2.3.5 Road tanker transportation

This is temporary vehicle transportation considered for lateral drainage-1 (elimination of standing water)

Amount to be transported	:	1.0 m^3/min
No. of road tankers	:	8 unit/day (5,000 Imp. gallon tanker)
Distance	:	10 km to West Bay
Operation hours	:	12 hours/day

- Cycle time of vehicle

Loading time	:	20 min
Transportation	:	60 min (return)
Unloading	:	20 min
One cycle	:	100 min

- Required number of road tankers

  Capacity of transportation per unit tanker

  22.5 m^3/100 min = 0.225 m^3/min/unit

  Required number

  1.0 m^3/min x 24/12/0.225 m^3/min = 8

  8 units of 5,000 Imp. Gallon tankers

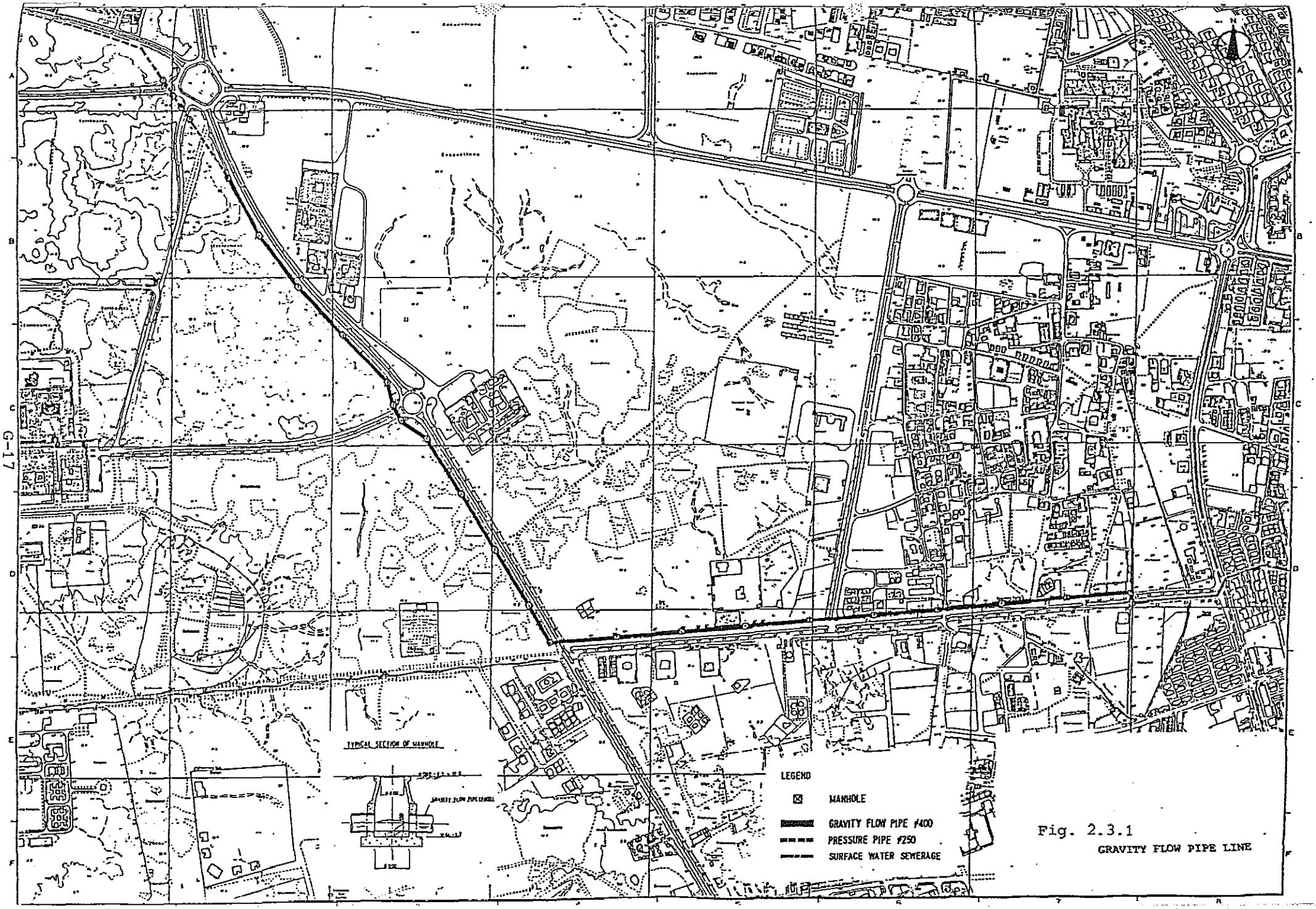


Fig. 2.3.1
GRAVITY FLOW PIPE LINE

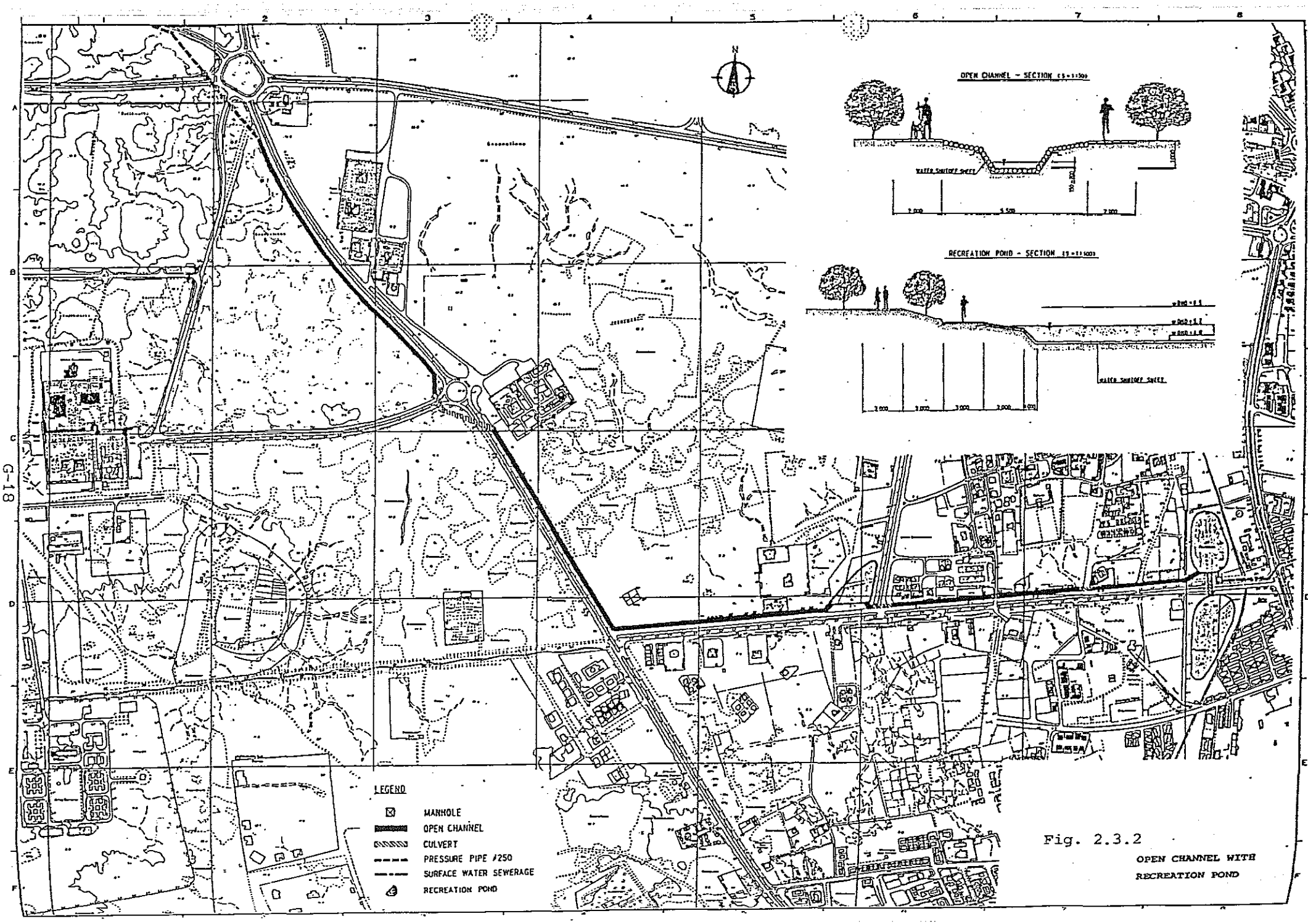


Fig. 2.3.2
OPEN CHANNEL WITH RECREATION POND

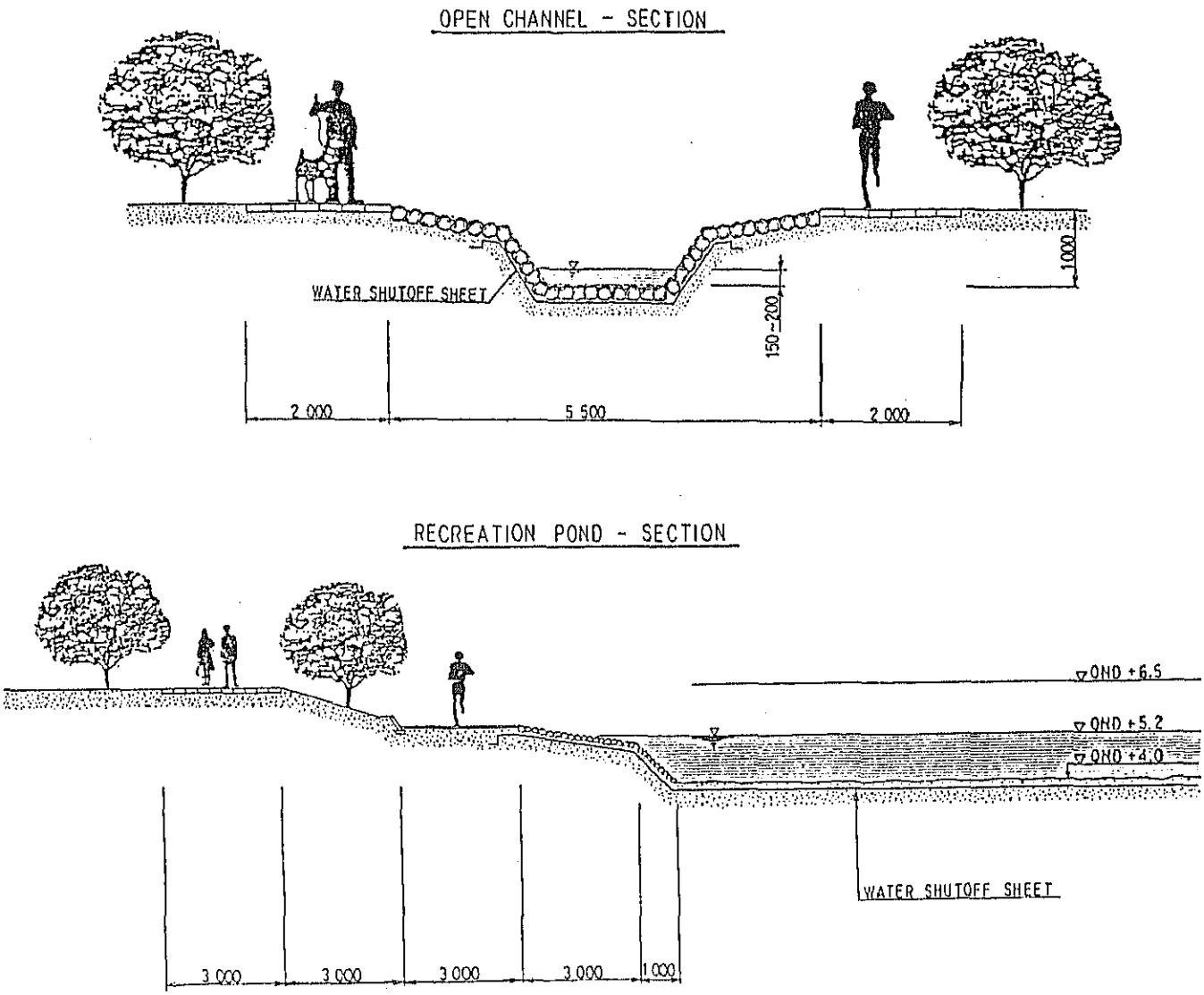
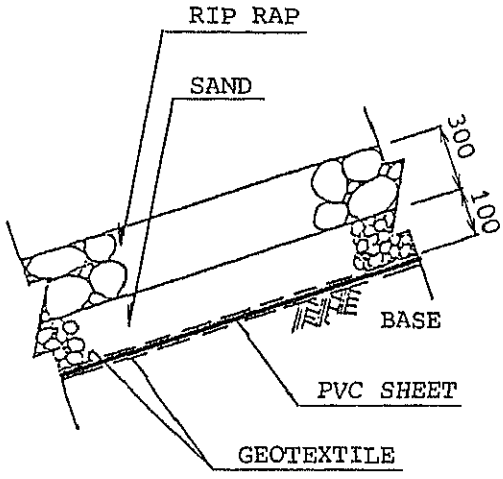
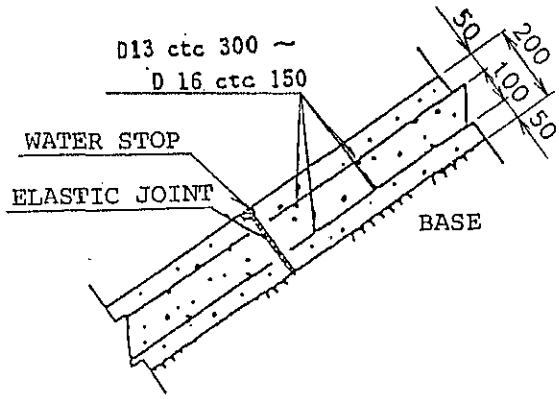


Fig. 2.3.3 Section of Open Channel and Recreation Pond

Sheet Method



Concrete Slab Method



Rubber Asphalt Method

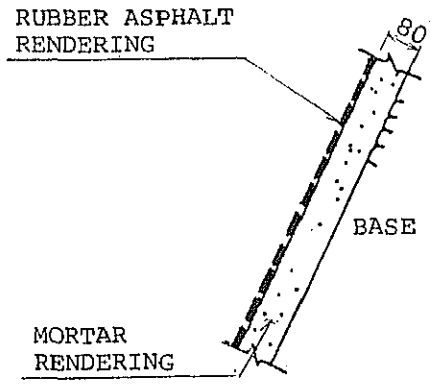


Fig. 2.3.4 Water Shut-off Methods

2.4 Disposal Points

Unless the quantity is very limited, there is a problem that high salinity groundwater abstracted from Rayyan may diminish biological treatment capacity at sewage treatment works if disposed there.

Therefore disposal points are either sea or desert.

2.4.1 West Bay

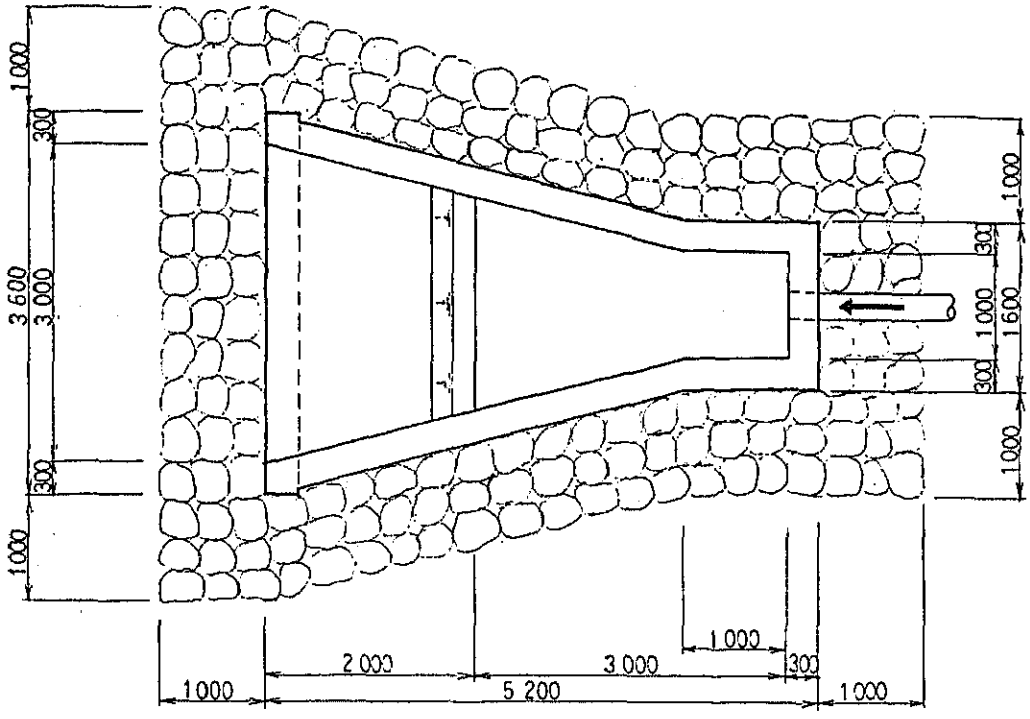
Water shall be discharged into sea directly by way of outfall (Fig. 2.4.1) or through a mangrove lagoon DRP-4006 for water quality improvement.

2.4.2 Musherib Stormwater Trunk Line

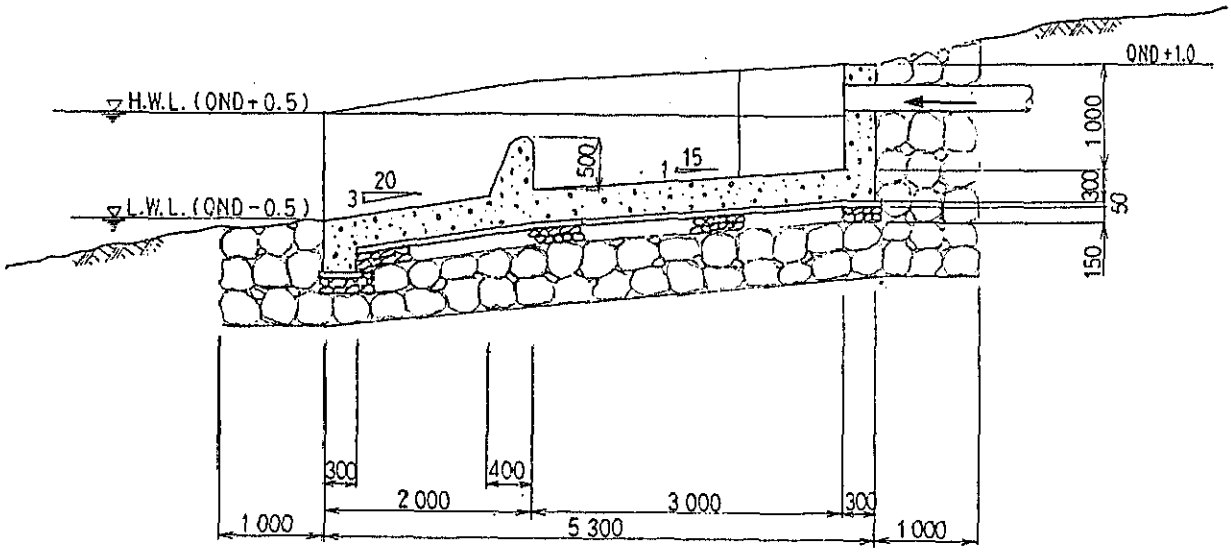
Transfer line shall be connected to the upstream end of the Wadi Musherib stormwater trunk line in progress at Wadi Musherib, discharging the water into Doha Bay.

2.4.3 Desert

Disposal at desert area was examined but considering the recirculation of discharged water, distance to the possible area is far greater than those for the other two alternatives. Should closer locations be used, shutoff of infiltration by sheet covering is required for a huge area and not economical.



PLAN



SECTION

Fig. 2.4.1 Outfall Structure

2.5 Cost Estimation of the Alternatives

Regarding all the alternative in Section 2, rough cost estimation was made for comparison purpose according to the cost data obtained in Doha and information in Japan. Prior to cost estimation, quantities of the works for each alternative were also calculated.

Especially cost for mangrove lagoon project is just indicative cost for civil construction.

2.5.1 Unit rates

Sources of unit rates are referred to in the relevant section of Wadi Musherib drainage plan. In addition for pump station equipment and special pipe for transfer line, prices currently prevailing in Japan were used.

The applied unit rates for cost estimation are listed in Table 2.5.1.

Table 2.5.1 Unit Rates for Cost Estimation

Item	Specification		Unit	Rate (QR)	Remarks
Excavation	Including dewatering		m^3	180	
Disposal of surplus soil			"	30	
Backfilling			"	30	
Gravel filling	Dia. 13-20, 25-45 and 50-75 mm with compaction		"	45	
Structural concrete	Sulphate resistant cement, GRADE 25		"	300	
Lean concrete	Sulphate resistant cement, GRADE 15		"	260	
Reinforcing bar			ton	3,000	
Shuttering			m^2	20	
Peforated pipe	ESVC pipe	ø300	m	150	Material and installation
		ø450	"	200	
		ø600	"	500	
Closed pipe	Concrete pipe	ø600	m	200	
Manhole	Precast concrete manhole, ø900 (inner diameter)	H=4-5 m	no.	6,000	Material and installation
		5 -6 m	"	7,000	
		> 6 m	"	8,500	
Reinstatement of road	Asphalt pavement		m^2	75	
Embankment	H=1.7 m		"	25	
Fence	Galvanized wire mesh fence, H=2.0 m		m	400	
Gate	W=6.0 m, H=2.0 m		no.	5,250	
Pump house	Reinforced concrete frame with block wall		m^2	3,500	
Discharge pipe	Ductile iron pipe with bends and fittings	ø250	m	326	Material and installation
		ø350	"	489	
Earthwork	Excavation, disposal of surplus soil, backfilling and dewatering		m^3	180	
Pavement cutting and resurfacing			m^2	250	For discharge pipe line
Intermediate water chamber			no.	41,000	
Branch			"	2,670	
Temporary outfall			"	12,000	

2.5.2 Bill of Quantities

Quantities of the major works for groundwater collection system and transfer system are as follows;

(1) Collection system

Table 2.5.2 Quantities of the Works for Collection System at Old Rayyan

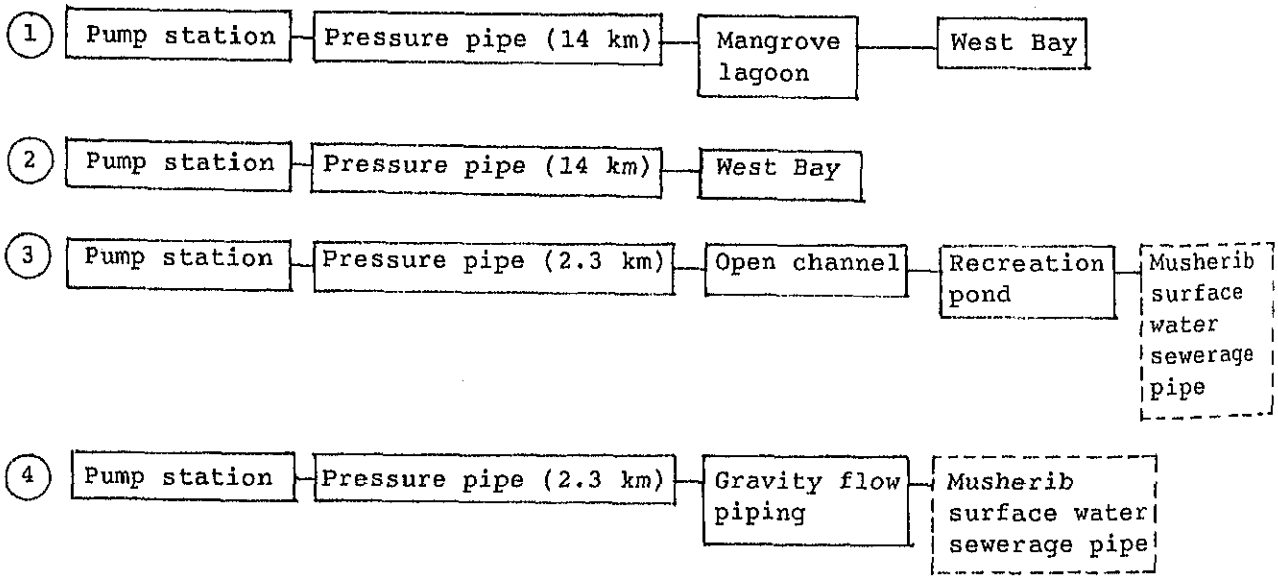
Item		Spec.	Unit	Elimination of standing water	Comb arrangement	Perimeter arrangement
Pipe Length	ø600	Perforated pipe	m	-	-	327
	ø450	"	"	1,030	2,500	1,646
	ø300	"	"	-	3,580	3,868
Manhole			no.	10	59	59
Excavation			m^3	8,700	57,800	54,800
Gravel filling			"	3,800	26,100	24,900
Sand filling			"	-	-	-
Concrete			"	600	1,700	1,600

(2) Transfer system

Table 2.5.3 Quantities of the Works for Transfer System at Old Rayyan

Item		Spec.	Unit	①	②	③	④
Pipe Length	ø250	Ductile iron pipe	m	6,700	6,700	-	-
	ø350	Ductile iron pipe	"	6,400	6,400	-	-
	ø250	Poly vinyl chloride pipe	"	-	-	2,400	2,400
	ø400	ESVC pipe	"	-	-	-	3,400
Open channel		W=5.5 D=1.5	m	-	-	3,300	-
Manhole			no.	0	0	4	25
Excavation			m^3	37,000	37,000	171,400	9,700
Sand filling			"	0	0	1,100	4,000

The numbers of transfer systems mentioned in Table 2.5.3 refer to the following four routes;



2.5.3 Construction Cost

From unit rates and quantities of the works, construction cost for alternatives were derived as follows;

In these construction costs, land requisition cost and engineering fee are not included.

(1) Collection system

Table 2.5.4 Construction Cost of Collection System for Old Rayyan

(Unit: x 10^3 QR)

Item \ Alternative		Elimination of standing water	Comb arrangement	Perimeter arrangement	Remarks
Pipe work	Earth work	1,990	11,630	11,030	Excavation, disposal of surplus soil, backfilling and dewatering
	Installation	700	2,880	2,760	Pipe material delivered at site, concrete cradle, gravel and concrete bed
Manhole		150	870	870	Material, installtion and earth work
Road reinstatement		150	380	1,200	
Pump station		1,000	-	-	Equipment, building and pump pit
Total		3,900	15,770	15,860	

(2) Transfer system

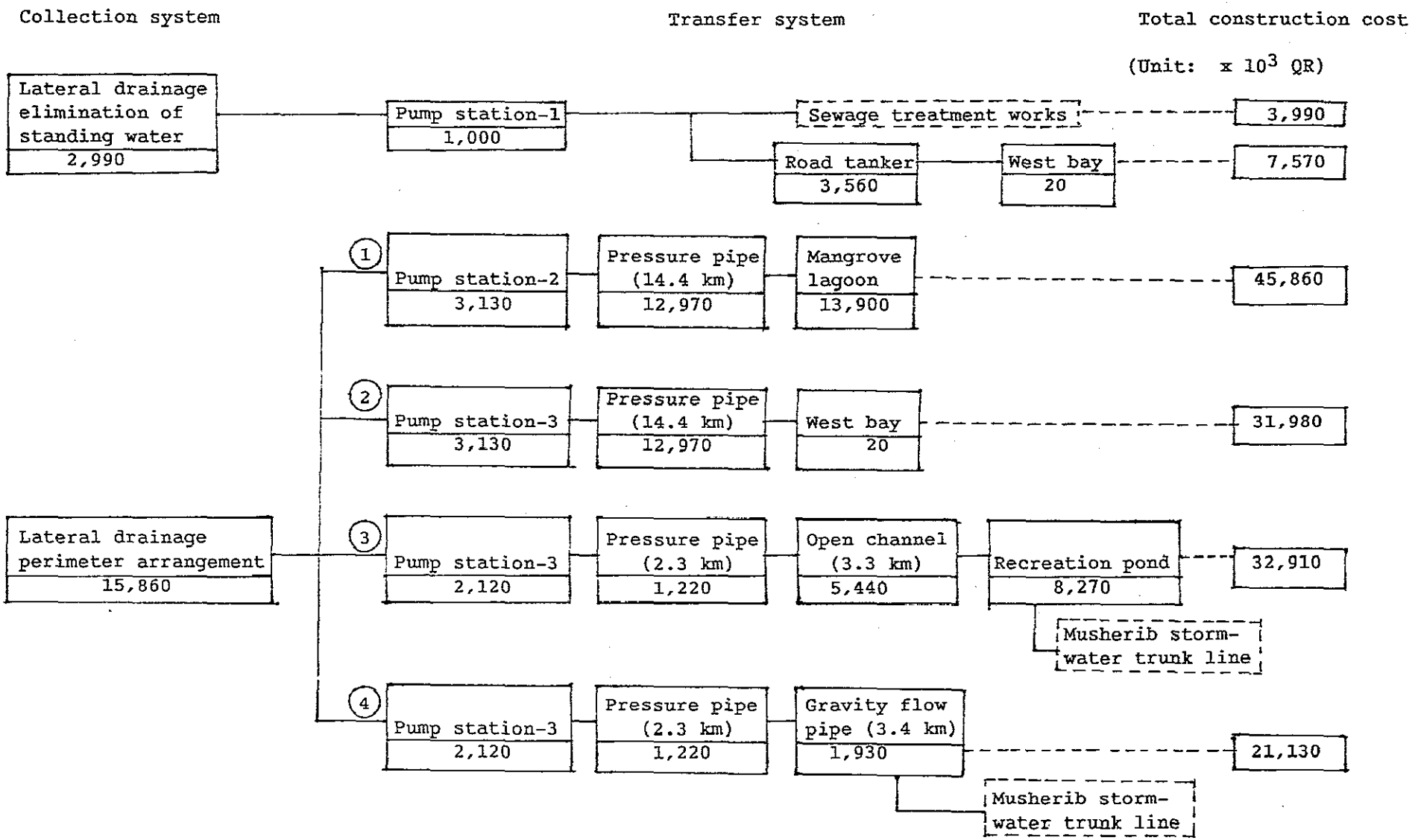
Table 2.5.5 Construction Cost of Transfer System at Old Rayyan

Unit Qatar Rials ($x10^3$)

Item		①	②	③	④	Remarks
Pipe Work	Earth work	6,660	6,660	610	1,820	Excavation, disposal of surplus soil, backfilling and dewatering
	Installation	6,310	6,310	590	1,220	Pipe delivered at site Concrete cradle, gravel and bed concrete, thrust boring
Manhole		-	-	20	110	Material installation and earth work
Open channel		-	-	5,440	-	Earth work, slope protection, water shutoff sheet, walkway, plantation, culvert, etc.
Recreation pond		-	-	8,270	-	Park facilities in addition to the items of open channel
Pump station		3,130	3,130	2,120	2,120	Equipment, building and pump pit
Outfall		-	20	-		Earth work, concrete work
Mangrove lagoon		13,900	-	-	-	
Total		30,000	16,120	17,050	5,270	

Construction cost for the whole drainage system (combination of the collection system and transfer system) is shown in Table 2.5.6.

Table 2.5.6 Summary of Cost Estimation for Old Rayyan



2.6 Comparison of Alternatives

Regarding collection system and transfer-disposal system, features of each alternative are examined here. However alternative plan for elimination of standing water is different in purpose from the others and has been removed from the comparison.

2.6.1 Collection system

Table 2.6.1 Comparison Table for Collection System at Old Rayyan

	Perimeter arrangement	Comb arrangement	Utilizing existing wells
Effect of diminishing groundwater level	High	High	Rather low due to random locations
Collection method	Cutting flow from outside of the area	Collecting ground-water inside the area	Collecting ground-water inside the area
Land use	Allocated under roads and almost no obstruction	Allocated inside the area and somewhat restricting	Small pipes restricting
Length of the lateral drainage	Relatively short	Relatively long	Rather short
Cost	Relatively small	Relatively high	Relatively high

As summarized above, perimeter arrangement is recommendable for collecting system at Old Rayyan.

2.6.2 Transfer and disposal system

Alternatives proposed here have basically different functions other than transfer and disposal of drained groundwater and they therefore cannot be evaluated by one scale. In order to determine the final plan the following parameters shall be considered.

a. Cost
b. Urgency
c. Re-use
d. Pollution control
e. Accordance with other projects

a. Cost
Route-4 (gravity flow pipe method via Jaida petrol station) is considerably cheaper than others.

b. Urgency
Considering the serious situation at Rayyan, at least the standing water shall be eliminated by the immediate implementation of phase-1. And discharge to No. 14 sewerage pumping station during phase-2 construction is inevitable.

When adopting Route-3 and 4 connecting to Wadi Musherib stormwater trunk line, implementation schedule thereof is important. Completion date for upstream end at Musherib Dam is not clear and there may be some discrepancy in timing of connection.

c. Re-use
Route-1 (West Bay mangrove lagoon) shall be evaluated by the re-use parameter. As irrigation water for mangrove and date plantation, groundwater from Rayyan is more efficient than sea water.

Route-3 (open channel and recreational pond) aims to contribute a scenic landscape and recreational area for the citizens.

d. Pollution control
It is estimated that quality of groundwater from Old Rayyan shall not require treatment before discharging into sea. Nevertheless Route-1 and 3 have water treatment functions. Route-1 contains the mangrove lagoon where mangrove trees improve COD and other ions by biochemical actions. On the other hand, Route-3 contains an open channel section where water flows on boulders and oxidization of water with air improves the water quality.

e. Accordance with other projects
Doha Municipality has a plan to develop a garden near the Musherib Dam area and the Amir's Office has a plan for mangrove lagoon in the West Bay Development project. Therefore all alternatives shall have accordance with other projects by authorities concerned.

2.6.3 JICA's recommendation

When considering the construction cost and period, total pipe line system via Jaida Petrol Station is the most effective, but from the point of landscaping, open channel and recreation pond system is highly evaluated. However the plan composed of discharging the abstracted groundwater to the mangrove afforestation lagoon near the seashore offers the best re-use opportunity for the abstracted water in accelerating the growth of mangrove and diversification of mangrove species, and the development of such a large green afforestation park will definately enhance the beauty of Doha City.

In conclusion the JICA study team recommend the lateral drainage in perimeter arrangement and discharge at West Bay coupled with mangrove afforestation.

3. Preliminary Design

According to the comparison of alternatives in 2.6, preliminary deisgn is performed hereinafer.

3.1 Lateral Drainage Facilities

3.1.1 Outline of Drainage Facilities

Quantities of the lateral drainage facilities are as follows;

- Perforated pipe : ø300 - 3,910 m
  ø450 - 1,664 m
  ø600 - 330 m
  Total 5,904 m
- Connection pipe to discharge pump station : ø600 - 25 m
- Manhole : 59 nos.

General plan of the lateral drainage system is shown on DWG. No. DRP-3001 and detailed plans on DWG. Nos. DRP-3020 and 3021. The transversal and longitudinal sections are on DWG. Nos. DRP-3002 thru 3004.

3.1.2 Outline of Drainage Plan

The lateral drainage facilities are designed to be located so as to cover and surround the project area. They shall be connected to the discharge pump station to be located in the center of the project area at the lowest part.

In addition to the perimeter drainage pipe, lateral drainage pipe is also provided in the central part of the network so that the distance between the drainage pipes located in parallel is at most 500 m. This enables the drainage by the lateral drain and the resultant drop of groundwater level to be more effective.

Since the lateral drainage pipe located in the central part of the network can collect less groundwater than the surrounding pipe once the groundwater level is lowered, it shall be used for the transfer line to the discharge pump station from the surrounding pipeline.

In the project area for Old Rayyan, the land is under suburban utilization such as large scale farming and housing so that few public roads run within this area. Therefore, a part of the lateral drainage pipeline shall be placed within private land.

(1) Determination of Route

The lateral drainage pipe shall be placed

- to surround and cover the area where the groundwater level is less than 1.5 m below the ground level,
- in principle along the secondary roads so that no land acquisition is required and the hindrance to traffic by the construction can be minimized,
- under the carriage way where it cannot be placed along the road because it is too narrow,
- where the elevation of the road is higher than that of the vicinity, at the bottom of the embankment in order to reduce the cost of earth work, and
- to avoid houses and structures in cases when it cannot be placed along the road.

(2) Depth of Lateral Drainage Pipe

The groundwater level in the lateral drainage network is about QND + 5.5 m and the invert level of pipe is set so that the depth of 3.5 to 4.0 m from the groundwater level can be kept.

Therefore, the invert level of the most upstream point is set as QND + 2.0 m. The hydraulic gradient is determined as 1/1000 and thereby the intake pit at the discharge pump station is not so deep.

As a result , the invert level is set ranging from QND + 2.0 m to QND + 0.3 m with an earth cover of 4 to 7 meters.

(3) Design of Pipe

Since most of the abstracted groundwater, discharge of which is taken as 3,000,000 m^3/year or 0.095 m^3/sec, is considered to come from outside the project area, pipes on the perimeter of the drainage system are designed to drain the whole abstracted groundwater and the groundwater discharge amount in the pipe is calculated per linear meter.

The diameter of pipes is calculated for the discharge at the point concerned of the network. The discharge at each point is shown in Fig. 3.1.1.

Calculation of the diameter shall be done in the same manner as the drainage plan for Wadi Musherib.

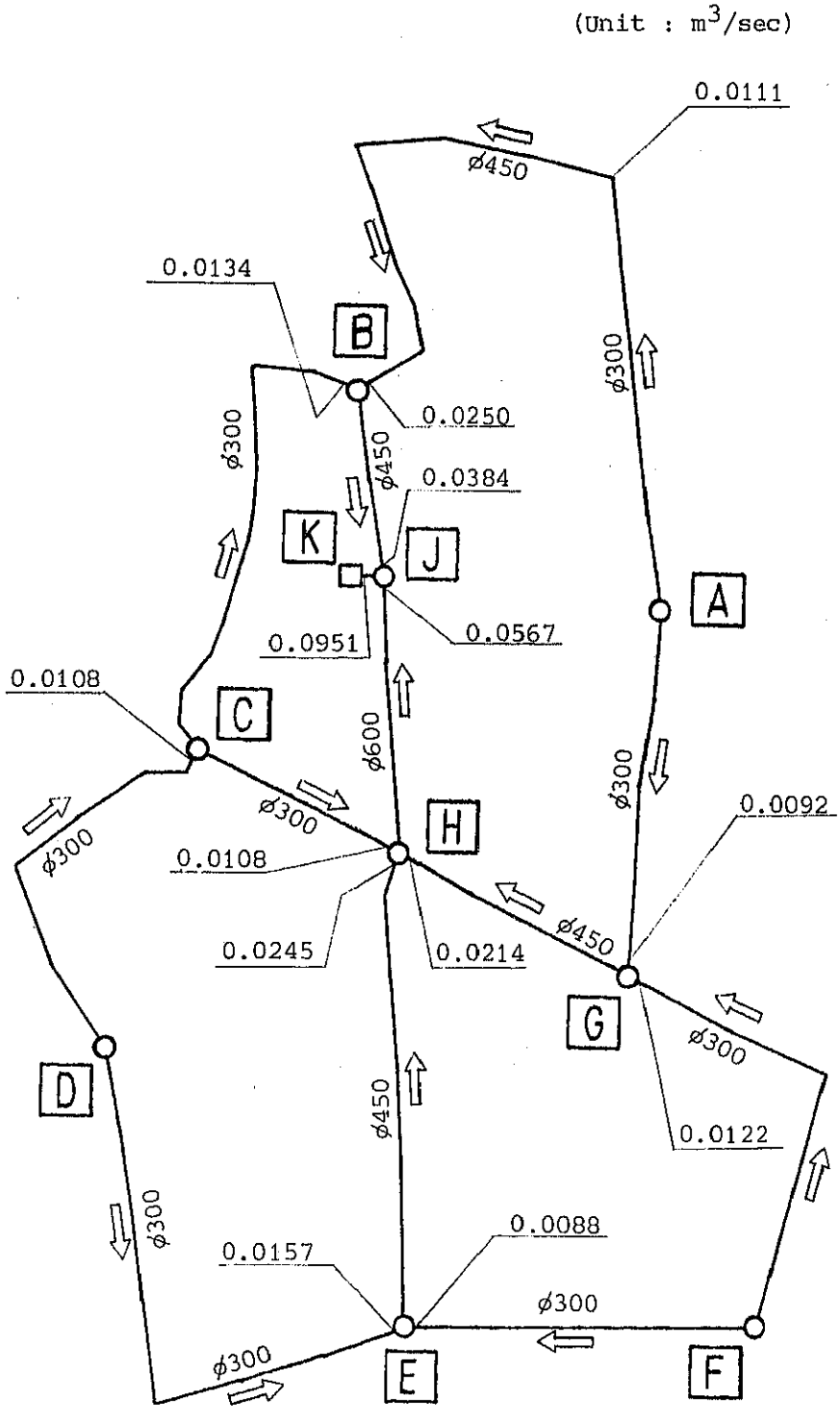


Fig. 3.1.1 Volume of Abstracted Groundwater at Each Point

Carrying capacities for different diameters of pipe are listed below;

Table 3.1.1 Carrying Capacity of Pipe

Diameter (mm)	Hydraulic gradient	Velocity (m/sec)	Discharge Capacity of Pipe (m^3/sec)
ø300	0.001	0.682	0.0241
ø450	0.001	0.911	0.0725
ø600	0.001	1.112	0.1573

(4) Typical Section of Lateral Drainage

A typical section of the lateral drainage shall be as shown below.

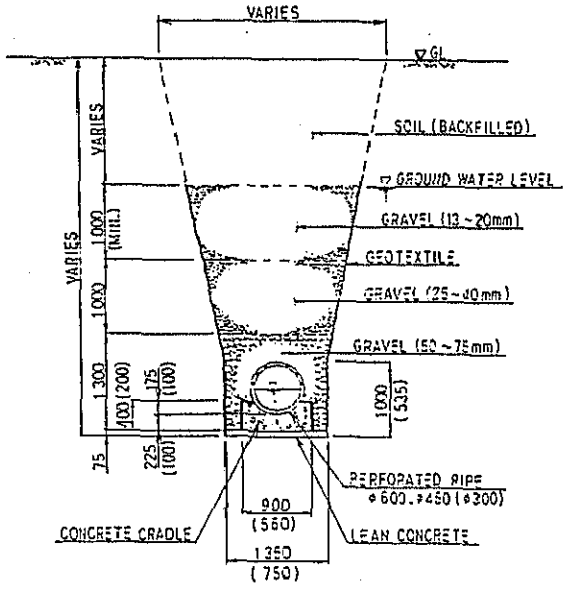


Fig. 3.1.2 Typical Section of Lateral Drainage

Since ground condition in this area is as a whole better than in the project area at Wadi Musherib, excavation can be done without supporting structures. However, in order to avoid the collapse of the excavated surface, excavation shall be done with the slope of 1:0.2 up to the top level of pipe and then vertically. This enables the earth pressure on the pipe to be reduced.

After pipe laying and prior to backfilling, geotextile sheets shall be applied and three kinds of gravel shall be filled around the perforated pipe as described in the relevant section of Wadi Musherib drainage plan.

(5) Pipe Foundation

The buried pipes are subject to moment and shear forces by the action of backfill materials and/or surcharge load on the ground. When the bearing surface is unevenly finished (bumpy) in the construction, pipes may be damaged by these forces. Therefore to resist the external forces by the combination of pipe and foundation, concrete foundation as attached below was considered.

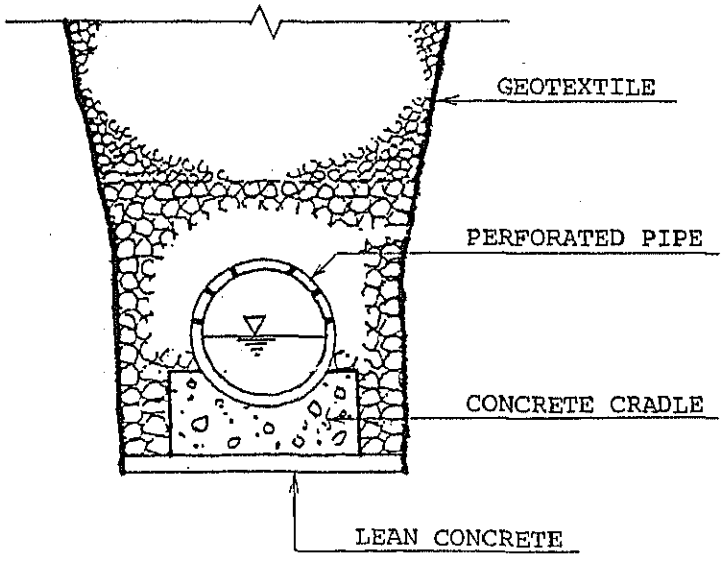


Fig. 3.1.3 Pipe Foundation

(6) Materials for Pipe

For pipe materials, as described in the relevant section of Wadi Musherib drainage plan, extra strength vitrified clay (ESVC) pipe shall be employed.

(7) Manhole
(Refer DRP-3005)

Manholes shall be located in general about 100 meter apart, as mentioned in the relevant section of Wadi Musherib drainage plan.

3.2 Discharge Pump Station and Discharge Pipe Line

3.2.1 Design Policy

(1) Design conditions

Basic design conditions are set as follows;

a. Design discharge quantity

3,000,000 m^3 per year
5.7 m^3 per min

b. Design water intake level of pump pit

According to the result of the lateral drainage network for groundwater collection, water intake levels are,

High water to start	QND + 1.500 m
Low water to stop	QND + 0.800 m

c. Ground floor level of pump station

Considering the future land reclamation around the pump station, ground floor level shall be QND + 7,000 m.

d. Operation

There shall be no full time operator but patrol once a day. Therefore pumps shall be activated or shut-off automatically according to the water level. Simple control system shall be considered as much as possible.

e. Electric power

Power source shall be from the public electric network system and received in 6,000V and 50Hz.

f. Settling basin

Conveyed water is groundwater without debris or suspended solids therefore settling basin is not provided.

g. Discharge point

Transfered water shall be discharged at Natural Reserve Area in the Regional Park for New District project which is proceeding by the Amir's Office.

h. Discharge pipe line

Route of the pipe line and longitudinal section are shown on the Drawing DRP-4001.

Highest point	:	Near cement factory in Haul Road, elevation QND + 20,960 m where an intermediate chamber is provided to have free water surface enabling the gravity flow after this point.
Number of curves	:	5 points in pressurized part out of 7 points in total

(2) Location of the pump station

Location of the pump station was selected at a point adjacent to a new pumping station for sewerage line planned by MPW and has the following advantages.

- Almost lowest point in the project area and suitable for collecting water.
- Adjacent to the existing and newly proposed pump station and convenient for daily patrol.
- Proposed site has been already incorporated in the governmental use area.

(3) Method of operation and monitoring

- Pumps are operated by automatic on-off according to the water level in the intake pit.
- Pump operation is controlled automatically for two (2) number units.
- One of three pumps is stand-by unit and automatically turned-on upon trouble in any one of the two running pumps.
- As monitoring equipment, flowmeter, integrating meter and EC meter with recording function are provided.

(4) Emergency power supply

Provision of diesel generator for emergency was examined but excluded for the following reasons.

- Reliability of public electric power supply system in Doha is very high.
- Purpose of the pump station is pumping of groundwater and even an occurance of one or two days black out may not cause serious problem.
- Cost for emergency generator and housing it is considerably high.

(5) Route of the discharge pipe line

Two routes, A and B, for the pipe line from Old Rayyan to the West Bay are considered as shown in Fig. 3.2.1. On either route, pipes are installed in the foot path of the road.

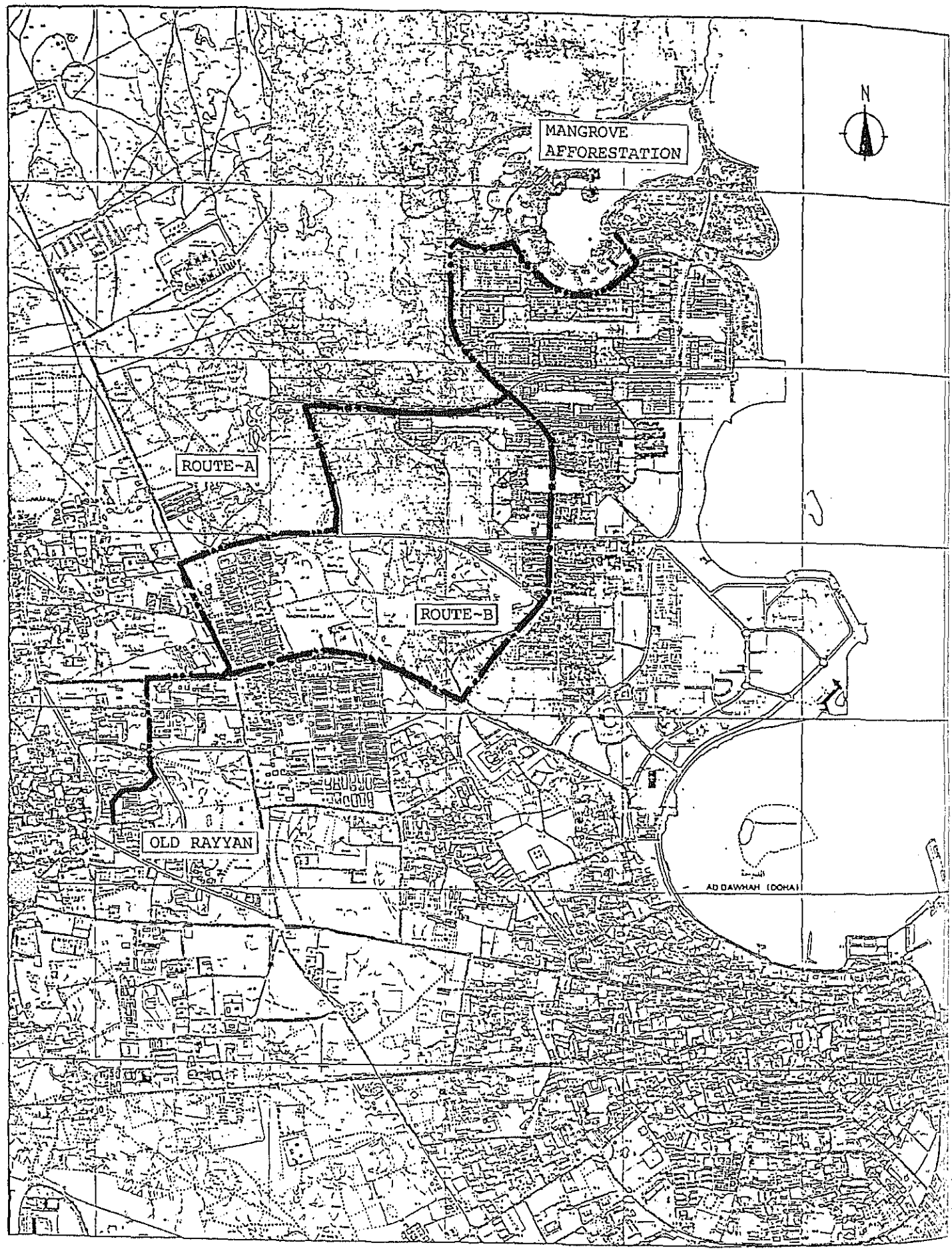


Fig. 3.2.1 Route of Discharge Pipe Line

For the Selection of Route A, following matters were considered.

- Length of the pipe line is shortest from pump station to the out fall.
- Curves at crossing of main roads are 7 in number but there is no sudden vertical change, and they are manageable from the hydraulic point of view.
- There is no difficulty in land acquisition
- In Route A, in comparison with Route B residential areas and commercial zones are much less and there is sufficient area secured for intermediate water chamber.

(6) Pipe material

Under such corrosive conditions, pipe materials generally considered are ductile iron pipe, aluminum coated steel pipe, fiber reinforced plastic pipe, poly vinyl chloride pipe, asbestos pipe etc. Anticorrosion measures for ductile iron pipe such as internal cement mortar lining and external PVC tape wrapping and for steel pipe such as aluminum smelt coating are considered.

After examination on safety, durability and workability, ductile iron pipe was selected for the following reasons;

- Widely adopted for underground pipes in Qatar and good results are obtained.
- Regarding PVC pipe and asbestos pipe, strength to withstand high pressure and durability is not sufficient.
- Aluminum coated pipe is preferable regarding anticorrosvie effect which is referred to in Fig. 3.2.2, and low cost but in durability and difficulty of site erection is inferior to ductile iron pipe.

It is recommended to adopt push-on-joint as joint for the ductile pipes.

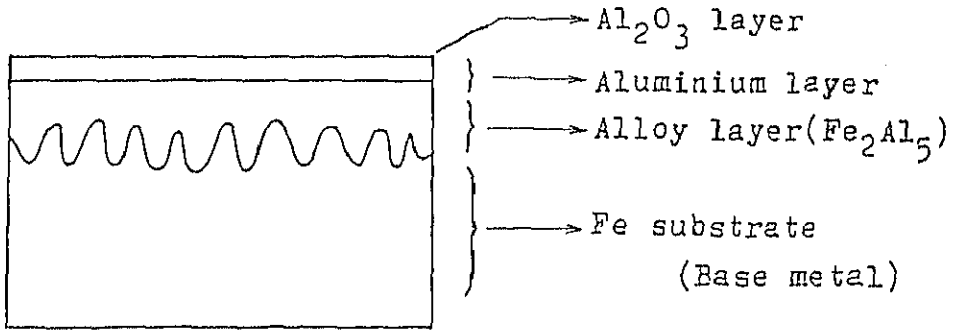


Fig. 3.2.2 Aluminized Steel Pipe

The microstructure of the coated layer of aluminium coated steel pipe is shown above. The microstructure consists of Al_2O, aluminium, alloy (Fe_2Al_5) and Fe substrate layers. The thickness of each layer is few angstrom units of Al_2O_3, 30 to 50 micron for the aluminium and 120 micron in average for the alloy layer, respectively. (According to JIS, the thickness of coated layer for anti-corrosion used should be more than 70 micron). The thickness of the coating may seem very thin but the galvanic corrosion protection mechanisms between each layer provides substantial prevention of corrosion in sea water.

(7) Depth of the pipe

Standard depth of pipe installation shall be 120 cm at places under road, foot path and road shoulder and at crossing parts with other pipes a minimum of 30 cm shall be secured, considering the following;

- Safety against horizontal earth pressure and live loads from above.
- Enabling the provision of control and air valves in the earth covering above pipe.
- In this pipe line there is no branch along the way with no possibility for provision of such in the future. Therefore this pipe line shall be installed as deep as possible in order to avoid interference with other piping and cabling.
- Standard depths of underground facilities are as follows

Potable water	90 mm
Sewerage	120 mm
Electric cable	40 mm
Telephone cable	40 mm

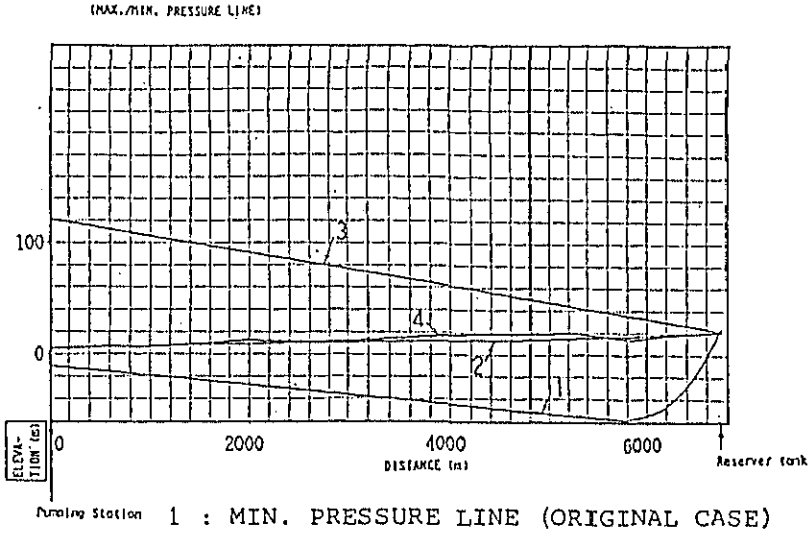
(8) Water hammer protection

There are some countermeasures for water hammering in the pipe line which are curbing intensive velocity change and curbing the pressure rise and fall. For this pipe line the fly wheel method was considered being one of the simple and reliable measures and was confirmed to be satisfactory in the computation.

- Result of the computation

without fly wheel
maximum negative pressure
- 7.436 kg/cm^2
at the point of 5,229.9 m from the pump station with the elevation of QND + 20.71 m and out of allowance

with fly wheel of 40 kg/m2
maximum negative pressure
- 0.530 kg/cm^2
at the point of 5,047.5 m from the pump station with the elevation of QND + 20.21 m and within allowance



1 : MIN. PRESSURE LINE (ORIGINAL CASE)
2 : MIN. PRESSURE LINE (WITH PREVENTION DEVICE OF FLYWHEEL)
3 : INITIAL HYDRAULIC GRADIENT
4 : PIPELINE PROFILE

Fig. 3.2.3 Result of Water Hammer Computation

3.2.2 Outline of the facilities

(1) Pump facilities

Flow diagram, electrical oneline diagram and arrangement of the pump system are as shown in Drawings DRP-4002 and 4003.

Total head	:	122.0 m
Actual head	:	21.4 m
Head loss	:	98.19 m
Flow rate	:	2.85 m^3/min
Number of Pumps	:	3 units (one stand by)
Type of Pump	:	
Material	:	Casing forged cast iron rotor, impellar, rod and sleeve SUS 316
Motor	:	110 KW x 415 V x 50Hz

(2) Discharge pipe line (pump station, water chamber, pressure pipe part)

Length	:	6,700 m
Pressure	:	12 kg/cm^2
Pipe material	:	Ductile iron pipe BS 4772 K-9 with external protection, 2 x 1.1 mm PVC tape wrapping and internal lining cement mortar 5 mm

(3) Intermediate water chamber

Water level	:	QND + 22.20 m
Ground level	:	QND + 20.96 m
Water chamber	:	Reinforced concrete chamber 2.5 m x 2.5 m x 3.3 m height
Capacity	:	30 m^3

(4) Discharge pipe line (Water chamber-West Bay, gravity flow part)

Length	:	7.7 m
Pressure	:	3 kg/cm^2
Pipe material	:	Ductile iron pipe same as above specification

3.3 Groundwater Distribution in Mangrove Lagoon at West Bay

Uniform distribution of groundwater is required for the lagoon. For this reason a water distribution channel was considered along the north bank.

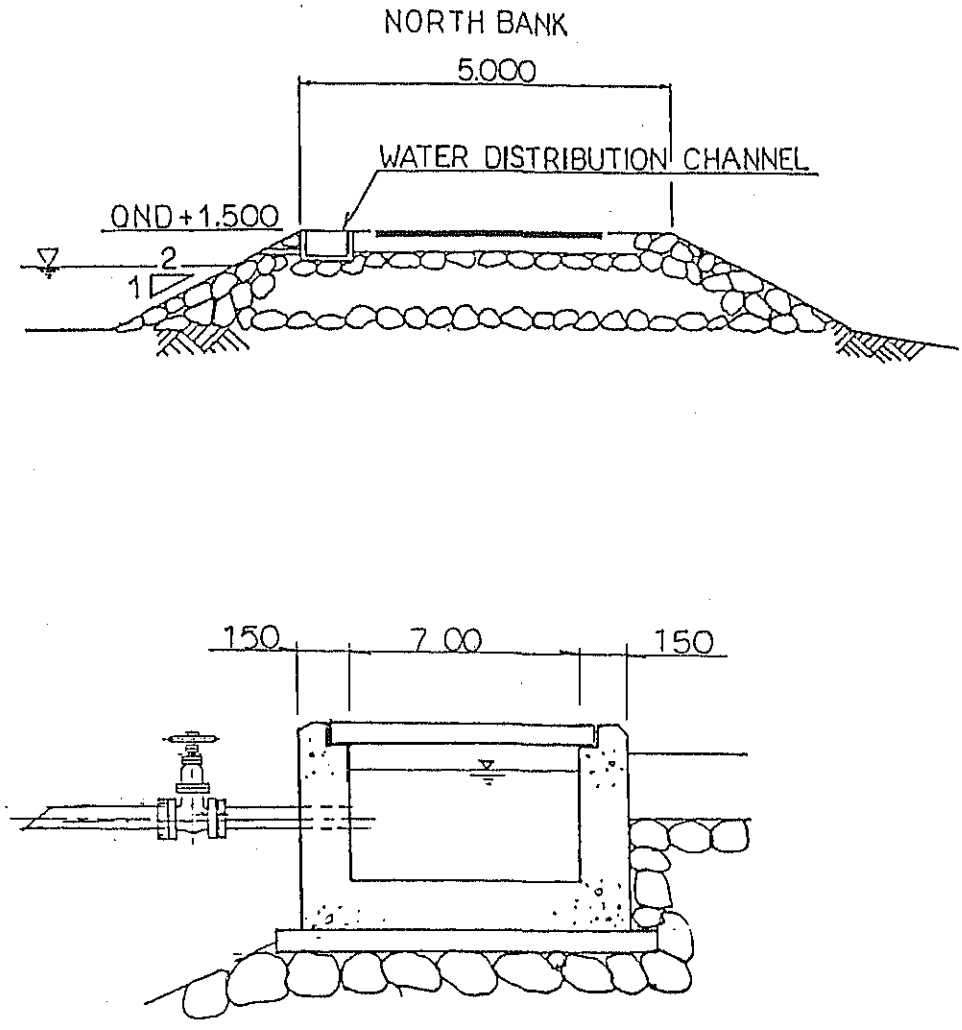


Fig. 3.3.1 Water Distribution Channel

3.4 Specification of Construction Work and Material

The standard specifications for civil, electrical and mechanical works published by Ministry of Public Works are deemed to be adopted in this project. Special notes to be specified in addition to these, are as follows.

(1) Investigation before excavation

Following investigation shall be done before excavation

- subsurface conditions
- neighboring buildings and structures
- necessity of shoring
- groundwater level
- groundwater quality

(2) Dewatering

All the excavation shall be executed in dry conditions with necessary dewatering. During all excavation work, attention shall be paid to excavation wall, that is, soil or rock condition, groundwater level and seepage aspect. Especially when encountering the situation where big flow seems to be connected with a particular source, the reason shall be clarified and adequate action shall be taken as required. "Washing out" or "piping" phenomena shall be carefully checked. Rate of dewatering at initial stage shall be moderate and determined considering the surrounding situation.

Disposal of the water shall be by the discharge pump station and sand settling basin shall be provided.

(3) Monitoring points

On both sides of the trench excavation, monitoring points for ground deformation by drawdown shall be selected, measured and recorded before and after the work. These points shall be strong enough for long term observation during drainage operation.

(4) Concrete work

Concrete used in this project shall be dense concrete. Covering to reinforcing steel in concrete shall be more than 70 mm and external surface in the ground shall be coated with an anti salt-attack paint.

(5) Perforated pipe

Pipe to be used in this drainage scheme shall be half perforated Extra Strength Vitrified Clay pipe conforming to BS 65.

Internal diameters to be used are;

300 mm
450 mm
600 mm

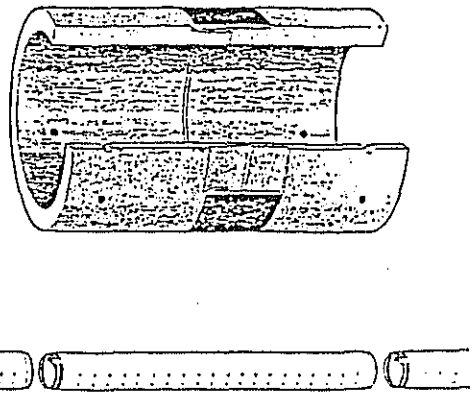


Fig. 3.4.1 Detail of Perforated Pipe

(6) Gravel

In backfilling work of lateral drainage trench, the following three kinds of gravel shall be used.

Nominal dia.	50 - 75 mm
Nominal dia.	25 - 40 mm
Nominal dia.	13 - 20 mm

(7) Geotextile

Geotextile material shall be synthetic fiber (polypropylene) and the type suitable for sand piping protection.

(8) Ductile iron pipe

Pipe for discharge pipe line shall be ductile iron pipe conforming to BS4772 designation K-9.

Diameter	Wall thickness	Unit length
250 mm	6.8 mm	5 - 6 m
350 mm	7.7 mm	6 m

External protection
PVC tape, thickness 1.1 mm spiral two (2) layer wrapping

Internal protection
Cement mortar coating 5 mm

Joint
T type push-on-joint

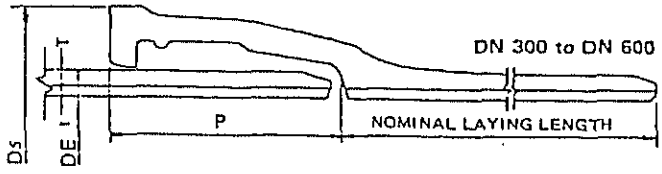


Fig. 3.4.2 Push-on Joint

3.5 Cost Estimation

The drainage system for Old Rayyan district is composed of the following;

a. Lateral drainage facilities
b. Discharge pump station and discharge pipe
c. Mangrove lagoon

3.5.1 Unit Rates

Source of unit rates applied in the cost estimation are referred to in the relevant section of Wadi Musherib drainage plan.

3.5.2 Bill of Quantities

(1) Lateral Drainage Facilities

Lateral drainage facilities are composed of ESVC perforated pipe (diameter 300, 450 and 600 mm), a short length (25 m) of concrete closed pipe (diameter 600 mm) and manholes (diameter 900 mm).

Bill of quantities for lateral drainage facilities are shown in Table 3.5.1.

Table 3.5.1 Bill of Quantites for Lateral Drainage Facilities

Item		Unit	ø300		ø450		ø600		Sub-Total	MANHOLE			Sub-total	Total
			3-5 m	5-7 m	3-5 m	5-7 m	3-5 m	5-7 m		4-5 m	5-6 m	> 6 m		
Excavation		m^3	6,626	27,678	7,884	7,218	1,656	1,598	52,660	472	829	844	2,145	54,805 m^3
Disposal of surplus soil		"	5,080	10,934	6,220	3,130	1,306	693	27,363	74	109	88	271	27,634 "
Backfilling		"	1,546	16,744	1,664	4,088	350	905	25,297	398	720	756	1,874	27,171 "
Gravel filling		"	4,748	10,221	5,475	2,755	1,111	589	24,899	4	5	3	12	24,911 "
Structural concrete		"	137	296	394	198	83	44	1,152	-	-	-	-	1,152 m^3
Lean concrete		"	69	148	111	56	23	12	419	4	5	3	12	431 "
Shuttering		m^2	491	1,056	876	441	184	98	3,146	-	-	-	-	3,146 m^2
Reinstatement of road		"	2,621	7,765	2,792	1,846	587	409	16,020	192	194	252	738	16,758 "
ESVC perforated pipe	ø300	m	1,227	2,641	-	-	-	-	3,868	-	-	-	-	3,868 m
"	ø450	"	-	-	1,095	551	-	-	1,646	-	-	-	-	1,646 "
"	ø600	"	-	-	-	-	205	122	327	-	-	-	-	327 "
Concrete pipe	ø600	"	-	-	-	-	25	-2	25	-	-	-	-	25
Precast concrete manhole		no	-	-	-	-	-	-	-	20	24	15	59	59 nos

Note: Figures below pipe diameters and manholes indicate excavation depths.

(2) Discharge Pump Station and Discharge Pipe line

Discharge pump station and discharge pipe line consist of the following;

A. Discharge pump station

i) Civil work
   a. Pump pit
   b. Surrounding works
      - Embankment
      - Access road
      - Fence & gate
      - Site surfacing

ii) Building work
   - Pump house (foundations for building and equipments, structure, and building facilities)

iii) Equipments
   a. Main pump units
   b. Valves
   c. Drainage pump
   d. Pipe
   e. Panel
   f. Instrument
   g. Overhead crane

B. Discharge pipe line

Discharge pipe line is composed of discharge pipe of ductile cast iron with diameter 250 mm for pressurized line and 350 mm for gravity flow line, intermediate water chamber and temporary outfall.

Bill of quantities for discharge pump station and discharge pipe line are shown in Table 3.5.2.

Table 3.5.2 Bill of Quantities for Discharge Pump Station and Discharge Pipe Line

Item	Unit	Discharge Pump Station				Discharge Pipe Line	Total
		Civil Work		Building work	Equipments		
		Pump pit	Surrounding work				
Excavation	m^3	1,140					1,140
Disposal of surplus soil	"	767					767
Backfilling	"	373					373
Structural concrete	"	208					208
Lean concrete		11					11
Reinforcing bar	ton	20.8					20.8
Shuttering	m^2	842					842
Embankment	m^3		1,415				1,415
Access road	m^2		100				100
Fence	m		96				96
Gate	no.		1				1
Site surfacing	m^3		62				62
Pump house	m^2			160			160
Main pump	set				3		3
Valves	"				3		3
Drainage pump	"				1		1
Pipe	"				1		1
Panel	"				1		1
Instrument	"				1		1
Overhead crane	"				1		1
Discharge pipe ø250	m					6,700	6,700
Discharge pipe ø350	m					7,700	7,700
Earthwork	m^3					37,000	37,000
Resurfacing	m^2					1,200	1,200
Intermediate water chamber	set					1	1
Branch	set					1	1
Temporary outfall	"					1	1

(3) Mangrove Lagoon

Construction of mangrove lagoon is composed of the following;

a. Embankment
b. Surface protection
c. Road pavement
d. Reinforced concrete distribution channel

Embankment to the level of QND + 0 for the mangrove plantation is not included in the cost.

Table 3.5.3 Bill of Quantities for Mangrove Lagoon

Item	Unit	Quantity
Embankment	m^3	150,000
Surface protection	m^3	30,000
Road	m^2	25,000
Water distribution channel	m	1,600

3.5.3 Construction Cost

Construction cost of the drainage system for Old Rayyan is obtained using the unit rates in Table 2.5.1 and bill of quantities in Table 3.5.1, 3.5.2 and 3.5.3.

Summary of the construction costs is shown in Table 3.5.4.

Table 3.5.4 Construction Cost for Old Rayyan

Item		Unit	Rate (QR)	Lateral Drainage Pipe		Discharge Pump Station & Discharge Pipe Line		Mangrove Lagoon	
				Quantity	Amount (x 10^3 QR)	Quantity	Amount (x 10^3 QR)	Quantity	Amount (x 10^3 QR)
Excavation		m^3	180	54,805	9,865	1,140	205		
Disposal of surplus soil		"	30	27,634	829	767	23		
Backfilling		"	30	27,171	815	373	11		
Gravel filling		"	45	24,911	1,121	-	-		
Structural concrete		"	300	1,152	346	208	62		
Lean concrete		"	260	431	112	11	3		
Reinforcing bar		ton	3,000	-	-	20.8	62		
Shuttering		m^2	20	3,146	63	842	17		
Perforated pipe	ϕ300	m	150	3,868	580				
	ϕ450	"	200	1,646	329				
	ϕ600	"	500	327	164				
Concrete pipe	ϕ600	"	500	25	13				
Precast concrete manhole	H= 4-5m	no.	6,000	20	120				
	5-6	"	7,000	24	168				
	> 6	"	8,500	15	128				
Embankment		m^3	25			1,415	35	150,000	3,750
Road		m^2	75	16,020	1,202	100	8	25,000	1,875
Fence		m	400			96	38		
Gate		no.	5,250			1	5		
Site surfacing		m^3	45			62	3		
Pump house		m^2	3,500			160	560		
Main pump		set	317,000			3	951		
Valves		"	18,000			3	54		
Drainage pump		"	5,000			1	5		
Pipe		"	81,000			1	81		
Panel		"	641,000			1	641		
Instrument		"	270,000			1	270		
Overhead crane		"	108,000			1	108		
Discharge pipe	ϕ250	m	326			6,700	2,184		
	ϕ350	"	489			7,700	3,765		
Earthwork		m^3	180			37,000	6,660		
Cutting & resurfacing		m^2	250			1,200	300		
Intermediate water chamber		set	41,000			1	41		
Branch		"	8,000			1	8		
Temporary outfall		"	12,000			1	12		
Surface protection		m^2	260					30,000	7,800
Distribution channel		m	300					1,600	480
Subtotal					15,860		16,100		13,900
Total						45,860	(x 10^3 QR)		

4. Implementation Program

4.1 Implementation program

This project consists of the following three major facilities;

- Lateral drainage facility
- Discharge pump station and discharge pipe line
- Mangrove afforestation

The overall term for implementation is three (3) years considering site investigation, detailed design, tendering, equipment procurement, civil works and mechanical and electrical erection works, after which maintenance of young mangrove trees will be started.

Overall program is as shown in Table 4.1.1. Major points to be noted in the Implementation Program are the following. Because of the difficulty in disposal of highly saline groundwater during construction stage of lateral drainage facility, permanent discharge pump station and discharge pipe line to West Bay shall be constructed at first. Under the present progress of New District "Regional Park" project, it is unavoidable to directly discharge abstracted groundwater at West Bay temporarily until dredging and mangrove lagoon have been completed. It is considered that (2.5) years will be required for dredging, and that within a total of (3) years related road works in the park will be completed. At the same time the appropriate grovernment body executing the mangrove afforestation should begin test plantation and production seedlings, such that within (4) years actual afforestation may commence.

Table 4.1.1 IMPLEMENTATION PROGRAM FOR OLD RAYYAN

No.	Description	1st year						2nd year						3rd year						4th year						5th year					
		1			6		12	1			6		12	1			6		12	1			6		12	1			6		12
1.	Lateral Drainage																														
	(1) Topographic Survey & Underground Facility Survey																														
	(2) Detail Design & Tender Documents																														
	(3) Tender													▽Contract																	
	(4) Civil Works																														
2.	Pump Station & Discharge Pipe																														
	(1) Topographic survey & Underground Facility Survey																														
	(2) Detail Design & Tender Documents																														
	(3) Tender							▽Contract																							
	(4) Land Acquisition																														
	(5) Pump Station																														
	a) Civil & Building Works																														
	b) Equipments																														
	(6) Discharge Pipe													(Temporary outfall)						Extension of Discharge pipe to Mangrove lagoon											
														Road Construction of Regional Park																	
3.	Mangrobe Afforestation																														
	(1) Culture Test of Seedings																														
	(2) Culture of Seedings																														
	(3) Mangrove Lagoon Construction																														
														Regional Park Dredging																	
	(4) Afforestation & Maintenance																														

4.2 Expenditure in Each Fiscal Year

Total cost of the Project is summarized in the table below.

Lateral drainage	17.5	MNQRS
Discharge pump station and pipeline	18.9	MNQRS
Civil work for Mangrove afforestation	15.3	MNQRS
Total	51.7	MNQRS

Above figures consist of;

- Topographic survey and investigation of underground facilities
- Detail design, Tender, and Construction management
- Land acquisition for pump station
- Civil construction and associated temporary facilities
- Equipment procurement and electrical and mechanical erection works

On the other hand the following items are not considered;

- Governmental administrative cost
- Compensation to residents for inconvenience during construction (if any)
- Land acquisition for mangrove afforestation
- Cost for mangrove afforestation itself

Cost breakdown by each fiscal year are tabled in Table 4.2.1 below.

Table 4.2.1 Expenditure for Each Fiscal Year

(Unit: $x10^3$QR)

Item \ Year	1st	2nd	3rd	4th	Total
1. Engineering Services	1,600	3,000	-	-	4,600
2. Land Acquisition	1,200	-	-	-	1,200
3. Civil & Building Works	-	12,000	29,800	2,000	43,800
4. Equipments	-	2,100	-	-	2,100
Total	2,800	17,100	29,800	2,000	51,700

Notes:

1) Cost of engineering servies were derived from 10 percent of construction cost.

2) Land acquisition for Discharge Pump Station was considered only and unit rate per square meter is 1,000 QR.

3) Breakdowns of each item in the table are shown on Table 4.2.2 and allocation to each year is shown on Table 4.2.3.

Table 4.2.2 Cost Breakdown

(Unit: x 10^3 QR)

Item	Construction Cost	Engineering Fee	Land Acquisition
1. Lateral Drainage		1,000	—
(1) Pipe Work	15,000		
(2) Manhole	900		
Sub Total	15,900	1,600	0
2. Discharge Pump Station & Discharge Pipe line		1,600	
(1) Discharge Pump Station			1,200
- Civil & Building Work	1,000		
- Equipments	2,100		
(2) Discharge Pipe			
- Pipe material	4,200		
- Civil Work & Pipe Installation	8,800		
Sub Total	16,100	1,600	1,200
3. Mangrove Lagoon Construction	13,900	1,400	—
Total	45,900	4,600	0
Grand Total	51,700		

Table 4.2.3 COST ALLOCATION FOR OLD RAYYAN

No.	Description	1st year	2nd year	3rd year	4th year	Total x 10^3 QRS
1.	Lateral Drainage					
	(1) Topographic Survey & Underground Facility Survey					
	(2) Detail Design & Tender Documents		1,600			1,600
	(3) Tender			Contract		
	(4) Civil Works			15,900		15,900
2.	Pump Station & Discharge Pipe					
	(1) Topographic survey & Underground Facility Survey					
	(2) Detail Design & Tender Documents	1,600				1,600
	(3) Tender		Contract			
	(4) Land Acquisition	1,200				1,200
	(5) Pump Station					
	a) Civil & Building Works		1,000			1,000
	b) Equipments		2,100			2,100
	(6) Discharge Pipe		11,000	(Temporary outfall)	Extension of Discharge pipe to Mangrove lagoon	
				Road Construction of Regional Park	2,000	13,000
3.	Mangrobe Afforestation					
	(1) Culture Test of Seedings	←	→			
	(2) Culture of Seedings	←	→			
	(3) Mangrove Lagoon Construction		1,400	13,900		15,300
			Regional Park Dredging			
	(4) Afforestation & Maintenance				→	
	Total	2,800	17,100	29,800	2,000	51,700 10^3

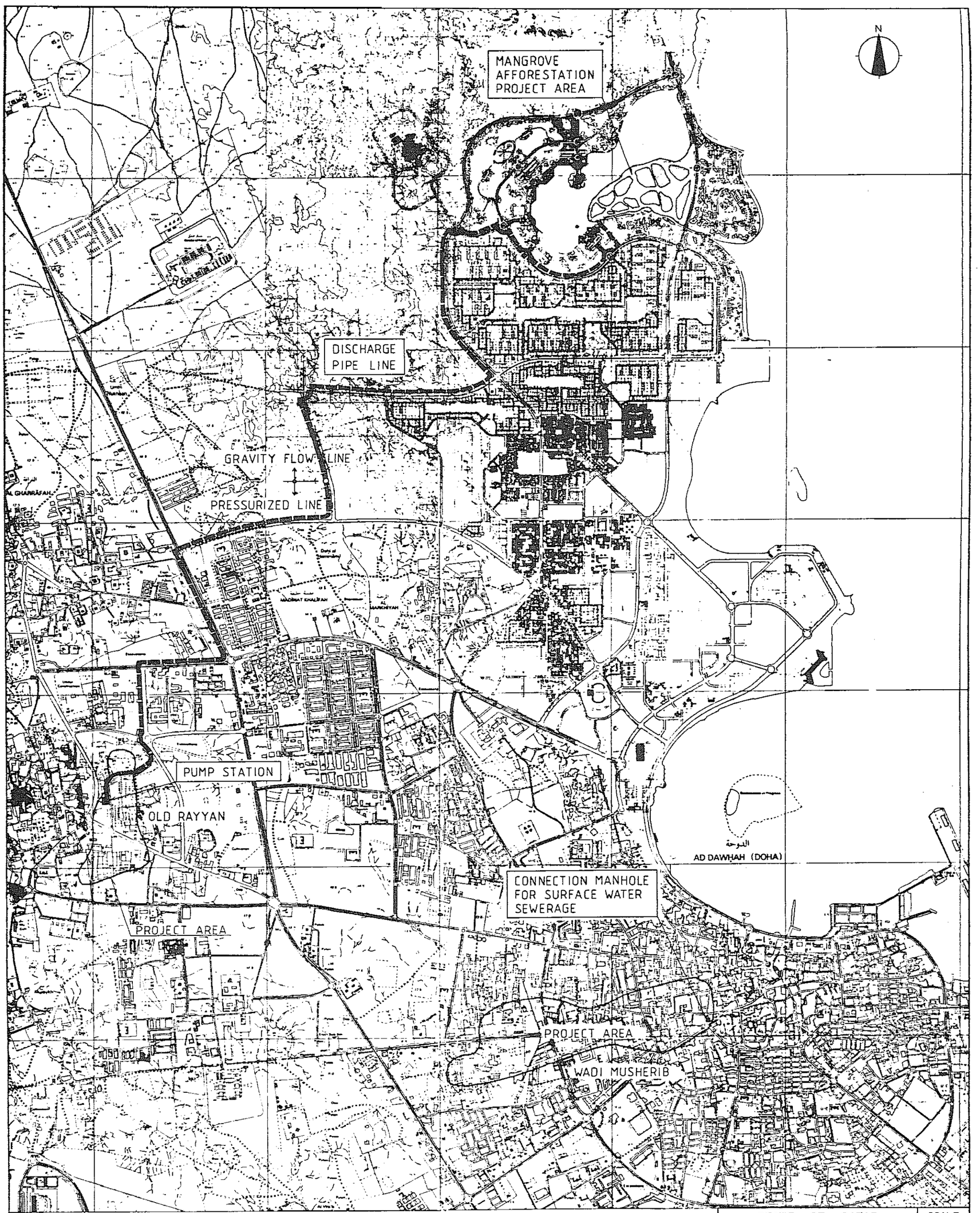
5. Drawings

DRAWING LIST

(1/2)

DWG. NO.	TITLE
DRP-1001	DRAINAGE IMPROVEMENT PLAN
DRP-3001	OLD RAYYAN LATERAL DRAINAGE-GENERAL PLAN
DRP-3002	OLD RAYYAN LATERAL DRAINAGE TRANSVERSAL AND LONGITUDINAL SECTIONS (1/3)
DRP-3003	OLD RAYYAN LATERAL DRAINAGE TRANSVERSAL AND LONGITUDINAL SECTIONS (2/3)
DRP-3004	OLD RAYYAN LATERAL DRAINAGE TRANSVERSAL AND LONGITUDINAL SECTIONS (3/3)
DRP-3005	OLD RAYYAN MANHOLE AND TYPICAL SECTION OF LATERAL DRAIN
DRP-3020	OLD RAYYAN LATERAL DRAINAGE - DETAILED PLAN (1/2)
DRP-3021	OLD RAYYAN LATERAL DRAINAGE - DETAILED PLAN (2/2)
DRP-4001	DISCHARGE PIPE LINE GENERAL PLAN AND LONGITUDINAL SECTION
DRP-4002	DISCHARGE PUMP STATION (1/2)
DRP-4003	DISCHARGE PUMP STATION (2/2)
DRP-4004	DISCHARGE PIPE LINE DETAILS (1/2)
DRP-4005	DISCHARGE PIPE LINE DETAILES (2/2)
DRP-4006	MANGROVE AFFORESTATION PLAN
DRP-4020	DISCHARGE PIPE LINE DETAILED PLAN (1/9)
DRP-4021	DISCHARGE PIPE LINE DETAILED PLAN (2/9)
DRP-4022	DISCHARGE PIPE LINE DETAILED PLAN (3/9)

DWG. NO.	TITLE
DRP-4023	DISCHARGE PIPE LINE DETAILED PLAN (4/9)
DRP-4024	DISCHARGE PIPE LINE DETAILED PLAN (5/9)
DRP-4025	DISCHARGE PIPE LINE DETAILED PLAN (6/9)
DRP-4026	DISCHARGE PIPE LINE DETAILED PLAN (7/9)
DRP-4027	DISCHARGE PIPE LINE DETAILED PLAN (8/9)
DRP-4028	DISCHARGE PIPE LINE DETAILED PLAN (9/9)
DRP-4029	DISCHARGE PIPE LINE TRANSVERSAL AND LONGITUDINAL SECTIONS (1/10)
DRP-4030	DISCHARGE PIPE LINE TRANSVERSAL AND LONGITUDINAL SECTIONS (2/10)
DRP-4031	DISCHARGE PIPE LINE TRANSVERSAL AND LONGITUDINAL SECTIONS (3/10)
DRP-4032	DISCHARGE PIPE LINE TRANSVERSAL AND LONGITUDINAL SECTIONS (4/10)
DRP-4033	DISCHARGE PIPE LINE TRANSVERSAL AND LONGITUDINAL SECTIONS (5/10)
DRP-4034	DISCHARGE PIPE LINE TRANSVERSAL AND LONGITUDINAL SECTIONS (6/10)
DRP-4035	DISCHARGE PIPE LINE TRANSVERSAL AND LONGITUDINAL SECTIONS (7/10)
DRP-4036	DISCHARGE PIPE LINE TRANSVERSAL AND LONGITUDINAL SECTIONS (8/10)
DRP-4037	DISCHARGE PIPE LINE TRANSVERSAL AND LONGITUDINAL SECTIONS (9/10)
DRP-4038	DISCHARGE PIPE LINE TRANSVERSAL AND LONGITUDINAL SECTIONS (10/10)



STATE OF QATAR	SCALE
THE STUDY ON DRAINAGE IMPROVEMENT PLAN, DOHA CITY	1 : 20000
DRAINAGE IMPROVEMENT PLAN	DRP I 1001
JICA JAPAN INTERNATIONAL COOPERATION AGENCY	
DRAWN / CHECKED / APPROVED	

LEGEND

PERFORATED PIPE

MANHOLE

PRESSURIZED PIPE

PUMP STATION

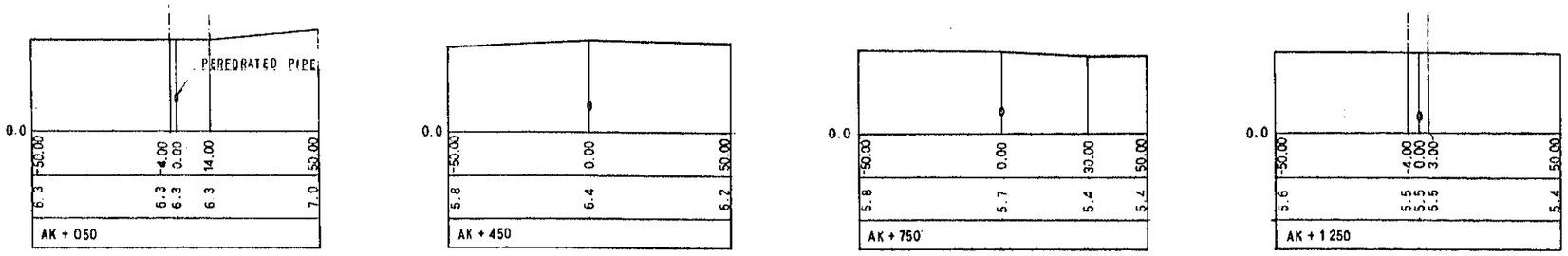
STATE OF QATAR	SCALE
THE STUDY ON DRAINAGE IMPROVEMENT PLAN, DOHA CITY	1 : 5000
OLD RAYYAN LATERAL DRAINAGE GENERAL PLAN	DRP I 3001
JAPAN INTERNATIONAL COOPERATION AGENCY	
DRAWN / CHECKED / APPROVED	

METRES ABOVE QATAR NATIONAL DATUM

OFFSET

GROUND LEVEL

CHAINAGE

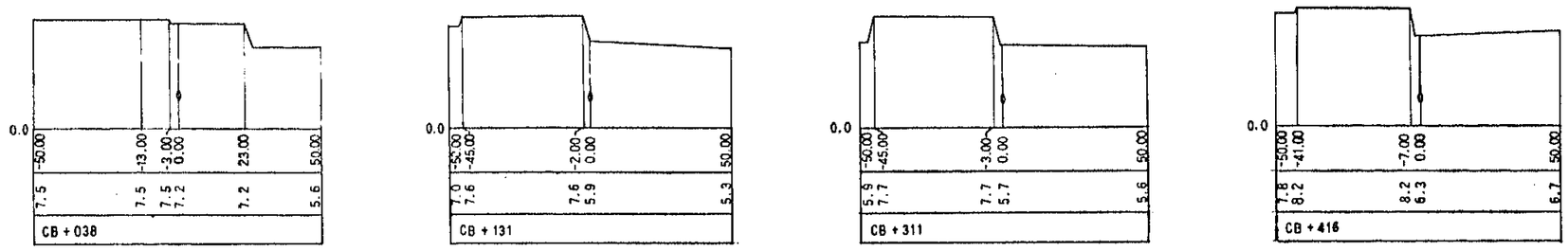


METRES ABOVE QATAR NATIONAL DATUM

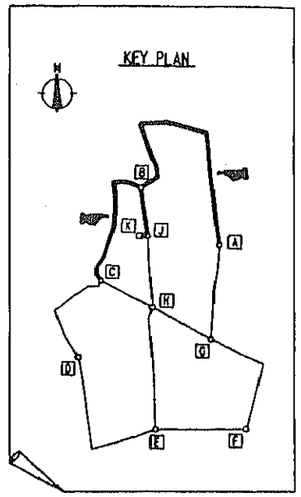
OFFSET

GROUND LEVEL

CHAINAGE



TRANSVERSAL SECTION (SCALE VER. 1:200, HOR. 1:1000)

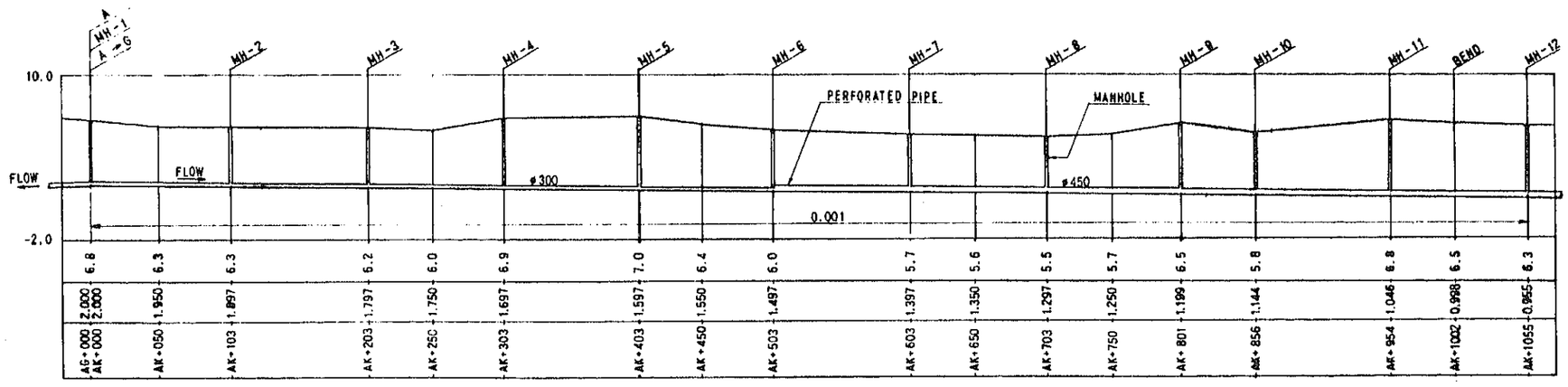


METRES ABOVE QATAR NATIONAL DATUM

GROUND LEVEL

INVERT LEVEL

CHAINAGE



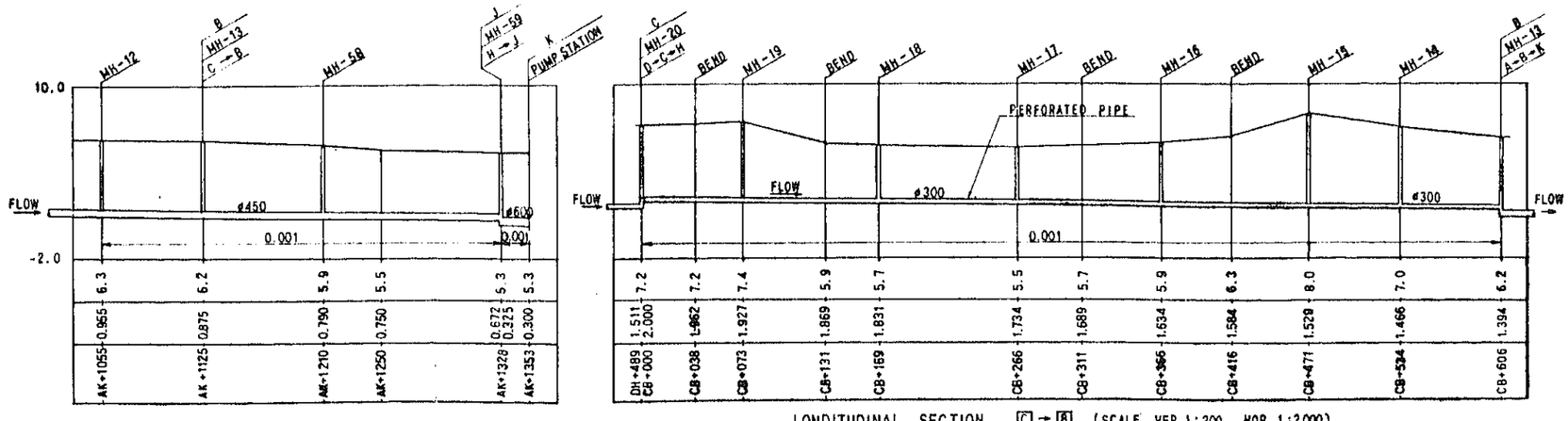
LONGITUDINAL SECTION A → B → J → K (SCALE VER 1:200, HOR. 1:2000)

METRES ABOVE QATAR NATIONAL DATUM

GROUND LEVEL

INVERT LEVEL

CHAINAGE



LONGITUDINAL SECTION C → B (SCALE VER. 1:200, HOR. 1:2000)

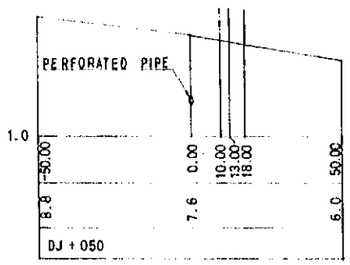
STATE OF QATAR	SCALE
THE STUDY ON DRAINAGE IMPROVEMENT PLAN, DOHA CITY	1 : 200 1 : 1000 1 : 2000
OLD RAYYAN LATERAL DRAINAGE – TRANSVERSAL AND LONGITUDINAL SECTIONS (1/3)	DRP I 3002
JAPAN INTERNATIONAL COOPERATION AGENCY	
DRAWN / CHECKED / APPROVED	

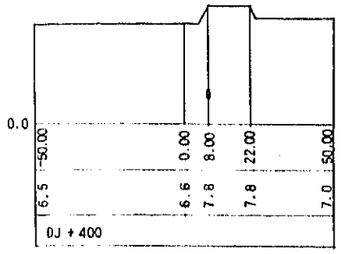
METRES ABOVE QATAR NATIONAL DATUM

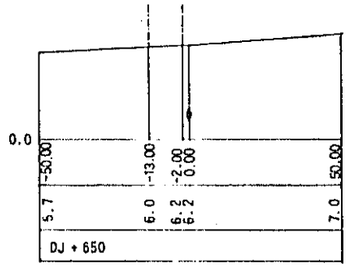
OFFSET

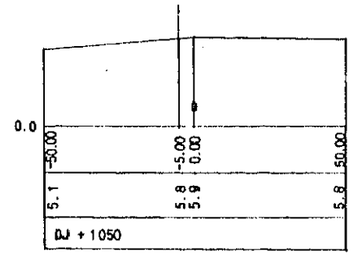
GROUND LEVEL

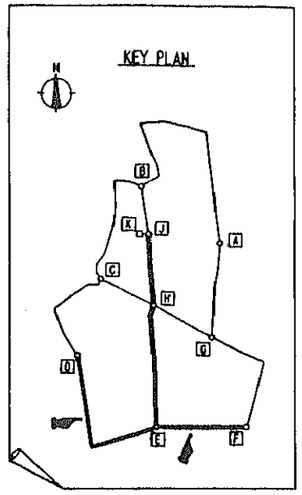
CHAINAGE









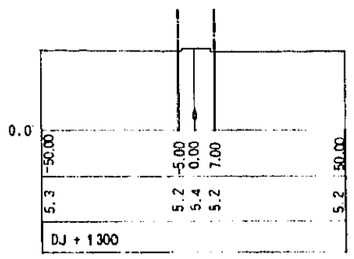


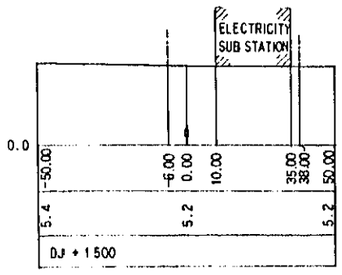
METRES ABOVE QATAR NATIONAL DATUM

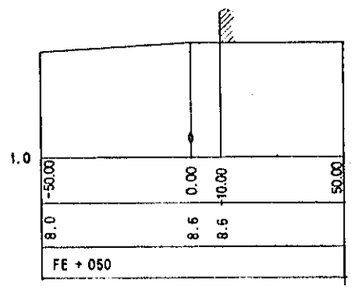
OFFSET

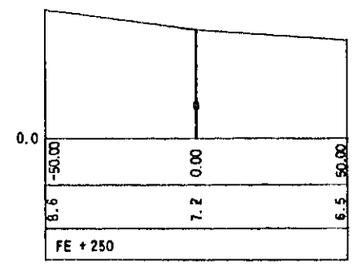
GROUND LEVEL

CHAINAGE









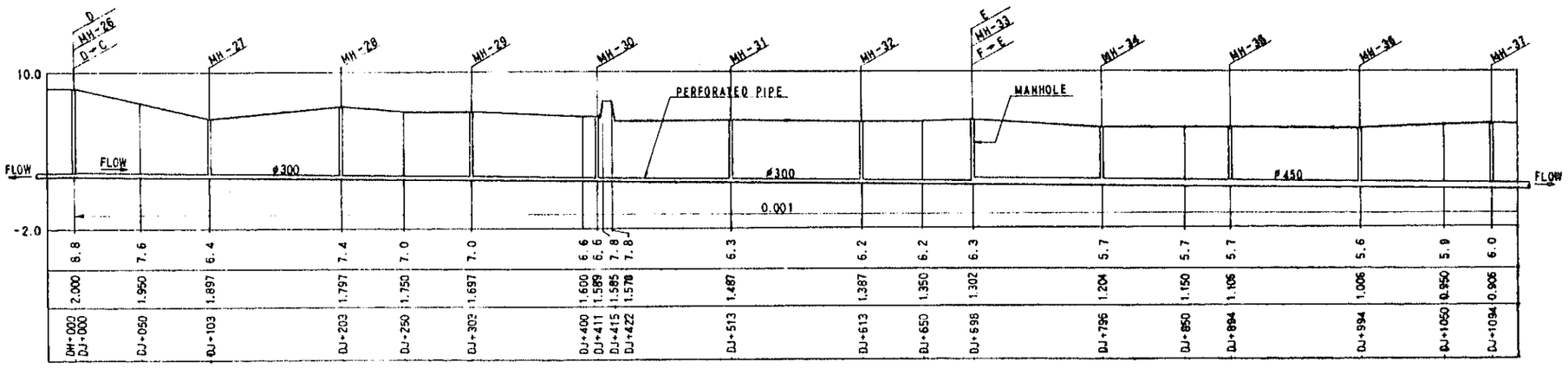
TRANSVERSAL SECTION (SCALE VER. 1:200, HOR. 1:1000)

METRES ABOVE QATAR NATIONAL DATUM

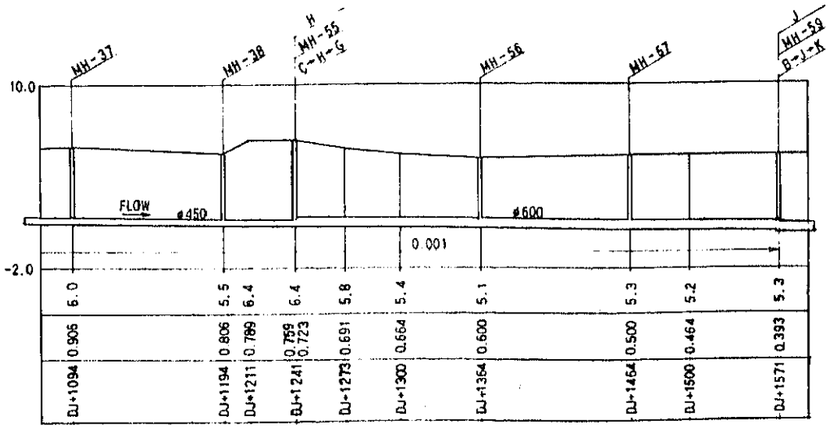
GROUND LEVEL

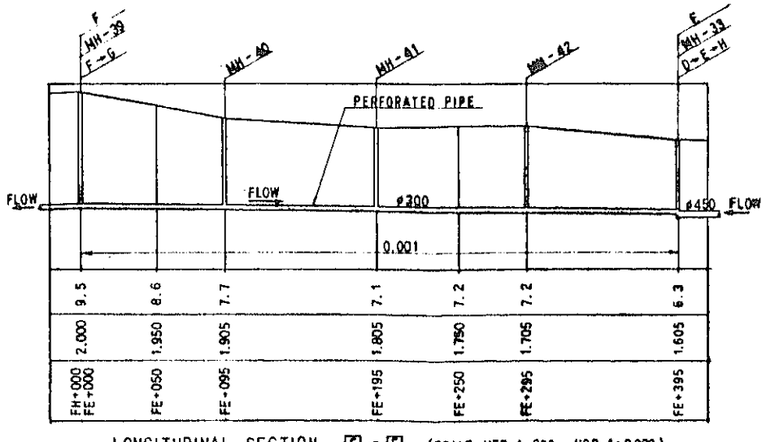
INVERT LEVEL

CHAINAGE



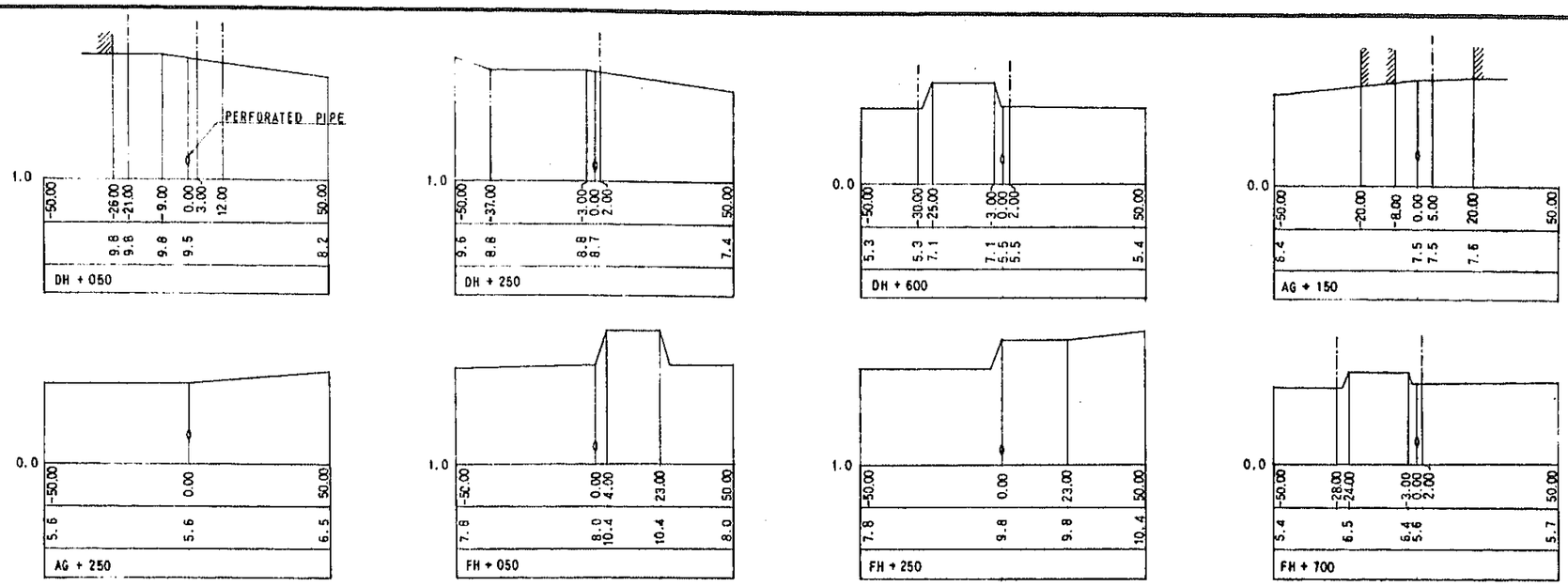
LONGITUDINAL SECTION D → E → H → J (SCALE VER. 1:200, HOR. 1:2000)

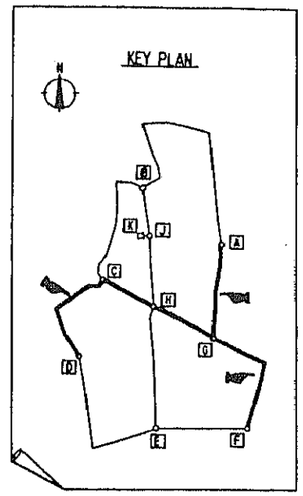




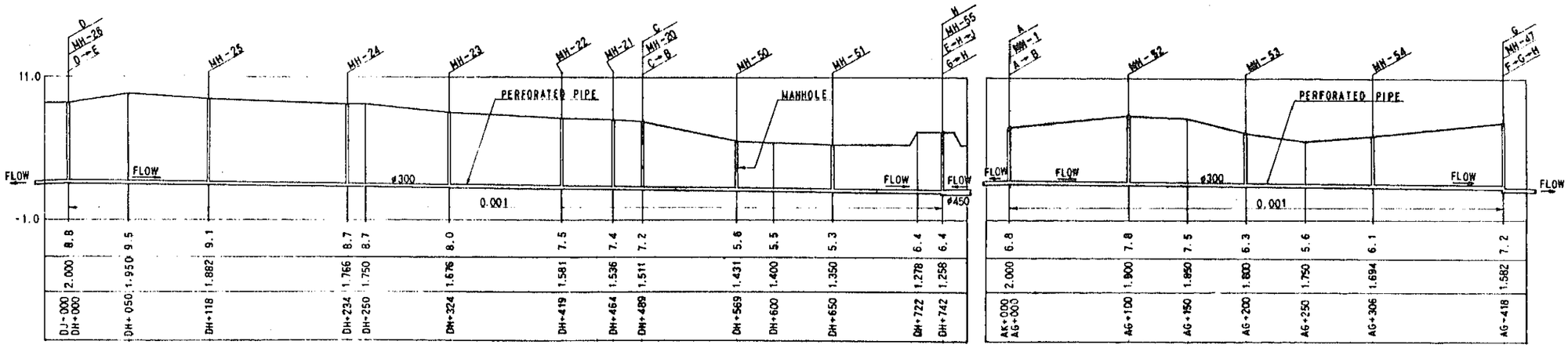
LONGITUDINAL SECTION F → E (SCALE VER. 1:200, HOR. 1:2000)

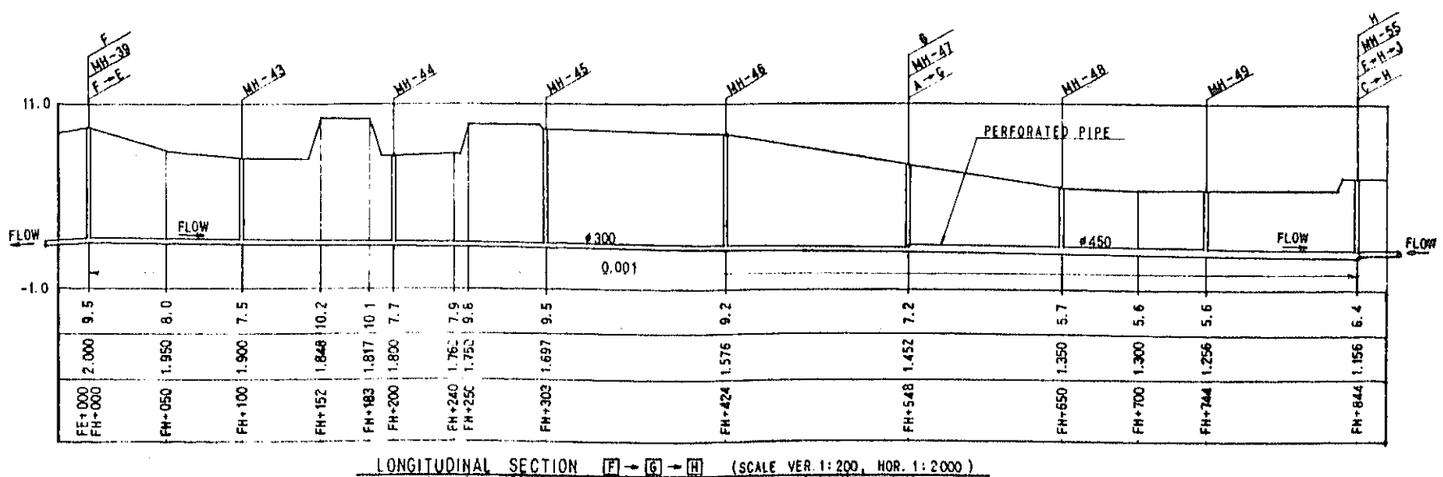
STATE OF QATAR	SCALE
THE STUDY ON DRAINAGE IMPROVEMENT PLAN, DOHA CITY	1:200 1:1000 1:2000
OLD RAYYAN LATERAL DRAINAGE - TRANSVERSAL AND LONGITUDINAL SECTIONS (2/3)	DRP I 3003
JAPAN INTERNATIONAL COOPERATION AGENCY	
DRAWN	CHECKED / APPROVED





TRANSVERSAL SECTION (SCALE VER. 1:200, HOR. 1:1000)

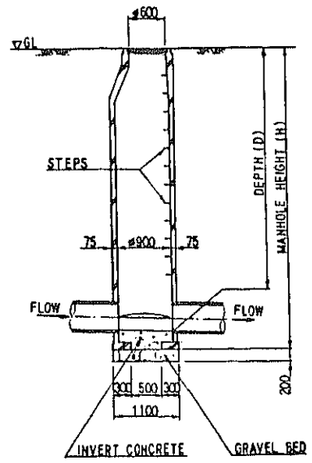




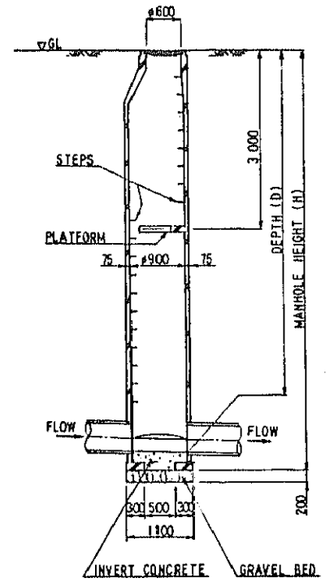
STATE OF QATAR THE STUDY ON DRAINAGE IMPROVEMENT PLAN, DOHA CITY	SCALE 1 : 200 1 : 1000 1 : 2000
OLD RAYYAN LATERAL DRAINAGE - TRANSVERSAL AND LONGITUDINAL SECTIONS (3/3)	DRP I 3004
JAPAN INTERNATIONAL COOPERATION AGENCY DRAWN / CHECKED / APPROVED	

MANHOLE LIST

MANHOLE NO.	LOCATION	DEPTH (D) (m)	TYPE	MANHOLE HEIGHT (H) (m)
1	AK+ 000 AG+ 000	4.800	A	5.100
2	AK+ 103	4.403	A	4.710
3	AK+ 203	4.403	A	4.710
4	AK+ 303	5.203	B	5.510
5	AK+ 403	5.403	B	5.710
6	AK+ 503	4.503	A	4.810
7	AK+ 603	4.303	A	4.610
8	AK+ 703	4.203	A	4.510
9	AK+ 801	5.301	B	5.610
10	AK+ 856	4.656	A	4.960
11	AK+ 954	5.754	B	6.060
12	AK+1055	5.345	B	5.650
13	AK+1125 CB+ 606	5.325	B	5.630
14	CB+ 534	5.534	B	5.840
15	CB+ 471	6.471	B	6.780
16	CB+ 366	4.266	A	4.570
17	CB+ 266	3.766	A	4.070
18	CB+ 169	3.869	A	4.170
19	CB+ 073	5.473	B	5.780
20	CB+ 000 DH+ 489	5.689	B	5.990
21	DH+ 464	5.864	B	6.170
22	DH+ 419	5.919	B	6.220
23	DH+ 324	6.324	B	6.630
24	DH+ 234	6.934	B	7.240
25	DH+ 118	7.218	B	7.520
26	DH+ 000 DJ+ 000	6.800	B	7.100
27	DJ+ 103	4.503	A	4.810
28	DJ+ 203	5.603	B	5.910
29	DJ+ 303	5.303	B	5.610
30	DJ+ 411	5.011	B	5.320
31	DJ+ 513	4.813	A	5.120
32	DJ+ 613	4.813	A	5.120
33	DJ+ 688 FE+ 395	4.998	A	5.300
34	DJ+ 796	4.496	A	4.800
35	DJ+ 894	4.594	A	4.900
36	DJ+ 994	4.594	A	4.900
37	DJ+1094	5.094	B	5.400
38	DJ+1194	4.694	A	5.000
39	FE+ 000 FH+ 000	7.500	B	7.800
40	FE+ 095	5.795	B	6.100
41	FE+ 195	5.295	B	5.600
42	FE+ 295	5.495	B	5.800
43	FH+ 100	5.600	B	5.900
44	FH+ 200	5.900	B	6.200
45	FH+ 303	7.803	B	8.110
46	FH+ 424	7.624	B	7.930
47	FH+ 548 AG+ 418	5.748	B	6.080
48	FH+ 650	4.350	A	4.650
49	FH+ 744	4.344	A	4.650
50	DH+ 569	4.169	A	4.470
51	DH+ 650	3.950	A	4.250
52	AG+ 100	5.900	B	6.200
53	AG+ 200	4.500	A	4.800
54	AG+ 306	4.406	A	4.710
55	DJ+1241 DH+ 742 FH+ 844	5.677	B	5.980
56	DJ+1364	4.500	A	4.800
57	DJ+1464	4.800	A	5.100
58	AK+1210	5.110	B	5.410
59	AK+1338 DJ+1571	4.975	A	5.280

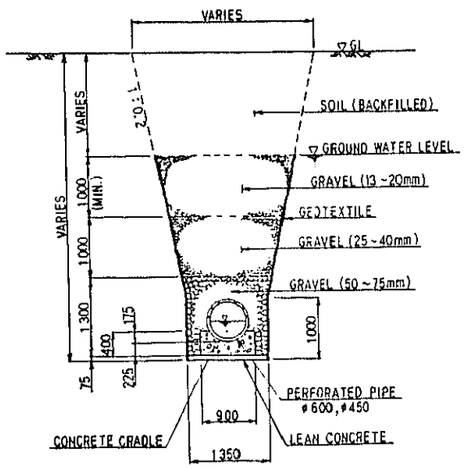


D < 5.0 M

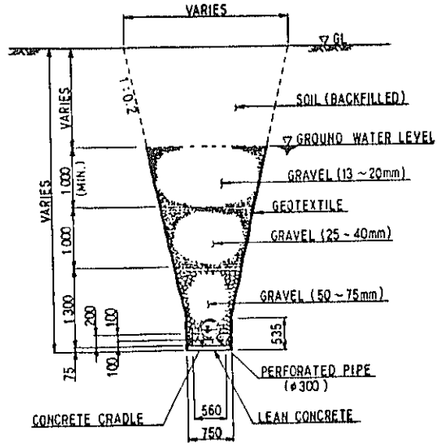


D ≧ 5.0 M

TYPICAL SECTION OF MANHOLE (S=1:50)



PERFORATED PIPE ϕ600 & ϕ450



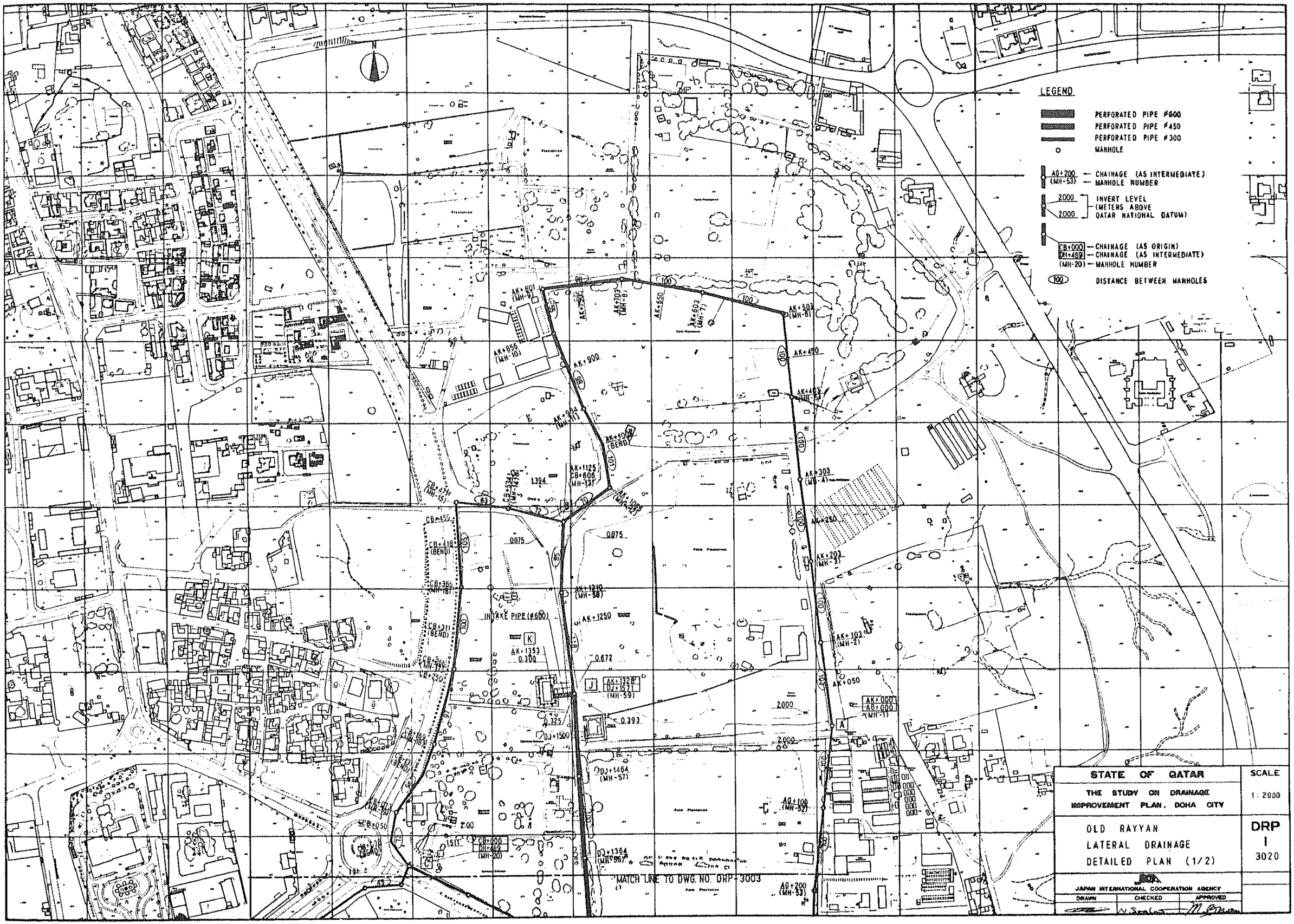
PERFORATED PIPE ϕ300

TYPICAL SECTION OF LATERAL DRAIN (S=1:50)

NOTES

1. FOR GENERAL PLAN OF LATERAL DRAINAGE, SEE DWG. NO. DRP-3001.
2. FOR TRANSVERSAL AND LONGITUDINAL SECTIONS, ON WHICH THE LOCATIONS OF MANHOLES ARE INDICATED, SEE DWG. NOS. DRP-3002 THRU 3004.
3. GEOTEXTILE SHALL BE PROVIDED ON THE EXCAVATED SURFACE FROM THE TRENCH BOTTOM TO THE GROUND WATER LEVEL AT THE SITE.
4. GRAVEL (13~20mm) SHALL BE PROVIDED ABOVE THE GROUND WATER LEVEL AND THE THICKNESS SHALL NOT BE LESS THAN 10 METER.

STATE OF QATAR	SCALE
THE STUDY ON DRAINAGE IMPROVEMENT PLAN, DOHA CITY	1:50
OLD RAYYAN MANHOLE AND TYPICAL SECTION OF LATERAL DRAIN	DRP I 3005
JAPAN INTERNATIONAL COOPERATION AGENCY	
DRAWN / CHECKED / APPROVED	



STATE OF QATAR	SCALE
THE STUDY ON DRAINAGE IMPROVEMENT PLAN, DOHA CITY	1:2000
OLD RAYYAN LATERAL DRAINAGE DETAILED PLAN (1/2)	DRP I 3020
JAPAN INTERNATIONAL COOPERATION AGENCY	
DRAWN / CHECKED / APPROVED	

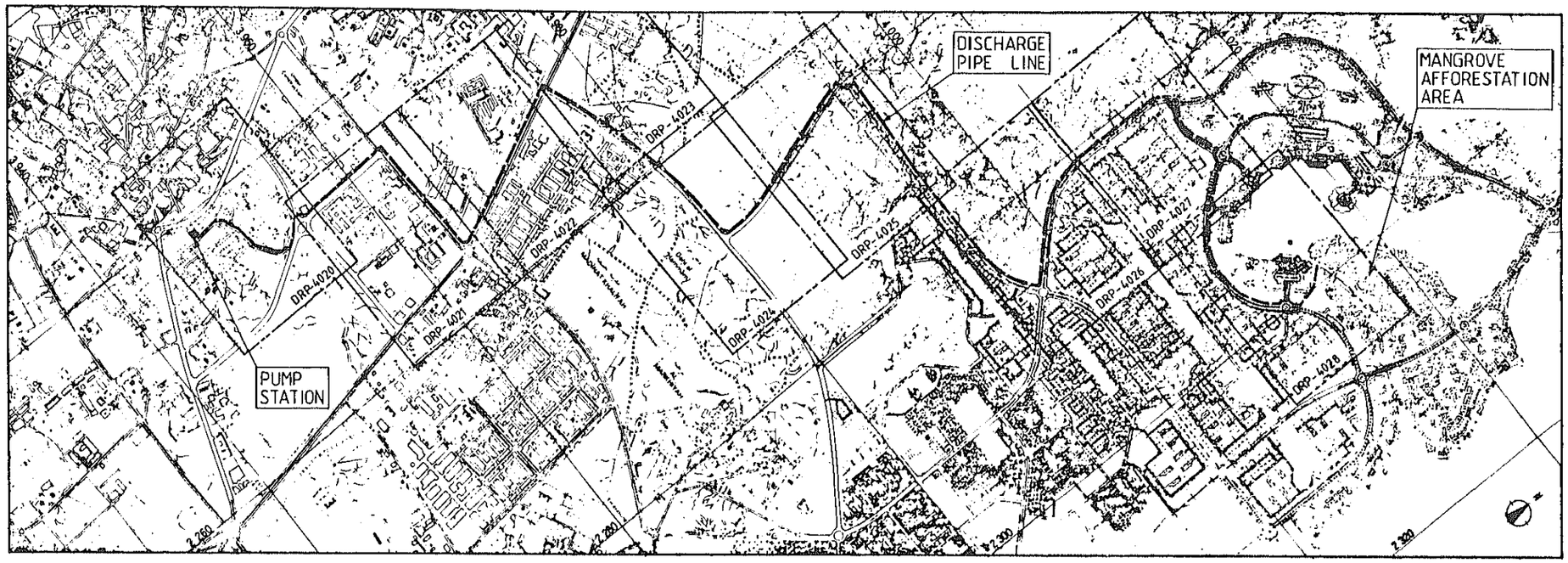
MATCH LINE TO DWG. NO. DRP-3002

LEGEND

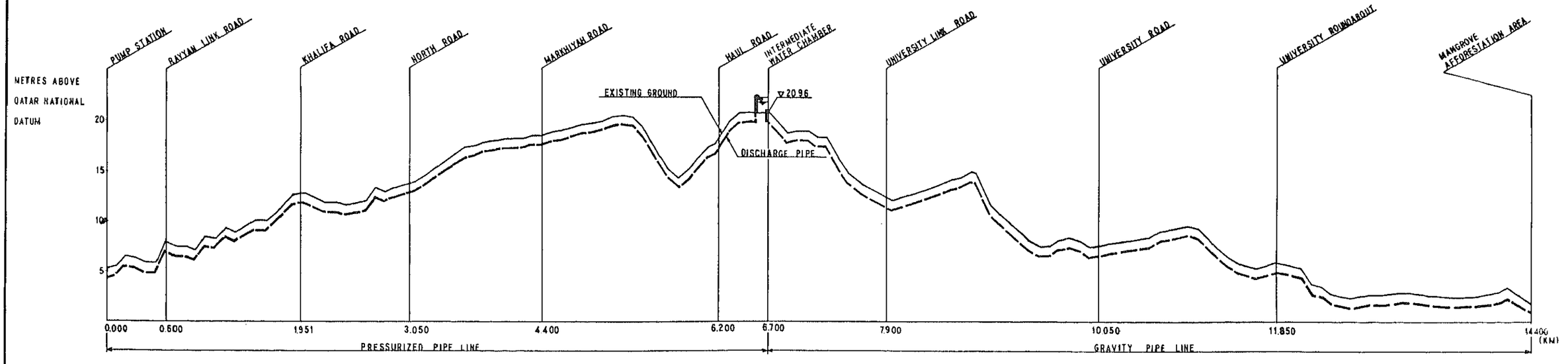
- PERFORATED PIPE ϕ600
- PERFORATED PIPE ϕ450
- PERFORATED PIPE ϕ300
- MANHOLE
- AG+200 (MH-53) — CHAINAGE (AS INTERMEDIATE) / MANHOLE NUMBER
- 2.000 / 2.000 — INVERT LEVEL (METERS ABOVE QATAR NATIONAL DATUM)
- CB+000 / DH+489 (MH-20) — CHAINAGE (AS ORIGIN) / CHAINAGE (AS INTERMEDIATE) / MANHOLE NUMBER
- (100) — DISTANCE BETWEEN MANHOLES

STATE OF QATAR	SCALE
THE STUDY ON DRAINAGE IMPROVEMENT PLAN, DOHA CITY	1 : 2000
OLD RAYYAN LATERAL DRAINAGE DETAILED PLAN (2/2)	DRP I 3021
JAPAN INTERNATIONAL COOPERATION AGENCY	
DRAWN / CHECKED / APPROVED	

RAYYAN DISCHARGE PIPE LINE

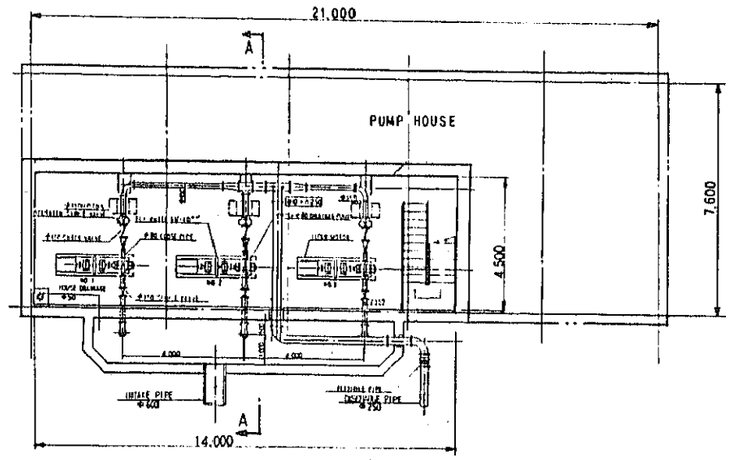


PLAN (SCALE 1 : 20,000)

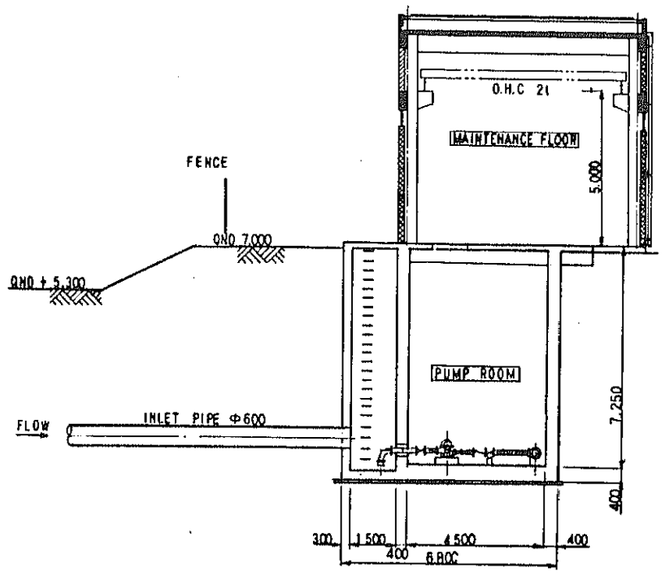


LONGITUDINAL SECTION (SCALE VER. 1:200 , HOR. 1:20,000)

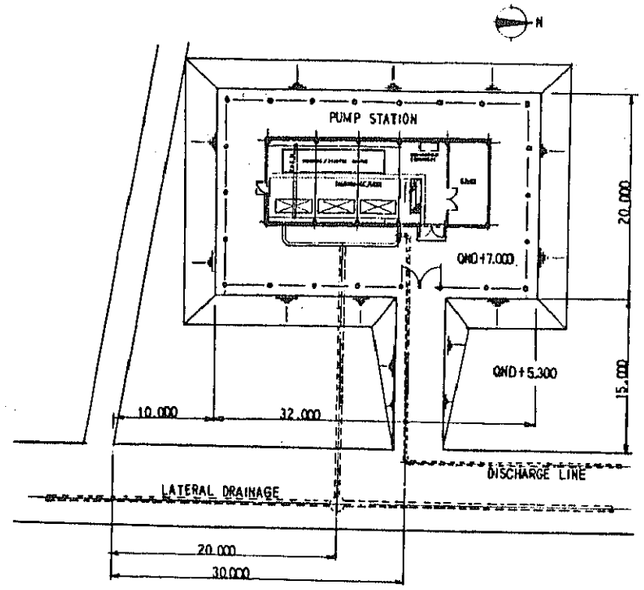
STATE OF QATAR THE STUDY ON DRAINAGE IMPROVEMENT PLAN, DOHA CITY	SCALE 1 : 200 1 : 20 000
DISCHARGE PIPE LINE GENERAL PLAN AND LONGITUDINAL SECTION	DRP I 4001
JICA JAPAN INTERNATIONAL COOPERATION AGENCY DRAWN / CHECKED / APPROVED	



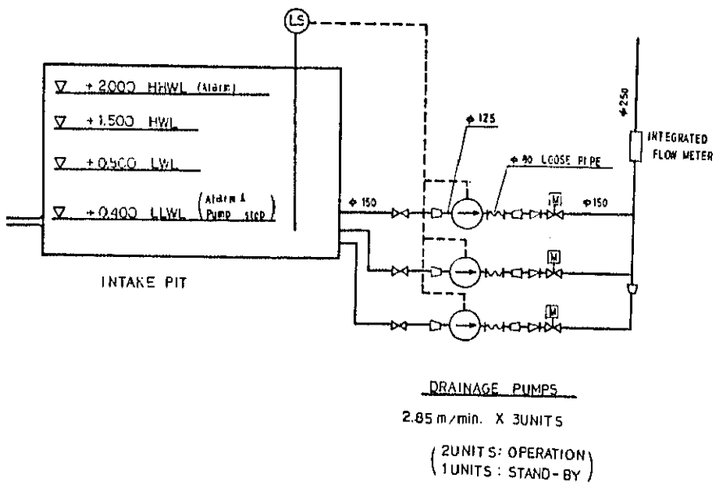
PUMP ARRANGEMENT S=1:100



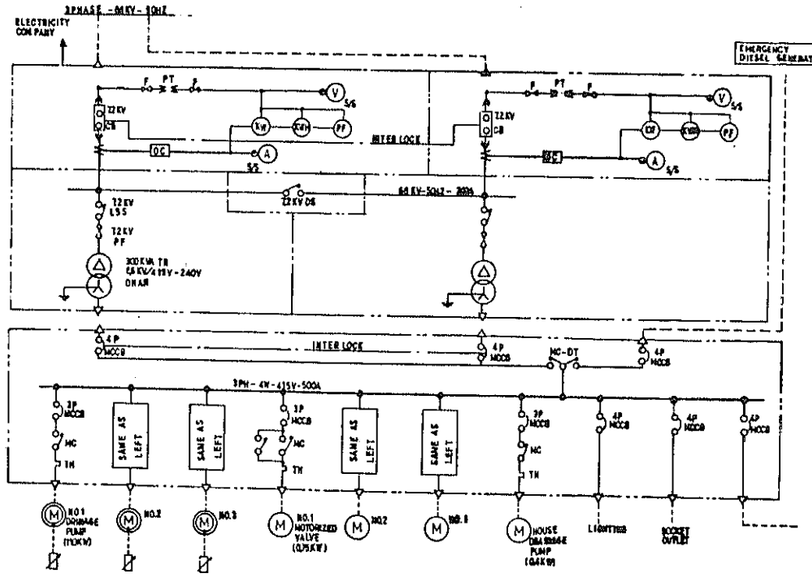
SECTION A-A S=1:100



LATOUT OF PUMP STATION S=1:300

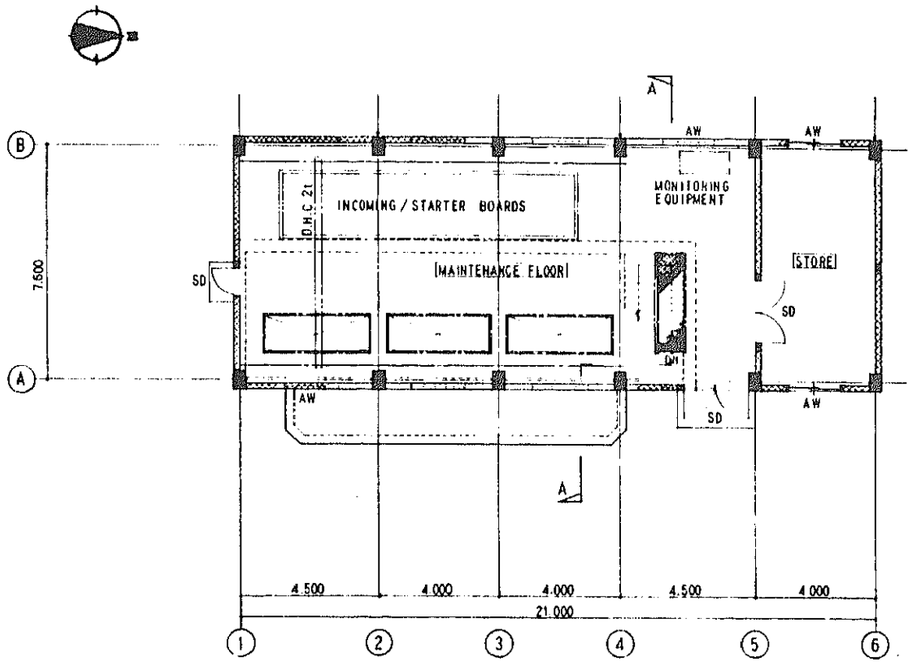


FLOW DIAGRAM

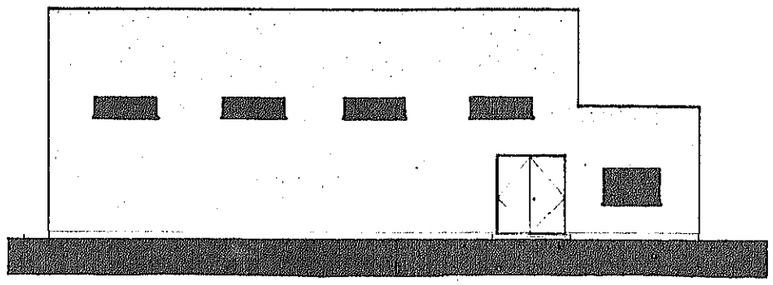


ELECTRICAL ONE LINE DIAGRAM

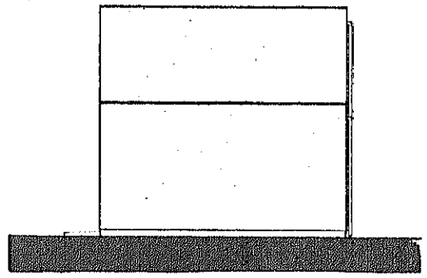
STATE OF QATAR THE STUDY ON DRAINAGE IMPROVEMENT PLAN, DOHA CITY		SCALE 1 : 100 1 : 300
DISCHARGE PUMP STATION (1/2)		DRP I 4002
JICA JAPAN INTERNATIONAL COOPERATION AGENCY		
DRAWN	CHECKED	APPROVED



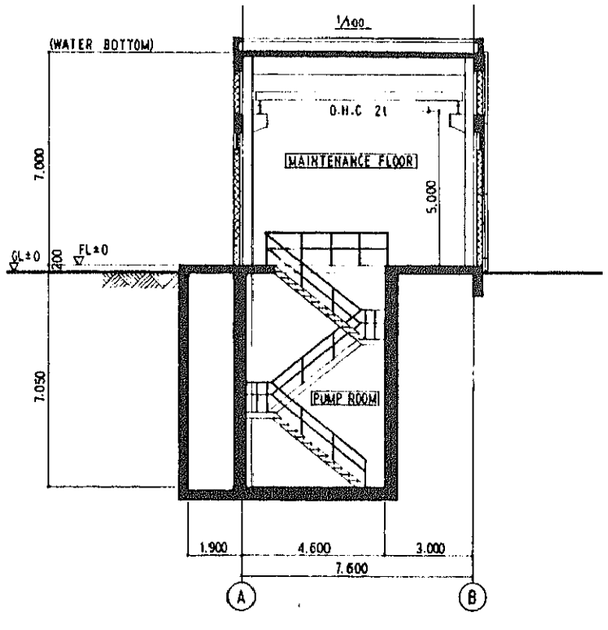
PLAN S=1:100



EAST ELEVATION S=1:100



NORTH ELEVATION S=1:100



A - A SECTION S=1:100

STRUCTURE		
FOUNDATION , COLUMN AND BEAM	: R.C	R.C : REINFORCED CONCRETE
WALL	: HOLLOW CONCRETE BLOCK t=200	OP : OIL PAINT
		EP : EMULSION PAINT
		SD : STEEL DOOR
		AW : ALUMINUM WINDOW

EXTERIOR FINISH SCHEDULE	
ROOF	: WATERPROOF CEMENT MORTAR + INSULATION + ASPHALT WATERPROOFING
WALL	: CEMENT MORTAR LITHING SPRAYING
BASEBOARD	: EXPOSED CONCRETE
PORCH	: CONCRETE STEEL TROWELED
DOOR & WINDOW	: STEEL DOOR & ALUMINUM WINDOW SD- 900W x 2.000H AW - 1.800W x 1.000H - 2.200W x 2.500H - 1.800W x 600H
DOWNPIPE	: PVC ϕ100

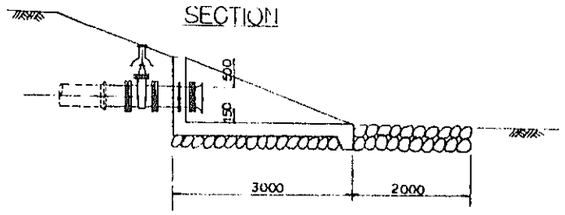
INTERIOR FINISH SCHEDULE

ROOM \ MATERIAL	FLOOR	BASEBOARD	WALL	CEILING	REMARKS
MAINTENANCE FLOOR	CONCRETE STEEL TROWELED		EP ON CONCRETE MORTAR	EP ON EXPOSED CONCRETE	
STORE	CONCRETE STEEL TROWELED		EP ON CONCRETE MORTAR	EP ON EXPOSED CONCRETE	
PUMP ROOM	CONCRETE STEEL TROWELED		EXPOSED CONCRETE	EXPOSED CONCRETE	
STAIR	OP ON CH.R-45				OP ON HANDRAIL

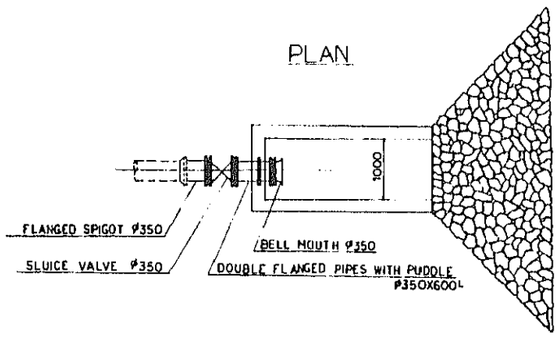
STATE OF QATAR	SCALE
THE STUDY ON DRAINAGE IMPROVEMENT PLAN, DOHA CITY	1 : 100
DISCHARGE PUMP STATION (2/2)	DRP I 4003
JAPAN INTERNATIONAL COOPERATION AGENCY	
DRAWN / CHECKED / APPROVED	

TEMPORARY OUTFALL 1:50

SECTION

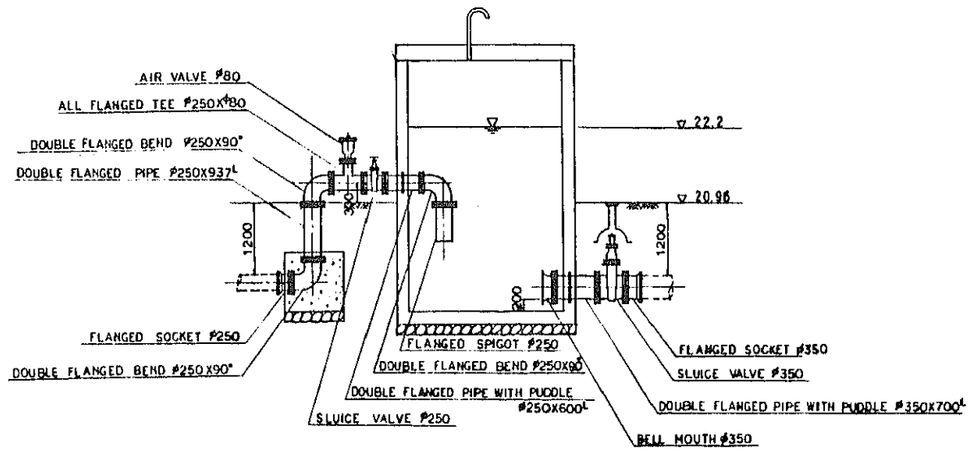


PLAN

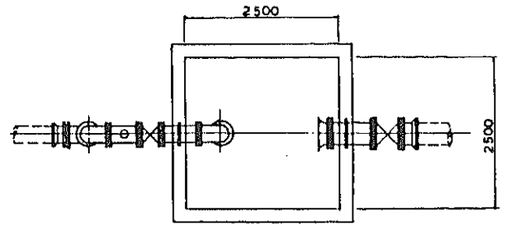


INTERMEDIATE WATER CHAMBER 1:50

SECTION

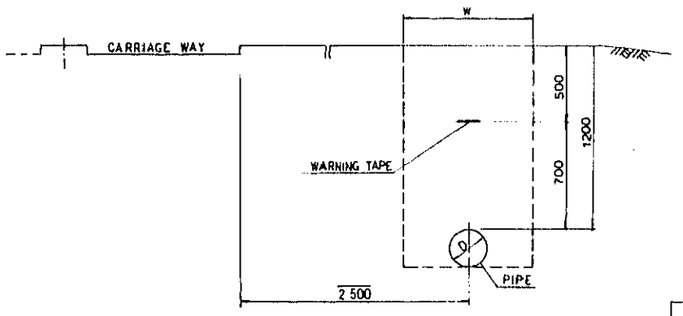


PLAN

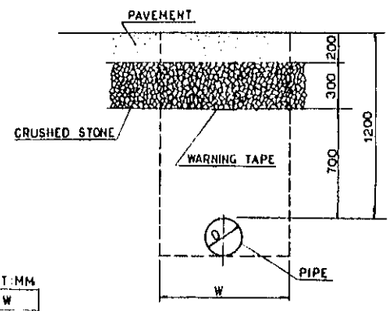


TYPICAL SECTION 1:20

SHOULDER OF ROAD



UNDER ROAD



UNIT: MM

D	W
250	850
350	950

LEGEND

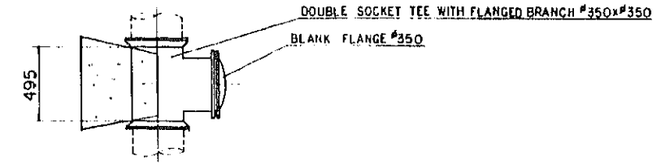
PUSH-ON JOINT

FLANGE JOINT

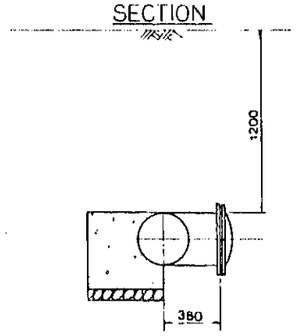
STATE OF QATAR	SCALE
THE STUDY ON DRAINAGE IMPROVEMENT PLAN, DOHA CITY	1 : 20 1 : 50
DISCHARGE PIPE LINE DETAILS (1/2)	DRP I 4 004
JICA JAPAN INTERNATIONAL COOPERATION AGENCY	
DRAWN / CHECKED / APPROVED	

BRANCH 1 : 20

PLAN

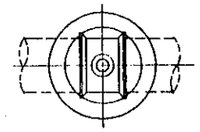


SECTION

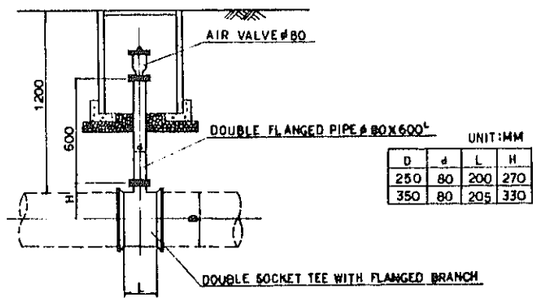


AIR VALVE BOX 1 : 20

PLAN



SECTION

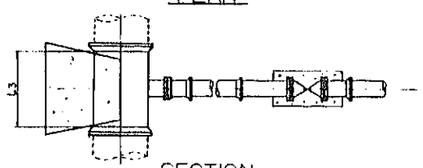


UNIT:MM

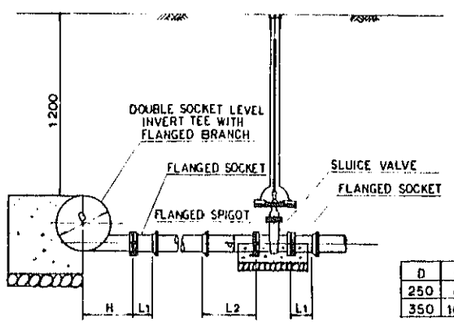
D	d	L	H
250	80	200	270
350	80	205	330

DRAINAGE 1 : 20

PLAN



SECTION

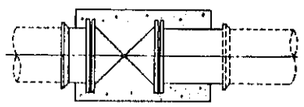


UNIT:MM

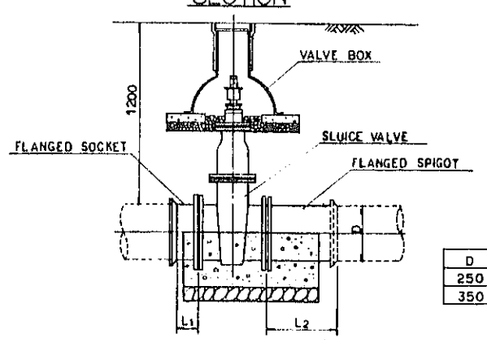
D	d	H	L1	L2	L3
250	80	275	130	350	250
350	100	325	130	360	280

SLUICE VALVE BOX 1 : 20

PLAN



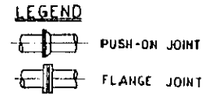
SECTION



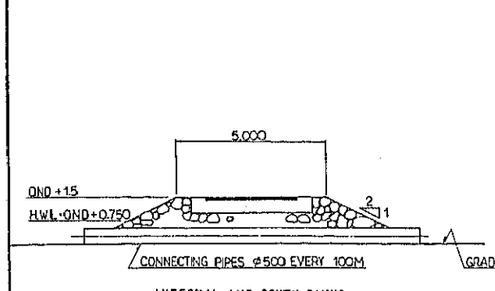
UNIT:MM

D	L1	L2
250	145	420
350	155	460

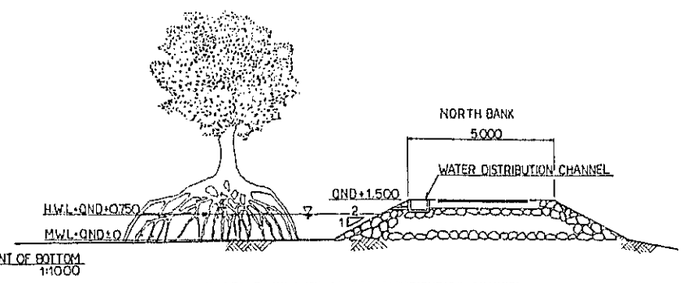
LEGEND



STATE OF QATAR	SCALE
THE STUDY ON DRAINAGE IMPROVEMENT PLAN, DOHA CITY	1 : 20
DISCHARGE PIPE LINE DETAILS (2/2)	DRP I 4005
JAPAN INTERNATIONAL COOPERATION AGENCY	
DRAWN / CHECKED / APPROVED	



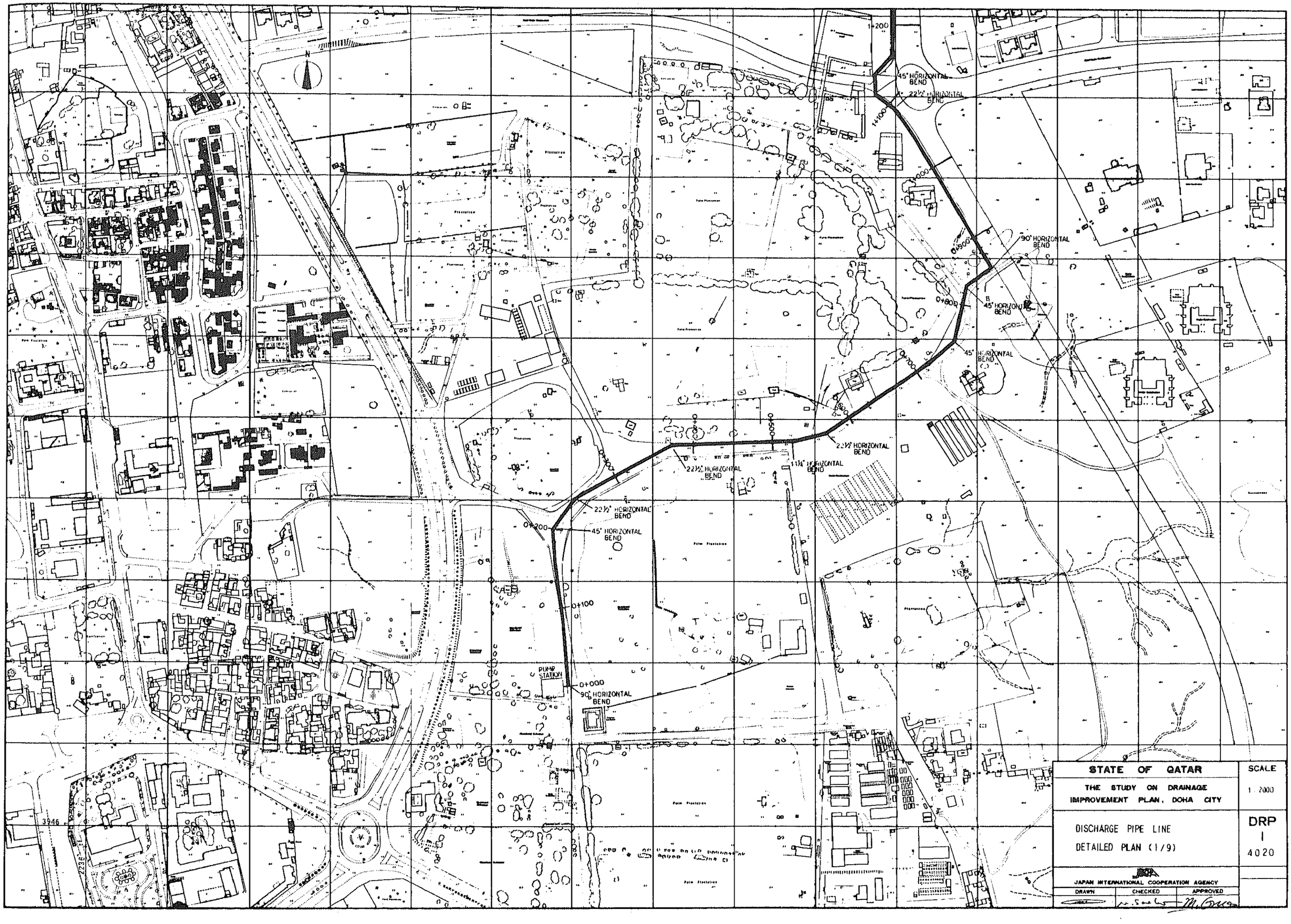
INTERNAL AND SOUTH BANKS



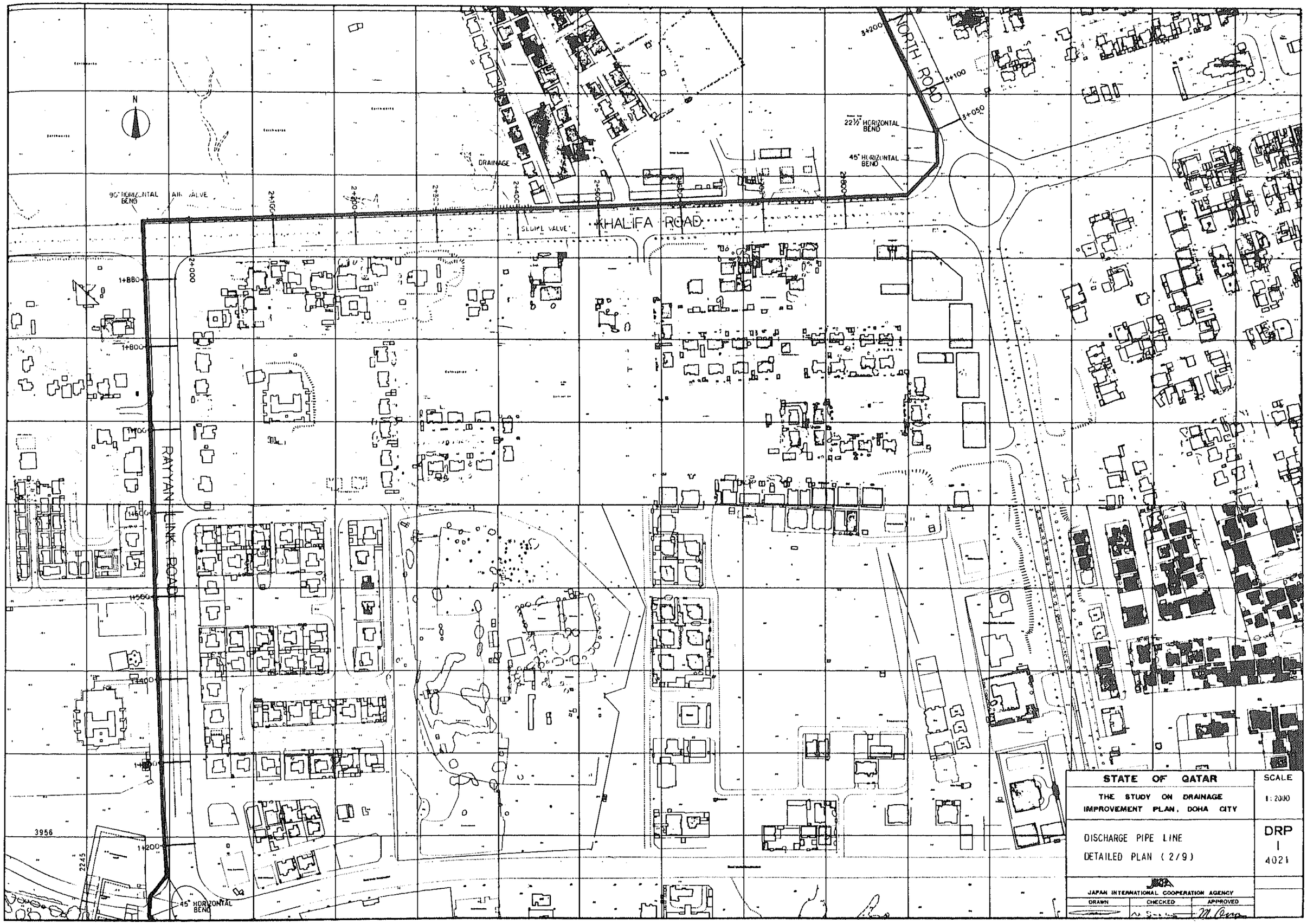
NORTH BANK WITH WATER DISTRIBUTION CHANNEL

MANGROVE AFFORESTATION PLAN

STATE OF QATAR THE STUDY ON DRAINAGE IMPROVEMENT PLAN, DOHA CITY	SCALE 1 : 100 1 : 5 000
MANGROVE AFFORESTATION PLAN	DRP I 4006
JICA JAPAN INTERNATIONAL COOPERATION AGENCY	
DRAWN / CHECKED / APPROVED	



STATE OF QATAR THE STUDY ON DRAINAGE IMPROVEMENT PLAN, DOHA CITY		SCALE 1 : 2000
DISCHARGE PIPE LINE DETAILED PLAN (1/9)		DRP I 4020
JICA JAPAN INTERNATIONAL COOPERATION AGENCY		
DRAWN	CHECKED	APPROVED



STATE OF QATAR

THE STUDY ON DRAINAGE IMPROVEMENT PLAN, DOHA CITY

SCALE 1:2000

DISCHARGE PIPE LINE
DETAILED PLAN (2/9)

DRP
I
4021

JICA
JAPAN INTERNATIONAL COOPERATION AGENCY

DRAWN	CHECKED	APPROVED