3－4　関連事業

3－4－1　上水道事業

現在，Dhaka　WASA　が所管し，約90MGD（409,000㎥／day）の上水供給が行われている。普及率約70～80％に達し，約2,500千人に供給されているといわれている。これから類推すると1人当り約160ℓ／日の使用量である。

水源の95％は地下水に依存し106箇所の取水井を管理している。残り5％は Old Dhaka　近くの河川水を用いている。

WASA の計画では，向う4年以内に約20MGD（90,000㎥／day）の供給施設の増設を行い，将来的にはさらに約100MGD（454,000㎥／day）の増設を行う予定である。

給水管延長は1984年時点で612 miles（約985km）であり，年々増設されている。

3－4－2　雨水排水事業

Dhaka 市の雨水排水事業はDPHEによって行われている。Fig 3.13，3.14に既存の雨水排水設備を示す。

既存排水施設の雨水排除機能は不十分であり雨季には市内の各所に浸水地域が生ずる。Fig 3.15（写真19，20）に浸水地域の例を示す。市内の雨水排水が不十分なため，前述のように市内の随所で，汚水管に雨水を混入させている。従って，雨天時においては，分流式下水道といえ汚水管に相当の雨水が流入してくることとなる。

汚水整備計画と雨水整備計画とは密接なつながりをもっており，相互に調整をとりながら整備することが望ましい。健全な汚水整備，維持管理は，雨水排水の根本的な解決をなくして行われ得えい。しかしながら，雨水排水事業は現在，JICAがF／S 対象地域の選定を行っている段階であり，またその事業費も膨大なものと予想される。このような段階にあっては，汚水排除施設においても雨水を排除する部分的な合流式下水道的考え方によって対処することも現実的な方策とも考えられる。

以下に，JICA によって行われている雨水排水事業調査の概要を示す。

(1)　経　緯

ダッカ市は，ガンジス，ブラマプトラ及びメグナの国際的大河川が形成した氾濫源／デルタの中に発達し，さらに四方を中小河川にとり囲まれた人口約400万人を擁する「バ」国第一の都市であるが，同市では，排水施設の不備が原因で雨期には低地部の地域が長期間に亘って冠水し，日常の市民生活に大きな影響を与えている。

また，これにより市内の公共施設も被害を受け，その改修経費が同市の財政を圧迫するなど市の発展を著しく阻害している。

これに対しバングラデシュ国政府は，ダッカ市の総合開発計画のマスタープランとも言える Dacca Metropolitan･Area Iutegrated Urban Development Projectを，1980年に ADB，UNDP　の協力の下，策定した。本計画は，ダッカ首都圏を対象として，総合的な都市開発戦略を西暦2000年を目標にして検討したものであるが，洪水，雨

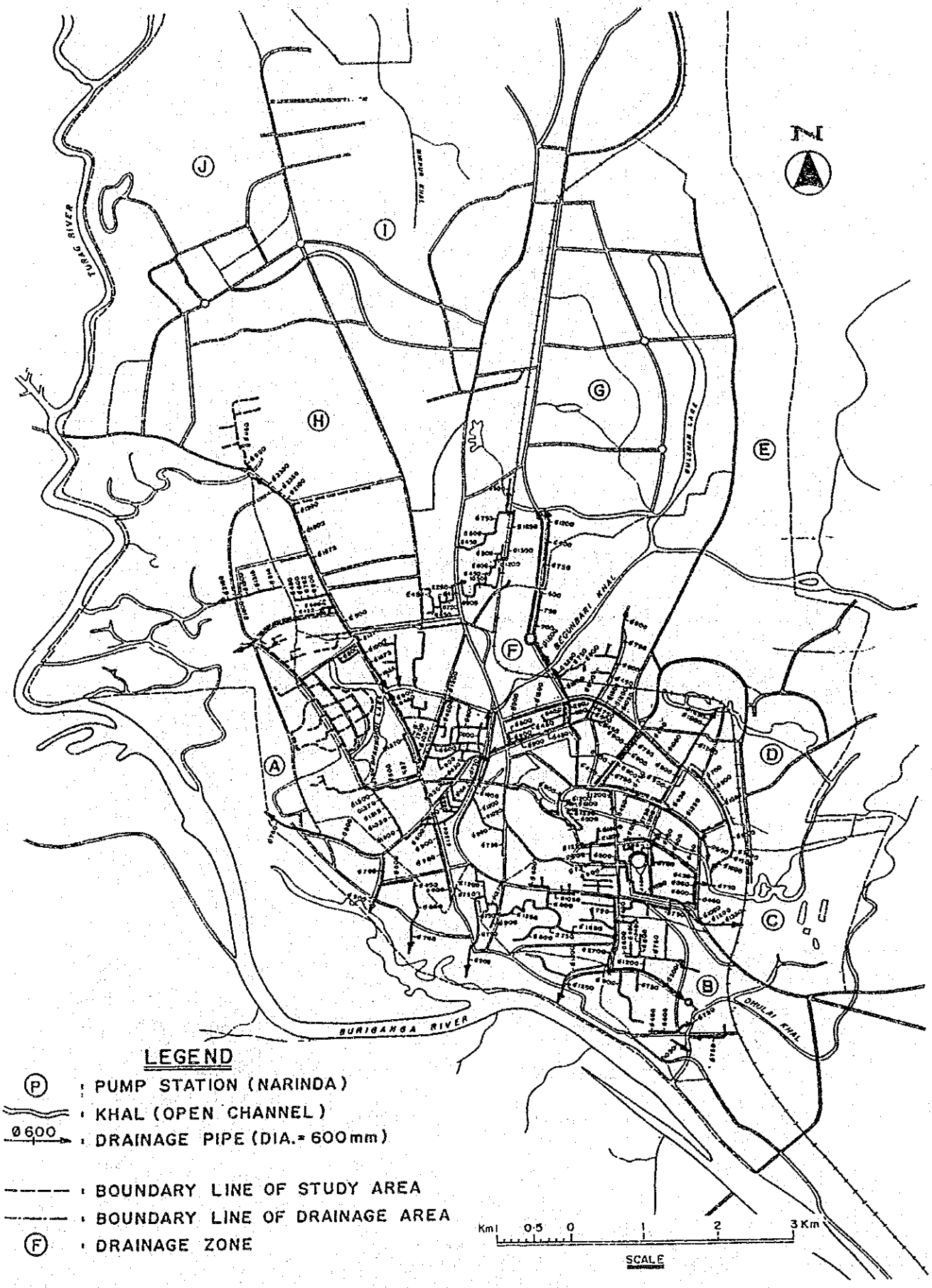


Figure 3.13 Existing Drainage Facilities(1) [6]

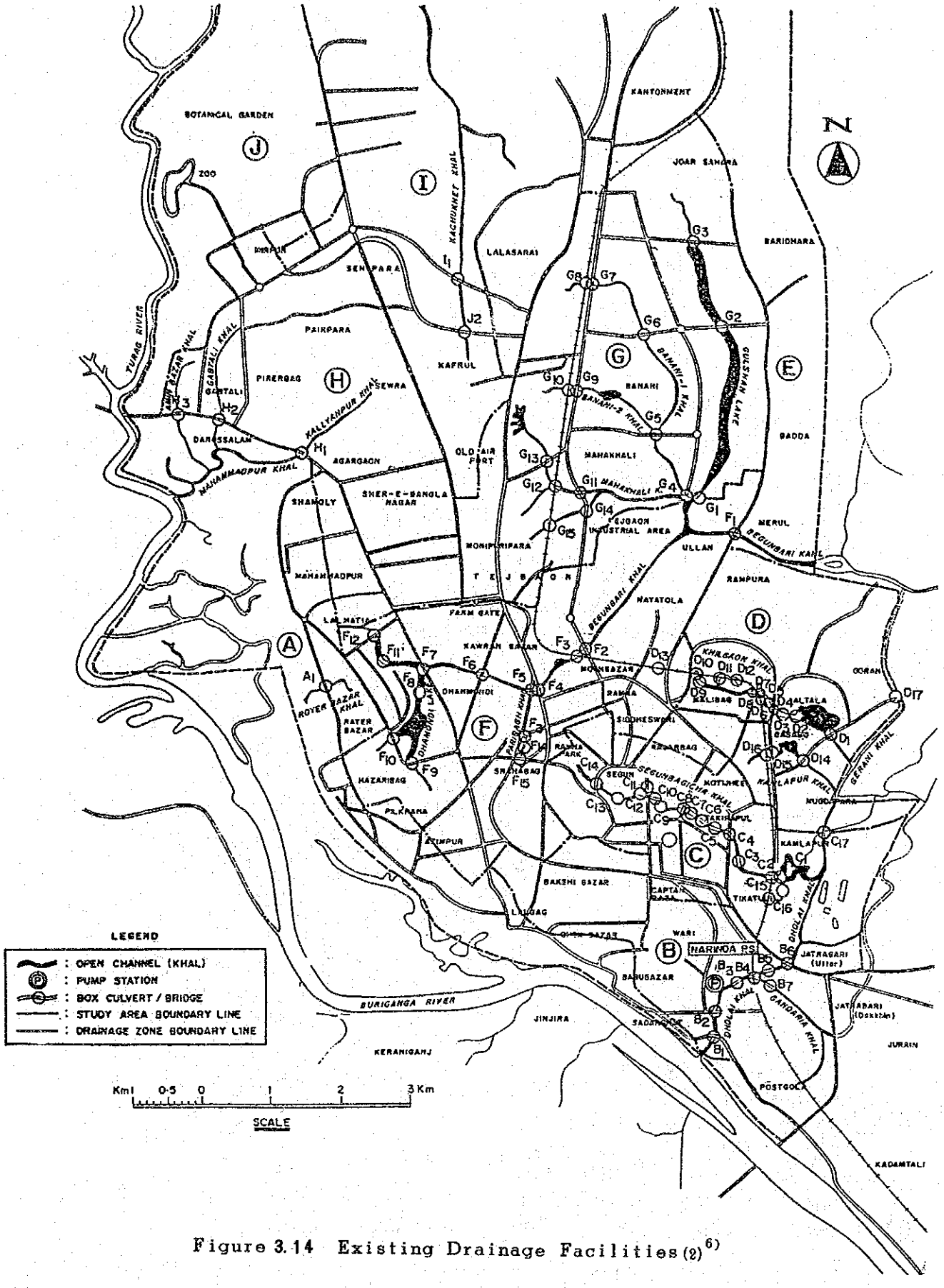


Figure 3.14 Existing Drainage Facilities (2)[6]

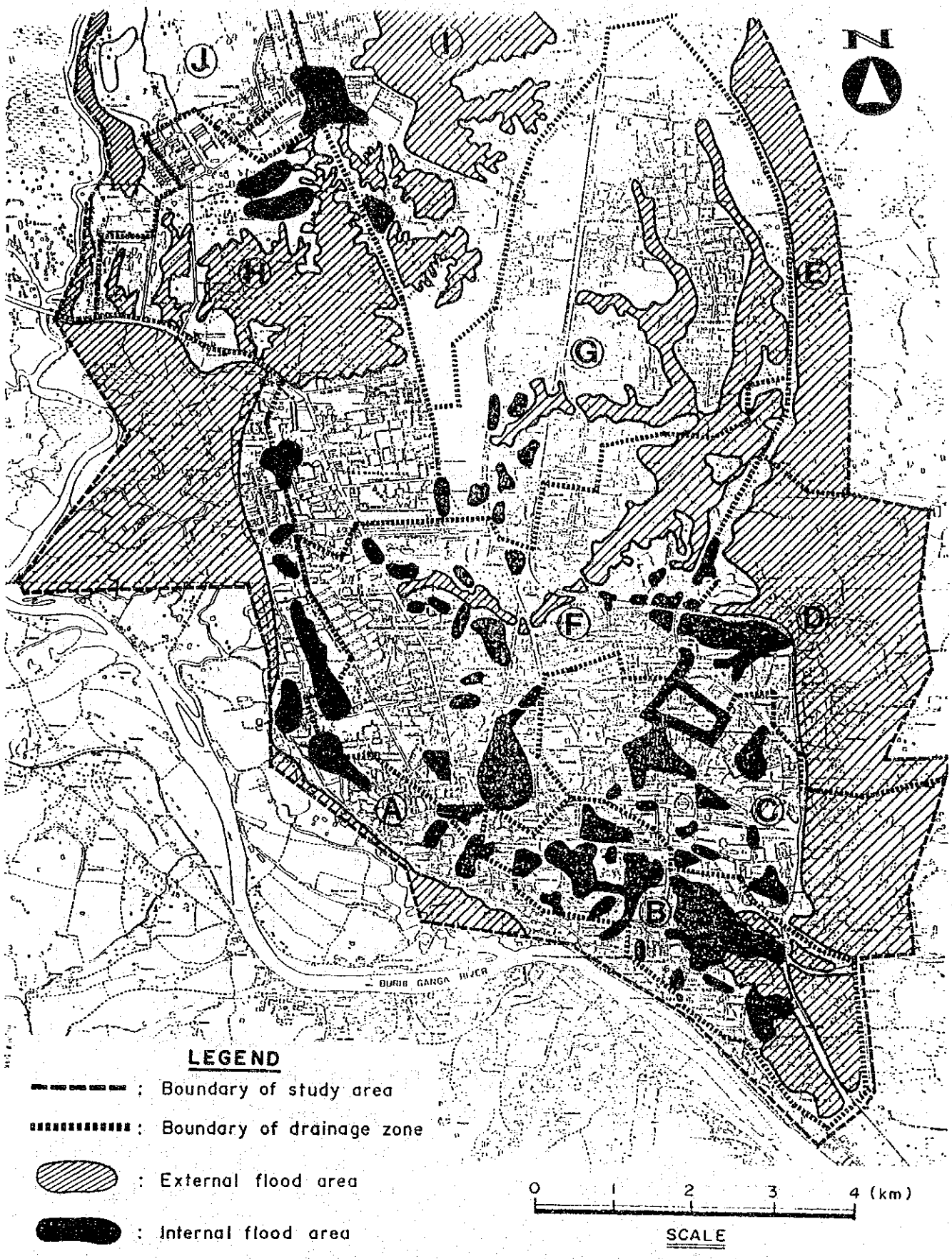


Figure 3.15 Maximum Flood Area in Past 10 Years [6)]

水排水に関する具体的な検討結果は含まれておらず，必要となる調査内容を提案するに止っている。

かかる背景を受け，バングラデシュ国政府は，上記の提案を含め，ダッカ市における雨水排水施設整備に関する調査を，わが国に対し要請し，これを受けて６１年３月に第一次，同年５月から６月にかけて第二次事前調査団が派遣された。

(2) 本格調査

事前調査の結果を踏まえ，現在，下記目的，基本方針，工程に沿って本格調査が進行中である。

1) 目的及び対象地域

本格調査の目的は，バングラデシュ国政府の要請に基づき，ダッカ市行政区域（Ａ＝４１４㎢）のうち，約２６０㎢から成る既成市街地及びその外縁部を含む区域（Study area）に対し，

a) 排水施設整備構想を検討しつつ，Study area を対象とした雨水排水施設整備計画に関する Phased program を作成すると共に，特に緊急対策を要する最優先地域を選定すること。

b) 上記最優先地域（Project area）を対象に，雨水排水施設整備計画に関するフィージビリティ調査を実施すること。

c) 上記各策定作業を通じ，バングラデシュ国のカウンターパートに対する技術移転を行うこと。

2) 調査の基本的方針

a) Dhaka 市は，Ganqes，Brahmaputra 及び Meghna の国際的大河川が，形成した氾濫原／デルタの中に発達し，さらに四方を中小河川にとり囲まれている。このようなきわめて低平な地形的宿命から，市域は外水の浸入とそこに降る雨水が重なり，恒常的に浸水被害を受けている。

b) この深刻な浸水被害を解消するため，幾多の排水施設整備計画が立案されたものの，財政的制約を主たる理由にその実現には至っていない。現況施設は突貫的あるいは応急的に対処されたに過ぎず，量的には著しく不足している。

c) 前述したとおり，Dhaka の浸水被害はほとんど毎年発生しており恒常化しているが，５～１０年に１度大被害があるため，人口４３０万人を擁する首都としては大きな問題である。「バ」側の関係機関が浸水対策の緊急性を全員等しく極めて強く訴えていたことでもうかがわれる。

d) Dhaka 市における浸水問題の解決は，基本的には外水の浸入防止という外水対策と，池の有効活用，水門整備，排水機場の設置及び排水路整備等の内水対策の実施により図られることとなろう。

e) 一方，現況の Dhaka 市は人口増加が激しく都市化が極めて活発である。雨水排水対

策による新規整備，改善等はこれら都市開発，道路整備等と合わせて，総合的に，長期的な視野から実施されることが望ましい。

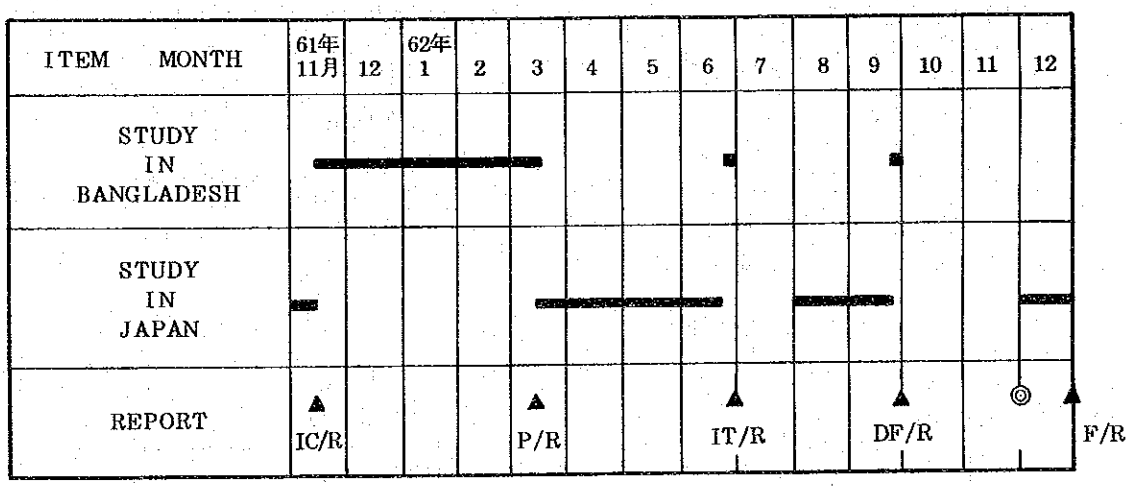
f) このため調査は，上記観点に立ち，①市域全体（A＝260㎢）を対象とした Phased program の作成と，②最優先地域の雨水排水施設整備計画に対する F／S の実施の2段階に分けられる。

g) Phased program は，対象域の地形，土地利用等の現況，浸水特性，都市開発の動向と度合等を十分みきわめた上で，ブロック分割，基本的な対応策の提示，対策実施の優先度を検討する。この際「バ」国という国力を十分配慮した program として作成することが肝要である。

h) 最優先地区として選定された地区に対し排水施設計画の F／S を実施する。その F／S では計画案が早急に実施にむすびつくよう工費，工事内容等に特に配慮が必要となろう。必要に応じ，工事効果の早期発生のための Stage 分けも検討の要がある。

3) 調査工程

現在下記工程に沿って本格調査が継続中である。



（REMARKS） IC／R : Inception Report　　P／R : Progress Report
IT／R : Interim Report　　DF／R : Draft Final Report
◎ : Comment　　F／R : Final Report

3－4－3 廃棄物処理事業

Dhaka 市の廃棄物処理は，Dhaka Municipal Corporation（DMC）によって行われている。しかし，一般廃棄物，産業廃棄物ともにその収集，処分システムは不十分であり，市内の随所にゴミの山がみられる。Dhaka 市周辺にいくつかの廃棄物処分場があるということであるが，その収集システムが不十分なため路上に捨てられたゴミが汚水管きょに流入していることは前述したとおりである。

汚水管きょの流下能力の低減を招くようなゴミ等の流入を極力減らし，管路の清掃頻度を減

らすために廃棄物処理システムの改善が望まれるところである。

3－4－4　工場排水処理

主要な工場排水は，汚水管に流入させずに雨水管もしくは公共用水域に直接排水されているとのことである。主要なものは，Hazaribagh 地区の皮革工場排水等，Tongi 地区の電気，化学工場排水等，Lakhya　川沿いの繊維工場排水等である。

工場排水に対する試行的な放流基準を次に示す。

Tentative Industrial Effluent Quality standard of Bangladesh.

Parameter	Propesed standard.
1. pH	6.5－9.2
2. Colour	Jlear
3. Taste and odour	No offensive taste and odour.
4. Temperature	Nearly 20℃
5. S.S（Suspended solid）	30－150 ppm
6. T.D.S.(Total dissolved solid)	200－1000 ppm
7. BOD（5 days at 20℃）	20－50 ppm
8. Ammonia（NH_3 as N）	0.5－3.0 ppm
9. Chloride	200－600 ppm
0. Free chloride	0.65 ppm
1. Phosphate	35 mg／l
2. H_2S（Hydrogen sulfide）	0.2－1.0 ppm
3. CO_2（caroon dioxide）	2－3 ppm
4. Oil and Grease	8－10 ppm
5. Arsenic	0.05 ppm
6. Chromium	0.05 ppm
7. Copper	0.1 ppm
8. Cadmium	0.015 ppm
9. Zine	0.1 ppm（5 ppm）
0. Lead	0.025 ppm
1. Mercury	0.01 ppm
2. Silver	0.1 ppm
3. Iron	2.0 ppm
4. Magnisium	125 ppm
5. Cyanides（CN）	0.20 ppm
6. Fluorides	1.0 ppm

Collected Prom　EPC

調査団は，代表的な皮革工場の排水状況を視察したが，ほとんど未処理のまま排水されていた（写真２１）。河川，水路等の水質保全のためには下水処理場の改善のみならず，これら工場排水の処理施設の整備が望まれるところである。

参 考 資 料

1. JICA "ダッカ市雨水排水施設整備計画調査，事前調査報告書" 昭和６１年７月
2. RMP International Ltd and James M. Montgomery, Consulting Engineer, Inc.
   "FEASIBILITY REPORT FINAL" APRIL 24, 1981
3. Dhaka WASA "GRANT PROPOSAL FOR URGENT SEWRAGE CONSTRUCTION AND REHABILITATION PROJECT" JUNE, 1985
4. Dhaka WASA "BRIEF ON DHAKA CITY WATER SUPPLY AND SANITATION FACILITIES" ARRIL 06, 1987
5. COL.M. SHARIFUL ISLAM CHAIRMAN DWASA
   "DHAKA WATER SUPPLY AND SEWERAGE AUTHORITY ITS PRESENT AND FUTURE" JULY 1986
6. JICA "Study on Storm Water Drainage System Improvement Project in Dhaka City PROGRESS REPORT" (March 1987)

第４章　プロジェクトの実施に向けて

４－１　現況と主要な問題点

Dhaka 市の下水道は，１９２３年 Narinda ポンプ場が設置されて以来，逐次増設されてきており，現在，Old Dhaka の８０～８５％，その他の地域の約４０％，あわせて人口約１００万人に供用されているといわれている。

現施設の主要な問題点は次のとおりである。

(1) 管きよの老朽化および容量不足等のため，汚水の路面等への漏水。（写真３）

(2) Ｌ.Ｓ.（小規模汚水中継ポンプ場）の老朽化。

特にハザリバーグＬ.Ｓ.は，設置レベルの誤りにより未稼動状態であった。

(3) ナリンダ中央ポンプ場の老朽化。また，新ナリンダ中継ポンプ場は設置レベルの誤りにより未稼動状態であった。

(4) パグラ処理場の放流水質が悪く，ブリガンガ川放流点直下流の水質の悪化。（写真１６）

(5) パグラ処理場からの放流ポンプおよび放流管の老朽化。

(6) 雨水排水システムが不十分なため，汚水管への雨水混入。（写真４）

(7) 生活廃棄物の回収システムが不十分なこと，雨水混入が多いことなどから，管内にゴミ，土砂等が流入し，管の流下能力が低下している箇所が多いようである。（写真５）

４－２　Dhaka　WASA の要望事項

Dhaka WASAから提出されたリハビリテーション等への要望事項は次のとおりである。

(1) 管きよ

1) 幹線管きよの能力増強のための改修（つけ替工事を含む）

2) 枝線管きよの能力増強のための改修（　〃　）

(2) Ｌ.Ｓ.

1) 揚水能力の増強

2) 沈砂，し渣を除去するための施設の設置

3) その他老朽設備，構造物の改修（ゲート，ポンプ，建物 etc ）

(3) ナリンダ中央ポンプ場

1) 新ナリンダ中央ポンプ場のレベル関係の調査および根本的改造

2) 沈砂，し渣を除去するための施設の設置

3) その他老朽設備等の改善（クレーン，ゲート etc ）

(4) パグラ処理場

1) 放流水質の改善に係る事業

2) その他老朽設備等の改善

(5) パグラ処理場の放流施設

1) パグラ放流ポンプ場の改善

2) 放流管きょの新設

(6) 管きょ清掃用機材

1) 管きょ清掃用バキュームカー，高圧洗浄車

2) 除去汚泥，ごみ等の運搬車

3) 排水用ポンプ etc

4－3 基本設計の範囲

Dhaka WASA の要望，現地調査，更には長期計画と当面実施すべき改善計画の関係の整理の必要性等を踏まえ，基本設計は以下の範囲とする。

(1) 既存リストステーションおよび関連施設のリハビリ

(2) ナリンダ中央ポンプ場（新・旧）のリハビリ

(3) パグラ下水処理場の改善（処理水量及び水質）

(4) 処理水放流施設のリハビリ

特に(1)の関連施設については，緊急に実施すべき管渠の補修及び適正な維持管理に不可欠な機器類の補充を含むものである。

4－4 プロジェクトの実施に向けて

本事前調査では，援助要請のあった下水道施設（汚水系）の政策，改善について，その実態を把握するとともに，援助対象プロジェクトの適性の確認を行った。

Dhaka WASA との協議および6箇所のリフトステーション，ナリンダポンプ場（新・旧）パグラ処理場等の現地調査を実施し，その結果，要請のあった下水道施設について老朽化，能力不足等により，緊急な対策が望まれる状態にあることを確認した。

また，維持管理の実態，技術者の養成状況からも施設の適正な運転管理が期待し得るとの感触を得た。よって，本件を援助対象プロジェクトとする前提で基本設計に着手することについて適当であると思料される。

ここでは，本件プロジェクトをより効率的ならしめるため基本設計に際し考慮すべき事項，本件プロジェクトと併せて実施を推進されるべき施策に関し述べる。

(1) 基本設計で対象となるのは，要請のあった緊急に対応が必要な施設の改善が主となるが，改善計画は，現有施設の正確な評価と同時に，長期計画上具備すべき能力を勘案したうえで策定される必要がある。

したがって，基本設計の中で，長期計画と改善計画の関係を整理する。

(2) リフトステーション

1) 下水に含まれる固形物の量が多いことから，リフト・ステーション入口にスクリーンを設置する必要があるが，人力によるかき上げが容易な構造とすること。

2） ポンプ容量の設定に際し，下流管渠の流下能力，雨期における雨水浸入実態を考慮すること。

(3) 処理場

1） 散水濾床法のほか，安定化池の増設，エアレーション池，最初沈澱池＋安定化池等を代替案として検討に加えること。

2） サンドベッドによる汚泥脱水方式が雨期においても有効か否かの検討および汚泥の安定化池に返送する案についても検討すること。

(4) 今回の要請は汚水処理に係る施設の改築，改善等に限られているが，雨期に道路の冠水が日常化している本地域では，汚水整備のみではその効果は十分に期待できないことから，雨水排水整備についても併せて推進することが望まれる。

(5) 汚水管，雨水管ともに，果物の皮，ゴミ等が原因で流下能力を低下させていることが現地調査等から明らかであった。下水道施設整備（汚水・雨水）の効果を十分に発現させるためには，適正な廃棄物の収集システムの確立が望まれる。

なお，当面の対策としては，管渠の清掃機器の導入も検討に値しよう。

付　属　資　料

MINUTES OF DISCUSSION
ON
the Sewerage Construction and Rehabilitation Project
IN
THE PEOPLE'S REPUBLIC OF BANGLADESH

In response to the request of the Government of the People's Republic of Bangladesh, the Government of Japan decided to conduct a preliminary study on the Sewerage Construction and Rehabilitation Project (hereinafter referred to as "the Project"), and entrusted the study to the Japan International Cooperation Agency (JICA). JICA sent to the People's Republic of Bangladesh the study team headed by Mr. Yasuo NISHIGUCHI, Deputy Director, Sewerage Planning Division, Sewerage and Purification Department, Ministry of Construction (hereinafter referred to as "the Team") from June 1 to 13, 1987.

The team had a series of discussion on the Project with the officials concerned of the Government of the People's Republic of Bangladesh headed by Mr. S.A.N.M. Wahed, Chief Engineer, DWASA and conducted a field survey in the relevant areas to the project.

As a result of the study, both parties agreed to recommend to their respective Governments that the major points of understanding reached between them, attached herewith, should be examined towards the realization of the project.

Dhaka, June 11, 1987

Yasuo Nishiguchi

Mr. Yasuo NISHIGUCHI
Team Leader
Preliminary Study Team
Japan International
Cooperation Agency.

LT.BRIG. CHOWDHURY KHALEQUZZAMAN (Retd.)
CHAIRMAN
DHAKA WATER SUPPLY AND SEWERAGE AUTHORITY.

ATTACHMENT:

1. The objective of the Project is to rehabilitate sewage lift stations and Narinda Sewerage Pumping stations, and to improve the existing treatment facilities at Pagla to upgrade the discharged water quality:

2. The site of the Project is located in the city of Dhaka, capital of the People's Republic of Bangladesh. (Site map is atached as Annex I)

3. The Project Components requested by the Bangladesh side are as follows:

   a) Rehabilitation of the existing lift stations and related facilities including rehabilitation of sewer.

   b) Rehabilitation of Narinda central Pumping stations (old and new)

   c) Rehabilitation of Pagla outfall system.

   d) Improvement of the existing sewage treatment plant at Pagla.

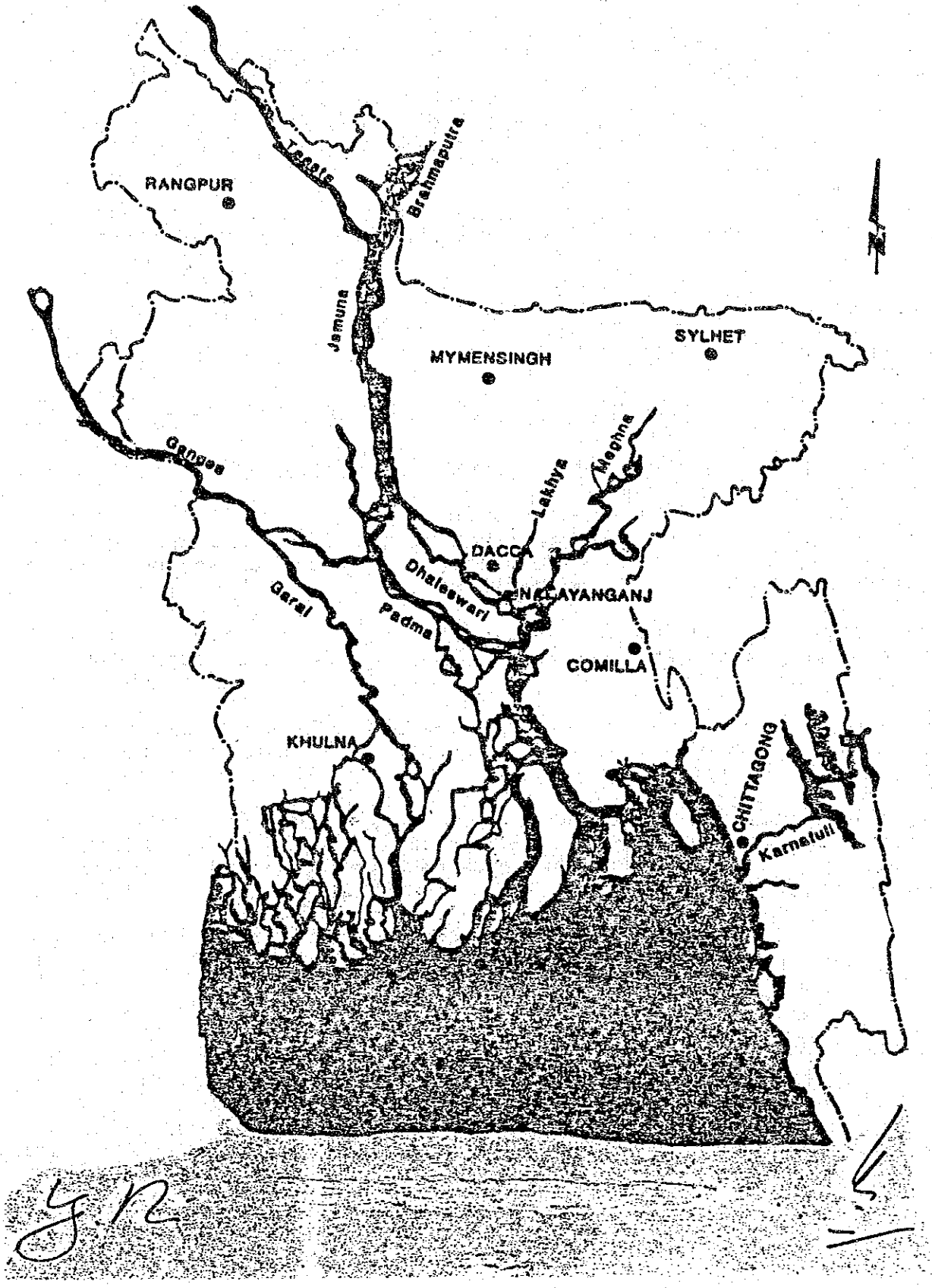
4. Water Supply and Sewerage Authority (DWASA) is responsible for the administration of the project.

5. The Bangladesh side has understood Japanese Grant Aid System explained by the Team.

6. Japanese Government will send a Basic Design Study Team at an earlier date in order to collect further information and data and to make the Basic Design in consultation with Dhaka WASA, when this project is regarded as practicable through the report of the preliminary Study.

7. The Bangladesh side shall provide all necessary assistance, information and data relating to the project when the Basic Design Study Team visits the People's Republic of Bangladesh.

Annex I


RANGPUR
Teesta
Brahmaputra
Jamuna
MYMENSINGH
SYLHET
Ganges
Lakhya
Meghna
DACCA
Dhaleswari
Garai
Padma
NARAYANGANJ
COMILLA
KHULNA
CHITTAGONG
Karnafuli
N

QUESTIONNAIRE

A GENERAL MATTERS

1, The topographic map and the geological map of Dhaka city (to be clear as much as possible)

2, The maps of current main sewerage facilities. -1) trunk sewers 2) lift stations 3) the pumping station 4) the sewage treatment plant.

3, What monitoring system for rainfall in Dhaka do you have ?

4, The materials which show flood area, period and its water level.

5, The photographs which show situations of flood.

6, The annual wage of employees who operate and maintain sewerage facilities.

7, The newer data which show the water quality of the Burhi Ganga River, other rivers and at the sampling stations before and after the discharge point of the Pagla S.T.P.

8, The plan of the water purification plant of Narayanganj city -the intake point, maximum daily flow and stage construction plan.

9, The situation of electric power supply -1) the capacity of electricity supply to the Narinda pumping station and the Pagla S.T.P. 2) the frequency of power failure. 3) electric charge

10, The situation of operating and maintaining sewerage facilities .-1) manpower of each facilities and their skill. 2) how are those facilities operated in night time ? 3) are there any manuals for their works ?

B SEWAGE LIFT STATIONS AND THE NARINDA CENTRAL PUMPING STATION

1, The more detailed explanation why pumps and control panel do not work well.

2, The more detailed explanation why some newer lift stations do not work well while some old lift stations do not require any rehabilitation.

3, The more detailed reasons why the new Narinda central pumping station has been out of operation since its construction in 1978.

4,The detailed design materials of each lift stations and the pumping station.
1) the water levels. 2) main floor plans and cross sections. 3)types, capacities and TDH of pumps.

5, The data of actual influent flow rate into each facilities in both dry and wet seasons.

6, Were there any destruction accidents of sewers such as a depression of road ?

7, The frequency of sewer cleaning. - are there any routine works of sewer cleaning ?

C THE PAGLA SEWAGE TREATMENT PLANT

1, The detailed design materials of the existing the S.T.P.
1) the water levels. 2) plans and cross sections. 3) design factors.

2, The newer data of the influent and efluent water quality.

3, The future plan -stage construction plan until it will have the whole capacity.

4, The detailed explanation of effectiveness of upgrading the Pagla S.T.P.

5, Land cost around the S.T.P site.

6, Are there any possibilities of getting more site around the existing S.T.P. for expansion ?

7, How many communal sanitation blocks (CSB) are there in Dhaka ?

Questionnaire に対する回答

B. 2 .

New sewage lift station has a base floor for installation of Motors at a very lower elevation (about 15ft. from G.L.).The sump well is underneath this base floor. During non operation hour the base floor remains under upward hydraulic thrust and this causes over-flow through manhole and as a result motors submerge under sewage. And hence most often motors are submerged in water. This do not happen in case of new sewage lift station as the same has different arrangement having no upward hydraulic thrust on the base floor of motors and the floor never goes under water .

B. 3.

The invert of the sump-well of the Newly constructed Narind Central sewge lift station is at a comparatively higher elevation in comparison with that of the nearest manhole of sewarage system. As a result normal sewage flow inside the sump well is very much disturbed ad this cause disturbance in normal pumping causing stagnancy, blockaged and over-flow of sewage in theupstream .

B. 5.

No data was recorded as measuring device was faulty and it is now necessary to make measuring device for doing the needful in future .

B. 6 .

Yes. Such cases occured :-

(i) the sewer that runs to the SLS (suction side) of Tejgaon lift station .

(ii) the valve installed on the suction line of Hazaribagh sewage lift station .

(iii) out - fall sewer had depression in some places and the same were demolishd and re-constructed .

Contd...pg...2...

B. 7.

We do make annual routine cleaning during dry season that is sometimes during the months from February to May. But routine annual cleaning is not very much effective for the reasons mentioned below :-

(i) the sewers in old Dhaka was laid long time back. Some were laid in British regime i.e. before 1947 and some were laid during Pakistani regime i.e. before 1971 . At that time population of the city was much less than it is now . The diameter was at that time quite adequate but now these diameter has to be replaced by bigger ones for smooth flow of abnormal sewage load.

(ii) Drainage system of many roads of the city is not good and hence after rainfall there is always stgnancy of water on may roads. Road users uncover the covers of the manholes and thus water escapes through sewarage system resulting intrusion of solids of the road surface inside the sewers.

(iii) Dhaka Municipal Corporation in many places connected drainage system with WASA sewer.

(iv) Consumers dispose solid wastes such co-conut, bannana skin pine-apple skin, paper, cloth, sandle etc. inside manholes directly.

(v) Storm water intrusion

改修要請施設の現状と問題点

1. Rehabilitation of sewage collection system.

1.1 The trunk sewer passing through low-lying area from Tejgaon to Pagla through Bashaboo & Shamibag has been profesely leaking in many places. As a result the pumps installed in Tejgaon,Bashaboo & Shamibag lift station are not only pumping sewage but also pumping stagnant surface water of the low-lying areas.

These sewers should either be repaired or reconstructed so that they become water-light.

1.2 The diameter of existing sewer from Gulshan to Tejgaon appears inadequate as it carries sewage from many places such as Gulshan,Banani, Tejgaon and their adjacent areas.It is recorded that the diameter should be at least 30" (inch).

1.3 The diameter of the sewer from Asadgate lift station to Tejgaon lift station also appears low and this may also be examined.It is recommended to make this diameter from 18" (inch) to 30" (inch).

1.4 The construction of western sewer along the bank of the river Buriganga appears faulty and hence it may be repaired/reconstructed.

1.4 The dia of the sewer from Hazaribagh to New Market sewage lift station may be made 30" (inch).

1.5 The diameter from P&T lift station to Narinda which is only 36" may be examined for replacement by requisite diameter.It is proposed to make this diameter 45".

1.6 The sewer starting from Nawabgonj to the crossing of Agamoshi and Alauddin road should also be higher in diameter.It is recommended to make it 30".

1.7 The lateral sewers comming from different lanes and by lanes to the trunk sewer need also be properly designed for changing diameter as per existing load according to present population.The trunk sewers running through low lying areas which remains under water during monsoon should be covered with earth(at least 5 ft.above the top of the sewer).

2.1 It is necessary to examine whether the capacity of lift stations at Tejgaon,New Market,Bashaboo,Shamibag etc.are adequate to handle the loads receiving by them at present and also in future.

2.2 The sump-well at Narinda may be demolished and re-done for deepening the same to provide provision for lowering suction pipe so that smooth pumping of seweage is possible.This will ensure blockage and over-flow of sewage in the upstream.

2.3 Both the delivery and suction pipe of all individual pump of all sewage lift stations should be independent.

2.4 The sump-well of all the sewage lift stations should be made bigger in size.The existing ones are inadequate in size and hence over-flow quickly.

2.5 There must be a provision of separation of floated and submerged solids from the sewage before it enters,the sump-well of lift stations.It is proposed that the present lift stations may be converted to a sort of grit chamber with provision for lifting of both floated and sedimented solid material and screen may be provided in it. Regular sewage lift station may be made by the side of each existing lift station with provision of dry well and wet well as we have in our old sewage lift stations.

2.6 The delivery from the delivery line of the pump to the nearest bigger dia sewer may be made independent.

2.7 The capacity of pump and their nos.are to be analyzed according to load comming in the lift station and prescribe accordingly.

3. Rehabilitation of Pagla Lagoon.

3.1 Measuring device in both inflow line and out going line must be made so that flow measurement can be made easily.These are extremely necessary.

3.2 The sluice gates(of both inflow line and out going line) must be checked properly and incase of necessity,replacement repair must be made by good ones.

3.3 There is existing R.C.C. work for slope profection of the banks of all the lagoons but it is not adequally raised and as a result during the monsoon the R.C.C. work goes under water and the same needs be raised by at least another 5 ft.

3.4 The ancillary structure made in 1977-78 do not work properly and the same are to be checked and repaired replaced in case of necessity.

3.5 Degree of treatment of sewage by the present system appears not upto standered for disposal to the stream of the Buriganga and hence,system may need upgrading for more effective treatment so that effluent can safely be disposed to the river without endanging human and aquatic life.

condt.....3/-

Outfall sewer:

The outfall sewer which carries effluent from the treatment plant to the river is faulty.It may be mentioned here that the treatment plant is situated in a low-lying area bounded by irrigation embankment.The water level of the Buriganga in some time of the years go more than 10 ft.above the normal level of this low lying areas and hence failure of faulty outfall sewer may endanger human life and property.

It is,therefore,suggested that a parallel outfall sewer may be constructed alternatively.

The arrangement for withdrawal and re-installation of pumps,valves, motors and other machineries in sewage lift stations is very poor in all the lift stations and specially in Pagla.Proper arrangement for withdrawa. of pumps & machineries and are installation of the same may be made.

Structure at the disposal point at river is away from the river bank and hence maintenance and operation of the same is difficult.

It is proposed that a small arrangement may kindly be made for going and coming to the structure at disposal point.

Signaling arrangement may be made for giving caution to boats and ships etc. running throught the river.

Office of the Superintending Enginner
R,P,E,& M Circle
Dhaka Wasa .

Memo No:- dt:-

Sub:- Joint Inspection of Sewer Installations by S.E. P&D, C&D, R P E&M, and representative of S.E, MODS

Enclosed here- with the joint inspection report of all the sewer Lift stations i/c pagla out fall sewer lift station and Narinda Central Sewage pumping station identifying the electrical and mechanical problems which requires immediate modification and repair for your kind pre-perosenel perosal and accomodating these in the proposed schemes. Regarding the problems in sewerage system a report from the S.E. MODS may kindly be obtained.

(Md. Sanaullah)
Superintending Engineer(i/c)
R.P.E.& M Circle,
Dhaka Wasa .

Memo No:- dt:-

C.C.to.

1.Superintending Engineer, P&D, C&D, MODS, Circle, Dhaka Wasa .

2. E.E, FMD. Dhaka Wasa .

Superintending Engineer(i/c)
R.P.E.& M Circle
Dhaka Wasa .

Dated the 2nd June 1987, Joint inspection of sewage lift statio.

1. Asad Gate S/L. station.

a) No. Grit chamber & screen in the incoming line/chamber creates serious problem.

b. Prob. arises due to common suction line for all the pumps during maint of pump.

c. Higher capacity pumps to be installed i/c. replacing the in adequate delivery pipe upto the chamber.

d) L.T.panel board not in operation.

e) N.R.Vs of suction line to be replaced by sluice valves

f) N.R.Vs. are not working.

g) De-watering pump needs to be installed.

h) Sump well water level indicator out of order.

i) Sluice gates in the incoming & out going line are not working.

j) Pumping equipment is submerged due to infiltration of ground water and raw sewage through the M.H.cover within the sump which is to be eliminated by changing the design of the sump or some other means.

2. Nilkhet S/L. station.

a) No Grit chamber & screen in the incomming line or chamber.

b) In-coming manhole is 22' deep, and the length/depth of the pump suction pipe is to be extended or lowered as the sewage found 6' in the incoming manhole but the suction line becomes dry.

c) N.R.Vs. are so installed last over the floor which creates problems to take them out for maintenances.

d) Over head joist installed for lifting pumps is away from the pump alignment is to be shifted to pump alignment.

e) Water level indicator out of order.

f) Common suction line for pumps, causes maintenance problems .

g) De-watering pump to be installed.

3. Ajimpur S/L. station.

a) Both sluice gates, incoming line are defective.

b) Low voltage prevails every day from 10 A.M.to 5 P.M. except on Friday/ Holiday which pumping is suspended.

c) No Grit chamber and screen in the incoming line/chamber.

d) No By-pass line in the S/L. station.

Contd.....P/2.

4. Nowabgonj S/L.station and Faridabad S/L. station

a) The brick structure of sump well is very old and needs total ~~xxx~~ re-construction immediately. Otherwise this may cause accident at any time and also dengerous from maintenance problem.

b) Size of existing increased Delivery main to be ~~widened~~. Because 10 to 15 minuts pump operation causes overflow in the manhole near the lift station .

c) By pass line should be constructed.

5. Medical S/L. station.

a) Common suction line for all the pumps to be modified.

b) L.T.pannel to be replaced/rehebilited .c) Bypass line should be

c) In-coming sluice gate defective . constructed.

d) Pump capacity to be increased.

e) N.R.Vs. are installed in the suction line to be replaced by S.V.

f) To eliminate over flow of the M.H. defective out going line to be modified.

6. P.& T S/L. station.

a) No grit chamber & screen in the incoming line.

b) Pump capacity to be increased to coup with the system load.

c) By pass line to be modified & made effective.

d) L.T.pannel board to be replaced/ repaired.

7. Narinda (Old) S/L. station.

a) 113 H.P. & 50 H.P. very old pumps to be procured and replaced.

b) Over-head moving chain pully (10 -Ton capacity) needs to be replaced.

c) Mechanical operated screen of grit chamber to be repla-ced.

d) Top slab of sump wells to be reconstructed .

e) 32" M.S. Force main to be replaced including making connection at swami-bagh with trunk sewer.

8. Narinda S/L. station (New).

a) The level of pump suction lines to be checked for lowering and arrange-ment for individual suction line for each pump to be made.

b) Grit chamber to be constructed with mechanically operated screen.

Contd.....P/3.

9. Pagla S/L. station.

a) Over head joint and suitable moving chain pully to be installed for maintenance.

b) Spare pump & Motor set required. i/c repair of the Generator.

c) Ancillialy structures between the lagoons to be modified.

10. Swamibagh, Tejgaon & Bashaboo S/L. station(Common problems).

a) No grit chamber & screen in the incoming line.

b) Common suction for all the pumps installed to be modified.

c) Sump well manhole overflow during rainy season which submerges pumping equipment.

11. Hazaribagh s/l. station.

a) Pump equipments are submerged during monsoon due to infiltration of ground water & leakage of raw sewage to the sump well.

b) The slope of delivery/out going line is towards the lift station which require modification.

c) In-coming trunk sewer line defective.

d) The lift station has not yet put into commissioned.

9/4/69

要 請 機 材 一 覧 表

Sub:- Requirement of pump, Utility vehicles & equipments for the maintenance and operation of existing sewerage facilities of Dhaka WASA.

In connection with the above one list in duplicate is sent herewith for favour of handing over the same to the visiting Japany team for inclusion in the proposed sewerage Project under review. Sending herewith also the informations regarding the capacity of electric supply of Narinda & Pagla as wanted by the team.

C.E.

(Md. Sanaullah) 6/5/89
Superintending Engineer(I/C)
RPE&M Circle,
Dhaka WASA.

Requirement of Utility vehicle & equipments.

1. 3-Ton capacity sludge carrying Pick-up - 6 Nos.
2. Sludge de-watering pump petrol/Diesel driven alongwith hose pipe- 6 Nos.
3. 3" dia pressure hose pipe for sludge carrying tract with nozle.
4. Tructor for sewer cleaning traillors - 3 Nos.
5. 10-Ton capacity chain pully for Narinda(Old) C.S. P.S.- 1 set
6. Mechanically operated sluice gate for ~~x~~ different sewer lift stations including Narinda C.S. P.S. and Pagla S.T.P.
7. 3-Ton capacity hydraulic operated fork-lifter for handling of pumps and Motors etc - 1 set
8. Vaccume Sewage cleaning Trucks.

6/4/89

6/4/89

(Md. Sanaullah)
Superintending Engineer(I/C)
RPE&M Circle,
Dhaka WASA.

英 文 要 請 書

DHAKA WATER SUPPLY AND SEWERAGE AUTHORITY
DHAKA, PEOPLE'S REPUBLIC OF BANGLADESH

GRAND PROPOSAL
FOR
URGENT SEWERAGE CONSTRUCTION
AND REHABILITATION PROJECT

JUNE, 1985

GRANT PROPOSAL FOR
URGENT SEWERAGE CONSTRUCTION
AND REHABILITATION PROJECT
DHAKA, PEOPLE'S REPUBLIC OF
BANGLADESH

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ABBREVIATIONS AND ACRONYMS

DPHE	Department of Public Health Engineering
DIT	Dhaka Improvement Trust
MODS	Maintenance, Operation, Distribution and Services Circle
WASA	Water Supply and Sewerage Authority

Technical Terms

BOD	Biochemical Oxygen Demands at 5-day, 20°C
pH	The reciprocal of the logarithm of the hydrogen-ion concentration
SS	Suspended Solids

Units

cm	Centimetre
Ha	Hectare
hr	Hour
km	Kilometre
m	Metre
mm	Millimetre
m^3	Cubic metre
MGD	Million gallons per day
mg/l	Milligrams per litre
m^3/day	Cubic metres per day
kW	Kilowatt
hp	Horse power

EXECUTIVE SUMMARY

Dhaka City, the capital of the People's Republic of Bangladesh, has a sewerage system which started its construction and operation in the early 1920's. Since then, the sewerage system has gradually been extended in order to meet the requirements by the increased population and now has sewer networks of 233 miles, 14 sewage pumping stations, and one sewage treatment works, serving approximately one million residents of the City.

The existing sewerage system collects the sewage from households, commercial buildings, and industries, through house connections, branch and laterals, and trunk mains, and conveys it to the sewage treatment works of anaerobic ponds located at Pagla for the final treatment. The effluent from the treatment works in disposed of to the Buriganga River through the outfall pumping station and outfall sewer.

The existing system of sewer lines, pumping stations, and sewage treatment works are unsatisfactory, and have caused serious unsanitary problems at many locations in the area. The sewage pumping stations have been deteriorated due mainly to the lack of proper maintenance and rehabilitation works. Some of the stations occasionally became out of order or at least suspended their operation because of the raw sewage and groundwater infiltration into the dry pump wells and resulting submergence of the equipment.

These deteriorated sanitary conditions have further been aggravated by insufficient capacities of the sewers. At many locations, the sewer pipelines are often clogged by sand deposit or broken manholes, and the sewage overflowed from manholes and trunk sewers particularly during peak hours and rainstorms.

The anaerobic pond treatment plant produces the effluent of BOD of 50 to 120 mg/l which is far below the requirements to prevent further contamination of the receiving waters. The ever-increasing population and improvement of the living conditions in the area have rapidly increased and will further increase the water use and the existing sewage treatment is no longer capable of treating the inflowing sewage to the acceptable level. The river water contamiantion caused by unsatisfactory treatment system has already become a deplorable level, requiring immediate actions to prevent degradation of the sanitary conditions in the area.

Most serious effect of the wastewater discharge to the river is a potential high danger to contaminate the water supply systems downstream of the Buriganga River. Narayanganj City, located a few km downstream from the outfall, is planned to rely its water source on the river to supply a drinking water to 120,000 residents and industries, and therefore the City has been in the chronic danger of contacting with the contaminated river water.

The cases of communicable diseases for the year 1984 in Bangladesh were 699,891 and, if the sewerage system was upgraded and rahabilitated, a significant portion of these diseases could have been eliminated.

In view of the unsatisfactory conditions of the existing sewerage system, WASA has been intensively undertaking sewerage improvement programme; however, the shortage of the fund for the works has made the programme significantly behind the schedule. WASA has made several representations with the DPHE and other agencies concerned for additional funds for the implementation of this urgent improvement project, but so far no sufficient amount could be allocated.

In the mean time, we have leaned from various sectors of the national governments that the Japanese Government is now considering to provide special grants for socio-economic projects in Bangladesh, upon accepting our request, with non-reimbursable funds for backing-up our efforts in self-development.

We have studied with WASA's engineering staff as to design and costs for this project, technology transfer from Japan, and we are submitting herewith our preliminary upgrading and rehabilitation plan together with the costs required to implement the project.

The proposed upgrading and rehabilitation project comprises 1) 6 sewage lift stations, 2) Narinda central pumping stations (new and old stations), 3) Pagla sewage treatment works, and 4) effluent outfall facilities.

Accordingly, the following features have been proposed after careful investigations and studies on the existing sewerage facilities:

a. Upgrading and rehabilitation of the existing six sewage lift stations by replacing obsoleted pumps, pipe laying and jointing of the necessary pump suctions and discharges.

b. Upgrading and rehabilitation of Narinda central pumping stations equipment by replacing pumps, pipe laying and jointing of the necessary pump suctions and discharges.

c) Providing a new sewage treatment plant at the existing Pagla treatment works site, to alleviate the water pollution of the Buriganga River.

d) Improvement of the existing Pagla outfall pumping station and outfall sewers for the effluent disposal of the treatment plant effluent to the Buriganga River.

After careful technical studies and investigations on the above mentioned subjects, and in view of the fact that upgrading and rehavilitation of these facilities are most urgently required, we have come to the conclusions that the above project be immediately implemented. If no immediate actions are taken, the sanitary conditions will become progressively worse.

We have every assurance that this design is based on the realistic appraisal of the present situation of the Dhaka city. When the project is completed, significant benefits to public health economy can be expected, including avoidance of productivity losses due to water-borne diseases and avoidance of much higher cost of controlling the water pollution by other means. In view of these, it is believed that the benefits will exceed the costs, and the project, as detailed in this report, is both economically and technically sound.

The total foreign currency costs for the proposed project is estimated at Japanese Yen 3,987,200,000.- and the local currency costs at Taka 5,000,000.-

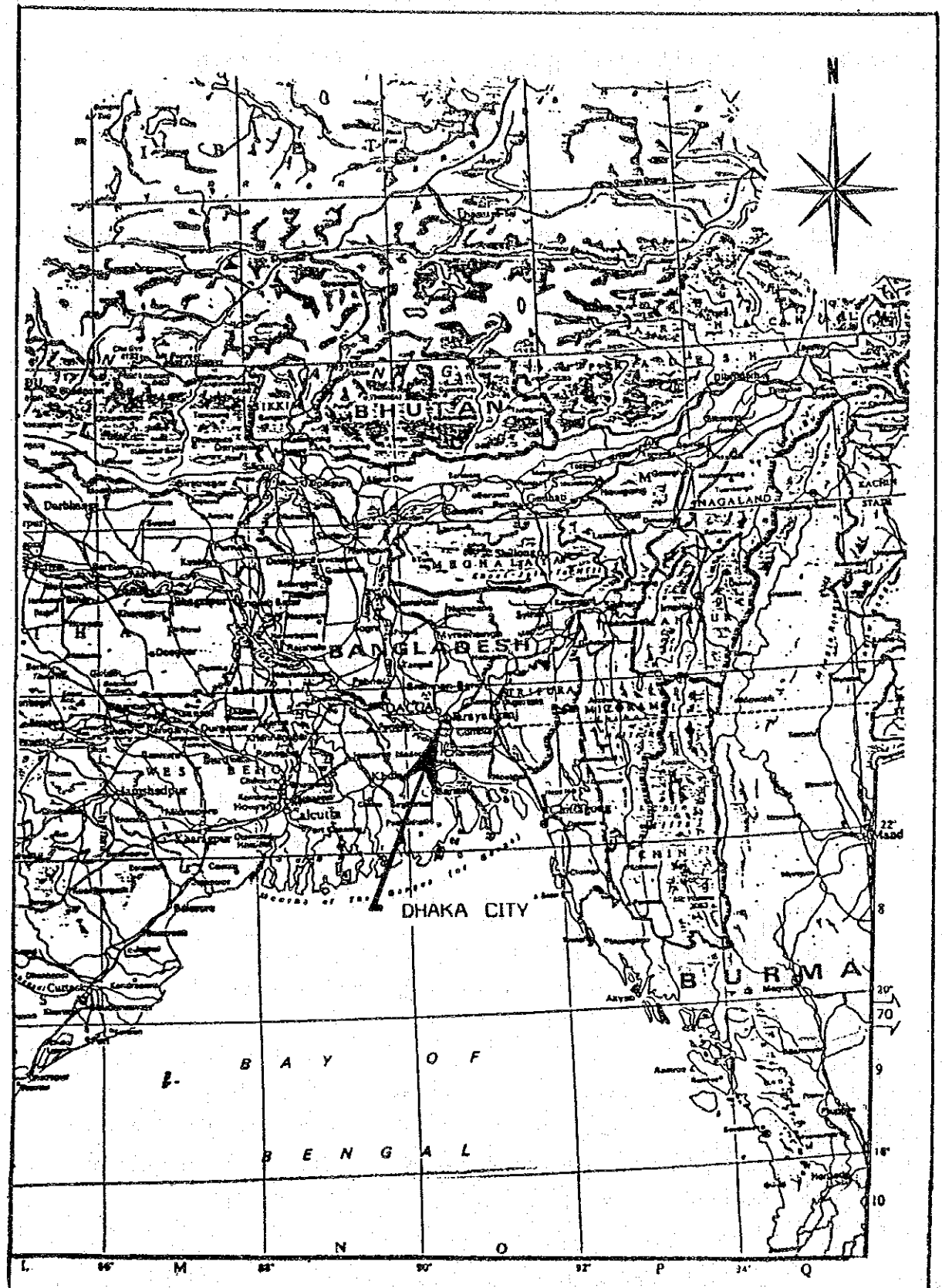

FIGURE 1 LOCATION OF THE PROJECT AREA

I. BACKGROUND AND SUPPORTING INFORMATION

1.1 LOCATION OF PROJECT AREA

The City of Dhaka, capital of the People's Republic of Bangladesh, is situated at latitude 23°40'N and longitude 90°25'E approximately, on the north bank of the Buriganga River, as illustrated in Figure 1. The area lies in the flood plain of the Buriganga tributary, and its geological features are primarily deltaic. Most of the area is covered either alluvium or young rocks.

Historically, the urban development of the City has been confined to the flood plain area on the north bank of the river. At present time, the urban area of the City occupies about 72.5 km^2.

1.2 CLIMATE

The region has a typical semi-tropical monsoon climate and is characterized by high temperatures, high humidities, and extensive cloudness. The period from November through February is, however, dry and warm season having moderate temperature and low humidity. The summer season starts in March and lasts until May, during which period the highest temperature occurs. The monsoon season extends from June to October, and almost three-quarters of the annual rainfalls concentrates in three months of June, July and August. The rain is brought by the strong rain-laden wind originated in Indian Ocean. During the autumn season, from mid-October through December, the temperature falls down to 20 to 24°C. The lowest temperature of 9.4°C was recorded in January. Temperatures, humidities and precipitations in Dhaka by month are shown in Table 1.

As may be seen from the table, the monthly rainfalls in Dhaka ranged from the lowest 2 mm in December to the highest 430 mm in July, with the average annual precipitation of 1,837 mm.

Table 1 Temperature, Humidity and Rainfall in Dhaka

Item	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sept.	Oct.	Nov.	Dec.
Temperature (°C) Max.	25.5	28.0	32.5	35.0	33.7	31.7	30.7	31.0	31.0	30.9	28.6	26.2
Temperature (°C) Min.	11.7	13.4	18.8	23.4	25.4	25.9	26.0	26.2	30.8	23.7	17.6	12.7
Humidity (%) at 6 a.m.	93	90	88	91	93	95	95	94	95	95	94	95
Humidity (%) at 6 p.m.	61	48	44	54	75	81	82	83	83	79	71	70
Precipitation (mm)	18	31	57	68	191	317	430	300	232	166	25	2

1.3 POPULATION

The population of the City has rapidly increased in the last two decades. The City's population of 521,034 in 1961 increased to 1,679,752 by 1974 at the growth rate of 222.4 per cent in the 13 years. The population increase further continued and reached 2,830,632 by the year 1979 at the growth rate of 68.53 per cent in this period. The present population of the City is estimated at approximately 4 million. The population increase is expected to continue further and by the year 2000 it is assumed to reach about 8 million.

1.4 INSTITUTIONAL FRAME WORK

Responsibility for water supply and sewerage system planning and construction rests with the Department of Public Health Engineering (DPHE) which belongs to the Ministry of Local Government, Rural Development Cooperatives and Religious Affairs and also to the Water Supply and Sewerage Authority (WASA).

The operation and maintenance of the water supply and sewerage systems in the two major cities of Dhaka and Chittagon are the responsibility of WASA, while DPHE is responsible for such undertaking as water supply and sewage works, public health, flood control, etc., for allover Bangladesh except for the two cities.

WASA was established in the two cities to manage the water supply and sewerage system operation and maintenance. WASA was separated from DPHE in 1963 and, like DPHE, it is a public enterprise (Authority) that belongs to the Ministry of Local Government, Rural Development, Cooperatives and Religious Affairs.

The sewerage system facilities are operated and maintained by the Maintenance, Operation, Distribution, and Services Circle (MODS) under the charge of Superintending Engineer, with the aid of 1,012 staff as of March 1985. The entire sewerage service area is divided into six sewerage zones for administrative and managerical purposes, as shown in Figures 2 and 3, and each of the zones is controlled by the Executive Engineer. Organizations of WASA and MODS Circle are shown in Figures 4 and 5, respectively.

1.5 WATER SUPPLY SYSTEM

Since its establishment, WASA has been responsible for water supply system. The system development scheme of 1959 reviewed and revised in 1966 and a first-stage master plan covering a design period of ten years developed, based on which a project was executed.

Presently, WASA is supplying approximately 90 MGD (409,200 m^3/day) drinking water to about 2.5 million residents of Dhaka or 70 to 80 per cent of the City's total population of 4 million. The water sources rely on a total of 106 tubewells and a water purification plant. The water distribution pipe lines have been extended gradually and now the total pipe length reached 612 miles.

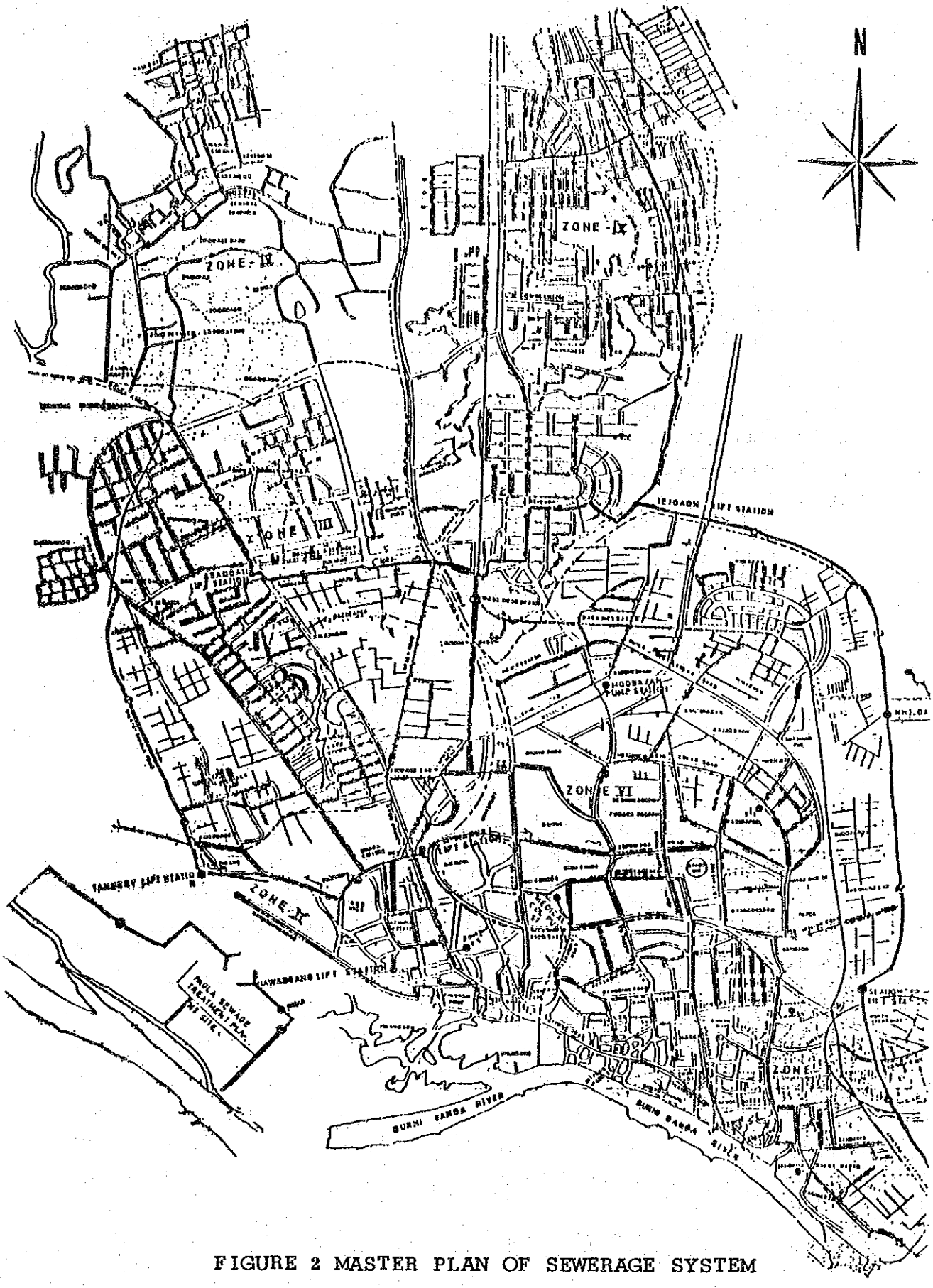

FIGURE 2 MASTER PLAN OF SEWERAGE SYSTEM

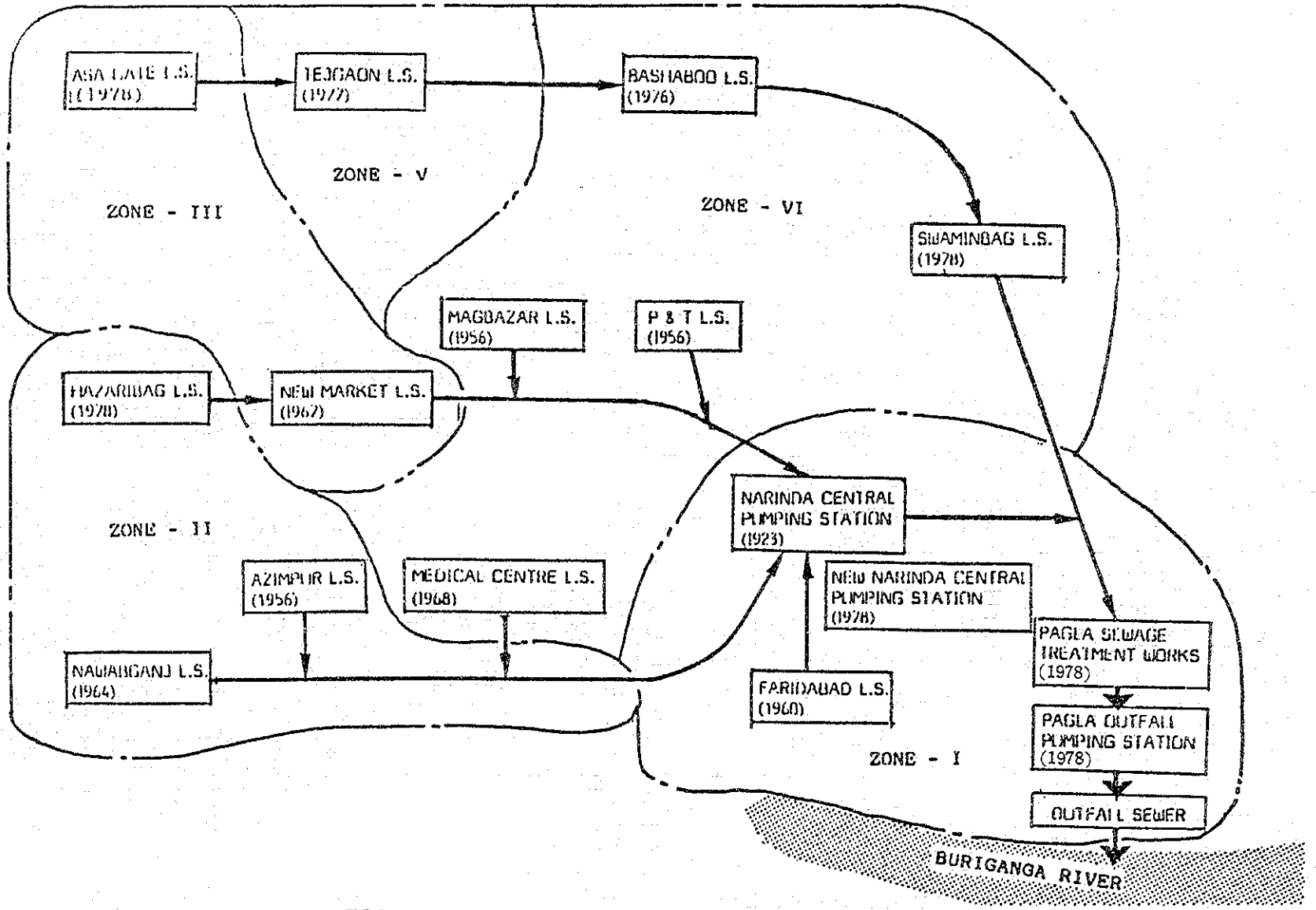

FIGURE 3 SCHEMATIC OF SEWERAGE SYSTEM

ORGANISATION CHART.

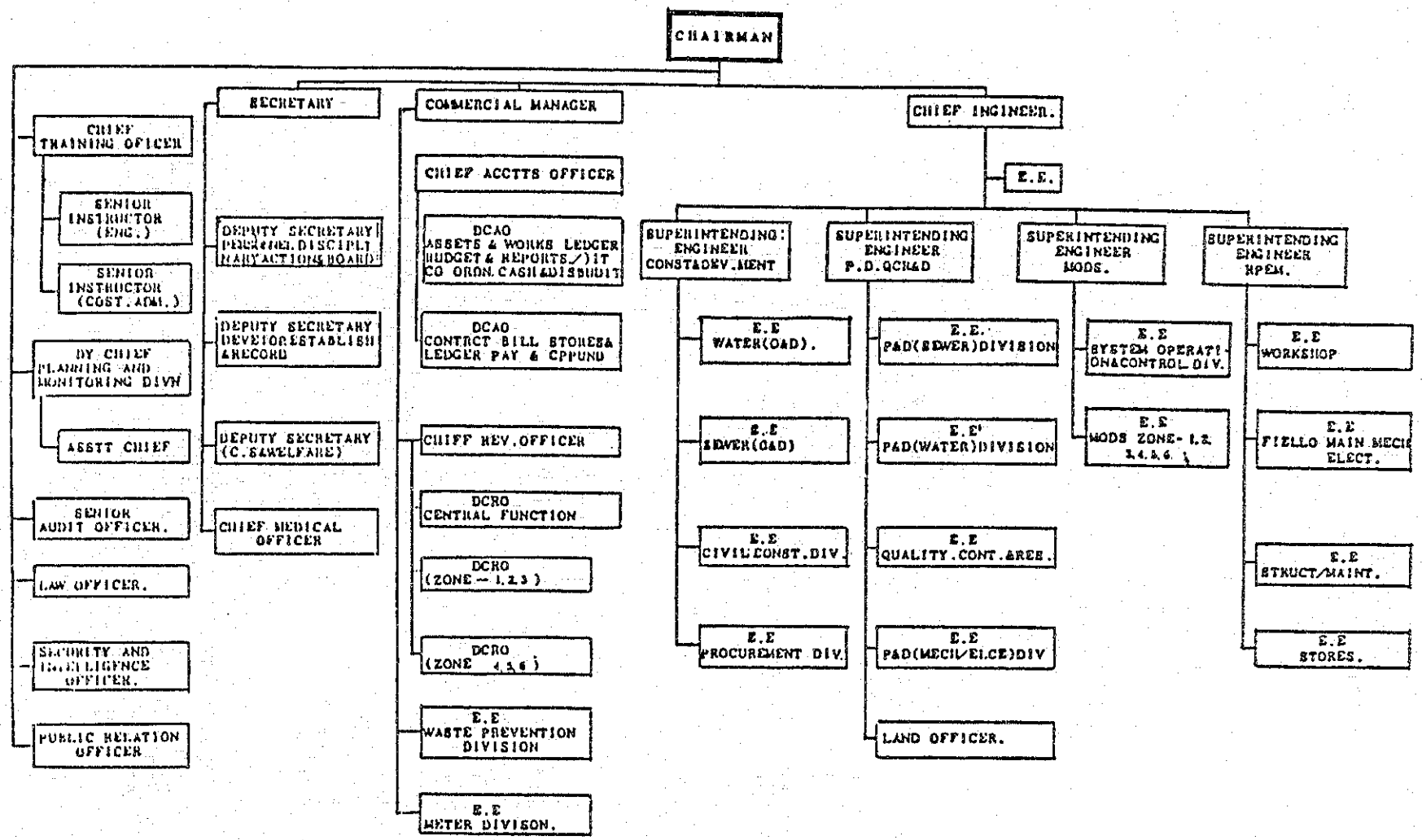

FIGURE 4 DHAKA WATER SUPPLY AND SEWERAGE AUTHORITY

REMARKS:

EXISTILLGAS ON DEC/1984

WATER LINE	612	MILES
SEWER LINE	233	NOS
WATER PUMP	106	NOS
SEWER PUMP	14	NOS
WATER CONNECTIONS	84889	NOS
SEWER CONNECTIONS	23431	NOS
WATER PRODUCTION	91	MGD
STREET HYDRANT	1209	NOS
OVER HEAD TANK	29	NOS
GAS CHLORINATOR	47	NOS
BLESSING POWDER	58	NOS
WATER CARRIER	14	NOS
MOVABLE GENERATOR	19	NOS
GENERATOR FIXED	6	NOS

MODS CIRCLE
TOTAL MANPOWER 997

MODS CIRCLE

TOT. 8

S.E.	1
A.E.	1
Stenographer	1
U.D.A.	1
L.D.A. CUM.TYPST	2
MLSS	2

SEWAGE LIFTING STATION : TOT 14

WATER PUMP STATION : TOT 106

DHAKA WATER WORKS : TOT 1

ZONE-I	ZONE-II	ZONE-III	ZONE-IV	ZONE-V	ZONE-VI	SYSTEM CONTROL
TOTAL MAN POWER 206	T.M.P 199	T.M.P 136	T.M.P 108	T.M.P 108	T.M.P 167	T.M.P 65
S.L.S 3	S.L.S 3	S.L.S 2	S.L.S 0	S.L.S 1	S.L.S 5	
W.P.S 25	W.P.S 11	W.P.S 17	W.P.S 13	W.P.S 14	W.P.S 26	

FIGURE 5 SET-UP OF MODS CIRCLE (EXISING AS ON 31 ST. DEC/1984)

1.6 SEWERAGE SYSTEM

Since its construction started in the early 1920's, the sewerage system has gradually been extended and now serves approximately 80 to 85 per cent of the old Dhaka city area and 30 to 40 per cent of the new Dhaka city area with the served population of about 1 million. WASA has a sewerage improvement programme to serve up to 80 per cent of the City's population by the year 2010. The outline of the existing sewerage system is as follows:

- Total sewer length : 233 miles
- Pumping stations: 14 stations
- House connections: 23,431 houses
- Sewage treatment works: 1 plant

In each of the six sewerage zones, the sewage pumping station's is provided to boost the sewage. As illustrated in Figure 3, the sewage from the sewerage zones III, V and VI is conveyed to Swaminbag pumping station and transmitted to the treatment works, whereas that from the remaining zones is led to the treatment plant via Narinda Central pumping station. The sewage is treated by the anaerobic poind process and eventually disposed of to the Briganga River through Pagla outfall pumping station.

The existing system of sewage pumping, treatment and disposal are unsatisfactory. The functions of the pumping stations have been deterded due to the lack of proper maintenance and rehabilitation. Also, the Pagla sewage treatment works has inadequate treatment capacity and efficiency, and outfall pumping and sewers do not function effectively as intended, particularly during the period of high water elevations of the river.

(a) Sewer Lines and Sewage Lift Stations

Of the existing 12 sewage lift stations, old stations are relatively well operated, while new stations are not. Six new lift stations, namely, 1) Asad Gate L.S. (Zone III), 2) Tejgaon L.S. (Zone V), 3) Bashaboo L.S. (Zone VI), 4) Swaminbag L.S. (Zone VI), 5) Magbazar L.S. (Zone VI), and 6) P&T L.S. (Zone VI), have not been well operated due to occasional raw sewage and/or groundwater infiltration into dry wells during the rainy seasons. Also, most of the old lift stations were flooded by the raw sewage during the rainy seasons, resulting in occasional suspensions of the operation.

At many locations in the sewer lines, the raw sewage frequently overflowed from manholes or trunk sewers, due to the breakdown of old brick sewers and clogging of the pipes by accumulated sand and debris.

(b) Narinda Central Pumping Station

There exist two separately provided pumping stations at Narinds, one was constructed in 1923 and the new one in 1978. The old station has a total of 7 horizontal centrifugal pumps either driven by electric motors or diesel engines, manually controlled, as listed below:

No. of Pumps	Prime Mover	Output
2	Elec. motor	113 hp
2 (standby)	Elec. motor	113 hp
2 (standby)	Diesel engine	50 hp
1	Elec. motor	50 hp

During the dry seasons, two largest pumps have been in operation while in the rainy seasons additional small size pumps are put in operation to discharge the increased wastewater inflows.

(c) Pagla Sewage Treatment Works

The sewage from Swaminbag and Narinda central pumping stations is finally transmitted to the sewage treatment wroks at Pagla to receive an anaerobic treatment by a series of shallow anaerobic ponds. The works with the treatment capacity of 40 MGD produces the effluent having BOD concentrations ranging from 60 to 120 mg/l. The sewage from Narinda pumping station inflows to the primary anaerobic ponds (No. 1 and No. 2). The primary ponds effluent is then led to the final poind (No. 3). The effluent is chlorinated and pumped up at the Pagla outfall pumping station for the final disposal to the Buriganga River. The total capacity of the ponds is estimated to be approximately 394,000 m^3, which retains the daily average sewage inflow for about 2.5 days (design retention period is 2.1 days).

The outfall pumping station has a capacity of about 40.1 MGD or 185,000 m^3/day, when all the pumps are fully operated. The treatment plant effluent is discharged through the outfall sewer of horseshoe section provided with a raised outlet structure to prevent backflow from the river. The outfall sewer, made of bricks, cannot sustain the water pressure of high river water elevation and as such it does not function while the river water level is high. Moreover, the gatesof the outfall are out of order and unable to prevent the river water backflows.

The pond effluents were collected at each pond outlet and analysed on 27th February and 3rd March, 1985, by the Department of Environmental Pollution Control Laboratory, for the items of pH, SS, BOD_5 and others. The results of the analyses are shown in Table 2.

Table 2. Anaerobic Ponds Effluent Qualities

Location	pH	Temperature (°C)	Transparency (cm)	BOD5 (mg/l)	Colour	SS (mg/l)	Date
No. 1 Lagoon	7.2		2 - 3	104	Slightly darkgrey	328	Feb. 27/1985
No. 3 Lagoon	7.2		5 - 6	118	"	31	"
No. 2 Lagoon	7.2	27.5	2.0	56	Light pink	111	Mar. 3/1985
No. 3 Lagoon	7.2	27.5	5.0	76.5	Light green	39	"

1.7 CRITIQUE OF EXISTING SEWERAGE SYSTEM

The ever-increasing population of Dhaka has rapidly increased the wastewater production, and the city area has outgrown its sanitary systems, particularly the sewerage extension. At present, the existing sewerage system collects and treats only about 40 per cent of the total wastewater production, the rest being discharged directly to the nearby drains, ground and other waterways.

As a result, the wastewater is everywhere in evidence, in the gutters, in the rivers, and during the rainy seasons in the floodwaters that rise to house level in many locations, and now the sanitary condition and water contamination of public water bodies have become a deplorable level. A significant water quality deterioration has also been observed in the Buriganga River and will progressively become worse due to accelerating growth of the population and industry.

The recent water quality surveys conducted by WASA and Environmental Pollution Control Board confirmed that the river water has been gradually polluted by the wastewaters. BOD concentrations at the selected monitoring points in the Buriganga River at the upstream

of the treatment works ranged between 2.1 and 2.6 mg/l, whereas that at about 1.2 miles downstream of the outfall was 4 mg/l. The BOD concentrations at just downstream of the outfall were in the range of 14 to 18 mg/l.

Although the data showing relationships between the shortecoming of sewerage and the incidences of the water-borne diseases in the area are not readily available, the cases of communicable diseases in 1984 in Bangladesh were 699,891. A significant portion of these diseases may be associated with improper disposal of human wastes to the water courses. It is reasonable to associate such outbreaks with the increased human contact with the domestic wastewaters which is almost impossible to avoid times of rising waters. During the rainy seasons, the sewage frequently overflows at many locations throughout the area and has aggravated the spreading of the diseases. Polluted drinking water is also bound to occur if there are leaks in the water supply services lines.

Another serious effect of the wastewater discharge to the river is a potential high danger to contaminate the water supply systems downstream of the Buriganga River. Narayanganj City, located a few km downstream of the sewage treatment works outfall, is planned to rely its water source mainly on the river to supply drinking water to 120,000 residents and industries, and therefore, the City has been in the chronic danger of contacting with the polluted water.

The available information strongly indicates a continuing high level of communicable diseases in the area associated with the poor sewerage and other sanitation facilities throughout the city area. Based on comparison with conditions elesewhere, it can be said that the level of water pollution and sanitation continues to be the most serious public health and environmental problem in the area.

1.8 NEED FOR AN URGENT PROJECT

In pursuance of the ultimate objective of improving environmental sanitary conditions throughout the project area, the WASA, with the assistance of the DPHE, has completed preliminary investigations and studies into the adequancy of the existing sewerage facilities, and appropriate methods whereby deficiencies can be eliminated. On the basis of the results of investigations, and in view of the fact that construction and rehabilitation of the sewerage facilities are most urgently required, we have come to the conclusion that the identified project be immediately implemented.

Extension and improvement to the existing system have been deterred for over many years. The high incidence of enteritic diseases emphasizes the urgent need for an efficient sewerage system to convey wastewater away from the populace and dispose of its safely.

Steps are now needed to fully plan and design the necessary construction and rehabilitation schedule, prepare documents of international competitive bidding, construct civil structures, and procure and install the equipment for the project.

When the project is completed, significant benefits to public health and economy can be expected. Associated benefits resulting from the improvement of the public health conditons, environmental aspects, reduction of water purification costs, increase in land value, and opportunities to facilitate housing and industrial construction, together with other various intangible benefits will also warrant the feasibility of the project. If no actions are taken right now the sanitary conditions will become rapidly worse.

II. IDENTIFICATION AND JUSTIFICATION OF THE PROJECT

2.1 SEWAGE TREATMENT WORKS

The following five alternative biological treatment processes have been evaluated to select the most desirable treatment method for the project:

- Anaerobic pond
- Oxidation pond
- Aerated lagoon
- Biological filtration
- Activated sludge

Each of the above alternatives has been evaluated for four major features, namely 1) cost effectiveness, 2) simplicity of process, 3) ease of process operation and maintenance, and 4) treatment efficiency, and reliability of process operation and maintenance.

Both anaerobic pond and oxidation pond systems are the least expensive among the alternative plans, and easy to construct, operate and maintain. There is no mechanical equipment to maintain; however, the large space requirement is the governing factor to rule out these processes from further consideration. The available land space for the expansion of the existing treatment works is not sufficient to provide facilities to treat the sewage inflow in the future. The required land space for treating the sewage from the 8 million inhabitants in the year 2010 will be about 1,300 ha for oxidation ponds (if the BOD loading of 300 kg/ha. is applied). Also, the present anaerobic ponds system cannot reduce the BOD below 20 mg/l within the detention time of a few days, and therefore, cannot produce a high quality effluent to prevent further pollution of river water.

The aerated lagoons system requires less land space than the oxidation ponds and anaerobic ponds, and has various other advantages; however,

the energy consumption is the highest among the alternatives. Although many advantages are realized, the high energy requirements do not overcome the advantages, and therefore, this process was ruled out from further study.

The biological filter process requires energy only for lifting up the sewage to the biofilters but no other power is required for the sewage aeration, thus the power consumption is the lowest among other mechanically aerated methods. Besides, this process is stable under conditions of fluctuating hydraulic and organic loads, requiring simple operation and control. Maintenance of the units is also simple, because the main mechanical components are those to distribute the sewage, and because no drive units are provided for each set of the distributor. The minimum number of moving components makes the servicing very easy; only occasional checking or greasing will be required.

The activated sludge process has many such advantages as small space requirements, reliability of operation, high quality of effluent, etc.; however, the power requirements are high. The overall costs are also high compared with other alternatives. In view of the facts that both capital and recurrent costs are prohibitively high and operation and control of the process are complicated, this process was screened out.

The above discussions have led to the conclusions that the trickling filter process shall be adopted to the new sewage treatment system. The advantages of the process may summarized as follows:

- Low operation and maintenance costs
- Production of a high quality effluent, particularly in hot climate regions like Dhaka
- Simple structure of the facilities
- Easy operation and maintenance
- Simple process and reliability of operation particularly against the fluctuation of hydraulic and organic loads

- Low excess sludge production
- Low power cost requirements
- Low capital cost requirement

The new biological filters by rotary distributor will treat the sewage effluent from the existing anaerobic ponds, thus the costs are considerably saved. The excess sludge is introduced to the sand sludge drying beds.

The proposed treatment plant flow diagram and plot plan are shown in Figures 6 and 7, respectively.

2.2 SEWAGE PUMPING STATIONS

In Narinda old pumping station, only main large pumps are being operated and other pumps and control equipment are mostly out of works, and therefore, these facilities need to be completely renewed.

The new Narinda sewage pumping station has been out of operation since its construction in 1978. Pump suction and floor levels should be checked and necessary improvement measures be considered to make the station operable.

2.3 SEWAGE LIFT STATIONS

The sewage lift stations need to be rehabilitated and improved. The groundwater and raw sewage infiltration into the dry wells have been caused by the defective civil structures and improper plans. The pumps obsoleted be renewed by new pumps, together with pipe laying and jointing of the necessary pump suctions and discharges.

2.4 PAGLA OUTFALL FACILITIES

The outfall pumping station has not been functioning efficiently. At least defected pumps should be replaced by new ones because of the leakage of the raw sewage from the pumps. Also, the total capacity of the station is not sufficient to handle the inflowing sewage particularly during the rainy seasons. The pump capacity should be recovered so as to meet the requirements of the maximum discharge.

Presently no means is provided at the outfall station to measure the sewage flow rates. The accurate records of the sewage discharge from the treatment works is a basic requirement to the proper operation and maintenance of the sewerage system.

For the pump operation, considerations should be given to improve the control system. The pump operation control system is necessary to operate the pumps in the most efficient manners, and thereby saving a significant power cost. The dosing capacity of the chlorinators is inadequate. The chlorinators should be renewed.

III. DESCRIPTION OF THE PROJECT

The proposed sewerage upgrading and rehabilitation project comprises the following works:

3.1 SEWAGE LIFT STATION

Follwoing pumps which are being installed at the listed below sewage lifting stations shall be rehabilitated, and renewed. Pipe laying and jointing of necessary pump suction and discharge shall be considered.

(a)	Tejgaon Lift Station	30 HP x 2,	20 HP x 2
(b)	Basbaboo Lift Station	30 HP x 1,	15 HP x 1
(c)	Magbazar Lift Station	15 HP x 2,	
(d)	Hazaribag Lift Station	10 HP x 2,	5 HP x 1
(e)	Faridabad Lift Station	15 HP x 1,	
(f)	New Market Lift Station	10 HP x 1,	5 HP x 1

Control pannels of the following sewage lift stations shall be rehabilitated.

(a) Azimpur Lift Station
(b) Magbazar Lift Station
(c) Faridabad Lift Station
(d) P. and T. Lift Station

3.2 NARINDA CENTRAL PUMPING STATION (OLD)

Following pumps shall be installed

Pumps : Type ; Horizontal Centrifugal Pump
Capacity; 15 m^3/min.
TDH ; 11 m

Motor output ; 37 kW
Suction & discharge
opening ; 350 mm
Quantity ; 2 sets

Control and wiring: Control pannel shall be newly installed and pumps shall be mannually operated.

Civil works: Rehabilitation of pump foundation

Piping and valves : Pipelaying and jointing of necessary pump suction and discharge shall be considered.

NARINDA CENTRAL PUMPING STATION (NEW)

Extension of existing each pump suction pipe shall be considered.
A vacuum pump system shall be newly installed.

3.3 PAGLA SEWAGE TREATMENT WORKS

New sewage treatment plant which consist of followings shall be required.

(a) Sewage Pumping System
Following horizontal centrifugal pumps shall be newly replaced.

Capacity ;	32 m^3/min.	12 m^3/min.	5 m^3/min.
TDH ;	10.5 m	10.5 m	10.5 m
Motor output;	75 kW	37 kW	22 kW
Quantity ;	1 set	1 set	1 set
S/D openings;	400 mm	350 mm	300 mm

(b) Biological Filter

Type	High Rate Trickling Filter
Quantity	6 filters
Filter diameter	25 mm
Filter depth	4.0 m
Surface area	490 m^2
Type of distributor	Rotary - reaction type distributor

(c) Final Sedimentation Tank

Type	Circular Center Feed Tank
Quantity	6 units
Tank depth	3 m
Tank diameter	36 m
Sludge collection	Fringe drive scraper blades
Sludge removal	By gravity through central sludge hopper

(d) Chlorine Contact System

Type	Longitudinal baffled tank
Quantity	1 unit
Chlorinator	Liquid-gas chlorinator with a capacity of 625 g/m
Contact time	15 min.
Dosing rate	5 mg Cl_2/l of sewage

(e) Sludge Thickener

Type	Gravity thickening
Quantity	2 units
Tank depth	3 m
Sludge scraper	Scraper with a pier-supported center drive with scraper blades
Motor output	0.75 kW

(f) Thickened Sludge Pump

Type	Centrifugal slurry type pump
Quantity	3 sets
Capacity	0.4 m^3/min
TDH	10 m
Suction & discharge opening	80 mm x 80 mm
Motor output	2.2 kW

(g) Sludge Drying Bed

Type	Sand bed
Quantity	4 beds (Sand bed is devided into four beds)
Dimension of bed	45 m x 70 m x 1.0 m
Sludge detention time	15 days

3.4 PAGLA OUTFALL SYSTEM

Following system shall be required

(a) Outfall Pumping Station

Pump :

Type	Submersible pump
Quantity	5 sets
Capacity	25 m^3/min.
TDH	8 m
Motor output	55 kW
Suction and discharge opening	400 mm x 400 mm
Piping	Necessary pipelaying and jointing

(b) Outfall Pipe Line Rehabilitation

Rehabilitation of existing outfall pipe line shall be required.

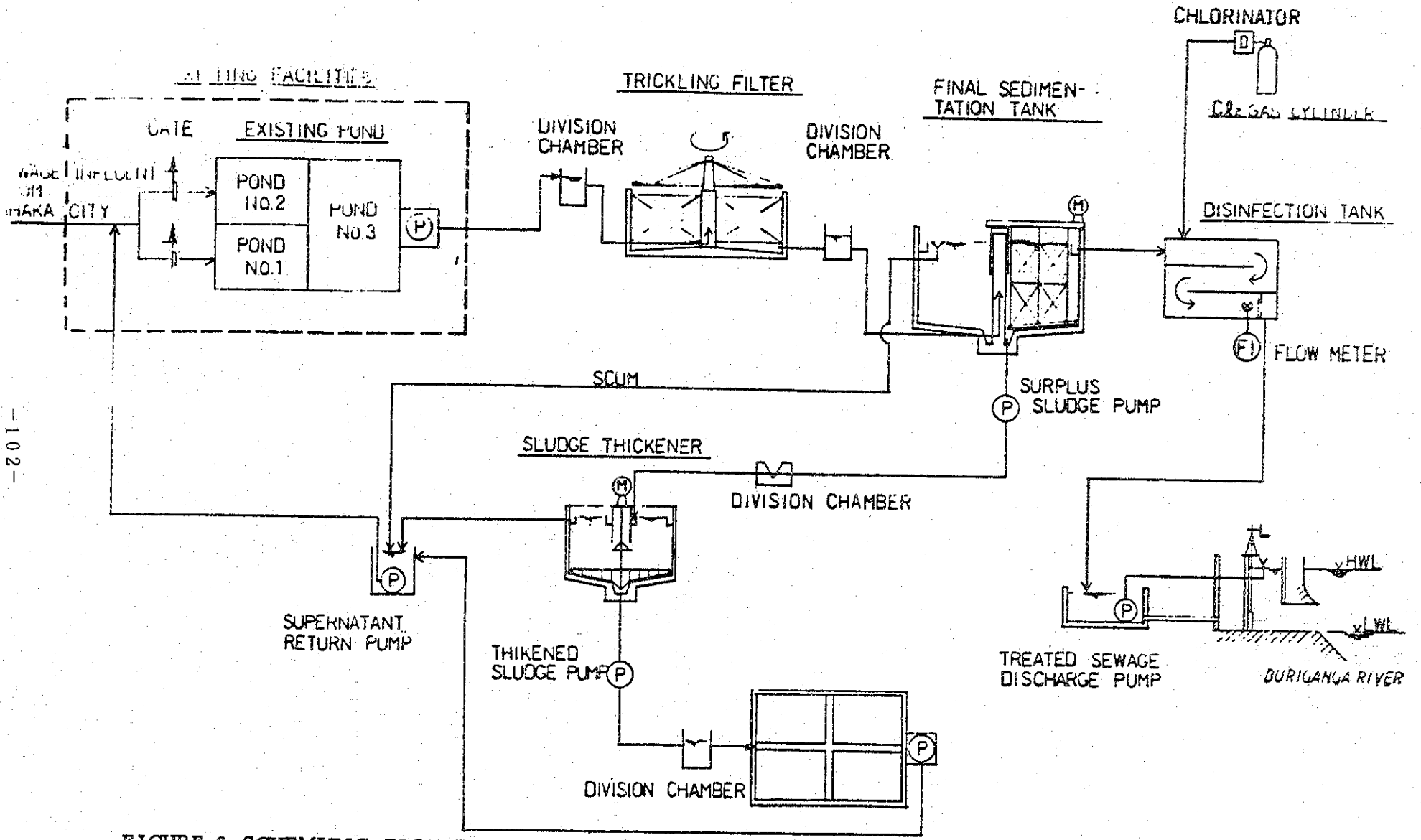

FIGURE 6 SCHEMATIC FLOW DIAGRAM OF ADVANCED SEWAGE TREATMENT PLANT PROPOSED

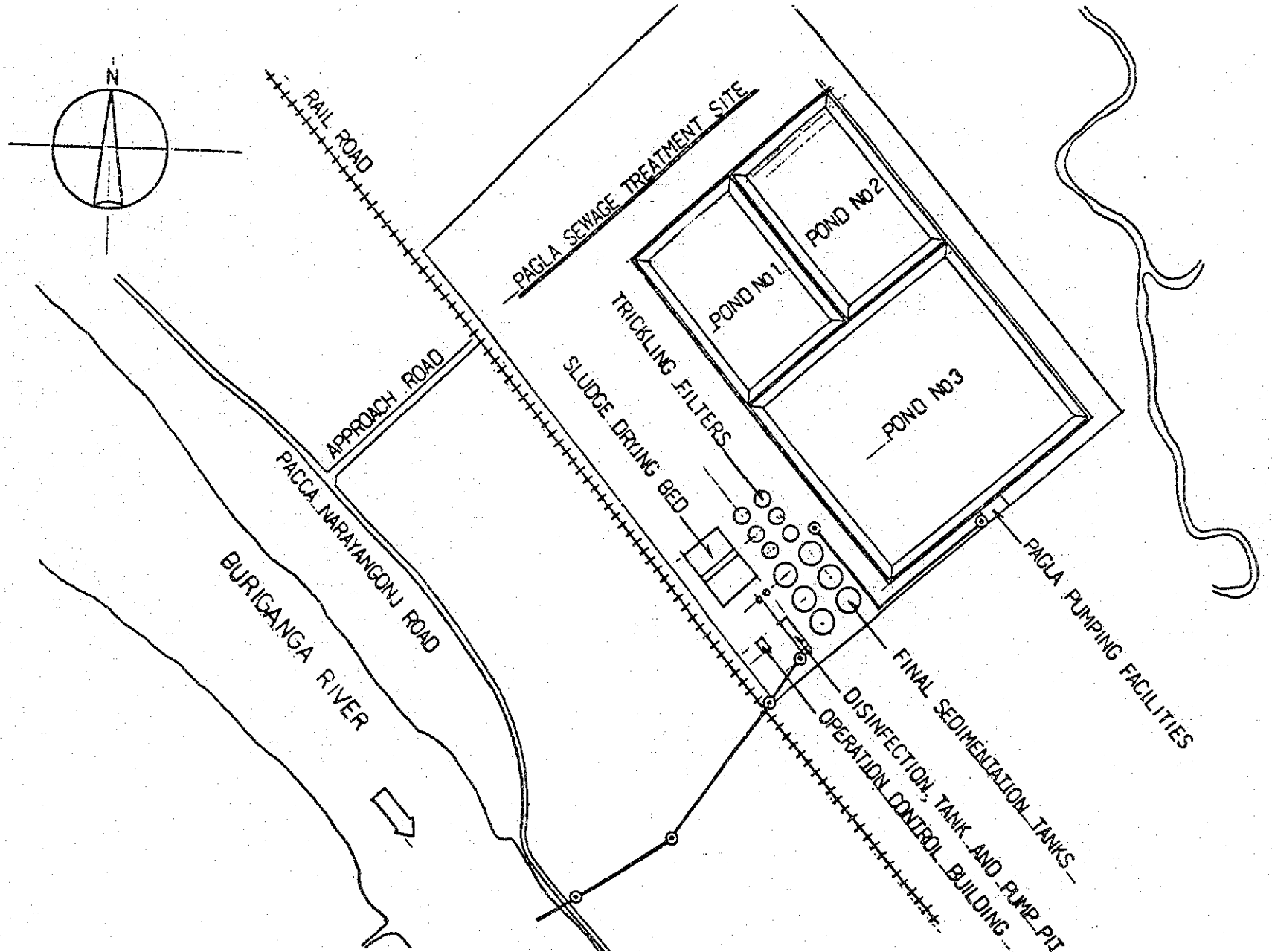

FIGURE 7 PLOT PLAN OF ADVANCED SEWAGE TREATMENT PLANT PROPOSED

IV. PROJECT COSTS

Table 3 Project Costs

(I)	Foreign Currency		(in 1,000 Japanese Yen)	
	a)	Consulting Services	Yen	170,000.-
	b)	Pagla Sewage Treatment Works		
		Supply of machinery, electric and control equipment	Yen	1,404,000.-
		Erection and installation of equipment	Yen	207,000.-
		Civil engineering works	Yen	1,293,000.-
	c)	Narinda Sewage Pumping Station		
		Supply of machienry, electric and control equipment	Yen	128,300.-
		Erection and installation of equipment	Yen	21,300.-
		Civil engineering works	Yen	7,300.-
	d)	Sewage Lift Stations		
		Supply of machinery, electric and control equipment	Yen	127,200.-
		Erection and installation of equipment	Yen	19,200.-
		Civil engineering works	Yen	8,700.-
	e)	Pagla Outfall System		
		Supply of machinery, electric and control equipment	Yen	100,500.-
		Erection and installation of equipment	Yen	18,700.-
		Civil engineering works	Yen	56,300.-
	f)	Training and Supervisory Works	Yen	28,000.-
	g)	Contingency	Yen	200,000.-
		Total cost	Japanese Yen	3,789,500.-
(II)	Local Currency		(in 1.000 Bangladesh Taka)	
	a)	Site preparation for Pagla	Tk.	2,000
	b)	Utility Supply works	Tk.	500
		Total cost	Bangladesh Tk.	2,500

IV. PROJECT COSTS

Table 3 Project Costs

(I)	Foreign Currency		(in 1,000 Japanese Yen)	
	a) Consulting Services		Yen	170,000.-
	b) Pagla Sewage Treatment Works			
	Supply of machinery, electric and control equipment		Yen	1,404,000.-
	Erection and installation of equipment		Yen	207,500.-
	Civil engineering works		Yen	1,471,000.-
	c) Narinda Sewage Pumping Station			
	Supply of machinery, electric and control equipment		Yen	128,300.-
	Erection and installation of equipment		Yen	21,300.-
	Civil engineering works		Yen	7,300.-
	d) Sewage Lift Stations			
	Supply of machinery, electric and control equipment		Yen	127,200.-
	Erection and installation of equipment		Yen	19,200.-
	Civil engineering works		Yen	8,700.-
	e) Pagla Outfall System			
	Supply of machinery, electric and control equipment		Yen	100,500.-
	Erection and installation of equipment		Yen	18,700.-
	Civil engineering works		Yen	75,500.-
	f) Training and supervisory works for operation		Yen	28,000.-
	g) Contingency		Yen	200,000.-
	Total Cost	Japanese	Yen	3,987,200.-
(II)	Local Currency		(in 1.000 Bangladesh Taka)	
	a) Site preparation for Pagla		Tk.	4,500
	b) Utility Supply works		Tk.	500
	Total Cost	Bangladesh Taka		5,000

The total construction cost of the project is estimated at about Japanese Yen 3,987,200,000.- in foreign currency and Bangladesh Taka 5,000,000 in local currency.

As regard Local currency portion such as Site Preparation and Construction of Access Road, Levelling works and Utility Supply Works for the construction are to be provided by the government of the Bangladesh.

V. PROJECT SCHEDULE

The preliminary survey work is scheduled to start one month after the Grant Proposal is submitted, and the design work assumes that consultants can be engaged within seven months after the submission. It is also assumed that all necessary financing is assured before the design work starts and that construction and procurement contracts can be signed from the 19th month onwards. The construction and equipment installation will last until the 39th month. Whole project is scheduled to complete within 42 months. The schedule is illustrated in Figure 8.

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