Chapter 2 Contents of the Project

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2-1 Basic Concept of the Project

The forecast of national water demand and the water resources development plan of Macedonia were proposed in "The Study for Long Term Water Supply in the Republic of Macedonia up to 2025" in 1993. Based on this study, "Water Resources Development and Management Master Plan (M/P)" was formulated to propose specific projects in accordance with the development study conducted by Japanese assistance in 1999. The M/P consists of three phases. The goal of Phase 1, as a short-term plan, is to raise the national coverage of water supply from the present figure of 75% to 80% by the year 2005.

In the Project areas, the rate of population served of rural municipalities outside Skopje city are from 18% to 78%, on the contrary to 85% in Cair municipality in Skopje city. The statistics reveals that there are relatively many cases of water-borne disease in such areas. This implies poor hygienic condition in non-served villages. The delay in providing water supply facilities is remarkable in comparison with the progress in construction of other public infrastructures such as roads and power supply.

In order to improve the water supply situation mentioned above, the Project will set the objective of raising the rate of population served to more than 80% in target Municipalities (over 90% in Cair).

In order to achieve this objective, the Project will carry out the construction of water supply facilities in the target areas, which will improve the present water supply situation in the areas around Skopje city and will bring about the following effects of project execution.

1) Safe water will be stably supplied to the residents in the Project areas (the rates of population served of the municipalities are 18 to 85 % at present while the planned target rate for each village is 100%).

2) It is expected that rate of water-borne disease infection will be decreased.

The Project will provide the materials, personnel and fund required for the construction of water supply facilities in villages in Skopje outskirts. The project design matrix (PDM) of the Project is shown as Table 2-1.

Table 2-1 Project Design Matrix (PDM)

Narrative Summary	Indicator	Means of Verification	Important Assumption
Overall Goal The living conditions are improved in the villages in Skopje outskirts.	1. Population of the village 2. Morbidity of water-borne disease	1. Municipality 2. Municipality, Ministry of Health (MOH)	• There is no change or influence in the socio-economy by conflict, etc.
Project Purpose Safe and enough volume of water is supplied to the residents in Skopje outskirts.	1. Population served/ rate of population served 2. Supply volume 3. Water quality 4. Duration of water supply	1. Municipality, PE 2. PE 3. PE, MOH 4. PE	• Other infrastructures, such as sewerage system, are improved.
Output 1. Water supply facilities are constructed at 20 target villages.	1. Construction facility	1. Construction record	• O&M works are carried out continuously. • Residents pay the house connection fee.
Activity 1. To construct water supply facilities at 20 target villages	Input *Japanese Side* [Material/equipment] Construction materials & equipment [Manpower] Engineer, skilled labor, labor [Cost] Construction cost	*Macedonian Side* [Material/equipment] Construction materials & equipment [Manpower] Engineer, skilled labor, labor [Cost] Construction cost, O&M cost	• Budget for Macedonia side is approved. Precondition

2-2 Basic Design of the Requested Japanese Assistance

2-2-1 Design Policy

(1) Basic Policy

The Project study areas were composed of 21 villages in seven municipalities. However, overlap with USAID was found in project components of Pobozje village in Cucer Sandevo municipality. As the result of coordination with Macedonian side, Pobozje was excluded from the Project. Accordingly, the Project areas are finally to be 20 villages in seven municipalities as shown in Table 2-2. The Project will construct water supply facilities for the areas. The planned facilities consist of intake facilities, pumping facilities, reservoir tanks and transmission and distribution pipelines. They together form a water supply system with house connections with water meter. The scope of Japanese Assistance is to construct the facilities up to the secondary distribution pipelines. Macedonian side, on the other hand, will construct house connection facilities (diversion cocks, water supply pipes, water meter). A part of the planned facilities has already been constructed by Macedonian side. Taking this into consideration, the scope of construction works by Japanese side will eventually cover the rest of the planned facilities that are not yet constructed.

Table 2-2 The Target Area and Population

Municipality	Village	Population in 2002
Cucer Sandevo	Kuceviste	2,057 people
Cair	Radisani	8,676 people
Gazi Baba	Goce Delcev	1,421 people
	Jurumleri	3,319 people
	Kolonie Idrizovo	1,288 people
	Idrizovo	2,384 people
Ilinden	Bujkovci	670 people
	Mrsevci	700 people
	Miladinovci	1,500 people
	Mralino	830 people
Petrovec	Ognjanci	1,255 people
	Petrovec	2,588 people
	Kjojlija	368 people
	Rzanicino	939 people
Studenicani	Cvetovo	826 people
	Dolno Kolicani	1,516 people
Zelenikovo	Taor	169 people
	Pakosevo	246 people
	Novo Selo	165 people
	Strahojadica	251 people
Seven municipalities	20 villages	31,168 people

(2) Policy for Natural Conditions

The Project area is located in the low land zone in the Vardar river basin (elevation +220 to 230m) and the mountainous / hilly zone (elevation +500 to 1,000m) around Skopje city. Rich groundwater resource exists in the low land zone. In the mountainous / hilly zone, people depend mainly on the spring water and river-bed water. The soil conditions as a foundation of structures are good. However, in the case of excavation for distribution pipes in mountainous/ hilly areas where hard rock is expected, it is necessary to consider carefully the excavation method, either by manpower or by machinery.

The surrounding areas of Skopje city is the mountains with an elevation of 1,000-1,500m forming a basin, where the average annual precipitation is 400-500mm. The temperature varies remarkably throughout the year from 40^{o}C in summer to -17^{o}C in winter. Hence, the distribution reservoir should be covered with soil to be protected from such severe fluctuation of temperature. In addition, outdoor works in winter season (from December to January) should be considered carefully in the construction schedule, because it is too cold to carry out construction works in open air in the period.

(3) Policy for Social Conditions

Multi ethnic people live in Macedonia, such as Macedonian, Albanian, Turkish, Serbian, etc. Accordingly, their religion also varies; they are the Western Church, the Eastern Orthodox

Church, Islam, Judaism, etc. In Project implementation, such ethnic and religious consideration should be carefully taken. In this respect, religious holidays, local customs, etc. shall be considered according to the laws of Macedonia.

(4) Policy for Local Situation concerning Construction and Procurement

After the independence, the economic reform of Macedonia has progressed steadily due to the introduction of decentralization, market economy etc. The inflation rate was more than 100% in 1992 - 1994 immediately after the independence. However it stabilized at a level of around 5% in 2000 – 2001. Many kinds of goods, either imported or domestic, are traded more actively and are available in markets. The product standard is now mainly that of EU or ISO because Macedonia is economically under the strong influence of EU. Thus, the Project will employ mainly domestic products while considering the use of products from the third countries. This will help achieve both reasonable budgeting and assured quality of the Project.

There are four major construction companies in Macedonia, which were once the state owned companies during the era of former Yugoslavia and these companies have the experiences of construction works overseas. These companies will be utilized in principle in the Project. However, observing the concrete works done completed by some of these companies reveals that the quality of the work is not at a satisfactory level; the delay of schedule, improper finishing etc. are observed and their quality control and schedule control don't seem to be always satisfactory. Therefore, Japanese engineers will be posted at the site in order to control and manage quality and progress properly.

(5) Policy for Capability of Executing Agency for Management of O&M

PE (Public Communal Enterprise), which is the public service entity established by the council of each municipality, are in charge of operation and maintenance of water supply facilities. Most PEs in the Project area receive supports from international aid agencies or Skopje city water and sewerage PE about the methods for operation and maintenance. PEs were originally established for the purpose of managing public facilities such as water supply and sewerage, solid waste disposal, market place administration, public park maintenance etc. However, some of these tasks such as solid waste disposal and public park maintenance are not as profitable as they should be for an enterprise. The national policy for PE management is now directed to separation of the water supply and sewerage sector from others in order to strengthen the self-supporting accounting system of PEs and to manage the other sector by subsidy from Municipality. Thus, the water supply system shall be designed so as to minimize the operation and maintenance costs.

(6) Policy for grade establishment concerning facilities, machinery and materials

The facilities to be constructed by the Project are mainly transmission and distribution pipelines including intake and transmission pumps and water reservoir etc. For the piping materials, polyethylene pipe will be employed in principle for the following reasons.

1) They can meet the specification.
2) They are easily procured and low cost in comparison with ductile and steel piles because they are locally manufactured
3) They are workable and easy to handle.

Ground pumps have been produced domestically since the era of former Yugoslavia and can be imported from the Republic of Serbia and Montenegro or Croatia. However, these products of former Yugoslavian countries have lower pump efficiency compared to the EU counterparts, which will lead to consuming more electricity. For this reason, the pumps imported from EU countries are used in many cases at present. For submersible pumps, they are not produced domestically and they have to be imported from the third countries. For the existing wells, EU products, especially German products, are mainly used. The Project will procure, in principle, the pumps from EU countries considering the fact that those products are more efficient and consume less electricity and that they can be imported through local distributors that will provide sufficient after-sale service.

(7) Policy for construction / procurement methods

The best construction / procurement method shall be adopted taking into consideration of the access to construction sites of each facility and their soil conditions. Regarding Cvetovo system in Studenicani, the construction sites for the intake facilities and transmission pipelines are located inside beech forest, and construction of access road is required to transport the machineries. However, the villagers are requesting that cutting down of beech forest should be avoided as much as possible. Therefore, the excavation work for the intake facilities and transmission pipelines shall be done by manpower and the concrete works shall be also done by manpower. Even the cement and aggregate materials will be transported and mixed manually at site.

(8) Policy for construction period

The Project, from its designing to construction, will be implemented by the finance of the Government Bond Type A[#1] (3 years), in which 2 years are dedicated to construction. In formulating a construction schedule, 2 months in winter (December and January) will be regarded as non-workable period.

[#1] Government Bond Type A: Two types of Exchange of Notes will be concluded. One is for the detailed design (1 year). The other is for construction (2 years).

(9) Use of the technical documents

Technical documents (T/D) have been prepared for the requested facilities, which is equivalent to “approved drawing and specifications” of Japan. The documents have information on population, water demand projection and basic design for the facilities. The Project will utilize T/D in such a way that facilities planning will be made on the basis of T/D in combination with the result of field surveys after both of them are fully reviewed.

(10) Policy for handling of existing water supply facilities

Some of the target villages already have water supply systems. In the Project, the facilities will either “be used as they are”, “repair or rehabilitation” or “replaced”, so as to enable economically and technically optimal plan.

Table 2-3 Policy for Handling of Existing Facilities

System	Existing facility	This Project	Remarks
Kuceviste	Intake facility for river-bed water	Used as they are	Extend intake facility to enhance intake amount
	Distribution reservoir	Repair of the body Replace pipes	
	Distribution pipeline	Replace and extend	Will not remove the existing pipelines
Joint System of 3 municipalities	Two Wells	Used as they are Replace the vertical axis pump with submersible pump	Construct two more wells in accordance with the increase in amount of demand
	Disinfection	The house is used as it is Removal of the existing facility and replace with larger capacity	
	Transmission and distribution pipelines	Used as they are	Part of the transmission pipelines will be renewed by Macedonian side after the Project
Ilinden East	Distribution reservoir	Used as they are	A reservoir will be constructed by the Macedonian side after the Project
	Distribution pipeline	Used as they are	Macedonian side will renew and expand on its own account after the Project
Dolno Kolicani	Intake facility	Replace the existing pump facility	
	Distribution pipeline	Used as they are	

(11) Policy for adaptation to future plans

In the case of the systems for which there is a future extension plan of the system by Macedonian side, the design should take into consideration of these future plans.

Table 2-4 Adaptation to Future Plans

System	Future Expansion Plan by Macedonian side	Adaptation in the Project
Kuceviste	Extension to Kucevaska Bara	Choosing appropriate diameter for distribution main for future extension
Radisani	Additional pump facilities to extend supply area	Allocating a plot for future pump installation
Ilinden East	Extension of supply area (extension of distribution pipelines)	Choosing appropriate diameter for transmission pipe considering the increased flow due to future extension
	Construction of distribution reservoir	Allocating a plot for a pump installation due to future increase in flow.
Cvetovo	Transmission facilities from No. 4 water source (pump, Transmission pipe)	Designing appropriate distribution reservoir and distribution pipelines to accommodate increased flow in future

2-2-2 Basic Plan

(1) Planned Target Year and Population

1) Planned target year

The project is a short-term project designed to cope with the urgent water demand under the scheme of Japan's Grant Aid cooperation. The project period is approximately 3 years starting from detailed design to the completion of construction. Since the Project is short-term, the target year of the Project will be year 2008 which is five years after the end of the basic design study. Longer-term plans to cope with future population increase shall be carried out by Macedonian side on its own account.

2) Target population

The population of the villages in 2002 was estimated based on the population from the village-based census in 1994, the population growth rate by municipality taken from the census in 2002 and on other information obtained from each municipality. Then, the population in 2008 was estimated based on the population and population growth rate in 2002 in consideration of the information from municipalities. The estimated population for each village in 2002 and 2008 is presented in Table 2-5. The population in the Project area in 2008 is 33,709 people and planned served population is 32,435 people.

Table 2-5 Village Population (2002) and Projected Population (2008)

Municipality	Village	Population in 2002 (people)	Growth Rate (%)	Population in 2008 (people)
Cucer Sandevo	Kuceviste	2,057	1.0	2,183
Cair	Radisani	8,676	1.8	9,656[#1]
Gazi Baba	Goce Delcev	1,421	1.5	1,554
	Jurumleri	3,319	1.2	3,565
	Kolonie Idrizovo	1,288	1.2	1,384
	Idrizovo	2,384	1.2	2,561
Ilinden	Bujkovci	670	1.0	711
	Mrsevci	700	1.0	743
	Miladinovci	1,500	1.0	1,592
	Mralino	830	1.0	881
Petrovec	Ognjanci	1,255	1.0	1,332
	Petrovec	2,588	1.0	2,748
	Kjojlija	368	1.0	391
	Rzanicino	939	1.0	996
Studenicani	Cvetovo	826	1.0	877
	Dolno Kolicani	1,516	1.0	1,609
Zelenikovo	Taor	169	1.0	180
	Pakosevo	246	2.0	277
	Novo Selo	165	2.0	186
	Strahojadica	251	2.0	283
Total		31,168		33,709

Note #1) The population in Cair is divided into 4,345 and 5,311 in high and low distribution areas respectively, by referring to the Technical Document.

For the calculation of the population in 2008 (P_{2008}), the following formula was used.

$$P_{2008} = P_{2002} \times (1+k)^n$$

where,

P_{2002} : Population in 2002
k : Population growth rate
n : 6 years (2008-2002)

(2) Planned Served Area and Water Supply System

1) Planned served area

The planned served areas are the 20 target villages. The Project aims to achieve the rate of population served to be 100% for all villages. Two villages, namely Kuceviste and Dolno Kolicani, use existing water supply facilities. Since the existing facilities of Kuceviste are aged and deteriorated, these facilities including intake, transmission and distribution facilities are to be renovated by the Project. As for Dolno Kolicani, the existing distribution system will be used as it is so that the planned served area by the Project is to be current non-served area. The existing and planned population served by village is shown in Table 2-6.

2) Water supply system

In water supply planning and facility designing, the Project area was divided into eight systems, as shown in Table 2-6, in consideration of water sources and geographical characteristics.

Twelve villages in the three municipalities of Gazi Baba, Ilinden and Petrovec constitute a single water supply system whose water source is the groundwater of Jurumleri. According to the topographic differences of each served area, the system has been divided into two systems: the gravity flow system (Joint system of three municipalities composed of nine villages) and the booster pump system (Eastern Ilinden of three villages). The municipality of Zelenikovo plans to receive water from Skopje city water and sewerage PE and distribute the water to four villages. The system has been divided into two systems: three villages system with only extension of distribution pipes and Strahojadica system needing a booster pump system.

Table 2-6 The population served and rate of population served

Municipality	Village	Population (Year 2008)	Existing Facility (Year 2002)		Plan (Year 2008)		Water supply system
			Population Served	Served Rate	Population Served	Served Rate	
Cucer Sandevo	Kuceviste	2,183	1,000	46%	2183[#1]	100%	Kuceviste
Cair	Radisani	9,656	0	0%	9,656	100%	Radisani
Gazi Baba	Goce Delcev	1,554	0	0%	1,554	100%	Joint System of three municipalities
	Jurumleri	3,565	0	0%	3,565	100%	
	Kolonie Idrizovo	1,384	0	0%	1,384	100%	
	Idrizovo	2,561	0	0%	2,561	100%	
Petrovec	Ognjanci	1,332	0	0%	1,332	100%	
	Petrovec	2,748	0	0%	2,748	100%	
	Kjojlija	391	0	0%	391	100%	
	Rzanicino	996	0	0%	996	100%	
Ilinden	Mralino	881	0	0%	881	100%	
	Bujkovci	711	0	0%	711	100%	Ilinden East
	Mrsevci	743	0	0%	743	100%	
	Miladinovci	1,592	0	0%	1,592	100%	
Studenicani	Cvetovo	877	0	0%	877	100%	Cvetovo
	Dolno Kolicani	1,609	1,274	79%	335[#2]	100%	Dolno Kolicani
Zelenikovo	Taor	180	0	0%	180	100%	Zelenikovo three villages
	Pakosevo	277	0	0%	277	100%	
	Novo Selo	186	0	0%	186	100%	
	Strahojadica	283	0	0%	283	100%	Strahojadica
		33,709	2,274	7%	32,435	100%	

Note

#1: Although there are existing facilities, renewal and expansion of the existing system is proposed by the Project,. The planned population served is that of the entire village including the population already served.

#2: Service population is divided into two, namely existing service population (1,274) and that in expansion area (335). The rate of population served in 2008 is calculated by adding those of the existing and expansion areas.

(3) Unit Water Demand

The water demand (Daily average amount) is determined based mainly on domestic water and it also includes public water. The water for livestock mentioned in Technical Documents (T/D) is not included in the water demand of the Project.

1) Domestic water

There is no unified national standard or criteria for unit water demand for domestic use in Macedonia. According to T/D, the unit domestic water demand is 150 L/c/d. However, the Project areas extend from the suburb of the capital to villages in mountain areas, each with different living conditions and different water consumptions. In consideration of this situation, four types of unit water demand (150, 145, 100 and 65 L/c/d) have been proposed by examining present water bill, water use condition at site and the result of the interview in the village survey. As the result, different unit water demand is applied to each village (see Table 2-7).

Table 2-7 Determination of Unit Water Demand

Unit water demand	Service Area (System)	Reason
150 L/c/d	Radisani Zelenikovo 3 villages Strahojadica	The municipality is neighboring Skopje city. The water supply in Skopje is 450 L/c/d (including industrial, commercial and leakage). The area has no large-scale industrial or commercial blocks. The water consumption in the service area is estimated to be 1/3 of that of Skopje excluding industrial, commercial and PE's own consumption (35%) plus leakage and other unaccountable water (30%).
145 L/c/d	Joint system of three municipalities Ilinden East	Calculated according to the present billing sheet of Ilinden PE.
100 L/c/d	Kuceviste Dolno Kolicani	The service area locates in the mountainside. According to village survey water consumption is 42 - 90L/c/d. A figure of 100L/c/d is considered reasonable.
65 L/c/d	Cvetovo	The service area locates in the mountainside. According to village survey water consumption is 27L/c/d. A figure of 65L/c/d is considered reasonable.

2) Other use

Other water uses to be included is public use, the water used in such places as schools, hospitals, offices, parks, etc. According to the actual water bill of Ilinden PE, around 30 % of domestic water consumption falls in the category of public use. Three types of unit water demand, namely 30, 20 and 10 % have been proposed in consideration of existence of public utilities (hospital, school etc.) and size of the villages (see Table 2-9).

(4) Peak Day Demand

In order to design intake facilities and distribution reservoirs, peak day demand was determined using the rate of leakage and peak day factor (daily average and seasonal maximum).

1) Leakage rate

Leakage rate is set to be 10% for newly constructed facilities under the Project. The maximum leakage rate for the existing system is 32%. Since more than half of the existing pipes will be renewed in the Project, the leakage rate of the whole system is set to be 20% in the case of the systems which are to be connected to an existing pipe network. Leakage volume (R m^3/d) is calculated as follows.

$$R = Q \times r / (1-r)$$

where,

Q: Water demand (m^3/d),

r: Leakage rate

2) Peak day factor

The peak day factors are set through verification of T/D value, design guideline value of Skopje city water and sewerage PE and examination on water source capacity of Cvetovo. The peak factor for each system is shown in Table 2-8.

Table 2-8 Peak Day Factor

Peak Day Factor	System	Reason
1.5	Kuceviste Joint system of 3 municipalities Ilinden east Dolno Kolicani Zelenikovo 3 villages Strahojadica	Actual record of Ilinden PE was analyzed. 1.5 is applied considering natural and social conditions.
1.3	Radisani	Radisani belongs to urban area and 1.3 is employed as the design guideline value of Skopje City Water and Sewerage PE .
1.0	Cvetovo	As the result of analysis on exploitable capacity and operation and maintenance cost, water sources which can be transmitted by gravity is proposed. Hence, 1.0 is employed.

2-1) Verification from Actual Record of Ilinden PE

In T/D, the peak day factor is planned to be 1.5. The value was reviewed by assessing the water bills of Ilinden PE and the peak day factor of 1.5 was verified as follows.

Maximum Annual Consumption (July to August): 220 L/c/d

Average Annual Consumption: 145 L/c/d

Accordingly,

220/145 = 1.51 …… 1.5

Although the factor of 1.5 seems to be considerably large compared to those of Japan and other countries, it is regarded as reasonable taking into consideration of the local customs (watering in garden in summer, etc.) due to large difference in temperature between summer and winter.

2-2) Peak day factor for Radisani system

Radisani system covers the urban area of Skopje city and the system is operated and managed by Skopje city water and sewerage PE. For this system, the peak day factor of 1.3 is employed, that is set as a standard by the PE.

2-3) Peak day factor for Cvetovo system

For Cvetovo system (Studenicani), the proposed water sources planned in the T/D are four as shown in Figure 2-1. Among the four sources, three sources (from No.1 to 3) can supply water by gravity to the Reservoir. A pump system is required for No.4 water source which is located in the village. However, it is not feasible to use the No.4 source from the financial point of view, since the operation of the transmission pump will need electricity and the cost of O&M will be about twice as much compared to the gravity flow system. Thus, the facilities to be designed under the Project are only those of gravity flow system. Then the total intake amount in this case is 76 m^3/day, and the peak day factor is calculated to be 1.0.

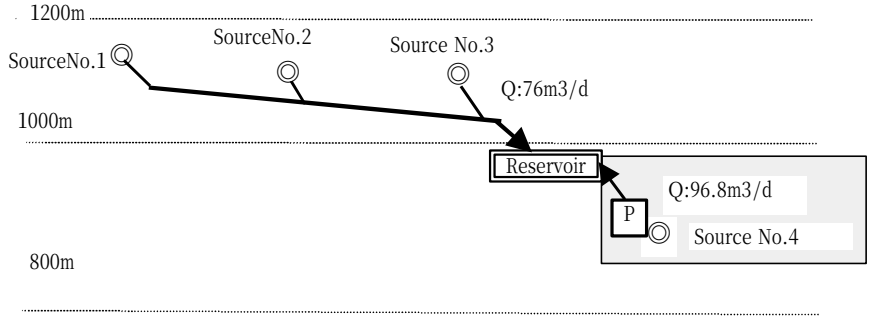


Figure 2-1 Water Sources of Cvetovo

3) Peak day demand of the joint system of three municipalities and Ilinden East

In the joint system of three municipalities and Ilinden East system, the proposed water supply system is planned as the expansion of the existing water supply system, by increasing the intake capacity of the existing water source in Jurumleri wellfield. In addition, further expansion of Ilinden east system is planned which will be executed by Macedonian side. Therefore, the peak day demand for the systems should be calculated based on water demand of the proposed project area, the existing served area and future expansion area.

In this way, the peak day demand has been calculated by multiplying the sum of average day demand and leakage amount by the peak day factor. The design water demand for each village is summarized in Table 2-9.

Table 2-9 Water Demand by Village

System	Village	Population Served (2008)	Unit Demand		Average Day Demand	Average Day Production		Peak Day Production		Production Capacity by System
			Domestic (L/c/d)	Other (%)	Total (m^3/d)	Leakage Rate (%)	Production (m^3/d)	Peak Day Factor	Production (m^3/d)	(m^3/d)
Kuceviste	Kuceviste	2,183	100	30	284	20	355	1.5	532	532
Radisani	Radisani	9,656	150	30	1,883	10	2,092	1.3	2,720	2,720
Joint system 3 municipalities	Goce Delcev	1,554	145	30	293	20	366	1.5	549	9,757
	Jurumleri	3,565	145	30	672	20	840	1.5	1,260	
	K. Idrizovo	1,384	145	30	261	20	326	1.5	489	
	Idrizovo	2,561	145	30	483	20	603	1.5	905	
	Ognjanci	1,332	145	30	251	20	314	1.5	471	
	Petrovec	2,748	145	30	518	20	647	1.5	971	
	Kjojlija	391	145	30	74	20	92	1.5	138	
	Rzanicino	996	145	30	188	20	235	1.5	352	
	Mralino	881	145	30	166	20	208	1.5	311	
	Existing Area	12,197	145	30	2,299	20	2,874	1.5	4,311	
Ilinden East	Bujkovci	711	145	30	134	20	168	1.5	251	1,448
	Mrsevci	743	145	30	140	20	175	1.5	263	
	Miladinovci	1,592	145	30	300	20	375	1.5	563	
	Future Plan	1,051	145	30	198	20	248	1.5	371	
Studenicani	Cvetovo	877	65	20	68	10	76	1.0	76	76
	Dolno Kolicani	335	100	10	37	20	46	1.5	69	69
Zelenikovo 3 villages	Taor	180	150	30	35	10	39	1.5	59	209
	Pakosevo	277	150	30	54	10	60	1.5	90	
	Novo Selo	186	150	30	36	10	40	1.5	60	
Strahojadica	Strahojadica	283	150	30	55	10	61	1.5	92	92

(5) Water Source Plan

1) Water Source Capacity

Intake capacity is designed based on the peak day demand.

1-1) Water supply from Skopje

For the system of Radisani, Zelenikovo three villages and Strahojadica, bulk water supply from the Skopje city water and sewerage PE is planned. The supplied water is treated (chlorination) by the PE and can be distributed as drinking water.

1-2) Jurumleri Intake facilities

The proposed water source for the Joint system of three municipalities and Ilinden east system is groundwater of Jurumleri in Gazi Baba. Planned intake facilities (wells) are located in the same wellfield as the existing ones. The planned intake capacity can be

calculated to be 11,205 m^3/day combing the proposed peak day demand of 6,523 m^3/day, the existing water production of 4,311 m^3/day and the planned expansion water volume of 371 m^3/day.

Production capacity of the intake facility is to be 11,232 m^3/d in total by constructing two new wells (capacity: 5,616 m^3/d) in addition to the existing two wells (capacity: 5,616 m^3/d).

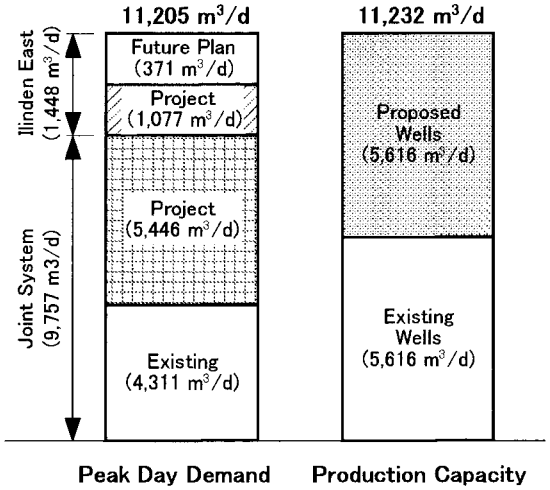


Figure 2-2 Peak Day Demand and Production Capacity for Joint System and Ilinden East System

1-3) Kuceviste, Dolno Kolicani, Cvetovo System

Individual water sources such as spring water and river-bed water are proposed for each of the systems of Cucer Sandevo and Studenicani municipalities, taking into account of the capacity of water sources, site conditions, etc.

2) Exploitable intake capacity

Examination of the exploitable capacity against design production demand is described below.

2-1) Kuceviste system (River-bed water)

According to a hydrological study report (2000), the river water flow of the proposed intake site recorded a minimum of 12 L/sec (August – September) and a maximum of 192 L/sec (April) during the period from 1975 to 1985. The flow measured in May 2003 is 136 L/sec (including irrigation use of 6 L/sec). The capacity of the existing intake facilities decreased to 2.7 L/sec due to clogging. Since thorough investigation is

required to renovate the buried existing facilities and it is costly for its effects, the use of the existing facilities without any repair is proposed to maintain the present capacity of 2.7 L/sec. To supplement the lack of intake capacity, additional intake facilities to draw river-bed water are proposed. Since, the village council demands some of the river water for irrigation, 50% of the minimum river water flow (6 L/sec) is exploitable for intake. The proposed intake facilities consist of screen pipes that are embedded along the river for river-bed water collection. Total production capacity is planned to be 8.7 L/sec (751 m^3/d) including that of the existing intake facility of 2.7 L/sec.

2-2) Joint system / Ilinden east system (Jurumleri groundwater)

As the result of a pumping test carried out in May 2003 using the existing pump, the groundwater potential of the area is estimated to be at least 83,000 m^3/day. The discharge capacity of the existing pumps is 32.5 L/sec for each of the two wells. The total discharge capacity of the intake will be 130 L/sec (32.5 x 4=11,232 m^3/day) if additional two wells are installed. Although interference among the four wells is anticipated in this case, the degree of influence by the two new wells is expected to be as little as 20 to 30 cm. Therefore the interference, in this case, is negligible.

2-3) Cvetovo system (Spring water)

According to T/D, the total production capacity is planned to be 2.0 L/sec (from one site of the existing public fountain and three water sources in the mountains). The water flows measured at the four sites in May 2003 amount to 2.54 L/sec. Taking into account of interviews with local residents and of the fact that two sites are in beech forest, 20% of decline in water flow in dry season is expected. Accordingly, exploitable capacity is calculated to be 2.03 L/sec (176 m^3/day). However, the elevation of the existing public fountain is lower than the proposed distribution reservoir, which requires a pump system to transfer water to the reservoir. It is considered unfeasible to use a booster pump from the financial point of view since the O&M cost is high. Therefore, the water source of the existing public fountain (capacity of 1.12 L/sec) should not be used. Accordingly, the only water sources in mountain where gravity flow system is secured will be employed to give a total production capacity of 0.91 L/sec.

2-4) Dolno Kolicani (Spring water)

The water flow from the proposed intake site (spring or river-bed water) measured in May 2003 was 1.88 L/sec. According to the interview with local residents, decline in water flow in dry season in 2001 was minor at the existing public fountain in the village,

even though the overflow from the intake and the water of the stream near the intake dried up. Having examined the information from the local residents, the minimum water flow in dry season was estimated to be 0.8 L/sec. That is, the production capacity is set to be 0.8 L/sec. (69 m^3/d)

Design intake capacity and exploitable capacity is shown in Table 2-10.

Table 2-10 Design Intake Capacity and Exploitable Capacity by System

System	Water Source	Intake Capacity	Exploitable Capacity	Remarks
Kuceviste	River-bed water	532 m^3/d	751 m^3/d	
Radisani	Bulk water supply #1	2,720 m^3/d	2,720 m^3/d	High: 1,224 m^3/d Low: 1,496 m^3/d
Joint System	Groundwater	9,757 m^3/d #2	11,232 m^3/d	
Ilinden East	Groundwater	1,448 m^3/d #3		
Cvetovo	Spring water	76 m^3/d	79 m^3/d	
Dolno Kolicani	Spring water	69 m^3/d	69 m^3/d	
Zelenikovo 3 village	Bulk water supply #1	209 m^3/d	301 m^3/d	
Strahojadica	Bulk water supply #1	92 m^3/d		

Note: #1: Bulk water supply from Skopje city water and sewerage PE
#2: Including existing water production capacity of 4,311 m^3/d
#3: Including future expansion capacity of 371 m^3/d

3) Raw Water Quality

Water quality tests were conducted for water samples taken at each planned water source. The location of the samples and the test results are shown in Tables 2-11 and 2-12. The date of sampling is 23 May 2003.

Table 2-11 Water Sampling Point

Sample No.	Village	Water Source	Sampling Point
No.1	Kuceviste	River water	River
No.2	Kuceviste	River-bed water	Existing intake facility
No.3	Jurumleri	Groundwater	Existing intake (Well No.2)
No.4	Jurumleri	Groundwater	Existing intake (Well No.1)
No.5	Dolno Kolicani	Spring	Overflow water of the existing intake facility
No.6	Cvetovo	Spring	Source No. 4 (Existing intake facility in village)
No.7	Cvetovo	Spring	Source No. 1 (Spring in the forest of beech)
No.8	Cvetovo	Spring	Source No. 2 (Spring along the road)

Table 2-12 Result of Water Quality Analysis

	No.1	No.2	No.3	No.4	No.5	No.6	No.7	No.8	Standard
Temperature (°C)	12.5	9.0	12.0	15.0	10.5	10.5	6.0	10.3	8 - 12
Color (TCU)	5	-	-	-	-	-	-	-	10(15)
Odor on 25°C	-	-	-	-	-	-	-	-	Nothing
Taste on 12°C	-	-	-	-	-	-	-	-	Nothing
Turbidity (mg/l)	-	-	-	-	-	-	-	-	
pH	7.60	7.60	7.58	7.82	7.50	7.29	7.15	7.13	6.8 - 8.5
$KMnO_4$ (mg/l)	3.4	2.8	1.3	1.3	2.5	2.5	3.1	1.3	8
TDS (mg/l)	352	502	413	439	485	498	51.8	30.8	(1000)
Electric Conductivity (iS/cm)	348.9	510.9	429.9	448.3	492.0	520.2	52.91	25.34	500
NH_3 (mg/l)	-	-	-	-	-	-	-	-	
NO_2 (mg/l)	-	-	-	-	-	-	-	-	3
NO_3 (mg/l)	-	1.36	3.16	4.97	1.36	5.42	0.9	-	50
Cl (mg/l)	6	9	21	21	12	15	4	4	25(250)
Fe (mg/l)	0.141	0.026	0.042	0.026	0.009	0.015	0.043	0.029	0.05(0.3)
Mn (mg/l)	0.001	0.001	0.001	-	-	0.003	0.008	-	0.02(0.5)
F (mg/l)	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	1.0(1.5)
Ca (mg/l)	77.2	108.1	81.0	77.2	104.2	92.6	4.97	3.06	
Mg (mg/l)	2.76	5.75	8.51	12.88	5.91	9.20	5.26	2.11	30
Total Hardness (mg/l)	11.45	16.48	13.34	13.82	15.49	15.12	1.53	1.04	
Cabonate Hardness (mg/l)	10.64	15.12	11.48	11.48	14.56	14.28	1.4	0.98	
Cu (mg/l)	-	0.004	-	-	-	-	-	-	0.1(2)
Zn (mg/l)	0.012	0.025	0.015	0.091	0.091	0.007	0.029	0.005	0.1(3)
Pb (mg/l)	0.010	0.009	0.003	0.007	0.005	0.001	0.002	0.001	0.05(0.01)
Cd (mg/l)	-	-	-	-	-	-	-	-	0.003
Co (mg/l)	-	-	-	-	-	-	-	-	
Ni (mg/l)	-	-	-	-	-	-	-	-	
Cr^{6+} (mg/l)	-	-	-	-	-	-	-	-	
Total Cr (mg/l)	-	-	-	-	-	-	-	-	0.05
Sr (mg/l)	0.258	0.407	0.106	0.107	0.412	0.083	0.014	0.018	
As (mg/l)	0.00181	-	0.00051	-	-	-	-	-	0.05(0.01)
Total colonies,spc.	-	16	-	-	100	150	50	-	
Coliform group,cfg.	240,000	50	-	-	20	16	161	-	0

Note) The figure in the parenthesis under the "Standard" column shows WHO guideline.

3-1) Sample No.1 (Kuceviste river water): Ammonia is detected. Coliforms, and total iron exceed the water quality standard for drinking water

- Excrement from livestock, etc. is assumed to have flowed into the river, causing ammonia and coliforms to be detected. The proposed intake facility is designed to intake river-bed water that is filtered through gravel and sand layers. In that case, these exceeding parameters can be expected to be reduced. In addition, the raw water is planned to be disinfected by the proposed chlorination system.
- Although the total iron exceeds the domestic water quality standard, it satisfies the WHO drinking water quality standard and is regarded as acceptable. The iron exists in the form of ferrous iron and precipitates in water. The water sample of No.2, the same source as No.1, has lower content of iron that is within the standard since the raw water

is filtered by sand and gravel. Hence, the iron content of sample No.1 can be reduced to a satisfactory level when the water is taken as river-bed water due to filtration by sand and gravels.

3-2) Sample No.2 (Kuceviste river-bed water): Electric conductivity exceeds the standard value

- Electric conductivity of sample No.2 (river-bed water of Kuceviste) slightly exceeds the standard. The reason is assumed to be higher contents of organic matters and minerals. However, these organic matters and minerals are harmless to human. Coliforms can be treated by disinfection.

3-3) Sample No.6 (Cvetovo water source No.4): The same issues as sample No.2.

3-4) Sample No.7 (Cvetovo water source No.1): Coliforms exceed the standard value

- Coliform contamination can be treated by disinfection.

The results of the test descried above suggest that the water from all the sources (sampling points) can be used for drinking only with disinfection by chlorination.

(6) Facility Plan

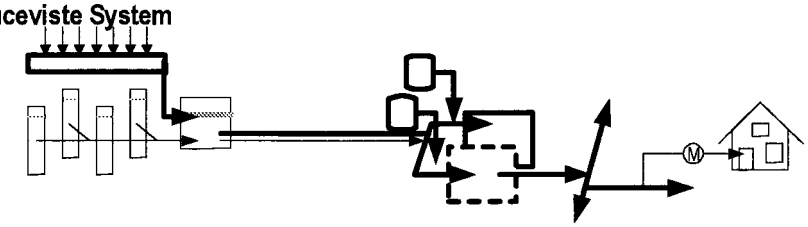
The requested facilities by system are summarized in Table 2-13. Design principles are described thereafter.

Table 2-13 Proposed Facility by System

System	(a) Intake	(b) Disinfection	(c) Pump	(d) Reservoir	(e) Transmission / distribution pipe
Kuceviste	(a-1)	(b-1)	—	(d-1)	(e-1)
Radisani	—	—	(c-1)	—	(e-2)
Joint system of 3 municipalities	(a-2)	(b-2)	—	—	(e-3)
Ilinden East	—	—	(c-2)	—	(e-4)
Cvetovo	(a-3)	(b-3)	—	(d-2)	(e-5)
Dolno Kolicani	(a-4)	(b-4)	(c-3)	(d-3)	(e-6)
Zelenikovo 3 villages	—	—	—	—	(e-7)
Strahojadica	—	—	(c-4)	(d-4)	(e-8)

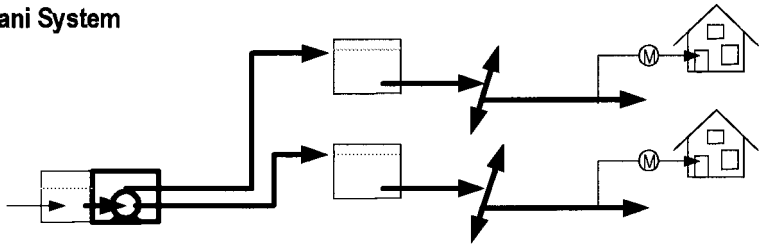
(Note) Alphabet with numerical code denotes the heading number for the subsequent description for each facility

Kuceviste System



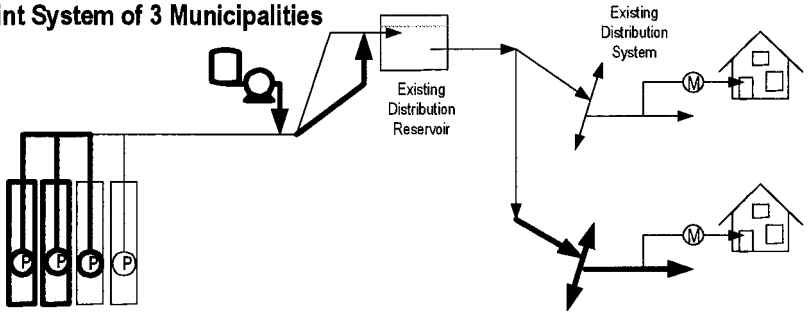
Proposed	Expansion of Intake Facility (Undercurrent water)	Transmission Pipe (Expansion)	Disinfection Facility	New Construction and Rehabilitation of Distribution Reservoir	Distribution Network
Macedonia					Individual House Connection

Radisani System



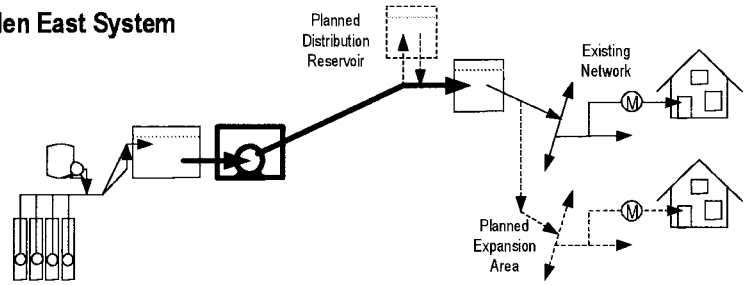
Proposed	Transmission Pump	Transmission Pipe (Higher / Lower Zones)	Secondary Networks (Higher / Lower Zone)	
Macedonia	Existing Distribution Reservoir (Skopje City Water & Sewerage PE)	Transmission Pipe (Approx. 600m)	Distribution Reservoir (Completed)	Individual House Connection

Gazi Baba/ Ilinden/ Petrovec
Joint System of 3 Municipalities



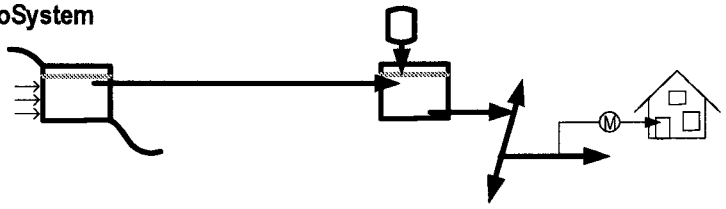
Proposed	New Wells (2 wells) Replacement of intake pump (1 set)	Disinfection Facility	Transmission Pipe	Primary and Secondary Pipe	
Macedonia				Primary Pipe (Under construction)	Individual House Connection

Ilinden East System



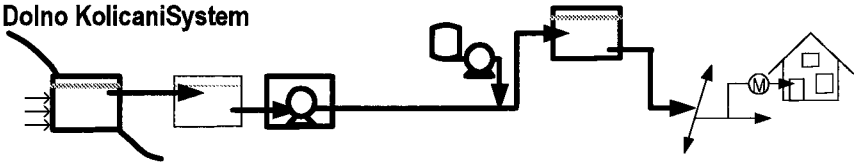
Proposed		Pump Station	Transmission Pipe		
Macedonia			New Distribution Reservoir (under planning)	Expansion of Secondary Network (under planning)	Individual House Connection (Existing)

CvetovoSystem



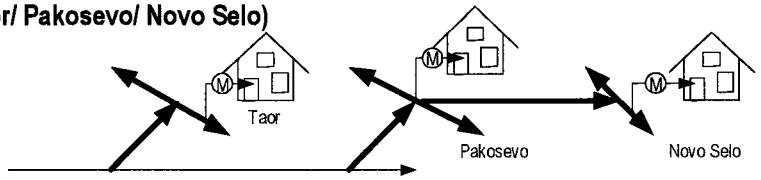
Proposed	Intake Facility (Spring)	Transmission Pipe	Disinfection Facility	Distribution Reservoir	Distribution Pipe	
Macedonia						Individual House Connection

Dolno KolicaniSystem

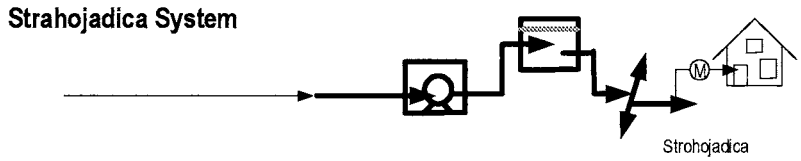


Proposed	Renovation of Intake Facility	Transmission Pump	Transmission Pipe	Disinfection Facility	Distribution Reservoir	Primary Pipe	
Macedonia	Distribution Reservoir (Existing)					Secondary Network (Existing)	Individual House Connection

Zelenikovo Three Villages System
(Taor/ Pakosevo/ Novo Selo)



Proposed	Primary Pipe	Secondary Pipe	
Macedonia	Existing Distribution Pipe (Skopje city water & sewerage PE)		Individual House Connection



Proposed	Transmission Pipe	Pump Station	Distribution Reservoir	Secondary Network	
Macedonia	Existing Distribution Pipe (Skopje city water & sewerage PE)				Individual House Connection

(a) Intake Facility

Three types of water sources are proposed, namely river-bed water, groundwater and spring water. Description of the intake facilities are summarized below:

	System	Source	Description	Qty
(a-1)	Kuceviste	River-bed water	Water collection pipe (PVC Screen Pipe: 400mm x 30m)	1 set
(a-2)	Joint System of 3 Municipalities	Groundwater	Deep well (Dia.: 600mm, Depth: 30m) Replacement of Pump (Same type as the existing submersible pump: 37kW)	2 wells 1 set
(a-3)	Cvetovo	Spring	Intake Catchment (Concrete)	3 nos
(a-4)	Dolno Kolicani	Spring	Intake Catchment (Concrete)	1 no

(a-1) Kuceviste Intake Facility

New facilities for river-bed water collection is proposed, since the existing intake facilities (2.7 L/sec) cannot satisfy the peak day demand (6.16 L/sec). The proposed intake capacity is 3.46 L/sec. The existing facility is proposed to be used as it is, as stable intake capacity is secured and no serious deficits have not been identified in the structure so far.

Table 2-14 Kuceviste Intake Facilities

Water source	River-bed water from the Kuceviste river
Intake point	Within the area of the existing intake facility (Approx. 40m×500m)
Design production	299 m^3/d (3.46 L/s) =[Total flow: 6.16 L/s]-[Existing flow: 2.7 L/s]
Facility	Type: Underground collecting pipe system Collecting pipe: Screen pipe of PVC, DN400 mm, Opening rate 5%, L = 30.0 m Intake pipe (Connection of existing collecting chamber): PE of ND140mm (ID125mm), L = 52.6m Transmission pipe (In the intake area): PE of ND110mm (ID100mm), L = 214.2m Accessories: Stop valve, Air release valve, Drain valve

Design of underground collecting pipe system

The system is designed based on Hydrogeological formulation of unconfined groundwater. According to the following calculation, with the use of the screen pipe (ND400mm x 30 m length, with opening rate 5%), the discharge capacity (Q) is 3.5 L/s.

$$Q = \frac{k(H^2 - h^2)\ell}{L}\sqrt{\frac{t+0.5r}{h}}\sqrt[4]{\frac{2h-t}{h}}$$

Where

Q : Discharge capacity (m^3/s)
k: Hydraulic conductivity, 0.01 m/s (From hydrological and hydrogeological data(#) of the site)
L: Radius of influence, 50 m (estimated by site conditions)
H: Actual groundwater level, 2.5 m (From hydrological and hydrogeological data(#) of the site)
r : Radius of the underground pipe, 0.2 m (screen pipe for well, PVC 400mm, opening rate is more than 5%)
h: Depth from static water level in the underground pipe to impermeable stratum, 1.9 m (Calculated by embedded depth of the pipe and water level in the pipe)
t: Water depth of the underground pipe, 0.3 m (estimated to be the medium point of 200-400mm)
l: Length of underground pipe, 30 m
(#) Data Source: Kuceviste Hydrogeological Study (year 2000)

(a-2) Intake Facilities of the Joint System of 3 municipalities

Two new intake wells are proposed, to complement the existing intake capacity of 5,616 m^3/day, to supply a total peak day demand of 11,206 m^3/day. Well structure and specifications of pumps will basically be the same as those of the existing facilities. The existing pump of well No.1, a vertical shaft type, are aged and subject to frequent failure. In addition, since groundwater level rises in rainy season and operating another pump to drain the water will cost electric power. Therefore, it is proposed that this pump be replaced with a submersible pump of the same type as No.2.

Table 2-15 Intake Facilities for the Joint System of Three Municipalities

Source	Groundwater
Intake point	Existing intake area in Jurumleri
Design production	5,590 m^3/d =[Peak day production (11,206 m^3/d)]-[Capacity of existing facility (5,616 m^3/d)]
Facility	Type: Deep well Structure: Diameter of well - 600mm, Diameter of screen pipe - 400mm, Depth - 30m, Construction - 2 wells Submergible pump: 37 kW x 3sets(1set for replacement) Transmission pipe (well – distribution main pipe): Diameter of PE -225 mm×265.4 m in length, Diameter 280mm×180.6 m in length

(a-3) Cvetovo Intake Facility

There exists a public fountain in Cvetovo village that takes water from a spring. Three additional spring water sources are proposed in the Project. Intake facilities consist of a concrete chamber with perforated walls to take in water. The water is, then, transferred to the proposed distribution reservoir by gravity.

Table 2-16 Facility for Cvetovo System

Source	Spring
Intake point	Three selected sites out of the ones mentioned in T/D. The sites where transmission by gravity have been selected.
Design production	76 m^3/d
Facility	Concrete structure (Intake No.1:3 sets, intake No.2:1set,intake No.3:1 set)

(a-4) Dolno Kolicani Intake Facility

There are three existing water sources for public water supply system in Dolno Kolicani. Among them, one source that supplies water to the public fountain in the village center is proposed to be renovated to supply water to the un-served area. (approximately 300 households)

Table 2-17 Intake Facility for Dolno Kolicani System

Source	Spring
Intake point	Existing source for the public tap in the center of village.
Design production	69 m^3/d
Facility	Water collecting pit, concrete structure, 1 set

(b) Disinfection Facility

Disinfection facilities are designed for every system that has its own water sources. Sodium hypochlorite is proposed as disinfectant because it is locally available, safe and easy to handle. Metering pump or drop type systems are proposed for chemical dosing. Appropriate system will be proposed, taking into account of site condition, dosing rate, etc.

Table 2-18 Disinfection Facility

	System	Disinfectant	Dosing point (proposed)	Dosing system (proposed)	Operation (proposed)
(b-1)	Kuceviste	Sodium hypochlorite	2 sets of reservoir tank inlet	Drop (2 sets)	Manual
(b-2)	Joint system of three municipalities	Sodium hypochlorite	Inlet of transmission pipe	Diaphragm pump (4 sets)	Automatic interlock step control system with pump
(b-3)	Cvetovo	Sodium hypochlorite	Reservoir tank inlet	Drop (1set)	Manual
(b-4)	Dolno Kolicani	Sodium hypochlorite	Reservoir tank inlet	Drop (1set)	Manual

(b-1) Kuceviste Disinfection Facility

New disinfection systems for both existing and new reservoirs are proposed at the inlet of the reservoirs. Since no raw water flow control is planned, constant dosing is done by drop type chlorination equipment.

Table 2-19 Disinfection Facility for Kuceviste

Chlorine dosing rate	Average: 1.0 mg/L, Maximum: 2.0 mg/L (setting of the dosing rate is controlled manually)
Chemical	Sodium hypochlorite (effective chlorine concentration: 3% solution diluted from 12% solution
System	Drop type chlorinator, 2 sets Ave. dosing capacity per set: 14.8 m^3/h×1.0 mg-Cl_2/L / 3% / 1.03 kg/L / 2 = 0.24 L/h Max. dosing capacity per set : 22.2 m^3/h×2.0 mg-Cl_2/L / 3% / 1.03 kg/L /2 = 1.44 L/h
Operation	Manual system

(b-2) Disinfection Facility for Joint System of three municipalities

Existing disinfection system (liquid chlorine) is old and under-capacity to meet the proposed production capacity. A new system of sodium hypochlorite injection will be introduced by removing the existing one. Four metering pumps will be operated by step-wise control in accordance with the number of submersible pumps in operation. Two separate dosing points are proposed for the existing pipeline (of two wells) and for new pipeline (of two wells).

Table 2-20 Disinfection Facility for Joint System of Three Municipalities

Dosing rate	Average: 0.5 mg/L, Maximum: 1.0 mg/L (Setting of the dosing rate is controlled manually)
Chemical	Sodium hypochlorite (effective chlorine concentration: 5% solution diluted from 12% solution)
System	Measuring pump (Diaphragm pump)×4 set Ave. dosing capacity: 117 m^3/h (submersible pump discharge)×0.5 mg-Cl_2/L / 5% / 1.05 kg/L = 1.11 L/h Max. dosing capacity: 117 m^3/h(submersible pump discharge)×1.0 mg-Cl_2/L / 5% / 1.05 kg/L = 2.23 L/h
Control	Automatic step-wise control linked with no. of submersible pump, (2sets of existing and new pump lines)

(b-3) Cvetovo Disinfection Facility

Drop type chlorination equipment is proposed to be installed at the inlet of the planned distribution reservoir. Taking into account of absence of flow control of raw water, unavailability of power supply and small dosing rate, drop type system that doesn't require power source is proposed.

Table 2-21 Disinfection Facility for Cvetovo

Dosing rate	Average: 0.5 mg/L, Maximum: 1.0 mg/L (Setting of the dosing rate is controlled manually)
Chemical	Sodium hypochlorite (effective chlorine concentration: 1% solution diluted from 12% solution
System	Drop type chlorinator, 1 set Ave. dosing capacity: 3.17 m^3/h×0.5mg-Cl_2/L / 1% / 1.01 kg/L= 0.16 L/h Max. dosing capacity: 3.17 m^3/h×1.0 mg-Cl_2/L / 1% / 1.01 kg/L = 0.31 L/h
Operation	Manual system

(b-4) Dolno Kolicani Disinfection System

Drop type chlorination equipment is proposed to be installed at the inlet of the proposed distribution reservoir. Taking into account of small dosing rate, drop type system that doesn't require power source is proposed.

Table 2-22 Disinfection Facilities for Dolno Kolicani

Dosing rate	Average: 0.5 mg/L, Maximum: 1.0 mg/L (Setting of the dosing rate is controlled manually)
Chemical	Sodium hypochlorite (effective chlorine concentration: 1% solution diluted from 12% solution)
System	Drop type chlorinator, 1 set Ave. dosing capacity: 1.92 m^3/h×0.5mg-Cl_2/L / 1% / 1.01 kg/L= 0.10 L/h Max. dosing capacity: 2.88 m^3/h×1.0 mg-Cl_2/L / 1% / 1.01 kg/L = 0.29 L/h
Operation	Manual system

(c) Transmission Pump Facility

Transmission pump facilities serve to transfer water to the distribution reservoir. The type of proposed pump is centrifugal pump in principle. Design specifications will be determined based on the discharge capacity, required pump head, etc. The number of pumps will be decided taking into account of the total capacity of the pumps to achieve an optimum efficiency in constant operation. At least one standby pump is required according to the Macedonian design standard, which will also be included in the plan.

Table 2-23 Transmission pump

System	Proposal specifications	Qty	Operation
Radisani	Multistage centrifugal pump (High pressure area:18.5kW) Multistage centrifugal pump (Low pressure area:15kW)	3 sets 3 sets	Automatic control according to water level of reservoir tank
Ilinden east	Multistage centrifugal pump (18.5 kW)	3 sets	Manual
Dolno Kolicani	Multistage centrifugal pump (2.2 kW)	2 sets	Automatic control according to water level of reservoir tank
Strahojadica	Multistage centrifugal pump (4kW)	2 sets	Automatic control according to water level of reservoir tank, with automatic stop device by primary pressure sensor of the pump

(c-1) Radisani Transmission Pump

The planned served area consists of high and low elevation zones. Two sets of transmission pumps are proposed to transmit water to the reservoirs in both low and high zones (under construction by Cair). The proposed pump station with pump facilities will be newly constructed in the site of existing pump station that supplies water to existing served area of Radisani urban settlement. According to T/D, space for installation of pumps have to be set aside in view of future expansion of the served area. Radio operation system of the pump is proposed in T/D. Since the transmission pipeline is long and some portions are already constructed by Cair, a radio operation system is considered more reasonable both economically and technically than installing control cable underground.

Table 2-24 Transmission Pump for Radisani Higher Zone

Total head	140 m (Actual head: 128 m, friction loss:12 m)
Qty	3 sets (1 set for stand by)
Discharge	30.6 m^3/h ([Peak day water capacity: 1,224 m^3/d] / [20 hours] / [2 sets])
Type	Multistage centrifugal pump with motor
Motor output	18.5 kW
Operation	Automatic operation by water level of reservoir tank

Table 2-25 Transmission Pump for Radisani Lower Zone

Total head	70 m (Actual head: 63 m, Friction loss:7 m)
Qty	3 sets (1 set for stand by)
Discharge	37.4 m^3/h ([Peak day production capacity: 1,496 m^3/d] / [20 hours] / [2sets])
Type	Multistage centrifugal pump with motor
Motor output	15 kW
Operation	Automatic operation by water level of reservoir tank

(c-2) Ilinden East Transmission Pump

A transmission system is planned to convey water from the existing Bnardzik Pump Station to the existing distribution reservoir (200 m^3) in the Ilinden East service area. For this system Macedonian side has a plan to construct a new distribution reservoir (500 m^3) and additional distribution pipe networks to expand the service area to three more villages on its own account. Therefore, the facilities to be constructed under the Project should be designed to allow for the future expansion plan. The same type of pumps should be used both for the proposed and future plans. The number of pumps proposed for the Project is three (including one for standby) and one more is proposed for future expansion. Land space should be appropriately allocated to the additional one pump to secure the future expansion. Manual operation method is proposed to control the pumps, on account of long transmission pipeline and absence of the future distribution reservoir.

Table 2-26 Transmission Pump for Ilinden East

Total head	167 m (Actual head: 152 m, friction loss: 15 m)
Qty	3 sets (1 set for stand by, after expansion, the pump of 3 sets and 1 for standby)
Discharge	24.1 m^3/h ([Peak day production capacity in future:1,448 m^3/d] / [20 hours] / [3sets])
Type	Multistage centrifugal pump with motor
Motor output	18.5 kW
Operation	Manual

Note)
- Production capacity of the Project (1,077 m^3/d) can be discharged from two sets of pump by 22 hours operation
- Peak day production capacity in future: Total capacity of Ilinden East and future expansion
- Production capacity of the Project: The capacity for Ilinden east only.

(c-3) Dolno Kolicani Transmission Pump

A pump house is to be constructed beside the existing distribution reservoir in order to transmit water from the pump station to the proposed new reservoir. The operation of the pump is

proposed to be automatic On/Off system by water level of the distribution reservoir, through control cable.

Table 2-27 Transmission Pump for Dolno Kolicani

Total head	73 m (Actual head: 68 m, friction loss: 5 m)
Qty	2 sets (1set for stand by)
Discharge	3.45 m^3/h ([Peak day production capacity: 69 m^3/d] / [20 hours])
Type	Multistage centrifugal pump with motor
Motor output	2.2 kW
Operation	Automatic operation by water level of the reservoir tank.

(c-4) Strahojadica Transmission Pump

The proposed plan is an expansion of the existing distribution system that receives water from Skopje city water and sewerage PE. Strahojadica area doesn't provide sufficient water pressure to transmit water to the planned reservoir. Thus, the water needs to be pressurized somewhere along the pipeline. According to the T/D of Macedonia, the pump is planned to be installed directly on the transmission pipeline. Therefore, auto-stop device with pressure detector at the inlet-pipe of the pump is proposed. The operation method is proposed to be automatic On/Off by water level detection of the distribution reservoir via control cable.

Table 2-28 Transmission Pump for Strahojadica

Total head	128 m (Actual head: 123 m, friction loss: 5 m)
Qty	2 sets (1 set for stand by)
Discharge	4.6 m^3/h ([Peak day production capacity: 92 m^3/d]÷[20 hours])
Type	Multistage centrifugal pump with motor
Motor output	4 kW
Operation	Automatic operation by water level of the reservoir.

(d) Distribution Reservoir

The capacity of the distribution reservoirs is determined employing a normal retention time of six hours and additional storage amount for fire fighting. Structure of the reservoir is proposed to be of reinforced concrete because it is commonly employed and of which Macedonia has a lot of experience in construction. In order to avoid freezing in winter as well as to maintain water temperature in midsummer, the reservoir is placed half underground and is covered by soil blanket (approximately 80cm deep). In consideration of operation and maintenance, each reservoir will be equipped with a water-level-gauge and a cumulative flowmeter.

Table 2-29 Distribution Reservoir

	System	Type	Structure	Capacity	Qty	Accessories
(d-1)	Kuceviste	Rectangular, Semi underground	Reinforced concrete	100 m^3 100 m^3	1 (new) 1 (rehabilitation)	WLG, WFM[#1]
(d-2)	Cvetovo	Rectangular, Semi underground	Reinforced concrete	100 m^3	1 tank	WLG, WFM[#1]
(d-3)	Dolno Kolicani	Rectangular, Semi underground	Reinforced concrete	100 m^3	1 tank	WLG, WFM[#1]
(d-4)	Strahojadica	Rectangular, Semi underground	Reinforced concrete	100 m^3	1 tank	WLG, WFM[#1]

Note: #1 WLG (Water Level Gauge), WFM (Water Flow Meter)

Table 2-30 Calculation of Reservoir Capacity

	Population served	[1] Peak day production.	[2] Capacity for 6 hours ([1] x 6 / 24)	[3] Fire extinguish ($1m^3$/min x 60min)	[4] Total capacity ([2]+[3])	[5] Design capacity
Kuceviste	2,183	532 m^3/d	133.0 m^3	60 m^3	193.0 m^3	New 100 m^3 Exist 100 m^3
Cvetovo	877	175 m^3/d[#]	43.8 m^3	60 m^3	103.8 m^3	100 m^3
Dolno Kolicani	335	69 m^3/d	17.3 m^3	60 m^3	77.3 m^3	100 m^3
Strahojadica	283	92 m^3/d	23.0 m^3	60 m^3	83.0 m^3	100 m^3

The reservoir tank capacity of Cvetovo includes future expansion capacity.

(d-1) Kuceviste Distribution Reservoir

A new distribution reservoir (100 m^3) is proposed to be constructed adjacent to the existing distribution reservoir (100 m^3). The existing reservoir will be rehabilitated by repairing cracks and leakage, and by replacing pipes and valves, etc.

(d-2) Cvetovo Distribution Reservoir

A new reservoir is proposed to be constructed in the site described in T/D.

(d-3) Dolno Kolicani Distribution Reservoir

A new reservoir is proposed to be constructed in the site described in T/D.

(d-4) Strahojadica Distribution Reservoir

A new reservoir is proposed to be constructed in the site described in T/D.

(e) Transmission / Distribution Pipe

Pipe routes are planned and designed based on T/D and the result of field reconnaissance. The pipe length will be determined by referring to the drawings of the T/D in principal. However, its data for some target villages (such as Kuceviste, Petrovec, Rzanicino, Kjojlija and Dolno Kolicani) is too old to reflect the actual condition. Thus, it is impossible to obtain a reliable data on pipe routes and length. For this reason, pipe routing will be redesigned based on topographic maps of 1:2500 scale and on some information provided by Macedonian side. Diameters of the pipes presented in T/D will be reviewed and determined through hydraulic analysis based on the water demand projection.

Table 2-31 Transmission and Distribution Pipe

System	Existing Conditions	Rehabilitation	Expansion
Kuceviste	Pipes are installed in the central area of the village, detailed information (year of embedment, specification) is unclear and pipes are highly deteriorated.	The existing transmission pipe between existing intake and reservoir tank (PVC 100mm) is utilized as it is. All the distribution pipes are rerouted. Existing pipe won't be removed.	Due to the expansion of the intake capacity, new pipeline is constructed along the existing transmission pipeline. The pipe network is expanded as service area is expanded.
Radisani	In part of the distribution pipe used to receive water from Radisani urban is completed.	The existing pipe network will be used as a part of the proposed new network for lower zone. (There's no existing pipe in higher zone)	The pipe material is Ductile Iron for the expansion area.
Joint system of 3 municipalities	There are completed part and under construction part of the primary pipe by Macedonian side. The secondary pipe is not construction yet.	-	Japanese side will construct after flange connection.
Ilinden East	There is no existing system.	-	The pipe diameter will be designed to allow for future expansion plan such as construction of additional reservoir carried out by Macedonian side.
Cvetovo	There is no existing system.	-	Transmission and distribution pipeline will be newly constructed.
Dolno Kolicani	There is existing piped water supply system. In addition to the public system, there are some individual piped system by using private water source.	The existing pipe network will be used as they are.	Transmission and primary distribution pipes are proposed to connect the existing network.
Zelenikovo 3 villages	Some part has already been completed by Macedonian side	The completed distribution pipeline will be utilized.	Pipes are newly installed for the rest of the planned area.
Strahojadica	There is no existing pipeline.	-	Transmission and distribution pipeline will be newly constructed.

In Macedonia, polyethylene pipe (PE pipe) of good quality in compliance with ISO standards is produced. Since it is resistant earthquake and freezing, and it has high workability and economic performances, MTC (Ministry of Transport and Communications) recommend the use of polyethylene pipe. Hence, PE pipe is proposed for the pipe material in principal in this Project. Meanwhile, in Ilinden East system where the water pressure becomes relatively high in the pipe, the

use of steel pipe will be considered. In Radisani system, ductile iron pipe (DI pipe) is basically employed since DI pipe is taken as the standard pipe material of Skopje city water and sewerage PE that is supposed to take over the operation and maintenance of the completed system.

Table 2-32 Pipe material

System	Material
All system other than the two below	PE pipe
Ilinden East	Steel pipe
Radisani	Ductile Cast Iron Pipe

According to Macedonian standard, soil covering depth is normally from 1.2 to 1.4 m and 0.8 m at minimum. In the Project, average covering depth of 1.2 m is adopted as standard and 0.8 m for rocky terrains in which working condition is not good. In the case of exposed pipes attached to a bridge etc., the pipes will be protected by insulation materials. In the case of embedding pipes in rocky terrains, sand bedding (10 cm) will be employed to protect the pipes.

Stop valves, air valves, drain valves, fire hydrants, etc. are to be designed in accordance with Macedonian standard by referring to T/D. Bulk water meter will be installed at the entrance of each village for the joint system of three municipalities and for the systems of Zelenikovo to enable flow measurement by district and leakage control.

(e-1) Kuceviste System

Kuceviste

Category	Material	Length (mm)	Length (m)
Transmission Pipe	PE	110	3,000.00
Distribution Pipe	PE	160	232.20
Distribution Pipe	PE	110	1,575.70
Distribution Pipe	PE	90	1,136.20
Distribution Pipe	PE	75	2,711.90
Distribution Pipe	PE	63	572.30

(e-2) Radisani System

Radisani Lower Zone

Category	Material	Length (mm)	Length (m)
Transmission Pipe	DIP	200	646.34
Distribution Pipe	DIP	150	910.93
Distribution Pipe	DIP	100	5,816.83

Radisani Higher Zone

Category	Material	Length (mm)	Length (m)
Transmission Pipe	DIP	200	1,430.80
Transmission Pipe	DIP	150	583.80
Distribution Pipe	DIP	150	2,201.32
Distribution Pipe	DIP	100	6,585.39
Distribution Pipe	DIP	80	2,435.00

(e-3) Joint System of Three Municipalities

Gazi Baba/ Ilinden/ Petrovec Joint System of Three Municipalities

Category	Material	Diameter (mm)	Length (m)
Distribution Pipe Gazi Baba	PE	280	2,015.00
Distribution Pipe Ilinden	PE	280	2,313.00
Distribution Pipe Petrovec	PE	160	1,300.00

Jurumleri

Category	Material	Diameter (mm)	Length (m)
Distribution Pipe	PE	160	1,607.45
Distribution Pipe	PE	140	655.09
Distribution Pipe	PE	110	2,929.56
Distribution Pipe	PE	90	6,003.59
Distribution Pipe	PE	63	342.60

Goce Delcev

Category	Material	Diameter (mm)	Length (m)
Distribution Pipe	PE	140	711.54
Distribution Pipe	PE	110	2,171.28
Distribution Pipe	PE	90	3,703.08

Kolonie Idrizovo

Category	Material	Diameter (mm)	Length (m)
Distribution Pipe	PE	125	28.00
Distribution Pipe	PE	110	2,624.26
Distribution Pipe	PE	90	1,818.30

Idrizovo

Category	Material	Diameter (mm)	Length (m)
Distribution Pipe	PE	110	2,864.15
Distribution Pipe	PE	90	5,094.75

Mralino

Category	Material	Diameter (mm)	Length (m)
Distribution Pipe	PE	90	3,258.95

Petrovec

Category	Material	Diameter (mm)	Length (m)
Distribution Pipe	PE	110	1,511.00
Distribution Pipe	PE	90	2,722.00
Distribution Pipe	PE	75	5,799.00
Distribution Pipe	PE	63	2,591.00

Rzanicino

Category	Material	Diameter (mm)	Length (m)
Distribution Pipe	PE	110	2,370.00
Distribution Pipe	PE	90	3,293.00

Ognjanci

Category	Material	Diameter (mm)	Length (m)
Distribution Pipe	PE	110	725.00
Distribution Pipe	PE	90	3,620.00

Kjojlija

Category	Material	Diameter (mm)	Length (m)
Distribution Pipe	PE	90	1,530.00

(e-4) Ilinden East System

Ilinden East

Category	Material	Diameter (mm)	Length (m)
Transmission Pipe	SP	219	2,260.00
Transmission Pipe	PE	225	1,897.50
Transmission Pipe	PE	160	693.00

(e-5) Cvetovo System

Cvetovo

Category	Material	Diameter (mm)	Length (m)
Transmission Pipe	PE	63	825.00
Transmission Pipe	PE	75	2,940.00
Transmission Pipe	PE	75	1,160.00
Transmission Pipe	PE	75	270.00
Distribution Pipe	PE	90	151.00
Distribution Pipe	PE	90	941.60
Distribution Pipe	PE	65	259.30

(e-6) Dolno Kolicani System

Dolno Kolicani

Category	Material	Diameter (mm)	Length (m)
Transmission Pipe	PE	90	200.00
Distribution Pipe	PE	90	386.00
Distribution Pipe	PE	110	120.00

(e-7) Zelenikovo Three Villages System

Taor

Category	Material	Diameter (mm)	Length (m)
Transmission Pipe	PE	110	320.00
Distribution Pipe	PE	110	55.00
Distribution Pipe	PE	90	1,180.00
Distribution Pipe	PE	75	70.00

Pakosevo & Novo Selo

Category	Material	Diameter (mm)	Length (m)
Distribution Pipe	PE	160	2,345.00
Distribution Pipe	PE	110	2,335.00
Distribution Pipe	PE	90	255.17
Distribution Pipe	PE	63	1,798.57

(e-8) Strahojadica System

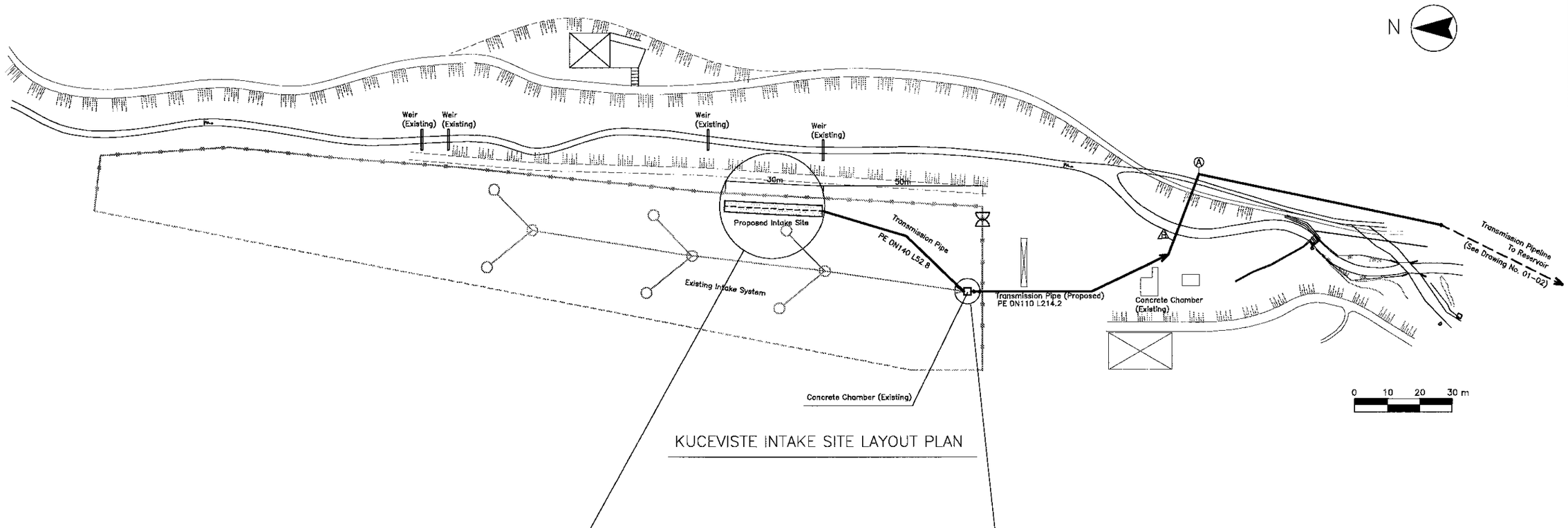
Strahojadica

Category	Material	Diameter (mm)	Length (m)
Distribution Pipe	PE	110	295.00
Distribution Pipe	PE	90	590.00
Distribution Pipe	PE	90	630.00
Distribution Pipe	PE	110	235.00
Distribution Pipe	PE	90	400.00
Distribution Pipe	PE	63	225.00

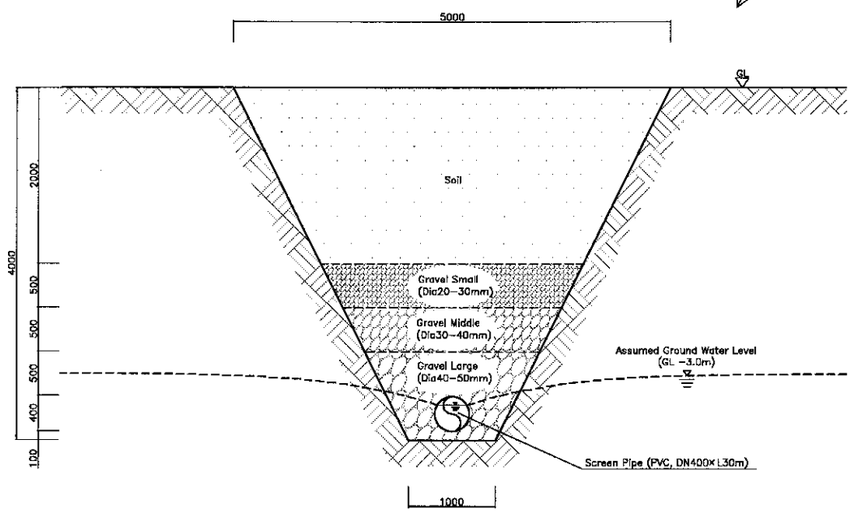
2-2-3 Basic Design Drawing

Table 2-33 Drawings of Basic Design

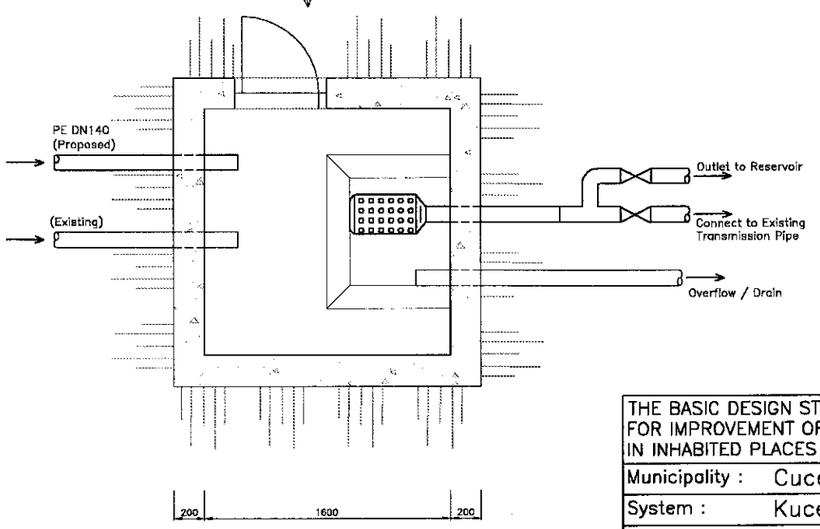
No.	Municipality	System	Title
01-01	Cucer Sandevo	Kuceviste	Kuceviste Intake
01-02	Cucer Sandevo	Kuceviste	Raw Water Transmission Pipeline
01-03	Cucer Sandevo	Kuceviste	Distribution Reservoir
01-04	Cucer Sandevo	Kuceviste	Distribution Network
02-01	Cair	Radisani	Pump Station
02-02	Cair	Radisani	Lower Zone
02-03	Cair	Radisani	Higher Zone
03-01	Gazi Baba	Joint System	Jurumleri Intake
03-02	Gazi Baba	Joint System	Disinfection Facility
03-03	Gazi Baba/ Ilinden/ Petrovec	Joint System	Primary Pipeline
03-04	Gazi Baba	Joint System	Goce Delcev Secondary Network
03-05	Gazi Baba	Joint System	Jurumleri Secondary Network
03-06	Gazi Baba	Joint System	Kolonie Idrizovo Secondary Network
03-07	Gazi Baba	Joint System	Idrizovo Secondary Network
03-08	Ilinden	Joint System	Mralino Secondary Network
03-09	Petrovec	Joint System	Petrovec Secondary Network
03-10	Petrovec	Joint System	Rzanichino Secondary Network
03-11	Petrovec	Joint System	Ognanci Secondary Network
03-12	Petrovec	Joint System	Kjojlija Secondary Network
04-01	Ilinden	Ilinden East	Ilinden East Pump Station
04-02	Ilinden	Ilinden East	Transmission Pipeline
05-01	Studenicani	Cvetovo	Intake Facility
05-02	Studenicani	Cvetovo	Transmission Facility
05-03	Studenicani	Cvetovo	Distribution Reservoir
05-04	Studenicani	Cvetovo	Distribution Network
06-01	Studenicani	Dolno Kolicani	Intake Facility
06-02	Studenicani	Dolno Kolicani	Pump Station
06-03	Studenicani	Dolno Kolicani	Transmission Facility
06-04	Studenicani	Dolno Kolicani	Distribution Reservoir
07-01	Zelenikovo	Zelenikovo Three Villages	Taor Secondary Network
07-02	Zelenikovo	Zelenikovo Three Villages	Pakosevo & Novo Selo Secondary Network
08-01	Zelenikovo	Strahojadica	Booster Pump Station
08-02	Zelenikovo	Strahojadica	Transmission/ Distribution Pipeline
08-03	Zelenikovo	Strahojadica	Distribution Reservoir



KUCEVISTE INTAKE SITE LAYOUT PLAN

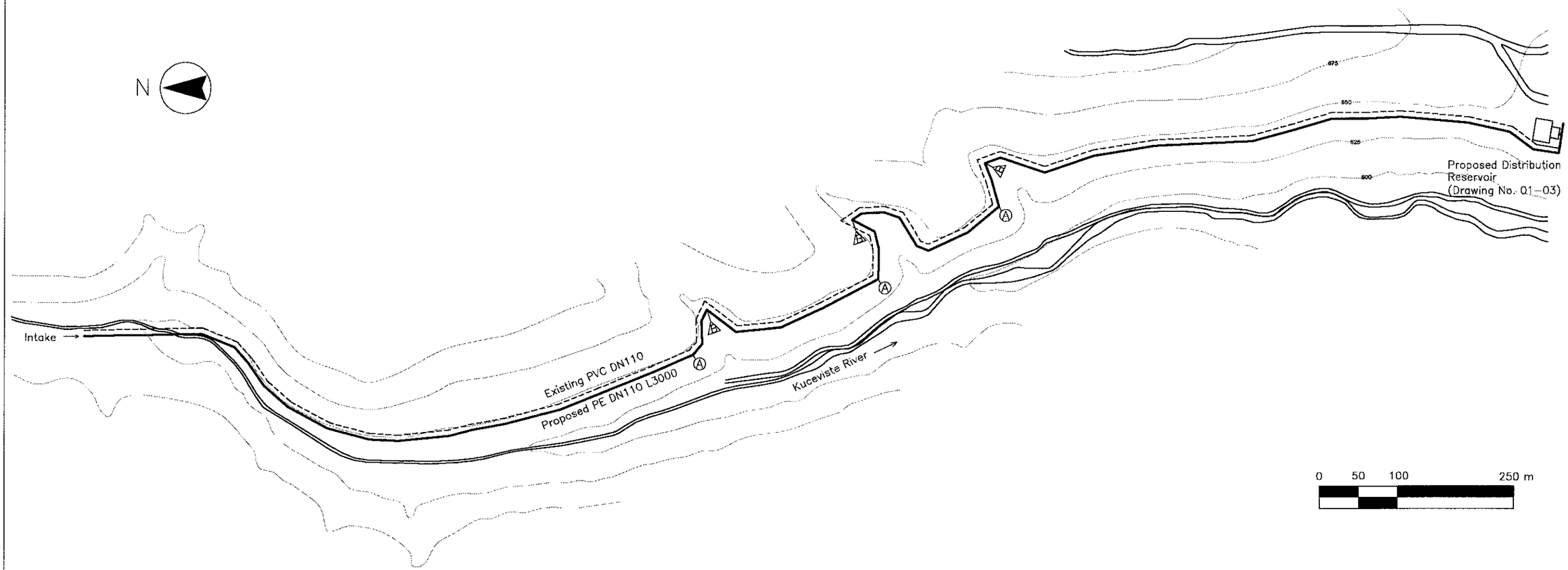


PROPOSED INTAKE CROSS SECTION

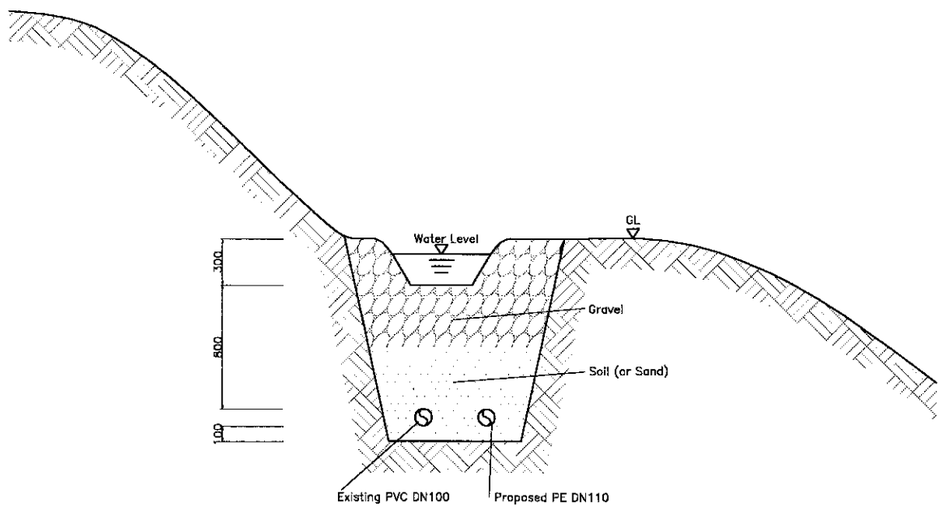


EXISTING CONCRETE CHAMBER

THE BASIC DESIGN STUDY ON THE PROJECT FOR IMPROVEMENT OF WATER SUPPLY IN INHABITED PLACES IN SCOPJE OUTSKIRTS		
Municipality : Cucer Sandevo		
System : Kuceviste		
Title : Kuceviste Intake		Scale : Non
August 2003	Drawing No : 01-01	
JAPAN INTERNATIONAL COOERATION AGENCY		

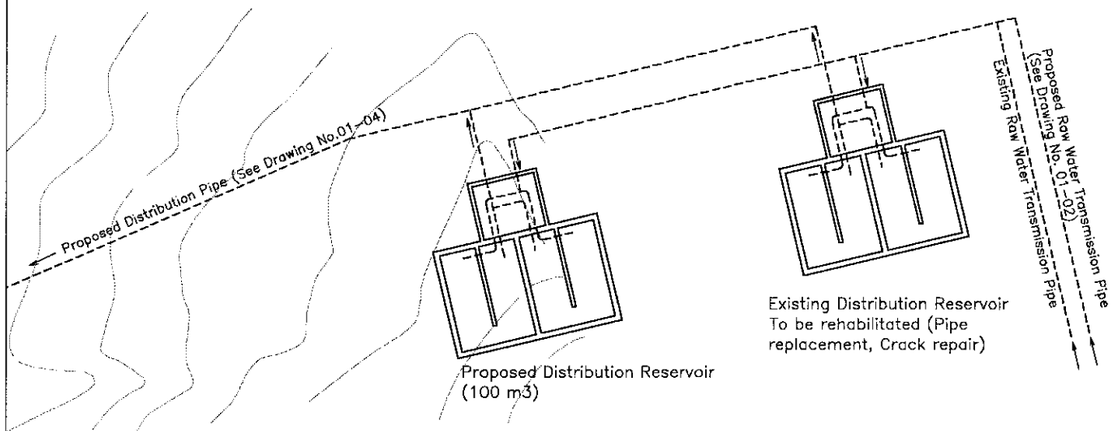


RAW WATER TRANSMISSION PIPELINE LAYOUT PLAN

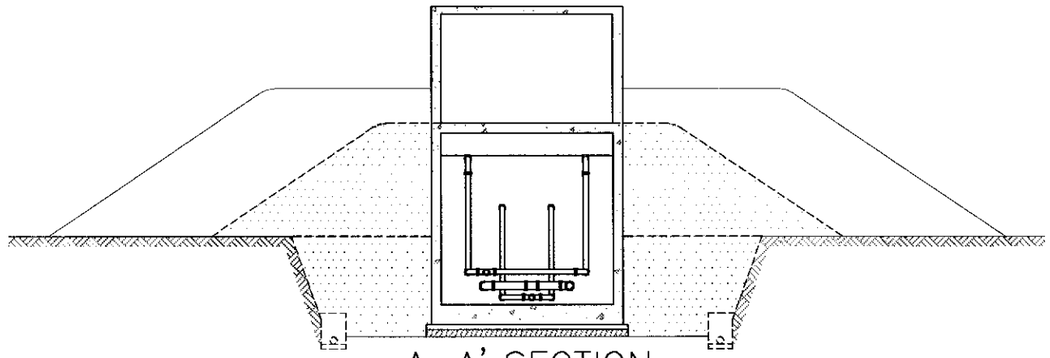


TYPICAL SECTION FOR PYPE LAYING

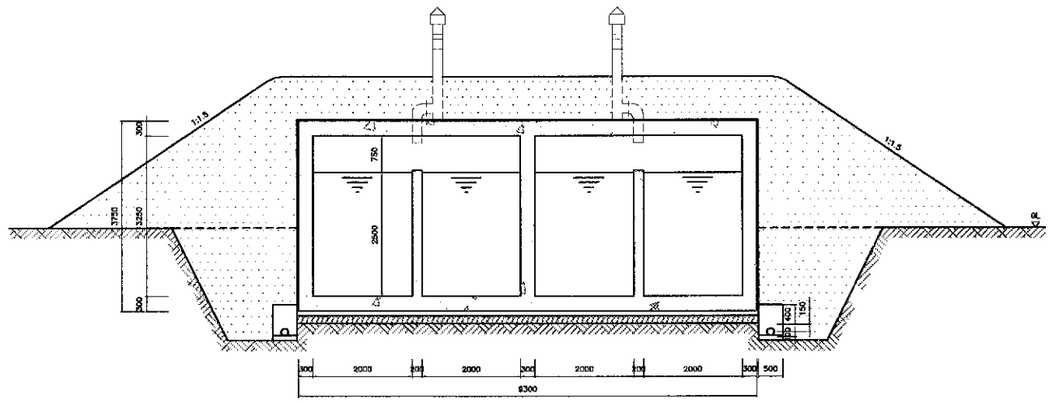
THE BASIC DESIGN STUDY ON THE PROJECT FOR IMPROVEMENT OF WATER SUPPLY IN INHABITED PLACES IN SCOPJE OUTSKIRTS		
Municipality : Cucer Sandevo		
System : Kuceviste		
Title : Raw Water Transmission Pipeline		Scale : Non
August 2003	Drawing No : 01-02	
JAPAN INTERNATIONAL COOERATION AGENCY		



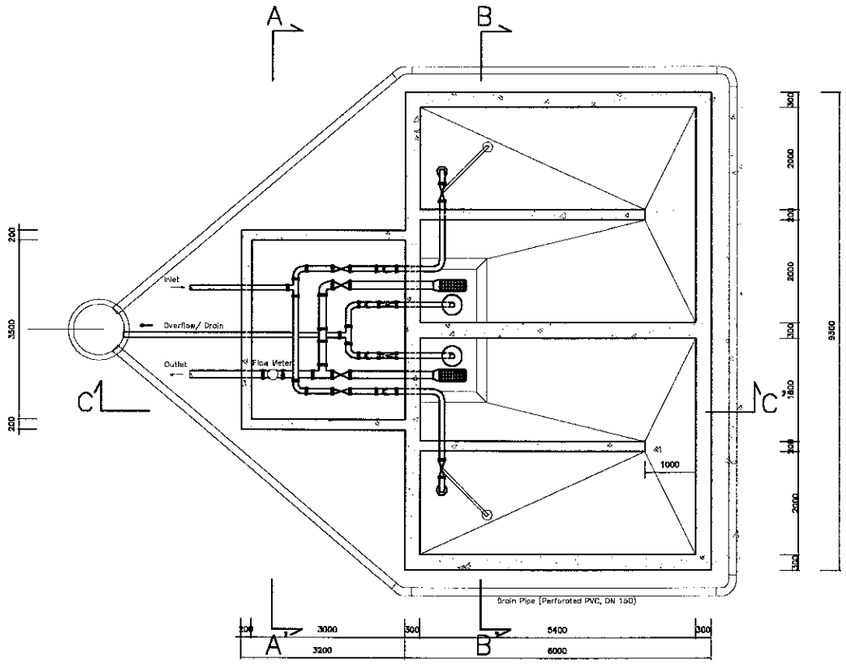
LAYOUT PLAN



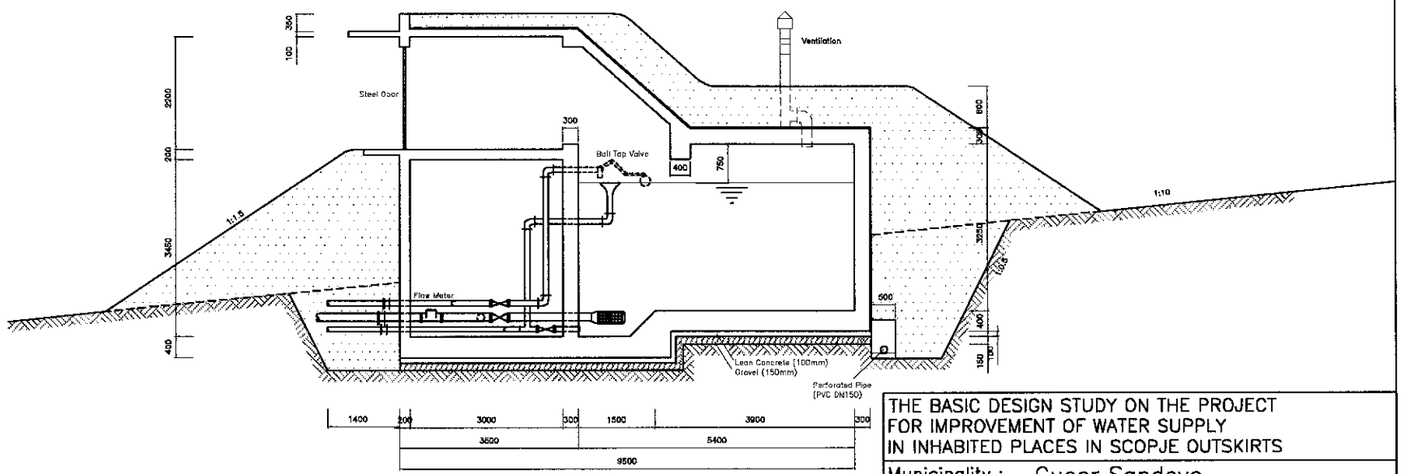
A-A' SECTION



B-B' SECTION

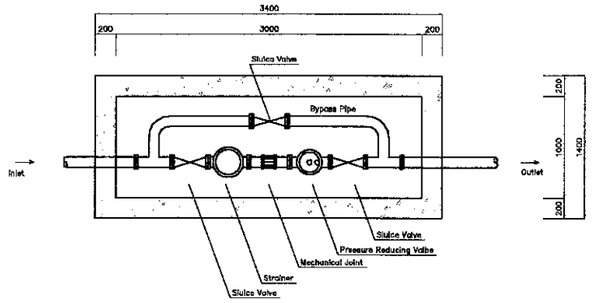


PLAN

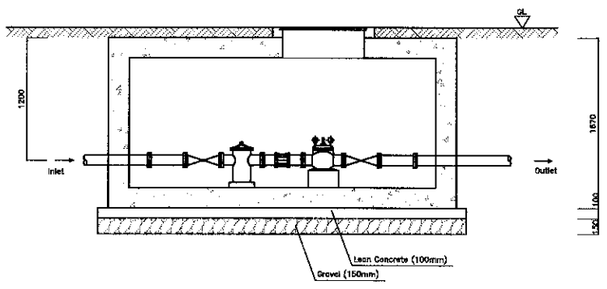


C-C' SECTION

THE BASIC DESIGN STUDY ON THE PROJECT FOR IMPROVEMENT OF WATER SUPPLY IN INHABITED PLACES IN SCOPJE OUTSKIRTS		
Municipality : Cucer Sandevo		
System : Kuceviste		
Title : Distribution Reservoir (100m3)		Scale : Non
August 2003	Drawing No : 01-03	
JAPAN INTERNATIONAL COOERATION AGENCY		

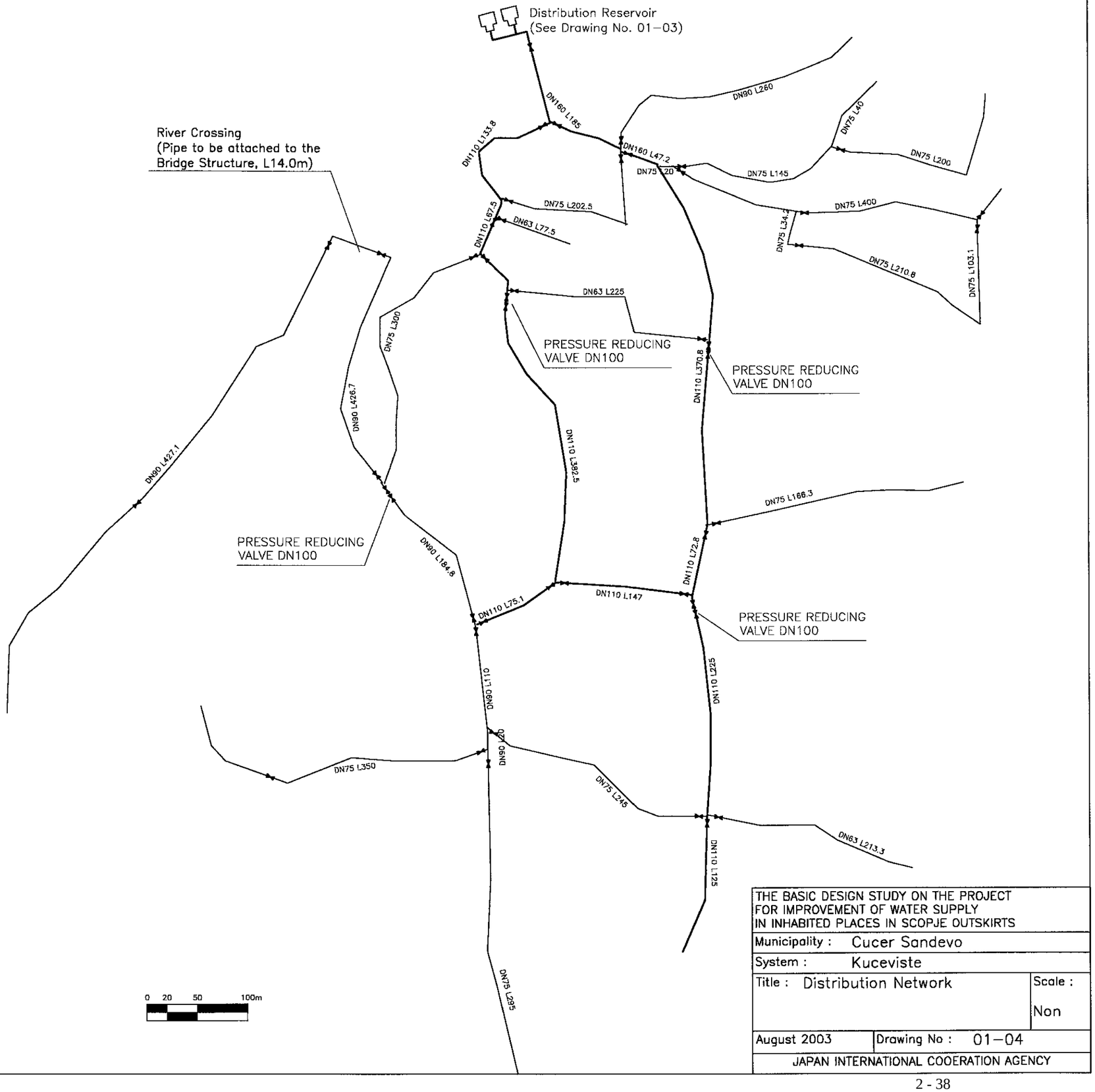


Plan



Section

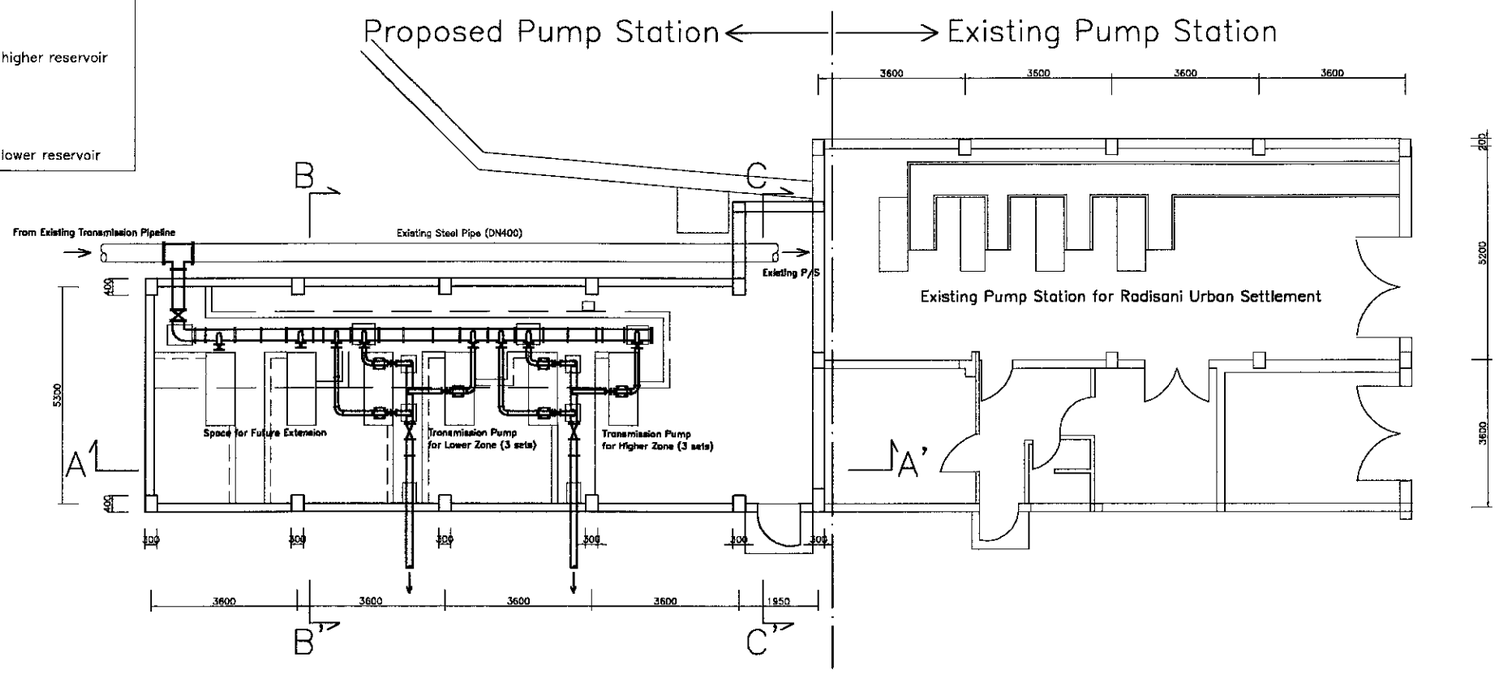
PRESSURE REDUCING VALVE



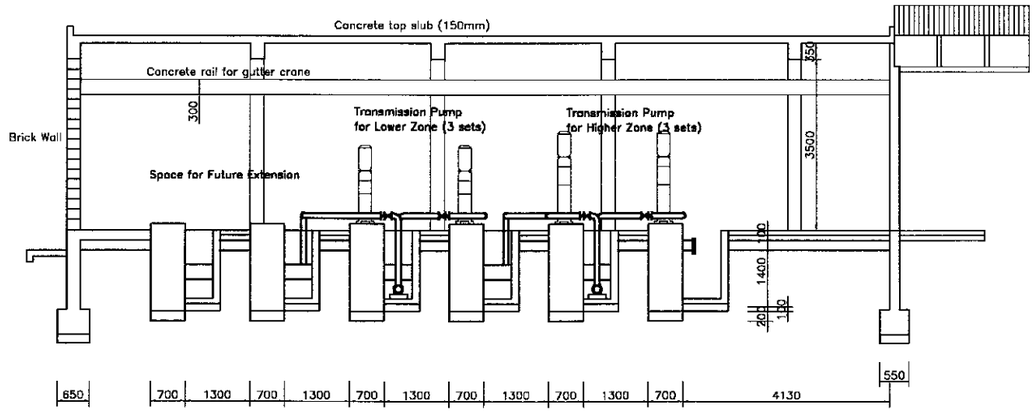
THE BASIC DESIGN STUDY ON THE PROJECT FOR IMPROVEMENT OF WATER SUPPLY IN INHABITED PLACES IN SCOPJE OUTSKIRTS		
Municipality : Cucer Sandevo		
System : Kuceviste		
Title : Distribution Network		Scale : Non
August 2003	Drawing No : 01−04	
JAPAN INTERNATIONAL COOERATION AGENCY		

Transmission Pump for Higher Zone (3 sets)
Type: Multistage centrifugal Pump with Motor
Discharge: 30.6 m3/h
Head: 140 m
Operation: On/Off control by water level of the higher reservoir

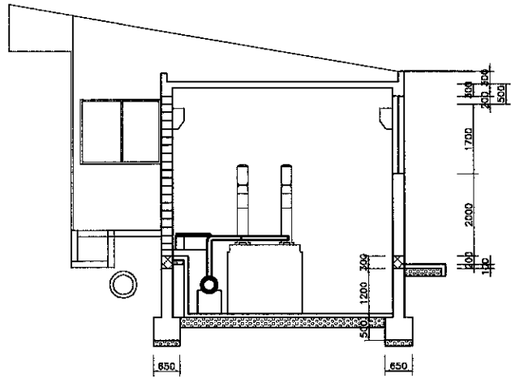
Transmission Pump for Lower Zone (3 sets)
Type: Multistage centrifugal Pump with Motor
Discharge: 37.4 m3/h
Head: 70 m
Operation: On/Off control by water level of the lower reservoir



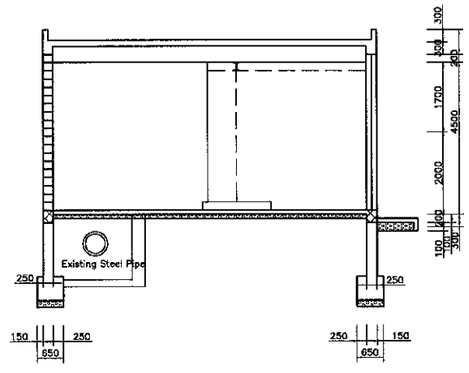
PLAN



A–A' SECTION

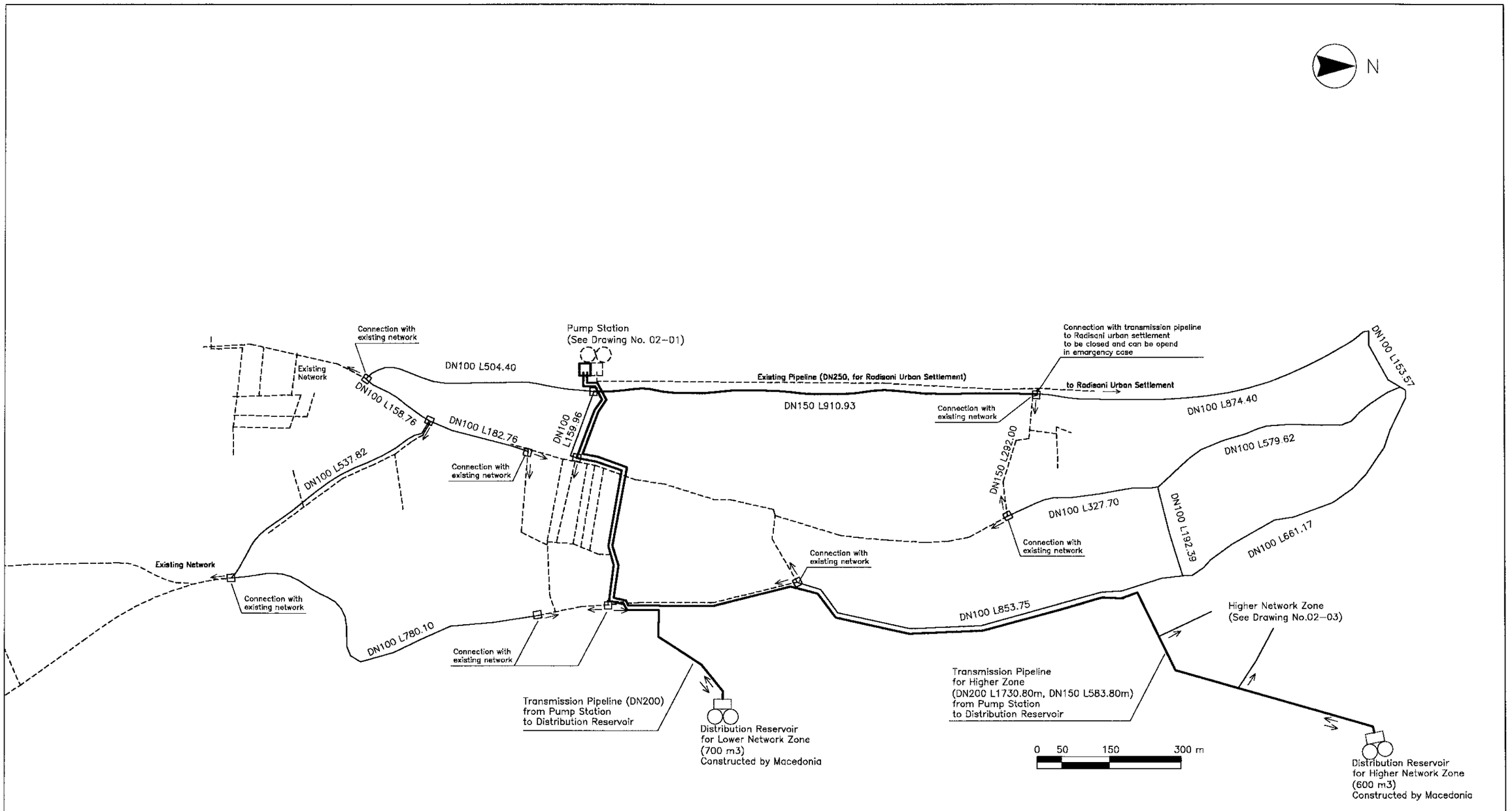


B–B' SECTION



C–C' SECTION

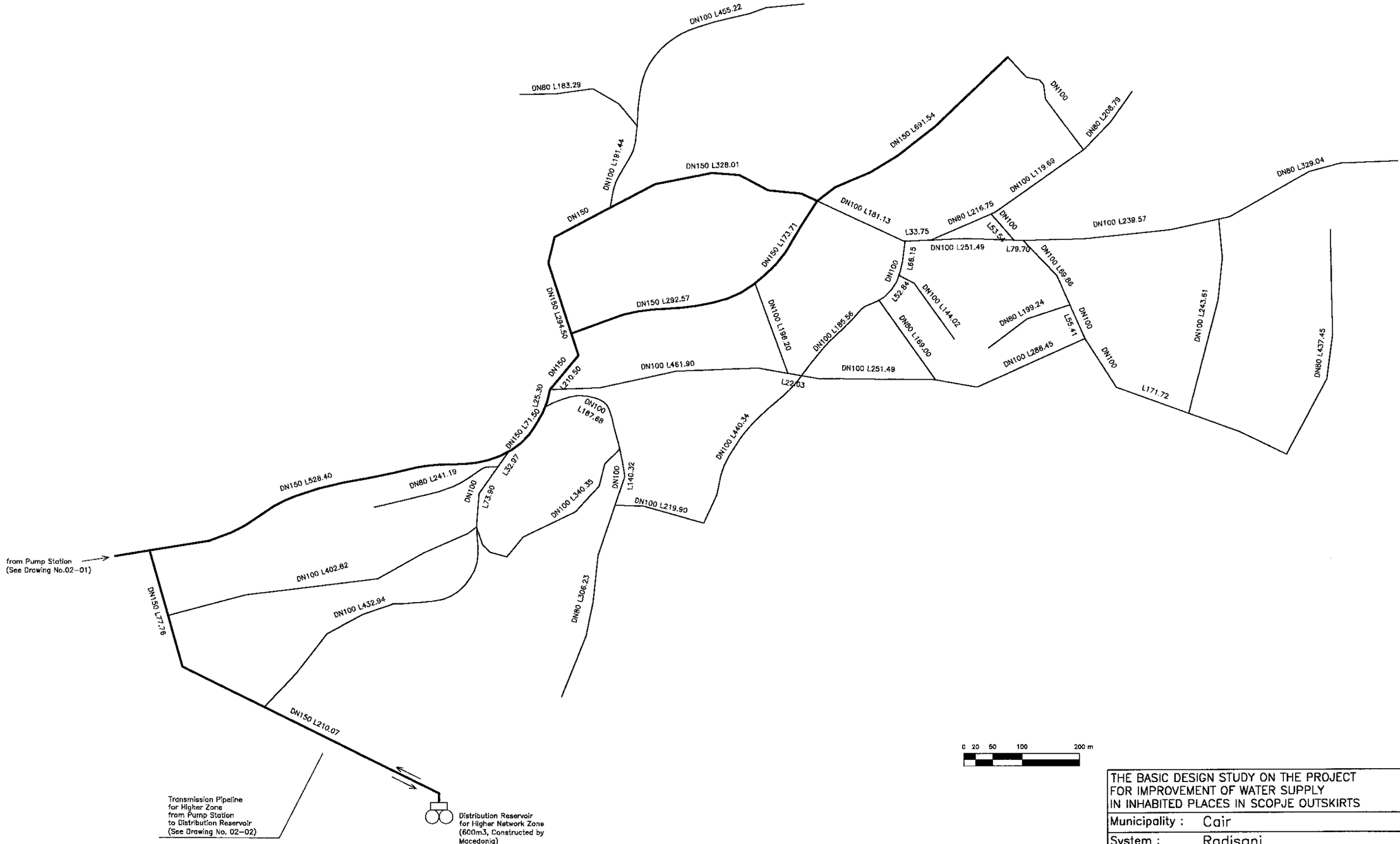
THE BASIC DESIGN STUDY ON THE PROJECT FOR IMPROVEMENT OF WATER SUPPLY IN INHABITED PLACES IN SCOPJE OUTSKIRTS		
Municipality : Cair		
System : Radisani		
Title : Pump Station		Scale : 1:750
August 2003	Drawing No : 02–01	
JAPAN INTERNATIONAL COOERATION AGENCY		



THE BASIC DESIGN STUDY ON THE PROJECT FOR IMPROVEMENT OF WATER SUPPLY IN INHABITED PLACES IN SCOPJE OUTSKIRTS

Municipality :	Cair
System :	Radisani
Title : Lower Zone	Scale :
August 2003	Drawing No : 02-02

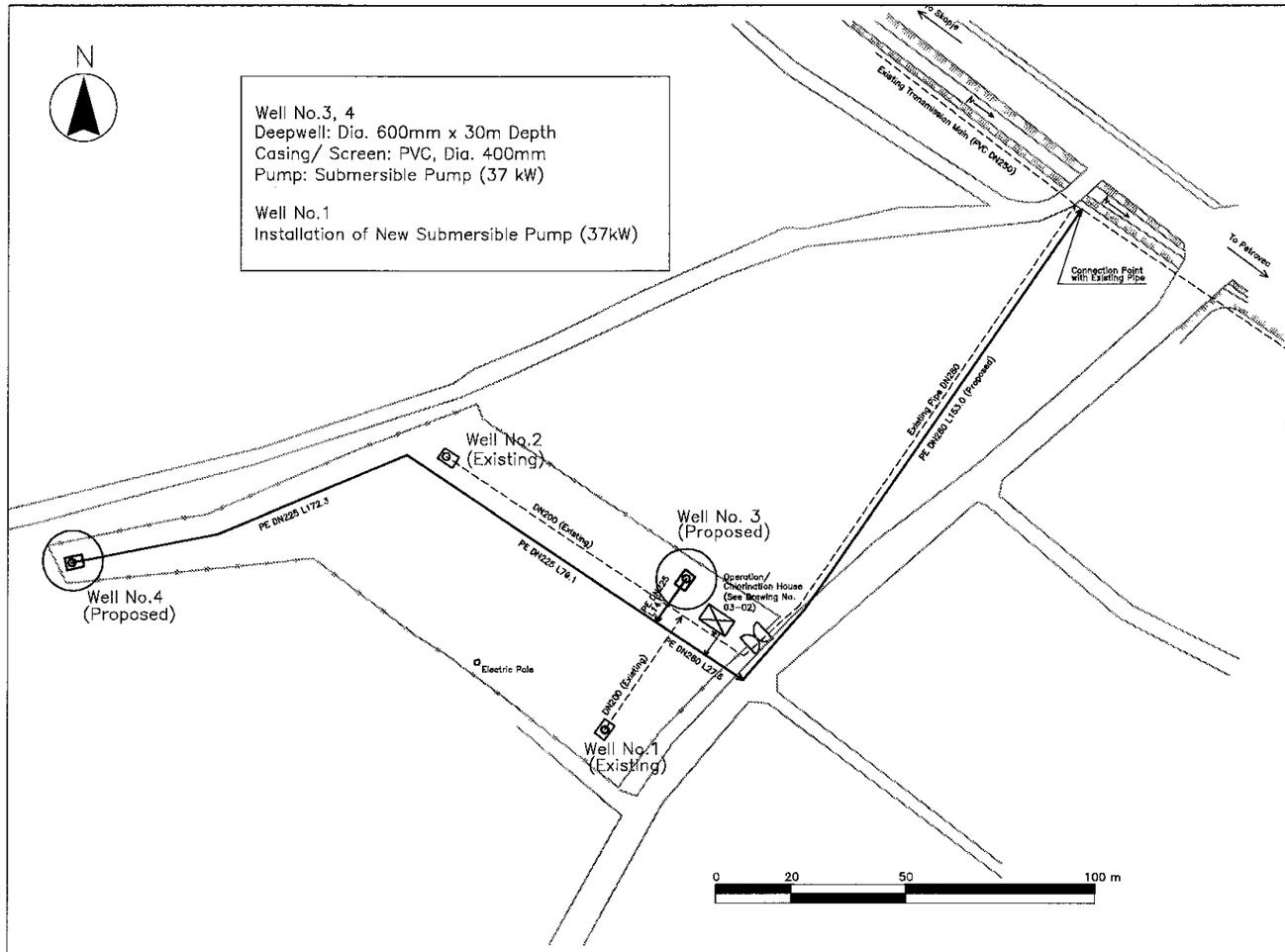
JAPAN INTERNATIONAL COOERATION AGENCY



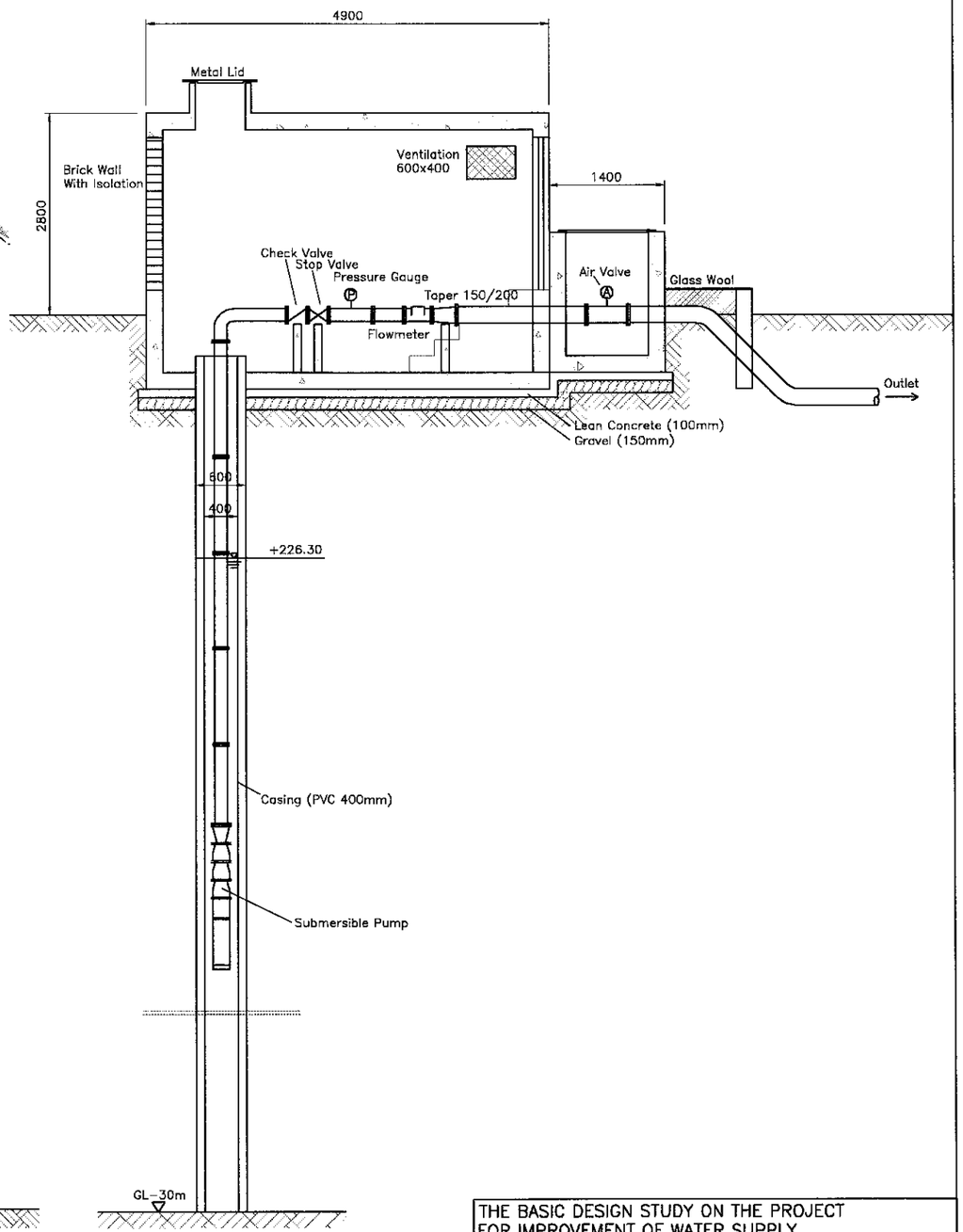
THE BASIC DESIGN STUDY ON THE PROJECT FOR IMPROVEMENT OF WATER SUPPLY IN INHABITED PLACES IN SCOPJE OUTSKIRTS	
Municipality : Cair	
System : Radisani	
Title : Higher Zone	Scale :
August 2003	Drawing No : 02-03
JAPAN INTERNATIONAL COOERATION AGENCY	

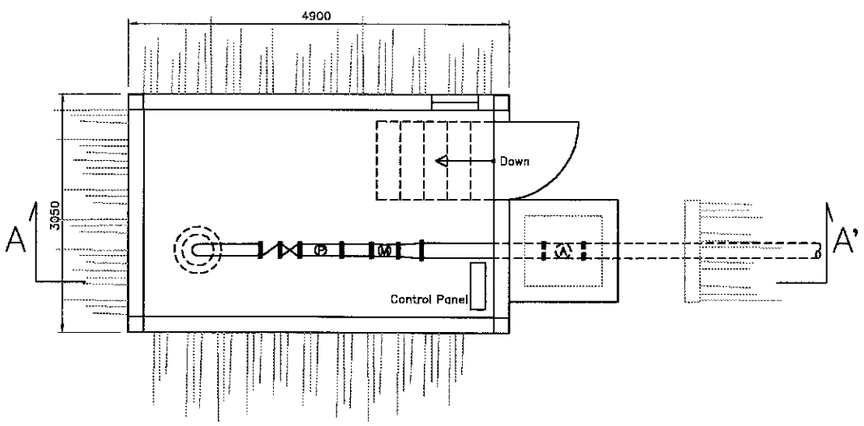
Well No.3, 4
Deepwell: Dia. 600mm x 30m Depth
Casing/ Screen: PVC, Dia. 400mm
Pump: Submersible Pump (37 kW)

Well No.1
Installation of New Submersible Pump (37kW)

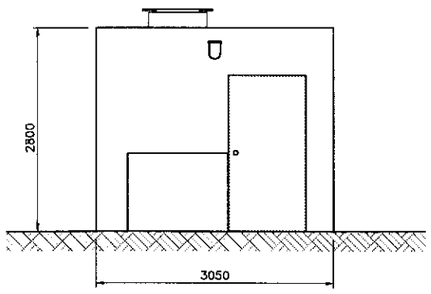


LAYOUT PLAN





Plan

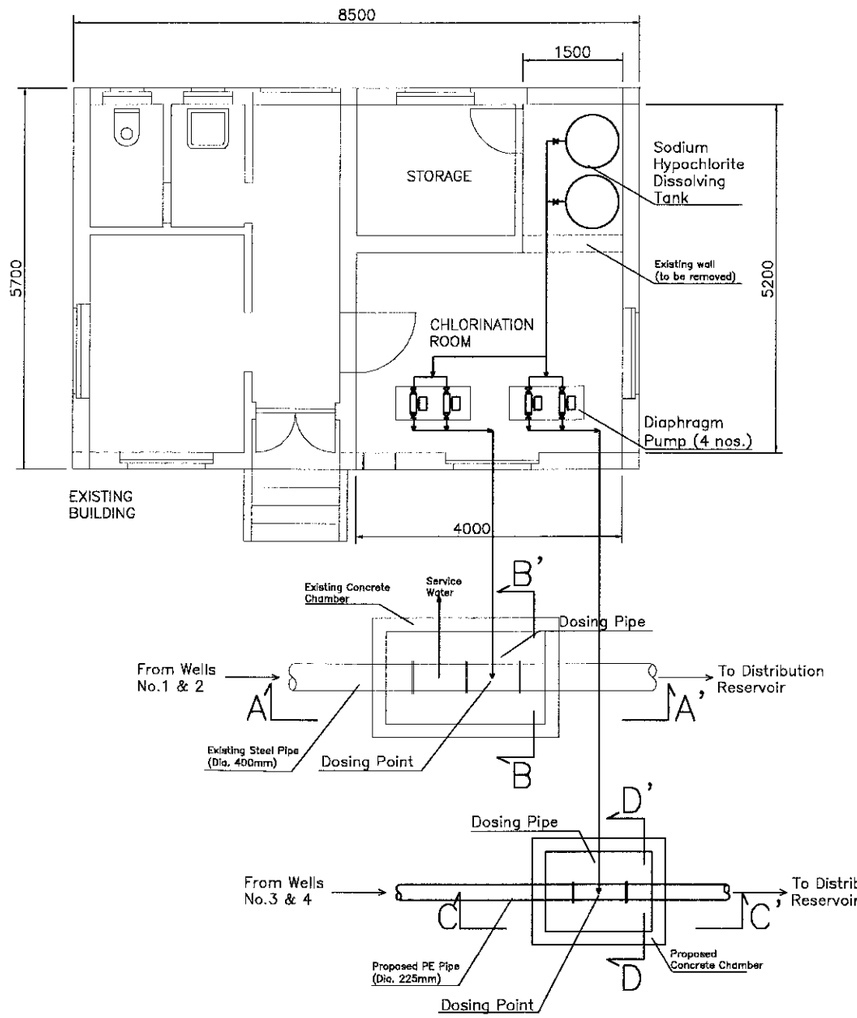


Elevation

A–A' Section

WELL (No.3, 4)

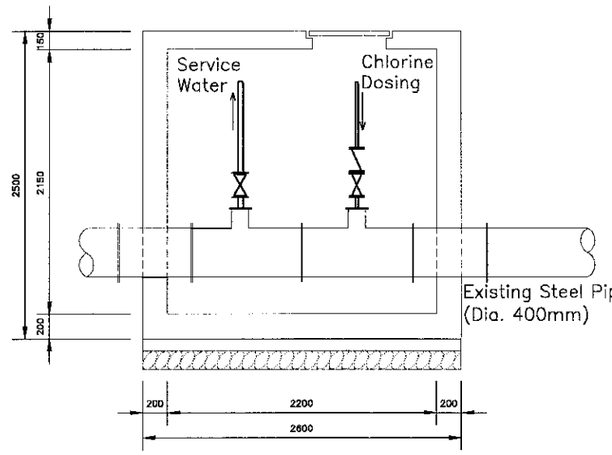
THE BASIC DESIGN STUDY ON THE PROJECT FOR IMPROVEMENT OF WATER SUPPLY IN INHABITED PLACES IN SCOPJE OUTSKIRTS		
Municipality : Gazi Baba		
System : Joint System of Three Municipalities		
Title : Jurumleri Intake		Scale : Non
August 2003	Drawing No : 03–01	
JAPAN INTERNATIONAL COOERATION AGENCY		



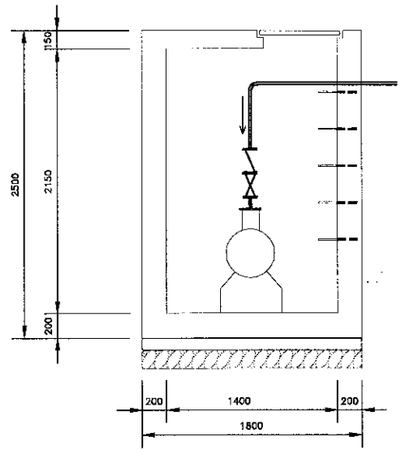
PLAN

Existing concrete chamber is to be used.

Dosing pipe and service pipe are to be newly installed.

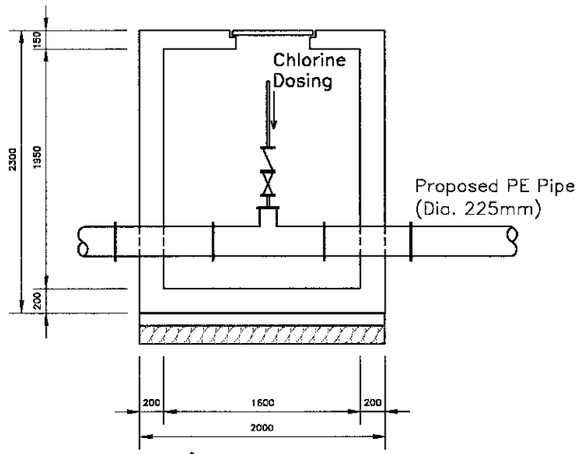


A–A' SECTION

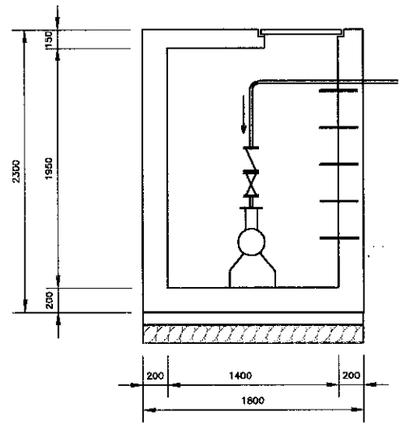


B–B' SECTION

EXISTING CHAMBER (Wells No.1&2 Line)



C–C' SECTION



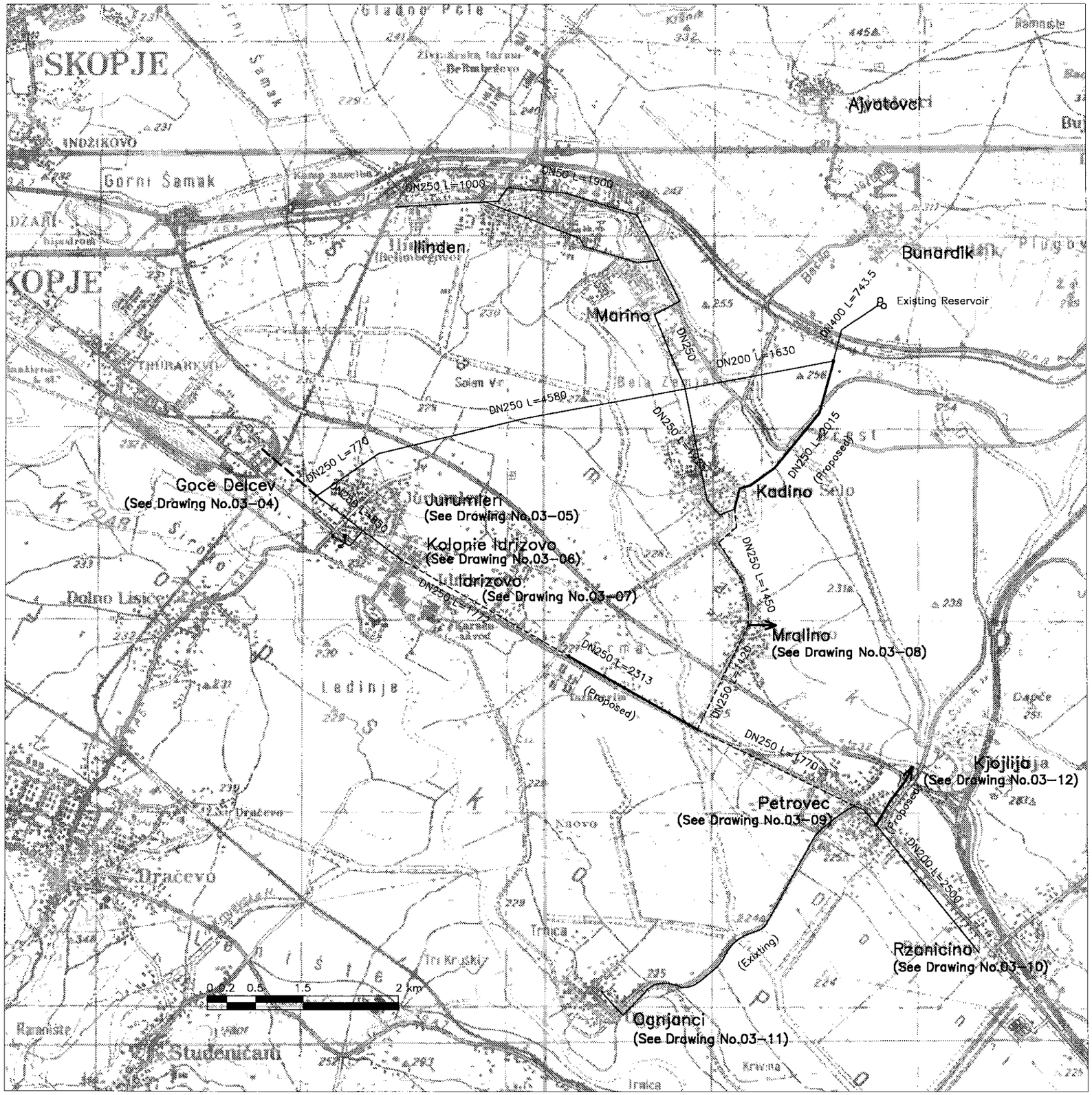
D–D' SECTION

PROPOSED CHAMBER (Wells No.3&4 Line)

Concrete chamber and pipe, etc. are to be newly installed.

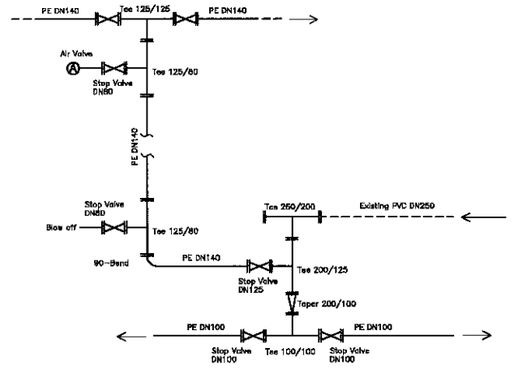
Chlorination System
Disinfectant: Sodium Hypochlorite
Dissolving Tank: 2 tanks
Dosing Pump: Diaphragm Pumps (4 nos.)
Dosing Point: 2 Points (Well No.1&2 Line, Wells No.3&4 Line)
Control: Automatic control by operation of submersible pumps
Building: Existing building is to be used.
Equipment: Existing system would be removed and new system installed.

THE BASIC DESIGN STUDY ON THE PROJECT FOR IMPROVEMENT OF WATER SUPPLY IN INHABITED PLACES IN SCOPJE OUTSKIRTS	
Municipality : Gazi Baba	
System : Joint System of Three Municipalities	
Title : Disinfection Facility	Scale : Non
August 2003	Drawing No : 03–02
JAPAN INTERNATIONAL COOERATION AGENCY	



N

THE BASIC DESIGN STUDY ON THE PROJECT FOR IMPROVEMENT OF WATER SUPPLY IN INHABITED PLACES IN SCOPJE OUTSKIRTS		
Municipality : Gazi Baba / Ilinden / Petrovec		
System : Joint System of Three Municipalities		
Title : Primary Pipeline		Scale :
August 2003	Drawing No : 03-03	
JAPAN INTERNATIONAL COOERATION AGENCY		



Connection Point Detail

THE BASIC DESIGN STUDY ON THE PROJECT FOR IMPROVEMENT OF WATER SUPPLY IN INHABITED PLACES IN SCOPJE OUTSKIRTS		
Municipality : Gazi Baba		
System : Joint System of Three Municipalities		
Title : Goce Delcev Secondary Network		Scale : 1:3000
August 2003	Drawing No : 03-04	
JAPAN INTERNATIONAL COOERATION AGENCY		

N

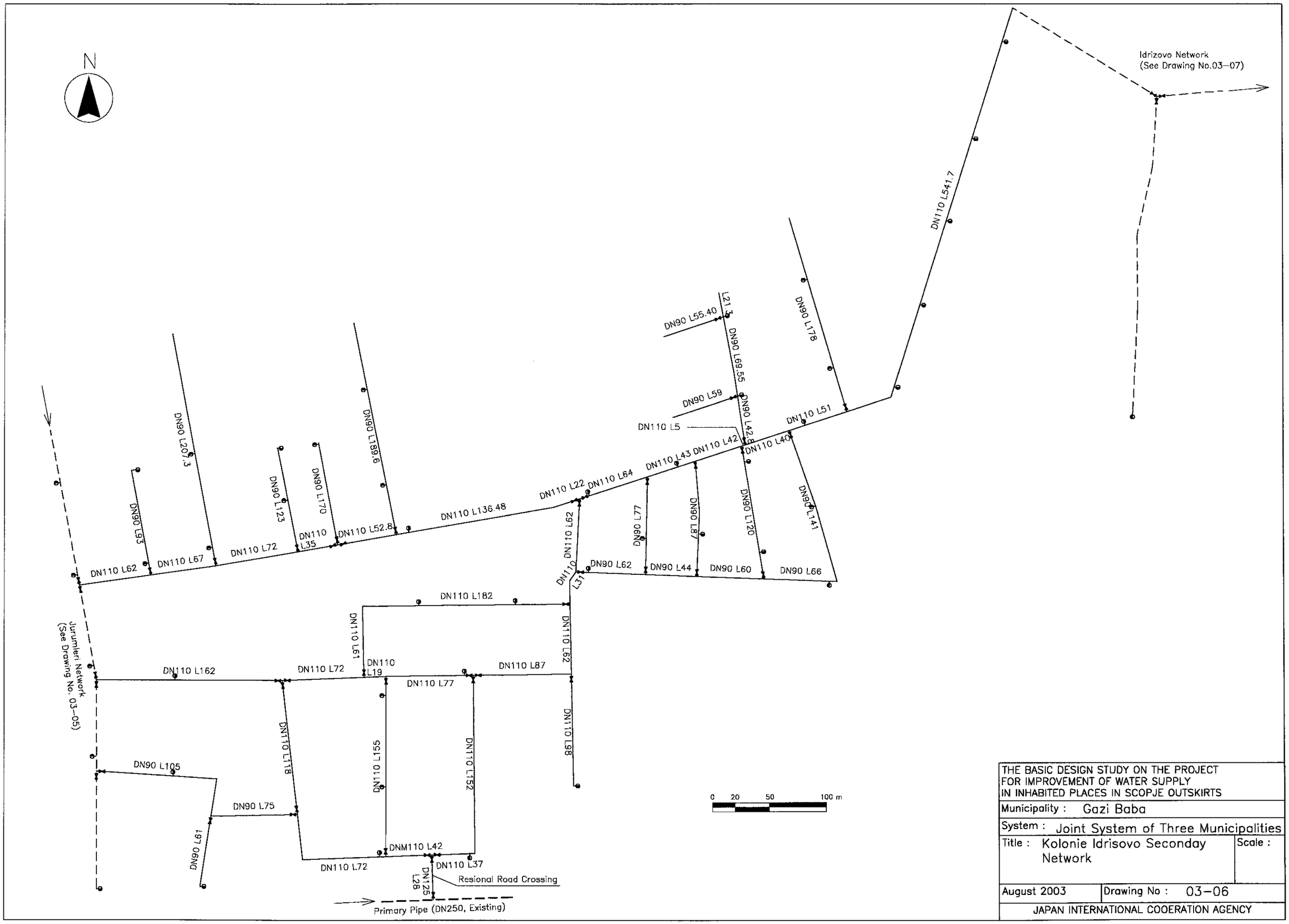
Existing PVC Pipe
constructed by Macedonia

Vardar River

Kolonie Idrizovo
(See Drawing No. 03-06)

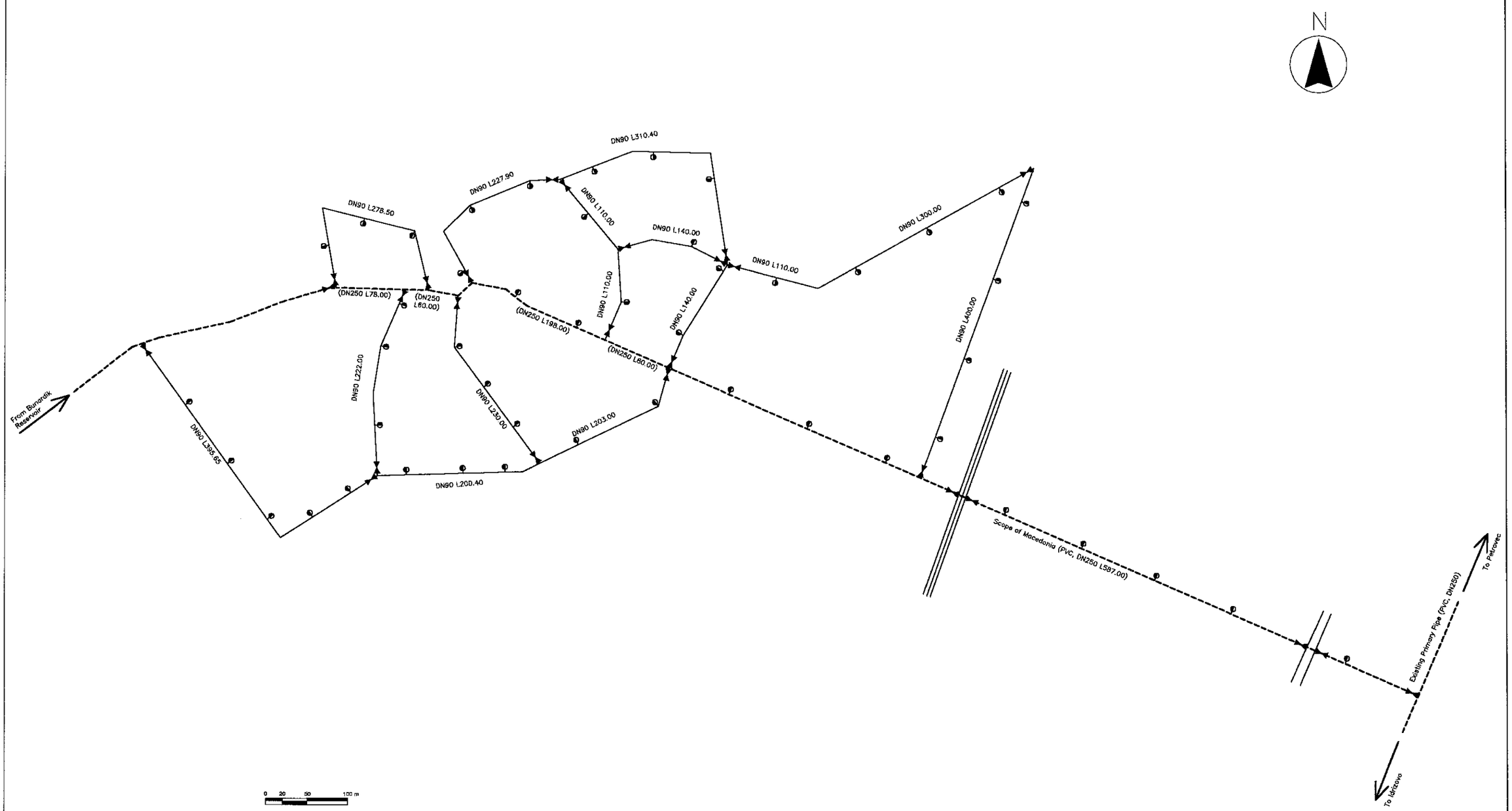
0 50 100 150 200 m

THE BASIC DESIGN STUDY ON THE PROJECT FOR IMPROVEMENT OF WATER SUPPLY IN INHABITED PLACES IN SCOPJE OUTSKIRTS	
Municipality : Gazi Baba	
System : Joint System of Three Municipalities	
Title : Jurumleri Seconday Network	Scale : 1:17500
August 2003	Drawing No : 03-05
JAPAN INTERNATIONAL COOERATION AGENCY	

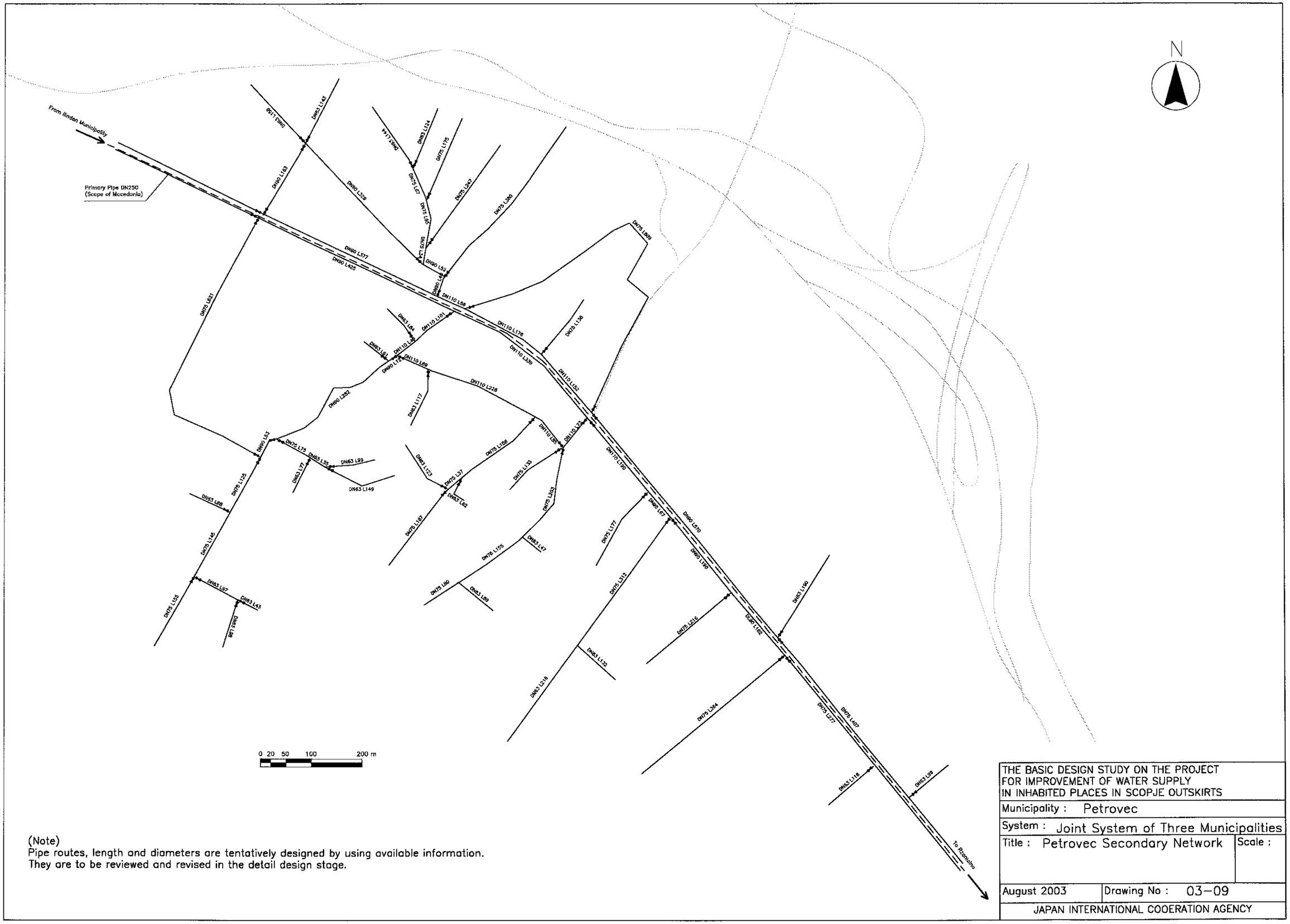


THE BASIC DESIGN STUDY ON THE PROJECT FOR IMPROVEMENT OF WATER SUPPLY IN INHABITED PLACES IN SCOPJE OUTSKIRTS	
Municipality : Gazi Baba	
System : Joint System of Three Municipalities	
Title : Kolonie Idrisovo Seconday Network	Scale :
August 2003	Drawing No : 03–06
JAPAN INTERNATIONAL COOERATION AGENCY	

THE BASIC DESIGN STUDY ON THE PROJECT FOR IMPROVEMENT OF WATER SUPPLY IN INHABITED PLACES IN SCOPJE OUTSKIRTS	
Municipality : Gazi Baba	
System : Joint System of Three Municipalities	
Title : Idrisovo Seconday Network	Scale :
August 2003	Drawing No : 03–07
JAPAN INTERNATIONAL COOERATION AGENCY	

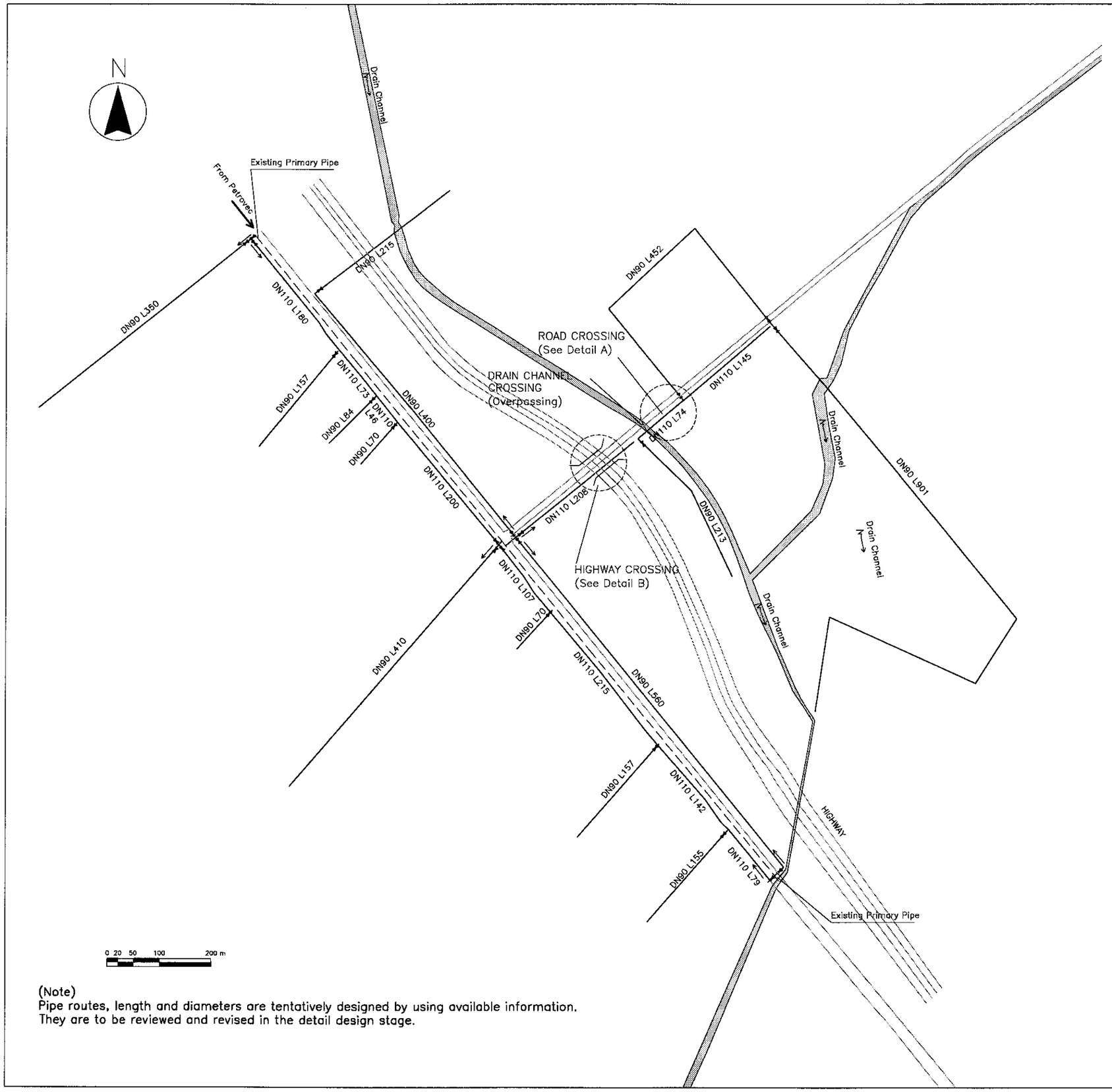


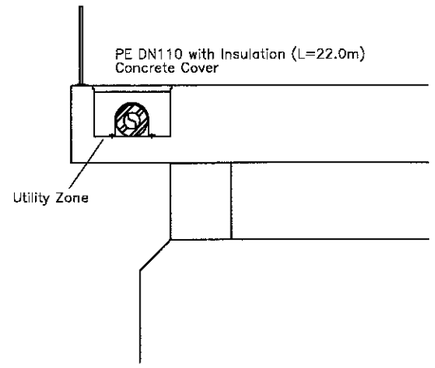
THE BASIC DESIGN STUDY ON THE PROJECT FOR IMPROVEMENT OF WATER SUPPLY IN INHABITED PLACES IN SCOPJE OUTSKIRTS		
Municipality : Ilinden		
System : Joint System of Three Municipalities		
Title : Mralino Seconday Network		Scale : 1:11250
August 2003	Drawing No : 03-08	
JAPAN INTERNATIONAL COOERATION AGENCY		



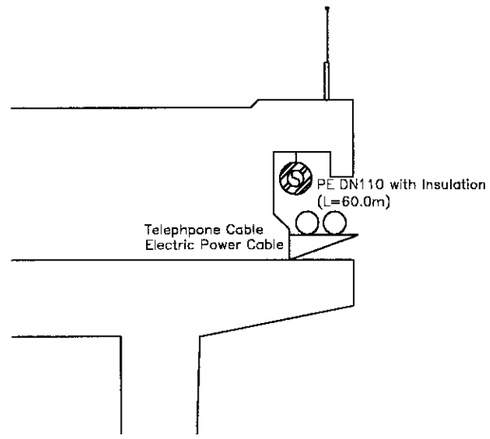
(Note)
Pipe routes, length and diameters are tentatively designed by using available information.
They are to be reviewed and revised in the detail design stage.

THE BASIC DESIGN STUDY ON THE PROJECT FOR IMPROVEMENT OF WATER SUPPLY IN INHABITED PLACES IN SCOPJE OUTSKIRTS	
Municipality : Petrovec	
System : Joint System of Three Municipalities	
Title : Petrovec Secondary Network	Scale :
August 2003	Drawing No : 03–09
JAPAN INTERNATIONAL COOERATION AGENCY	





DETAIL A
ROAD CROSSING



DETAIL B
HIGHWAY CROSSING

(Note)
Pipe routes, length and diameters are tentatively designed by using available information.
They are to be reviewed and revised in the detail design stage.

THE BASIC DESIGN STUDY ON THE PROJECT FOR IMPROVEMENT OF WATER SUPPLY IN INHABITED PLACES IN SCOPJE OUTSKIRTS		
Municipality : Petrovec		
System : Joint System of Three Municipalities		
Title : Rzanicino Secondary Network		Scale :
August 2003	Drawing No : 03–10	
JAPAN INTERNATIONAL COOERATION AGENCY		