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RIVER REHABILITATION PROGRAM FOR THE MANILA BAY REGION

PHASE I



FINAL REPORT

AUGUST 1991
QUEZON CITY, PHILIPPINES

EMB - DENR
ENVIRONMENTAL MANAGEMENT BUREAU
DEPARTMENT OF ENVIRONMENT AND NATURAL RESOURCES
REPUBLIC OF THE PHILIPPINES

UNEP
UNITED NATIONS ENVIRONMENT PROGRAMME

RIVER REHABILITATION PROGRAM

FOR THE MANILA BAY REGION

Phase I

Identification of Environmental Challenges and Consideration of Options for Meeting Them

A Report Prepared by a UNEP-Funded Study Team
In Coordination with the Environmental Management Bureau
Department of Environment and Natural Resources
Republic of the Philippines

August 1991

RIVER REHABILITATION PROGRAM FOR THE MANILA BAY REGION

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ABBREVIATIONS

ACPC	-	Agricultural Credit Policy Council
ADB	-	Asian Development Bank
AIDAB	-	Australian International Development Assistance Bureau
APD	-	Areas for Priority Development
BCGS	-	Bureau of Coast and Geodetic Survey
BFAR	-	Bureau Fisheries and Aquatic Resources
BHC	-	Benzene Hexachloride
BOD	-	Biochemical Oxygen Demand
BUTEL	-	Bureau of Telecommunications
CALABAR	-	Cavite, Laguna, Batangas, Rizal
CAR	-	Cordillera Autonomous Region
CIF	-	Capital Investment Folio
CORD	-	Cabinet Officer for Regional Development
CPI	-	Consumer Price Index
CRC	-	Center for Research and Communication
CREBA	-	Chamber of Real Estate and Builders Associations
CSC	-	Civil Service Commission
cu m	-	Cubic Meter(s)
cu m/sec	-	Cubic Meters per Second
CWC	-	Council for the Welfare of the Children
CZO	-	Comprehensive Zoning Ordinance
DA	-	Department of Agriculture
DANIDA	-	Danish International Development and Assistance
DBM	-	Department of Budget and Management
DDB	-	Dangerous Drug Board
DECS	-	Department of Education Culture and Sports
DENR	-	Department of Environment and Natural Resources
DLG	-	Department of Local Government
DLSU	-	De la Salle University
DO	-	Dissolved Oxygen
DOF	-	Department of Finance
DOH	-	Department of Health
DOJ - RTC	-	Department of Justice-Regional Trial Court
DOLE	-	Department of Labor and Employment
DOST	-	Department of Science and Technology
DOT	-	Department of Tourism
DOTC	-	Department of Transportation and Communication
DOTC -LTO	-	DOTC-LTO, Land Transportation Office
DPWH	-	Department of Public Works and Highways
DSWD	-	Department of Social Welfare and Development
DTI	-	Department of Trade and Industry
E. O.	-	Executive Order
ECA	-	Environmental Critical Area
ECC	-	Environmental Compliance Certificate

ABBREVIATIONS

EIA	-	Environmental Impact Assessment
EIARC	-	Environmental Impact Assessment Review Committee
EIS	-	Environmental Impact Statement
EMB	-	Environmental Management Bureau
ENMAP	-	Energy Management Association of the Philippines
EPA	-	Environmental Protection Authority
ERB	-	Energy Regulatory Board
ERDAS	-	Earth Resources Data Analysis System
ERDS	-	Ecosystem Research and Development Staff
FAO	-	Food and Agriculture Organization
FFCCI	-	Federation of Filipino-Chinese Chamber of Commerce and Industries
FIES	-	Family Income and Expenditures Surveys
FTI	-	Food Terminal Incorporated
GDP	-	Gross Domestic Product
GIS	-	Geographic Information Systems
GNP	-	Gross National Product
GOP	-	Government of the Philippines
GRDP	-	Gross Regional Domestic Production Information Authority
ha	-	hectare
HCH	-	Hexachlorocyclohexane
HIGC	-	Home Insurance Guarantee Corporation
HLURB	-	Housing and Land Use Regulatory Board
HRAP	-	Hotel and Restaurant Association of the Philippines
HSRC	-	Human Settlements Regulatory Commission
HUDCC	-	Housing and Urban Development Coordinating Council
IA	-	Intramuros Administration
IACC	-	Inter-Agency Consultative Committee
IBRD	-	International Bank for Reconstruction and Development (World Bank)
IEIAP	-	Integrated Environmental Impact Action Plan
JICA	-	Japan International Cooperation Agency
kg	-	Kilogram
kg/cm	-	Kilogram per Centimeter
km	-	Kilometer
KPSPP	-	Kalayaan Pump Storage Power Plant
LAP	-	Lighterage Association of the Philippines
LDPO	-	Local Development Planning Office
LGU	-	Local Government Unit
LIVECOR	-	Livelihood Corporation
LKP	-	Luntiang Kamaynilaan Project
LLDA	-	Laguna Lake Development Authority
LRTA	-	Light Rail Transit Authority
LTFRB	-	Land Transportation Franchising and Regulatory Board
m	-	Meter
MERALCO	-	Manila Electric Company

ABBREVIATIONS

METROSS	-	Metro Manila Sewerage and Sanitation Project
Mg/L	-	Milligram per Liter
MMA	-	Metro Manila Authority
MMAPS	-	Metro Manila Physical Survey
MMBOL	-	Metro Manila Building Officials League
MMC	-	Metro Manila Commission
MMC-ESC	-	MMC-Environmental Sanitation Center
MMC-OCP	-	MMC-Office of the Commissioner of Planning
MMCouncil	-	Metro Manila Council
MMCZAO	-	MMC Zoning Administrator's Office
MMDCC	-	Metro Manila Disaster Coordinating Council
MMFCDC	-	Metro Manila Flood Control and Drainage Council
MMLTCC	-	Metro Manila Land Transportation Coordinating Committee
MMML	-	Metro Manila Mayors League
MMR	-	Manila Metropolitan Region
MMRDP	-	Metro Manila Regional Development Plan
MOE	-	Management and Operating Expenses
MTDP	-	Medium Term Development Plan
MTDS	-	Medium Term Development Strategy
MW	-	Megawatt(s)
MWSS	-	Metropolitan Waterworks and Sewerage System
NAIA	-	Ninoy Aquino International Airport
NAMRIA	-	National Mapping and Resources Information Authority
NAPOCOR	-	National Power Corporation
NAPOLCOM	-	National Police Commission
NCR	-	National Capital Region
NCRDC	-	National Capital Region Defense Command
NCSO	-	National Census and Statistics Office
NEA	-	National Electrification Administration
NEDA	-	National Economic and Development Authority
NEMA	-	National Environmental Management Authority
NEPC	-	National Environmental Protection Council
NFA	-	National Food Authority
NFIS	-	National Fishery Information System
NFP	-	National Forestry Program
NGO	-	Non-Government Organization
NHA	-	National Housing Authority
NHCS	-	Napindan Hydraulic Control Structure
NHMFC	-	National Home Mortgage Financing Corporation
NIA	-	National Irrigation Administration
NLRC	-	National Labor Relations Commission
NMTT	-	Navotas-Malabon-Tullahan-Tenejeros
NMYC	-	National Manpower and Youth Council
NNC	-	National Nutrition Council

ABBREVIATIONS

NOCOP	-	National Operations Center for Oil Pollution
NPC	-	National Productivity Center
NPCC	-	National Pollution Control Commission
NPPMM	-	National Programs and Projects for Metro Manila
NRMDP	-	Natural Resources Management and Development Program
NRW	-	Non-Revenue Water
NSO	-	National Statistics Office
NTC	-	National Telecommunications Commission
NWC	-	National Wages Council
OEA	-	Office of Energy Affairs
OECF	-	Overseas Economic Cooperation Fund
OSHC	-	Occupational Safety and Health Center
P.D.	-	Presidential Decree
PACU	-	Philippine Association of Colleges and Universities
PAP	-	Philippine Assistance Program
PATA	-	Philippine Association of Travel Agencies
PBSP	-	Philippine Business for Social Progress
PC	-	Personal Computer
PCAPI	-	Pollution Control Association of the Philippines, Inc.
PCCI	-	Philippine Chamber of Commerce and Industries
PCG	-	Philippine Coast Guard
PCUP	-	Presidential Commission on Urban Poor
PCYA	-	Philippine Council for Youth Affairs
PEA	-	Public Estates Authority
PFDA	-	Philippine Fisheries Development Authority
PFMP	-	Philippine Forestry Master Plan Project
PLDT	-	Philippine Long Distance Telephone
PM	-	Pasig-Marikina
PMO	-	Project Management Office
PMS-PSF	-	Presidential Management Staff-Presidential Support Fund
PNOC	-	Philippine National Oil Company
PNR	-	Philippine National Railways
POPCOM	-	Population Commission
PPA	-	Philippine Ports Authority
PSC	-	Project Steering Committee
PSO	-	Postal Service Office
PSSD	-	Philippine Strategy for Sustainable Development
PT & T	-	Philippine Telegraph and Telecommunications
PTA	-	Philippine Tourism Authority
PTFSWM	-	Presidential Task Force on Solid Waste Management
PUD	-	Planned Unit for Development
RCPI	-	Radio Communications of the Philippines, Inc.
RDP	-	Regional Development Plan
REBAP	-	Real Estate and Builders Association of the Philippines

ABBREVIATIONS

RO	-	Regional Office
RP	-	Republic of the Philippines
SAVE	-	Solid Alliance of Vigilant Environmentalists
SMC	-	San Miguel Corporation
SPPBS	-	Synchoronized Planning, Programming and Budgeting System
STAMP	-	Septic Tank Maintenance Program
TELOF	-	Telecommunications Office
THS	-	Toxic and Hazardous Substance
TLRC	-	Technology and Livelihood Resource Center
TWG	-	Technical Working Group
ug/su m	-	Microgram per Cubic Meter
um	-	Micrometer
UNEP	-	United Nations Environment Programme
UP	-	University of the Philippines
UP - SLIR	-	School of Labor and Industrial Relations
USA	-	United States of America
USAID	-	United States Agency for International Development
WHO	-	World Health Organization

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FOREWORD

This study entitled the **River Rehabilitation Program for the Manila Bay Region** was carried out at the request of the Government of the Republic of the Philippines and funded by the United Nations Environment Programme (UNEP) and the Environmental Management Bureau (EMB) of the Department of Environment and Natural Resources (DENR).

The Study was undertaken by a team of one external and three national experts with counterpart staff and secretariat support provided by the Government through the EMB of the DENR. Phil. Govt. + Enviro.

The Study (Phase I) was carried out from 26 February 1991 to 26 July 1991 with the primary objective of identifying the environmental challenges in the Manila Bay river drainage area and to seek options for resolving them. The 5-month undertaking was essentially a review study which involved the collection, analysis and synthesis of available information on the environmental situation in the Manila Bay Region which could lead to the identification of areas of common perception of the environmental problems at hand and their causes. This Report is the outcome of the review and forms the basis for further debate amongst all concerned parties to address the problems and issues that have been identified, including proposed remedial actions. This process was facilitated through the holding of a UNEP- EMB/DENR Seminar-Workshop on 24-25 July 1991, which provided the forum for a better appreciation of the need for greater interagency coordination and cooperation in the basin-wide river rehabilitation program. The Seminar-Workshop led to the formulation of pragmatic and realistic policy recommendations, including indications of the need for assistance from foreign development and funding institutions, in support of the basin-wide river rehabilitation program. The outcome of this Workshop is submitted as an Annex to this Main Report.

This Report was prepared by the following members of the Study Team and support staff from EMB-DENR.

UNEP Representative	:	M. Reza Amini
UNEP Consultants	:	Low Kwai Sim Angel C. Alcala
Filipino Experts	:	Jorge G. de las Alas Francisco B. Arellano
Project Advisers	:	Ella S. Deocadiz Erlinda A. Gonzales
Project Coordinator	:	Leza A. Acorda

Research Specialist/	:	David C. Villarosa
Technical Staff	:	Raul M. Tejada
		Emmanuelita Mendoza
		Luis Fidel B. Ronquillo
		Allan L. Leuterio
		Charles C. Dery
Secretariat and Other	:	Ernald A. Hernandez
Support Services		Josefina P. Hipolito
		Reynaldo P. Genove

The outcome of this Study was made possible with the assistance and cooperation of numerous persons and agencies in both the public and private sectors including foreign development and financing institutions, many of whom participated in the Seminar-Workshop. To them we extend our sincere appreciation and gratitude. We would also like to thank the Department of Environment and Natural Resources, particularly the Director of the Environmental Management Bureau and the able staff for the excellent support and friendship provided. Last, but not least, we would like to thank the UNEP for providing the funding for the Study and the Workshop.

1. INTRODUCTION

1.1 Background

Rapid expansion of the economic activities and population growth in the catchment areas of the rivers draining into the Manila Bay, as well as in the coastal zone of the Bay itself, have led to accelerated degradation of the natural aquatic resources of the basin area and undermined their capacity to provide livelihood and life-quality for human beings. This phenomenon has been attributed to the indiscriminate dumping of industrial, domestic and other wastes to these water bodies. In the Philippines, several heavily polluted rivers including the Laguna Lake drain to the Manila Bay. These include the Pasig/Napindan River, the Navotas, Malabon, Tullahan, Tenejeros Rivers (NMTT), the San Juan River, the Marikina River, the Paranaque River, the Bulacan and Pampanga Rivers, as well as the Imus and Zapote Rivers in Cavite.

In Metro Manila alone, there are currently about 217 water pollutive firms along the river banks. Of these 22% comes from the food manufacturing industry, 19% from metal industry, 17% from textile industry, and 15% from non-metallic and mineral products industry. The situation is even worse in Region III (which covers Bulacan and Pampanga) where livestock production comprises 45% of the total 275 water pollutive industries in the region. The effluents coming from these firms are directly discharged to the river systems.

Results of water quality analysis by the National Pollution Control Commission (now Environmental Management Bureau) have shown that the biological oxygen demand (BOD) ranges from 3-70 mg/l for Pasig/Marikina River, 25-44 mg/l for Parañaque River and 30-190 mg/l for Tullahan-Tenejeros. The Tullahan-Tellejeros River System is receiving all kinds of solid and liquid wastes from about 29 firms along its banks. Dissolved oxygen (1987 data) did not conform to the standard set for Class C Waters (fresh surface water for propagation and growth of fish and other aquatic resources, Table 1) which should not be more than 10 mg/l for BOD and not less than 5 mg/l for DO.

For Manila Bay, bacterial count (1982-1985 data) along the coast ranged from 3 to even a hundred times greater than the standard set for Class SB (marine and estuarine waters used for primary contact recreation). The fecal coliform counts were high at Baclaran, South Breakwater, Pasig River outlets and Bacoor. DO values obtained generally conformed to the 5 mg/l criterion for Class SB waters except in some portions of the Pasig River where DO was observed to be as low as 3.4 mg/l. Sedimentation rate (1984 data) near the mouth of the Pampanga River and within the Bacoor Bay area was found to be 4.3 cm/yr and for Meycauayan (Bulacan) area, 3.2 cm/yr. Compared to the sedimentation rate obtained in San Miguel Bay in Bicol Region, these figures are relatively high.

The concentration of trace metals such as copper, lead and cadmium has also been noted to exceed the criteria set for water bodies for propagation and growth of fishes and other aquatic resources. In Pampanga, Meycauayan and Bacoor outlets, cadmium has been found to be as high as 0.09-0.11 mg/l compared to the standard 0.01 mg/l allowable limit. Lead, on the other hand, ranges from 0.5-0.8 mg/l in contrast to the 0.05 mg/l limit

Previous efforts of the EMB to monitor the water quality of the rivers as well as the Manila Bay have justified the need to protect the resources from further degradation and maintain the water quality. National figures on fisheries production, though increasing in absolute terms, reveal quite an erratic behavior when marginal increases are taken into account. Based on the Bureau of Fisheries and Aquatic Resources (BFAR) statistics, a declining growth rate is experienced by the fisheries sector, i.e. 6.93%, 4.7% and 3.82% for the period 1971-75, 1976-80, 1981- 85, respectively. This trend is even consistent for breakdown of production of fish by type (commercial, municipal and aquaculture) except in aquaculture wherein production is continuously increasing by significant percentages.

Fish production from commercial fishing vessels seems to be in the most dismal situation. Negative production growth rates have been incurred starting the late 70's as compared to its previous increasing trend. Export market even shows a poor performance during the last five years. It is even interesting to note the increase in the import of fish by a significant volume from 1984 until 1986. These shows that supply cannot meet the demand for fish.

Fisheries production data by commercial fishing vessels in the Manila Bay shows a decrease of about 45% from 22,607 metric tons figure in 1976 to 12,399 metric tons in 1986. Combined figures for the National Capital Region and Region IV (which covers Manila Bay and Laguna de Bay) estimated commercial fisheries production at about 222,848 metric tons. This represents about 40% of the total commercial fishery production in the country for 1986.

In Laguna Lake, nutrient inflow and sedimentation is proceeding at an alarming rate. The lake is presently characterized by sedimentary deposits carried by tributary streams and surface runoff. The estimated total annual sediment inflow to the lake is about 120,000 m^3. Due to the highly eutrophied condition of the lake (estimated figure on nutrient input is about 4,000 metric tons of nitrogen and 930 metric tons of phosphorus, SOGREAH, 1973 data) fish kill had been observed to occur periodically as a consequence of heavy algal bloom. Fish productivity was also estimated at 4 metric tons/ha/yr from fish pen culture and only 438 kg/ha/yr for open lake. This difference has been attributed to over-fishing and as a consequence of heavy pollution of the Pasig River which is the only outlet to Manila Bay.

Further, with the rapid increase of the population in the metropolis (with an increase of about 20% from 5,970,300 in 1980 to 7,561,400 in mid 1988) the urban poor families have found their way squatting in the river banks causing alteration of the original dimensions of the rivers.

1.2 Objectives and Scope of the Study

Concerned over this state of affairs, the Government of the Philippines has decided to launch a comprehensive effort to help reorient environmentally destructive practices related to agriculture, fisheries, industry and human settlements towards patterns of natural resources use that would be commensurate with the up-keep of the life supporting capacity and ecological integrity of the environment in the Manila Bay Basin. The deterioration of water quality, alterations of water flows and undesirable changes in the

conditions of human health and prosperity associated herewith can be regarded as consequences of increased human activity within several sectors. Moreover, demand on the ecosystems and their resources has risen throughout the catchment area, and Government advocates a basin-wide, cross-sectoral and multi-disciplinary approach to the identification of problems and the options for their solution.

Responding to the Government's concern over degradation of the Manila Bay Basin, efforts have already been made over the past several years by concerned national bodies with some assistance from foreign development agencies to study the nature and scope of the problems and to identify remedial and prevention measures. These initiatives, however, are limited to parts of the Basin area, such as the Laguna de Bay and Metro Manila areas. A similar activity is being prepared for the Pasig River. On the basis of these studies, some projects have already been implemented. Unfornately, most of these studies have been independently executed with minimal interagency consideration. The Government has recognized this as a contributary factor accounting for the limitation of such projects in generating the multi-agency support needed to progress into project implementation. Thus, a basin-wide multidisciplinary approach envisaged by the Government would help in building up a common understanding of the existing problems and also provide an overall framework for a concertation of efforts. This basin-wide environmental management study, sponsored by the United Nations Environment Programme (UNEP), is a response to this challenge.

The Terms-of-Reference of the present Study basically defined the scope and content of Phase 1 of the River Rehabilitation Program for the Manila Bay Region. The aim of this Phase was to identify the main environmental challenges faced by the Government and the population of the region and to create a forum for debate of these issues amongst all involved parties, with a view to discuss the possibilities for solving problems and agree on a common agenda of action. This would define action required by the immediate users of the resources of the region, the central, district and city governmental administration, industry, research institutional and private ogranizations. Thus, the objectives of the Study are:

1. To assist in launching a process of consultation of environmetal degradation in the Manila Bay Region and on options for reverting undesirable and supporting favorable trends.

2. To guide this process towards the formulation of a coherent framework of remedial and preventive action for the concerned parties.

The scope of the First Phase Study of the River Rehabilitation Program for the Manila Bay Region involved the collection, analysis and synthesis of available information on the environmental situation in the Manila Bay river drainage area, to identify areas of common perception of the problems at hand and their causes and to catalyze further debate amongst all concerned parties. This was used as a basis for reaching agreement on the overall thrust and contents of a basin-wide rehabilitation program, outlining also the need for further research, readjustment of existing policies, programs and projects and for coordination of on-going activities. This latter phase of the Study was made possible by the holding of a UNEP-sponsored Workshop attended by representatives of local government industry, concerned central, district and city government agencies, research institutions and foreign development and financing institutions.

TABLE 1

WATER US AGE AND CLASSIFICATION

Classification	Beneficial Use
(a) **Fresh Surface Waters (Rivers, Lakes, Reservoirs, etc.)**	
Class AA	Public Water Supply Class I. This class is intended primarily for waters having watersheds which are uninhabited and otherwise protected and which require only approved disinfection in order to meet the National Standards for Drinking Water (NSDW) of the Philippines.
Class A	Public Water Supply Water Class II. For sources of water supply that will require complete treatment (coagulation, sedimentation, filtration, and disinfection) in order to meet the NSDW.
Class B	Recreational Water Class I. For primary contact recreation such as bathing, swimming, skin diving, etc. (particularly those designated for tourism purposes).
Class C	1) Fishery Water for the propagation and growth of fish and other aquatic resources; 2) Recreational Water Class II (Boating, etc.) 3) Industrial Water Supply Class I (For manufacturing processes after treatment).
Class D	1) For agriculture, irrigation, livestock watering, etc.; 2) Industrial Water Supply II (e.g. cooling, etc.) 3) Other inland waters, by their quality, belong to this classification.
(b) **Coastal and Marine Waters**	
Class SA	1) Waters suitable for the propagation, survival and harvesting of shellfish for commercial purposes; 2) Tourist zones and national marine parks and reserves established under Presidential Proclamation No. 1801; existing laws and/or declared as such by appropriate government agency; 3) Coral reef parks and reserves designated by law and concerned authorities.

Class SB	1) Recreational Water Class I (Areas regularly used by the public for bathing, swimming, skin diving, etc.)
	2) Fishery Water Class I (Spawning areas for Chanos chanos or "Bangus" and similar species).
Class SC	1) Recreational Water Class II (e.g. boating, etc.);
	2) Fishery Water Class II (Commercial and sustenance fishing);
	3) Marshy and/or mangrove areas declared as fish sanctuaries.
Class SD	1) Industrial Water Supply Class II (e.g. cooling, etc.);
	2) Other coastal and marine waters, by their quality, belong to this classification.

Source : Revised Water Usage and Classification Water Quality Criteria DENR Administrative Order No. 34 (Series of 1990)

2. THE MANILA BAY REGION

2.1 Study Area

The study area consists of Region I (Province of Pangasinan), II (Neuva Vizcaya), III (Bataan, Bulacan, Nueva Ecija, Pampanga, Tarlac, Zambales), IV (Batangas, Cavite, Laguna, Rizal, Quezon), including NCR - Metro Manila, which together cover an area of 17,681 sq. km. (Table 2). It has a population of 16 million people (representing some 27% of the national population) of which 13 million (81%) are urbanites. The average population of growth rate for 1980 - 1990 was 3.0% as against the national average of 2.4%. The population of the Manila Bay Region is projected to reach 22.3 million in the Year 2005 of which the urban population is 19.2 million (86%).

Manila Bay is a marine estuary which serves as the ultimate receiving water body for the wastes generated in 26 river basins. It has a coastline approximately 190 km long and a surface area of 1,800 sq. km. It is about 54 km long and its width varies from 22 km at its mouth to about 60 km inside the Bay. The bottom topography gradually rises from its mouth, where it is deepest, at a rate of about 1 m rise for every kilometer of horizontal distance.

The Manila Bay catchment area is bounded by the Sierra Madre mountain range to the east, the Caraballo mountains to the north, the Zambales mountains to the northwest and the Bataan mountains to the west. The Tagaytay ridge and Mt. Banahaw chain of mountains form the southern boundary of the area.

Manila Bay receives drainage from approximately 17,000 sq. km. of watershed consisting of 26 catchment areas (Fig. 1). Table 3 shows the major river systems and creeks within the overall Manila Bay catchment area. The two major contributory areas are the Pasig and Pampanga River Basins. The Pasig River Basin has an area of 3,900 sq. km. and includes the Marikina and Laguna de Bay catchment areas. The largest watershed draining into the Bay is the Pampanga River Basin which has a catchment area of 9,000 sq. km. Most of the river systems in the provinces of Pampanga, Bulacan and Nueva Ecija drain into the Pampanga River.

2.2 Climate

The climate of Manila Bay and its catchment areas which results from the composite effects of the prevailing air streams and topographical features is classified as Type I of the Coronas Classification of Philippine Climate. It is characterized by two pronounced seasons, dry in winter and spring, and wet in summer and autumn. The maximum rain period is from June to September during the prevalence of the Southwest Monsoon. The dry season lasts from three to six or even seven months. Meteorological data from several PAGASA stations within Manila Bay's catchment area were used to characterize climate. These stations are: (a) Manila International Airport, (b) Manila Port Area, (c) Science Garden, Quezon City (d) Sangley Point, Cavite, and (e) Munoz, Neuva Ecija.

TABLE 2

AREA AND POPULATION OF THE MANILA BAY REGION

	AREA km2	POPULATION 1990	URBAN POPULATION 1990	POPULATION PROJECTION 2005	URBAN POPULATION PROJECTION 2005
Total Philippines	300,000.0	60,684,887	26,245,568	81,590,921	41,507,344
Study Area:					
Region I:					
Pangansinan	30.0	13,978	870	8,026	1,839
Region II:					
Nueva Vizcaya	280.5	16,833	3,341	23,155	7,027
Region III:					
Bataan	984.8	344,244	204,694	585,175	352,883
Bulacan	2,625.0	1,505,219	967,476	1,965,185	1,561,308
Nueva Ecija	5,259.2	1,306,385	408,622	1,699,421	684,701
Pampanga	2,180.7	1,532,682	1,103, 401	2,058,860	1,786,889
Tarlac	1,063.3	274,012	60,914	390,886	89,293
Zambales	147.0	24,872	15,359	28,613	28,613
NCR	636.0	7,832,000	7,832,000	10,737,419	10,737,419
Region IV:					
Batangas	163.1	121,770	29,634	202,787	50,721
Cavite	1,213.6	1,062,818	673,272	1,633,437	1,339,956
Laguna	1,665.7	1,297,080	985,975	1,861,912	1,553,720
Rizal	1,158.9	867,784	644,063	1,133,268	1,023,810
Quezon	309.3	4,219	174	4,084	256
	17,681.1	16,203,876	12,929,795	22,332,219	19,218,435

FIG. 1

WATERSHEDS TRIBUTARY TO MANILA BAY

TOTAL TRIBUTARY AREA 17,000 km^2
EACH WATERSHED IS NUMBERED SOLID DASHED LINES INDICATE AREA COVERED BY RECENT STUDIES

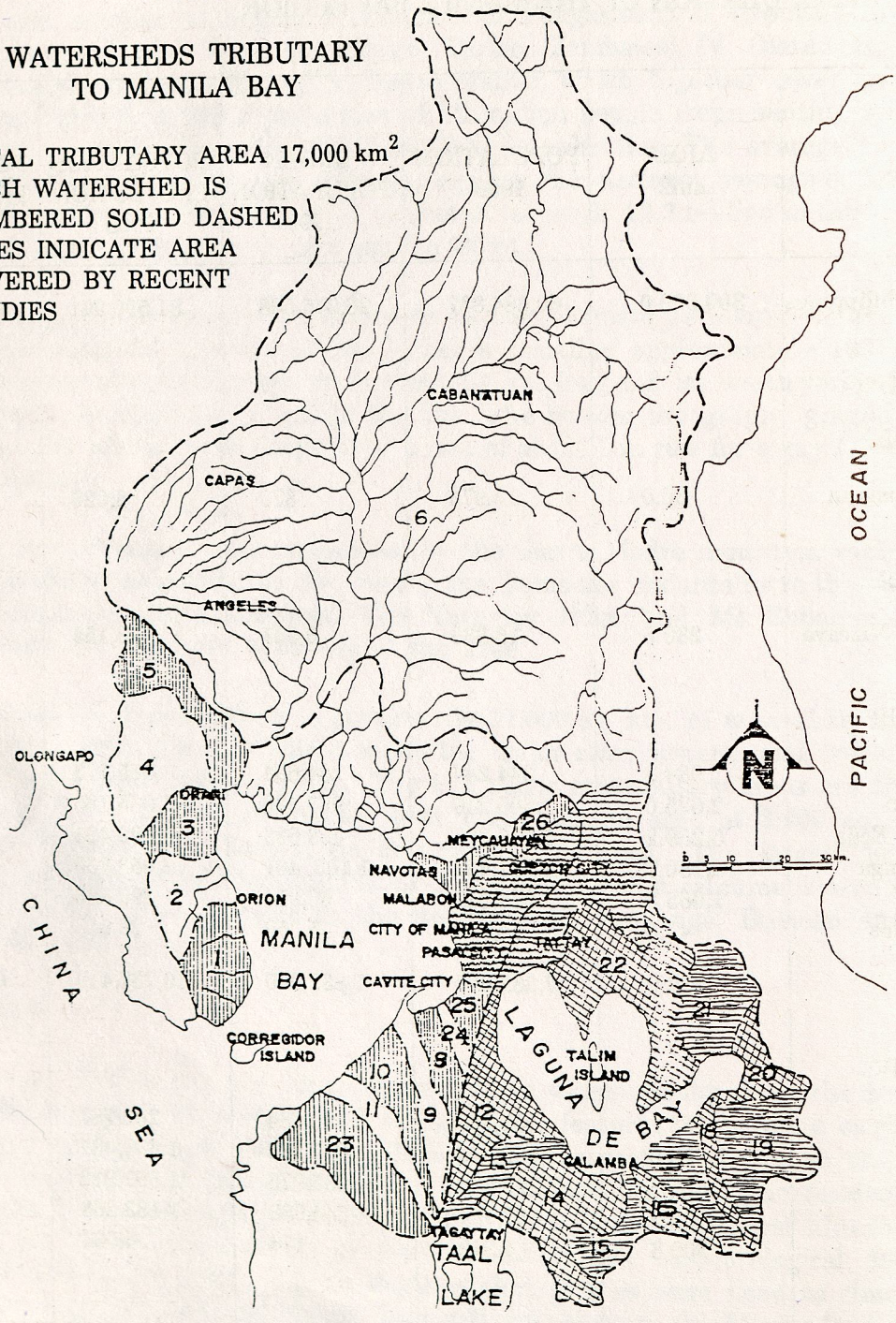

TABLE 3

RIVERS AND CREEKS IN THE MANILA BAY REGION

1. Abo-abo River
2. Abuyo River
3. Agsahin River
4. Alamang River
5. Alangan Creek
6. Amo River
7. Angat River
8. Angilisan River
9. Antipas River
10. Balantay River
11. Balintungan River
12. Balsahan River
13. Baluyot River
14. Bamban River
15. Banca-banca River
16. Banco Creek
17. Bay River
18. Biñan River
19. Binbin River
20. Boso-boso River
21. Bugnan River
22. Buhu River
23. Bulacan River
24. Cabu River
25. Cadaclan River
26. Calibuyo River
27. Calo River
28. Canas River
29. Canates River
30. Caponita River
31. Caringalan River
32. Caulamang River
33. Chico River
34. Coronel River
35. Dalitaan River
36. Dasmariñas River
37. Diamanan River
38. Dicalam River
39. Digmalta River
40. Digoliat River
41. Divatin River
42. Golona River
43. Gumain River
44. Hermosa River
45. Imus River
46. Juibos River
47. Kalaguman River
48. Kilogan River
49. Lamao River
50. Layac River
51. Maasim River
52. Macaua River
53. Magam River
54. Magsuong River
55. Malabon River
56. Malago River
57. Mamaca River
58. Maputi River
59. Marimlan River
60. Marikina River
61. Mariveles River
62. Matulis River
63. Makaliki River
64. Minatula River
65. Montalban River
66. Morong River
67. Murcon River
68. Nabao River
69. Nangka River
70. Napindan River
71. Narvaes River
72. Naugut River
73. Navotas River
74. Obispo River
75. Onan River
76. Orani River
77. Orion River
78. Padulonan River
79. Pagsanjan River
80. Pampanga River
81. Panasayan River
82. Pangalisan River
83. Pangil River
84. Parañaque River
85. Pasag River
86. Pasig River
87. Pasong Camachile
88. Patinas River
89. Patingan River
90. Patiwling River
91. Pita River
92. Porac River
93. Potrero River
94. Postema River
95. Pucot River
96. Puray River
97. Quitangil River
98. Rio Chico River
99. Rio Grande River
100. Romero River
101. Saba Creek
102. Sacobia River
103. Salupungan River
104. San Antonio River
105. San Isidro River
106. San Juan River
107. Sapang Cauayan River
108. Sapay River
109. Siguim River
110. Sin River
111. Sinalio River
112. Sta. Cruz River
113. Sta. Maria River
114. Sta. Rosa River
115. Sumacban River
116. Tabuating River
117. Tagalio River
118. Talavera River
119. Talisay River
120. Tama River
121. Tanay River
122. Tayabasan River
123. Tenejeros River
124. Tigas River
125. Tinalan River
126. Tocod River
127. Tonga River
128. Tullahan River
129. Tunansincillo River
130. Ylang River
131. Zapote River

Rainfall

The rainfall within the Manila Bay catchment area is characterized by a maximum rain period from June to September and a dry period from November to May. August is the rainiest month with an average monthly rainfall of over 400 mm while February is the driest with less than 10 mm monthly rainfall.

Temperature

The annual mean temperature within the catchment is just over 27.0°C with January being the coldest month registering a mean of 26°C and May the warmest with a mean temperature of over 29°C. The annual mean maximum temperature is about 31.5°C while the average minimum temperature is about 23.1°C.

Prevailing Winds

Three wind regimes prevail over the catchment area at the various times of the year. In general, the Northeast Monsoon is dominant from October to January or February. This is replaced by the Trades from March to May. From June to September, the Southeast Monsoon becomes dominant. During the prevalence of the Trades, the wind current comes from either the east or the southeast. The wind speeds over the area are generally light, ranging from 2 to 4 meters per second.

Tropical Cyclones

The Philippines is located in the most cyclone-proned area of the world. There are about 20 tropical cyclones of various intensities per year occuring in the country and its immediate surrounding. In particular, Manila Bay and its catchment areas are within a zone that can expect the passage of about 5 tropical cyclones every three years.

While tropical cyclones, especially typhoons, are considered destructive due to the intense winds and rainfall associated with their passage, they also bring considerable benefits in terms of the much needed rainfall. Tropical cyclones contribute 47% of the total rainfall in most parts of the country.

2.3 Hydrology and Water Resources

The contribution of the various watersheds to the fresh water inflow to Manila Bay was taken from the Sewerage and Sanitation Master Plan for Metro Manila (MWSS, 1979). The fresh water budget of the Manila Bay is shown in Table 4.

TABLE 4

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FRESH WATER BUDGET FOR MANILA BAY (CUBIC METERS/SEC)

Month	Sources Pasig (a)	Pampanga (b)	Others (c)	Total Inflow	Net Evapo-Precip.	Net Flux
Jan	205	138	85	428	-60	368
Feb	173	100	77	350	-83	267
Mar	136	80	66	279	-121	158
Apr	75	86	62	223	-121	102
May	12	178	116	306	-48	258
June	41	444	256	741	103	844
Jul	149	737	350	1236	108	1416
Aug	212	938	459	1609	249	1858
Sep	250	754	413	1417	179	1596
Oct	276	615	296	1187	60	1247
Nov	278	367	208	853	15	868
Dec	234	214	121	572	-9	563
Annual	170	391	205	766	29	795

Note: (a) Pasig River watershed area is 3,900 sq. km.

(b) Pampanga River Watershed area is 9,000 sq. km.

(c) Other rivers watershed area is 4,100 sq. km.

It is noted that the Pampanga River contributes about 49% to the net fresh water influx into the Manila Bay on an annual basis, while the Pasig River contributes about 21% and other river systems 26%. The balance of 4% comes from the net precipitation over the Bay. The relative contribution of the various rivers on the fresh water budget of the Bay on a monthly basis varies. Even with its small watershed area (3,900 sq. km. or 23% of the total catchment area), the Pasig River significantly contributes to the fresh water inflow into the Bay during the dry season from December to March when its flow exceeds that of the Pampanga River. The contribution of the river systems to the fresh water inflow of Manila Bay and the Bay's fresh water budget are illustrated in Fig. 2 and 3.

These waters have multiple existing and potential uses, often conflicting with one another. Under the current water classification scheme, the rivers and Laguna Lake currently have Fresh Surface Water Classification C, which indicates they meet the criteria for navigation, agriculture, irrigation, livestock water, industrial cooling and processing, and the propagation and growth of fish and other aquatic resources. Unfortunately, most of the aquatic resource criteria are not met for the rivers, largely because of insufficient dissolved oxygen. Laguna Lake meets Class C, but is being considered for use as a potable water supply, in which case it will need to be upgraded to Class A.

2.4 Oceanography

Bay Currents

The complex current patterns of Manila Bay are generally attributed to the interplay of at least three major factors, namely: the surface wind stress, the tidal forces and the influence of the fresh water discharges into the Bay. The current system of Manila Bay has been studied earlier through the use of drift cards, drogues, current meters and radioisotope tracers. These studies were discussed in Black and Veatch International Master Plan for a Sewerage System for Manila Metropolitan Area (1979). A mathematical modelling study was also conducted by de las Alas and Sodusta (1985) to determine the wind driven current component of Manila Bay's circulation in various prevailing wind situations.

Fresh Water Currents

During the dry season (January to May), discharge into the Manila Bay drops below 500 cu.m/sec. This amount of discharge is considered too small to influence the current patterns of the Bay, except in areas close to the river mouths. However, during periods of high river discharges which occur between July and October, the surface current conditions may be significantly modified by fresh water flows. In these instances, fresh water forms a thin sheet at the water surface that flows seaward into the Bay from the rivers. This flow, in turn, is subjected to the effects of wind and tides, thus forming a very complex system. According to previous studies (e.g. J.M. Montgomery - DCCD - Kampsax - Krugger Consultants, 1979), the current velocity induced by the fresh water inflows is of the order of 0.05 m/sec except in the vicinity of the river mouths where it is slightly greater. The same study postulated a compensating current from the ocean into the Bay at a depth of 2 to 5 m. This compensating flow plays an important role in the renewal of water quality of the Bay.

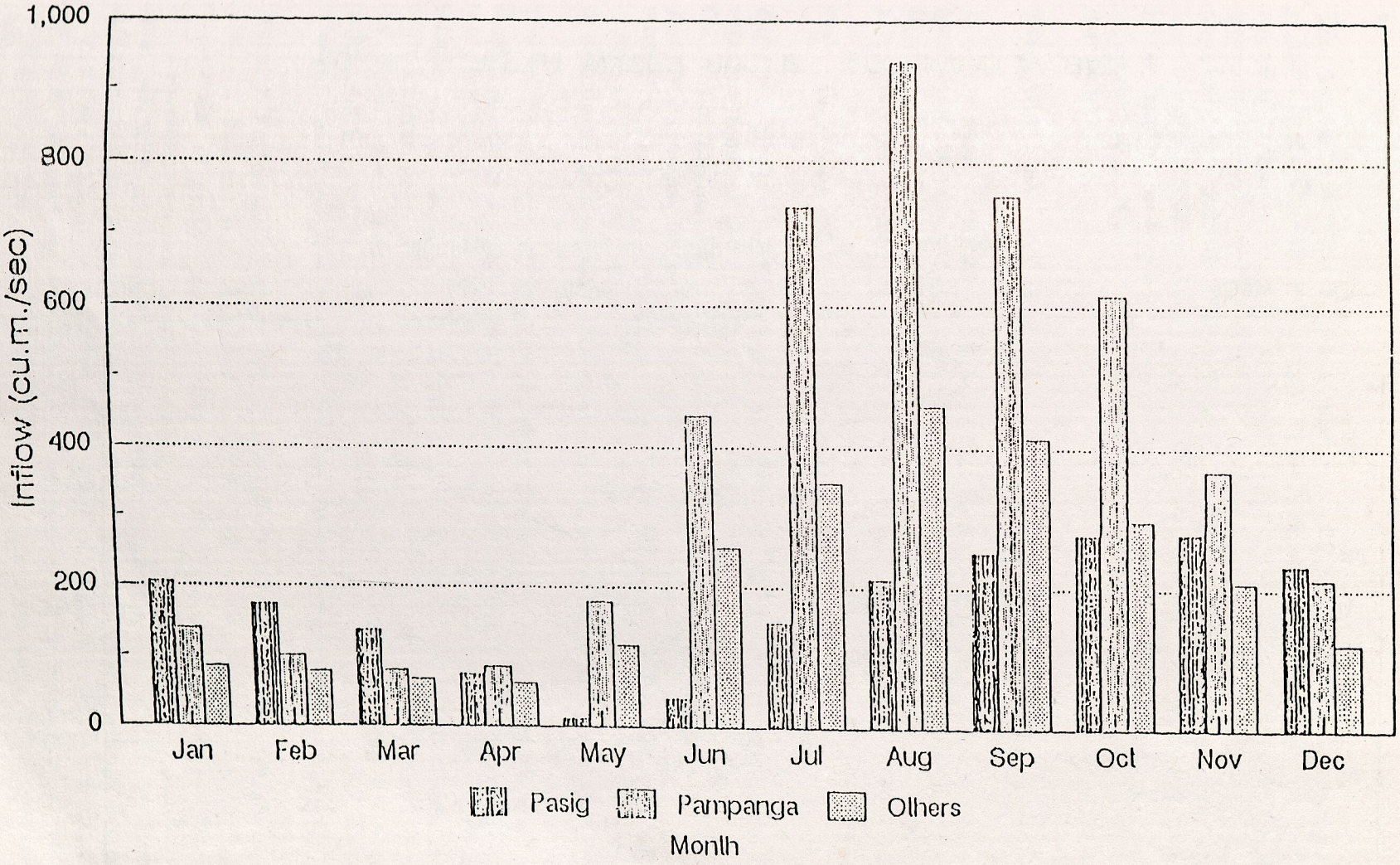

FIG. 2 FRESHWATER INFLOW FROM RIVERS TO MANILA BAY

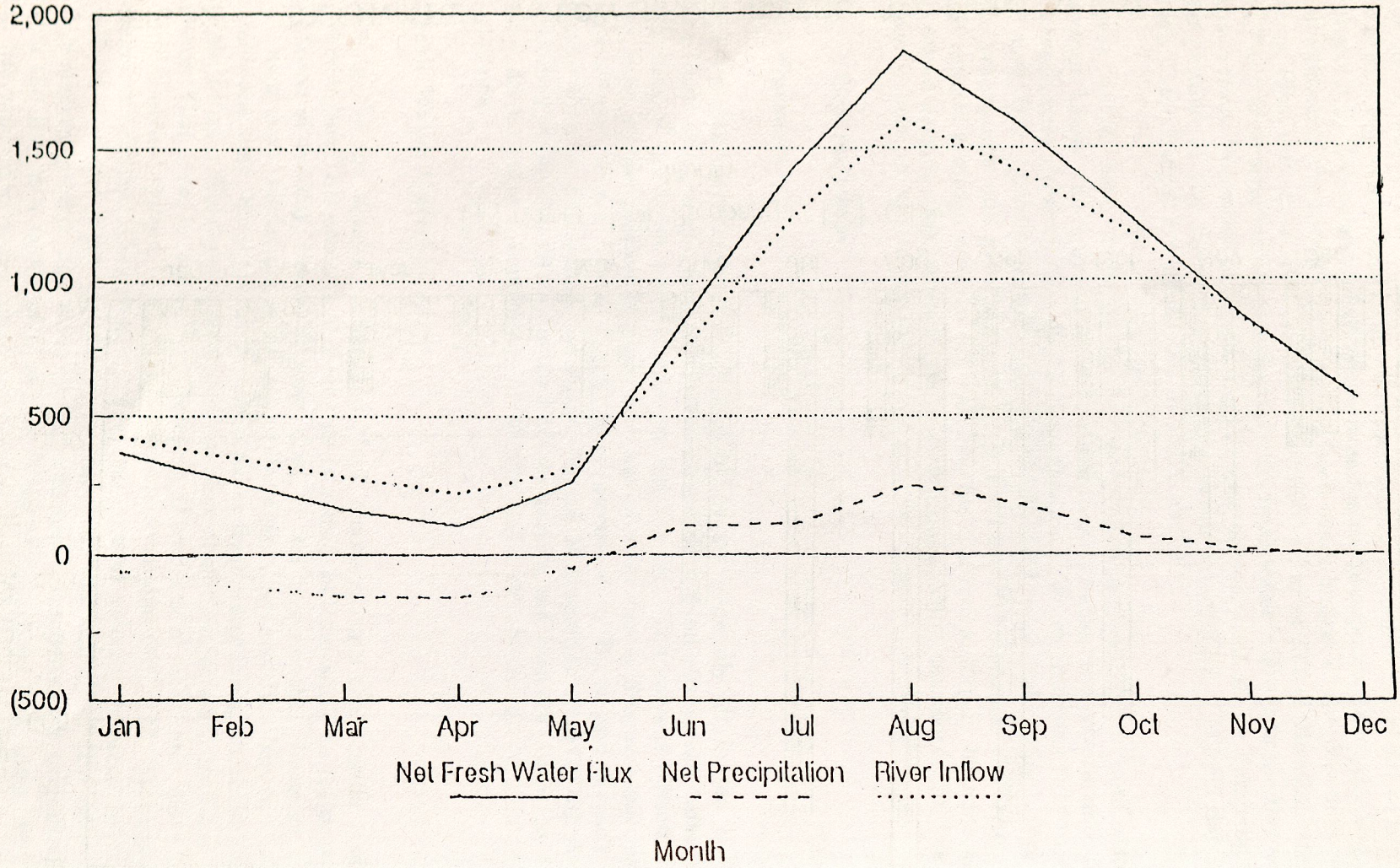

FIG. 3 FRESH WATER BUDGET FOR MANILA BAY

Wind Currents

The Manila Bay Region comes under the influence of at least three major wind regimes. From October to January, steady winds blow with a northeasterly direction with an average speed of about 5 m/sec. From February to May, the dominant flow is southeasterly with speeds ranging from 3 to 6 m/sec. Steady southwesterly flow is observed from June to September with speeds of 5 to 7 m/sec. These wind conditions were used in a mathematical simulation of the wind driven circulation of the Manila Bay by de las Alas and Sodusta (1985). The results are consistent with the finding that water movement is generally with the wind in shallower areas where wind stress is more dominant.

Tidal Currents

Earlier studies confirmed that tidal currents are dominant at the mouth of Manila Bay because of its topographic configuration. At the mouth, tidal current speeds range from about 0.50 - 0.80 m/sec. at spring tide. Inside the Bay itself, tidal current speeds show a sharp decrease such that in the shallower areas the typical speed is about 0.05 m/sec.

2.5 Fisheries and Other Aquatic Resources

Fisheries along coastal waters produced 62% of total fish output in 1987 thereby supplying most of the protein requirements of the rural population. Catch by small-scale fisheries in marine and inland waters has remained about the same, and the fact that gross value added from the fisheries sector doubled between 1970 and 1988 can be attributed to sharp increases in aquaculture production, rather than to higher output by municipal fishing activities. In addition, about 75% of the country's coral reefs which contribute to productivity of near shore waters are considered in poor conditions.

The freshwater prawn (Macrobrachium) has been reported by Natividad (1982) in the Pampanga River system, mostly in the municipalities of Guagua and Macabebe during the months of February and March. The average weight of an individual prawn in a sample of 14 specimens (9 males and 5 females) was 826 g (range, 42-114.5 g). He observed that the prawn was becoming rarer because of industrial pollution. Aside from the prawn, he noted the presence of fish (mullets, Mugilidae; and common carp, Cyprinus carpio, and tilapia Tilapia mossambica and freshwater snails in the river. Macrobrachium inhabits unpolluted streams and requires free access to salt water in order to breed.

Recently, Fortes and Darvin (1990) reported the presence of the prawn in the Calumpit River in Bulacan but expressed the view that the river "may well be one of the last sanctuaries" of prawn, which in the past was widely distributed in the country. About 690 fishermen depend on the fisheries of Calumpit River, of which 40 are prawn fishermen, with an average daily catch of 1- 2 kg per person. The peak production is 4 kg/day/person in November-February, but this livelihood source is threatened by pollutants from a paper mill and an alcohol plant (PCAMRD, 1990). A grant from PCAMRD has been released to the mayor of Calumpit and a cooperator to make a resource assessment of the prawn in the Calumpit and Pampanga rivers (Fortes and Darvin, 1990).

The yield of the fisheries of the Pampanga-Bulacan River has not been quantified separately but lumped together with those of several lakes (PCARR, 1981). The estimated fisheries yield composed of finfish and shellfish showed an increasing yield from 32,228 mt in 1976 to 104,933 mt in 1979; the Macrobrachium yield, assumed to have come from the Pampanga-Bulacan River, was 25 mt in 1979.

Another estimate of the fisheries yield of Pampanga River was placed at 300 kg/ha in 1978 (Anonymous, 1978), and cited in the Feasibility Report on the Pampanga Delta Development Project Commissioned by JICA (Republic of the Philippines, National Irrigation Authority, 1982). This figure probably includes cultured fish.

The Candaba swamp, which is flooded by the Pampanga River during the rainy season, harbors a fish fauna composed of carps, gorami, and catfish. These fish are caught during the dry season. One landowner with 330 hectares harvested and sold in 1975 10.7 tons of fish, or a yield of 32 kg per hectare (RP-NIA, 1982). Candaba Swamp, which has an area of 63,000 hectares, could potentially yield about 10,000 tons of fish, assuming only half of the total area is habitable by fish.

Rice-Fish culture in rice paddies has been practiced in Pampanga and other provinces in the catchment area. In one study (De la Cruz and Lopez, 1980), rotational farming of Tilapia, nilotica and rice was shown to be economically feasible at certain stocking densities. Standing crops of fish can range from 69 to 208 kg/ha/season, and yields as high as 310 to 590 kg/ha/season were reached in 1978 (RP-NIA, 1982).

Backyard pond culture of fresh water fish has also been tried in P ampanga but was not popular. Yields were variable, from 30 to 1,500 kg/ha/year (RP-NIA, 1982).

The largest lake in the catchment area is Laguna de Bay (area, 90,000 ha). The fisheries of the lake have been described (PCARR, 1981; Anonymous, undated). Both culture and culture fisheries exist in the lake. The capture fisheries in 1973 consisted of 63.6% snails, 19.4% shrimps, and 17% finfish. The finfish comprised Theraponidae (66%), white goby (26%), sea catfish, Arius (5%); the remainder consisted of the common carp, catfish, tilapia, gorami, etc. The finfish yields have shown a decreasing trend from 82,882 mt. in the 1961-63 to 20,723 mt in 1973. The productivity decreased from 920 kg/ha in 1961-63 to 334 kg/ha in 1968, to 230 kg/ha in 1973. Productivity (282 kg/ha) has not decreased during the succeeding 6 years (up to 1979). However, anecdotal reports at this time indicate much lower rates than those in the 1970's; for example, it now takes twice as long for fish to grow to harvestable sizes. This decrease has been attributed by some to the deterioration of water quality, since the number of fishermen has remained about the same, about 10,000 between 1968 and 1 983 (Anonymous, undated; PCARRD, 1988).

The other type of fishery is pen and cage culture. Fishpens culturing bangus (Chanos chanos) peaked in 1974 at 7,000 ha but reduced to about 2,600 ha in 1977 because of fish kills in 1975 and typhoons in 1976 (PCARRD, 1988). The number has probably decreased to less than 5,000 at present mainly as a result of complaints of capture fishermen who accused fishpen operators of encroaching into the communal capture fishing grounds (pers. obs.) Fish yields from fishpens were almost equal to those from open lake fisheries. For example, the 1973 production of 39,927 mt included 19.204 mt from fishpens (PCARRD, 1988).

The raising of fish, primarily tilapia, in net cages is popular in the smaller lakes in Laguna (PCARRD, 1988).

Fishery problems in Laguna de Bay include eutrophication, which has been tagged as the cause of algal blooms, which decompose to cause anoxic conditions. These conditions were observed almost every year from 1971 and were apparently the cause of death of 5 million milkfish in fishpens in 1975 (PCARRD, 1988).

There are 23 species of fish in the lake, some of which are catadromous, which return to the sea to breed and whose larvae or juvenile stages go upstream to grow in the lake. These fishes have been observed to have practically disappeared. The suspicion is that the polluted Pasig River has acted as a barrier to the migration of these fishes (PCARRD, 1981). In addition, some species, such as the endemic Clarias macrocephalus is dissappearing probably because of overexploitation.

Another important Laguna Lake fishery is the ulcerative disease fishes caused by the bacterium Aeromonas hydrophilia. The disease has been observed since 1981-82 and received scientific attention in 1986 (PCARRD, 1988). The species affected are the bottom dwellers, such as the snakehead (Ophicephalus striatus). It is believed that unfavorable environment (polluted water, low water temperature, high turbidity) are contributory factors to the incidence of this disease.

Laguna Lake has still another problem. This is at the level of policy and implementation of regulations. A recent paper (Malayang, 1991) describes the nature of this problem in these words: "The Laguna Lake Basin is host to a wide array of competing users of naturally limited resources whose behaviors are being sought to be regulated by myriad public agencies with overlapping mandates, and these provide the condiments for either opportunities or conflicts in the Basin."

The brackish or estuarine waters of Manila Bay, those at or near mouths of rivers where mangrove forests existed in the past, have been developed into fishponds stocked mainly with milkfish and prawns (Penaeus). The estimated areas of these fishponds in 1988 are 703 ha in the National Capital Region (NCR), 3,325 ha in Bataan; 21,973 ha in Bulacan; 26,922 ha in Pampanga, and 651 in Cavite, or a total of 53,575 ha (Hingco, 1990). An estimated 28,500 ha for the Pampanga River Delta was given by RP-NIA (1982). Between 1980 and 1988, there was an increase in hectarage of 53.039. Practically, all of these fishponds are privately owned, operated by 2,424 operators in 1980, which increased to 3,263 exclusive of NCR in 1988 and employing some 22,643 persons in 1980 (Hingco, 1990).

Hingco (1990) summarizes the production of these fishponds based on 1988 statistics. Milkfish production was 48,237 mt, about 25.42% of the national production; prawn production was 10,189 mt, about 24.52% of national production; and other species 11,083 mt, accounting for 48.77% of national production. Bulacan was the largest producer of milkfish (30,204 mt) and Pampanga the largest producer of prawns (5,786 mt). Overall, Manila Bay is a substantial producer of cultured milkfish and prawns, accounting for 28.9% of the national production.

The average productivity of milkfish in the Pampanga area is 1,125 kg/ha/yr with sales at P10,150/ha/yr; in this delta, the greatest constraint to milkfish culture is flooding,

estimated to cost P3,889/ha in 1980 (RP-NIA, 1982). Destruction of fishponds by floods is common throughout the country.

There are two other methods of fish culture in Manila Bay; fish cage and fishpen. Hingco (1990) gives a summary of data as follows: In 1988, fish production by fish cages in Metro Manila was 305 mt or 1.06% of the national production; and by fishpens 3,815 mt or 16.02% of total production in the country.

Two other species of shellfish in addition to prawns are cultured in Manila Bay. These are oysters and mussels. Hingco (1990) gives these production statistics: In 1988, the production of oysters was 1,730 mt (13.9% of total national production), with Cavite contributing the bigger share. The number of operators was 367, farming about 86 ha. Mussel production in 1988, mainly from Cavite, was 8,658 mt, or about 56% of the national production. There were 113 mussel operators farming 17.5 ha in 1980.

There are other biological resources in the Bay, such as shellfish and algal species which have been exploited by the people but whose production has not been quantified. As early as 1912, Seale (1912) listed and figured 28 species of gastropod and bivalve molluks used as food by the people and sold in Manila markets. Talavera and Faustino (1983) reported 45 species of edible mollusks, mostly bivalves, in Manila Bay area. Recently Gabral-Llana and Cabrera (1985-87) surveyed the southeastern part of Manila Bay (Cavite-Rizal area) for bivalves. They reported 43 species belonging to 16 families, mostly venerid and ark shell species. Because of taxonomic difficulties the results of the Talavera and Faustino (1983) study cannot be compared with the Gabral-Llana and Cabrera study (1985-87), although the latter authors state that about 10 species are common to the two studies. One important finding of the Gabral-Llana and Cabrera study was the absence of the window-pave oyster (Placuna placenta) from their samples. This species used to abound in large numbers in the Bacoor area in the 1960's (Blanco, 1981), and it must be assumed that the species is disappearing probably as a result of overexploitation and pollution.

Algal resources in the bay include Gracilaria, a source of agar-agar. Trono and Azanza-Corrales (1981) reported that peaks in biomass of this algae occurred in November to February, during the Northeast Monsoon, which is a calm season in the Bay.

The statistics on capture-fisheries of the Bay have been summarized by Belnas (undated) for shrimps and Hingco (1990), Munoz (undated) and Silvestre et al. (1987) for finfish. For shrimps, the commercial production was 5,356 mt in 1975; 2,263 mt in 1976; and 983 mt in 1977. In all these years, Manila Bay ranked second to the Visayan Sea, which produced 6.5 to 7.0 thousand mt. Unfortunately, the effort for these downward productions is not given by the author (Belnas, undated). The catch per day of medium trawlers was 13, 21, 26 kg in March 1979; 11-20 kg in August 1979; 0.1, 8.5, 23 kg in October-November 1979.

For finfish, the total production of the municipal and commercial sectors increased from 28,000 mt in 1978 to about 38,000-40,000 mt through the next 6 years (up to 1984). Municipal fisheries yield in 1987 was 32,389 mt and commercial fisheries yield in 1988 was 18,174 mt. About 95% of the fisheries production in the Bay was due to trawl fisheries in 1975 but subsequently declined about 30% in 1984. On the contrary, the number of

trawlers operating in the Bay increased from about a hundred in the 1950's to about 1,000 in 1988. In addition, about 500 mini-trawlers operate in the shallow portions of the Bay to catch shrimps and juvenile fishes.

It appears that the maintenance of the annual fisheries production in the Bay at around 40,000 mt is due to the proliferation of trawlers and other small-scale fishing gears.

3. POLICIES AND INSTITUTIONAL FRAMEWORK

3.1 Philippine Development Plan

The Philippine Development Plan provides the broad national policy framework for economic development; productivity and growth; equitable distribution of opportunities, income and wealth, including the means of production; and poverty alleviation. In addition to these national development goals, greater emphasis is given to the protection and conservation of the country's environment and natural resources. It is in this light that the new conceptual framework now known as the Philippine Strategy for Sustainable Development (PSSD) was formulated and subsequently adopted through Cabinet Resolution No. 37 of 29 November 1989. The main goal of the PSSD is the achievement of economic growth with adequate protection to biological resources and diversity, vital ecosystem functions, and overall environmental qualities.

3.2 Sectoral Policies and Development Programs

Several sectoral policies and development programs are interdependent and mutually compatible to the overall river rehabilitation program for the Manila Bay Region. These will be briefly discussed in the context of their relationships to three major life support systems in the country: the uplands which comprise about 45% of the country's land area and support some 30% of the population; the coastal resources, which are important to about 80% of the archipelagic country's municipalities; and the urban environment, where 43% of the national population resides.

Upland Forestry Resources

Some discussion of upland forestry resources is included because of the secondary impacts of forest and watershed management on the quality and capacity of surface waters. Philippine forests are one of the most species-diverse in Southeast Asia and one of the most endangered. The forest contain a variety of tropical broadleaf hardwoods, pines and rare and endangered wildlife, and are used as national parks and protection forests, watersheds, and for timber production. Economic and cultural pressures for timber and slash-and burn agricultural practices have resulted in uncontrolled cutting, causing soil erosion, followed by heavy siltation in water courses, and flooding of the water courses as channel capacities are reduced. Flash flooding and loss of productive soils also result. Deforestation may also alter wind paths, temperature, rainfall, patterns and other aspects of the microclimate. Currently, the country has 6 million ha of forested area which comprises only 0.99 million ha of primary growth, 3.8 million ha of secondary growth and the rest are mangrove and pine forests. Together, these forests cover 20% of national land area, representing a large decline from the 15 million ha of

primary forests which covered 50% of total land area in the mid 1960's. Basic to solving the country's deforestation problem is the determination of optimum land use that provides societal needs while enlisting the participation of the various users of the upland resources. The DENR and Senate Bill 1401 proposed a Forest Master Plan to be implemented by DENR in which selective logging with DENR supervision is permitted in residual and logged-over forests and logging is banned in virgin forests. With substantial allocation of funds for the Integrated Social Forestry Program (P327 million in 1990 versus P45 million in 1986) 4 million individuals are targetted to benefit during the next 10 years. The government has earmarked 300,000 ha of open and denuded forest lands for reforestation and also the establishment of some 125,000 ha of industrial forests plantations. For Regions III and IV (part of it in the catchment area), a total of 9,665 ha were reforested in 1989 and 20,193 ha in 1990. Funding agencies were the Asian Development Bank and Overseas Economic Cooperation Fund.

Coastal Resources

The country is an archipelago consisting of 7,107 islands and a total coastline of 17,460 km. Thus, about 55% of the population resides along coastal areas and a significant proportion of the rural population depends on fishing for their livelihood. As the second largest archipelago in the world, the Philippine aquatic resources should be a significant factor in planning for national and regional development. The trend and pattern of production from coastal resources indicate a decline in productivity from the traditional municipal sector and increasing importance of aquaculture fisheries. Depletion of coastal fishery resources is caused by (i) excessive effort by both municipal and commercial fishermen; (ii) destructive techniques such as the use of dynamite, cyanide and the muro-ami (noise/netting) methods; (iii) the clearing and conversion of mangrove areas into fishponds and other purposes which reduce fish nursery grounds; and (iv) pollution and siltation, which destroy marine resources including corals. The Manila Bay Clean Up Program recognizes that improving Manila Bay will require controlling the pollution sources and the rivers that carry pollutants to the Bay. The major river systems of concern are:

(1) Navotas-Malabon-Tenejeros-Tullahan; (2) Pasig-San Juan-Marikina; (3) Las Piñas-Zapote; (4) Parañaque; (5) Laguna Lake Basin; and (6) Meycauayan Basin. The clean up program will require a multisectoral effort in reduction of domestic and industrial wastes, management of uncontrolled solid waste disposal, river dredging and squatter resettlement. Rehabilitation work, such as construction of artificial reefs, mangrove reafforestation, maintenance of fish sanctuaries and rehabilitation of municipal ports, is likewise to be pursued. The recently launched Philippine Fisheries Sector Program which grants exclusive rights to small-scale local fishing communities for coastal fishing tasked with protecting the assigned fishing grounds will assist in this Bay rehabilitation effort. In spite of the growing pollution, Manila Bay is still a highly productive body of water, and supports one of the most important and diverse fisheries in the country.

Urban Environment

As in the most urban areas in developing countries, the major urban centers are beset with pollution and slum problems, arising from inadequate infrastructure systems which serve rapidly growing populations that are mostly poor. The urbanized portion of the

total population grew from 31.8% in 1970 and 37.3% in 1980 to 42.7% in 1990. Due to the lack of balanced spatial and regional development, growth rates have been faster in the larger cities. Expansion of the urban sector was a result of migration from the rural area to the major cities and not a consequence of the growth and development of the less urban areas. Part of the immigration observed for Metro Manila and elsewhere is due to the concentration of industrial activities in the National Capital Regional (NCR). The compelling force behind rural-urban migration is the lack of economic opportunities in the rural areas and deteriorating peace and order situation in the countryside.

Conditions have deteriorated more rapidly in the urban areas than in the rural. Together with urban poverty there is a lack of access to basic services, such as water supply and sewerage services which together with congestion contributes to higher environment-related health ailments. While the price of piped water is relatively low, very few have access to piped water, compelling the majority to rely on more expensive and less safe vended water. At the same time, significant number among the poor participate in the increasingly difficult to manage garbage collection and disposal systems, which expose them to further health hazards. The inability of city governments to provide basic services can be traced to local financial resource constraints.

The negative environment impact of squatter settlements has been identified as follows (MM Region-EIS, 1990):

- slums and squatter settlements along and often within rivers and waterways are contributary causes of water pollution, flooding and drainage problems throughout the NCR. This is generally attributed to solid waste and excreta deposited as a result of inadequate sanitation and garbage collection/disposal facilities.

- the existence of slums and squatter settlements in government service reservations and easements, including rivers and waterways, often physically obstructs attempts to improve, extend and maintain public infrastructure and services, and in the case of the main roads and highways, has had a direct contributory effect on the worsening problem of traffic congestion.

- the lack of basic infrastructure and services, and cramped and unhealthy living conditions are the principal reasons for a higher incidence of sickness and disease in the squatter areas than in other regions, especially among children.

The National Shelter Program (NSP) provides housing assistance through home mortgage financing, production, and development loans to public and private developers, and community housing programs. The Philippine Development Plan has focused the need to develop a Comprehensive Program for Squatter Settlements. The provision of land tenure will be pursued through the intensification of slum upgrading and the development of sites and services projects. In addition, the development of in-city resettlements sites for squatters occupying priority infrastructure project sites and danger areas such as esteros and river banks have been undertaken but the results are not encouraging.

3.3 Environmental Policies and Management

Industrial development has been identified as a national thrust to bring the country to the Newly Industrialized Country Status by the year 2000 and to create jobs that will help alleviate poverty. Realizing also the need to pursue development that is sustainable, industrial development is pursued with due consideration for the environmental impact of industrialization.

During the three years under review (1987 to 1989), the environment and natural resources sector initiated and put in place policy reforms addressing the root causes of environmental degradation and unsustainable resources depletion. Key programs were boldly redesigned and implemented to support these policy reforms and further encourage citizen participation in environmental management. To improve organization efficiency, the Department of Environment and Natural Resources (DENR) pursued decentralization and reoriented natural resources management strategies from a regulatory to a development approach.

Role of the Environmental Management Bureau

Under the existing organizational structure of the DENR, one of the sectoral bureaus is the EMB which merged and took over the functions of the former National Environmental Protection Council (NEPC) and the National Pollution Control Commission (NPCC). The EMB is basically providing the DENR Secretary with advice on matters relating to environmental management, conservation and pollution control. Its mandated functions are:

- Recommend possible legislations, policies and programs for environmental management and pollution control;
- Advise the Regional Offices in the efficient and effective implementation of policies, programs and projects for effective and efficient environmental management and pollution control;
- Formulate environmental quality standards such as quality standards for water, air, land, noise, and radiation;
- Recommend rules and regulations for environmental impact assessments and provide technical assistance for their implementation and monitoring;
- Advise the Secretary on the legal aspects of environmental management and pollution control, and assist in the conduct of public hearings in pollution cases;
- Provide secretariat assistance to the Pollution Adjudication Board;
- Coordinate with the interagency committees that may be created for the preparation of the State of the Philippine Environment Report and the National Conservation Strategy; and

- Provide assistance to Regional offices in the formulation and dissemination of information on environmental and pollution laws, and in the conduct of environmental research programs.

The EMB has 3 staff offices and 4 line divisions. The total staff complement of EMB members some 219 persons, of which 105 are technical professionals while 114 comprise the administrative, clerical and other non-technical personnel.

The EMB was only organized in June 1987, and its relatively short existence appears to be the major reason for its difficulty in the pursuit of more effective intervention strategies in environmental and pollution matters. The continued existence and operations of the LLDA is another major constraints, as its functions often overlap with those of EMB, as well as those of DENR-NCR. Moreover, the EMB's internal capability for research and monitoring of environmental quality has been affected by budgetary cut-backs just as has the entire DENR.

Despite these limitations, the EMB has demonstrated its technical capability in policy formulations and has enthusiastically pursued inter-agency coordination. It provided much of the substance for the sector on environmental management of the Metro Manila Medium Term Regional Development Plan.

Direct controls are employed in the country as the major policy instrument for pollution control. Thus, there are air and water quality standards that define maximum allowable limits of emissions and effluents from industrial activities. These standards were first established in 1967 and have been revised three times, partly to take into account local and Asian studies, evaluations done by WHO consultants on the 1978 and 1982 Philippine Standards, and implementation possibilities. For instance, during their years of implementation, questions arose on the feasibility to attaining permissible limits set on some parameters. The cost of attaining the effluent standard for color for Class C waters was seldom attained; it was considered too stringent. Recognizing that limited resources were available for monitoring water quality both in government environmental agencies and industrial dischargers, a notable amendment to the 1978 water quality criteria was the inclusion of a guide on significant pollutants to be monitored in certain types of industries. The number of water pollution parameters is reduced from 50 to 24. The question that needs to be addressed is whether further reduction is needed, in order to obtain effective monitoring at least cost.

A system of fines to complement the emission standards has been established based on duration of violation in terms of the number of days, present condition of the environment, capacity of the source for discharging effluent, average deviation from the effluent or emission standards, and degree of pollution generated. However, this system has not been proven very effective, because industries find it "profitable" to pay the fines rather than to control their pollution. For such a system of fines to be effective, it should allow polluters to internalize the negative impacts of harmful residues. Pollution taxes must be high enough so that polluters will eventually opt for spending on pollution control devices to meet effluent/emission standards. Studies are needed that would investigate the ability of the system to encourage shifts towards pollution abatement across various types of polluter firms. Basic to the imposition of a system of penalties is the monitoring of emissions, but monitoring has been limited by the lack of available

manpower and equipment. This is also true for another environmental management tool, the Environmental Impact Assessment (EIA), the implementation of which was limited to 10% of the firms required to conduct EIA's.

Although closer coordination has been forged between DENR and the National Economic and Development Authority (NEDA) to ensure that development projects programmed for implemenatation would undertake an EIA, full implementation of this plan is still hampered by lack of financial and manpower resources. There is a need to train both the EMB and NEDA staff in EIA technology. The EIA should be an integral component of the feasibility study for all projects, the conduct of which is normally left to private consulting groups. This implies that private sector participants in the conduct of EIA would also require manpower training, as would private interest groups who would be involved in monitoring. In this regard the government has allocated the necessary budget under the Human Resources Development Program to benefit 50% of the DENR personnel.

Institutional Arrangement

Realizing the importance of maintaining the country's ecological balance, the Department of Environment and Natural Resourse (DENR) spearheaded a project aimed at resurrecting dead rivers and instituting steps to prevent heavily polluted rivers from further degradation. Specifically, the project is geared towards the following:

(a) To prevent and control the pollution of the river systems from industrial, domestic and other wastes;

(b) To implement an effective flood control program including the restoration and recovery of the original banks and rights-of- ways;

(c) To undertake a comprehensive resettlement program in consultation with the affected urban poor families;

(d) To strengthen the delivery of health and medical services to residents of the area within the river system; and

(e) To conduct educational and public information campaign in all phases of implementation of the program.

Because of the social and economic dimensions involved, the DENR has adopted a multisectoral approach with the assistance of other government agencies and San Miguel Corporation, which represents the private sector. This concerted effort underscores the department's determination to solve the nation's river pollution problem. With the project's slogan 'Ilog Ko Irog Ko' emphasizing its thrust, the Navotas-Malabon-Tenejeros-Tullahan (NMTT) River System was chosen as the launching pad for the river revival project. The NMTT River System is considered to be the most polluted river system in Metro Manila. With a signing of Memorandum of Agreement on November 1987 the blueprint for seven Task Forces was drawn. These Task Forces, created initially to

formulate policies and guidelines for the effective implementation of the program, and coordinated by a lead agency, have been designated as follows:

(a) Task Force on Industrial Wastes (DENR)
(b) Task Force on Domestic Sewage (MWSS)
(c) Task Force on Refuse/Solid Wastes (MMA)
(d) Task Force on Squatters (NHA)
(e) Task Force on Flood Control and River Bank Relocation (DPWH)
(f) Task Force on Health and Medical Services (DOH)
(g) Task Force on Public Information (DECS)

3.4 Role of Foreign Development Agencies

There are numerous foreign development agencies concerned with varying degrees of environmental rehabilitation in Manila Bay and its watershed area. Some of these agencies have merely provided funds for feasibility studies (e.g. UNDP, UNEP, ESCAP, JICA) while others not only funded the studies but also provided grants or soft loans for project implementation (DANIDA, ADB). There are projects on reafforestation being carried out by DENR and funded by USAID.

The overall role of the agencies has been to promote or catalyze sectoral development in the Bay and its watershed area for the benefit of the people through such programs as environmental protection, environmental rehabilitation and environmental management. The sectoral approach, though often useful because resources are directed to solve a set of sectoral problems, needs to give way to an integrated approach. For example, it is not practical to develop irrigation and anti-flood infrastructure without doing something about the root causes of flooding (e.g. deforestation).

Some of the projects reviewed are concerned with the sustainability of the targetted resources, such as water, agriculture, and fisheries, primarily for the resident populations. On-going foreign-funded projects have also provided assistance in expertise through foreign consultants. However, the development agencies should include in the program local manpower development schemes that will allow Filipino experts to continue their involvement in similar projects after the foreign consultants have withdrawn.

Another role of foreign development agencies is to assist local researchers on environmental rehabilitation projects and to make available to the country the current state-of-art methods and techniques of environmental rehabilitation. Lack of research opportunities has generally hampered the development of these methodologies in the country. An example is modelling technique for pollution management. The role of foreign development agencies to assist in providing funding and/or technical assistance for human resource development, such as in environmental management ranging from EIA/GIS technology, river basin management, planning techniques, monitoring, right down to laboratory skills and techniques, will greatly facilitate the process of the river rehabilitation program.

4. IDENTIFICATION OF ENVIRONMENTAL PROBLEMS AND ISSUES

The environmental problems and issues relating to the river rehabilitation program for the Manila Bay Region will be discussed in the context of the negative impacts arising from industrial development, human settlements, forestry and agricultural activities in the respective river basins, including issues of environmental management. Many of these issues and problems (including plans of actions for overcoming them) have already been raised in recent studies associated with river rehabilitation in critical regions of the study area. Thus, extensive reference will be made to the findings of these studies, in particular the following:

(1) Manila Metropolitan Region Environmental Improvement Study (ADB, 1990)

(2) Pasig River Rehabilitation Project Feasibility Study (CARL Bro International a/s-DANIDA, 1991)

(3) The Study of Flood Control and Drainage Project in Metro Manila (JICA, 1990)

(4) Laguna Lake Toxic and Hazardous Waste Management Feasibility Study (URS International, Inc., 1989)

(5) Reports of the Presidential Committee for Laguna Lake (1987)

(6) Pampanga Delta Development Project Study (JICA, 1982)

4.1 Pollution of River Systems

A description of the environmental conditions of three major river systems in the Manila Bay Region will generally give an overall impression of the environmental state of the other minor river systems in the catchment areas. The major water bodies in the MMR are the Pasig-Marikina River System, the Navotas-Malabon-Tenejeros-Tullahan (NMTT) River System, Manila Bay and Laguna Lake. The Pasig River connects Laguna Lake and Manila Bay and the NMTT River System from the La Mesa Dam in Novaliches discharges into Manila Bay. All the major rivers in the study area are heavily polluted and are considered to be biologically dead except for the upstream portion of the Marikina River. Manila Bay is showing signs of ecological stress due to domestic, industrial and agricultural wastes which are discharged directly into the Bay.

Pasig River System

The Pasig River flows east to west through Metropolitan Manila for 25 km from the confluence of the Marikina and Napindan Rivers at Buting, Taguig to its mouth at Manila Bay. The River has three principal tributaries, the San Juan River, the Marikina River and the Napindan River. In addition, approximately 19 esteros discharge directly into the Pasig River System. The river watershed contains some 60% of the Metro Manila area and contains approximately 7.8 million people in the City of Manila, Quezon City, and municipalities of San Juan, Mandaluyong, Makati, Pasig, Taguig, Marikina, San Mateo and Montalban. The Pasig River varies in flow and quality with the seasons, with the

appearance of the waters best in the wet season when the river flows full, and worst in the dry season when low flows expose black, anaerobically decomposing wastes releasing odorous gases, including hydrogen sulphide. The river is at all times, however, extremely turbid and black. It is also subject to tidal influence for a portion of its length because of the flat slopes in the MM area. At high tide in the dry season, salt water sometimes flows up the river all the way to the Laguna Lake inlet. The river is highly polluted with untreated domestic and industrial wastes, solid wastes and the wastes produced by squatters in makeshift dwelling on the banks and stilts in the river itself.

The NMTT River System

The Navotas-Malabon-Tenejeros-Tullahan (NMTT) River System springs from the Novaliches Dam or La Mesa Dam in Quezon City, winds through Caloocan City and Valenzuela, down into Malabon and Navotas from which it spills its waters into Manila Bay. At its widest in Navotas, it spans about 60 m bank to bank. Upstream in Quezon City where it is narrowest is about 5 m across. On the average it is a murky, sluggish, serpent winding across three municipalities and two cities. Long before its demise under domestic and industrial wastes, the river was a major artery for riverine commerce; a source of fresh-water clams and fishes; turned to for water sport like fishing and swimming. The river has had a BOD level of 500 mg/L at times. In addition, the channel is heavily silted, and its reduced carrying capacity causes flooding in adjacent communities during the wet season. The river system is odorous and biologically dead caused by wastes discharged from highly polluting industries and squatters' homes in its watershed. Near its mouth are lands below high tide level, where the polluted river and marine waters mix and enter homes, gardens, streets, schools and industrial premises. There is a high incidence of communicable diseases in the area. The NMTT is considered to be the most polluted river in Metro Manila.

Pampanga River System

The Pampanga River Basin is one of the two major basin groups in the Central Luzon Water Resource Region with a drainage area of 9,759 sq. km. The River stretches approximately 250 km with its headwaters located within the borders of Nueva Ecija and Nueva Vizcaya. The upper basin traverses several towns of Nueva Ecija while the lower section traverses the municipalities of Arayat, Candaba, San Luis, San Simon, Apalit, Macabebe and Masantol, all in the Province of Pampanga. Its water resources consist mainly of rainfall, surface run-off and groundwater. Water supply in the basin at 8,762 mcm/yr is not even adequate to meet projected agricultural water demand of 14,316 mcm/yr by year 2000. However, present information indicates that an extensive area parallel to the Pampanga River has excellent groundwater potential for both domestic and agricultural purposes. This could therefore be tapped to supplement the existing water supply in the basin.

The Pampanga River System serves as the main conveyance system of all pollutants within the basin such as sediment from denuded areas, agricultural chemicals applied on croplands, domestic, agricultural and industrial residues. The six major forest reserve areas within the basin have been installed with several water resource projects. The biggest of these are the Pantabangan and Angat Multi-Purpose Reservoirs. Along the

watersheds, mostly at the foothills, are identified intermediate water impounding reservoirs for domestics and irrigation purposes for the topographically isolated arable lands. Being the main drainage pathway for Central Luzon and in view of the attachment of the residents of the area to the riverine system, the Pampanga River is of historical, political, economic and cultural significance.

A wide portion of the river basin has perenially suffered from flood inundation during typhoons or tropical storms due to the overflowing of the Pampanga River and its tributaries. The conveyance capacities of these waterways have been decreased through the years because of heavy siltation caused by denuded forests of the surrounding mountains. To alleviate the area from the yearly destructions and damages brought about by floods and improve the depressed conditions in the area, provision of more effective flood control measures and facilities is urgently needed. A feasibility study on the Pampanga Delta Development Project was conducted by the Japan International Cooperation Agency (JICA) from 1980 to 1982. The project consisted of a flood control component as well as an irrigation development component. The project has since been implemented.

The June 1991 eruption of Mt. Pinatubo, which is located in the Province of Pampanga and about 90 km northwest of Manila, is one of the biggest eruptions in the Philippines this century and poses a serious setback to the river rehabilitation program in the Manila Bay Region. Scientists have estimated that the deadly pyroclastic flows - hot rocks, gas and other volcanic debris - reached 900 C when they poured down from the volcano. The start of the heavy rain had released tons of debris and mudflow that cascaded down the mountain at 15-25 kph through abandoned villages in the northwest slope and towards Angeles on the east volcanic ash and mud washed into the streams. The extent of the negative environmental impacts of this unexpected natural phenomenon on the river systems in the long run cannot be ascertained at this point in time but their effects on aquatic resources (see Section 4.2) and flooding, for example, are almost predictable.

4.2 Threats to Fishery Resources

In the upper portion of the catchment area of Manila Bay, excessive sedimentation brought about by erosion is a threat to the fishery resources. The species affected are the river fishes and fresh water prawn Macrobrachium. While some species like the catfish can tolerate a certain degree of sediment in the water, others like the Mugilidae, Macrobrachium and Gobiidae may not. Another factor that has not been studied is the effect of reduced and intermittent flow of water on the freshwater fishery species.

Two agencies of government have primary mandates which bear on the conservation of these resources. These are the DENR and the National Irrigation Administration (NIA). The DENR is expected to reduce the rates of erosion of highlands through its National Forestation Program as described in several DENR Administrative Orders and Memorandum Circulars (see DENR Memoranda and Issuances, 2 vols). One of its bureaus, EMB, controls pollution as mandated by P.D. No. 1152 (Philippine Environment Code establishing standards for air, water and land resources), P. D. No. 984 (establishing a stronger pollution control), and P. D. No. 1586 (establishing an EIS System). The NIA, through its water works and flood control programs, such as the Pampanga Delta Development

Project, can conserve water resources and even provide for fish sanctuaries. The third government agency is the Department of Local Government, which can legislate local regulations for the sustainable use of the resources and implement the regulations governing their use according to Section 30, Chapter IV of the Fisheries Decree of 1975 (P.D. 704), including regulation of population movements and human settlements in critical areas.

In the lowlands of the catchment area, the threats include flooding, pollution, and overexploitation. Flooding, although destructive to fish culture, is responsible for the fresh water fishery in the Candaba swamp area of Pampanga. Pollution by factories (e.g. alcohol distilleries) and pig farms affect the river fisheries of Pampanga, including the freshwater prawn, which has been reported to have nearly disappeared in some tributaries of the Pampanga River. However, from present reports, it is not possible to eliminate overcollection as one of the causes of the decline of fresh water prawn fisheries.

The relevant agencies in this portion of the catchment area include, in addition to those already mentioned, the Department of Agriculture (DA), primarily the fisheries personnel of DA (Bureau of Fisheries and Aquatic Resources). The BFAR is mandated to manage and conserve freshwater fisheries according to PD 704. To balance the promotion of fishery production, DA should set up protected areas or sanctuaries for threatened fishery species, as set forth in Section 32, Chapter V of P.D. No. 704.

The fishery and environmental issues in Laguna de Bay are very complex. This lake is a classic example of the saying that "too many cooks spoil the broth." Whatever the solution to this problem, the threats to the fishery remain. They are (1) water pollution, as indicated by observations on the increased rearing period of fish, (2) disappearance of some species because of a) overharvesting, and b) failure to complete their life cycles as Pasig River serves as a barrier to free access to and from Manila Bay. It is clear that the EMB's Pasig River Clean-up Project is a step in the right direction. But some claim that the Napindan gate also holds the key to improvement of fisheries by allowing salt water to enter the lake. Saltwater coming in contact with freshwater results in flocculation and settling sediments. The role of DA and the Laguna Lake Development Authority (LLDA), as mandated by Executive Order 927, in the conservation of the fisheries remains to be emphasized. Because of the many government agencies having overlapping mandates for the lake, it is obvious that the policies for the multiple use of lake resources need to be reviewed and that some understanding among the various agencies, including the NGO's, be forged so that something can be done right away about the declining fisheries of the lake. Another potential problem is the controversy between the fishpen owners and capture fishermen regarding the use of the fishery resources. In this connection, the NGO's need to be brought in as part of the framework of fishery development in the lake.

The fishponds in the estuarine portions of the Bay are always threatened with floods, usually brought about by typhoons. An average of 20-21 typhoons enter the country every year, and many of them affect the Manila Bay region. Fishponds which have been built to include part of a river bed have been tagged as a cause of flooding as they impede the normal flow of floodwaters. In the past, the government destroyed such fishponds by dynamite. The Pampanga Delta Development Project could alleviate the problem of flooding in the long term.

There have been reports during sectoral discussion that fishponds in some portions of the Bay have encroached into the common fishing groups of small-scale fishermen. This is an issue for DA to settle as it has jurisdiction over the building of fishponds under P.D. No. 704.

A local environmental problem that has been raised against fishpond owners is their release of chemical washings into the Bay. These effluents have been reported to be toxic to a number of marine organisms. This problem has to be referred to DENR.

Living resources other than finfish in the Bay include marine species, such as algae and mollusks. The main threats to these resources are probably overharvesting and pollution. It is not possible to separate the effects of these two factors in most cases, although the case of the disappearance of the window-pane oyster (Placuna placenta) could be attributed more to over- collection than to pollution.

A real threat to the oyster and mussel fishery of Manila Bay is the "red tide" phenomenon. This occured in Bacoor Bay (within Manila Bay) in June 1988 killing cultured mussels and oysters through reduced oxygen in the water, and people stopped eating shellfish and finfish (Ronquillo, 1990). These species have been shown to accumulate in their tissues large quantities of paralytic shellfish poisons (PSP) which could affect humans (Gonzales, 1989a, 1989b, Ronquillo, 1990). PSP is elaborated by certain species of dinoflagellates which are filtered by shellfish. Sixty-five cases of PSP were reported and validated from Manila Bay in August-September 1988 (Gonzales, 1989a). The question of the factors responsible for the rapid reproduction of red tide organisms is debatable. Some like Ronquillo (1990) would put emphasis on pollution, especially organic pollution; others would attribute the phenomenon to a host of oceanographic factors such as high salinity, warning of the seawater brought about by El Nino, unfavorable currents, etc. Whatever are the factors, the facts seem to point to the relatively slow circulation of water in enclosed bays, such as Masinloc Bay in Zambales, Maqueda Bay in Samar, and Bacoor Bay, as the common predisposing factor for the incidence of red tides. Manila Bay has moderately good water circulation patterns which change with the Northeast and Southwest Monsoons (Ronquillo, 1990; De las Alas, 1990), and certain parts of the Bay receive polluted waters from the north during the Northeast Monsoon months. These waters are trapped in Bacoor Bay and circulate slowly, their movements being impeded by land reclamations (De las Alas, pers. comm.). Bacoor Bay has been found to contain large numbers of red tide organisms (Ronquillo, 1990; Gonzales, 1989 a, b). Ronquillo (1990) documented fishkills in 1987 near Bacoor Bay due to oxygen lack brought about by reproduction of non-toxic dinoflagellates. He also mentioned fishkills due to polluted waters in the Pampanga area of the Bay.

The DA through the BFAR has the broad mandate (P.D. No. 704) to prevent red tide poisonings. The Department of Health and the Philippine Council for Health Research and Development of the Department of Science and Technology are also concerned with this phenomenon. The Council can help in the research aspect, the Department of Health in the preventive aspect. BFAR has had a monitoring and information dissemination program since 1988. BFAR can also do the research into the culture techniques of the fishery which could minimize or prevent outbreaks of red tide. It has been suggested, for example, that the floating culture technique could be developed so that the shellfish can easily be moved to unaffected areas.

The Manila Bay Monitoring Program (MBMP) has concluded that the Bay shows signs of stress as indicated by low DO and traces of black sulfide mud at the bottom, the polluted coastal water which is unsafe for contact recreational activities, high bacterial counts, low species diversity of bottom fauna, and algal blooms during summer indicating nutrient-rich water. The concentrations of heavy metals, though sometimes unacceptable, were not alarming. This condition is probably due in part to the fairly good circulation of water in the Bay (De las Alas, 1990). How these conditions relate to fisheries cannot be stated with certainty. The relatively low concentrations of heavy metals in fish caught in Manila Bay can probably be explained by the nature of the fisheries (mostly pelagic species coming from the South China Sea).

Three marine communities in the Manila Bay area require conservation or rehabilitaion in order that they can support fisheries production. These are mangroves, seagrass beds, and coral reefs. Mangroves have been practically cut and converted to aquaculture areas and salt beds. Seagrass beds probably still exist in certain areas. Coral reefs are practically gone, being limited to small areas near the mouth of the Bay.

The programs that should be given attention are in the nature of rehabilitation, in view of research showing their benefits to fisheries (CLRP Symposium Proceedings, in press, 1991). Thus far, the National Forestation Program of DENR in pursuance of DENR Administrative Orders is replanting mangroves in some parts of the Bay. The Bay will benefit from reforestation in terms of the reduction of the rate siltation, which varies from 3.2 cm/yr to 4.3 cm/yr (De las Alas, 1990). No effort at seagrass rehabilitation has been attempted. An attempt to replant seagrasses in the Limay, Bataan area has met with failure; the seagrasses failed to grow (Cruz, pers. comm.). It is suspected that portions of the Bay can no longer support seagrass growth probably due to pollution. The construction of artificial reefs can rehabilitate reef fisheries if reef fish stock still exists.

The relevant government agencies to lead in the rehabilitation of Manila Bay fishery environment are DA and DENR: DENR in the reforestation and control of pollution through EMB and DA in the rehabilitation of marine fishery habitats. DA through the Fisheries Sector Program in accordance with P.D. No. 704 can set up protected areas administered by fishing communities as well as NGO's.

In connection with environmental rehabilitation, the island of Corregidor, a World War II relic, should be included under the control of the Department of Tourism. The island has potentials for tourism.

A study of the demersal fishery resources, the main fishery of Manila Bay (Silvestre, Munoz and Pauly, 1987), has shown that the resources have suffered from massive biological and economic overfishing. The conclusion is based on trends of trawl catches, demersal biomass, and overall mortality index from 1948 through 1984. The available data on species and size composition of trawl catches, though meager, also point to overfishing. This study indicates that the demersal fisheries which have an MSY of 13,100-20,000 mt per year (whose economic rent is negligible at present) can generate an economic rent at maximum economic yield (MEY) of 3,100-9,700 mt per year or about US$ 1.5-5.8 million worth of finfish and invertebrates per year as of 1987. For this to happen, it is necessary to reduce the fishing effort to almost a third to that of the

1983-84 level. In practical terms, the number of fishing boats should be decreased and the mesh-size of nets be increased to at least 5-6 cm from the present 2 cm. This solution requires the provision of alternative livelihoods for displaced fishermen.

Even though the deterioration of the water and bottom environment has been confirmed, this condition is not easy to relate to fishery yields. No doubt, the environmental effects have been confounded by the effects of overfishing. It is possible that the observed reduced species richness of the bottom fauna is due to the altered environmental conditions, but to what extent the silted condition and the increased chemical loading of the Bay's waters contributed to the change in species and size composition of the fishery is hard to say.

The case of Manila Bay fisheries parallels those of the fisheries in other parts of the country. Pauly (1989) in a recent paper on fishery resources management advanced the view that Philippine fisheries cannot be developed because it is already overloaded. The solutions lie in the implementation of the many laws and fishery regulations, such as the relevant provisions in P.D. No. 704; P. D. No. 705, banning commercial fishing in shallow waters reserved for municipal fishermen; and the several Fisheries Administrative Orders (FAO) bearing on conservation and management (De la Torre, 1991, in press). Some FAO's (e.g., No. 40 regulating the mesh sizes of nets to be not less than 2 cm) need upward revision. No less important is the participation of local fishing communities and credible NGO's in the management of these resources.

Finally, the DA should be recognized as the single lead government agency responsible for overall fisheries management. All others minimally concerned with this sector should play subordinate roles.

4.3 Pollution Sources and Waste Types

Industrial Effllluent

The types of industries causing the most concern are the chemical and chemical-related processing plants which include petroleum industries, oil-based industries, chemical and pharmaceutical laboratories, and industries producing health care products. Next on the list of concern are the community and social services industries which include hospitals, markets and schools (PRRP-FS Interim Report, 1990).

An overview of the pollution of the Navotas-Malabon-Tenejeros- Tullahan (NMTT) River System as affected by industrialization could serve as a reference for the protection/rehabilitation of other river systems in the Philippines where deterioration in river water quality has taken place. Once serving as the area's source of livelihood and daily needs, the NMTT River System now reflects the years of neglect and indifference brought by the country's development, and is now considered as the dirtiest and most polluted river in the country. Because of the indiscriminate dumping of wastes by industries and the general public into this water system, the once clear waters have become a danger to health and the environment. The river system is characterized by shallow heavily silted winding channels which erode a land of 85 sq. km. carrying flood flows into the nearby communities during the rainy season. The river is murky with a foul odor due to the depletion of dissolved oxygen and the predominant septic conditions. Marine life, if it still exists in some upstream sections, has been dramatically reduced because of the river's biological degeneration.

There are several parameters to compare the pollution contribution of industrial firms and domestic or residential effluents. Industrial firms in the basin may discharge hazardous wastes such as acids/alkali, toxic and heavy metals. At this point, there is no concrete evidence of any present danger from toxic and hazardous substances (THS) or the THS have exceeded existing water quality criteria. A recently completed study of Laguna de Bay, the "Laguna Lake Toxic and Hazardous Waste Management Feasibility Study, 1989", indicates that THS levels in the lake inflow and the lake itself are less than what would have been expected. The organic pollution load of the NMTT River System comes mainly from five major pollution sources: Domestic sewage from residential/commercial areas; domestic sewage from river bank squatters; solid wastes from river bank squatters; and industrial wastes from about 111 big industrial firms and about 200 small industrial/commercial firms.

It is estimated that for 1989, a total of 75,000 kg. BOD/day comes from industrial firms or representing the highest contributor at 48%. The balance comes from domestic sewage (33%), residential solid waste (9%), solid wastes from river bank squatters (8%) and domestic sewage from river bank squatters (2%).

Most of these 111 major industrial firms are just beginning to plan to treat their industrial effluents. A number of industries who have put up wastewater treatment plants before 1988 realize that operating a treatment plant is expensive. Others prefer to save on pollution control chemicals and electricity resulting in the improper treatment operation and discharging effluent which does not meet the DENR effluent standards.

DENR's Pollution Adjudication Board (PAB) issues Cease and Desist Orders (CDO) to polluting industries after it has been established through proper documentation that these industries are indeed releasing pollutants. The documentation may consist of reports of investigations by DENR personnel and complaints from the public affected by the pollution. DENR has regional office staff headed by regional directors and include provincial and community environmental officers assigned to communities in the provinces. Since the implementation of the DENR's plan to lower 60% of the industrial pollution loading the NMTT River System in April 1989, the DENR has issued CDO to no less than 46 industrial firms whose violations ranged from:

(a) no wastewater treatment plant for a number of years;
(b) not operating on existing wastewater treatment plant;
(c) constructing by-pass canals and by-pass pumps;
(d) improper operation of wastewater treatment plants by saving on electricity and chemicals resulting in effluents not meeting the standards.

The NMTT River Basin is the final sink for wastes other than industrial wastes. These are domestic sewage, solid waste from residential areas whose solid waste or refuse is carried by rainwater to the river system, solid wastes or garbage from squatters and lastly domestic sewage from squatter families.

During the rainy season, which usually occurs during June to October, the NMTT River System has insufficient storage capacity to absorb the flood flows which usually follow a storm or monsoon rain. Flooding during intense storms is caused by (a) the overflowing of the main rivers; (b) by insufficient inland drainage facilities to cope with excessive surface run-offs; or

(c) by a combination of these. Flooding is further compounded by high tides occuring simultaneously with intense storms. Flooding due to insufficient inland drainage occurs more frequently, by flooding due to river overflows resulting in much more destructive damage. The capacity of the waterways has also been reduced primarily due to the indiscriminate dumping of solid wastes and to a lesser degree by siltation due to soil erosion of deforested areas in the upper portions of the watersheds.

Domestic Wastes and Sewage

Solid Wastes

One of the more serious environmental problems that confronts the study area on a daily basis is the pollution brought about by an inadequate solid waste management program (MM Region-EIS, 1990; PRRP-FS Interim Report, 1990). For example, about 4,000 tons of solid wastes are generated daily within Metro Manila and of these, only about 3,400 tons are collected and transported to existing dumpsites. The balance of about 600 tons is (a) left on the streets, creating aesthetic and health problems; (b) dumped into storm drains, esteros, canals, creeks, or rivers,; (c) burned, there by creating air pollution; or (d) recycling by scavengers. About 50% of the solid wastes generated comes from residential or domestic sources and contains a high percentage of putrescible food wastes.

There are four existing open dumpsites within the Metropolitan Manila boundary where 90% of the collected refuse is dumped, and these are all nearing maximum available capacity. The four open dumpsites are located in Balut-Tondo, Payatas-Quezon City, Pasig and Valenzuela. The remaining 10% of the collected refuse is disposed of in landfill in Baras, Rizal.

Wastes also accumulate in unauthorized and uncontrolled locations which, together with general problems of littering and the use of open dumping for disposal operations, result in the exposure of virtually all wastes to the elements, vermins and other disease carrying vectors. In addition to the creation of generally unsanitary conditions, adverse environmental impacts are caused by leachates and surface-runoff from the exposed waste materials. Other detrimental impacts occur from flooding, resulting when refuse-related blockages occur in drains and esteros.

In solid management, P.D. No. 825 provided penalties for improper disposal of garbage and other forms of uncleanliness. The responsibility of implementing this Decree was vested upon DPWH with the assistance of DOH and LGU's. However, the Decree had not been effectively implemented. The ineffectiveness of the Decree was largely owned to the inconsistency between the provision that DPWH was the implementor of the Decree and the fact that MMA was the responsible agency for solid waste management in the MMR.

The Presidential Task Force on Waste Management, which was created by virtue of Memorandum Circular No. 30, Series of 1987, to upgrade the existing solid waste management system in the MMR, specifically prohibits the opening of new dumpsites, aims to close the existing ones and specifies the adoption of the sanitary landfill technique of final disposal for solid wastes. Furthermore, the MMA and DPWH have been assigned as the respective lead agency for the Task Force on Solid Wastes and the Task Force on Flood Control and River Bank Relocation under the national institutional arrangement.

Domestic Liquid Wastes

The total population of the cities and municipalities within the study area is estimated at 16 million people. The NHA has identified that slums dwellers and squatters constitute 33.6% of the total population in the Metro Manila area. The primary cause of concern of water pollution is the discharge of domestic wastewater, which accounts for about 70% of organic pollutant load in Pasig River and 58% in the Malabon-Tullahan River. According to MWSS, NEDA and DPWH records, the existing sewerage system serves altogether about 750,000 people or roughly 10% of MMR. This includes about 600,000 people in the City of Manila, who are served by a sewerage system and about 150,000 people in Quezon City, Las Piñas and Makati, who are served by septic tanks and isolated sewerage systems. Consequently, from about 16 million people in the study area it is estimated that about 13 million people are contributing domestic liquid waste pollution to the river systems, where the total BOD loading in estimated at 436 kg/day.

The Septic Tank Maintenance Program (STAMP) under the MWSS is hampered by financial and manpower constraints in the carrying out of the desludging of septic tanks where only 20,346 from the targetted 600,00 septic tanks were desludged. Due to the non-availability of dumpsites, the sludge is inevitably dumped into the river systems. Even with the construction of METROSS I Sewerage Project (Central System), only about 15% of the population in Metro Manila will be sewered. Construction of the subsequent stages of the METROSS plan has been deferred due to financial constraints. As a result, the discharge of untreated domestic sewage into the river systems and the shoreline waters of Manila Bay has increased significantly, further deteriorating the quality of the receiving bodies of water.

Soil Erosion

While the critical ecosystems identified in the Metro Manila Region and tributary watersheds are aquatic in nature, the secondary impacts of past and present forest and watershed management on the quality and capacity of surface waters and aquatic resources have to be addressed. Advanced soil erosion arising from deforestation and agricultural practices has led to heavy siltation in water courses and flooding (Section 3.2) and poses a threat to fishery and other aquatic resources (Section 4.2).

Forest resources remaining in the study area are limited almost entirely to a few tiny batches east of Laguna de Bay and the northeast corner of the Marikina Valley watershed. Elsewhere unproductive grasses have colonized the deforested areas. Reforestation in the Philippines have been difficult to implement, hampered by public apathy, the high cost of reforestation, the slow growth of trees, the lack of effective technology for the transplanting and aftercare of young trees, the lack of skilled manpower, and the difficulty of reforesting rugged terrains. Moreover, current reforestation techniques typically involve initial clearing of the land, so that in the initial years, reforestation efforts contribute to increasing erosion.

4.4 Environmental Management Issues

Environmental degradation in major urban cities such as Metro Manila can also indirectly be attributed to a poor and ineffective urban management system. The MM Region-EIS (1990) has clearly echoed the present situation as follows:

"The development of Metropolitan Manila's administration has not kept pace with the demands of urbanization. The existing environmental management system has not institutionalized itself within the broader framework covering its relationship with the overall processes involved in an integrated urban management system. The preparation of environmental policies, plans, programs and projects and their subsequent implementation and enforcement are currently being undertaken by several agencies largely independent of each other. While the EMB is considered the primary agency responsible for environmental policy, its power as well as its financial and manpower resources to implement major environmental programs is limited.

The apparent lack of coordination at the study stage has often failed to achieve the multi-agency support needed to obtain the funds required for implementation. Lack of coordination and integration is experienced throughout the entire process of environmental management. Major policy changes placing more emphasis on environmental projects will be required in order for major physical projects in environmental improvements to be funded. Many of the current pollution problems are interrelated and in order to address such problems properly in a given sector, the impact or effect of other sectoral problems needs to be considered. Without an effective and integrated environmental management system (for Metro Manila), many of the current problems will continue to exist.

A summary of the environmental issues and problems relating to industrial development, human settlement, fisheries, agricultural and forestry activities is presented in Table 5.

TABLE 5

ENVIRONMENTAL PROBLEMS AND ISSUES

ACTIVITY	PROBLEMS AND ISSUES
1. Industry - Chemical/Chemical-Related - Community & Social services - Commercial establishments	Discharge of industrial liquid /solid wastes (Conventional types)/high organic wastes Toxic and hazardous wastes/chemicals (Non-conventional types)/no secure provisions for disposal Lack of data to quantify THW except for Laguna Lake Bioaccumulation in aquatic organisms Oil refinery wastes Thermal effluents Cost of treatments
2. Human Settlement - Human - Rural	Domestic solid/Liquid wastes Sewage/Septage discharge/Human excreta/slow progress of Septic Tank Maintenance Program (MWSS)

	Sludge dumped into rivers Lack of dumpsites High cost of waste management/lack of financial resources to build infrastructure and control facilities Lack of regular maintenance/manpower Under ground water pollution in dump sites (Leachate) at Payatas/Pasig Encroachment of squatters/industries on flood plains/lakeshore areas considered part of lake bed e.g. Laguna de Bay/flooding Squatter settlements near water ways/open dump sites obstruct dredging/rubbish removal by DPWH Lack of coordinated planning among local government/national agencies in environmental protection Lack of a comprehensive environmental management program Inability to enforce regulations/standards for pollution control Lack of urban planning/updated landuse plan Existing land uses-residental/commercial/ industrial/open spaces-major contributors of solid wastes/septic tank discharges/industrial effluents.
3. Fisheries - Aquaculture (Fishpen/Fish cage culture) - Open water capture	Fish production affected by water pollution/ excessive sedimentation due to erosion in upper catchment/flooding Competing and conflicting uses of lake resources e.g. Laguna de Bay Irrigation/hydroelectric power generation/future source of domestic water supply to MMR Water hyacinth proliferation - fish production/navigation (including oil barging) affected /depletion of DO in water Problems associated with operation of the Napindan Hydraulic Control Structure - decline in fish production/water hyacinth proliferation Navigation hampered by fishpens/cages Red-Tide phenomenon Derelicts in rivers pose hazards to navigation
4. Agriculture	Soil erosion Sedimentation in water bodies Agrochemical pollution due to fertilizers and pesticides - render fish unacceptable to human con-

	sumption Agricultural wastes - increase of ogranic loading in water
5. Forestry - Deforestation in watersheds	Soil erosion / siltation from denuded forests in watersheds Sedimentation in water bodies reduced the carrying capacity of the waterways - counter productive t o DPWH efforts to annually clear storm drains/dredge rivers Flash flooding in wet seasons/little or low river flow in dry seasons

5. RIVER REHABILITATION PROGRAM

5.1 Plan of Action

The Plan of Action (Table 6) for the River Rehabilitation Program for the Manila Bay Region is essentially a synthesis of the action plans proposed by numerous previous studies on related river rehabilitation in the study area. The Plan will follow closely the approach adopted in the Integrated Environmental Improvement Action Plan (IEIAP) of the Manila Metropolitan Regional Environmental Improvements Study (1990) as the environmental issues and problems in the study area are rather similar in facts and relationship. A review of these previous and on-going river basin studies clearly shows that their proposed remedial actions for river rehabilitation are in consonance with the six major environmental issues put forward in the IEIAP for remediation. These are:

(a) Policy Reforms
(b) Environmental Management and Monitoring
(c) Solid Waste Management
(d) Flood Control and Drainage
(e) Water Quality Management
(f) Industrial Pollution Control

A list of environmentally-related projects in the Manila Bay region is shown in Table 7.

5.2 Implementation Issues

The successful implementation of the Action Plan will require an understanding of the interrelationship of the many issues involved so that effective policy mechanisms can be devised or revised to ensure its smooth implementation. Against the background of the environmental scenario that has been identified are the following implementation issues that need to be addressed and where policy direction is required.

(a) Government Support and Institutional Arrangement

In line with the conceptual framework of the Philippine Strategy for Sustainable Development (PSSD), environmental improvements would require the necessary political support

as the programs require substantial investments in financial and human resources. An integrated environmental improvement program, such as the river rehabilitation project, is multi-sectoral in nature which requires inter-agency coordination and synchronization and supported by the necessary government policies and institutional arrangements. This framework must set the overall policy direction for the initial action plan and the long term environmental programs. A forum must be provided for consultation and coordination among the various government agencies and the private sector in the pursuit of environmental objectives. There is an urgent need to strengthen the institutional framework for environmental improvement building on existing linkages among concerned agencies. In this regard, the proposal for the creation of a permanent inter-agency program coordinating committee for environmental management (MMR-EIS, 1990) is highly commendable. It is highly likely that without an effective and integrated environmental management system and the commitment that goes with it many of the current problems will continue to exist.

The ESCAP study (1990) makes the observation that while the inter-agency approach adopted in the NMTT Project is commendable, there is the parallel need for long range planning and goals setting. A master plan for the NMTT river system (or, for that matter, the whole river system in the Manila Bay Region) is proposed which sets out targets and activities to be undertaken and financial investments required over a 10-year period. The ultimate goal is to have a river system that meets Class C river quality standards. Through these further activities, the present activities will be kept alive and the targets clear. These will lead to attracting the interest of the donor community and facilitate the identification of components for possible external funding and/or technical assistance. The Plan of Action presented in the Report has the characteristics of such a master plan.

(b) Project Financing

Investment in environmental improvement is highly capital intensive. For example, the investment for the flood control and drainage project in Metro Manila is estimated at 13,523 million pesos (JICA, 1990) and US$ 710 million for the I ntegrated Environmental Improvement Action Plan for the Metro Manila Region (MMR-EIS, 1990). Probably the most important issue that needs to be resolved at the national level is the portion of the national budget that should be committed to pollution abatement. The IEIAP has proposed an annual investment of about 1.0 percent of GNP. The financing plans proposed include a combination of external financing from international development banks (grants, soft loans and commercial loans), internal cash generation and government equity. Small projects such as feasibility studies, monitoring and others are expected to be financed by technical assistance grants. The proposed industrial pollution control fund (hopefully to be funded by the World Bank to the tune of $100 million) will help finance the borrowing requirements of industries (and possibly government agencies in the case of common treatment facilities for clusters of small industries), for equipment, and other capital investments in industrial efficiency, pollution control and waste minimization.

While the river rehabilitation program should largely be a public sector activity, there is a need for Government to force and seek greater private sector involvement, particularly the bigger industries, in the nationwide river rehabilitation program. This will involve

Government planning, encouragement through financial incentives to industries which install treatment facilities, and infrastructure development such as those associated with solid waste management, water quality management, flood control and drainage. To relieve or to lessen the financial burden of the Goverment in these capital-intensive activities, particularly solid wastes, sewerage and sanitation management, there is a need for private sector involvement on a joint venture basis in these activities with the Government. The privatization concept should be seriously explored and studied so that an equitable arrangement between waste producers and handlers can be arrived at. The development of a new and more appropriate revenue collection system for handling of solid wastes and sewerage wastes is a policy decision that may lead to this equitable arrangement.

It would be beneficial to start looking into the economic aspects (benefit/cost analysis) of alternative industrial pollution control policies, including the possibility of implementing the effluent charge policy, or an adaption of it, with the view of minimizing the overall cost of pollution control. This would involve conducting a detailed study on the cost of industrial waste treatment and setting a time-phased effluent charge level which could result in the desired pollution load reduction at a minimum cost in real terms (ESCAP, 1990).

(c) Project Prioritization, Phasing and Monitoring

Due to the magnitude and diversity of the environmental projects that have been identified for implementation, a system of project prioritization and phasing will have to be established. NEDA's point scoring system involves the use of a number of evaluation criteria and assigned corresponding weights to determine project significance. Thus, all physical improvement projects under the IEIAP were subjected to this prioritization evaluation, the order of which is as presented in the Action Plan. The environmental management (non-physical) projects, which include public education/awareness, institutional development, data bank systems, and monitoring and mapping, were not subjected to this evaluation as they were deemed as prerequisites for the proper design and successful implementation of the proposed physical projects. There is also the need to continuously monitor on-going projects so that they meet the desired objectives and, if not, remedial actions will have to be instituted immediately.

(d) Technical Proficiency of the Human Resource Base

The full spectrum of managerially and technically proficient manpower to implement the river rehabilitation program needs to be addressed for that itself is the ultimate resource, beside financial that will ensure the successful implementation of the program. The need for skilled and competent manpower requires little justification; the best-laid plans come to nought unless supported by people to plan, implement, operate and maintain the environmental program and projects, both in the public and private sectors. There is a need to train the EMB staff in all facets of environmental management ranging from EIA technology, river basin management, planning techniques, monitoring, right down to acquiring the latest laboratory skills and techniques. In this regard the recent

allocation of a governmental budget under the Human Resources Development Program to benefit 50% of the DENR personnel is a step in the right direction.

The DENR should also consider obtaining external funding and/or technical assistance for human resources development. For instance a proposal by ESCAP (1990) may be submitted to USAID for the attachment of local staff to the USEPA for a few months to train on river basin planning. It is observed that local expertise in this particular field is lacking. It has also been observed that several countries in the region have urban river revival programs. To exchange experiences and information and facilitate transfer of technology and know-how, ESCAP (1990) has also proposed the organization of a week-long regional workshop on the upgrading/management/planning of urban rivers, possibly with financial/consultancy/assistance from Japan, UNDP, UNEP and/or ADB. Other bilateral and multilateral funding agencies may also be considered.

Although there is an adequate supply of university graduates that could be rapidly trained and oriented to environmentally-related programs, the level below that is inevitably lacking. A considerable shortage is identified in the intermediate level, especially pollution plant supervisors and operators. Presently, there are few public training courses for such plant operators. Although it may be considered acceptable that the private sector train their personnel themselves, Government does have a responsibility here. This responsibility can be exercised by subsidizing industrial training schools or by setting up regional training centers. It is recommended that this possibility as a cooperative effort between Government and industry be further studied.

In general, the present approach adopted in human resources development in environmental management is ad-hoc in nature and of short-term duration. The Government, through DENR, should coordinate the overall training needs in environmental management and technology development of its department personnel, including those from the relevant public agencies and the private sector. It should act to enhance and institutionalize linkages for industrial training between industry and institutions of higher learning and industrial training institutes, including the coordination and monitoring of all training assistance programs provided by external funding agencies. The long term plan should include the necessary scheduling and budgetary requirements from both Government and foreign development agencies.

(e) Geographical Dispersal of Industries

Prudent and proper location of industrial plants, particularly the highly polluting ones, away from public waterways and centers of high population density, will have to be gradually but decisively instituted. The incentive package to encourage the geographical dispersal of investments needs to be reexamined to facilitate this process.

The squatter and livelihood support program has not been able to achieve the desired objective due to a variety of problems, chief of which is funding for land acquisition and development. This is the challenge for policy makers to devise effective mechanisms to relocate and upgrade the slum settlements to minimize the negative impacts of these settlements on river systems. Landuse and urban planning is also necessary to control development of areas adjacent to rivers and water ways.

(f) Development of Environmental Protection Technology

The Philippine Strategy for Sustainable Development reiterates the vital role of industrialization to sustain future economic growth while giving due consideration to the environment within which it operates to ensure sustainability of development and natural resources. It is generally agreed that pollution of river systems in the Manila Bay Region is essentially organic in origin of which a major portion comes from the food, agro-based and livestock industries. Anaerobic digestion is a versatile biological waste treatment process for treating high-strength organic wastes and is aptly suitable for use in these industries. The country has developed considerable experience and expertise in anaerobic digestion technology as judged by the numerous published and field projects (e.g. at Maya Farms, some 25 km from Metro Manila) in this area of work by local technologists and researchers in both public and private institutions. The Government should further support this form of technology development through R & D financing or a Skills Development Fund so that local expertise in design, construction and operation of appropriate anaerobic treatment systems can be developed and enhanced to assist local industries in organic waste treatment and control. Taking this pragmatic approach, industries will be in a better position to invest in low-cost treatment technology developed locally.

(g) Local Consultants and Expertise

The country has carried out numerous major feasibility studies on river rehabilitation using foreign consultants appointed by the foreign development agencies. The input of local consultants and expertise in these studies is, however, very minimal. Foreign development agencies should include in their future programs a higher component of local consultants and experts, especially those from institutions of higher learning. This will allow the local experts to continue their involvement in the project after the foreign consultants have withdrawn. The Team members feel that local experts should be given the opportunity to undertake river rehabilitation studies using some of the techniques already used in the major river rehabilitation studies carried out by foreign consultants. There are many more smaller river systems in the country, besides those in the Manila Bay region, where detailed studies specific to the locality are still required. Moreover, local experts are more aware of the local environment and its problems and given the opportunity, with inputs from their foreign counterparts, a more appropriate approach to the basin-wide river rehabilitation program can be evolved.

6. SEMINAR-WORKSHOP ON RIVER REHABILITATION

A UNEP-EMB/DENR Seminar-Workshop on the River Rehabilitation

Program for the Manila Bay Region was held on 24-25 July 1991 in Quezon City (Program as per Annex A). The objectives of the Seminar-Workshop were:

(a) To provide a forum for a better appreciation of the need for greater inter-agency coordination and cooperation in the basin-wide river rehabilitation program in the Manila Bay region;

(b) To discuss and exchange information on the environmental situation in the region and of reaching agreement on the broad directions and contents of timely and concerted remedial and preventive intervention in the basin-wide river rehabilitation program;

(c) To provide an opportunity to understand better the role of foreign development and financing institutions involved in environmental protection programs;

(d) To put forward policy recommendations and indications of the need for assistance from foreign development and funding institutions necessary for meeting the objectives of the river rehabiliation program;

A cross-sectoral representation of concerned central, district and city government agencies, local communities, research institutions and foreign development and financing institutions were invited to participate in this Seminar-Workshop. This Study Report serves as the basis for a more detailed discussion of the problems and issues at hand and the proposed plan of action. The Seminar-Workshop provided the forum for formulation of pragmatic and realistic policy recommendations, including indications of the need for assistance from foreign development and financing institutions, in support of the basin-wide river rehabilitation program. The proceedings and outcome of the Workshop are documented as an Annex to this Main Report.

TABLE 6

PLAN OF ACTION FOR RIVER REHABILITATION PROGRAM FOR THE MANILA BAY

PROPONENT ISSUES		ACTIONS	AGENCY		PROPOSED SCHEDULE
A. Policy Reforms	1.	Creation of a permanent inter-agency coordinating committee for environmental management under the Inter-Agency Consultative Committee	DENR-EMB	MMREIS	Action
	2.	Revision of NEA policies and criteria for the evaluation of environmental projects		MMREIS	Action
	3.	Confirmation of permanent stature of MMA as a regional planning body		MMREIS	Action
	4.	Creation of a separate Solid Waste Management Authority for solid waste management under MMA	MMA	MMREIS	Action

		5. Development of a new and more appropriate revenue collection system for solid waste		MMREIS	Action
		6. Commitment from government agencies to give higher priority to environment concerns (MWSS to commit to continue to expand sewerage system in line with the expansion of the water supply system)		MMREIS	Action
		7. Preparation of an updated regional landuse policy and a corresponding zoning ordinance and landuse plan;		MMREIS	Action
		Landuse and urban planning to control development of areas adjacent to the Pasig River		PRRPFS	Action
		8. Commitment of national leader ship to an annual investment of about 1.0 percent of GNP for pollution abatement		MMREIS	Action
		9. Agreement on institutional arrangement with potential participants in rehabilitation of the Pasig River		PRRPFS	Action
B.	Environmental Management and Monitoring	1. Public education/awareness project	DENR-EMB	MMREIS PRRPFS	1990-1994 1991-1993
		2. Data base system for environmental pollution control monitoring	DENR-EMB	MMREIS	1990-1993
		3. Hazardous wastes & toxic chemicals management project	DENR-EMB	MMREIS	1990-1993
		4. Mapping environmentally critical areas	DENR-EMB	MMREIS	1990-1991
		5. Biomedical hospital waste management project	DOH	MMREIS	1990-1992
		6. Local environmental improvement impact project	NHA	MMREIS	1990-1992
		7. Urban & environmental management enhancement project	MMA	MMREIS	1990-1992
		8. Promotion of the Pasig River utilization for transport and - removal of sunken derelicts - facelifting of historical buildings - repair of embankments/bridges		PRRPFS ESCAP	1991-1993
		9. Feasibility study for selection of appropriate GIS technology	MMA/DENR/ NAMRIA	MMREIS	1991

	10.	Improvement/upgrading DENR-EMB Laboratories; Training for environmental monitoring	DENR-EMB	PRRFS	1991-1993
	11.	The NMTT Project needs to have more resources including the possibility of securing external financial & technical assistance	DENR-EMB	ESCAP	Action
	12.	Human resources development in river basin management	DENR-EMB	ESCAP	1991-1993
	13.	Proposed the holding of a week-long regional workshop on up-grading/management/planning of urban rivers.	ESCAP		1991/1992
	14.	Develop and coordinate a comprehensive and long term training program in environmental management	DENR-EMB	UNEP	1991/1992
	15.	Master plan for NMTT River rehabilitation (to be incorporated as part of the overall river rahabilitation program for Manila Bay Region)	DENR-EMB	ESCAP	1991/1992
	16.	Planning for eventual use of Laguna Lake as a supplementary source of domestic water of Metro Manila	LLDA	PCLL	Action
	17.	Strengthen LLDA's coordinating function relating to all activities in the Laguna Lake Basin including supervision and control of the Napindan Hydraulic Structure and the Manggahan Floodway	LLDA	PCLL	Action
	18.	Demolition of all illegal fishpens in Lake Laguna - maximum area of Lake area to be 10,000 ha	LLDA	PCLL	Action
	19.	Total approach and responsibility to environmental management and control residing in LLDA as mandated in EO 927; additional funding support for its functions in pollution monitoring and control; human resource development ; promotion of inter-agency cooperation	LLDA	PCLL	Action
C. Solid Waste Management	1.	Solid waste project management (Pre-Loan)	MMA/DENR-EMB	MMREIS	Action
	2.	Solid waste management project, collection, handling, transfer & disposal	MMA/LGU	MMREIS PRRPFS	1990-1994 1993-1997
	3.	Closure of open dumpsites	MMA	MMREIS	1990-1993

	4.	Squatter/scavenger resettlement & livelihood support program; Resettlement of squatters along the Pasig River The relocation and/or upgrading of slum settlements along NMTT	LGU/NHA/ DSWD	MMREIS PRRPFS	1990-1993 1991-1993
	5.	Solid waste management training program	MMA	MMREIS	1990-1991
	6.	Ground water monitoring & control around landfill sites	DENR-EMB	MMREIS	1990-1991
	7.	Pilot landfill for hazardous & toxic wastes	DENR-EMB	MMREIS	1990-1991
	8.	Solid waste collection efficiency improvement along Pasig River; Alternative solid waste treatment e.g. biogas technology		PRRFS	1991-1993 1993-1997
	9.	Immediate closure of the Valenzuela dumpsite		ESCAP	1990/1991
D. Flood Control and Drainage	1.	East-West Manggahan drainage & flood control project	DPWH	MMREIS JICA	1990-1994 1991-2000
	2.	Navotas-Malabon drainage & flood control project	DPWH	MMREIS JICA	1990-1994 1991-2000
	3.	Flood control & drainage project: San Juan; Mandaluyong-Pasig; Marikina; Valenzuela; Parañaque-Las Piñas; Navotas-Malabon	DPWH	JICA	2001-2010
	4.	Pasig-Marikina River Flood control project	DPWH/NHA	MMREIS	1990-1995
	5.	Upgrading/realignment of squatters along DPWH priority flood control projects	DPWH	MMREIS	1990-1994
	6.	Dredging of the NMTT River System to remove accumulated silt to minimize flooding and improve river flow		ESCAP	1990-1993
E. Water Quality Management	1.	Water quality monitoring project	DENR-EMB	MMREIS	1990-1994
	2.	Sludge and Dredge Spoil Disposal Feasibility Study	MWSS/DPWH	MMREIS	1991/1992
	3.	Accelerated septic tank desludging project; Septic tank maintenance project	MWSS PRRPFS	MMREIS	1990-1993 1995-2000
	4.	Second Manila sewerage and sanitation project	MWSS	MMREIS	1990-1995
	5.	Environmental management program for Laguna de Bay	LLDA	MMREIS	1990-1994

	6.	NMTT River Rehabilitation Upgrading Resettlement Program	DENR-EMB/NHA	MMREIS	1990-1994
	7.	Urban forestation project	DENR-FMB	MMREIS	1990-1992
	8.	Controlled flushing of the Pasig River		PRRPFS	1991-1993
	9.	Improvement in effluent quality through cleaner technologies or central treatment plants		PRRPFS	1993-1997
	10.	Reduction of pollution from the San Juan River by diverting flow to Manila Bay		PRRPFS	1993-1997
	11.	Watershed management of the Marikina River Basin		PRRPFS	1991-1993
F. Industrial Pollution Control	1.	Setting up a loan fund for industrial efficiency, pollution control and waste reduction improvements	DENR-NCR	MMREIS	Action
	2.	Closure of highly polluting industries around Laguna Lake	LLDA	PCLL	Action
	3.	A study to look into the economic aspects (benefit/cost analysis) of alternative industrial pollution control policies, including the possibility of implementing the effluent charge policy	DENR-EMB	ESCAP	Action
	4.	A study of financial incentives to industries which install treatment facilities	DENR-EMB	ESCAP	Action
	5.	A study on setting up common treatment facilities for small and medium industries	DENR-EMB	ESCAP	Action
	6.	R & D in anaerobic digestion technology through government-industry funding (e.g. the setting of a Skills Development Fund)	DENR-EMB	ESCAP	Action

TABLE 7

ENVIRONMENTALLY - RELATED PROJECTS
IN THE MANILA BAY REGION

	PROJECT TITLE	LOCATION	PROJECT PROPONENT
1.	Casecnan Transbasin Diversion Project (Irrigation Component)	Nueva Ecija and Tarlac	National Irrigation Administration (NIA)
2.	Angat-Magat River Irrigation System	Bulacan Pampanga Provinces	NIA
3.	Pampanga Delta Development Project (Irrigation Component) (1982)	Pampanga Province	NIA; JICA
4.	Gumain Reservoir Project	Pampanga Province	NIA
5.	Pasig River Rehabilitation Project (1990)	Pasig River	Philippine Coast Guard; DANIDA; Carl Bro International
6.	Parent Education on Manila Bay Rehabilitation and Environmental Education Program	Schools near Manila Bay Region	Department of Education, Culture and Sports
7.	Arnedo Dike	Apalit, San Simon and San Luis	DPWH-PRCS-PMO
8.	Gumain-Porac Diversion Channel	Lubao, Pampanga	PRCS-PMO-DPWH
9.	Gugu River Control	Bacolor, Pampanga	PRCS-PMO-DPWH
10.	Sapang Maragut River Control	Sta. Rita, Pampanga	PRCS-PMO-DPWH

11. Quitangil River Control	Magalang, Pampanga	PRCS-PMO-DPWH
12. Angat Water Supply Optimization Study (Stage 1, 1987)	Angat-Bulacan	NIA-NPC-MWSS - Private Companies
13. Abacan River Control	Angeles City Pampanga	PRCS-PMO
14. Baliwag River Control	Baliwag Bulacan	DPWH-PRCS-PMO
15. Engineering Island Reclamation	Laguna Lake	Private/Public Estates Authority
16. Laguna De Bay Reclamation	Laguna Lake Bacoor Bay	Private/Public Estates Authority
17. Regal Bay City Reclamation	Manila Bay/ Bacoor Bay	Private/Public Estates Authority
18. MCCRP North Sector Reclamation (Southern Parcel)	Manila Bay	Private/Public Estates Authority
19. MCCRP North Sector Reclamation (North Sector)	Manila Bay	Private/Public Estates Authority
20. Navotas Bayshore Reclamation	Navotas	Private/Public Estates Authority
21. Orient City Reclamation	Parañaque, Las Piñas and Bacoor	Private/Public Estates Authority
22. The Non-Conventional Energy Program	Cavite, Laguna Batangas, Rizal, and Quezon (CALABARZON)	Non-Conventional Resources Division (NCRD)/JICA
23. Port of Manila Pollution Control and Disaster Prevention Project	Manila	Philippine Ports Authority

24. Assessment of Manila Bay Fisheries	Manila Bay	Bureau of Fisheries and Aquatic Resources (BFAR)
25. Land Use Inventory	Nationwide	DENR-Land Service (Lands Management Bureau)
26. Malabon-Navotas-Valenzuela (MANAVA Flood Control and Water Pollution Control Project	Municipalities of Malabon, Navotas, and Valenzuela, all in Metro Manila	DPWH-NCR for Flood control and Drainage Component; DENR for Pollution Control Component
27. Study on Flood Control and Drainage Projects in Metro Manila	Metro Manila	DPWH, JICA, CTI Engineering Co., Ltd. and Nippon
28. Retrieval of Flood Prone Areas in Metro Manila	Metro Manila	DPWH-NCR
29. Nationwide Dredging Program	Laoag, Amburayan, Agno, Cagayan Pampanga, and Bicol Rivers in Luzon; Amnay-Patrick River in Mindoro; Panay and Jalaur Rivers in Panay Island; Ilog River in Negros and Tagaloan, Agusan and Mindoro (Cotabato) Rivers in Mindanao	DPWH
30. Balog-Balog Multi-Purpose Project Flood Control Component	Tarlac Province	NIA-Irrigation Component DPWH -Flood Control and Drainage Component
31. Parañaque Spillway	Rizal Province	DPWH

32. Pumping Stations and Floodgates	Metro Manila	NCR, DPWH
33. Magalang Water Supply	Magalang	MWSS , DPWH
34. Carrying Capacity of Areas Zoned for Urban Users in the Municipality of the Province of Laguna	Province of Laguna	HLURB
35. Garbage Disposal Improvement Project	Manila Bay Area Adjacent to the existing Balut Dumpsite (City of Manila)	MMA
36. Manila Metropolitan Region Environmental Improvement Study (1990)	Metro Manila	MMA; ADB; James Montgomery Consulting Engineers Inc.
37. Laguna Lake Toxic and Hazardous Waste Management Feasibility Study (1989)	Laguna Lake	LLDA; URS International Inc.
38. Comprehensive Water Quality Management Program, Laguna de Bay (1978)	Laguna Lake	LLDA; WHO; UNDP; ADB
39. Assessment of Eutrophication of the Pasig River	Pasig River	DENR-NCR
40. Study on the Concentration Levels of Nutrients in Pasig River	Pasig River	DENR-NCR
41. Study of the Biological Indicators of Eutrophication of Pasig River	Pasig River	DENR-NCR
42. Growth of Macrophytes along Pasig River	Pasig River	DENR-NCR

43. Socio Economic Implications of Water Pollution along Pasig River	Pasig River	DENR-NCR
44. Ecological Assessment and Mapping of NCR	NCR	DENR-NCR
45. Soil Erosion Potential in NCR	NCR	DENR-NCR
46. Urban Assessment of Brackish and Fresh-water Bodies in NCR	NCR	DENR-NCR
47. Assessment of Waste Reduction Technologies in the NCR	NCR	DENR-NCR
48. Characterization Survey of Industrial Firms in the NCR	NCR	DENR-NCR
49. Manila Bay Monitoring Program	Manila Bay	EMB, MWSS

ANNEX A

PROGRAMME

UNEP-EMB/DENR SEMINAR-WORKSHOP
on
RIVER REHABILITATION PROGRAM
FOR THE MANILA BAY REGION

24-25 July 1991
M.A.B. Hall, Philippine Heart Center Bldg.
East Avenue, Diliman, Quezon City

Wednesday - 24 July 1991

8:00 - 9:00 a.m.	Registration
9:00 - 9:30 a.m.	Opening Ceremonies
	National Anthem
	- **ENGR. DAVID C. VILLAROSA** Supervising Environmental Management Specialist, E.M.B.
	Introduction of Participants
	- **MS. LEZA A. ACORDA** Project Coordinator
	Welcome Address
	- **HON. FULGENCIO S. FACTORAN, JR.** **Secretary, D.E.N.R.**
9:30 - 10:00 a.m.	Opening Remarks
	Objective of Seminar-Workshop and Overview of River Rehabilitation Program for the Manila Bay Region
	- **DR. LOW KWAI SIM** U.N.E.P. Consultant
	Message
	- **DR. DELFIN J. GANAPIN, JR.** Asst. Secretary, D.E.N.R.
10:00 - 10:15 a.m.	Coffee Break

10:15 - 10:45 a.m.	Human Settlements and Environmental Issues - **MS. ASTEYA M. SANTIAGO** Dean, U.P.S.U.R.P.
10:45 - 11:15 a.m.	Discussion
11:15 - 11:45 a.m.	Industry and Environmental Issues - **ENGR. NYRH P. CABANCE** Assistant General Manager L.L.D.A.
11:45 - 12:15	Discussion
12:15 - 1:30 p.m.	Lunch
1:30 - 2:00 p.m.	Fisheries and Environmental Issues - **MRS. SIMEONA M. AYPA** Chief, Aquaculture Division B.F.A.R.
2:00 - 2:30 p.m.	Discussion
2:30 - 3:00 p.m.	Forestry and Environmental Issues - **MR. DEMETRIO BARTOLAZO** OIC, Reforestation Division F.M.B.
3:00 - 3:30 p.m.	Discussion
3:30 - 3:45 p.m.	Coffee Break
3:45 - 4:15 p.m	Agriculture and Environmental Issues - **DR. ANGEL C. ALCALA** President Silliman University
4:15 - 4:45 p.m.	Discussion
Thursday - 25 July 1991	
9:00 - 9:30 a.m.	Environmental Management and Inter-Agency Participation - **MR. SIXTO TOLENTINO, JR.** EIA Head, E.M.B.
9:30 - 10:00 a.m.	Discussion
10:00 - 10:15 a.m.	Coffee Break

10:15 - 11:30 a.m.	Workshop Session: Frame work for Inter-Agency Participation in River Rehabilitation e.g. Inter-Agency Coordinating Committee for Environmental Management - **DR. JORGE G. DE LA ALAS** Professor, U.P.C.S.
11:30 - 12:00 n.n.	The Role of U.S.A.I.D. in Environmental and Natural Resources Management - **DR. ABDUL H. WAHAB** Chief, Natural Resources Division Office of Natural Resources Agriculture and Decentralization U.S.A.I.D.
12:00 - 12:15 p.m.	Discussion
12:15- 1:30 p.m.	Lunch
1:30 - 3:30 p.m.	Prioritization of Proposed Plan of Action (Short/Medium/Long Term) - **ENGR. FRANCISCO ARELLANO** Chief, Research Department M.W.S.S.
3:30 - 4:30 p.m.	Presentation/Discussion of Project Proposals and Funding - **DR. ANGEL C. ALCALA** President Silliman University
4:30 - 5:00	Closing Ceremonies Awarding of Certificates of Attendance - **MS. LEZA A. ACORDA** Project Coordinator Closing Remarks - **MS. ELLA S. DEOCADIZ** OIC, Assistant Director Environmental Management Bureau

MS. CECILIA CONCEPCION T. MERCADO
Master of Ceremonies

ANNEX B: REFERENCES

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ANNEX C: ANNOTATED BIBLIOGRAPHY

1. A GUIDE TO PROJECT DEVELOPMENT

National Economic and Development Authority (NEDA), Manila.

1978. 263 p, 6 fig., 2 tab, 51 ref, 2 append, 5 annexes.

Key Words: Project planning, Project feasibility, Demand, Technical feasibility, Financial analysis, Benefit-cost analysis, Operation, Project studies, Financing, Engineering services, Evaluation.

Concerned with the preparation and appraisal of development projects, the volume defines and classifies such projects and recognizes the interrelationship between project development and national planning. An overall picture of the project development cycle, and an overview of project identification are presented together with the principles and procedures of project preparation. In addition, that the emerge as feasible, and steps needed to bring the project the problem of selecting from among projects from the preparatory to the implementation phase are dealt with. A discussion of post project evaluation is also included.

2. ANALYSIS AND EVALUATION OF RUNOFF COEFFICIENTS FOR SOME SMALL AGRICULTURE WATERSHEDS IN LUZON, PHILIPPINES

Smitthimdhindra, W.

A Thesis Presented to the Faculty of the Graduate School, Gregorio Araneta University Foundation, Metro Manila, September, 1979. 287 p, 37 fig, 31 tab, 118 ref, 9 append.

Key Words: Agricultural watersheds, Small Watersheds, Runoff coefficient, Peak discharge, Rainfall intensity, Hydrograph analysis, Rational formula, Analysis.

The study involves selected hydrologic methods to determine the runoff coefficients for 12 small rural gaged watersheds in Luzon. These are used in estimating peak from small ungaged drainage basins for the design of small drainage structures, highways, and other related constructions. It is an attempt towards hydrologic analysis of available data that have been gathered from hydrologic and climatological information provided by some government agencies in the Philippines. The rational method and a comparative hydrograph analysis are the techniques adopted in the evaluation, which showed similar results for the 12 selected watersheds.

3. ANNEX TO THE FIVE-YEAR PHILIPPINE DEVELOPMENT PLAN, 1978-1982: PROFILES OF SELECTED DEVELOPMENT PROJECTS

National Economic and Development Authority (NEDA), Manila.

September 1977. 281 p, 88 fig, 9 tab.

Key Words: Future planning (projected), Projects, Programs, Philippines, Agricultural development, Regional development, Social services, Transportation, Communication, Electric power industry, Water resources development.

In line with the national economic development goals of the Philippines, a list of major programs and projects to be implemented over the next five years is presented herein. This compilation contains the proposed technical and capital assistance programs for agriculture, industry, health (nutrition and population), education and manpower, social services and community development, water resources, transport, power and electrification, telecommunications, and integrated area development for which no financial commitments by foreign lending institutions have been firmed up.

4. ANNUAL REPORT: 1979

Ministry of Public Works, Manila.

1980. 34 p, figures, tables.

Key Words: Annual reports, Projects, Project summaries, Flood Control, Drainage, Water supply, Ports, Harbors, Reclamation, Infrastructure programs.

The Ministry of Public Works is composed of the Ministry proper, four staff bureaus, thirteen regional and seventy-five district offices. Eight government corporations are attached to it for policy and program coordination. Administrative supervision is also exercised over two councils. In this report, the activities, accomplishments and program thrusts of the Ministry and its four staff bureaus, attached agencies and corporations are outlined.

5. **ANNUAL REPORT: 1980**

Laguna de Bay Development Coordinating Council, Metro Manila.

1980. 43 p.

Key Words: Water supply, Irrigation, Control structures, Annual reports, Projects.

The Laguna de Bay Development Coordinating Council was established in 1975 to synchronize and monitor the various activities that would lead to orderly development of the Laguna de Bay and its watershed. The year 1980 witnessed the start of construction of the Napindan Hydraulic Control Structure, the continuing implementation of the Laguna de Bay Development Irrigation Components A and B, and the detailed pre-construction engineering of the Lakeshore Interceptor Project. Details of these projects are discussed in the report.

6. ANNUAL REPORT: 1980

National Water Resources Council, Quezon City.

January 1981. 19 p, 18 fig.

Key Words: Annual reports, Water allocation (policy), Water permits, Data collection systems, Projects, Foreign assisted projects, Training, Personnel, Finance, Programs.

By virtue of Presidential Decree No. 424, the National Water Resources Council was created on March 28, 1974. The body undertakes the task of promoting scientific and orderly development of all water resources, consistent with the principles of optimum utilization, conservation and protection to meet present and future needs. The year under review lists the council's accomplishments in the registration of water users, the adjudication of several cases on water use conflicts, research studies, establishment of basin data and a comprehensive review of water resources projects.

7. ANNUAL REPORT : 1980

National Irrigation Administration, Quezon City.

44 p, 38 fig, 6 tab.

Key Words: Annual reports, Progress reports, Operation and maintenance, Project, Irrigation, Research and development, Infrastructure programs, Water management (applied, Feasibility studies, Budget, Foreign projects.

Contained herein are the highlights of the accomplishments of the National Irrigation Administration for the year 1980, namely: (1) the operation and maintenance of 144 national irrigation systems with a total crop area of 656,436 hectares planted with rice yielding approximately 57.75 million cavans of palay; (2) completion of 201 communal irrigation projects: (3) sanctioning of the 27 ongoing foreign-assisted projects and 28 locally funded projects; (4) partial completion of the Magat River Multipurpose project accomplishing 52.33% of the Irrigation Aspect (Stages I & III) and 52.70% of the Dam Aspect; and (5) the initiation of new projects one of which is the Watershed Management and Erosion Control Project covering about 25,000 hectares in Pantabangan and 7,500 hectares in Magat.

8. ANNUAL REPORT : 1981

Laguna Lake Development Authority, Pasig, Metro Manila.

1982. 16 p, figures, tables.

Key Words: Annual reports, Projects, Project summaries, Financial statements, Organization charts.

The management of the lake fishery was in the forefront for the year under review. The lake area covered by fisheries increased dramatically due to reconstruction and expansion of old pens and the construction of new ones. Likewise, the thrust to assist small fishermen through its Fishpen Development Project made progress with the distribution of three hundred sixty certificates to pre-qualified fishermen sub-borrowers.

The past year also witnessed the Authority's continued effort in its development activities and programs. The report also includes the corporation's financial status.

9. **ANNUAL REPORT: 1981**

Local Water Utilities Administration (LWUA), Quezon City.

Key Words: Annual reports, Project summaries, Financial statements, Organization charts.

Since its establishment in 1973 by virtue of Presidential Decree 198, LWUA has formed, organized and developed two hundred twelve water districts all over the Philippines covering more than twelve million potential water users. Details of its achievements in its manifold activities are summarized. However, the Administration's pitfalls are also reported. The reasons for such shortcomings are briefly stated. Finally, a brief financial statement is presented.

10. **ANNUAL REPORT: 1981**

National Water Resources Council (NMRC), Quezon City.

January 1982, 35 p, 30 fig, 1 tab, 1 append.

Key Words: Annual reports, Projects, Project summaries, Water resources management, Water utilization, Manpower, Financial statements.

The accomplishment of the Council for the year 1981 are reported herein. Activities pertaining to major functional areas of water use regulation, water resources data system, project evaluation, integration and coordination, and training and manpower development are highlighted. Budget and income statement for calendar year 1981 are included. Program thrusts for the incoming year are briefly enumerated.

11. **ANNUAL REPORT: 1982**

National Pollution Control Commission (NPCC), Manila.

1983, 31 p, 1 fig, 14 tab.

Key Words: Annual reports, Pollution control, Environmental quality, Environmental monitoring, Research and development, Manpower development, Financial statements, Organizational structure.

Since the creation of the NPCC on 18 June 1964, the Commission has been continuously implementing programs and projects geared towards the fulfillment of its task of preventing, abating and controlling environmental pollution for the more effective utilization of the country's natural resources. This report summarizes the major achievements and activities of the NPCC for the year 1982.

12. **ANNUAL REPORT: 1982**

Ministry of Public Works and Highways, Project Management. Office for Rural Water Supply, Port Area, Manila.

January 1984. 30 p, figure, 10 tab.

Key Words: Annual reports, Rural water supply programs, Organizational structure, Water supply personnel, Training programs, Financial statements.

By virtue of Ministry Order No. 14, the Project Management Office for Rural Water Supply (PMO-RWS) was created on 3 December 1981 to ensure the effective management of the foreign assisted rural water projects assigned to the Ministry of Public Works and Highways (MPWH). The present report embraces the activities and projects of the PMO-RWS accomplished during its second year of operation. An overview of the agency's plans for the succeding years in accordance with its objectives is also discussed at length.

13. **CLIMATONOMY OF THE MABACAN RIVER WATERSHED: I. EVAPOTRANSPIRATION**

Master of Science Thesis, University of the Philippines, Quezon City, October 1973. 65 p, 12 fig, 5 tab, 18 ref, 3 append.

Key Words: Evapotranspiration, Mabacan River Watershed (Laguna), Runoff, Hydrometeorology, Soil moisture assessment, Model studies, Water balance, River basins.

Flaws of simulation techniques in evaluating the runoff rates from a watershed are solved by the evapotranspiration climatonomy adopted in the present study which includes the effects of the immediate and delayed processes representing a significant part of the total runoff. The evapotranspiration climatonomy model developed by H. Lettau was used and applied to the 46-square kilometer Mabacan River Watershed at Calauan, Laguna. The study concerned the development of appropriate methods to refine and evaluate the parameterization procedures. Mass (precipitation) and solar enery are required as input to estimate runoff, evapotranspiration and soil moisture storage. Results show that climatonomy is a useful indication of climatic trends for average years. However, for short-period processes, the model still needs further modification refinement.

14. **COMPREHENSIVE WATER QUALITY MANAGEMENT PROGRAM: LAGUNA DE BAY**

World Health Organization, Geneva. United Nations Development Programme. Asian Development Bank, Manila. Laguna Lake Development Authority, Pasig.

Vol. I - Summary Report, May 1978. 214 p, 60 fig, 8 tab, 70 ref.

Key Words: Laguna Lake, Water quality, Management, Project summaries, Recommendations, Project studies, Project planning, Environmental policy, River basin development, Limnology, Water utilization, Meteorology, Hydrology, Ecology, Mathematical models.

Volume I of the three-volume report on Laguna de Bay presents the summary, conclusions, recommendations, and pertinent background information on the water quality management and development program for the largest freshwater lake in Southeast Asia. The main objective of the program is to conserve the water quality of Laguna Lake, and to insure the protection of intended beneficial uses of the lake water resources. Two key project elements are the water quality monitoring and limnological investigation of the lake. In this volume a summarized version of the detailed report on lake limnology and beneficial water uses is presented. The summary discusses the study areas meteriology, hydrology, water quality, and ecological modelling.

15. COMPREHENSIVE WATER QUALITY MANAGEMENT PROGRAM: LAGUNA DE BAY

World Health Organization, Geneva. United Nations Development Programme. Asian Development Bank, Manila. Laguna Lake Development Authority, Pasig.

Vol. II - Summary Report, May 1978. 184 p 29, fig, 48 tab, 36 ref.

Key Words: Laguna Lake, Water quality, Management, Water pollution, Domestic wastes, Industrial wastes, Farm wastes, Solid wastes, Pollution abatement, Water control, Waste disposal.

An assessment of the pollution loading of Laguna de Bay is presented in this volume together with the proposed measures to abate the pollution problems is the lake. A study of the community, industrial, agricultural and solid wastes in the lake shows that eutrophication appears to be one of the most significant considerations in water quality management of Laguna de Bay with nitrogen to be more likely the limiting factor in comparison with phosphorus and other nutrients. Other significant pollutants inflows that affect the water quality standards of the lake are (1) organic pollutants; (2) industrial discharges of toxic chemicals, oils, and heavy metals; (3) pesticides from agricultural runoff; and (4) pathogenic bacteria and infectious viruses from human excrement.

16. COMPREHENSIVE WATER QUALITY MANAGEMENT PROGRAM: LAGUNA DE BAY

World Health Organization, Geneva. United Nations Development Programme. Asian Development Bank, Manila. Laguna Lake Development Authority, Pasig.

Vol. III - Summary Report, May 1978. 223 p, 24 fig, 29 tab, 48 ref, 1 append.

Key Words: Laguna Lake, Water quality, Management, Return flow, Water quality standards, Oil wastes, Water supply, Water hyacinth, Land use, Waste stabilization ponds, Fisheries, Fish management, Financing, Administration, Benefit-cost and analysis, Environmental aspects, Environmental impact, Social aspects.

A continuation of the two preceeding volumes, this volume presents a report of the special and related studies undertaken to provide essential technical supporting information for

the formulation of the water quality management program for Laguna de Bay. These studies are on irrigation return flows, water quality standards, lake oil pollution, public water supply flows, water hyacinths, land use, high rate algal growth ponds, and fishery development. In addition, an environmental assessment of the study area, and a study of the institutional and financial aspects of the program are presented.

17. **COMPREHENSIVE WATER QUALITY MANAGEMENT PROGRAM: LAGUNA DE BAY**

World Health Organization, Geneva. United Nations Development Programme. Asian Development Bank, Manila. Laguna Lake Development Authority, Pasig.

Volume IV: Annex I, Limnology of Laguna de Bay, May 1978. 130 p, 26 tab, 34 ref.

Key Words: Water quality, Water quality control, Hyrology, Limnology, Water chemistry, Water utilization.

A limnological research of Laguna de Bay and its tributary rivers was undertaken as part of the water quality management program. Regular sampling was undertaken in 9 stations in the lake, 9 stations in the tributary rivers and 3 stations in the Pasig- Marikina rivers. Thirty additional stations were established to collect background water quality data. Major findings are herein contained.

18. COMPREHENSIVE WATER QUALITY MANAGEMENT PROGRAM: LAGUNA DE BAY

World Health Organization, Geneva. United Nations Development Programme. Asian Development Bank, Manila. Laguna Lake Development Authority, Pasig.

Volume V: Annex I, Limnology of Laguna de Bay, May 1978. 181 p, 181 fig.

Key Words: Water quality, Water quality control, Hydrology, Limnology, Water chemistry, Graphical analysis, Charts.

The main objectives of the present study are: (1) to establish a long term baseline for the lake ecology; (2) to predict the lake water quality after the construction of the hydraulic control structure (HCS); and (3) to assess the present and future impact of pollution particularly the impact of eutrophication and toxic substance. This volume constitutes the following: location maps of monthly misohyets; rainfall distribution and frequency, lake hydrographs; and monthly average concentration of various substances.

19. COMPREHENSIVE WATER QUALITY MANAGEMENT PROGRAM: LAGUNA DE BAY

World Health Organization, Geneva. United Nations Development Programme. Asian Development Bank, Manila. Laguna Lake Development Authority, Pasig.

Volume VI: Annex I, Limnology of Laguna de Bay, May 1978. 365 p, figures, tables.

Key Words: Water quality, Water resources management, Limnology, Chemical properties, Tables (data), Field data, Water analysis, Water quality control.

The scope of this report covers the water quality data of the tributary rivers and that of the Pasig river plus the first part of the water quality data of Laguna de Bay. Sampling frequency for the nine tributary rivers varies from once a month to 5 times a month from 1973 to 1977. The mineral content of the streams is generally low, the hardness from soft to medium hard. Turbidity is quite high, particularly those that drain the Taal mountain slopes. Almost all parameters in the down stream sampling stations are significantly higher than those in the upstream stations.

20. COMPREHENSIVE WATER QUALITY MANAGEMENT PROGRAM: LAGUNA DE BAY

World Health Organization, Geneva. United Nations Development Programme. Asian Development Bank, Manila. Laguna Lake Development Authority, Pasig.

Volume VII: Annex I, Limnology of Laguna de Bay, May 1978. 359 p, figures, tables.

Key Words: Water quality, Water resources management, Limnology, Chemical properties, Tables (data), Field data, Water analysis, Water quality control.

In this part of the report turbidity shows a seasonal trend: higher by more than 200 mg Si_2 /l during the cold months (December to March) and less than 30 during summer. The concentration of total solids in the lake is strongly influenced by the salt water intrusion. A maximum of 2000 mg/l was recorded in 1973. The mean concentrations of total solids were 334 and 251 mg/l respectively for 1976. The average dissolved oxygen (DO) concentration for the entire lake (measurements in the open lake only) varies from 5 to 11 mg/l, or in terms of DO saturation, from 60 to 160 percent and is around 100 percent during the cool months.

21. COMPUTER MODELING OF OXYGEN IN MARIKINA RIVER

Espiritu, A. B.

University of the Philippines, College of Engineering, Quezon City.

MS Thesis, 1983. 228 p, 16 fig, 24 tab, 19 ref, 12 append.

Key Words: Marikina river, Math models, Dissolved oxygen.

A mathematical characterization of the physical and biochemical processes responsible for the existing water quality profile of the Marikina river was developed by utilizing a modified concept of the Streeter-Philps oxygen-sag equation model. The model predicts the annual mean dissolved oxygen and biochemical oxygen

demand profiles of the river. Other processes such as sedimentation, adsorption, suspension, respiration, and photosynthesis were incorporated into the model. Also, the sensitivity of the model to varying values of system parameters was tested.

22. DEPARTMENT OF PUBLIC WORKS, TRANSPORTATION, AND COMMUNICATIONS: ACCOMPLISHMENTS 1969-1977, LONG TERM AND TEN YEAR PLANS 1978-2000

Department of Public Works, Transportation and Communications (DPWTC), Quezon City.

September 1977. 347 p, figures, tables.

Key Words: Public works, Transportation, Communications, Water resources, Power, Constructions, Progress reports, Project summaries, Documentation.

This report presents the achievements and the current as well as future plans and projects of the DPWTC. It is divided into different bureaus, agencies, and attached corporations in high use, the transportation, water resources, power, communications, and social infrastructure fields. Each division contains background information, highlights of accomplishments before and during martial law period, program thrust for 1977, the ten year plan for CY 1978 -1987, and the perspective plan for CY 1978-2000.

23. DIRECTORY OF INSTITUTIONS AND INDIVIDUALS ACTIVE IN ENVIRONMENTALLY-SOUND AND APPROPRIATE TECHNOLOGIES

United Nations Environment Programme

Volume I: UNEP Reference Series, Pergamon Press, Oxford, 1979. 152 p, 2 append.

Key Words: Directories, Technology, Technologists, Institutions, Appropriate technology.

This directory consists of a listing of some 2000 institutions world-wide which are able to supply information to inquiries, on required and under mutually agreed terms on aspects of environmentally sound technology. The listing is international and representative.

24. EFFECTIVE RAINFALL CALCULATION FOR LOWLAND RICE IN THE PHILIPPINES

Aberin, E.A.

Thesis submitted to the Faculty of the Graduate School, University of the Philippines, Los Baños, September 1974. 75 p, 12 fig, 13 tab, 21 ref, 2 append.

Key Words: Effective precipitation, Consumptive use (water), Rice, Crop response, Water requirements, Rainfall, Irrigation efficiency.

The results of an investigation conducted to determine the optimal transplanting dates and effective rainfall utilization by lowland rice in some selected locations in the Philippines are presented herein. Six representative areas namely, Tuguegarao, Cabanatuan City, UPLBCA, Legaspi City, Iloilo City and Midsayap, Cotabato which have complete and accurate climatological and rainfall data for a period of twenty years or more were used. Computer analyses were used to interpret data and conclusions were drawn to integrate effective utilization with the rational approaches of solving the water-for-irrigation inadequacy problem.

25. FEASIBILITY STUDY REPORT ON ALCOGAS PROJECT IN MARAGONDON, CAVITE: THE REPUBLIC OF THE PHILIPPINES

Japan International Cooperation Agency (JICA), Tokyo.

Volume III: Appendices, May 1982. 225 p, 22 fig, 105 tab, 7 append.

Key Words: Crops, Topography, Soils, Hydrology, Agriculture, Infrastructure programs, Farms, Project evaluation.

Various technical information towards the implementation of the alcogas program are appended. Specifically discussed are the agricultural tests conducted to determine the most suitable raw material crop for the project and a physical description of the project area, including its topographical, hydrological, and geological structures. The details of the agricultural development plan are presented as well as the road network, and farming facilities that will be used for alcohol distillation. The establishment plan for both the distillation plant and the sugarcane plantation, the role of a pilot research farm, and the financial, economic, and socio-economic effects of the entire fuel production venture are also covered.

26. FEASIBILITY REPORT ON THE PAMPANGA DELTA DEVELOPMENT PROJECT

Ministry of Public Works and Highways, Port Area, Manila. National Irrigation Administration, Quezon City, Japan International Cooperation Agency, Tokyo.

Main Text, February 1982. 128 p, 29 fig, 27 tab.

Key Words: Feasibility studies, Pampanga River Basin (Central Luzon), River basin development, Flood control, Irrigation, Water resources development.

The flood control of the Pampanga river and the provision of adequate irrigation for the surrounding delta are studied. The selected flood control plan aims to protect the land of the South Candaba Swamp and the downstream region below Sulipan, Calumpit against flooding from the Pampanga and Angat Rivers by constructing levee along the rivers. The improvement needed consists mainly of the embankment of levee, widening and excavating the river channel in the stretch of 40 km between Candaba and Manila

Bay. The irrigation project on the other hand is expected to produce incremental rice production of about 47,000 tons.

27. FIVE-YEAR PHILIPPINE DEVELOPMENT PLAN, 1978-1982

National Economic and Development Authority (NEDA), Manila.

September 1977. 443 p, 46 fig, 121 tab.

Key Words: Future planning (projected), National economic development, Economic growth, Regional development, Social aspects, Social services, Infrastructure programs, Financing, Administration, Programs, Projects, Philippines.

The Philippine development plan sets forth the development goals and directions for the next five to ten years. Economic and social development is the main thrust and in this regard, the role of the economic sectors and the requisites to attain a high level of social progress and quality of life are identified. Strategies to achieve these are specified for health and nutrition, education and manpower, housing, social services and community development. Requisite infrastructures needed to support development activities are mentioned; plans for improving the capacity of the economy to generate resources for development activities are discussed; and administrative options for successful plan implementation are examined. A profile of selected development projects are presented in an accompanying volume.

28. GROUNDWATER OF THE PHILIPPINES

National Water Resources Council, QuezonCity.

Report No. 34-1, June 1980. 44 p, 13 fig, 5 tab, 4 ref, 2 append.

Key Words: Groundwater, Philippines, Groundwater investigations, Groundwater sources, Groundwater potential, Groundwater management, Administrative agencies.

The present report is an initial assessment of the country's hydrologic conditions, underground water availability and related parameters based on analysis of limited data from different water related agencies for the purpose of guiding macro-planning endeavors. Observations indicate that the main trend of groundwater use is towards the domestic and industrial sectors while surface water are gearing towards agricultural and other similar uses. The four major basins in the country necessitate the undertaking of groundwater exploration activities in order to aquifer areas, there is the need to define aquifer boundaries, salt fresh water lens, and the like in order to have appropriate well design and construction.

29. HYDROLOGICAL DATA BOOK ON THE PAMPANGA RIVER BASIN, PHILIPPINES: MAJOR FLOODS DURING THE 1960-1974

Japan International Cooperation Agency

October 1977. 289 p, figures, tables, 7 ref, 1 append.

Key Words: Hydrologic data, Pampanga River Basin (Central Luzon), Floods, Tables (data).

This data book is a collection and compilation of hydrological data of six past major floods that occurred in the Pampanga River Basin. Divided in two parts, the main body contains the characteristics of each major flood and other shows the comparison of characteristics of each major flood with the help of figures and tables. For comparison, each major flood is described based on the following factors, namely: weather record, typhoon track, rainfall, gage height, discharge, peak time, flood damage, and flood forecasting. In addition, descriptions of basin characteristics, rainfall stations and lag time of the floods are given.

30. HYDROLOGICAL INVESTIGATION AND OPERATIVE ASPECTS OF THE PAMPANGA RIVER SYSTEM

Department of Public Works, Transportation and Communications, Planning Project Development Office, Manila. Tahal Consulting Engineers, Ltd., Israel.

January 1977. 268 p, figures, tables, appendices.

Key Words: Pampanga River Basin (Central Luzon), Candaba swamps (Pampanga), Hydrologic models, Hydrologic study, Hydrologic data, Hydrometeorological station, Gaging stations, Hydrometry, Discharge (water), Flow measurement.

Partial results of the ongoing hydrological studies being conducted on the Pampanga River Basins are presented herein. The following aspects have been considered in this particular report: (1) a master directory of the rainfall gaging stations; (2) sample results of estimated evaporation losses; (3) available daily discharge, gage height and instantaneous flow measurements; (4) historical (5-20 yrs) and probabilistic (20-30 yrs) series on rainfall for selected stations; (5) hydrometric data and analysis (6) hydrometeorological results and analysis; (7) agrometeorological and reservoir operation simulation model.

31. IMMEDIATE IMPROVEMENT PROGRAM: CALAMBA WATER DISTRICT

Camp Dresser and McKee International, Inc., Boston, Massachussetts. Local Water Utilities Administration, Quezon City.

Interim Report, 1977. 37 p, 7 fig, 17 tab.

Key Words: Water supply, Water supply systems, Water districts, Calamba (Laguna), Feasibility studies, Waterwork, Planning, Water resources development, Water demand, Financial feasibility.

The objective of the immediate program of the Calamba Water District is to increase source, transmission and distribution system capability to provide service to its growing population within the 2-year period of the program. This will be done primarily by the construction of a new pumping station replacing the existing one at Bukal Spring, and

the installation of 8.71 km of 100, 150 and 20-mm pipelines. The main report gives a detailed description of the program, while the addendum to the interim report provides the economic justification of the project.

32. IRRIGATION DEVELOPMENT PLAN FOR CENTRAL LUZON

National Irrigation Administration, Quezon City. Engineering Consultants, Inc., Denver.

July 1979. 151 p, 11 fig, 25 tab.

Key Words: Irrigation programs, Central Luzon, Project planning, Regional development, Land use, Water resources, Economic aspects, Project purposes, Multiple purpose projects, Economic analysis, Financial analysis.

The Central Luzon Irrigation Development Plan is the result of the appraisal irrigation potentials in Central Luzon involving alternative combination of storage, gravity, pump and groundwater irrigation. It is also an effort to optimize and rationalize the development and utilization of water and related land resources in the region. Although conceived basically as an irrigation and agricultural study, other potential uses of water and possible multiple project functions are also investigated. The plan of development envisions the implementation of 34 projects whereby water supplies would be obtained through the regulation of surface water, utilization of ground water and diversion of direct streamflow and irrigation return flow.

33. IRRIGATION INVENTORY: 1977

National Water Resources Council (NWRC), Quezon City.

Report No. 17-B, July 1980. 53 fig, 57 tab, 1 append.

Key Words: Irrigation programs, Water management (applied), Irrigation practices, Water resources management, Planning, Documentation.

Cognizant of the difficulty usually encountered by most planners in the collection of comprehensive data on irrigation and other sectoral data for purposes of planning, research feasibility studies, the Council has initiated this inventory. Included are existing and proposed irrigation projects classified as national, communal and private irrigation projects. These programs are listed, analyzed, compiled, and summarized in graphs and tables by provinces and regions, and their locations delineated in 1:50,000 scale maps. The purposes of the report is to provide a readily available benchmark information on the country's irrigation sector for planning, development and management of the nation's water resources.

34. LAGUNA DE BAY DEVELOPMENT COORDINATING COUNCIL: ANNUAL REPORT

Laguna de Bay Development Coordinating Council, Manila.

1981. 52 p, figures, tables.

Key Words: Annual reports, Project summaries, Projects, Financial statements.

The Council which was conceived in 1975 coordinates the implementation of various projects within the Laguna Lake region. This report consolidated the on-going projects being undertaken by its implementing agencies, namely: (a) the Napindan Hydraulic Control Structure (Ministry of Public Works and Highways); (b) Laguna de Bay Development Project (National Irrigation Administrtion); and (c) the Lakeshore Interceptor Project (Laguna Lake Development Authority).

35. LAND USE PLAN: LAGUNA DE BAY WATERSHED-NORTHWEST AND SOUTHWEST AREAS)

Laguna Lake Development Authority, Pasig, Metro Manila. Human Settlements Commission, Makati, Metro Manila.

Volume I: Summary, June 1978. 161 p, 25 fig, 10 tab.

Key Words: Laguna Lake, Planning, Land use, Watersheds (basins), Water resources development, Land development, Area redevelopment, Urbanization.

The present land use study, which is concerned with the dominantly rural eastern and southern portion of the basin completes the conceptual land use for the entire basin. A regional scheme for land development supported with maps and diagrams has been prepared to serve as a rational basis for land management and the preparation of detailed community plans. This study is part of the sustained efforts of the Laguna Lake Development Authority in establishing a pragmatic and viable management program for the preservation, conservation and development of the lake water and related land resources.

36. LAND USE PLAN: LAGUNA DE BAY WATERSHED-NORTHWEST AND SOUTHEAST AREAS

Laguna Lake Development Authority (LLDA), Pasig, Metro Manila. Human Settlements Commission, Makati, Metro Manila.

Volume II: Socio-Economic Study and Administrative Study, June 1978. 198 p, 2 fig, 57 tab, 41 append.

Key Words: Laguna Lake, Planning, Land use, Watersheds (basins), Economic study, Social aspects, Administrative, Demography, Agriculture, Crop production, Fishing, Livestock, Poultry, Industries, Local governments, Government agencies, Area redevelopment.

This volume presents two main sectoral studies. The first focuses on the economic and social activities of the people in the project area while the second deals mainly on the nature and extent of their planning and development activities. The first sectoral study aims at providing information on economic parameters and a general overview of the economic base

of the project area. It reports on the economic status and the development potentials of the project area with topics covering population, agriculture and industry. The second assesses the existing relationships and the prospect of future coordination between the LLDA and local governments.

37. LAND USE PLAN: LAGUNA DE BAY WATERSHED-NORTHEAST AND SOUTHEAST AREAS

Laguna Lake Development Authority, Pasig, Metro Manila. Human Settlements Commission, Makati, Metro Manila.

Volume III: Physical Study, June 1978. 238 p, 51 tab.

Key Words: Laguna Lake, Planning, Land use, Watersheds (basins), Land forms, Land resources, Soil classifications, Land classifications, Land development, Infrastructure programs, Transportation, Power supplies, Water resources, Communication, Irrigation, Flood control, Projects.

A brief description of the physical conditions of the project area based on two areas of study is presented. The physical sector study inquires into the natural features and other physical attributes of the study area which have influenced the past and are likely to influence future land developments. The infrastructure study, on the other hand, focuses on availability or ease of extending infrastructure facilities to support land development. In addition, soil characteristics, land capabilities and soil suitabilities for various land uses are given concern since such provide the threshold information in the land use planning approach.

38. LAND USE PLAN: LAGUNA DE BAY WATERSHED-NORTHWEST AND SOUTHWEST AREAS

Laguna Lake Development Authority, Pasig, Metro Manila. Human Settlements Commission, Makati, Metro Manila. Development Academy of the Philippines.

Volume I: Summary, April 1977. 162 p, 22 fig, 6 tab, 39 ref.

Key Words: Laguna Lake, Planning, Land use, Watershed (basins), Land Development, Infrastructure programs, Area development, Urbanization.

A general land use plan indicating general locations and categories of land uses such as settlement areas, agricultural, forest, grassland, institutional and conservation areas is formulated. The plan includes projections and recommendations on: (1) general locations for urban expansions for the years 1980, 1990 and 2000; (2) areas which would generally need infrastructure support facilities for development; and (3) areas and issues for land use policy considerations, and corresponding methods for land use implementation. In addition, the present study covers only the fast urbanizing northwest and southwest area of the lake watershed.

39. LAND USE PLAN: LAGUNA DE BAY WATERSHED-NORTHWEST AND SOUTHWEST AREAS

Laguna Lake Development Authority, Pasig, Metro Manila, Human Settlements Commission, Makati, Metro Manila. Development Academy of the Philippines.

Volume II: Socio-Economic Study, April 1977. 60 p, 3 fig, 33 tab, 20 append.

Key Words: Laguna Lake, Planning, Land use, Watersheds (basins), Economic study, Social aspects, Agriculture, Cultivated lands, Crop production, Industrial production, Demography.

The study aims to provide an anlytical evaluation of the role of agriculture in the economic development of the Laguna Lake Region. It evaluates the present position of the agricultural sector in the overall economic activity in the region. Such evaluation provides the necessary inventory of the region's natural endowments and an estimate of its productive capacity. In addition, the existing Industrial base of each municipality was studies to serve as a basis for determining the degree of industrial development in the municipality. Part of the study also presents a demographic analysis of each municipality and correlates such trends to the economic development of the region.

40. LAND USE PLAN: LAGUNA DE BAY WATERSHED-NORTHWEST AND SOUTHWEST AREAS

Laguna Lake Development Authority, Pasig, Metro Manila, Human Settlements Commission, Makati, Metro Manila. Development Academy of the Philippines.

Volume III: Physical Study, April 1977. 82 p, 32 tab.

Key Words: Laguna Lake, Planning, Land use, Watersheds (basins), Land forms, Land resources, Water resources, Land classification, Soil classifications, Infrastructure programs, Transportation, Communication, Water supply, Projects.

Physical study is a determinate factor in the formulation of a land use plan. It analyzes suitability and capability as well as constraints in the development of specific areas to provide a basis for, and rationalize the identification of functional areas like industrial and agricultural. The specific objectives of the present project study include: (1) physical studies such as land suitability and land capability, urban area, industrial location and others as may be needed; (2) reduction into spatial dimension of the land requirements of the different functional uses; (3) formulation of guidelines for the land use allocation in the local level.

41. LAND USE PLAN: LAGUNA DE BAY WATERSHED - NORTHWEST AND SOUTHWEST AREAS

Laguna Lake Development Authority, Pasig, Metro Manila. Human Settlements Commission, Makati, Metro Manila. Development Academy of the Philippines.

Volume IV: Administrative Study, April 1977. 56 p, 2 tab.

Key Words: Laguna Lake, Planning, Land use, Watersheds (basins), Administration, Administrative agencies, Policies, Water resources development, Land development.

During the course of the study, government agencies and local governments who were consulted emphasized the pragmatic and pressing necessity of a regional scheme to guide their development efforts. The land use approach viewed from the broader perspective of regional development is considered for the protection, and economic and rational use of the lake area and related land resources. In the application and implementation of a land use plan, would be problems and venues for implementation, which are intiating factors and main concern for this study, are identified. The purpose of this volume is to indicate the method of implementation recommended, including general recommendations regarding the formulated land use development policies.

42. LLDA ANNUAL REPORT

1980. 20 p.

Key Words: Annual reports, Projects, Foreign aid, Research and development, Reviews.

Established on July 18, 1966 by virtue of RA 4850, the Laguna Lake Development Authority was created to promote and accelerate the development and balanced growth of the Laguna Lake region within the context of the regional and national policies and programs for social and economic development. With this objective the LLDA has undertaken projects focusing on water quality management, water supply, agriculture, transport, tourism and flood control, all of which are briefly discussed in this report. Future prospects of the LLDA are also described.

43. LLDA: ANNUAL REPORT

1982. 20 p, figures, tables.

Key Words: Annual reports, Projects, Project summaries, Financial statements, Organizational charts.

The major projects and accomplishments in the areas of fisheries, water-quality management, fruit tree farm, farm service, bamboo tree farm, demonstration fishpen and watershed management are briefly reported, together with the activities undertaken by its administrative, engineering and construction and legal divisions. Included is the agency's financial status.

44. LWUA: 1980 ANNUAL REPORT

Local Water Utilities Administration, Quezon City

36 p, 24 fig, 8 tab.

Key Words: Annual reports, Operations, Finance, Organization charts, Projects.

The Local Water Utilities Administration is the national agency which is chartered by PD 198 enacted in 1973 to attend to the needs of established water districts. This report outlines the agency's multifarious activities in the local rehabilitation and expansion of provincial domestic water supply systems.

45. MANILA: TOWARD THE CITY OF MAN

National Media Production Center, Manila.

63 p, 25 fig, 1 tab.

Key Words: City planning, Area redevelopment, Social aspects, Metro Manila.

This basic framework for the growth of Metropolitan Manila consists of four parts: (1) the vision for Metropolitan Manila; (2) the planning perspective, including the critical issues on population economy, land use and environmental quality; (3) the development framework; and (4) the implementting strategy. It is concerned mainly with the relative location of activities, the spatial arrangement of functional areas, and the desired pattern of metropolitan growth. Moreover, it establishes the physical framework for the preparation of more detailed local plans, and provides the guidelines for continuing studies on key areas and development programs.

46. MANILA WATER SUPPLY PROJECT

Metropolitan Waterworks and Sewerage System (MWSS), Manila. Camp Dresser and Mckeee International, Inc., Boston, Massachussets.

Vol.-I - Text, Supply Report, May 1976. 196 p, 59 fig, 30 tab, 18 ref, 1 append.

Key Words: Water supply systems, Project summaries, Hydrology, Systems analysis, Reservoir operation, Project feasibility.

A study is made of the proposed improvements to the MWSS supply, treatment, and distribution systems that would sufficiently meet expected water demands of the area through 1982. The supply system covers all storage, regulation and conveyance facilities supplying raw water to treatment plants, and several alternative treated-water aqueducts terminating at the proposed Bagbag distribution storage reservoir. The site for a new treatment plant, together with the aqueducts upstream and downstream, was selected. A review of previous reports, recommendations, analysis of previously proposed facilities and selection of design capacities and characteristics of proposed facilities to be constructed is also included.

47. MANILA WATER SUPPLY PROJECT

Metropolitan Waterworks and Sewerage Sytem, Manila. Camp Dresser and Mckee International, Inc., Boston, Massachussetts.

Supplement to Supply Report, May 1876, 299 p, tables.

Key Words: Hydrologic data, Records, Evaporation, Rainfall, Streamflow records, Computer programs.

Hydrologic data are contained here in reference to 'Hydrology' Chapter 3 of the Manila Water Supply Report. Included are : (1) monthly historical records of rainfall, evaporation and streamflow at various locations in the provinces of Batangas, Bulacan, Cavite, Laguna, Quezon, Rizal, Pampanga, Nueva Ecija, and Pangasinan, as well as the cities of Manila and Quezon City; (2) listings of seven computer programs used in the hydrologic analysis (augmentation on extension of short-term records, generation of synthetic hydrologic data, development of yield-volume curves, etc.); (3) one-hundred-year augmented records of rainfall and streamflow at locations of interest for water supply planning for the Manila Metropolitan area.

48. METRO MANILA: ACCOMPLISHMENT REPORT, 1978-83/84

Office of the Prime Minister, May 1984. 23 p, 1 fig, 14 tab.

Key Words: Metro Manila, Infrastructure programs, Agricultural development, Economic development, Social services, Government supports.

Metropolitan Manila is initiated at the heart of Luzon and is composed of 4 cities and 13 municipalities subdivided into 1,692 barangay units. As internal revenue collections rose significantly during the review period, the construction of highways, railway tracks, sea and air linkages, irrigation and water supply systems, and flood control structures and the improvement of power plants and of the city-wide communications network were implemented. Projects under the social services sector include the establishment of housing units for the human settlement program and the upgrading of education and public health standards. The development of indigenous cottage industries and the promotion of the industrial estates program were also undertaken.

49. METRO MANILA FLOOD CONTROL AND DRAINAGE PROGRAM: STATUS AND ACCOMPLISHMENTS, 1972-1977

Ministry of Public Works, Transportation and Communications, Quezon City.

1977. 47 p, 17 fig, 4 tab.

Key Words: Flood control, Drainage programs, Progress reports, Drainage systems, Projects, Metro Manila.

Annual flood looses incurred in Metro Manila every year is placed at P 40 M. The Ten-Year Flood Control and Drainage Program is expected to reduce these losses; and after its first five years of implementation, favorable results have already been established. This report capsulizes the major accomplishments of the Program. It presents a historical background of past efforts to contain the flood problems and outlines the magnitude and scope of work which the program covers. The highlights of completed and on-going projects, under the categories of pumping station installation, drainage

main constructions, estero dredging, bank improvement and drainage improvements comprise the major portion of this report. Finally, the plans and program for the next five years (1978-1982) are presented on an annual basis.

50. MINISTRY OF NATURAL RESOURCES: 1981 ANNUAL REPORT

Ministry of Natural Resources, Quezon City.

July 1982. 33 p, figures, tables.

Key Words: Annual reports, Fisheries, Forestry, Land, Mines, Resource management.

The 1981 programs and accomplishments of the Ministry, its bureaus and agencies are presented. The achievements of the following attached agencies are reported: the Bureau of Forest Development, the Bureau of Fisheries and Aquatic Resources, the Bureau of Lands, the Bureau of Mines and Geo-Sciences and the Forest Research Institute.

51. 1981 MPW INFRASTRUCTURE PROGRAM

Ministry of Public Works, Manila.

November 1980. 440 p, tables.

Key Words Infrastructure programs, Public works, Finance, Tables (data).

A detailed account of infrastructure funding from Public Works Acts are contained herein. A total of 1,717 million pesos with a foreign component of 24 million U.S. dollars is broken down according to region under the proposed Program of Obligation and Cash Disbursement Schedule. Figures are tabulated according to project categories: (1) Irrigation; (2) Flood control and drainage; (3) Level I (Wells and Springs); (4) Level II (Communal Faucet); (5) Level III (Waterworks); (6) Shore protection; (7) Ports; (8) Lighthouses; (9) School buildings; (10) Hospital/Health centers; (11) National Buildings; (12) Dagat-dagatan Project; (13) Metro Manila Infrastructure, Utilities and Engineering Projects (MMINUTE); (14) Preliminary/Detailed Engineering; and (15) Miscellaneous public works.

52. NATIONAL HYDRAULIC RESEARCH CENTER: ANNUAL REPORT

National Hydraulic Research Center, Quezon City.

1982. 8 p, figures.

Key Words: Annual reports, Laboratory facilities, Laboratories, Projects.

A summary of the Center's accomplishments in its various undertakings during the just concluded year is given. Specifically, brief accounts of its manifold endeavor in the fields

of applied hydraulics, data processings, training, and research are presented. Both ongoing and completed research projects are reported.

53. PAMPANGA DELTA/CANDABA SWAMP AREA DEVELOPMENT PROJECT

Department of Public Works, Transportation and Communications, Planning and Project Development Office, Quezon City. Tahal Consulting Engineers Ltd., Israel.

Vol. 2: The Philippines Final Report, Report prepared for the United Nations, 1978. 201 p, 53 fig, 81 tab.

Key Words: Pampanga River Basin, Candaba Swamp (Pampanga), Area redevelopment, Project feasibility, Project planning, Geomorphology, Climatic data, Soil surveys, Land use, Water resources, Social aspects, Economic aspects, Agriculture, Fisheries, Hydrologic study, Hydraulic study, Water resources development, Plan formulation, Project studies, Evaluation.

Following devastating floods in the Pampanga Delta and Candaba Swamp areas in 1972, pre-investment studies directed towards their development were made. The scope and objectives of the work included: (1) a study of the rehabilitation and development needs of the Pampanga Delta and Candaba Swamp areas on a multi-sectoral basis; (2) the formulation of integrated policy guidelines and the preparation of a comprehensive plan for medium and long-term rehabilitation and development of the areas; and (3) the identification of high-priority projects and the undertaking of pre-feasibility studies for such.

54. PAMPANGA DELTA/CANDABA SWAMP AREA DEVELOPMENT PROJECT

Department of Public Works, Transportation and Communications, Planning and Project Development Office, Quezon City. Tahal Consulting Engineers Ltd., Israel. University of the Philippines, Institute of Environmental Planning, Quezon City.

Appendix A: Land Resources Studies, 1978. 123 p, 19 fig, 11 tab, 24 ref, 4 annexes.

Key Words: Pampanga River Basin, Candaba Swamp (Pampanga), Area redevelopment, Project feasibility, Project planning, Land resources, Soil surveys, Land classification, Geomorphology, Soils, Soils investigations, Soil management, Soil erosion, Soil conservation.

The land classification of the Pampanga Delta and the Candaba Swamp is reported herein. It was undertaken to provide the land resources input data for agricultural planning in the area and to evaluate the potential of the area in terms of these resources. The study evolves three major facets of analysis: the environment, the soil and soil survey interpretation, and land classification. The second part of the volume presents preliminary data on the physical and erosional conditions in the watershed. It describes and reviews the major elements of the existing erosional situation and trends of development. Finally it identifies and evaluates critical erosion problems requiring immediate solution.

55. PAMPANGA DELTA/CANDABA SWAMP AREA DEVELOPMENT PROJECT

Department of Public Works, Transportation and Communications, Planning and Project Development Office, Quezon City. Tahal Consulting Engineers Ltd., Israel. University of the Philippines, Institute of Environmental Planning, Quezon City.

Appendix B: Surface Water Studies, 1978. 313 p, 108 fig, 74 tab, 7 ref, 7 annexes.

Key Words: Pampanga River Basin, Candaba Swamp (Pampanga), Area redevelopment, Project feasibility, Project planning, Surface waters, Climatology, Climatological characteristics, Precipitation (atmospheric), Rainfall disposition, Hydrometry, Hydrologic study, Mathematical models, Simulation, Water demand, Salinity.

The characteristic features of the project area's surface waters are discussed herein. Topics discussed include: (1) climatic and hydrological characteristics of the project area; (2) monthly and annual flow summaries for the 28 sub-basins comprising the entire Pampanga River System; (3) hydro and agrometeorological simulation models to derive the area's irrigation requirements and flood control measures; and (4) salinity studies conducted on the Pampanga and Bulacan rivers. Accompanying tables and graphs are also provided in the annexes.

56. PAMPANGA DELTA/CANDABA SWAMP AREA DEVELOPMENT PROJECT

Department of Public Works, Transportation and Communications, Planning and Project Development Office, Quezon City. Tahal Consulting Engineers Ltd., Israel. University of the Philippines Institute of Environmental Planning, Quezon City.

Appendix C: Simulation Studies, 1978. 57 p, 11 fig, 23 tab, 5 annexes.

Key Words: Pampanga River Basin, Candaba Swamp (Pampanga), Area redevelopment, Project feasibility, Project planning, Simulation, Water balance, Reservoir operation.

The Candaba Swamp Operation Model (CANDOP) is a hydrologic- hydraulic simulation of the complex hydro-network of the Candaba Swamp. The model was conceived to investigate the efficiency of the swamp as a flood retention basin for the Lower Pampanga River and the four rivers draining directly into the swamp, a water basin. The basin's water balance was obtained by a hydrometeorological simulation model.

57. PAMPANGA DELTA/CANDABA SWAMP AREA DEVELOPMENT PROJECT

Department of Public Works, Transportation and Communications, Planning and Project Development Office, Quezon City. Tahal Consulting Engineers Ltd., Israel. University of the Philippines, Institute of Environmental Planning, Quezon City.

Appendix D: Groundwater Studies, 1978. 107 p, 29 fig, 6 tab, 9 annexes.

Key Words: Pampanga River Basin, Candaba Swamp (Pampanga), Area redevelopment, Project feasibility, Project planning, Groundwater, Groundwater investigation, Hydrogeology, Aquifer characteristics, Groundwater hydrology, Groundwater flow, Groundwater recharge, Groundwater depletion, Evaluation.

The hydrogeolocical characteristics of the Pampanga Delta/Candaba Swamp Area is presented herein with particular emphasis on groundwater and aquifer potentials. Groundwater balance is described with the study of the area's groundwater inflows and outflows, natural replenishments, stream per colations, irrigation return flows, and pumpage. Water level declination and sea water intrusion have given rise to some adverse effects. Therefore, recommendations are drawn to check these problems and to establish a proper groundwater management for the area. In addition, an economic evaluation of the groundwater development projects is also presented.

58. **PAMPANGA DELTA/CANDABA SWAMP AREA DEVELOPMENT PROJECT**

Department of Public Works, Transportation and Communications, Planning and Project Development Office, Quezon City. Tahal Consulting Engineers Ltd., Israel. University of the Philippines, Institute of Environmental Planning, Quezon City.

Appendix E: Water Supply Studies, 1978. 36 p, 2 fig, 13 tab.

Key Words: Pampanga River Basin, Candaba Swamp (Pampanga), Area redevelopment, Project feasibility, Project planning, Water supply, Water demand, Water quality, Water distribution (applied), Water supply systems.

A review of the present state of domestic and industrial water supply in the project area is presented herein. The appendix sets down some recommendations on the planning of waterworks for future supply with particular emphasis on water quality. Data are presented on present populations and water consumption; and on population projections and forecast water demand up to year 2000. The findings of a water quality survey, conducted in six watersheds in the area, are described and compared to Philippine and U.S. drinking water standards. Finally, the appendix outlines the principles governing the design of the components of urban and rural water supply systems, applying these principles to project requirements.

59. **PAMPANGA DELTA/CANDABA SWAMP AREA DEVELOPMENT PROJECT**

Department of Public Works, Transportation and Communications, Planning and Project Development Office, Quezon City. Tahal Consulting Engineers Ltd., Israel. University of the Philippines, Institute of Environmental Planning, Quezon City.

Appendix F-1: River Hydraulics and Flood Control-Engineering Studies, 1978. 144 p, 50 fig, 19 tab, 3 annexes.

Key Words: Pampanga River Basins, Candaba Swamp (Pampanga), Area redevelopment, Project feasibility, Project planning, Open channel flow, Flood control, Engineering evaluation, Flood plain studies, Flood protection, Flood damage.

The approach espoused by this study is that flood control is not a goal in itself but a means towards an end, the real goal being flood damage alleviation to be achieved by economically feasible and socially viable methods. The same criteria will be applied to the analysis and evaluation of flood control measures projected by the study team and to various, alternative combinations of these measures. An attempt will also be made to identify and evaluate non-structural flood damage alleviation strategies which might be implemented as complementary to the structural flood control works, both existing and planned.

60. PAMPANGA DELTA/CANDABA SWAMP AREA DEVELOPMENT PROJECT

Department of Public Works, Transportation and Communications, Planning and Project Development Office, Quezon City. Tahal Consulting Engineers Ltd., Israel. University of the Philippines, Institute of Environmental Planning, Quezon City.

Appendix F-2: Irrigation and Drainage-Engineering Studies, 1978. 93 p, 26 fig, 22 tab, 8 annexes.

Key Words: Pampanga River Basin, Candaba Swamp (Pampanga), Area redevelopment, Project feasibility, Project planning, Irrigation, Drainage, Engineering evaluation, Irrigation systems, Drainage systems, Multiple purpose projects, Evaluation, Reclamation.

The major contribution of irrigation lies in the intensification of crop production on cultivated lands. The purpose of this study is to assess such an intensification. It also presents an inventory of existing irrigation systems and describes potential options and irrigation and drainage developments in the project area. The present work outlines the current state of irrigated agriculture, identifies problems and needs in this respect, puts forward development alternatives for irrigated agriculture and describes specific projects for further studies and implementation.

61. PAMPANGA DELTA/CANDABA SWAMP AREA DEVELOPMENT PROJECT

Department of Public Works, Transportation and Communications, Planning and Project Development Office, Quezon City. Tahal Consulting Engineering Ltd., Israel. University of the Philippines, Institute of Environmental Planning, Quezon City.

Appendix H: Regional Macro-Economic Analysis, 1978. 110 p, 27 tab, 14 ref, 12 annexes.

Key Words: Pampanga River Basin, Candaba Swamp (Pampanga), Area redevelopment, Project feasibility, Project planning, Economic analysis, Mathematical models, Input-output analysis, Economic study, Economic feasibility.

The macro-economic analysis for the Pampanga/Candaba area has been conceived to attain the following objectives: (1) to generate an overall regional development scenario with internal consistency based on quantitative analysis; (2) to serve as the highest level of the hierarchical planning process adopted for the study, and thus test the economic feasibility and socio- political acceptability of sectoral development basins; and (3) to derive alternative regional development guidelines which can be updated when new or refined data become available. Conclusions drawn from the analysis confirm the

feasibility of the approach adopted in the study and their suitability to support more detailed specific studies on sectoral and project levels.

62. PAMPANGA DELTA/CANDABA SWAMP AREA DEVELOPMENT PROJECT

Department of Public Works, Transportation and Communications, Planning and Project Development Office, Quezon City. Tahal Consulting Engineers Ltd., Israel. University of the Philippines, Institute of Environmental Planning, Quezon City.

Appendix I: Agricultural Development Studies, 1978. 159 p, 9 fig, 54 tab, 9 annexes.

Key Words: Pampanga River Basin, Candaba Swamp (Pampanga), Area redevelopment, Project feasibility, Project planning, Agriculture, Agricultural development, Agricultural engineering.

The agricultural development studies for the project area was realized within the context of the regional development objectives of Central Luzon on one hand and that of Metro Manila on the other. It responded to the following regional challenges: to meet the food and employment requirements of the projected increase of population, natural and migratory, particularly from the Metro Manila area and to intensify agricultural production from the limited area of farm lands and land reserves which are being depleted by the rapid rate urbanization. These were analyzed with due consideration to the overall regional development strategy and the interdependency between the project area and the Metro Manila complex.

63. PAMPANGA DELTA/CANDABA SWAMP AREA DEVELOPMENT PROJECT

Department of Public Works, Transportation and Communications, Planning and Project Development Office, Quezon City. Tahal Consulting Engineers Ltd., Israel. University of the Philippines, Institute of Environmental Planning, Quezon City.

Appendix J: Fisheries Development Studies, 1978. 51 p, 2 fig. 6 annexes.

Key Words: Pampanga River Basin, Candaba Swamp (Pampanga), Area redevelopment, Project feasibility, Project planning, Fisheries, Commercial fishing, Fish management.

Presented in this appendix are: (1) review of the current rate of the industry in the Pampanga Delta/Candaba Swamp area; (2) analysis of the production potential of the area; (3) the required improvements consistent with the targets of the comprehensive regional plan; and (4) recommendations aimed at raising the output and incomes of fishpond operators. Strategies have been formulated for raising production and production efficiencies in the area, and recommendations with regard to various alternatives have been drawn up on the basis of form budgets and economic analyses.

64. PAMPANGA DELTA/CANDABA SWAMP AREA DEVELOPMENT PROJECT

Department of Public Works, Transportation and Communications, Planning and Project Development Office, Quezon City. Tahal Consulting Engineers Ltd., Israel. University of the Philippines, Institute of Environmental Planning, Quezon City.

Appendix K: Pampanga River Basin, Candaba Swamp (Pampanga), Area redevelopment, Project feasibility, Project Planning, Environmetal aspects, Environmental protection, Waste water management, Sewerage, Pollutant identification, Solid waste management, Public Health, Environmental impact.

The environmental aspects related to the development for the project area are discussed herein. An assessment of the present environmental situation in the area is presented; together with tentative proposals for the protection of the environment from future degradation. The studies also reveal that the positive cumulative impacts of the recommended projects outweigh the possible adverse effects. Other topics discussed include: wastewater quality control; criteria for sewerage systems; agricultural and industrial pollution; solid waste disposal; and public health.

65. PAMPANGA DELTA/CANDABA SWAMP AREA DEVELOPMENT PROJECT

Department of Public Works, Transportation and Communications (DPWTC), Quezon City.

Interim Repor t III, August 1976: various paging, tables, appendices.

Key Words: Pampanga (Central Luzon), Candaba Swamp (Pampanga), Deltas, Development projects, Agricultural development, Fisheries, Water supply.

The issues and planning facets in the fields of agriculture, agricultural economics, aquaculture and fisheries development, urban development, water quality and water supply are discussed. Status reports on the hydrological studies, flood control, irrigation, macroeconomic, and socio-economic studies supplement the above aspects.

66. PHILIPPINE ENVIRONMENT, 1978: SECOND ANNUAL REPORT

Ministry of Human Settlements, National Environmental Protection Council, Quezon City.

June 1979. 203 p, 32 fig, 68 tab, appendices.

Key Words: Philippine Environmental aspects, Environmental quality, Environmental management, Land use, Soils, Forestry, Coasts, Fisheries, Water resources, Mineral resources, wildlife, Energy development, Water pollution, Water quality, Air pollution, Noise pollution, Toxins, Solid wastes, Housing (residential), Environmental sanitation, Public health, Disasters, Expenditures.

The second annual report makes mention of all existing standards which could help in assessing the condition of a particular area of concern in the environment. It proceeds to discuss relevant topics pertaining to the current condition of environmental resources, major problems, plans and programs, and other related issues. Starting from a broad, national framework, the report winds up a short presentation of critical areas which could help pinpoint the conditions discussed.

67. PHILIPPINE ENVIRONMENT, 1978 - CONCERNS AND ISSUES: A DIGEST

Ministry of Human Settlements, National Environmental Protection Council, Quezon City.

June 1979. 27 p, 12 fig.

Key Words: Philippines, Environmental aspects, Documentation.

The report recognizes the fact that a comprehensive assessment of concerns in the environment would find justification in the concept of environmental unity. Hence, this booklet summarizes all emerging issues and concerns discussed in the first volume. The aims of this annual report are: (1) to provide a comprehensive framework for more intensive treatment of environmental conditions; (2) to shed more light to the understanding of environmental unity and help future assessments fit into the basic concept; and (3) to stimulate public interest in environmental matters and promote effective measures in the interest of environmental protection.

68. PHILIPPINE ENVIRONMENTAL LAW

National Environmental Protection Council (NEPC), Quezon City.

June 1 978. 524 p, 1 fig, 4 tab, 14 ref, 2 annexes.

Key Words: Laws, Environmental aspects, Philippines, Natural resources, Fisheries, Fish management, Aquatic environment, Legal aspects, Institutional constraints, Legislations, Wildlife conservation, Forest management, Forestry, Soil conservation, Flood Control, Drainage systems, Energy development, Mineral resources, Wastes, Management, Population, Balance of nature, Cultural resources, Research and development.

Legal, institutional, and operational aspects of the natural resources management and conservation are presented through this Philippine Environmental Law. Included are Republic Acts, Commonwealth Acts, and Presidential Decrees governing: (1) fisheries and aquatic resources ; (2) wildlife; (3) forestry and soil conservation; (4) flood control measures, drainage systems and natural calamities; (5) energy development; (6) mineral resource; (7) waste management; (8) population-environmental research. Discussion on each of the subjects are included.

69. **PHILIPPINE FLOOD CONTROL: 1977**

National Water Resources Council, Quezon City.

Report No. 17-A, June 1978. 89 p, figures, tables, 24 ref, 8 append.

Key Words: Flood control, Philippines, Flood protection, Regions, Regional flood.

The study provides an overview of the government's efforts to reduce flood damages in the various flood prone areas of the country. It also contains a nation-wide inventory of existing, on-going and proposed flood control projects. Dividing the country into twelve water resources regions, descriptions are made on the water and related land resources in each region, the flood prone areas, the flood problems, the causative factors, and the various structural and non-structural measures adopted to mitigate the effects of flooding in the areas. The salient features of the existing flood control measures are summarized in tabular form. In addition, the location of the projects are shown in maps by region.

70. **PHILIPPINE MUNICIPAL FISHERIES: A REVIEW OF RESOURCES, TECHNOLOGY AND SOCIO-ECONOMICS**

Smith, I. R., Puzon, M. Y. and Libunao, C.N.V.

International Center for Living Aquatic Resources Management, Makati. Fishery Industry Development Council, Quezon City.

1980. 87 p, 31 fig, 19 tab, 3 append.

Key Words: Fisheries, Fishery resources, Fishing operations, Fishing vessels, Socio-economic analysis, Fish managemet.

Recent research findings related to the technology and socio- economics of small-scale municipal fishermen in the Philippines and the "open-access" resources they exploit are reviewed. Evidence is provided of a trend towards overfishing of Philippine coastal waters, and of a willingness among fishermen to consider alternative activities to capture fishing. The review concludes with a discussion of the implication of these research findings to fisheries management and research.

71. **PHILIPPINE WATER DATA 1970**

National Water Resources Council (NWRC), Quezon City.

Philippine Water Data Series No. I: Surface Water Records No. 13, 1980. 412 p, 12 fig, 2 append.

Key Words: Streamflow records, Philippines, River basins, Tables (data), Gaging stations, Discharge (water).

This publication contains stream discharge records as well as river and lake stages. It is intended as a ready reference for planners, designers and operational personnel of entities engaged in the development of water and related land resources. Records covering the years 1908-22 and 1945-69 are presented in Water Supply Bulletins Nos. 1-12 under the direction of the Water Resources Survey Division, Bureau of Public Works. The present volume which covers the 1970 records, is in succession to the Water Supply Bulletin series.

72. PHILIPPINES WATER DATA: 1971

National Water Resources Council (NWRC), Quezon City

Surface Water Records No. 14, n. d. various paging, figures, tables, 11 append.

Key Words: Water data, Surface waters, Regions, Gaging stations, Stream gages, Water resources regions.

Data on stream discharge as well as river and lake stages are presented in twelve sections. Each section corresponds to a water resources region which contains data and information from stream gaging stations belonging to it. Location maps and brief descriptions of each region are provided.

73. PHILIPPINE WATER RESOURCES SUMMARY DATA

National Water Resources Council, Quezon City

Vol. I: Streamflow and Lake or River Stage Er ding December 31, 1970, Report No. 9, January 1980. 452 p.

Key Words: Water resource, Tables (data), Regions, Stations, Streamflow data.

This summary provides information on 440 streamflow gaging stations in the Philippines where hydrologic data are being gathered or have been collected. Details of such station location, drainage area and other relevant information are given. Annual extremes and statistical parameters are included. The report is based on data gathered as of December 31, 1970. The format and content have been designed to facilitate storage in computer media for further analyses.

74. PHILIPPINES: WATER SUPPLY AND SEWERAGE SECTOR STUDY

World Health Organization, Geneva. International Bank for Reconstruction and Development (World Bank), Washington, D.C.

Volume 2: Annexes, January 1977. 39 p, 17 tab, 21 annexes.

Key Words: Water supply, Sewerage, Water resources, Water quality, Data collections, Philippines.

The second of two volumes, this publication primarily contains annexes discussing the problems of water supply, possible water resources and waste disposal. Based on researches made, groundwater reservoirs are believed to cover a wide area in the region of Luzon as well as in the other two regions of the country. Data about the rate of water supply both in urban and rural areas are analyzed. Programs and forthcoming investments of the government in relation to the problem of potable water supply and waste pollution are evaluated taking into consideration the important role of population growth. The possibility of accepting assistance from other countries for the installation of wells to avail the rural folk of potable water is also discussed.

75. PRE-FEASIBILITY STUDY REPORT OF MADLUM RIVER RESERVOIR PROJECT, BIAC-NA-BATO RIVER RESERVOIR PROJECT, SALAPANGAN RIVER RESERVOIR PROJECT

Central Luzon-Cagayan Valley Authority, Manila.

1978. 64 p, 1 annex.

Key Words: Feasibility studies, River basin development, Resource development, Economic growth, Social services, Project benefits.

According to this pre-feasibility study, the Madlum River, Biac- Na-Bato, and the Salapangan River Reservoir Projects are infrastructure essential to the social, economic and financial advancement of the province of Bulacan. Primary benefits consist of increased agricultural area and optimum production thru the adequate year-round supply of irrigation water. Secondary and consequential benefits are definite forward movements to provide a broader employment base, and a wider distribution of income. Other benefits that are solid project oriented functions are probable hydropower generation together with favorable possibilities for an agro-industrial development.

76. PROBING OUR FUTURE: THE PHILIPPINES 2000 A.D.

Development Academy of the Philippines, Makati, Metro Manila. University of the Philippines, School of Economics, Quezon City. University of the Philippines, Population Institute, Manila.

July 1980. 222 p, figures, tables, 2 append.

Key Words: Population, Resource conservation, Resource development, Environments, Health, Forecasting, Future planning (projected).

Population, Resources, Environment and the Philippine Future (PREPF) focuses on the Philippines in year 2000 in order to identify necessary policy actions at the present time by which to secure in so far as it is within human capabilities, the best possible future out of a set of feasible, foreseeable future. In the present publication, some seven thousand pages of PREPF technical reports are summarized. Various issues covered by the research

projects are population projections, health, education, income distribution, energy pollution, and natural resources conservation.

77. PROGRESS REPORT NO. 5B: GROUND WATER RESISTIVITY SURVEY, PROVINCE OF TARLAC, AUGUST 1980

National Water Resources Council (NWRC), Quezon City.

Technical Report, August 1980. 38 p, 21 fig, 6 tab.

Key Words: Resistivity surveys, Surveys (data collection), Geophysical prospecting, Groundwater, Hydrology, Tarlac.

As part of the government's program of assessing the ground water situation of the country, a resistivity survey was conducted on 48 sites in 23 towns of Tarlac. The result of the survey would serve for the planning of domestic water supply and for the rationale management of groundwater resources of the province. The report opens up with a general description of the hydrogeological conditions of the area. It then goes to give the details of the survey such as the synthesized survey data, the geo-electric interpretation results, and some conclusion and recommendations.

78. PROJECT REPORT FOR THE INTERIM IMPROVEMENT OF WATER DISTRICT

Local Water Utilities Administration, Quezon City.

Interim Demonstration Program, February 1978. 54 p, 7 fig, 20 tab, 2 append.

Key Words: Water supply systems, Water districts, Water distribution (applied), Water delivery, Water demand, Water resources development, Water supply forecasting, Water resources, Financial analysis, Economic analysis, Progress reports.

The report discussed herein describes engineering and feasibility studies conducted for the Camiling Water District service area. The study includes: (1) survey and evaluation of existing water system and available water resources; (2) projection of future population, service area, required water production and consumption; (3) preparation of a water supply plan; (4) preparation of a financial analysis of future revenues and expenses along with proposed water rates; and (5) preparation of socio-economic analysis including an investigation of cost- benefit relationships. The result of the study, as concluded, shows the necessity of upgrading the present water system of Camiling to bring it to acceptable standards.

79. PROJECT REPORT FOR THE INTERIM IMPROVEMENT OF MONCADA WATER DISTRICT

Local Water Utilities Administration, Quezon City.

Interim Demonstration Program, March 1979. 63 p, 8 fig, 22 tab, 4 append.

Key Words: Water supply systems, Water districts, Water distribution (applied), Water delivery, Water demand, Water resources development, Water supply forecasting, Water resources, Financial analysis, Economic analysis, Progress reports.

Discussed in this report are the engineering and feasibility studies conducted for the Moncada Water District service area. The results of the study revealed that the project is financially viable and sufficient to meet the water needs of the district up to the year 1984. The program includes the planning, design and construction of improvements requiring a relatively low capital investment. It involves: (1) bringing the existing water system up to acceptable standards; (2) extending service to high density areas; and (3) providing a sufficient supply of high quality water to meet the needs of the people within the service for a short period of time into the future.

80. PROJECT REPORT FOR THE INTERIM IMPROVEMENT OF PANIQUI WATER DISTRICT

Local Water Utilities Administration (LWUA), Quezon City.

Interim Demonstration Program, July 1978. 63 p, 8 fig, 23 tab, 2 append.

Key Words: Water supply systems, Water districts, Water resources development, Project summaries, Water demand, Water supply forecasting, Financial analysis, Economic analysis.

The result of the engineering and financial-economic studies undertaken for the Panique Water District (PAN-WD) are presented. The studies show that there is a need to upgrade the present water system of Paniqui to bring it to acceptable standards. The recommendations are: (1) PAN-WD should adopt and implement the construction of the water system improvements as proposed in the report; (2) PAN-WD should obtain the Conditional Certification of funding of the project; (3) PAN-WD shall proceed with the purchase of additional land where the existing Assemblea Pumping Station is situated; (4) PAN-WD should obtain water rights of its existing sources; and (5) LWUA shall prepare the necessary contract documents for the project, and once the District has achieved a satisfactory level of institutional development, solicit bids from prequalified contractors.

81. PROJECT REPORT FOR THE INTERIM IMPROVEMENT OF TANAY WATER DISTRICT

Local Water Utilities Administration, Quezon City.

March 1980. 56 p, 13 fig, 18 tab.

Key Words: Tanay Water District (Rizal), Feasibility studies, Projects, Project planning, Water supply systems, Population forecasting, Water demand, Water resources, Evaluation, Financial analysis, Environmental impact, Economic analysis.

The engineering and feasibility studies conducted for the service area of Tanay Water District are described herein. The investigations particularly include the following: surveys and evaluation of the existing water system and the available water resources; projection of future population, service area, required water production and consumption; preparation of a water supply plan; preparation of a financial analysis of future revenues and expenses together with the development of a schedule of proposed water rates; and the preparation of a socio-economic analysis including an investigation of cost-benefit relationship. Recommendations are also given.

82. PROVINCE OF BATAAN: ACCOMPLISHMENT REPORT, 1978-83/84

Office of the Prime Minister, May 1984. 39 p, 6 fig, 29 tab.

Key Words: Bataan, Infrastructure programs, Agricultural development, Economic development, Social services, Government supports.

The Bataan peninsula lies on the southwestern part of Central Luzon and is composed of 12 municipalities with 226 barangays. Agricultural progress was achieved through increased yields in rice, cotton, and other flood crops. Infrastructure programs centered on the completion of the nuclear power plant aside from the construction of roads, ports, irrigation systems, and shore protection structures. Likewise attained was economic stability through the establishment of the export processing zone and the development of indigenous cottage industries. As internal revenues increased throughout the 5-year period, human settlements, education and health were improved.

83. PROVINCE OF BULACAN: ACCOMPLISHMENT REPORT, 1978-83/84

Office of the Prime Minister, May 1984. 43 p, 7 fig, 29 tab.

Key Words: Bulacan, Infrastructure programs, Agricultural development, Economic development, Social Services, Government supports.

The province of Bulacan forms part of the Central Luzon region and consists of 24 municipalities subdivided into 514 barangays. Aside from the improvement of roads and highways, infrastructure programs focused on the construction of airstrips commercial ports, irrigation and water supply systems, and shore protection and flood control structures. Prime commodity crops managed to sustain production growths together with the increase in poultry and livestock populations. Economic progress revolved around the cottage industry development program and the promulgation of employment opportunities while the social services sector relied on the establishment of housing units for the settlements program and on the provision of health protection services.

84. PROVINCE OF CAVITE: ACCOMPLISHMENT REPORT, 1978-83/84

Office of the Prime Minister, May 1984. 41 p, 7 fig, 29 tab.

Key Words: Cavite, Infrastructure programs, Agricultural development, Economic development, Social services, Government supports.

The province of Cavite is situated at the southern part of Luzon and is composed of 3 cities and 20 municipalities with 470 barangay units. Rice production and livestock population declined during the review period. Economic progress was, however, through the potentials of the indigenous cottage industries, the establishment of an export processing zone and of three industrial estates, and the promotion of self sufficiency projects. Housing facilities and the improvement of educational standards and of public health protection were also funded. Although internal revenue collections constantly decreased, infrastructure development programs were initiated continuously.

85. PROVINCE OF LAGUNA: ACCOMPLISHMENT REPORT, 1978-83/84

Office of the Prime Minister, May 1984. 50 p, 7 fig, 31 tab.

Key Words: Metro Manila, Infrastructure programs, Agricultural development, Economic development, Social services, Government supports.

Metropolitan Manila is situated at the heart of Luzon and is composed of 4 cities and 13 municipalities subdivided into 1,692 barangay units. As internal revenue collections rose significantly during the review period, the construction of highways, railways tracks, sea and air linkages, irrigation and water supply systems, and flood control structures and the improvement of power plants and of the city wide communications network were implemented. Projects under the social services sector include the establishment of housing units for the human settlements program and the upgrading of education and public health standards. The development of indigenous cottage and the promotion of the industries estates program were also undertaken.

86. PROVINCE OF NUEVA ECIJA: ACCOMPLISHMENT REPORT, 1978-83/84

Office of the Prime Minister, May 1984. 43 p, 6 fig, 29 tab.

Key Words: Nueva Ecija, Infrastructure programs, Agricultural development, Economic development, Social services, Government supports.

The province of Nueva Ecija forms part of the Central Luzon region and is composed of 3 cities and 29 municipalities which are subdivided into 803 barangay units. Cotton and tobacco yields registered slight growth percentages together with the increased in poultry and livestock populations. Rice, corn and other food crops, however, suffered substantial decreases over the period under review. Major undertakings by the economic and social services sector include the development of small and medium scale cottage industries, the generation of employment opportunities through livelihood programs, and the improvement of education and health standards. Construction of roads, irrigation and water supply systems and flood control structures were emphasized as revenues constantly increased.

87. PROVINCE OF PAMPANGA: ACCOMPLISHMENT REPORT, 1978-83/84

Office of the Prime Minister, May 1984. 54 p, 7 fig, 36 tab.

Key Words: Pampanga, Infrastructure programs, Agricultural development, Economic development, Social services, Government supports.

The province of Pampanga forms part of the Central Luzon Region and is composed of one city and 21 municipalities subdivided into 535 barangays. As internal revenue collections posted impressive gains throughout the review period, the development of indigenous cottage industries, the initiation of self-sufficiency projects, and the upgrading of education and health standards were emphasized. Major projects by the public works sector include the construction of shore protection and flood control structures, roads, sea and air linkages,. and water supply systems and the intensification of the electrification program. However, productions of rice and livestock groups suffered substantial losses.

88. PROVINCE OF RIZAL: ACCOMPLISHMENT REPORT, 1978-83/84

Office of the Prime Minister, May 1984. 42 p, 5 fig, 28 tab.

Key Words: Rizal, Infrastructure programs, Agricultural development, Economic development, Social services, Government supports.

The province of Rizal forms part of the Southern Tagalog region and consists of 14 municipalities which are subdivided into 170 barangay units. The construction of roads, commercial ports, irrigation and water supply networks, and flood control structures were funded and completed as internal revenue collections continuously increased throughout the review period. Economic progress was accomplished through the development of indigenous cottage industries and the promotion of livelihood works while efforts by the social services sector were geared towards the general improvement of education and health standards and the establishment of housing units for resettlement purposes. Rice, cotton and poultry registered slight percentage.

89. PROVINCE OF TARLAC: ACCOMPLISHMENT REPORT, 1978-83/84

Office of the Prime Minister, May 1984. 45 p, 7 fig, 24 tab.

Key Words: Tarlac, Infrastructure programs, Agricultural development, Economic development, Social services, Government supports.

The province of Tarlac forms part of the Central Luzon region and is composed of 17 municipalities which are subdivided into 508 barangay units. Aside from the construction of irrigation and water supply systems, the public works sector pursued the rehabilitation of roads and the intensification of the electrification campaign. In agriculture, production of corn, cotton, sugar and other food crops registered substantial growth percentages throughout the review period. Other major projects undertaken include the development of indigenous cottage industries, the upgrading of education and public health standards, and the generation of employment opportunities.

90. **RAPID ASSESSMENT OF WATER SUPPLY SOURCES : PROVINCE OF BATAAN**

National Water Resources Council (NWRC), Quezon City.

Volume 15, Report No. 36, May 1982. 32 p, 2 fig, 3 tab, 1 append.

Key Words: Bataan, Groundwater resources, Water supply, Geology, Soils, Population, Wells, Water demand.

The Bataan Peninsula with a total land area of about 1,373 square kilometers forms part of the Central Luzon region. The difficult areas which embrace 85% of the total land area are located in the portions of the province while shallow well areas which comprise 15% of the province occupy the coastal districts. Deep well areas are not found to exist. However, 15 percent of the total water demand in the year 2000 will be supplied by deep wells, and 45 percent by shallow wells. The remaining two fifths will be met by springs, rain, and other surface water sources.

91. **RAPID ASSESSMENT OF WATER SUPPLY SOURCES : PROVINCE OF BULACAN**

National Water Resources Council (NWRC), Quezon City.

Volume 16, Report No. 36, May 1982. 92 p, 2 fig, 3 tab, 1 append.

Key Words: Bulacan, Groundwater resources, Water supply, Geology, Soils, Population, Wells, Water demand.

The province of Bulacan with a total land area of about 2,672 square kilometers forms part of the Central Luzon region. Exactly 50% of the province have the potential for shallow well development while deep well areas consist one fifth of the land. The former are towns found in the western half of the province while the latter occupy the central part of the land. Difficult areas constitute the remaining three tenths of the land. Three fourths of the total water demand will be met by shallow wells, a tenth by deep wells, and the rest by surface water sources.

92. **RAPID ASSESSMENT OF WATER SUPPLY SOURCES: PROVINCE OF CAVITE**

National Water Resources Council (NWRC), Quezon City.

Volume 23, Report No. 36, May. 1982. 44 p, 2 fig, 3 tab, 1 append.

Key Words: Cavite, Groundwater resources, Water supply, Geology, Soils, Population, Wells, Water demand.

The province of Cavite has a total land area of 1,288 square kilometers and forms part of the Southern Tagalog region. A major portion of the land is classified under the difficult area category while shallow well areas occupy 16 percent of the total land area, and deep well areas cover 13 percent. Forty-six percent of the total water demand for the year 2000 will be met by shallow wells, 18 percent by deep wells, and the rest by surface waters.

93. RAPID ASSESSMENT OF WATER SUPPLY SOURCES: PROVINCE OF LAGUNA

National Water Resources Council (NWRC), Quezon City.

Volume 24, Report No. 36, May 1982. 45 p, 2 fig, 3 tab, 1 append.

Key Words: Laguna, Groundwater resources, Water supply, Geology, Soils, Population, Wells, Water demand.

The province of Laguna with a total land area of about 1,757 square kilometers forms part of Southern Tagalog region. Difficult areas dominate the land while shallow well areas cover only 15 percent of the total land area. The former, comprising 85 percent of the land, occupy the central and southern parts of the province while the latter are found along the southern shores of Laguna de Bay. Deep well areas are not found to exist in the land. However, a fifth of the total water demand will be augmented by deep wells, 35 percent by shallow wells, and the rest by surface waters.

94. RAPID ASSESSMENT OF WATER SUPPLY SOURCES: PROVINCE OF NUEVA ECIJA

National Water Resources Council (NWRC), Quezon City.

Volume 17, Report No. 36, May 1982. 59 p, 2 fig, 3 tab, 1 append.

Key Words: Nueva Ecija, Groundwater resources, Water supply, Geology, Soils, Population, Wells, Water demand.

The province of Nueva Ecija has a total land area of about 5,284 square kilometers and forms part of the Central Luzon region. More than half of the total provincial area have the potential for shallow well development. Difficult areas comprising a fourth of the total land, are predominant in the eastern part of the province while deep well areas, occupying 22 percent of the land, are located at the central sections. Based on future projections and on safe yield concepts, shallow wells will provide three fourth of the water demand, 15 percent by deep wells, and a tenth by surface waters.

95. RAPID ASSESSMENT OF WATER SOURCES: PROVINCE OF PAMPANGA

National Water Resources Council (NWRC), Quezon City.

Volume 18, Report No. 36, May 1982. 50 p, 2 fig, 3 tab, 1 append.

Key Words: Pampanga, Groundwater resources, Water supply, Geology, Soils, Population, Wells, Water demand.

Pampanga, a 2,181 square kilometer province, forms part of the Central Luzon region. Shallow well areas comprise 85 percent of the province. Difficult areas prevail in the western tip portion of the province, comprising the towns of Mabalacat, Angeles, Porac, and Floridablanca. The remaining 2 percent are accounted for by deep well areas. Based on projections for the year 2000, shallow wells will supply 85 percent of the total water demand, and only 3 percent by deep wells. The rest of the demand will be met by existing springs, rain, and other surface water sources.

96. RAPID ASSESSMENT OF WATER SUPPLY SOURCES : PROVINCE OF RIZAL

National Water Resources Council (NWRC), Quezon City.

Volume 30, Report No. 36, May 1982. 32 p, 2 fig, 3 tab, 1 append.

Key Words: Rizal, Groundwater resources, Water supply, Geology, Soils, Population, Wells, Water demand.

The province of Rizal (excluding Metro Manila) has a total land area of about 1,350 square kilometers that form part of the Southern Tagalog region. Underlain by volcanic rocks, the province is predominantly under the difficult area category, while shallow well areas cover about a tenth of the total land, and deep well areas amass one fifth of the province. Based on future projections, shallow wells are expected to supply a tenth of the total water demand in the year 2000, 15 percent by deep wells, and three fourths by surface waters.

97. RAPID ASSESSMENT OF WATER SUPPLY SOURCES: PROVINCE OF TARLAC

National Water Resources Council (NWRC), Quezon City.

Volume 19, Report No. 36, May 1982. 44 p, 2 fig, 3 tab, 1 append.

Key Words: Tarlac, Groundwater resources, Water supply, Soils, Geology, Population, Wells, Water demand.

The province of Tarlac has a total land area of about 3,053 square kilometers and forms part of the Central Luzon region. Shallow well areas which cover more than half of the province prevail in the eastern part of the province whereas, difficult areas which occupy 33% of the land dominate the western end. The remaining 15 percent are deep well areas. Based on projections for the year 2000, shallow wells are expected to meet

three fifths of the total water demand, and a fifth by deep wells. The rest will be supplied by springs, rain, and other surface water sources.

98. RURAL WATER SUPPLY AND SANITATION MASTER PLAN

Ministry of Public Works and Highways (MPWH), Manila.

December 1982. 249 p, 19 fig, 66 tab, 20 append.

Key Words: Rural water supply systems, Sanitation, Water supply, Water quality, Project planning, Planning, Water quality control.

The Philippine Government has committed itself to an extensive program designed to install safe and dependable water supply and sanitary facilities to serve the rural populace in the shortest practicable time and in the most cost-effective manner. The ensuring plan as reported herein is focused on specific policies, targets and action programs for the provision of water supply and excreta disposal facilities to service the rural communities, where the need for these basic service has been identified to be particularly extensive. The existing water supply situation which affects the overall rural water supply plan covering the period 1982 to 2000 is likewise presented, together with the feasibility study of implementing the master plan.

99. STA. CRUZ WATER IMPOUNDING PROJECT: FEASIBILITY REPORT

Farms Systems Development Corporation, Manila.

April 1977. 93 p, 31 fig, 9 tab, 5 append.

Key Words: Impoundments, Project feasibility, Feasibility studies, Sta. Cruz (Pampanga), Area redevelopment, Hydrology, Dam design, Irrigation systems, Economic aspects, Project benefits, Financial analysis.

The engineering feasibility and economic justification of the proposed Sta. Cruz Water Impounding Project at Bo. Balitii, Arayat, Pampanga is presented herein. The Project would serve the specific purposes of irrigation, fish culture, and hydrologic data collection. Its plan of advancement is designed to provide a scheme for accelerated development of the project area. It shall include the dam and reservoir on the Baluga Creek and new irrigation delivery and distribution works. The dam will be a homogenous earth fill structure with spill ways capable of discharging 30.46 cubic meters per second at maximum water surface. The reservoir created by the dam will have a controlled capacity of 147.7 thousand cubic meters and will inundate about 4.32 hectares of land. Irrigation works consist of outlet structures and an irrigation system to provide year- round irrigation service to 172 hectares of land.

100. SOIL SURVEY OF THE PHILIPPINES

Bureau of Soils, Manila.

Government Printing Office, Manila, 1974. 42 Volumes.

Key Words: Soil surveys, Soil conservation, Reconnaissance surveys, Soil properties, Area investigations, Philippines.

Prompted by the need for soil conservation by redirecting soil management practices, the Bureau of Soils conducted soil surveys of all provinces to study their physical and chemical characteristics and to assess losses by erosion. The surveys provide the basis for a systematic classification of the Philippine Soils according to productivity rating, textural class and land capability. Such classification together with the survey and a general conservation guide are contained in a separate report for every province.

101. STATE OF THE ART: ENVIRONMENTAL PROTECTION RESEARCH

Philippine Council for Agriculture and Resources Research and Development (PCARRD), Los Baños, Laguna.

Mine Series No. I, 1982. 50 p, 12 tab, references, 11 append.

Key Words: Environmental protection, Mine wastes, Coastal protection, Institutional constraints, Mineral resources.

Recognizing that the high cost of fossil fuel energy, combined with growing public sensitivity to environmental hazards, challenges researchers into thinking of new ways of tapping resources without dealing a savage blow to ecological balance, PCARRD has embarked on the state-of-the-art series which analyzes and identifies baseline technology, updates information previously collated, assesses the component disciplines for a realistic identification of research gaps, and finally comes up with a research program truly responsive to current needs.

102. SURVEY/INVENTORY ON WATER IMPOUNDING RESERVOIRS

National Water Resources Council (NWRC), Quezon City.

Report No. 17-E, April 1978. 128 p, 12 fig, 12 tab.

Key Words: Surveys (data collection), Impoundments, Reservoirs, Water resources development, Multiple purpose projects, Damsites, River basins, Philippines.

A comprehensive and systematic inventory of the Philippines' impounding reservoirs for multi-purpose development is contained herein. The study efforts seek to: (1) provide significant information on the current status and prospects of water impounding projects in the country; (2) identify river basins and damsites with potentials for development which can be further investigated singly or jointly by water resources agencies; (3) guide and assist planners involved in the planning and programming of water resources development projects to accelerate the country's social and economic progress; and (4) idenfity areas where basic water resources data collection program will need to be

intensified. Description and identification of the water resources potentials were undergone on each of the twelve water resources regions as defined by the NWRC.

103. THE ANGAT RIVER HYDROELECTRIC PROJECT

National Power Corporation, Manila.

1967. 72 p, figures, tables.

Key Words: Angat River Hydroelectric powerplants, Project planning, Construction management.

The Angat River Hydroeletric Project was originally conceived in 1939 as a run-of-river plant primarily for power development with a comparatively low capacity commensurate with the limited demand. However, due to the advances made in the development of water resources, it was shown that the project could be designed to integrate the functional activities that would serve the complex social and economic needs of the community. The geological and physical features of the project were assessed which served as the basis of the various components of the dam. For the course of the construction of the project, challenging features and problems were manifested which required complicated engineering solutions. Construction of the Project was substantially completed when it was inaugurated on September 9, 1967.

104. THE PHILIPPINE COASTAL ZONE

National Environmental Protection Council (NEPC), Quezon City.

Volume I, Coastal Zone Resources, June 1980. 24 p, 34 fig, 30 tab, 38 ref, 3 annexes.

Key Words: Coasts, Coastal zone management, Coastal protection, Resources, Forestry, Marine fisheries, Minerals.

Pollution, beach erosion, over-exploitation and other damages to shore property threaten the Philippines' shorelines ecologically, as well as aesthetically. A key to its proper development and wise utilization is public awareness of the bounty of these shores. An inventory of its resources is presented in this volume to provide such awareness and to emphasize environmental considerations in the exploitation of its wealth.

105. THE PHILIPPINE ENVIRONMENT: 1982

National Environmental Protection Council (NEPC), Quezon City.

1983. 190 p, 26 fig, 55 tab.

Key Words: Environmental aspects, National parks, Industrial pollution, Soils, Forestry, Coasts, Fisheries, Air pollution, Water quality, Environmental health.

The level and trends of the country's environmental quality as reflected in a given set of environmental concerns are presented with emphasis on national parks and on industrial pollution. The industrial endeavors in the 80's and its environmental impacts are assessed along with the existing trends and conditions of wildlife habitat and parks. The declining soil fertility caused by erosion, the over exploitation and misuse of forest resources, the effects of water pollution on the ecology of coastal areas and on fisheries, the sources and control of air and water pollution, the diseases caused by toxic wastes, and the impacts of natural calamities on the environment are also assessed.

106. **TIDE AND CURRENT TABLES: PHILIPPINES, 1980**

Ministry of National Defense, Bureau of Coast and Geodetic Survey, Manila.

Special Publication No. 500, November 1979. 88 p.

Key Words: Tides, Tables (data), Tidal prediction, Currents (water), Harbors, Ocean currents.

The predictions contained in this publication are based on constants obtained from the harmonic analysis of a year's observation for tides and for at least 29 days of continuous observations for currents. Projections were prepared using an electronic computer, IBM 360/30. The tables of data give the following: tidal predictions; current predictions; height of tide at anytime; local civil time of sunrise and sunset; reduction of local time to standard time; moonrise and moonset; and astronomical data.

107. **TIDE AND CURRENT TABLES: PHILIPPINES, 1981**

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109. TIDE AND CURRENT TABLES: PHILIPPINES, 1983

Ministry of National Defense, Bureau of Coast and Geodetic Survey, Manila.

Special Publication No. 500, October 1983. 98 p.

Key Words: Tides, Tables (data), Tidal prediction, Currents (water), Harbors, Ocean currents.

The data given in this document are predictions based on constants obtained from the harmonic analysis of a year's observations for tides and for at least 29 days of continuous observations for currents. Such data provide the following information: tide predictions, current predictions; height of tide at anytime; local civil time of sunrise and sunset; reduction of local civil time to standard time; moonrise and moonset; and astronomical data.

110. TIDE AND CURRENT TABLES: PHILIPPINES, 1984

Ministry of National Defense, Bureau of Coast and Geodetic Survey, Manila.

Special Publication No. 500, October 1983. 150 p.

Key Words: Tides, Tables (data), Tidal prediction, Currents (water), Ocean currents.

The predictions provided herein are presented in two parts. The first division given the times and heights of the daily high and low waters at twenty stations in the country. Tidal differences and constants for estimating the tide at some two hundred fifty stations are also included. The second section gives the daily predicted time and velocity of maximum flood and ebb and times of slack water at five current stations in the Philippine waters.

111. WATER SUPPLY FEASIBILITY STUDY: LOS BAÑOS WATER DISTRICT - VOLUME I

Local Water Utilities Administration (LWUA), Quezon City. Camp Dresser and Mckee International, Inc., Boston, Massachussetts.

Final Report, April 1978. 405 p, 67 fig. 69 tab, 11 annexes.

Key Words: Los Baños Water District (Laguna), Feasibility studies, Water supply, Water supply systems, Water districts, Economic feasibility, Water resources, Planning, Urban areas, Water demand, Financial feasibility, Financial analysis.

The recommended plan for the upgrading and expansion of the water supply stream of the Los Banos Water District is a technically and economically feasible program for providing the water district adequate water supply up to the year 2000. This volume which contains the recommended plan and the methodology memoranda also includes the description of the water district and the existing facilities, the feasibility study criteria, the population and water demand projections, the resources, the analysis and evaluation of alternatives, the description and cost of the recommended plan, and the economic and financial feasibility analysis.

112. WATER SUPPLY FEASIBILITY STUDY: PHILIPPINE PROVINCIAL URBAN AREAS

Local Water Utilities Administration (LWUA), Quezon City. Camp Dresser and Mckee International, Inc., Boston, Massachussetts.

Summary Report, July 1976. 45 p, 1 fig, 5 tab, 2 append.

Key Words: Water supply, Feasibility studies, Urban areas, Recommendations, Planning, Cost analysis, Benefit-cost analysis.

Highlights of the water supply feasibility studies for the urban areas of Ozamis, Daet, Butuan, Zamboanga, Cebu, Lucena, Lipa, Tarlac, Cabanatuan and San Fernando (La Union) are summarized in this report. The investigations involve more than eight percent of all people living in provincial urban areas of the Philippines. The summary findings on pre-feasibility surveys of 131 communities served 110 waterworks systems are included.

113. 1979 YEAR-END REPORT TO THE PRESIDENT

Ministry of Public Works, Manila.

Febuary 1980. 95 p, 4 fig, 33 tab.

Key Words: Annual reports, Public works, Infrastructure programs, Projects, Project summaries.

The continuous efforts being exerted by the infrastructure sector in support of the overall socio-economic development plans are highligthed. Various public works projects including irrigation, waterworks, flood control and drainage systems, portworks, school buildings, national buildings, hospitals, and barangay/rural health centers were put up to make use of the economic potential contributable to the goals and objectives of the government. Each of these projects is herein reported in detail.

114. **1980 YEAR-END REPORT TO THE PRESIDENT**

Ministry of Public Works, Manila.

February 1981. 133 p, 49 tab.

Key Words: Annual reports, Public works, Infrastructure programs, Projects, Project summaries.

The various activities and accomplishments on infrastructure which support the country's social and economic development plan are herein reported. The period under review saw the restructuring of the Ministry of Public Works into two ministries: the Ministry of Public Works (MPW) and the Ministry of Transportation and Communication (MOTC). Achievements, programs, as well as ongoing projects of these ministries are summarized in this year-end report.