4. PLAN FORMULATION

4.1 Basic Concepts for the Formulations of Plans

The study consists of three major tasks. These are 1) formulate the plan for the DMA system to enhance leakage detection efforts in the distribution systems of Damascus City, 2) formulate the development plan for the distribution network in the Mezze-Razy & Kafar Souseh-Lawan informal area, 3) formulate the organizational and management improvement plan for the automation and integration of financial management functions.

Taking into account the above mentioned basic tasks, the basic concepts for the formulations of plans area as follows:

(1) Plan for the DMA System

a) To establish the DMA system as a countermeasure to alleviate water shortage problems,
b) To consider the analysis of distribution networks extended into informal areas,
c) To establish the DMA system that is easy to maintain and simple to operate,
d) To divide the distribution system into appropriate blocks based on the character and size of the service area,
e) To minimize the number of inflow and outflow points for each block,
f) To obtain data on minimum night flows and water pressure distribution in the network,
g) To evaluate the proposed DMA plan for reliability of supply, maintainability, efficiency, economic viability and impartiality,
h) To install the flow meters on those loop mains where flow is sufficiently high in order to avoid the difficulty of installing sectional valves,
i) To coordinate with the new Supervisory Control and Data Acquisition (SCADA) system and,
j) To select a pilot area among the proposed blocks for the purpose of demonstrating flow rate monitoring with ultrasonic flow meters.

(2) Development Plan for the Distribution Network in the Mezze-Razy & Kafar Souseh-Lawan

a) To review the results of the interview survey and grasp the water needs,
b) To grasp the present status of the urban development plan and normalization of informal residential areas in Damascus city, and to confirm the intention of City officials for the Mezze-Razy & Kafar Souseh-Lawan area,
c) To employ the DMA system in designing the water supply system,
d) To establish the development plan as an extension of DAWSSA's water supply system, and to consider the implications to the SCADA system, and
e) To appraise the financial impact on DAWSSA and affordability to consumers for the determination of project scale.

(3) Improvement Plan on Financial Management Functions

a) To improve the water charge collecting system by structuring a computerized database to manage metering data and customer accounts.
b) To develop a strategy for the automation of the billing, customer accounting and financial management information systems and,
c) To prepare the recommendation plans on organizational changes, manpower and training required to support automation and provide greater integration of DAWSSA's financial management functions.

4.2 DMA Planning

4.2.1 General

This section describes results of the study on a DMA planning taking into consideration not only management of the distribution network but also leakage control from the viewpoint of securing the efficient and simple control of transmission and distribution systems in the City.

The objectives of the study are to:

i) Identify the present conditions of the distribution systems,
ii) Analyze the distribution network systems,
iii) Formulate the plan for the DMA system to enhance leakage detection efforts in the distribution systems,
iv) Select a Pilot DMA for insitu test of a flow rate monitoring system.

4.2.2 Field Survey

(1) Survey areas and items

Field surveys were conducted within the existing DAWSSA water supply service areas excluding Dummar and Kassioun Mountain in the City. The area covers approximately 72 km^2 and the total length of distribution pipeline is estimated at 1,057 km.

The survey consisted of:

i) Measurement of the 11 main pipes from the 5 main service reservoirs was carried out using ultra sonic flow meters.
ii) Measurement of the portable record-type pressure gauge installed on 19 hydrants for 24 hours in succession.
iii) Meter reading and interview survey on individual reservoirs at Midan and Yarmouk
iv) Water leakage detection on the main pipes for a space of 7 km (mainly cast iron)

(2) Finding

1) Flow rate

Service reservoirs for flow measurement are illustrated in Figure 4.2.1 and flow measurement records for 11 pipelines are illustrated in Figures 4.2.2. The average daily flow rate is measured at 479,537 m^3/d while water consumption was estimated at 612,308 m^3/d

according to the M/P study. Minimum night flow is estimated at 4.34 m^3/sec from results of flow measurements.

2) Pressure

Pressure measurement points are shown in Figures 4.2.1. In this study, the existing distribution conditions were evaluated from the pressure records based on the following DAWSSA criteria:

i) High pressure zone : 50 m to 60 m
ii) Medium pressure zone : 40 m to 50 m
iii) Low pressure zone : 30 m to 40 m

The results of pressure measurement are summarized in Table 4.2.1. Water pressure higher than 6.0 kgf/cm^2 was measured at some water mains in Mouhajreen, Ruku Aldyn and Berze districts. However, in Kadam, Yarmouk, Shaghour and Jobar water pressure was less then 3.0 kgf/cm^2.

3) Residential meters and interview survey on individual storage reservoirs

The meter reading survey was carried out for six samples as shown in Table 4.2.2. Based on the survey, it is judged that the rate of the meter malfunction is more than 10 percent and the accuracy is quite low.

Daily water consumption patterns were identified from this survey. The peak of the daily water consumption occurs between 10:00 to 14:00 and 20:00 to 24:00 in case of the houses with the individual storage reservoir. In the case of the houses without the individual storage reservoir, water is used continuously with peak consumption all day. The malfunctions occur especially in case when taps are opened and closed frequently.

The results of the interview survey on individual reservoirs in the pilot area and the Mezze-Razy & Kafar Souseh-Lawan informal area are shown in Tables 4.2.3 and 4.2.4 respectively. The survey results indicate that 100% of those interviewed with individual storage reservoirs use them with no relation to the season and at least 21 % of individual reservoir users operate their reservoir everyday.

4) Leakage

The Master Plan Study estimated the average loss due to system leakage at approximately 7.0 m^3/h/km in 1995. From the results of the leakage detection survey, the leakage is mainly caused by the deteriorated lead run joints and the corrosion of cast iron. It is estimated that the frequency of leakage per unit pipe length is 3.8 leaks/km and the unit amount of leakage is 30.3 m^3/hr/km of pipe length.

4.2.3 Network Analysis

(1) General

In all but the simplest system, a network analysis is considered an essential first step for implementing the DMA system. The analysis should be also conducted for three conditions; wet season, dry season and emergency use such as a fire during dry season. The analysis in the City was created with utilization of the computer program of the name of Visual Pipeline Network Simulator.

(2) Model construction

This section describes the construction of a network model covering the existing water supply area in the City as shown in Figure 4.2.3, and input data are summarized below:

i) Pipe data (length, diameter and roughness coefficient) 937 pipe line
ii) Variable head reservoir and pumping data
iii) Node data (identification number, elevation and coordinates) 921 node
iv) Estimated population served and allocation of demand
v) Reservoir and production well. Fringe well (elevation and operation assumed head)

The total length of pipeline to be analyzed is estimated at 368 km corresponding to 35% of the total length (1,050 km) of pipeline in the study area with a diameter more than ND80 mm.

(3) Simulation results and recommended improvements

The simulation results for flow and pressure in the Wet Season case with maximum flow are presented in Figures 4.2.4 and 4.2.5. The simulations indicate that pressures in blocks D02, D09 and D10 are lower than 3.0 kgf/cm^2. The simulation results and recommendations are summarized below.

i) The average daily water supply, through the ND800 mm main that distributes water partly to D11 by the existing WALI route, is 51,276 m^3/day and the maximum velocity is 1.9 m/sec. Also, the residual Water Head around the divergent point is more than 81 m, and so a valve has to be set up to reduce the water pressure.

ii) To correct the range of water pressure between the blocks D10.4 and D10.5, a feeder pipe (ND400 mm) shall be installed from the existing water main (ND800 mm) at D10.1 up to the existing water main (ND250 mm) at D10.5.

iii) Since water pressure in D01 and D02 is partially more than 10 kgf/cm^2, pressure reduction valves with diameter of 250 mm for D01 and 400 mm for D02 are required.

iv) The water main (ND600 mm) with pipe length of 3.5 km between the water service reservoir and the Mezze service reservoir shall be replaced by a larger ND800 mm main since flow velocity is more than 5 m/s.

v) From a simulation of diffusion of nitric acid from the Production Well and Fringe Well, the result shows that there is no area with high density of nitric acid.

vi) It is also judged that residual chlorine does not significantly decrease, the longest water travel time is 11 hours in the network.

4.2.4 DMA Planning

The following scale at each block system was adopted for design criteria to plan the DMA system:

Classification	Scale
Large block system	A service zone of an individual reservoir, Total length of distribution main: 50-300 km
Medium block system	Total length of distribution main: 30-50 km
Small block system	Total length of distribution man: 10-15 km, Population served: 15,000-20,000

A DMA system is proposed, as shown in Figures 4.2.6 and 4.2.7, to be constructed to optimize water distribution and facilitate leakage control. Integration with DAWSSA's new SCADA system is taken into consideration for planning the DMA. Because the SCADA system focuses on the transmission pipes and distribution mains, the DMA system is designed in two layers. The first layer contains, transmission pipelines that connect reservoirs, and distribution mains. These are grouped as SCADA 01 block. The second layer consists of 21 large blocks which define each service area. A total of 8 large blocks among 21 large blocks were subdivided into 36 medium blocks according to administrative boundary, road, elevation and pressure stabilization determined by network analysis. The number of proposed blocks for DMA is summarized below:

Classification of Block	Number of Blocks
i) Large Block System	22
• SCADA01 of the superior district	1
• Large blocks of the distribution district without medium blocks	13
• Large blocks of the distribution district with medium blocks	8
ii) Medium Block System	36
iii) Total Number of Proposed Blocks	50

Further subdivision into smaller blocks was also examined but is not proposed, since the small block system should only be introduced after monitoring of the distribution system has been installed and sufficient data is available to evaluate the need for smaller blocks.

The priority for implementing DMA system in the proposed blocks also is evaluated from the view point of necessity of leakage control as shown in Table 4.2.5. Areas with high priority are identified as medium blocks located to the south of D10 and D11 in the Kafar Souseh district. The number of blocks by priority are summarized below:

• High priority blocks	: 10 blocks
• Medium priority blocks	: 21 blocks
• Low priority blocks	: 18 blocks

4.2.5 Selection of DMA Pilot Area

The purpose for selecting a pilot area was to demonstrate flow rate monitoring using the ultrasonic flow meters and obtain the minimum night flow data for leakage detection control.

As shown in Figure 4.2.8, Medium blocks consisting of the medium block D10.5 located in Midan district and the medium block D10.4 located in Yarmouk district in the large block D10 were selected for the following reasons:

i) Midan and Yarmouk districts have a much high population density and
ii) Flow measurement indicate that total daily flows and the flow rate in the pipeline from the western reservoir to Block D10 are very high
iii) Cast iron pipe used ratio is high
iv) Informal connection areas are dispersed widely in the districts.

4.3 DMA Pilot Area Study

4.3.1 Description of Pilot Area

The pilot area has residential and commercial land use areas. The area includes informal connection areas with population of 86,068 at Tadamon & Zaherea and 36,750 at Takadom. Average household size of this area is 8 persons/household. The statistics in the pilot areas are described as follows:

Medium Block Number	D10.6	D10.5
Name of District	Midan	Yarmouk
Area (ha)	181	227
Population	88,300	214,700
Total Population	303,000	
Water Demand (m^3/day)	37,270	65,900
Water Demand (m^3/day) for Informal Residents	0	24,560
Sub total (m^3/day)	37,270	90,460
Percentage (%)	29	71
Total Demand (m^3/day)	127,730	

4.3.2 Field Survey

(1) Flow measurement

Flow measurements in the Pilot Area were conducted 2 times from June 10 to June 15 and August 7 to August 9 at 8 measurement points.

The results of the measurements are summarized as follows:

	Wet season		Dry season	
DMA Name	D10.6	D10.5	D10.6	D10.5
Water Consumption (m^3/day)	56,865	60,382	49,839	66,315
Percentage (%)	49	51	42	58
Total (m^3/day)	117,247		116,154	

(2) Pressure measurement

A pressure measurement survey was carried out at 5 hydrants in the Pilot Area over the same period as the flow measurement using portable water pressure recorders (Figure 4.2.1). Pressure records are shown in Figure 4.3.1

The results of the pressure survey are summarized as follows:

Measurement Points		Static Elevation (m)	Water Pressure (kgf/cm^2)			Head Loss (m)
No.	EL (m)		Max.	Min.	Variable	
P5	678.00	77.50	4.0	1.8	2.2	37.5
P6	683.50	72.00	5.3	3.6	1.7	19.0
P7	686.00	69.50	5.0	2.5	2.5	19.5
P8	675.00	80.50	3.8	1.5	2.3	42.5
P9	673.50	82.00	3.5	1.0	2.5	47.0

The area belongs to the low pressure zone as classified by DAWSSA with water pressure less than 30 m.

4.3.3 Existing Network Analysis

(1) Analysis of problem

i) Problem: Water pressure in the west of Salah Al Din Al Ayoby Street (D10.5) is significantly low.

ii) Analysis: The current system is designed to provide water to this area through a ND200 mm pipe which is branched off a ND700 mm main, and also by a ND250 mm pipe that comes from D10.1 block. However, due to the demand in other areas, the ND200 mm pipe does not have sufficient capacity to supply water to this area. Likewise the supply from ND250 mm pipe is used up in D10.9 resulting in insufficient supply to D10.5 block.

(2) Recommendation

To reduce the difference in water supply capacity within D10.5, a new ND400 mm pipe shall be installed to connect the ND800 mm from the Western Reservoir to the existing ND200 mm and ND250 mm (refer to the Figure 4.3.2).

4.3.4 Minimum Night Flow and UFW

From the result of the field surveys, minimum night flow per property is estimated as shown below:

Area	Measurement minimum flow data		Population	House Hold	Minimum night flow Ltr/ Property/ Hr	Used replenish to tank		
						Number of house	Consumption	
	m^3/sec	m^3/hr					m^3/hr	%
Measurement area (DMA)	4.34	15,624	1,261,600	210,267	74	39,950	2,905	19
Pilot area	1.19	4,284	303,000	37,900	113	7,201	526	12

There is a large difference between the minimum night flow per household in the Pilot Area (113 l/property/hr) and the minimum night flow per household in the DMA area (74 l/property/hr). It is assumed that the pilot area includes areas where many formal residents and informal residents coexist, and many old cast iron pipes (total length: 7.67 km) are in use. The difference was thus attributed to night time water use and leakage.

UFW in the pilot area is estimated based on the results of the field survey:

	(m^3/hr)	(l/property/hr)	%
Minimum Night Flow	4,280	113	100
Storage Tanks	525	14	12
Other Water Use	550	15	13
UFW*	3,010	84	75

*: UFW (unaccounted-for-water) includes leakage and informal use.

4.4 Water Requirement of the Mezze-Razy & Kafar Souseh-Lawan Area

4.4.1 Service Area

(1) Present DAWSSA service area

DAWSSA supplies water to formal residents and public facilities (schools, hospitals and offices, etc.) along the Faez Mansour Moterway and the Hafez Al Assad Motorway.

The service area along the Faez Mansour Motorway is supplied from the Wali service reservoir, while the area along the Hafez Al Assad Motorway is supplied from the Western reservoir. The Mezze-Razy & Kafar Sousch-Lawan informal area is taking water from the service area fed by the Wali service reservoir and the Dahadil Naher Eshah area takes water from the service area fed by the Western service reservoir.

(2) Areas designated under the DMA plan

According to the proposed DMA plan, Mezze-Razy & Kafar Souseh-Lawan informal areas would be part of the large block D11 supplied from the Wali sevice reservoir. The Dahadil Naher Eshah area is part of the large block D10 supplied from the Western service reservoir.

(3) Service area

The service area to be improved is determined based on the above mentioned analysis as follows:

i)	Service area to be improved	: 191 ha
	• Formal area	: 47 ha
	• Informal area	: 93 ha
	• Farmland/Green area	: 51 ha
ii)	Additional area to be considered for total water demand	: 395 ha
iii)	Total area for water requirement	: 586 ha
	• Formal area	: 450 ha
	• Informal area	: 136 ha

4.4.2 Population Served

The population served in the area is estimated based on projections adopted by the JICA Master Plan Study as follows:

i) Population served in improvement areas : 46,800
- Formal : 14,800
- Informal : 32,000

ii) Additional population served to be considered for total water demand : 20,400

iii) Total population served for water requirement : 67,200
- Formal : 20,400
- Informal : 46,800

4.4.3 Water Demand Projection and Water Requirements

Daily water demand and water requirement projections for the area are estimated based on the projections of the JICA Master Plan Study and summarized below:

i) Water requirements of Mezze-Razy & Kafar Souseh-Lawan area including UFW
- Domestic requirements : 8,740 (m^3/d)
- Non domestic requirements : 6,330 (m^3/d)

ii) Total water requirements of Mezze-Razy & Kafar Souseh-Lawan including UFW : 15,070 (m^3/d)

iii) Additional water requirements of other areas in D11 to be considered for plan of distribution trunk main : 6,600 (m^3/d)

iv) Total water requirement of D11 : 21,670 (m^3/d)
- Daily average supply : 251 l/s
- Daily maximum supply : 286 l/s

4.5 Financial Management Change Strategy

4.5.1 The Need for Change

The profile that emerges is one of an organization whose administrative and management processes have not kept pace with the rapidly growing quantity and the increasing complexity of the information it must manage. While DAWSSA is a "Public" utility and should be a commercially viable operation, it is recognized that it operates at a loss, generating sufficient funds to meet day to day operating expenses but not enough to cover the growing capital contributions required to finance new works.

4.5.2 Change Strategy

Creating an organization that is financially self supporting, and cost-effective is clearly the long term goal. The present feasibility study is aimed at developing a change strategy that will: (a) Improve financial management processes; (b) Increase revenues; and (c) Improve management's ability to budget and control costs.

DAWSSA needs to maximize the use of it's limited financial resources to provide better, and more cost effective services. Today's modern utility is meeting similar challenges through the use of computers. The implementation of information technology is at the heart of the change strategy required to improve DAWSSA's future financial well being. The feasibility of various options for change are reviewed in detail in Appendix E and the recommended improvements, discussed and agreed with DAWSSA's senior management team, are briefly outlined in the following paragraphs.

4.5.3 Organization Structure

Organizational changes are needed to: (a) streamline decision making; and (b) clarify roles and responsibilities. These objectives can be achieved by consolidating the organizational structure along functional lines. The recommended organizational structure is presented in Figure 4.5.1.

Recommendation: move payment collection functions from Consumer Affairs to the Finance Directorate. This change will alleviate the work load on the Consumer Affairs Directorate, giving it a clear customer service focus. All cash collection activities will be under the management of the Finance Directorate allowing it to be fully accountable for collecting the revenues it needs to manage cash flow needs.

Recommendation: move all store keeping functions from the Finance Directorate to the New Works & Studies Directorate which is the largest user and specifier of materials. This change is required to provide the Finance Directorate with the time it needs to focus on financial management issues and provides the New Works Directorate with an opportunity to manage it's own material needs.

Recommendation: Create an Information Technology Directorate to support the planning, implementation and operation of new computer systems, SCADA systems and data communications systems. The significant growth of new computer systems and computer users will require specialized technical support. In addition, planning of integrated systems will require clear direction and strong leadership. Computer applications cannot continue to develop without the support of a centralized group of trained specialists.

4.5.4 Customer Information Management System

A well organized customer information system is needed to support the billing functions that generate revenue. The objectives are to: (a) improve access to account information; (b) improve accuracy and speed of customer service transactions; and (c) improve retrieval and archiving of customer information. These objectives can be met by providing an integrated data base management system for customer information.

Recommendation: Implement a computerized customer information system and enter all customer information into a database management system. Important legal documents should be scanned and stored in a document management system interfaced to the database management system. All remote payment collection centers should be connected to the database to have access to current account information.

4.5.5 Customer Metering, Billing & Collection

Changes in the customer billing and payment collection process are required to reduce inefficiencies and increase annual revenues. The overall objectives are to: (a) reduce time delays and duration of billing activities; (b) reduce billing errors; and (c) accelerate the collection of late payments. These objectives can be met firstly by reducing inefficient administrative processes and secondly by implementing appropriate technology for automating metering and billing.

Recommendation: Implement meter installation standards to improve meter reading productivity. The work of reading meters can be greatly improved by installing meters so they are always accessible and in a position that is easy to read. The standard should be developed by the New Works & Studies Directorate with input from the staff of the Connection Department and the Meter Reading Department in Consumer Affairs Directorate.

Recommendation: Automate meter reading. The ultimate solution to many of the problems associated with meter reading is an automated system of reading and processing the results by computer. The most commonly used method consists of using remote register meters and hand-held data entry terminals (HDET) for on-site data processing. Unfortunately in DAWSSA's case the use of remote mounted meter registers is not currently feasible the 1/2" meters are locally manufactured and cannot be upgraded in the near future with the required new technology. Nevertheless, HDETs can be used by meter readers to manually register readings. These devices are simple to use and can be downloaded with all of the customer information required by the meter reader, including maps, and previous consumption data to flag out of limit readings. In order to minimize data entry errors, all meters should be bar coded with a unique serial number. The bar code would be read by a small pen scanner connected to the HDET to identify the correct customer account before manually entering the meter reading.

Recommendation: Reduce the waiting period between steps in the billing process. Assuming the duration of each activity in the billing process remains the same as it is now, the average time per district can be reduced from 197 to 103 days as shown in Table 4.5.1.

Recommendation: Consolidate error detection and correction activities. Error verification is currently carried out by two different work groups. All error verification should be consolidated within the Accounting Directorate in a single step process. Once the bills have been thoroughly checked and printed they should be issued directly to the payment collection centers without delay. When combined with the above recommended improvements the average billing time per district can be reduced to 80 days as shown in Table 4.5.2.

Recommendation: Change the meter reading and billing cycle from 3 months to 4 months. It currently takes 131 days (4.5 months) to complete the cycle of reading all metering districts. It is DAWSSA's intention to increase meter reading staff to obtain quarterly (90 days) readings. The existing bill production cycle currently takes about 4 months (128 days) to complete and cannot be shortened without the implementation of automated systems. Therefore, improvements in the meter reading schedule will not yield the desired result of issuing quarterly bills. It is therefore recommended that the more achievable target of a 4 months billing cycle be adopted and that staff increases be postponed until computer systems are modernized. The current meter reading cycle takes four and a half months and it should be possible once some of the recently hired staff are fully trained, to bring this down to four months. When combined with other efficiencies previously described, the overall cash flow is greatly improved, providing a net increase of 57.5 million SL (US$1.15 million) in billings over a six month period.

Recommendation: Implement a modern computer system for customer accounting and billing. The new system should provide automatic data validation features to eliminate the need for manual error verification and should be integrated with the recommended customer information management system. This change combined with the use of HDET by meter readers for capturing meter readings will completely eliminate the need for time consuming manual data entry thereby greatly reducing data entry errors. As shown in Figure 4.5.2 a quarterly billing cycle is achievable if the implementation of a new system is combined with the efficiency improvements previously identified and an appropriate increase in meter reading staff.

Recommendation: Issue late payments notices monthly. The current 45 day waiting period for collecting payments should be changed to the 30 day norm adopted by most utilities and commercial businesses. Customers should be given late payment notices at regular monthly intervals after the initial 30 day period and a final notice with warning of impending disconnection should be issued after no more than 6 months.

4.5.6 Financial Management and Cost Accounting

The existing accounting systems that are supposed to support financial management need to be changed to provide the information required to control costs, analyze trends and plan for budget needs. The overall objectives are to: (a) provide accurate and timely financial information; (b) provide the cost information required to control expenditures; (c) provide the information required to improve budget preparation. These objectives can be met by firstly implementing cost accounting and secondly by implementing financial reporting through the use of an automated financial management system.

Recommendation: Implement cost accounting to provide the basic data required for identify where and how DAWSSA spends it's money. Cost accounting can be implemented in accordance with the National Unified Accounting System (UAS) which outlines the account code structure that should be used. The implementation of cost accounting is considered feasible using the existing computerized accounting system and should begin at the start of the next fiscal year.

Recommendation: Provide a new financial management information system for cost accounting, budget preparation, cash management and reporting. The system should be fully integrated with the customer accounting and billing system to provide meaningful and timely reports on the financial performance of the establishment. The heart of the system should be the accounting module which would be used by Finance and Accounting Directorates to record and control expenditure transactions.

4.6 Computer Systems

4.6.1 Overview

The configuration of the recommended Customer Information System (CIS) and the Financial Management System (FMIS) is illustrated in Figure 4.6.1. The main system will be located at DAWSSA headquarters with file servers located in the existing computer center. It is essential that remote payment collection and customer service centers continue to operate even if communications fail. Therefore the 20 remote payment collection centers should have their own separate systems for stand alone operations. The master database will reside centrally at DAWSSA headquarters and be distributed to remote sites where it will be used, updated and returned to the central database.

The process of entering meter readings, and calculating bills will be carried out centrally at DAWSSA headquarters. The process of printing bills, collecting payments and recording customer account transactions will be carried out at the remote payment collection locations where the customer pays in person. Complete customer account information will be available at each payment collection location to answer customer inquiries.

Within DAWSSA headquarters, on-line access for real time processing of data can be achieved by extending the recently installed local area network (LAN). Remote payment collection centers can be connected to each other and to the central headquarters system via the public X.25 packet switching network service operated by the Syrian Telephone Exchange (STE). This system is relatively inexpensive and provides reliable network communications that can meet all of DAWSSA's requirements. Although there are other communication options, the X.25 is the simplest and most cost effective solution for DAWSSA because it eliminates the need to investment in costly, specialized data communications and network control equipment, and minimizes the need for having specially trained data communication staff for maintenance and trouble shooting.

4.6.2 Software Requirements

The most critical software decision involves selecting an operating system that is widely used, well supported by vendors, and compatible with recently implemented applications and hardware. Although large client server applications are usually UNIX based, recent improvements in technology have seen the development of several PC based utility management applications that can satisfy DAWSSA's needs. All future network applications should be therefore be Windows based and compatible for use in a Novell network environment. A modern relational database with query language capabilities such as Oracle SQL is recommended for information management and reporting.

There are various alternatives for application software - either packages can be purchased and modified for use, or customized applications can be developed from scratch. Customization however should be minimized if at all possible in favor of commercially available packages to reduce long term costs. Packaged applications offer many advantages: (1) software is continuously being enhanced; (2) software maintenance costs are reduced in the long term through the availability of upgrades; (3) there is generally better user support and documentation; (4) software changes keep up with technological advancements in hardware. The final decision can be made at the design stage. For the purposes of estimating budget costs it is assumed that the applications will be custom developed since this option would result in higher costs.

The customer information system should consist of four integrated modules:

(a) the customer accounting module will maintain the database of relevant information about customers, such as consumption and billing history, meter and service information, address, account status, accounts receivable and transaction summaries.

(b) the billing module will take data from the customer's meters, the customer accounting system and customer service system and produce bills, process payments, track accounts receivable and direct the collection process.

(c) the customer service module will take information from customers regarding special needs, e.g. high billing complaints, inquiries, interruption of service, transactions or changes in accounts, initiation of services, water rights. The module will be interfaced to a document management system capable of providing digital images of the relevant customer application documents kept on file.

(d) the management information module will provide management with trend reports, financial reports related to billings issued, unpaid, accounts receivable, and engineering/service reports regarding distribution network management such as number of service connections, and type.

The FMIS should consist of three fully integrated modules completely integrated with the Customer Information System:

(a) the financial accounting module will be a fully automated system based on the existing chart of accounts and the introduction of an appropriate chart of cost accounting codes. Data will be captured only once, as an accounting transaction progresses through the system. It will enable expenditures and revenues to be recorded at a detail level and related to specific programs, projects and activity centers throughout the organization

(b) the budget preparation module will support the process of preparing and monitoring both investment and operating (ordinary) budgets. The module will receive from the various Directorates (spending units) the details of their programs and projects, consolidate them and produce from them a budget document for review and discussion. The module will facilitate the iterative process of budget submission, consolidation, review/negotiation and documentation until the budget is finalized and approved. After approval, the system will produce the approved budget estimates in a format suitable for budget implementation and accounting purposes.

(c) the management information module will produce the financial reports required by the various users. This will include, monthly financial reports on revenue and expenditure accounts, budget reports showing amounts remaining until fiscal year end and accounts were expenditures will potentially exceed the budgeted amount. The system will have capabilities for search and query to facilitate interaction with the users for easy retrieval, analysis and reporting of data by the users.

4.6.3 Hardware Requirements

Generic descriptions of the hardware required to support the implementation of new CIS and FMIS systems are provided in Table 4.6.1. It is important to recognize that computer technologies change rapidly and that by the time DAWSSA is ready to proceed with implementation, many of these specifications will likely be out of date. The specifications are therefore intended as a guide to obtain a reasonable budget estimate of the costs.

(1) Remote payment collection & customer service sites

All computers should be PC desk top machines with mid to high end processing power and high clock speeds to minimize the time spent for each customer transaction. The main file server should be a high end PC machine with sufficient hard disk storage to keep customer account information for a least one year. Data back-up is not required as this function should be carried out automatically by the central server at headquarters, polling each remote site at the end of each working day. All bills would be encoded with the account number to facilitate processing. When the customer returns payment, cashiers would scan the bar code on the previous bill to access the right account, print the current bill and record payment into the right account.

(2) Computer center at DAWSSA headquarters

The systems and the data for the CIS and FMIS will reside on the file servers at the headquarters billing center located in the existing computer room. The CIS and FMIS should each have their own file server and a second identical machine should be provided in a redundant "off-line" configuration to ensure that the systems are available at all times in case the main file server has a catastrophic failure. The size of disk storage for CIS data will depend on the number of customers billed and the number of years of historical information maintained on-line. Initially it would be desirable to have up to 10 years of storage on-line for 300,000 customers to allow for proper trend analysis. A tape drive is recommended for the purposes of backing up and recovering files in case of hardware or software failure.

There is ample space available within the existing computer center for the new equipment. The cooling requirements for the new computer systems are quite small and the existing computer room already has a dedicated air conditioning system with adequate capacity to support the addition of the new file servers. Power from the existing emergency diesel generator is available but a new UPS with sufficient capacity for 1/2 hour will be required to ensure enough time is available to execute an orderly shutdown of computer systems should the emergency diesel generator fail.

Table 4.2.1 Pressure Record

Name of Reservoir	Name of Large Block	Measurement Point No	Measurement Point Season	Measurement Point (1)Elevation m	Reservoir (2)Elevation m	Static Head (3)Elevation (3)=(2)-(1)m	Water Pressure (Kgf/Cm2) (4) Max	Water Pressure (Kgf/Cm2) (5) Min	Water Pressure (Kgf/Cm2) (6)Variable (6)=(4)-(5)	(7) Head Loss (7)=(3)-(4)m	Assessment
IE	B03	P1	Wet	753.00	785.00	32.00	3.0	2.3	0.7	2.0	not good
			Dry	753.00	785.00	32.00	2.5	0.7	1.8	7.0	not good
	D03	P1	Wet	767.00	785.00	18.00	14.0	4.0	10.0	-122.0	not good
IA	D04	P1	Wet	717.00	801.17	84.17	8.4	7.8	0.6	0.2	not good
	D04	P2	Wet	740.53	801.17	60.64	3.7	2.7	1.0	23.6	good
			Dry	740.53	801.17	60.64	3.9	2.9	1.0	21.6	good
	D05	P1	Wet	698.00	801.17	103.17	7.1	6.0	1.1	32.2	good
			Dry	698.00	801.17	103.17	1.7	3.5	1.2	56.2	good
IIE	D08	P1	Wet	689.00	749.38	60.38	5.6	4.7	0.9	4.4	good
	D09	P1	Wet	672.00	749.38	77.38	5.6	3.0	2.6	21.4	good
II0	D06	P1	Wet	696.00	755.50	59.50	5.4	4.2	1.2	5.5	good
			Dry	696.00	755.50	59.50	5.8	4.0	1.8	1.5	good
	D10	P1	Wet	690.00	755.50	65.50	5.1	3.2	1.9	14.5	good
		P2	Wet	698.00	755.50	57.50	5.3	3.8	1.5	4.5	good
			Dry	698.00	755.50	57.50	5.0	3.5	1.5	7.5	good
		P3	Wet	689.00	755.50	66.50	6.2	4.4	1.8	4.5	good
			Dry	689.00	755.50	66.50	6.8	4.5	2.3	-1.5	good
		P4	Wet	682.00	755.50	73.50	5.2	3.4	1.8	21.5	good
			Dry	682.00	755.50	73.50	5.0	3.3	1.7	23.5	good
		P5	Wet	678.00	755.50	77.50	4.0	1.8	2.2	37.5	not good
		P6	Wet	683.50	755.50	72.00	5.3	3.6	1.7	19.0	good
			Dry	683.50	755.50	72.00	5.1	2.5	2.6	21.0	not good
		P7	Wet	686.00	755.50	69.50	5.0	2.5	2.5	19.5	not good
		P8	Wet	675.00	755.50	80.50	3.8	1.5	2.3	42.5	not good
		P9	Wet	673.00	755.50	82.50	3.5	1.0	2.5	47.5	not good
			Dry	673.00	755.50	82.50	4.0	1.7	2.3	42.5	not good
M1	M01	P1	Wet	720.00	772.25	52.25	4.3	2.7	1.6	9.3	good
M2	M02	P1	Wet	769.80	824.81	55.01	5.5	4.5	1.0	0.0	good
	M02	P2	Dry	769.80	824.81	55.01	5.0	4.1	0.9	5.0	good

(Source:DAWSSA&JICA)

Table 4.2.2 House Meter Reading Survey

Sample No	Kind of House	Area		Reservoir	Persons	Period						Flow Meter	House Meter	Meter Malfunction
						start			end			m3/day	m3/day	of House Meter
1	Condominium	D10.6	Formal	With	7	7/7	12:42	to	7/8	12:22		3.369	3.040	10%
2	Small House	D10.5	Formal	Without	8	7/8	13:34	to	7/9	13:34		0.142	0.110	23%
3*	Small House	D10.5	Formal	With	14	7/13	11:26	to	7/14	12:40		0.287	0.000	
4	Police office	D10.6	Formal	With		8/2	15:00	to	8/4	12:14		30.970	0.840	97%
5	Small House	D10.6	Formal	With	11	8/3	16:07	to	8/4	16:15		6.670	1.040	84%
6*	Small House	D10.6	Formal	With	11	8/10	14:30	to	8/11	14:30		22.550	0.000	
7	Mosque	D10.5	Formal			8/4	19:46	to	8/5	19:25		4.750	not equip	
8	Small House	M05	Informal	With	4	8/4	12:14	to	8/4	12:14		40.140	no meter	
9	Small House	M05	Informal	With	10	8/6	12:46	to	8/7	13:08		5.070	no meter	
10	Small House	M05	Informal	With	12	8/3	16:13	to	8/4	17:15		35.010	no meter	

Note: * Not working

Table 4.2.3 Water Storage Device in Pilot Area

(1)

Type of Building	District	Total	Availability of water storage device									
			No		Yes							
			Total	Percentage	Total	Percentage	Capacity of water storage device					
							<=0.5 (m3)		1.0 m3		> 1.0 m3	
							Total	Percentage	Total	Percentage	Total	Percentage
Houses	Meedan	23	1	4.3%	22	95.7%	14	63.6%	6	27.3%	2	9.1%
	Old Zahera	13	1	7.7%	12	92.3%	5	41.7%	5	41.7%	2	16.7%
	New Zahera	15	0	0.0%	15	100.0%	5	33.3%	9	60.0%	1	6.7%
	Yarmouk Camp	15	1	6.7%	14	93.3%	6	42.9%	7	50.0%	1	7.1%
	Palestine Camp	13	1	7.7%	12	92.3%	8	66.7%	4	33.3%	0	0.0%
	Tadamon Quarter	11	0	0.0%	11	100.0%	8	72.7%	2	18.2%	1	9.1%
Sub-Total		90	4	4.4%	86	95.6%	46	53.5%	33	38.4%	7	8.1%
Schools		4	0	0.0%	4	100.0%	0	0.0%	0	0.0%	4	100.0%
Hospitals		4	0	0.0%	4	100.0%	0	0.0%	0	0.0%	4	100.0%
Governmental Office Building		2	0	0.0%	2	100.0%	0	0.0%	0	0.0%	2	100.0%
Sub-Total		10	0	0.0%	10	100.0%	0	0.0%	0	0.0%	10	100.0%
Total		100	4	4.0%	96	96.0%	46	47.9%	33	34.4%	17	17.7%

(2)

Type of Building	District	Availability of Water Storage Device (Cont.)																				
		Yes (Cont.)																
		Total of Tanks	Frequency of filling up the water storage device in the day						Time of filling up the water storage device				Control of filling up the water storage device			
			One time per day		Two times per day		Three times or more per days		Day time		Night time		Automatic Control		Hand-operarted control	
			Total	Percentage	Total	Percentage	Total	Percentage	Total	Percentage	Total	Percentage	Total	Percentage	Total	Percentage
Houses	Meedan	22	7	31.8%	0	0.0%	0	0.0%	1	4.5%	5	27.3%	15	68.2%	7	31.8%
	Old Zahera	12	1	8.3%	0	0.0%	0	0.0%	0	0.0%	1	8.3%	11	91.7%	1	3.3%
	New Zahera	15	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	15	100.0%	0	0.0%
	Yarmouk Camp	14	4	28.6%	0	0.0%	0	0.0%	1	7.1%	3	21.4%	10	71.4%	4	28.6%
	Palestine Camp	12	4	33.3%	0	0.0%	1	8.3%	1	8.3%	4	33.3%	7	58.3%	5	41.7%
	Tadamon Quarter	11	2	18.2%	0	0.0%	0	0.0%	0	0.0%	2	18.2%	9	81.8%	2	18.2%
Sub-Total		86	18	20.9%	0	0.0%	1	1.2%	3	3.5%	16	18.6%	67	77.9%	19	22.1%
Schools		4	0	0.0%	0	0.0%	1	25.0%	1	25.0%	0	0.0%	3	75.0%	1	25.0%
Hospitals		4	0	0.0%		0.0%	0	0.0%	0	0.0%	0	0.0%	4	100.0%	0	0.0%
Governmental Office Building		2	0	0.0%	1	50.0%	0	0.0%	1	50.0%	0	0.0%	1	50.0%	1	50.0%
Sub-Total		10	0	0.0%	1	10.0%	1	10.0%	2	20.0%	0	0.0%	8	80.0%	2	20.0%
Total		96	18	18.8%	1	1.0%	2	2.1%	5	5.2%	16	16.7%	75	78.1%	21	21.9%

(3)

Sub-District	Water Tank >1.0 m3			
	Number of tanks	Capacity of Tank	Total Capacity	
Meedan	2	2	4	
Old Zahera	2	2	4	
New Zahera	1	2	2	
Yarmouk Camp	1	2	2	
Palestine Camp	0		0	
Tadamon	1	2	2	Average
Sub-Total	7	10	14	2
Schools	4	10	40	
Hospitals	4	5	20	
Governmental Buildings	2	3	6	Average
Sub-Total	10	18	66	6.6
Total	17	28	80	4.7

(Source: JICA Study Team)

Table 4.2.4 Water Storage Device in Mezze-Razy & Kafar Souseh-Lawan

(1)

District	Formality	Total of Houses	Availability of Water Storage Device									
			No		Yes							
							Capacity of water storage device					
							<=0.5 (m3)		1.0 m3		> 1.0 m3	
			Total	Percentage	Total of Tanks	Percentage	Total	Percentage	Total	Percentage	Total	Percentage
Mezze-Razi	Formal	32	1	3.1%	31	96.9%	10	32.3%	18	58.1%	3	9.7%
	Informal	38	1	2.6%	37	97.4%	16	43.2%	20	54.1%	1	2.7%
Sub-Total		70	2	2.9%	68	97.1%	26	37.1%	38	54.3%	4	5.7%
Lawan	Formal	12	0	0.0%	12	100.0%	8	66.7%	4	33.3%	0	0.0%
	Informal	18	1	5.6%	17	94.4%	7	41.2%	9	52.9%	1	5.9%
Sub-Total		30	1	3.3%	29	96.7%	15	50.0%	13	43.3%	1	3.3%
Total		100	3	3.0%	97	97.0%	41	41.0%	51	51.0%	5	5.0%

(2)

District		Availability of Water Storage Device (Cont.)														
		Yes (Cont.)														
		Total of of Tanks	Frequency of filling up the water storage device in the day						Time of filling up the water storage device				Control of filling up the water storage device			
			One time per day		Two times per day		Three times or more per days		Day time		Night time		Automatic control		Hand-operated control	
			Total	Percentage	Total	Percentage	Total	Percentage	Total	Percentage	Total	Percentage	Total	Percentage	Total	Percentage
Mezze-Razi	Formal	31	0	0.0%	0	0.0%	0	0.0%	0	0.0%	1	3.2%	30	96.8%	1	3.2%
	Informal	37	1	2.7%	0	0.0%	0	0.0%	1	2.7%	0	0.0%	37	100.0%	1	2.7%
Sub-Total		68	1	1.5%	0	0.0%	0	0.0%	1	1.5%	1	1.5%	67	98.5%	2	2.9%
Lawan	Formal	12	4	33.3%	4	33.3%	0	0.0%	1	8.3%	8	66.7%	4	33.3%	8	66.7%
	Informal	17	9	52.9%	2	11.8%	0	0.0%	1	5.9%	11	64.7%	7	41.2%	11	64.7%
Sub-Total		29	13	44.8%	6	20.7%	0	0.0%	2	6.9%	19	65.5%	7	24.1%	19	65.5%
Total		97	14	14.4%	6	6.2%	0	0.0%	3	3.1%	20	20.6%	74	76.3%	21	21.6%

(3)

District		Availability of Water Storage Device (Cont.)								
		Yes (Cont.)								
		Total of of Tanks	Time use of water storage device							
			All year		Winter		Summer		Every six months	
			Total	Percentage	Total	Percentage	Total	Percentage	Total	Percentage
Mezze-Razi	Formal	31	24	77.4%	1	3.2%	6	19.4%	1	3.2%
	Informal	37	29	78.4%	0	0.0%	8	21.6%	0	0.0%
Sub-Total		68	53	77.9%	1	1.5%	14	20.6%	1	1.5%
Lawan	Formal	12	11	91.7%	0	0.0%	1	8.3%	0	0.0%
	Informal	17	9	52.9%	0	0.0%	8	47.1%	0	0.0%
Sub-Total		29	20	69.0%	0	0.0%	9	31.0%	0	0.0%
Total		97	73	75.3%	1	1.0%	23	23.7%	1	1.0%

(Source: JICA Study Team)

Table 4.2.5 (1/2) Evaluation of Priority for Proposed Blocks

No. of Large Block	Factor of Evaluation						Result of Evaluation
	Population	Informal Population	Water Consumption by M/P	Saving Water by DMA	Cast Iron Pipe Used Ratio	Differences between Forecasted and Measured Demand	
E01	C	B	C	C	C	C	C
E02	C	B	C	C	C	C	C
B01	C	B	C	C	C	C	C
B02	B	C	C	B	C	C	C
B03	B	C	B	B	B	C	B
B04	B	C	C	B	C	C	C
D01	B	B	C	C	C	C	B
D02	B	B	B	C	C	C	B
D03	B	C	B	B	B	C	B
D04	B	C	A	A	A	C	A
D05	B	C	B	B	A	C	A
D06	A	C	A	A	A	B	A
D07	B	C	B	C	C	C	B
D08	B	C	B	B	C	B	B
D09	A	B	A	A	B	C	A
D10	A	A	A	A	A	A	A
D11	B	A	B	C	B	C	A
M01	B	C	B	B	B	C	C
M02	B	C	B	B	B	C	B
M03	B	A	C	C	C	C	B
M04	C	C	C	B	C	C	C
						Total Number	21

Remarks : Evaluation factors are determined below:

A: High priority (6 Blocks) B: Medium priority (8 Blocks) C: Low priority (7 Blocks)

Evaluation	Population	Informal Population	Water Consumption by M P (m3/d)	Saving Water by DMA (m3/d)	Cast Iron Pipe Used Ratio	Differences between Forecasted and Measured Demands
A	>100,000	>30,000	>30,000	>5,000	>12 %	>1.15 times
B	10,000-100,000	30,000-10,000	30,000-10,000	5,000-1,000	12 %-5 %	1.10 times- 1.00 time
C	<10,000	<10,000	<10,000	<1,000	< 5 %	None

(Source : DAWSSA & JICA)

Table 4.2.5 (2/2) Evaluation of Priority for Proposed Blocks

No. of Proposed Block	Factor of Evaluation: Population	Informal Population	Water Consumption by M/P	Saved Water by DMA	Cast Iron Pipe Used Ratio	Differences between Forecasted and Measured Demand	Result of Evaluation
E01	C	B	C	C	C	C	C
E02	C	B	C	C	C	C	C
B01	C	B	C	C	C	C	C
B02	B	C	C	B	C	C	C
B03.1	C	C	C	C	B	C	C
B03.2	B	C	C	C	B	C	C
B03.3	C	B	C	C	B	C	C
B04	B	B	C	A	B	C	B
D01	B	B	C	C	C	C	C
D02	B	B	B	B	C	C	B
D03	B	C	B	A	C	C	C
D04.1	B	C	B	A	C	C	C
D04.2	B	C	B	A	C	C	C
D04.3	B	C	C	A	A	C	B
D05	B	C	B	A	A	C	B
D06.1	B	C	C	C	A	B	B
D06.2	B	C	B	C	A	B	B
D06.3	A	C	A	C	C	B	A
D06.4	B	C	B	C	A	B	A
D06.5	B	C	C	B	A	B	B
D07	B	B	B	C	C	C	B
D08.1	B	C	C	C	B	C	C
D08.2	B	C	C	C	B	B	C
D08.3	B	C	B	C	B	B	B
D08.4	B	C	B	C	B	B	B
D09.1	B	B	C	B	A	C	B
D09.2	B	C	C	A	A	C	B
D09.3	B	B	B	A	B	C	B
D09.4	B	B	B	A	C	C	B
D09.5	B	C	C	B	B	C	C
D10.1	B	C	B	B	A	C	B
D10.2	B	C	B	A	C	C	B
D10.3	A	A	A	A	C	C	A
D10.4	A	A	A	A	A	A	A
D10.5	A	B	A	A	A	A	A
D10.6	B	B	C	B	C	A	B
D10.7	B	C	B	A	A	A	A
D10.8	B	C	B	A	A	B	A
D10.9	B	C	A	B	B	A	A
D10.10	B	B	C	A	A	B	A
D10.11	B	B	C	A	B	B	B
D11	A	A	A	C	B	C	A
M01.1	C	C	C	B	B	C	C
M01.2	C	C	C	B	B	C	C
M01.3	B	C	B	A	A	C	B
M02.1	C	C	C	B	A	C	B
M02.2	C	C	C	A	B	C	C
M03	C	A	C	C	C	C	B
M04	C	C	C	A	C	C	C
						Total Number	49

Remarks Evaluation factors are determined below:

A: High priority (10 Blocks) B: Medium priority (21 Blocks) C: Low priority (18 Blocks)

Evaluation	Population	Informal Population	Water Consumption by M/P (m3/d)	Saved Water by DMA	Cast Iron Pipe Used Ratio	Differences between Forecasted and Measured Demands
A	>50,000	>30,000	>20,000	>1,000	>12 %	>1.25 times
B	50,000-10,000	30,000-10,000	20,000-10,000	1,000-500	12 %-5 %	1.25 times- 1.0 time
C	<10,000	<10,000	<10,000	<500	< 5 %	None

(Source : DAWSSA & JICA)

Table 4.5.1 Improved billing schedule - reduced waiting periods

Reduced | Reduced | Reduced

No.	District name	Collection centre		Consumer Affairs Directorate				Accounting Directorate								Consumer Affairs Directorate					
				Read Meters				Enter Data			Verify &	Produce Bills				Statement Correction				Statement issued	Total Time
			No. of Bills	start	end	duration	delay	start	end	duration	Correct	printed	issue	Duration	delay	Receiv'd	Back to Actg	duration	delay	To cashier	lapse [3]
1	Kanawat	A-Kanawat	15,987	25-Jul-96	11-Aug-96	17	14	25-Aug-96	3-Sep-96	9	9	12-Sep-96	27-Sep-96	15	2	29-Sep-96	4-Nov-96	36	7	11-Nov-96	109
		B- DAWSSA																			
2	Zifha	Bab Musala	6,294	4-Sep-96	28-Sep-96	24	14	12-Oct-96	13-Oct-96	1	39	21-Nov-96	22-Nov-96	1	2	24-Nov-96	27-Dec-96	33	7	3-Jan-97	121
3	Akrad	A- Akrad	11,031	28-Jul-96	20-Aug-96	23	14	3-Sep-96	8-Sep-96	5	26	4-Oct-96	11-Oct-96	7	2	13-Oct-96	7-Nov-96	25	7	14-Nov-96	109
		B-Al jeser Al Abiad																			
4	Janoub Yazid	Janoub Yazid	6,587	10-Aug-96	25-Aug-96	15	14	8-Sep-96	9-Sep-96	1	32	11-Oct-96	16-Oct-96	5	2	18-Oct-96	18-Nov-96	31	7	25-Nov-96	107
5	Salhia Sharkia	A-Al jeser Al Abiad	8,731	4-Aug-96	21-Aug-96	17	14	4-Sep-96	11-Sep-96	7	5	16-Sep-96	28-Sep-96	12	2	30-Sep-96	22-Oct-96	22	7	29-Oct-96	86
		B- DAWSSA																			
6	Salhia Gharbia	Salhia Gharbia	9,094	4-Aug-96	21-Aug-96	17	14	4-Sep-96	4-Sep-96	0	37	11-Oct-96	13-Oct-96	2	2	15-Oct-96	30-Oct-96	15	7	6-Nov-96	94
7	Mohajreen	Mohajreen	13,923	18-Aug-96	18-Sep-96	31	14	2-Oct-96	27-Oct-96	25	66	1-Jan-97	2-Jan-97	1	2	4-Jan-97	19-Jan-97	15	7	26-Jan-97	161
8,9,10	Kimaria	A-Shagour	22,294	22-Aug-96	18-Sep-96	27	14	2-Oct-96	20-Oct-96	18	66	25-Dec-96	29-Dec-96	4	2	31-Dec-96	11-Jan-97	11	7	18-Jan-97	149
		B-Baghdad st.																			
		C-Bab Touma																			
		D-Abasyin																			
11	Sharky Al Tijara	Abasyin	1,835	19-Oct-96	31-Oct-96	12	14	14-Nov-96	17-Nov-96	3	57	13-Jan-97	23-Jan-97	10	2	25-Jan-97	19-Feb-97	25	7	26-Feb-97	130
12	Barza Al Balad	Masaken Barza	3,012	15-Oct-96	6-Nov-96	22	14	20-Nov-96	22-Nov-96	2	10	2-Dec-96	9-Dec-96	7	2	11-Dec-96	26-Dec-96	15	7	2-Jan-97	79
13	Shagour	A-Shagour	1,001	18-Aug-96	3-Sep-96	16	14	17-Sep-96	21-Sep-96	4	44	4-Nov-96	6-Nov-96	2	2	8-Nov-96	26-Nov-96	18	7	3-Dec-96	107
		B- DAWSSA																			
14	Midan	A-Al Ashmar	15,141	23-Sep-96	15-Oct-96	22	14	29-Oct-96	19-Nov-96	21	4	23-Nov-96	27-Nov-96	4	2	29-Nov-96	27-Dec-96	28	7	3-Jan-97	102
		B-Bab Masala																			
15	Sarouja	A-Baghdad st.	14,241	1-Sep-96	22-Sep-96	21	14	6-Oct-96	11-Oct-96	5	54	4-Dec-96	6-Dec-96	2	2	8-Dec-96	28-Dec-96	20	7	4-Jan-97	125
		B- DAWSSA																			
16	Mezze [2]	Mezze 1	16,127	10-Nov-96	30-Nov-96	20	14	14-Dec-96	19-Dec-96	5	12	31-Dec-96	2-Jan-97	2	2	4-Jan-97	24-Jan-97	20	7	31-Jan-97	82
		Mezze 2																			
17,18	Kiwan Doumar [2]	Doumar	12,701	2-Nov-96	12-Nov-96	10	14	26-Nov-96	26-Nov-96	0	23	19-Dec-96	24-Dec-96	5	2	26-Dec-96	23-Jan-97	28	7	30-Jan-97	89
19	Masaken Barza	Masaken Barza	7,182	8-Oct-96	31-Oct-96	23	14	14-Nov-96	18-Nov-96	4	20	8-Dec-96	8-Dec-96	0	2	10-Dec-96	23-Dec-96	13	7	30-Dec-96	83
20	Kaboun	Kaboun	5,492	17-Oct-96	29-Oct-96	12	14	12-Nov-96	23-Nov-96	11	4	27-Nov-96	28-Nov-96	1	2	30-Nov-96	7-Jan-97	38	7	14-Jan-97	89
21	Joubar	Joubar	9,801	17-Sep-96	5-Oct-96	18	14	19-Oct-96	21-Oct-96	2	47	7-Dec-96	16-Dec-96	9	2	18-Dec-96	4-Jan-97	17	7	11-Jan-97	116
22	Tabala	Tabala	2,826	23-Sep-96	17-Oct-96	24	14	31-Oct-96	1-Nov-96	1	18	19-Nov-96	2-Dec-96	13	2	4-Dec-96	19-Dec-96	15	7	26-Dec-96	94
23	Moukhaiam [2]	Moukhaiam	18,813	13-Nov-96	3-Dec-96	20	14	17-Dec-96	25-Dec-96	8	12	6-Jan-97	7-Jan-97	1	2	9-Jan-97	19-Jan-97	10	7	26-Jan-97	74
24	Kadam	A-Kafersousse	4,900	24-Oct-96	14-Nov-96	21	14	28-Nov-96	29-Nov-96	1	6	5-Dec-96	6-Dec-96	1	2	8-Dec-96	15-Dec-96	7	7	22-Dec-96	59
		B-Al Ashmar																			
25	Kafersousse [2]	A-mezze	9,332	21-Oct-96	15-Nov-96	25	14	29-Nov-96	3-Dec-96	4	24	27-Dec-96	31-Dec-96	4	2	2-Jan-97	16-Jan-97	14	7	23-Jan-97	94
		B-Kafersousse																			
26	Kassioun	A-Akrad	9,599	14-Sep-96	2-Oct-96	18	14	16-Oct-96	30-Oct-96	14	26	25-Nov-96	30-Nov-96	5	2	2-Dec-96	4-Jan-97	33	7	11-Jan-97	119
		B-Mohajreen																			
		Total	225,944		Average [4]	20	14		Average [4]	7	28		Average [4]	5	2		Average [4]	21	7	Average [4]	103

Time to complete one cycle 131

Time to complete one cycle 128

Notes

1. Days = calendar days, seven calendar days=six working days, 1 day= .86 work days
2. Bills have not been delivered to collection centres as of June 9 1997, but meters have been read for next billing cycle.
3. Time from last meter reading until bill issued to collection centre
4. Averages are for completing one district

Table 4.5.2 Improved billing schedule - consolidate error verification.

				Consumer Affairs Directorate				Accounting Directorate							Reduced	Consumer Affairs Directorate			Reduced		
No.	District name	Collection centre		Read Meters				Enter Data			Verify &	Produce Bills				Statement Correction				Issues Statement	Total Time
			No. of Bills	start	end	duration	delay	start	end	duration	Correct	printed	issue	Duration	delay	Receiv'd	Back to Actg	duration	delay	To cashier	lapse [3]
1	Kanawat	A-Kanawat	15,987	25-Jul-96	11-Aug-96	17	14	25-Aug-96	3-Sep-96	9	9	12-Sep-96	27-Sep-96	15	7	4-Oct-96	4-Oct-96	0	0	4-Oct-96	71
		B- DAWSSA																			
2	Zifta	Bab Musala	6,294	4-Sep-96	28-Sep-96	24	14	12-Oct-96	13-Oct-96	1	39	21-Nov-96	22-Nov-96	1	7	29-Nov-96	29-Nov-96	0	0	29-Nov-96	86
3	Akrad	A- Akrad	11,031	28-Jul-96	20-Aug-96	23	14	3-Sep-96	8-Sep-96	5	26	4-Oct-96	11-Oct-96	7	7	18-Oct-96	18-Oct-96	0	0	18-Oct-96	82
		B-Al jeser Al Abiad																			
4	Janoub Yazid	Janoub Yazid	6,587	10-Aug-96	25-Aug-96	15	14	8-Sep-96	9-Sep-96	1	32	11-Oct-96	16-Oct-96	5	7	23-Oct-96	23-Oct-96	0	0	23-Oct-96	74
5	Salhia Sharkia	A-Al jeser Al Abiad	8,731	4-Aug-96	21-Aug-96	17	14	4-Sep-96	11-Sep-96	7	5	16-Sep-96	28-Sep-96	12	7	5-Oct-96	5-Oct-96	0	0	5-Oct-96	62
		B- DAWSSA																			
6	Salhia Gharbia	Salhia Gharbia	9,094	4-Aug-96	21-Aug-96	17	14	4-Sep-96	4-Sep-96	0	37	11-Oct-96	13-Oct-96	2	7	20-Oct-96	20-Oct-96	0	0	20-Oct-96	77
7	Mohajreen	Mohajreen	13,923	18-Aug-96	18-Sep-96	31	14	2-Oct-96	27-Oct-96	25	66	1-Jan-97	2-Jan-97	1	7	9-Jan-97	9-Jan-97	0	0	9-Jan-97	144
8,9,10	Kimaria	A-Shagour	22,294	22-Aug-96	18-Sep-96	27	14	2-Oct-96	20-Oct-96	18	66	25-Dec-96	29-Dec-96	4	7	5-Jan-97	5-Jan-97	0	0	5-Jan-97	136
		B-Baghdad st.																			
		C-Bab Touma																			
		D-Abasyin																			
11	Sharky Al Tijara	Abasyin	1,835	19-Oct-96	31-Oct-96	12	14	14-Nov-96	17-Nov-96	3	57	13-Jan-97	23-Jan-97	10	7	30-Jan-97	30-Jan-97	0	0	30-Jan-97	103
12	Barza Al Balad	Masaken Barza	3,012	15-Oct-96	6-Nov-96	22	14	20-Nov-96	22-Nov-96	2	10	2-Dec-96	9-Dec-96	7	7	16-Dec-96	16-Dec-96	0	0	16-Dec-96	62
13	Shagour	A-Shagour	1,001	18-Aug-96	3-Sep-96	16	14	17-Sep-96	21-Sep-96	4	44	4-Nov-96	6-Nov-96	2	7	13-Nov-96	13-Nov-96	0	0	13-Nov-96	87
		B- DAWSSA																			
14	Midan	A-Al Ashmar	15,141	23-Sep-96	15-Oct-96	22	14	29-Oct-96	19-Nov-96	21	4	23-Nov-96	27-Nov-96	4	7	4-Dec-96	4-Dec-96	0	0	4-Dec-96	72
		B-Bab Masala																			
15	Sarouja	A-Baghdad st.	14,241	1-Sep-96	22-Sep-96	21	14	6-Oct-96	11-Oct-96	5	54	4-Dec-96	6-Dec-96	2	7	13-Dec-96	13-Dec-96	0	0	13-Dec-96	103
		B- DAWSSA																			
16	Mezze [4]	Mezze 1	16,127	10-Nov-96	30-Nov-96	20	14	14-Dec-96	19-Dec-96	5	12	31-Dec-96	2-Jan-97	2	7	9-Jan-97	9-Jan-97	0	0	9-Jan-97	60
		Mezze 2																			
17,18	Kiwan, Doumar [2]	Doumar	12,701	2-Nov-96	12-Nov-96	10	14	26-Nov-96	26-Nov-96	0	23	19-Dec-96	24-Dec-96	5	7	31-Dec-96	31-Dec-96	0	0	31-Dec-96	59
19	Masaken Barza	Masaken Barza	7,182	8-Oct-96	31-Oct-96	23	14	14-Nov-96	18-Nov-96	-4	20	8-Dec-96	8-Dec-96	0	7	15-Dec-96	15-Dec-96	0	0	15-Dec-96	68
20	Kaboun	Kaboun	5,492	17-Oct-96	29-Oct-96	12	14	12-Nov-96	23-Nov-96	11	4	27-Nov-96	28-Nov-96	1	7	5-Dec-96	5-Dec-96	0	0	5-Dec-96	49
21	Joubar	Joubar	9,801	17-Sep-96	5-Oct-96	18	14	19-Oct-96	21-Oct-96	2	47	7-Dec-96	16-Dec-96	9	7	23-Dec-96	23-Dec-96	0	0	23-Dec-96	97
22	Tabala	Tabala	2,826	23-Sep-96	17-Oct-96	24	14	31-Oct-96	1-Nov-96	1	18	19-Nov-96	2-Dec-96	13	7	9-Dec-96	9-Dec-96	0	0	9-Dec-96	77
23	Moukhaiam [2]	Moukhaiam	18,813	13-Nov-96	3-Dec-96	20	14	17-Dec-96	25-Dec-96	8	12	6-Jan-97	7-Jan-97	1	7	14-Jan-97	14-Jan-97	0	0	14-Jan-97	62
24	Kadam	A-Kafersousse	4,900	24-Oct-96	14-Nov-96	21	14	28-Nov-96	29-Nov-96	1	6	5-Dec-96	6-Dec-96	1	7	13-Dec-96	13-Dec-96	0	0	13-Dec-96	50
		B-Al Ashmar																			
25	Kafersousse [2]	A-mezze	9,332	21-Oct-96	15-Nov-96	25	14	29-Nov-96	3-Dec-96	4	24	27-Dec-96	31-Dec-96	4	7	7-Jan-97	7-Jan-97	0	0	7-Jan-97	78
		B-Kafersousse																			
26	Kassioun	A-Akrad	9,599	14-Sep-96	2-Oct-96	18	14	16-Oct-96	30-Oct-96	14	26	25-Nov-96	30-Nov-96	5	7	7-Dec-96	7-Dec-96	0	0	7-Dec-96	84
		B-Mohajreen																			
		Total	225,944		Average [4]	20	14		Average [4]	7	28		Average [4]	5	7		Average [4]	0	0	Average [4]	80
					Time to complete one cycle	131							Time to complete one cycle	128							

Notes
1. Days = calendar days, seven calendar days=six working days, 1 day= .86 work days
2. Bills have not been delivered to collection centres as of June 9 1997, but meters have been read for next billing cycle.
3. Time from last meter reading to bill issued to collection centre
4. Averages are for completing one district

Table 4.6.1 Equipment and Hardware Requirements

Remote Payment Collection Centers

Equipment		Function	Quantity
Server (PC)	CPU 64 MB, 200 Mhz	for customer information system	20
	X25 card	for commnications with WAN	
	Ethernet card	for LAN	
	Hard Disk, 4 GB	storing data and processing applications	
Printer	laser	for printing bills	20
	laser	for printing forms and reports	26
Workstations (PC)	CPU 32 MB, 166 Mhz	cashiers	54
	Hard Drive 2 GB		
Workstations (PC)	CPU 32 MB, 166 Mhz	for customer service representatives	21
	Hard Drive 2 GB		
Workstations (PC)	CPU 32 MB, 166 Mhz	for meter repair crews	5
	Hard Drive 2 GB		
Bar code scanners	pen laser	for reading bar codes on bills	67
UPS	5 KVA,15 min battery,	power supply & transient protection	20

Computer Center at Headquarters

Equipment		Function	Quantity
Server (PC)	CPU, 128 MB, 200 Mhz	for CIS and FMIS (redundant configuration)	4
	Ethernet card	for LAN	
	Floppy drive	for information transfer	
	Hard Disks 4 GB x 2	storing data and processing applications	
	Tape Backup	backing up & restoring files	1
Secondary Storage	Hard Disk, 4 GB x 2	on line data storage for FMIS	1
	Optical disk, 16 GB	on line data storage & retrieval for CIS	1
Printer	laser	for printing forms and reports	2
Printer	line, high speed	for printing bill statements	2
Workstations (PC)	CPU 32 MB, 166 Mhz	system operators	2
	Hard Drive 2 GB		
	Floppy Drive		
Workstations (PC)	CPU 32 MB, 166 Mhz	network management	1
	Hard Drive 2 GB		
	Floppy Drive		
UPS	5 KVA,30 minute battery	power supply & transient protection	1

DAWSSA Headquarter LAN

Equipment		Function	Quantity
Network Server (PC)	CPU 128 MB, 200 Mhz	Novell Netware, newtwork management	1
	X25 card	for commnications with WAN	
	Ethernet card	for LAN	
	Hard Disk, 8 GB		
HDET's	portable data entry terminals	to input meter readings	35
Scanner	high resolution, A4 size	to digitize customer file documents	1
Printer	laser	for printing forms and reports	21
Workstations (PC)	CPU 32 MB, 166 Mhz	miscellaneous users	46
	Hard Drive, 2 GB		
	Floppy Drive		
Network	10 MBps, Ethernet co-ax bus	headquarters PC LAN	1

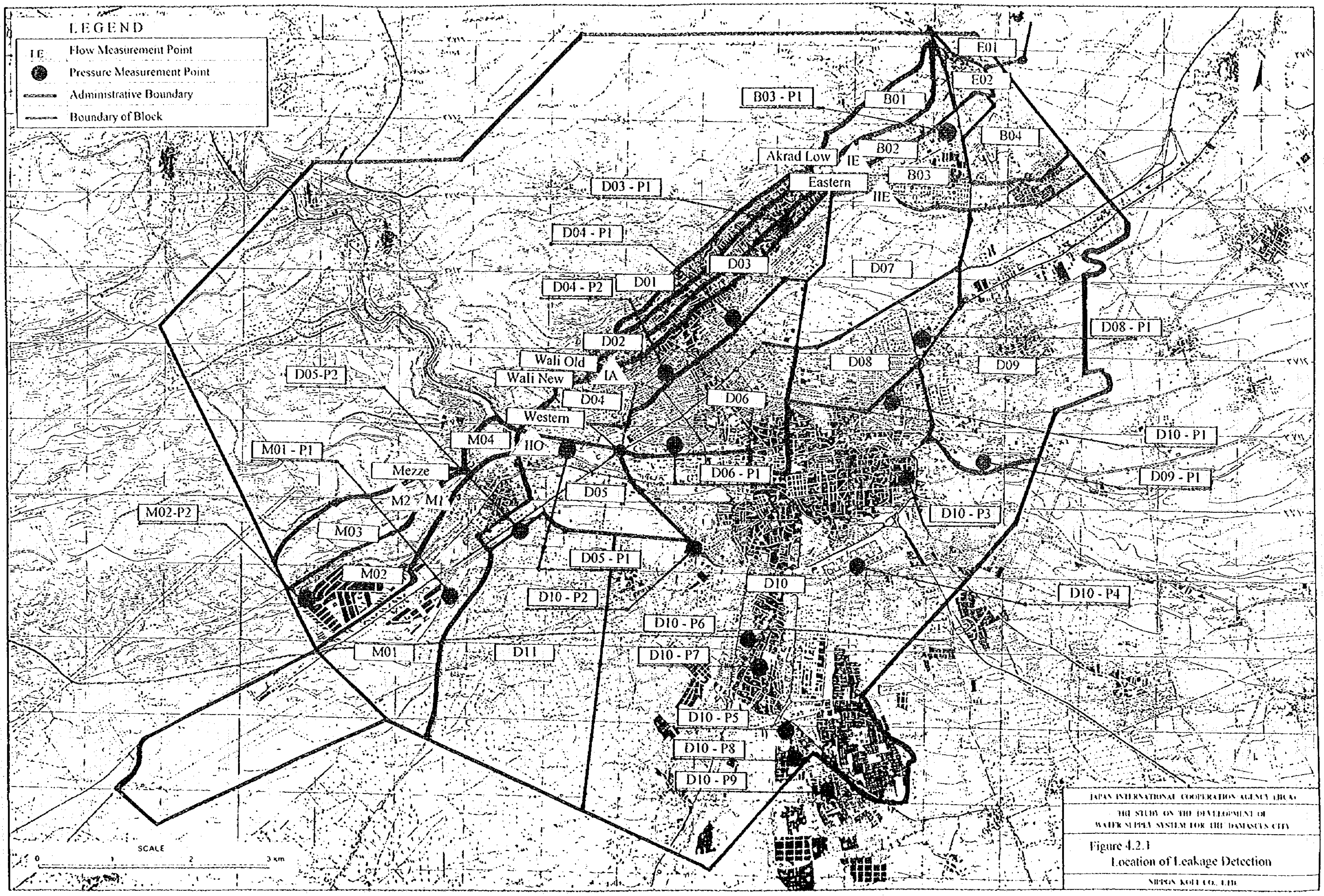
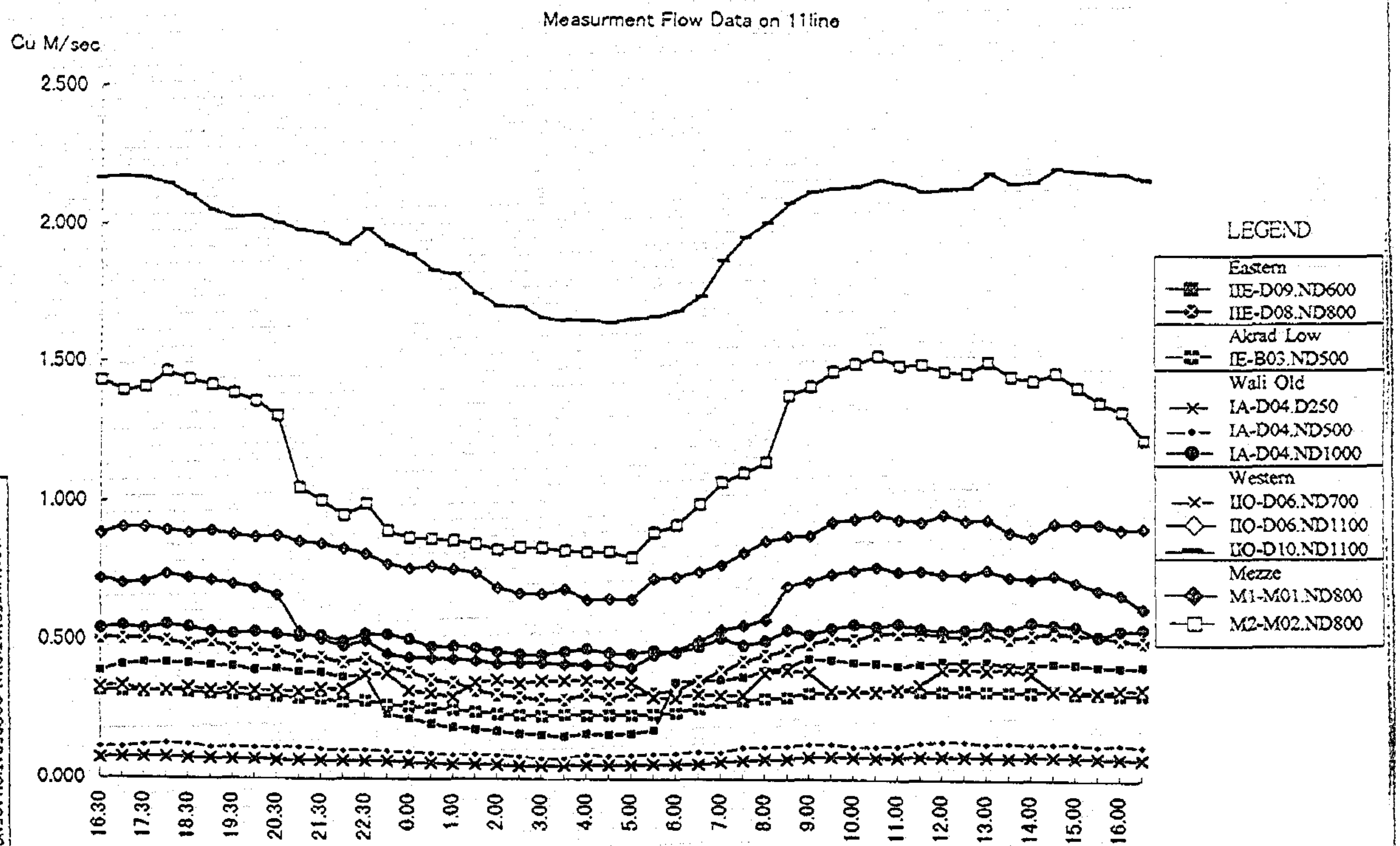


Figure 4.2.1
Location of Leakage Detection

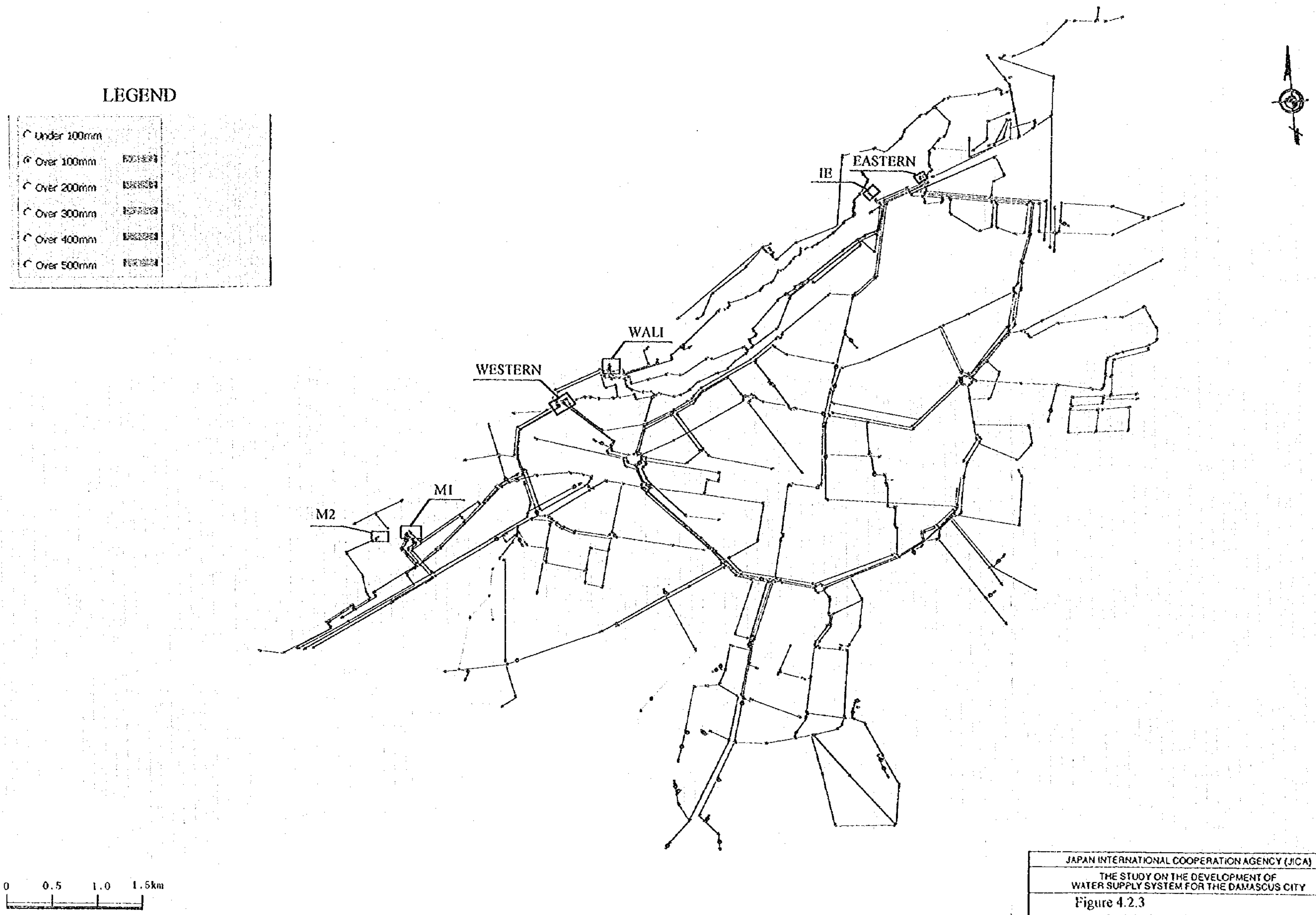


JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)

THE STUDY ON THE DEVELOPMENT OF WATER SUPPLY SYSTEM FOR THE DAMASCUS CITY

Figure 4.2.2 Measurement Flow data

NIPPON KOEI CO., LTD.



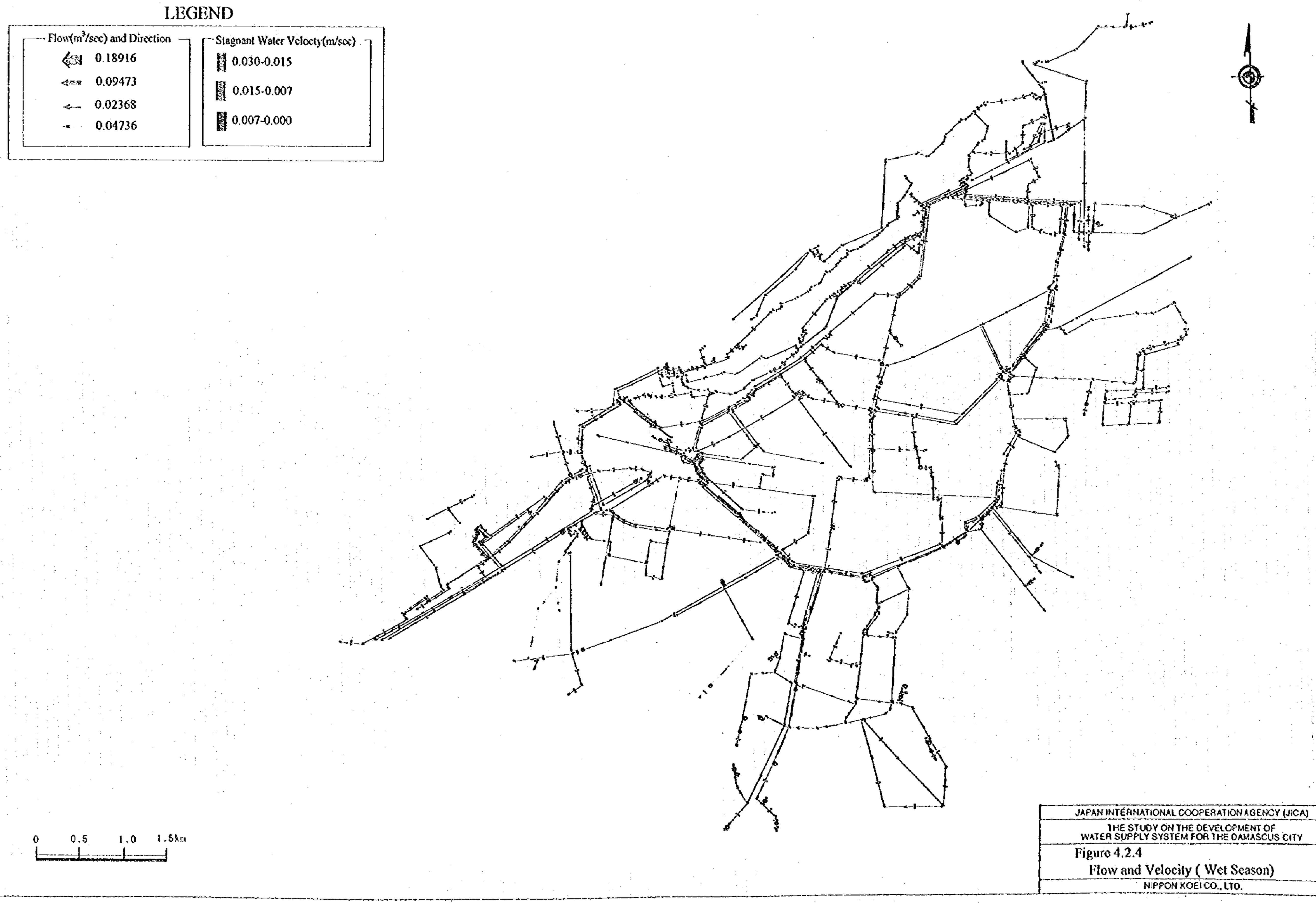
JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)

THE STUDY ON THE DEVELOPMENT OF WATER SUPPLY SYSTEM FOR THE DAMASCUS CITY

Figure 4.2.3

Net Work Model

NIPPON KOEI CO., LTD.

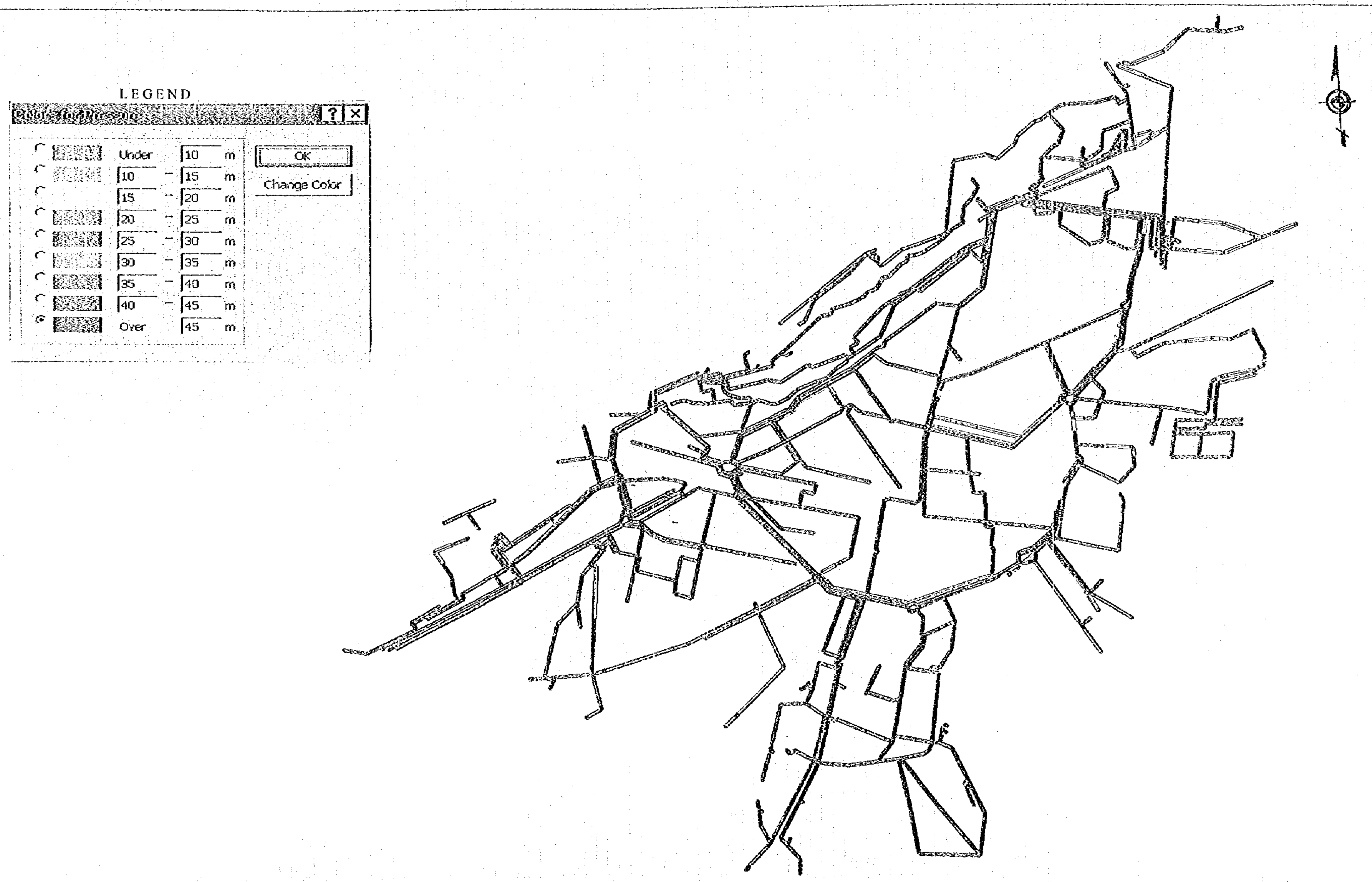


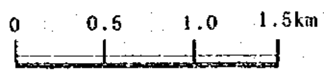
JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)

THE STUDY ON THE DEVELOPMENT OF WATER SUPPLY SYSTEM FOR THE DAMASCUS CITY

Figure 4.2.4
Flow and Velocity (Wet Season)

NIPPON KOEI CO., LTD.





JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)

THE STUDY ON THE DEVELOPMENT OF WATER SUPPLY SYSTEM FOR THE DAMASCUS CITY

Figure 4.2.5

Pressure (Wet Season)

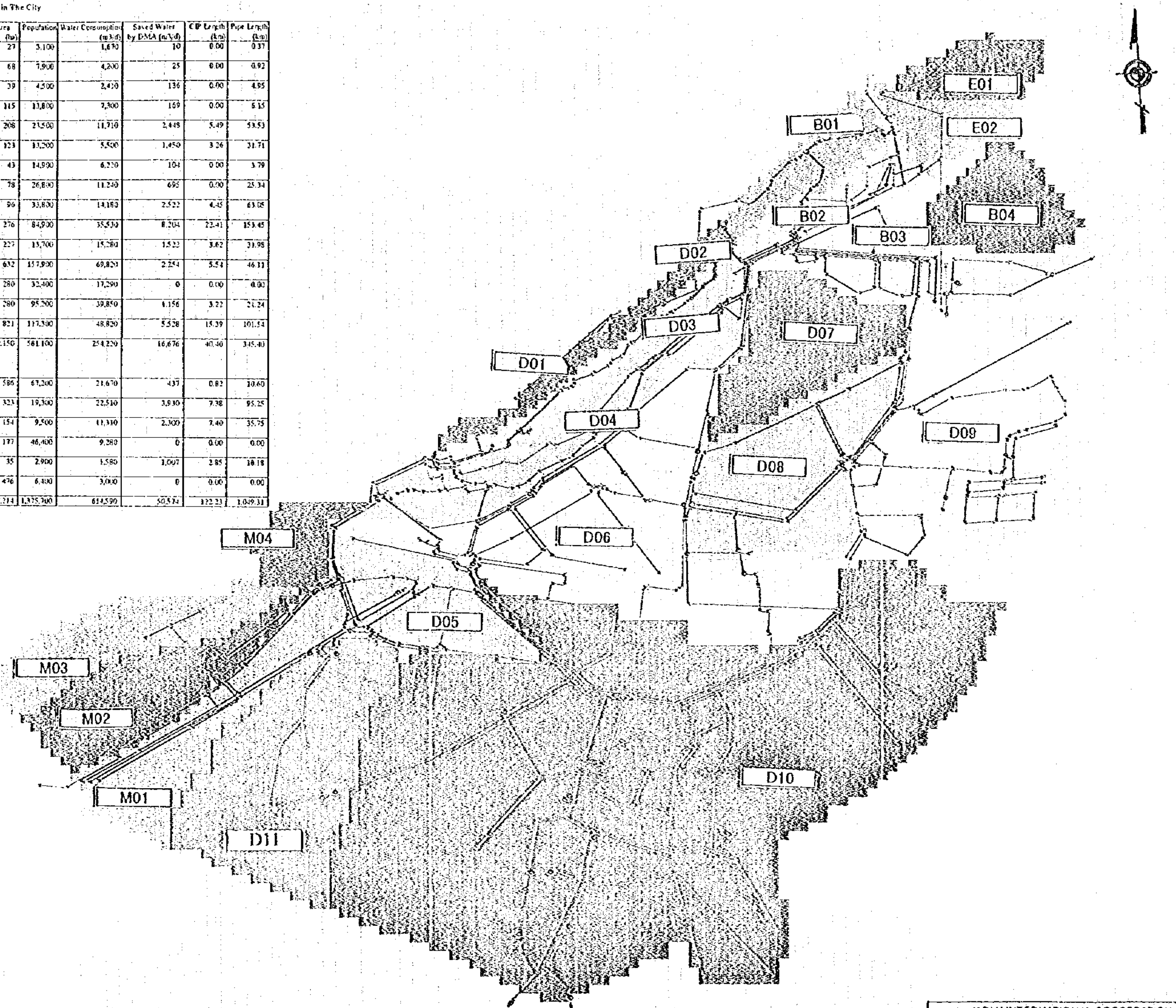
NIPPON KOEI CO., LTD.

Characteristic of Large Blocks in The City

No. of Large Block	Pressure Zone	Name of Water Source (Service Reservoir and Production Well Center)	Area (ha)	Population	Water Consumption (m3/d)	Saved Water by DMA (m3/d)	CIP Length (km)	Pipe Length (km)
E01	Eastern Berze High I	Kaboon Booster Pumping Station & High S.R. (C.k)	27	3,100	1,610	10	0.00	0.37
E02	Eastern Berze High I	Berze Village S.R. (B.Iv)	68	7,900	4,200	25	0.00	0.92
B01	Berze High II	Akrad High S.R. (B.2)	39	4,500	2,430	136	0.00	4.95
B02	Berze High I	Berze Buhooth S.R. (B.1b)	115	13,800	7,300	169	0.00	6.15
B03	Berze Medium	Akrad Low S.R. (I.E)	206	23,500	11,710	2,448	5.49	53.53
B04	Berze Medium	Kaboon Booster Pumping Station & High S.R. (C.k)	123	13,200	5,500	1,450	3.26	31.71
D01	Damas Center Superior High	Kassioun Superior S.R. (K.7)	43	14,900	6,220	104	0.00	3.79
D02	Damas Center High II	Kassioun High S.R. (K.3)	78	26,800	11,240	695	0.00	25.34
D03	Damas Center High I	Kassioun Middle S.R. (K.1)	96	33,800	14,180	2,522	4.45	63.05
D04	Damas Center Medium	Wali S.R. (I.A)	276	84,900	35,530	8,204	22.41	153.45
D05	Damas Center Medium	Western S.R. (II.O) University P.W.C. (J.A)	227	13,700	15,280	1,522	3.62	31.98
D06		Western S.R. (II.O) Oumawiyin P.W.C. (A.2)	632	157,900	69,820	2,254	5.54	46.11
D07	Damas Center Low	Ibn Al Nafeas S.R. (N.1) Mazraa P.W.C. (M.2a)	280	32,400	17,290	0	0.00	0.00
D08	Damas Center Low	Eastern S.R. (II.E)	280	95,200	39,850	4,156	3.22	21.24
D09	Damas Center Low	Eastern S.R. (II.E)	821	117,300	48,820	5,528	15.39	101.54
D10	Damas Center Low	Western S.R. (II.O) Ibn Assaker P.W.C.(A) Kadam Store (K.M) & Kadam Railway P.W.C(K.s) Takadom P.W.C (4)	2,150	581,100	254,220	16,676	40.40	345.40
D11	Damas Center Low	Wali S.R. (I.A)	586	67,200	21,670	437	0.82	10.60
M01	Mezze Medium	Mezze S.R.(M.1)	323	19,300	22,510	3,930	7.38	95.25
M02	Mezze High I & II	Mezze High S.R. (M.2)	154	9,500	11,310	2,300	7.40	35.75
M03	Mezze High I & II	Mezze High S.R. (M.2)	177	46,400	9,280	0	0.00	0.00
M04	Mezze High I & II	Wali S.R. (I.A)	35	2,900	1,580	1,097	2.85	10.18
Airport	Mezze Medium	Mezze S.R. (M.1): Bulk water supply	476	6,400	3,000	0	0.00	0.00
Total			7,214	1,375,300	614,590	50,574	122.23	1,049.31

(Source: DAWSSA & JICA)

Remarks 1) System loss is estimated based on the existing water demand (1995).
2) Existing percentage of system loss is 35 %.
3) Target percentage of system loss is 25 %.



0 0.5 1.0 1.5km

JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)

THE STUDY ON THE DEVELOPMENT OF WATER SUPPLY SYSTEM FOR THE DAMASCUS CITY

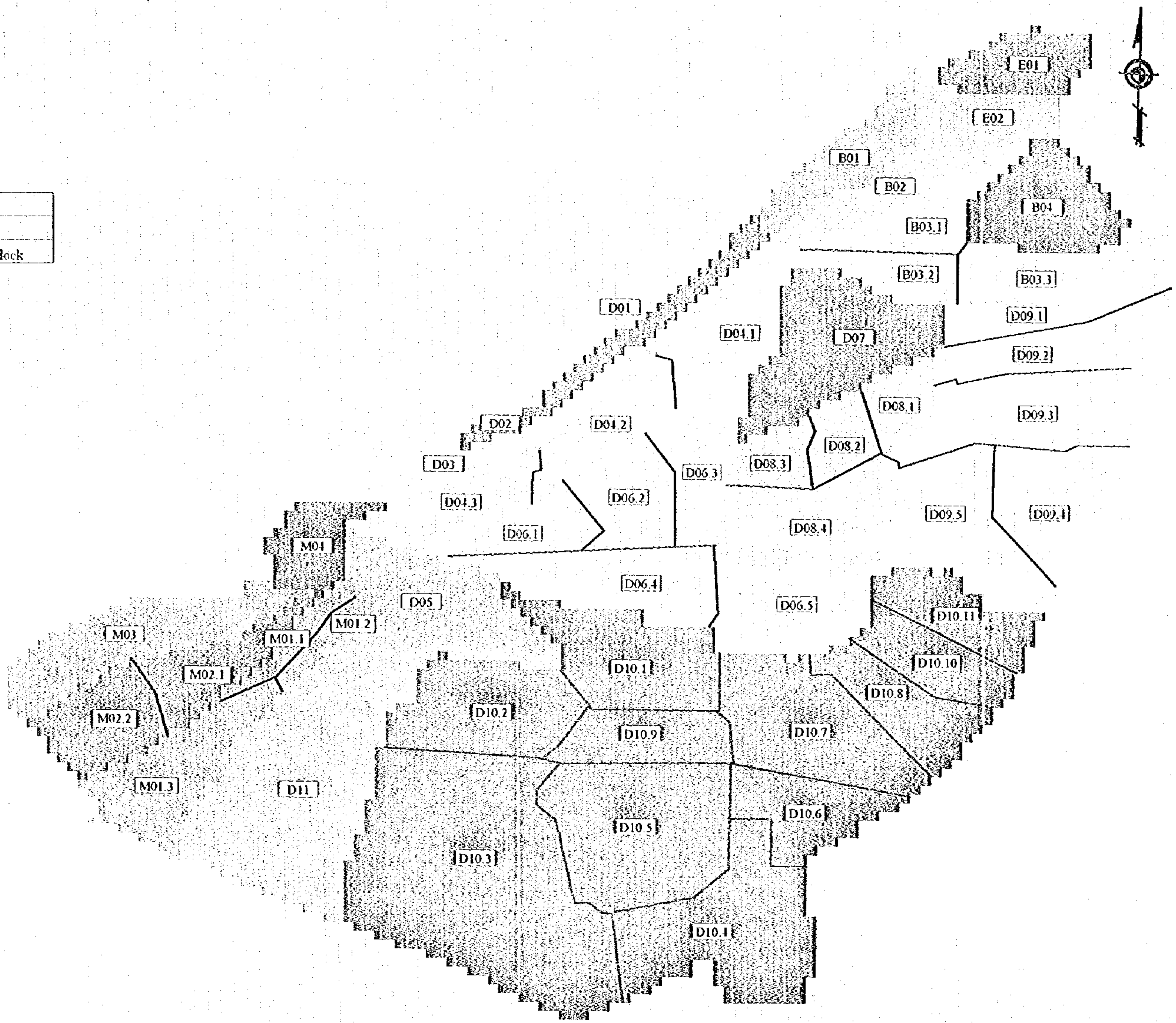
Figure 4.2.6

Large Block System

NIPPON KOEI CO., LTD.

LEGEND

D07	Large Block
D10.1	Medium Block
————	Boundary of Medium Block



0 0.5 1.0 1.5km

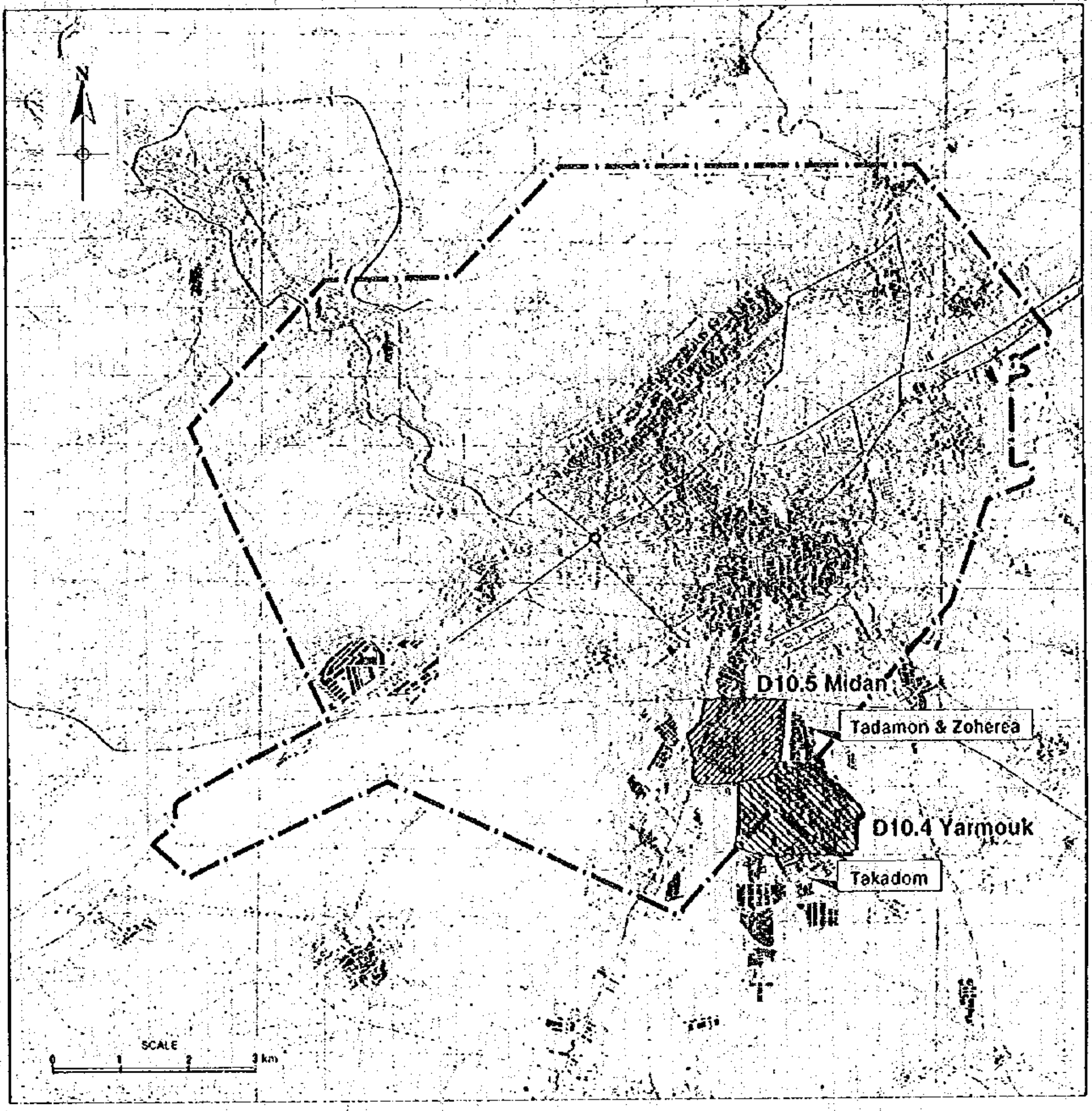
JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)

THE STUDY ON THE DEVELOPMENT OF WATER SUPPLY SYSTEM FOR THE DAMASCUS CITY

Figure 4.2.7

Proposed Block system

NIPPON KOEI CO., LTD.



LEGEND

:D10.5 Midan

:D10.4 Yarmouk

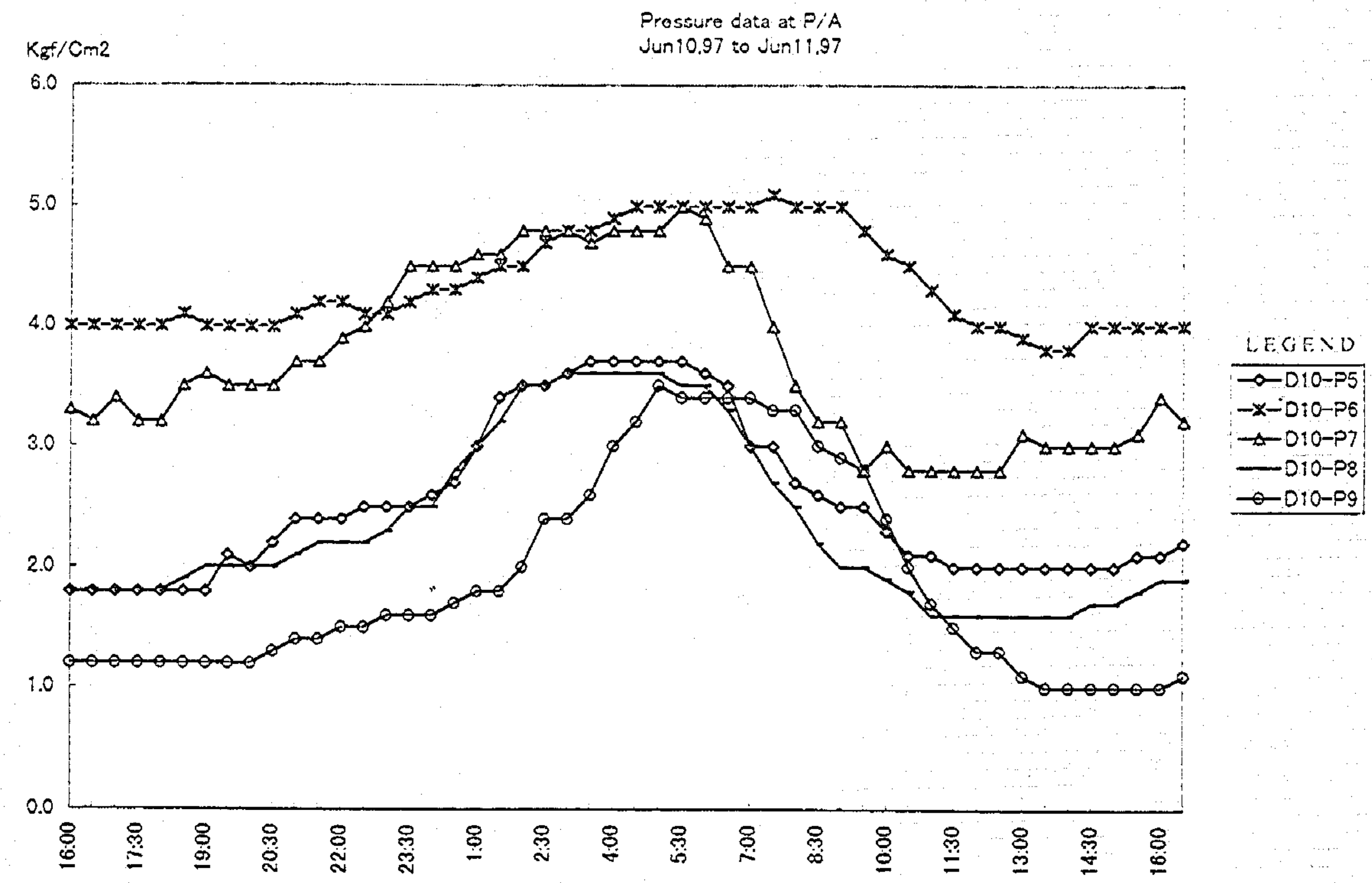
:Informal Connection Area

JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)

THE STUDY ON THE DEVELOPMENT OF WATER SUPPLY SYSTEM FOR THE DAMASCUS CITY

Figure 4.2.8 Pilot Area

NIPPON KOEI CO., LTD.

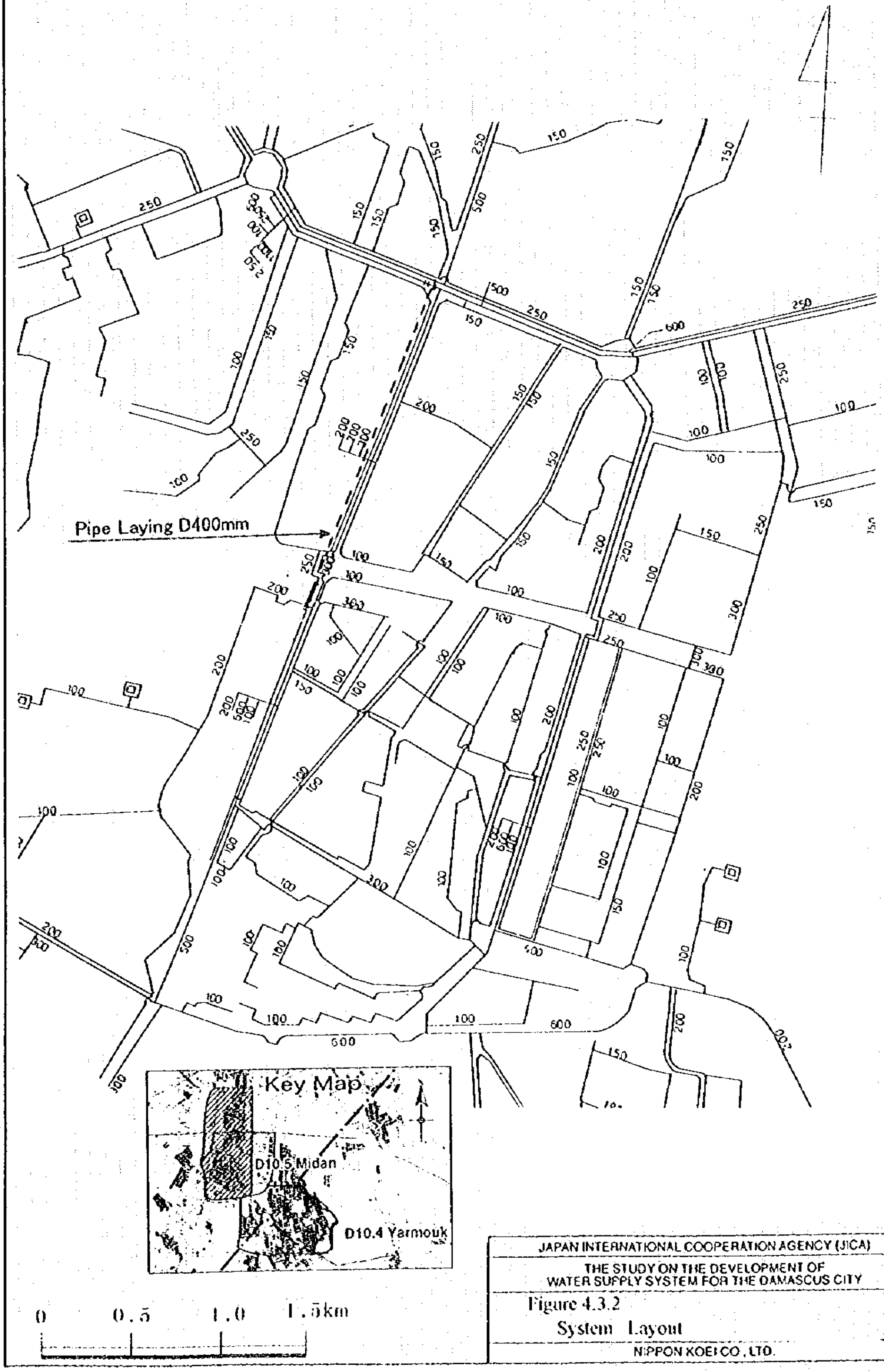


JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)

THE STUDY ON THE DEVELOPMENT OF WATER SUPPLY SYSTEM FOR THE DAMASCUS CITY

Figure 4.3.1
Pressure Records

NIPPON KOEI CO., LTD.



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THE STUDY ON THE DEVELOPMENT OF WATER SUPPLY SYSTEM FOR THE DAMASCUS CITY

Figure 4.3.2

System Layout

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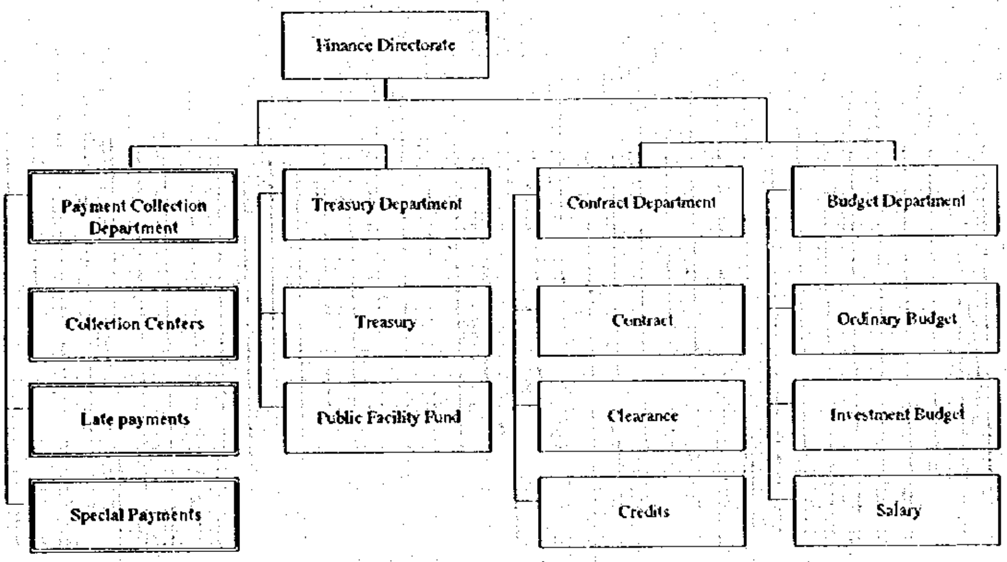
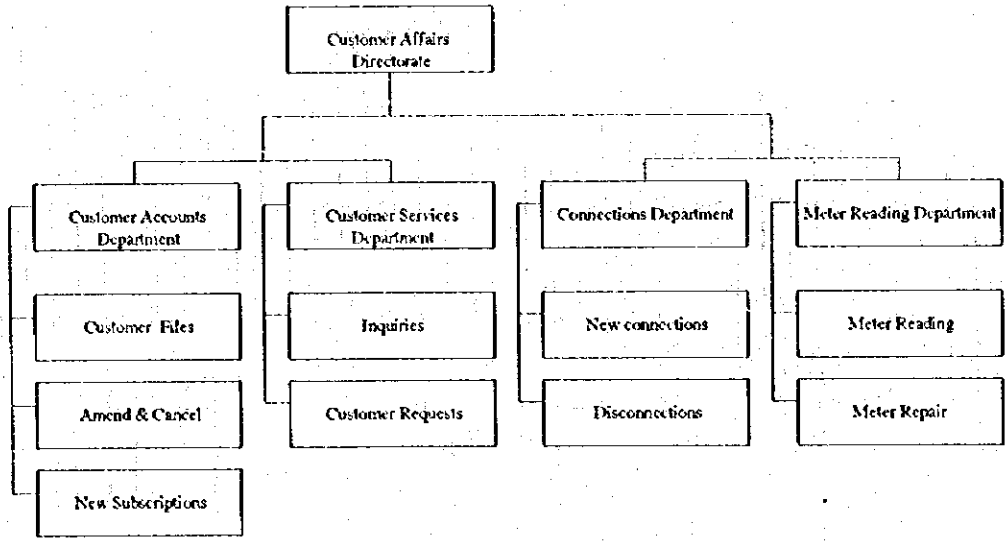


☐ indicates responsibility moved from Customer Affairs Directorate



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THE STUDY ON THE DEVELOPMENT OF WATER SUPPLY SYSTEM FOR THE DAMASCUS CITY

Figure 4.5.1 (1/2)
Proposed Organizational changes

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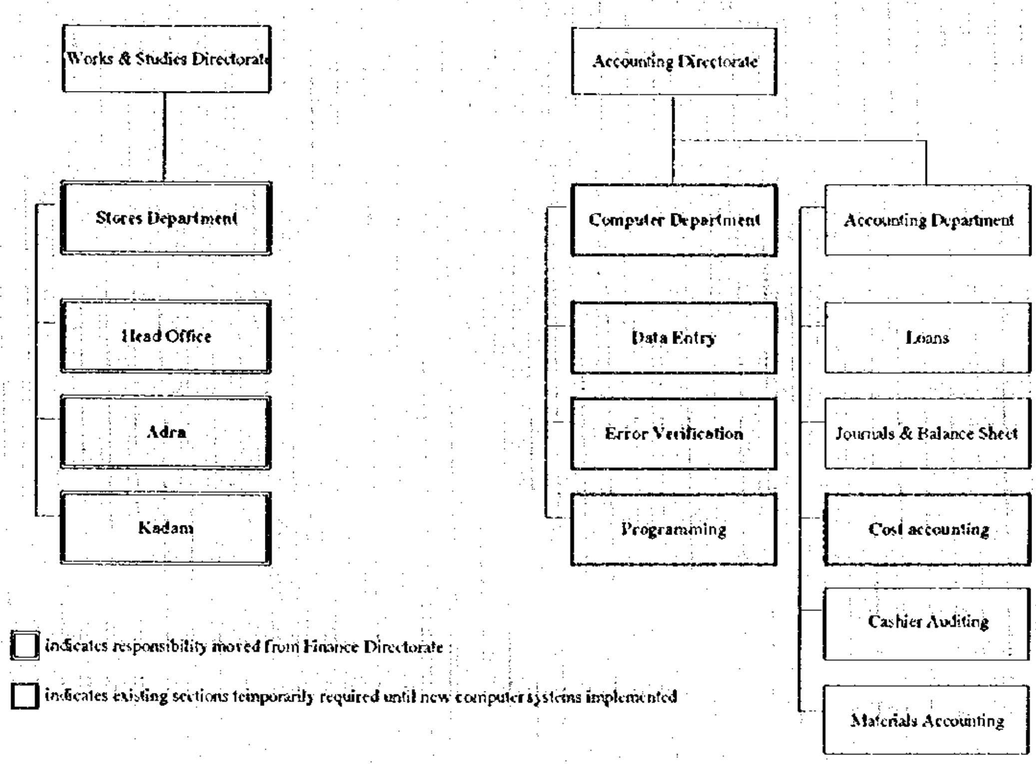

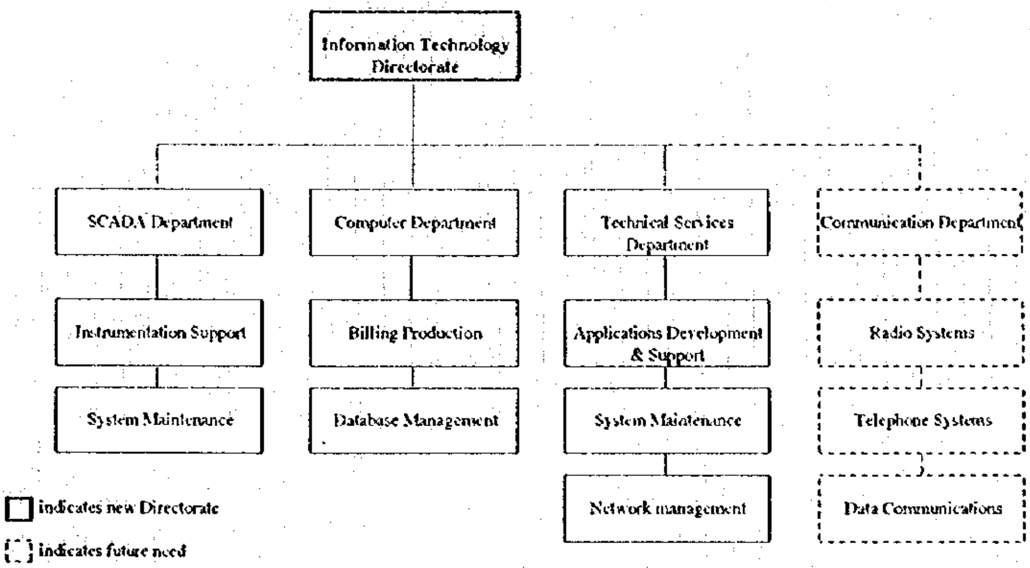

JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)

THE STUDY ON THE DEVELOPMENT OF WATER SUPPLY SYSTEM FOR THE DAMASCUS CITY

Figure 4.5.1 (2/2)

Proposed Organizational Changes

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Billing district		Month 1				Month 2				Month 3				Month 4				Month 5				Month 6				Month 7				Month 8				Month 9				Month 10				Month 11				Month 12			
No. Name	Bills	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4
1 Kanawat	15,987	m			d	b												m			d	b												m			d	b											
3 Akrad	11,031		m			d	b												m			d	b												m			d	b										
4 Janoub Yazid	11,031			m		d	b													m		d	b													m		d	b										
5 Salhia Sharkia	6,587		m			d	b												m			d	b												m			d	b										
6 Salhia Gharbia	9,094		m			d	b												m			d	b												m			d	b										
13 Shagour	1,001				m		d	b													m		d	b													m		d	b									
7 Mohajreen	13,923				m				d	b											m				d	b											m				d	b							
8 9,10 Kimaria	22,294				m				d	b											m				d	b											m				d	b							
2 Ziftia	6,294						m			d	b												m			d	b												m			d	b						
15 Sarouja	14,241						m			d	b												m			d	b												m			d	b						
14 Midan	15,141								m			d	b												m			d	b												m			d	b				
21 Joubar	9,801								m			d	b												m			d	b												m			d	b				
26 Kassioun	9,599								m			d	b												m			d	b												m			d	b				
22 Tabala	2,826									m				d	b											m				d	b											m				d	b		
19 Masaken Barza	7,182											m			d	b												m			d	b												m			d	b	
20 Kaboun	5,492												m		d	b													m		d	b													m		d	b	
11 Sharky Al Tijara	1,835												m		d	b													m		d	b													m		d	b	
12 Barza Al Balad	3,012												m			d	b												m			d	b												m			d	b
17 18, Doumar, Kiwan	12,701	b													m		d	b													m		d	b													m		d
24 Kadam	4,900	b												m			d	b												m			d	b												m			d
25 Kafersousse (2)	9,332	b												m			d	b												m			d	b												m			d
16 Mezze(2)	16,127		d	b												m			d	b												m			d	b												m	
23 Moukhaiam (2)	18,813			d	b												m			d	b												m			d	b												m

m =meter reading

d =data entry based on actual meter reading

b =bill issued to collection centre

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Figure 4.5.2 Billing Schedule
Based on a 4 Month Cycle

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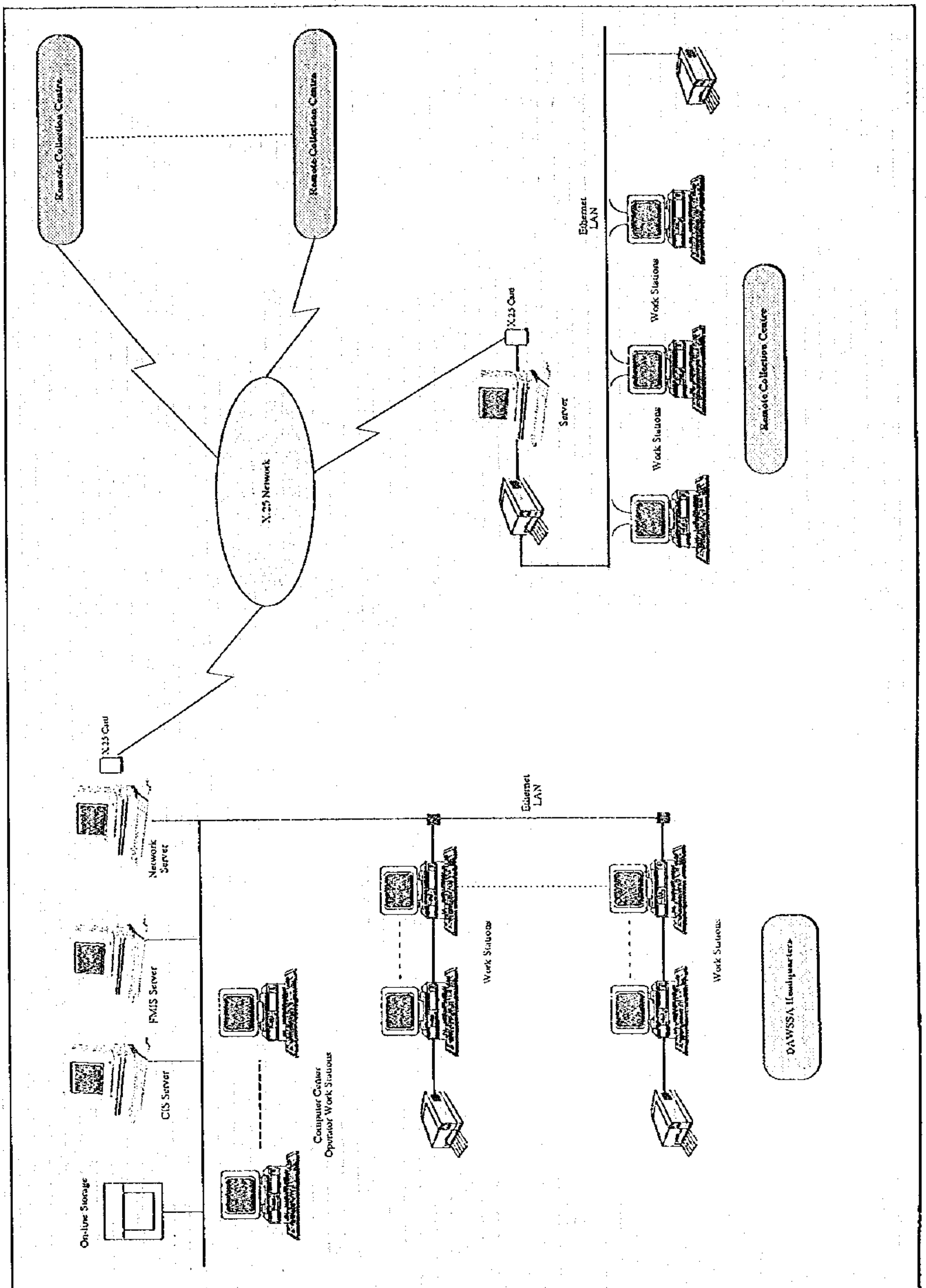

JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)

THE STUDY ON THE DEVELOPMENT OF WATER SUPPLY SYSTEM FOR THE DAMASCUS CITY

Figure 4.6.1

Computer System Configuration

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5. THE PROPOSED PROJECTS

5.1 Objectives

The main and physical components objectives of the project are to provide an adequate reliable water supply in the dry season and to increase water available for consumption to meet future demand by reducing the unaccounted for water (UFW) in DAWSSA's distribution network. Concurrently, an indispensable objective for DAWSSA's management is to strengthen revenue management by improving collection of water charges and financial management information.

The principal objectives for physical components and financial management improvement are described hereafter.

5.1.1 Physical Components

The UFW study was carried out during Phase I, and assessed the current situation in Damascus, where 64 % of the total water production in 1995 was attributed as being unaccounted for water. Some of the major contributory factors for leakage in Damascus are the informal areas where there are great losses from old cast iron mains, some of which date back to the early part of this century. Therefore measures for reducing leakage losses in the distribution network are required in addition to finding new sources of water. In order to reduce the unaccounted for water figure, a water leakage production program based on the District Meter Area (DMA) system and a water supply project for the Mezze-Razy & Kafar Souseh-Lawan informal area were proposed in the Main Report for Phase I, as priority projects to proceed immediately to the Feasibility Study stage.

(1) Plan for the DMA System

The DMA system will be established as a countermeasure to alleviate water shortage problems by improving leakage detection through the regional control of water supply amounts.

The implementation of DMA is an essential requirement for an effective leakage control strategy as mentioned in Chapter 4.5 in the Main Report of Phase I. Without any information on district flows, it is impossible to determine accurate leakage levels or pin-point where maintenance and leakage should focus their efforts. The DMA system is required to reach the targets identified in the Master Plan for reduction of system leakage.

In an attempt to measure leakage more directly rather than estimating it from a block balance approach, the flows for each DMA blocks are recorded regularly. The advantage of this technique is that it can be used to target detection efforts more efficiently (since leakage levels will vary from area to area) and the leakage teams will be directed to those areas with high leakage levels.

In the study, the flow rate monitoring system is proposed to formulate a water leakage control system and provide a water consumption monitoring system in the distribution network by the DMA method.

A pilot area was selected among the proposed medium blocks for the purpose of demonstrating flow rate monitoring with ultrasonic flow meters and obtaining the necessary data for water leakage control.

(2) Development Plan for the Distribution Network in the Mezze-Razy & Kafar Souseh-Lawan

There are currently 14 informally populated sites in and around Damascus and these sites are a major contributing factor to unacceptably high levels of unaccounted for water. There is an estimated population of 407,000 persons with a daily water consumption of 78,580 m^3/d. Besides the fact that no revenue is generated from this informal water consumption, there are also substantial losses through leaks at informal connection points.

Improving water supply conditions in the informal areas was identified as a priority by municipal authorities. It is proposed to improve water supply in informal areas by 2005 as described in the Section 4.5 in Main Report of Phase I.

The projects are aimed at improving availability and safety of potable water supply and reducing leakage at informal area connection points. These objectives will be achieved by extending water main coverage and providing properly metered service connections. A total eleven improvement schemes are selected for the master plan except where DAWSSA has already initiated a feasibility study.

The 11 informal areas proposed as priority projects were further ranked to determine implementation priority by applying three factors:

i) the ratio of project cost the amount of water consumed through informal use, the lower the ratio the higher the benefit
ii) the degree of urgency based on social needs and,
iii) economic viability.

The Mezze-Razy & Kafar Souseh-Lawan project was ranked as the highest priority. There is a large population living in this informal area which is located in the heart of Damascus City. Informal use is high and the projects are urgently required to meet basic human needs and generate large savings in unaccounted for water.

While this area is categorized as an informal residential area, the development plan will identify connections to and extension of DAWSSA's water supply system. Therefore, the comprehensive coordination between water supply development and regional urban development is very important. Environmental aspects and integration with existing infrastructure will be considered as one of the important requirements for this plan.

5.1.2 Financial Management Improvement

A primary factor to the existing financial management problems of DAWSSA is inefficiency of the systems for the collection of water charges and customers services.

At present the collection of water charges from customers takes over one year due to an inefficient meter reading and billing process. This matter seriously affects DAWSSA's financial performance and ability to manage.

As a counter measure to the problem, it is desirable to improve the billing and collection system by structuring a computerized database to manage metering data and customer accounts. The intention of the billing and collection system is to ensure that sufficient revenues are available to operate, maintain the water supply system, and provide finding for investment of projects.

The plan includes recommendations on organizational changes, manpower and training required to support automation and provide greater integration of DAWSSA's financial management functions. Improvement plan on financial management functions is described in Chapter 6.

5.2 DMA System

5.2.1 General

The loss of water through transmission and distribution system leakage has always been of concern to DAWSSA. The present UFW in the system is estimated at 63 % of water production and consists of 14.4 % for meter malfunction, 13.6 % for informal use and 35.0 % for system leakage. This system leakage is rather large and is also wasteful use of resources. Leakage also increases the likelihood of inadequate water pressure and may, in some cases, increase the risk of water contamination. A leakage control policy is essential and important for any water utility. The adequate leakage control policy should be based on an economic balance between the benefits of leakage reduction and the costs of planning, implementing and running the leakage control program.

An active and well-planned leakage control program is a positive indicator of DAWSSA's overall management ability and effectiveness and also a direct measure for enhancement of its efficiency. It is imperative that DWSSA has an active policy for reduction of UFW, and that the determined policy optimize: 1) the operation of the whole supply system, 2) availability of resources and 3) satisfaction of demand.

5.2.2 Leakage Detection and Control

A leakage detection and control program based on the DMA system is proposed with the following components:

i) A mains renewal plan to reduce the level of leaking lead joints on cast iron mains and reinforce the existing distribution system thus safeguarding supplies.
ii) A plan setting up the DMA system that will enable DWSSA to monitor the flow rate of distribution system and identify areas of high leakage.
iii) A plan for setting up regulated pressure zones which will reduce the levels of leakage in high pressure zones. This program supports the DMA system.
iv) A program for reinforcement of regular acoustic sounding surveys for leak detection at the distribution system in cooperation with the DMA system.
v) A program for water supply improvement with establishment of DMA system in informal areas like the Mezze-Razy & Kafar Souseh-Lawan System planned in this stage.

The water main replacement program identified in the Master Plan is recommended and proposed as an urgent priority. It is described in detail in the Section 3.1.7, because it is closely linked to the implementation of the DMA system. The program for improving water supply in informal areas was proposed by the Master Plan and is not discussed in this report.

5.2.3 Proposed DMA Plan

The DMA system was proposed and formulated to provide DAWSSA with an active leakage control program, as shown in Figures 4.2.6 and 4.2.7. The proposed DMA system consists of 50 blocks including SCADA01, 13 large blocks and 36 medium blocks.

The DMA system requires a set of sluice valves, and monitoring chambers to be installed at the intersections of pipes with the DMA borders. To set the borders, therefore, it is important to take into account the cost of installation and O&M, in addition to the general operational requirements. The locations of monitoring chambers used for standing and seasonal flow monitoring are given in Figure 5.2.1. Flow meters, pipes and valves required for the establishment of the DMA system are presented in Figure 5.2.2 and Table 5.2.1. The required equipment is summarized below:

Standing monitoring chamber	32	(for Large Blocks)
Seasonal monitoring chamber	133	(for Medium Blocks)
Gate valve (ND150 mm)	3	
Butterfly valve (ND500 mm)	2	
Reduction valve (ND150 mm)	1	
Reduction valve (ND 400 mm)	1	
Reduction valve (ND 800 mm)	1	
Ductile Iron pipe (ND200 mm to ND600 mm)	2,000 m	

5.2.4 Monitoring and Inspection of Blocks

To run the DMA system efficiently, it is important to take into account both the operation itself and operation costs. The monitoring schedule for the DMA system is shown in Figure 5.2.3 and the implementation schedule for setting up the DMA system is discussed later in Section 5.5. The program for setting up regulated pressure zones was included in the DMA program.

- All flow rate for DMA blocks shall be monitored once per season (wet and dry), and the flow rate of large blocks will be monitored and inspected monthly. For safe and accurate installation of flow meters, an installation team shall consist of two workers per team. A team will be able to install a maximum of 7 portable flow meters a day, and all flow meters that surround a DMA block will have to be installed at the same time. Therefore, it will take two teams to install all flow meters in a medium block as the maximum number of monitors is 13.

Flow rate monitoring shall be conducted for 24 hours, which will take 2 days to complete. To monitor all 49 DMA blocks during the wet season (4 months), a total of 98 days will be needed, and two teams will be needed for monitoring and maintenance of medium blocks. Flow rate of large blocks shall be monitored and inspected monthly because flow meters equipped with data logger will be used. The team required for these tasks shall consist of two workers. Every month, all 23 blocks are to be monitored with the standing monitoring chamber, and the pressure/flow rate data to be collected. Considering the data handling, an appropriate data acquisition interval would be 5 minutes. An engineer is also needed for simulations and analysis of leakage. Therefore, the entire operation requires 3 teams and one engineer, or seven workers.

5.2.5 Leakage Detection Survey

The current leakage control teams in DAWSSA consist of 4 teams of 5 surveyors/team, or 20 surveyors. However, regular survey is not practiced, and their activities are generally limited to case-based ones. The suggested leakage survey activities are summarized below.

i) Selection of priority survey areas shall be cast iron pipes, high pressure zones, D10 block (especially Yarmouk area) and areas with high minimum flow.

ii) Survey methods consist of three activities: 1) Day time activities - Leak sound surveys of protruding part of system, such as hydrant and valves, 2) Night time activities - Leak sound survey of pipes at the sites where leakage is suspected in the Day time activities above, and 3) Day time activities - Confirmation of leakage at the site selected by leak sound survey of pipes above.

iii) For the confirmation survey, the leakage site is pinpointed by comparing the leak sounds at different holes (about 19 mm) in the ground (road) drilled by a hammer drill.

iv) Since the ground in Damascus is hard and sound of leakage is easily transmitted to the ground surface, leakage survey based on leak sound method appears to be the most suitable choice.

v) The total length of distribution pipes in 50 DMA blocks is about 1,220 km. Assuming these pipes are investigated once a year, and 200 working days per year, the survey distance is about 6.1 km/day, or 30.5 km/week (5 days). This work load requires at least two teams of two surveyors per team, or 4 surveyors.

vi) Required equipment for survey is 4 leak detectors, 4 leak sound detection bars, 2 pipe locators, 2 hammer drills, 2 boring bars, and 2 vehicles.

The teams need to be coordinated and their works have to be scheduled. A full-time system is recommended. The schedule for the program of reinforcing regular acoustic sounding surveys is presented in Figure 5.2.4.

5.3 Mezze-Razy & Kafar Souseh-Lawan System

5.3.1 Design Criteria

The following DWSSA design criteria are adopted for the improvement plan of Mezze- Razy & Kafar Souseh-Lawan system:

i) Minimum effective head	: 30 m
ii) Maximum velocity	
• Distribution main (at least ND250 mm)	: less than 2 m/s
• Distribution sub-main (Secondary & Tertiary)	: less than 1 m/s
iii) Quality of materials	
• Distribution main (at least ND250 mm)	: Ductile iron pipe
• Distribution sub-main	
Secondary pipe (at least ND100 mm)	: Ductile iron pipe
Tertiary pipe (less than ND100 mm)	: Polyethylene pipe
iv) Interval of hydrants	: 300 m to 400 m
v) Type of hydrant	: French/USA (underground type)
vi) Seasonal load factor	: 1.14
vii) Hourly load factor	: 1.25

Mezze- Razy & Kafar Souseh-Lawan system should be developed in accordance with the proposed DMA plan as described in the Section 5.2.3. The DMA plan recommends that the Mezze- Razy & Kafar Souseh-Lawan area be part of the large block D11 to be supplied from the Wali service reservoir as illustrated in Figure 5.3.1. This recommendation also was adopted as design criteria.

5.3.2 Overall Water Supply Improvement Plan

The overall water supply improvement plan is formulated as shown in Figure 5.3.1, in consideration of the existing conditions in the area, results of network analysis for the whole distribution system, the DMA plan, the water requirements and the above stated design criteria. The improvement plan covers water demand not only for the Mezze- Razy & Kafar Souseh-Lawan area but also for the areas adjacent to the study area where informal residents have settled and connected to the distribution system as described in the Section 4.4.

The goals for analysis of the water distribution network are as follows: i) analyze the existing system to identify difficulties, ii) address the existing system difficulties (e.g. increase diameters, add loop distribution network, etc.) and analyze impact of improvements, iii) identify ways of increasing the supply and extending the distribution network. The technical approach and method for planning is described below:

(1) Analysis of the existing water supply system

The existing water supply system in the study area is shown in Figures 5.3.2 and 5.3.3 (refer to the aforesaid Section 3.2.3). Water is supplied in the area by a 250 mm diameter distribution pipeline from the Wali service reservoir and a 150 mm diameter distribution pipeline from the Western service reservoir. The existing distribution network consists of a looped distribution network in Mezze- Razy and a branched distribution system in Kafar Souseh-Lawan.

An analysis of the existing water supply system is used in order to evaluate potential differences such as insufficient flow, low pressure, etc. and compare with the results of the interview survey as described in the Section 3.2.3. The analysis is based on the following assumption:

i) Service reservoir : Wali service reservoir (LWL: +800.17 m)

ii) Elevation of effective head at measured point of water main (D05-P1) : 31.50 m (measured)

iii) Combined ND150 mm and ND100 mm : Equivalent diameter is 169 mm
iv) Daily average water requirements : only formal residents in the area

The above head loss of 31.5 m was measured during this study on the 250 mm inlet pipe at the pressure measurement point (D05-P1) about 2,000 m away from point (M3-381). The analysis of the looped network is presented at Table 5.3.1 and the summary of the flow network analysis including the branched network is shown in Table 5.3.2. Problems of the existing system are clarified as follows from the analysis:

i) The result of the looped network analysis indicates that conditions of the existing system are normal, however head loss and velocity are estimated to be extremely high when water requirements for informal use are included.
ii) As for the branch system (see Table 5.3.2), the effective head in the Kafar Souseh-Lawan area supplied through the pipeline connected with Mezze-Razy is negative. This result indicates that flow capacity of the existing pipe is not enough and residents cannot get water adequately.
iii) Analysis of the city wide network indicates that the ND250 mm feeder main from the Wali reservoir has insufficient capacity to meet the flow of the existing service area plus those of the informal areas in Kafar Souseh district. The effective head at the end of the ND250 mm (M3-381) main is calculated at less than 10 m.
iv) The results of the analysis coincide with the results of the interview survey carried out by the JICA Study Team in collaboration with DAWSSA. For instance, 67% of residents in the Kafar Souseh-Lawan area complained about insufficient water quantity and 56% identified low pressure.

It is therefore necessary that the improvement of Mezze-Razy & Kafar Souseh-Lawan distribution system including informal areas be planned taking into consideration not only the distribution system in the area but also the new distribution trunk and the possibility of water supply from other service reservoirs.

(2) Frameworks for improvement plan

Proposed improvements to correct deficiencies in the Mezze- Razy & Kafar Sousch-Lawan system are shown in Figure 5.3.4. The capacity of the new distribution trunk main was determined for the total water requirements of block D11 recommended by the DMA plan. The existing trunk main (ND800 mm) from Wali service reservoir was selected as a transmission pipe, since the flow capacity of the exiting pipes (ND250 mm and ND150 mm) from the Wali and Western service reservoirs was not enough to supply for the residents. The existing trunk main (ND800 mm) is located at the Faez Mansour Moterway on the north of the block D11.

The plan was formulated based on the following factors:

Factor	Service Area (ha)	Population Served	Water Requirements including UFW (m^3/d)
i) Mezze- Razy & Kafar Sousch-Lawan area	191	46,800	15,070
• Formal area	47	14,800	4,770
• Informal area	93	32,000	10,300
• Farmland/Green area	51		
ii) Large Block: D11 considered for plan of distribution trunk main	395	20,400	6,600
• Formal area including farmland	395	5,600	1,820
• Informal area	43	14,800	4,780
Total	586	67,200	21,670

(3) Network analysis for improvement plan

The analysis for the above frameworks was conducted on the same assumption of the existing network analysis, in order to evaluate each alternative of transmission pipeline and distribution service reservoir. The looped distribution network was analyzed tentatively as presented in Table 5.3.3. The result of flow network analysis in case of the Wali service reservoir is summarized in Table 5.3.4 and in Table 5.3.5 in case of the Mezze service reservoir.

(4) Alternatives for improvement plan

The DMA plan recommends that the Mezze-Razy & Kafar Souseh-Lawan area be part of block D11 to be supplied by the Wali service reservoir although the area is supplied from the Wali service reservoir and the Western service reservoir at present. Since the Western service reservoir covers almost 70% of the service area in the City, it is not affordable to supply new areas and the flow capacity of the exiting pipes (ND250 mm) from the Wali service reservoirs is not enough to supply for the existing area, the following alternatives are proposed:

i) Alternative 1: construction of a new distribution trunk main from water main (ND800 mm) of the Wali service reservoir
ii) Alternative 2: construction of a new distribution trunk main from the Mezze service reservoir

The above alternatives are compared as follows:

	Name of Service Reservoir	Length of New Trunk Main
Alternative 1	Wali	ND600 mm: 700 m ND500 mm: 250 m
Alternative 2	Mezze	ND600 mm: 1,800 m ND400 mm: 500 m

Alternative 1 is the cheapest for initial cost and O&M cost, and more reasonable from a technical perspective. Alternative 1 is proposed for the water supply improvement plan of Mezze-Razy & Kafar Souseh-Lawan system as shown in Figure 5.3.1and 5.3.4. The network of the proposed plan is analyzed in Table 5.3.6. The proposed network plan considers the utilization of the existing pipe network as far as possible.

(5) Summary of improvement plan

Outline of the improvement plan was summarized as follows:

i) Planned service area : 191 ha
ii) Planned population served : 46,800 persons

iii) Service reservoir : Wali New service reservoir
iv) DMA system block : D11
v) Improved informal population : 32,000 persons
vi) Water requirement for service area
Daily mean water demand : 15,070 m^3/d (174 l/s)
Daily maximum water demand : 17,180 m^3/d (200 l/s)
Peak hourly water demand : 21,475 m^3/d (249 l/s)
vii) Water requirements for D11
Daily mean water demand : 21,670 m^3/d (251 l/s)
Daily maximum water demand : 24,700 m^3/d (286 l/s)
Peak hourly water demand : 30,875 m^3/d (357 l/s)
viii) Distribution system : Looped network

5.3.3 Distribution Trunk Main

The distribution mains from N508 branch point are extended till N508-2 point via N508-1 point by ND600 mm pipes with 700 m length, and till N508-3 point by ND500 mm pipe with 250 m length. Considering a future expansion of pipe network in D11 area, both distribution mains should be provided with a pipeline capacity of required distribution quantity including 248 l/s for Mezze-Razy and Kafar Souseh-Lawan area and 109 l/s for other and joining areas. The existing pipelines of ND150 mm and ND100 mm from N508-1 point should be joined to new distribution pipeline of ND200 mm extending to the network. The new distribution pipeline of ND300 mm branching at N508-3 feeding point should be joined to the network.

A flow meter of ultrasonic type is to be installed on the distribution main of ND600 mm for the permanent measurement of flow-rate in DMA system. The area belongs to D11 in the DMA system and is monitored with flow conditions by a ND 600 mm flow meter.

5.3.4 Distribution Pipelines

The network is composed of the distribution main of ND250 mm to ND400 mm DIP and ND100 mm to ND200 mm DIP as secondary pipelines. ND50 mm to ND80 mm polyethylene pipe (PE) are installed as tertiary pipelines from the network. Total length of new distribution pipeline is approximately 35 km. The existing ND100 mm and ND150 mm DIP has a total length of 8 km and is integrated in the network and used as the distribution pipelines.

Section valves are planned to be installed at downstream sides of branched points and arranged to minimize the areas of water supply suspension by shutting of 2 to 4 valves for repairing the damaged pipeline. To facilitate the monitoring of flow rate conditions, ND400 mm and ND200 mm DIP which are the main supply lines for the Lawan and western growth areas are to be equipped with the flow meter sensors on the pipelines for temporary measurement in the DMA system. The required distribution facilities under the present scheme are summarized in Table 5.3.7.

As for the service connections from secondary and tertiary pipeline to the individual households, polyethylene pipe (PE) is used for branch connection with saddle, brass union sockets and stop cock. DAWSSA is responsible for all aspects of the service from the pipeline to the meter box. The meter box is the responsibility of the subscriber. Water meters for individual house connection are of turbine type meter, 3 cubic meter, 15 mm pipe size, and of Syrian make.

5.4 Cost Estimates

5.4.1 Construction Costs

(1) Composition of project costs

The project costs are composed of direct construction costs, tax and duty, administration costs, engineering costs, physical contingency costs and price contingency costs. The foreign currency portion (F.C.) includes the cost in CIF price of equipment and materials to be imported. The local currency portion (L.C.) includes the costs of labor, equipment and materials procured locally, custom clearance costs and inland transportation costs of imported equipment and materials.

(2) Conditions and assumptions for cost estimates

1) Price level : July 1997
2) Exchange rates used in the cost estimates are as follows;
   US$ 1.0 = SL 45 = ¥ 115 (SL : Syrian Pound)
3) Unit costs : The unit construction costs used in the local currency portion are taken as the unit costs recently used in DAWSSA contracts.
   The unit costs used in the foreign currency portion are taken as the CIF prices of imports from Japan, at Tartus.
4) Import duty : 8 to 28 % of CIF prices of the costs of foreign procurement.
   DIP : 28 %, Valve : 21 %, Water meter : 9 %,
   Steel pipe : 13 %, Pump & Generator : 8 %
5) Stamp duty : 1.248 % of contract amount :
   These tax and duty in SL 35 equivalent to a US dollar.
6) Tax for installation work : 18 % of the cost for manpower supply :
   These tax and duty in SL 35 equivalent to a US dollar.
7) Administration expenses : 10 % of the direct construction cost
8) Engineering services expenses : 10 % of the direct construction cost
9) Land acquisition and compensation : executed by DAWSSA
10) Physical contingency : 10 % of the direct and indirect construction costs
11) Price contingency : 5 % per annum for the local currency component and 3 %
12) for the foreign currency component

(3) Project Costs

The estimated costs of each project are summarized as follows;

(a) District Meter Area (DMA) System Project

(Unit: US$ 1,000)

	Items		L.C.	F.C.	Total
1.	Direct Construction Cost		628	2,647	3,275
2.	Tax and Duty		411	0	411
3.	Administration Cost	(10% of Direct cost)	63	0	63
4.	Engineering Cost	(10% of Direct cost)	63	265	328
5.	Physical Contingency		75	291	366
6.	Price Contingency		64	125	189
	Total		1,304	3,328	4,632

(b) Mezze-Razy & Kafar Souseh-Lawan System Project

(Unit: US$ 1,000)

	Items		L.C.	F.C.	Total
1.	Direct Construction Cost		1,951	2,210	4,161
2.	Tax and Duty		787	0	787
3.	Administration Cost	(10% of Direct cost)	195	0	195
4.	Engineering Cost	(10% of Direct cost)	195	221	416
5.	Physical Contingency		234	243	477
6.	Price Contingency		157	90	247
	Total		3,519	2,764	6,283

5.4.2 Operation and Maintenance Costs

(1) for O&M costs of DMA System : US$36,000 / year

(2) for Water leakage repair costs of DMA system: As a result of DMA starting with a US$35,000/year increase after the first year and a total increase of US$250,000/year after the program is fully implemented.

(3) for Replacement of Flow meters : US$3,014,000

(4) for Mezze-Razy & Kafar Souseh-Lawan : Operation and maintenance costs are insignificant and not included.

5.5 Implementation Program

The implementation of the District Meter Area (DMA) System project is planned to be completed by the year 2006, and the Mezze-Razy & Kafar Souseh-Lawan System project by the year 2001. The implementation of the projects is planned for the purpose of properly executing the work by taking into consideration: the conditions for the projects, including contractors, procurement of construction materials and labor force; the manner of procurement of water supply equipment and materials; and the manner of construction.

5.5.1 Availability of Materials and Labor Force

As shown in these construction works, the construction materials necessary for the pipe laying works and the civil works are locally available.

1) The main construction materials and equipment will be procured as follows:

Local procurement:	cement, fine sand, gravel, re-bar, asphalt pavement materials, unplasticized polyvinyl chloride pipe, PE pipe and water meter (1/2" size)
Foreign procurement :	ductile cast iron pipe, accessory for pipeline valves, flow meters, pumps, electrical control panels, water meter (except 1/2" size)

2) The local labor force is skilled enough for the water supply works : pipe laying, pump houses and reservoirs that are not large-scale works. There should be an abundance of unskilled laborers available for excavation and back-filling during the pipe laying works.

5.5.2 Capability of Local Contractor

Contractors and suppliers who intend to undertake the construction works and the supply of construction equipment and materials for public works shall be registered with the government agencies concerned. The Syrian Construction Contractors Association is responsible for contractor classification and registration.

DAWSSA has experienced contractor capabilities through many projects already executed. The local registered contractors have the capabilities and experience required to construct the proposed projects without the used of foreign experienced contractors. Local contractors have sufficient construction machinery and equipment including to heavy construction machines.

5.5.3 Construction and Procurement Methods

The methods of construction and procurement of equipment and materials can be executed in Syria except for projects with high technology components which are procured through international competitive tendering. Civil works are procured by local competitive tendering procedure in accordance with the guideline of DAWSSA.

(1) The recommended tendering procedure:

Separated contracts: contracts should be separated into international tendering for procurement of pump equipment and pipe materials and local tendering for construction works. The ability of local contractors is deemed suitable for the implementation at the proposed projects because the proposed projects consist of ordinary civil works without any advanced high technology.

(2) The manner of procuring the materials and civil works will be as follows;

(a) International tendering

for District Meter Area (DMA) System project :

- Pipe materials and accessory for pipelines (CIP)
- Supply of mechanical and electrical equipment including supervision of installation
- Flow meters

for Mezze-Razy & Kafar Souseh-Lawan System project:

- Pipe materials (CIP)
- Accessory for pipelines (CIP and PE)
- Supply of mechanical and electrical equipment including supervision of installation
- All water meters are except 1/2"diameter

(b) Local tendering

Civil engineering works are grouped into multiple-packages by area or contract period for local tendering by the registered contractors.

for District Meter Area (DMA) System project:

- Pipe laying works of distribution pipe lines
- Construction civil works include monitoring chambers
- Execution of mechanical and electrical works with DAWSSA supervisor, assisted by foreign supervisor

for Mezze-Razy & Kafar Souseh-Lawan System:

- Pipe materials (PE)
- Pipe laying works of distribution pipe lines
- Construction civil works include flow meter chambers
- Execution of mechanical and electrical works with DAWSSA supervisor, assisted by foreign supervisor
- Water meters 1/2" diameter

(3) Construction method for pipe laying

(a) in cases where there is ample space: new pipe line should be laid in parallel to existing pipe without removal of old pipe to maintain service to the district considered, all connections should be executed after pipe laying finished. One lane of the road will be closed during construction period.

(b) in case of a narrow road: new pipe is laid at same position as the existing pipe after existing pipe is removed, temporary water service pipes should be provided before existing pipes are removed. Excavation and back filling works are executed manually for the completion of works within contract period. Road is closed during construction period and by-pass road is used around the construction area.