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REPUBLIC OF INDONESIA
MINISTRY OF PUBLIC WORKS
DIRECTORATE GENERAL OF HOUSING BUILDING
PLANNING AND URBAN DEVELOPMENT (CIPTA KARYA)

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MEDAN URBAN DEVELOPMENT, HOUSING, WATER SUPPLY AND SANITATION PROJECT

TECHNICAL MEMORANDUM NO. 29

RECOMMENDED WASTEWATER MANAGEMENT SYSTEM

This is a draft of Section 11 of the Master Plan Report for Water Supply and Sanitation

NOVEMBER 1979

ENGINEERING - SCIENCE, INC. • SINOTECH ENGINEERING CONSULTANTS, INC
A JOINT VENTURE
in association with
PADCO and P.T. DACREA

MEDAN URBAN DEVELOPMENT, HOUSING, WATER SUPPLY AND SANITATION PROJECT
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Our ref.: 79/1198/MUDS/313 8 November 1979

Director General Cipta Karya
Ministry of Public Works
Jalan Pattimura 20
Kebayoran Baru
Jakarta Selatan

Subject: Technical Memorandum No. 29, Recommended Wastewater Management System

Dear Sir:

Attached are 20 copies of the subject Technical Memorandum for your information and review. The material contained in this memorandum constitutes submission of Section 11 of the draft Master Plan for Water Supply and Sanitation Report.

Yours faithfully,

ENGINEERING SCIENCE INDONESIA MEDAN URBAN PROJECT

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Project Representative

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* Not yet submitted.

LIST OF TECHNICAL MEMORANDA PREVIOUSLY SUBMITTED

Report No.	Title	Date Submitted
1.	Preliminary Site Selection Criteria for Perumnas Medan III, SSCH/LCH Project	March, 1979
2.	Work Plan for Water Supply and Sanitation Master Plans and Feasibility Studies	April, 1979
3.	Policy Issues for Project Guidance	March, 1979
4.	Drainage - Principal Rivers and Rainfall Analysis	May, 1979
5.	Preliminary Evaluation of Sunggal Water Treatment Plant	May, 1979
6.	Public Health Considerations	July, 1979
7.	The Present Drainage System	August, 1979
8.	Recommended Drilling Program	August, 1979
9.	Medan Household Income/Expenditures	August, 1979
10.	Existing Land Use in Medan	August, 1979
11.	The Regional Functions of Medan	August, 1979
12.	Existing Solid Wastes Systems and Projected Solid Wastes Characteristics	August, 1979
13.	Evaluation of Medan Master Plan	August, 1979
14.	Physical Constraints to Urbanization	August, 1979
15.	Development in Health Care in Medan	September, 1979
16.	Existing Water Supply Systems	September, 1979
17.	Developments in Education	October, 1979
18.	Existing Water Supply and Sanitation Systems	October, 1979
19.	Public Health and Environmental Aspects	October, 1979
20.	Alternative Solid Wastes Management Systems	October, 1979

LIST OF TECHNICAL MEMORANDA PREVIOUSLY SUBMITTED (CONTINUED)

Report No.	Title	Date Submitted
21	The Distributed Investment Strategy Plan (DISP)	October, 1979
22	Recommended Solid Wastes Management System	October, 1979
23	Recommended Drainage Management System	October, 1979
24	Alternative Water Supply Management Systems	November, 1979
25	Water, Wastewater, Stormwater and Solid Wastes Systems	November, 1979
26	Alternative Wastewater Management Systems	November, 1979
27	Design Criteria and Bases for Cost Estimates	November, 1979
28	Recommended Water Supply Management System	November, 1979

SECTION 11

RECOMMENDED WASTEWATER MANAGEMENT SYSTEM

The recommended wastewater management system for the city of Medan combines programs to improve private and public disposal facilities with the construction of a sewer system in urban areas where latrines and septic tank systems cannot provide acceptable service.

11.1 DESCRIPTION OF THE RECOMMENDED SYSTEM

11.1.1 Collection System

The configuration of the major collectors of the wastewater system and the recommended staging of their construction are shown in Figure 11.1.

The area to be served by the wastewater collection system is partly within the Deli River basin and partly in the Kera basin. The natural topography of the area therefore requires that hydraulically independent sub-systems be provided to collect the flows from each drainage basin. The Deli system is the larger of the two and collects approximately two-thirds of the total wastewater flow.

Wastewater from the Deli basin will flow to the treatment site by gravity. Wastewater from the Kera basin will flow to a pump station which will pump the flow to the boundary of the Deli basin. From that point, the wastewater will flow to the treatment site by gravity. This pump station will be designed for an average flow of 39,300 m^3/d and a peak flow of 60,000 m^3/d by the year 2000. The station will have a separate wetwell and pump room. Automatic level controls and stand-by diesel generators will be provided.

The relatively flat terrain of Medan indicates that several small lift stations will be required in the collection system to avoid excessively deep excavation. The level of detail of the available topographic maps was not, however, sufficient to determine the exact number and location of the lift stations which will be required. A rough estimate of the cost of these lift stations was made on the basis of the limited information available and was included in the cost of the minor collector sewers.

FIGURE II.1 a

PRIMARY ELEMENTS OF WASTEWATER COLLECTION SYSTEM AND RECOMMENDED FIRST STAGE SERVICE AREA

LEGEND

YEAR 2000 SERVICE AREA

MAJOR GRAVITY SEWERS

FORCE MAIN

FIRST STAGE SERVICE AREA

P SEWAGE PUMPING STATION

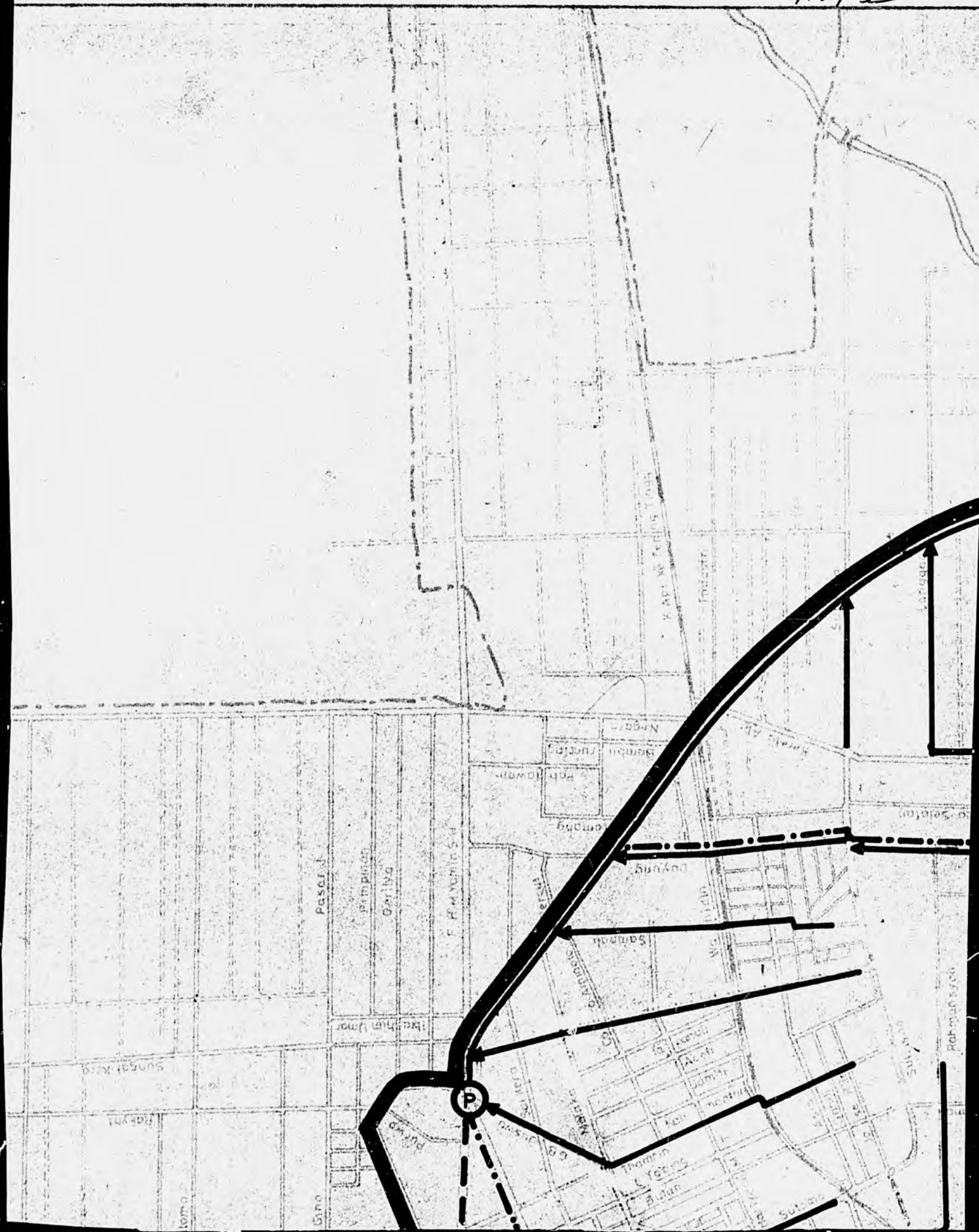
11.1
b

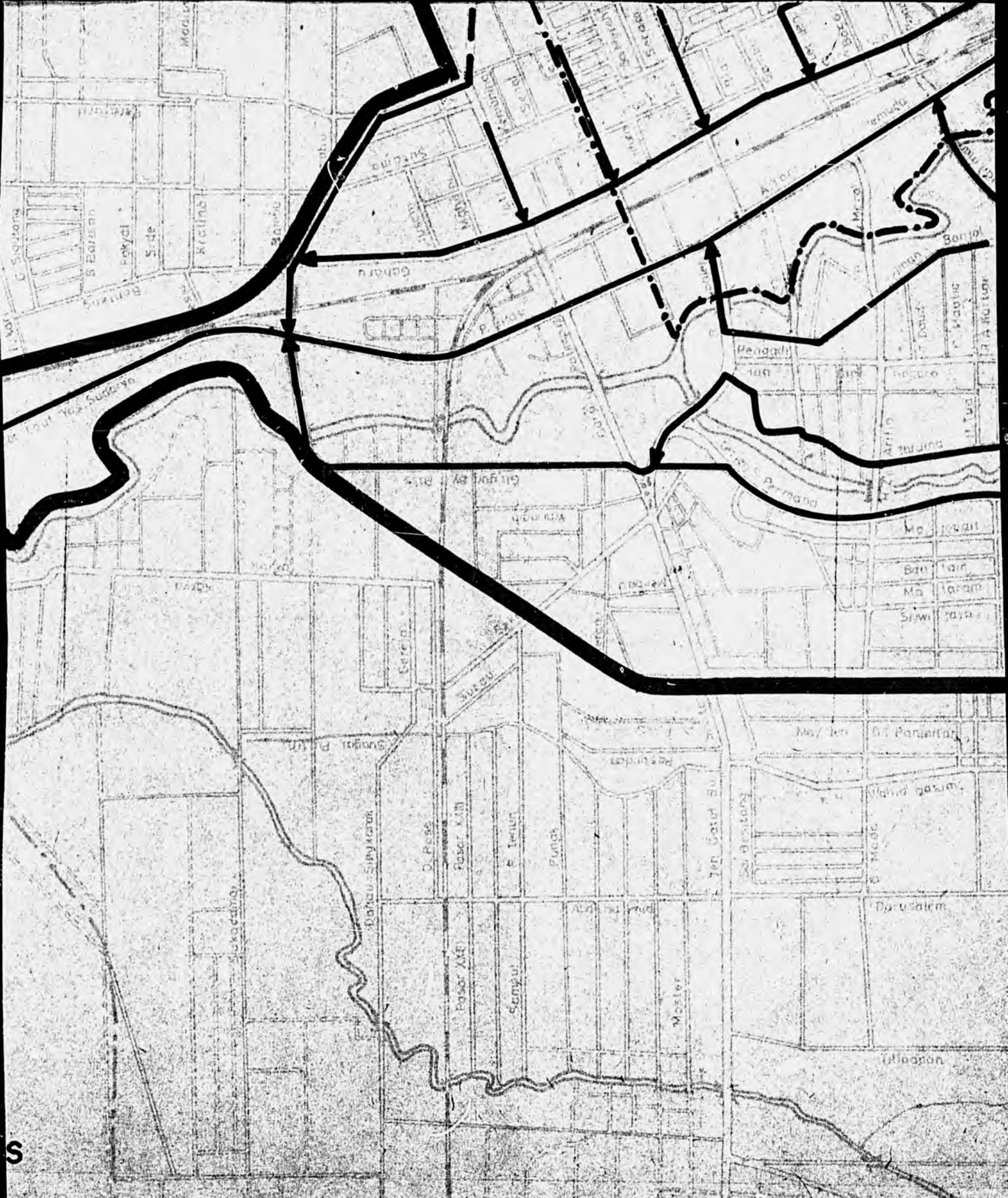
11.1 c

Sukawati
Perame
Air Bersih
Sendara
Amanalun
Ufama
Telaban
Sumbul
Manikamal
Singamangarajo

11.1 d

11.1e




Yos Sudarso
Pemuda
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Permana
Side
Pasar XXI
Sampul
Punah
Moster
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S

11.1 f

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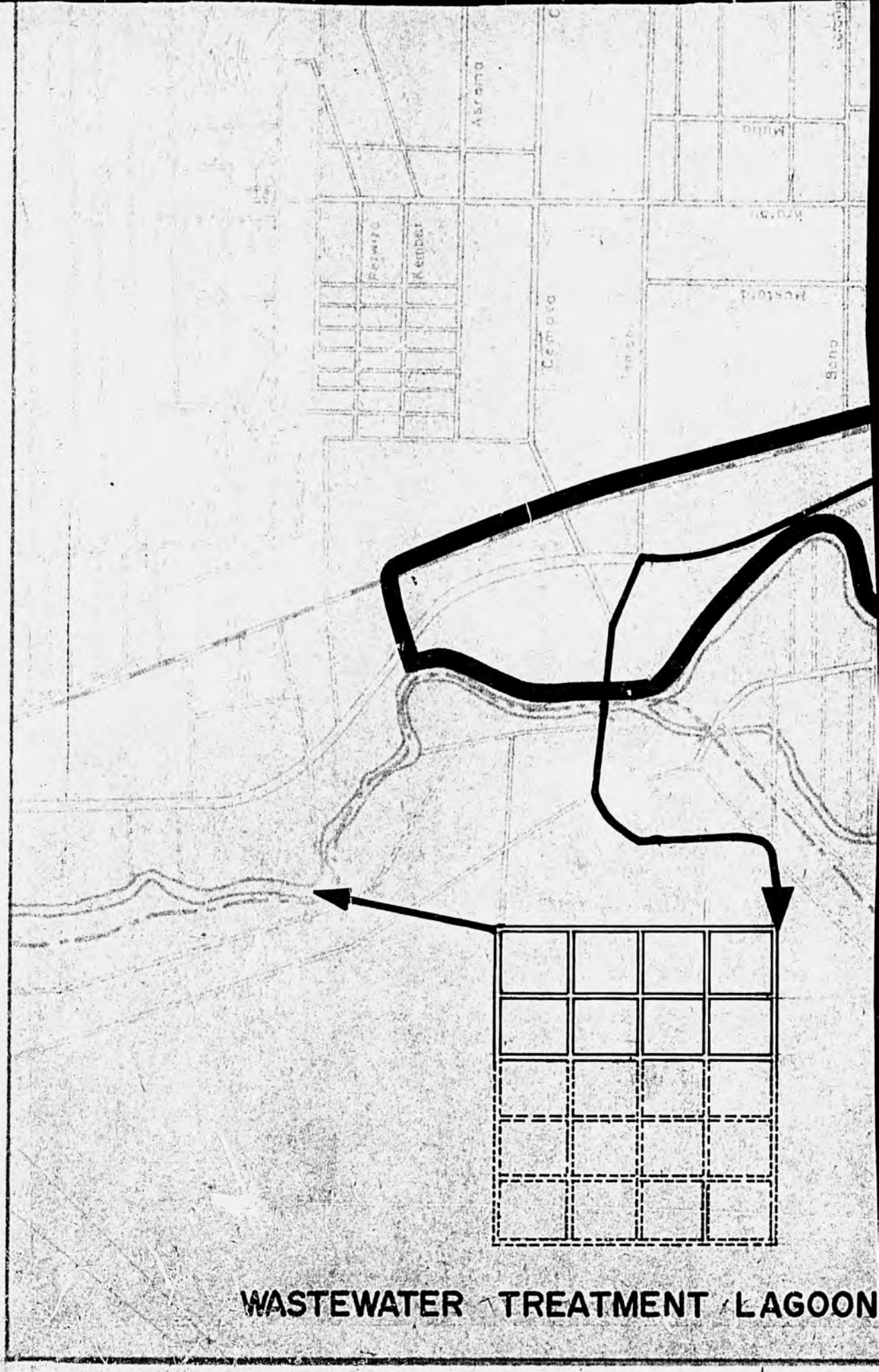

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11.1h

11.1.2 Treatment

Treatment of the wastewater will be provided by several two stage lagoons operating in parallel. The first stage will consist of anaerobic lagoon with a detention time of approximately five days. The second stage will consist of a facultative lagoon with a detention time of approximately 18 days. This two stage treatment process will provide 80 to 95 percent BOD removal and over 99 percent bacterial reduction without chemical disinfection. Effluent will be discharged to the Deli River via an open channel.

The ponds will be preceeded by bar screens and manually cleaned grit removal channels to prevent large objects and heavy inorganic solids from entering the ponds.

The configuration of these lagoons, as sized for the 1990 and year 2000 wastewater flows, is shown in Figure 11.2.

11.1.3 Interim and Long Term Latrine Programs

An interim latrine improvement program will be needed in the portion of the city where the sewer system will be constructed to relieve existing problems before the system becomes fully operational. Of particular concern are several low income, high density urban areas where there are presently few if any toilet facilities of any kind.

The interim improvement program should concentrate on providing water seal latrines in areas where the need is greatest. Water seal units are much more desirable than open pit latrines from a public health standpoint, are relatively inexpensive, and their public acceptance is very high. The emphasis of the interim improvement program should be on providing individual family latrines wherever possible. Where this is not possible, efforts should be made to provide latrines that are shared by no more than three families, and preferably three related families.

The long term latrine program will serve to improve waste disposal facilities in medium and low density areas of Medan where it is not economically feasible to install sewers and may not be for many years to come. The goal of this program should be to provide every resident of Medan who lives outside the sewered area of the city with access to a properly constructed individual family latrine, preferably a water sealed

WASTEWATER TREATMENT LAGOONS SIZED FOR FIRST STAGE AND YEAR 2000 FLOWS

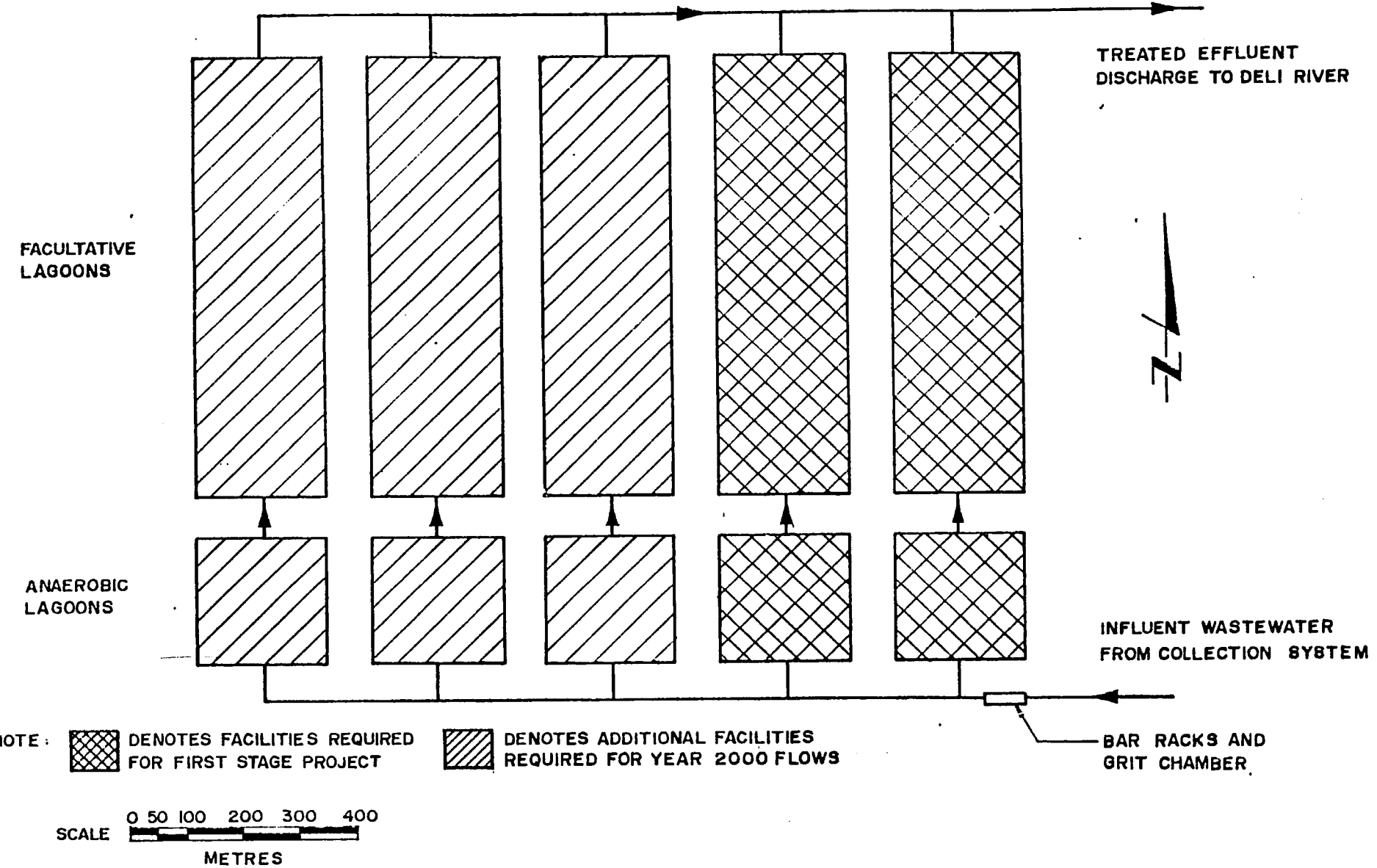

FIGURE II.2

unit. In a few scattered locations, shortages of land may make this infeasible. In these places, shared latrines might be acceptable provided that they are shared by no more than three families.

11.1.4 Septic Tank Pumpage

It is recommended that the current practice of discharging septic tank pumpage directly to the Deli river be discontinued as soon as possible. When the wastewater oxidation ponds have been completed and put in operation, septage should be discharged to the headworks of the ponds.

11.2 OPERATION AND MAINTENANCE

11.2.1 System Operation

Although the wastewater collection and treatment systems will require a significant amount of maintenance to ensure reliable performance, the operational requirements are rather modest. The large wastewater pumping station in the Kera basin will be provided with automatic controls. However, one operator will be required in the station at all times to ensure that all equipment functions properly and to activate stand-by equipment in the event of any mechanical failure. The small lift stations incorporated into the collection system and the collection system itself will require regular inspection. The treatment lagoons will require a significant amount of maintenance. The treatment process itself does not require extensive operational control.

11.2.2 System Monitoring

It is essential to the efficient operation of the wastewater system that an accurate, thorought and continuous monitoring program be implemented. Data accumulated by this program will not only provide a measure of system efficiency, but will also identify developing problems and allow management to take corrective action in the early stages.

11.2.2.1 Collection System Performance

The overall performance of the wastewater collection system must be regularly checked to determine where repair, replacement or expansion is needed. Accurate flow measurements are the most valuable tool for making these determinations. Measurements should be made at the junction of all

local collectors with trunk sewers at least once each year by installing temporary V-notch weirs in the junction manholes. Flow should be measured and recorded on an hourly basis for one full day each time. Measurements made very early in the morning are useful for assessing the amount of infiltration entering the system through leaky joints or cracked pipes. Excessive amounts of infiltration can severely reduce the effective capacity of the system and can, in extreme cases, result in surcharging and overflows. Measurements taken during periods when the daily flows are highest can indicate the necessary capacity of various components of the system. Peak flows recorded during periods of heavy rainfall show how much inflow is entering the system through manholes, storm drain connections and other sources which should be eliminated wherever possible.

Long term records of this type are extremely valuable indicators of changes in flow, inflow and infiltration and can be used to pinpoint problems, determine what measures are most desirable for correcting them and to project what future capacity will be required in the system.

11.2.2.2 Treatment Process Control

The primary objectives of the treatment process are to provide sufficient removal of bacteria and organic matter that the discharge does not cause excessive physical and chemical degradation of the Deli river and does not create a public health hazard.

Treatment facities will initially be sized to provide adequate treatment for only a small portion of the ultimate flows. As the collection system is gradually extended, flows will increase and additional lagoons will have to be constructed to maintain the recommended level of treatment. Also, the gradual accumulation of sludge in the lagoons will effectively reduce their volume thus reducing the detention time of the wastewater and efficiency of the treatment process. Regular monitoring of the BOD, suspended solids and bacterial content of the effluent will be required to verify that adequate treatment is being provided and to determine when expansion of the lagoons is necessary. Monitoring of the influent BOD and suspended solids content should also be done to determine the efficiency of the treatment process so that future expansions of the lagoons will be properly sized. The thickness of the sludge layer in the lagoons should also be monitored to determine when the lagoons need to be cleaned.

11.2.2.3 Receiving Water Quality

In order to verify directly that the discharge of treated wastewater does not degrade the physical, chemical or bacteriological quality of the Deli river excessively, a sampling program should be established to monitor the quality of the Deli river above and below the point of discharge from the oxidation ponds. BOD, suspended and dissolved solids, dissolved oxygen and coliform bacteria connectrations should be sampled at a minimum of two locations downstream of the discharge point, and at one location immediately upstream of the discharge.

In addition to documenting the effects of existing dicharges, these samples will help determine whether or not higher levels of treatment will be required in the future as the wastewater flows increase.

Additional upstream and downstream sampling would provide valuable data on the extent of pollution entering the river from other sources, particularly from the urban areas of Medan. An expanded sampling program to include these areas should be established if sufficient financial resources are available. The ultimate goal of this program should be to establish numerical water quality standards for important water quality parameters, such as dissolved oxygen, pH and fecal coliform levels. These standards should be set at levels which will ensure that the existing uses of surface waters can be continued, and efforts should be made to maintain these standards in all surface waters as development continues.

11.2.3 Repairs and Maintenance

The condition of the sewer system should be continuously monitored to determine the need for cleaning and to locate any areas that need additional attention. A special sewer inspection team should be organized to make systematic inspection at regular intervals. Manholes should be opened and the depth of sediment and flow recorded. The condition of the sewers and manholes themselves should also be noted. The timing of the inspections should be varied so that each inspection point is examined very early in the morning and in the middle of the day on alternate inspections to obtain estimates of maximum daily flows and the rate of infiltration.

Upon discovery of any unsatisfactory conditions, cleaning or repair should begin as soon as possible to prevent further deterioration and possible failure of the system. Records of cleaning and repairs should be kept to pinpoint chronic problem areas and help determine possible long term solutions.

The pump stations should also be regularly inspected and any developing problems should be corrected at the earliest possible opportunity. It is particularly important that the flow and pressure at the discharge of the pumps in large pump stations be carefully monitored and recorded. This will provide an accurate measure of pump wear, changes in the condition of the force mains and, to some extent, the condition of the upstream collection system. To facilitate this monitoring, the Kera pump station will be equipped with a flow meter and totalizer and individual pump discharge pressure gages. Operators should keep a weekly record of the discharge pressure of each pump. Accurate records should also be kept of weekly power requirements, and each motor should be equipped with a running time meter.

The small lift stations will be provided with discharge pressure gages only, and pressure measurements should be taken and recorded weekly. These records will indicate when pumps should be taken out of service for repair or replacement.

Maintenance of the oxidation ponds will primarily involve removal of aquatic vegetation growing near the edge of the ponds to eliminate conditions favorable for insect breeding. The banks themselves will also require repair occasionally. Sludge will have to be removed from the lagoons when it begins to significantly reduce their volume, but this is normally done only once in several years. Grit removal and cleaning of the bar racks will be required daily.

11.3 PHASED IMPLEMENTATION PLAN

The implementation schedule of each component of the recommended wastewater management system is shown graphically in Figure 11.3.

The implementation of the recommended wastewater collection and treatment systems and the interim and long term latrine improvement

programs will be phased over the entire 20 year planning period. Various portions of the collection system, such as the major interceptors, will be completed in the early stages of the project and will be put in service as soon as possible. Other portions of the system, such as the local collectors and service connections, will be constructed at a uniform rate through the year 2000.

11.4 COSTS

The major unit components of the wastewater collection system are shown in Figures 11.1 and 11.2. The total estimated capital cost of each major phase of the program, including construction of collection and treatment facilities and the latrine improvement programs, is presented in Table 11.1. The estimated operation and maintenance costs for each component of the recommended system are presented in Table 11.2.

TABLE 11.1

ESTIMATED CAPITAL COSTS - WASTEWATER MANAGEMENT SYSTEM Rp.(millions)
CONSTANT 1979 PRICES

Item	REPELITA III							Total
	1979/80	1980/81	1981/82	1982/83	1983/84	1984/89	1989/2000	1979/2000
Pumping Stations	-	-	8	16	16	8	8	56
Treatment facilities	-	-	-	-	597	597	1,791	2,985
Interceptor sewers	-	-	195	390	390	-	-	975
Major collector sewers	-	-	35	71	71	354	-	531
Minor collector sewers	-	-	150	301	301	1,503	3,309	5,564
Service connections	-	-	58	116	116	581	1,279	2,150
Interim latrine program	-	-	8	17	17	83	83	208
	(8)	(17)	(8)	-	-	-	-	(33)
Long term latrine program			15	31	31	154	336	567
	(15)	(31)	(15)	-	-	-	-	(61)
Base Totals	-	-	469	942	1,539	3,280	6,806	13,036
	(23)	(48)	(23)	-	-	-	-	(94)
Engineering	-	-	45	89	149	304	639	1,225
Land	-	-	-	-	125	125	375	625
Contingencies	-	-	77	155	272	556	1,173	2,233
	(3)	(7)	(3)	-	-	-	-	(13)
Totals	-	-	591	1,186	2,085	4,265	8,993	17,120
	(26)	(55)	(26)	-	-	-	-	(107)

Note: ( ) indicates immediate action program expenditures.

TABLE 11.2

ESTIMATED O & M COSTS - WASTEWATER MANAGEMENT SYSTEM Rp.(millions)
CONSTANT 1979 PRICES

Item	REPELITA III							Total
	1979/80	1980/81	1981/82	1982/83	1983/84	1984/89	1989/2000	1979/2000
Pumping Stations	-	-	0.2	0.5	0.8	4.5	10.5	16.5
Treatment facilities	-	-	-	-	11.9	89.6	489.5	591.0
Interceptor sewers	-	-	0.2	5.9	9.8	48.8	97.5	164.0
Major collector sewers	-	-	0.4	1.1	1.8	19.5	53.1	75.9
Minor collector sewers	-	-	1.5	4.5	7.5	82.7	407.5	503.7
Service connections	-	-	0.6	1.7	2.9	31.9	157.5	194.6
Totals	-	-	4.7	13.7	34.7	277.0	1,215.6	1,545.7

WASTEWATER IMPLEMENTATION SCHEDULE

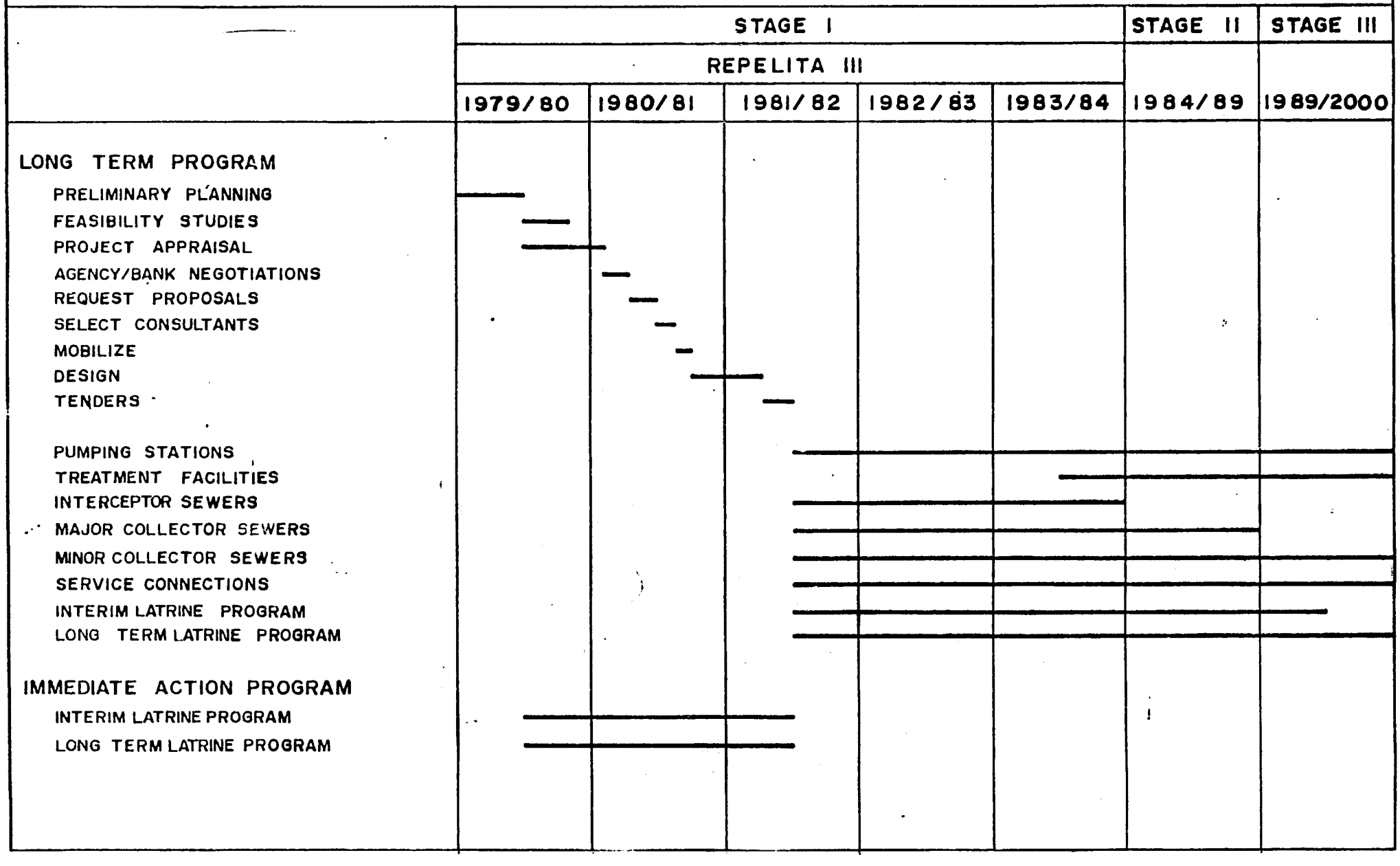

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FIGURE 11.3