CHAPTER 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 main collector 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.

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 5.1.

Table 5.1 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)

The population in settlements by Saraj F/S is shown in Table 5.2.

Table 5.2 Population of Settlement in Saraj

(Persons)

No	Settlement	Pipe Network Existing or Not	Selected for Preliminary DD	2002	2025	2035
1	Dolna Matka and Weekend Houses	No	Yes	no data	697	847
2	Gorna Matka	No	Yes	468	697	847
3	Glumovo	No	Yes	1,683	2,508	3,046
4	Sisevo	No	Yes	3,376	5,030	6,111
5	Grcec	No	Yes	1,900	3,267	3,986
6	Krusopek and Laka	No	Yes	1,902	2,834	3,443
7	Ljubin	Yes		2,044	3,046	3,700
8	Saraj	Yes		5,232	7,796	9,470
9	Gorna & Dolna Arnakija,	No		1,077	1,605	1,949
10	Caljane	No		580	864	1,050
11	Semeniste	No		559	833	1,012
12	Bukovic	No		1,723	2,567	3,119
13	Panicari	No		261	389	472
14	Raovic	No		213	317	386
15	Bojane	Yes		2,230	3,323	4,036
16	Laskarce	No		1,190	1,773	2,154
17	Kopanica	No		1,714	2,554	3,102
18	Dvorce	No		249	371	451
19	Radusa &Rudnik Radusa	Yes		2,103	3,133	3,806
20	Gorno Svilare	No		712	1,061	1,289
21	Dolno Svilare	No		2,010	2,995	3,638
22	Rasce	Yes		2,697	4,019	4,882
23	Kondovo	Yes		3,384	5,042	6,125
	Total:			37,307	56,721	68,921
	Average Annual Change of Population				2.26 %	2.15 %
	Industrial Load based on PE			-	*5,672*	-
	Total Design PE				*62,394*	

Source: F/S for Saraj (REC)

In the F/S, three alternatives were compared (see Figure 5.1 to Figure 5.3). 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 main collectors, is selected as the most economical option (see Table 5.3). Following this conclusion, the preliminary D/D has been carried out for the 6 settlements selected as the priority projects (see Table 5.2)[1].

Table 5.3 Summary of Alternatives

	Alternative A		Alternative B		Alternative C	
	Quantity	Cost (Million EUR)	Quantity	Cost (Million EUR)	Quantity	Cost (Million EUR)
Secondary Pipe	74.6 km	6.9	74.6 km	6.9	74.6 km	6.9
Main Collector	25.7 km	3.1	16.2 km	1.7	5.8 km	0.6
WWTP, Decentralized	4	3.5	6	3.7	17	4.0
WWTP, Centralized	1		3		0	
Total		13.5		12.3		11.4

Note: including VAT and other taxes
Source: F/S for Saraj (REC)

Aerobic biological treatment (Bio-aeration pools) process was selected for all WWTPs. This process is similar to CASP (see Figure 5.4). Bio-aeration basin is operated with a HRT of 8 hr, which is the same as in case of CASP. The remaining units are also similar to CASP.

[1] Costs of 6 treatment plants are listed in the draft government budget of the year 2009 as of October 2008.

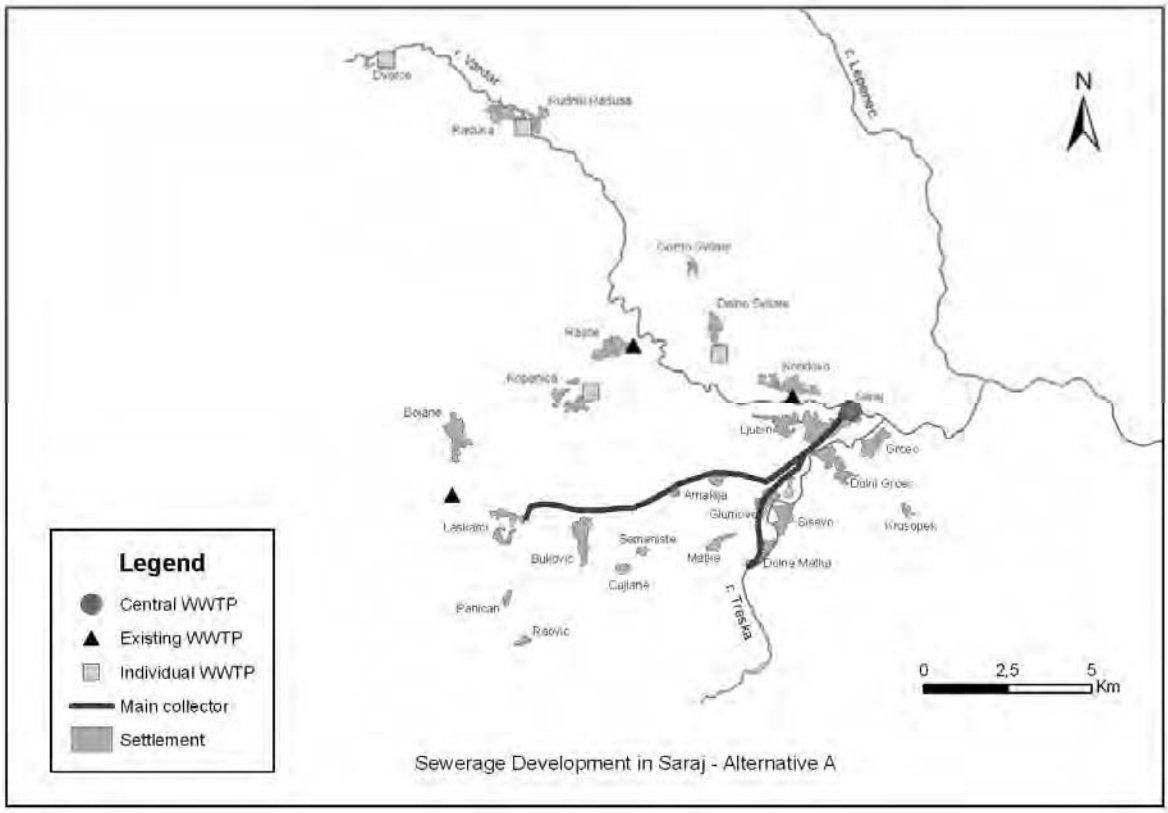


Figure 5.1 Saraj Sewerage Development - Alternative A

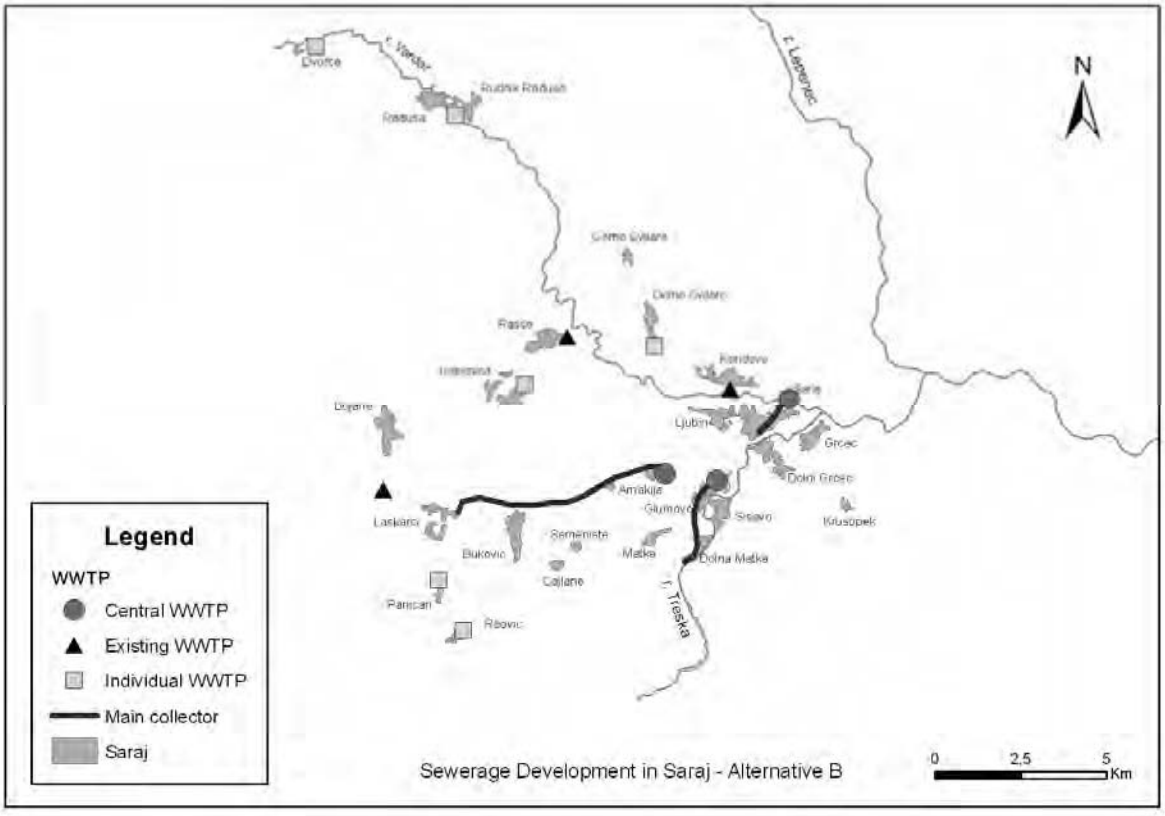


Figure 5.2 Saraj Sewerage Development - Alternative B

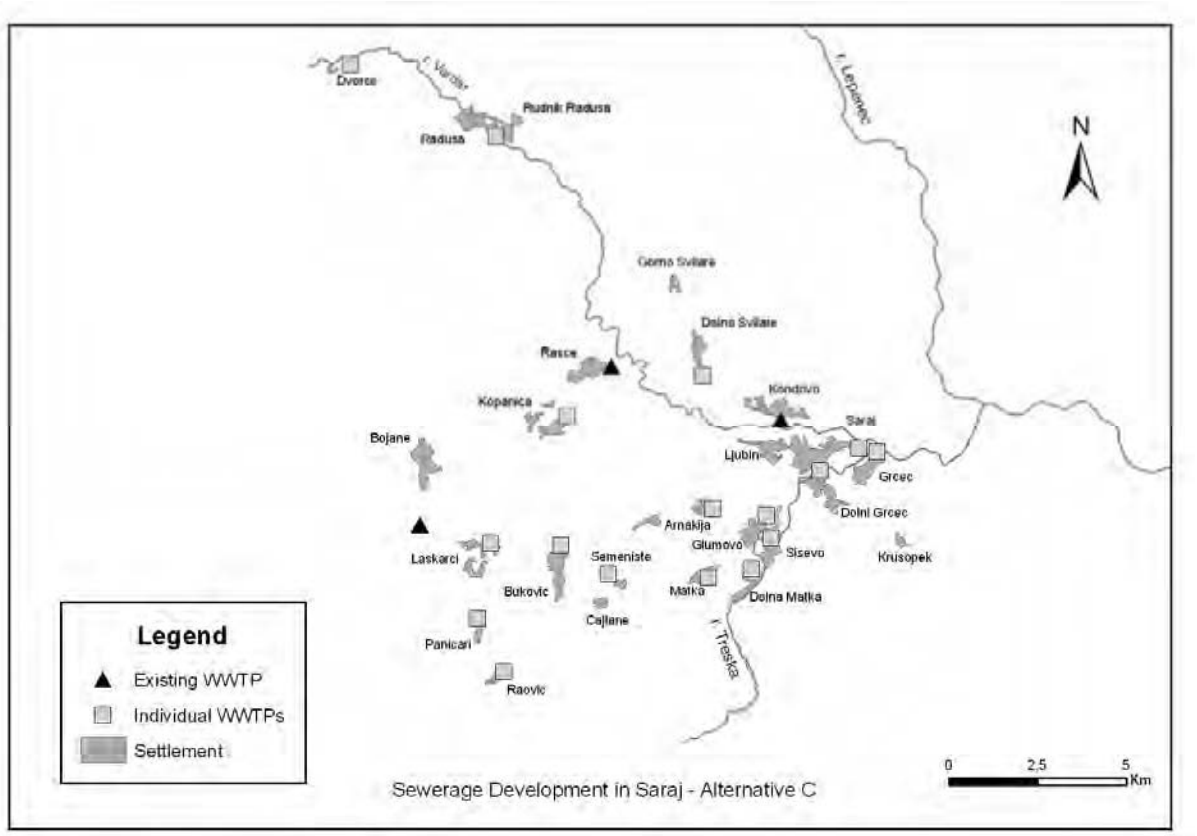


Figure 5.3 Saraj Sewerage Development - Alternative C

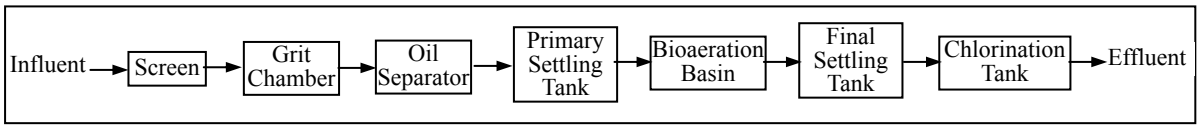


Figure 5.4 Flow Sheet of Aerobic Biological Wastewater Treatment (Bio-aeration Pools)

5.2.2 Technical Review Applied to this Study

Feasibility study conducted by Saraj municipality concluded that the Alternative C in which lots of WWTPs are constructed avoiding long trunk sewers is most economical because settlements in the municipality are scattered, which results in long and expensive trunk sewers in other two alternatives. However, it is not certain whether 17 small scale WWTPs with 4,000 thousand population equivalent for each can be operated or not. Though the Feasibility Study assumes inexpensive O&M costs expecting several staff members in charge of each WWTP's O&M, treatment processes adopted have to be easily operated with assured performance.

5.2.3 Environment and Feasibility of the Project

The whole of Saraj municipality is designated as water resource protection area of Rasce spring. Besides, Treska River area, a tributary of the Vardar River, is also designated as nature reservation area. These situations are the reasons why the Feasibility Study was conducted and Saraj municipality environment activity plan was established with the support of MEPP. From the origins of these studies and small scale implementation, it is expected that the early implementation based on these studies would be realized.

5.2.4 Municipality's Policy

Saraj municipality has already announced that the sewerage there would be implemented separately from central sewer district and that it will operate constructed sewerage facilities for themselves.

Local autonomy law admits that Saraj municipality can construct and operate sewerage facilities themselves. On the other hand, City Law of Skopje consisting of 10 municipalities including Saraj stipulates that any public works that can not be divided into municipalities have to be implemented by the City. It is not certain whether sewerage in Saraj can be separated or not, but the issue would be finally settled by the consultation between Governor of Skopje and Mayor of Saraj. It is expected that the sewerage in Saraj would be politically separated because Albanians account for the majority of Saraj citizen.

5.2.5 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.

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 main collector (length: 2.5km, diameter: 600mm) has been started and will be completed in 2008. Secondary sewer pipe will be constructed after the main collector. 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 5.4.

Table 5.4 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 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.

- ✓ Planned Population (2030): 16,100 person
- ✓ Average Daily Wastewater Generation: 3,220 m^3/d
- ✓ Maximum Hourly Wastewater Generation: 6,440 m^3/d (=0.075 m^3/s)(assuming peak factor of 2)
- ✓ Primary Collector Diameter: 450 mm (assuming 1.0 m/s velocity)

There is a primary collector for the south with 900 mm diameter, 1.5 km from the planned North Gorce Petrov WWTP. The planned population in the south is 41,300 persons in 2030. It is found that the primary collector can accommodate the flow from the north.

- ✓ Planned Population (2030): 41,300 person
- ✓ Daily Wastewater Generation: 10,821 m^3/d
- ✓ Domestic: 8,260 m^3/d
- ✓ Industrial: 2,561 m^3/d (assuming 31% of domestic)
- ✓ Hourly Wastewater Generation: 21,642 m^3/d (=0.251 m^3/s)(assuming peak factor as 2.0)
- ✓ Primary Collector Diameter: 900 mm (Existing)
- ✓ Flow Capacity of the above: 0.382 m^3/s (assuming 1.2 m/s velocity)

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 one. Figure 5.5 presents the comparison of Alternative A planned by Gorce Petrov Municipality and Alternative B connected to the Central one.

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. This plan is called as alternative B while the municipality plan is called as A (see Figure 5.5).

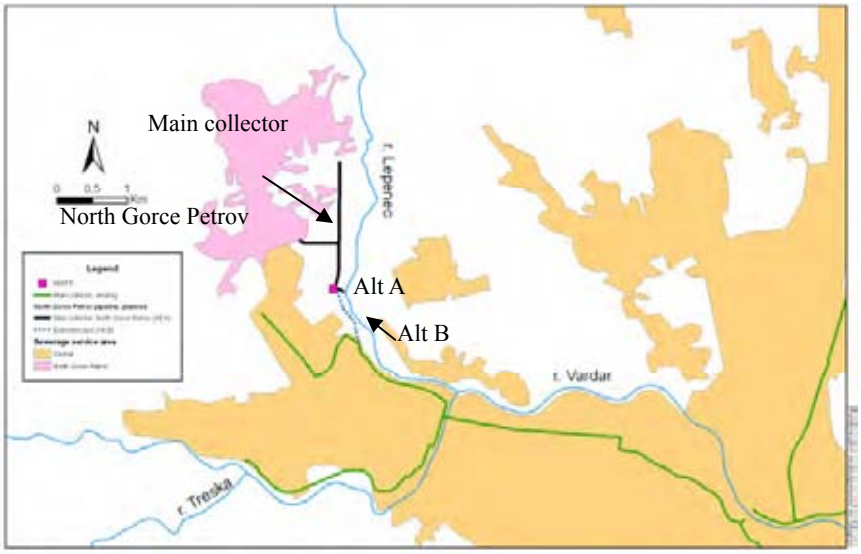


Figure 5.5 Comparison of Alternative North Gorce Petrov Sewerage Development Plan

The alternative B (combined with the central sewer district) is economically superior to the alternative A as shown in Table 5.5. Cost breakdown is shown in Appendix Part I, 5.1.

Table 5.5 Cost Comparison for Two Alternatives

	Independent (Alternative "A")	Combined (Alternative "B")
Construction Cost (Euro)		
Collector (Diameter 450 mm, Length 1.5km)	0	180,000
N.G.P. WWTP (3,220 m^3/d)	1,771,000	-
Increase Central WWTP (+3,220 m^3/d, +2 %)	-	1,328,000
Total	1,771,000	1,508,000
	(Large)	(Small)

5.3.3 Environment and Municipality's Policy

In this area, residents do not have provision of utility services (water supply, collection of solid waste, etc.) from city and therefore, they do not need to pay communal tax. Referendum was held regarding the sewerage project in the area, with conclusion of residents' contribution of 500 Euros per household. In addition, Skopje City and the municipality are contributing to the project, 60 % by the City and 40 % by the municipality. If the plan prepared by the municipality is modified, the following issues will arise: 1) financial support for new pipe installation cost, 2) revision of agreement with residents, and 3) administration process and necessary approvals. It is expected that considerable time would be required for working out these issues.

At the junction of the Vardar River and the Lepenec River, there are wells for serving drinking water to Skopje City during dry season, generally in summer. Considering groundwater quality aspect, sewerage development in this area is very important. Therefore, the project is needed to be implemented as soon as possible.

5.3.4 Recommendation by this Study

Despite an economical advantage of the combined plan, 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 own WWTP rather than connected to the central WWTP.

5.4 Dracevo Sewer District

5.4.1 Outline of the Municipality Plan

The Dracevo Treatment District is located at the edge of Kisela Voda Municipality. It 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 supplied 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. At present,

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 5.6 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)
Main Collector		Dia. 700 mm, Length 944 m	---
Treatment Level		Secondary Treatment	---
Treatment Process		Contact Stabilization Process	---
Project Cost (only for Main Collector)		3,534,000 EUR	---

Flow chart of contact stabilization process is presented in Figure 5.6.

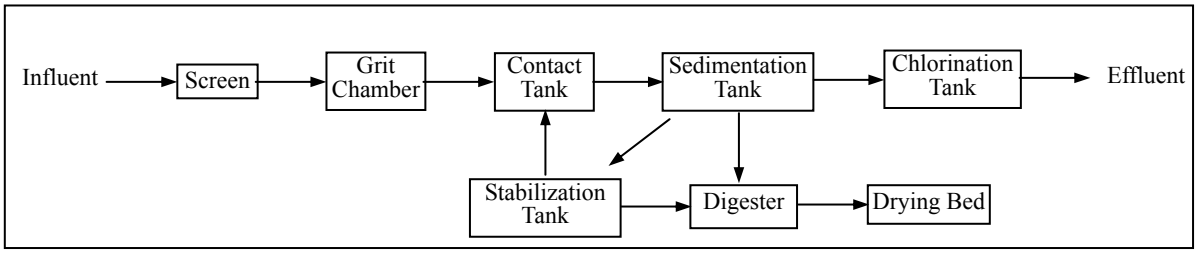


Figure 5.6 Flow Sheet of Contact Stabilization Process

Figure 5.6 shows the flow schematic of contact stabilization process that is modified CASP. In CASP, organics contained in the influent are adsorbed in the aeration tank and the adsorbed organics are slowly decomposed by indogenous respiration of activated sludge. Contact stabilization process utilizes the adsorption process in the contact tank. Sedimentation tank follows contact tank but organics are not fully decomposed. Considerable decomposition takes place in stabilization tank receiving the liquid returned from contact tank. The process is said to be appropriate for small scale plants because large stabilization tank is needed for large scale plants.

5.4.2 Technical review applied to this study

In technical review, two alternatives are compared: alternative A, to have own WWTP in Dracevo prepared by Kisela Voda Municipality, and alternative B, connecting to the Central WWTP (see Table 5.7 and Figure 5.7). 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 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. Refer to Appendix Part I, 5.1 for the detail.

Table 5.7 Cost Comparison for Two Alternatives

	Independent (Alternative "A")	Combined (Alternative "B")
Construction Cost (EUR)		
Dracevo WWTP (8,000 m^3/d)	4,400,000	-
Increase Central WWTP (+8,000 m^3/d)	-	3,300,000
Collector (Diameter 1500 mm, Length 7.0km)	0	2,520,000
Pumping Station (3 nos.)	-	1,200,000
Total	4,400,000	7,020,000
	(Small)	(Large)
Operation and Maintenance Cost (EUR/year)		
WWTP	73,000	73,000
Pumping Station (3 nos.)	0	47,000
Total	73,000	120,000
	(Small)	(Large)

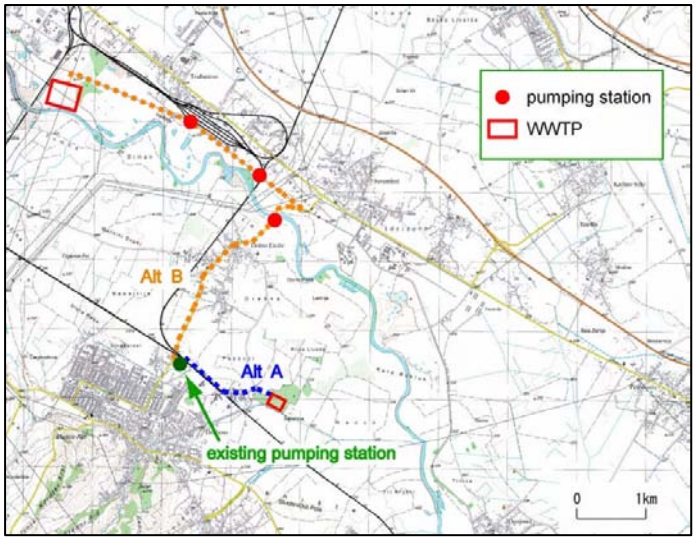


Figure 5.7 Comparison of Sewerage Development Plan in Dracevo

5.4.3 Environment and Municipality's policy

Kisela Voda Municipality has the policy to install Dracevo WWTP to treat sewage from this area, not to connect to the Central WWTP. As mentioned earlier, the municipality has applied for the financial support from donor agencies. The site for WWTP has also been already reserved. Treated wastewater is planned to be used for irrigation. If sewage is transported to the Central WWTP, this area might not be able to use treated effluent for agricultural activity.

5.4.4 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 includes surrounding settlements considering the future developments.

CHAPTER 6 SEWERAGE FACILITY PLANNING ON CENTRAL SEWER DISTRICT

6.1 Framework of Central Sewer District

Table 6.1 shows design parameters for collection system in its target year of 2030 and treatment system in its target year of 2020, respectively. 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, respectively.

Table 6.1 Design Parameter of Central Sewer District

	2020	2030
District Area (km^2)	72.8	
Population	513,570	555,650
Population Equivalent	660,380	691,350
Sewage Flow (average daily) (m^3/d)		
Domestic	102,720	111,130
Industrial	32,300	34,840
Stormwater	31,000	31,000
Total	166,020 ≒166,000	176,970 ≒177,000
Pollutant loading in BOD (kg/d)		
Domestic	30,814	33,339
Industrial	5,399	4,732
Stormwater	3,410	3,410
Total	39,623	41,481
Pollutant loading in SS (kg/d)		
Domestic	23,111	25,004
Industrial	9,175	8,041
Stormwater	12,400	12,400
Total	44,686	45,445
Influent Concentration (mg/l)		
BOD	239 ≒240	234 ≒230
SS	269 ≒270	257 ≒260

Note: (1) Area includes Sopiste and Soncev Grad communities outside Skopje City.
(2) Population equivalent is calculated supposing per capita per day loading is 60 gpcd stipulated by EU.

Figure 6.1 shows general layout plan of Central Sewer District.

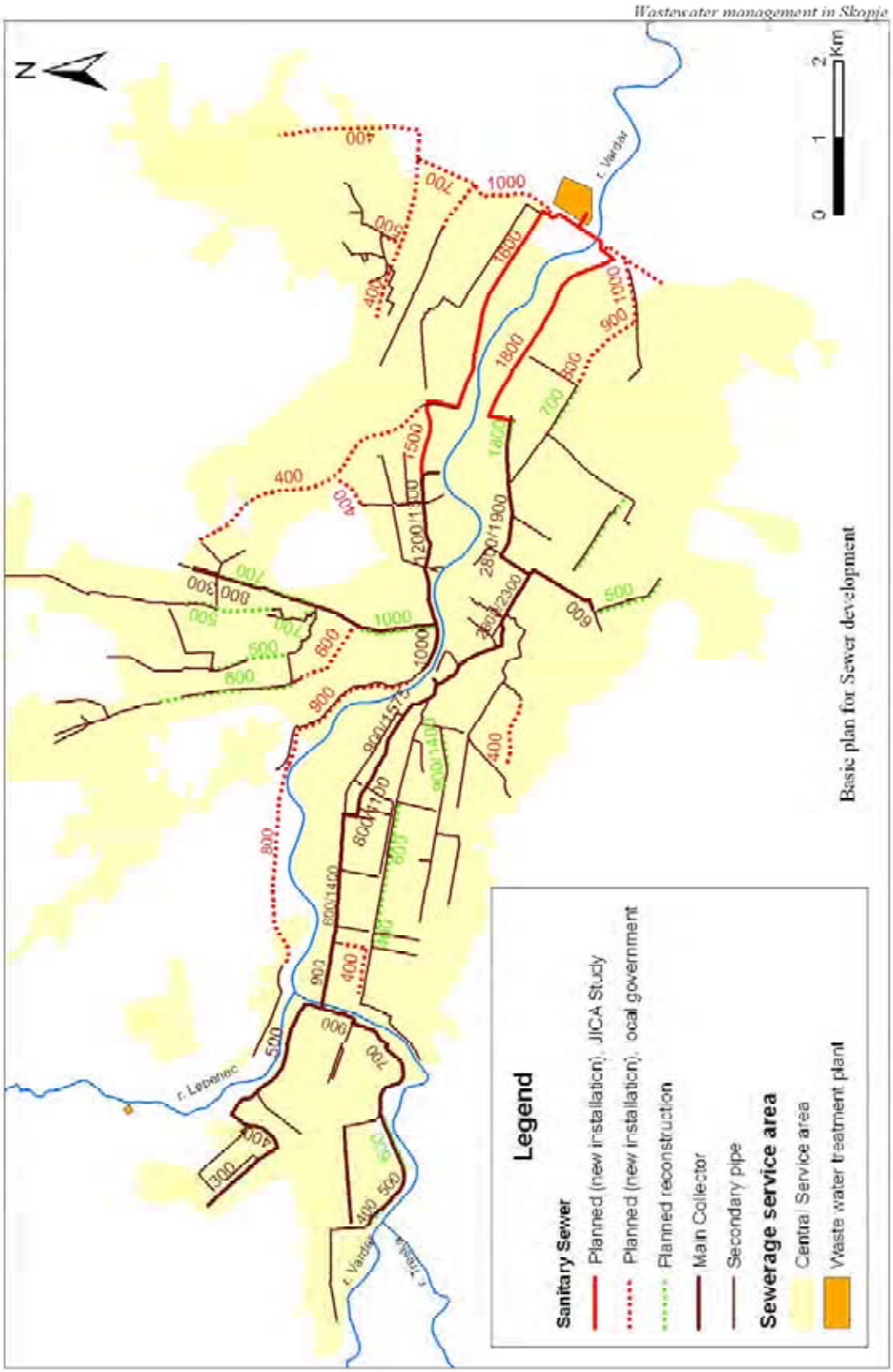


Figure 6.1 General Layout Plan of Central Sewer District

6.2 Plan of Trunk Sewer

6.2.1 Design Framework

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 at present with the treatment plant. Trunk sewers are planned with the target year of 2030. Chapter 3 discusses planned population and average daily sewage flow. Table 6.2 shows design parameters in 2030. Table 6.3 shows planned population on municipality basis and right/left bank side basis.

Hourly maximum flow is two times average daily flow assuming the followings.

(Average daily flow) / (Maximum daily flow = 1:1.25 (experience in water supply)
(Maximum daily flow) / (Maximum hourly flow) = 1:1.4 (Babbit M curve for the population of 550,000)
(Maximum hourly flow) / (Average daily) = $1.25 \times 1.4 = 1.75 \fallingdotseq 2.0$

As for industrial wastewater, it is assumed that maximum daily flow is the same as average daily flow and that maximum hourly flow is 1.5 times the average daily flow taking average operation hours of factories of 17 hours into account (24/17 being approximately 1.5). 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 6.2 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 (Person)	555,650			Left bank side: 237,550 Right bank side: 318,100
	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	-

Table 6.3 Planned Population on Right/Left Bank Sides Basis (2030)

	Planned Population		
	Right Bank	Left Bank	Total
Skopje city			
Aerodrom	87,350	0	87,350
Butel	0	45,500	45,500
Gazi Baba	0	73,500	73,500
Gorce Petrov	41,300	0	41,300
Karpos	71,420	1,380	72,800
Kisela Voda	54,640	0	54,640
Centar	49,230	7,970	57,200
Cair	0	81,500	81,500
Suto Orizari	0	27,700	27,700
Total	303,940	237,550	541,490
Outside Skopje City			
Sopiste	8,160	0	8,160
Soncev Grad	6,000	0	6,000
Total	14,160	0	14,160
Grand Total	318,100	237,550	555,650

6.2.2 Selection of Trunk Sewer Route

(1) Trunk sewer route in Sewerage M/P

Sewerage M/P proposes one trunk sewer on the left bank side and the other on the right bank side as shown in Figure 6.2. The left bank side trunk sewer is planned partly under the existing road near the manholes of 106 and 111, and is to be laid under the planned road at the downstream after manhole 111. On the other hand, the right bank side trunk sewer is to be laid under the planned road after a large scale housing complex. For the time being, it is not certain when the planned road will be constructed.

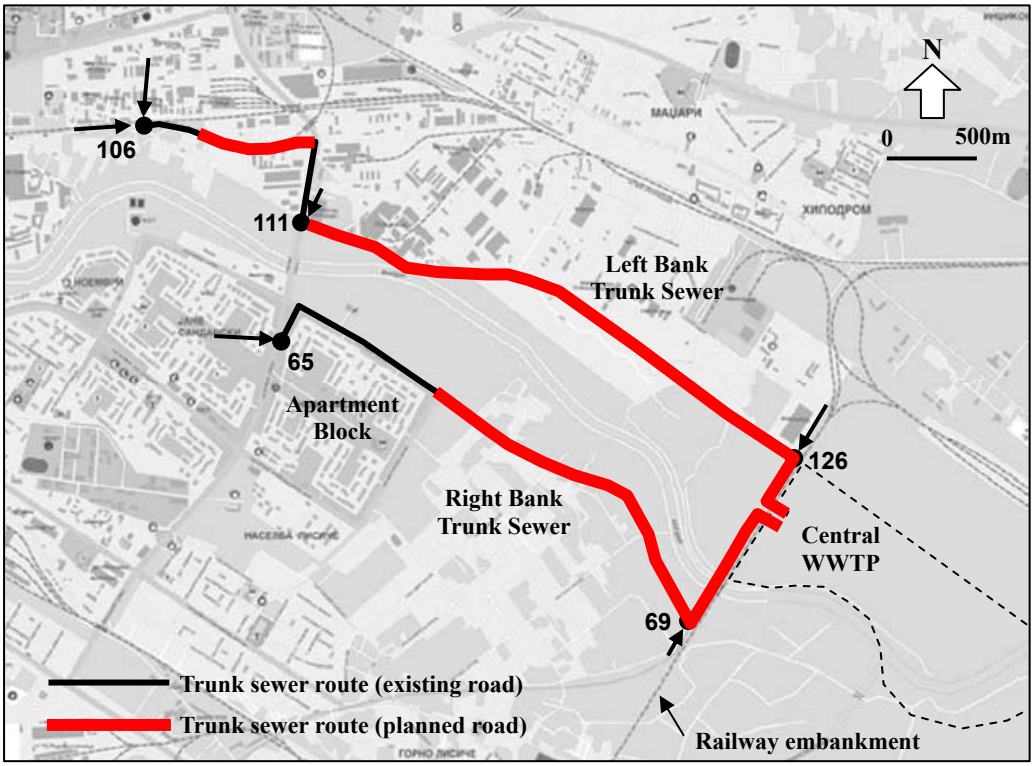


Figure 6.2 Route of Trunk Sewers (Sewerage M/P 99)

(2) Alternative routes of trunk sewer

As shown in Figure 6.3, the other route (Alternative 2) for left bank side trunk sewer is possible against Alternative 1 (in Sewerage M/P 99), but Alternative 2 is 400 m longer than Alternative 1 and hence more expensive and the construction work is considerably difficult due to the narrow road width. It is judged that Alternative 1 is better than Alternative 2. On the other hand, there is no existing road on the right bank side for another route.

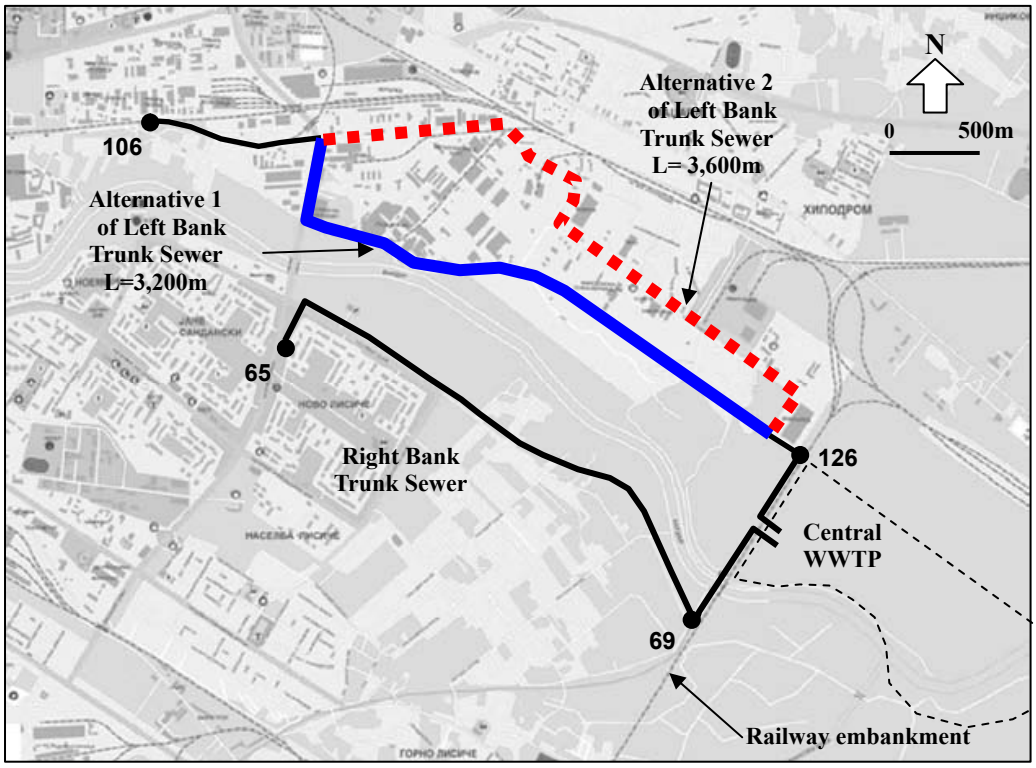


Figure 6.3 Alternative Routes of Trunk Sewers

(3) Comparison of river and railway crossing methods

The Central WWTP site is located at the left bank side of the Vardar River and the right bank side trunk sewer has to cross the river. Two roads crossing the river near the site are planned to be constructed as shown in Figure 6.4. Some crossing points are compared to choose the most appropriate one. Both right and left side bank trunk sewers have to cross the railway embankment because the WWTP site is located beyond the embankment.

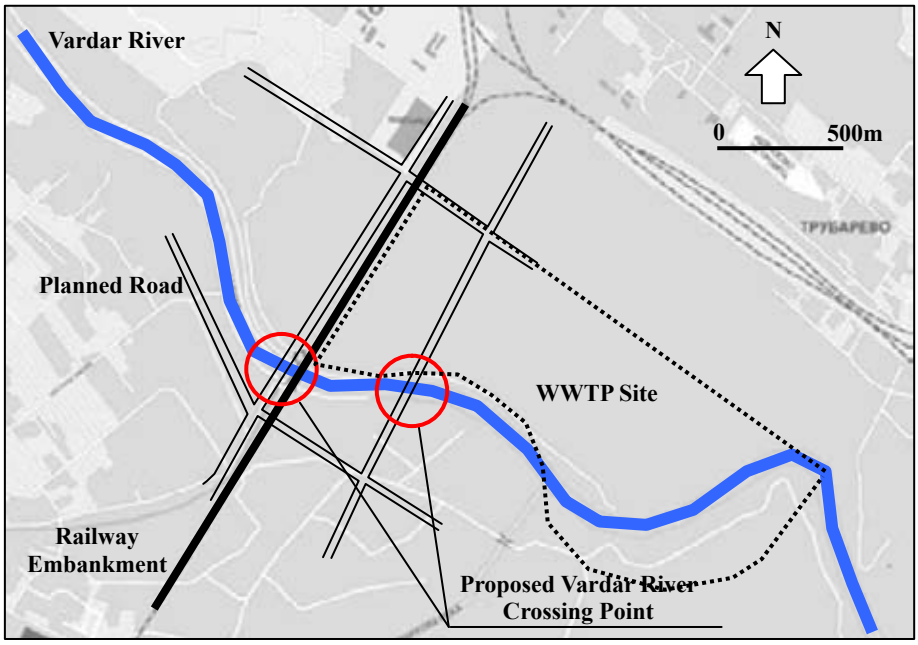


Figure 6.4 Planned Road and Railway Embankment near WWTP Site

Tables 6.4 and 6.5 compare these alternatives in terms of the stretch, crossing points, construction costs and so forth for the right bank and left bank sides, respectively.

Table 6.4 Route Selection at the Right Bank Side

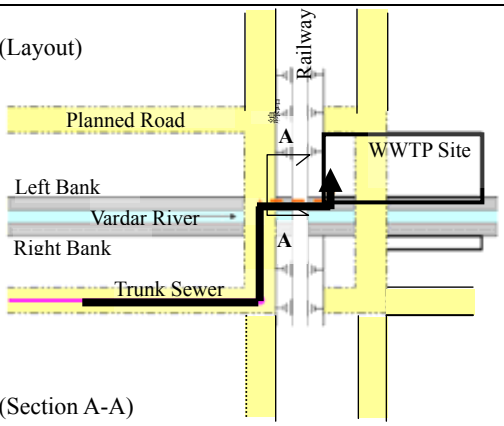
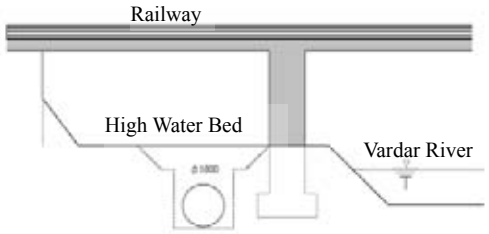
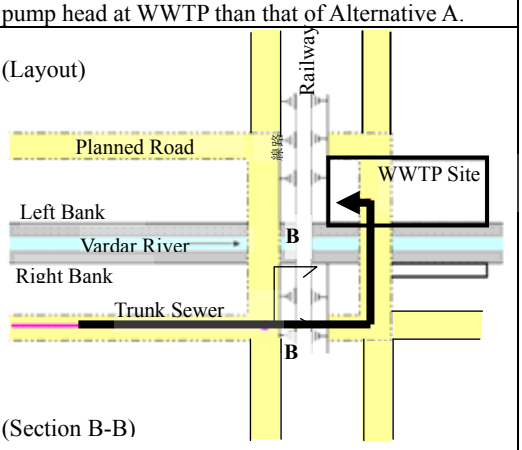
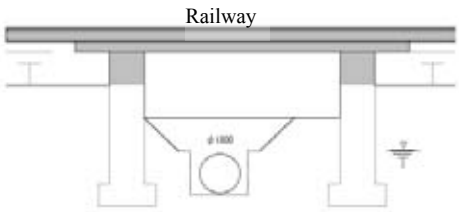
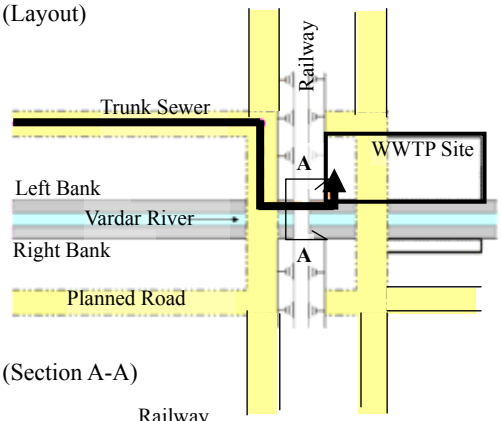
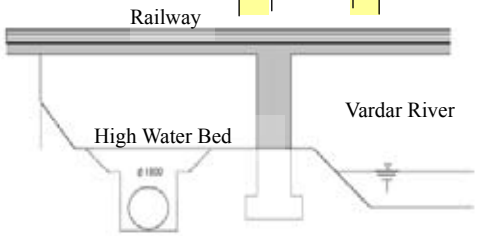
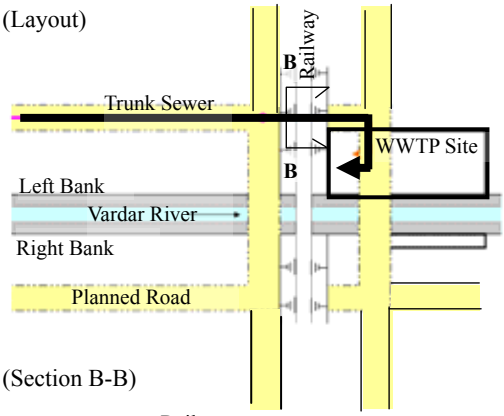
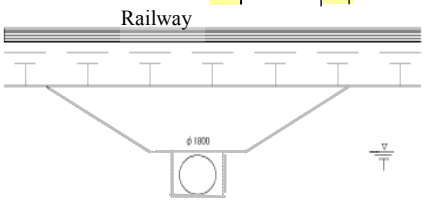
	Alternative A	Alternative B
Explanation	The sewer crosses the Vardar River at the western side of railway and reaches WWTP after crossing the railway at railway bridge	The sewer crosses the railway under the road bridge at the south-east of railway bridge and reaches WWTP after crossing the river at the eastern part of railway.
Stretch	3.6 km	4.4 km
River Crossing	Crossing at the western part of railway River section and its flow nearly the same Have experience of sewer laying crossing the Vardar River	Crossing at the eastern part of railway River section and its flow nearly the same Have experience of sewer laying crossing the Vardar River
Railway Crossing	The sewer is laid at the high water level dyke under the railway bridge crossing the Vardar River. It is not necessary to excavate the railway embankment and thus the construction work is not difficult. The return period of the high water level is 300 years that is far longer than the life time of sewers of 50 years. Even if the sewer is destroyed, its life time would have ended at that time.	The sewer is laid under the road located at 400 m south-west of the railway bridge (20m).
Level of Sewer Bottom at Its Destination	The sewer bottom at the destination is higher than that of Alternative B and hence its pump head at WWTP is smaller than that of Alternative B.	Its total length of the sewer is 800 m longer than that of Alternative A and hence its sewer bottom at the destination is lower, which results in larger pump head at WWTP than that of Alternative A.
Conceptual Drawing	(Layout)  (Section A-A) 	(Layout)  (Section B-B) 
Conclusion	Viable	Not Viable

Table 6.5 Route Selection at the Left Bank Side

	Alternative C	Alternative D
Explanation	This is the route in which the sewer crosses the railway under the railway bridge at the Vardar River and reaches WWTP.	This is the route in which the sewer crosses the railway embankment at the north of WWTP site and reaches WWTP.
Stretch	5.3 km	5.2 km
River Crossing	Not required	Not required
Railway Crossing	The same as in right bank side route The sewer is laid at the high water level dyke under the railway bridge crossing the Vardar River. It is not necessary to excavate the railway embankment and thus the construction work is not difficult. The return period of the high water level is 300 years that is far longer than the life time of sewers of 50 years. Even if the sewer is destroyed, its life time would have ended at that time.	The sewer crosses the railway embankment but the construction work is technically difficult for the following reasons. ・Pipe diameter is as large as 1,800 mm. ・The soil is of gravel and the groundwater level is high. Drainage is difficult. ・Pipe jacking has not been experienced in Macedonia.
Level of Sewer Bottom at Its Destination	The sewer bottom is nearly the same as that of Alternative B.	The sewer bottom is nearly the same as that of Alternative A.
Conceptual Drawing	(Layout)  (Section A-A)  	(Layout)  (Section B-B) 
Conclusion	Viable	Not Viable

6.2.3 Layout and Section Plans of Trunk Sewer

Table 6.6 outlines right and left bankside trunk sewers. See Appendix Part I, 6.1 for sewage flows at respective connection points, flow calculation at right and left bank sides. Figure 6.5 shows layout plan of right bank and left bank side trunk sewers. Right bank side trunk sewer starts at the existing manhole or connection point 65, collects most wastewater generated at the right bank side and heads for the east along the planned road (partly constructed) and finally reaches connection point 69. It further receives the wastewater from Aerodom and Kisela Voda, 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 receives most of the sewage generated at the left bank side at the existing manhole or connection point 106, heads for the east along the planned road and goes down to the south until it reaches connection point 126. It further receives the sewage from Gazi Baba at

connection point 126 and 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 reaches the treatment plant.

There are existing sewers from existing manholes No. 65 and 106 which discharge the sewage to the river. These sewers will be used only for emergency stormwater discharge in case of heavy rain after trunk sewers connected to the treatment plant are constructed.

Diameters of trunk sewers were approved by GUP as 1,800 mm for right side bank sewer and as 1,500 mm, 1,600 mm and 1,800 mm from the upstream for the left side bank sewer. It is possible to design trunk sewers with necessary diameters as calculated diameters as shown in Table 6.6 but Vodovod insisted that it is really difficult to change the diameters once approved. It was concluded that trunk sewers would be designed as approved.

Table 6.6 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 reaching point of siphon at the right bank side.
Number of connecting points 65, 69, 106, 111 and 126 are the same as those shown in existing plan by Vodovod.

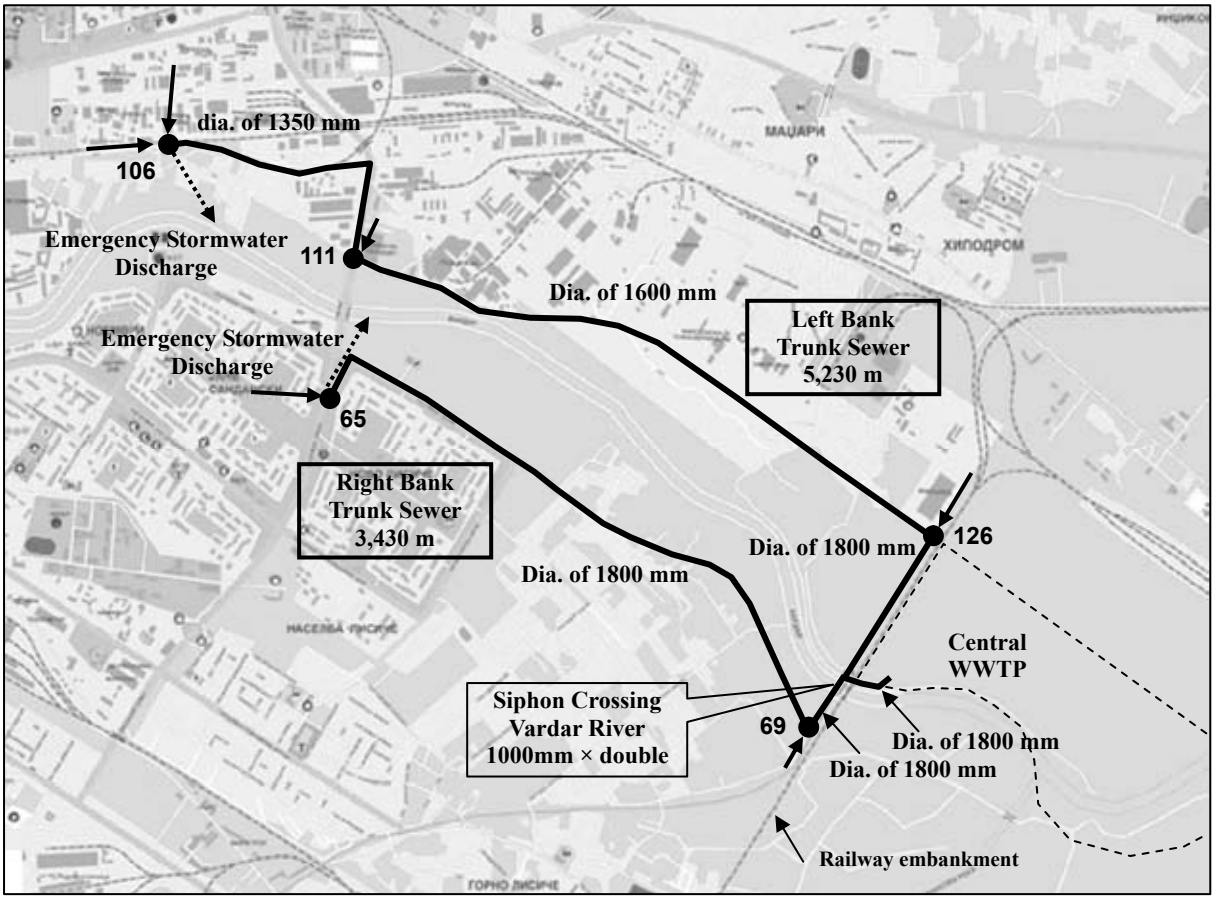


Figure 6.5 Layout Plan of Right Bank and Left Bank Side Trunk Sewer

Figure 6.6 and Figure 6.7 show longitudinal profiles of right bank and left bank trunk sewers, respectively.

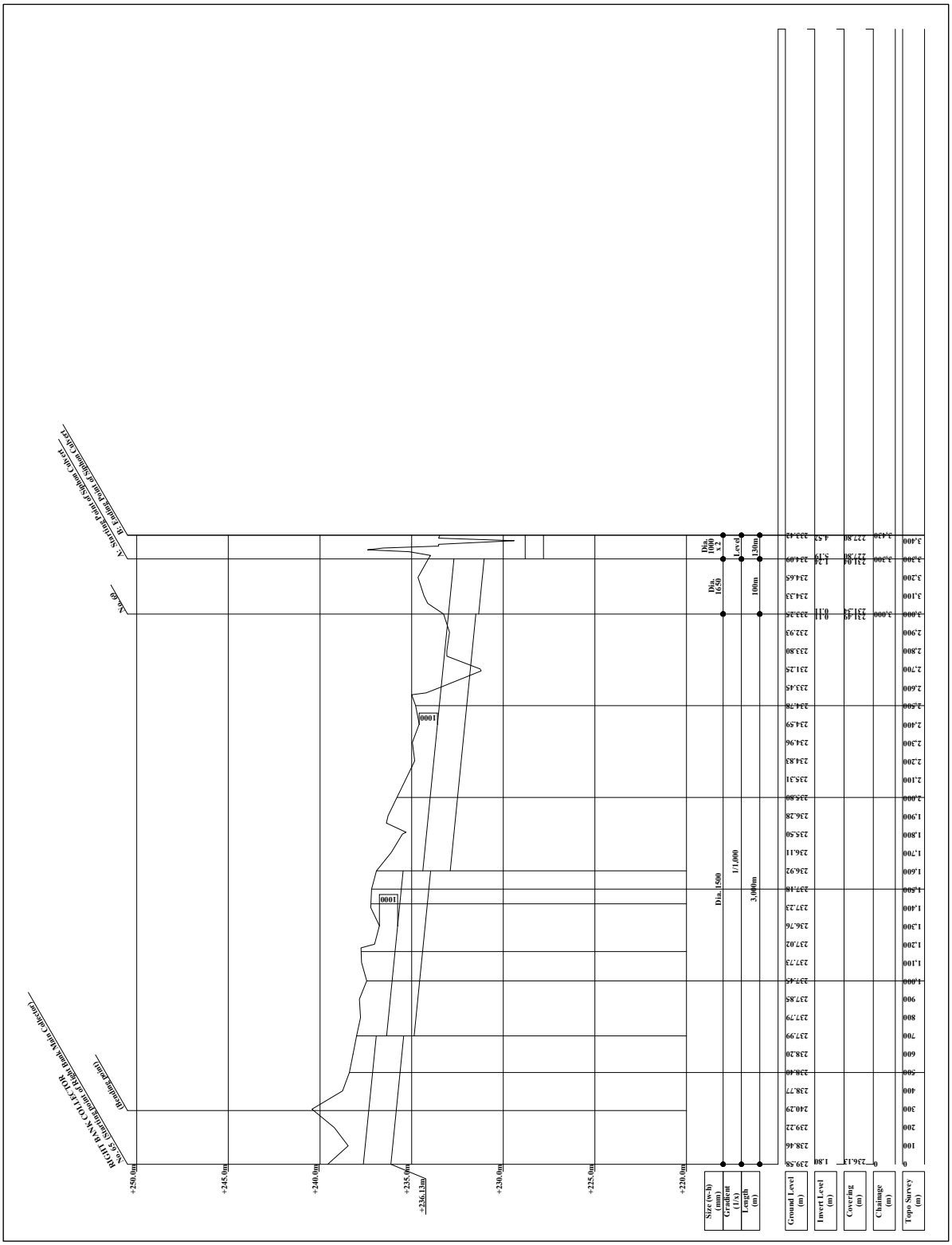


Figure 6.6 Longitudinal Profile of Right Bank Side Trunk Sewer

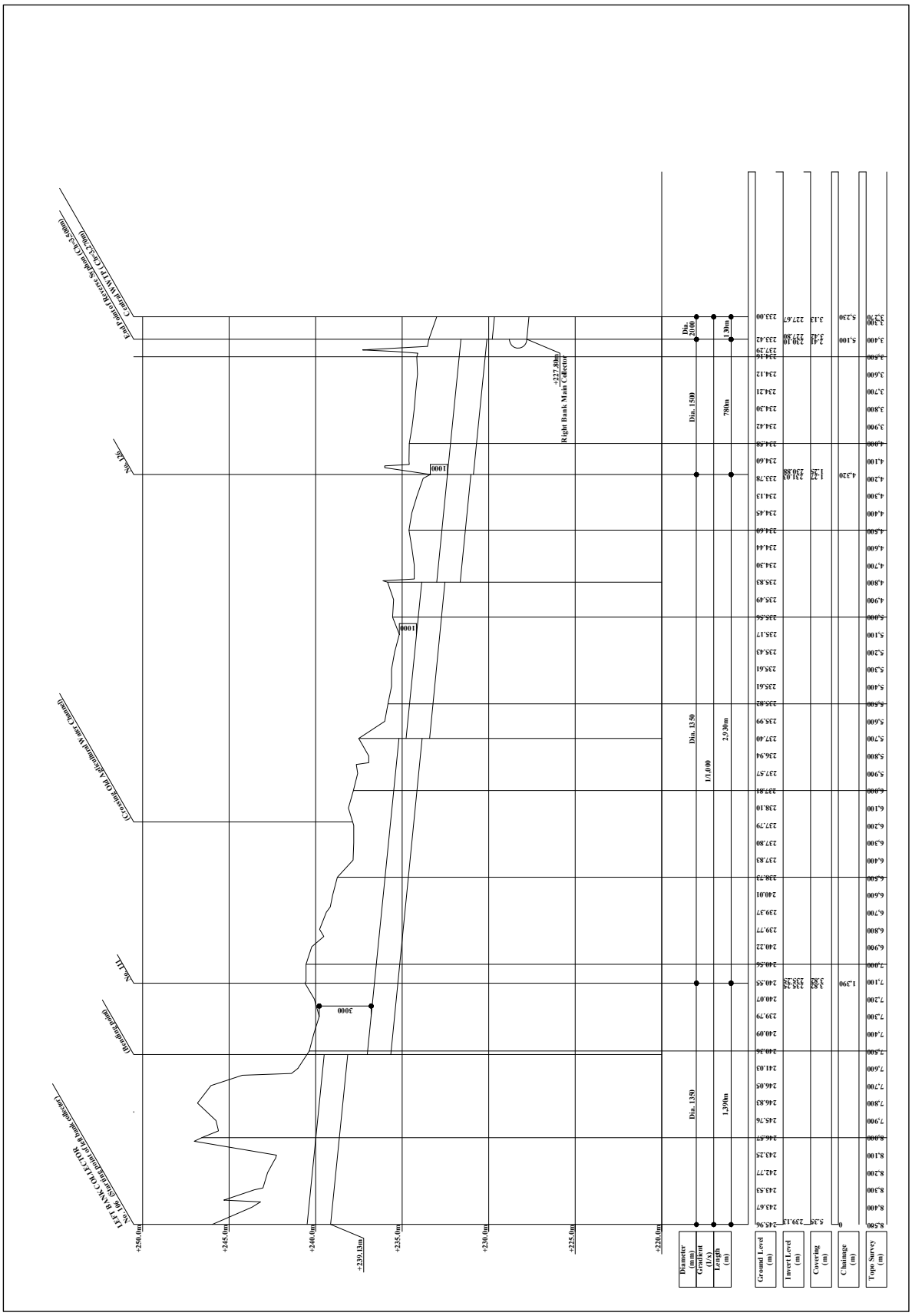


Figure 6.7 Longitudinal Profile of Left Bank Side Trunk Sewer

6.3 Facility Plan of Central Wastewater Treatment Plant (WWTP)

6.3.1 Planning Policy

(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 central WWTP.
(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 described in Chapter 4.
(6) Generated sewage sludge is disposed of at the designated disposal site but its storage space is taken into account.
(7) The site is 57 ha excluding the protected area and others from the allocated 106 ha in "Water Economy Facility Area" established in GUP.

6.3.2 Framework of central WWTP

Table 6.7 shows framework of central WWTP. The flow to the plant is 166,000 m^3/d including domestic and industrial wastewaters and stormwater.

Table 6.7 Framework of Central WWTP in 2020

	Design Population	Population Equivalent	Flow Rate in Average Daily (m^3/d)	Pollutant Load (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	660,380	166,020 ≒166,000	39,623	44,686	239 ≒240	269 ≒270

Notice:
(1) Sewer district includes Sopiste and Soncev communities outside Skopje city.
(2) Population equivalent is calculated by dividing total pollutants by per capita per day BOD loading of 60 g/c/d stipulated in EU directives pertaining to domestic wastewater.

6.3.3 Effluent Qualities

Macedonia has promoted environmental improvement policy according to EU directives in principle. Sewerage M/P 99 also recommends the application of EU Directives in the future sewerage implementation. It is judged that the implementation of sewerage facilities needs to be in line with relevant EU Directives.

Table 6.8 shows treatment level on population size basis to be met in a short period required by EU Directives in which effluent receiving water bodies are classified into three categories of normal, sensitive and less sensitive.

Long term target is applied when legal and executing systems pertaining to sewage works are established and operated according to EU Directives, until that time short term target is applied. Population equivalent of central sewer district is 630,000 and secondary level treatment is required with the effluent BOD of less than 25 mg/l and effluent SS of less than 35 mg/l, respectively.

Table 6.8 Scale Basis Required Sewerage Facilities by EU

Scale of City (PE)	Required Facilities	Remarks
Less than 2,000	- Sewage collection system - Sewage treatment system with adequate treatment process	
More than 2,000	- Sewage collection system - Sewage treatment system at secondary level	Standard for secondary treatment facilities

	Effluent Standard	Min. Removal Efficiencies
BOD	25 mg/l	70-90 %
SS	35 mg/l	90 %

Water quality of the Vardar River in the vicinity of Central WWTP is categorized as type II stipulated in water quality standard, which is less than 7 mg/l for BOD and less than 30 mg/l for SS, respectively. Pollution analysis in Chapter 4 proposes that industrial wastes be regulated and sewage be treated in order to comply with the standard. Treatment level is secondary with the effluent BOD of less than 25 mg/l and treatment efficiency of more than 90%.

6.3.4 Treatment Process

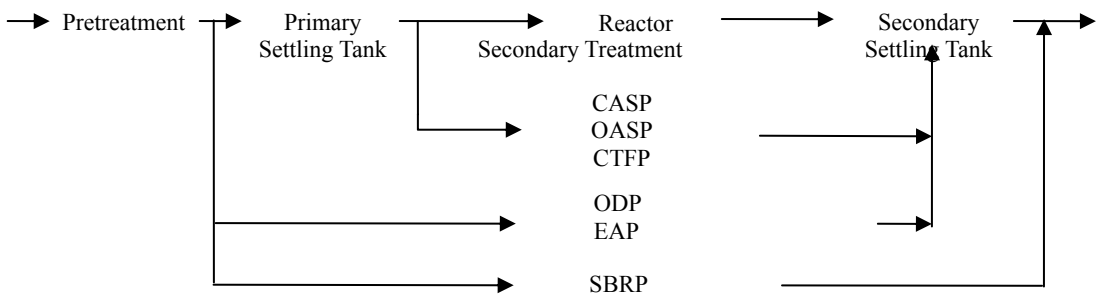
Table 6.9 lists several treatment processes that can treat the sewage to the effluent BOD of less than 25 mg/l and with the treatment efficiency of more than 90%. Flow schematics of candidate processes are shown in Figure 6.8. Processes in the table are listed taking into account the followings:

- required treatment level
- low impact on the environment
- site availability
- necessity of digestion process for safe sludge production and easier handling
- less expensive sludge dewatering process

Table 6.9 Removal Efficiencies of Various Processes

Treatment level	Treatment Process	BOD	SS
Secondary	Conventional activated sludge process (CASP)	Around 90%	Around 90%
	Oxygen activated sludge process (OASP)		
	Oxidation ditch process (ODP)		
	Extended aeration process (EAP)		
	Sequencing batch reactor process (SBRP)		
	Aerated lagoon process (ALP)		
	Conventional trickling filter process (CTFP)		

Source: Sewerage facilities planning design guidelines by Japan Sewage Works Association



Source: Sewerage facilities planning/design guidelines by Japan Sewage Works Association

Figure 6.8 Flow Schematic of Secondary Treatment Processes

Central WWTP receives domestic sewage and no industrial wastes including high organics concentrations are expected be to flow in. Hence, oxygen activated sludge process is not suitable to adopt. Besides, sequencing batch reactor process is not appropriate because of its suitability for smaller scale plants.

Table 6.10 compares five processes including aerated lagoon and conventional trickling filter process. Figure 6.9 through Figure 6.13 show how necessary facilities are allotted for five processes. CASP is judged to be the most economic for its least construction cost and least O&M cost among activated sludge processes. It has been used in many places providing plenty of experiences in medium to large scale plants, which leads to established O&M guidelines. Though aerated lagoon and conventional trickling filter processes require smaller O&M costs in spite of their greater construction costs, their adoptions to central WWTP are not possible mainly due to their site constraints. ALP requires conversion of nature conservation area into treatment site as well as river route diversion.

Annual cost shown in Table 6.10 includes construction cost divided by life time of respective structure and equipment (50 years for concrete structures and 15 years for mechanical/electrical equipment) and annual operation & maintenance cost.(see Appendix Part1,6.2 and 6.3 in detail)

Reuse of treated effluent

The sewage flowing into Central WWTP contains various kinds of industrial wastewaters and careful check of influent constituents is required for effluent reuse after the plant begins its operation. New Water Law stipulates that treated effluent and generated sludge have to be used if they comply with certain standards and that their use has to be approved by state level agency in charge of water management (the Law recommends Ministry of Environment and City Planning).

Table 6.10 Comparison of Treatment Processes

	Conventional Activated Sludge Process (CASP)	Oxidation Ditch Process (ODP)	Extended Aeration Process (EAP)	Aerated Lagoon Process (ALP)	Conventional Trickling Filter Process (CTFP)
Performance	Susceptible to flow fluctuation in both quality and quantity due to its higher loading (BOD-SS loading of 0.2 to 0.4 kg/kg/d) than that of ODP and EAP. Nitrification is not likely to occur even in summer when the water temperature is high for its smaller SRT. Existing facilities can be upgraded to an advanced treatment facilities by adding aeration tank and secondary settling tank.	Stable organics removal is possible even if flow fluctuates in both quality and quantity for its lower loading operation (BOD-SS loading of 0.03 to 0.05 kg/kg/d). Anoxic zone might be needed to avoid low pH effluent due to inevitable nitrification for its longer ASRT. No primary settling tanks are installed. Existing facilities can be upgraded to an advanced treatment facilities by adding aeration tank and secondary settling tank.	Stable organics removal is possible even if flow fluctuates in both quality and quantity for its lower loading operation (BOD-SS loading of 0.05 to 0.1 kg/kg/d) Anoxic zone might be needed to avoid low pH effluent due to inevitable nitrification for its longer ASRT. Attention should be paid to sludge dispersion caused by excessive aeration and lowered sludge activity. No primary settling tanks are installed. Existing facilities can be upgraded to an advanced treatment facilities by adding aeration tank and secondary settling tank.	Stable treatment is possible for its longer retention time. However, attention has to be paid to allotment of aerators and inlet and outlet of lagoons. Existing facilities are abandoned if an advance treatment (denitophication) is required.	Comparatively resistant to influent fluctuations such as flow rate and water temperature. Effluent is not as clear as that of suspended growth processes including CASP. Existing facilities are abandoned if an advance treatment (denitophication) is required
Operation and Maintenance	O&M technology has been established for its prevailing adoption to medium to large scale plants. It is possible to design larger capacity for one train, which leads to higher economy of scale. From this point, the process is efficient to adopt to Central WWTP with large capacity.	In spite of its stable performance, it is most applicable to small scale plants, and hence it shows smaller economy of scale.	Stable operation is possible for its lower loading rate. Different from ODP, the capacity of one train can be large, which leads to higher economy of scale.	Easier maintenance is expected due to the absence of sludge return to the reactor. Sludge level in settling lagoons has to be periodically checked to decide when the sludge will be withdrawn.	Maintenance easier due to the absence of sludge return as well as DO control.
Sludge Production	Larger compared with ODP and EAP.	Smaller than that of CASP for its longer SRT.	Smaller than that of CASP for its longer SRT.	Considerably small because sludge accumulated at the bottom of settling lagoons has been consolidated for years and digested to a greater extent. It is assumed that its sludge production is as low as a half of CASP.	Smaller than that of CASP due to digestion of microbes attached to filter media. Sludge production is similar to that of ODP if primary sludge is digested.
Loading to Secondary Settling Tank	Overflow rate of secondary settling tank can be set at 20 - 30 $m^3/m^2/d$ for its good solid liquid separation due to its lower MLSS concentration of 1,500 - 2,000mg/l.	Settling velocity of sludges is smaller because of larger MLSS concentration of 3,000 - 4,000 mg/l. It requires smaller overflow rate at SST of 8 - 12 $m^3/m^2/d$.	Settling velocity of sludges is smaller because of larger MLSS concentration of 3,000 - 4,000 mg/l. It requires smaller overflow rate at SST of 8 - 12 $m^3/m^2/d$.	Overflow rate similar to that of CASP is needed.	Humus separated from filter media is not readily settleable. Hence, smaller overflow rate is required.
Oxygen Requirement	Primary effluent contains lower BOD loading to the reactor because of expected BOD removal of 40% at primary settling tank. Higher energy efficiency is expected because of lower BOD loading and consequent less oxygen requirement as well as smaller nitrification rate due to smaller ASRT.	Loading to the reactor is high because of the absence of PST. Nitrification rate is also high due to longer ASRT. Because of these, oxygen requirement is as high as three times of CASP. Surface aerators commonly used in ODP shows lower oxygen transfer rate, which further increases energy consumption.	Loading to the reactor is high because of the absence of PST. Nitrification rate is also high due to longer ASRT. Because of these, oxygen requirement is as high as three times of CASP.	Similar to that of CASP in principle.	Oxygen is taken during the spraying of primary influent on filter media. Hence, no equipment and associated energy is required.
Outline of Facilities	PST: Dia. 23m × 8 tanks AT: 16m × 65m × 5m × 8 tanks SST: Dia.23m × 16 tanks CT: 10m × 86m × 2m × 1 tank ST: Dia. 21m × 2 tanks SD: Dia. 23m × 11m × 4 tanks GH: 12m × 10m × 2 tanks SDB: 10 ha	OD: 32m × 173m × 3m × 10 tanks SST: Dia. 32m × 10 tanks CT: 10m × 17m × 2m × 1 tank 10m × 69m × 2m × 1 tank ST: Dia. 16m × 2 tanks SDB: 10 ha	AT: 30m × 116m × 3m × 8 tanks SST: Dia. 26m × 16 tanks CT: 10m × 86m × 2m × 1 tank ST: Dia. 16m × 2 tanks SDB: 10 ha	AL: West: 61,000 m^2×3m East: 216,000 m^2×3m Total: 277,000 m^2 SL: West: 49,000 m^2×1.5 m East: 172,000 m^2×1.5 m Total: 221,000 m^2 CT: 10m × 86m × 2m ×1 tanks SDB: 5 ha	PST: Dia. 16m × 16 tanks TF: Dia. 47m × 2m × 48 tanks SST: Dia. 23m × 16 tanks CT: 10m × 86m × 2m ×1 tanks ST: Dia. 21m × 2 tanks SD: Dia. 23m × 11m × 2 tanks GH: Dia. 12m × 10m × 1 tank SDB: 10 ha
Allotment of Facilities and Area Requirement	West of planned road: (about 8 ha) — Pumps, wastewater treatment facilities, administration building, power substation	West of planned road: (about 12.7 ha) — Pumps, wastewater treatment facilities (8/10), administration building, power substation	West of planned road: (about 12.7 ha) — Pumps, wastewater treatment facilities, administration building, power substation	West of planned road (about 12.8 ha) — Pumps, administration building, power substation	West of planned road: (about 10.8 ha) — Pumps, wastewater treatment facilities (2/8), administration building, power substation
	East of planned road (about 22 ha) — Sludge treatment facilities, gas holder, sludge drying bed	East of planned road (about 22.4ha) — Wastewater treatment facilities (2/10), sludge treatment facilities, sludge drying bed	East of planned road (about 22.0 ha) — Sludge treatment facilities, sludge drying bed	East of planned road (about 60 ha) — Aerated lagoon, settling lagoon, sludge drying bed	East of planned road: (about 51.0 ha) — Wastewater treatment facilities (6/8), sludge treatment facilities, gas holder, sludge drying bed
	No ceding of natural protection area required for allotment of facilities. Major facilities are concentrated on the west side of planned road. Sludge drying bed only is constructed at eastern side of planned road.	No ceding of natural protection area required for allotment of facilities.	No ceding of natural protection area required for allotment of facilities. Major facilities are concentrated on the west side of planned road. Sludge drying bed only is constructed at eastern side of planned road.	River improvement is inevitable unless protected area can be partly appropriated to treatment facilities.	No ceding of natural protection area required for allotment of facilities.
Environmental impact (represented by CO_2 Emission)[1)]	Medium (200%)	High (280%)	High (260%)	Low (120%)	Low (100%)

	Conventional Activated Sludge Process (CASP)	Oxidation Ditch Process (ODP)	Extended Aeration Process (EAP)	Aerated Lagoon Process (ALP)	Conventional Trickling Filter Process (CTFP)
Construction Cost	50.2 million EUR (100%)	54.5 million EUR (109%)	53.0 million EUR (106%)	68.4 million EUR (136%)	69.5 million EUR (138%)
O&M Cost	1.62 million EUR (100%)	2.66 million EUR (164%)	2.24 million EUR (138%)	0.89 million EUR (55%)	0.95 million EUR (59%)
Annual Cost	4.37 million EUR (100%)	5.64 million EUR (126%)	5.07 million EUR (114%)	3.44 million EUR (79%)	4.55 million EUR (104%)
Site Area	30 ha (100%)	35 ha (117%)	35 ha (117%)	73 ha (243%)	62 ha (207%)
Evaluation	A	C	B	E	D

Note:
PST: Primary Settling Tank SST: Secondary Settling tank OD: Oxidation Ditch SD: Sludge Digester Tank GH: Gas Holder Tank AL: Aeration Lagoon
AT: Aeration Tank CT: Chlorination Tank TF: Trickling Filter ST: Sludge Thickening Tank SDB: Sludge Drying Bed SL: Settling Lagoon

1) Calculation of CO_2 emission are shown in Appendix 6.5

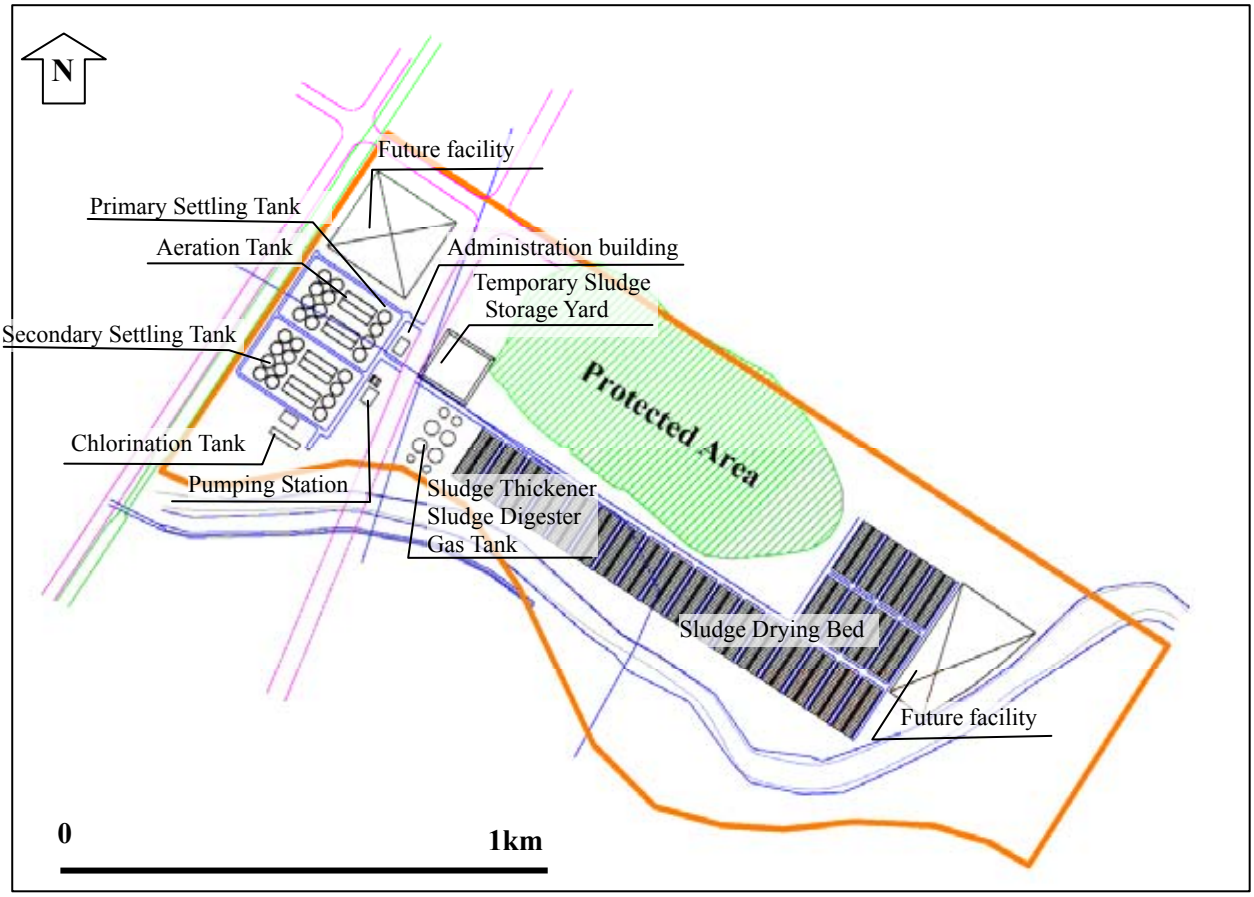


Figure 6.9 Layout of Conventional Activated Sludge Process Facilities

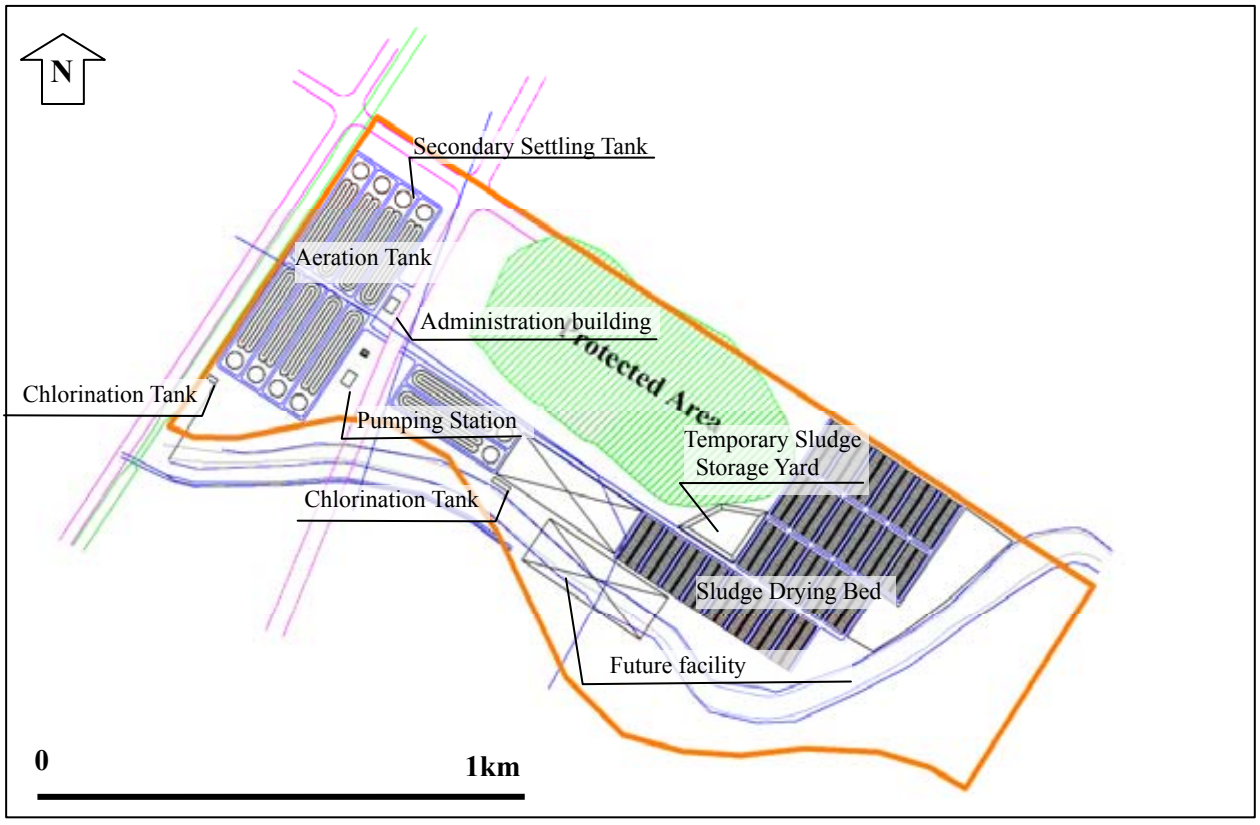


Figure 6.10 Layout of Oxidation Ditch Process Facilities

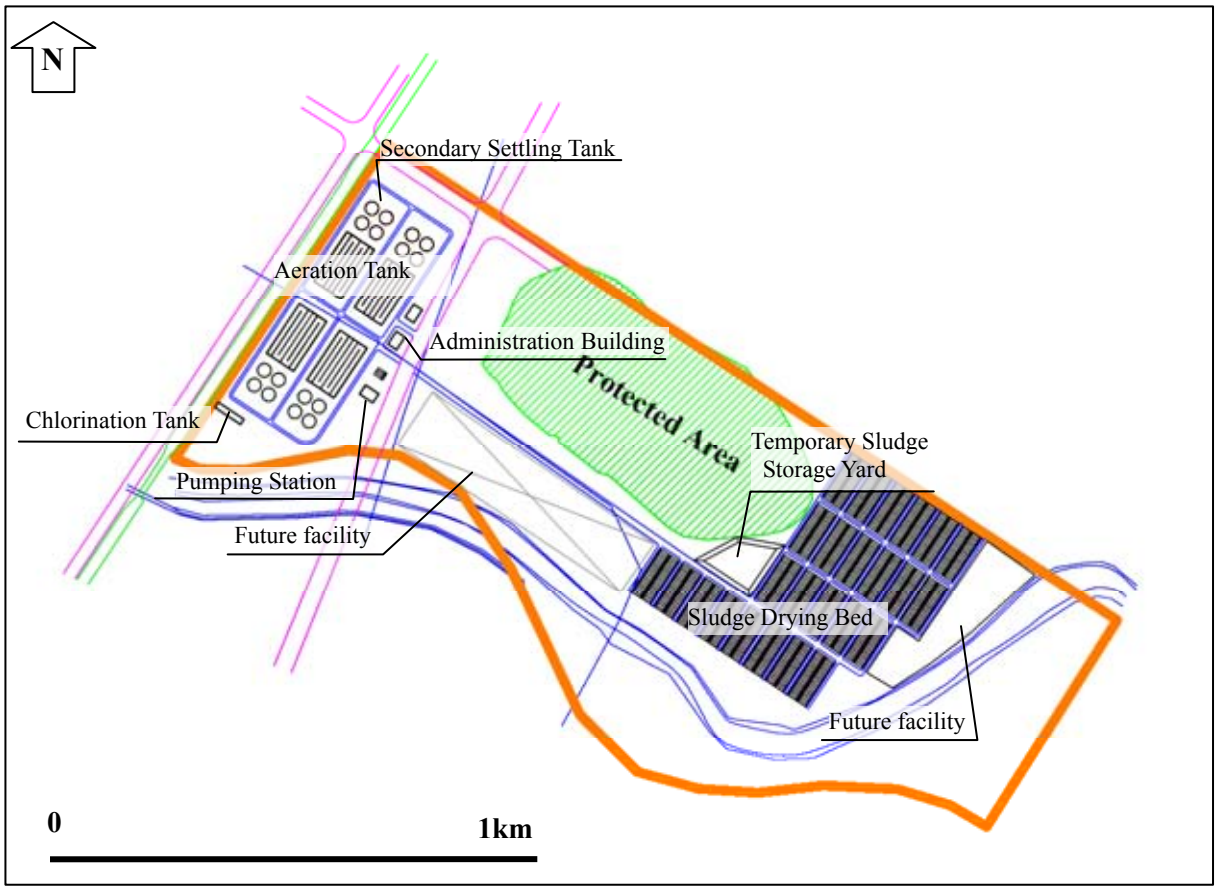


Figure 6.11 Layout of Extended Aeration Process Facilities

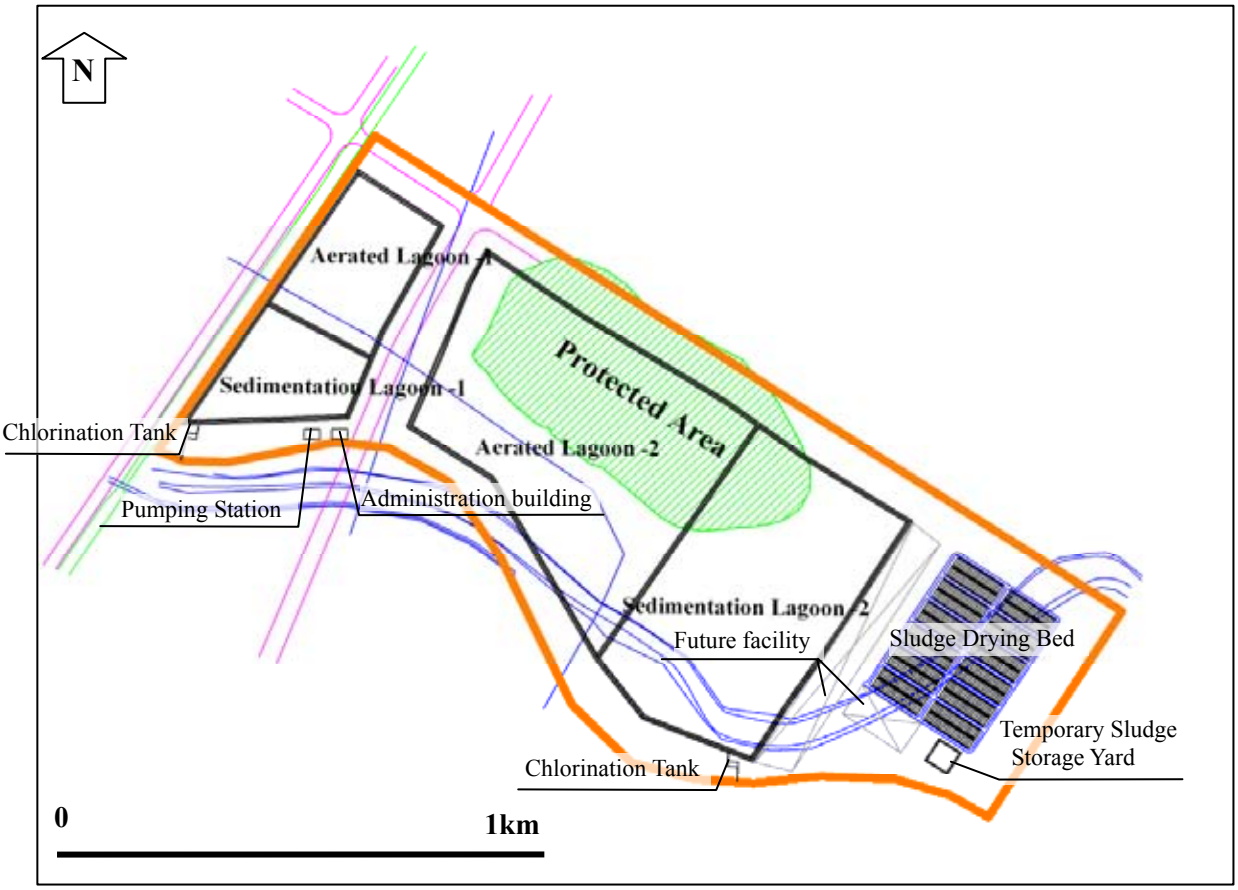


Figure 6.12 Layout of Aerated Lagoon Process Facilities

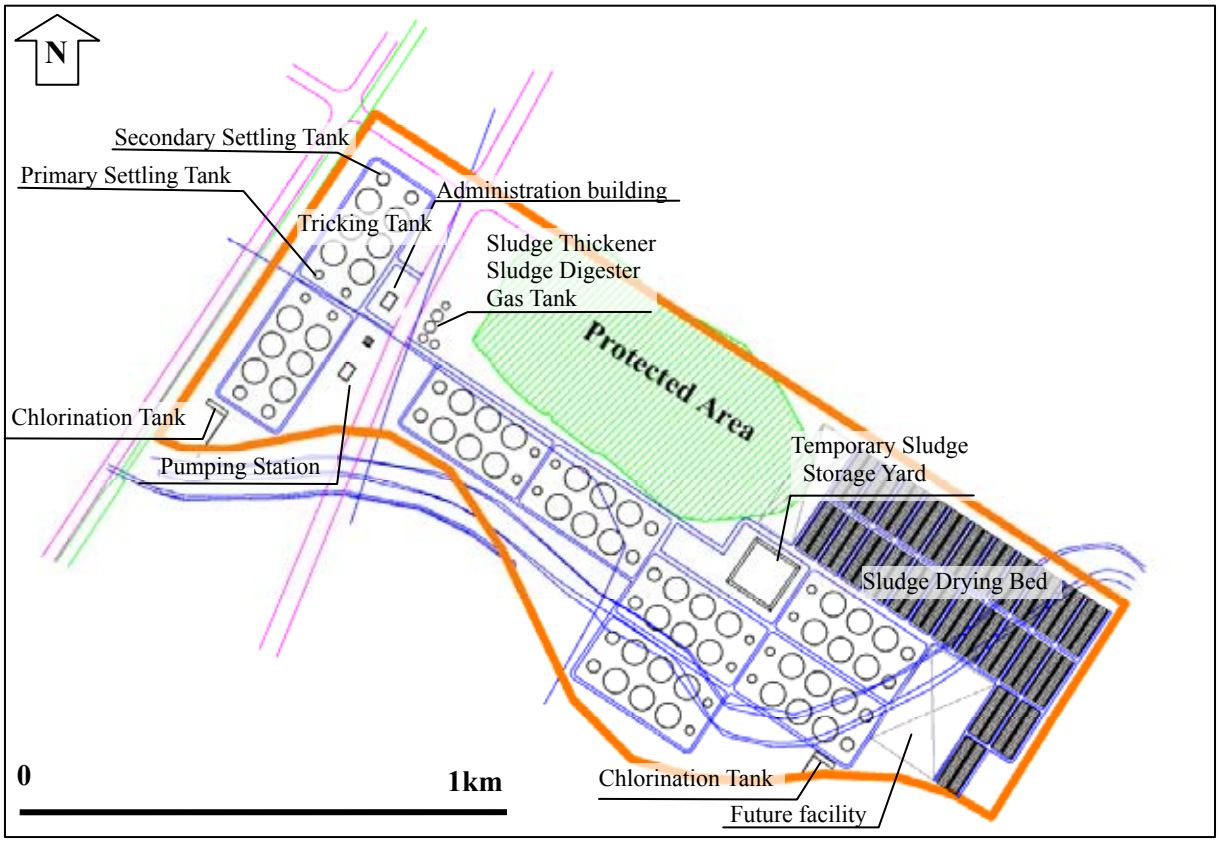


Figure 6.13 Layout of Trickling Filter Process Facilities

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 treatment is somewhat related to global warming in the sense that warming gases such as methane and carbon dioxide are emitted through sludge processing.

(1) Sludge treatment processes

Sludge is treated based on 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

Use of sludge follows its qualitative stabilization including digestion process to get rid of bacteria. Unit processes to fulfill these requirements are as follows.

- Reduction of amount: thickening, dewatering, drying
- Reduction of solids: digestion, incineration, melting
- Qualitative stabilization: digestion, composting, incineration, melting

(2) Comparison between sludge drying and mechanical dewatering

Natural drying and mechanical dewatering are compared in terms of mechanism of dewatering, required site area, cost and characteristics of final product and easiness of operation. In both cases, digestion is done prior to dewatering because of less odor emission of digested sludge.

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. (see Table 6.11 and appendix Part1, 6.4).

Table 6.11 Comparison of Sludge Treatment Processes

	Natural Drying	Mechanical Dewatering	Remarks
Mechanism	Natural dewatering by gravity followed by drying through evaporation by wind	Mechanical dewatering using tension of two layer filter cloth between which the sludge is put	Mechanical dewatering consumes considerable amount of energy and chemicals.
Required Site Area (m^2)	100,000	1,100	Mechanical dewatering requires a building for dewatering equipment.
Moisture Content of Product	About 65%	About 80%	Naturally dried sludge is easier to handle because of lower moisture content
Amount of Product	80 m^3/d	142 m^3/d	Difference in moisture content causes difference in quantity
Easiness of Operation	Laborious sludge scraping is needed but little skill is required.	Skilful operators are needed.	
Construction Cost	7,100,000 EUR	12,000,000 EUR	Including land acquisition and compensation cost
Operation Cost	345,000 EUR/year	1,438,000 EUR/year	Including sludge disposal cost
Annual Cost	457,000 EUR/year	2,120,000 EUR/year	Supposing life time of 50 years for civil works and of 15 years for mechanical and electrical equipment

Note: Breakdown of costs are shown in Appendix 6.4.

Figure 6.14 shows the proposed combination of unit processes mentioned above.

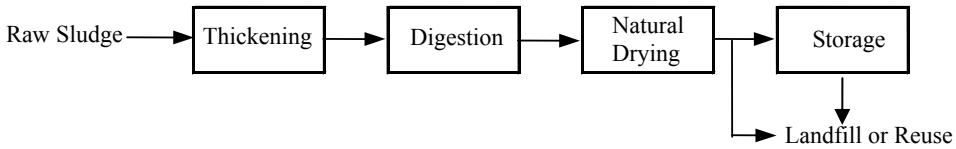


Figure 6.14 Sludge Treatment Process

The influent to central WWTP includes industrial wastewaters. Macedonia has established water quality standard for influent to sewerage facilities in Official Gazette No. 99 which stipulates that industrial wastes have to be treated prior to the discharge to public sewerage system. The influent flowing into central WWTP, however, possibly contains harmful substances and it is necessary to check whether the produced sludge there contains these substances prior to disposal at Drisla disposal site and/or reuse of the sludge. For the time being, it might happen that sludge will not be able to be disposed of at Drisla, and some site might be needed for temporary storage within the plant. Some structure such as concrete wall might be needed for sludge storage from environmental viewpoints. 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.

(3) 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 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 lower that the standards. In this

regard, agricultural use of sludges requires an in depth consultation with environmental and agricultural authorities after checking actual metal concentrations of sludges. Composting dried sludges might be needed depending on the agricultural requirements.

B/P recommends the use of methane gas for heating digesters taking lower atmospheric temperature and easier application into account. Unused excess methane gas in higher temperature season will be burnt to decrease global warming potential and to prevent explosion as well. Table 6.12 shows the constituents of digester gas. Methane gas accounts for 60 to 65 % of the gas. Figure 6.15 shows how to uses methane gas. In colder season, most of methane gas is used to heat digesters for more efficient digestion.

Table 6.12 Constituents of Digester Gas

(v/v %)

Methane	Carbon Dioxide	Hydrogen	Nitrogen	Hydrogen Sulphide
60~65	33~35	0~2	0~3	0.02~0.08

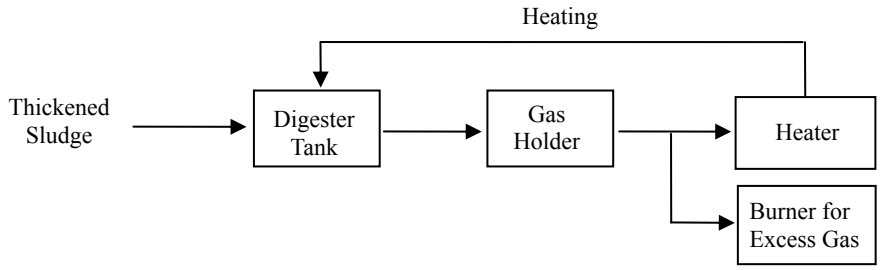


Figure 6.15 Schematic of Methane Use

6.3.6 Wastewater/Sludge Treatment Processes Schematic

Figure 6.16 illustrates wastewater and sludge treatment processes including anaerobic digestion.

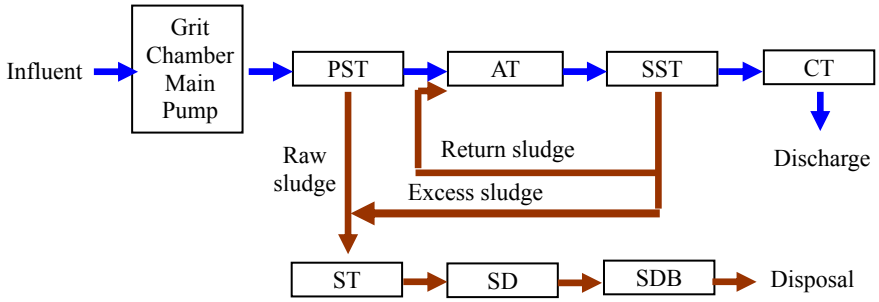


Figure 6.16 Overall Flow Schematic of Central WWTP

6.3.7 Conditions of WWTP site and allotment of treatment facilities

Figure 6.17 illustrates WWTP site and its surroundings. The area surrounded by red line of about 106 ha is designated as Water Economy Facility site 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 western side of the plant site faces the railway embankment. 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. In other words, 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 at the former river area and is designated as nature protection area. It should be avoided to construct any structure of sewerage facilities in the protection area. Two power lines of high tension and one power line of low tension pass through the plant site. Seven pylons exist at the site to support these power lines and it is needed to transfer these pylons along with the lines to allot

treatment facilities with fewer constraints. Though gas pipes and optical fiber cables are laid at the western edge of the site, they do not have to be transferred because sewerage facilities can be allotted staying out of them.

Table 6.13 shows substantially available plot for WWTP that is about 57 ha.

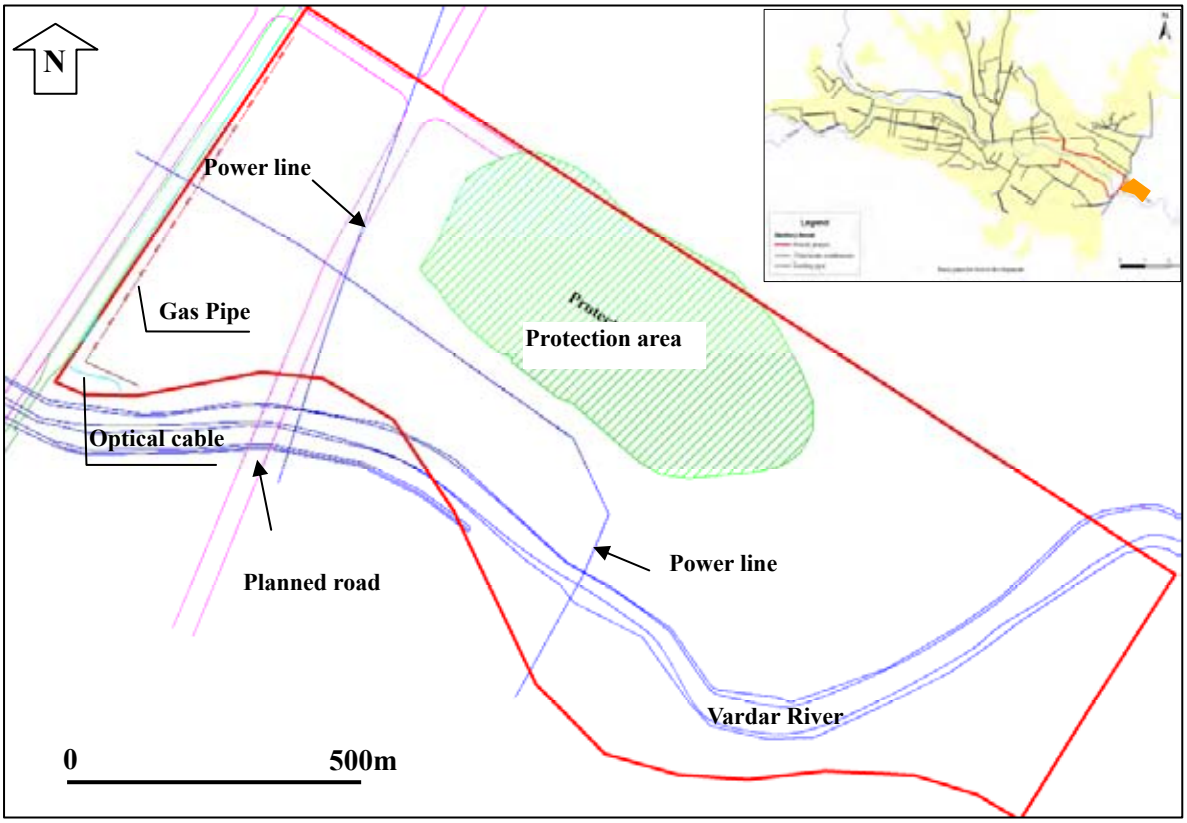


Figure 6.17 Central WWTP Site Conditions

Table 6.13 Available Area of WWTP Site

	Area	Remarks
Water economy facility zone	106 ha	
River area and dyke	-8 ha	River improvement is not foreseeable.
Right bank side of the Vardar River	-18 ha	River improvement is not foreseeable.
Planned road	-3 ha	W32m × L850m
Protection area	-20 ha	
Substantially available land	57 ha	

Table 6.14 shows necessary areas to allot to respective facilities and Figure 6.18 shows the location of allotted facilities.

Table 6.14 Necessary Areas to be Allotted to Respective Treatment Facilities

Name of Zone	Major Facilities	Location	Necessary Areas (ha)
Common	Administration building, Power substation Grit chamber/Pumping	Western side	2.0 ha
Wastewater Treatment	PST, AT, SST, CT	Western side	6.0 ha
Sludge Treatment	ST, SD and its associated equipment, GH	Western side	2.0 ha
Drying Bed	SDB	Eastern side	18.0 ha
Green Buffer	Road within the plant, trees	Whole	-
Total			28.0 ha +Green buffer zone

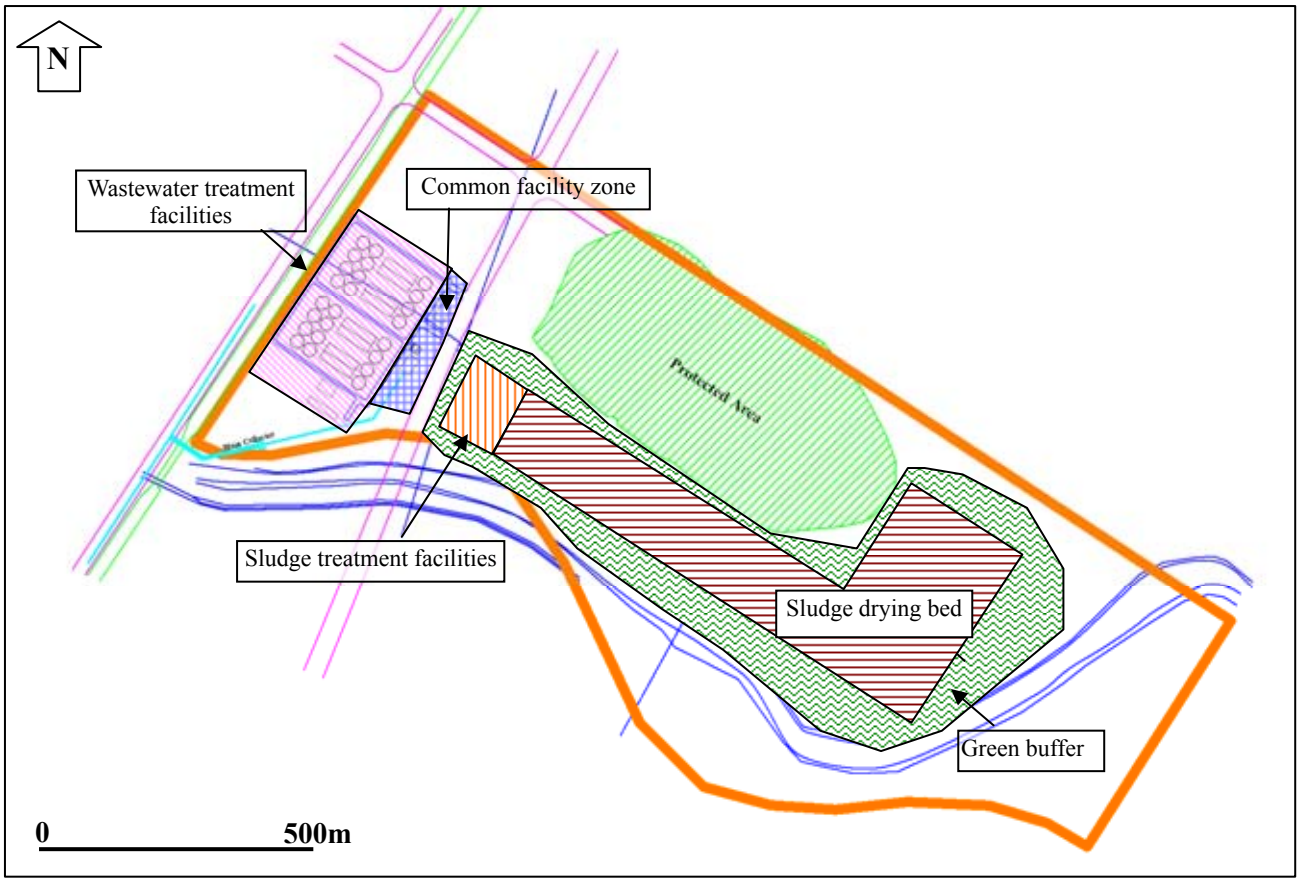


Figure 6.18 Facilities Allotment of Central WWTP

6.3.8 Access Road

The land for the access road construction is difficult to secure because the plant site is surrounded by railway embankment at northern and western sides and by the Vardar River at southern and eastern sides as detailed in Table 6.15.

The consultation with Skopje City concluded that the access road for temporary use would be constructed from the north-eastern side of the WWTP site to the site crossing the railway at the same level as that of the railway embankment.

Table 6.15 Conditions of Access Road

	Constraints	Explanation
Northern Side	Railway Embankment	Railway embankment is situated 400m north of the site boundary. There is a road crossing under the railway and trucks can pass. However, the clearance is not enough for large construction machineries to pass. It is needed to construct the access road between the trunk road at north and the railway and between the railway and the site boundary.
Western Side	Railway Embankment	There exists railway embankment along the site boundary. There is no path under the embankment and it is impossible to access.
Southern and Eastern Sides	Vardar River	It might be possible to use the path at the high water level bank of the river. It is not easy for heavy construction machineries to pass under the railway bridge because of small clearance. Besides, it is necessary for vehicles to get across the river embankment of 1000 year return period from the existing road to the path at high water level embankment. (very steep slope)

6.4 Outline of Sewerage Facilities and Project Cost

6.4.1 Outline of Facilities

Sewerage facilities for Feasibility Study include interceptors 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 6.16 outlines above mentioned facilities.

Table 6.16 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)
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

Breakdown of the project cost is as follows.

- Project cost consists of construction cost, administration cost, engineering cost, contingencies (physical and price), land acquisition and compensation cost and relevant taxes.
- Project cost is estimated for each of LC (local currency portin) and FC (foreign currency portion).
- Project administration cost in Macedonia 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 costs, 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 anuual price increase index in Macedonai 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.
- The present currency of Macedonia is Denar, but is strongly affected by Euro.

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 the equipment is imported in principle.
- Land acquisition and compensation 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.
- No pumping station is needed along the interceptor route because the available elevation data shows that sewage can be conveyed to WWTP site by gravity.

6.4.4 Project cost

The total project cost is 116 million EUR (18.9 billion Yen) including customs and tax and 97.7 million EUR (15.9 billion Yen) excluding customs and tax, respectively. Table 6.17 shows the breakdown of the project cost.

Table 6.17 Breakdown of Project Cost

No.	Item	Local Currency (EUR)	Foreign Currency (EUR)	Total (Euro)
1.	Construction Cost			
A	Collection System			
A.1	Trunk Sewers	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
	Sub-total (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
5.	Price Contingency	8,631,000	3,716,000	12,347,000
6.	Land Acquisition and Compensation Cost	8,550,000	0	8,550,000
7.	Others (Accesses 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
	Sub-total (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.

- 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 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.

Table 6.18 Operation and Maintenance Costs

Item	O& M Costs (EUR/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 at advanced level are roughly designed and their dimensions are computed. Advanced treatment modifying 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.(see Figure 6.19) 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.

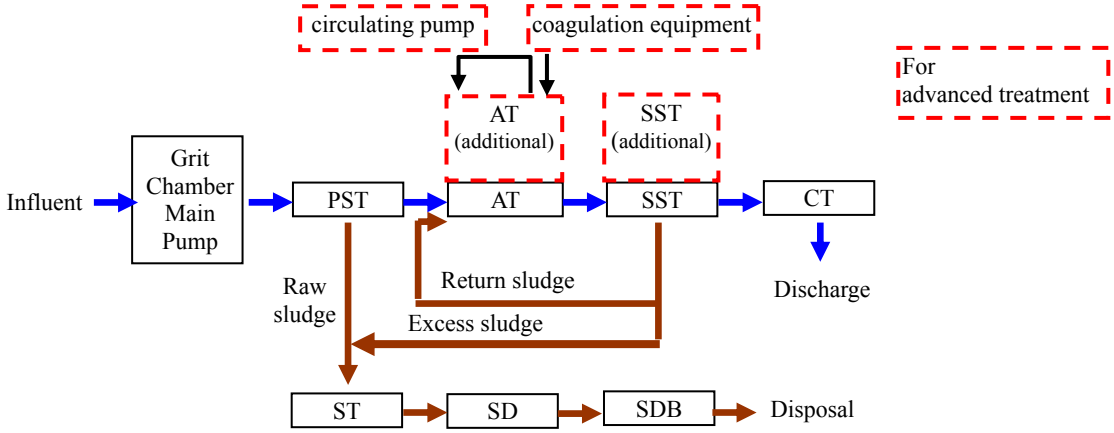


Figure 6.19 Overall Flow Schematic of Central WWTP (Advanced Treatment)

Advanced treatment
Treatment Process: Polymer added biological nitrification and denitrification process
Average daily flow: 166,000m^3/d

Table 6.19 Dimensions of Additional 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 are allotted as shown in Figure 6.20

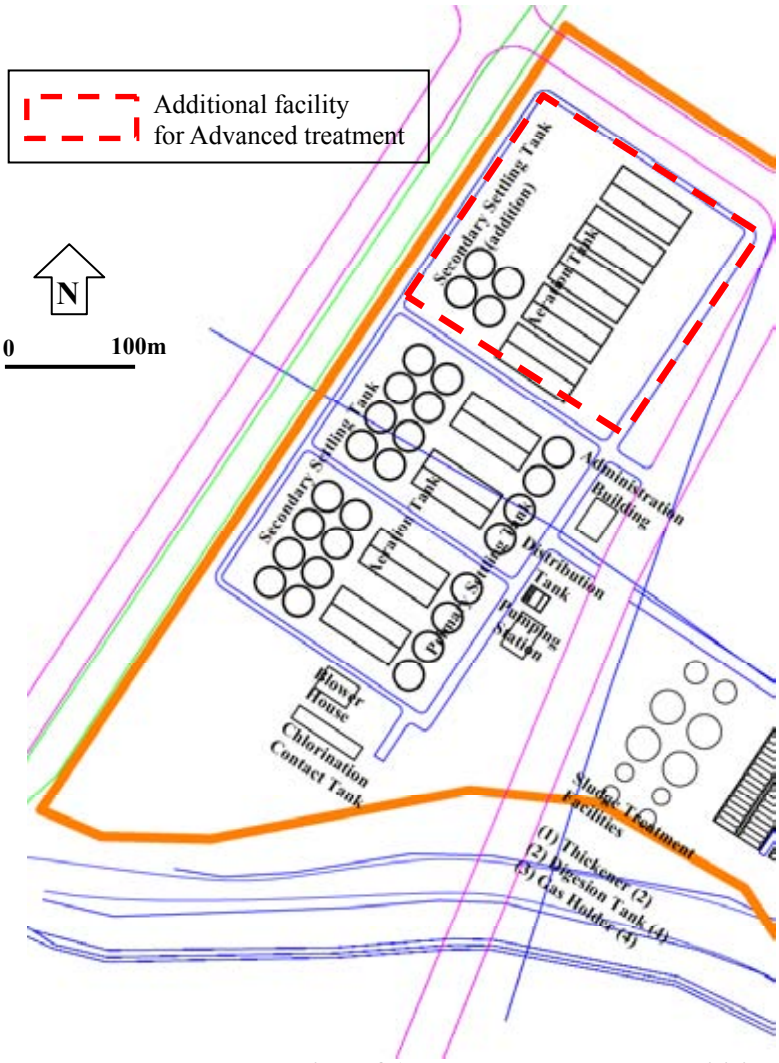


Figure 6.20 Location of Advanced Treatment Facilities

Project and O&M costs for advanced treatment facilities are estimated and shown in Table 6.20 and Table 6.21, respectively.

Table 6.20 Breakdown of Project Cost (Advanced Treatment)

No.	Item	Local Currency (EUR)	Foreign Currency (EUR)	Total (EUR)
1.	Construction Cost			
A	Collection System			
A.1	Trunk Sewers	7,430,000	0	7,430,000
B	Treatment System			
B.1	Wastewater Treatment Facilities	23,144,000	21,103,000	44,247,000
B.2	Sludge Treatment Facilities	11,808,000	6,555,000	18,363,000
	Sub-Total (1)	**42,382,000**	**27,658,000**	**70,040,000**
2.	Administration Cost	1,807,000	0	1,807,000
3.	Engineering Cost	5,465,000	3,412,000	8,877,000
4.	Physical Contingency	4,238,000	2,766,000	7,004,000
5.	Price Contingency	9,208,000	5,660,000	14,868,000
6.	Land Acquisition and Compensation Cost	8,550,000	0	8,550,000
7.	Others (Accesses Road and Others)	948,000	0	948,000
8.	Customs/Tax	22,788,000	0	22,788,000
9.	Interest during Construction	5,920,000	2,451,0000	8,371,000
	Sub-Total (2)	**58,924,000**	**14,289,000**	**73,213,000**
	Total (including customs/tax)	**101,306,000**	**41,947,000**	**143,253,000**
	Total (excluding customs/tax)	**78,518,000**	**41,947,000**	**120,465,000**

Table 6.21 Operation and Maintenance Costs (Advanced Treatment)

Item	O& M Costs (EUR/year)
Personnel Cost	165,000
Consumables Cost	2,851,600
Sludge disposal Cost	332,100
Spare parts Cost	305,500
Sewer cleaning Cost	2,200
Total	**3,656,400**

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. As mentioned in the review of the existing plans, municipalities of Saraj, North Gorce Petrov and Dracevo have tried to improve environmental condition including the preparation of public sewerage master plan. 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. This river 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.

CHAPTER 7 ENVIRONMENTAL AND SOCIAL CONSIDERATIONS

7.1 Purpose and Level of Environmental and Social Considerations

7.1.1 Purpose

The purpose of the Environmental and Social Considerations (IEE Level[1]) 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) should also be taken into account.

The JICA Study Team is assisting the Skopje City as an investor to consider the environmental and social aspects of this study. The role of the JICA Study Team is to:

- Help Skopje City implement the proper environmental and social considerations,
- Prepare the Basic Plan and select priority project(s) which will not cause significant negative environmental or social impacts,
- Assist Skopje City to consult with stakeholders while preparing the Basic Plan and conducting the Feasibility Study to foster support for the projects,
- Ensure positive information disclosure for accountability and promotion of participation of various stakeholders.

7.1.2 Level of Consideration Required by JICA

The Preparatory Study (which was conducted by JICA in 2007) concluded that this study requires considerations of environmental and social assessment. The categorization[2] is in accordance with JICA's Guidelines for Environmental and Social Considerations, which were revised in 2004. In the assessment conducted in Preparatory Study, some environmental items were evaluated as 'A' such as water pollution and involuntary resettlement. In addition to this, 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.

7.1.3 EIA Requirement by Macedonia

The projects which are subject to EIA are specified by Macedonian Laws and Regulations (See section 6.2.1 for detail). According to the laws and regulations, wastewater treatment plants with a capacity exceeding 100,000 person equivalents are subjects to EIA and EIA should be carried out in the Feasibility Study stage[3]. The priority project(s) which is selected at the end of the Basic Plan stage include the wastewater treatment plant with capacity more than 100,000 persons equivalent, thus EIA level study[4] should be carried out at the Feasibility Study stage according to Macedonian laws and regulations.

7.1.4 Implementation Schedule

The implementation schedule of environmental and social considerations based on Macedonian laws and regulations and JICA's Guidelines is illustrated in Figure 7.1.

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[1] "Initial Environmental Examination (IEE) level study" means a study including analysis of alternative plans, prediction and assessment of environmental impacts, and preparation of mitigation measures and monitoring plans on the basis of secondary data and simple field surveys.

[2] Based on the JICA Guidelines, the proposed projects are classified into one of three categories: A, B or C. The project classified as Category A is likely to have significant adverse impacts, and the project classified as Category B is likely to have less adverse impacts than those of Category A project. The project classified as Category C is likely to have minimal or no adverse impacts.

[3] The timing of EIA is mentioned as "Projects that are subject to environmental impact assessment before development consent can be given", and "EIA shall be carried out before decision on approval or non approval of the application for project realization is taken by the MEPP". JICA Study Team discussed with MEPP about the timing of EIA for this project and it is concluded that EIA should be conducted during F/S stage.

[4] "Environmental Impact Assessment (EIA) level study" means a study including analysis of alternative plans, prediction and assessment of environmental impacts, and preparation of mitigation measures and monitoring plans on the basis of detailed field surveys.

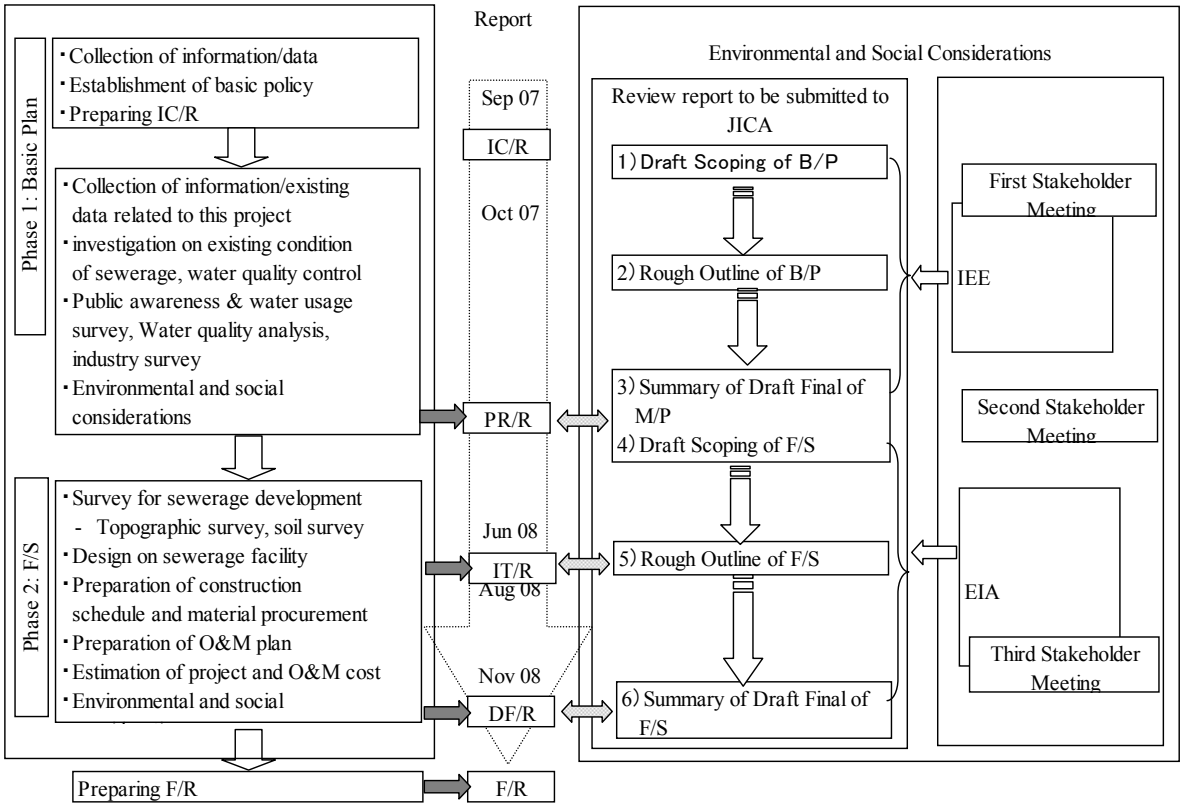


Figure 7.1 Implementation Schedule of Environmental and Social Considerations

The stakeholder meetings were organized two times in the B/P, and one time in the F/S period and, the schedule and agenda of each stakeholder meeting are shown in table below.

Table 7.1 Stakeholder Meetings in Basic Plan and F/S Stage

	First	Second	Third
	Basic Plan Stage		F/S Stage
Schedule	9 Nov. 2007	22 Feb. 2008	16 Oct. 2008
Agenda	• Introduction of JICA Study (background, objectives, schedule, etc.) • Explanation of environmental and social considerations (objectives, content, schedule, etc.) • Results of draft scoping of Basic Plan and TOR	• Contents of Basic Plan • Results of IEE level study (alternative study, impact and mitigation measure, monitoring plan, etc.) • Priority project for F/S • Results of draft scoping of F/S and TOR	• Results of F/S • Results of EIA study (alternatives, impact and mitigation measure, monitoring plan, risk analysis, etc.)
Participant	• Central government (MTC, MEPP, MAFWE) • Skopje City, Municipalities, Vodovod • People who live near proposed WWTP, people who will be affected by project • Industries • NGOs working in environmental field, university, institutions • International Donor Agencies		

7.2 Legal Framework of Environmental and Social Considerations

7.2.1 Laws and Regulations on EIA

EIA of certain projects is required to be carried out in Macedonia in accordance with Articles 76-94 of the *Law on Environment* of June 2005 (Official Gazette No. 53/2005). The types of projects that require an EIA are to be determined in accordance with Article 77 of the Law on Environment which are specified in the "*Decree for Determining Projects for which and criteria on the basis of which the screening for an environmental impact assessment shall be carried out*" (Official Gazette No. 74/2005). Projects are classified in two groups: all the projects listed in Annex I are subject to compulsory EIA while the projects listed in Annex II require screening procedure based on whether the project, because of its type, scale or location, is likely to have significant potential negative impacts on environment. EIA shall be carried out before decision on approval or non-approval of the application for project realization is taken by the MEPP.

7.2.2 EIA Process in Macedonia

The EIA procedure consists of several steps or phases, which includes notification on the intention of the project implementation, screening, scoping, assessment and evaluation of the direct and indirect impact on the environment resulting from the project implementation or non-implementation. The impact of the project on the environment is assessed in accordance with the status of the environment in affected area at the time of submission of the notification on the intention to carry out the project. For assessing the project environmental impact, the following points are taken into consideration:

- the project preparation, execution, implementation and completion, including the results and effects arising from the implementation of the project,
- removal of the polluting substances and restoration of the affected area into its original condition, if such obligation is prescribed by special regulation, and
- normal functioning of the project, as well as the likelihood of accidents.

(1) Notification on the intention for project implementation

The investor shall submit the notification on their intention to implement the project, together with an opinion of the need of EIA to MEPP. The information that is needed to be incorporated in the notification is described in the *"Ordinance on the information contained in the notification of intent to implement a project and the procedure for determining the need for environmental impact assessment of a project"* (Official Gazette no. 33/06). MEEP informs the investor within 10 days from the date of the receipt of the notification on the need for supplementing the notification if it is incomplete. MEPP, within five working days of the receipt of the full notification, is obliged to publish the notification in at least one daily newspaper available throughout the territory of Macedonia, and on the website of the MEPP.

(2) Screening (determining whether an EIA is required)

Screening is a stage of EIA process during which the MEPP determines whether an EIA is required for a certain project when a notification on the project implementation intention is made. The specific content and the procedure to conduct screening is prescribed in the *"Decree on determining projects for which and criteria on the basis of which the screening for EIA"* (official Gazette No. 74/05). After receiving a full notification, the MEPP is supposed to complete the screening procedure within 30 days from the date of receipt, and inform the investor about its decision whether an EIA should be carried out or not. The decision is to be published, within five days from the date of issuance, in at least one daily newspaper and on the website of MEPP. Within eight days from the date of publication of the decision, the investor, the legal entities or natural persons concerned as well as the citizens' associations established for the purpose of environmental protection and improvement may lodge an appeal against the decision to the Second Instance Commission of the Government of the Macedonia that is responsible for resolution of administrative matters in the area of environment.

(3) Scoping

The scoping stage is the process during which the MEPP determines the content and extent of the matters which should be covered in the EIA report. The purpose of the scoping is to inform the

investor of the issues that the final report on EIA study should respond to. For determining the scope of the EIA study, the MEPP may authorize persons from the List of Experts[5]. In drafting the contents on the scope of EIA study, the MEPP shall take into account the opinions of the investor and the opinions obtained after publication of the decision for screening.

Once scoping is completed, the EIA study can be undertaken. The investor prepares EIA report and submits it to the MEPP in written and electronic form. The specific contents of the EIA report are described in Appendix 7.1.2 Requirements for EIA report. The investor is obliged to engage at least one person from the List of Experts, who shall sign the study as a responsible person with regard to its quality. Within five days from the receipt or completion of EIA report, the MEPP publishes the EIA report and announces that the EIA study has been prepared and is available to the public. Any person may submit their opinion in written form to the MEPP within 30 days from the date of publication of the EIA report. If the submitted report does not contain the requirements, the MEPP shall return the study to the investor and shall set a term for its supplement or revision which may not be longer than 40 days from the date of receipt of the study.

(4) EIA Reviewing

After the submission of EIA study, the EIA process continues with the review stage. Review is the process of checking the adequacy of the EIA study. The report on the adequacy of the EIA study is prepared by the MEPP or by persons appointed thereby from the List of Experts. The report on the adequacy states whether the EIA study fulfils the requirements, proposes the conditions which should be set out in the permit for the project implementation, as well as measures for prevention and reduction of harmful impacts. The term for preparation of the adequacy report is not longer than 60 days from the date of the submission of EIA report. During the review stage, the MEPP is obliged to organize a public hearing at least 5 days before the expiry of the term referred above, and ensure availability of information needed to the public. If certain deficiencies are found out in the EIA study in the course of the review and evaluation, the MEPP shall return the study to the investor, who shall supplement with the required information and finalize it within not more than 30 days.

On the basis of the EIA report, the report on the adequacy of the EIA study, the public debate and the opinions obtained, the MEPP issues a decision on whether or not to grant consent for the application of the project implementation within 40 days from the date of submission of the report on the adequacy of EIA study. The decision contains assessment of whether the EIA study fulfils the requirement, and the permit conditions for the project implementation. It also includes information on measures for prevention and reduction of the harmful effects especially (i) prevention against harmful impact on the environment resulting from the project implementation, (ii) prevention, limitation, mitigation or reduction of harmful impacts, (iii) enhancement of the favourable impacts on the environment resulting from the project implementation, and (iv) evaluation of the expected effects from the proposed measures. The MEPP, within five days from the day of issuance of the decision, submits the decision to the investor, to the body of the state administration responsible for issuance of permit or decision for the project implementation and to the municipality or the City of Skopje, the territory where the project would be implemented. The decision has to be published in at least one daily newspaper available throughout the country, on the website as well as on the notice board of the MEPP. This decision ceases to have a legal effect within two years from the date of its issuance.

(5) Public Hearing

The MEPP shall provide a public hearing during the preparation of the report on adequacy of EIA study, and ensure availability of information needed to the public for participation in the public hearing. This information on public hearing should also be provided to citizens' associations established for the purpose of environment protection and improvement in the project area. The MEPP shall prepare minutes of the public hearing containing the list of participants as well as the

[5] According to the Law on Environment, MEPP has to prepare the list of experts who will evaluate the EIA report. The EIA experts have to have the technical knowledge at an expert level in the field of environment and have a minimum of five years experience. The list of experts is not prepared in March 2007.

conclusions, and stenographic notes and video or audio records of the hearing should be attached to the minutes. Information protected under special regulations shall not be discussed in the public hearing.

7.2.3 Expropriation of Private Property

The Law on Expropriation (Official Gazette No. 33/95, 20/98, 40/99, 31/03, 46/05) regulates the expropriation of the property ownership and rights (real-estate) for the purpose of construction of facilities and other issues of public interest, establishment of the public interest and assigning the righteous compensation for the expropriated realty, calculated based on the market value of the real-estate.

Public interest means the organization, rational use and special humanization, as well as the protection and improvement of the environment by construction of facilities according to the special plans.

The procedure starts with the submission of a request for expropriation by the user of the expropriated land to the responsible authority for expropriation; the administration for property affairs. This is followed by a hearing to which the owner of the real-estate and user of the expropriation are invited, and concludes with the issuance of a decision for accepting or rejecting the request for expropriation, issued by the responsible authority.

The compensation for expropriated land is settled by providing land that represents a suitable replacement for the expropriated land in terms of size, quality and location. In cases when expropriation beneficiaries are unable to provide suitable land or in some other circumstances (such as massive expropriations, expropriation of small lot portions), the compensation shall be settled in cash.

7.3 Initial Environmental Examination (IEE)

7.3.1 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 study on IEE was undertaken with the purpose of (1) knowing the existing social and natural environmental conditions of the Study area, and (2) identifying constraints and problems for the basic plan project.

7.3.2 Proposed Project

Based on the review of the existing plans and facilities, new facilities with cost estimations are planned. As a result, facilities for four independent treatment/sewer districts are planned. Their main features are shown in Figure 7.2 and Table 7.2 (see Chapter 5 and 6 for detail).

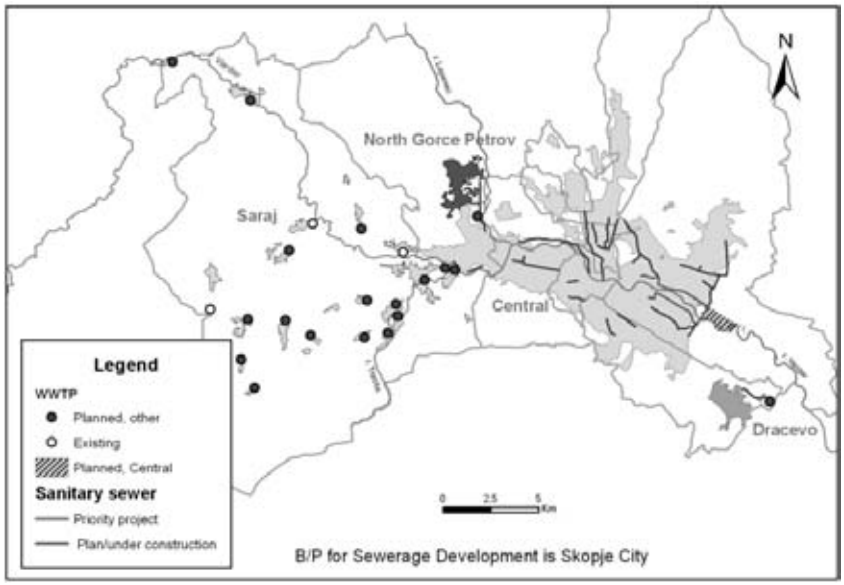


Figure 7.2 Basic Plan for Sewerage Development in Skopje

Table 7.2 Contents of Basic Plan

	Central Treatment District	Saraj Treatment District	North Gorce Petrov Treatment District	Dracevo Treatment District
Target Year WWTP Collector	 2020 2030	 2025 2035	 - 2030	 - -
Design Population	513,570 (p)	56,721 (p)	16,000 (PE)	30,000 (PE)
Service Area	72.8 km^2	7.5 km^2	3.2 km^2	4.0 km^2
Capacity of WWTP	166,000 (m^3/d)	62,395 (PE)	17,000 (m^3/d)	16,200 (m^3/d)
Wastewater treatment process	Conventional Activated Sludge Process (CASP)	Aerobic biological wastewater treatment (Bio-aeration pools)	Not yet decided	Contact Stabilization Process
Sewer	ϕ 1,000mm～ ϕ 1,800mm Total Length 8,660m	～ ϕ 500mm Total Length 80,400m	ϕ 600mm Total Length 2,500m	ϕ 700mm Total Length 944m
Executing Agencies	MTC, Skopje City, MEPP	Saraj Municipality	Georce Petrov Municipality	KiselaVoda Municipality
Current Situation (main finance source)	May 2009: completion of F/S (JICA)	February 2008: completion of preliminary D/D (Government of Norway)	End of 2008: completion of trunk sewers' construction (Government of Macedonia)	January 2007: Completion of preliminary D/D (own finance)
Cost	97.7 million Euros	11.4 million Euros	0.4 million Euros （sewer only）	3.5 million Euros

Note: p denotes population in number, PE denotes population equivalent in number

7.3.3 Scoping

In the "Guidance for conducting screening, scoping and review in environmental impact assessment" prepared by Environmental Management Strengthening Project funded by EU, scoping checklist is provided. This scoping checklist is used to assess what type and magnitude of impacts will be resulting by this project (see Appendix 7.3.1). The summary is presented in the Table below.

The assessment of the environmental impacts is made using several criteria in order to identify the significance of the impact taking into account following impact parameters: the type of impact (direct or indirect effect), magnitude (low, medium, high), extent or location where the impact occurs (area, volume or dispersion), timing when the impact occurs (immediate or delayed), duration of the impact (short, medium or long-term), reversibility of the impact (reversible or irreversible), likelihood of an impact (certain, probably or unlikely) and the border of significance (global, transboundary, regional or local).

Table 7.3 Results of the Scoping

Environment	Construction Phase: Type of the Impact	Positive (+) or Negative (-)	Magnitude	Extent / Location where the impact occurs	Timing when the impact occurs	Duration of an impact	Reverersible/ Irreversible	Likelyhood of an impact	Significance	Impact	Operational Phase: Type of the Impact	Positive (+) or Negative (-)	Magnitude	Extent / Location where the impact	Timing when the impact occurs	Duration of an impact	Reverersible/ Irreversible	Likelyhood of an impact	Significance	Impact
Physical / Natural Environment																				
Topography and geology	-	-	-	-	-	-	-	-	-	No impact	-	-	-	-	-	-	-	-	-	No impact
Groundwater	direct	negative	low	area	immediate	short-term	reversible	probable	local	B (-)	direct	positive	high	area	immediate	long-term	reversible	certain	national	A (+)
Bottom Sediment	direct	negative	low	area	immediate	short-term	reversible	probable	local	Negligible impact	direct	negative	low	area	immediate	short-term	reversible	unlikely	local	Negligible impact
Hydrological situation	direct	negative	low	volume	immediate	short-term	irreversible	probable	national	Negligible impact	direct	positive	high	volume	immediate	short-term	irreversible	certain	national	Negligible impact
Wildlife and Ecosystem	direct	negative	low	area	immediate	short-term	irreversible	unlikely	local	B (-)	direct	positive	high	area	immediate	long-term	irreversible	certain	local	B (+)
Meteorology	-	-	-	-	-	-	-	-	-	No impact	-	-	-	-	-	-	-	-	-	No impact
Landscape and visual environment	direct	negative	low	area/volume	immediate	short-term	irreversible	probable	local	B (-)	direct	negative	low	area/volume	immediate	long-term	irreversible	probably	local	Negligible impact
Protected Area	indirect	negative	medium	area	immediate	long-term	irreversible	probable	local	B (-)	indirect	negative	low	area	immediate	long-term	irreversible	probable	local	C (-)
Water and energy resources	direct	negative	medium	area	immediate	short-term	irreversible	probable	local	B (-)	direct	negative	high	area	immediate	long-term	irreversible	certain	local	B (-)
Global Warming	indirect	negative	low	area/volume	delayed	medium-term	irreversible	probable	national	Negligible impact	indirect	negative	medium	volume	delayed	medium-term	irreversible	unlikely	national	Negligible impact
Public Hazardous Elements																				
Air quality	direct	negative	high	area/volume	immediate	short-term	reversible	certain	local	B (-)	direct	negative	high	area/volume	immediate	short-term	reversible	certain	local	B (-)
Water quality	direct	negative	low	area/volume	immediate	short-term	irreversible	unlikely	local	Negligible impact	direct	positive	high	area	immediate	long-term	reversible	certain	transboundar y	A (+), B(-)
Soil pollution	cumulative	negative	low	dispersion	delayed	long-term	reversible	probable	local	B (-)	cumulative	negative	medium	dispersion	immediate	long-term	reversible	probable	local	B (-)
Waste (construction)	direct	negative	high	area/volume	immediate	long-term	reversible	certain	local	A (-)	direct	negative	low	area/volume	immediate	short-term	reversible	unlikely	local	Negligible impact
Waste (sewage sludge)	-	-	-	-	-	-	-	-	-	No impact	cumulative	negative	high	area/volume	immediate	long-term	reversible	certain	regional	A (-)
Noise and Vibration	direct	negative	high	area	immediate	long-term	irreversible	certain	local	B (-)	direct	negative	low	area	immediate	long-term	irreversible	unlikely	local	B (-)
Ground subsidence	direct	negative	low	area	delayed	long-term	irreversible	unlikely	local	C (-)	-	-	-	-	-	-	-	-	-	No impact
Offensive odors	-	-	-	-	-	-	-	-	-	No impact	direct	negative	high	dispersion	immediate	long-term	reversible	certain	regional	A (-)
Social Environment																				
Involuntary resettlement and Land acquisition	direct	negative	high	area	immediate	long-term	irreversible	certain	local	A (-)	-	-	-	-	-	-	-	-	-	No impact
Livelihood and local economy	indirect	positive	high	area	immediate	long-term	reversible	certain	local	B (+)	indirect	positive	high	area	immediate	long-term	reversible	certain	regional	B (+)
Change in land use and local resources	direct	negative	medium	area	immediate	medium-term	irreversible	probably	local	A (-)	direct	positive	medium	area	immediate	medium-term	irreversible	probable	regional	C (-)
Social institutions	indirect	positive	low	dispersion	delayed	long-term	reversible	unlikely	local	C(+)	indirect	positive	low	dispersion	delayed	long-term	reversible	unlikely	local	C(+)
Local decision-making institutions	indirect	positive	high	dispersion	immediate	long-term	reversible	certain	local	B (+)	indirect	positive	medium	dispersion	immediate	long-term	reversible	certain	local	B (+)
Existing social infrastructure and services	indirect	negative	low	area	immediate	short-term	reversible	probable	local	B (-)	-	-	-	-	-	-	-	-	-	No impact
Public Health and safety	direct	negative	low	area	immediate	short-term	reversible	unlikely	local	B (-)	direct	positive	high	area	immediate	long-term	reversible	certain	national	B (+)
Socially vulnerable groups	-	-	-	-	-	-	-	-	-	No impact	-	-	-	-	-	-	-	-	-	No impact
Cultural, historical heritage	-	-	-	-	-	-	-	-	-	No impact	-	-	-	-	-	-	-	-	-	No impact
Gender, children's rights	-	-	-	-	-	-	-	-	-	No impact	-	-	-	-	-	-	-	-	-	No impact
Misdistribution of benefit and damage	-	-	-	-	-	-	-	-	-	No impact	direct	negative	medium	dispersion	immediate	long-term	reversible	probable	regional	B (-)
Local conflicts of interest	direct	negative	low	area	immediate	short-term	reversible	unlikely	local	B (-)	direct	negative	low	area	immediate	short-term	reversible	unlikely	local	Negligible impact
Water use	direct	negative	medium	area	immediate	short-term	irreversible	probable	local	Negligible impact	direct	positive	high	area	immediate	long-term	reversible	certain	transboundar y	A (+)
Infectious diseases	indirect	negative	low	dispersion	delayed	short-term	reversible	unlikely	local	Negligible impact	indirect	negative	low	dispersion	delayed	long-term	reversible	certain	national	Negligible impact

Legend/Level of categories:
Impact Score: A- Large impact; B-Medium impact; C-Uncertain impact
Type of an impact: Direct; Indirect; Cumulative
Magnitude: High; Medium; Low
Extent/Location:Area; Volume; Dispersion
Timing: Immediate; Delayed
Duration: Short-term; Medium-term; Long-term
Reversibility: Reversible; Irreversible
Likelihood of an impact: Certain; Probable; Unlikely
Significance: Local; Regional; National;Transboundary; Global

7.3.4 Analysis of Alternatives

(1) With/Without Project

With the project, it is expected that following positive impacts would result.

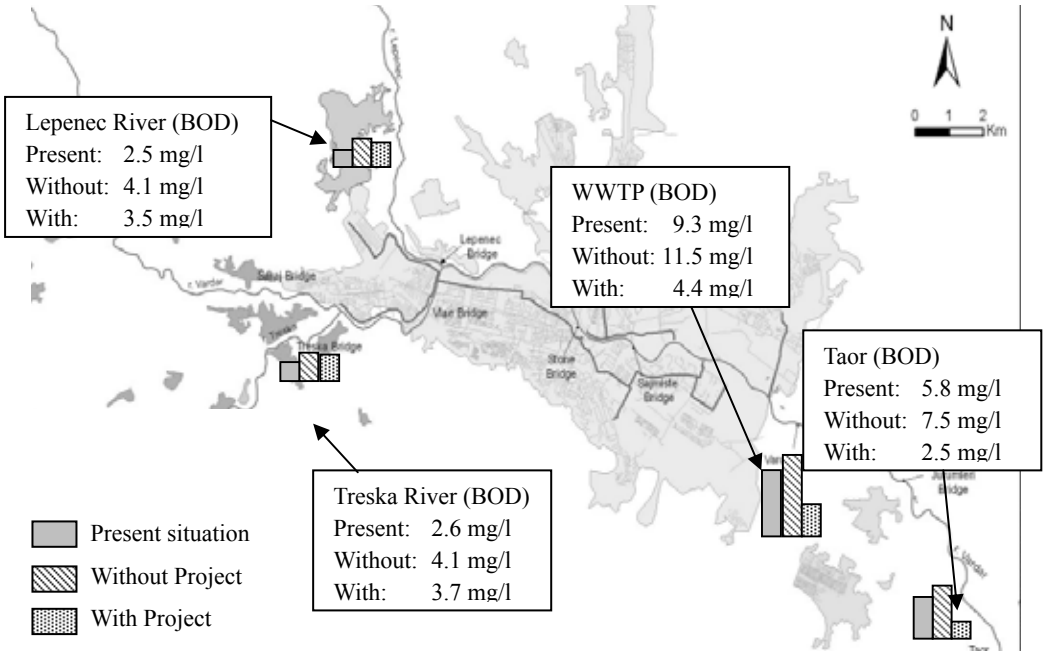
- The collection and treatment of untreated sewage before entering the Vardar River will improve water quality of the river and river environment.
- A proper sewage handling and disposal arrangement will minimize the chances of contamination of ground and surface water.
- Such provisions would assist to maintain ecological balance by reducing damages to flora and fauna.
- Improvement in the existing sewerage facilities will help tourism and boost the economy of the area.
- Dried sludge can be used for irrigation, or as a material of cement, if it meets the standards which are decided in EU Directives.
- One of the conditions to join EU will be met through improvement of sewerage system and it will enhance the possibility of the country to join EU.

If the project is not implemented, the water quality of Vardar River in 2020 will deteriorate due to the continuous discharge of untreated wastewater and increased amount of wastewater from increased inhabitants. The polluted water would continue to affect the ground water quality, threatening irrigation activities and drinking water safety (usually drawn from the ground waters) affecting the health of urban and rural residents. As a consequence, the quality of life and the standard of living of residents in the proposed project area will deteriorate.

In addition, the Vardar River is the transboundary water body that is shared between Macedonia and Greece. Therefore, the river water quality is one of the essential environmental issues discussed between neighbouring countries during the transboundary water management negotiations. In 2005 Macedonia has been granted EU candidate status and one of the conditions for EU membership is that the candidate country aligns its national legal system with EU legislation. The transposition of the EU water related directives has been started and the provisions of wastewater treatment plant related EU Directives should also be enhanced. Hence, the pressure from legal obligations on national and transboundary level will be very strong and the alternative of no project seems to be not realistic under these conditions. The figure below shows the river water quality in cases of with project and without project scenario.

If the project is not implemented, the quality of river water near the proposed WWTP site in 2020 is estimated to be 16 mg/l in terms of BOD. However, in case of with the Project, the BOD concentration in river water is expected to be 5 mg/l.

The comparison between cases of with project and without project considering different environmental elements (also presented in impact assessment) has been carried out and is presented in Figure 7.3. “Without project” is no construction of central and other three WWTPs but with industrial wastewater management to all factories, and “with project” is construction of central and other three WWTPs and industrial wastewater management to six industries which discharge their wastewater directly into the Vardar River.



Note: Without scenario is Case-2 and with scenario is Case-5 of Chapter 4, Part I (B/P)

Figure 7.3 River Water Quality of Present / With / Without Project Scenario

According to the results of water quality simulation, in without project scenario, water quality exceeds the designated water quality standard through every stretches. At the location of central WWTP where the designated water quality standard is 7 mg/l (BOD), the water quality will be 11.5 mg/l (BOD). In with project scenario, the water quality standards are met if central and other three WWTP and industrial wastewater management is conducted.

The table blow shows the impacts in environmental elements in with project and without project scenarios.

Table 7.4 Impacts of With / Without Scenario

Environmental Element	With Project		Without Project
	Construction phase	Operation phase	
Physical / Natural Environment			
Topography and geology	No impact	No impact	No impact
Groundwater	B (-)	A (+)	A (-)
Bottom Sediment	Negligible impact	Negligible impact	B (-)
Hydrological situation-quantities, flows or levels of rivers, lakes, etc.	Negligible impact	Negligible impact	No impact
Wildlife and Ecosystem	B (-)	B (+)	B (-)
Meteorology	No impact	No impact	No impact
Landscape and visual environment	B (-)	Negligible impact	No impact
Protected areas	B (-)	C (-)	No impact
Water and energy resources	B (-)	B (-)	No impact
Global Warming	Negligible impact	Negligible impact	No impact
Public Hazardous Elements			
Air quality	B (-)	Negligible impact	No impact
Water quality	Negligible impact	A (+), B (-)	A (-)
Soil pollution	B (-)	B (-)	B (-)
Waste (construction)	A (-)	Negligible impact	No impact
Waste (sewage sludge)	No impact	A (-)	No impact
Noise and Vibration	B (-)	B (-)	No impact
Ground subsidence	C (-)	No impact	No impact
Offensive odors	No impact	A (-)	No impact
Social Environment			
Involuntary resettlement and Land acquisition	A (-)	No impact	No impact

Environmental Element	With Project		Without Project
	Construction phase	Operation phase	
Livelihood and local economy	B (+)	B (+)	B (-)
Change in land use and local resources	A (-)	C (-)	No impact
Social institutions	C (+)	C (+)	No impact
Local decision-making institutions	B (+)	B (+)	No impact
Existing social infrastructure and services	B (-)	No impact	No impact
Public health and safety	B (-)	B (+)	B (-)
Socially vulnerable groups	No impact	No impact	No impact
Cultural, historical heritage	No impact	No impact	No impact
Gender, children's rights	No impact	No impact	No impact
Misdistribution of benefit and damage	No impact	No impact	No impact
Local conflicts of interest	B (-)	Negligible impact	No impact
Water use	Negligible impact	A (+)	B (-)
Infectious diseases	Negligible impact	Negligible impact	No impact

Impact Score: A- Large impact; B-Medium impact; C-Uncertain impact
(+) positive impact; (-) negative impact

(2) Alternative Sewerage system

Three independent sewer districts were proposed under previous wastewater management system prepared and proposed by Sewerage M/P 99 (Figure 7.4). In this alternative study, the centralized sewer district and independent sewer districts are considered.

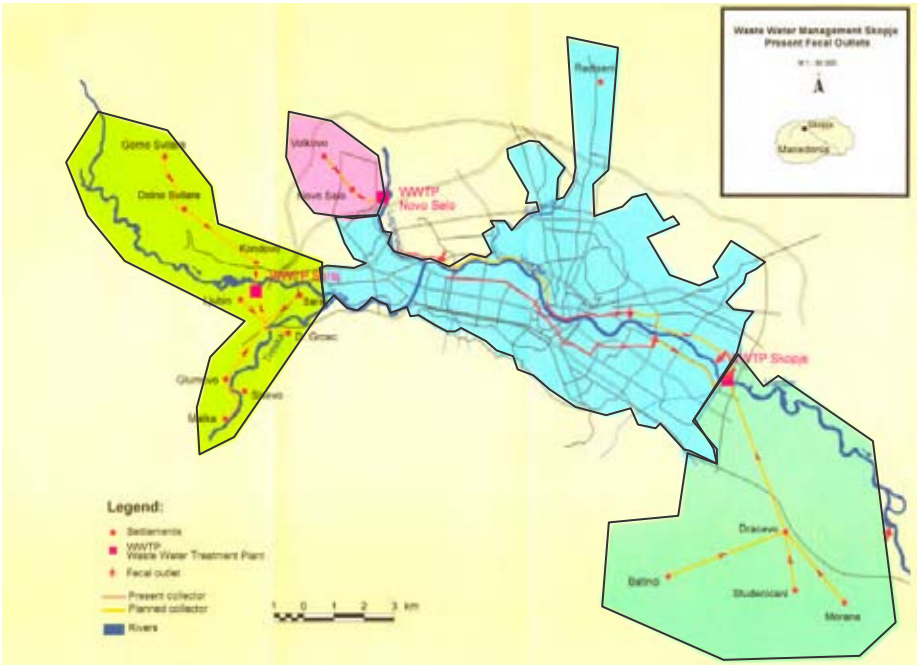


Figure 7.4 Sewer District Proposed in Sewerage M/P 99

The alternative comprises a 100 % centralized solution, in which all wastewater is collected and carried to the proposed location of the central wastewater treatment plant at the left bank of the Vardar River downstream in Trubarevo. The advantages of the centralized solution are:

- Construction cost of wastewater treatment plant is cheaper than the construction of individual independent treatment plants,
- The effectiveness of operation and maintenance is increased in case of one wastewater treatment plant,
- Cost of trunk sewers is high due to their long distance,
- Environmental and social impacts of wastewater treatment plant is limited to one central location,
- Monitoring and quality control is easy.

On the other hand, the disadvantages of the centralized solution are:

- As the distance of trunk sewer is long, the difficulty of operation and maintenance of collectors and risk of accidents will be high,
- The cost for installation of trunk sewers is higher,
- The diameter of the trunk sewers will be increased,
- Pumping stations are necessary to send collected wastewater to treatment plant.

In Sewerage M/P 99, three districts (Saraj, Novo Selo and Skopje) are proposed, but during collection of information, another treatment district Dracevo is identified. As the independent treatment plant alternative, the plan and project in Saraj, North Gorce Petrov (former Novo Selo) and Dracevo are studied (see Chapter 5).

The preparation of F/S was finished in November 2007 by Norway fund and 23 villages were targets for the Study in Saraj Municipality. Among 23 villages, total 16 WWTPs were proposed in F/S and detail design of 6 WWTPs was expected to be completed in February 2008. The villages in Saraj are scattered and if the wastewater is to be brought to the central WWTP, it will require very long collector. From the environmental and social point of view, the impact by the land acquisition and change in land use will be larger compared with one central WWTP. According to the feasibility report of Saraj, the WWTPs are proposed on the vacant area and agriculture field. The process of land acquisition is required but no involuntary resettlement will occur. As Rasce spring which is protection zones under Spatial Plan of Macedonia for the main water source for Skopje City is located in the Saraj Municipality, the early realization of project is necessary. F/S was conducted by a support of the MEPP and the project size is small, thus the realization through IPA fund is expected. Considering the importance of early realization of the project, high construction cost and O&M difficulty due to long distance collector, the independent system for Saraj Municipality is appropriate.

For North Gorce Petrov, the location of WWTP is decided in GUP (see 6.3.5 (1) for detail). Land acquisition is necessary but involuntary resettlement and change in land use is not expected. The groundwater under the confluence of the Vardar River and Lepenec River is important water source of Skopje City during drought season and North Gorce Petrov is located at the upstream of the Lepenec River. The early realization of project is recommended. Considering the time required to change the GUP, agreement between Municipality and residents about the share of burden for construction cost for trunk sewers, the independent system for this district is appropriate.

For Dracevo area on Kisela Voda Municipality, the preparation of design is finished and the location of WWTP is selected. The project is under consideration and the request for the construction fund to donor organization is expected to be submitted. If this area will be connected to the central WWTP, the pump stations and long distance collectors would be necessary. Considering the above mentioned factors, independent system is recommended.

On the basis of the analysis of alternatives considering various factors, the independent four district of wastewater treatment are recommended (see Figure 7.2).

(3) Alternative Location for WWTP

The alternatives of the WWTP site are analyzed. It is recommended that the WWTP should be located:

- downstream of the sewer network in Skopje to collect all the wastewater,
- along the river side to discharge the effluent,

The sewer outlet which is located downstream of Skopje sewer network, and the settlements are shown in Figure 7.5. Alternative locations are selected with the above mentioned characteristics.

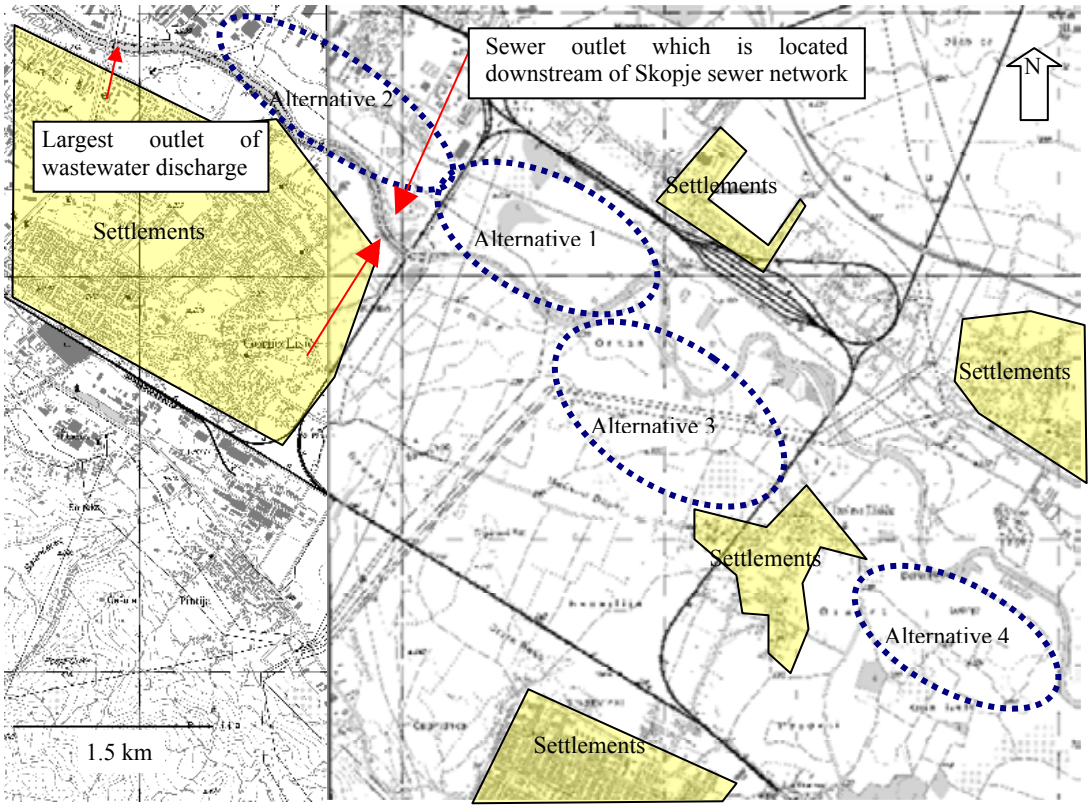


Figure 7.5 Alternatives for WWTP Location and Settlements

a) Alternative 1: Water Economy Facility Zone in GUP

This area is designated as "water economy facility zone" in GUP and Sewerage M/P 99. The location is decided based on the information of Vodovod with the following reasons:

- Downstream of the Vardar River,
- Out of the city boundary,
- No residential area near the proposed site,

In addition to this, the proposed location has these advantages:

- The sewer network is installed upstream of the proposed site and the main outlet of collected wastewater is 3-4 km upstream of proposed site. It is easy to bring the collected wastewater to the WWTP,
- The proposed site is located along the river and it is easy to discharge the effluent to the river,
- The wind blows along the river and the odour will be swept away downstream of the Vardar where there is no residential area,
- There is no house/structure within the area and no involuntary resettlement might be required
- The area is designated as "water economy facility zone" in GUP and approved by the relevant administrative bodies for its use.

b) Alternative 2: Former Waste Disposal Site

This area is located upstream of the sewer outlet which is located downstream of Skopje sewer network. This location is the former waste disposal site and this area is not used for any purpose. As the area was used for the waste dumping site, the ground is not solid and stable. Some facilities of treatment plant such as collectors and pumping system should be installed underground and this area is not suitable for such facilities.

c) Alternative 3

Alternative 3 is located downstream of Alternative 1 along the Vardar River. This area is used for agriculture and is divided into small parcels. This area also has the advantages like the downstream, river side, no possibility of resettlement. However, the settlement is located near this area and there might be the impacts by the odour. In addition to this, collectors should be installed to the WWTP but there is neither existing road nor planned road where the collectors can be installed, thus the additional land acquisition and construction of road will be necessary.

d) Alternative 4

Alternative 4 is located downstream of other alternatives along the Vardar River. This area is used for agriculture and is divided into small parcels. This area also has the advantages like the downstream, river side, no possibility of resettlement, and no settlement downstream of this site. However, this area is around 5 km away from the sewer outlet which is located downstream of Skopje sewer network, and the extension of two large collectors (1,600 and 1,800 mm diameter) on both banks of the river and the additional crossing of railway are necessary. Same with the Alternative 3, there is no roads under which the trunk sewers can be installed and the additional land acquisition and construction of road will be necessary.

Considering the above alternatives, Alternative 1 is the most appropriate location for WWTP.

(4) Alternative trunk sewer route

The alternative routes for installation of trunk sewers are analyzed. In this area, the local roads exist in both the banks of the Vardar River, but these do not lead to the WWTP site. As the installation of trunk sewers in the banks of the river is not allowed, the construction of new roads is required.

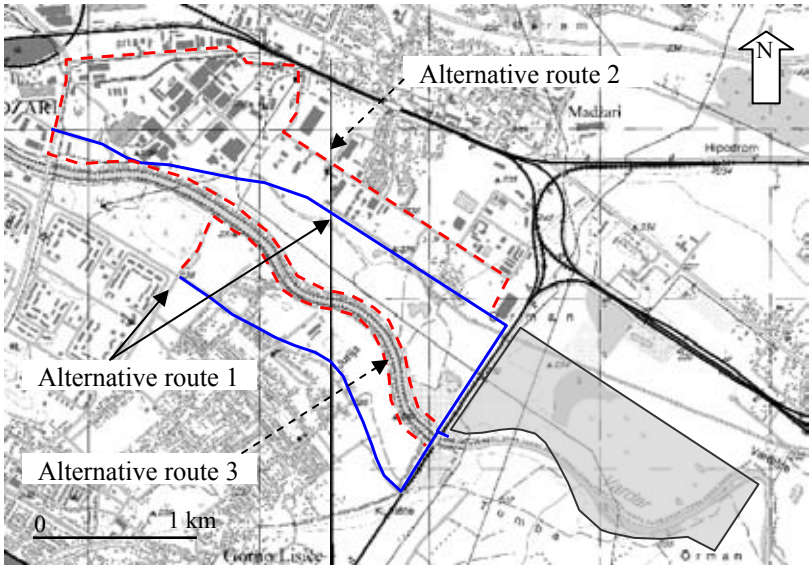


Figure 7.6 Alternative Routes for Trunk Sewers

a) Alternative 1: Proposed roads in GUP

The alternative routes 1 shown in Figure 7.6 are the proposed roads in GUP. The target year of GUP is 2020 and these roads are not constructed yet. The responsible organization for road construction is Skopje City and the budget for design of these roads was approved by City Council in 2008.

b) Alternative 2: The route for the left bank

There is the road in the left bank of the Vardar River which comes near the proposed WWTP site. This route will be 400 m longer than alternative 1 and it leads the increase of construction cost. In addition to this, the existing pipeline is installed under this road and the route is rather narrow, thus the construction work is much more difficult than proposed road.

c) Alternative 3: Along the Vardar River

There is another alternative to install the trunk sewers along the Vardar River. This will be the shortest route but it makes the O&M difficult as there are no access roads to this route and the land acquisition will be required.

Considering the above factors, using the proposed roads under GUP seems to be the best option.

(5) Alternative sludge disposal site

Considerable amount of sludge will be generated from treatment plant and the disposal method should be analyzed for the generated sludge. Skopje city has Drisla Landfill that accepts the domestic and non-hazardous waste. The hazardous waste[6] is not allowed to be disposed in this landfill. PE "Communal Hygiene" agreed that the quantity of sludge can be acceptable at Drisla Landfill, but their concern is the quality of sludge. Therefore, if the sludge does not include the hazardous substances, it can be disposed of at the existing Drisla Landfill. There are no criteria of heavy metal concentration in sludge in Macedonia but the sludge with the heavy metals is hazardous waste. The judgement standards between hazardous and non-hazardous will be discussed with PE "Communal Hygiene" at F/S stage.

As the domestic wastewater and industrial wastewater are mixed in the collectors in Skopje city, it is difficult to collect and treat only domestic wastewater separately in this project. This implies that the industrial wastewater will also be collected and treated in the same WWTP.

Under the Law on Environment, the IPPC has come into force in 2007 and the prevention measures of water, air and soil will be the obligation of each industry before discharge. Each industry is required to implement the prevention measures by 2014 and the hazardous substances should be pre-treated before the wastewater is discharged into the collectors. Thus, the sludge generated at WWTP will not include the hazardous elements and it is possible to dispose of generated sludge from this WWTP at the existing landfill site.

If the sludge cannot be accepted in the existing landfill site, then alternative landfill site should be decided or new site for sludge disposal should be constructed. As of October 2008, Skopje City has no landfill site for hazardous waste, nor has any plan to construct new landfill site. If the new landfill site should be constructed, the selection of site in outskirts should be considered, and the consideration of land acquisition and involuntary resettlement (if necessary) are inevitable. The construction of new landfill site will result into increased cost for construction and O&M and this cannot be covered by user charges. Therefore, the construction of new sludge landfill site is not feasible. Considering the above situation, the disposal at the existing Drisla landfill is appropriate option.

If the sludge contains the dangerous substances and cannot be disposed of at the existing landfill, the sludge should be disposed of at the planned industrial hazardous waste management plants and landfills of MEPP in 2014. The detail plan is described in section 6.5.4 of Part II (F/S).

7.3.5 Results of Impact Assessment and Recommended Mitigation Measures

The results of impact assessment and recommended mitigation measures are summarized in the Table below.

[6] Hazardous waste is the waste containing substances having one of these properties: explosiveness, reactivity, flammability, irritability, toxicity, infectiveness, cancerous effects, mutation, teratogenesis, eco-toxicity and discharge of poisonous gases through chemical reactions or biological decomposition.

Table 7.5 Results of Impact Assessment and Mitigation Measures

Environmental Elements	Construction/Operation Action/activity	Construction phase	Operational phase	Mitigation measures	Mitigation strategy	Responsible institutions
Physical / Natural Environment						
Groundwater	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 (+)	At detail design stage, the flow and table of groundwater should be checked and excavation and installation should be conducted. Planning & organization of construction works should ensure minimization of leakages of polluted wastewater to groundwater.	Minimize the impact	Skopje City, VODOVOD Contractor
Wildlife and ecosystem	The proposed WWTP location is within the hunting area. Pheasant, hare and partridge exists within the hunting area.	B (-)	B (+)	The total area for hunting is 1475 ha, and proposed WWTP site is maximum 57 ha. The site is not large compared to the total area, the impact is not significant.	Compensate the impact	Skopje City VODOVOD
Landscape and visual environment	Visually unaesthetic 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 impact	Good construction practices have to be implemented – including fencing and protection of building sites. Enhance aesthetics through proper management of construction site, repair pavements and roads after sewer laying work is completed, completing the construction activity by removing all spoils will also mitigate the impacts. The design of WWTP should be prepared in most environmental friendly way and WWTP should be located away from the densely populated residential areas.	Minimize the impact	Skopje City VODOVOD Contractor
Protected area	Protected area under IUCN is located near the proposed WWTP site. This is the arboretum of Faculty of Forestry, Skopje University. Disturbances during construction works with land use, occupation of the land, noise and vibration, construction of new roads will affect the arboretum. Rasce and Nerezi-Lepenec is located in Saraj and North Gorce Petrov. The impacts during construction phase will be expected.	B (-)	C (-)	Good construction practices have to be adopted – including fencing and protection of building sites according to positive national legislation. The noise and vibration mitigation measures should be applied. During construction, the impacts on river and groundwater might be expected. The proper management of spoil and excavation should be conducted.	Minimize or diminish effect	Skopje City VODOVOD State and Municipality Environmental Inspectorate MAFWE -Department for Hunting

Impact Score: A- Large impact; B-Medium impact; C-Uncertain impact
Mitigation strategy: Avoid Impact; Minimize or Diminish effect; Repair or Rehabilitation; Reduce or Eliminate over time; Provide Compensation

Environmental Elements	Construction/Operation Action/activity	Construction phase	Operational phase	Mitigation measures	Mitigation strategy	Responsible institutions
Water and energy resources	Increased consumption of energy during construction and operation phase.	B (-)	B (-)	Design of the technological process should provide as much use of gravity flow as possible. Equipment & machines and technology selection should also include 'energy efficiency 'as selection criterion. Maintenance plan for the equipment to be prepared and duly implemented.	Minimize the impact	Skopje City VODOVOD Contractor
Public Hazardous Elements						
Air quality	The construction activities will increase emissions of suspended particulate matter during excavation and removal of the excavated earth, emissions from the mobile sources (vehicles and construction machinery) of CO_2, NOx, SO_2. The operation activities will cause emissions into air from energy sources (GHGs-methane) and digesters for sludge.	B (-)	B (-)	The mitigation measures to minimize dust generation during construction should include: Construction site, transportation routes and materials handling sites should be water-sprayed on dry and windy days, especially near residential areas (urban part of Skopje); Vehicles and construction machinery will be required to be properly maintained and to comply with relevant emission standards; Construction materials should be stored in appropriate places covered to minimize dust	Minimize or Diminish effect	Contractors Skopje City VODOVOD Operator of the WWTP
Water Quality	During operation of the WWTP, the water quality of Vardar River will be significantly improved. In the other hand, the WWTP will accept the part of industrial wastewater which should be pre-treated in each industry, there is the risk of contamination of wastewater due to the untreated industrial wastewater and it will affect the effluent quality. If the effluent with hazardous elements is discharged, the water quality of Vardar River will be affected.	Negligible impact	A (+) B (-)	The IPPC has come into force and the each industry has the obligation to treat the industrial wastewater before discharging, thus the risk of contamination of effluent is low. If the industrial wastewater which is not treated to ideal level, the operator shall report it to MEPP or Skopje City, which has the rights and responsibilities for inspection of the industries, to make industries to treat their wastewater.	Avoid Impact	Operator Skopje City Vodovod MEPP
Soil pollution	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	B (-)	B (-)	The possible mitigation measures for minimization of the soil pollution are: Transportation vehicles should be enclosed to avoid potential leakage; Promptly clean-up spills of transported material on public roads; Stabilize all slopes with provision of benches/pitching; Provide	Minimize or Diminish effect	Skopje City VODOVOD Contractors WWTP Operators Accredited

Environmental Elements	Construction/Operation Action/activity	Construction phase	Operational phase	Mitigation measures	Mitigation strategy	Responsible institutions
	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.			adequate cross drainage facilities; Restrict traffic movements and use low ground pressure machines; Preserve top soil to be replaced after the completion of construction activity; avoid wet soils; Plant shrubs/trees/grass on exposed slopes and surfaces		laboratories
Waste (construction)	During the construction phase there are several actions that affect waste generation, such as excavated soil, rejected materials and bushes during site clearing, communal and commercial waste. During the WWTP operation only communal and commercial waste can be expected.	A (-)	Negligible impact	The good waste management practice should be applied including: The contract with the company for waste collection and transportation should be signed; The construction waste should be promptly removed from the site; The materials should be covered during the transportation to avoid waste dispersion; Burning of construction waste should be prohibited; Internally (at the WWTP site) the segregation of waste should be performed by types of waste: PET bottles, paper, batteries and glass; Possible hazardous waste from the laboratory should be collected separately.	Minimize or Diminish effect	Investor Subcontractors WWT Operators Accredited laboratories
Waste (Sewage Sludge)	The WWTP will generate sewage sludge. The type of the waste (non-hazardous or hazardous if contains the dangerous substances from the industrial wastewaters) will be the criteria whether to dispose the sludge to the Drisla Landfill or other new special landfill for hazardous waste.	No impact	A (-)	The WWTP will receive industrial wastewater after the pre-treatment at each industry, thus the chance of hazardous materials included in the sludge is not high. If the hazardous materials is included in the sludge, the sludge should be disposed of at the landfill for hazardous waste. Preparation of the Sludge Disposal Management Plan based on laws and regulations in Macedonia and EU, is necessary which includes; Monitoring sludge quality (heavy-metals concentrations in sludge); Identifying land for disposal taking care on the concentrations of heavy metals in soil where the sludge is planned to be used; Restrictions on amounts of metals which may be added annually to the land; The frequency for sludge analysis with sampling and	Minimize or Diminish effect	Investor Subcontractors WWTP Operators On-site laboratory Accredited laboratories

Environmental Elements	Construction/Operation Action/activity	Construction phase	Operational phase	Mitigation measures	Mitigation strategy	Responsible institutions
				analysis methods (soil sampling, sludge sampling and methods for analysis). The pre-treatment of the industrial wastewaters should be established (according to the IPPC permit) and the authorization for the discharges into urban sewage collecting systems should be entered into force (with adoption of the new Law on Waters).		
Noise and Vibration	The construction activities and traffic will cause noise and vibration due to the machinery and vehicles used for digging of the collector system and WWTP construction, transport of workers, transport of goods and materials. The potentially affected will be nearby residents (during the construction of collector system the urban part of Skopje will be affected) The operation of WWTP will result into noise and vibration but it will not be located in residential area and the impact is not significant.	B (-)	B (-)	Due to the fact that the construction works for the collector system have to be done within the urban part of Skopje City, the noise control measures should be implemented to minimize impacts. Noise impact should be minimized by: Limiting construction activities to the daytime only; The selection of mechanical and electrical equipment with low noise level characteristics; Modification of the design specifications - low noise ventilation fans, pumps and electromotor drives. The equipment and machinery installed at the proposed WWTP would meet all national noise regulation for max. allowed noise levels at day and night time;	Minimize or Diminish effect	Investor Procurement Department at Skopje City Authority State and Municipality Environmental Inspectorate VODOVOD
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 (-)	No impact	If the area for WWTP is identified as not enough strong for the structures, the pile foundation or foundation strengthening should be considered.	Minimize effect	Skopje City, VODOVOD Contractor
Offensive odours	Odour from a WWTP is caused by the presence of one or more compounds in sewage.	No impact	A (-)	The remedial measures to minimize the potential odour problem of the WWTP include:	Avoid impact/Minimize effect	Investor WWTP Operator

Environmental Elements	Construction/Operation Action/activity	Construction phase	Operational phase	Mitigation measures	Mitigation strategy	Responsible institutions
	Compounds such as sulphides, mercaptan, disulphate and volatile fatty acids are responsible for the odour. The gas phase of hydrogen sulphide is the most common cause of odour complaints and is generally formed in the sludge concentration area of the plant (digester and sludge drying bed).			To control the odour sources; To cover the sludge processing facilities; To avoid storing dewatering sludge in the plant; To create a greenbelt around the plant; To plant trees as much as possible		
Social Environment						
Involuntary resettlement and Land acquisition	The settlement does not exist within the proposed land for the WWTP location in Trubarevo. Thus, the resettlement impacts have not been identified. Land acquisition is necessary.	A (-)	No impact	The Acquisition Plan should be done considering the following issues: Identification of the people affected by the acquisition of land; People affected by the temporary use of land for the trunk sewer construction; The compensation according to the legal framework; Monitoring and evaluation of the land acquisition	Provide Compensation	Investor Ministry of Transport and Communication
Change in land use and local resources	Land use changes at the location of WWTP in Trubarevo. The WWTP location is proposed under General Urban Plan. The location is used as hunting area and agriculture field, some impacts on land use will be expected. Construction of the collector system will not make any impact on the land use pattern of the area, as most of the collectors will be laid on the right of way of the roads.	A (-)	C (+)	The total hunting area is 1475 ha and the area of WWTP is 57 ha. The WWTP area in hunting area is small and this will not cause the educational and scientific purpose of Skopje University. The noise and vibration and transportation of construction materials will affect the animals within hunting area during construction phase, the mitigation measures mentioned in “Noise and Vibration” should be taken. The strong public awareness programme should be launched in order to inform the public about the project development activities, benefits of the project and compensation procedure.	Provide Compensation	Investor Ministry of Transport and Communication
Existing social infrastructure and services	The traffic will have to be diverted during collector laying, as much of the roads will be occupied for installation work. Traffic congestion will be experienced on the roads connected to the WWTP sites. The impact will be temporary and of short duration.	B (-)	No impact	The schedule of installation of trunk sewers should be informed in advance to the public. Traffic control should be done and relief road or temporary roads to divert the traffic are necessary.	Avoid impact/Minimize effect	Skopje City, VODOVOD Contractor

Environmental Elements	Construction/Operation Action/activity	Construction phase	Operational phase	Mitigation measures	Mitigation strategy	Responsible institutions
Public health and Safety	During construction, the dust generated in the air may give discomfort to the workers and nearby residents. Thus public health may be adversely affected, but the impact will not be serious and will be of a temporary nature. The workers are usually the immediately affected people if unsanitary practices are adopted on the construction site.	B (-)	B (+)	The impact will be adverse but it will be avoidable by providing adequate sanitation facilities for the construction site and WWTP. During construction, health and safety measures should be applied by the contractors: Security measures like: perimeter fence, life jackets, work in pairs on dangerous tasks, warning signs for the public around the construction site; Maintain a good level of personal hygiene-have on site installations for washing, cleaning; Health protection-first aid kits and medical service on sites	Avoid Impact/ Repair or Rehabilitatio n	Investor contratos VODOVOD
Local conflicts of interest	The construction and operation phase of the WWTP and collector system can affect the interests of the local self-governments and City of Skopje. The affected municipalities are: Aerodrom, Kisela Voda, and Gazi Baba (especially Trubarevo settlement). All permits for construction and operation works should be obtained at the national and local level at all affected municipalities.	B (-)	Negligible impact	A strong agreement between all municipalities within Skopje (especially the affected ones) and Skopje City authority should be signed to avoid conflict of interest. As it is the large scale project, the representatives from all affected municipalities should take active participation within the decision-making process at all project phases. A perfect coordination between all authorities within the municipalities and City of Skopje authority on various day by day activities should be established. Each municipality should play active role for the public awareness and discussion with their citizens about the benefits of the project, schedule of project tasks, mitigation measures.	Reduce or Eliminate over time	Investor Mayors of the affected municipalities and Mayor of Skopje City Ministry of Local self-governmen t Union for Local-self governments (ZELS)

(1) Involuntary Resettlement and Land Acquisition

The sewerage facilities proposed under the Basic Plan are new WWTP.

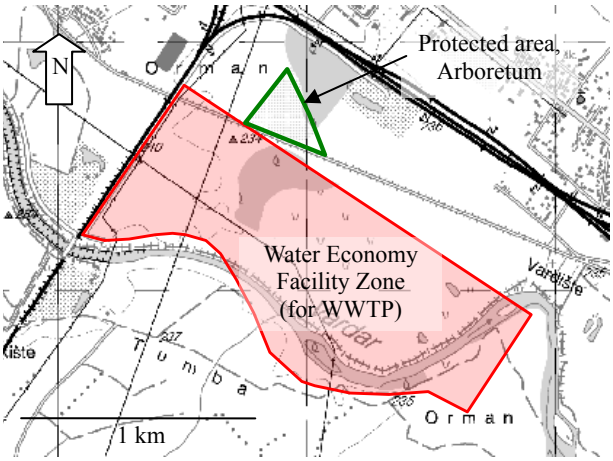


Figure 7.7 Proposed Site for WWTP

For new WWTP, the land acquisition is necessary but no settlements exist within the boundary of the proposed sites (see the Figure below). Therefore, involuntary resettlement would not occur.

Figure 7.8 Proposed Site for WWTP

The WWTP is proposed to be located within the boundary of Water Economy Facility Zone under GUP. This area is used as hunting area and there is information that this land belongs to State. Ninety percent of this zone is state owned land but there are several requests for de-nationalization. The detail land owner information is described in the Section 6.4 of Part II (F/S).

The proposed WWTP sites for Saraj, North Gorce Petrov and Dracevo are also checked. According to the feasibility report of Saraj, the WWTPs are proposed on the vacant area and agriculture field. The process of land acquisition is required but no involuntary resettlement will occur. The area of North Gorce Petrov and Dracevo are shown in figure below. In these cases also, land acquisition is necessary but involuntary resettlement will not be required.

Figure 7.9 Proposed WWTP Site for North Gorce Petrov

Figure 7.10 Proposed WWTP Site for Dracevo

The trunk sewers are proposed to be installed under the proposed roads in GUP. Though this is not the direct impact by this project, the involuntary resettlement is unavoidable by land acquisition required for construction of these roads as there are settlements in the proposed area. The responsible organization for road construction is Skopje City and the budget for preparation of design of these roads is already approved by Skopje City Council. The progress of road construction should be closely monitored for smooth implementation of construction of trunk sewers.

(2) Land Use

The WWTP in Trubarevo will be constructed within the boundary of Water Economy Facility Zone in GUP (see Figure 7.7). The area including this zone is used as hunting area for hare, partridge and pheasant. These are not endangered species and the area is not protected. This is not the commercial hunting area but closed type for scientific and educational purpose, and the hunting is conducted 3 – 4 times per year. Total area for hunting is 1,475 ha and the proposed WWTP requires only 57 ha. The approval for hunting area is up to 2008 and MAFWE is not taking any procedures for extension yet. By construction of WWTP, the land use will be affected, but under GUP, some parts of this area are already designated for water economy facility Zone. Thus, through providing appropriate compensation and substitute land, the impacts on land use can be mitigated.

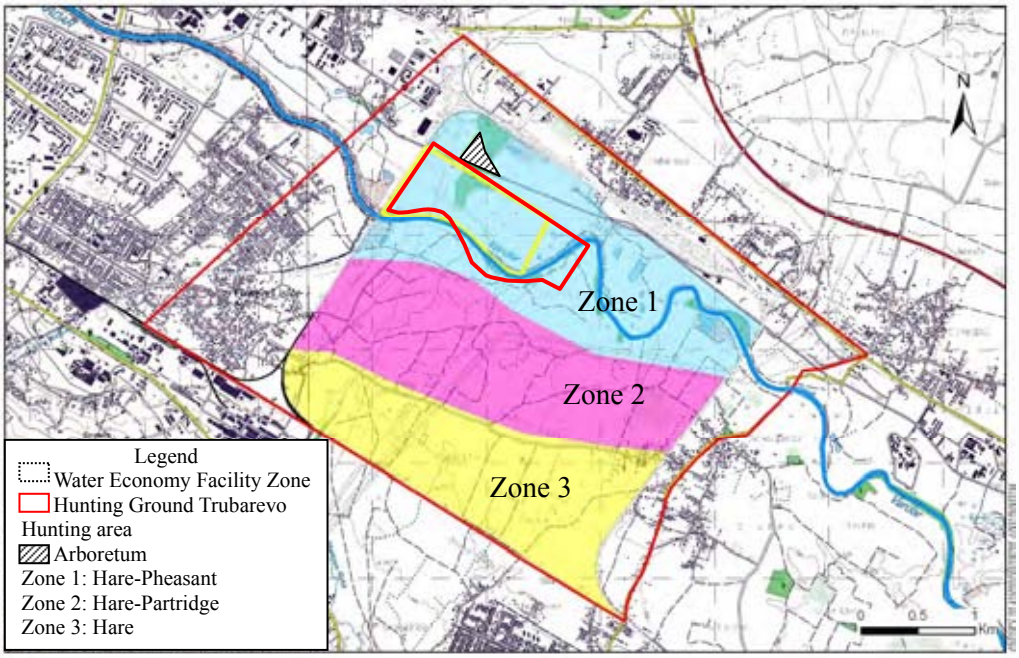


Figure 7.11 Area for Hunting and Proposed WWTP Site

Gorce Petrov Municipality has decided the location of WWTP (see right map in figure below) according to the GUP (see left map in figure below) and the conceptual design of WWTP is completed. The proposed area is vacant (see Figure 7.9) and no serious impact on land use is expected.

Figure 7.12 Urban Plan of Gorce Petrov Municipality

WWTPs of Sarai and Dracevo are not included in the GUP as these areas were not under jurisdiction of Skopje City when the preparation of the Plan was undertaken. However, Skopje City has the plan to revise the GUP this year and these WWTPs will be located in the Plan. The sites are not used for any purposes and the impact on land use changes caused by this Project is low (see Figure 7.10).

(3) Protected Area

The protected area in the vicinity of Skopje City is illustrated below. The affected areas by the facilities proposed in B/P are Rasce (protection area for water source) located in Saraj, Nerezi-Lepenec (protection area for groundwater) in North Gorce Petrov, and Trubarevo (arboretum) in central sewer district. The operation of WWTP in Saraj and North Gorce Petrov will affect the water source and groundwater positively; however, the adverse impacts by construction might be expected. But the period is short and appropriate prevention measures such as appropriate spoil treatment can minimize the impacts.

The arboretum managed by Faculty for Agriculture, Skopje University is located near the WWTP site in central sewer district in Trubarevo (see Figure 7.11). The impacts such as noise and vibration, construction of roads, and land use might be expected during construction period.

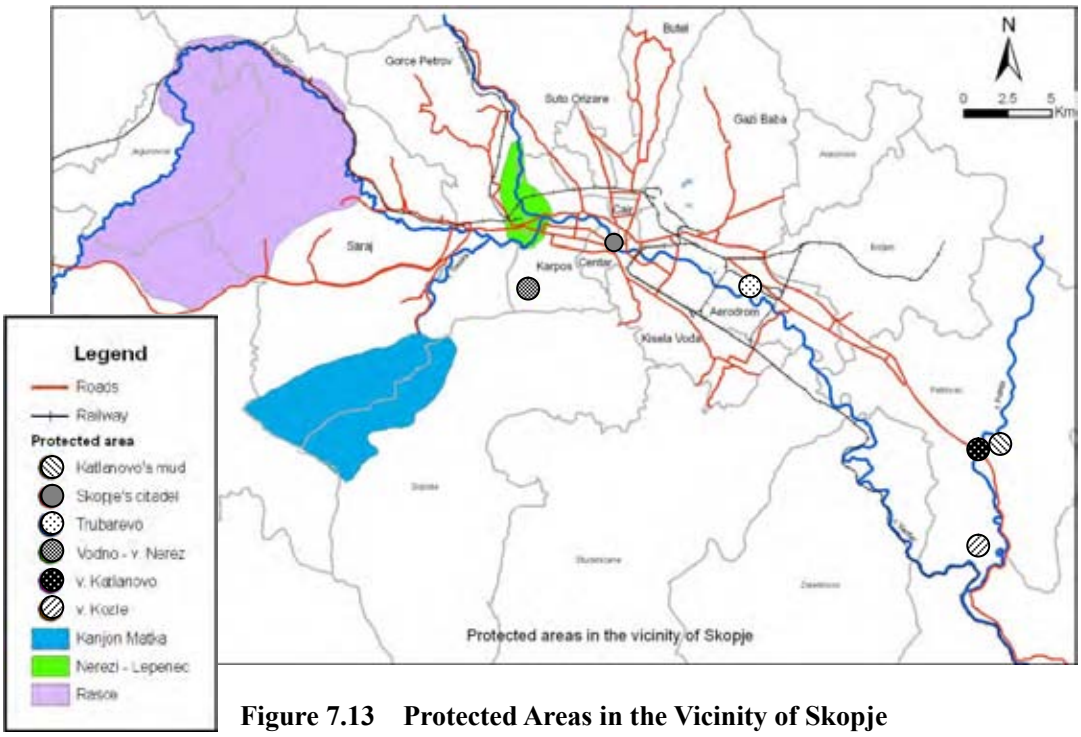
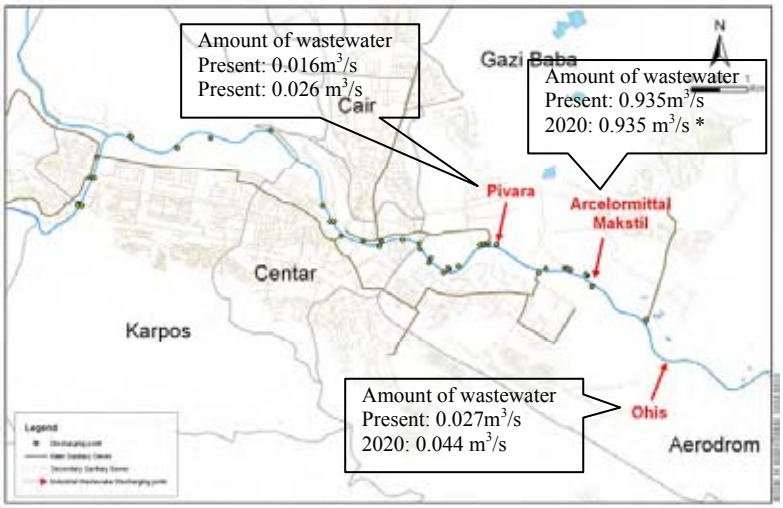


Figure 7.13 Protected Areas in the Vicinity of Skopje

(4) Water Pollution

In the JICA preparatory study, the water pollution caused by the increase of industrial wastewater pollution load in the Vardar River was evaluated. By collection of domestic and industrial wastewater for treatment, the river water flow will be decreased, and it will lead to increase in the pollution load from industrial wastewater (that are not collected and treated) in the Vardar River.



* Note: Discharge in 2020 will not increase because the existing amount has almost reached to water supply capacity.

Figure 7.14 Discharging Points of Industrial Wastewater

In 2020, the industrial wastewaters which will not be discharged into the WWTP are from six factories; Arcelormittal, Makstil, Skopsko Leguri and RZ Usulugi (steel industry), Pivara (beer), and Ohis (chemical industry). Their willingness for treatment of wastewater is confirmed by Industrial

Survey conducted by JICA Study Team. Five factories except Pivara have their own treatment plants but these are not operated appropriately and the wastewater is discharged into the Vardar River as of October 2008.

BOD load of six factories in 2006 is 6,253 kg/d, this is the 30 % of total run-off BOD load (20,543 kg/d). In 2020, by implementation of IPPC, the expected BOD load from these six factories will be 1,845 kg/d, decreased by 70 %. The domestic wastewater and other industrial wastewater will be treated at the central WWTP, the BOD load of the upper stream of central WWTP will be 1,845 kg/d from six factories. It means that by implementation of industrial wastewater management and operation of sewerage system, the BOD load of upper stream of central WWTP will be decreased from 20,543 kg/d to 1,845 kg/d (91 % reduction). On the other hand, the decrease of river flow by transferring wastewater to WWTP will be from 27.4 m^3/s to 26.0 m^3/s, only five % reduction. The effect on reduction of BOD load is much larger than the decrease of river water flow, the deterioration of river water quality by WWTP operation will not occur. The detail water quality simulation is conducted in the Chapter 4 of Part I (B/P).

The WWTP will treat the industrial wastewater which is pre-treated to acceptable level at WWTP. If the industrial wastewater is not pre-treated to appropriate quality and contains the hazardous substance, this will affect the effluent quality. The pre-treatment of industrial wastewater before discharging to the sewer is the obligation of each factory under IPPC system, the risk of contamination is not high. When the contamination of effluent by industrial wastewater is identified through monitoring, the WWTP should report the fact to MEPP or Skopje City which have the authority of inspection to make the factories pre-treat their wastewater.

(5) Sludge

Sludge will be generated during the wastewater treatment process. The sludge will be thickened and digested to make the quality stable and dried in the sludge drying bed. As discussed in the alternative study, the construction of new sludge landfill is not realistic and feasible. When the IPPC comes into force, it will require each industry to install the pre-treatment of wastewater. Each industry is required to implement the prevention measures by 2014 and the hazardous substances should be pre-treated before the wastewater is discharged into the sewerage system. By implementation and compliance of IPPC system, there is the low risk of sludge contamination by hazardous substances and the sludge can be disposed of at the existing landfill site. In addition to this, if the quality meets the EU standards, the sludge can be used for the agriculture (EU Directives 86/278/EEC). However, there is the possibility of mixing the hazardous substances in the sludge even if the IPPC system is conducted. The quality of the sludge will be checked at the WWTP and if the hazardous substances are mixed in the sludge, the responsible person has to inform the MEPP and Skopje City and ask them to inspect the industries as they have the responsibility and the authority to monitor and inspect the discharge of the industries. The sludge with the hazardous substances should be disposed of at the landfill for the hazardous waste which MEPP has the plan to construct by 2014.

(6) Offensive Odour

The offensive odour from WWTP is unavoidable. But by selection of appropriate technology and O&M, this impact will be mitigated. The odour will be generated during the treatment process of sludge. If the sludge is not digested appropriately in digestion tank, the odour will spread in the sludge drying bed. By appropriate O&M and creation of green buffer zone, this impact will be mitigated.

7.4 Public Consultation

7.4.1 Approaches

The stakeholder meetings for public consultation were held three times during Basic Plan stage and F/S stage according to the JICA's Guidelines.

Table 7.6 Schedule and Objectives of Stakeholder Meeting

	Date	Objectives
First Meeting	9th November 2007	(1) Introduction of JICA Study (objectives, contents, schedule) (2) Explanation of procedures and schedule of environmental and social considerations (3) Draft scoping of IEE level study
Second Meeting	22nd February 2008	(1) Contents of Basic Plan and result of IEE (2) Results of IEE (3) Priority projects in F/S and scoping of EIA
Third Meeting[7]	16th October 2008	(1) Contents of F/S (2) Results of EIA

The organizer was Skopje City in cooperation with MTC and MEPP.

7.4.2 Selection of Stakeholders

The selection of stakeholders is carried out by Skopje City in collaboration with JICA Study Team, and the stakeholders are categorised as follows.

- People in the Study area and people who will be affected by the proposed projects, including socially vulnerable people
- Ministries and relevant governmental agencies (MTC, MEPP, MAFWE, MOF etc.)
- Skopje City and 10 municipalities
- Research institute and universities (public health, hydrometeorology, etc.)
- Main Industries
- NGOs working in the environmental field
- International Organizations and Donors

Main stakeholders will be identified and selected regularly based on the roles and responsibilities of each stakeholder at different stages of the public consultations.

7.4.3 First Stakeholder Meeting

First stakeholder meeting was held on 9th Nov. 2007 by Skopje City at City Hall and 56 persons participated in this meeting.

Table 7.7 Participants in First Stakeholder Meeting

Ministries	7	NGOs	5
Skopje City, Municipality	18	International organizations	3
Research institutes, University	13	Others	10
			56

During this meeting, the questions and comments mentioned below were raised.

- The options like independent WWTP in Saraj and Gorce Petrov, or central WWTP for 10 municipalities should be considered.
- The water quality categorization of the river might change so that the calculation of WWTP should consider the parameters of outlet from WWTP as second class category.
- Industrial wastewater should be separated from domestic wastewater.
- The effluent must abide by EU Directive and standards. The EU Directive is also considering formulation of sensitive and non-sensitive areas, and accordingly Macedonia should also define this.

7.4.4 Second Stakeholder Meeting

Second stakeholder meeting was held on 22nd February 2008 by Skopje City at City Hall and 57 persons participated in this meeting.

[7] The third stakeholder meeting is held during F/S stage. The detail information is described in the section 6.9.3 of Part II (F/S).

Table 7.8 Participants in Second Stakeholder Meeting

Ministries, Governments	9	NGOs	4
Skopje City, Municipality	21	International organizations	2
Research institutes, University	8	Others	8
Media	5	Total	57

During this meeting, the questions and comments mentioned below were raised.

- The mitigation measures should be taken properly (the opinion from the Trubarevo Community Council)
- From the view point of groundwater protection, the project for North Gorce Petrov should be included in the priority projects.
- The sludge drying bed is proposed in the Study, but if another technology is adopted, the requirement of land can be decreased. This should be considered.
- The arboretum and hunting area are used for the educational and scientific purpose and taken as important places. The groundwater flows in this area and it is used for arboretum, any construction should not disturb the groundwater table.

7.5 Selection of Priority Project from the Environmental and Social Point of View

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 these four districts are shown in Table 7.6. The wastewater treatment plant and the trunk sewer comprise the Project.

Table 7.9 Outline of Four 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

The table below shows the environmental and social evaluation.

Table 7.10 Environmental and Social Evaluation

Item/Alternative	Central		Saraj		North Gorce Petrov		Dracevo		Without Project
	C	O	C	O	C	O	C	O	
1 Natural Environment									
(1) Topography and Geology									
(2) Groundwater	B (-)	A (+)	B (-)	A (+)	B (-)	A (+)	B (-)	B (+)	A (-)
(3) Bottom Sediment	N	N		B (+)		B (+)		B (+)	B (-)
(4) Hydrological Situation	N	N							
(5) Wildlife and Ecosystem	B (-)	B (+)							B (-)
(6) Meteorology									
(7) Landscape	B (-)	N	B (-)	N	B (-)	N	B (-)	N	
(8) Protected Area	B (-)	C (-)	A (-)	A (+)	A (-)	A (+)			
(10) Global Warming	N	N		N		N		N	
2 Public Hazard									
(1) Air Pollution	B (-)	B (-)	B (-)	N	N	N	N	N	
(2) Water Pollution	N	A (+), B(-)	N	A (+)	N	A (+)	N	B (+)	B (-)
(3) Soil Pollution	B (-)	B (-)	B (-)	B (-)	B (-)	B (-)	B (-)	B (-)	B (-)
(4) Waste	A (-)	A (-)	B (-)	B (-)	B (-)	B (-)	B (-)	B (-)	
(5) Noise and Vibration	B (-)	B (-)	B (-)	B (-)	B (-)	B (-)	B (-)	B (-)	
(6) Ground Subsidence	C (-)		C (-)		C (-)		C (-)		
(7) Offensive Odours		A (-)		B (-)		B (-)		B (-)	
3 Social Environment									
(1) Involuntary Resettlement and Land Acquisition	A (-)		B (-)		B (-)		B (-)		
(2) Livelihood and Local Economy	B (+)	B (+)	B (+) B (-)	B (+)	B (+) B (-)	B (+)			B (-)
(3) Change in Land Use and Local Resources	A (-)	C (-)	B (-)		B (-)		B (-)		
(4) Social Institution	C (+)	C (+)							
(5) Local Decision-Making									
(6) Existing Social Infrastructure and Services	B (-)		B (-)		B (-)		B (-)		
(7) Public Health and Safety	B (-)	B (+)	B (-)	B (+)	B (-)	B (+)	B (-)	B (+)	B (-)
(8) Socially Vulnerable Groups									
(9) Cultural Heritage									
(10) Gender, Children's Rights									
(11) Misdistribution of Benefits and Loss/Damage		B (-)		B (-)		B (-)		B (-)	
(12) Local Conflicts of Interest	B (-)	N	B (-)		B (-)		B (-)		
(13) Water Use	N	A (+)							B (-)
(14) Infectious Diseases	N	N							

Note: A – significant impact, B – moderate impact, C – uncertain, N – negligible, Blank – no impact

All 4 projects include the construction of different sizes of WWTP, and Saraj project includes several WWTPs. In central sewerage area, the installation of 8.7 km trunk sewers is included.

The total impacts on society and environment are larger in central project compared with other 3 projects as the size of WWTP is large and installation of trunk sewers is included. Especially the impacts on land acquisition, land use, wildlife and ecosystem are large. As the WWTPs in Saraj and North Gorce Petrov will be constructed within the protected area for water source, the impacts on river water and groundwater during construction period might be expected. During the operation of these WWTPs, positive impacts will be expected.

The negative impacts on society and environment of central district are larger than of other 3 projects, however, the impacts can be avoided and mitigated by taking proper mitigation measures. The expected mitigation measures are listed in the table below. The detail mitigation measures and monitoring plan will be prepared in EIA at F/S stage.

Table 7.11 Major Impacts and Mitigation Measures

Item	Impact and Mitigation Measures
Involuntary Resettlement and Land Acquisition	Houses and structures are not located within the proposed WWTP site and involuntary resettlement will not be required. As the proposed sites belong to the state as well as private, the land acquisition is necessary for private land. Macedonia has the law on expropriation and the compensation should be done by substitute land or cash. The compensation should be properly done to mitigate the impacts. The impact can also be minimized by selecting the state land as much as possible. Identification of project-affected people will be done during the EIA study.
Change in Land Use and Local Resources	Some change in land use will be expected by land acquisition of WWTP site. The area including proposed WWTP site is used as hunting area for educational and scientific purpose by Faculty of Forestry, Skopje University. As the hunting area is 1475 ha and the WWTP site is 57 ha, the impact on land use will be small and insignificant. However, the noise and vibration during construction and transportation of materials will affect the animals, thus the mitigation measures for noise and vibration should be taken. Close discussion with MAFWE and Faculty of Forestry, Skopje University to mitigate the impacts will be required.
Waste	Eighty tons/d of the sewage sludge will be generated through treatment process. The quantity of the sludge is acceptable at Drisla Landfill site. The WWTP will receive industrial wastewater after the pre-treatment at each industry, thus the hazardous materials will not be included within the sludge. The pre-treatment is obligation of each industry required by IPPC under Law on Environment and this will be finished by 2014. The sludge will not include hazardous elements and it can be accepted at Drisla Landfill site.

From the environmental, social points of views and the above mentioned reasons, the Study Team selects the project for the Central District as the priority project.

7.6 Scoping of Priority Project

Table 7.12 Draft Scoping

	Elements	Nature of Impacts	Impact Score		Affected Object	Magnitude/ Extent	Occurrence Probability
			C	O			
Natural Environment							
1	Topography and geology	The scale of facility is not large.	-	-	-	-	-
2	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 (+)	Groundwater	Small	Small
3	Bottom sediment	The quality of bottom sediment will be improved by collection and treatment of wastewater which are currently discharged directly into Vardar River	-	Negligible	Vardar River	Medium	Medium
4	Hydrological situation	The river flow will change due to the collection of sewage which is currently discharged into the river and discharge of effluent from sewage treatment plant, but this is negligible impacts	Negligible	Negligible	-	-	-
5	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 (+)	Wildlife Skopje University	Medium	Medium
6	Meteorology	The scale of facility is not large.	-	-	-	-	-
7	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	People in surrounding area	Small	Medium
8	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 (-)	Faculty of Forestry	Medium	High
9	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 (-)	Global	Medium	Medium
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	People in surrounding area	Medium	Medium
2	Water pollution	Water turbidity due to construction of sewage treatment plant and installation of trunk sewers might be expected.	Negligible	A (+) B (-)	Downstream area	Small	Small

	Elements	Nature of Impacts	Impact Score		Affected Object	Magnitude/ Extent	Occurrence Probability
			C	O			
3	Soil pollution	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 (-)	People in surrounding area Disposal site / Surrounding communities	Medium	Small
4	Waste	The spoil will be generated during installation of pipelines and construction of WWTP. The sludge will be generated from sewage treatment plant.	A (-)	A (-)	Project area Surrounding communities Dumping site	Medium	Medium
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 (-)	Neighbouring people	Medium	Medium
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 (-)	-	Neighbouring people	Uncertain	Uncertain
7	Offensive odours	The operation of treatment plant and sludge drying facility might generate offensive odours.	-	A (-)	Surrounding communities	Medium	Medium
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 (-)	-	Project Affected Peoples	Large	High
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 (+)	Residence in Skopje City	Medium	Medium
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 (-)	Landowners, Skopje University Farmers	Large	High
4	Social institution	Various actors are involved in this project: central government, Skopje city, municipalities and citizens. The coordination among the local society is important.	-	-	-	-	-
5	Local decision-making	-	-	-	-	-	-

	Elements	Nature of Impacts	Impact Score		Affected Object	Magnitude/ Extent	Occurrence Probability
			C	O			
6	Existing social infrastructure and services	Traffic disturbance is expected due to transportation of construction materials and installation of trunk sewers.	B (-)	-	Neighbouring people, public transportation	Medium	Hig
7	Public health and Safety	During construction, the dust generated in the air may give discomfort to the workers and nearby residents. Tthe impact will not be serious and will be of a temporary nature.	B (-)	B (+)	Worker Neighbouring people	Medium	Medium
8	Socially vulnerable groups	No impact	-		-	-	-
9	Cultural heritage	There is no major cultural / historical heritage identified near the construction sites.	-	-	-	-	-
10	Gender, children's rights	-	-		-	-	-
11	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 (-)	Users	Medium	Medium
12	Local conflicts of interest	The related municipalities should be in agreement with the purpose of the project to avoid conflicts of interest.	B (-)	-	Skopje city, Municipalities, Residents	Medium	Medium
13	Water use	-	-		-	-	-
14	Infectious diseases	-	-		-	-	-

CHAPTER 8 PRIORTY PROJECTS FOR F/S

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 these four districts are shown in Table 8.1. The table indicates that the Central District occupies a built-up area, and has a large population and many factories, and that the population in the District covered by the sewer system is as large as 80% the total. The wastewater collected from the city area is at present 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 with only chlorination since the treatment process is not functioning. All the three Municipality administrations for Saraj, North Gorce Petrov and Dracevo 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 a 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 feasibility study, which can be a convenient material for the presentation of the Project to a lending agency.

Table 8.1 Outline of Four Sewer Districts

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	Main collectors 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

The evaluation from the environmental and social point of view are shown in Table 7.10.

The four projects are evaluated from the environmental and social point of views. The total impacts on society and environment are larger in central project compared with other 3 projects as the size of WWTP is large and installation of trunk sewers is included. Especially the impacts on land acquisition, land use, wildlife and ecosystem are large. As the WWTPs in Saraj and North Gorce Petrov will be constructed within the protected area for water source, the impacts on river water and groundwater during construction period might be expected. During the operation of these WWTPs, the positive impacts will be expected.

The impacts on society and environment of central district are larger than of other 3 projects, however, the negative impacts can be avoided and mitigated by taking proper mitigation measures. The expected mitigation measures are listed in the table 7.11. The detail mitigation measures and monitoring plan will be prepared in EIA at F/S stage.

From the environmental, social points of views and the above mentioned reasons, the Study Team selects the project for the Central District as the priority project. The wastewater treatment plant and the main collector comprise the Project.

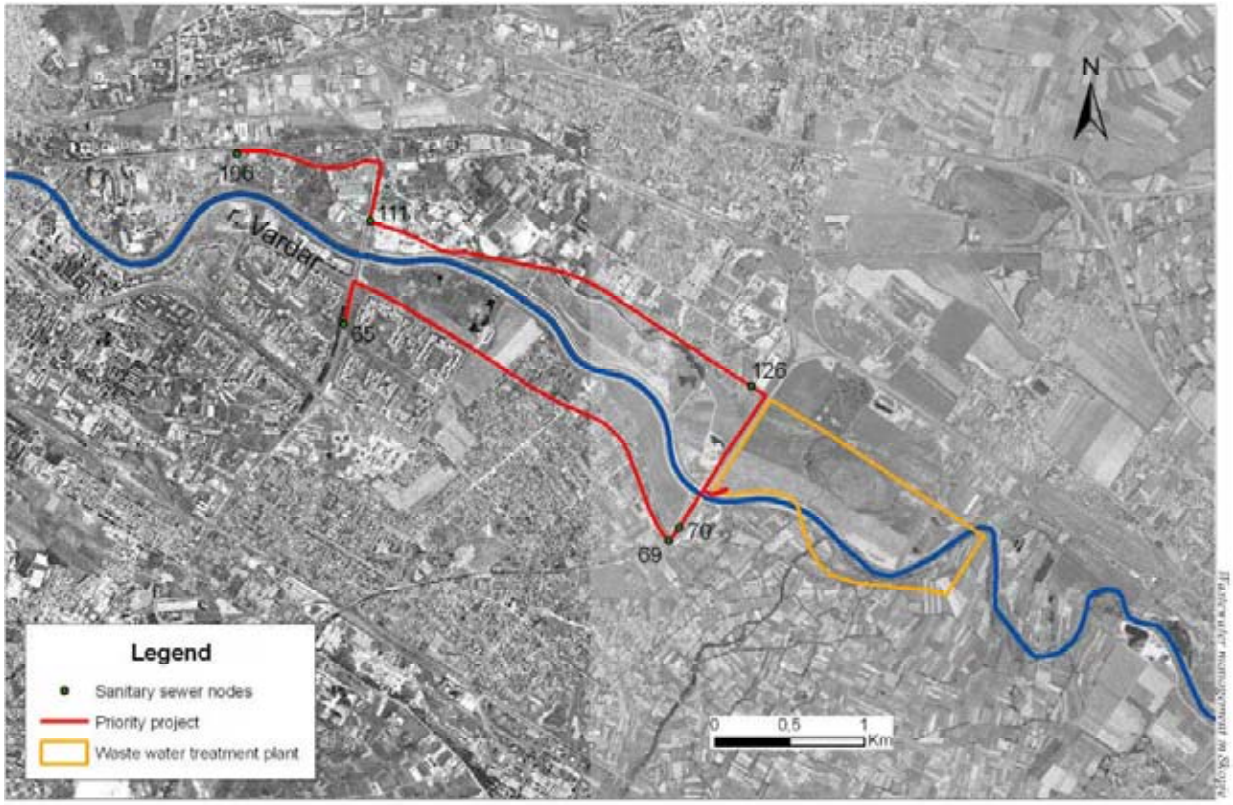


Figure 8.1 Priority Project