No.

JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)

NATIONAL DEVELOPMENT PLANNING AGENCY (BAPPENAS)

PROVINCIAL GOVERNMENT OF NANGGROE ACEH DARUSSALAM

THE STUDY
ON
THE URGENT REHABILITATION AND RECONSTRUCTION SUPPORT PROGRAM
FOR
ACEH PROVINCE AND AFFECTED AREAS IN NORTH SUMATRA

(URGENT REHABILITATION AND RECONSTRUCTION PLAN FOR BANDA ACEH CITY)

IN THE REPUBLIC OF INDONESIA

FINAL REPORT (2)
VOLUME III : APPENDICIES

MARCH 2006

NIPPON KOEI CO., LTD.

YACHIYO ENGINEERING CO., LTD.

PASCO CORPORATION

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CHAPTER 1 DESIGN WORKS AND COST ESTIMATE

1.1 DESIGN CONDITIONS

1.1.1 Background of the Project

The purpose of the project is to rehabilitate septage treatment plant (*Instalasi Pengelolaan Lumpur Tinja*, IPLT) which was built in 1995 and was destroyed completely by the Tsunami. It is a matter of importance to implement and complete the project as earlier as possible to preserve the public hygiene. After the Tsunami, the septage which are regularly collected from septic tanks of houses and buildings in BAC, are disposed of to the sea directly without any treatment, resulting in environmental problems. Under the above situation, the Municipal Government of Banda Aceh City through the Government of Indonesia (GOI) requested to the JICA assistance for implementation of the project "Rehabilitation of Septage Treatment Plant" (the Project) in April 12th, 2005. In response to the request JICA decided to implement the Project.

1.1.2 Situation before Disaster

In BAC there was no centralized sewerage system including waste water treatment plant, and septic tank was the most common means of sewage treatment. It is estimated that 80 % of houses and buildings is relying on such on-site treatment facilities for their sewage treatment and disposal. The rest is dependent on pit latrines and other means. Septic tanks are normally connected to storm water drainages which are eventually linked to the main rivers/floodway within the city area. On the other hand domestic wastewater is directly drained to the urban drainages without any treatment.

Unfortunately there is no data available with regard to strength of septage, quality of effluent from septic tanks and domestic waste water, and quality of the river water which is receptacle of the effluent from the septic tanks and the domestic wastewater. However the river water might have been contaminated to certain extent judging from its turbidity.

Sanitation and Park Department of the City Municipality (DKP) is serving the collection, treatment and disposal of septage and has an IPLT which still exists nearby river-mouth of the Aceh River. It comprises two (2) lines of an imhoff tank, an anaerobic tank, a facultative tank and a maturation tank as show in Table 1.1.1 and Figure 1.1.1.

Table 1.1.1 Features of Main Components of IPLT

Components		Dimension (m)			Storage capacity (m^3)
1	Imhoff Tank	Bottom Length	Bottom Width	Depth	
2	Anaerobic Tank	10.8	3.0	3.5	392
3	Facultative Tank	48.0	13.9	1.35	1,078
4	Maturation Tank	15.8	7.0	1.35	221
5	Sludge Drying Bed	8.0	4.0	1.2	38

Source: Outline Plan of Pembuangan Air Limbah Domestic Kota Banda Ache, DPU

In addition to the above treatment facilities, the plant was provided with operation office. Before the disaster it is reported that DKP had operated three (3) vacuum cars and the private operators also had the same numbers of the vacuum cars.

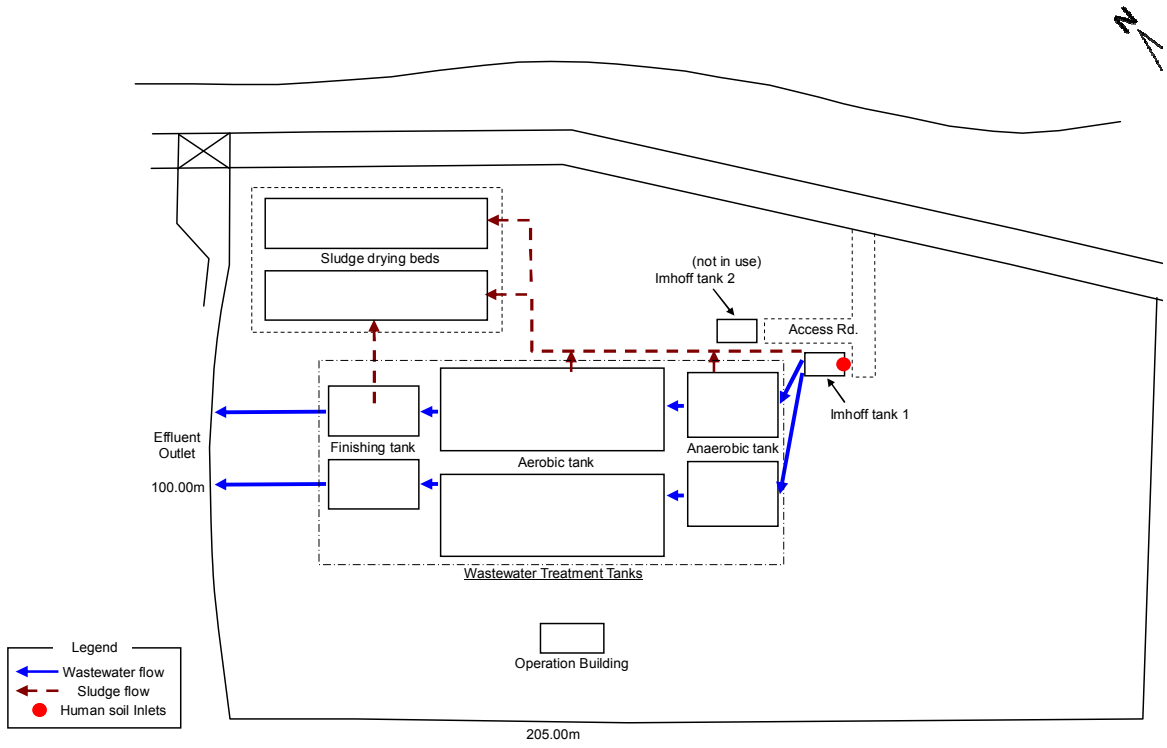

Figure 1.1.1 Schematic Layout of IPLT before Disaster

The treatment capacity was not exactly known. Given total storage capacity of 3,382 m^3 by two lines and assumed retention time of 60 days, treatment capacity is assessed to be 50m^3/day.
According to DKP one of Imhoff tanks remains out of operation even before the disaster, mainly because of sedimentation at the bottom of the tank. The septage contains plastic products, garbage, soils and other materials, and DKP had to engage a lot of manpower in desludging work. Outflow from the maturation tanks was discharged to the sea and dried sludge was disposed to the landfill site in the vicinity of the plant.

1.1.3 Situation after Disaster

According to the investigation by DKP and the JICA Study Team, the plant is no longer usable after the disaster. The main components were completely washed away/collapsed/destroyed. For instance there are a number of cracks in the anaerobic, facultative and maturation ponds, resulting in leakage of wastewater, and sludge drying bed is no longer in place. In addition DKP's three (3) vacuum cars were washed away.

The septage collected is at present directly discharged to the sea near the mouth of the Aceh River. There is therefore urgent need of rehabilitation or construction of the septage treatment plant.

1.1.4 Design Concept

In accordance with the principles of the request made by GOI, the IPLT is to be rehabilitated under the following concepts:

- ✓ The existing IPLT is required to be rehabilitated to urgently preserve urban and natural environment.
- ✓ Rehabilitation shall be directed to restore the existing IPLT with the same functions before the disaster damages.
- ✓ Rehabilitation also aims at improving operation and maintenance aspects.
- ✓ To use construction equipment and materials available from the local markets as much as possible.
- ✓ It is intended that construction works results in increasing job opportunity.

It is also planned not only rehabilitating the existing IPLT but also improving existing access road and providing drainage and traffic safety facilities.

1.2 DETAIL DESIGN

1.2.1 Design Criteria

(1) IPLT

The following planning criteria are set forth for IPLT:

- Treatment capacity : $50m^3$/day, to be the same as existing IPLT
- Treatment process : Same as existing
- Transportation of septage : 8 hours per day

(2) Access Road

The following planning criteria are set forth for access road:

(a) Design Standard

Indonesia Road Design Standard is adaptable in principle. Such other standards as British Standards, AASHTO, and Japanese Standards are also adopted where the Indonesian standards are not clear.

(b) Design Speed

The design speed of the access road is set at 30km/h except for the sections of sharp gradient, as the access road is classified as urban road in densely populated areas.

(c) Geometric Design

Road alignment is designed within the existing right-of-way in principle. Larger radius of

curvature shall be adopted to increase traffic volume and traffic safety level.

(d) Carriageway Width

Carriageway width from Km 0+00 to Km 0+550 are 4 m and from Km 0+550 to Km 2+00 are 6 m.

(e) Traffic Sign

Traffic signs are to be installed at critical road sections to secure traffic safety based on Indonesia Standard.

(f) Road Marking

Road marking is provided on the critical road sections.

(g) Passing Line

Passing line with 3.0m in width is provided.

(h) Pavement Design

AASHTO, among others, is adopted as the most popular international method.

The following procedures are adopted for the design as described in Figure. 1.2.1:

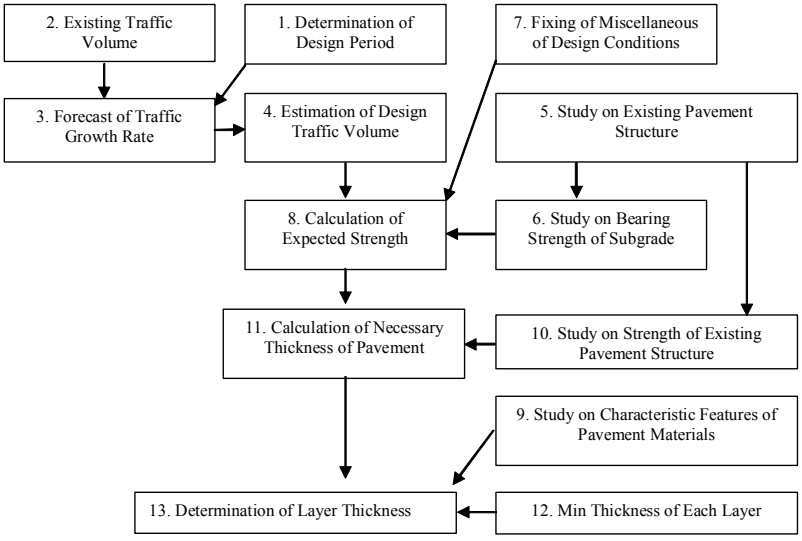

Figure 1.2.1 Asphalt Pavement Design Procedure by AASHTO

Necessary strength of the pavement, termed as Structural Number (SN), is calculated by the following formula:

$$\log_{10} W_{18} = Z_R * S_0 + 9.36 * \log_{10}(SN+1) - 0.20 + \frac{\log_{10}\frac{\Delta PSI}{(4.2-1.5)}}{0.4+\frac{1094}{(SN+1)^{5.19}}} + 2.32 * \log_{10} M_R - 8.07$$

Where,

- W_{18}: passing number of equivalent single axle load of 18 kip (=8t)
- Z_R: coefficient for reliability = －1.037
  (Corresponding to Reliable Probability: R=85%. 80~99% is for urban road)
- So: Overall Standard Deviation=0.45 (normally 0.45 is applied for flexible pavement)
- MR: Resilient Modulus
- ΔPSI: Loss of Performance Serviceability Index

(Ref. : initial value: Po=4.2, terminal value: Pt=2.5 Loss=Po-Pt=1.7)

1.2.2 Project Component

Prior to commencement of the rehabilitation design, the JICA Study Team made technical discussions with DKP to define the rehabilitation requirements and to find better operation practice than before the disaster. The rehabilitation design presented herein is therefore joint output of the DKP and the JICA Study Team.

As the same as the existing facilities, the whole treatment process shall be achieved by gravity flow, and no mechanical equipment will be used for any part of treatment process, excepting for lighting and deep well pump for a control house.

(1) Imhoff Tanks

According to DKP, existing imhoff tanks and their operation had the following problems:

(a) They were originally constructed for the purpose of sludge decomposition but they were not properly functioning due to small storage capacity and mixture of solid waste such as soils, clothes, etc. in septage.

(b) Before the disaster it was then used for separation of solid materials and septage.

(c) It was necessary to input a huge amount of labor force to move out solid waste and sediment deposit at bottom of the tanks.

Through technical discussions with DKP, it is determined to rehabilitate the tanks with the following measures:

① Both the tanks will be modified only for a separation of septage and solid waste. The septage will be led to the anaerobic tanks through open ditch.

② In order to facilitate the removal of solid waste and soils, imhoff tank shall be provided with screen at its inlet and bottom outlet at its bottom. The bottom of the tank shall have sloped bottom for both longitudinal and cross-sectional directions.

③ The solid waste and sediment which passing through the screen shall be flushed out through the bottom outlet by using a head between the inlet and the bottom outlet. Such solid waste and sediments shall be conveyed to sludge drying bed.

④ Approach road shall be constructed to the tanks in order to allow discharge of septage by collection vehicle into inlet of the tank.

(2) Anaerobic, Aerobic and Finishing Ponds

The existing anaerobic, aerobic and finishing ponds are all lined with concrete at their bottom and slopes. But such concrete ling were cracked and destroyed at many places and also interconnecting conduits from one tank to another were also cut out at many locations. It is therefore determined to reconstruct all tanks completely with the following measures:

(a) The locations and dimensions of tanks shall be the same as existing tanks in principle.

(b) Existing concrete lining shall be removed entirely and bottom and slopes of new tanks shall be lined with a reinforced concrete with a thickness of 0.15 m.

(c) Inflow into and outflow from the tank shall be controlled by overflow weir which shall be installed at outlet of the tank.

(3) Interconnection Conduits

All the ponds from anaerobic down to finishing ponds are interconnected by a gravity flow conduits. In view of maintenance, open conduit with pre-cast concrete cover is adopted. The dimension of the conduits is 30 cm in height and bottom wide.

(3) Sludge Drying Beds

All debris of damaged structure is removed and new sludge drying bed is determined to be constructed at the same location. Removal of debris and land grading are indispensable to start construction works. The new drying bed is designed with asphalt pavement on its surface which has a gentle slope towards edge of the bed to accelerate the process. The bed is connected to the anaerobic ponds by conduits to convey drain water for treatment.

(4) Outlet Work

Effluent from finishing tanks shall be discharged into the sea through outlet works. The outlet consists of a discharge pipe with a diameter of 30 cm and outlet structure equipped with a flap gate. The flap gate is to protect inflow of sea water into IPLT when high tide.

(5) Surrounding Dyke and Landscaping

IPLT shall be surrounded by earth embankment with average height of 2 m and at its entrance steel gate is provided. The embankment slopes are protected with sod facing and a number of trees are planted at the top surface of the embankment and several places within IPLT compound.

(6) Control house

New control house is built and has a floor area of approximately 90 m^2. It is divided into office, laboratory, and toilet. Water supply system is installed by means of deep well with pump.

(7) Access Road

The access road is rehabilitated for a length of approximately 2 km. It is of asphalt pavement structure and has a width of 4 m and 6 m and a wearing course thickness of a wearing course 5 cm.

Principal features of IPLT after rehabilitation works will be as given in Table 1.2.1.

Table 1.2.1 Features of Main Components of Septage Treatment Plant

Components		Dimension (m)			Storage capacity (m^3)
1	Imhoff Tank	Bottom Length	Bottom Width	Depth	
2	Anaerobic Tank	10.8	3.0	3.5	392
3	Facultative Tank	48.0	13.9	1.35	1,078
4	Maturation Tank	15.8	7.0	1.35	221
5	Sludge Drying Bed	8.0	4.0	1.2	38

1.3 DESIGN DRAWINGS

In total 38 drawings are prepared as Tender Drawing as shown in Table 1.3.1 and all compiled in Volume 3 of Tender Documents.

Table 1.3.1 List of Tender Document

No.	Title
1.	Location Map
2.	Layout Plan
3.	Preparation of Work
4.	Entrance Road
5.	Plan Cross Section
6.	Deatail of Tanks
7.	Structures
8.	Standard Structure of Borehole
9.	Access Road
10.	Access Road Typical Cross Section
11.	Layout of Office Building
12.	Cross Section of Office Building
13.	Electrical Installation
14.	Air-Conditioner Installation Plan
15.	Plumbing Installation Plan
16.	Water Reservoir Unit
17.	Septic Tank
18.	Absorptive Plan
19.	Laboratory Waste Tank Plan
20.	Detail of Roof Structure
21.	Ceiling Plan
22.	Kozen Installation Plan
23.	Details of Window
24.	Details of Door
25.	Foundation Plan
26.	Laboratory Room

1.4 COST ESTIMATE

Construction cost of the restoration works is estimated at the price level of July 2005 as given in Table 1.4.1.

Table 1.4.1 Bill of Quantities

Bill Item No.	Pay Item No.	Item	Unit	Unit Price (US$)	Quantity	Amount (US$)
1.		**General**				
	1.1	Mobilization	L.S.	24,999.94	1.0	25,000
	1.2	Demobilization	L.S.	7,999.94	1.0	8,000
2.		**Excavation, Filling and Disposal**				
	2.1	Site Clearing and Removal of Debris	Cu.m	1.50	5,170.0	7,755
	2.2	Common Excavation	Cu.m	4.15	160.0	665
	2.3	Common Embankment	Cu.m	22.34	2,690.0	60,103
	2.4	Trimming of Sub-grade for Roads	Cu.m	6.94	3,730.0	25,878
3.		**Cleaning of Existing Ditches**				
	3.1	Cleaning of Existing Ditch	m	0.88	1,000.0	880
4.		**Cleaning of Existing Tanks**				
	4.1	Cleaning of Existing Imhoff Tanks	nos	791.21	1.0	791
	4.2	Cleaning of Existing Anaerobic Tanks	nos	1,837.53	2.0	3,675
	4.3	Cleaning of Existing Aerobic Tanks	nos	6,680.64	2.0	13,361
	4.4	Cleaning of Existing Finishing Tanks	nos	1,522.02	2.0	3,044
5.		**Removal of Existing Asphalt Pavement and Drainage**				
	5.1	Removal of Existing Asphalt Pavement	Sq.m	7.82	3,730.0	29,164
	5.2	Removal of existing U-shaped ditch	m	1.50	500.0	750
	5.3	Removal of existing crossing culvert	m	4.15	30.0	125
6.		**Rehabilitation of Existing Tanks**				
	6.1	Rehabilitation of Existing Imhoff Tanks	nos	2,885.75	2.0	5,771
	6.2	Rehabilitation of Existing Anaerobic Tanks	nos	16,569.11	2.0	33,138
	6.3	Rehabilitation of Existing Aerobic Tanks	nos	40,062.38	2.0	80,125
	6.4	Rehabilitation of Existing Finishing Tanks	nos	18,383.62	2.0	36,767
7.		**Sub-base Course and Base Course**				
	7.1	Sub-base course (t=250mm, crusher-run)	Sq.m	7.53	3,730.0	28,092
	7.2	Sub-base course (t=250mm, recycled crusher-run)	Sq.m	6.28	3,550.0	22,280
	7.3	Base course (t=100mm)	Sq.m	3.01	3,140.0	9,459
	7.4	Base course (t=150mm)	Sq.m	4.52	6,610.0	29,869
8.		**Bituminous prime coat**				
	8.1	Bituminous prime coat	Sq.m	1.28	7,280.0	9,308

9.		**Bituminous tack coat**				
	9.1	Bituminous tack coat	Sq.m	0.38	20,055.0	7,692
10.		**Asphalt concrete pavement**				
	10.1	Asphalt concrete surface course for carriageway (t=50mm)	Sq.m	16.92	20,055.0	339,407
11.		**Drainage works**				
	11.1	Type-A side ditch (Open Drain)	m	25.37	187.8	4,764
	11.2	Type-B cross culvert (D=600)	m	85.88	25.2	2,164
	11.3	Type-A Catchpit (H=2000)	nos	279.72	1.0	280
	11.4	Type-B Catchpit (H=1000)	nos	259.92	1.0	260
	11.5	Catchpit Cover	nos	15.86	2.0	32
	11.6	Outlet	nos	456.82	1.0	457
12		**Road marking**				
	12.1	Type-A Road marking (150mm wide)	m	1.53	4,062.0	6,233
	12.2	Type-A Road marking (450mm wide)	m	4.60	30.0	
13.		**Traffic signs**				
	13.1	Type-A Traffic sign	nos.	217.47	10.0	2,175
	13.3	Type-B Traffic sign	nos.	217.47	10.0	2,175
14.		**Planting**				
	14.1	Sodding	Sq.m	1.40	1,499.0	2,099
	14.2	Tree planting	nos.	24.48	150.0	3,672
	14.3	Flower Planting	nos.	13.99	500.0	6,995
	14.4	Gardening soils	Cu.m	4.25	100.0	425
15.		**Site Office**				
	15.1	Site Office	nos.	32071.00	1.0	32,071
16		**Fenceing**				
	16.1	Fenceing(include Gate)	m	224.64	300.0	67,392
Grand Total						**912,291**

Sub Total carried forward to Summary

CHAPTER 2 PREPARATION OF TENDER DOCUMENTS

2.1 TENDER CONDITIONS

2.1.1 Outline of the Contract Works

The Project aims at rehabilitating the access road with a length of 2 km and IPLT with a daily treatment capacity of 50 m^3 in terms of septage in BAC. The contract works will include the supply of all labors, equipment, plants, materials and support services required for construction, inspection, testing, and commissioning of the following:

- site clearance (includes removal of debris);
- cleaning of all existing tanks;
- surrounding dykes and drainages;
- access road
- two (2) Imhoff tanks
- two(2) anaerobic tanks;
- two(2) Aerobic tanks;
- two(2) finishing tanks;
- sludge drying bed;
- control office

2.1.2 Details to Tender

JICA implements the Project in compliance to the request of the Banda Aceh City Government through GOI in accordance with the following pre-construction schedule:

1)	Request of Banda Aceh Municipality to JICA	April 12th, 2005
2)	Submission of Draft Tender Documents to JICA	May 23rd, 2005
3)	Approval of Draft Tender Documents (JICA)	May 31st, 2005
4)	Distribution of Tender Documents	June 01st, 2005
5)	Tender Opening	June 16th, 2005

2.1.3 Eligibility of Contractor and Required Documents

The Tender is determined to be evaluated in a numerical rating system, in which the Tender is divided into two categories: the first category is Tenderer's qualification including their financial status, construction experience and technical proposal for the contemplated contract works and the second category is tender price. Both the categories are evaluated by means of a numerical rating system respectively in addition to their formality and completeness and the first lowest tenderer is determined to be the one who gained the highest aggregate point of the both categories.

The following conditions and requirements are determined to be set forth in the Tenderer's

qualification requirements in order to procure reputable and reliable contractor in the contract works:

(1) Qualification of Tenderer

(a) Origin

The Tenderer shall be Japanese or Indonesian construction firm who has a license for construction business.

(b) Financial status including balance sheet and profit and loss statement in the last two (2) years be submitted

(c) Business license including registration of the firm be submitted

(d) Experience in Construction Works

The Tenderer shall have at least one (1) experience in construction works similar to the Project with contract of a value equivalent to US$ 900,000 or more in the last ten (10) years.

(e) Type of Tenderer: single firm or joint operation by plural firms. In case of the joint operation, joint operation agreement shall be submitted together with the Tender.

(2) Technical Proposal

The Tenderers are requested to submit the following documents in accordance with the prescribed format:

(a) Proposed organization for the contract works

(b) Key personnel to be engaged

(c) Proposed constructional equipment

(d) Basic construction program

(e) Narrative construction plan

(3) Other Requirement

The Tenderers are encouraged to employ as many Ache people as possible in execution of the contract works.

2.2 TENDER DOCUMENTS

The Tender Documents will comprise three (3) volumes as listed up hereunder:

(1) VOLUME I	Section 1	Invitation for Tenders
	Section 2	Instructions to Tenderers

	Section 3	Tender Data
	Section 4	Bill of Quantities
	Section 5	Forms, Annexes and Enclosures
	Section 6	Conditions of Contract
	Part I:	General Conditions of Contract
	Part II:	Conditions of Particular Application
	Part III:	Appendix to Tender
(2) VOLUME II	Section 7	Technical Specifications
(3) VOLUME III	Section 8	Drawings

CHAPTER 3 TENDER RESULTS

3.1 TENDER EVALUATION CRITERIA

(1) Overall Criteria

The Tender submitted are to be evaluated in accordance with the manner mentioned in Sub-section 2.1.3 hereof. Allocation of points between the technical aspects and the tender price is determined to be as follows:

		Weighting
a.	Stage 1 : Tenderer's Qualification	80 Points
b.	Stage 2 : Tender Price	20 Points
		Full mark 100 Points

It is pre-determined that the Stage 2 evaluation is to be conducted only for such Tenderers that gained the score 50 or more at the Stage 1 evaluation.

(2) Criteria for Stage 1: Evaluation of Tenderer's Qualification

The Tenderer's legal status, financial status, past experience and technical proposal for the contract works are evaluated also by means of the numerical rating system. There are 8 evaluation sub-items in total, and for each sub-item point is allocated as tabulated below:

			Rating (Points)
a.	Company Profile	Enclosure No. 1	5
b.	Particular Experience Record	Enclosure No. 2	10
c.	Financial Capability	Enclosure No. 3	10
d.	Joint Venture Agreement (if applicable)	Enclosure No. 4	-
e.	Organisation and Key Personnel	Enclosure No. 5	10
f.	List of Contractor's Equipment	Enclosure No. 6	10
g.	Basic Programme of the Works	Enclosure No. 7	20
h.	Outline of Construction Plan	Enclosure No. 8	15
		Total	80 Points

(3) Criteria for Stage 2: Price Evaluation

The lowest Tender price is to be given a full mark of 20, and score of the other Tenderers is decided to be calculated in accordance with the following equation:

$$\text{Score} = 20 \text{ points} \quad X \ \frac{\text{Lowest price}}{\text{Tenderder price}}$$

3.2 TENDER OPENING

(1) Tender schedule

1)	Submission of the Draft Tender documents (JICA)	May 23rd, 2005
2)	Approval of the Draft Tender documents (JICA)	May 31st, 2005
3)	Distribution of Tender Documents	June 01st, 2005
4)	Inquiries from the Tenderers	June 06th, 2005
5)	Answers from the Consultants (Addendum No.1)	June 10th, 2005
6)	Date of Tender Opening	June 16th, 2005
7)	Tender Evaluation	June 17th-20th, 2005
8)	Submission of Tender Evaluation Report	June 21st, 2005

(2) Participants at Tender Opening Meeting

1) Client

- NAGAMI Kozo: Assistant Resident Representative Japan International Cooperation Agency (JICA) Indonesia Office
- SUGANO Yuichi: Japan International Cooperation Agency (JICA), Social Development Department

2) Counterpart

- Drs.H.T. Saifuddin, TA.M.Si: Head of Sanitation and Park Department, Banda Aceh City Government

3) Engineer

- INUZUKA Isao: Facility Plan/Infrastructures Designer, JICA URRP Study Team
- IZAWA Tetsuro: Cost Estimate/Procurement Plan 1, JICA URRP Study Team

4) Tenderer

- PT. TENAGA INTI MAKMU BEUSARE: Teuku Umar No.109 Street Banda Aceh
- PT. YUNIDA SWASTA: Prof. A. Mohd. Idrahim Street No.18
- PT. HATARI RAYA: Sri Ratu Safiatuddin Street No.12 Banda Aceh

3.3 TENDER EVALUATION

3.3.1 Formality and Completeness of Tenders Submitted

The formality and completeness of the tenders submitted were at first examined. The results are as presented in Table 3.3.1.

Table 3.3.1 Formality and Completeness of Tenders submitted

	PT. TENAGA INTI MAKMU BEUSARE	PT. YUNIDA SWASTA	PT. HATARI RAYA
Number of Tender	OK	OK	OK
Certificate of Register of companies	OK	OK	OK
Receipt of Tender Documents	OK	OK	OK
Affidavit of Site Inspection	OK	OK	OK
Form of Tender	OK	OK	OK
Priced Bill of Quantities	OK	OK	OK
Enclosure No 1 (Company Profile)	OK	OK	OK
Enclosure No 2 (Particular Experience Record)	OK	OK	OK
Enclosure No 3 (Financial Capability)	OK	OK	OK
Enclosure No 4 (Joint venture Agreement)	-	-	-
Enclosure No 5 (Organization & Key Personnel)	OK	NO	OK
Enclosure No 6 (List of Contractor's Equipment)	OK	OK	NO
Enclosure No 7 (Basic Programme of the Works)	OK	NO	NO
Enclosure No 8 (Outline of Construction Plan)	OK	NO	NO

3.3.2 Evaluation at Stage 1: Tenderer's Qualification

(1) Evaluation of Tenderer' Eligibility and Status

1) Company Profile and Line of Business (Enclosure No 1)

	PT. TENAGA INTI MAKMU BEUSARE	PT. YUNIDA SWASTA	PT. HATARI RAYA
Head Office	Teuku Umar No.109 Street Banda Aceh	Prof. A. Mohd. Idrahim Street No.18, Banda Aceh	Sri Ratu Safiatuddin Street No.12, Banda Aceh
Owner	Mr. Makmur,SE	Mr. Syahrul	Mr. Mawardi Yusuf
TEL	0651-40311	0651-92102	0651-7428673
FAX	651-49412	-	-

Business Registrations	Civil, Architecture, Environment System	Civil, Architecture, Environment System	Civil, Architecture.

2) Annual Turnover (Enclosure No 2)

		PT. TENAGA INTI MAKMU BEUSARE	PT. YUNIDA SWASTA	PT. HATARI RAYA
Projects with a value equivalent to US$ 900,000 or more	1995	-	-	-
	1996	-	-	-
	1997	-	-	-
	1998	-	-	-
	1999	-	-	-
	2000	-	-	-
	2001	-	-	-
	2002	-	-	-
	2003	-	-	-
	2004	1	-	-
	Total	1	-	-

3) Financial Status (Enclosure No 3)

Unit : (US$, million)

		Evaluated Scores														
		PT. TENAGA INTI MAKMU BEUSARE					PT. YUNIDA SWASTA					PT. HATARI RAYA				
		00	01	02	03	04	00	01	02	03	04	00	01	02	03	04
1	Total assets	0.68	0.74	0.90	0.95	1.00	0.35	0.41	0.47	0.51	0.54	0.30	0.33	0.36	0.42	0.44
2	Current assets	0.48	0.49	0.57	0.63	0.75	0.38	0.42	0.53	0.60	0.63	0.29	0.33	0.38	0.40	0.47
3	Total liabilities	0.06	0.06	0.07	0.08	0.10	0.04	0.05	0.05	0.06	0.07	0.04	0.05	0.05	0.06	0.06
4	Current liabilities	0.03	0.04	0.05	0.05	0.06	0.03	0.03	0.03	0.04	0.05	0.02	0.03	0.03	0.04	0.04
5	Profits before taxes	0.24	0.29	0.37	0.39	0.32	0.00	0.02	0.03	0.05	004	0.03	0.03	0.01	0.05	0.02
6	Profits after taxes	0.23	0.28	0.36	0.36	0.30	0.00	0.02	0.03	0.05	0.04	0.00	0.02	0.03	0.05	0.04
7	Net worth(1-3)	0.63	0.83	0.83	0.87	0.91	0.31	0.36	0.42	0.45	0.48	0.26	0.29	0.31	0.36	0.38
8	Working capital(2-4)	0.45	0.53	0.53	0.57	0.69	0.35	0.39	0.50	0.56	0.58	0.37	0.30	0.35	0.37	0.43

4) Joint Venture Agreement (Enclosure No 4)

There are no Tenderers with a joint operation.

	PT. TENAGA INTI MAKMU BEUSARE	PT. YUNIDA SWASTA	PT. HATARI RAYA
Joint venture Agreement	Single	Single	Single

(2) Evaluation of Technical Proposal

1) Proposed Organization and Key Personnel (Enclosure No 5)

		PT. TENAGA INTI MAKMU BEUSARE	PT. YUNIDA SWASTA	PT. HATARI RAYA
Project Manager	Name	Ir.Twk. mansursyay	NO	Mr. Ridwan Dahilan, ST
	Age	51 years old	NO	35 years old
	nationality	Indonesia	NO	Indonesia
	Specialty	Civil Engineer	NO	Civil Engineer
	Experience	20Years	NO	6 Years
	Other language	English	NO	English
Site Manager	Name	Khairul Syahmega, ST	NO	Mr.Fuadi, ST
	Age	34 years old	NO	37 years old
	nationality	Indonesia	NO	Indonesia
	Specialty	Civil Engineer	NO	Civil Engineer
	Experience	5 Years	NO	6 Years
	Other language	English	NO	English
Organizational chart		OK	NO	OK

2) List of Contractor's Equipment (Enclosure No 6)

Name of Equipment	PT. TENAGA INTI MAKMU BEUSARE			PT. YUNIDA SWASTA			PT. HATARI RAYA		
	Capa	Number	Mobilisa	Capa	Number	Mobilisa	Capa	Number	Mobilisa
1. Excavator	0.8m3	2	July 1	0.8m3	1	July 1	-	-	-
2. Bulldozer	115Hp	1	July 1	140Hp	1	June 1	-	-	-
3. Vibratory Roller	110Hp	1	July 10	12 t	1	July 1	-	-	-
4. Motor Grader	100Hp	1	July 10	-	-	-	-	-	-
5. Flat Bed Truck	30 t	1	July 1	-	-	-			
6. Dump Truck	15m3	2	July 1	15m3	5	July10	-	-	-
7. Dump Truck	4m3	8	July 1	4m3	8	July10	-	-	-

8. Generator Set	300Kv	1	July 10	-	-	-	-	-	-
9. Tandem Roller	12 t	1	July 15	12 t	1	July 1	-	-	-
10 PTR	12 t	1	July 15	-	-	-	-	-	-
11 Asphalt Sprayer	300 L	1	July 15	300 L	1	July10	-	-	-
12 Asphalt Finisher	5 m	1	July 15	5 m	1	July 1	-	-	-
13 Water Tanker	4,000L	1	July 10	-	-	-	-		
14 Water Pump	6 Hp	1	July 10	-	-	-	-	-	
15 Tamper	5 Hp	1	July 10	-	-	-	-	-	-
16 Concrete Mixer	0.3m3	3	July 10	-	-	-	-	-	-
17 Concrete Vibrator	5 Hp	1	July 10	-	-	-	-	-	-

3) Basic Programme of the Works (Enclosure No 7)

Item	PT. TENAGA INTI MAKMU BEUSARE	PT. YUNIDA SWASTA	PT. HATARI RAYA
1 Site clearance and Removal of debris	Acceptable	NO	NO
2 Cleaning of all existing tanks	Acceptable	NO	NO
3 Production of Pre-cast concrete block	NO	NO	NO
4 Access road for Base course	Acceptable	NO	NO
5 Repair work of each tank	Acceptable	NO	NO
6 All As pavement work	Acceptable	NO	NO
7 Facilities construction	Acceptable	NO	NO

4) Outline of Construction Plan (Enclosure No 8)

Item	PT. TENAGA INTI MAKMU BEUSARE	PT. YUNIDA SWASTA	PT. HATARI RAYA
1. Over-all plan	OK	NO	NO
2. Execution stage of works	OK	NO	NO
3. Materials quality control.	OK	NO	NO
4. Workmanship and Capacity	OK	NO	NO
5. Security Control method	NO	NO	NO

(3) Results of the Stage 1 Evaluation

All description and data given in the enclosures were evaluated according to the rating system as summarized table below: Each sub-item is classified into four (4) grades: excellent, good, fair and marginal, and a rating are allocated at 1.0, 0.8, 0.7 and 0.0 in order of category.

Table 3.3.2 Evaluated Scores at Stage 1: Tenderer's Qualification

		PT. TENAGA INTI MAKMU BEUSARE				PT. YUNIDA SWASTA				PT. HATARI RAYA			
		E	G	F	M	E	G	F	M	E	G	F	M
		1.0	0.8	0.7	0	1.0	0.8	0.7	0	1.0	0.8	0.7	0
Enclosure No 1	5Pt		4				4				4		
Enclosure No 2	10Pt		8					7				7	
Enclosure No 3	10Pt		8				8				8		
Enclosure No 4	-	-	-	-	-	-	-	-	-	-	-	-	-
Enclosure No 5	10Pt		8						0		8		
Enclosure No 6	10Pt	10					8						0
Enclosure No 7	20Pt			14					0				0
Enclosure No 8	15Pt			10					0				0
Total		62				27				27			

Legend E: Excellent G: Good F: Fair M: Marginal

Only PT. Tenaga Inti Makmu Breusare gained the score more than minimum requirement of 50 points, and is therefore pre-qualified, for stage 2 evaluation

3.3.3 Evaluation at Stage 2: Tender Price

The Tender prices of the Tenderers are as summarized in table below:

Table 3.3.3 Comparison of Tender Prices

Engineer's Estimation 912,388 (100.00%)	Tender Prices (US$)		
	PT. TENAGA INTI MAKMU BEUSARE	PT. YUNIDA SWASTA	PT. HATARI RAYA
	866,000 (94.91 %)	1,094,000 (119.90 %)	917,000 (100.01 %)

PT. Tenaga Inti Makmu Beusare offered the lowest price among the three (3) tenders received and is therefore given a full mark of 20 points. The Tender price of the other two Tenderers, PT. Yunida Swasta and PT. Hatari Raya were not evaluated since their Tenders were disqualified at the first stage.

Table 3.3.4 Evaluated Scores at Stage 2: Tender Prices

Evaluated Scores		
PT. TENAGA INTI MAKMU BEUSARE	PT. YUNIDA SWASTA	PT. HATARI RAYA
20 Point	-	-

3.3.4 Conclusion

The results of the tender evaluation are as tabulated below:

Table 3.3.5 Overall Result of Tender Evaluation

Tenderer	PT. TENAGA INTI MAKMU BEUSARE	PT. YUNIDA SWASTA	PT. HATARI RAYA
Technical Evaluation	62 Points	27 Points	27 Points
Price Evaluation	20 Points	-	-
Total	82 Points	27 Points	27 Points
Ranking	1	-	-

The Tender submitted by PT. Tenaga Inti Makmu Beusare is concluded to be the lowest responsive tender among there (3) Tenders received and is therefore recommended for award of the contract.

CHAPTER 4 CONSTRUCTION SUPERVISION WORKS

4.1 SCOPE OF CONSTRUCTION SUPERVISION WORKS

Scope of construction supervision works is mainly categorized into: (1) Progress Control, (2) Quality Control, (3) Cost Control and (4) Safety Control during the course of the following major activities on supervision works:

- Review and approval of construction drawings, methods, schedule and proposals submitted by the Contractor
- Modification of construction drawings, as required
- Review and approval of manufacturer's design and drawings, if necessary
- Inspection of the completed works
- Inspection and witness of final acceptance tests
- Certification of completed works
- Review and certification of statement of progress and final payments
- Preparation of monthly progress report, completion report and compilation of As-built Drawings.

4.2 ORGANIZATION OF CONSTRUCTION SUPERVISION TEAM

Organization of construction supervision team was set as shown in Figure 4.1.1.

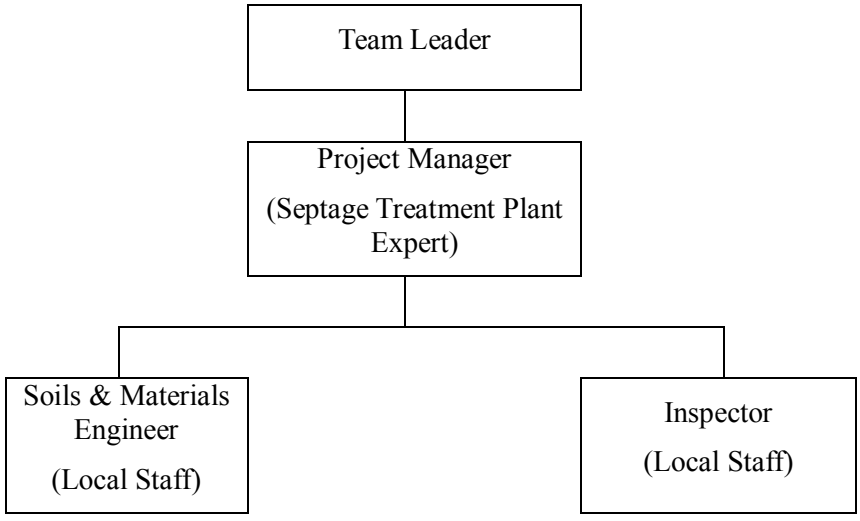

Figure 4.1.1 Organization of Construction Supervision Team

Team Leader of the JICA URRP Study Team is responsible for management of the construction supervision team.

Septage Treatment Plant Expert of the JICA URRP Study Team acted as a Project Manager who is

responsible for all construction supervision works.

Soils and Materials Engineer (Local Staff) was assigned for all construction materials including borrow pits, quarries, stockpiles, concrete and asphalt production, on-site manufacturing yard and off-site supplies.

Inspector (Local Staff) was also assigned for inspection works.

4.3 CONSTRUCTION SUPERVISION WORKS

4.3.1 Progress Control

Progress control was made based on the work program. Actual progress of works was checked at the site and compared to the planned progress. Regular review of the program was made to ensure that the planned progress of each project component could be made in each month.

The comparisons of the actual and planned progress were described in the monthly report together with explanations of reasons of delay if any, and details of measures taken or to be taken to avoid further delay. Monthly meetings were held to monitor respective works.

4.3.2 Quality Control

(1) Quality Control on Materials

Construction materials used for the project are divided into in-situ materials and procured materials. The in-situ materials are produced from the approved borrow pits, quarry sites, river deposits and beach areas, while procured materials are products manufactured at factories like cement, rebar, bitumen, piles, pipes, paint, hardware and road signs. All of these were confirmed as acceptable quality prior to construction.

(2) Quality Control on Workmanship

Quality control on workmanship was carried out on products made by the Contractor under the supervision of the Engineer in accordance with the Conditions of Contract, Specifications, Drawings and other relevant Contractual Documents.

The major work items subject to quality control on workmanship are as follows:

- Excavation works
- Embankment works
- Sand filling
- Slope protections consisting of rip-rap, gabions, masonry, etc.
- Instrumentation (for site office)
- Concrete works
- Metal works and painting

4.3.3 Cost Control

Each work item described in the Bill of Quantities was reviewed and adjusted as required. Cost control was made based on the measured work quantities and unit rates, lump sums and provisional sums in close cooperation with Inspector.

4.3.4 Safety Control

Safety is considered one of the key issues for any type of construction works. The safety control was fully taken during construction with establishment of safety control organization, meetings and monitoring.

4.3.5 Handover of the Project

The Project was completed with sufficient control on progress, quality, cost and safety on December 20, 2005, 8 days before the contacted completion date on December 28, 2005. Handover ceremony was conducted on the same day with the presence of Minister of Embassy of Japan, JICA Resident Representative, Mayor of Banda Aceh City, BRR and other related agencies.

Signing on handover agreement and signing on agreement on transfer of the Project were also undertaken in the ceremony.

APPENDIX 2

RECOVERY OF WATER SUPPLY SYSTEM IN BANDA ACEH CITY UNDER JAPAN'S NON-PROJECT TYPE GRANT AID

APPENDIX-2 RECOVERY OF WATER SUPPLY SYSTEM IN BANDA ACEH CITY UNDER JAPAN'S NON-PROJECT TYPE GRAND AID

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CHAPTER 1 DESIGN WORKS AND COST ESTIMATE

1.1 DESIGN CONDITION

1.1.1 General

The Project aims at restoring water distribution network in the city to the pre-disaster situation in principle.

The detailed design was conducted in 3 months period from May to September 2005 by the JICA Study Team in close coordination and cooperation with BRR, PU, PDAM and other organizations/agencies concerned in pipe water supply in the Project area.

1.1.2 Scope of Design Works

The scope of work comprises (1) design works and cost estimate, and (2) preparation of technical report for restoration of water distribution network in Banda Aceh City.

It should also be noted that quantity of design discharge shall be forecasted based on the water demand for the year 2009, which is the end of rehabilitation and reconstruction program of Banda Aceh City as set forth by GOI.

1.1.3 Pipe Water Supply before Disaster

In Banda Aceh City public pipe water supply is managed and administered solely by PDAM.

There are two (2) sources of public water supply in the Project area: one is Lambaro Water Treatment Plant and the other is Siron Water Treatment Plant. According to hearing from PDAM staff and PDAM annual reports, the features of pipe water supply facilities before the disaster are as summarized in Table1.1.1.

General layout of pipe water supply system is as shown in Figure 1.1.1. This layout is produced by cooperation of the JICA Study Team and PDAM after the disaster, and it is a benchmark data for contemplated design works.

Table 1.1.1 Principal Features of Water Supply System Existed before Disaster

Main Facilities		Lambaro System	Siron System
Raw water pumping station	Number	5	2
	Capacity of each	[Q:208 l/s, h;20m] x3	Q:22 l/s, h:15m
		[Q:147 l/s, h;20m] x2	
Water treatment plant	Production capacity	37,584 m^3/d	1,728 m^3/d
	Treatment process	Rapid sand filtration	Rapid sand filter
	Number of treatment line	2	1
	Main treatment component	Pre-sedimentation, clarifier, rapid sand filter, clear water reservoir	Flocculator and Coagulator chamber, sedimentation tank, rapid sand filter, clear water reservoir
Treated water pumps	Number of pump	5	3
	Capacity of each	Q:147 l/s, h:60m	Q:20 l/s, h:50m
Distribution pipelines	Pipe materials	Steel pipe (SP) for D300 – 600	
		Polyvinyl chloride (PVC) for D100 - 250	
	Pipe length	D600 = 7,566m	
		D500 = 6,053m	
		D400 = 1,451m	
		D300 = 754m	
		D250 = 6,389	
		D200 = 4,090m	
		D150 = 31,789m	
		D100 = 29,255m	
Water meter	Number	24,411	

Source: PDAM

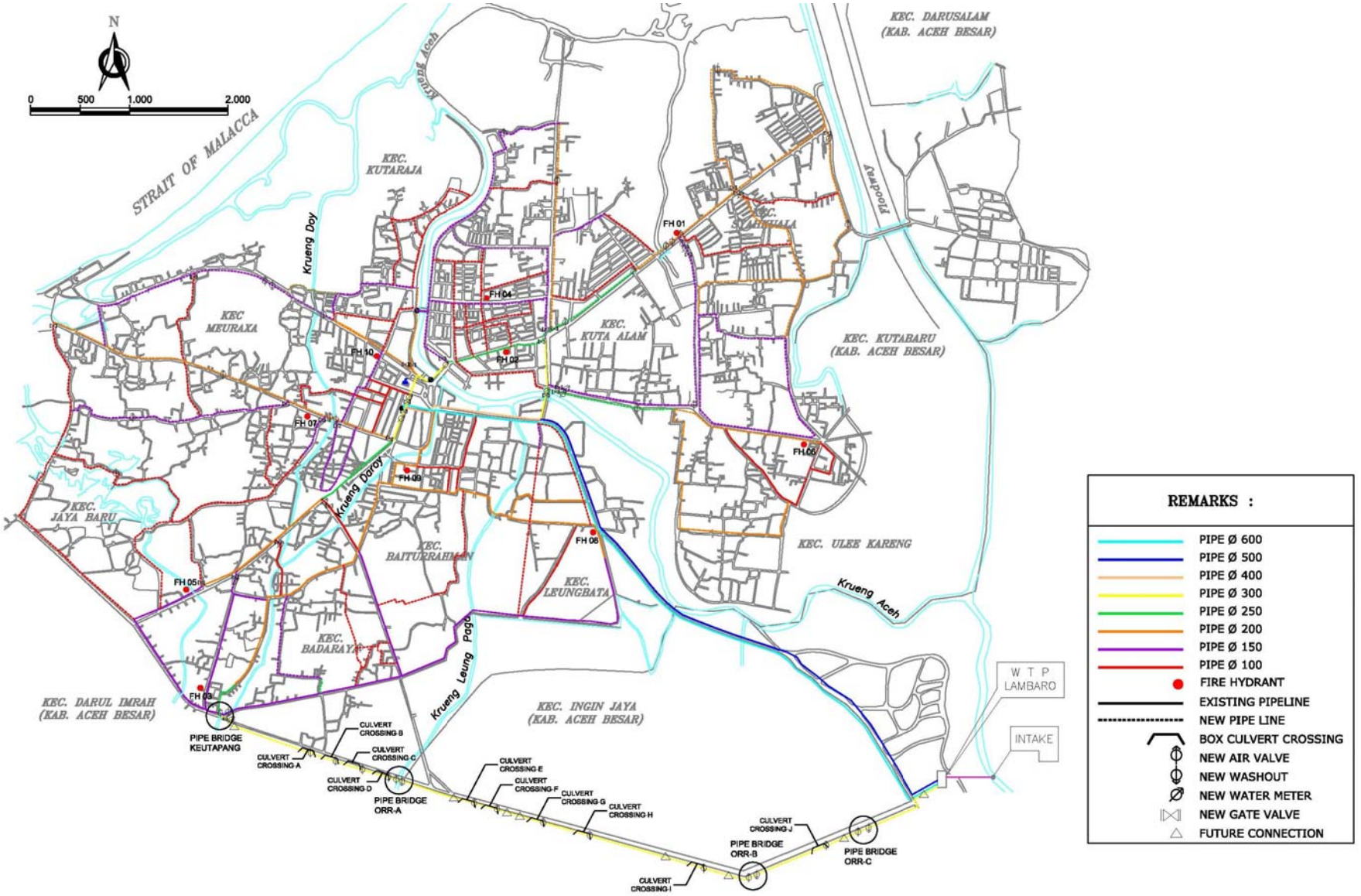

Figure 1.1.1 General Layout of Pipe Water Supply System before the 2004 Disaster

(1) Water Treatment Plants

A schematic layout of Lambaro and Siron WTPs are as shown in Figures 1.1.2 and 1.1.3 respectively. Both the plants depend on unregulated surface runoff of the Aceh River for raw water intake.

The Lambaro WTP has a raw water pumping station on the left bank of the Aceh River with 5 pumping units. The capacity of each pump is as presented in Table 1.1.1. The treatment plant has a daily production capacity of 37,584 m^3 and is divided into two (2) lines. The first line was constructed in 1974 and the second in 1998. The first line appears to be timeworn.

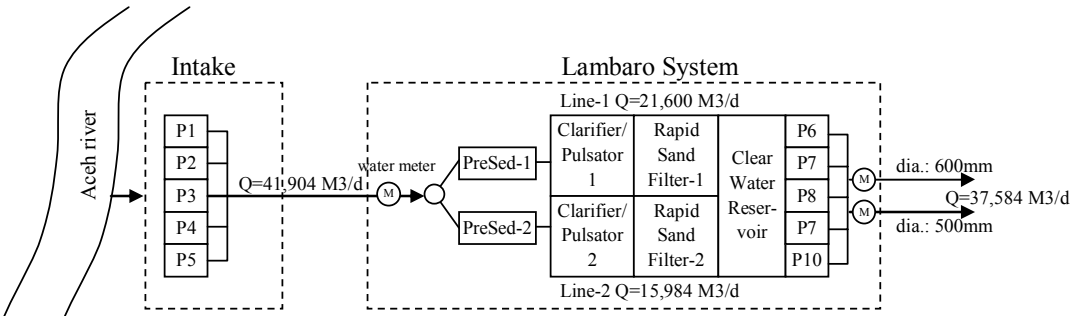

Figure 1.1.2 Schematic Layout of Lambaro WTP

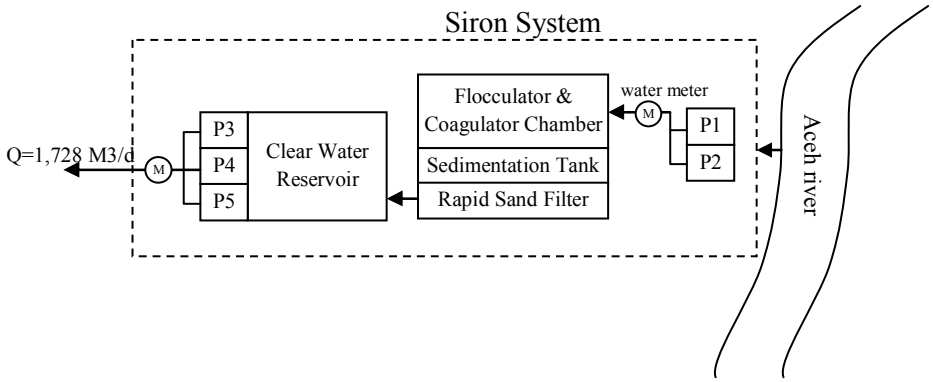

Figure 1.1.3 Schematic Layout of Siron WTP

The Siron WTPis located on the right bank of the Aceh River and had a daily production capacity of 3,460m^3.

(2) Distribution Facilities

The distribution systems of the Lambaro and Siron supply systems are basically the same each other. The system consists of treated water pumping facilities and primary, secondary and tertiary distribution pipelines. There is no service reservoir in distribution system, and the treated water is distributed directly from clear water reservoir in the treatment plant by means of pressured flow by treated water pumping facilities.

The Lambaro system is equipped with 5 treated water pumping units and has two (2) primary distribution mains, while the Siron system is provided with 3 treated water pumping units and a single primary main.

Total length of the distribution pipelines was approximately 87 km and there were 24, 400 water meters. Pipe materials were steel for pipe diameter larger than 500 mm and polyvinyl for pipes less than 350 mm in diameter.

(3) Status of Water Supply

Pipe water supply system had a daily water supply capacity of 40,000 m^3 before the 2004 disaster and had individual connection of 24,411 and public tap of 100. The historical water supply record and layout of distribution network reveals the following:

① Assuming the average family member of each household was 5, total connected people were 138,984 in 2004, meaning service connection ratio of about 57%. The rest of population was deemed to be relied on groundwater and/or other water resources for its water supply.

② The average water consumption per capita was 136 liter per day.

③ Un-accounted for water was relatively high, calculated at 49%.

④ The distribution pipelines appear to be not systematic and rational, resulting in uneven distribution of pressure and water through out the service area.

⑤ There was no major industry or bulk water consumer in the Project area, though there were a large number of retail shops throughout the Project area..

1.1.4 Pipe Water Supply after Disaster

(1) Physical Damages

① Water treatment plants

Fortunately, there is no serious structural and mechanical damage in Lambaro WTP, so that the plant has started its production soon after the disaster. Installment in auto-desludging equipment in pre-sedimentation and clarifier are however out of order in the first treatment line. On the other hand the Siron WTP had lost its production capacity at all.

② Distribution Network

The distribution pipelines were destroyed in many locations and areas especially in the areas along the coast (Kecamatan Meraxa, Kuta Raja, Jaya Baru and Syiah Kuala) where the

houses and infrastructure were completely destroyed and/or heavily damaged. It is still not possible to distribute the treated water to such Kecamatan areas.

As of September 2005, pipe water service is provided to the areas where distribution pipelines are not damaged and/or restored already, and those 3 Kecamatan areas are served by public taps which are regularly filled up by water tankers.

(2) Administrative Damages

According to PDAM, out of 173 PDAM staff, 29 staffs were killed and/or missing, hampering operation of water supply system, billing and collecting tariff.

In addition various data and information on pipe water service were destroyed, in particular distribution pipelines record, tariff billing and collection, etc.

1.1.5 Available Data and Information

(1) Topography and Geology

There are very limited topographic and geological data and information made available for detail design.

Topographic map in a scale of 1 to 2000 is available but it is without contour. URRP has produced GIS by using latest satellite images after the 2004 disaster and is very useful tool for the current design works. Unfortunately elevation data was not made available during the design period.

Sub-surface and soil characteristics data were also hardly available. It is therefore necessary to conduct detailed topographic mapping along the proposed pipelines and sub-surface geological survey at major structure sites such as pipe bridges before execution of actual construction works.

(2) Data on Pre-disaster Pipe Water Supply Facilities

For the purpose of completing the detailed design, it is required to redevelop distribution pipe network map including diameters of the pipes installed before the disaster. The JICA Study Team in cooperation with PDAM attempted such redevelopment before commencement of the design. At first PDAM staff concerned located distribution pipes with diameters on topographic maps in a scale of 1 to 2,000 based on their knowledge. The JICA Study Team and PDAM then conducted field survey to confirm such information from street to street and physical condition of the primary and secondary pipe lines by visual inspection. The distribution network map shown in Figure 1.1.1 is output of these elaborations.

1.2 DETAIL DESIGN

1.2.1 Design Criteria

In July 6, 2005 there was a meeting at Meeting Room of Urban and Rural Development, Western Region, DG of Human Resettlement, MPW in Jakarta to discuss about restoration works of the

distribution system among the representatives of JICA Study Team, Ciptakarya, BRR and other parties concerned and the following are mutually agreed among the attendants:

(1) Service population should be 80% of population in Banda Aceh City in 2009.

(2) Elevated tank should not be reconstructed, since it is observed that it does not function in many areas in Indonesia as wells as Banda Aceh City.

(3) Minimum water pressure and other design criteria/condition should follow PU Guidelines.

Based on the above the following design criteria are determined to be adopted:

(1)	Design discharge	:	Maximum hourly, to be 1.5 times of the average daily demand
(2)	Required minimum pressure	:	5 m
(3)	Hydraulic analysis	:	EPANET-2
(4)	Boosting capacity of Transmission pumps	:	6 bars (to be the same capacity of pumps existing at Lambaro WTP)
(5)	Standards for pipe	:	BS, AWWA, JIS and their equivalent

1.2.2 Water Demand Forecast

(1) Forecast Population

Though the Project aims at restoring the pipe water distribution network basically to the situation before the 2004 disaster, it is envisaged to redevelop the city with disaster preparedness and more upgraded infrastructure than the ones existed before the disaster. The JICA study Team has worked out a spatial plan and land use plan of the Banda Aceh City as explained and presented in detail in the Main Report. This land use plan is fundamental for laying out pipelines.

Population in the Project area is another important element in forecasting pipe water demand in the Project area. The Main Report also presents the future population forecast in the Project area on a basis of Desa (village) unit and it is summarized in Table 1.2.1.

Table 1.2.1 Projected Population by Desa

NO	KECAMATAN	DESA/KELURAHAN	ID #	POPULATION FORECAST				
				2005	2006	2007	2008	2009
1	MEURAXA	Gampong Pie	117101001	94	93	93	92	92
		Deah Glumpang	117101002	332	330	328	326	325
		Ulee Lheu	117101003	784	787	790	793	796
		Lambung	117101004	239	239	238	238	237
		Alue Deah Tengoh	117101005	219	220	220	220	221
		Deah Baro	117101006	202	202	203	203	203
		Cot Lamkeweuh	117101007	175	174	173	173	172
		Blang Oi	117101008	573	576	578	581	584
		Gampong Blang	117101009	84	85	86	87	88
		Lamjabat	117101010	169	168	167	166	165
		Asoe Nanggroe	117101011	169	169	168	168	167
		Punge Ujong	117101012	504	506	508	509	511
		Lampaseh Aceh	117101013	418	419	421	423	424
		Punge Jurong	117101014	1,041	1,038	1,034	1,031	1,027
		Surien	117101015	313	316	318	320	323
		Gampong Baro	117101016	345	345	346	347	348
		Total		**5,661**	**5,667**	**5,671**	**5,677**	**5,683**
2	BAITURRAHMAN	Desa Ateuk Jawo	117102001	4,366	4,411	4,461	4,519	4,586
		Desa Ateuk Deah Tanoh	117102002	1,382	1,382	1,383	1,384	1,386
		Kel. Ateuk Pahlawan	117102003	4,727	4,740	4,753	4,768	4,785
		Desa Ateuk Munjeng	117102004	1,643	1,650	1,657	1,665	1,674
		Desa Neusu Aceh	117102005	966	975	986	998	1,012
		Kel. Setui	117102006	5,017	5,022	5,031	5,038	5,047
		Kel. Sukaramai	117102007	4,716	4,724	4,733	4,742	4,753
		Kel. Neusu Jaya	117102008	3,578	3,586	3,595	3,605	3,616
		Kel. Peniti	117102009	7,888	7,890	7,895	7,898	7,901
		Kel. Kampong Baro	117102010	2,611	2,633	2,658	2,686	2,720
		Total		**36,894**	**37,013**	**37,152**	**37,303**	**37,480**
3	KUTA ALAM	Peunayong	117103001	2,858	2,872	2,887	2,903	2,919
		Laksana	117103002	6,650	6,669	6,689	6,709	6,729
		Keuramat	117103003	6,214	6,225	6,236	6,247	6,258
		Kuta Alam	117103004	4,183	4,186	4,189	4,192	4,195
		Beurawe	117103005	6,102	6,150	6,202	6,260	6,325
		Kota Baro	117103006	1,450	1,465	1,481	1,499	1,517
		Bandar Baru	117103007	6,605	6,656	6,713	6,775	6,845
		Mulia	117103008	3,098	3,157	3,223	3,299	3,386
		Lampulo	117103009	2,372	2,444	2,524	2,615	2,719
		Lamdingin	117103010	1,581	1,646	1,718	1,798	1,891
		Lambaro Skep	117103011	2,394	2,458	2,530	2,609	2,700
		Total		**43,507**	**43,928**	**44,392**	**44,906**	**45,484**
4	ULEE KARENG	Pango Raya	117104101	1,605	2,400	3,250	4,157	5,222
		Pango Deah	117104102	695	1,219	1,734	2,222	2,656
		Ilie	117104103	2,580	3,301	4,079	4,922	5,942
		Lamteh	117104104	2,198	2,472	2,765	3,079	3,416
		Lambhuk	117104105	4,146	4,671	5,199	5,719	6,210
		Doy	117104106	2,074	2,393	2,751	3,161	3,647
		Lam Glumpang	117104107	2,482	2,703	2,943	3,205	3,496
		Ceurih	117104108	2,855	3,249	3,663	4,092	4,533
		Ie Masen Ulee Kareng	117104109	1,561	1,829	2,088	2,329	2,536
		Total		**20,196**	**24,237**	**28,472**	**32,886**	**37,658**
5	JAYA BARU	Lampoh Daya	117101101	513	516	519	522	525
		Emperon	117101102	873	872	871	871	870
		Lamjamee	117101103	413	413	414	415	416
		Bitai	117101104	369	370	372	373	375
		Lamtemen Barat	117101105	2,368	2,370	2,372	2,374	2,376
		Lamtemen Timur	117101106	745	744	742	741	740
		Ulee Patah	117101107	157	158	158	158	159
		Geuceu Menara	117101108	2,702	2,702	2,702	2,702	2,702
		Punge Blang Cut	117101109	3,222	3,230	3,238	3,246	3,254
		Total		**11,362**	**11,375**	**11,388**	**11,402**	**11,417**
6	BANDA RAYA	Lhong Raya	117101201	1,893	2,080	2,277	2,486	2,706
		Lampuoet	117101202	2,566	2,787	3,042	3,346	3,729
		Mibo	117101203	1,509	1,996	2,467	2,908	3,290
		Lam Ara	117101204	1,637	2,049	2,501	3,001	3,567
		Lhong Cut	117101205	1,831	2,516	3,217	3,923	4,614
		Penjeurat	117101206	1,754	2,455	3,191	3,962	4,805
		Geuceu Kaye Jato	117101207	1,041	1,082	1,118	1,145	1,162
		Geuceu Inem	117101208	2,076	2,312	2,558	2,813	3,072
		Geuceu Komplek	117101209	2,488	2,683	2,884	3,090	3,297
		Lamlagang	117101210	4,430	4,455	4,482	4,511	4,542
		Total		**21,225**	**24,415**	**27,737**	**31,185**	**34,784**
7	LUENG BATA	Batoh	117102101	4,521	5,640	6,863	8,212	9,830
		Lamdom	117102102	1,625	2,415	3,240	4,093	5,058
		Cot mesjid	117102103	2,715	2,906	3,104	3,310	3,519
		Desa Lueng Bata	117102104	3,232	3,508	3,809	4,138	4,505
		Blang Cut	117102105	1,997	2,497	3,029	3,598	4,203
		Lampaloh	117102106	533	619	711	807	908
		Sukadamai	117102107	2,137	2,183	2,231	2,281	2,334
		Panteriek	117102108	1,146	1,498	1,860	2,229	2,597
		Lamseupeng	117102109	2,731	2,832	2,941	3,059	3,189
		Total		**20,637**	**24,098**	**27,788**	**31,727**	**36,143**
8	SYIAH KUALA	Ie Masen Kaye Adang	117104001	3,254	3,297	3,345	3,399	3,461
		Pineung	117104002	3,753	3,777	3,803	3,833	3,865
		Lamgugop	117104003	8,639	8,745	8,867	9,010	9,178
		Kopelma Darussalam	117104004	5,926	5,982	6,045	6,120	6,209
		Rukoh	117104005	8,866	8,918	8,977	9,046	9,126
		Jeulingke	117104006	4,116	4,180	4,252	4,334	4,431
		Tibang	117104007	912	981	1,059	1,150	1,256
		Alue Naga	117104008	483	557	641	739	854
		Deah Raya	117104009	35	64	97	135	180
		Total		**35,984**	**36,501**	**37,086**	**37,766**	**38,560**
9	KUTA RAJA	Kel. Keudah	117103101	602	622	644	672	701
		Kel. Pelanggahan	117103102	987	1,026	1,070	1,121	1,180
		Gp. Pande	117103103	220	252	289	332	383
		Gp. Jawa	117103104	1,247	1,370	1,511	1,674	1,867
		Kel. Merduati	117103105	1,463	1,497	1,535	1,578	1,629
		Lampaseh Kota	117103106	858	892	932	977	1,031
		Total		**5,377**	**5,659**	**5,981**	**6,354**	**6,791**
				GRAND TOTAL				
				200,843	**212,893**	**225,667**	**239,206**	**254,000**

(2) Water Demand Forecast

① Population in the Project area

Population in the Project area is as stated in Table 1.2.1. According to the last census average family size is set at 5 people per household throughout the planning horizon.

② Pipe water service ratio

The pipe water service ratio is estimated at 57 % in 2004. According to PDAM medium term plan and the PU Guidelines it is planned to increase year after year and to reaches at 57 % in 2005 to 80 % in 2009.

It is also planned that the pipe water will be served through individual connection and public taps. The rates of individual and public taps connection are assumed at 90 % and 10 % respectively.

③ Unit water consumption

Water demand is classified into domestic use and non-domestic uses. It is also assumed that quantity of the non-domestic use is equivalent to 20 % of the domestic use and this rate is constant throughout the planning horizon.

Per capita water consumption in the domestic use is 150 liter per day on average and remains constant through out the planning horizon.

④ Un-accounted for water

After the disaster the un-accounted for water is estimated to amount to about 50 % of total water produced. It is assumed that the rate would gradually reduce year after year: 50 % in 2005 to 30 % in 2009.

Those basic parameters are as summarized in Table 1.2.2.

Table 1.2.2 Basic Parameters Applied for Water Demand Forecast

Description		unit	2005	2006	2007	2008	2009	PU guideline
Connection	Served population	%	58	60	65	70	80	
	Average family size		1:5					1:(5-6)
	House connection	%	90					80-90
	Public tap	%	10					10-20
Unit consumption	House connection	lpcd	150					150
	Public tap	lpcd	40					30-50
	Non-Domestic	%	20					15-30
UFW		%	50	45	40	35	30	30-50
Maximum Daily Demand Factor			1.1					1.1-1.25
Peak Hourly Demand Factor			1.5					1.5-2.0

note: PU guideline for house connection per capita consumption applied figure for the city with 100,000-500,000 population.

⑤ Forecast Water Demand

The water demand is forecasted for the respective desa annually during the period from 2005 to 2009 and for the year 2015 as reference for a long-term pipe water supply planning. Table 1.2.3 presents the net amount of the domestic and non-domestic demands in the year 2009. The average daily gross water demand including the amount of the un-accounted for water is forecasted at 29,146 m^3 in 2005, 30,894 m^3 in 2006, 34,269 m^3 in 2007, 37,705 m^3 in 2008, and 44,062 m^3 in 2009.

Table 1.2.3 Water Demand and Supply Capability

Description		unit	2005	2006	2007	2008	2009	2015
Population		person	200,843	212,893	225,767	239,206	254,000	360,304
Served Population	Total	person	116,489	127,736	146,749	167,444	203,200	288,243
	House Conn.	person	104,840	114,962	132,074	150,700	182,880	259,419
	Public Tap	person	11,649	12,774	14,675	16,744	20,320	28,824
Net Demand	House Conn.	m^3/day	15,726	17,244	19,811	22,605	27,432	38,913
	Public Tap	m^3/day	466	511	587	670	813	1,153
	Non-Domestic	m^3/day	3,238	3,551	4,080	4,655	5,649	8,013
	TOTAL	m^3/day	19,430	21,306	24,478	27,930	33,894	48,079
UFW	Rate		50%	45%	40%	35%	30%	30%
	Amount	m^3/day	9,715	9,588	9,791	9,775	10,168	14,424
Gross Demand		m^3/day	29,146	30,894	34,269	37,705	44,062	62,503
Supply Capacity	Lambaro	m^3/day	37,584	37,584	37,584	37,584	37,584	37,584
	Siron	m^3/day	1,728	1,728	1,728	1,728	1,728	1,728
	Total	m^3/day	39,312	39,312	39,312	39,312	39,312	39,312
	Balance	m^3/day	10,166	8,418	5,043	1,607	-4,750	-23,191

⑥ Design Discharge for Distribution Network

The daily average demand by desa in 2009 is as given in Table 1.2.4. These figures are basically employed as design discharge of distribution pipelines after applying hourly peak factor.

Table 1.2.4 Net Water Demand by Desa

KECAMATAN	DESA/KELURAHAN	ID #	water demand (m3/day)	KECAMATAN	DESA/KELURAHAN	ID #	water demand (m3/day)
MEURAXA	Gampong Pie	117101001	12.28	JAYA BARU	Lampoh Daya	117101101	70.06
	Deah Glumpang	117101002	43.37		Emperon	117101102	116.09
	Ulee Lheu	117101003	106.22		Lamjamee	117101103	55.51
	Lambung	117101004	31.63		Bitai	117101104	50.04
	Alue Deah Tengoh	117101005	29.49		Lamtemen Barat	117101105	317.05
	Deah Baro	117101006	27.09		Lamtemen Timur	117101106	98.75
	Cot Lamkeweuh	117101007	22.95		Ulee Patah	117101107	21.22
	Blang Oi	117101008	77.93		Geuceu Menara	117101108	360.55
	Gampong Blang	117101009	11.74		Punge Blang Cut	117101109	434.21
	Lamjabat	117101010	22.02			**Total**	**1,523.48**
	Asoe Nanggroe	117101011	22.28	BANDA RAYA	Lhong Raya	117101201	361.09
	Punge Ujong	117101012	68.19		Lampuoet	117101202	497.60
	Lampaseh Aceh	117101013	56.58		Mibo	117101203	439.02
	Punge Jurong	117101014	137.04		Lam Ara	117101204	475.98
	Surien	117101015	43.10		Lhong Cut	117101205	615.69
	Gampong Baro	117101016	46.44		Penjeurat	117101206	641.18
		Total	**758.34**		Geuceu Kaye Jato	117101207	155.06
BAITURRAHMAN	Ateuk Jawo	117102001	611.96		Geuceu Inem	117101208	409.93
	Ateuk Deah Tanoh	117102002	184.95		Geuceu Komplek	117101209	439.95
	Ateuk Pahlawan	117102003	638.51		Lamlagang	117101210	606.08
	Ateuk Munjeng	117102004	223.38			**Total**	**4,641.58**
	Neusu Aceh	117102005	135.04	LUENG BATA	Batoh	117102101	1,311.72
	Setui	117102006	673.47		Lamdom	117102102	674.94
	Sukaramai	117102007	634.24		Cot mesjid	117102103	469.58
	Neusu Jaya	117102008	482.52		Desa Lueng Bata	117102104	601.15
	Peniti	117102009	1,054.31		Blang Cut	117102105	560.85
	Kampong Baro	117102010	362.96		Lampaloh	117102106	121.16
		Total	**5,001.33**		Sukadamai	117102107	311.45
KUTA ALAM	Peunayong	117103001	389.51		Panteriek	117102108	346.54
	Laksana	117103002	897.92		Lamseupeng	117102109	425.67
	Keuramat	117103003	835.07			**Total**	**4,823.06**
	Kuta Alam	117103004	559.78	SYIAH KUALA	Ie Masen Kaye Adang	117104001	461.84
	Beurawe	117103005	844.01		Pineung	117104002	515.75
	Kota Baro	117103006	202.43		Lamgugop	117104003	1,224.71
	Bandar Baru	117103007	913.40		Kopelma Darussalam	117104004	828.53
	Mulia	117103008	451.83		Rukoh	117104005	1,217.64
	Lampulo	117103009	362.82		Jeulingke	117104006	591.27
	Lamdingin	117103010	252.34		Tibang	117104007	167.60
	Lambaro Skep	117103011	360.29		Alue Naga	117104008	113.96
		Total	**6,069.38**		Deah Raya	117104009	24.02
ULEE KARENG	Pango Raya	117104101	696.82			**Total**	**5,145.31**
	Pango Deah	117104102	354.42	KUTA RAJA	Keudah	117103101	93.54
	Ilie	117104103	792.90		Pelanggahan	117103102	157.46
	Lamteh	117104104	455.83		Gp. Pande	117103103	51.11
	Lambhuk	117104105	828.66		Gp. Jawa	117103104	249.13
	Doy	117104106	486.66		Merduati	117103105	217.37
	Lam Glumpang	117104107	466.51		Lampaseh Kota	117103106	137.58
	Ceurih	117104108	604.88			**Total**	**906.19**
	Ie Masen Ulee Kareng	117104109	338.40			**GRAND TOTAL**	**33,893.76**
		Total	**5,025.08**				

1.2.3 Network Analysis under Pre-disaster Condition

It is considered to be important to assess whether distribution network existed before the 2004 disaster is capable of properly conveying the design discharge (the forecast water demand in the year 2009) with required residual pressure with booster pumping facilities existing. For this purpose of assessment, the distribution pipelines existed before the disaster is aligned into network as given in Figure 1.2.1 and the design discharge is assigned to the respective section as presented in Table 1.2.5.

Table 1.2.5 Design Discharge for Hydraulic Analysis

Water Demand Nodes	Population Served	Water Demand (L/sec)
Kec. Meuraxa *Node No.: 91, 92, 95, 98, 99, 100*	4,546	11.41
Kec. Baiturrahman *Node No.: 3, 56, 57, 58, 59, 60, 61 ,62 ,66, 67, 68, 77, 83, 84, 85, 86, 87, 88, 89, 90, 111*	29,984	75.25
Kec. Kuta Alam *Node No.: 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 18, 19, 20, 21, 22, 28, 29, 34, 49, 50, 51, 107, 108, 109, 110*	35,587	91.32
Kec. Ulee Kareng *Node No.: 38, 39, 40, 41, 42, 43, 44, 45, 46, 47, 48,125*	30,126	75.61
Kec. Jaya Baru *Node No.: 81, 82, 94, 96, 97, 115, 116,117, 126*	9,134	22.92
Kec. Banda Raya *Node No.: 69, 70, 71, 72, 73, 74, 75, 76, 78, 79, 80, 112, 113, 114, 129*	27,827	69.84
Kec. Lueng Bata *Node No.: 1, 2, 4, 5, 55, 63, 64, 6, 123, 124, 131*	28,914	72.57
Kec. Syiah Kuala *Node No.: 30, 31, 32, 33, 35, 36, 37, 52, 53, 54*	30,848	77.42
Kec. Kuta Raja *Node No.: 23, 24, 25, 26, 27, 101, 102, 103, 104, 105, 106, 118*	5,433	13.64
TOTAL	**203,200**	**509.98**

The results of network analysis are shown in Table 1.2.6 and in Figure 1.2.2 showing residual pressure. The following are the conclusion:

① The design discharge is able to be distributed with the required residual head only to the central part of the Project area. It is found that several sections subject to negative pressure.

② The eastern and western parts of the Project area are unable to receive the required quantity of water mainly due to complicated network and smaller size of pipe in many sections.

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Table 1.2.6

Hydraulic Analysis of Pre-Disaster Distribution Network

* Version 2.0 *

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Input File: Existing.NET

Link - Node

Link ID	Start Node	End Node	Length m	Diameter mm
1	1	5	5,908	500
2	5	4	145	500
3	1	2	4,906	600
4	2	3	2,140	600
5	2	55	971	150
6	5	6	191	400
7	4	3	998	400
8	3	60	262	400
9	3	61	610	100
10	61	62	466	100
11	61	58	341	100
12	58	59	100	100
13	59	56	216	100
14	58	57	256	100
15	62	57	572	200
16	57	56	146	200
17	62	68	837	200
18	56	55	705	200
19	55	63	668	200
20	63	65	541	200
21	63	64	1,094	100
22	65	64	1,736	150
23	64	66	1,642	150
24	66	67	369	150

Node Results:

Node ID	Demand LPS	Pressure m
1	-401.91	Reservoir
2	2.21	46.72
3	2.21	46.58
4	2.21	44.52
5	2.21	44.50
6	2.21	43.42
7	2.21	40.80
8	3.21	8.46
9	3.21	8.18
10	3.21	8.53
11	3.21	7.64
12	3.21	7.44
13	3.55	8.28
14	3.55	10.98
15	3.55	8.85
16	3.55	16.29
17	3.55	14.56
18	3.55	13.89
19	3.55	20.12
20	3.55	19.20
21	3.55	13.52
22	3.55	8.26
23	3.21	12.59
24	3.21	12.15

Link Results:

Link ID	Velocity m/s
1	0.81
2	0.17
3	0.86
4	0.71
5	2.23
6	1.52
7	0.29
8	1.16
9	2.09
10	0.93
11	0.88
12	0.26
13	0.02
14	0.34
15	0.62
16	0.61
17	0.77
18	0.69
19	0.50
20	0.31
21	0.48
22	0.46
23	0.58
24	0.14

25	67	68	997	150
26	67	69	664	200
27	60	83	380	250
28	83	77	949	250
29	83	84	216	250
30	84	88	185	250
31	88	85	181	250
32	84	86	739	100
33	85	86	985	100
34	85	87	72	200
35	87	89	88	200
36	89	93	223	200
37	93	92	183	200
38	86	93	738	100
39	92	91	204	150
40	88	87	1,536	150
41	89	90	467	150
42	90	111	420	100
43	111	91	946	100
44	68	77	635	100
45	6	7	78	300
46	7	19	520	250
47	7	40	1,542	150
48	7	48	1,301	200
49	48	40	243	200
50	40	41	332	150
51	41	42	978	150
52	41	43	1,004	100
53	43	45	502	100
54	45	42	502	100
55	48	43	2,775	100
56	42	46	81	100
57	46	47	433	250
58	47	39	1,741	100
59	39	38	1,026	150
60	42	38	1,168	100
61	39	36	274	100

25	3.21	12.04	25	0.59
26	3.21	11.97	26	0.34
27	3.21	11.97	27	2.92
28	3.21	18.11	28	1.44
29	3.21	6.72	29	1.41
30	3.21	19.59	30	1.25
31	3.21	19.26	31	1.06
32	3.21	18.89	32	0.56
33	3.21	18.47	33	0.32
34	3.21	19.24	34	1.46
35	2.31	5.89	35	1.54
36	4.14	3.00	36	1.11
37	1.46	4.66	37	1.10
38	3.23	4.61	38	0.43
39	3.84	3.21	39	0.76
40	4.51	27.34	40	0.34
41	3.62	18.37	41	0.56
42	4.08	5.59	42	0.81
43	4.85	7.22	43	0.28
44	3.61	4.98	44	1.26
45	4.23	5.32	45	2.67
46	5.21	3.26	46	2.60
47	4.84	3.17	47	0.88
48	3.59	28.92	48	1.10
49	3.21	9.00	49	0.84
50	3.21	19.49	50	1.53
51	1.69	20.25	51	1.03
52	4.14	18.21	52	0.65
53	3.53	15.53	53	0.60
54	1.15	16.49	54	0.04
55	2.21	9.95	55	0.57
56	2.21	8.65	56	1.24
57	2.21	8.48	57	0.09
58	2.21	8.96	58	0.04
59	2.21	8.93	59	0.31
60	2.82	45.62	60	0.17
61	2.21	12.79	61	0.17

62	36	35	1,099	100	62	2.82	4.98	62	0.35
63	38	35	616	150	63	2.21	7.69	63	0.42
64	40	52	1,818	150	64	1.60	6.04	64	0.59
65	19	30	1,154	250	65	1.60	7.30	65	0.45
66	30	32	246	200	66	2.21	1.08	66	0.55
67	32	52	307	200	67	2.21	0.99	67	0.39
68	30	31	70	100	68	2.21	4.21	68	0.22
69	31	50	994	100	69	5.58	0.49	69	0.19
70	19	50	448	200	70	7.97	-1.38	70	0.46
71	50	28	497	200	71	7.96	-1.35	71	0.31
72	19	20	41	250	72	7.97	-1.98	72	1.79
73	20	16	346	250	73	7.97	-1.22	73	1.24
74	20	49	517	150	74	7.97	-1.29	74	1.31
75	49	8	145	150	75	7.97	-1.27	75	0.67
76	8	9	142	100	76	5.58	-0.22	76	0.29
77	9	10	502	100	77	3.25	21.31	77	0.12
78	8	11	506	150	78	3.25	16.13	78	0.36
79	11	12	165	150	79	5.58	0.87	79	0.28
80	12	107	143	150	80	3.25	7.34	80	0.27
81	107	108	618	150	81	3.25	6.93	81	0.19
82	107	22	269	100	82	3.86	6.80	82	0.39
83	12	13	252	100	83	3.25	30.53	83	0.37
84	11	10	199	100	84	3.55	28.52	84	0.43
85	10	13	174	100	85	3.55	25.77	85	0.24
86	13	22	168	100	86	3.55	23.53	86	0.01
87	22	21	369	100	87	3.55	24.44	87	0.83
88	14	16	461	100	88	3.55	27.37	88	0.76
89	14	17	230	100	89	3.55	22.82	89	0.90
90	15	18	239	100	90	3.55	20.72	90	1.04
91	16	17	238	250	91	3.55	16.77	91	1.05
92	17	18	162	250	92	3.55	18.32	92	0.83
93	18	21	173	250	93	3.55	20.32	93	0.59
94	21	23	183	250	94	3.86	5.62	94	0.57
95	23	24	181	250	95	1.86	15.31	95	0.43
96	21	7	1,119	100	96	1.86	15.31	96	1.14
97	23	105	922	150	97	1.86	13.93	97	0.22
98	24	25	231	300	98	1.86	12.98	98	0.25

99	25	26	364	300
100	26	27	81	300
101	26	103	370	100
102	103	104	111	100
103	104	105	155	100
104	25	105	684	200
105	105	106	220	200
106	27	101	519	150
107	101	102	106	100
108	102	103	611	100
109	102	106	1,019	150
110	15	13	78	100
111	14	10	87	100
112	52	53	757	200
113	35	53	1,261	150
114	53	54	1,426	200
115	35	37	1,980	100
116	33	34	556	100
117	34	28	594	150
118	28	51	1,163	200
119	11	109	589	100
120	107	108	601	100
121	49	29	517	150
122	29	109	650	150
123	109	110	413	150
124	110	118	1,267	150
125	66	69	443	150
126	69	71	385	150
127	71	113	1,100	150
128	113	114	161	150
129	114	115	1,156	150
130	114	79	1,206	150
131	79	80	237	150
132	115	81	792	150
133	81	82	780	150
134	79	75	404	150
135	71	70	151	250

99	1.86	13.69
100	1.86	13.98
101	3.21	12.07
102	3.21	11.64
103	3.21	11.83
104	3.21	11.83
105	3.21	12.30
106	3.21	12.27
107	3.21	7.40
108	3.18	7.00
109	3.21	5.86
110	3.21	7.76
111	3.55	14.96
112	7.97	-0.65
113	5.58	-0.59
114	5.57	0.51
115	2.03	5.52
116	1.86	13.41
117	2.03	9.04
118	1.41	5.51

99	0.11
100	0.03
101	0.30
102	0.04
103	0.37
104	0.21
105	0.14
106	0.05
107	0.43
108	0.15
109	0.06
110	0.59
111	1.21
112	0.59
113	0.79
114	0.04
115	0.19
116	0.20
117	0.27
118	0.05
119	0.19
120	0.15
121	0.46
122	0.28
123	0.18
124	0.08
125	0.32
126	0.60
127	0.20
128	0.68
129	0.57
130	0.43
131	1.50
132	0.57
133	0.09
134	0.75
135	0.13

136	70	72	1,071	100
137	72	73	191	150
138	68	73	872	200
139	73	74	101	200
140	74	75	104	200
141	74	78	623	100
142	113	112	391	250
143	112	76	173	150
144	76	75	809	200
145	77	78	625	250
146	78	80	495	200
147	80	81	378	200
148	111	82	984	100
149	82	94	212	100
150	94	117	1,887	100
151	115	117	2,282	100
152	91	96	738	150
153	96	97	1,059	150
154	97	116	370	100
155	117	116	510	100
156	92	95	1,151	200
157	95	99	802	200
158	99	100	599	200
159	96	95	613	100
160	116	100	919	100
161	101	98	1,564	200
162	98	99	1,441	200
163	95	98	999	100
164	42	44	201	100
165	44	45	400	75
166	32	33	131	100
167	110	108	445	150

136	0.21
137	0.54
138	0.68
139	0.12
140	0.17
141	1.21
142	0.06
143	0.29
144	0.34
145	1.17
146	1.42
147	0.48
148	0.65
149	0.37
150	0.13
151	0.25
152	0.44
153	0.34
154	0.53
155	0.63
156	0.56
157	0.42
158	0.14
159	0.02
160	0.34
161	0.23
162	0.22
163	0.30
164	0.35
165	0.20
166	0.21
167	0.08

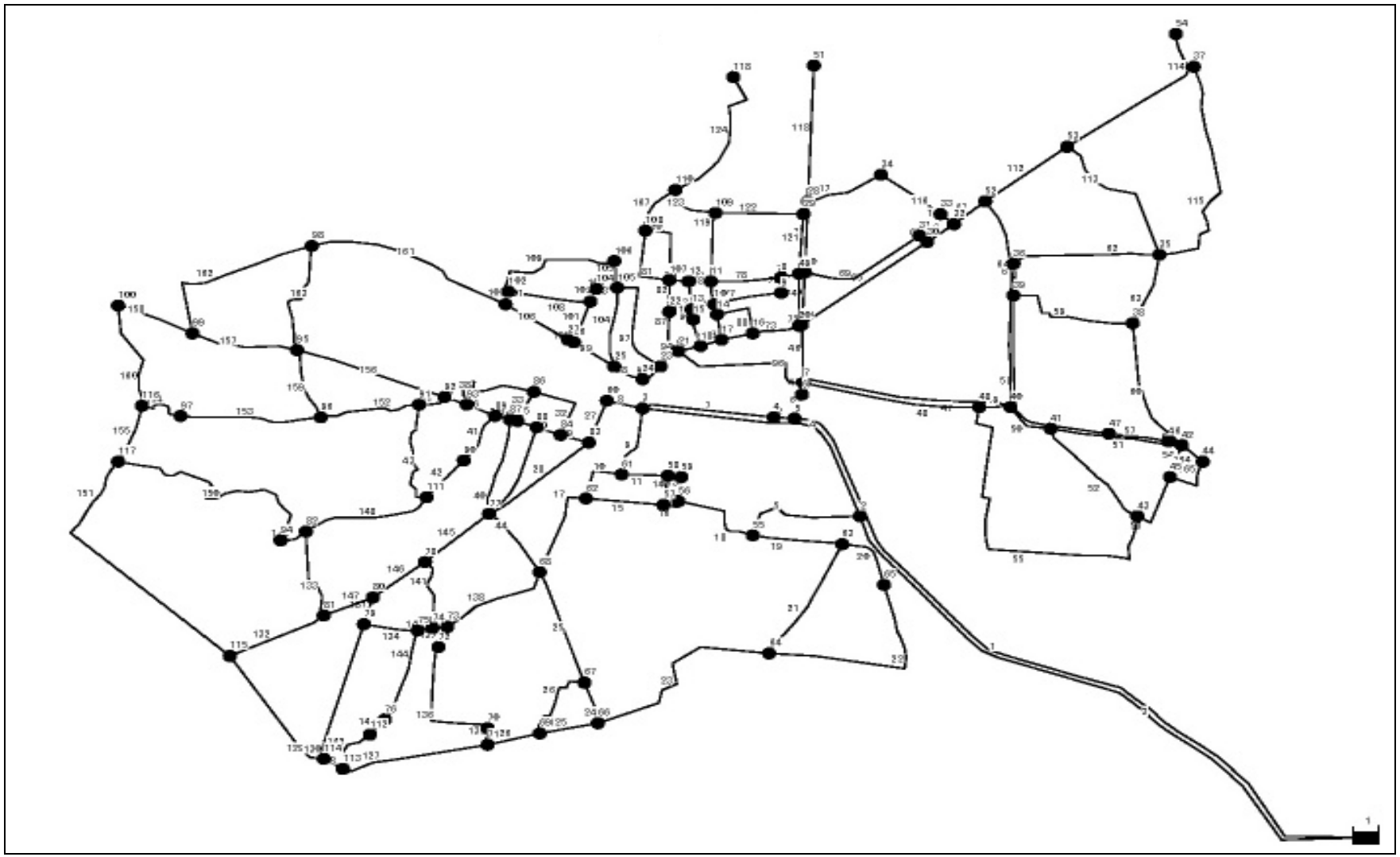

Figure 1.2.1 Water Distribution Link and Nodes, Pre-disaster Case

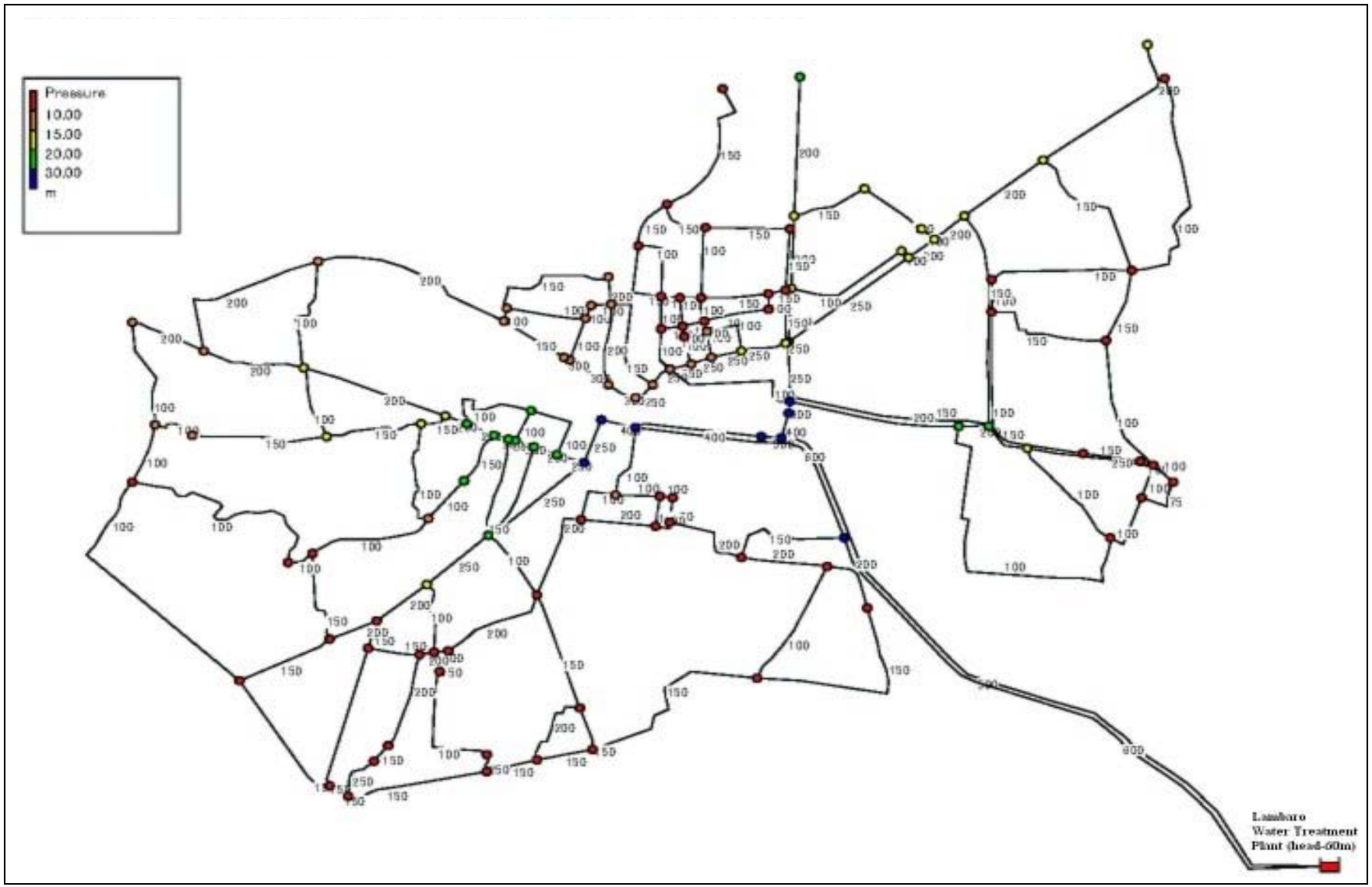

Figure 1.2.2 Result of Hydraulic Analysis, Pre-disaster Case

1.2.4 Restoration Design of Distribution System

(1) Basic Approach

Taking into consideration of the hydraulic characteristics and damages of the pre-disaster distribution network, the restoration works are determined to include the following principles:

① A complete new distribution network will be installed in the area of Kecamatan Jaya Baru, Muaraxa and Ulee Kareng where distribution pipelines were completely destroyed and/or severely damaged.

② Aiming at achieving rational and efficient control and flexibility in water distribution, the water service area is proposed to be divided into four (4) zones as shown in Figure 1.2.3.

③ Aiming also at minimizing head loss and efficient distribution of water throughout the network, it is determined to adopt a loop system. The system will also allow changing direction of flow in case of emergency.

④ New secondary pipelines will be located in the southern part of the Project area in compliance with the proposed expansion of the city structure. It is proposed to accommodate new housing and city government offices in future in such area. The new secondary pipeline will eventually contribute efficient water supply to the southern and western parts (Zones 1 and 2).

⑤ It is proposed to replace existing pipes which are identified to be defective in terms of hydraulic design with new pipes. Such replacement mainly occurs in Zone 4.

⑥ It is important to increase the number of water meter as many as possible in order to reduce un-accounted for water and increase collection of tariff. It is proposed to procure 5,000 sets of PDAM standard type connection unit under the Project, and their installation are determined to be executed directly by PDAM keeping pace with progress of rehabilitation and reconstruction of residential houses and commercial units in the disaster affected areas.

(2) Restoration of Distribution Network

The proposed distribution network is almost identical to the ones existed before the 2004 disaster. But it is more effective and efficient in terms of water distribution and control and stronger against possible disaster. The lengths of pipe lines by diameters are as given in Table 1.2.7.

Table 1.2.7 Pipe ID Table (1/2)

ZONE 1						
No	PIPE ID	DIAMETER (mm)	LENGTH (m)	DRAWING		
1	Z107_001	75	316	D6		
2	Z107_002	75	255	D6		
3	Z107_003	75	165	D6		
4	Z107_004	75	271	D6		
5	Z107_005	75	825	D5	D6	
6	Z107_006	75	326	D5		
7	Z107_007	75	256	D5		
8	Z110_001	100	110	D7		
9	Z110_002	100	428	D7		
10	Z110_003	100	312	D7		
11	Z110_004	100	206	D7		
12	Z110_005	100	50	D7		
13	Z110_006	100	205	D7		
14	Z110_007	100	141	D7		
15	Z110_008	100	898	D6	D7	
16	Z110_009	100	200	D6		
17	Z110_010	100	156	D6		
18	Z110_011	100	436	D6		
19	Z110_012	100	1,202	D5	D6	
20	Z110_013	100	201	D5		
21	Z110_014	100	294	D5		
22	Z110_015	100	575	D4	D5	
23	Z110_016	100	964	E6		
24	Z110_017	100	306	E5		
25	Z110_018	100	501	E5		
26	Z115_001	150	1,468	C6	C7	D7
27	Z115_002	150	1,597	E5		
28	Z115_003	150	301	E5		
29	Z115_004	150	238	C6		
30	Z120_001	200	633	D4	D5	
31	Z125_001	250	52	C8		
32	Z130_001	300	86	C8		
33	Z130_002	300	1,915	C8	D8	
34	Z130_003	300	373	D8		
35	Z130_004	300	142	D8		
36	Z130_005	300	1,341	D8	E8	E9
37	Z130_006	300	632	E9	F9	
38	Z130_007	300	679	F9		
39	Z130_008	300	1,311	F9	G9	G8

ZONE 2						
No	PIPE ID	DIAMETER (mm)	LENGTH (m)	DRAWING		
1	Z205_001	50	317	C4		
2	Z205_002	50	440	C4	D4	
3	Z207_001	75	127	D2		
4	Z207_002	75	131	D2		
5	Z207_003	75	202	D3		
6	Z207_004	75	464	D3		
7	Z207_005	75	567	C3		
8	Z207_006	75	1,005	C3	C4	
9	Z207_007	75	635	C3	C4	
10	Z207_008	75	462	C4		
11	Z207_009	75	255	C4		
12	Z207_010	75	146	C5		
13	Z207_011	75	67	C5		
14	Z207_012	75	77	C5		
15	Z207_013	75	43	C5		
16	Z207_014	75	115	C5		
17	Z207_015	75	97	C5		
18	Z207_016	75	274	C5		
19	Z207_017	75	64	C5		
20	Z207_018	75	121	C5		
21	Z207_019	75	4	C5		
22	Z207_020	75	280	C5		
23	Z207_021	75	86	C5		
24	Z207_022	75	81	C5		
25	Z207_023	75	166	C5		
26	Z207_024	75	208	C5		
27	Z207_025	75	83	C5		
28	Z207_026	75	39	C5		
29	Z207_027	75	63	C5		
30	Z207_028	75	187	C5		
31	Z207_029	75	124	C5		
32	Z207_030	75	143	C5		
33	Z207_031	75	102	C5		
34	Z207_032	75	245	C5		
35	Z207_033	75	328	C5		
36	Z207_034	75	108	C5		
37	Z207_035	75	76	C5		
38	Z207_036	75	71	C5		
39	Z207_037	75	178	C5		
40	Z207_038	75	290	C5		
41	Z207_039	75	201	C5		
42	Z207_040	75	41	C5		
43	Z207_041	75	39	C5		
44	Z207_042	75	91	C5		
45	Z207_043	75	729	C5	C6	
46	Z207_044	75	197	C5		
47	Z210_001	100	720	D2		
48	Z210_002	100	117	D2		
49	Z210_003	100	159	D2		
50	Z210_004	100	216	D2		
51	Z210_005	100	8	D2		

ZONE 2						
No	PIPE ID	DIAMETER (mm)	LENGTH (m)	DRAWING		
52	Z210_006	100	120	D2		
53	Z210_007	100	237	D2		
54	Z210_008	100	313	D2		
55	Z210_009	100	197	D2		
56	Z210_010	100	140	D2		
57	Z210_011	100	168	D2		
58	Z210_012	100	241	D2	D3	
59	Z210_013	100	195	D3		
60	Z210_014	100	285	D3		
61	Z210_015	100	340	D3		
62	Z210_016	100	290	D3		
63	Z210_017	100	142	D3		
64	Z210_018	100	116	D3		
65	Z210_019	100	243	D3		
66	Z210_020	100	466	C3	D3	
67	Z210_021	100	118	C3		
68	Z210_022	100	112	C3		
69	Z210_023	100	366	D3	D4	
70	Z210_024	100	557	C4	D4	
71	Z210_025	100	97	D4		
72	Z210_026	100	229	C4		
73	Z210_027	100	54	C4		
74	Z210_028	100	587	C4		
75	Z210_029	100	173	C5		
76	Z210_030	100	62	C5		
77	Z210_031	100	8	C5		
78	Z210_032	100	203	C5		
79	Z210_033	100	134	C5		
80	Z210_034	100	273	C5		
81	Z210_035	100	67	C5		
82	Z210_036	100	352	C5		
83	Z210_037	100	9	C5		
84	Z210_038	100	456	C5		
85	Z210_039	100	874	B6	C5	C6
86	Z210_040	100	584	C6		
87	Z210_041	100	313	B6		
88	Z210_042	100	844	B6	B7	
89	Z210_043	100	468	B6		
90	Z210_044	100	966	B6	B7	
91	Z210_045	100	428	B6		
92	Z210_046	100	437	A6	B6	
93	Z210_047	100	683	A6	B6	
94	Z210_048	100	173	A6		
95	Z210_049	100	696	A6	B5	
96	Z210_050	100	2,017	B5	B6	
97	Z210_051	100	542	A5	B5	
98	Z210_052	100	967	A4	B4	B5
99	Z210_053	100	191	B4		
100	Z210_054	100	614	B4		
101	Z210_055	100	1,067	B3	B4	
102	Z210_056	100	91	D2		

ZONE 2						
No	PIPE ID	DIAMETER (mm)	LENGTH (m)	DRAWING		
103	Z215_001	150	1,491	B3	B4	
104	Z215_002	150	1,011	B3	C3	
105	Z215_003	150	121	C3		
106	Z215_004	150	248	C3		
107	Z215_005	150	233	C3		
108	Z215_006	150	59	C3		
109	Z215_007	150	116	C3		
110	Z215_008	150	269	C3		
111	Z215_009	150	89	C3		
112	Z215_010	150	323	C3	D3	
113	Z215_011	150	200	D3		
114	Z215_012	150	291	D4		
115	Z215_013	150	128	D4		
116	Z215_014	150	96	D4		
117	Z215_015	150	304	C4	C5	D4
118	Z215_016	150	829	C5	D5	
119	Z215_017	150	589	C5		
120	Z215_018	150	777	C5		
121	Z215_019	150	165	C5		
122	Z215_020	150	127	C5		
123	Z215_021	150	33	C5		
124	Z215_022	150	199	C5		
125	Z215_023	150	61	C5		
126	Z215_024	150	99	C4		
127	Z215_025	150	117	C4		
128	Z215_026	150	130	C4		
129	Z215_027	150	47	C5		
130	Z215_028	150	586	C5		
131	Z215_029	150	1,404	B5		
132	Z215_030	150	78	D4		
133	Z220_001	200	618	A4	B4	
134	Z220_002	200	13	B4		
135	Z220_003	200	819	B4		
136	Z220_004	200	1,104	C4		
137	Z220_005	200	49	C4		
138	Z220_006	200	120	C4		
139	Z220_007	200	48	C4		
140	Z220_008	200	88	C4		
141	Z220_009	200	85	C4		
142	Z220_010	200	69	C4		
143	Z220_011	200	128	C5		
144	Z220_012	200	34	C5		
145	Z220_013	200	143	D5		
146	Z220_014	200	412	D5		
147	Z220_015	200	595	C4	D4	
148	Z220_016	200	354	D4		
149	Z220_017	200	107	D4		
150	Z220_018	200	670	D3	D4	
151	Z220_019	200	8	D3		
152	Z220_020	200	192	D5		
153	**Z220_021**	**200**	**219**	**D5**		

ZONE 3							
No	PIPE ID	DIAMETER (mm)	LENGTH (m)	DRAWING			
1	Z303_001	32	126	F1			
2	Z303_002	32	127	F1			
3	Z303_003	32	121	F1			
4	Z303_004	32	108	F1			
5	Z303_005	32	60	F1			
6	Z303_006	32	80	F1			
7	Z303_007	32	30	F1			
8	Z303_008	32	57	F1			
9	Z303_009	32	114	F1			
10	Z303_010	32	67	E3			
11	Z303_011	32	49	E3			
12	Z303_012	32	132	E3			
13	Z303_013	32	56	E3			
14	Z303_014	32	178	D3	E3		
15	Z303_015	32	33	D3			
16	Z303_016	32	43	D3			
17	Z303_017	32	25	D3			
18	Z303_018	32	90	D3			
19	Z305_001	50	225	F1			
20	Z305_002	50	217	F1			
21	Z305_003	50	101	F1			
22	Z305_004	50	203	F1			
23	Z305_005	50	196	F1	G1		
24	Z305_006	50	183	F1	F2	G1	
25	Z305_007	50	180	F1			
26	Z305_008	50	179	F1			
27	Z305_009	50	179	F1			
28	Z305_010	50	178	F1			
29	Z305_011	50	177	F1			
30	Z305_012	50	177	F1			
31	Z305_013	50	22	F1			
32	Z305_014	50	109	F1			
33	Z305_015	50	16	F1			
34	Z305_016	50	77	F1			
35	Z305_017	50	48	F1			
36	Z305_018	50	53	F1			
37	Z305_019	50	87	F1			
38	Z305_020	50	67	F1			
39	Z305_021	50	40	F1			
40	Z305_022	50	35	F1			
41	Z305_023	50	58	F1			
42	Z305_024	50	102	F1			
43	Z305_025	50	62	F1			
44	Z305_026	50	59	F1			
45	Z305_027	50	107	F1			
46	Z305_028	50	94	F1			
47	Z305_029	50	131	F2			
48	Z305_030	50	63	F2			
49	Z305_031	50	40	F2			
50	Z305_032	50	250	F2			

ZONE 3							
No	PIPE ID	DIAMETER (mm)	LENGTH (m)	DRAWING			
51	Z305_033	50	51	F2			
52	Z305_034	50	102	F2			
53	Z305_035	50	48	F2			
54	Z305_036	50	50	F2			
55	Z305_037	50	40	F2			
56	Z305_038	50	111	F2			
57	Z305_039	50	116	F2			
58	Z305_040	50	182	E2			
59	Z305_041	50	153	E2			
60	Z305_042	50	143	E2			
61	Z305_043	50	97	E2			
62	Z305_044	50	73	E2			
63	Z305_045	50	54	E2			
64	Z305_046	50	78	E2			
65	Z305_047	50	145	E2			
66	Z305_048	50	139	E2			
67	Z305_049	50	150	E2			
68	Z305_050	50	63	E2			
69	Z305_051	50	82	E2			
70	Z305_052	50	85	E2			
71	Z305_053	50	44	E2			
72	Z305_054	50	50	E2			
73	Z305_055	50	49	E2			
74	Z305_056	50	284	E2			
75	Z305_057	50	45	E2			
76	Z305_058	50	69	E2			
77	Z305_059	50	37	E2			
78	Z305_060	50	45	E2			
79	Z305_061	50	120	E2			
80	Z305_062	50	140	E2			
81	Z305_063	50	159	E2			
82	Z305_064	50	173	E2			
83	Z305_065	50	189	E2			
84	Z305_066	50	213	E2	E3		
85	Z305_067	50	257	E2			
86	Z305_068	50	339	E2	E3		
87	Z305_069	50	420	E2	E3		
88	Z305_070	50	499	E3			
89	Z305_071	50	575	E3			
90	Z305_072	50	131	E3			
91	Z305_073	50	53	E3			
92	Z305_074	50	193	E3			
93	Z305_075	50	190	E3			
94	Z305_076	50	97	E3			
95	Z305_077	50	36	E3			
96	Z305_078	50	41	E3			
97	Z305_079	50	58	E3			
98	Z305_080	50	173	E3			
99	Z305_081	50	90	E3			
100	Z305_082	50	60	E3			

ZONE 3							
No	PIPE ID	DIAMETER (mm)	LENGTH (m)	DRAWING			
101	Z305_083	50	22	E3			
102	Z305_084	50	73	E3			
103	Z305_085	50	7	E3			
104	Z305_086	50	73	E3			
105	Z305_087	50	217	E3			
106	Z305_088	50	43	E3			
107	Z305_089	50	46	E3			
108	Z305_090	50	63	E3			
109	Z305_091	50	143	E3			
110	Z305_092	50	44	D3	E3		
111	Z305_093	50	59	E3			
112	Z305_094	50	231	E3			
113	Z305_095	50	74	D3	E3		
114	Z305_096	50	48	D3			
115	Z305_097	50	85	D3			
116	Z305_098	50	46	D3			
117	Z305_099	50	103	D3			
118	Z305_100	50	148	D3			
119	Z305_101	50	77	D3			
120	Z305_102	50	83	D3			
121	Z305_103	50	93	D3			
122	Z305_104	50	123	D3			
123	Z305_105	50	118	D3			
124	Z305_106	50	114	D3			
125	Z305_107	50	111	D3			
126	Z305_108	50	81	D3			
127	Z305_109	50	107	D3			
128	Z305_110	50	107	D3			
129	Z305_111	50	108	D3			
130	Z305_112	50	103	D3			
131	Z305_113	50	60	D3			
132	Z305_114	50	55	D3			
133	Z305_115	50	92	D3			
134	Z305_116	50	133	D2	D3		
135	Z305_117	50	130	D2	D3		
136	Z305_118	50	130	D2	D3		
137	Z305_119	50	132	D2	D3		
138	Z305_120	50	87	D2			
139	Z305_121	50	63	D3			
140	Z305_122	50	50	D2			
141	Z305_123	50	14	D2			
142	Z305_124	50	57	D2			
143	Z305_125	50	29	D2			
144	Z305_126	50	39	D2			
145	Z305_127	50	50	D2			
146	Z305_128	50	53	D2			
147	Z305_129	50	100	D2			
148	Z305_130	50	71	D2			
149	Z305_131	50	38	D2			
150	Z305_132	50	44	D2			

ZONE 3							
No	PIPE ID	DIAMETER (mm)	LENGTH (m)	DRAWING			
151	Z305_133	50	42	D2			
152	Z305_134	50	104	D2			
153	Z305_135	50	115	D2			
154	Z305_136	50	116	D2			
155	Z305_137	50	36	D2			
156	Z305_138	50	24	D2			
157	Z305_139	50	114	D2			
158	Z305_140	50	44	D2			
159	Z305_141	50	34	D2			
160	Z305_142	50	48	D2			
161	Z305_143	50	37	D2			
162	Z305_144	50	62	D2			
163	Z305_145	50	39	D2			
164	Z305_146	50	37	D2			
165	Z305_147	50	38	D2			
166	Z305_148	50	115	D2			
167	Z305_149	50	47	D2			
168	Z305_150	50	50	D2			
169	Z305_151	50	42	D2			
170	Z305_152	50	6	D2			
171	Z305_153	50	107	D3			
172	Z305_154	50	134	D3			
173	Z305_155	50	46	D3			
174	Z305_156	50	29	D3			
175	Z305_157	50	43	D3			
176	Z305_158	50	35	D3			
177	Z305_159	50	84	D3			
178	Z305_160	50	120	D3			
179	Z305_161	50	42	D3			
180	Z305_162	50	71	D3			
181	Z305_163	50	132	E3			
182	Z305_164	50	103	E3			
183	Z305_165	50	136	E3			
184	Z305_166	50	97	E3			
185	Z305_167	50	93	E3			
186	Z305_168	50	74	E3			
187	Z305_169	50	177	E3			
188	Z305_170	50	65	D3			
189	Z305_171	50	29	D3			
190	Z305_172	50	89	D3			
191	Z305_173	50	102	D3	D4		
192	Z305_174	50	104	D3	D4		
193	Z305_175	50	47	D3			
194	Z305_176	50	108	D3	D4		
195	Z305_177	50	53	D3			
196	Z305_178	50	47	D3	D4		
197	Z305_179	50	44	D4			
198	Z305_180	50	136	D4			
199	Z305_181	50	65	D4			
200	Z305_182	50	41	D4			

ZONE 3							
No	PIPE ID	DIAMETER (mm)	LENGTH (m)	DRAWING			
201	Z305_183	50	192	D3	D4	E3	E4
202	Z305_184	50	78	D4	E3		
203	Z305_185	50	24	D3			
204	Z307_001	75	107	F1			
205	Z307_002	75	69	F1			
206	Z307_003	75	156	F1			
207	Z307_004	75	36	F1			
208	Z307_005	75	16	F2			
209	Z307_006	75	219	F2			
210	Z307_007	75	108	F2			
211	Z307_008	75	45	F2			
212	Z307_009	75	100	F2			
213	Z307_010	75	110	F2			
214	Z307_011	75	33	F2			
215	Z307_012	75	44	F2			
216	Z307_013	75	57	F2			
217	Z307_014	75	4	F2			
218	Z307_015	75	135	F2			
219	Z307_016	75	128	F2			
220	Z307_017	75	51	F2			
221	Z307_018	75	94	F2			
222	Z307_019	75	91	F2			
223	Z307_020	75	79	F2			
224	Z307_021	75	29	F2			
225	Z307_022	75	61	F2			
226	Z307_023	75	37	F2			
227	Z307_024	75	63	F2			
228	Z307_025	75	128	F2			
229	Z307_026	75	139	F2			
230	Z307_027	75	48	F2			
231	Z307_028	75	49	F2			
232	Z307_029	75	153	F2			
233	Z307_030	75	46	F2			
234	Z307_031	75	34	F2			
235	Z307_032	75	60	F2			
236	Z307_033	75	93	F2			
237	Z307_034	75	112	E3			
238	Z307_035	75	109	E3			
239	Z307_036	75	98	E3			
240	Z307_037	75	11	E3			
241	Z307_038	75	104	E3			
242	Z307_039	75	84	E3			
243	Z307_040	75	104	E2	E3		
244	Z307_041	75	270	E3			
245	Z307_042	75	60	E3			
246	Z307_043	75	10	E3			
247	Z307_044	75	181	E3			
248	Z307_045	75	194	E3			
249	Z307_046	75	85	E3			
250	Z307_047	75	140	E3			

ZONE 3							
No	PIPE ID	DIAMETER (mm)	LENGTH (m)	DRAWING			
251	Z307_048	75	75	E3			
252	Z307_049	75	156	D3	E3		
253	Z307_050	75	45	E3			
254	Z307_051	75	59	E3			
255	Z307_052	75	61	D3			
256	Z307_053	75	39	D3			
257	Z307_054	75	85	D3			
258	Z307_055	75	62	E3			
259	Z307_056	75	114	E3			
260	Z307_057	75	108	E3			
261	Z307_058	75	45	E3			
262	Z307_059	75	157	D3	E3		
263	Z307_060	75	58	E3			
264	Z307_061	75	157	E3			
265	Z307_062	75	59	E3			
266	Z307_063	75	49	E3			
267	Z307_064	75	82	E3			
268	Z307_065	75	96	E3			
269	Z307_066	75	24	E3			
270	Z307_067	75	93	E3			
271	Z307_068	75	35	E3			
272	Z307_069	75	117	E3			
273	Z307_070	75	40	E3			
274	Z307_071	75	60	E3			
275	Z307_072	75	33	E3			
276	Z307_073	75	70	E3			
277	Z307_074	75	86	E3			
278	Z307_075	75	86	E3	E4		
279	Z307_076	75	75	D3			
280	Z307_077	75	130	D3			
281	Z307_078	75	54	D3			
282	Z307_079	75	137	D3			
283	Z307_080	75	85	D3			
284	Z307_081	75	91	D3			
285	Z307_082	75	86	D3			
286	Z307_083	75	46	D3			
287	Z307_084	75	59	D3	E3		
288	Z307_085	75	33	E3			
289	Z307_086	75	68	E3			
290	Z307_087	75	77	E3			
291	Z307_088	75	36	E3			
292	Z307_089	75	174	D3	E3		
293	Z307_090	75	46	D3	D4		
294	Z307_091	75	48	D4			
295	Z307_092	75	14	D4			
296	Z307_093	75	41	D4			
297	Z307_094	75	54	D4			
298	Z307_095	75	30	D4			
299	Z307_096	75	150	D4			
300	Z307_097	75	176	D3	D4		

ZONE 3							
No	PIPE ID	DIAMETER (mm)	LENGTH (m)	DRAWING			
301	Z307_098	75	70	D3			
302	Z307_099	75	39	D3			
303	Z307_100	75	40	D3			
304	Z307_101	75	49	D3			
305	Z307_102	75	39	D3			
306	Z307_103	75	44	D3			
307	Z307_104	75	74	D3			
308	Z307_105	75	38	D3			
309	Z307_106	75	5	D3			
310	Z307_107	75	94	D3			
311	Z307_108	75	101	D3			
312	Z307_109	75	71	D3			
313	Z307_110	75	44	D3			
314	Z307_111	75	96	D3			
315	Z307_112	75	41	D3			
316	Z307_113	75	16	D3			
317	Z307_114	75	33	D3			
318	Z307_115	75	42	D3			
319	Z307_116	75	47	D3			
320	Z307_117	75	106	D3			
321	Z307_118	75	9	D3			
322	Z307_119	75	64	D3			
323	Z307_120	75	31	D3			
324	Z307_121	75	40	D3			
325	Z307_122	75	47	D3			
326	Z307_123	75	56	D3			
327	Z307_124	75	58	D3			
328	Z307_125	75	29	D3			
329	Z307_126	75	44	D3			
330	Z307_127	75	55	D3			
331	Z307_128	75	122	D3			
332	Z307_129	75	42	D3			
333	Z307_130	75	88	D3			
334	Z307_131	75	47	D3			
335	Z307_132	75	86	D3			
336	Z307_133	75	17	D3			
337	Z307_134	75	163	D3			
338	Z307_135	75	46	D3			
339	Z307_136	75	108	D3			
340	Z307_137	75	108	D3			
341	Z307_138	75	37	D3			
342	Z307_139	75	106	D3			
343	Z307_140	75	35	D3			
344	Z307_141	75	106	D3			
345	Z307_142	75	15	D3			
346	Z307_143	75	45	D3			
347	Z307_144	75	13	D3			
348	Z307_145	75	30	D3			
349	Z307_146	75	49	D3			
350	Z307_147	75	16	D3			

ZONE 3							
No	PIPE ID	DIAMETER (mm)	LENGTH (m)	DRAWING			
351	Z307_148	75	36	D3			
352	Z307_149	75	34	D3			
353	Z307_150	75	265	D3	D4		
354	Z307_151	75	264	D3	D4		
355	Z307_152	75	134	D3			
356	Z307_153	75	134	D3			
357	Z307_154	75	135	D3			
358	Z307_155	75	133	D3			
359	Z307_156	75	130	D3	D4		
360	Z307_157	75	131	D3	D4		
361	Z307_158	75	128	D3	D4		
362	Z307_159	75	91	D4			
363	Z307_160	75	22	D4			
364	Z307_161	75	73	D4			
365	Z307_162	75	12	D4			
366	Z307_163	75	46	D4			
367	Z307_164	75	22	D4			
368	Z307_165	75	264	D4			
369	Z307_166	75	114	D4			
370	Z307_167	75	48	D4			
371	Z307_168	75	116	D2			
372	Z307_169	75	82	D2			
373	Z307_170	75	46	D2			
374	Z307_171	75	62	D2			
375	Z307_172	75	255	D2			
376	Z307_173	75	135	D2			
377	Z307_174	75	59	D2			
378	Z307_175	75	6	D2			
379	Z307_176	75	34	D2			
380	Z307_177	75	391	D2			
381	Z307_178	75	144	D2			
382	Z307_179	75	122	D2			
383	Z307_180	75	269	E1	E2		
384	Z307_181	75	983	E1			
385	Z307_182	75	853	D1			
386	Z307_183	75	163	E2			
387	Z307_184	75	220	E2			
388	Z307_185	75	56	E2			
389	Z307_186	75	53	E2			
390	Z307_187	75	46	E2			
391	Z307_188	75	73	E2			
392	Z307_189	75	44	E2			
393	Z307_190	75	81	E2			
394	Z307_191	75	152	E2			
395	Z307_192	75	108	E2			
396	Z307_193	75	53	E2			
397	Z307_194	75	318	E2			
398	Z307_195	75	130	E2			
399	Z307_196	75	89	E3			
400	Z307_197	75	57	D4			

ZONE 3							
No	PIPE ID	DIAMETER (mm)	LENGTH (m)	DRAWING			
401	Z307_198	75	45	D3			
402	Z310_001	100	48	F1			
403	Z310_002	100	48	F1			
404	Z310_003	100	46	F1			
405	Z310_004	100	47	F1			
406	Z310_005	100	47	F1			
407	Z310_006	100	46	F1			
408	Z310_007	100	116	F1			
409	Z310_008	100	16	F1			
410	Z310_009	100	164	F1			
411	Z310_010	100	124	F1			
412	Z310_011	100	34	F1			
413	Z310_012	100	220	F1			
414	Z310_013	100	33	F1			
415	Z310_014	100	135	F1			
416	Z310_015	100	45	F1			
417	Z310_016	100	47	F1			
418	Z310_017	100	49	F1			
419	Z310_018	100	44	F1			
420	Z310_019	100	47	F1			
421	Z310_020	100	48	F1			
422	Z310_021	100	449	F1			
423	Z310_022	100	26	F1			
424	Z310_023	100	40	F1			
425	Z310_024	100	158	F1			
426	Z310_025	100	126	F1			
427	Z310_026	100	78	F1	F2		
428	Z310_027	100	47	F1			
429	Z310_028	100	44	F1			
430	Z310_029	100	34	F1			
431	Z310_030	100	92	F1			
432	Z310_031	100	115	F1			
433	Z310_032	100	102	F1	F2		
434	Z310_033	100	72	F2			
435	Z310_034	100	58	F2			
436	Z310_035	100	55	F2			
437	Z310_036	100	47	F2			
438	Z310_037	100	147	F2			
439	Z310_038	100	48	F2			
440	Z310_039	100	201	F2			
441	Z310_040	100	120	F2			
442	Z310_041	100	74	E2			
443	Z310_042	100	70	E2			
444	Z310_043	100	76	E2			
445	Z310_044	100	66	E2			
446	Z310_045	100	88	E2			
447	Z310_046	100	13	E2			
448	Z310_047	100	58	E2			
449	Z310_048	100	26	E2			
450	Z310_049	100	18	E2			

ZONE 3							
No	PIPE ID	DIAMETER (mm)	LENGTH (m)	DRAWING			
451	Z310_050	100	80	E2			
452	Z310_051	100	7	E2			
453	Z310_052	100	51	E2			
454	Z310_053	100	117	E2			
455	Z310_054	100	32	E2			
456	Z310_055	100	146	E2			
457	Z310_056	100	65	E2			
458	Z310_057	100	203	E2			
459	Z310_058	100	31	E2			
460	Z310_059	100	32	E2			
461	Z310_060	100	44	E2			
462	Z310_061	100	139	E2			
463	Z310_062	100	55	E2			
464	Z310_063	100	65	E2			
465	Z310_064	100	9	E2			
466	Z310_065	100	72	E2			
467	Z310_066	100	48	E2			
468	Z310_067	100	141	E2			
469	Z310_068	100	223	E2			
470	Z310_069	100	109	E2			
471	Z310_070	100	31	E2			
472	Z310_071	100	87	E2			
473	Z310_072	100	43	E2			
474	Z310_073	100	18	E2			
475	Z310_074	100	27	E2			
476	Z310_075	100	104	E2			
477	Z310_076	100	178	E2			
478	Z310_077	100	183	E2	E3		
479	Z310_078	100	70	E2	E3		
480	Z310_079	100	300	E3			
481	Z310_080	100	75	E2			
482	Z310_081	100	18	E2			
483	Z310_082	100	70	E2			
484	Z310_083	100	69	E2			
485	Z310_084	100	80	E2			
486	Z310_085	100	70	E2			
487	Z310_086	100	71	E3			
488	Z310_087	100	58	E3			
489	Z310_088	100	73	E3			
490	Z310_089	100	16	E3			
491	Z310_090	100	506	E3			
492	Z310_091	100	131	E3			
493	Z310_092	100	81	E3			
494	Z310_093	100	42	E3			
495	Z310_094	100	63	E3			
496	Z310_095	100	230	E3			
497	Z310_096	100	89	E3			
498	Z310_097	100	71	E3			
499	Z310_098	100	82	E3			
500	Z310_099	100	192	E3			

Table 1.2.7 Pipe ID Table (2/2)

ZONE 3							
No	PIPE ID	DIAMETER (mm)	LENGTH (m)	DRAWING			
500	Z310_099	100	192	E3			
501	Z310_100	100	55	E3			
502	Z310_101	100	163	E3			
503	Z310_102	100	83	E3			
504	Z310_103	100	63	E3			
505	Z310_104	100	157	D3	E3		
506	Z310_105	100	182	D3			
507	Z310_106	100	67	D3			
508	Z310_107	100	54	D3			
509	Z310_108	100	146	D3			
510	Z310_109	100	73	D3			
511	Z310_110	100	37	D3			
512	Z310_111	100	27	D3			
513	Z310_112	100	176	D3			
514	Z310_113	100	77	D3			
515	Z310_114	100	129	D3			
516	Z310_115	100	104	D3			
517	Z310_116	100	54	D3			
518	Z310_117	100	57	D3			
519	Z310_118	100	44	D3			
520	Z310_119	100	53	D3			
521	Z310_120	100	217	D3			
522	Z310_121	100	195	D3			
523	Z310_122	100	176	D3			
524	Z310_123	100	214	D3			
525	Z310_124	100	110	D3			
526	Z310_125	100	17	D3			
527	Z310_126	100	69	D3			
528	Z310_127	100	13	D3			
529	Z310_128	100	49	D3			
530	Z310_129	100	18	D3			
531	Z310_130	100	27	D3			
532	Z310_131	100	6	D3			
533	Z310_132	100	38	D3			
534	Z310_133	100	132	D3			
535	Z310_134	100	134	D3	D4		
536	Z310_135	100	15	D4			
537	Z310_136	100	145	D4			
538	Z310_137	100	338	D3	D4		
539	Z310_138	100	49	D3			
540	Z310_139	100	110	D3	D4		
541	Z310_140	100	64	D4			
542	Z310_141	100	87	D4			
543	Z310_142	100	108	D4			
544	Z310_143	100	46	D4			
545	Z310_144	100	96	D3			
546	Z310_145	100	50	D3			
547	Z310_146	100	33	D3			
548	Z310_147	100	133	D3			
549	Z310_148	100	68	E3			

ZONE 3							
No	PIPE ID	DIAMETER (mm)	LENGTH (m)	DRAWING			
550	Z310_149	100	42	E3			
551	Z310_150	100	36	E3			
552	Z310_151	100	13	E3			
553	Z310_152	100	125	E4			
554	Z310_153	100	157	E3			
555	Z310_154	100	101	E3			
556	Z310_155	100	51	E3			
557	Z310_156	100	45	E3			
558	Z310_157	100	55	E3			
559	Z310_158	100	89	E3			
560	Z310_159	100	8	E3			
561	Z310_160	100	39	E3			
562	Z310_161	100	6	E3			
563	Z310_162	100	29	E3			
564	Z310_163	100	113	E3	E4		
565	Z310_164	100	64	E3			
566	Z310_165	100	140	D3			
567	Z310_166	100	15	D3			
568	Z310_167	100	81	D3			
569	Z310_168	100	49	D3			
570	Z310_169	100	71	D3			
571	Z310_170	100	73	D3			
572	Z310_171	100	7	D3			
573	Z310_172	100	27	D3			
574	Z310_173	100	94	D3			
575	Z310_174	100	99	D3			
576	Z310_175	100	74	D3			
577	Z310_176	100	101	D3			
578	Z310_177	100	92	D3			
579	Z310_178	100	146	D3			
580	Z310_179	100	133	D2	D3		
581	Z310_180	100	49	D2			
582	Z310_181	100	21	D2			
583	Z310_182	100	39	D2			
584	Z310_183	100	43	D2			
585	Z310_184	100	14	D2			
586	Z310_185	100	43	D2			
587	Z310_186	100	40	D2			
588	Z310_187	100	64	D2			
589	Z310_188	100	34	D2			
590	Z310_189	100	29	D2			
591	Z310_190	100	134	D2			
592	Z310_191	100	165	D2			
593	Z310_192	100	237	D2	D3		
594	Z310_193	100	110	D2			
595	Z310_194	100	58	D2			
596	Z310_195	100	554	D2	E2		
597	Z310_196	100	33	D2			
598	Z310_197	100	51	D2			
599	Z310_198	100	71	D2			

ZONE 3							
No	PIPE ID	DIAMETER (mm)	LENGTH (m)	DRAWING			
600	Z310_199	100	243	E2			
601	Z310_200	100	91	E2			
602	Z310_201	100	73	E2			
603	Z310_202	100	418	D4			
604	Z310_203	100	74	E2			
605	Z315_001	150	347	E2			
606	Z315_002	150	165	E2			
607	Z315_003	150	38	E2			
608	Z315_004	150	33	E2			
609	Z315_005	150	101	E2			
610	Z315_006	150	51	E2			
611	Z315_007	150	45	E2			
612	Z315_008	150	22	E2			
613	Z315_009	150	234	E2			
614	Z315_010	150	250	E2	E3		
615	Z315_011	150	320	E3			
616	Z315_012	150	86	E3			
617	Z315_013	150	128	E3			
618	Z315_014	150	115	E3			
619	Z315_015	150	363	E3			
620	Z315_016	150	83	E3			
621	Z315_017	150	172	E3			
622	Z315_018	150	7	E3			
623	Z315_019	150	122	E3			
624	Z315_020	150	158	D3	E3		
625	Z315_021	150	8	D3			
626	Z315_022	150	118	D3			
627	Z315_023	150	87	D3			
628	Z315_024	150	79	D3			
629	Z315_025	150	17	D3			
630	Z315_026	150	89	D3			
631	Z315_027	150	15	D3			
632	Z315_028	150	46	D3			
633	Z315_029	150	27	D3			
634	Z315_030	150	21	D3			
635	Z315_031	150	131	D3			
636	Z315_032	150	73	D3			
637	Z315_033	150	17	D3			
638	Z315_034	150	126	D3			
639	Z315_035	150	275	D3			
640	Z315_036	150	10	D4			
641	Z315_037	150	48	D4			
642	Z315_038	150	168	D3			
643	Z315_039	150	206	D3			
644	Z315_040	150	437	D2	D3		
645	Z315_041	150	69	D2			
646	Z315_042	150	46	D2			
647	Z315_043	150	63	D2			
648	Z315_044	150	52	D2			
649	Z315_045	150	57	D2			

ZONE 3							
No	PIPE ID	DIAMETER (mm)	LENGTH (m)	DRAWING			
650	Z315_046	150	79	D2			
651	Z315_047	150	123	D2			
652	Z315_048	150	55	D2			
653	Z315_049	150	39	D2			
654	Z315_050	150	485	D2			
655	Z315_051	150	202	D1	D2		
656	Z315_052	150	653	D1	E1		
657	Z315_053	150	253	D2	D3		
658	Z315_054	150	46	D3			
659	Z315_055	150	44	D3			
660	Z315_056	150	43	D3			
661	Z315_057	150	27	D3			
662	Z315_058	150	18	D3			
663	Z315_059	150	45	D3			
664	Z315_060	150	225	D3			
665	Z315_061	150	14	D3			
666	Z320_001	200	15	D4			
667	Z320_002	200	189	D4			
668	Z320_003	200	150	D4			
669	Z320_004	200	629	E3			
670	Z320_005	200	154	E2			
671	Z320_006	200	49	E2			
672	Z320_007	200	30	E2			
673	Z320_008	200	71	E2			
674	Z320_009	200	66	E2			
675	Z320_010	200	34	E2			
676	Z320_011	200	152	E2			
677	Z320_012	200	319	E2			
678	Z320_013	200	51	E1			
679	Z320_014	200	226	E1			
680	Z320_015	200	48	F2			
681	Z320_016	200	56	F2			
682	Z320_017	200	110	F2			
683	Z320_018	200	78	F1			
684	Z320_019	200	87	F1			
685	Z320_020	200	19	F1			
686	Z320_021	200	72	F1			
687	Z320_022	200	123	F1			
688	Z320_023	200	47	F1			
689	Z320_024	200	376	F1			
690	Z320_025	200	63	F1			
691	Z320_026	200	148	F1			
692	Z320_027	200	96	F1			
693	Z320_028	200	113	F1			
694	Z320_029	200	52	F1			
695	Z320_030	200	229	F1			
696	Z320_031	200	116	F1			
697	Z320_032	200	168	F1			
698	Z320_033	200	219	F1			
699	Z320_034	200	72	F1			

ZONE 3							
No	PIPE ID	DIAMETER (mm)	LENGTH (m)	DRAWING			
700	Z320_035	200	195	F1			
701	Z320_036	200	29	F1			
702	Z320_037	200	48	F1			
703	Z320_038	200	94	F1			
704	Z320_039	200	45	F1	G1		
705	Z320_040	200	52	G1			
706	Z320_041	200	64	G1			
707	Z320_042	200	138	F1			
708	Z320_043	200	181	F1			
709	Z320_044	200	520	F1			
710	Z320_045	200	162	F2			
711	Z320_046	200	34	F2			
712	Z320_047	200	45	F2			
713	Z320_048	200	32	F2			
714	Z325_001	250	251	F2			
715	Z325_002	250	178	F2			
716	Z325_003	250	332	F2			
717	Z325_004	250	305	E2	F2		
718	Z325_005	250	223	E3			
719	Z325_006	250	145	E3			
720	Z325_007	250	362	E3			
721	Z325_008	250	208	E3			
722	Z325_009	250	133	E3			
723	Z325_010	250	30	E3			
724	Z325_011	250	279	E3			
725	Z325_012	250	33	E3			
726	Z325_013	250	80	E3	E4		
727	Z325_014	250	219	E4			
728	Z325_015	250	22	E4			
729	Z325_016	250	265	D4	E4		
730	Z325_017	250	171	D4			
731	Z325_018	250	96	D4			
732	Z325_019	250	111	D4			
733	Z325_020	250	22	D4			

ZONE 4					
No	PIPE ID	DIAMETER (mm)	LENGTH (m)	DRAWING	
1	Z405_001	50	298	E3	
2	Z405_002	50	390	E3	
3	Z405_003	50	123	E4	
4	Z405_004	50	512	E4	
5	Z407_001	75	1,217	E3	
6	Z407_002	75	256	E4	
7	Z407_003	75	121	E4	
8	Z407_004	75	68	F2	
9	Z407_005	75	121	F2	
10	Z407_006	75	116	F2	
11	Z407_007	75	25	F2	
12	Z407_008	75	116	F2	
13	Z407_009	75	316	F2	
14	Z407_010	75	212	F2	
15	Z407_011	75	198	F2	
16	Z407_012	75	138	F2	
17	Z407_013	75	120	F2	
18	Z407_014	75	434	F2	
19	Z407_015	75	199	F2	
20	Z407_016	75	214	F2	
21	Z407_017	75	229	F2	
22	Z407_018	75	187	F2	
23	Z407_019	75	140	F2	
24	Z407_020	75	126	F2	
25	Z407_021	75	83	F2	
26	Z407_022	75	142	F2	
27	Z410_001	100	869	D4	
28	Z410_002	100	282	E4	
29	Z410_003	100	117	E4	
30	Z410_037	100	211	E4	
31	Z410_004	100	98	E4	
32	Z410_005	100	41	E4	
33	Z410_006	100	265	E3	
34	Z410_007	100	153	E3	
35	Z410_008	100	301	E4	
36	Z410_009	100	279	E3	
37	Z410_010	100	310	F2	F3
38	Z410_011	100	169	F2	
39	Z410_012	100	221	F2	
40	Z410_013	100	144	F2	
41	Z410_014	100	309	F2	
42	Z410_015	100	223	F2	
43	Z410_016	100	375	F2	
44	Z410_017	100	55	F2	
45	Z410_018	100	51	F2	
46	Z410_019	100	218	F2	
47	Z410_020	100	101	F2	
48	Z410_021	100	35	F2	
49	Z410_022	100	73	F2	
50	Z410_023	100	119	F2	

ZONE 4					
No	PIPE ID	DIAMETER (mm)	LENGTH (m)	DRAWING	
51	Z410_024	100	139	F2	
52	Z410_025	100	280	F2	
53	Z410_026	100	70	F2	
54	Z410_038	100	242	F2	
55	Z410_027	100	46	F2	
56	Z410_028	100	243	F2	
57	Z410_029	100	61	F2	
58	Z410_030	100	167	F2	
59	Z410_031	100	251	F2	
60	Z410_032	100	165	F2	
61	Z410_033	100	514	F2	G2
62	Z410_034	100	507	F2	G2
63	Z410_035	100	547	F4	
64	Z410_036	100	314	F4	
65	Z415_001	150	157	E4	
66	Z415_002	150	254	E4	
67	Z415_003	150	365	E4	
68	Z415_004	150	58	E4	
69	Z415_005	150	209	E4	
70	Z415_006	150	98	E4	
71	Z415_007	150	526	E4	
72	Z415_008	150	642	E4	
73	Z415_009	150	569	F4	
74	Z415_010	150	1,911	F3	F4
75	Z415_011	150	415	F4	
76	Z415_012	150	1,105	F3	
77	Z415_013	150	590	F3	F4
78	Z415_014	150	626	G4	
79	Z415_015	150	23	G4	
80	Z415_016	150	1,329	F4	
81	Z415_017	150	603	F3	F4
82	Z420_001	200	1,617	F4	G4
83	Z420_002	200	313	F3	
84	Z420_003	200	217	F3	
85	Z420_004	200	913	F3	
86	Z420_005	200	582	F3	
87	Z420_006	200	814	G2	G3
88	Z420_007	200	398	G2	
89	Z420_008	200	674	G1	G2
90	Z420_009	200	288	F2	F3
91	Z420_010	200	89	F2	
92	Z420_011	200	55	F2	
93	Z420_012	200	59	F2	
94	Z420_013	200	73	F2	
95	Z420_014	200	130	F2	
96	Z420_015	200	49	F2	
97	Z420_016	200	56	F2	
98	Z420_017	200	69	F2	
99	Z420_018	200	122	F2	
100	Z420_019	200	109	F2	
101	Z420_020	200	48	F2	
102	Z420_021	200	53	F2	
103	Z420_022	200	53	F2	
104	Z420_023	200	114	F2	
105	Z420_024	200	104	G2	
106	Z425_001	250	1,312	E4	F4

ZONE	GATE VALVE	UNIT	ID	DRAWING
1	150	1	GV15_03	C6
	300	3	GV30_01	C8
			GV30_02	D4
			GV30_03	D4
2	100	6	GV10_02	B3
			GV10_03	B7
			GV10_04	B7
			GV10_05	C5
			GV10_06	C6
			GV10_07	C6
	150	3	GV15_01	C4
			GV15_02	C5
			GV15_03	D5
	200	2	GV20_01	D4
			GV20_02	D4
3	150	3	GV15_05	E4
			GV15_06	E3
			GV15_07	F2
	200	2	GV20_04	F2
			GV20_05	F2
	250	2	GV25_01	E3
			GV25_02	E3
4	100	2	GV10_01	A4
			GV10_08	D4
	200	2	GV20_06	G1
			GV20_03	D5
	250	1	GV25_03	E4
	300	1	GV30_04	E4

ZONE	AIR VALVE	UNIT	ID	DRAWING
1	100	1	AV10_02	D7
	250	1	AV25_01	C8
	300	13	AV30_01	D8
			AV30_02	D8
			AV30_03	D8
			AV30_04	D8
			AV30_05	D8
			AV30_06	D8
			AV30_07	D8
			AV30_08	F9
			AV30_09	F9
			AV30_10	F9
			AV30_11	E9
			AV30_12	E8
			AV30_13	E8
2	100	1	AV10_01	B5
	150	3	AV15_01	B5
			AV15_02	C3
			AV15_03	C3
	200	2	AV20_01	C4
			AV20_02	C5
3	150	1	AV15_04	D1
	200	2	AV20_03	E2
			AV20_05	F1
	250	3	AV25_02	E2
			AV25_03	E3
			AV25_04	E3
4	150	2	AV15_05	F4
			AV15_06	F2
	200	1	AV20_04	G2
	250	1	AV25_05	E4

ZONE	WATER METER	UNIT	ID	DRAWING
1	150	1	WM15_01	C6
	300	1	WM30_01	C8
2	100	1	WM10_01	C5
	300	2	WM30_03	D4
			WM30_04	D4
3	150	1	WM15_03	F2
4	100	1	WM10_02	C6
	150	1	WM15_02	E4
	200	2	WM20_01	F2
			WM20_02	G1
	250	1	WM25_01	E4
	300	2	WM30_02	D4
			WM30_05	E4

ZONE	WASH OUT VALVE	UNIT	ID	DRAWING
1	250	1	WV25_01	C8
	300	3	WV30_01	D8
			WV30_02	F9
			WV30_03	F9
2	150	1	WV15_01	C3
	200	1	WV20_01	C5
3	250	1	WV25_02	E2

ZONE	FIRE HYDRANT	UNIT	ID	DRAWING
1	150	1	FH03	C7
	200	2	FH08	E5
			FH09	D5
2	150	1	FH05	C6
	150	1	FH10	D4
	200	1	FH07	C4
3	150	1	FH04	D3
	250	1	FH01	F2
4	200	1	FH06	G4
	250	1	FH02	E4

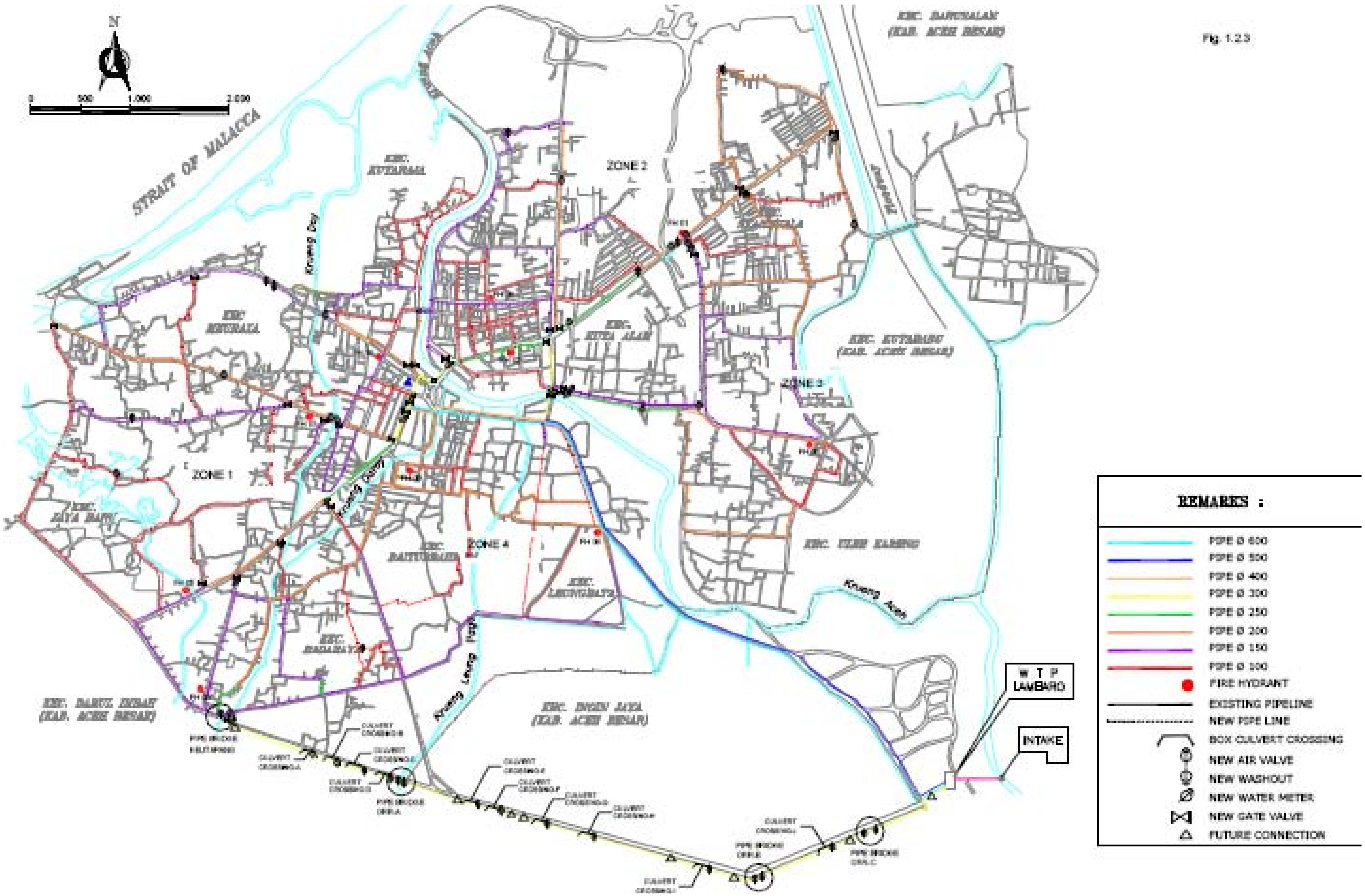

Figure 1.2.3 Water Supply Distribution Network Plan

(a) Pipe materials

Pipe materials are selected through technical discussion between the JICA Study Team, PU and PDAM and in due consideration of strength, durability and easiness in installation and transportation. It is proposed to use Ductile Iron Pipe (DIP) for pies with a diameter of 400 and more, and High Density Polyethylene Pipe (HDEP) for the others.

(b) Fire hydrant

Ten (10) fire hydrants are proposed to be installed by the Project at the locations shown in Figure 1.2.3. The location is determined based on consultation to PDAM, Dinas PU and Department of Fire Fighting, and take into account population density, land use condition, administrative services, etc.

(c) Public stand pipe

It is proposed to install 33 public stand pipes by the Project, especially in most affected three (3) Kecamatan: Baru Jaya, Muaraxa and Ulee. A large portion of lands in these areas are still under water and no land restoration works are yet taken, though temporary housing construction has been taken place at many locations. In order to expedite return of internally dislocated people from their temporary shelters, it is considered to be matter of importance to extend safe pipe water service. There are a number of villages in such areas but the public stand pipe is determined to be installed at a rate of one location per 355 inhabitants. As a result, the number and location of public stand pipe are as follows:

Table 1.2.8 Distribution of Public Stand Pipe

Kecamatan	Desa	Unit
1. Meraxa	except desa Punge Jurong	15 (one per desa)
2. Kuta Raja	Gumpong Jawa	4
	Gumpong Pande	1
	Peulanggahan	3
	Kedua	2
3. Jaya Baru	Lampoh Daya	1
	Lamjamee	1
	Bitai	1
	Ulee Patah	1
	Geuceu Menara	1
4. Syiah Kuala	Tibang	3
TOTAL		**33**

(3) Network Analysis for Proposed Restoration

A trial and error method is carried out to identify the optimal network in terms of hydraulic behavior and restoration cost. The hydraulic calculation was conducted by using a computer software ESPANET-2. The design discharge is the same as that applied for the hydraulic analysis of the pr-disaster disaster network. The results of calculation are as shown in Table 1.2.9.

A schematic distribution network of the optimum plan is as shown in Figure 1.2.4, which also indicates the residual water pressure.

1.2.5 Design of Pipe Laying Works and Valve Chambers

(1) Pipe Laying Works

Pipe laying works basically follows the PDAM design standards. In principle, the pipe is designed to be buried within the right of way of existing road, and characterized by types of backfilling of trench there are two (2) types in installation as shown in Figure 1.2.5. Minimum coverage of backfill is determined to be 60cm above crown of the pipes.

Pipes are designed to be laid in trench and backfilled with selected material. Where there is pavement, such pavement is to be reinstated with the same materials as existing after backfilling of the trench.

Where the pipes are located within a road carriage both longitudinal and crossing directions, they are designed to be protected by surrounding concrete.

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* Table 1.2.9 *

Hydraulic Analysis of Proposed Restoration Network

* Version 2.0 *

****

Link - Node Table:

Link ID	Start Node	End Node	Length m	Diameter mm
1	1	5	5,908	500
2	5	4	145	400
3	122	1	6,546	600
4	130	131	302	100
5	55	130	971	200
6	5	6	191	400
7	4	60	1,260	400
8	3	60	262	600
9	3	61	610	200
10	61	62	466	200
11	61	58	341	100
12	58	59	100	100
13	59	56	216	100
14	58	57	256	100
15	62	57	572	200
16	57	56	146	200
17	62	68	837	200
18	56	55	705	200
19	124	55	300	200
20	63	131	200	200
20b	65	131	341	200
21	63	64	1,094	100
22	65	64	1,736	150
23	64	66	1,642	150
24	66	67	369	150

Node Results:

Node ID	Demand LPS	Pressure m
1	-509.88	Reservoir
3	2.87	41.97
4	3.00	40.00
5	2.28	40.01
6	9.38	39.01
7	2.87	36.65
8	5.48	24.90
9	4.18	24.65
10	4.18	25.62
11	1.58	24.80
12	4.18	24.68
13	4.62	25.57
14	4.62	28.42
15	4.62	26.43
16	4.62	33.81
17	4.62	33.90
18	4.62	34.23
19	4.62	33.43
20	4.62	33.23
21	4.62	34.97
22	4.62	25.65
23	4.62	34.95
24	4.18	35.37
25	2.09	36.27
26	2.08	33.63

Link Results:

Link ID	Velocity m/s
1	0.90
2	0.17
3	0.91
4	0.14
5	0.30
6	1.22
7	0.14
8	0.70
9	1.40
10	1.13
11	0.73
12	0.38
13	0.94
14	0.75
15	0.53
16	0.62
17	0.49
18	0.77
19	0.37
20	0.16
20b	0.12
21	0.12
22	0.10
23	0.03
24	0.32

25	67	68	997	150
26	67	69	664	100
27	60	83	380	300
28	83	77	949	250
29	83	84	216	200
30	84	88	185	200
31	88	85	181	200
32	84	121	400	100
33	85	86	985	150
34	85	87	72	200
35	87	89	88	200
36	89	93	223	200
37	93	92	183	200
38	86	93	738	100
39	92	91	204	150
40	88	87	1,536	150
41	89	90	467	150
42	90	111	420	100
43	111	91	946	100
44	68	77	635	100
45	6	7	78	250
46	7	19	520	300
47	7	128	1,542	150
48	7	48	1,301	250
49	48	40	243	200
50	40	41	332	150
51	41	42	978	200
52	41	43	1,004	100
53	43	45	502	100
54	45	42	502	100
55	48	43	2,775	200
56	47	125	514	150
57	113	46	6	150
58	47	39	1,741	150
59	39	38	1,026	150
60	38	125	1,168	150
61	36	39	274	200

27	2.30	37.67	
28	4.18	27.97	
29	4.18	23.68	
30	4.18	29.34	
31	4.17	29.02	
32	4.18	28.49	
33	4.17	27.92	
34	4.17	28.79	
35	3.00	23.36	
36	4.21	22.70	
37	1.76	25.52	
38	4.19	22.91	
39	4.99	22.62	
40	5.86	33.97	
41	4.71	32.21	
42	1.35	31.71	
43	5.52	30.13	
44	4.40	30.73	
45	4.07	30.65	
46	0.00	33.81	
47	4.64	22.13	
48	4.67	34.70	
49	4.20	25.25	
50	4.20	30.77	
51	2.20	28.91	
52	5.38	27.58	
53	4.69	25.32	
54	1.50	25.65	
55	2.87	19.63	
56	2.87	24.34	
57	2.87	25.08	
58	2.87	28.03	
59	1.43	28.44	
60	3.66	41.65	
61	2.87	31.84	
62	3.66	24.63	
63	2.87	17.80	

25	0.59
26	0.23
27	1.36
28	0.98
29	1.41
30	1.23
31	0.98
32	0.42
33	0.33
34	1.02
35	1.05
36	0.62
37	0.60
38	0.49
39	0.56
40	0.31
41	0.49
42	0.52
43	0.27
44	1.05
45	2.93
46	1.41
47	0.47
48	0.62
49	0.54
50	0.63
51	0.22
52	0.06
53	0.36
54	0.26
55	0.28
56	0.13
57	1.49
58	0.14
59	0.14
60	0.20
61	0.15

62	36	35	1,099	200
63	38	35	616	200
64	52	128	1,818	150
65	19	30	1,154	250
66	30	32	246	250
67	32	52	307	250
68	30	31	70	100
69	31	50	994	100
70	19	50	448	200
71	50	28	497	200
72	19	20	41	250
73	20	16	346	250
74	20	49	517	150
75	49	8	145	150
76	8	9	142	100
77	9	10	502	100
78	8	11	506	150
79	11	12	165	150
80	12	107	143	150
81	107	108	618	150
82	107	22	269	100
83	12	13	252	100
84	11	10	199	100
85	10	13	174	100
86	13	22	168	100
87	22	21	369	100
88	14	16	461	100
89	14	17	230	100
90	15	18	239	100
91	16	17	238	250
92	17	18	162	250
93	18	21	173	250
94	21	23	183	300
95	23	24	181	300
96	21	7	1,119	100
97	23	105	992	150
98	24	25	231	300

64	2.08	19.74	
65	2.08	17.68	
66	2.87	20.05	
67	2.87	20.62	
68	2.87	25.15	
69	7.25	19.85	
70	9.84	19.95	
71	10.35	19.96	
72	10.35	20.34	
73	10.35	22.54	
74	10.35	22.78	
75	10.35	23.30	
76	2.08	38.02	
77	4.35	31.30	
78	4.22	29.48	
79	7.25	24.41	
80	3.22	26.12	
81	2.11	26.13	
82	5.02	23.94	
83	4.22	37.68	
84	2.30	34.08	
85	4.61	30.13	
86	2.30	31.78	
87	4.61	29.42	
88	2.30	31.90	
89	4.61	28.68	
90	4.61	27.01	
91	3.61	26.16	
92	4.61	27.05	
93	4.61	27.74	
94	3.02	23.46	
95	2.41	27.28	
96	2.41	26.02	
97	2.09	43.48	
98	2.41	28.47	
99	2.41	27.06	
100	2.41	27.34	

62	0.29
63	0.33
64	0.47
65	0.81
66	0.69
67	0.56
68	0.21
69	0.32
70	0.86
71	0.64
72	0.58
73	0.07
74	1.15
75	0.58
76	0.27
77	0.26
78	0.15
79	0.22
80	0.15
81	0.07
82	0.40
83	0.38
84	0.41
85	0.10
86	0.15
87	1.14
88	0.77
89	1.12
90	1.31
91	0.15
92	0.42
93	0.73
94	0.66
95	0.77
96	0.31
97	0.18
98	0.83

99	25	26	364	200
100	76	26	293	150
101	26	103	370	100
102	103	104	111	100
103	104	105	100	100
104	25	105	684	200
105	105	106	220	200
106	101	26	590	200
107	101	102	106	100
108	102	103	611	100
109	106	127	255	150
109b	102	127	764	150
110	15	13	78	100
111	14	10	87	100
112	52	53	757	250
113	35	53	1,261	200
114	53	37	1,091	200
115	35	37	1,980	200
116	33	34	556	100
117	34	28	594	150
118	28	51	1,163	200
119	11	109	589	100
120	107	108	601	100
121	49	29	517	150
122	29	109	650	150
123	109	110	413	150
124	110	118	1,267	150
125	66	69	443	150
126	69	71	385	150
127	71	113	1,100	150
128	129	114	121	150
129	114	115	1,156	150
130	114	79	1,206	150
131	79	80	237	150
132	126	81	528	150
132b	115	126	264	150
133	81	82	780	100

101	4.72	32.61
102	4.18	32.66
103	4.18	33.17
104	4.72	33.22
105	4.72	34.89
106	4.17	34.67
107	4.18	24.74
108	4.13	24.65
109	1.57	23.48
110	4.18	25.60
111	4.61	24.46
112	10.35	29.45
113	8.19	30.70
114	7.74	29.09
115	3.14	27.45
116	3.91	27.45
117	3.14	26.25
118	1.83	25.62
119	0.32	38.79
120	2.30	37.79
121	2.00	37.71
122	1.43	46.43
123	2.28	23.16
124	1.30	23.91
125	1.35	25.72
126	3.51	30.24
127	0.00	38.84
128	0.00	37.16
129	0.00	33.65
130	10.06	23.39
131	0.00	23.55

99	0.89
100	0.54
101	0.36
102	0.12
103	0.72
104	0.55
105	0.31
106	0.43
107	0.14
108	0.05
109	0.27
109b	0.32
110	0.73
111	1.30
112	0.62
113	0.43
114	0.24
115	0.28
116	0.22
117	0.33
118	0.32
119	0.07
120	0.05
121	0.33
122	0.10
123	0.04
124	0.34
125	0.20
126	0.11
127	0.88
128	1.08
129	0.31
130	0.33
131	0.68
132	0.31
132b	0.07
133	0.35

134	79	75	404	150
135	71	70	151	250
136	70	72	1,071	150
137	72	73	191	150
138	68	73	872	200
139	73	74	101	200
140	74	75	104	200
141	74	78	623	100
142	112	129	391	250
143	112	75	982	200
144	94	126	357	100
145	77	78	625	250
146	78	80	495	200
147	80	81	378	200
148	111	82	984	100
149	82	94	212	100
150	94	117	1,887	100
151	115	117	2,282	100
152	91	96	378	150
153	116	96	1,429	150
154	113	129	40	150
155	117	116	510	100
156	92	95	1,151	200
157	95	99	802	200
158	99	100	599	200
159	96	95	613	100
160	116	100	919	100
161	101	98	1,564	150
162	98	99	1,441	150
163	95	98	999	100
164	42	44	201	100
165	44	45	400	100
166	32	33	131	100
167	110	108	445	150
168	97	25	300	300
169	51	118	655	150
170	37	54	335	200

134	0.60
135	0.06
136	0.38
137	0.96
138	0.33
139	0.55
140	0.70
141	0.72
142	0.65
143	0.69
144	0.41
145	0.72
146	0.81
147	0.33
148	0.21
149	0.09
150	0.06
151	0.14
152	0.24
153	0.23
154	0.15
155	0.31
156	0.14
157	0.04
158	0.15
159	0.29
160	0.29
161	0.56
162	0.32
163	0.23
164	0.46
165	0.10
166	0.31
167	0.14
168	1.50
169	0.44
170	0.09

171	1	46	6,968	300
172	86	27	300	150
173	27	76	123	150
174	60	97	198	300
175	76	119	234	100
176	119	97	220	100
177	86	121	332	100
178	121	120	225	100
179	120	119	200	100
180	27	120	234	100
181	59	122	557	100
182	106	127	902	100
183	122	3	500	600
184	123	130	1,316	100
185	123	124	1,074	100
186	63	124	368	200
187	54	53	2,799	200
188	46	129	40	250

171	1.06
172	0.54
173	0.59
174	1.65
175	0.38
176	1.04
177	0.31
178	0.15
179	0.62
180	0.18
181	1.51
182	0.11
183	0.87
184	0.08
185	0.21
186	0.28
187	0.14
188	0.99

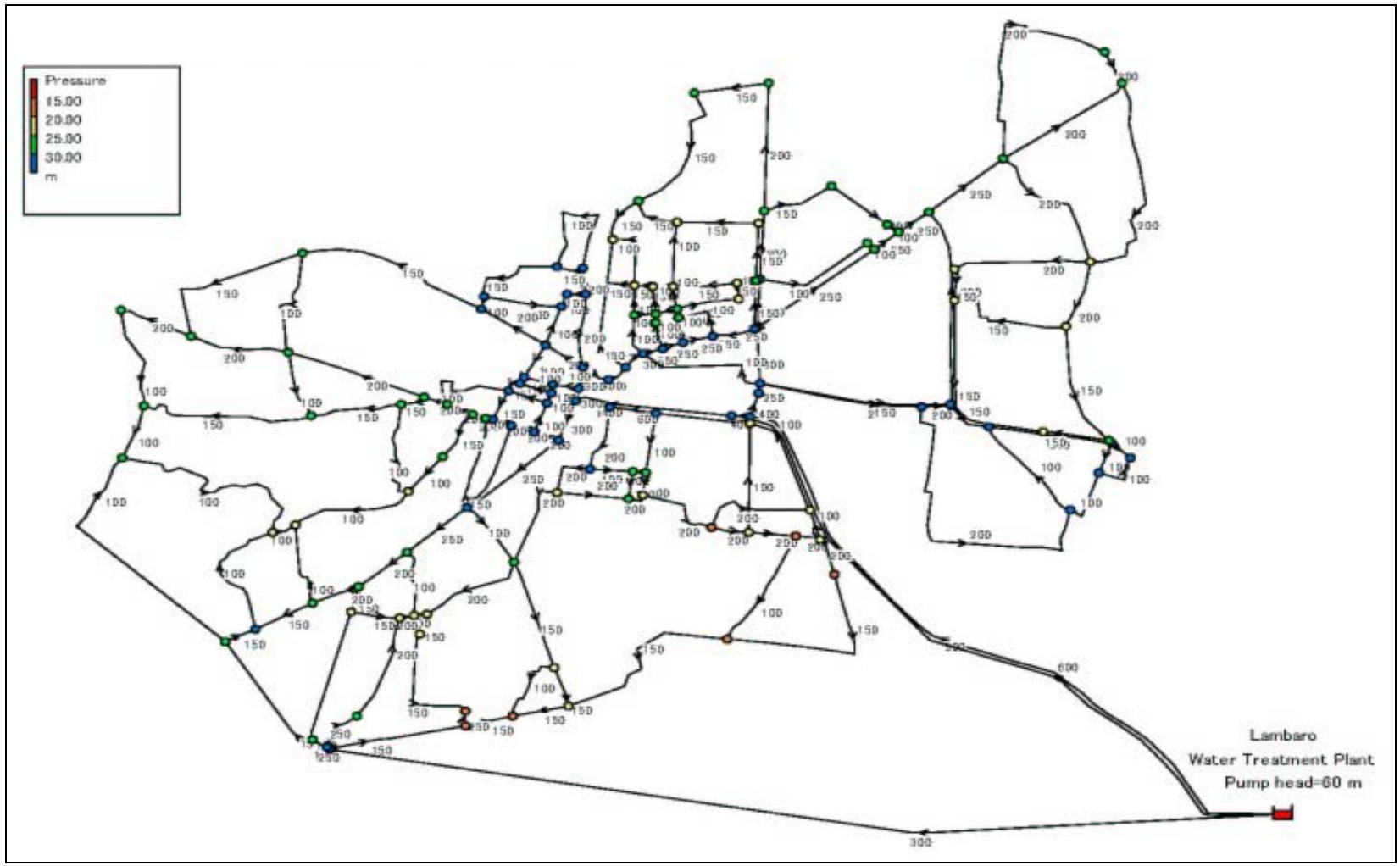
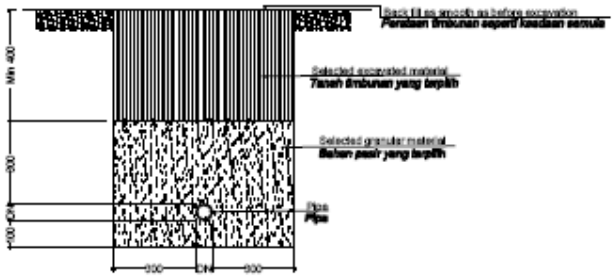


Figure 1.2.4 Result of Hydraulic Analysis, Proposed Restoration Network



Type I (Beneath Road Shoulder)
Tipe I (Dibawah Bahu Jalan)

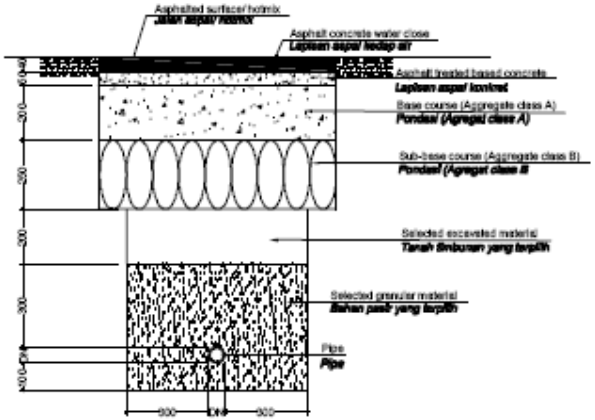
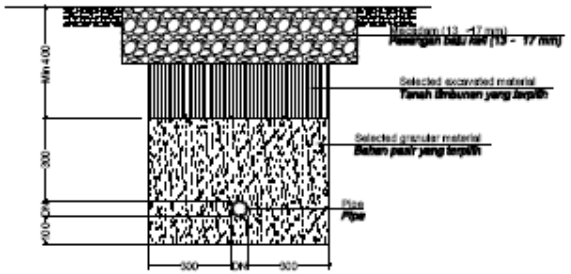
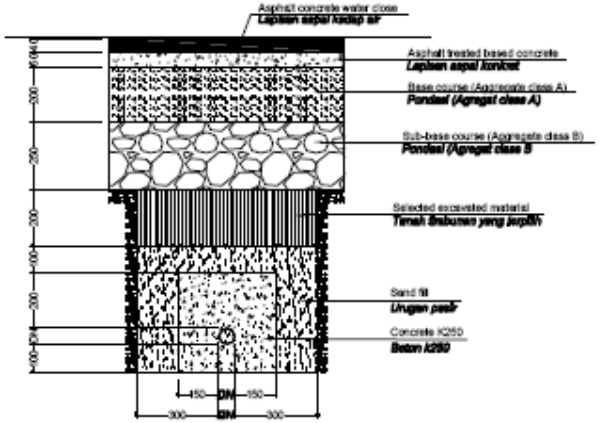


Fig. 1.2.4

Type II (Beneath Asphalt Pavement)
Tipe II (Dibawah Jalan Aspal)



Type III (Beneath Macadam Pavement)
Tipe III (Dibawah Jalan Kerikil)



Type IV (Road Crossing)
Tipe IV (Penyeberangan Jalan)

Figure 1.2.5 Pipe Laying

(2) Valve Chambers

Pipelines associate with 31 air valves, 28 section valves, and 7 washouts as shown in Table 1.2.10.

Table 1.2.10 List of Valves

Valves	Diameter	Zone 1	Zone 2	Zone 3	Zone 4	Total
Gate valve	300	3	-	-	1	4
	250	-	-	2	1	3
	200	-	2	2	2	6
	150	1	3	3	-	7
	100	-	6	-	2	8
Air valve	300	13	-	-	-	13
	250	1	-	3	1	5
	200	-	2	2	1	5
	150	-	3	1	2	6
	100	1	1	-	-	2
Wash-out	300	3	-	-	-	3
	250	1	-	1	-	2
	200	-	1	-	-	1
	150	-	1	-	-	1
	100	-	-	-	-	-
Water meter	300	1	2	-	2	5
	250	-	-	-	1	1
	200	-	-	-	2	2
	150	1	-	1	1	3
	100	-	1	-	1	2

① Air valves

There two (2) types of air valves: one is a single vent and the other is double vents. The air valves are designed to be installed in concrete chambers excepting pipe bridges sites. The design of the chamber is as shown in Figure 1.2.6.

② Section valves

The section valves are to be sited at 28 locations, and their locations are determined in conjunction with zoning of the network. All the valves are to be encased in concrete chamber of which design is shown in the Figure 1.2.7.

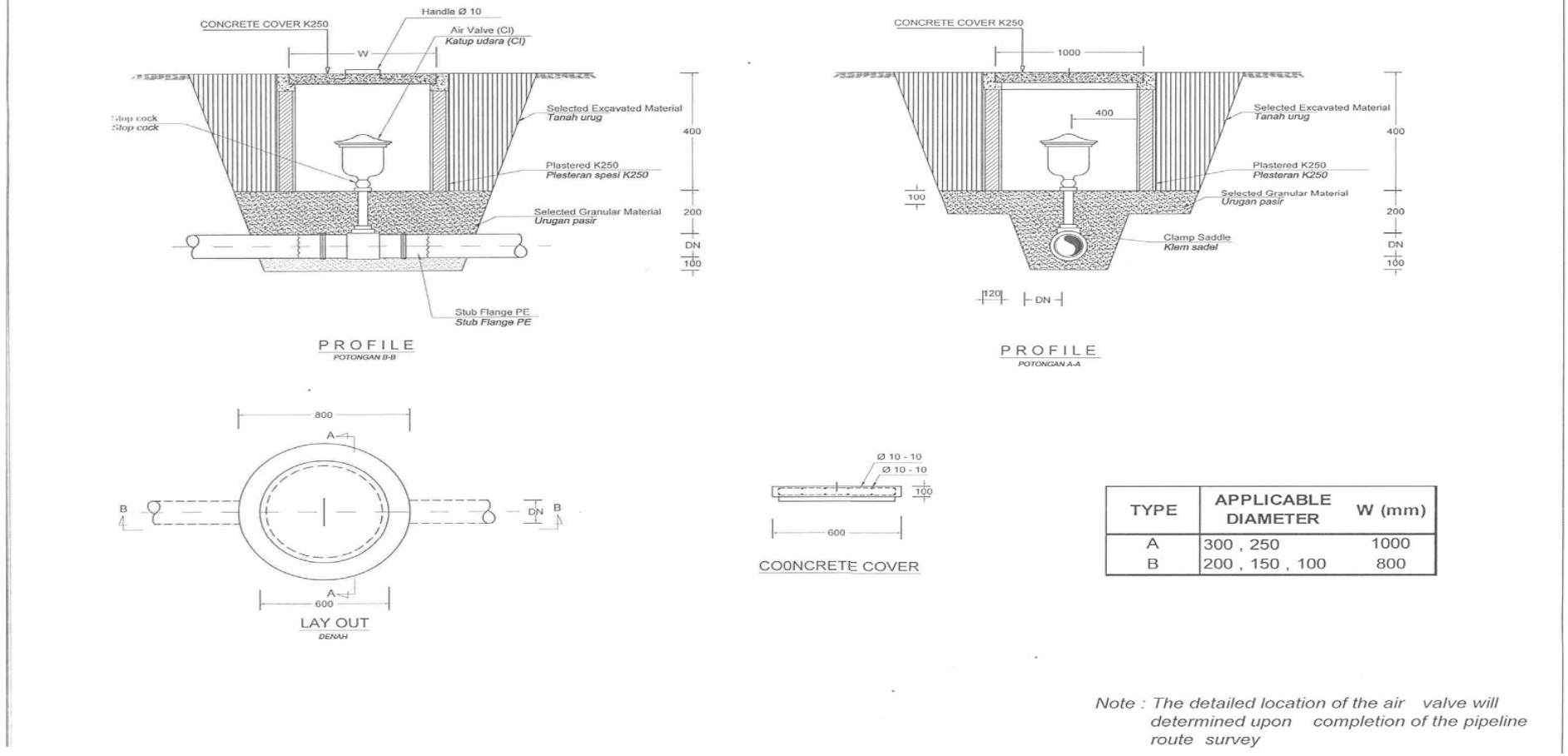


Figure 1.2.6 Air Valve Chamber

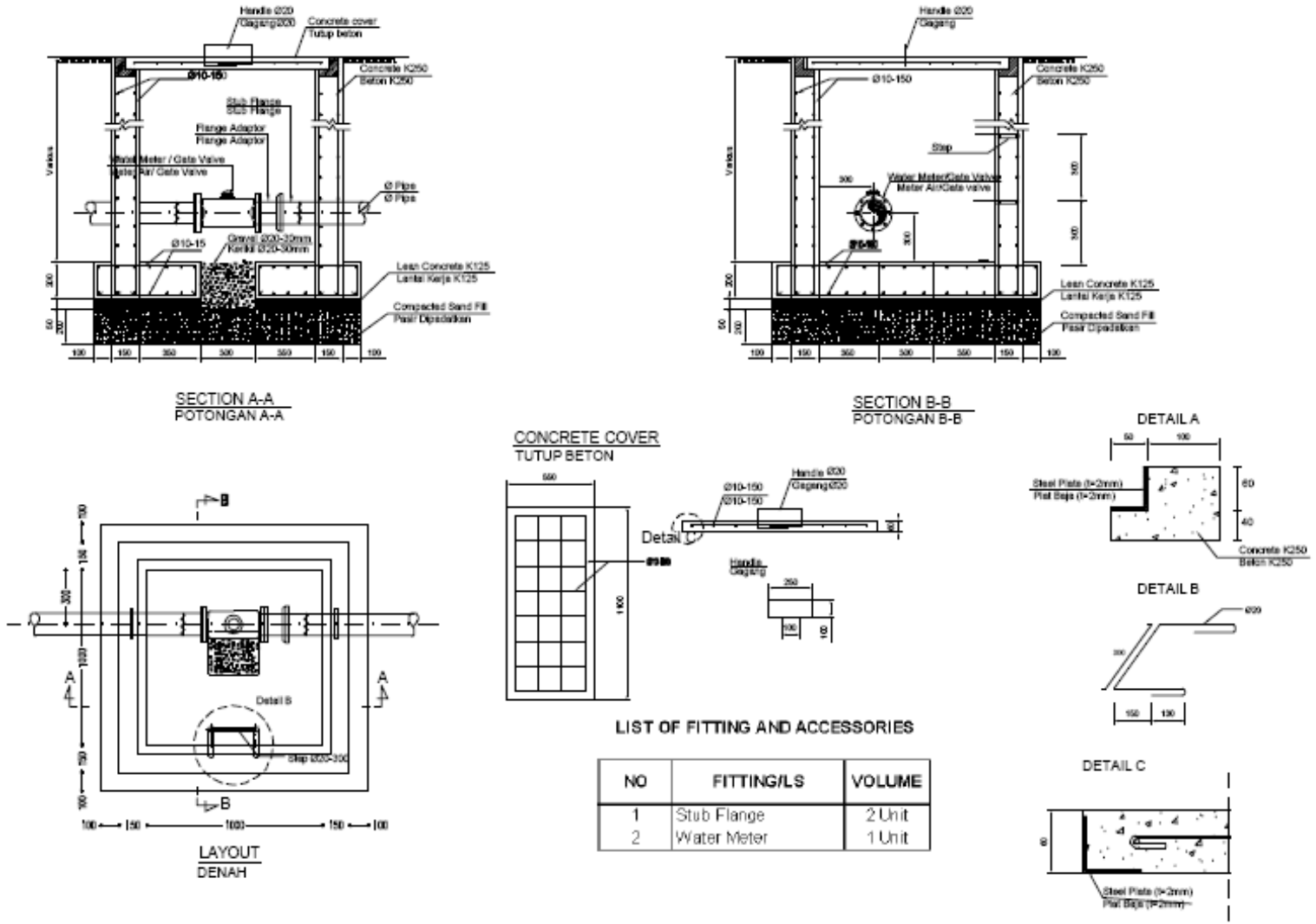


Figure 1.2.7 Standard Gate Valve and Water Meter Chamber