3.7.4 DESIGN CRITERIA AND SPECIFICATIONS OF WATER SUPPLY FACILITIES

(1) Special Request from Egyptian Government

The following matters were requested by the Egyptian Government, especially for the water supply system design of the project:

(a) Stable Supply

The water supply system shall responsible to serve a safety water stably, to ensure a stable production of the industrial estate.

The design incorporates a water stock for eight hours supply in the raw water reservoir and the treated water reservoir. This water stock can avoid the emergency stoppage of water treatment.

As for the emergency power source, generator sets are installed at the intake pump station and the water treatment plant. Capacity of these generator sets are 50% provision of full scaled operation.

(b) Fire Hydrant System

Fire attack system is one of the important utilities for the industrial estate as well as the stable water supply, to save properties in the service area. In this design, the fire hydrants are installed alone the distribution main pipeline which is more than Nominal Diameter (ND) 200mm. A coverage of one hydrant tap is 50 m radius.

(c) Recycling System of Sludge Draw-off Water

Landscaping design of the project area includes planting schedule of trees, shrub. For economical view, the draw-off water generated in the water treatment plant will be recycled for this planting purpose.

(2) General Layout of Water Supply Facilities

<u>Site Selection of Water Treatment Plant</u>

Preliminary layout of the water supply facilities were given in the Master Plan 1986. JICA study team made the field investigation to improve the preliminary layout. Final layout of the water supply facilities are shown in FIG.1.1-WS. Major alterations in the improved layout are listed below;

- For irrigation and planting purpose, draw-off water supply system is strongly requested by MODANC to add newly in the project.
- Location of the water treatment plant is relocated from the intake point to the project area (Ataqa I.E., Adabiya I.F.Z.).
- Location of the intake point is as same as the master plan, which is 3 km upstream from the existing SCA water treatment plant.
- Pipeline route (19.5 km) between Intake to Water Treatment Plant is selected in the desert area through outside of the urban area of Suez City.

(3) Intake Facilities

Layout plan of the intake facilities and process and instrumentation diagram are shown in FIG. 4.1-WS and 4.2-WS.

(a) Design Criteria

Main function of the Intake Facilities is to intake raw water from Suez Sweetwater Canal and pump it up to the Water Treatment Plant to be constructed in the Ataqa Industrial Estate with about 19.5 km distance to convey.

The Intake Facilities is to be located at about 3 km up-stream from the existing SCA water treatment plant. The facilities consist of Intake mouth, Guide channel, Screens, Pumping station, Electric power sub-station and utilities.

The major criteria of the intake facilities shall comply with followings:

1) Intake mouth and Guide Channel

Flow Quantity : Max. 100,000 cu.m per day

Flow in Guide Channel	:	Max. 0.6 m per sec.
Water level at Intake mouth	:	EL3.5m (H.W.L)
		EL 3.0m (L.W.L.)
Gates of Intake mouth	:	Stop Log and Sluice gate
Screens	:	Coarse bar screen and Motor drive fine screen

2) Intake Pump station

Water level at Suction	:	EL 3.3m
Total Pump Capacity	:	69.44 cu.m per min.
Total Pumping head	:	120 m
Pumping Rate	:	18.00 m^3/sec
Distance to Convey	:	19,450 m
Number of Pumps installed	:	4 duty pumps and 2 stand-by
Pump speed	:	1,000 rpm
Water-hammer prevention	:	Internal fly-wheel, Air vessel

3) Constants

Flow factor (C) for pipe	:	Ductile cast iron pipe 110
Head-loss factor (f) for fittings: Bell mouth		0.2000
Bend 45 deg.		0.1028
Sluice valve		0.5000
Butterfly valve		0.2000
Check valve		0.5000

4) Power Supply

Power Sub-station to be installed in the inside of the yard receives the power of 22 KV from commercial line and transform it to 6 KV and 380/220 V, then distribute to the Intake facilities.

Emergency generator to be installed at the above Power Sub-station provides 50% of required power of fully operation mode.

(b) Major Specifications of Intake

1) Screen

Type	: Bar screen (int.25mm) with Motor-drive rotary rake.
Dimensions	: W 1,700 x D 2,700 mm
Inclination	: 70 degrees
Max. head loss	: 300 mm
Quantities	: 2 duty units for 2 guide channels
Accessories	: Local control panel, Level switch, Trash container

2) Sluice Gate

Type	: Steel Sluice Gate
Dimensions	: 1.7m span x 1.5m height
Quantities	: 2 units for 2 guide channels

3) Intake Pump

Type	: Double suction centrifugal multi stage type
Discharge per unit	: 18.00 m3/min.
Pump speed	: 1,000 rpm
Total pumping head	: 120 m (see TABLE 4.1-WS)
Constant of Pump	: Efficiency 0.75, Excess ratio for Power 1.10

Pump Characteristic Curve : see FIG.4.3-WS

Motor rating power : 500 kW

Quantities : 6 units (4 duty pumps and 2 stand-by)

Materials : Gray cast iron casing with stainless steel impeller and shaft

4) Motor

Type : Slip-ling type induction moter

Voltage : 6,000 V

Output : 500 kW

Speed : 6 poles (1,000 rpm)

Insulation : equivalent as Class F (JIS)

5) Air Vessel

Materials : Rolled steel

Capacity : 40 m3

Design pressure : 16 kg/cm

Accessories : Air compressor x 2 sets, Water level switch, Air release valve

6) Switchgear

6 kV incoming panel : 1 panel

Auto transformer starter panel : 6 panels

Motor control panels : 6 panels

Low voltage control panel : 1 panel

7) Instrumentation

Water level indicator, water flow indicator/recorder, obstacle alarms, pump start/stop, emergency stop sequence, generator control sequence, complete graphic

operation indicator system, the telemetering system of water level at raw water reservoir for pump operation

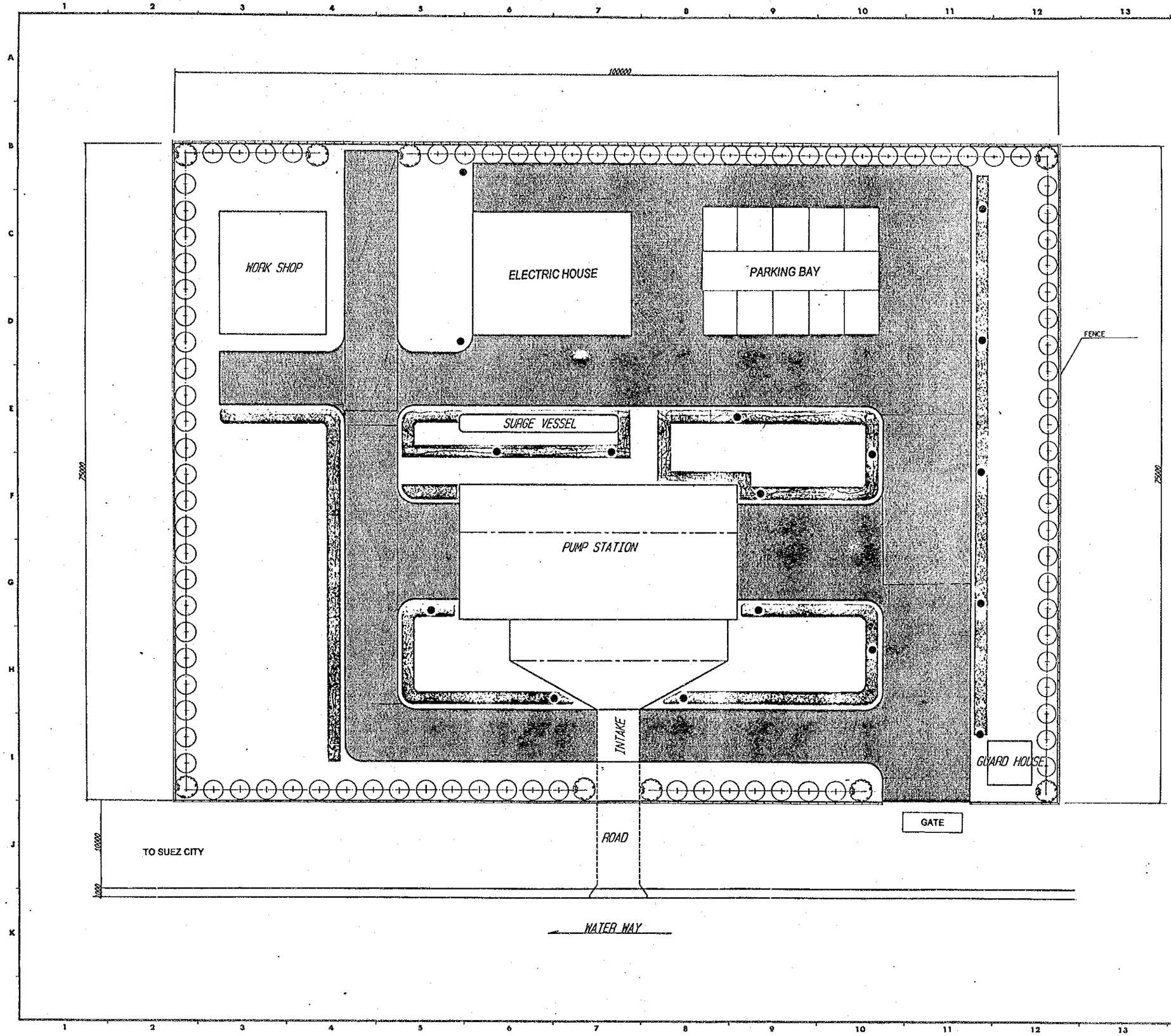
8) Miscellaneous

Valves	: 18 sets of butterfly valves with manual apparatus
Flow control valve	: 1 set of butterfly valves with manual apparatus
Flow meter	: 1 unit of venturi tube type
Pipes (for pump room)	: Rolled steel, 16 kg/cm2
Flexible pipe joint	: 1 set of rubber type flex. joint
Drain pump	: 2 sets of submersible pump (1.5 kW)
Maintenance tools	: 1 complete set to be used for pump maintenance.

TABLE 4.1-WS LOSS CALCULATION TABLE

Service :

Item No.	Description of losses	Flow (m3/sec)	Dia. (mm)	Velocity (m/sec)	f	Loss (m)
0	Screen loss	0.00000	0	0.000	0.0000	0.300
1	Bellmouth	0.30000	400	2.387	0.2000	0.058
2	45 deg Bend	0.30000	400	2.387	0.0994	0.029
3	Straight pipe(William Hazen) Length= 8.00(m) C=110	0.30000	400	2.387	0.0229	0.133
4	Sluice valve	0.30000	400	2.387	0.0500	0.015
5	Taper pipe(Divergent)	0.30000	D1= 300 D2= 400	V1= 4.244 V2= 2.387	0.1717	0.030
6	Butterfly valve	0.30000	400	2.387	0.2000	0.058
7	Non-return valve	0.30000	400	2.387	0.5000	0.145
8	Confluence flow at T	0.30000	D1= 400 D2=1100	V1= 2.387 V2= 0.316	46.0531	0.234
9	Straight pipe(William Hazen) Length= 4.00(m) C=110	0.30000	1100	0.316	0.0262	0.000
10	Confluence flow at T	0.60000	D1= 400 D2=1100	V1= 2.387 V2= 0.631	0.6869	0.014
11	Straight pipe(William Hazen) Length= 4.00(m) C=110	0.60000	1100	0.631	0.0236	0.002
12	Confluence flow at T	0.90000	D1= 400 D2=1100	V1= 2.387 V2= 0.947	0.5228	0.024
13	Straight pipe(William Hazen) Length= 4.00(m) C=110	0.90000	1100	0.947	0.0222	0.004
14	Confluence flow at T	1.20000	D1= 400 D2=1100	V1= 2.387 V2= 1.263	0.4202	0.034
15	Straight pipe(William Hazen) Length= 15.00(m) C=110	1.20000	1100	1.263	0.0213	0.024
16	Ventury flow meter	0.00000	0	0.000	0.0000	0.200
17	Straight pipe(William Hazen) Length=19450.00(m) C=110	1.20000	1100	1.263	0.0213	30.642
18	Ventury flow meter	0.00000	0	0.000	0.0000	0.200
19	Other loss	0.00000	0	0.000	0.0000	0.800
20	Velocity head	1.20000	1100	1.263	1.0000	0.081
	Sum of Hydraulic losses in meter					33.028
	Static head					85.300
	Total Head					(118.328) 120.0



GENERAL NOTES

LEGEND

TREE

COVER SOIL

OUTDOOR LIGHTING

Asphalt Pavement

Fence

DESCRIPTIONS	DWG. NO.
REFERENCE DRAWINGS	

NO.	DATE	DESCRIPTIONS	BY	APP'D
REVISIONS				

ARAB REPUBLIC OF EGYPT

MINISTRY OF DEVELOPMENT,
NEW COMMUNITIES, HOUSING AND PUBLIC UTILITIES

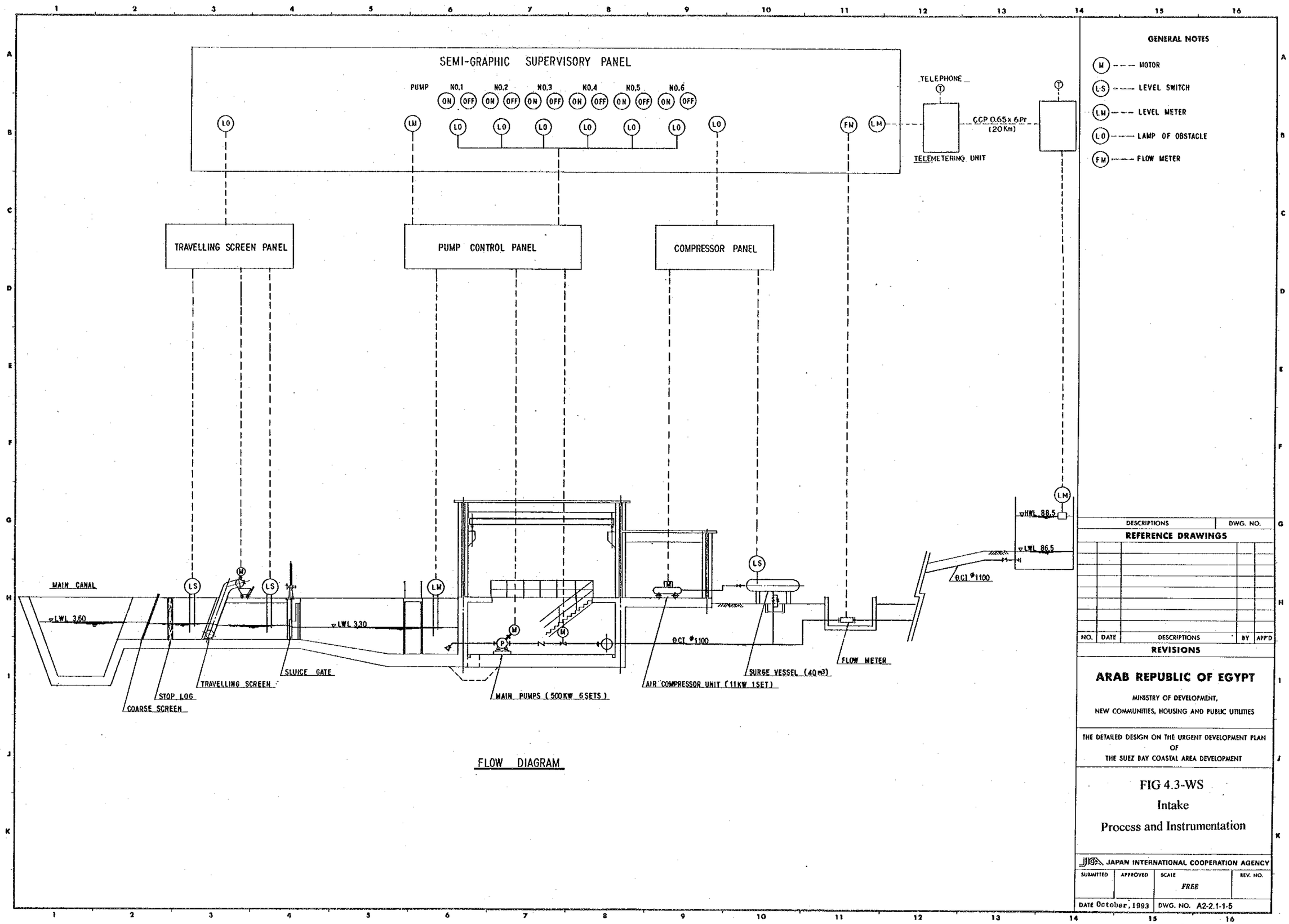
THE DETAILED DESIGN ON THE URGENT DEVELOPMENT PLAN
OF
THE SUEZ BAY COASTAL AREA DEVELOPMENT

FIG. 4.2-WS

LAYOUT PLAN
OF
INTAKE FACILITIES (2)

JICA JAPAN INTERNATIONAL COOPERATION AGENCY

SUBMITTED	APPROVED	SCALE	REV. NO.
		1:200	
DATE October, 1993		DWG. NO. A2-2.1-1-4	



FLOW DIAGRAM

DESCRIPTIONS	DWG. NO.
REFERENCE DRAWINGS	

NO.	DATE	DESCRIPTIONS	BY	APP'D
REVISIONS				

ARAB REPUBLIC OF EGYPT

MINISTRY OF DEVELOPMENT,
NEW COMMUNITIES, HOUSING AND PUBLIC UTILITIES

THE DETAILED DESIGN ON THE URGENT DEVELOPMENT PLAN
OF
THE SUEZ BAY COASTAL AREA DEVELOPMENT

FIG 4.3-WS
Intake
Process and Instrumentation

JICA JAPAN INTERNATIONAL COOPERATION AGENCY

SUBMITTED	APPROVED	SCALE	REV. NO.
		FREE	
DATE October, 1993		DWG. NO. A2-2.1-1-5	

NC-165

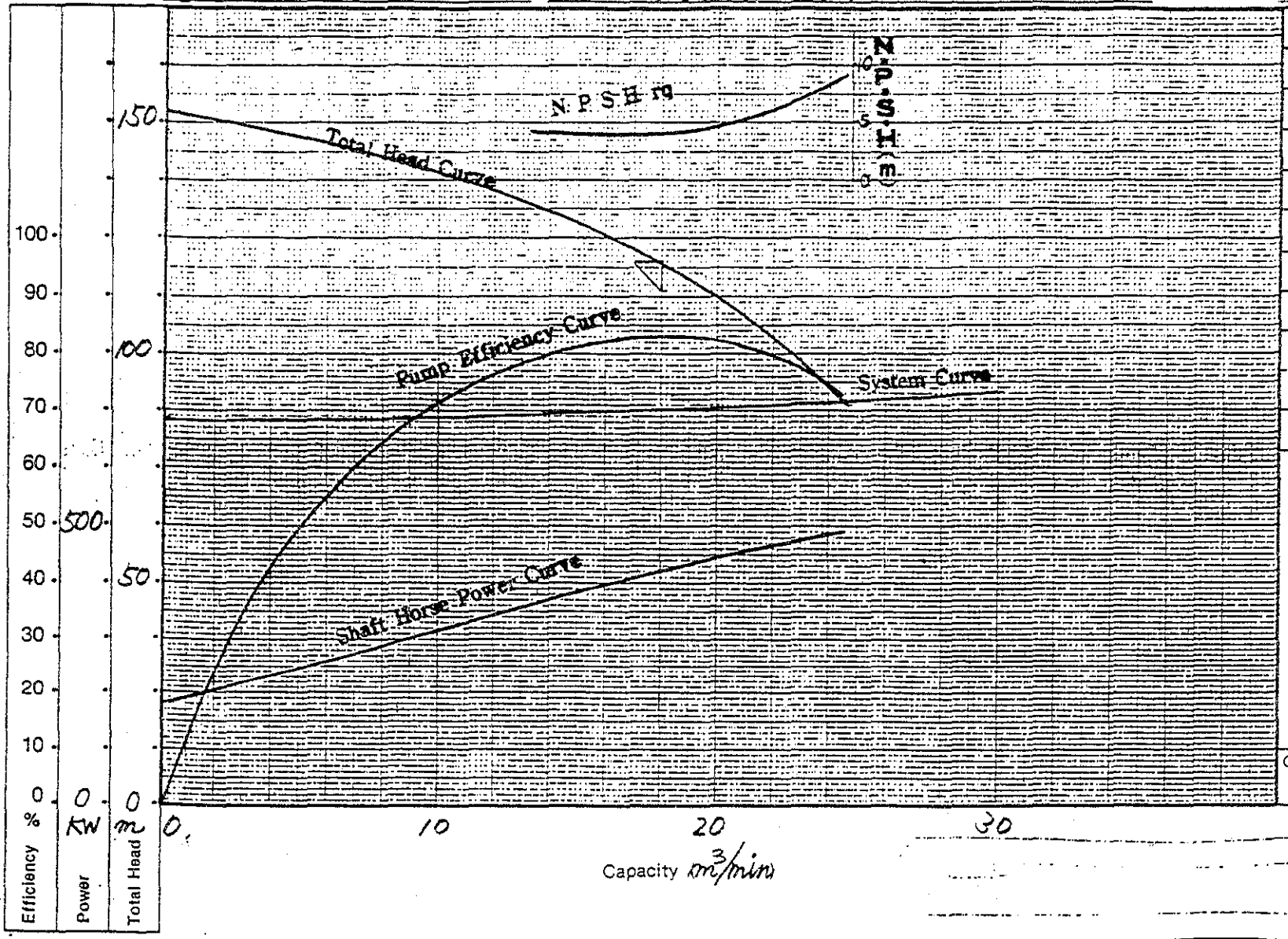
FIG 4.4 -WS

Characteristic Curves of the Pump (Expected)

Customer

Item No.

Type Double Suction Volute Size(Suc) 400 mm (Dis) 300 mm No. of Stages 2



Specification of the Pump	
Liquid.	RIVER WATER
Specific gravity	1.0
Temp.	NOR.
Total Head	120 m
Capacity	18 m³/min
No. of Rev.	980 rpm
Specification of the Prime Mover	
Type	INDUCTION MOTOR
Out put	500 KW
No. of Rev.	SS 1000 rpm
Note	

Order No.	Estimate No.
	PC-2023

Date 16 Sep '93

File No.

3.7-26

(4) Aqueduct

Layout plan of the aqueduct pipeline and the profile are shown in FIG. 4.5-WS and 4.6-WS.

(a) Design Criteria

The main function of aqueduct pipeline is to convey raw water from the intake to WTP. The distance to convey is 19,785 m.

Design flow rate is 100,000 m3/d (1.157 m3/sec) as maximum.

Design flow velocity is less than 2.0 m/sec.

The aqueduct pipeline has no booster pump station, because of complication of operation and maintenance and power supply for booster pump.

The aqueduct design conforms to the Egyptian Code of Water Works 1990 and Ministrial decree 268-1988.

The telemetering wire is laid along the aqueduct pipeline, for telemetering and communication between the WTP and the intake P/S.

Following design criteria is adopted to the aqueduct design:

1) Hydraulic Formula adopted

Hazen-William's formula is principally used for calculation of gravity flow.

2) Constants

Flow factor (C) for pipe	:	Ductile cast iron pipe	110
Head-loss factor (f) for fittings	:	Bend 45 deg.	0.1028
		Sluice valve	0.5000
		Butterfly valve	0.2000

3) Minimum cover for embedding : 1.0 m

4)	Flange rating	:	16 kgf/cm2
5)	Elevation at discharge (WTP)	:	H.W.L. 88.5 m
			L.W.L. 86.5 m
6)	Surplus for Pumping head	:	5.0 m (Egyptian Code)
7)	Constant for Installation		
	Unit weight of cover soil	:	1.8 t/m3
	Load of vehicle	:	20 ton for 4m(L) x 1.75m(W)
			Point load (Front wheel) 2.0t/wheel
			Point load (Rear wheel) 8.0t/wheel
	Linear Load	:	5.0 t/m
	Plane Load	:	350 kg/m2 (Span > 80m)
	Impact factor (i)	:	20 / (50 + Span : m)

(b) Major Specifications

1)	Material of Pipe	:	Ductile cast iron pipe, Minimum tensile strength 420 N/mm2, Minimum elongation less than 7%
2)	Diameter of Pipe	:	ND 1,100
3)	Total Length	:	19,785 m
4)	Joint type of pipe	:	Push-on joint - Minimum deflection allowed for jointing 2 deg.
			Mechanical joint - Minimum tensile strength 400 N/mm2, Minimum elongation less than 5%, Socket depth 130mm

5)	Coating and Lining	:	Outer coating - Epoxy ,t = 0.1mm
		:	Inner lining - Mortar, t = 10mm±3mm
6)	Valves (Class)	:	Working Pressure - 10 kgf/cm2, 16 kgf/cm2
	(Maintenance valve)	:	Butterfly valve, to be install at either 1 km interval or crossings of road and railway.
	(Air valve)	:	Double mouth rapid exhaust type, ND 200 mm, to be installed at peaks when ratio of gradient between inflow and outflow is more than 2:3.
	(Blow-off valve)	:	Sluice valve, to be installed at either bottoms with interval of 2 to 3 km as Minimum or crossings of road and railway.
7)	Polyethylene Encasement	:	19,875 m (equalize to DCIP length)
8)	Ancillary works		
	(Railway crossing)	:	2 sites, Double pipe system for protection, Pipe-jacking method
	(Aque-bridge)	:	1 site, Steel pipe with Air valve
	(Road crossing)	:	10 sites, Double pipe system for protection, Pipe-jacking method or Open trench method
	(Telemetering wiring)	:	Signal conveyance cable, 20 km length

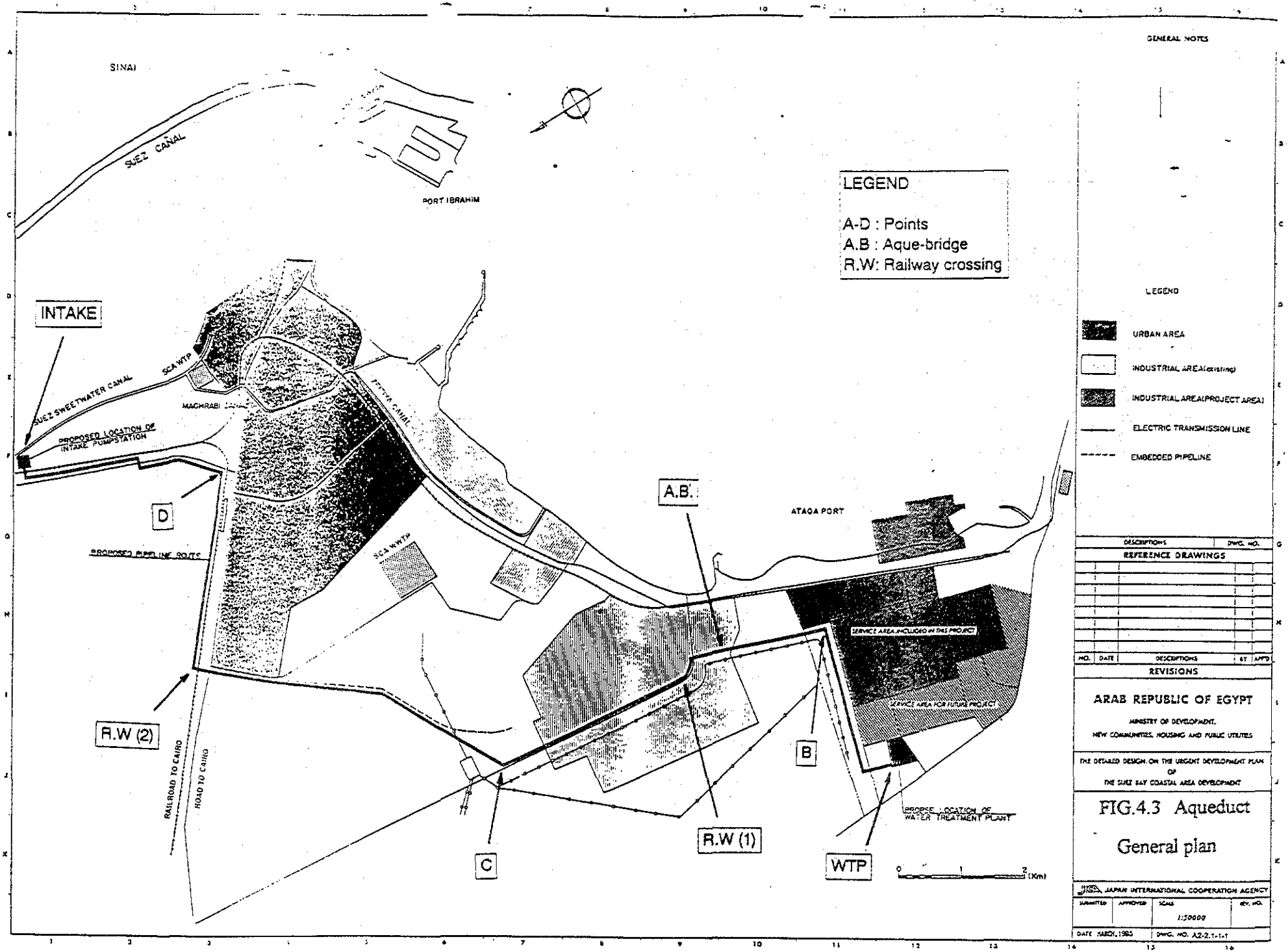
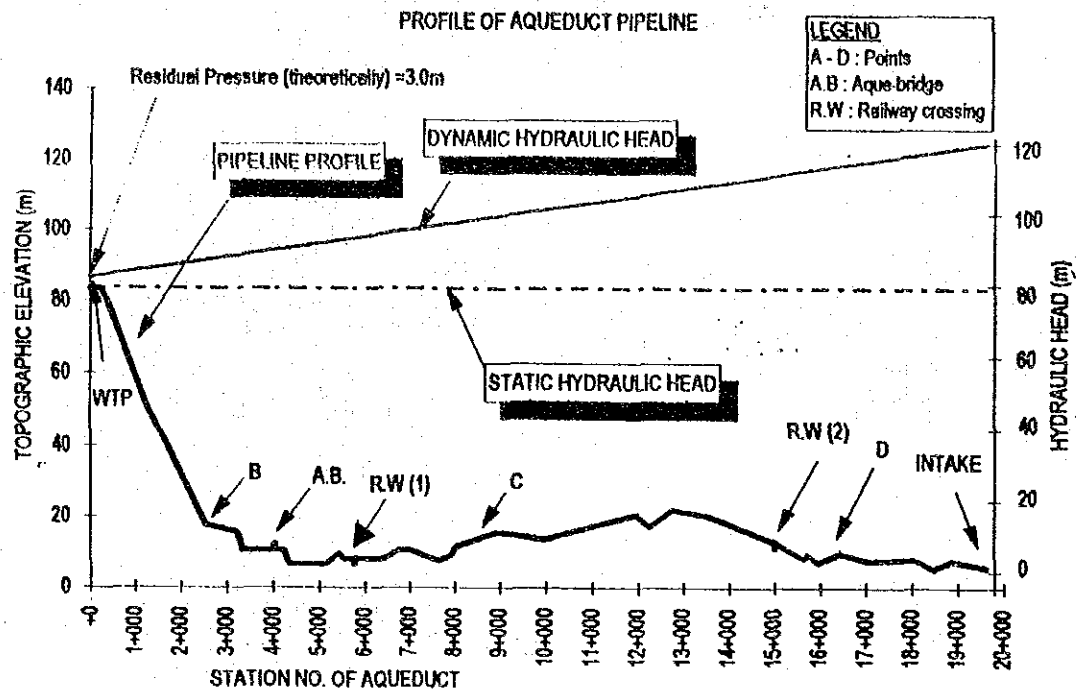
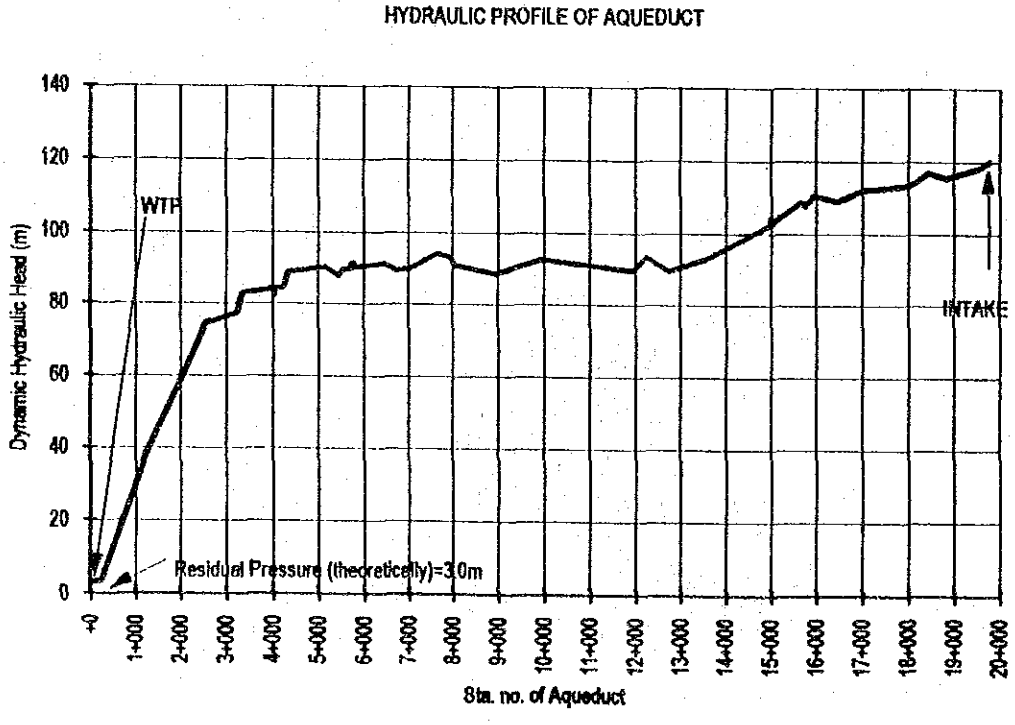

SINAI
SUEZ CANAL
PORT IBRAHIM
LEGEND
A-D : Points
A.B : Aque-bridge
R.W: Railway crossing
INTAKE
SUEZ SWEETWATER CANAL
SCA WTP
MAGHRABI CANAL
PROPOSED LOCATION OF INTAKE PUMPSTATION
D
PROPOSED PIPELINE ROUTE
FAYDA CANAL
SCA WWTP
A.B.
ATAQA PORT
SERVICE AREA INCLUDED IN THIS PROJECT
SERVICE AREA FOR FUTURE PROJECT
B
R.W (2)
RAILROAD TO CAIRO
ROAD TO CAIRO
C
R.W (1)
WTP
PROPOSE LOCATION OF WATER TREATMENT PLANT
0 1 2 (Km)
GENERAL NOTES
LEGEND
URBAN AREA
INDUSTRIAL AREA(existing)
INDUSTRIAL AREA(PROJECT AREA)
ELECTRIC TRANSMISSION LINE
EMBEDDED PIPELINE
DESCRIPTIONS
DWG. NO.
REFERENCE DRAWINGS
NO. DATE DESCRIPTIONS BY APP'D
REVISIONS
ARAB REPUBLIC OF EGYPT
MINISTRY OF DEVELOPMENT, NEW COMMUNITIES, HOUSING AND PUBLIC UTILITIES
THE DETAILED DESIGN ON THE URGENT DEVELOPMENT PLAN OF THE SUEZ BAY COASTAL AREA DEVELOPMENT
FIG.4.3 Aqueduct
General plan
JICA JAPAN INTERNATIONAL COOPERATION AGENCY
SUBMITTED APPROVED SCALE 1:50000 REV. NO.
DATE MARCH, 1983
DWG. NO. A2-2.1-1-1

FIG.4.4 PROFILE OF AQUEDUCT PIPELINE





(5) Water Treatment Facilities

(a) Design Criteria

Layout plan of the water treatment facilities and the process and instrumentation diagram are shown in FIG. 4.5-WS and 4.6-WS.

1) General

Design treated water quality for this project is based on the Egyptian standard for potable water. The design treated water quality is presented in TABLE 4.2-WS.

The Water Treatment Facilities consists of Raw water reservoir, Coagulation and Sedimentation basin, Filter, Treated water reservoir, Filter washing water basin, Draw-off water reservoir, Sludge drying beds, Administration Bldg., Chemical Bldg., Electric Sub-station and their utilities.

The production capacity of the treated water in the plant is 100,000 cu.m per day. It is about 120% of production estimated in the previous master plan[1].

The Water Treatment Facilities shall be operated 24 hours a day. The power source of the plant is fed from commercial power supply lines with 22 KV. The Power is transformed with 380/220V at the Power Sub-station to be constructed in the plant. For emergency, the plant has an emergency generator sets in the Power Sub-station, to keep 50 % production of water against normal operation.

The number of treatment process series are four (25,000 cu.m per day x 4 series). The treatment process from the Raw water reservoir to the Draw-off water reservoir is using gravity flow.

2) Treatment Process

The treatment process, Raw water quality and Design treated water quality are presented briefly below:

---

1 after "Table 1.2.5 and Table 1.2.8, Study on the Development Plan of Suez Bay Coastal Area in the Arab Republic of Egypt, July 1986, vol.III Short Term Plan"

- The raw water is conveyed from the Intake pump station through Aqueduct with about 19 km distance and inflow to the Raw water reservoir. The storage capacity of Raw water reservoir is 4 hour as retention time. This is to buffer the deficit in the emergency. The storage capacity of the Raw water reservoir is approx. 16,800 cu.m.

- The raw water inflows from the raw water reservoir to the coagulation and sedimentation basin. The raw water is disinfected in the receiving basin as pre-chlorination, then Alum as coagulation agent is dosed in the mixing basin. The dosing rate of chlorination and Alum is determined in accordance with indication of the flow meter to be installed at influent of the receiving basin. After these dosing and mixing, the raw water passes coagulation basin with vertical and horizontal baffle flow and settles major coagulated turbid in the sedimentation flow in longitudinal flow. The retention time of each basins are as follows:

a.	Receiving basin	:	4.3 min.
b.	Mixing basin	:	2.8 min.
c.	Coagulation basin	:	31 min.
d.	Sedimentation basin	:	120 min.

- After sedimentation, the water is filted in the Filter which is Rapid Sand Filter. Filting rate is 120 m per day. 1 treatment line has 6 filters (5 duty filters and 1 washing and stand-by filter). Hence, total 24 filters are equipped. The filter operation including operation and washing are controlled by programmed Local Control Panels at site and observed in the central control room of the Administration Bldg. The filter washing interval is 36 hours as Maximum. The filters washing uses air blow and backwash water. The backwash water is discharged from the Filter washing water basin.

- The Filter washing water basin has storage capacity 700 cu.m for 3 backwashing. The washing water is recharges from the Treated water reservoir by pumping.

- The treated water is stored in the Treated water reservoir, then distribute to the service area by gravity. The storage capacity of the Treated water reservoir is 4 hours as retention times, means 17,000 cu.m. Therefore, total 8 hours allowance (Raw water reservoir and Treated water reservoir) is scheduled in the plant, to maintain an emergency situation.

- The water for domestic and process use for the plant is distributed from the Treated water reservoir by pumping.

- The sludge draw-off is gathered into the Draw-off water reservoir which has capacity of 3,240 cu.m (about 12 hours storage). The super-natant of the draw-off water (expected SS 50 mg/l) is collected and distribute to the service area for irrigation and planting use. The sub-natant is discharged to the Sludge Drying Beds by pumping and dewatered by evaporation. The dewatered sludge is scraped by man-power and disposed to the desert. The 1 treatment series (25,000 cu.m per day) is allotted 6 drying bed (5 duties and 1 cleaning and stand-by).

- The chemical dosing equipment which are chlorinator and Alum dosing equipment, is installed in the Chemical Bldg.

- Previous alternative study to choose the type of treatment facilities are annexed as ATTACHMENT 3-WS.

(b) Major Specifications of Water Treatment Facilities

1) General

Number of Treatment series	:	25,000 m3/day x 4 series
Water mass balance	:	(see FIG.4.7-WS)
Sludge generation	:	(see FIG.4.7-WS)
Hydraulic Profile in treatment process		(see FIG.4.8-WS)

2) Raw water reservoir

Retention time	:	4 hours
Storage	:	4,167 m3 x 4 series = 16,667 m3
Water level in the reservoir	:	H.W.L. 88.5m, L.W.L. 86.5m
Valves : (inlet)		ND 600 butterfly valve with manual apparatus

(outlet)		ND 700 butterfly valve with manual apparatus
Flow meter	:	ND 700 short Venturi tube type
Pipes	:	ND 400, 600, 700 , mild steel

3) Coagulation and Sedimentation Basin

Composition	:	Receiving basin, Mixing basin, Coagulation basin, Sedimentation Basin
Retention time	:	as mentioned before
Influent level	:	85.0 m
Total head loss	:	1.33 m
Dosing schedule	:	Pre-Chlorination in Receiving basin Alum dosing in Mixing basin (refer to Chemical Bldg.)
Type of Coagulation basin	:	Tapered flocculation system
Flow rate	:	at Coagulation 0.3 to 0.6 m/sec
		at Sedimentation 0.094 m/sec
Flow meter	:	Overflow notch with Flow indicator (stainless steel)
G value for Flash mixer	:	250
Flash mixer	:	4 sets of Vertical shaft turbine type, Rapid mixer 5.5kW
G-T value for Coagulation basin	:	$\geqq$100,000
Inlet gate valve	:	8 sets of ND 500 Out-screw valve with manual apparatus
Baffle plate	:	4 basins x 60 pcs x 1m(W) x 4.5m(H), Resin board

Sludge scraper	:	8 units of Linked-belt type, Submerged collector, Traveling speed 0.2m/min., 1.5 kW
Collection trough	:	Orifice type overflow trough, Fiber reinforced plastic, 350 (W) x 350 (D) x 4,000 mm (L)
Collection pipes	:	ND 250, mild steel
Isolating valves	:	ND 250, Sluice valve for Sludge draw-off with manual apparatus

4) Filter

Number of Filter beds	:	6 bed in one series x 4 series, 5 duty filting beds and 1 washing and stand-by bed in one series.
Filting rate	:	120 m3/m2•day
Dimension of Filting bed	:	6 x 7 m
Influent level of Filter	:	83.15m
Total head loss	:	3.75 m
Filter washing	:	Air blow + Backwashing
Filter Washing Interval	:	1 time/36 hrs (see FIG.4.9-WS)
Water required for Backwashing	:	336 m3/time/bed
Filted water collection system	:	Perforated block type, Plastic.
Filter media	:	0.6 mm silica sand, Uniformity 1.5, t=800 mm with 2 to 20 mm gravel, T=200 mm
Overflow drain trough for Backwashing	:	168 units, Fiber reinforced plastic

Blower		:	8 sets, Roots blower, 42m3/min., 0.35 kgf/cm2, 45 kW, Pressure release valve, Silencer for Suction and Discharge
Valves	(Influent)	:	24 sets x ND 350 butterfly valve with motor drive apparatus
	(Effluent)		48 sets x ND 350 butterfly valve with motor drive apparatus
	(Air blow)		24 sets x ND 200 sluice valve with motor drive apparatus
	(Drain)		24 sets x ND 200 sluice valve with motor drive apparatus
	(Washing drain)		24 sets x ND 800 sluice valve with motor drive apparatus
Flow meter	(Filted water)	:	24 sets x ND 350 venturi type
	(Backwash)	:	1 set x ND 700 venturi type
Pipes	(Influent)	:	ND 350, mild steel
	(Effluent)	:	ND 350, mild steel
	(Air blow)	:	ND 200, mild steel
	(Backwash)	:	ND 700, Mild steel
	(Drain)	:	ND 200, mild steel
	(Washing drain)	:	ND 900, mild steel

5) Treated water reservoir

Retention time	:	4 hours
Storage	:	4,167 m3 x 4 series = 16,667 m3
Water level in the reservoir	:	H.W.L. 79.0m, L.W.L. 75.0m

Valves	(inlet)	:	ND 700 butterfly valve with manual apparatus
	(outlet)	:	ND 700 butterfly valve with manual apparatus
Flow meter		:	ND 700 short Venturi tube type
Water supply pump		:	12 units, Horizontal shaft centrifugal pump, 2.8m3/min., 25 m total head, 18.5 kW

6) Sludge draw-off reservoir

Number of basins	:	2 basins/series x 4 series = 8 basins
Storage capacity	:	405 m3/basin ≒washing drain water of filter per time (336 m3) + (Drain water of Sedimentation basin and Raw water reservoir)
Suspended Solid of Influent	:	892 mg/l
Suspended Solid of Super natant	:	50 mg/l
Suspended Solid of Sub natant	:	20,000 mg/l
Sludge disposal Pump	:	8 sets x Horizontal shaft centrifugal slurry pump, 0.6 m3/min. x 12 mH, 3.7 kW
Pipes (Effluent, Super-natant)	:	ND 200, mild steel
(Effluent, Sub-natant)	:	ND 150, mild steel
(Influent)	:	ND 900, mild steel

7) Sludge drying beds

Number of Drying beds	:	6 beds/series x 4 series
		(5 duties and 1 clearing)
Suspended Solid of Influent	:	20,000 mg/l (2%)

Suspended Solid aiming	:	400,000 mg/l (40%)
Trans-evaporation rate	:	8 mm/day
Quantity of Sludge generated	:	2.6 m3/d
		(at 100,000m3/d production)
Dimension of bed	:	20m (W) x 40m (L) x 0.6m (D) per bed
Pipes	:	ND 150, mild steel

8) Filter washing water reservoir

Storage capacity	:	336m3/time/bed x 3 beds = 1008 m3
Discharge rate	:	0.8 m3/m2/min. for Backwashing

9) Dosing Equipment in Chemical Bldg.

Dosing schedule (1) Chlorination

Dosing rate	Max.(mg/l)	Ave.(mg/l)	Basin
Pre-Chlorination	10	4	Receiving basin of Coagulation and Sedimentation basin
Post-Chlorination	3	2	Treated water reservoir

Dosing capacity	Max.(kg/h)	Ave.(kg/hr)
Pre-Chlorination	41.6	16.8
Post-Chlorination	12.4	8.4

- Required water for Chlorination 290l/min.. (6 kgf/cm2)

Dosing schedule (2) Coagulation agent (Alum)

	Max.	Ave	Basin
Dosing rate	60mg/l	40mg/l	Mixing basin of Coagulation and Sedimentation Basin

Dosing capacity	35.2m3/d	23.6m3/d
Alumina content		13 %
Concentration of dosing solution		18 %
Capacity of the dissolved reservoir		2 days

Chlorination

Chlorinator	:	10 sets, (5 for Pre-chl., 5 for Post-chl.), Vacuum type solution feed gas Chlorinator,
		(Pre-Chlorination) 15 kg/hr
		(post-Chlorination) 5 kg/hr
Container weight scale	:	4 units, Load cell type with digital indicator, full scale 4,000 kgw
Container lifting tool	:	1 set, Motor drive monorail crane, 2.5ton
Injector booster pump	:	8n sets x Centrifugal pump, 350 l/min. x 60 mH, 7.5 kW
Chlorine gas neutralization units		
(Neutralization speed)	:	500kg/hr as Chlorine gas
	:	1 set x 16 m3 Caustic-Soda tank, Rubber lining tank
	:	2 units x Tower type neutralization tank
	:	2 sets x Caustic-Soda pump, 450 l/min. x 15 mH
	:	2 sets x Centrifugal blower, 45 m3/min. x 175 mmAg, 3.7 kW
	:	10 sets of Leakage detectors

	:	2 sets x Centrifugal chemical drain pump, 100l/min.. x 10 mH, 0.75 kW

Alum dosing

Alum solution tank	:	8 tanks x Rectangle FRP tank, 18 m3
Alum metering pump	:	6 sets x Diaphragm type metering pump, 370 l/hr x 10 kgf/cm2, 0.4 kW with Air chamber, Release valve, Pressure gage.
	:	8 sets x Alum mixer, Vertical shaft mixer, 3.7 kW
	:	1 set x Manual chain block, 1 ton x 3mH

10) Electrical

The single line diagrams of the Intake and WTP are shown in FIG.4.10-WS

11) Power Supply

The power supply diagram is shown in FIG.4.11-WS.

12) Instrumentation

The instrumentation diagram is shown in FIG.4.12-WS. The operation method is described in 5. Operation and Maintenance.

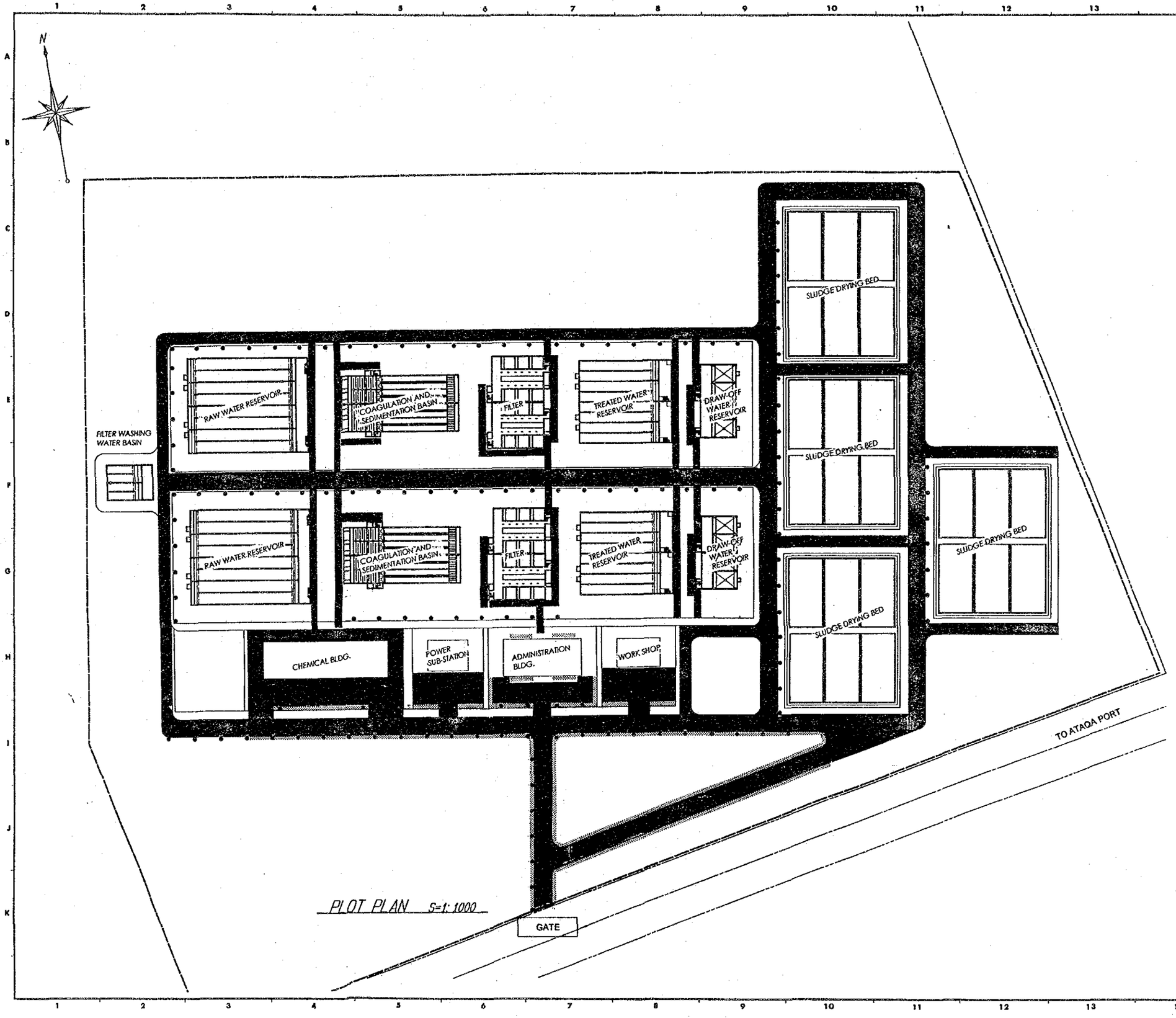
TABLE 4.2-WS Treated Water Quality

(Unit : mg/l except for pH and where noted.)

Item	Limitation
Color (Platinum-Cobalt units)	50
Turbidity (NTU)	5
Taste	shall be acceptable
Odor	shall be acceptable
Lead	0.10
Arsenic	0.05
Cyanide	0.05
Cadmium	0.01
Selenium	0.01
Mercury	0.001
Barium	shall not be included
Chromium	shall not be included
Fluoride	0.80
Nitrite	45
Total Dissolved Solids	1500 [2] 500 [3]
Iron	1.00
Manganese	0.50
Copper	1.50
Zinc	15
Calcium	200
Magnesium	150
Total Hardness as CaCO3	500
Chloride	600
Sulfate	400
Phenol	0.002
pH	6.5 - 9.2
Mineral Oil	shall not be included
Hydrogen Sulfide	shall not be included
Anionic Detergents/Forming Agents	shall not be included
Gross alpha activity (pCi/l)	3
Gross beta activity (pCi/l)	30

2 Egyptian Standard for Drinking Water.

3 Recommendation of NOPWASD



PLOT PLAN S=1:1000

GENERAL NOTES

LEGEND

- Asphalt Pavement
- Cover Soil and Planting
- Out-door Lighting
- Fence

DESCRIPTIONS	DWG. NO.
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THE DETAILED DESIGN ON THE URGENT DEVELOPMENT PLAN
OF
THE SUEZ BAY COASTAL AREA DEVELOPMENT

FIG.4.5-WS WTP

General Layout

JICA JAPAN INTERNATIONAL COOPERATION AGENCY

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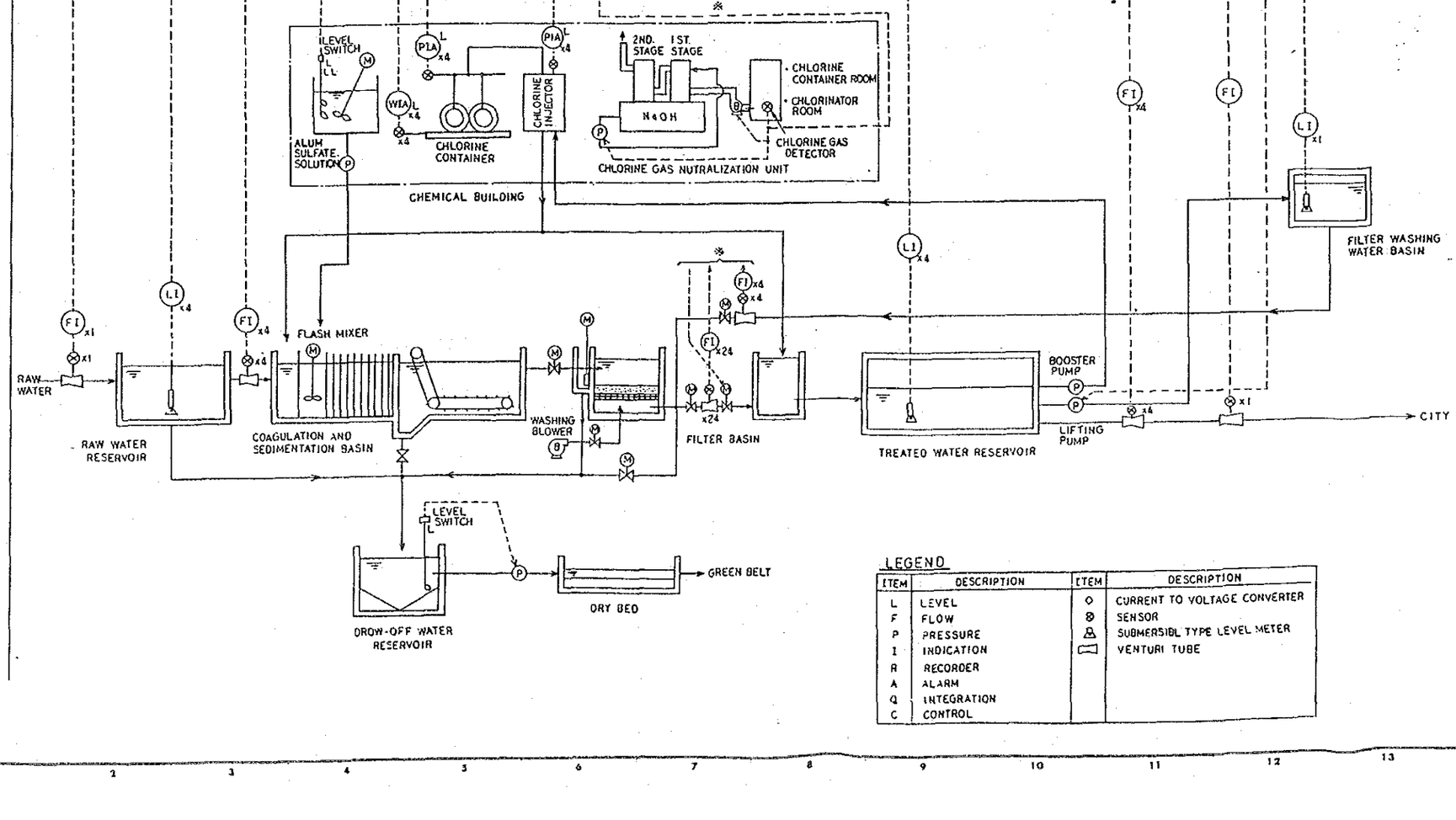
DATE OCT. 1993 | DWG. NO.: A2-2.3-1-1 (2)

NO.	1	2	3	4	5	6	7	8	9	10	11	12	13
NAME OF LOOP	RAW WATER FLOW (1)	WATER LEVEL OF RAW WATER RESERVOIR	RAW WATER FLOW (2)	ALUM SULFATE SOLUTION TANK LEVEL ALARM	CHLORINE CONTINER WEIGHT ALARM	CHLORINE GAS HEADER PRESSURE ALARM	CHLORINE LEAKAGE ALARM	FILTED WATER FLOW	BACK WASH WATER FLOW	WATER LEVEL OF TREATED WATER RESERVOIR	TREATED WATER FLOW (1)	TREATED WATER FLOW (2)	WATER LEVEL OF FILTER WASHING BASIN
CONTROL ROOM	FIR x1	LIR x4	FIR x4	LA H L x4	LA L LL x2	WA L x4	PA L x8	CLA x2					
	12 POINT RECORDER							12 POINT RECORDER			6 POINT RECORCER		
DATA WAY	FQ x1		FQ x4					FQ x4	FQ x4	LA H L x4	FQ x4	FQ x1	LA H L x1
LOCAL CONTROL PANEL	FI x1 FQ x1	LI x4 LA H L x4	FI x4 FQ x4	LA L LL x2	WA L x4	PA L x8	CLA	FIC x24 FQ x24	FI x4 FQ x4	LI x4 LA H L x4	FI x4 FQ x4	FI x1 FQ x1	LI x1 LA H L x1
FIELD	FI x1	LI x4	FI x4								FI x4	FI x1	LI x1



LEGEND

ITEM	DESCRIPTION	ITEM	DESCRIPTION
L	LEVEL	◇	CURRENT TO VOLTAGE CONVERTER
F	FLOW	⊗	SENSOR
P	PRESSURE		SUBMERSIBL TYPE LEVEL METER
I	INDICATION		VENTURI TUBE
R	RECORDER		
A	ALARM		
Q	INTEGRATION		
C	CONTROL		

GENERAL NOTES

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FIG.4.12-WS

INSTRUMENTATION FLOW DIAGRAM

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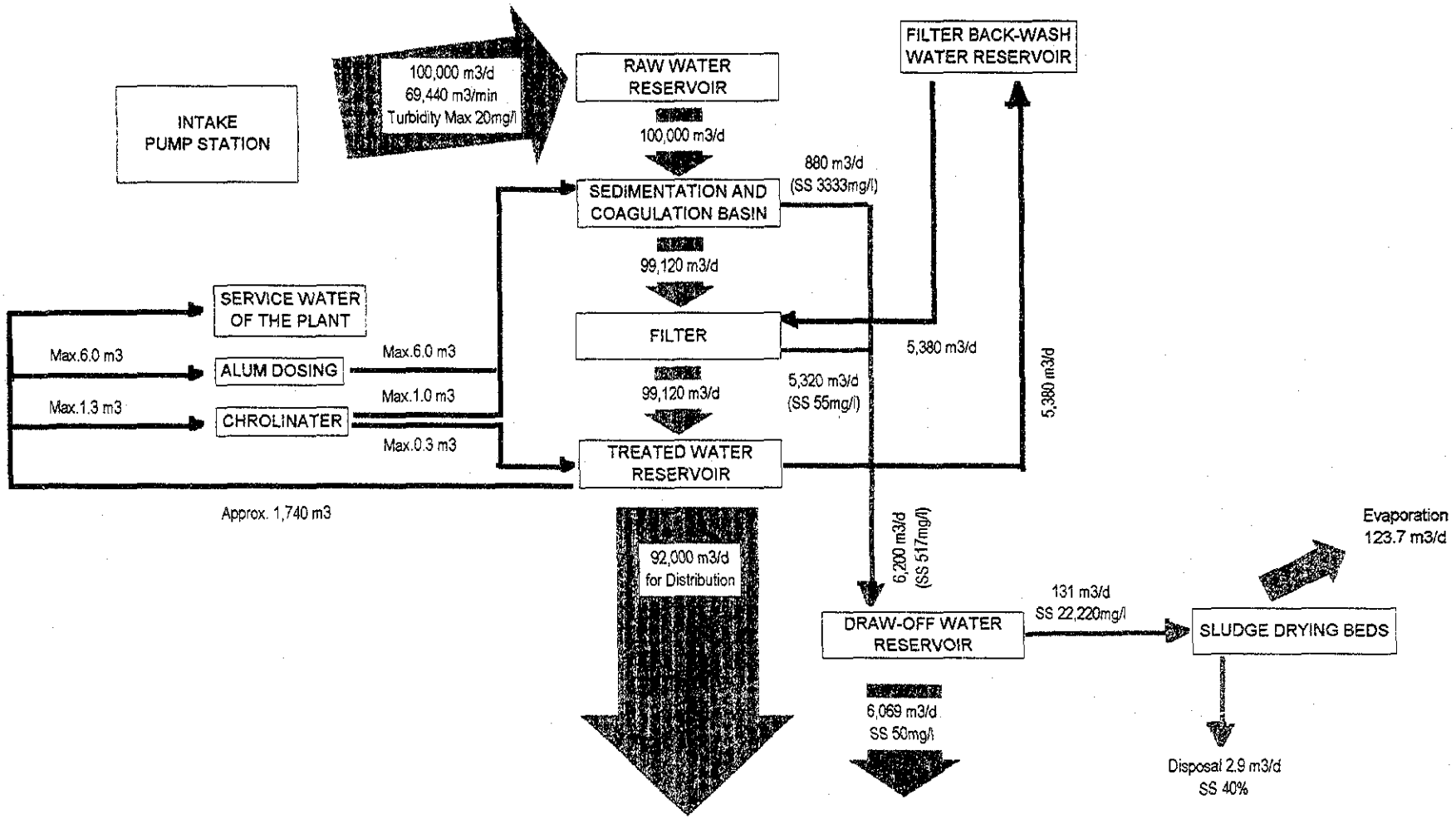
		FREE	
DATE MARCH, 1993		DWG. NO. A2-2.3-3-1	

FIG. 4.7-WS WATER MASS BALANCE DIAGRAM



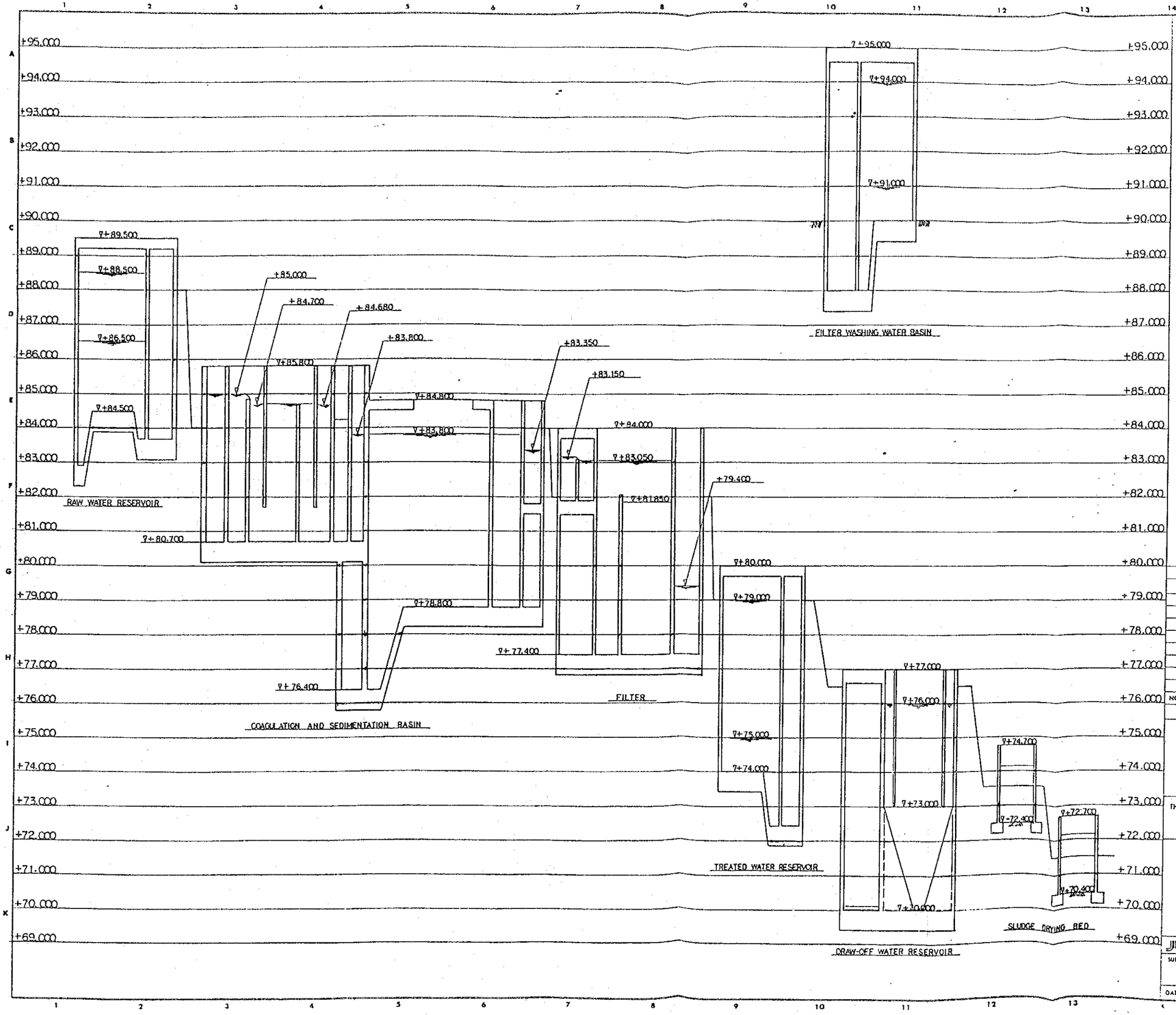


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FIG.4.8-WS WTP

HYDRAULIC PROFILE

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		FREE	
DATE MARCH, 1983		DWG. NO. A2-2.3-1-5	

FIG.4.9-WS FILTER WASHING PROGRAM (3 DAYS PER 1 CYCLE)

W : Washing
R : Stand-by

(1) First Day

FILTER POND NO.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
1	28	29	30	W	R	R	R	R	R	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
2	22	23	24	25	26	27	28	29	30	W	R	R	R	R	R	1	2	3	4	5	6	7	8	9
3	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	W	R	R	R	R	R	1	2	3
4	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	W	R	R
5	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27
6	R	R	R	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21

(2) Second Day

FILTER POND NO.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
1	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	W	R	R	R	R	R	1	2	3
2	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	W	R	R
3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27
4	R	R	R	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21
5	28	29	30	W	R	R	R	R	R	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
6	22	23	24	25	26	27	28	29	30	W	R	R	R	R	R	1	2	3	4	5	6	7	8	9

(3) Third Day

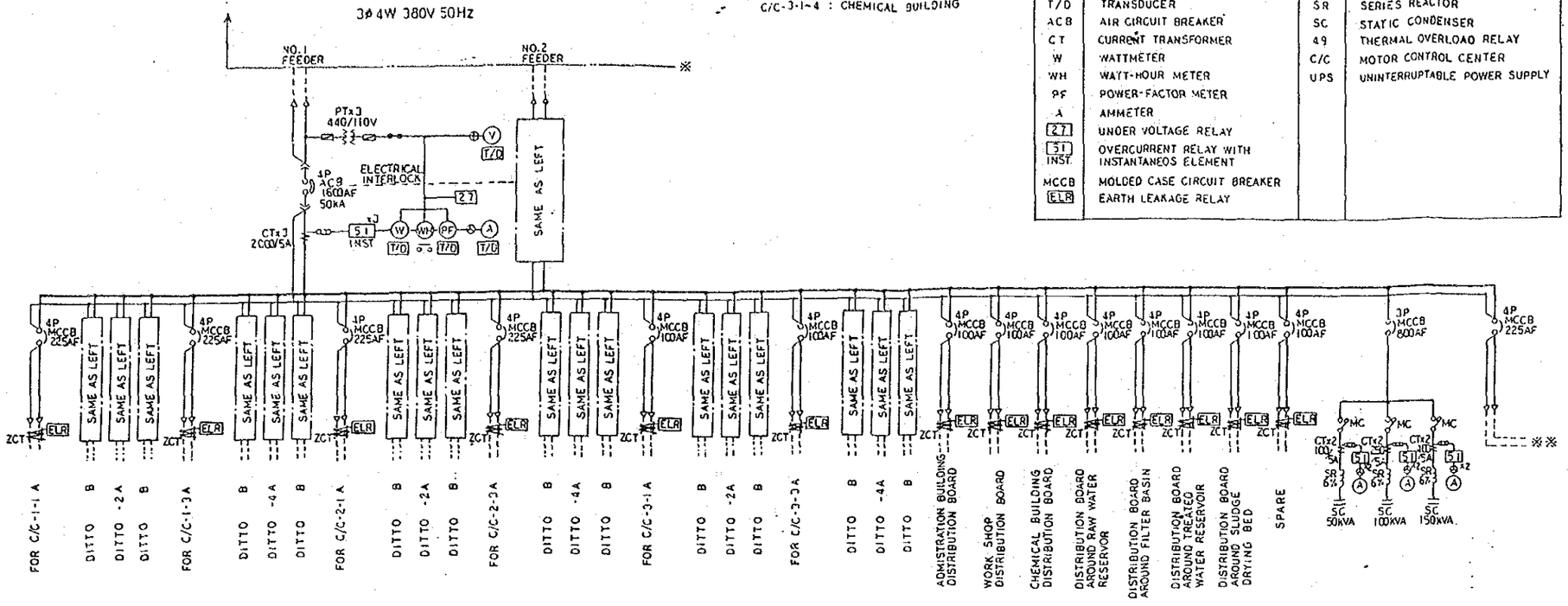
FILTER POND NO.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
1	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27
2	R	R	R	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21
3	28	29	30	W	R	R	R	R	R	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
4	22	23	24	25	26	27	28	29	30	W	R	R	R	R	R	1	2	3	4	5	6	7	8	9
5	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	W	R	R	R	R	R	1	2	3
6	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	W	R	R

C/C-1-1~4 : FILTER BASIN
C/C-2-1~4 : TREATED WATER RESERVOIR
C/C-3-1~4 : CHEMICAL BUILDING

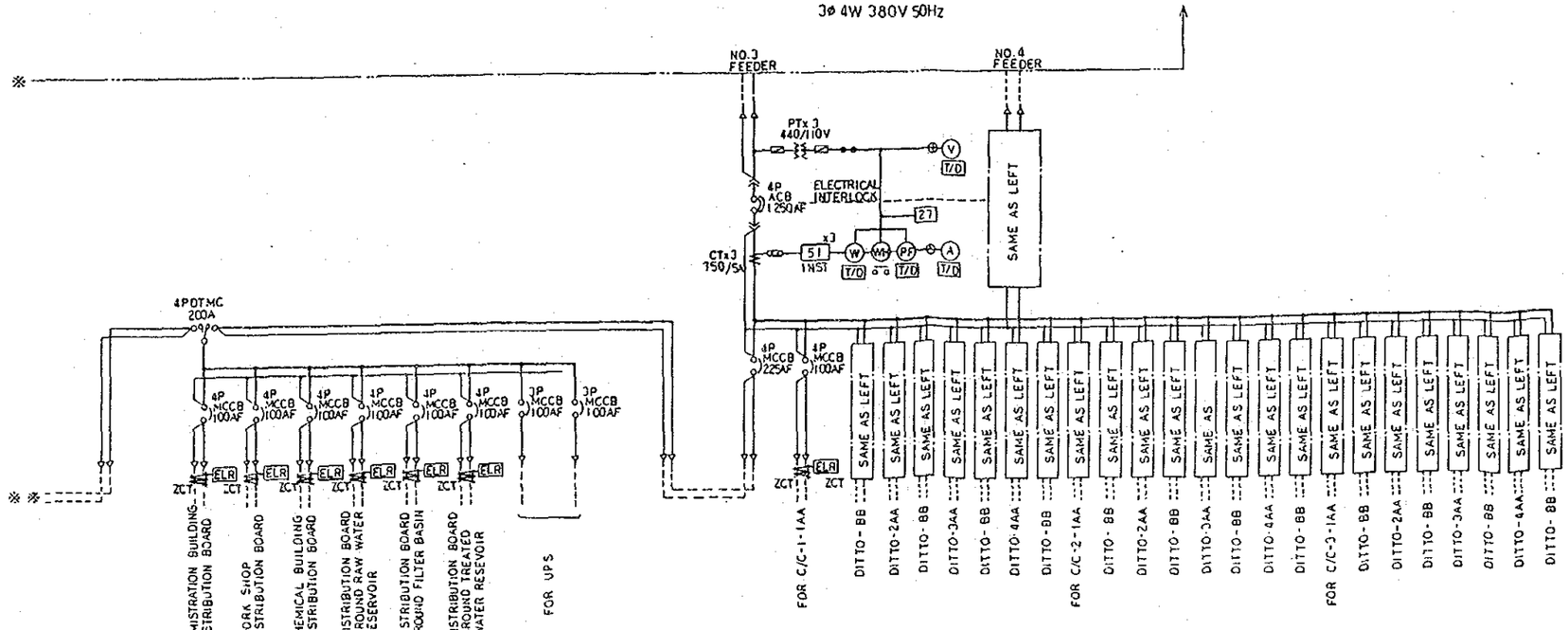
LEGEND

ITEM	DESCRIPTION	ITEM	DESCRIPTION
PT	POTENTIAL TRANSFORMER	MC	MAGNETIC CONTACTOR
V	VOLTMETER	51	OVERCURRENT RELAY
T/D	TRANSDUCER	SR	SERIES REACTOR
ACB	AIR CIRCUIT BREAKER	SC	STATIC CONDENSER
CT	CURRENT TRANSFORMER	49	THERMAL OVERLOAD RELAY
W	WATTMETER	C/C	MOTOR CONTROL CENTER
WH	WATT-HOUR METER	UPS	UNINTERRUPTABLE POWER SUPPLY
PF	POWER-FACTOR METER		
A	AMMETER		
27	UNDER VOLTAGE RELAY		
51 INST.	OVERCURRENT RELAY WITH INSTANTANEOS ELEMENT		
MCCB	MOLDED CASE CIRCUIT BREAKER		
ELR	EARTH LEAKAGE RELAY		

(22kV/380V SUBSTATION)
3φ 4W 380V 50Hz



380V ENGINE GENERATOR IN SUBSTATION
3φ 4W 380V 50Hz



GENERAL NOTES

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FIG.4.10-WS

SINGLE LINE DIAGRAM
(FOR 380V INCOMING
AND DISTRIBUTION)

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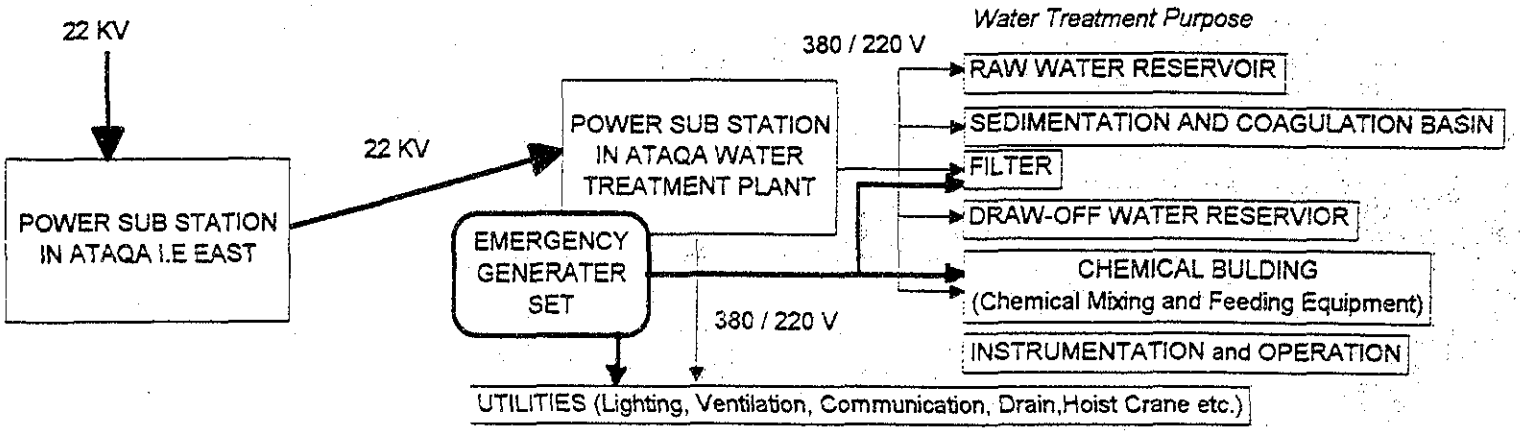
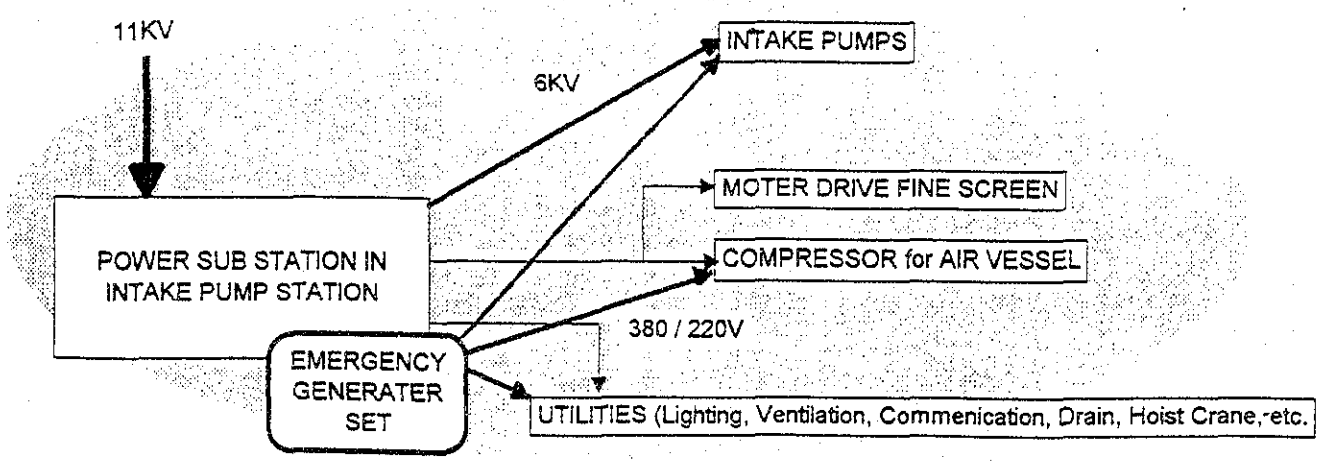
		FREE	
DATE MARCH, 1993		DWG. NO. A2-2.3-3-2	

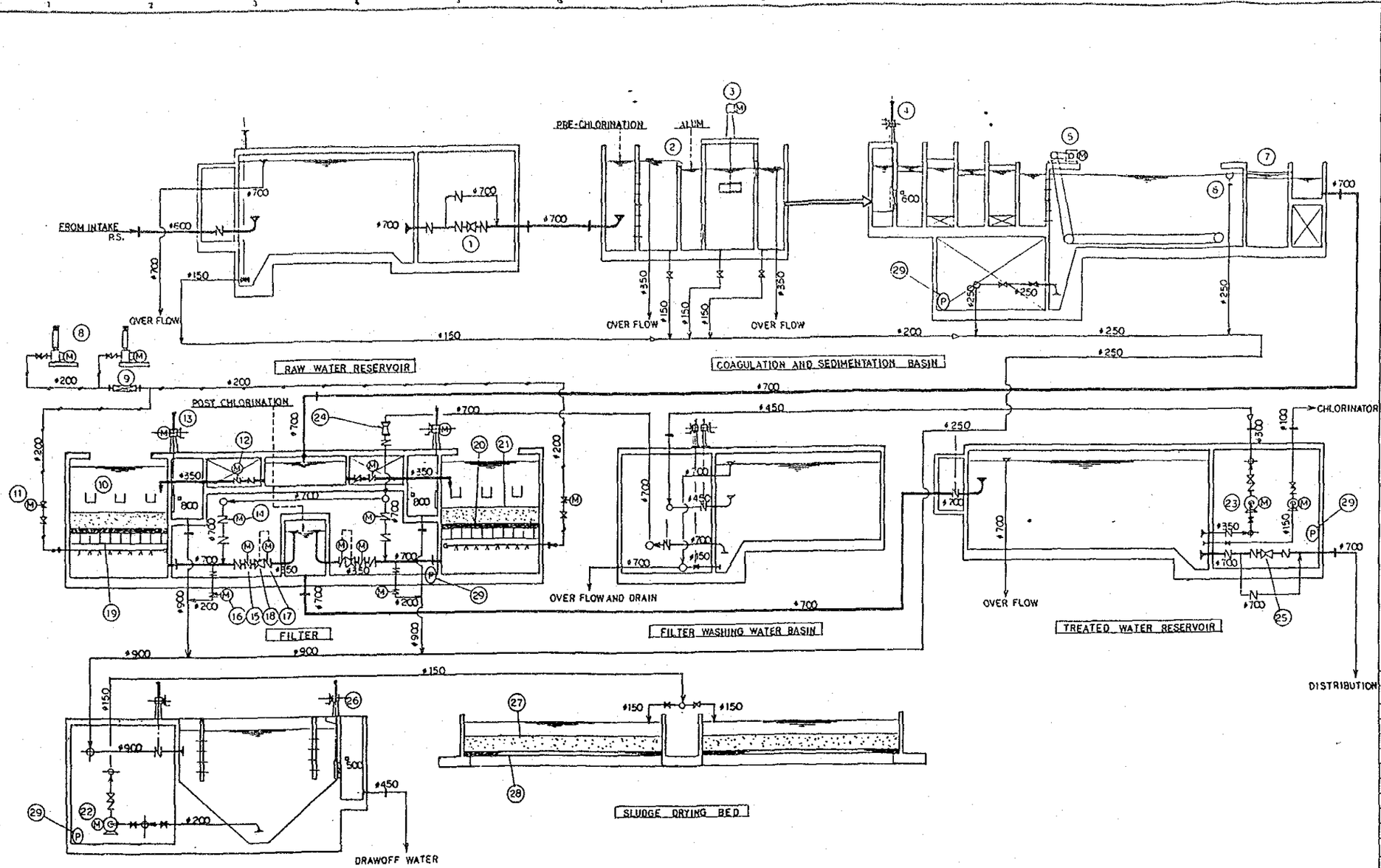
FIG.4.11-WS **POWER SUPPLY DIAGRAM**

(1) WATER TREATMENT PLANT



(2) RAW WATER INTAKE FACILITIES





GENERAL NOTES

	BUTTERFLY VALVE
	SLUICE VALVE
	VENTURI PIPE
	AIR PIPE
	FEEDING EQUIPMENT OF CHEMICALS PIPE

EQUIPMENT NO.	①	②	③	④	⑤	⑥	⑦	⑧	⑨	⑩	⑪	⑫	⑬	⑭
NAME	RAW WATER FLOW METER	WEIR	FLASH MIXER	INFLUENT GATE	SLUDGE SCRAPER	SCUM SKIMER MANUAL PIPE SKIMER	EFLUENT TROUGH	WASHING BLOWER	OUTLET SILENCER	WASH OUTLET TROUGHS	AIR VALVE MOTER DRIVEN GATE VALVE	INLET VALVE MOTOR DRIVEN BUTTERFLY VALVE	WASH OUTLET GATE	WASHING VALVE MOTOR DRIVEN BUTTERFLY VALVE
TYPE	VENTURI TUBE	WHOLE WIDTH WEIR	TURBINE TYPE	MANUAL	LINK BELT	PIPE SKIMER	PERFORATED TYPE	ROOTS		OVER FLOW WEIR			MOTOR GATE	
CAPACITY	φ700	W=3.5m		□ 600		φ250	WIDTH=300	$42 m^3/M \times 0.35 kg/cm^2$	φ200	WIDTH=300	φ200	φ350	□ 800	φ700
POWER SOURCE & MOTOR	—	—	$3\phi\ 380V\ 50HZ\ 5.5kw$	—	1.5^{kw}	—	—	45^{kw}	—	—	0.4^{kw}	0.4^{kw}	0.75^{kw}	0.75^{kw}
TOTAL QUANTITIES (STAND BY)	4	4	4	8	8	16	48	8 (4)	4	168	24	24	24	24
ACCESSORY	INDICATOR		STAGE	MANUAL OPERATED TABLE									MOTOR OPERATED TABLE	

EQUIPMENT NO.	⑮	⑯	⑰	⑱	⑲	⑳	㉑	㉒	㉓	㉔	㉕	㉖	㉗	㉘	㉙
NAME	OUTLET VALVE	DRAIN VALVE	AUTOMATIC FLOW CONTROL VALVE	CLEAR WATER FLOW METER	COLLECTION UNIT	FILTER GRAVEL	FILTER SAND	SLUDGE DISPOSAL PUMP	LIFTING PUMP	WASH WATER SERVICE FLOW METER	CLEAR WATER FLOW METER	SUPERNATANT WATER GATE	SAND BED	GRAVEL	FLOOR DRAIN PUMP
TYPE	MOTOR DRIVEN BUTTERFLY VALVE	"	"	VENTURI TUBE	PERFORATED BLOCK	2–20mm	SILICA SAND	SLURRY PUMP	VOLUTE PUMP	VENTURI TUBE	VENTURI TUBE	MANUAL			IMMERSION PUMP
CAPACITY	φ350	φ200	φ350	φ350	$42 m^3/SET$	$8.4 m^3/SET$	$33.6 m^3/SET$	$0.6 m^3/M \times 12mH$	$2.8 m^3/M \times 25mH$	φ700	φ700	□ 500	$800 m^2 \times 6$ SET	$800 m^2 \times 6$ SET	$0.1 m^3/M \times 10mH$
POWER SOURCE & MOTOR	0.4^{kw}	0.4^{kw}	0.4^{kw}	—	—	—	—	3.7^{kw}	18.5^{kw}	—	—	—	—	—	0.75^{kw}
TOTAL QUANTITIES (STAND BY)	24	24	24	24	36 SETS	36 SETS	36 SETS	8 (4)	12 (4)	4	4	8	4	4	32 (16)
ACCESSORY										INDICATOR	INDICATOR	MANUAL OPERATED TABLE			

DESCRIPTIONS	DWG. NO.
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FIG.4.6-WS WTP

Process and Instrumentation

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3.7-50		FREE	

NO. A2-2.3-1-4

(6) Treated-water and Draw-off water Distribution Network

Coverage area of distribution systems are shown in FIG. 4.13-WS to 4.16-WS.

(a) Design Criteria

Residual Hydraulic Head

(Treated-water Distribution Network)	:	Minimum 15m
(Fire Hydrant)	:	Minimum 20m
Design Coverage of Hydrant	:	Radius 50m as Maximum, (Hydrants are installed in pipes of over ND200.)
Material	:	
(Over ND 250)		Ductile cast iron pipe
(Less than ND 300)		PVC
Coefficient : C	:	
(Ductile cast iron pipe)		110
(PVC pipe)		120
Terminals	:	to be installed stop valve (sluice valve with cap.)

(b) Major Specifications

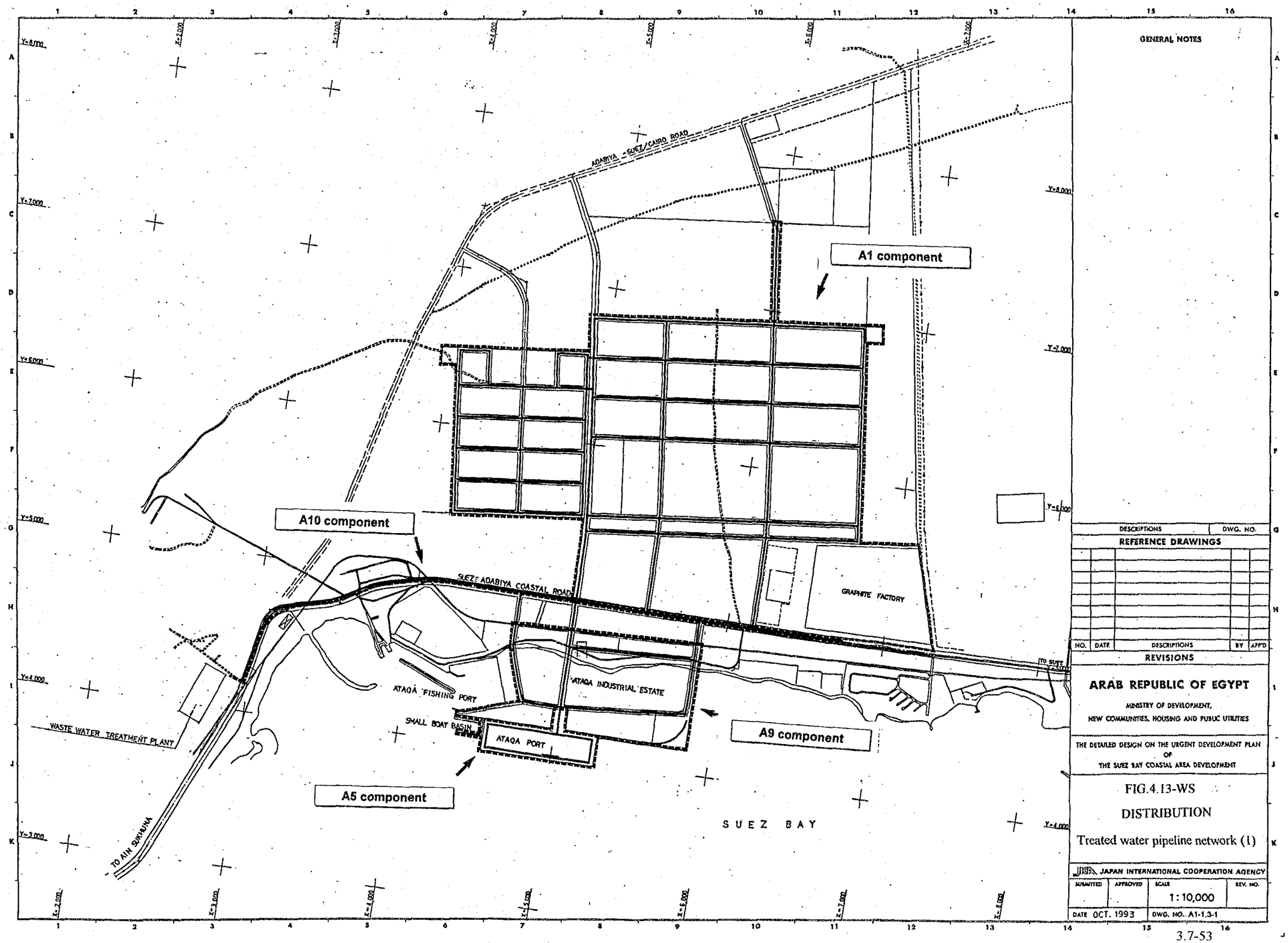
1) Material of Pipe :

(Ductile cast iron pipe)	Over ND 350, Minimum tensile strength 420 N/mm2, Minimum elongation less than 7%

	(PVC pipe)		Less than ND 300, JIS K-6741 and JIS K-6742 or equivalent, 10 kgf/cm2
2)	Diameter of Pipe	:	ND 100 to 1,200
3)	Hydraulic Condition	:	
	(Treated water distribution)		see FIG.4.17-WS to 4.20-WS
	(Draw-off water distribution)		see FIG.4.21-WS to 4.24-WS

Flow calculation sheet is annexed as ATTACHMENT 4-WS.

4)	Joint type of pipe (DCIP)	:	
	(Push-on joint)		Minimum deflection allowed for jointing 2 deg.
	(Mechanical joint)		Minimum tensile strength 400 N/mm2, Minimum elongation less than 5%, Socket depth 130mm
	Joint type of pipe (PVC)	:	Solvent cement joint or Rubber-ring joint
5)	Coating and Lining (DCIP)	:	Outer coating - Epoxy ,t = 0.1mm
		:	Inner lining - Mortar, t = 10mm±3mm
	(PVC)	:	non
6)	Valves Class	:	Working Pressure - 10 kgf/cm2
7)	Polyethylene Encasement	:	equalize to DCIP length
8)	Ancillary works		
	(Railway crossing)	:	1 sites, Double pipe system for protection, Pipe-jacking method
	(Road crossing)	:	3 sites, Double pipe system for protection, Pipe-jacking method or Open trench method



GENERAL NOTES

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THE DETAILED DESIGN ON THE URGENT DEVELOPMENT PLAN OF THE SUEZ BAY COASTAL AREA DEVELOPMENT

FIG.4.13-WS

DISTRIBUTION

Treated water pipeline network (1)

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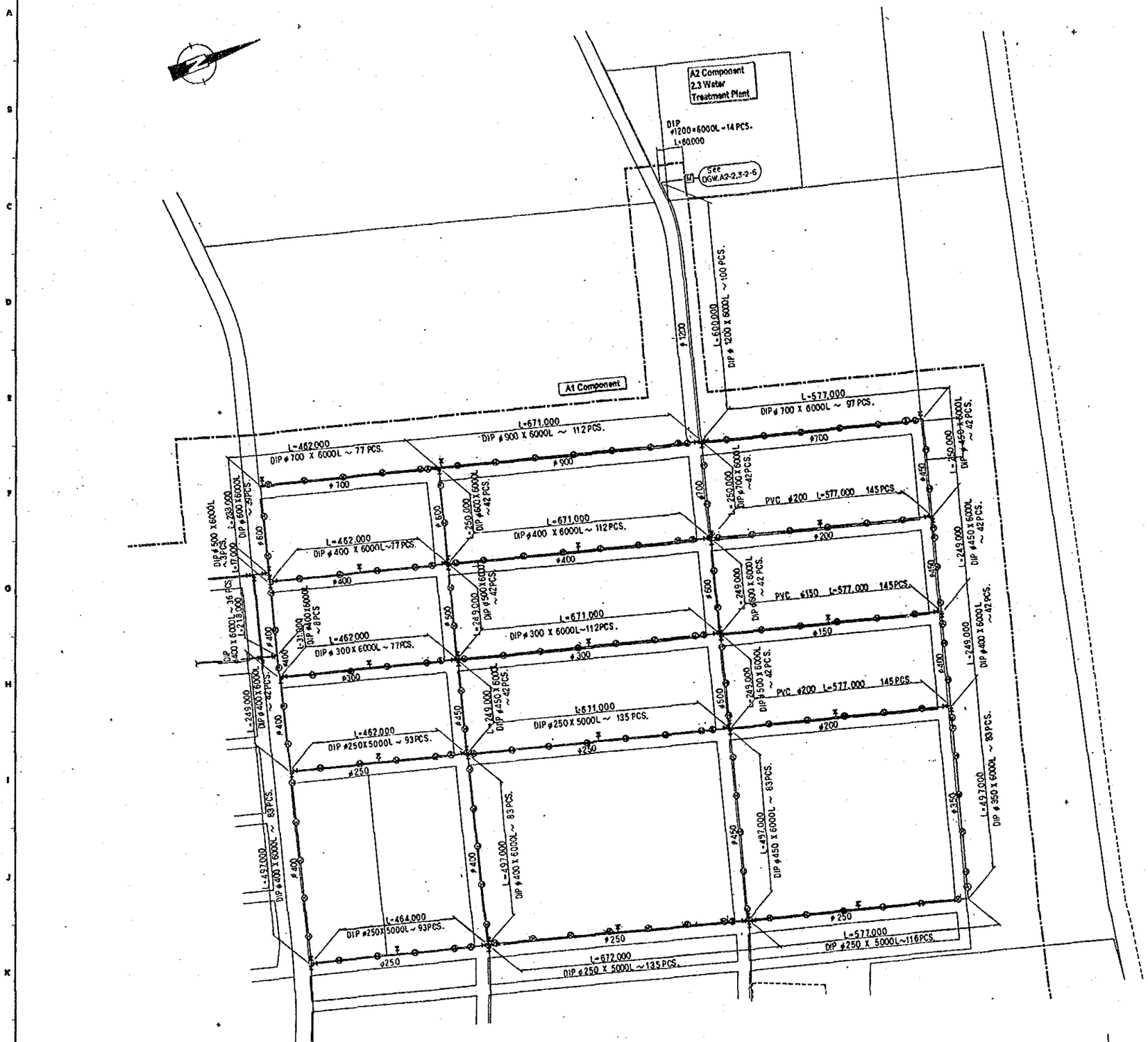
		1:10,000	
DATE OCT. 1993		DWG. NO. A1-1.3-1	



GENERAL NOTES

LEGEND

- ⋈ --- VALVE
- Ⓐ --- AIR RELIEF VALVE
- Ⓗ --- FIRE HYDRANT
- PIPE CONNECTION

DESCRIPTIONS	DWG. NO.
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OF
THE SUEZ BAY COASTAL AREA DEVELOPMENT

FIG.4.14-WS

DISTRIBUTION

Treated water pipeline network (2)

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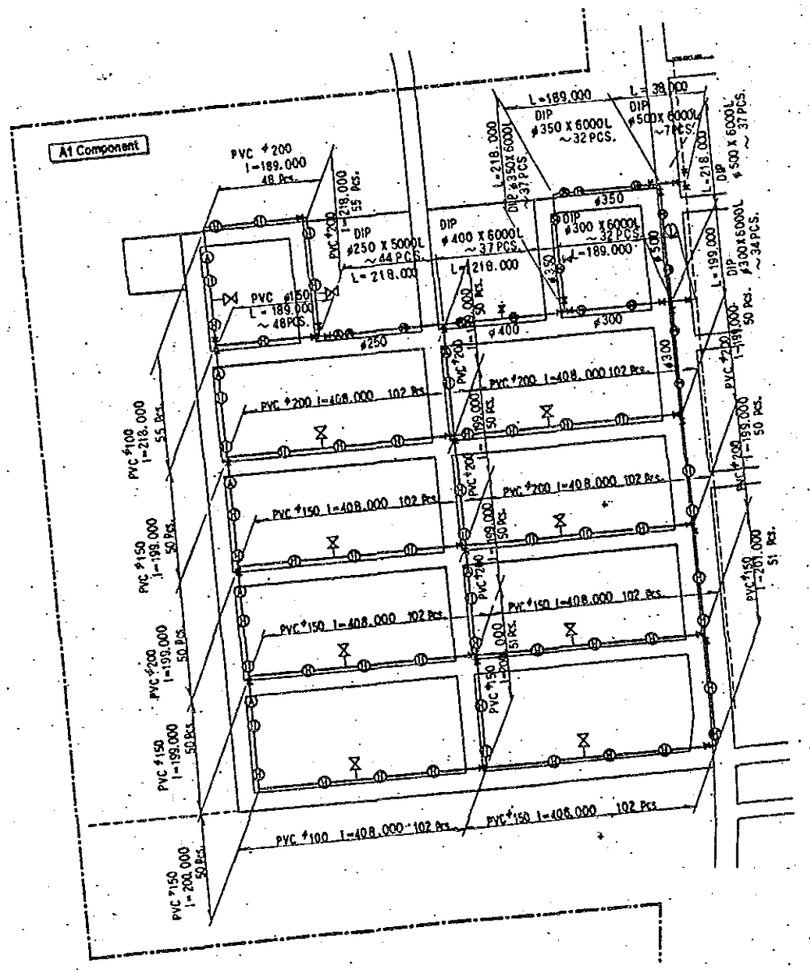
SUBMITTED	APPROVED	SCALE	REV. NO.
		1:5000	
DATE OCT. 1993		DWG. NO. A1-1.3-2	



① : DIP L=38.000 φ500 X 6000L ~7PCS.

GENERAL NOTES

LEGEND

- ⋈ --- VALVE
- Ⓐ --- AIR RELIEF VALVE
- Ⓗ --- FIRE HYDRANT
- ⋈ --- PIPE CONNECTION

DESCRIPTIONS	DWG. NO.
REFERENCE DRAWINGS	

NO.	DATE	DESCRIPTIONS	BY	APP'D
REVISIONS				

ARAB REPUBLIC OF EGYPT

MINISTRY OF DEVELOPMENT,
NEW COMMUNITIES, HOUSING AND PUBLIC UTILITIES

THE DETAILED DESIGN ON THE URGENT DEVELOPMENT PLAN OF THE SUEZ BAY COASTAL AREA DEVELOPMENT

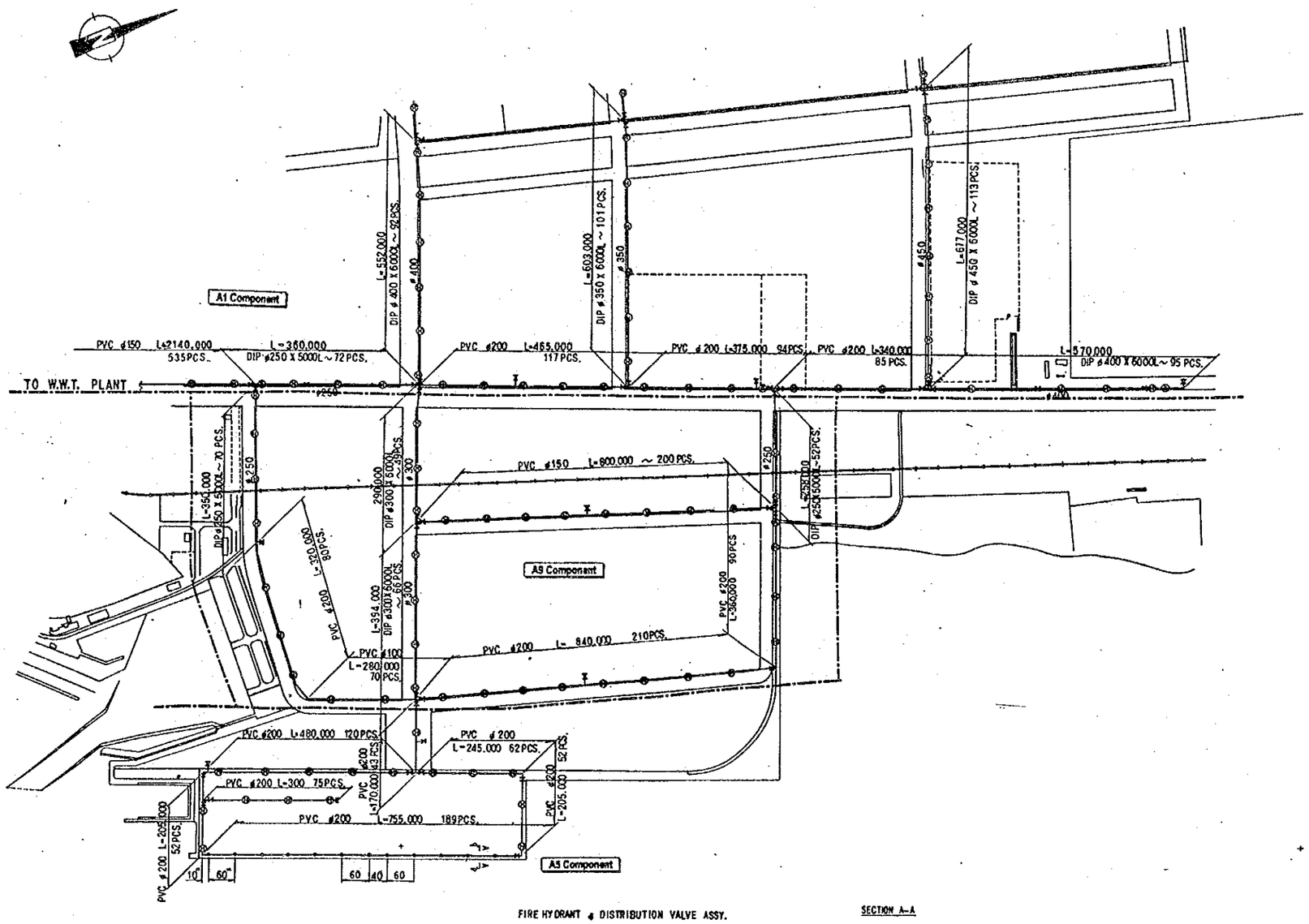
FIG.4.15-WS

DISTRIBUTION

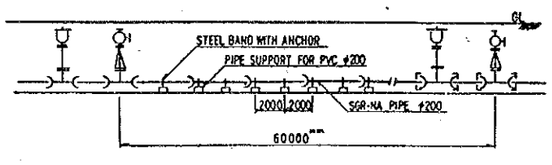
Treated water pipeline network (3)

JICA JAPAN INTERNATIONAL COOPERATION AGENCY

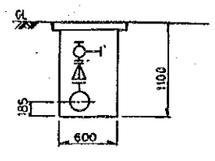
SUBMITTED	APPROVED	SCALE	REV. NO.
		1:5000.	
DATE OCT. 1993		DWG. NO. A1-1.3-4	



FIRE HYDRANT & DISTRIBUTION VALVE ASSY.



SECTION A-A



GENERAL NOTES

LEGEND

- VALVE
- AIR RELIEF VALVE
- FIRE HYDRANT
- PIPE CONNECTION

DESCRIPTIONS	DWG. NO.
REFERENCE DRAWINGS	

NO.	DATE	DESCRIPTIONS	BY	APP'D
REVISIONS				

ARAB REPUBLIC OF EGYPT

MINISTRY OF DEVELOPMENT, NEW COMMUNITIES, HOUSING AND PUBLIC UTILITIES

THE DETAILED DESIGN ON THE URGENT DEVELOPMENT PLAN OF THE SUEZ BAY COASTAL AREA DEVELOPMENT

FIG.4.15'-WS

DISTRIBUTION

Treated water pipeline network (4)

JICA JAPAN INTERNATIONAL COOPERATION AGENCY

SUBMITTED	APPROVED	SCALE	REV. NO.
		1:5000	
DATE OCT. 1993		DWG. NO. A1-1.3-3	

DETAIL A

DETAIL B

DETAIL C

SCALE FOR DETAIL
0 10m

ADABIYA - SUEZ/CAIRO ROAD

A1 Component

A2 Component
2.3 Water
Treatment Plant

A9 Component

A10 Component

GRAPHITE FACTORY

SUEZ BAY

TO AIN SUKHUNA

TO SUEZ

13A BRANCH DETAIL

20A BRANCH DETAIL

GENERAL NOTES

LEGEND
Figures presented along the pipes
ex. 150 / 218 = Dia. 150 mm with 218 m length

DESCRIPTIONS	DWG. NO.
REFERENCE DRAWINGS	

NO.	DATE	DESCRIPTIONS	BY	APP'D
REVISIONS				

ARAB REPUBLIC OF EGYPT
MINISTRY OF DEVELOPMENT,
NEW COMMUNITIES, HOUSING AND PUBLIC UTILITIES

THE DETAILED DESIGN ON THE URGENT DEVELOPMENT PLAN
OF
THE SUEZ BAY COASTAL AREA DEVELOPMENT

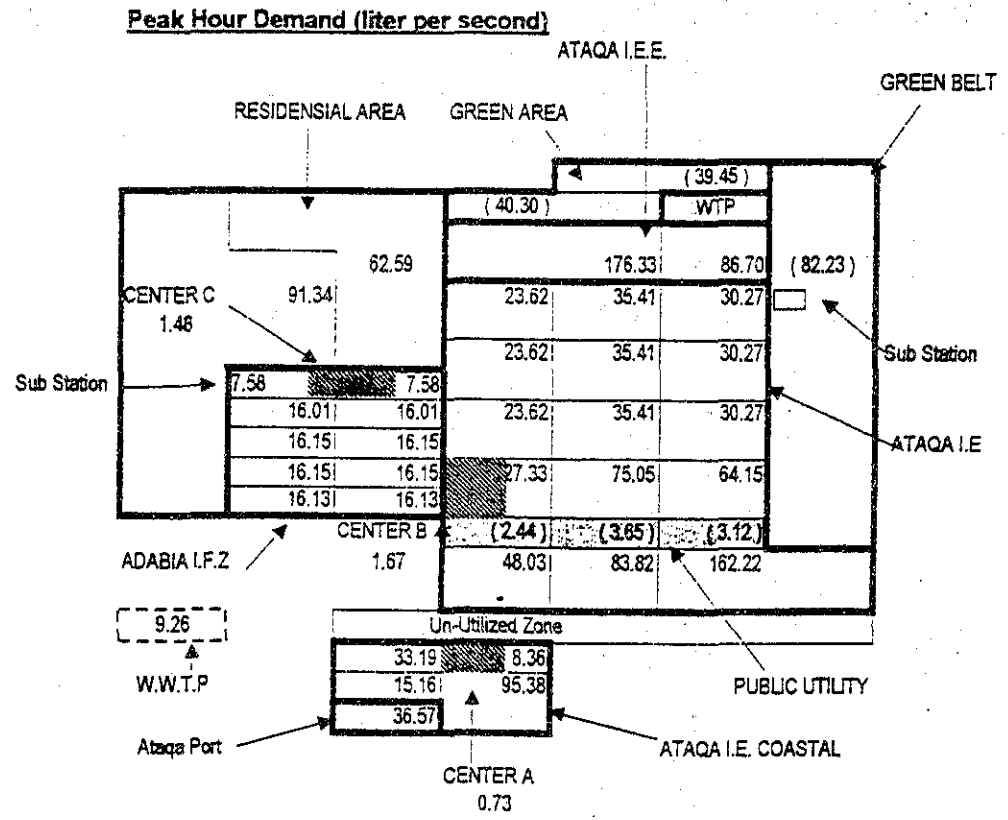
FIG.4.16-WS
DISTRIBUTION

Draw-off water pipeline network

JICA JAPAN INTERNATIONAL COOPERATION AGENCY

SUBMITTED	APPROVED	SCALE	REV. NO.
		1:10,000	
DATE October, 1993		DWG. NO.	

FIG.4.17-WS DISTRIBUTION Hydraulics of Treated water pipeline network (1)



Bracket number is not required for treated water.

FIG.4.18-WS DISTRIBUTION Hydraulics of Treated water pipeline network (2)

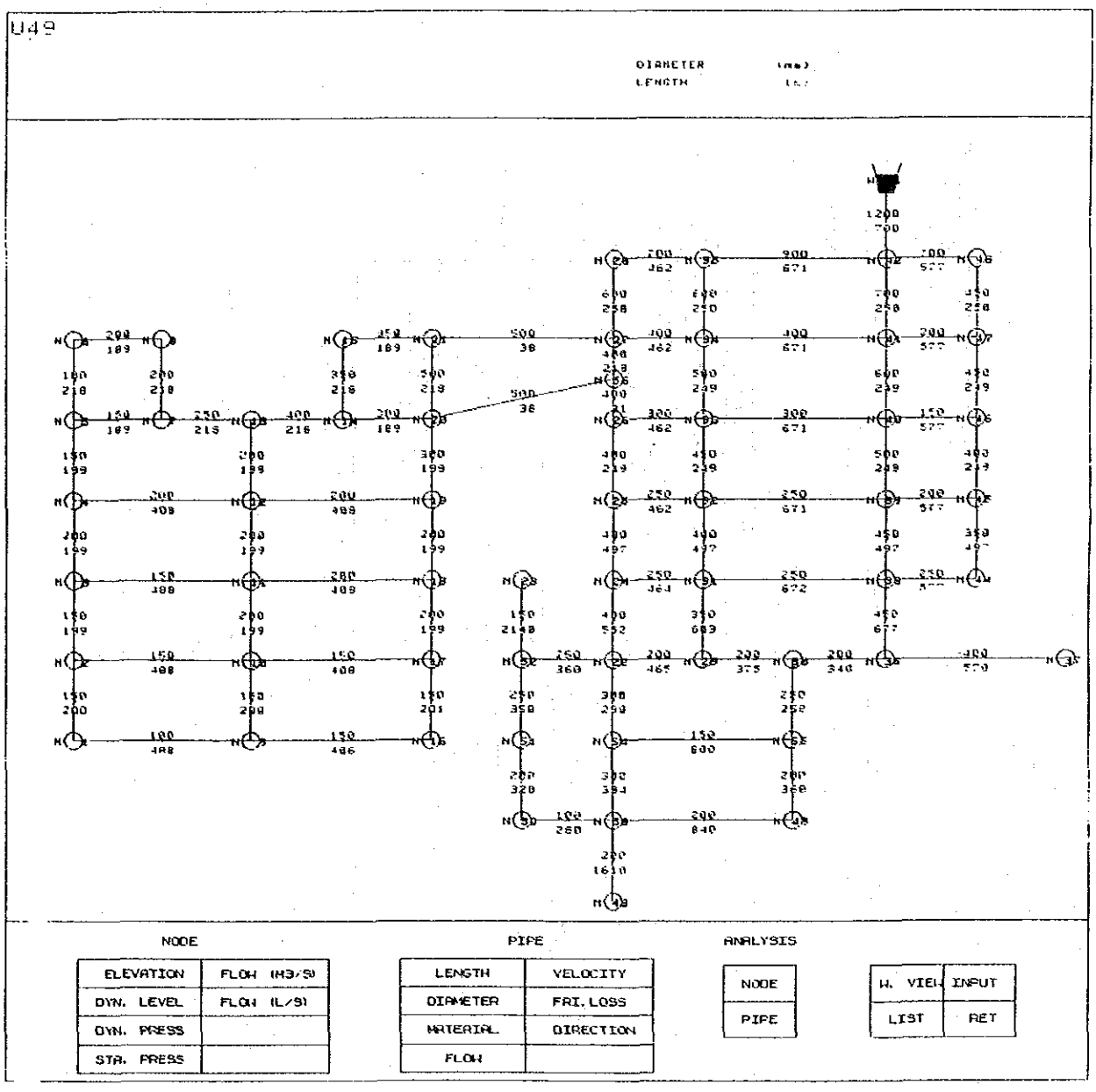


FIG.4.19-WS DISTRIBUTION Hydraulics of Treated water pipeline network (3)

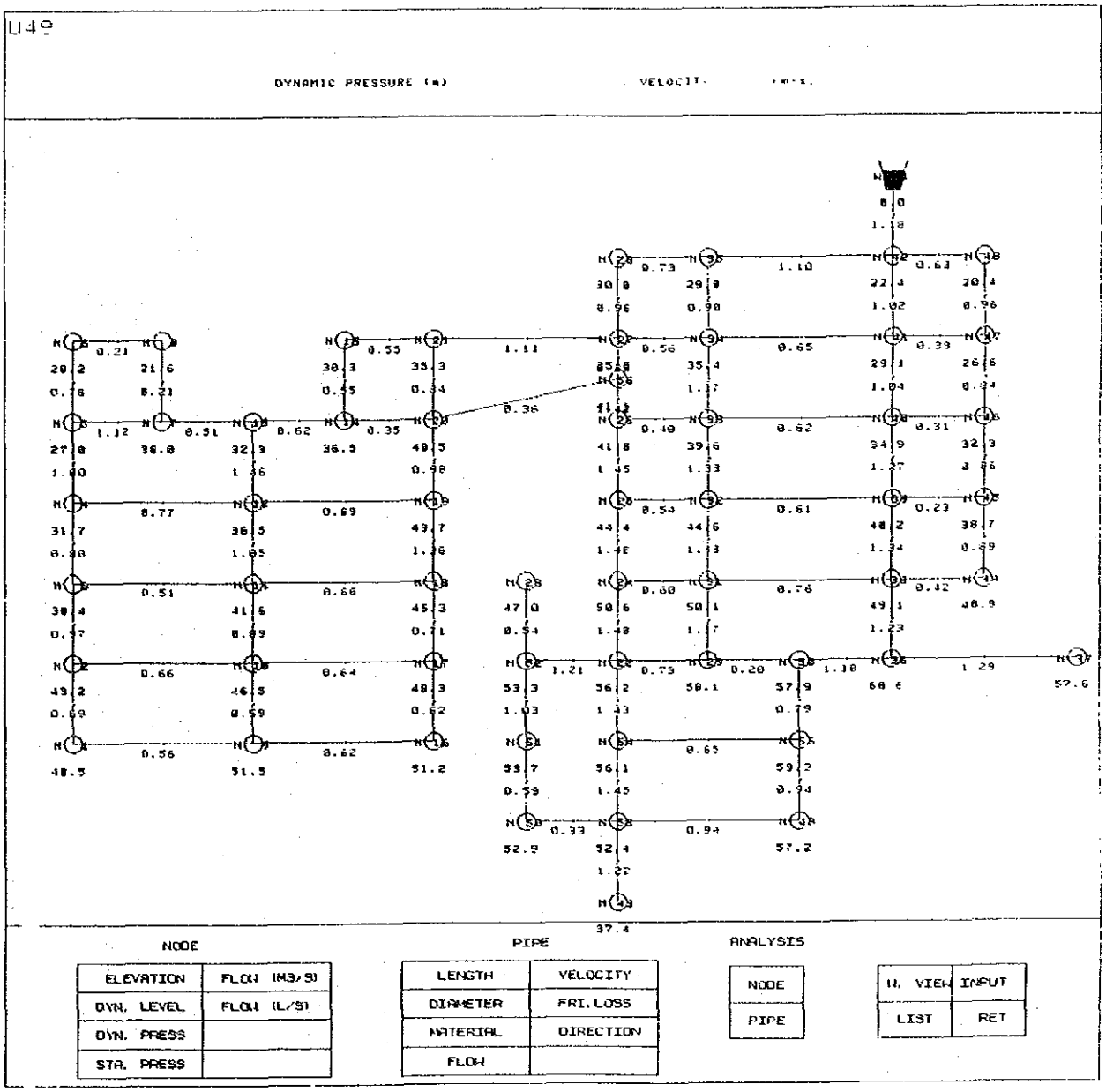


FIG.4.20-WS DISTRIBUTION Hydraulics of Treated water pipeline network (4)

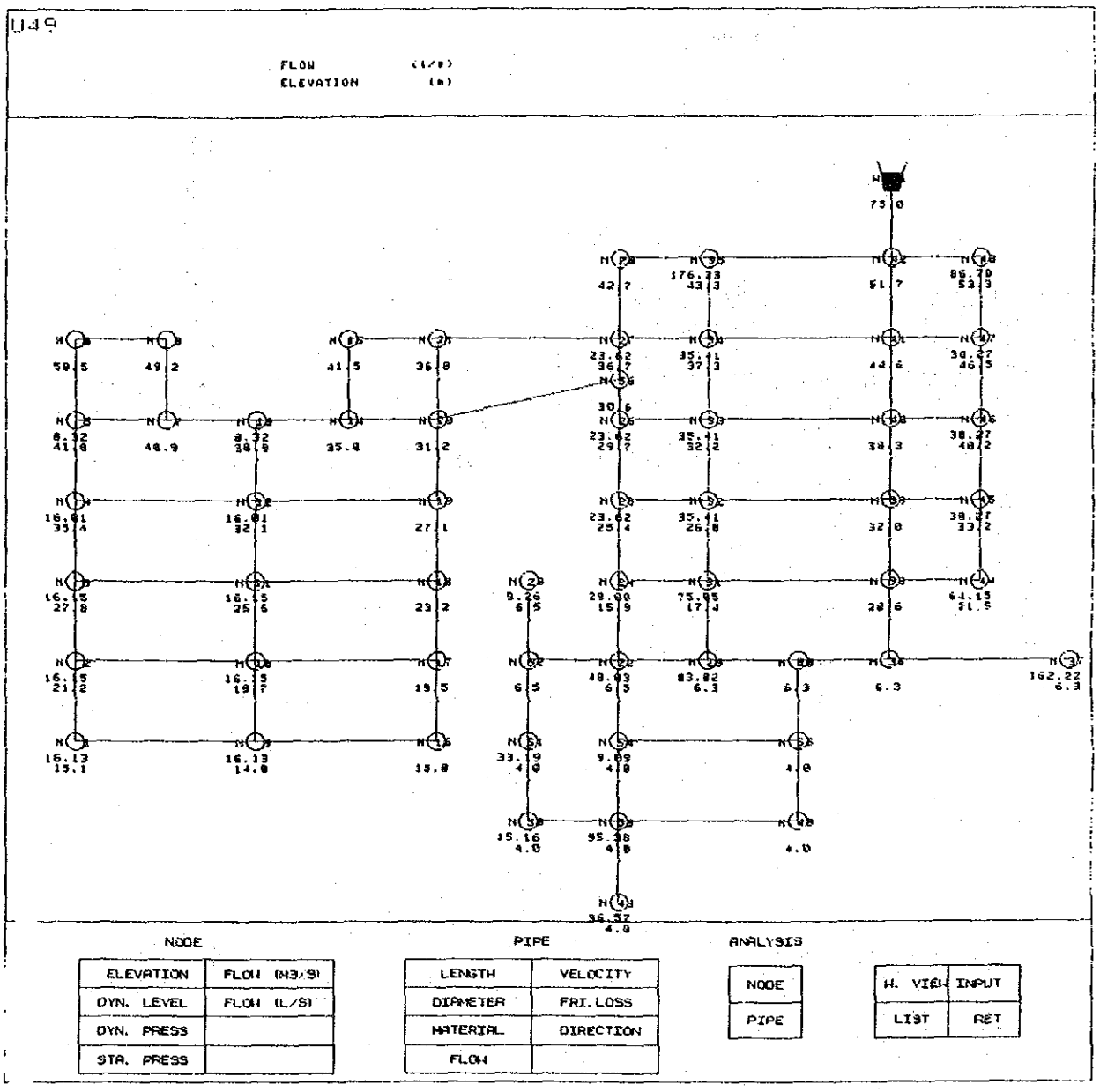


FIG.4.21-WS DISTRIBUTION Hydraulics of Treated water pipeline network (5)

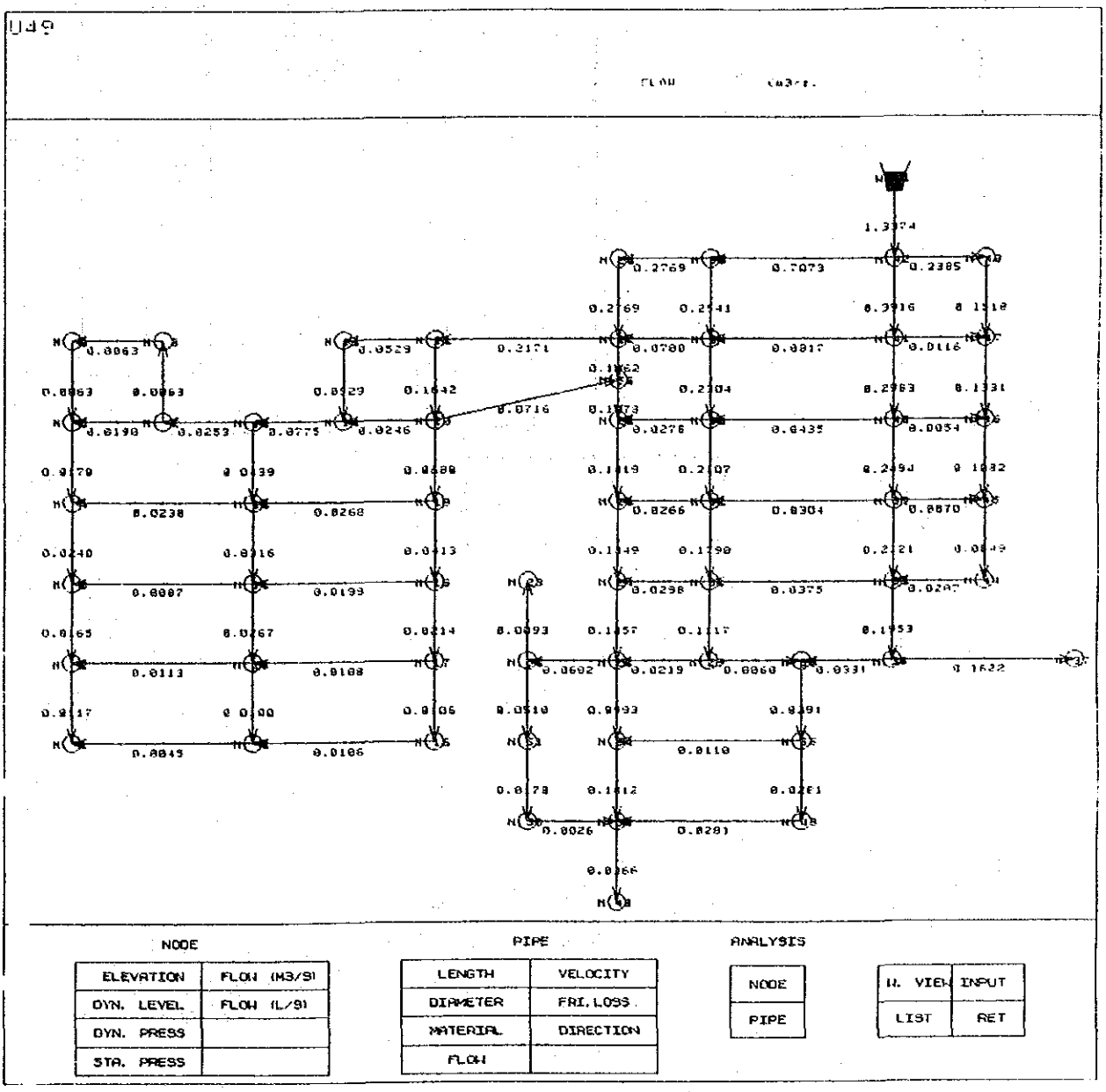
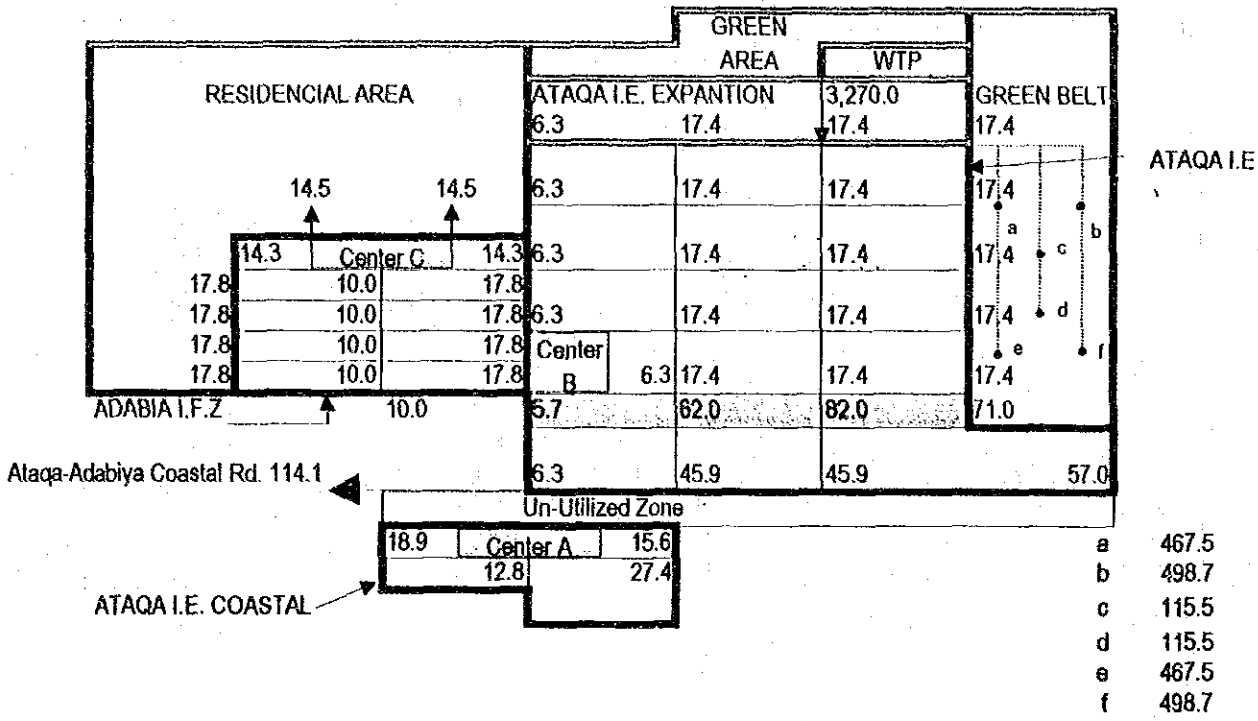


FIG. 4.22-WS DISTRIBUTION Hydraulics of Draw-off water pipeline network (1)

DESIGN WATER CONSUMPTION FOR PLANTING (cu.m per day)



DESIGN DEBIT RATE FOR PLANTING (litter per second)

note : Supply hour = 8 hrs per day

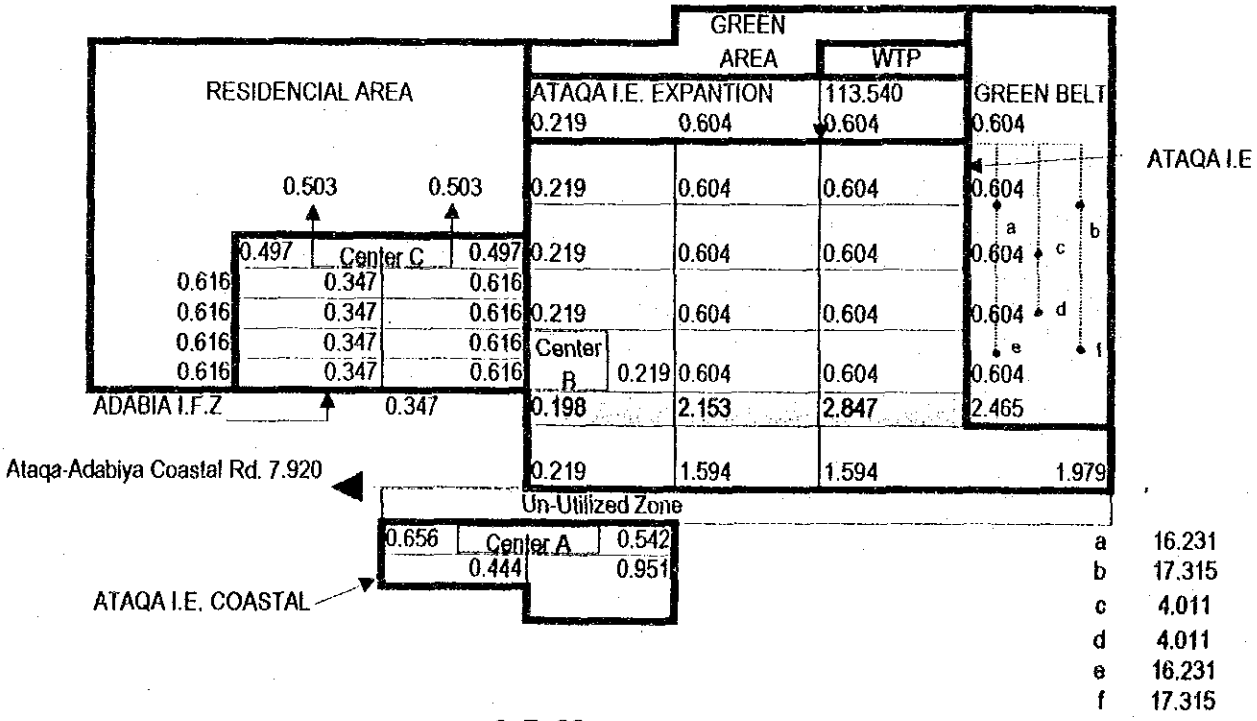


FIG.4.23-WS DISTRIBUTION Hydraulics of Draw-off water pipeline network (2)

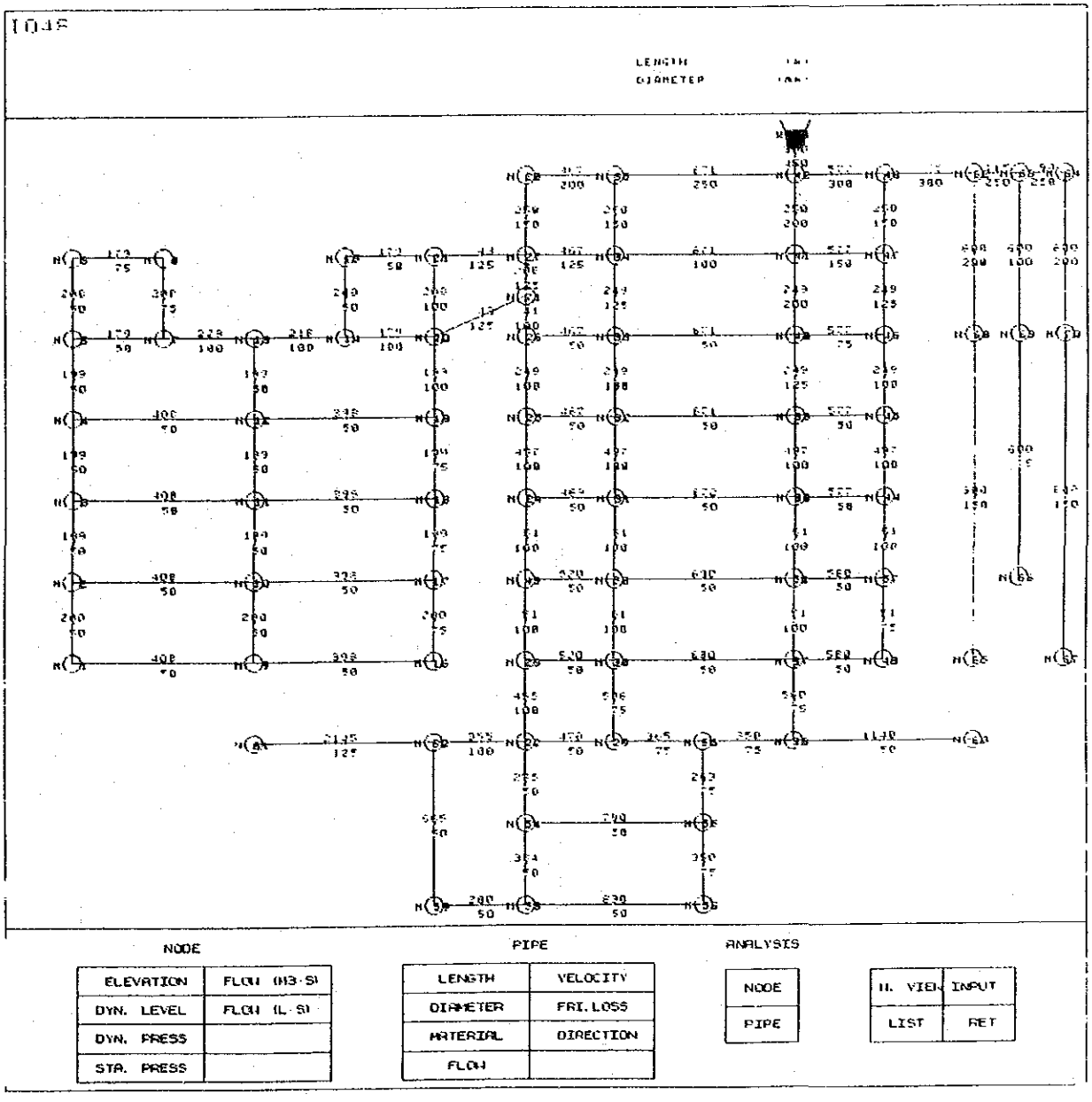


FIG.4.24-WS DISTRIBUTION Hydraulics of Draw-off water pipeline network (3)

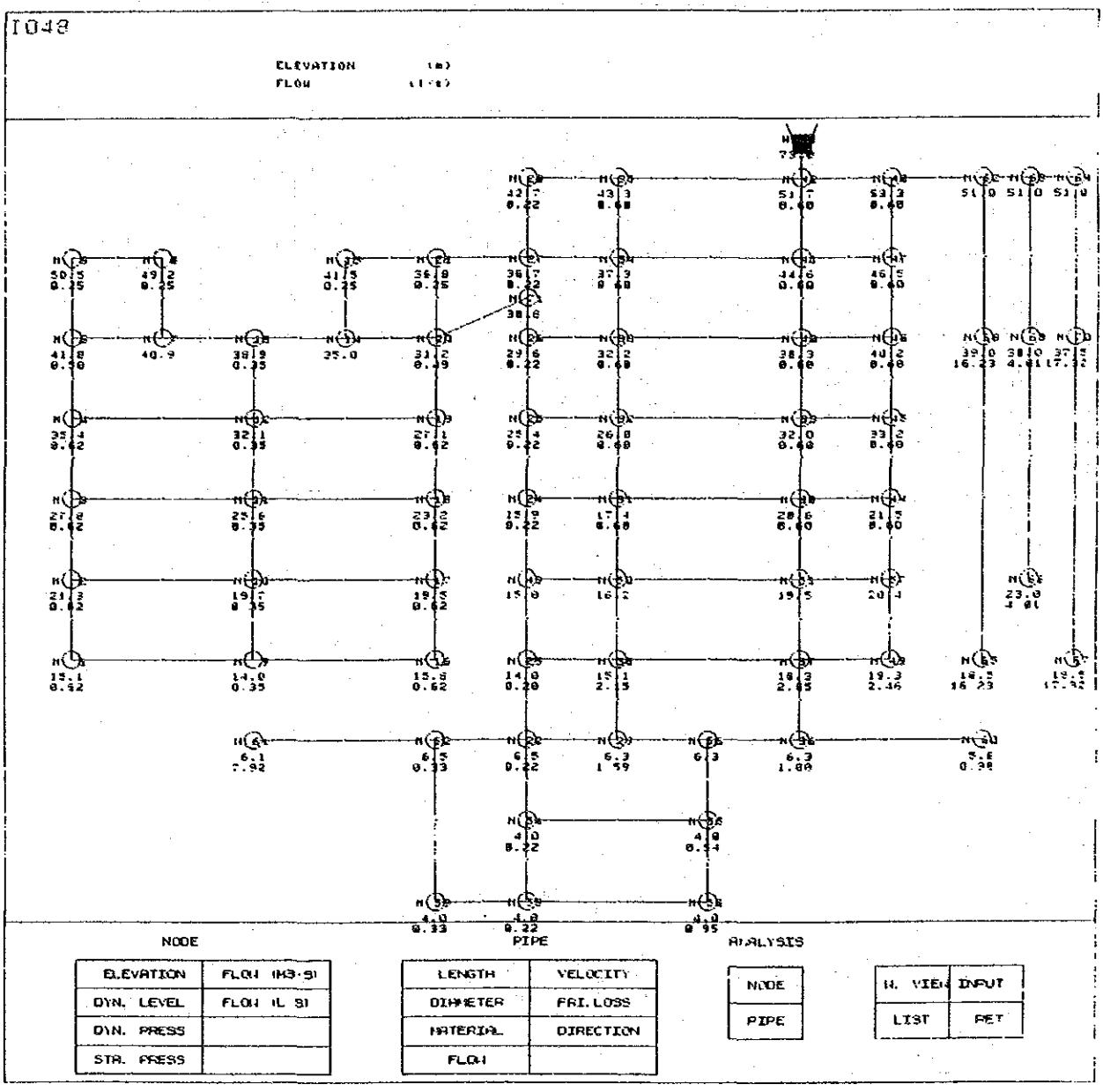
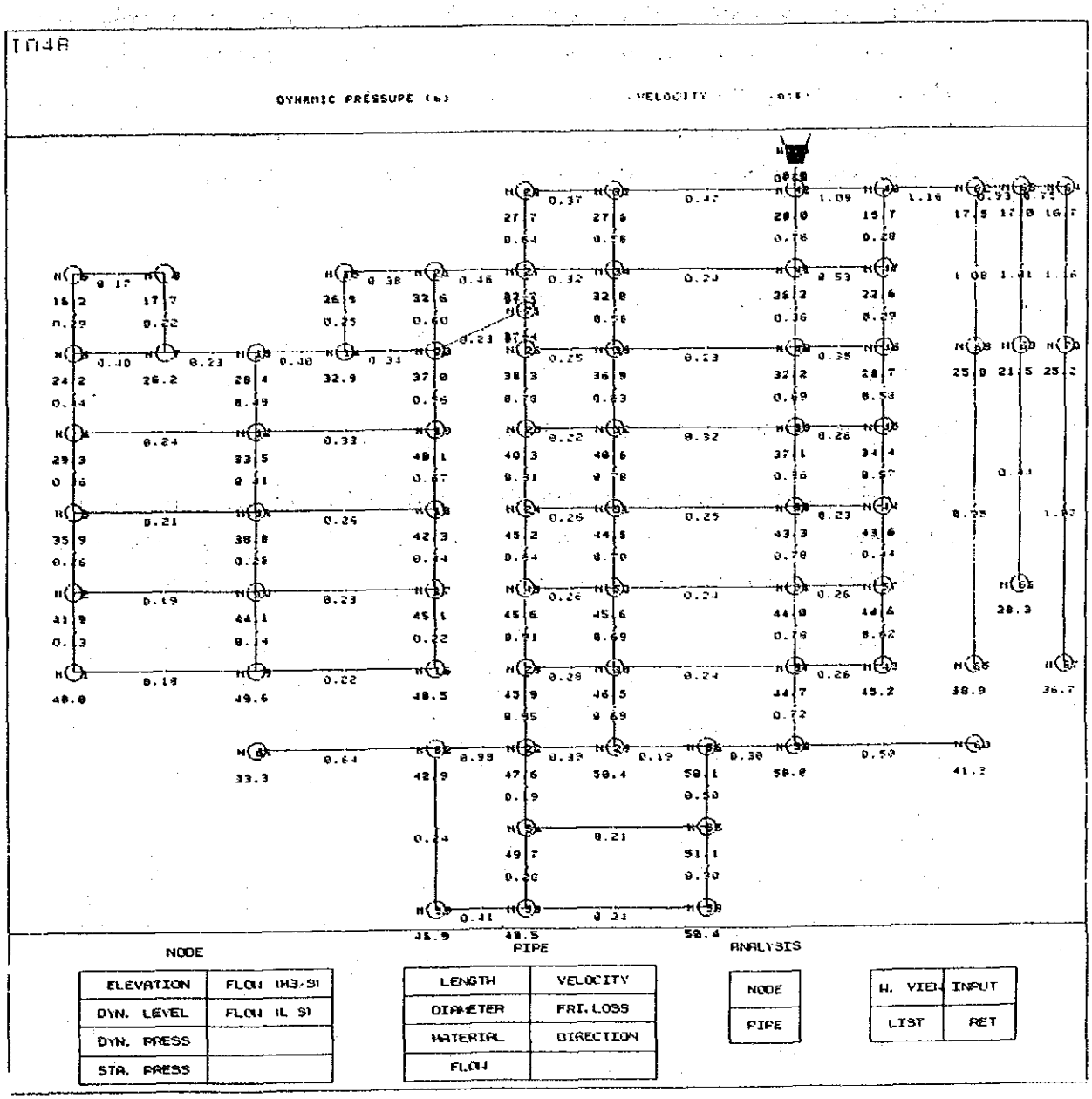


FIG.4.25-WS DISTRIBUTION Hydraulics of Draw-off water pipeline network (4)



3.7.5 OPERATION AND MAINTENANCE

(1) Engineering Staffing for Operation and Maintenance

Referring to engineering and management staffing of the 6 October water treatment plant, the staffing projection for this water supply system is drafted. (see FIG.5.1) This draft staffing projection recommends 1 administrative director, 15 engineers and 150 works to be engaged to operation and maintenance, but not include financial planning/management section in charge of tariff collection, logistic and so on.

(2) Basic Operation Methods of the System

(a) Relation between Intake Operation and Raw water reservoir

The intake pump operation is depending on the water level of raw water reservoir. The intake pump shall be operated, to keep water level of the raw water reservoir in upper third of the available water level range.

The water level of raw water reservoir is always observed by water level indicator and recorder in the central control room of WTP. The water level signal is also transmitted to the intake pump station by wired telemetering system. The communication between intake pump station and central control room is made by telephone system. The communication between raw water reservoir and central control room is made by interphone system. The communication and telemetering between the central control room of WTP and the intake P/S is made by the special cable laid along the aqueduct.

(b) Operation of Intake Pump

Semi-graphic supervisory panel of the intake pump operation are installed in the control room of the pump house. This panels indicate pump operation, power supply condition, flow rate, screen operation, water level at pump sump, water hammer prevention system and water level of the raw water reservoir. (see FIG. 4.2-WS)

The water level signal is transmitted to the moter control panel of the intake P/S, for automatic switching (On/Off) of the intake pumps in accordance with the water level of the raw water reservoir. The operational water level of the raw water reservoir is upper third of the available water range.

Pump operation is also controlled manually by switchgears installed in the control room of the pump house and/or local panels at each pumps.

(c) Operation of Water Treatment Plant

The operation apparatus/switchgears are installed at each equipment. The operation of major equipment and facilities of the water treatment plant are observed by The central control room. The operation of water treatment process in five typical situations are presented in FIG.5.2-WS, 5.3-WS and TABLE 5.1-WS to 5.5-WS.

Chemical Doing Control

Chemical dosing rate such as Chlorination and Alum dosing are controlled automatically by information of the flow indicator at ahead of coagulation and sedimentation basin.

Flush mixer of Coagulation and Sedimentation Basin

Activation of the flush mixer is controlled by information of the flow indicator at ahead of coagulation and sedimentation basin.

Filter Washing

Filter washing program is shown in FIG.4.9-WS. Filter washing is controlled by local control panels at each filter beds. The local control panels are respectively programmed with a series of filter washing action which are mainly valve operation. The filter operation status is sent to the central control room and indicated on the graphic panel.

The status of valves at filter washing is shown in TABLE 5.4-WS.

Treated Water Reservoir

Effluent valve of the treated water reservoir for distribution is principally always opened.

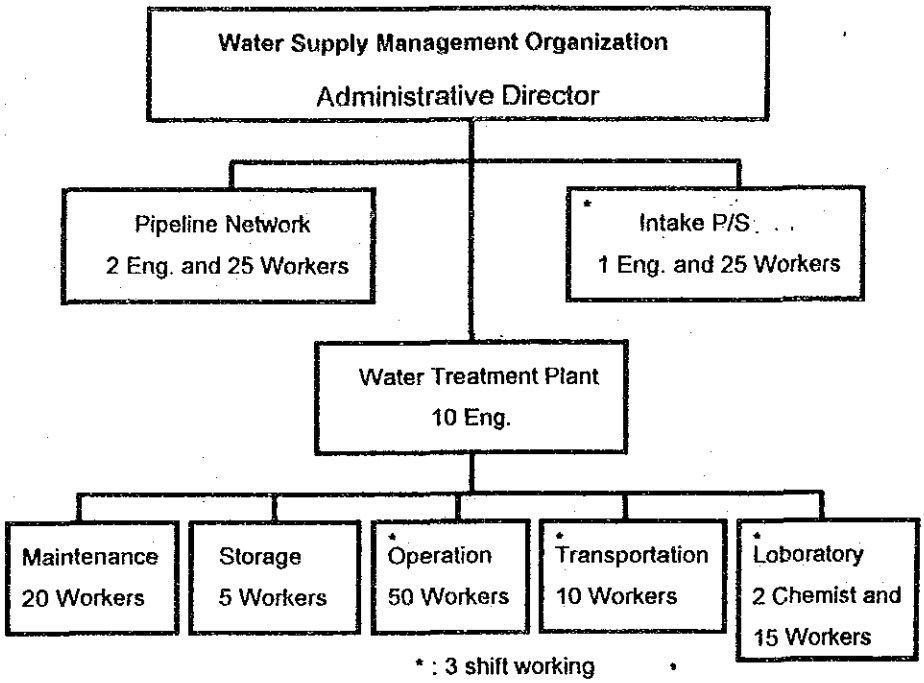
For filling of the filter washing water basin, the booster pump of the treated water reservoir is controlled by information of water level indicator in the filter washing water basin.

Sludge Draw-off Water Reservoir

Slurry pumps to convey sub-natant to the sludge drying beds are operated by manually.

Emergency Stoppage of Electric Power Supply

Emergency stop of power supply is detected in the power substation, and automatically switch to the generator system.



Facilities	Number of Engineers	Number of Workers	Remarks
Adiministrative Director	1	0	The office is located in the treatment plant.
Pipeline Network	2	25	3 shift working
Water Treatment Plant	10	100	3 shift working
Intake Pump Station	2	25	3 shift working
Total	15	150	

FIG.5.1-WS OPERATIONAL FRAMEWORK OF WATER SUPPLY SYSTEM (DRAFT)

FIG. 5.2-WS OPERATION APPRATUS DIAGRAM (WATER TREATMENT PLANT)

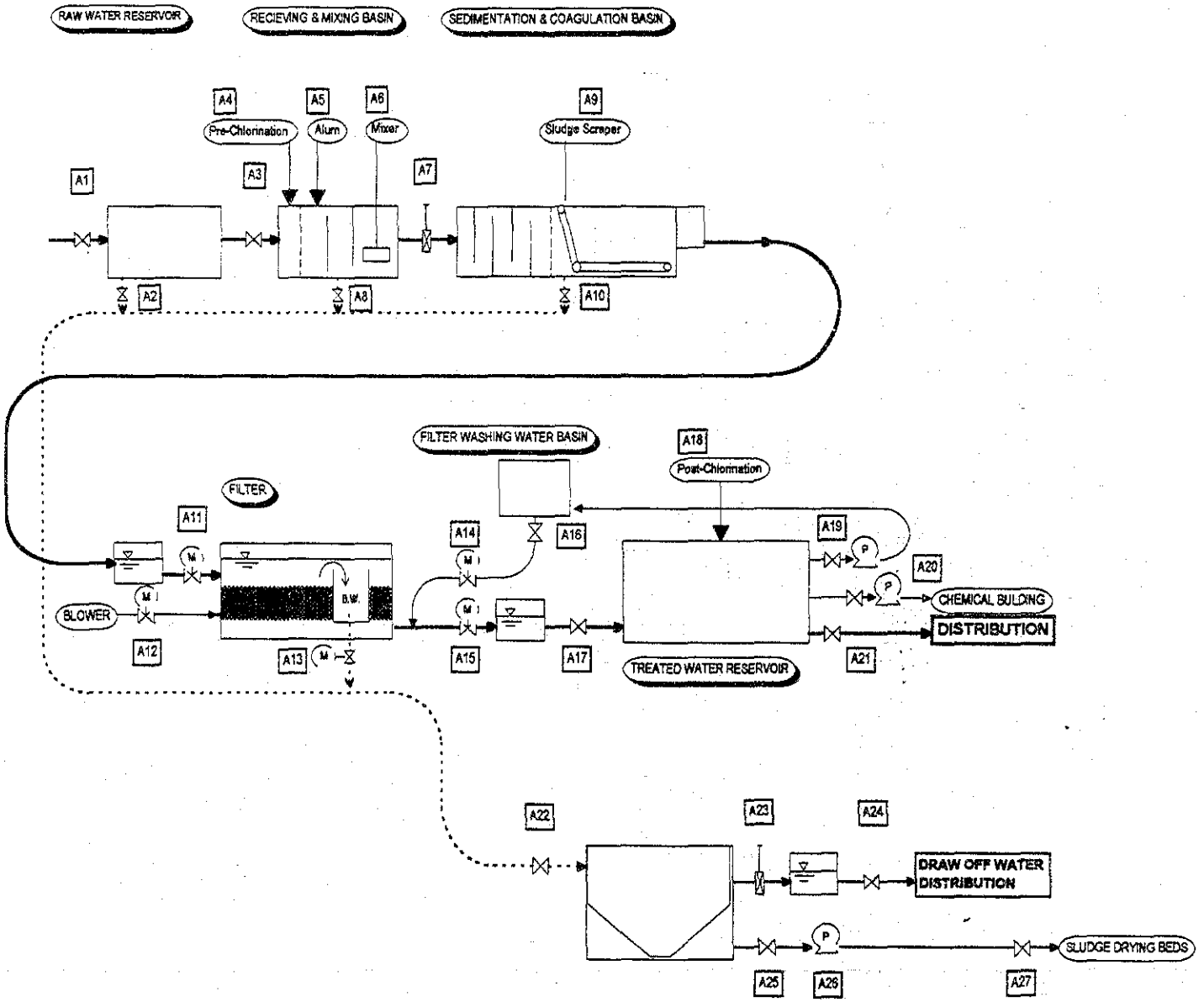


FIG.5.3-WS **INSTRUMENTATION DIAGRAM (WATER TREATMENT PLANT)**

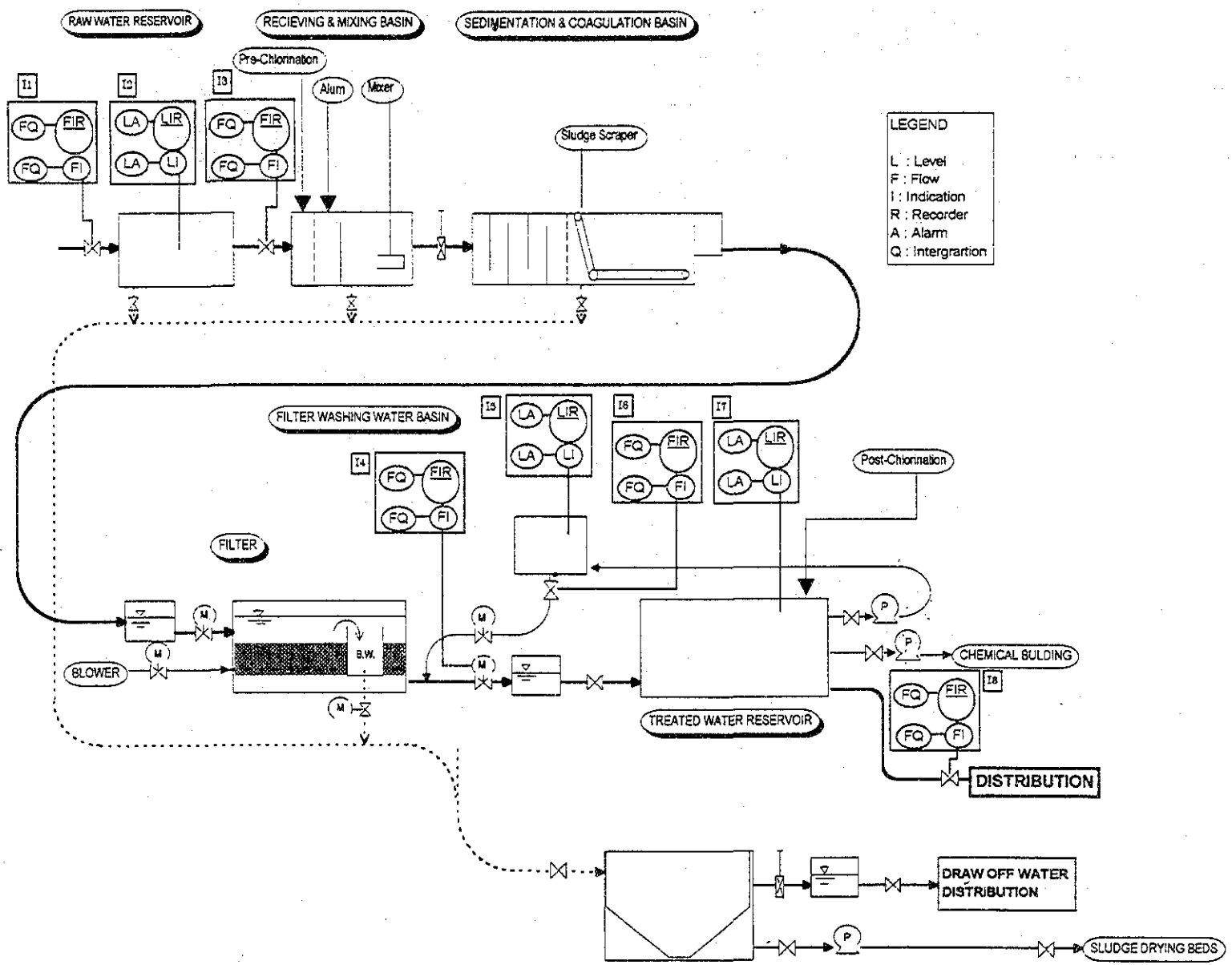


TABLE 5.1-WS OPERATION TABLE (NORMAL OPERATION)

APPARATUS					STATUS	INSTRUMENTATION RELATED							
No.	Facility	Name	Driving Mode	Operation mode	Ordinal Operation	I1	I2	I3	I4	I5	I6	I7	I8
Intake Pump Operation					**Active**		●					●	●
A1	Raw Water Reservoir	Influent Valve	H.O.	Manual at Site	**Open**	●	●						
A2		Sludge Disposal Valve	H.O.	Manual at Site	Close								
A3	Recieving and	Influent Valve	H.O.	Manual at Site	**Open**			●					
A4	Mixing Basin	Pre-Chlorination		Auto in Chem. bldg.	**Active**			●					
A5		Alum Dosing		Auto in Chem. bldg.	**Active**			●					
A6		Mixer	M.D.	Auto. at Site	**Active**			●					
A7		Sluice Gate	H.O.	Manual at Site	**Open**			●					
A8		Sludge Draw-off Valve	H.O.	Manual at Site	Close			●					
A9	Sedimentation and	Sludge Scraper	H.O.	Manual at Site	**Active**			●					
A10	Coagulation Basin	Sludge Draw-off Valve	H.O.	Manual at Site	Close								
A11	Filter	Influent Valve	M.D	Manual at Site	**Open**				●				
A12		Blower Valve	M.D	Auto at Site	Close								
A13		Back Wash Draw-off Valve	M.D	Auto at Site	Close								
A14		Back-wash Water Valve	M.D	Auto at Site	Close								
A15		Treated Water Efluent Valve	M.D	Auto at Site	**Open**				●				
A16	Filter Washing W. Basin	Efluent Valve	H.O.	Manual at Site	**Open(adjusted)**						●		
A17	Treated Water Reservoir	Influent Valve	H.O.	Manual at Site	**Open**								
A18		Post-Chlorination		Auto in Chem. bldg.	**Active**								
A19		Lift Pump to Filter W.W. Basin		Manual at Site	**Intermittent**					●			
A20		Lift Pump to Chemical Bldg.		Auto at Site	**Active**			●					
A21		Efluent Valve for Distribution	H.O.	Munaual at Site	**Open**								
A22	Draw-off Water Reservoir	Influent Valve	H.O.	Munaual at Site	**Open**								
A23		Sluice Gate	H.O.	Munaual at Site	**Open**								
A24		Draw-off water Efluent Valve	H.O.	Munaual at Site	**Open**								
A25		Sludge Disposal Valve	H.O.	Munaual at Site	**Intermittent**								
A26		Slurry Pump	H.O.	Munaual at Site	**Intermittent**								
A27	Sludge Drying Beds	Influent Valve	H.O.	Munaual at Site	**Open**								

TABLE 5.2-WS OPERATION TABLE (ELECTRIC STOPPAGE)

APPARATUS					STATUS	INSTRUMENTATION							
No.	Facility	Name	Driving Mode	Operation mode	Electric Stopage	I1	I2	I3	I4	I5	I6	I7	I8
Intake Pump Operation					**Active (50%)**		●					●	●
A1	Raw Water Reservoir	Influent Valve	H.O.	Manual at Site	**Open**	●	●						
A2		Sludge Disposal Valve	H.O.	Manual at Site	Close								
A3	Recieving and	Influent Valve	H.O.	Manual at Site	**Open**			●					
A4	Mixing Basin	Pre-Chlorination		Auto in Chem. bldg.	**Active**			●					
A5		Alum Dosing		Auto in Chem. bldg.	**Active**			●					
A6		Mixer	M.D.	Auto. at Site	**Active**			●					
A7		Sluice Gate	H.O.	Manual at Site	**Open**			●					
A8		Sludge Draw-off Valve	H.O.	Manual at Site	Close			●					
A9	Sedimentation and	Sludge Scraper	H.O.	Manual at Site	**Active**			●					
A10	Coagulation Basin	Sludge Draw-off Valve	H.O.	Manual at Site	Close								
A11	Filter	Influent Valve	M.D	Manual at Site	**Open**				●				
A12		Blower Valve	M.D	Auto at Site	Close								
A13		Back Wash Draw-off Valve	M.D	Auto at Site	Close								
A14		Back-wash Water Valve	M.D	Auto at Site	Close								
A15		Treated Water Efluent Valve	M.D	Auto at Site	**Open**				●				
A16	Filter Washing W. Basin	Efluent Valve	H.O.	Manual at Site	**Open(adjusted)**						●		
A17	Treated Water Reservoir	Influent Valve	H.O.	Manual at Site	**Open**								
A18		Post-Chlorination		Auto in Chem. bldg.	**Active**								
A19		Lift Pump to Filter W.W. Basin		Manual at Site	Inactive								
A20		Lift Pump to Chemical Bldg.		Auto at Site	**Active**			●					
A21		Efluent Valve for Distribution	H.O.	Munaual at Site	**Open**								
A22	Draw-off Water Reservoir	Influent Valve	H.O.	Munaual at Site	**Open**								
A23		Sluice Gate	H.O.	Munaual at Site	**Open**								
A24		Draw-off water Efluent Valve	H.O.	Munaual at Site	**Open**								
A25		Sludge Disposal Valve	H.O.	Munaual at Site	**Intermittent**								
A26		Slurry Pump	H.O.	Munaual at Site	Inactive								
A27	Sludge Drying Beds	Influent Valve	H.O.	Munaual at Site	**Open**								

TABLE 5.3-WS OPERATION TABLE (FULLY STOP)

APPARATUS					STATUS	INSTRUMENTATION							
No.	Facility	Name	Driving Mode	Operation mode	Fully Stop	I1	I2	I3	I4	I5	I6	I7	I8
Intake Pump Operation					Inactive								
A1	Raw Water Reservoir	Influent Valve	H.O.	Manual at Site	Close								
A2		Sludge Disposal Valve	H.O.	Manual at Site	Close								
A3	Recieving and	Influent Valve	H.O.	Manual at Site	Close								
A4	Mixing Basin	Pre-Chlorination		Auto in Chem. bldg.	Inactive								
A5		Alum Dosing		Auto in Chem. bldg.	Inactive								
A6		Mixer	M.D.	Auto. at Site	Inactive								
A7		Sluice Gate	H.O.	Manual at Site	Close								
A8		Sludge Draw-off Valve	H.O.	Manual at Site	Close								
A9	Sedimentation and	Sludge Scraper	H.O.	Manual at Site	Inactive								
A10	Coagulation Basin	Sludge Draw-off Valve	H.O.	Manual at Site	Close								
A11	Filter	Influent Valve	M.D	Manual at Site	Close								
A12		Blower Valve	M.D	Auto at Site	Close								
A13		Back Wash Draw-off Valve	M.D	Auto at Site	Close								
A14		Back-wash Water Valve	M.D	Auto at Site	Close								
A15		Treated Water Efluent Valve	M.D	Auto at Site	Close								
A16	Filter Washing W. Basin	Effluent Valve	H.O.	Manual at Site	Close								
A17	Treated Water Reservoir	Influent Valve	H.O.	Manual at Site	Close								
A18		Post-Chlorination		Auto in Chem. bldg.	Inactive								
A19		Lift Pump to Filter W.W. Basin		Manual at Site	Inactive								
A20		Lift Pump to Chemical Bldg.		Auto at Site	Inactive								
A21		Effluent Valve for Distribution	H.O.	Munaual at Site	Close								
A22	Draw-off Water Reservoir	Influent Valve	H.O.	Munaual at Site	Close								
A23		Sluice Gate	H.O.	Munaual at Site	Close								
A24		Draw-off water Effluent Valve	H.O.	Munaual at Site	Close								
A25		Sludge Disposal Valve	H.O.	Munaual at Site	Close								
A26		Slurry Pump	H.O.	Munaual at Site	Inactive								
A27	Sludge Drying Beds	Influent Valve	H.O.	Munaual at Site	Close								

TABLE 5.4-WS OPERATION TABLE (FILTER WASHING)

Not Directly Related

APPARATUS					STATUS	INSTRUMENTATION							
No.	Facility	Name	Driving Mode	Operation mode	Filter Wasing	I1	I2	I3	I4	I5	I6	I7	I8
Intake Pump Operation					**Acitive**		●					●	●
A1	Raw Water Reservoir	Influent Valve	H.O.	Manual at Site	**Open**	●	●						
A2		Sludge Disposal Valve	H.O.	Manual at Site	Close								
A3	Recieving and	Influent Valve	H.O.	Manual at Site	**Open**			●					
A4	Mixing Basin	Pre-Chlorination		Auto in Chem. bldg.	**Active**			●					
A5		Alum Dosing		Auto in Chem. bldg.	**Active**			●					
A6		Mixer	M.D.	Auto. at Site	**Active**			●					
A7		Sluice Gate	H.O.	Manual at Site	**Open**			●					
A8		Sludge Draw-off Valve	H.O.	Manual at Site	Close			●					
A9	Sedimentation and	Sludge Scraper	H.O.	Manual at Site	**Active**			●					
A10	Coagulation Basin	Sludge Draw-off Valve	H.O.	Manual at Site	Close								
A11	Filter	Influent Valve	M.D	Manual at Site	Close				●				
A12		Blower Valve	M.D	Auto at Site	**Open**				●				
A13		Back Wash Draw-off Valve	M.D	Auto at Site	**Open**				●				
A14		Back-wash Water Valve	M.D	Auto at Site	**Open**				●				
A15		Treated Water Efluent Valve	M.D	Auto at Site	Close				●				
A16	Filter Washing W. Basin	Efluent Valve	H.O.	Manual at Site	**Open(adjusted)**						●		
A17	Treated Water Reservoir	Influent Valve	H.O.	Manual at Site	**Open**								
A18		Post-Chlorination		Auto in Chem. bldg.	**Active**								
A19		Lift Pump to Filter W.W. Basin		Manual at Site	**Intermittent**					●			
A20		Lift Pump to Chemical Bldg.		Auto at Site	**Active**			●					
A21		Efluent Valve for Distribution	H.O.	Munaual at Site	**Open**								
A22	Draw-off Water Reservoir	Influent Valve	H.O.	Munaual at Site	**Open**								
A23		Sluice Gate	H.O.	Munaual at Site	**Open**								
A24		Draw-off water Efluent Valve	H.O.	Munaual at Site	**Open**								
A25		Sludge Disposal Valve	H.O.	Munaual at Site	**Intermittent**								
A26		Slurry Pump	H.O.	Munaual at Site	**Intermittent**								
A27	Sludge Drying Beds	Influent Valve	H.O.	Munaual at Site	**Open**								

TABLE 5.5-WS OPERATION TABLE (SLUDGE DRAW-OFF)

Not Directly Related

APPARATUS					STATUS	INSTRUMENTATION							
No.	Facility	Name	Driving Mode	Operation mode	Sludge Draw-off	I1	I2	I3	I4	I5	I6	I7	I8
Intake Pump Operation					**Active**		●					●	●
A1	Raw Water Reservoir	Influent Valve	H.O.	Manual at Site	**Open**	●	●						
A2		Sludge Disposal Valve	H.O.	Manual at Site	**Open**								
A3	Recieving and	Influent Valve	H.O.	Manual at Site	**Open**			●					
A4	Mixing Basin	Pre-Chlorination		Auto in Chem. bldg.	**Active**			●					
A5		Alum Dosing		Auto in Chem. bldg.	**Active**			●					
A6		Mixer	M.D.	Auto. at Site	**Active**			●					
A7		Sluice Gate	H.O.	Manual at Site	**Open**			●					
A8		Sludge Draw-off Valve	H.O.	Manual at Site	**Open**			●					
A9	Sedimentation and	Sludge Scraper	H.O.	Manual at Site	**Active**			●					
A10	Coagulation Basin	Sludge Draw-off Valve	H.O.	Manual at Site	**Open**								
A11	Filter	Influent Valve	M.D	Manual at Site	**Open**				●				
A12		Blower Valve	M.D	Auto at Site	Close								
A13		Back Wash Draw-off Valve	M.D	Auto at Site	Close								
A14		Back-wash Water Valve	M.D	Auto at Site	Close								
A15		Treated Water Efluent Valve	M.D	Auto at Site	**Open**				●				
A16	Filter Washing W. Basin	Efluent Valve	H.O.	Manual at Site	**Open(adjusted)**						●		
A17	Treated Water Reservoir	Influent Valve	H.O.	Manual at Site	**Open**								
A18		Post-Chlorination		Auto in Chem. bldg.	**Active**								
A19		Lift Pump to Filter W.W. Basin		Manual at Site	**Active**					●			
A20		Lift Pump to Chemical Bldg.		Auto at Site	**Active**			●					
A21		Efluent Valve for Distribution	H.O.	Munaual at Site	**Open**								
A22	Draw-off Water Reservoir	Influent Valve	H.O.	Munaual at Site	**Open**								
A23		Sluice Gate	H.O.	Munaual at Site	**Open**								
A24		Draw-off water Efluent Valve	H.O.	Munaual at Site	**Open**								
A25		Sludge Disposal Valve	H.O.	Munaual at Site	**Intermittent**								
A26		Slurry Pump	H.O.	Munaual at Site	**Intermittent**								
A27	Sludge Drying Beds	Influent Valve	H.O.	Munaual at Site	**Open**								

3.7.6 REFERENCED STANDARD OF DESIGN

The following standards are applied to the detailed design of water supply system:

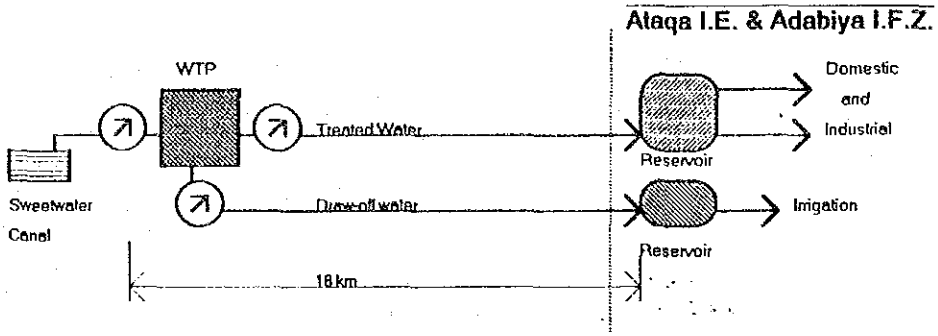
- Egyptian Code of Water Works 1990
- Ministerial Decree no. 286/1989 for Water Works
- Egyptian Reinforced Concrete Standard 1989
- JIS : Japan Industrial Standard
- JWWA : Japan Water Works Association
- JASS : Japan Architectural Standard Specification
- ACI : American Concrete Institute

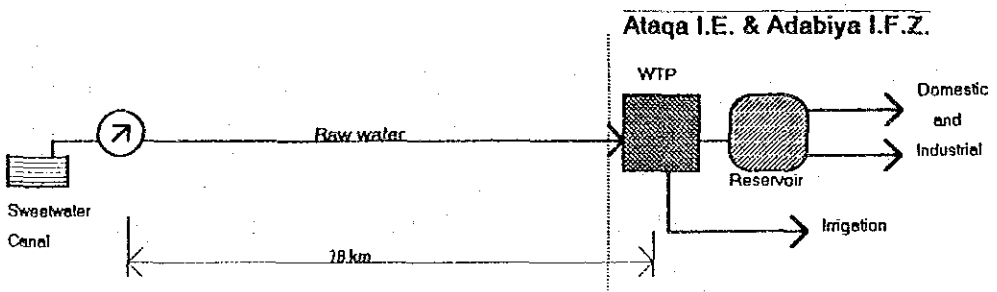
ATTACHMENT WS-1 RAW WATER QUALITY TESTS
(Suez Sweetwater Canal, May'92)

items	unit	SCA data	Investigation data
Color	degree	nil	2
Turbidity	NTU	Max.18 Ave.12-15	15
Total Hardness as CaCO3	mg/l	224	-
Total Dissolved Solid	mg/l	733	-
Total Alkalinity	mg/l	174	172
Ammonium-N	mg/l	nil	0.1
Nitrate	mg/l	nil	0.05
pH		8	8.27
Cyanide	mg/l	nil	-
Mercury	mg/l	nil	-
Arsenic	mg/l	nil	-
Iron	mg/l	nil	nil
Manganese	mg/l	nil	nil
Potassium	mg/l	59	-
Magnesium	mg/l	21	-
Chloride	mg/l	172	172
Phenol	mg/l	nil	-

ATTACHMENT 2-WS ALTERNATIVE STUDY OF LAYOUT FOR WATER SUPPLY FACILITIES.

TABLE (1) Comparison table of the system layout





Description	MASTER PLAN 1986	RECOMMENDATION
Layout	Intake point is located at 3 km upstream from SCA water treatment plant.	same as the master plan.
	Water treatment plant (WTP) is located at the intake point of the Suez Sweetwater Canal.	WTP is relocated to the project area (Ataqa I.E. , Adabiya I.F.Z.)
	Treated water is transmitted 18 km to the project area, then distribute to the project area.	Treated water is distributed from the WTP located in the project area.
	Draw-off water is conveyed 18 km by the pipeline laid along treated water pipeline.	Draw-off water is distributed from the WTP located in the project area.
Soil Condition	Intake & WTP : Swampy	Intake : Swampy, WTP : Hard
Land Owner	Intake & WTP : Private owner.	Intake : Private, WTP : MODANC
Estimated Pipeline Size from Intake to WTP	Treated Water : ND1000mm, DCIP Draw-off Water : ND400mm, DCIP	Raw Water : ND1100mm, DCIP
Operation and Maintenance	Complicated because of lots of pump stations.	Easier than the master plan.
Costs (for reference only)	Assuming Construction Cost = 100 O&M Cost = 100 (as index, no unit)	Comparing with the master plan Construction Cost = 80 O&M Cost = 90 (as index, no unit)

ATTACHMENT 2-WS ALTERNATIVE STUDY OF LAYOUT FOR WATER SUPPLY FACILITIES.

TABLE (2) Comparison table of the pipeline route

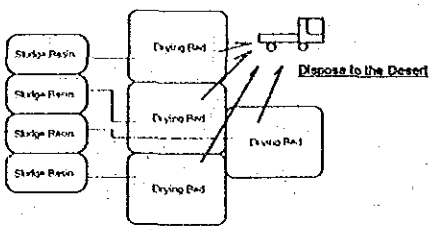
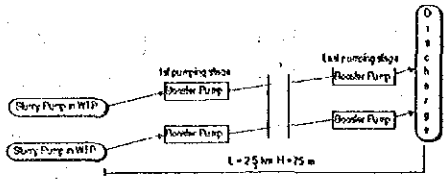
(Between Intake and Water treatment plant)

Area	Master Plan 1986		Recommendation	
	Route	Obstacles	Route	Obstacles
from Intake Point to Suez Railroad Station.	Along Suez - Cairo Road.	Railroad (Suez - Ismailia)	Same as the master plan.	Railroad (Suez - Ismailia)
in Urban Area of Suez City	Running across the urban area.	Railroad (Suez - Cairo), Suez-Cairo Road Water supply pipes, Sewer pipes, Electric cables.	Round about the urban area.	Railroad (Suez - Cairo) Suez-Cairo Road
from Suez Urban Area to Ataqa I.E , Adabiya I.F.Z.	Along the coastal road.	Water supply pipes, Oil pipes, Electric cables	In the desert area (west of Suez City) along Electric transmission line and Ring road	non
Total Length	About 13 km		About 19.5 km	

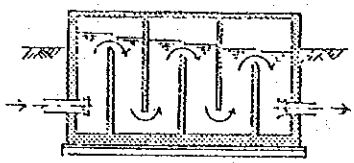
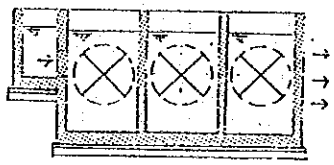
ATTACHMENT 3

ALTERNATIVE STUDY ON TREATMENT SYSTEM

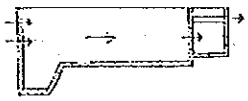
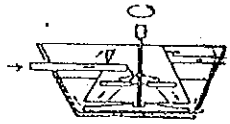
ATTACHMENT 3-WS Comparison table of Sludge Disposal Method

	Drying Beds	Direct Disposal
System Diagram		
Construction and Equipment	• Gravity flow can be available between the sludge basin to the drying beds. • 8 sets of 3.7 kW slurry pumps (4 for operation and 4 for stand-by) are required to convey the sludge water to the drying beds. • 0.7 km of ND 150 steel pipes are required. • About 2.4 ha is required for the drying beds in the WTP. • Electric power for the pumps is supplied from the substation in WTP. • No need to install the emergency generator sets.	• Pump lifting is required. According to 2.5 km of conveyance, total 10 pump stations (one transmission and nine boosters) are required. • About 20 sets of 6 kW slurry pumps (10 for operation and 10 for stand-by) are required. • (2 lines x 2.5 km) of ND50 steel pipe is required. • About 100 m2 for pump pits (in WTP) and about 500 m2 for disposal well (in the desert) are required. • Remote booster station is required additional power substation other than substation of WTP. • Each slurry pump station needs each emergency generator sets, except in WTP. Hence total 9 generators are required.
Operation and Maintenance	• No instrumentation is needed. • Gathering of dried sludge is carried out by manpower. One truck (cap. 2 ton) is required for the sludge conveyance from WTP to the desert.	• Based on inflow quantity of the pump pits, slurry pump shall be operated. • No need to maintain the solid sludge disposal daily. However, periodical maintenance of pipeline and disposal point are required.
Judgment	• Construction cost: Cheap • O&M: Simple and Economy **Conclusion : Good**	• Construction cost: Expensive • O&M: Complicate and Expensive **Conclusion : Inferior**

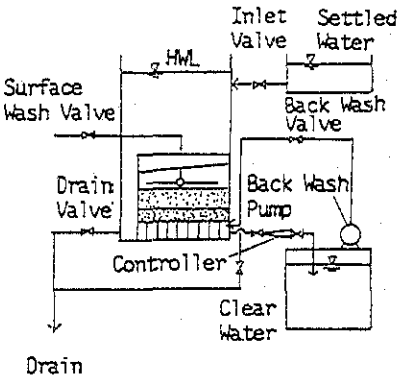
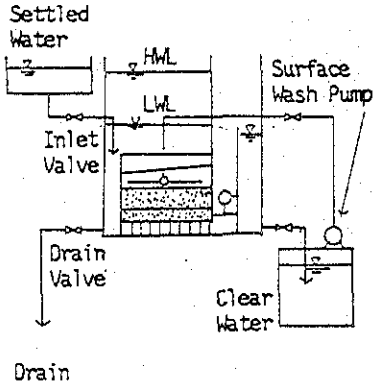
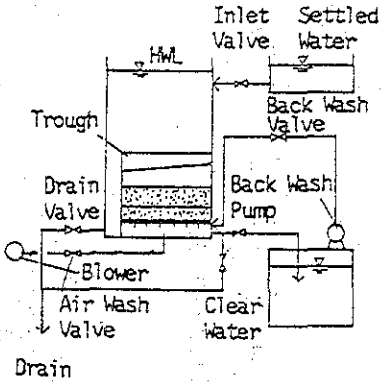
a. Comparison of flocculation basin

Type Item	a. Hydraulic Type	b. Mechanical Type
		
	The above figures show typical types.	
1. Facilities	Basin Baffle walls	Basin Flocculators and motors Motor room/space Compartment walls
2. Head loss	About 40 cm	Negligible
3. Reliability for flocculation	Good	Good
4. Adjustability for water mixing	Unadjustable	Adjustable
5. Maintenance and repair	Not necessary	Necessary
6. Desludging	Difficult	Easy
7. Endurance period	Long	Short
8. Economical aspects		
8-1 Construction cost	100	210
8-2 Operation cost	Not necessary	Necessary

b. Comparison of sedimentation basin

Type / Item	a. Horizontal Flow Type	b. Horizontal Flow Type with inclined plates/tubes	c. Clarifire Type
			
	The above figures show typical types.		
1. Facilities	Basin Sludge scraper	Basin inclined plates/tubes Sludge scraper	Basin Mechanical equipment Chemical feeding equipment
2. Detention time	3 - 4 hrs	0.5 - 1 hrs	1.5 - 2 hrs
3. Adaptability to fluctuation of water quality and quantity	Very good	Good	Good
4. Desludging	Easy	Rather difficult	Rather easy
5. Operation	Easy	Easy	Rather difficult
6. Maintenance and repair	Easier	Easy	Rather difficult
7. Endurance period	Long	Long	Short
8. Economical aspects			
8-1 Construction cost	120	145	100
8-2 Operation cost	100	900	600
9. Land area	400	100	160

C. Comparison Table of Rapid Filters

Item \ Type	Surface washing rapid filter (Gravity flow filtration type)	Surface washing rapid filter (Horizontally uniform filtration and self back washing type)	Air washing rapid filter (Gravity flow filtration type)
1) Structure (Schematic drawing)	 Note : * Every filter basin is separated each other.	 Notes : * Every filter basin is connected each other with filtered water conduit. * To separate individual filter basins, clean water valves are necessary.	 Note : * Every filter basin is separated each other.
2) Outline	This type of filter has separated filter basins. When a filter is required to be cleaned, the filtered water in a clean water reservoir is used to wash the filter sand via the back washing pump.	This type of filter separates each 8 to 10 filter basins as a group. When a filter is required to be cleaned, the filtered water introduced from other filter to the filtered water conduit is applied to wash the target filter.	This type of filter has separated filter basins. When a filter is required to be the filtered water in a clean water reservoir is used to wash the filter sand via the back washing pump.
3) Grouping of the number of filter basins	Two or more filter basins including a spare basin is necessary.	8 to 10 filter basins are necessary for one unit. (Spare basin may or may not necessary.)	Two or more filter basins including a spare basin is necessary.
4) Height of facility	Approximately 5.0 m at the basin	Approximately 7.5 m at the basin	Approximately 5.0 m at the basin
5) Filter layers	Thickness of sand layer : 70 cm Thickness of gravel : 20 cm Effective size : commonly 0.6 - 0.7 mm	Thickness of sand layer : 70 cm Thickness of gravel : 20 cm Effective size : commonly 0.6 - 0.7 mm	Thickness of sand layer : 100 cm Effective size : 0.9 mm

C. Comparison Table of Rapid Filters

Item \ Type	Surface washing rapid filter (Gravity flow filtration type)	Surface washing rapid filter (Horizontally uniform filtration and self back washing type)	Air washing rapid filter (Gravity flow filtration type)
6) Filtration rate	120 m/day - 150 m/day	120 m/day - 150 m/day	120 m/day
7) Underdrain system	Perforated block	Low head loss type perforated block	Nozzles for washing water and air scour
8) Washing methods	Back washing : 0.6 - 0.9 $m^3/m^2 \cdot min$ carried with back washing pump Surface washing : (at a fixed velocity of 0.15 - 0.2 $m^3/m^2 \cdot min$) carried with surface washing pump	Back washing : 0.6 - 0.9 $m^3/m^2 \cdot min$ Continuous feed of filtered water of other basin within the same unit. Surface washing : (at a fixed velocity of 0.15 - 0.2 $m^3/m^2 \cdot min$) carried with surface washing pump	0.6 - 0.9 $m^3/m^2 \cdot min$ Carried with a back washing pump.
9) Maintenance	* The unit includes many valves, a surface washing pump, and a back washing pump. The electric sequence and instruments network are also complex. * Difficult in maintenance and inspection. * Adjustment is more complicated than in the case of ② . * Flow controllers are provided to all basins, which makes the mechanism complex.	* Number of valves is decreased, and no back washing blower nor back washing pump is necessary. Only a surface washing pump is necessary. Electric sequence network is simple. * Structure is simple because the amount of washing water is equal to the amount of discharge.	* The filter have number of valves, an air washing blower, and a back washing pump. Electric sequence network and instruments are complex. * Difficult in maintenance and inspection.
10) Space for installation	Large (Needs a back washing tank)	Small (No need of back washing tank)	Large (Needs a back washing tank and blower room)
11) Maintenance cost	100%	70%	100%
12) Construction cost	100%	70 - 80%	100%
13) Evaluation	B * High construction cost * Difficulty in maintenance * Complex daily operation procedure * Large installation space required	A Recommended * Low construction cost * Easy maintenance * Simple daily operation procedure * Small installation space required	B * High construction cost * Difficulty in maintenance * Large installation space required

Pipe	Advantage	Disadvantage	Available Size	Cost
Ductile iron pipe	1. High strength and excellent impact resistant. 2. Corrosion resistant. 3. Flexible joints. 4. Jointing works can be easily done without a skilled worker. 5. For normal soil condition ,no special bedding is required and can be backfilled by excavated soil.	1. Thrust block is required where thrust force is generated. However, thrust block will not be required or will be reduced in volume if restrained joints are used.	(Ø1,100) o	(Ø1,100) 100
Steel pipe	1. High strength and excellent impact resistance. 2. Thrust block is not required because pipes are joined by welding.	1. Poor corrosion resistance requiring heavy duty corrosion protective coating or system. 2. Welding of joints requires a long time and skilled worker and is interrupted by rain and ground water. 3. Sand bed and fine sand backfilling with compaction are required to prevent excessive deformation.	o	110
Polyvinyl chloride pipe	1. Lightweight, therefore, jointing work is very easy. 2. Excellent corrosion resistance.	1. The strength tends to decrease with increasing temperature. 2. Can be damaged by organic solvent, heat and ultraviolet. 3. Sand bed and fine sand backfilling with compaction are required to prevent excessive deformation. 4. Thrust block is required.	×	-
Asbestos cement pipe	1. Corrosion resistant except under some condition. 2. Flexible joints.	1. Poor impact resistance needs careful handling to avoid damage. 2. Will corroded in acid water and acid soil. 3. Thrust block is required. 4. Asbestos may affect human health. 5. Sand bed and fine sand backfilling with compaction are required to get a large supporting angle.	×	-
Prestressed concrete pipe	1. Corrosion resistant. 2. Flexible joints.	1. Poor impact resistance needs careful handling to avoid damage. 2. Rigid and requires sand bed and fine sand backfilling with compaction to get a large supporting angle. 3. Heavy. O-shaped rubber rings are generally used at the joints, so leakage would easily occur.	o	50
Glass Fiber reinforced pipe	1. Excellent corrosion resistance. 2. Lightweight, therefore jointing work is very easy.	1. Poor impact resistance needs careful handling to avoid damage . 2. Sand bed and fine sand backfilling with compaction are required to prevent excessive deformation. 3. Thrust block is required.	×	

Note : o : available
× : not available