3.3 SPECIFICATIONS

Technical specifications proposed herein are minimum requirement for the CSS instrumentation. Tables III-3.2 and III-3.3 list the proposed specifications and the quantity required for the CSS hardware, primary sensors and control equipment respectively, which are developed on the basis of the CSS software specified below.

CSS Software

1) Data Collection and Processing

Data from RTU stations through the data radio communication system should be at five minutes interval at least. The collected data are processed into the format of hourly, daily, monthly and yearly data after accumulation (flow data only), unit conversion and logical check. As for the data on water level, pressure and flow rate, the daily average, minimum and maximum values are computed and stored simultaneously.

2) Data Storage

The processed data will be stored in main memory during certain periods as proposed in the table. Primary five minutes data that require the largest storage capacity in random access memory (RAM) are tentatively determined as for 10 days, whereas hourly data for 3 months, daily data for 3 years and annual data for 10 years. After storage in main memory, most of the data are restored in secondary memory such as hard disc, magnetic tape and diskette.

3) Alarm

The upper and lower limits shall be set manually for water level, water pressure and flow rate severally. All input data except discrete signal data will be compared with the limits. Alarm signal shall be generated when the input value exceeds the presetting limits.

4) Data Display on Graphic Panel

All five minutes data received at the central data processing system at CSS building shall be displayed on the graphic panel. The Panel shall designate whole water supply system including water treatment plant, booster pumping station, service storage reservoir, trunk mains and off-takes in the project area as shown on Fig. III-3.2.

These data are annunciated with visible and audible means when the received data exceed presetting limit by the alarm function of the central data processing system. The audible annunciator should be extinguished by manual.

5) Cathode Ray Tube (CRT) Display

The CRT display displays information from the water supply system on the screen in both graphic and numeric symbols. The displayed information on the screen will be copied by a hard copy device.

6) Data Printout

The daily, monthly, yearly operation report, including alarm, statistic list, and other specified data will be printed out in the designated format.

7) Data File

The central data processing system will provide booking file, data accumulation file and task file for various kinds of function.

8) Pump and Valve Control

The pumps and/or valves at the pumping stations will be controlled at a designated remote site through the Central Supervisory System.

The six storage lift pumps and two reservoir release valves at Tumpuna Storage Lift Pumping Station will be operated by the Plant Control Panel

at Caroni Water Treatment Plant (remote control station) in compliance with the direction from the CSS building.

The pumps and valves of Tunapuna, Valsayn, El Socorro, San Fernando, Malgretoute and TCO booster pumping stations will be controlled by the remote control panel at the CSS building.

9) Data Radio Communication System

The function of the data radio communication system is as follows:

- data communication between remote facilities and central data processing system at WASA Headquarters.

- operation command communication between remote manual control station and remote controlled pump station.

The data communication system operates in a periodic scanning mode during data collection. The central data processing system (CDPS) generates the interrogation scan message, but in the event of a failure, a backup interrogation scan generator will be provided in the data radio communication system in the CSS building.

The operation command communication operates in transmitting operation command from remote manual control station to pumping station, and receiving response signals from pumping station.

The data radio network will consist of VHF and UHF together with repeater system at Pepper Hill.

The VHF network operates between repeater system and each RTU, and UHF network operates between repeater system and CDPS at WASA Headquarters.

CSS Hardware

1) Memory Capacity

To improve speed of computation, main memory of the central data processing system is expanded to eight mega bytes. Concurrently, the fixed disk drive will have an expanded memory capacity of 547 mega bytes for installing system software and for completing necessary tasks.

2) CRT Display and Accessories

For easy operation of CRT display, light pen and mouse in addition to keyboard will be newly attached as input devices. Further, a hard copy machine is furnished for effective use of the CRT display pictures.

3) Graphic Panel

Graphic panel to be furnished will be big enough to display selected real-time data on a schematic diagram of the whole water supply system. The panel will be positioned in the control room for easy monitoring.

4) Uninterruptible Power Supply

Rechargeable alkali battery is considered as the most reliable and economical power supply when emergency. Alkali battery for CSS instruments and for RTU will be durable for one hour use.

5) MODEM

In consideration of data acquisition interval of five minutes and size of logged data, MODEM (modulator and demodulator) will have a modulation speed at 4,800 bps (bit per second).

6) RTU

For ease of maintenance, RTU will have an auxiliary function to detect input and output failure at transducers/RTU. To this end, microprocessor will have a memory capacity of 512KB.

7) Radio Transceiver

Output power of radio transceiver is tentatively proposed to be 10 watts and 1 watt for UHF and VHF respectively. This power will be finally determined on the basis of radio propagation test to be conducted on site during detailed design.

8) Polling System

Polling system is a recommended communication interface in consideration of data communication by two radio frequencies.

9) Signal Transmission

Standard format internationally accepted for signal transmission is the 4 to 20 milliampere direct current. Transducers that output such data signal to RTU is commonly available one for easy maintenance.

10) Pump Remote Control Panel

Pump remote control panel to be furnished in the CSS building will have same function as the one in the existing booster pumping station which consists of annunciator, push button switch and status indicators.

11) Work Station at Regional Office

The work station has three functions of a) data input/transmit, b) monitoring of water supply status and c) individual computer function using application software installed at main computer in CSS building.

Monitoring and Control Equipment

1) Float Type Level Meter

Float type level meter will consist of float, float cable and drum. The float cable will wind or unwind on a drum rim as the water level rises and falls. The drum will be connected to a transmitter that converts the measurement to an electrical signal.

2) Differential Pressure Type Level Meter

Differential pressure type level meter to be installed near the base of a tank/reservoir is to read water level directly based on the pressure produced by the weight of water column above the pressure transducers.

3) Annubar Type Flow Meter

Annubar type flow meter will be installed on pressurized water mains/off-takes without system shutdown. The meter should have sufficient accuracy (error: less than 1%) and should be effective for bidirectional flow sensing.

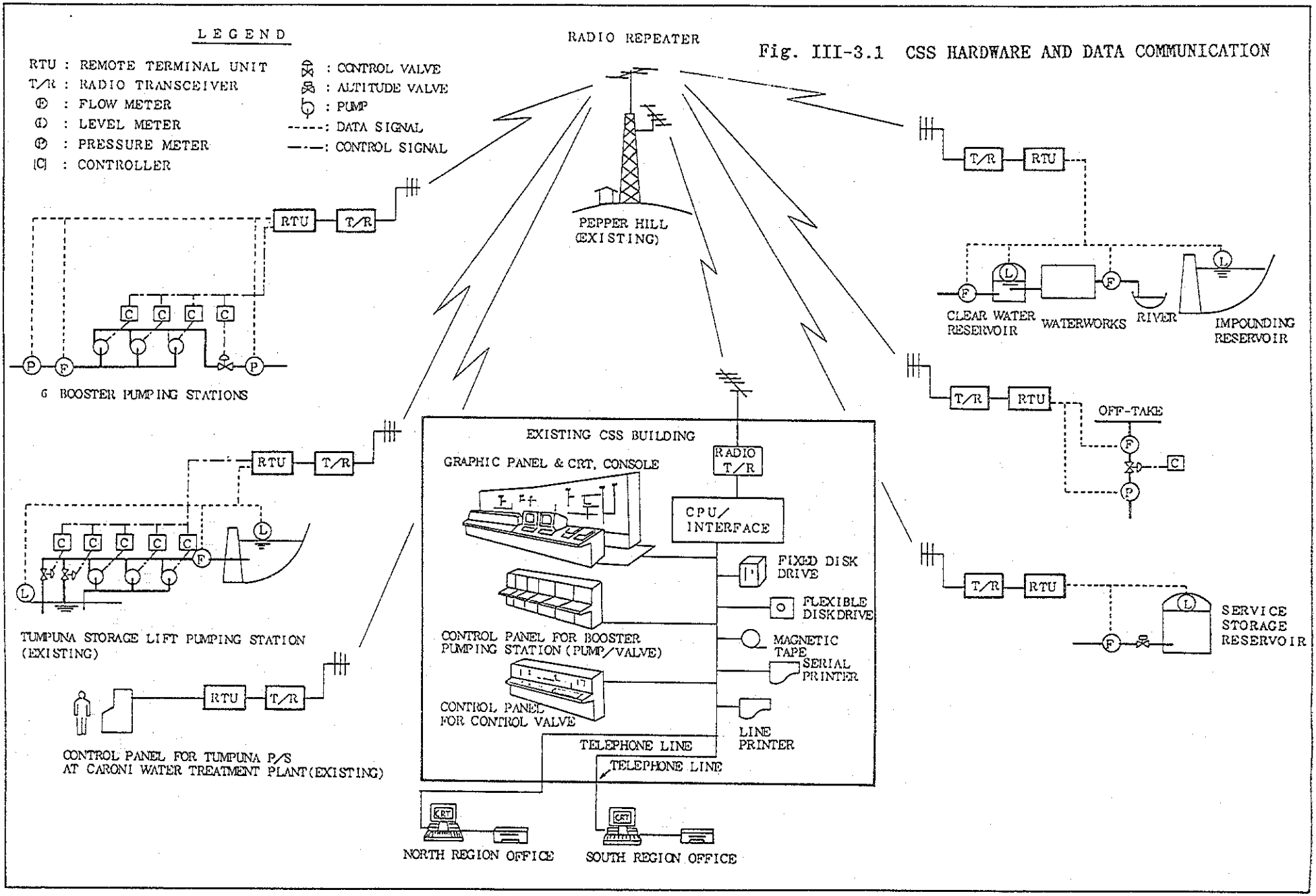
4) Pressure Gauge

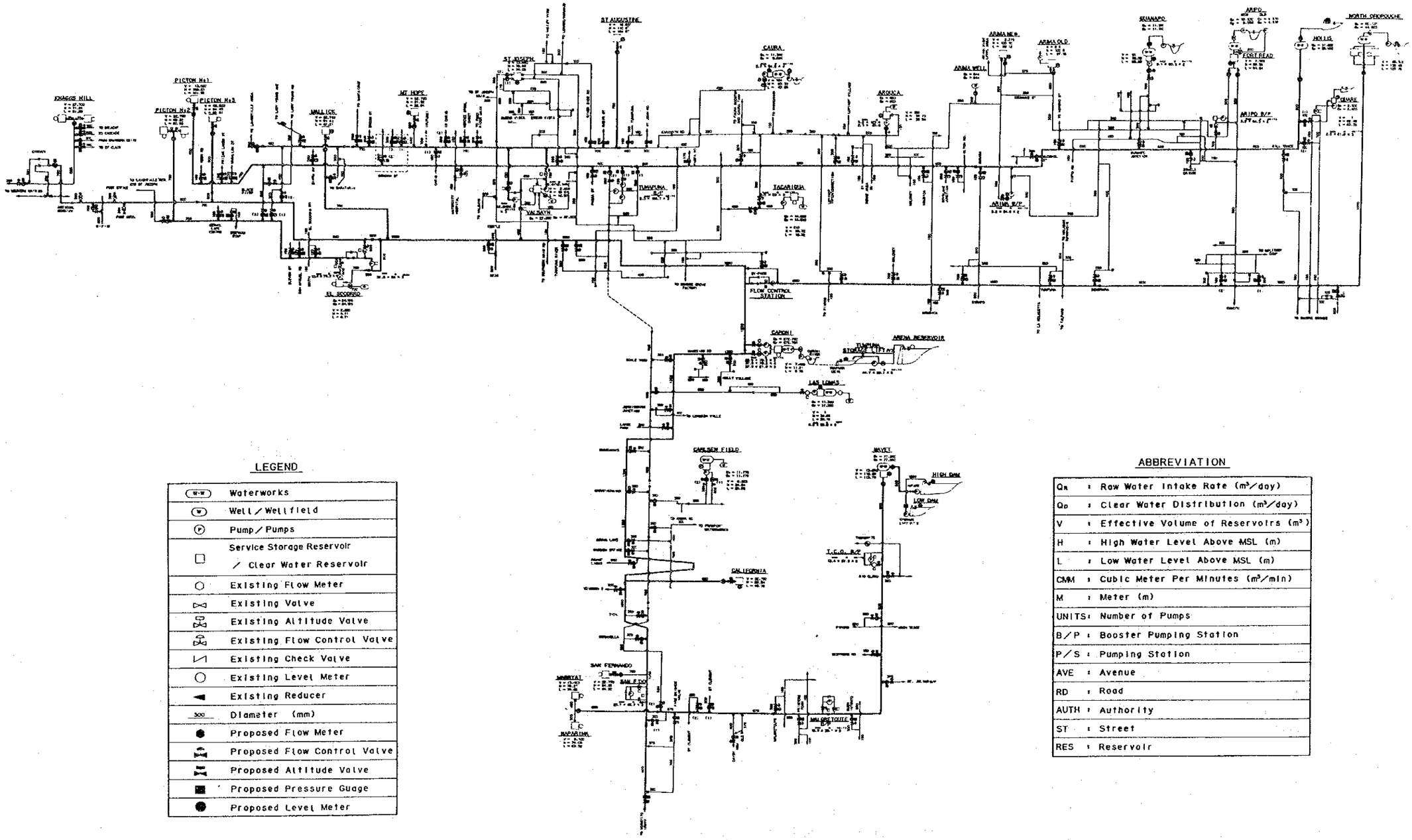
Pressure gauge as described previously is Bourdon-tube type. Pressure range of measurement, which may vary from 0 kg/cm^2 to 10 kg/cm^2, should be determined for each pressure gauge in the course of detailed design.

5) Control Valve

As presented in Supporting Report K "Concept for Designing Flow-Pressure Control Valve", type of valves should be carefully selected in consideration of the designed flow rate, water demand, pipeline characteristics and topographical conditions. Butterfly-valve made of FCD is tentatively selected as flow rate controller although this should be determined in the further detailed surveys and analyses.

Fig. III-3.1 CSS HARDWARE AND DATA COMMUNICATION





LEGEND

W-W	Waterworks
W	Well / Wellfield
P	Pump / Pumps
□	Service Storage Reservoir / Clear Water Reservoir
○	Existing Flow Meter
⋈	Existing Valve
	Existing Altitude Valve
	Existing Flow Control Valve
	Existing Check Valve
○	Existing Level Meter
	Existing Reducer
500	Diameter (mm)
●	Proposed Flow Meter
	Proposed Flow Control Valve
	Proposed Altitude Valve
■	Proposed Pressure Guage
●	Proposed Level Meter

ABBREVIATION

Q_R	:	Raw Water Intake Rate (m^3/day)
Q_D	:	Clear Water Distribution (m^3/day)
V	:	Effective Volume of Reservoirs (m^3)
H	:	High Water Level Above MSL (m)
L	:	Low Water Level Above MSL (m)
CMM	:	Cubic Meter Per Minutes (m^3/min)
M	:	Meter (m)
UNITS	:	Number of Pumps
B/P	:	Booster Pumping Station
P/S	:	Pumping Station
AVE	:	Avenue
RD	:	Road
AUTH	:	Authority
ST	:	Street
RES	:	Reservoir

Fig. III-3.2 WATER SUPPLY SYSTEM UNDER NEW CSS (1)
(GENERAL)

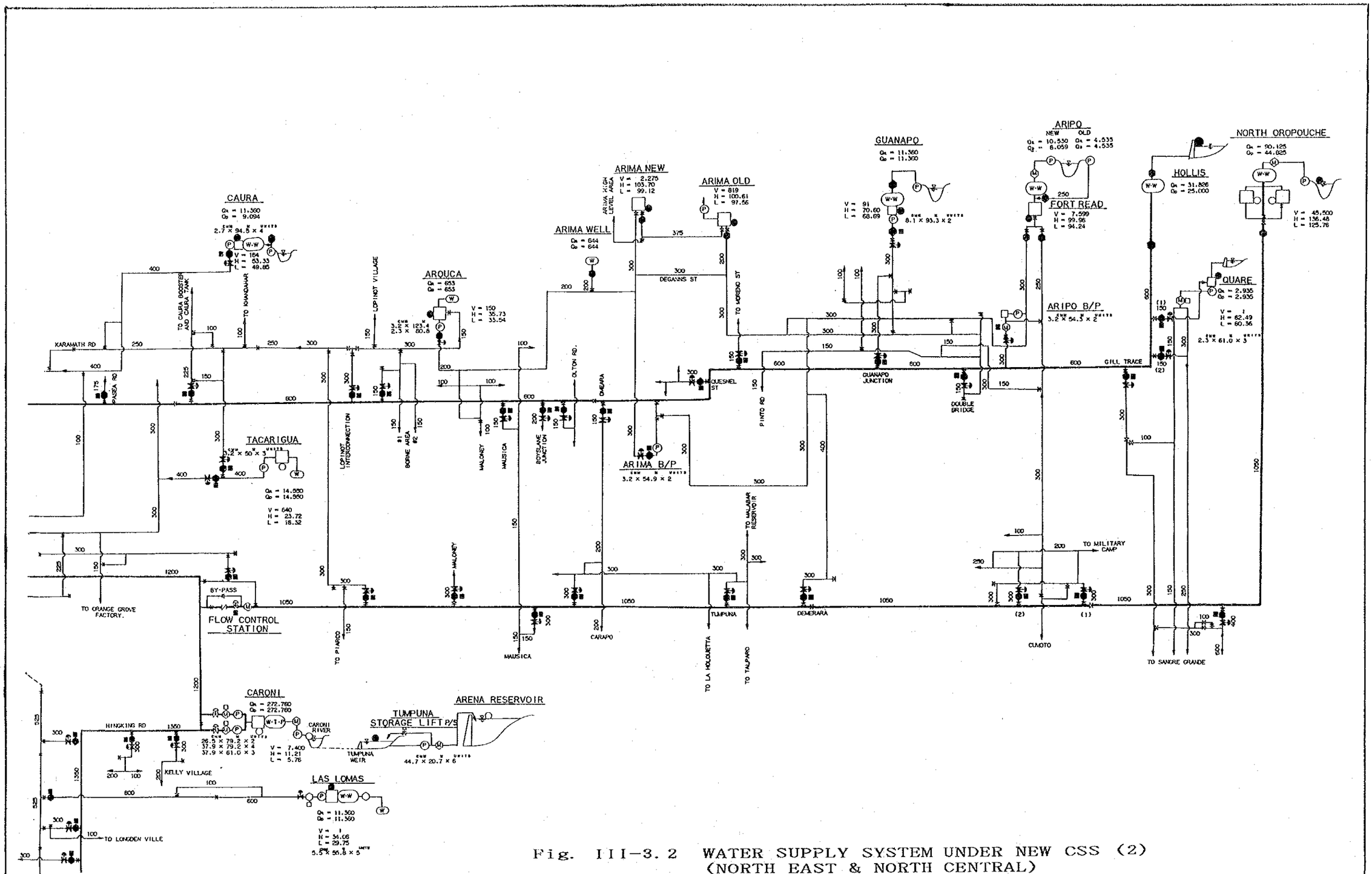


Fig. III-3.2 WATER SUPPLY SYSTEM UNDER NEW CSS (2)
(NORTH EAST & NORTH CENTRAL)

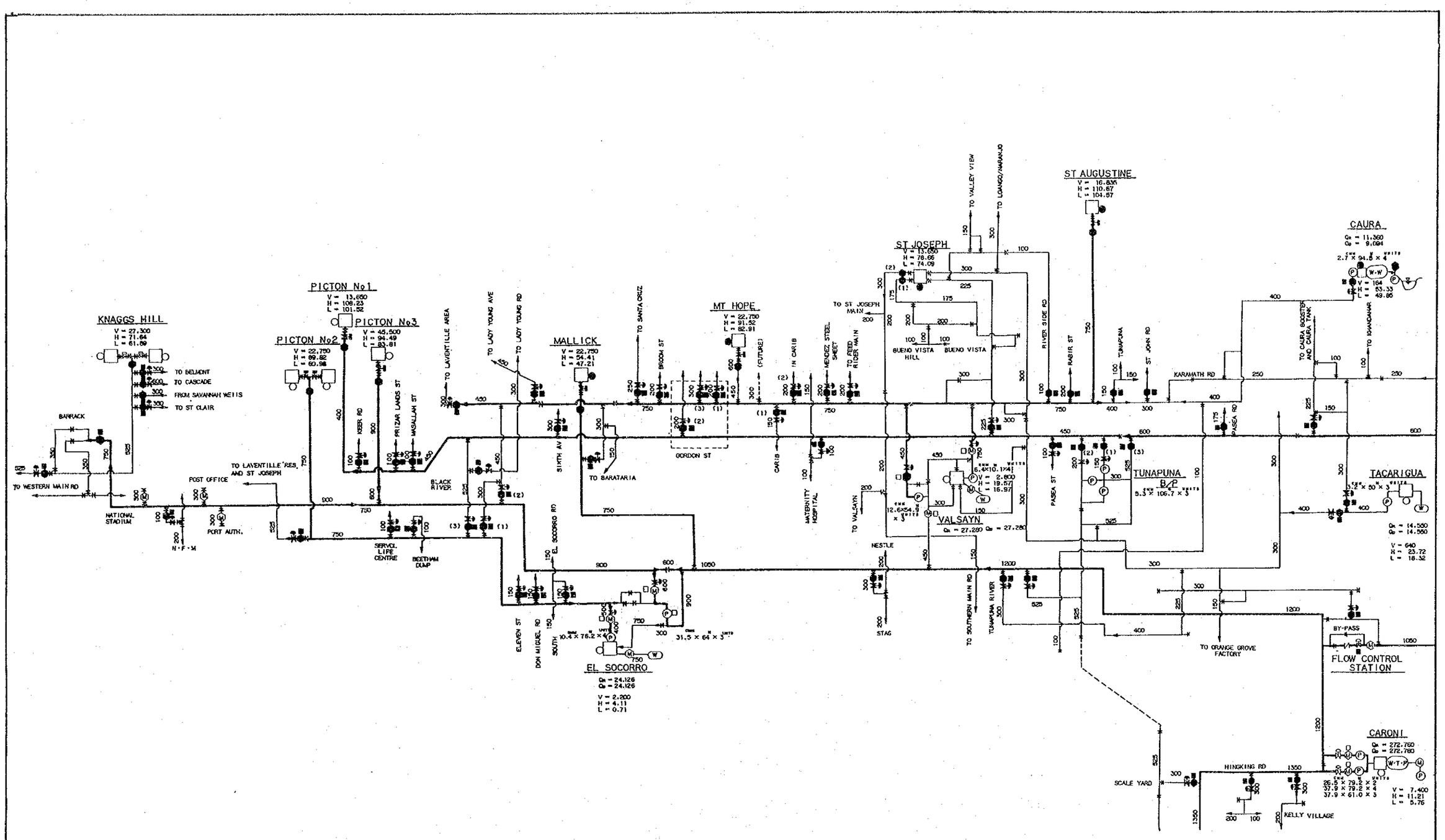


Fig. III-3.2 WATER SUPPLY SYSTEM UNDER NEW CSS (3)
(NORTH CENTRAL, NORTH WEST & PORT OF SPAIN)

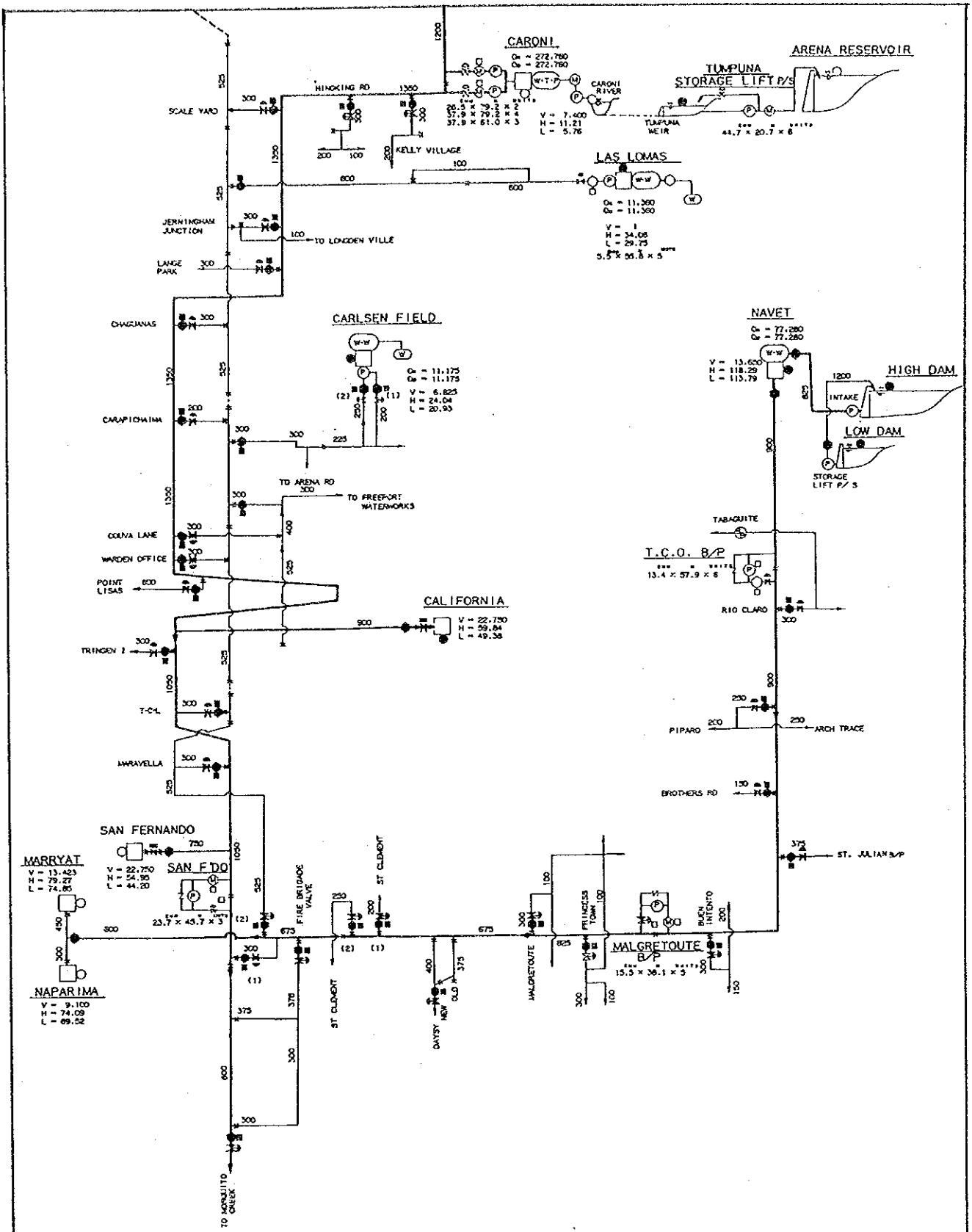
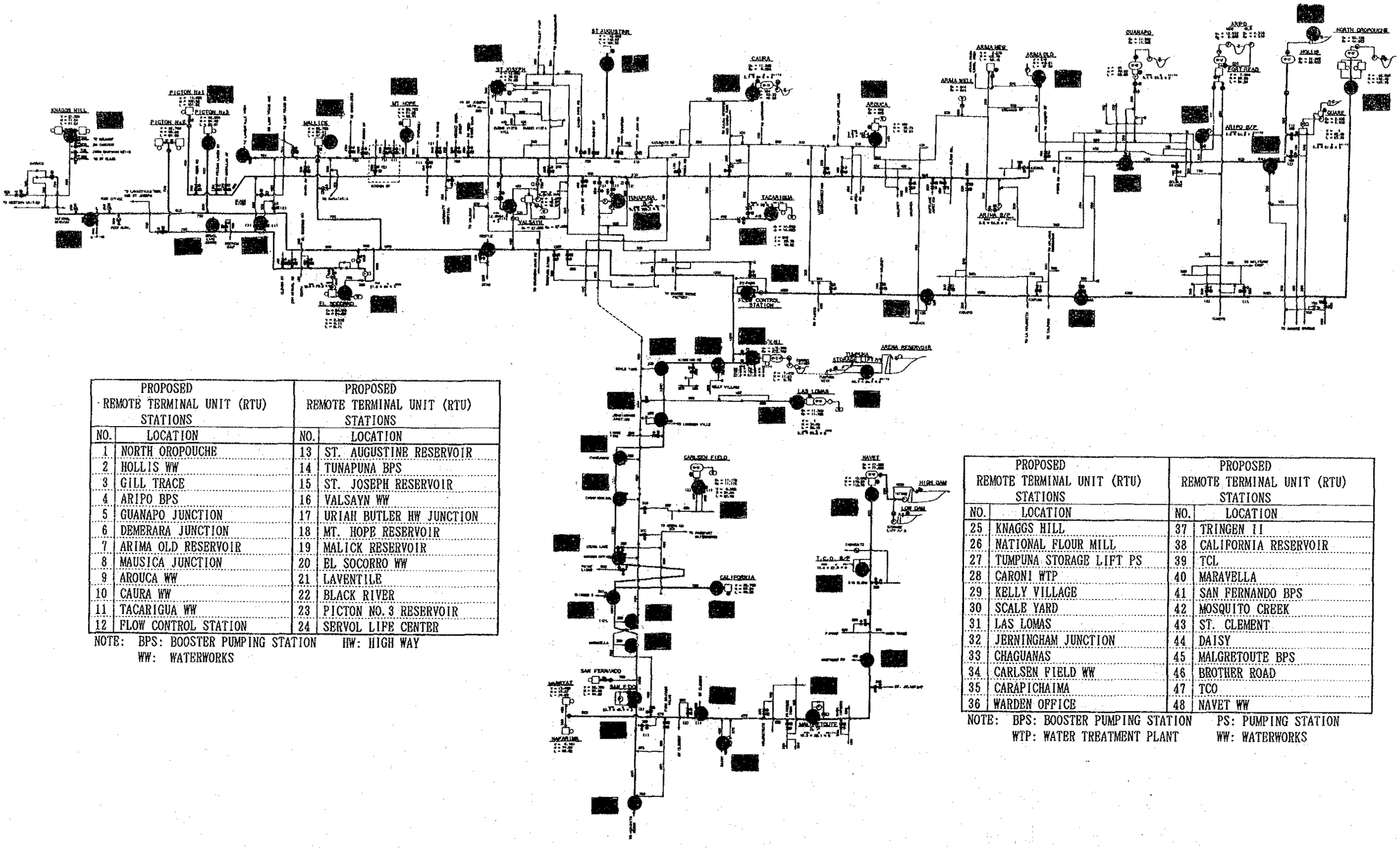


Fig. III-3.2 WATER SUPPLY SYSTEM UNDER NEW CSS (4)
(SAN F'NDO/SOUTH CENTRAL & SOUTH EAST)



PROPOSED REMOTE TERMINAL UNIT (RTU) STATIONS		PROPOSED REMOTE TERMINAL UNIT (RTU) STATIONS	
NO.	LOCATION	NO.	LOCATION
1	NORTH OROPOUCHE	13	ST. AUGUSTINE RESERVOIR
2	HOLLIS WW	14	TUNAPUNA BPS
3	GILL TRACE	15	ST. JOSEPH RESERVOIR
4	ARIPO BPS	16	VALSAYN WW
5	GUANAPO JUNCTION	17	URIAH BUTLER HW JUNCTION
6	DEMERARA JUNCTION	18	MT. HOPE RESERVOIR
7	ARIMA OLD RESERVOIR	19	MALICK RESERVOIR
8	MAUSICA JUNCTION	20	EL SOCORRO WW
9	AROUCA WW	21	LAVENTILE
10	CAURA WW	22	BLACK RIVER
11	TACARIGUA WW	23	PICTON NO.3 RESERVOIR
12	FLOW CONTROL STATION	24	SERVOL LIFE CENTER

NOTE: BPS: BOOSTER PUMPING STATION HW: HIGH WAY
WW: WATERWORKS

PROPOSED REMOTE TERMINAL UNIT (RTU) STATIONS		PROPOSED REMOTE TERMINAL UNIT (RTU) STATIONS	
NO.	LOCATION	NO.	LOCATION
25	KNAGGS HILL	37	TRINGEN II
26	NATIONAL FLOUR MILL	38	CALIFORNIA RESERVOIR
27	TUMPUNA STORAGE LIFT PS	39	TCL
28	CARONI WTP	40	MARAVELLA
29	KELLY VILLAGE	41	SAN FERNANDO BPS
30	SCALE YARD	42	MOSQUITO CREEK
31	LAS LOMAS	43	ST. CLEMENT
32	JERNINGHAM JUNCTION	44	DAISY
33	CHAGUANAS	45	MALGRETOUTE BPS
34	CARLSEN FIELD WW	46	BROTHER ROAD
35	CARAPICHAIMA	47	TCO
36	WARDEN OFFICE	48	NAVET WW

NOTE: BPS: BOOSTER PUMPING STATION PS: PUMPING STATION
WTP: WATER TREATMENT PLANT WW: WATERWORKS

Fig. III-3.3 PROPOSED LOCATION OF RTU STATIONS

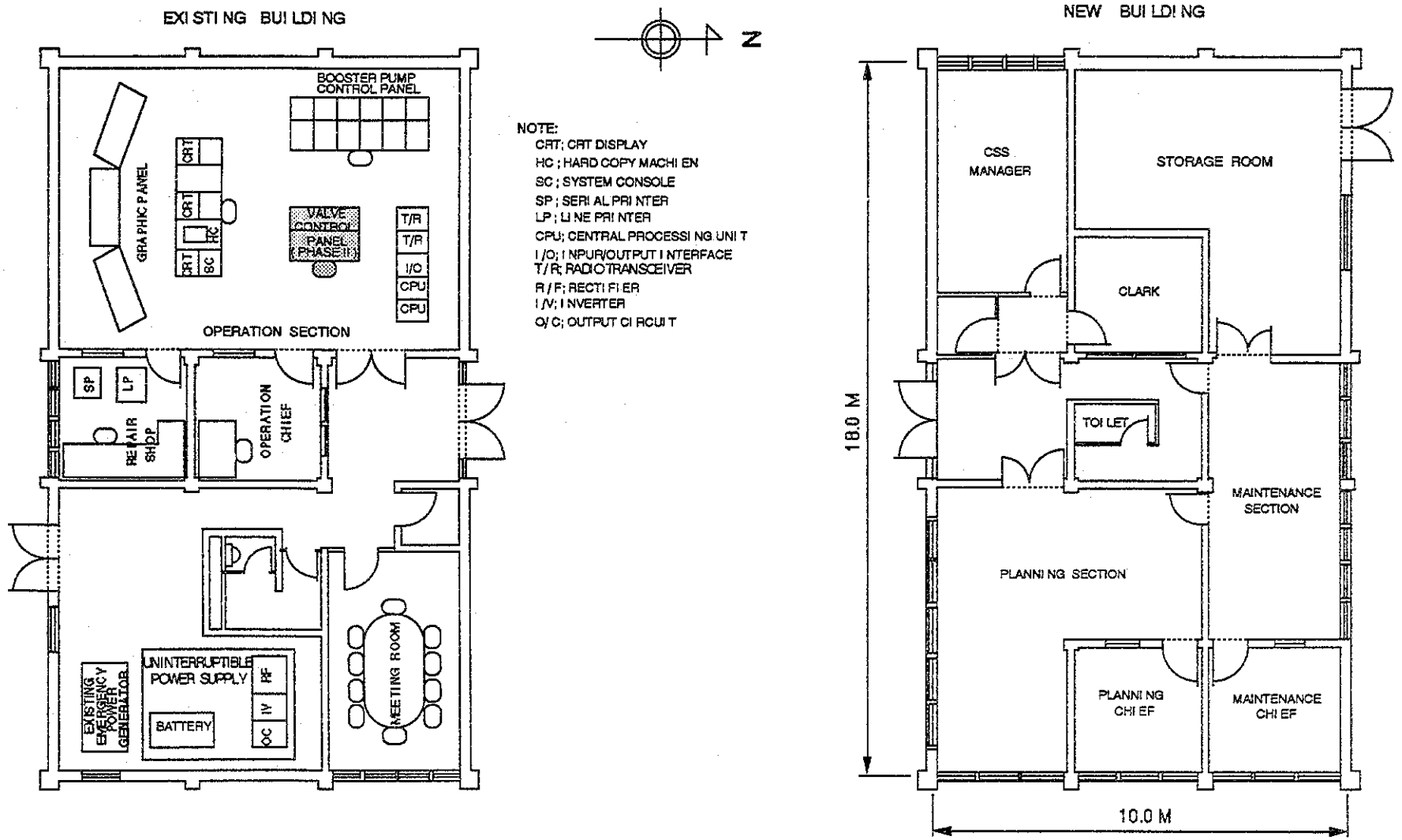
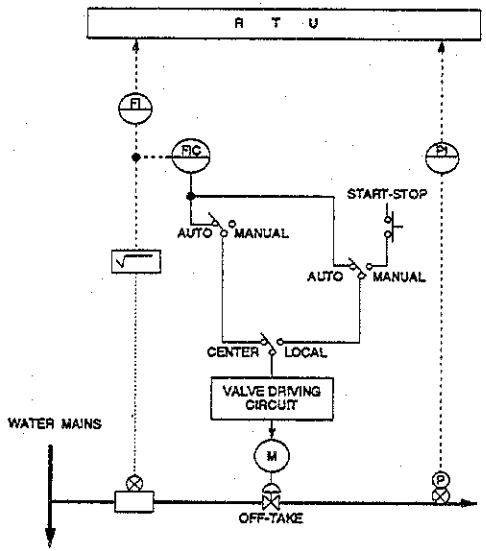
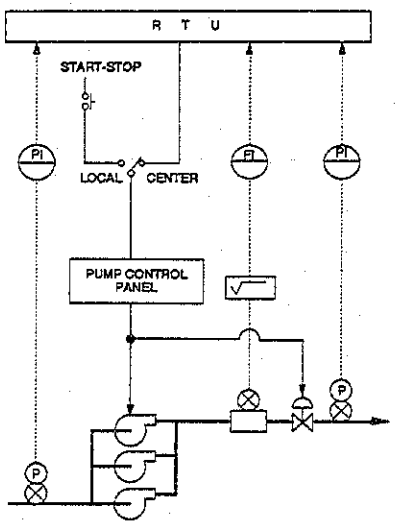


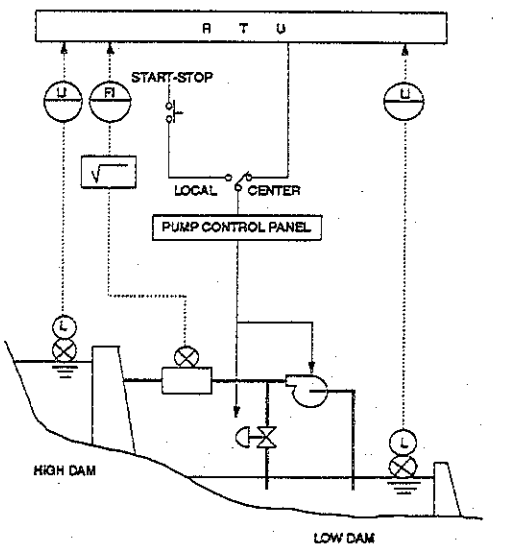
Fig. III-3.4 CSS BUILDING



(1) OFF-TAKE



(2) BOOSTER PUMPING STATION



(3) TUMPUNA STORAGE LIFT PUMPING STATION

Fig. III-3.5 PROCESS AND INSTRUMENTATION DIAGRAM

Table III-3.1 LIST OF MONITORING AND CONTROL EQUIPMENT IN PHASE I BY CENTRAL SUPERVISORY SYSTEM (1)

NOTE: AN; ANNUBAR, P ; PROPELLAR TYPE, RES; RESERVOIR, (300); PIPE DIAMETER(MM),
AP; AIR PURGE TYPE, PF; PARSHALL FLUME, IT ; INTAKE, "*"; EXISTINGS TO BE USED,
AV; ALTITUDE VALVE, V ; VENTURI TUBE, WW ; WATERWORKS, "¥"; EXISTINGS (REPLACEMENT PERIPHERALS),
B ; BOURDON TUBE, RD; ROAD, OT ; OFF-TAKE, "#"; INSTALLATION OF CONTROL EQUIPMENT,
BU; BUTTERFLY VALVE, Av; AVENUE, JCT; JUNCTION,
CV; CONE VALVE, HW; HIGH WAY, IC ; INTERCONNECTION,
F ; FLOAT TYPE, SH; SHEET, BPS; BOOSTER PUMPING STATION,
O ; ORIFICE PLATE, ST; STREET, D ; DIFFERENTIAL PRESSURE TYPE,

RTU NO. & LOCATION	MONITORING POINT	PHASE I														
		EQUIPMENT TO BE INSTALLED				NUMBER OF MONITORING DATA BY CENTRAL SUPERVISORY SYSTEM (CSS)							EQUIPMENT TO BE CONTROLLED			
		LEVEL METER	PRESS GAUGE	FLOW METER	CONTROL VALVE	WATER LEVEL	WATER PRESS	FLOW RATE	VALVE STATUS	PUMP STATUS	ALARM	TOTAL	PUMP NO.	PUMP PLACE	VALVE NO.	VALVE PLACE
1	NORTH OROPOUCHE WW											5				
	RAW WATER	F		¥ PF		1		1								
	CLEAR WATER RESERVOIR	* D-2				2										
	DISTRIBUTION (1050)			AN				1								
2	HOLLIS WW											3				
	IMPOUNDING RESERVOIR	F				1										
	RAW WATER (300)			AN				1								
	DISTRIBUTION (600)			AN				1								
3	GILL TRACE											15				
	QUARE WATER TANK	D				1										
	QUARE DISTRIBUTION (300)		¥ B	¥ V			1	1								
	GILL TRACE OT (300)		B	AN	BU		1	1	1						1	SITE
	QUARE(1) OT (150)		B	AN	BU		1	1	1						1	SITE
	QUARE(2) OT (150)		B	AN	BU		1	1	1						1	SITE
	TO SANGRE GRANDE OT (400)		B	AN	BU		1	1	1						1	SITE
4	ARIPO BPS											15				
	ARIPO(NEW) RAW WATER (300)			¥ O				1								
	ARIPO(OLD) RAW WATER (250)			AN				1								
	FORT READ RESERVOIR (250)	D		AN		1		1								
	FORT READ RESERVOIR (300)	D		AN		1		1								
	ARIPO BPS (300)		B	¥ V	BU		1	1	1						1	SITE
	CUMOTO(1) OT (300)		B	AN	BU		1	1	1						1	SITE
	CUMOTO(2) OT (300)		B	AN	BU		1	1	1						1	SITE
5	GUANAPO JUNCTION											11				
	GUANAPO RAW WATER (300)			AN				1								
	GUANAPO RESERVOIR (300)	D				1										
	GUANAPO WW DIST. (300)		B	AN	BU		1	1	1						1	SITE
	DOUBLE BRIDGE OT (150)		B	AN	BU		1	1	1						1	SITE
	GUANAPO JUNCTION OT (300)		B	AN	BU		1	1	1						1	SITE
6	DEMERARA JUNCTION											6				
	DEMERARA JCT OT (300)		B	AN	BU		1	1	1						1	SITE
	TUMPUNA JCT OT (300)		B	AN	BU		1	1	1						1	SITE
7	ARIMA OLD RESERVOIR											17				
	ARIMA NEW RESERVOIR (375)	F		AN		1		1								
	ARIMA OLD RESERVOIR (200)	D		AN		1		1								
	TO MORENO ST OT (150)		B	AN	BU		1	1	1						1	SITE
	QUESNEL ST OT (300)		B	AN	BU		1	1	1						1	SITE
	OMERA JCT OT (150)		B	AN	BU		1	1	1						1	SITE
	ARIMA BPS (300)		B	AN	BU		1	1	1						1	SITE
	ARIMA WELL (200)			AN				1								
	ARIMA B/PUMPS															
8	MAUSICA JUNCTION											18				
	OLTON RD OT (150)		B	AN	BU		1	1	1						1	SITE
	BOYS LANE OT (200)		B	AN	BU		1	1	1						1	SITE
	MAUSICA JCT OT (150)		B	AN	BU		1	1	1						1	SITE
	CARAPO OT (300)		B	AN	BU		1	1	1						1	SITE
	MAUSICA OT (300)		B	AN	BU		1	1	1						1	SITE
	MALONEY JCT OT (300)		B	AN	BU		1	1	1						1	SITE
9	AROUCA WW											9				
	CLEAR WATER TANK	D				1										
	DISTRIBUTION (200)			AN	BU			1	1						1	SITE
	BORNE AREA #1 OT (150)		B	AN	BU		1	1	1						1	SITE
	LOPINOT IC OT (300)		B	AN	BU		1	1	1						1	SITE
10	CAURA WW											5				
	RAW WATER (400)			AN				1								
	CLEAR WATER TANK	D				1										
	DISTRIBUTION (400)		B	AN	BU		1	1	1						1	SITE
11	TACARIGUA WW											12				
	CLEAR WATER RESERVOIR	¥ D				1										
	DISTRIBUTION(1) (300)		B	AN	BU		1	1	1						1	SITE
	DISTRIBUTION(2) (400)		B	AN	BU		1	1	1						1	SITE
	TO CAURA BPS OT (225)		B	AN	BU		1	1	1						1	SITE
	PASEA RD OT (175)		B	AN			1	1								

Table III-3.1 LIST OF MONITORING AND CONTROL EQUIPMENT IN PHASE I BY CENTRAL SUPERVISORY SYSTEM (2)

NOTE: AN; ANNUBAR, P ; PROPELLAR TYPE, RES; RESERVOIR, (300); PIPE DIAMETER(MM),
AP; AIR PURGE TYPE, PF; PARSHALL FLUME, IT ; INTAKE, "*"; EXISTINGS TO BE USED,
AV; ALTITUDE VALVE, V ; VENTURI TUBE, WW ; WATERWORKS, "¥"; EXISTINGS (REPLACEMENT PERIPHERALS),
B ; BOURDON TUBE, RD; ROAD, OT ; OFF-TAKE, "#"; INSTALLATION OF CONTROL EQUIPMENT,
BU; BUTTERFLY VALVE, Av; AVENUE, JCT; JUNCTION,
CV; CONE VALVE, HW; HIGH WAY, IC ; INTERCONNECTION,
F ; FLOAT TYPE, SH; SHEET, BPS; BOOSTER PUMPING STATION,
O ; ORIFICE PLATE, ST; STREET, D ; DIFFERENTIAL PRESSURE TYPE,

RTU NO. & LOCATION	MONITORING POINT	PHASE I														
		EQUIPMENT TO BE INSTALLED				NUMBER OF MONITORING DATA BY CENTRAL SUPERVISORY SYSTEM (CSS)							EQUIPMENT TO BE CONTROLLED			
													PUMP		VALVE	
		LEVEL METER	PRESS GAUGE	FLOW METER	CONTROL VALVE	WATER LEVEL	WATER PRESS	FLOW RATE	VALVE STATUS	PUMP STATUS	ALARM	TOTAL	NO.	PLACE	NO.	PLACE
12	FLOW CONTROL STATION											11				
	PIARCO JCT OT (300)		B	AN	BU		1	1	1						1	SITE
	BY-PASS OT (300)		B	AN	BU		1	1	1						1	SITE
	FLOW CONTROL STATION(800)		B-2	¥ V	# CV-2		2	1	2						2	SITE
13	ST AUGUSTINE RESERVOIR											10				
	RESERVOIR (750)	F		AN	AV	1		1								
	ST JOHN RD OT (300)		B	AN			1	1								
	TO TUNAPUNA OT (150)		B	AN			1	1								
	RABIR ST OT (200)		B	AN			1	1								
	RIVERSIDE RD OT (100)		B	AN			1	1								
14	TUNAPUNA BPS											48				
	TUNAPUNA(1) (150)		B	AN	BU		1	1	1						1	CSS
	TUNAPUNA(2) (200)		B	AN	BU		1	1	1						1	CSS
	TUNAPUNA(3) (525)		B	AN			1	1								
	PASEA ST OT (100)		B	AN	BU		1	1	1						1	SITE
	TUNAPUNA RIVER (1) (300)		B	AN	BU		1	1	1						1	SITE
	TUNAPUNA RIVER (2) (525)		B	AN	BU		1	1	1						1	SITE
	TUNAPUNA B/PUMPS									6	25		3	CSS		
15	ST JOSEPH RESERVOIR											15				
	RESERVOIR	F				1										
	TO ST JOSEPH OT (225)		B	AN	BU		1	1	1						1	SITE
	TO RIDER MAIN OT (200)		B	AN	BU		1	1	1						1	SITE
	MENDEZ STEEL SH. OT (200)		B	AN	BU		1	1	1						1	SITE
	MATERNITY HP. OT (100)		B	AN	BU		1	1	1						1	SITE
	ST JOSEPH(1) (175)			AN				1								
	ST JOSEPH(2) (300)			AN				1								
16	VALSAYN WW											41				
	RAW WATER (750)			¥ V				1								
	CLEAR WATER RESERVOIR	¥ D				1										
	DISTRIBUTION (750)		¥ B	¥ V	BU		1	1	1						1	SITE
	BOOSTER SUCTION (450)		¥ B	¥ AN			1	1								
	BOOSTER DELIVERY (450)		¥ B	AN	BU		1	1	1						1	CSS
	VALSAYN B/PUMPS									6	25		3	CSS		
17	URIAH BUTLER HW JUNCTION											3				
	STAG/NESTL OT (300)		B	AN	BU		1	1	1						1	SITE
18	MT. HOPE RESERVOIR											23				
	RESERVOIR (600)	D		AN	AV	1		1								
	CARIB(1) OT (150)		B	AN	BU		1	1	1						1	SITE
	CARIB(2) OT (200)		B	AN	BU		1	1	1						1	SITE
	MT. HOPE OT (300)															
	GORDON ST (1) OT (200)		B	AN	BU		1	1	1						1	SITE
	GORDON ST (2) OT (200)		B	AN	BU		1	1	1						1	SITE
	GORDON ST (3) OT (300)		B	AN	BU		1	1	1						1	SITE
	BROOM ST OT (200)		B	AN	BU		1	1	1						1	SITE
	TO SANTA CRUZ OT (250)		B	AN	BU		1	1	1						1	SITE
19	MALICK RESERVOIR											11				
	RESERVOIR (750)	D		AN	AV	1		1								
	TO BARATARIA OT (300)		B	AN	BU		1	1	1						1	SITE
	SIXTH Av. OT (300)		B	AN	BU		1	1	1						1	SITE
	TO LADY YOUNG Av. OT (450)		B	AN	BU		1	1	1						1	SITE
20	EL SOCORRO WW											49				
	RAW WATER (750)			¥ V				1								
	CLEAR WATER RESERVOIR	¥ AP				1										
	BOOSTER SUCTION (900)		¥ B				1									
	BOOSTER DELIVERY (600)		¥ B	¥ AN	BU		1	1	1						1	CSS
	DISTRIBUTION (400)		¥ B	¥ AN	BU		1	1	1						1	SITE
	EL SOCORRO RD OT (150)		B	AN	BU		1	1	1						1	SITE
	DON MIGUEL RD OT (150)		B	AN	BU		1	1	1						1	SITE
	ELEVENTH ST OT (150)		B	AN	BU		1	1	1						1	SITE
	EL SOCORRO B/PUMPS									6	25		3	CSS		
21	LAVENTILLE											3				
	TO LAVENTILLE OT (300)		B	AN	BU		1	1	1						1	SITE
22	BLACK RIVER											12				

Table III-3.1 LIST OF MONITORING AND CONTROL EQUIPMENT IN PHASE I BY CENTRAL SUPERVISORY SYSTEM (3)

NOTE: AN; ANNUBAR, P ; PROPELLAR TYPE, RES; RESERVOIR, (300); PIPE DIAMETER(MM),
AP; AIR PURGE TYPE, PF; PARSHALL FLUME, IT ; INTAKE, "*"; EXISTINGS TO BE USED,
AV; ALTITUDE VALVE, V ; VENTURI TUBE, WW ; WATERWORKS, "¥"; EXISTINGS (REPLACEMENT PERIPHERALS),
B ; BOURDON TUBE, RD; ROAD, OT ; OFF-TAKE, "#"; INSTALLATION OF CONTROL EQUIPMENT,
BU; BUTTERFLY VALVE, Av; AVENUE, JCT; JUNCTION,
CV; CONE VALVE, HW; HIGH WAY, IC ; INTERCONNECTION,
F ; FLOAT TYPE, SH; SHEET, BPS; BOOSTER PUMPING STATION,
O ; ORIFICE PLATE, ST; STREET, D ; DIFFERENTIAL PRESSURE TYPE,

RTU NO. & LOCATION	MONITORING POINT	PHASE I														
		EQUIPMENT TO BE INSTALLED				NUMBER OF MONITORING DATA BY CENTRAL SUPERVISORY SYSTEM (CSS)							EQUIPMENT TO BE CONTROLLED			
		LEVEL METER	PRESS GAUGE	FLOW METER	CONTROL VALVE	WATER LEVEL	WATER PRESS	FLOW RATE	VALVE STATUS	PUMP STATUS	ALARM	TOTAL	PUMP NO.	PUMP PLACE	VALVE NO.	VALVE PLACE
	BLACK RIVER (1) OT (300)		B	AN	BU		1	1	1						1	SITE
	BLACK RIVER (2) OT (450)		B	AN	BU		1	1	1						1	SITE
	BLACK RIVER (3) OT (525)		B	AN	BU		1	1	1						1	SITE
	TO LADY YOUNG RD OT (300)		B	AN	BU		1	1	1						1	SITE
23 PICTON NO.3 RESERVOIR												16				
	PICTON #1 RESERVOIR (400)	* D		AN	AV	1		1								
	PICTON #2 RESERVOIR (750)	* D-2		AN	AV-2	2		1								
	PICTON #3 RESERVOIR (900)	* D		AN	AV	1		1								
	MASALLAH ST OT (100)		B	AN	BU		1	1	1						1	SITE
	PRIZAR LANDS ST OT (100)		B	AN	BU		1	1	1						1	SITE
	KERR RD OT (100)		B	AN	BU		1	1	1						1	SITE
24 SERVOL LIFE CENTER												9				
	BEETHAM DUMP OT (100)		B	AN	BU		1	1	1						1	SITE
	SERVOL LIFE C. OT (100)		B	AN	BU		1	1	1						1	SITE
	TO LAVENTILLE OT (525)		B	AN	BU		1	1	1						1	SITE
25 KNAGGS HILL												19				
	RESERVOIR (525)	* D-2		AN	* AV-2	2		1								
	TO BELMONT OT (300)		B	AN	BU		1	1	1						1	SITE
	TO CASCADE OT (600)		B	AN	BU		1	1	1						1	SITE
	TO ST CLAIR OT (350)		B	AN	BU		1	1	1						1	SITE
	WESTERN MAIN ROAD (525)		B	AN	BU		1	1	1						1	SITE
	FROM SAVANNAH WELLS (300)		B	AN			1	1								
	BARRACK (750)		B	AN			1	1								
26 NATIONAL FLOUR MILL												3				
	NFM OT (100)		B	AN	BU		1	1	1						1	SITE
	PORT AUTHORITY (300)															
	POST OFFICE (300)															
	NATIONAL STADIUM (300)															
27 TUMPUNA STORAGE LIFT PS												77				
	ARENA IMPOUNDING RES.	¥ AP				1										
	TUMPUNA WEIR	F				1										
	TO/FROM RESERVOIR (1200)			¥ V-2				2								
	RIVER DISCH. VALVE (1200)				¥ BU-2				2						2	CARONI
	TUMPUNA S.L./PUMPS									12	59		6	CARONI		
28 CARONI WTP												9				
	RAW WATER	¥ AP		¥ PF		1		1								
	CLEAR WATER RESERVOIR	¥ AP				1										
	CARONI NORTH (900)		* B	¥ AN	¥ BU		1	1	1						1	CARONI
	CARONI SOUTH (1200)		* B	¥ AN	¥ BU		1	1	1						1	CARONI
29 KELLY VILLAGE												3				
	KELLY VILLAGE OT (300)		B	AN	BU		1	1	1						1	SITE
30 SCALE YARD												6				
	SCALE YARD OT (300)		B	AN	BU		1	1	1						1	SITE
	HINGKING RD OT (300)		B	AN	BU		1	1	1						1	SITE
31 LAS LOMAS WW												5				
	RAW WATER (600)			¥ O				1								
	CLEAR WATER RESERVOIR	D				1										
	DISTRIBUTION (600)		¥ B	¥ V	BU		1	1	1						1	SITE
32 JERNINGHAM JUNCTION												5				
	TO LAS LOMAS OT (600)		B	AN			1	1								
	JERNINGHAM JCT OT (300)		B	AN	BU		1	1	1						1	SITE
33 CHAGUANAS												6				
	CHAGUANAS OT (300)		B	AN	BU		1	1	1						1	SITE
	LANGE PARK OT (300)		B	AN	BU		1	1	1						1	SITE
34 CARLSEN FIELD WW												7				
	CLEAR WATER RESERVOIR	F				1										
	DISTRIBUTION(1) (200)		B	AN	BU		1	1	1						1	SITE
	DISTRIBUTION(2) (250)		B	AN	BU		1	1	1						1	SITE
35 CARAPICHAIMA												7				
	CARAPICHAIMA OT (200)		B	AN	BU		1	1	1						1	SITE
	TO CARLSEN FIELD OT (300)		B	AN			1	1								
	TO FREEPORT WW OT (300)		B	AN			1	1								
36 WARDEN OFFICE												9				

Table III-3.1 LIST OF MONITORING AND CONTROL EQUIPMENT IN PHASE I BY CENTRAL SUPERVISORY SYSTEM (4)

NOTE: AN; ANNUBAR, P ; PROPELLAR TYPE, RES; RESERVOIR, (300); PIPE DIAMETER(MM),
AP; AIR PURGE TYPE, PF; PARSHALL FLUME, IT ; INTAKE, "*"; EXISTINGS TO BE USED,
AV; ALTITUDE VALVE, V ; VENTURI TUBE, WW ; WATERWORKS, "¥"; EXISTINGS (REPLACEMENT PERIPHERALS),
B ; BOURDON TUBE, RD; ROAD, OT ; OFF-TAKE, "#"; INSTALLATION OF CONTROL EQUIPMENT,
BU; BUTTERFLY VALVE, Av; AVENUE, JCT; JUNCTION,
CV; CONE VALVE, HW; HIGH WAY, IC ; INTERCONNECTION,
F ; FLOAT TYPE, SH; SHEET, BPS; BOOSTER PUMPING STATION,
O ; ORIFICE PLATE, ST; STREET, D ; DIFFERENTIAL PRESSURE TYPE,

RTU NO. & LOCATION	MONITORING POINT	PHASE I													
		EQUIPMENT TO BE INSTALLED				NUMBER OF MONITORING DATA BY CENTRAL SUPERVISORY SYSTEM (CSS)							EQUIPMENT TO BE CONTROLLED		
		LEVEL METER	PRESS GAUGE	FLOW METER	CONTROL VALVE	WATER LEVEL	WATER PRESS	FLOW RATE	VALVE STATUS	PUMP STATUS	ALARM	TOTAL	PUMP NO.	PUMP PLACE	VALVE NO.	VALVE PLACE
	WARDEN OFFICE OT (300)		B	AN	BU		1	1	1						1	SITE
	COUVA LANE OT (300)		B	AN	BU		1	1	1						1	SITE
	POINT LISAS OT (600)		B	AN	BU		1	1	1						1	SITE
37 TRINGEN II												3				
	TRINGEN II OT (300)		B	AN	BU		1	1	1						1	SITE
38 CALIFORNIA RESERVOIR												2				
	RESERVOIR (900)	D		AN	AV	1		1								
39 TCL												3				
	TCL OT (300)		B	AN	BU		1	1	1						1	SITE
40 MARAVELLA												3				
	MARAVELLA OT (300)		B	AN	BU		1	1	1						1	SITE
41 SAN FERNANDO BPS												49				
	SAN F'DO RESERVOIR (750)	¥ D		AN	AV	1		1								
	MARRYAT RESERVOIR (600)	¥ D		AN		1		1								
	NAPARIMA RESERVOIR	¥ D				1										
	BOOSTER SUCTION (900)		¥ B	¥ AN			1	1								
	BOOSTER DELIVERY (900)		¥ B		* BU		1		1						1	CSS
	ROUND ABOUT(1) OT (300)		B	AN	BU		1	1	1						1	SITE
	ROUND ABOUT(2) OT (525)		B	AN	BU		1	1	1						1	SITE
	FIRE BRIGADE OT (375)		B	AN	BU		1	1	1						1	SITE
	SAN F'DO B/PUMPS									6	25		3	CSS		
42 MOSQUITO CREEK												3				
	TO MOSQUITO CR. OT (600)		B	AN	BU		1	1	1						1	SITE
43 ST CLEMENT												6				
	ST CLEMENT (1) OT (200)		B	AN	BU		1	1	1						1	SITE
	ST CLEMENT (2) OT (250)		B	AN	BU		1	1	1						1	SITE
44 DAISY												3				
	DAISY OT (400)		B	AN	BU		1	1	1						1	SITE
45 MALGRETOUTE BPS												64				
	BOOSTER SUCTION (900)		¥ B	¥ V			1	1								
	BOOSTER DELIVERY (900)		¥ B		BU		1		1						1	CSS
	BUEN INTENTO OT (300)		B	AN	BU		1	1	1						1	SITE
	TO PRINCESS TOWN OT (300)		B	AN	BU		1	1	1						1	SITE
	TO MALGRETOUTE OT (300)		B	AN	BU		1	1	1						1	SITE
	MALGRETOUTE B/PUMPS									10	41		5	CSS		
46 BROTHER ROAD												9				
	BROTHER ROAD OT (150)		B	AN	BU		1	1	1						1	SITE
	TO PIPARO/ARCH OT (250)		B	AN	BU		1	1	1						1	SITE
	TO ST JULIAN OT (375)		B	AN	BU		1	1	1						1	SITE
47 TCO BPS												68				
	BOOSTER SUCTION (900)		¥ B				1									
	BOOSTER DELIVERY (900)		¥ B	¥ V	BU		1	1	1						1	CSS
	RIO CLARO OT (300)		B	AN	BU		1	1	1						1	SITE
	TCO B/PUMPS									12	49		6	CSS		
48 NAVET WW												9				
	HIGH DAM	F				1										
	LOW DAM	F				1										
	STORAGE LIFT PS (1200)			AN				1								
	RAW WATER (450)			AN-4				4								
	CLEAR WATER RESERVOIR	F				1										
	DISTRIBUTION (900)			AN				1								
	T O T A L	38	127	160	124	38	127	160	113	58	249	745	29		113	
	= LIST OF ITEMS =	¥AP 4 D 11 *D 8 ¥D 5 F 10	¥B 14 B 111 *B 2	¥AN 6 AN139 ¥O 2 ¥PF 2 ¥V 11	AV 9 *AV 2 BU106 *BU 1 ¥BU 4 ¥CV 2								6 23	CARONI CSS CARONI	102 7 4	SITE CSS CARONI

Table III-3.2 PROPOSED SPECIFICATIONS OF CSS HARDWARE

COMPONENTS OF SYSTEM HARDWARE	QUANTITY	SPECIFICATIONS
(1) CENTRAL DATA PROCESSING SYSTEM (CDPS)		
CENTRAL PROCESSING UNIT (CPU)	2	MAIN MEMORY RAM 8 MB, CACHE 120 KB
FIXED DISK DRIVE	2	CAPACITY 547 MB, SPEED 2.4 MB/S
FLEXIBLE DISK DRIVE	2	CAPACITY 1.2 MB
CARTRIDGE TAPE DRIVE	2	CAPACITY 150 MB, SPEED 88 KB/S
COMMUNICATION INTERFACE	2	TYPE 16 bit, SPEED 10 KB/S
SERIAL INTERFACE	2	INTERVAL 10 ms
SERIAL INPUT/OUTPUT INTERFACE	2	SPEED 9600 bps
CRT DISPLAY	2	20 INCHES, COLOR, DISPLAY 4992 CHARACTERS
HARD COPIER	1	SPEED 60 S, COLOR 7
LINE PRINTER	1	SPEED 240 LINE/MINUTE, NUMBER OF CHARACTERS 136/LINE
SERIAL PRINTER	1	SPEED 120 C/S, NUMBER OF CHARACTERS 136/LINE
SYSTEM CONSOLE	1	CRT 12 INCHES, NUMBER OF CHARACTERS 136/LINE
GRAPHIC PANEL	1	SIZW ABOUT HEIGHT 2.0 M, WIDTH 7.0 M
UNINTERRUPTIBLE POWERN SUPPLY	1	15 KVA, BACK UP 1 HOUR
MODEM	2	SPEED 4800 bps
(2) REMOTE TERMINAL UNIT (RTU)		
INTERNAL CONTROLLER	48	MICROPROCESSOR MAIN MEMORY RAM 512 KB
SERIAL INPUT/OUTPUT INTERFACE	48	INTERVAL 10 ms
PROCESS I/O INTERFACE	48	INPUT/OUTPUT DC 4 - 20 mA, INPUT FAILURE ALARM
(3) DATA RADIO COMMUNICATION SYSTEM		
(CSS BUILDING)		
UHF TRANSCEIVER	2	413.250 MHz, 418.025 MHz, 10 W
COMMUNICATION INTERFACE	2	POLLING 5 Minutes, SPEED 200 bps, MANUAL POLLING
(REPEATER STATION)		
UHF REPEATER	2	413.250 MHz, 418.025 MHz, 10 W
VHF REPEATER	2	153.950 MHz, 159.960 MHz, 1 W
UNINTERRUPTIBLE POWERN SUPPLY	1	1 KVA, BACK UP 4 HOURS
(RTU STATION)		
VHF TRANSCEIVER	48	153.950 MHz, 159.960 MHz, 1 W
COMMUNICATION INTERFACE	48	POLLING 5 Minutes, SPEED 200 bps
UNINTERRUPTIBLE POWERN SUPPLY	48	1 KVA, BACK UP 1 HOUR
(4) REGIONAL OFFICE		
WORK STATION (CRT AND COMPUTER)	2	20 INCHES, COLOR, MAIN MEMORY 8 MB, FDD 200 MB
OPTICAL CHARACTER READER (OCR)	2	RESOLUTION 300 DOT PER INCH, SCANNER
HARD COPIER	2	SPEED 60 S, COLOR 7

NOTE:
RAM; RANDOM ACCESS MEMORY, MB; MEGA-BYTE, KB; KILO-BYTE, MB/S; MEGA-BYTE PER SECOND, KB/S; KILO-BYTE PER SECOND, ms; MILLI-SECOND, bps; BIT PER SECOND, S; SECOND, C/S; CHARACTER PER SECOND, M; METER, KVA; KILO-VOLT-AMPERE, DC; DIRECT CURRENT, mA; MILLI-AMPERE, MHz; MEGA-HERTZ, W; WATT, I/O; INPUT/OUTPUT, FDD; FIXED DISK DRIVE,

Table III-3.3 PROPOSED SPECIFICATIONS OF MONITORING AND CONTROL EQUIPMENT

COMPONENTS OF MONITORING AND CONTROL EQUIPMENT	QUANTITY	SPECIFICATIONS
(1) MONITORING EQUIPMENT		
LEVEL METER : FLOAT TYPE	10	DRUMS, FLOAT & FLOAT CABLE
: DIFFERENTIAL PRESSURE TYPE	11	DIAPHRAGM PRESSURE TRANSDUCER
FLOW METER : ANNUBAR TYPE	139	DIA. 100 MM - 1,200 MM,
		ACCURACY; ±1%, BI-DIRECTIONAL FLOW SENSING
PRESSURE GAUGE: BOURDON TUBE TYPE	111	PRESSURE RANGE; 0 kg/cm2 - 10 kg/cm2
(2) INSTRUMENTATION		
LEVEL METER : AIR PURGE TYPE	4	INDICATOR, TRANSMITTER (DC 4 - 20 mA)
: DIFFERENTIAL PRESSURE TYPE	24	INDICATOR, TRANSMITTER (DC 4 - 20 mA)
: FLOAT TYPE	10	INDICATOR, TRANSMITTER (DC 4 - 20 mA)
FLOW METER : ANNUBAR TYPE	160	INDICATOR, ROOTER, TRANSMITTER (DC 4 - 20 mA)
PRESSURE GAUGE: BOURDON TUBE TYPE	125	INDICATOR, TRANSMITTER (DC 4 - 20 mA)
(3) CONTROL EQUIPMENT		
CONTROL VALVE : BUTTERFLY VALVE	106	MOTOR DRIVEN, FCD, DIA. 100 MM - 1,200 MM
CONTROL PANEL FOR CONTROL VALVE	113	INDICATOR, ONE LOOP CONTROLLER
INSTRUMENT PANEL FOR RTU AND CONTROL VALVE	113	INDICATOR, ONE LOOP CONTROLLER
REMOTE CONTROL PANEL FOR BOOSTER PUMPS	6	PUSH BUTTON, INDICATOR

NOTE: DC; DIRECT CURRENT, mA; MILLI-AMPERE, DIA.; DIAMETER, MM; MILLIMETER,

4. COST ESTIMATES AND DISBURSEMENT SCHEDULE

4.1 COST ESTIMATES

Cost estimates of the project are summarized in the Part II Master Plan of this report. This section will provide a basis of cost estimation together with breakdown of the Phase I Project costs.

Results of the cost estimates are given in Table III-4.1. All costs are current price as of March 1991. They are principally products of unit costs and the number of equipment and materials to be required. The unit costs of materials and equipment are based on quotation from prevailing manufacturers and/or market price. The unit costs of civil work such as excavation, backfilling, scaffolding, etc. are the standard price as of December 1988, officially published in Trinidad and Tobago. To obtain current price from these figures, following escalation factors are employed:

1988*1	1989*1	1990*1	1991*2	1992 and afterwards*2
7.8	11.4	10.8	10.0	8.0

*1...Actual inflation rate quoted from Trinidad and Tobago Gazette, Vol.29, No.320, 14th Nov., 1990

*2...Inflation rates forecast by Inter-American Development Bank (IDB)

As regards engineering cost, man-months of assigned engineers and experts are tentatively estimated from the developed manning schedule and the standard monthly rate of the expatriate engineers. This engineering services may be rendered during whole period of project implementation, i.e., from October 1992 to December 1995, since the project execution requires special expertise in various field of water supply engineering, instrumentation, system operation and maintenance.

All costs as referred to Table III-4.1 are brokendown into foreign and local currency portions according to source countries of materials and works.

The base cost as of March, 1991 is thus estimated with a total of US$ 35,530,000 including US$ 30,680,000 (or 86.3% of the total) and TT$ 20,630,000 (or 13.7%) for foreign and local currency portions respectively.

To estimate total project cost, VAT (Value Added Tax) and physical contingencies are considered in addition to the above. The VAT currently levied on commercial transaction in Trinidad and Tobago is exclusively 15%. Therefore, the VAT may be computed as a product of total amount of the base cost and this percentage (15%). Physical contingencies are provision for increased expenditures due to uncertainty of the work. Percentage applied for physical contingencies is rather optimistic 15% of the base cost in view of the shortage of accurate data on pipelines and facilities.

Furthermore, 0.5% of the base cost is provided as WASA's administration cost required for preparatory works and administrative procedures. They are costs for various printing works, office equipment, communication, advertisement for tender calling, expenses for L/C (Letter of Credit) opening procedures, etc., to be incurred during project implementation.

Total project cost thus estimated amounts US$ 46,370,000 including US$ 35,280,000 (or 74.9%) for foreign currency and TT$ 47,130,000 (or 25.1%) for local currency. This total cost, as discussed above, covers entire works contained in the Phase I Project.

4.2 DISBURSEMENT SCHEDULE

Project formulated in the former sections will require vast amount of investment cost. To figure out the scale of annual investment, estimated costs are further brokendown into the form of the disbursement schedule. In developing the disbursement of the project cost, followings are taken into consideration:

1) Payment method and period required for administrative procedures

Payment method usually applied in short-term contract for supply of equipment and materials may be 40% of the contract cost as advance

payment, 30% as second payment after delivery of the materials and 30% as final payment. Civil work contract is usually based on construction progress. Hence, 25% as advance payment, 25% as second and third payments and 25% as final payment are tentatively assumed to estimate amount of the annual investment. It is also supposed that the payment will be made within one month after payment request by contractors.

2) Construction schedule

Schedule of payment will also be affected by construction schedule. Hence, construction period and timing will be considered together.

3) Project scale

As considered in Part II Master Plan, project scale is a key for the international financing agencies to determine an annual loan amount of financing for project execution. In this regard, the project scale will be appropriate also for the financing agencies.

4) Financial burden of central government and WASA

If a large amount of investment concentrates in the same year, this situation might be undesirable for WASA. As financial burden on the central government and WASA shall be kept minimum, construction schedule will be deliberately prepared in consideration of this aspect.

The disbursement schedule developed is presented in Table III-4.2. As seen in this table, the annual investment concentrates in the years of 1994 and 1995. These amounts, however, are considered still within financial capability of WASA and the government.

In addition, preliminary cost estimates and disbursement schedule for the Immediate Projects implementation are tentatively prepared in this report as shown below.

The costs, inclusive of engineering fees, replacement/installation of service mains/connection and meters, leak repair, valve repair/replacement,

VAT, physical contingencies, and administration costs are all associated with the leakage abatement and universal metering, namely, major components of the Immediate Projects. Proposed area for the leakage abatement is consistent with the project area of the Phase I Project. The annual investments in the table are obtained by multiplying assumed percentage and the estimated cost.

Consequently, these are estimates for the purpose of the financial and economic evaluation of the Phase I Project to be detailed in Section 6 of this report.

It is recommended that all costs in the table will be reviewed in the course of WASA's relevant studies and analyses on more sound engineering basis.

ANNUAL INVESTMENT FOR IMMEDIATE PROJECT Unit: 1,000US$

YEAR	LEAKAGE REDUCTION	METERING	TOTAL
1991	-	-	-
92	6,409	4,833	11,242
93	7,100	4,833	11,933
94	4,729	4,833	9,562
95	5,041	4,833	9,874
96 and afterwards	5,041	-	5,041
TOTAL	43,441*	19,334	62,775*

*...These totals are costs invested during the period from 1992 to 1999.

Table III-4.1 SUMMARY OF COST ESTIMATE FOR PHASE I PROJECT

UNIT: IN x 1,000

ITEM	NAME OF FACILITIES AND EQUIPMENT	PHASE I									
		FOREIGN CURRENCY (US$)			LOCAL CURRENCY (TT$)						TOTAL (US$)
		SUPPLY			CIVIL WORKS				SUPPLY		
		PRIMARY EQUIPMENT	INSTRUMENT -ATION	TOTAL (US$)	F-M/C-V CHAMBER	BUILDING WORKS	INSTAL-LATION	SUB-TOTAL (CIVIL)	TRANS-PORTATION	TOTAL (TT$)	
[1]	CONSTRUCTION WORKS										
	[CSS]										
	FLOW METER	494.2	1,329.8	1,824.0	1,438.4	---	775.2	2,213.6	155.0	2,368.7	2,381.3
	CONTROL VALVE	2,156.4	3,779.8	5,936.2	1,396.5	---	2,522.9	3,919.4	504.6	4,424.0	6,977.1
	LEVEL METER	32.5	279.6	312.0	---	---	132.6	132.6	26.5	159.1	349.5
	PRESSURE GAUGE	---	566.7	566.7	---	---	240.8	240.8	48.2	289.0	634.7
	CSS's CENTRAL EQUIP	---	5,861.9	5,861.9	---	385.3	1,902.6	2,287.9	380.5	2,668.4	6,489.7
	REGIONAL OFFICE	---	211.6	211.6	---	---	89.9	89.9	18.0	107.9	236.9
	REPEATER STATION	---	219.1	219.1	---	---	93.1	93.1	18.6	111.7	245.4
	RTU STATION	---	11,832.0	11,832.0	---	2,219.5	5,028.6	7,248.1	1,005.7	8,253.8	13,774.1
	BOOSTER P/S	---	226.7	226.7	---	---	96.3	96.3	19.3	115.6	253.9
	SPARE PARTS	---	249.3	249.3	---	---	---	---	21.2	21.2	254.3
	SUB-TOTAL	2,683.1	24,556.3	27,239.4	2,834.9	2,604.9	10,882.1	16,321.9	2,197.6	18,519.5	31,596.9
	[LSS]										
	FLOW METER	---	---	---	---	---	---	---	---	---	---
	SUB-TOTAL	---	---	---	---	---	---	---	---	---	---
	T O T A L	2,683.1	24,556.3	27,239.4	2,834.9	2,604.9	10,882.1	16,321.9	2,197.6	18,519.5	31,596.9
[2]	ENGINEERING SERVICES	---	---	3,437.0	---	---	---	---	---	2,109.3	3,933.3
TOTAL OF ITEMS [1] & [2]		2,683.1	24,556.3	30,676.4	2,834.9	2,604.9	10,882.1	16,321.9	2,197.6	20,628.7	35,530.2
[3]	TAX (VAT)	---	---	---	---	---	---	---	---	22,650.5	5,329.5
[4]	CONTINGENCY	---	---	4,601.5	---	---	---	---	---	3,094.3	5,329.5
[5]	ADMINISTRATION	---	---	---	---	---	---	---	---	755.0	177.7
GRAND-TOTAL		2,683.1	24,556.3	35,277.9	2,834.9	2,604.9	10,882.1	16,321.9	2,197.6	47,128.6	46,367.0

NOTE: EQUIP.; EQUIPMENT, P/S ; PUMPING STATIONF-M/C-V; FLOW METER AND CONTROL VALVE,
VAT ; VALUE ADDED TAX, EXCHANGE RATES; 1 US$ = ¥ 135 AND 1 US$ = TT$ 4.25,

Table III-4.2 DISBURSEMENT SCHEDULE FOR PHASE I PROJECT

UNIT: IN x 1,000

NO.	YEAR / ITEM	PHASE I															
		1992			1993			1994			1995			TOTAL		
		F/C (US$)	L/C (TT$)	TOTAL (US$)	F/C (US$)	L/C (TT$)	TOTAL (US$)	F/C (US$)	L/C (TT$)	TOTAL (US$)	F/C (US$)	L/C (TT$)	TOTAL (US$)	F/C (US$)	L/C (TT$)	TOTAL (US$)
[1]	CONSTRUCTION - SUPPLY	---	---	---	---	---	---	10,895.8	879.0	11,102.6	16,343.6	1,318.6	16,653.9	27,239.4	2,197.6	27,756.5
	CONSTRUCTION - CIVIL WORK	---	---	---	---	---	---	---	9,793.1	2,304.3	---	6,528.7	1,536.2	---	16,321.9	3,840.4
	SUB-TOTAL	---	---	---	---	---	---	10,895.8	10,672.2	13,406.9	16,343.6	7,847.3	18,190.1	27,239.4	18,519.5	31,596.9
[2]	ENGINEERING SERVICES	511.1	283.3	577.8	1,140.7	724.1	1,311.1	629.6	409.3	725.9	1,155.6	692.6	1,318.5	3,437.0	2,109.3	3,933.3
SUB-TOTAL		511.1	283.3	577.8	1,140.7	724.1	1,311.1	11,525.4	11,081.4	14,132.8	17,499.2	8,539.9	19,508.6	30,676.4	20,628.7	35,530.2
[3]	TAX (VAT)	---	368.3	86.7	---	835.8	196.7	---	9,009.6	2,119.9	---	12,436.7	2,926.3	---	22,650.5	5,329.5
[4]	CONTINGENCY	76.7	42.5	86.7	171.1	108.6	196.7	1,728.8	1,662.2	2,119.9	2,624.9	1,281.0	2,926.3	4,601.5	3,094.3	5,329.5
[5]	ADMINISTRATION	---	12.3	2.9	---	27.9	6.6	---	300.3	70.7	---	414.6	97.5	---	755.0	177.7
	TOTAL	587.8	706.4	754.0	1,311.9	1,696.4	1,711.0	13,254.2	22,053.6	18,443.3	20,124.1	22,672.2	25,458.7	35,277.9	47,128.6	46,367.0

NOTE: EXCHANGE RATES; 1 US$ = ¥ 135 AND 1 US$ = TT$ 4.25.

5. CONSTRUCTION AND IMPLEMENTATION SCHEDULE

5.1 CONSTRUCTION SCHEDULE

Construction schedule as shown on Fig. III-5.1 is worked out in consideration of the characteristics of the work involved and the implementation schedule presented in Part II Master Plan. Followings are specific aspects of the project to be considered during construction of the CSS facilities.

CSS Building

1) The new CSS building will occupy an eastern part of the WASA's parking space located in front of the existing CSS building. The new building will accommodate mainly staff and officials concerned of the planning and maintenance sections of the CSS division.

   On the other hand, the CSS instruments are installed in the existing CSS building to monitor and control the water supply system. The operators and engineers in the operating section will usually station in the existing building which will be modified slightly for this purpose. Construction schedule and method will be carefully designed so as not to hinder WASA's daily activities.

2) Modification of the existing CSS building will precede the construction of the new building to install CSS instruments and equipment within a limited time frame.

RTU Station

1) Exact location of the RTU stations will be determined in consideration of the topographical features, distance to the primary sensors, existing electric cable lines, accessibility to the stations, etc. It is desirable to locate the stations within WASA's properties to minimize investment and time required for land acquisition.

2) Construction of 48 RTU stations might be voluminous. Sub-packaging of

contract in terms of the work volume and geographical distance between construction sites is recommended to complete the work as planned.

3) As the installation of the RTU instruments will follow the construction of the RTU buildings, the construction of the RTU buildings and installation will be a critical path of the entire construction schedule. Any delay in construction will cause further delay of the succeeding works.

Valve Chambers, Stands, etc.

1) The valve installation will require special arrangements such as pipe detection, instruction of the work to the consumers, temporary shutting and dewatering of the pipelines, traffic control, and water supply during construction. Adequate work arrangements are of vital importance to carry out the work without delay.

2) Existing valves found at every off-take of the water mains without exception may be effective as temporary shutting during installation of the control valve.

Package Design

Package design also affects construction schedule. Following are tentatively considered for designing packages for supply of materials and civil works:

1) Construction of the CSS building and RTU stations will be combined into the least number of package because of similar nature of the works.

2) The package shall be attractive in size to invite many contractors as possible.

3) Works shall be carefully designed so that contractors can execute their work/supply as planned.

4) It may be appropriate that construction sites shall concentrate in one area for ease of construction.

5) According to the nature of materials, period required for the manufacturing varies much from three months to nearly ten months.

From the above, it is recommended that all works shall be grouped into three supply and two (or three) civil work packages as listed below:

1) The CSS related instruments which has a similar nature.

2) Flow meters, pressure gauges, level meters, etc., of which manufacturing does not require a long period.

3) Flow control valves that require rather longer period for manufacturing.

4) Construction of the CSS and RTU buildings and installation of CSS instruments under supervisory of manufacturers. (one or two packages depending on the capability of contractors)

5) Installation of meters, valves and gauges including construction of valve and meter chambers, and valve control panel stands.

Packages 1), 2) and 3) above are to procure materials from overseas through open international competitive bidding, and packages 4) and 5) are civil works conducted by local contractors. Package 4) contains installation of the equipment in the CSS and RTU buildings. As specified in the former section, this work will be carried out under supervisory of manufacturers.

5.2 IMPLEMENTATION SCHEDULE

The period required for Phase I Project implementation is about four years as set forth in the Part II of this report.

Major procedures for implementing the Project are loan application, consultants selection, detailed design and tender documentation, tendering, award of contract, manufacturing, shipping, installation/construction, test operation and commissioning.

Loan application for the project usually requires some six to ten months. For preparing the implementation schedule, ten months are employed for safety. To minimize the period for administrative procedures, it is desirable to consider type of the project loan that covers costs of both detailed design and construction at the same time.

Period for the succeeding consultants selection shall be kept minimum in view of the urgency of the project. To avoid any duplication of studies and surveys conducted so far, direct appointment of the consultants might be recommendable if possible.

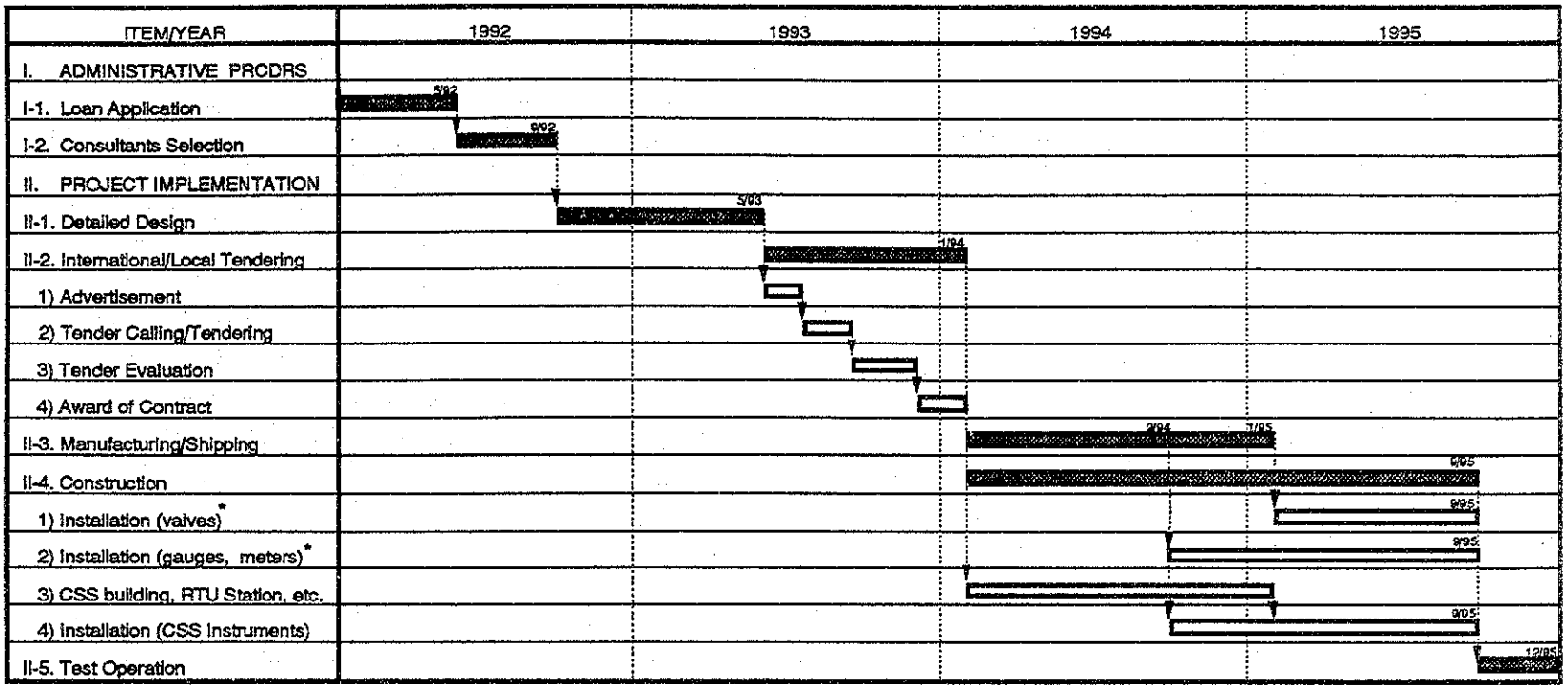
The eight month period for detailed design can be allowed to prepare tender documents including preparation of general condition, technical specification, bill of quantities, detailed drawings, etc. Tendering and award of contract will extend minimum eight months according to the experience obtained in the similar projects.

Period for manufacturing and shipping depends largely to the manufacturers' capability and experience. Major equipment and utilities to be procured for this project are usually manufactured on quotation basis. Hence, one year is a minimum duration for manufacturing and shipping.

Installation of valves, pressure gauges, flow meters, RTU and other instrumentation will be rather short of eleven months after delivery of materials including three month test operation. The building for CSS units will be constructed under separate contract package by the local contractors at the early stage of the implementation. Immediately after completion of the CSS building, the equipment delivered from overseas will be installed therein.

From the above, total period required for project implementation is estimated at fifty three months. Fig. III-5.1 also shows an implementation schedule developed for Phase I Project.

Fig. III-5.1 CONSTRUCTION/IMPLEMENTATION SCHEDULE



* ..... Pressure gauges, flow meters and CSS instruments will be delivered to the site in the first shipment, while valves in the second shipment.

6. PROJECT EVALUATION

6.1 GENERAL

1) Benefits

Benefits accrued from the WSSS are such as described in Section 8 of Part II. As the evaluation is confined to Phase I project (the Project), benefits accrued from the Project are confirmed below.

As the Project focuses on monitoring the water supply systems with the CSS, some of the aforementioned benefits are excluded from the benefits of the Project. The reduction of operational costs by establishing the minimum cost operating strategy is expected to take place in Phase II. However, an opportunity could be ascertained to reduce the operational costs by flexibly supplying water which coincides with changes in water demand.

The other benefits are expected to accrue even in Phase I, namely:

- Stable water supply to customers,
- Foresight of or prompt reaction to abnormal occurrences,
- Monitoring and detection of water leakage,
- Reduction of personnel costs involved with the installation of the CSS, and
- Contribution to planning of water supply systems.

Although the benefit of the Project is pointed out as mentioned above, the tangible benefits are confined to the reduction of leakage that can be interpreted into the reduction of UFW and the reduction of personnel costs to be realized by the installation of CSS. In this Study, these two items are considered as the benefit of the Project.

The reduction of UFW was targeted for the project evaluation purpose as follows:

Year	Level of UFW(%)
Present (Estimate)	50
1995	40
2000	30

Since the reduction of UFW further than 30% would require an enormous cost and time, it is unrealistic to assume and include a UFW of less than 30% level in the project evaluation at the present time. Therefore, in this evaluation, the UFW of less than 30% was not taken into consideration.

2) Costs

Associated costs are added to the cost of CSS since the benefits of the Project are not accrued without them. They are equivalent to the costs of what should be done by the time the CSS will work, or the prerequisites described in Section 6 of Part I.

Among the prerequisites, update of data and drawings and calibration/ overhaul/replacement of mechanical/electrical equipment should be done in the course of daily works of WASA. Accordingly, the costs are counted in the evaluation for leakage reduction program and universal metering system including service connection meters.

Only for the evaluation purpose, the costs are roughly estimated by the JICA study team as shown in the Supporting Report N "Data on Cost Estimate". The leakage reduction program includes the replacement of the existing deteriorated pipelines which are associated with the leakage. Its costs are estimated, assuming it achieve the decrease in unaccounted-for-water from 50% to 30% in 2000.

3) Assumptions

Major assumptions common to both economic and financial evaluation are as follows:

- The evaluation period is taken at construction periods plus 20 years

with one-time replacement of the CSS of which economic life is 10 years;

- The base period for cost estimates of the Project is set in March 1991;

- Official exchange rates are used in the evaluation as well as the cost estimates: US$ 1 = TT$ 4.25 = Yen 135;

- Targets of reduction of UFW, which is defined here as nearly equivalent to water leakage, are set 40% in 1995, 30% in 2000 and thereafter, while the existing percentage of UFW (50%) will continue without of project and leakage reduction program.

6.2 ECONOMIC EVALUATION

6.2.1 Measurement of Benefits

Out of the benefits enumerated in 1) of 6.1, only an economic benefit can be measured on the basis of available data: monitoring and detection of water leakage. Other benefits are intangible.

Implementation of the universal metering program is expected to reduce the water which otherwise would be wasted by customers. The benefits with regard to the effect such as the deferment of investment expenditures and savings in operational costs cannot be measured for this evaluation.

The tangible benefits are figured out by multiplying average water rate (billable revenue/sales volume) by annual volume to be saved. The average water rate is calculated at TT$ 0.99/m^3 1988 and 1989, based on the data as of September 1989. For economic evaluation, however, the water rate is not suitable as a surrogate of lower end of customer's willingness-to-pay because current water charge system has nothing to do with the water volume consumed and customers' willingness-to-pay. Therefore, average water rate based on metered account (TT$ 1.94/m^3) is adopted as a unit benefit although the metered account is less than one percent of the total accounts in the country.

Table III-6.1 shows the water revenue, water consumption, average water rate and adjusted average water rate for metered account. The average water rate for metered account has to be adjusted since its composition of water consumption by customer category is different from that of total accounts. The adjusted average water rate for metered account is calculated at TT$ 1.94/m^3, which is employed as unit benefit, assuming that the water use pattern for metered account represent the one in the Phase I project area.

Based on the water demand estimated by the JICA study team, the economic benefits of the Project are calculated as shown in Table III-6.2.

6.2.2 Costs

Table III-6.3 presents the disbursement schedules of the Project in both the financial and economic prices. The following are major parameters to convert financial costs into economic costs:

Internal Transfer Payments

For economic evaluation, internal transfer payments such as import duties, taxes and subsidies should be excluded from the costs since they do not either increase nor decrease the availability of real resources to the rest of economy. Unit prices employed in the cost estimates are surveyed before the introduction of VAT of 15%, so that 3% of local market prices is estimated to be the internal transfer payments. There are no subsidies to goods and materials except for some agricultural products.

Standard Conversion Factor (SCF)

Standard Conversion Factor (SCF) is used in the economic evaluation to derive economically efficient prices from the market prices in local markets, in an approximate way, by multiplying the latter by the SCF. The SCF in Trinidad and Tobago is estimated at 0.97, applying the figures in Table III-6.4 to the following formula:

$$SCF = \frac{M + X}{(M + t_m - s_m) + (X - t_X + s_X)}$$

where,

- M : Border price value of all imports,
- X : Border price value of all exports,
- t_m : Taxes on imports,
- s_m : Subsidies to imports,
- t_X : Taxes on exports and
- s_X : Subsidies to exports.

Year	1985	1986	1987	1988	1989
SCF	0.94	0.95	0.96	0.97	0.97

Shadow Prices of Main Inputs

In the economic evaluation of projects, in general, shadow prices of major inputs are figured out for economic evaluation, typically, land and wage rates. Taking into account the features of the Project, the cost for land and unskilled labor is considered to be negligible as compared to the total costs. The shadow wage rate of skilled labor is allowed for in the evaluation. The shadow wage rate of skilled labor is considered equal to their market wage rate and adjusted with SCF.

6.2.3 Economic Internal Rate of Return

Table III-6.5 shows the economic benefit and cost stream of the Project, based on the Tables III-6.2 and III-6.3. In the table, residual value is counted in the final year of the evaluation period.

The economic internal rate of return (EIRR) is calculated at 9.6%. The figure is lower than the Opportunity Cost of Capital (OCC) in Trinidad and Tobago. The OCC is estimated at 12% by Inter-American Development Bank. However, the EIRR understates a variety of intangible benefits of the Project and "associated" benefits of universal metering program as mentioned before.

6.2.4 Sensitivity Analysis

Sensitivity analysis is to see what change in the value of a dependent variable is consequent on a chosen change in the value of one or more of the variables that determines it. In this Study, sensitivity of the EIRR is seen by changing values of costs and benefits.

The results of sensitivity analysis is summarized below:

Cost / Benefit	+20%	+10%	0%	-10%
+10%	8.2	9.6	11.1	12.8
0%	6.8	8.1	9.6	11.2
-10%	5.3	6.6	8.0	9.6
-20%	3.7	4.9	6.2	7.8

The result indicated that the EIRR is slightly more sensitive to changes in benefits than those in costs.

6.3 FINANCIAL EVALUATION

6.3.1 Measurement of Benefits

Financial benefits which can be measured comprise incremental revenue due to the reduction of water leakage and reduction of personnel costs with the installation of the CSS.

Increase in Revenue

Increase in revenue will be estimated in the same way as employed in the economic evaluation. Unlike the case of economic evaluation, however, the actual water rate will be adopted to obtain the incremental revenue by the implementation of the project.

Current average water rate is calculated at TT$ 0.99/m^3, based on the data in 1988 and 1989 (as of September, 1989), as shown in Table III-6.6.

Savings in Personnel Cost

Savings in personnel cost will be accrued when the reduction of staff is achieved in the Project. The Study assumes that current 40 operators at booster pump stations be reduced to 4 in Phase I, (whereas 80 turncock operators to 40 in Phase II). The saving is derived from average personnel cost per staff to be displaced, being multiplied by the number of staff to be displaced by year. The average personnel cost to be displaced per staff is estimated at TT$ 2,700 per month in 1989, based on salary scales of Compensation Plan for Public Service and the proportion of salary to personnel cost (0.885).

Table III-6.7 presents the financial benefit stream during the evaluation period.

6.3.2 Costs

Financial costs of the Project and associated costs are shown in the aforementioned Table III-6.3. Import duties are excluded from the costs since they will be exempted according to "Water and Sewerage Authority (Tax Exemption) Order, 1990".

The goods and materials to be procured in local markets are subject to value-added tax (VAT), 15% of retail prices, which was amended in early 1990. Therefore, the tax is included in the costs. The VAT, however, is refundable to WASA as the VAT involved with sales of water is zero-rated.

The costs do not take the inflation into account. The inflation is allowed for in the evaluation only when changes in relative prices of goods and services can be foreseen. In the Study, it is impossible to verify specific inflation rates for each good and service invested to the Project.

6.3.3 Financial Internal Rate of Return

Financial cash flow is made from the derived financial benefits and costs (Ref. Table III-6.8). The tax (VAT) is excluded in the financial costs since it is refunded as mentioned above.

The financial internal rate of return (FIRR) is calculated at 0.3%. Although the figure is positive, it cannot be judged that the Project is financially sound even if the intangible benefits are not reflected in the figure.

It is worthwhile examining the increase in water revenue to get the Project financially viable. If WASA has its standard of the rate of return to the investment, the standard can be applied to judge the financial viability of the Project. However, there is no such standard at the moment.

Accordingly, an analysis will be made to derive some water rates which get the FIRR of the Project eight, ten and twelve percentages. The result of the analysis is as follows:

FIRR	Average Water Rate
8%	TT$ 1.74/m^3
10%	TT$ 1.98/m^3
12%	TT$ 2.24/m^3
(0.3%)	(TT$ 0.99/m^3)

The above water rates are some indices showing the rates at March 1991 prices to be raised by the commissioning year of the Project.

An attention should be paid to the impacts of increases in water rates on the customers, especially domestic customers. In other words, it is required to check if they can afford to pay for the water charges.

Table III-6.9 indicates the estimated average water rates by customer category in 1990 and 1995. The water rates by customer category in 1995 are estimated to get the average water rate in total TT$ 2.24/m^3 (FIRR = 12%), based on the data in 1990. The average water rate of domestic category has to be increased to TT$ 2.64/m^3 from TT$ 1.08/m^3 in 1990.

As per capita demand of domestic category is estimated to increase up to 223.8 lpcd or 6.7m^3 per month, household consumption would be 27.5 m^3 per month in 1995, assuming the family size of 4.1 (1990) constant. Therefore, a household would pay TT$ 72.6 at March 1991 prices for the water consumption per month, on average.

For the average income of each household, it is officially estimated at TT$ 1,872 per month in 1988. The average monthly household income is converted to some TT$ 2,300 at March 1991 prices, using the consumer price index (11.4% and 10.8% during period from 1988 to 1989, and from October, 1989 to October, 1990, respectively).

Assuming the household income constant in real terms until 1995, the proportion of expenditures in water to monthly household income is 2.7%. The percentage will decline when the GDP grows in real terms. Indeed, it is forecasted to grow from 1991 to 1995 by National Planning Commission ("Medium Term Macro Planning Framework, 1989-1995, September 1990).

The average household could afford to pay the increased water rates, as the upper limit of the capacity-to-pay for water charges is generally considered three to five percent of the household income. However, it should be noted that the derived percentage is the average of total households, so that a careful attention should be paid to the low income households' capacity-to-pay.

6.3.4 Sensitivity Analysis

The result of sensitivity analysis is as follows:

Cost / Benefit	+10%	0%	-10%	-20%
+20%	1.7	2.7	3.9	5.2
+10%	0.3	1.5	2.7	3.9
0%	-	0.3	1.3	2.6
-10%	-	-	0.3	1.1

As is the case in the economic evaluation, the FIRR is slightly more sensitive to changes in the benefits than those costs.

6.4 FINANCING PLAN OF THE PROJECT

6.4.1 General

The most probable source of finance for the Project is the Inter-American Development Bank (IDB). Since 1967, the IDB has provided US$ 18.8 million to help T&T finance development projects with a total project cost of US$ 63.5 million. Since 1975, however, T&T has not applied for IDB loans due to its favorable position resulting from the increase in petroleum prices. The greatest contribution of the IDB has been in the area of water supply and distribution as described hereunder:

1) Loan amount of US$ 300,000 in 1967 for a study of water resources and needs.

2) Two loans with a total of US$ 5.7 million succeeding to the above, for the first stage implementation of the program, which consists of development of a storage system based on pumping water from the Navet river dam to a nearby water treatment plant.

3) Technical cooperation grant with an amount of US$ 120,000 in 1978 to map the water distribution system; to provide leak detection and system control and maintenance of sewage treatment plants.

The capital transfer from the Government may hardly be expected at a large scale for the time being. Actually, a commercial loan was introduced to WASA for the first time in the long history of WASA in 1990. The interest rate was prime rate minus 1% for 25-year loan and prime minus 2% for 15 year loan, the prime rate being 13% at the present time with floating rate.

For the finance of CSS, no explicit funding has been committed. However, it would be possible, according to WASA, to include CSS finance in the loan for the trunk main replacement project to reduce UFW that is explicitly

committed by IDB. Another possible financing source would be the Caribbean Development Bank but it can finance only small amount according to its past practice.

6.4.2 Loan Repayability

It is important for WASA and the Government to see whether the loan procured for the Project will be repaid only with the revenue of the Project. The donors and conditions of loan are set as follows, assuming IDB the foreign donor and concessional loan from commercial banks for local markets:

Loan from foreign donors:
Interest rate : 8.05%
Grace period : Implementation period or four years
Repayment period : 20 years
Loan portion of total cost: 70% of total cost

Loan from local financial market
Interest rate : 11.5%
Grace period : No grace period
Repayment period: 20 years

Although both the interest rates above are subject to fluctuation, the current ones are adopted and assumed constant. The loan repayability is assessed at nominal terms, taking the forecasted inflation rates into account during the construction period. There is no authorized projection of inflation which is publicized. However, Inter-American Development Bank (IDB) forecasted the inflation rates in Trinidad and Tobago for the six years from 1990 to 1995, as shown below:

Year	1990	1991	1992	1993	1994	1995
Rate (% p.a.n.)	12.0	10.0	8.0	8.0	8.0	8.0

Source: IDB, as of September 25, 1990

The annual inflation rates of foreign currency is based on inflation

indices of MUV (Manufacturing Unit Value) which is defined as the unit value index of manufactured exports from the selected developed countries to LDC markets (The World Bank "Price Prospects for Major Primary Commodities").

Year	1991	1992	1993	1994	1995	1996
Rate (% p.a.n.)	1.4	2.7	7.5	5.1	5.2	4.4

Table III-6.10 shows a result of loan repayability under the assumptions above. The average water rate assumed to be TT$ 1.74/m^3 could get the FIRR of the Project 8%, and increase keeping pace with the inflation rate of local currency.

As shown in the said table, annual balance would begin to be deficits for several years after the commencement of debt services to the assumed foreign loan. However, cumulative balance would never become deficits, indicating that the costs of the Project including capital costs could be fully recovered only by the revenue of the Project at the assumed average water rate of TT$ 1.74/m^3.

6.4.3 Financial Impact of the Project

WASA's investment has long been financed by the capital transfer from the Government in the past. WASA did not need to make loans from any external financing agencies recently. Moreover, the enormous amount of the government loans of about US$ 1,761 million over the period of 1971 to 1986 were shifted to the equity capital of WASA in July 1989. Therefore, WASA had few loans before it concluded commercial loans first time in its history in 1990. However, there are many investment projects including the leakage detection project, the universal metering installment project and the present CSS project. For the financing of these investments, it is one of the preconditions for WASA to establish its self-sufficiency in financial status. For this purpose, three concrete targets are set for the conditionality of SAL agreement concluded between WASA and the World Bank in 1989 which are referred to in the subsection 5.5.2 in Part I.

Of the three targets mentioned above, the target of reduction of the working ratio (the ratio of operating expenditures less depreciation to operating income) from current 1.58 to 1.05 by the end of 1991 and 0.95 by the end of 1993 is most essential.

Accompanied by the implementation of the investment projects in the near future, there may be big changes in financial status of WASA: on the revenue side, as the UFW decreases and the water demand increases, the sales volume will increase. The water revenue will increase largely accompanied by both the effects of sales volume increase and the water rate amendment. The decrease of account receivable would contribute to the revenue increase as well.

While, on the expenditure side, accompanied by inflation in the future, wage rate will be raised up and O&M cost will go up as well followed by new investments.

Under the situation of changing revenue and expenditures, the working ratio of less than the unity, which means that the revenue should be larger than the expenditures is the supreme order given to WASA for its attainment of self-sufficiency in financial aspects.

The "Task Force Report" prepared by a WASA task force team in 1989, targeted the working ratio of 0.95 in 1991 as shown in Table I-6.1. In this report, as the precondition of the said target, the staff reduction was scheduled as shown in Table I-6.2 which shows the staff reduction from the current 4,963 to 2,969 at the end of 1990 though this target year may be amended.

As mentioned above, WASA is required to be responsible for repayment of both the interest and principal of external loans which WASA is going to make in the near future. The repayability of the loan for the CSS project and those for the leakage detection and universal metering projects of which cost estimate is still subject to further refinement is studied in the preceding section of 6.4.2. However, the financial impact of these borrowings will be enormous to WASA. In addition to the attainment of the working ratio of less than unity, the allowance for depreciation of the new facilities should be

provided properly in the accounting system of WASA. This depreciation reserves will become the fund for repayment of the loans made for the new investments.

Meanwhile, depreciation on the assets is calculated on the straight line basis and the useful lives and salvage rates applied are as shown in the table which follows:

Categories	Useful Life	Salvage Rate
1) Structures, reservoirs, rivers, boreholes, wells, mains, stores, equipment, truck and lateral lines and pumping station equipment	30 years	15%
2) Pumps, water treatment equipment, meters, office equipment, transport equipment	15 years	15%
3) Tool shop and garage equipment, laboratory equipment, communication and other equipment	10 years	-

6.5 MACRO SOCIO-ECONOMIC IMPACTS

Major macro socio-economic impacts of the Project would be 1) to improve people's health by reducing water-borne/associated diseases and 2) to enhance the production of industrial activities by providing sufficient and stable water to them. The impacts are assessed only qualitatively due to the difficulty of quantitative assessment.

Health

Water-borne or associated diseases include dengue fever, gastroenteritis, typhoid fever, scabies, hepatitis and viral hepatitis. Table III-6.13 shows reported cases of such diseases in Trinidad and Tobago. Gastroenteritis has been reported the most frequently, followed by scabies, hepatitis, viral

hepatitis dengue fever and typhoid fever although the reported cases of the latter three diseases are not available during the period from 1988 to 1990.

Gastroenteritis is found throughout Trinidad and Tobago but has proven to be more prevalent in areas where there is an inadequate supply of potable water or where there are improper or deficient sanitary facilities and practices (WASA, National Evaluation of the International Drinking Water Supply and Sanitation Decade 1981-1990 and Projections for the Future, 1990). According to the sample survey on water use carried out in the Study, some 53% of total sample households have containers such as cisterns, tanks and drums due to the inadequate and inconsistent supply of pipe-borne water. Water by way of the containers is said to be less safe than piped water and provide breeding grounds for mosquitoes which carry dengue fever and malaria.

With the implementation of the Project, more sufficient and stable piped water will be provided to the people and expected to improve their health.

Production of Industries

Water is necessary for most of economic activities. Above all, sufficient and stable piped water is required for manufacturing and commercial activities. Table III-6.14 shows business establishments in Trinidad and Tobago. In terms of the number of establishments, distribution sector (wholesale and retail trade) has the largest share of 52%, followed by personal services (23.1%). On the other hand, petroleum industries occupy only 2.2% of total establishments, but the largest share of production (31% of total production).

Manufacturing industries are concentrated in the capital region, particularly in the Diego Martin-Arima strip and the Couva-Point Lisas area. The Couva-Point Lisas area has recently been developed as a newly industrialized area due to its economic and physical advantages. Main industries are large-scale and heavy ones such as fertilizers, iron and steel, aluminum smelter, petrochemicals, cement and liquefied natural gas.

Water demand forecast made in this Report indicates that special industrial water demand in five water areas (Port of Spain, Barataria, St.

Joseph, Arouca and Couva) would increase from 63 lpcd in 1990 to 85 lpcd in 2005: 2.0% per annum, on average, which is the highest rate among those of all the customer categories. Among the five water areas, Couva occupies the largest share of 68% of total water allocation to the areas, followed by St. Joseph of 13.5%.

As the Phase I project area covers almost all the main commercial and industrial areas in the country, the Project will contribute to increase in and expansion of production, and hence the growth of gross domestic products.

6.6 COMMUNITY PARTICIPATION

Since the Board of WASA agreed that the authority should support "self-help" projects in 1984, community participation in expanding water supply has been encouraged with the assistance of WASA. Self-help projects are usually characterized as follows:

- projects mainly comprising pipe laying and small scale,
- projects which WASA consider unfeasible and therefore have low priorities, but demand for water is increasing,
- projects which are located in rural areas including outskirts of urban or suburban areas where settlements are formulated in line along the access roads connected to the main ones, and
- projects of which each beneficiary is relatively fewer.

Under the constraints of financial or limited resources, those projects are not considered to be implemented only by WASA. On the other hand, the local people are eager to lay the pipeline connected with the existing pipe lines, partly because truck-borne water appears more expensive. Table III-6.15 shows the self-help projects implemented in 1990 (as of August).

Such form of community participation in water supply projects does not appear directly applicable to the Project due to the features of the Project:

water supervisory system with electronic equipments and water leakage reduction. Taking the objectives of the Project into account, however, it is important to encourage customers to effectively utilize water on demand side. Efficient use of water on demand side can be achieved with at least two measures: improvement of customers' attitudes towards and behaviors of water use, and amendment of water charge/tariff system which encourage them to save water. Although water charge (at appropriate rate) in proportion to volume of water consumed, in general, has an effect to urge them to save water, this is not related to community participation.

Improvement of customers' attitudes towards water use is a sort of community participation in the Project. A principal measure to realize the improvement is public relations. In general, measures of public relations include use of mass media such as newspapers, radios and televisions, publication of pamphlets and leaflets, use of posters, etc. Such measures will be utilized:

- to have the customers understand the importance of saving water with financial and other situations of WASA, difficulty of resource development, limitation of water resources, etc. and

- to inform the customers of how to save water.

Although WASA has made efforts in public relations, more efforts would be required, focusing on the specific purpose of saving water.

Table III-6.1 BILLABLE REVENUE, WATER CONSUMPTION AND AVERAGE WATER RATE OF WASA (METERED ACCOUNT)

1. Water Revenue

Year / Customer Categories	1988 TT$	1988 (%)	1989 TT$	1989 (%)
Domestic	1,388,647	8.0	331,230	1.9
Commercial	824,062	4.7	1,477,623	8.4
Industrial	15,146,697	87.2	15,812,027	89.6
Agricultural	18,424	0.1	26,934	0.2
Total	17,377,830	100	17,647,814	100

2. Consumption of Water by Category

Year / Customer Categories	1988 M3	1988 (%)	1989 M3	1989 (%)
Domestic	544,147	4.8	388,984	4.5
Commercial	414,180	3.7	292,246	3.4
Industrial	10,200,282	90.7	7,864,286	91.5
Agricultural	83,683	0.7	49,615	0.6
Total	11,242,292	100	8,595,131	100

3. Average Water Rate by Category

Year / Customer Categories	1988 TT$/M3	1989 TT$/M3
Domestic	2.55	0.85
Commercial	1.99	5.06
Industrial	1.48	2.01
Agricultural	0.22	0.54
Total	1.55	2.05

4. Adjusted Water Rate by Category

Year / Customer Categories	1988 Consumption (%)	1988 Water Rate (TT$/m3)	1989 Consumption (%)	1989 Water Rate (TT$/m3)
Domestic	72.2	2.55	40.6	0.85
Commercial	15.0	1.99	9.8	5.06
Industrial	10.1	1.48	48.2	2.01
Agricultural	2.5	0.22	1.3	0.54
Weighted Average		2.30		1.82

Customer Categories	Average Consumption (%)	Water Rate (TT$/m3)
Domestic	54.9	1.84
Commercial	12.1	3.26
Industrial	31.0	1.71
Agricultural	1.9	0.34
Weighted Average		1.94

Source: WASA Commercial Department

TABLE III-6.2 ECONOMIC BENEFIT STREAM

ITEM	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
Production(m3/day)	545636	545636	545636	545636	545636	545636	545636	545636	545636	545636	545636	545636	545636	545636	545636	545636	545636	545636	545636	545636	545636	545636	545636	545636	545636
WITHOUT PROJECT																									
Un-accounted-for Water(%)	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50
Volume of Water Loss(m3/day)	272818	272818	272818	272818	272818	272818	272818	272818	272818	272818	272818	272818	272818	272818	272818	272818	272818	272818	272818	272818	272818	272818	272818	272818	272818
Available Sales Volume(m3/day)	272818	272818	272818	272818	272818	272818	272818	272818	272818	272818	272818	272818	272818	272818	272818	272818	272818	272818	272818	272818	272818	272818	272818	272818	272818
Water Demand(m3/day)	265682	273599	281753	290149	298795	307681	316911	326419	336211	346298	356830	367035	377533	388330	399436	410788	422537	434621	447051	459837	472988	486516	500430	514742	529464
Sales Volume(m3/day)	265682	272818	272818	272818	272818	272818	272818	272818	272818	272818	272818	272818	272818	272818	272818	272818	272818	272818	272818	272818	272818	272818	272818	272818	272818
Annual Sales Volume(1000m3)	96974	99579	99579	99579	99579	99579	99579	99579	99579	99579	99579	99579	99579	99579	99579	99579	99579	99579	99579	99579	99579	99579	99579	99579	99579
Average Water Revenue(TT$/m3)	1.94	1.94	1.94	1.94	1.94	1.94	1.94	1.94	1.94	1.94	1.94	1.94	1.94	1.94	1.94	1.94	1.94	1.94	1.94	1.94	1.94	1.94	1.94	1.94	1.94
Annual Water Revenue(TT$1000)	188129	193182	193182	193182	193182	193182	193182	193182	193182	193182	193182	193182	193182	193182	193182	193182	193182	193182	193182	193182	193182	193182	193182	193182	193182
WITH PROJECT																									
Un-accounted-for Water(%)	50	50	50	50	50	40	40	40	40	40	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30
Volume of Water Loss(m3/day)	272818	272818	272818	272818	272818	218254	218254	218254	218254	218254	163691	163691	163691	163691	163691	163691	163691	163691	163691	163691	163691	163691	163691	163691	163691
Available Sales Volume(m3/day)	272818	272818	272818	272818	272818	327382	327382	327382	327382	327382	381945	381945	381945	381945	381945	381945	381945	381945	381945	381945	381945	381945	381945	381945	381945
Water Demand(m3/day)	265682	273599	281753	290149	298795	307681	316911	326419	336211	346298	356830	367035	377533	388330	399436	410788	422537	434621	447051	459837	472988	486516	500430	514742	529464
Sales Volume(m3/day)	265682	272818	272818	272818	272818	307681	316911	326419	327382	327382	356830	367035	377533	381945	381945	381945	381945	381945	381945	381945	381945	381945	381945	381945	381945
Annual Sales Volume(1000m3)	96974	99579	99579	99579	99579	112304	115673	119143	119494	119494	130243	133968	137799	139410	139410	139410	139410	139410	139410	139410	139410	139410	139410	139410	139410
Average Water Revenue(TT$/m3)	1.94	1.94	1.94	1.94	1.94	1.94	1.94	1.94	1.94	1.94	1.94	1.94	1.94	1.94	1.94	1.94	1.94	1.94	1.94	1.94	1.94	1.94	1.94	1.94	1.94
Annual Water Revenue(TT$1000)	188129	193182	193182	193182	193182	217869	224405	231137	231819	231819	252671	259898	267331	270455	270455	270455	270455	270455	270455	270455	270455	270455	270455	270455	270455
Savings in Personnel Costs (TT$1000)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Incremental Revenue Benefits (TT$ 1000)	0	0	0	0	0	24686	31223	37955	38636	38636	59489	66715	74148	77273	77273	77273	77273	77273	77273	77273	77273	77273	77273	77273	77273
Total Benefits(TT$1000)	0	0	0	0	0	24686	31223	37955	38636	38636	59489	66715	74148	77273	77273	77273	77273	77273	77273	77273	77273	77273	77273	77273	77273

TABLE III-6.3 FINANCIAL AND ECONOMIC COSTS (1/3)

(TT$1000)

ITEM	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
I. FINACIAL COST																							
1) Initial Cost & Replacement Cost																							
a) Foreign Currency																							
Leakage Reduction Program																							
- Main Component	9081	6086	4705	5342	5342	5342	5342	5342	0	0	0	0	0	0	0	1381	1381	0	0	0	0	0	0
- Engineering Services	2869	4820	1951	918	918	918	918	918	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
- Physical Contingency	2386	2181	1331	1252	1252	1252	1252	1252	0	0	0	0	0	0	0	276	276	0	0	0	0	0	0
- Price Increases	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Sub-total	14316	13087	7987	7512	7512	7512	7512	7512	0	0	0	0	0	0	0	1658	1658	0	0	0	0	0	0
Metering Program																							
- Main Component	6296	6296	6296	6296	0	0	0	0	0	0	6296	6296	6296	6296	0	0	0	0	0	0	6296	6296	6296
- Physical Contingency	944	944	944	944	0	0	0	0	0	0	944	944	944	944	0	0	0	0	0	0	944	944	944
- Price Increases	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Sub-total	7241	7241	7241	7241	0	0	0	0	0	0	7241	7241	7241	7241	0	0	0	0	0	0	7241	7241	7241
CSS Program(incl.valving & metering)																							
- Construction (Supply)	0	0	49044	73567	0	0	0	0	0	0	0	0	31354	47031	0	0	0	0	0	0	0	0	0
- Construction (Civil Work)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
- Engineering Services	2172	4848	2676	4911	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
- Physical Contingency	326	727	7758	11772	0	0	0	0	0	0	0	0	4703	7055	0	0	0	0	0	0	0	0	0
- Price Increases	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Sub-total	2498	5575	59478	90249	0	0	0	0	0	0	0	0	36057	54086	0	0	0	0	0	0	0	0	0
Total	24054	25903	74706	105002	7512	7512	7512	7512	0	0	7241	7241	43298	61326	0	1658	1658	0	0	0	7241	7241	7241
b) Local Currency																							
Leakage Reduction Program																							
- Main Component	7854	10829	7960	9448	9448	9448	9448	9448	0	0	0	0	0	0	0	4994	744	0	0	0	0	0	0
- Engineering Services	319	536	217	102	102	102	102	102	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
- Physical Contingency	1635	2273	1635	1910	1910	1910	1910	1910	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
- Administration	101	111	74	79	79	79	79	79	0	0	0	0	0	0	0	32	11	0	0	0	0	0	0
- Tax (VAT)	3015	3341	2225	2372	2372	2372	2372	2372	0	0	0	0	0	0	0	956	319	0	0	0	0	0	0
- Price Increases	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Sub-total	12923	17089	12111	13910	13910	13910	13910	13910	0	0	0	0	0	0	0	5982	1073	0	0	0	0	0	0
Metering Program																							
- Main Component	9444	9444	9444	9444	0	0	0	0	0	0	9444	9444	9444	9444	0	0	0	0	0	0	9444	9444	9444
- Physical Contingency	1417	1417	1417	1417	0	0	0	0	0	0	1417	1417	1417	1417	0	0	0	0	0	0	1417	1417	1417
- Administration	79	79	79	79	0	0	0	0	0	0	79	79	79	79	0	0	0	0	0	0	79	79	79
- Tax (VAT)	2361	2361	2361	2361	0	0	0	0	0	0	2361	2361	2361	2361	0	0	0	0	0	0	2361	2361	2361
- Price Increases	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Sub-total	13301	13301	13301	13301	0	0	0	0	0	0	13301	13301	13301	13301	0	0	0	0	0	0	13301	13301	13301
CSS Program(incl.valving & metering)																							
- Construction (Supply)	0	0	931	1397	0	0	0	0	0	0	0	0	627	941	0	0	0	0	0	0	0	0	0
- Construction (Civil Work)	0	0	10455	6970	0	0	0	0	0	0	0	0	4715	3143	0	0	0	0	0	0	0	0	0
- Engineering Services	283	724	409	693	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
- Physical Contingency	43	109	1769	1359	0	0	0	0	0	0	0	0	801	613	0	0	0	0	0	0	0	0	0
- Administration	12	28	318	438	0	0	0	0	0	0	0	0	183	256	0	0	0	0	0	0	0	0	0
- Tax (VAT)	368	836	9527	13131	0	0	0	0	0	0	0	0	5504	7667	0	0	0	0	0	0	0	0	0
- Price Increases	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Sub-total	706	1696	23410	23986	0	0	0	0	0	0	0	0	11831	12619	0	0	0	0	0	0	0	0	0
Total	26931	32087	48822	51197	13910	13910	13910	13910	0	0	13301	13301	25132	25920	0	5982	1073	0	0	0	13301	13301	13301

TABLE III-6.3 FINANCIAL AND ECONOMIC COSTS (2/3)

(TT$1000)

ITEM	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
2) O & M Cost																							
Leakage Reduction Program	0	0	0	0	874	874	874	874	874	874	874	874	874	874	874	874	874	874	874	874	874	874	874
Price Contingency	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Sub-total	0	0	0	0	874	874	874	874	874	874	874	874	874	874	874	874	874	874	874	874	874	874	874
Metering Program	0	0	0	0	972	972	972	972	972	972	972	972	972	972	972	972	972	972	972	972	972	972	972
Price Increases	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Sub-total	0	0	0	0	972	972	972	972	972	972	972	972	972	972	972	972	972	972	972	972	972	972	972
CSS Program(incl.valving & metering)																							
- Operation Cost	0	0	0	0	1150	1150	1150	1150	1150	1150	1150	1150	1150	1150	1150	1150	1150	1150	1150	1150	1150	1150	1150
- Maintenance Cost	0	0	0	0	756	756	756	756	756	756	756	756	756	756	756	756	756	756	756	756	756	756	756
- Price Increases	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Sub-total	0	0	0	0	1906	1906	1906	1906	1906	1906	1906	1906	1906	1906	1906	1906	1906	1906	1906	1906	1906	1906	1906
Total	0	0	0	0	3752	3752	3752	3752	3752	3752	3752	3752	3752	3752	3752	3752	3752	3752	3752	3752	3752	3752	3752

TABLE III-6.3 FINANCIAL AND ECONOMIC COSTS (3/3)

(TT$1000)

ITEM	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
2. ECONOMIC COST																							
1) Initial Cost & Replacement Cost																							
a) Foreign Currency																							
Leakage Reduction Program																							
- Main Component	9061	6086	4705	5342	5342	5342	5342	5342	0	0	0	0	0	0	0	1381	1381	0	0	0	0	0	0
- Engineering Services	2869	4820	1951	918	918	918	918	918	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
- Physical Contingency	2386	2181	1331	1252	1252	1252	1252	1252	0	0	0	0	0	0	0	276	276	0	0	0	0	0	0
Sub-total	14316	13087	7987	7512	7512	7512	7512	7512	0	0	0	0	0	0	0	1658	1658	0	0	0	0	0	0
Metering Prohram																							
- Main Component	6296	6296	6296	6296	0	0	0	0	0	0	6296	6296	6296	6296	0	0	0	0	0	0	6296	6296	6296
- Physical Contingency	944	944	944	944	0	0	0	0	0	0	944	944	944	944	0	0	0	0	0	0	944	944	944
Sub-total	7241	7241	7241	7241	0	0	0	0	0	0	7241	7241	7241	7241	0	0	0	0	0	0	7241	7241	7241
CSS Program(incl. valving & metering)																							
- Construction (Supply)	0	0	49044	73567	0	0	0	0	0	0	0	0	31354	47031	0	0	0	0	0	0	0	0	0
- Construction (Civil Work)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
- Engineering Services	2172	4848	2676	4911	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
- Physical Contingency	326	727	7758	11772	0	0	0	0	0	0	0	0	4703	7055	0	0	0	0	0	0	0	0	0
Sub-total	2498	5575	59478	90249	0	0	0	0	0	0	0	0	36057	54086	0	0	0	0	0	0	0	0	0
Total	24054	25903	74706	105002	7512	7512	7512	7512	0	0	7241	7241	43298	61326	0	1658	1658	0	0	0	7241	7241	7241
b) Local Currency																							
Leakage Reduction Program																							
- Main Component	7396	10198	7497	8897	8897	8897	8897	8897	0	0	0	0	0	0	0	4703	700	0	0	0	0	0	0
- Engineering Services	300	504	204	96	96	96	96	96	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
- Physical Contingency	1539	2140	1540	1799	1799	1799	1799	1799	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
- Administration	95	105	70	74	74	74	74	74	0	0	0	0	0	0	0	30	10	0	0	0	0	0	0
Sub-total	9331	12948	9311	10867	10867	10867	10867	10867	0	0	0	0	0	0	0	4733	710	0	0	0	0	0	0
Metering Program																							
- Main Component	8894	8894	8894	8894	0	0	0	0	0	0	8894	8894	8894	8894	0	0	0	0	0	0	8894	8894	8894
- Physical Contingency	1334	1334	1334	1334	0	0	0	0	0	0	1334	1334	1334	1334	0	0	0	0	0	0	1334	1334	1334
- Administration	74	74	74	74	0	0	0	0	0	0	74	74	74	74	0	0	0	0	0	0	74	74	74
Sub-total	10303	10303	10303	10303	0	0	0	0	0	0	10303	10303	10303	10303	0	0	0	0	0	0	10303	10303	10303
CSS Program(incl. valving & metering)																							
- Construction (Supply)	0	0	877	1315	0	0	0	0	0	0	0	0	591	886	0	0	0	0	0	0	0	0	0
- Construction (Civil Work)	0	0	9846	6564	0	0	0	0	0	0	0	0	4440	2960	0	0	0	0	0	0	0	0	0
- Engineering Services	267	682	385	652	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
- Physical Contingency	40	102	1666	1280	0	0	0	0	0	0	0	0	755	577	0	0	0	0	0	0	0	0	0
- Administration	12	26	299	412	0	0	0	0	0	0	0	0	173	241	0	0	0	0	0	0	0	0	0
Sub-total	318	810	13074	10223	0	0	0	0	0	0	0	0	5958	4663	0	0	0	0	0	0	0	0	0
Total	19952	24061	32687	31392	10867	10867	10867	10867	0	0	10303	10303	16260	14966	0	4733	710	0	0	0	10303	10303	10303
2) O & M Cost																							
Leakage Reduction Program	0	0	0	0	823	823	823	823	823	823	823	823	823	823	823	823	823	823	823	823	823	823	823
Metering Program	0	0	0	0	915	915	915	915	915	915	915	915	915	915	915	915	915	915	915	915	915	915	915
CSS Program(incl. valving & metering)																							
- Operation Cost	0	0	0	0	1083	1083	1083	1083	1083	1083	1083	1083	1083	1083	1083	1083	1083	1083	1083	1083	1083	1083	1083
- Maintenance Cost	0	0	0	0	712	712	712	712	712	712	712	712	712	712	712	712	712	712	712	712	712	712	712
Sub-total	0	0	0	0	1795	1795	1795	1795	1795	1795	1795	1795	1795	1795	1795	1795	1795	1795	1795	1795	1795	1795	1795
Total	0	0	0	0	2618	2618	1795	2618	2618	2618	2618	2618	2618	2618	2618	2618	2618	2618	2618	2618	2618	2618	2618

Table III-6.4 INTERNATIONAL TRADE IN TRINIDAD AND TOBAGO

(TT$ Million)

Year	Export (1)	Import (2)	Total (3)	Taxes Import (4)	Taxes Other (5)	Taxes Total (6)	Export Allowanc (7)
1985	5,247	3,739	8,986	567	-	567	n.a.
1986	4,989	4,940	9,929	487	-	487	n.a.
1987	5,255	4,239	9,494	374	-	374	5
1988	5,412	4,283	9,695	336	0.2	337	6
1989	6,695	5,188	11,883	345	0.2	345	11

Sources: Central Bank Of Trinidad and Tobago, "Annual Economic Survey 1989", 1990
Republic of Trinidad & Tobago, "Review of Economy 1990"
Ministry of Finance

Table III-6.5 ECONOMIC BENEFIT AND COST STREAM

(TT$ 1000)

Year	CSS Initial	CSS Replace-ment	CSS O & M	CSS Residual Value	CSS Sub-total	Leakage Reduction Initial	Leakage Reduction Replace-ment	Leakage Reduction O & M	Leakage Reduction Residual Value	Leakage Reduction Sub-total	Metering Initial	Metering Replace-ment	Metering O & M	Metering Residual Value	Metering Sub-total	Total Costs	Benefit	B - C
1992	2,816	0	0	0	2,816	23,647	0	0	0	23,647	17,544	0	0	0	17,544	44,007	0	-44,007
1993	6,385	0	0	0	6,385	26,035	0	0	0	26,035	17,544	0	0	0	17,544	49,964	0	-49,964
1994	72,552	0	0	0	72,552	17,298	0	0	0	17,298	17,544	0	0	0	17,544	107,394	0	-107,394
1995	100,472	0	0	0	100,472	18,379	0	0	0	18,379	17,544	0	0	0	17,544	136,395	24,686	-111,709
1996	0	0	1,795	0	1,795	18,379	0	823	0	19,202	0	0	915	0	915	21,912	31,223	9,311
1997	0	0	1,795	0	1,795	18,379	0	823	0	19,202	0	0	915	0	915	21,912	37,955	16,043
1998	0	0	1,795	0	1,795	18,379	0	823	0	19,202	0	0	915	0	915	21,912	38,636	16,724
1999	0	0	1,795	0	1,795	18,379	0	823	0	19,202	0	0	915	0	915	21,912	38,636	16,724
2000	0	0	1,795	0	1,795	0	0	823	0	823	0	0	915	0	915	3,533	59,489	55,956
2001	0	0	1,795	0	1,795	0	0	823	0	823	0	0	915	0	915	3,533	66,715	63,182
2002	0	0	1,795	0	1,795	0	0	823	0	823	0	17,544	915	0	18,459	21,077	74,148	53,071
2003	0	0	1,795	0	1,795	0	0	823	0	823	0	17,544	915	0	18,459	21,077	77,273	56,196
2004	0	42,015	1,795	0	43,810	0	0	823	0	823	0	17,544	915	0	18,459	63,092	77,273	14,181
2005	0	58,749	1,795	0	60,544	0	0	823	0	823	0	17,544	915	0	18,459	79,826	77,273	-2,553
2006	0	0	1,795	0	1,795	0	0	823	0	823	0	0	915	0	915	3,533	77,273	73,740
2007	0	0	1,795	0	1,795	0	6,391	823	0	7,214	0	0	915	0	915	9,924	77,273	67,349
2008	0	0	1,795	0	1,795	0	6,391	823	0	7,214	0	0	915	0	915	9,924	77,273	67,349
2009	0	0	1,795	0	1,795	0	0	823	0	823	0	0	915	0	915	3,533	77,273	73,740
2010	0	0	1,795	0	1,795	0	0	823	0	823	0	0	915	0	915	3,533	77,273	73,740
2011	0	0	1,795	0	1,795	0	0	823	0	823	0	0	915	0	915	3,533	77,273	73,740
2012	0	0	1,795	0	1,795	0	0	823	0	823	0	17,544	915	0	18,459	21,077	77,273	56,196
2013	0	0	1,795	0	1,795	0	0	823	0	823	0	17,544	915	0	18,459	21,077	77,273	56,196
2014	0	0	1,795	-7,692	-5,897	0	0	823	-6,391	-5,568	0	17,544	915	-42,106	-23,647	-35,111	77,273	112,384
																	EIRR=	9.6 %

TABLE III-6.6 BILLABLE REVENUE, WATER CONSUMPTION AND AVERAGE WATER RATE OF WASA (TOTAL ACCOUNT)

1. Water Revenue

(Unit:TT$)

Year / Customer categories	1988	(%)	1989	(%)
Domestic	82,130,664	64.6	55,837,349	54.8
Stand Pipe	6,446,585		4,639,585	
Yard Tap	8,160,581		6,412,249	
Internally Serviced	67,523,498		44,785,515	
Commercial	28,963,033	22.8	23,769,754	23.3
Industrial	15,352,139	12.1	21,623,135	21.2
Agricultural	494,085	0.4	440,979	0.4
Charitable Organizations	181,883	0.1	151,318	0.1
Total	127,121,804	100.0	101,822,535	100.0

2. Consumption of Water by Category

(Unit:cu.m)

Year / Customer categories	1988	(%)	1989	(%)
Domestic	75,919,516	72.2	51,861,076	40.6
Stand Pipe	18,549,580		13,127,468	
Yard Tap	12,651,766		9,305,490	
Internally Serviced	44,718,170		29,428,118	
Commercial	15,736,111	15.0	12,486,404	9.8
Industrial	10,660,050	10.1	61,630,315	48.2
Agricultural	2,672,933	2.5	1,654,806	1.3
Charitable Organizations	187,011	0.2	140,688	0.1
Total	105,175,621	100.0	127,773,289	100.0

3. Average Water Rate by Category

(Unit:TT$/cu.m)

Year / Customer categories	1988	1989	Average	
Domestic	1.08	1.08	1.08	
Stand Pipe	0.35	0.35	0.35	
Yard Tap	0.65	0.69	0.66	
Internally Serviced	1.51	1.52	1.51	
Commercial	1.84	1.90	1.87	
Industrial	1.44	0.35	0.51	
Agricultural	0.18	0.27	0.22	
Charitable Organizations	0.97	1.08	1.02	
Total	1.21	0.80	0.99	

Note: The figures in 1989 is as of Sep., 1989
Source: WASA Commercial Department

Table III-6.7 FINANCIAL BENEFIT STREAM

ITEM	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
Production(m3/day)	545636	545636	545636	545636	545636	545636	545636	545636	545636	545636	545636	545636	545636	545636	545636	545636	545636	545636	545636	545636	545636	545636	545636	545636	545636
WITHOUT PROJECT																									
Un-accounted-for Water(%)	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50
Volume of Water Loss(m3/day)	272818	272818	272818	272818	272818	272818	272818	272818	272818	272818	272818	272818	272818	272818	272818	272818	272818	272818	272818	272818	272818	272818	272818	272818	272818
Available Sales Volume(m3/day)	272818	272818	272818	272818	272818	272818	272818	272818	272818	272818	272818	272818	272818	272818	272818	272818	272818	272818	272818	272818	272818	272818	272818	272818	272818
Water Demand(m3/day)	265682	273599	281753	290149	298795	307681	316911	326419	336211	346298	356830	367035	377533	388330	399436	410788	422537	434621	447051	459837	472988	486516	500430	514742	529464
Sales Volume(m3/day)	265682	272818	272818	272818	272818	272818	272818	272818	272818	272818	272818	272818	272818	272818	272818	272818	272818	272818	272818	272818	272818	272818	272818	272818	272818
Annual Sales Volume(1000m3)	96974	99579	99579	99579	99579	99579	99579	99579	99579	99579	99579	99579	99579	99579	99579	99579	99579	99579	99579	99579	99579	99579	99579	99579	99579
Average Water Revenue(TT$/m3)	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99
Annual Water Revenue(TT$1000)	96004	98583	98583	98583	98583	98583	98583	98583	98583	98583	98583	98583	98583	98583	98583	98583	98583	98583	98583	98583	98583	98583	98583	98583	98583
WITH PROJECT																									
Un-accounted-for Water(%)	50	50	50	50	50	40	40	40	40	40	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30
Volume of Water Loss(m3/day)	272818	272818	272818	272818	272818	218254	218254	218254	218254	218254	163691	163691	163691	163691	163691	163691	163691	163691	163691	163691	163691	163691	163691	163691	163691
Available Sales Volume(m3/day)	272818	272818	272818	272818	272818	327382	327382	327382	327382	327382	381945	381945	381945	381945	381945	381945	381945	381945	381945	381945	381945	381945	381945	381945	381945
Water Demand(m3/day)	265682	273599	281753	290149	298795	307681	316911	326419	336211	346298	356830	367035	377533	388330	399436	410788	422537	434621	447051	459837	472988	486516	500430	514742	529464
Sales Volume(m3/day)	265682	272818	272818	272818	272818	307681	316911	326419	327382	327382	356830	367035	377533	381945	381945	381945	381945	381945	381945	381945	381945	381945	381945	381945	381945
Annual Sales Volume(1000m3)	96974	99579	99579	99579	99579	112304	115673	119143	119494	119494	130243	133968	137799	139410	139410	139410	139410	139410	139410	139410	139410	139410	139410	139410	139410
Average Water Revenue(TT$/m3)	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99
Annual Water Revenue(TT$1000)	96004	98583	98583	98583	98583	111181	114516	117951	118299	118299	128941	132628	136421	138016	138016	138016	138016	138016	138016	138016	138016	138016	138016	138016	138016
Reduction of Personnel Cost (TT$1000)	0	0	0	0	0	648	648	648	648	648	648	648	648	648	648	648	648	648	648	648	648	648	648	648	648
Incremental Revenue Benefits (TT$ 1000)	0	0	0	0	0	12598	15933	19369	19717	19717	30358	34045	37839	39433	39433	39433	39433	39433	39433	39433	39433	39433	39433	39433	39433
Total Benefits(TT$1000)	0	0	0	0	0	13246	16581	20017	20365	20365	31006	34693	38487	40081	40081	40081	40081	40081	40081	40081	40081	40081	40081	40081	40081

Table IIII-6.8 FINANCIAL CASH FLOW

(TT$1000)

	CSS					Leakage Reduction					Metering					Total Costs	Benefit	B-C
	Initial	Replace-ment	O & M	Residual Value	Sub-total	Initial	Replace-ment	O & M	Residual Value	Sub-total	Initial	Replace-ment	O & M	Residual Value	Sub-total			
1992	2,836	0	0	0	2,836	28,064	0	0	0	28,064	18,181	0	0	0	18,181	49,081	0	-49,081
1993	6,435	0	0	0	6,435	26,835	0	0	0	26,835	18,181	0	0	0	18,181	51,451	0	-51,451
1994	73,361	0	0	0	73,361	17,873	0	0	0	17,873	18,181	0	0	0	18,181	109,415	0	-109,415
1995	101,104	0	0	0	101,104	19,050	0	0	0	19,050	18,181	0	0	0	18,181	138,335	13,246	-125,089
1996	0	0	1,906	0	1,906	19,050	0	874	0	19,924	0	0	972	0	972	22,802	16,581	-6,221
1997	0	0	1,906	0	1,906	19,050	0	874	0	19,924	0	0	972	0	972	22,802	20,017	-2,785
1998	0	0	1,906	0	1,906	19,050	0	874	0	19,924	0	0	972	0	972	22,802	20,365	-2,437
1999	0	0	1,906	0	1,906	19,050	0	874	0	19,924	0	0	972	0	972	22,802	31,006	8,204
2000	0	0	1,906	0	1,906	0	0	874	0	874	0	0	972	0	972	3,752	34,693	30,941
2001	0	0	1,906	0	1,906	0	0	874	0	874	0	0	972	0	972	3,752	38,487	34,735
2002	0	0	1,906	0	1,906	0	0	874	0	874	0	18,181	972	0	19,153	21,933	40,081	18,148
2003	0	0	1,906	0	1,906	0	0	874	0	874	0	18,181	972	0	19,153	21,933	40,081	18,148
2004	0	42,384	1,906	0	44,290	0	0	874	0	874	0	18,181	972	0	19,153	64,317	40,081	-24,236
2005	0	59,038	1,906	0	60,944	0	0	874	0	874	0	18,181	972	0	19,153	80,971	40,081	-40,890
2006	0	0	1,906	0	1,906	0	0	874	0	874	0	0	972	0	972	3,752	40,081	36,329
2007	0	0	1,906	0	1,906	0	6,684	874	0	7,558	0	0	972	0	972	10,436	40,081	29,645
2008	0	0	1,906	0	1,906	0	6,684	874	0	7,558	0	0	972	0	972	10,436	40,081	29,645
2009	0	0	1,906	0	1,906	0	0	874	0	874	0	0	972	0	972	3,752	40,081	36,329
2010	0	0	1,906	0	1,906	0	0	874	0	874	0	0	972	0	972	3,752	40,081	36,329
2011	0	0	1,906	0	1,906	0	0	874	0	874	0	0	972	0	972	3,752	40,081	36,329
2012	0	0	1,906	0	1,906	0	0	874	0	874	0	18,181	972	0	19,153	21,933	40,081	18,148
2013	0	0	1,906	0	1,906	0	0	874	0	874	0	18,181	972	0	19,153	21,933	40,081	18,148
2014	0	0	1,906	-7,742	-5,836	0	0	874	-6,684	-5,810	0	18,181	972	-43,634	-24,481	-36,127	40,081	76,208
																	FIRR=	0.3 %

Table III-6.9 ESTIMATED AVERAGE WATER RATE BY CUSTOMER CATEG

Customer Category	1990					1995				
	Annual Water Demand* (m3/year)	%	Water Rate** (TT$/m3)	Annual Revenue (TT$)	%	Annual Water Demand* (m3/year)	%	Water Rate** (TT$/m3)	Annual Revenue (TT$)	%
a. Domestic	68877026	68	1.08	74387188	80	77695276	66	2.64	204780549	78
b. Industrial/ Agriculture	2748947	3	0.51	1401963	2	3508910	3	1.50	5250783	2
c. Commercial/ Public	1374474	1	1.87	2570266	3	1754455	1	4.49	7876174	3
d. Special Industrial	28255745	28	0.51	14410430	16	34246344	29	1.30	44631658	17
e. Total or Average	101256192	100	0.92	92769847	100	117204985	100	2.24	262539164	100
f. Domestic Category Per Capia Demand (lpcd)	215.4					223.8				

Notes:

* Annual water demand was estimated by JICA study team.

** Water rates in 1990 were taken as the same as an average of those in 1988 and 1989. Average water rate in 1990 is different from the actual figure of 0.99 since the former is based on the estimated water demand.

TABLE III-6.10 LOAN REPAYABILITY (1/2)

(TT$1000)

Year	FOREIGN LOAN						LOCAL LOAN											
	Loan Disbursement			Repayment			Loan Disb.	Repayment First year loan			Repayment Second year loan			Repayment Third year loan			Repayment Fourth year loan		
	Capital	IDC*	Cumlative Debt	Interest	Principal	Total	Capital	Int.	Pri.	Tot.	Int.	Pri.	Tot.	Int.	Pri.	Tot.	Int.	Pri.	Tot.
1	28,745	2,873	31,618				25,588												
2	31,437	6,306	69,361				30,709	2,943	376	3,319									
3	83,606	14,573	167,540				47,090	2,899	420	3,319	3,532	452	3,983						
4	114,880	26,082	308,502				49,794	2,851	468	3,319	3,480	503	3,983	5,415	692	6,108			
5	9,794	29,268	347,564				13,650	2,797	522	3,319	3,422	561	3,983	5,336	772	6,108	5,726	732	6,459
6	9,819	32,716	390,099				13,781	2,737	582	3,319	3,357	626	3,983	5,247	861	6,108	5,642	816	6,459
7	9,847	36,447	436,393				13,922	2,670	648	3,319	3,285	698	3,983	5,148	960	6,108	5,548	910	6,459
8	9,878	40,483	486,754				14,075	2,596	723	3,319	3,205	778	3,983	5,038	1,070	6,108	5,444	1,015	6,459
9			461,180	39,184	25,574	64,757		2,513	806	3,319	3,115	868	3,983	4,914	1,193	6,108	5,327	1,132	6,459
10			433,548	37,125	27,632	64,757		2,420	899	3,319	3,016	967	3,983	4,777	1,331	6,108	5,197	1,262	6,459
11			403,692	34,901	29,857	64,757		2,317	1,002	3,319	2,904	1,079	3,983	4,624	1,484	6,108	5,052	1,407	6,459
12			371,431	32,497	32,260	64,757		2,201	1,117	3,319	2,780	1,203	3,983	4,454	1,654	6,108	4,890	1,569	6,459
13			336,574	29,900	34,857	64,757		2,073	1,246	3,319	2,642	1,341	3,983	4,263	1,844	6,108	4,709	1,749	6,459
14			298,911	27,094	37,663	64,757		1,930	1,389	3,319	2,488	1,495	3,983	4,051	2,057	6,108	4,508	1,950	6,459
15			258,217	24,062	40,695	64,757		1,770	1,549	3,319	2,316	1,667	3,983	3,815	2,293	6,108	4,284	2,175	6,459
16			214,246	20,786	43,971	64,757		1,592	1,727	3,319	2,124	1,859	3,983	3,551	2,557	6,108	4,034	2,425	6,459
17			166,735	17,247	47,510	64,757		1,393	1,926	3,319	1,910	2,073	3,983	3,257	2,851	6,108	3,755	2,704	6,459
18			115,400	13,422	51,335	64,757		1,172	2,147	3,319	1,672	2,311	3,983	2,929	3,179	6,108	3,444	3,014	6,459
19			59,933	9,290	55,468	64,757		925	2,394	3,319	1,406	2,577	3,983	2,564	3,544	6,108	3,097	3,361	6,459
20			-0	4,825	59,933	64,757		649	2,670	3,319	1,110	2,873	3,983	2,156	3,952	6,108	2,711	3,748	6,459
21								342	2,977	3,319	779	3,204	3,983	1,702	4,406	6,108	2,280	4,179	6,459
22											411	3,572	3,983	1,195	4,913	6,108	1,799	4,659	6,459
23														630	5,478	6,108	1,264	5,195	6,459
24																	666	5,792	6,459
25																			
26																			
27																			
28																			
Total	298,006	188,748		290,333	486,754	777,087	208,609	40,790	25,588	66,378	48,953	30,709	79,662	75,066	47,090	122,156	79,376	49,794	129,170

* Interests during construction
** Operation, Maintenance and Replacement Cost
Inflation is taken into account during the construction period
*** Average Water Rate = TT$ 1.74 / m3
Foreign Loan: 8.05%, 20 years Local Loan:11.5%, 20 Years

TABLE III-6.10 LOAN REPAYABILITY (2/2)

(TT$1000)

Year	LOCAL LOAN												OMR** Costs	Annual Expenditure	Refund of Tax	Annual*** Revenue	Surplus or Deficit	Cumulative Surplus (Deficit)
	Repayment Fifth year loan			Repayment Sixth year loan			Repayment Seventh year loan			Repayment Eighth year loan								
	Int.	Pri.	Tot.	Int.	Pri.	Tot.	Int.	Pri.	Tot.	Int.	Pri.	Tot.						
1														0	5,744	0	5,744	5,744
2														3,319	6,538	0	3,219	8,963
3														7,302	14,113	0	6,811	15,774
4														13,410	17,864	0	4,454	20,228
5													2,165	22,033	2,372	31,005	11,344	31,572
6	1,570	218	1,787										2,186	23,842	2,372	42,099	20,629	52,201
7	1,545	243	1,787	1,585	203	1,787							2,208	25,651	2,372	55,048	31,769	83,970
8	1,517	271	1,787	1,562	226	1,787	1,601	205	1,806				2,232	27,481	2,372	60,500	35,391	119,361
9	1,486	302	1,787	1,536	252	1,787	1,577	228	1,806	1,619	207	1,826	2,232	94,064	2,372	65,340	-26,352	93,009
10	1,451	336	1,787	1,507	281	1,787	1,551	255	1,806	1,595	231	1,826	2,232	94,064		99,958	5,894	98,903
11	1,412	375	1,787	1,474	313	1,787	1,522	284	1,806	1,568	257	1,826	25,514	117,346		111,954	-5,392	93,512
12	1,369	418	1,787	1,438	349	1,787	1,489	316	1,806	1,539	287	1,826	25,514	117,346	2,361	124,294	9,309	102,821
13	1,321	466	1,787	1,398	389	1,787	1,453	353	1,806	1,506	320	1,826	76,132	167,964	2,361	129,481	-36,122	66,699
14	1,267	520	1,787	1,353	434	1,787	1,412	393	1,806	1,469	357	1,826	95,434	187,266	7,865	129,481	-49,920	16,779
15	1,208	580	1,787	1,303	484	1,787	1,367	439	1,806	1,428	398	1,826	2,232	94,064	10,028	129,481	45,445	62,224
16	1,141	647	1,787	1,248	540	1,787	1,317	489	1,806	1,382	443	1,826	9,904	101,736		129,481	27,745	89,969
17	1,067	721	1,787	1,186	602	1,787	1,260	545	1,806	1,331	494	1,826	4,995	96,827	956	129,481	33,610	123,580
18	984	804	1,787	1,116	671	1,787	1,198	608	1,806	1,274	551	1,826	25,514	117,346	319	129,481	12,454	136,034
19	891	896	1,787	1,039	748	1,787	1,128	678	1,806	1,211	615	1,826	25,514	117,346		129,481	12,135	148,169
20	788	999	1,787	953	834	1,787	1,050	756	1,806	1,140	685	1,826	25,514	117,346		129,481	12,135	160,304
21	673	1,114	1,787	857	930	1,787	963	843	1,806	1,061	764	1,826	25,514	52,589		129,481	76,892	237,196
22	545	1,242	1,787	750	1,037	1,787	866	940	1,806	974	852	1,826	25,514	49,270		129,481	80,211	317,408
23	402	1,385	1,787	631	1,156	1,787	758	1,048	1,806	876	950	1,826	25,514	45,287		129,481	84,194	401,602
24	243	1,545	1,787	498	1,289	1,787	637	1,168	1,806	766	1,059	1,826	25,514	39,179		129,481	90,302	491,904
25	65	1,722	1,787	350	1,438	1,787	503	1,303	1,806	644	1,181	1,826		7,206			-7,206	484,698
26				184	1,603	1,787	353	1,452	1,806	509	1,317	1,826		5,419	2,361		-3,058	481,640
27							186	1,620	1,806	357	1,468	1,826		3,631	2,361		-1,270	480,370
28										188	1,637	1,826		1,826	2,361		535	480,905
Total	20,944	14,805	35,749	21,968	13,781	35,749	22,193	13,922	36,115	22,437	14,075	36,512	431,578	1,750,157	87,092	2,143,970	480,905	

* Interests during construction

** Operation, Maintenance and Replacement Cost
Inflation is taken into account during the construction period

*** Average Water Rate = TT$ 1.74 / m3

Foreign Loan: 8.05%, 20 years Local Loan:11.5%, 20 Years

Table III-6.11 REVENUE AND EXPENDITURE PROJECTIONS FOR 1990-1991 AFTER REORGANIZATION

(TT$ 1,000)

I T E M S	1990	1991
1. Revenue	174,800	184,100
North		114,000
South		62,700
Tobago		7,400
2. Expenditure		
Personnel Emoluments	124,000	99,000
Salaries		59,000
Wages		30,000
National Insurance		2,600
Others		7,400
Goods and Services	67,500	67,500
Chemicals		17,000
Materials		17,000
Transport		13,500
Electricity		12,000
Travelling		3,500
Telephones		1,000
Others		3,500
Minor Equipment and Furniture	1,000	1,000
Current Transfers and Subsidies	8,600	8,600
Pension Scheme		3,600
Graturies		3,000
Others		2,000
Total Expenditures	201,100	176,100
3. Surplus (Deficit)	-26,300	8,000
Ref. Operating Ratio =	1.150	0.957

Source: "Report on Self Sufficiency WASA - 1991" WASA Task Force, January 1989.

Table III-6.12 SCHEDULE OF STAFF REDUCTION PROPOSED IN TASK FORCE REPORT

Department/Section	Existing	After Phase I	After Phase II
Operation & Maintenance	2,593	2,244	1,780
Wastewater	303	279	227
Quality Control	37	37	37
Water Resources	83	83	71
Internal Audit	16	16	16
Directorate	10	10	10
Secretariate	2	2	2
Personnel	120	96	77
Legal	4	4	4
Safety	1	1	1
Stores & Supplies	123	91	75
Commercial	130	111	111
Expenditure	93	73	45
Costing	17	6	0
EDP	22	22	22
Major Maintenance	203	149	79
Planning	3	3	3
Public Relations	19	19	19
Engineering Administration	13	12	12
Budjet	19	11	9
Security	178	178	178
Investigation & Design	69	54	42
Registry	15	15	15
Major Projects	9	5	5
Transport	402	295	40
Office Services & Property Maintenance	54	54	32
Construction	198	64	54
Board & Committees	3	3	3
Unestablished Posts (Operation & Maintenance)	224	0	0
T O T A L	4,963	3,937	2,969

Notes : According to the "Task Force Report", Phase I should be effected by the end of 1989 and Phase II should be implemented not later than the end of 1990.

Source: "Report on Self Sufficiency WASA - 1991" WASA Task Force, January 1989.

Table III-6.13 REPORTED CASES OF COMMUNICABLE DISEASES

Year	Dengue Fever	Gastro-enteritis	Typhoid Fever	Scabies	Hepatitis	Viral Hepatitis
1983	118	14,750	18	112	n.a.	89
1984	31	18,987	25	282	n.a.	51
1985	5	24,632	7	703	n.a.	42
1986	85	20,425	5	4,885	8,645	45
1987	106	29,269	5	7,020	238	78
1988	n.a.	23,335	n.a.	8,439	343	n.a.
1989	n.a.	17,033	n.a.	6,241	525	n.a.
1990	n.a.	13,052	n.a.	14,612	434	n.a.

Note : n.a. means "not accessible".
Source: Ministry of Health

Table III-6.14 BUSINESS ESTABLISHMENT IN TRINIDAD AND TOBAGO

No.	Sector	Establish-ment (Nos.)	Share (%)	Production* (TT$ Million)	Share (%)
1	Agriculture	8	0.0	467.0	2.2
2	Petroleum Industries	420	2.2	6,598.4	30.7
3	Food Processing & Drink	239	1.3	892.8	4.2
4	Textiles, Garments etc.	116	0.6	75.7	0.4
5	Printing, Publishing etc.	169	0.9	131.7	0.6
6	Wood and Related Products	333	1.8	42.8	0.2
7	Chemicals & Non-metaric Minerals	132	0.7	268.8	1.2
8	Assembly Type & Related Industries	334	1.8	405.7	1.9
9	Miscellaneous Manufacturing	114	0.6	60.0	0.3
10	Electricity & Water	2	0.0	349.4	1.6
11	Construction	290	1.5	1,669.8	7.8
					0.0
12	Distribution	9,763	51.8	2,900.1	13.5
13	Hotels & Guest Houses	137	0.7	55.4	0.3
14	Transportation, Communication & Storage	357	1.9	1,893.9	8.8
15	Finance, Insurance & Business services	1,523	8.1	2,171.2	10.1
16	Centarl & Local Government	21	0.1	2,404.4	11.2
17	Education & Cultural Community Services	543	2.9	731.6	3.4
18	Personal Services	4,359	23.1	388.9	1.8
	Total	18,860	100.0	21,507.6	100.0

Note : * Gross Domestic Product including impueted servivce charge.
Source: Central Statistical Office

Table III-6.15 SELF-HELP WATER SUPPLY PROJECTS IN 1990
(AS OF AUGUST)

No.	Location	Type	No. of Beneficiaries (Households)	Actual Cost (TT$)	Cost per Household (TT$/household)
1	Sackar Trace, El Socorro	Pipe Laying	72	75,000	1,042
2	Seecharan Trace, Guaracara	Pipe Laying	11	36,982	3,362
3	Jones Town off, De Gannes Street	Pipe Laying	65	99,202	1,526
4	Girez Lane, El Socorro	Pipe Laying	31	57,010	1,839
5	Savannah Terrace, Bagatelle Road, Diego Martin	Pipe Laying	26	49,634	1,909
6	Ramkisson Trace, Santa Cruz	Pipe Laying	13	101,528	7,810
7	Herrera Trace, Kelly Village, Caroni	Pipe Laying	16	60,225	3,764
8	Harkoo Trace, Las Lomas #2	Pipe Laying	7	71,041	10,149
9	Hosein Circular Road, Bamboo Settlement #2	Pipe Laying	19	75,779	3,988
10	Ramkissoon Trace, Pasea South	Pipe Laying	21	51,000	2,429
11	Acbar Trace, Fyzabad	Pipe Laying	40	259,237	6,481
12	Warner Village, Bejucal	Pipe Laying	60	247,863	4,131
13	Chin Johnson Trace, Longdenville	Pipe Laying	17	35,987	2,117
14	Glod. Road Poole, Rio Claro	Pipe Laying	23	342,568	14,894
15	Mowlah Trace, Rivulet Road, Freeport	Pipe Laying	44	95,115	2,162
16	Acass Ali Street, Chandaragore	Pipe Laying	9	20,343	2,260
17	Mt. Pleasant Trace, Couva	Pipe Laying	13	43,097	3,315
18	Field Trace, Blue basin, Diego Martin	Pipe Laying	30	20,550	685
	Average		29	96,787	3,370

Source: WASA

PART FOUR: COMPARATIVE STUDY

1. COMPARISON BY PRESENT VALUE METHOD

1.1 POSSIBLE OPTIONS

The scope of the Phase I Project, identified in the Master Plan, covers a vast range of system monitoring, operation, control, data processing and water supply planning by installing CSS instruments and monitoring equipment as described in Part II.

Feasibility Study presented in Part III analyses an early establishment of the CSS in 1995 as Phase I Project, in accordance with the results of the mutual discussions between GRTT and Study Team during Master Plan stage.

One of the main purposes of the Phase I Project, however, is also to formulate the operation status system of data/information with the aid of computer system, within a short period in the initial stage of Master Plan. This is considered as an urgent work of the improvement of the existing CSS, which is followed by the improvement and expansion of the major facilities of the existing CSS.

Notwithstanding, as analyzed and suggested in Section 6 Project Evaluation, Part III, the implementation of the above planned project by the year 1995 is studied too optimistic (or rather hard to justify its feasibility without conditionality) from financial points of view.

This Part, hence, seeks optimal implementation for the Phase I Project (the Project) of which outcome is responding to the requirements in the above scope of work with full-scale CSS improvement and development, even with its longer implementation period than the above early implementation. For this Project, a possible option of the works of Project is considered to be implemented stepwise. In this regard, Phase I Project implementation will have following two possible options:

<u>Option A</u>

1) Installation of primary sensors (flow meters, pressure gauges and level meters) with recorders, construction of meter chambers and computer system

for electronic data storage mainly for monitoring purpose at the first Step.

2) Monitoring and data acquisition for conducting hydraulic pipe network analyses and developing comprehensive water supply plan during Step 2.

3) Installation of CSS instruments, installation of flow control valves, construction of RTU stations and valve chambers, remote control instrumentation for booster pumping stations and expansion of the CSS building at Step 3. This final step totally coincides with the outcome of the following Option B.

Option B

1) Unified or single-step installation of primary sensors, control equipment and CSS related instruments and initiation of the CSS operation by the year 1995.

As Part III Feasibility Study details the scope, design criteria, preliminary design, cost estimates, etc. of Option B, succeeding sections highlights mainly outline of Option A for comparison purpose.

1.2 OUTLINE CONCEPTS

Concept of these options are briefly described below with an emphasis on project requirements, operation and implementation schedule:

Option A

Proposed location of the primary sensors (flow meters, level meters and pressure gauges) with recorders as presented on Fig. IV-1.1 is on the transmission and distribution mains, off-takes, waterworks, service storage reservoirs and major booster pumping stations which are located within the project area.

In addition, a personal computer and optical character reader (OCR) is to

be furnished at six district offices and two units of personal computers (including one standby) at the existing CSS building for data input and processing. This status is seen on Fig. IV-1.2. The six district offices are Port of Spain, North West, North Central, and North East in North Region, and San Fernando/South Central and South East in South Region, which cover the present project area.

Further, each office and the CSS building is furnished with one set of serial printer, namely, 7 serial printers in total. All computers embodied with MODEM are interconnected each other through telephone cables. Major function of data processing and compilation will be carried out at the existing CSS building. All works described above will be executed during Step 1.

Flow rate control of water mains and booster pumping stations will be done locally by operators/turncockers stationed at district offices and waterworks. Major equipment to be installed on site are level meters, flow meters and pressure gauges as summarized in Table IV-1.1. Data on pressure, flow rate and water level obtained from recorders are delivered periodically to each respective district office. Operators stationed in the office electronically input these data into the computer by the said OCR for transmittal to the CSS building.

In several years of operation as the second step, these accumulated data will provide valuable information regarding water level fluctuation in the reservoirs, and water flow condition of transmission/distribution mains and off-takes through computerized pipe network analyses. Basic strategies for developing comprehensive water supply plan including CSS will be established thereafter.

It is the third step during which motor driven flow rate controllers will be installed on the selected points of the waterworks, booster pumping stations, transmission/distribution mains/off-takes and CSS instrumentations including central data processing system, remote terminal units (RTU), cathode ray tube (CRT) displays, and graphic panel will be installed at the CSS building (and/or RTU stations). Remote control of the six booster pumping stations will start parallelly with an initiation of the CSS operation.

From all the above, an implementation of the Option A requires rather longer period of 9 years, of which schedule is delineated on Fig. IV-1.3 and also summarized as follows:

Period	Work
1992-1995:	First step implementation including installation of primary sensors, construction of meter chambers and computer system for electronic data storage,
1996-1997:	Operation and data acquisition, and development of comprehensive water supply plan,
1997-2000:	Installation of CSS instruments, installation of flow control valves, construction of RTU stations and valve chambers, remote control instrumentation (booster pumping stations) and expansion of the CSS building. This final step totally coincides with the outcome of the Option B.

Option B

This option is to execute simultaneously all works contained in the Phase I Project aiming at starting CSS operation at earliest possible date as discussed in Part III. Major works are construction of CSS building, RTU stations, installation of CSS instruments, monitoring and control equipment.

System operation and control after completion of the CSS will be carried out on the basis of the directions/instructions from the CSS building. Remote control from the CSS building is effective only for operation of the major six booster pumping stations. Data obtained at site are transmitted to the central data processing system through RTU and repeater station in the form of electric signal instantaneously.

Project period required for construction and installation is approximately four years from 1992 to 1995. The implementation schedule is given in Fig. III-5.1, Part III.

1.3 SYSTEM FUNCTION

Major distinctive functions of the two options are seen during steps 2 and 3 of operation period of Option A before installation of step 3, namely, between 1996 and 2000, which are summarized as follows:

Function	Option A	Option B
1) Data acquisition and transmission	- Records locally obtained are handcarried by site staff to district office. - Data electronically input by OCR into computer at each district office to transmit to main computer.	- Data sensed at primary sensors are transmitted through RTU to CSS instantaneously.
2) Flow rate control of water mains	- Manual control of existing gate valves (by turncock).	- Automatic feedback control by setting rates at controller.
3) Communication	- Local area network (LAN) by personal computer and telephone line	- Data radio communication.
4) System operation	- Batch system, off-line data processing.	- On-line real time data processing.
5) System software	- Combination of operating system and application.	- Software designed for CSS.

In addition to the above, Option A will have following advantages and disadvantages as compared to Option B:

Advantage

1) In several years of operation during step 2, the accumulated data will provide valuable information regarding water level fluctuation in the reservoirs, and water flow condition of transmission/distribution mains and off-takes through computerized pipe hydraulic analysis. Therefore, installation of full scale CSS instruments and control equipment are designed and installed based on actual operation data, relevant studies and analysis.

2) Contribution to the leakage control with the actual flow and pressure fluctuation data in the main pipelines.

3) Moderate in construction cost, not requiring the huge amount of initial investment, and no major negative affection to investment on immediate projects.

4) Comparing with the existing system, flow rate control of water mains and booster pumping stations will be done precisely by local operators and turncockers based on the actual flow and pressure records.

Disadvantage

1) Delayed installation of CSS instruments about five years which affects more time requirement for the comprehensive supervisory system formulation.

2) Delayed improvement of work efficiency by recruiting a large number of turncockers/operators to appropriate posts in the other sections/ departments.

3) Quick response and speedy reaction against abnormal water supply conditions will not be made since installed annunciators, which instruct operators the emergent situation, are not installed yet in Step 1.

4) Slightly moderate in construction cost, however, it requires additional costs for recorders and panel stands, printers, personal computers and their peripherals.

1.4 COST ESTIMATES

To determine the method of project implementation, project costs are estimated as summarized in Table IV-1.2 for Option A and Table IV-1.3 for Option B. Method applied for cost estimation is similar to that detailed in Section 4, Part III. Initial investment costs required for Steps-1 and 3 of Option A are US$ 6.9 million and US$ 41.1 million respectively. The Option B