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REPORT
ON
CONFERENCE ON THE ORGANIZATION AND FINANCING
OF
SEWERAGE SECTOR DEVELOPMENT

HELD AT
PORT-OF-SPAIN, TRINIDAD AND TOBAGO
JUNE 13-15, 1989

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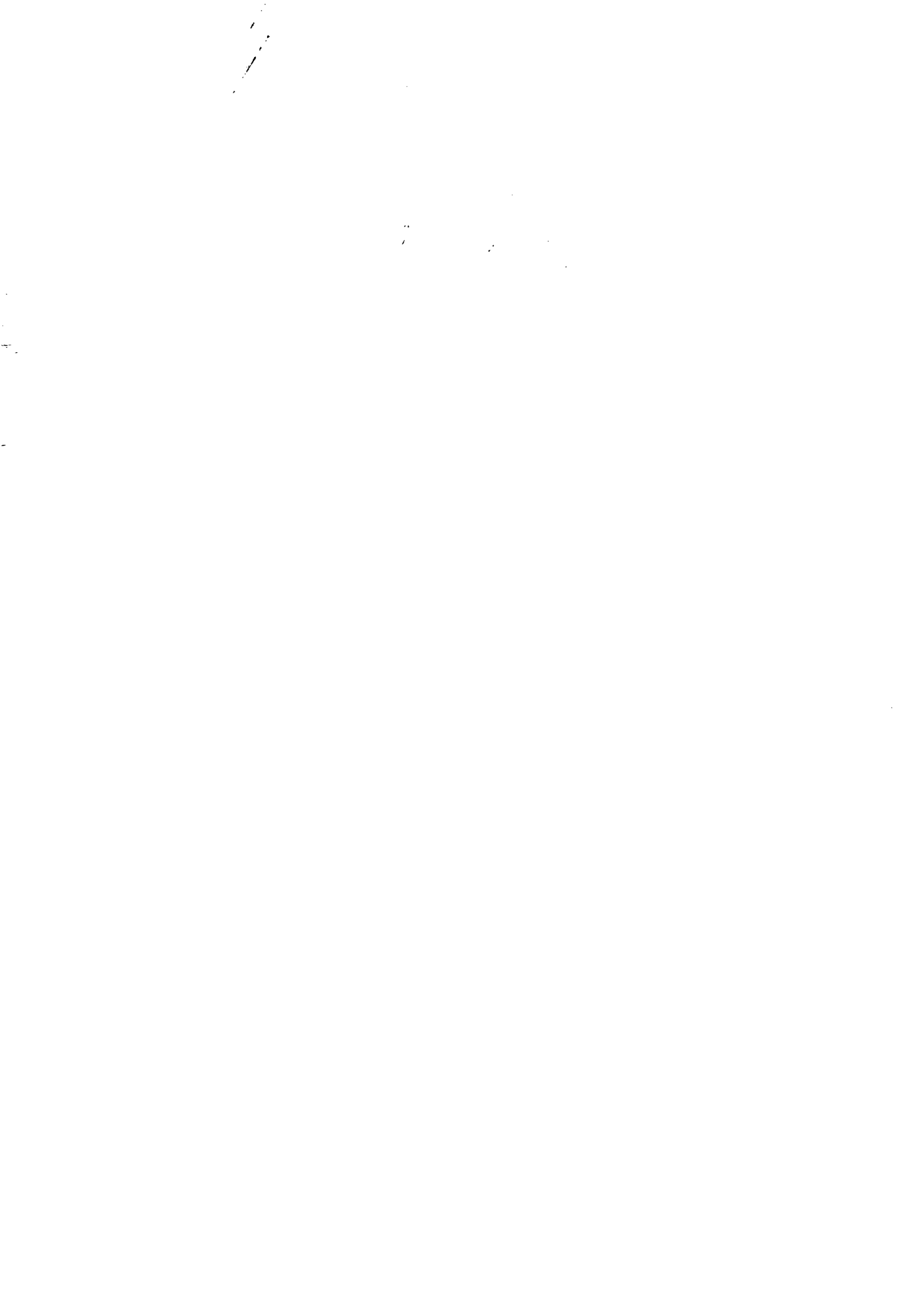
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PREFACE

With the ever increasing evidence of the adverse impacts of waste water on the environment - terrestrial, aquatic, coastal and marine - countries of the Caribbean Region are becoming more cognisant of the fact that, with increasing supplies of running water to homes, commercial and industrial properties, there are correspondingly increasing volumes and complexities of waste water (sewage) to be collected, treated, and adequately disposed of.

Over the past two decades evidence of potable water, river and stream pollution by waste water, and the erosion and destruction of the aesthetic and economic values of coastal and marine ecosystems such as mangroves, sea grasses and coral reefs, has sensitized scientists, ecologists, engineers and others to the need to seriously address the requirements of collecting, treating and disposing of waste water. These requirements have more recently been recognized at the policy making level, as the more visible negative impacts of sewage pollution on public health, aesthetics, and on the economies of several Caribbean countries dependent on ideal environmental conditions as a major contribution of the region's attraction to tourists become more financially and socially stressful.

"The Conference on Organization and Financing of Sewerage Sector Development in the Caribbean", organized jointly by the UN Economic Commission for Latin America and the Caribbean (UNECLAC), the Pan American Health Organization (PAHO), the Caribbean Development Bank (CDB) and the CARICOM Secretariat, here provides the forum for deliberation, planning, and the mechanisms for taking future action for the development of the regional sewerage sector with its objectives of protecting the public health, environmental and economic progress and stability of the people of the Caribbean Region.

In the deliberations of the Conference special note is taken of the major projects and studies which formed a basis for discussion on the stages and scope of sewerage development in the Caribbean, namely, "The UNEP/CARICOM/PAHO Project for the Protection of the Coastal and Marine Environment of the Caribbean Islands"; and the "UNECLAC Regional Sewage Disposal and Coastal Conservation Studies" with financial and technical assistance from the Canadian International Development Agency (CIDA), PAHO, the Governments of the Netherlands and Barbados, and the CARICOM Secretariat. The Conference also makes special note of the advances in Water Supply as influenced by the UN 1981-90 "International Drinking Water Supply and Sanitation Decade", but also notes the comparative lack of provision of adequate facilities for the collection, treatment and disposal of sewage.

This report records the salient factors and conditions in the development of the sewerage sector in the Caribbean in papers presented and discussions undertaken during the three (3) days of the Conference, and of Country Statements on sewerage submitted to the Conference Secretariat as well as Conference Recommendations for policies, strategies and a plan of action for sewerage development action at the national and Regional levels.

Copies of the full text of papers presented and circulated may be obtained from the office of the PAHO Caribbean Project Coordinator, Dayrells Road, Christ Church, Barbados.

INTRODUCTION

The Regional Conference on Organization and Financing of Sewerage Sector Development was convened at the Holiday Inn Hotel, Port-of-Spain, Trinidad and Tobago, June 13 to 15, 1989.

Sponsors of the Conference were the United Nations Economic Commission for Latin America and the Caribbean (UNECLAC), the Caribbean Development Bank (CDB), the Pan American Health Organization (PAHO), and CARICOM, with the Trinidad and Tobago Water and Sewerage Authority being the host agency.

Participants of the Conference - thirty-six (36) - were invited from CARICOM and CDB member states, also from Bermuda, the Netherlands Antilles and Suriname. Regional and International Agencies attending the Conference included CIDA, EEC, IADB, OAS, UNDP, and Hamilton Engineering International of Ottawa, Ontario, Canada.

Major reasons for the timely convening of the Conference stem from the increasing adverse public health and environmental problems associated with increasing supplies of running water to homes, commercial and industrial establishments where, in the majority of regional countries, the provision of appropriate technologies for waste water disposal infrastructure and management mechanisms have not yet been developed. The results of these deficiencies have been the rapidly increasing discharges of waste water from homes on to the land, into wells, rivers and nearshore marine waters with intestinal organisms, some pathogenic, and where mixed with the toxins, high particulate matter and grease in waste water discharges from commerce and industry, contribute to the deterioration of the environmental quality of territories, especially in coastal areas.

Further, tourism has become a major source of vital foreign exchange earnings for many regional countries with its direct and indirect benefits of increased employment, marketing of local foods, handicrafts etc., with coastal areas, beaches and nearshore marine areas being the greatest visitor attractions in most countries. Treatment and disposal of waste water from urban, near coastal and coastal areas have thus become a serious constraint in tourism development, with the need for the development of the sewerage sector becoming a top priority in development planning for public health, tourism, improved environmental quality, and a major contributor to the economic viability of many Regional countries.

Objectives of the Conference

The main objective of the Conference is:

- To examine the organization, financing and technology for accelerated sewerage sector development in the Caribbean.

Specific Objectives are:

- To strengthen the priority given by Caribbean governments to sewerage sector development.
- To identify technical and other guidelines and sub-regional standards for sewerage sector development and operation.
- To assist in easing the mechanics of sewerage project development and funding.
- To review donor agency policies and requirements for funding sewerage projects, and encourage an increase in the availability of such funds.

The report on the deliberations of the Conference, conclusions, recommendations and the plan of action follow. Papers presented daily are mildly summarized, focussing mainly on the salient factors in Latin America and the Caribbean, and those considered contributory to the future organization and development of the sewerage sector in the Region. Conference papers in their full text may be obtained from the Pan American Health Organization Office in Barbados.

FINAL CONFERENCE RECOMMENDATIONS

The final recommendations of the Conference are presented in a concise manner projecting the policy, strategies and a plan of action to be implemented at the National and Regional levels.

Policy

1. National sewerage sector policy will be guided by and be consistent with national developmental health and environmental policy.
2. Necessary steps should be taken at national level to clearly enunciate such a policy.
3. Review of national developmental plans to reflect the enunciated sewerage sector policy should be undertaken.
4. Donor activity will be facilitated by the existence of clear national policies.
5. A recommended policy statement might be as follows:

Development of the sewerage sector is primarily to ensure that the health of the citizen is protected and preserved, while concomitantly protecting the tourism industry, so vital to many regional countries. Governments should, therefore, accept the provision of sewerage as a social investment in the health of its citizens, while protecting their vital areas of economies based on tourism, fisheries and coastal environmental management.

Strategies

1. National strategies should be developed to provide the necessary legislative and institutional framework which together with appropriate supporting measures would lead to effective policy implementation.
2. Elements of the strategy should include:
 - (a) Appropriate tariff structures to allow utilities to recover the cost of sectoral development.
 - (b) Adequate human resources development programmes.
 - (c) *TCDC mechanisms within the Caribbean.
 - (d) Clear institutional roles and responsibilities at the national level.

*TCDC: Technical Cooperation among Developing Countries.

- (e) A regional Institution such as the Caribbean Environmental Health Institute (CEHI) should be requested to facilitate information exchange, TCDC, uniformity in professional practice, etc.

Plan of Action

1. Necessary action required to put the policy and strategy elements in place should be undertaken immediately.
2. Countries should be encouraged to generate baseline environmental data to facilitate future impact assessment and programme evaluation.

FIRST DAY - JUNE 13, 1989

STATEMENTS BY REPRESENTATIVES OF SPONSORING AGENCIES

SUMMARY OF PROCEEDINGS

The first session of the Conference which opened on Tuesday, June 13, 1989, was chaired by Eng. Ronald Williams of PAHO, who introduced the speakers making the opening addresses for the Sponsoring Agencies of the Conference.

Caribbean Development Bank (CDB):

Mr. W. Lawrence

Mr. Wendell Lawrence, in addressing the Conference, expressed his good fortune to be enjoying the hospitality of the people of Trinidad and Tobago for the fourth time in the period of just over one month. He stated that his current visit and attendance at the Conference linked back to the "Conference of Ministers Responsible for the Environment", at which wastes disposal was identified as a major issue in the management of our environment, an environment which is the key attraction and building base for our Regional Tourist Industry. To develop this environment, we need the financial and technical assistance which CDB's ability to deliver in conjunction with other aid agencies in the region, was earlier examined by the Bank's Board of Governors.

Mr. Lawrence expressed his pleasure to see so many of the Bank's member countries present at the Conference, and took the opportunity to applaud them for their increasing commitment to providing water and sewerage services to their people which is one of the most important and cost effective means of improving the health of the region's populace, thus raising productivity and providing a sound basis for development.

He saw progress in the sewerage sector depending on several factors, such as overcoming economical and financial constraints, institutional weakness at all levels and developing training systems for manpower development, better coordination of responsibility among agencies; and most importantly, obtaining support at the highest level of Government for expanding basic drinking water and sewerage services as essential components of development.

In concluding, Mr. Lawrence made reference to what CDB regarded as funding relatively few projects in the sewerage sector these include:

- The Castries Sewerage Project - St. Lucia
- Roseau Sewerage Feasibility Study - Dominica
- Sewerage System for West Bay Beach - Grand Cayman
- Sewerage Feasibility Study - San Pedro, Belize
- Sewerage System for Cable Beach - Nassau, Bahamas

United Nations Economic Commission for
Latin America and the Caribbean (UN ECLAC): Mr. C. Applewhite

Mr. Applewhite expressed the view of the right of the Caribbean Region to be concerned about the negative effects that pollution has on Public Health, and on the further development of tourism, fisheries and agriculture, the three last sectors being crucial economic sectors in the region. Their importance in terms of employment, contribution to GDP and to the alleviation of chronic foreign exchange shortages need no further elaboration. He stressed the point that, despite the time, effort and funds spent on projects and programmes to improve public health, and the competitiveness of the tourism, fishing and agricultural sectors, investments in the sewerage sector have been lagging with the detrimental effects of our soils, rivers and coastal waters becoming heavily polluted by sewage which threatens the economic feasibility of other projects, and concomitantly, the socio-economic development of Caribbean countries.

In pointing to the insufficiently known value of sewerage systems, Mr. Applewhite referred to the fact that, apart from the offensive odours with which some of us are often familiar, little is known of the indirect degenerative and health threatening effects of the contamination of drinking water, eating shell fish contaminated with sewage, and the cause of the disappearance of our beaches to which coastal waters polluted by sewage play a major role.

Mr. Applewhite then pointed to the fact that in the past sewerage projects have had low priority, as they appear not to produce anything materialistic. He also stated that, without exception, implementation of sewerage projects is costly, and cost recovery may be problematical, and financial and economic benefits difficult to quantify. But he alluded to the discerning fact that sewerage systems are not only a necessary component of sustainable development, but they reduce further deterioration of our natural resources and avoid future developmental costs.

Mr. Applewhite referred to the fact that the Conference was the conclusion of a series of studies and joint efforts beginning with the "UNEP/CARICOM/PAHO Protection of the Coastal and Marine Environment of Caribbean Islands Project", and the "UNEP/ECLAC Tourism and the Wider Caribbean Project", and commended the two projects on Sewerage and Coastal Conservation carried out by the Government of Barbados and the Inter-American Development Bank (IDB) on highlighting the need for sewerage and coastal protection in the Region. He further stated that to take the conclusions and recommendations of the two aforementioned regional projects further, UNECLAC/CDB/PAHO/CEHI* assisted by the

* Caribbean Environmental Health Institute

Secretariats of CARICOM and OECS, and with financial assistance from the Governments of Canada and the Netherlands, and with technical assistance from the Government of Barbados, he hopes that contrary to his earlier reference to the studies and projects undertaken as a conclusion, the Conference will serve as a new beginning to the era of actual implementation of sewerage sector development projects in the Caribbean.

Pan American Health Organisation (PAHO)

Dr. Dorothy Blake

After extending greetings on behalf of Dr. Carlyle Guerra de Macedo, Director of PAHO, and the Organization's Caribbean Programme Coordinator, Dr. Halmond Dyer, Dr. Blake enunciated PAHO's promotion of the development of the sewerage sector in Latin America and the Caribbean since its inception in 1902. She further referred to the heightening role of PAHO (as the WHO's Regional Office for the Americas) in the context of the International Drinking Water and Sanitation Decade which has as its objective the provision of safe Water and Adequate Sanitation for the World's populace by the year 1990.

Continuing, Dr. Blake said it has become clear that, despite impressive gains in water supply and sanitation, the goals of the Water Decade will not be met by 1990, rapid population growth and worldwide recession combining to hamper progress towards the projected goals.

WHO's on-going evaluation of the activities of the decade give the indication that there has been significant expansion of water supply facilities, but little expansion of facilities for sewerage and excreta disposal. Some reasons given for this deficiency include greater public demand for water supply than sewerage, and from the point of view of development agencies, water supply offers more attractive possibilities for cost recovery.

Dr. Blake made the point that despite the attractiveness of water supply development, there is an urgent need for the development of facilities for the safe disposal of human wastes, not only as a matter of public convenience, but also for the essential purposes of controlling communicable diseases and protecting our environment from the debilitating effects of pollution. She further stressed the essentiality of institutions being developed to efficiently and effectively operate, maintain and manage those facilities to ensure the attainment of the objectives of convenience, health and environmental protection.

Dr. Blake also saw the experience in the Caribbean Region parallel with the Western Hemisphere as a whole, with significant strides in water supply but with precious little activity in the sewerage sector. But a greater need is in the

Caribbean region for sewerage development, not only for convenience health and the environment, but also for the essential economic motive of protecting the tourism industry. What we have been seeing is the need for the development of the sewerage sector, is the development of Isolated sewage treatment plants at hotels and other resorts, which, without the requisite institutional structure behind them, quickly fall into disrepair and malfunctioning.

She then alluded to the commendable progress Trinidad and Tobago has made towards the development of the sewerage sector. Areas of progress include the Water and Sewerage Authority establishing an organisational unit for sewerage staffed by trained and experienced professionals, maintaining collection, treatment and disposal facilities in major urban centres, has developed plans for expansion of the sewerage facilities, and is presently examining its cost recovery and control policies.

Dr. Blake concluded by expressing PAHO/WHO's pleasure to have taken part along with CDB, UNECLAC and CARICOM in the organisation of the conference, and assured her audience of PAHO/WHO's commitment to the development of the sewerage sector and the mobilization of resources for that purpose.

CARICOM

Dr. Naresh Singh

On behalf of the Caribbean Community Secretariat (CCS), and the Caribbean Environmental Health Institute (CEHI), Dr. Singh enjoined the speakers before him in welcoming the participants from member states of the Caribbean Community, CARICOM, as well as participants from non CARICOM states with whom we share the Caribbean Sea and the Caribbean Atlantic.

Dr. Singh stated that sewage pollution of the marine environment in the Caribbean finds stiff competition only from petroleum pollution as the major type of marine pollution. While petroleum pollution is largely the result of accident, mischief or apathy, sewage pollution is typically the result of a deliberate act of society, and in many instances a legitimate one. The environment does have a capacity to assimilate waste, but not an infinite one. The level of treatment, if indeed treatment is necessary, the method and site of disposal with their attendant capital and maintenance costs must be informed by the environmental fate of the discharge.

As we consider the strategies necessary for the accelerated sewerage sector development focusing on Organisation, Human Resources, Project Development, Technology and Financing we need perhaps to re-examine the Caribbean Environmental Health

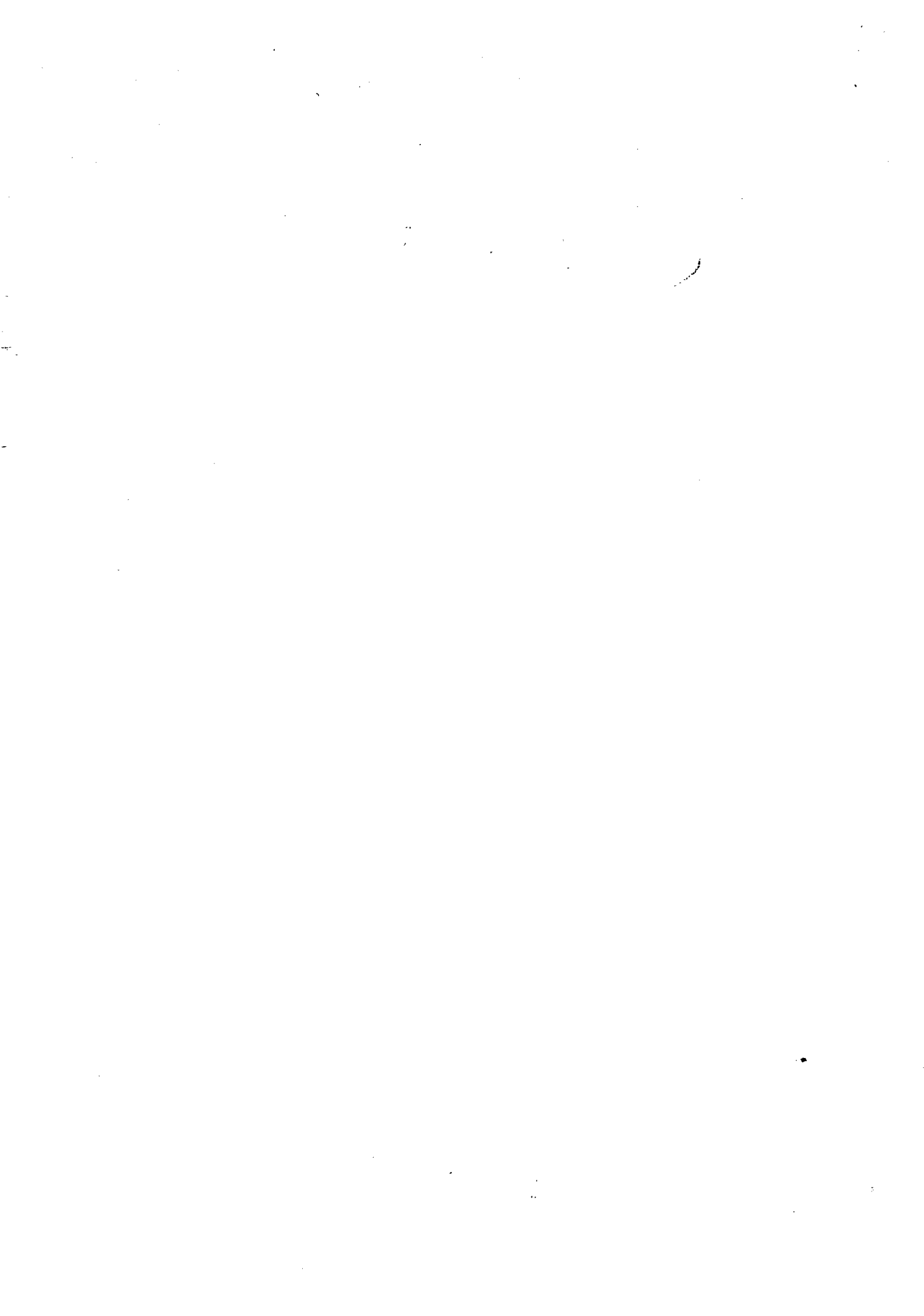
Strategy of 1978 and why it might not have delivered what many expected. In similar vein we need to reflect seriously on the failures and successes where these occurred of the International Decade now ending.

Dr. Singh further stated that as many of you would be aware, the CCS and the CEHI in collaboration with FAHO is about to embark on major Environmental Health Projects including Sewerage and other Liquid Waste Management with support from UNDP and the Federal Republic of Germany.

It is with very keen interest therefore that we look forward to a clear and practical policy and strategy guidelines, which take into account current realities without foreclosing future options.

Dr. Singh concluded by offering best wishes for a realistic and productive meeting.

CONFERENCE OPENING ADDRESS



Conference Opening Address

by

Hon. Pamela Nicholson
Minister of Public Utilities and Settlements,
Trinidad and Tobago

In her opening remarks the Honourable Minister stressed her country's recognition of the importance of any forum which provides an opportunity to find ways to improve the standard of living and environmental quality of our countries. She referred to man's prime physiological needs which lead naturally to the generation of waste water, the careless disposal of which in the Caribbean countries, especially in coastal zones, affects the environment and consequently human health, hence the Conference assumes even greater significance.

The Honourable Minister further stressed the point that in attending the Conference, Governments and participants recognise the fact that there is much more to be done towards achieving the objectives of the International Water and Sanitation decade, and as water supplies increase accompanied by expanding sewage disposal systems, most of our existing sanitation systems within our region leave much to be desired. It was also emphasised that in the context of sewerage and environmental protection, in addition to our concerns for our indigenous populations, environmental protection is vital to the protection of tourism which contribute in no small way to the economies of many Caribbean countries. The realization that all wastes (liquid and solid) must be properly treated and recycled is here.

With the economic downturn in many Caribbean countries, which presents difficulty in committing funds for the development of the sewerage sector, the operation and maintenance of associated sewerage systems and sewage treatment plants, and the improvement of related human resources which have contributed to absence of adequate infrastructure in many countries, the conference must strive to make recommendations for assisting in easing the mechanics of sewerage project development funding, the high capital costs of which have deterred many Caribbean countries from seeking assistance therefor, despite the need for them.

The Minister then referred to her country's attention to the sewerage sector development, through the Water and Sewage Authority. Steps taken include:

- Extension of the provision of potable water in areas prone to water related diseases;
- Effective management and control of all sewage treatment facilities throughout the country and waste water disposal methods through:
 - (a) Establishment of necessary policy and regulations;
 - (b) Takeover of all private sewage treatment plants by 1991.
- Declaration of the entire country a sewerage area.

She also referred to the special plans for Tobago which include:

- Construction of a Scarborough Wastewater Treatment Plant for the existing sewer system.
- Studies for a Sewerage System in South-west Tobago to, inter alia, cope with the effects of increased tourism.

In concluding the Minister stated the need for all to become sensitized to the need for the sewerage sector and its development, and must become more committed to zealously and consistently attacking and coping with the constraints which in the past have affected the ability of Caribbean countries to obtain funding from donor Agencies for sewerage projects.

PRESENTATIONS OF NATIONAL DEVELOPMENT AND SEWERAGE SECTOR

The Water Resources of Latin America
and the Caribbean: Water Pollution

Presented by

Mr. Torrence Lee of UNECLAC

A Hallmark of the second half of the 20th Century in the use of water resources of Latin America and the Caribbean has been the emergence of pollution as a significant and alarming feature of many water bodies. Disparate factors which account for this increase in pollution include rapid population growth, particularly urban populations, improvement in the provision of potable water supplies and sewerage services, the expansion of industry and the technification of agricultural factors unaccompanied by the development of wastes treatment facilities and pollution control. To date there has been no systematic regional evaluation of water pollution in Latin America and the Caribbean or its impact on the welfare of the population with its economic consequences. The overall magnitude of pollution of the Region's water resources is unknown.

Water Pollution Caused by Point
Source Wastes Discharges

One of the main causes of water pollution in the region is the direct discharge of domestic sewage and industrial effluent, domestic sewage being the more important particularly in large population centres, e.g. Rio de Janeiro, Brazil, where 70% of pollutants in receiving water are of human origin, while 30% are industrial and organic wastes. There is a general absence of waste water treatment plants for any but toxic industrial wastes as virtually all municipal and industrial wastes are discharged to rivers and streams without any treatment.

The geographical pattern of water pollution from point source wastes discharges in Latin America and the Caribbean show the substantially greater flows originating from large metropolitan areas, although water bodies in non-metropolitan concentrations of mining and manufacturing industry also receive significant wastes discharges.

Average per capita sewage production in Latin America and the Caribbean ranges from 30 Litres to 100 Litres per day, but may be higher; e.g. in Chile per capita discharge of waste water (1984) was 1000 litres per day - the main ingredient of domestic sewage is 99% water. Since some portion of the population carries various diseases, domestic sewage is infected by pathogenic organisms, the most significant including coliform bacteria, faecal streptococci, helminthic eggs, salmonella typhosa and various viruses.

Bacteriological load of raw sewerage in Latin America varies between 10×10^6 and 10×10^7 coliforms/100ml. With high BOD and suspended solids. Owing to large population concentrations and a lack of sewage treatment facilities, the input of sewage into recipient water bodies exceed the natural decomposition and dispersal capacity with the resultant significant degradation of the quality of the water. Estimates of domestic wastes treated suggests less than 2% of urban sewage flows receive treatment.

A direct and sensitive measure of the overall state of pollution of water bodies by domestic sewage is the coliform count. Recent data on 24 regionally representative South American rivers suggests that the "point source pollution situation" is worse than in other parts of the World. A comparison of rivers in the other regions with faecal coliform counts more than 100,00/100ml. show 8% in Central and South America compared to only 4% in other regions. Demands on water resources for the disposal and transport of domestic wastes and the resulting potential for pollution can be expected to expand enormously in the region to the end of the Century.

Industrial Effluents

The process of industrialisation in Latin America and the Caribbean Countries has contributed to increased water pollution. In many countries practically all but the most toxic industrial effluent is discharged into the nearest water body without treatment. Demands on Water resources for the disposal and transport of wastes and subsequent pollution problems can be expected to increase. Industries such as pulp and paper, steel and iron have been growing twice as fast as the economy in Latin America. Figure 1 shows the massive use of water in industry in Latin American and some other Caribbean countries.

Chemical and Biological Pollution

Of all pollution caused by industry, Chemical and Biological pollution ranks foremost in the region owing both to the high toxicity and non-biodegradability of industrial pollutants.

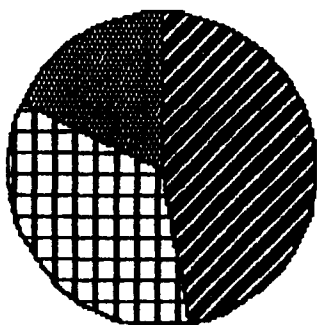
Industrial waste water may contain heavy metals, soluble organics causing depletion of dissolved oxygen, various toxic substances, phenols, turbidity, suspended solids, nutrients and other organic and inorganic substances, many of their components resistant to biodegradation.

The major industrial loads in the region are generated by pulp and paper, chemicals and petro-chemicals and petroleum refining, metal working (particularly iron and steel production

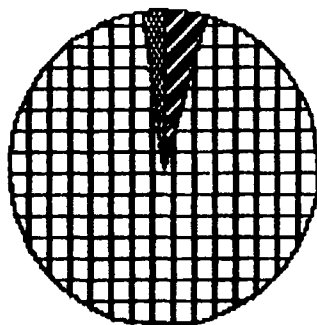
FIGURE 1

WATER USE BY INDUSTRY

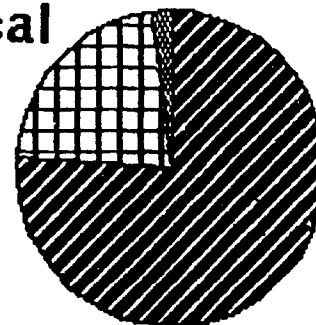
Food



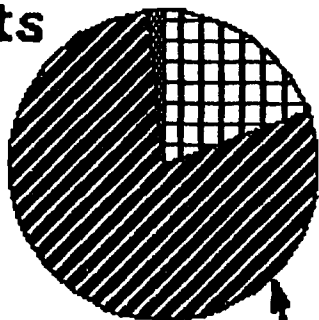
Paper



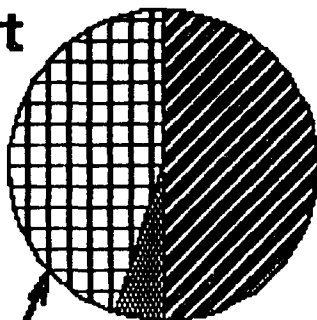
Chemical



Metal products



Cement



Petroleum refining



Cooling

Processes

Sanitary & boilers

and non-ferrous metal refining) food processing (particularly in sugar producing countries) fish meal, coffee processing, thermal electricity generation and textile industries. Process characteristics of some regional industries follow:

Pulp and Paper

The typical effluent from a paper industry contains chlorinated organic compounds, colloidal solids, dyes, fats, nutrients (nitrogen and phosphorus) oil, phenols and various organic pollutants. This industry produces an average of 200m³ of effluent per ton of cellulose pulp, and 100m³ per ton of paper.

Petroleum Refining

Waste water discharges from petroleum refining contaminants include phenols, other organic pollutants and suspended dissolved solids to alkaline and caustic sludge, cyanide, heavy metals and sulphides. Petroleum refining produces an average of 380 litres of effluent per barrel of crude oil refined.

Iron and Steel production

The various processes in iron and steel production produce waste water discharges containing ammonia, cyanides, oils, phenols, fluorides, ferrous chlorides, sulphuric and hydrochloric acids and large quantities of suspended solids. Iron and steel mills generate an average 25m³ effluent per ton of production; annually pollutional load for untreated effluent in the region is put at 1,762,000 tons of suspended solids, 910 tons phenols, 400 tons cyanide, 1100 tons nitrogen (ammonia) and 38,500 tons mineral oils.

Non-Ferrous Metal Refining

Effluents contain high concentrations of arsenic, Lead, Cadmium, Copper, Nickel, Zinc, and other non-biodegradable substances. Refineries generate an average of 20m³ per second per ton of production.

Food Processing and Related Industries

Brewery, dairy, cannery and coffee wastes show high BOD with the sugar-related rum distillery wastes with its strong organic wastes having a BOD of 1200 to 2000 mg. per litre. In addition to high BOD and suspended solids:

- (a) Cannery wastes contain large quantities of oil and grease,

- (b) the poultry processing and packing industry produces high concentrations of blood and excreta with elevated levels of salmonella bacteria, and
- (c) distillery wastes have a low pH, 3.0, with a strong aromatic odour.

The potential volumetric discharge of effluent from food processing industries in 19 Latin America and the Caribbean countries is about 60m^3 per second, is seasonal, with increasing pollutional potential if discharged during periods of low flow in streams and rivers. Of special note is the pollutional potential of the coffee processing industry. In Latin America and the Caribbean, over 17.5 million tons of coffee are produced annually. It is estimated that 10 million tons of wastes are dumped per year into rivers creating serious water pollution problems and presenting a health hazard.

Fishing Industry

Effluents from large fish processing and fish meal factories are large sources of contamination of coastal waters. Apart from pollution caused by fish blood, fish meal factories wastes produce an extremely high BOD (70,000 mg per litre). Effluents produced by fish meal plants average 23% of tonnage produced. Chile and Peru produce the highest estimated volume (flow) of fish meal processing effluent in the region that is 70ml^3 per day and 452m^3 per day respectively.

Energy Production

Thermal discharges from energy production contributes to water pollution by discharges of certain trace metals. In areas of hydroelectric projects, flooding of forests can lead to the generation of sulphides and other harmful substances which pose health risks. However, the most harmful effects of thermal discharges into water bodies, due to rise in temperatures, are the effects on aquatic fauna and flora, with increased evaporation and the reproduction of available dissolved oxygen.

Petroleum Production

Oil production is recognized as a significant source of pollution of water bodies in the region, both from points of extraction and from transport by pipelines and ships. Historically pollution related to petroleum production was only significant in Trinidad and Tobago and Venezuela; e.g. in Lake Maracaibo in Venezuela the ecological balance is reportedly in moral danger due to oil pollution. But recently discovery of petroleum deposits in other Central and South American countries

have added to the polluted water bodies and coastal areas in the region. It has been estimated that the total ocean and sea spills of hydrocarbons in the region amount to more than 500,000 tons per annum, with sea transport responsible for 28% of spills.

II Non-Point Source Water Pollution

The percolation, precipitation and unregulated run-off of already contaminated water into water bodies are the constituents of non-point sources of water pollution. Run-off from agricultural land and storm water flows from urban areas are the most significant of such sources in Latin America and the Caribbean.

Run-off from Agricultural land

In the majority of Latin American and Caribbean countries, agriculture is the prime source of contaminated run-off. The principal source of sediment from contaminated land surfaces is soil erosion. Irrigation drainage water can also be a major source of pollution especially in the practice of surface gravity irrigation involving channelling water through furrows or flooding entire fields. Contaminants include suspended solids, dissolved salts, fertilisers, pesticides, insecticides, herbicides, pathogenic organisms (when organic fertilisers are used), and other substances. Notes on some pollutants follow.

Fertilisers

The consumption of fertilisers in Latin America and the Caribbean increased approximately 97% between 1973 and 1985. In 1984 consumption of fertilisers (N, P₂O₅, K₂O) per hectare of farmland in Latin America was 7.9Kg. compared to 142.7Kg. in Europe and 45.8Kg. in the United States of America. In some Regional countries - Cuba, St. Lucia, Suriname, Trinidad and Tobago, fertiliser consumption is similar to that in developed countries. Increasing use of fertilisers pose the following problems for the region's water resources:

- (a) fertilisers, synthetic and animal wastes, support the accumulation of nutrients in water bodies which contribute to eutrophication,
- (b) use of organic residues not only cause nitrate and phosphorus pollution, but can also be a source of pollution by pathogens, ammonia, elevated BOD, et al,
- (c) the increasing use of nitrate and phosphorus concentrations pose potential health hazards.

Pesticides, Herbicides, Insecticides
and other Chemical Substances

Two characteristics of these materials make them a major hazard for water resources:

- (a) they are toxic to aquatic and human life, particularly organophosphates which tend to penetrate deeply into the soil posing a threat to deep water supply aquifers; and
- (b) they are often non-biodegradable or degrade very slowly, and not only tend to accumulate, but also prone to food chain concentration.

Regional countries place relatively few restrictions on the use of agrochemicals. As a result the countries continue to employ chemical substances whose use is either restricted or banned in countries with more stringent environmental legislation. Organic chlorinated compounds, such as DDT and Aldrin, used in the region over 30 years play a key role in water pollution in the region. They are however giving way to phosphates and carbamates.

Improper application and misuse of these potentially dangerous materials result in a high number of cases of pesticide poisoning. Little information on the impact of agrochemicals on the water resources of the region exists. But Brazil, where a level of some 150,000 tons are consumed annually, products such as Aldrin, Eldrin, Heptachlor and Lidane banned or restricted in Europe and the USA are still in use. The use of banned or restricted Agrochemicals used in Latin America and the Caribbean are shown at Table 1.

Storm Water Run-off

Storm water run-off in the region is generally channelled into natural drainage systems. the pollutant potential of urban storm water run-off is related to BOD, suspended solids content, organic and inorganic and bacterial pollution. When collected in some combined sewage systems, e.g. in Honduras, sewers and sewage treatment plants are overloaded with the resultant pollution and health problems in urban areas and receiving water bodies.

Percolation of polluted Water into Groundwater

Seepage from wastes dumps, septic tanks, sewerage systems, oil and chemical spills etc. can result in percolation of polluted water into groundwater with the ultimate pollution of rivers, lakes and the sea. Percolated contaminated human wastes

TABLE 1

LATIN AMERICA AND THE CARIBBEAN: PESTICIDES USED IN OR SOLD TO AGRICULTURE WHOSE CONSUMPTION AND/OR SALE HAVE BEEN BANNED, WITHDRAWN, SEVERELY RESTRICTED OR NOT APPROVED BY GOVERNMENTS a/

| Product | Country | Year b/ | 100 kg |
|------------|-------------|---------|--------|
| ALDRIN c/ | Argentina | 1984 | 5 832 |
| | Ecuador | 1984 | 689 |
| | El Salvador | 1979/81 | 432 |
| | Guatemala | 1979/81 | 1 470 |
| | Guyana | 1979/81 | 22 |
| | Mexico | 1985 | 1 000 |
| | Suriname | 1979/81 | 630 |
| | Uruguay | 1985 | 126 |
| ARSENICALS | Uruguay | 1979/81 | 26 |
| EHC | Argentina | 1984 | 60 |
| | El Salvador | 1979/81 | 12 |
| | Mexico | 1985 | 2 500 |
| | Suriname | 1979/81 | 961 |
| DDT | Argentina | 1979/81 | 6 |
| | Ecuador | 1984 | 4 000 |
| | El Salvador | 1979/81 | 1 269 |
| | Guatemala | 1979/81 | 12 570 |
| | Mexico | 1985 | 3 000 |
| | Suriname | 1979/81 | 33 |
| LINDANE | Argentina | 1984 | 1 725 |
| | Guatemala | 1979/81 | 11 |
| | Honduras | 1986 | 1 371 |
| | Mexico | 1985 | 150 |
| | Uruguay | 1985 | 5 |
| PARATHION | Argentina | 1984 | 9 234 |
| | Ecuador | 1984 | 584 |
| | El Salvador | 1979/81 | 12 144 |
| | Guatemala | 1979/81 | 905 |
| | Honduras | 1986 | 1 360 |
| | Mexico | 1985 | 46 000 |
| | Uruguay | 1985 | 140 |

TABLE 1 (cont'd)

| Product | Country | Year b/ | 100 kg |
|-----------|-------------|---------|--------|
| TOXAPHENE | El Salvador | 1979/81 | 5 252 |
| | Mexico | 1985 | 6 000 |
| 2,4-D | Argentina | 1984 | 12 024 |
| | Ecuador | 1984 | 8 684 |
| | Honduras | 1985 | 28 |
| | Mexico | 1985 | 14 000 |
| | Suriname | 1979/81 | 525 |
| | Uruguay | 1985 | 1 424 |
| 2,4,5-T | Argentina | 1979/81 | 117 |
| | El Salvador | 1979/81 | 168 |
| | Guatemala | 1979/81 | 124 |
| | Mexico | 1984 | 500 |
| | Suriname | 1979/81 | 200 |

Source: FAO, 1987 FAO Production Yearbook, Vol. 41, Rome, 1988, pp. 9-10 and 119-127; and United Nations, Consolidated list of products whose consumption and/or sale have been banned, withdrawn, severely restricted or not approved by governments, ST/ESA/192, 1987, Second issue.

- a/ Data refer generally to quantities of pesticides used in, or sold to agriculture. They are shown in terms of active ingredients, except for Ecuador and Guatemala, where data refer to formulation weight. Formulation weight usually includes active ingredients plus diluents and adjuvants.
- b/ The latest year for which consumption data have been available.
- c/ Consumption figures are for aldin and similar insecticides.

from septic tanks and poorly maintained sewage systems are major sources of ground water contamination, particularly by micro-organisms and nitrates. Groundwater may also be contaminated by fertilisers and agrochemicals, although the problem is not as widespread in Latin America and the Caribbean as in developed temperate countries.

A particular aspect of the percolation problem is salt water intrusion resulting from the use of groundwater from coastal aquifers. This is a problem in the region, particularly in the islands of the West Indies where groundwater is also the source of potable water supply.

III The Impact of Water Pollution and Human Health and Welfare

Untreated human wastes are considered the most dangerous environmental threat to human health. In Latin America and the Caribbean, despite advances made in recent years, diseases transmitted through water contaminated by human wastes are still common, but with fewer deaths.

Human Wastes and Human health

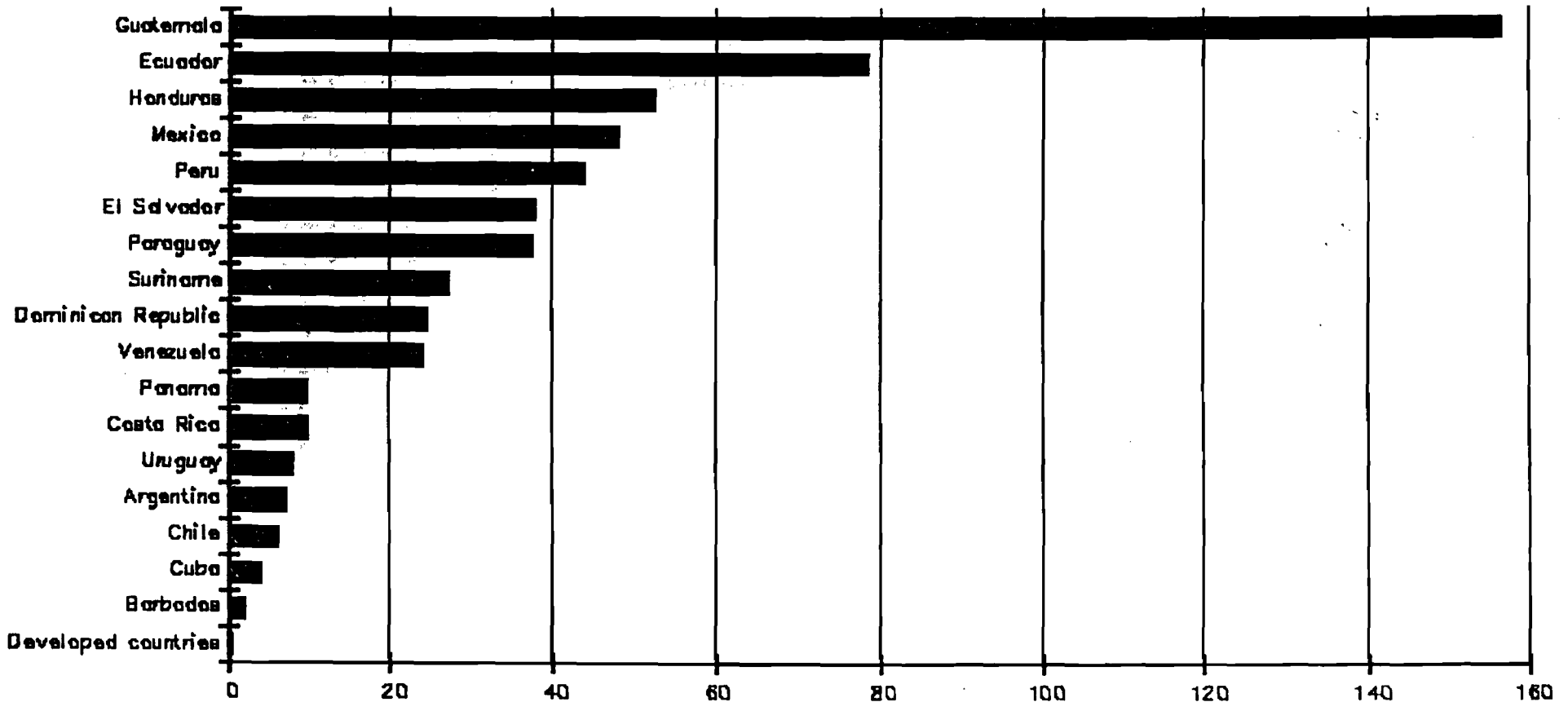
Water pollution by human wastes, organic matter and other substances are responsible for the transmission of diseases including Cholera, Typhoid fever, Dysentery and the other intestinal infectious diseases. Transmission of disease can occur directly through drinking water. In 1985, 14% and 55% of regional urban and rural populations respectively, lacked a protected source of drinking water. Indirect transmission of disease organisms can occur through bathing in polluted water, through contaminated agricultural products and fish. Pollution of surface waters by domestic sewage has been proven responsible for the high rate of infant mortality, which is higher in the region than in developed countries. Polluted water is said to be responsible for a high percentage of deaths of infants one (1) year and under. Figure 2 graphically illustrates the higher incidence of Typhoid and other bowel diseases regarded as attributable to pollution of water bodies by human wastes compared to the low incidence in developed countries.

Recreation and Health

Offensive odours, floating materials such as sewage solids, suspended sediments etc. create aesthetically repellent conditions for recreational uses of water bodies. More importantly high levels of bacterial contamination and other types of pollution can render water bodies unsuitable for recreational uses. This is of particular concern for countries where tourism is an important source of foreign exchange and employment.

FIGURE 2

DEATHS FROM TYPHOID FEVER AND OTHER INTESTINAL INFECTIOUS DISEASES, RATES PER 100 000 POPULATION



Source: WHO, information for various recent years.

In general, recreation is a much neglected use of water in the region, hardly considered in the process of water management. Many water bodies suitable for recreational purposes are increasingly contaminated by domestic sewage and industrial effluents.

Water Pollution Control

Most countries are developing laws for water pollution control. In a few, e.g. Chile, Guyana, Panama, a guarantee of clean water in a clean environment is contained in their national constitutions. Columbia, Mexico and Venezuela are cited as having the most comprehensive legislation and strongest institutions for environmental management in the region. In the majority of countries Water Pollution Control Regulations are incorporated in different spheres of water resource management and use. In Antigua and Barbuda public health laws prohibit pollution of water courses and drains, while in Jamaica the Mining Act contains safeguards against pollution. In most cases legislation specifically prohibits discharge of untreated or inadequately treated effluent into water bodies.

Pollution Control Legislation usually specifies the measures to be used to ensure compliance with established norms. Several regional countries have adopted the requirement that all new projects be evaluated in terms of their impact on the environment, including possible water pollution. The apparent contradiction between the widespread occurrence of water pollution, and the existence of sophisticated control legislation in many Latin America and Caribbean countries seems to arise from the fact that the implementation (enforcement) of such legislation is usually weak.

Water Quality Monitoring

even the best Water Pollution Control Legislation is almost certain to fall short of its objectives, due to lack of support by an adequate water pollution control network. The network should have the capability to measure the quality of potable water, surface and ground water in situ, and of effluent, and tracing pollutants to their source. Of these the control of drinking water is the most highly developed in the region. The paper cites the few areas in the region with adequate water pollution control networks, and records the assistance given by International Agencies (viz. CEPIS of PAHO and UNEP) in the field of water quality monitoring.

The paper concludes with sectors dealing with Regional Methods of Water Treatment, Human resources Development, and the Work of International Organizations.

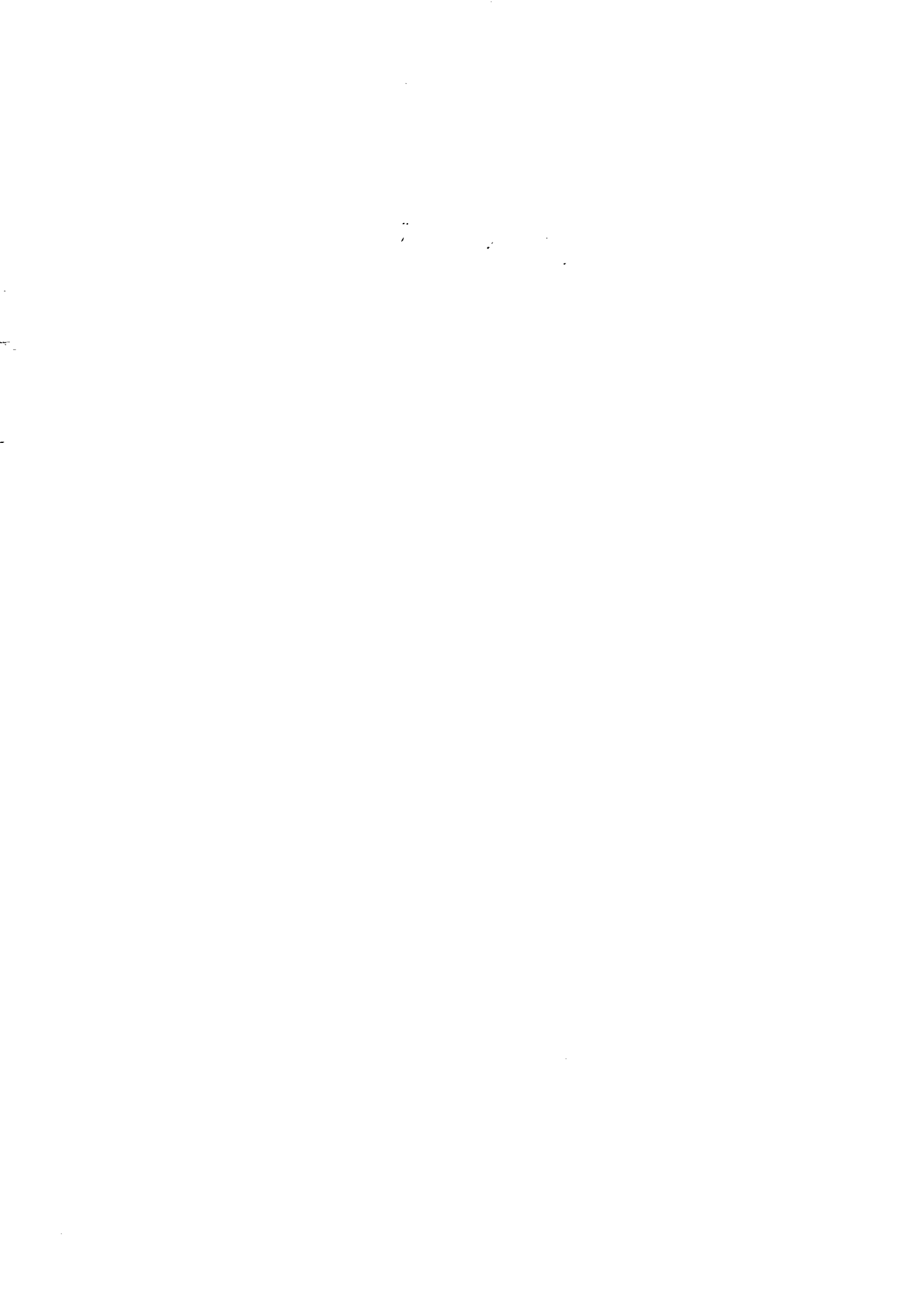
In water treatment, stabilization ponds are recognized as low cost and highly efficient, and suited to the tropical and sub-tropical character of the region. Research carried out in several countries, notably by Brazil where biodegradable wastes have been converted to agricultural fertilisers and methane gas, and in Bolivia the use of seeds and aquatic weeds have been used for waste water purification is cited.

The issue of Human Resource Development cites the lack of appropriate trained personnel as an obstacle to better water pollution control, and names of institutions in the region where Water Pollution Control training can be obtained.

The Assistance given by Regional and International Banks such as the World Bank and the Inter-American Development Bank (IDB) is highlighted. Examples of assistance given include an IDB loan of US\$46 million to the Government of Mexico for expansion of water and sewerage services in Tijuana, and the World Bank Loan of US\$60 million for the development of water supply and sewerage in Santiago, Chile.

The paper contains extensive Annexes illustrating:

1. Estimates of Domestic sewage outflow for cities with 100,000 inhabitants.
2. Installed capacity of selected industries, by water body.
3. Mining Production, by minerals, Countries and Years.



STATUS REPORT ON SEWERAGE SECTOR IN CARIBBEAN COUNTRIES

STATUS OF THE SEWERAGE SECTOR IN CARIBBEAN COUNTRIES

by
Arthur B. Archer

INTRODUCTION

Despite the scientific and technological advances in health and environmental sciences, sewage is still a misunderstood substance in the Caribbean. The necessity for sewerage systems is not fully appreciated even at the highest levels of community and national management.

The post-1939-1945 war years Industrial Revolution, with its attendant urbanization has transformed sewage from being mainly an aqueous substance (99% water) with just one percent of organic solids, to one containing industrial wastes, some domestic wastes containing detergents, inorganic chemicals, and often non-biodegradable substances toxic to beneficial microbial life, animals and man. These new substances predicate the need for sewerage systems with appropriate treatment facilities to protect public health and the terrestrial and marine environment.

Sewage and Excreta Disposal Practices in the Caribbean

Like other developing areas of the world, with improving standards of living, the installation of running water in homes has resulted in the need for the installation of wastewater disposal systems.

In many Regional countries the septic tank is regarded as the optimum sewage treatment facility before disposal on land, into streams, rivers and the sea. In land disposal, often the texture and absorbability of the soil renders it incapable of absorbing septic tank effluents e.g. in hard sintered volcanic soil in parts of the Windward Islands, in coastal soils where the ground water is high as in Barbados, St. Lucia and the Bahamas, and in the close textured plastic virtually impermeable clays of St. John's, Antigua. The common result in soils of poor absorption is the occurrence of surcharging resulting in ponding of sewage in the environs of the septic tank, disposal well and the tile field with its threat to health and the deterioration of aesthetic and environmental conditions.

Positive Influence of Tourism

The growth of the tourist industry in the Caribbean appears to have generated a greater awareness of the need to improve environmental and public health conditions, particularly in coastal areas, as the beaches, nearshore marine recreational areas are established as the greatest tourism attractions in the region, especially in the islands. Additionally there is a greater awareness of the need for protection of the coastal ecosystems, especially coral reefs and fisheries. In the case of coral reefs they form natural barriers protecting beaches and coastal property, and are submarine scenic attractions, while the fisheries are sources of vital fish protein and in most cases exist symbiotically with the coral reef systems.

The Regional coastal areas are also becoming urbanized, especially in the islands, with increasing population densities disposing wastewater well beyond the absorptive capacity of the coastal soil, and with accompanying pollution and public health problems. At the larger properties such as hotels, apartment buildings, hospitals and some government buildings, the package sewage treatment plant is much used. The effluents from these plants - generally poorly operated and maintained - and with the discharge of septic tank effluents directly into the sea or seeping through the subsoil from wells and tile fields into the marine environment, stresses are imposed on coral reefs, sea grasses and fisheries with degrading consequences, contributing to beach erosion, loss of fisheries, and detraction from the aesthetic and recreational quality of coastal areas.

Sewerage Systems in the Caribbean

Sewerage systems are not new in the Caribbean. The fourth decade of this century saw cities of the Windward Islands - Castries in St. Lucia, Roseau in Dominica, St. Georges in Grenada, having sewer systems installed. Port-of-Spain in Trinidad and Tobago, and Kingston and St. Andrew in Jamaica had sewer collection systems installed even earlier. Almost without exception the collection systems lacked adequate sewage treatment plants, and marine outfalls were sited and installed without apparent adequate concern for marine water quality, coastal ecosystems protection and health risks to sea-bathers. With the increasing density of urban and urban/coastal areas, the need for central sewerage systems increases. With future projections of urban and coastal development with

increasing populations, tourism with its demands for improved water and wastewater treatment infrastructure and improved aesthetic and recreational amenities, studies and designs for construction of sewerage systems in the region have increased, with International Donor Agencies being sought for technical and financial assistance.

REGIONAL STUDIES OF SEWAGE DISPOSAL AND ITS ENVIRONMENTAL AND PUBLIC HEALTH IMPACT

(A) The UNEP/CAICOM/PAHO Project for the Protection of the Coastal and Marine Environment of the Caribbean Islands - 1981/82

The project employed the services of seven (7) short-term consultants in eleven (11) CARICOM countries; including Belize in Central America. The study took account, not only of water-borne systems, but systems of disposal of excreta. From an inventory of disposal systems, it was estimated that only 9% of the populations of the territories were served by centralised sewerage systems. See Pie Chart at Figure 3 for populations served by various sewage and excreta disposal systems. It was also found that a large percentage of populations, mainly in hilly and low-income areas either had no domestic sanitation facilities, or used communal facilities.

Sewage/Excreta Related Illnesses

The CAREC Epidemiological statistics for 1978 to 1982 show a high incidence of sewage pollution related bowel disease in nine (9) of the eleven countries studied. The highest disease incidence was Gastro-enteritis of which sewage and excreta polluted water was suspected as the main mode of transmission, but poor sanitation conditions are seen as the overall causative conditions. The highest occurrence of Typhoid fever was in areas without sewerage systems, and where streams and rivers are used for human wastes disposal. Ground water polluted by sewage was also seen as a mode of transmission of disease; this was highly suspected in the high incidence of Gastro-enteritis (e.g. in the Bahamas) where ground water from shallow wells was used for domestic purposes. Table 2(a) shows the incidence of some sewage pollution related diseases in nine (9) of the eleven (11) countries studied for the period 1978 to 1982. Table 2(b) shows more recent statistics on Typhoid and Gastro-enteritis, with viral Hepatitis emerging as a serious water pollution related disease.

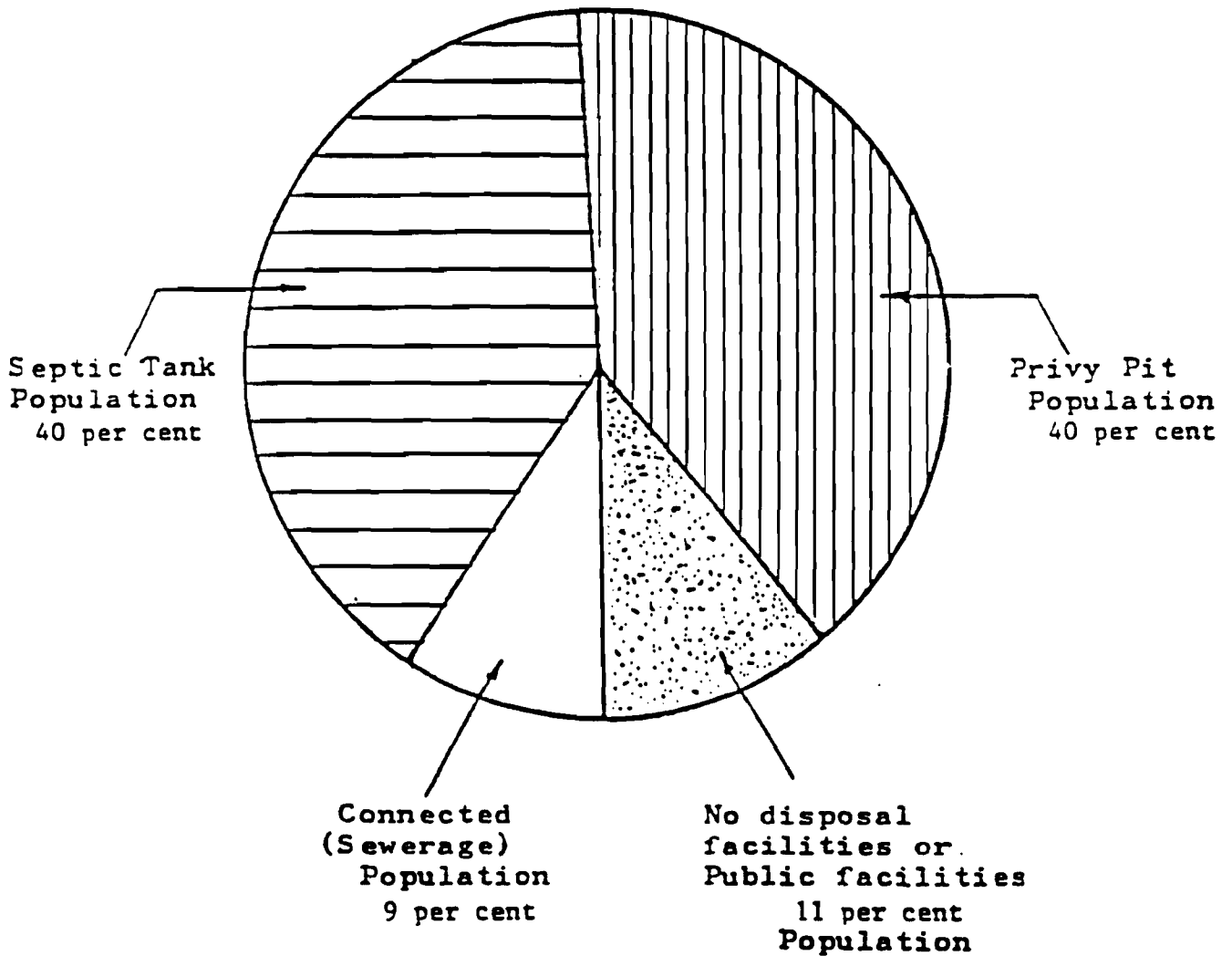
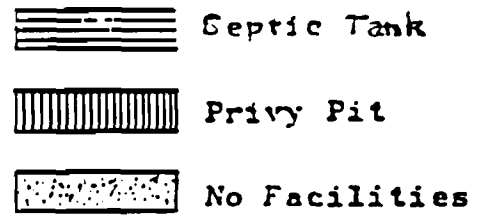


Figure 3

Regional Composite Percentages of Domestic Waste Treatment and Disposal Facilities

Table 2(a)
Occurrence of Waste Disposal, Water Pollution, and Related Diseases in the Caribbean
Country

| Year | Antigua | Bahamas | Barbados | Dominica | Grenada | Montserrat | St.Kitts-Nevis | St. Lucia | St. Vincent |
|--|---------|---------|----------|----------|---------|------------|----------------|-----------|-------------|
| <u>TYPHOID FEVER</u> | | | | | | | | | |
| 1978 | 0 | 0 | 2 | 40 | 4 | - | 0 | 10 | 0 |
| 1979 | 0 | 2 | 4 | 18 | 1 | - | 0 | 4 | 0 |
| 1980 | 1 | 3 | 1 | 16 | 1 | - | 0 | 7 | 0 |
| 1981 | 1 | - | 1 | 65 | 2 | - | 0 | 14 | 4 |
| 1982 | - | 2 | 3 | - | - | - | - | 10 | - |
| <u>GASTRO ENTERITIS (children under 5 years old)</u> | | | | | | | | | |
| 1978 | 310 | 2,100 | 104 | 350 | 1,610 | 35 | 450 | 1,430 | 440 |
| 1979 | 270 | 2,000 | 370 | 339 | 885 | 90 | 780 | 900 | 986 |
| 1980 | 1,678 | 1,146 | 164 | 82 | 1,041 | 6 | 601 | 876 | 1,015 |
| 1981 | 423 | - | 141 | 67 | 335 | - | 665 | 377 | 1,366 |
| 1982 | 98 | 1,934 | 187 | - | - | - | 302 | 604 | - |
| <u>DYSENTERY</u> | | | | | | | | | |
| 1980 | - | - | - | - | - | - | - | 153 | - |
| 1981 | - | - | - | - | - | - | - | 103 | - |
| 1982 | - | - | - | - | - | - | - | 19 | - |

Notes:

- = Data not available or disease not notifiable

Data source: CAREC Review of Communicable Diseases in the Caribbean.

Table 2(b)
Occurrence of Sewage Disposal, Water Pollution and Related Diseases in the Caribbean

| | <u>Country</u> | | | | | | | | | | | | | | | | |
|---------------------------|----------------|---------|---------|----------------|--------|-----------------|--------|--------|------|-------|---------|-----------------|--------------|----------------|-------|----------------|-------------------|
| | Anguilla | Antigua | B'hamas | B'dos | Belize | Cay. Islands | Dom'ca | Guyana | G'da | J'ca | Mon'rat | St.C./ Nevis | St. Lucia | St. Vincent | Sur'm | T'dad T'bgo | Turks/ Cai.Is. |
| <u>TYPHOID FEVER</u> | | | | | | | | | | | | | | | | | |
| 1985 | 0 | 3 | 2 | 2 | 3 | 0 | 25 | 243 | 1 | 63 | 0 | 0 | 8 | 0 | 20 | 7 | 0 |
| 1986 | 0 | 0 | 3 | 5 ^a | 1 | 0 | 9 | 125 | 1 | 152 | 0 | 0 | 66 | 0 | 25 | 5 | 0 |
| 1987 | n | 0 | 0 | 0 | 2 | 0 | 20 | 68 | 1 | 43 | 0 | 0 | 50 | 0 | 16 | 5 | 0 |
| <u>GASTRO - ENTERITIS</u> | | | | | | | | | | | | | | | | | |
| 1985 | 0 | 32 | 1234 | 532 | 2202 | 324 | 182 | 4447 | 621 | 17739 | 14 | 396 | 1000 | 947 | | 24632 | 140 |
| 1986 | 9 | 156 | 1486 | 130 | 2515 | 41 | 294 | 3640 | 814 | 14121 | 70 | 337 | 399 | 524 | 1500 | 20425 | 122 |
| 1987 | 49 | 680 | 1904 | 150 | 2179 | 28 | 8 | 5220 | 685 | 10535 | 50 | 258 | 711 | 982 | 1550 | 23408 | 118 |
| <u>VIRAL HEPATITIS</u> | | | | | | | | | | | | | | | | | |
| 1985 | 0 | 1 | 28 | 35 | 90 | 6 | 0 | 126 | 34 | 28 | 5 | 383 | 8 | 10 | 15 | 178 | 0 |
| 1986 | 0 | 101 | 39 | 25 | 31 | 3 | 10 | 309 | 35 | 24 | 39 | 6 | 26 | 3 | 17 | 111 | 0 |
| 1987 | n | 136 | 33 | 17 | 94 | 3 | 438 | 193 | 29 | 20 | 14 | 8 | 32 | 9 | 36 | 240 | 0 |

Notes

* = Imported Cases (2)

n = No report

0 = No cases

-34-

Ironically, some Caribbean countries have central sewage collection systems in their capital cities, but numerous suburban and rural areas with increasing population densities and water borne wastes, and with serious wastes disposal problems. It would seem public health wise to consider serving such areas using appropriate technologies which would not require the higher capital costs for sewerage construction and recurrent cost of operation and maintenance, but yet environmentally acceptable.

(B) UNECLAC Regional Sewage Disposal and Coastal Conservation Studies

UNECLAC has taken the initiative in seeking the acceleration of the implementation of the construction of needed sewerage systems through a programme of studies and project proposals within the Caribbean Region, the major effort being in the Eastern Caribbean.

Studies were carried out in Anguilla, Antigua and Barbuda, Aruba, British Virgin Islands (Tortola), Curacao, Dominica, Grenada, Montserrat, St. Christopher/Nevis, St. Lucia, St. Vincent and Trinidad and Tobago during the period December 1987 to late April 1988. Major objectives of the sewerage sector of the project included:

- (i) the preparation and submission of project proposals for sewerage at the prefeasibility, feasibility, and final design stages, and for sewerage construction funding where feasible; and
- (ii) the submission of recommendations for a Regional Project for sewerage and sewage disposal.

Findings

Briefly, it was found that in virtually all the countries studied there is dire need for sewerage systems especially in the densely populated coastal urban cities. In several countries untreated and partially treated sewage is reaching the marine environment by pipeline discharges or by sub-soil infiltration, and poses threats to public health and to the economy of several countries where tourism is a major or the main source of valuable foreign exchange earnings.

In at least three (3) countries towns are partially served by sewage collection systems with ineffectively located marine outfalls discharging raw sewage, while in

four (4) other countries old collection systems are in poor operational condition receiving wastes beyond their hydraulic capacity and being potential health hazards through leaking pipelines and surcharged manholes.

Apart from the awakening commitment to providing sewerage systems for coping with increasing volumes of wastewater, a common obstacle to countries constructing sewerage systems is their inability to provide the capital funding for construction. A major cooperative effort by Regional countries, heavily assisted by International Donor and Lending Agencies is required to effect sewage clean-up through the public health and environmentally protective construction of sewerage systems.

Sewerage Proposals

Sewerage and other sewage disposal proposals submitted for eleven of the twelve (12) countries studied were:

Anquilla

Studies and preliminary sewerage designs for the main town, The Valley.

Antigua

Studies, Final Design and Investment negotiations for the construction of a sewerage system for the capital city, St. John's.

Aruba

Studies and preliminary design for a sewage treatment facility and/or a long marine outfall, with extensions to the existing sewage collection system at St. Nicholas. Also proposals for improved management, with training for the Oranjestad Sewage treatment plant staff.

British Virgin Islands

(a) Tortola

Sewage treatment and marine studies for the technical and economic feasibility of treatment prior to ocean disposal of Road Town sewage; sewerage and other sewage disposal studies for smaller communities at East End, Long Look et al.

(b) Virgin Gorda
feasibility study for sewage disposal, groundwater badly polluted by sewage with widespread parasitic infection.

Dominica

- (a) Investigations into the condition of Roseau sewer system, feasibility studies for phasing collection systems at adjacent housing estates into the Roseau system, and linkage of coastal outlets to sea into a limited number of interceptors channelled to a treatment plant or long marine outfall.
- (b) Studies for sewerage systems for coastal towns of Castle Bruce and Portsmouth.
- (c) Staff training and general strengthening of sewerage management.

Grenada

Investigations into the condition of sewer system in St. George's, and studies and design for sewer systems in the River and Tempe areas and phasing into St. George's system; and design of sewage treatment for the St. George's system.

Montserrat

Pefeasibility sewerage study for City of Plymouth and sewage disposal studies for densely developed housing estates.

St. Christopher-Nevis

- (a) Feasibility study and preliminary sewerage design for City of Basseterre and adjacent Ponds Pasture Industrial Park and Bird Rock Residential area.

St. Lucia

- (a) Final design and funding for small sewerage systems at Anse-la-Raye, Micoud, Dennery and Faux-a-Chaux.
- (b) Studies and preliminary design for central sewerage system for Vieux Fort.

- (c) Study of river and coastal pollution by sewage at Soufriere.

St. Vincent

Finalise drawings, specification etc. for extension of Kingstown Sewerage System and technical and financial assistance with construction.

Trinidad and Tobago

(a) Trinidad

Studies and update of final design for extension of sewerage system along Eastern Main Road, Port-of-Spain, and studies for treatment and disposal of industrial wastes.

(b) Tobago

Studies and final design for a sewerage system for south-west Tobago.

Regional Cooperative Approach to Improving the Sewerage Sector

The paper cites and commends individual countries and International and Regional Agencies for cooperative efforts in implementing sewerage systems. Cited are the Frigate Bay system, St. Christopher; the system at Cable Beach, Nassau, Bahamas; the Grand Anse-Morne Rouge system to be executed in Grenada; and the completed Bridgetown sewerage system technically and financially assisted by CIDA, CDB, USAID, and the IDB respectively.

But cognisant of the current financial constraints of countries in the region and the limited technological and trained manpower resources, a cooperative regional approach to improving the sewerage sector seems imperative.

In seeking technical and financial assistance from countries, and International and Regional Lending and donor Agencies, consideration may be given to making requests on a sub-regional basis and/or where physical and pollution and environmental requirement commonalities make assistance feasible to the region as a whole.

Note should be taken of the Mediterranean experience where sixteen (16) sovereign countries joined in the "Barcelona Treaty" to obtain assistance from several International Lending/Donor Agencies to clean up the

Mediterranean sea and coastal areas of sewage and industrial pollution, which was taking that water body to ecological, economical and environmental disaster.

Annex 2 tabulates the UNECLAC project proposals for Regional Sewerage and sewage disposal with costs and recommended schedules.

Status Report on the Sewerage Sector in Trinidad and Tobago

by

E. D. Sharma, Er. M. Kerof and Er. A.S. Tota

1. Introduction

In introducing the report it was stated that approximately 30% of the population of Trinidad and Tobago (which number 1.2 million) is served by centralised waste water systems. The rest of the population is served by septic tank soakaway systems and pit latrines. There are however areas of dense populations that are in crying need of centralised systems.

Historically, it was reported that Trinidad first sewerage system was constructed in Port-of-Spain in the year 1861, with the first major sewerage works built in 1902 having the Mucurapo Pumping Station and a sewer along Wrightson Road to which street sewers were added until 1935-1937 when another sewerage construction was carried out. Between 1937 and 1962 no further sewerage development took place.

The year 1962 saw the beginning of the country's largest single sewerage project when Port-of-Spain, San Fernando and Arima were sewered, with its completion in 1965 resulting in the construction of 384 km. (243 miles) of sewers ranging from 150 m.m. to 1800 m.m. (6" to 72") diameter, with pumping stations and treatment plants in all three municipalities.

The Water and Sewerage Authority (WASA) was formed in 1965 and became responsible for the development of a more comprehensive and dynamic policy for the provision of sewerage facilities, objectives including:

- (a) Expansion of the existing systems within the constraints of sound economic policy
- (b) Connection of all properties which can be served by the Sewerage System.
- (c) Provision of sewerage and sewage treatment facilities for non-housing and industrial developments.

Financial limitations have kept the development of the sewerage facilities to a modest level. Conditions point to the pressing need for a greater thrust in sewerage development in the present and next decade if the country's deterioration of health standards and the environment are to be halted.

Since 1965 major housing, commercial and industrial developments have taken place in the East - West corridor from Carenage to Arima, in San Fernando and in most major population centres. In the absence of public sewerage systems there have been a proliferation of package sewage treatment plants in these developments throughout the country.

2. Waste Water Department

To give more attention to the operation and maintenance of the waste water systems, WASA restructured the operation and maintenance department with two (2) engineers having sole responsibility for the operation and maintenance of the waste water system. In 1989 the department was upgraded with a Chief Engineer as its head, and with the department assuming responsibility for all aspects of waste water management including investigations, design and formulation of policy and procedures.

3. Existing Sewerage Systems

Major waste water facilities are in Port-of-Spain - central and environs - Arima, Trincity, Chaguaramas, San Fernando, and Package plants in newly developed communities, country-wide. Highlights of some pressing problems in existing systems follow:

Port-of-Spain

Sewers in Central Port of Spain are now inadequate to handle waste water loads because of -

- (a) age
- (b) increased loads due to expansion and construction of high-rise buildings; and
- (c) change in types of waste e.g. grease from fast food outlets.

Because of high strength industrial wastes and increased loads, lagoons are overloaded and practically filled with sludge. In addition the 48" force main from the main pumping station to the lagoon is in poor condition.

Chaguaramas

The facilities are in disrepair, some components of the system not functional, hence the entire system needs design and reconstruction.

San Fernando

Many areas, some heavily populated and lying just outside the city are still using septic tanks and pit latrines despite the unsuitability of the soil for disposal. Conditions are a threat to public health. The existing system needs to be expanded.

Package-Type Treatment Plants

It is a national Statutory requirement that private housing developments in excess of 30 lots must provide a central sewerage system. There is thus a proliferation of small, and not so small package sewage treatment plants throughout the country discharging effluents into streams and in the sea. With poor operation and maintenance of the majority of plants, health hazards and a potentially dangerous situation now prevails.

Following the declaration of Trinidad and Tobago being a sewer area from 1987, with the authority to charge sewer rates outside sewered areas, WASA may now take over and operate private sewerage systems. But problems exist in such takeovers, e.g.

- Plants in disrepair requiring extensive refurbishment
- Equipment in plants from many countries e.g. USA, UK, France, Germany et al
- Many private development companies having gone out of business have difficulty in determining negotiating party for WASA takeover.

National Development

During the boom years of 1978 and onwards, capital works programme undertaken was broadly based on large projects in virtually every segment of the country's social and economic infrastructure, except sewerage. Within the last decade with the significant increase of housing developments, and the proliferation of package sewage treatment plants therefor, particularly along the East-West corridor, steps were taken to prepare final sewerage designs for along the Eastern Main Road in 1982, but construction has been shelved due to the downturn in the economy.

The Government's Current Economic Plan places heavy emphasis on the provision of adequate infrastructure in accordance with the pivotal roles assigned to agriculture, tourism, manufacturing and energy. In support of the tourism

thrust, priority will be given to improvement of water supply, electricity and upgrading development of waste water (sewage) disposal facilities, and transport facilities in areas with high tourism potential. In this tourism thrust, the sewerage of South-West Tobago becomes a critical project for execution. The implementation of this project is urgent as, inter alia, it is required to preserve the coastal environment of Tobago, as it relates to and affects recreation and the marine ecology, especially the Buccoo Coral reef of South-west Tobago.

The national Sewerage Projects with budgeted costs are given at Table 3.

TABLE 3
National Sewerage Sector Projects
Budgeted Costs

| A R E A | Estimated Population (1990) | Approximate* Costs \$ (Millions) |
|---|-----------------------------------|--|
| 1. Greater Port of Spain to include desludging of Beetham Lagoons, design of additional treatment facilities replacement of force main reconstruction of downtown P.O.S. sewers and sewerage Santa Cruz, Maraval, Diego Martin, East Dry River etc. | ** 15,000 | 140 |
| 2. South West Tobago | 25,000 | 60 |
| 3. Scarborough Tobago | 10,000 | 15 |
| 4. East-West Corridor | 300,000 | 600 |
| 5. Greater San Fernando | ** 30,000 | 60 |
| 6. Couva/California | 25,000 | 50 |
| 7. Chaguanas | 50,000 | 100 |
| 8. Point Fortin | 10,000 | 20 |
| 9. Mayaro/Guayaguayare | 10,000 | 20 |
| 10. Chaguaramas | 5,000 | 10 |
| T O T A L | 480,000 | \$M 1,075 |

* These figures are very approximate and should be considered as subject to fairly substantial variation until more detailed studies are completed. They are based, primarily, on the figures given in the Metcalf & Eddy report on 'Sewerage Facilities' (1968), and the Attas and De Four reports on Sewerage Systems for Tobago and the East-West Corridor. The costs have been increased to take care of inflation and possible changes in the scope of work involved.

** Additional population to benefit.

ORGANIZATIONAL ASPECTS OF SEWERAGE SECTOR DEVELOPMENT

Organizational Aspects of Sewerage Sector Development

by

Eng. Raymond Reid: PAHO, Washington

A. National Authorities

Sanitary sewers perform a vital public utility function for the development of the community by the collection of water-borne wastes from domestic, commercial and industrial sources to a central point of discharge.

Responsibility for the construction, operation and maintenance of sanitary sewer systems are usually delegated to one of the following entities:

- National Water and Sewerage Authorities
- City council
- Special Commission
- Sanitary District

B. Consultants

These are professionals involved mainly in the planning and designing of sewerage facilities, and providing information and training, namely:

- Engineer and Engineering firms
- City Planner - Physical Planner
- Government Agencies providing information
- School of Engineering
- Engineering Associations

C. Contractors

- Builders
- Manufacturers: Pipe - Sewerage Plants - pumps etc.
- Plumbers

D. Regulatory Agencies

- Ministries of Health
- Central Planning Divisions
- Local Health Department
- Regional Planning Commission
- Laboratory

E. Operation and Maintenance

- Operators
- Manufacturers of Equipment
- Technical Schools
- Technicians Association

Principal Requirements for Progress and Success¹

The Principal requirements for progress follow:

- (a) Commitment of all concerned is vital for progress and ultimate success. The importance of good health must be analysed with emphasis on the needs to achieve it, coupled with the elevation of concern to areas where action results. Commitment includes the objectives, programs and the resources to do the job.
- (b) Organization of governmental forces for services to be provided is a critical element it is the machine for actual accomplishment. Government's institutional structure must incorporate planning for the organization and coordination of actions needed. With limited resources the process of organization must be efficient from all aspects to avoid duplication, waste and confusion.
- (c) Personnel are essential as they are the only element to accomplish change, and innovately apply what works. Basic measures for the required personnel are quality of performance, dedication and commitment.
- (d) Finances, adequate and on a timely basis are needed. With changing services, Appropriate Technology is as low-cost as possible, and among important considerations is its provision of reliable service, which does not create problems difficult or impossible to solve.

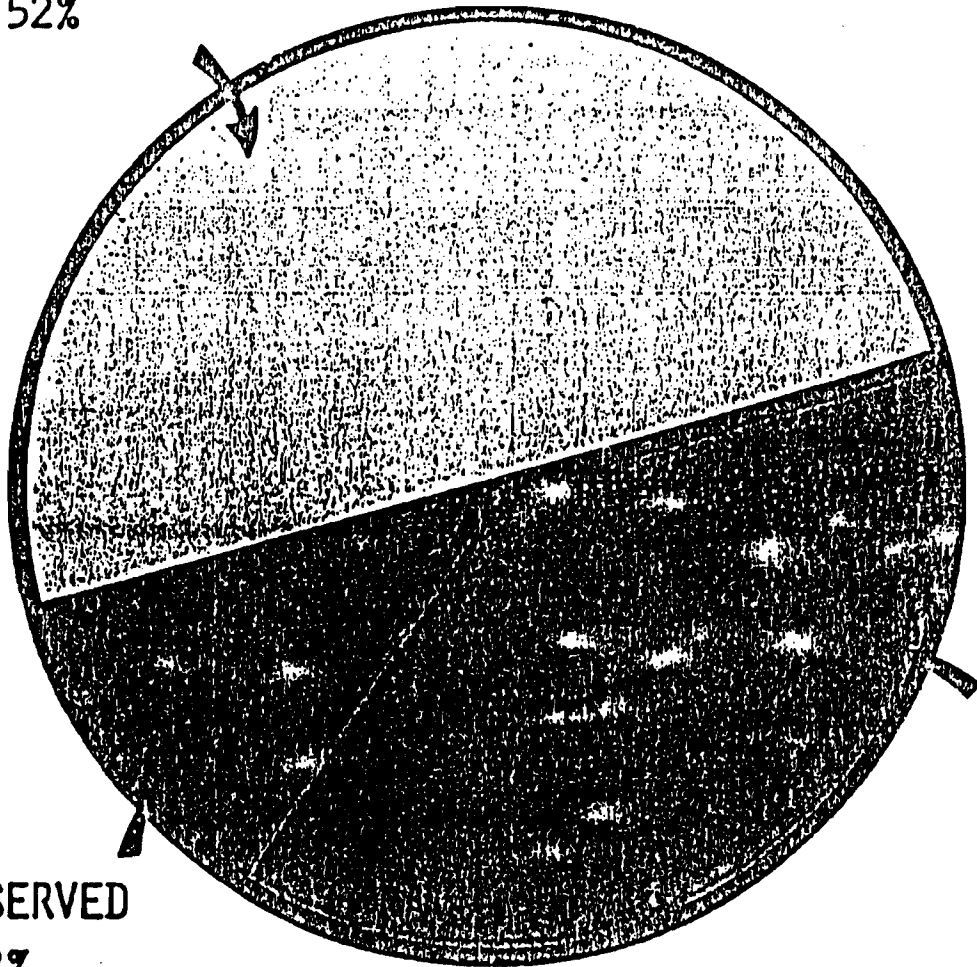
The paper illustrates the Regional Status of the following:

1. Water and Wastes Disposal - The Forgotten Step - F.W. Montari: Report of Survey carried out in Latin America and the Caribbean.

- (i) Coverage of water supplies. See Figure 4.
- (ii) Urban and Rural population with drinking water and sewerage service in Latin America and the Caribbean. See Figure 5.
- (iii) Coverage of Domestic Waste Treatment and Disposal facilities - as at Figure 3.

WATER SUPPLIES

HOUSE CONNECTION
52%



EASY ACCESS
35%

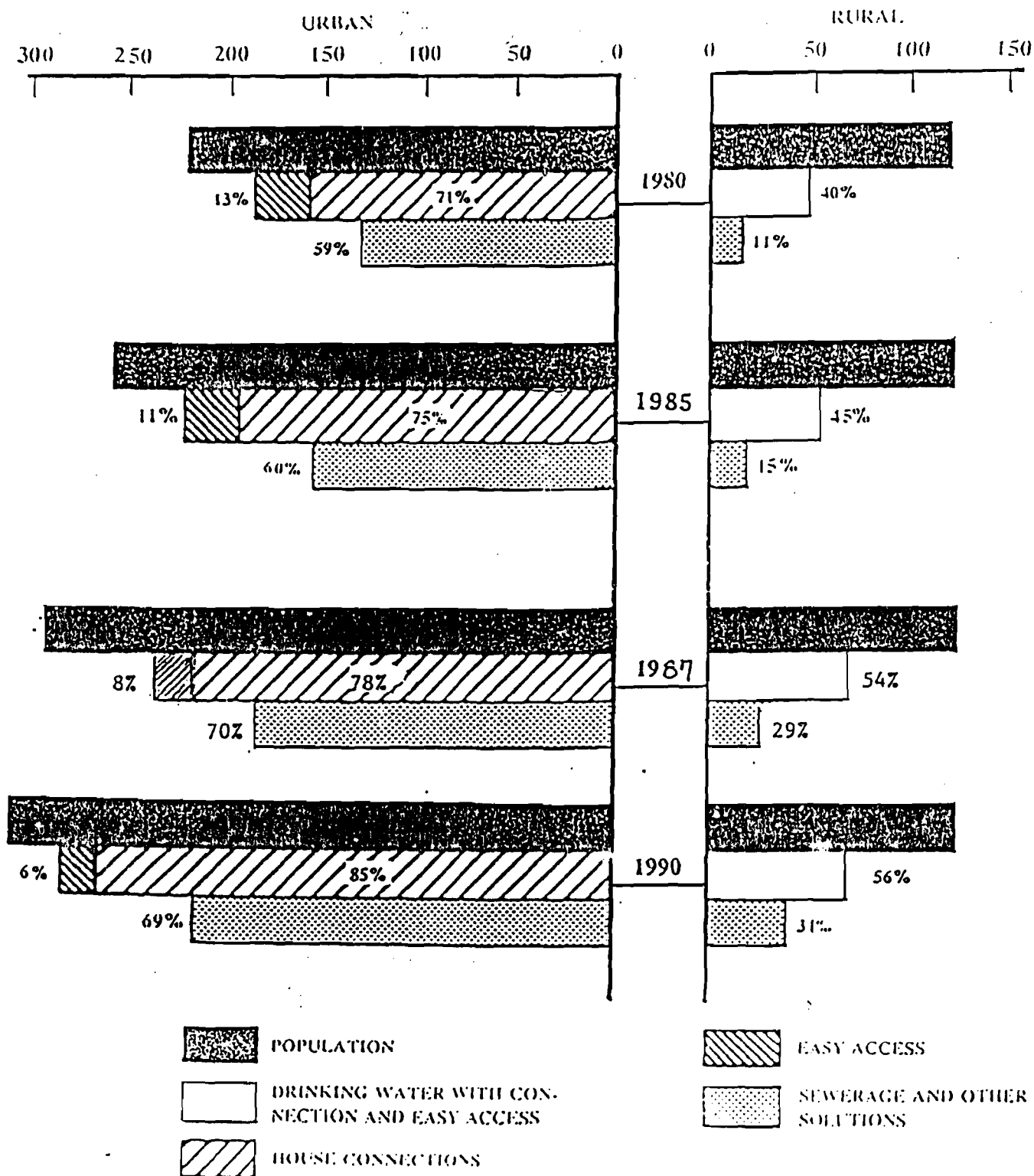
NOT SERVED
12%

FIGURE 4

COVERAGE OF WATER SUPPLIES

URBAN AND RURAL POPULATION WITH DRINKING WATER AND SEWERAGE SERVICE IN LATIN AMERICA AND THE CARIBBEAN 1980, 1985 AND 1987 and target for 1990

FIGURE NO. 5



Note: The information on 1980 and 1990 provided by 25 countries has been updated with new data. Data available in 1983 and 1985. 1987 data were provided by 21 countries.

Changes in urban and rural sewerage and sanitation percentages are due to revision of coverage figures submitted by Brazil.

Conclusions of Working Group Meeting
on Wastewater and Excreta Disposal²

General Conclusions

- The large sanitation deficit, which implies the problem of uncontrolled wastewater and excreta disposal, goes beyond the purely sanitary aspect, and should be considered in a broad social context as it influences the quality of life directly and affects mainly those at the lowest socio-economic levels. The problem has technical, material as well as morel implications and constitutes an important risk to health.
- The program's objective should be extension of coverage of sewerage and excreta disposal services to the whole population. This also implies attention to other problems such as the under-utilization of existing sewerage systems where they exist; adequate wastewater treatment to the risk of environmental pollution; and cost reduction. Contamination of toxic chemicals is also a matter of concern.
- Important advances in simplified technology adapted to the social and economic reality of Latin American and Caribbean countries are known, but the benefits and possible risks need to be technically evaluated.
- To avoid negative reactions it is desirable to speak of "Modern or Advanced Technology" instead of Low-cost Technology since the latter can give the impression of lesser quality.
- In the evaluation of the benefits of a policy for collection of waste-water and excreta, not always measurable objectively by cost-benefit analysis, it is necessary to take into account other less tangible factors beyond the objective appraisal.
- Sanitary Engineers when proposing expansion of sewerage works, should offer alternative solutions, paying attention to improvement of operation and maintenance to increase the efficiency of the service.
- The economic crises countries are experiencing and the need to frame programs within national policies that demand economy, austerity and creation of employment should be taken into account.

2. Extract report of an Internal Working Meeting on the Environmental Health Program at the Pan American Health Organization.

Specific Sectoral Conclusions

Specific detailed conclusions are presented in the sectors of technical aspects, financial aspects, socio-cultural, Institutional and Human Resources aspects, but are briefly summarized hereunder.

Technical Aspects

- Due to the complexity of research on the effects of contact with waste-water and excreta, and the many intervening factors, epidemiological studies do not reach conclusions on health risks. In Regional countries analytical methodology is lacking, along with an operative system of registration, analysis and control of sewerage projects, resulting in lack of systematic evaluation of environmental deterioration.
- Public sewerage is the most effective measure of sanitary improvement in a community, but individual systems well constructed and utilised are also useful health-wise. But frequently the population is not connected to systems due to lack of resources or not understanding the benefits of connecting.
- Standards are generally adopted from developed countries. It is necessary to review and update existing standards. Also modern complex installations lose their efficiency if operated by unqualified persons or for lack of maintenance and replacement of parts.
- In general, operation and maintenance of waste water treatment systems in the region is poor. Lack of training of operatives contribute to the deterioration of services.
- Raw wastewater is used in some countries with sewer systems for agriculture, livestock development etc. This practice brings serious risks to health mainly when used in the cultivation of vegetables eaten raw.

Financial Aspects

- The cost of conventional sewerage systems are high. This impacts most heavily on lower levels of coverage, especially in the current economic crisis.
- External debt of Regional Countries makes the access to International financing difficult, hence countries need to try to assign their own resources to sanitation. However, effects of the economic crisis on employment, inflation, and poverty need to be seriously considered.

- Economic conditions in Regional countries makes it necessary to promote financial contribution from all levels of government to contribute to the finances necessary to solve disposal problems.
- When well informed, encouraged and coordinated, community participation can contribute to the simplification of sewage disposal problems in the poorest communities.

Socio-Cultural Aspects

- Community participation needs to be encouraged in programs of sewage and excreta disposal, in the planning, construction, operation and maintenance of systems.
- Institutions managing sanitary sewer systems need to be more sensitive to social factors. services can be underutilised due to institutions¹ failure to sensitize communities.
- Health Education needs to be intensified in the Region. Sewerage and sanitary disposal of excreta services are not adequately utilised due to lack of Health Education.
- Very alarming is the lack of recognition of the effects of poor sanitation on human health.

Institutional and Human Resources Aspects

- There is need for better institutional coordination in the sewerage and sewage disposal sector at central and local levels.
- Generally local authorities do not receive adequate support from central authorities in the planning, development and financing of service implementation in the sewerage sector.
- A good national sanitation policy demands multisectoral action. Ministries of Health should perform normal surveillance and health promotion functions, while coordinating inter-sectoral action.
- In designing sewerage systems, Urban Development Master Plans must be considered.
- There is need for more human resources for the waste water sector. More programs are required for training of design, construction, operation and maintenance personnel. Also needed are more operation and maintenance programs in Universities instead of the almost singular training in sophisticated technologies from developed countries.

- There is need for the dissemination of technical guidelines, methodologies, manuals and reference material adapted to the actual requirements of countries in the Region.
- Existing legislation is inadequate and inappropriate for advanced or modern technologies, e.g. there are legal difficulties in acquiring land and rights of way for sanitary works.

RECOMMENDATIONS

- Give high priority to sewerage, wastewater and excreta disposal services in the marginal urban and rural areas.
- Expand the coverage of sewerage systems without neglecting treatment, while keeping in mind the possibility of recycling and the need to meet sanitary standards.
- Proceed gradually and by stages to the planned extensions of coverage using solutions adapted to each socio-economic stratum - the socio-economic conditions of the population - giving appropriate consideration to individual disposal systems.
- Intensify and encourage scientific and technological research on sanitation with special support to the Institutions responsible or, if necessary, promote the creation of centres or national institutes devoted specifically to this activity.
- Establish in each country an information system and the evaluation of the services of water supply, sewerage and excreta disposal, to evaluate the different methods proposed and adopted and their actual operation, as well as coverage and economic factors.
- Adopt the term "Modern Technology" or "Simplified advanced technology" instead of the currently used expression "low Cost Technology" that is often interpreted as technology of low quality.
- The extension of coverage of sewerage systems should include compulsory house connections.
- The expectations and cultural patterns of populations to be served by sanitation projects should be considered in sanitation projects.
- Maintain up-to-date information on the progress in solving problems of contamination caused by toxic chemical substances in wastewater.

FINANCING OF SEWERAGE SECTOR DEVELOPMENT

FINANCING OF SEWERAGE SUB-SECTOR DEVELOPMENT

by

Ms. C.A. Peters, Caribbean Development Bank

Many utilities throughout the Caribbean are responsible for both water supply and sewerage. But water supply is given priority to the detriment of sewerage development. In general there is cross subsidization between the two, with water supply revenue subsidizing sewerage operations. With financing agencies now suggesting elimination of cross subsidization, to accomplish viability of the sewerage sub-sector, proper planning for its financing is now necessary. The highlights of the more important aspects of financial management applicable to the sewerage sector follow.

The financing is divided into two categories consisting of:

- (A) The financing of capital sewerage works,
and
- (B) The financing of sewerage operations.

A. THE FINANCING OF SEWERAGE CAPITAL WORKS

To determine the level and method of financing, capital costs for the project must first be evaluated. From reports on the sewerage sub-sector in the Caribbean, substantial capital works need to be undertaken to address existing deficiencies. The magnitude of these planned programmes makes strict control of capital expenditure imperative. This can be achieved by capital budgetting which involves:

- (i) Generation of investment proposals;
- (ii) Estimation of cash flows for the proposal;
- (iii) Evaluation of cash flows;
- (iv) Selection of projects based upon an acceptance criterion; and
- (v) Re-evaluation of investment projects after their acceptance.

Having identified problems and methods of solution for a capital development programme a least cost analysis to find the least cost solution for each problem at an adequate discount rate should be performed. These aggregated solutions can then be aggregated into one capital development programme. Capital costs must also contain costs for mitigation methods, for adverse environmental impacts, and also for training and attachments. CDB uses the Net Present Value (NPV) to determine the least cost solution.

Financing Capital Investment Programme

This programme can be financed in two ways:

- (i) Internal generation of funds; and
- (ii) External financing.

External financing precedes internal generation of funds.

External Financing

External financing can be accomplished by a number of methods which include:

- (i) Government equity;
- (ii) Government loans;
- (iii) Financing Agency Equity;
- (iv) Financing Agency Loans;
- (v) Commercial Bank Loans; and
- (vi) Developers contributions

Government Equity

This can be by the provision of goods and services and/or of cash. From the Utility's point of view this is an ideal situation, but from an economic point of view it is not, as government will be subsidizing customers of the system at a cost to the national economy.

Government Loans

The loans to Utilities are normally interest free or minimal interest with negotiable pay back and grace periods. Government needs to carefully consider the method and its effects on the country's fiscal situation.

Financing Agency Equity

This is usually given in terms of goods, services and/or cash, but is tied to terms and conditions which may include procurement requirements of the country. This is normally given on a bilateral basis which may require procurement of

all goods and services from the host country. This increases the cost of the project, and may lead to future maintenance costs.

Financing Agency Loans

These are usually given by both bilateral and multilateral institutions. In multilateral funding for projects a detailed project appraisal is usually performed to determine if the following criteria hold true; the project is

- (i) the least cost solution
- (ii) financially viable
- (iii) economically viable; and
- (iv) environmentally acceptable

Two very important aspects of the appraisal report are the Financial and Economical Analyses. There are normally three (3) criteria used to determine whether a project should be funded; these are:

- (i) Value of the Financial Rate of Return (FRR) should exceed cost of capital for the Utility;
- (ii) Value of Economic Rate of Return (ERR) should exceed the opportunity cost of capital for the country; and
- (iii) Values of FRR and ERR should exceed the rate used to prioritise the project.

For the CDB this combined rate for the FRR is 12% and that for the ERR is 15%.

Because of many difficulties associated with obtaining the financial value of some benefits, for financial analysis, less emphasis is placed on the FRR values and more emphasis placed on the financial projections of the particular Utility and on the rate of return on a rate base, and on the internal cash generation as a percentage of future expansion programmes for the utility. These projections will include the determination and evaluation of tariffs necessary to ensure the utility meet operating costs, depreciation, debt service requirements along with providing counterpart funds for capital projects. Sometimes, in extreme cases, if financial returns are inadequate, social benefits of the project, particularly health, may be sufficiently overwhelming to provide justification for proceeding with the project.

Commercial Loans

These consist of loans at commercial rates and terms, e.g. commercial rates with 5 to 10 years repayment periods. These are generally not recommended for funding sewerage projects because the repayment period is generally less than the payback period of the project.

Developer Contributions

This is equity provided by customers or proposed customers to the service of a particular system. For sewerage projects, this is becoming a more popular form of financing.

B. FINANCING OF SEWERAGE OPERATIONS

The first priority is determination of the operating costs associated with sewerage operations. These expenses can be classified under the following headings:

- (i) Collection system;
- (ii) Sewerage treatment;
- (iii) Accounting and Revenue Collections;
- (iv) Customer service;
- (v) Administrative and General.

For categories (i) and (ii) the expenses consists of:

- (a) Operator supervision
- (b) Labour, power, chemicals and other supplies;
- (c) Maintenance of structures and equipment;
- (d) Transportation;
- (e) Sludge disposal; and
- (f) Insurance.

For (iii), the Accounting and Revenue collection consists of:

- (i) Determination of billing amounts;
- (ii) Customer billing;
- (iii) Accounting;
- (iv) Collection; and
- (v) Cashiers and payment processing.

For (iv) Customer Service, the categories are:

- (a) Customer enquiries
- (b) New service and billing requests, and

for (v) under the heading "Administration and General", the costs are the following:

- (ai) Administrative salaries;
- (bi) Other general office salaries;
- (ci) General office supplies and expenses,
- (di) Special services (Engineering and Legal);
- (ei) Insurance;
- (fi) Other employee costs i.e. Workman's Compensation;
- (gi) Special requirements of grant programmes;
- (hi) Miscellaneous expenses.

Administrative and General expenses are most difficult to assess as workers/staff time and expenses are shared by water and sewerage operations. Two other elements which must be included are costs associated with borrowing money-interest payments, commitment fees, frontend fees and principal repayments - and allowances for depreciation.

In order to finance sewerage operations which include all of the above-mentioned costs an adequate tariff rate is imperative.

Tariffs

Factors considered in adopting an adequate tariff structure include:

- (i) Marginal cost pricing
- (ii) Measures of cross subsidization between more affluent and less affluent users of the system;

- (iii) Billing frequency;
- (iv) Surcharge for industrial users considering large sewage flows and specific strength characteristics of industrial wastes;
- (v) Financial contributions by new customers recognizing previous capital investment by previous and existing customers which will benefit new users.
- (vi) Counterpart contribution by Utility towards funding of projects;
- (vii) Debt service requirements; and
- (viii) Contingency reserves.

Financial Guidelines

Guidelines should be developed to assist the Utility Manager to provide benchmarks to ensure financial strength, and should include the following:

- (i) Revenues should be sufficient to support current expenditures, including debt service and other obligations of the system;
- (ii) Debt should be used only for capital expansion and improvement of plant and not for current expenses;

- (iii) Contingency reserves should be maintained at levels sufficient to provide for unanticipated, non-recurring costs such as major failures;
- (iv) Capital projects financed through the issuance of bonds should be financed for a period of time not to exceed the expected useful life of the project;
- (v) Net revenues (gross revenue less Operating and Maintenance expenses) available for debt service should be generated at a level of 1.2 to 1.5 times the average annual debt service requirement;
- (vi) Net revenues that exceed operating expenses and debt service should be used for capital expenditures, restoration of contingency reserves of the wastewater system, and other wastewater purposes;
- (vii) Capital financing should be provided through debt financing, current revenues, and contributions from developers, customers and other governmental entities;
- (viii) Cost of service studies should be performed periodically and the relation of revenues to cost reviewed annually. Rate increases as appropriate should be recommended when required, but normally, no more frequently than annually; and

(ix) Funds generated by the Utility should be used solely for the development, operation, and maintenance (including payment in lieu of taxes if required) of the wastewater system.

DONORS STATEMENTS AND PANEL DISCUSSION

SUBJECT:

**POLICIES AND PROCEDURES FOR FINANCING
SEWERAGE SECTOR DEVELOPMENT**

Policies and Procedures for Financing Sewerage Sector
Development - Donor Statements and Panel Discussion

Donor agencies represented at the Conference included the Canadian International Development Agency (CIDA), the Caribbean Development Bank (CDB); Germany (GTZ), European Economic Community (EEC), Inter-American Development Bank (IDB).

Brief statements were made by Donor Agencies Representatives followed by a period of lively discussion. In the statements, information included the following:

- (a) IDBs assistance since 1959 with 184 loans to the Region for water and waste water projects for 507 communities at a cost of US\$4.3 billion;
- (b) Germany is providing US\$130 million to the Caribbean for Bilateral and Multilateral projects. Financial assistance is channelled through Regional bodies e.g. CDB, and CARICOM through the Caribbean Environmental Health Institute (CEHI);
- (c) EEC is providing assistance to the Region e.g. through the Lome Convention. Financial and Technical Assistance is being provided on a National and Regional basis. However, sewerage is seen as a very costly sector, and assistance on a multi-donor basis is preferred;
- (d) CIDA has been giving technical and financial assistance in several Caribbean Countries, mainly in water resources, and also in waste water projects e.g. in Grenada, St. Lucia, Dominica, Barbados.

The International Agencies will provide assistance on National and Regional bases, but there must be positive commitments to the preparation and operation of sewerage projects and systems. Technology for respective projects must be compatible with the country's/region's affordability to execute and operate. Information and advice for taking action towards applying for assistance in the preparation and construction of sewerage systems included:

- (a) The priority for the construction, operation and maintenance of sewerage systems must be high. It appears that in many regional countries the priority needs to be upgraded particularly at the policy making level.
- (b) To obtain funding for the sewerage sector, countries must have the following established or in the course of being established or actuated:

- (i) An appropriate institution for managing, operating and maintaining the system. Water and sewerage authorities seem the preferred institution in the Caribbean Region.
 - (ii) A tariff structure for sewerage needs to be established. This should at least meet the financial requirements for management, operation and maintenance, and depreciation of plant. It is highly desirable that the tariff contribute to the Authority's repayment loan.
 - (iii) The mechanism for inter-sectoral coordination and participation in the preparation, construction, operation and maintenance of the system(s) is essential.
 - (iv) Staff must be well trained, experienced and competent personnel to operate and maintain the system. Appropriate training must be an established preparatory factor in the application for funding.
 - (v) Appropriate, strong legislation must be enacted to, inter alia, achieve maximum connections to system and to ensure collection of tariff rates.
 - (vi) In large high cost sewerage projects it may be necessary for the country to apply to more than one funding/donor agency for financial assistance.
- (c) International lending/donor agencies will be reluctant to provide financial assistance in the sewerage sector if the above items are not established or are not being undertaken, but would offer technical assistance leading to the preparation and construction of sewerage systems once their priority has been truly established.

Discussion

In the course of discussions details given on progress in some countries included statements that a high priority is given to the sewerage sector in most Caribbean countries, but economic problems are the major obstacle to pursuing funding of the projects; e.g. in Jamaica, the priority is highest in urban, sub-urban and tourism areas. Areas where existing systems are being extended and upgraded include Kingston, Ocho Rios and Negril. Grenada is establishing a Water and Sewerage Authority to take over from the Central Water Authority, with sewerage taken from the Ministry of Health. Dominica is planning the change of responsibility of the Roseau sewer system from the City Council to the Water Authority.

Intersectoral Consultation is on the rise with Planning Ministries and Units being the coordinating agencies. Trinidad and Tobago with perhaps the strongest Water and Sewerage Authority in the Eastern Caribbean sub-region has established a planning unit which will negotiate with lending/donor agencies for funding. However, in many other regional countries planning departments/units are the focal point of inter-sectoral consultation, and negotiation with the funding agency. Such agencies exist in Jamaica, Dominica, Grenada, Barbados et al.

It was further concluded that in approaching negotiations with funding agencies for the development of the sewerage sector, countries in the region would not be handicapped to any great extent as, in general, the expertise is available in government ministries, to whom the agency/unit responsible for sewerage sector developments/projects can resort for the required negotiating expertise.

Other Papers Distributed but not Presented at Conference

- (i) Paper on "National Development and the sewerage sector in the Caribbean" prepared by Lester H. Forde Ph.D of the Trinidad and Tobago Water and Sewerage Authority.
- (ii) Paper on "Sanitation in Latin America and the Caribbean: The Achievement of the International Drinking Water Supply and Sanitation Decade." Distribution Restricted.

SECOND DAY JUNE 14, 1989

SEWERAGE PROJECT DEVELOPMENT

SEWERAGE PROJECT DEVELOPMENT

by

Eng. C. Pemberton

1. INTRODUCTION

1.1 Sewerage systems have been constructed in the Caribbean as far back as the nineteenth century. The city of Port-of-Spain, Trinidad and Tobago's first sewerage system was constructed in the year 1861. Other Caribbean countries with sewerage systems installed include St. Lucia, Dominica, Grenada, St. Vincent, the Bahamas and Jamaica. However, the need for new sewerage systems throughout the region has been identified. (Archer 1988).

1.2 Like all other construction projects, a sewerage project is developed along a well defined cycle, i.e.

- (i) Project identification
- (ii) Preparation and Appraisal
- (iii) Execution
- (iv) Operation and Maintenance
- (v) Evaluation

1.3 The gestation periods of sewerage projects are long and in all but a few cases facilities are constructed, while in even fewer cases do the constructed facilities function adequately. Each utility represented at the conference would find in its archives, prefeasibility and feasibility studies, detailed designs, and on the ground, partially constructed and in many cases malfunctioning sewerage systems. Improvements can and must take place in sewerage project developments to adequately respond to the demands for sewerage facilities throughout the Caribbean.

1.4 Generally the in-house capability of sewerage Authorities or Companies to generate funds to undertake development projects is very limited, hence a substantial number of sewerage projects will have to be undertaken utilising financial assistance from donors.

2. Project Identification

2.1 The process of project identification begins with the identification needs and ends with the decision to cater for such needs. The problems generating the needs for sewerage systems are many and include:

- (i) the adverse consequences of improper disposal of sewage which can lead to the transmission of diseases including Typhoid fever, Dysentery, Cholera and Infectious hepatitis;

- (ii) the wanton destruction of the environment by untreated and partially treated sewage from homes, commercial and industrial enterprises;
- (iii) the stench from wayside drains;
- (iv) the destruction of our coral reefs, sea grasses and mangrove swamps; and
- (v) floating solids, grease, scum, and the high turbidity of our sea-bathing waters.

These are all ample evidence of the need to undertake measures to properly collect and dispose of our sewage. It is thus imperative that adequate sewerage facilities are planned and installed parallel with physical developments, i.e. housing settlements, tourism complexes and Industrial Estates.

2.2 The old sewers in the Region suffer from a variety of operational problems including (i) under capacity; (ii) tree roots growing through leaks in pipe joints; (iii) open joints, particularly old cement-sand joints; (iv) cracks in pipes; and (v) settlement of pipes causing formation of solids pockets reducing pipe capacity and even causing blockage.

Rehabilitation of sewers in many instances such as in Dominica is imperative.

2.3 The need for sewerage projects in the Caribbean can be justified by:

- (i) the existing heavy backlog of sewage collection and disposal problems;
- (ii) the need to forestall creation of new problems; and
- (iii) the need to rehabilitate old sewers.

2.4 Sector Plans

When the number of projects identifiable based on foregoing needs are viewed against available human and financial resources, time constraints and the apathy of decision-makers, the problems appear insurmountable. But proper sewerage sector planning may offer a solution. The basic objectives of sewerage sector planning should:

- (i) quantitatively and qualitatively present service levels and set targets to be achieved within a given time;

- (ii) determine resources required for achieving targets and identify constraints which emerge when requirements are compared with available resources; and
- (iii) establish investment priorities which should lead to the formulation of a complete investment programme for the sector.

2.5 Where in-house resources do not exist, donors like CDB are willing to consider technical assistance both in preparation of the sector plan or the wider institutional strengthening programme which includes provision of an in-house sewerage sector planning capability.

2.6 Pre-feasibility

Following the development of the sector plan prefeasibility of project identification follows. The study should include:

- (i) a broad definition of project objectives followed by a review of objectives of the sector plan;
- (ii) projection of demands for the sewerage service;
- (iii) identification of major constraints to project development with possible solutions, and also identification of available technological choices.
- (iv) establishment of applicable engineering criteria;
- (v) preliminary designs of alternative schemes to meet project objectives;
- (vi) assessment of environmental impacts of alternatives;
- (vii) preliminary financial and economic cost analyses, and possible sources of funding;
- (viii) processing schedule for project development; and
- (ix) recommendation on whether a detailed feasibility study should be pursued.

2.7 Based on information presented in the pre-feasibility study, the owner is able to decide through project preparation and appraisal whether the project should proceed to the feasibility stage.

2.8 For most owners, in-house capability to perform pre-feasibility studies is not available hence consultants have to be engaged. Donors, including the CDB are willing to consider technical assistance in the form of loans, contingent recoverable loans or grants for employment of consultants to undertake pre-feasibility studies.

3. Project Preparation and Appraisal

3.1 Project preparation could be taken as the preparation of a proposal for review at the appraisal stage. Project preparation normally falls under the purview of the owner while appraisal is undertaken by the donor.

3.2 Successful preparation should result in a project where:

- (i) objectives of the project are clearly defined, fit into the sector plan, and a strategy for meeting objectives agreed between owner and possible donors;
- (ii) the most appropriate technology and least cost solution is adopted;
- (iii) capability of the owner to properly operate and maintain the completed facility is assessed; institutional improvements re: hiring staff, training and maintenance equipment requirements are known;
- (iv) the project is financially and economically viable; in particular, its revenue generating capacity based on an appropriately developed tariff structure, and the project's contribution to development objectives of the country;
- (v) the project is environmentally sound; and
- (vi) funding requirements are identified and sufficient funds allocated for consecutive stages including operation and maintenance.

3.3 Feasibility Study

The feasibility study covers the following activities:

- (i) A review of the sewerage sector plan; also assessment of alternative solutions involving a trade-off between appropriate technology, least cost solution and environmental impacts leading to preliminary design of the preferred alternative;

- (ii) preparation of cost estimates of the preferred alternative; also the preparation of an implementation schedule;
- (iii) preparation of a financing plan;
- (iv) financial and economic analyses, including effects on the financial viability of the institution; and
- (v) assessment of legislation governing the functioning of the institution, including necessary by-laws.

The feasibility study is normally undertaken by consultants. Financial assistance for engagement of consultants can be obtained from donors as loans and/or contingently recoverable loans or grants.

3.5 Appraisal

In project appraisal, a review of all aspects of the project is undertaken by potential donors to assess whether the project preparation is comprehensive in its scope, and its worthiness of investment. It covers the technical, institutional, economic, financial and social aspects of the project. Following a field visit by a donor's team, and preparation of a report on proposed terms of a loan, a review of the team's report is made by the donor's management before negotiations with the borrower prior to presentation for approval. The entire process of preparation and appraisal for a sewerage project may take between 18 months to 2 years.

3.6 Whether or not external financing of a project is required, the full project preparation procedure is recommended for all sewerage projects.

4. Execution

4.1 The execution of a sewerage project covers the following functions:

- (i) preparation of the contract document and procurement suppliers of goods and services thereof; and
- (ii) construction of the facility in accordance with the contract document.

The paper deals only with the administrative issues of project execution.

4.2 Procurement

Procurement must be managed to serve three objectives:

- (i) It must help ensure the efficient and economical execution of the project;
- (ii) it can be used to promote national goals for development of domestic industry and
- (iii) for balanced regional development or for expansion of small scale enterprises.

The principal steps in the procurement process are:

- (i) preparation of contract documents;
- (ii) advertising, prequalification and issuance of contract document;
- (iii) bid preparation, receipt and opening of bids;
- (iv) evaluation of bids, recommendation and review of award; and
- (v) contract finalisation with winning bidder.

4.3 Donors have guidelines which must be strictly adhered to whenever their funds are used in the procurement of goods and services. Where it becomes necessary to deviate from procurement guidelines, a waiver must be obtained. Annex III summarizes General procurement requirements of IDB, IBRD and CDB.

4.4 Procurement issue donors have to address with increasing frequency is the contracting of construction services vis-a-vis construction by "force account".

4.5 Force Account work has inherent disadvantages, namely, (i) the risk of political interference, (ii) bureaucratic overstaffing, (iii) lack of financial discipline, (iv) it can inhibit growth of a viable domestic construction industry, and (v) it can seriously inhibit the viability of the owner by the institution having to carry the payload of managerial and supervising staff, and at times for labour where there is not work.

4.6 For sewerage works "force account" could only be justifiable for the rehabilitation of sewers where it would not be possible to measure the extent of work in advance, and when the works would have to be coordinated while maintaining a service to customers.

These conditions can lead to higher costs and the inefficient use of resources.

4.8 Project Management

It is desirable (and necessary for projects using donor funds) that the owner appoints a Project Manager whose duties are:

- (i) representation of the owner in all its dealings with consultants, suppliers and contractors;
- (ii) the issue of tenders, evaluation and recommendation of the award of contracts;
- (iii) cost control;
- (iv) expedition of the submission of certified contractor/supplier claims for reimbursement;
- (v) provide the liaison on behalf of the owner with the donor on all aspects of the project; and
- (vi) preparation of progress reports, and in particular, the construction completion report.

5. Operation and Maintenance

5.1 Sewerage projects produce facilities which have to be operated and maintained. Operational failures are in most instances manifestation of inadequate project development.

5.2 At the commissioning of a project the following should be in place:

- (i) an appropriate technological choice;
- (ii) an operation and maintenance plan, including operating manuals, a system of record keeping and preventive maintenance programme;
- (iii) funds allocated to meet operating costs (wages, salaries, supplies and services);
- (iv) appropriate tariff structure and arrangements for collecting revenue;
- (v) organizational structure, including adequate management, accounting and technical personnel;
- (vi) a functioning training programme;
- (vii) appropriate legislation, including relevant bye-laws; and
- (viii) safety programme and safety equipment for workers.

5.3 The involvement of donors in a project does not cease at the end of the disbursement of funds at the execution stage, but continues into operation and maintenance. The owner is required to submit operating statements. For a sewerage project, information that may be requested for any period under review includes review collected, operating costs, number of sewerage connections made, influent quality to treatment units and effluent quality, treatment plant through put, chemical and biological condition of waters receiving effluent, and a report on the preventive maintenance programme.

6. Evaluation

Objectives

6.1 The objectives of project evaluation are:

- (i) to examine the performance of the organizations that may have had a major input into the implementation of the project;
- (ii) to determine whether the project goals have been attained taking into consideration any changes in scope of work, cost escalation, and time over-run; and
- (iii) to allow future project approaches, policies and procedures to be improved from lessons learnt.

6.2 In the CDB, the principal evaluation products are the Project Completion Report (PCR) and the Ex-Post Evaluation Report.

6.3 Project Completion Report (PCR)

The PCR should be prepared within six (6) months of completion of project implementation, and in the case of special circumstances e.g. contractual disputes, prior to final disbursement. In preparing the PCR, actual time and cost for implementation, operation costs and benefits over the remainder of the project life is re-estimated. Based on information collected, new financial and economic analyses are undertaken. The PCR also comments on performances including those of the executing agency, the borrower, the donor and consultant.

6.4 Monitoring Indicators

For sewerage projects, possible monitoring indicators may include, the number of house of building connections made, revenue generated, incidence of a particular waterborne disease where such disease has been identified as being caused by inadequate sewerage disposal facilities, and chemical and/or biological parameters of waters receiving sewage effluents.

6.5 Ex-Post Evaluation

Ex-post evaluation is usually undertaken several years after completion of the investment. This evaluation may cover the whole of the project cycle or only selected aspects. Ex-post evaluation attempts to analyse all important aspects of the project.

APPROPRIATE TECHNOLOGY FOR SEWERAGE SECTOR DEVELOPMENT

Appropriate Technology and Wastewater Engineering
In Trinidad and Tobago

by

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Introduction

Technology owes origin to man's need to subdue and manage the forces of nature. When the concept of social progress became synonymous with continuous economic expansion the need for debate on Appropriate Technology became urgent.

Some developing countries may possess mature technologies which could with benefit be adopted by other developing countries. Historical and economic factors have militated against such mutual assistance or even the recognition of such a heritage. The "South-South" dialogue of the 1980's, or Technical Cooperation among Developing Countries (TCDC) is tending to modify this situation.

The perception of "appropriateness" for a given developing country at a given time may differ from one advanced society to another. The preferred option often depends on the allegiances of the visiting expert or on the forms of export credit and financial assistance available from the developed country.

A partial example of the problem arose from the adaptation of technology for the waterwall drilling technology by the Water Department in the 1960s. Laboratory testing by the Water Department's chemist confirmed the efficiency of the use of polyphosphates (Calgon) for the sequestering of ferric and ferrous compounds contained in fresh water from the Erin formation, seen as important for development to relieve water shortages in County St. Patrick. An International supplier of pressure filter equipment disagreed with the local findings, and instead, recommended "iron removal pressure filters". It was only after months of discussion that the recommendations of the Chemist prevailed.

The question is asked, what then is appropriate technology for a particular community?

Replying, the paper states, much of the discussion on appropriate technology carries inference that either the Capital Costs, or the recurrent expenses, or both, to the client are thereby lowered. The examples given in the paper, especially the Bon Accord Housing Estate Sewage Works Project, are attempts to throw light on the matter.

In The Beginning

E.F. Schumacher, Economic Adviser to the National Coal Board in Britain in the 1950s who was also predictor of the International Oil Crisis of 1962, is credited with starting the focus on "Appropriate Technology" in the early 1970s with the twin advocates that:-

- (i) technology should be compatible with the general socio-economic conditions in which it is utilised; and
- (ii) the typical analyses of project at that time were inadequate if not misleading tools for application to poor and developing economies.

In attempting to define "appropriateness" Schumacher designated five (5) attributes for the chosen technology:-

- (i) it should have a "human face";
- (ii) it should become cheap enough so everyone can use it, small enough so that it is suitable for scale enterprises, and creative enough so man is not alienated from it;
- (iii) it should facilitate "production by the masses rather than mass production". Mobilizing physical resources in a way that "modern knowledge and experience are made compatible with decentralization, ecology, scarcity of material resources and the need to serve people";
- (iv) it should be labour intensive as far as possible to facilitate the functions of maintenance, repair, replacement, supervision, control and organization;
- (v) it should avoid labour-saving devices (thus creating labour surplus), and should favour self-help methods instead.

Later commentators on "Appropriate Technology" have summarised that the technology should:

- (i) be acceptable and suited to the specific site;
- (ii) be flexible;
- (iii) not necessarily impair the quality of the environment, and
- (iv) intrinsically encourage public participation.

In further postulating the concept of Appropriate Technology it is stated that it has significance for the techniques applied to transfer of technology, and the following observations are made in that regard:

(a) Transfer of Technology

In the absence of prolific indigenous research both at the level of the University of the West Indies and the operating agencies for sewerage services, aggravated by a lack of mechanisms for pooling the experiences of Consultants and Contractors, most information on new products, procedures and processes is introduced with new imports. Actual performance of these new items may fall short of their advertised characteristics. It is then of interest to know how knowledge transfer is facilitated.

Dr. Castro Ranis is quoted as having analysed the historical development experience of Brazil, Germany, UK, USA and other countries and wrote that the critical factors facilitating the successful transfer of Science and Technology from one country to another were:

- (i) sufficient investment in an educational system which imparts a modicum of scientific understanding to a large proportion of the population; and
- (ii) freedom of innovation and application of research from governmental guidance and interference.

Ranis pointed to the relative absence of scientific information in the broader community and official attitudes to science and technology. He found that in developing societies the decision-making echelons of government tended to hold the indigenous scientific and technological community in low esteem. An example given is in the area of storm water management in Trinidad and Tobago where local engineering knowledge could be ignored while storm water mismanagement can be defended as an "act of God".

Legal effects may hinder technology transfer on the grounds of National Security, head office policy, financial decisions to augment home profits or lower environmental and related standards in the recipient communities. The case of the use of "hard detergents" in Trinidad and Tobago illustrates the point. The current controversy over the export of hazardous wastes for disposal in lesser developed economies underlines it further.

Social Orientation

In analysing the social orientation of appropriate technology in Trinidad and Tobago, the paper refers to client preference in the area of social origins of advice which should

not be ignored. The perception of managers of technology of the social status and prospects of would-be recipients affect the level of technology preferred to the recipient community.

Reference is made to medical opinion in Port of Spain prior to 1862 which saw underground sewers as a greater danger to health than open surface drains and gutters, wherein the true question was who would pay for the new sewers to serve low and middle income neighbourhoods. Reference is also made to the period after 1862 when estate labour unrest occurred on the sugar plantations, and the report of the Surgeon General, laid in the Legislative Council in 1906 quoted opinion that former African slaves and East Indian indentured immigrants would have to be coerced into using pit latrines and sewerage facilities. The quotation continued, "besides, the absence of latrines on small and moderately sized estates is not offensively apparent, and no useful object would be served by building them." The pit latrine was thus seen as advanced technology in 1906.

Political Development

The level of political maturity in a recipient country may affect the level of technology transferred. The 1941 US Leased areas Agreement and the Guided Missile Tracking Station at Chaguaramas may be cited. An example is the Imhoff tank constructed at the US Naval base at Chaguaramas which benefitted from work on that system of sewage disposal then taking place in Chicago, Illinois, USA.

Effects of Inappropriate Technology

Technology which is ill-transferred may have severe political consequences. Problems at the project level tend to be reflected in lower benefits to recipients in the forms of lower plant capacity, cost over-runs, longer construction schedules, higher maintenance costs, altered employment generation, diminished institution authority, and allegations of corruption and malfeasance. Not every allegation or instance of corruption, however, should be taken as an indication of inappropriate technology on a project.

Local Perspectives

In addressing the local perspectives on Appropriate Technology, the paper alludes to the problems encountered by Trinidad and Tobago which largely included:

- (a) problems associated with the entry of Britain into the European Common Market which threatened the country's Petroleum interests, and the further threat to the petroleum industry after the

discovery of petroleum deposits in the Gulf of Paria which led to the dispute with Venezuela for oil rights and the eventual demarcation of territorial boundaries for offshore oil production; and

- (b) the "brain drain" through loss of large numbers of professionals and trained technical personnel to North America and other Developed Countries (10,885 persons during the period 1962-1969) trained mainly at the Trinidad and Tobago College of Arts and Sciences, the John Donaldson Institute and the Trinidad and Tobago Electricity Training Programme.

The paper refers to the efforts made by the Government of Trinidad and Tobago to regenerate the pool of trained personnel through bodies including the National Council for Technology Development which was assigned the full responsibility for the Caribbean Industrial Research Institute (CARIRI) and the establishment of the Inter-Ministerial committee under the Chairmanship of the Prime Minister with the authority to coordinate activities related to the development of science and technology, and the funding of specific research and development projects of the highest priority to Government. Reference is made to the fact that, despite these efforts there was a considerable rise in work permits for Professionals (544 of which 489, or 89% in the construction industry 1975-1978) which was cited as a deficiency in local professional firms. The Technology transfer for many reasons, including adequate number of involved local professionals did not occur. Note Table 4(a) and 4(b) recording the emmigration of National Professionals and Expatriate applications for Work Permits.

Despite the heavy influx of professionals, very little of the technological bonanza occurred, and some of the fallout are matters engaging the attention of the Local and International courts. The absence of appropriate consultation alone rendered "Government-to-Government arrangements", by whatever name or device, suspect as an acceptable or efficient vehicle of technology transfer.

In the petroleum industry, April 14, 1989, the Managing Director of Trintoc indicated that present investment in new plants "with their advanced technology and automated processes" required for its success a higher level of "highly qualified professionals which the country does not now have".

Overshadowing all of the above is the question of reliability of official comments on matters of technology after 1962, the year when the technology applied to the operation of Government Departments had become irretrievably out-dated.

Biotechnology

Like the revolution in the management of information, the results of biotechnology have already wrought many changes in the closing years of the 20th Century. The basis of wastewater management and renovation is biological. Biotechnological stripping of grease and scum in sewer blockages points the way.

TABLE 4

4(a) Emigration of National Professionals
1962 - 1968

| Category | Departures | |
|------------------------|---------------|---------------|
| | Numbers | Percent (%) |
| Doctors | 143 | 1.3 |
| Engineers | 170 | 1.6 |
| Nurses | 679 | 6.2 |
| Teachers | 784 | 7.2 |
| Other Professionals | 909 | 8.4 |
| Technicians, Craftsmen | <u>8,200</u> | <u>75.3</u> |
| Total | <u>10,885</u> | <u>100.0%</u> |

Source: Budget Speech, December 11, 1970

4(b) Various Expatriate Applications
for Work Permits

| Group | 1975 | 1976 | 1977 | 1978 | Total |
|--------------------|------|------|------|------|-------|
| Engineers | 15 | 51 | 100 | 101 | 267 |
| Architects | 2 | 2 | - | 1 | 5 |
| Quantity Surveyors | - | 12 | 12 | 13 | 37 |
| Managerial | 30 | 42 | 50 | 55 | 177 |
| Technicians | 7 | 13 | 13 | 22 | 55 |
| Other | - | 3 | - | - | 3 |
| Total | 54 | 123 | 175 | 192 | 544 |

Source: Budget speech December 1, 1978

Coupled with further understanding of cell biology enhanced by laboratory studies in space, biotechnology may demand leaps in sewage treatment without which the "persistent dichotomy" of simultaneous "development and underdevelopment" of which an increasing number of countries speak, is determined on the side of persistent underdevelopment.

Disease Transmitted by Sewage

Acceptable sewage treatment, whatever the technology used, must destroy pathogenic bacteria contained in sewage and industrial wastewater. The treatment process should eliminate those substances which may contaminate sources of food and water. Visual and olfactory nuisance should also be overcome. There are nearly forty (40) diseases that afflict humans which are spread by sewage and wastewater.

Published figures for diseases caused by sewage contamination are shown at Table 5. These figures alone do not support a demand for additional wastewater management and treatment systems. What is not published, nor so easily available, are the costs of various intervention mechanisms in place which have been found easy to administer, e.g. Figure 6 shows statistics on immunizations. In the absence of immunization figures for certain years, the environment itself points to the need for permanent solutions. Periodic fish kills and the death pangs of the Caroni Swamp indicate the presence of the subliminal poisons finding their way into the human food chain. "The beast is vicious: when it is attacked it defends itself; the beast being the environment. In the absence of the necessary surveillance systems to establish background data, and detect the appearance of new occupational diseases it is easy to lose sight of the dangers that exist. The ominous danger is the likelihood of epidemics in the event of failure of the present recurrent interventions.

Values in Wastewater

The volume of sewage and industrial wastewater will grow as population increases and industry expands. Figure 7 shows population growth and growth rate trends from 1844 to year 1990.

There are approximately thirty-two (32) basic processes used in the treatment and disposal of waste water. The application of these theoretical concepts to achieve desired practical results yield the technology. No treatment process yet devised is able to deliver an acceptable quality of effluent at a financial profit. There is mounting governmental pressure to make this happen. Waste water does contain components which should be conserved by the treatment process:

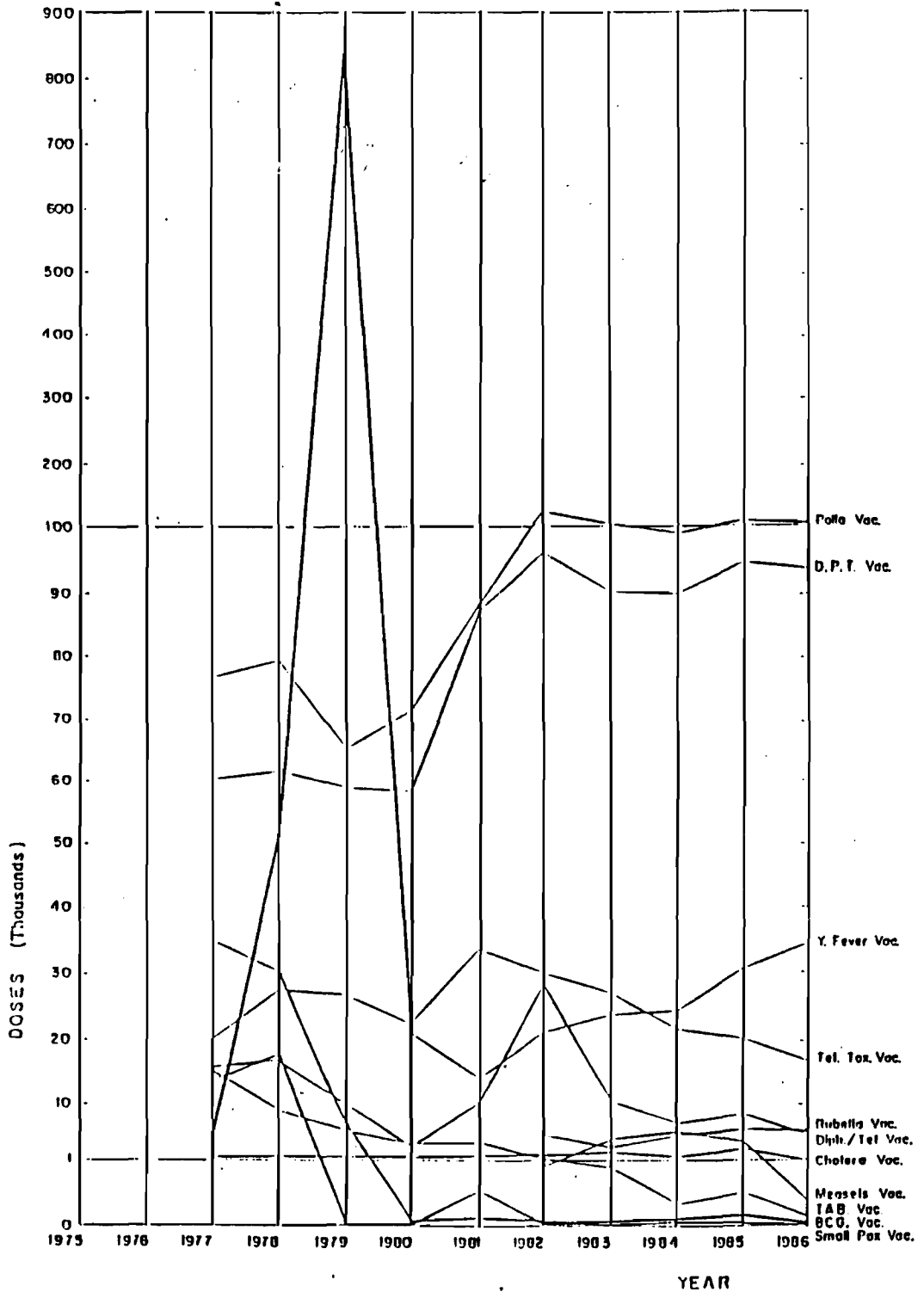
TABLE 5

**Excerpt: Notifiable Infectious and other
Communicable Disease by Number
of cases Reported**

**Sources: Annual Statistical Digest, 1987
: Central Statistical Office**

| DISEASE | Y E A R | | | | | | | | | | |
|----------------------------|---------|-----|----|----|----|----|----|-----|----|----|----|
| | 1978 | 79 | 80 | 81 | 82 | 83 | 84 | 85 | 86 | 87 | 88 |
| Ankylostomiasis | 151 | 82 | 56 | 44 | 43 | 31 | 3 | 66 | - | - | * |
| Enteric (Typhoid) Fever | 9 | 14 | 27 | 20 | 5 | 18 | 25 | 7 | 5 | 5 | * |
| Acute Polio myelitis | - | - | - | - | - | - | - | - | - | - | * |
| Dysentery | 6 | 12 | 7 | 1 | - | - | - | - | - | - | * |
| Leptospirosis | * | * | * | * | * | 27 | 47 | 31 | 24 | 89 | 85 |
| TOTAL | 166 | 108 | 90 | 65 | 48 | 76 | 75 | 104 | 29 | 94 | 85 |

* = Not Available
- = Nil reported



IMMUNIZATIONS GIVEN BY THE PUBLIC HEALTH SERVICE

SOURCE: Annual Reports Of The Ministry Of Health

FIGURE 6.

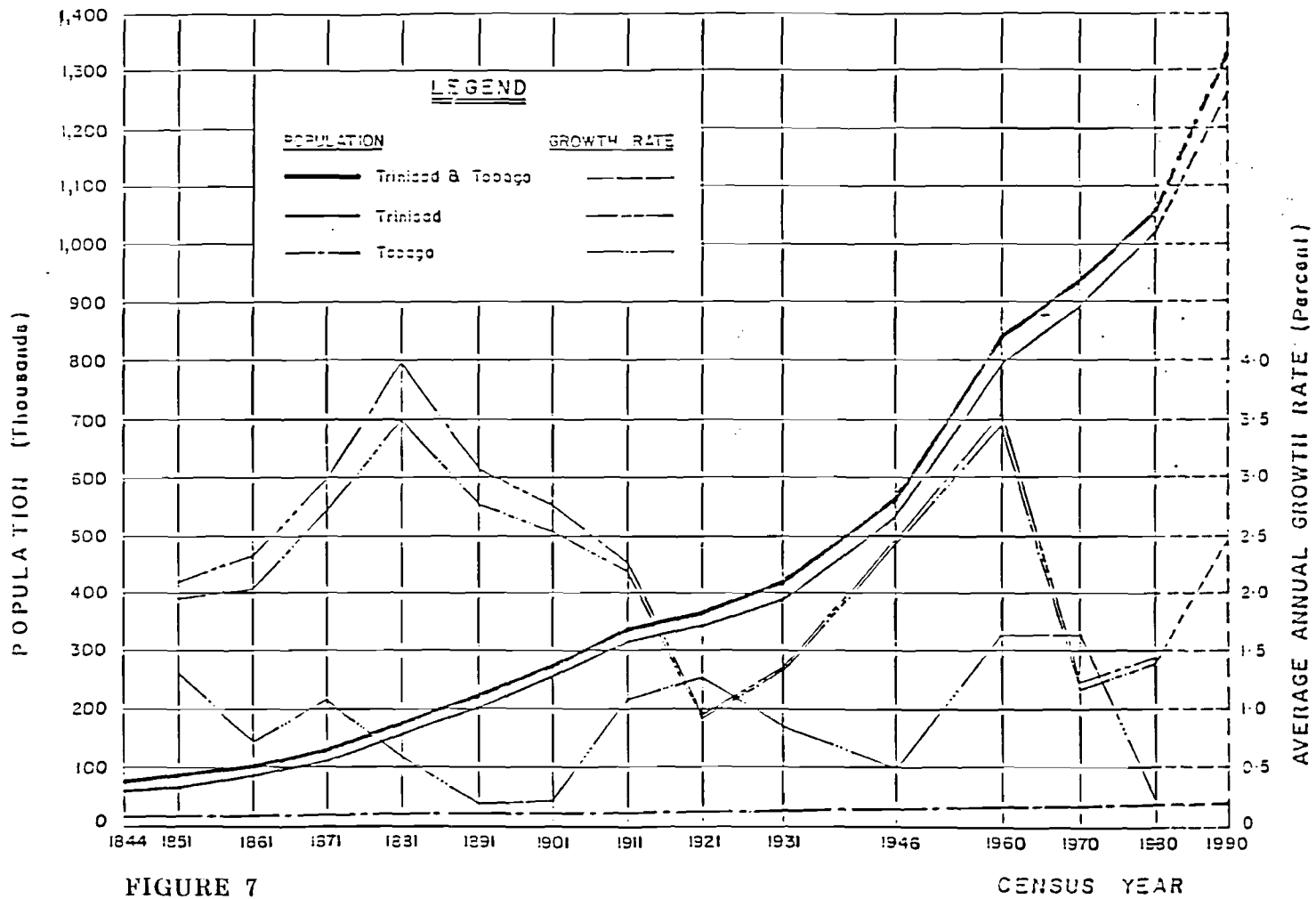


FIGURE 7

POPULATION OF TRINIDAD AND TOBAGO AT CENSUS DATES

SOURCE: C.S.O.'s Annual Statistical Digest

- (i) effluent:
for irrigation, cooling industrial raw-water, aquifer recharge, and counter-current washwater in processing industries;
- (ii) Sludge:
for its values as a fertiliser or animal food;
- (iii) Grit:
for road building
- (iv) gas:
as fuel.

The renovation of "greywater" for watering lawns and gardens at domestic premises is also seen as an outstanding challenge to technological innovation.

Assessment of Appropriate Technology as Applied to Actual Projects

The paper gives details on several projects in assessing the appropriateness of technologies used for sewerage and sewage disposal in different areas of Trinidad and Tobago with differing types and volumes, of flow, quality of effluents, disposal media and environmental impacts. These include:

- (i) The Usine, St. Madeline Project which arose out of efforts by Caroni (1975) limited to curbing pollution of the Ciperro River by waste water from its sugar manufacturing plant at Usine, St. Madeline;
- (ii) Eastern Main Road Communities Sewerage Facilities. This project was designed to serve a population of 415,000 over 7000 ha. plus 66,400 persons to give saturation density. Secondary treatment was the proposed treatment, but provision had to be made for tertiary treatment at a later date. The project was also designed to serve some 132 industries with employee numbers ranging from one (1) to 4,400;
- (iii) Port of Spain Stormwater Drainage Study. This project involved the provision of storm water drainage over the 12 sq. km. of the City of Port-of-Spain, sufficient to cope with a 25 year storm;
- (iv) Couva Sewerage facilities Project, designed to serve an estimated 198,753 persons over 3,975 ha. in 2030 AD, with a total flow of 133,792.7 m³/day, comprising 56,445.9 m³/day domestic sewage, 25,397.4 m³/day industrial waste water and 31,949 m³/day infiltration; and

- (v) Bon Accord Housing Estate Sewage Works Project; included the construction of an activated sludge sewage treatment plant built Circa 1974-75, to serve the Bon Accord 260 unit single family housing estate and to protect the environment and ecology of marine life at Buccoo Reef.

Details of the Couva Sewerage Facilities Project, and the Bon Accord project are cited for assessment of appropriateness of the technologies used.

Couva Sewerage Facilities

The sewerage facilities designed to serve 198,753 persons by year 2030 AD had a total design flow of 113,792.7m³/day. Flow from the PLIPDECO predominately industrial waste estimated at 64,000m³/day, and a further 87,556m³/day from approximately 700 industries were omitted, the latter being required to provide individual wastewater treatment. The scheme comprised the laying of 68.6 km. of sewers with a maximum size of 950 mm., with one (1) treatment works and two thousand six hundred (2,600) manholes.

An examination of "Appropriate Technology" was made, and nine (9) on-site systems for single houses and groups of houses were discussed. A comparison of on-site systems versus central systems were made. Comments were made on the effect of rating structure and the bulk cost of water on the volume of industrial waste water generated.

The report on the project listed ten (10) tenents of appropriate technology including:

- (i) there should be a coincidence of the financial interest of decision makers and the economic and social interest of the community;
- (ii) the difference between appropriate technology and technological gadgetry should be recognized;
- (iii) the key role of shadow-pricing in the selection of appropriate technology should be noted; and
- (iv) the facility of the selected technology to enhance management and other skills of the beneficiary population over time should be studied.

Two systems considered:

(i) Onsite Systems

Because of the relatively clustered settlement pattern and the effective zoning of heavy industry, a close examination was made of onsite sewage disposal systems, the possibility being that such systems be attached to each other as settlement expanded, and costs and benefits could thus grow in step with each other.

(ii) Pressure-Assisted Sewers

A system of pressure-assisted sewerage would have reduced sewer sizes and depth of trench required. This system increased several-fold the dependence of the project on the reliability of the public electricity supply. Although the cost of sewers decreased very substantially, the stand-by power requirements which would have been required rendered the option unattractive.

Bon Accord Housing Estate Sewage Works

The Bon Accord housing Estate Sewerage Works were designed to serve the 260 unit single family housing project. Sewage treatment was by an activated sludge treatment plant designed and manufactured in Trinidad.

The sewage works were identified as part of a "low-cost housing" scheme. Emphasis was placed on minimising cost of infrastructure so that the unit costs for the completed housing project would be attractive. Inadequate laboratory facilities and supervisory office space, and all the undesirable features of part-time resident waterworks supervision for rural water resources mitigated against the efficient operation of the system.

The sewage treatment works, in addition to treating sewage from the homes were intended to protect the marine life at Buccoo and Speyside reefs, as concern for the reefs stemmed from several marine investigations including the work of a committee appointed by Cabinet on May 10, 1969 under the Minister of state of Tobago Affairs to investigate and make recommendations in respect of the operation of pleasure boats, safety of passengers and the protection of marine life.

The plant worked well for a short period, but shortage of maintenance funds and on-the-spot trained technicians, as well as difficulty of transportation of spare parts and chemicals from Port-of-Spain soon led to unacceptable effluent quality.

At this stage it was found that sludge build-up had taken place in the influent and aeration tanks. Destruction of rags and other flotables by burial also proved impractical due to the limestone geological structure of the plant site.

A "Lagoon" excavated adjacent to the treatment works to polish the effluent worked well for a time, but its effectiveness decreased due to sludge build-up in the sedimentation tank and the Lagoon itself. Action to desludge took second place to speculation over whether the lagoon was behaving as an aerobic, facultative or anaerobic unit. Soon essentially untreated sewage was flowing from the "lagoon", and the inlet sewer and the sump of the inlet pumping station were clogged with sediment and detritus.

Following a treatment plant refurbishment exercise in 1981, a renovation job was carried out by the Solid wastes Management Co. Ltd. (SWMCL) resulting in the production of an acceptable quality effluent. A major question during the refurbishment exercise was the bypassing of the plant sewage; for while the malfunctioning of the treatment works was a problem, the flow of raw sewage through private property and into the waters of the coral reef were seen as open sesame to litigation.

Enough is said of the Bon Accord Project to illustrate what may be appropriate to one part of the territory at a given time may be inappropriate elsewhere. The case of Tobago with its perennial problem of "internal and inter-island" transportation, yet a designated high-profile role to play in the national economy is the most poignant example of the need for wisdom in the choice of technology.

Conclusions

From the above comparatively concise presentation of the paper, the following major conclusions may be drawn:

1. The application of appropriate technology to a site offers substantial financial and other advantages to a client and may mean the difference between success and failure of the project to attain its immediate goals and long-term objectives.
2. While appropriate technology takes into account local preferences, current sentiments, and indigenous materials, it does not exclude respect for a knowledge of the wider experiences of the professional disciplines involved.

3. Selection of appropriate technology is a multi-disciplinary exercise which should be preferred by clients and their bankers as the solution to a problem is thereby more likely to be in harmony with the immediate physical and social environment. Inappropriate technology is more costly to all concerned in the medium and long-term.
4. Appropriate technology does not necessarily equate with lower initial investment cost for a project, although it does so more frequently than not. Minimum recurrent costs are almost assured.
5. Wide and meaningful consultation and feedback are necessary to the identification of appropriate technology from which no relevant group should be omitted.
6. Choice of appropriate technology is not a single final act, but is subject to evolution with the management skills of the community.
7. Appropriate technology takes into account the control of extreme environmental phenomena arising on the systems to be designed, constructed, operated and maintained.
8. Choices of appropriate technology in Trinidad and Tobago are affected by social, political and economic ties with the CARICOM region, and there are limits to the degree to which the "more developed countries" can advance beyond the horizons of the "lesser developed countries" in the context of subsisting Caribbean integration arrangements.
9. The social origins of technology are important to recipients for economic, political and other reasons as illustrated latterly by the failure of Trinidad and Tobago in the oil boom years to convert financial assistance within CARICOM to long-term management and services contracts.

SUMMARY REPORT OF WORKING GROUPS

ON

STRATEGIES FOR ACCELERATED SEWAGE SECTOR DEVELOPMENT

(A) STRATEGIES

(B) PLAN OF ACTION

SUMMARY OF WORKING GROUPS' RECOMMENDATIONS

NATIONAL LEVEL

- (1) Evaluation of existing sewerage sector situation:
 - Institutional capacity
 - Legislation and Standards
 - Public awareness
 - Funding possibilities
- (2) Utilisation of projects (with external funding) for all aspects of sewerage sector development.
- (3) Establishment of a "Sector Plan" for sewerage sector development including:
 - agency/system improvement and expansion by projects.
 - raising level of priority for sewerage sector development.
 - improving intersectoral coordination.
 - establishment of effluent and other standards.
 - examination of appropriate technology.
- (4) In the implementation of the sewerage sector development programme:
 - (a) The first priority should be given to institutional strengthening as a prerequisite to project development;
 - (b) The strategy of technical cooperation among developing countries (TCDC) within the region should be used at all times.

REGIONAL LEVEL

- (1) CDB/PAHO/ECLAC/CARICOM should assist Caribbean countries in carrying joint evaluations of their existing sewerage sector situation.
- (2) (a) CDB/PAHO/ECLAC/CARICOM should assist countries in the mobilisation of external resources for national and inter-country sewerage sector development projects.

- (b) CDB should assist in manpower development by mounting (in 1989-90) a 2-week course in sewerage project development.
- (3) CDB/PAHO/ECLAC/CARICOM should assist sector plan development in all countries by providing technical expertise, travelling fellowships, model legislation and standards, etc.
- (4) All donor agencies should be asked to assist in programme implementation by helping to mobilise and fund TCDC assistance in the area.

WORK GROUP SESSION #1

STRATEGIES FOR ACCELERATED SEWERAGE SECTOR DEVELOPMENT

GROUP 1: ORGANIZATION

Organizational Unit

1. Whether or not there exists an Organizational Unit with the resources and organizational structure capable of undertaking the governmental task of accelerated sewerage sector development, what recommendation would you make to government(s) on such a Unit in order to accomplish this?

Human Resources

2. It is generally felt that few Caribbean governments have adequate professionals and technicians trained to satisfactorily operate and maintain sewerage systems in our capital cities and elsewhere. If you agree with this, what can be done about increasing sewerage sector manpower to meet sewerage system expansion in any country?

Other resources

3. Besides Manpower, Agencies/units responsible for the sewerage sector need offices, equipment (office and field), laboratory facilities, etc. To what extent are such other resources available to sewerage personnel to ensure that sector development can be accelerated?

Legislation

4. Are there generally appropriate laws, regulations, procedures and standards in sewage and industrial waste disposal to support accelerated sewerage sector development? If not, list suggested areas for attention in order of priority!

Sector Planning

5. Sector planning is considered the link between national economic planning and project planning, and comprises six steps: Assess present service coverage and standards; set targets for service coverage and standards; calculate the required resources; identify constraints; identify solutions; and set investment/project priorities. To what extent is each of these steps pursued in sewerage sector development in the Caribbean?

Project Management

6. Which is the principal agency of government responsible for taking the lead in coordinating and steering the planning and implementation of sewerage projects by consulting firms (assuming that project funds are from external sources)? and does such an agency have the experience and technical capacity to undertake such a task effectively?

Strategy

7. Based on the above (questions and answers), what does your group recommend as a priority strategy and approach under "Organization"?

GROUP 2: MANPOWER

Quantity

1. Considering that communal sewerage systems exist in many capital cities in the Caribbean and individual systems for coastal hotels, is the present supply of sewerage trained technical personnel in the area adequate to meet operation and maintenance demands of such systems?

Quality

2. What levels and qualifications) of professional and sub-professional manpower - technical and administrative - are needed to provide adequate support for the operation of the sewerage sector in any Caribbean country? (Make assumptions on the sewerage systems involved).

training

3. What is the role and importance of education and training in the provision and utilization of various levels of technical personnel in serving the accelerated development of the sewerage sector in any Caribbean country?

Supervision

4. In the absence of professional engineers and administrators in the sewerage sector in any Caribbean country, the sectoral program is likely to suffer from a lack of supervision. What do you think are the resulting weaknesses that such a program might suffer from in terms of staff performance and appraisal, as well as efficiency and depth of routine and emergency operations?

Career Development

5. In view of the small number of staff positions in the sewerage sector in some Caribbean countries and the inevitable lack of career mobility, what would you recommend to governments who wished to retain their staff while providing opportunities for career development?

Industrial Relations

6. The occupational health and safety conditions of sewerage workers are generally considered more taxing than for water personnel due to the organics and gasses in their working environment. Is this a problem in hiring and employing operations and maintenance staff in the sewerage sector? And if so, what can be done about it?

Strategy

7. Based on the above (questions and answers), what does your group recommend as a priority strategy and approach under "Manpower"?

GROUP 3: PROJECT DEVELOPMENT

Priority

1. What level of priority is being given to the development of the sewerage sector in national development planning in Caribbean countries? Where a low priority is given, what are the reasons for that; and how can the priority be raised?

Identification

2. In most Caribbean countries it is said that there is generally local agreement on the identification of sewerage projects? But do you think that such consideration includes both intersectoral and public consultations?

Documentation

3. The documentation of proposed projects through profiles and proposals often depend on the preparation expertise of donor/funding agencies. To what extent would the development of sewerage projects in the Caribbean be handicapped if such expertise is lacking in the Agency/unit responsible for sewerage sector development?

Appraisal and Funding

4. What are the main constraints experienced in the Caribbean countries in obtaining appraisal and funding of government-prepared sewerage projects by donor/funding agencies? Explain!

Implementation

5. What do you think are the most important responsibilities of a governmental steering Committee during the implementation of a sewerage project? What Ministries/Agencies and NGOs should be represented on the Committee?

Monitoring and Evaluation

6. Do you believe that government personnel in the sewerage sector are capable enough (in numbers and in training) to participate meaningfully in the monitoring and evaluation of sewerage sector projects in the Caribbean? Explain!

Strategy

7. Based on the above (questions and answers), what does your group recommend as a priority strategy and approach under "Project Development"?

GROUP 4: TECHNOLOGY

Appropriate Technology

1. "Appropriate technology" has been defined as "a technology that is technically sound, culturally acceptable, and financially feasible". What role, if any, should appropriate technology play in the selection of sewage/excreta disposal facilities in Caribbean communities, in the context of national development?

Manpower Development

2. Is "appropriateness" a major feature in the technical training of sewerage sector personnel in the Caribbean? Explain with respect to training program content and methodology!

System Design

3. Because of high cost (capital and recurrent) and visibility, sewage treatment plants, are often the focus of public attention. What criteria and guidelines would you recommend should influence the design and location of such plants in the Caribbean.

Public Health Aspects

4. The public health aspects of the disposal of effluent and sludge from a sewage treatment plant are well known; yet it may be appropriate technology in small States to recycle them in the country's water and soil. How can both recycling and pollution prevention be achieved (at low cost)?

System Construction

5. The selection of sewer pipe and other materials, building equipment, the workmanship, the standards used, etc. are fundamental features of sewerage system construction. Discuss the technology options during construction as they apply to Caribbean conditions!

System Operation and Maintenance

6. Simplicity, low-cost and ease of operation and maintenance are welcomed criteria but must be built into sewerage systems at the design stage. How do we ensure that these are included in the Caribbean systems?

Strategy

7. Based on the above (questions and answers), what does your group recommend as a priority strategy and approach under "Technology"?

GROUP 5 : FINANCING

Ecological Csts

1. If one could effectively quantify the economic value of such externalities as rivers, beaches, harbours, marinas and other coastal areas/waters, to what extent should their pollution by domestic sewage and industrial wastes, and the resulting loss of value, influence the installation of sewerage systems in coastal communities in the Caribbean?

Capital costs

2. The capital costs of sewerage system construction (e.g. sewers, plant, outfall, etc.) are so high that Caribbean governments shy away from such projects despite the need for them. Is this statement true or false? Either way, what could be done to counter high capital costs in sewerage system development?

recurrent costs

3. In sewerage sector development, improvements in operations can be brought about by increases in staff and equipment which are bound to lead to increased operations and maintenance costs. The question is: How can systems be expanded and operations improved at minimum annual cost?

Domestic Sewerage Rates

4. It is generally felt that domestic sewerage rates should play an important part in cost recovery for sewerage system construction projects; but in some Caribbean countries (water and) sewerage rates are unrealistically low. What changes, if any, would you recommend in such a situation?

Industrial Effluent Rates

5. Because of the variation in quantity and quality in effluents from industry to industry, special rates are recommended for receiving industrial effluents into public sewers. What is the potential revenue value for such rates in Caribbean countries? Explain.

Project Financing

6. Some government officials in the Caribbean in the past have complained that not enough money is available from international donor agencies for sewerage system construction projects, while donor representatives have suggested that this was not a priority with most governments. What do you think? Comment!

Strategy

7. Based on the above (questions and answers), what does your group recommend as a priority strategy and approach under "financing".

THIRD DAY

REPORT OF WORK GROUP SESSION #1 (CONT'D)

**STRATEGIES AND PLAN OF ACTION FOR
ACCELERATED SEWERAGE SECTOR DEVELOPMENT**

The following are detailed views, conclusions and recommended plans of action of the five (5) working groups

GROUP NO. 1: ORGANISATION

1. SECTOR PLANNING:

Sector planning exists generally and to a large extent they follow the classical methods of planning.

There are, however, variations in each territory influenced by:

- resources
- political considerations
- sociological impact
- institutional requirements

2. LEGISLATION

- there are wide variations with respect to legislation in each territory
- adequacy of legislation
- enforcement
- standards exist with respect to engineering design
- need for new environmental standards.
- new standards to allow for introduction of appropriate technology

3. ORGANISATIONAL UNIT:

- exists in all territories to deal with both water and sewerage
- sewerage has traditionally been the weaker section
- resources are inadequate due to low priority accorded sewerage

4. HUMAN RESOURCES

- there are not enough professionals and technicians
- sewerage sector requires special skills and disciplines

- cycle of development particularly in smaller territories mitigates against rapid development of expertise in the sector

5. OTHER RESOURCES

- larger territories have offices, equipment and laboratory facilities
- integrate facilities regionally for small territories
- maximise use of existing equipment
- recognise different roles of existing operating and regulatory agencies
- standardisation of equipment and procedures for regional institutions in the sector

6. IMPLEMENTATION

- the principal agencies of government are the water and sewerage utilities generally
- in other instances the public works department or even independent agencies have responsibility totally or in part.
- some agencies particularly in the larger territories have the experience and technical capacity

7. STRATEGY

- (i) Establish sector plan
- (ii) establish standards
- (iii) correct the inequities that exist between water and sewerage units
- (iv) recruit and train personnel
- (v) optimise use of existing resources, and assist smaller territories where other resources are lacking.
- (vi) utilise the most efficient organisational form with special emphasis on local or regional expertise.

(vii) educate the public with regards to health and environmental benefits of sewerage sector development.

(viii) sensitise governments to health and environmental benefits of sewerage sector development.

8. PLAN OF ACTION

1. Sector Plan

(i) Mobilize resources for improved sector planning;

(ii) Prepare plan where they do not exist and upgrade in other cases;

(iii) Higher priority should be accorded the sewerage sector by governments in order to prevent irreversible damage to countries' economies particularly in their tourism thrusts.

2. Legislation

(i) Review existing legislation and develop a model act as a guideline for the region's territories;

(ii) Special courts should be established to deal with breaches in water and sewerage legislation;

(iii) A model regional environmental standard must be developed to assist individual countries. The standards must reflect appropriate technology.

3. Organisational Unit

(i) Review existing units in each territory to strengthen the sewerage sections/divisions.

4. Human Resources

(i) Determine the human resources requirements necessary for the effective management of the sewerage sector;

(ii) Recruit and train personnel in the required disciplines;

(iii) Considering the special conditions of the smaller territories, a regional pool of professionals and technicians should be established to assist as and when required.

5. Other Resources

- (i) PAHO/UNEP prepare an inventory of accessible laboratory resources;
- (ii) These resources must be made available to countries that do not have same.

6. Implementation

- (i) Establish a directory of sewerage consultants and contractors from which countries lacking in technical expertise can seek assistance;
- (ii) In order to facilitate technology transfer joint ventures with non-regional countries should be encouraged;
- (iii) Establish a regional engineering review board.

GROUP 2: MANPOWER

1. QUANTITY

After some discussion, the members of the group agreed that the present supply of sewerage trained technical personnel in the area was adequate to meet the operation and maintenance demands of existing systems.

The group was conscious of the fact that the Sewerage sector was in different stages of development in all the territories so that each territory's staffing need would be influenced by the level of sector development.

The group was, however, of the opinion that the current staffing levels would be inadequate to cope with planned development of the sector in the region.

2. QUALITY

The group was aware that the wastewater disposal systems existing throughout the region were of varying levels of sophistication.

The group recognised that the quality of staffing required by the individual countries would be influenced by the level of sophistication of its plant - the more sophisticated the plant the higher the level of qualifications that would be required.

During the discussions, the group assumed that all countries would utilise conventional type wastewater treatment and disposal systems as opposed to package plants and sea out-falls.

It was agreed that the quality and existing level of professional staff was adequate to provide support for the operation of the sewerage sector within the Caribbean countries.

At the sub-professional level it was recognised that there were deficiencies in the quality of technical staff available.

The levels and quality of administrative staff was adequate and in the interest of economy and to minimise duplication of duties, it was agreed that administrative services should be shared by both the water and wastewater sectors where these form part of the same utility.

In order to improve the quality of the Technical, supervisory, and operation staff, some regional certification system should be agreed by all countries.

3. TRAINING

The group recognised the importance of the attainment of basic level of education as a pre-requisite to training and enhancing the technical knowledge of persons who would be required to serve in the accelerated development of the sewerage sector in any Caribbean country.

It was noted that in Trinidad & Tobago three 'O' levels is the basic requirement at Operator Level.

Because of its importance the group agreed that training should especially be concentrated at the Middle Supervisory level.

4. SUPERVISION

The group agreed that countries will not enjoy full economic benefits of their large financial investments if there is insufficient trained personnel to operate and maintain systems.

Unavailability of such personnel would result in

- (i) shortened life of equipment
- (ii) frequent breakdowns
- (iii) inefficiency
- (iv) unreliable services to consumer
- (v) delayed responses to complaints
- (vi) poor operation of maintenance planning etc.

5. CAREER DEVELOPMENT

The group questioned the advisability of compartmentalising the Water Supply and Sewerage Sectors.

The group agreed that there would be greater scope for employee career development if there was freedom for mobility between the Water and the Wastewater Sectors.

6. INDUSTRIAL RELATIONS

The group felt that notwithstanding any stigmas that may be attached to the wastewater sector, there is no substitute for providing safe and hygienic working conditions for employees.

The group recognised that ease of recruitment in the sector was greatly influenced by the level of unemployment existing in the individual country at the time.

The group agreed that the onus should be placed on the employer to ensure safe sanitary working conditions at all times while insisting that all employees utilised protective clothing provided.

7. STRATEGY

After due consideration to the foregoing, the group has recommended the following Sector Manpower Strategy:-

- (i) Prepare Sector Project Development programme for agreed planning horizon.
- (ii) Carry out assessment of manpower and education requirements to satisfy the agreed planning horizon and planned development.
- (iii) Prepare manpower training needs.
- (iv) Review Manpower organisational structure.
- (v) Where cost effective, Training Unit to be set up.
- (vi) Budget appropriate amount for training and staff development.

8. Action Plan

The group came up with the following Action Plan.

Identify

1. A list of activities that can be undertaken.
 - (a) At regional level
 - (b) At national level e.g. training

2. Request assistance from Donors for regional activities.
3. Each country to prepare its own action plan for the activities on the national level:-

This would include:

- (a) Preparation of Project Development and Implementation Plan.
 - (b) Manpower Plan involving:
 - i) Restructuring.
 - ii) Review and where necessary draw up proper job descriptions.
 - iii) Establish goals and perform criteria.
 - iv) Prepare Training Plan
 - v) Prepare Recruitment Plan.
4. Establish systems to monitor and ensure attainment of goals and objectives.

GROUP 3: PROJECT DEVELOPMENT

The following were the Group's conclusions on the requirements for Project Development.

1. Priority

In assessing the level of priority of the sewerage sector in National Development Planning in Caribbean countries, the consensus of the group was that the sector is emerging as a high priority. This view is based on the governments' preparation of legislation for the establishment of Water and Sewerage Authorities to manage, operate and maintain sewerage systems where such legislation and/or authorities do not exist, and the higher allocation of funds in national budgets for social services in general and sewerage and sewerage disposal in particular.

In countries with low priorities, which are quite few, are those where sewerage feasibility studies have not yet been undertaken, or are incomplete as is the case for studies in progress in Dominica. In general, most countries are giving priority to the development of the sewerage sector as the links between the sector and the impact on the quality of the tourism product becomes more apparent.

The priority can be raised in the few countries where priority of the sewerage sector is low by:

- (a) The execution of diagnostic studies of the excreta and disposal practices, and their impact on health, the environment and the economy;
- (b) Educating the populace to the necessity to improve methods of treating and disposing of sewage by the installation of sewerage systems stressing the use of the system in reducing the occurrence of sewage pollution related disease, and the importance of tourism in improving environmental conditions, particularly in coastal areas; and
- (c) Sensitizing policy makers to the necessity of upgrading the health and environmental image of the countries and increasing budget allocations for sewerage systems where required.

2. Identification

In general, sewerage projects are identified in Caribbean countries at the intersectoral level of governments. In most countries, the requirements of clean beaches, marine environments and general aesthetic conditions are impressed on

governments by tourist boards and other NGOs as imperative to the enhancement and sustenance of tourism which is a major foreign exchange earner throughout the region. Consultations on sewerage projects are thus undertaken among government agencies such as Ministries of Health, Public Works, Planning and Finance and Departments/Ministries of the Environment and Boards of Tourism, National Trusts and other cultural bodies.

Public consultation is rare and needs to be developed as a means of identification of and participation in the acceptance of sewerage projects by the public.

3. Documentation

The development of documentation of proposed projects through profiles and proposals, if the expertise for such documentation preparation is lacking in the agency/unit responsible for sewerage sector development would not be handicapped to any great extent as that expertise is generally available in government ministries/departments in Caribbean countries. If and when necessary personnel with the required expertise can be assigned to the sewerage sector agency/unit to prepare the required documentation for the donor/funding agency.

4. Appraisal and funding

The main constraints experienced in Caribbean countries in obtaining appraisal and funding of sewerage projects by donor/funding agencies are:

- (a) The absence of legislation in some countries giving statutory powers to an authority to manage, operate and maintain sewerage systems, or in some countries the incomplete process of enacting such legislation;
- (b) Limited manpower resources with expertise to execute functions of a project execution unit;
- (c) Perceived inability of the country to meet the costs of the management of the completed sewerage project;
- (d) Difficulty in obtaining external financial assistance if the size and cost of the sewerage project requires the necessity to seek assistance from multi-donors, each with differing guidelines and stipulation for execution and repayment.

5. Implementation

The concept of a "Steering Committee" differs in different countries and with different donor/funding agencies. However, responsibilities of such a committee include:

- (a) To ensure that conditions precedent to disbursements are adhered to;
 - (i) the consultants prepare designs, specifications, contracts and documents consistent with the requirements of their contracts with government ;
 - (ii) work schedules are adhered to and invoices are tendered and disbursements made in a timely manner, through information from the project management unit;
 - (iii) coordination of the inputs of member ministries/departments comprising the committee are timely, relevant and meaningful;
- (b) At the construction stage, to see that:
 - (i) resident engineering is being executed efficiently. This information is obtained through the project management unit;
 - (ii) the management of the project(s) in general is being executed as required in contracts with the resident engineer and the contractor(s), and disbursements of the project are being kept within the required tender price(s); and
 - (iii) project phases and completion and kept within agreed schedules.
- (c) The Ministries/Agencies and NGOs which should be represented on the Steering Committee include the Ministry of Finance and Planning, Ministry of Housing, Health and Environment, Works, Housing, project managers and selected NGOs.

6. Monitoring and evaluation

We believe that government personnel in the sewerage sector in the some CARICOM countries have the personnel in numbers and training to meaningfully participate in the monitoring and evaluation of sewerage sector project.

The incapability of some countries is due to inadequate institutional arrangements and management expertise. However, it is felt that these countries can acquire assistance from the countries with existing capabilities on a TCDC basis.

7. Strategy

The Group recommends the following as an administrative strategy and approach to Project Development:

- (a) Establish national policy objectives for the sewerage sector;
- (b) Develop national sewerage sector plans to include:
 - (i) Training;
 - (ii) Establishment of effluent standards;
 - (iii) Means of financing and phasing of project including donor agency assistance and appropriate tariff structures;
 - (iv) Appropriate mechanisms to facilitate public participation.
- (c) Define institutional and legislative framework;
- (d) Seek technical assistance in designing projects;
- (e) Provide budget for counterpart participation and operation and maintenance of finished system.

8. Plan of Action

- (a) From the outset obtain political commitment to the project and its funding and also to concrete legislation to meet the cost of management, operation and maintenance of the completed system.
- (b) Ascertain that documentation required by donor/funding agency is thoroughly prepared and submitted thereto in a timely manner.
- (c) Positively identify and establish the country's project management unit, and staff it with appropriately trained and experienced technical administration and finance management personnel; and
- (d) Establish and maintain intersectoral discussion in the development of the project, and have consultations with and sensitize the public to the need for the sewerage system.

GROUP 3

PLAN OF ACTION

The group recommends the following plan of action for sewerage project development.

- (a) Ascertain that documentation required by donor/funding agency is thoroughly prepared and submitted thereto in a timely manner;
- (b) Obtain political commitment to the project and its funding during execution, and also to concrete legislation, including tariffs to meet the cost of management, operation and maintenance of the completed system;
- (c) positively identify and establish the country's project execution unit, and staff it with appropriately trained and experienced technical administration and finance management personnel; and
- (d) establish and maintain intersectoral discussion in the development of project, and convene an adequate number of public meetings and consultations, particularly in the project area or areas, during the period of project conception to commencement of construction.

GROUP 4: TECHNOLOGY

The Group discussed the question of technology relative to certain given guideline headlines, viz.,

1. Appropriate technology

It was generally agreed that the definition was adequate and acceptable but should not be limited to the development of the sewerage sector alone, but to all aspects of sanitation in the region. The group felt that the selection and use of appropriate technology should play a prominent role, fueled by continuing public education to accept the technology where cultural influence might otherwise lead to rejection.

2. Manpower development

This addresses the appropriateness of technical and other training of sewerage sector personnel in the region. The group responded in the negative, but qualified the statement by stating that in most cases training is limited to a specific plant, as opposed to broader training in the general principles of sewerage plant operations and maintenance. The question of regional training, utilizing existing institutions and established water/sewerage authorities in the region could make a positive impact on our training needs.

3. System design

Plants or systems should be environmentally acceptable, financially affordable, satisfactorily sited with adequate landscaping to enhance the aesthetics of the surrounding and adjacent areas, with security to prevent unauthorized intrusion. Criteria for standards should be as directed or established by the local regulatory body.

4. Public health aspects

The group had a rather lengthy discussion on this, as it was felt that cultural prejudices could cause the rejection of the whole idea of recycling. However, it was later agreed that the effluent could be recycled in areas where ground water would not be readily affected; and digested sludge can be used as a soil conditioner on non-food crops

5. System construction

It was felt that consideration be given to the selection of regionally available suitable materials which are financially affordable, taking into account the operation and maintenance of the system.

6. System operation and maintenance

Having regards to the many problems associated with the operation and maintenance of some plants in the region it was agreed that detailed study of a range of technologies should be undertaken at the feasibility stage and program developed for simplicity of operation and maintenance.

7. Strategy

- Develop and support public education in respect of improved standards for sewage treatment.
- Ensure by research that sewage/excreta disposal systems in the region are technically sound, locally maintainable, culturally acceptable and financially affordable.

Plan of action

- Institute where necessary pre-feasibility studies to determine the need if any for sewerage sector development projects.
- Compile list of available technical human resources within the region.
- The enactment of the necessary legislation including regulations, to control all aspects of the sewerage sector.
- Identify an appropriate existing body that will collect and disseminate relevant information and to effect training programmes at the regional level for technicians and professionals in the sewerage sector.
- Formulate and publish environmentally safe and accepted standards for effluent in Caribbean conditions.
- Formulate and support studies for the identification and selection of a range of technologies appropriate to the Caribbean area.

Group 5: Financing

1. Ecological Costs

On the Caribbean Sewerage projects are usually contemplated on the basis of public health considerations. However, the justification for financing of such projects very often hinges on environmental/ecological benefits.

Consequently, the effective quantification of the economic value of such externalities as rivers, beaches and other coastal areas, and the resulting loss of value caused by pollution by domestic sewage and industrial wastes, should idealistically influence the installation of sewerage systems in coastal communities.

Wherever such costs can be effectively quantified it is imperative that they be included in the economic analysis so as to determine the validity of implementation of the project under consideration.

It should be noted however that although the inclusion of ecological costs in the economic analysis of sewerage projects are theoretically sound, and as such desirable, the accurate quantification of such costs is extremely difficult to ascertain. At best, crude estimates can be made on the basis of assumptions; and these assumptions are themselves subjective and variable.

Admittedly, the apparent lack of ability on the part of planners to adequately quantify ecological costs poses a major deterrent to the acceptance by government of projects worthy of investment. This is hampering the development of the sewerage sector.

It is, therefore, recommended that the institutions involved in sewerage sector development in the region devote some resources to the development of economic parameters for quantification of ecological cost for sewerage projects

2. Capital Costs

It is acknowledged that the high capital costs of sewerage system construction prohibits effective implementation of such projects by Caribbean Governments. The following recommendations are put forward to counter this situation:

- (a) Increased research on alternative low cost technologies;
- (b) Lobbying with donor agencies for more concessionary financing terms for sewerage projects;

- (c) Seeking other innovative means of financing e.g. special bond issues, part financing by private sector;
- (d) Adopting a phased approach to implementation of sewerage sector projects to match available financing;
- (e) Special consideration should be given to making sewerage projects revenue generating. For example, attempts should be made to incorporate other components such as water reuse.

3. Recurrent Costs

With the expansion of sewerage facilities special attention should be paid to the minimization of operations and maintenance costs. It is recommended that certain financial indicators be established so as to provide management with a guide to achieving operational efficiency. Appropriate staff training programmes should be promoted so as to improve performance/productivity.

Sewerage least cost analysis should pay due consideration to discounting rates as they might unduly influence the outcome in the choice between capital vis-a-vis operational costs.

Finally, introduction of new technologies should be encouraged as a means of reducing maintenance costs.

4. Domestic Sewerage Rates

There was no consensus to the supposedly held belief that water/sewerage rates in the caribbean are unrealistically low. However, it is generally felt that in determining sewerage rates the following criteria should be addressed.

- (a) There should be separation of water and sewerage rates so that there is not cross subsidization between the water and sewerage sector.
- (b) Sewerage rates should be charged to allow the sewerage sector to be financially viable i.e. to meet operating costs and meet capital investments.

5. Industrial Effluent Rates

It is recognized that Caribbean Countries are engaged in the process of industrialization of their economies. The potential for revenue generation from disposal of industrial effluents exists although this will depend on the extent of industrialization of the particular country.

The recommended strategy in this case is for the establishment of special standards for discharge of such effluents and establish an appropriate tariff structure on the basis of those standards. Additional rates will be charged once standards are exceeded.

6. Project Financing

Funds are generally available for most Caribbean Countries. However, sewerage projects remain at times as a low government priority. Also; given the weak financial structure of water and sewerage departments, eligibility criteria as set by donor agencies or banks are not easily met.

7. Strategy

Based on the six points discussed above a priority strategy for financing of sewerage projects should comprise the following steps.

- (1) Establishment of Macro Economic framework for project implementation i.e. master plan.
- (2) Project development, this should include:
 - (a) Identification of alternatives paying adequate attention to possibly differing technologies;
 - (b) Determine least cost solution;
- (3) Undertake Institutional Assessment to determine financial health of the implementing agency and it's capability to execute the project.
- (4) Identify funding source(s) e.g. local (private, public); external (loan, grant).
- (5) Determine financing terms. Particular attention should be paid to the revenue generating capacity of the project being considered. This involves the determination of appropriate tariffs so as to ensure amortization cost can be met.

8. Plan of action

- (1) Preparation of Sewerage Sector Plan for individual countries.
- (2) Carrying out of tariff studies where necessary to determine the appropriateness of existing tariff structures.
- (3) Establishment of standards for discharge of industrial effluent.

- (4) Establishment of financial indicators to guide management of sewerage authorities towards attainment of economic efficiency.
- (5) Establish regional "desk" for provision of information regarding new and appropriate technologies for sewerage sector development to the countries of the region.

ANNEXES

CONFERENCE AGENDA

DAY 1: JUNE 13, 1989

TIME

EVENTS

- 9.00 a.m. 1. Opening Session
- (a) Welcoming Remarks by
Eng. R. Williams,
Chairman of Session

 - (b) Brief Statements by
Representatives of
Sponsoring Agencies
 - CDB : Mr. W. Lawrence
 - PAHO : Dr D. Blake
 - UNECLAC: Mr. C. Applewhite
 - CARICOM: Dr. N. Singh

 - (c) Opening Address by:
The Hon. Ms. Pamela Nicholson
Minister of Public Utilities
and Settlements
Government of Trinidad and Tobago

 - (d) Vote of Thanks by Participant
- 9.45 COFFEE BREAK

- 10.00 a.m. 2. Presentation on National Development and
the Sewerage Sector
- (a) Latin America
 by Terrence Lee, ECLAC,
 Santiago, Chile
- (b) Caribbean
 by Dr. Lester Forde of WASA
 Trinidad and Tobago
- 11.00 3. Status Report on Sewerage Sector in
Caribbean Countries
- (a) Sub-Regional Scenario
 by Arthur B. Archer
 of Barbados
- (b) Country Statement
 by Engs. D. Sharma, M. Kerof
 and A. S. Tota of Trinidad and
 Tobago
- 12.30-2.00 LUNCH
- 2.00 p.m. 4. Organizational Aspects of Sewerage Sector
Development
 by Eng. Raymond Reid PAHO, Washington
- 3.00 5. Financing of Sewerage Sector Development
 by Ms. C. A. Peters, CDB, Barbados
- 3.45-4.00 COFFEE BREAK

4.00 6. Donor Statements and Panel Discussion on Policies and Procedures for Financing Sewerage Sector Development. Donors include CIDA, CDB, IDB, EEC, GTZ (Germany)

5.00 p.m. ADJOURNMENT

DAY 2: JUNE 14, 1989

9.00 a.m. 7. Sewerage Sector Development

(a) Eng. C. Pemberton,
CDB, Barbados

(b) Regional Sewerage Studies Initiatives
by Representatives of PAHO, ECLAC and
CARICOM

10.00 8. Appropriate Technology for Sewerage Sector Development
by Dr. E. Millette of Trinidad and Tobago

11.00 9. Panel Discussion on Support for Sewerage Sector Development - Participating countries and Agencies include Trinidad and Tobago, Jamaica, Barbados, Aruba, PAHO.

12.30-2.00 LUNCH

- 2.00 10. Work Group Session #1 on Strategies and Plan of Action for Accelerated Sewerage Sector Development - Five (5) groups on Organization, Manpower, Project Development, Technology and Financing.
- 2.00-2.30 - Presentation by Eng. R. Williams, PAHO
- 2.30-4.00 - Work Groups
- 2.30-5.00 - Plenary
- 5.00 p.m. ADJOURNMENT

DAY 3: JUNE 15, 1989

- 9.00 a.m. Work Group Session #1 continued
- 9.00-9.30 - Presentation by Eng. R. Williams, PAHO
- 9.30-11.30 - Work Groups
- 11.30-12.30 - Plenary
- 12.30-2.00 LUNCH
- 2.00 p.m. 11. Plenary Session on Meeting Report and Recommendations
Chairman: Eng. R. Williams, PAHO
Final Recommendations of Working Groups, Policy, Strategies and Plan of Action.
- 5.00 p.m. ADJOURNMENT
- N.B. Scheduling of events was adjusted as required during the period of the Conference.

U.N. - E.C.L.A.C

REGIONAL SEWAGE DISPOSAL AND COASTAL CONSERVATION PROJECT - SEWAGE DISPOSAL

| Country and Areas | Type of Project - Costs - US\$, 000s | | | | | | Services Person/ Month (External) | Project Duration Months | Country Totals | | | |
|------------------------|--------------------------------------|------------|----------------------|------------|-----------------------------|--------------|-----------------------------------|-------------------------|----------------|-------------------|-----------------|-----------------|
| | Feasibility & Pre-Design | | Feasibility & Design | | Final Design & Construction | | | | Studies \$M. | Services Person/M | Duration Months | Cost US\$ 000s |
| | Est. | Loc. | Est. | Loc. | Est. | Loc. | | | | | | |
| Anguilla | | | 160 | 32 | | | 10 | 3 | 10 | 3 | 192 | |
| Antigua | | | | | 13,525 | 125 | 30 | 24 | 30 | 24 | 13,650 | |
| Aruba | 116 | 24 | | | | | 6.5 | 3 | 6.5 | 3 | 140 | |
| British Virgin Islands | 103 | 15 | | | | | 12 | 3 | 7.5 | 3 | 132 | |
| Dominica | | | 225 | 50 | | | 18 | 6 | 18 | 6 | 275 | |
| Grenada | | | 313 | 50 | | | 19 | 7 | 19 | 7 | 363 | |
| Montserrat | | | | | | | 15 | 1 | 1 | 1 | 15 | |
| St. Kitts | 240 | 30 | | | | | 15 | 3 | 15 | 3 | 270 | |
| St. Lucia | | | | | | | | | | | | |
| Anse-La Raye | | | 40 | | | | 5 | 3 | | | | |
| Micoud Village | | | 50 | | | | 4 | 3 | | | | |
| Dennery | | | 75 | | | | 6.5 | 3 | | | | |
| Faux-a-Chaux | | | 85 | | | | 13 | 6 | | | | |
| Vieux Fort | 203 | | | | | | 13.5 | 6 | | | | |
| Soufriere | | | | | | | 2 | 2 | 44 | 23 | 480 | |
| St. Vincent | | | | | 1,939.6 | 215.5 | 37 | 18 | 37 | 18 | 2,155.1 | |
| Trinidad & Tobago | | | | | | | | | | | | |
| Trinidad | | | | | | | 30* | | | | 30 | |
| Tobago | 301 | 50 | | | | | 22 | 6 | 22 | 6 | 351 | |
| Regional Totals | 970 | 119 | 948 | 132 | 15,464.6 | 340.5 | 79 | 210 | 97 | 210 | 97 | 18,053.1 |

* Local Personnel

| REGIONAL COUNTRIES AND PROJECT AREAS | UN - ECLAC REGIONAL SEWAGE DISPOSAL PROJECT - SEWERAGE PROJECTS SCHEDULE | | | | | | | | | | | | |
|--|--|--|--|------|--|--|------|--|--|------|--|--|--|
| | YEAR | | | YEAR | | | YEAR | | | YEAR | | | |
| <u>ANGUILLA</u> | | | | | | | | | | | | | |
| VALLEY - Study & Pre Design | | | | | | | | | | | | | |
| <u>ANTIGUA</u> | | | | | | | | | | | | | |
| ST. JOHNS Studies Final Des | | | | | | | | | | | | | |
| Investment Negotiations | | | | | | | | | | | | | |
| Sewerage Construction | | | | | | | | | | | | | |
| <u>ARUBA</u> | | | | | | | | | | | | | |
| ST. NICHOLAS Studies Pre Des | | | | | | | | | | | | | |
| <u>BVI</u> | | | | | | | | | | | | | |
| TORTOLA - Studies Pre Design | | | | | | | | | | | | | |
| TORTOLA .GORDA STC. Stud. | | | | | | | | | | | | | |
| <u>DOMINICA</u> | | | | | | | | | | | | | |
| ROSEAU - Studies Design | | | | | | | | | | | | | |
| <u>GRENADA</u> | | | | | | | | | | | | | |
| ST. GEORGES Studies/Design | | | | | | | | | | | | | |
| GOUYAVE Studies/Design | | | | | | | | | | | | | |
| <u>MONTSEERAT</u> | | | | | | | | | | | | | |
| Prefeasibility Studies | | | | | | | | | | | | | |
| <u>ST. KITTS</u> | | | | | | | | | | | | | |
| BASSETERRE - Studies Pre Design | | | | | | | | | | | | | |
| <u>ST. LUCIA</u> | | | | | | | | | | | | | |
| ANSE-LA-RAYE Studies/Design | | | | | | | | | | | | | |
| MICOUD - Final Design | | | | | | | | | | | | | |
| DENNERY - Studies-Design | | | | | | | | | | | | | |
| FAUX-AU-CHAU - Studies/Design | | | | | | | | | | | | | |

| REGIONAL COUNTRIES AND PROJECT AREAS | UN - ECLAC REGIONAL SEWAGE DISPOSAL PROJECT - SEWERAGE PROJECTS SCHEDULE | | | | | | | | | | | | |
|--|--|--|--|------|--|--|------|--|--|------|--|--|--|
| | YEAR | | | YEAR | | | YEAR | | | YEAR | | | |
| VIEUX FORT Studies Pre Design | | | | | | | | | | | | | |
| SCUFRIERE - SIC | | | | | | | | | | | | | |
| <u>ST. VINCENT</u> | | | | | | | | | | | | | |
| KINGSTOWN Design Up Date | | | | | | | | | | | | | |
| Sewerage Construction | | | | | | | | | | | | | |
| <u>TRINIDAD & TOBAGO</u> | | | | | | | | | | | | | |
| SW TOBAGO Studies & Design | | | | | | | | | | | | | |
| Industrial Wastes Studies | | | | | | | | | | | | | |
| E. MAIN ROAD Studies & Design | | | | | | | | | | | | | |

PROCUREMENT REQUIREMENTS FOR CONSULTING SERVICES
(US\$)

| CDB | CDB | CDB | CDB/IDB |
|---|---|---|---|
| Work of Special Nature With few Specialist Firms available | Project Cost <\$200,000 or Fees <\$ 50,000 | Project Cost >\$200,000 or Fees >\$ 50,000 | Fees >\$100,000 Otherwise: CDB 1-3 |
| 1(a) Letters of invitation to qualified specialist firms. | 2(a) Letters of invitation to three or more firms considered suitable to receive invitations. | 3(a) Advertise in newspapers of widest circulation in the territory of the Borrower. | 4(a) See 3(a) |
| <u>PLUS</u> | <u>PLUS</u> | <u>PLUS</u> | <u>PLUS</u> |
| 1(b) Written notification to official representatives in the Borrower's territory of CDB member states and territories and official representatives of other eligible countries. | 2(b) See 1(b) | 3(b) Advertise in at least one newspaper of wide circulation outside such territory. | 4(b) See 3(b) |
| <u>PLUS</u> | <u>PLUS</u> | <u>PLUS</u> | <u>PLUS</u> |
| 1(c) Written notification to the nearest official representative of CDB member states and territories and of other eligible countries where no representative exists in the borrower's territory. | 2(c) See 1(c) | 3(c) Copies of advertisement to official representatives in the Borrower's territory of CDB member states and territories and official representatives of other eligible countries. | 4(c) See 3(c) |
| <u>PLUS</u> | <u>PLUS</u> | <u>PLUS</u> | <u>PLUS</u> |
| 1(d) Written notification to all CDB Directors | 2(d) See 1(c) | 3(d) Copies of advertisement to the nearest official representative of CDB member states and territories and other eligible countries where no representation exists in the Borrower's territory. | 4(d) See 3(d) |
| | | <u>PLUS</u> | <u>PLUS</u> |
| | | 3(e) Copies of advertisement to all CDB Directors. | 4(e) Copies of advertisement to embassies and consulates of all member countries of IDB with offices in the Region. |
| | | Note: If requesting proposals minimum of six weeks between advertisement and closing date for replies. | |

**GENERAL PROCUREMENT REQUIREMENTS
(US\$)**

| CDB | CDB | CDB | CDB | CDB |
|------------------------------------|--|---|---|---|
| \$5,000 Per Unit \$30,000 Total | Works <\$100,000 Goods <\$100,000 | Works \$100,000-175,000 Goods \$100,000-175,000 | Works >\$175,000 <\$500,000 Goods >\$175,000 <\$750,000 | Used Equipment <\$100,000 Used Ships <\$175,000 |
| off the Shelf Any Source) | 2(a) Letters of invitation to three or more qualified contractors or suppliers resident in the territory where the project is located or, if there are not at least three qualified contractors or suppliers resident in the territory where the project is located, to three or more qualified regional contractors or suppliers. | 3(a) Letters of Invitation to three or more qualified contractors or suppliers. | 4(a) Letters of Invitation to at least three qualified contractors or suppliers resident in the territory where the project is located and at least one qualified contractor or supplier from each other eligible country which is a potential supplier of such goods and services. | 5(a) May be procured otherwise than in accordance with the Guidelines with prior Bank approval. |

For other Funding Sources not mentioned use CDB 1-6 where applicable.

| CDB | CDB/IDB | CDB/IBRD | CDB/IBRD |
|--|--|---|--|
| Works > \$500,000 Goods > \$750,000 | Services > \$100,000 Goods > \$200,000 Civil works > \$200,000 Otherwise CDB: CDB 1-3 Private Sector: CDB 1-6 | Civil Works > \$2,000,000 Otherwise: CDB 1-6 | Equipment > \$100,000 Otherwise: CDB 1-3 Private Sector: CDB 1-6 |
| 6(a) Advertise in newspaper of widest circulation in territory of Borrower. | 7(a) See 6(a) | 8(a) See 6(a) | 9(a) See 6(a) |
| <u>PLUS</u> | <u>PLUS</u> | <u>PLUS</u> | <u>PLUS</u> |
| 6(b) Advertise in at least one newspaper of wide circulation outside such territory | 7(b) See 6(b) (But only in CARICOM areas) | 8(b) See 6(b) | 9(b) See 6(b) |
| <u>PLUS</u> | <u>PLUS</u> | <u>PLUS</u> | <u>PLUS</u> |
| 6(c) Copies of advertisement to official representatives in the Borrower's territory of CDB member states and territories and official representatives of other eligible countries. | 7(c) See 6(c) | 8(c) See 6(c) | 9(c) See 6(c) |
| <u>PLUS</u> | <u>PLUS</u> | <u>PLUS</u> | <u>PLUS</u> |
| 6(d) Copies of advertisement to the nearest official representatives of CDB member states and territories and other eligible countries where no representation exists in the Borrower's territory. | 7(d) See 6(d) | 8(d) See 6(d) | 9(d) See 6(d) |
| <u>PLUS</u> | <u>PLUS</u> | <u>PLUS</u> | <u>PLUS</u> |
| 6(e) Copies of advertisement to all CDB Directors. | 7(e) See 6(e) | 8(e) See 6(c) | 9(e) See 6(c) |
| <u>PLUS</u> (if equal or greater than US\$1 an) | <u>PLUS</u> | <u>PLUS</u> | <u>PLUS</u> |
| 6(f) Publication of advertisement in the UN Development Forum (Business Edition). Such advertisement should be sent to the CPO (Technical Cooperation), CDB for transmission. | 7(f) Copies of advertisement to embassies and consulates of all member countries of CDB and IDB with offices in the territory of members of CARICOM and directly to contractors believed to be interested in participating | 8(f) Copies of advertisement to official representatives of all other member states of IBRD and Switzerland in the Borrower's territory that are potential suppliers of the works required. | 9(f) See 8(f) |
| | | <u>PLUS</u> | |
| | | 8(g) Publication of the advertisement in an international publication such as Development Forum or Engineering New Record. | |

COUNTRY STATEMENTS

COUNTRY STATEMENTS

The following are brief records of Country Statements submitted at the Conference featuring the salient factors more relevant to addressing the issues and positive measures in Sewerage Sector Development.

ARUBA

Aruba is a Caribbean island, a separate entity within the Kingdom of the Netherlands. It has an area of 77 sq. miles, situated 19 miles north of Venezuela with a population of 60,000. Topographically the Island is generally flat except for some hills in the central and northern areas. The capital city is Oranjestad with San Nicholas the second town.

Economy

Until 1985 when the Logo Oil refinery was closed, petroleum refining and transshipment was the largest economic activity, producing 420,000 barrels daily from Venezuelan crude oil. Tourism is now the major industrial sector of the country's economy.

The estimated Aruban economy in 1987 was US\$439 million, with a per capita income of US\$6,600. Tourism provides 25% of Gross Domestic product (GDP), and employs 50% of the labour force. In 1987 there was a total of 2,741 hotel rooms, with a projected expansion of an additional 900 rooms by 1990.

Health and Environmental Conditions

Water Supply

Virtually the entire population (98.7%) receive running water from the public distribution system, 0.8% have running water and cisterns or ground water, while only 0.5% receive water by water trucks and other means. The Water and Energy Plant Authority is responsible for water supply.

Sewage and Excreta Disposal

There is a sewer system in Aruba to which most homes are connected, but many of the pipelines discharge raw sewage into the harbour or along the coast-line. There is one sewage treatment plant, an "Oxidation Ditch" at Oranjestad which largely serves the coastal hotel sector. Its operation and maintenance is the responsibility of the Water and Energy Plant Authority. In some areas sewage is discharged into sub-surface pits, but new homes are now required to provide septic tanks to permit the reuse of effluents. Vacuum trucks periodically remove septic tank sludges.

The country statement reports no obvious special sewerage problems on Aruba, however, discharge and possible sub-surface sewage seepage will have to be addressed. In some cases discharges into lagoons cause odour problems which are being resolved by sewage plant improvements or connections to sewers which terminate at the treatment plant.

Serious consideration is being given to the construction of a sewage treatment plant at San Nicholas. Currently sewage from the existing sewer pipelines discharge raw sewage directly into the sea.

There are reportedly no Environmental Laws, Regulations or Standards, which pose Control problems. However, these are being developed. Netherlands, US, and WHO Standards are used as guidelines. An inventory and new baseline survey and coastal water analyses are being planned to obtain basic data.

There is no Sewerage Development Policy. A Committee has recently been established which will address this issue. Plans are to clean the sewerage systems and to improve the existing sewage plant operations.

Conclusions

1. The country can utilise new sewage treatment plants e.g. in San Nicholas, to eliminate raw sewage discharges into the sea and other areas. Discharges of raw sewage into coastal waters need to be eliminated to stop damage to coral reefs and other marine life.
2. Existing sewage treatment plant require expansion in the near future.

Recommendations

1. Adequate legislation for sewerage and sewage disposal should be established and enforced.
2. Introduce modern appropriate, applicable and cost effective existing technology to correct/reduce sewerage and sewage disposal problems.
3. Proper training in process operation and maintenance is required.
4. Periodic Baseline Surveys and Coastal Analyses (5 year) are required to assess norms established are adequate to permit an acceptable marine environment.

5. Special systems must be planned and implemented for chemical wastes treatment and disposal.
6. Consider generation of energy from wastes sludge from sewage plant operation.
7. Introduce levy charges (based on factors for each type of waste) to provide for maintenance and pay-back of loans.
8. Short and long term programmes relative to sewage problems must be prepared.

THE COMMONWEALTH OF THE BAHAMAS

General and Physical

The Commonwealth of the Bahamas consists of a group of 700 islands and Cays stretching 750 miles through the Caribbean from 50 miles east of the South-east coast of Florida to approximately 100 miles north of Haiti and the Dominican Republic. The total land area of the islands is near 5,400 sq. miles with Andros being the largest island with an area of 1600 sq. miles. The Islands of low elevation with the highest point being 200 ft. above sea level at Cat island, while on most of the other islands' highest elevations are no more than 100 feet above sea level. There are no streams or rivers.

The Capital City, Nassau, is situated on the Island of New Providence where 65% of the Commonwealth's population of 210,000 reside. Another 15% live on Grand Bahama with the popular resort, Freeport.

Economy

Priorities within the National Development programme have been identified as tourism and resort development, the major industry of the country which provide 35% of GDP and 50% employment; other priorities include improvement in health care and environmental health, provision of water supply, electricity, telecommunications and an improved network of roads in the country.

Water Supply

The current source of potable water supply is ground water drawn from freshwater lenses underlying New Providence and the neighbouring Andros Island. Well fields in New Providence total 6,000 acres in area with an additional 6,000 acres located in Andros. The average daily supply is 6.5 million gallons, with work in hand to expand the Andros well fields by an additional 2,600 acres.

Health and Environmental Conditions

In the Bahamas and in New Providence in particular, a number of water borne diseases are prevalent. The diseases most frequently encountered, particularly among the poorer sections of the community include Typhoid, Amoebic Dysentery, Gastro-enteritis, Hepatitis, Paratyphoid and Hookworm. Gastro-enteritis is the most prevalent enteric disease with about 2,000 cases per year, a high proportion of the cases being infants under five (5) years old. Dysentery and Hepatitis are numbered between 100 and 150, and 35 to 40 per annum respectively.

Sewerage and Sewage Disposal

The older built-up areas of Nassau have a conventional sewerage system comprising a collection system with a deep well injection disposal system at Malcolm's Park near Nassau Harbour.

Septage from septic tanks, which provide the only available means of sewage treatment for a large portion of the developed areas in New Providence is trucked and disposed of in the Malcolm's Park disposal wells. Sewage disposal with no biological treatment is considered unsatisfactory as there is evidence of sub-surface sewage pollution in water abstraction wells in the vicinity due to faults in the well casing. The Water and Sewerage Corporation has remedial works in hand.

It is the ultimate plan to divert sewage flows from the Malcolm Park well to a central waste water treatment facility to serve a large portion of New Providence, with two subsidiary plants to service the remainder of the island. The Water and Sewerage Corporation has recently commissioned a firm of British Consultants to review earlier reports and update the "Master Plan" for sewerage prepared in 1972.

Sewerage Sector programme

Organization

Sewerage Sector Development is controlled mainly by the Water and Sewerage Corporation as authorised by the 1976 Water and Sewerage Act. The Ministry of health and the Building Control Division of the Ministry of Works and Lands control certain aspects of hotel and condominium development. The Water and Sewerage Corporation has a staff of approximately 360, whose responsibilities include the design and construction of Sewerage Systems. The Environmental Health inspectorate in the Ministry of health with a staff of 300 has the responsibility of policing existing facilities and monitoring pollution, with particular emphasis on ground water quality.

Sewerage and Sewage Disposal - Systems and Problems

On New Providence there are several relatively large centralised sewerage systems, and in excess of twenty (20) smaller systems in varying states of repair, covering about 2,000 of the 54,000 land acres of the Island. Existing systems include pipe gravity sewers, numerous pumping stations due to the flat topography of the land, some primary, secondary and tertiary treatment facilities with effluent disposal via deep wells. Sludge is usually dried and used as landfill or for soil conditioning.

The large majority of the population use septic tanks and soakaways or disposal wells, with the remainder using pit latrines. Areas where sewage disposal problems occur include the dense low income area of Grant's Town, and at Yellow Elder Gardens, a low cost housing scheme served by a malfunctioning Vacuum Sewerage System which is now being replaced by a conventional gravity system.

At present most of the hotels of reasonable size utilise package Sewage Treatment Plants with deep well disposal. Inadequate operation and maintenance of the private plants cause most of the pollution problems, and the water and Sewerage Corporation is pursuing proposals to replace these plants with a centralised sewerage system, especially in the tourism areas. The Corporation operates and maintains all public sewerage systems in New Providence, while privately owned facilities are operated and maintained by owners with the Environmental Health Inspectorate responsible for monitoring effluent quality.

Financing

With the rapid expansion and development of the economy and the demands on Water and Sewerage Corporation facilities, financing of programmes has been sought from various sources including the World Bank, European Investment Bank, the Caribbean Development Bank (CBD) and governmental sources. Cost recovery for water supply is based on metered consumption, and in the case of sewerage the charges are based on a unit rate associated with the number of plumbing fixtures in a property. Ninety-four percent (94%) of the Corporation's revenue is from the sale of water, while the remaining 6% is from the provision of sewerage services. Means are being actively pursued to realise a more sensible sewerage tariff for the services.

Constraints

Finance is a major constraint with only so much money available. A shortage of skilled manpower for installation, operation and maintenance of sewerage facilities is also evident.

Major problems encountered in the recent past have been convincing developers that centralised Sewerage is an essential part of any new development especially as it is relatively expensive in comparison with water, electricity and telecommunications. Additionally public opinion shows a negative reaction to sewerage because of previous problems, and public education of the necessity for centralised sewerage is essential.

Projections for Accelerated Sewerage Sector Development

The Water and Swerage Corporation is presently pursuing a five (5) year programme with financing from the World Bank, CDB, and the European Investment Bank, a substantial proportion of which is sewerage related. If the economy continues to grow an inevitable consequence of expansion will be an increased and extended sewerage system.

Conclusions and Recommendations

Politicians should be lobbied and the general public educated into the necessity of safe and adequate disposal of waste water. They should be made aware of the fact that it is expensive, but the price must be paid because failure to deal with these problems will be disastrous, eventually resulting in serious pollution, possible if not inevitable epidemic and ultimately economic suicide.

COMMONWEALTH OF DOMINICA

Physical Features

The Island of omnica lies in the centre of the Lesser Antilles arc between the French Islands of Martinique in the south and Guadeloupe in the north. it is situated at longitude 61°2' west and latitude 15°2' north. The land area is 298 square miles.

Dominica, a typical volcanic island, has a very rugged and mountainous terrain with 60% of the country covered by forests. 70% of the land area is unsuitable for agriculture mainly because of erosion risks, water logging and poor soils. The Country's highest peak, Mount Diablotin, rises 4,747 feet (1,447 metres) above sea level. Rainfall varies from 70 to 120 inches per annum in the coastal areas and can reach as high as 350 inches/annum in the higher central mountains.

Population

The estimated population of Dominica, 1986, was 80,469. Human settlements are concentrated on the coastal areas and in the valleys. The areas for human settlements are limited and have little or no room for expansion. In Greater Roseau, the Capital, Portsmouth and the North-eastern part of the island, settlements are expanding at the expense of cultivated land.

Economy

Agriculture, the mainstay of the economy accounts for 30% GDP and provides a living for more than 7-% of the population. The most agricultural products are bananas, coconuts and citrus fruit. Other major contributors to GDP are 7% from the manufacturing sector, 10% for wholesale and retail trade and 5% from construction sector which was expected to be a main contributor to GDP during 1988.

Water

Dominica has a good water supply service which is attributable to its abundant rainfall. There are more than forty-five (45) separate water systems serving more than fifty (50) communities. Water works facilities include approximately 129 miles of distribution pipelines, 56 reservoirs, and about 8,500 service connections. The total system serves 68,000 residents or 85% of the population.

Planners and developers are required to submit proposed water supply, storage and distribution to the National Water Services Department (NWS) for approval after the NWS has confirmed its ability to cope with the increased demand.

Sewerage

The disposal of raw sewage and effluents into the sea and coastal ecosystems result in serious pollution and coastal deterioration. Along the west coast between Newtown and Canefield, outflows are discharged untreated into the sea.

The City of Roseau which includes Goodwill and Canefield is the only area with public sewerage. However, this system is old and inadequate resulting in frequent back-up in manholes.

The most common method of excreta disposal is pit latrines used particularly in the rural areas. Sewage and Excreta Disposal is considered inadequate in the areas of Portsmouth, the West coast, Good Hope, Wesley and Calibishie.

Sixty percent of households along the coast are without individual facilities. These household members use the facilities of communal latrines. In Roseau 40 to 45% of households have individual toilet facilities.

Sewerage Programme

Responsibility of sewerage is shared by the Environmental Health Department, Ministry of Health, Housing Division, Ministry of communication, Works and Housing, and the Roseau City council. In Roseau, the Roseau City Council is responsible for the collection of sewerage dues. No dues are collected for the areas of Goodwill and Canefield although being sewered. For disposal of excreta in the rural area, there is

There are presently no sewerage policies or development programmes. Legislation for sewerage is outdated and needs updating and revision. The lack of manpower (trained personnel) and resource allocation for sewerage have been main constraints for sewerage development.

Recently a local consulting firm was contracted to do a feasibility study for the Roseau Sewerage systems funded by the CDB, PAHO and UNDP. The OAS collaborated with PAHO in funding the services of a Sanitary Engineer.

Sewerage Sector project

Completion of the feasibility study of the Roseau sewerage systems will assist identification of sewerage projects. Any proposed project must take into consideration the Housing Development projects within Roseau and its environs e.g. Wall House, Canefield, Goodwill, Simon Bolivar and Bath Estate.

It is expected that by 1990, the responsibility of sewerage will be transferred to the National Water Services Department. Completion of the feasibility study of the Roseau sewerage systems and transfer of sewerage to the NWSA are likely to provide a framework for the policies and priorities of the sewerage sector.

GRENADA

Physical Features

Grenada is located 150 miles southwest of Barbados and 90 miles northwest of Trinidad, in the Windward Islands, at Latitude 12°10' north and Longitude 61°40' west. Its area is 133 sq. miles. Topographically it is mountainous, with the mountains rising steeply from the west coast, and descending gently to the east coast. The main mountain mass runs approximately north-south, with the highest point, Mt. St. Catherine, 2,756 feet (840 meters) above sea level.

Grenada's climate is semi-tropical with a mild dry season from January to May, and a wet season June to December. Annual rainfall varies from less than 60 inches in the coastal regions to between 150 to 200 inches in the mountainous areas. Average annual temperature is 78°F. Grenada's population, according to the 1980 - 81 census is 89,000.

Economy

Grenada has a fairly well diversified economy combining a peasant and export agriculture, with a tourist trade, and a small manufacturing sector. The real GDP in 1988 was EC\$350.2 million, with an average per capita income of EC\$3,350. In 1988, the economy grew by 5.3% and had an inflation rate of 6.5%.

Housing

In 1981, the housing stock stood at 21,017, an average of 4.23 persons per household, approximately 45% of the total housing stock being dilapidated, with 20% unfit for human habitation.

Water Supply

Grenada's Central Water Commission (CWC) operates 28 water supply schemes producing 6.1 to 7.2 MGD. The primary water source is surface water taken from rivers at high elevation. Currently in the distribution system there are 14,062 private running water connections serving 70% of the population, while 4,216 households or 21% of the population are served by standpipes.

Sewerage, sewage and Excreta Disposal

The St. George's Sewerage system is the only functioning system in Grenada which serves 1,200 households representing about 5.7% of the population. The 1988 Statistics of the Ministry of Health show that about 50% of households use pit latrines, 6% are linked to the St. George's sewer system, about 40% use septic tanks while the other 4% have no facilities.

Impact of Development

With the development of the tourist industry, the southern part of Grenada has been the area showing most progress with regards to construction and industrialisation. Hotels, factories, and other businesses, as well as residential construction have been going up at a fairly rapid pace. These developments have led to greater quantities of effluent being disposed in the area, and contributing to marine water quality deterioration and beach erosion. The government is now in the process of finalising plans for sewerage development in the area.

Sewerage Sector programme

At present the Ministry of Health through its Environmental Health Division is responsible for sewerage sector development, but the Division lacks the engineering expertise and the equipment necessary for assuming responsibility for project design, construction, and operation and maintenance in the expanding sewerage sector. Institutional responsibility for the sewerage sector is currently undergoing transition.

The Central Water Commission possesses the nucleus of the required expertise, and currently provides the major technical input into the St. George's Sewerage System - with close liaison with the Environmental Division.

Legislation

Existing Sewerage Sector legislation is considered to be totally inadequate. There are no wastewater treatment regulations defining standards for design or construction of treatment facilities, and for physical, chemical and bacteriological constraints in the discharges of treatment facilities.

Sewerage Systems

The St. George's Sewerage system is the only central sanitary sewer system in Grenada, and serves an estimated 5,000 persons in an area of approximately 480 acres in the town of St. George's, Grenada's capital. The system, reportedly completed in year 1940, does not include treatment. Raw sewage is collected in the sewer pipelines and transmitted via two lift (pumping) stations, force mains and gravity lines to a newly constructed 1250 ft. (381m) marine outfall located off near Queen's Park. Many of the functional problems of the St. George's system were relieved by the replacement/installation of system elements through the CIDA-funded St. George's Marine Outfall/Sewer Project, completed in mid 1988.

The primary sewerage and sewage disposal areas in Grenada are the Grand Anse Coastal area, the St. George's Harbour and lagoon, and the River/Tempe area. The Grand Anse and St. George's Harbour and Lagoon areas have been heavily polluted by septic tank and grey water effluents from hotels near the beach and houses uphill at Grand Anse, Morne Rouge, Carenage, Belmont, Paddock and Spring areas. River Road and Tempe are primarily densely populated elevated areas tributary to the St. John's River, a major vehicle of polluted water and solids which reach the south-west coast as far as Grand Anse.

Apart from localised sewage treatment plants at some hotels and the Point Salines International Airport, all areas in Grenada outside the St. George's sewerage system, are unsewered.

Technology

The septic tank and the privy pit are the primary sewage and excreta disposal technology in use in Grenada. Many septic tank systems do not function efficiently due to high ground water table and low soil permeability problems.

The general practice in suburban areas is the construction of a reduced size septic tank to receive wastes from the WC compartment, while grey water (bath, kitchen and laundry wastes) is allowed to run downhill into concrete and earthen drains. These wastes mixed with septic tank effluent reach the coasts and are a source of heavy pollution.

Major existing problems in the St. George's sewerage system are leakages and excessive deposits in laterals and collectors, due to heavy infiltration, which leads to frequent overflowing of manholes when lift stations come on line, and the periodic malfunctioning of the sewage pump contactors.

Operation and Maintenance

The Central Water Commission (CWC) currently provides the major input into the operation and maintenance of the St. George's Sewerage system. However, the CWC does not have in place a full complement of middle-level skilled technical staff, and the infrastructural support is not presently adequate.

Training

The CIDA funded St. George's Marine Outfall Sewer Project, completed in mid-1988, included the training of CWC personnel in the operation and maintenance of the new equipment and facilities. The contractor for the project also provided CWC and the Ministry of Health with appropriate operation and maintenance manuals for the electro-mechanical components of the system.

Considering the recent upgrading of the St. George's system, the imminent implementation of the USAID funded Grand Anse Sewerage Project, and the anticipated further expansion of the system in St. George's and environs, there is the necessity for a detailed operation and maintenance training programme.

Financing

Subsequent to the completion of the St. George's Sewerage system, 1940, there was no major capital input into the sewerage sector precedent to the Can.\$1.95 million CIDA grant for the St. George's Marine Outfall Sewer project.

The basic thrust of the impending sewerage sector legislation is the establishment of an Authority operated on sound engineering, economic and management principles, with the authority setting rate structures and collecting revenues required for operation, maintenance and debt servicing.

The CWC is currently developing a financial plan, including rate schedules by which the upcoming Grand Anse sewerage project can be financed.

Sewer Sector Projects

Project Identification

The new statutory Body will be responsible for sewerage sector programmes and projects. The Ministry of Health has recently prepared a document outlining a number of projects that should be given serious consideration for implementation, but this will be reviewed with the CWC and the Ministry of Health.

Funding

Current funding of sewerage projects in Grenada is inextricably linked to the development funding thrusts of several International Agencies, primarily USAID and CIDA, e.g. the Grand Anse Sewerage project funded by USAID, the estimated cost of which is US\$3.3 million.

The Ministry of health has identified five (5) specific projects estimated to cost EC\$13.9 (US\$5.15) million, for upgrading the St. George's sewerage system. These projects comprise:

- (i) the Carenage - Melville connector;
- (ii) the Carenage Collector;
- (iii) the General Hospital/Fort George System;
- (iv) the River Road - Tempe system; and
- (v) the Belmont - Lagoon Road System.

Constraints

The primary constraint faced by Government Agencies in Grenada's Sewerage Sector is the traditional total lack of a sound financial base. This has prohibited the allocation of adequate funds for the operation and maintenance of the existing facilities, and totally precluded the possibility of meeting Capital development costs.

In view of the economic problems in developed countries which have led to budgetary constraints on the part of some International Development Agencies, it is widely held in Grenada that the primary condition precedent for the provision of additional development assistance in the sewerage sector, is the creation of a Water and Sewerage Authority.

Conclusions and Recommendations

1. Conclusions

- (i) Tourism is one of Grenada's major foreign exchange earners, and its coastal environment - beaches, bathing water, and coral reefs - is a major tourist attraction. The threat to tourism, and to coastal/urban development, largely through the inability to meet the needs for sewage and excreta disposal, is a major concern for Government and Sewerage Sector Authorities.

- (ii) The implementation of the proposed Grand Anse Sewerage Project is expected to be the most effective mitigatory measure, with positive impacts on tourism, the marine ecosystems, and the general standard of health and wellbeing of the local population.

2. Recommendations

- (i) The primary task which should be addressed by the new Water and Sewerage Authority is the development of a sewerage sector development plan which would include the selection of treatment facility sites, treatment processes and the development of a financing plan and schedule.
- (ii) Detailed feasibility studies and engineering designs for sub-projects incorporating the complete replacement/upgrading of the existing St. George's sewerage system, would be executed to complement CIDA's and USAID's assistance.
- (iii) The impact of the discharge from the recently installed Queen's Park ocean outfall should be monitored as a guide to anticipated impacts in locations off Grand Anse, and the need for effluent treatment.
- (iv) The Ministry of Health should retain a monitoring role with respect to sanitary sewage collection, treatment and disposal as presently exists in the water supply sector.
- (v) A formal training programme addressing the needs of management, operation and maintenance of the sewerage system should be incorporated into project proposals.
- (vi) It is recommended that a large scale, co-operative regional approach to the solution of sewerage sector problems be addressed.

SAINT LUCIA

St. Lucia is a member of the chain of Windward Islands in the East Caribbean, with an area of 238 sq. miles (616 km³). Topographically the island is characterised by numerous mountains and ridges, with approximately 20% of the total land surface being flat. The climate is tropical with a typical dry season from January to June and a wet season from July to December. The annual rainfall ranges from 50 inches (127 mm) on the coast to 180 inches (457 mm) in the mountains.

Population and Economy

St. Lucia's population is approximately 145,000. There is an uneven distribution of population around the island with the greatest concentration, approximately 40% in and around Castries, the Capital and centre of the country's administrative, commercial and industrial activities. The rest of the population is distributed amongst the towns of Vieux Fort, Soufriere, Gros Islet and the remaining villages. The economy of the country is largely dependent on agriculture, and to a lesser extent on Tourism and light industry.

Water Supply, Sewerage, Sewage and Excreta Disposal

The St. Lucia Water and Sewerage Authority (WASA) formerly the Central Water Authority assumed responsibility for sewerage in 1986 following the passage of the water and Sewerage Authority Act in 1984. Until then the sewerage functions were performed by various Government Ministries and Departments including the Ministry of Health through its Environmental Health Branches and the Castries City Council which managed and maintained the only public sewerage system in Castries. Some quasi-government authorities, e.g. the National Housing Development Corporation and the Urban Development Corporation were also involved in the small sewerage systems to serve Government housing Schemes.

Water Supply

St. Lucia's water supply has been developed almost entirely from surface sources and that supplied by the WASA is subjected to all or some of the following treatment processes before distribution: filtration, coagulation where necessary, and disinfection by chlorination.

There are some 38 individual water supply systems due to the country's varied topography, but there are three (3) main systems at Sarot, Hill 20, and Vieux Fort. The overall daily production from all sources averages 7 MGD. Currently, the water supply coverage is as follows:

- (i) Running water house connections - 50% of population
- (ii) Served by public standpipe only - 40% of population
- (iii) No access to first time supply - 10% of population.

The expansion of the water supply system has not kept pace with the rapid growth in demand, especially in Castries and other urban areas. The Roseau Dam project currently under consideration will address this problem where it exists within the project area for the foreseeable future with provision to satisfy demand up to Year 2025.

Sewage and Excreta Disposal

In St. Lucia several different sewage and excreta disposal practices are utilised dependently on geological conditions and the economic status of residents in specific areas.

The privy pit is still very much the excreta disposal method among low income residents in the rural and some suburban areas. The septic tank with a soakaway is the on-site method of sewage treatment and disposal in areas where soil conditions are conducive to absorption. There are however, numerous areas, e.g. North-west St. Lucia, and Micoud, where the hard volcanic subsoil limits effluent absorption with the resultant pollution of terrestrial surrounding streams and rivers.

In the flat coastal areas with high ground water level, the inevitable pollution of the coastal area and the sea results from piping septic tank and package sewage treatment plant effluents into the sea and quite often on the beaches, and subsoil infiltration.

Package Sewage Treatment Plants

The use of package sewage treatment plants is the sewage treatment method used at many coastal hotels and some commercial and industrial properties. Monitoring by the Ministry of Health has found both the effluents and plant operations at some locations below the required public health standards. Up to the end of 1987, the Ministry of Health and the Development Control Authority had frozen development in most sectors of the Rodney Bay area because of poor soil absorption conditions, unsatisfactory operation of some plants, and to ensure that levels of pollution of coastal waters remain below certain acceptable limits.

Coverage of sewerage systems include:

- (i) Castries City Centre - approximately 7km (4.3 miles) of sanitary sewer installed in 1951, disposing through a very short outfall into Castries Harbour.
- (ii) Castries Suburbs - approximately 5km (3.1 miles) of sanitary sewer installed in the late 60's and early 70's discharging into the above noted outfall. The combined conditions of (i) and (ii) are 1,200 residential and 180 commercial, serving 5,400 people.

- (iii) Hotels - under the individual operation of the private hotels there are seven package treatment plants. The St. Lucian Hotel plant also treats sanitary sewage from a section of the Rodney Bay Development.
- (iv) Rodney Bay Marina - privately operated package plant to service the Rodney Bay commercial and Yacht basin areas.
- (v) Other Sewerage Facilities - for those premises not connected to the piped systems disposal is by septic tank, pit latrine or bucket system and public installations. Nightsoil is disposed into the Castries City System and the septic tank sludge into the Union Treatment Plant. Collection and charging is carried out by City Council.
- (vi) Union Treatment Plant - for the disposal of septic tank sludge; consists of three digesters and sludge drying beds, supernatant is disposed of by a soakaway system. The plant is operated by the Ministry of health.

National Development

Up to the present, Agriculture has been the corner stone of St. Lucia's development and this trend is expected to continue into the foreseeable future. It is the largest single employer of labour and the biggest contributor to the national income. It is Government's stated policy at this time to continue to invest in the Agricultural industry, to sustain inducement and incentive, and to promote Agricultural diversification and to modernise and expand this industry.

The second priority for the pursuit of national development is the expansion and upgrading of the "Tourism Industry". St. Lucia is one of the latent entrants in this field, one which is recognized as the fastest field for growth in the entire world. It is now accepted by all policy makers that the tourism industry should be developed to the fullest.

Government's plans for tourism for the next decade envisage the construction of an additional 300 hotel rooms to bring the total rooms available in St. Lucia to 5,000 by the year 2000. This goal is considered desirable so as not to place the country's agricultural resources and environment under undue pressure. To achieve this goal there must be a number of physical complements which must be in place, primary among these being the implementation of an adequate public sewerage scheme.

An overall development strategy (master plan) for the north-western corridor - designated as a "Tourism Zone" - has been developed with the assistance of UNDP. In conjunction with this exercise a Project Evaluation and Assessment of the environmental impact has also been carried out. These studies have revealed the level to which the sewerage sector is required to operate and the added implication of development on this sector.

Sewerage Inadequacies

Sewerage schemes in Castries and the heavily developed north-western region are severely inadequate. At present the pollution of beaches and other negative environmental impacts of untreated and inadequately disposed sewage are imminent if immediate mitigative measures are not implemented. Consequently, the Government of St. Lucia has been actively seeking to implement a public sewerage system in the Rodney bay area in the north. This is a highly developed Tourism area where the environmental impact of inadequate sewerage schemes demands immediate remedial action. Government plans to continue the implementation of public sewerage schemes in the major urban areas on a phased basis thereafter.

Constraints

Having acknowledged the need to embark on an expansion and upgrading of the sewerage sector, the government of St. Lucia has been forced to address a number of related issues. Primary among these is the question of funding. As many other Capital Programmes, the sewerage sector development plans are conditioned by insufficient financial resources. To date, the government has been forced to rely almost entirely on external funding sources to implement sewerage projects.

An additional constraint is the institutional capabilities for design and implementation of sewerage systems. It is recognised that at this time most of the technical expertise required to successfully design and implement such projects are lacking. The government must therefore face the added responsibilities of institution strengthening as an integral part of the development of the sewerage sector.

Sewerage Sector Programme

Organization

Following the passage of the water and Sewerage Authority Act No. 18, 1984, responsibility for sewerage sector development was transferred to the Water and Sewerage Authority.

There has thus been a streamlining of the functions of the organization. The Engineering Division is responsible for the planning and design functions, and has the capability to deal, within limits, with these functions. The Division also provides the maintenance of plant and equipment through the "Support Services" arm.

Legislation, Regulations and Standards

To the date of the Country Statement no special regulations have been prepared by the Authority. No special standards have been prepared although the Authority specifies standards that are acceptable for its individual projects.

Under the Public health Act the Ministry of Health is responsible for policing the quality of effluent from sewerage facilities, and regulations exist under the act for controlling the disposal of sewage.

Sewerage Systems

The areas served by sewerage systems are as follows:

(i) Sections of Castries - as previously stated

- (a) Castries City Centre - comprising approximately 7 km (4.3 miles) of sanitary sewers installed in 1957, disposing of raw-sewage through a very short outfall into Castries Harbour.
- (b) Castries suburbs - comprising approximately 5 km (3.1 miles) of sanitary sewers installed late 1960s and early 1970s discharging into the castries City outfall. The combined systems in the City Centre and suburbs have 1,200 residential and 180 commercial connections serving 5,400 persons.

(ii) Hotels

- (a) There are seven (7) sewage treatment plants at hotels. The St. Lucian Hotel plant also treat sanitary sewage from a section of the Rodney bay Development.
- (b) There is a privately owned and operated package plant at the Rodney Bay Marina servicing the Rodney Bay Commercial and yacht basin areas.

(iii) Vieux Fort Area

A stabilisation pond treatment facility for disposal of wastes from the Black Bay Residential Development was installed by the National Development Corporation.

- (iv) The Hewanorra Airport operates its own private system with treatment by stabilisation pond.

Other Sewage Treatment and Disposal Facilities

- (i) Union Treatment Plant - used for treatment of septic tank sludge; consisting of three (3) digestors and sludge drying beds. The supernatant (liquid) is disposed of by a soakaway system. This plant is operated by the Ministry of health.
- (ii) For premises not connected to the piped (sewer) systems, disposal is by septic tank, public conveniences, pit latrine and bucket facilities. Nightsoil (excreta) is disposed into the Castries City sewer system, and septic sludge into the Union Treatment plant. Collection and charging (fee system) is carried out by the City Council.

Operation and Maintenance

As previously stated, the St. Lucia WASA is responsible for the operation and maintenance of all public systems.

There are no local institutions specifically responsible for training and certification of sewerage operatives. WASA has been arranging training through the Caribbean Basin Water Management Project (CBWMP) for operatives, mainly on water supply at the College of Science and Technology, Jamaica.

Limited operations manuals distributed by plant suppliers and manufacturers are available.

Financing

Financing of sewerage projects is by one of the following methods:

- (i) External Grant Funding from traditional bilateral donor Agencies
- (ii) Loan Funding
- (iii) Developer Contributions
- (iv) Local Government Funding

Identification

Policies and Procedures

There must be need for project:

- (i) Selection on least cost
- (ii) Geological conditions of area
- (iii) Economic situation of beneficiary and affordability
- (iv) Viability of project
- (v) Socio-political considerations and benefits
- (vi) Environmental conditions.

Documentation

Presently a 10 year Capital programme has been prepared for sewerage Development in St. Lucia. See projects and tentative schedules at Table 6.

TABLE 6

Ten-Year Capital Programme for Sewerage Development
in St. Lucia

| SCHEME | EST COST | SCH. NO. | 1986 | 1987 | 1988 | 1989 | 1990 | 1991 | 1992 | 1993 | 1994 | 1995 | 1996 |
|-------------------------------|-------------|-------------|------|-------|------|------|-------|-------|-------|------|------|------|------|
| La Pansee | 708 | 4.1 | 22 | 686 | | | | | | | | | |
| Rodney Bay & Grds Islet | 23500 | 4.8 | | 500 | 5000 | 5000 | 5000 | 4000 | 4000 | | | | |
| Ravine Chabot | 99 | 4.9 | | 11 88 | | | | | | | | | |
| Micoud | | 4.9 | | 44 | 1700 | 589 | | | | | | | |
| Anse-La Raye | 888 | 4.10 | | 5 10 | 300 | 573 | | | | | | | |
| Chege Charles Boulevard | 310 | 4.3 | | | 16 | 294 | | | | | | | |
| Sunbilt | 546 | 4.4 | | | 17 | 529 | | | | | | | |
| Faux-A- Chaux | 1185 | 4.5 | | | | 17 | 1168 | | | | | | |
| Vieux Fort Industrial | 2085 | 4.11 | | | | | 100 | 1985 | U | U | | | |
| George Ville | 468 | 4.6 | | | | | | 22 | | 446 | | | |
| Castries Medium Templan | | 4.7 | | | | | | U | U | U | U | U | U |
| Vieux Fort Town | | 4.12 | | | | | | | | | U | U | U |
| Dennery | | 4.13 | | | | | | | | | U | U | |
| Soufriere | | 4.14 | | | | | | | | | | U | U |
| Minor Works | 500 | 4.15 | | 50 | 50 | 50 | 50 | 50 | 50 | 50 | 50 | 50 | 50 |
| TOTAL | 32622 | | 22 | 1394 | 7377 | 6758 | *6318 | *6503 | *4050 | *50 | *50 | *50 | *50 |

* Part Costed Total

\$'000

U Uncosted Schemes

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