as a comprehensive environmental pollution prevention system in water, air and soil. The operation permit application for any new installation is evaluated based on the concept of BAT (Best available techniques) in EIA stage.

The application of A classified industries has started according to types of industries. Seventy one (71) factories have already finished the applications so far and the first approval will be permitted soon. To get the permission about six (6) months are needed. During the period, announcement of the application is made by newspaper, internet and public hearing. The permission is reviewed every seven (7) years.

The emissions with significant breach of the BREF associated values are matter of improvement program or adjustment plan (AP). This is like a temporary permission for existing installations until 1st of April 2014. In case of emission not based on BREF (BAT reference), the followings are required.

- Strong justification that the improvement benefits would not be adequate to the investments made.
- Improvement plan
  - Operators applying for an environmental integrated permit submit a draft improvement plan for improving the environmental performance and protection of the environment
- Adjustment plan
  - The operators of the existing installations submit an application for an adjustment permit with an adjustment plan

Content of AP includes the followings measures, phase-specific solutions and deadlines for achieving the:

- conditions for obtaining integrated environmental permit;
- conditions for the operation of the installation;
- schedule of implementation of the plan by specific phases (one phase – max.12 months)
- monitoring and manner of reporting;
- summary of financial resources required for the implementation of each of the phases of the adjustment plan, and summary of the total financial resources required for the implementation of the plan;
- emission values during the implementation of specific phases of the plan;
- indicators of usage of raw materials, energy, natural resources, water and other materials by specific phases of the plan; and
- other issues stipulated in the special laws on individual environmental media and areas protection

To get AP permit, it needs about six (6) months. Deadline of realization of AP is not later than 1st of April 2014.

2.7.2 Monitoring of IPPC System

There are eight (8) MEPP staff members and two (2) staff members of Department of Environment and Nature Protection in the City of Skopje to evaluate the permission and issue operation permission under IPPC system for category A and B, respectively. The number of inspectors who supervise the implementation of IPPC system has been increasing every year. There are fourteen (14) state inspectors among which five (5) are in charge of installations of category A in the City of Skopje and four (4) city inspectors of department of environment and nature protection are in charge of installations of category B in February 2008. However, the personnel resources are still lacking and capacity strengthening of the inspectors is urgently required.

2.7.3 Issues of IPPC System

Although IPPC system is ideal to cope with comprehensive environmental problems, the followings should be discussed to implement it.

(1) Measures to alternatives

In permitting installation operation, EIA is necessary as a principle. EIA shall be evaluated, based on

BAT and setting up BAT committee is obligated in order to evaluate the proposed BAT. However, it is said that the committee was never organized and has never acted as of October 2008. For a different technical proposal from BREF or the type of industry is not included in IPPC system, establishing the discharge criteria should consider the BREF. To evaluate the case it will need considerable labor resources with competence; which will need more time to give the permission.

(2) Financial assistance

In order to promote IPPC and BAT system based on EU directive, cleaner production (CP) facilities, improvement of process facility, installation of wastewater and air pollution prevention plant, etc. are required. However, financial assistance system for enterprise is not established. As the financial resources, accumulated fund by fines to the enterprises which violate law and donor assistance are expected. However, how legal violator could be identified without clear definition of discharge criteria still remains a question.

2.8 Tasks on Water Quality Improvement

2.8.1 Current Water Quality

The Vardar River is classified as class II in the upstream of the Skopje city and as class III in its downstream. The class II is defined as "a very clean, mesotrophic water, which in its natural state can be used for bathing and recreation, water sports, production of other types of fish / ciprinides /, or which can be used – after usual methods of purification / coagulation, filtration, disinfection etc./–for drinking and production and processing of food products". The class III is as "moderately euthrophic water, which in its natural state can be used for irrigation, and after usual purification methods (conditioning) for industries which do not need drinking water quality. Buffering capacity of the water is low, bat it maintains the / pH value / acidity at a level still suitable for most fish".

In the upstream, BOD is mostly 2 mg/l, falling under the class II, however occasionally exceeding the upper limit value of 4 mg/l for class II. SS ranges from 20 to 60 mg/l, averaging 30 mg/l which equals to the upper limit value for class II. Harmful and dangerous substances such as cyanide, nitrate as nitrogen, chromium 6+, phenol etc. exceed the upper limit value and the river falls practically under the class III category. Fecal-coliform also exceeds the upper limit value.

In the downstream, after the right bank main sewer outlet, BOD ranges from 2 to 7 mg/l, which is below the upper limit value of 7 mg/l for Class III, however occasionally it exceeds the limit. SS ranges from 10 to 100 mg/l with average of 35 mg/l upper limit value of which is 35 mg/l. Concentrations of harmful and dangerous substances such as cyanide, nitrate, chromium 6+, phenol etc. fall under the class III category. Fecal-coliform exceeds the upper limit value for Class III.

2.8.2 Wastewater Treatment Plant and Industrial Wastewater Management

To meet the BOD value for the current situation and future worsened situation, with the classes II or III, biological wastewater treatment plant is effective. It will biologically treat the wastewater and reduce BOD value. However, biological treatment cannot remove harmful and dangerous substances. Therefore, in parallel with wastewater treatment, industrial wastewater management through IPPC system enforcement is required. IPPC system has started its operation with provisional adjustment plan being enforced until the beginning of the year 2014. After that, IPPC system is planned to be fully implemented. The Study Team understands that such full implementation is very important to improve the Vardar River water quality. It is also noted that harmful and dangerous substances seem not only generated inside the Skopje city but also its upstream like Tetovo city, considering that they are detected far upstream of the Skopje city.

3. FRAMEWORK OF THE STUDY

3.1 Objective of Sewerage B/P and Target Year

3.1.1 Objective

The water quality in Skopje, upstream stretch of the Vardar River is in rather good condition with BOD level ranging from 2 to 3 mg/l but it deteriorates in downstream and is recorded as 4 mg/l. The Vardar River water qualities might not meet the environmental water quality standard of Category IV (BOD of more than 7 mg/l) at the downstream in 2020, if the domestic and industrial wastewater continues to be discharged into the river with no treatment and no control.

EU Directives on Urban Wastewater Treatment stipulates that cities with the population of more than 2,000 need to treat their wastewaters at secondary level. Needless to say, Skopje City far exceeds the population size. From this background, the objectives of the Sewerage B/P are to implement sewers in the areas that have not been sewered, to implement trunk sewers and to treat collected wastewater to secondary level.

3.1.2 Target Year

Both Sewerage M/P (established in 1999) and GUP (established in 2002) decided to have the target year of 2020. It is reasonable to set the target year of about 20 years from the time of plan establishment. Though only 10 years are left from 2008, staged construction of WWTP is not difficult and the target year of 2020 is reasonable. On the other hand, it is rather difficult to extend trunk sewers due to their nature and the target year of 2030 for trunk sewers is recommended.

3.1.3 Area for Planning

Pertaining to the area for sewerage B/P, four sewer districts as shown in Figure I.11 are proposed taking Sewerage M/P and GUP into account. Chapter 5, Part I discusses whether these four districts are handled together or separately.

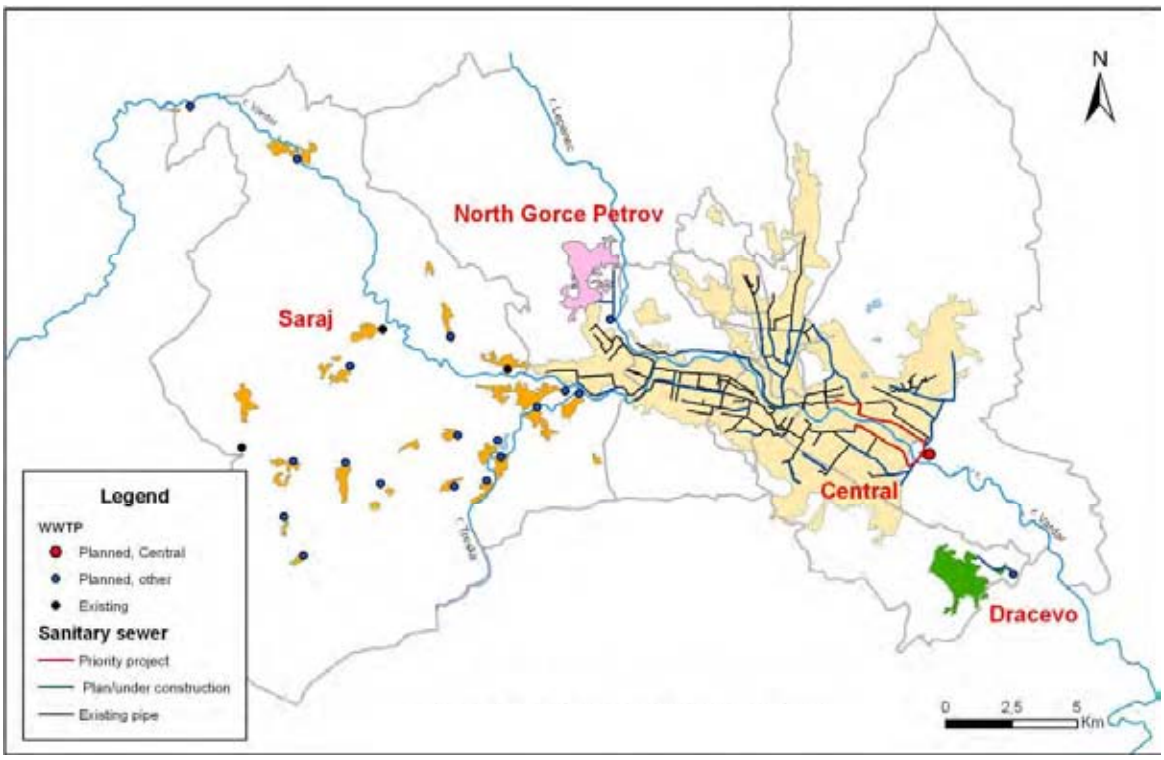


Figure I. 13 B/P for Sewerage Development in Skopje City

Table I. 4 B/P Sewer District Area

Name	Size (km^2)	Municipality
Central	72.8	Aerodrom, Butel , Gazi Baba, Gorce Petrov, Karpos, Kisela Voda, Centar, Suto Orizari Plus out of Skopje city
Saraj	7.5	Saraj
North Gorge Petrov	3.2	Gorce Petrov
Dracevo	4.0	Aerodrom, Kisela Voda, Plus out of Skopje city
Total	87.5	

3.1.4 Collection System

Sanitary and storm sewers have been implemented targeting separate system. However, financial constraints have prioritized sanitary sewers implementation with the current service ratio of as high as 80% while service ratio of storm sewers remains as low as 30%. Many storm sewers have been temporarily connected to sanitary sewers, which allows stormwater to enter sanitary sewers. Sanitary sewers were planned based on larger forecast for population, per capita sewage generation and industrial wastes, and they are considered to have sufficient capacities for stormwater inclusion.

Trunk sewers are planned supposing stormwater overflows to the river, in principle. However, EU Directives require sewerage authorities to take measures against river water quality deterioration caused by stormwater discharge. B/P proposes that 31,000 m^3/d stormwater be treated as a certain amount of what is called "first flush" that corresponds to 25% of 135,000 m^3/d, the total of domestic and industrial wastewaters.

3.1.5 Industrial Wastewater Treatment

Among various industrial wastes, four steel related factories that discharge a large amount but less organic wastewater and one organic chemical factory, OHIS, have already provided with their own industrial waste treatment facilities. Hence, these industrial wastewaters are not treated at Central WWTP. A beer and beverage factory discharges lots of wastewater with high organic content. The wastewater might harm the performance of Central WWTP and B/P proposes that it be treated separately.

All the industrial wastewaters except for those from above mentioned six factories are to be treated at Central WWTP.

3.1.6 Treatment Level

EU Directives and new Law on Waters incorporating them require municipalities of more than 2,000 population to treat their wastewaters at secondary level (BOD of less than 25 mg/l, COD of less than 125 mg/l and SS of less than 35 mg/l). The Law stipulates that water pollution has to be controlled on river basin basis or River Basin Management. As described in Chapter 4, Water Quality Simulation on the Vardar River, secondary level treatment sufficiently reduces organic matter in the effluent to the required level.

However, by the time of the implementation of B/P, River Basin Management Plan might be established and the effluent receiving water body might be possibly designated as Sensitive Area. Besides, the Vardar River is an international river discharging into Aegean Sea, which might lead to the requirement of nitrogen and phosphorous removal. Since the implementation of the sewerage plan will be funded by IPA Fund, or EU grant, Feasibility Study as well as EIA report will be examined by EU Committee. Taking these future circumstances into account, nitrogen and phosphorous removal process will be incorporated in the second phase of the implementation.

3.1.7 Reuse of Treated Effluent and Sludge

The reuse of treated effluent contributes to the total pollutant reduction for receiving water body and to effective utilization of water resources. Article 117 of new Law on Water stipulates that treated

effluent has to be used as much as possible. Treated effluent can be used for various purposes such as washing water within WWTP, spraying water and miscellaneous uses outside WWTP. However, no reuse method has been decided yet and the effluent is to be discharged to the Vardar River except for the use within WWTP.

The sludge can be used for fertilizer. Article 118 of new Law on Water stipulates that sewage sludge has to be used as much as possible. However, the Law does not regulate toxic substance concentrations in sludges. EU Directives, on the other hand, regulates maximum concentrations in the soil, maximum concentrations of sludges and maximum annual use in weight for seven metals; cadmium, copper, nickel, lead, zinc, mercury, and chromium. It stipulates that agricultural use of sludges is possible if all these standards are met. If all the sludge cannot be used, a part or all of it is to be disposed of at Drisla disposal site. The sludge might be disposed of at hazardous wastes disposal site to be completed in 2014[2] if it does not meet the quality standard to be received at Drisla disposal site.

It is vitally important to monitor effluent and sludge qualities not only for the Vardar River water quality but also for improvement of citizens' health and for the promotion of effluent and sludge use. If hazardous matters are detected in effluent and sludge, it is essential to investigate about its cause. For this purpose, factories that discharge hazardous wastes have to be identified and orders to improve have to be issued. As of October 2008, MEPP is authorized to identify the factories and issue these orders, but it is proposed that WWTP itself have similar authority.

3.2 Wastewater Generation

3.2.1 Domestic Wastewater Generation

It is reasonable to forecast the annual population growth rate of 0.7 to 0.8 % based on State Statistical Office forecast. The population forecast described in Sewerage M/P has been approved by State Statistical Office. The figure of 0.8 % is applied which is the same as in 1999 JICA Report "The Study on Integrated Water Resources Development and Management Master Plan in the Republic of Macedonia". Hence, the annual population growth rate in B/P of this study is set as 0.8 %. Current population of Skopje City and its projection to the planned year on sewer district basis are listed in Table I. 5.

Table I. 5 Design Population in Treatment District

(Unit: persons)

	Central	Saraj	NGP	Dracevo
2006	447,235	38,628	9,800	35,760
2020	513,570	52,500	13,200	39,900
2030	555,650	62,800	16,100	43,200

Wastewater quantity

Per capita domestic wastewater is estimated based on the water consumption in the period between 2002 and 2006. According to Vodovod, water consumption by illegal connection accounts for 10 to 20 % of total water supply, which is taken into account in the domestic wastewater estimate. It is assumed that 90 % of water consumption is converted to wastewater and 10 % of domestic wastewater is added as groundwater.

Domestic water consumption is nearly constant during the period between 2002 and 2006, and wastewater generation per capita per day is supposed to be constant at 200 l/c/d until the target year of 2030. Domestic wastewater generation in each sewer district is calculated based on the population in the planned area, connection ratios and per capita wastewater generation, whose result is shown in Table I. 6.

[2] If the sludge contains hazardous substances exceeding the standards, it should be disposed of at the hazardous waste disposal site, which is planned to be completed by 2014 as stated in the "waste strategic plan". The responsibility of construction and operation is the State. The request for conducting F/S is made but the realization is not progressed.

Table I. 6 Domestic Wastewater Generation by Sewer District (including Groundwater Infiltration)

	Unit	2006	2020	2025	2030
Central Sewer District					
Population in the District	person	447,235	513,570	534,610	555,650
Sewage Generation	m^3/d	89,450	102,710	106,920	111,130
Saraj Sewer District					
Population in the District	person	38,628	52,500	57,650	62,800
Sewage Generation	m^3/d	7,730	10,500	11,530	12,560
North Gorce Petrov Sewer district					
Population in the District	person	9,800	13,200	14,650	16,100
Sewage Generation	m^3/d	1,960	2,640	2,930	3,220
Dracevo Sewr District					
Population in the District	person	35,670	39,900	41,550	43,200
Sewage Generation	m^3/d	7,130	7,980	8,310	8,640
Total Sewage Generation	m^3/d	106,270	123,830	129,690	135,550

3.2.2 Industrial Wastewater

Fifty factories in the planned area were interviewed on their wastewaters. It was found that the amount of industrial wastewaters was 28,464 m^3/d. Since fifty factories account for 65 % of total factories, total amount of industrial wastewaters is estimated to be 43,791 m^3/d. The wastewater of 19,495 m^3/d from six factories does not flow into sewers because of their own treatment. In conclusion, the industrial wastewater of 24,296 m^3/d is to be handled by sewerage system.

The future industrial wastewater generation is estimated taking industrial growth rate into account. The growth rate was about 4% in 2004 and 2005. As for the industrial growth rate in the last few years, the minimum growth was experienced in 2002 and it increased by 13 % (annual average of 3.25 %) from the year 2002 to 2006. Then, it is assumed that annual increase rate of industrial wastewaters would be 3.5 %. It is also assumed that the industrial wastewaters would be reduced by the introduction of "cleaner production." Future industrial wastewaters generation is forecast as shown in Table I. 7.

Table I. 7 Estimation of Industrial Wastewater Quantity

	2006	2007	2020	2025	2030
Industrial Wastewater Generation(m^3/d)	23,446	24,296	38,000	45,130	53,600
Growth Ratio (annual growth rate of 3.5 %)	0.965	1.00	1.56	1.86	2.21
Reduction Ratio with Cleaner Production	-	-	15%	25%	35%
Industrial Wastewater Generation with CP(m^3/d)	23,450	24,300	32,300	33,850	34,840

3.2.3 Stormwater

Though Skopje City has implemented sewers targeting separate system, most rainfall in Central sewer district of 7,287 ha flows into sanitary sewers due to insufficient implementation of storm sewers. Hence, Central WWTP is to treat certain amount of stormwater as tentative measures until storm sewers are implemented in the whole sewer district. It is not viable, however, to treat all the stormwater and it is proposed to treat a part of stormwater that is regarded as first flush with higher pollution loadings. The rainfall in an hour is supposed to be the first flush and is calculated as follows.

Rainfall intensity: 1 mm/h
Area: Area of central sewer district is 7,287 ha out of which 70 % is not served by storm sewer and thus stormwater in 5,101 ha is supposed to flow into central WWTP.
Runoff coefficient: 0.6
$Q = (1/360) \times 0.6 \times 1 \times 5{,}101 = 8.5\ m^3/s$
Stormwater in an hour is;
$8.5\ m^3/s \times 3{,}600\ \text{seconds} = 30{,}600\ m^3 \fallingdotseq 31{,}000\ m^3$

The amount of 31,000 m^3 is supposed to be daily stormwater to be treated at Central WWTP. The amount will remain the same until the target year.

3.2.4 District-wise Wastewater Generation

Table I. 8 shows district-wise wastewater generation.

Table I. 8 District-wise Wastewater Generation

(m^3/d)

	2006	2020	2025	2030
Central Sewer District				
Domestic	89,450	102,720	106,930	111,130
Industrial	23,450	32,300	33,850	34,840
Stormwater	31,000	31,000	31,000	31,000
Total	143,900	166,020	171,780	176,970
Saraj Sewer District				
Domestic	7,730	10,500	11,530	12,560
Total	7,730	10,500	11,530	12,560
North Goerce Petrov Sewer District				
Domestic	1,960	2,640	2,930	3,220
Total	1,960	2,640	2,930	3,220
Dracevo Sewer District				
Domestic	7,130	7,980	8,310	8,640
Total	7,130	7,980	8,310	8,640

3.3 Wastewater Quantity and Load

3.3.1 Load of Domestic Wastewater

EU Directives on Urban Wastewater Treatment stipulates that per capita BOD generation per day is 60 g/c/d. The Directives allows municipalities to apply figures other than 60 if they have good reasons to do so along with clear grounds. In case of Skopje, there is no ground to show its per capita BOD loading. Performance data of Kumanovo WWTP that recently began its operation shows the BOD loading similar to that in EU Directives. Hence, B/P proposes 60 g/p/d for per capita BOD loading. The Directives has no regulation on SS loading and it is proposed to apply 45 g/c/d for SS loading obtained in Dracevo area where no industrial wastewaters are generated. Table I. 9 shows domestic pollutants load for respective sewer districts.

Table I. 9 Domestic Pollutants Load by Sewer District

	Unit	2006	2020	2025	2030
(1) Central Sewer District					
Population	person	447,235	513,570	534,610	555,650
BOD Load	kg/d	13,417	30,814	32,077	33,339
SS Load	kg/d	18,337	23,111	24,057	25,004
(2) Saraj Sewer District					
Population	person	38,628	52,500	57,650	62,800
BOD Load	kg/d	1,159	3,150	3,459	3,768
SS Load	kg/d	1,584	2,363	2,594	2,826
(3) North Gorce Petrov Sewer District					
Population	person	9,800	13,200	14,650	16,100
BOD Load	kg/d	294	792	879	966
SS Load	kg/d	402	594	659	725
(4) Dracevo Sewer District					
Population	person	35,670	39,900	41,550	43,200
BOD Load	kg/d	1,070	2,394	2,493	2,592
SS Load	kg/d	1,462	1,796	1,870	1,944

3.3.2 Quantity and Quality of Industrial Wastewaters

Table I. 10 shows the quantity and quality of industrial wastewaters that are estimated based on interview survey to factories.

Table I. 10 Load from Industrial Wastewater (Year 2007)

	Generation (m^3/d)	Water Quality (mg/l)		Load (kg/d)	
		BOD	SS	BOD	SS
For 50 Factories	28,464	142	262	4,039	7,447

As mentioned before, wastewaters from six factories are not received in Central WWTP and are deducted as shown in Table I. 11.

Table I. 11 Pollutants Load from Industry Discharging to Sewerage System (2007)

	Generation (m^3/d)	Water Quality (mg/l)		Load (kg/d)	
		BOD	SS	BOD	SS
50 Factories from the Industrial Survey	28,464	142	262	4,039	7,447
6 Factories, not connected with Sewerage System	19,495	111	219	2,165	4,263
Factories Discharging to Sewerage System	8,969	209	355	1,875	3,184

Industrial wastewater quality is planned to be improved due to gradual introduction of CP targeting 35 % reduction on concentration basis by 2030. Table I. 12 shows forecast quantity and quality of industrial wastewaters flowing into sewerage system towards 2030.

Table I. 12 Industrial Wastewater Quantity and Quality (Central District)

	2006	2007	2020	2025	2030
(1) Industrial Wastewater Generation (m^3/d)	23,450	24,300	32,300	33,850	34,840
(2) BOD Load					
BOD Load Reduction with Cleaner Production	0%	0%	20%	27.5%	35%
BOD Concentration with Cleaner Production (mg/l)	209	209	167	152	136
BOD Load (kg/d)	4,901	5,079	5,399	5,145	4,732
(3) SS Load					
SS Load Reduction with Cleaner Production	0%	0%	20%	27.5%	35%
SS Concentration with Cleaner Production (mg/l)	355	355	284	257	231
SS Load (kg/d)	8,325	8,623	9,175	8,699	8,041

3.3.3 Stormwater

Table I. 13 shows pollutant loadings by stormwater that is to be treated at Central WWTP.

Table I. 13 Quality and Load of Stormwater

	Quantity	Quality	Load
BOD	31,000 m^3/d	110 mg/l	3,410 kg/d
SS		400 mg/l	12,400 kg/d

3.3.4 Overall Loading to WWTP in Respective Sewer Districts

Table I. 14 shows overall loadings flowing to WWTP for respective sewer districts.

Table I. 14 Quantity, Load and Quality of Sewerage Influent

	Unit	2006	2020	2025	2030
(1) Central Sewer District					
Total Flow	m^3/d	143,900	166,020	171,780	176,970
BOD Load					
Domestic	kg/d	13,417	30,814	32,077	33,339
Industrial	kg/d	4,901	5,399	5,145	4,732
Stormwater	kg/d	3,410	3,410	3,410	3,410
Total Load	kg/d	21,728	39,623	40,632	41,481
BOD Concentration	mg/l	151	239	237	234
SS Load					
Domestic	kg/d	18,337	23,111	24,057	25,004
Industrial	kg/d	8,325	9,175	8,699	8,041
Stormwater	kg/d	12,400	12,400	12,400	12,400
Total Load	kg/d	39,062	44,686	45,156	45,445
SS Concentration	mg/l	271	269	263	257
(2) Saraj Sewer District					
Total Flow	m^3/d	7,730	10,500	11,530	12,560
BOD Load	kg/d	1,159	3,150	3,459	3,768
BOD Concentration	mg/l	150	225	225	225
SS Load	kg/d	1,584	2,363	2,594	2,826
SS Concentration	mg/l	205	225	225	225

	Unit	2006	2020	2025	2030
(3) North Gorce Petrov Sewer District					
Total Flow	m^3/d	1,960	2,640	2,930	3,220
BOD Load	kg/d	294	792	879	966
BOD Concentration	mg/l	150	225	225	225
SS Load	kg/d	402	594	659	725
SS Concentration	mg/l	205	225	225	225
(4) Dracevo Sewer District					
Total Flow	m^3/d	7,140	7,980	8,310	8,640
BOD Load	kg/d	1,070	2,394	2,493	2,592
BOD Concentration	mg/l	150	225	225	225
SS Load	kg/d	1,462	1,796	1,870	1,944
SS Concentration	mg/l	205	225	225	225

4. WATER QUALITY ESTIMATION

The objective of the Study is to improve water quality of the Vardar River. The Study is conducted with an aim of achieving this objective. Therefore, effect of the proposed project resulting from the Study will become a "project effect indicator". In order to evaluate the project effect, water quality simulation is conducted as part of the Study. The simulation estimates water quality in the Vardar River with various scenarios such as "with or without sewerage treatment plant", "with or without industrial wastewater management (strict enforcement of IPPC system)" and their combinations.

4.1 Vardar River

4.1.1 Flow Rate

Water quality is estimated for low water flow which is observed in July and August and the Table I. 15 shows low water flow and draught water flow.

Table I. 15 Flow Rate in the Vardar River and Tributaries; Low and Draught Water

(m^3/s)

	Vardar River			Treska River	Lepenec River
	Vlae	Skopje	Taor		
Low-water (275-day) Flow Rate (m^3/s)	19.6	25.7	29.8	8.4	3.9
Draught-water (355-day) Flow Rate (m^3/s)	12.1	15.1	18.9	5.5	2.4

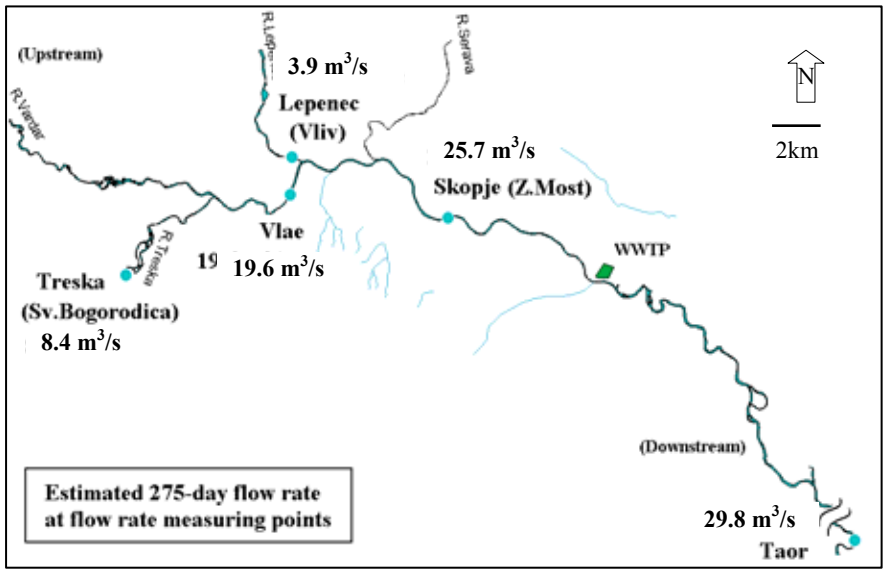


Figure I. 14 Flow Rate in the Vardar River and Tributaries (Low Water)

4.1.2 Water Quality of the Rivers and BOD Load

It is necessary to know water qualities of the Vardar River, the Treska River and the upstream part of the Lepenec River as boundary conditions in pollution estimation. Measured water qualities are used for the estimation of current conditions, whereas water qualities stipulated in the environmental water quality standard (BOD of 4 mg/l) are used for the estimation in the target year of 2020 supposing the water quality would meet the standard and expecting some pollution abatement measures would be taken at the upstream of the river. Table I. 16 shows water quality boundary conditions.

Table I. 16 Water Quality and BOD Load of the Vardar River and Its Tributaries (Boundary Condition)

River	Point	Low Water Flow (m^3/s)	BOD (mg/l)		BOD Load (kg/d)	
			Current (2006)	Target Year (2020)	Current (2006)	Target Year (2020)
Vardar	Rasce	11.2	2.5	4.0	2,419	3,871
Treska	Upstream	8.4	2.3	4.0	1,669	2,903
Lepenec	Upstream	3.9	2.1	4.0	708	1,348

4.2 BOD Pollution Load Generation from Skopje City

＜Point Source Pollution Load＞

(i) Municipal wastewater discharged into rivers from sewerage system
(ii) Industrial wastewater discharged into rivers either directly or through sewerage system
(iii) Industrial wastewater discharged into rivers directly from individual use pipe.

＜Non-Point Source Pollution Load＞

(i) Wastewater from households (not covered by the sewerage system)
(ii) Natural from lands (agricultural land, pasture and shrub/forest, livestock).

There is no irrigation area inside urban planning area of Skopje City, but dry-field farming is practiced on a portion of land. Irrigation is carried out only in the upstream and downstream areas outside of Skopje urban planning area.

4.2.1 Point Source Pollution Load Generation

There are all sizes of sewer outlets at approximately 50 places (use/unused including) together on both banks of the Vardar River. The majority of outlets are located within the city central area stretching from point “A” to point “E” (see Figure I. 15).

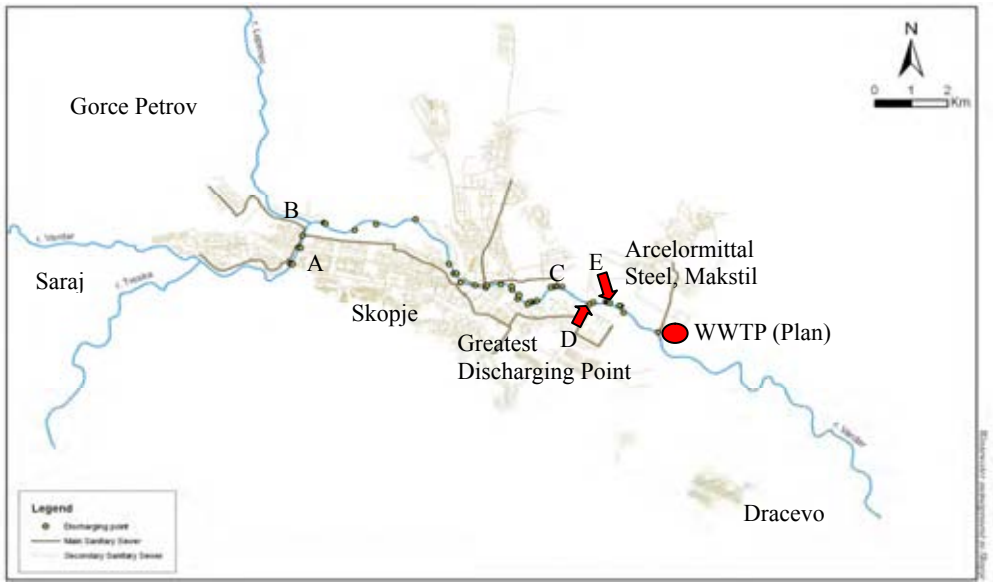


Figure I. 15 Outlet of Domestic Wastewater and Industry Wastewater

The largest domestic sewer outlet of point "D" (summer season 31,000m^3/d) is located on the right bank of the Vardar River, 20 m downstream of Serbia Bridge where the river water quality standard changes from Class II to Class III. The point "C" is the largest sewer outlet on the left bank side. The point "E" (80,700m^3/d), which has the maximum industrial discharge, is located on the left bank of the Vardar River where the wastewater from steel related industry (Arcelormittal Steel and Makstil) is discharged through the private pipe.

Average daily flow and BOD pollution load are calculated based on the results of water quality and flow measurements (two times measurement in November and December 2007) data of the domestic/ industrial wastewater outlet. The result is shown in Table I. 17. About 183,623 m^3/d (2.1 m^3/s) of sewage (including the domestic and industrial wastewater from Skopje City) is directly discharged into the Vardar River. Of this, about 44 % of total sewage amount, that is 80,784 m^3/d, is generated from steel related industry (Arcelormittal Steel and Makstil) which is discharged directly into the Vardar River through private pipe without treatment. Comparison between the wastewater amount (see Table I. 17) and water supply amount by Vodovod shows that both amounts are almost same and it can be judged that the average daily flow from each outlet is grasped accurately considering the infiltration, underground permeation and evaporation, etc.

Table I. 17 Sewage and Pollution Load Generation of the Vardar River

	Average Daily Wastewater	BOD Pollution Load Generation
Sewage (Mix of Domestic/Industry)	102,839 m^3/d	9,322 kg/d
Industrial Wastewater (Steel Industry)	80,784 m^3/d	4,847 kg/d
Total	183,623 m^3/d	14,169 kg/d

Note: Average daily wastewater is estimated based on the measured flows in major outlets (refer to Appendix I.10.2). It does not include flows in many small outlets (refer to Appendix I.2.7).

Table I. 18 Average Water Supply by Vodovod (2006)

	Average Daily Water Supply	Note
Municipal Water Supply	111,000 m^3/d	Total amount of water supply
Industrial Water Supply	78,000 m^3/d	Steel related industry
Total	189,000 m^3/d	

Source: Vodovod Annual Report

4.2.2 Non-Point Source Pollution Load Generation

Non-point source pollution load of the Vardar River is shown in Table I. 19. In addition, the generation of pollution load from outside sewer service area is added as a Non-point source.

Table I. 19 Non-Point Source Pollution Load (BOD)

(kg/d)

	2006	2020
Natural	178	178
Domestic (Outside of sewer area)	423	948
Total	601	1,126

4.3 Outline of Simulation Model

Water quality simulation is conducted to know the effects by the proposed measures. The model covers about 40.6 km stretch from Rasce (upstream of Skopje city) to Taor (downstream monitoring point outside of Skopje city).

Table I. 20 Pollutant Loads List

	Pollution Source		Chainage from Taor (km)	Remarks
1	River	Vardar River	40.60	
2 a	River	Treska River	32.99	
2 b	Point	Saraj Sewer District		Discharging into Treska River, tributary of Vardar
3		Central Sewer District Right-1	32.99 ～18.93	Small discharges of both bank side of Vardar
4 a	River	Lepenec River	28.46	
4 b	Point	North Gorce Petrov Sewer District		Discharging into Lepenec River, tributary of Vardar
5		Central Sewer District Left	19.89	Largest discharging at left bank
6		Factory (Pariva)		A factory discharging into Vardar directly
7		Central Sewer District Right-2	18.93	Largest discharging at right bank
8		Large Steel Factories	18.47	Factories discharging into Vardar directly
9		Factory (Ohis)	15.86	A factory discharging into Vardar directly
10		Central WWTP	15.51	WWTP for Central Sewer District (future)
11		Dracevo Sewer District	5.64	
12	Non Point	Non Point Source (Domestic)	40.60 ～ 0.00	
13		Non Point Source (Natural)	40.60 ～ 0.00	

Note: Numbers in the table correspond to those in Figure Ⅰ.16.

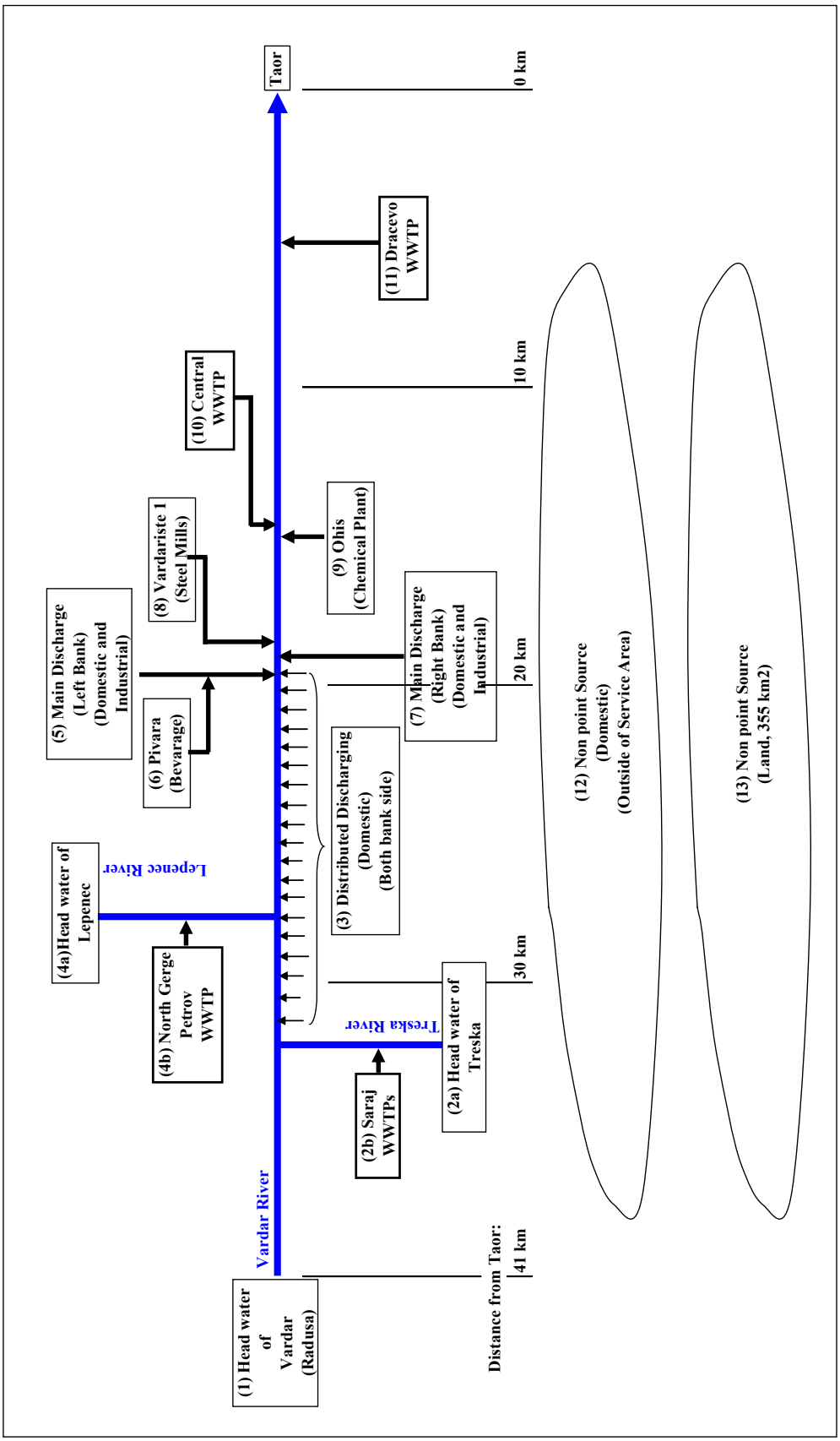


Figure I. 16 Water Quality Simulation Model

4.4 Wastewater Generation in the Target Year

4.4.1 Water Quality Improvement Scenarios for the Target Year

Water quality simulation is conducted for the current situation and 5 cases in the target year as shown in Table I. 21 in order to assess the proposed mitigation measures. The case-1 in the target year represents "without project" scenario while the cases from case-2 to case-5 represent various "with the project" scenarios in the target year.

Table I. 21 Scenarios of Water Quality Improvement for the Target Year

	Title	Industrial Wastewater Management	Wastewater Treatment Plant		Explanation
			Central	Other 3	
Current (2006)		Without	Without	Without	
Case-1	No measures	Without	Without	Without	
Case-2	Industrial Wastewater Management	With	Without	Without	1. No Wastewater Treatment Plant 2. Industrial Wastewater Management to all factories
Case-3	Primary Treatment in the Central	With	Primary	Without	1. Primary Wastewater Treatment Plant in Central 2. No Wastewater Treatment Palnt in other 3. 3. All but 6 factories are discharged to WWTP 4. Industrial Wastewater Management for 6 factories
Case-4	Secondary Treatment in the Central	With	Secondary	Without	1. Secondary Wastewater Treatment Plant in Central 2. No Wastewater Treatment Palnt in other 3. 3. All but 6 factories are discharged to WWTP 4. Industrial Wastewater Management for 6 factories
Case-5	Secondary Treatment in All 4	With	Secondary	Secondary	1. Secondary Wastewater Treatment Plant in 4 plants 2. All but 6 factories are discharged to WWTP 3. Industrial Wastewater Management for 6 factories

Note:
(1) Other 3 are Saraj, North Gorce Petrov and Dracevo
(2) BOD effluent is BOD 25mg/l in case of industrial wastewater management
(3) BOD effluent in primary treatment is 143 mg/l =239 × (1 - 0.4) assuming 40% removal rate.
(4) BOD effluent in secondary treatment is 25mg/l, upper limit of EU Directives.

4.4.2 Estimation of Wastewater Generation

Wastewater generations by source and by case are shown in Table I. 22 and Figure I. 17. Wastewater generation in the year 2020 increases by two times from the current one if "no-measures" are taken. By implementing various measures corresponding to cases 2 to 5, it will decrease by 22%" to 86%" compared with "case-1".

Table I. 22 Wastewater Generation by Case

(BOD-kg/day)

	Current (2006)	Target Year (2020)				
		Case-1	Case-2	Case-3	Case-4	Case-5
BOD Load Reduction Measures						
Industrial Wastewater Management	Without	Without	With (25 mg/l)	With (25 mg/l)	With (25 mg/l)	With (25 mg/l)
Wastewater Treatment Plant in Central	-	-	-	Primary (143 mg/l)	Secondary (25 mg/l)	Secondary (25 mg/l)
Wastewater Treatment Plant in Other 3	-	-	-	-	-	Secondary (25 mg/l)
Wastewater (BOD Load) Generation						
Point Source						
Domestic	15,939	37,150	37,150	6,336	6,336	0
Industrial	11,155	15,068	2,653	1,845	1,845	1,845
Wastewater Treatment Plant	0	0	0	19,307	3,375	3,904
Sub-total	27,094	52,218	39,803	27,488	11,556	5,749
Non-point Source						
Domestic	423	948	948	948	948	948
Natural	178	178	178	178	178	178
Sub-total	601	1,126	1,126	1,126	1,126	1,126
Total	27,695	53,344	40,929	28,614	12,682	6,875
BOD Reduction Rate	-	1.00	0.79	0.55	0.25	0.13

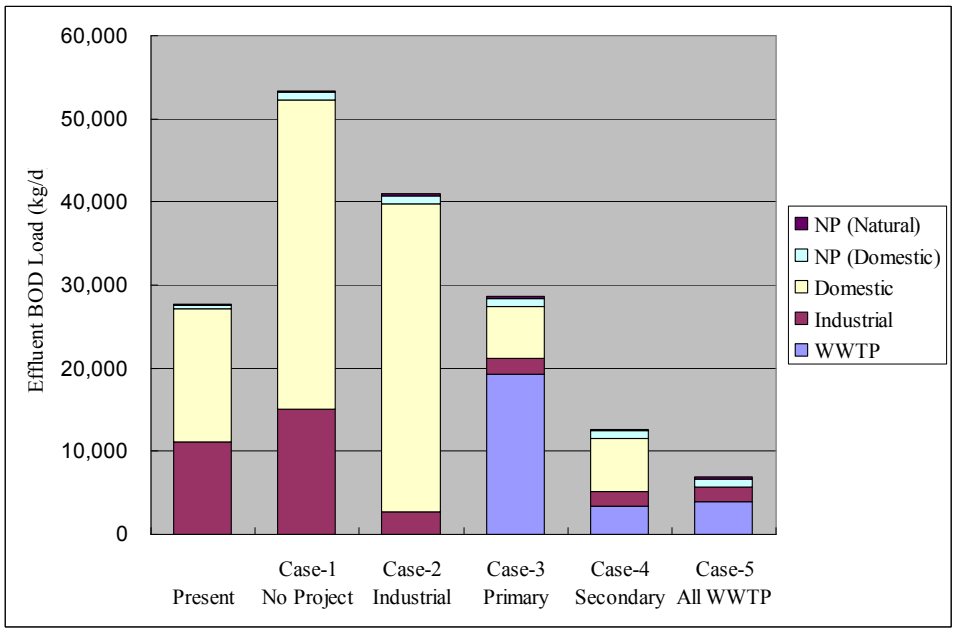


Figure I. 17 Wastewater (BOD Load) Generation By Case

4.5 Estimated Water Quality

Table I. 23 shows the simulated water quality (BOD) based on the calculated wastewater generation in section 4.4. The darkened Columns indicate exceeding environmental water quality standard.

The result of analysis describes the water quality of the Vardar River in 2020 as follows.

(1) In case-1 (No measures), water quality exceeds the designated water quality standard through every stretche from Radusa to Taor.
(2) In case-2 (Industrial Wastewater Management), water quality is improved but still exceeds the standard throughout the stretches.

(3) In case-3 (case 2 + Primary treatment in the Central), most stretches down to the Central WWTP satisfy the water quality standard due to transferring the sewerage discharge point to the WWTP. However, water quality downstream of WWTP does not satisfy it.
(4) In case-4 (Secondary treatment in the Central), water quality in every section except confluences with the Treaka and the Lepenec meets the standard.
(5) Water quality standards are met if secondary treatment plants are provided in all 4 districts (case-5).

EU Directives necessitates every settlement with more than 2,000 P.E. to construct secondary treatment plants. Our simulation confirms the necessity of secondary treatment plants in each of the 4 districts.

Table I. 23 Estimated Water Quality (BOD, 2020)

(mg/l)

	Rasce	Main Load discharge point							Taor
		Treska	Lepenec	Left-bank Outlet	Right-bank Outlet	Steel Outlet	WWTP	Trubarevo Bridge	
Current	2.5	2.6	2.5	5.7	7.9	9.7	9.3	7.1	5.8
Case-1	4.0	4.1	4.1	10.3	14.8	16.3	15.6	12.4	11.0
Case-2	4.0	4.1	4.1	8.2	11.6	11.9	11.5	8.8	7.5
Case-3	4.0	4.1	3.8	3.0	3.0	3.6	11.3	8.4	7.0
Case-4	4.0	4.1	3.8	3.0	3.0	3.6	4.6	3.4	2.8
Case-5	4.0	3.7	3.5	2.8	2.7	3.4	4.4	3.2	2.5
Water Quality	Class II				Class III				
	4				7				

Note: darkened Columns indicate exceeding environmental water quality standard for Class II.

	Title	Industrial Wastewater Management	Wastewater Treatment Plant	
			Central	Other 3
Current (2006)		No enforcement	Without	Without
Case-1	No measures	No enforcement	Without	Without
Case-2	Industrial Wastewater Management only	All	Without	Without
Case-3	Primary Treatment in the Central	All	Primary	Without
Case-4	Secondary Treatment in the Central	All	Secondary	Without
Case-5	Secondary Treatment in All 4	All	Secondary	Secondary

4.6 Estimated Water Quality (in draught flow)

Pollution analysis for low water flow showed that environmental water quality standard can be met if all the WWTPs are provided secondary treatment and industrial wastewaters are controlled in an appropriate manner. This section projects water quality for draught water flow. Environmental water quality standard of Macedonia does not mention at which flow the standard has to be met. EU Directive 91/271/EEC pertaining to effluent qualities which will be applied in Macedonia stipulates that effluent qualities can violate the effluent standard for a certain times according to the number of sampling. If the effluent is sampled and analyzed every day, it can violate the effluent standard for 25 times in a year. In other words, the effluent has to meet the standard for 340 days out of 365 days. Supposing the provision can be applied to the environmental water quality standard, pollution analysis is done for draught flow.

The result of analysis describes the water quality of the Vardar River in 2020 as follows.

(1) Even during draught flow, secondary treatment at all the WWTPs (Case 5) will make the quality standard to be met within the Class III area in spite of somewhat deteriorated water quality.

(2) Quality standard can not be met within the Class II area even if all the WWTPs are provided with secondary treatment. It is because the upstream BOD is supposed to be 6.8 mg/l. If the upstream BOD is 4 mg/l corresponding to Class II, the quality standard at Class II area is expected to be met.

5. ALTERNATIVE STUDY ON PERIPHERAL SEWER DISTRICT ARRANGEMENT

Four treatment districts were proposed in the Sewerage M/P, namely Central, Saraj, Novo Selo (currently called as North Gorce Petrov), and Dracevo. The Central and Dracevo Treatment Districts were planned to be treated as one sewerage system with one WWTP. The remaining two districts were planned to be separate and independent with one WWTP each.

Based on the proposed plan, further study and construction works were conducted in each district by these municipalities. In Saraj, the preliminary D/D on the prioritized projects selected through the F/S is scheduled to be completed in February 2008. In North Gorce Petrov, the construction of the trunk sewer started in 2006 and will be completed in 2008. On the other hand, Kisela Voda Municipality planned its system with an independent treatment district for Dracevo, which is not in conformity with the Sewerage M/P. In this chapter, these three districts are reviewed from the viewpoint of technical, environmental and municipalities' policy. As a result of the review, the study team proposes four treatment districts, namely Central, Saraj, North Gorce Petrov and Dracevo.

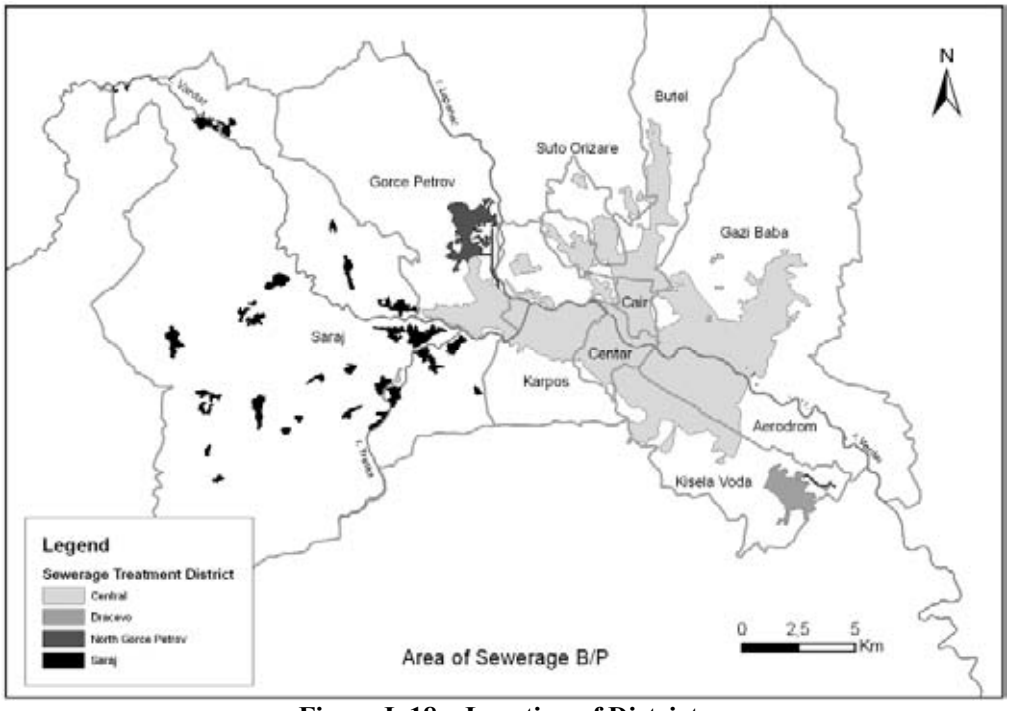


Figure I. 18 Location of Districts

5.1 Progress of Project Realization

This alternative study was conducted on February 2008. Since then, the situation of three sewer districts are progressed, Macedonian side expressed their opinions for three sewer districts in S/C held on 3rd December 2008.

1. The budget for 2009 (January to December 2009) is allocated to priority areas in Saraj and North Gorce Petrov district.
2. The Trunk sewers (both right and left) in central district are included in the budget for 2009.

3. However, the budget is not approved (as of October 2008), the trunk sewers are the target of the Feasibility Study.
4. The responsible organization is MTC and MEPP.

Dracevo district is not included in the budget for 2009 because of the political confusion.

5.2 Saraj Sewer District

5.2.1 Outline of F/S

The F/S and preliminary D/D on sewerage development in Saraj has been conducted with financial assistance of Norway. The report for F/S was completed in November 2007. Preliminary D/D on the prioritized settlements/projects was completed in February 2008. The salient features of F/S and the proposal of the Study Team are compared in Table I 24.

Table I. 24 Salient Features of Saraj Sewer District

		Planning Parameter	
		Plan by Municipality	Study Team Proposal
Target Year	Pipe	2035	2030
	WWTP	2025	2020
Population Equivalent			
Domestic		56,721	52,500
Industrial		5,672	0
Total		62,393	52,500
Per Capita Wastewater Generation		210 lpcd	200 lpcd
Planned Wastewater Generation		13,100 m^3/d	10,500 m^3/d
Treatment Level		Secondary (Biological)	---
Treatment Process		Bio-aeration pools	---

Source: F/S for Saraj (REC)

In the F/S, three alternatives were compared. Differences in three alternatives are number of WWTPs: the alternative A has 1 centralized WWTP while the alternative C has 17 decentralized WWTPs. The number of WWTPs in alternative B lies in between. Reflecting scattered large number of settlements, decentralized WWTP of the alternative C, which does not require trunk sewers, is selected as the most economical option (see Figure I.19). Following this conclusion, the preliminary D/D has been carried out for the selected 6 settlements along the Treska River as the priority projects.

5.2.2 Recommendation by this Study

Though there are some technical issues for Saraj municipality to solve in advancing its sewerage scheme for itself, it has an existing WWTP and the design of a new WWTP is in progress. Besides, additional construction cost for the trunk sewer crossing the Vardar River is needed if Saraj sewer district is incorporated into central sewer district. It is judged from these aspects that Saraj municipality has its own sewer district according to its sewerage plan.

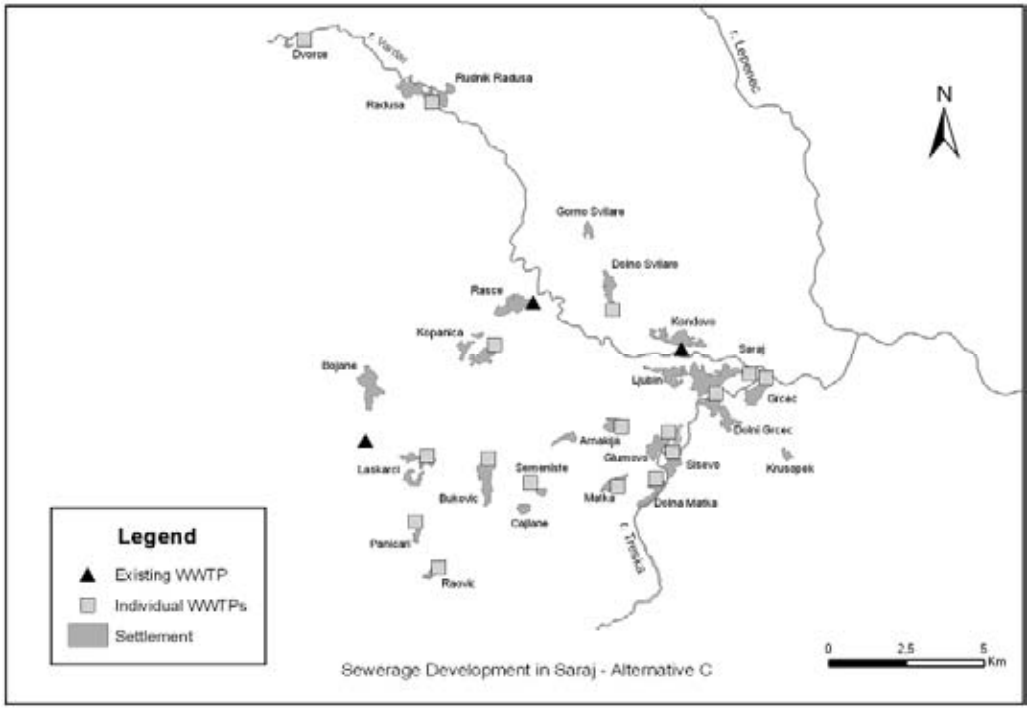


Figure I. 19 Saraj Sewerage Development - Alternative C

5.3 North Gorce Petrov Sewer District

5.3.1 Outline

The south part of Gorce Petrov Municipality, a part of urban area in Skopje City, is served as a part of Central Treatment District. However, North Gorce Petrov (formerly Novo Selo), out of Central Treatment District, does not have any sewerage network. Currently, based on the D/D on sewerage development, the construction of a trunk sewer (length: 2.5 km, diameter: 600 mm) has been started and will be completed in 2008. Secondary sewer pipe will be constructed after the trunk sewer. Residents have agreed to the terms of payment by beneficiary with the municipality. Regarding a site for the WWTP, the municipality has decided the location, and has also negotiated with land owners. If the land owners do not agree to the municipality's plan, the municipality has a plan to sue the land owners. Under such a policy of the municipality, the sewerage development in North Gorce Petrov has been carried out independently from Central Treatment District. However, the project cost for the WWTP has not been prepared. The salient features of F/S and the proposal of the Study Team are compared in Table I. 25.

Table I. 25 Salient Features of North Gorce Petrov Sewer District

		Planning Parameter	
		Plan by Municipality	Study Team Proposal
Target Year	Pipe	2030	2030
	WWTP	2030	2020
Population Equivalent (Person)		16,000	13,200 (2020) 16,100 (2030)
Per Capita Wastewater Generation		688 lpcd	200 lpcd
Planned Wastewater Generation			
Domestic		11,000 m^3/d	2,640 m^3/d (2020) 3,220 m^3/d (2030)
Industrial		6,000 m^3/d	0 m^3/d
Total		17,000 m^3/d	2,640 m^3/d (2020) 3,220 m^3/d (2030)
Treatment Level		---	---
Treatment Process		---	---
Project Cost (only for Primary Collector)		21.8 Million MKD	---

5.3.2 Technical Review applied to this Study

North Gorce Petrov sewer district is planned to be independent with its own wastewater treatment plant according to the Gorce Petrov municipality. However, the district is rather close to the south Gorce Petrov which is already a part of the central sewer district and topographically it is higher than the south so that connecting the north with the south could be considered.

Wastewater generation is planned as 17,000 m^3/d with per capita generation of 688 lpcd and population of 16,000 in the Municipality plan. On the other hand, the study team proposes 3,220 m^3/d with per capita generation of 200 lpcd and population of 16,100. Using the proposed figures, combined plan is analyzed.

The existing primary collector can accommodate the flow from the north. The existing main sewers starting from the Vardar River to the main outlet totaling about 20 km can accommodate the flow from North Gorce Petrov without pipe expansion. Therefore, 4.5 km of newly installed pipe including a siphon is required in case North Gorce Petrov sewer district is connected to the Central WWTP. Only a connecting collector starting from the planned north Gorce Petrov to the existing 900 mm dia. collector is required with 1.5 km length.

The combined system is economically superior to the separate system.

5.3.3 Recommendation by this Study

Despite an economical advantage of the combined system, this study proposes sewerage development plan prepared by the municipality taking into the following factors:

- Land acquisition for the WWTP is under process
- Cost allocation agreement between the residents and the municipality
- Early completion required for well preservation

However, if the above factors change, the combined arrangement is worth consideration.

The bypass road (a section of the East-West Corridor) has been completed in the north of this region. According to Gorce Petrov Municipality, there is a development plan for residential land converting from agricultural and bare land located between the bypass and North Gorce Petrov. If the plan is successfully implemented, population together with wastewater generation in this area will increase significantly. The Gorce Petrov municipality expresses that this plan will be included in the revised GUP, starting its revision in year 2008. In this case, a new pipe with a length of 17 km would be required to connect to the central WWTP because of the insufficient capacity of the existing pipes. In this case, it is appropriate for North Gorce Petrov to have its own WWTP rather than to be connected to the central WWTP.

5.4 Dracevo Sewer District

5.4.1 Outline of the Municipality Plan

The Dracevo Treatment District includes not only entire Dracevo area but also part of settlement in the Aerodrom municipality of the Skopje city. It further includes adjacent settlements in Studeniciani, Morani and Batinti which are out of the Skopje city but supply area of Vodovod. In the center of the district, at Naselba Dracevo, there is an existing pumping station and a WWTP (inhoff tank). The plant was constructed in 1965 but has not been operated for a long period. Replacement of relevant parts is required for its operation. As of October 2008, sewage is discharged to the Vardar River through a pumping station, an open channel, and a stream.

Kisela Voda Municipality, administrative office of Dracevo, has prepared the D/D on sewerage development in Dracevo. The municipality has already applied for the financial support from the donor agencies.

Table I. 26 Salient Features of Dracevo Sewer District

		Planning Parameter	
		Plan by municipality	Study Team Proposal
Target Year	Pipe	---	2030
	WWTP	---	2020
Population Equivalent (Person)		30,000	39,900 (2020) 43,200 (2030)
Per Capita Wastewater Generation		540 lpcd	200 lpcd
Planned Wastewater Generation		16,200 m^3/d	7,980 m^3/d (2020) 8,640 m^3/d (2030)
Trunk sewer		Dia. 700 mm, Length 944 m	---
Treatment Level		Secondary Treatment	---
Treatment Process		Contact Stabilization Process	---
Project Cost (only for Trunk sewer)		3,534,000 EUR	---

5.4.2 Technical Review applied to this Study

In technical review, two alternatives are compared: alternative A, to have its own WWTP in Dracevo prepared by Kisela Voda Municipality, and alternative B, connecting to the Central WWTP. Alternative B requires 7 km of pipe installation and three pumping stations, which results in considerable amount of the project cost. On the other hand, alternative A has advantage with respect to topographic condition. Sewage is conveyed to WWTP and discharged to the Vardar River by gravity. In addition, there is a high possibility to utilize sludge and treated wastewater for agricultural activities owing to no industries within the sewer district. Thus, the plan to have its own WWTP for Dracevo is recommended rather than connecting to the Central WWTP.

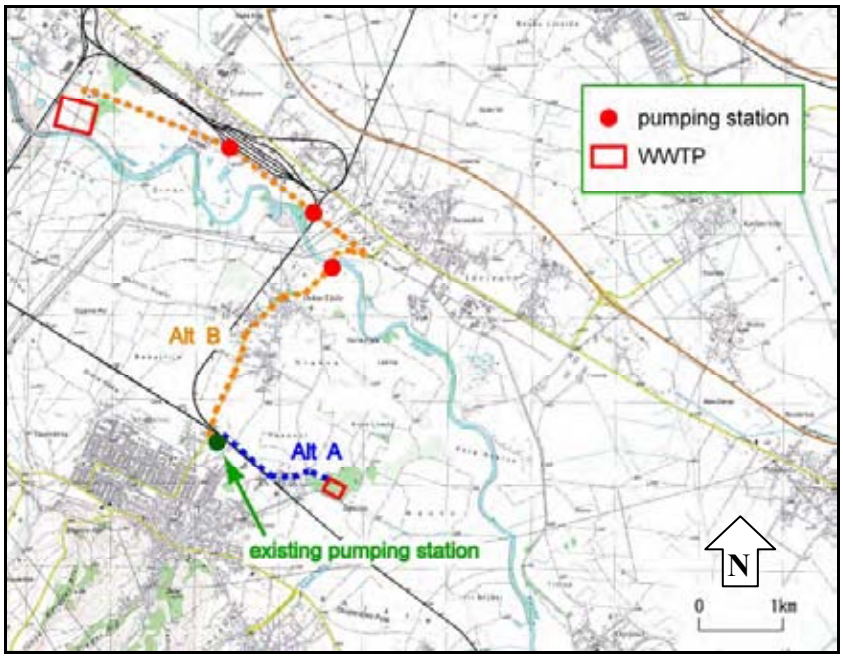


Figure I. 20 Comparison of Sewerage Development Plan in Dracevo

5.4.3 Recommendation by this Study

The municipality has put in efforts for installing new WWTP. The preparation of D/D has been completed. Currently, the municipality is looking for the financial supports. Treated effluent is planned to be utilized for irrigation, which is needful considering condition of water availability in the area.

Considering surrounding settlements, it is preferable to include domestic wastewater from these neighboring settlements (belonging to other municipalities) in Dracevo sewerage development plan.

However, Kisela Voda Municipality and the other municipalities have not agreed on the common project. Therefore, some time may be required for the realization. As a result of discussion with Vodovod, the sewerage B/P recommends that Dracevo include the surrounding settlements considering the future developments.

6. SEWERAGE FACILITY PLANNING ON CENTRAL SEWER DISTRICT

6.1 Framework of Central Sewer District

Table I. 27 shows design parameters for collection system in its target year of 2030 and treatment system in its target year of 2020. Population equivalent calculated by dividing BOD generation by unit per capita per day BOD loading of 60 g is 660,380 in 2020 and 691,350 in 2030.

Table I. 27 Design Parameter of Central Sewer District

	2020	2030
Destrict Area (km^2)	72.8	
Population	513,570	555,650
Population Equivalent	660,380	691,350
Sewage Flow (average daily) (m^3/d)		
Total	166,020 ≒166,000	176,970 ≒177,000
Pollutant Loading in BOD (kg/d)	39,623	41,481
Pollutant Loading in SS (kg/d)	44,686	45,445
Influent Concentration (mg/l)		
BOD	240	230
SS	270	260

Note: Area includes Sopiste and Soncev Grad communties outside Skopje City.

6.2 Plan of Trunk Sewer

Trunk sewers planned in the B/P are two lines at both sides of the river that connect two manholes from which the collected sewage is discharged to the river in 2008 without treatment.

Table I. 28 shows design parameters in 2030. Hourly maximum flow is two times average daily flow for domestic wastewater. As for industrial wastewater, maximum daily flow is assumed to be the same as that of daily average flow and maximum hourly flow is assumed to be 1.5 times average daily flow. Stormwater is assumed to flow in the margin of flow capacity of 50 to 100% and hence is not taken into account in designing trunk sewers.

Table I. 28 Design Parameters of Trunk Sewer in 2030

	Parameter			Remarks
Area (km^2)	72.8			Left bank side: 36.5 km^2 Right bank side: 36.3 km^2
Population	555,650			Left bank side: 237,550 Right bank side: 3318,100
	Av. Daily	Max. Daily	Max. Hourly	
Design flow (m^3/d)				
Domestic	111,130	138,910	222,260	Ratios:= 1:1.25:2.0
Industrial	34,840	34,840	52,260	Ratio= 1:1:1.5
Total	145,970	173,750	274,520	-

Two roads have been planned, one on each side of the Vardar River connecting the sewage treatment plant and the starting point of two trunk sewers. It is most viable to lay two trunk sewers under these planned roads. Two alternatives are compared in terms of their lengths, sewer bottom levels, easiness

of construction and construction costs. It was concluded that the concept shown in Figure I. 21 is the most appropriate.

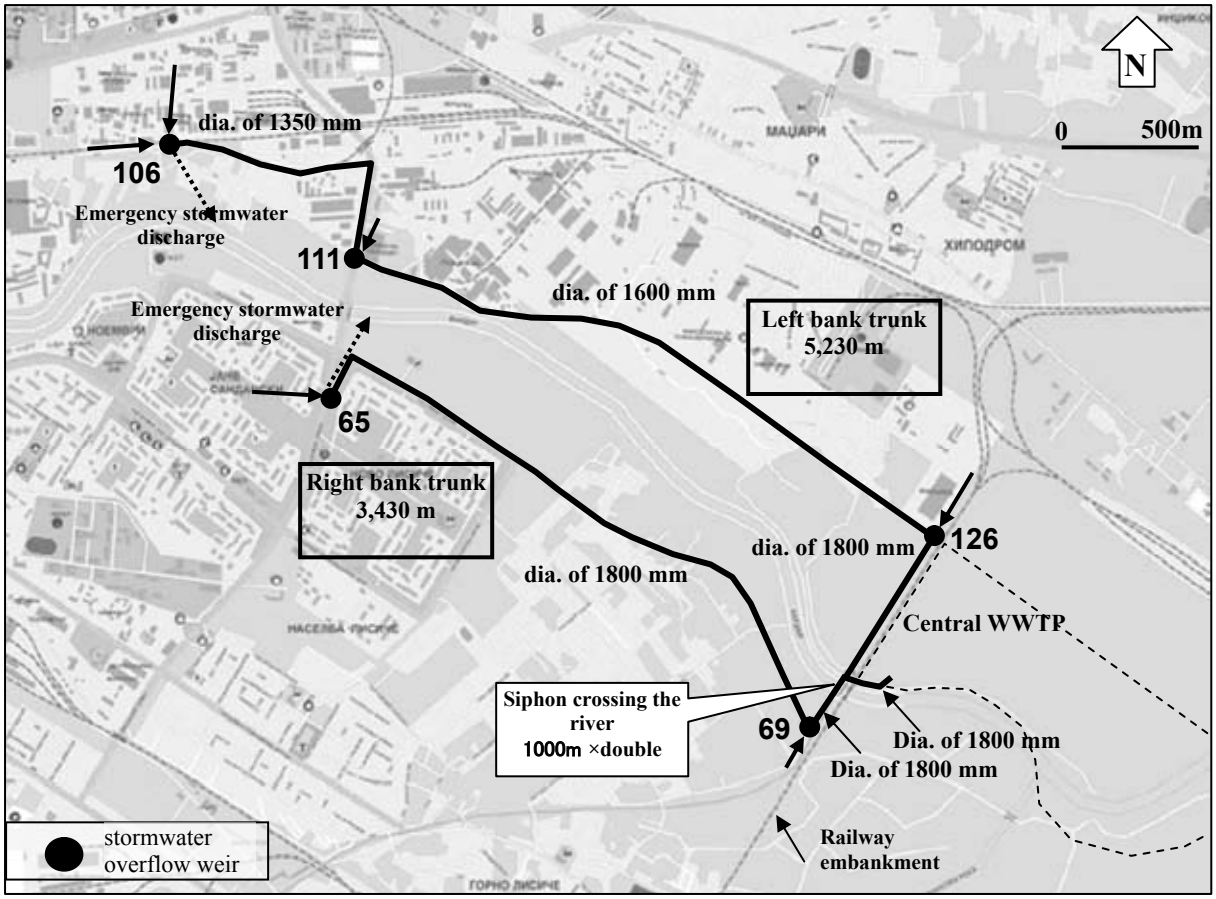


Figure I. 21 Layout Plan of Right Bank and Left Bank Side Trunk Sewer

Table I. 29 outlines right bank and left bank side trunk sewers. Right bank side trunk sewer starts at the existing manhole or connection point 65 and heads for the east along the planned road (partly constructed) and finally reaches connection point 69. It then heads for the north and joins left bank side trunk sewer after crossing the Vardar River. River crossing part is of siphon structure with two lines.

The left bank side trunk sewer starts at the existing manhole or connection point 106 and heads for the east along the planned road and goes down to the south until it reaches connection point 126. It further goes down to the south along the bank of the railway. It joins the right bank side trunk sewer at the lower bank of the river under the railway, heads for the east and then reaches the treatment plant.

Pipe diameters of trunk sewers are 1,800 mm for right bank sewer and 1,500 mm, 1,600 mm and 1,800 mm from upstream on the left bank sewer, respectively as already approved in GUP. Based on the calculation of the necessary diameter, it is possible to design trunk sewers which is smaller than the Vodovod's design diameter as shown in Table I. 29. However due to the difficulty to change the diameter once approved in GUP, it was concluded that trunk sewers would be designed as approved.

Table I. 29 Outline of Right bank and Left Bank Trunk Sewers

Manhole (connecting point)		Calculated Diameter (mm)	Design Diameter (mm)	Gradient	Length (m)	Remarks
Starting	Reaching					
Right bank side trunk						
65	69	1,500	1,800	1/1,000	3,000	
69	A	1,500	1,800	1/1,000	300	
A	B	1,000×double	1,000×double	Level	130	Siphon crossing the river
Total					3,430	
Left bank side trunk						
106	111	1350	1,500	1/1,000	1,390	
111	126	1,350	1,600	1/1,000	2,930	
126	B	1,500	1,800	1/1,000	780	
B	Treatment plant	1,800	1,800	1/1,000	130	
Total					5,230	

Note: Manhole A is the starting point of siphon at the left bank side.
Manhole B is the end point of siphon at the right bank side.
Number of connection points of 65, 69, 106, 111 and 126 are the same as those shown in existing plan
Source: Vodovod

6.3 Facility Plan of Central Wastewater Treatment Plant (WWTP)

6.3.1 Planning Policy

Central WWTP facilities are planned based on the followings.

(1) Target year is 2020.
(2) All the domestic wastewater generated in the central sewer district is treated.
(3) All the industrial wastewaters except for six large scale factories are to be treated at the plant.
(4) Stormwater in the area where no storm sewers are implemented is partly treated depending on the conditions.
(5) Effluent BOD and SS are 25 mg/l and 35 mg/l, respectively, according to relevant EU Directives and the results of pollution analysis is described in Chapter 4.
(6) Generated sludge is disposed of at the designated disposal site.
(7) The site allocated for central WWTP is 106 ha in "Water Economy Facility Area" established in GUP.

6.3.2 Framework of Central WWTP

Table I. 30 shows design framework of central WWTP. The flow to the plant is 166,000 m^3/d including domestic and industrial wastewaters and stormwater.

Table I. 30 Framework of Central WWTP in 2020

	Design Population	Population Equivalent	Flow rate in Average Daily (m^3/d)	Pollutants (kg/d)		Influent Quality (mg/l)	
				BOD	SS	BOD	SS
Domestic Wastewater	513,570	513,570	102,720	30,814	23,111	300	225
Industrial Wastewater	-	89,980	32,300	5,399	9,175	167	284
Stormwater	-	56,830	31,000	3,410	12,400	110	400
Total	513,570	630,380	166,020 ≒166,000	39,623	44,686	239 ≒240	269 ≒270

Notice: Sewer district includes Sopiste and Soncev communities outside Skopje city.

6.3.3 Effluent Qualities

Macedonia has promoted environmental improvement policy according to EU directives (sewage collection and its treatment at secondary level is required if the population equivalent exceeds 2,000)

in principle.

Environmental water quality standard of the Vardar River in the vicinity of Central WWTP is set at category II (BOD of less than 7 mg/l and SS of less than 30 mg/l). On the other hand, pollution analysis in Chapter 4 shows that it is needed to control industrial wastes as well as to treat wastewater at secondary level (BOD of less than 25 mg/l and BOD removal efficiency of more than 90%) to achieve this quality.

From these two aspects of EU directives requirement and achievement of environment water quality standard, the treatment process has to be chosen among those that meet the effluent BOD of 25 mg/l and SS of 35 mg/l, respectively.

6.3.4 Treatment Process

Several treatment processes that can treat the sewage to the effluent BOD of less than 25 mg/l and with the treatment efficiency of more than 90% should be applied.

Following five possible treatment processes are compared from viewpoints of treatment efficiency, easiness of operation and maintenance, site requirement, costs etc.

> Conventional activated sludge process (CASP), oxidation ditch process (ODP), extended aeration process (EAP), aerated lagoon process (ALP) and conventional trickling filter process (CTFP)

CASP shows the smallest construction cost, has a variety of applications for medium to large WWTPs and its operation and maintenance procedures have been established. Oxidation ditch and extended aeration processes require larger O&M costs. Aerated lagoon facilities can be allotted only if river improvement is done and the protected area can be appropriated for them. Conventional trickling filter process cannot be adopted unless river improvement is done. In conclusion, conventional activated sludge process is most appropriate for Central WWTP.

Reuse of Treated Effluent

The wastewater in the central treatment district includes various types of industrial discharges. The possibility of re-use of the treated effluent should be carefully examined by checking the presence of harmful and dangerous substances. “Law on Waters” to be constituted in 2008 states that treated municipal wastewater shall be re-used whenever appropriate provided that any adverse effect on the environment is reduced to the lowest possible level, and after prior permit issued by the MEPP. However, there are no possible farms nearby.

6.3.5 Sludge Treatment

Sludge is inevitably generated through sewage treatment and it needs to be treated in an efficient and sustainable manner. Sludge is treated for the followings.

- To reduce its amount by decreasing its moisture content
- To stabilize its physical as well as chemical properties
- To process and condition its properties to use it as resources

Taking final sludge disposal into account, thickening and digestion processes are inevitable prior to dewatering/drying. Digestion is also done prior to dewatering because of less odor emission of digested sludge. Dewatering/drying is done either naturally or mechanically.

After comparison of natural drying and mechanical dewatering in terms of mechanism of dewatering, required site area, cost, characteristics of final product and easiness of operation, in spite of its much larger site area, natural drying is much more viable for central WWTP in terms of energy consumption, sludge production, operation and maintenance, handling of the final product and costs.
Natural drying at sludge drying beds is recommended for its smaller costs.

The influent to central WWTP includes industrial wastewaters. Macedonia has established water quality standard for influent to sewerage facilities which stipulates that industrial wastewaters have to be treated prior to the discharge to public sewerage system. Based on the pre-treatment of industrial wastewaters, the sludge can be disposed of at the existing Drisla landfill site. Sludge disposal cost is MKD 680 per ton. The annual disposal cost is computed to be MKD 19.9 (32 thousand Euros, 52.2 million Yen). In order to reduce the cost as much as possible, it is worth discussing reuse of dried sludge.

Reuse of Sludge

Some 80 tons of dried sludge is produced everyday. Taking its considerable disposal cost into account, it is desirable to use it as much as possible from cost saving and effective resource use viewpoints. Dried sludge contains certain concentrations of nutrients such as nitrogen and phosphorous and its inorganic properties are similar to those of cement. Thus, it can be used as fertilizer, soil conditioner and possibly as a source of cement in the future. Digestion process produces methane gas which can be used to heat digesters in lower temperature season and to generate power in higher temperature season.

Directives 86/278/EEC stipulates that metal concentrations of the soil to be amended by sewage sludge should be lower than the standard, that metal concentrations of the sludge should be lower than the standard and that accumulated metal concentrations in the soil should be lower that the standards. In this regard, agricultural use of sludge requires an in-depth consultation with environmental and agricultural authorities after checking actual metal concentrations of sludge. Composting dried sludge might be needed depending on the agricultural requirements.

6.3.6 Wastewater/Sludge Treatment Processes Schematic

Figure I. 22 illustrates wastewater and sludge treatment processes including anaerobic digestion.

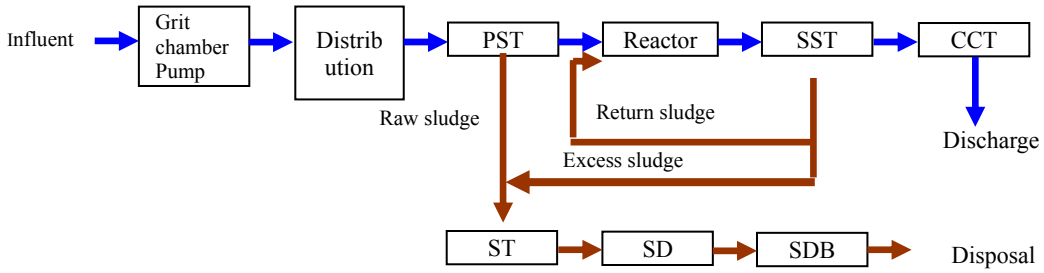


Figure I. 22 Overall Flow Schematic of Central WWTP

6.3.7 Conditions of WWTP Site and Allotment of Treatment Facilities

The area of about 106 ha is designated as Water Economy Facility Zone that is allotted to Central WWTP site. The southern border of the site is in conformity with the improved Vardar River course. As shown in the figure, the river currently passes through the plant site. The river improvement in the area has not been scheduled and hence the area at the right bank side is substantially not available.

The road of 25 m width is planned to be constructed from north to south at 300 m east from the western edge of the site. The site is divided into two by the planned road. At the center-north of the plant site, there is forest area of about 20 ha that is designated as nature protection area. It should be avoided to construct any structure of sewerage facilities in the protection area. Subtracting all these areas where no facilities of WWTP can be constructed from 106 ha, the available land is 57 ha.

Figure I. 23 shows the allotment of WWTP facilities.

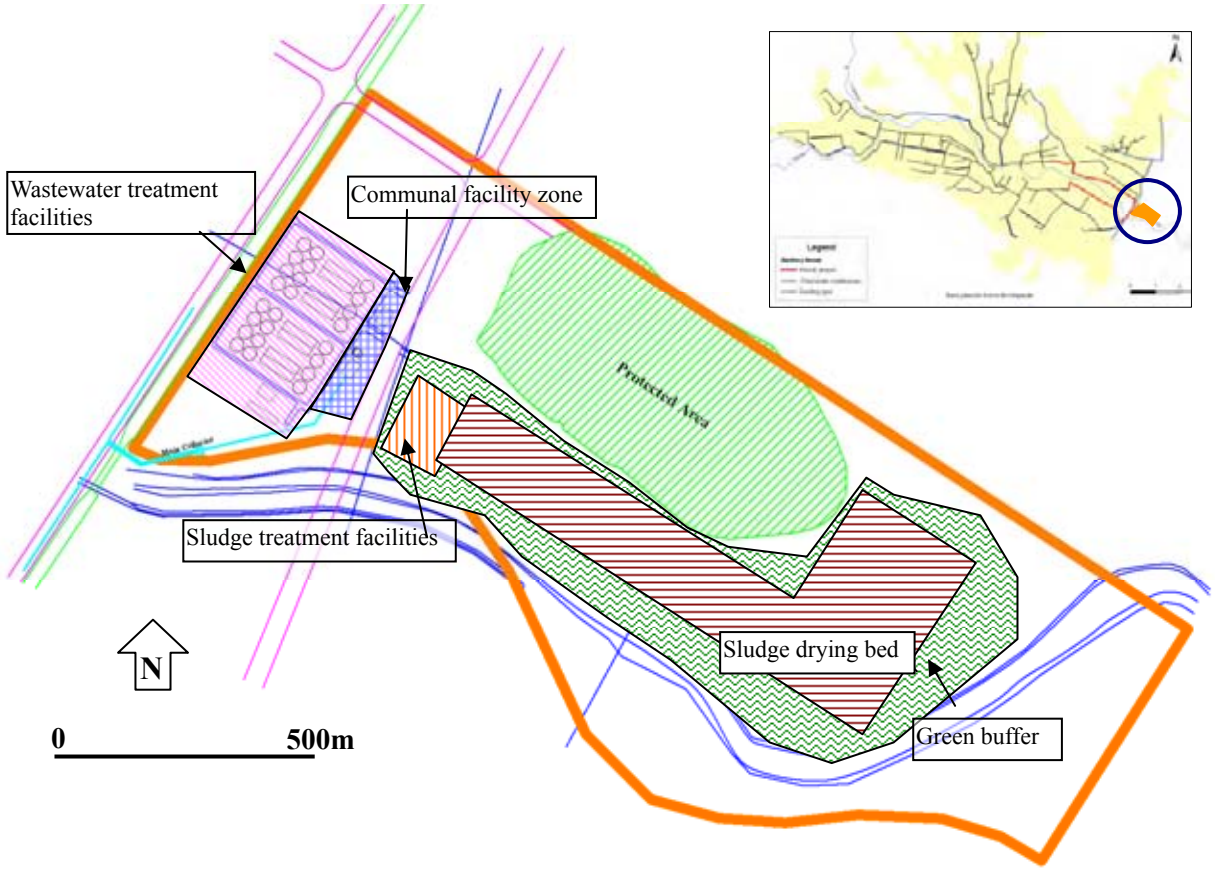


Figure I. 23 Facilities Allotment of Central WWTP

6.4 Outline of Sewerage Facilities and Project Cost

6.4.1 Outline of Facilities

Sewerage facilities for Feasibility Study include trunk sewers to collect and convey sewage, wastewater treatment facilities to treat the sewage at the required level and sludge treatment facilities to treat generated sludge. Table I. 31 outlines above mentioned facilities.

Table I. 31 Outline of Facilities

No.	Specifications	Quantity
1.	Collection system	
1.1	Left bank side trunk sewer	
	R. C. pipe φ1500	1,390 m
	R. C. pipe φ1600	2,930 m
	R. C. pipe φ1800	910 m
1.2	Right banks side trunk sewer	
	R. C. pipe φ1800	3,300 m
	R. C. pipe φ1000	130 m
2.	Central WWTP	
2.1	Wastewater treatment facilities	
2.1.1	Grit chamber and pumps	
	Main pumps Q=44m^3/m	5 (including one for standby)
2.1.2	Primary settling tank	
	Circular dia. 24m × water depth 3m	8 tanks (2/train×4trains)
2.1.3	Aeration Tank	
	Rectangular W16m × L67m × D5m	8 tanks (2/train×4trains)
2.1.4	Secondary settling tank	
	Circular dia. 24m × water depth 3m	16 tanks (4/train×4trains)

No.	Specifications	Quantity
2.1.5	Chlorine contact tank	
	Rectangular W10m × L86m × water depth 2m	1 tank
2.2	Sludge treatment facilities	
2.2.1	Gravity thickener	
	Circular dia. 21m × water depth 4m	2 tanks
2.2.2	Anaerobic digester	
	Cylindrical dia. 26m × water depth 14m	4 tanks
	Gas holder volume 2,000m^3	4 tanks
2.2.3	Sludge drying bed	
	W10m × L20m × D0.2m	500 beds (10/train×50trains)
2.2.4	Temporary Sludge Storage Yard	
	80m × 200m	1 place

6.4.2 Breakdown of the Project Cost

The project cost is estimated as follows.

- Project cost consists of construction cost, administration cost, engineering cost, contingencies (physical and price), land acquisition cost and relevant taxes.
- Project cost is estimated for each of LC (local currency portion) and FC (foreign currency portion).
- Price contingency is 2.3% per year; 3.2% for local currency portion taking annual price increase index in Macedonia into account and 2.3% for foreign currency portion taking the index in EU countries into account.
- Customs rate is in the range between 3 and 15% taking import tax rate applied in Macedonia into account. Tax ratio is 18% which is the same as VAT (value added tax) in Macedonia.
- The exchange rates are 1 Euro = 163.11 Yen = 62.03 MKD.

6.4.3 Assumptions in the Estimate of Construction Cost

Construction cost is estimated based on the following assumptions.

- Civil and architectural materials, labor and general construction machineries are domestically procured in principle.
- Mechanical and electrical equipment are not manufactured in Macedonia and it is assumed that equipment is imported in principle.
- Land acquisition cost is estimated for the area of 57 ha including the one for future extension.
- The costs needed for additional construction works including river embankment, access road and the transfer of pylons are estimated.

6.4.4 Project Cost

The total project cost is 116 million Euros (18.9 billion Yen) including customs and tax and 97.7 million Euros (15.9 billion Yen) excluding customs and tax, respectively. Table I. 32 shows the breakdown of the project cost.

Table I. 32 Breakdown of Project Cost (Unit: Euro)

No.	Item	Local Currency (Euro)	Foreign Currency (Euro)	Total (Euro)
1.	Construction Cost			
A	Collection System			
A.1	Trunk Sewer	7,430,000	0	7,430,000
B	Treatment System			
B.1	Wastewater Treatment Facilities	15,182,000	14,605,000	29,787,000
B.2	Sludge Treatment Facilities	11,808,000	6,555,000	18,363,000
	Subtotal (1)	**34,420,000**	**21,160,000**	**55,580,000**
2.	Administration Cost	1,434,000	0	1,434,000
3.	Engineering Cost	4,438,000	2,610,000	7,048,000
4.	Physical Contingency	3,442,000	2,116,000	5,558,000

No.	Item	Local Currency (Euro)	Foreign Currency (Euro)	Total (Euro)
5.	Price Contingency	8,631,000	3,716,000	12,347,000
6.	Land Acquisition cost	8,550,000	0	8,550,000
7.	Others (access road and others)	948,000	0	948,000
8.	Customs/Tax	18,376,000	0	18,376,000
9.	Interest during Construction	4,907,000	1,875,000	6,782,000
	Subtotal (2)	**49,545,000**	**10,931,000**	**60,476,000**
	Total (including customs/tax)	**83,965,000**	**32,091,000**	**116,056,000**
	Total (excluding customs/tax)	**65,589,000**	**32,091,000**	**97,680,000**

6.4.5 Operation and Maintenance Costs

Operation and maintenance costs are estimated based on the following assumptions, which is summarized in Table I. 33.

- Personnel cost is estimated for the staff members needed for the operation and maintenance of the facilities proposed in the B/P.
- Consumables include electricity and chemicals.
- Spare parts cost is estimated for mechanical and electrical equipment.
- Sludge disposal cost is estimated supposing all the dried sludge is disposed of at the designated sludge disposal site.
- Sewer cleaning is done for the sewers proposed in the B/P.

Table I. 33 O&M Costs

Item	O& M Costs (Euro/year)
Personnel Cost	165,000
Consumables Cost	753,800
Sludge Disposal Cost	320,100
Spare Parts Cost	285,600
Sewer Cleaning Cost	2,200
Total	**1,526,700**

6.5 Dimensions of Advanced Treatment Facilities and their Roughly Estimated Cost

Sewerage facilities to treat wastewater at advanced level are roughly designed and their dimensions are computed. In advanced treatment process employing additional component to the proposed CASP, nitrogen is to be removed by biological nitrification/denitrification process and phosphorous is to be removed by chemical addition. Aeration tanks have to be extended for nitrification/denitrification and secondary settling tanks have to be extended to decrease overflow rate to cope with lowered sludge settleabilty due to longer aeration period. Sand filtration might be needed if effluent standard for phosphorous is stringent. However, the standard is yet to be formulated and no sand filtration is planned in the B/P.

6.5.1 Dimensions of Advanced Treatment Facilities

Average daily flow: 166,000 m^3/d
Reactor: Capacity: HRT = 14 h = 96,800 m^3
SST: Overflow rate: 20 $m^3/m^2/d$ = 8,300 m^2

Table I. 34 Dimensions of Total Facilities

	Criteria for BOD Removal	Area or Volume (1)	Criteria for Advanced Treatment	Area or Volume (2)	Additional Volume (2)－(1)	Additional Size
PST	Overflow rate: 50 $m^3/m^2/d$	3,320 m^2	Overflow rate: 50 $m^3/m^2/d$	3,320 m^2	—	Dia24m × 8tanks
Reactor	HRT: 6hr	41,500 m^3	HRT: 14hr	96,800 m^3	55,300 m^3	16m×67m×5.0m×10 tanks
SST	Overflow rate: 25 $m^3/m^2/d$	6,640 m^2	Overflow rate: 20 $m^3/m^2/d$	8,300 m^2	1,660 m^2	Dia 24m×4tanks

From above discussions, the area for advanced treatment facilities is located as shown in Figure I.24.

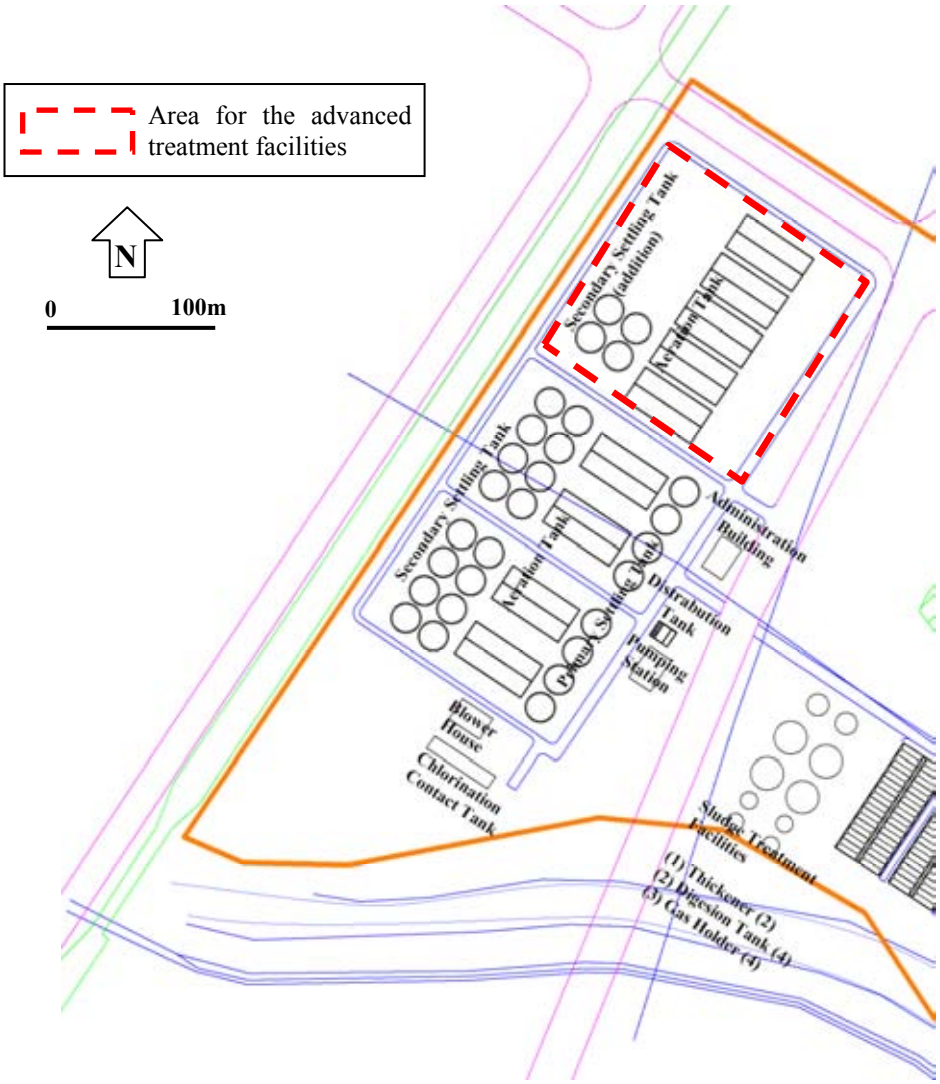


Figure I. 24 Location of Advanced Treatment Facilities

6.5.2 Project Cost

Project and O&M costs for advanced treatment facilities are estimated. Total project cost including advanced treatment is 143 million EUR. The operation and maintenance cost is 3.6 million EUR.

6.6 Project Evaluation

City of Skopje is a major actor of Macedonian economic and industrial activities with the population of around 520,000. Its activities are accompanied by a lot of domestic and industrial wastewaters. Some 80% of the central area of the city is assumed to be sewered. The improvement in living and

water environment is strongly desired along with the lower sewered ratio in the surroundings. Collected sewage, however, is mostly discharged to the river or channels untreated except for a small part of Saraj. The Vardar River, the largest river in Macedonia as well as an international river, passes through the city, is provided with a number of water quality monitoring points and the monitored water quality is recorded as "the water quality of the Vardar River". The water qualities monitored at After Ohis and Trubarevo Bridge located in the downstream of the river sometimes do not comply with the standard, which is said to deteriorate environmental and public sanitary conditions at the downstream. Further development of the city will surely increase domestic and industrial wastewaters in the future. It is inevitable to treat the sewage at secondary level to achieve the environmental water quality standard, which is clearly shown in the estimated water quality of the Vardar River.

Though the master plan for sewerage implementation was prepared in November 1999 with the assistance of EU, the actual implementation has not been materialized to date. The Study reviewed the said master plan and prepared the B/P. If the B/P is put into practice, the water qualities of the Vardar River will be surely improved and the living and water environment of the city will be remarkably improved as well.

Macedonia, on the other hand, has implemented environment related laws and regulations in compliance with EU directives in order to be one of EU member countries. Comprehensive review of the plan is prioritized including future prospect of sewerage implementation, more efficient operation and maintenance of sewerage facilities and streamlining of sewage works. The B/P will surely fulfill these requirements and the implementation according to the B/P will facilitate Macedonia's joining with EU members.

7. ENVIRONMENTAL AND SOCIAL CONSIDERATIONS

7.1 Purpose and Level of Environmental and Social Considerations

The purpose of the Environmental and Social Considerations is to ensure that development options under consideration are environmentally and socially sound and sustainable and that the environmental consequences of the project are recognized early and taken into account in the project design. The procedure should follow the Macedonian Laws and Regulations, and JICA's Guidelines for Environmental and Social Considerations (2004) are also need to be taken into account.

The Preparatory Study (which was conducted by JICA in 2007) concluded that this study requires considerations of environmental and social assessment. The environmental and social impacts such as involuntary resettlement, and water pollution are recognized and the project will require an environmental impact assessment according to the laws and regulations in Macedonia. Therefore, this project is evaluated as "Category A" in the preliminary assessment. According to the Macedonian Laws and Regulations, wastewater treatment plants with capacity more than 100,000 persons equivalent are subjects to EIA, thus the project proposed under the Study will require the implementation of EIA in F/S Stage.

7.2 Initial Environmental Examination (IEE)

7.2.1 Objectives

IEE is a very important and useful planning tool for development projects / programs at early stage. Original formulation of any projects / programs may be modified, if significant negative impact is predicted through the results of the IEE. The IEE has following two objectives:

- To preliminarily review current environmental and social conditions in the project area based on the secondary data and simple field surveys
- To identify and predict the environmental and social impacts and prepare the mitigation

measures and monitoring plans

Considering the above objectives, the IEE study was undertaken with the purpose of (1) knowing the existing social and natural environmental conditions of the Study area, (2) identifying constraints and problems for the B/P project.

7.2.2 Analysis of Alternatives

The analysis of 4 alternatives is conducted during the Study.

- With/Without Project
- Alternative sewerage system
- Alternative WWTP site
- Alternative trunk sewer route
- Alternative sludge disposal site

7.2.3 Results of Impact Assessment and Recommended Mitigation Measures

The construction and operation of the project have the large and medium impacts on the quality of groundwater, wildlife and ecosystem, public health and safety, and water use.

The possible negative impacts identified are:

- Groundwater: during construction of trunk sewers, disturbances of groundwater table, the leakage from the pipeline connections,
- Wildlife and ecosystem: disturbance of animals within hunting area due to construction activities,
- Protected area: Arboretum is located near the proposed site,
- Air quality: due to the operation of construction machineries and increased traffic,
- Waste: excavated soil, rejected materials and bushes, generated sludge during operation phase,
- Noise and vibration: due to the operation of construction machineries and increased traffic,
- Offensive odour: odour from the treatment system of wastewater and sludge during construction phase,
- Involuntary resettlement and land acquisition: land acquisition for WWTP site is necessary,
- Change in land use and local resources: land use within the WWTP will be changed,

The mitigation measures and monitoring plan are proposed and if these measures and monitoring will be properly implemented, the identified negative impacts will be mitigated, minimized and prevented.

7.3 Stakeholder Meeting

The stakeholder meetings for public consultation were held three times during B/P stage and F/S stage. The organizer was Skopje City in cooperation with MTC, MEPP and JICA Study Team. First stakeholder meeting was held on 9th Nov. 2007 by Skopje City at City Hall and 56 persons participated in the meeting. Second meeting was held on 22nd February 2008. The third meeting was held on 16th October 2008 in the F/S stage.

7.4 Scoping of Priority Project

Draft scoping is conducted for the propriety project.

Table I. 35 Draft Scoping

	Elements	Nature of Impacts	Impact Score	
			C	O
Natural Environment				
1	Groundwater	No groundwater extraction is proposed. During construction of trunk sewer local disturbances of groundwater table can be expected. Also some pollution is possible due to leakages during pipelines re-connection.	B (-)	A (+)

	Elements	Nature of Impacts	Impact Score	
			C	O
2	Wildlife and Ecosystem	The proposed WWTP location is within the hunting area. Pheasant, hare and partridge exist within the hunting area but these are not endangered species.	B (-)	B (+)
3	Landscape	Visually anaesthetic conditions due to cluttering of waste, spoil, and dug up roads and pavements during construction. WWTP might pose an unaesthetic sight but it affects only close residents.	B (-)	Negligible
4	Protected Area	The Arboretum belongs to Faculty of Forestry, Skopje University is located near to the water economy facility zone where the WWTP will be constructed.	B (-)	C (-)
6	Global Warming	The operation of construction machinery and equipment will emit the gases but it is short duration and negligible impact. Operation phase – increased emission of GHG.	Negligible	B (-)
Public Hazard				
1	Air Pollution	Dust generated by earth works during construction of sewage treatment plant and installation of trunk sewers. Transportation of sludge will increase the emission of combustion gases into the air	B (-)	Negligible
2	Water Pollution	Water turbidity due to construction of sewage treatment plant and installation of trunk sewers might be expected. During operation, if the industrial wastewater which is not pre-treated to appropriate level will affect the effluent quality and it results to water pollution of the Vardar River.	Negligible	A (+) B (-)
3	Soil Contamination	The impacts on soil arising from WWTP development construction activities are not large. Due to excavation and earthwork: soil erosion, loss of top soil, silting and blocking of river/canal which can cause slush; damage to existing structures might be expected. Low impact during the operation phase. The compaction of soil can be expected due to vehicle movement, ground contamination from the spillage of materials such as vehicle fuel, sewage sludge, construction waste, chemicals.	B (-)	B (-)
4	Waste	The spoil will be generated during installation of pipelines and construction of WWTP. The sludge will be generated from sewage treatment plant. There is the possibility of contamination of the sludge with dangerous substances due to the industrial wastewater	A (-)	A (-)
5	Noise and Vibration	Noise and vibration during construction of sewage treatment plant and installation of trunk sewers might be expected. The operation of treatment plant and pumping stations might generate noise and vibration. These facilities will be located in non-residential area, the impact is negligible.	B (-)	B (-)
6	Ground Subsidence	The specified WWTP area is entirely situated over an alluvial sediment formation. As the metal structure for electricity transmission and railway exists in this area, it is estimated that the land can withstand civil structures.	C (-)	-
7	Offensive Odours	The operation of treatment plant and sludge drying facility might generate offensive odours.	-	A (-)
Social Environment				
1	Involuntary Resettlement and Land Acquisition	Land acquisition is necessary for WWTP, and there are currently no inhabitants so that resettlement can be avoidable. The land belongs to the State and privates. The detail landownership should be surveyed during F/S. The trunk sewers will be installed under the proposed road of General Urban Plan, thus no land acquisition is necessary for installation of collectors.	A (-)	-
2	Livelihood and Local Economy	Construction of the WWTP and trunk sewers may temporarily affect the city's local business and transport system during construction. Construction works provide positive impacts on local economy such as increase in employment, commercial services.	B (-) B (+)	B (+)
3	Change in Land Use and Local Resources	The proposed site for WWTP is designated as water economy facility zone under General Urban Plan of Skopje City. The large area including this zone is currently used as hunting of hare and partridge, and agriculture. The area for WWTP is small (30 ha) compared with the total hunting area (1,475 ha), but the change in land use is inevitable.	A (-)	C (+)
4	Existing Social Infrastructure and Services	Traffic disturbance is expected due to transportation of construction materials and installation of trunk sewers.	B (-)	-
5	Health and Safety	During construction, dust generated by earth works will affect the health to the workers and neighbouring people.	B (-)	B (+)

	Elements	Nature of Impacts	Impact Score	
			C	O
6	Misdistribution of Benefits and Loss/Damage	The costs for construction and O&M might be covered by user charge. Willingness and ability to pay must be considered in order to avoid inequalities.	-	B (-)
7	Local Conflicts of Interest	The related municipalities should be in agreement with the purpose of the project to avoid conflicts of interest.	B (-)	-

Note: A – significant impact, B – moderate impact, C – uncertain, Blank – no impact
C: Construction phase, O: Operational phase

8. PRIORTY PROJECTS FOR F/S STUDY

The Study Team recommends that the city area of Skopje be divided into four sewage treatment districts; Central, Saraj, North Gorce Petrov, and Dracevo for the development of sewerage. The conditions of the four districts are shown in Table I. 36. The table indicates that the Central District occupies a built-up area. It has a large population and many factories, and that the population in the District covered by the sewer system is as large as 80% of the total. The wastewater collected from the city area is discharged without treatment at downstream of the Vardar River. Hence, the present Project will contribute to the improvement in the water quality of the river to a great extent.

Although almost entire population of Dracevo is covered by a sewer system and a primary treatment process, the sewage from the Dracevo district is discharged to the Vardar River through a small stream only with chlorination since the treatment process is not functioning. All the three Municipality administrations for Saraj, and North Gorce Petrov have strong intentions to construct sewerage facilities although the progress in preparation to that end is different from each other. In effect, it will not be advantageous for them to be given a priority status to their project since detailed designs for their projects have been completed. Furthermore, there is a high probability for them to have grant assistance from the IPA fund etc. since the sizes of the projects are relatively small.

There is high possibility for the project for the Central District to be implemented under a loan as the project is big in size. It is highly valuable to undertake this F/S study, which can be a convenient material for the presentation of the Project to a lending agency. From the view points of environmental and social impacts, the impacts on society and environment are larger in Central sewer district compared to other three alternatives though the impacts might be mitigated and minimized by taking proper mitigation measures. The detail mitigation measures and monitoring plan will be studied during EIA study at F/S stage.

For this reason, the Study Team selects the project for the Central District as the priority project. The wastewater treatment plant and the trunk sewer comprise the Project.

Table I. 36 Outline of 4 Sewer District

Item	Central	Saraj	North Gorce Petrov	Dracevo
Location	Central	Upstream	Upstream	Downstream
Settlement status	City	Rural settlements	Rural settlements	Urban settlement
Relative location with the Central District	—	Neighboring	Neighboring	Separate
Sewer coverage	80%	Almost nil	Trunk sewers under construction	Almost 100%
Sewerage Planning	—	F/S completed in 2007 Preliminary Detailed Design on-going for selected settlements	—	Detailed Design of WWTP completed in 2007
Population	Large	Small	Small	Small
Industry	Many	Small	Small	Small
Project Cost	Large	Small	Small	Small
Possibility of Grant or Loan	Loan	Grant	Grant	Grant
Intention of Municipality on Sewer District	Independent	Independent	Independent	Independent
Contribution to water quality improvement in the Vardar River	Large	Small	Small	Small
Contribution to conservation of water source	Small	Large	Large	Small
Impacts on Society and Environment	Large	Medium	Medium	Medium

PART II: FEASIBILITY STUDY

1. SCOPE OF PRIORITY PROJECTS

Central wastewater treatment plant and trunk sewers connecting the existing two main outlets with the central WWTP are selected as priority projects. The F/S is conducted for the selected priority projects.

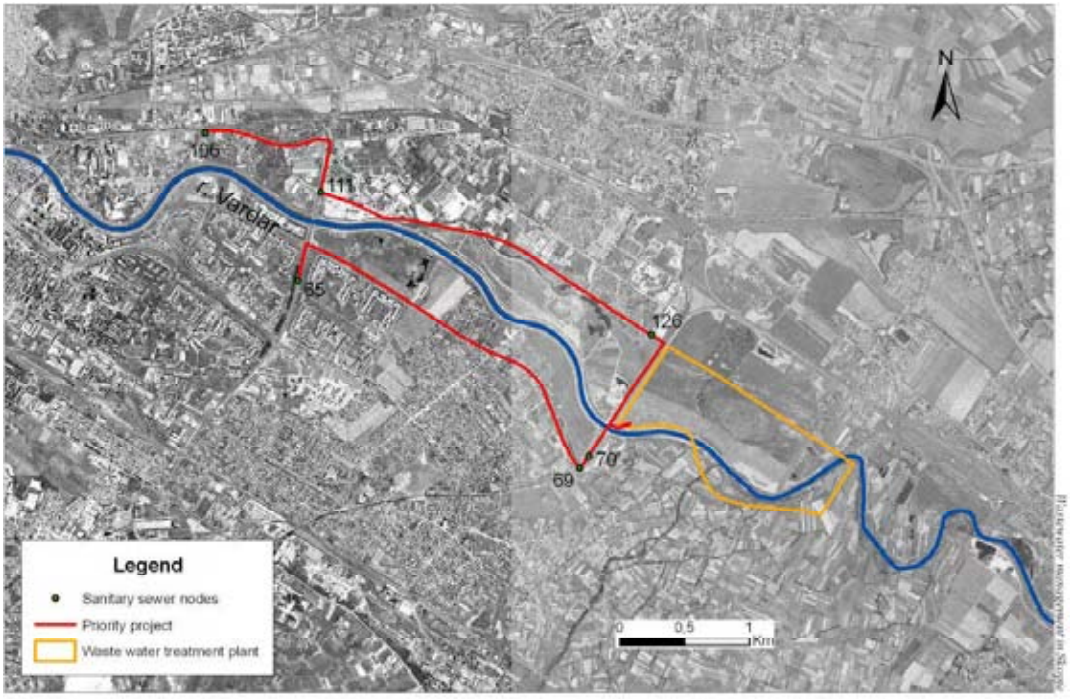


Figure II. 1 Scope of F/S

1.1 Scope of Trunk Sewers

Table II. 1 Specifications of the Trunk Sewers

	Pipe material	Diameter (mm)	Length (m)	Route (Node No.)
Right Bank	R. C.	1,000	130	Siphon (Crossing River) 130×2
	R. C.	1,800	3,770	65 – 69 – 70 - WWTP
Sum			3,900	
Left Bank	R. C.	1,500	1,400	106 – 111
	R. C.	1,600	2,890	111 – 126
	R. C.	1,800	940	126 - WWTP
Sum			5,230	
Total			9,130	

Note: The length in the table is different from the length in B/P

1.2 Scope of Central Wastewater Treatment Plant

Table II. 2 Basic Condition of Central WWTP (1)

	Population (person)	Per Capita Flow (lpcd)	Flow (m^3/d)		
			Average	Peak Factor	Hourly Maximum
Domestic Wastewater	513,570	200	102,720	2.0	205,440
Industrial Wastewater	-	-	32,300	1.5	48,450
Stormwater	-	-	31,000	-	-
Total	513,570	-	166,020 ≒166,000	-	253,890

Table II. 3 Basic Condition of Central WWTP (2)

	Popula-tion (person)	Per Capita Flow (lpcd)	Average Flow (m^3/d)	Per Capita Load (g/capita-d)		Pollution Load (kg/d)		Water Quality (mg/l)	
				BOD	SS	BOD	SS	BOD	SS
Domestic Wastewater	513,570	200	102,720	60	45	30,814	23,111	300	225
Industrial Wastewater			32,300			5,399	9,175	167	284
Stormwater			31,000			3,410	12,400		
Total			166,020 ≒166,000			39,623	44,686	239 ≒240	269 ≒270

Note: Population Equivalent based on pollution load is 660,380 persons, using 60 g/capita-day

Table II. 4 Target Water Quality

Parameter	Quality	Remarks	Stage
BOD	25 mg/l	EU directives for urban wastewater: (1) Population Equivalent of Central WWTP sewer district is over 2,000 (2) Skopje is not located in "Less Sensitive Area" nor in "Sensitive Area"	Target Year 2020 (as a first stage)
SS	35 mg/l		
COD	125 mg/l		
N	10 mg/l	EU directives for urban wastewater: (1) In case of " Sensitive Area", this Directives governs WWTP effluent	After 2020 (as a second stage)
P	1 mg/l		

2. PRELIMINARY DESIGN OF TRUNK SEWERS

2.1 Review of Design Framework

Trunk sewers are designed based on the framework as follows.

Table II. 5 Design Framework of Trunk Sewer

Target year	2030
Sewer District Area	72.87 km^2 (36.34 km^2 at the right bank side, 36.53 km^2at the left bank side)
Wastewater	3.17 m^3/s (274,520 m^3/d)
Domestic	2.57 m^3/s (222,260 m^3/d)
Industrial	0.60 m^3/s (52,260 m^3/d)

2.2 Design Criteria

Design criteria are determined as follows:

- Flow calculation: Manning formula

$$Q = \frac{1}{n} \times R^{2/3} \times I^{1/2} \times A$$

Where, Q is flow rate in m^3/s, n is roughness coefficient of 0.013,
R is hydraulic radius in meter, I is gradient and A is flow section in m^2.

- Velocity: 0.8 m/s[3] at minimum and 3.0 m/s at maximum

2.3 Route and Longitudinal Section of Trunk Sewers

The trunk sewers are planned to be laid beneath the planned road and the elevation of the planned road

[3] This minimum velocity, which is usually employed for a stormwater sewer is applied to the trunk sewers as well because they will continues to function as a stormwater sewers for the time being.

is vitally important in planning the trunk sewers. However, it might take years to obtain the elevation data of the planned road because of the road implementation procedure. Based on the topographic survey done during the Feasibility Study, it was assumed that the current ground level would be the lowest level of the planned road surface. Consequently, the longitudinal profile of the trunk sewers is determined supposing their earth cover is one meter to the road surface.

The trunk sewers have to be laid staying out of existing underground structures. The trunk sewer at the left bank side will cross three existing sewers with diameters of 500, 1,000 and 1,200 mm at its most downstream. If the existing sewer of 500 mm diameter is relocated by 1.6 m deeper and 130 m away, the trunk sewer can be laid 1.1 m lower only, not 5 m lower. Since the horizontal relocation of 105 m out of 130 m will be done in parallel with trunk sewer laying, the earth work needed for the relocation can be minimized. From the above discussion, it is concluded to lay the trunk sewer as shallow as possible by relocating the existing sewer of 500 mm diameter.

2.4 Considerations in Trunk Sewer Laying

2.4.1 Connection with the Existing Pipe

At the right bank side

Existing trunk sewers were planned and constructed as sanitary sewers, but the collected sewage is currently discharged to the Vardar River through storm sewer. A new trunk sewer in parallel with the existing storm sewer is to be laid instead of converting the storm sewer to trunk sanitary sewer. The new trunk sewer will be equipped with stormwater overflow weir from which wastewater is conveyed to a sewage treatment plant and stormwater is discharged to the river.

At the left bank side

Existing trunk sewer was designed as sanitary sewer and the collected sewage is discharged to the Vardar River without any treatment. The weir will be added in the existing manhole as the starting point of the trunk sewer to divert the flow exceeding the design value to the river.

2.4.2 Stormwater Overflow Weir

Though the City of Skopje has constructed sewers aiming at the complete separate system, storm sewers have been installed at only 30 % of the central sewer district to date. Rain fallen in the area where no storm sewers are laid possibly flows into sanitary sewers. The trunk sewer is designed for maximum hourly flow and the stormwater flowing into trunk sewers has to be separated and diverted to the river. Some apparatus such as stormwater overflow weir needs to be installed where other sewers are connected to the trunk sewer.

At the right bank side, two stormwater overflow weirs are to be installed at No.65 (the starting point of new trunk sewer) and at No.70 (the point prior to river crossing) in Figure II. 2. At the left bank side, on the other hand, three chambers are to be installed at No.106 (the starting point of trunk sewer), at No.111 (about one and a half kilometers downstream) and at No.126 (the point before turning to the right) in Figure II. 2.

2.4.3 River Crossing

Siphon structure is to be installed in river crossing with two units of the same diameter and siphon box with either gate or sliding weir. The velocity in the siphon structure should be greater than the upstream part of the sewer by 20 to 30 %.

Since siphon structure is to be constructed under important facilities such as rivers or railways, it has to be strong enough to resist outer pressures. At the same time, no leakage is allowed in order to prevent pollution of the Vardar River. From these viewpoints, siphon structure is to be a circumferentially closed concrete structure.

2.5 Layout Plan and List of Major Facilities

Table II. 6 shows specifications of the trunk sewers and their relevant facilities. Figure II. 2 shows the layout plan of the trunk sewers.

Table II. 6 Specifications of the Trunk Sewers

	Pipe material	Diameter (mm)	Length (m)	Route (Node No.)
Right Bank	R. C.	1,000	130	Siphon (Crossing River) 130×2
	R. C.	1,800	3,770	65 – 69 – 70 - WWTP
Sum			3,900	
Left Bank	R. C.	1,500	1,400	106 – 111
	R. C.	1,600	2,890	111 – 126
	R. C.	1,800	940	126 - WWTP
Sum			5,230	
Total			9,130	

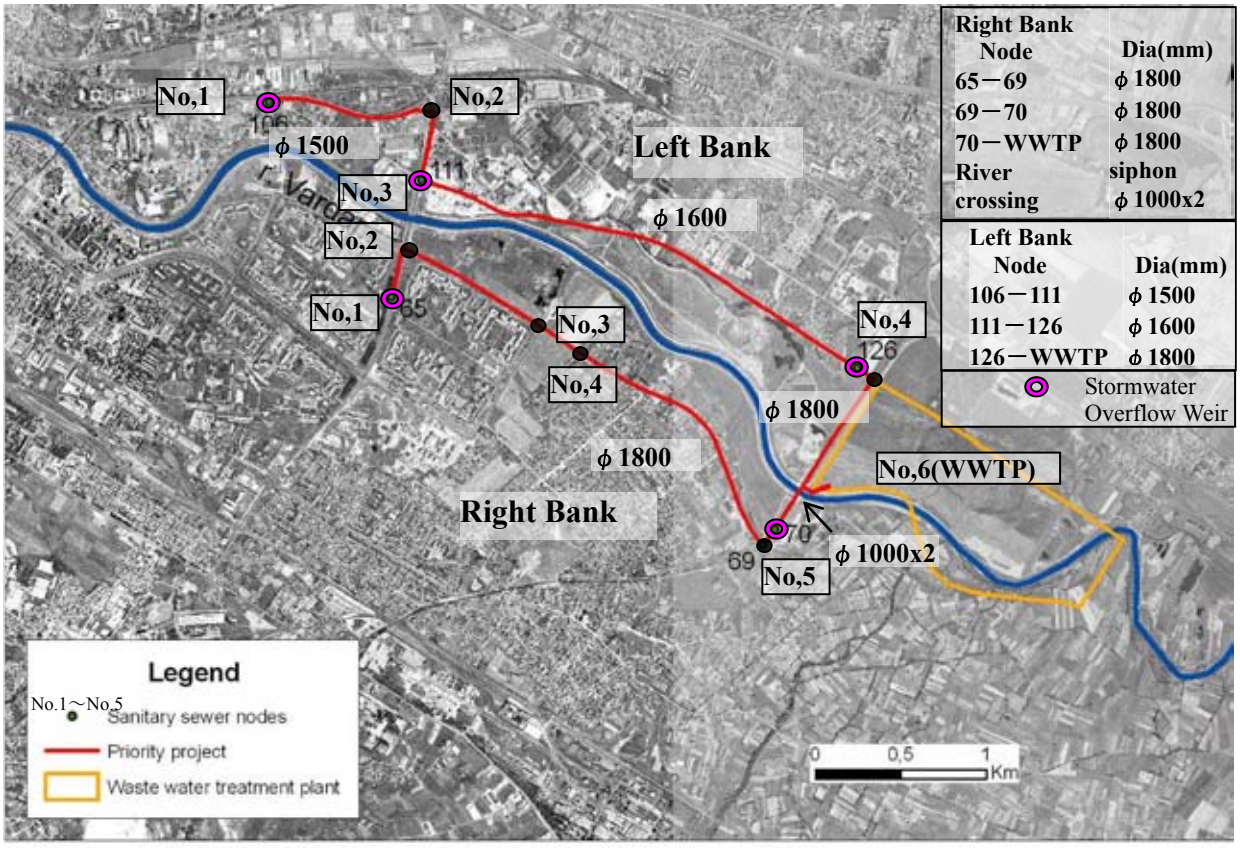


Figure II. 2 Layout Plan

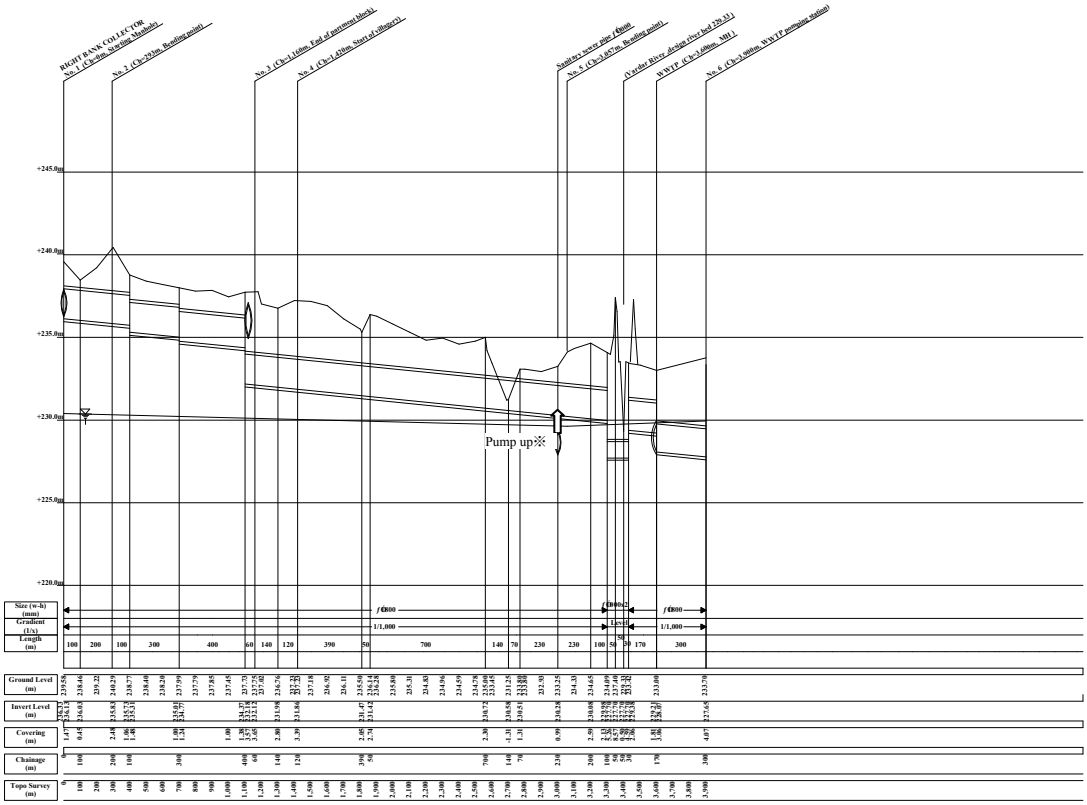


Figure II. 3 Longitudial Profile (Right Bank)

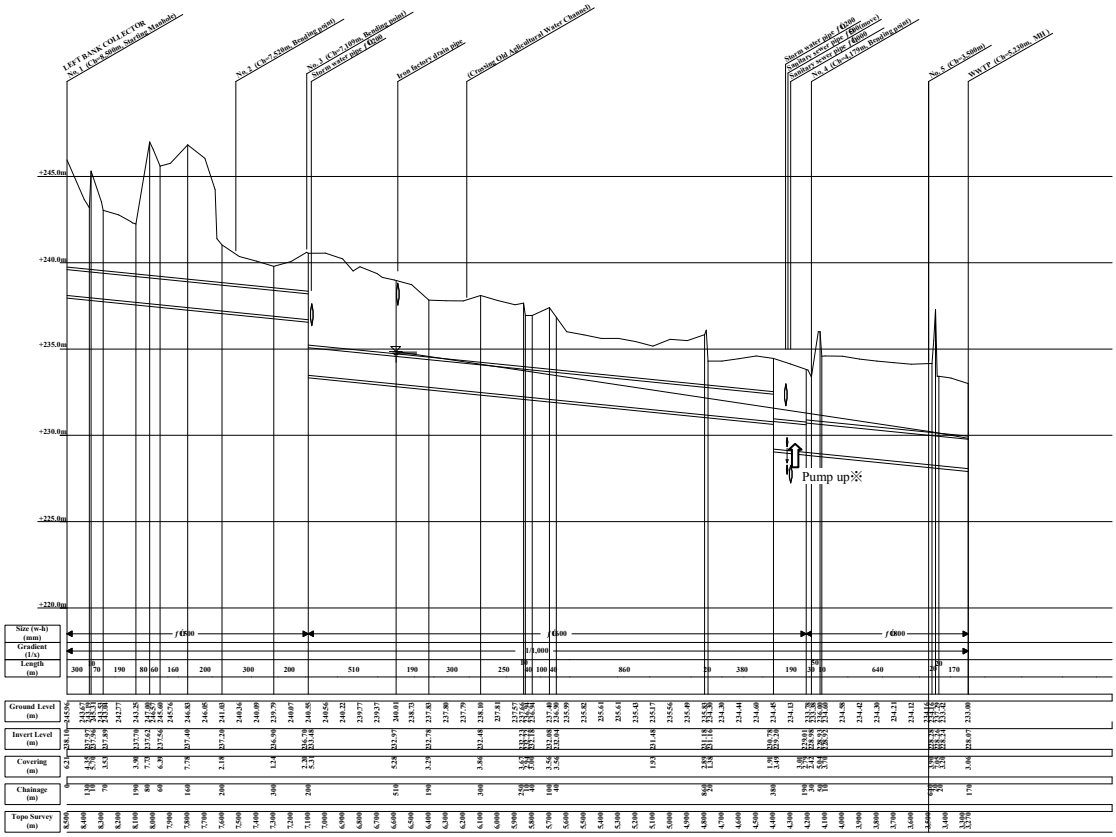


Figure II. 4 Longitudial Profile (Left Bank)

※out of the scope of the Study

3. PRELIMINARY DESIGN OF CENTRAL WWTP

3.1 Design Parameter

The target year of this feasibility study for Central WWTP is 2020. The basic condition of Central WWTP for 2020 is shown in Table II.2 and II.3. Treated wastewater is planned to be discharged into the Vardar River which flows in proximity to Central WWTP site. Water quality standard for treated wastewater discharge into rivers is shown in Table II.4. This standard is defined in EC directives for urban wastewater.

3.2 Design Criteria

B/P selects conventional activated sludge process for wastewater treatment process and gravitational thickening followed by anaerobic digestion and natural drying for sludge treatment process. Table II. 7 summarizes design parameters of these unit processes.

Table II. 7 Design Criteria for Treatment Facilities

Facility	Item	Criteria	
			Range
A. Wastewater Treatments (for BOD Removal)			
(1) Grit Chamber			
(2) Primary Settling Tank	Overflow Rate	50 $m^3/m^2/d$	35 – 70
(3) Aeration Tank	Hydraulic Retention Time	6.0hr	6.0 – 8.0
(4) Secondary Settling Tank	Overflow Rate	25 $m^3/m^2/d$	20 - 30
(5) Chlorine Contact Tank	Contact Time	15 min	
B. Sludge Treatment			
(1) Gravity Sludge Thickener	Solids Surface Loading	75 $kg/m^2/d$	60 - 90
(2) Anaerobic Sludge Digester	Hydraulic Retention Time	20 days	
(3) Sludge Drying Bed	Drying Days	14 days	
(4) Gas Holder	Storage Volume	12 hr	
(5) Temporary Sludge Storage Yard	Storage Volume	1 year	

Note: Design guidelines of Japan are referred to.

Conventional activated sludge process is proposed to remove organic pollutants measured as BOD for the target year 2020 considering the urban wastewater directives of EU, constraints on the WWTP site and the project and maintenance costs. In the second stage after 2020, nitrogen and phosphorous removal processes will be introduced if necessary.

Table II. 8 Proposed Treatment Process

	Stage	Proposed Process
Wastewater Treatment	Stage I (2020)	Conventional activated sludge process for BOD removal
	Stage II (after 2020)	Nitrification/Denitrification for nitrogen removal and chemical addition for phosphorous removal
Stormwater Treatment	Stage I (2020)	Secondary treatment for certain amount of stormwater regarded as first flush
	Stage II (after 2020)	Check whether detention reservoir is needed or not through qualitative and quantitative survey on stormwater
Sludge Treatment		Sludge Thickening, Sludge Digestion and Sludge Drying

Note: Stage II in case "Sensitive Area"

3.3 Process Calculation and Hydraulic Calculation

Table II. 9 outlines the results of process calculation done based on the design criteria shown in Table II. 7. The magnitude of facilities is determined to include stormwater regarded as first flush.

Table II. 9 Summary of Proposed Facilities

Facility	Dimension / Number	Remarks
A. Wastewater Treatment		
(1) Grit Chamber		
(2) Main Pumps	166 m^3/min in total	For maximum hourly
(3) Primary Settling Tank	Dia. 24.0m × 8 tanks	
(4) Aeration Tank	16.0m × 67.0m × 5.0m × 8 tanks	
(5) Secondary Settling Tank	Dia. 24.0m × 16 tanks	
(6) Chlorine Contact Tank	10.0m × 86.0m × 2.0m × 1 tank	
B. Sludge Treatment		
(1) Gravity Sludge Thickener	Dia. 21.0m × 2 tanks	
(2) Anaerobic Digestion Tanks	Dia. 26.0m × 14.0m × 4 tanks	
(3) Gas Holder	Dia. 16.0m × 10.0m × 4 tanks	
(4) Sludge Drying Bed	18.0 ha	Including transportation aisle
(5) Temporary Sludge Storage Yard	80m × 200m	

3.4 Layout of Facilities and Flood Protection

3.4.1 Present Condition

Water economy facility zone occupies 106 ha. However, subtracting 49 ha for present river area, right bank side of the present Vardar River, planned road area and protected area, the land available for Central WWTP construction is 57 ha.

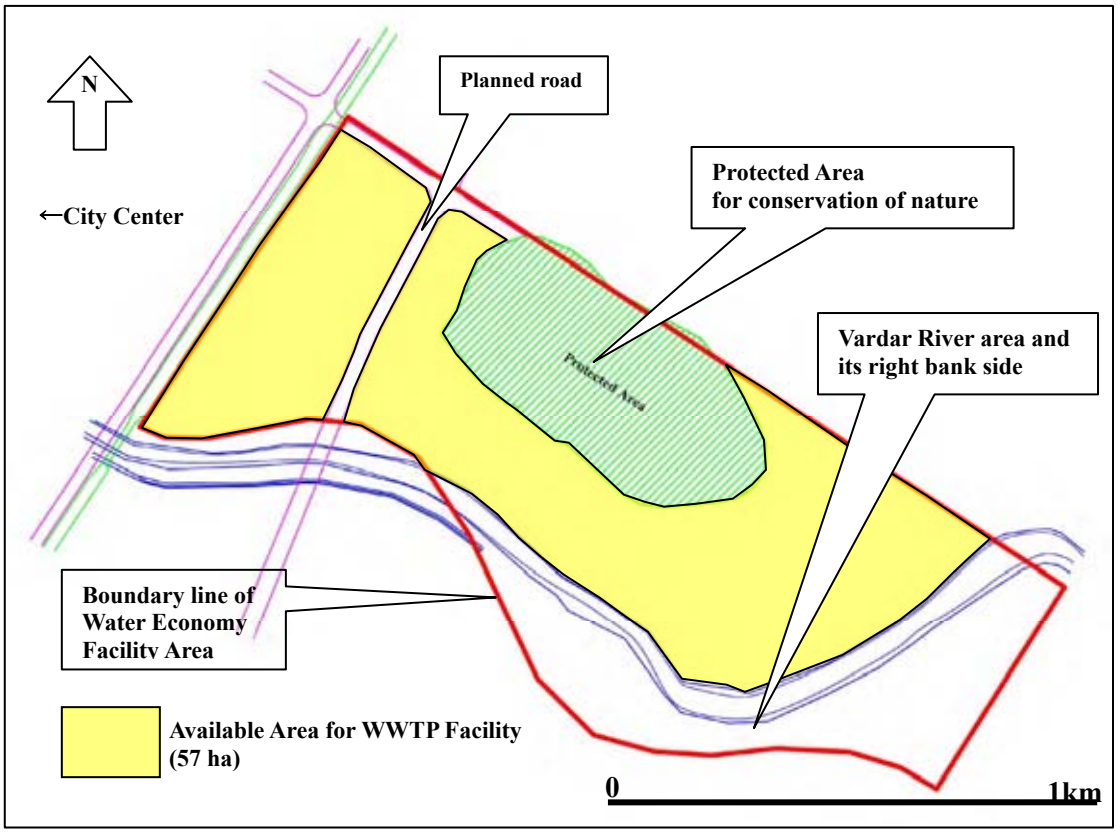


Figure II. 5 Present Condition of Central WWTP Site

3.4.2 Facility Layout Plan

Figure II. 6 and Figure II. 7 show layout plan of Central WWTP that is prepared taking the followings into account.

- Wastewater treatment facilities are allocated at the western part of the planned road, sludge treatment facilities such as sludge thickeners and sludge digesters are planned in the eastern part of the planned road.

- Sludge drying beds are planned in the eastern part because the beds cannot be located in the western part. Required area of the sludge drying beds is about 18 ha including related facilities like transportation aisle.
- Sludge drying beds are surrounded by green buffer zone to minimize odor emission.
- Temporary or emergency dried sludge storage space for one year production is reserved.

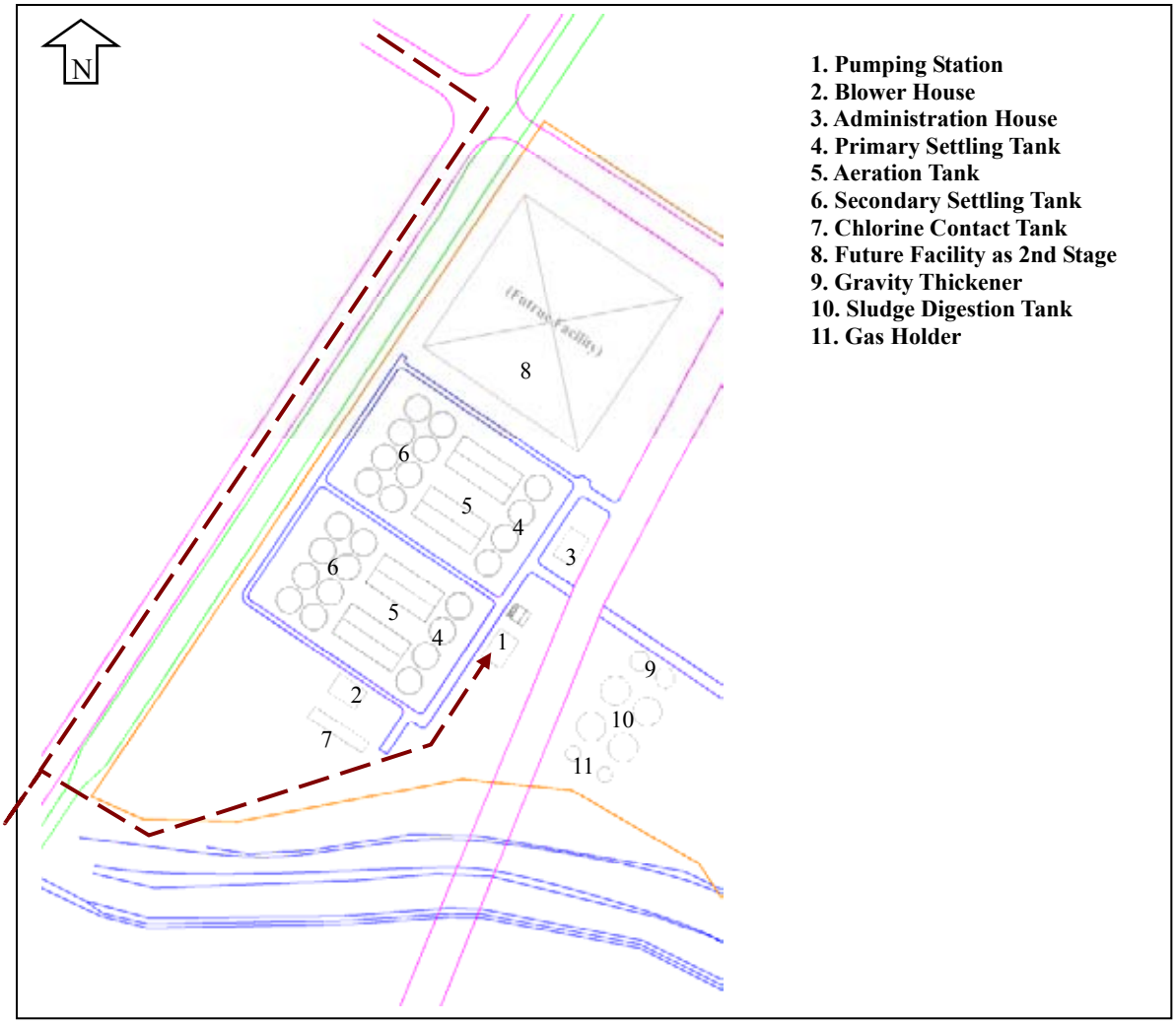


Figure II. 6 Layout Plan of Central WWTP (1)

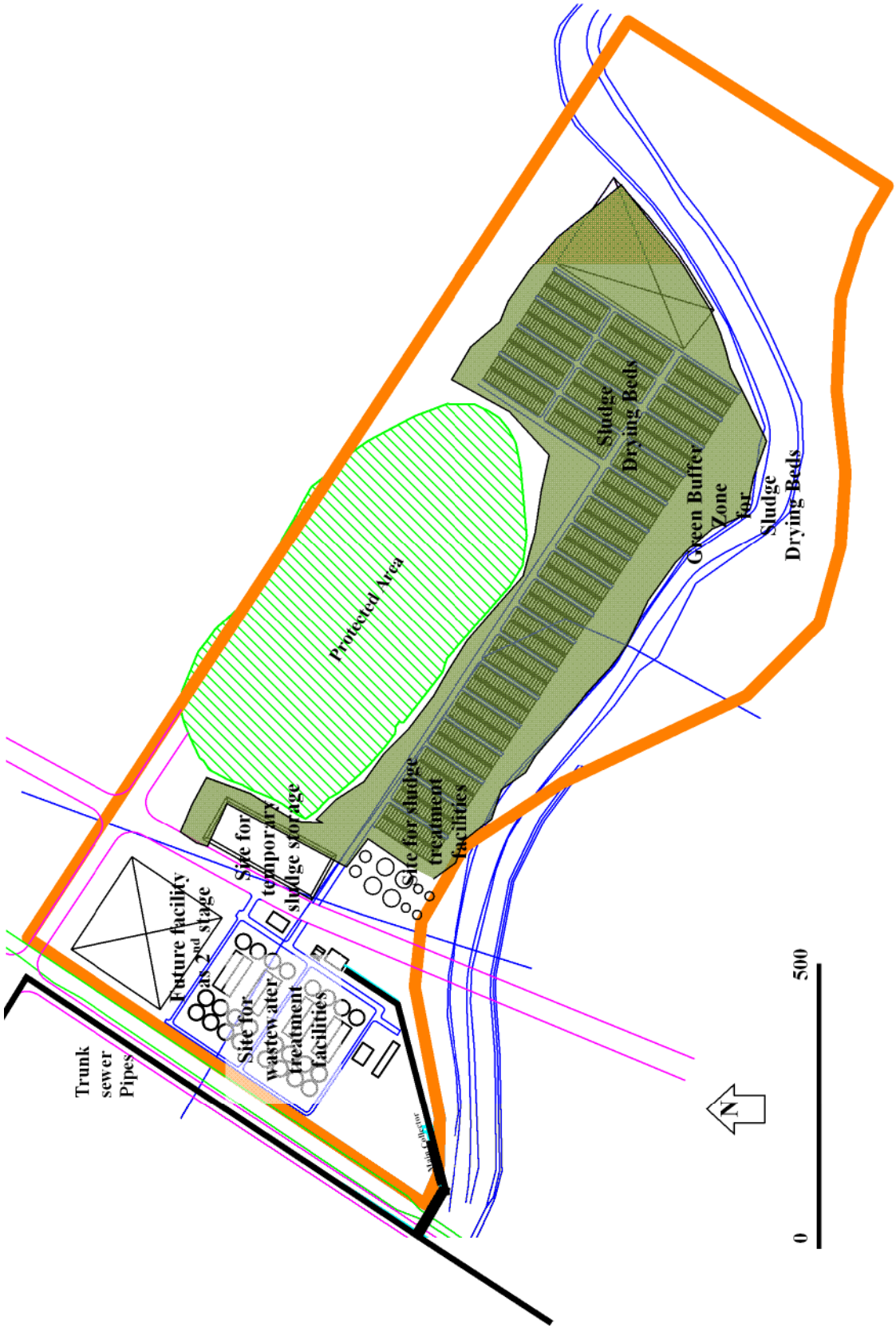


Figure II. 7 Layout of Treatment Facilities (2)

3.4.3 Flood Protection

For flood protection purpose, the dyke to cope with 1,000 year return period flood, partly existing, is to be extended towards the downstream of the river.

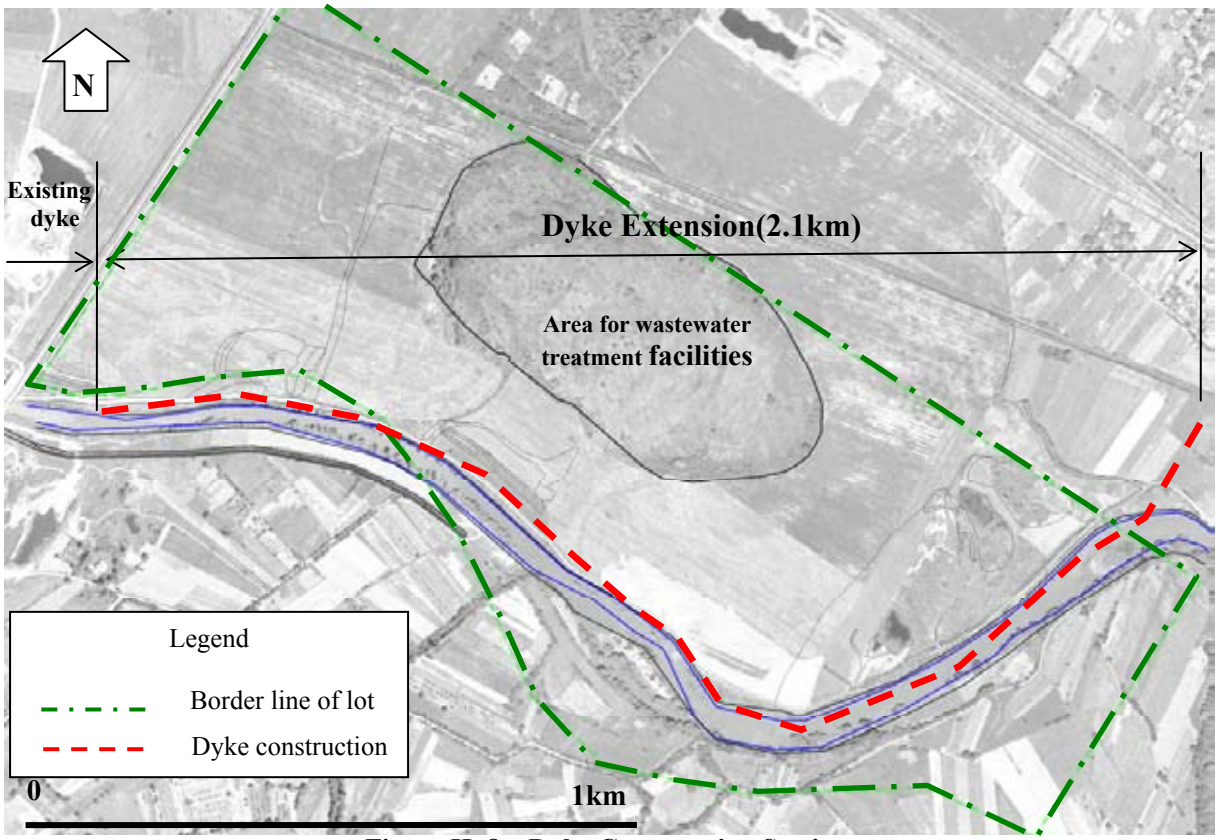


Figure II. 8 Dyke Construction Section

3.5 Facility Construction and Temporary Structure Construction Methods

Geological survey shows that the ground of WWTP site consists of silt layer from the ground level (GL) down to 2 meters below GL and of gravel layer 2 meters beneath from the surface with N-value of greater than 30. Hence, it has sufficient bearing strength. No foundation is judged to be needed. Open cut method is adopted in principle for good soil conditions, small rainfall and sufficient space.

3.6 Clean Development Mechanism

There are two methodologies approved by CDM Executive Board in the field of wastewater treatment. These methodologies are ACM[5]0014: Avoided methane emissions form wastewater treatment and AMS[6]-III.H: Methane recovery in wastewater treatment. Application of the project activity is investigated based on those approved methodologies.

The potential application of CDM in the project activity is utilization of digested gas by generating electricity. It results in the reduction of CO_2 emission by replacing grid power supply generated using fossil fuel with electricity generated using biogas.

The common practice is to utilize digested gas generated from anaerobic digestion as heat resource to keep digesters at the adequate temperature and to flare the excess gas. In this feasibility study, two systems to utilize digested gas are investigated: “Co-generation System” and “Heater and Gas engine Generator system”.

[5] Approved Consolidated Methodologies (UNFCCC)
[6] Approved Small-scales Methodologies (UNFCCC)

Table II. 10 Method of Digested Gas Utilization

System	Description of System	Heat Efficiency
Co-generation System	Electricity is generated by gas engine which is driven by digested gas. Simultaneously, anaerobic digester is warmed by heat energy recovered form exhaust gas and cooling water through heat recovery device.	32% of calorific energy is transformed into electricity and 25% - 30% of calorific energy is utilized as heat energy. Total efficiency of energy recovery is 57% - 62%.
Heater and Gas Engine Generator	Anaerobic digester is warmed by heating device by utilizing digested gas. Electricity is generated by gas engine using surplus digested gas.	Efficiency of heating device is comparatively high. Efficiency of gas engine is the same. However total efficiency is inferior because it does not recover heat energy.

Total efficiency of co-generation system is superior in terms of energy recovery. Even during summer, calorie recovered from waste energy is not sufficient to warm anaerobic digester. Therefore, auxiliary fuel such as crude oil is inevitable at all time of the year. It is not appropriate to supplement shortage of calorie by using auxiliary fuel from the aspect of reducing CO_2 emission considering application of CDM. Therefore, introduction of co-generation system is not applicable.

Then, the other system, in which anaerobic digester is warmed by a heating device and electricity is generated by using surplus digested gas, is investigated. Production of electricity and reduction of CO_2 emission in case of introduction of digested gas generator system is summarized in Table II. 11.

Table II. 11 Production of Electricity and Reduction of CO_2 Emission

	Jun	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Production of Electricity (MWh/day)	7.6	8.7	10.0	11.3	11.3	11.3	11.3	11.3	11.3	11.3	9.9	8.7
Reduction of CO_2 Emission (ton/day)	6.1	6.9	8.0	9.0	9.0	9.0	9.0	9.0	9.0	9.0	7.9	6.9

Estimation in case of introduction of digested gas generator system is summarized in Table II. 12.

Table II. 12 Estimation of Parameters for Digested Gas Generator System

Item	Cost
Operation revenue = Benefit – O&M cost	95,423 Euro <In case including benefit form CER> 59,301 Euro <In case excluding benefit from CER>

Payout time of initial investment is 29 years in case of excluding benefit from CER and 18 years in case of including benefit from CER. It is impossible to payout initial investment within economic life of equipment since the standard economic life of mechanical and electrical equipment which constitute digested gas generator system is 15 years. Therefore, introduction of digested gas generator system is not applicable based on the results of investment analysis.

4. OPERATION AND MAINTENANCE PLAN

4.1 Organizational Strengthening of the Sewerage Sector

Vodovod is a large utility providing water supply and sewerage services. Its major strength is its ability to handle all the water utility activities only using its own human resources and equipment including operation and maintenance of water supply and sewerage facilities and construction work for their expansion and replacement. On the other hand, Vodovod needs to strengthen its capacity to carry out the work after the completion of the Project, which is bigger in volume and higher in technology. In

other words, more efficient operating system should be established.

4.1.1 Necessity for Capacity Development

Required organization in the Vodovod is proposed to operate additional works of the wastewater treatment plants. In parallel, the Vodovod should be a financially and administratively sound organization to manage it. After the tariff hike in 2007 by almost 100%, the Vodovod has become a financially sound entity. And even the raised tariff is still within an affordable level. Thanks to the existing water supply facilities, the Vodovod operates the facilities without a major investment. However, on the other hand, it has resulted in, for example, huge water losses. It unnecessarily wastes energy. Rectifying this will require a considerable investment. A study on balancing investment and expenditure is out of this Study. However, at least the Study Team considers, if financial and administrative improvements are made on the Vodovod, financial situation will improve. Thus, future tariff increase can be avoided or reduced. Therefore, the institutional and financial capacity of Vodovod was studied and assessed in the Study. As a result, action plans are developed and presented in the separate part of the Report. Identified/ required areas include the organizational structure, human resources management, financial operation, and operation and maintenance of the facilities. They are reproduced in this section.

4.1.2 Existing Organization

Vodovod has all the divisions (Sectors) and sections required to perform day-to-day operations. The scope of works and lines of order of the Sectors are rather complicated even though there appears to be no significant duplications.

4.1.3 Proposed Organizational Structure – Project Implementation Stage

The executing agency must be capable of handling various activities related to the preparation and implementation of the Project. They include, inter alia, (1) review of Project plan and feasibility reports, (2) preparation for PQ (pre-qualification) and bidding in accordance with the Guidelines for Procurement under a loan from the lending agency (e.g., JICA), (3) procedures of application and withdrawal of loan proceeds, (4) recruitment of consultants, (5) review of detailed design work, (6) construction supervision, (7) commissioning of Project facilities, etc.

It is recommended for the executing agency, namely, Vodovod[7], to establish a special unit for the implementation of the Project under its Technical Director. The unit may be named Project Management Unit (PMU). It is also proposed to add a Support Committee, which assists the PMU in technical, administrative and financial aspects of the Project implementation. The PMU shall be composed of a Project Director, Technical Manager, Procurement Manager, Project Coordinator, and engineers and clerks. The Support Committee members shall consist of Deputy General Director, Technical Director, Sector Directors for Sewerage, Water Supply, Mechanization, Technical Affairs & Development, O&M, Accounting, Financing & Commerce, Legal, Personnel & General Affairs, and one or two representatives from Skopje City.

4.1.4 Proposed Organizational Structure –O&M Stage

There will be an absolute need to establish an independent or additional organizational unit for the O&M of the WWTP since there is no such unit in the Vodovod's present organization. Alternative organizational structures are proposed as follows:

Alternative 1: Sector Wastewater Treatment is newly added to Vodovod directly under Technical Director. The function of the Sector is only the operation of WWTP, not including maintenance of facilities, which shall be carried out by Sector O&M (Exploitation, Maintenance of Facilities).

[7] During the Study, other form of operation was discussed such as private-partnership, creation of central Public Enterprise other than Vodovod. However, Vodovod is assumed to operate the proposed wastewater treatment plant in the Study according to the agreed scope of work between the two governments. The Study Team believes that it is better operated technically together with sewers and pumping stations and that Vodovod can have a power to force beneficiaries to disconnect water supply services if they do not pay the sewerage tariffs.

Alternative 2: Sector Sewerage assumes the responsibility for not only maintenance of sewers but also for O&M of the WWTP. Under the same concept, Sector Water Supply will perform not only maintenance of water mains but also O&M of water intake facilities, chlorination plant and pumping stations (including service reservoirs).

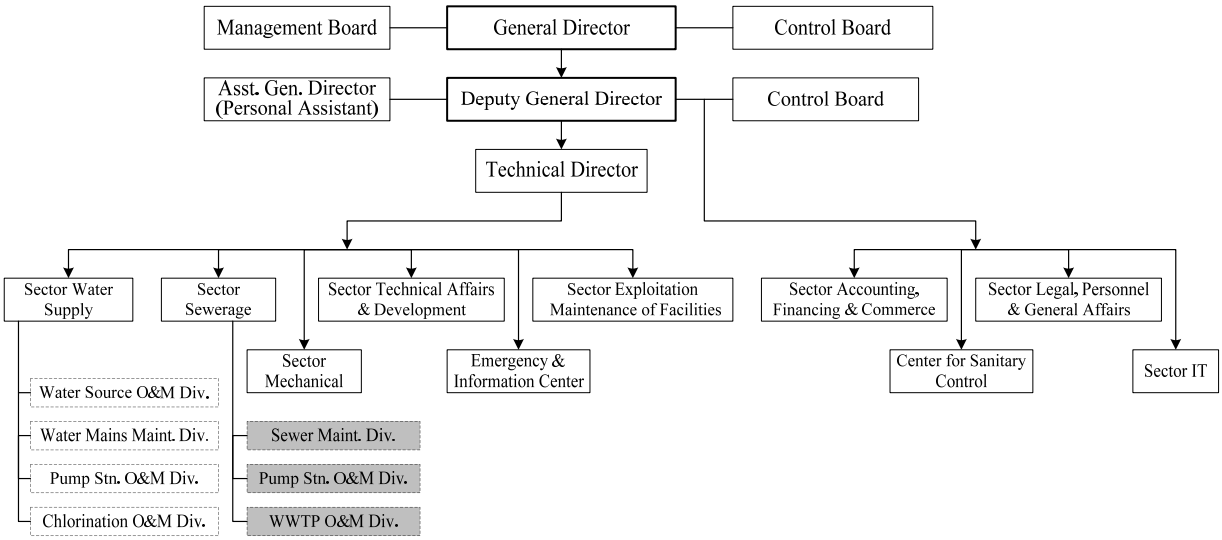


Figure II. 9 Organizational Structure of Vodovod with WWTP (Alternative 2)

Alternative 3: Vodovod is reorganized to have four departments, namely, Water Supply Department, Sewerage Department, Technical Department, and Administration Department. Technical Department will contain Sector Mechanical, Sector Technical Affairs & Construction, and Sector Information and IT. Administration Department will consist of Sector Accounting, Finance & Commerce, and Sector Legal, Personnel & General Affairs. All the functions of the former Sector O&M will be moved to either Water Supply Department or Sewerage Department. Division for Design, and Construction will be newly added to Sector Technical. The function of leakage detection will move to Water Supply Department as a special unit. Sector IT and Emergency and Information Center will be agglomerated to form a new Sector Information and IT. The functions of Sanitary Control Center will be transferred to Water Supply Department and Sewerage Department as Drinking Water Laboratory and Wastewater Laboratory, respectively.

Alternative 3 embodies a significant merit in that Sewerage Department and Water Supply Department can handle maintenance work as well as operation of facilities by themselves even including water quality control functions; that Sector Technical Affairs and Construction, Sector Mechanical and Sector Information and IT are grouped in Technical Department, which will make the management of technical activities systematic and rational; and that administrative Sectors of "Accounting, Finance and Commerce" and "Legal, Personnel and General Affairs" are Grouped in Administrative Department.

It appears advantageous for Vodovod to renovate its organization towards Alternative 3. However, it seems to be difficult to complete such renovation well before the commissioning of the Project, which is expected to take place around 2015. Considering the time factor and effectiveness of organizational renovation, Alternative 2 appears to be suitable to implement for the time being with an aim to shift towards Alternative 3 in future.

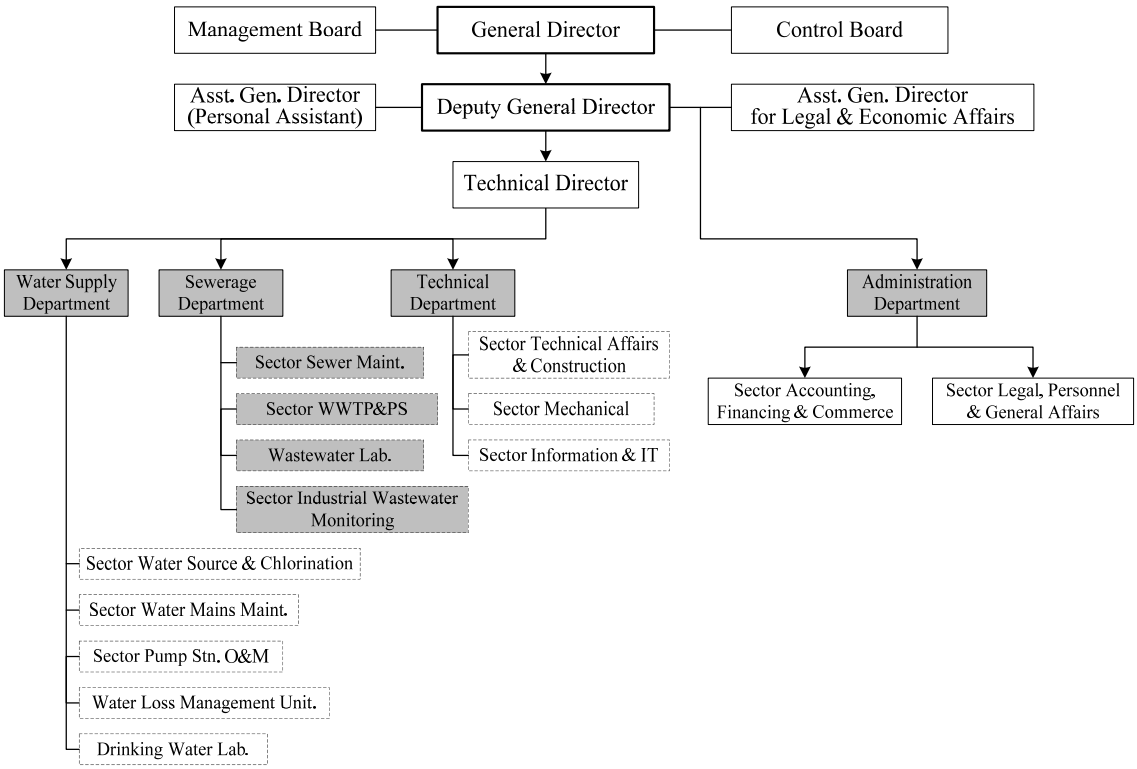


Figure II. 10 Organizational Structure of Vodovod with WWTP (Alternative 3)

4.2 Laws and Regulations regarding O&M

About the operation/maintenance of the wastewater facilities in Macedonia, there are "Law on Environment" and "Law on Water Supply, Drainage of Urban Wastewater" other than new "Law on Waters" which have been revised based on the relevant EU Directives. On the other hand, the Law on Water Supply, Drainage of Urban Wastewater (Official Gazette 68/04, 28/06, 103/08) does not reflect an approximation to the EU laws, it is necessary to amend it in the new legislation to harmonize with the new Law on Waters.

It seems that it is necessary to examine the following prescripts in the planned establishment of a government ordinance/regulation of the Law on Waters or amendment of the current Law on Water Supply and Drainage of Urban Wastewater from comparison with the Sewerage Law in Japan.

a) Establishment of improvement target of water quality in each basin and basin wide sewerage implementation program
b) Uniform effluent standard and severer standard for discharge from WWTP
c) Effluent standards of pretreatment facility for industrial wastewater discharging to sewer and its monitoring/inspection
d) Terms necessary for implementation and operation/maintenance of sewerage facilities to be ordained in municipal ordinance
e) Sewage sludge control; sludge to be reduced as much as possible and effectively utilized/ appropriately disposed of
f) Financial sources on construction cost of sewerage facilities (subsidy from state government and the other)
g) Certification system for skilled personnel, and so on.

4.3 O&M Executive System

4.3.1 Purpose of O&M

The purpose of the operation and maintenance of sewerage is to maintain the facilities in an

appropriate technical level and to operate them adequately and effectively, best utilizing the facilities. With proper functioning and adequate maintenance the facilities will last until their designated life period. For this purpose it is necessary to draw up a maintenance plan from a long-term and comprehensive point of views, and to perform proactive maintenance.

4.3.2 Contents of O&M Work

Operation and maintenance work related to sewerage management consists of the following work fields;

1) Legal matter/Budget/Accounting/General affairs
2) Execution of budget/Contract
3) Asset management
4) Public relations/Awareness
5) Estimation/Collection of sewer service charge
6) Guidance on house connection
7) Monitoring of industrial wastewater and guidance to the industries
8) O&M of sewer network
9) O&M of wastewater treatment plant and pumping stations
10) Water quality control
11) Management of sewerage registers
12) Environmental conservation
13) Management for safety and health

4.3.3 O&M based on Public Authority

The O&M works are divided into duties using public authority, such as collection of sewer service charge, guidance of house connection and monitoring of industrial wastewater, and the other duties related to operation and maintenance of sewer net work, pumping station and wastewater treatment plant.

In Macedonia, effluent regulation for effluent from factories is carried out by IPPC system under the jurisdiction of the MEPP. Vodovod has no right to regulate (monitor, inspect, etc.) industrial effluent discharged to its sewer which includes wastewater from business establishment such as gas station, laundry, laboratory, etc. However, it should be monitored and regulated by Vodovod from the viewpoint of protecting sewerage facilities and maintaining effluent water quality within a standard.

4.3.4 Function and Role of Wastewater Treatment Management

It is necessary to make the system of wastewater treatment plant which can function as designed any time day or night. Maintenance functions and the role of the WWTP management are as follows.

a) Establishment of improvement target of water quality in each basin and basin wide sewerage implementation program
b) Uniform effluent standard and severer standard for discharge from WWTP
c) Effluent standards of pretreatment facility for industrial wastewater discharging to sewer and its monitoring/inspection
d) Terms necessary for implementation and operation/maintenance of sewerage facilities to be ordained in municipal ordinance
e) Sewage sludge control to be reduced as much as possible and effectively utilized/ appropriately disposed of

The other works that are desirable to manage in a unified manner with wastewater treatment of Central WWTP are:

f) Financial sources on construction cost of sewerage facilities (subsidy from state government and the other)
g) Certification system for skilled personnel, and so on.

4.3.5 Required Personnel for O&M of WWTP (Rough Estimation)

On examining O&M system of treatment plant, it is necessary to take into account the number of personnel requirement and possibility of their acquisition, such as specialized personnel and number of O&M staff. It is also necessary to consider the associated expense in a comprehensive manner. The O&M system differs greatly by the form; direct management or outsourcing.

Almost all municipalities in Japan utilize some kind of outsourcing to streamline O&M system. On the other hand, Vodovod performs current water and sewage business by the direct management, administers an independent machine repair shop and employs enough staff, security guards, and so on. In sewerage, Vodovod has sewer network O&M sector of the direct management, and all of the five maintenance district offices under the sector implement cleaning and dredging of sewers by their own staff and machines.

There is no reliable private company for outsourcing in Macedonia, even if privatization is opted. Since history of the direct management is long in Macedonia, there was less opportunity for a market to grow up. In addition, judging from the past performance or the current O&M system of the direct management, Vodovod has ability to operate and maintain the first WWTP in Skopje City by the direct management.

From the above-mentioned examination and the direct management performance of a similar Japanese WWTP, necessary O&M personnel at the start-up of Central WWTP are roughly estimated as shown in Table II. 13. Specialized personnel are shown in this table as M is mechanical engineer/technician, E is electrical engineer/technician, C is chemist and B is biologist.

Table II. 13 O&M Personnel of Central WWTP (Rough Estimation)

Part	Jobs	Estimated Number	Estimation Base (M:Mechan., E:Elec. C:Chem., B:Biol.)	Target Number
1. Operation	Patrol/Inspection, Operation/Control, & Record/Report	12	Day work: M2+E2 Shift work: (M1+E1)×4shifts	12
2. Maintenance	Regular Check for Mechanical/Electrical Equipment, & Repair/Maintenance	8	Day work: M4+E4	6
3. O&M of Pumping Station	11Pumping Stations= 8SanitaryPS+3RainyPS	6	Day work: (M1+E1)×3teams	4
4. Water Quality Analysis	Water Quality/Sludge Analysis, Record/Report & Direction for Operation	8	Routine Analysis (C4+B2)＋ Industrial wastewater(C2)	7
5. Building Maintenance & General Affaires	Account/Budget, Asset & personnel Regular Check & Repair/Maintenance for Building/Equipment	6	2 4=Security guard 1×4shifts	5
6. Field Work	Scraping/Storage/Transport of Dried Sludge Cleaning Works at Treatment Facilities, Building and Laboratory	14	8=(Tractor Driver1+ Worker1)×4teams 6	14
7. Monitoring of Industrial Wastewater	Target sites: 250= FactoryA:50+FactoryB:100+Others:100 Monitoring number of times: 700sites/year=3.5sites/day	6-4=2	6=(C1+M/E1+Worker1)×2teams Chemists and M/E double as Water Quality Analysis Part and Operation Part. Support necessary from legal section	2
Total		56	M:13+E:13+C:6+Bio:2=34	50

The number of necessary O&M personnel totals to 56 people. It may be said that this is the start-up original lineup which reflects the existing system of Vodovod. Afterwards, if they acquire experience of the operation and maintenance of WWTP and become familiar with duties, operation part and

maintenance part may serve as the operation and maintenance duties of the pumping station partly, and the reduction of the security guard will be enabled by the promotion of efficiency of the night shift system. With above expectation, 50 people are assumed as the target number of personnel for O&M.

4.3.6 Necessary Qualifications for O&M Work in WWTP

The adherence to the qualifications established in laws and ordinances is needed for managing the WWTP. Because the personnel should be prepared at the WWTP start-up, it is necessary to foster the resources with the qualifications beforehand. A series of examples of qualifications in Japan was introduced to Macedonia government and Vodovod, and as a consequence they decided to investigate the kind/level of the qualification found in related laws and ordinances of Macedonia.

4.3.7 Training of Operation and Maintenance Engineers

When the construction schedule of WWTP is fixed, it is necessary to start various preparations as shown below, targeting the commencement of WWTP.

a) Preparation of laws, ordinances and regulations related to sewerage and sewage treatment
b) Establishment of the O&M structure
c) Security and training of the O&M engineers/technicians
d) Security and training of the necessary qualified staffs
e) Security of the budget
f) Preparation of regulations, rules and codes related to sewerage and sewage treatment
g) Preparation of sewerage registers and daily, monthly, yearly report
h) Purchase of equipment and expendable consumable supplies
i) Public information to citizens and the users

Of these, security of O&M engineers/technicians and necessary qualified staff is the most important issue. In the O&M of WWTP, expertise and technology for many fields are necessary such as mechanical/electrical engineering, chemistry, biology, civil engineering and legal/management of the sewerage. For the startup of the Central WWTP several years later, the training of staff to be engaged in O&M has to be implemented beforehand and effectively to develop and improve their ability.

As for the O&M, work experience and accumulation of experience at the site is important in particular. Therefore it is necessary to incorporate on-the-job training in a training plan, which covers practical issues and the training is provided on WWTP site to be able to learn theory and practical business concurrently.

Four experts (lecturers) in mechanical, electrical, water quality analysis and industrial wastewater will be dispatched for eight man months (M/M) in two years, from one year before to one year after the WWTP commencement.

4.4 Water Quality Control and Sludge Control

4.4.1 Effluent Quality Control of Wastewater Treatment Plant

The effluent quality standard of the Law on Waters is going to be established as a government ordinance/regulation of the law by the year 2010, based on “Urban waste water treatment, EU Directive 91/27/EEC”. The effluent quality standard in the EU Directive which will be applied to the Central WWTP is shown in Table II. 14. In addition the water quality standard for “sensitive area” is shown in Table II. 15 for reference.

Table II. 14 Effluent Quality Standard from Urban Wastewater Treatment Plant (91/271/EEC)

Parameters	Concentration	Reduction ratio
BOD （20 ℃, without nitrification）	25 mg/l	70-90 %
COD	125 mg/l	75 %
TSS	35 mg/l	90 % (optional)

Remarks: Values for concentration or reduction ratio shall apply.
（Other remarks and measurement method are omitted.）

Table II. 15 Effluent Quality Standard from WWTP to "Sensitive Area" (91/271/EEC)

Parameters	Concentration （P.E. : population equivalent）	Reduction ratio
TP	2 mg/l (10,000 - 100,000 P.E.) 1 mg/l (more than 100,000 P.E.)	80 %
TN	15 mg/l (10,000 - 100,000 P.E.) 10 mg/l (more than 100,000 P.E.)	70-80 %

Remarks: One or two parameters shall apply.
Values for concentration or reduction ratio shall apply
（Other remarks and measurement methods are omitted.）

On the other hand, industrial wastewater is regulated by effluent standard of hazardous substance including heavy metal, being determined by the IPPC system. The wastewater treatment plant is not designated by the IPPC system, though the urban solid waste facility is now included in the IPPC system. Therefore, it is necessary to include a wastewater treatment plant "A" category in the IPPC system if it will be the regulation object of the system.

If a wastewater treatment plant receiving industrial wastewaters does not become the object of the IPPC system, the hazardous substance shall be prescribed in the effluent quality standard which will be established in a government ordinance/regulation of the Law on Water, in order to close a loophole of the hazardous substance effluent regulation.

A tentative effluent standard from Wastewater Treatment Plant which can be applied to the Central WWTP is shown is proposed in the Study. This is a table, excluding the parameters (BOD, COD, TSS, TN and TP) from the parameters of the wastewater regulations in the Japanese Water Pollution Control Law. The water pollution control for the wastewater treatment plant in Japan is made not only by Water Pollution Control Law but also by the Sewerage Law.

Under the Sewerage Law, the effluent from wastewater treatment plant is required to meet a "Technical Standard" established in a government ordinance. As the "Technical Standard", there is a uniform effluent quality standard (pH:5.8 to 8.6, coliform bacteria count: less than 3,000/cm^3, SS: less than 40mg/l), a planed effluent quality standard designated by a sewerage administrator (BOD: less than 10mg/l / less than 15mg/l, Nitrogen content: less than 10mg/l / less than 20mg/l, Phosphorus content: less than 0.5mg/l / less than 1mg/l / less than 3mg/l) and a effluent standard of combined sewer overflows.

In the Water Pollution Control Law, effluent quality standards for the hazardous substances including heavy metal and for the other parameters are provided. In addition, depending on the local conditions such as lakes and closed water body, the Prefectural Governor can establish severer effluent quality standard (an additional standard) in the local ordinance.

The SS, BOD, Nitrogen content and Phosphorus content of the technical standard established in a government ordinance of the Sewerage Law are severer than the effluent quality standard of the Water Pollution Control Law.

4.4.2 Water Quality Measurement of the WWTP Effluent

The "Urban waste water treatment, EU Directive 91/27/EEC" provides the water quality measurement to monitor where it observes effluent quality standard as follows:

- The minimum number is 24 samples for 50 000 P.E. or over during the first year.
- Flow-proportional or time-based 24-hour samples shall be collected in the outlet and if necessary in the inlet of the treatment plant.

4.4.3 Industrial Wastewater Monitoring and Regulation

The Vodovod has the discharge criteria to sewer system, which is not fitting with the times. By the startup of the WWTP, the discharge criteria should be established and modified.

The sewerage law in Japan establishes the discharge criteria and gives sewerage administrator the authority to regulate, monitor and inspect factory discharge and pretreatment facility. An outline of the water quality regulation by the sewerage law is shown in Table II. 16.

Table II. 16 Industrial Wastewater Regulation by the Sewerage Law in Japan

Purpose of the Regulation	Means of the Regulation	Discharge Criteria	Target Factory and Other Business Establishment
Protection of Sewerage Facilities	Setting of Pretreatment Facility	Criteria by ordinance of local government	Factory and other business establishment in the drainage area
Security of Effluent Water Quality	Discharge Regulation by Direct Punishment	Criteria by government ordinance (for the materials which are difficult to treat in WWTP)	Specified factory and other business establishment in the treatment area
		Criteria by ordinance of local government (for the materials which are possible to treat in WWTP)	
	Setting of Pretreatment Facility	Criteria by ordinance of local government	Factory and other business establishment in the treatment area

4.4.4 Sewage Sludge Management and the Management of Environmental Item

a) Disposal of Sewage Sludge and Others

Wastewater treatment generates grit, screenings and sewage sludge as by-products. Their appropriate disposal is the most important matter in operation/maintenance of WWTP together with treating wastewater to meet the effluent standard. For this purpose, their transportation and disposal plans should be prepared before the startup of WWTP.

Some of the disposal methods of these grit, screenings and sludge cake are:

- Landfill as urban wastes at the existing Drisla site,
- Landfill as the industrial waste at the planned site, and
- Agriculture use.

In Macedonia how to handle or regulate the sewage sludge is not clear at this moment in the related laws such as Waste Disposal Law or Fertilizer Regulatory Law. But in the near future, a standard will be established for regulation of the landfill disposal and agriculture use using examples from the related EU Directives, and it will be applied to the sewage sludge disposal or utilization.

It seems that grit and screenings can be disposed of at the existing Drisla land fill site. Disposal method of the sludge cake will depend on industrial wastewater management based on the IPPC system. At first, in the making of the sewage sludge disposal plan, dewatered sludge properties have to be examined, and then it becomes possible to judge by the contents such as the heavy metals whether to utilize the sludge as a soil conditioner/fertilizer, to dispose at the urban wastes landfill site or to dispose at a planed hazardous waste disposal site.

If it is possible to dispose the dewatered sewage sludge at the Drisla urban wastes disposal site, the expenditure is estimated as about 21 million MKD/year (55 million yen/year); that is 680MKD (tax-included 714MKD)/ton of disposal rate at Drisla and 80ton/day of dewatered sludge generation.

In this case it will be possible to develop the way of agricultural use, too.

If it becomes impossible to dispose the sewage sludge at the Drisla, it will be forced to spend more than above, and also shutting the way of utilization of the sludge. This implies that it is important to strengthen the monitoring of industrial wastewater discharge, regulate the hazardous substance (heavy metal) mixture, and implement the sludge quality control, from the view point of O&M cost reduction and improvement of the sewerage management.

b) The management of environmental item

The facilities of WWTP should be operated and maintained carefully paying due attention to air pollution, noise/vibration and odor, so that there is no or minimum influence on inhabitants around the plant. Therefore it is important to investigate the facilities which are likely to become the sources of above mentioned pollutions, to make monitoring plans of ambient air, noise/vibration and odor, and to monitor them regularly.

The possible sources are as follows:

- boiler of the digestion tank: air pollution
- construction machine and blowers: noise/vibration
- many places such as grit chamber, screen and digestion tank: odor.

The operators of WWTP should monitor these sources regularly to confirm whether it will meet the regulation criteria at the regulation point such as site borders.

4.5 Sewer Register and Records with GIS

The sewer register is the basic needs for proper O&M. It helps to formulate records and to grasp a correct perception of the present situation of sewer facilities. The register is also needed to provide public with information and to provide related institutions with data in response to requests.

In order to prevent accidental troubles as much as possible and at the same time, to promote life-extension of facilities, it is required to carry out necessary repair and cleaning in accordance with planned maintenance and accumulated information in the register.

The contents of register is as follows:

(1) Document

At least the following contents should be included in the register.

1) Areas, population served and name of places of each treatment district.
2) Date of commencement of service.
3) Location of discharge points and name of receiving waters.
4) Length of sewer, number of manhole and house connection pit of sanitary sewage and stormwater.
5) Location, area of site, configuration and capacity of treatment plants.
6) Location, area of site, configuration and capacity of pumping stations.

(2) Drawing

1) General Plan
   i) Administrative boundary
   ii) Name and boundary of treatment district, sub-district, and name of sanitary sewage and stormwater.
   iii) Location of sewer and discharge point and name of receiving water.
   iv) Location and name of treatment plants and pumping stations.
   v) Bearings, scale, legend and date of drawing.

2) Plan View of Facilities

i) Above mentioned contents of i)~iii) and vi).
ii) Location, shape, inner size, slope invert level and direction of flow of sewer.
iii) Location, shape and inner size of house connection pipe.
iv) Location, type and size or diameter of manhole.
v) Location and type of sanitary sewage and stormwater house connection pit.
vi) Location of outfall and name of receiving water together with high, middle and low water levels.
vii) Location, shape, inner size and name of point at which gutter or open channel is connected to drainage facilities.
viii) Boundary and name of treatment plant and pumping station.
ix) Location, shape, size and water level of major facilities in the site of treatment plant and pumping station.
x) Name and location of relevant facilities, except sewerage system, constructed with the permission of or in consultation with administrator of sewerage system.
xi) Location of road, river and rail way, etc, located near by.

O&M could be carried out more easily with application of GIS. GIS allows us to view, understand and visualize data in the form of map. Vodovod has already conducted maintenance based on the existing register.

4.6 Maintenance of Sewer System

4.6.1 Purpose of Sewer Maintenance

Sewer maintenance is carried out, with sufficient information of facilities, to achieve following objectives:

(a) to maintain functional capability of facilities
(b) to extend the life of facilities (decrease life cycle cost)
(c) to prevent adverse effect to other facilities and to prevent damages or defects due to other construction works.

4.6.2 Planned Maintenance Work

In order to utilize fully the functional capability of facilities, it is necessary to observe the capabilities reasonably and to apply appropriate measures for keeping the function by means of planned surveillances and inspections.

The sewer maintenance plan is to be established using flow chart from the time of facility construction until reconstruction due to completion of useful life.

The daily and properly scheduled surveillances and inspections, based on the long- term perspective, are the basic requirements of sewer maintenance work, which enable to figure out the existing situation of facilities.

Almost all unusual or abnormal situations can be surveyed with eyes. However, water-tightness inside small size pipes can be confirmed only by TV camera.

In order to implement planned maintenance work, it is necessary to collect data in accordance with the prepared schedule, to arrange it systematically and to utilize it effectively. The data concerning maintenance include the followings:

- Figures made at the time of completion of construction.
- Data resulted from surveillance, inspection, cleaning and repair work.
- Implementation reports of counter measures taken in response to claims or reports from citizen.
- Reports on accident such as flooding and road sagging.

4.7 O&M of Pumping Station

O&M of pumping station can be classified generally into daily routine work, one of at the time of heavy rain and in case of machine trouble. O&M consists of the following components:

(1) Maintenance of grit chamber
(2) Manipulation of inflow gate
(3) Operation of screening equipment
(4) Operation of grit removal equipment
(5) Operation of lift pump
(6) Manipulation of discharge gate
(7) Maintenance and checking of machine and electric equipment

4.8 Public Relations on Wastewater Treatment

The contents of the wastewater treatment service has the characteristic of invisibility, compared with the water supply and solid waste collection services, as the wastewater is collected through the pipelines laid underground and treated in the WWTP which is generally located away from the city centre. Wastewater treatment service with such characteristic needs to obtain the residents' support and understanding on its necessity and importance, and the structure of the finance and increased tariff. Thus the public relation is necessary.

Generally, as for the public relation of administration, emphasis tends to be put on the public announcement as a communicative function which asks residents for an understanding and cooperation by offering information. However, it is important to enrich public hearing as an information gathering function in which the administration also hears the opinion of the residents .

5. COST ESTIMATION AND IMPLEMENTATION SCHEDULE

5.1 Cost Estimation

5.1.1 Estimation of Project Capital Cost

The capital cost of the project is estimated based on the following conditions.

- Project capital cost consists of construction cost, administration cost, engineering cost, contingencies (physical and price escalation), land acquisition cost, other cost, relevant taxes and interest during construction.
- Project administration cost of Macedonia side is 2% of construction cost.
- Engineering cost is 10% of construction cost.
- Physical contingency is 10% of the total of construction cost, administration and engineering cost, since civil works account for the major part of the construction cost.
- Price contingency is 2.3% per year; 3.2% for local currency portion taking annual price increase index in Macedonia into account and 2.3% for foreign currency portion taking the index in EU countries into account.
- Customs rate is in the range between 3 and 15% for imported goods taking import tax rate applied in Macedonia into account. Tax ratio is 18% which is the same as VAT (value added tax) in Macedonia.
- The exchange rate of Japanese Yen to Euro is 163.11 based on the latest average rates in the period between May and August 2008. The exchange rate of Macedonian Denar to Euro is 62.03 based on the average value in the same period.
- Land acquisition cost is estimated for the area of 57 ha including the one for future extension.
- Other cost needed for additional construction works including river embankment, access road and the transfer of pylons are estimated.
- Interest during construction is estimated taking in to consideration of that the project is financed by loan.

- Project cost is estimated for each of LC (local currency portion) and FC (foreign currency portion).
- The exchange rate of Japanese Yen to Euro is 163.11 based on the latest average rates in the period between May and August 2008. The exchange rate of MKD to Euro is 62.03 based on the average value in the same period.

5.1.2 Estimation of Project Capital Cost (including Indirect Cost)

The total capital cost of the project is 116.6 million Euros (19.0 billion Yen) including customs and tax and 98.1 million Euros (16.0 billion Yen) excluding customs and tax, respectively. The estimated costs are summarized in Table II. 17. The direct construction cost occupies 48 % of the total capital cost whereas the indirect construction cost including the remaining costs is 52%. The local currency portion occupies 72% of total capital cost and the foreign currency portion occupies 28%. The construction cost of trunk sewer occupies 14% of the total construction cost and the construction cost of WWTP occupies 86%.

Table II. 17 Capital Cost of the Project

No.	Item	Local Currency (Euro)	Foreign Currency (Euro)	Total (Euro)
1.	Construction Cost			
A	Collection System			
A.1	Trunk Sewer	7,700,000	0	7,700,000
B	Treatment System			
B.1	Wastewater Treatment Facilities	15,182,000	14,605,000	29,787,000
B.2	Sludge Treatment Facilities	11,808,000	6,555,000	18,363,000
	Sub total (1)	**34,690,000**	**21,160,000**	**55,850,000**
2.	Administration Cost	1,441,000		1,441,000
3.	Engineering Cost	4,474,000	2,610,000	7,084,000
4.	Physical Contingency	3,469,000	2,116,000	5,585,000
5.	Price Contingency	8,699,000	3,716,000	11,836,000
6.	Land Acquisition & Compensation Cost	8,550,000	0	8,550,000
7.	Others (access road and others)	948,000	0	948,000
8.	Customs/Tax	18,447,000	0	18,447,000
9.	Interest during Construction	4,936,000	1,875,000	6,811,000
	Subtotal (2)	**49,771,000**	**10,931,000**	**60,702,000**
	Total (including customs/tax)	**84,461,000**	**32,091,000**	**116,552,000**
	Total (excluding customs/tax)	**66,014,000**	**32,091,000**	**98,105,000**

5.2 Operation and Maintenance Cost

5.2.1 Condition of Estimation of O&M Cost

The operation and maintenance cost is estimated based on the following conditions.

- Personnel cost is estimated for the staff members needed for the operation and maintenance of the facilities proposed in the B/P.
- Consumables include electricity, chemicals and so on.
- Maintenance cost includes spare parts of mechanical and electrical equipment.
- Sludge disposal cost is estimated supposing all the dried sludge is disposed of at the designated sludge disposal site.
- Sewer cleaning is done for the sewers proposed in the B/P.

5.2.2 Estimation of O&M Cost

The annual maintenance and operation cost, which is additionally required for the facilities constructed by the project, is 1.53 million Euros (0.25 billion Yen). The estimated costs are summarized in Table II. 18.

Table II. 18 Annual Operation and Maintenance Cost

Item	O&M Cost (Euro/year)
Personnel Cost	165,000
Consumables Cost	753,800
Sludge Disposal Cost	320,100
Maintenance Cost	285,600
Sewer Cleaning Cost	2,200
Total	**1,526,700**

5.3 Implementation Schedule and Disbursement Schedule of the Project

5.3.1 Implementation Schedule

The project is planned to start from loan arrangement in 2009, followed by selection of consultant in 2010, detailed design in 2011, tendering and evaluation for selecting the contractor in 2012. Land acquisition is required to be completed by 2010 since it is vital and basic condition for the detailed design. Additional construction works including river embankment, access road and the transfer of pylons are planned to be implemented in 2011 since it is necessary for these works to be completed before the commencement of the construction of WWTP. As a result, the implementation schedule has been prepared as shown in Figure II. 11.

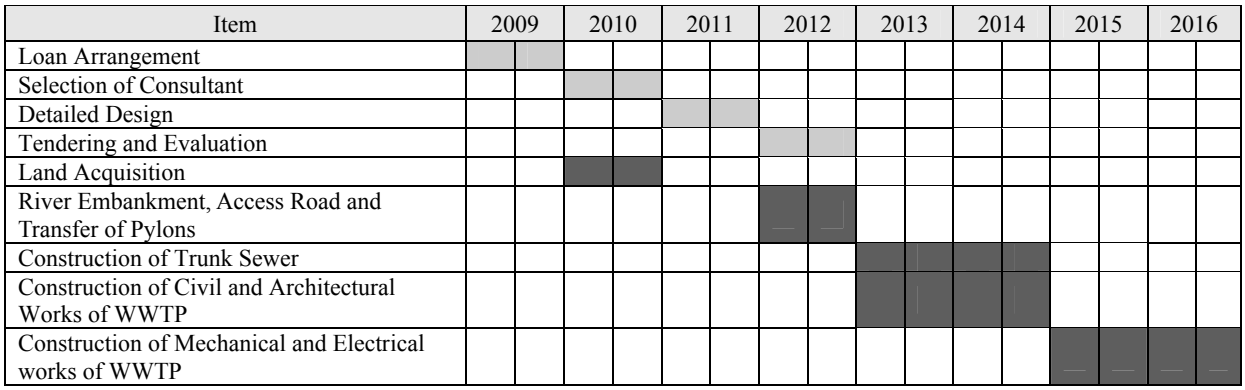


Figure II. 11 Implement Schedule

5.3.2 Disbursement Schedule

The disbursement schedule based on the above implementation schedule has been prepared as shown in Table II. 19.

Table II. 19 Disbursement Schedule

Item		2009	2010	2011	2012	2013	2014	2015	2016	Total
Direct Construction Cost	Local Currency (Million Euro)	0.0	0.0	0.0	0.0	15.7	15.7	1.7	1.7	34.7
	Foreign Currency (Million Euro)	0.0	0.0	0.0	0.0	0.0	0.0	10.6	10.6	21.2
	Total	0.0	0.0	0.0	0.0	15.7	15.7	12.2	12.2	55.9
Indirect Construction Cost	Local Currency (Million Euro)	0.0	11.8	1.7	3.0	12.7	13.6	3.4	3.6	49.8
	Foreign Currency (Million Euro)	0.0	0.0	0.7	0.7	0.3	0.4	4.3	4.6	10.9
	Total	0.0	11.8	2.3	3.7	13.0	13.9	7.7	8.2	60.7
Total	Local Currency (Million Euro)	0.0	11.8	1.7	3.0	28.4	29.3	5.1	5.2	84.5
	Foreign Currency (Million Euro)	0.0	0.0	0.7	0.7	0.3	0.4	14.9	15.2	32.1
	Total	0.0	11.8	2.3	3.7	28.7	29.6	19.9	20.4	116.6

6. ENVIRONMENTAL IMPACT ASSESSMENT (EIA)

6.1 Purpose and Level of Environmental and Social Considerations

The EIA study is conducted based on Macedonian Laws and Regulations as well as JICA's Guidelines for Environmental and Social Considerations. According to Macedonian Laws and Regulations, the

EIA study should be conducted in the F/S stage and all the necessary procedures are taken during the Study.

- Notification and Screening: submitted to MEPP from Skopje City on 30th June 2008,
- Opinion of scoping: the opinion is issued from MEPP to Skopje City on 14th October 2008,
- EIA study: conducted and EIA report was submitted to MEPP in 3rd November 2008.
- After receiving the EIA report, MEPP will organize the public hearing.

Prior to the public hearing, the third stakeholder meeting is organized to receive the public comments and opinions and reflect into the study.

6.2 Environmental Impact Assessment (EIA)

The implementation of the project will have the large positive impacts especially on water quality of the Vardar River and groundwater, on the other hand, some negative impacts are also expected. The impacts on society and environment expected to be caused by construction and operation of the proposed projects (WWTP and trunk sewers) are assessed in the EIA Study and the results are summarized below.

(1) Impacts during Construction Phase

The large and medium negative impacts during construction phase are expected on:

- Topography and geology: land slides and slips during construction due to the poor geo-mechanical features of the sites,
- Water quality of the Vardar River and groundwater: surface runoff by rainwater and soil erosion during excavation, leakages and spills of fuels and oils,
- Hydrology of the Vardar River: different river diversion structures and tail dams for the construction of siphon,
- Protected Area/Biodiversity/Flora and Fauna: due to increase of human approach, traffic movements, noise and vibration,
- Air quality/Noise and Vibration: due to the increased vehicles for transportation of the materials, operation of machineries and equipments in the construction sites,
- Involuntary resettlement/land acquisition/land use: due to the expropriation of land for WWTP and trunk sewers,
- Public infrastructure and services: due to the increased vehicle movements, re-direction of the traffic,
- Waste: due to the excavation and preparation of the sites.

(2) Impacts during Operational Phase

The large and medium negative impacts during operational phase are expected on:

- Water quality of the Vardar River and groundwater: due to the leakages of the system, infiltration of drying beds and temporary sludge storage leachete,
- Protected Area/Biodiversity/Flora and Fauna: due to the human approach and increased noise/vibration,
- Water: due to the generation of the large quantities of sludge,
- Offensive odour: due to the operation of the WWTP and sludge treatment.

In total, the identified negative impacts during construction and operational phase can be mitigated, minimized and prevented if the proposed mitigation measures are appropriately taken during the construction and operation. Also the monitoring plan proposed will confirm and ensure that the environmental impacts are minimized and the benefits are maximized through good practice.

6.3 Stakeholder Meeting

The stakeholder meetings for public consultation were held three times during B/P stage and F/S stage. The organizer was Skopje City in cooperation with MTC, MEPP and JICA Study Team. The third stakeholder meeting was held on 16th October 2008 by Skopje City at City Hall and around 50 persons

participated in the meeting.

6.4 Public Hearing

Public hearing which is required by laws and regulations on EIA in Macedonia was held on 23rd January 2009 by MEPP.

7. EVALUATION OF PRIORITY PROJECT

7.1 Financial Evaluation

7.1.1 Methodology of Financial Evaluation

Financial evaluation of a project is a process to find the profit (or deficit) to be obtained from an investment. For financial evaluation of a project, (1) income statements forecast and (2) cash flow statements forecast for the life of the project should be provided. The income statements forecast examine how much profit (or deficit) can be obtained from the operation. The cash flow statement forecast tests if the available sources of funds can meet funds required for initial investments, reinvestment for replacement of equipment and repayment of a loan (loans) borrowed for the Project.

7.1.2 Financial Costs and Benefits

Financial costs of the Project are categorized into two: (1) operating costs including all the expenses accruing in the operation of the Project; and (2) capital costs, which consist of initial investment capital, reinvestment capital for replacement of facilities during the life of the Project and funds required for repayment of a loan for the Project.

The net financial benefits are defined as the balance between the operating revenue and the operating expenses including depreciation. The government or city subsidies may be included in the income. On the capital cash side, retained earnings, and depreciation both from the operation and external borrowing are sources of fund. Future net operating profits are found using income statements forecast for the life of the Project, 30 years. Sources and uses of funds are forecast by cash flow statements. Income statements forecast and cash flow statements forecast were made with assumption that the Project is financed by a JICA loan for 80% of the Project cost and 20% by a government grant.

7.1.3 Affordability Assessment

Affordability of the water and sewerage rates are defined as the maximum amount of water and sewerage rates at which a family can pay for water and sewerage from its disposable income. A household, which has the average disposable income, is considered to be the objective household.

The social survey conducted under this study shows that the 25-percentile disposable income level was at 8,000 MKD/month and that of the 50-percentile income level was at 16,000 MKD/month in Skopje City.

The water and sewerage charges combined of the average income household is 514 MKD/month, i.e., 3.2 % of their disposable household income. The ratio is 2.9% for the low-income household. The maximum affordability to pay for water and sewerage is considered to be 4% of household disposable income. Based on this, the affordable water rate for the average income group is 640 MKD/m^3; and that for the low income group is 320 MKD/m^3.

7.1.4 Willingness-to-pay Assessment

According to a social survey conducted under the Study, the average willingness-to-pay in excess of their present payment for improved sewerage is estimated at 432 MKD per household. The willingness-to-pay of low income group (25-percentile) in excess of their present payment is estimated at 220 MKD per household. Accordingly the total willingness-to-pay is computed as follows:

Table II. 20 Average Willingness-to-pay in Excess of their Present Payment for Improved Sewerage Service

Household Category	Current Payment for Water (MKD)	Current Payment for Sewer Services (MKD)	Willingness-to-pay for Extra Payment for Improved Sewer Services (MKD)	Total (MKD)
Low Income	138	97	220	455
Average Income	302	212	432	946

It is noted that the total willingness-to-pay of both income groups is significantly high. The respective values for the average and low income groups are equal to 5.9% and 5.7%. Although the "willingness-to-pay" and "affordable-to-pay" do not normally equal to each other, this result shows considerably strong aspiration of residents for the improvement in their living environment.

7.1.5 Scenarios of Financial Evaluation

(1) Scenarios

Financial viability of the Project is tested based on the following scenarios with various combinations of fund sources, its lending conditions, magnitude of tariff increase and different rate of capital cost recovery in terms of depreciation.

Selected scenarios are tabulated as follows: (%)

Table II. 21 Scenarios of Financial Evaluation

Scenario	EIB	JICA	IPA	Government	Tariff hike	Depreciation
1	90	0	0	10	20	100
2	50	50	0	0	20	100
3	0	80	10	10	10	100
4*	0	80(0)	10	10	10	100

*Assuming that borrowing is made from JICA, but the Project is handed over to Vodovod on a grant basis.

Factor of money source[8]:

1. European Investment Bank (EIB): interest rate 4 %; repayment term 20 years; grace period 0 year
2. JICA fund: interest rate 0.75 %; repayment term 40 years; grace period 10 years
3. IPA fund: grant
4. Government: grant

(2) Financial Performance of the Project

The financial performance of the Project is computed based on financial benefits defined as the increment of revenue from the base year (without Project) and each year thereafter for the Project life. The same concept applies to expenses side, which includes not only the incremental operating expenses but also the initial and reinvestment (for replacement of mechanical and electrical equipment) capital outlays. Results are presented according to the above financing scenarios hereunder.

Table II. 22 Cash Flow Balance

Scenario	Cash Flow Balance	Financial Viability
1	Cash balance is always positive except for at the brief time of reinvestment with the terminal cash balance of 5,500 million MKD	Good
2	There will be no shortage in cash throughout Project life with a cash buildup of 6,100 million MKD	Good
3	There will be no shortage in cash throughout Project life with a cash buildup of8,500 million MKD	Good
4	There will be no shortage in cash throughout Project life with a cash buildup of12,600 million MKD	Good

*The method of financing affects the cash flow, but does not influence the operation.

[8] The terms of lending of the respective lending institutions are those which were prevailing at end 2007.

Assuming 20% tariff increase to be made at the time of Project commissioning around 2017, the Project will financially be viable on any Scenarios although cumulative cash balance is different from each other, namely, 5,500 million MKD on Scenario 1 to 12,600 million MKD on Scenario 4. The resulting FIRR will be unanimously 5.2% since the FIRR is not affected by the method of financing. The Project viability will be slightly negatively affected if the lending rate of the JICA loan is raised to certain extent, e.g., 0.95%, but the Project stands robust to such minor change. The replacement of the mechanical and electrical equipment can internally be financed, namely, without external borrowings. A financial analysis was also made for the Scenarios with a tariff increase by 15%. However, the Project does not seem feasible since the deficit on the operating side is too large.

The total present value (PV) of loan repayments will be 2,985 million MKD on 90% EIB financing; 2,146 million MKD on 50% EIB and 50% JICA financing; and 752 million MKD on 80% JICA financing at the discount rate of 10%. They are 3,442 million MKD, 2,600 million MKD and 1,043 million MKD respectively at the discount rate of 8%.

7.1.6 Recommended Scenario with the Proposed Water Supply and Sewerage Tariffs

The Project will be financially viable when it is financed with a JICA loan for 70 to 80% of the Project cost and grant assistance from IPA fund and/or the government for 20 to 30% of the cost, i.e., 10% from IPA fund and 20% from the government; or 10% from IPA fund and 10% from the government.

The Project seems to be unviable when it is financed with (1) an EIB loan for 90% of the Project cost and 10 % a grant from the government; or (2) an EIB loan for 50% of the Project cost, a JICA loan for 50% of the cost, even if the maximum tariff, i.e., 4% of disposable household income, is applied.

Given the above, recommended Project funding scenarios are as follows:
Recommended scenario 1: JICA loan 80% IPA fund 10% and government grant 10% with 20% tariff increase
Recommended scenario 2: JICA loan 70% IPA fund 10% and government grant 20% with 20% tariff increase

7.1.7 FIRR

The FIRR of the recommended Scenarios is 5.2%. Sensitivity analysis was conducted using different parameters. The results are summarized as follows:

Table II. 23 Sensitivity Analysis (FIRR)

Parameter	Change	FIRR	Sludge disposal method
Project Cost	+10%	4.2%	Drying beds
(ditto)	-10%	6.3%	(ditto)
Tariff Hike	20%+2.5%	6.1%	(ditto)
(ditto)	20% - 2.5%	4.2%	(ditto)
Sludge Dewatering	Mechanical	2.2%	Mechanical

7.2 Economic Evaluation

7.2.1 Methodology of Economic Evaluation

An economically viable project must also be financially sustainable. Economic analysis attempts to assess the overall impact of the Project on improving the economic welfare of the citizens of the country concerned. In other words, the Project is assessed in the context of the national economy, rather than for the Project participants, i.e., Vodovod's customers, or the Project entity, namely, Vodovod. Economic analysis measures the Project's positive and negative impacts not in terms of actual payments but in terms of willingness to pay for units of increased consumption, and to accept compensation for foregone units of consumption. Because

- The impacts by project which should be calculated as economic benefits is not marketable (e.g. conservation of biodiversity, principle of market mechanism is not working like water supply and sanitary projects)

- If it is marketable, there exist the pricing regulations by government or imperfect competition.

Shadow prices may be used in estimating the willingness to pay and willingness to accept compensation values in the face of these absences and market imperfection. Although Macedonia is broadly known for its apparent shadow economy, there has been no survey on the shadow rate.

Economic benefit can be calculated as the difference of social income between with and without condition.

7.2.2 EIRR

The EIRR is computed using the incremental benefits (=incremental revenue – incremental operating expenses), the consumer's benefit and initial investments and reinvestments The EIRR is thus computed at 6.2%. This figure is considered moderate, which may rise if implicit economic benefits such as more productive labor due to healthier living environment can be quantified although such quantification was not attempted because of lack of information. Sensitivity analysis was conducted using different parameters as follows:

(1) A rise or reduction in the Project cost by ±10%
(2) Change in tariff increase (base case: +20%): 20%±2.5%
(3) Change in the method of sludge disposal: From drying beds to mechanical dewatering

The results are summarized as follows:

Table II. 24 Sensitivity Analysis (EIRR)

Parameter	Change	EIRR
Project Cost	+10%	5.3%
(ditto)	-10%	7.3%
Tariff Hike	20%+2.5%	7.1%
(ditto)	20% - 2.5%	5.3%
Sludge Disposal Method	Drying beds to mechanical dewatering	3.2%

The EIRR will get significantly larger if such potential economic benefits as alleviation of diseases and damage to health to be reduced owing to the Project are quantified although their data and cost functions are currently unavailable.

7.3 Evaluation of Environmental and Social Considerations

The implementation of the project will have the large positive impacts especially on water quality of the Vardar River and groundwater, in the other hands; the negative impacts are also expected. The impacts on society and environment caused by construction and operation of the proposed projects (WWTP and trunk sewers) are assessed in the EIA Study and the results are summarized below.

The identified negative impacts during construction and operational phase can be mitigated, minimized and prevented if the proposed mitigation measures are appropriately taken during the construction and operation. Also the monitoring system proposed will confirm and ensure that the environmental impacts are minimized and the benefits are maximized through good practice.

7.4 Evaluation of Technical Feasibility

Vodovod has long history of laying large length of sewer pipes and constructing siphons. Therefore, Vodovod will have no difficulty in constructing the trunk sewers and siphon. On the other hand, the wastewater treatment plant is new to Vodovod. Recently, many wastewater treatment plants have been constructed in Macedonia. The Study Team had chances to observe the three wastewater treatment plants. For Ohrid and Struga cities with about 20 year operation, the staff members have managed to operate their plants against a relatively overloaded inflow. The Kumanovo wastewater treatment plant

inaugurated its plant in the early 2008. With a small number of staff, it seems to have operated sufficiently judging from the three times visits and its daily water quality data.

The two plants are of oxidation ditch process. It has long detention time and relatively free from flow and quality variation. The project recommends an activated sludge process which has short detention time, requiring more careful attention than an oxidation ditch process. However, the Vodovod can manage the plant operation if adequate training is provided. Vodovod has long technical history of more than 100 years and capable staff members of more than 1,000. During the study, some capacity development programs were conducted and short lectures were provided in Japan. This is a first step. In order to enhance the staff members' capability, the Study recommends more detailed training similar to Kumanovo case which provided 1 year training to its staff members.

As a sludge treatment, the study recommends sludge drying bed after confirmation of no odour impact in the surrounding area. This is thanks to relatively large area designated in the edge of the city by the GUP, resulting in large savings in cost.

As a whole, the technical feasibility is confirmed.

7.5 Project Effect Indicator

The Project is likely to be financed by loans either entirely or partially. Lending agencies usually need to assess the Project after its lending. The Project is not intending to increase service ratio, service population etc. but to improve the water quality of the Vardar River. Therefore, most appropriate project effect indicators are as follows:

Table II. 25 Project Effect Indicator

Proposed Indicator	Current Level	Target Level
・ Treated Wastewater Amount (m^3/day)	・ 0	・ 166,000
・ Treated Wastewater Quality against Designed Wastewater Quality (%)	・ -	・ BOD 25 mg/l
・ Water Quality at Taor of the Vardar River	・ BOD Exceeding 7 mg/l	・ BOD 7 mg/l

7.6 Overall Evaluation and Recommendations

The project is of great value towards improving water quality in the Vardar River even though some negative impacts as well as necessity of additional measures as follow will occur:

- ✓ Water and sewerage rate hike
- ✓ Impact on flora and fauna
- ✓ Impact on sludge generation
- ✓ Impact on odour generation
- ✓ Upgrade of technical skills for operation and maintenance of the treatment plant
- ✓ Control on industrial wastewater effluent

However, as mentioned in the Report, these issues can be solved/ mitigated with appropriate measures which are recommended in the study. They are public relations, mitigation measures, monitoring plans, capacity development and so on.

City of Skopje is a major actor of Macedonian economic and industrial activities with the population of around 520,000. Its activities are accompanied by a lot of domestic and industrial wastewaters. Some 80% of the central area of the city is sewered. At present, collected sewage, however, is mostly discharged to the river or channels untreated except for a small part of Saraj. The Vardar River, the largest river in Macedonia as well as an international river, passes through the city. The water qualities monitored at after Ohis and Trubarevo Bridge located in the downstream of the river sometimes do not comply with the standard, which is said to deteriorate environmental and public sanitary conditions at the downstream. Further development of the city will surely increase domestic

and industrial wastewaters in the future.

If the project is undertaken, the water qualities of the Vardar River as well as the living and water environment of the city will be remarkably improved.

Macedonia, on the other hand, has progressed the implementation of environment related laws and regulations in compliance with EU directives in order to be one of EU member countries. With the revision of Law on Waters, all the environmental related laws are now in conformity with the EU related laws. The next steps are provision of many by-laws and actual implementation of the measures like the sewerage projects. Industrial hazardous waste disposal site is also planned as one of the next steps. It is planned after the study (Donor is being requested), it will be completed by the year 2015. The Study Team emphasizes that it should be completed as scheduled. Otherwise, treated wastewater and treated sludge cannot be utilized. In that sense, IPPC system is also recommended to implement as scheduled: full implementation by the year 2014.

The project is estimated to complete in around 2015. So, with all measures, wastewater will be treated safely and treated by-products would be utilized.

However, when a wastewater treatment plant is constructed, attention should be paid to the following industrial wastewater issues because of its large effect on the water quality in the Vardar River:

- IPPC system implementation
- Hazardous waste disposal plant construction
- Pre-treatment industrial effluent standard discharging to the sewerage system
- Monitoring and correcting authorities to Vodovod

PART III ACTION PLAN ON INSTITUTION AND FINANCIAL CAPACITY

1. INTRODUCTION

The institutional and financial capacity of Vodovod was studied and assessed in Phase 1 of the Study. Based on the study, the goals for capacity development (CD) of the respective areas are presented hereunder. The Action Plan (A/P) will provide the methods for undertaking CD activities in order to fill the gap between the goal and the present status.

1.1 The Goal for Institution and Financial Capacity

The Goal for institution and financial capacity is 1) to develop institutional system with which the proposed wastewater treatment plant is operated and maintained and 2) to establish a financial mechanism (including tariff increase) with which an increased operation and maintenance costs are covered.

1.2 Basic Policy for Formulation of Action Plan

(1) Firstly, the capacity and requirement of the implementing agency is assessed.
(2) Based on the result of assessment, A/P is formulated with strategic goal to achieve vision and mission of the implementing agency.
(3) Out of the various activities formulated in A/P, some plans are selected as CD programs to be implemented (or upon discussion) jointly with C/P (Vodovod) considering timeframe of the Study, their effectiveness, and urgencies, etc.

1.3 Necessary Action Plan

Table III. 1 shows summary of capacity assessments.

Table III. 1 Summary of Capacity Assessment

No.	Items to be Evaluated	Capacity Assessment	Purpose
1	Staff recruitment and training	♦ No experience in operation and maintenance of wastewater treatment plant.	♦ The Vodovod's present staff size is considerably large. After the completion of the Project Vodovod should manage the utility which will augment in terms of not only quantity but also quality while keeping the operating and personnel costs at the minimum. Vodovod needs to set goals for setting its staff sizes in each trade with classification for level of competence. Therefore, Vodovod is required to recruit competent personnel, relocate staff with specific expertise or redundant personnel to a new division and train them to fit to the forthcoming new technologies related to the Project and adjust to the renovated operating environment.
2	Improvement in the O&M system	♦ The tap water is safe and customers are satisfied with the available water quantity and quality. ♦ Most facilities, especially water mains, service pipes, sewers and pumping stations, are old and defective, and in urgent need of repair or replacement.	♦ A water supply and sewerage utility has to have refined O&M manuals for each division of Sectors. For example, an O&M manual for the sewer maintenance division of Sector Sewerage may be consisted of the following: ♦ Upkeep of sewer database: Drawings (plan, section and profile) of sewers are to be regularly updated. The sewer drawings shall contain location, elevation, size (diameter, etc.), section length, material, etc. and location, depth and size of manholes. A separate book may be needed to record the history of sewer repair. ♦ Upkeep of pumping station database: Drawings (location, plan and section) of pumping stations are to be regularly updated. The drawings shall contain specification of pumps and motors. A separate book may be needed to record the history of pump repair and replacement.

No.	Items to be Evaluated	Capacity Assessment	Purpose
			♦ Instructions on how to maintain sewers: (a) method of sewer and service connection inspection; (b) method of sewer and service connection repair; and (c) method of sewer cleaning. ♦ Instructions on how to maintain pumps, motors and switchgears: (a) inspection method of pumps, motors and switchgears; (b) repair method for repairing pumps, motors and switchgears, (c) instruction on how to deal with unexpected power failure and other disasters; (d) instruction on how much and how to stockpile spare parts and materials required for pumping station maintenance.
3	Financial management	♦ The balance have turned surplus in 2007 owing to a large (98%) rate hike of 2007. ♦ The recovery rate (rate of actually paid amount to the total of billed water charges) of water charges has been improving, but still remains low at 80%. ♦ Assets used for water supply and sewerage have not regularly been evaluated for their working condition, economic lives and reevaluated values.	♦ The collection rate of water and sewer services charges should be improved to at least 90%. ♦ Long-term projections should be made for personnel expenses, energy cost, repair cost, maintenance cost, overhead, depreciation and capital costs so that they form a firm base for the rate policy.
4	Organizational structure	♦ Vodovod has all the divisions (Sectors) and sections required to perform day-to-day operations. The scope of works and lines of order of the Sectors are rather complicated even though there appears to be no significant duplications.	♦ The terms of reference of each Sector and its divisions should be clearly redefined ♦ If possible, mutually related activities should be organized into one Sector ♦ There may be a need to reform the organizational structure. Efforts must be made to acquire as many competent personnel as needed while consideration must be given in future to a reduction in staff size if there are any areas which have redundant staffing.
5	Rate policy	♦ Although the self-reliant rule has been practiced for the operation of water supply and sewerage utilities, Vodovod has no right to set the water and sewer service rates, which are decided by the City Council of Skopje ♦ Although the self-reliant rule has been practiced for the operation of water supply and sewerage utilities, Vodovod has no right to set the water and sewer service rates, which are decided by the City council of Skopje.	♦ The need for revision of the rate should regularly be checked since the Vodovod's financial environment changes year by year including various cost components, e.g., energy cost, salaries and wages, cost for renovation of the IT system and so forth. ♦ Consumer's support or understanding is essential in the course of setting the new rate. In between Vodovod's proposal of a new rate and its deliberation in the City council, Vodovod can appeal to the public for the need of the new rate through consumer dialogues including the establishment of a rate council and public hearing.
6	Reduction in non-revenue water (NRW)	♦ Physical water loss probably amounts to one half of the production.	♦ It is absolutely needed to identify where from and how much water losses are occurring. ♦ Vodovod needs to review whether or not the following conditions have been achieve so as to control the water losses at a satisfactory level; ♦ Updating of the record (DB) (property[material, diameter, location, length etc.], drawings etc. of water mains are regularly done; ♦ Improvement in customer cadastre (DB) has been undertaken; ♦ Sufficient number of staff members are exclusively in charge of leak detection; ♦ Transfer of leakage detection technology has been made; ♦ Illegal connections have been detected; ♦ Accuracy of water meters is checked regularly, and defective meters are replaced; ♦ Appropriate budgeting is made for replacement of superannuated water mains.

2. FORMATION OF ACTION PLAN

As to the setting of Strategic Goals and the themes of the A/P, discussions between the C/P (Vodovod's Deputy General Director and his staff, in group or independently) and the Study team were held more than 15 times during the Phase 1 period (October - November 2007 and February 2008) and Phase 2 period (May-June 2008). It was agreed that CD activities should be conducted in the following six areas, that CD activities in particular three areas (See below) be carried out by means of a workshop or a seminar to be conducted by the Study team, and that CD activities for the remaining three areas should be undertaken by the chiefs of Sectors related to the areas at appropriate timing in future.

(1) Human resources development and management
(2) Improvement in the O&M system
(3) Improvement in Financial Operation
(4) Renovation of organizational (operating) system
(5) Improvement in rate policy and process of rate setting
(6) Reduction in non-revenue water (NRW)

Table III.2 shows action plans, activities, main object of the activities, time schedule and CD Program during Study Period (June - October 2008). Table III.2 shows Implementation Schedule of A/P and Activities for Industrial Wastewater Management.

Table III. 2 A/P, Activities, Main Objects of the Activities and Time Schedule

Item of A/P	Activities Required	Main Objects of Activities	Time Schedule (year)
1. Human Resources Development and management	(1) Identification of Vodovod's good corporate cultures. How to enforce such cultures. (See Reference-1: CD related to Human resources management in Volume: Attachment for more details.) (2) A study on human resources requirements during and after completion of the Project (3) Provision of a plan on recruitment and repositioning of personnel and training thereof as required to undertake activities which will increase quantitatively as well as qualitatively during Project implementation and after completion. (4) Optimization of the staffing in each Division in terms of not only staff size but also qualification of staff. Examination of the possibility of reducing staff size or repositioning of staff if there is any overstaffing. (5) A review of the present system of human resources development (training) and proposal of any possible improvement. (6) Evaluation of the present system of staff performance evaluation as a proper base for promotion and repositioning. Proposal of a proper staff performance evaluation and reward system to retain competent staff and give incentives to them to stay with Vodovod.	Deputy General Director; Assist. Gen. Dir. for Legal & Economic Affairs; Assist. Gen. Dir. for Technical Affairs; all Directors; Manager, Personnel Div.; staff in charge of training	2010
2. Improvement in the O&M system	(1) A review of technical terms of reference of Sectors and their sections related to the O&M of facilities; Examination of the TORs if they are suitable for activities to be performed in the new corporate environment. (2) Examination if there are any areas for improvement in O&M including a review of O&M manuals. (3) Review of the logistics system and proposal of a possible change (purchase, storage, deployment and disposal etc. in the most effective timing). (4) A study on preventive maintenance and planned facility replacement.	Assist. Gen. Dir. for Technical Affairs; Dir., Sector Exploitation, Maintenance of Facilities and his selected staff; Directors of all other Sectors except for Sector A/C, Finance & Commerce and Sector Legal, Personnel & General Affairs	2010

Item of A/P	Activities Required	Main Objects of Activities	Time Schedule (year)
3. Improvement in Financial Operation	(1) Examination of possible measures to raise water and sewer service charge collection rate (improvement in the efficiency of billing and collection of water charges); (2) (Operation side) Preparation of a long-term budget plan with estimates of revenues and expenditures including ones for the period after the completion of the Project. Measures for reduction in operating cost shall be practiced (e.g., pump delivery pressure control to avoid unnecessary high pressure during low demand time zones). (3) (Capital side) Preparation of a long-term investment plan with cost estimates of major replacement of facilities and those of the Project. (4) Revaluation of assets in terms of economic lives and actual capacities of facilities and equipment (5) Trial calculation of depreciation based on economic lives of assets. (6) Proposal of budgeting for proactive repair and replacement of facilities.	Director, Sector Accounting (A/C), Financing & Com. Sector; all Managers of the Sector; and incumbent staff of accounting and finance	2010
4. Renovation of the operating system	(1) Documentation of terms of reference of Sectors and their Divisions from administrative point of view. (Refer to 1.2 above for TORs to be provided in future.) (2) Redefinition of such terms of reference if there are any areas which are redundant or insufficient, especially when considering the need for new activities or higher grade of handling methods. (3) Examination of what organizational reform is needed to deal with the additional administrative requirements during and after completion of the Project.	General Director; Deputy General Director; Director, Sector Legal, Personnel & General Affairs, all Managers of the Sector; Directors of all other Sectors	2010
5. Improvement in rate policy and process of rate setting	(1) Proposal of a system of public participation, including public hearing and a rate council on the water and sewer service rate. - The concept of selecting stakeholders who participate in the hearing. - The process and materials of implementing such a hearing. - Main theme and method of presentation. (2) Proposal of measures to raise "willingness-to-pay". - Examination of measures for public relations to be taken by Vodovod: (i) newspaper ad, (ii) TV commercial, (iii) posters, etc. - Contents of such message: the purpose, cost and benefits for them of a new project so as to understand about the need for the project and have better motivation to pay their bills.	Deputy General Director; Assist. Gen. Dir. for Legal & Economic Affairs; Assist. Gen. Dir. for Technical Affairs; Dir., Sector A/C, Financing & Commerce; and staff of Commerce Division	2012
6. Reduction in non-revenue water (NRW)	(1) Proposal of the management of water mains DB (property [material, diameter, location, length etc.], drawings etc.) (2) Examination of the customer register (DB) including property of the services (connections); A proposal on how to improve it. (3) Proposal of alternative methods of transfer of leakage detection technology. (4) Review of the set-up for leak detection operation (including the number of personnel and equipment), and their future needs. (5) Establishment of a proactive budget plan for replacement of old water mains.	Assist. Gen. Dir. for Technical Affairs; Dir., Sector Exploitation, Maintenance of Facilities; Dir., Sector Water Supply and his staff; and Dir., Emergency & Information Center and his staff	Long Term

Table III. 3 Implementation Schedule of CD

No.	Area of CD	Schedule
1.	Human resources management	Over the period of 2009-2010, partly conducted during Study Period (June 2008)
2.	Improvement in the O&M system	Over the period of 2009-2010, partly conducted during Study Period (September 2008)
3.	Improvement in Financial Operation	Over the period of 2009-2010, partly conducted during Study Period (September 2008)
4.	Renovation of the operating system	Over the period of 2009-2010
5.	Improvement in rate policy and process of rate setting	Over the period of 2011-2012
6.	Reduction in non-revenue water (NRW)	All through the present time and future

3. ACTIVITIES RELATED TO CAPACITY DEVELOPMENT

During the study, the following activities related to capacity development were implemented.

3.1 Seminar on CD for Human Resources Management

A seminar entitled "Capacity Development related to Human Resources Management" as one of the CD activities was conducted. Contents of the Seminar are as follows:

Table III. 4 CD Activities (1)

Item	Activities of Seminar
SWOT	・ The existing culture of Vodovod was evaluated prior to the evaluation of the existing organization structure and human resource development. ・ Vodovod possesses good corporate culture such as (1) It has historically realized water service with stable service with enough quantity and quality, which leads to consumers' confidence to Vodovod; (2) Salaries of the staff is good, and their loyalty to their employer is strong etc.. ・ Vodovod possess bad corporate cultures such as (1) Extensive water losses have poorly been attended; (2) No wastewater treatment is undertaken resulting in the pollution of the river; (3) TORs for Sectors and their division are not firmly established etc.
Principles of Human Resources Management	It was explained that the following principles shall be carried out so as to cultivate good cooperate culture and reduce the bad ones; (1) Recognition of the existing corporate cultures; (2) Evaluation of the existing organizational structure; (3) Understanding of important means for human resources development and management; (4) Method of performance evaluation; (5) Review of the salary structure; (6) Recommendation for structural renovation.
Items of discussion at the seminar	・ The above six topic were discussed among seminar attendants.
Conclusions and recommendations	・ Vodovod shall undertake organizational renovation and human resources management while aiming at proliferating the existing good corporate cultures, and at the same time reducing the bad cultures. ・ Simplification of operation, which is highly complex at present as seen above, is desirable when Vodovod undertakes the renovation of its organizational system. ・ Leaving from the egalitarianism, Vodovod shall consider practicing performance evaluation of the Sectors and their divisions as well as individual staff in future.

3.2 Seminar on Improvement in the O&M system

A seminar on "Improvement in the Operation and Maintenance (O&M) system" as one of CD activities was carried out. Contents of the Seminar are as follows:

Table III. 5 CD Activities (2)

Item	Activities of Seminar
Principle of Organization for Operation and Maintenance (O&M)	・ The principle of organization for O&M of pumping facilities and the wastewater treatment plant (WWTP) was presented. Required classification of activities, positioning of staff, commission of jobs, and measures against emergency cases were explained. ・ It was pointed out that the total staff size was 1,120, which seemed to be significantly large compared with other examples in market-oriented economies.
Proposed organization for O&M of WWTP	・ It was recommended that a new Sector is created for O&M of the WWTP, which is to be placed directly under Technical Director. ・ Three alternative organizational structures of Vodovod which include Sector (Division) Sewerage were proposed and discussed in seminar.
Experience in other countries on organization for sewerage works	・ Organizational charts for sewerage works in Beograd and Yokosuka City were introduced for reference to seminar attendants.

3.3 Seminar on Improvement in Financial Operation

A seminar entitled "Improvement in Financial Operation under the Project" as one of CD activities was conducted. Contents of the Seminar are as follows:

Table III. 6 CD Activities (3)

Item	Activities of Seminar
Background	・ Then the scope and cost of the Project was explained. It was stressed that The Project, which will provide a wastewater treatment plant (WWTP) and main collectors (sewers), will form a very large component of the Vodovod's sewerage system. ・ It was pointed out that the Project cost will be 80% of the existing total fixed assets of Vodovod.
Current Financial Position of Vodovod	・ The present financial position of Vodovod was explained using the income statement and the balance sheet prior to the examination of the Project. ・ The financial position was also examined with other useful financial indicators, such as operating ratio, revenue water ratio, comparing '06 & '07 experience with Nagoya and Akita cities.
Improvement in Financial Operation	・ It was pointed out that there would be two ways for improving financial operation, namely, (a) an increase in revenue and (b) a decrease in outlays. ・ The ways of (a) are increase in the number of customers, increase in unit consumption per customer, reduction in uncollectible water bills and hike in water and sewer service rate. ・ The ways of (2) are reduction in energy cost, rational procurement, outsourcing of security service, reduction in personnel costs and partial or entire omission of depreciation.
Project Financing	・ It was explained that there would possibly be various combinations financing sources for the Project.
Financial Evaluation	・ Four scenarios financing the Project were evaluated by comparing calculated cash flow and present value of the loan repayment.
Recommended Scenario and sewerage tariffs	・ It was pointed out that the Project would have the biggest financial benefits when it was financed with a JICA loan for 80% of the Project cost and grant assistance from IPA fund and/or the government for 20% of the cost. ・ 20% of tariff increase is recommended.

PART IV ACTION PLAN FOR INDUSTRIAL WASTEWATER MANAGEMENT AND WATER QUALITY MONITORING

1. INTRODUCTION

Considering the current water quality and the estimated water quality of the Vardar River in the target year 2020, presented in the B/P, it is realized that it would be indispensable to consider industrial wastewater management/treatment along with municipal wastewater treatment in order to improve water quality of the Vardar River. In this part of the Report, Action Plan (A/P) for industrial wastewater management and water quality monitoring system is described.

1.1 The Goal for Industrial Wastewater Management

The Goal for Industrial Wastewater Management is to implement IPPC system properly and effectively.

1.2 Basic Policy for Formulation of Action Plan

(1) Firstly, the capacity and requirement of the implementing agency is assessed. Based on the result of assessment, A/P is formulated with strategic goal to achieve vision and mission of the implementing agency.
(2) Out of the various activities formulated in A/P, some plans are selected as CD programs to be implemented (or upon discussion) jointly with C/P (MEPP and City of Skopje) considering timeframe of the Study, their effectiveness, and urgencies, etc.
(3) Development of A/P with due consideration of already implemented by other donor agencies and future plan prepared by Macedonian side.

1.3 Necessary Action Plan

Table IV. 1 shows summary of capacity assessments of administrative office and enterprises regarding industrial wastewater management.

Table IV. 1 Summary of Capacity Assessment

No.	Items to be evaluated	Capacity Assessment	Purpose
Capacity Assessment of Administrative Office			
1	Establishment of Legislative System	♦ New Water Law was modified in August, 2008. Its implementation is scheduled in 2010. ♦ Under preparation of sub-laws and regulations such as discharge criteria to sewer and public water bodies, construction of industrial waste disposal site, etc.	♦ Regulations as the backgrounds for implementation of industrial wastewater management ♦ Regulations to implement and monitor IEP system.
2	Improvement/Establishment of Data Reliability	♦ No standard analysis methods for sewerage, industrial wastewater and identification of wastes exist ♦ Insufficient in analysis manuals or missing to train staff ♦ No accredited laboratory for industrial wastewater analysis ♦ Insufficient in exhausted gas. No wastewater treatment	♦ Reliable monitoring
3	Capacity Development of Environmental Inspector	♦ The number of inspectors is extremely low to monitor all categorized installations ♦ Lacking practical experiences and knowledge to supervise IEP	♦ Monitoring of IEP system

No.	Items to be evaluated	Capacity Assessment	Purpose
4	Grasping Accurate Industrial Wastewater Generation and Quality	♦ Data is very limited under self-monitoring system ♦ No existing of monitoring plan for each installation by MEPP Central laboratory	♦ To secure the plan of industrial wastewater management
5	Classification and Decision on Industrial Wastewater Discharged to Sewers	♦ Data is very limited under self-monitoring system	♦ To secure the plan of industrial wastewater management
6	Study on Collective or Individual Treatment	♦ Data is very limited to study.	♦ To secure the plan of industrial wastewater management
7	Preparation of Industrial Wastewater Treatment Guidelines	♦ No guideline exists.	♦ To plan and design of industrial wastewater treatment plant
8	Establishment of Financial Assistance System	♦ There are some ideas but neither concrete plan nor financial assistance system for industrial wastewater treatment facility.	♦ To promote IPPC system
9	Construction of Hazardous Industrial Waste Disposal Landfill	♦ No industrial waste landfill established yet	♦ To promote IPPC system
10	Consideration of Certified Pollution Controller System	♦ No official certification system exists.	♦ To secure the industrial wastewater management and IPPC system
11	Utilization of Local Consultants, Institutions and Associations	♦ Personnel resources who involves in many EU projects are not used due to insufficient information exchange. ♦ As a result, wide knowledge of environment is insufficient.	♦ Utilization of local consultants, etc. to promote IPPC system
12	Preparation of Concrete Materials for Public Relation	♦ Concrete materials and amount of information are insufficient to enlighten and educate people and enterprises.	♦ To enlighten and educate people and enterprise
Capacity Assessment of Enterprises			
13	Establishment of Pollution Control Management System	♦ Among 50 surveyed industries, only 20 % installations arrange pollution controller. ♦ Of twenty one (21) factories that have ISO 9000 or 14000, more than half of them do not have arrangement of pollution controller.	♦ To strengthening environmental management
14	Establishment of Pollution Controller Association to Exchange Information	♦ National CP center says that some enterprises participate in CP activities and exchange information through seminars and visiting installations of each other	♦ To Exchange Information
15	Measures to Grasp Quality and Quantity of Industrial Wastewater	♦ There is no enterprise having equipment to measure industrial wastewater generation ♦ Most of the industrial units discharge their industrial wastewater directly into sewer and, that seems to make it more difficult to grasp quality and quantity of each industrial wastewater.	♦ To plan industrial wastewater treatment
16	Positive Cooperation with Environmental Inspector	♦ Information are not yet sufficient to know their exact activity and situation.	♦ To promote IPPC system
17	Construction of Industrial Wastewater Treatment Plant	♦ Of the fifty (50) surveyed industries, only nine (9) industries have their own treatment plants including simple oil separator.	♦ To preserve water quality of the Vardar River
18	Reporting on the Environmental Management Activities	♦ There seems no enterprise practicing this.	♦ To raise reputation of environmental activity in order to stipulate investment

2. FORMULATION OF ACTION PLAN

Table IV.2 shows action plans, activities, main object of the activities, time schedule and CD Program during Study Period (June - October 2008). Action plan is divided into two, one is by administrative office and the other is by enterprises. Figure IV.1 shows Implementation Schedule of A/P and Activities for Industrial Wastewater Management.

Table IV. 2 A/P, Activities, Main Object of the Activities, Time Schedule and CD Program during Study Period (June - October 2008)

Item of A/P	Activities Required	Main Objects of Activities	Time Schedule (year)	CD Program during Study Period (June-October 2008))
By Administrative Office				
1. Enactment and enforcement of laws and regulations related to industrial wastewater and industrial waste management	(1) Preparation of discharge standards to water body or public sewerage system (2) Preparation of analysis procedure of waste identification (3) Preparation of technical guidelines on industrial wastewater treatment or disposal of sludge	MEPP, EU consultants	2012	Concept is described in 1.4.1. Explained the cases in Japan by the seminar "Environmental Law System in Japan"
2. Establishment of Data Reliability	(4) Preparation of a draft of analysis standard for industrial wastewater and waste identification procedure (5) Preparation and modification of manuals with training at laboratory (6) Installation of Pollution Control Facilities (7) To obtain ISO17025	MEPP central laboratory	2011	Concept is described in 1.4.2. Explained the concept by the seminar "Certified Environmental Analyst System in Japan"
3. Capacity Development of Inspectors	(8) Preparation of training manuals to monitor IEP 1) Cleaner production and some concrete studies 2) Prevention of ground water and soil pollution 3) Noise and vibration management 4) Meaning of hazardous substances regulation 5) Industrial wastewater and air pollution control - Principle of treatment for each regulated parameter, - Design concepts of treatment facilities of industrial wastewater and polluted soot, - Industrial waste treatment and disposal, reuse, recycle, - Operation and maintenance of the above facilities - Outline of analysis for each parameter - Emergency measures by industry for environmental accident (2) Establishment of database on State Environment Inspector, (3) Modification of inspection sheet (4) Others as required	State and local inspectors	2011	Concept is described in 1.4.3. Explained the concepts of (1) 2), 4), 5), 6) by the seminars "Environmental Law System in Japan", "Industrial Wastewater Treatment" and "An Experience of Toxic Industrial Waste Treatment"

Item of A/P	Activities Required	Main Objects of Activities	Time Schedule (year)	CD Program during Study Period (June-October 2008))
4. Grasping accurate industrial wastewater generation and quality: Strengthening of monitoring	(1) Preparation of inspection and monitoring schedule of each installation with the parameters and frequency with the cooperation of inspector and MEPP central laboratory (2) Study of necessary equipment for inspection (3) Securing budget for the activity (4) Data compiling and database management	State and local inspectors, MEPP central laboratory	2014	Concept is described in 1.4.4.
5. Classification and decision on industrial wastewater discharged to sewers	(1) Study on; - The discharge quantity, rate - The ratio of N (nitrogen) and P (phosphorus) to BOD - Discharge standard to sewer or water body - IEP of each installation - Enterprise's willingness to pay for sewerage service - Sewerage plan: discharge pipe rearrangement is necessary? - Enterprise's will of own treatment plant construction plan - Industrial wastewater management capacity of enterprise: O/M and monitoring	MEPP, Vodovod, City of Skopje, Enterprise	2013	Concept is described in 1.4.5.
6. Study on collective or individual treatment	Comparison of advantage and disadvantage of both concepts	MEPP, City of Skopje, Enterprise	2014	Concept is described in 1.4.6.
7. Preparation of Wastewater Treatment Guideline	(2) Study on discharge quality of each parameters and quantity in each industrial category (3) Preparation of industrial wastewater treatment guideline - Unit process, the limit of unit process - Design and O/M of the treatment process - Sludge treatment and disposal - Reuse or recycle of treated industrial effluent and sludge - Experiment procedure for design and O/M of the treatment process - Use of industrial waste: (3) Study on reuse of waste acid with rich metal, not to include a lot of chelating agents	State and local inspectors, enterprise	2010	Concept is described in 1.4.7. (1) Refer to Appendix 3.8, Part I (B/P) (2) Explained the concept by the seminar "Industrial Wastewater Treatment" (3) Explained the concept by the seminar "An Experience of Toxic Industrial Waste Treatment"

Item of A/P	Activities Required	Main Objects of Activities	Time Schedule (year)	CD Program during Study Period (June-October 2008))
8. Establishment of Financial Assistance System	The study on incentive both for enterprises and investors and implementation	MEPP, City of Skopje, Government	2012	Concept is described in 1.4.8 Introduced the examples in Japan by the seminar "Environmental Law System in Japan"
9. Construction of Hazardous Industrial Waste Disposal Landfill	(1) Study on the landfill structure, in particular, shield type of landfill (2) Construction of hazardous industrial waste disposal landfill	MEPP, City of Skopje, Government	2015	Concept is described in 1.4.9 Explained the concept by the seminar "Environmental Law System in Japan"
10. Consideration of Certified Pollution Controller System	Study on pollution controller system and the role in environmental management in Japan	MEPP, Government	2010	Concept is described in 1.4.10 Explained the concept by the seminar "Environmental Law System in Japan"
11. Utilization of Local Consultants, Institutions and Associations	Organize the regular workshops for information exchange to understand comprehensive understanding about environmental issues.	MEPP, Local consultants, Institute, Associations, University, Donors	2014	Concept is described in 1.4.11
12. Preparation of Concrete Materials for Public Relation	The following materials and information should at least be collected. (1) Model studies of implementation of CP, BREFs (BAT reference) with specifications of the facilities, cost estimation, investment recovery period, etc., (2) What are prohibited to discharge to sewer, why are they prohibited, (3) Information of financial assistance system to invest on CP facilities (4) How to save and use water efficiently in households and factories/enterprises (5) Environmental damages or risks to human life; why are the hazardous substances risky to human life or environment (6) How to decide the limit value of harmful substances in drinking water (7) Introduction of research and studies related to environmental matters by Macedonian institutes/universities including the report of new technology of BAT, CP, industrial wastewater treatment,	MEPP Public Relation Department, donors' agencies, local consultants, institutions, universities, enterprise	2014	Concept is described in 1.4.12 Introduced the cases in Japan about (2), (3), (4), (5), (6), (10) by the seminar "Environmental Law System in Japan" and "Industrial Wastewater Treatment"

Item of A/P	Activities Required	Main Objects of Activities	Time Schedule (year)	CD Program during Study Period (June-October 2008))
	(8) List of institutions and consultants related to EU projects and their activities (9) List of projects by donors or international organizations and activities (10) Introduction of the enterprises/factories' environmental management			
By Enterprise				
13. Establishment of pollution control management system	(1) Arrange full-time pollution controller, (2) Make a plan to reduce pollutants and energy consumption by preparing material balance (3) Review raw materials and manufacturing process.	Enterprise	2010	Concept is described in 1.4.13 Introduced the cases in Japan about (2), (3), (4), (5), (6), (10) by the seminar "Environmental Law System in Japan" and "Industrial Wastewater Treatment"
14. Establishment of pollution controller association to exchange information	Exchange information on environmental management	Enterprise	2010	Concept is described in 1.4.14
15. Measures to grasp quality and quantity of industrial wastewater	(1) Installation of a pit to take samples for quality analysis, and a weir to measure wastewater generation, etc. (2) Installation of continuous flow meter and auto-water quality analyzer will be necessary in case of large factories (3) Pipe separations by process wastewater and cooling water to discharge to sewer or water body directly	Enterprise	2012	Concept is described in 1.4.15 Explained the concept by the seminar "Industrial Wastewater Treatment"
16. Positive cooperation with environmental inspector	Positively provide accurate information to inspectors as much as possible	Enterprise, Inspector	2014	Concept is described in 1.4.16
17. Construction of Industrial Wastewater Treatment Plant	New construction of pre-treatment or full-treatment or remodeling the existing industrial wastewater treatment facility	Enterprise	2014	Concept is described in 1.4.17
18. Reporting on the Environmental Management Activities	Regularly reporting on the environmental management activities	Enterprise, MEPP Public Relations	2014	Introduced some examples in Japan by the seminar "Environmental Law System in Japan"

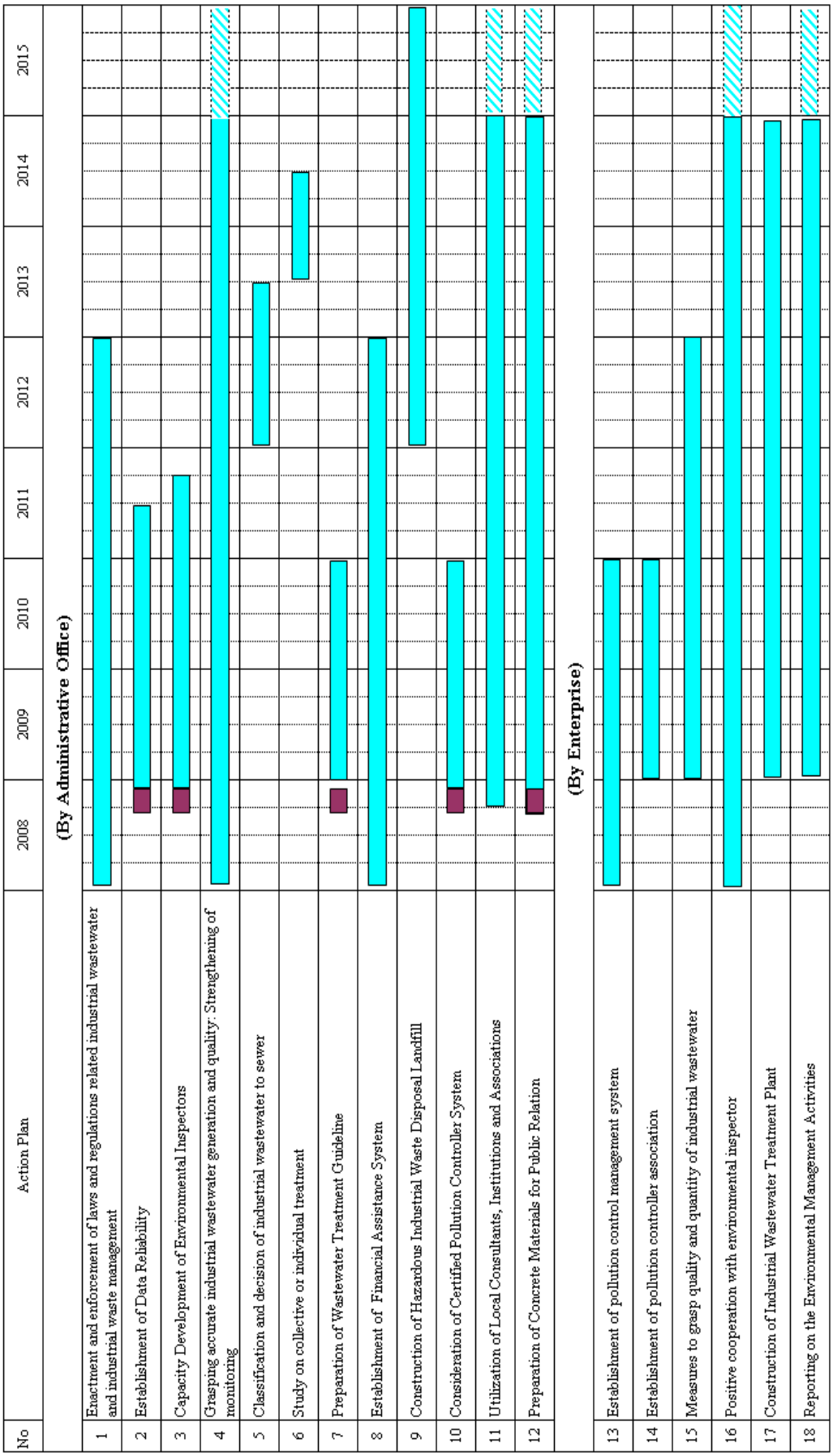


Figure IV. 1 Implementation Schedule of A/P and Activities for Industrial Wastewater Management

3. ACTIVITIES RELATED TO CAPACITY DEVELOPMENT

During the study, the following activities related to capacity development were implemented.

3.1 Seminars

The following seminars with wide contents of industrial wastewater management were implemented.

(1) Approach to Environmental Problems : An Experience of Treatment of Liquid Toxic Waste
This seminar was the project the member in charge of industrial wastewater management and water quality monitoring actually implemented almost 25 years age for three years and half in an industrial waste treatment company in Japan. The seminar introduced the procedures of development of treatment of the wastes with lots of hazardous substances and lots of chelating agents and big fluctuation in concentrations and amount of the wastes and construction of the treatment plant. This project was finally evaluated as a failure, but is a good example to consider how to solve the environmental problems.

The seminar includes;
- Intermediate and final evaluation from wide viewpoints and the matters of treatment processes, analysis, O/M, sludge return to mining company, quality control, education, etc.
- Introduction of a project where water quality was estimated with a simple microscope in order to raise the interest in natural environment

(2) Environmental Law System in Japan
The seminar introduced issues which will become a reference for enactment and implementation of concrete laws and regulations in environmental management in Macedonia, with the introduction of the cases in Japan.

The seminar includes;
- Background of enactment of pollution control law- Introduction of Minamata and Itai itai diseases, food chain, compensations for the both diseases
- Environmental law system- Seven (7) pollution control laws, EIA system, Pollution control manager system, Financial assistance system, Sewerage law, Waste Disposal and Public Cleansing Law, etc., The rolls of Ministry of Environment and other Ministries and local governments including water quality monitoring
- Financial assistance and tax reduction for pollution control
- Water Pollution Control Law- Specified facilities, unified discharge criteria, pollution control manager system, the rolls of pollution control manager and senior pollution controller, classification of water pollution control manager , required knowledge for first class water pollution control manager
- The relation of pollution control manager system and ISO 14001
- Examples of environmental management reports
- Current environmental issues in Japan- Strengthening water quality standard, (13) Pollution reduction rate by industrial category by water reuse
- The importance to remove nitrogen and phosphorus, water quality indicator
- Pre-treatment facility and an example of pre-treatment criteria in sewerage law
- The current situation of recycle of urban and industrial waste, industrial waste generation and recycle rate by industry and kind of waste, Measures of waste recycle
- Identification of inorganic industrial waste, remarks, disposal criteria, identification procedures in other countries and difference in the result of leachate test
- Disposal method of organic waste
- Structures of controlled and shield-type landfills
- Others,

(3) Certified Environmental Analyst System in Japan: How to secure accuracy in analysis

To secure analysis accuracy is the most fundamental issue in environmental management. Introduced certified environmental analyst system in Japan and attentions to be paid in analysis of industrial wastewater quality from the practical experiences of the member in charge of industrial wastewater management and water quality monitoring.

The seminar includes;

- Background of certified environmental analyst system in Japan
- The knowledge and rolls of certified environmental analyst
- Measurement law system in Japan- Ultimate purpose, direct purpose, approach and concrete activities, Institutes to secure measurement certification business and concrete rolls and activities, Key points of measurement law such as specified measuring instrument, verification and periodic inspection system, acceptable error of vessel for measuring volume (Mess cylinder, mess pipette, mess flask, mess burette
- Environmental measurement certification business- Parties not necessary registration as a measurement certification business, Specified measuring instruments used for certification of noise/ vibration level or concentration, Classification of environmental measurement certification business, On-site inspection before and after registration
- Required documents for registration of environmental measurement certification business- Example of analyzer, facilities and equipment for measurement of concentration and specified concentration of water or soil, Business regulation
- Example of minimum limit of determination and significant figure
- Example of certificate
- Problems of Current Measurement Law and countermeasures
- Traceability system
- Accuracy management in environmental measurement- Internal and external accuracy management, Attentions in using measurement instruments, Attentions in measurement of industrial wastewater quality

(4) Industrial wastewater treatment

As a part of industrial wastewater management, held the seminar of industrial wastewater treatment covering wide variety of topics with the practical experiences of the member in charge of industrial wastewater management and water quality monitoring.

The seminar includes;

- Planning of Wastewater Treatment- What to be studied to plan industrial wastewater treatment, Outline of load reduction measures and some examples, How to determine the tank volume to make the average of water quantity and quality, Counter flow cleaning
- Procedures to plan and design industrial wastewater treatment plant- Experimental procedures of industrial wastewater treatment and experiment equipment for inorganic and organic industrial wastewater
- Highlights of industrial wastewater treatment- HDS (high density solid) method, Removal of Nitrification and Phosphorus by Biological Treatment, Membrane bio-rector, others
- Flow rate measurement- Flow rate measurement at open channel: Instrument, principal, measurement range, head loss, remarks, accuracy, etc, Flow rate measurement in pipe Instrument, principal, measurement range, head loss, remarks, accuracy, etc, Examples of measuring flow rate at open channel and in pipe
- Biological treatment- Classification, principal, characteristics
- Performance evaluation procedure of industrial wastewater treatment facility
- Effects of oil on sewer system
- Treatment of heavy metals- Treatment processes of industrial wastewater including chelating agents, in particular with some examples
- Waste treatment and recycle- Example of recovery of heavy metals and current problems, Eco-cement, Eco-town

- Treatment of hazardous substances and remarks
- Analysis of hazardous substances based on water pollution control law in Japan with remarks
- Characteristics of dehydrator
- Others- Remarks in designing wastewater treatment plant and operation and maintenance, etc

3.2 Site Survey of Factories' Industrial Wastewater Management

Survey results for 5 installations, organic chemical industries, metal processing industry, meat food processing industry and steel manufacturing industry are;

- As a general impression, enterprises are lacking of the principles of industrial wastewater treatment and facility management.
- Most of IEP applications are prepared by local consultants; however, some cases where water quality analysis estimation or results apparently seem to be wrong are found. For example, COD value is three-digit number with one digit number of BOD value or nitrogen of 0 in meat processing.
- In an organic chemical industry, they say conducting self-monitoring; however, they don't have spectrometer but use a simple color former test kit and know the results by comparing the color with the standard colored paper without pre-treatment. In addition, color former agents are out of date.
- From these facts, analysis results by self-monitoring and outsourcing are doubtful a lot. Accordingly, standard analysis procedure and accuracy control procedure should be established urgently. Without reliable analysis, IPPC system would not be fixed.

3.3 Distribution of Materials

Distributed the following materials to be considered necessary to raise environmental awareness of the people and enterprises to MEPP public relation department, etc.

- PR DVD introducing waste management in Tokyo Metropolitan Government -English version:
- PR DVD introducing recycle of waste in Yokosuka Recycle Center-English on superimpose
- JIS K0102 (Analysis of Industrial Wastewater), English version
- Seminar material "An Experience of Treatment of Liquid Toxic Waste", "Industrial Wastewater Management in Japan-1 Environmental Law System in Japan", "Industrial Wastewater Management in Japan-2 Certified Environmental Analyst System in Japan", "Industrial Wastewater Treatment", Power Point-English version, Macedonian version, narration-English version
- VCD introducing CEAF (COMMUNITY ENVIRONMENTAL AWARENESS PROGRAM) activity in the Environmental Improvement Project in Ho Chi Minh City, Vietnam, funded by ADB hich was edited the contents through the discussion with TV staff by the member in charge of industrial wastewater and water quality monitoring was broadcasted in TV in Ho Chi Minh City
- Manuscript of CP (Cleaner Production) for next seminar:
- VCD for education and enlightening of cover soil in waste landfill which was edited by my company's expense and by the member in charge of industrial waste management and water quality monitoring in the project-Integrated Waste Management in Havana City, Cuba- by JICA-narration is deleted for the man in charge to narrate himself, with English explanation
- VCD for education of measurement of waste by potable truck scale which was edited by my company's expense and by the member of industrial wastewater management and water quality monitoring in the project-Integrated Waste Management in Havana City, Cuba- by JICA-narration is deleted for the man in charge to narrate himself, with English explanation