# PAPUA NEW GUINEA WATER SUPPLY AND SANITATION SECTOR PROFILE



ASIAN DEVELOPMENT BANK

September 1987

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This Sector Profile has been prepared by consultants with the assistance of the staff of the Water Supply Division of the Asian Development Bank and in consultation with the Government of Papua New Guinea.

## AGENCIES, COMMITTEES AND OFFICES

| | | |
|---|---|---|
| ADB | - | Asian Development Bank |
| ABPNG | - | Agriculture Bank of Papua New Guinea |
| CSA | - | Commercial Statutory Authority |
| DOH | - | Department of Health |
| DOW | - | Department of Works |
| EHS | - | Environmental Health Section |
| LGS | - | Local Government Section |
| NCDIC | - | National Capital District Interim Commission |
| NEC | - | National Executive Council |
| NPEP | - | National Public Expenditure Plan |
| WATERBOARD | - | National Water Supply and Sewerage Board 1/ |
| PHD | - | Provincial Health Division |
| PNG | - | Papua New Guinea |

## ABBREVIATIONS

| | | |
|---|---|---|
| APO | - | Aid Post Orderly |
| HI | - | Health Inspector |
| NRW | - | Non-revenue Water |
| O & M | - | Operations and Maintenance |
| RNV | - | Rural Non-Village |
| ROR | - | Rate of Return |

## TERMS

| | | |
|---|---|---|
| cm | - | centimeter |
| cu m | - | cubic meter |
| kl | - | kilo litre |
| lpcd | - | liters per capita per day |
| mld | - | million liters per day |
| sq km | - | square kilometer |

## NOTES

(i) The Government's fiscal year ends on 31 December.

(ii) In this Report "$" refers to US dollars, "K" to PNG Kinas, and "A" to Australian dollars.

(iii) The exchange rate prevailing at the time of the Mission's field work in PNG was US$1.00 = K0.95 and US$1.00 = A$1.53.

1/ Name changed on the 1 January 1987 to "The Waterboard".

## FOREWORD

This water supply and sanitation sector profile is included in a planned series of reviews of the sector of selected Developing Member Countries (DMCs). The objective of these reviews is the systematic documentation of recent trends in the sector for the purpose of assessing water supply and sanitation development plans, reviewing programs of future developments, outlining major constraints facing and prospects for the sector, and assisting in identifying potential areas for Bank support.

Since 1976, Bank assistance for water supply and sanitation projects has been extended to Papua New Guinea (PNG) through two loans amounting to US$18.9 million and two technical assistance amounting to US$365,000. The loans focused on the development of piped water systems in the provincial capitals of Lae, Wewak, Mt. Hagen and Madang while technical assistance studies helped address the institutional, managerial and financial weaknesses encountered by various executing agencies concerned. Since 1982, involvement in the rural areas, which entailed provision of water supply schemes has been facilitated through two Bank-financed rural health services projects.

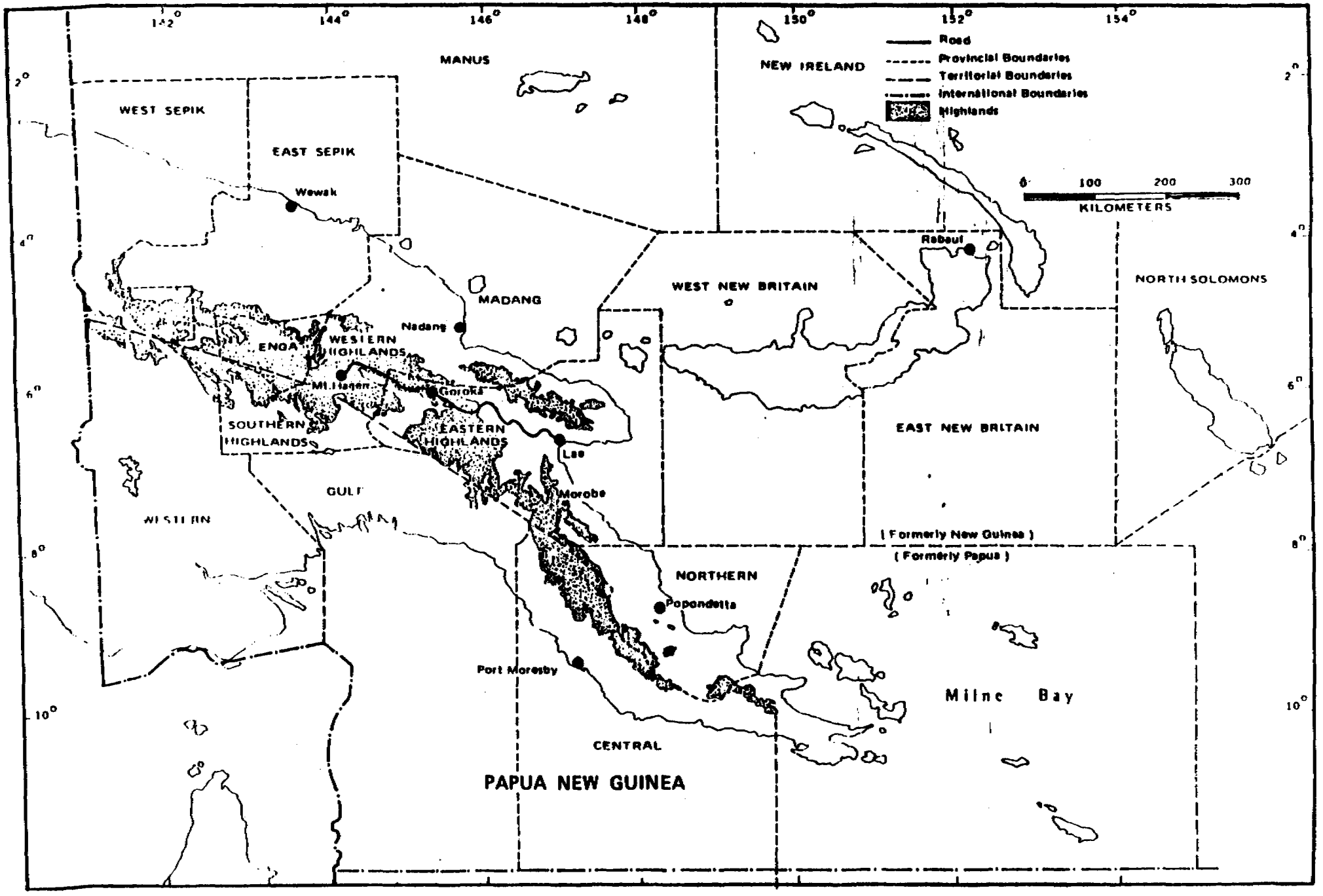
Anticipating a continuing Bank involvement in the water supply and sanitation sector in PNG, it was considered of high priority that the Bank should prepare a more detailed assessment of future sector demand, thereby determining the potential and possibilities for external financial assistance to the sector, and develop a pipeline of projects.

This Profile, prepared by Bank staff and consultants, is the result of the study. A draft was reviewed by the Government in May 1987. Though the Profile has been discussed by the Bank and the Government, it does not necessarily reflect formal Bank or Government views on the sector.

In producing the profile for wider dissemination, we hope that it will be useful to all interested in the past and future development of PNG's water supply and sanitation sector.

S. V. S. Juneja
Director
Infrastructure Department

TABLE OF CONTENTS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Nadzab
ENGA
WESTERN HIGHLANDS
Mt Hagen
Goroka
SOUTHERN HIGHLANDS
EASTERN HIGHLANDS
Lae
EAST NEW BRITAIN
GULF
Morobe
WESTERN
( Formerly New Guinea )
( Formerly Papua )
NORTHERN
Popondetta
Port Moresby
Milne Bay
CENTRAL
PAPUA NEW GUINEA

# SUMMARY AND RECOMMENDATIONS

## Introduction

1. This profile of the water supply and sanitation sector of Papua New Guinea has the following objectives:

(i) to produce a reference document based on analysis of existing data;

(ii) to assess the water supply and sanitation sector performance to the extent that available information and analysis permit this (this includes assessment of sector approaches and strategies);

(iii) to identify and define policy issues;

(iv) to establish the need for more detailed policy-oriented studies as an input into the formulation of a national water supply and sanitation policy, including broad terms of reference for such studies; and,

(v) to identify priority investment programs in the sector, particularly those which need to be supported by external agencies.

## Sector Policies and Plans

2. From independence until 1985, Government policies were guided by the National Development Strategy and its program detailed in the National Public Expenditure Plan (NPEP). The principal policies relevant to the water supply and sanitation sector recognized the need to increase government provision of infrastructure to rural areas and small towns, noted the importance of cost recovery particularly in urban areas, and limited urban water supply and sanitation schemes to those that would be necessary for basic health and safety.

3, Until 1982, responsibility for water supply and sewerage rested with the then Department of Works and Supply (now Department of Works or DOW). However, under the National Water Supply and Sewerage Act of 1982, a new authority, the National Water Supply and Sewerage Board (the Waterboard), was established and made responsible for the development of the water supply and sanitation sector throughout the country. The Act empowered the Waterboard to declare as districts nationally administered water supplies and sewerage facilities in the country, regulate the operations of water supply and sewerage systems run by other organizations or agencies, (e.g. provincial governments, local governments, missions, statutory authorities, private enterprises, etc.), and set water supply and sewerage tariffs. In the face of limited financial resources with which to pursue economic development, the Government has moved steadily toward reducing the amount of Government subsidy to the sector by requiring consumers to pay for the costs of providing water supply and sewerage services particularly in the larger urban areas. By the end of 1985 the Government had succeeded in converting a K3.5 million subsidy to the four Waterboard districts of Lae, Madang, Wewak and Mt. Hagen into a

K0.5 million surplus over operating costs. Subsequently, as a result of the success with cost recovery, in January 1987, the Government converted the Waterboard into a commercial statutory authority (CSA) under a new (1985) Act that concentrates on undertaking revenue-generating activities. As a CSA, the Waterboard is required to earn a rate of return on its investments as set by the Budget Priorities Committee each planning period and will undertake noncommercial activities as requested by the Government only when the necessary subsidy funds are made available. The Budget Priorities Committee has set 1990 as a target year for the Waterboard to achieve full cost recovery (i.e. operation plus capital costs).

4. Inspite of this emphasis on cost recovery, equity and social considerations predominate. The Government recognizes that safe water is an essential commodity that should be made available to the entire population, and this has been considered in the formulation of the tariff structure and in the financing arrangements for rural water supply and sanitation facilities. The Waterboard currently enforces a uniform national tariff that calls for the cross-subsidization by the more viable districts of the less viable ones where tariffs ought to be higher. In the rural areas, where many people still have to enter the cash economy, all water supply and sanitation systems continue to be financed as grants. Tariffs are virtually non-existent, and operations and maintenance (O&M) costs are borne by the governments subject to availability of funds. In the development of rural water supply and sanitation facilities, the Government has enunciated a policy of self-help and community participation in the construction and management of water supply and sanitation systems. The Government is likewise promoting the utilization of simple and appropriate technology.

Institutional Framework

5. The principal agency concerned with water supply and sanitation is the Waterboard that was established in September 1982 as a government agency. The Waterboard was subsequently converted into a commercial statutory authority with full financial powers and hiring authority effective 1 January 1987 through the National Water Supply and Sewerage Act 1986. The Waterboard is charged with the coordination of planning, design, construction and management of water supply and sewerage facilities, and setting of tariffs. To date, it operates four declared water districts (Lae, Madang, Wewak and Mt. Hagen) and two sewerage districts (Lae and Madang). Increasing responsibilities are anticipated in the future as new systems commence operations as districts and more systems are taken over by the Waterboard.

6. The responsibility for the operation of the water supply and sewerage district in the capital, Port Moresby, is handled by the National Capital District Interim Commission (NCDIC). This system, which is the biggest in the country, is expected to be taken over by the Waterboard within 1987. In smaller urban areas and institutions, water supply and sanitation facilities are operated by local authorities, DOW, or private organizations, such as religious missions.

7. Responsibility for the development and management of rural water supply and sanitation facilities has been delegated by the Waterboard to

the Department of Health (DOH) until 1990. DOH undertakes the implementation of rural water supply and sanitation projects through the Environmental Health Section (EHS) of provincial governments. DOH undertakes policy-making, planning and staff training at the national level, while the EHS in each province takes charge of planning, design, construction and, to a certain extent, maintenance of the systems. Other organizations involved in rural water supply include: the Local Government Councils, which are responsible for the operation and maintenance of water supply schemes at the local level; and the Local Government Section of DOW, which provides assistance in the design and construction of facilities, and in the training of staff who will be involved in the construction of rural water supply systems.

Public Health and Environmental Aspects

8. Information on the health situation of the country is limited and varies somewhat in reliability from province to province. The leading causes of morbidity and mortality are communicable diseases, including water-borne and water-related diseases, which results from a poor environment and lack of health facilities, services and disease control program. Filariasis is reported in the western province and typhoid is endemic. Many natural water sources used for drinking and for domestic purposes show the presence of bacteria associated with wastewater and poor sanitation practices. Although PNG posted sustained declines in morbidity and mortality over the past 10 to 15 years, the health situation is still far from satisfactory when compared with other countries. Moreover, further substantial gains in health status will be more difficult to achieve and will require considerable social, economic, environmental and nutritional improvements in addition to the provision of better health services.

Water Supply

9. Of the total population of 3.3 million (1985 estimate), about 430,000 people or 13 per cent lives in urban areas while the remaining 2.87 million or 87 per cent lives in the rural areas. There is no accurate estimate of the number of people with access to safe and reliable water supplies. Water supply facilities however, are available to an estimated 33,300 households or 41 to 52 per cent of total urban population, and to 14 per cent of the rural population. The vast majority of the population obtain their drinking water from unprotected sources, usually streams, rivers, springs, open shallow wells and, in urban areas, rainwater collectors. The limited water testing which has been done in recent years indicates that most of these traditional water sources are subject to fecal contamination.

Sanitation

10. Only 17 areas have piped sewerage systems that serve approximately 11.4 per cent of the country's total population. There are no reliable estimates on the percentage of rural households with sanitary excreta disposal facilities but recent surveys conducted by DOH place this at about 52 per cent.

11. In urban areas, the method of excreta disposal varies widely, ranging from the conventional water-borne sewerage system to the less sanitary pit latrines and pan collection. In the rural areas, the most common sanitary facility is the pit latrine, which is often constructed with local materials. The adoption and use of latrines by the rural population, however, has been very slow and a substantial number of people still prefer to use the surrounding areas for excreta disposal.

Financing

12. Funds for the planning, development, and management of water supply and sanitation facilities are provided from government funds (consisting of internal revenues, borrowings and the Australian Budget Support), external sources and, to a very limited extent, customer collections. Government investments have been channelled mainly to the urban water supply and sanitation subsector, which received a total of K20.3 million from 1981 to 1985. For the period 1983-1985, the rural subsector obtained only 2.09 million.

13. Cost recovery is implemented only in the Waterboard districts, Port Moresby and in three other urban areas where a flat tariff is normally applied. The Waterboard's tariff structure provides for a uniform national tariff, cross-subsidization among the various types of consumers, and progressive increases in water tariff relative to consumption in order to discourage wasteful usage of water. Except in Port Moresby, Goroka, Arawa, and Rabaul which apply different tariffs water is provided free of charge in all other areas. The concept of water charging is relatively new in PNG and is far from being accepted. As a result, water supplies get to be maintained only when the concerned authority has funds for such purpose.

Private Sector

14. Private sector involvement in the water supply subsector has been directed mainly to the provision of services to the urban subsector specifically to the Waterboard. As PNG suffers from a lack of skilled technicians and professionals, the consulting industry is dominated by foreign consulting firms from the more developed countries. Local manufacturing capability is quite limited and, except for basic materials and equipment, other items required for water supply and sanitation projects have to be imported. In the rural areas, the government is aiming to elicit greater community involvement by requiring members to participate in the construction and management of water systems. Local construction capability is adequate and involvement of international contractors is generally secured only for the bigger projects.

Issues and Recommendations in the Water Supply and Sanitation Sector

1. Policy and Planning

15. There has been no attempt to undertake comprehensive planning for the development of the entire water supply and sanitation sector. Although the Waterboard assumes overall control of the sector, its planning activities are limited to the bigger urban systems that are

the Department of Health (DOH) until 1990. DOH undertakes the implementation of rural water supply and sanitation projects through the Environmental Health Section (EHS) of provincial governments. DOH undertakes policy-making, planning and staff training at the national level, while the EHS in each province takes charge of planning, design, construction and, to a certain extent, maintenance of the systems. Other organizations involved in rural water supply include: the Local Government Councils, which are responsible for the operation and maintenance of water supply schemes at the local level; and the Local Government Section of DOW, which provides assistance in the design and construction of facilities, and in the training of staff who will be involved in the construction of rural water supply systems.

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Issues and Recommendations in the Water Supply and Sanitation Sector

1. Policy and Planning

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potential Waterboard districts. Responsibility for the provision of water supplies and sanitary services for the rest of the country has been delegated to other authorities that have been considered the most suited in regard to their technical and organizational capability to carry out planning and implementation of water supply systems. Projects are planned considering the appropriate level of service and available technology but often in the rural areas when communities request piped water supplies authorities find it difficult to restrict this to the provision of simpler systems. Similarly, with pit latrines.

16. An integrated water supply and sanitation development plan should be prepared for the sector. This would include long-range plans based on a data bank of relevant information for each urban center, town, and village. The preparation of the initial development plan is suggested to be financed through technical assistance from an international funding agency. In addition, as a CSA, the Waterboard should bring forward the establishment of the planning unit to spearhead the development of a unified plan and strategy for the provision of water supply and sanitation facilities to the entire country. In planning for the provision of water supply and latrine systems, due consideration would be given to the type of system that is most appropriate for the community's needs. A clear definition of service levels of a water supply service should also be formulated as follows:

Level I - a point source system, usually with a handpump

Level II - piped water supply system with public standpipes

Level III - piped water supply with metered house connections

17. As a CSA, the Waterboard would exercise its role as the Government's chief regulatory and advisory body in all matters relating to water supply and sanitation sector in PNG. The Government should control the sector's development by directing all financial assistance to the sector through the Waterboard, which must be the coordinating agency for all sector projects.

2. Lack of Skilled Manpower

18. There is a lack of technical and other trained personnel for successful sector development and operation. This problem is closely tied up to the inadequacy of local training facilities and funding, the lack of formal training and the limited number of people with any formal education.

19. Investment and other incentives should be offered to encourage foreign owned firms to assist nationals to practice in the country. In addition, the Government can impose certain measures to promote the transfer of skills and knowledge to PNG citizens. For instance, foreign consulting or construction firms should be assisted to hire national professional staff, or to enter into joint venture agreements with local consulting or construction firms.

20. Training facilities and programs oriented toward water supply and sanitation, and geared to the development of a competent cadre of professionals and subprofessionals should be initiated to meet present and future manpower needs. This could be done by establishing a professorial chair in water supply or sanitation engineering or sponsoring scholarships to attract promising students to take up water supply or sanitation related courses.

### 3. Operations and Maintenance

21. Poor operations and maintenance of water supply and sanitation systems are common in both urban and rural areas. This is attributed to insufficient operating funds and technical expertise, lack of commitment from the rural communities to properly maintain the systems and lack of personnel. A high level of nonrevenue water has been noted in some areas, including in Port Moresby, and water quality surveillance is not regularly undertaken for most systems. Except for some notable exceptions, the operations and maintenance of sewerage systems also leave much to be desired. Many of the sewerage systems do not have O&M manuals, and routine maintenance activities are not regularly undertaken. In rural areas, problems include the failure to keep latrines clean and free from offensive odors.

22. Staff training on preventive and routine maintenance activities should be instituted, simple operating and repair manuals prepared, and O&M given funding priority in order to prolong the serviceable life of water supply and sewerage systems and postpone costly investments in future works. In addition, greater community involvement and participation in both system construction and maintenance should be encouraged, and community members trained to undertake basic maintenance and repair of rural water supply systems. The replacement of pit latrines with ventilated improved pits or water-seal toilets should be promoted to minimize problems identified with pit latrines.

### 4. Inadequate Health Education

23. There is very little health education at the village level and little or no primary health care activities are undertaken. The importance of preventive health measures, personal and household hygiene, safe drinking water and sanitary latrine facilities are not adequately imparted to rural health workers, who in turn are unable to properly educate the villagers. As a result, a substantial number of the population continue to rely on traditional water sources and methods of excreta disposal, which tend to worsen health and environmental problems.

24. Safe water supplies and sanitary excreta and wastewater disposal practices are considered essential in the promotion of primary health care. Villagers should therefore be assisted and educated on the importance of water and sanitation to the improvement of health and the environment. Various health education programs should be carried out at the village level, taking into account available information on the knowledge, attitudes, beliefs, and practices of each village to serve as adequate bases for determining the nature and scope of health education programs and activities. These activities should be supported by

sanitarians and health educators operating from aidposts and health subcenters. They should be trained in health education, in dealing with problems relating to customs and traditions affecting usage of water and excreta disposal, in protection of water sources, and in latrine construction.

### 5. Financing and Cost Recovery

25. Although the Government is optimistic regarding economic performance over the next five years, the financial resources needed to finance sector development at an accelerated pace may not be available. External assistance to the sector has decreased in previous years, and this trend is expected to continue with the reduction in the Australian Budget Support.

26. If the sector targets are to be met, cost recovery would have to be increased in areas where water charging is already being practised, and introduced in areas where water is still provided free of charge. Tariffs should be periodically reviewed and, if necessary, restructured. The Waterboard should request the Government to review the rate of return for Waterboard operations taking into account the socio-economic impact of sector projects. It is suggested that the rate not be higher than 3 per cent, and this should be achieved over a ten-year period. It may also be worthwhile to explore the possibility of recovering additional costs from commercial and industrial users in order to provide more substantial cross-subsidization between consumer types. In urban centers of other developing countries like Malaysia, Indonesia and the Philippines, commercial users are usually charged around 2.5 times more than residential users. Waterboard policy on uniform tariffs should likewise be reviewed. With uniform tariffs, cross-subsidies from the larger to the smaller water districts and from the ground water to the surface water schemes are a feature of the tariff structure. As there are wide variations in the cost of water between water districts, uniform tariffs could presumably lead to problems of inefficient locational decisions, particularly by industries using large quantities of water. The price paid by consumers should reflect the costs of providing the service, and consumers' "willingness to pay" should signal service standards and augmentation decisions.

27. In the rural areas, the Government should move away from the tradition of providing all services, including water, free of charge. The Government should study the feasibility of funding the capital costs of rural water supply schemes through a mix of grants and loans to the community. Prior to the construction of the water system, the community members should commit to undertake the operation and maintenance of the water supply systems, including the payment of water charges to defray O&M and, if applicable, amortization and other expenses.

28. More detailed studies could be carried out, possibly with the help of consultants, to establish institutional and financial guidelines in the implementation of the water supply and sanitation development program. These studies will determine suitable financing arrangements, including the share in the capital costs of both the Government and the

community in the case of rural water supply schemes. It will likewise determine the possible extent of cost recovery based on estimates of the community's willingness and ability to pay.

6. Organizational Strengthening of Waterboard

29. The two principal functions of the Waterboard are to provide adequate water supply and sanitation services on a commercial basis in urban areas and to promote water supply and sanitation in urban fringes and rural areas. To be able to perform these functions effectively, the Waterboard has to be provided institution-building assistance to hone its capability to lead in the planning, provision and maintenance of water supply and sanitation services throughout the country. In addition, its present staff of engineers and accountants, the Waterboard will need economists and management specialists. Staff training geared towards achieving greater operational and financial efficiency will have to be given greater emphasis particularly in areas where the Waterboard's capability is weakest.

30. In the rural areas, for instance, the Waterboard can collaborate with other organizations in the development of training programs for ground water prospecting, hydrogeological investigations and in the use of hydrogeological instruments, such as simple resistivity instruments. This could be done with the assistance of international organizations.

Proposed Sector Investments

31. A summary of proposed sector investments as determined in this study is presented as follows:

Summary of Sector Investment Requirements (in 1986 Prices)
(in Kina Million)

| Subsector | Executing Agency | Amount (K) | Amount ($) |
|---|---|---|---|
| Urban Water Supply a/ | Waterboard | 36.16 | 37.28 |
| Rural Water Supply c/ | MOH b/ | 49.22 | 50.58 |
| Urban Sanitation d/ | Waterboard | 14.20 | 14.64 |
| Rural Sanitation e/ | MOH b/ | 7.20 | 7.42 |

a/ Port Moresby, 1986-2000
Other Urban Areas, 1986-2000
b/ Through the Waterboard
c/ Port Moresby, 1986-1990
d/ 1987-1998
e/ 1987-1995

Source: National Ministries, Departments, the Waterboard and study estimates, 1986.

# PART ONE

## THE CONTEXT

### I. INTRODUCTION

1. Since the country's independence on 16 September 1975, the Government of Papua New Guinea (PNG) has accorded high priority to the improvement of water supply and sanitation services. Particular emphasis has been placed on the establishment of suitable institutional arrangements in order to facilitate the development of the sector. In 1982, the National Water Supply and Sewerage Board (the Waterboard) was established and entrusted with the responsibility of coordinating the planning, development, and management of water supply and sanitation facilities in the whole country. The Government subsequently transformed the Waterboard into a Commercial Statutory Authority (CSA) resting it with full corporate powers to efficiently undertake the development of water supply and sewerage systems throughout the country.

2. The Bank has assisted the water supply and sanitation sector in Papua New Guinea with two technical assistance amounting to a total of $365,000 1/ and two loans amounting to a total of $18.9 million. 2/ Technical assistance studies focused on the determination of the most appropriate institutional, managerial and financial arrangements for the sector while the loans financed the development of piped water systems in the provincial capitals of Lae, Wewak, Mt. Hagen and Madang. Bank assistance has likewise been extended for the provision of water supply facilities in the rural areas through Bank-financed rural health services projects. 3/

3. On 26 December 1985, the Bank approved technical assistance (TA No. 736-PNG: Water Supply and Sanitation Systems Review) to the Government of Papua New Guinea in the amount of $200,000. The principal objective of the technical assistance was to review the water supply and sanitation sector, in order to determine the possibilities for Bank assistance to the sector in the future and thereby develop a pipeline of projects for Bank consideration. A detailed institutional study was likewise carried out to assist the Waterboard in planning and developing the sector and its institutions, and in improving the management of the financial and technical activities of the Waterboard and the four districts it manages. The technical assistance was carried out by consultants. Mr. P. Wallum (Project Economist, Water Supply Division) was the Mission Leader and assisted the consultants with the economic and financial analyses. A list of persons met in Papua New Guinea is shown in Appendix 1.

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1/ TA No. 179-PNG: Water Supply ($165,000) 1976; and TA No. 736-PNG: Water Supply and Sanitation Systems Review ($200,000) 1985.

2/ Loan No. 278-PNG: Water Supply ($13.5 million) 1976; and Loan No. 346-PNG: Second Water Supply ($5.4 million) 1978.

3/ Loan No. 586-PNG: Rural Health Services Project ($12.0 million) 1982; and Loan No. 746-PNG: Second Rural Health Services Project ($13.8 million) 1986.

## II. BACKGROUND

4. Papua New Guinea is situated between Australia and the Pacific Ocean. It has a land area of about 461,700 sq km and a population of 3.33 million (1985 estimate) growing at an average annual rate of 2.0 per cent over the last five years. The bulk of the population (87 per cent) lives outside the urban areas, frequently in very isolated and primitive conditions. Among the Bank's developing member countries, PNG has one of the lowest densities at seven persons per sq km with the largest aggregation of people found in the National Capital District, Port Moresby (123,000 in 1980). The rugged mountain ranges at the mainland and some 600 widely scattered islands form a unique demographic pattern characterized by pockets of population separated by considerable distance. PNG's topography is characterized by wide valleys, large rivers, extensive jungles and coastal swamps. Lowlands are hot and humid while the extensive highlands have cool temperatures.

5. PNG is one of the largest constantly wet areas in the world. Several large areas receive more than 400 cm of rain a year, and a few centers have averages of more than 700 cm over short periods. Except for limited areas, average annual rainfall everywhere is estimated to be well over 200 cm. Despite the overall abundance of rainfall, however, problems regarding availability of safe water are encountered in most parts of the country. The country's natural resource endowment is substantial, but constraints include a severe shortage in investment resources and skilled manpower, inadequate physical and social infrastructure, a land ownership system that makes efficient land utilization extremely difficult, and weak institutional capability. The modern sector of the economy accounts for about 60 per cent of aggregate production but only 13 per cent of total employment. It is dominated by a relatively large public sector and an enclave mining sector, comprising large-scale copper and gold development at Bougainville and Ok Tedi. The modern sector also includes small manufacturing enterprises, retailing, banking and service industries, and plantations and estates. The traditional sector, which accounts for the livelihood of the remaining 87 per cent of the work force, is primarily dependent on subsistence agriculture supplemented by the cultivation of cash crops. Overall production of cash crops has expanded at an accelerated rate in the past decade on account of the rapid increase in the production of oil palm. Selected economic indicators for the country are presented in Appendix 2.

6. The proportion of the population with access to safe and adequate supply of water is estimated at about 41-52 per cent in urban areas and only 14 per cent in rural areas. Only 17 towns have central sewerage systems servicing approximately 11 per cent of the country's total population. The rest of the population depend on traditional methods of excreta disposal, particularly in the rural areas where only 52 per cent of the population are equippoed with sanitary latrine facilities. Per capita investment in the water supply and sanitation sector in PNG was relatively lower than the investments of other countries in the region in 1985 as

shown below:

| Country | 1985 Per Capita Investment ($) Water Supply | Sanitation |
|---|---|---|
| Solomon Islands | 42 | 23 |
| Fiji | 135 | 143 |
| Cook Islands | 93 | 110 |
| PNG | 49 | 17 |

## III. NATIONAL POLICY ON WATER SUPPLY AND SANITATION

7. From independence until 1985, Government policies were guided by the National Development Strategy and its program detailed in the National Public Expenditure Plan (NPEP). The principal policies relevant to the water supply and sanitation sector emphasized government provision of infrastructure to rural areas and small towns, noted the importance of recipients' paying the operational costs of services (especially in urban areas), and limited urban water and sanitation schemes to those that would be necessary for basic health and safety.

8. Until 1982, responsibility for water and sewerage rested with the then Department of Works and Supply (now Department of Works (DOW)). However, under the National Water Supply and Sewerage Act of 1982, a new authority, the National Water Supply and Sewerage Board (the Waterboard) was formed and made responsible for the development of the water supply and sanitation sector throughout the country. Following the Act, the Waterboard has assumed control of the management of four water supply systems (Lae, Madang, Wewak and Mt. Hagen) and two sewerage systems (Lae and Madang) (see also para 15). Responsibility for the operation and maintenance of other urban water supplies remain with the local authorities, while the Department of Health (DOH) and village councils retain control of rural water supply and sanitation.

9. The Government of PNG in 1984 initiated a review of existing national policy, the purpose of which was to develop and implement a Medium-Term Development Plan covering the period 1986-1990. The Waterboard's draft plans for the same period were incorporated in this Plan. With the change in government in November 1985, however, a number of policy and procedural reforms were initiated including the reshaping of the planning and programming mechanism in the country. The new Government did not consider the Medium-Term Development Plan formulated by the previous government a substantial improvement over the NPEP. Hence, the plan was replaced by a number of sectoral investment programs that were included in the budget documents presented to Parliament in March 1986. For 1986, the "infrastructure sector", which includes the development of water supply and sanitation facilities, was allocated K122.6 million, or 16.6 per cent less than the 1985 allocation. Of this, a total of K9.0 million was earmarked for capital works in the water supply and sewerage sector.

10. The National Water Supply and Sewerage Act of 1982 empowered the Waterboard to declare as districts nationally administered water supplies and sewerage facilities in the country, and to authorize other bodies (e.g. national government authorities, provincial governments, local governments, missions, statutory authorities, private enterprise, etc.) to construct, operate, maintain, and collect tariffs for facilities administered by them. Part of the Waterboard's responsibility is the setting of water tariffs as cost recovery is one of the Government's ultimate objectives in providing urban infrastructure (the other being affordability). The aim is to achieve full cost recovery within declared water and sewerage districts by 1990. Full cost recovery is taken to include the costs of operation and maintenance (O&M), interest, capital depreciation, capital additions, administrative and general expenses and opportunity costs of capital. To keep water service affordable while recovering costs, the Waterboard in

July 1986 introduced a uniform national tariff providing for progressive water charges and cross-subsidization between different categories of consumers and between declared districts.

11. Policies and strategies for improving access to sanitary facilities for excreta disposal are considerably less clear than they are for water supplies. While urban households are equipped with sanitary facilities of some kind, the latrine programs launched in the rural areas have failed to elicit the interest of the rural communities such that the majority still resort to traditional, not very sanitary means of excreta disposal. In general, the plan is to encourage rural communities to construct pit latrines through health education and by the provision of demonstration latrines at schools and health facilities. In practice, the provincial rural water supply and sanitation programs are primarily or, in many cases, totally water supply projects. In both urban and rural areas, the provision of sanitary waste disposal facilities to the people has been hampered by inefficient planning, inadequate financial resources, and the absence of a unified strategy.

12. In December 1986, the National Water Supply and Sewerage Act of 1986 was passed by Parliament to better define the Government's thrust in expanding the coverage of water supply and sanitation facilities in both urban and rural areas. More important, the Act provided for the transformation of the Waterboard into a commercial statutory authority with full financial powers, and recruitment and hiring authority effective 1 January 1987 (see Appendix 3). Waterboard operations in the past have been hampered by its dependence on DOW for basic support services ranging from technical maintenance to accounting, and by the centralization of administration that led to the predominance of the Department of Finance and the Public Service Commission. As a CSA, the Waterboard will now have greater autonomy in conducting its affairs. It will operate primarily as a commercial enterprise oriented toward financial self-sufficiency, to be subsidized only if noncommercial activities are undertaken as required by the Government. The Waterboard's commercial activities will be concentrated in the large urban towns, while noncommercial activities will be undertaken in smaller, less populated urban centers. 1/

13. Water supply and sanitation in rural areas and urban fringe areas, on the other hand, will remain the responsibility of DOH, which is committed to accelerate its efforts to expand the current service coverage. In the development of rural water supply and sanitation facilities, continuing emphasis will be given to the utilization of appropriate 2/ technology and inviting community participation for the development as well as the subsequent operation and maintenance of the system. Increased community involvement is perceived to be necessary in enhancing the community members' commitment to properly and responsibly manage the systems.

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1/ An urban area was defined in the 1980 census as a settlement with a generally urban character and a minimum population density of 195 persons per sq. km. (see also para 31 for definition of urban areas).

2/ Appropriate technology is defined as technology which, among several alternatives, satisfies the identified demand and/or need in a manner that is technically, socioeconomically and culturally acceptable, and which is affordable to the user.

## IV. INSTITUTIONAL FRAMEWORK

### A. National Water Supply and Sewerage Board

14. The principal agency concerned with water supply and sanitation is the Waterboard. The Waterboard was established in September 1982 through the National Water Supply and Sewerage Act to institutionalize cost recovery and comply with loan covenants set forth for the Bank-assisted water supply projects. 1/ The Waterboard is charged with the coordination of planning, design, construction and management of water and sewerage facilities throughout the country and for setting rates. Its corporate powers and functions are vested in the Board of Directors comprising representatives from the Department of Works, the Department of Finance, the Department of Health, private consumer groups, the PNG Institute of Accountants and the Society of Professional Engineers of PNG. Members are appointed for a term of three years by the Head of State by notice inserted in the National Gazette. The role of the Board is to evolve and implement policies within the bounds of the Act, for effective technical and financial management.

15. The Waterboard is headed by a Managing Director and currently has a staff of 110 persons. Under the new organizational structure the Waterboard is divided into three divisions: Engineering, Operations, and Commercial (see Appendix 4). Field operations continue to be organized around gazetted water and sewerage districts, each supervised by a District Manager. To date, only four water districts (Lae, Madang, Wewak and Mt. Hagen) and two sewerage districts (Lae and Madang) have been declared.2/ Further districts will be declared in the large centers and initially, priority will be given to nationally owned water or sewerage schemes. New projects for urban water supply or sewerage works will commence operations as districts. This expansion in the Waterboard's responsibility and the recent change in its status to that of a CSA has placed heavy burdens on the present management, requiring urgent strengthening of the organization and its resources.

### B. National Capital District Interim Commission

16. At present, the water supply and sewerage system in the capital, Port Moresby, is the responsibility of the National Capital District Interim Commission (NCDIC). The Port Moresby system is the largest in the country with about 16,000 connections to the water supply system and 10,500 connections to the sewerage system, and is easily the most financially viable system in the country. Within NCDIC, a staff of 198 oversee its water supply and sewerage operations (see organization chart in Appendix 6. The Port Moresby system is expected to be taken over by the Waterboard on July 1987.

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1/ Loan No. 278-PNG: Water Supply and Sanitation ($13.5 million) 1976 and Loan No. 246-PNG: Second Water Supply ($5.4 million) 1978.

2/ The organizational structure of these water districts are presented in Appendix 5.

C. Department of Health

17. Responsibility for the development and management of rural water supply and sanitation facilities has been delegated by the Waterboard to the Department of Health until 1990. At present, the Waterboard has no plans to assume responsibility for rural water supply and sanitation after 1990, and it is assumed that DOH and the provincial governments will continue to be responsible for them for the foreseeable future.

18. DOH undertakes the implementation of rural water supply and sanitation projects through the Environmental Health Sections (EHS) of the provincial governments, which are the principal agencies responsible for the planning, design, construction and, to a certain extent, maintenance of rural water supply and sanitation facilities. Each EHS is headed by a Provincial Health Inspector who manages a staff of Health Inspectors, artisans and laborers, who form teams to construct water supply and sanitation systems. DOH remains responsible for policy-making, planning and staff training. The National Environmental Health Section of DOH, which is headed by a Coordinator, has the responsibility for establishing policy and standards for rural water supplies and sanitation. 1/

D. Other Organizations

19. Water supply facilities in smaller urban areas and institutions are operated by local authorities, the Department of Works, or private organizations such as religious missions. Other organizations involved in water supplies and sanitation include the Local Government Councils, sometimes called District Councils, which have responsibilities for rural water supply projects at the local level. In some cases, they select which villages are to receive services and request feasibility studies to be undertaken by DOH or the provincial Local Government Section (LGS) depending on the size and complexity of the project. The Councils sometimes provide funds granted by provincial sources. Although the Councils are supposed to be responsible for the operation and maintenance of systems within their areas, most have not been able to establish viable organizations that can carry out institutionalized functions.

20. The LGS of DOW is also involved in the construction of rural water supplies, but usually only on a case-to-case basis and generally only with larger systems. LGS provides assistance in the design and construction of facilities, and in the training of rural water supply construction personnel. It designs mostly gravity systems, which are built by the community members under LGS supervision. Currently, it has a staff of 110. Additional information on LGS is given in Appendix 8. A list of water supply projects implemented by LGS in the Morobe province during the period 1983-1986 is likewise shown in Appendix 9.

21. The responsibilities of the various agencies and organizations involved in the water supply and sanitation sector are detailed in Appendix 10.

1/ The organizational structure of DOH is presented in Appendix 7.

## V. PUBLIC HEALTH AND ENVIRONMENTAL ASPECT

22. Information on the health and population situation of the country is limited and varies somewhat in reliability from province to province. Nevertheless, available indicators show a remarkable improvement in morbidity and mortality rates over the past 10 to 15 years. Infant mortality, although still high, declined substantially for the nation as a whole from 132 to 72 per 1,000 live births between 1971 and 1980. Country-wide average for child mortality rates decreased from 91 per 1,000 children (aged 1 to 4 years) in 1971 to 45 per 1,000 in 1980 and to 13 per 1,000 in 1985. The average growth rate of the population was estimated at about 2.0 per cent per annum for the period 1981-85 and is possibly slowly increasing as mortality is thought to be declining somewhat faster than fertility. The crude birth rate for the nation as a whole was estimated at 26.0 per thousand population in 1985 although there are substantial inter-provincial variations.

23. Available health indicators also highlight the disparity in health status between rural and urban communities, and the generally poor level of rural health. Life expectancy is one to two years longer in towns than in rural areas. 1/ Such disparity may be brought about by variation in travel time and distance to primary health services. In some areas, it takes more than two days to get to the nearest facility, although 95 per cent of the population is within two hours walk of a health facility.

24. The leading causes of morbidity and mortality are communicable diseases which result from a poor environment and lack of health facilities, services and disease control program. Hospital data indicate that water-borne diseases are among the leading causes of morbidity and mortality, generally more prevalent in the rural areas. Filariasis is reported in the Western Province and typhoid is endemic (see Appendix 11).

25. Although far from satisfactory when compared with other countries, the overall health picture is one of sustained declines in morbidity, particularly among infants and children, achieved mainly through control of infectious diseases and some improvement in nutritional status. Rural health services are thought to have had a substantial effect on the fall in mortality. However, it is likely that further substantial gains in health status will be more difficult to achieve and will require considerable social, economic, environmental and nutritional improvements in addition to the provision of better health services.

26. The Government has consistently given high priority to the development of health services specifically to the provision of primary health care in rural areas and lower-level facilities staffed by paramedical workers. The new Five-Year Health Plan seeks, inter alia, to continue the focus of previous policies on rural health services. Instead of expanding the rural health infrastructure, emphasis will be placed on improving the quality of health services, especially in high priority areas, such as maternal child health.

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1/ The expectation of life at birth (1985) was estimated at 50 years in urban areas.

27. Responsibility for health within the Government is shared between the national and provincial levels. At the national level, the Minister of Health, assisted by the Secretary of Health and staff of DOH, has overall responsibility for health services within the country including the provision of rural water supply and sanitation facilities. DOH is responsible for establishing overall policy guidelines for the country and for evolving plans on matters of national concern, e.g. manpower development and training. With the decentralization of various functions to the provinces, Provincial Health Officers have become responsible for the planning of activities within their jurisdiction.

28. Rural health services are administered in primary health service facilities consisting of aidposts, health subcenters, and health centers. In 1985, there were 2,231 aidposts and it is estimated that in January 1986 there were about 2,150 Aid Posts Orderlies (APO). Each aidpost serves from 500 to 3,000 people and provides mostly curative services and referral to health centers. The health subcenters, on the other hand, serve from 3,000 to 6,000 people and provide curative services and health education. The health centers serve from 5,000 to 20,000 people and provide curative services, supervision of aidposts and subcenters, disease control, environmental improvement, and health education. Only in exceptional circumstances are health centers staffed with doctors.

29. In 1984, primary health services accounted for 47.5 per cent of the health budget. Total health expenditures represent on the average about 20 per cent of Government spending. According to 1985 estimates, about 12 per cent of established positions for health workers remained unfilled. APOs, although paid by the Government, are not considered to be a part of civil service. Additional information about health workers is given in Appendix 12.

30. The water supply and sanitation sector is to be looked into in conjunction with other sectors and a linkage established where applicable. Such sectoral linkings, particularly with environmental aspects should be considered during project formulation and implementation. In this connection, the Bank's Environmental Guidelines for Selected Infrastructure Projects of June 1986 can be used.

# PART TWO

# WATER SUPPLY AND SANITATION: PERFORMANCE AND PROGRAMS

## VI. WATER SUPPLY

### A. Background

31. Information on the water supply and sanitation situation in the country is limited and generally urban-based. An urban area was defined in the 1980 census as a settlement with a generally urban character, and a minimum population density of 195 persons per sq km. Based on this criteria, some 63 areas are classified as urban in PNG with a total population of 0.39 million people (1980 census) representing 13 per cent of the country's total population. Table 1 shows the distribution of the urban population by size of towns.

Table 1. Urban Population by Size of Towns (1980)

| Population Range | No. of Towns | Total Population within the Range | Per cent of Population Urban | Per cent of Population Total |
|---|---|---|---|---|
| Over 100,000 | 1 | 123,624 | 32 | 4 |
| 10,000 - 99,999 | 7 | 162,336 | 41 | 5 |
| 1,500 - 9,999 | 22 | 79,705 | 20 | 3 |
| 500 - 1,499 | 33 | 27,466 | 7 | 1 |
| Total | 63 | 393,131 | 100 | 13 |

Source: 1980 National Population Census.

32. The remaining 87 per cent of the country's population comprising 2.62 million people live in rural areas. The number of rural communities is not known, but is estimated to range from 10,000 to 12,000 (see Appendix 13 for additional information).

### B. Urban Water Supply

#### 1. Existing Situation

33. At present, only 28 of the 63 towns in PNG have piped water systems although this is expected to increase with the installation of water supply systems in three additional towns. The existing systems serve about 33,300 households or an estimated 166,500 to 199,800 people, representing from 41 to 52 per cent of the urban population. The rest of the population depend mainly on rainwater collectors. Of the 28 towns with piped systems, 14 are found in the lowland provinces and five in the highland provinces of the country. The majority of the systems utilize surface water sources with yields ranging from 90 mld for the Port Moresby system to 0.2 mld for the Alotan water supply system. A number of the existing water sources are projected to meet water demand up to the year 2000. In general, the water supply in most of the towns with piped water

systems far exceed demand. This underutilization of system capacity may be attributable to inadequate reticulation system or, in some cases, to over-optimistic assumptions regarding the number of households and other users that would connect to the system. 1/

2. Operations and Maintenance

34. The operations and maintenance of urban water supply schemes is undertaken by the Waterboard for the four districts under it, NCDIC for the Port Moresby system, and the local authorities for other urban systems. A unique case of private sector involvement in the operation of a water supply and sewerage system exists in Kiunga, a small urban area serving as a river port for the huge private mining complex, the Ok Tedi group of companies. Here, the Government pays the mining complex to operate and maintain the water supply and sewerage systems.

35. Except in the Waterboard districts and in Port Moresby a substantial number of service connections in all urban areas remains unmetered particularly in urban centers where the concept of charging consumers for the cost of water supplies has not been introduced. In areas where water meters have been installed, collection of water tariffs is sometimes impaired when meter breakdowns occur. It has been observed that water meters used in PNG are quite delicate and are easily damaged even by small quantities of solid matter present in the water, such as for instance, fine sand from boreholes or deposits from mains. This situation has been aggravated by the absence of a program for the regular cleaning and repair of meters and is reflective of a bigger problem regarding the poor maintenance of water supply systems throughout PNG. Routine and preventive maintenance activities such as the replacement of defective or missing parts and equipment, removal and overhauling of pumps, desilting of bores, and cleaning of screens are not systematically undertaken. Manuals on operations and maintenance are generally not available and the few existing ones are deficient and need to be improved. Many systems are likewise faced with the problem of high non-revenue water (NRW). Leakages in the distribution system, and measurement and billing errors are among the reasons cited for this situation. In Port Moresby, for instance, the prevailing practice is to read meters only twice a year but to prepare billings every quarter. This implies that billings are based more on estimates than on actual volume of water consumed for the billing period. As there is a long interval in between readings, meter breakdowns are not immediately discovered and repaired, thus increasing the likelihood of committing errors in the measurement of water consumption.

36. There are two levels of responsibility for surveillance of water quality in PNG. Overall responsibility rests with DOH, which monitors water quality in the whole country. In addition, the various agencies involved in the operation and management of water supply systems conduct their own water sampling and bacteriological analysis to ensure that water produced is safe for drinking. While monitoring standards and frequency of sampling have been prescribed, such standards are oftentimes not followed

1/ Additional information about urban water supply is given in Appendix 14.

and the regularity and thoroughness of water quality testing varies from one system to another. In fact, the Waterboard itself has no regular program for bacteriological testing and only undertakes residual chlorine tests.

37. Three institutions carry out standard bacteriological and/or chemical tests of water: (i) Central Public Health Laboratory of Port Moresby General Hospital; (ii) PNG University of Technology at Lae; and (iii) Laboratory of the training school of DOW in the National Capital District. For declared districts, the Waterboard has prepared a list of sampling requirements for bacteriological testing of water supplies (see Appendix 15).

### 3. Development Plans

38. Although nearly all major towns have piped water supply systems, only about half of the urban population is connected to the water mains. The remaining half uses alternative water sources such as rainwater collection and storage systems that are generally inadequate and of doubtful quality. The development plans for urban water supply will aim to provide these urban communities that are currently unserved with safe and reliable piped water supplies whenever such systems are technically and financially viable. The underutilization of existing water supply systems in a number of towns also has to be considered in development plans, especially since the Waterboard will have to recover costs and realize a return on its investments.

39. The estimated costs of the proposed capital works program for urban water supply for the period 1986-2000 are summarized in Table 2.

Table 2. Proposed Urban Water Supply Projects
('000 in 1986 prices)

| | Total Estimated Costs | |
|---|---|---|
| | K | $ |
| Port Moresby (1986-1990) a/ | 12,510 | 12,897 |
| Urban Water Supplies b/ | 23,650 | 24,381 |
| Total Estimated Costs | 36,160 | 37,278 |

a/ Details of these estimates are given in Appendix 16.
b/ Details of these estimates are given in Appendix 17.

Source: Study estimates.

40. The 1987 Government Budget Document explains the infrastructure sector objectives and the role of the Government as follows: "The role of Government in this sector is to ensure that services are provided as efficiently as possible whether this is done directly, through statutory

organizations or the private sector. While maximum economic efficiency and cost recovery are the general objectives which apply to this sector, emphasis will also be given to equity considerations in the planning of new infrastructural investments and to operational efficiency."

41. The Budget Document provides information on planned development expenditure for the period 1987-1991. The urban water supply projects listed in the Budget Document are given in Appendix 18 and estimated costs are summarized in the following Table:

Table 3. Planned Urban Water Supply Projects, 1987-1991
('000 in 1986 prices)

| | Total Estimated Costs | |
|---|---|---|
| | K | $ |
| Urban Water Supply Projects | | |
| Continuing Projects | 2,071 | 2,135 |
| New Projects | 18,790 | 19,371 |
| Subtotal | 20,861 | 21,506 |
| Urban Water Supply and Sewerage Projects a/ | 774 | 798 |
| Total | 21,635 | 22,304 |

a/ In two towns, costs of water supply and sewerage schemes are combined.

Source: Budget 1987-1991, MOF, 1986.

C. Rural Water Supply

1. Existing Situation

42. There is no accurate estimate of the percentage of the rural population with access to reliable water supplies. Village surveys conducted in the mid-1970s found that 77 per cent of the villages had what was then called an adequate supply of water throughout the year. However, information from the provincial water supply and sanitation surveys conducted by DOH indicates that only an estimated 14 per cent of the rural population has access to a safe and reliable supply of drinking water.

43. The vast majority of the rural population obtain their drinking water from unprotected sources, usually streams, rivers, springs or open shallow wells. The usual measure of a water source's acceptability is its distance from the household and the traditional uses which have been associated with it. The limited water testing which has been done in recent years indicates that most of these traditional water sources are subject to fecal contamination (see Appendix 19).

44. The provincial Environmental Health Sections use three basic types of water systems for providing water supplies to rural communities. These are: rainwater catchment and storage; shallow wells, generally with handpumps; and reticulated or piped water supplies usually with water distribution through public taps by gravity. All of these systems have been in use in the country for many years and are generally well understood by EHS staff in most provinces. The basic technologies being used now are essentially appropriate choices 1/ for use in the rural areas of PNG, and past failures and inefficiencies appear to be largely the result of selecting the wrong system for a particular community, incorrectly sizing the system and failing to provide any sort of organized maintenance for the system once it is placed in operation.

45. While rainwater catchment and storage systems represent a good choice for providing water supplies to institutions in areas with regular rainfall, they have not proven effective for use as community systems for several reasons. Very few rural communities have communal buildings with roof areas large enough or of the right material to serve as a catchment area. In those communities that do have a building with a suitable roof surface for rainwater collection, the amount of storage provided is usually determined without consideration of the actual storage and roof area required to ensure sufficient water supplies for all of the intended users. Finally, even if sufficient catchment area and storage volume is provided, very few rural communities have the self-discipline and organizational capabilities to ration water during periods of light or no rainfall. In practice, community rainwater catchment and storage systems tend to be used during periods of good rainfall, but have to be abandoned by most of the users for other sources during periods of light or no rainfall.

46. Shallow wells equipped with hand pumps have been used to provide community water supplies. They have, however, developed a very poor reputation for reliability and are generally not considered by either the public or the government agencies to be a desirable system. Many of the hand pumps that are used were designed for single family installations and do not stand up well to heavy community use. But the principal reason for their frequent breakdowns is that no method was provided to maintain the systems. While the same thing can be said of piped water systems, it must be pointed out that the failure of one part of a piped water system does not necessarily shut down the entire system as it frequently does with a hand pump.

47. Piped water systems are the type of water system preferred by rural communities. These systems are perceived as providing a higher level of service and greater reliability than either shallow wells with hand pumps or rainwater collection and storage systems. Consequently, they receive priority in the provincial rural water supply program. The bulk of the funds alloted to rural water supplies is spent on piped systems and most of the organizational effort is directed to them.

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1/ For definition of "appropriate technology," see para 13. See Appendix 19, pages 3-5 for proposed preselection information and selection criteria required for community water supply and excreta disposal practices.

### 2. Operations and Maintenance

48. There is very little data available on the operational condition of rural water supplies constructed in recent years. Information from the provincial water supply and sanitation surveys undertaken by EHS indicate that the percentage of these systems out of order or providing inadequate levels of service is very high. The principal problems with the systems are failed hand pumps on shallow well systems and silted up intakes, plugged pipes and broken valves and taps in piped water supplies. Vandalism, often associated with the tribal practice of "payback", is also responsible for a considerable amount of the maintenance problems in some areas.

49. It is the Government's intention that operation and maintenance be the responsibility of the community served by the water system. The only direct rural water system maintenance responsibility accepted by Government are for systems which primarily serve government institutions. However, in practice, it appears that most of the maintenance activities carried out are performed by the water system construction teams of EHS or, in some cases, by LGS. These maintenance activities are generally performed on an ad hoc basis, frequently using funds intended for the construction of new systems.

50. The currently very poor situation with regard to water systems maintenance appears to be due to several factors besides the lack of an organized attempt to support maintenance activities. Although communities usually want the water supply systems that are provided, they are seldom required to participate in the planning process and in the construction of water supply schemes. They, therefore, see the water supply systems as Government utilities which the Government should maintain. Even in those communities that come to rely upon the water supply schemes and want to keep them in good order, the skills required to undertake simple and minor repairs are not there. This is because most rural communities receive no training in basic maintenance when the water supply facilities are provided.

### 3. Development Plans

51. In PNG, unavailability of safe and adequate water for drinking and personal and household hygiene constitutes one of the more important health hazards for a very large proportion of the rural population. Existing rural water supply programs do not achieve the expected effects. There is a need therefore for a major rethinking of the rural water supply policy, strategy and plans. As a CSA, the Waterboard is in a better position to play an effective role in this process.

52. Estimates of investment requirement for the national rural water supply program 1987-1998 are detailed in Appendix 20 and summarized in Table 4.

Table 4. Proposed Rural Water Supply Program 1987-1998
('000 in 1986 prices)

| | | Total Estimated Costs | |
|---|---|---|---|
| | | K | $ |
| Level I - | Point Source System | 2,475 | 2,552 |
| Level II - | Piped Water Supply with Public Stand-pipes | 38,500 | 39,691 |
| Level III - | Piped Water Supply with Metered House Connections | 8,250 | 8,505 |
| Total Estimated Cost | | 49,225 | 50,748 |

Source: Study estimates.

53. The 1987 Budget Document provides information about the planned rural water supply expenditure for period 1987-1991. For this period, proposed investments in rural water supply are in the order of K6.61 million ($6.81 million) based on 1986 prices. Details of planned expenditure for each province are given in Appendix 21.

# VII. SANITATION

## A. Background

54. Only 17 towns in PNG have central sewerage systems, a number of which serve only hospital complexes and school compounds. The population of these 17 towns is 344,556 representing 11.4 per cent of the country's total population. The rest of the population utilize various types of excreta disposal facilities such as septic tanks (a few with absorption trenches), sanitary pan (or pail) collection, pit latrines, and in one known case, an Imhoff tank. Except in one small area that uses fiberglass, septic tanks are usually made of concrete.

## B. Urban Sanitation

### 1. Existing Situation

55. In urban areas, the sanitation facility utilized by the population varies widely and ranges from the more convenient and expensive water-borne sewerage systems to the less sanitary pit latrines and pan collection. Communities are generally served by a combination of systems including central waterborne sewerage, septic tanks, pit latrines and pan collection. The eight biggest towns with populations of more than 10,000 have central piped sewer systems, namely; Port Moresby, Lae, Madang, Wewak, Goroko, Rabaul, Mt. Hagen and Arawa. Of these, only the sewerage systems of Lae and Madang are under the management of the Waterboard. The Port Moresby system which, at present, has 10,500 connections, is scheduled to be taken over by the Waterboard in July 1987. Appendix 6, page 2 to 4 lists the towns and their respective methods of excreta disposal. Additional information on urban sanitation in PNG are contained in Appendix 22.

56. Conditions in PNG favor the use of oxidation ponds and lagoons for wastewater treatment. In general, the sewerage systems are not very well maintained and treatment of wastewater and effluent from septic tanks is not always properly undertaken. There are some notable exceptions however, such as the lagoons in Port Moresby and the two facultative lagoons in Kimbe. Unlike in other countries, public awareness of the benefits of hygienic excreta disposal practices is not as developed in PNG. This situation is further worsened by the shortage of skilled manpower that can undertake the operation and maintenance of the systems. Most systems are encountering problems in O&M and few steps have been taken to remedy their causes.

### 2. Development Plans

57. In the urban areas of PNG, sewerage and sanitation facilities have been developed for a number of years and nearly all major towns now have sanitary excreta disposal. Provision of adequate and efficient sewerage systems is necessary in densely populated urban areas as sanitation development should go hand in hand with urban water supply development.

58. For the period 1987-1991, the Government is targeting the expansion of urban sanitation coverage through the rehabilitation and expansion of existing facilities in selected urban areas. The Budget Document estimates total investment requirements to be K5.6 million ($5.76 million) based on 1986 prices (see Appendix 23). On the other hand, NCDIC proposed capital works programs for the period 1986-1990 is estimated at K8.6 million ($8.9 million) based on 1986 prices (see Appendix 24). In addition, a storm water drainage project for Port Moresby is also being planned for 1986-1990 with an estimated investment of K1.75 million ($1.80 million) (see Appendix 25).

## C. Rural Sanitation

### 1. Existing Situation

59. There are no reliable estimates on the percentage of rural households with sanitary excreta disposal facilities. Information from the community water supply and sanitation surveys carried out by DOH in five provinces indicates that approximately 52 per cent of the rural population has access to sanitary latrine facilities. The most commonly used facility is the pit latrine that is constructed with local materials. The adoption and use of such facility by the rural population, however, has been very slow and a substantial number of people still use the surrounding bushes as toilets. In some instances, local beliefs and practices have hindered the acceptance of environmental health improvement activities and have resulted in the non-utilization of some latrines in the more remote villages. Health education campaigns at the village level are almost non-existent and people have remained unaware of the problems that may be caused by the use of the surrounding areas for excreta disposal, such as pollution and contamination of water sources.

60. There is very little material assistance being provided to rural communities to help them improve their methods of excreta disposal. EHSs of several provinces provide prefabricated, reinforced concrete slabs for the construction of pit latrines to schools and health facilities on a limited basis. In general, assistance to rural communities consists of lectures delivered by DOH personnel advocating the use of latrines and, occasionally, the distribution of posters and pamphlets showing how to construct pit latrines using bush materials.

### 2. Development Plans

61. It appears from the latest provincial surveys conducted by DOH that more family latrines are available in the rural areas than was originally estimated. However, about 48 per cent of households still do not have latrines. At the provincial level, only one province has proposed a sanitation program for the period 1987-1991. At the national level, the Government is targeting the installation of 360,000 latrines in rural areas over the next nine years (1987-1995), with a total estimated cost of K7.2 million ($7.4 million).

# VIII. FINANCING

## A. Financing Sources

### 1. General

62. The budgetary requirements of the Government as spelled out in the National Public Expenditure Plan (NPEP) have been financed through internally generated revenues, commercial, concessional and internal borrowings, and grants from multilateral and bilateral institutions. Foreign aid from bilateral sources is almost exclusively provided under the five year Australia-Papua New Guinea Aid Agreement (Australian Budget Support) which extends from Australian financial year 1986/87 to 1990/91. 1/ Originally, the Agreement provided that the Government would receive A$1,500 million (or $980 million) for budgetary support and about A$100 million (or $65 million) for specific project implementation. Recent developments, however, have resulted in a relatively sharp decrease in the Australian Budget Support for the next five years. A further cut of A$10 million (or $6.5 million) was announced in the package of about A$297.5 million (or $194.4 million) per annum beginning July 1986 which is to be reduced every year by 5 per cent in real terms. The amount of assistance is further reduced as a result of the depreciation of the Australian dollar against the Kina.

63. The World Bank has been PNG's largest multilateral source of assistance. Total assistance extended amounted to $375 million as of end of June 1986 with the biggest shares going to the agriculture, education and transport sectors. The Bank, on the other hand, is second to World Bank in terms of annual allocation of funds to PNG. As of the end of June 1986, the Bank has extended a total of 23 loans for 17 projects to PNG at an aggregate amount of $219 million. Bank lending is concentrated in the transport sector, with the social infrastructure and agriculture sectors also getting major shares.

64. Other sources of the country's external financing are the Kreditanstalt fuer Wiederaufbau (KfW), the Overseas Economic Cooperation Fund (OECF), Organization of Petroleum Exporting Countries (OPEC), the International Fund for Agricultural Development (IFAD), and the Kuwait Fund for Arabian Economic Development (KFAED).

65. Figure 1 shows sources of funds for the 1986 Government budget while Appendix 26 presents Government sources of financing from 1981 to 1985. Over the past five years, internal revenue and the Australian Budget Support have been the major sources of financing, accounting for 61 and 26 per cent of Government funds in 1985, respectively. However, with the expected reduction in the Australian Budget Support in the coming years, Government reliance on external assistance to support its budgetary requirements is likely to be more significant in the medium-term particularly if it is unable to meet its projected internal revenues. Appendix 27 shows that the 1986 level of internal revenues is expected to decrease by 1 per cent in 1987; hence, the Government will have to increase borrowings from 15 per cent in 1986 to 18 per cent in 1987.

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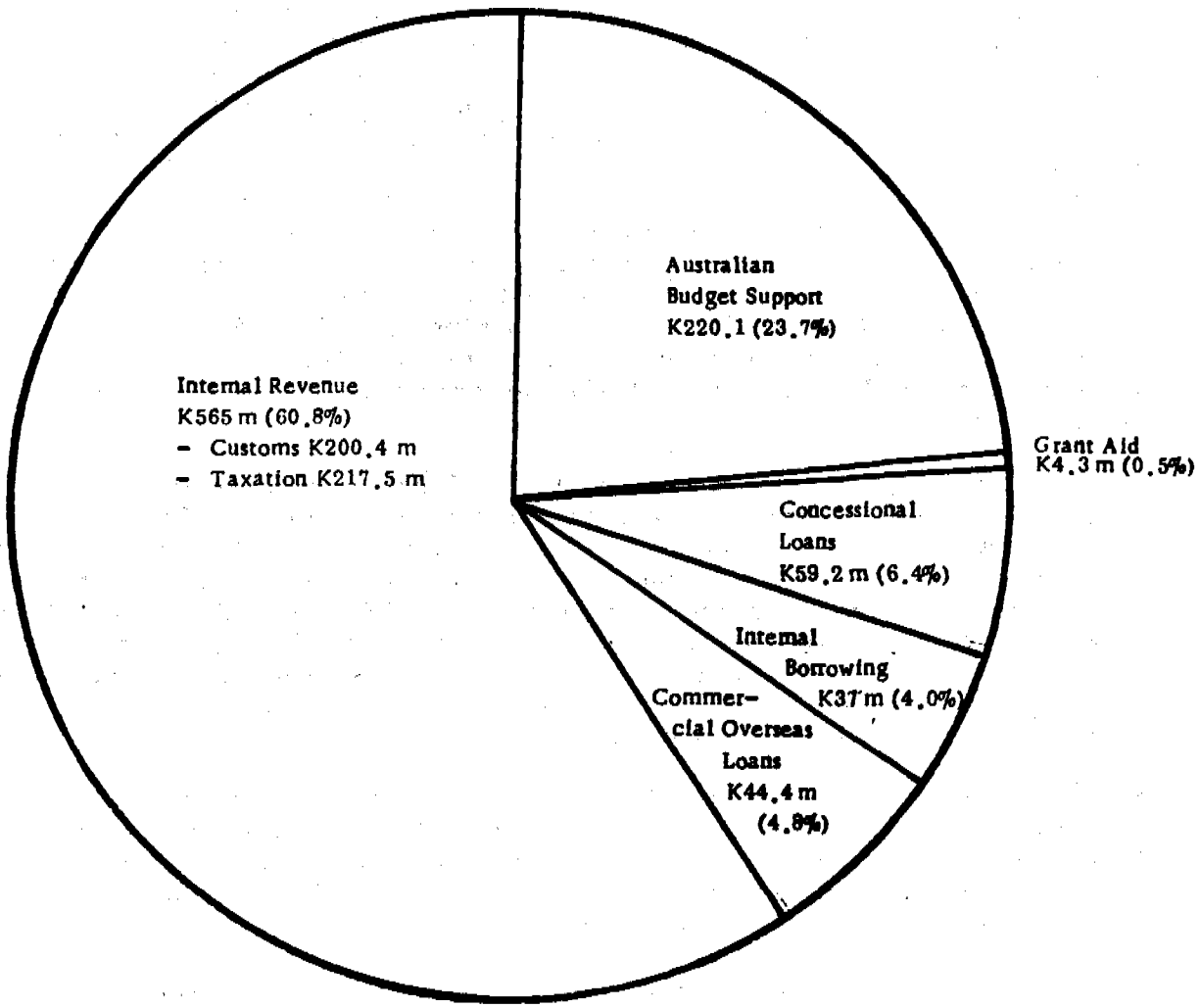
1/ Australian fiscal year ends on 30 June.

FIGURE 1
FINANCING THE BUDGET

Sources of Funds for 1986 Budget

Total Expenditure K930 million
Total Internal Revenue K565 million
(1986 Prices)




Notes:

In 1986 the approximate rates of interest payable on borrowing are likely to be as follows:

| | | |
|---|---|---|
| o | Concessional | 7 - 8% p.a. |
| o | Internal | 15 - 16% p.a. |
| o | Commercial | 9 - 10% p.a. |

Source: Planning and Budgetary Strategy, Budget Document No. 2. For the year ending 31st December 1986.

66. Shown in Figure 2 is the Government's allocation of the K930 million budget for 1986. Budgets for national departments and statutory institutions, provincial financing, and commercial investments in terms of sector allocations are likewise presented in Figure 3. As may be noted, the provincial sector 1/ was given the biggest allocation of 31 per cent while the infrastructure sector obtained the second biggest share with 17 per cent. The concentration of Government resources to the provincial sector has been the trend in the last five years as the Government pursued a policy of decentralization (see Appendix 28).

2. Water Supply and Sanitation

67. Figure 4 shows schematically the flow of funds through the various levels of the Government for both the urban and rural subsectors prior to the conversion of the Waterboard into a CSA. As a CSA, the Waterboard now obtains its funds directly from the Government. Apart from this new procedure, the fund delivery system is essentially unchanged for other organizations and agencies involved in the development of water supply and sanitation facilities. A summary of sector loans obtained for urban and rural projects is shown in Appendix 29.

a. Urban Water Supply and Sanitation

68. Operations of urban water supply and sanitation systems are primarily financed from customer collections and concessional loans. The difference between the Government's programmed disbursements and the funds generated from collections and loans is sourced from internal revenues and the Australian Budget Support.

69. Actual sources and uses of funds for the period 1981 to 1985 have been identified, to the extent possible, and matched in Appendix 30. As may be observed, development during 1981 to 1982 relied heavily on external assistance. In more recent years, sector development went at a slower pace and was substantially funded from internally generated revenues of the Government and the Australian Budget Support. The emphasis on cost recovery especially for Waterboard districts has resulted in an increase in the proportion of funds contributed by consumers.

70. The Waterboard being a CSA, now receives its budgetary allocation directly from the National Government. Funds for noncommercial activities will be manage separately by the Waterboard, which may utilize appropriate Government and nongovernment organizations as implementors of its noncommercial projects. Prior to its conversion into a CSA, the Waterboard's budget for operations and maintenance formed part of the Department of Works' allocation. The Waterboard's capital works was controlled entirely by DOW as part of the latter's Major Contracts Program and disbursements of funds sourced out of these allocations were handled directly by DOW through its central and provincial offices.

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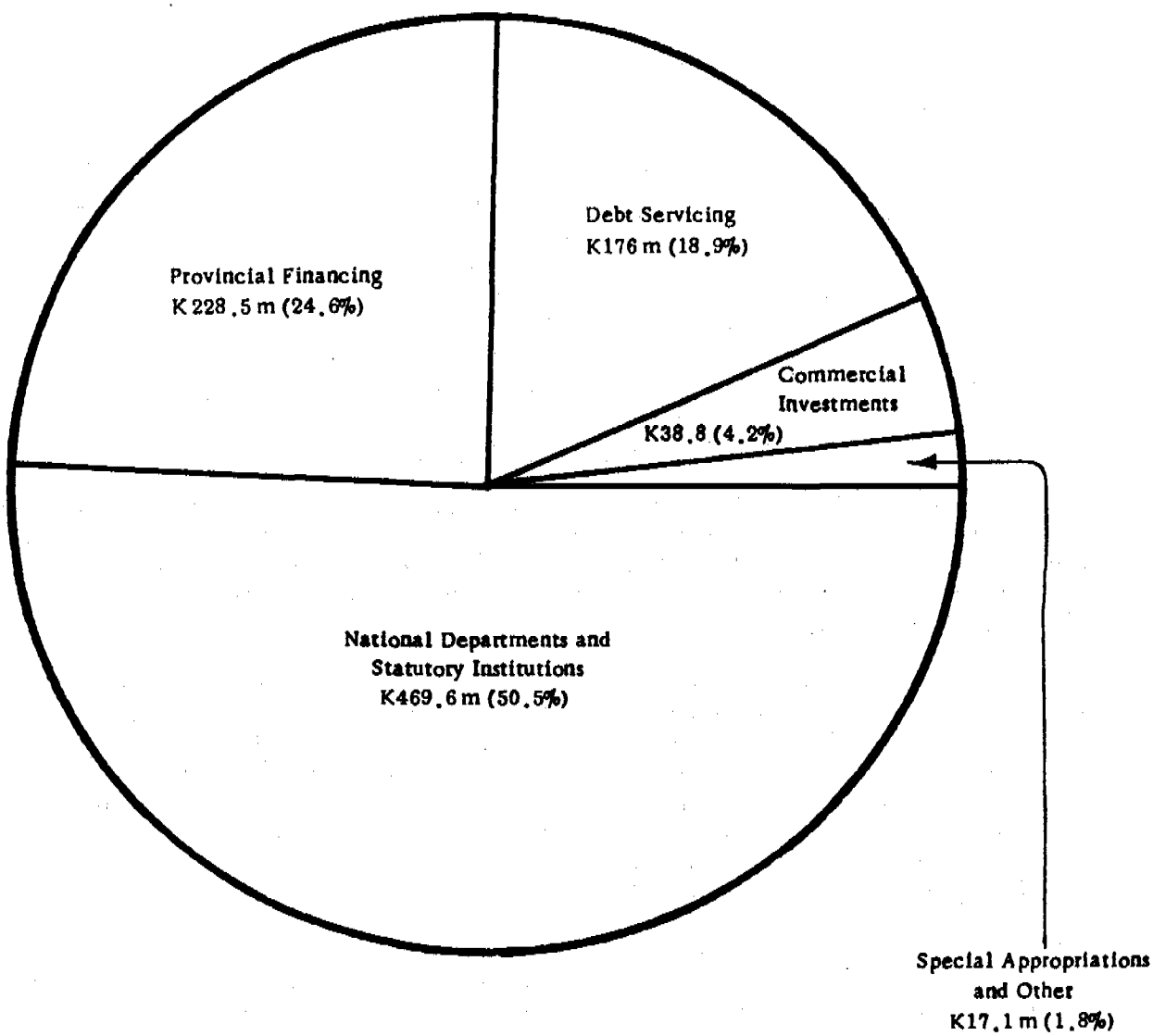
1/ For purposes of fund allocation, provinces and municipalities constitute a sector and receive an allocation for their various projects.

FIGURE 2
SUMMARY OF 1986 BUDGET

Total Allocation : K930 million

Goods and Services : K714.2 million



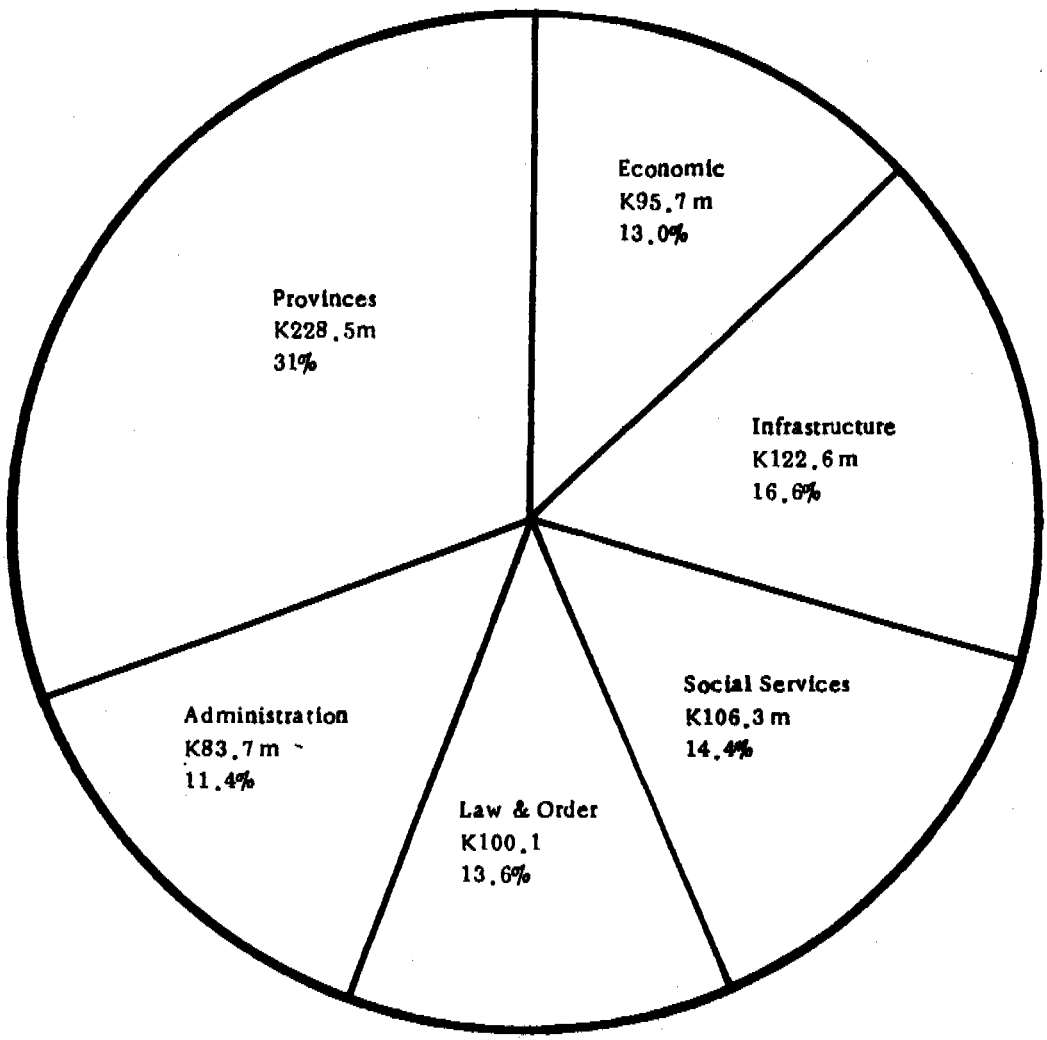

Notes:

- o The Goods and Services Total excludes Debt Servicing and Commercial Investments.
- o Provincial Financing includes Provincial Divisional allocations, the Minimum Unconditional Grant, and all other grants to provinces.
- o All totals are in 1986 prices.

Source: Planning and Budgetary Strategy.
Budget Document No. 1. For the year ending 31st December 1986.

FIGURE 3
BUDGETARY ALLOCATIONS BY SECTOR - 1986 BUDGET

- Total Allocation for Sectors and Provinces: K736.9 million

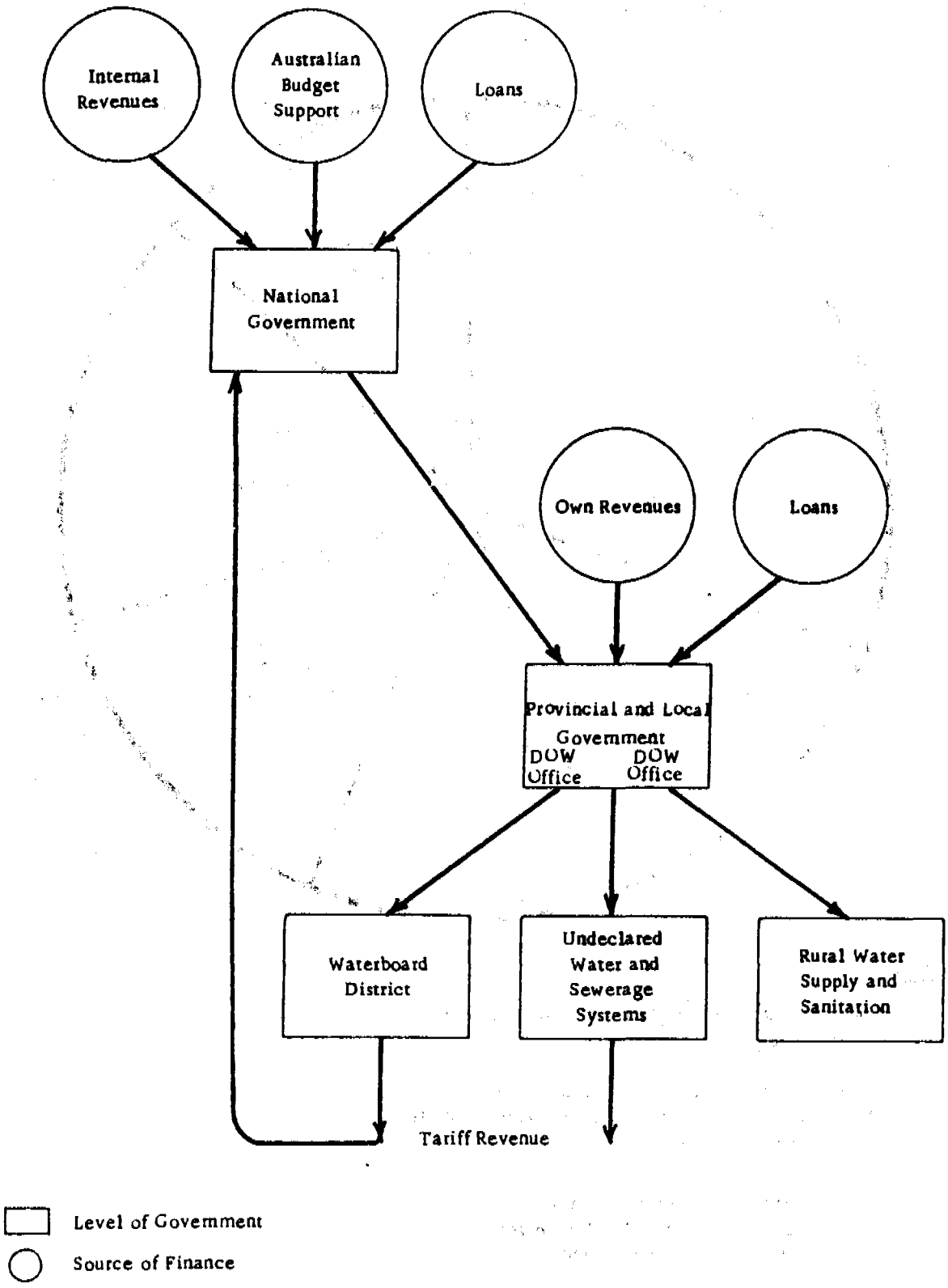



Notes:

- Debt servicing and Special Appropriations are excluded from this categorisation.
- Provincial Financing includes Provincial Divisional Allocations, Minimum Unconditional Grants, and all other grants to Provinces.

Source: Planning and Budgetary Strategy, Budget Document No. 1, For the year ending 31st December 1986.

FIGURE 4
SOURCES AND FLOW OF TOTAL GOVERNMENT FUNDS



71. Undeclared water systems, on the other hand, have allocations from the national budget of DOW as well as from the budgets of the provincial governments.

b. Rural Water Supply and Sanitation

72. Financing for rural water supply and sanitation activities comes from a number of sources, including NPEP's rural water supply and sanitation allocations, the provincial governments' budgets, the Local Government Councils' allocations and from private sources. Funds from sources other than NPEP are not centrally controlled. They are usually provided on a case to case basis, and the amounts vary greatly from year to year and province to province. In general, while significant in some provinces, funds from sources other than NPEP do not exert a significant impact on the sector as a whole.

73. NPEP funding for rural water supply and sanitation activities from 1983 to 1986 has increased considerably by about 158 per cent and has continued to be substantially sourced from Government internal revenues and external assistance. Appendix 31 shows the actual expenditures for the period 1983 to 1985 for the rural water supply and sanitation subsectors.

74. NPEP rural water supply and sanitation funding is expected to increase to about K1.30 million per year from 1987 to 1991 (see para 51). However, with the rural population growing at over 2 per cent per annum, funding at considerably higher levels than this will be required to significantly improve the coverage of the rural water supply and sanitation program.

B. Cost Recovery

1. Urban Water Supply and Sanitation

75. The National Water Supply and Sewerage Act of 1982 state the following cost recovery and tariff policies (see Appendix 32):

(i) the Board is to ensure that the full cost of urban water supply and sanitation facilities is recovered from users of the systems;

(ii) the Board will seek to achieve full cost recovery within declared water and sewerage districts by 1990;

(iii) the Board will set a progressive tariff which favors consumers who use small quantities of water per connection; and

(iv) the Board supports cross-subsidization between districts in order to set a uniform national tariff.

76. Given the above policy objectives, the Waterboard undertook a study as part of a Federal Republic of Germany technical aid 1/ and came up

1/ "Water Supply and Sewerage Tariff Study," prepared by CITEC consult GMBA in April 1986.

with a recommendation for a simple tariff system 1/ for both water supply and sewerage services based on water consumption alone. This system became the basis for establishing the tariff structure that was implemented by the Waterboard in July 1986. The approved rates, however, are lower than those proposed in the study (see Appendix 34). The reduction in tariff was made in consideration of the decision to advance the takeover by the Waterboard of the Port Moresby Water Supply and Sewerage System to 1987 instead of 1988 as originally planned. As Port Moresby will account for a substantial portion of volume of water sold and sewage disposed, overall dynamic water production and sewage disposal cost will be reduced resulting in the net reduction of tariffs.

77. The combined water and sewerage tariff structure provides for cross-subsidy in favor of the low-consuming group, assumed to be the domestic consumers. Moreover, the general principle adopted provides for progressive increases in water tariff relative to consumption in order to discourage wasteful usage of water. Thus, commercial and industrial users pay more than the basic rate by about 1.13 per cent. 2/

78. Residential users with metered connections consuming up to 10 kilolitres and those with unmetered connections are charged a flat rate while those consuming above 25 cu m are charged based on the volume of water consumed. Costs incurred by the Waterboard in connection with the

installation of new water and sewer connections are recovered from consumers. 3/ For water supply connections, consumers have to pay K125 for connections of up to 26 meters inside the property boundary, or the actual cost if it exceeds this length. For sewer connections, the amount of K500 is charged to the consumers. With these rates, and under the present term of full payment before a connection is made, the Waterboard may be unwittingly discouraging new connections.

79. The tariff structure also provides for cross-subsidization among water districts in order to set a uniform national tariff. As a result, viable water districts pay more than the actual cost of water service in order to subsidize operations of the less viable districts.

80. From 1987 onwards, the Government expects the Waterboard, being a CSA, to earn a rate of return on its commercial activities as determined from time to time by the National Executive Council (Cabinet). The 1987 Planning and Budgetary Strategy issued by the Department of Finance states that "With regard to the Government's major investments in which it is the

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1/ The recommended tariff structure provided for a gradual increase in water rates over the five-year period from 1986-1990 in order to attain full cost recovery by 1990 (see Appendix 33).

2/ The implemented water and sewerage charges for each consumer category as compared to those proposed under the study are shown in Appendix 35. Likewise, a comparison of tariff among consumer types is shown in Appendix 36.

3/ The Waterboard has a standing policy for new projects whereby service connections applied for within a pre-determined period set by the Waterboard are installed free of charge (see Appendix 37).

sole owner (Elcom, PTC .... and, from 1987, the National Water Supply and Sewerage Board) ...., the Government will, from 1987, expect a 10 per cent return on its investments". 1/ Considering this, the Waterboard will have to be more thorough in evaluating the profitability of future projects it will undertake. In the past, other than for the Bank-financed projects, comprehensive feasibility studies that would have assessed the financial and economic viability of the projects were not undertaken. 2/ Projects were evaluated only to determine which of the technical alternatives was the most appropriate. In addition, there has been very minimal monitoring of actual versus projected performance even for projects with feasibility studies.

81. The relatively high rate of return imposed by the Government 3/ may also affect the Waterboard's plan to takeover 13 water districts which will bring the Waterboard-declared districts to a total of 17 by the year 1990 (see Appendix 38). Appendix 39 shows that six out of these 17 districts will have recurrent water production costs above the effective water supply tariff of K0.40 per cu m and one district will incur sewage disposal costs above the effective sewerage tariff of K0.12 per cu m. This means that these districts will not be able to recover recurrent operating costs, much less capital costs. If the takeover is pursued, tariffs may have to be increased further in order to subsidize these less viable districts as a consequence of a uniform tariff scheme.

82. All water supply systems in the four Waterboard districts are metered and water charges are collected from about 7,200 connections. The billing and collection systems of these districts are computerized. Water charges have to be paid within 30 days from the date of billing, otherwise service is discontinued and appropriate recovery action is taken. The District Managers are authorized to negotiate with disconnected customers to facilitate settlement of unpaid accounts.

83. Consumers in the urban centers outside Waterboard declared districts are generally provided with water supply systems free of charge except in the provinces of Goroka, Arawa and Rabaul which apply different tariffs on a flat rate.

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1/ This is consistent with the Government policy adopted in 1986 which required projects included in the Water Supply and Sewerage Capital Works Program to have a rate of return of at least 10 per cent. Projects with a rate of return less than 10 per cent were included on public health grounds or where it was shown that water and/or sewerage infrastructure was required for the creation of productive formal sector employment opportunities. In all cases, full cost recovery was required unless an explicit subsidy for operations was made available in the national budget or by another authority.

2/ This is partly due to certain political considerations as a result of a post-independence policy which required the immediate provision of full town water supply, particularly to all provincial capitals, covering a total of 20 towns.

3/ The rate of return required for similar projects in the region ranges from 4 to 6 per cent only. Most of the past urban sector projects of the Bank likewise called for rates of return within this range.

2. Rural Water Supply and Sanitation

84. The Rural Health Plan for 1986-1990 has as one of its policy objectives the promotion of self-help and community participation. Each prospective project is proposed to be discussed with the community concerned in order to gain their interest and participation in the project. The community should contribute toward the cost of the scheme (50 per cent) and should provide all the unskilled labor required in the construction of the system. Inspite of this strategy statement, however, no effort has been made to implement the plan nor to study possible financing arrangements. In fact, proposed rural subsector projects in the plan will continue to be financed as grants from external assistance and from internal revenues.

85. Tariffs are virtually non-existent in the rural areas and hardly any attempt has been made to systematize the recovery of O&M costs for rural water supplies. While DOH policy requires rural communities to operate and maintain their own systems, the general practice is to maintain water supply systems for communities free of charge whenever funds are available. When funding constraints arise, water supply systems generally do not get maintained. DOH has previously attempted to introduce the policy that communities pay for the spare parts that are required to maintain water supply schemes. Unfortunately, there exist organizational structures in the rural areas that might be expected to introduce and manage water supply systems for the complete recovery of O&M costs.

# IX. PRIVATE SECTOR

## A. Water Supply

86. Private sector involvement in the water supply subsector has been directed mainly to the provision of services to the urban subsector specifically to the Waterboard.

### 1. Consultants

87. There are three groups of consultants active in the water supply subsector: consulting engineers, management consultants, and one building consultant. The consulting engineers are organized into the Association of Consulting Engineers which counts 15 member firms all based in the National Capital District. Some of these firms have branch offices in other large urban centers (see Appendix 40). Of the 15 firms, four are particularly active in their dealings with the Waterboard, namely: Binnie & Partners (PNG), Beca Gure Pty. Ltd. (PNG), Scott and Furphy Engineers Pty., and Willing & Partners Pty. Ltd.

88. There are five management consulting firms operating in PNG, the biggest of which is Coopers & Lybrand with ten offices. The company has computer linkage facilities around the country which the Waterboard avails of for a fee. The management consulting firms in PNG are organized into the PNG Institute of Management and the PNG Society of National Managers. Appendix 41 gives a listing of consultants in PNG. As PNG suffers from a lack of skilled and trained professionals, the consulting industry is dominated by large foreign consulting firms from more developed countries.

### 2. Contractors

89. Several types of contractors are involved in water supply projects, as follows: boring and drilling, building, earth-moving, hire, pile driving, and pipeline contractors. Building contractors, a number of which have had contracts with the Waterboard, include those with experience in plumbing, civil engineering, general construction, septic tank cleaning and pump-out. A list of construction contractors grouped by specialization is shown in Appendix 42.

### 3. Local Manufacturers and Suppliers

90. The local manufacturing capability is rather limited in the water supply industry as may be expected from a young country like PNG. The only materials and equipment manufactured locally are water tanks, structural metals, chain wire, welding wire, cement, concrete and concrete products, and plastic pipes and fittings. Most materials for civil works are readily available through local suppliers who carry the complete range of building materials, PVC pipes and fittings, pumps, valves, concrete pipes, motors, generators and electronic equipment. Treatment plant equipment and instrumentations however, are imported. A partial list of local suppliers who have participated in Waterboard projects is shown in Appendix 43.

## B. Sanitation

### 1. Consultants

91. Most of the 15 member-firms of the Association of Consulting Engineers of PNG are also involved in sanitation projects. Consulting services are usually engaged for the planning, design and construction supervision of sanitation systems.

### 2. Contractors

92. Construction of most sanitation projects is undertaken by local contractors. The involvement of international contractors is generally secured for the bigger projects with the local firms sometimes acting as subcontractors. This set-up has resulted in transfer of skills so that some local firms now have the capability to undertake certain jobs on their own, such as pipe laying and construction of civil works.

### 3. Manufacturers and Suppliers

93. Some materials for civil engineering works in sanitation are locally available, e. g. cement, ready-mixed concrete, sheet metal tanks, lumber, nails, hollow blocks, plastic pipes and fittings. On the other hand, equipment for wastewater treatment plants, i.e. pumps, valves, instrumentation, electrical switch gears, metal, and ceramic pipes are all imported.

# PART THREE

# ISSUES IN THE WATER SUPPLY AND SANITATION SECTOR

## X. WATER SUPPLY

### A. Policy and Planning

94. At present, there exist no comprehensive planning for the development of the water supply and sanitation sector. Although the Waterboard has overall control of the sector, its operations are centered mainly on the large urban areas that have been declared either as water or sewerage districts. Responsibility for the provision of water supplies and sanitary services for the rest of the country has been delegated to other authorities without regard for their technical and organizational capability to carry out planning and implementation of water supply and sewerage systems. A number of provincial governments include the improvement of supplies as objectives in their development plans. Few, however, develop strategies or plans for implementing their objectives. Planning for water and sanitation activities at the provincial level thus becomes principally an exercise in spending the money allocated for the sector.

95. At present, projects are planned without considering the appropriate level of service and available technology. In the rural areas, communities usually request piped water supplies and the authorities take no action to encourage the provision of simpler systems. Experience in other countries shows the need for a systematic definition of service levels based on the location and adequacy of the water source and the size and needs of the population served. The service levels may be defined as follows:

(i) Level I - a point source system with a handpump

(ii) Level II - piped water supply with public standpipes

(iii) Level III - piped water supply with metered individual connections

### B. Shortage of Qualified Manpower

96. There is a lack of qualified manpower that can be employed in the water supply and sanitation sector, a problem that is closely related to the inadequacy of local training. This is proven by the presence of a considerable number of expatriates in the Waterboard, and the number of vacant positions that have remained unfilled not only in the Waterboard but in other water agencies as well. In some instances, the expatriates themselves are not exempted from professional deficiency. The policy of the Government to train nationals to be understudies is commendable. Often, however, there is no understudy to train.

97. Formal training in water supply and sanitation development is not offered in PNG. University curricula are confined to civil, mechanical and electrical engineering, and no course is offered in sanitary or environmental engineering. At the higher secondary or lower college level, there are plumbing courses but these are intended only for instruction in buildings. A more advanced training for larger diameter, pipe-fitting is still wanting. Training facilities of LGS at Goroka are available for training of persons involved in the construction and management of simple piped water schemes. These training facilities, however, are not adequately utilized by the provincial health organizations implementing rural water supply systems. As a result, there exist deficiencies in the design and construction of a number of water supply systems.

98. Since the majority of expatriates and qualified professionals and technicians are working in the urban subsector, rural water supplies have had to be developed by the provincial government's EHS. Many EHS staff have a good overall understanding of the principles of water supply systems. Their training has not, however, been sufficient to allow them to design systems, particularly piped water systems. Other areas in which they have inadequate knowledge or skills are planning, monitoring, cost accounting, water quality assurance and community development. Most of the personnel involved in the actual construction of water supply systems develop their skills on the job. As a result, they tend to have very limited ideas about the best way to construct a system and are generally reluctant to try new techniques. In recent years, the national EHS has sponsored a number of activities to upgrade the skills and knowledge of provincial EHS staff. Such activities need to be reinforced and expanded to address more of the issues confronting field implementors.

99. As there is a lack of professionals and highly skilled technicians in PNG, the development of local consulting capability has proceeded slowly and with this, the transfer of technology from highly developed countries. There is a need to improve the situation to enable PNG to reduce its overdependence on foreign expertise and rely more on local consultants.

## C. Operations and Maintenance

100. At the Waterboard districts and the NCDIC water supply and sewerage systems, there are no preventive maintenance plans and no adequate operating and repair manuals for water supply and sewerage systems. In many of the facilities and installations visited, missing components of equipment and inoperational instruments were noted. Routine maintenance activities were not being undertaken resulting in the malfunctioning and eventual breakdown of the systems. Apart from residual chlorine tests, the Waterboard has no regular program for bacteriological testing of water. Monitoring and analyses of water quality to ensure the safety of water produced are likewise not conducted regularly in other systems. NRW is thought to be significant in many urban water schemes including the Port Moresby water supply system where excessive pressure exists in certain zones and per capita consumption is unusually high at 400 lpcd. These problems in operations and maintenance are traceable partly to the inadequacy of staff training and partly, to the lack of simple maintenance and repair manuals that can be used for reference by systems operators.

## D. Lack of Community Involvement

101. There is ample evidence that in the past, rural communities were not involved in the planning process and construction of water supply systems. In most of the provincial water supply programs, the only community participation required is the decision as to whether or not they want a water system. The obligation of the community to contribute to the cost of the system and to properly operate and maintain it is frequently not explained and training in basic systems maintenance is often neglected. It is not surprising therefore, that these communities show only limited interest in operating and maintaining their water supply facilities.

102. In most rural areas, it is the responsibility of women and children to collect water. It has been observed, however, that women are seldom consulted on the installation of new water supply systems which is one of the reasons for the low level of acceptance accorded new water schemes by the community.

## E. Inadequate Health Education

103. There is very little health education at the village level. The importance of preventive health measures, the promotion of personal and household hygiene and the necessity of obtaining safe drinking water are not taught extensively to villagers. Selection of water source and usage of water are influenced by tradition and local beliefs. 1/ Very often, particularly during the dry seasons, villagers use unprotected springs as sources of drinking water. These springs often show the presence of bacteria associated with wastewater and poor sanitation practices. The use of these springs contributes to the high incidence of water-borne diseases in the rural areas.

## F. Financing and Cost Recovery

### 1. Inadequacy of Government Financial Resources

104. Although the Government has optimistic predictions regarding the economy's performance over the next five years, the financial resources necessary to accelerate the provision of water supply facilities may not be available. At present, only about 50 per cent of the urban population and about 14 per cent of the rural population have access to an adequate supply of potable water. As the population grows, new systems would have to be constructed while existing ones would have to be properly maintained to prolong their useful life, and thereby enable the Government to narrow the gap between the supply of and the demand for safe water. To help finance construction and rehabilitation activities, cost recovery would have to be increased in areas where water charging is already being practised, and introduced in areas where water is still provided free of charge.

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1/ Selected information on this subject is discussed in Appendix 44.

2. Cost Recovery in Rural Areas

105. While the Waterboard has made some progress in the recovery of costs for operation and maintenance of water and sewerage facilities in urban areas, it has made no attempt to have DOH do so in the rural areas. Rural communities should increasingly absorb O&M costs and in the long run, shoulder part of the capital costs through cash payments or contributions of materials or labor. However, even with a decision in principle for villagers to bear part of systems cost, a problem exists in determining the villagers' ability and willingness to pay. The concept of cost recovery is new in the rural areas and far from being accepted. In addition, there is a lack of reliable data on rural incomes as many people still have to enter the cash economy.

106. For purposes of getting some indication of the possible extent of cost recovery that may be achieved, estimates were made on the unit cost of each system, i.e., Level I, II and III, based solely on the cost of materials used since it is assumed that all labor inputs will be provided by the community. The estimated cost of materials for each system is: K300 for Level I, K5,000 for Level II, and K7,500 for Level III. Average annual household income is placed at $900. Assuming that villagers can afford to allocate between 2 to 5 per cent of their income for water supply expenses, the proportion of material costs that they can shoulder will depend on the financing arrangements for the construction of the water supply scheme. The community can provide the unskilled labor needed in the construction of the system while the Government can finance the cost of materials either through a loan to the community (Community Loan Option) or as equity in the system (Government Equity Option).

a. Government Equity Option

107. The estimated average annual household income of $900 can assure the full recovery of O&M costs (estimated at 3 per cent of materials cost) for the three types of water supply systems. Over and above the payments for O&M, the amount set aside for water-related expenditures will be sufficient to cover the entire materials cost of Level I systems but only part of the materials cost of Level II and III systems (see Table 5 below). The funding deficiency may then be put up by the Government in the form of equity which, as can be derived from Table 5, will range from 58 to 81 per cent of total materials cost depending on the percentage of household income allocated to water expenses.

Table 5. Estimated Percentage of Materials Cost Rural Communities Can Shoulder

| Type of system | At 2% a/ | At 5% a/ |
|---|---|---|
| Level I | 100 | 100 |
| Level II | 15 | 42 |
| Level III | 9 | 27 |

a/ Indicates percentage of income that can be alloted to water expenditures.

b. Community Loan Option

108. Under this scheme, communities provide labor and obtain a loan to finance materials costs. For purposes of computation, loans are assumed to carry a 5 per cent interest rate with a ten-year repayment period, similar to the terms offered by the Agriculture Bank of PNG. Indicative computations show that O&M costs of all systems will be within the community members' ability to pay. However, communities can only afford to pay loan amortizations for Level I and II systems. Loan repayments for Level III are affordable only if households are willing to allocate 5 per cent of their incomes to payment of water charges.

109. The choice of lending agency will be of crucial importance to the success of this scheme. Possible alternatives include the Waterboard and the Agriculture Bank of PNG (ABPNG).

(i) The Waterboard

Considering its regulatory function over the entire water supply and sewerage sector, the Waterboard appears to be the most appropriate institution to handle the lending function for the rural water supply and sanitation subsectors. The necessary legislation will have to be enacted to increase the scope of its responsibility to include lending. This lending function will strengthen the Waterboard since loans can be used as financial leverage to ensure compliance with performance standards. At the same time, the Waterboard will be committed to enforce collection of loan repayments.

(ii) The Agriculture Bank of PNG

ABPNG at present grants loans to rural communities for housing purposes through its four regional offices, six branches, four subbranches and 13 representative offices. 1/ The Waterboard may use this bank as its agent for extending loans and collecting amortization payments. It is important, however, that the Waterboard retains responsibility for the management of the loan funds.

110. The magnitude of investments in the rural water supply subsector for the twelve-year period 1987-1998 is given in Table 6.

111. The Rural Water Supply Program, which is to be carried out in three stages, will require the following investments for each stage:

| | |
|---|---|
| 1987-1990 | K11 million |
| 1991-1994 | 18 " |
| 1995-1998 | 21 " |
| Total | K50 million |

1/ A brief background on ABPNG is presented in Appendix 45.

Table 6. Materials Cost for Rural Water Supply Schemes For Plan Period 1987-1998 (Based on 1986 Prices)

| | Material Cost Per System | No. of Systems | Total Cost (In K Million) |
|---|---|---|---|
| Level I Point Source System | 300 | 8,250 | 2,475 |
| Level II Piped Water Supply with Public Standpipes | 5,000 | 7,700 | 38,500 |
| Level III Piped Water Supply with Metered House Connections | 7,500 | 1,100 | 8,250 |
| Total | | 17,050 | 49,225 |

112. Should the Government adopt the Community Loan Option however, and assuming it achieves 100 per cent collection efficiency, the magnitude of investments to be financed by the Government will be drastically reduced. The Government would only have to provide "seed capital" 1/ of K5.2 million for 1987-1990 and K3.0 million for 1991-1994 (see Appendix 46) with the balance of K40.8 million to be funded from customer collections. A high rate of repayment may, however, be difficult to achieve. High wages and better employment opportunities in urban areas have had a migratory pull on the rural population, and the resulting mobility of the population may not assure the steady collection of loan amortizations over a long period of time such as ten years. The choice of collecting agency and the establishment of effective collection schemes will therefore be crucial in ensuring a high level of loan repayments.

113. Tariffs for Level I systems, although fully recoverable, pose several problems in collection. Since the water supply system may be several meters away and households use different containers, it is difficult, if not impossible, to charge water on the basis of actual consumption. Charging by household also creates some problems in collection enforcement since a household which refuses to pay can hardly be prevented from drawing water from the source. For Level II systems, charging water on the basis of actual consumption is much simpler. The village Head or his representative can collect from each customer for each can of water as it is drawn from the standpipe or at the agreed collection dates. For Level III systems, billing based on actual consumption is possible if all connections are metered.

1/ Seed capital is defined as an initial investment which would be used as a revolving fund for future expenditures. Revolving fund is a fund set for specified purposes with the proviso that payments to the fund may be used again for these purposes.

### 3. Water Tariff in Urban Areas

114. The present tariff is progressive to discourage wasteful consumption of water and allows for cross-subsidy from heavy users of water to the small consumers. Cross-subsidies between customer types is, however, quite insignificant. Commercial tariff is only slightly higher (1.13 per cent) than residential and noncommercial tariffs. The Waterboard policy likewise calls for a uniform national tariff. Although this type of tariff is easier to administer, its use makes difficult the evaluation of the individual systems' financial viability.

115. Except for Goroka, Arawa and Rabaul, which apply different tariffs on a flat rate, all other water supply systems in urban centers outside the Waterboard districts provide services free of charge to consumers. It is therefore likely that the takeover by the Waterboard of these systems and the resulting imposition of tariffs will meet strong resistance from affected consumers.

## G. Technical Problems

### 1. Underutilization of Water Systems

116. Some water systems in rural areas have been observed to be underutilized. The PNG Blaire handpump of indigenous technology is simple to operate and lasts for many years without mechanical trouble. The pump, however, can cause backaches among users, particularly women and children. As a result, installations with this pump are not utilized as frequently as expected. Another reason for system underutilization is the distance of the water source to user households, which are often located at a distance of more than 30 meters from households. This has prompted villagers to continue relying on traditional sources of water, such as springs and rivers for washing and bathing purposes, and even for drinking if the water is thought to be potable.

### 2. Lack of Standards

117. Two essential functions of the Waterboard are to exercise control over organizations providing water supply and sanitation services, and to approve standards for materials and equipment used in the sector. To be able to perform these functions effectively, the Waterboard needs to establish local product standards and a code of practice to guide professionals. At present, foreign standards and practices are being followed even though these do not always apply to local conditions, culture and traditions.

## H. Organizational Strengthening of Waterboard

118. The two principal functions of the Waterboard are to provide adequate water supply and sanitation services on a commercial basis in the urban areas and to promote water supply and sanitation in the rural areas. To be able to perform these functions effectively, the Waterboard has to develop its own planning and programming capability. To its present professional staff of engineers and accountants, the Waterboard

will need to add economists and management specialists. Staff training, particularly in the financial and technical areas will have to be given greater emphasis to enable the Waterboard to cope with its increasing responsibilities and realize its objectives including its targeted rate of return. In becoming a CSA, the Waterboard will have to effect certain adjustments in its operations, including a change in its accounting system, from cash system to commercial system of accounting. To the Waterboard's credit, it correctly anticipated the transitional problems that may arise and sought to minimize these by hiring a firm of chartered accountants to train its staff in the new system. Similar training programs should be conducted in areas where the skills or knowledge of Waterboard staff are inadequate, such as ground water prospecting and hydrogeological investigations.

# XI. SANITATION

## A. Influence of Customs and Traditions

119. In many places in PNG, there are pockets of communities still without access to sanitary excreta disposal facilities. In some cases, however, families still resort to the unregulated use of the environment despite the installation of sanitary latrines. Inadequate health education provided to rural health workers and villagers has fostered a lack of appreciation of the benefits of proper waste disposal practices, and rendered health extension workers unable to disprove local superstitious beliefs that discourage the use of latrines. Likewise, villagers who are used to excreting in the open fields find the smell of unventilated pit latrines offensive specially after these have been used for some time. Since water is generally not used for washing and flushing, water-seal latrines have not been popular with people in the rural areas. Clearly, health extension workers should be trained more extensively on the benefits of hygienic methods of excreta disposal in order for them to effectively impart their knowledge to villagers and convince the latter to abandon traditional beliefs and practices.

120. In areas where sanitary pans and ordinary pit latrines are utilized, serious efforts should be made to replace these with more sanitary facilities, such as pour-flush latrines. Wastewater from the laundry, kitchen or bath can be reused for flushing the latrine. Potable water, especially if in limited supply, need not be used directly for flushing latrines.

## B. Operation and Maintenance of Sanitation Facilities

121. Except for some notable exceptions, such as the lagoons of Port Moresby and the Kimbe sewerage system, the operations and maintenance of existing sewerage systems leave much to be desired. Many of the sewerage systems do not have O&M manuals and routine maintenance activities are not regularly undertaken. The reasons for poor O&M vary from one system to another, the most common reasons being lack of personnel and insufficient funds.

122. Before augmenting an existing sewerage system or constructing a new one, it is important that all efforts be made to ensure that the existing system is utilized to its full capacity. This will entail the investigation of O&M problems, such as leaks in the reticulation system, as well as possible overloading and infiltration, and determination of the adequacy of existing treatment process and capacity. Improvements in O&M practices and simple rehabilitation schemes may prove to be more cost-effective than the expansion of existing central sewerage systems, and should be prioritized to maximize the benefits of the system and reduce huge capital outlays programmed for future works. Such improvements should cover, aside from physical rehabilitation, institutional strengthening measures including the streamlining of administrative procedures, training programs, and preparation of O&M manuals.

123. In the rural areas, O&M problems arise when families are unable to properly maintain their latrines. Family pit latrines constructed with local materials often have wooden floors covered with mud, which are generally difficult to keep clean and can be health hazards. The offensive odor of direct pit latrines is another problem that most rural families have to contend with. To eliminate these problems, the construction of pour-flush latrines and cement floors should be encouraged whenever funds are available.

C. Inadequate Training

124. As in the water supply subsector, the sanitation subsector has a lack of skilled technical and professional staff. For the two sewerage districts under the Waterboard, regulations require that each one should have, inter alia, the positions of Sewerage Engineer, Sewerage Inspector, and Supervision Officer. At present, however, these three positions are occupied in a concurrent capacity by the District Manager of the water district because of the lack of qualified personnel.

125. Training programs oriented toward sanitation and geared to the development of a competent cadre of professionals and subprofessionals should be initiated to meet present and future manpower needs. The Waterboard could, for instance, establish a professorial chair in sanitary or environmental engineering at the University of Technology or it may sponsor scholarships in both water supply and sanitary engineering. These activities will not only attract promising students to take up water supply- or sanitation-related courses, but may also lead to research undertakings that will further the development of the sector. One of the functions of the Waterboard is to promote research related to problems in water supply and sanitation. In carrying out this function, the Waterboard can either develop its in-house capability or engage the services of local consultants or members of the academe. Research and development efforts in sanitation, however, should be geared mainly to developing or identifying appropriate low-cost technology that will achieve the same health and environmental objectives.

D. Planning for Subsector Development

126. A more systematic and comprehensive planning for the development of sewerage systems in urban areas should be spearheaded by the Waterboard to ensure that PNG's scarce resources are efficiently allocated. A master plan should be prepared, which will identify priority works to be undertaken over a given period of time, taking into consideration the rate of return required of Waterboard projects and the Government subsidy available for noncommercial projects. Current levels of local funding for sanitation projects in both urban and rural subsectors are relatively low when compared to allocations for water supply and need to be increased by external funding in the form of soft loans and technical assistance.

# PART FOUR

# SUMMARY OF PROPOSED SECTOR INVESTMENT AND POSSIBLE FUTURE INVOLVEMENT OF THE BANK

## XII. SUMMARY OF PROPOSED SECTOR INVESTMENT

### A. Past Investments in the Sector

#### 1. Urban Water Supply and Sanitation

127. Government investments in the urban water supply and sanitation subsectors from 1981 to 1985 amounted to K20.3 million representing an annual average of K4.06 million. The bulk of these investments or 73 per cent, went to the four existing Waterboard districts and to the Port Moresby water supply and sewerage systems. For 1986, approved allocation to the urban water suply and sanitation subsector amounted to K9.0 million of which some K5.16 million or 57 per cent went to sewerage projects. With the conversion of the Waterboard into a CSA and its plan to take over an additional 13 districts, Government expenditures in the subsector are expected to average around K5.4 million ($5.6 million) per year up to 1991.

#### 2. Rural Water Supply and Sanitation

128. Based on available statistics, Government expenditures for the rural water supply and sanitation subsectors totalled K2.09 million from 1983 to 1985 while approved funding for 1986 amounted to K1.71 million. Under the Investment Plan for the period 1987 to 1991, investments in the subsector will amount to about K1.2 million per year beginning in 1989.

### B. Future Investments

129. The Investment Plan as contained in the 1987 Budget Document projects that the water supply and sanitation sector will require a bigger share of the overall Government budget in the years to come. While the overall increase in the entire Government budget from 1986 to 1987 is placed at 9 per cent only (see Appendix 47), Government allocation to the water supply and sanitation sector is expected to be maintained at significant levels to be able to attain targeted coverage of sector development.

130. As determined in this study, the proposed investment requirements of the sector are summarized in Table 7.

Table 7. Summary of Sector Investment Requirements
(in Kina million)

| Subsector | Executing Agency | New Projects | |
|---|---|---|---|
| Urban Water Supply | Waterboard | K36.16 a/ | $37.28 |
| Rural Water Supply | MOH b/ | K49.22 c/ | $50.58 |
| Urban Sanitation | Waterboard | K14.20 d/ | $14.64 |
| Rural Sanitation | MOH b/ | K 7.20 e/ | $ 7.42 |

a/ Port Moresby, 1986-1990
Other Urban Areas, 1986-2000
b/ Through the Waterboard.
c/ Port Moresby, 1986-1990
Other Urban Areas, 1987-1991
d/ 1987-1998
e/ 1987-1995

Source: National Ministries, Departments, the Waterboard and Mission estimates, 1986.

## XIII. POSSIBLE FUTURE INVOLVEMENT OF THE BANK

131. The country's economic development efforts is seriously handicapped by, among others, a limitation in financial resources. In the urban water supply and sanitation subsectors alone, an attempt to match projected fund receipts from internal revenues and cost recovery, against projected investments (see Appendix 48) indicates that the National Government will have finance about 54 per cent of projected expenditures from its internally generated revenues if no external assistance is solicited.

132. Available statistics indicate that projected levels of expenditures are likely to exceed projected fund receipts of the Government mainly due to the decline in Australian Budget Support over the next five years (see para 62). Hence, the Government's plan to phase out overseas commercial borrowings is not expected to materialize as it exerts more effort to tap various sources of external assistance.

133. In view of the funding constraints facing PNG, the need to continue external support for the sector's development appears inevitable. It is necessary that the catalystic role of external assistance be maximized. It is suggested that external funding assistance be specifically extended in support of the projects listed in Tables 8 and 9.

Table 8. Water Supply and Sanitation Sector
Technical Assistance Program Proposed for 1987-1991
($ '000)

| Project Name | Project Division | Type of TA | Bank Financing Total FX | LC | OCR | Grant | % Total Project Cost | Financing from Other Sources Source(s) | FX | LC | Total | Total Project Cost | Year of TA |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1. Port Moresby Water Supply | IFWS | PP | 150 | - | - | 150 | 88 | Govt. | - | 20 | 20 | 170 | 1987 |
| 2. Integrated Water Supply Study/Rural Water Supply and Sanitation Sector a/ | - | PP | 130 | - | - | 130 | 87 | Govt. | - | 20 | 20 | 150 | 1988 |
| 3. Institutional Support to the Waterboard b/ | IFWS | AO | 350 | - | - | 350 | 88 | Govt. | - | 50 | 50 | 400 | 1988 |
| 4. Provincial Towns Water Supply and Sanitation | IFWS | PP | 150 | - | - | 150 | 88 | Govt. | - | 20 | 20 | 170 | 1989 |
| 5. Port Moresby Sewerage | IFWS | PP | 75 | - | - | 75 | 88 | Govt. | - | 10 | 10 | 85 | 1991 |

a/ This PPTA is proposed to be financed possibly by donors other than the Bank.
b/ This AOTA is proposed to be piggy-backed to loan - Port Moresby Water Supply scheduled for 1987.

Notes:

TA - Technical Assistance
FX - Foreign Exchange Cost
LC - Local Cost
OCR - Ordinary Capital Resources

Table 9. Water Supply and Sanitation Sector
Lending Program Proposed for 1987-1995
($ million)

| Project Name | Project Division | Year of TA Approval | Bank Financing Total FX | IDC | LC | OCR | ADF | % Total Project Cost | Financing from Other Sources Source(s) | FX | LC | Total | Total Project Cost | Year of Loan |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1. Port Moresby Water Supply | IFWS | 1987 | 10 | - | - | 10 | - | 60 | Govt. | - | 6 | 6 | 16 | 1988 |
| 2. Rural Water Supply Sector and Sanitation a/ | - | 1988 | 4 | - | - | - | 4 | 80 | Govt. | - | 1 | 1 | 5 | 1988 |
| 3. Provincial Towns Water Supply and Sanitation | IFWS | 1989 | 10 | - | - | 10 | - | 60 | Govt. | - | 6 | 6 | 16 | 1991 |
| 4. Second Rural Water Supply and Sanitation Sector a/ | - | - | 6 | - | - | | 6 | 75 | Govt. | - | 2 | 2 | 8 | 1992 |
| 5. Port Moresby Sewerage | IFWS | 1991 | 10 | - | - | 10 | - | 60 | Govt. | - | 6 | 6 | 16 | 1993 |
| 6. Third Rural Water Supply and Sanitation a/ | - | - | 10 | - | - | - | 10 | 66 | Govt. | - | 5 | 5 | 15 | 1995 |

a/ These projects are proposed to be possibly financed by donors other than the Bank.

Notes:

TA - Technical Assistance
FX - Foreign Exchange Cost
LC - Local Cost
OCR - Ordinary Capital Resources
ADF - Asian Development Fund

Detailed descriptions of some of the major loan and TA projects are as follows:

1. Port Moresby Water Supply - Project Preparation Technical Assistance (PPTA)

(i) Project Concept, Objectives, Scope and Description

In 1984 Consultants, Camp Scott Furphy, Consultant Engineers from Australia carried out a study of Port Moresby's water supply system. A program of works was recommended that would allow certain suburbs, such as Genehu, to expand, and provide for general augmentation of the system. As water demand appears to be high in the city due to leakage and poor management, a technical assistance is proposed to prepare a project that would expand and rehabilitate the existing system, and to establish a Water Conservation Unit to minimize non-revenue water (NRW). Consultants will be required to carry out a feasibility study and to identify project components.

(ii) Cost Estimates and Financing Plan

The total cost of PPTA is estimated at about $170,000 comprising foreign cost component of about $150,000 and local cost of $20,000. The Government has requested the Bank to finance the total foreign exchange cost of $150,000 as a grant.

(iii) Executing Agency

The National Water Supply and Sewerage Board will be the executing agency.

(iv) Project Benefits

The existing system cannot keep up with demand. Construction of critical capital works in conjunction with a program to reduce NRW will allow the continued supply of water to all sections.

(v) Project Processing Schedule

TA Fact-Finding Mission is proposed to be mounted in April 1987, for approval by July 1987. The TA is expected to be completed by early June 1988 and possible loan could be considered within the 1988 lending program. The total Project cost is estimated at $16 million including the foreign exchange cost of $10 million. The Project will be implemented over four or five years.

2. Port Moresby Water Supply - Project Loan

(i) Project Concept, Objectives, Scope and Description

For Project concept, objectives, scope and description (see above item 1. (i) on page 65). Consultants will also be required to carry out detailed designs and documentation.

(ii) Cost Estimates and Financing Plan

The project cost has been estimated at $16 million over a construction period of four to five years. The foreign exchange cost will be in the order of $10 million.

(iii) Executing Agency

The National Water Supply and Sewerage Board will be the executing agency.

(iv) Project Benefits

The existing system cannot keep up with demand. Construction of critical capital works in conjunction with an intensified water conservation program will make possible the continuous supply of water to all sections of the community at an affordable price. There would be health benefits as well.

(v) Project Processing Schedule

A PPTA is scheduled for 1987 and the loan is proposed for 1988.

3. Integrated Water Supply Study/Rural Water Supply and Sanitation-PPTA

(i) Project Concept, Objectives, Scope and Description

For the water supply and sanitation sector development program to succeed, an integrated development plan that will outline the long-range plans for the sector must be prepared. In conjunction with this, a data bank of relevant information (population, incomes, existing systems, etc.) shall be established for all urban centers, communities, and villages be used in identifying a pipeline of projects to be implemented once the necessary funding is available. Of particular importance at this point is the formulation of a Rural Water Supply and Sanitation Subsector Development Plan. It is estimated that about 10 manmonths of consultant services are required.

(ii) Cost Estimates and Financing Plan

The total cost is estimated at $150,000 comprising foreign cost component of about $130,000 and local cost of about $20,000. This PPTA is proposed to be financed possibly by donors other than the Bank.

(iii) Executing Agency

The National Water Supply and Sewerage Board will execute the project on behalf of the Government.

(iv) Project Benefits

This will set the sector planning activity in motion.

(v) Project Processing Schedule

This TA is scheduled for 1988 prior to the proposed loan/grant for the Rural Water Supply and Sanitation. Project can also be financed possibly by donors other than the Bank.

4. Institutional Support to the Waterboard - Advisory and Operational Technical Assistance (AOTA)

(i) Project Concept, Objectives, Scope and Description

The objective of the TA will be to carry out a study, followed by a remedial program to reduce the present high NRW component in the city. The Consultant shall, for a selected pilot area in the maximum demand area in the city:

(a) identify the causes (both physical and administrative) for the high level of NRW and the extent of loss due to each cause;

(b) prepare a policy for the control of non-revenue water which will consider the most cost-effective approach;

(c) based on the policy accepted by the city, formulate remedial measures to contain the losses and where feasible and cost-effective, eliminate the cause; and

(d) prepare an implementation schedule, formulate institutional arrangements and prepare an estimate of cost for the work to be carried out to implement the policy.

(ii) Cost Estimates and Financing Plan

Total project cost is estimated at $400,000 consisting of $350,000 in foreign cost and $50,000 in local cost. The Government has requested the Bank to finance the technical assistance in form of a grant amounting to $250,000 to cover the foreign exchange cost.

(iii) Executing Agency

The National Water Supply and Sewerage Board will execute the project on behalf of the Government.

(iv) Project Benefit

The Project will provide institutional support to the Waterboard through a critical stage of expansion. Maximum use of existing capacity will be possible as a result of the Project, particularly since operational efficiency and revenue generation will be improved leading to better financial management and less waste. Contamination resulting from leakages in the system will likewise be eliminated reducing risks to health.

(v) Project Processing Schedule

The proposed TA could commence in 1988 and may be piggy-backed to the proposed loan for Port Moresby Water Supply Project.

5. Provincial Towns Water Supply and Sanitation - Project Loan

(i) Project Concept, Objectives, Scope and Description

(a) Madang Water Supply - Subproject

The existing water supply system of Madang constructed with the assistance of Bank Loan Nos. 278(SF) and 346(SF) was commissioned in 1982 utilizing ground water source. However, the expected yield of 10 ml/day has not been sustained following continuous water abstraction, and current safe yield is estimated at only 2.5 ml/day.

Preliminary studies have been carried out for a proposed surface water source. It would consist of pumping from a weir on the Gum River, providing full treatment, and pumping 300 mld through a 1.5-kilometer pipeline to the existing treatment plant and storage reservoirs. This would supplement the ground water source initially by 6.0 ml/day.

(b) Other Towns Water Supply and Sanitation - Subprojects (to be determined)

(ii) Cost Estimates and Financing Plan

The cost of the Madang subproject is in the order of $5.0 million over a three-year period with the foreign exchange component amounting to $4.0 million. Total project cost is estimated at about $16.0 million, with a foreign exchange cost of about $10.0 million. It is expected that the Government will request the Bank to finance this.

(iii) Executing Agency

The National Water Supply and Sewerage Board will execute the project on behalf of the Government.

(iv) Project Benefits

Supply of water to certain sections of the town (Madang) has been stopped and new connections are not being encouraged. As a result of this, rain water collection tanks removed from Government houses have been returned. The new source would provide supply of water to the town as originally planned.

(v) Project Processing Schedule

Detailed design and documentation is now required. A loan is proposed for 1990/91.

# LIST OF APPENDICES

# PERSONS MET IN PAPUA NEW GUINEA

## A. CENTRAL GOVERNMENT

### 1. Office of National Executive Council

Office of Legislative Counsel
Mr. James M. Fraser - First Legislative Counsel

### 2. Department of Finance and Planning

Department of Finance and Planning
Mr. J. E. Sequiera - First Assistant Secretary, Expenditure
Mr. Peter Sinclair - First Assistant Secretary, Revenue
Mr. Philip George - Assistant Secretary, Provincial Liaison

Foreign Aid Management Division
Mr. Robert Igara - First Assistant Secretary

Bilateral Programs Branch
Ms. Fiu Williame - Assistant Secretary

International Financial Institutions Branch
Mr. Geral Mwyubu - Officer dealing with ADB

Loans and International Finance
Ms. Margo Vogel - Assistant Secretary
Mr. George Paru - Senior Investigations Officer

Public Enterprise Branch
Mr. Balue Umetrifo - Research Officer

Management Accounting and Consultancy Branch
Mr. S. Ramamurthy - Assistant Secretary (Consultancy)

Planning Services Section
Ms. Mary Anne Grieg-Gran

### 3. Department of Works and Supply

Mr. Andrew I. Temu - Secretary of the Department and Chairman of the National Water Supply and Sewerage Board
Mr. John Zickrow - Computer Manager
Mr. D. P. Wanigasdekara-Mchotti - Contracts Manager
Mr. Flor V. Conejares - Field Coordinator, S. Region
Mr. Honorato Victorio - Senior Trust Accountant

Staff Development and Training Branch
Mr. John Swinson - Senior Training Officer
Mr. Peter Corke - Building Trades Training Specialist

Planning Division
Mr. Avoa Maraiappo - Principal Planning Officer

4. National Water Supply and Sewerage Board

Mr. Ian Powell - General Manager

Commercial Division
Mrs. Anna Simet - Actg. Financial Controller from 1.8.86
Mr. John Nicolson - Executive Financial Controller until 30.7.86
Mr. Morea Igo - Senior Accountant

Engineering Division
Mr. Ted Webber - Manager, Engineering
Mr. Tom Fawcett - Executive Engineer, Water
Mr. Peter Beckman - Project Engineer, Water
Mr. Cameron Ure - Executive Engineer, Sewerage
Mr. Vince Lim - Project Engineer, Sewerage
Mr. Paison M. Yabom - Drafting Officer

5. Department of Health

Environmental Health
Mr. Lindsay Piliwas - Asst. Secretary, Environmental Health

6. Department of Youth and Home Affairs

Ms. Felecia Dobunaba - Secretary

7. Department of Housing

Housing Schemes and Land Development
Mr. Ken Rabura - Coordinator (O&M)

8. Department of Labor and Employment

Employment and Training Division
Mr. Patric A. Sariman - Executive Officer of Apprenticeship Board

9. Department of Provincial Affairs

Mr. Bill Kua - Senior Provincial Office

## B. PROVINCIAL GOVERNMENT AND ORGANIZATIONS

### 1. Chimbu Province

Department of Works and Supply, Kundiawa

| | | |
|---|---|---|
| Mr. R. K. Ivanov | - | Provincial Manager |
| Mr. P. Douflinger | - | Provincial Engineer |
| Mr. M. Kuluwah | - | Kundiawa Water Supply |

### 2. Madang Province

Department of Works and Supply
Local Government Engineering Services

| | | |
|---|---|---|
| Mr. Will Guthrie | - | Manager |
| Mr. Saidi Inia | - | District Manager, Madang Water District |
| Mr. Bruce Sevua | - | Senior Operator, Madang Water District |

### 3. Morobe Province, Lae City

Local Government Engineering Services
Department of Works

| | | |
|---|---|---|
| Mr. David Rowsome | - | Engineer |

Lae Water District, Department of Works

| | | |
|---|---|---|
| Mr. Bob Bament | - | District Manager |
| Mr. Les Mulder | - | Actg. District Manager |
| Mr. Apelis Vue | - | Accountant |
| Mr. Kondoa Kanaring | - | Senior Operator |
| Ms. Elizabeth Rangau | - | Data Processing Supervisor |
| Mr. U. Barrel | - | Foreman II |
| Mr. Udo Bara | - | German Volunteer |

Department of Health

| | | |
|---|---|---|
| Dr. Like Theo | - | Asst. Secretary |
| Mr. Raphael Kababa | - | Provincial Health Inspector |
| Mr. Ebu Qangazi | - | Health Inspector |

### 4. National Capital District

National Capital District Interim Commission

| | | |
|---|---|---|
| Mr. T. Balakrishnadas | - | Deputy General Manager |
| Mr. David Elliot | - | City Engineer |
| Mr. R. Arasaratnam | - | Financial Controller |
| Mr. Brian Martin | - | Executive Engineer, Water Supply, and Sewerage Engineer |
| Mr. Dick Nihara | - | Water Supply and Sewerage Engineer |
| Mr. Karl Lapinskas | - | Water Treatment Plant Manager |
| Mr. Bernard Kipit | - | Water Engineer |
| Mr. Arthur Cirrodus | - | Sewerage Foreman |
| Mr. Aloysius Miria | - | Chief, Billing Section |

5. Western Province

Kiunga Town
Department of Provincial Affairs
Mr. Trever Downs

Department of Works and Supply
Mr. Ken Heddle

Department of Health
Dr. Thomas Kubu - Medical Superintendent, Kiunga Hospital
Mr. Usa Soqi - Health Inspector

OK Tedi Mining Ltd. at Kiunga
Mr. Wes Adams - Administrator
Mr. Russ Peterson

Montfort Catholic Mission at Kiunga
Sister Marie

Mr. Sauna Gageya - School Teacher, Gre Village
Mr. Swokin Kawa - Village Elder, Dande Village

6. Western Highlands Province

Department of Works and Supply
Mr. N. Boag - Provincial Manager
Mr. S. Schwarz - Resident Engineer, Mount Hagen Sewerage Project

Mt. Hagen Water District
Mr. R. A. Brown - District Manager
Mr. B. William - Accountant
Mr. R. H. Bonoro - Accountant
Mr. C. Ken - Cashier

Baisu Prison, Mt. Hagen
Mr. B. Forova - Orderly Officer

7. West New Britain Province

Mr. Ukartha Oti - Assistant Resident Engineer, Kimbe Water Supply Project

C. OTHER ORGANIZATIONS

1. University of Papua New Guinea

Department of Anthropology and Sociology
Prof. Maev O' Collins - Professor of Anthropology and Sociology

C. OTHER ORGANIZATIONS (cont'd)

2. University of Technology at Lae

| | | |
|---|---|---|
| Mr. T. W. Gee | - | Registrar |
| Prof. J. E. Cousines | - | Head, Department of Civil Engineering |

Appropriate Technology Development Institute

| | | |
|---|---|---|
| Dr. R. Burton | - | Director |
| Mr. Borang Tiewete | - | Research Engineer |

3. Technical College at Lae

| | | |
|---|---|---|
| Mr. John R. Cook | - | Principal |
| Mr. Graham Whicker | - | Head, Building and Civil Engineering Department |

4. Agriuclture Bank of Papua New Guinea, Port Moresby

| | | |
|---|---|---|
| Mr. K. S. Gill | - | Deputy Managing Director |

5. Coopers and Lybrand, Management Consultants

| | | |
|---|---|---|
| Mr. Ian Mackintosh | - | Resident Partner |
| Mr. Chris White | - | Consultant |
| Mr. Peter Heijkop | - | Consultant |
| Mr. Geoffrey Parker | - | Computer Specialist |

6. Touche Ross Services Pty., Management Consultants

| | | |
|---|---|---|
| Mr. Brian Thomson | - | Senior Consultant |

7. GITEC Consult, GMBH

| | | |
|---|---|---|
| Mr. Wolfgang Stenzel | - | Resident Engineer, Kimbe Water Supply Project |

8. Scott and Furphy Consulting Group, Consulting Engineers

| | | |
|---|---|---|
| Mr. Lindsay Rockett | - | Manager, Port Moresby |

9. Belltek Laboratories, Pty. Ltd.

| | | |
|---|---|---|
| Mr. Caesar Nunez | - | Production Manager |

D. INTERNATIONAL ORGANIZATIONS

1. ADB Rural Health Services Project

| | | |
|---|---|---|
| Ms. Jane Thomason | - | Project Co-ordinator |
| Mr. Gunther Seidel | - | Sanitary Engineer |

2. World Health Organization

| | | |
|---|---|---|
| Mr. E. Dekel | - | AG WPC |

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# BASIC DATA SHEET OF PAPUA NEW GUINEA
(As of 30 April 1986)

| | | 1970 | Estimate | Remarks |
|---|---|---|---|---|
| AREA | Total (1,000 sq km) | | 462.84 | 1981 |
| | Cropped Land Per Capita (ha) | 0.14 | 0.11 | 1982 |
| POPULATION | Total (million; mid-year) | 2.45 | 3.33 | 1985 est |
| | Density (persons/sq km) | n.a. | 7 | 1985 |
| | Annual Growth Rate (%) | 2.3 | | 1980-1983 |
| GNP PER CAPITA | (US$) | | 763 | 1984 |
| SOCIAL/ DEVELOPMENT INDICATORS | Life Expectancy at Birth (years) | 49 | 53 | 1982 |
| | Infant Mortality (per 1,000 live births) | 125 | 99 | 1982 |
| | Access to Safe Water (% of population) | | | |
| | In Urban Areas | | 30 | 1980 |
| | In Rural Areas | | 19 | 1980 |
| | Daily Per Capita Calorie Supply (gm) | 2,200 | 2,090 | 1982 |
| | Persons per Physician | 11,630 | 16,440 | 1982 |
| | Gross Primary School Enrollment (%) | 52 | 65 | 1982 |
| | Adult Literacy Rate (%) | 32 | 32 | 1980 |
| | Energy Consumption per Capita (kg coal equivalent) | 141 | 296 | 1980 |

| | | 1981 | 1982 | 1983 | 1984 | 1985 Est. |
|---|---|---|---|---|---|---|
| GROSS DOMESTIC PRODUCT (Mn Kina) | GDP at Current Purchaser's Value (pv) | 1,681.2 | 1,749.1 | 1,969.7 | 2,172.7 | 2,340.0 |
| | GDP at Constant 1977 pv | 1,422.8 | 1,420.2 | 1,433.9 | 1,499.9 | 1,059.4 |
| | Growth Rate (%) | 1.5 | -0.2 | 1.0 | 4.6 | 3.3 |
| GDP, AT CONSTANT 1977 PV (percentage share by expenditure) | Private Consumption | 55.0 | 53.7 | 54.8 | 56.5 | 53.3 |
| | Government Consumption | 23.2 | 22.6 | 21.7 | 20.8 | 20.1 |
| | Gross Fixed Capital Formation | 24.9 | 28.9 | 29.3 | 21.2 | 18.1 |
| | Increase in Stocks | 0.4 | -0.8 | -0.3 | 2.7 | 0.6 |
| | Exports of Goods and Services | 38.2 | 36.8 | 39.2 | 48.9 | 53.6 |
| | Less: Imported Goods and Services | 58.7 | 60.5 | 57.6 | 50.8 | 45.8 |
| | Statistical Discrepancy | 1.9 | 1.4 | -0.6 | 0.7 | .0 |
| RESOURCE GAP AT CURRENT MP (%) | Gross Domestic Savings/GDP | 14.1 | 15.5 | 17.9 | 18.6 | 13.6 |
| | Gross Domestic Investment/GDP | 27.2 | 32.2 | 32.0 | 23.6 | 21.7 |
| | Savings-Investment Gap/GDP | -13.1 | -16.7 | -14.1 | -5.1 | -8.1 |
| PRICE INDEXES | Consumer (Port Moresby, 1977 = 100) | 143.1 | 150.1 | 168.3 | 171.6 | 183.6 |
| | Annual Change (%) | 5.8 | 4.9 | 12.1 | 2.0 | 7.0 |
| MONEY AND CREDIT (Mn Kina) | Commercial Banks Time and Savings Deposits | 273.1 | 296.6 | 388.6 | 425.4 | 466.0 Jun |
| | Domestic Credits Outstanding | 308.0 | 343.2 | 394.9 | 487.9 | 536.5 Jun |
| | Money Supply (M1) | 335.1 | 321.0 | 353.9 | 381.2 | 373.7 Jun |
| | Annual Change (%) | 12.0 | -4.2 | 10.2 | 7.7 | |

| | | 1981 | 1982 | 1983 | 1984 | 1985 Est. |
|---|---|---|---|---|---|---|
| CENTRAL GOVERNMENT FINANCE (In Kina) | Total Revenue | 374.0 | 373.0 | 415.7 | 475.7 | 510.7 |
| | Total Expenditure | 658.8 | 667.1 | 713.1 | 822.8 | 930.1 |
| | Overall Surplus/Deficit(-) | -284.8 | -294.1 | -297.4 | -347.1 | -419.4 |
| | Financing Domestic Borrowings, net | 17.1 | -31.7 | -26.7 | 34.8 | 62.0 |
| | Foreign Borrowing | 83.7 | 75.7 | 110.9 | 79.8 | 112.3 |
| | Foreign Grants | 184.0 | 186.7 | 213.2 | 232.5 | 245.7 |
| | Use of Cash Balance (Increase) | .0 | .0 | .0 | .0 | -0.6 |
| BALANCE OF PAYMENTS (Mn US$) | Exports (fob) | 840 | 765 | 824 | 915 | 909 |
| | Imports (fob) | -1,096 | -1,018 | -975 | -966 | -863 |
| | Trade Balance | -256 | -253 | -151 | -51 | 46 |
| | Services (net) | -419 | -374 | -380 | -440 | -339 |
| | Transfer (net) | 154 | 138 | 160 | 167 | 127 |
| | Current Balance | -521 | -489 | -371 | -324 | -166 |
| | Capital Flow | 417 | 479 | 456 | 256 | 141 |
| | Direct Investment | 86 | 84 | 138 | 113 | n.a. |
| | Portfolio Investment | -2 | - | - | - | - |
| | Other Long-Term Capital | 308 | 397 | 312 | 124 | n.a. |
| | Other Short-Term Capital | 25 | -2 | 6 | 19 | n.a. |
| | Net Errors and Omissions | 53 | -28 | 12 | 115 | 13 |
| | Overall Balance | -51 | -38 | 97 | 47 | -12 |
| | Allocation of SDRs | 4 | - | - | - | - |
| | Monetary Movements | 47 | 38 | -97 | -47 | 12 |
| LEADING EXPORT COMMODITIES (Percentage Share) | Copper | 23.9 | 21.6 | 23.4 | 16.7 | 18.4 |
| | Coffee Bears | 13.1 | 13.7 | 13.8 | 13.8 | 12.4 |
| | Gold | 28.1 | 30.2 | 29.3 | 23.1 | 28.4 |
| | Forest Products | 7.8 | 10.9 | 8.0 | 10.2 | 8.5 |
| | Cocoa | 6.0 | 5.6 | 6.0 | 8.4 | 6.3 |
| EXCHANGE RATE | Kina/US$ (end of period) | 0.6805 | 0.7429 | 0.8755 | 0.9434 | 1.001 |
| INTER-NATIONAL RESERVES (Mn US$) | Total (end of year) | 412.0 | 467.4 | 463.4 | 435.0 | 423.9 |
| | Gold, National Valuation | 15.9 | 14.5 | 12.7 | 11.0 | 11.0 |
| | Foreign Exchange | 357.6 | 418.6 | 427.3 | 413.9 | 400.5 |
| | Reserve Position in the Fund | 0.0 | 0.1 | 5.6 | 5.2 | 5.9 |
| | Ratio to Merchandise Imports (months) | 5.2 | 4.3 | 6.1 | 4.6 | 5.9 |
| EXTERNAL DEBT (Mn US$) | Publicly Guaranteed, Outstanding, Including Undisbursed (end of period) | 802.7 | 915.5 | 1,131.5 | 1,209.3 | n.a. |
| | Disbursed Only (end of period) | 629.0 | 748.0 | 911.2 | 925.2 | n.a. |
| | Private Non-Guaranteed, Outstanding Disbursed Only (end of period) | 337.9 | 653.3 | 820.1 | 890.0 | n.a. |
| | Disbursements (total for period) d/ | 414.2 | 567.8 | 508.3 | 330.9 | n.a. |
| | Principal Repayments (total for period) d/ | 80.2 | 112.9 | 160.8 | 221.8 | n.a. |
| | Interest Payments (total for period) d/ | 73.3 | 103.3 | 120.7 | 148.3 | n.a. |
| | Debt Service Ratio (%) d/ | 7.0 | 10.2 | 11.1 | 12.9 | n.a. |

n.a. Data not available

a/ World Bank estimate using 1982-1984 as base period.

b/ Figures are for the first two quarters of 1985.

c/ Figures for 1985 are as of July.

d/ Include transactions on public and private non-guaranteed debt.

INDEPENDENT STATE OF PAPUA NEW GUINEA.

No. of 1986.

# *National Water Supply and Sewerage Bill* 1986.

ARRANGEMENT OF CLAUSES.



MT

PART III. - ESTABLISHMENT, MEMBERSHIP AND MEETINGS OF THE BOARD OF DIRECTORS OF THE WATERBOARD.



PART IV. - MANAGING DIRECTOR.



PART V. - STAFF OF THE WATERBOARD.



PART VI. - FINANCES, ETC.



PART VII. - POLICY, STANDARDS, LICENSING, ETC.



PART VIII. - SEWERAGE AND WATER SUPPLY DISTRICTS, ETC.



PART IX. - MISCELLANEOUS.

PART X. - REPEAL.



PART XI. - TRANSITIONAL AND SAVINGS.

Draft of 5/12/86.
INDEPENDENT STATE OF PAPUA NEW GUINEA.

A BILL

for

AN ACT

entitled

***National Water Supply and Sewerage Act* 1986,**

Being an Act to establish a Waterboard, to provide for co-ordinated water supply and sewerage services in the country, to repeal previous legislation on the subject, and for related purposes,

MADE by the National Parliament to come into operation -
(a) all provisions except Section 39(*b*) - on 1 January 1987;
(*b*) Section 39(*b*) - 1 July 1987.

PART I. - PRELIMINARY.

1. THE PURPOSES OF THIS ACT.
The purposes of this Act are to establish a Waterboard and to charge it with the duty of co-ordinating planning, design, construction, management of, and charging for, water supply and sewerage services throughout the country.

2. COMPLIANCE WITH CONSTITUTIONAL REQUIREMENTS.
(1) This Act, to the extent that it regulates or restricts a right or freedom referred to in Subdivision III.3.C (*qualified rights*) of the Constitution namely -
(*a*) the freedom from arbitrary search and entry conferred by Section 44 of the Constitution; and
(*b*) the right to privacy conferred by Section 49 of the Constitution,
is a law that is made for that purpose.

(2) For the purposes of Section 29 of the ***Organic Law on Provincial Government***, it is declared that this Act relates to a matter of national interest.

MT

(3) For the purposes of Section 53 (*protection from unjust deprivation of property*) of the Constitution, the purposes expressed in Section 1 are public purposes.

3. INTERPRETATION.

In this Act, unless the contrary intention appears -

"the Board" means the Board of Directors of the Waterboard established under Section 9;

"customer" in relation to water supply or sewerage means any person to whom service is provided under this Act;

"occupier" means a person in actual occupation of any land or, if there is no person in actual occupation, the person entitled to possession of the land;

"owner" includes -

(*a*) in relation to land the subject of a State lease under or continued in force by the ***Land Act*** - the lessee under the lease; and

(*b*) where a person is in occupation of Government improved land under an agreement with the Government - that person;

"sanitation" means all forms of waste disposal including sewerage;

"sewage" means any water contaminated by domestic wastes or trade effluent or any contents of a sewer;

"sewerage charges" means a charge related to the quantity of sewerage discharged;

"sewerage district" means an area declared under Section 27 to be a sewerage district;

"sewerage system" includes sewers, fittings, fixtures, appliances, plant, machinery and sewerage systems constructed for the purposes of treatment and conveyance of sewage but shall exclude traditional village systems;

"tariff" means a set of charges, rates and fees set under this Act;

"this Act" includes the Regulations, By-laws and Rules;

"water" means any water treated or untreated that is transported and made available to the public;

"water supply district" means an area declared under Section 27 to be a water supply district;

"water supply charges" means a charge based on the quantity of water supplied;

"water supply system" means a reservoir, well, bore, tank, aqueduct, tunnel, building, pipe or other system constructed for the purposes of supplying water but shall exclude traditional village systems;

"Waterboard" means the Waterboard established under Section 4;
"Waterboard district" means a sewerage district or a water supply district or a combination of both such districts.

PART II. - ESTABLISHMENT, FUNCTIONS AND POWERS ETC., OF THE WATERBOARD.

4. ESTABLISHMENT.
(1) The Waterboard is hereby established.

(2) The Waterboard -
(*a*) is a corporation with perpetual succession; and
(*b*) shall have a common seal; and
(*c*) may acquire, hold and dispose of property; and
(*d*) may sue and be sued in its corporate name.

(3) All courts, Judges and persons acting judicially shall take judicial notice of the common seal of the Waterboard affixed to a document and shall presume that it was duly affixed.

5. FUNCTIONS OF THE WATERBOARD.
The functions of the Waterboard are -
(*a*) to provide water supply and sanitation services to meet the reasonable needs of the urban population, Governments and business enterprises; and
(*b*) to promote water supply and sanitation in rural areas and urban fringe areas through community participation on self-help bases and where necessary with the help of loans, grants or aid; and
(*c*) to maintain its assets in good order; and
(*d*) to exercise such control as the Waterboard may determine over persons and organizations providing water supply and sanitation services, or services related to water supply and sanitation; and
(*e*) to set such standards as the Waterboard may determine for materials and equipment used in water supply and sanitation; and
(*f*) to advise the National Executive Council on all matters relating to water supply and sanitation; and
(*g*) to engage in research related to water supply and sanitation activities; and
(*h*) to carry out such other functions as are specified in this Act; and
(*i*) generally to do such supplementary, incidental or consequential acts and things as are

necessary or convenient for carrying out its functions.

6. OBJECTIVES OF THE WATERBOARD.

In carrying out its functions under Section 5, the Waterboard shall pursue the following objectives:-

(a) in its commercial activities to earn a rate of return as determined from time to time by the National Executive Council;

(b) to engage in non-commercial activities, other than advisory research and control activities, only where an explicit subsidy for operations is made in the National Budget or by some other authority;

(c) in the provision and promotion of water supply and sanitation services to contribute, as far as is practicable, to the improvement of public health by -

(i) making water supply and sewerage services available on a commercial basis to as many people in the urban areas as is practicable, and extending those services as rapidly as is practicable so that all people in urban areas have access to them; and

(ii) promoting water supply and sanitation with community participation on self-help bases, and where necessary with help of loans, grants or aid to as many people in the rural areas and in the urban fringe areas as is practicable;

(d) to employ officers and employees in a working environment that contributes to a high level of staff morale and operational efficiency and, where appropriate, to assist officers and employees to gain the skills necessary for the career development consistent with the Waterboard's functions;

(e) to be a responsible corporate citizen by -

(i) protecting the physical and social environment where practicable in relation to the Waterboard's activities; and

(ii) contributing to the national welfare but not so as to compete with any bodies whose main functions are promotion of welfare; and

(iii) refraining from providing services which are not justified by reasons of high cost or limited demand;

(f) to keep abreast of and contribute to developments in the field of water supply and sanitation management, and to improve and extend water supply and sanitation services in

the light of such developments bearing in mind the needs, goals and aspirations of the people, Governments and business enterprises;

(g) to encourage the development of efficient national manufacturing, service and other industries related to the Waterboard's activities.

7. POWERS OF THE WATERBOARD.

The Waterboard has, in addition to the powers otherwise conferred by this Act and by any other law, power to do all things that are necessary or convenient to be done in connection with the performance of its functions and objectives.

8. DELEGATION.

The Waterboard may, by instrument, delegate to any person all or any of its functions and powers (except this power of delegation).

## PART III. - ESTABLISHMENT, MEMBERSHIP AND MEETINGS OF THE BOARD OF DIRECTORS OF THE WATERBOARD.

9. ESTABLISHMENT AND MEMBERSHIP OF THE BOARD OF DIRECTORS OF THE WATERBOARD.

(1) There shall be a Board of Directors of the Waterboard.

(2) The Board shall consist of -

(a) the Departmental Head of the Department responsible for finance matters or his nominee; and

(b) the Departmental Head of the Department responsible for health matters, or his nominee; and

(c) the Departmental Head of the Department responsible for works matters, or his nominee; and

(d) one member representing private consumer groups with extensive experience in commerce, nominated by the Papua New Guinea Chamber of Commerce; and

(e) one member with extensive experience of accounting and business practice, holding a senior accounting position, nominated by the Papua New Guinea Institute of Accountants; and

(f) one member with extensive experience in the engineering of water supply and sanitation systems, holding a senior engineering position, nominated by the Society of Professional Engineers of Papua New Guinea; and

(*g*) one member with extensive experience of management practice, holding a senior management position, nominated by the Papua New Guinea Institute of Management; and

(*h*) the Managing Director.

(2) Where under Subsection (1)(*a*), (*b*) or (*c*) a nominee is nominated, the nominee shall be an officer of not less than Assistant Secretary level or the equivelant, and the Departmental Head concerned shall give prior written notice to the Managing Director of the name of the nominee.

(3) The members referred to in Subsection 1(*d*), (*e*), (*f*) and (*g*) -

(*a*) shall be appointed by the Head of State, acting on advice, by notice in the National Gazette; and

(*b*) shall be appointed for a period not exceeding three years; and

(*c*) shall be appointed on such terms and conditions as are determined by the National Executive Council; and

(*d*) are eligible for re-appointment.

10. ALTERNATE MEMBERS.

(1) For each of the members appointed under Section 9(1)(*d*), (*e*), (*f*) and (*g*) an alternate member shall be appointed in the same way and subject to the same conditions as the member for whom he is alternate.

(2) In the event of the inability to act of a member, the alternate member has and may exercise all his powers, functions, duties and responsibilities and this Act applies accordingly.

(3) An alternate member may, unless the Board otherwise directs, attend all meetings of the Board but shall not, except where he is attending in the absence of the member for whom he is the alternate, take part in debate, vote on any matter or be counted towards a quorum.

11. CHAIRMAN AND DEPUTY CHAIRMAN.

The Head of State, acting on advice, shall appoint a member, other than the Managing Director, to be the Chairman of the Board, and another member to be the Deputy Chairman of the Board, for such period as is determined by the Head of State, acting on advice.

12. LEAVE OF ABSENCE.

The Chairman may grant leave of absence to a member on such terms and conditions as determined by the Board.

13. VACATION OF OFFICE.

(1) A member, other than an *ex officio* member, may resign his office by writing signed by him and delivered to the Managing Director.

(2) If a member, other than the Managing Director -

(*a*) becomes permanently incapable of performing his duties; or

(*b*) resigns his office under Subsection (1); or

(*c*) is absent, except with the written consent of the Chairman, from three consecutive meetings of the Board; or

(*d*) fails to comply with Section 15; or

(*e*) becomes bankrupt, or applies to take the benefit of any law for the relief of bankrupt or insolvent debtors, compounds with his creditors or makes an assignment of his remuneration for their benefit; or

(*f*) is convicted of an offence punishable under a law by a term of imprisonment for one year or longer, or by death, and as a result of the conviction is sentenced to imprisonment or death,

the Head of State, acting on advice, shall terminate his appointment.

(3) The Head of State, acting on advice, may, at any time, by written notice, advise a member that he intends to terminate his appointment on the grounds of inefficiency, incapacity or misbehaviour.

(4) Within 14 days of the receipt of a notice under Subsection (3), the member may reply in writing to the National Executive Council, who shall consider the reply, and, where appropriate, advise the Head of State to terminate the appointment.

(5) Where the member referred to in Subsection (3) does not reply in accordance with Subsection (4), his appointment is terminated.

14. VACANCY NOT TO AFFECT POWERS OR FUNCTIONS.

The exercise or performance of a power or function of the Board is not invalidated by reason of a vacancy in the membership of the Board.

15. DISCLOSURE OF INTEREST.

(1) A member who has a direct or indirect interest in a matter being considered or about to be considered by the Board, otherwise than as a member of, and in common with the other members of, an incorporated company which consists of more than 25 persons and of which he is not a director, shall, as soon as the relevant facts have come to his knowledge, declare his interest at a meeting of the Board.

(2) A declaration under Subsection (1) shall be recorded in the minutes of the Board and the member -

(a) shall not take part, after the declaration, in any deliberation or decision of the Board in relation to the matter; and

(b) shall be disregarded for the purpose of constituting a quorum of the Board in that deliberation or decision.

16. MEETINGS OF THE BOARD.

(1) The Board shall meet as often as the business of the Waterboard requires, and at such times and places as it determines, or as the Chairman, or in his absence, the Deputy Chairman, directs, but in any event not less frequently than once in every three months.

(2) Where he receives a request to do so by the Managing Director or by not less than two members, the Chairman, or in his absence the Deputy Chairman, shall convene a meeting of the Board within 14 days.

(3) At a meeting of the Board -

(a) four members constitute a quorum; and

(b) the Chairman, or in his absence the Deputy Chairman, shall preside and if both the Chairman and the Deputy Chairman are absent the members present shall appoint a Chairman for that meeting from among their own number; and

(c) matters arising shall be decided by a majority of the votes of the members present and voting; and

(d) the person presiding has a deliberative, and in the event of an equality of votes on any matter, also a casting vote.

(4) The Board shall cause minutes of its meetings to be recorded and kept.

(5) Subject to this Act, the procedures of the Board are as determined by the Board.

PART IV. - MANAGING DIRECTOR.

17. APPOINTMENT, ETC., OF MANAGING DIRECTOR.

(1) There shall be a Managing Director of the Waterboard who shall be -

(a) appointed by the Head of State, acting on advice given after considering a recommendation from the Board; and

(b) appointed for a period of 3 years and be eligible for reappointment; and

(c) the Chief Executive of the Waterboard; and

(*d*) the Head of the service.

18. TERMINATION OF APPOINTMENT.

(1) Where the Managing Director -

(*a*) becomes permanently incapable of performing his duties; or

(*b*) resigns his office by writing under his hand addressed to the Head of State through the Board; or

(*c*) engages, without the written consent of the Board, in any paid employment outside the duties of his office; or

(*d*) become bankrupt or applies to take the benefit or any law for the relief of bankrupt or insolvent debtors, compounds with his creditors or makes an assignment of his renumeration for their benefit; or

(*e*) is convicted of an offence punishable under a law by death or by imprisonment for one year or longer, and as a result of the conviction, is sentenced to death or imprisonment,

the Head of State, acting on advice, given after considering a report from the Board, shall terminate his appointment.

(2) The Head of State, acting on advice, may, at any time, by written notice, advise the Managing Director that he intends to terminate his appointment on ground of inefficiency, incapacity or misbehaviour.

(3) Within 14 days of the receipt of a notice under Subsection (2), the Managing Director may reply in writing to the Head of State, who shall, acting on advice, consider the reply and where appropriate, terminate his appointment.

(4) Where the Managing Director does not reply in accordance with Subsection (3), his appointment is terminated.

19. PUBLIC SERVICE RIGHTS.

Where an officer of the Public Service or other National Government authority is appointed to be Managing Director, his service as Managing Director shall be counted as service in the Public Service for the purpose of determining his rights (if any) in respect of all accrued benefits.

20. FUNCTIONS OF MANAGING DIRECTOR.

(1) The Managing Director shall -

(*a*) manage the Waterboard and shall, in relation to the management of the Waterboard, act in accordance with the policy and direction of the Board; and

(*b*) advise the Board on any matter concerning the Waterboard referred to him by the Board.

(2) The Managing Director has such other functions as the Board from time to time determines.

PART V. - STAFF OF THE WATERBOARD.

21. APPOINTMENT OF OFFICERS.

(1) The Waterboard may appoint to be officers of the Waterboard such persons as it thinks fit and necessary for the purposes of the Waterboard.

(2) The Managing Director and officers of the Waterboard constitute the staff of the Waterboard.

(3) Where an officer of the Waterboard was, immediately before his appointment, an officer of the Public Service or other National Government Authority, his service as an officer of the Waterboard shall be counted as service in the Public Service for the purpose of determining his rights (if any) in respect of all accrued benefits.

(4) Subject to this Act and to the ***Salaries and Conditions Monitoring Committee Act***, officers hold office on such terms and conditions as are determined by the Board.

22. RULES FOR THE STAFF OF THE WATERBOARD.

(1) The Rules may make provision in relation to the staff of the Waterboard and, in particular, may -

(*a*) subject to the ***Salaries and Conditions Monitoring Committee Act***, prescribe the terms and conditions of employment; and

(*b*) make provision for a superannuation or other retirement benefits scheme to provide benefits for the staff; and

(*c*) prescribe disciplinary procedures, creation and abolition of offices, classification of offices, promotion of officers and other matters for the regulation of the service of the Waterboard.

(2) In the absence of Rules under Subsection (1), the provision of Regulations or General Orders pertaining to the National Public Service shall, in so far as applicable, apply.

23. OTHER EMPLOYEES.

(1) The Managing Director may appoint such other employees, on such conditions as he thinks necessary for the purposes of the Act.

PART VI. - FINANCES, ETC.

24. APPLICATION OF ***PUBLIC FINANCES (MANAGEMENT) ACT*** 1986.

(1) The ***Public Finance (Management) Act*** 1986 applies to and in relation to the Waterboard.

(2) The Waterboard is a trading enterprise for the purpose of Section 61 of the ***Public Finances (Management) Act*** **1986.**

(3) For the purposes of Section 58 of the ***Public Finances (Management) Act*** **1986** tenders shall be publicly invited and contracts taken by the Waterboard for all works, supplies and services, the estimated cost of which exceeds K10,000.00 or any other figure as declared by the Minister responsible for finance matters.

25. TARIFF, RATES, FEES AND CHARGES.

(1) Subject to any determination under Section 21 of the ***Prices Regulation Act*** (Chapter 320), the Board may fix and set a tariff, rates, fees and charges to be made for goods and services supplied by the Waterboard.

(2) Notification of the tariff, rates, fees and charges fixed under Subsection (1) shall be made in the National Gazette and otherwise as the Board determines.

## PART VII. - POLICY, STANDARDS, LICENSING, ETC.

26. POLICY, STANDARDS, LICENSING, ETC.

(1) The Waterboard shall set policy and standards for, and establish a system of licensing and regulation of, plumbers throughout the country.

(2) The Waterboard shall approve and license and set licensing fees for all water supply and sewerage systems not operated by the Waterboard.

(3) Any tariff set in respect of a water supply or sewerage system not operated by the Waterboard shall be submitted to the Waterboard and shall have no effect until approved by the Waterboard, except that any such tariff in effect immediately before the coming into operation of this Act shall be deemed to have been approved by the Waterboard until further advised by the Waterboard.

(4) A person who, without the prior approval of the Waterboard, constructs, operates or manages any public water supply and sewerage system, is guilty of an offence.

Penalty: A fine not exceeding K10 000.00.

(5) All other matters pertaining to national standards, policy, land matters and easements, licences and approvals under this section shall be as prescribed in the Regulations, By-laws or Rules.

## PART VIII. - SEWERAGE AND WATER SUPPLY DISTRICTS, ETC.

27. SEWERAGE DISTRICTS AND WATER SUPPLY DISTRICTS.

(1) The Minister may, on the recommendation of the Board, declare an area to be -

(*a*) a sewerage district; or

(*b*) a water supply district.

(2) The Waterboard may operate and maintain either through acquisition under this Act or by construction -

(*a*) sewerage systems in a sewerage district; and

(*b*) water supply systems in a water supply district.

(3) The By-laws or Regulations may make provision for all matters relating to the water supply and sewerage systems protection and control and the assessment and recovery of water supply and sewerage rates, charges and fees under this Act.

28. DECLARATION BY THE MINISTER.

(1) The Minister may, on the recommendation of the Board, by notice in the National Gazette, declare any water supply system or sewerage system, by whatever name called to be a water supply district or a sewerage district under this Act.

(2) A water supply system or sewerage system to which this section applies shall, on the date of publication of the notice under Subsection (1), together with all the lands, goods, materials and things forming part of that water supply system or sewerage system, vest in the Waterboard and be the property of the Waterboard.

29. SAVING OF CONTRACTS.

All contracts, agreements, conveyances, deeds, leases, licences and other instruments and undertakings entered into by, made with, or addressed to, any person or body in respect of any water supply system or sewerage system the property of the Waterboard by virtue of Section 28, being a person who, or body which, immediately before publication of the notice under that section, was responsible for the management or operation of the water supply system or sewerage system, as the case may be, shall to the extent that they were previously binding on and enforceable against that person or body, be, on publication of the notice, binding and of full force and effect in every respect against or in favour of the Waterboard as fully and effectually as if, instead of that person or body, the Waterboard had been a party to them or bound by them or entitled to the benefit of them.

30. ACTIONS, ETC., NOT TO ABATE.

Where, immediately before publication of a notice under Section 28, any action, arbitration or proceeding, or any cause of action, in relation to the water supply system or sewerage system, the subject of the notice, was pending or existing by, against or in favour of, the person or body referred to in Section 29, it does not, on the publication of the notice, abate or discontinue to be affected in any way by any provision of this Act, but may be prosecuted, continued and enforced by, against or in favour of the Waterboard as and when it could have been enforced by, against or in favour of, that person or body.

31. APPLICATION OF ACTS, ETC.

Where a notice under Section 28 has been published in respect of any water supply system or sewerage system -

(*a*) any Act or subordinate legislation other than this Act; or

(*b*) any document or instrument whenever made or executed,

in which a reference express or implied is made to the person or body responsible for the management or operation of those water supply system or the sewerage system, as the case may be, immediately before publication of the notice, shall after that publication and except where the contrary intention appears, be construed and has effect as a reference to the Waterboard.

PART IX. - MISCELLANEOUS.

32. PROTECTION FROM PERSONAL LIABILITY.

A member of the Board, or officer, employee or agent of the Waterboard is not personally liable for any act or default of himself or the Waterboard done or omitted to be done in good faith in the course of the operation of the Waterboard, or for purposes of the Waterboard.

33. ***BUILDING ACT*** PROVISIONS.

Where any provisions in this Act relating to plumbing, draining, water supply, sewerage or sanitation matters are inconsistent with provisions of the ***Building Act*** (Chapter 301) and regulations made thereunder, the provisions of this Act shall apply.

34. QUALITY STANDARDS TO COMPLY WITH OTHER LEGISLATION.

All provisions of this Act, in so far as relating to quality standards, shall comply with the provision of the ***Public Health Act*** (Chapter 226) and the ***Water Resources Act*** (Chapter 205).

35. REGULATIONS.

The Head of State, acting on advice, may make regulations, not inconsistent with this Act, prescribing all matters that by this Act are required to be prescribed or

are permitted to be prescribed or are necessary or convenient to be prescribed for carrying out or giving effect to this Act, and in particular for prescribing fees and charges for any services and for prescribing penalties (including minimum penalties) for offences of fines not exceeding. K10 000.00 and default penalties of fines not exceeding K500,00.

36. BY-LAWS.

(1) The Board may make By-laws not inconsistent with this Act for carrying into effect the purposes of this Act.

(2) A person who contravenes or fails to comply with a provision of a By-law is guilty of an offence.

Penalty: A fine not exceeding K1,000.00.
Default Penalty: A fine not exceeding K100.00.

(3) A By-law shall have no force and effect until approved by the Head of State, acting on advice, and published in the National Gazette.

37. RULES.

The Board may make Rules.

38. ADOPTION OF STANDARD CODES.

(1) The By-laws may adopt a standard code or procedure laid down by the National Standards Council or any other authority approved by the Waterboard in relation to -

(a) the construction, maintenance or operation of plant or machinery; or
(b) the carrying out of processes; or
(c) any other matter of thing within the function of the Waterboard.

(2) In adopting a standard code or procedure under Subsection (1), the By-laws may adopt it subject to such modifications, conditions or restrictions as are precribed in the By-laws.

A standard code or procedure adopted under Subsection (1) shall be deemed to form part of the By-laws, subject to any modifications, conditions or restrictions effected under Subsection (2), and non-compliance with such standard code or procedure shall be non-compliance with the provisions of the By-law.

## PART X. - REPEAL.

39. REPEAL.

The following Acts are repealed:-

(a) ***National Water Supply and Sewerage Act*** (Chapter 393);
(b) ***Water Supply (Papua) Act*** (Chapter 328).

PART XI. - TRANSITIONAL AND SAVINGS.

40. INTERPRETATION.
In this Part -
"former Board" means the National Water Supply and Sewerage Board established under the repealed Act;
"repealed Acts" means the Acts repealed by Section 38.

41. TRANSFER OF ASSETS.
All assets (other than land held by the State) which immediately before the coming into operation of this Act were occupied or held by the former Board and all obligations and liabilities of the former Board immediately before that coming into operation are, on that coming into operation, transferred to the Waterboard.

42. SAVING OF CONTRACTS.
All contracts, agreements, conveyances, deeds, leases, licences and other instruments and undertakings entered into, made with or addressed to the former Board shall, to the extent that they were previously binding on and enforceable against the former Board, be, on the coming into operation of this Act, binding and of full force and effect in every respect against or in favour of the Waterboard as if, instead of the former Board, the Waterboard had been a party to them or bound by them or entitled to the benefit of them.

43. ACTIONS NOT TO ABATE.
Where, immediately before the coming into operation of this Act, any action, arbitration or proceeding, or any cause of action was pending or existing by, against or in favour of the former Board, it does not, on that coming into operation, abate or discontinue or be affected in any way by any provision of this Act, but may be prosecuted continued and enforced by, against or in favour of the Waterboard as and when it could have been enforced by, against or in favour of the former Board.

44. STAFF.
An officer holding an office or appointment under Part IV of the ***National Water Supply and Sewerage Act*** (Chapter 393) (repealed) immediately before the coming into operation of this Act shall, on that coming into operation, be deemed to hold the equivelant office or appointment under this Act and on the same terms and conditions, until such time as appointments are made, and terms and conditions determined, under this Act.

45. WATER DISTRICT, ETC.
An area declared under the repealed Acts to be -
(d) a water district; or

(*b*) a sewerage district,

shall be deemed to be a District declared under Section 27.

46. APPLICATION OF ACTS, ETC.

Where -

(*a*) any Act or subordinate legislation other than this Act; or

(*b*) any document or instrument whenever made or executed, contains a reference to the repealed Act or to the former Board, that reference shall, after the coming into operation of this Act be deemed to be a reference to this Act or to the Board, as the case may be.

47. CONTINUATION IN OFFICE OF THE BOARD.

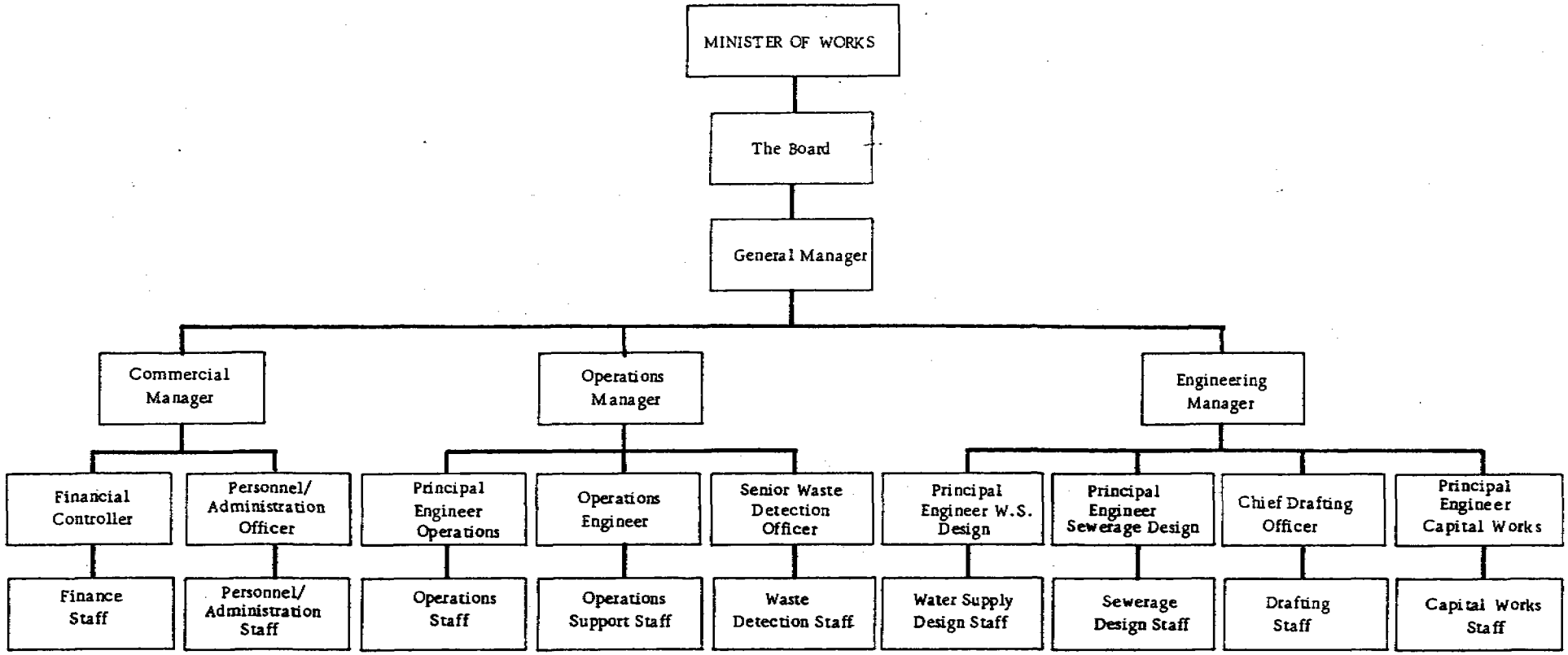
The Chairman, Deputy Chairman and members of the National Water Supply and Sewerage Board established under the repealed Acts, holding office immediately before the coming into operation of this Act shall, on that coming into operation and during the period until appointments to the Board of Directors are made under this Act, be deemed to be the Chairman, Deputy Chairman and members respectively of the Board of Directors of the Waterboard and during that period the Waterboard shall be deemed to be validly constituted and the quorum and procedure of meetings shall be as provided in the repealed Acts.

48. CONTINUATION IN FORCE OF CERTAIN PROVISIONS IN REPEALED ACTS.

The provisions of Parts V, VI, VII and VIII of the ***National Water Supply and Sewerage Act*** (Chapter 393) (repealed) and of the Regulation made thereafter, in force immediately before the coming into operation of this Act, shall, on that coming into operation, continue in force, in so far as not inconsistent with the provisions of this Act, until such time as the appropriate provisions are made by Regulation, By-law or Rule under the Act.

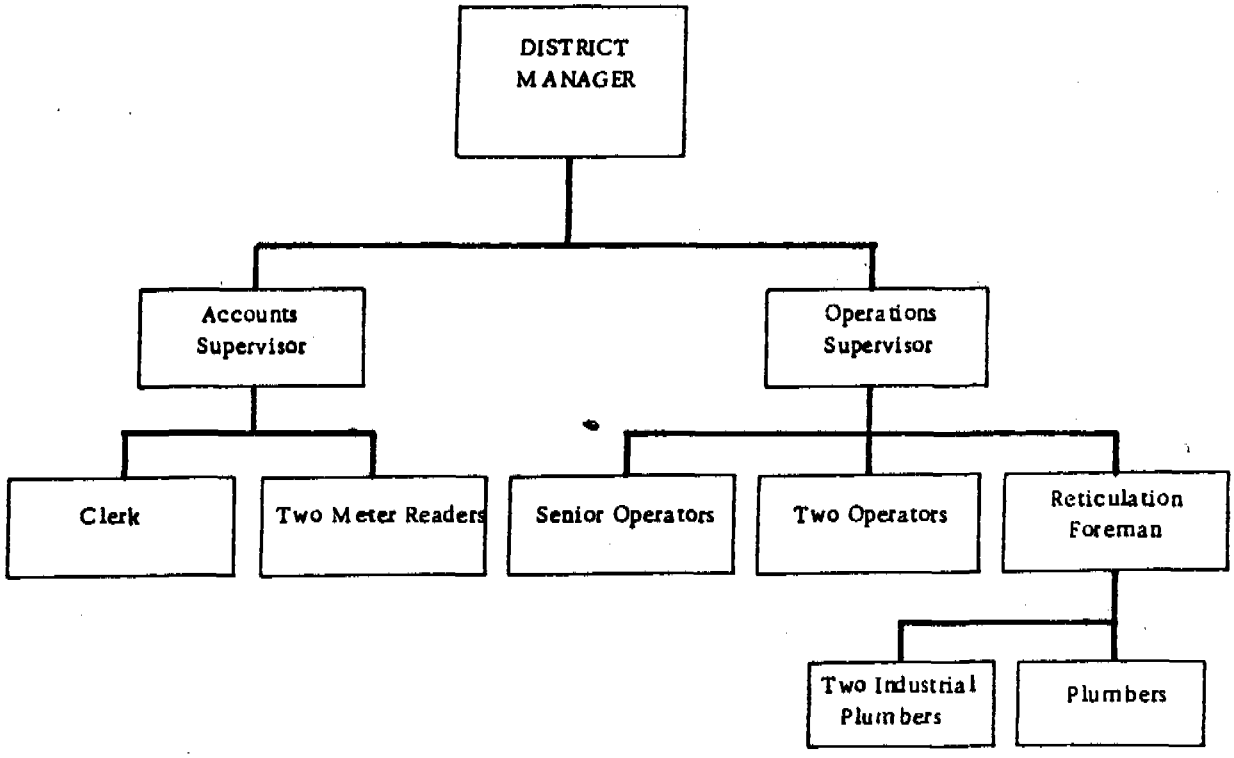
NATIONAL WATER SUPPLY AND SEWERAGE BOARD

(Staffing based on the PSC approval of 30.6.86 see Appendix 2 Page 1)



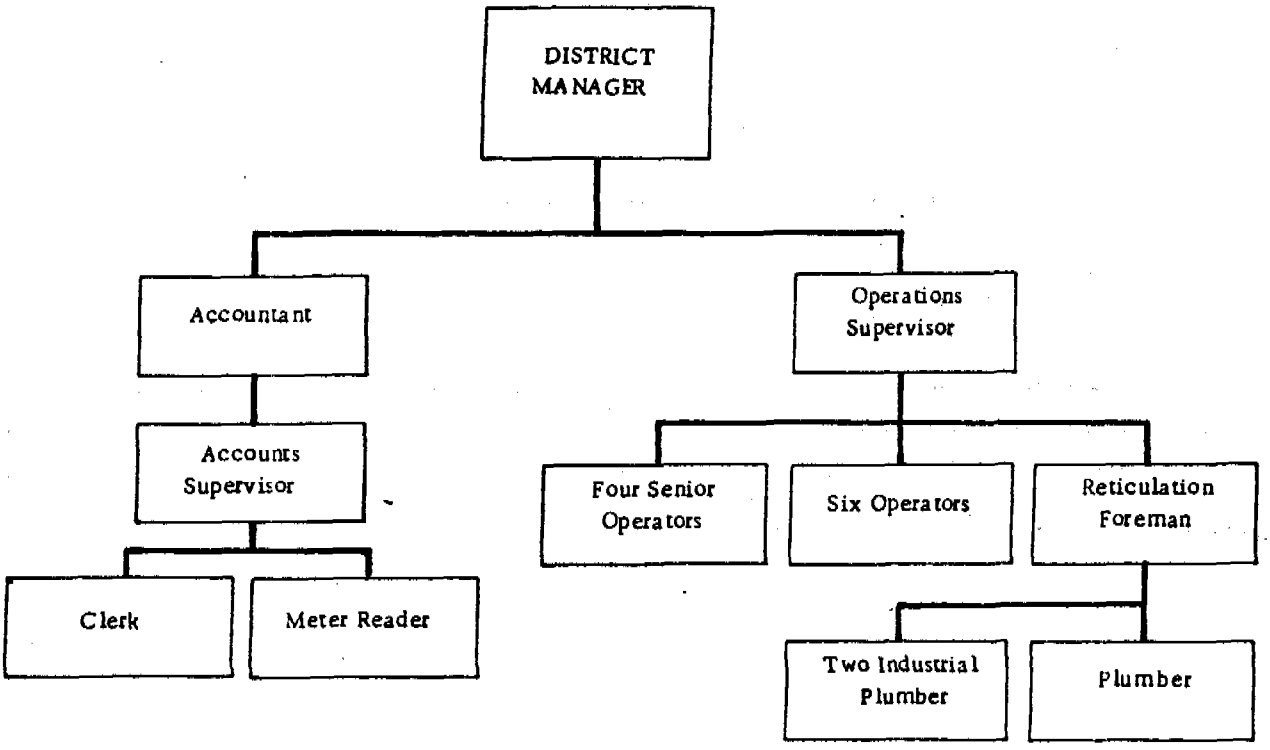

Source: WATERBOARD

NATIONAL WATER SUPPLY AND SEWERAGE BOARD
MADANG WATER DISTRICT



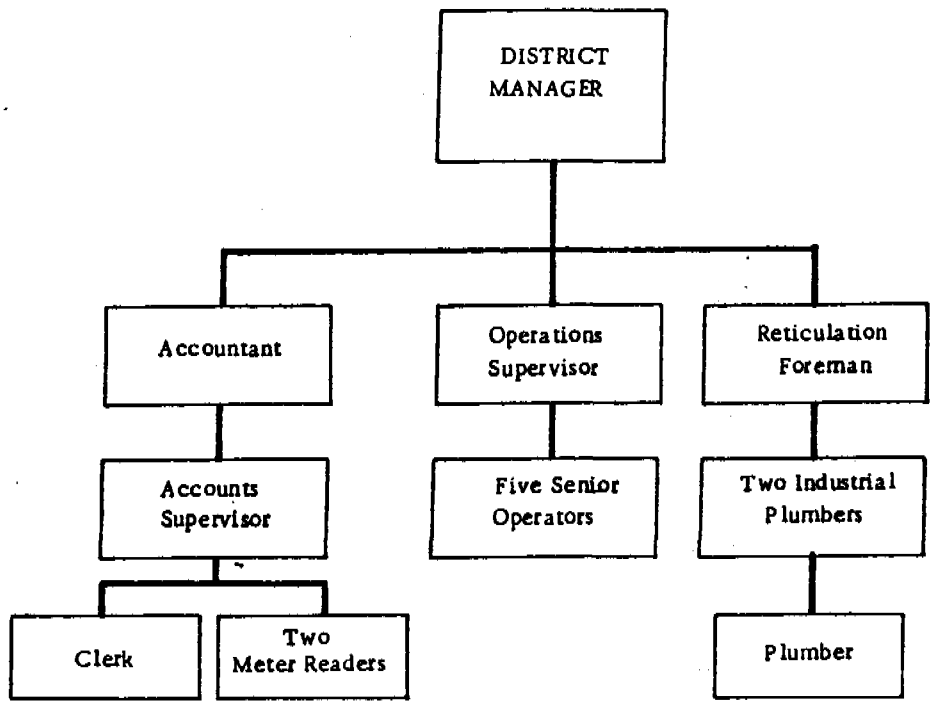

Source: Waterboard

NATIONAL WATER SUPPLY AND SEWERAGE BOARD
WEWAK WATER SUPPLY



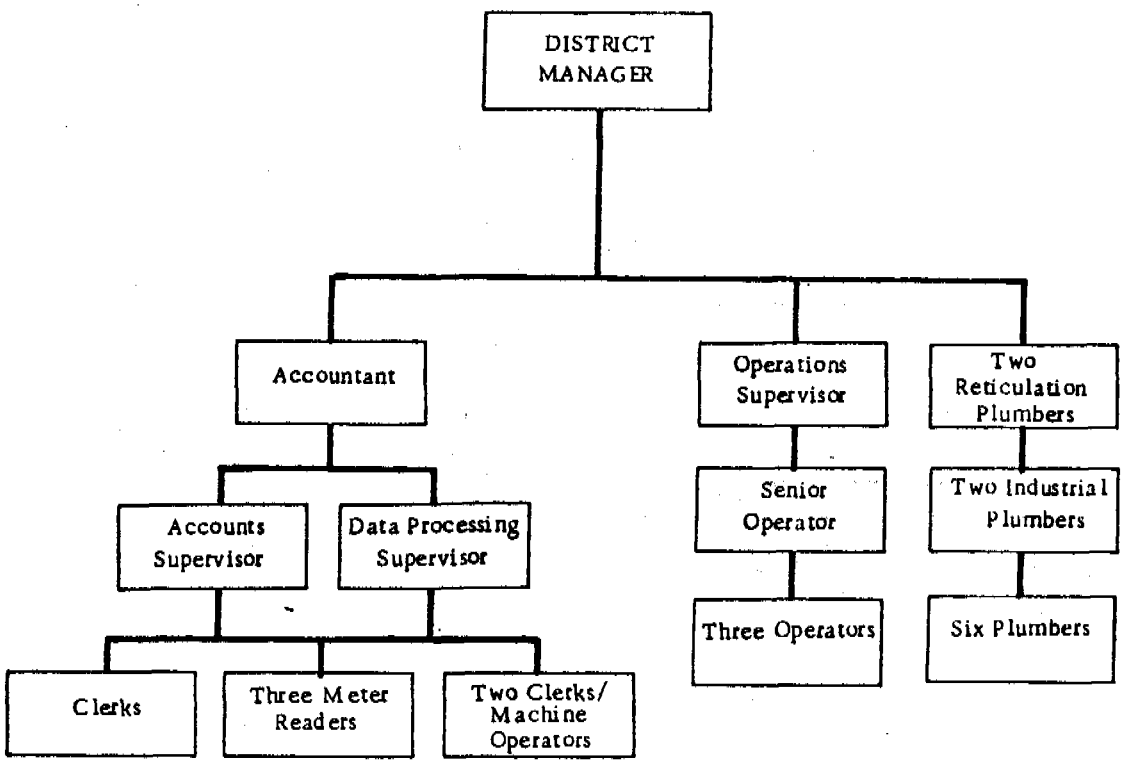

Source: Waterboard

NATIONAL WATER SUPPLY AND SEWERAGE BOARD
MT. HAGEN WATER AND SEWERAGE DISTRICT



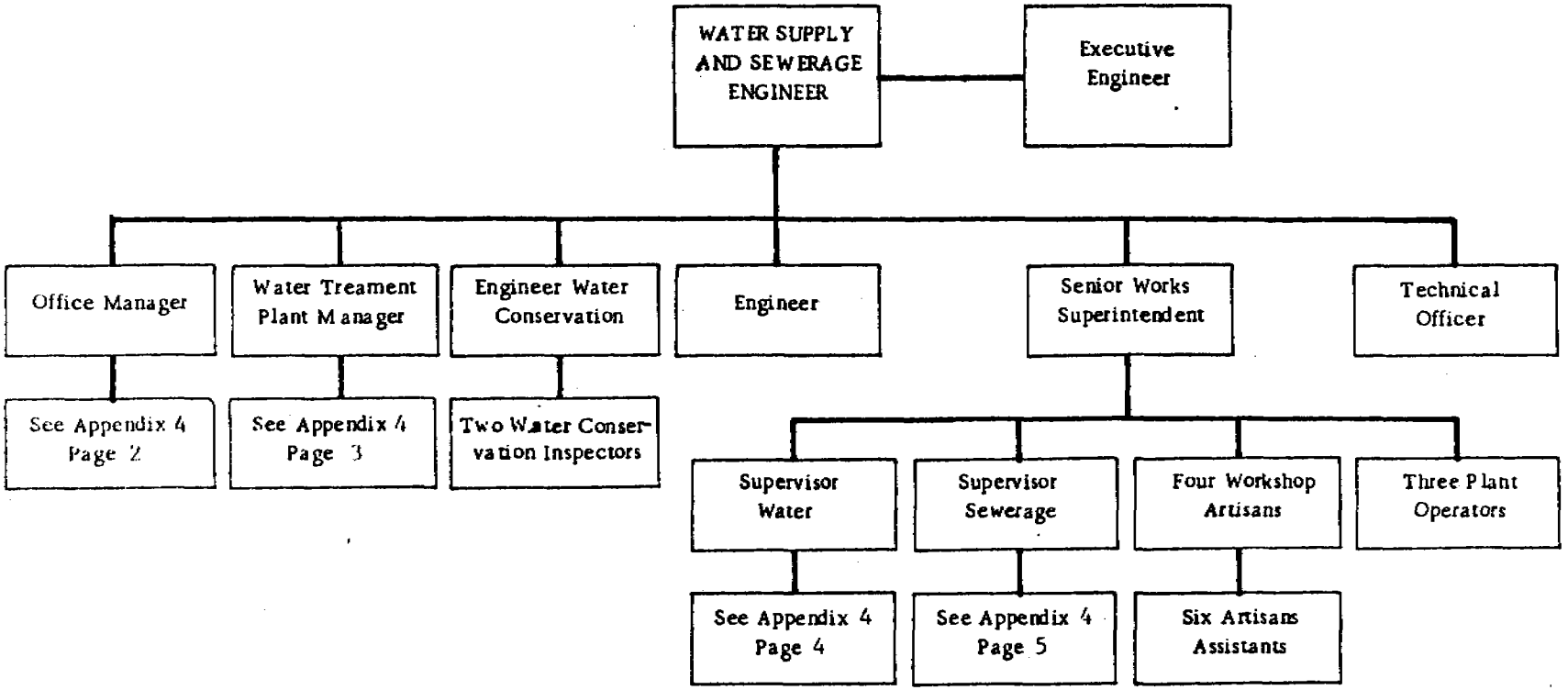

Source: Waterboard

NATIONAL WATER SUPPLY AND SEWERAGE BOARD
LAE WATER AND SEWERAGE DISTRICT



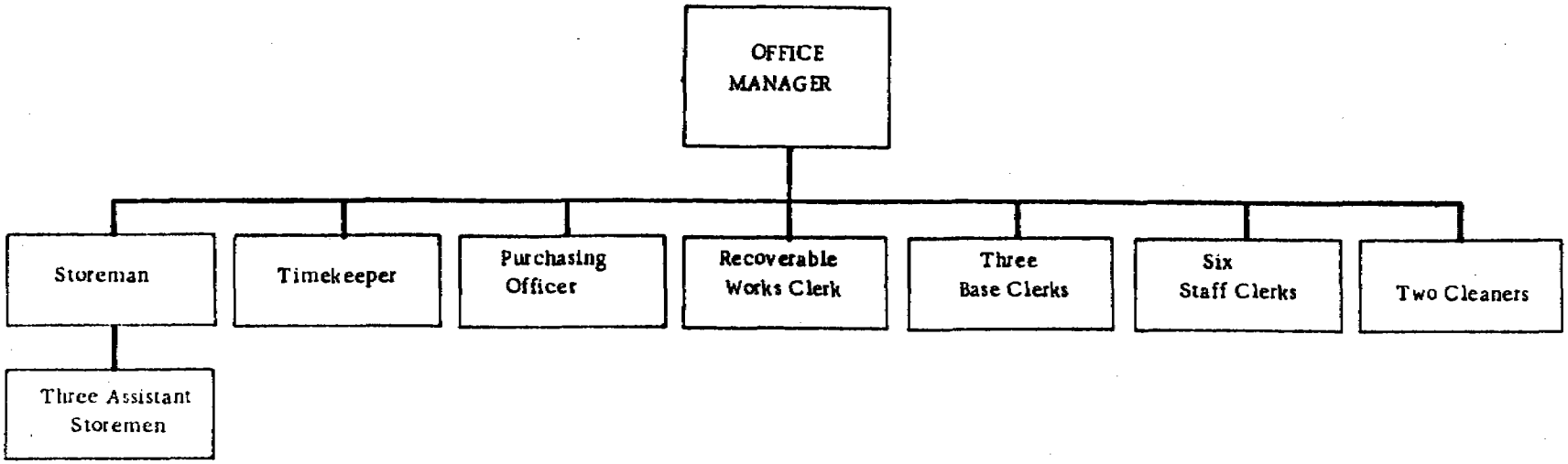

Source: Waterboard

NATIONAL CAPITAL DISTRICT INTERIM COMMISSION
WATER SUPPLY AND SEWERAGE ORGANIZATION CHART



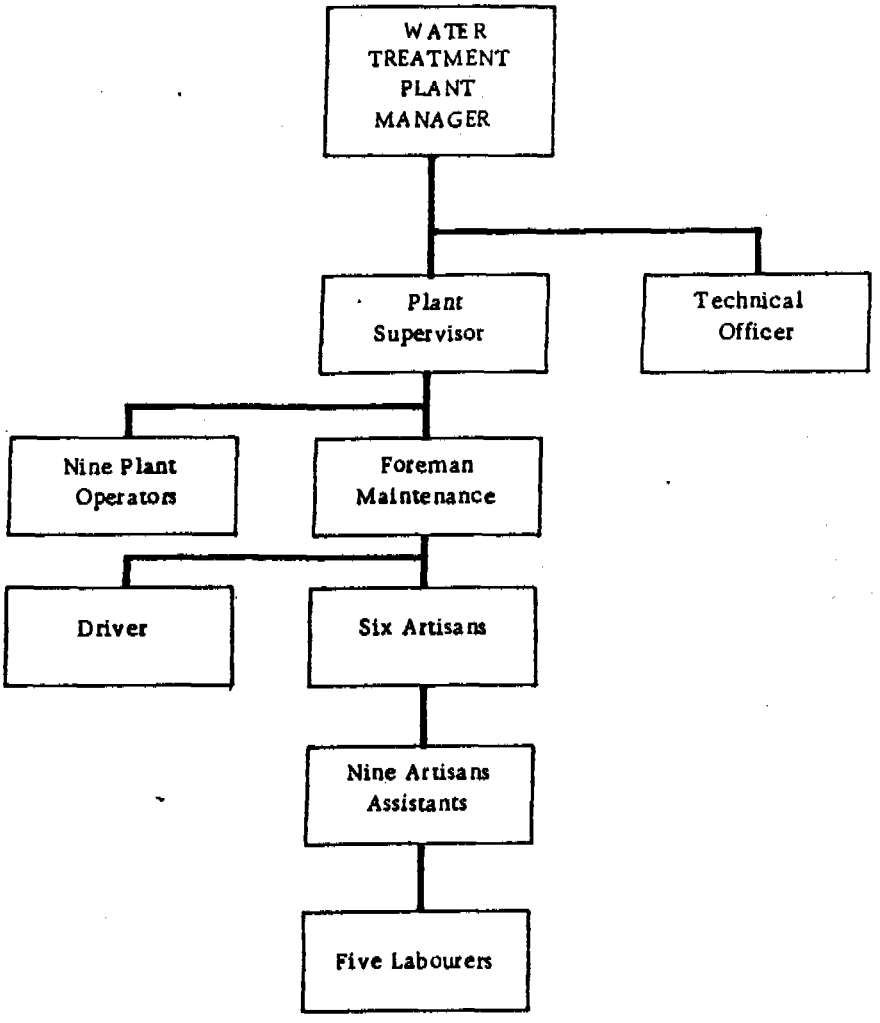

Source: NCDIC, 1986

NCDIC - WATER SUPPLY AND SEWERAGE



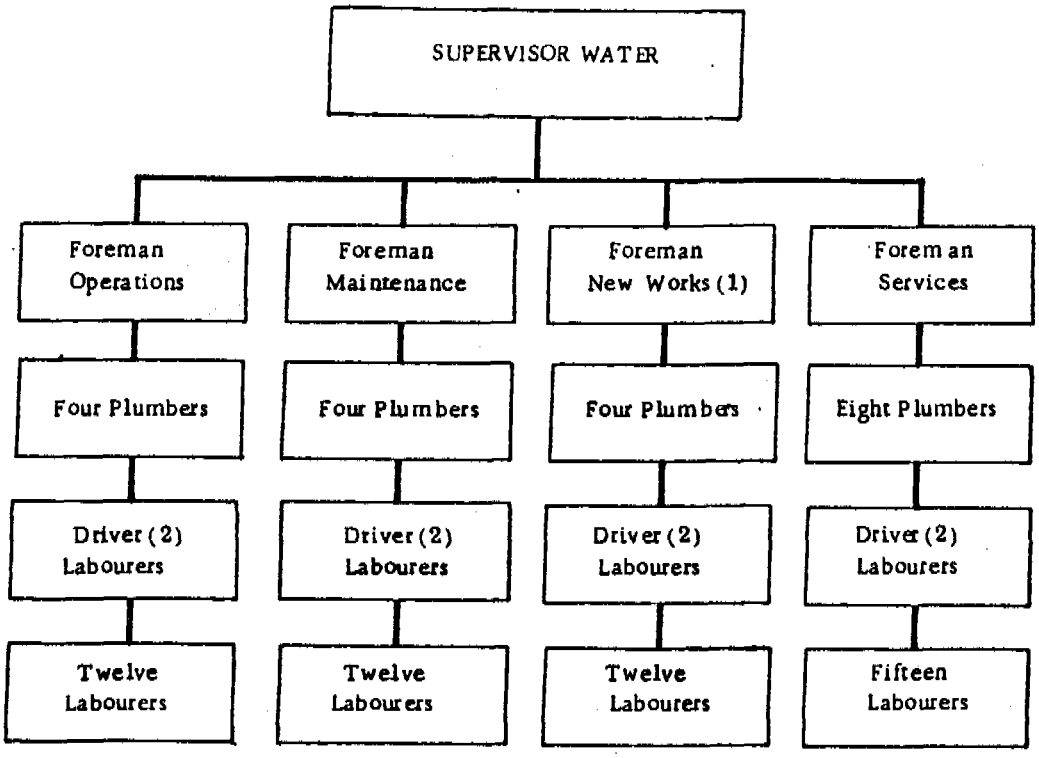

Source: NCDIC, 1986

NCDIC - WATER SUPPLY AND SEWERAGE




Source: NCDIC, 1986

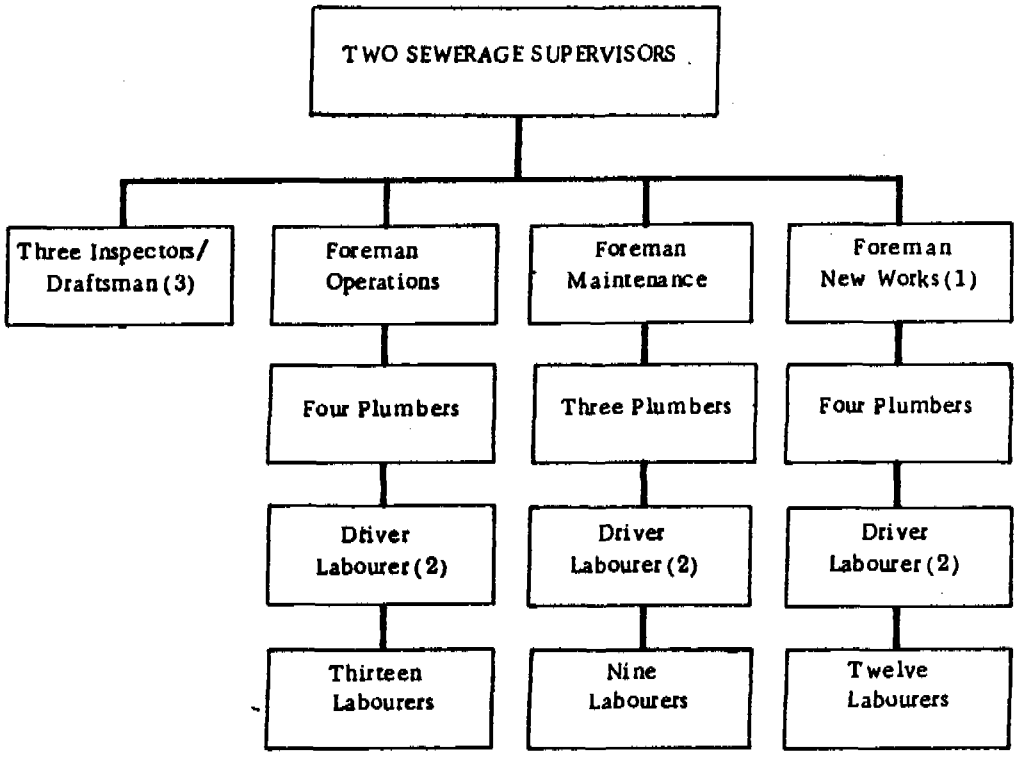
NCDIC - WATER SUPPLY AND SEWERAGE




(1) This person also performs similar duties i.e. The Sewerage Section
(2) Post vacant

Source: NCDIC, 1986

NCDIC - WATER SUPPLY AND SEWERAGE

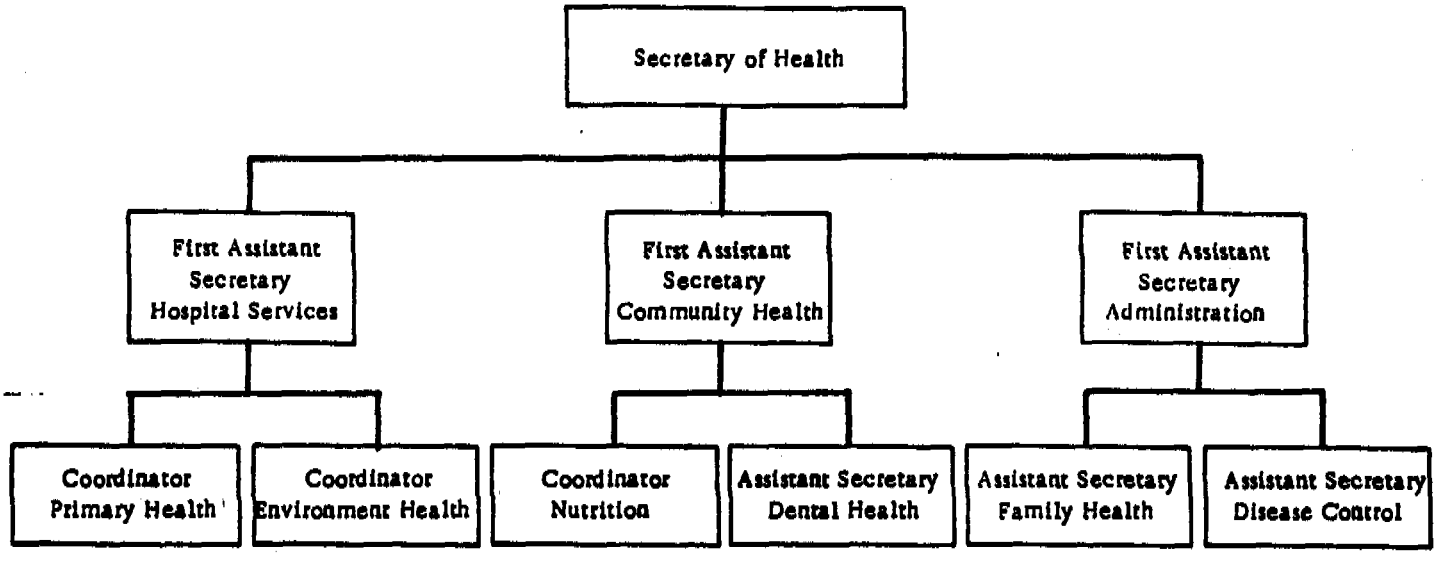



(1) This person also performs similar duties i.e. water section
(2) Position vacant
(3) One position vacant

Source: NCDIC, 1986

Appendix 7

ORGANIZATION CHART - NATIONAL DEPARTMENT OF HEALTH




Source: DOH, 1985

# LOCAL GOVERNMENT SECTION - DEPARTMENT OF WORKS

## Background

Since 1965, the Local Government Section (LGS) has been providing technical assistance to local government councils. In 1986, its staff numbered 110, 15 of whom work in the design unit. Most of the personnel supervise construction.

## Location of Construction Activities

The LGS has active programs in seven provinces as follows:

| | | |
|---|---|---|
| Morobe | 25 | LGS personnel |
| W. Highlands | 8 | |
| S. Highlands | 6 | |
| E. Sepik | 5 | |
| N. Solomons | 4 | |
| Enga | 4 | |
| W. New Britain | 3 | |

In addition, in some provinces the LGS personnel work only part of the time on small rural development programs which do not require full-time involvement. Generally, the LGS responds to requests for construction assistance on a project-by-project basis.

## Design Office

The Design Office is located at Madang. Limited design activities also take place at the provincial level, but these designs are checked at Madang. Design standards are reviewed regularly to ensure they are relevant to the needs of the people. The method of construction has a bearing on the design. In majority of cases, construction is carried out through village labor under the supervision of LGS. Local materials are incorporated in the designs as appropriate.

## Type of Work

The LGS undertakes design and construction of rural water supplies, low-cost housing, schools, aidposts and bridges. In water supply, the projects involve mainly large piped gravity schemes and the development of PNG Blair handpump (for additional details, see Appendix 2, page 30). Since the early 1970s the LGS uses technique of ferrocement for construction of rainwater storage tanks.

## LGS Training School

The LGS runs a training school at Goroka which can accommodate 18 students. The school offers a water supply course of nine months' duration. Eighty per cent of the course is spent on practical training and 20 per cent on lectures. The course is designed for people who will be involved in simple water supply construction in rural areas.

(Reference in text: page 12, para 20)

# WATER SUPPLY PROJECTS CONSTRUCTED IN MOROBE PROVINCE BY THE LOCAL GOVERNMENT SECTION OF DOW

| No. | Project | Allocation | Year Completed | Remarks |
|---|---|---|---|---|
| 01 | Masangko V. | 5,000 | 1983 | Gravity system |
| 02 | Qapa V. | 4,500 | 1984 | Catchment & storage tanks |
| 03 | Yanga V. Stg. I | 7,500 | 1984 | Deep bore & electric pump, with storage tank 6 m. high |
| 04 | Gunazaking V. | 3,000 | 1984 | Gravity system |
| 05 | Matak V. | 3,500 | 1984 | Gravity system |
| 06 | Tamaman V. | 4,903 | 1984 | Catchment & storage tanks |
| 07 | Wantoat V. | 4,903 | 1984 | Upgrading of gravity system |
| 08 | Yalu V. | 7,000 | 1984 | Gravity system |
| 09 | Gabinsis V. | 2,000 | 1984 | Gravity system |
| 10 | Godowa V. | 2,000 | 1984 | Gravity system |
| 11 | Kasanga V. | 5,300 | 1984 | Gravity system |
| 12 | Nasiglatu V. | 7,000 | 1984 | Gravity system |
| 13 | Busion V. | 1,750 | 1984 | Gravity system |
| 14 | Magazaing V. | 3,800 | 1985 | Gravity system |
| 15 | Embewaneng V. | 2,500 | 1985 | Gravity system |
| 16 | Kalansom V. | 3,950 | 1985 | Gravity system |
| 17 | Masa V. | 4,500 | 1985 | Catchment & storage tanks |
| 18 | Aluke V. | 4,000 | 1985 | Gravity system |
| 19 | Yanga V. Stg. II | 6,000 | 1985 | Gravity from storage tank |
| 20 | Aronai Is. | 1,465 | 1986 | Catchment & storage tanks |
| 21 | Malai Is. | 3,000 | 1986 | PNG Blair handpump on shallow well |
| 22 | Aupwel V. | 3,000 | 1986 | PNG Blair handpump on shallow well |
| 23 | Wagang V. | 4,000 | 1986 | Gravity system from tank, pumped (motor) from well |
| 24 | Hanzua V. | 9,000 | 1986 | Gravity system |
| 25 | Tamigidu V. | 4,800 | 1986 | Gravity system |
| 26 | Indagen V. | 12,000 | 1986 | Gravity system |
| 27 | Wabazaire V. | 7,200 | 1986 | Gravity system |
| 28 | Gwasak school | 3,135 | 1986 | Gravity system |
| 29 | Barim V. | 2,400 | 1986 | Gravity system |
| 30 | Kui V. | 2,160 | 1986 | Gravity system |
| | Total Kina | 139,363 | | |

Notes:
1. All projects include 25 per cent cash contribution from the requesting village. This is collected after the project is approved in the Provincial Budget.
2. At the time of writing this report (2.9.86) all water supply schemes included in this list were in working order.

Source: LGS, Madang, 1986

(Reference in text: page 12, para 20)

# WATER SUPPLY AND SANITATION SECTORS
# DELEGATION OF POWERS BY THE WATERBOARD

| Type of System | Policy and Standards | Project Selection and Budget Allocation a/ | Investigations and Design | Groundwater Protection, Abstraction and Disposal | Technical Approval (License) | Supply/ Construction | O&M and Revenue Collection |
|---|---|---|---|---|---|---|---|
| A. Simple | DoH | DoH | DoH | n.a. | DoH | DoH | DoH |
| Transported by tanker | | | | | | | |
| Hand pumps, wells, etc. | | | | | | | |
| Minor gravity pipelines less than 1 km long | | | | | | | |
| Rainwater and tanks | | | | | | | |
| All simple rural supplies | | | | | | | |
| On-site sewage disposal | DoH | DoH | DoH | n.a. | DoH | DoH | DoH |
| Sanitary pan collection | DoH | PG | PG | n.a. | DoH | PG | PG |
| B. Intermediate | WB | PG | PG | n.a. | DoWLG | PG | PG |
| Small powered pump systems | | | | | | | |
| Chlorination only | | | | | | | |
| Water ram, solar and wind pumps | | | | | | | |
| Gravity system more than 1 km long | | | | | | | |
| Single shallow boreholes | | | | | | | |
| Sanitation | n.a. | n.a. | n.a. | n.a. | n.a. | n.a. | n.a. |
| C. Complex | WB | WB | WB | n.a. | WB | WB | WB |
| Larger powered pumps | | | | as licenses are issued by the BWR | | | |
| Wellfield development | | | | | | | |
| Fuller treatment (water and sewerage) | | | | | | | |
| Reticulated mains systems (water and sewage) | | | | | | | |
| Sanitary pan disposal | | | | | | | |

a/ Budget allocation, etc., not applicable to development in the private sector.

Notes:

1. Where powers are delegated, reference should be made back to the Waterboard in cases where the delegate has insufficient expertise.
2. Where the Waterboard is indicated, no delegation is implied.

Abbreviations:

BWR - Bureau of Water Resources
DoH - Department of Health
DoWLG - Department of Works, Local Government Section
n.a. - Not applicable
PG - Appropriate Provincial or Local Government
WB - Waterboard

Source: The Waterboard's Design Manual (in a draft form yet).

(Reference in text: page 12, para 21)

## AREAS OF RESPONSIBILITY FOR IMPLEMENTATION

| Type of System | Policy and Standards | Project Selection and Budget Allocation a/ | Investigations and Design | Groundwater Protection, Abstraction and Disposal | Technical Approval (License) | Supply/ Construction | O&M and Revenue Collection |
|---|---|---|---|---|---|---|---|
| A. Simple | DoH | PG or DoH | DoH | Licensed by BWR | DoH | Community served and PG | Community served |
| Transported by tanker | | | | | | | |
| Hand pumps, wells, etc. | | | | | | | |
| Minor gravity pipelines less than 1 km long | | | | | | | |
| Rainwater and tanks | | | | | | | |
| All simple rural supplies | | | | | | | |
| On-site sewage disposal | DoH | PG or DoH | DoH | BWR | DoH | same | same |
| Sanitary pan collection | DoH | PG | PG | BWR | DoH | PG | PG |
| B. Intermediate | WB | PG or DoH | DoWLG | BWR | DoWLG | PG | PG or DoWSP (under license from the WB) |
| Small powered pump systems | | | | | | | |
| Chlorination only | | | | | | | |
| Water ram, solar and wind pumps | | | | | | | |
| Gravity system more than 1 km long | | | | | | | |
| Single shallow boreholes | | | | | | | |
| Sanitation | n.a. | n.a. | n.a. | n.a. | n.a. | n.a. | n.a. |
| C. Complex | WB | National Government on the WB recommendation | WB | BWR and OE | WB | DoWCB and/or contract | WB or DoWSP under license from WB |
| Larger powered pumps | | | | | | | |
| Wellfield development | | | | | | | |
| Fuller treatment (water and sewerage) | | | | | | | |
| Reticulated mains systems (water and sewage) | | | | | | | |
| Sanitary pan disposal | | | | | | | |

a/ Budget allocation, etc., not applicable to development in the private sector.

Notes:

1. Not applicable to development in the private sector.

Abbreviations:

BWR - Bureau of Water Resources
DoH - Department of Health
DoWCB - Department of Works, Construction Branch
DoWLG - Department of Works, Local Government Section
DoWSP - Department of Works, Static Plant Section
n.a. - Not applicable
OE - Office of Environment
PG - Appropriate Provincial or Local Government
WB - Waterboard

Source: The Waterboard's Design Manual (in a draft form yet).

(Reference in text: page 12, para 21)

# ENTERIC DISEASES

## Diarrheal Diseases

These diseases are associated with contaminated water supplies and/or with inadequate personal, domestic and food hygiene. Diarrheal diseases are especially dangerous for young children, particularly when combined with malnutrition.

Diarrheal diseases can be prevented by improving hygiene through health education, by provision of safe and adequate water for drinking and for domestic use, and by sanitary disposal of excreta. Treatment of these diseases is comparatively simple when applied properly and without delay. The main effect, severe dehydration of the body, can be very dangerous if neglected. Diarrheal diseases can be treated at home, except for more serious cases, by rehydration. Again, proper health education and access to the oral rehydration salts are essential.

Certain amount of information about incidence of diarrheal diseases in PNG is available. DOH collects information about cases admitted to hospitals and also receives monthly reports from health centers and hospitals about these diseases as part of the epidominological intelligence (EPINT) system for monitoring communicable diseases. This information is summarized on page 3 of this Appendix.

It is possible that differences exist in reporting practices among health institutions. This should be noted when statistics from different provinces are compared (see page 4 of this Appendix). According to DOH, about a quarter of all reported cases of diarrheal diseases are admitted to hospitals, where they account for about 6 per cent of total admissions. Children under five with dirarrheal diseases constitute 22 per cent of admissions. The mortality among admitted patients is 1.9 per cent and is higher among the very young. No records are available for mortality from diarrheal diseases for cases not admitted to hospitals.

A survey carried out in 1983 in Southern Islands Province showed that a large amount of diarrheal diseases were not reported to the health authorities and that only about 3.5 per cent of all cases were admitted to hospitals. If these findings were representative of the situation in the rest of the country, one can estimate that only about 15 per cent of diarrheal disease cases are reported. The national incidence of the diarrheal diseases could be as high as 352,200 cases per annum, or 111 cases per 1,000 population.

As far as diarrheal diseases are concerned, the DOH National Health Plan 1986-1990 (final draft April 1986) includes activities concentrating on health education to improve hygiene and on improving treatment at home with rehydration salts.

(Reference in text: page 14, para 24)

Typhoid Fever

According to DOH, "epidemiological reports from all provinces indicate that typhoid is on increase in Papua New Guinea". However, this is not reflected in the statistics of the EPINT system since many cases probably go undiagnosed for lack of diagnostic facilities. In Port Moresby General Hospital there has been a gradual increase in the number of cases admitted since 1975. Statistics relating to the typhoid cases are shown in page 5 of this Appendix.

With regard to typhoid, the DOH five-year plan envisages activities that will concentrate on improving speed and competence of notification and on a more systematic program of contact tracing. It will also prepare and distribute information materials designed to educate the community about the need for personal and domestic hygiene, for proper disposal of faces, and protecting drinking water supplies from contamination.

(Reference in text: page 14, para 24)

PNG - CASES OF DIARRHEA AND TYPHOID
(Data from Discharge Reporting)

| Year | Diarrhea | Typhoid |
|---|---|---|
| 63 | 3,364 | 8 |
| 64 | 3,711 | 10 |
| 65 | 6,087 | 9 |
| 66 | 7,227 | 5 |
| 67 | 9,489 | 7 |
| 68 | 8,840 | 4 |
| 69 | 9.047 | 3 |
| 70 | 13,241 | 7 |
| 71 | 10.422 | 6 |
| 72 | 21,401 | 1 |
| 73 | 27,451 | 0 |
| 74 | 28,624 | 14 |
| 75 | 25,558 | 0 |
| 76 | 28,505 | 234 |
| 77 | 34,419 | 120 |
| 78 | 36,548 | 24 |
| 79 | 46,343 | 16 a/ |
| 80 | 49,166 | 10 a/ |
| 81 | 56,457 | 11 a/ |
| 82 | 49,711 | 11 a/ |
| 83 | 50,186 | 25 a/ |
| 84 | 65,564 | 67 a/ |

a/ These data are from Discharge Reporting.

Source: EPINT, from selected morbidity statistics in Papua New Guinea

(Reference in text: page 14, para 24)

## CASES OF DIARRHEAL DISEASES BY PROVINCE, 1984

| Province | 1980 Population | | | Diarrhea Number of Cases 1984 |
|---|---|---|---|---|
| | Total | Rural Sector | Urban Sector | |
| Morobe | 310,622 | 238,138 | 72,484 | 3,526 |
| Eastern Highlands | 276,726 | 252,757 | 23,969 | 3,867 |
| Western Highlands | 265,565 | 248,687 | 16,969 | 4,325 |
| Southern Highlands | 236,052 | 231,306 | 4,746 | 10,120 |
| East Sepik | 221,890 | 197,998 | 23,892 | 1,976 |
| Madang | 211,069 | 188,479 | 22,590 | 4,206 |
| Chimbu | 178,290 | 172,067 | 6,223 | 3,022 |
| Enga | 164,534 | 162,154 | 2,380 | 4,661 |
| East New Britain | 133,197 | 115,182 | 18,015 | 5,858 |
| North Salomons | 128,794 | 105,886 | 22,908 | 1,747 |
| Milne Bay | 127,975 | 121,653 | 6,322 | 1,115 |
| NCD a/ | 123,624 | b/ | 123,624 | 5,827 |
| Central | 116,964 | 112,722 | 4,242 | 866 |
| West Sepik | 114,912 | 107,753 | 6,439 | 2,520 |
| West New Britain | 88,941 | 83,658 | 5,283 | 7,024 |
| Western | 78,575 | 68,933 | 9,642 | 1,277 |
| Northern | 77,442 | 71,013 | 6,429 | 938 |
| New Ireland | 66,028 | 60,642 | 5,386 | 603 |
| Gulf | 64,120 | 57,941 | 6,179 | 1,822 |
| Manus | 26,036 | 20,627 | 5,409 | 264 |
| Papua New Guinea | 3,010,727 | 2,617,596 | 393,131 | 65,564 |

a/ National Capital District.
b/ All of the National Capital District is classed as urban.

Source: 1980 National Population Census, Pre-release; Summary of Final Figures; and Department of Health, EPINT

(Reference in text: page 14, para 24)

## MORTALITY AND MORBIDITY STATISTICS
## PNG - DIARRHEAL DISEASES

| Year | Mortality a/ | | Morbidity | |
|---|---|---|---|---|
| | Number | As per cent of all deaths | Number | As per cent of all deaths |
| 60/61 | 94 | 3.8 | 4,693 | 4.7 |
| 61/62 | 150 | 6.1 | 5,163 | 5.3 |
| 62/63 | 170 | 6.1 | 5,104 | 5.0 |
| 63/64 | 175 | 6.8 | 5,784 | 5.1 |
| 64/65 | 166 | 6.5 | 5,102 | 4.9 |
| 65/66 | 187 | 6.9 | 8.084 | 7.1 |
| 66/67 | 250 | 8.7 | 9,223 | 7.5 |
| 67/68 | 332 | 11.6 | 11,980 | 9.9 |
| 68/69 | 284 | 10.2 | 12,611 | 9.8 |
| 69/70 | 250 | 8.8 | 11,666 | 9.1 |
| 70/71 | 343 | 10.8 | 14,043 | 9.7 |
| 71/72 | 375 | 11.3 | 15,905 | 9.3 |
| 73/75 | n.a. | n.a. | n.a. | n.a. |
| 76 | n.a. | 8.3 | n.a. | 7.9 |
| 77 | 173 | 8.2 | 9.081 | 7.1 |
| 78 | n.a. | n.a. | 14,575 | 8.3 |
| 79 | 173 | 5.5 | 11,164 | 6.2 |
| 80 | 148 | 4.1 | 11,462 | 6.0 |
| 81 | 166 | 3.9 | 11,273 | 5.1 |
| 82 | 133 | 3.5 | 9,843 | 4.7 |
| 83 | 222 | 4.5 | 11,726 | 5.0 |
| 84 | 289 | 7.4 | 14,710 | 6.7 |

a/ Death occurring in health institutions only.

Source: Discharge Statistics, Department of Health

(Reference in text: page 14, para 24)

# HEALTH MANPOWER IN PNG IN RELATION TO THE WATER SUPPLY AND SANITATION SECTOR

## Background

The training of health workers in PNG started in 1951. Of special interest to the water supply and sanitation sectors, the training of aid post orderlies started in 1958 and that of health inspectors in 1967.

Health manpower planning is even of more recent origin. The first plan is embodied in the 1974-1978 National Health Plan which stated:

> "No person should be engaged to perform a task if a lesser trained, lesser paid worker could be employed to carry out that task adequately."

## Aid Post Orderlies

Aid Post Orderlies (APO) provide a simple yet comprehensive level of health care to the people of a village. Their role was originally curative. During the last decade, however, their role was expanded to include health promotion and disease prevention. Since 1976 APOs have been paid full-time, but are not yet classified as public servants. Although the number of APOs trained and employed is not known (some are trained and employed by churches), it is estimated that there were about 2,150 APOs in January 1986. In 1984 there were seven training schools for APOs one of which was run by DOH. Training lasts from two to three years.

In 1985 there were 2,231 aid posts, 110 of which were operated by churches. It is envisaged that by year 2000 there will be about 2,400 aid posts, of which 110 will be run by churches.

## Health Inspectors

DOH describes the Health Inspector (HI) as "a specialist who improves environmental health conditions in the community by advising, supervising, and planning the environmental health measures required for healthy living, and by motivating communities, through health education, to accept responsibility for a healthy and clean environment."

Health Inspectors undergo a three-year training at the Paramedical College in Madang, previously known as College of Allied Health Sciences. As of 1984, 234 HIs had been trained. HIs receive practical training during the second year of the training program. In 1985, 182 HIs were employed in different parts of the country, as follows:

(Reference in text: page 15, para 29)

| Location | Number |
|---|---|
| Provincial Health Offices | 66 |
| District Health Centers | 59 |
| Local Authorities | 35 |
| Paramedical College, Madang | 7 |
| DoH, Port Moresby | 11 |
| Private | 1 |
| Defence Forces | 3 |
| Total | 182 |

Source: DOH

DOH recognizes the need for increasing the number of HIs in order to develop primary health care and the rural water supplies program. One HI for every district is the target that has been set. DOH plans to increase the number of HIs it employs from 136 in 1985 to 191 by year 2000.

(Reference in text: page 15, para 29)

# 1980 NATIONAL POPULATION CENSUS

## EXPLANATORY NOTES

### Definition of Urban and Rural Sectors

An URBAN AREA was defined for the 1980 census as a settlement with a generally urban character, a minimum population of 500 persons, and a minimum population density of about 195 persons per sq km. For the boundaries of the larger urban centers, the density criterion was applied a little more loosely in order to set boundaries conforming with geographic features and, in particular, to include migrant settlements closely associated with the urban center. The 63 urban areas are listed on page 3 of this Appendix.

A RURAL VILLAGE was defined for census purposes as a collection of people in a rural area who either live in a traditional village or hamlet or are gathered at a defined point (often a "rest house") for census enumeration because their dwellings are widely scattered.

A RURAL NON-VILLAGE (RNV) establishment is a collection of persons living in a rural area but not in a traditional rural village (for example, a mission station, aid post, plantation, school, settlement scheme).

For operational purposes, RNV are divided into "large RNV" and "small RNV". These are defined as follows:

> "Large RNVs" generally have over 100 persons but they also include all locations (irrespective of size) not closely integrated with traditional villages, for example, sawmills, plantations, mining camps, larger government stations, and settlement schemes.
>
> "Small RNVs" generally have less than 100 persons and are closely integrated with traditional villages, for example, schools, aid posts, small migrant settlements.

In many cases, it was not worthwhile identifying a "small" RNV separately from the village with which it was integrated for census purposes. Thus, for tabulation purposes, villages and "small" RNVs have been combined.

The RURAL NON-VILLAGE SECTOR contains only the "large" RNVs as defined above while the RURAL VILLAGE SECTOR consists of all rural villages and all "small" RNVs, as defined above.

(Reference in text: page 19, para 32)

The term "rural sectors" used on page 4 of this Appendix refers to the combination of the rural village sector and the RNV sector, as defined above. Thus, it covers all persons other than those living in the defined urban areas.

It should be noted that the RNV sector for the 1980 Census differs from the 1966 and 1971 Censuses, and any comparison would be completely invalid.

Source: 1980 National Population Census, Pre-release: Summary of Final Figures

(Reference in text: page 17, para 32)

## POPULATION OF EACH URBAN AREA

| | Urban Area | | | Urban Area | |
|---|---|---|---|---|---|
| 1. | Port Moresby | 123,624 | 33. | Kerowagi | 1,189 |
| 2. | Lae | 61,617 | 34. | Sogeri | 1,139 |
| 4. | Madang | 21,335 | 35. | Maprik | 1,121 |
| 4. | Wewak | 19,890 | 36. | Balimo | 1,108 |
| 5. | Goroka | 18,511 | 37. | Ambunti | 1,035 |
| 6. | Rabaul | 14,954 | 38. | Kwikila | 1,022 |
| 7. | Mount Hagen | 13,441 | 39. | Kupiano | 948 |
| 8. | Arawa | 12,588 | 40. | Loloho | 920 |
| 9. | Daru | 7,127 | 41. | Banz | 913 |
| 10. | Bulolo | 6,730 | 42. | Minj | 898 |
| 11. | Popondetta | 6,429 | 43. | Kerevat | 894 |
| 12. | Kimbe | 4,662 | 44. | Buin | 885 |
| 13. | Kavieng | 4,633 | 45. | Samarai | 864 |
| 14. | Alotau | 4,311 | 46. | Laiagam | 862 |
| 15. | Kundiawa | 4,299 | 47. | Malalaua | 841 |
| 16. | Mendi | 4,130 | 48. | Kikori | 763 |
| 17. | Lorengau | 3,986 | 49. | Finschhafen | 756 |
| 18. | Kainantu | 3,779 | 50. | Bogia | 755 |
| 19. | Panguna | 3,506 | 51. | Namatanai | 753 |
| 20. | Kieta | 3,491 | 52. | Chuave | 735 |
| 21. | Kerema | 3,389 | 53. | Baimuru | 645 |
| 22. | Aitape | 3,368 | 54. | Kandrian | 621 |
| 23. | Vanimo | 3,071 | 55. | Tari | 616 |
| 24. | Wau | 2,349 | 56. | Bereina | 583 |
| 25. | Kokopo | 2,167 | 57. | Losuia | 575 |
| 26. | Anogram | 1,846 | 58. | Bwagaoia | 572 |
| 27. | Kagamuga | 1,717 | 59. | Tapini | 550 |
| 28. | Aiyura/Ukarumpa | 1,679 | 60. | Ihu | 541 |
| 29. | Buka Passange | 1,518 | 61. | Mumeng | 517 |
| 30. | Wabag | 1,518 | 62. | Kaiapit | 515 |
| 31. | Lombrum Base | 1,423 | 63. | Saidor | 500 |
| 32. | Kiunga | 1,407 | | | |
| | Subtotal 1-32 | 368,495 | | Subtotal 33-63 | 24,636 |
| | | Total 1-63 | 393,131 | | |

Source: 1980 National Population Census, Pre-release Summary of Final Figures

(Reference in text: page 17, para 32)

## POPULATION BY PROVINCE: 1980 CENSUS

| Province | Total | Rural Sector | Urban Sector |
|---|---|---|---|
| Morobe | 319,622 | 238,138 | 72,484 |
| Eastern Highlands | 276,726 | 252,757 | 23,969 |
| Western Highlands | 265,656 | 248,687 | 16,969 |
| Southern Highlands | 236,052 | 231,306 | 4,746 |
| East Sepik | 221,890 | 197,998 | 23,892 |
| Madang | 211,069 | 188,479 | 22,590 |
| Chimbu | 178,290 | 172,067 | 6,223 |
| Enga | 164,534 | 162,154 | 2,380 |
| East New Britain | 133,197 | 115,182 | 18,015 |
| North Salomons | 128,794 | 105,886 | 22,908 |
| Milne Bay | 127,975 | 121,653 | 6,322 |
| NCD a/ | 123,624 | b/ | 123,624 |
| Central | 116,964 | 112,722 | 4,242 |
| West Sepik | 114,192 | 107,753 | 6,439 |
| West New Britain | 88,941 | 83,658 | 5,283 |
| Western | 78,575 | 68,933 | 9,642 |
| Northern | 77,442 | 71,013 | 6,429 |
| New Ireland | 66,028 | 60,642 | 5,386 |
| Gulf | 64,120 | 57,941 | 6,179 |
| Manus | 26,036 | 20,627 | 5,409 |
| Papua New Guinea | 3,010,727 | 2,617,596 | 393,131 |

a/ National Capital District.
b/ The entire National Capital District is classified as urban.

Source: 1980 National Population Census, Pre-release: Summary of Final Figures

(Reference in text: page 17, para 32)

## ECONOMIC ACTIVITIES OF HOUSEHOLDS

For the vast majority of the population, private economic activities remain the dominant source of livelihood. In 1980, only 16 per cent of households had a wage earner. The distribution between the urban and rural sectors was 48 per cent and 52 per cent, respectively. Details of this distribution are given in the table below.

### Citizen Households with and without Wage Earners in 1980

| | Households with Wage Earners | Households without Wage Earners | All Households |
|---|---|---|---|
| Rural Village | 32,269 ( 6%) | 524,250 (94%) | 556,519 (100%) |
| Rural Non-Village | 20,602 (74%) | 7,410 (26%) | 28,012 (100%) |
| Urban | 49,172 (86%) | 7,740 (14%) | 56,912 (100%) |
| All Sectors | 102,043 (16%) | 539,400 (84%) | 641,443 (100%) |

Source: L. Moranta "Women in Households in PNG", 1985

(Reference in text: page 17, para 32)

# URBAN WATER SUPPLY

## A. Existing Situation

### 1. General

The water supply situation in Papua New Guinea presents a good opportunity for a serious effort at augmentation and, in a number of cases, even construction of new systems. This is true for both urban and rural areas.

At present, less than half of the 63 urban areas in PNG have reticulated water supply systems. In terms of population served, this represents about 12 per cent of the total population of PNG. Of the 28 areas with piped water, 14 are found in the lowland provinces and five in the highland provinces of the country. Water in all but one of the piped water supply systems is treated in one or more ways, ranging from simple chlorination to the more sophisticated filtration. Eight of the systems draw water from subsurface sources and 19 are fed from either rivers or creeks. Only one of the water systems uses both surface and subsurface sources. Other populated areas of PNG, whether urban or rural, are dependent on rainwater.

To date, only four of the biggest reticulated water supply systems in PNG have been placed directly under the administration of the Waterboard. These are Lae, Madang, Wewak and Mt. Hagen, each one of which has been declared a "Water District". The operation and maintenance of the water systems in these water districts is the responsibility of the Waterboard and the personnel of the District are employees of the Board.

For the rest of the country with some kind of water supply, the systems are managed either by a local government authority or by DOH. Only a few of the systems levy water charges or collect water bills. The rural folks, in particular, feel that water should be had for free since it is a natural resource. If water is to be conserved, a price must be placed on the use of water.

### 2. Urban Water Supply

In this report, the definition of urban areas (UAs) follows that used by the National Census Office in the 1980 National Population Census. An urban area was then defined as "a settlement with a generally urban character, a minimum population of 500 persons and a minimum population density of about 195 persons per square kilometer." Appendix 13, page 3 gives the names and populations of the 63 urban areas.

The total population of the 63 urban areas was 393,131 in the 1980 census, representing 13 per cent of the total population of PNG at that time (3,010,727). Page 4 of this Appendix lists not only the 28 UAs with existing piped water system but also the three UAs (Kieta, Vanimo and Balimo) whose water systems are under various stages of construction. These 31 UAs had an aggregate population of 354,015 persons in 1980, representing 90 per cent of the entire urban population and less than 12

per cent of PNG's total population. The largest of the UAs is the National Capital District (NCD), which includes and is loosely referred to as Port Moresby, with a total population of 123,624 as of the 1980 census. These and other information about the water supply systems are presented in pages 9-12 of this Appendix.

NCD has the biggest source of water supply among the UAs with water systems. The source, Laloki River, yields an average of 90 million liters daily (mld). The UA with the smallest source is Alotan whose creek yields approximately 0.2 mld. For 11 of the UAs, existing sources of water supply are projected to be capable of meeting water demand up to year 2000.

The various types of treatment used in PNG include: screening (1); prechlorination (2); flocculation (4); sedimentation (8); filtration (13); chlorination (27); fluoridation (2); pH correction (7); aeration (1); and ionization (1). 1/ Of the ten different treatments, Mt. Hagen uses seven; Port Moresby, six; and Wewak, Goroka, Kwikila, five. The treatment plant capacity of Port Moresby of 92-81 ml/d ranks highest among the 29 systems with water treatment.

Among the 22 UAs with available information on pumping stations, four are boosting the water; the others are not. The pumping capacities range from a maximum of 50.5 liters per sec for Port Moresby -- NCD, to a minimum of 0.4 mld for Goroka.

All but three of the piped water supply systems have storage facilities ranging from the biggest capacity of 66 million liters for NCD to the smallest of 0.036 ml for Malalaua.

As expected, the UA with the most number of water service connections is Port Moresby. At present it has 14,371 service connections, of which 10,710 are metered. The smallest system, with only 45 connections, is that of Kundiawa. All told, except for one UA with no reported data, there are 33,333 service connections in PNG, 19,267 of which are metered.

The actual water demand profile in the UAs is rather erratic. The average demand of an UA is not necessarily proportional to its population. There are big UAs whose water demand is less than those of smaller UAs. Port Moresby leads with an average water demand of 40 mld; Malalaua brings up the rear with 0.187 mld. Significantly, the total demand from these reticulated water systems is slightly over 100 mld. It is interesting to note that although the population of NCD represents about 35 per cent of the total urban population, its water demand is 40 per cent of total water demand in all urban areas.

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1/ The numbers in parentheses indicate the number of UAs using that particular treatment.

A wide disparity exists in the range of operation and maintenance (O&M) costs and manpower. With a personnel complement of 130, Port Moresby's annual cost for both water and sewerage, O&M is K3,552,805. Kokopo's, with a one-man O&M crew, spends K17,810 for water supply alone. Mumeng, with four men, spends K6,600.

A look at the water quality control picture reveals a gap between actual practice and standards. Appendix 15 gives the monitoring requirements for bacteriological analysis of water samples. Based on the standards, the bigger the population served, the more frequent is the water sampling and the greater the minimum number of samples per month. The December 1985 report by Scott and Furphy Engineers in its study of town water supplies shows that only three UAs were collecting samples for bacteriological analysis either forthnightly or monthly even as sampling should be done at least weekly. Two UAs were reported to have no testing at all. Most of the UAs conducted daily tests for residual chlorine only. Other chemical tests were being done at varying frequencies for six UAs.

Information on the revenues being realized by the UAs with piped water supply systems is rather limited. No reports are available on 13 of the urban areas. Seven systems do not levy any water charge, much less collect revenue. For those with reported revenues, Port Moresby leads with K5,371,040, but this amount is for both water supply and sewerage. On the other extreme, Kundiawa collects K400 yearly from a solitary customer, a hotel. The fact remains that many had been enjoying free water supply from the government.

Two major water supply projects during the past decade have served to accelerate the development of the country's water supply sector. The first of these projects was the Four Towns Water Supply Scheme (FTWSS) that the Bank-financed through a US$18.9 million loan and a technical assistance grant of US%165,000 for the design and construction of the water supply systems of Lae, Wewak, Mt. Hagen and Madang. FTWSS also led to the establishment of the Waterboard, the implementation of a cost recovery system in the four urban centers, and the rise in public awareness of the responsibilities attendant to the commissioning of the waterworks in 1982. The total cost of FTWSS was K27 million.

The second of the two landmark projects is the Three Towns Scheme for the construction of waterworks in the urban areas of Kundiawa and Kimbe, and the addition of a sewerage system in Mt. Hagen. The German Government, through the Kreditanstalt fuer Wiederaufbau (KfW), underwrote the Scheme with a DM9.2 million loan and a DMO.8 million grant to finance the services of a Financial Controller. Started in 1982, the project is still in progress and will cost K4.5 million when finished.

Under the 1985 Waterboard Ca;ital Works Program for which K100,000 is budgeted, there are five ongoing projects in water supply. These are the following: (i) Kimber Water Supply; (ii) Port Moresby Water Supply; (iii) Popondetta Water Supply; (iv) Goroka Water Supply Upgrading; and (v) Kundiawa Water Supply. The Kimbe and Kundiawa Water Supply Projects provide local counterpart support for the Three Towns Scheme under the KfW.

B. Development Plans

Before the change of PNG Government in November 1985, the Waterboard had submitted 24 new projects for inclusion in the Medium-Term Development Program (MTDP) for 1986-1990. Although the MTDP was not adopted by the new government, the medium-range water supply development plan of the Waterboard remains substantially unchanged. In fact, the 24 projects in the original MTDP are now included in the five-year Capital Works program of the present government. These projects consist of 13 ongoing projects for 1986 and 13 indicative projects, totalling K12,029,000 for both water supply and sewerage up to 1990.

The indicative projects for water supply are: (i) Port Moresby Water Supply; (ii) Water Supplies Minor Extensions; (iii) Madang Water Supply - New Water Source; (iv) Improved Rain Water Collection; (v) Daru Water Supply Upgrading; (vi) Wau Water Supply Upgrading; (vii) Alotan Water Supply Stage II; (viii) Bulolo Water Supply Upgrading; (ix) Arawa Water Supply Upgrading; (x) Kagamuga/Dobel Water Main Extension; (xi) Kerema Water Supply; and (xii) Bereina Water Supply; and (xiii) Kwikila Water Supply.

As mentioned in the Institutional Study, changes in the Waterboard's development plans will mostly be made as a result of its reorientation from an ordinary government authority to a commercial statutory authority (CSA).

C. Water Supply Issues

1. Organization STructure and Management

The Waterboard's conversion into a commercial statutory authority (CSA) augurs well for water supply industry since it marks a welcome relief from some of the inevitable constraints of bureaucratic red tape. But this development also requires the strengthening of the Waterboard's capability to operate and maintain waterworks and to generate and collect revenue. The Waterboard's initial experience with the administration of the FTWSS water districts will serve it in good stead.

2. Water Revenue Collection

Since the Waterboard has to achieve a targeted rate of return, it has to follow through its successful effort at water revenue collection with even greater determination. This will be especially true for new water districts that used to enjoy free water. The Waterboard should take not that in most developing countries, a major share of arrearages come from government institutions.

3. Accounting System

The Waterboard and all the water districts under it will have to adapt to the new accounting system designed for a CSA. This subject is adequately covered in the section on Organization and Management Thrust of the Interim Report's Institutional Aspects. This particular issue should be given due attention.

4. Shortage of Qualified Personnel

This problem is closely related to inadequacy of local training. The lack of professionals and highly skilled technicians is endemic to PNG. Symptomatic of this organizational and technical malady is the presence of so many expatriates in the Waterboard and in the NCDIC and some position vacancies. In some instances, even the expatriates themselves are not exempt from the professional deficiency. The understudy policy of the government is good but very often there is not understudy to train. A deeper sense of commitment among the PNG youth is needed.

5. Problems in Training and Education

A rather peculiar situation exists in the area of higher education where the demand for university-trained professionals is greater than the supply of secondary school graduates. At the University of Technology, available resources in the university (manpower and facilities) can accommodate twice the present student population. The present ratio of teachers to students is a very high one to two. On the other hand, there is a Commission for Higher Education ruling prohibiting "non-viable" sources, i.e., course where less than nine students are enrolled. Another dimension of the problem is the limited number of courses to meet the needs of the water supply and sanitation sector. University curricula in PNG are confined to civil, mechanical and electrical engineering courses only. No course is offered in sanitary or environmental engineering. At the higher secondary or lower college level there are plumbing courses, but these are intended for houses and buildings only. A more advanced training for larger diameter, pipe-fitting is still wanting. A redeeming feature is the Operator's Course that the DDW Training Center in Boroko, NCD is conducting regularly for water treatment plants.

6. Non-Revenue Water (NRW)

For the Waterboard to be able to determine the magnitude of non-revenue water with accuracy and certitude, all service connections must be metered, gauging points installed, bulk meters put in place, isolation valves made operational and fire flows monitored. And to be useful and meaningful, information on non-revenue water must be broken down into such components as losses due to leaks in pipes, valves, meters and hydrants, measurement errors, illegal connection and bypasses, water used for blowing off or flushing mains (after construction or repair), and if applicable water supplied gratis to charitable institutions. Otherwise, rough and careless determination of the amount of non-revenue water can lead to unreliable information, false conclusions, and even wrong decisions. There is reason to believe that some of the sparse data on non-revenue water in PNG are not very reliable.

7. Operation and Maintenance Problems

In PNG, preventive maintenance does not seem to be one of the strong points of water agencies. This was observed in many of the

regularly, for example yearly. Moreover, water meters are usually tested, repaired, or replaced only when there is a complaint from the concessioner or a report from the meter reader. This is normal, especially if the water system is comparatively new. As the waterworks age, however, a system-wide meter replacement program should be considered. This program involves regular repair and cleaning of old meters. Similarly, for a borefield, apart from regular servicing, inspection and record-keeping of each borehole installation, deepwell pumps should be removed and overholed. The bores should be desilted, screens cleaned, and decalcified, etc. Prevention is cheaper and easier to do than repairing. Preventive maintenance also results in the avoidance of prolonged service interruptions and costly repair, if not replacement, of major parts of the water systems plants, instruments, or equipment. Some operation manuals are available in the offices and field installations of the Waterboard water districts, but these need to be improved. The draft of a design manual has been prepared and reviewed by the engineering staff of the Waterboard; it now awaits final production.

## 8. Operational Difficulties of Port Moresby Water Supply System

The Camp, Scott and Furphy (CSF) Consulting Group made a water supply study of the Port Moresby Water Supply System (PMWSS) and reported its findings in September 1980. At that time losses from various sources were estimated to exceed 25 per cent. At the time of writing of this report, the NCDIC assumes the loss to be 15 per cent. Considering the different methods used in arriving at the two figures and the events that have transpired in the interregnum, NCDIC's estimate of losses appears to be overoptimistic. Furthermore, the per capita daily consumption of 400 liters exceeds the usual rate for a typical urban center in a developing country. The problem of excessive pressure in certain zones of the Port Moresby waterworks that was reported by CSF in 1980, such as in the Boroko area, still exists. The situation remains unchanged also in some zones that are not adequately supplied with water. The computer model designed and used by CSF in 1980 has not been used since then. However, it is in the process of being revised and updated by the Waterboard. A good monitoring system is needed to determine actual consumption levels, measure and minimize wastage and losses, and meet maintenance requirements immediately. The prevailing practice at the NCDIC is to read water meters twice a year, but to prepare billings quarterly. Thus, between readings and billings, the occupancy or tenancy of the building could have changed. Reports about meters not being read persist. The meter reading and billing systems can stand some improvements.

There is a determined attempt to bring the Eriara Treatment Plan to its design capacity. Much of the success in improving the operation and maintenance of the plant is traceable to the interest and drive of its incumbent plant manager. Despite the manager's lack of experience in running a water treatment complex, substantial improvements have been effected including the repair of laboratory instrumentation, innovations in chemical dosing systems, and even a modest attempt at computerizing part of the monitoring system. The Port Moresby water supply and sewerage systems in PNG can gain a lot from more of similarly dedicated supervisors and better-trained personnel.

## WATER SAMPLING FOR COMMUNITY WATER SUPPLY SYSTEMS
## MONITORING REQUIREMENTS FOR BACTERIOLOGICAL ANALYSIS a/

| Population Served | Minimum No. of Samples per month | Frequency |
|---|---|---|
| up to 1,000 | 2 | once a month |
| 1,001 to 2,000 | 3 | once a month |
| 2,001 to 4,000 | 4 | once a month |
| Urban Centers | | |
| 2,001 to 4,000 | 4 | twice per month |
| 4,001 to 5,000 | 6 | twice per month |
| 5,001 to 8,000 | 8 | twice per month |
| 8,001 to 10,000 | 10 | twice per month |
| 10,000 to 15,000 | 12 | weekly |
| 15,001 to 20,000 | 15 | weekly |
| 20,001 to 30,000 | 18 | weekly |
| 30,000 to 50,000 | 20 | weekly |
| 50,000 to 75,000 | 25 | weekly |
| 75,000 to 100,000 | 30 | weekly |
| 100,001 to 150,000 | 40 | weekly |

a/ Adopted by the Waterboard.

(Reference in text: page 20, para 37)

## NCDIC - PROPOSED WATER SUPPLY CAPITAL WORKS PROGRAM
(In Kina '000)

| Project Description | 1986 | 1987 | 1988 | 1989 | 1990 |
|---|---|---|---|---|---|
| Rezoning | 150 | 100 | 50 | | |
| Water Conservation | 80 | 50 | 50 | 50 | |
| Water Pump Station | 50 | | | | |
| Replacement of Chemical Shed | 100 | | | | |
| Reactivation of Bomana Booster PS | 50 | | | | |
| Major Reservoir Upgrading | 160 | 100 | 100 | 100 | 100 |
| Reticulation New Works/Upgrade (2% p.a. of existing) | 100 | 500 | 500 | 500 | 500 |
| Paga Hill Water Supply | 50 | | | | |
| Chemical Feeders | 30 | | | | |
| Raw Water Main Needle Valve | 25 | | | | |
| Minor Reservoir Upgrading | 40 | 60 | 50 | 70 | 70 |
| Village Water Supply | 20 | 20 | 20 | | |
| Reticulation Gerehu Stage 1-3 | 70 | 150 | | 150 | |
| Pipeline - Bomana to Gerehu/Erima | | 1,000 | 1,000 | 1,000 | 1,000 |
| Pipeline - Erima to Waigani Reservoir | | 640 | | | |
| Waigani Reservoir Construction | | 200 | 1,000 | | |
| Treatment Plant Upgrading | | 50 | 50 | 50 | 50 |
| Pipeline - Erima to Boroko Reservoir | | | | | 100 |
| Gerehu Reservoir | | | | 800 | |
| Koki Reservoir Duplication | | | | 200 | 280 |
| Pipeline - Waigani Reservoir to Hohola Reservoir | | | | | 525 |
| Replacement of Boroko Reservoir | | | | | 300 |
| Flow Control Center Computer | | | | | 50 |
| Total | 925 | 2,870 | 2,820 | 2,920 | 2,975 |

Source: NCDIC, 1986

(Reference in text: page 21, para 39)

# NCDIC - PLANNED WATER SUPPLY DEVELOPMENT IN 1986-1990

| | 1986 | 1987 | 1988 | 1989 | 1990 |
|---|---|---|---|---|---|
| **Water Conservation** | | | | | |
| Set up and maintain monitoring programs to reduce losses from system and general misuse of water | X | X | X | X | X |
| **Pressure Rezoning** | | | | | |
| Continue program of bringing major reservoirs on-line and feeding defined areas | X | X | X | | |
| **At MT Eriama TP** | | | | | |
| Replace chemical shed | X | | | | |
| Replace chemical feeders | X | | | | |
| Upgrade plant instrumentation, equipment, etc. | X | X | X | X | X |
| Automate raw water flow control valve | X | | | | |
| **Reticulation** | | | | | |
| Paga Hill - upgrade pumps, rising main | X | | | | |
| Bomana to Erima trunk, construct new 900mm trunk main to reduce head losses | | X | X | X | X |
| Erima to new Waigani reservoir trunk - construct 600mm trunk main from Erima to proposed new reservoir at Waigani | | X | | | |
| Gerehu trunk - construct new 250mm main from Gerehu Stage 1 to Stage 3 | X | X | | X | |
| General reticulation - replace 40km of mains in 5-year period | X | X | X | X | X |
| Erima to Boroke res. trunk - commence construction of new 900mm trunk main | | | | | X |
| Waigani res. to Hohola res. - construct trunk main linking existing reservoirs | | | | | X |
| Inventory of mains - compile on computer all water mains in city | X | X | | | |

| | 1986 | 1987 | 1988 | 1989 | 1990 |
|---|---|---|---|---|---|
| Reservoirs | | | | | |
| Major - upgrade roofing, ladders, level recorders, etc. | X | X | X | X | X |
| Minor - upgrade or replace minor structures | X | X | X | X | X |
| Waigani (Embassy Hill) - construct new 30ml reservoir | | X | X | | |
| Gerehu - construct new 20ml reservoir | | | | X | |
| Koki - duplicate existing 10ml reservoir | | | | X | X |
| Boroko - replace existing 10ml reservoir; funding carried into 1991 | | | | | X |
| Pumping Stations | | | | | |
| Bomana raw water - reactive old station to provide 20ml/day emergency backup supply to Mt. Eriama | X | | | | |
| Bomana booster - reactive to enable water to be pressure-busted to city to fill reservoirs as necessary | X | | | | |
| Flow Measurement | | | | | |
| Relocate 1,000 industrial/commercial meters to underground pits to reduce damage due to vandalism | X | X | X | | |
| Establish computerized flow control center; funding continued into 1991 | | | | | X |
| Preventive Maintenance | | | | | |
| Set up systematic preventive maintenance programs for:<br>- pump stations<br>- fire hydrants<br>- valves (aid, stop, flow control) | X | | | | |

## URBAN WATER SUPPLY SYSTEM - ESTIMATED DEVELOPMENT REQUIREMENTS, 1986-2000
(In Kina '000)

| Town | Number of Connections/ Housing Units | O&M Cost 1985 | Ir Index | Estimated Cost 1986/ 1990 | Estimated Cost 1991/ 2000 | Total |
|---|---|---|---|---|---|---|
| Alotau | 575/902 | 106 | 2.45 | 245 | 105 | 350 |
| Angoram | n.a/n.a. | 22 | 1.88 | 463 | 63 | 526 |
| Arawa | 2,601/2,688 a/ | 209 | n.a. | 433 | 367 | 800 |
| Bulolo | 551/926 | 49 | 1.67 | 257 | 606 | 863 |
| Daru | 1,176/395 a/ | 208 | 1.61 | 225 | 6 | 231 |
| Goroka | 124/854 | 81 | 1.72 | 615 | 265 | 880 |
| Kainantu | 856/n.a. | 27 | 1.77 | 408 | 75 | 483 |
| Kavieng | n.a./720 | 75 | 2.82 | 73 | 224 | 297 |
| Kieta | 618/820 | 146 | n.a. | 3,040 | n.a. | 3,040 |
| Kimbe | 39/n.a. | 30 | 2.30 | 206 | 105 | 311 |
| Kikopo | 333/300 a/ | 18 | 1.85 | 155 | 330 | 485 |
| Kundiawa | 141/162 | 14 | 2.13 | 266 | 148 | 414 |
| Kupiano | 82/111 a/ | 38 | 1.50 | 212 | 106 | 318 |
| Kwikila | 245/635 | 43 | 1.18 | 155 | 26 | 181 |
| Lorengau | 899/4,377 | 44 | 3.20 | 301 | 766 | 1,067 |
| Madang | 93/95 | n.a. | n.a. | 4,551 | 900 | 5,451 |
| Malalaua | 74/90 | 17 | 1.20 | 59 | 25 | 84 |
| Mumeng | 155 a//n.a. | 7 | 1.57 | 120 | 32 | 152 |
| Namtanai | 756/741 a/ | 51 | 2.75 | 168 | 110 | 278 |
| Popondetta | 627/4,089 | 114 | 2.19 | 451 | 158 | 609 |
| Rabaul | n.a./n.a. | 117 | 1.86 | 3,086 | n.a. | 3,086 |
| Vanimo | 396/396 a/ | 75 | 2.75 | 873 | 70 | 943 |
| Wabag | 113/259 | 91 | 2.92 | 82 | 22 | 104 |
| Wau | 1,231/4,429 | 10 | 1.90 | 388 | 140 | 528 |
| Wewak | | n.a. | n.a. | 1,888 | 281 | 2,169 |
| Total | 13,656/27,722 | | | 18,720 | 4,930 | 23,650 |

a/ "Informal" housing was not included.

Source: Prefeasibility Study of Town Water Supply Projects; Scott & Furphy Engineers Pty. Ltd., Melbourne, Australia, 1985

(Reference in text: page 21, para 39)

APPROVED URBAN WATER SUPPLY PROJECTS, 1987-1991
(In Kina '000)

| | 1986 | 1987 | 1988 | 1989 | 1990 | 1991 | Total 1987-1991 |
|---|---|---|---|---|---|---|---|
| Waterboard Capital Works Program | 1,318.9 | 1,042.3 | 3,514.0 | 3,630.0 | 4,247.0 | 6,356.7 | 18,790.0 |
| Ongoing Projects | | | | | | | |
| Kimbe WS a/ | 749.0 | 417.0 | 3.0 | 0.0 | 0.0 | 0.0 | 420.0 |
| Kundiowe WS a/ | 1,005.0 | 936.0 | 0.0 | 0.0 | 0.0 | 0.0 | 936.0 |
| Popondetto WS | 158.0 | 100.0 | 125.0 | 0.0 | 0.0 | 0.0 | 225.0 |
| Goroka WS | 241.0 | 450.0 | 40.0 | 0.0 | 0.0 | 0.0 | 490.0 |
| Port Moresby | 155.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Subtotal Ongoing | 2,308.0 | 1,903.0 | 168.0 | 0.0 | 0.0 | 0.0 | 2,071.0 |
| Total Urban Water Supply | 3,626.9 | 2,945.3 | 3,682.0 | 3,630.0 | 4,247.0 | 6,356.7 | 20,861.0 |
| Water Supply and Sewerage | | | | | | | |
| Kiunga WS&S | 200.0 | 452.0 | 122.0 | 0.0 | 0.0 | 0.0 | 574.0 |
| Kainantu WS&S | 20.0 | 0.0 | 200.0 | 0.0 | 0.0 | 0.0 | 200.0 |
| Total Water Supply & Sewerage | 220.0 | 452.0 | 322.0 | 0.0 | 0.0 | 0.0 | 774.0 |

a/ KfW-funded.

Source: 1987 Budget Document No. 3 (Investment Plan for Urban Water Supply and Sanitation).

(Reference in text: page 21, para 41)

# SUMMARY OF BACTERIOLOGICAL TESTS CARRIED OUT ON SOME WATER SOURCES IN RURAL AREAS OF PNG

Studies carried out in 1981 by the PNG Institute of Medical Research on village water supplies in the Eastern Highlands showed the following:

(i) at Asaro Valley -- only two out of 21 bacteriological samples were satisfactory, i.e., had less than 10 coliforms per 100 ml. These were hillside sources (bamboo drip). Ten samples had more than 1,000 coliforms. These samples were not tested for fecal coliforms.

(ii) in the Waisa area -- five out of nine samples had fecal coliforms present.

In the above tests, three samples taken from rain water storage tanks showed no fecal coliform. Out of seven tests conducted on water samples from hillside bamboo drip sources, two showed presence of fecal coliforms. Generally, rivers, streams, creeks, drains and some village wells showed a high degree of pollution and presence of fecal coliforms.

At the Buko settlement at Lae, 11 out of 18 samples contained fecal coliforms. At Yalu village, Morobe Province, where a gravity water supply scheme was constructed and is in operation, tests of unprotected source and of tap water indicated presence of fecal coliform.

Source: PNG Institute of Medical Research, 1985; LGS, 1986

(Reference in text: page 23, para 43)

## A SIMPLE TEST FOR DETECTION OF FECAL POLLUTION IN DRINKING WATER

There exists a simple, rapid and inexpensive field test based on detection of hydrogen sulphide producing organisms in drinking water. 1/

### Preparation of the Medium and the Test

The concentrated medium used in the test contains 20 g of peptone, 1.5 g of dipotassium hydrogen phosphate, 0.75 g ferric ammonium citrate, 1 g of sodium thiosulphate, 1 g of Teepol and 50 ml of water. Aliquots of the 1 ml of the concentrated medium are absorbed onto folded tissue paper (80 sq cm) and placed in a McCartney bottle, autoclaved and dried at 50° C under sterile conditions. The water samples to be tested are placed in the bottles up to a calibrated mark (20 ml) and allowed to stand at ambient temperature (30-37° C). Fecal pollution is indicated if the contents of the bottle turns black within 12-18 hours.

### Tests Conducted by the University of Technology at Lae

Dr. S. Hugman of the University of Technology at Lae has conducted several tests at different temperatures in the range 8-37° C, and established that bottles must be incubated at a temperature between 30 and 37° C to obtain valid results. He also confirmed that the duration of incubation should be from 12 to 18 hours as prolonged tests produce false positive (black) results. Generally, the samples should be collected in the afternoon, incubated overnight, and the results (yellow or black) recorded the following morning.

| Source | Hydrogen Sulphide Test a/ | Membrane Filter Test b/ |
|---|---|---|
| Yalu stream | B, B, B | 22 |
| Yalu tap | B, B, B | 20, 30 |
| Yalu well | Y, Y | 1, 1 |
| Manum tank | Y, Y | - |
| Manum creek | B, B, B | 2,400 |
| Erap river | B | 140 |

a/ Y = yellow; B = black (hydrogen sulphide produced).
b/ Fecal coliform organism per 100 ml.

Source: WHO, Port Moresby

1/ "A simple field test for the detection of fecal pollution in drinking water" by K. S. Manja, S. Maurga and K. M. Rao. Published in Bulletin of WHO 1982, Vol. 60, No. 5, 797-801.

## PROPOSED PRESELECTION INFORMATION REQUIRED FOR COMMUNITY WATER SUPPLY AND EXCRETA DISPOSAL PROJECTS

1. To identify all existing water supply sources, by usage, and community customs and traditions with regard to selection of sources and the use of water.

2. To identify any seasonal variations and problems as well as families that have more than 30 meters to the nearest safe water source.

3. To identify existing excreta disposal methods and community customs and traditional concerning excreta disposal.

4. To identify persons who are responsible for delivering water for family use and whether these persons are likely to have any influence on decisions concerning any future water supply proposals.

5. To determine incidence of diarrhea and state of personal and household hygiene.

6. To identify where the nearest Aid Post is and whether it is used by the community. To determine whether people are taking part in the primary health care.

7. To determine whether the community has received any health education. To determine the need for further health education.

8. To identify steps or action necessary to improve water supply and excreta disposal to an adequate level.

9. To collect information about present population, community organization, groups and clubs, particularly about women groups.

10. To find out whether the community had previous experience in communal activities, for example, economic, even cultural.

11. To find out if findings have been discussed with the community (and women groups) and if so, what their attitude was. To find out if the community is willing and able to pay for the necessary development work and to take complete care of the maintenance and repairs of the project.

12. If there appears to exist a need for financial assistance, to find out the amount needed and what percentage it represents of the total cash requirements of the project.

13. To find out realistic prospects for obtaining (and when):

    i) a Government grant; or
    ii) a grant from a NGO; or
    iii) a soft loan from a revolving fund.

14. To find out if the water supply and excreta disposal proposals for this community have been approved by the following:

    i) Provincial Department of Health; and/or
    ii) Local Government Engineering Section in case of a piped water supply system.

## PROPOSED SELECTION CRITERIA REQUIRED FOR COMMUNITY WATER SUPPLY AND EXCRETA DISPOSAL PROJECTS

1. Need to reduce incidence of diarrhea and/or helminthic infestation among children.

2. Need to provide safe water all year round.

3. Need to reduce distance to safe water source for each family to less than 30 meters.

4. Willingness and ability of the community to provide the necessary labor and local materials free of charge.

5. Willingness and ability of the community to bear the total, or partial cost of the development works and to maintain and to keep the works repaired.

6. In case of a need for financial assistance the availability of:

   a. a Government grant; or
   b. a grant from a NGO; or
   c. a soft loan from a revolving fund.

7. In case of a piped water supply system, availability of approval of the designs and documentation of the scheme by the Local Government Engineering Section of DoW.

# PROPOSED RURAL WATER SUPPLY PROGRAM IN PNG

## Levels of Rural Water Service

| Characteristics | | Level I | Level II | Level III |
|---|---|---|---|---|
| 1. | Description of water service | Point source system | Piped water supply with public standpipes | Piped water supply with metered house connections |
| 2. | Type of water source | Free-flowing well; shallow well, 20 m max. depth; deep well, over over 20 m depth; spring capture; surface water intake or rain collection | | |
| 3. | Distance from farthest user | 250 m maximum | 25 m maximum faucets | N.A. |
| 4. | Number of households served | 40 to 100/ deep well 5-40/shallow well | 6 per faucet | 600 minimum |
| 5. | Water supply in liters per day (lpcd) | 30 lpcd minimum | 60 lpcd per faucet | 100 lpcd per household |
| 6. | Per capita consumption | 15 lpcd | 30 lpcd | 80 lpcd |

(Reference in text: page 26, para 52)

Estimated Costs a/
(Cost of materials and equipment only,
in Kina in 1986 prices)

| Solution Type | Cost of Scheme | Persons Served | Per Capita Cost |
|---|---|---|---|
| Level I | K 300 | 250 | K 1.20 |
| Level II | K5,000 | 250 | K20.00 |
| Level III | K7,500 | 250 | K30.00 |

a/ Excluding physical and price contingencies.

Assumed Program

| Solution Type | Per Cent of Rural Communities in PNG a/ Program Period | | | Total |
|---|---|---|---|---|
| | Initial 1987-1990 | Intermediate 1991-1994 | Ultimate 1995-1998 | |
| Level I | 60% | 15% | - | 20% b/ |
| Level II | 16% | 24% | 30% | 70% |
| Level III | - | 5% | 5% | 10% |
| c/ | 14% | - | - | - |
| Total | 90% | 44% | 35% | 100% |

a/ It is assumed that there are 11,000 rural communities in PNG.
b/ Some of the initially used Level I solutions will be ultimately replaced by Level II or III solutions.
c/ Population assumed to be with access to safe water at the beginning of the program. It is assumed that these communities will ultimately have schemes with solutions Level II or III.

Number of Schemes to be Implemented per Planning Period

| Solution Type | Per Cent of Total | Total Number | Number in Each Period | | |
|---|---|---|---|---|---|
| | | | Initial 1987-1990 | Intermediate 1991-1994 | Ultimate 1995-1998 |
| Level I | 75% | 8,250 | 6,600 | 1,650 | - |
| Level II | 70% | 7,700 | 1,760 | 2,640 | 3,300 |
| Level III | 10% | 1,100 | - | 550 | 550 |

(Reference in text: page 26, para 52)

## NUMBER OF WATER SUPPLY SCHEMES TO BE IMPLEMENTED PER ANNUM, PER MONTH AND PER WEEK a/

Implementation Period

| Solution Type | 1987-1990 | | | 1991-1994 | | | 1995-1998 | | |
|---|---|---|---|---|---|---|---|---|---|
| | p.a. | p.m. | p.w. | p.a. | p.m. | p.w. | p.a. | p.m. | p.w. |
| Level I | 1,650 | 138 | 31 | 412 | 34 | 8 | - | - | - |
| Level II | 440 | 37 | 8 | 660 | 55 | 13 | 825 | 69 | 16 |
| Level III | - | - | - | 138 | 11 | 3 | 138 | 11 | 3 |

a/ This table is to illustrate that the proposed national program is feasible if institutional support is also financed to assist the Waterboard, and through it the LGS of DOW and the DOH, in the implementation.

Estimated Cost of the Program

It is assumed that there are about 11,000 rural communities in PNG.

Cost of Each Phase of Program
(In Kina '000, 1986 prices)

| Solution Type | Unit Cost | Initial 1987-1990 | Intermediate 1991-1994 | Ultimate 1995-1996 | Total Cost a/ |
|---|---|---|---|---|---|
| Level I | K 300 | K1,980 | K 495 | - | K 2,475 |
| Level II | K5,000 | K8,800 | K13,200 | K16,500 | K38,500 |
| Level III | K7,500 | - | K 4,125 | K 4,125 | K 8,250 |
| Total | | K10,780 | K17,820 | K20,625 | K49,225 |

a/ Excluding physical and price contingencies.

## INVESTMENT PLAN FOR RURAL WATER SUPPLY AND SANITATION
(in Kina '000)

| Province/ Project Name | 1986 | 1987 | 1988 | 1989 | 1990 | 1991 | Total 1987-1991 |
|---|---|---|---|---|---|---|---|
| New and Ongoing Projects of the Ministry of Health | | | | | | | |
| Morobe | 54.3 | 110.9 | 85.0 | 85.0 | 85.0 | 85.0 | 450.9 |
| E. Highlands | 63.6 | 95.0 | 95.0 | 95.0 | 95.0 | 95.0 | 445.0 |
| W. Highlands | 49.5 | 49.8 | 63.3 | 63.3 | 63.3 | 63.3 | 303.0 |
| S. Highlands | 42.4 | 121.5 | 121.5 | 121.5 | 121.5 | 121.5 | 607.5 |
| E. Sepik | 50.7 | 62.6 | 62.6 | 62.6 | 62.6 | 62.6 | 313.0 |
| Madang | 57.6 | 57.6 | 66.6 | 66.6 | 66.6 | 66.6 | 324.0 |
| Simbu | 50.7 | 77.8 | 97.1 | 70.0 | 70.0 | 70.0 | 384.9 |
| Enga | 59.4 | 60.0 | 70.0 | 70.0 | 70.0 | 70.0 | 340.0 |
| E. New Britain | 41.1 | 40.5 | 48.1 | 48.1 | 48.1 | 48.1 | 232.9 |
| N. Solomons | 50.0 | 50.0 | 50.0 | 50.0 | 50.0 | 50.0 | 240.0 |
| Milne Bay | 47.8 | 49.1 | 54.7 | 54.7 | 54.7 | 54.7 | 267.9 |
| Central | 88.3 | 60.0 | 60.5 | 60.5 | 60.5 | 60.5 | 302.0 |
| W. Sepik | 127.7 | 52.7 | 62.3 | 62.3 | 62.3 | 62.3 | 301.9 |
| W. New Britain | 48.0 | 48.0 | 48.0 | 48.0 | 48.0 | 48.0 | 240.0 |
| Western | 40.5 | 32.3 | 48.0 | 48.0 | 48.0 | 48.0 | 224.3 |
| Northern a/ | 39.4 | 40.4 | 48.0 | 48.0 | 48.0 | 48.0 | 232.4 |
| New Ireland | 39.9 | 48.5 | 48.1 | 48.1 | 48.1 | 48.1 | 240.9 |
| Gulf 63.4 | 54.8 | 62.3 | 62.3 | 62.3 | 62.3 | 304.0 | |
| Manus | 25.0 | 25.0 | 35.0 | 45.0 | 45.0 | 45.0 | 195.0 |
| Subtotal | 1,039.3 | 1,136.5 | 1,226.1 | 1,199.0 | 1,199.0 | 1,199.0 | 5,959.6 |
| Other Rural Water Supply Projects of the Ministry of Health | | | | | | | |
| Morobe/ Finschaffer | 210.0 | 0.0 | 300.0 | 0.0 | 0.0 | 0.0 | 300.0 |
| E. Highlands/ Henganoft | 156.0 | 51.0 | 0.0 | 0.0 | 0.0 | 0.0 | 51.0 |
| E. Highlands/ Goroka | 303.0 | 198.0 | 100.0 | 0.0 | 0.0 | 0.0 | 298.0 |
| Subtotal | 669.0 | 249.0 | 400.0 | 0.0 | 0.0 | 0.0 | 649.0 |
| Total | 1,708.3 | 1,385.5 | 1,626.1 | 1,199.0 | 1,199.0 | 1,199.0 | 6,608.6 |

a/ Water Supply and Sanitation Project.

Source: 1987 Budget Document No. 3, Ministry of Finance, 1986 and 1987

(Reference in text: page 27, para 53

# URBAN SANITATION

## A. Existing Situation

### 1. General

A review of population centers in PNG shows that no more than 17 have central or reticulated sewerage systems, of which a number are limited to hospital complexes and school compounds. The population of these 17 urban areas with central sewerage systems is 344,556 representing 11.4 per cent of the country's total population of 3,010,727 (1980 census). While these sewerage systems are inevitably found in urban areas, 14 of these urban areas do not have waterborne sewerage systems.

Other types of liquid waste disposal facilities include septic tanks (a few with absorption trenches), sanitary pan (or pail) collection, pit latrines, and in one known case, an Imhoff tank. except in one small urban area that uses fiberglass, septic tanks are usually made of concrete.

Detailed information on existing sewerage systems in PNG are contained in pages 4 to 7 of this Appendix.

### 2. Urban Sanitation

So far, only two cities have been declared sewerage districts by the Waterboard, namely, Lae and Madang, the two biggest urban areas in the country after the National Capital District (NCD). All the eight biggest urban areas with population exceeding 10,000 have central reticulated sewerage systems. These are Port Moresby (NCD), Lae, Madang, Wewak, Goroko, Rabaul, Mt. Hagen and Arawa, although Mt. Hagen's system is still under construction.

Of the urban areas in PNG, 29 have septic tanks, 20 have pit latrines, 14 utilize sanitary pan collection, and one has an Imhoff tank. We observed that most of the urban areas with a central sewerage system also had septic tanks, pit latrines, or pan collection. Eight of the urban areas with reticulated sewerage systems are served by ponds or lagoons.

In some urban areas, like Port Moresby, Mt. Hagen and Popondetta, septic tank pumpout services are done by private plumbing contractors. Appendix 37 lists the sewerage contractors in PNG.

Treatment is effected through septic tanks, Imhoff tanks or lagoons and ponds. In Kundiawa, one of the smaller urban areas with a reticulated system, there is tertiary treatment. In many areas of PNG, the conditions favor the use of lagoons. The lagoons in Port Moresby are very well-maintained. The abundant fish life in the lagoons are evidence of the quality of the wastewater in the lagoons. Similarly, well-maintained are the two facultative lagoons in Kimbe where the odor of sewage is hardly noticeable.

In sharp contrast are the oxidation ponds in Lae and Madang. Hardly visible beneath the lush growth of grass and other wild vegetation, a pond in Taraka has just been taken over by the newly declared Lae Sewerage District. Apparently, the facilities had been neglected for some time, even as raw sewage continuously flowed into the pond. The ponds in Madang containing septic liquid waste served as receiving waters for the sewage from collection pails. Both ponds were badly in need of repair and sludging.

## B. Development Plans

The 13 ongoing projects under the Waterboard's K0.1 million Capital Works Program for 1986 includes eight sewerage projects. These are: (i) Popondetta Sewerage Augmentation; (ii) Lae Sewerage; (iii) Walgani-Gerehu Lagoon Augmentation; (iv) Port Moresby Sewerage Augmentation; (v) OK Tedi-Kiunga Water and Sewerage; (vi) Mt. Hagen Sewerage; (vii) Goroko Sewerage-Kama Estate; and (viii) Kainantu Sewerage Water Supply. The Popondetta Sewerage Augmentation Project is intended to increase the capacity of the sewage treatment installation by constructing a new lagoon and lining all treatment ponds with a fabric to seal against seepage.

All the 13 indicative projects under the Waterboard Capital Works Supply and Sewerage Capital Works Program must have an economic rate of return of at least 10 per cent under the MWSS Act 1986. Projects having a lower rate of return may still be implemented for reason of public health or if the infrastructure is needed to create employment opportunities. The NWSS Act 1986 further requires that unless an explicit subsidy for operations is included in the National Budget or by another authority, full cost recovery on a collective basis will be implemented in urban areas declared as Waterboard Districts. The Waterboard is expected to be in a position to recover costs by 1990.

By official definition, full-cost recovery includes cost of operation and maintenance, debt service charges on outstanding loans, capital replacement costs of obsolete facilities, and administrative expenses.

## C. Sanitation Issues

### 1. Adopting Local Standards and Codes of Practice

As discussed in Section VII-C, under Water Supply Issues, there is a need to formulate and adopt local standards and codes of practice in the sewerage and water supply to ensure that local requirements and aspirations of PNG are realized. For example, standards in highly developed urban centers with high-rise buildings may be too expensive for small urban areas with a few thousand inhabitants and whose highest edifice may be a two-storey hotel or a government building.

2. Improving the Operation and Maintenance of Sewerage Systems

Except for some notable exceptions already cited, such as the lagoons of the Port Moresby and Kimbe sewerage systems, much is left to be desired in the O&M of existing sewerage systems. Whether the reasons is insufficient funds, shortage of personnel or apathy, the neglected state of the facilities cannot be denied.

3. Need for Personnel

In the two sewerage districts recently declared by the Waterboard, regulations require that each one should have inter alia the positions of Sewerage Engineer, Sewerage Inspector and Supervision Officer. At present, however, these three positions are occupied in a concurrent capacity, by the District Manager of the Water District because of the lack of qualified personnel in the present sewerage districts. The discussion in Section VII-C under Water Supply Issues on the shortage of qualified personnel is also applicable to sewerage and sanitation.

4. Need for Expanded Urban Sanitation Program

Before an existing system is augmented or expanded, there should be a deliberate and systematic attempt to investigate if the present reticulation system is overloaded, infiltrated, or leaking. The quality of the influents and the effluents should be monitored to determine whether or not the treatment system is adequate. Having identified and quantified the problems and inadequacies, the planners and designer should then decide on the measures needed to solve these problems and meet inadequacies. Priorities must be established and options elaborated to help management decide. In the process, it may turn out that upgrading of the operation and maintenance of an existing septic tank system would be more cost-effective than installation of a new but rather expensive extention of an existing central sewerage system. In brief, the urban sanitation program should be expanded along these directions.

5. Funding for Implementing Sewerage Projects

At present, local funding sources are inadequate and must be augmented by external fund sources in the form of soft loans and technical assistance. International banking accommodations and bilateral arrangements should be tapped whenever available.

6. Suitable Training Programs

Problems in training and education in sewerage and sanitation is far more serious than in the water supply subsector. For the latter, there are Plumbing Courses being offered at higher secondary or lower college level and an Operators' Course at the DOW Training Center in Boroko, which are all oriented towards water supply. Similar courses must be designed and offered for sewerage with the encouragement and material support of the Waterboard. At the college and university level, suitable programs must also be instituted in sewerage and sanitation that will meet the needs of engineers, planners and other professionals.

7. Need for Local Research and Development

Among the functions of the Waterboard is to "promote research related to water supply and sanitation activities in PNG". Basic data needed for planning in sewerage and sanitation are not readily available in PNG. This constraint can be eased if not eliminated through a well-planned and well-directed program of research and development (R&D). It would be highly desirable for local R&D to identify solutions to local problems. In carrying out its function of promoting research, the Waterboard can either develop its own in-house capability for local R&D or engage the services of local consultants or members of the academe.

D. Sanitation Recommendations

Training programs oriented towards sanitation and sewerage and appropriate for professionals and subprofessionals should be developed to meet present and future manpower needs. The Waterboard can give the program a big boost by establishing a professorial chair in sanitary or environmental engineering at the Unitech. it can also sponsor scholarships in both water supply and sanitary engineering. These activities will not only attract promising students to take up these courses, but can also lead to researches in fields that are relatively new in PNG by members of the academe.

The R&D efforts of the Waterboard should be geared toward developing or identifying appropriate low-cost technology that will achieve the same health and environmental objectives. Given limited funding, attention should be focussed on applied research rather than on basic research.

A prefeasibility study of sewerage profits in urban areas similar to the study for water supply projects done by Scott and Furphy Engineers last year should be prepared. This study should then lead to the preparation of a sewerage master plan for each of the urban areas covered. The Waterboard must see to it that each master plan, which provides for future sewerage needs, is implemented in phases according to predetermined priorities. The format designed by Scott and Furphy in the water supply study could very well serve as a model for the proposed sewerage study.

The operation and maintenance of sewerage problems should be given higher priority to ensure that the large investments made in them will not be wasted. Proper operation and regular preventive maintenance should go hand in hand. Operation and maintenance manuals are therefore necessary and should be made available to field personnel.

In areas where sanitary pans and ordinary pit latrines are still in use, serious efforts should be made to replace these with septic tanks or, if soil and topographic conditions warrant it, at least with pour-flush latrines. Wastewater from the laundry, the kitchen or the shower can be reused for flushing the latrine. Potable water, especially if in limited supply, need not be used directly for latrine flushing.

It is a good policy to require all new housing, commercial and industrial developments to include sewerage systems. The Waterboard should also adopt a policy prohibiting the throwing of toxic, redioactive and dyeing wastes into the central sewerage systems.

APPROVED URBAN SEWERAGE PROJECTS, 1987-1991
(In Kina '000)

| | 1986 | 1987 | 1988 | 1989 | 1990 | 1991 | Total 1987-1991 |
|---|---|---|---|---|---|---|---|
| Sewerage | 5,157.0 | 2,610.0 | 1,662.0 | 1,000.0 | 300.0 | 0.0 | 5,572.0 |
| Port Moresby | 2,240.0 | 15.0 | 1,300.0 | 1,000.0 | 300.0 | 0.0 | 2,615.0 |
| Popondetta | 0.0 | 0.0 | 104.0 | 0.0 | 0.0 | 0.0 | 104.0 |
| Lae | 2,005.0 | 2,206.0 | 258.0 | 0.0 | 0.0 | 0.0 | 2,464.0 |
| Mt. Hagen a/ | 896.0 | 169.0 | 0.0 | 0.0 | 0.0 | 0.0 | 169.0 |
| Goroka | 16.0 | 220.0 | 0.0 | 0.0 | 0.0 | 0.0 | 220.0 |

a/ KfW-funded.

Source: 1987 Budget Document No. 3 (Investment Plan for Urban Water Supply and Sanitation).

(Reference in text: page 29, para 58)

## NCDIC - PROPOSED SEWERAGE CAPITAL WORKS PROGRAM
(In Kina '000)

| Project Description | 1986 | 1987 | 1988 | 1989 | 1990 |
|---|---|---|---|---|---|
| Sewer Touaguba | 125 | 150 | 150 | 150 | |
| Boroko Sewer Upgrade | 120 | 320 | 320 | 320 | 320 |
| Waigani Lagoon Upgrade | 50 | 25 | 25 | 25 | 25 |
| Sewer Extensions/Upgrade | 20 | 100 | 100 | 100 | 100 |
| Sewer Pump Stations Upgrade | 25 | 25 | 25 | 25 | 25 |
| Mt. Erima Housing Drainage | 10 | | | | |
| Sewer Flow Measurements | 20 | 25 | | | 50 |
| Joyce Bay Trunk Sewer | | 100 | 550 | 550 | |
| Joyce Bay Treatment/Outfall | | 100 | 600 | 600 | 1,200 |
| Sewer Morata Stage 2 | | 50 | | | |
| Paga Point Outfall Screens Upgrade | | 50 | 150 | 150 | 300 |
| Industrial Waste Disposal | | 100 | 150 | 150 | 150 |
| Gabutu Trunk Sewer | | | | 200 | 200 |
| Total | 370 | 1,295 | 2,320 | 2,270 | 2,370 |

Source: NCDIC, 1986

(Reference in text: page 29, para 58)

## NCDIC - PLANNED SEWERAGE DEVELOPMENT IN 1986-1990

| | 1986 | 1987 | 1988 | 1989 | 1990 |
|---|---|---|---|---|---|
| **Reticulation** | | | | | |
| Touaguba Hill - sewer area above Royal Yacht club currently served by septic tanks | X | X | X | X | |
| Boroko/Korobosea - progressively replace 34km old earthenware sewers to reduce infiltration and blockages | X | X | X | X | X |
| Other areas - progressively replace 13km-old earthenware sewers | | X | X | X | X |
| Morata Stage 2 - sewer sections still on septic tank | | X | | | |
| Minor extensions - provide for 8.4km of minor sewer extensions to connect new properties | X | X | X | X | X |
| Joyce Bay Trunk - convey all effluent from Koki, Badili, Kaugere, Gabutu to Joyce Bay | | X | X | X | |
| Gabutu Tank - convey effluent from Gabutu to Joyce Bay Trank sewer | | | | X | X |
| **Treatment** | | | | | |
| Waigani lagoons - upgrade screens, flow measurement, sanitary conditions, etc. | X | X | X | X | X |
| Paga Point Outfall - install fire screening plant to remove solids from discharge to ocean | | X | X | | |
| Joyce Bay - construct fine screening plant and ocean outfall | | X | X | X | X |
| **Pumping Stations** | | | | | |
| Upgrade, install duct vents, pump replacements | X | X | X | X | X |
| **Flow Measurement** | | | | | |
| Set up flow meter at Paga Point | X | | | | |
| Measure flow Gerehu Lagoons | | X | | | |
| Other | | | | | X |

## NCDIC - PLANNED STORMWATER DRAINAGE DEVELOPMENT IN 1986-1990

| | 1986 | 1987 | 1988 | 1989 | 1990 |
|---|---|---|---|---|---|
| Major Drains | | | | | |
| Upgrade 8km of Boroko and Waigani Creek systems | X | X | X | | |
| Minor Drains | | | | | |
| Upgrade or construct 8km minor drainage channel | X | X | X | | |

(Reference in text: page 29, para 50)

ACTUAL GOVERNMENT SOURCES OF FINANCING, 1981-1985
(In Million Kina)

| Source | 1981 Amount | % | 1982 Amount | % | 1983 Amount | % | 1984 Amount | % | 1985 Amount | % |
|---|---|---|---|---|---|---|---|---|---|---|
| Internal Revenue | 394.9 | 56 | 422.0 | 56 | 406.2 | 52 | 457.7 | 56 | 516.9 | 61 |
| Australia Budget Support | 184.1 | 26 | 198.6 | 26 | 213.3 | 27 | 232.5 | 28 | 218.2 | 26 |
| Borrowings | | | | | | | | | | |
| Commercial | | | | | | | | | | |
| Overseas | | | | | | | | | | |
| Loans | | | | | | 19.0 | | 23.4 | | |
| Concessional | | | | | | | | | | |
| Loans | | | | | | 60.8 | | 48.6 | | |
| Internal | | | | | | | | | | |
| Borrowing | | | | | | 34.8 | | 43.6 | | |
| Subtotal | 115.3 | 16 | 130.6 | 17 | 168.7 | 21 | 114.6 | 14 | 115.6 | 14 |
| Total | 694.3 | 100 | 751.2 | 100 | 788.2 | 100 | 822.8 | 100 | 850.7 | 100 |

Source: Estimates of Revenue and Expenditures, various years

(Reference in text: page 33, para 65)

EXPECTED GROWTH RATES FOR GOVERNMENT SOURCES OF FUNDS, 1986-1987
(In Million Kina; 1986 Prices)

| Nature | 1986 Amount | % | 1987 Amount | % |
|---|---|---|---|---|
| Internal Revenue | 565 | 61 | 557 | 60 |
| Australian Budget Support | 220 | 24 | 210 | 22 |
| Commercial Overseas Loans | 44 | 5 | 36 | 4 |
| Internal Borrowing | 37 | 4 | 47 | 5 |
| Grant Aid | 64 | 6 | 85 | 9 |
| Grand Total | 930 | 100 | 935 | 100 |

Source: Planning and Budgetary Strategy, Budget Document No. 1

## ACTUAL GOVERNMENT EXPENDITURES, 1981-1985
(In Million Kina)

| Nature | 1981 Amount | % | 1982 Amount | % | 1983 Amount | % | 1984 Amount | % | 1985 Amount | % |
|---|---|---|---|---|---|---|---|---|---|---|
| Sectors | | | | | | | | | | |
| Province | 72.0 | 10 | 78.0 | 10 | 90.2 | 11 | 216.4 | 26 | 215.6 | 25 |
| Infrastructure | 155.0 | 22 | 166.8 | 22 | 136.1 | 17 | 104.3 | 13 | 87.8 | 10 |
| Social Services | 109.2 | 16 | 113.2 | 15 | 89.8 | 11 | 88.4 | 11 | 102.6 | 12 |
| Law and Order | 66.5 | 10 | 66.7 | 9 | 70.9 | 9 | 91.9 | 11 | 93.8 | 11 |
| Economic | 82.8 | 12 | 73.4 | 10 | 76.8 | 10 | 65.1 | 8 | 61.3 | 7 |
| Administration | 136.4 | 20 | 152.2 | 20 | 189.9 | 24 | 90.9 | 11 | 83.7 | 10 |
| Subtotal | 622.1 | | 650.3 | | 643.7 | | 657.0 | | 644.8 | |
| Debt Service | 72.2 | 10 | 100.9 | 13 | 134.5 | 17 | 143.3 | 17 | 165.0 | 19 |
| Special Appropriations | | | | | | | 22.8 | 3 | 21.9 | |
| Grand Total | 694.3 | 100 | 751.3 | 100 | 788.2 | 100 | 822.8 | 100 | 850.7 | 100 |

Source: Estimates of Revenue and Expenditures, various years

(Reference in text: page 33, para 66)

# SCHEDULE OF LOANS
# WATER SUPPLY AND SANITATION SECTOR

| Date Approved | Bank | Name of Project | Loan Number | Loan Amount (Million) |
|---|---|---|---|---|
| URBAN WATER SUPPLY AND SEWERAGE PROJECTS | | | | |
| 11/11/76 | Asian Development Bank (ADB) | Water Supply (Lae, Mt. Hagen, Wewak) | 278-PNG (SF) | US$13.5 |
| 7/25/78 | Asian Development Bank | PNG-Second Water Supply (Madang) | 346-PNG (SF) | US$ 5.4 |
| | | | | US$18.9 |
| 4/13/83 | Kreditanstalt fuer Wiederaufbau (KfW) | KfW Water & Sewerage | 80-66-300 | DM9.2 |
| 9/29/78 | Overseas Economic Cooperation Fund | Goroka Sewerage | OECF-PN-1-1 | Y155 |
| | Overseas Economic Cooperation Fund | Wabag Water Supply | OECF PN-1-1 | Y 90 |
| 11/05/82 | Asian Development Bank | Rural Health I | 586-PNG | US$12.0 |
| 4/04/84 | Asian Development Bank | Rural Health II | 746-PNG (SF) | 8.4 |
| | | | 747-PNG | 5.4 |
| | | | | US$25.8 |

Note: As of 4 December 1986:
US$1 = Kina .97
= Deutschmarks (DM) 2.00
= Yen (Y) 163

Source: Department of Finance, Loans and International Finance Division Reports

(Reference in text: page 34, para 67)

## ACTUAL SOURCES AND USES OF FUNDS
## URBAN WATER SUPPLY AND SANITATION SECTOR, 1981-1985
(In Kina '000)

| Nature | 1981 Amount | % | 1982 Amount | % | 1983 Amount | % | 1984 Amount | % | 1985 Amount | % |
|---|---|---|---|---|---|---|---|---|---|---|
| **Receipts** | | | | | | | | | | |
| Loan Drawdowns | | | | | | | | | | |
| ADB 278 | 4,540 | | 1,870 | | | | | | | |
| ADB 346 | 1,650 | | 460 | | 850 | | 180 | | 160 | |
| KfW | | | | | | | 40 | | | |
| OECF PN-1-1 | 10 | | 30 | | | | | | | |
| OECF PN-102 | | | 11 | | | | | | | |
| Subtotal | 6,190 | 59 | 2,371 | 28 | 850 | 20 | 220 | 10 | 160 | 5 |
| Internal Receipts Cost Recovery from Customers | | | | | | | | | | |
| Waterboard Districts a/ | | | | | | | | | | |
| Undeclared Districts | | | | | | | | | | |
| Subtotal b/ | 12,859 | | 5,456 | | 1,902 | | 1,175 | | 1,117 | |
| **Disbursements** | | | | | | | | | | |
| Operations Waterboard Districts c/ | | | | | 1,264 | | 435 | | | |
| Capital Program d/ | 10,519 | | 8,249 | | 2,762 | | 1,734 | | 3,035 | |
| Debt Service | | | | | | | | | | |
| ADB 278 | 40 | | 80 | | 100 | | 110 | | 110 | |
| ADB 346 | 10 | | 20 | | 30 | | 40 | | 50 | |
| OECF PN-1-1 | 10 | | 10 | | 20 | | 20 | | 20 | |
| OECF PN-1-2 | | | 10 | | 10 | | 10 | | 10 | |
| KfW | | | | | | | 10 | | 10 | |
| Subtotal | 10,579 | 100 | 8,369 | 100 | 4,186 | 100 | 2,359 | 100 | 3,235 | 100 |
| Balance (funded from Government Internal Generation) | 2,280 | 37 | (2,913) | 63 | (2,284) | 75 | (1,184) | 59 | (2,118) | 65 |

a/ Surplus of Waterboard Receipts over Disbursements.
b/ Details not available.
c/ Deficit from Waterboard Operations.
d/ Appendix 28, page 2.

Source: Waterboard Financial Reports; Estimates of Revenues and Expenditures, various years; and Department of Finance, Loans and International Finance Division Reports.
(Reference in text: page 31, para 69)

URBAN WATER SUPPLY AND SANITATION SECTOR
EXPENDITURES FROM 1981 TO 1985
(In Kina '000)

| Project | 1981 | 1982 | 1983 | 1984 | 1985 |
|---|---|---|---|---|---|
| Waigani-Gerehu Lagoon Augmentation | | | 34.8 | 799.1 | 16.0 |
| Kimbe Water Supply | | | 1,406.0 | 39.6 | 281.3 |
| Port Moresby Water Supply & Sewerage | 1,608.1 | 1,825.2 | 220.8 | 205.1 | 1,386.8 |
| Kiunga Water & Sewerage | | | 73.4 | 81.3 | 141.6 |
| Mt. Hagen Water Supply | 2,091.9 | 1,504.9 | 251.9 | 112.3 | 61.3 |
| Lae Water Supply | 2,091.9 | 1,504.9 | 196.0 | 104.1 | 17.1 |
| Madang Water Supply | 2,091.9 | 1,504.9 | 339.9 | 140.6 | 164.1 |
| Wewak Water Supply | 2,091.9 | 1,504.9 | 178.0 | 104.1 | 34.9 |
| Popondetta Water Supply | | 34.3 | 7.7 | 0.2 | 25.3 |
| Mt. Hagen Sewerage | | | | 65.6 | 537.6 |
| Kundiawa Water Supply | | | | 40.6 | 40.4 |
| Goroka Sewerage Southwest | | | | 29.6 | |
| Bulolo Forestry Water Supply | 204.5 | 51.2 | 40.0 | 5.0 | |
| Lorengau Water Supply | 51.7 | 110.6 | 10.7 | 2.6 | |
| Arawa Sewerage Upgrade | | 135.2 | 11.2 | 3.7 | |
| Lae Sewerage | | | | | 166.2 |
| Alotau Water Supply | | | | | 119.8 |
| Samarai Water Supply | | | | | 42.6 |
| Kainantu Storage Tank | 54.5 | 3.0 | | | |
| Wabag Town Water Supply | 92.4 | 92.1 | | | |
| Arawa Water Supply | 106. | 4.3 | | | |
| Total | 10,519.4 | 8,248.9 | 2,761.8 | 1,733.5 | 3,035.0 |

Source: Planning Division, Department of Works

(Reference in text: page 34, para 69)

# RURAL WATER SUPPLY AND SANITATION EXPENDITURES FOR 1983, 1984 AND 1985
(In Kina '000)

| Province | 1983 | 1984 | 1985 |
|---|---|---|---|
| Western Province | | 34.2 | 17.7 |
| Gulf Province | 60.2 | 48.6 | 50.4 |
| Central | 60.2 | 33.7 | 40.5 |
| Milne | 41.7 | 42.2 | 39.7 |
| Oro | | | 33.7 |
| Southern Highlands | 91.6 | 42.3 | 42.1 |
| Enga | 60.0 | 53.5 | 61.0 |
| Western Highlands | | 55.1 | 50.1 |
| Simbu | 41.7 | 39.6 | 45.4 |
| Eastern Highlands | | | 58.0 |
| Morobe | 41.9 | | 31.1 |
| madang | 60.3 | 47.9 | 58.6 |
| East Sepik | 60.2 | 57.4 | 58.6 |
| Sandaun | 60.2 | 45.5 | 42.2 |
| Manus | | | |
| New Ireland | | 29.0 | 30.1 |
| East New Britain | 41.2 | 40.8 | 45.5 |
| West New Britain | 41.2 | 37.7 | 37.8 |
| North Solomons | | 38.2 | 37.0 |
| Total | 660.4 | 645.7 | 779.5 |

Source: Public Accounts for the Government of PNG, 1984 and 1985; Rural Health Program Allocation, 1983

(Reference in text: page 35, para 73)

# NATIONAL WATER SUPPLY AND SEWERAGE BOARD POLICIES FOR IMPLEMENTATION OF THE NATIONAL WATER SUPPLY AND SEWERAGE ACT 1982

PREAMBLE: Section 1 of the Act

THE PURPOSES OF THIS ACT

"The purposes of this Act are to establish a National Water Supply and Sewerage Board and to charge it with the duty of coordinated planning, design, construction, management of, and charging for, water and sewerage facilities throughout the country."

## I. GENERAL

Implementation of policy in Water Districts and Sewerage Districts will be under the direct control of the Board or its agents. In any other center, authorization from the Board is required for implementation undertaken by bodies such as National Government authorities (e.g., Department of Works, Local Government Section; Department of Works, Static Plant Section); Provincial Governments; Local Government Councils; Statutory Authorities; missions; private enterprise; etc.

## II. PARTICULAR POLICIES

### A. Board's Overall Responsibility

#### 1. Board to Extend Direct Control

The Board is to bring under its control -- through the declaration of Districts -- water and sewerage facilities as follows:

(i) nationally administered water supplies plus Port Moresby, Goroka, Arawa and Rabaul, concentrating on the larger towns first.
(ii) nationally administered sewerage facilities plus Port Moresby.

#### 2. Delegation of Rural Systems to Department of Health

In the period to 1990, water supply and sanitation facilities in rural areas will remain the primary responsibility of the Department of Health. As the Board has delegated its overall responsibility to the Department of Health, it will limit its involvement to chairing a subsidiary committee, which shall include all interested or affected parties, to coordinate policy on water supplies and sanitation in rural areas.

#### 3. Authorization to Other Bodies

Other authorities, persons, bodies, etc., may be authorized by the Board, under Sections 18(1) and 23(1) of the Act, to construct, maintain, operate and collect revenue for facilities administered by them.

(Reference in text: page 36, para 75)

4. Approvals at Each Stage

Where other authorities, persons, bodies, etc., wish to investigate, construct or operate any water supply or sanitation facility in which government (includes National, Provincial and Local Governments and Statutory Authorities) funds are involved, or in which privately developed infrastructure is to be handed over to a government body, the Board must be informed and give approvals at each stage from inception to completion.

For non-government infrastructure, the Board must be informed and give approvals as determined in each case.

B. Cost Recovery and Tariffs in Board Districts

1. Full Cost Recovery

The Board is to ensure that the full cost of urban water and sanitation facilities is recovered from users of the system. In particular, the Board will seek to achieve full cost recovery within declared water and sewerage Districts by 1990. A tariff shall be set to reflect this policy.

2. Tariffs to be Progressive

The Board will set a progressive tariff which favors consumers who use small quantities of water per connection.

3. Uniform National Tariff

The Board supports cross-subsidization between Districts in order to set a uniform national tariff.

C. Operation, Conservation and Education

1. Operation of Existing Systems

The Board is to ensure the continued operation of all existing systems in the following order:

(i) systems in declared Board Water or Sewerage Districts;
(ii) national systems operated by the Department of Works;
(iii) systems under provincial or local government administration; and
(iv) all other systems operating within the country.

D. Capital Works

1. Medium-Term Development Program (MTDP)

All submission for funding of water supply of sewerage facilities in urban areas from the MTDP shall be directed in the first instance to the Board. Such submissions will be forwarded to the Department of National Planning and Development for consideration by the

Medium Term Development Strategy (MTDS) assessment bodies according to priorities set by the Board, provided that they fall within the technical and economic criteria of the MTDS and that they fall within any overall funding request ceiling set by the National Government.

2. Appropriate Levels of Service

For augmentations and new systems the Board will seek to develop facilities through the provision of appropriate levels of service. Emphasis will be placed on simplicity, reliability and cost effectiveness consistent with quality and capacity requirements.

For sanitation requirements, the Board will consider every alternative, particularly on-site systems, and recommend the system most appropriate for a particular site.

# NATIONAL WATER SUPPLY AND SEWERAGE ACT 1982
## WATER SUPPLY AND SEWERAGE TARIFFS

Charges, Fees, Rates, from 1st July 1986

In accordance with Sections 20, 39 and 42 of the National Water Supply and Sewerage Act 1982, notice is hereby given that the following water supply and sewerage tariffs will become effective in declared Water Supply Districts and Sewerage Districts from 1st July 1986.

A. CHARGES BASED ON WATER METER READING

| | K i n a | |
|---|---|---|
| | Water Supply | Sewerage |
| | (Water Meter Readings) | |
| **Residential** | | |
| Metered (per month) | | |
| Up to 10 kiloliters - minimum charge | 2.80 min. | 0.60 min. |
| 10 to 40 cu m | 0.10 per cu m | 0.12 per cu m |
| above 40 cu m | 0.70 per cu m | 0.12 per cu m |
| For customers with rainwater tanks | not applicable | 1.50 (per 9,000 liter tank or part thereof) |
| Unmetered (per month) | | |
| Private connection | 2.80 per house | 0.60 per house |
| Public standpipe (shared) | 2.00 per house | not applicable |
| For customers with rainwater tanks | not applicable | 1.50 (per 9,000 liter tank or part thereof) |
| **Non-Commercial, Government Institutions and Related Customers** | 0.40 per cu m | 0.12 per cu m |
| **Commercial/Industrial** (incl. hydrants & vessels, etc.) | 0.45 per cu m | 0.14 per cu m |
| **Water Tankers** | | |
| Up to 10 cu m - minimum charge per tanker | 5.00 min. | not applicable |
| Above 10 cu m | 0.55 per cu m | not applicable |

Notes:
1. If the user makes a request in writing, or if the Waterboard directs, the sewerage charge shall be based on a water meter (reading) fitted to a private bore system, or other source of supply. The user shall bear the cost of installation, at cost.
2. Charges have been set on a per connection basis.
3. In the case of multiple residential buildings, such as flats, dormitories, duplexes, etc., the user may apply to be charged on the basis of the non-commercial tariff (2) above.
4. If a connection serves a mixed occupancy property, the higher tariff scale shall apply.

(Reference in text: page 37, para 76)

B. CHARGES BASED ON EFFLUENT METER READING

If the user makes a request in writing, or if the Waterboard directs, the sewerage charge shall be based on an effluent meter reading. The user shall bear the cost of installation, at cost.

| | Water Supply | Sewerage |
|---|---|---|
| | (Effluent Meter Readings) | |
| Effluent meters | not applicable | 0.075 per cu m |
| Sewerage sludge tanker discharge | not applicable | 7.50 per tanker |

C. JUNCTION/CONNECTION FEES

| | Water Supply | Sewerage |
|---|---|---|
| | (Flat Fee) | |
| New Junctions | | |
| For 15 mm (Water) and 100 mm (Sewer) diameter pipe up to 26 meters length to on meter inside the property boundary. Junctions exceeding the above will be charged at cost. The customer is responsible for the cost of connecting to the building from the property boundary. | 125.00 per junction | 500.00 per junction |
| Supervision Fee | | |
| In full cost of the installation of the junction is borne by the customer, a supervision fee only will be charged. | 5.00 per junction | 20.00 per junction |

C. JUNCTION/CONNECTION FEES (cont'd)

| | Water Supply (Flat Fee) | Sewerage (Flat Fee) |
|---|---|---|
| **Reconnection** | | |
| Where supply has not been disconnected (e.g., change of tenancy only). | 5.00 | not applicable |
| Where supply had been disconnected and water meter removed. | 25.00 | not applicable |
| **Temporary Connection** | | |
| To metered hydrant, etc. | 25.00 per connection plus meter reading | not applicable |

All fees and charges become due and payable 14 days after publication of the tariff in the National Gazette. Fees foe new junctions and reconnections and any other charges to customers who do not have an approved account must be paid in advance. All other charges must be paid within 30 days after the date of delivery of an account. Failure to pay accounts within the stipulated period will lead to service being discontinued and recovery action being taken. The user of the service is responsible for paying bills or for ensuring that they are paid.

## PROPOSED TARIFF FOR 1986 TO 1990
(Charges only; in current terms)

| Description | Unit | 1985 | 1986 | 1987 | 1988 | 1989 | 1990 |
|---|---|---|---|---|---|---|---|
| Discount Rate | % | 0 | 1 | 2 | 3 | 4 | 5 |
| DWPC a/ in real 1985 terms | k/cu m | 0.45 | 0.48 | 0.51 | 0.54 | 0.57 | 0.61 |
| DSDC b/ in real 1985 terms | k/cu m | 0.10 | 0.11 | 0.12 | 0.13 | 0.15 | 0.17 |
| Assumed Inflation Rate | % | n.a. | 5.0 | 5.5 | 6.0 | 6.5 | 7.0 |
| DWPC in nominal terms | k/cu m | 0.45 | 0.50 | 0.56 | 0.63 | 0.71 | 0.82 |
| DSDC in nominal terms | k/cu m | 0.10 | 0.12 | 0.14 | 0.16 | 0.19 | 0.23 |
| Proposed Water Supply Tariff | | | | | | | |
| Residential Tariff | | | | | | | |
| - up to 10 cu m | k | 2.50 | 2.80 | 3.10 | 3.50 | 3.90 | 4.50 |
| - up to 25 cu m | k/cu m | 0.45 | 0.50 | 0.55 | 0.65 | 0.70 | 0.80 |
| - above 25 cu m | k/cu m | 0.65 | 0.70 | 0.80 | 0.90 | 1.05 | 1.20 |
| Institutional Tariff | k/cu m | 0.45 | 0.50 | 0.55 | 0.65 | 0.70 | 0.80 |
| Commercial/Industrial Tariff | k/cu m | 0.55 | 0.60 | 0.70 | 0.80 | 0.90 | |
| Proposed Sewerage Tariff | | | | | | | |
| Residential Tariff | | | | | | | |
| - up to 10 cu m | k | 0.50 | 0.60 | 0.70 | 0.80 | 0.95 | 1.15 |
| - 10 to 25 cu m | k/cu m | 0.10 | 0.12 | 0.14 | 0.16 | 0.19 | 0.23 |
| - above 25 cu m | k/cu m | 0.15 | 0.18 | 0.21 | 0.24 | 0.29 | 0.35 |
| Institutional Tariff | k/cu m | 0.10 | 0.12 | 0.14 | 0.16 | 0.19 | 0.23 |
| Commercial/Industrial Tariff | k/cu m | 0.12 | 0.14 | 0.17 | 0.19 | 0.23 | 0.28 |

a/ Dynamic Water Production Costs.
b/ Dynamic Sewerage Disposal Costs.

## COMPARISON BETWEEN PROPOSED AND IMPLEMENTED TARIFF

| Consumer Type | Unit of Measure | | Water | | | Sewerage | | |
|---|---|---|---|---|---|---|---|---|
| | P | I | P | I | % | P | I | % |
| Residential | | | | | | | | |
| Metered | up to 10 | same | 2.80 | same | | 0.60 | same | |
| | 10–25 cu m | | 0.50 | 0.40 | 20 | 0.12 | same | |
| | | 26–40 cu m | 0.70 | 0.40 | 43 | 0.18 | 0.12 | 33 |
| | above 40 cu m | | 0.70 | 0.70 | | | | |
| Residential | | | | | | | | |
| Unmetered | | | | | | | | |
| Private | | | | | | | | |
| Connection | n.a. | per house | n.a. | 2.80 | n.a. | 0.60 | | |
| Public Standpipe | n.a. | per house | n.a. | 2.00 | n.a. | n.a. | | |
| Rainwater Tanks | n.a. | per 9,000 liters | | | n.a. | 1.50 | | |
| Institutional | k/cu m | same | 0.50 | 0.40 | 20 | 0.12 | same | |
| Commercial | k/cu m | same | 0.55 | 0.45 | 18 | 0.14 | same | |
| Water Tankers | n.a. | up to 10 | 5.00 | n.a. | | | | |
| | | above 10 | 0.55 | n.a. | | | | |

n.a. - Not Available.
P - Proposed Rates per GITEC Study.
I - Implemented Rates.
% - % Reduction of GITEC Proposed Tariff.

(Reference in text: page 37, para 77)

## COMPARISON OF TARIFF AMONG DIFFERENT CATEGORIES OF CONSUMERS

| | Per Cu M | Factor |
|---|---|---|
| Residential | | |
| First 10 cu m 0.28 | | |
| Next 10-40 cu m 0.40 | | |
| Above 40 cu m 0.70 | | |
| Mid-Rate for Comparison Purposes | 0.40 | 1.00 |
| Non-Commercial, Government Institutions and Related Customers | 0.40 | 1.00 |
| Commercial/Industrial | 0.45 | 1.13 |

(Reference in text: page 37, para 77)

NATIONAL WATER SUPPLY AND SEWERAGE BOARD

BUSINESS PAPER

| | | | |
|---|---|---|---|
| Meeting No. | : 33 | Agenda Item | : 5.4 |
| Meeting Date | : 5th June 1986 | File | : 24/25-60-01 |

SUBJECT: WATERBOARD POLICY FOR CONNECTIONS TO WATER SUPPLY AND SEWERAGE SYSTEMS

Purpose:

To establish a policy for making connections to water supply and sewerage systems.

Discussions:

A policy is needed for carrying out connections particularly with new water supply and sewerage schemes. A draft is attached for discussion. This was submitted in a different format at the Board Meeting No. 32 of 27th February and comments invited from Board members.

Recommendation:

That Board members consider the draft and provide guidelines for further action.

R. M. LEGGETT
Executive Engineer Operations

I. B. POWELL
General Manager

# POLICY FOR WATER SUPPLY CONNECTIONS

## Notes to be Read in Conjunction with Diagram

1. An application form is to be completed, signed and returned to the Waterboard together with the fee (if any) prior to commencement of any work.

2. Where the owner requests the District Manager to carry out work at his/her cost an estimate of the cost is provided by the District Manager and is paid for in full before work commences. Work may also be carried out under contract if convenient or by an approved private contractor at the owners' own arrangement.

3. All internal plumbing is to be inspected and repaired if necessary before a connection is carried out.

4. Private work must be approved at all stages by the Waterboard Water Engineer/District Manager and the appropriate fees paid in advance.

5. Water mains and junctions are normally located in a road or drainage reserve (junction extended to 1 meter inside property). Where located within the allotment served, the junction will be extended 1 meter from the water main in a location that will allow connection to the building or standpipe.

6. In low-cost housing areas where a building connection is not proposed, a standpipe will be provided 1 meter inside the boundary and included as part of the junction.

7. For new systems and extensions to reticulation systems carried out by the Waterboard, water meters shall be provided under the contract and delivered to the store. Waterboard will install meters and turn on the water when all other conditions of connection have been complied with.

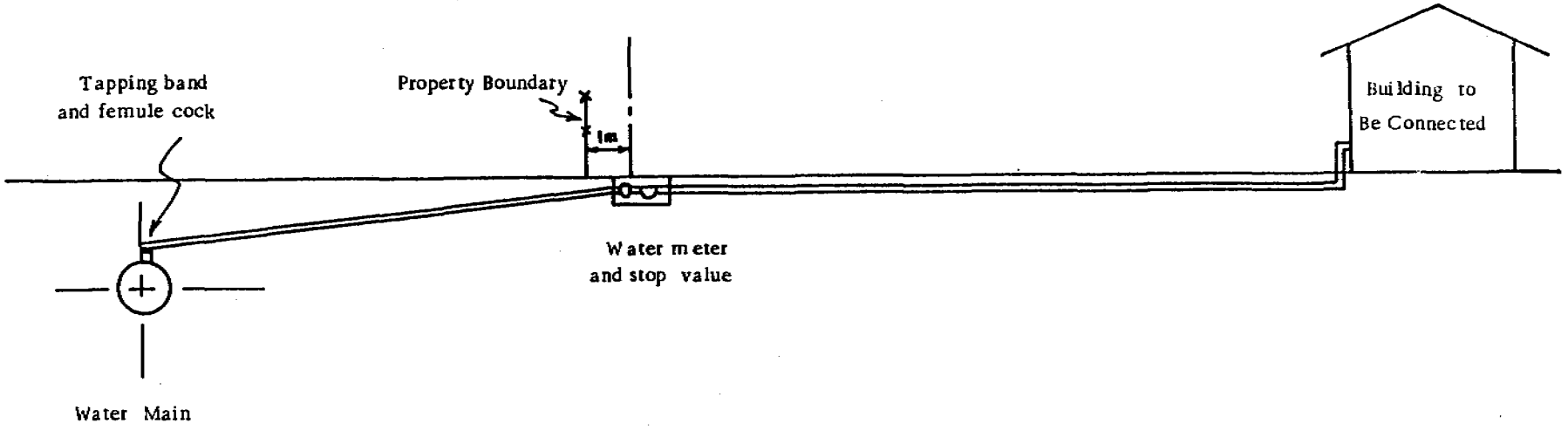
8. where the land is not formally subdivided into allotments (e.g., institutional properties, urban villages, informal settlements, etc.) community standpipes will be constructed provided an individual, leader of a group, etc., completes, signs and returns an application form to the District Manager. Water points shall be determined by the Design Engineer for each situation and the rules for junctions apply. Standpipes may be shared or private.

9. Junction requirements to vacant lots to be assessed at design stage by the Engineer. Generally junctions will be constructed under the Contract if the land is subdivided and that there is a likelihood of a building being constructed within two years.

10. The c cates who pays for and carries out various parts of the conr k -- "a" refer to before closing date set by Waterboard and s to after the closing date. This date is set for new pr ng constructed.

11. c properties include all Departments directly funded under nal Government Budget but excludes Local Government , Government Business ARms, Statutory Authorities, etc.

| | | | | |
|---|---|---|---|---|
| Government Properties | a | Work Done and Funded Under Contract | Work Done and Funded Under Contract | Department |
| | b | Work Arranged by Waterboard - Junction Fee Applies | Work Arranged and Paid for by Department | |
| All Other Properties | a | Work Done and Funded Under Contract - (Max. 26m. in length) | Work Done and Funded Under Contract - (for pipes up to 15 mm ø and 25 m. in length) | Owner |
| | b | Work Arranged by Waterboard - Junction Fee Applies | Work Arranged and Paid for by Owner | |
| Section of Sewer Main | | Junction | Building Connection | Internal Plumbing |




Policy for Connecting into a Watermain in Waterboard Water Districts
(To be read in conjunction with attached notes)

# POLICY FOR SEWER CONNECTIONS

## Notes to be Read in Conjunction with Diagram

1. An application form is to be completed, signed and returned to the Waterboard together with the fee (if any) prior to commencement of any work.

2. Where the owner requests the District Manager to carry out work at his/her cost an estimate of the cost is provided by the District Manager and is paid in full before work commences. Work may also be carried out under contract if convenient or by an approved contractor at the owners' own arrangement.

3. Private work must be approved at all stages by the Waterboard Sewerage Engineer/District Manager and the appropriate fees paid in advance.

4. Sewer mains and junctions are normally located in a road or drainage reserve (junction extended to 1 meter inside property). Where located within the allotment served, the junction will be extended 1 meter from the sewer main in a location that will allow connection from the building.

5. Junction requirements to vacant lots to be assessed at design stage by the Engineer. Generally junctions will be constructed under the Contract if the land is subdivided and that there is a likelihood of a building being constructed within two years.

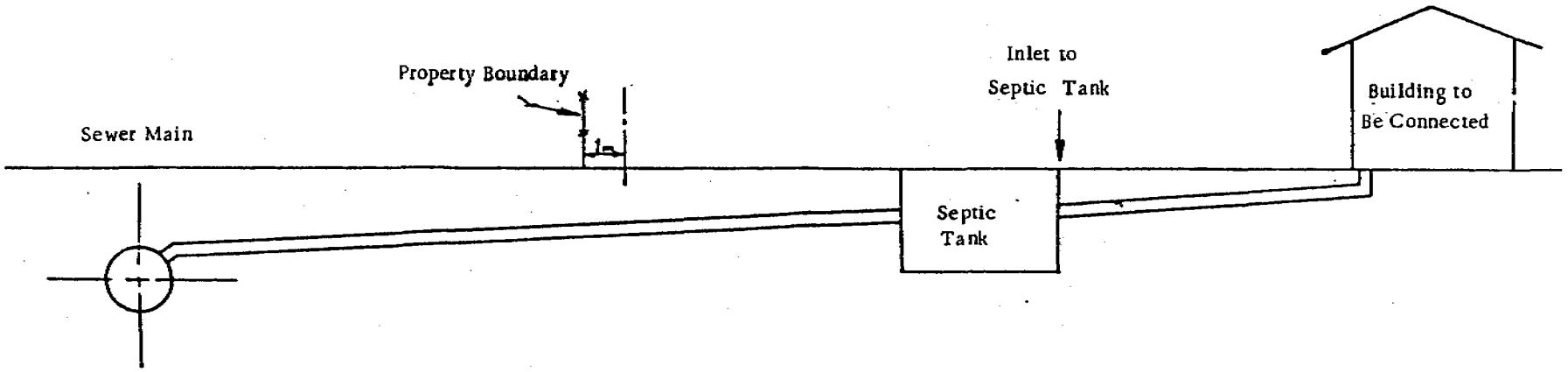
6. Where the land is not formally subdivided into allotments (e.g., institutional properties, urban villages, informal settlements, etc.), the sewer main will terminate at a position to be determined by the Design Engineer.

7. The chart indicates who pays for and carries out various parts of the connection work -- "a" refers to before closing date set by Waterboard and "b" refers to after the closing date. This date is set for new projects being constructed.

8. Government properties include all Departments directly funded under the National Government Budget but exclude Local Government Councils, Government Business Arms, Statutory Authorities, etc.

| | | | | |
|---|---|---|---|---|
| Government Properties | a | Work Done and Funded Under Contract | Work Done and Funded Under Contract | Department |
| | b | Work Arranged by Waterboard - Junction Fee Applies | Work Arranged and Paid for by Department | |
| All Other Properties | a | Work Done and Funded Under Contract - Sewers up to 26 m. in length | Work Done and Funded Under Contract - Sewers up to 25 m. in length | Owner |
| | b | Work Arranged by Waterboard - Junction Fee Applies | Work Arranged and Paid for by Owner | |

| | | | |
|---|---|---|---|
| Section of Sewer | Junction (1) | Connection - Septic Tank (2a) | Septic Tank to Building (2b) |
| | | Connection - Building (2) | Internal Plumbing (3) |




Policy for Connecting into a Sewer Main in Waterboard Sewerage Districts
(To be read in conjunction with attached notes)

# PROPOSED NEW WATERBOARD DISTRICTS

| Districts | Type | 1986 | 1987 | 1988 | 1989 | 1990 | 1991-2019 |
|---|---|---|---|---|---|---|---|
| Mt. Hagen | S | X | | | | | |
| Kimbe | WS | X | | | | | |
| Kiunga | WSS | | X | | | | |
| Port Moresby | WSS | | X | | | | |
| Arawa and Kieta | WSS | | X | | | | |
| Goroka and Kainatu | WSS | | X | | | | |
| Kundiawa | WS | | X | | | | |
| Alotau | WS | | | X | | | |
| Popondetta | WSS | | | X | | | |
| Daru | WS | | | | X | | |
| Kavieng | WS | | | | X | | |
| Wabag | WS | | | | X | | |
| Lorengau | WS | | | | | X | |
| Rabaul | WS | | | | | X | |
| Angoram | n.a. | | | | | | X |
| Balimo | n.a. | | | | | | X |
| Bulolo | n.a. | | | | | | X |
| Kieta | n.a. | | | | | | X |
| Kokopo | n.a. | | | | | | X |
| Kupiano | n.a. | | | | | | X |
| Kwikila | n.a. | | | | | | X |
| Laiagam | n.a. | | | | | | X |
| Malalaua | n.a. | | | | | | X |
| Mumen | n.a. | | | | | | X |
| Namatanai | n.a. | | | | | | X |
| Vanimo | n.a. | | | | | | X |
| Vau | n.a. | | | | | | X |

Notes:
S - Sewerage
WS - Water Supply
WSS - Water Supply and Sewerage
n.a. - Information Not Available

(Reference in text: page 39, para 81)

## ESTIMATED WATER PRODUCTION AND SEWAGE DISPOSAL COSTS

(Kina/cu m; at 1985 constant prices)

| | Recurrent Water Production Costs | Number of Connections |
|---|---|---|
| Lae | 0.16 | 4,553 |
| Madang | 0.47 | 833 |
| Wewak | 0.32 | 1,035 |
| Mt. Hagen | 0.47 | 840 |
| Kimbe | 0.36 | 618 |
| Kundiawa | 0.96 | 333 |
| Kiunga | 0.68 | 153 |
| Port Moresby | 0.14 | 16,000 |
| Arawa | 0.19 | 2,688 |
| Goroka | 0.23 | 1,929 |
| Popondetta | 0.31 | 756 |
| Alotau | 0.33 | 575 |
| Daru | 0.41 | 2,196 |
| Wabag | 1.16 | 396 |
| Kavieng | 0.28 | 856 |
| Lorengau | 0.35 | 245 |
| Rabaul | 0.29 | 627 |
| Average | 0.26 | |

| | Recurrent Sewerage Disposal Costs |
|---|---|
| Lae | 0.03 |
| Mt. Hagen | 0.12 |
| Kiunga | 0.13 |
| Port Moresby | 0.03 |
| Arawa | 0.02 |
| Goroka | 0.08 |
| Rabaul | 0.05 |
| Average | 0.04 |

Notes: 1. Costs based on GITEC Tariff Study.
2. Number of Connections based on actual figures for present Waterboard Districts, and based on figures provided in the Scott and Furphy Prefeasibility Study, for future Waterboard Districts.

(Reference in text: page 39, para 81)

# LIST OF CONSULTING ENGINEERS IN PAPUA NEW GUINEA

| | |
|---|---|
| Agonia Binnie Consultants Pty. Ltd. | |
| Binnie & Partners (PNG | |
| P.O. Box 7894, Boroko | 251725, 256070 |
| Arup Australia International Pty. Ltd. | |
| Ove Atup & Partners Pacific Pty. Ltd. | |
| P.O. Box 1594, Port Moresby | 214918, 214397 |
| P.O. Box 2193, Lae | 421229 |
| P.O. Box 2141, Rabaul | 922465 |
| Beca Guire (PNG) Pty. Ltd. | |
| P.O. Box 1720, Boroko | 256059, 256544 |
| Camp Scott Furphy Pty. Ltd. | |
| Scott & Furphy Engineers Pty. Ltd. | |
| Rendel Scott Furphy | |
| P.O. Box 1071, Boroko | 258044, 253075 |
| Cameron, McNamara, Kramer Pty. Ltd. | |
| Waigani Drive, Port Moresby | 256033 |
| Cardino & Davies PNG Pty. Ltd. | |
| P.O. Box 319, Port Moresby | 212278, 212275, 212244 |
| P.O. Box 673, Goroka | 722796 |
| P.O. Box 1824, Lae | 423097 |
| Frame Harvey & West | |
| P.O. Box 1789, Boroko | 256288, 256341 |
| T. I. Kias Pty. Ltd. | |
| P.O. Box 2140, Boroko | 260843 |
| Maunsel Consultants PNG | |
| P.O. Box 809, Port Moresby | 219555 |
| Reg. Connors & Associates Pty. Ltd. | |
| P.O. Box 7080, Boroko | 213644, 213645 |
| Willing & Partners Pte. Ltd. | |
| P.O. Box 1826, Boroko | 254606, 255084 |
| P.O. Box 602, Madang | 823139 |
| P.O. Box 210, Rabaul | 921949 |

(Reference in text: page 41, para 84)

## LIST OF MANAGEMENT CONSULTANTS IN PAPUA NEW GUINEA

| | |
|---|---|
| Coopers & Lybrand | |
| P.O. Box 484, Port Moresby | 211500, 258644 |
| P.O. Box 1156, Atawa | 951355 |
| P.O. Box 451, Goroka | 921177 |
| P.O. Box 451, Lae | 422644 |
| P.O. Box 1, Madang | 822573 |
| P.O. Box 191, Mendi | 591111 |
| P.O. Box 622, Mount Hagen | 521092 |
| P.O. Box 497, Rabaul | 922322 |
| P.O. Box 312, Wewak | 862692 |
| Econsult (PNG) Pty. Ltd. | |
| P.O. Box 608, Port Moresby | 254125 |
| Haugie John & Associates Pty. Ltd. | |
| P.O. Box 1788, Boroko | 252146, 252189 |
| Luke Manage Services | |
| P.O. Box 746, Madang | 823030 |
| Niugini Research & Development Co. Pty. Ltd. | |
| P.O. Box 1662, Lae | 421091 |
| Pacific Management Services | |
| P.O. Box 1103, Boroko | 254682 |
| Peat Marwick, Metchell | |
| P.O. Box 874, Goroka | 711010, 721935, 721019 |
| P.O. Box 1226, Lae | 421811, 424943, 423530 |

## BUILDING CONSULTANT IN PAPUA NEW GUINEA

| | |
|---|---|
| Rider Hunt & Partners | |
| Daugo Drive, Tuaguba | 213891 |

(Reference in text: page 41, para 85)

# LIST OF CONTRACTORS IN PAPUA NEW GUINEA

| | Telephone Nos. |
|---|---|
| **Boring and Drilling Contractors** | |
| Seiscom Delta United<br>P. O. Box 108, Madang | 822411 |
| New Guinea Water Drillers Pty. Ltd.<br>P. O. Box 871, Lae | |
| **Building Contractors** | |
| Barclay Bros. (PNG) Pty. Ltd.<br>P. O. Box 1180, Boroko, NCD | 255711 |
| Bodiam (PNG) Pty. Ltd.<br>Curtis Street | 256844 |
| Brush and Hammer Constructions and Consultants<br>Varahe Road, Gordons, Port Moresby | 252097, 252048 |
| Enpien Builders<br>P. O. Box 201, Boroko, NCD | |
| Hebou Constructions (PNG) Pty. Ltd.<br>P. O. Box 6207, Boroko, NCD | 253077 |
| Hornibrook Construction Pty. Ltd.<br>P. O. Box 1396, Konedabu, NCD | 211892 |
| Madaka Constructions Pty. Ltd.<br>Ahuia Street, Hohola, Port Moresby | 253519 |
| Michel Constructions Pty. Ltd.<br>P. O. Box 9083, Hohola, NCD | 255470, 256813 |
| Miland Investments Pty. Ltd.<br>P. O. Box 1442, Boroko, NCD | 256280, 257127 |
| Morobe Constructions Pty. Ltd.<br>Saraga Street, 6-Mile, Port Moresby | 253144 |
| NPN Constructions Pty. Ltd.<br>P. O. Box 40, Gerehu, NCD | 260285 |
| Roma Construction Pty. Ltd.<br>P. O. Box 139, Badili, NCD | 258193 |
| E. T. Taylor Constructions Pty. Ltd.<br>P. O. Box 660, Boroko, NCD | 254944, 251075 |

(Reference in text: page 42, para 86)

| | Telephone Nos. |
|---|---|
| **Building Contractors (cont'd)** | |
| Tolken Building Pty. Ltd.<br>P. O. Box 7397, Boroko, NCD | 254362 |
| **Civil Engineering Contractors** | |
| Atlas Plant Hire Pty. Ltd.<br>P. O. Box 5054, Boroko, NCD | 261111 |
| Fletcher Constructions (PNG) Pty. Ltd.<br>P. O. Box 848, Port Moresby, NCD | 253144 |
| Star Earthmoving and Construction Pty. Ltd.<br>P. O. Box 6961, Boroko, NCD<br>P. O. Box 318, OK Mine Site, Tabubil | 255054<br>589039 |
| C. J. Constructions (PNG) Pty. Ltd.<br>P. O. Box 688, Wewak | 862355 |
| C & M Plant Hire Pty. Ltd.<br>P. O. Box 250, Lae | 457240, 457417, 457096 |
| Hornibrook Constructions Pty. Ltd.<br>P. O. Box 1396, Boroko, NCD<br>P. O. Box 1812, Lae<br>P. O. Box 106, Madang<br>P. O. Box 753, Arawa | 253099<br>424266<br>822672<br>951897 |
| **Earthmoving Contractors** | |
| Arama Transport Pty. Ltd.<br>P. O. Box 9171, Hohola | 258183, 258315, 258353 |
| Atlas Plant Hire Pty. Ltd.<br>P. O. Box 5054, Boroko | 261111 |
| INDTRAC<br>P. O. Box 75, Port Moresby | 217036 |
| Ambesugi Earthmoving Co. Pty. Ltd.<br>P. O. Box 955, Madang | 822676, 822233 |
| AMRI Transport Pty. Ltd. | 822836 |
| C & M Plant Hire Pty. Ltd.<br>P. O. Box 350, Lae | 457240, 457417, 457096 |
| Hagen Aggregates Pty. Ltd.<br>P. O. Box 676, Mt. Hagen | 551300 |

| | Telephone Nos. |
|---|---|
| **Earthmoving Contractors (cont'd)** | |
| Jimi Earthmoving Contractors Pty. Ltd.<br>P. O. Box | |
| Mendi Motors Pty. Ltd.<br>P. O. Box 226, Mendi | 591094 |
| Nuigini Earthmoving Pty. Ltd.<br>P. O. Box 70, Wewak | 8626663 |
| Pangia Construction Group Pty. Ltd.<br>P. O. Box 152, Mt. Hagen | 521344 |
| Paragon Earthmoving<br>P. O. Box 893, Goroka | 722892 |
| PNG Contractors Pty. Ltd.<br>P. O. Box 380, Lae | 422148, 421583 |
| W & R Parer Pty. Ltd.<br>P. O. Box 3, Aitape | 872015 |
| Sikapi Contractors Pacific Pty. Ltd.<br>P. O. Box 647, Goroka | 823095, 822527, 722838 |
| Tangin Drilling Pty. Ltd.<br>P. O. Box 148, Kundiawa | 751012 |
| Tansearth Pty. Ltd.<br>P. O. Box 166, Kundiawa<br>P. O. Box 367, Goroka | 751085<br>722976 |
| Earthmovers Pty. Ltd.<br>P. O. Box 42, Kieta | 956161 |
| Bismark Earthmoving Co. Pty. Ltd.<br>P. O. Box 227, Kieta | 856239 |
| Logging and Trading Co. Pty. Ltd.<br>P. O. Box 392, Kimbe | 935229 |
| **Fencing Contractors** | |
| Arc Titan Pty. Ltd.<br>P. O. Box 1026, Lae<br>P. O. Box 804, Port Moresby | 457111<br>217712 |
| Sefco Pty. Ltd.<br>P. O. Box 1665, Port Moresby | 257777 |

| | Telephone Nos. |
|---|---|
| **Hire Contractors** | |
| Acrow-Carpenter (PNG) Pty. Ltd.<br>P. O. Box 1068, Boroko, NCD | 217657, 217414 |
| Atlas Plant Hire Pty. Ltd.<br>P. O. Box 5054, Boroko, NCD | 261111 |
| Crosbies Hire Service<br>P. O. Box 1063, Boroko, NCD | 255010 |
| Niugini Earthmoving Pty.<br>P. O. Box 70, Wewak<br>P. O. Box 103, Maprik | 862666<br>891313 |
| PNG Contractors Pty. Ltd.<br>P. O. Box 380, Lae | 421583, 422148 |
| Transearth Pty. Ltd.<br>P. O. Box 166, Kundiawa | 751085 |
| Arawa Hire and Engineering Services Pty. Ltd.<br>P. O. Box 1151, Arawa | 951434, 951777 |
| Garom Pty. Ltd.<br>P. O. Box 313, Rabaul | 922044, 922479 |
| **Pile-Driving Contractors** | |
| Frankpile Australia Pty. Ltd.<br>P. O. Box 2, Hamilton Central Queensland | (807) |
| **Pipeline Contractors** | |
| Atlas Plant Hire Pty. Ltd.<br>P. O. Box 5054, Boroko, NCD | 261111, 353957 |
| **Road Contractors** | |
| Finschhafen Kabwun Construction Pty. Ltd.<br>P. O. Box 177, Finschhafen | 447060 |
| Nawae Constructions Pty. Ltd.<br>Butibun Road, Lae<br>Port Moresby | 422087<br>258949 |
| Shoranliff (PNG)<br>P. O. Box 1554, Lae | 457444 |
| Totima Constructions Pty. Ltd.<br>P. O. Box 387, Lae | 457141 |

## LIST OF MANUFACTURERS AND SUPPLIERS USED BY THE WATERBOARD

| | |
|---|---|
| A. F. Martin & Sons Ltd. | Palmerston, North New Zealand |
| Arc Titan Pty. Ltd. | P.O. Box 1026, Lae |
| Armco (PNG) Pty. Ltd. | P.O. Box 845, Lae |
| J. Blakeborough & Sons Ltd. | Brighouse, England |
| Daikin Pty. Limited | c/o PNG Motors, Lae |
| Danco New Zealand Ltd. | P.O. Box 21-475, Henderson New Zealand |
| Dimet International | Doonside, NSW Australia 2767 |
| Dulux PNG Pty. Ltd. | P.O. Box 578, Lae |
| Eureka Valve Co. | Ballarat, Victoria Australia |
| Lockwood Perry (PNG) Pty. Ltd. | P.O. Box 752, Lae |
| Lockwood Perry/Am Bisley & Co. Ltd. | Palmerston North, New Zealand |
| George Kent (Malaysia) Berhad | P.O. Box 1100, Petaling Jaya, Malaysia |
| Gillies Foundry & Engineering Co. | New Zealand |
| Hornibrook Constructions Pty. Ltd. | P.O. Box 1396, Boroko |
| James Hardie & Co. Pty. Ltd. | P.O. Box 12-070 Penrose, Auckland, NZ |
| John Holland (Constructions) | 435 Coronation Drive, Auchenflower Qld. |
| Kent Meters Ltd. | Pondwicks Road Luton, England |
| Lysaght PNG Pty Ltd. | P.O. Box 872, Lae |
| Metz & Co. Pty | P.O. Box 100, Mt. Waverley, Victoria 3149 |
| Miyairi Valve Mfg. Co. | Japan |
| Monier PNG Ltd. | P.O. Box 378, Lae |
| Neptune Glenfield Ltd. | Low Glencairn St., Kilmarnock Scotland |

(Reference in text: page 42, para 89)

| | |
|---|---|
| NGI Pty Ltd. | P.O. Box 92, Lae |
| New Zealand Steel Limited | New Zealand |
| Readymix Concrete | P.O. Box 755, Lae |
| Sathask Draim Co. Ltd. | GPO Box 1145, Bangkok, Thailand |
| Shorncliffe PNG Pty Ltd. | P.O. Box 1554, Lae |
| Spiral Welded Pipes Limited | New Zealand |
| Tru-cast Stoves Pty Ltd. | P.O. Box 160, Lae |
| William Boby & Co. Ltd. | 44 Koornang Road, Scoresby Victoria |
| Winstone Plastics Ltd. | P.O. Box 846, Palmerston North, NZ |
| WRA Barber Ltd. | P.O. Box 547, Palmerston North, NZ |

# SOME CULTURAL ASPECTS OF WATER SUPPLY AND SANITATION IN PNG

Very little information is available about the influence of tradition and culture on water usage and on excreta disposal in rural areas of PNG. This Appendix contains extracts from some publications describing work carried out by nationals of this country, mostly students of Anthropology or Sociology at the University of Papua New Guinea.

A. Extracts from the "Report on Chivasing Village Blair hand pump water supply: An evaluation study on water usage and health impact". By John D. Maru and Joseph N. Klapat. 1986. Social Work Programme, Department of Anthropology and Sociology, University of Papua New Guinea.

"Chivasing village is the biggest village in the Wampar Zone of the Lae District. It has a population of 923 -- from the 1980 census .... The households are scattered along the roadside and farther away from the Highlands highway. People are living in hamlets of family groups."

1. Water Usage Pattern

The Rumu river is the main river system used by the people of Chivasing village. The river is used almost for all purposes -- body washing, clothes washing, washing of cookwares and also for other purposes like washing vehicles or animals.

At the side of the river, women dig holes to collect filtered water because the main river system is dirty at all times and it is believed that the river is polluted upstream by the people living farther up.

The clear water collected is mainly used for cooking food and drinking .... The river is also used by those who use the pumps.

In the area ... 15 households have tanks. The tank water is used for cooking and drinking. In the school and the police station, tank water is also used for washing clothes, body and cookwares ....

Otherwise, most of the other purposes are catered for by the main river. During the dry season tank water is strictly used for drinking and cooking only.

Many households with iron roofs have drums. These drums are used during rainy season to collect water. This water is used for cooking food and drinking.

There are about four creeks and two springs, these sources are used for al purposes -- drinking, cooking, washing clothes and cookware and washing body .... If the creeks dry up in the dry season, people depend on the pumps for water.

Chivasing has about 14 pumps -- 5 Blair pumps and 9 others.

The water from the blair pumps is used almost for all purposes except for washing body and clothes .... The same applies to other pumps. Otherwise, washing clothes and body is done in the river.

Talking to people using the Blair pumps, we learned that there was no private ownership of these pumps. The pumps are felt to be owned by the community. with the other types of pumps, there is a certain degree of private ownership because the persons or families who owned the pumps actually bought the pumps themselves. There are also committees to cater for the pumps and to collect taxes which are used for the maintenance costs of the pumps. The other sources such as the river and creeks do not seem to have any private ownership.

The time taken by the users to travel to the nearest pump ranged from 1 to 5 minutes. The time taken for users of river ranged from about 1 to 30 minutes.

2. Sanitation Practices

From the observations and interviews, we learned that almost 100 per cent of the population have no toilets. They use the surrounding bushes as toilets. The reason for this is not known but according to the Aid Post Orderly, the people fear that they might get killed by sorcerers when using toilets.

The animals run loose in the village and in the morning the village is strewn with their droppings. We strongly recommend that the people should be encouraged to build toilets and put the pigs and chickens in a fenced area.

3. Conclusions

Despite the introduction of Blair hand pumps and other pumps, the village life has not changed very much. People still prefer the other water sources. This could be because people are not aware of the advantage of using the hand pumpwater supply .... The use of water pumps is circumstantial. The pumps are heavily used when there is immediate need for water.

B. Extracts from the "Hand pump installation and testing in the Makham Valley: An evaluation study on social and cultural aspects". 1985, by Rosa Aimo, Aiffe Mionzing and Osila Teko, Social Work Programme, Department of Anthropology and Sociology, University of Papua New Guinea.

1. Naroparap Settlement

The estimated population of Naroparap settlement is 80 persons and the size of the households range from 5-8 persons.

Respondent in Naroparap stated that they do not collect water from sources such as creeks for cooking and drinking, since the pump was installed. But they do use the creek which is about 8 minutes walk for washing clothes, utensils and for bathing. At times water from the pump is used for washing utensils, food stuff and personal washing. Such activities are done some distances away from the pump site.

All users of the pump (PNG Blair hand pump) stated that they had difficulties when using the pump. Most of them claimed that the pump is too heavy to lift when pumping and often led to arm and back aches.

The surrounding of the handpump looks clean and well kept, the whole community is responsible for the cleanliness of the pump site.

2. Noa Camp

The estimated population (of Noa Camp) is 260, and the size of their households range from 5-10 persons. There are 15 households using the pump.

The time taken to walk from the closet household to the pump site is 1 minute and the farthest is about 3 minutes.

Three respondents said that, apart from using the pump they sometimes collected water from the creek which is about an hour's walk, mainly to have a change of taste after drinking water from the pump most of the time. Water collected from the creek is used only for cooking and drinking.

The pump site looks clean and tidy, and users are asked to keep the area around the pump neat and tidy.

3. Gabsongkek Village

One of the largest villages in the Makham Valley has a total population of 632 according to the 1980 National Population Census. The villagers are subsistence farmers, mostly earning income from selling betelnuts and bananas.

We found that only 24 households use the water pump. Other source like creek, which is 1-2 minutes' walk, is still used for laundering and bathing.

Respondents also indicated that the pump water is sweet and cleaner than the creek even though some still use it for drinking purposes. Couple who own tanks said that they prefer to drink water from the tanks because it is cleaner and tastes better than water from the pump.

4. Major Findings

Additional to the above-mentioned problems (location of pump, taste of water and difficulties in using the pump) that we have discovered this year are lack of participation by people and lack of communication between the monitoring agencies. And the caretakers of water pumps especially concerning the maintenance of the pump ....

... caretakers of the pumps ... become owners of the pumps and, thus, it restricts the others from using them ....

There is also the problem of lack of participation from the community concerned with the pumps .... Before the pumps were installed people were not consulted on where to install the pumps, were not involved in any planning or decision making concerning handpumps maintenance and choosing of caretakers. The authorities concerned just went ahead and installed the pumps beside the old pumps and as a result others are restricted from using the pumps.

5. Distribution of Benefits

... important point to consider is that when the pumps were installed into private land or near somebody's house, the person in charge of those properties tend to claim ownership over the water pumps. In doing so he restricts many others from using the pump.

C. Extracts from "Freshwater Supplies, Past and Present in Lese Oalai, a Gulf Province Village" by Chris Haiveta of Institute of Applied Social and Economic Research, Port Moresby.

Lese Oalai ... population is approximately 800, of whom more than 50 per cent are absent. The village is predominantly Catholic, with a community school, an aid post, an airstrip and three trade stores. The majority of villagers supplement subsistence production with cash income, from copra-making and selling fish, crabs, shellfish, surplus garden goods and betelnut. Remittances from absent relatives in wage employment in towns around the country contribute a significant part of the total income of some villagers.

1. Traditional Perceptions, Rights of Access to Sources and Ownership of Water

In traditional Moripi society people believe water had been in existence since the beginning of time.

There were three main sources of fresh water in traditional times. River water was fetched from the Miaru and Kapure rivers during trips for sago-making; water was also obtained from wells around or near the village; and rain water was collected from thatched roofing of houses during rainy periods. The ownership of water depended upon the ownership of rights of access to a particular source. River water was not owned by any particular person.

Well sites were carefully selected. If a person or a group wanted water, they would dig at different places and taste the water. The site with the preferred taste was then selected.

In my village, according to my grandmother, there was only one recognized well that was used communally by the whole of Lese Oalai village and Lese Kovora village as well. I feel, however, that well water access, usage and the development of well sites were more closely linked to land rights in the initial phase of settlement, and later became more communal and accessible to a larger proportion of the village population through inter-marriage and other forms of alliance within the group. Well water might also have been more accessible as an expression of kindness, or as a means of acquiring prestige or power by leaders or others.

Water from the rivers was thought to be the purest, while water from the well was the most commonly used, and rain water was the least used. Fresh water was used mainly for cooking, drinking and washing utensils. Washing or having a bath with fresh water was restricted to new mothers and their babies and people performing rituals or other spiritual and magical rites. Persons not included in these categories usually bathed in the sea or creek near the village ....

2. Sources of Water Today

Today in Lese Oalai village, people still use wells, and rely on river water as an emergency source. Other important sources are tanks, containing rain water from buildings with corrugated metal roofs, and piped water supply system, which has not been operating for the last three years ....

In my study in 1978, I found that well water was used mainly for washing clothes and in some cases, bathing. Most families used tank water to wash clothes, bathe and wash cooking and eating utensils, primarily during the wet season. This pattern changed in the dry season, when tank water was used only for drinking and cooking food. Wells served the other domestic purposes. Most people use the creek nearby for bathing.

The Lese Oalai piped water supply system was constructed to provide an adequate supply of good-quality water throughout the year. The total project cost was K26,000 which came from contributions from villagers, a local government allocation and a major component from Rural Improvement Programme funds. The systems was officially opened in March 1977, but has only supplied water to the village for one week in the whole three years of its existence.

Why has the piped water supply only worked successfully for one week? ... during the three or four months while the system was constructed, the village people devoted most of their time and energy to make it a success. In due course old gardens were not made. Poor harvests have resulted over the past few years and many villagers simply do not have the incentive any more to collectively attempt to help fix the windmill.

... not enough information was given to the village people about the project's details and effects. Only the benefits were aired loudly. Community projects, especially a sophisticated system like this one, should be made more communal. All stages of such projects, from planning down to implementation, must involve consultation and communication with the recipients.

... although I have referred to a communal well, communal or village-owned property is not a traditional idea in Lese Oalai. In the case of the old communal well, there were rules about who had the responsibility for maintenance. Women of the village carried water and looked after the well but were not associated directly with leadership and authority in the village.

... communal ownership is an introduced concept; no legal and social sanctions exist within the contemporary system of social order to protect the system from damage by people.

## AGRICULTURE BANK OF PAPUA NEW GUINEA

In 1967, the PNG Development Bank, the precursor of the Agriculture Bank of PNG, started operations under the PNG Bank Ordinance 1965. In 1985, the Bank was renamed the Agriculture Bank of PNG,with its focus shifting to the development of the rural sector.

The Agriculture Bank of PNG is assigned a major role in making credit available and its utilization to the agriculture sector. It has smallholder development programs designed to encourage villagers to consolidate landholdings to accelerate the pace of rural development.

The Bank's gross approvals in 1984 increased to K19.2 million from K18.7 million in 1983. Of this total, K13.8 million was accounted for by some 1,000 subprojects in the agriculture sector. The share of agriculture financing thus increased from 60 per cent in 1983 to 72 per cent in 1984. More than 90 per cent of the loans approved were directed to the smallholder sector.

In 1986 the bank started financing a rural housing program with a K0.5 million grant it received from the Government. Under this scheme, loan amounts are limited to K10,000 at 5 per cent interest per annum payable up to 25 years. The demand for these loans was such that another grant of K1.0 million is being negotiated by the bank with the Ministry of Finance.

At present, a "site and services" project in four major towns is being considered for the development of low-cost housing. The Agriculture Bank may also implement a proposed experimental mortgage scheme for that type of housing.

In discussions with the Agriculture Bank, they indicated that it would be feasible to operate a rural water supply and sanitation loan program in support of the self-reliance based rural water supply and sanitation program.

The Agriculture Bank operates four regional offices, six branches, four subbranches, and 13 representative offices. Its regional organization is as follows:

(Reference in text: page 51, para 108)

| Regional Offices | Popondetta | Subbranches | Representative Offices |
|---|---|---|---|
| Port Moresby | Popondetta<br>Kiunga | Alotau | Daru<br>Kerema<br>Moreguina |
| Mt. Hagen | Goroka | Wabag | Kainantu<br>Kundiawa<br>Mendi |
| Lae | Wewak | Madang | Finschhaffen<br>Maprik<br>Vanimo |
| Rabaul | Kimbe<br>Arawa | Bialla | Buka<br>Kavieng<br>Lorengau<br>Namatanai |

Source: Agriculture Bank of PNG, 1986.

(Reference in text: page 51, para 107)

# COST RECOVERY COMPUTATIONS

1. Consumer's Ability to Pay

Average Per Capita Income in the Rural Area:

| | |
|---|---|
| Cash Income (PNG GNP per capita of $800 a/ x 10%) | $ 80 b/ |
| Non-Cash Income | 100 |
| Total Income per Capita | $180 |
| x 5 Persons per Household | 5 |
| Total Income per Household | $900 |

Ability to Pay per Household: c/

| | at 2% | at 5% |
|---|---|---|
| Per Year | $18.00 | $45.00 |
| Per Month | 1.50 | 4.00 |

2. Capital Costs

Materials costs for three levels of service were based on figures in Appendix 7, pages 15-16.

Labor costs were not included in the computations since the systems will be developed on a self-help basis and labor will be provided by the communities.

3. O&M Costs

These are assumed to be at 3 per cent of Capital Costs (materials only) per annum per system to cover only minor repairs. d/ The salary of the caretaker was not provided for in the computation of O&M costs since it is assumed that the caretaker will be paid in kind or will be rendering voluntary labor.

OPTION I

Government Equity Scheme

4. Cost Recovery from Consumers (in Kina)

| | Level I | Level II | Level III |
|---|---|---|---|
| Materials Cost | 300.00 | 5,000.00 | 7,500.00 |

a/ Gross National Product (GNP) based on economic survey of Papua New Guinea, ADB, July 1985.
b/ Per ADB Memo dated 27 November 1986.
c/ Similar ability-to-pay ratios were used by ADB in the Island Provinces Rural Water Supply Sector Project for the Philippines.
d/ Water Supply and Sanitation Sector Strategy Review, ADB, April 1986.

(Reference in text: page 52, para 111)

4. Cost Recovery from Consumers (in Kina) (cont'd)

| | Level I | Level II | Level III |
|---|---|---|---|
| Cost Recovery: Ability to Pay (ATP) per Household (HH) | | | |
| at 2% ATP | 18.00 | 18.00 | 18.00 |
| at 5% ATP | 45.00 | 45.00 | 45.00 |
| Less: O&M per HH a/ | .18 | 3.00 | 4.50 |
| Balance for Recovery of Materials Cost per HH b/ at 2% ATP | 17.82 | 15.00 | 13.50 |
| at 5% ATP | 44.82 | 42.00 | 40.50 |
| Total Amount Available for Recovery of Materials Cost c/ at 2% | 297.00 | 15.00 | 9.00 |
| at 5% | 747.00 | 42.00 | 27.00 |

5. Weighted Average of Materials Costs Recoverable

at 2% Ability to Pay

| | | | |
|---|---|---|---|
| Total Amount Available per System | 891.00 | 750.00 | 675.00 |
| Multiplied by Number of Systems a/ | 8,250.00 | 7,700.00 | 1,100.00 |
| Total Amount Available for All Systems (in million Kina) | 7.35 | 5.80 | .70 |
| Materials Cost | 300.00 | 5,000.00 | 7,500.00 |
| Multiplied by Number of Systems | 8,250.00 | 7,700.00 | 1,100.00 |

a/ Materials cost multiplied by 3 per cent O&M divided by 50 households per village.
b/ Ability to Pay less O&M.
c/ Balance for recovery of materials cost per household multiplied by 50 households per village.

(Reference in text: page 52, para 110)

5. Weighted Average of Materials Costs Recoverable (cont'd)

| | Level I | Level II | Level III |
|---|---|---|---|
| Total Materials Cost for All Systems (in million Kina) | 2.50 | 38.50 | 8.30 |
| Sum of Total Amount Available for All Systems (in million Kina) | 13.90 | | |
| Divided by Sum of Total Materials Cost for all Systems I (in million Kina) | 49.30 | | |
| Weighted Average | 28% | | |
| at 5% Ability to Pay | | | |
| Total Amount Available per System | 2,241.00 | 2,100.00 | 2,025.00 |
| Multiplied by Number of Systems | 8,250.00 | 7,700.00 | 1,100.00 |
| Total Amount Available for All Systems | 14.80 | 16.20 | 2.20 |
| Sum of Total Amount Available for All Systems | 33.20 | | |
| Divided by Sum of Total Materials Cost for All Systems a/ | 49.30 | | |
| Weighted Average | 67% | | |

OPTION II

LOAN SCHEME

1. Ability to Repay Loan

The following computations show the ability of the communities to shoulder loan repayments for all systems being considered. The computations were based on a 5 per cent interest rate and ten-year repayment period under an equal annual repayment plan.

a/ Same as Sum of Total Materials Cost for all systems at 2 per cent Ability to Pay.

(Reference in text: page 52, para 110)

| Period Covered | | | | 1987-1990 | 1991-1994 | 1995-1998 |
|---|---|---|---|---|---|---|
| For 1991-1994 Loan | | | | | | |
| Level | Number of Schemes | Total Loan Payment a/ | Total Collection b/ | | | |
| I | 1,650 | 156 | 257,400 | | | |
| II | 2,640 | 2,592 | 6,842,880 | | | |
| | Subtotal | | | | 9,236,480 | 9,236,480 |
| For 1995-1998 Loans | | | | | | |
| Level | Number of Schemes | Total Loan Payment a/ | Total Collection b/ | | | |
| II | 3,300 | 2,592 | 8,553,600 | | | |
| III | 550 | 3,884 | 2,136,200 | | | |
| | Subtotal | | | | | 10,689,800 |
| | TOTAL COLLECTIONS | | | 5,591,520 | 14,828,000 | 22,722,040 |

a/ Total annual loan repayment multiplied by four years.
b/ Number of schemes multiplied by total loan repayment.

| | Level I | Level II | Level III |
|---|---|---|---|
| Materials Costs | 300.00 | 5,000.00 | 7,500.00 |
| Total Annual Loan Repayment | 39.00 | 648.00 | 971.00 |
| Total Annual Loan Repayment per household a/ | 0.78 | 12.96 | 19.43 |
| Balance for Recovery of Capital Costs per Household b/ | | | |
| at 2% ATP | 17.82 | 15.00 | 13.50 |
| at 5% ATP | 44.82 | 42.00 | 40.50 |
| Less Annual Loan Repayment per Household | 0.78 | 12.96 | 19.43 |
| Surplus or Deficit per Household at 2% ATP | 17.04 | 2.04 | -5.93 |
| at 5% ATP | 44.04 | 29.04 | 21.07 |

3. Analysis of Required Seed Capital for Loan Scheme (In 000 Kina)

| Period Covered | 1987-1990 | 1991-1994 | 1995-1998 |
|---|---|---|---|
| Required Program Disbursements | 10,780 | 17,820 | 20,625 |
| Less Collection from Communities (see Computation below) | 5,592 | 15,828 | 22,722 |
| Balance from Government | 5,188 | 2,992 | (2,097) |

4. Computation of Collection from Communities

| Period Covered | | | | 1987-1990 | 1991-1994 | 1995-1998 |
|---|---|---|---|---|---|---|
| For 1987-1990 Loans | | | | | | |
| Level | Number of Schemes | Total Loan Payment c/ | Total Collection d/ | | | |
| I | 6,600 | 156 | 1,029,600 | | | |
| II | 1,760 | 2,592 | 4,561,920 | | | |
| | Subtotal | | | 5,591,520 | 5,591,520 | 2,795,760 |

a/ Total Annual Loan Repayment divided by 50 households per village.
b/ See No. 4 on Government Equity Scheme Cost Recovery from Consumers.
c/ Total annual loan repayment multiplied by four years.
d/ Number of schemes multiplied by total loan repayment.

EXPECTED GROWTH RATES FOR GOVERNMENT EXPENDITURES, 1986-1987
(In Million Kina; 1986 prices)

| Nature | 1986 Amount | % | 1987 Amount | % |
|---|---|---|---|---|
| Sectors | | | | |
| Provinces | 229 | 29 | | |
| Infrastructure | 123 | 13 | | |
| Social Services | 106 | 11 | | |
| Law and Order | 100 | 11 | | |
| Economic | 96 | 10 | | |
| Administration | 84 | 10 | | |
| Subtotal | 737 | 79 | 761 | 81 |
| Debt Service | 176 | 19 | 174 | 19 |
| Special Appropriations | 17 | 2 | | |
| Grand Total | 930 | 100 | 935 | 100 |

PROJECTED SOURCES AND USES OF FUNDS
URBAN WATER SUPPLY AND SANITATION SECTOR, 1986-1990
(In Kina '000)

| Nature | 1986 Amount | % | 1987 Amount | % | 1988 Amount | % | 1989 Amount | % | 1990 Amount | % |
|---|---|---|---|---|---|---|---|---|---|---|
| **Receipts** | | | | | | | | | | |
| Loan Drawdowns | | | | | | | | | | |
| ADB 346 | 500 | | | | | | | | | |
| KfW | 3,000 | | | | | | | | | |
| Subtotal | 3,500 | 37 | | | | | | | | |
| Internal Revenues Cost Recovery from Customers | | | | | | | | | | |
| Waterboard Districts a/ | | | 961 | | 1,486 | | 1,985 | | 2,679 | |
| Undeclared Districts | 295 | 3 | | 14 | | 24 | | 34 | | 46 |
| Subtotal | 3,795 | | 961 | | 1,486 | | 1,985 | | 2,679 | |
| **Disbursements** | | | | | | | | | | |
| Operations b/ | 139 | | | | | | | | | |
| Capital Program | 9,004 | | 6,007 | | 5,666 | | 4,630 | | 4,547 | |
| Debt Service | | | | | | | | | | |
| ADB 278 | 200 | | 450 | | 420 | | 420 | | 420 | |
| ADB 346 | 80 | | 80 | | 80 | | 130 | | 180 | |
| OECF PN-1-1 | 20 | | 20 | | 20 | | 520 | | 510 | |
| OECF PN-1-2 | 10 | | 10 | | 10 | | 10 | | 40 | |
| KfW | 50 | | 100 | | 100 | | 100 | | 00 | |
| Subtotal | 9,503 | 100 | 6,667 | 100 | 6,296 | 100 | 5,810 | 100 | 5,797 | 100 |
| Balance (funded from Government Internal Generation) | 5,708 | 60 | 5,706 | 86 | 4,810 | 76 | 3,825 | 66 | 3,118 | 54 |
| Per Cent Increase (Decrease) | | | 110 | | (24) | | 19 | | (21) | |

a/ Surplus of Waterboard Receipts over Disbursements.
b/ Deficit from Waterboard Operations.

Source: Waterboard Financial Reports; Estimates of Revenues and Expenditures, various years; and Department of Finance, Loans and International Finance Division Reports

(Reference in text: page 61, para 128)