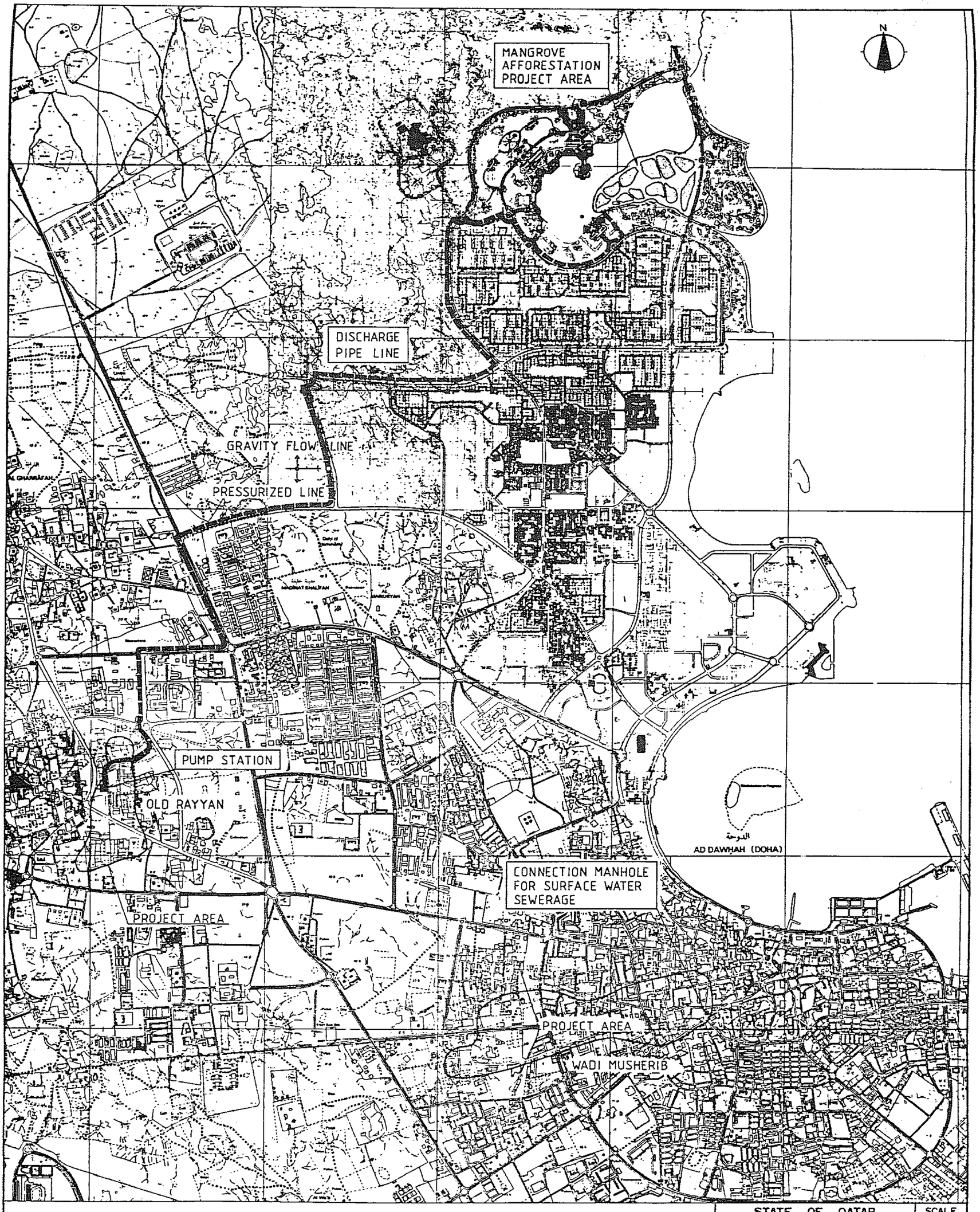
5. Drawings

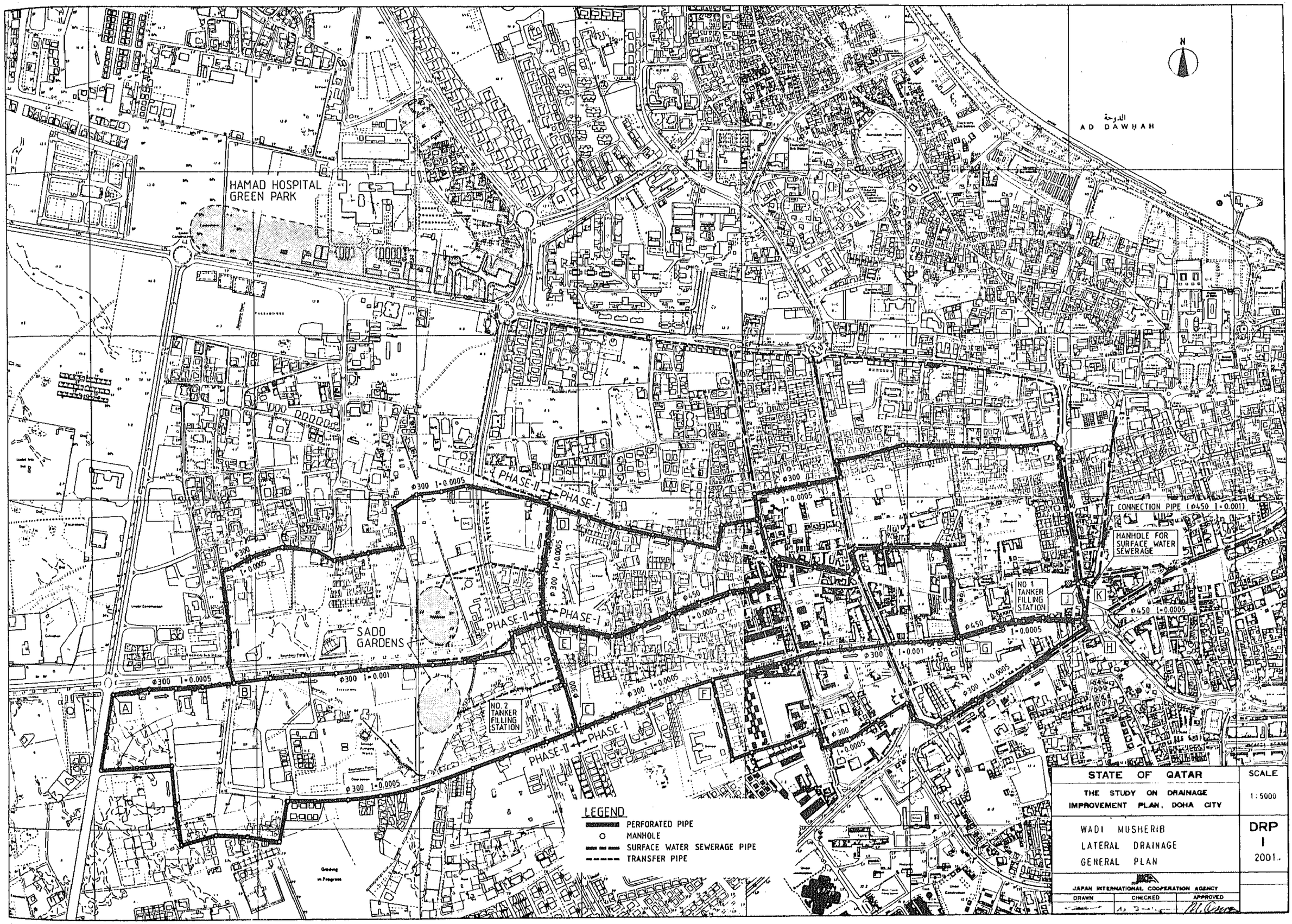
DRAWING LIST

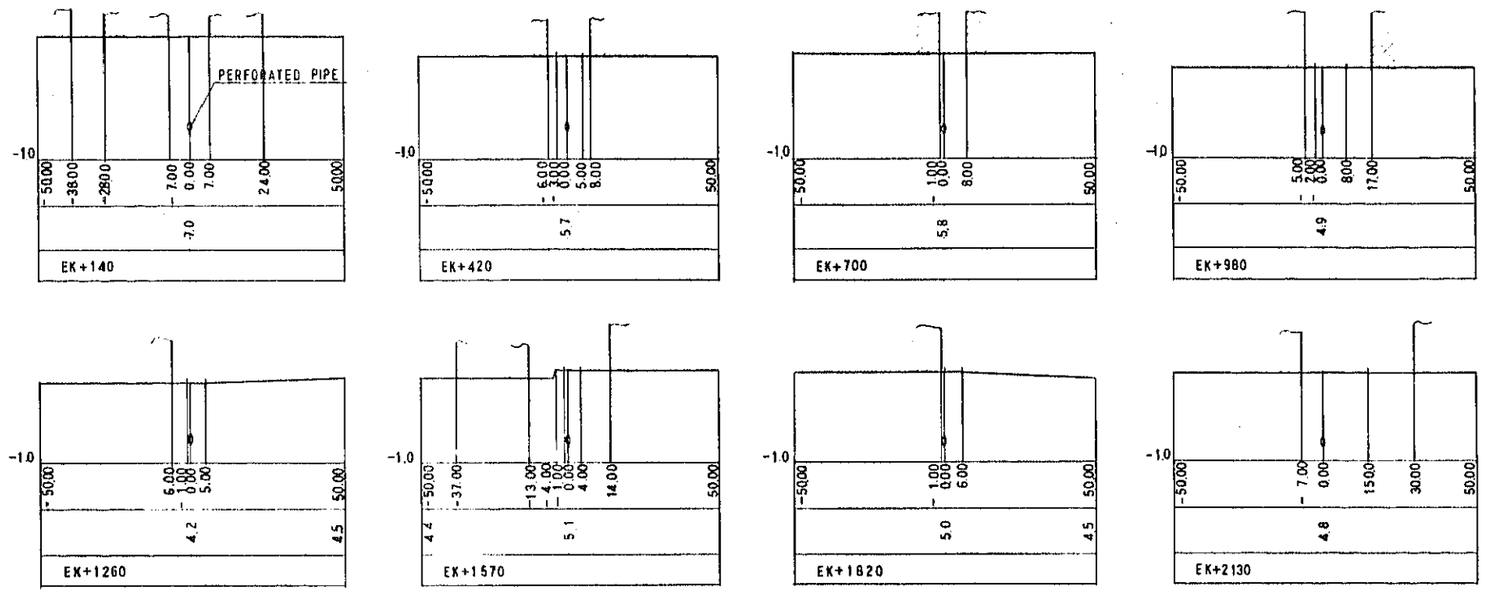
DWG. NO.	TITLE
DRP-1001	DRAINAGE IMPROVEMENT PLAN
DRP-2001	WADI MUSHERIB LATERAL DRAINAGE-GENERAL PLAN
DRP-2002	WADI MUSHERIB LATERAL DRAINAGE TRANSVERSAL AND LONGITUDINAL SECTIONS (1/7)
DRP-2003	WADI MUSHERIB LATERAL DRAINAGE TRANSVERSAL AND LONGITUDINAL SECTIONS (2/7)
DRP-2004	WADI MUSHERIB LATERAL DRAINAGE TRANSVERSAL AND LONGITUDINAL SECTIONS (3/7)
DRP-2005	WADI MUSHERIB LATERAL DRAINAGE TRANSVERSAL AND LONGITUDINAL SECTIONS (4/7)
DRP-2006	WADI MUSHERIB LATERAL DRAINAGE TRANSVERSAL AND LONGITUDINAL SECTIONS (5/7)
DRP-2007	WADI MUSHERIB LATERAL DRAINAGE TRANSVERSAL AND LONGITUDINAL SECTIONS (6/7)
DRP-2008	WADI MUSHERIB LATERAL DRAINAGE TRANSVERSAL AND LONGITUDINAL SECTIONS (7/7)
DRP-2009	WADI MUSHERIB MANHOLE AND TYPICAL SECTION OF LATERAL DRAIN
DRP-2010	TANKER FILLING STATION AND CONNECTION TO SURFACE WATER SEWERAGE
DRP-2011	TANKER FILLING STATION - DETAILS
DRP-2020	WADI MUSHERIB LATERAL DRAINAGE - DETAILED PLAN (1/4)
DRP-2021	WADI MUSHERIB LATERAL DRAINAGE - DETAILED PLAN (2/4)
DRP-2022	WADI MUSHERIB LATERAL DRAINAGE - DETAILED PLAN (3/4)

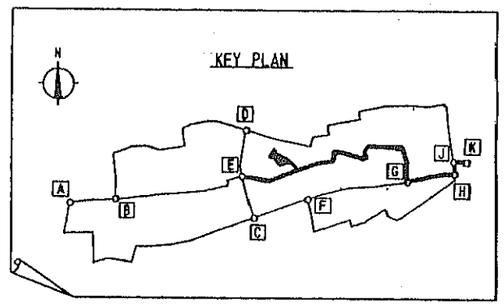
DWG. NO.	TITLE
DRP-2023	WADI MUSHERIB LATERAL DRAINAGE - DETAILED PLAN (4/4)
DRP-2030	ROAD HIERARCHY (1/2)
DRP-2031	ROAD HIERARCHY (2/2)



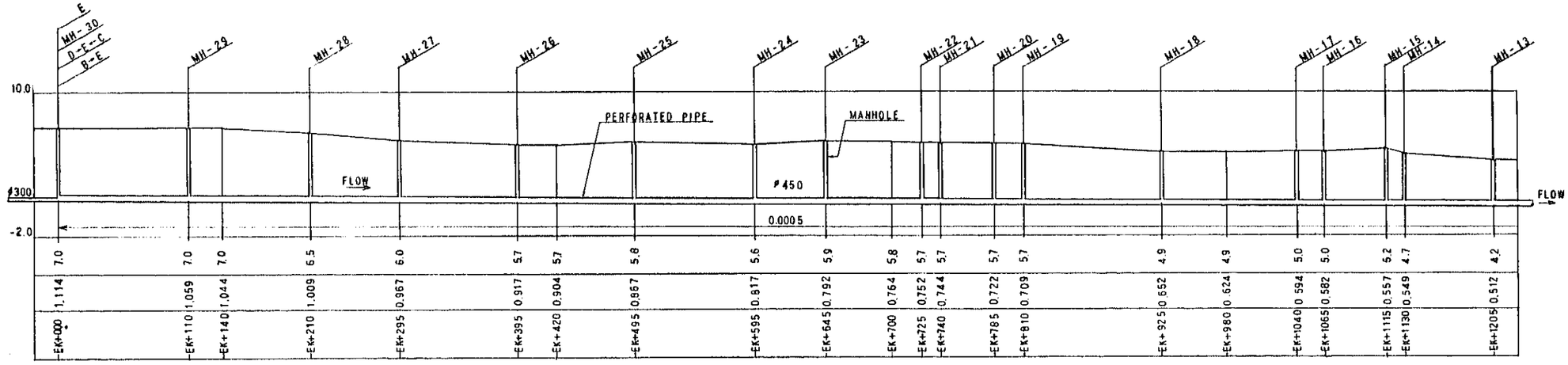
STATE OF QATAR	SCALE
THE STUDY ON DRAINAGE IMPROVEMENT PLAN, DOHA CITY	1 : 20000
DRAINAGE IMPROVEMENT PLAN	DRP I 1001
JICA JAPAN INTERNATIONAL COOPERATION AGENCY	
DRAWN / CHECKED / APPROVED	

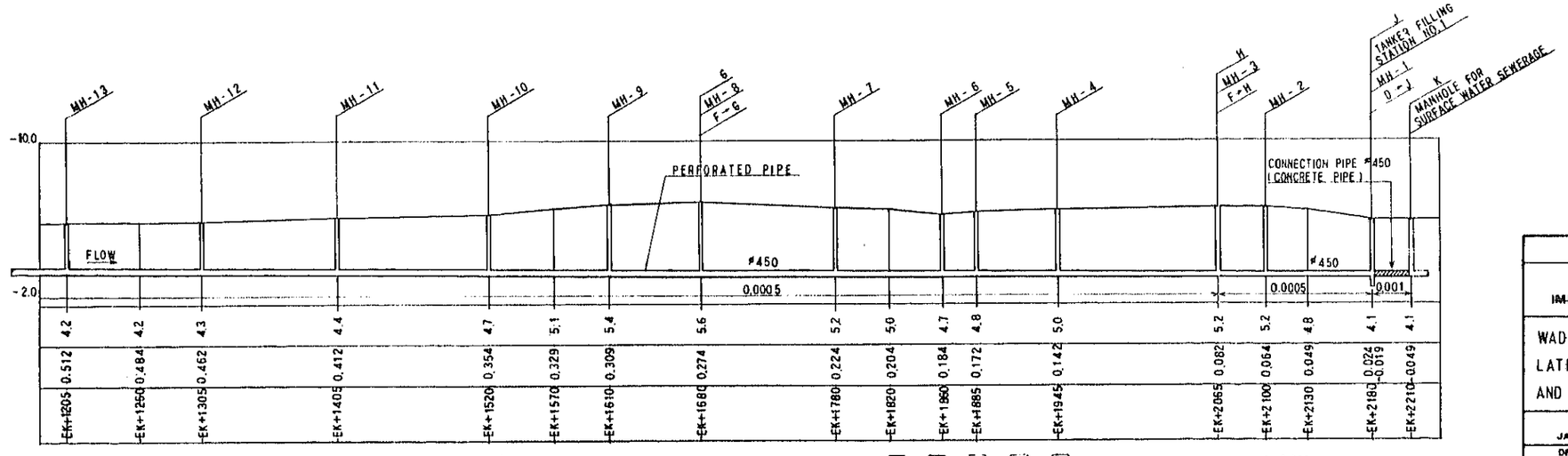

HAMAD HOSPITAL
GREEN PARK
SADD
GARDENS
الدوحة
AD DAWḤAH
NO.2
TANKER
FILLING
STATION
NO.1
TANKER
FILLING
STATION
PHASE-I
PHASE-II
φ300 I=0.0005
φ300 I=0.001
φ450 I=0.0005
φ450 I=0.001
CONNECTION PIPE (φ450 I=0.001)
MANHOLE FOR
SURFACE WATER
SEWERAGE
LEGEND
PERFORATED PIPE
MANHOLE
SURFACE WATER SEWERAGE PIPE
TRANSFER PIPE
STATE OF QATAR
THE STUDY ON DRAINAGE
IMPROVEMENT PLAN, DOHA CITY
SCALE
1:5000
WADI MUSHERIB
LATERAL DRAINAGE
GENERAL PLAN
DRP
I
2001.
JAPAN INTERNATIONAL COOPERATION AGENCY
DRAWN
CHECKED
APPROVED





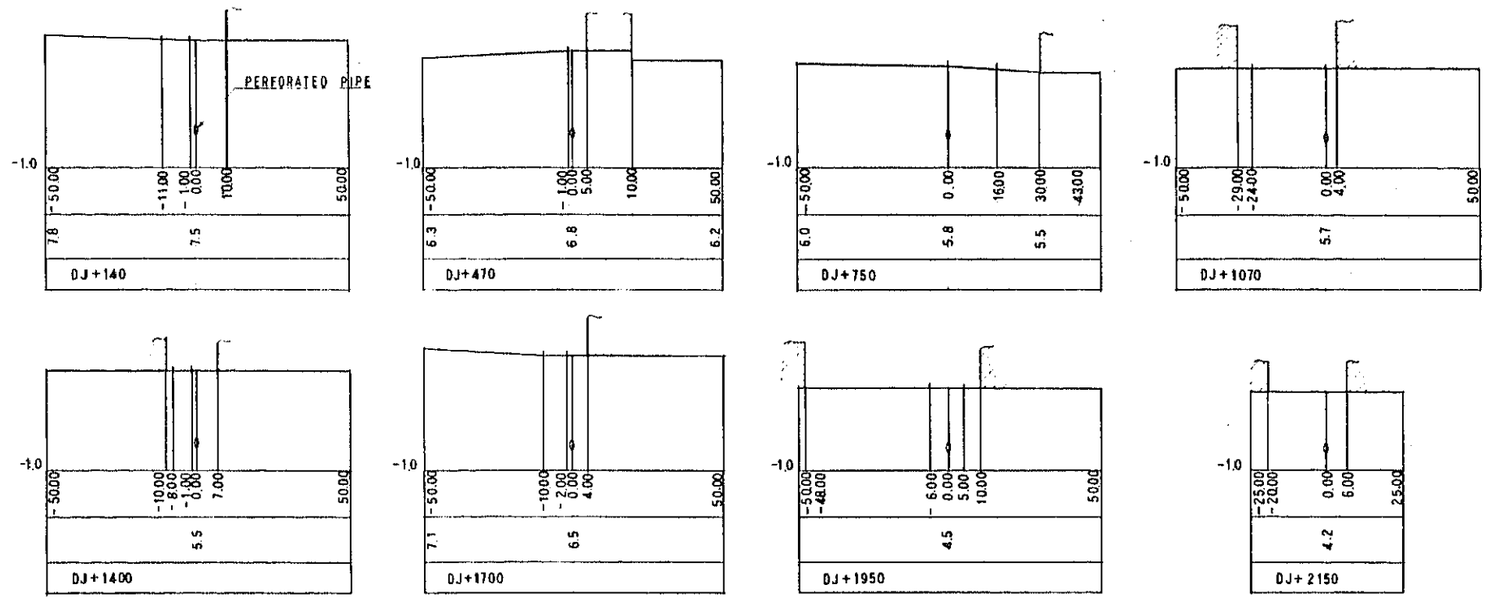
TRANSVERSAL SECTION (SCALE VER. 1:200, HOR. 1:1000)

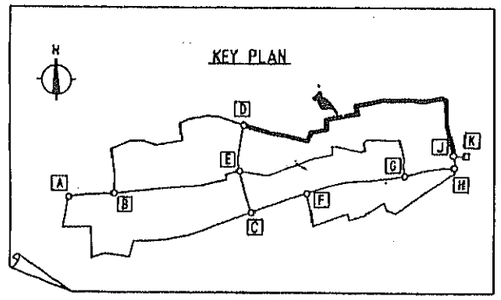




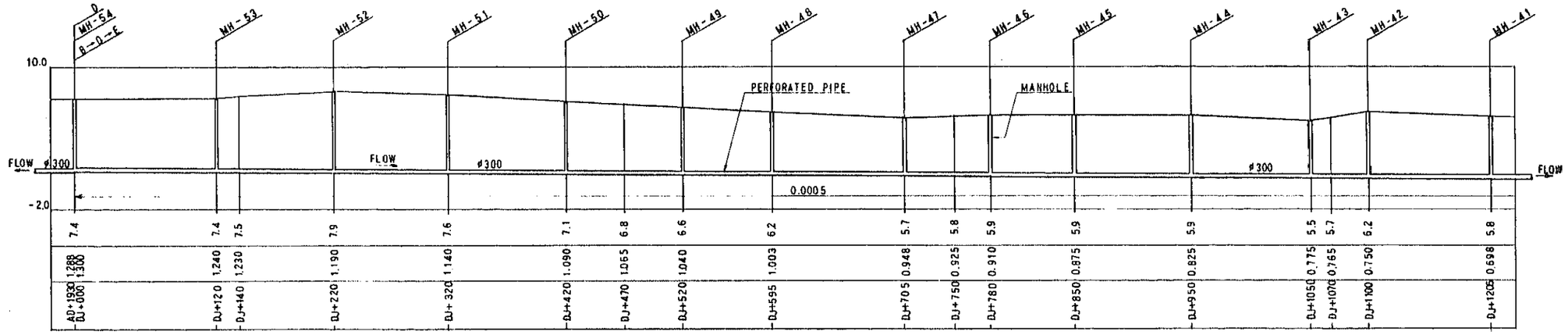
LONGITUDINAL SECTION E → G → H → J → K (SCALE VER. 1:200, HOR. 1:2000)

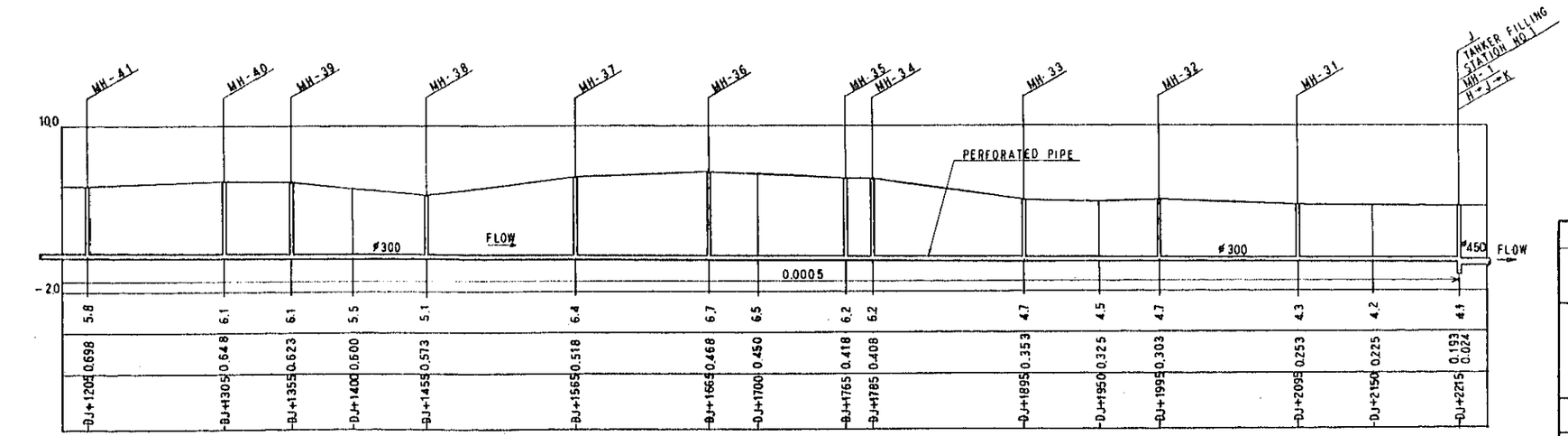
STATE OF QATAR	SCALE
THE STUDY ON DRAINAGE IMPROVEMENT PLAN, DOHA CITY	1 : 200 1 : 1 000 1 : 2 000
WADI MUSHERIB LATERAL DRAINAGE - TRANSVERSAL AND LONGITUDINAL SECTIONS (1/7)	DRP 1 2002
JAPAN INTERNATIONAL COOPERATION AGENCY	
DRAWN / CHECKED / APPROVED	





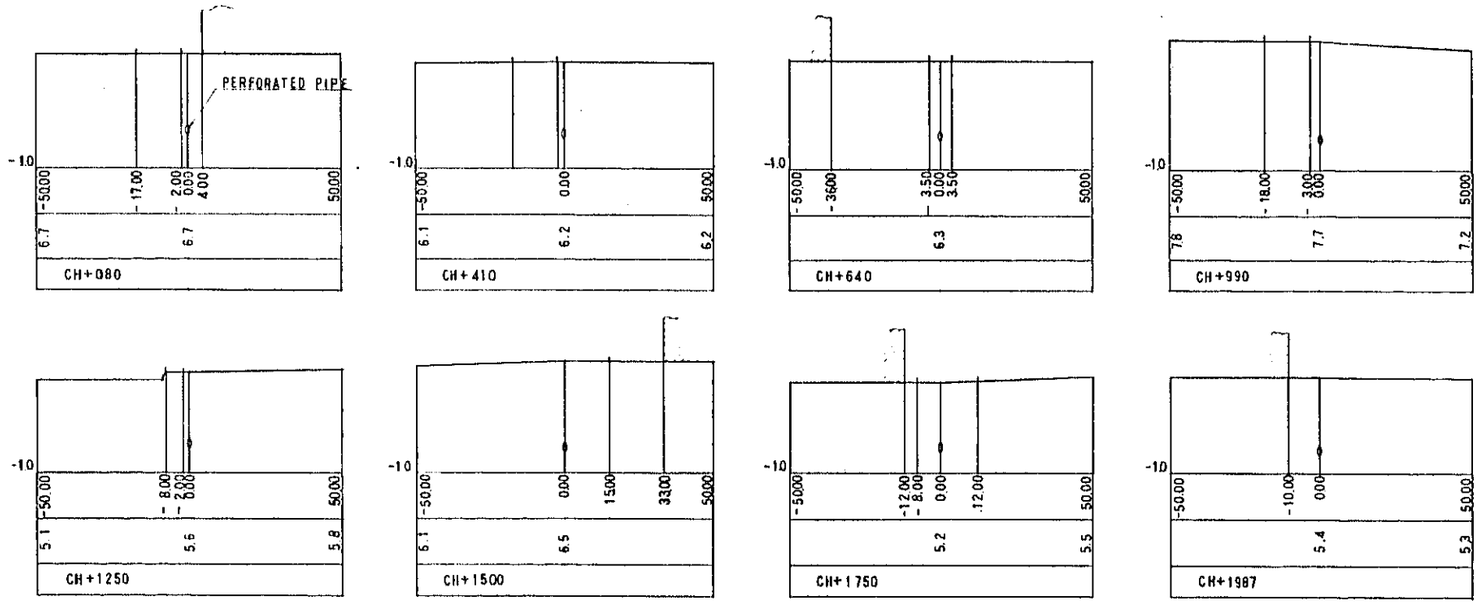
TRANSVERSAL SECTION (SCALE VER. 1:200, HOR. 1:1000)

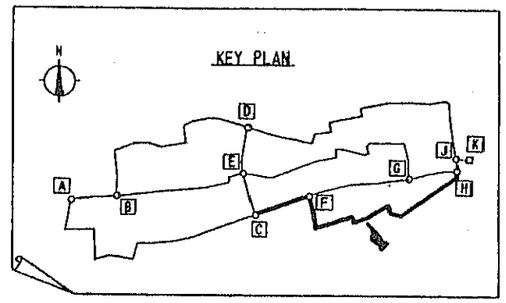




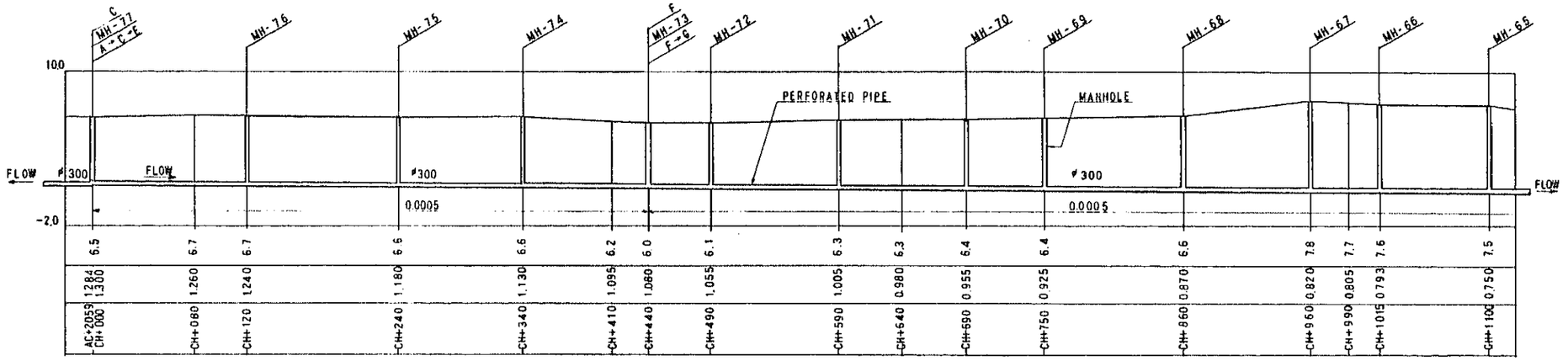
LONGITUDINAL SECTION D → J (SCALE VER. 1:200, HOR. 1:2000)

STATE OF QATAR	SCALE
THE STUDY ON DRAINAGE IMPROVEMENT PLAN, DOHA CITY	1 : 200 1 : 1000 1 : 2000
WADI MUSHERIB LATERAL DRAINAGE - TRANSVERSAL AND LONGITUDINAL SECTIONS (2/7)	DRP I 2003
JAPAN INTERNATIONAL COOPERATION AGENCY	
DRAWN / CHECKED / APPROVED	



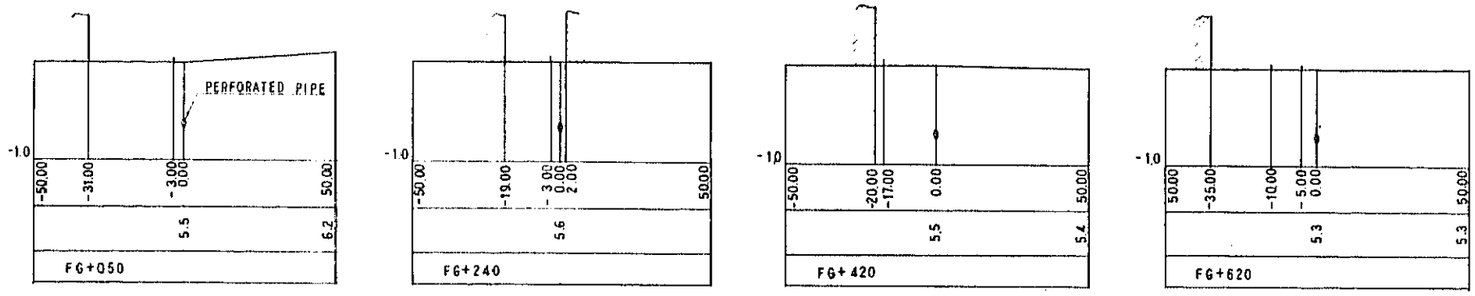


TRANSVERSAL SECTION (SCALE VER. 1:200, HOR. 1:1000)

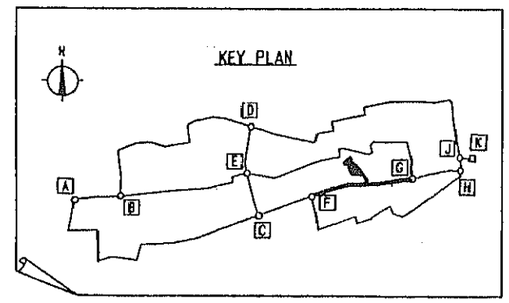


LONGITUDINAL SECTION C → F → H (SCALE VER. 1:200, HOR. 1:2 000)

STATE OF QATAR	SCALE 1 : 200 / 1 : 1 000 / 1 : 2 000
THE STUDY ON DRAINAGE IMPROVEMENT PLAN, DOHA CITY	
WADI MUSHERIB LATERAL DRAINAGE - TRANSVERSAL AND LONGITUDINAL SECTIONS (3/7)	DRP I 2004
JAPAN INTERNATIONAL COOPERATION AGENCY	
DRAWN / CHECKED / APPROVED	

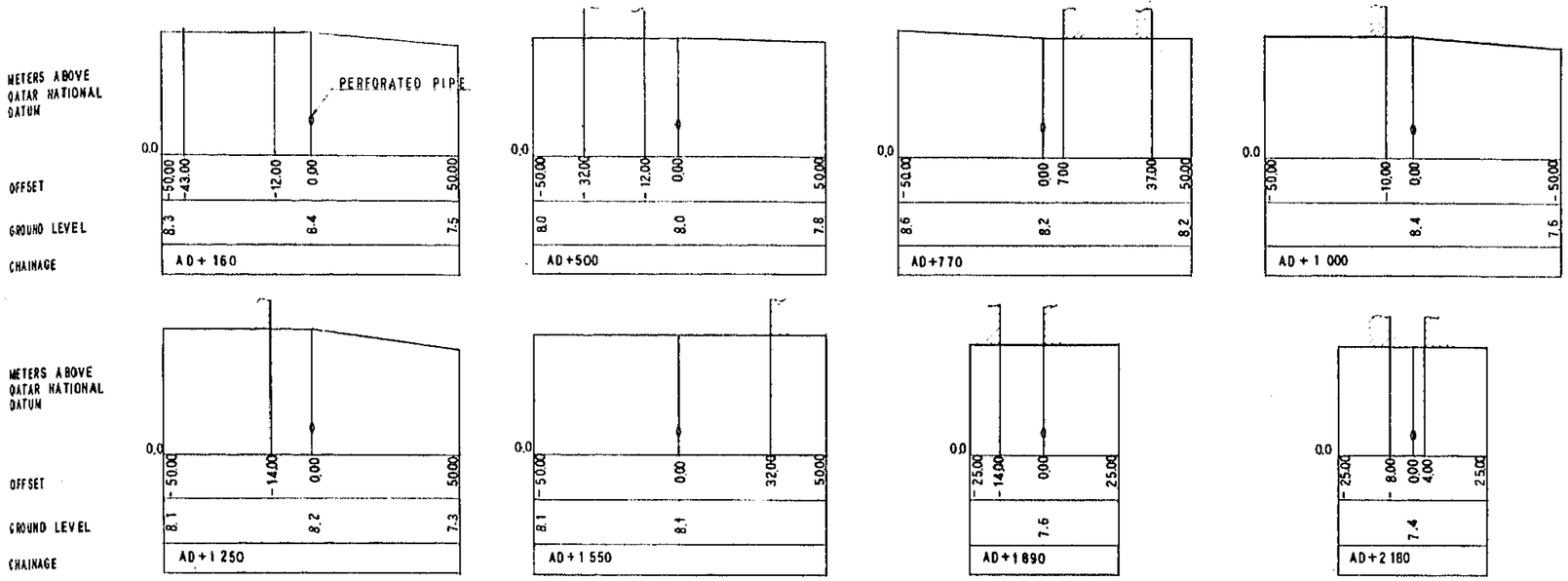


TRANSVERSAL SECTION (SCALE VER. 1 : 200, HOR. 1 : 1 000)

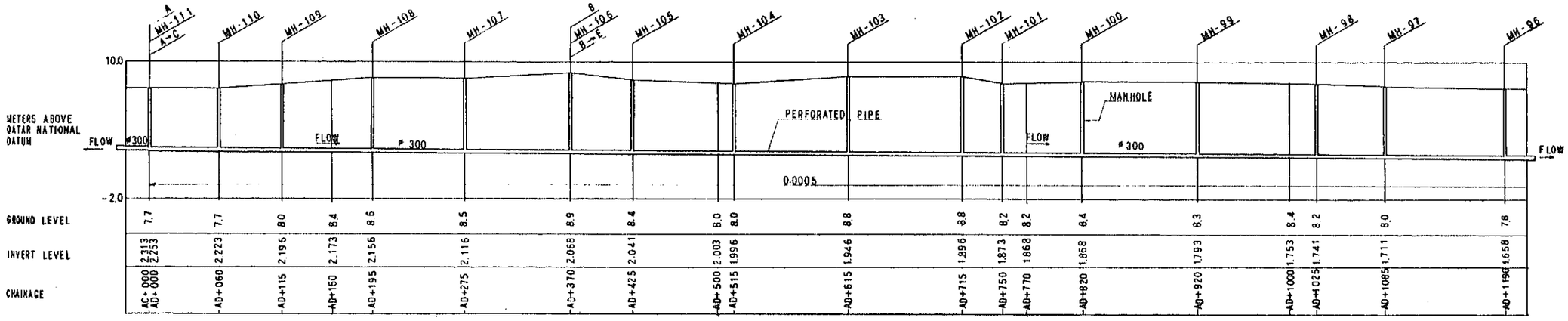


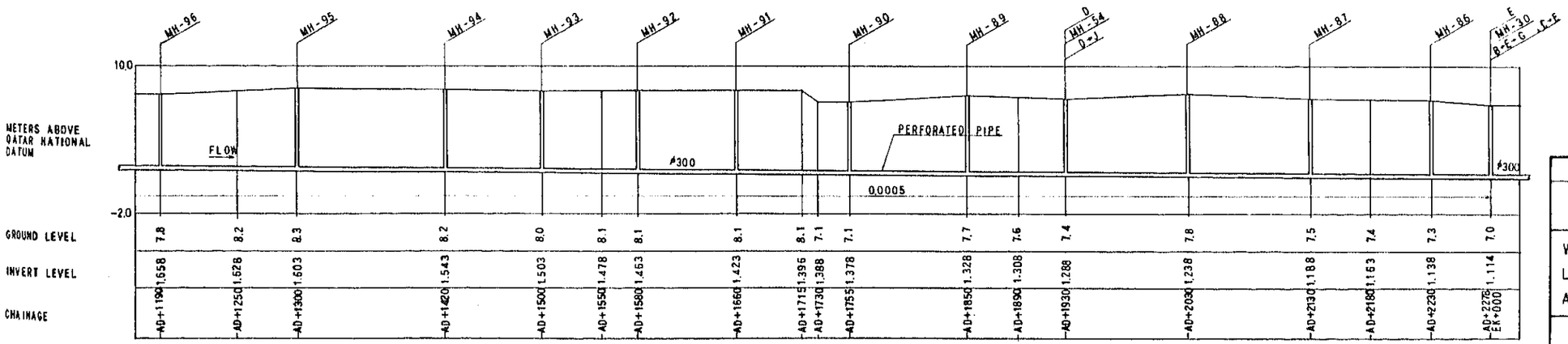
LONGITUDINAL SECTION F — G (SCALE VER. 1 :200, HOR. 1:2 000)

STATE OF QATAR THE STUDY ON DRAINAGE IMPROVEMENT PLAN, DOHA CITY	SCALE 1 : 200 1 : 1 000 1 : 2 000
WADI MUSHERIB LATERAL DRAINAGE - TRANSVERSAL AND LONGITUDINAL SECTIONS (4/7)	DRP I 2005
JAPAN INTERNATIONAL COOPERATION AGENCY DRAWN / CHECKED / APPROVED	

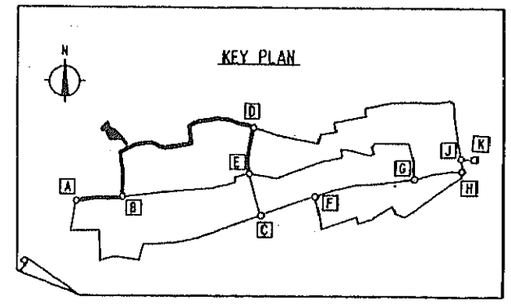


TRANSVERSAL SECTION (SCALE VER.1:200, HOR. 1:1000)

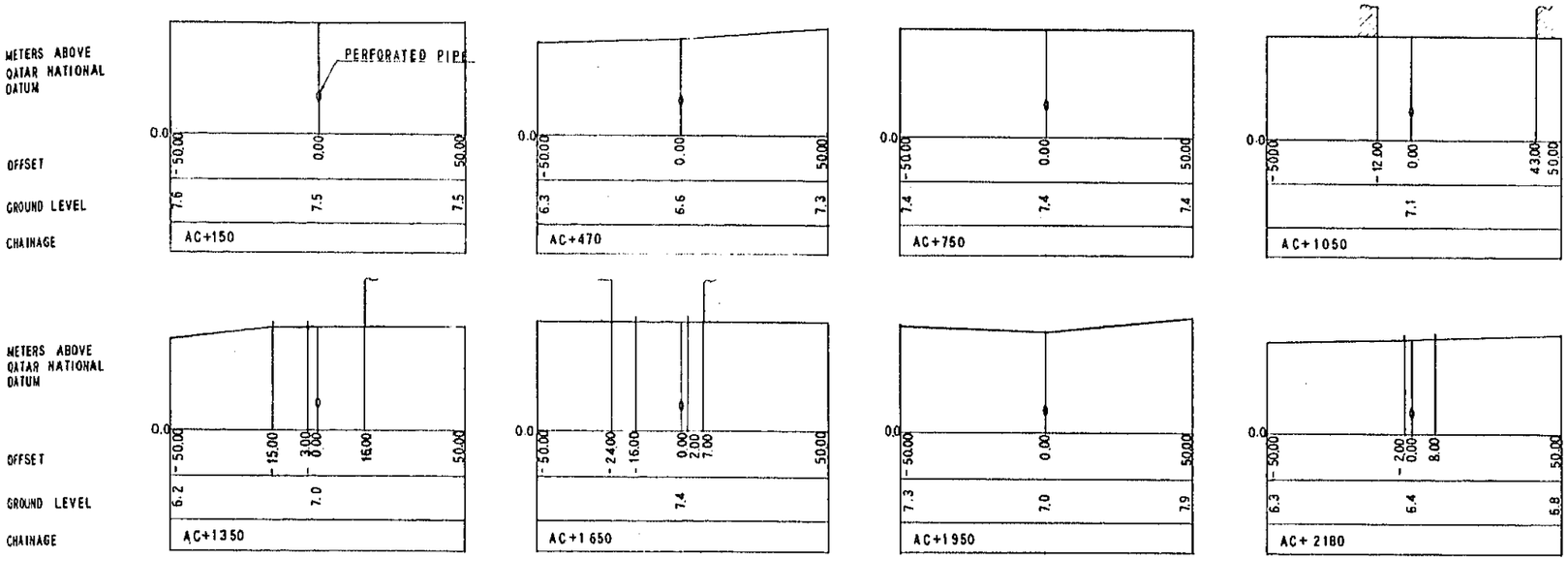


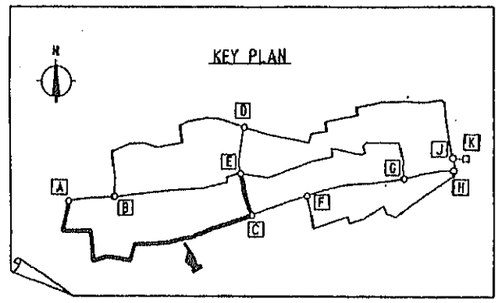


LONGITUDINAL SECTION A → B → D → E (SCALE VER. 1:200, HOR. 1:2000)

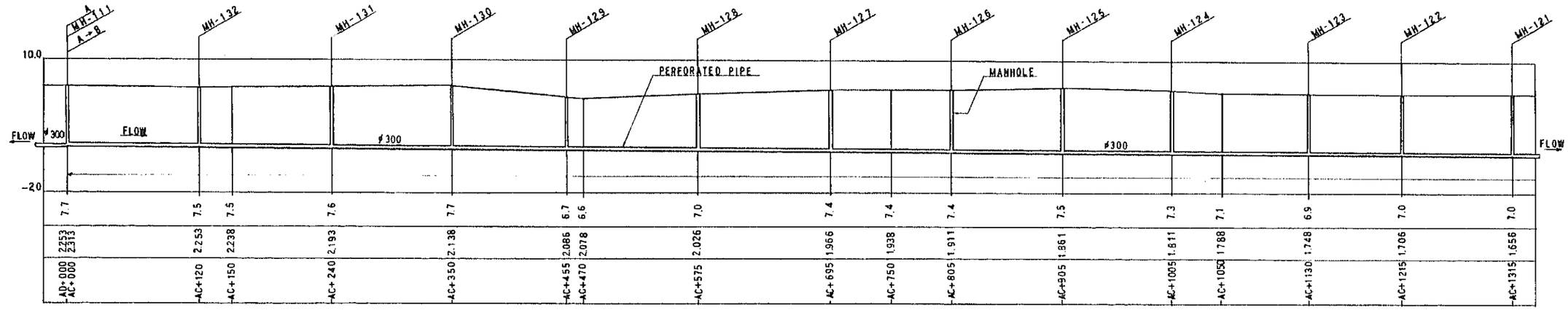


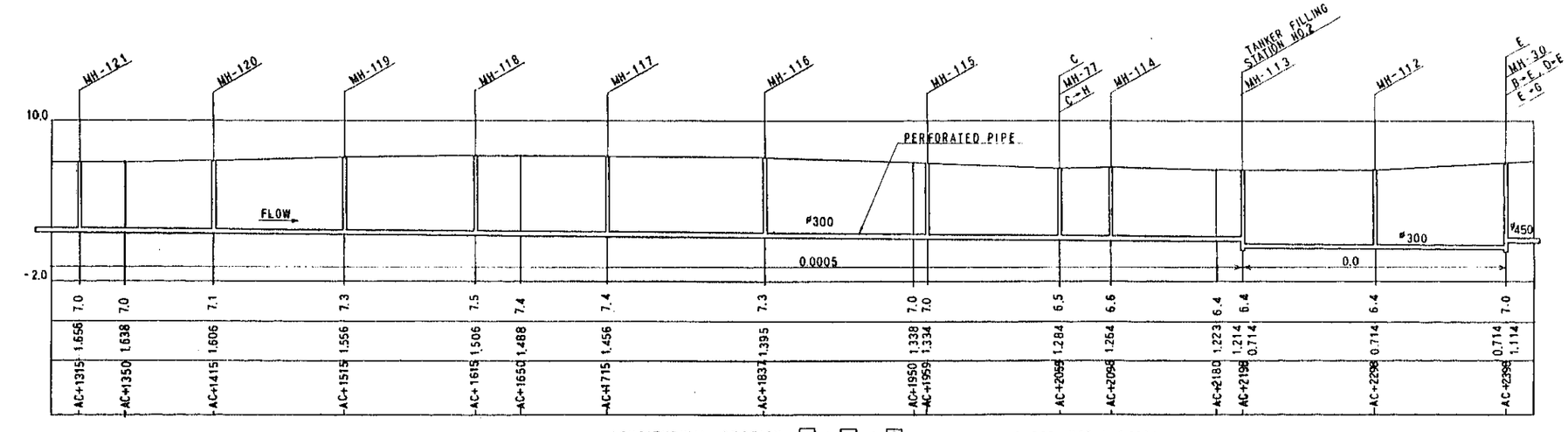
STATE OF QATAR	SCALE
THE STUDY ON DRAINAGE IMPROVEMENT PLAN, DOHA CITY	1 : 200 1 : 1 000 1 : 2 000
WADI MUSHERIB LATERAL DRAINAGE - TRANSVERSAL AND LONGITUDINAL SECTIONS (5/7)	DRP 1 2006
JAPAN INTERNATIONAL COOPERATION AGENCY	
DRAWN / CHECKED / APPROVED	





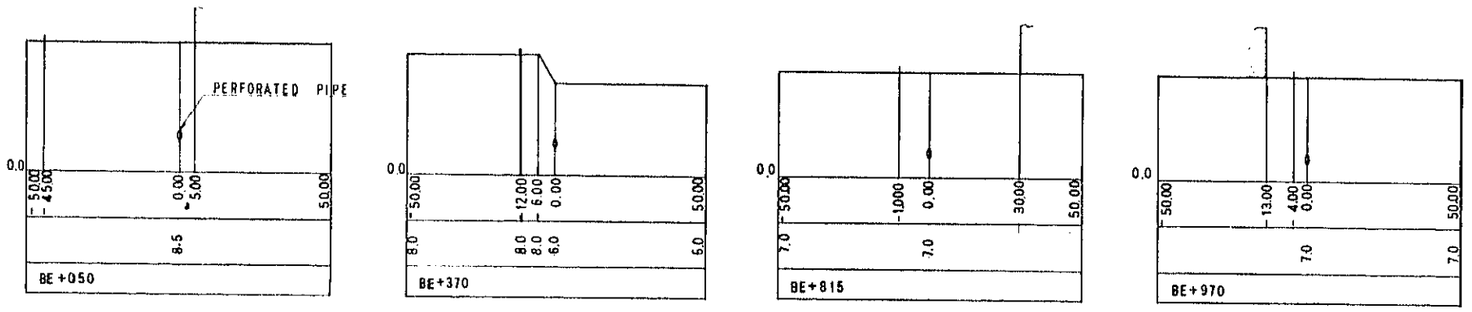
TRANSVERSAL SECTION (SCALE VER. 1:200, HOR. 1:1000)

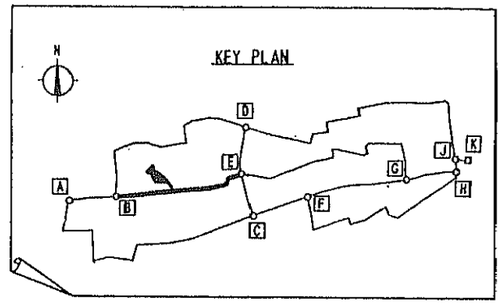




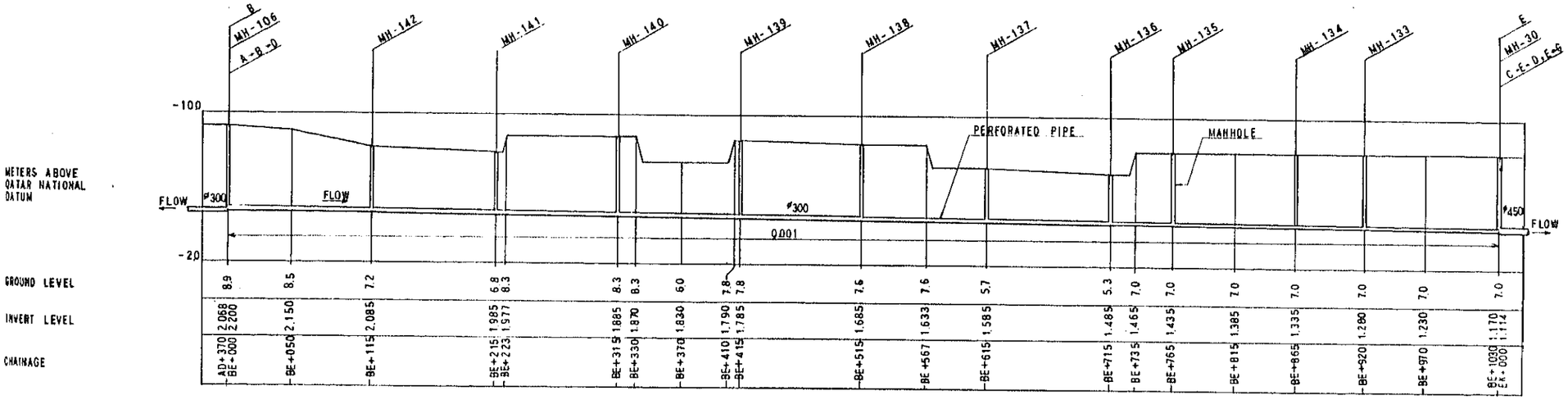
LONGITUDINAL SECTION A → C → E (SCALE VER. 1:200, HOR. 1:2000)

STATE OF QATAR THE STUDY ON DRAINAGE IMPROVEMENT PLAN, DOHA CITY	SCALE 1 : 200 1 : 1 000 1 : 2 000
WADI MUSHERIB LATERAL DRAINAGE - TRANSVERSAL AND LONGITUDINAL SECTIONS (6/7)	DRP I 2007
JAPAN INTERNATIONAL COOPERATION AGENCY DRAWN / CHECKED / APPROVED	





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

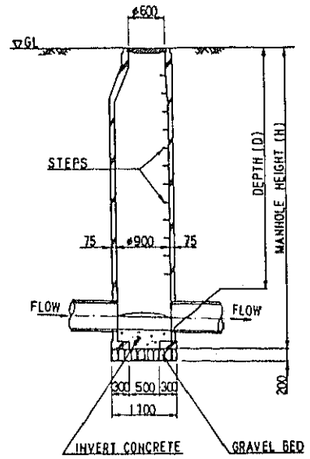


LONGITUDINAL SECTION B → E (SCALE VER. 1:200, HOR. 1:2000)

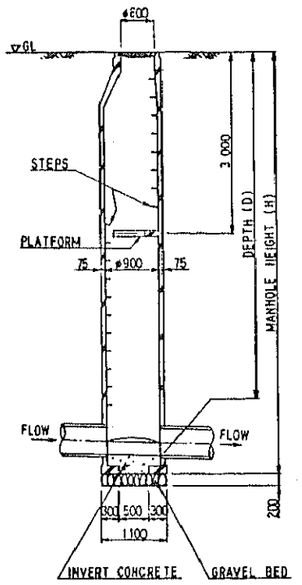
STATE OF QATAR THE STUDY ON DRAINAGE IMPROVEMENT PLAN, DOHA CITY		SCALE 1 : 200 1 : 1000 1 : 2000
WADI MUSHERIB LATERAL DRAINAGE - TRANSVERSAL AND LONGITUDINAL SECTIONS (7/7)		DRP I 2008
JAPAN INTERNATIONAL COOPERATION AGENCY		
DRAWN	CHECKED	APPROVED

MANHOLE LIST

MANHOLE NO.	LOCATION	DEPTH (D) (m)	TYPE	MANHOLE HEIGHT (H) (m)
1	EK+2180 DJ+2215	4.577	A	4.880
2	EK+2100	5.154	B	5.460
3	EK+2065 CH+2002	5.119	B	5.420
4	EK+1945	4.858	A	5.160
5	EK+1885	4.628	A	4.930
6	EK+1860	4.516	A	4.820
7	EK+1780	4.976	A	5.320
8	EK+1680 FG+ 772	5.326	B	5.670
9	EK+1610	5.091	B	5.440
10	EK+1520	4.346	A	4.690
11	EK+1405	3.988	A	4.330
12	EK+1305	3.838	A	4.180
13	EK+1205	3.688	A	4.030
14	EK+1130	4.153	A	4.500
15	EK+1115	4.643	A	4.990
16	EK+1065	4.418	A	4.760
17	EK+1040	4.406	A	4.750
18	EK+ 925	4.248	A	4.590
19	EK+ 810	4.991	A	5.340
20	EK+ 785	4.978	A	5.320
21	EK+ 740	4.956	A	5.300
22	EK+ 725	4.948	A	5.290
23	EK+ 645	5.108	B	5.450
24	EK+ 595	4.783	A	5.130
25	EK+ 495	4.933	A	5.280
26	EK+ 395	4.783	A	5.130
27	EK+ 295	5.033	B	5.380
28	EK+ 210	5.491	B	5.840
29	EK+ 110	5.941	B	6.290
30	EK+ 000 AD+2278 AC+2398 BE+1030	5.886	B	6.230
31	DJ+2095	4.047	A	4.390
32	DJ+1995	4.397	A	4.740
33	DJ+1895	4.347	A	4.690
34	DJ+1785	5.792	B	6.140
35	DJ+1765	5.782	B	
36	DJ+1665	6.232	B	6.580
37	DJ+1565	5.882	B	6.230
38	DJ+1455	4.527	A	4.870
39	DJ+1355	5.477	B	5.820
40	DJ+1305	5.452	B	5.800
41	DJ+1205	5.102	B	5.450
42	DJ+1100	5.450	B	5.790
43	DJ+1050	4.725	A	5.070
44	DJ+ 950	5.075	B	5.420
45	DJ+ 850	5.025	B	5.370
46	DJ+ 780	4.990	A	5.330
47	DJ+ 705	4.752	A	5.100
48	DJ+ 595	5.197	B	5.540
49	DJ+ 520	5.560	B	5.900
50	DJ+ 420	6.010	B	6.350
51	DJ+ 320	6.460	B	6.800
52	DJ+ 220	6.710	B	7.050
53	DJ+ 120	6.160	B	6.500
54	DJ+ 000 AD+1930	6.112	B	6.460
55	CH+1975	5.287	B	5.630
56	CH+1875	4.937	A	5.280
57	CH+1775	4.687	A	5.030
58	CH+1675	5.137	B	5.480
59	CH+1575	5.487	B	5.830
60	CH+1475	6.137	B	6.480
61	CH+1425	6.412	B	6.760
62	CH+1355	6.377	B	6.720
63	CH+1305	5.652	B	6.000
64	CH+1205	5.102	B	5.450
65	CH+1100	6.750	B	7.090
66	CH+1015	6.807	B	7.150
67	CH+ 960	6.980	B	7.320
68	CH+ 860	5.730	B	6.070
69	CH+ 750	5.475	B	5.820
70	CH+ 690	5.445	B	5.790
71	CH+ 590	5.295	B	5.640
72	CH+ 490	5.045	B	5.390
73	CH+ 440 FG+ 000	4.920	A	5.260
74	CH+ 340	5.470	B	5.810
75	CH+ 240	5.420	B	5.760
76	CH+ 120	5.460	B	5.800
77	CH+ 000 AC+2059	5.216	B	5.560
78	FG+ 752	5.252	B	5.600
79	FG+ 652	4.492	A	4.840
80	FG+ 572	3.872	A	4.220
81	FG+ 472	4.372	A	4.720
82	FG+ 372	4.972	A	5.320
83	FG+ 312	4.112	A	4.460
84	FG+ 212	4.512	A	4.860
85	FG+ 112	4.612	A	4.960
86	AD+2230	6.162	B	6.510
87	AD+2130	6.312	B	6.660
88	AD+2030	6.562	B	6.910
89	AD+1850	6.372	B	6.720
90	AD+1755	5.722	B	6.070
91	AD+1660	6.677	B	7.020
92	AD+1580	6.637	B	6.980
93	AD+1500	6.497	B	6.840
94	AD+1420	6.657	B	7.000
95	AD+1300	6.697	B	7.040
96	AD+1190	6.142	B	6.490
97	AD+1085	6.289	B	6.630
98	AD+1025	6.459	B	6.800
99	AD+ 920	6.507	B	6.850
100	AD+ 820	6.532	B	6.880
101	AD+ 750	6.327	B	6.670
102	AD+ 715	6.904	B	7.250
103	AD+ 615	6.854	B	7.200
104	AD+ 515	6.004	B	6.350
105	AD+ 425	6.359	B	6.700
106	AD+ 370 BE+ 000	6.832	B	7.180
107	AD+ 275	6.384	B	6.730
108	AD+ 195	6.444	B	6.790
109	AD+ 115	5.804	B	6.150
110	AD+ 060	5.477	B	5.820
111	AD+ 000 AC+ 000	5.447	B	5.790
112	AC+2298	5.686	B	6.030
113	AC+2198	5.686	B	6.030
114	AC+2098	5.336	B	5.680
115	AC+1959	5.666	B	6.010
116	AC+1837	5.905	B	6.250
117	AC+1715	5.944	B	6.290
118	AC+1615	5.994	B	6.340
119	AC+1515	5.744	B	6.090
120	AC+1415	5.494	B	5.840
121	AC+1315	5.344	B	5.690
122	AC+1215	5.294	B	5.640
123	AC+1130	5.152	B	5.500
124	AC+1005	5.489	B	5.830
125	AC+ 905	5.639	B	5.980
126	AC+ 805	5.489	B	5.880
127	AC+ 695	5.434	B	5.780
128	AC+ 575	4.974	A	5.320
129	AC+ 455	4.614	A	4.960
130	AC+ 350	5.562	B	5.910
131	AC+ 240	5.407	B	5.750
132	AC+ 120	5.247	B	5.590
133	BE+ 920	5.720	B	6.060
134	BE+ 865	5.665	B	6.010
135	BE+ 765	5.565	B	5.910
136	BE+ 715	3.815	A	4.160
137	BE+ 615	4.115	A	4.460
138	BE+ 515	5.915	B	6.260
139	BE+ 415	6.015	B	6.360
140	BE+ 315	6.415	B	6.760
141	BE+ 215	4.815	A	5.160
142	BE+ 115	5.115	B	5.460

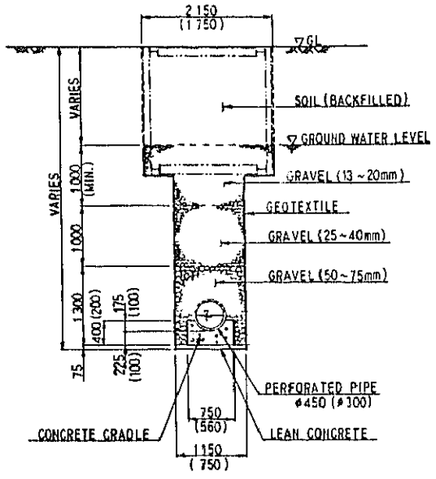


D < 5.0M

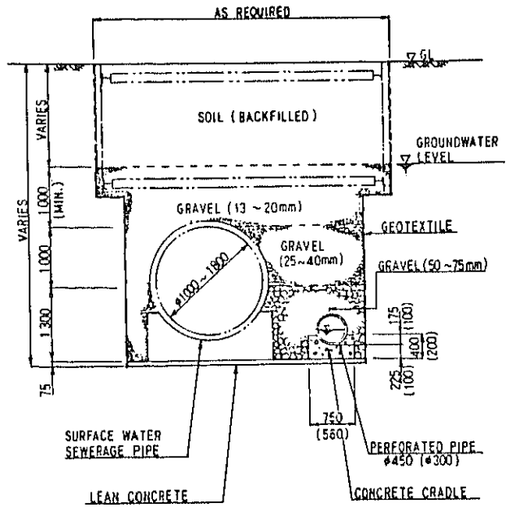


D ≧ 5.0M

TYPICAL SECTION OF MANHOLE (S=1:50)



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

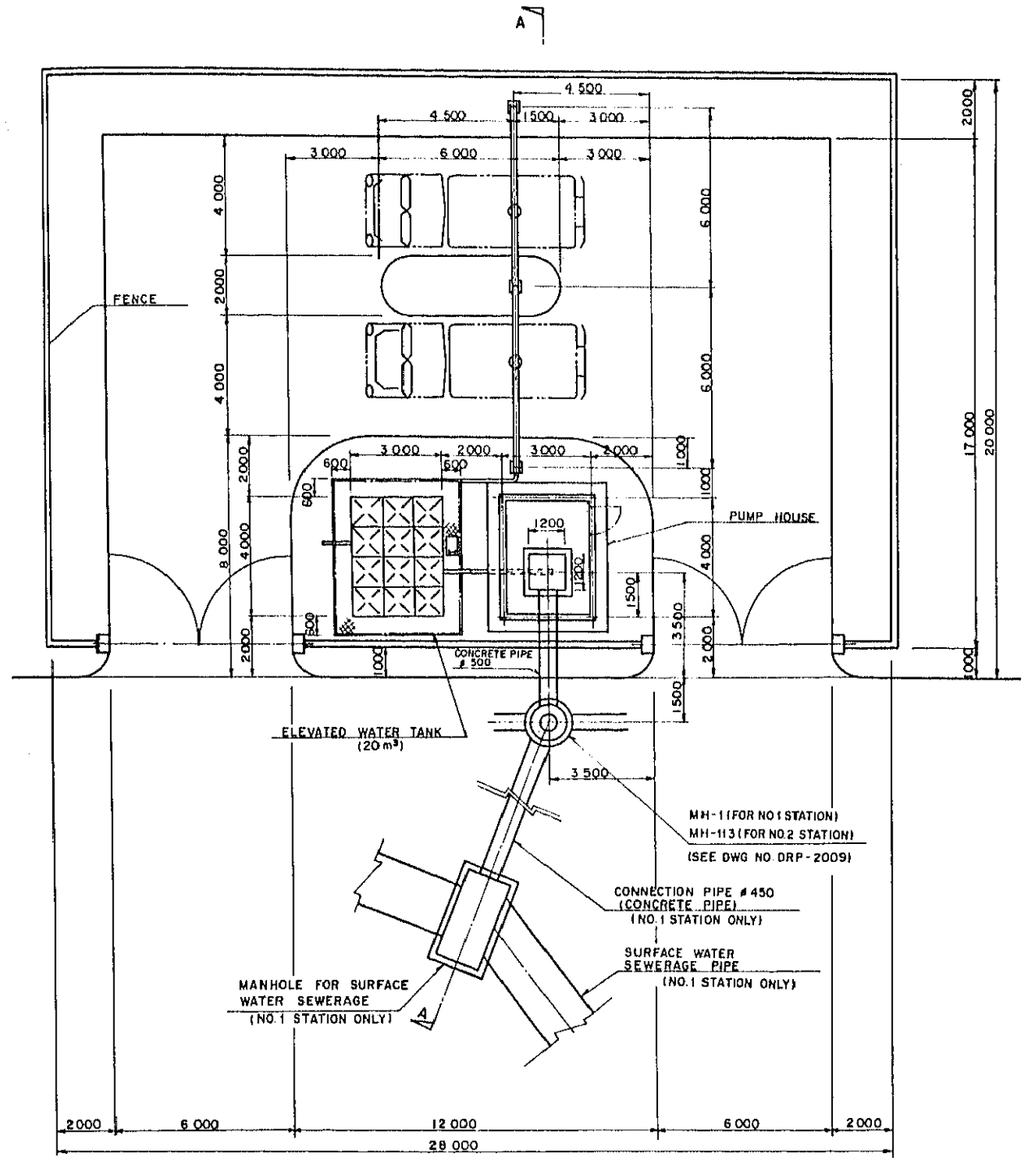


MODIFICATION OF SURFACE WATER SEWERAGE FOR LAND DRAINAGE TYPICAL SECTION (S=1:50)

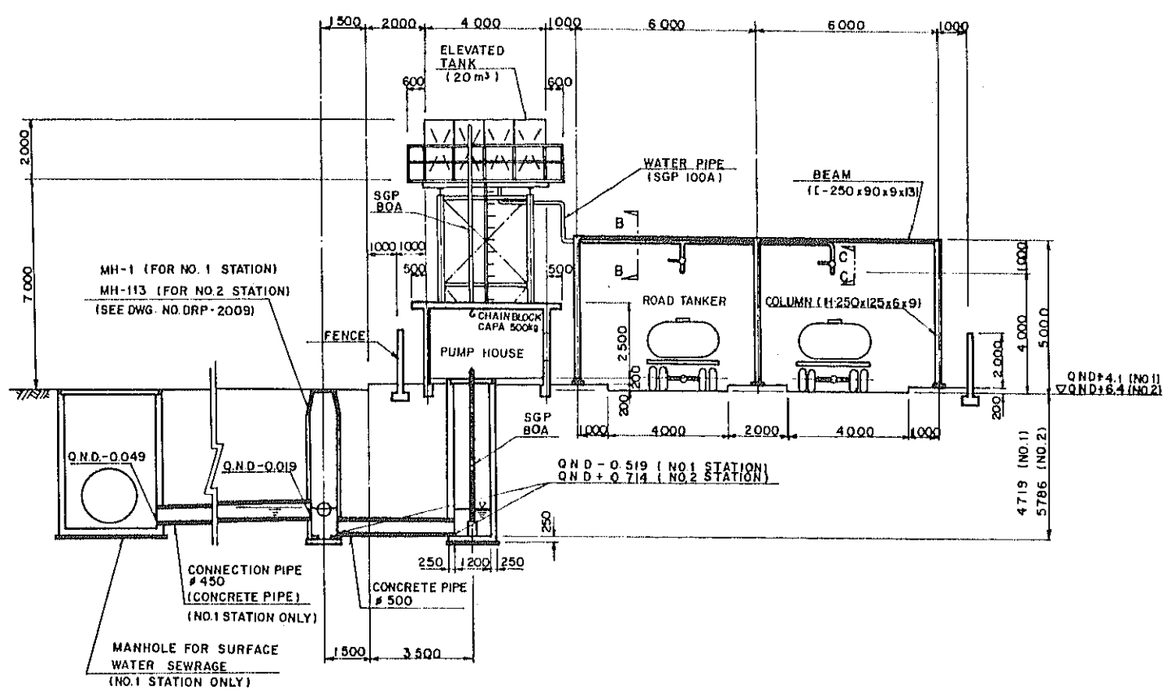
NOTES

1. FOR GENERAL PLAN OF LATERAL DRAINAGE, SEE DWG NO. DRP - 2001.
2. FOR TRANSVERSAL AND LONGITUDINAL SECTIONS, ON WHICH THE LOCATIONS OF MANHOLES ARE INDICATED, SEE DWG. NOS DRP - 2002 THRU 2008.
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 1.0 METER
5. MANHOLES SHOWN ABOVE ARE OF PRECAST CONCRETE AND STANDARD TYPE WIDELY USED IN JAPAN SO THAT INDICATED DIMENSIONS (DIAMETER AND THICKNESS) ARE SUBJECT TO CHANGE

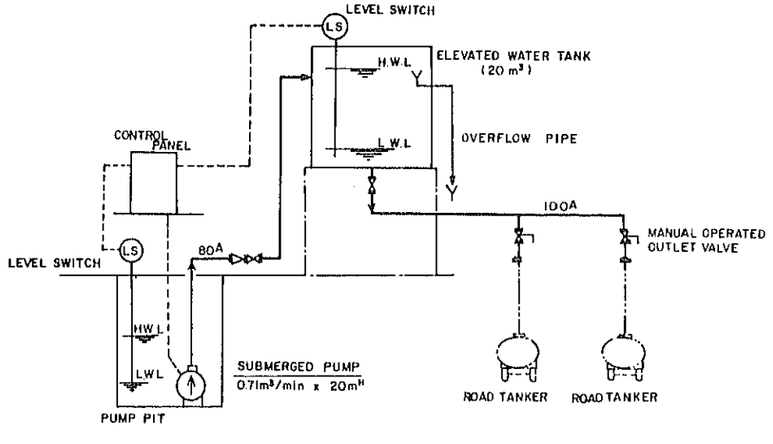
STATE OF QATAR	SCALE
THE STUDY ON DRAINAGE IMPROVEMENT PLAN, DOHA CITY	1 50
WADI MUSHERIB MANHOLE AND TYPICAL SECTION OF LATERAL DRAIN	DRP 1 2009
JAPAN INTERNATIONAL COOPERATION AGENCY	
DRAWN / CHECKED / APPROVED	



PLAN 1:100



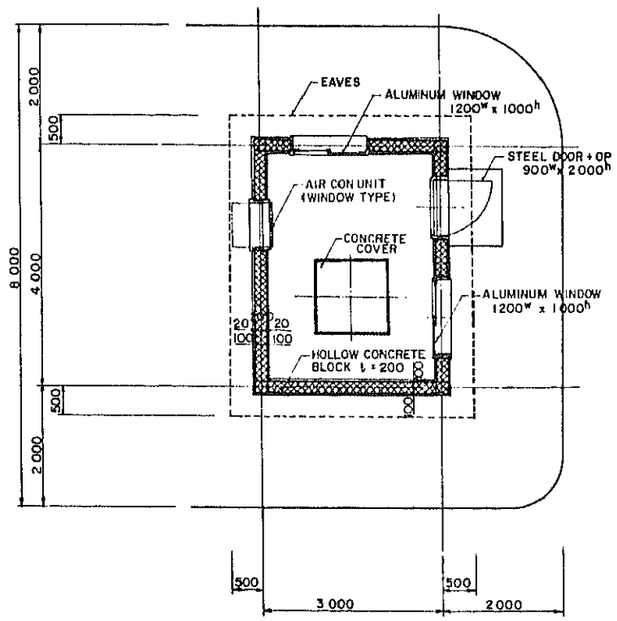
SECTION A-A 1:100



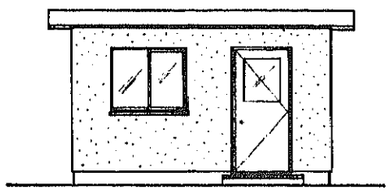
FLOW DIAGRAM

STATE OF QATAR THE STUDY ON DRAINAGE IMPROVEMENT PLAN, DOHA CITY	SCALE 1:100
TANKER FILLING STATION & CONNECTION TO SURFACE WATER SEWERAGE	DRP I 2010
JAPAN INTERNATIONAL COOPERATION AGENCY DRAWN / CHECKED / APPROVED	

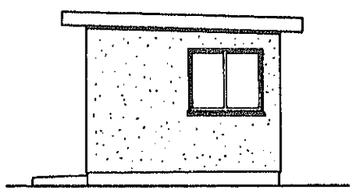
PUMP HOUSE



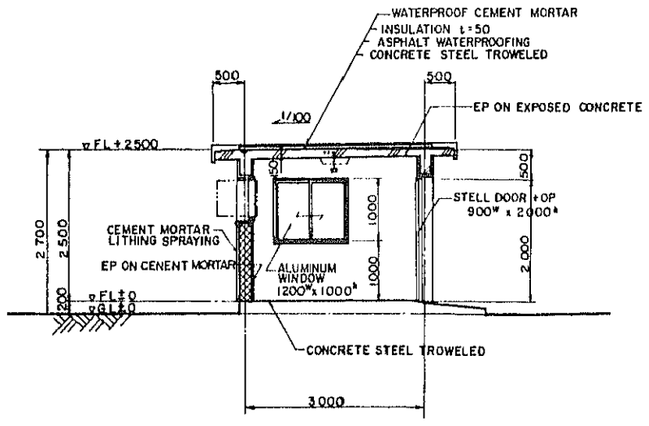
PLAN 1:50



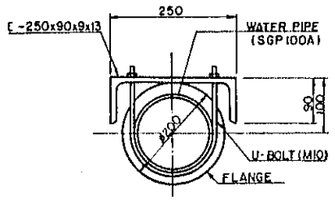
FRONT ELEVATION 1:50



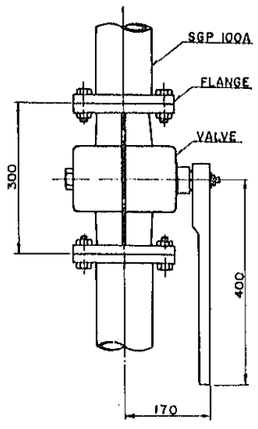
SIDE ELEVATION 1:50



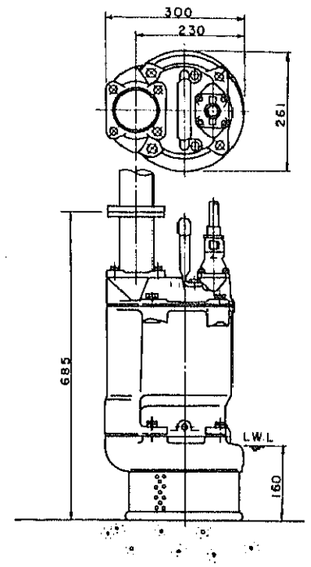
SECTIONAL DETAIL 1:50



SECTION B-B 1:6
(SEE DWG. NO. DRP-2010)

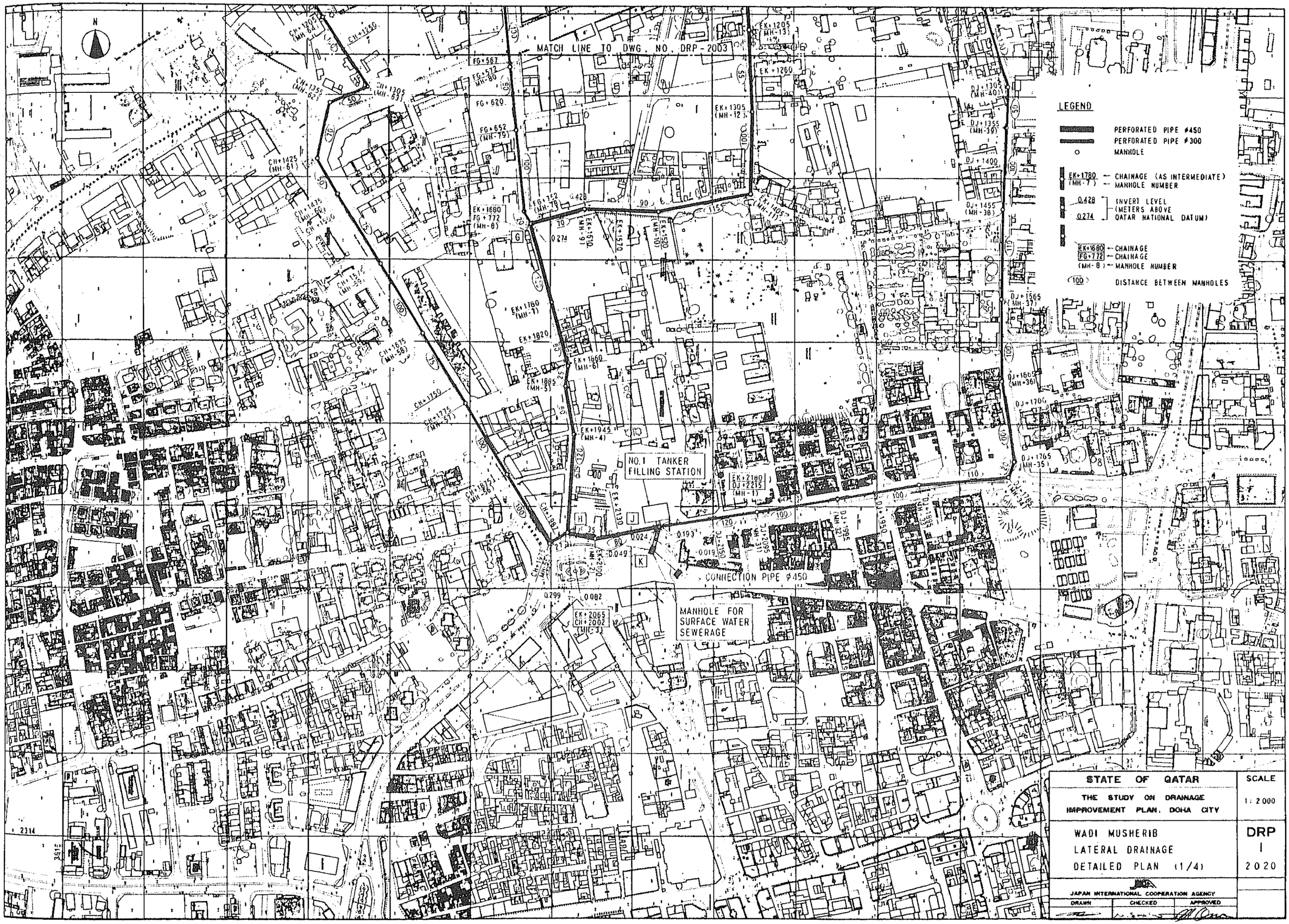


MANUAL OPERATED OUTLET VALVE 1:6
(VIEW C-C, SEE DWG. NO. DRP-2010)



OUTLINE OF SUBMERGED PUMP
(NOT TO SCALE)

STATE OF QATAR	SCALE 1:6 1:50
THE STUDY ON DRAINAGE IMPROVEMENT PLAN, DOHA CITY	
TANKER FILLING STATION DETAILS	DRP I 2011
JAPAN INTERNATIONAL COOPERATION AGENCY	
DRAWN / CHECKED / APPROVED	


MATCH LINE TO DWG. NO. DRP-2003
LEGEND
PERFORATED PIPE φ450
PERFORATED PIPE φ300
MANHOLE
EK+1780 — CHAINAGE (AS INTERMEDIATE)
(MH-7) — MANHOLE NUMBER
0.428 } INVERT LEVEL (METERS ABOVE
0.274 } QATAR NATIONAL DATUM)
EK+1680 — CHAINAGE
FG+772 — CHAINAGE
(MH-8) — MANHOLE NUMBER
(100) DISTANCE BETWEEN MANHOLES
NO.1 TANKER FILLING STATION
CONNECTION PIPE φ450
MANHOLE FOR SURFACE WATER SEWERAGE
STATE OF QATAR
THE STUDY ON DRAINAGE IMPROVEMENT PLAN, DOHA CITY
SCALE 1: 2000
WADI MUSHERIB
LATERAL DRAINAGE
DETAILED PLAN (1/4)
DRP
I
2020
JAPAN INTERNATIONAL COOPERATION AGENCY
DRAWN
CHECKED
APPROVED

MATCH LINE TO DWG NO DRP-2004

MATCH LINE TO DWG. NO. DRP-2002

LEGEND

- PERFORATED PIPE ⌀450
- PERFORATED PIPE ⌀300
- MANHOLE
- EK+495 (MH-25) — CHAINAGE (AS INTERMEDIATE) / MANHOLE NUMBER
- 1080 / 1200 — INVERT LEVEL (METERS ABOVE QATAR NATIONAL DATUM)
- CH+440 / FG+000 (MH-73) — CHAINAGE / CHAINAGE / MANHOLE NUMBER
- (100) — DISTANCE BETWEEN MANHOLES

STATE OF QATAR	SCALE
THE STUDY ON DRAINAGE IMPROVEMENT PLAN, DOHA CITY	1:2000
WADI MUSHERIB LATERAL DRAINAGE DETAILED PLAN (2/4)	DRP I 2021
JAPAN INTERNATIONAL COOPERATION AGENCY	
DRAWN / CHECKED / APPROVED	

MATCH LINE TO DWG. NO. DRP-2005

MATCH LINE TO DWG. NO. DRP-2003

NO 2 TANKER FILLING STATION

LEGEND

- PERFORATED PIPE ϕ450
- PERFORATED PIPE ϕ300
- MANHOLE
- BE+415 (MH-139) — CHAINAGE (AS INTERMEDIATE) — MANHOLE NUMBER
- 1288 / 1300 — INVERT LEVEL (METERS ABOVE QATAR NATIONAL DATUM)
- DJ+000 — CHAINAGE; AD+1930 (MH-54) — CHAINAGE — MANHOLE NUMBER
- (100) — DISTANCE BETWEEN MANHOLES

STATE OF QATAR

THE STUDY ON DRAINAGE IMPROVEMENT PLAN, DOHA CITY

WADI MUSHERIB
LATERAL DRAINAGE
DETAILED PLAN (3/4)

SCALE 1 : 2 000

DRP
I
2022

JAPAN INTERNATIONAL COOPERATION AGENCY

DRAWN	CHECKED	APPROVED

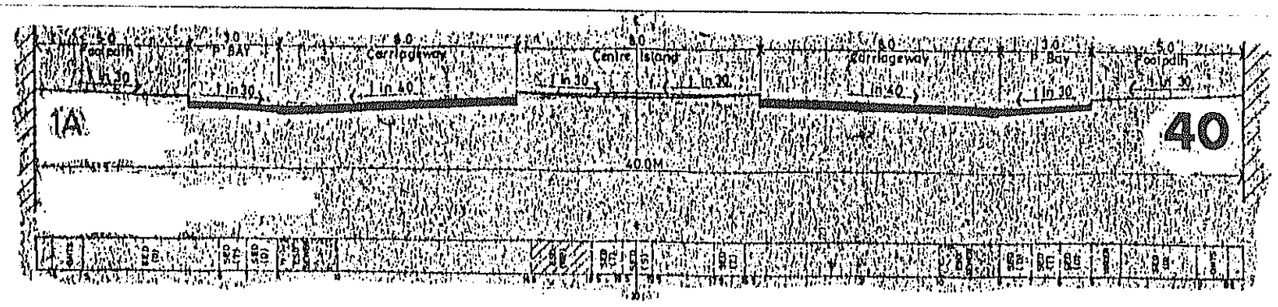
N

LEGEND

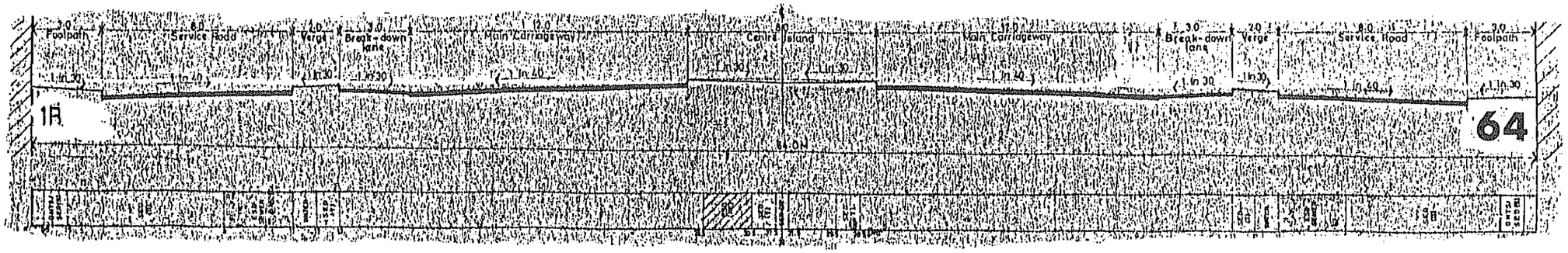
- PERFORATED PIPE ϕ450
- PERFORATED PIPE ϕ300
- MANHOLE
- AD+060 / MH-110 — CHAINAGE (AS INTERMEDIATE) / MANHOLE NUMBER
- 2313 / 2253 — INVERT LEVEL (METERS ABOVE QATAR NATIONAL DATUM)
- AD+370 / BE+000 / (MH-106) — CHAINAGE / CHAINAGE / MANHOLE NUMBER
- (100) — DISTANCE BETWEEN MANHOLES

AC+240 (MH-131)
AC+120 (MH-132)
AC+150
AC+350 (MH-130)
AC+575 (MH-128)
AC+455 (MH-129)
AC+410
AC+750
AC+905 (MH-126)
AC+905 (MH-125)
AC+1005 (MH-124)
AC+1050
AC+1130 (MH-123)
AD+000 AC+000 (MH-111)
AD+060 (MH-110)
AD+115 (MH-109)
AD+160
AD+195 (MH-108)
AD+275 (MH-107)
AD+325 (MH-105)
AD+370 BE+000 (MH-106)
AD+500
AD+515 (MH-104)
AD+695 (MH-103)
AD+715 (MH-102)
AD+750 (MH-101)
AD+770
AD+820 (MH-100)
AD+920 (MH-99)
BE+115 (MH-142)
2280
2314
2253
2200
2068
3915
MATCH LINE TO DWG. NO. DRP-2004

STATE OF QATAR	SCALE
THE STUDY ON DRAINAGE IMPROVEMENT PLAN, DOHA CITY	1 : 2000
WADI MUSHERIB LATERAL DRAINAGE DETAILED PLAN (4/4)	DRP I 2023
JAPAN INTERNATIONAL COOPERATION AGENCY	
DRAWN / CHECKED / APPROVED	



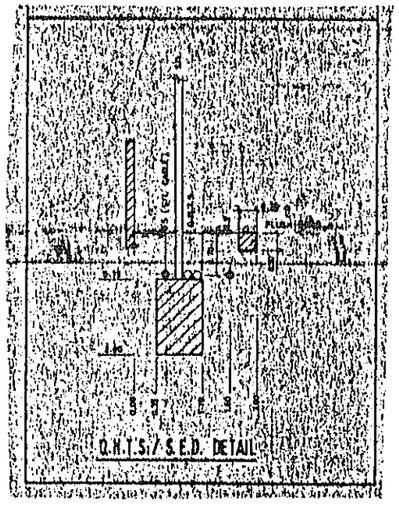
NOTE: WHERE PLANTING OCCURS IN 2·0 METRE WIDE VERGE A 0·5 METRE WIDE RETURN EFFLUENT RESERVE WILL BE REQUIRED IN VERGE!



1A/1B/1C MAJOR (PRIMARY) DISTRICT DISTRIBUTORS (40/64M)

NOTES:

1. IT IS RECOMMENDED THAT 32/40/64 CROSS SECTIONS RELATE TO SINGLE FRONTAGE DEVELOPMENT ONLY. LAYOUTS WITH DOUBLE PLOTS WILL REQUIRE ADDITIONAL SERVICES WITHIN THESE CORRIDORS.
2. IN LANDSCAPED / PLANTED ZONES ALL MAIN UTILITIES SHOULD HAVE A MINIMUM DEPTH OF COVER OF 600 MILLIMETRES TO ALLOW IRRIGATION PIPEWORK TO BE LAID OVER THE UTILITIES. TREE PITS REQUIRE 1·5 m^3 AND SPACE IS AVAILABLE FOR TREE PLANTING WITHIN CENTRE ISLANDS OF 40 AND 64m CORRIDORS. EXACT LOCATION NEEDS TO BE AGREED WITH ESO (RETURN EFFLUENT) AND SED TRANSMISSION & STREET LIGHTING
3. IRRIGATION PIPEWORK TO BE LAID NOT LOWER THAN 600 MM.
4. GUIDANCE UTILITY WORKING CLEARANCE = 0·5M MINIMUM EXCLUDING MANHOLES INSPECTION PITS AND SIMILAR CONSTRICTIONS.
5. SEE SEPERATE UTILITY QUALIFICATIONS.
6. O.H.T.S. OUTSIDE EDGE OF DUCT AT 1·1M FROM OUTSIDE BOUNDARY. (SEE DETAIL)
7. WHEN ROAD IS NOT OBVIOUSLY IN NORTH / SOUTH OR WEST / EAST DIRECTION PLEASE CONTACT PLANNING DEPARTMENT (UTILITY APPROVALS) FOR FINAL DECISION TO DETERMINE UTILITY PLACEMENT.

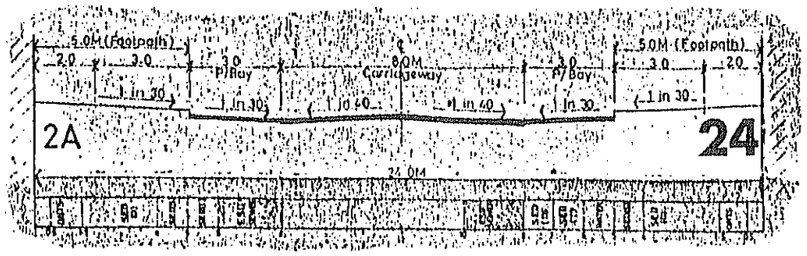


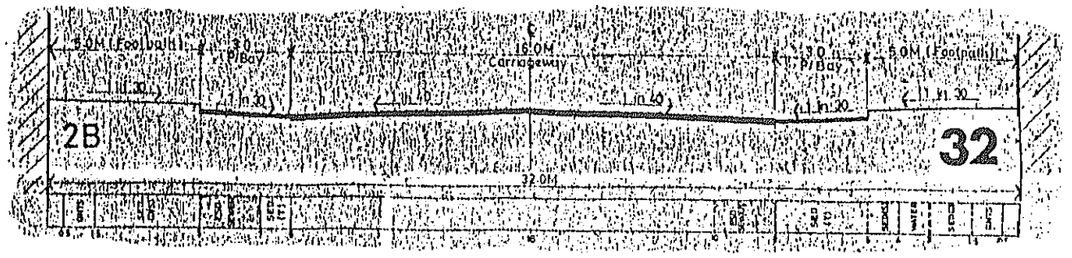
KEY

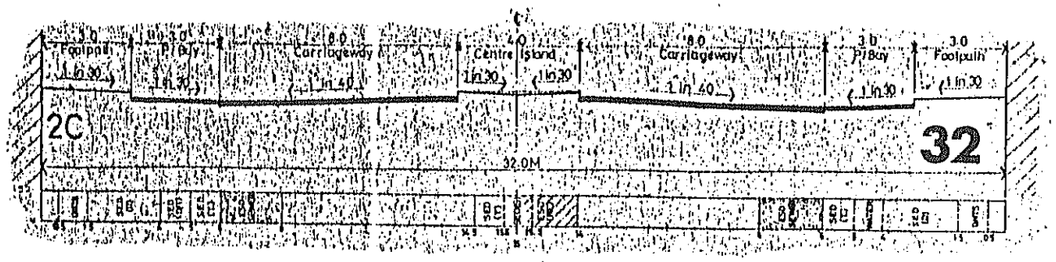
SEWER RESERVE

RETURN EFFLUENT RESERVE

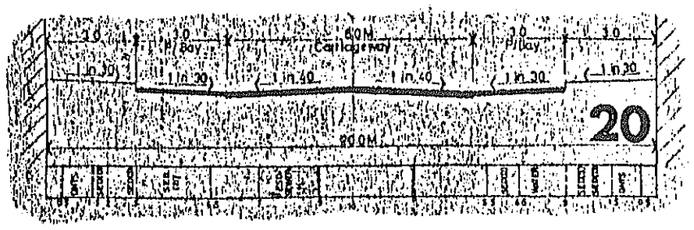
STATE OF QATAR	SCALE
THE STUDY ON DRAINAGE IMPROVEMENT PLAN, DOHA CITY	NOT TO SCALE
ROAD HIERARCHY (1/2)	DRP I 2030
JICA JAPAN INTERNATIONAL COOPERATION AGENCY	
DRAWN / CHECKED / APPROVED	



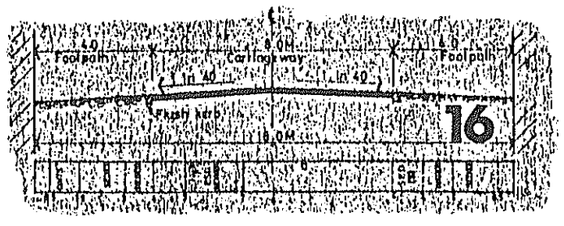




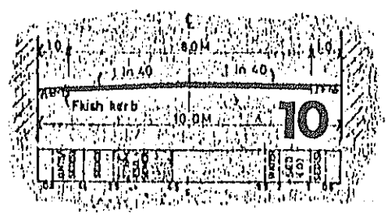
2A/2B/2C NEIGHBOURHOOD (SECONDARY) DISTRIBUTORS (24-32M)

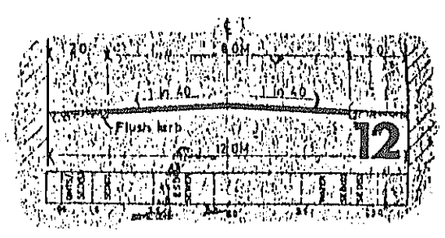


3. MAJOR RESIDENTIAL DISTRIBUTOR (20M)



4. RESIDENTIAL ACCESS (16M)





5. MINOR RESIDENTIAL ACCESS (10-12M)

STATE OF QATAR THE STUDY ON DRAINAGE IMPROVEMENT PLAN, DOHA CITY	SCALE NOT TO SCALE
ROAD HIERARCHY (2/2)	DRP I 2031
JICA JAPAN INTERNATIONAL COOPERATION AGENCY DRAWN / CHECKED / APPROVED	

P A R T : G

Rayyan Urgent Drainage Improvement Plan

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List of Figures

List of Tables

G. DRAINAGE PLAN AT OLD RAYYAN

1. Basic Conditions for Drainage Plan

(1) Project Area for Drainage Schemes

Old Rayyan area is a topographical depression located west of Doha City and its east, south and north are respectively surrounded by 'D' Ring Road, Rayyan Road and Khalifa Road. Many farms and large scale residences are scattered in this area.

The project area for drainage schemes at Old Rayyan, as described in Chapter 6, is the lowest part where the groundwater level is less than 1.3 m below ground surface.

The project area spreads on both sides of Old Rayyan road with lengths of 700 m and 1,600 m in the east-west and north-south directions respectively, and with an area of 70 ha, as shown in the figure below. The ground elevation varies from QND + 5.3 m to + 8.0 m, in this area.

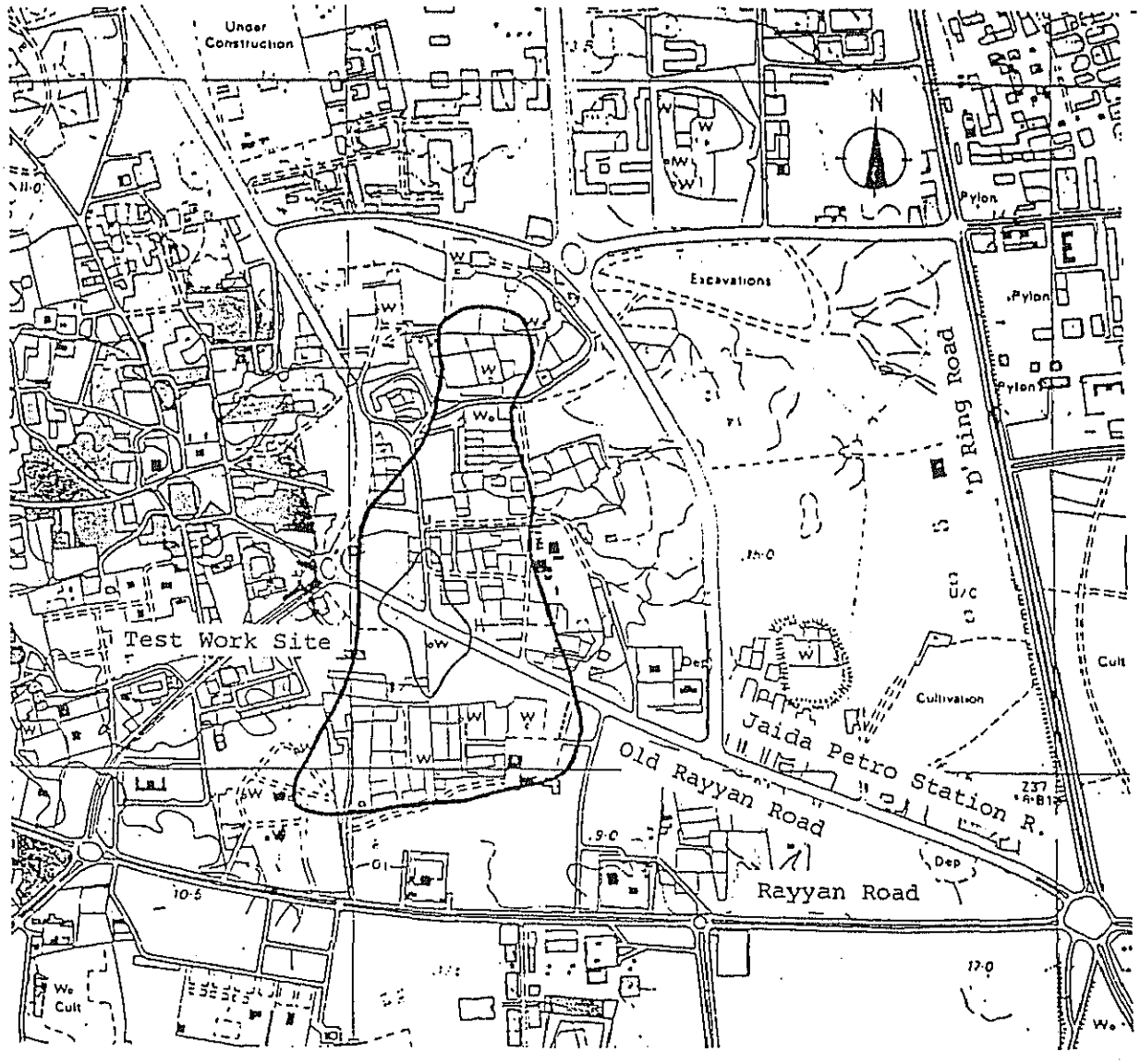


Fig. 1.1.1 Project Area for Drainage Schemes at Old Rayyan

(2) Proposed Design Groundwater Level

Groundwater level for the entire project area is to be kept below 1.3 m from ground level considering the depth of capillary zone and underground facilities.

(3) Discharge Amount

With the provision of lateral drainage network along the perimeter of the project area and maintaining groundwater level at 4.0 m below ground level at the lateral drains, amount of groundwater to be discharged is 3,000,000 m^3/year in accordance with the groundwater analysis presented in chapter 6 (Main Report).

(4) Depth of the Lateral Drainage

Depth of the lateral drainage at Old Rayyan shall basically be 4 m from ground surface considering the hydrogeological conditions and construction method.

(5) Project Site

As a rule, lateral drainage shall be planned along public roads. However if network arrangement makes this difficult in some places, built-up area shall be avoided as much as possible and cultivation area shall be used instead.

(6) Water Quality

Estimates of water quality for the groundwater to be discharged by this drainage plan are as follows;

EC value	15,000 micro mhos/cm
COD value	Max. 10 mg/l
pH	8.0

2. Alternatives of Drainage Systems

Drainage systems are divided into three subsystems by their functions, i.e. collection, transfer and disposal or re-use and alternatives are considered for respective subsystems as summarized in Table 8.2.1 below.

Table 2.2.1 Alternatives of Drainage System at Old Rayyan

Collection	Pumping system	Transfer	Disposal or Reuse
Lateral drainage-1 (Solving standing water)	Pump station-3 (No. 14 P/S)	Pressure pipe	Existing No. 14 Pump station
Lateral drainage-2 (Perimeter arrangement)	Pump station-1 (14 km pipe)	Gravity flow pipe	Musherib storm-water trunk line
Lateral drainage-3 (Comb arrangement)	Pump station-2 (2.5 km pipe)	Open channel	West bay (via mangrove lagoon)
Existing wells		Road tankers	Desert

2.1 Collection of Groundwater

In this area, collection methods considered are lateral drainage and utilization of existing wells. Regarding arrangement there are three alternatives for lateral drainage.

2.1.1 Lateral drainage - 1
(Refer Fig. 2.1.1 & 2.1.4)

Solving only standing water area is the purpose of this plan and it can be deemed as phase-I of any of the other two alternative. The lateral drainage is located in cross shape at the center of the area. Because of the short length of the drains, amount of abstracted groundwater is limited and long transfer line for discharge is not economical. Therefore this plan is considered to discharge abstracted groundwater to sewerage line when Doha West new sewage treatment work will be completed and the total treatment capacity will be increased or transportation by road tankers until the groundwater drainage phase-II will be implemented.

Outline

Depth of lateral drainage : 4 m
Diameter of perforated pipe : 450 mm
Proposed length of lateral drainage: 1,000 m
Manholes pitch : 100 m
Estimated discharge : 500,000 m^3/year
(1.0 m^3/min)

Quantity of 500,000 m^3/year to be drained was determined as follows.

a. It is considered almost equal to the amount evaporated from the surface of standing water.

b. Area of standing water at Rayyan was estimated to be 11 ha in 1986 and 25 ha, i.e. twice that estimate, was adopted.

c. Evaporation rate of 5.5 mm/day was adopted as yearly average.

d. Considering the possibility of road tanker transportation, it was limited to a practical amount for temporary vehicle transportation.

2.1.2 Lateral drainage - 2
(Refer Fig. 2.1.2 & 2.1.4)

Aiming at the area where groundwater level depth is less than 1.5 m from ground, lateral drainage is allocated along the perimeter of this area.

This area is the lowest part of the depression and groundwater flows in, therefore drainage facilities are most effective in collecting groundwater. Connecting line to the pumping station is also used as drainage pipes.

Outline

Depth of lateral drainage	:	4 m
Diameter of perforated pipe	:	300 mm, 450 mm, 600 mm
Proposed length of lateral drainage	:	5,900 m
Manhole pitch	:	100 m
Estimated discharge	:	3,000,000 m^3/year (5.7 m^3/min)

2.1.3 Lateral drainage - 3
(Refer Fig. 2.1.3 & 2.1.4)

Objective area for drainage is the same as that for the above perimeter arrangement plan, but lateral drainage is allocated totally in the area in comb shape.

Outline

Depth of lateral drainage	:	4 m
Diameter of perforated pipe	:	300 mm, 450mm, 600 mm
Proposed length of lateral drainage	:	6,000 m
Manhole pitch	:	100 m
Estimated discharge	:	3,000,000 m^3/year (5.7 m^3/min)

2.1.4 Utilization of existing wells
(Refer Fig. 2.1.5)

Existing wells in the abandoned farms inside the project area are utilized for collecting groundwater to lower the level. Groundwater is abstracted by individual pumps and collected to the discharge pumpstation.

Number of wells	:	40
Additional lateral drainage line	:	2,000 m
Estimated amount	:	5.7 m^3/min (3,000,000 m^3/year)

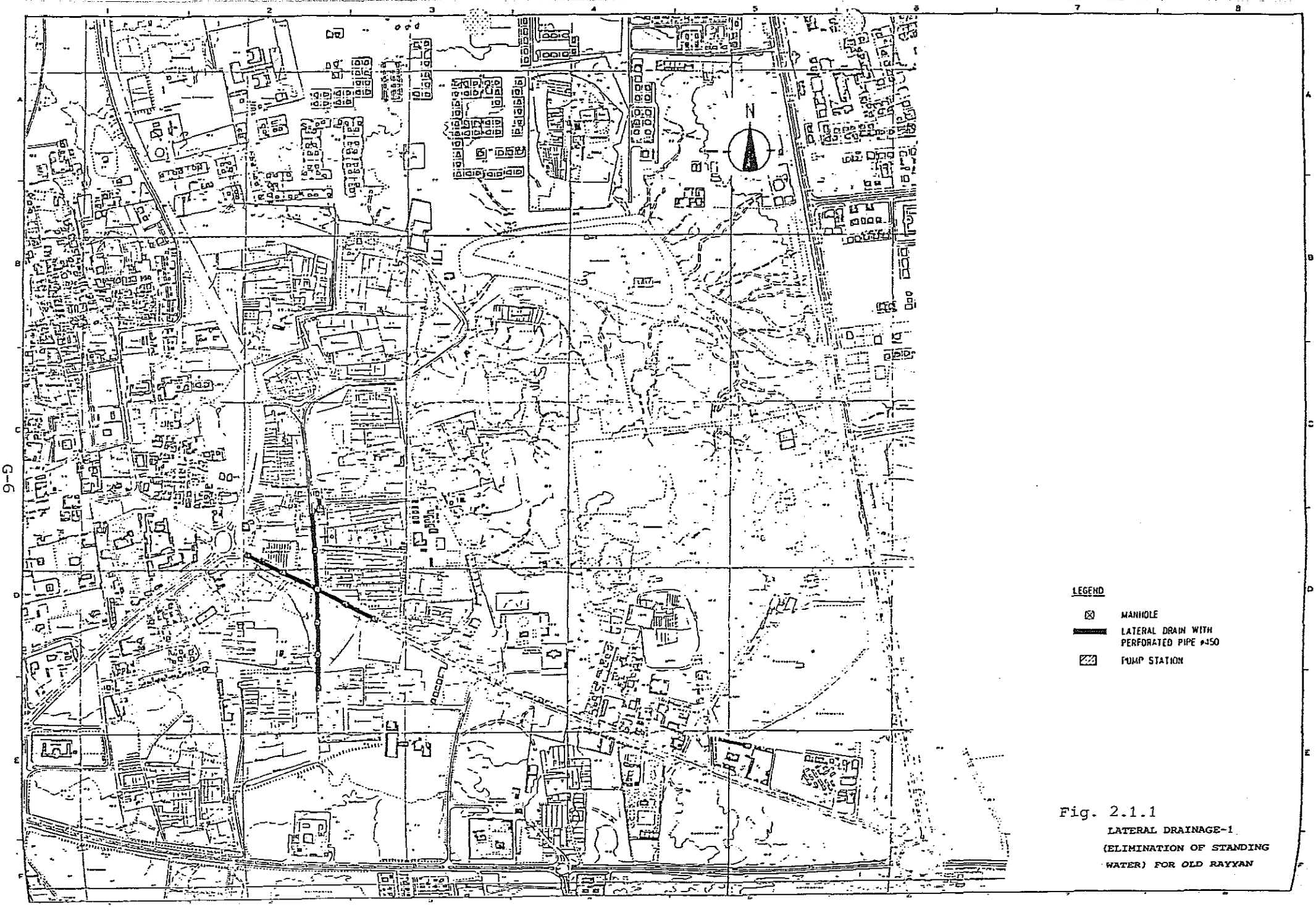


Fig. 2.1.1
LATERAL DRAINAGE-1 (ELIMINATION OF STANDING WATER) FOR OLD RAYYAN

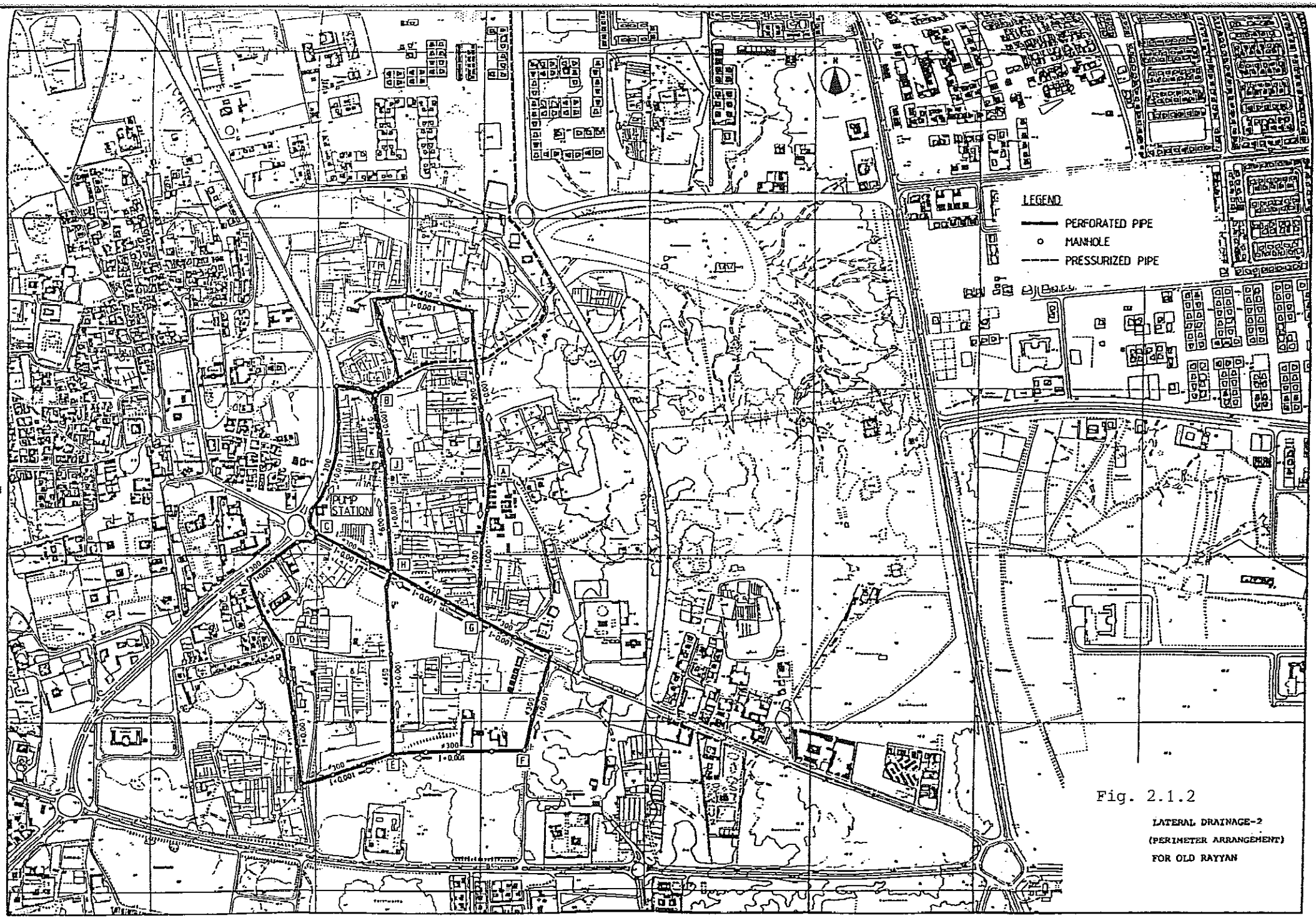


Fig. 2.1.2

LATERAL DRAINAGE-2
(PERIMETER ARRANGEMENT)
FOR OLD RAYYAN

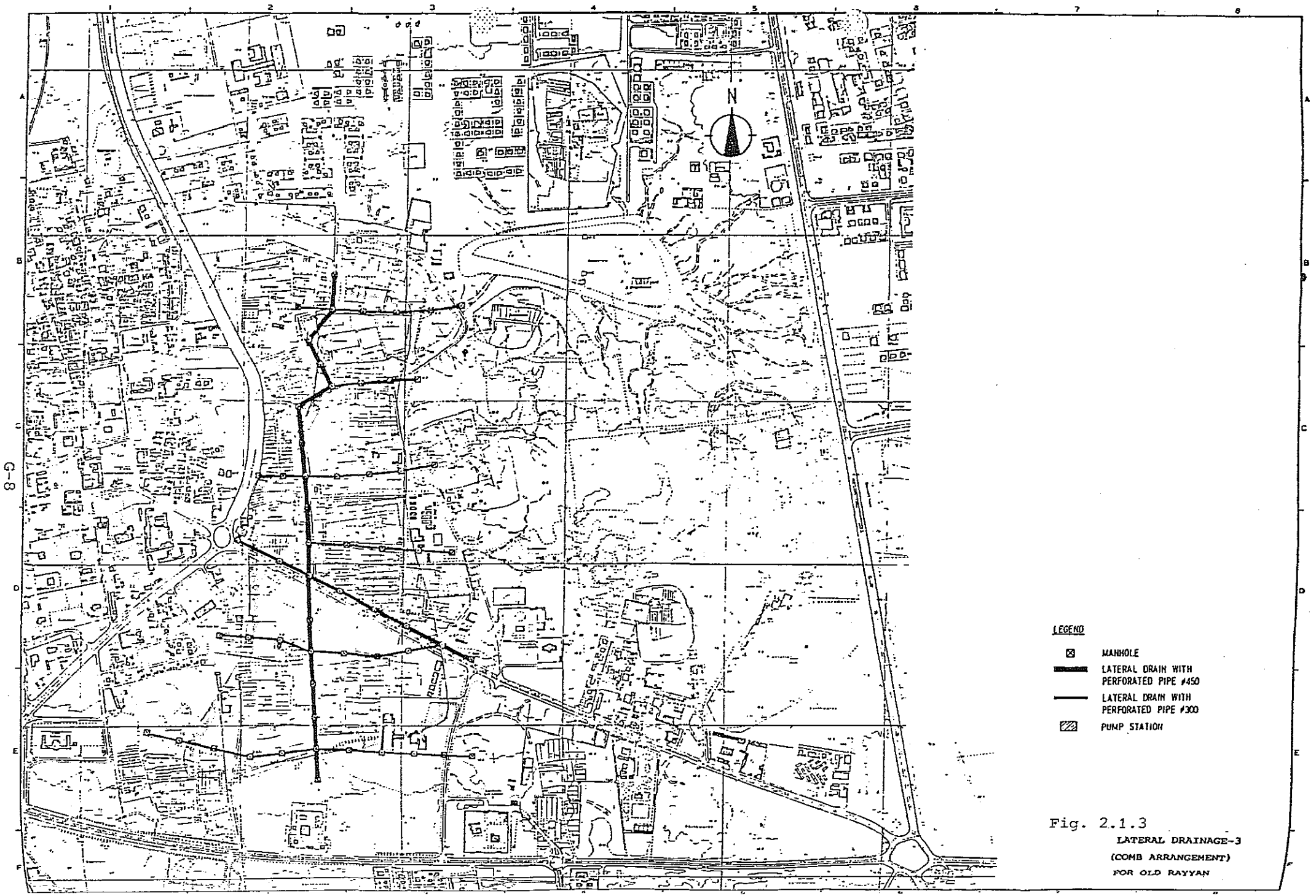
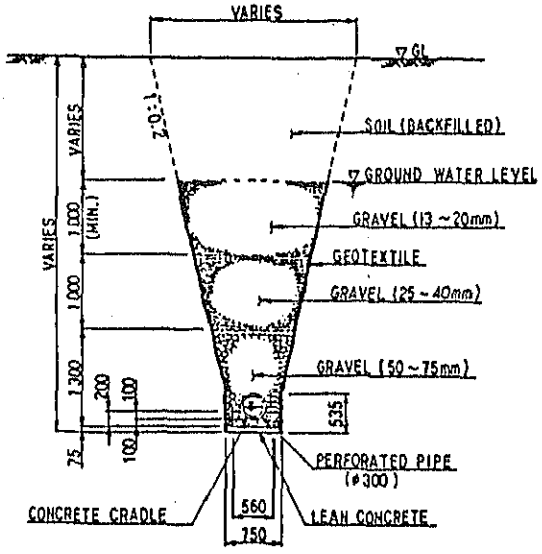
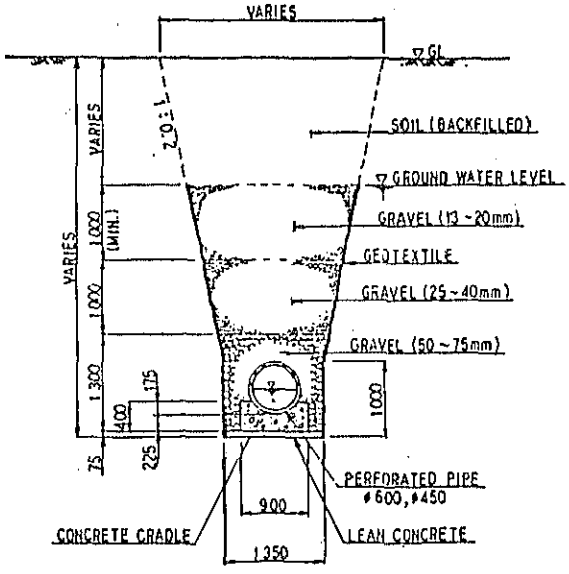


Fig. 2.1.3
LATERAL DRAINAGE-3
(COMB ARRANGEMENT)
FOR OLD RAYYAN



FOR PERFORATED PIPE ϕ300



FOR PERFORATED PIPE ϕ450 & ϕ600

Fig. 2.1.4 Typical Section of Lateral Drainage

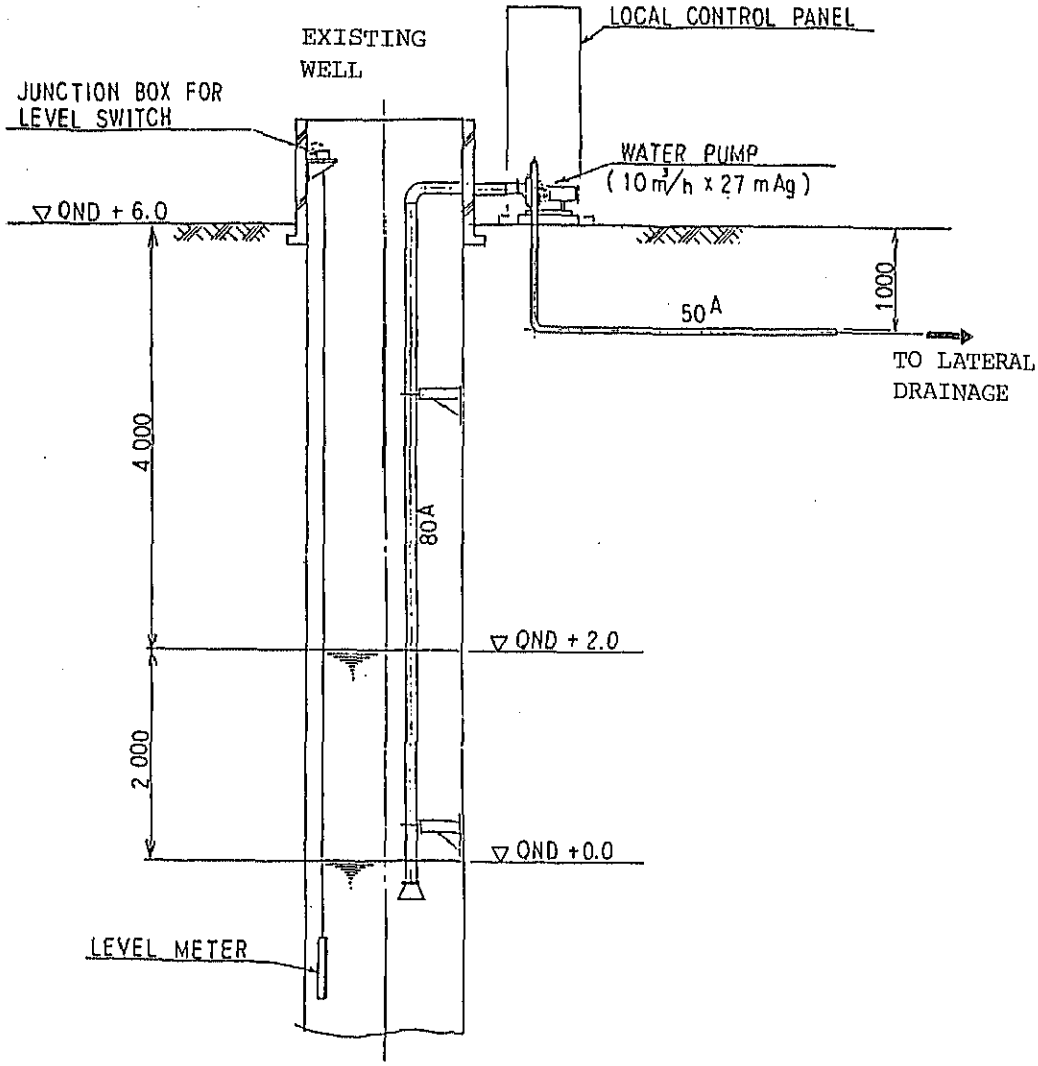


Fig. 2.1.5 Section of Existing Well with New Pump

2.2 Pumping System

The project area in Old Rayan is geographically located at the bottom of the basin structure. When disposing abstracted groundwater from the area, transfer by gravity flow is not possible in either of the sea side or inland directions and pressurised transfer by pumping is inevitable to any disposal point.

2.2.1 Pump station - 1

For lateral drainage-1, pumping system to discharge groundwater into the adjacent No. 14 sewerage pump station is as follows;

Discharge amount	:	1.0 m^3/min
Head	:	10 m
Total head	:	20 m
Delivery pipe	:	80 mm dia.
Pump type	:	Submerged centrifugal pump, discharge bore 80 mm, 2 units
Motor	:	7.5 kw x 2 units
Stand by	:	One unit of 100%

2.2.2 Pump station - 2
(Refer DRP-4002 and 4003)

From Rayyan to West Bay, abstracted groundwater is transferred a distance of approximately 14.4 km by pumping. After the point of intermediate water chamber (6.7 km), water is discharged by gravity flow.

Discharge amount	:	5.7 m^3/min
Actual head	:	21 m
Total head	:	122 m
Delivery pipe	:	250 mm dia.
Pump type	:	Horizontal double suction volute pump 2.85 m^3/min x 3 units Suction bore : 124 mm Discharge bore: 80 mm
Motor	:	110 kw x 3 units
Water hammer protection	:	Fly wheel 40 kg.m^2
Stand-by unit	:	One unit of 50%

2.2.3 Pump station - 3
(Refer Fig. 2.2.1)

From Rayyan to 'D' Ring Road, groundwater is transferred a distance of approximately 2.3 km by pumping, where a watershed between Doha city and Rayyan exists and after which it can be transferred by gravity flow.

Discharge amount	:	5.7 m^3/min
Actual head	:	16 m
Total head	:	70 m
Delivery pipe	:	250 mm dia.

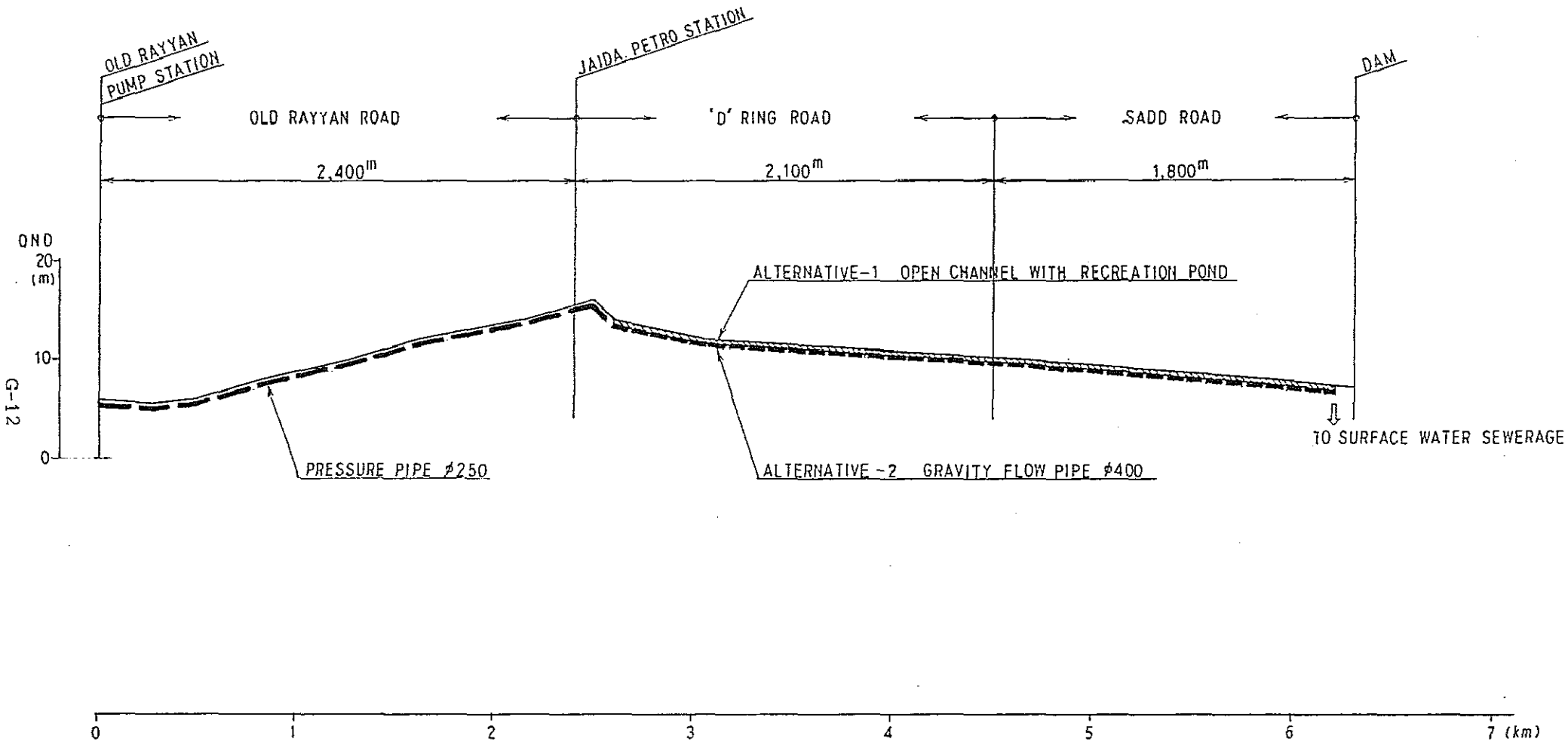


Fig. 2.2.1 Longitudinal Section of Transfer Line Between Old Rayyan and Wadi Musherib

Pump type	:	Horizontal double suction volute 2.85 m^3/min x 3 units Suction bore : 125 mm Discharge bore: 80 mm
Motor	:	50 kw x 3
Water hammer protection	:	Fly wheel 40 kg.m^2
Stand-by unit	:	One unit of 50%

2.3 Transfer Line

According to the selection of disposal point, the following three alternative methods of groundwater transfer are considered. In case of desert disposal, transfer line is the same as pressure pipe-1 system.

2.3.1 Pressure pipe - 1
(Refer Drawing DRP-4001)

When the disposal point is West Bay, some big undulations exist along the route. Therefore until the escarpment near shore line, pressurized transfer is necessary. Upon the pump operation, one intermediate water chamber is required at the highest point.

As for the pipe material, considering corrosion by transfer of high salinity groundwater and external aggressive soil, corrosion protection or anticorrosion material under high pressure are examined.

Detailed plan of discharge pipeline are shown on DWG. Nos. DRP-4020 thru 4028. The transversal and longitudinal sections are on DWG. Nos. DRP-4029 thru 4038.

Outline

Length	:	14.7 km
Pipe diameter	:	250 mm (until 6.7 km) and 350 mm (7.7 km)
Pressure	:	15 kg/cm^2 (until 6.7 km) and 5 kg/m^2
Intermediate water chamber	:	One at 7.6 km point
Depth of pipe	:	Ground level minus 1.2 m
Pipe material	:	Ductile iron pipe with external protection by 1.1 mm thick PVC tape wrapping in two layers and internal lining by 5 mm thick cement mortar

2.3.2 Pressure pipe - 2
(Refer Fig. 2.3.1)

When Wadi Musherib stormwater trunk line is selected as a disposal point, transfer point is a watershed at 'D' Ring Road.

Required pressure is relatively low because of the short distance and polyvinyl chloride pipes are adopted for the whole length.

Outline

Length	:	2.3 km
Pipe diameter	:	250 mm
Pressure	:	6 kg/m^2
Depth of pipe	:	Ground level minus 1.0 m
Pipe material	:	Poly vinyl chloride pipe

2.3.3 Gravity flow piping
(Refer Fig. 2.3.1 & 2.3.4)

For the case of disposal at Wadi Musherib stormwater trunk line, underground gravity flow pipeline from Jaida Petrostation on 'D' Ring Road to Wadi Musherib Dam will be applied.

Outline

Length	:	3.4 km
Pipe diameter	:	400 mm
Depth of pipe	:	General Ground level minus 1.0 m Under road Ground level minus 1.5 m
Gradient	:	2.0%
Pipe material	:	Extra strength vitrified clay pipe
Manhole pitch	:	200 m

2.3.4 Open channel and recreation pond
(Refer Fig. 2.3.2, 2.3.3, 2.3.4)

Open channel from Jaida petrostation to recreation pond at Wadi Musherib Dam is considered, including a small pond on the way.

Purpose of this method is to moderate the water quality by contact air oxidization, and develop the landscape with open channel and green belt.

Outline

Length	:	3.3 km (part of open channel)
Width of channel	:	1.5 m
Depth of flow	:	10 - 20 m
Area of small pond	:	10,000 m^2
Area of recreational ponds at Wadi Musherib Dam	:	34,000 m^2

Under open channel and recreation pond, sealing is necessary to prevent infiltration of water into ground. As method of sealing, following methods are considered.

(1) Sheet method

This is water shutt-off method by synthetic resin sheet. It is suitable for large area work and small gradient base (less than 1:3). There are so many kinds of synthetic resin products and costs depend on the selection of sheet material but generally this method is cheaper than the other two methods.

(2) Concrete Slab method

This method provides covering by concrete slab and is the most suitable and durable of these three methods. Generally 200 mm thickness is necessary and maximum size of block shall be 10 m x 10 m with elastic joint considering the shrinkage of concrete. It takes considerable time for construction and its cost is expensive although common material is used and it is advantageous for small work area.

(3) Rubber Asphalt method

This is rubber asphalt rendering method on mortar layer and shutt-off effect is relatively small but it can be applied on steep inclination and its cost is cheap when work area is large.

Details of the methods are as shown in Fig. 2.3.4.

Judging from the above "sheet method" is adopted. Basic specifications are as follows;

Material	:	PVC
Thickness	:	1.5 mm
Joint	:	overlap heat bonding
Protection sheet	:	geotextile on both sides