BASIC DESIGN STUDY REPORT
ON
THE PROJECT FOR RETRIEVAL OF
FLOOD PRONE AREAS IN METRO MANILA
IN
THE REPUBLIC OF THE PHILIPPINES

JUNE 1989

JAPAN INTERNATIONAL COOPERATION AGENCY

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P R E F A C E

In response to the request of the Government of the Republic of the Philippines, the Government of Japan has decided to conduct a Basic Design Study on the Project for the Retrieval of Flood Prone Areas of Metro Manila and entrusted the study to the Japan International Cooperation Agency (JICA). JICA sent to the Philippines a survey team headed by Mr. Yoichi Takeuchi, Deputy Director, Planning Department, Chubu Regional Construction Bureau, Ministry of Construction, from March 28 to April 22, 1989.

The team exchanged views on the Project with the officials concerned of the Government of the Republic of the Philippines and conducted a field survey in the City of Manila and its vicinity. After the team returned to Japan, further studies were made and the present report has been prepared.

I hope that this report will serve for the development of the Project and contribute to the promotion of friendly relations between our two countries.

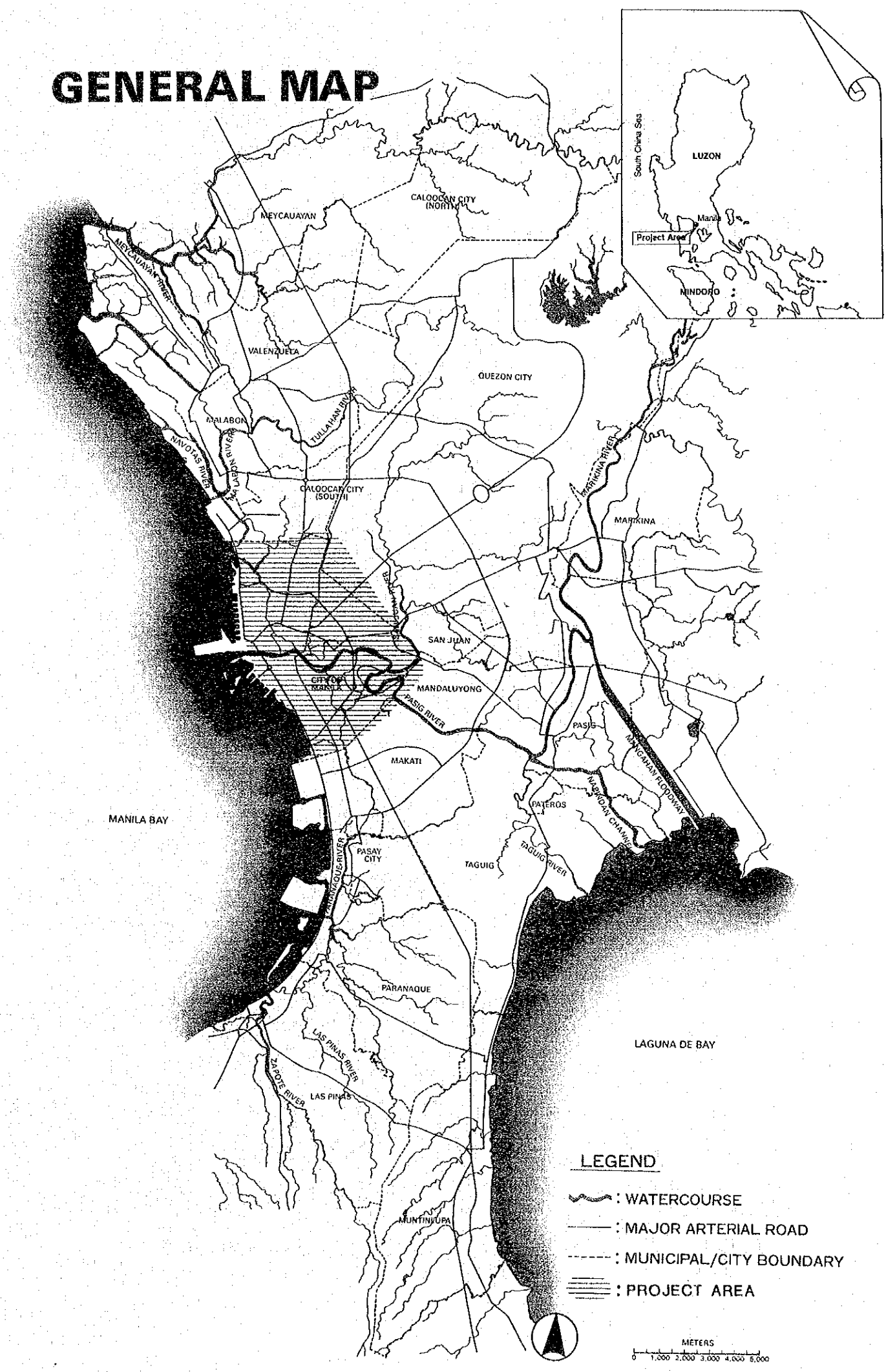
I wish to express my sincere appreciation to the officials concerned of the Government of the Republic of the Philippines for the close cooperation extended to the team.

June 1989

Kensuke Yanagiya

KENSUKE YANAGIYA
President
Japan International Cooperation Agency

GENERAL MAP


South China Sea
LUZON
Manila
Project Area
MINDORO
MEYCAUAYAN
CALOOCAN CITY (NORTH)
MEYCAUAYAN RIVER
VALENZUELA
QUEZON CITY
MALABON
TULLAHAN RIVER
NAVOTAS RIVER
MA LABON RIVER
CALOOCAN CITY (SOUTH)
MARIKINA RIVER
MARIKINA
SAN JUAN
MANDALUYONG
PASIG RIVER
PASIG
MANGAHAN FLOODWAY
MAKATI
PATEROS
NAPINDAN CHANNEL
MANILA BAY
PASAY CITY
TAGUIG
TAGUIG RIVER
PARANAQUE
LAS PINAS RIVER
ZAPOTE RIVER
LAS PINAS
LAGUNA DE BAY
MUNTINLUPA
LEGEND
: WATERCOURSE
: MAJOR ARTERIAL ROAD
: MUNICIPAL/CITY BOUNDARY
: PROJECT AREA
METERS
0 1,000 2,000 3,000 4,000 5,000

S U M M A R Y

The Medium-Term Development Plan for 1987-1992 prepared by the Government of the Philippines sets forth the basic policy for social infrastructure preparedness to make full use of existing facilities through appropriate maintenance. For flood control facilities, retrieval of the existing urban drainage facilities is emphasized, especially in Metro Manila, to immediately reduce flood damage and promote a desirable urban environment.

The master plan for stormwater drainage in Metro Manila was established in the 1950s, and various drainage projects have been implemented since the 1970s through external assistance. In spite of the continuous efforts made on drainage work, the city of Manila and its vicinity are still facing the menace of recurrent floods attributed to the inadequate maintenance of existing drainage channels due to an extreme shortage of maintenance equipment. Many of the existing drainage systems are, therefore, blocked with sediment and garbage.

Under the above circumstances, the Government of the Philippines plans to dredge the existing drainage channels and unclog the existing drains in the city of Manila and its vicinity. A request has been made for the Government of Japan to procure the necessary equipment for the retrieval work through grant aid and, at the same time, to effect the transfer of technical knowledge necessary for the operation and maintenance of such equipment.

In response to the request, the Government of Japan decided to carry out a basic design study. A study team was dispatched to the project site by the Japan International Cooperation Agency (JICA) from March 28 to April 22, 1989 to carry out the necessary field survey in the Philippines and confirm the contents of the request. Upon the return of the study team to Japan, a study was done on the project scale, implementation schedule and necessity of the Project.

The existing drainage system in the city of Manila and its vicinity is classified into (1) creeks or canals called "esteros" which are used as the primary drainage channels, (2) the primary drains which are big box

culverts and are called either "drainage mains" or "outfalls," and (3) the secondary drains called "laterals." As a result of the field survey, the following are estimated as the necessary volumes to be dredged or unclogged from each part of the existing drainage system.

Drainage System	Total Length (m)	Volume (m^3)
Esteros	13,422	219,655
Drainage Mains/Outfalls	19,623	67,505
Laterals	193,824	24,355

The appropriate duration of the retrieval work is estimated at five (5) years in consideration of the work volume, the conditions of the project site, and the service life of the equipment. The major items of equipment to be used for the retrieval works were determined as follows.

Name of Equipment	No. of Units
(1) Equipment for Dredging Esteros	
- Clamshell Crawler with Pontoon Barge	5
- Scow	10
- Tugboat	2
- Hydraulic Truck Crane	2
- Hydraulic Wheel Crane	3
- Dump Truck	15
- Truck Tractor with Semi-Trailer	1
(2) Equipment for Unclogging Drainage Mains/Outfalls	
- Wheel Crane with Dragline Bucket, Clamshell and Crane	4
- Submersible Sand Pump Set with Diesel Engine Generator	2
- Dump Truck	20
(3) Equipment for Unclogging Laterals	
- Water Jet Cleaner	3
- Lift-Dump Type Dehydration Vacuum	3
- Water Tanker	3
- Dump Truck	6

The Project is regarded as a sort of pilot project for the retrieval of existing drainage systems in the Philippines. Knowledge on the management, operation and maintenance of the equipment listed above is considered to be inadequate. Accordingly, in addition to the procurement of equipment, transfer of technical knowledge is necessary to enable the Government of the Philippines to continue the appropriate use of the equipment even after the expiration of the grant aid.

To achieve the most effective and reliable transfer of knowledge, actual implementation of retrieval work in model areas ("Model Implementation") was proposed for inclusion in the grant aid. The Model Implementation will be carried out by an eligible Japanese contractor with the supervision of a Japanese consultant, and all major equipment to be supplied will be used at the areas of the Model Implementation. Since it is anticipated that the working conditions for retrieval of the existing drainage system are quite different in the dry season and the wet season, the Model Implementation will have to be done in both the dry and rainy seasons.

Taking the above requirement into account, the appropriate duration of the Model Implementation is taken to be about seven (7) months. The work volume to be achieved through the Model Implementation (within seven months) is expected to be about ten (10) percent of the entire work volume for the proposed retrieval work that will continue for five (5) years.

The model areas were selected in accordance with the following considerations.

(1) The area shall have a dense population with a high level of socioeconomic activity, and the retrieval work in the area will provide immediate definite effects.

(2) Areas that have administrative problems such as difficulty in the necessary removal of squatters shall be excluded.

Technical knowledge will be transferred through the Model Implementation to the staff of the National Capital Region (NCR), Department of Public Works and Highways, which is the executing agency for the proposed retrieval work. The NCR has secured, through its Medium-Term

Public Investment Program, the funds and staff necessary for management, operation and maintenance of the equipment.

The implementation of the Grant Aid Plan is scheduled to be completed in about seventeen (17) months after the Exchange of Notes (E/N) between the Government of Japan and the Government of the Philippines. The delivery of equipment will be completed in about ten (10) months after the E/N, and the aforesaid retrieval work in the model areas will be carried out. The Government of the Philippines will continue the retrieval work immediately after the implementation of the Grand Aid Plan is completed, and will bear the necessary cost for the retrieval work which is totally estimated at about 130 million pesos.

From the retrieval works on the existing drainage system in the city of Manila and its vicinity under the Grant Aid Plan, the following benefits are expected.

(1) The drainage capacity of the existing facilities in the city of Manila and its vicinity will be restored to cope with the stormwater of a 10-year return period after retrieval is completed. Restoration of the drainage capacity will reduce the present flood damage in about thirty (30) percent of the entire project area and its corresponding annual average of damage reduction is estimated at about 280 million pesos.

(2) The following improvements will be provided to the existing urban environment in the city of Manila and its vicinity.

   (a) Stormwater inundation will be reduced, which will lead to more effective prevention of epidemics and the improvement of sanitary conditions.

   (b) Hazardous traffic conditions which often occur in every rainy season due to the prolonged stormwater inundation will be relieved, and economic activity will be promoted.

   (c) Foul odors and causes of epidemics will be removed by dredging and unclogging of the existing drains, and thus sanitary conditions will be improved.

The NCR has prepared the funds and staff for the operation and maintenance of the Project. In consideration of the benefits to be derived, project implementation through grant aid from the Government of Japan is justified. Since the Project's objective is to retrieve the existing drainage systems in Metro Manila and its vicinity, more effective results could be obtained should the Government of the Philippines intensify its efforts to cope with the illegally dumped garbage with more effective measures that could be realized through coordination and cooperation among the NCR, the Metropolitan Manila Commission (MMC) and the city/municipal government offices.

Urban drainage systems are being improved in Metro Manila and in other regions of the Philippines. To maintain their functions, completed drainage systems will require adequate maintenance in the future. It is expected that through this Project, which is regarded as a sort of pilot project for the retrieval of existing drainage systems, the Government of the Philippines will develop the appropriate methodology for facility retrieval and widely implement it throughout the country.

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CHAPTER 1. INTRODUCTION

The project area, comprised of the city of Manila and its vicinity, is located on the alluvial plain that has developed along the coast of the Manila Bay on the lower reaches of the Pasig River. Most of the project area lies on low-lying land of less than 2.0 m above mean sea level (MSL), where the ground is relatively flat, and inundations have frequently occurred during the rainy season from June to November due to flooding of the Pasig River and unsatisfactory drainage of stormwater.

The plan of flood control and drainage for the Manila Metropolitan Area, including the project area, began with the Basic Plan for Flood Prevention in Manila instituted in 1952 and various projects have since been implemented for flood control on rivers and drainage of stormwater. Flood control projects carried out so far include the construction of the Mangahan Floodway and those for stormwater drainage include the construction of 10 drainage pumping stations (7 of them within the project area) and establishment of a network of drains.

Despite such measures for drainage, serious flood damage has continued to plague the city of Manila and its vicinity. Flood damage is traced to the inadequate maintenance of existing drains due to the extreme shortage of maintenance equipment, so that many of these drains are blocked with sediment deposits and garbage that are indiscriminately dumped into them resulting in the loss of capacity for unobstructed water flow.

Under the above circumstances, the Government of the Philippines plans to carry out improvement work on the existing drains in the city of Manila and its vicinity and has made a request for the Government of Japan to procure the necessary equipment through grant aid and to effect the transfer of technical knowledge necessary for the operation and maintenance of the equipment. In response to the request, the Government of Japan decided to carry out a basic design study and a team headed by Mr. Yoichi Takeuchi, Deputy Director of the Planning Department, Chubu Regional Construction Bureau, Ministry of Construction, was dispatched to the project site by the Japan International Cooperation Agency (JICA) between March 28 and April 22, 1989.

The study team confirmed and discussed the content of the request, examined the background of the project and conditions at the site, affirmed the structure of implementation and, at the same time, explained the Japanese grant aid system and how it works to the Government of the Philippines. The team also confirmed the responsibilities that the two governments will take should the project be implemented. On the strength of the field survey, JICA carried out investigations in Japan on the details, scale, schedule and costs, etc., the results of which are compiled in this report.

CHAPTER 2. BACKGROUND OF THE PROJECT

2.1 Outline of Flood Control Projects in the Philippines

Existing Flood Damage Condition

The inundation area of floods in the Philippines add up to a total of 1,316,230 hectares, of which 136,159 hectares are in urban areas and other areas of habitation. The annual average amount of flood damage is estimated at about 5.0 billion pesos, and the recent two typhoons in 1987 and 1988 (Sisang and Unsang) brought about a considerable amount of damage as tabulated in Table 2-1.

Immediately after the passage of Typhoon Unsang, another strong typhoon named Typhoon Yoning struck Luzon Island and the surrounding areas in November 1988 and 150 people were reported to have died. As shown in Table 2-1, the majority of damage was in agricultural products caused by the overflowing of rivers and inundation of rice fields in the floodplains.

Flood Control Works

Basic flood control measures began to be established at the beginning of the century; however, the progress of work implementation has been extremely slow because of financial difficulties. At first, the aim of flood control works was to protect agricultural lands from floods. To this day, agricultural lands provide the economic base of the country and the first flood control works were the dikes to protect the major granary of the region on the lower reaches of the Pampanga River. These works were later extended to the Agno River and the flood prevention plans for the Pasig River that flows through the city of Manila was formulated in the 1950's.

Flood control works and plans have since been carried out on major rivers throughout the country, but it was only in the 1960's that the first long-term flood control master plan covering the whole river basin was formulated. These were the flood prevention plans for the Pasig River and the flood control master plan for the Bicol River which were established with external technical assistance.

Table 2-1. Recent Flood Damage by Typhoons in the Philippines

Damage Item	Typhoon Sisang (Dec. 1987)	Typhoon Unsang (Oct. 1988)
1. Human Damage		
Deaths	808	108
Injuries	927	64
Losts	171	27
2. Number of People and Families Affected		
People	2,019,385	1,492,845
Families	318,968	311,293
3. Destruction to Housing		
Whole Destruction	153,339	13,405
Partial Destruction	175,449	34,109
4. Damages (in million pesos)		
Agriculture Products	608	1,232
Roads and Bridges	105	52
Public Works	247	150
General Properties	53	Unknown
Communication Facilities	3	Unknown
Public Buildings	103	Unknown
Sub-Total	1,119	2,890
5. Agricultural Land Affected (ha)	52,136	167,000

In the 1970's, the government began to extend the long term flood control master plan to other major river basins, where the stage-wise development was made towards the final goals with sufficient funding for each stage. Likewise, restoration works and other disaster prevention measures continued to be implemented.

Flood control master plans for drainage basins of the following seven (7) rivers have been established as of 1980. The main theme of the master plans was to cope with the flood overflows of river channels, while measures for urban stormwater drainage also became a major theme in the flood control plan, especially for Metro Manila.

- Agno River, Pangasinan
- Pampanga River, Pampanga and Nueva Ecija
- Pasig River, Metro Manila
- Bicol River, Camarines Sur
- Cotabato River, Cotabato
- Ilog-Hilabangan River, Negros Occidental
- Agusan River, Agusan

The rapid expansion and increase in population of Metro Manila have, however, necessitated the revision of the basic plan for flood control. In June 1985 and September 1986 two major floods occurred one after the other and in response, the ongoing study for the basic plan of comprehensive flood control in Metro Manila, with the aim of coordinating the control measures with the development of urban areas, has been launched in early 1988 with technical assistance from JICA.

Problems at Present and Objectives of the Project

The Department of Public Works and Highways (DPWH), which is the governmental agency responsible for implementing flood control plans, began to undertake surveys throughout the country to upgrade the maintenance of existing flood control facilities and make them function fully in accordance with the Medium-Term Development Plan. It has been confirmed through the surveys that the majority of existing drainage systems, riparian works, dikes and protection works require some form of restoration or improvement work.

According to the estimation of the DPWH and the National Economic Development Administration (NEDA), the necessary maintenance cost for the existing flood control facilities amounts to 142 million pesos a year. Budgetary requirements and actual maintenance fund allocations for the past 7 years are shown in Table 2-2.

Table 2-2. Budgetary Requirements and Maintenance Fund Allocations

(Unit: Thousand Pesos)

Fiscal Year	Budgetary Requirement	Maintenance Fund Allocation
1982	92,135	11,270
1983	38,748	2,853
1984	62,545	2,395
1985	78,595	78,000
1986	126,534	105,000
1987	149,903	149,903
1988	166,721	166,721

As shown in Table 2-2, the maintenance fund allocation has been increasing since 1985. Thus, it is obviously observed that the government has paid attention to the maintenance of flood control facilities. Most of the budget, however, has been directed towards restoration of the existing structures on the principal rivers and financing of stormwater drainage facilities, mainly in Metro Manila, has been delayed accordingly.

Damage due to floods in Metro Manila, on the other hand, has become increasingly serious every year and about 50% of the damage can be attributed to the inadequacy of the stormwater drainage. Furthermore, it has been pointed out in a recent survey by JICA that the principal cause of malfunctioning of the drains is blockage due to sediment deposits. In view of this situation, the project which aims at the retrieval of the existing drainage system is of considerable significance and can be expected to contribute greatly towards flood control plans in the future.

2.2 Summary of Related Plans

2.2.1 National Development Plan

The following four objectives have been stipulated in the Five-Year Medium Term Development Plan for the period from 1987 to 1992.

- Reduction of poverty
- Creation of productive employment opportunities

- Promotion of social equality and justice
- Achievement of sustained economic growth

An important part of the strategy for achieving these objectives is to enlarge the role of the provinces (there are 13 administrative regions) and local communities in the national development plan. Each administrative region has been given its own development program to reduce the regional inequalities in income resulting from the uneven distribution of development works. The basic policy of the development programs is to aim at activating the national agricultural economy by increasing production and improving living standards.

The government has established development strategies and targets for each of the administrative regions and has directed each region to make full use of their natural and human resources. The population, employment rate and gross product for each region are as shown in Table 2-3 in accordance with the goals set for 1992.

Table 2-3. Targets for Regional Medium-Term Development Plan

Administrative Region	Regional Gross Product* (million Pesos)	Population (million)	Employment Rate (%)
The Whole Country	135,331	64.26	95.1
Metro Manila	37,607	8.38	85.1
I	6,099	4.45	95.9
II	3,916	2.98	96.0
III	12,152	6.42	94.7
IV	19,662	8.52	96.4
V	4,753	4.58	97.7
VI	10,923	5.91	96.2
VII	9,452	4.79	97.8
VIII	3,511	3.48	97.9
IX	5,024	3.33	96.9
X	7,109	3.80	97.2
XI	9,452	4.54	97.1
XII	5,671	3.09	96.9

Note *: 1972 price level

For the purpose of achieving the regional development targets above, the government obliges the Regional Development Council and the National

Economic Development Board to carry out close consultation with the local government agencies and to establish investment programs for regional development. The basic policy for infrastructures in the Medium-Term Development Plan is to make full use of the existing facilities by retrieving and maintaining them and thus reduce the need for investment for new facilities. Together with the promotion of drainage works in Manila, promotion of improvement works on regional rivers for the protection of agricultural lands from floods and securing high levels of productivity is emphasized in the plans for the establishment of flood control facilities as a part of social infrastructures.

2.2.2 Regional Development Plan

The Metropolitan Manila Commission (MMC) has established a Medium-Term Plan for the five-year period from 1987 to 1992 for the whole of Metro Manila including the project area (Manila City and its vicinity). This development plan is based on the national development plan described above and aims at the achievement of the following three objectives in order to deal with the rapid growth of population and expansion of the urban area.

(1) Reduction of Poverty

The following items are planned for implementation with the aim of improving the life of low-income population.

- Low interest loans
- Distribution of basic foodstuff at below market prices
- Provision of infrastructure (housing, sanitary facilities, schools, etc.) for low-income population.

(2) Creation of Productive Employment Opportunities

The aim is to increase employment by vitalizing medium and small firms through liberalization of restrictions on government loans to these firms and introduction of special loans systems, as well as establishment of a training program for engineers. Efforts are also being made to increase employment opportunities abroad.

(3) Creation of Desirable Urban Environment

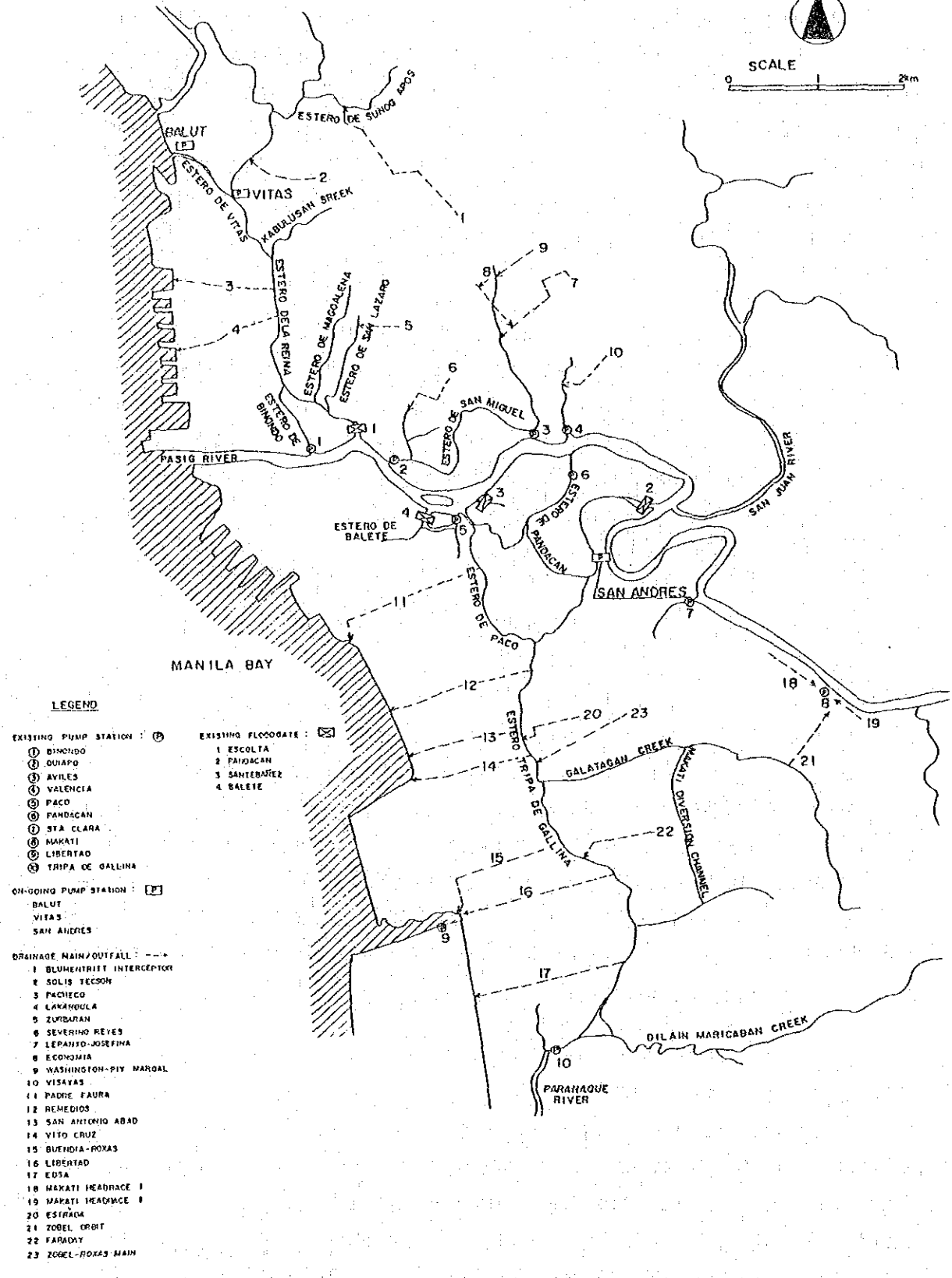
The main aim is to remove the slum areas by establishing permanent housing for illegal residents and develop the necessary infractructures such as water supply, electricity, stormwater and sewage drains, roads and communal facilities (hospitals, schools, etc.). In the flood control plan which is a part of the social infrastructure development plan, the immediate and effective reduction of flood damage is emphasized by retrieving the existing drainage facilities in the city of Manila and its vicinity so as to create a desirable urban environment.

Aside from the city of Manila and its vicinity, the whole of Metro Manila is now rapidly enlarging the urban storm drainage network which will require adequate maintenance in the future. In this connection, the Project for the Retrieval of Existing Drainage System in Metro Manila is regarded as a sort of pilot project and the Government of the Philippines expects to develop the appropriate methodology to be widely implemented throughout the country.

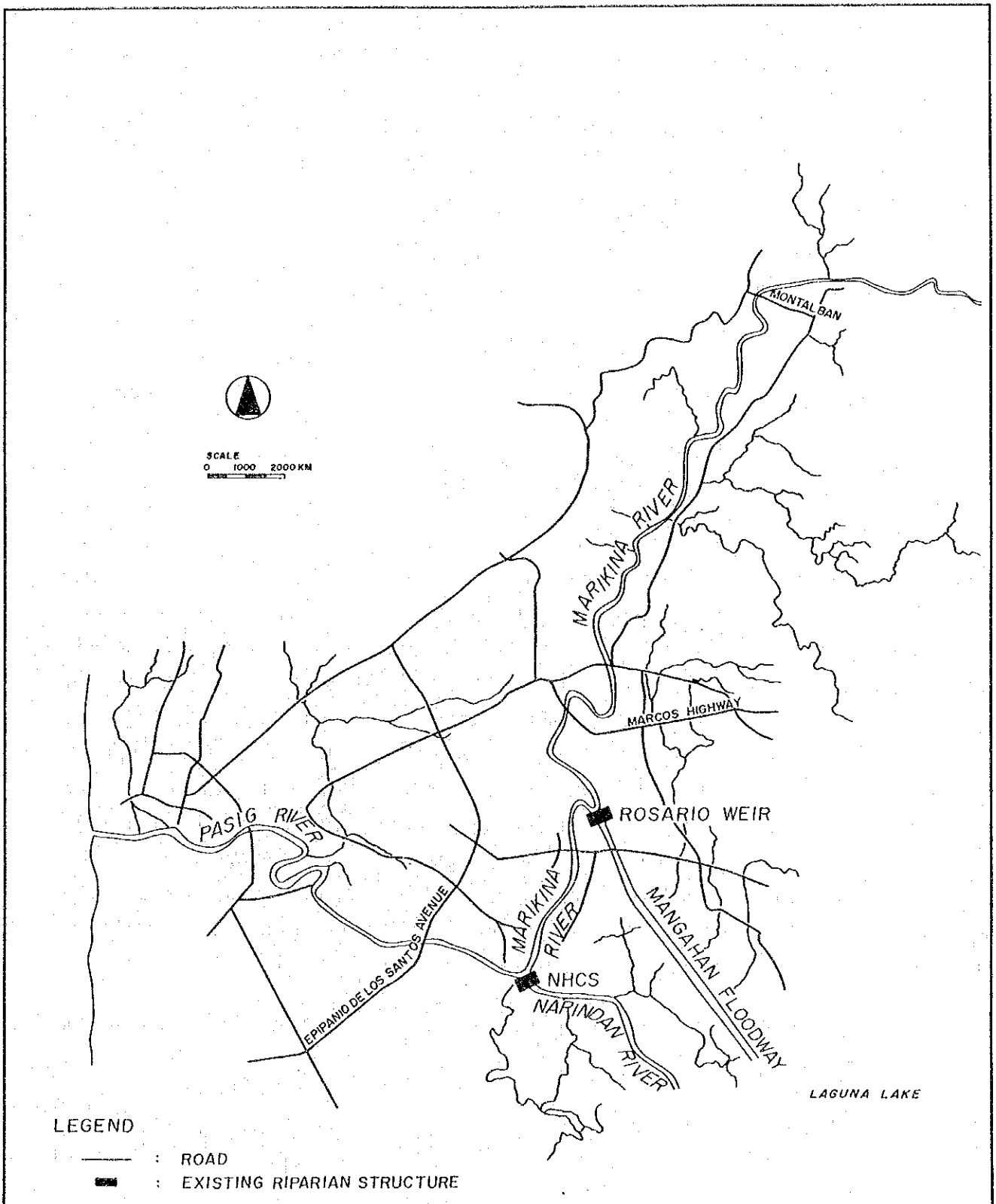
2.2.3 Flood Control Development Plan

The present urban stormwater drainage works in Metro Manila are based on the Drainage Plan for Manila and Suburbs prepared by the Bureau of Public Works (now the Department of Public Works and Highways) in 1952. The works executed so far under this plan are the construction of ten (10) drainage pumping stations, the primary drains with a total length of 121.1 km and the secondary drains with a total length of 193.8 km (refer to Fig. 2-1). In addition to these, construction of three pumping stations and improvement of related drains are in progress with financing from the Overseas Economic Cooperation Fund (OECF).

In parallel with these urban drainage works, works for flood control measures have been carried out on the Pasig-Marikina River that flow through Metro Manila. These works are based on the Marikina River Multipurpose Development Works adopted in 1954 and construction of the Mangahan Floodway and riparian improvements of the Pasig River have been carried out (refer to Fig. 2-2). To meet the rapid urbanization and increase in population of Metro Manila, the flood control plan formulated



THE PROJECT FOR THE RETRIEVAL OF FLOOD PRONE AREAS OF METRO MANILA	Fig. 2-1 DRAINAGE SYSTEM IN METRO MANILA
JAPAN INTERNATIONAL COOPERATION AGENCY	



THE PROJECT FOR THE RETRIEVAL OF FLOOD PRONE AREAS OF METRO MANILA	Fig. 2-2 PASIG-MARIKINA RIVER AND MANGAHAN FLOODWAY
JAPAN INTERNATIONAL COOPERATION AGENCY	

in the 1950's has been deemed to be obsolete under the present conditions and thus the Study on Flood Control and Drainage Project in Metro Manila commenced with technical assistance from JICA in early 1988 to update the integrated plan of flood control and drainage system in the region. The Study, although still going on, pointed out the need for the immediate retrieval of existing drainages channels and drains and the basic design study for the project under discussion begun against this background.

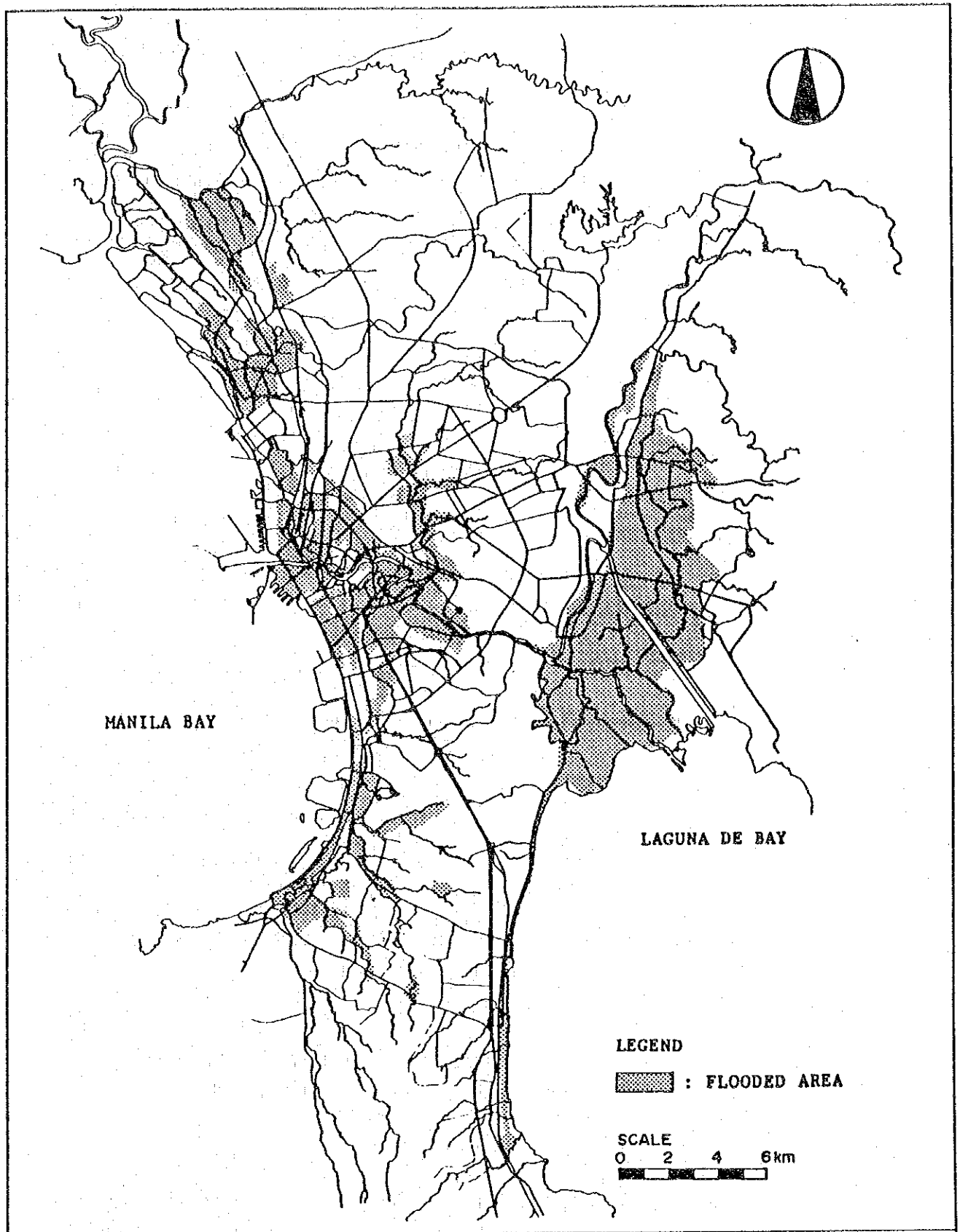
2.3 History and Content of Request

History of Request

The project site in the city of Manila and its vicinity (parts of Quezon City, Pasay City and Makati) is witnessing a rapid increase in urban population, although a major part of this area is located in low-lying land of less than 2 m above mean sea level and is prone to floods. The first plan for flood control works in Metro Manila including the project area was the Basic Plan for Flood Control in Manila adopted in 1952 and various works for flood control measures and stormwater drainage have since been implemented. Flood control works implemented so far include improvements on the Pasig River that flow through the center of the project area and the construction of the Mangahan Floodway carried out with financial assistance from the OECF. Ten (10) pumping stations were also constructed in Metro Manila with financial assistance from OECF and the Export-Import Bank of Japan and seven (7) of these stations are located within the project area. A drainage network consisting of esteros (river channels for storm drainage), drainage mains/outfalls (the primary drains) and laterals (the secondary drains) were installed at the same time as the construction of the pumping stations.

Despite the drainage works mentioned above, serious flood damage has continued to occur in the city of Manila and its vicinity. An area of approximately 22 km^2, amounting to 40% of the whole project area, was inundated and considerable damage was inflicted in the 1986 flood (refer to Fig. 2-3).

The main cause of these floods is the inadequate maintenance of the existing drainage channels and drains, resulting in their being unable



THE PROJECT FOR THE RETRIEVAL OF FLOOD PRONE AREAS OF METRO MANILA	Fig. 2-3 FLOOD AREA IN 1986
JAPAN INTERNATIONAL COOPERATION AGENCY	

to fulfill their functions. Many of the drainage channels and drains are blocked with sediment deposits and garbage, and they have lost their original flow capacities.

In view of this situation, the Government of the Philippines plans to improve the conditions of the existing drains in the city of Manila and its vicinity and has made a request to the Government of Japan for a grant aid with the aim of obtaining the necessary equipment and effecting the transfer of technical knowledge needed in the operation and maintenance of the equipment.

Content of Request

The content of the request made by the Government of the Philippines has been confirmed to consist of the following items.

(1) Objectives

In order to implement the retrieval of existing drainage channels, the following are requested from the Government of Japan.

- To procure the equipment required for the retrieval.
- To effect the transfer of knowledge required for the operation and maintenance of the equipment through the execution of actual retrieval work in a model area.

(2) Implementing Organization

The National Capital Region, Department of Public Works and Highways, is to be the implementing organization for the retrieval work.

(3) Project Area

The project area is the whole city of Manila and parts of Quezon City, Pasay City and Makati that border on the city of Manila.

(4) Equipment Requested

The equipment listed hereinafter are the equipment to be used for the dredging of esteros (river channels) and the unclogging of drainage

mains/outfalls (the primary drains) and laterals (the secondary drains) over a 5-year period.

Dredging Equipment

(1)	Hydraulic Excavator, 0.3 m^3 Crawler-Mounted Backhoe	4 units
(2)	Hydraulic Excavator, 0.3 m^3 Crawler-Mounted Backhoe with Small Scows	2 units
(3)	Hydraulic Excavator, 0.13 m^3 Crawler-Mounted on Pontoon Backhoe with Small Scows	1 unit
(4)	Attendant Equipment	
	(a) Pontoon to Carry Excavator	4 units
	(b) Scows, 10 m^3 or 20-ton Capacity with Complete Accessories	8 units
	(c) Tugboat, 60 PS with Complete Standard Accessories	2 units
(5)	Crawler Crane, Wheel-Mounted, 20-ton Capacity with 0.6 m^3 Clamshell with Complete Standard Accessories	2 units
(6)	Dump Truck, 8-ton	6 units

Unclogging Equipment

(1)	Water Jet Cleaner, 4-ton, Truck-Mounted (250 Bar, 200 l/min)	2 units
(2)	Water Jet Cleaner, 4-ton, Truck-Mounted (350 Bar, 300 l/min)	2 units
(3)	Vacumn Cleaner, 4-ton, Truck-Mounted	4 units
(4)	Vacumn Cleaner, 11-ton, Truck-Mounted	6 units
(5)	Water Tanker, 4-ton, Truck-Mounted	4 units
(6)	Water Tanker, 11-ton, Truck-Mounted	4 units
(7)	Rodding Machine, composed of 2-ton Truck-Mounted Motor Driven Winch and Trolley-Mounted Winch, Complete with 7 Buckets, 3 Brushes, 3 Steel Cylinders for Various Sizes of Pipes, and Standard Accessories	5 sets

CHAPTER 3. OUTLINE OF THE PROJECT AREA

3.1 Location and General Conditions of the Area

The project area is located more or less at the center of Metro Manila and, in terms of administrative districts, contains the whole of Manila City and parts of Quezon City, Pasay City and the municipality of Makati. It has an area of 50.84 km^2 making up approximately 8% of the total area of Metro Manila (636 km^2).

The population of the project area, according to the 1980 census, was 1.63 million, making up approximately 28% of the total population of Metro Manila. The population density of the project area, approximately 410/ha, is far in excess of the average of 100/ha for the whole of Metro Manila and housing in the area tends to be crowded. As a result, there is relatively little inflow of population from the surrounding areas and the population growth of the project area was approximately 2% per year between 1975 and 1980, far below the average in Metro Manila of 3.6% and below even the national average of 2.7%.

The project area, located in the old urban area of Metro Manila, has long been known as a commercial center and the area along Manila Bay in the southern part of the city of Manila has become noted as a tourist area. With regard to the gross regional domestic product (GRDP), which provies an indication of the level of economic activities in the area, the figures for the period between 1980 and 1986 for the whole of Metro Manila is 29,437 million pesos, amounting to 31% of the gross domestic product for the whole of the Philippines. Although the deterioration in the economic conditions between 1983 and 1985 resulted in annual decrease of 4.0 to 6.0% in the GRDP of Metro Manila, an increase of approximately 1% was registered in 1986.

3.2 Natural Conditions

The project area is located on an alluvial plain that had developed along Manila Bay on the lower reaches of the Pasig River. Most of the area lies in low-lying areas of less than 2 m above mean sea level (MSL) and the

flow conditions of the rivers and drains in the area are greatly influenced by the tides in the bay. Excess uptake of groundwater in the past had resulted in land subsidence but since 1980, the groundwater levels have been showing signs of recovery and subsidence is slowing.

There are two seasons, rainy and dry seasons, in the project area. The dry season generally lasts from December to May and the rainy season from June to November. Rainfall records taken at the Port Area (Manila) Observatory are given in Table 3-1. As can be seen from the table, the annual rainfall is approximately 2,100 mm and 91% of the precipitation occurs in the rainy season. Furthermore, the project area is located on the path of tropical cyclones, especially between August and November.

There is little variation in temperature throughout the year, with the maximum temperatures remaining between 30°C and 34°C and the minimum temperatures between 20°C and 25°C. Relative humidity remains high throughout the year at between 65 and 85%. Average duration of sunshine is just over 6 hours. Northeasterly winds at annual average velocity of 0.8 m/s prevail during the dry season and southwesterlies at average velocity of 0.5 m/s during the rainy season.

3.3 Social Environment

Roads and Highways

The total length of roads in the city of Manila is 688.9 km, of which 235.1 km are under the jurisdiction of the state, 46.8 km under the province and 407.0 km under the city. The road density of 16.4 km/km^2 is the highest in Metro Manila. The road network in Metro Manila is shown in Fig. 3-1.

Water Supply

Water supply comes under the jurisdiction of the Metropolitan Waterworks and Sewerage System (MWSS). The MWSS completed the second phase of the Manila Water Supply Project in June 1987, allowing daily water supply of 2,500 million liters. The project was aimed at a high-level use of the existing water source on Angat River and at rehabilitation and expansion of the existing water supply system. The implementation of the

Table 3-1. Monthly and Annual Rainfall Record

(Unit: mm)

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
1988	96.2	9.6	0.8	12.5	115.4	367.7	426.5	279.5	341.0	573.2	135.9	1.6	2359.9
1987	3.9	0.0	0.0	2.4	27.4	224.1	147.0	236.1	295.2	170.6	96.8	71.2	1274.7
1986	0.7	48.2	0.0	16.6	254.2	149.0	632.3	710.8	545.4	623.0	252.9	53.0	3286.1
1985	0.2	0.9	6.7	68.5	8.4	867.3	239.2	301.0	290.2	299.6	132.5	45.1	2259.6
1984	25.3	0.0	7.6	12.6	169.1	443.2	218.6	500.1	139.9	311.4	65.8	10.1	1903.7
1983	23.3	0.3	0.0	1.4	0.0	31.0	177.1	409.8	250.1	239.0	9.4	2.6	1144.0
1982	1.6	4.0	5.5	27.5	27.5	182.2	492.3	348.9	270.2	88.7	28.2	60.8	1537.4
1978	0.2	6.0	1.6	12.4	168.5	164.4	206.6	881.5	435.1	627.0	124.1	46.6	2674.0
1975	16.3	3.3	0.5	26.4	58.0	196.3	100.1	505.9	260.7	310.7	100.6	113.6	1692.6
1974	0.4	0.0	0.0	57.1	61.0	411.3	287.6	1188.1	24.4	319.6	352.5	130.0	2836.4
Ave.	16.9	7.2	2.3	23.7	88.9	303.7	292.7	536.2	285.6	356.3	129.9	53.5	2096.8

Note: Recorded at Port Area Gauging Station, City of Manila

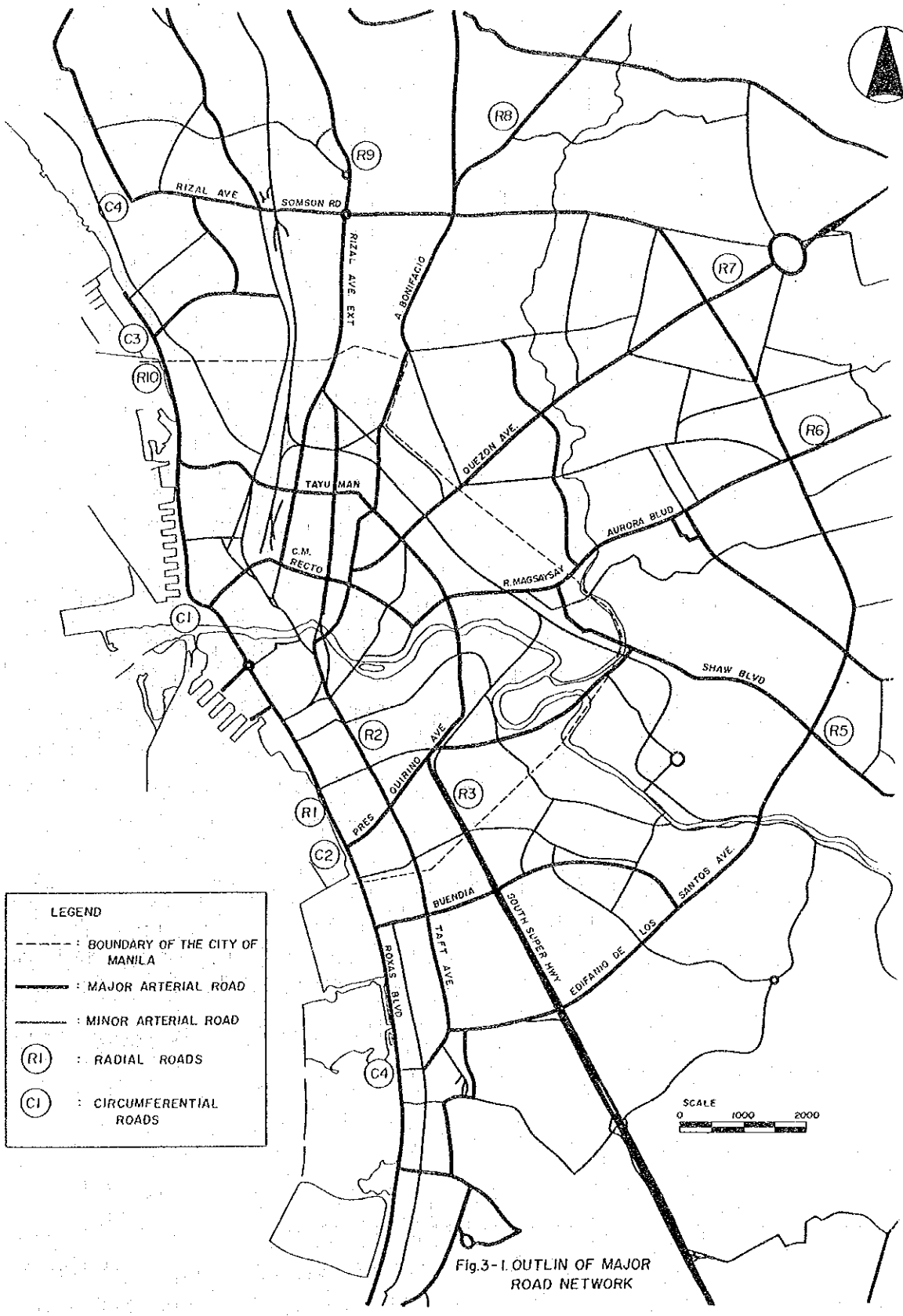


Fig.3-1 OUTLIN OF MAJOR ROAD NETWORK

THE PROJECT FOR THE RETRIEVAL OF FLOOD PRONE AREAS OF METRO MANILA	Fig. 3-1 MAJOR ROAD IN METRO MANILA
JAPAN INTERNATIONAL COOPERATION AGENCY	

project has resulted in 39.1% of the total population of Metro Manila being served by MWSS.

The Manila Water Supply Rehabilitation Project, in progress at present, aims at reducing the loss of water supply in 56 zones (9,541 ha) within the area served by MWSS. The average water loss is as high as 65% at present and the plan is to reduce this rate to between 25 and 30% by the second half of 1989. The districts of Sampaloc and Tondo in the city of Manila are included among the objective zones of this project.

Also in progress at present is the Metro Manila Water Distribution Project, which aims at maximizing the use of the water supply capacity enlarged through the Manila Water Supply Project and so reap the benefits of the investment as soon as possible. The project is aimed at completion in 1990, and about 1.9% of the works had been accomplished in 1987.

Sewers

There are two sewage networks in Metro Manila. One is the Central Manila Sewage Network covering an area of 1,850 ha in the central part of the city of Manila. The network, completed before 1909 and with a capacity for handling sewage produced by a population of 220,000, now has to handle sewage produced by a population of 530,000. The other network, handling sewage from the residential and commercial areas of Quezon City and Makati Municipality, has a capacity for a total population of 350,000.

The Metro Manila Sewage and Sanitation Project is under way at present. The project is composed of two parts. The first component entails the rehabilitation and expansion of the existing sewage network in central Manila to cover the service area of MWSS. The other is the sanitation component, aimed at removal of waterways especially in areas with high concentration of low-income people.

Waste Disposal

The Environment and Sanitation Center of the Metropolitan Manila Commission (MMC) is responsible for disposal of waste in Metro Manila. The center administers the comprehensive programs for improving the environment through beautification of roads, pedestrian paths and waterways, cleaning of roads and collection of waste.

The daily production of waste in Metro Manila is estimated at 10,000 tons, of which 8,000 tons are collected. The remainder is dumped in nearby waterways, burned or recycled.

3.4 Outline of Urban Drainage Facilities

The urban drainage (stormwater drainage) plan for the project area aims at preventing inundation of the area in the event of occurrence of a 10-year probability rainfall. For this purpose, seven drainage pumping stations (total drainage capacity: 62.8 m^3/s) have been constructed in the area and installation of a drainage network has been implemented. Construction of an additional three pumping stations (total drainage capacity: 51.2 m^3/s) is planned together with improvement of drains.

The existing drainage channels and drains in the project area can be classified into the following three groups.

- Esteros

  Esteros are either natural rivers or artificial waterways used as the primary drainage channels with widths of 5 to 30 m. Total length within the project area is approximately 40 km.

- Drainage Mains and Outfalls

  These are large culverts used as the primary drains. Their sizes vary but, in general, their depths exceed 2 m and their widths 3 m. The outfalls are those connecting the esteros to Manila Bay. The rest are simply referred to as "drainage mains". There are 22 mains within the project area with a total length of approximately 22 km.

- Laterals

  These are secondary drains with diameters of 12 to 42 inches running along roads and connected to the drainage mains mentioned above. There are 178 laterals within the project area with a total length of approximately 194 km.

It has been pointed out in the Study on Flood Control and Drainage Project in Metro Manila, begun by JICA in 1988, that the deposit that has settled in the drains mentioned above is causing major hindrance to drainage of water in the area. Upon being informed of the results of the study, the Government of the Philippines has taken up the removal of deposits in the existing drains as a major task in the work on urban drainage.

CHAPTER 4. OUTLINE OF THE PROJECT

4.1 Objective

The objectives of the Project is to restore the functions of the existing drainage network in the city of Manila and its vicinity by procuring the necessary equipment to dredge the drainage channels and unclog the drains and by transfering the technical knowledge required for the operation and maintenance of the equipment.

4.2 Study and Evaluation of the Request

4.2.1 Pertinence of the Project

Although the drainage pumping facilities in the city of Manila and its vicinity have the original drainage design capacity of 4.3 $m^3/s/km^2$, it has been clarified through the Study on Flood Control and Drainage Project in Metro Manila (conducted by JICA since January 1988) that the actual capacity has decreased to about 2 $m^3/s/km^2$ because of sediment deposits and the garbage blocking the drainage channels and drains. Unless these are removed, newly constructed pumping stations will become ineffective.

The amount of deposits to be removed is estimated at 300,000 m^3 (refer to Section 5.2). Removal by hand, which has been done in the past due to the lack of appropriate equipment, is inefficient. In view of the urgency of restoration of the original drainage capacity, the use of machinery and equipment is indispensable, and the procurement of equipment to retrieve the existing drainage channels and drains is regarded to be appropriate as the object of the Project. Furthermore, since the retrieval work using the equipment to be procured is a sort of pilot project in the Philippines, the Government of the Philippines has inadequate experience in their operation and maintenance. Accordingly, in addition to the procurement of equipment, it is appropriate to carry out an actual retrieval work in a model area, as a part of the Project, with the aim of transferring the technical knowledge required in the operation and maintenance of the equipment.

4.2.2 Implementation and Operation Plan

(1) Organizational Structure

Operation and maintenance of the procured equipment are to be carried out by the National Capital Region (NCR), Department of Public Works and Highways. In the implementation of the Project, the director of the NCR will be the chief executive for the maintenance organization and the operational plans are to be determined by the Flood Control and Water Supply Section in the Maintenance Division of the NCR.

Members of the Flood Control and Water Supply Section, as well as those of the North and South Manila engineering districts, will participate in the field work for drainage retrieval in accordance with directions from the NCR main office. There are also plans for entrusting parts of the field work to private firms as the need arises. Repairs of the equipment will be carried out by the Regional Equipment Service of the NCR.

These organizations have been engaged in the drainage improvement work in Metro Manila and the repair and maintenance of the equipment used. The number of personnel to participate in the operation and maintenance of the equipment to be procured under the Project are as summarized below. When the knowledge necessary for operation and maintenance of the equipment has been imparted to these personnel through the model operation, there should be no problem with operation and maintenance being carried out by the Government of the Philippines.

- Management Staff	:	17
- Engineers engaged in establishment of operational plans and supervision of implementation	:	37
- Personnel engaged in field work	:	143 (part of work entrusted to private firms according to need)
- Engineers for repair of equipment	:	123

(2) Financial Plan

The Department of Public Works and Highways has set aside the following special budgets from the Medium-Term Public Investment Program for securing funding for operation and maintenance under the Project.

- 1990	:	16 million pesos (approx. 100 million yen)
- 1991 to 1992	:	30 million pesos (approx. 188 million yen)
- After 1992	:	60 million pesos in total (approx. 376 million yen)

The amount of 75 million pesos a year (approx. 470 million yen) is also to be set aside in the Medium-Term Public Investment Program as an ordinary budget to cover costs for operation and maintenance measures of flood control in Metro Manila. Budgets allocated to the Department of Public Works and Highways in the annual budgets for the past three (3) years are as shown in Table 4-1.

The budgetary plan for the Project shown above is judged to be realistic in view of this record for the past three years. It is possible to supply the necessary expenses (estimated at about 29 million pesos, refer to Subsection 4.3.5) for the Project under this budgetary plan and it is judged that there are no problems regarding the budgets for operation and maintenance.

Table 4.1 Annual Budget Allocated to NCR for the Past Three Years

(Unit: million pesos)

Item	1987	1988	1989
Total Budget	414.0	326.0	652.3
Budget for Maintenance Costs	55.0	55.5	84.4

4.2.3 Related Projects

The following two projects related to the Project under discussion are in progress at present.

Metro Manila Flood Control Project

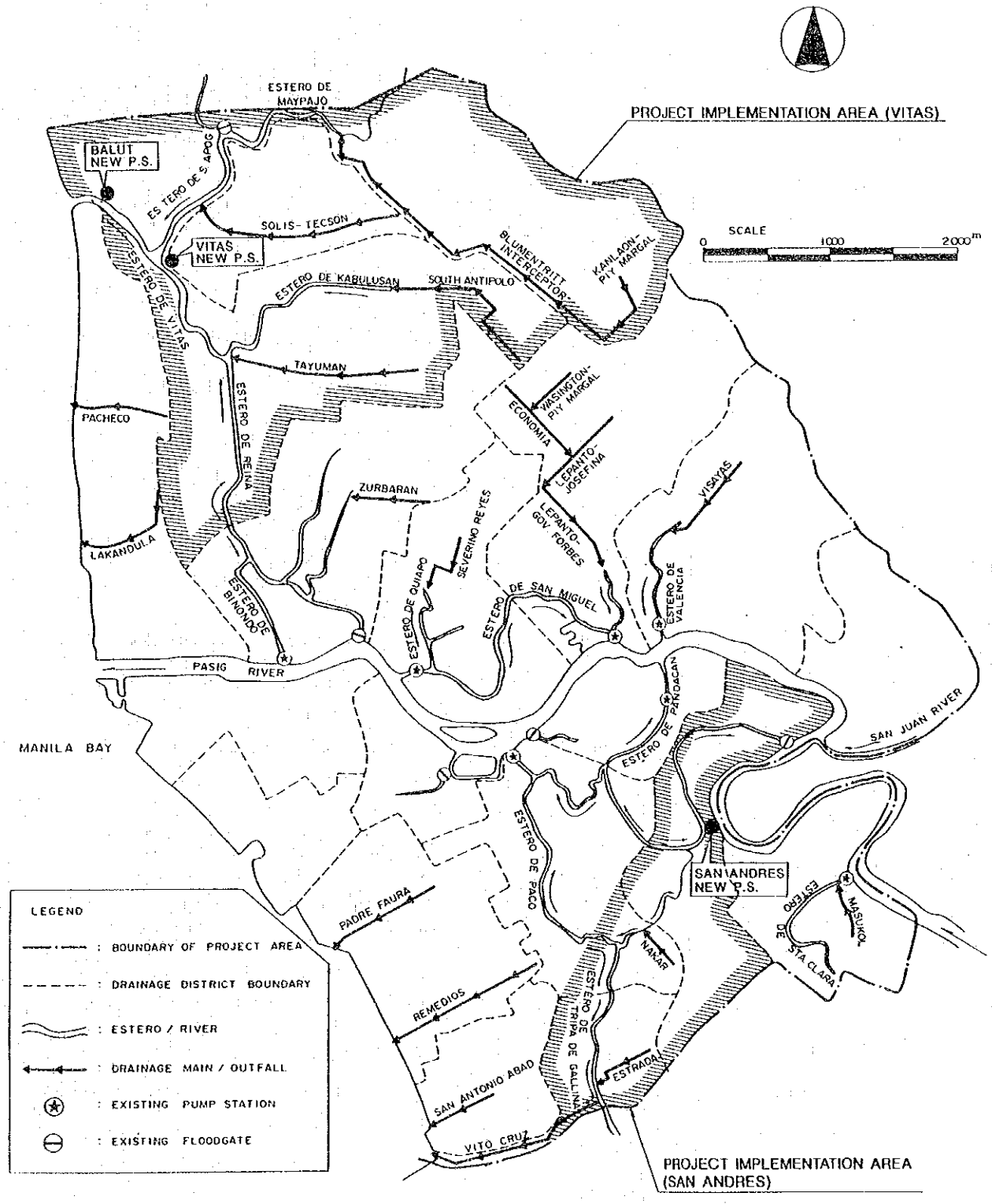
In response to the flood in 1985, the Department of Public Works and Highways (DPWH) executed a feasibility study concerning flood control in Metro Manila and two (2) districts, Vitas and San Andres, were selected as the areas most urgently requiring measures to be taken. On the strength of this study, a plan for establishment of pumping stations at three (3) locations was adopted as a part of the 14th Financial Assistance Project of the Overseas Economic Cooperation Fund (OECF) and the loan agreement for this purpose was signed in January 1988. The project was originally planned to run for a 5-year period from 1988 to 1994, but its completion is expected to be delayed for one (1) year at present.

The project sites and items of work are as listed in Fig. 4-1 and Table 4.2. During the discussions on the loan agreement, the necessity of retrieval of existing drainage channels to meet the drainage capacity of the three (3) new pumping stations was pointed out. In this connection, it was agreed that the Government of the Philippines will implement the retrieval of existing drainage channels connecting to the new pumping stations solely under financing by local funds. The scope of retrieval work is the dredging of the following four (4) esteros.

- Two (2) esteros in Vitas District, namely Vitas and Apog.
- Two (2) esteros in San Andres District, namely Pandacan and Tripa de Gallina.

Study on Flood Control and Drainage Project in Metro Manila

The master plan for the Flood Control and Drainage Project in Metro Manila is being drawn up at present by JICA subject to the target year of 2020. According to the mid-term report prepared through this study in November 1988, many of the existing drainage channels and drains have been blocked by sediment deposits and, unless the deposits are removed, newly built drainage facilities will be ineffective. The Project under



THE PROJECT FOR THE RETRIEVAL OF FLOOD PRONE AREAS OF METRO MANILA	Fig. 4-1 IMPLEMENTATION AREA OF METRO MANILA FLOOD CONTROL PROJECT
JAPAN INTERNATIONAL COOPERATION AGENCY	

Table 4-2. Scope of Work for Metro Manila Flood Control Project

Financial Source	Drainage Area	Scope of Work
Financial Assistance from Overseas Economic Cooperation Fund (OECF), Japan	Vitas	1. Construction of Vitas Pumping Station 2. Construction of Balut Pumping Station 3. Improvement of Estero de Vitas, Estero de la Reina, Estero Sunog Apog and Estero Maypajo 4. Extension of Solis-Tecson Drainage Main
	San Andres	1. Construction of San Andres Pumping Station 2. Improvement of Estero de Pandacan and Estero Tripa de Gallina
Local Funds	Vitas	1. Dredging of Estero de Vitas and Estero Sunog Apog 2. Construction of New Kabulusan Outfall 3. Improvement of Blumentritt Interceptor 4. Improvement of Laterals
	San Andres	1. Dredging of Estero de Pandacan and Estero Tripa de Gallina 2. Improvement of Laterals

discussion is to respond to this situation by making possible the removal of the deposits through the procurement of the necessary equipment.

4.2.4 Equipment Requested

The types of equipment requested consist of those required in removing deposits in drainage channels and drains in the city of Manila and its vicinity and mobile pumps for use in emergencies. The following decisions were made as a result of the investigation on types of equipment needed and their appropriateness from the technical and financial points of view and the discussions with the Philippine government officials concerned.

Equipment Required in Retrieval of Existing Drainage Channels and Drains

The equipment requested can be classified into the following three (3) groups.

- Equipment for unclogging laterals (the secondary drains)
- Equipment for unclogging drainage mains/outfalls (the primary drains)
- Equipment for dredging esteros (main water channels for drainage)

Mechanical removal of deposits has been carried out on parts of the esteros and drainage mains/outfalls, but the areas of removal have been limited due to the shortage of equipment. Unclogging work has also been carried out on the laterals by human labor using simple tools, but the efficiency of this method is extremely low.

In view of the extremely low rate of removal of deposits in drainage channels and drains, the quantity of deposits has reached 300,000 m^3 in the city of Manila and its vicinity alone and mechanical equipment has become indispensable in carrying out the removal work. Most of the machinery used by the NCR, DPWH (refer to Table 4-3), which is responsible for the maintenance of drainage systems in Metro Manila, has exceeded its service life and can no longer be put to practical use.

The types of equipment requested are those used widely in the Tokyo Metropolitan District and elsewhere and, so long as the transfer of

Table 4-3 Equipment Used by NCR,DPWH
(As of June 1988)

Equipment Type	Status /1					Total
	A	B	C	D	E	
Dredger			4		4	8
Amphidredger		9		3	2	14
Amphidozer		3				3
Survey Boat		1				1
Dredge Tender				4		4
Work Boat				3	3	6
Sewer Jet			5	1	6	12
Vacuum Cleaner	1	1		3		5
Water Pump	4	12	5	8	6	35
Dump Truck		33	7	18		58
Dragline, Bucket		1				1
Clampshell, Bucket		1				1
Crane Truck		4	1	1	1	7
Others /2	51	205	25	153	21	455
Total	56	270	47	194	43	610

Note /1 : A - Idle; Ready to Run
B - Equipment on Rental
C - Under Repair
D - Awaiting Repair
E - Unserviceable

/2 : Other equipment include Breaker, Asphalt Mixer, Concrete Mixer, Concrete Cutter, Electric Generator, Road Roller, Vehicle, etc.

technical knowledge is accomplished, there should be no problem in their use. It was also confirmed that there will be no problem from the point of view of the cost of maintaining the number of machinery required for removal of the quantity of deposits as requested (refer to Subsection 4.3.5).

Mobile Pumps for Emergency Drainage

Since the areas for intended use of the requested pumps are those regularly visited by floods, it was judged to be more advantageous to install permanent pumps. As a result of consultations with the Philippine government officials concerned, it was decided that a plan to install permanent pumps should be promoted by the Government of the Philippines and this item was removed from the scope of the Project.

4.2.5 Basic Policy in Implementation of the Grant Aid Project

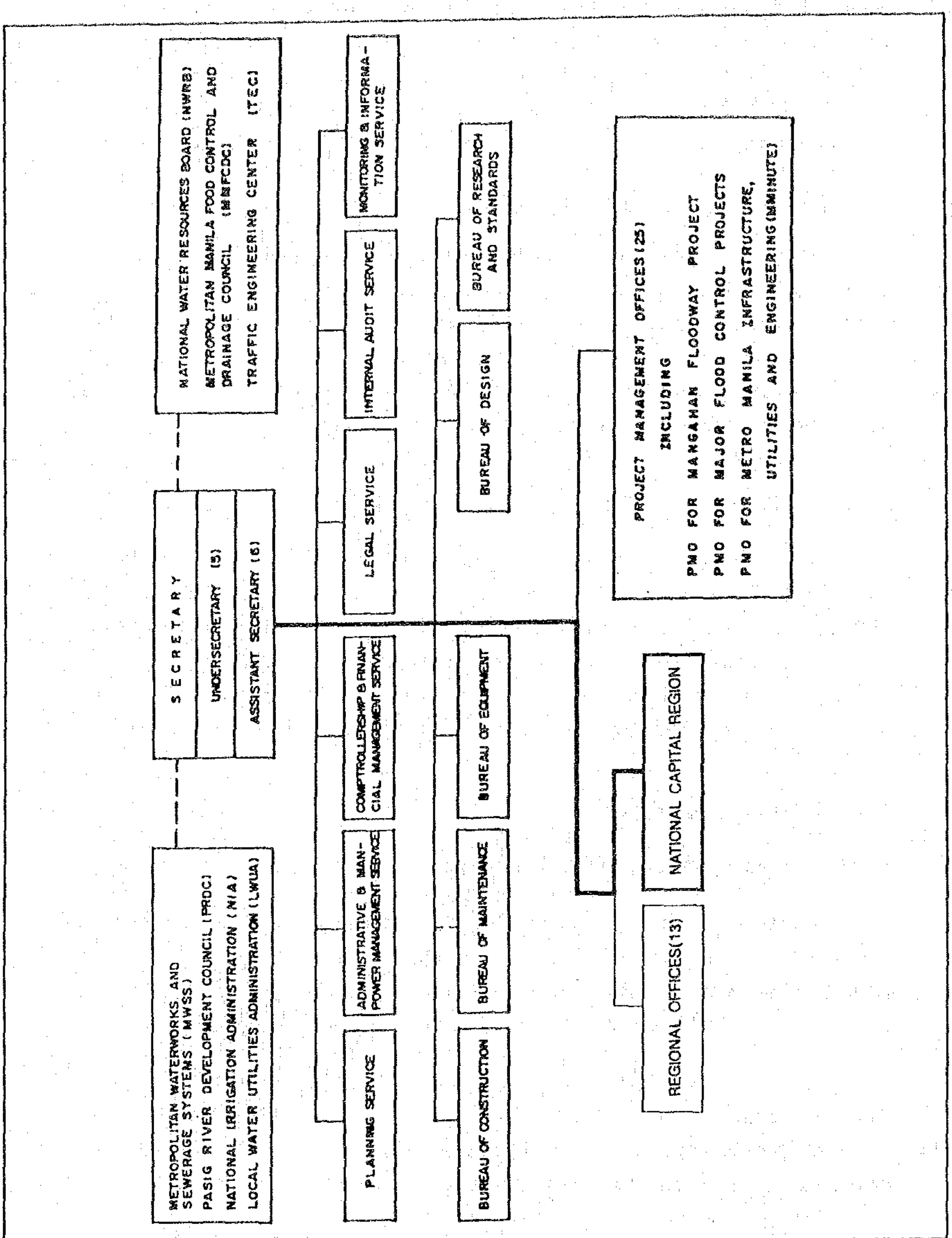
It was judged appropriate to implement the procurement of equipment required for the retrieval of existing drainage channels and drains and to transfer the technical knowledge required for the operation and maintenance of the equipment under grant aid from the Government of Japan. The impact and feasibility of the implementation and the capacity of the recipient country have been confirmed through the investigations mentioned above.

4.3 Project Description

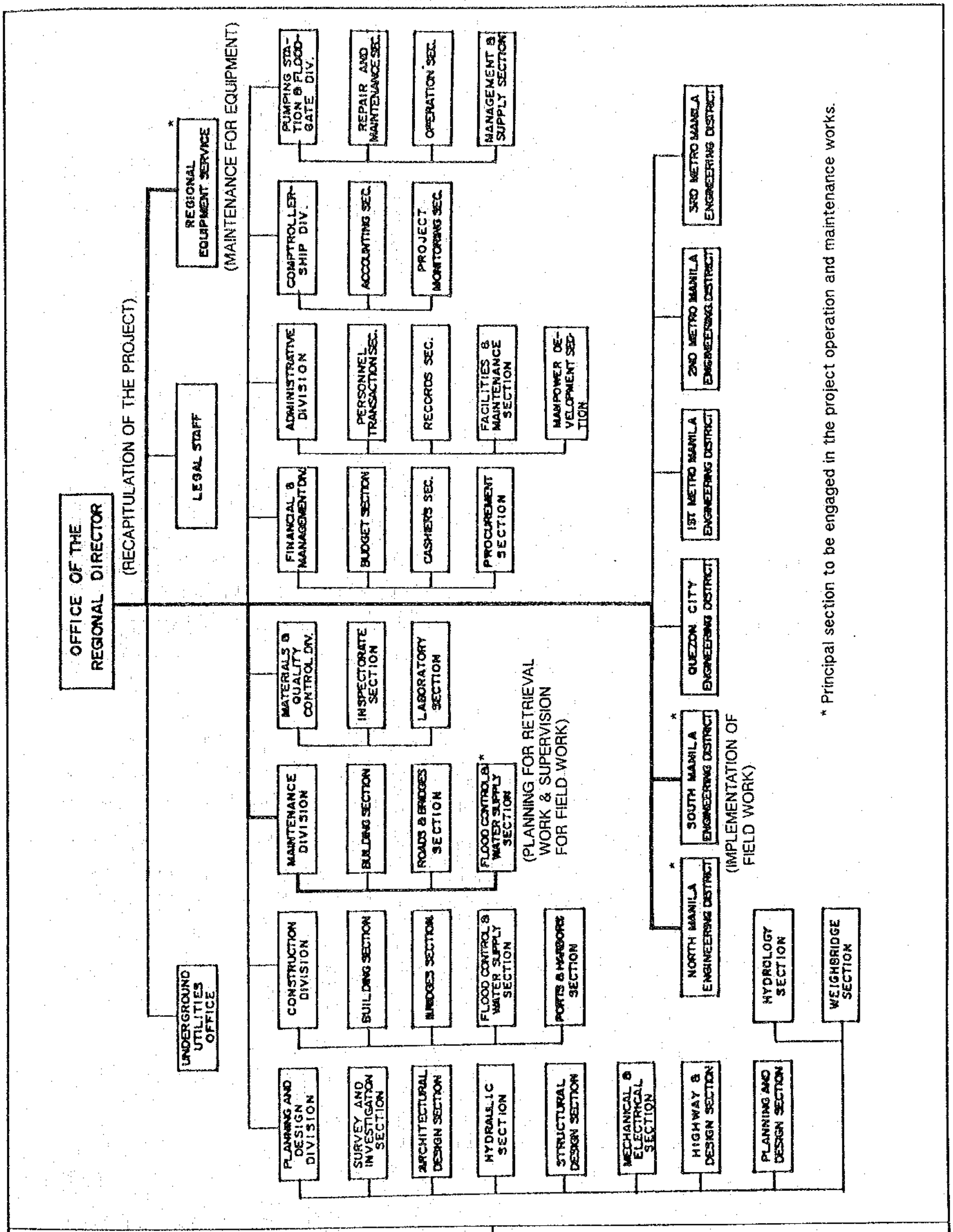
4.3.1 Executing Agency and Operational Structure

Maintenance and operation of the drainage channels and drains in Metro Manila come under the jurisdiction of the National Capital Region (NCR), Department of Public Works and Highways (DPWH). Organization charts of the DPWH and the NCR are given in Figs. 4-2 and 4-3, respectively.

In the organization of the NCR, the Maintenance Division, the district engineering offices (North Manila and South Manila) and the Regional Equipment Service will be responsible for the operation and maintenance of the equipment procured through the Project, and the



THE PROJECT FOR THE RETRIEVAL OF FLOOD PRONE AREAS OF METRO MANILA	Fig. 4-2 ORGANIZATION CHART OF THE DEPARTMENT OF PUBLIC WORKS AND HIGHWAYS
JAPAN INTERNATIONAL COOPERATION AGENCY	



THE PROJECT FOR THE RETRIEVAL OF FLOOD PRONE AREAS OF METRO MANILA	Fig. 4-3 ORGANIZATION CHART OF THE NATIONAL CAPITAL REGION, DPWH
JAPAN INTERNATIONAL COOPERATION AGENCY	

following staff will be engaged in the implementation under the director of the NCR.

NCR Maintenance Division

This body is responsible for maintenance and supervision of public facilities in Metro Manila. A total of 103 members of the Flood Control and Water Supply Section will be engaged, according to need, in the operation of the procured equipment. The composition of the staff is as follows.

- Maintenance Engineers	:	4
- Civil Engineers	:	23
- Field Work Engineers	:	100
- Clerical Staff	:	18

Operation of the equipment to be procured through the Project will be carried out by the maintenance engineers mentioned above and actual planning and supervision by the 23 civil engineers. Besides the 100 field work engineers, 42 laborers will be engaged in the field work. Apart from the staff under direct control, there are plans for entrusting parts of the field work to private firms as the need arises.

NCR District Engineering Offices

There are six (6) engineering district offices under the NCR. Of these, those of North Manila and South Manila will participate in the operation of the equipment to be procured through the Project by order of the NCR Maintenance Division. The numbers of staff participating from the district engineering offices are as follows.

(1) North Manila Engineering District Office

- Management Staff	:	5
- Civil Engineers	:	7
- Field Workers	:	12
Total	:	24

(2) South Manila Engineering District Office

- Management Staff	:	6
- Civil Engineers	:	7
- Field Workers	:	31
Total	:	44

NCR Regional Equipment Service

This department, consisting of the following staff, will be responsible for the repair and maintenance of the equipment.

- Supervisors	:	2
- Marine Equipment Repair Engineers	:	53
- Land Equipment Repair Engineers	:	70
- Clerical Staff	:	26
Total	:	151

4.3.2 Plan of Operation

The aim of this Project is to remove the deposits in the drainage channels and drains in the city of Manila and its vicinity using the procured equipment. A period of five (5) years has been set as the total period for the improvement work as a result of investigations on the durability of the equipment and the request of the Government of the Philippines (see Subsection 5.2.2). The drainage channels and drains can be classified into three (3) groups, namely esteros, drainage mains/outfalls and laterals. The areas of retrieval in each of these categories and the quantities of deposits to be removed using the equipment are as follows.

(1) Dredging of Esteros

Upon comparative investigation of the cross-sectional drawings according to the survey on the present situation and the planned conditions (to handle a 10-year probability flow), and taking account of the results of the site survey, it was judged to be necessary to extend the originally requested length to be dredged from 12.3 km to 13.4 km, to include a 1,100 m stretch on the upper part of Estero de Paco in order to prevent

inundation of the southern part of the city of Manila (refer to Fig. 4-4). The total dredging volume was then adjusted to approximately 220,000 m^3, equivalent to 67% of the requested volume, upon close examination of the drawings of the present situation and the planned conditions.

The lengths of the stretches to be dredged and the volume of deposits to be dredged are given in Table 4-4. The total length and total volume of dredging are as follows.

- Total Length : 13,422 m
- Total Volume of Dredging : 219,665 m^3

(2) Removal of Deposits from Drainage Mains/Outfalls

While the Government of the Philippines requested removal work to be carried out on a total of 39 drainage mains and outfalls, removal work will be limited to the 20 drainage mains and outfalls located within the project area because the request included drainage mains and outfalls located outside of the project area which would extend the area of work too widely. Drainage mains and outfalls where operations are to be carried out are as shown in Fig. 4-4.

The lengths of culverts, their cross-sectional dimensions and volume of deposits for removal are given in Table 4-5. The total length and the total quantity of deposits to be removed are as follows.

- Total Length : 19,623 m
- Total Volume of Deposits for Removal : 67,505 m^3

(3) Removal of Deposits from Laterals

All the laterals in the project area are subject to serious blockage due to siltation. The laterals to be cleared under the Project (see Table 4-6) consist of culverts with diameters ranging from 12 to 42 inches. The total length and total quantity of deposits to be removed are as follows.

Diameter of Drain (inch)	Length (m)	Work Volume (m^3)
12	30,846	1,092
18	44,273	3,522
24	94,226	13,324
30	17,365	3,958
36	6,453	2,156
42	661	303
Total	193,824	24,355

4.3.3 Location and Conditions of Project Area

Areas of Operation of Procured Equipment

The project area is located more or less at the center of Metro Manila and contains, in terms of administrative divisions, the whole of the city of Manila and parts of Quezon City, Pasay City and the municipality of Makati (refer to Fig. 4-5). The project area is 50.84 km^2, amounting to 8% of the total area of Metro Manila (636 km^2).

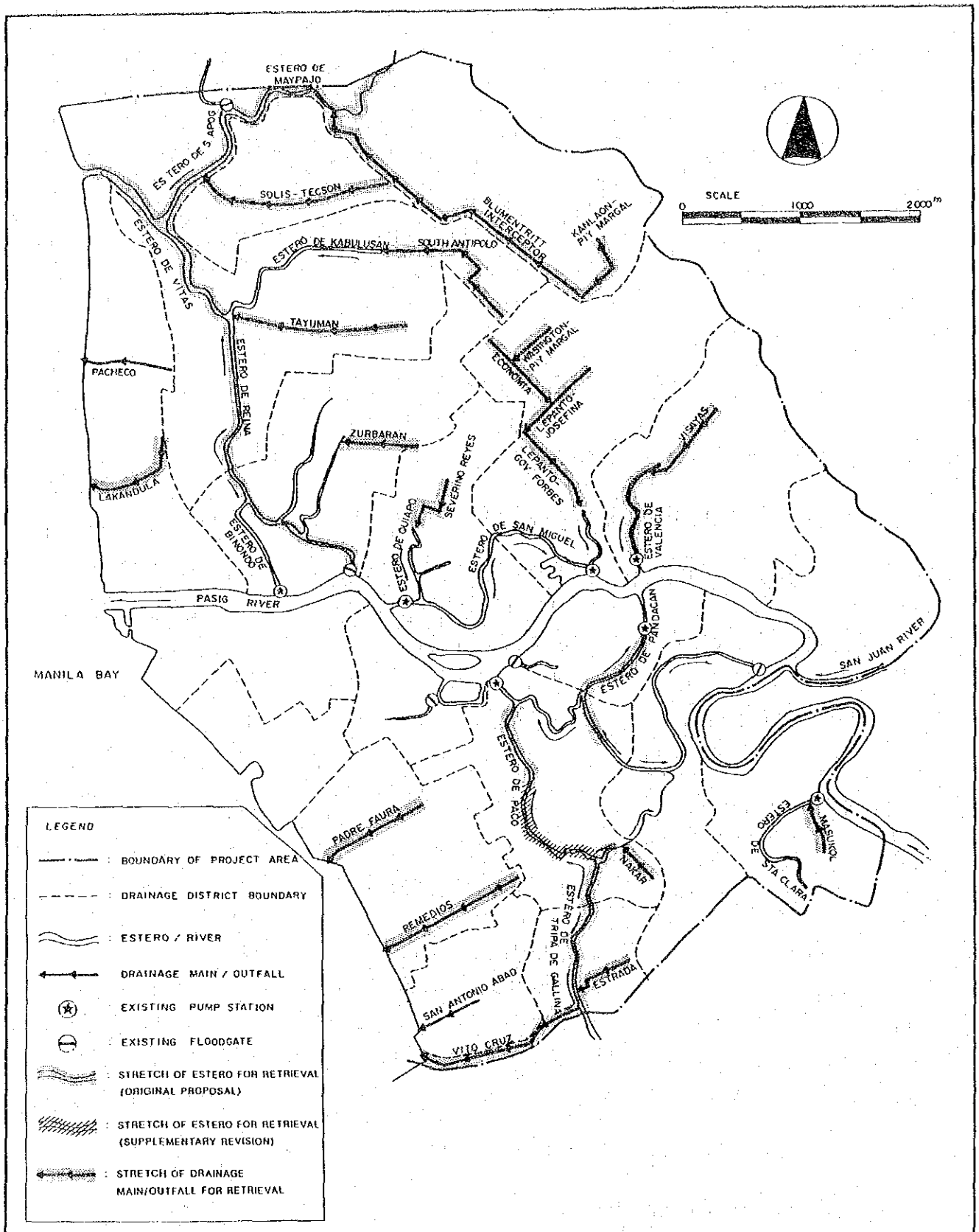
The areas subject to frequent inundation within the project area are as shown in Fig. 4-6. The flood conditions in each of the drainage areas (see Fig. 4-7) are given below.

(1) Vitas, Reina and Sunog Apog Drainage Areas

Stormwater is naturally drained at present via Estero de Vitas and the areas of inundation are distributed along the estero. The flooding is due to the decrease of flow capacity and the virtual impossibility of drainage during periods of high tide in Manila Bay, because the ground in the area is less than 2 m above the average tide level in the bay.

(2) Valencia, Aviles, Quiapo and Binondo Drainage Areas

Stormwater is drained from each of these drainage areas into the Pasig River via pumping stations. Results of the field survey indicate that the esteros in each of these areas have relatively large flow



THE PROJECT FOR THE RETRIEVAL OF FLOOD PRONE AREAS OF METRO MANILA	Fig. 4-4 STRETCH OF DRAINAGE FOR RETRIEVAL
JAPAN INTERNATIONAL COOPERATION AGENCY	

Table 4-4 Esteros for Dredging

NO.	NAME OF ESTERO	LENGTH (m)	VOLUME OF DREDGING (m3)
1	Vitas	1800	103300
2	Sunog-Apog	1120	43150
3	Maypajo	1800	9750
4	Reina	2855	32760
5	Valencia	1124	3955
6	Paco	1859	13760
7	Pandacan	1134	4800
8	Tripa de Gallina	1730	8190
	TOTAL	13422	219665

Table 4-5 (1/2) Drainage Mains/Outfalls for Removal of Deposit

(NORTH MANILA)

NO.	NAME OF DRAINAGE MAIN/OUTFALL	LENGTH (m)	SIZE OF CULVERT AT OUTLET POINT				DISCHARGE POINT	SILTED VOLUME		REMARKS
			NO. OF BAYS	WIDTH (m)	DEPTH (m)	INVERT EL. (m)		% OF SILTATION	VOLUME (m3)	
N-1	Blumentritt Interceptor	2973	2	2.57	2.57	8.510	Estero de Maypajo	52.5	17040	Actually surveyed.
N-2	Kanlaon-Piy Margal Main	650	1	2.00	1.40	11.760	Blumentritt Interceptor	50.0	737	Estimated from Blumentrit Intercepter.
N-3	Solis-Tecson Main	1475	2	2.20	1.50	9.500	Estero de Sunog Apog	42.8	3661	Actually surveyed.
N-4	South Antipolo	1093	1	4.40	3.45	9.296	Estero de Kabulusan	64.9	8885	Actually surveyed.
N-5	Lakandula Main	876	1	3.84	2.02	8.848	Manila Bay	40.9	1833	Actually surveyed.
N-6	Zurbaran Main	705	1	3.00	1.50	9.380	Estero de San Lazaro	37.5	1482	Actually surveyed.
N-7	Severino-Reyes Main	536	1	3.20	1.60	9.300	Estero de Quiapo	36.0	987	Actually surveyed.
N-8	Lepanto-Gov. Forbes Main	1057	3	3.60	2.80	8.350	Estero de Aviles	33.6	10731	Actually surveyed.
N-9	Economia (Lepanto) Main	605	3	2.76	2.20		Lepanto-Josefina Main	16.2	635	Actually surveyed.
N-10	Lepanto-Josefina Main	1156	1	4.22	2.20	9.600	Lepanto-Gov. Forbes Main	4.0	461	Actually surveyed.
N-11	Economia Main	586	2	2.20	1.50	9.740	Lepanto-Josefina Main	29.1	842	Actually surveyed.
N-12	Washington-Piy Margal Main	361	1	2.40	1.83	9.817	Economia Main	26.5	322	Actually surveyed.
N-13	Visayas Main	668	2	2.05	2.05	9.585	Estero de Valencia	33.6	1500	Actually surveyed.
N-14	Tayuman Main	1605	1	2.40	1.40		Estero de Vitas	74.5	3045	Actually surveyed.
		14346							52161	

Table 4-5 (2/2) Drainage mains/Outfalls for Removal of Deposit

(SOUTH MANILA)

NO.	NAME OF DRAINAGE MAIN/OUTFALL	LENGTH (m)	SIZE OF CULVERT AT OUTLET POINT				SILTED VOLUME		REMARKS
			NO. OF BAYS	WIDTH (m)	DEPTH (m)	INVERT EL. (m)	DISCHARGE POINT	% OF SILTATION	VOLUME (m3)	
S-1	Padre Faura Main	1157	1	3.20	2.88	9.500	Manila Bay	34.0	2340	Estimated from Remedios Outfall.
S-2	Remedios Main	1355	1	4.40	3.00	9.750	Manila Bay	33.9	4438	Actually surveyed.
S-3	Estrada Main	592	1	2.94	1.57	9.700	Tripa de Gallina	30.0	563	Estimated from Vito Cruz Outfall and Zobel Roxas Main.
S-4	Nakar Main	383	1	1.10	1.60		Tripa de Gallina	78.5	529	Actually surveyed.
S-5	Masukol Main	465	1	3.50	2.00		Sta. Clara	74.0	2308	Actually surveyed.
S-6	Vito Cruz Outfall	1325	1	1.96	2.05	9.130	Manila Bay	97.0	5166	Actually surveyed.
		5277							15344	

Table 4-6 (1/4) Laterals for Removal of Deposit
(NORTH MANILA)

No.	Name of Street	LENGTH (M) BY DIAMETER (INCH) 12"	18"	24"	30"	36"	42"	Total
1	J. Torres	9		459				467
2	J. Rizal Ave.	264	110	2378	1990			4742
3	Pampanga St.	38	26	211				276
4	Tayuman St.	434	17	302				753
5	Zurbaran St.	580	25	14	4			622
6	Quezon Blvd.	751	273	32				1056
7	C. Aguila St.	32		504				536
8	P. Casal St.	360		284				644
9	Cordillera St.	31	171	54				256
10	R. Magsaysay Blvd.	236	176	548	281	783		2022
11	Hermosa St.	119	338					456
12	Herbosa St.	1277						1277
13	Perla St.	2		38	8			48
14	Solis St.	249	144					393
15	Sto. Cristo St.	108	150	244				502
16	Tecson St.	212	129					341
17	Ugbu St.	39	35	135				209
18	Vitas St.	10	56	570				636
19	Zaragosa St.	54	258	196	7	429		944
20	Madrid St.		84	24	8			116
21	Rosario St.	10	675					685
	(Quintin Paredes)'							0
22	Mendoza St.	1169				568		1737
23	Algeciras St.	911	644	360	648	170		2734
24	Blumentritt St.	178	422					600
25	Buenos Aires St.	15	224	19	211			470
26	Dapitan St.	1088	245	1243	1239	115		3930
27	Dimasalang St.	78	183		217			477
28	Espana Blvd.	163	83	291	296	268		1101
29	Gov. Forbes St.					300		300
30	V. G. Cruz St.	117		1056	1912			3086
31	Lerma St.	17	375	37				429
32	A. Maceda St.	60	133	627	230	158		1209
33	Bustillos St.	90	14	344				448
34	Castanos St.	29		263				292
35	E. Quintos St.	582	573	869	704			2728
36	F. Cayco	50	184	34				268
37	G. Tuazon St.	1291	534	862				2686
38	J. Fajardo St.	1724	110	86	539	127		2586
39	Laong-Laan St.	387	1693	939				3018
40	Legarda St.	443	915	76				1433
41	M. dela Fuente	1748	755	228			161	2892
42	M. Earnshaw	49	493	760				1302
43	N. Reyes St.	210		20				230
44	P. Florentino St	295	573	587	47			1501
45	S. H. Loyola St.	1178	279	251	134			1842
46	Antonio Rivera St.	32	417					448
47	Dagupan St.	42	922	1215				2179
48	Del Pan St.		25	18	556			599
49	Escoda St.	48		266				314
50	H. Lopez St.	439	639	974	1007	807		3866
	Sub-total	17246	13101	17417	10036	3724	161	61685

Table 4-6 (2/4) Laterals for Removal of Deposit
(NORTH MANILA)

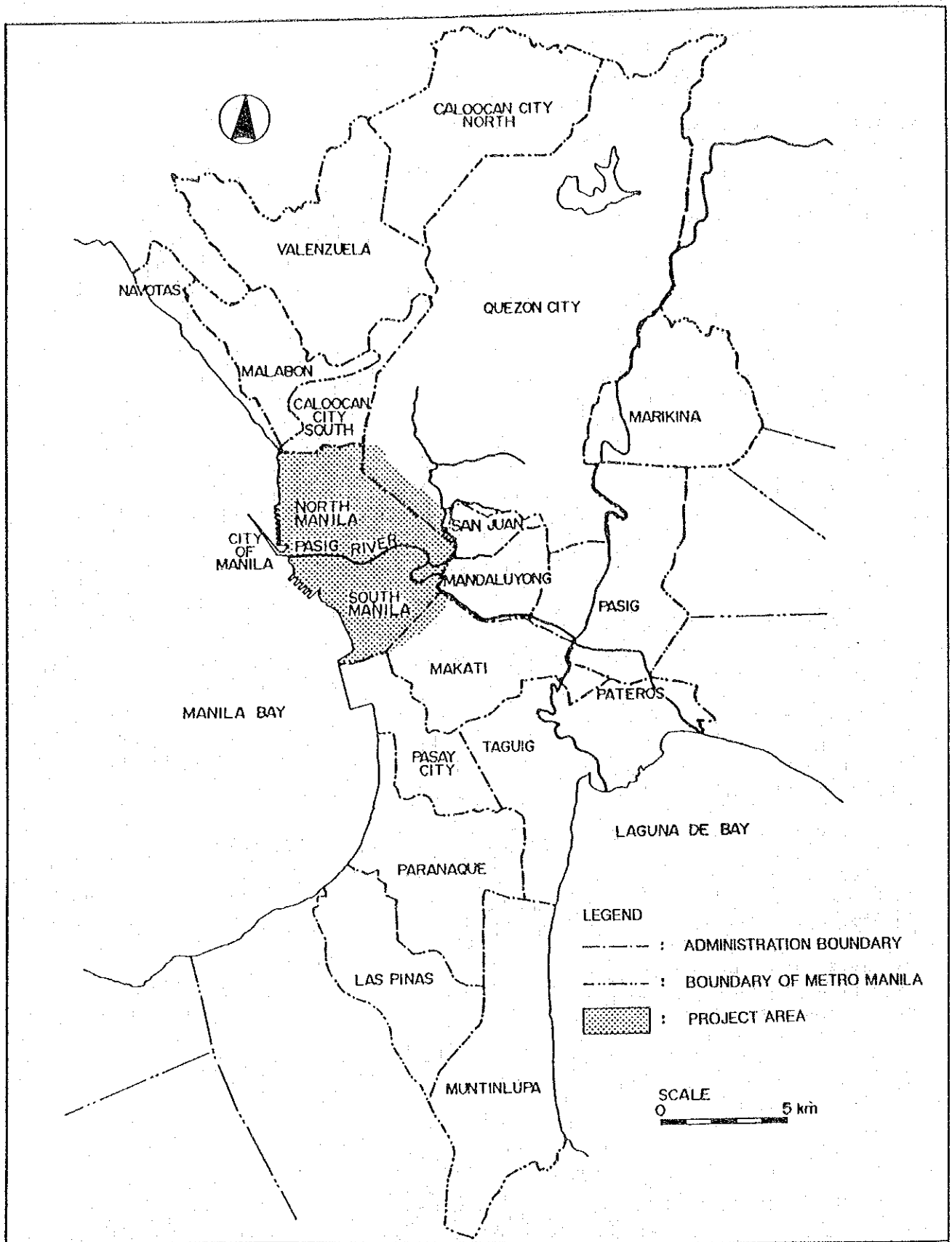
No.	Name of Street	LENGTH (M) BY DIAMETER (INCH) 12"	18"	24"	30"	36"	42"	Total
51	J. A. Santos Ave.	699	774	4485	283			6240
52	Juan Luna St.	2420	416	2045	451			5332
53	Kalakal St.	24		115				139
54	Moriones St.	308	480	970	607		186	2550
55	Rodriguez St.			145	622	613	314	1694
56	Sta. Maria St.	270	296					566
57	Earnshaw St.	44	84	205		239		571
58	Velasquez St.	529	218	503	335	658		2244
59	Dasmarinas St.	14	85					99
60	Reina Regante St.		27	220		273		520
61	San Fernando	102	180					283
62	Alvarez St.	64	339					403
63	Aurora Blvd.	41	361	492				894
64	Carriedo St.	260	210	209				679
65	C. M. Recto Ave.	1283	3828	2715				7826
66	Oroquieta St.	626	573	2385	639			4223
67	Quiricada St.	506	133	383				1022
68	C. Palanca St.	347	345	141	256	125		1213
69	Evangelista St.	20	825	153	10			1008
70	Arlegui St.	67	175	670	536			1448
71	Gen. Solano St.	465						465
72	P. Laurel St.	35	1359		954			2347
73	J. Nepomuceno St.	13	22	80	67			182
74	Mendiola St.	406		30				436
75	N. Padilla St.	744						744
76	Bagumbayan St.	29						29
77	Nagtahan	882	27	257	55	520		1741
78	Old Sta. Mesa	314	306	329	332			1281
79	P. Sanchez	184		270				454
80	Reposo St.	36	267					303
81	Santol St.		106					106
82	Paltok St.	384	282	356				1022
83	Lubiran St.	180	59	850				1089
84	V. Mapa St.	735		157	53			945
	Sub-total	12031	11776	18164	5199	2429	499	50098
	Total	29277	24876	35581	15235	6153	661	111783

Table 4-6 (3/4) Laterals for Removal of Deposit
(SOUTH MANILA)

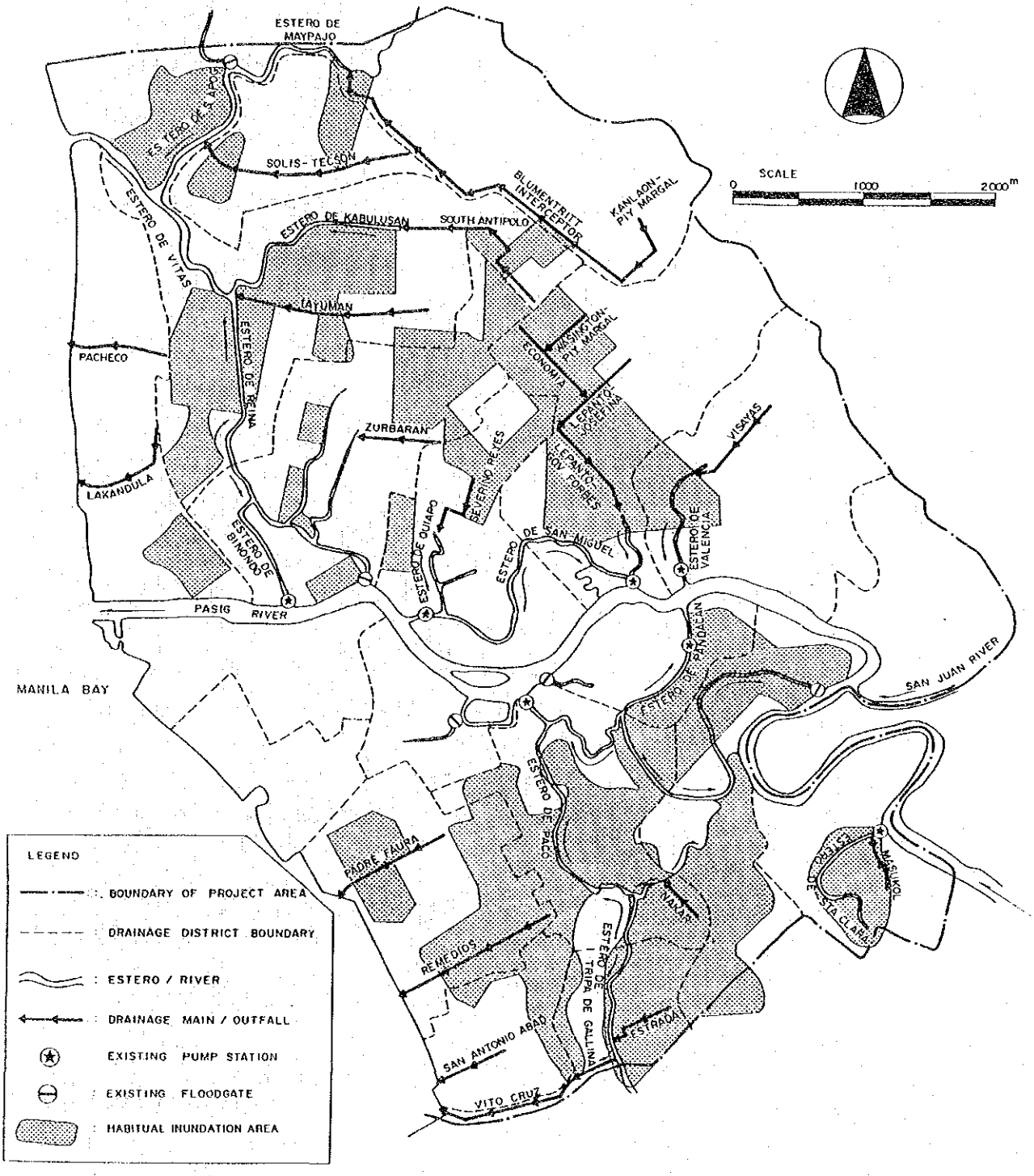
No.	Name of Street	LENGTH (M) BY DIAMETER (INCH) 12"	18"	24"	30"	36"	42"	Total
1	Muelle Tacoma	769						769
2	2nd St., Port Area		649					649
3	8th St., Port Area		655					655
4	11th St., Port Area		350					350
5	12th St., Port Area		252					252
6	13th St., Port Area			700				700
7	16th St., Port Area			500				500
8	17th St., Port Area			252				252
9	18th St., Port Area			155				155
10	19th St., Port Area		150					150
11	20th St., Port Area		217					217
12	21st St., Port Area			115				115
13	22nd St., Port Area		110					110
14	23rd St., Port Area		110					110
15	24th St., Port Area		125					125
16	25th St., Port Area		100	310				410
17	Bonifacio Interchange		450					450
18	Aduana, Intramuros				480			480
19	Bureau of Post			751				751
20	Railroad, Port Area			940				940
21	Atlanta, Port Area		450					450
22	Chicago, Port Area		500	112				612
23	Boston, Port Area		849					849
24	Bonifacio Drive		560	1000				1560
25	Magallanes Drive		450					450
26	Plaza Espana		200					200
27	Muelle de Magallanes		900					900
28	Muralla, Intramuros			1370				1370
29	Gen. Luna, Intramuros			2855				2855
30	Sta. Lucia, Intramuros		450					450
31	Anda, Intramuros			720				720
32	Liwasang Bonifacio			850				850
33	Finance Road, Ermita			400				400
34	Victoria, Intramuros			590				590
35	Arroceros			850				850
36	Concepcion, Ermita		600					600
37	Ayala Blvd., Ermita			900				900
38	U.N. Ave., Paco		350	750		150		1250
39	Romualdez, Paco		1300					1300
40	Paco Cemetery, Paco			500				500
41	San Marcelino, Paco			2590				2590
42	San Gregorio, Paco			515				515
43	Dart, Paco			800				800
44	Singalong, Paco			1800				1800
45	Leon Guinto, Paco			2300				2300
46	M. Orosa, Ermita			1000				1000
47	Taft Ave., Ermita		450	1500	450			2400
48	Adriatico, Ermita			2300				2300
49	Mabini, Ermita			1950	600			2550
50	Pres. Quirino, Malate			3130				3130
	Sub-total	769	10227	32505	1530	150	0	45181

Table 4-6 (4/4) Laterals for Removal of Deposit
(SOUTH MANILA)

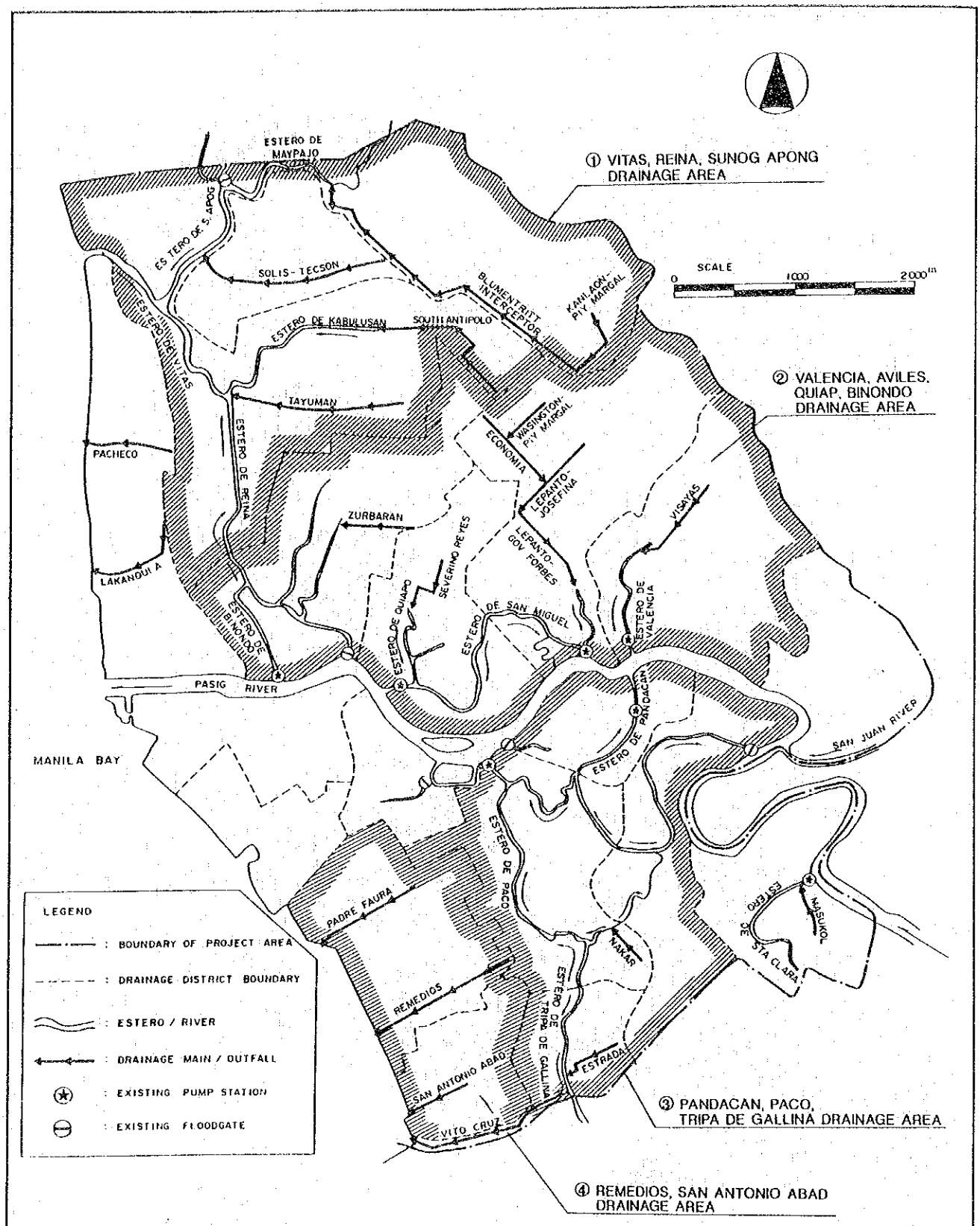
No.	Name of Street	LENGTH (M) BY DIAMETER (INCH) 12"	18"	24"	30"	36"	42"	Total
51	M.H. del Pilar, Malate			2100				2100
52	Roxas Blvd.			3100				3100
53	Katigbak, Ermita			270				270
54	New Luneta, Ermita		430					430
55	South Blvd., Ermita			250				250
56	T.M. Kalaw. Ermita			850				850
57	J. Escoda, Ermita			700				700
58	P. Gil, Paco			1650				1650
59	Dr. J. Quintos Sr., Paco			250				250
60	Remedios, Malate		150			150		300
61	San Andres, Malate		250	750				1000
62	Corbitarte, Malate		150					150
63	Estrada, Malate		450	500				950
64	V. Cruz, Sta. Ana			2150				2150
65	South Ave., Sta. Ana		540					540
66	G. del Pilar, Paco		900					900
67	S.Superhighway, Sta. Ana			1500				1500
68	A. Francisco, Sta. Ana			800				800
69	Onyx, Sta. Ana			700				700
70	Pasig Line, Sta. Ana			1950				1950
71	Tejeron, Sta. Ana		850					850
72	J. Syquia, Sta. Ana		700					700
73	M. Roxas, Sta. Ana		500					500
74	M. Roxas Sta. Ana		650					650
75	Calderon, Sta. Ana		350					350
76	R. del Pan, Sta. Ana			620				620
77	Havona, Sta. Ana		300					300
78	Lamoyan, Sta. Ana			900				900
79	N. Panaderos, Sta. Ana			1000	600			1600
80	Old Panaderos, Sta. Ana	800		600				1400
81	J. Posadas, Sta. Ana		400					400
82	A. Bautista, Sta. Ana		800					800
83	M. Carreon, Sta. Ana			600				600
84	Zamora, Sta. Ana			1300				1300
85	Labores, Sta. Ana		800					800
86	Jesus, Sta. Ana			900				900
87	Palumpong, Sta. Ana			250				250
88	Laura, Sta. Ana		650					650
89	Beata, Sta. Ana			850				850
90	Certeza, Sta. Ana		300					300
91	M. Guanzon, Paco			1300				1300
92	Mendiola Extn., Paco			300				300
	Sub-total	800	9170	26140	600	150	0	36860
	Total	1569	19397	58645	2130	300	0	82041
	Grand Total (City of manila)	30846	44273	94226	17365	6453	661	193824
	Grand Total of 12" to 24"							169345
	Grand Total of 30" to 42"							24479



THE PROJECT FOR THE RETRIEVAL OF FLOOD PRONE AREAS OF METRO MANILA	Fig. 4-5 PROJECT AREA AND ADMINISTRATIVE BOUNDARY
JAPAN INTERNATIONAL COOPERATION AGENCY	



THE PROJECT FOR THE RETRIEVAL OF FLOOD PRONE AREAS OF METRO MANILA	Fig. 4-6 HABITUAL INUNDATION AREAS IN THE PROJECT AREA
JAPAN INTERNATIONAL COOPERATION AGENCY	



THE PROJECT FOR THE RETRIEVAL OF FLOOD PRONE AREAS OF METRO MANILA

JAPAN INTERNATIONAL COOPERATION AGENCY

Fig. 4-7 MAJOR DRAINAGE AREAS IN THE PROJECT AREA

capacities; however, there are serious blockages due to deposits in the drainage mains and this latter factor is observed to be the main cause of inundations in the area.

(3) Pandacan, Paco and Tripa de Gallina Drainage Areas

Stormwater in these drainage areas is either drained artificially into the Pasig River via the Pandacan and Paco pumping stations or naturally into Manila Bay via the Vito Cruz Outfall. Areas regularly inundated are distributed throughout the area except in the vicinity of the pumping stations. The results of the field survey indicated that the major cause of the inundation lies in the serious lowering of the flow capacity on the Vito Cruz Outfall and the two esteros of Paco and Tripa de Gallina. Inundation damage in these areas is the greatest in the entire drainage area for the proposed retrieval work and these areas have been designated as the areas most urgently requiring improvement of their drainage systems by the Government of the Philippines.

(4) Remedios and San Antonio Abad Drainage Areas

Stormwater from this area is drained naturally into Manila Bay via the three outfalls of Padre Faura, Remedios and San Antonio Abad. The results of the field survey indicate that serious blockages due to deposits, especially in the Remedios Outfall, have been the major cause of inundation. This drainage area is a major commercial area in Metro Manila and is also undergoing development as a tourist area. For these reasons, the area has been designated by the Government of the Philippines as the area most urgently requiring improvement of its drainage system after the Pandacan, Paco and Tripa de Gallina drainage areas.

Dumping Sites

The following two sites have been selected as sites for disposal of the deposits removed under the Project. Their locations are as shown in Fig. 4-8. The maximum time required for transportation from the sites of removal to these dumping sites is about 45 minutes.

(1) Navotas Dumping Site

This 40-ha site on the reclamation area, approximately 7 km from the sites of removal work in the center of the city of Manila along the road R-10, has been selected as a dumping site for the Project. The site is sufficiently removed from urban areas and there will be no serious problems concerning hygiene.

(2) Las Piñas Dumping Site

This 1-ha site near the mouth of the Las Piñas River, approximately 15 km from the sites of removal work along the road R-1, has been selected as a dumping site. With the exception of several tens of houses belonging to illegal dwellers, there are no houses in the vicinity of the site and there will be no serious hygiene problems so long as these residents are transferred elsewhere. The Metropolitan Manila Commission (MMC) plans to use the site for temporary storage of garbage and the materials gathered here are to be finally transferred to the 68-ha Carmona Dumping Site, approximately 55 km to the south of the city of Manila.

Storehouses for Project Equipment

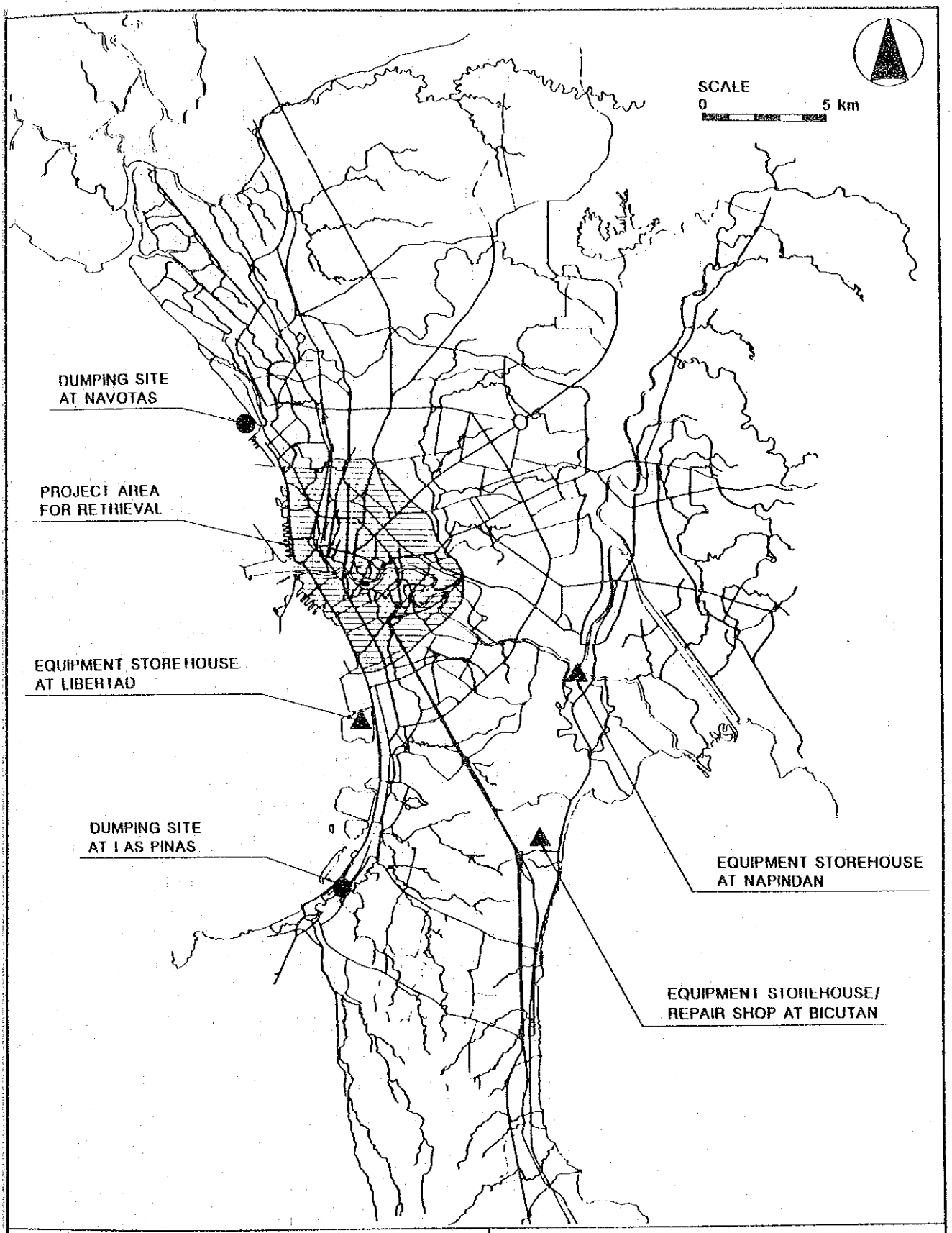
The following three sites have been selected as sites for the storage of equipment. Their locations are as shown in Fig. 4-8.

(1) Libertad

This 5.0-ha reclaimed site adjacent to the Libertad Pumping Station has been secured as a new site for the storage of equipment, and fencing is to be installed by the Department of Public Works and Highways (DPWH) under the 1990 budget.

(2) Napindan

This existing 2.1-ha storehouse (administered by DPWH) adjacent to Napindan Hydraulic Control Structure at the confluence of the Pasig and Napindan rivers will be used for the storage of equipment for the Project.



THE PROJECT FOR THE RETRIEVAL OF FLOOD PRONE AREAS OF METRO MANILA

JAPAN INTERNATIONAL COOPERATION AGENCY

Fig. 4-8 PROJECT DUMPING SITE AND EQUIPMENT STOREHOUSE

(3) Bicutan

This 0.5-ha site on the premises of the repair shop administered by the DPWH will be used for the storage of equipment under the Project.

Of the sites mentioned, above, that at Libertad, closest to the sites of retrieval work, will be used as the primary site for the storage of equipment. There are moorings at the Napindan site for dredgers, and repairs of dredgers for use on the esteros, as well as simple repairs (exchange of parts) for land equipment can be carried out here. Regular disassembly checks and necessary repairs of equipment will be carried out at the repair shop within which the storehouse at Bicutan is located.

4.3.4 Outline of Equipment

In consideration of the work volume and the conditions of the project site, the major items of equipment to be used for the retrieval work were determined to be as follows (refer to Chapter 5 for details).

(1) Equipment for Retrieval of Laterals

- Water Jet Cleaner (4-ton, Truck-Mounted) : 3 units
- Lift Dump Type Dehydration Vacuum Cleaner (4-ton, Truck-Mounted) : 3
- Water Tanker (4-ton, Truck-Mounted) : 3
- Dump Truck (Loading Capacity: 4-T) : 6

(2) Equipment for Retrieval of Drainage Mains/Outfalls with Concrete Maintenance Holes

- Wheel Crane : 4 units
- Dump Truck (Loading Capacity: 4-T) : 8

(3) Equipment for Retrieval of Drainage Mains/Outfalls with Steel Maintenance Holes

- Submersible Sand Pump (Discharge: 1 m^3/min)	:	2 units
- Engine Generator (45 KVA)	:	1
- Dump Truck (Loading Capacity: 2-T)	:	12

(4) Equipment for Retrieval of Large Esteros (Vitas and Sunog Apog)

- Clamshell Crawler (Bucket Capacity: 0.6 m^3)	:	2 units
- Pontoon Barge	:	2
- Scow	:	4
- Tugboat	:	2
- Hydraulic Truck Crane	:	2
- Dump Truck (Loading Capacity: 11-T)	:	6

(5) Equipment for Retrieval of Small Esteros

- Clamshell Crawler (Bucket Capacity: 0.2 m^3)	:	3 units
- Pontoon Barge (Easy Setup Type)	:	3
- Scow (Easy Setup Type)	:	6
- Truck Crane	:	3
- Dump Truck (Loading Capacity: 4-T)	:	9
- Truck Trailer (Loading Capacity: 11-T)	:	1

4.3.5 Maintenance Plan

Maintenance Structure

The director of the National Capital Region (NCR), Department of Public Works and Highways (DPWH), will have the ultimate responsibility for the operations, and the NCR Maintenance Division and the NCR Regional Equipment Service will be responsible for the maintenance work involved in the retrieval of the drainage channels and drains, including maintenance

and repair of the equipment to be procured. The composition of staff of these departments is as described in Subsection 4.3.1.

The NCR Maintenance Division is to be directly responsible for operating the equipment to be procured and for carrying out of the actual retrieval work. The division will be responsible for management of the work (schedule control, progress control, etc.), safety measures, labor and costs. It will also be responsible for managing the supply of fuel and water required for mechanical work.

The NCR Regional Equipment Service will manage the three equipment storehouses (see Subsection 4.3.3) designated for the Project and will be responsible for the maintenance of the construction machinery used in the retrieval work for the drainage system. Management work related to the machinery includes management of plans for the procurement of spare parts, plans for maintenance (including usual on-site maintenance and regular overhauls) and repairs.

Maintenance Duties

Taking into account operation stoppages due to rainfall and holidays, and time taken up in repairs and maintenance of the equipment, the number of equipment operation days in a year is estimated at 230 (see Subsection 5.2.2). During this period, operations using 60 construction machines, 5 dredgers and 10 earth-moving vessels, as well as operations relying on manual labor, will be executed in parallel with each other. The quantity of fuel used and the number of field workers mobilized per day are estimated as follows.

- Daily Consumption of Fuel (Gas Oil) : 3,700 liters
- Field Workers Mobilized per Day : 323 men
  - °On-Site Supervisors : 13
  - °Construction Machinery Operators : 160
  - °General Workers : 150

The NCR will need to carry out the following duties in order to raise work efficiency, to reduce costs and to avoid accidents that might occur during the course of the work.

(1) Schedule Management

To carry out annual schedule planning and to control the progress of work in accordance with these plans.

(2) Construction Management

To establish operational plans for the construction machinery and workers and to carry out management of on-site work.

(3) Cost Management

To establish plans for annual expenditures and to manage payment of construction costs.

(4) Equipment Management

To carry out spare parts control and management of equipment repairs.

(5) Safety Management

To implement measures for the prevention of accidents and the preservation of equipment.

(6) Labor Management

To secure the required number of workers and to provide health care for these workers.

Since construction machinery work is a major component of the Project, great care needs to be taken over the management of the items of equipment listed above. The maintenance work required for equipment management is as follows.

(1) Daily Maintenance

- Checks for damage by visual inspection of the exterior
- Measurement of wear on machine parts (wire ropes, wheels, etc.)
- Inspection and adjustment of machine parts
- Inspection for slack attachments

(2) Weekly Maintenance

- Application of grease

(3) Monthly Maintenance

- Change of engine oil, change or cleaning of oil filter
- Change of fuel filter
- Change of gear oil

(4) Annual Maintenance

- Overhaul

Spare parts such as wheel shafts, engine filter elements and wire ropes, which are subject to heavy wear, will be included in the items to be procured under the Project.

Maintenance Costs

The costs for operation and maintenance of the equipment to be borne by the Government of the Philippines will be approximately 14.4 million pesos in the first year and approximately 28.8 million pesos per year in the four subsequent years. It is herein noted that the cost in the first year is reduced because a part of the retrieval work is taken over by the Model Implementation of the Project. The total costs to be borne by the Government of the Philippines up to the completion of the drainage retrieval program will be approximately 130 million pesos. The details of the annual expenditures are as follows. (Note: Figures in parentheses are for the first year.)

(1) Cost of Fuel

3,700 ltr/day x 230 days x 5.8 pesos/ltr : 4.9 million pesos
(109) (2.3)

(2) Cost of Overhauls and Repairs of Equipment

5.0% of Equipment Cost : 7.9 million pesos
(2.5) (4.0)

(3) Labor Cost : 10.7 million pesos
(5.2)

- Foreman
  13 persons x 250 pesos x 230 days
  (109)

- Machine Operator
  65 persons x 200 pesos x 230 days
  (109)

- Assistant Operator
  65 persons x 120 pesos x 230 days
  (109)

- Sailor
  46 persons x 200 pesos x 230 days
  (109)

- Laborer
  150 persons x 90 pesos x 230 days
  (109)

(4) Indirect Cost : 2.9 million pesos
(1.7)

- Preparation/Transport Cost
  60 units x 30 pesos x 230 days
  (109)

- Safety Measures Cost
  13 teams x 80,000 pesos
  (40,000)

- Cost for Survey
  10 km x 100,000 pesos
  (50,000)

- Temporary Construction Cost
  0.5 million pesos, lump sum
  (0.5)

(5)	Administrative Cost 10% of (1), (2) and (3)	:	2.4 million pesos (1.2)
	Grand Total	:	28.8 million pesos (14.4)

CHAPTER 5. BASIC DESIGN

5.1 Design Policy

The basic policy in planning the procurement of equipment and its use in the Model Implementation will be as follows.

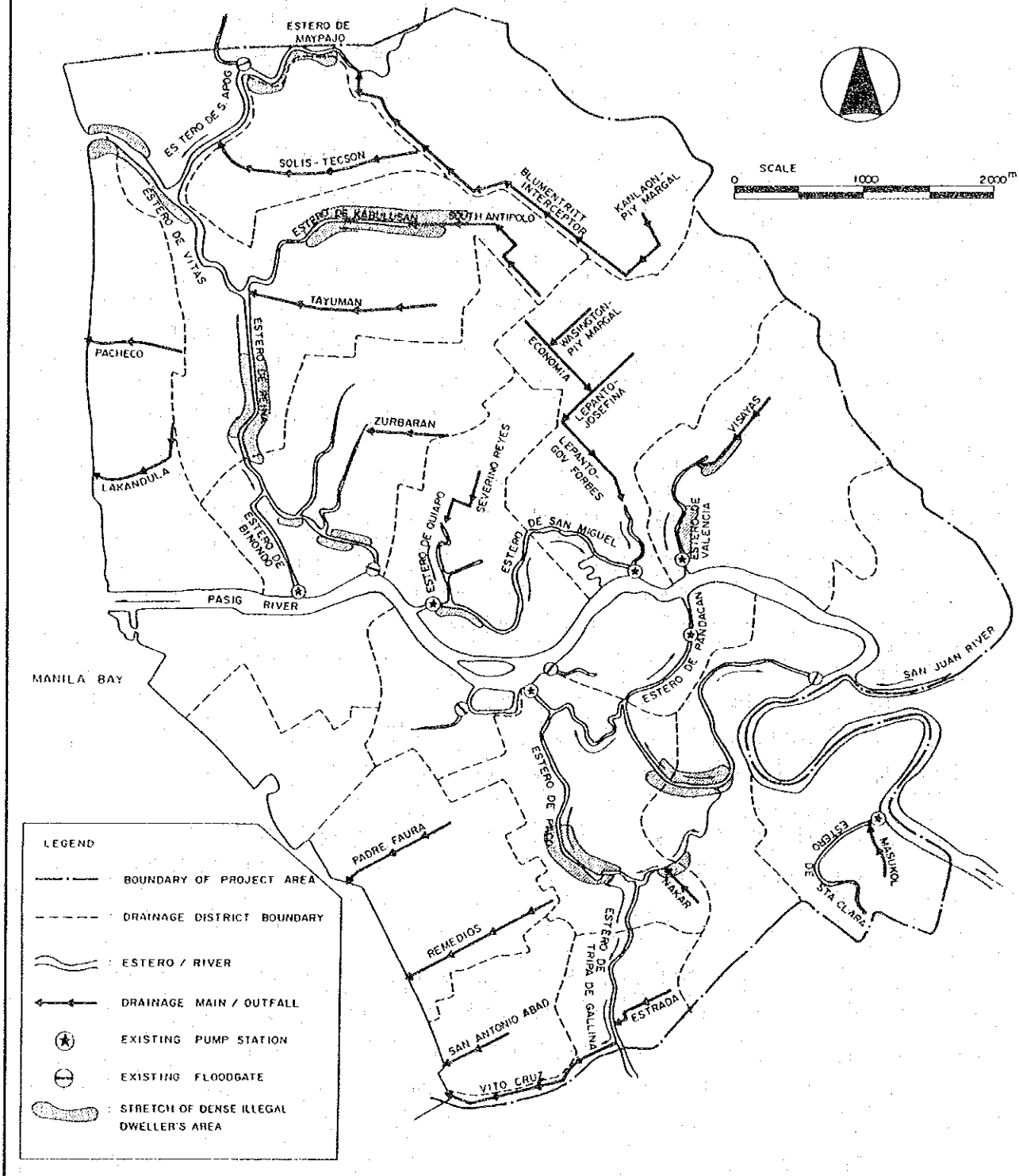
- The increase of discharged water in the drainage channels and drains during the rainy season between June and November may cause major obstacles to work on the removal of the deposits therein depending on the class of the equipment to be used, especially as regards work in the drainage mains/outfalls and the laterals. To enable the annual work load target to be reached without unnecessarily increasing the amount of equipment, equipment that will, in principle, allow work to continue during the rainy season will be selected.

- In the dredging work on the esteros, partial removal of houses along the waterways (inhabited mainly by illegal residents) will facilitate transportation of equipment to the sites. However, upon consultation with Philippine government officials, it has been decided that selection of the dredging equipment and the Model Implementation will be carried out on the assumption that there will be no removal of houses along the waterways. The stretches of dense illegal dwellings are as shown in Fig. 5-1.

- Equipment to be selected can minimize sanitary problems such as generation of foul odors during the removal and transportation of deposits.

- There is a possibility of accidents occurring due to emissions of poisonous gas during work on the removal of the deposits in the drainage channels and drains. In selecting the equipment and carrying out the Model Implementation, one must take into account not only the efficiency of the equipment but also the aspect of safety in operation.

- There is little experience related to the mechanical removal of deposits in drainage channels and drains in the Philippines. An



THE PROJECT FOR THE RETRIEVAL OF FLOOD PRONE AREAS OF METRO MANILA	Fig. 5-1 STRETCH WITH DENSE ILLEGAL DWELLER'S AREA
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adequate transfer of technical knowledge concerning the operation and maintenance of the equipment required in the work will be carried out through the Model Implementation. Spare parts which are difficult to obtain in the Philippines will also be included in the scope of the grant aid.

5.2 Study and Evaluation on Design Criteria

5.2.1 Conditions of Use of Equipment on Site

The following items are determined as the conditions of use of the equipment on site.

- Only small areas of the esteros are served by access roads for maintenance, making it difficult to dredge them with equipment stationed on the banks. The waterways of the esteros themselves will need to be used as the main access routes.

- With the exception of the esteros of Vitas and Sunog Apog which have relatively wide waterways, the less than 2-m clearance of structures crossing the esteros to be dredged is too low to allow the passage of dredgers. Due to this situation, equipment that can easily be dismantled and reassembled at the points of obstruction will be selected for use on the smaller esteros.

- In areas of heavy illegal residence along the esteros, the houses extend onto the waterways, hindering mechanical dredging of the waterways.

- Since esteros are open waterways, there is much illegal dumping of garbage into them. The deposits in the esteros, as a result, contain large amounts of solid waste and a grub dredger is the only type of dredger that can be used.

- The deposits in the drainage mains/outfalls contain a great amount of vinyl and large solid waste. Furthermore, most of the drainage mains/outfalls are made up of large box culverts of more than 2 m deep and 3 m wide, with the depth of water reaching 1 m even in the dry season. In view of these conditions, the dragline method of

deposit removal currently in use in the Philippines seems to be the most appropriate method.

- Access into the drainage mains/outfalls is through the maintenance holes located at intervals of about 50 m. These maintenance holes can be classified into two types: rectangular holes with concrete manhole covers (width: 1.5 tp 4.4 m) and circular holes with steel manhole covers (diameter: 18 inches). Although the former will allow introduction into the box culverts of equipment such as buckets, cranes are required for removing the manhole covers. With circular holes, on the other hand, while the steel covers can be removed by hand, the holes are too small to allow introduction of equipment such as buckets.

- Many of the drainage mains/outfalls are located under the middle of existing roads. While this facilitates the introduction of equipment, it also means that mechanical removal of deposits, requiring restrictions on traffic, can normally be only carried out at night.

- Fire hydrants are installed along the main roads. Permission has been granted by the Philippine government agency concerned (Metropolitan Waterworks and Sewerage System, MWSS) for the use of fire hydrants for the Project. This will facilitate procurement of a water supply for cleaning of the laterals using water jet cleaners.

- Garbage introduced through the openings on the roads is to be found among the deposits in the laterals, but there is little large solid waste of more than 20 cm in size.

- Taking into account the widths of the roads and the volume of traffic, it will be appropriate to use 4-ton dump trucks for transportation of deposits from the removal sites to the disposal sites. Only the traffic conditions around the larger esteros such as Vitas and Sunog Apog will allow the passage of larger (11-ton) dump trucks.