

APPENDIX C

EXISTING SEWERAGE FACILITIES

1. Introduction

This Appendix C presents the results of the investigation of the existing sewerage facilities carried out during the first on-site works period from December, 1988 till March, 1989 in compact tables and figures. Contents of tables and figures have been compiled from data and information collected and those obtained through observations and measurements made by the study team.

Order of presentation is arranged according to the categories of the sewerage facilities as described below.

Categories of Sewerage Facilities

- 1) Sewers and Manholes
- 2) Pumping stations and Comminutor station
- 3) Ocean outfalls
- 4) Sweepers' Passages

In addition to data categorized as mentioned above, results of measurements of invert levels of several sections of sewer pipeline are also illustrated in figures. Brief description of each group of tables and figures is as follows. For the convenience of reader, reference number or name of place has been put down to each facility. These numbers or names can be cross referred among all tables and figures included in this appendix.

1) Figures C.1 to C.4

These are key maps of sewerage facilities in the four districts with scale 1/10,000.

2) Tables C.1 to C.4

These tables contain summary of sewer pipes and manholes. Lengths of sewers classified according to nominal diameters and pipe materials are presented.

Numbers of manholes by type are also presented in the tables.

3) Figures C.5 and C.6

Standard types of manhole used in the four districts are illustrated in these figures.

4) Tables C.5 to C.34

These tables show present conditions of the pumping stations together with other technical data. Evaluation of the present status of machinery and structures are included in the tables.

5) Figures C.7 to C.16

These figures show structural design of the existing pumping stations tabulated in Tables C.5 to C.34. However, figures of some of the pumping stations are missing and not presented.

6) Table C.35 and Figure C.17

These are a table and a figure showing design of the comminutor station located in Khormaksar. Table and figure are presented in the same manner as that for pumping stations.

7) Table C.36

This is a list of the existing ocean outfalls in the four districts.

8) Figures C.18 and C.19

These figures show the locations of sweepers' passages in Ma'alla and Tawahi. Number of sweepers' passage in the figures are referred to those in the tables described below.

9) Tables C.37 and C.38

These tables summarize the present conditions of sweepers' passages in Ma'alla and Tawahi.

10) Figures C.20 to C.32

Figures C.20 and C.30 illustrate the routes of sewers in Ma'alla and Tawahi respectively, of which invert levels were measured by the study team. Plans and profiles of measured sections are presented in Figures C.21 to C.29, and C.31 to C.32. Velocities of full flow were calculated based on the following Manning equation, and indicated in the profiles of sewers.

Manning equation

$$v = (1/n)R^{2/3}I^{1/2}$$

where V: velocity (m/sec)
R: hydraulic radius (m)
I: gradient
n: coefficient of roughness (= 0.013)

11) Figures C.33 to C.38

Figures C.33 to C.35 show locations of manholes in Ma'alla and Tawahi of which invert levels were measured by the study team. Figures C.36 to C.38 illustrate the profiles of these manholes.

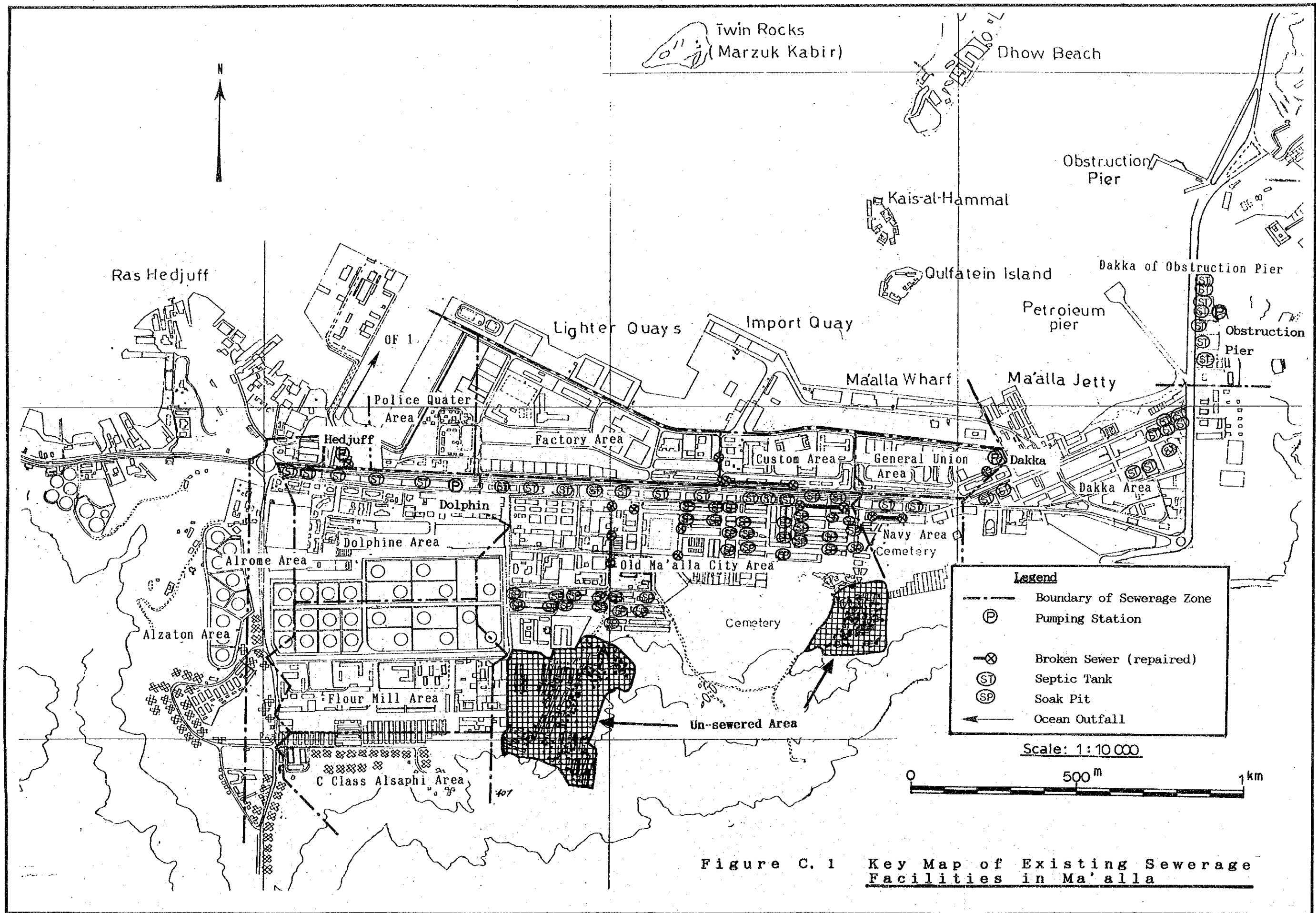


Figure C. 1 Key Map of Existing Sewerage Facilities in Ma'alla

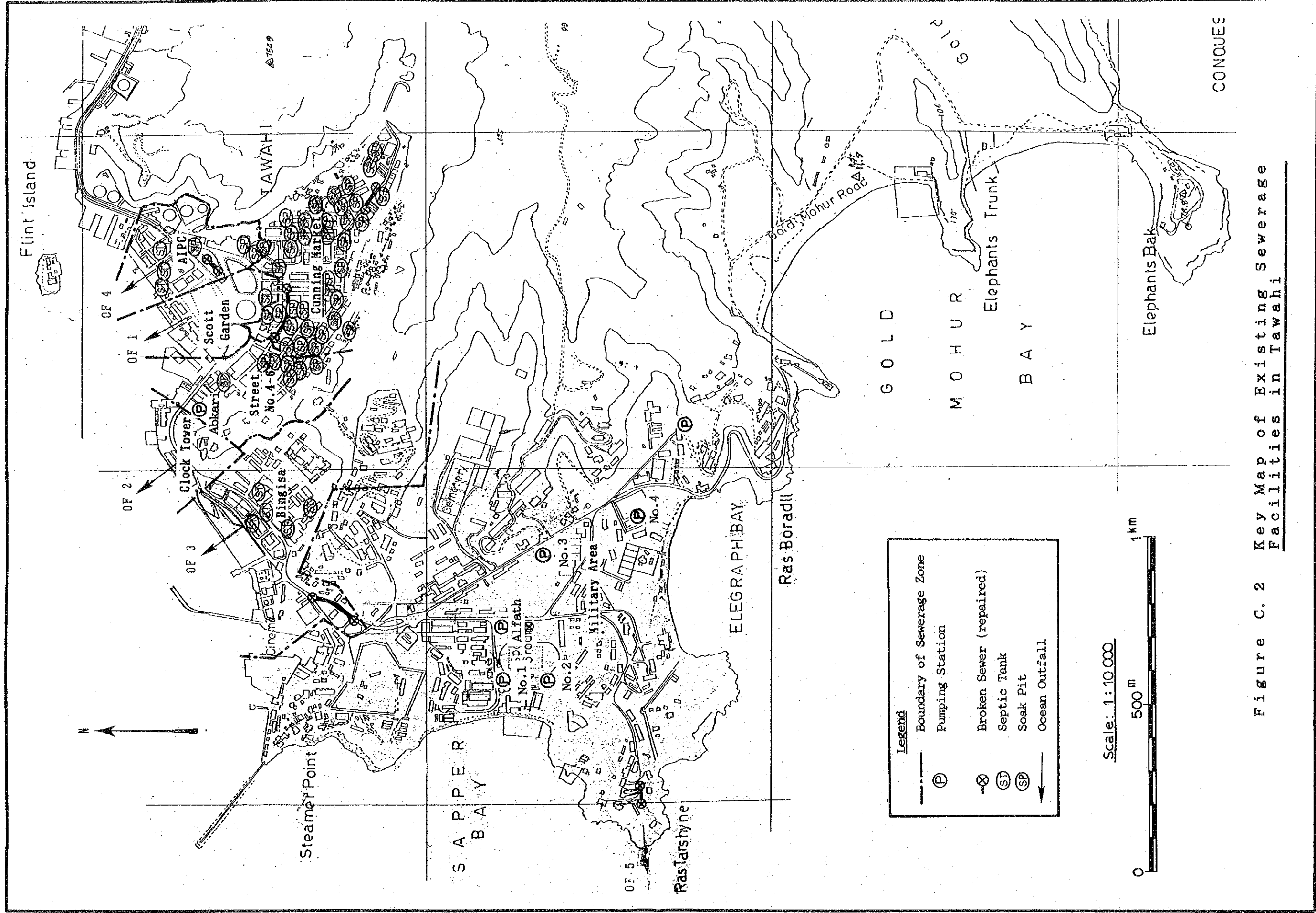


Figure C. 2 Key Map of Existing Sewerage Facilities in Tawahi

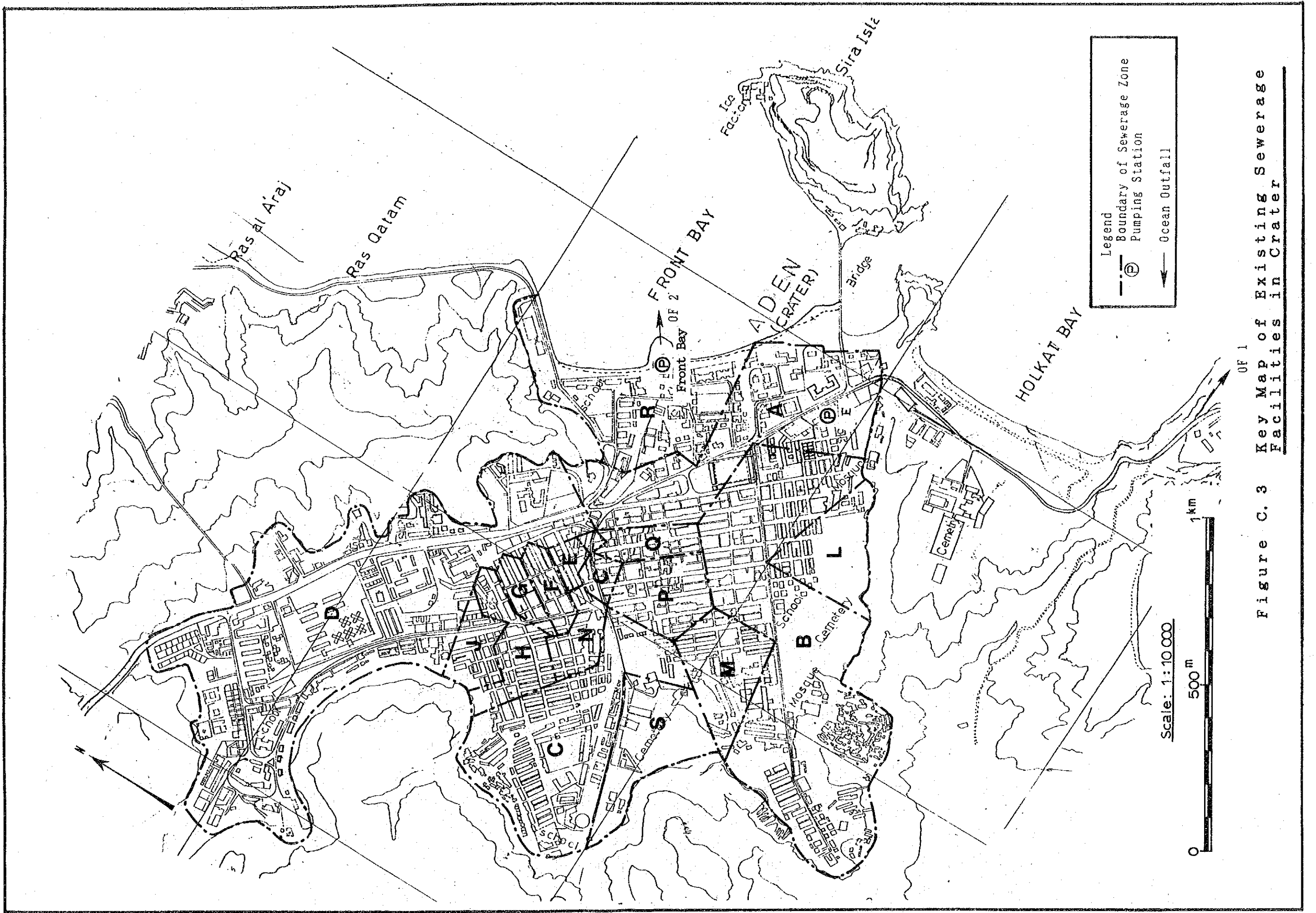


Figure C. 3 Key Map of Existing Sewerage Facilities in Crater OF 1

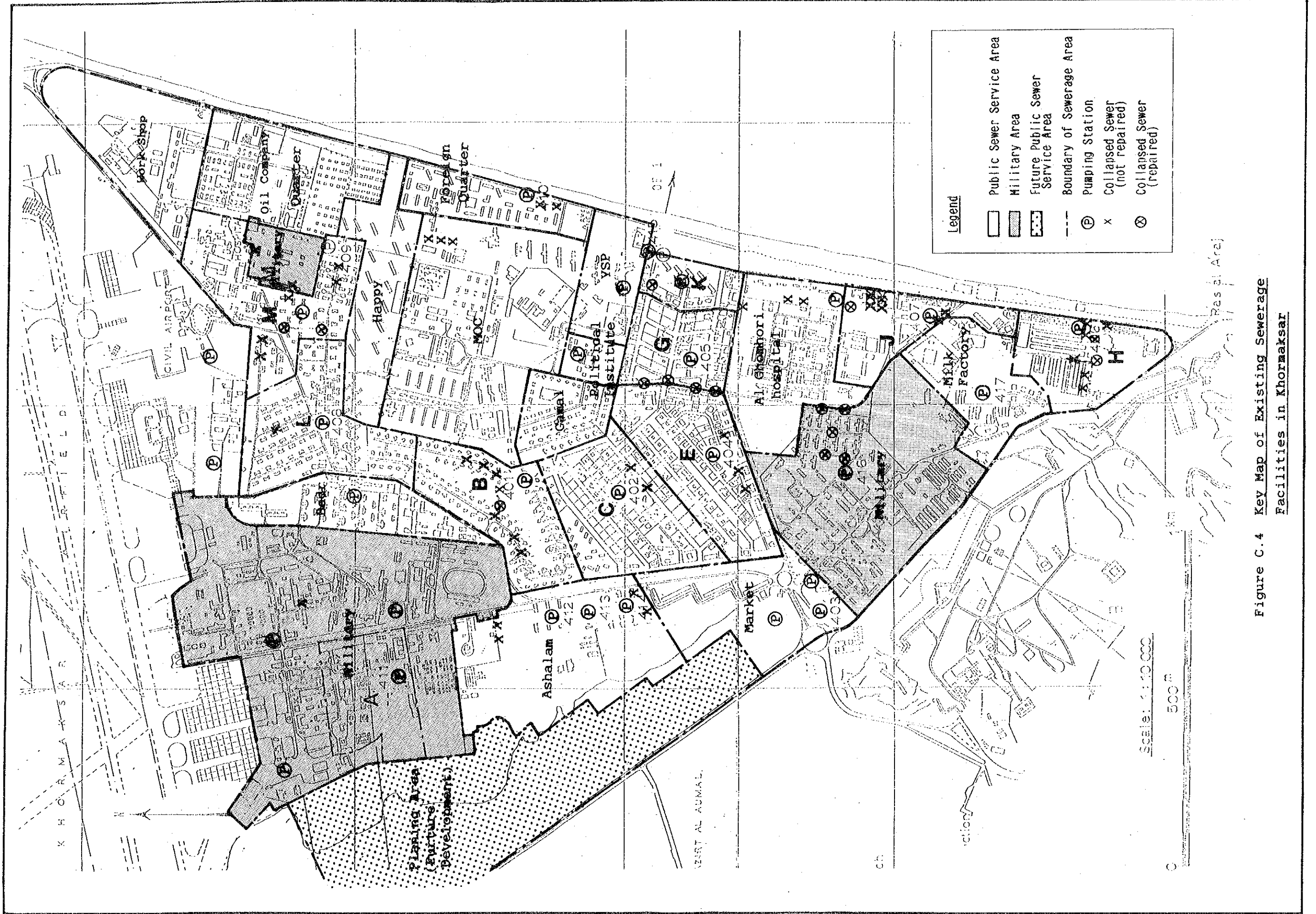
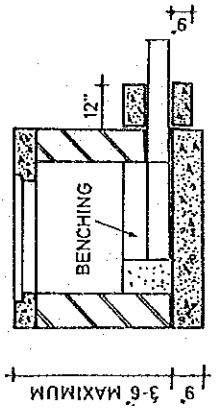
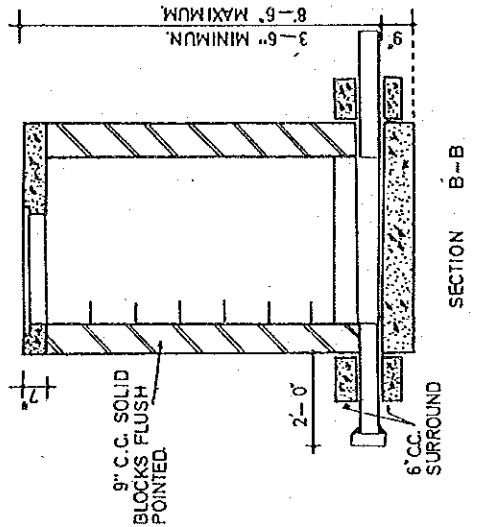
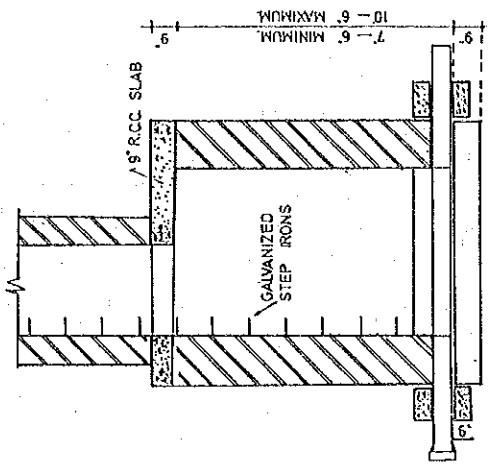
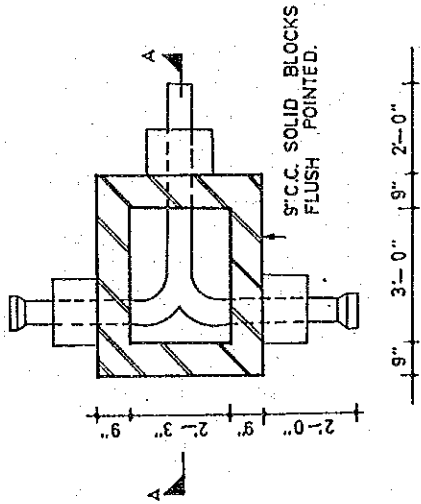
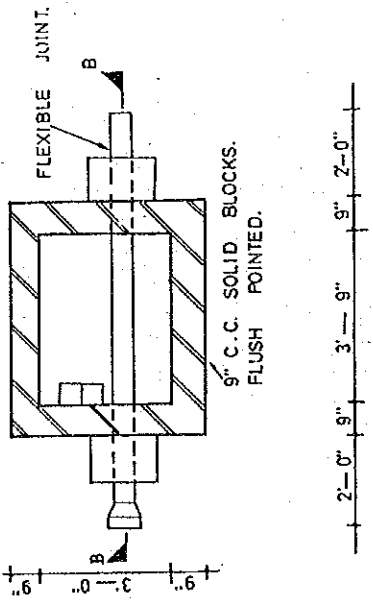
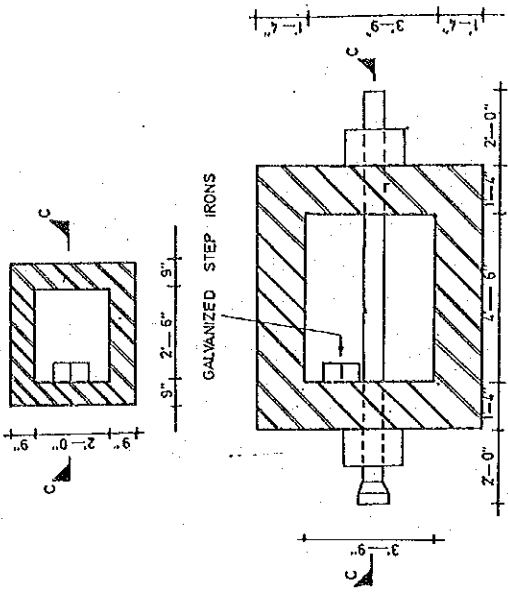


Figure C.4 Key Map of Existing Sewerage Facilities in Khormaksar

Table C. 4 List of Sewers in Khormaksar

Name of Zone (see Fig C.4)	Manhole(Nos)		Length of Sewer (m)												Remarks
	MA	MB	Drop	φ 100	φ 125	φ 150	φ 175	φ 200	φ 225	φ 250	φ 300	φ 375	φ 400		
	(see Fig C.4)	(see Fig C.6)	ACP	ACP	ACP	ACP	ACP	ACP	ACP	ACP	ACP	ACP	ACP		
A	1				125										
A	6								180				258		
B	1								742						
B	16								1,056		244	155			
C	1									122	883				
C	28								1,496			367			
E	1			350											
E	38	2							2,244						
G	1					320	514								
G	38	1							1,919						
H	35	1							1,960						
J	1						387			1,107					
J	60								2,379		315				
K				185											
K	12								501						
L	1														
L	41	3							2,610						
M	62	1							2,902						
P	1				677		418		450			629			
P	8														
Total	352	8		535	677	592	932	387	18,439	1,229	1,442	1,151	258		



SECTION C-C

MC

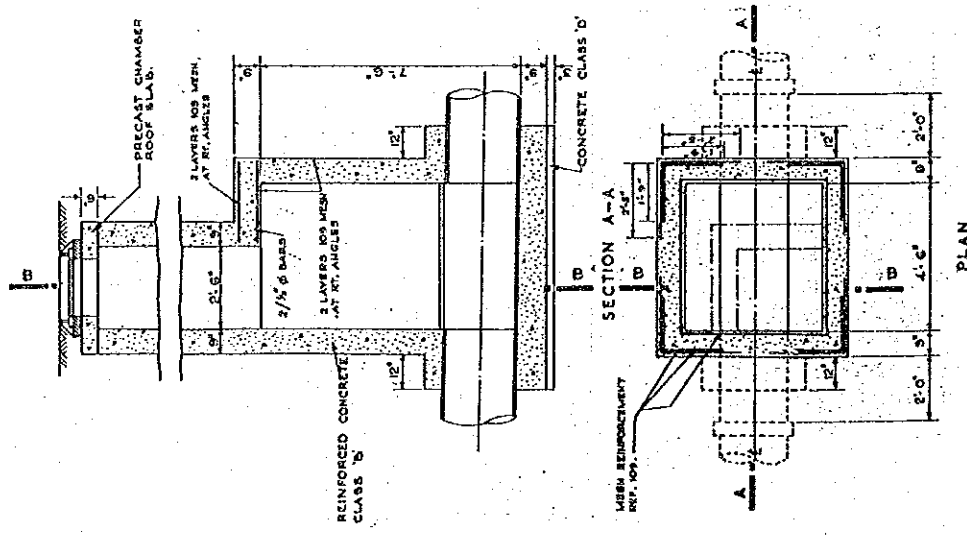
SECTION B-B

MB

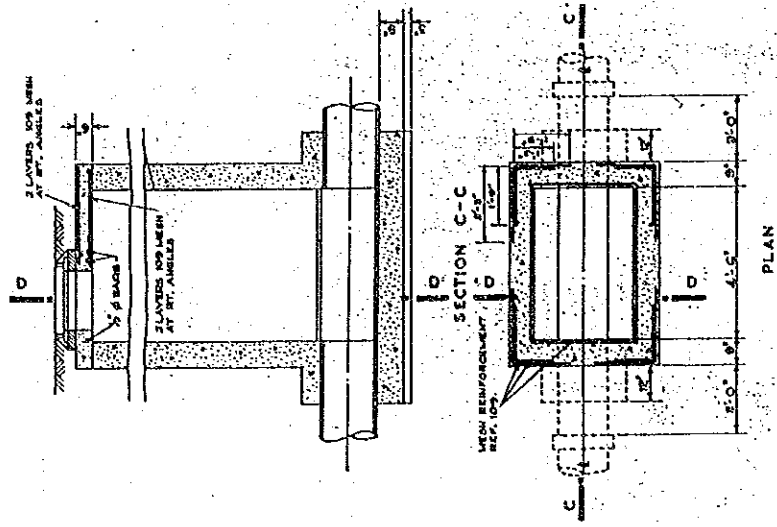
SECTION A-A

MA

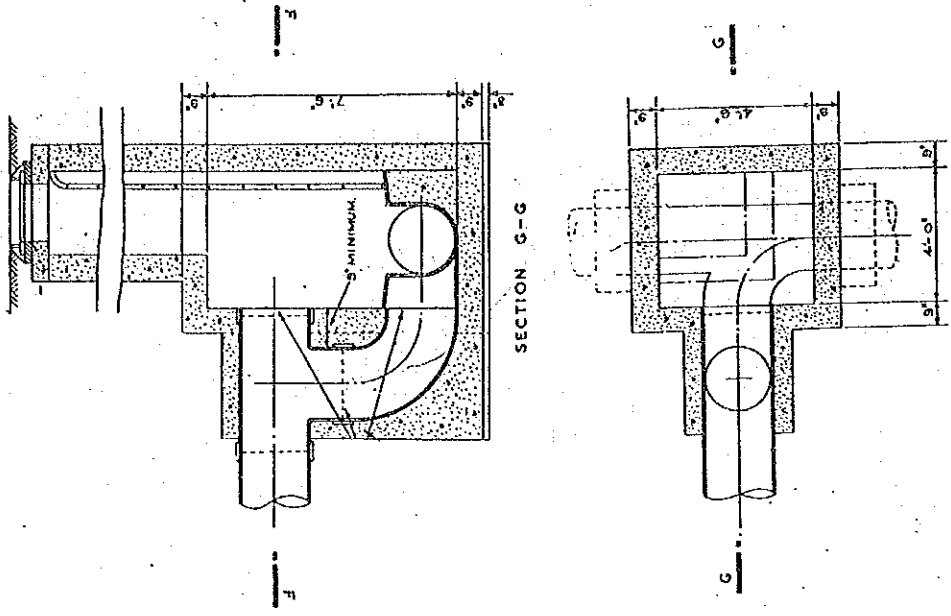
Figure C. 5 Standard Type of Manhole in Ma'alla and Tawahi



MA



MB



PLAN F-F

DROP

Figure C.6 Standard Type of Manhole in Crater and Khormaksar

Table C.5 Conditions of the Existing Pumping Stations

Name of District: Ma'alla	Year of Construction: 1957	
Name of P/S: Hedjuff Main Pumping Station	Year of Operation: 1958	
<u>Specification of Facility</u>		
Type of P/S: Chlorination Station (refer to Figure C. 7)		
Inlet Pipe	Dia.: 380 mm Delivery Pipe Dia.: 150 mm Material: VCP Material: CIP	
Pump Specs.	Type of Pump: Centrifugal Dia. (suction): 150 mm, Nos.: 2 (Nos. standby: 1) Total head: H= m Capacity: 5,040 l/min.	
Motor Specs.	Power: 10 KW Receiving Voltage: 400/400 V	
Operation Method: Automatic and Manual		
Ancillary Equipment: Two comminutors 25 RM, both are out of order.		
<u>Operation and Maintenance</u>		
Nos. Operator: 3 Shift: 3		
Operation of Pumps; Operating Time: 24 hrs./day Peak Time: 7:00 - 15:00		
Nos. of Pumps in Operation at Peak Flow: 1		
Maintenance of Machinery; Inspection by Demounting: 2 - 3/year		
Present Condition of Machinery: Good		
<u>Power Failure</u>		
Frequency of Power Failure: 4 times/year, Duration: 2-4 hrs.		
Overflow of Sewage from Upstream Manholes : Y e s		
<u>Structural Damage</u>		
<u>Location of Damage:</u>	<u>Degree of Damage:</u>	<u>Cause of Damage:</u>
1. Inlet manhole	a	Hydrogen sulphide gas
2. Channel	a	Hydrogen sulphide gas
Note: a. corrosion of concrete; b. exposure of steel bar; c. corrosion of steel bar		
<u>Remarks</u>		
1. All pump nuts were replaced in 1982. 2. Comminutors were broken about 10 years ago. 3. Powder, most likely crystallized calcium, is remarkably observed on the bottom of the inlet manhole. 4. Strength of concrete by Schmidt concrete test hammer, 220-360 kg/cm ² comminutor room, 200-220 kg/cm ² pump room. 5. H ₂ S gas, 50 mg/l in wet well (without cover) (14:00 Feb. 2, 1989)		

Table C. 6 Conditions of the Existing Pumping Stations

Name of District: Ma'alla		Year of Construction: 1957	
Name of P/S: Dakka		Year of Operation: 1957	
<u>Specification of Facility</u>			
Type of P/S: Dakka Pumping Station (refer to Figure C. 8)			
Inlet Pipe	Dia.: 225 mm Material: VCP	Delivery Pipe	Dia.: 200 mm Material: CIP
Pump Specs.	Type of Pump: Centrifugal Dia. (suction): 150 mm, Nos.: 3 (Nos. standby: 1) Total head: H= m Capacity: 2,700 l/min.		
Motor Specs.	Power: 6.5 KW	Receiving Voltage: 400/450 V	
Operation Method: Automatic and Manual			
Ancillary Equipment: None			
<u>Operation and Maintenance</u>			
Nos. Operator: 1		Shift: 1	
Operation of Pumps; Operating Time: 24 hrs./day Peak Time: 7:00 - 15:00 Nos. of Pumps in Operation at Peak Flow: 1			
Maintenance of Machinery; Inspection by Demounting: 2-3/year			
Present Condition of Machinery: Good			
<u>Power Failure</u>			
Frequency of Power Failure: 4-6 times/year, Duration: 4-6 hrs.			
Overflow of Sewage from Upstream Manholes: Yes			
<u>Structural Damage</u>			
<u>Location of Damage:</u>	<u>Degree of Damage:</u>	<u>Cause of Damage:</u>	
No damage			
Note: a. corrosion of concrete; b. exposure of steel bar; c. corrosion of steel bar			
<u>Remarks</u>			
1. One motor was removed and not yet equipped. 2. One operator stays all day at the station. 3. Pressure pipes, installed originally in 1956 were broken at two points in 1982, and these were replaced by the municipality.			

Table C. 7 Conditions of the Existing Pumping Stations

Name of District: Ma'alla		Year of Construction: 1957	
Name of P/S: Dolphin		Year of Operation: 1958	
<u>Specification of Facility</u>			
Type of P/S:	Dolphine Pumping Station (refer to Figure C. 9)		
Inlet Pipe	Dia.: 225 mm Material: VCP	Delivery Pipe	Dia.: 100 mm Material: CIP
Pump Specs.	Type of Pump: Centrifugal Dia. (suction): 100 mm, Total head: H= m	Nos.: 2 Capacity: 963 l/min.	(Nos. standby: 1)
Motor Specs.	Power: 6.25 KW	Receiving Voltage: 400/440 V	
Operation Method: Automatic and Manual			
Ancillary Equipment: None			
<u>Operation and Maintenance</u>			
Nos. Operator:	1	Shift:	1
Operation of Pumps; Operating Time: 24 hrs./day Peak Time: 7:00 - 15:00 Nos. of Pumps in Operation at Peak Flow: 1			
Maintenance of Machinery; Inspection by Demounting: 2-3/year			
Present Condition of Machinery: Good			
<u>Power Failure</u>			
Frequency of Power Failure: 4-6 times/year, Duration: 4-6 hrs.			
Overflow of Sewage from Upstream Manholes: Yes			
<u>Structural Damage</u>			
<u>Location of Damage:</u>	<u>Degree of Damage:</u>	<u>Cause of Damage:</u>	
1. Pump chamber	a	Hydrogen sulphide gas	
Note: a. corrosion of concrete; b. exposure of steel bar; c. corrosion of steel bar			
<u>Remarks</u>			
1. One motor is under repair.			
2. One operator stays all day at the station.			
3. Leakage of sewage on concrete wall is recognized.			
4. Pumps and motors are obsolete and in bad conditions.			

Table C. 8 Conditions of the Existing Pumping Stations

Name of District: Ma'alla		Year of Construction: 1957	
Name of P/S: Obstruction Pier		Year of Operation: 1958	
<u>Specification of Facility</u>			
Type of P/S: Ejector Pumping Station (refer to Figure C. 10)			
Inlet Pipe	Dia.: 225 mm	Delivery Pipe	Dia.: 100 mm
	Material: VCP		Material: CIP
Pump Specs.	Type of Pump: Ejector		
	Dia. (suction): 76 mm,	Nos.: 2	(Nos. standby: 1)
	Total head: H= m	Capacity:	450 l/min.
Motor Specs.	Power: 3.75 KW	Receiving Voltage: 400/400 V	
Operation Method: Manual			
Ancillary Equipment: None			
<u>Operation and Maintenance</u>			
Nos. Operator: 1		Shift: 1	
Operation of Pumps; Operating Time: 7:00 - 15:00 Peak Time: 7:00 - 14:00			
Nos. of Pumps in Operation at Peak Flow: 1			
Maintenance of Machinery; Inspection by Demounting: Every week			
Present Condition of Machinery: Not bad			
<u>Power Failure</u>			
Frequency of Power Failure: 4-6 times/year, Duration: 4-6 hrs.			
Overflow of Sewage from Upstream Manholes: Yes			
<u>Structural Damage</u>			
<u>Location of Damage:</u>		<u>Degree of Damage:</u>	
1. Slub of pump well (down side) c.		Hydrogen sulphide gas	
2. Wall of pump well b.		Hydrogen sulphide gas	
Note: a. corrosion of concrete; b. exposure of steel bar; c. corrosion of steel bar			
<u>Remarks</u>			
1. Starting up the ejector is difficult.			
2. It is impossible to obtain spareparts because of obsolete type of the ejector.			

Table C. 9 Conditions of the Existing Pumping Stations

Name of District: Tawahi		Year of Construction: 1957	
Name of P/S: Abkari Shopping Area		Year of Operation: 1958	
<u>Specification of Facility</u>			
Inlet Pipe	Dia.: 150 mm Material: VCP	Delivery Pipe	Dia.: 75 mm Material: CIP
Pump Specs.	Type of Pump: Ejector Dia. (suction): 75 mm, Nos.: 2 (Nos. standby: 1) Total head: H= m Capacity: 450 l/min.		
Motor Specs.	Power: 3 KW	Receiving Voltage: 400/440 V	
Operation Method: Manual			
Ancillary Equipment: None			
<u>Operation and Maintenance</u>			
Nos. Operator: 1		Shift: 1	
Operation of Pumps; Operating Time: 7:00 - 15:00 Peak Time: 7:00 - 14:00 Nos. of Pumps in Operation at Peak Flow: 1			
Maintenance of Machinery; Inspection by Demounting: 10/year			
Present Condition of Machinery: Bad			
<u>Power Failure</u>			
Frequency of Power Failure: 4-6 times/year, Duration: 4-6 hrs.			
Overflow of Sewage from Upstream Manholes: Yes			
<u>Structural Damage</u>			
<u>Location of Damage:</u>	<u>Degree of Damage:</u>	<u>Cause of Damage:</u>	
1. Ceiling	b.	Hydrogen sulphide gas	
Note: a. corrosion of concrete; b. exposure of steel bar; c. corrosion of steel bar			
<u>Remarks</u>			
1. Corrosion of concrete inside the ejector room is observed.			
2. Condition of machinery is also bad.			
3. One ejector is broken, unable to be repaired and another one is unsuitable for long time use.			

Table C. 10 Conditions of the Existing Pumping Stations

Name of District: Tawahi		Year of Construction: 1957	
Name of P/S: Alfath		Year of Operation: 1958	
<u>Specification of Facility</u>			
Inlet Pipe	Dia.: 225 mm Material: VCP	Delivery Pipe	Dia.: 100 mm Material: CIP
Pump Specs.	Type of Pump: Centrifugal Dia. (suction): 100 mm, Nos.: 4 (Nos. standby: 1) Total head: H= m Capacity: 900 l/min.		
Motor Specs.	Power: 31.25 KW	Receiving Voltage: 400/440 V	
Operation Method: Automatic and Manual			
Ancillary Equipment: Screen space 20 mm			
<u>Operation and Maintenance</u>			
Nos. Operator: 3		Shift: 3	
Operation of Pumps; Operating Time: 24 hrs./day Peak Time: 7:00 - 15:00 Nos. of Pumps in Operation at Peak Flow: 1			
Maintenance of Machinery; Inspection by Demounting: 2-3/year			
Present Condition of Machinery: Not bad			
<u>Power Failure</u>			
Frequency of Power Failure: 4-6 times/year, Duration: 3-6 hrs.			
Overflow of Sewage from Upstream Manholes: Yes			
<u>Structural Damage</u>			
<u>Location of Damage:</u>	<u>Degree of Damage:</u>	<u>Cause of Damage:</u>	
1. Pump well	b.	Hydrogen sulphide gas	
Note: a. corrosion of concrete; b. exposure of steel bar; c. corrosion of steel bar			
<u>Remarks</u>			
1. This pumping station consist of two stations delivers sewage to directions alternately according to the sea water level, one to Bingisar area (north) in low tide, and another to Presidential area (south) in high tide.			
2. Two pumps are broken and out of order.			
3. Discharging pipe were broken, and repaired.			

Table C. 11 Conditions of the Existing Pumping Stations

Name of District: Tawahi		Year of Construction: 1957	
Name of P/S: Military Area No.1		Year of Operation: 1958	
<u>Specification of Facility</u>			
Inlet Pipe	Dia.: 150 mm Material: VCP	Delivery Pipe	Dia.: 150 mm Material: CIP
Pump Specs.	Type of Pump: Centrifugal(Horizontal) Dia. (suction): 100 mm, Nos.: 2 (Nos. standby: 1) Total head: H= m Capacity: l/min.		
Motor Specs.	Power: KW	Receiving Voltage: 400/440 V	
Operation Method: Automatic and Manual			
Ancillary Equipment: None			
<u>Operation and Maintenance</u>			
Nos. Operator:	Shift: Traveling mechanic checks once a day.		
Operation of Pumps; Operating Time: 24 hrs./day Peak Time: 7:00 - 14:00 Nos. of Pumps in Operation at Peak Flow: 1			
Maintenance of Machinery; Inspection by Demounting: 2-3/year			
Present Condition of Machinery: Not bad			
<u>Power Failure</u>			
Frequency of Power Failure: 4-6 times/year, Duration: 3-6 hrs.			
Overflow of Sewage from Upstream Manholes: Yes			
<u>Structural Damage</u>			
<u>Location of Damage:</u>	<u>Degree of Damage:</u>	<u>Cause of Damage:</u>	
1. Wet well	c	Hydrogen sulphide gas	
<u>Remarks</u>			
1. One pump is out of order. 2. Corrosion at wet well is searious.			

Table C. 12 Conditions of the Existing Pumping Stations

Name of District: Tawahi		Year of Construction: 1957	
Name of P/S: Military Area No.2		Year of Operation: 1958	
<u>Specification of Facility</u>			
Inlet Pipe	Dia.: 75 mm Material: VCP	Delivery Pipe	Dia.: 75 mm Material: CIP
Pump Specs.	Type of Pump: Centrifugal(Horizontal) Dia. (suction): 75 mm, Nos.: 1 (Nos. standby: -) Total head: H= m Capacity: l/min.		
Motor Specs.	Power: KW	Receiving Voltage: 400/440 V	
Operation Method: Automatic and Manual			
Ancillary Equipment: None			
<u>Operation and Maintenance</u>			
Nos. Operator:		Shift: Traveling mechanic checks once a day.	
Operation of Pumps; Operating Time: 24 hrs./day Peak Time: 7:00 - 14:00 Nos. of Pumps in Operation at Peak Flow: 1			
Maintenance of Machinery; Inspection by Demounting: 1/year			
Present Condition of Machinery: Not bad			
<u>Power Failure</u>			
Frequency of Power Failure: 4-6 times/year, Duration: 3-6 hrs.			
Overflow of Sewage from Upstream Manholes: Yes			
<u>Structural Damage</u>			
<u>Location of Damage:</u>	<u>Degree of Damage:</u>	<u>Cause of Damage:</u>	
1. Ceiling	c	Salinity in concrete	
<u>Remarks</u>			

Table C. 13 Conditions of the Existing Pumping Stations

Name of District: Tawahi		Year of Construction: 1957	
Name of P/S: Military Area No.3		Year of Operation: 1958	
<u>Specification of Facility</u>			
Inlet Pipe	Dia.: 150 mm Material: VCP	Delivery Pipe	Dia.: 100 mm Material: CIP
Pump Specs.	Type of Pump: Ejector Dia. (suction): 100 mm, Nos.: 2 (Nos. standby: 1) Total head: H= m Capacity: 270 l/min.		
Motor Specs.	Power: 3.1 KW	Receiving Voltage: 400/440 V	
Operation Method: Manual			
Ancillary Equipment: None			
<u>Operation and Maintenance</u>			
Nos. Operator: - Shift: Traveling mechanic checks once a day.			
Operation of Pumps; Operating Time: 7:00-15:00 Peak Time: 7:00 - 14:00 Nos. of Pumps in Operation at Peak Flow: 1			
Maintenance of Machinery; Inspection by Demounting: -/year			
Present Condition of Machinery: Out of order			
<u>Power Failure</u>			
Frequency of Power Failure: 4-6 times/year, Duration: 3-6 hrs.			
Overflow of Sewage from Upstream Manholes: Yes			
<u>Structural Damage</u>			
<u>Location of Damage:</u>	<u>Degree of Damage:</u>	<u>Cause of Damage:</u>	
1. Slub of inlet pit	a	Salinity in concrete	
<u>Remarks</u>			
1. Structure is not corroded, but concrete has not enough strength. By Schmidt concrete test hammer, 310kg/cm ² or no strength wall, 210kg/cm ² or no strength ceiling, 200kg/cm ² or no strength slub.			
2. One ejector out of order 4 years ago, and the other out of order 5 months ago, now temporary pump works.			
3. By phenolphthalein test, no reaction for 6 cm thickness.			

Table C. 14 Conditions of the Existing Pumping Stations

Name of District: Tawahi		Year of Construction: 1957	
Name of P/S: Military Area NO.4		Year of Operation: 1958	
<u>Specification of Facility</u>			
Inlet Pipe	Dia.: 150 mm Material: VCP	Delivery Pipe	Dia.: 100 mm Material: CIP
Pump Specs.	Type of Pump: Centrifugal Dia. (suction): 100 mm, Nos.: 2 (Nos. standby: -) Total head: H= m Capacity: l/min.		
Motor Specs.	Power: KW	Receiving Voltage: 400/440 V	
Operation Method: Automatic and Manual			
Ancillary Equipment: None			
<u>Operation and Maintenance</u>			
Nos. Operator: - Shift: Traveling mechanic checks once a day.			
Operation of Pumps; Operating Time: 24 hrs./day Peak Time: 7:00 - 14:00 Nos. of Pumps in Operation at Peak Flow: 1			
Maintenance of Machinery; Inspection by Demounting: 2-3/year			
Present Condition of Machinery: Bad, out of order			
<u>Power Failure</u>			
Frequency of Power Failure: 4-6 times/year, Duration: 3-6 hrs.			
Overflow of Sewage from Upstream Manholes: Yes			
<u>Structural Damage</u>			
<u>Location of Damage:</u>	<u>Degree of Damage:</u>	<u>Cause of Damage:</u>	
<u>Remarks</u>			
1. Rocked, can't investigate the inner side.			
2. Two pumps are out of order. Now temporary pump works.			

Table C. 15 Conditions of the Existing Pumping Stations

Name of District: Tawahi		Year of Construction: 1957	
Name of P/S: Ministry of Defence No.5		Year of Operation: 1958	
<u>Specification of Facility</u>			
Inlet Pipe	Dia.: 150 mm Material: VCP	Delivery Pipe	Dia.: 100 mm Material: CIP
Pump Specs.	Type of Pump: Ejector Dia. (suction): 100 mm, Nos.: 2 (Nos. standby: 1) Total head: H= m Capacity: l/min.		
Motor Specs.	Power: 3.1 KW	Receiving Voltage: 400/400 V	
Operation Method: Manual			
Ancillary Equipment: None			
<u>Operation and Maintenance</u>			
Nos. Operator: -		Shift: Traveling mechanic checks once a day.	
Operation of Pumps;		Operating Time: 7:00-15:00	Peak Time: 7:00 - 14:00
		Nos. of Pumps in Operation at Peak Flow: 1	
Maintenance of Machinery; Inspection by Demounting: 5-6/year			
Present Condition of Machinery: Bad			
<u>Power Failure</u>			
Frequency of Power Failure: 4-6 times/year, Duration: 4-6 hrs.			
Overflow of Sewage from Upstream Manholes: Yes			
<u>Structural Damage</u>			
<u>Location of Damage:</u>	<u>Degree of Damage:</u>	<u>Cause of Damage:</u>	
1. Edge of roof	c	Salinity in concrete	
Note: a. crrosion of concrete; b. exposure of steel bar; c. corrosion of steel bar			
<u>Remarks</u>			
1. One pump is broken 4 years ago and out of order.			
2. Strength of concrete by Schmidt concrete test hammer, 130kg/cm ² or no strength ceiling, 180kg/cm ² or no strength wall.			

Table C. 16. Conditions of the Existing Pumping Stations

Name of District: Crater	Year of Construction: 1963	
Name of P/S: E Near Immigration	Year of Operation: 1964	
<u>Specification of Facility</u>		
Type of P/S: Main pumping station (refer to Figuer C. 11)		
Inlet Pipe Dia.: 750 mm Material: ACP	Delivery Pipe Dia.: 450 mm Material: ACP	
Pump Specs. Type of Pump: Centrifugal Dia. (suction): 300 mm, Nos.: 3 (Nos. standby: 1) Total head: H= 4.54 m Capacity: 9,137 l/min.		
Motor Specs. Power: 35 KW	Receiving Voltage: 400/440 V	
Operation Method: Automatic and Manual		
Ancillary Equipment: 2 Comminutors 25RM; out of order 1 generator 24 KVA; out of order		
<u>Operation and Maintenance</u>		
Nos. Operator: 3	Shift: 3	
Operation of Pumps; Operating Time: 24 hrs./day Peak Time: 6:00 - 14:00 Nos. of Pumps in Operation at Peak Flow: 2		
Maintenance of Machinery; Inspection by Demounting: 1/year		
Present Condition of Machinery: Good		
<u>Power Failure</u>		
Frequency of Power Failure: 6 times/year, Duration: 5 hrs.		
Overflow of Sewage from Upstream Manholes: Yes		
<u>Structural Damage</u>		
<u>Location of Damage:</u>	<u>Degree of Damage:</u>	<u>Cause of Damage:</u>
1. Ceiling of pump room	c.	Hydrogen sulphide gas
2. Wall of pump room	c.	Hydrogen sulphide gas
3. Channel of comminuter	c.	Hydrogen sulphide gas
Note: a. corrosion of concrete; b. exposure of steel bar; c. corrosion of steel bar		
<u>Remarks</u>		
1. One motor is out of order, waiting for spare parts from Crown Agent.		
2. One pump works 8 hours a day.		
3. Corrosion of structure is serious.		
4. Replacement of machinery is necessary.		

Table C. 17 Conditions of the Existing Pumping Stations

Name of District: Crater		Year of Construction: 1963	
Name of P/S: Front Bay Near Local Government Office		Year of Operation: 1964	
<u>Specification of Facility</u>			
Type of P/S:	Front Bay pumping station (refer to Figure C. 12)		
Inlet Pipe	Dia.: 300 mm Material: ACP	Delivery Pipe	Dia.: 100 mm Material: ACP
Pump Specs.	Type of Pump: Centrifugal		
	Dia. (suction): 100 mm,	Nos.: 2	(Nos. standby: -)
	Total head: H= 17 m	Capacity:	52 l/min.
Motor Specs.	Power: 7.5 KW	Receiving Voltage: 400/440 V	
Operation Method: Automatic and Manual			
Ancillary Equipment: None			
<u>Operation and Maintenance</u>			
Nos. Operator: -	Shift: -	One mechanic checks equipment every day early morning.	
Operation of Pumps; Operating Time: 24 hrs Peak Time: 7:00 - 14:00			
Nos. of Pumps in Operation at Peak Flow: 1			
Maintenance of Machinery; Inspection by Demounting: 1/year			
Present Condition of Machinery: Good			
<u>Power Failure</u>			
Frequency of Power Failure: 4 times/year, Duration: 4 hrs.			
Overflow of Sewage from Upstream Manholes: Yes			
<u>Structural Damage</u>			
<u>Location of Damage:</u>	<u>Degree of Damage:</u>	<u>Cause of Damage:</u>	
1. Motor room	Cracked	Hydrogen sulphide gas	
2. Outside of roof	c.	Wind from sea	
Note: a. corrosion of concrete; b. exposure of steel bar; c. corrosion of steel bar			
<u>Remarks</u>			
1. Same machanic takes care of P/S E.			
2. The crack on tje wall of motor room may be tear of mending part by mortar.			
3. Replacement of machinery is necessary.			

Table C. 18 Conditions of the Existing Pumping Stations

Name of District: Khormaksar		Year of Construction: 1963	
Name of P/S: B Al Madina, Al Baida		Year of Operation: 1964	
<u>Specification of Facility</u>			
Type of P/S:	Type 1 (refer to Figure C. 13)		
Inlet Pipe	Dia.: 250 mm x 2 Material: ACP	Delivery Pipe	Dia.: 250 mm Material: ACP
Pump Specs.	Type of Pump: Centrifugal Dia. (suction): 150 mm, Total head: H= 8 m	Nos.: 3 (Nos. standby: 1) Capacity: 2,909 l/min.	
Motor Specs.	Power: 5 KW	Receiving Voltage: 400/440 V	
Operation Method: Automatic and Manual			
Ancillary Equipment: None			
<u>Operation and Maintenance</u>			
Nos. Operator: 1		Shift: -	
Operation of Pumps; Operating Time: 24 hrs./day Peak Time: 6:00 - 14:00 Nos. of Pumps in Operation at Peak Flow: 1			
Maintenance of Machinery; Inspection by Demounting: 1/year			
Present Condition of Machinery: Good			
<u>Power Failure</u>			
Frequency of Power Failure: 4 times/year, Duration: 4 hrs.			
Overflow of Sewage from Upstream Manholes: Yes			
<u>Structural Damage</u>			
<u>Location of Damage:</u>	<u>Degree of Damage:</u>	<u>Cause of Damage:</u>	
1. Pump room	Crack	Salinity in concrete	
2. Wall of wet well	Crack	Hydrogen sulphide gas	
3. Concrete step in wet well (floor)	Crack	Hydrogen sulphide gas	
Note: a. corrosion of concrete; b. exposure of steel bar; c. corrosion of steel bar			
<u>Remarks</u>			
1. Structural damage is serious. 2. Replacement of machinery is necessary.			

Table C. 19 Conditions of the Existing Pumping Stations

Name of District: Khormaksar		Year of Construction: 1963
Name of P/S: C		Year of Operation: 1964
Behind Libian Embassy		
<u>Specification of Facility</u>		
Type of P/S:	Type 2 (refer to Figure C. 14)	
Inlet Pipe	Dia.: 375 and 225 mm Delivery Pipe Material: ACP	Dia.: 300 mm Material: ACP
Pump Specs.	Type of Pump: Centrifugal Dia. (suction): 150 mm, Total head: H= 6 m	Nos.: 3 (Nos. standby: 1) Capacity: 318 l/min.
Motor Specs.	Power: 10 KW	Receiving Voltage: 400/440 V
Operation Method: Automatic and Manual		
Ancillary Equipment: None		
<u>Operation and Maintenance</u>		
Nos. Operator:	1	Shift: 1
Operation of Pumps;	Operating Time: 24 hrs./day Peak Time: 6:00 - 14:00 Nos. of Pumps in Operation at Peak Flow: 1	
Maintenance of Machinery;	Inspection by Demounting: 1/year	
Present Condition of Machinery: Not bad		
<u>Power Failure</u>		
Frequency of Power Failure:	4	times/year, Duration: 4 hrs.
Overflow of Sewage from Upstream Manholes: Yes		
<u>Structural Damage</u>		
<u>Location of Damage:</u>	<u>Degree of Damage:</u>	<u>Cause of Damage:</u>
1. Wall of wet well	c.	Hydrogen sulphide gas
2. Wall of pump room	Cracked	Salinity in concrete
Note: a. corrosion of concrete; b. exposure of steel bar; c. corrosion of steel bar		
<u>Remarks</u>		
1. Shafts and gland sleeves of one pump were repaired by Docyard Co.		
2. Structural damage is serious.		
3. Replacement of machinery is necessary.		

Table C. 20 Conditions of the Existing Pumping Stations

Name of District: Khormaksar	Year of Construction: 1963	
Name of P/S: D Near Traffic Office	Year of Operation: 1964	
<u>Specification of Facility</u>		
Type of P/S: Type 3 (refer to Figure C. 15)		
Inlet Pipe Dia.: 250 mm x 2 Material: ACP	Delivery Pipe Dia.: 100 mm Material: CIP	
Pump Specs. Type of Pump: Centrifugal Dia. (suction): 100 mm, Nos.: 2 (Nos. standby: 1) Total head: H= 16.8 m Capacity: 52 l/min.		
Motor Specs. Power: 7.5 KW	Receiving Voltage: 400/440 V	
Operation Method: Automatic and Manual		
Ancillary Equipment: None		
<u>Operation and Maintenance</u>		
Nos. Operator: 1	Shift: - Pump operation is checked twice a day.	
Operation of Pumps; Operating Time: 24 hrs./day Peak Time: 7:00 - 14:00 Nos. of Pumps in Operation at Peak Flow: 1		
Maintenance of Machinery; Inspection by Demounting: 1/year		
Present Condition of Machinery: Good		
<u>Power Failure</u>		
Frequency of Power Failure: 4 times/year, Duration: 4 hrs.		
Overflow of Sewage from Upstream Manholes: Yes		
<u>Structural Damage</u>		
<u>Location of Damage:</u> 1. Pit cover (iron)	<u>Degree of Damage:</u> Corroded	<u>Cause of Damage:</u> Wind from sea
Note: a. corrosion of concrete; b. exposure of steel bar; c. corrosion of steel bar		
<u>Remarks</u>		
1. Ejectors were replaced by two pumps in 1986. 2. New pumps will be usable for next five years.		

Table C. 21 Conditions of the Existing Pumping Stations

Name of District: Khormaksar		Year of Construction: 1980	
Name of P/S: E Near Cuba Embassy		Year of Operation: 1981	
<u>Specification of Facility</u>			
Type of P/S:	Type 1 (refer to Figure C. 13)		
Inlet Pipe	Dia.: 225 mm x 2 Material: ACP	Delivery Pipe	Dia.: 150 mm Material: ACP
Pump Specs.	Type of Pump: Centrifugal Dia. (suction): 100 mm, Nos.: 3 (Nos. standby: 1) Total head: H= 16.8 m Capacity: 52 l/min.		
Motor Specs.	Power: 7.5 KW	Receiving Voltage: 400/440 V	
Operation Method: Automatic and Manual			
Ancillary Equipment: None			
<u>Operation and Maintenance</u>			
Nos. Operator: 1		Shift: -	
Operation of Pumps; Operating Time: 24 hrs./day Peak Time: 6:00 - 14:00 Nos. of Pumps in Operation at Peak Flow: 1			
Maintenance of Machinery; Inspection by Demounting: 1/year Points of Repair: All parts			
Present Condition of Machinery: Good			
<u>Power Failure</u>			
Frequency of Power Failure: 4 times/year, Duration: 4 hrs.			
Overflow of Sewage from Upstream Manholes: Yes			
<u>Structural Damage</u>			
<u>Location of Damage:</u>	<u>Degree of Damage:</u>	<u>Cause of Damage:</u>	
1. Pump room	Cracked	Tear caused by cement mortar repairing	
2. Pump room	c.	Hydrogen sulphide gas	
3. Wall of wet well	c.	Hydrogen sulphide gas	
Note: a. corrosion of concrete; b. exposure of steel bar; c. corrosion of steel bar			
<u>Remarks</u>			
1. Structural damage is serious.			
2. Replacement of machinery is necessary because of aging and insufficient capacity.			

Table C. 22 Conditions of the Existing Pumping Station

Name of District: Khormaksar	Year of Construction: 1963	
Name of P/S: G Omer, Al-Mukhtar	Year of Operation: 1964	
<u>Specification of Facility</u>		
Type of P/S: Type 1 (refer to Figure C. 13)		
Inlet Pipe Dia.: 225 mm x 2 Material: ACP	Delivery Pipe Dia.: 175 mm Material: ACP	
Pump Specs. Type of Pump: Centrifugal Dia. (suction): 150 mm, Nos.: 3 (Nos. standby: 1) Total head: H= 18 m Capacity: 1,150 l/min.		
Motor Specs. Power: 7 KW Receiving Voltage: 400/440 V		
Operation Method: Automatic and Manual		
Ancillary Equipment: None		
<u>Operation and Maintenance</u>		
Nos. Operator: 1 Shift: 1		
Operation of Pumps; Operating Time: 24 hrs/day Peak Time: 7:00 - 14:00 Nos. of Pumps in Operation at Peak Flow: 1		
Maintenance of Machinery; Inspection by Demounting: 2/year		
Present Condition of Machinery: Good		
<u>Power Failure</u>		
Frequency of Power Failure: 4 times/year, Duration: 4 hrs.		
Overflow of Sewage from Upstream Manholes: Yes		
<u>Structural Damage</u>		
<u>Location of Damage:</u>	<u>Degree of Damage:</u>	<u>Cause of Damage:</u>
1. Wall of pump room	c.	Hydrogen sulphide gas
2. Wall of pump room	Heavy crack	Salinity in concrete
Note: a. corrosion of concrete; b. exposure of steel bar; c. corrosion of steel bar		
<u>Remarks</u>		
1. Structural damage is serious. 2. Replacement of machinery is necessary because of very old age.		

Table C. 23 Conditions of the Existing Pumping Stations

Name of District: Khormaksar		Year of Construction: 1963	
Name of P/S: H Near Ministry of Education		Year of Operation: 1964	
<u>Specification of Facility</u>			
Type of P/S:	Type 1 (refer to Figure C. 13)		
Inlet Pipe	Dia.: 375 mm Material: ACP	Delivery Pipe	Dia.: 250 mm Material: ACP
Pump Specs.	Type of Pump: Centrifugal Dia. (suction): 150 mm, Nos.: 2 (Nos. standby: 1) Total head: H= 6 m Capacity: 1,773 l/min.		
Motor Specs.	Power: 4 KW	Receiving Voltage: 400/440 V	
Operation Method: Automatic and Manual			
Ancillary Equipment: None			
<u>Operation and Maintenance</u>			
Nos. Operator: - Shift: - Operation checked twice a day			
Operation of Pumps; Operating Time: 24 hrs./day Peak Time: 7:00 - 14:00 Nos. of Pumps in Operation at Peak Flow: 1			
Maintenance of Machinery; Inspection by Demounting: 1-2/year			
Present Condition of Machinery: Good			
<u>Power Failure</u>			
Frequency of Power Failure: 4 times/year, Duration: 4 hrs.			
Overflow of Sewage from Upstream Manholes: Yes			
<u>Structural Damage</u>			
<u>Location of Damage:</u>	<u>Degree of Damage:</u>	<u>Cause of Damage:</u>	
1. Concrete pipe support	No corrosion, but white powder	Hydrogen sulphide gas	
Note: a. corrosion of concrete; b. exposure of steel bar; c. corrosion of steel bar			
<u>Remarks</u>			
1. Building is in good condition. 2. Pumps are very old and capacities are insufficient.			

Table C. 24 Conditions of the Existing Pumping Stations

Name of District: Khormaksar	Year of Construction: 1963
Name of P/S: J October Quarter	Year of Operation: 1964
<u>Specification of Facility</u>	
Type of P/S: Type 2 (refer to Figure C. 14)	
Inlet Pipe Dia.: 375 mm Material: ACP	Delivery Pipe Dia.: 250 mm Material: ACP
Pump Specs. Type of Pump: Centrifugal Dia. (suction): 150 mm, Nos.: 3 (Nos. standby: 2) Total head: H= 8 m Capacity: 2,909 l/min.	
Motor Specs. Power: 10 KW	Receiving Voltage: 400/440 V
Operation Method: Automatic and Manual	
Ancillary Equipment: None	
<u>Operation and Maintenance</u>	
Nos. Operator: 1	Shift: - 6:00 - 14:00
Operation of Pumps; Operating Time: 24 hrs.	Peak Time: 7:00 - 14:00
Nos. of Pumps in Operation at Peak Flow: 1	
Maintenance of Machinery; Inspection by Demounting: 2/year	
Present Condition of Machinery: Good	
<u>Power Failure</u>	
Frequency of Power Failure: 4 times/year, Duration: 4 hrs.	
Overflow of Sewage from Upstream Manholes; Yes	
<u>Structural Damage</u>	
<u>Location of Damage:</u>	<u>Degree of Damage:</u>
No damage	<u>Cause of Damage:</u>
Note: a. corrosion of concrete; b. exposure of steel bar; c. corrosion of steel bar	
<u>Remarks</u>	
1. Building is in good condition. 2. Pumps are very old and capacities are insufficient.	

Table C. 25 Conditions of the Existing Pumping Stations

Name of District: Khormaksar		Year of Construction: 1963	
Name of P/S: L Near Al-Yemda Office		Year of Operation: 1964	
<u>Specification of Facility</u>			
Type of P/S:	Type 3 (refer to Figure C. 15)		
Inlet Pipe	Dia.: 225 mm x 3 Material: CIP	Delivery Pipe	Dia.: 125 mm Material: ACP
Pump Specs.	Type of Pump: Centrifugal Dia. (suction): 100 mm, Nos.: 2 (Nos. standby: 1) Total head: H= 8 m Capacity: 2,909 l/min.		
Motor Specs.	Power: 5 KW	Receiving Voltage: 400/440 V	
Operation Method: Automatic and Manual			
Ancillary Equipment: None			
<u>Operation and Maintenance</u>			
Nos. Operator: None Shift: Occasional check			
Operation of Pumps; Operating Time: 24 hrs./day Peak Time: 7:00 - 14:00 Nos. of Pumps in Operation at Peak Flow: 1			
Maintenance of Machinery; Inspection by Demounting: 1/year			
Present Condition of Machinery: Good			
<u>Power Failure</u>			
Frequency of Power Failure: 4 times/year, Duration: 4 hrs.			
Overflow of Sewage from Upstream Manholes: Adequate capacity for 2 day stopage			
<u>Structural Damage</u>			
<u>Location of Damage:</u>	<u>Degree of Damage:</u>	<u>Cause of Damage:</u>	
No damage			
Note: a. corrosion of concrete; b. exposure of steel bar; c. corrosion of steel bar			
<u>Remarks</u>			
1. Building is in good condition.			
2. Pumps are very old and capacities are insufficient.			

Table C. 26 Conditions of the Existing Pumping Stations

Name of District: Khormaksar		Year of Construction: 1963	
Name of P/S: M Central Market		Year of Operation: 1964	
<u>Specification of Facility</u>			
Type of P/S:	Type 3 (refer to Figure C. 15)		
Inlet Pipe	Dia.: 225 mm Material: ACP	Delivery Pipe	Dia.: 175 mm Material: ACP
Pump Specs.	Type of Pump: Centrifugal Dia. (suction): 150 mm, Total head: H= 8 m	Nos.: 2 (Nos. standby: -) Capacity: 2,909 l/min.	
Motor Specs.	Power: 7 KW	Receiving Voltage: 400/440 V	
Operation Method: Automatic and Manual			
Ancillary Equipment: None			
<u>Operation and Maintenance</u>			
Nos. Operator: 1	Shift: Same person takes care of P/S 408		
Operation of Pumps; Operating Time: 24 hrs./day Peak Time: 7:00 - 14:00 Nos. of Pumps in Operation at Peak Flow: 1			
Maintenance of Machinery; Inspection by Demounting: 2/year			
Present Condition of Machinery: Good			
<u>Power Failure</u>			
Frequency of Power Failure: 4 times/year, Duration: 4 hrs.			
Overflow of Sewage from Upstream Manholes: Yes			
<u>Structural Damage</u>			
<u>Location of Damage:</u> 1. Wall of wet well	<u>Degree of Damage:</u> c.	<u>Cause of Damage:</u> Hydrogen sulphide gas	
Note: a. corrosion of concrete; b. exposure of steel bar; c. corrosion of steel bar			
<u>Remarks</u>			
1. Building is in good condition. 2. Pumps are very old and capacities are insufficient.			

Table C. 27 Conditions of the Existing Pumping Stations

Name of District: Khormaksar		Year of Construction: 1963	
Name of P/S: P Military Area		Year of Operation: 1964	
<u>Specification of Facility</u>			
Type of P/S:	Type 1 (refer to Figure C. 13)		
Inlet Pipe	Dia.: 375 mm Material: ACP	Delivery Pipe	Dia.: 150 mm Material: ACP
Pump Specs.	Type of Pump: Centrifugal Dia. (suction): 150 mm, Nos.: 3 (Nos. standby: 2) Total head: H= 8 m Capacity: 2,909 l/min.		
Motor Specs.	Power: 7 KW Receiving Voltage: 400/440 V		
Operation Method: Automatic and Manual			
Ancillary Equipment: None			
<u>Operation and Maintenance</u>			
Nos. Operator: - Shift: Traveling mechanics checks every day.			
Operation of Pumps; Operating Time: 24 hrs./day Peak Time: 7:00 - 14:00 Nos. of Pumps in Operation at Peak Flow: 1			
Maintenance of Machinery; Inspection by Demounting: 2/year			
Present Condition of Machinery: Bad			
<u>Power Failure</u>			
Frequency of Power Failure: 4 times/year, Duration: 4 hrs.			
Overflow of Sewage from Upstream Manholes: Yes			
<u>Structural Damage</u>			
<u>Location of Damage:</u>	<u>Degree of Damage:</u>	<u>Cause of Damage:</u>	
1. Pump room	c.	Salinity in concrete	
Note: a. corrosion of concrete; b. exposure of steel bar; c. corrosion of steel bar			
<u>Remarks</u>			
1. Spare parts for one pump unit are yet to be supplied.			
2. Structural damage is so serious that rebuilding is required immediately.			
3. Machinery is also to be replaced.			

Table C. 28 Conditions of the Existing Pumping Stations

Name of District: Khormaksar		Year of Construction: 1963	
Name of P/S: A Badr Military area		Year of Operation: 1964	
<u>Specification of Facility</u>			
Type of P/S:	Type 1 (refer to Figure C. 13)		
Inlet Pipe	Dia.: 300 mm Material: ACP	Delivery Pipe	Dia.: 225 mm Material: ACP
Pump Specs.	Type of Pump: Centrifugal, Dia. (suction): 150 mm, Total head: H= 8 m	Nos.: 3 (Nos. standby: 1) Capacity: 2,909 l/min.	
Motor Specs.	Power: 7 KW	Receiving Voltage: 400/440 V	
Operation Method: Automatic and Manual			
Ancillary Equipment: None			
<u>Operation and Maintenance</u>			
Nos. Operator: -	Shift: Operation is checked twice a day,		
Operation of Pumps; Operating Time: 24 hrs./day Peak Time: 7:00 - 14:00 Nos. of Pumps in Operation at Peak Flow: 1			
Maintenance of Machinery; Inspection by Demounting: 2/year			
Present Condition of Machinery: Good			
<u>Power Failure</u>			
Frequency of Power Failure: 4 times/year, Duration: 4 hrs.			
Overflow of Sewage from Upstream Manholes: Yes			
<u>Structural Damage</u>			
Location of Damage:	Degree of Damage:	Cause of Damage:	
1. Wet well	c. Crack	Hydrogen sulphide gas	
2. Inside of inlet manhole	a.	Hydrogen sulphide gas	
3. Manhole cover	Rusted	Wind from sea	
Note: a. corrosion of concrete; b. exposure of steel bar; c. corrosion of steel bar			
<u>Remarks</u>			
1. Spare parts for pumping unit are yet to be supplied.			
2. Rebuilding of house is required.			
3. Machinery is also to be replaced.			

Table C. 29 Conditions of the Existing Pumping Stations

Name of District: Khormaksar		Year of Construction: 1963	
Name of P/S: Ashalam 1 Near Maaskar Badr		Year of Operation: 1964	
<u>Specification of Facility</u>			
Type of P/S:	Extra		
Inlet Pipe	Dia.: 150 mm Material: ACP	Delivery Pipe	Dia.: 100 mm Material: ACP
Pump Specs.	Type of Pump: Centrifugal Dia. (suction): 100 mm, Nos.: 2 (Nos. standby: 1) Total head: H= 16.8 m Capacity: 52 l/min.		
Motor Specs.	Power: 7.5 KW	Receiving Voltage: 400/440 V	
Operation Method: Automatic and Manual			
Ancillary Equipment: None			
<u>Operation and Maintenance</u>			
Nos. Operator:	2	Shift:	- Refer to Dobiwala No. 1
Operation of Pumps; Operating Time: 24 hrs./day Peak Time: 7:00 - 14:00 Nos. of Pumps in Operation at Peak Flow: 1			
Maintenance of Machinery; Inspection by Demounting: 1/year			
Present Condition of Machinery: Good			
<u>Power Failure</u>			
Frequency of Power Failure: 4 times/year, Duration: 4 hrs.			
Overflow of Sewage from Upstream Manholes: Yes			
<u>Structural Damage</u>			
Location of Damage:	Degree of Damage:	Cause of Damage:	
No damage			
Note: a. corrosion of concrete; b. exposure of steel bar; c. corrosion of steel bar			
<u>Remarks</u>			
1. P/S Ashalam 1, Ashalam 2, Ashalam 3 are operated by one person.			
2. One pump is under repair.			
3. Machinery is to be replaced.			

Table C. 30 Conditions of the Existing Pumping Stations

Name of District: Khormaksar		Year of Construction: 1980	
Name of P/S: Ashalam 2 Near the Mosque		Year of Operation: 1981	
<u>Specification of Facility</u>			
Type of P/S:	Extra		
Inlet Pipe	Dia.: 150 mm Material: ACP	Delivery Pipe	Dia.: 100 mm Material: ACP
Pump Specs.	Type of Pump: Centrifugal (Horizontal) Dia. (suction): 100 mm, Nos.: 2 (Nos. standby: 1) Total head: H= 56 m Capacity: 136 l/min.		
Motor Specs.	Power: 11 KW	Receiving Voltage: 400/440 V	
Operation Method: Automatic and Manual			
Ancillary Equipment: None			
<u>Operation and Maintenance</u>			
Nos. Operator: 2	Shift: Two operators take care of P/S 412 and 414		
Operation of Pumps; Operating Time: 24 hrs./day Peak Time: 7:30 - 15:10 Nos. of Pumps in Operation at Peak Flow: 1			
Maintenance of Machinery; Inspection by Demounting: 2/year			
Present Condition of Machinery: Not bad			
<u>Power Failure</u>			
Frequency of Power Failure: 4 times/year, Duration: 4 hrs.			
Overflow of Sewage from Upstream Manholes: Yes			
<u>Structural Damage</u>			
<u>Location of Damage:</u>	<u>Degree of Damage:</u>	<u>Cause of Damage:</u>	
No damage			
Note: a. corrosion of concrete; b. exposure of steel bar; c. corrosion of steel bar			
<u>Remarks</u>			
1. P/S Ashalam 1, 2 and 3 are operated by same operators.			
2. One pump is under repair.			
3. Pumps are very old and capacities are insufficient, to be replaced.			

Table C. 31 Conditions of the Existing Pumping Stations

Name of District: Khormaksar		Year of Construction: 1963	
Name of P/S: Ashalam 3 Near Shopping Area		Year of Operation: 1964	
<u>Specification of Facility</u>			
Type of P/S:	Extra		
Inlet Pipe	Dia.: 150 mm Material: ACP	Delivery Pipe	Dia.: N.A.mm Material: ACP
Pump Specs.	Type of Pump: Centrifugal		
	Dia. (suction): 100 mm,	Nos.: 2	(Nos. standby: 1)
	Total head: H= 16.8 m	Capacity:	52 l/min.
Motor Specs.	Power: 7.5 KW	Receiving Voltage: 400/440 V	
Operation Method: Automatic and Manual			
Ancillary Equipment: None			
<u>Operation and Maintenance</u>			
Nos. Operator:	2 Shift: Two operators take care of P/S 412 and 413		
Operation of Pumps; Operating Time: 24 hrs./day Peak Time: 7:00 - 14:00			
Nos. of Pumps in Operation at Peak Flow: 1			
Maintenance of Machinery; Inspection by Demounting: 1/year			
Present Condition of Machinery: Good			
<u>Power Failure</u>			
Frequency of Power Failure: 4 times/year, Duration: 4 hrs.			
Overflow of Sewage from Upstream Manholes: Yes			
<u>Structural Damage</u>			
<u>Location of Damage:</u>	<u>Degree of Damage:</u>	<u>Cause of Damage:</u>	
Repaired			
Note: a. corrosion of concrete; b. exposure of steel bar; c. corrosion of steel bar			
<u>Remarks</u>			
1. P/S Ashalam 1, 2 and 3 are operated by same operators.			
2. One pump is under repair.			
3. Damaged structure of the floor was repaired and modified into wood structure.			
4. Building is old, rebuilding is necessary.			
5. Pumps are also old, to be replaced.			

Table C. 32 Conditions of the Existing Pumping Stations

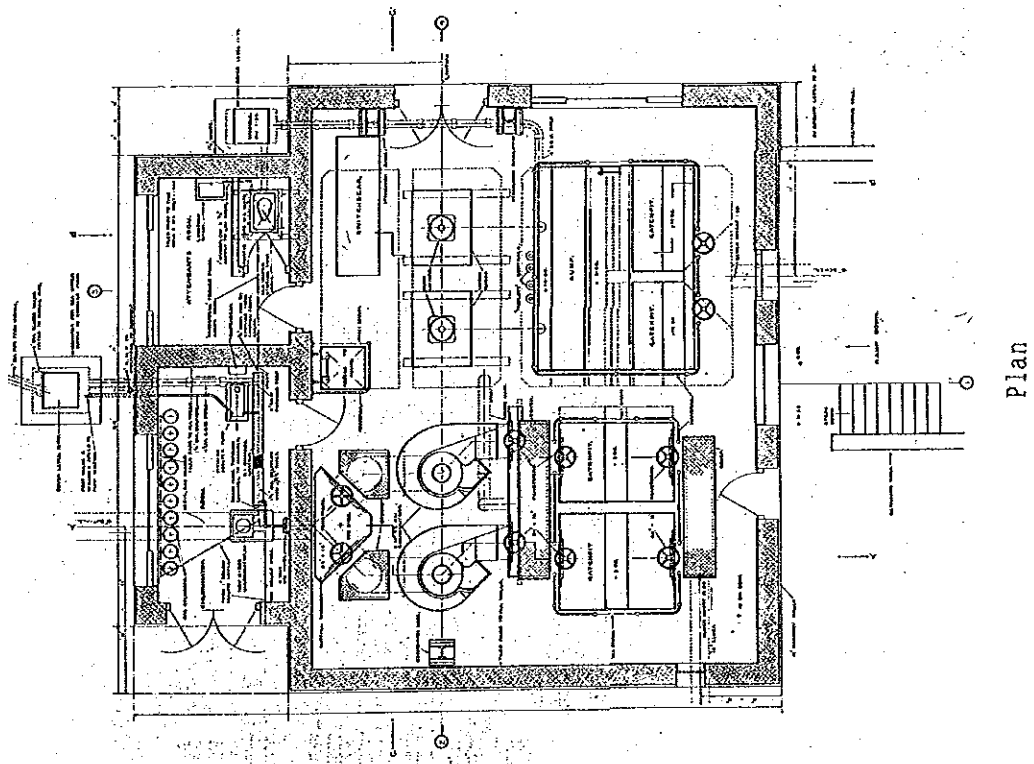
Name of District: Khormaksar	Year of Construction: 1963
Name of P/S: Comminutor	Year of Operation: 1964
<u>Specification of Facility</u>	
Type of P/S: Extra	
Inlet Pipe Dia.: 75 mm Material: ACP	Delivery Pipe Dia.: 80 mm Material: ACP
Pump Specs. Type of Pump: Centrifugal (Horizontal) Dia. (suction): 80 mm, Nos.: 2 (Nos. standby: 1) Total head: H= 7 m Capacity: 796 l/min.	
Motor Specs. Power: 2 KW	Receiving Voltage: 400/440 V
Operation Method: Automatic and Manual	
Ancillary Equipment: None	
<u>Operation and Maintenance</u>	
Nos. Operator: - Shift: Traveling mechanics check every day.	
Operation of Pumps; Operating Time: 7:00 - 14:00 Peak Time: 7:00 - 14:00 Nos. of Pumps in Operation at Peak Flow:	
Maintenance of Machinery; Inspection by Demounting: 1/year	
Present Condition of Machinery: Good	
<u>Power Failure</u>	
Frequency of Power Failure: 4 times/year, Duration: 4 hrs.	
Overflow of Sewage from Upstream Manholes: Yes	
<u>Structural Damage</u>	
<u>Location of Damage:</u>	<u>Degree of Damage:</u>
<u>Cause of Damage:</u>	
No damage	
Note: a. corrosion of concrete; b. exposure of steel bar; c. corrosion of steel bar	
<u>Remarks</u>	
1. This P/S is located in the same site of Comminuter Station.	
2. Rebuilding of house is required.	
3. Machinery is also to be replaced.	

Table C. 33 Conditions of the Existing Pumping Stations

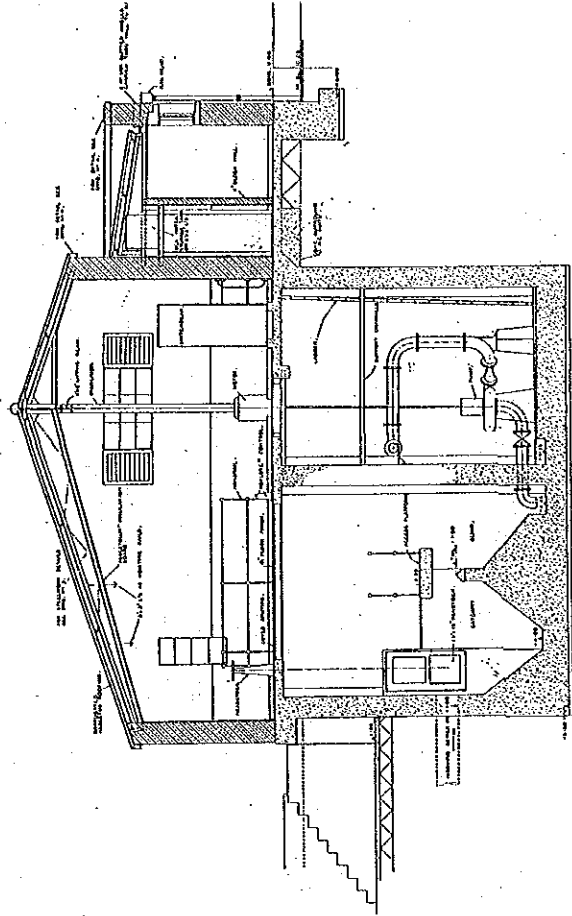
Name of District: Khormaksar		Year of Construction: 1963	
Name of P/S: Tarek Military area		Year of Operation: 1964	
<u>Specification of Facility</u>			
Type of P/S:	Extra		
Inlet Pipe	Dia.: 450 mm Material: ACP	Delivery Pipe	Dia.: 80 mm Material: ACP
Pump Specs.	Type of Pump: Centrifugal, (Horizontal)		
	Dia. (suction): 80 mm,	Nos.: 1	(Nos. standby: -)
	Total head: H= 7 m	Capacity:	796 l/min.
Motor Specs.	Power: 2 KW	Receiving Voltage: 400/440 V	
Operation Method: Automatic and Manual			
Ancillary Equipment: None			
<u>Operation and Maintenance</u>			
Nos. Operator: -	Shift: Traveling mechanics check every day		
Operation of Pumps; Operating Time: 7:00 - 14:00 Peak Time: 7:00 - 14:00			
Nos. of Pumps in Operation at Peak Flow: 1			
Maintenance of Machinery; Inspection by Demounting: 1/year			
Present Condition of Machinery: Good			
<u>Power Failure</u>			
Frequency of Power Failure: 4 times/year, Duration: 4 hrs.			
Overflow of Sewage from Upstream Manholes: Yes			
<u>Structural Damage</u>			
<u>Location of Damage:</u>	<u>Degree of Damage:</u>	<u>Cause of Damage:</u>	
No inspection			
Note: a. corrosion of concrete; b. exposure of steel bar; c. corrosion of steel bar			
<u>Remarks</u>			
1. Permission could not be obtained to go inside the P/S.			
2. Submersible pumps were installed before.			
3. Building is in good condition.			

Table C. 34 Conditions of the Existing Pumping Stations

Name of District: Khormaksar		Year of Construction: 1967	
Name of P/S: Milk Factory Military area		Year of Operation: 1968	
<u>Specification of Facility</u>			
Type of P/S:	Type 3 (refer to Figure C. 113)		
Inlet Pipe	Dia.: 100 mm Material: ACP	Delivery Pipe	Dia.: 150 mm Material: ACP
Pump Specs.	Type of Pump: Centrifugal Dia. (suction): 100 mm, Total head: H= 16.8 m	Nos.: 2 Capacity: 52 l/min.	(Nos. standby: 1)
Motor Specs.	Power: 7.5 KW	Receiving Voltage: 400/440 V	
Operation Method: Automatic and Manual			
Ancillary Equipment: None			
<u>Operation and Maintenance</u>			
Nos. Operator: - Shift: Traveling mechanics check every day.			
Operation of Pumps; Operating Time: 24 hrs./day Peak Time: 7:00 - 14:00 Nos. of Pumps in Operation at Peak Flow: 1			
Maintenance of Machinery; Inspection by Demounting: 2/year			
Present Condition of Machinery: Good			
<u>Power Failure</u>			
Frequency of Power Failure: 4 times/year, Duration: 4 hrs.			
Overflow of Sewage from Upstream Manholes: Yes			
<u>Structural Damage</u>			
Location of Damage:	Degree of Damage:	Cause of Damage:	
1. Roof	Crack	Wind from sea	
Note: a. corrosion of concrete; b. exposure of steel bar; c. corrosion of steel bar			
<u>Remarks</u>			
1. Strength of concrete structure by Schmidt concrete test hammer, 300-500 kg/cm ² .			
2. Building is old, rebuilding is necessary.			
3. Pumps are also old, to be replaced.			



Plan



Section

Figure C. 7 Structure of Chlorinator Station

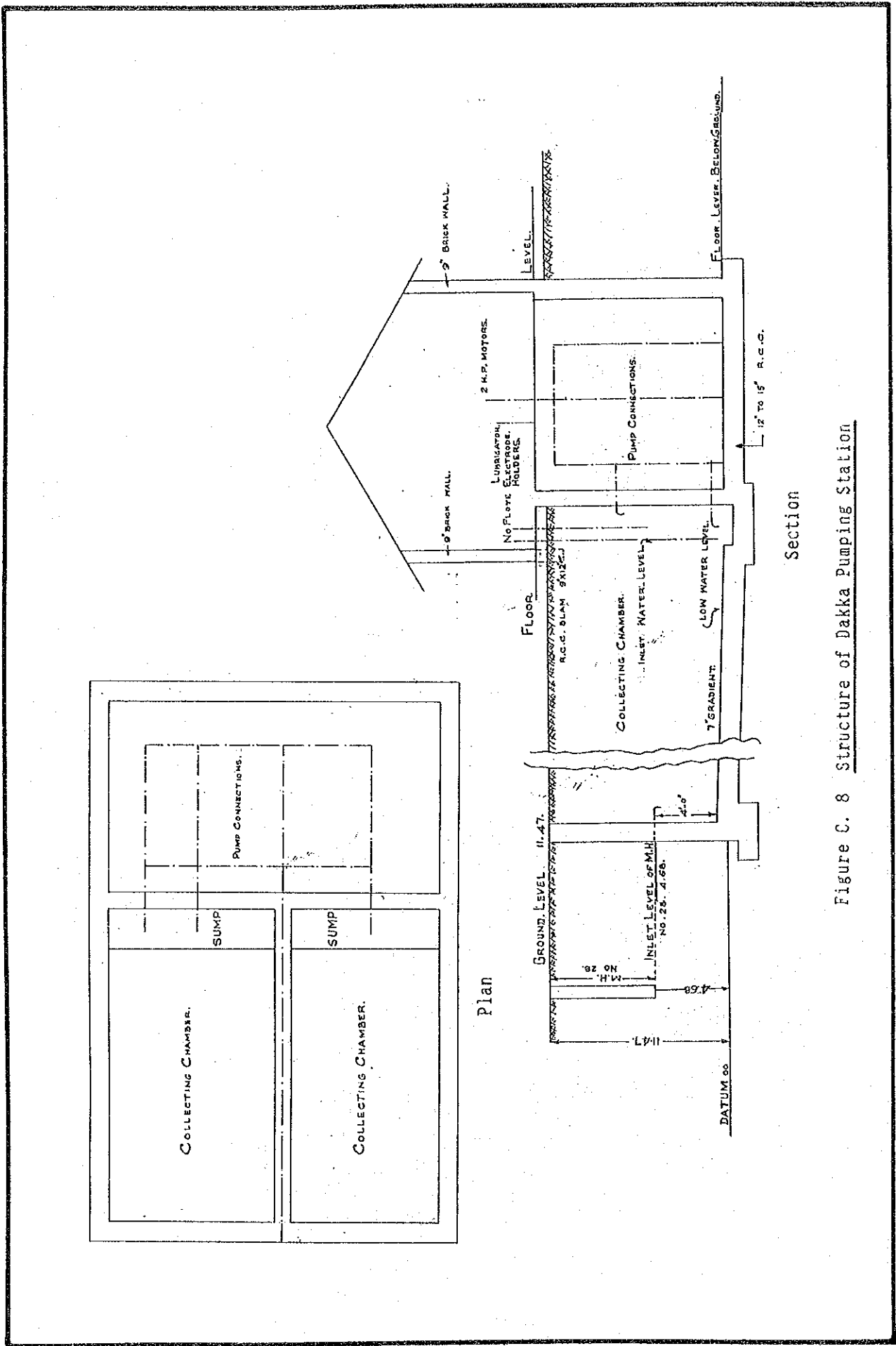
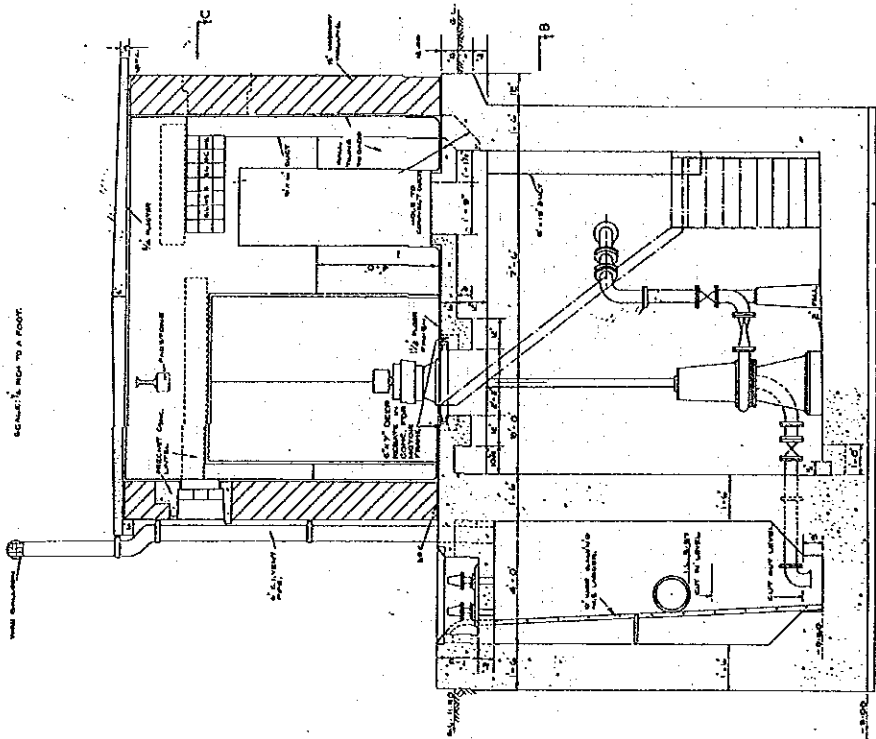
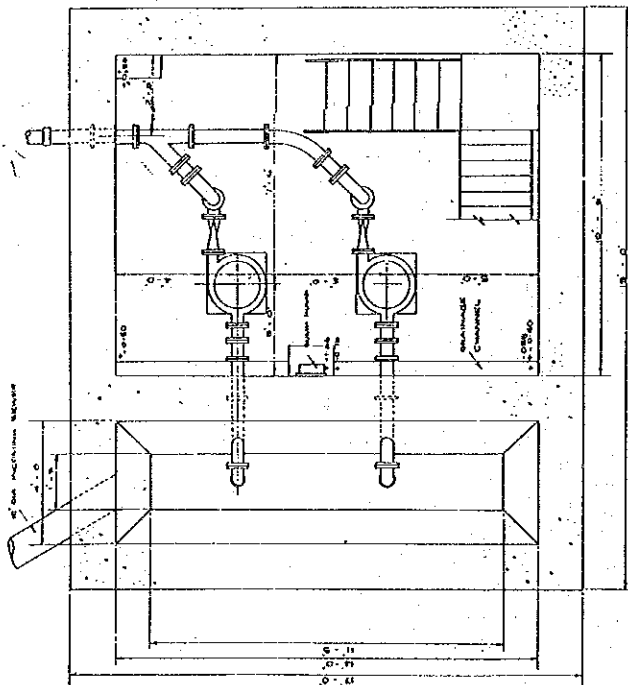


Figure C. 8 Structure of Dakka Pumping Station



Section



Plan

Figure C. 12 Structure of Front Bay Pumping Station

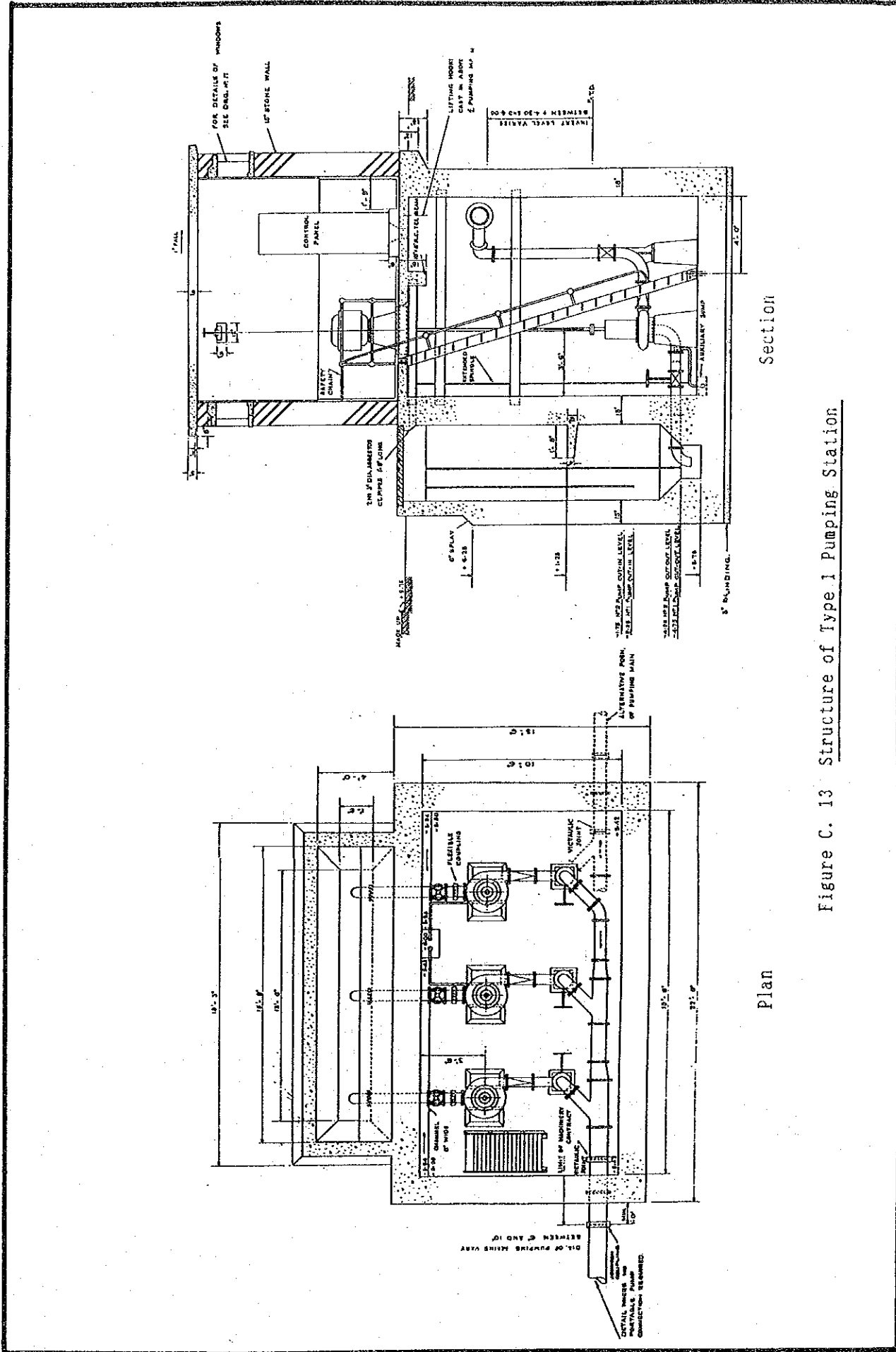
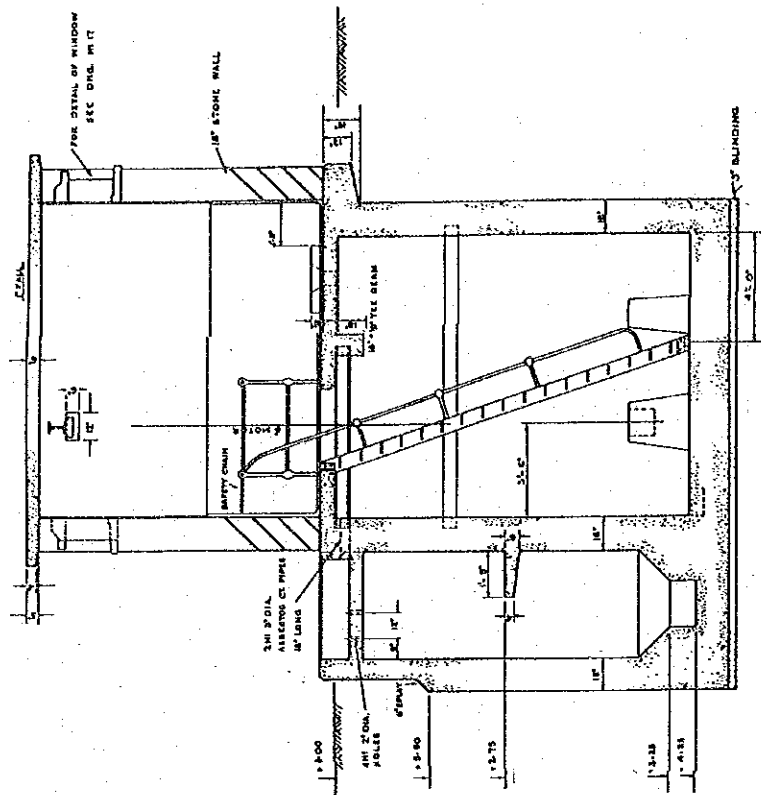


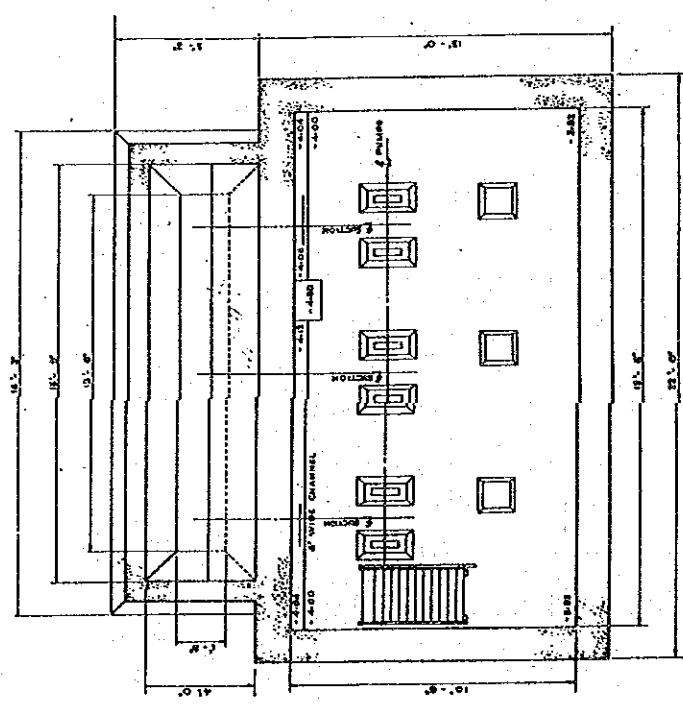
Figure C. 13 Structure of Type 1 Pumping Station

Section

Plan

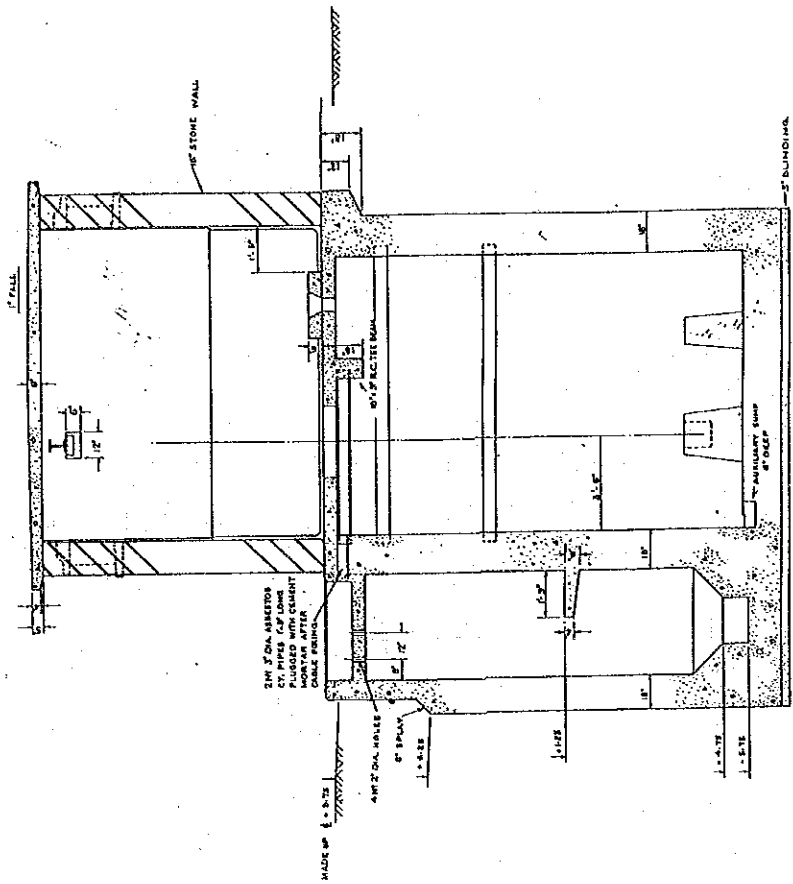


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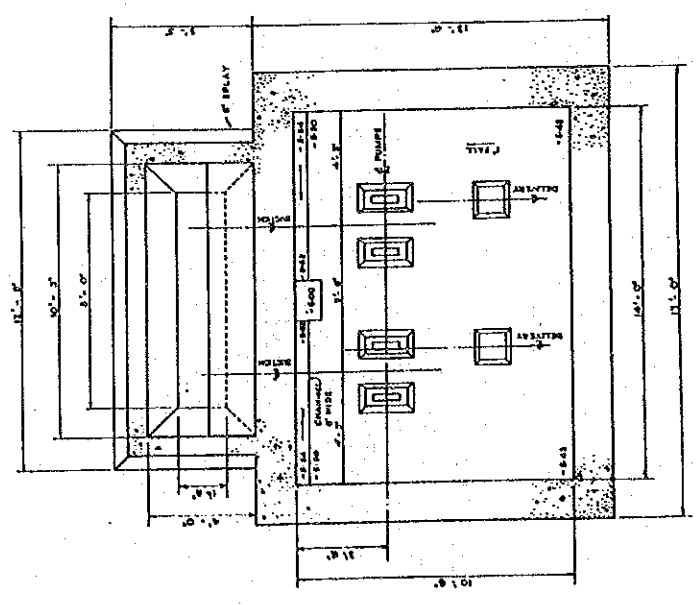


Plan

Figure C. 14 Structure of Type 2 Pumping Station



Section



Plan

Figure C. 15 Structure of Type 3 Pumping Station

Table C. 35 Conditions of the Existing Comminutor Station

Name of District: Khormaksar	Year of Construction: 1963	
Name of Station: Comminuter Station	Year of Operation: 1964	
<u>Specification of Facility</u>		
Type of P/S: Comminutor House (refer to Figure C. 17)		
Inlet Pipe Dia.: 225,300,175 mm	Delivery Pipe Dia.: 600 mm	
Material: ACP	Material: ACP	
Facilities Specs. No. of Comminutors: 2 x 25RM		
Motor Specs. Power: 2 KW Receiving Voltage: None		
Operation Method: None		
Ancillary Equipment: None		
<u>Operation and Maintenance</u>		
Nos. Operator: - Shift: -		
Operation of Pumps; Operating Time: - Peak Time: -		
Maintenance of Machinery; -		
Present Condition of Machinery: Entirely broken		
<u>Power Failure</u>		
Frequency of Power Failure: times/year, Duration: hrs.		
Overflow of Sewage from Upstream Manholes:		
<u>Structural Damage</u>		
<u>Location of Damage:</u>	<u>Degree of Damage:</u>	<u>Cause of Damage:</u>
1. Ceiling of the building	c.	Hydrogen sulphide gas
2. Wall of the building	a.	Hydrogen sulphide gas
Note: a. corrosion of concrete; b. exposure of steel bar; c. corrosion of steel bar		
<u>Remarks</u>		
1. P/S Comminuter Station is located in the same place.		
2. All sewages from Khormaksar district are pumped to this comminutor house for the disposal by an ocean outfall.		
3. Structural damage caused by hydrogen sulphide is very serious, and structures seem to be at the end of useful time of life.		

Table C. 36 List of Outfalls

District	No. *1	Location	Dia (mm)	Length (m)	Material	Support *2	Condition
Ma'alla	OF1	Hedjiuff	457	325	ACP	C.C	Half of length is broken and clogged.
Tawahi	OF1 OF2 OF3 OF4 OF5	Recreation Ground Clock Tower Nashwan Crescent Hotel Ras Tarshyne	150 150 225 225 150X2	150 10 30 10	VCP CIP VCP VCP CIP	C.C C.C C.C C.C C.S	Ending part 50m are damaged. Broken and clogged Good Good Corroded and broken, out of order, repair is necessary.
Crater	OF1 OF2	Front Bay Holkat Bay	375 450	350< 1,800	CIP CIP	C.C C.S	Broken, it is not used any more. Corroded out side by sea wind
Khornaksar	OF1	Comminuter Station	600	738	ACP, CIP	C.S	

Note : *1 No. of outfalls refer to Figures C.1 to C.4

*2 C.C ; Concrete Cover
C.S ; Concrete Support

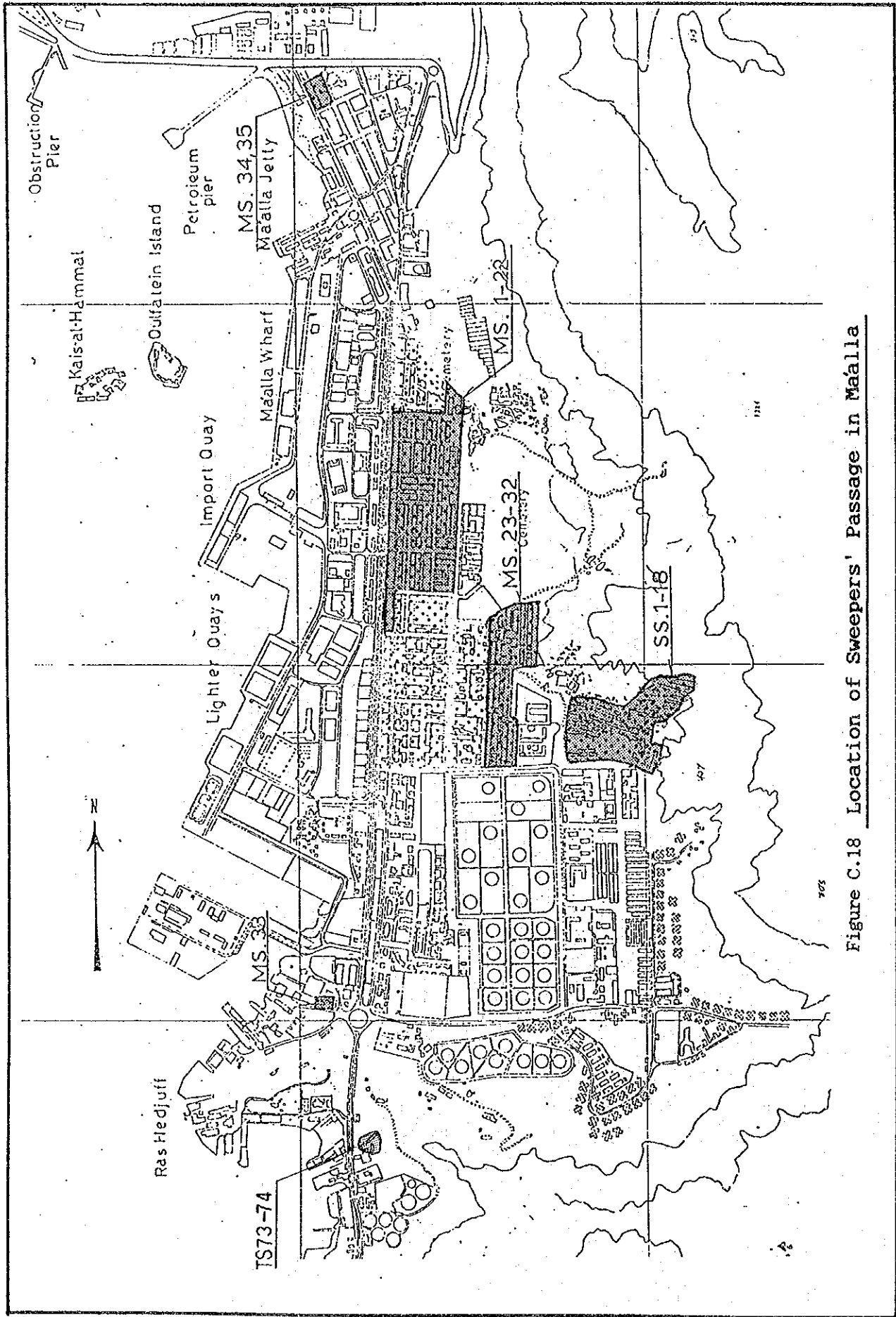


Figure C.18 Location of Sweepers' Passage in Maalla

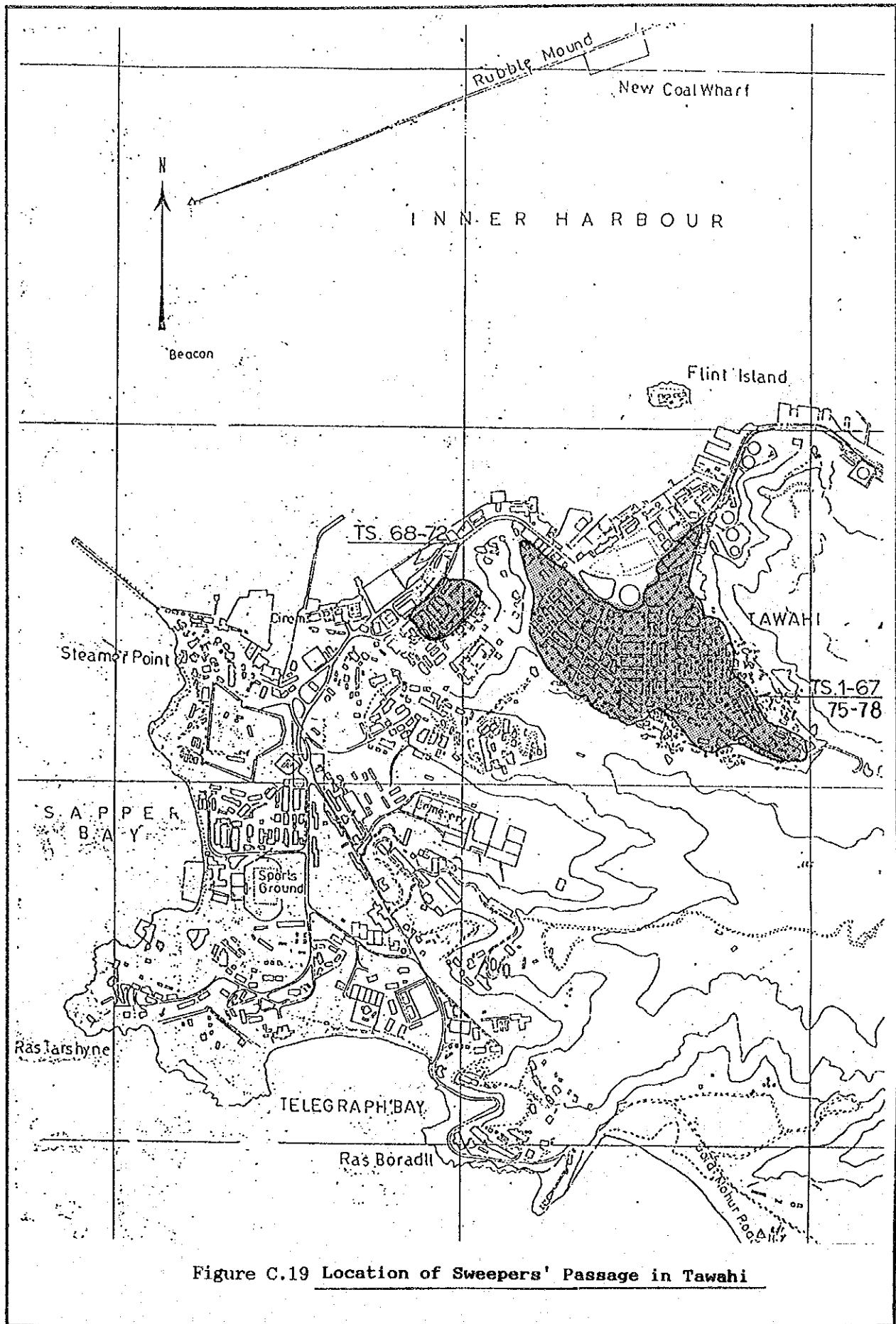


Figure C.19 Location of Sweepers' Passage in Tawahi

Table C.37 Sweepers' Passage
- Ma'alla District -

No.	Name of Area	Length (m)	Nos. of Bucket System	Nos. of Outlet Pipe	Nos. of Inspection Pit	Notes
MS 1	Old Ma'alla	92	0	66	11	*2
MS 2	Old Ma'alla	85	5	62	21	*2
MS 3	Old Ma'alla	47	5	17	0	*1 lateral pipe only
MS 4	Old Ma'alla	89	4	32	18	*2
MS 5	Old Ma'alla	24	1	14	11	*2
MS 6	Old Ma'alla	40	2	16	27	*2
MS 7	Old Ma'alla	23	2	12	12	*2
MS 8	Old Ma'alla	58	2	12	11	*2
MS 9	Old Ma'alla	41	1	9	0	*1 lateral pipe only
MS 10	Old Ma'alla	62	12	27	14	*2
MS 11	Old Ma'alla	23	3	10	1	*2
MS 12	Old Ma'alla	50	8	-	-	Locked
MS 13	Old Ma'alla	34	10	-	-	Locked
MS 14	Old Ma'alla	18	3	3	2	*2
MS 15	Old Ma'alla	43	2	7	4	*2
MS 16	Old Ma'alla	59	2	4	15	*2
MS 17	Old Ma'alla	46	5	30	13	*2
MS 18	Old Ma'alla	41	0	-	-	Locked
MS 19	Old Ma'alla	65	9	30	16	*2
MS 20	Old Ma'alla	44	0	28	9	*2
MS 21	Old Ma'alla	13	2	13	3	*2
MS 22	Old Ma'alla	40	10	19	0	*1
Sub-total		1037	88	411	188	
MS 23	Flour Mill	92	4	50	34	*2
MS 24	Flour Mill	116	5	109	35	*2
MS 25	Flour Mill	89	3	80	20	*2
MS 26	Flour Mill	58	0	57	19	*2
MS 27	Flour Mill	101	24	31	0	*1
MS 28	Flour Mill	10	2	6	9	*2
MS 29	Flour Mill	142	16	35	36	*2
MS 30	Flour Mill	9	1	13	11	*2
MS 31	Flour Mill	40	3	-	-	Improved
MS 32	Flour Mill	28	0	15	11	*2
Sub-total		685	58	396	175	
MS 33	PCEP	50	1	6	6	*2 lateral pipe only
Sub-total		50	1	6	6	
MS 34	Dakka	26	5	7	3	*2 lateral pipe only
MS 35	Dakka	28	0	2	6	*1 lateral pipe only
Sub-total		54	5	9	9	
SS 1	Sheik Asshag	38	3	7	13	*1
SS 2	Sheik Asshag	41	5	19	0	*1
SS 3	Sheik Asshag	38	4	21	7	*2
SS 4	Sheik Asshag	38	2	17	4	*2
SS 5	Sheik Asshag	43	-	17	0	*1
SS 6	Sheik Asshag	48	6	14	7	*1
SS 7	Sheik Asshag	31	7	11	4	*1
SS 8	Sheik Asshag	77	7	33	3	*1
SS 9	Sheik Asshag	72	12	21	1	*1 lateral pipe only
SS 10	Sheik Asshag	76	15	17	1	*1
SS 11	Sheik Asshag	57	7	15	2	*1
SS 12	Sheik Asshag	60	16	28	0	*1
SS 13	Sheik Asshag	67	10	22	0	*1
SS 14	Sheik Asshag	11	10	7	0	*1
SS 15	Sheik Asshag	30	17	11	0	*1
SS 16	Sheik Asshag	22	-	11	4	*1
SS 17	Sheik Asshag	63	7	28	4	*1
SS 18	Sheik Asshag	66	5	19	0	*1
Sub-total		878	133	318	50	
Total		2704	285	1140	428	
Average		51	6	24	9	

Notes *1 : Drain type is open channel system.

*2 : Drain type is combined both open channel and embeded pipe.

Table C.38 Sweepers' Passage
- Tawahi District -

No.	Name of Area	Length (m)	Nos. of Bucket System	Nos. of Outlet Pipe	Nos. of Inspection Pit	Notes
TS 1	Cunning Market	120	0	75	12	*2
TS 2	Cunning Market	50	0	18	2	*1
TS 3	Cunning Market	42	1	13	0	*1
TS 4	Cunning Market	3	1	1	0	*1 vertical pipe only
TS 5	Cunning Market	46	2	17	5	*1 vertical pipe only
TS 6	Cunning Market	46	4	16	11	*2
TS 7	Cunning Market	16	7	11	3	*1
TS 8	Cunning Market	44	10	9	5	*1 vertical pipe only
TS 9	Cunning Market	44	0	23	11	*2
TS 10	Cunning Market	44	9	35	9	*1
TS 11	Cunning Market	54	5	19	11	*2
TS 12	Cunning Market	73	8	11	0	*1
TS 13	Cunning Market	35	13	24	0	*1
TS 14	Cunning Market	26	7	14	0	*1 vertical pipe only
TS 15	Cunning Market	8	5	4	0	*1
TS 16	Cunning Market	24	3	5	3	*2
TS 17	Cunning Market	18	8	14	4	*1
TS 18	Cunning Market	48	8	15	1	*2
TS 19	Cunning Market	11	0	10	3	*1 vertical pipe only
TS 20	Cunning Market	19	0	-	-	Improved
TS 21	Cunning Market	20	4	12	2	*1 vertical pipe only
TS 22	Cunning Market	12	0	2	0	*1
TS 23	Cunning Market	12	0	7	3	*2
TS 24	Cunning Market	12	0	-	-	Abandoned
TS 25	Cunning Market	42	0	22	7	*2
TS 26	Cunning Market	44	8	16	4	*2
TS 27	Cunning Market	22	2	8	3	*1 vertical pipe only
TS 28	Cunning Market	6	0	-	-	Improved
TS 29	Cunning Market	32	2	13	2	*1
TS 30	Cunning Market	34	4	15	0	*1
TS 31	Cunning Market	46	0	-	-	Improved
TS 32	Cunning Market	43	4	19	0	*1
TS 33	Cunning Market	32	9	18	2	*1
TS 34	Cunning Market	36	10	-	-	Locked
TS 35	Cunning Market	8	2	7	3	*1 vertical pipe only
TS 36	Cunning Market	45	3	31	7	*2 107ppm
TS 37	Cunning Market	45	1	5	2	*2 Improved partially
TS 38	Cunning Market	45	0	-	-	Improved
TS 39	Cunning Market	33	0	-	-	Improved
TS 40	Cunning Market	9	1	-	-	Locked
TS 41	Cunning Market	33	4	14	3	*2
TS 42	Cunning Market	12	3	10	0	*1
TS 43	Cunning Market	18	0	-	-	Improved
TS 44	Cunning Market	29	1	-	-	Locked
TS 45	Cunning Market	51	5	16	0	*1
TS 46	Cunning Market	34	6	8	1	*1
TS 47	Cunning Market	19	0	13	1	*1
TS 48	Cunning Market	19	2	12	1	*2
TS 49	Cunning Market	34	4	14	0	*1
TS 50	Cunning Market	18	1	12	0	*1
TS 51	Cunning Market	46	0	11	13	*1
TS 52	Cunning Market	46	0	-	-	Improved
TS 53	Cunning Market	46	1	7	3	*1 lateral pipe only
TS 54	Cunning Market	36	12	0	0	*1 direct discharge
TS 55	Cunning Market	36	12	8	0	*1
TS 56	Cunning Market	36	11	4	0	*1
TS 57	Cunning Market	36	11	1	0	*1
TS 58	Cunning Market	20	6	11	8	*1 vertical pipe only
TS 59	Cunning Market	9	0	5	2	*2
TS 60	Cunning Market	44	10	10	2	*1 lateral pipe only

No.	Name of Area	Length (m)	Nos. of Bucket System	Nos. of Outlet Pipe	Nos. of Inspection Pit	Notes
TS 61	Cunning Market	44	8	14	5	*1 lateral pipe only
TS 62	Cunning Market	24	1	9	4	*2
TS 63	Cunning Market	8	0	4	0	*1
TS 64	Cunning Market	19	3	11	4	*1
TS 65	Cunning Market	40	5	16	7	*2
TS 66	Cunning Market	6	2	5	0	*1 vertical pipe only
TS 67	Cunning Market	26	5	12	6	*2 vertical pipe only
TS 75	Cunning Market	86	0	9	10	*2
TS 76	Cunning Market	20	0	-	-	Improved
TS 77	Cunning Market	21	0	12	0	*1
TS 78	Cunning Market	15	3	6	3	*2
Sub-total		2280	257	763	188	
TS 68	Bingisa	36	0	11	0	*1
TS 69	Bingisa	36	0	5	4	*2
TS 70	Bingisa	36	0	3	0	*1
TS 71	Bingisa	36	0	7	0	*1 lateral pipe only
TS 72	Bingisa	18	0	12	0	*1 lateral pipe only
Sub-total		162	0	38	4	
TS 73	Hedjuff	24	0	3	0	*1 lateral pipe only
TS 74	Hedjuff	45	0	7	0	*1 lateral pipe only
Sub-total		69	0	10	0	
Total		2511	257	811	192	
Average		32	4	13	3	

Notes *1 : Drain type is open channel system.

*2 : Drain type is combined both open channel and embeded pipe.

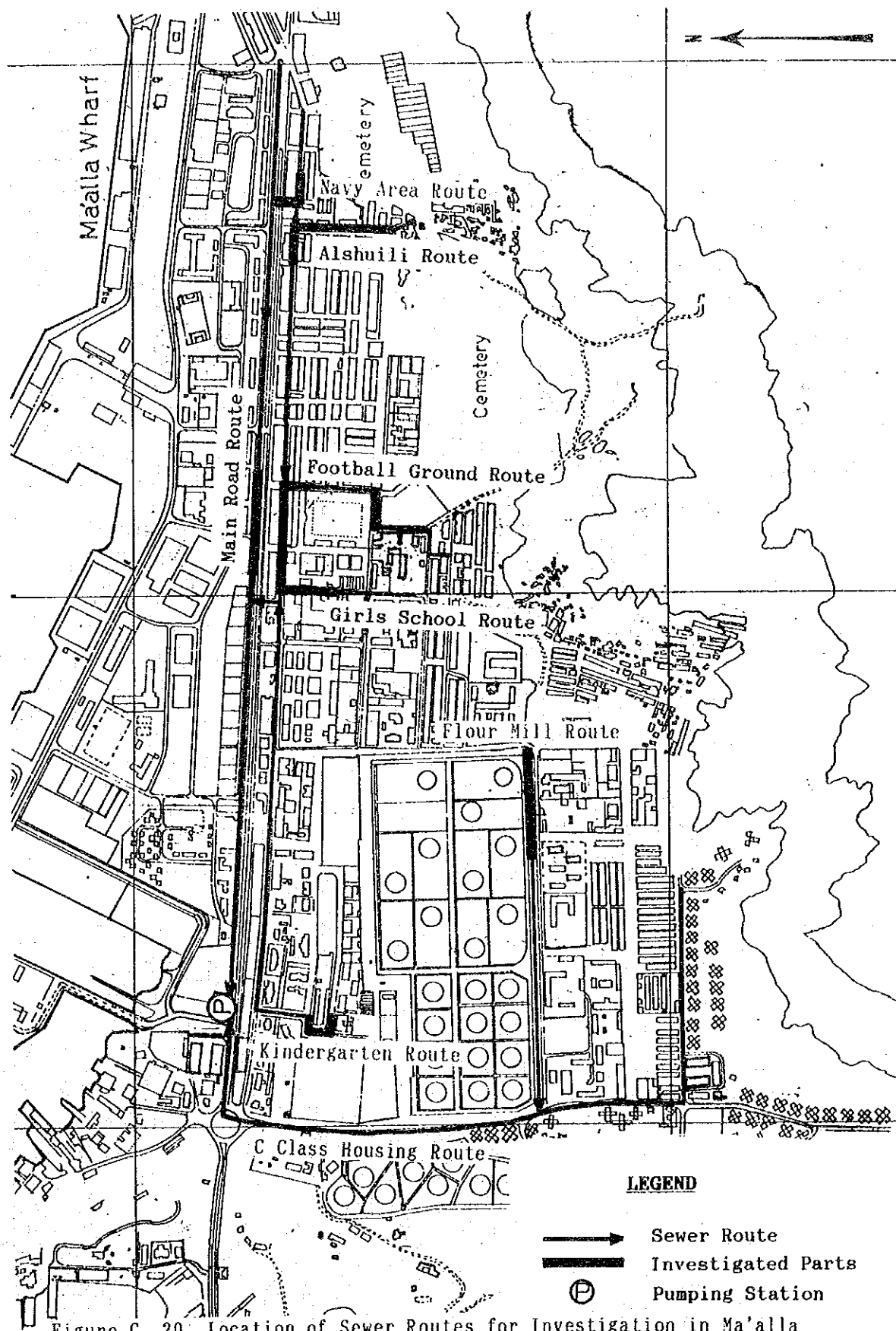
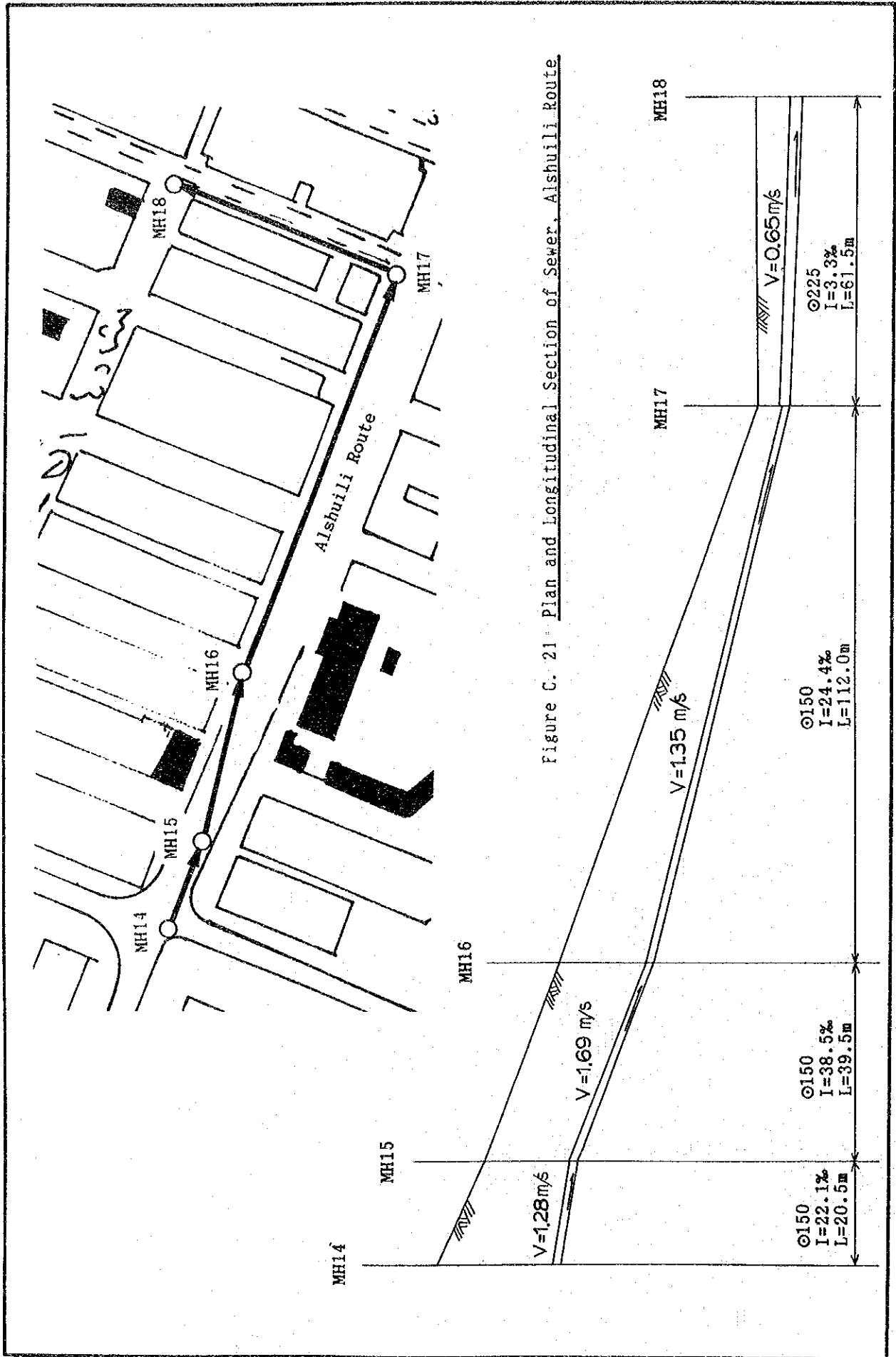


Figure C. 20 Location of Sewer Routes for Investigation in Ma'alla



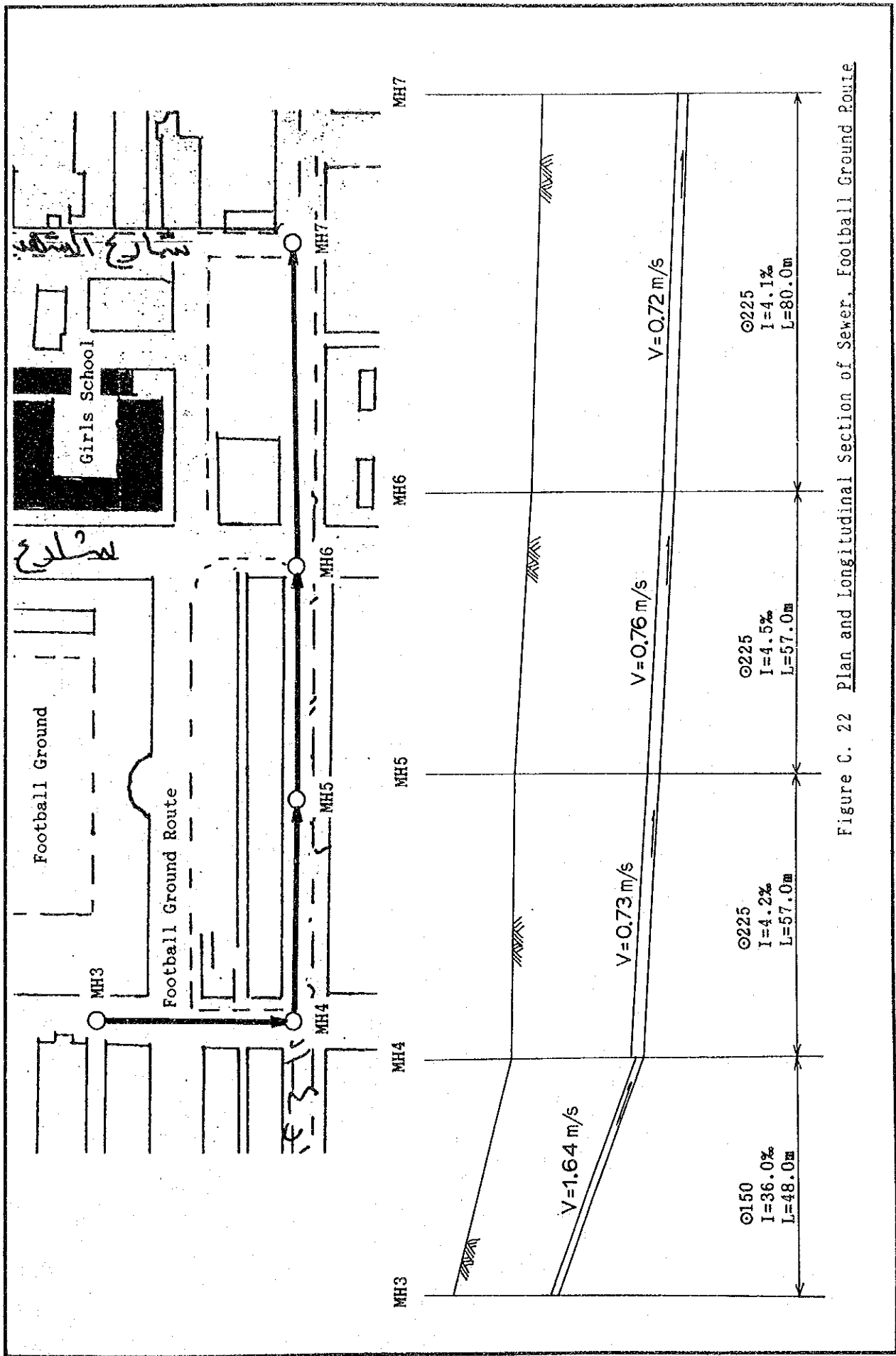


Figure C. 22 Plan and Longitudinal Section of Sewer, Football Ground Route

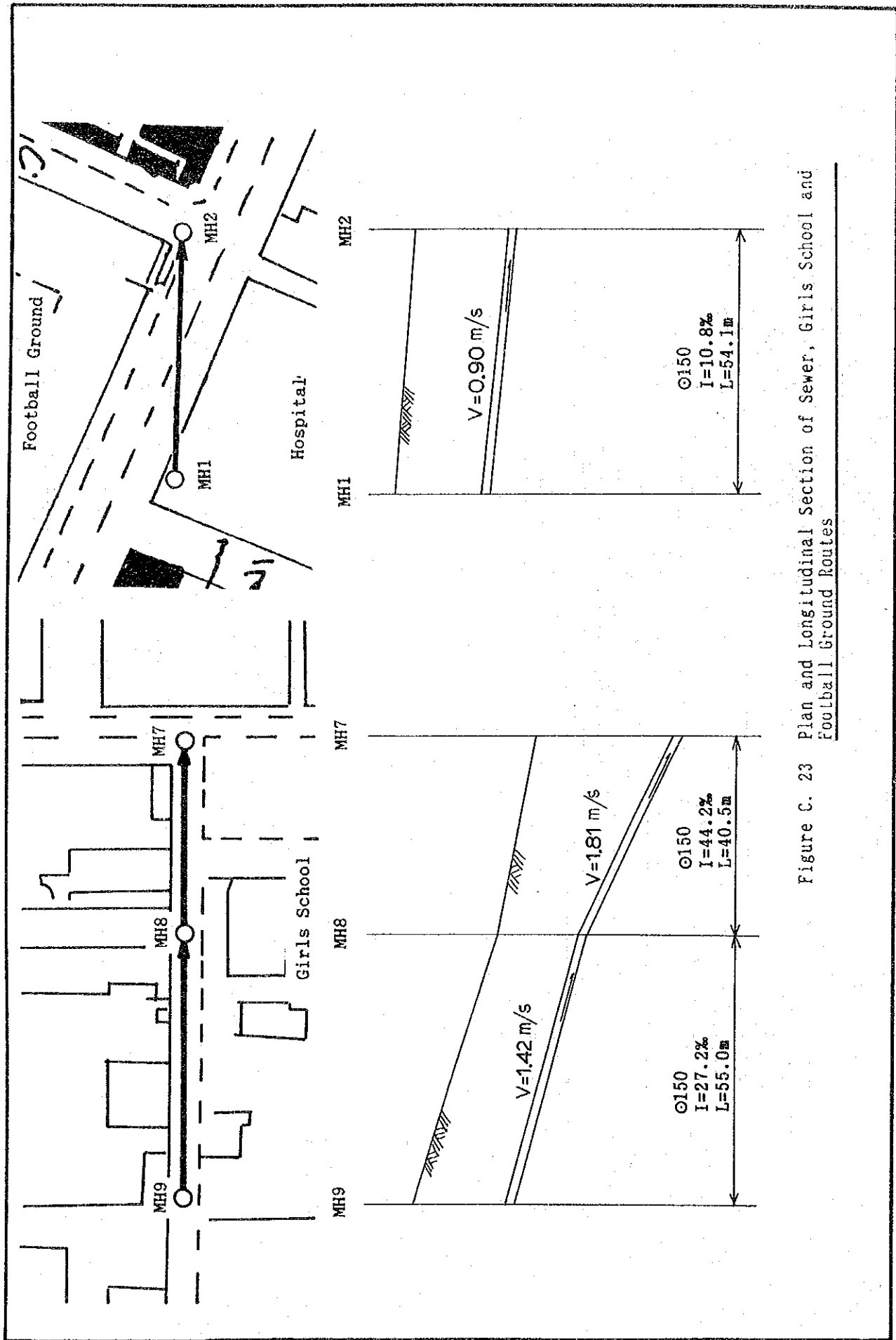


Figure C. 23 Plan and Longitudinal Section of Sewer, Girls School and Football Ground Routes

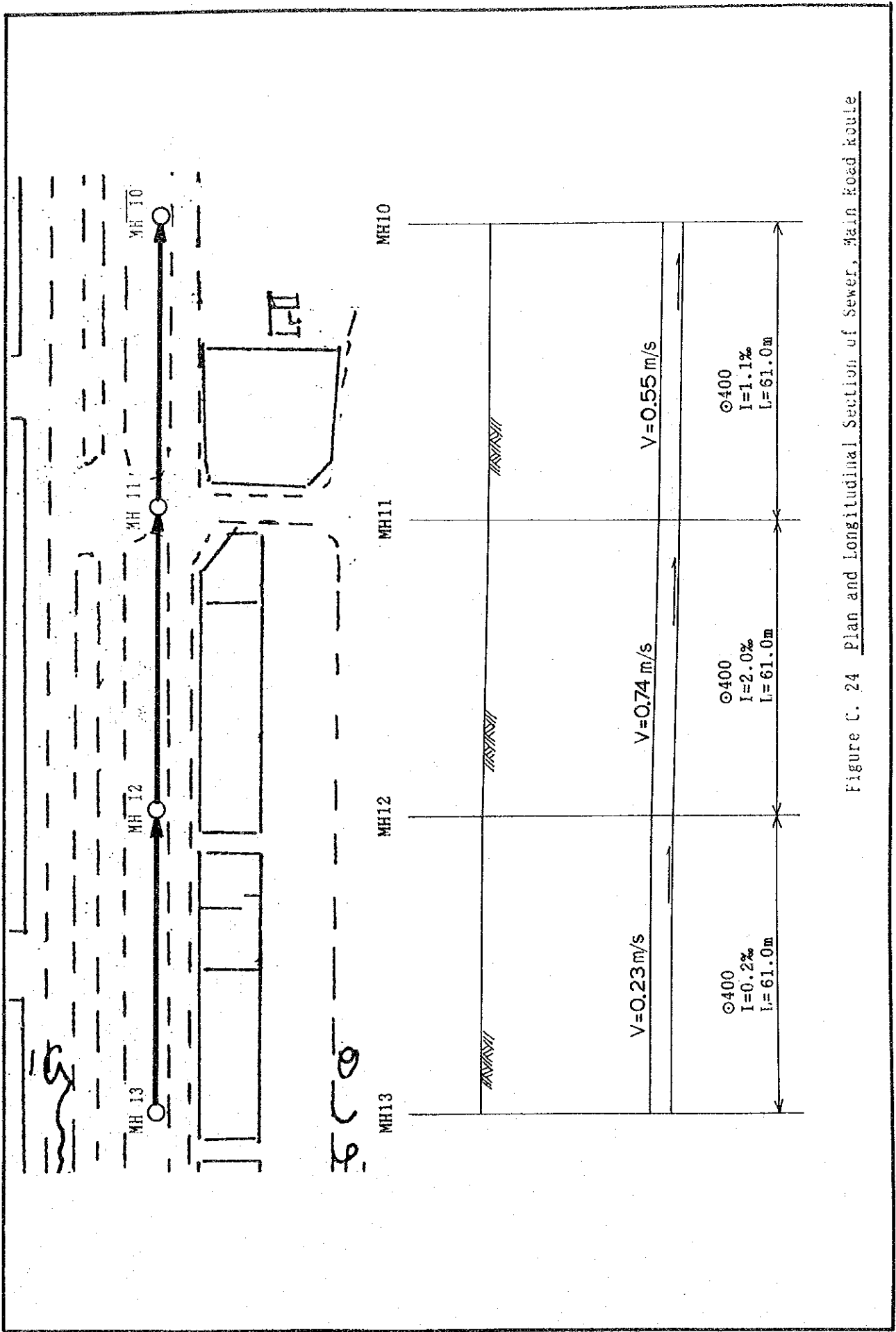


Figure C. 24 Plan and Longitudinal Section of Sewer, Main road koule

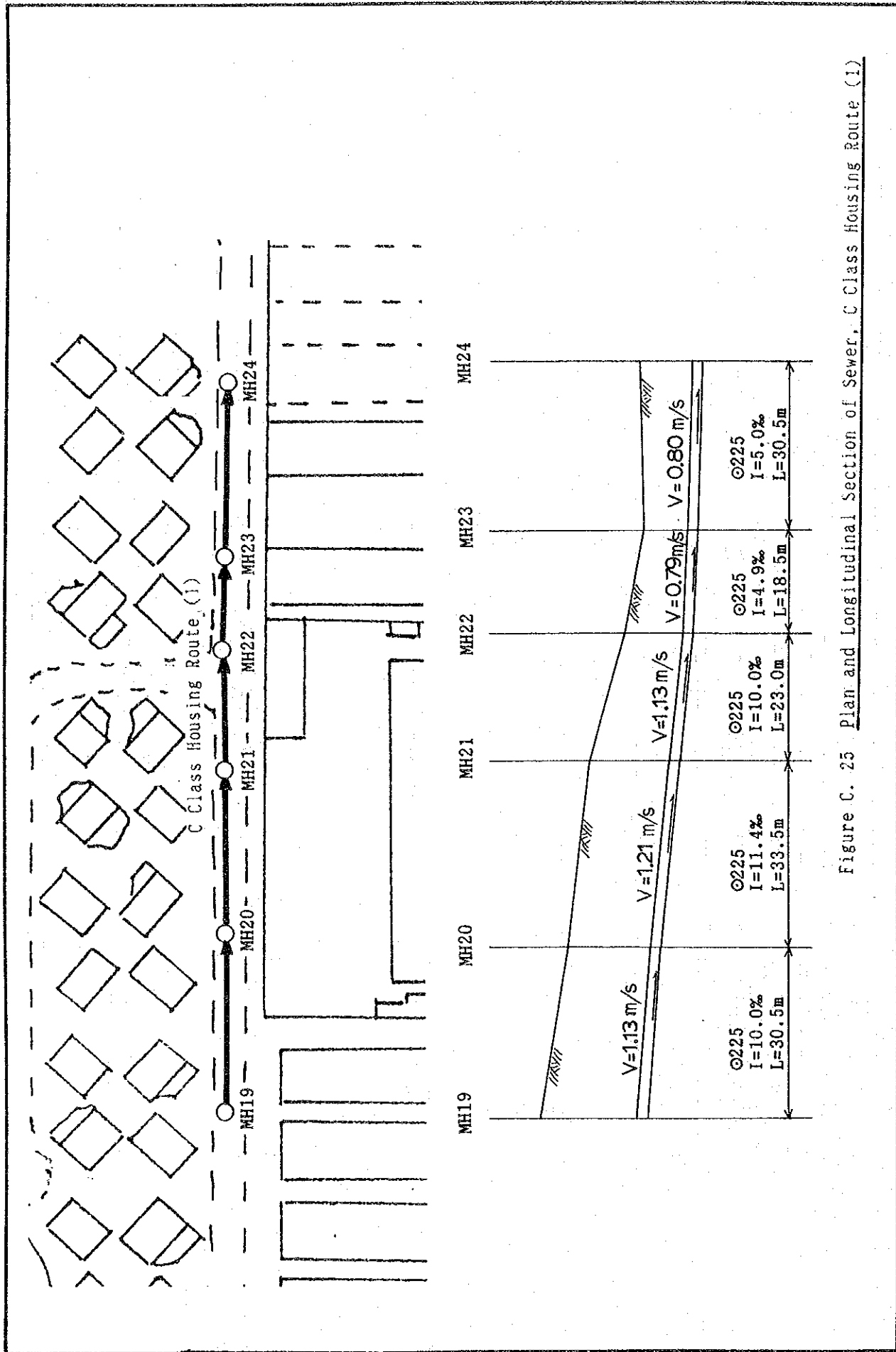


Figure C. 25 Plan and Longitudinal Section of Sewer, C Class Housing Route (1)

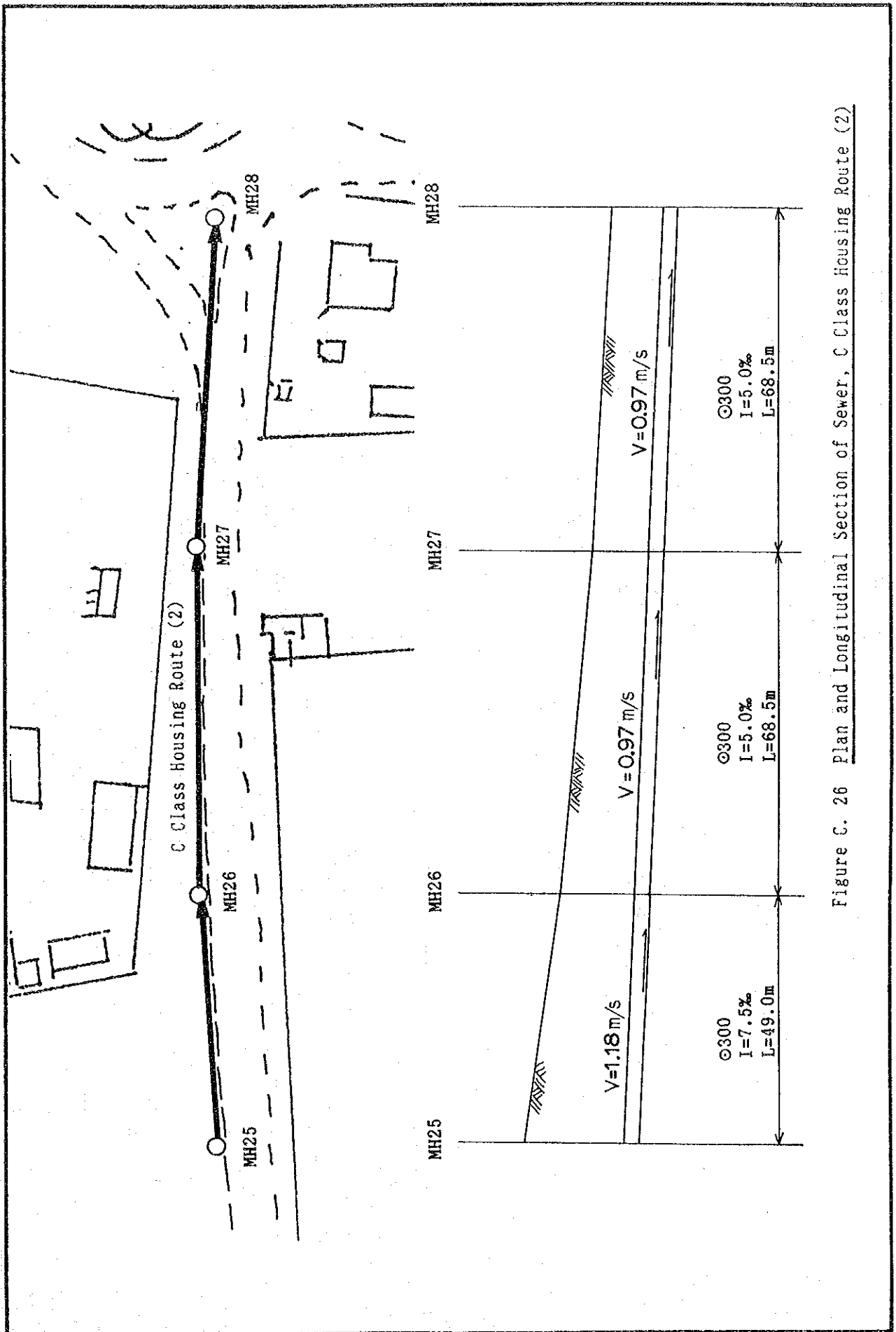


Figure C. 26 Plan and Longitudinal Section of Sewer, C Class Housing Route (2)

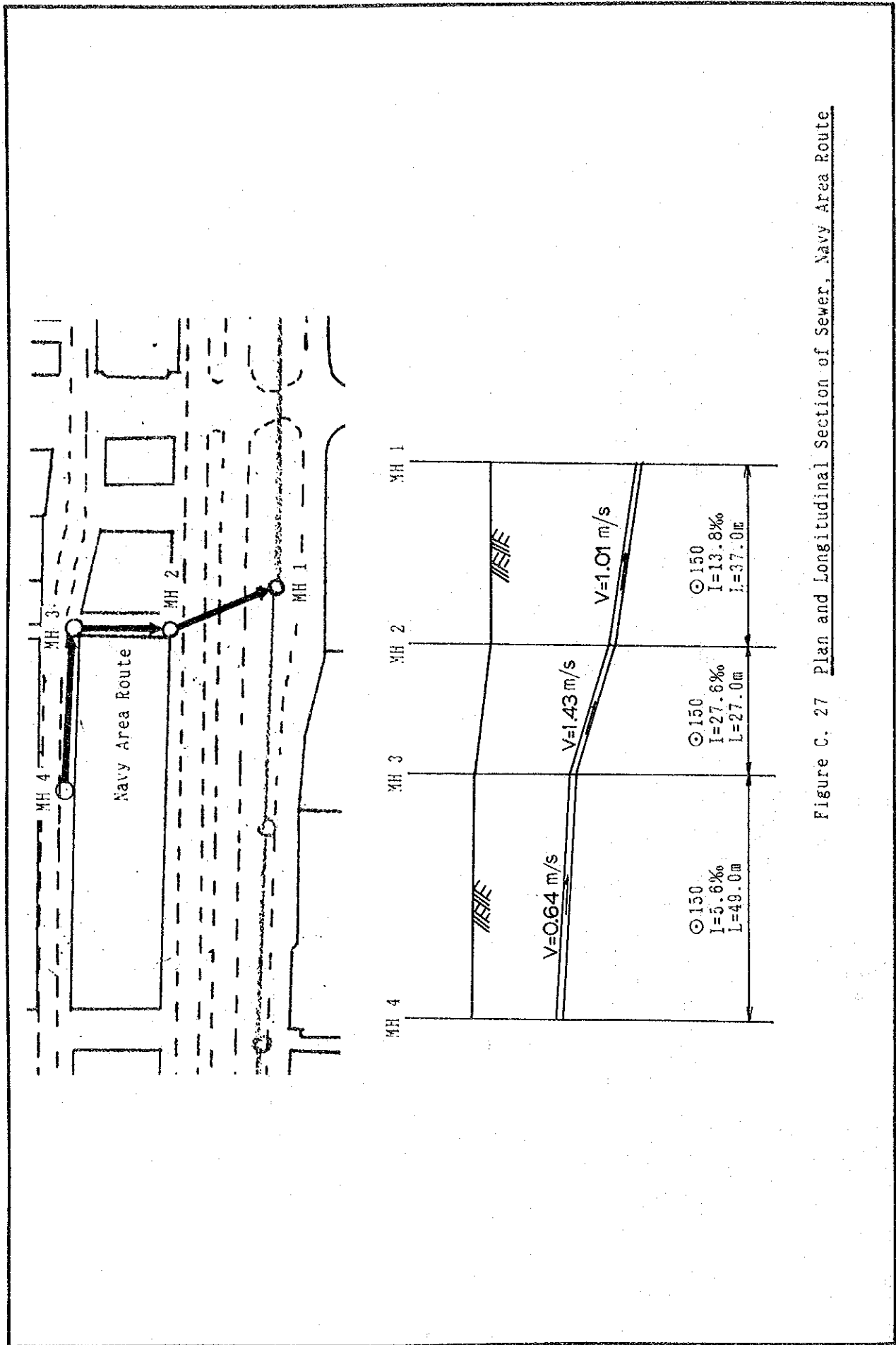


Figure C. 27 Plan and Longitudinal Section of Sewer, Navy Area Route

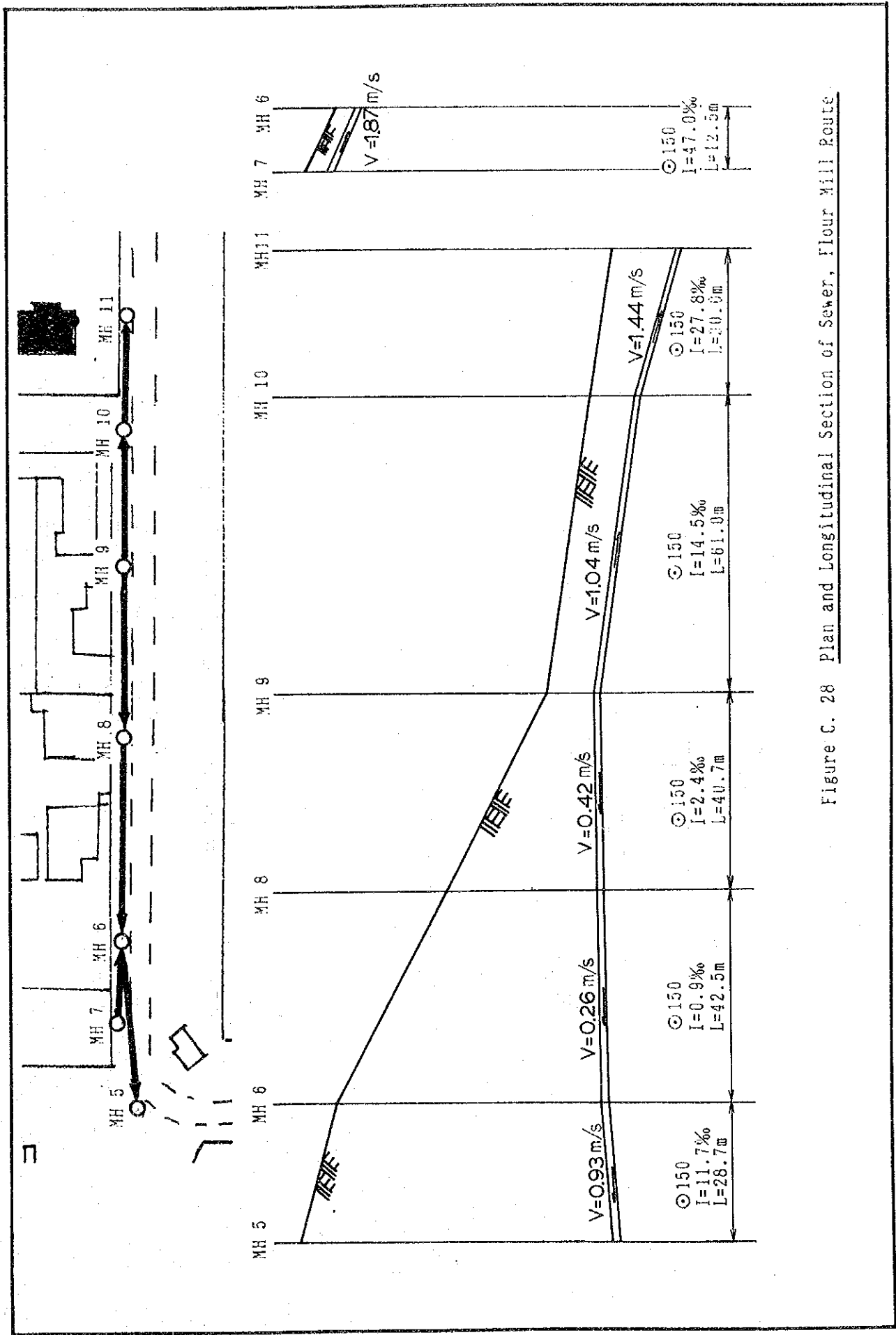


Figure C. 28 Plan and Longitudinal Section of Sewer, Flour Mill Route

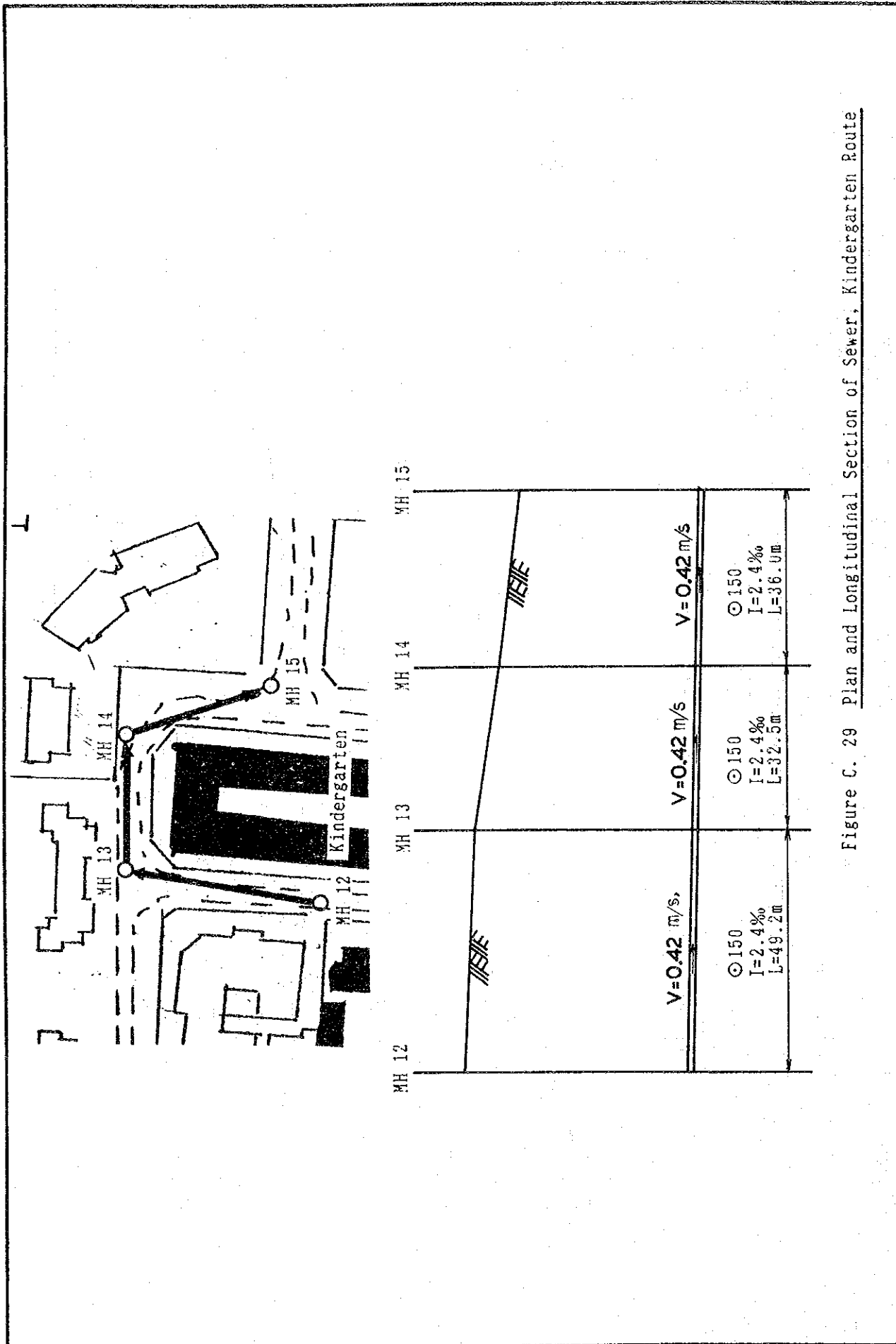


Figure C. 29 Plan and Longitudinal Section of Sewer, Kindergarten Route

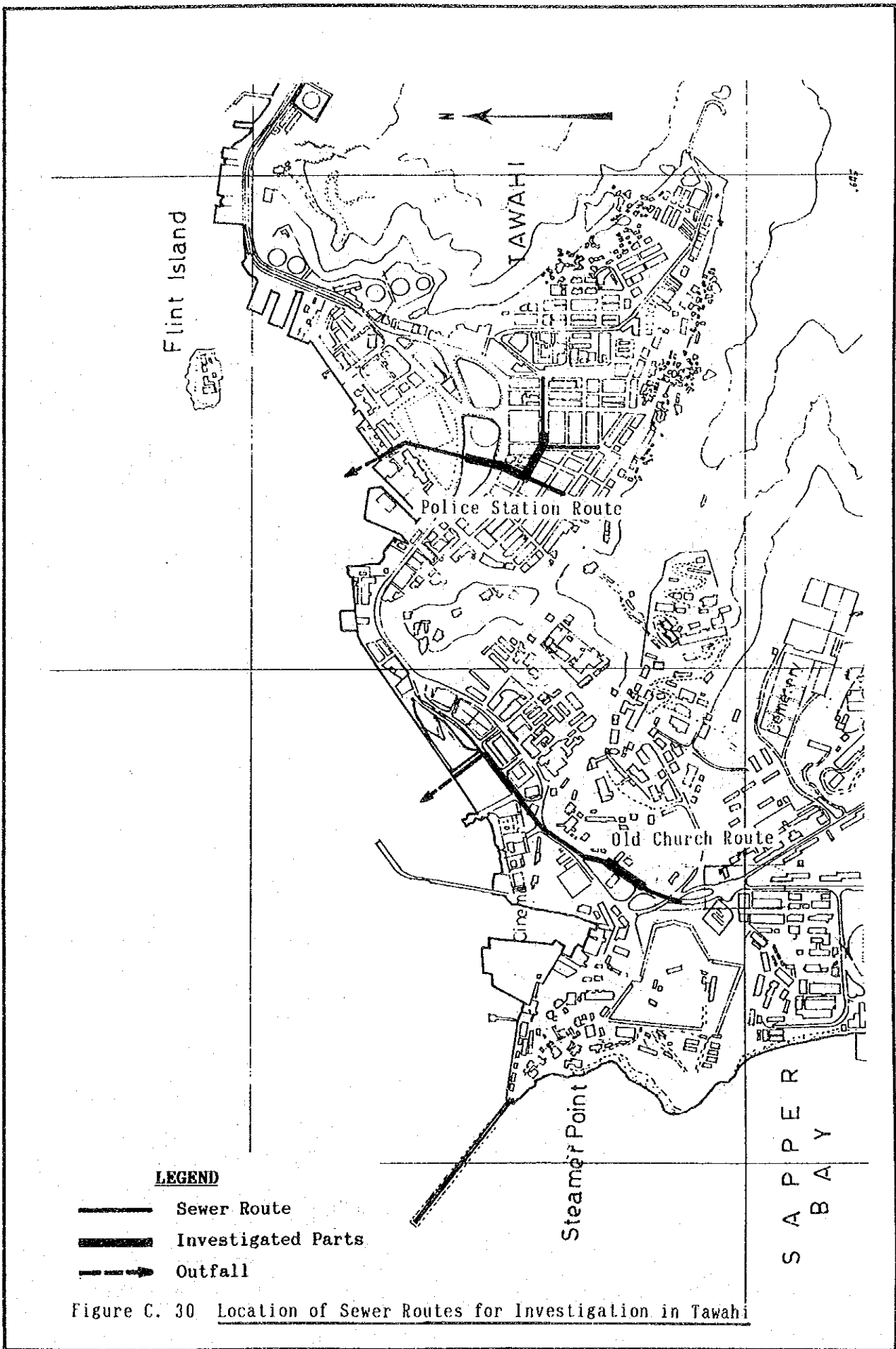


Figure C. 30 Location of Sewer Routes for Investigation in Tawahi

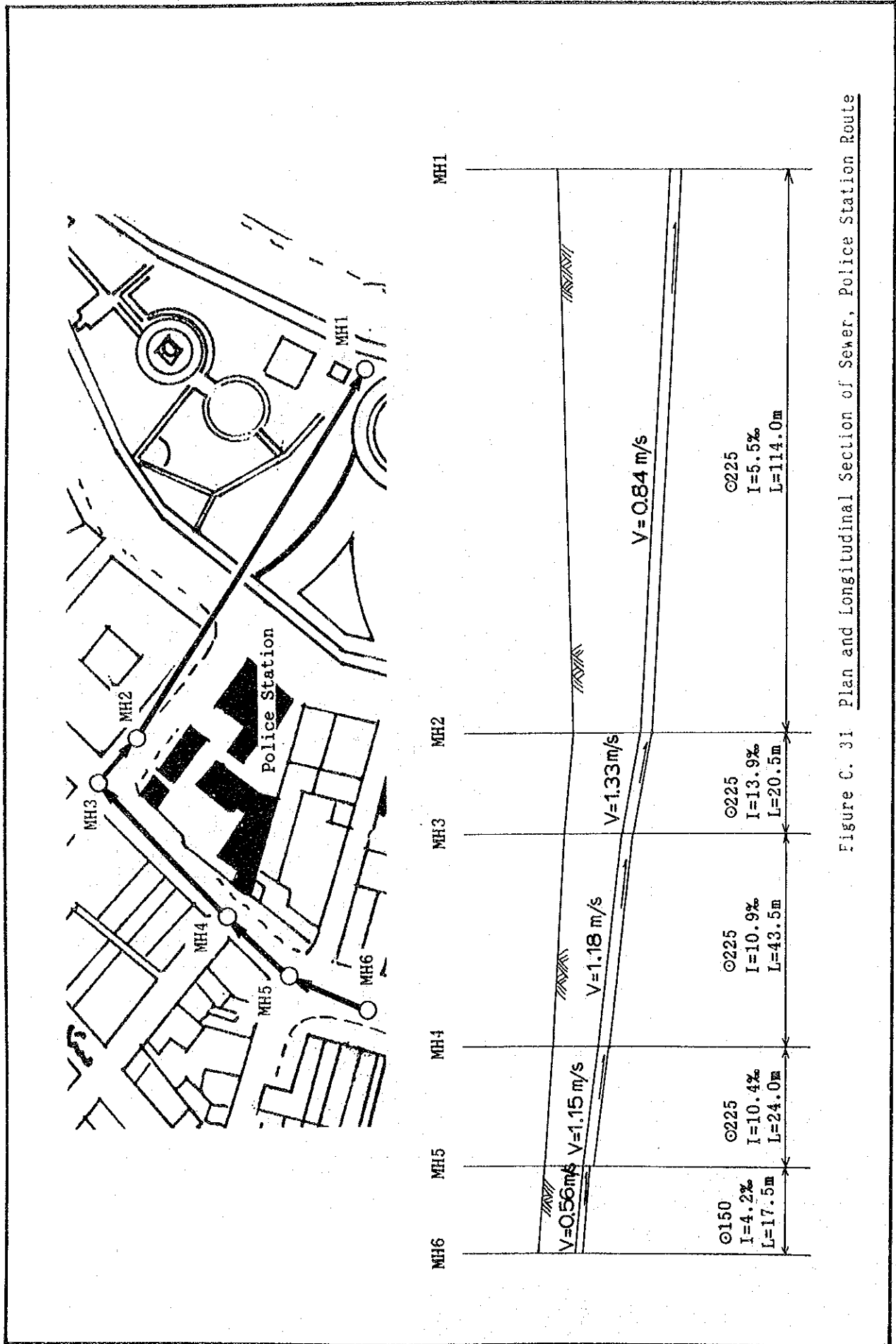


Figure C. 31 Plan and Longitudinal Section of Sewer, Police Station Route

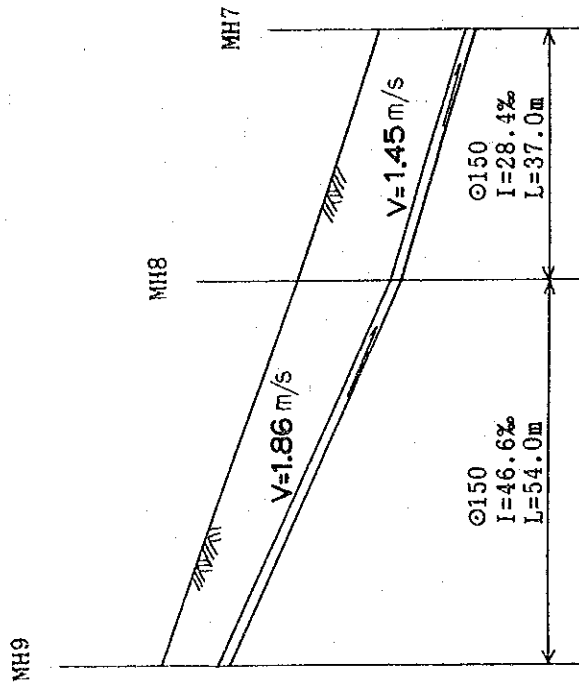
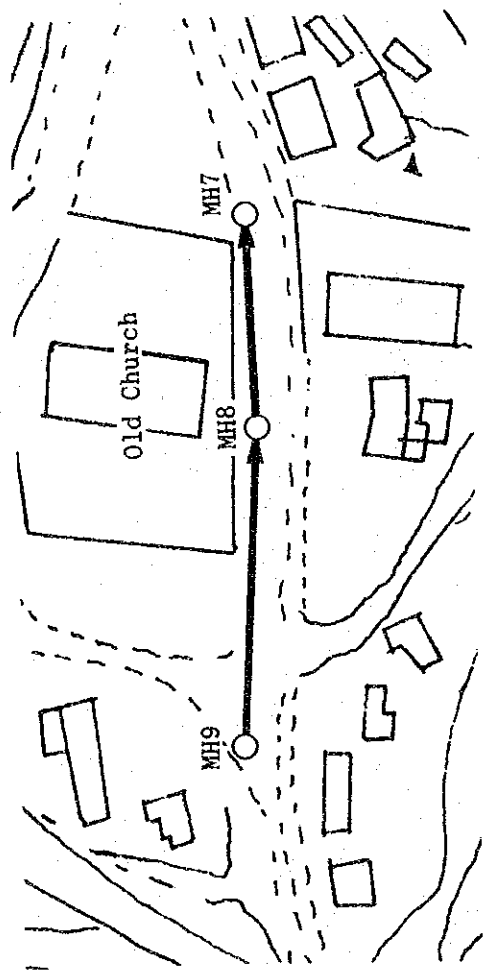


Figure C. 32 Plan and Longitudinal Section of Sewer, Old Church Route

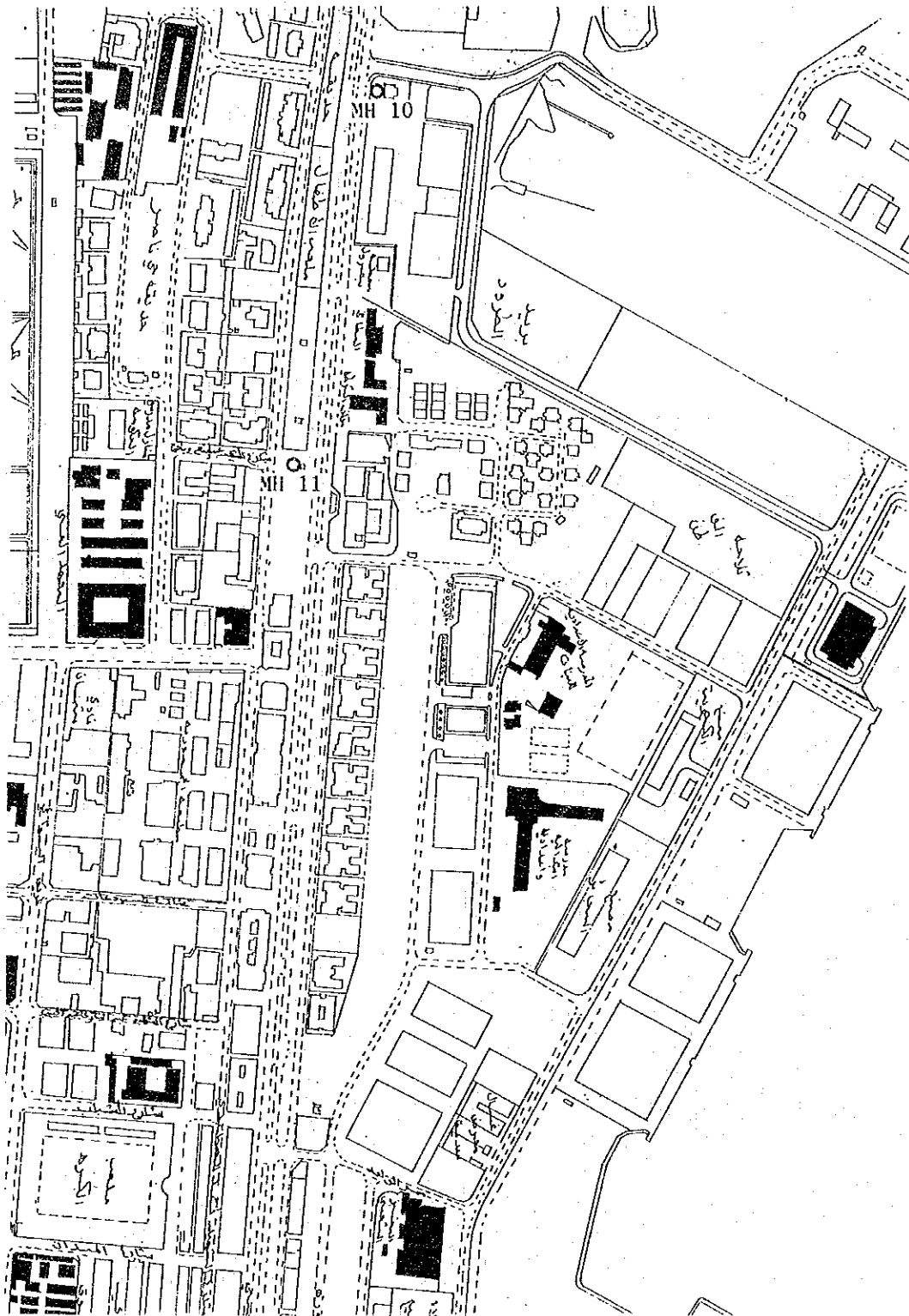


Figure C. 33 Location of Manholes Surveyed in Ma'alla (I)

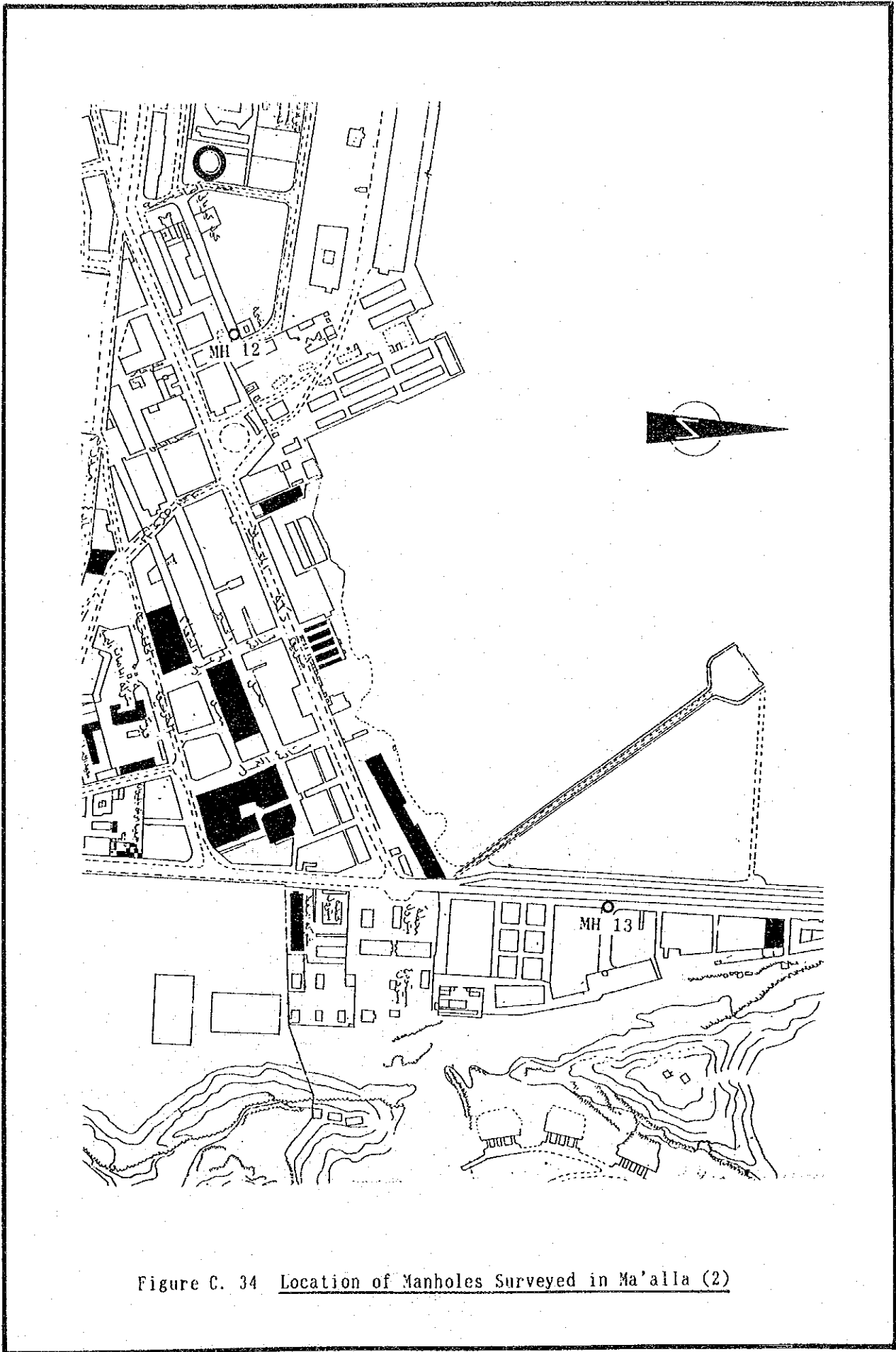


Figure C. 34 Location of Manholes Surveyed in Ma'alla (2)

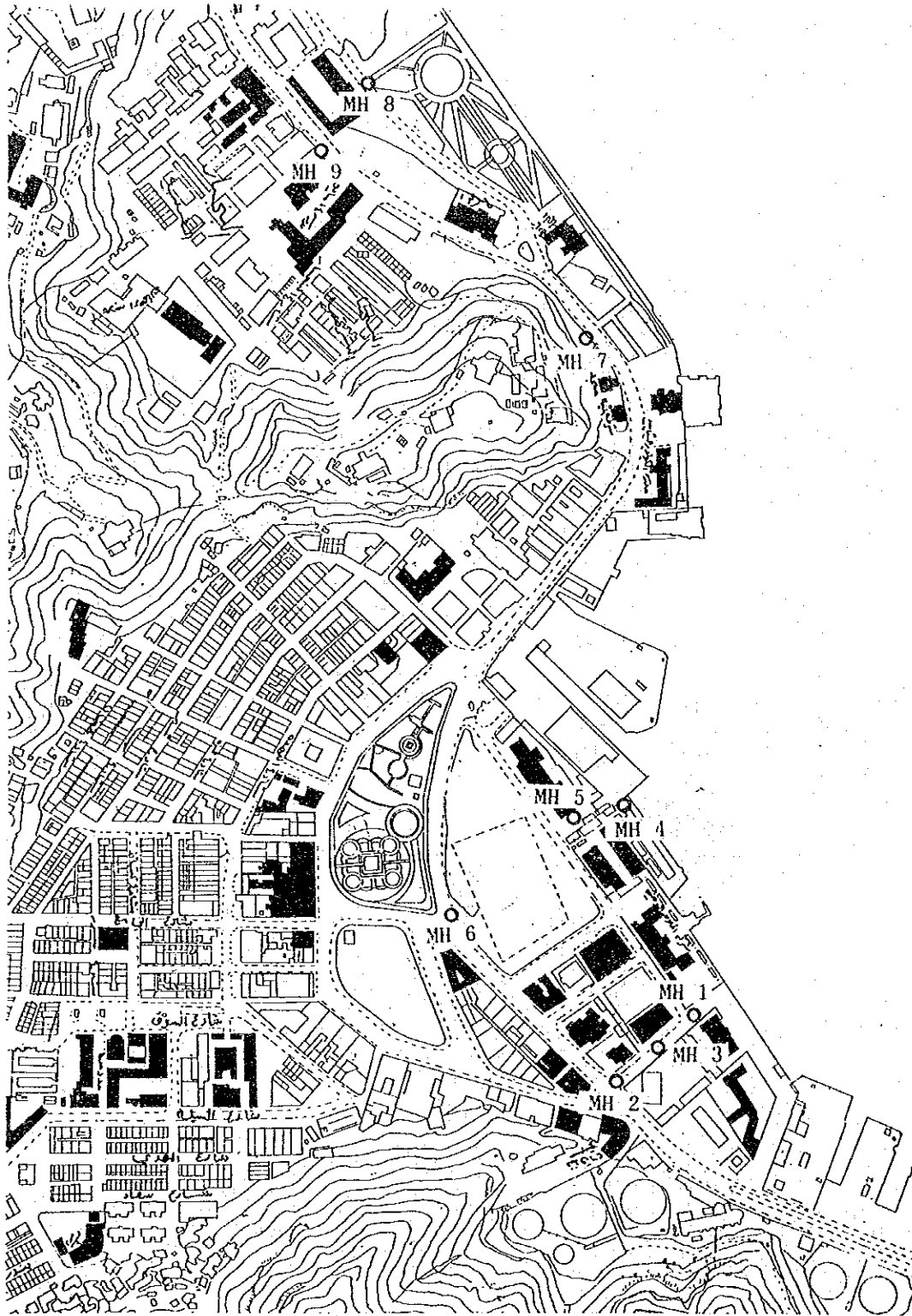
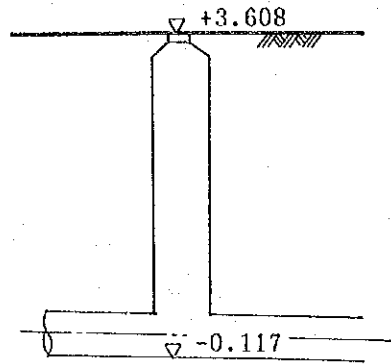
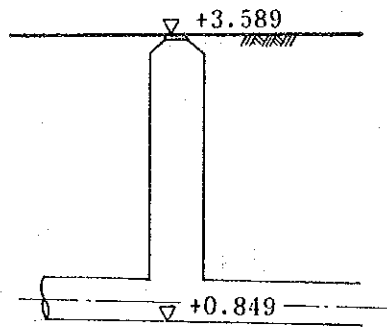


Figure C. 35 Location of Manholes Surveyed in Tawahi

MH 8



MH 9



MH 10

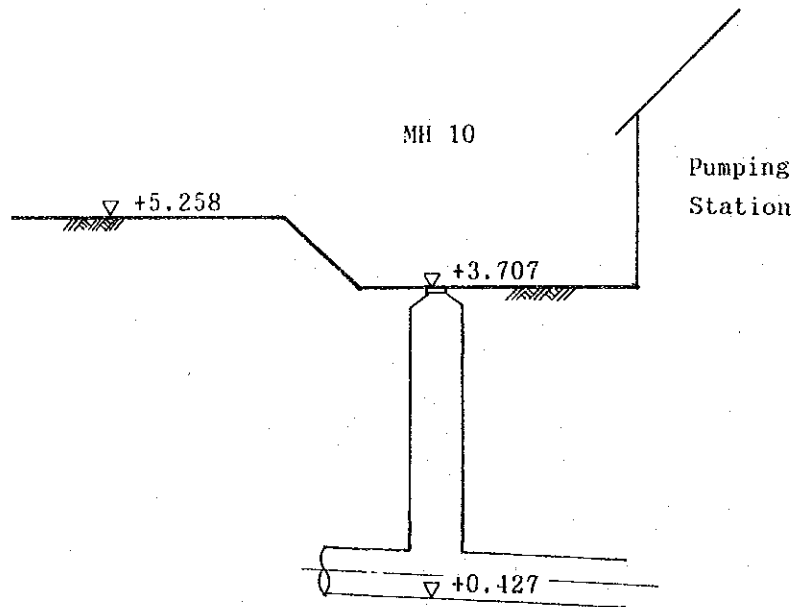
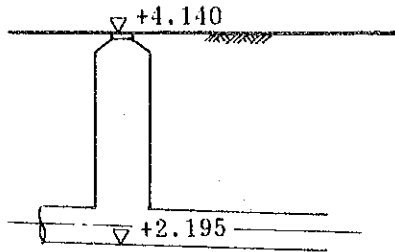
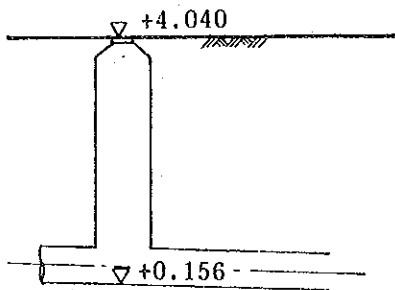


Figure C. 37 Profile of Manhole (2)

MH 11



MH 12



MH 13

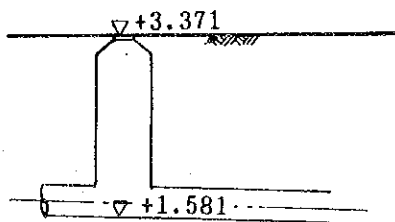


Figure C. 38 Profile of Manhole (3)

APPENDIX D
WATER QUALITY ANALYSIS

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WATER QUALITY ANALYSIS

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