investment cost is estimated at US$ 46.4 million. The Option B is slightly moderate in initial investment cost.

The table also shows replacement cost of the equipment and instruments to be required in future. Investment for replacement are assumption based on durable year of materials and equipment.

1.5 COMPARISON

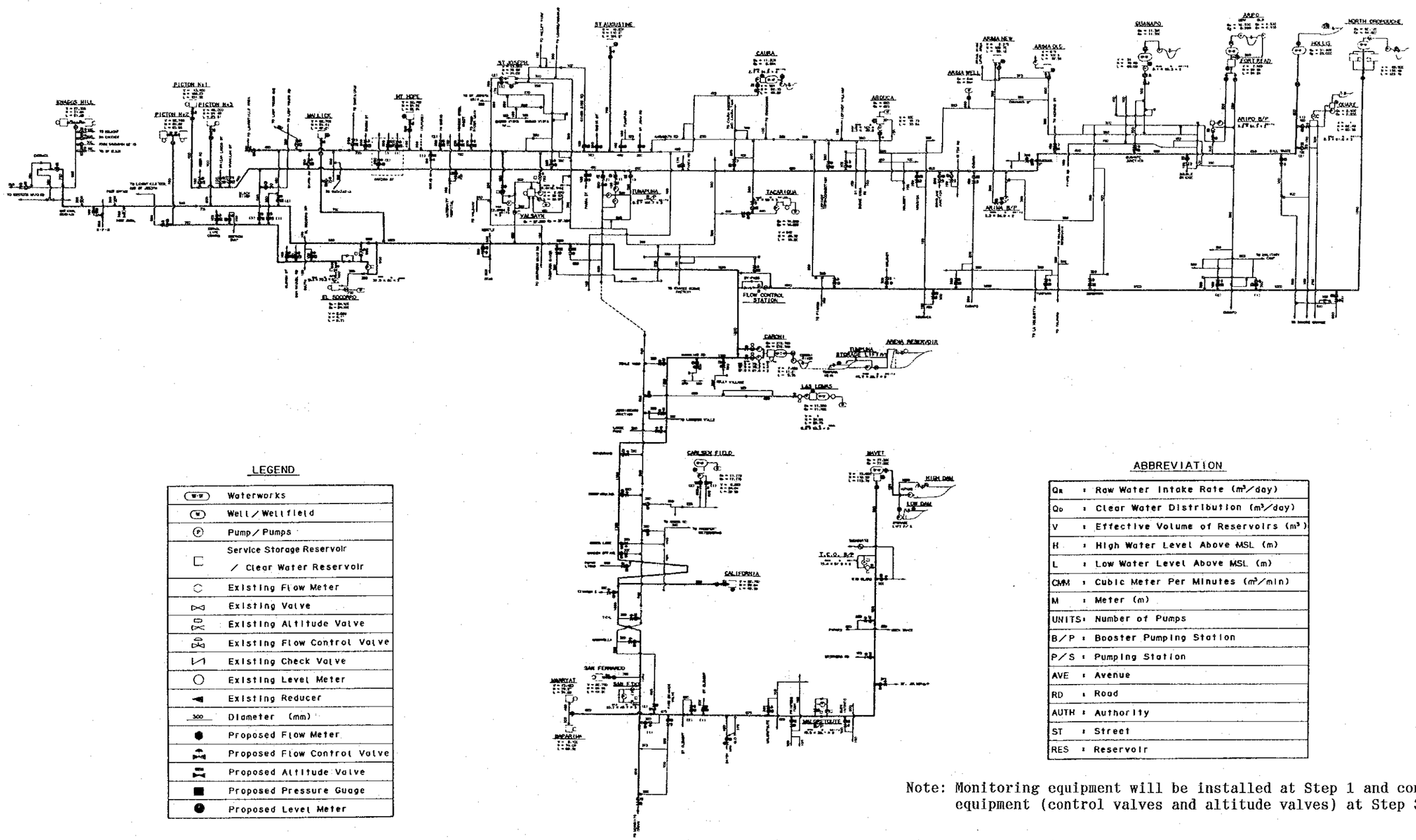
Table IV-1.4 shows an annual investment plan for these two options, which are developed on the basis of the initial investment and replacement costs estimated, a tentative construction schedule and expected design life of materials and equipment.

Present value method is applied to evaluate options. Discounts rates employed are 5%, 10%, 12% and 15% in consideration of domestic escalation factor, interest rate, etc. in Trinidad and Tobago. Present values are estimated from annual investment plans for coming 20 years up to 2010.

As clearly seen in the Table, "Option A" excels in every percentage of discount rates. Difference in the net present value ranges from US$ 8.7 million to 13.5 million. The table also suggests that the higher the discount rates are employed, the larger the deviation are seen. Since benefits accrued from these options can be considered almost similar, it may be concluded that "Option A" is a more feasible solution for Phase I Project implementation.

In the meantime, for further insight to the nature and scope of Option A, following tables and figures are prepared:

- Table IV-1.5 Proposed Specifications of CSS Hardware (Steps 1 and 3).
- Table IV-1.6 Proposed Specifications of Monitoring and Control Equipment.
- Table IV-1.7 Disbursement Schedule.



LEGEND

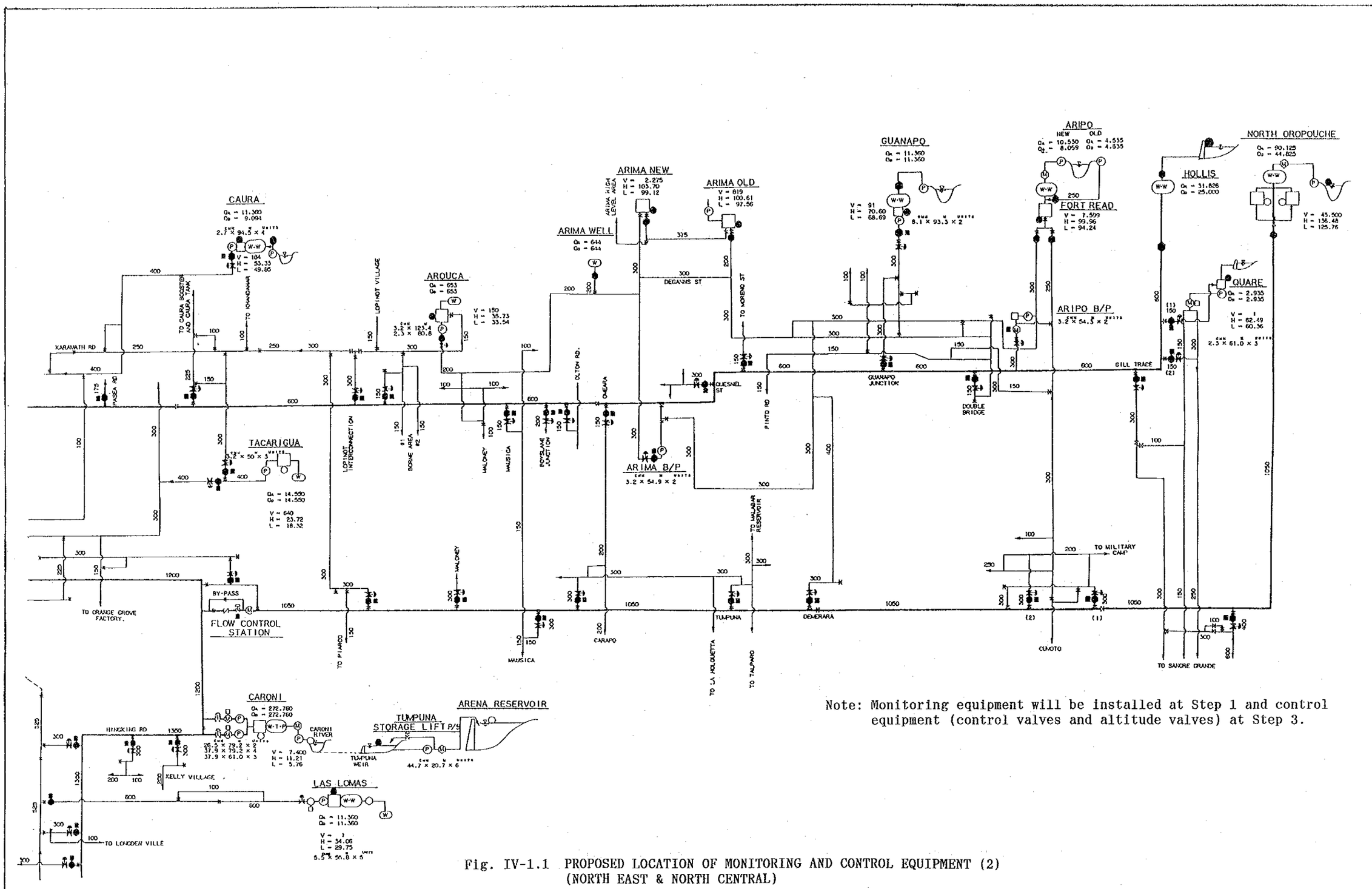
(W/W)	Waterworks
(W)	Well / Wellfield
(P)	Pump / Pumps
□	Service Storage Reservoir / Clear Water Reservoir
○	Existing Flow Meter
⋈	Existing Valve
⋈	Existing Altitude Valve
⋈	Existing Flow Control Valve
⋈	Existing Check Valve
○	Existing Level Meter
◀	Existing Reducer
300	Diameter (mm)
●	Proposed Flow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

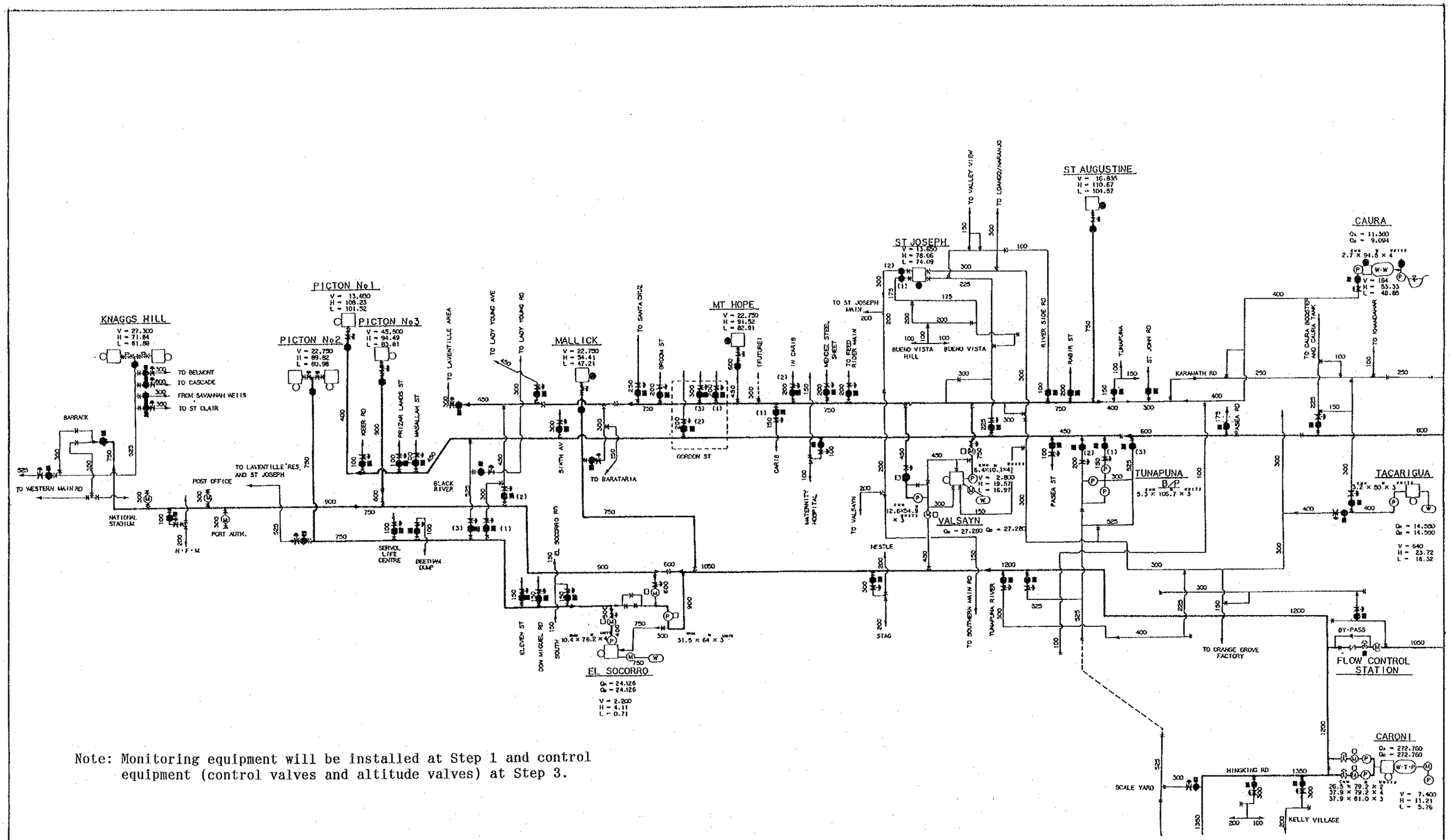
Note: Monitoring equipment will be installed at Step 1 and control equipment (control valves and altitude valves) at Step 3.

Fig. IV-1.1 PROPOSED LOCATION OF MONITORING AND CONTROL EQUIPMENT (1)
(GENERAL)



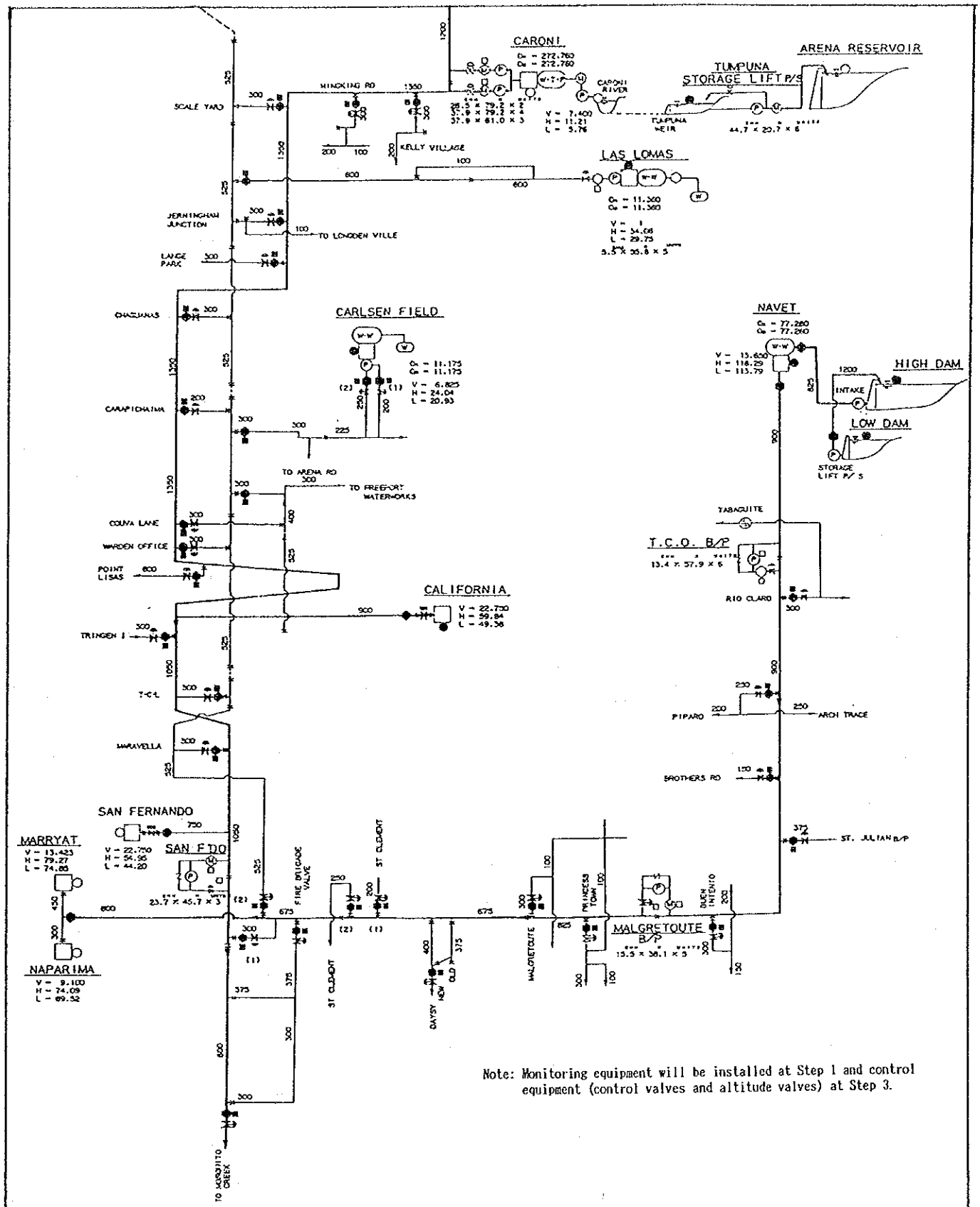
Note: Monitoring equipment will be installed at Step 1 and control equipment (control valves and altitude valves) at Step 3.

Fig. IV-1.1 PROPOSED LOCATION OF MONITORING AND CONTROL EQUIPMENT (2)
(NORTH EAST & NORTH CENTRAL)



Note: Monitoring equipment will be installed at Step 1 and control equipment (control valves and altitude valves) at Step 3.

Fig. IV-1.1 PROPOSED LOCATION OF MONITORING AND CONTROL EQUIPMENT (3)
(NORTH CENTRAL, NORTH WEST & PORT OF SPAIN)



Note: Monitoring equipment will be installed at Step 1 and control equipment (control valves and altitude valves) at Step 3.

Fig. IV-1.1 PROPOSED LOCATION OF MONITORING AND CONTROL EQUIPMENT (4) (SAN F'NDO/SOUTH CENTRAL & SOUTH EAST)

Fig. IV-1.2 CSS HARDWARE AND DATA COMMUNICATION - OPTION A

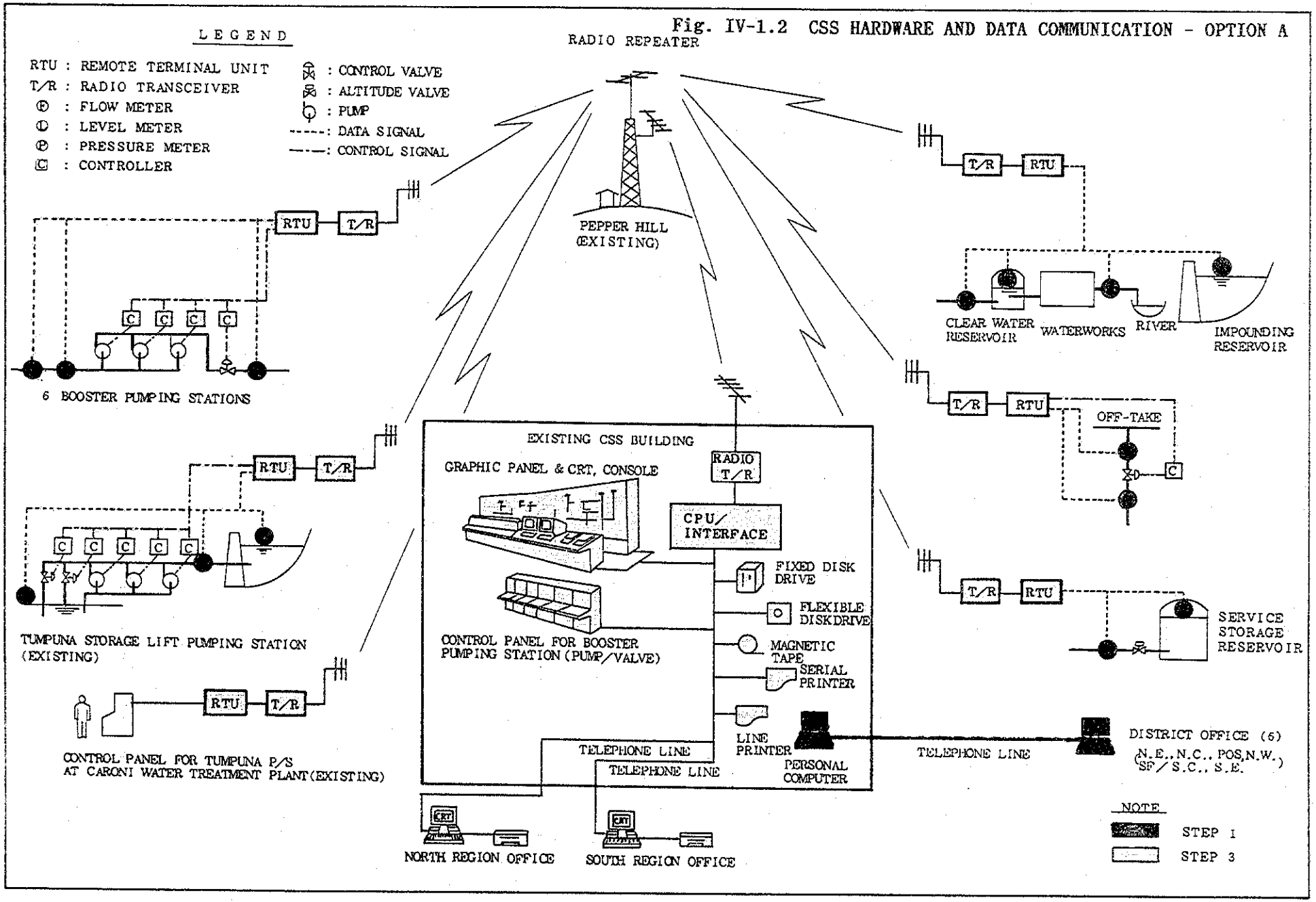
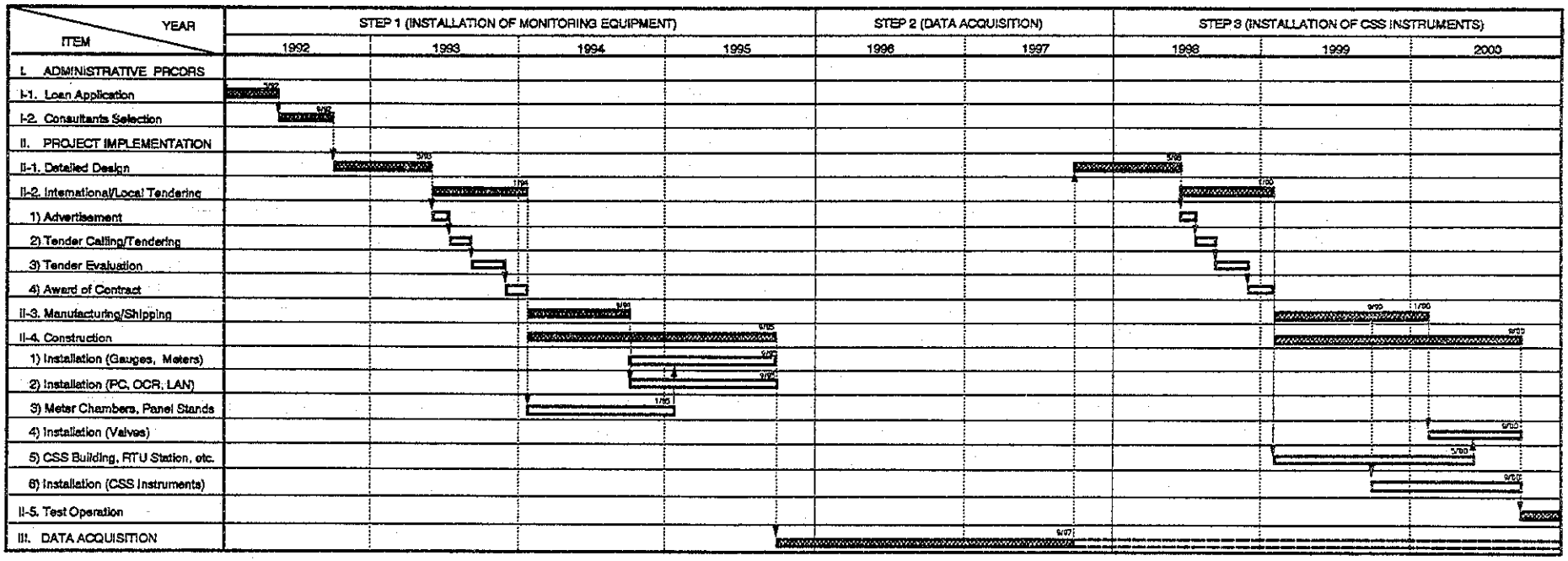


Fig. IV-1.3 CONSTRUCTION/IMPLEMENTATION SCHEDULE (OPTION A)



NOTE: PC; Personal Computer, OCR; Optical Character Reader, LAN; Local Area Network

Table IV-1.1 LIST OF MONITORING AND CONTROL EQUIPMENT BY CENTRAL SUPERVISORY SYSTEM - OPTION A (1)

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

NUMBER & NAME OF RTU STAT. TO BE INSTALLED [STEP 2]	NAME OF MONITORING POINT	PHASE I STEP 1 EQUIPMENT TO BE INSTALLED			NUMBER OF MONITORING DATA BY RECORDER				PHASE I STEP 3 INSTALL EQUIP.	NUMBER OF MONITORING DATA BY CENTRAL SUPERVISORY SYSTEM (CSS)							EQUIPMENT TO BE CONTROLLED			
		LEVEL METER	PRESS GAUGE	FLOW METER	WATER LEVEL	WATER PRESS	FLOW RATE	TOTAL	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								5				
	RAW WATER	F		¥ PF	1		1			1		1								
	CLEAR WATER RESERVOIR	* D-2			2					2										
	DISTRIBUTION (1050)			AN			1					1								
2 HOLLIS WW								3								3				
	IMPOUNDING RESERVOIR	F			1					1										
	RAW WATER (300)			AN			1					1								
	DISTRIBUTION (600)			AN			1					1								
3 GILL TRACE								11								15				
	QUARE WATER TANK	D			1					1										
	QUARE DISTRIBUTION (300)		¥ B	¥ V		1	1				1	1								
	GILL TRACE OT (300)		B	AN		1	1		BU		1	1	1						1	SITE
	QUARE(1) OT (150)		B	AN		1	1		BU		1	1	1						1	SITE
	QUARE(2) OT (150)		B	AN		1	1		BU		1	1	1						1	SITE
	TO SANGRE GRANDE OT (400)		B	AN		1	1		BU		1	1	1						1	SITE
4 ARIPO BPS								12								15				
	ARIPO(NEW) RAW WATER (300)			¥ O			1					1								
	ARIPO(OLD) RAW WATER (250)			AN			1					1								
	FORT READ RESERVOIR (250)	D		AN	1		1			1		1								
	FORT READ RESERVOIR (300)	D		AN	1		1			1		1								
	ARIPO BPS (300)		B	¥ V		1	1		BU		1	1	1						1	SITE
	CUMOTO(1) OT (300)		B	AN		1	1		BU		1	1	1						1	SITE
	CUMOTO(2) OT (300)		B	AN		1	1		BU		1	1	1						1	SITE
5 GUANAPO JUNCTION								8								11				
	GUANAPO RAW WATER (300)			AN			1					1								
	GUANAPO RESERVOIR (300)	D			1					1										
	GUANAPO WW DIST. (300)		B	AN		1	1		BU		1	1	1						1	SITE
	DOUBLE BRIDGE OT (150)		B	AN		1	1		BU		1	1	1						1	SITE
	GUANAPO JUNCTION OT (300)		B	AN		1	1		BU		1	1	1						1	SITE
6 DEMERARA JUNCTION								4								6				
	DEMERARA JCT OT (300)		B	AN		1	1		BU		1	1	1						1	SITE
	TUMPUNA JCT OT (300)		B	AN		1	1		BU		1	1	1						1	SITE
7 ARIMA OLD RESERVOIR								13								17				
	ARIMA NEW RESERVOIR (375)	F		AN	1		1			1		1								
	ARIMA OLD RESERVOIR (200)	D		AN	1		1			1		1								
	TO MORENO ST OT (150)		B	AN		1	1		BU		1	1	1						1	SITE
	QUESNEL ST OT (300)		B	AN		1	1		BU		1	1	1						1	SITE
	OMERA JCT OT (150)		B	AN		1	1		BU		1	1	1						1	SITE
	ARIMA BPS (300)		B	AN		1	1		BU		1	1	1						1	SITE
	ARIMA WELL (200)			AN			1					1								
	ARIMA B/PUMPS																			
8 MAUSICA JUNCTION								12								18				
	OLTON RD OT (150)		B	AN		1	1		BU		1	1	1						1	SITE
	BOYS LANE OT (200)		B	AN		1	1		BU		1	1	1						1	SITE
	MAUSICA JCT OT (150)		B	AN		1	1		BU		1	1	1						1	SITE
	CARAPO OT (300)		B	AN		1	1		BU		1	1	1						1	SITE
	MAUSICA OT (300)		B	AN		1	1		BU		1	1	1						1	SITE
	MALONEY JCT OT (300)		B	AN		1	1		BU		1	1	1						1	SITE
9 AROUCA WW								6								9				
	CLEAR WATER TANK	D			1					1										
	DISTRIBUTION (200)			AN			1		BU			1	1						1	SITE
	BORNE AREA #1 OT (150)		B	AN		1	1		BU		1	1	1						1	SITE
	LOPINOT IC OT (300)		B	AN		1	1		BU		1	1	1						1	SITE
10 CAURA WW								4								5				
	RAW WATER (400)			AN			1					1								
	CLEAR WATER TANK	D			1					1										
	DISTRIBUTION (400)		B	AN		1	1		BU		1	1	1						1	SITE
11 TACARIGUA WW								9								12				
	CLEAR WATER RESERVOIR	¥ D			1					1										
	DISTRIBUTION(1) (300)		B	AN		1	1		BU		1	1	1						1	SITE
	DISTRIBUTION(2) (400)		B	AN		1	1		BU		1	1	1						1	SITE
	TO CAURA BPS OT (225)		B	AN		1	1		BU		1	1	1						1	SITE
	PASEA RD OT (175)		B	AN		1	1				1	1								

Table IV-1.1 LIST OF MONITORING AND CONTROL EQUIPMENT BY CENTRAL SUPERVISORY SYSTEM - OPTION A (2)

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

NUMBER & NAME OF RTU STAT. TO BE INSTALLED [STEP 2]	NAME OF MONITORING POINT	PHASE I STEP 1 EQUIPMENT TO BE INSTALLED			NUMBER OF MONITORING DATA BY RECORDER				PHASE I STEP 3 INSTALL EQUIP.	NUMBER OF MONITORING DATA BY CENTRAL SUPERVISORY SYSTEM (CSS)							EQUIPMENT TO BE CONTROLLED			
		LEVEL METER	PRESS GAUGE	FLOW METER	WATER LEVEL	WATER PRESS	FLOW RATE	TOTAL	CONTROL VALVE	WATER LEVEL	WATER PRESS	FLOW RATE	VALVE STATUS	PUMP STATUS	ALARM	TOTAL	PUMP NO.	PUMP PLACE	VALVE NO.	VALVE PLACE
12 FLOW CONTROL STATION								7								11				
	PIARCO JCT OT (300)		B	AN		1	1		BU		1	1	1						1	SITE
	BY-PASS OT (300)		B	AN		1	1		BU		1	1	1						1	SITE
	FLOW CONTROL STATION(800)		B·2	¥ V		2	1		# CV-2		2	1	2						2	SITE
13 ST AUGUSTINE RESERVOIR								10								10				
	RESERVOIR (750)	F		AN	1		1		AV	1		1								
	ST JOIN RD OT (300)		B	AN		1	1				1	1								
	TO TUNAPUNA OT (150)		B	AN		1	1				1	1								
	RABIR ST OT (200)		B	AN		1	1				1	1								
	RIVERSIDE RD OT (100)		B	AN		1	1				1	1								
14 TUNAPUNA BPS								12								48				
	TUNAPUNA(1) (150)		B	AN		1	1		BU		1	1	1						1	CSS
	TUNAPUNA(2) (200)		B	AN		1	1		BU		1	1	1						1	CSS
	TUNAPUNA(3) (525)		B	AN		1	1				1	1								
	PASEA ST OT (100)		B	AN		1	1		BU		1	1	1						1	SITE
	TUNAPUNA RIVER (1) (300)		B	AN		1	1		BU		1	1	1						1	SITE
	TUNAPUNA RIVER (2) (525)		B	AN		1	1		BU		1	1	1						1	SITE
	TUNAPUNA B/PUMPS													6	25		3	CSS		
15 ST JOSEPH RESERVOIR								11								15				
	RESERVOIR	F			1					1										
	TO ST JOSEPH OT (225)		B	AN		1	1		BU		1	1	1						1	SITE
	TO RIDER MAIN OT (200)		B	AN		1	1		BU		1	1	1						1	SITE
	MENDEZ STEEL SH. OT (200)		B	AN		1	1		BU		1	1	1						1	SITE
	MATERNITY HP. OT (100)		B	AN		1	1		BU		1	1	1						1	SITE
	ST JOSEPH(1) (175)			AN			1					1								
	ST JOSEPH(2) (300)			AN			1					1								
16 VALSAYN WW								8								41				
	RAW WATER (750)			¥ V			1					1								
	CLEAR WATER RESERVOIR	¥ D			1					1										
	DISTRIBUTION (750)		¥ B	¥ V		1	1		BU		1	1	1						1	SITE
	BOOSTER SUCTION (450)		¥ B	¥ AN		1	1				1	1								
	BOOSTER DELIVERY (450)		¥ B	AN		1	1		BU		1	1	1						1	CSS
	VALSAYN B/PUMPS													6	25		3	CSS		
17 URIAH BUTLER HW JUNCTION								2								3				
	STAG/NESTL OT (300)		B	AN		1	1		BU		1	1	1						1	SITE
18 MT. HOPE RESERVOIR								16								23				
	RESERVOIR (600)	D		AN	1		1		AV	1		1								
	CARIB(1) OT (150)		B	AN		1	1		BU		1	1	1						1	SITE
	CARIB(2) OT (200)		B	AN		1	1		BU		1	1	1						1	SITE
	MT. HOPE OT (300)																			
	GORDON ST (1) OT (200)		B	AN		1	1		BU		1	1	1						1	SITE
	GORDON ST (2) OT (200)		B	AN		1	1		BU		1	1	1						1	SITE
	GORDON ST (3) OT (300)		B	AN		1	1		BU		1	1	1						1	SITE
	BROOM ST OT (200)		B	AN		1	1		BU		1	1	1						1	SITE
	TO SANTA CRUZ OT (250)		B	AN		1	1		BU		1	1	1						1	SITE
19 MALICK RESERVOIR								8								11				
	RESERVOIR (750)	D		AN	1		1		AV	1		1								
	TO BARATARIA OT (300)		B	AN		1	1		BU		1	1	1						1	SITE
	SIXTH Av. OT (300)		B	AN		1	1		BU		1	1	1						1	SITE
	TO LADY YOUNG Av. OT (450)		B	AN		1	1		BU		1	1	1						1	SITE
20 EL SOCORRO WW								13								49				
	RAW WATER (750)			¥ V			1					1								
	CLEAR WATER RESERVOIR	¥ AP			1					1										
	BOOSTER SUCTION (900)		¥ B			1					1									
	BOOSTER DELIVERY (600)		¥ B	¥ AN		1	1		BU		1	1	1						1	CSS
	DISTRIBUTION (400)		¥ B	¥ AN		1	1		BU		1	1	1						1	SITE
	EL SOCORRO RD OT (150)		B	AN		1	1		BU		1	1	1						1	SITE
	DON MIGUEL RD OT (150)		B	AN		1	1		BU		1	1	1						1	SITE
	ELEVENTH ST OT (150)		B	AN		1	1		BU		1	1	1						1	SITE
	EL SOCORRO B/PUMPS													6	25		3	CSS		
21 LAVENTILLE								2								3				
	TO LAVENTILLE OT (300)		B	AN		1	1		BU		1	1	1						1	SITE
22 BLACK RIVER								8								12				

Table IV-1.1 LIST OF MONITORING AND CONTROL EQUIPMENT BY CENTRAL SUPERVISORY SYSTEM - OPTION A (3)

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

NUMBER & NAME OF RTU STAT. TO BE INSTALLED [STEP 2]	NAME OF MONITORING POINT	PHASE I STEP 1 EQUIPMENT TO BE INSTALLED			NUMBER OF MONITORING DATA BY RECORDER				PHASE I STEP 3 INSTALL EQUIP.	NUMBER OF MONITORING DATA BY CENTRAL SUPERVISORY SYSTEM (CSS)							EQUIPMENT TO BE CONTROLLED			
		LEVEL METER	PRESS GAUGE	FLOW METER	WATER LEVEL	WATER PRESS	FLOW RATE	TOTAL	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		1	1		BU		1	1	1						1	SITE
	BLACK RIVER (2) OT (450)		B	AN		1	1		BU		1	1	1						1	SITE
	BLACK RIVER (3) OT (525)		B	AN		1	1		BU		1	1	1						1	SITE
	TO LADY YOUNG RD OT (300)		B	AN		1	1		BU		1	1	1						1	SITE
23 PICTON NO.3 RESERVOIR								13								16				
	PICTON #1 RESERVOIR (400)	* D		AN	1		1		AV	1		1								
	PICTON #2 RESERVOIR (750)	* D-2		AN	2		1		AV-2	2		1								
	PICTON #3 RESERVOIR (900)	* D		AN	1		1		AV	1		1								
	MASALLAH ST OT (100)		B	AN		1	1		BU		1	1	1						1	SITE
	PRIZAR LANDS ST OT (100)		B	AN		1	1		BU		1	1	1						1	SITE
	KERR RD OT (100)		B	AN		1	1		BU		1	1	1						1	SITE
24 SERVOL LIFE CENTER								6								9				
	BEETHAM DUMP OT (100)		B	AN		1	1		BU		1	1	1						1	SITE
	SERVOL LIFE C. OT (100)		B	AN		1	1		BU		1	1	1						1	SITE
	TO LAVENTILLE OT (525)		B	AN		1	1		BU		1	1	1						1	SITE
25 KNAGGS HILL								15								19				
	RESERVOIR (525)	* D-2		AN	2		1		* AV-2	2		1								
	TO BELMONT OT (300)		B	AN		1	1		BU		1	1	1						1	SITE
	TO CASCADE OT (600)		B	AN		1	1		BU		1	1	1						1	SITE
	TO ST CLAIR OT (350)		B	AN		1	1		BU		1	1	1						1	SITE
	WESTERN MAIN ROAD (525)		B	AN		1	1		BU		1	1	1						1	SITE
	FROM SAVANNAH WELLS (300)		B	AN		1	1				1	1								
	BARRACK (750)		B	AN		1	1				1	1								
26 NATIONAL FLOUR MILL								2								3				
	NFM OT (100)		B	AN		1	1		BU		1	1	1						1	SITE
	PORT AUTHORITY (300)																			
	POST OFFICE (300)																			
	NATIONAL STADIUM (300)																			
27 TUMPUNA STORAGE LIFT PS								4								77				
	ARENA IMPOUNDING RES.	¥ AP			1					1										
	TUMPUNA WEIR	F			1					1										
	TO/FROM RESERVOIR (1200)			¥ V-2			2					2								
	RIVER DISCH. VALVE (1200)								¥ BU-2				2						2	CARONI
	TUMPUNA S.L./PUMPS													12	59		6	CARONI		
28 CARONI WTP								7								9				
	RAW WATER	¥ AP		¥ PF	1		1			1		1								
	CLEAR WATER RESERVOIR	¥ AP			1					1										
	CARONI NORTH (900)		* B	¥ AN		1	1		¥ BU		1	1	1						1	CARONI
	CARONI SOUTH (1200)		* B	¥ AN		1	1		¥ BU		1	1	1						1	CARONI
29 KELLY VILLAGE								2								3				
	KELLY VILLAGE OT (300)		B	AN		1	1		BU		1	1	1						1	SITE
30 SCALE YARD								4								6				
	SCALE YARD OT (300)		B	AN		1	1		BU		1	1	1						1	SITE
	HINGKING RD OT (300)		B	AN		1	1		BU		1	1	1						1	SITE
31 LAS LOMAS WW								4								5				
	RAW WATER (600)			¥ O			1					1								
	CLEAR WATER RESERVOIR	D			1					1										
	DISTRIBUTION (600)		¥ B	¥ V		1	1		BU		1	1	1						1	SITE
32 JERNINGHAM JUNCTION								4								5				
	TO LAS LOMAS OT (600)		B	AN		1	1				1	1								
	JERNINGHAM JCT OT (300)		B	AN		1	1		BU		1	1	1						1	SITE
33 CHAGUANAS								4								6				
	CHAGUANAS OT (300)		B	AN		1	1		BU		1	1	1						1	SITE
	LANGE PARK OT (300)		B	AN		1	1		BU		1	1	1						1	SITE
34 CARLSEN FIELD WW								5								7				
	CLEAR WATER RESERVOIR	F			1					1										
	DISTRIBUTION(1) (200)		B	AN		1	1		BU		1	1	1						1	SITE
	DISTRIBUTION(2) (250)		B	AN		1	1		BU		1	1	1						1	SITE
35 CARAPICHAIMA								6								7				
	CARAPICHAIMA OT (200)		B	AN		1	1		BU		1	1	1						1	SITE
	TO CARLSEN FIELD OT (300)		B	AN		1	1				1	1								
	TO FREEPORT WW OT (300)		B	AN		1	1				1	1								
36 WARDEN OFFICE								6								9				

Table IV-1.1 LIST OF MONITORING AND CONTROL EQUIPMENT BY CENTRAL SUPERVISORY SYSTEM - OPTION A (4)

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

NUMBER & NAME OF RTU STAT. TO BE INSTALLED [STEP 2]	NAME OF MONITORING POINT	PHASE I																		
		STEP 1							STEP 3											
		EQUIPMENT TO BE INSTALLED			NUMBER OF MONITORING DATA BY RECORDER				INSTALL EQUIP.	NUMBER OF MONITORING DATA BY CENTRAL SUPERVISORY SYSTEM (CSS)							EQUIPMENT TO BE CONTROLLED			
		LEVEL METER	PRESS GAUGE	FLOW METER	WATER LEVEL	WATER PRESS	FLOW RATE	TOTAL	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		1	1		BU		1	1	1						1	SITE
	COUVA LANE OT (300)		B	AN		1	1		BU		1	1	1						1	SITE
	POINT LISAS OT (600)		B	AN		1	1		BU		1	1	1						1	SITE
37 TRINGEN II								2								3				
	TRINGEN II OT (300)		B	AN		1	1		BU		1	1	1						1	SITE
38 CALIFORNIA RESERVOIR								2								2				
	RESERVOIR (900)	D		AN	1		1		AV	1		1								
39 TCL								2								3				
	TCL OT (300)		B	AN		1	1		BU		1	1	1						1	SITE
40 MARAVELLA								2								3				
	MARAVELLA OT (300)		B	AN		1	1		BU		1	1	1						1	SITE
41 SAN FERNANDO BPS								14								49				
	SAN F'DO RESERVOIR (750)	¥ D		AN	1		1		AV	1		1								
	MARRYAT RESERVOIR (600)	¥ D		AN	1		1			1		1								
	NAPARIMA RESERVOIR	¥ D			1					1										
	BOOSTER SUCTION (900)		¥ B	¥ AN		1	1				1	1								
	BOOSTER DELIVERY (900)		¥ B			1			* BU		1		1						1	CSS
	ROUND ABOUT(1) OT (300)		B	AN		1	1		BU		1	1	1						1	SITE
	ROUND ABOUT(2) OT (525)		B	AN		1	1		BU		1	1	1						1	SITE
	FIRE BRIGADE OT (375)		B	AN		1	1		BU		1	1	1						1	SITE
	SAN F'DO B/PUMPS													6	25		3	CSS		
42 MOSQUITO CREEK								2								3				
	TO MOSQUITO CR. OT (600)		B	AN		1	1		BU		1	1	1						1	SITE
43 ST CLEMENT								4								6				
	ST CLEMENT (1) OT (200)		B	AN		1	1		BU		1	1	1						1	SITE
	ST CLEMENT (2) OT (250)		B	AN		1	1		BU		1	1	1						1	SITE
44 DAISY								2								3				
	DAISY OT (400)		B	AN		1	1		BU		1	1	1						1	SITE
45 MALGRETOUTE BPS								9								64				
	BOOSTER SUCTION (900)		¥ B	¥ V		1	1				1	1								
	BOOSTER DELIVERY (900)		¥ B			1			BU		1		1						1	CSS
	BUEN INTENTO OT (300)		B	AN		1	1		BU		1	1	1						1	SITE
	TO PRINCESS TOWN OT (300)		B	AN		1	1		BU		1	1	1						1	SITE
	TO MALGRETOUTE OT (300)		B	AN		1	1		BU		1	1	1						1	SITE
	MALGRETOUTE B/PUMPS													10	41		5	CSS		
46 BROTHER ROAD								6								9				
	BROTHER ROAD OT (150)		B	AN		1	1		BU		1	1	1						1	SITE
	TO PIPARO/ARCH OT (250)		B	AN		1	1		BU		1	1	1						1	SITE
	TO ST JULIAN OT (375)		B	AN		1	1		BU		1	1	1						1	SITE
47 TCO BPS								5								68				
	BOOSTER SUCTION (900)		¥ B			1					1									
	BOOSTER DELIVERY (900)		¥ B	¥ V		1	1		BU		1	1	1						1	CSS
	RIO CLARO OT (300)		B	AN		1	1		BU		1	1	1						1	SITE
	TCO B/PUMPS													12	49		6	CSS		
48 NAVET WW								9								9				
	HIGH DAM	F			1					1										
	LOW DAM	F			1					1										
	STORAGE LIFT PS (1200)			AN			1					1								
	RAW WATER (450)			AN-4			4					4								
	CLEAR WATER RESERVOIR	F			1					1										
	DISTRIBUTION (900)			AN			1					1								
	TOTAL	38	127	160	38	127	160	325	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	102 7 4	SITE CSS CARONI

Table IV-1.2 SUMMARY OF COST ESTIMATE FOR CENTRAL SUPERVISORY SYSTEM (OPTION A) - (1)

UNIT: IN x 1,000

ITEM	NAME OF FACILITIES AND EQUIPMENT	PHASE I-STEP I									PHASE I-STEP 3									
		FOREIGN CURRENCY (US$)			LOCAL CURRENCY (TT$)					TOTAL (US$)	FOREIGN CURRENCY (US$)			LOCAL CURRENCY (TT$)					TOTAL (US$)
		SUPPLY			CIVIL WORKS			SUPPLY	TOTAL (TT$)		SUPPLY			CIVIL WORKS			SUPPLY	TOTAL (TT$)		
		PRIMARY EQUIPMENT	INSTRUMENT -ATION	TOTAL (US$)	F-M/C-V CHAMBER	BUILDING WORKS	INSTAL-LATION	SUB-TOTAL (CIVIL)	TRANS-PORTATION			PRIMARY EQUIPMENT	INSTRUMENT -ATION	TOTAL (US$)	F-M/C-V CHAMBER	BUILDING WORKS	INSTAL-LATION	SUB-TOTAL (CIVIL)	TRANS-PORTATION		
[1]	CONSTRUCTION WORKS																			
	[CSS]																			
	FLOW METER	494.2	1,870.2	2,364.4	1,438.4	---	1,004.9	2,443.3	201.0	2,644.3	2,986.6	---	---	---	---	---	---	---	---	---
	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	380.9	413.4	---	---	175.7	175.7	35.1	210.8	463.0	---	---	---	---	---	---	---	---	---
	PRESSURE GAUGE	---	988.9	988.9	---	---	420.3	420.3	84.1	504.3	1,107.6	---	---	---	---	---	---	---	---	---
	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	526.7	3,240.0	3,766.7	1,438.4	---	1,600.8	3,039.3	320.2	3,359.4	4,557.1	2,156.4	22,380.3	24,536.7	1,396.5	2,604.9	9,733.4	13,734.8	1,967.9	15,702.7	28,231.5
	[DISTRICT OFFICE]																			
	PC & PRINTER	---	112.0	112.0	---	---	---	---	2.2	2.2	112.5	---	---	---	---	---	---	---	---	---
	SUB-TOTAL	---	112.0	112.0	---	---	---	---	2.2	2.2	112.5	---	---	---	---	---	---	---	---	---
	T O T A L	526.7	3,352.0	3,878.7	1,438.4	---	1,600.8	3,039.3	322.4	3,361.7	4,669.7	2,156.4	22,380.3	24,536.7	1,396.5	2,604.9	9,733.4	13,734.8	1,967.9	15,702.7	28,231.5
[2]	ENGINEERING SERVICES	---	---	489.4	---	---	---	---	---	382.6	579.4	---	---	2,823.9	---	---	---	---	---	1,788.4	3,244.7
	TOTAL OF ITEMS [1] & [2]	526.7	3,352.0	4,368.1	1,438.4	---	1,600.8	3,039.3	322.4	3,744.3	5,249.1	2,156.4	22,380.3	27,360.6	1,396.5	2,604.9	9,733.4	13,734.8	1,967.9	17,491.1	31,476.2
[3]	TAX (VAT)	---	---	---	---	---	---	---	---	3,346.3	787.4	---	---	---	---	---	---	---	---	20,066.1	4,721.4
[4]	CONTINGENCY	---	---	655.2	---	---	---	---	---	561.6	787.4	---	---	4,104.1	---	---	---	---	---	2,623.7	4,721.4
[5]	ADMINISTRATION	---	---	---	---	---	---	---	---	111.5	26.2	---	---	---	---	---	---	---	---	668.9	157.4
	GRAND-TOTAL	526.7	3,352.0	5,023.3	1,438.4	---	1,600.8	3,039.3	322.4	7,763.8	6,850.1	2,156.4	22,380.3	31,464.7	1,396.5	2,604.9	9,733.4	13,734.8	1,967.9	40,849.7	41,075.4

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

Table IV-1.2 SUMMARY OF COST ESTIMATE FOR CENTRAL SUPERVISORY SYSTEM (OPTION A) - (2)

UNIT: IN x 1,000

ITEM	NAME OF FACILITIES AND EQUIPMENT	REPLACEMENT COST OF PHASE I-STEP 1										REPLACEMENT COST OF PHASE I-STEP 3									
		FOREIGN CURRENCY (US$)			LOCAL CURRENCY (TT$)						TOTAL (US$)	FOREIGN CURRENCY (US$)			LOCAL CURRENCY (TT$)						TOTAL (US$)
		SUPPLY			CIVIL WORKS				SUPPLY			SUPPLY			CIVIL WORKS				SUPPLY		
		PRIMARY EQUIPMENT	INSTRUMENT -ATION	TOTAL (US$)	F-M/C-V CHAMBER	BUILDING WORKS	INSTAL-LATION	SUB-TOTAL (CIVIL)	TRANS-PORTATION	TOTAL (TT$)		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	---	1,329.8	1,329.8	---	---	565.2	565.2	113.0	678.2	1,489.4	---	---	---	---	---	---	---	---	---	---
	CONTROL VALVE	---	---	---	---	---	---	---	---	---	---	---	1,241.1	1,241.1	---	---	527.5	527.5	105.5	633.0	1,390.1
	LEVEL METER	---	279.6	279.6	---	---	118.8	118.8	23.8	142.6	313.1	---	---	---	---	---	---	---	---	---	---
	PRESSURE GAUGE	---	566.7	566.7	---	---	240.8	240.8	48.2	289.0	634.7	---	---	---	---	---	---	---	---	---	---
	CSS's CENTRAL EQUIP	---	---	---	---	---	---	---	---	---	---	---	3,486.9	3,486.9	---	---	1,481.9	1,481.9	296.4	1,778.3	3,905.3
	REGIONAL OFFICE	---	---	---	---	---	---	---	---	---	---	---	317.3	317.3	---	---	134.9	134.9	27.0	161.8	355.4
	REPEATER STATION	---	---	---	---	---	---	---	---	---	---	---	219.1	219.1	---	---	93.1	93.1	18.6	111.7	245.4
	RTU STATION	---	---	---	---	---	---	---	---	---	---	---	9,973.3	9,973.3	---	---	4,238.7	4,238.7	847.7	5,086.4	11,170.1
	BOOSTER P/S	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
	SPARE PARTS	---	---	---	---	---	---	---	---	---	---	---	249.3	249.3	---	---	---	---	21.2	21.2	254.3
	SUB-TOTAL	---	2,176.0	2,176.0	---	---	924.8	924.8	185.0	1,109.8	2,437.1	---	15,487.1	15,487.1	---	---	6,476.1	6,476.1	1,316.4	7,792.5	17,320.6
	[LSS]																				
	FLOW METER	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
	SUB-TOTAL	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
	T O T A L	---	2,176.0	2,176.0	---	---	924.8	924.8	185.0	1,109.8	2,437.1	---	15,487.1	15,487.1	---	---	6,476.1	6,476.1	1,316.4	7,792.5	17,320.6
[2]	ENGINEERING SERVICES	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
TOTAL OF ITEMS [1] & [2]		---	2,176.0	2,176.0	---	---	924.8	924.8	185.0	1,109.8	2,437.1	---	15,487.1	15,487.1	---	---	6,476.1	6,476.1	1,316.4	7,792.5	17,320.6
[3]	TAX (VAT)	---	---	---	---	---	---	---	---	1,553.7	365.6	---	---	---	---	---	---	---	---	11,041.9	2,598.1
[4]	CONTINGENCY	---	---	326.4	---	---	---	---	---	166.5	365.6	---	---	2,323.1	---	---	---	---	---	1,168.9	2,598.1
[5]	ADMINISTRATION	---	---	---	---	---	---	---	---	51.8	12.2	---	---	---	---	---	---	---	---	368.1	86.6
GRAND-TOTAL		---	2,176.0	2,502.4	---	---	924.8	924.8	185.0	2,881.7	3,180.4	---	15,487.1	17,810.2	---	---	6,476.1	6,476.1	1,316.4	20,371.3	22,603.4

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

Table IV-1.3 SUMMARY OF COST ESTIMATE FOR CENTRAL SUPERVOSORY SYSTEM (OPTION B)

UNIT: IN x 1,000

ITEM	NAME OF FACILITIES AND EQUIPMENT	PHASE I										REPLACEMENT COST OF PHASE I									
		FOREIGN CURRENCY (US$)			LOCAL CURRENCY (TT$)						TOTAL (US$)	FOREIGN CURRENCY (US$)			LOCAL CURRENCY (TT$)						TOTAL (US$)
		SUPPLY			CIVIL WORKS				SUPPLY	TOTAL (TT$)		SUPPLY			CIVIL WORKS				SUPPLY	TOTAL (TT$)		
		PRIMARY EQUIPMENT	INSTRUMENT -ATION	TOTAL (US$)	F-M/C-V CHAMBER	BUILDING WORKS	INSTAL-LATION	SUB-TOTAL (CIVIL)	TRANS-PORTATION			PRIMARY EQUIPMENT	INSTRUMENT -ATION	TOTAL (US$)	F-M/C-V CHAMBER	BUILDING WORKS	INSTAL-LATION	SUB-TOTAL (CIVIL)	TRANS-PORTATION		
[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	---	1,329.8	1,329.8	---	---	565.2	565.2	113.0	678.2	1,489.4
	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	---	1,241.1	1,241.1	---	---	527.5	527.5	105.5	633.0	1,390.1
	LEVEL METER	32.5	279.6	312.0	---	---	132.6	132.6	26.5	159.1	349.5	---	279.6	279.6	---	---	118.8	118.8	23.8	142.6	313.1
	PRESSURE GAUGE	---	566.7	566.7	---	---	240.8	240.8	48.2	289.0	634.7	---	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	---	3,486.9	3,486.9	---	---	1,481.9	1,481.9	296.4	1,778.3	3,905.3
	REGIONAL OFFICE	---	211.6	211.6	---	---	89.9	89.9	18.0	107.9	236.9	---	317.3	317.3	---	---	134.9	134.9	27.0	161.8	355.4
	REPEATER STATION	---	219.1	219.1	---	---	93.1	93.1	18.6	111.7	245.4	---	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	---	9,973.3	9,973.3	---	---	4,238.7	4,238.7	847.7	5,086.4	11,170.1
	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	---	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	---	17,663.1	17,663.1	---	---	7,400.9	7,400.9	1,501.4	8,902.2	19,757.8
	[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	---	17,663.1	17,663.1	---	---	7,400.9	7,400.9	1,501.4	8,902.2	19,757.8
[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	---	17,663.1	17,663.1	---	---	7,400.9	7,400.9	1,501.4	8,902.2	19,757.8
[3]	TAX (VAT)	---	---	---	---	---	---	---	---	22,850.5	5,329.5	---	---	---	---	---	---	---	---	12,595.6	2,963.7
[4]	CONTINGENCY	---	---	4,601.5	---	---	---	---	---	3,094.3	5,329.5	---	---	2,649.5	---	---	---	---	---	1,335.3	2,963.7
[5]	ADMINISTRATION	---	---	---	---	---	---	---	---	755.0	177.7	---	---	---	---	---	---	---	---	419.9	98.8
	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	45,367.0	---	17,663.1	20,312.6	---	---	7,400.9	7,400.9	1,501.4	23,253.0	25,783.9

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

Table IV-1.4 NET PRESENT VALUE FOR OPTIONS A AND B

UNIT: IN X US$ 1,000

DESCRIPTION / YEAR / ITEM	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	TOTAL
OPTION A	PHASE I - STEP 1				PHASE I - STEP 2 & 3					REPLACEMENT OF STEP 1					REPLACEMENT OF STEP 3					
[1] CONSTRUCTION	---	---	1,981	2,688	---	---	---	11,979	16,253	---	---	---	1,034	1,403	---	---	---	7,349	9,971	52,659
[2] ENGINEERING SERVICES	85	193	107	194	---	477	1,082	599	1,088	---	---	---	---	---	---	---	---	---	---	3,824
SUB-TOTAL	85	193	2,088	2,883	---	477	1,082	12,578	17,340	---	---	---	1,034	1,403	---	---	---	7,349	9,971	56,483
[3] TAX (VAT)	13	29	313	432	---	71	162	1,887	2,601	---	---	---	155	210	---	---	---	1,102	1,496	8,472
[4] CONTINGENCY	13	29	313	432	---	71	162	1,887	2,601	---	---	---	155	210	---	---	---	1,102	1,496	8,472
[5] ADMINISTRATION	0	1	10	14	---	2	5	63	87	---	---	---	5	7	---	---	---	37	50	282
TOTAL	111	252	2,725	3,762	---	622	1,411	16,414	22,629	---	---	---	1,349	1,831	---	---	---	9,591	13,013	73,710
			TOTAL =	6,850				TOTAL =	41,076				TOTAL =	3,180				TOTAL =	22,603	
NET PRESENT VALUE																				
5% [43,722]																				
10% [27,981]																				
12% [23,816]																				
15% [18,995]																				
OPTION B	PHASE I									REPLACEMENT OF PHASE I										
[1] CONSTRUCTION	---	---	13,407	18,190	---	---	---	---	---	---	---	---	8,257	11,501	---	---	---	---	---	51,355
[2] ENGINEERING SERVICES	578	1,311	726	1,319	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	3,933
SUB-TOTAL	578	1,311	14,133	19,509	---	---	---	---	---	---	---	---	8,257	11,501	---	---	---	---	---	55,288
[3] TAX (VAT)	87	197	2,120	2,926	---	---	---	---	---	---	---	---	1,239	1,725	---	---	---	---	---	8,293
[4] CONTINGENCY	87	197	2,120	2,926	---	---	---	---	---	---	---	---	1,239	1,725	---	---	---	---	---	8,293
[5] ADMINISTRATION	3	7	71	98	---	---	---	---	---	---	---	---	41	58	---	---	---	---	---	276
TOTAL	754	1,711	18,443	25,459	---	---	---	---	---	---	---	---	10,775	15,009	---	---	---	---	---	72,151
			TOTAL =	46,367									TOTAL =	25,784						
NET PRESENT VALUE																				
5% [52,442]																				
10% [40,418]																				
12% [36,885]																				
15% [32,505]																				

NOTE: EXCHANGE RATES; 1 US$ = TT$ 4.25 AND 1 US$ = ¥ 135, %; DISCOUNT RATE

Table IV-1.5 PROPOSED SPECIFICATIONS OF CSS HARDWARE

COMPONENTS OF SYSTEM HARDWARE	QUANTITY STEP 1	QUANTITY STEP 3	SPECIFICATIONS
(1) CSS BUILDING (EXISTING)			
PERSONAL COMPUTER	2	--	BACKING MEMORY; FD 1.2 MB x 2, HD 40 MB
SERIAL PRINTER	1	--	SPEED 82 C/S, NUMBER OF CHARACTERS 136/LINE
MODEM	6	--	HYBRID PHONE TYPE
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
(3) 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
(4) 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
(5) DISTRICT OFFICES (NE, NC, NW, POS, S.F/SC & SE)			
PERSONAL COMPUTER	6	--	BACKING MEMORY; FD 1.2 MB x 2, HD 40 MB
SERIAL PRINTER	6	--	SPEED 82 C/S, NUMBER OF CHARACTERS 136/LINE
OPTICAL CHARACTER READER (OCR)	6	--	RESOLUTION 300 DOT PER INCH, SCANNER
MODEM	6	--	HYBRID PHONE TYPE
(6) REGIONAL OFFICE			
WORK STATION (CRT AND COMPUTER)	--	2	20 INCHES, COLOR, MAIN MEMORY 8 MB, FDD 200 MB
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, FD; FLOPPY DISK, HD; HARD DISK, FDD; FIXED DISK DRIVE,

Table IV-1.6 PROPOSED SPECIFICATIONS OF MONITORING AND CONTROL EQUIPMENT

COMPONENTS OF MONITORING AND CONTROL EQUIPMENT	QUANTITY STEP 1	QUANTITY STEP 3	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/RECORDER (1-5 VDC/4-20 mADC, INKPEN, RECORDING PAPER-15 DAYS), TRANSMITTER (DC 4-20 mA)
: DIFFERENTIAL PRESSURE TYPE	24	--	INDICATOR/RECORDER (1-5 VDC/4-20 mADC, INKPEN, RECORDING PAPER-15 DAYS), TRANSMITTER (DC 4-20 mA)
: FLOAT TYPE	10	--	INDICATOR/RECORDER (1-5 VDC/4-20 mADC, INKPEN, RECORDING PAPER-15 DAYS), TRANSMITTER (DC 4-20 mA)
FLOW METER : ANNUBAR TYPE	160	--	INDICATOR/RECORDER (1-5 VDC/4-20 mADC, INKPEN, RECORDING PAPER-15 DAYS), ROOTER TRANSMITTER (DC 4-20 mA)
PRESSURE GAUGE: BOURDON TUBE TYPE	125	--	INDICATOR/RECORDER (1-5 VDC/4-20 mADC, INKPEN, RECORDING PAPER-15 DAYS), TRANSMITTER (DC 4-20 mA)
(3) CONTROL EQUIPMENT			
CONTROL VALVE : BUTTERFLY VALVE	--	106	MOTOR DRIVEN, 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,

Table IV-1.7 DISBURSEMENT SCHEDULE FOR PHASE I PROJECT (OPTION A) - (1)

UNIT: IN x 1,000

NO.	PHASING / ITEM	PHASE I - STEP 1														
	YEAR	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	---	---	---	---	---	---	1,551	129	1,582	2,327	193	2,373	3,879	322	3,955
	CONSTRUCTION - CIVIL WORK	---	---	---	---	---	---	---	1,698	400	---	1,341	316	---	3,039	715
	SUB-TOTAL	---	---	---	---	---	---	1,551	1,827	1,981	2,327	1,535	2,688	3,879	3,362	4,670
[2]	ENGINEERING SERVICES	73	51	85	162	131	193	90	74	107	165	126	194	489	383	579
S U B - T O T A L		73	51	85	162	131	193	1,641	1,901	2,088	2,492	1,660	2,883	4,368	3,744	5,249
[3]	TAX (VAT)	---	54	13	---	123	29	---	1,331	313	---	1,838	432	---	3,346	787
[4]	CONTINGIENCY	11	8	13	24	20	29	246	285	313	374	249	432	655	562	787
[5]	ADMINISTRATION	---	2	0	---	4	1	---	44	10	---	61	14	---	112	26
T O T A L		84	115	111	187	278	252	1,887	3,562	2,725	2,866	3,808	3,762	5,023	7,764	6,850

NOTE: F/C; FOREIGN CURRENCY, L/C; LOCAL CURRENCY, EXCHANGE RATES; 1 US$ = TT$ 4.25 AND 1 US$ = ¥ 135

Table IV-1.7 DISBURSEMENT SCHEDULE FOR PHASE I PROJECT (OPTION A) - (2)

UNIT: IN x 1,000

NO.	PHASING / ITEM	PHASE I - STEP 3																		
		1996			1997			1998			1999			2000			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$)	F/C (US$)	L/C (TT$)	TOTAL (US$)
[1]	CONSTRUCTION - SUPPLY	---	---	---	---	---	---	---	---	---	9,815	787	10,000	14,722	1,181	15,000	24,537	1,968	25,000
	CONSTRUCTION - CIVIL WORK	---	---	---	---	---	---	---	---	---	---	8,411	1,979	---	5,324	1,253	---	13,735	3,232
	SUB-TOTAL	---	---	---	---	---	---	---	---	---	9,815	9,198	11,979	14,722	6,505	16,253	24,537	15,703	28,231
[2]	ENGINEERING SERVICES	---	---	---	420	240	477	937	614	1,082	517	347	599	949	587	1,088	2,824	1,788	3,245
SUB-TOTAL		---	---	---	420	240	477	937	614	1,082	10,332	9,545	12,578	15,671	7,092	17,340	27,361	17,491	31,476
[3]	TAX (VAT)	---	---	---	---	304	71	---	689	162	---	8,018	1,887	---	11,054	2,601	---	20,066	4,721
[4]	CONTINGIENCY	---	---	---	63	36	71	141	92	162	1,550	1,432	1,887	2,351	1,064	2,601	4,104	2,624	4,721
[5]	ADMINISTRATION	---	---	---	---	10	2	---	23	5	---	267	63	---	368	87	---	669	157
TOTAL		---	---	---	483	590	622	1,078	1,419	1,411	11,882	19,262	16,414	18,022	19,579	22,629	31,465	40,850	41,076

NOTE: F/C; FOREIGN CURRENCY, L/C; LOCAL CURRENCY, EXCHANGE RATES; 1 US$ = TT$ 4.25 AND 1 US$ = ¥ 135

2. EVALUATION OF OPTIONS A AND B

According to the present value evaluation of the investments for the said two options, as referred to Table IV-1.4, the investment for Option A excels in every percentage of discount rates applied (5%, 10%, 12% and 15%) as discussed in Section 1.5 of the present report.

It is advised, therefore, that the Option A is a more feasible solution for the Phase I implementation. Economic and financial analyses of the above options, as referred to Tables IV-2.1 for economic and IV-2.2 for financial, are also made to verify viability of the Project as follows:

	EIRR *	FIRR at Water Rate (TT$/m^3)
Option A	12.5%	8% at 1.43 10% at 1.61 12% at 1.80
Option B	9.6%	8% at 1.74 10% at 1.98 12% at 2.24

*... EIRR is computed using the adjusted average water rate of TT$ 1.94 as unit benefit.

The above comparative study concluded that the Option A is more feasible for the Phase I Project implementation. The plan is also economically and financially viable, with less impact on the required water rate/tariff increase.

Option A, which has even its full-scale CSS improvement and development, is implemented in a longer period (1992-2000) than that of the other plan (Option B) for the Phase I Project (1992-1995). However, it is more recommendable from the technical point of view as the practical and effective implementation schedule, which installs the monitoring facilities and personal computers in Step 1 of Phase I.

Table IV-2.1 ECONOMIC BENEFIT AND COST STREAM (OPTION-A)

UNIT: TT$ 1,000

YEAR	C S S					LEAKAGE REDUCTION					METER INSTALLATION					TOTAL COSTS [C]	BENEFIT [B]	B - C
	INITIAL INVESTMENT	REPLACE-MENT	O & M	RESIDUAL VALUE	SUB-TOTAL	INITIAL INVESTMENT	REPLACE-MENT	O & M	RESIDUAL VALUE	SUB-TOTAL	INITIAL INVESTMENT	REPLACE-MENT	O & M	RESIDUAL VALUE	SUB-TOTAL			
1992	866	0	0	0	866	23,647	0	0	0	23,647	17,544	0	0	0	17,544	42,057	0	-42,057
1993	1,962	0	0	0	1,962	26,035	0	0	0	26,035	17,544	0	0	0	17,544	45,541	0	-45,541
1994	21,243	0	0	0	21,243	17,298	0	0	0	17,298	17,544	0	0	0	17,544	56,085	0	-56,085
1995	29,319	0	0	0	29,319	18,379	0	0	0	18,379	17,544	0	0	0	17,544	65,242	24,686	-40,556
1996	0	0	534	0	534	18,379	0	823	0	19,202	0	0	915	0	915	20,651	31,223	10,572
1997	1,958	0	534	0	2,492	18,379	0	823	0	19,202	0	0	915	0	915	22,609	37,955	15,346
1998	4,448	0	534	0	4,982	18,379	0	823	0	19,202	0	0	915	0	915	25,099	38,636	13,537
1999	47,891	0	534	0	48,425	18,379	0	823	0	19,202	0	0	915	0	915	68,542	38,636	-29,906
2000	66,113	0	534	0	66,647	0	0	823	0	823	0	0	915	0	915	68,385	59,489	-8,896
2001	0	0	1,738	0	1,738	0	0	823	0	823	0	0	915	0	915	3,476	66,715	63,239
2002	0	0	1,738	0	1,738	0	0	823	0	823	0	17,544	915	0	18,459	21,020	74,148	53,128
2003	0	0	1,738	0	1,738	0	0	823	0	823	0	17,544	915	0	18,459	21,020	77,273	56,253
2004	0	5,244	1,738	0	6,982	0	0	823	0	823	0	17,544	915	0	18,459	26,264	77,273	51,009
2005	0	7,115	1,738	0	8,853	0	0	823	0	823	0	17,544	915	0	18,459	28,135	77,273	49,138
2006	0	0	1,738	0	1,738	0	0	823	0	823	0	0	915	0	915	3,476	77,273	73,797
2007	0	0	1,738	0	1,738	0	6,391	823	0	7,214	0	0	915	0	915	9,867	77,273	67,406
2008	0	0	1,738	0	1,738	0	6,391	823	0	7,214	0	0	915	0	915	9,867	77,273	67,406
2009	0	34,674	1,738	0	36,412	0	0	823	0	823	0	0	915	0	915	38,150	77,273	39,123
2010	0	47,046	1,738	0	48,784	0	0	823	0	823	0	0	915	0	915	50,522	77,273	26,751
2011	0	0	1,738	0	1,738	0	0	823	0	823	0	0	915	0	915	3,476	77,273	73,797
2012	0	0	1,738	0	1,738	0	0	823	0	823	0	17,544	915	0	18,459	21,020	77,273	56,253
2013	0	0	1,738	0	1,738	0	0	823	0	823	0	17,544	915	0	18,459	21,020	77,273	56,253
2014	0	0	1,738	-49,032	-47,294	0	0	823	-6,391	-5,568	0	17,544	915	-24,727	-6,268	-59,130	77,273	136,403
.	173,800	94,080				158,875	12,782				70,176	122,808						

EIRR= 12.5%

Table IV-2.2 FINANCIAL CASH FLOW (OPTION-A)

UNIT: TT$ 1,000

YEAR	C S S					LEAKAGE REDUCTION					METER INSTALLATION					TOTAL COSTS [C]	BENEFIT [B]	B - C
	INITIAL INVESTMENT	REPLACE-MENT	O & M	RESIDUAL VALUE	SUB-TOTAL	INITIAL INVESTMENT	REPLACE-MENT	O & M	RESIDUAL VALUE	SUB-TOTAL	INITIAL INVESTMENT	REPLACE-MENT	O & M	RESIDUAL VALUE	SUB-TOTAL			
1992	893	0	0	0	893	28,064	0	0	0	28,064	18,496	0	0	0	18,496	47,453	0	-47,453
1993	2,023	0	0	0	2,023	26,835	0	0	0	26,835	18,496	0	0	0	18,496	47,354	0	-47,354
1994	21,900	0	0	0	21,900	17,873	0	0	0	17,873	18,496	0	0	0	18,496	58,269	0	-58,269
1995	30,226	0	0	0	30,226	19,050	0	0	0	19,050	18,496	0	0	0	18,496	67,772	12,598	-55,174
1996	0	0	550	0	550	19,050	0	874	0	19,924	0	0	972	0	972	21,446	15,933	-5,513
1997	2,019	0	550	0	2,569	19,050	0	874	0	19,924	0	0	972	0	972	23,465	19,369	-4,096
1998	4,586	0	550	0	5,136	19,050	0	874	0	19,924	0	0	972	0	972	26,032	19,717	-6,315
1999	49,372	0	550	0	49,922	19,050	0	874	0	19,924	0	0	972	0	972	70,818	30,358	-40,460
2000	68,157	0	550	0	68,707	0	0	874	0	874	0	0	972	0	972	70,553	34,045	-36,508
2001	0	0	1,792	0	1,792	0	0	874	0	874	0	0	972	0	972	3,638	38,487	34,849
2002	0	0	1,792	0	1,792	0	0	874	0	874	0	18,496	972	0	19,468	22,134	40,081	17,947
2003	0	0	1,792	0	1,792	0	0	874	0	874	0	18,496	972	0	19,468	22,134	40,081	17,947
2004	0	5,406	1,792	0	7,198	0	0	874	0	874	0	18,496	972	0	19,468	27,540	40,081	12,541
2005	0	7,336	1,792	0	9,128	0	0	874	0	874	0	18,496	972	0	19,468	29,470	40,081	10,612
2006	0	0	1,792	0	1,792	0	0	874	0	874	0	0	972	0	972	3,638	40,081	36,443
2007	0	0	1,792	0	1,792	0	6,684	874	0	7,558	0	0	972	0	972	10,322	40,081	29,759
2008	0	0	1,792	0	1,792	0	6,684	874	0	7,558	0	0	972	0	972	10,322	40,081	29,759
2009	0	35,747	1,792	0	37,539	0	0	874	0	874	0	0	972	0	972	39,385	40,081	696
2010	0	48,501	1,792	0	50,293	0	0	874	0	874	0	0	972	0	972	52,139	40,081	-12,058
2011	0	0	1,792	0	1,792	0	0	874	0	874	0	0	972	0	972	3,638	40,081	36,443
2012	0	0	1,792	0	1,792	0	0	874	0	874	0	18,496	972	0	19,468	22,134	40,081	17,947
2013	0	0	1,792	0	1,792	0	0	874	0	874	0	18,496	972	0	19,468	22,134	40,081	17,947
2014	0	0	1,792	-50,549	-48,757	0	0	874	-6,684	-5,810	0	18,496	972	-44,390	-24,922	-79,489	40,081	119,570
	179,176	96,989				168,022	13,368				73,984	129,472						

FIRR= 1.5%

PART FIVE:
CONCLUSION AND RECOMMENDATIONS

CONCLUSION AND RECOMMENDATIONS

In the course of the present Study, following recommendations are considered important to implement the Project. Item 1) below presents recommended option of CSS development, which is less costly and less sophisticated but requires longer period of project implementation as discussed in Part IV. Item 2) is a reproduction from the prerequisite for implementing the Phase I Project or the above option. On the other hand, items 3) and 4) are regarding institutional aspects of WASA and water resource development respectively.

1) Recommended Option of Phase I Project

Feasibility Study in Part III analyses an early establishment of the CSS in 1995, in accordance with the results of mutual discussions between GRTT and Study Team during Master Plan stage. As suggested in Section 6 Project Evaluation, Part III, implementation of the Phase I Project by the year 1995 is considered too optimistic (or rather hard to justify its feasibility without conditionality) from financial points of view.

Reflecting the above result of project evaluation, recommended option of the project implementation, of which outcome is responding to the scope of Phase I Project with full-scale CSS improvement and development will have three steps of implementation.

Installation of pressure gauges, flow meters and level meters furnished with recorders, and computer system for electronic data storage will be executed as the first step. This initial investment will benefit on providing valuable and reliable operational data in several years of operation as the second step. It is the very analyses and studies regarding actual water supply conditions and consumer's water use patterns, on which future water supply planning including development of CSS will be based. Then the installation of the CSS instruments may follow as third step. This final step is to operate the CSS along with operation manual developed.

Thus, the said indispensable main pipeline information/monitoring system is formulated in several years, using the installed monitoring facilities with the said computers, which collect and accumulate the main pipelines operation status data/information.

The new CSS of Phase I is completely developed after realization of the above pipeline information system, which is considered as the most recommendable process of the effective CSS formulation and operation.

As discussed in Part IV Comparative Study, Options A and B have the following steps of project implementation.

Option A

a) Installation of primary sensors (flow meters, pressure gauges and level meters) with recorders, construction of meter chambers and computer system for electronic data storage. (1992-1995)

b) Monitoring and data acquisition for conducting pipe network hydraulic analyses and developing water supply plan. (1996-1997)

c) Installation of CSS instruments, installation of flow control valves, construction of RTU stations and valve chambers, remote control instrumentation for booster pumping station and expansion of the CSS building. This final step totally coincides with the outcome of the following Option B (1997-2000).

Option B

a) Unified or single-step installation of primary sensors, control equipment and CSS related instruments (1992-1995).

Approximate cost required for the first step of Option A is estimated at US$ 6.9 million in total, i.e., about 15% of the Phase I Project (Option B) cost. As seen in Table IV-1.4, "Option A" excels in every percentage of discount rates applied (5%, 10%, 12% and 15%). Further, the results of economic and financial analyses of the Option A suggest that FIRR is largely

improved by adoption of Option A. Therefore, it may be concluded that "Option A" is a more feasible solution for Phase I Project implementation.

Further, economic and financial analyses of the option A is carried out simultaneously. The results suggest that FIRR is largely improved by adoption of Option A as seen in Table below.

2) Urgent Implementation of the Immediate Project

The current study suggests that the establishment of the CSS for all systems of WASA throughout the country is somewhat premature if the existing water supply system be left without any proper measures. As identified in the present report, implementation of the immediate project is a prerequisite condition for starting CSS operation. Otherwise, targets set up for the Phase I Project will not be achieved as intended. The immediate project will have the scope of establishment of sound metering system and tariff structure, urgent implementation of leakage reduction, update of data and maps of the existing pipe network, etc. as further described below:

Metering System

The present metering system adopted by WASA covers merely 1,802 connections (or less than 1%) out of the total 250,770 as of September 1990 to charge water tariff based on water consumption. Most consumers use water freely with little awareness on conservation of water resource because of absence of meters. To reduce consumer's wastage which contributes a substantial portion of the present UFW(50%) to an appropriate level, an early establishment of the universal metering system is indispensable, covering entire range of domestic, industrial and commercial consumers. Previous surveys carried out in developed countries suggest that per capita demand decreased significantly to 50% of the previous demand by employing metering system.

Tariff System

Concurrently with establishment of the above, normal tariff structure that

charges based on meter reading, or actual water consumption is ideal for reducing water wastage. As detailed in Section 5, Part I, there remains some room to raise water rates in view of the current tariff level and consumers' affordability to pay. Water rates should be determined and the desirable level should reflect WASA's actual expenditure and assets so far invested. Its early establishment can contribute greatly to strengthening the financial capability and hence institutional management of WASA.

Leakage Reduction

The above two aim at reducing water wastage by improving the institutional and financial aspects of WASA. In addition, it is recommended that WASA conducts a leakage reduction project to reduce physical water losses through the pipe network. According to the pilot leakage survey conducted under the current Study, most of unaccounted-for water is derived from physical leakage through the pipelines and valves. For smooth implementation of the leakage reduction project, objectives and implications of such activities will be recognized clearly by the public as well as WASA. Public understanding and cooperation are of primary importance in conducting the leakage reduction project.

Update of Data and Maps of the Existing Water Supply System

As-built drawings and data based on detailed surveys available in WASA, although very limited, are not always accurate as discussed in Part I of this report. These data and maps sometimes contradict each other. Possible reason for this may be attributable partly to the obscure unit system and base line for survey and measurement. To avoid such circumstances, WASA is recommended to conduct topographical surveys on the existing water supply system throughout the country based on an unified and standardized unit.

Periodical Calibration/Overhaul/Replacement of the Equipment

It is often observed during field reconnaissance that meters, pressure gauges, pumps and valves installed at the waterworks and on the transmission/distribution network are malfunctioning and left without

repair. More resources should be assigned to appropriate maintenance and periodical calibration of the installed equipment. Such activities on daily routine basis may be the most cost-effective measures to ensure effectiveness of monitoring and control of the whole water supply system.

Public Campaign to Reduce Water Wastage

As described above, unaccounted-for water reaches to a high ratio of approximately 50% according to the result of field surveys. This implies the half of the production and investment cost are wasted. If such wastage or losses were reduced, the water revenue would significantly increase. To generate further income, it is also an important measure to conduct campaign to enlighten the people how to use effectively the piped water without wastage.

Development of Long and Medium Term Water Supply Master Plan

The present report deals with the Master Plan of Water Supply Supervisory System and Feasibility Study of the identified Phase I Project. The report is prepared in the absence of any comprehensive long-term water supply master plan. In this sense, the current study on development of water supply supervisory system stands unsupported. It is desirable to establish long and medium term water supply master plan as expeditiously as possible: then, review the current study in compliance with the strategy and targets established.

Self-sufficiency of WASA

WASA depends significant part of the financing on the Central Government for project investment and even for routine maintenance. Vast amount of accounts receivable has been accumulated; equivalent to nearly annual water sales at the end 1989. Further, the working ratio (the ratio of operating expenditures less depreciation to operating income), 1.58 in 1989, suggests current critical financial position of WASA. It can be said that the financial capability of WASA is quite vulnerable and weak as sole utility responsible for developing and managing water and sewerage works in Trinidad and Tobago. As seen in SAL agreement concluded between

WASA and the World Bank in November 1989, it is fundamental to establish self-sufficiency of WASA in the early stage of the project development.

3) Improvement of Service Level of WASA to the Customers

Customers in some remote areas are suffering from water shortage whereas much water are wasted as leakage particularly in high pressure zone. Current practice by WASA to supply water to such customers is an intermittent supply by valve turncock or by tank truck. It can be said that the existing systems, particularly distribution network, have not been planned on the basis of actual water demand. Moreover, water tariff applied in Trinidad and Tobago is in principle a flat rate system according to the potential value of property; customers are unmetered (99% in number), therefore pay constant water rate regardless of water consumption. In such a situation, many may not be satisfied with the services rendered by WASA. Much emphasis should be directed to the strengthening institutional aspects to improve WASA's service level.

4) Water Resource Development

As suggested in the present Report, total dependable yields from the existing water sources available in the country is exceeding the water demand of the whole population. This situation will continue up to the target year of 2005, provided that the unaccounted-for water ratio be significantly reduced from the current 50% to 20% in 2005. The field survey conducted in the course of the Study also suggests that the southern rural area of Trinidad rather than the northern urban area, and most part of Tobago are suffering chronic water shortage. Immediate improvement of this situation in a few years might be impossible because of the constraints of physical configuration of the existing water supply systems, such as the transmission and distribution facilities, and the limited availability of water sources. It is therefore recommended that WASA urgently formulates comprehensive water source development plan to cope with this problem.