

**NATIONAL DEVELOPMENT STRATEGY
(2001-2010)**

A POLICY FRAMEWORK

ERADICATING POVERTY AND UNIFYING GUYANA

A CIVIL SOCIETY DOCUMENT

ANNEX 15

WATER

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The Annexes to the National Development Strategy: An Explanatory Note

In June 2000, the National Development Strategy (NDS) of Guyana was formally presented to the President of Guyana and the Leader of the Opposition in the form of a core document, a 348 page distillation of the main elements of the analysis of the Guyana situation and the resulting strategy for action drawn from material prepared by 24 sectoral committees of the National Development Strategy Committee (NDSC). While Chapter 1 of the core document provides an outline of the origins of the NDS and the methodology of its preparation, the purpose of the present note is to explain the Annexes to the core document.

The Annexes are edited versions of the original drafts that the sectoral committees prepared, using a format that facilitated systematic thinking, though at the cost of some repetition. They are therefore longer than the corresponding Chapters of the core document, and also differ from them in other ways:

1. While the Annexes were individually edited in terms of their content, in the core document, disagreements or dissonances between Chapters were removed; for example, if the Chapter on the Private Sector proposed a strategy for Education that was in contradiction with a strategy proposed in the Chapter on Education, the two were rationalised.
2. While the core document was updated with the most recent data where possible, the Annexes generally retain their original data; for recent economic and social statistics, the attention of readers is particularly drawn to the recently completed *1999 Guyana Survey of Living Conditions*. In addition, again because of differences in when they were prepared, what was a Bill at the time of the original draft may have become an Act by the time the core document was being edited. This type of difference may be footnoted in the Annexes.
3. The treatment of the Annexes as historical documents occasionally produced another kind of difference, the main example of which is the Annex on Energy which was written before the privatisation of the Guyana Electricity Corporation, and whose strategy was largely preempted by that privatisation; while the edited Annex deliberately relied on the original material, new material was developed for the core document. These differences may also be footnoted.

It is worth noting that the updates found in the core document usually demonstrate the soundness and continued applicability of assessments made on the basis of earlier data or other information.

There are fewer Annexes than there are Chapters in the core document. For various reasons, some sectoral committee drafts were finalised in the same format as the Chapters of the core document, and there would therefore be little difference between the Chapter and the corresponding Annex. (Examples of this are the Macro-Economic Strategies and the Management of the economy; Sugar; Urban Development; Land; Housing; and The Family). The core document also includes Chapters for which there were no corresponding sectoral committee drafts; the first three Chapters of the core document (Origins and Methodology, National Objectives and Governance) are examples.

For those sectors where there are both separate Annexes and core document Chapters, the titles and numbering of the two correspond except in two cases: one, the corresponding Annex for the Chapter on Manufacturing is titled Manufacturing and Technology and includes material on Science and Technology that the core document had placed elsewhere; and two, the corresponding Annex for Chapter 4, Macro-Economic Policy, is Annex 4, Financial Sector Policy, because the material prepared for the Financial Sector Policy Annex was incorporated into the Chapter on Macro-Economic Policy.

The National Development Strategy was published in summarised form (the core document) for the practical reason that few people would have the time to read the over 700 pages represented by the Annexes. Yet the Annexes have a clear value. They include background information and assessments that were too detailed for inclusion in the core document, but which trace the process that shaped the strategy. Above all, they preserve for us and for posterity the earlier thinking, and the full range of thinking, of the women and men whose work provided the foundation of the NDS. In doing so, they honour the labour which the sectoral committees put into distilling their own work and life experience and the views of the public they consulted in the process. It is this foundational material that is now being published, making the National Development Strategy of Guyana available in both summary and extended forms.

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LIST OF ACRONYMS

D&I	Drainage and Irrigation
DCP	Data Collection Platform
EC	European Community
EEC	European Economic Community
IDA	International Development Agency
IDB	Inter-American Development Bank
CDB	Caribbean Development Bank
IBRD	International Bank for Reconstruction and Development
NDC	Neighbourhood Democratic Council
NDIB	National Drainage and Irrigation Board
NHSM	National Hydrological Station Network
NMSM	National Meteorological Station Network (NMSN)
O&M	Operation and Maintenance
PEU	Project Executing Unit
RDC	Regional Democratic Council
TV	Television
UNDP	United Nations Development Programme
USAID	United States Agency for International Development
WMO	World Meteorological Organisation

ANNEX 15

WATER

I. Basic Features of the Sector

A. General

Approximately 90 percent of Guyana's population lives on a narrow coastal strip that accounts for only 5 percent of the country's total land area. This coastal strip, which stretches between the country's borders with Venezuela and Suriname, has rich alluvial soils suitable for the cultivation of rice, sugar cane, and other agricultural crops. Unfortunately, it lies between 1.5 to 3.5 feet below the mean high-water mark. The area therefore must be protected by defences to prevent inundation from the sea, and soil deterioration due to saline intrusion. Drainage, which is as important as sea defence, because the disposal of high surplus surface runoff by gravity is also complicated by the low level of the coastal plain, is effected through sea and river sluices which are opened during the low stage of the tide. Without these sea defences and a proper drainage system, all coastal property would be in jeopardy.

Compounding the difficulties of topography, are the problems that are inherent in the rainfall regime of the country. The average annual rainfall of Guyana is about 100 inches, with maxima and minima being 140 and 60 inches respectively. There are two distinct periods of high rainfall: May to June/July and November to December. In between these two wet seasons, there can be periods of severe drought.

The coastal plain of Guyana is also endowed with ground water. However, increasing demands for water for various uses severely challenge the availability of this resource. Perhaps not surprisingly, the competition of various uses – irrigated agriculture, the domestic sector, industry and commerce – is particularly felt in the dry seasons, during which severe water shortages are experienced throughout the country. The situation is aggravated by inappropriate water resource management, and inadequate institutional arrangements. Uncontrolled water withdrawal, inadequate water tariffs, an absence of economic incentives for water conservation, all contribute to the wasteful use of the water resource in both domestic and irrigation activities. Moreover, the environmental aspects of water development and urban sanitation are sometimes neglected and result in water contamination.

This coastal zone is protected from the intrusion of saline water by mangroves, dikes, sluices, and sea walls that have been built over the past two centuries. With the extensive drainage, irrigation and flood control network, the sea defences serve to make the coast habitable and cultivable. Without this hydraulic system, cultivation and settlement would have to be located much farther inland.

The area has a dense network of irrigation and drainage canals and other structures to provide water to the crops and keep it free from excess water for agriculture and other economic activities. The water for irrigation during moisture deficit periods is provided by conservancies which also serve to retain surplus rainwater, thus providing security against the flooding of the coastal plain. The conservancies and the drainage and irrigation infrastructure are, therefore, crucial to Guyana's economy.

Until the mid 1970s, sea defences and drainage and irrigation accounted for most of Guyana's capital expenditure. However, as has been frequently disclosed in this document, the country's economy went into decline during the 1980s. The maintenance and repair of sea defences and drainage and irrigation works were therefore seriously neglected. Indeed, over the years approximately forty kilometres of sea defences have either collapsed or have been brought to the point of failure, and the drainage and irrigation system has been reduced to a state of total disarray.

B. Sea Defences

Guyana's sea defences have evolved in response to extensions of the settled areas and changing perceptions of the nature of the threat from the sea. Today, it is understood that the design of the defences has to take into account the following five factors:

First, the land level of the coast lies below that of mean high-water spring tides by about one metre; hence, any development along the coast must be protected against flooding during high tides. A clay embankment is recommended, as it is inexpensive and watertight.

Secondly, incoming waves, which are much higher during high tides, will break against any obstruction they encounter. Therefore, any sea defence structure must be resistant to wave action. Because earthen embankments will erode under wave action, either their seaward face must be adequately protected, or other forms of sea defences, e.g., concrete or sheet piling walls should be used.

Thirdly, the foreshore of Guyana experiences the passage of large mud-banks that originate from deposits of the Amazon River. Wherever mud-banks are present, the foreshore will be high and sand and shell beaches may form, a process known as accretion. At locations between mud-banks, the foreshore will experience erosion and its levels will be much lower. The seaward toe of any sea defences at these locations should be placed below the erosion or scour level or else undermining, which will cause failure, will occur.

Fourthly, the fine nature of the predominant foreshore material does not encourage its deposition against barriers, so groynes are not very effective as protection structures along the Guyana sea coast. These structures are only useful where the transported material is sand that deposits easily. As such, groynes should be constructed only along the estuaries where sand is present.

A fifth factor to be considered in sea defence design is the weak nature of the foreshore soil. Embankments should therefore have gentle slopes or the earth will slide and heavy structures will experience excessive settlement over time.

Owing to the lack of adequate maintenance in recent decades, these five factors have led to a situation in which 40 of the existing 170 kilometers of embankment protection are in critical condition and in need of rehabilitation. The mangrove forests along the 40 kilometer length have been destroyed, and are rapidly eroding along the remaining 130 kilometers of embankment protection. Other areas, approximately 255 kilometers in total, are protected by sand banks and mangrove forests which are still stable, but which are undergoing minor erosion at some locations.

C. Drainage and Irrigation

In Guyana, the drainage and irrigation (D&I) system was developed by sugar estate owners along the coastlands to draw water from the marshy backlands behind their estates. The irrigation system basically consists of primary and secondary canals. The primary canals draw water from the conservancies or a perennial source such as a river, through a control structure/pump system at the head, and distributes it in the secondary system through a control mechanism for onward transfer of water to the fields. The drainage system also consists of secondary and primary drains and the latter generally discharge water to the river or ocean through sluices. The operation system today is still much the same as it was when it was originally constructed. Many primary drains do not drain directly into the sea but into a facade drainage canal running parallel to the coastline, which in turn drains into the sea through a sluice. Drainage and irrigation for the whole area is therefore dependent on the effective management of the network.

The efficient operation of this system is also dependent on regular maintenance. Canals need weeding and clearing between two to three times a year. If this does not take place, vegetation slows water flow and causes the canals to silt up more quickly, further slowing the flow. The neglect of essential maintenance to the D&I infrastructure over several years made the system almost inoperable. It is only during the last five years that concerted efforts have been made to rehabilitate it and to provide reasonable service to users, and this has resulted in a significant increase in agricultural production as compared to 1980s.

D. Hydrometeorological Service

The Hydrometeorological Service operates the National Meteorological Station Network (NMSN) and the National Hydrological Station Network (NHSN) and evaluates the climate and water resources. By collecting, processing, archiving, retrieving and analysing the data from the NMSN and the NHSN, it can provide information to agencies that are planning and designing agricultural and water development projects, maintaining the sea defences, and working on other sectoral development plans. It also analyses the lower and upper atmospheric weather data of the western hemisphere, and disseminates the information for use in aviation and other short-term public forecasts. Its main role is therefore to monitor and collect data on the atmosphere, water, and climate, with a view to identifying changes and providing early warnings when necessary.

Besides its regular duties, the Hydrometeorological Service collects information on long-term climate trends, water flows and tides, to provide early warning of the potential effects of climate change. The service needs upgrading and modernisation.

II. Policies of the Sector

A. Sea Defences: Past Policies

1. 1600 to 1855

Beginning in the 17th century, the Dutch used slave labour to turn the swamps of the coastal plain into thriving agricultural areas by draining the lands with a system of seawalls, earthen embankments, canals, drains and sea sluices. When the British gained final control of then British Guiana in 1814, they continued this type of agricultural infrastructure development. The Dutch spearheaded the planting of cotton and tobacco and later, sugar, while the British emphasised sugar production. During 1814, sugar production under the Dutch was 5,000 tons, while under the British, in 1824 it rose to more than 40,000 tons. In this period, plantations owned by individual proprietors were relatively small (tens or hundreds of acres), and at the beginning of the nineteenth century, there were more than 400 such holdings.

Proprietors developed their holdings or plantations perpendicular to the coastline, which was empoldered from the sea by means of earthen embankments. Protection of these embankments against erosion was provided by the natural mangrove and courida vegetation found along the coastline. Erosion of the foreshore resulted in the recession of the seaward fringe of the mangrove forests. Continued recession exposed the earthen embankments to wave action and these were inevitably breached. When this happened, the proprietors would remove their line of protection farther inland. Landowners did not consider more effective and therefore more costly means of coastal protection, since their relatively small holdings could not support these expenditures and there was no shortage of land despite the retreat of the shoreline. A comparison of maps of the East Coast Demerara produced during 1878 and 1953 showed that the area between Georgetown and LBI had receded between 1,800 and 3,000 feet.

During the first half of the nineteenth century a combination of social, economic and technical factors caused dramatic changes to the system of small estate ownership. These factors included the abolition of slavery, lowering of the market prices for sugar, and technological advances in factory processing. The first two of these developments combined to make the small estate an uneconomical venture, and many of them were abandoned or sold to larger groups. The larger estate groups improved on their production techniques and by the middle of the nineteenth century, the arrival of cheap indentured labour, mainly from India, enhanced their economic viability.

2. 1855 to 1945

During the latter half of the nineteenth century, emphasis in coastal zone management shifted from one of intermittent retreat of the shoreline embankment to one of strengthening and maintaining this structure. This shift was necessary since the larger estates had installed more

expensive infrastructure, and it was therefore more economical to reinforce the coastal protection rather than to abandon the infrastructure. Further, the depth of the inland cultivable space was attaining its limit at many reaches along the coast. Infrastructure installation by the Government, e.g., ports, railways and roads, also required protection.

The major event that triggered the shift of emphasis was the flooding of Kingston, Georgetown, during 1855.

Between 1855 and the Second World War, responsibility for sea defences in Guyana moved from the plantation owners to Government. The various enactments that gradually effected this change were:

a. By an Ordinance passed in 1883, the Director of Public Works was given wide powers over the control of the foreshore of Guyana. Included in these powers was the authority to direct estates to carry out, at their own expense, any coastal protection work he deemed necessary. Provision was also made in the 1883 Ordinance for money to be advanced for any necessary coastal protection work.

b. By Ordinance No. 7 of 1906, a body known as the East Demerara Sea Defence Commissioners was constituted, with the Director of Public Works as Chairman. All the sea defences on the East Coast District (approximately 40 km) were vested in these Commissioners, who were given powers to levy assessments at a uniform rate for each acre on all properties in the district, or pay annually for both recurrent and capital works. The Commissioners were also given power to raise money on loan for sea defence purposes.

c. In 1913, the Sea Defences Ordinance was passed, under which nine sea defence districts were formed, each having a local Board of Sea Defence Commissioners. These nine districts thus delineated controlled practically the whole of the occupied coastline of Guyana. The District Sea Defence Boards were responsible for the maintenance of existing sea defences and the construction of new works. Under this Ordinance, one-fourth of the cost of maintenance and new works was borne by the Government and three-fourths paid by rates levied on the land.

d. In 1933, the nine Sea Defence Boards of Commissioners were abolished by Ordinance and a single Sea Defence Board substituted. The Sea Defence Board is now responsible for the maintenance, management and construction of all works in declared sea defence districts. An amending Ordinance, No. 4 of 1937, legislated that "from the first day of January nineteen hundred and thirty-seven all costs and charges incurred in the construction or maintenance of any sea defence together with all expenses of administration shall be defrayed from such monies as may be provided from time to time by Legislative Council."

By these various enactments, management responsibilities for sea defences were transferred to the Director of Public Works. The arrangements by which Government finances the total costs of protection of the Guyana coasts continue to the present day, but they have obviously not provided the requisite levels of funding for the past two decades.

3. 1945 to 1975

Following the Second World War, Guyana, like other developing countries, experienced a tremendous feeling of national emergence. Colonial mastery was questioned and greater involvement of Guyanese professionals in the management of affairs was established. During this period, tremendous expansion of resources took place in the country. Sugar production expanded twofold between 1949 and 1960, rice production tripled and there was unprecedented infrastructural development. Together with housing, roads, schools, etc., sea defences and drainage and irrigation were at the forefront of a surge in construction that laid the physical groundwork for an independent Guyana.

During the early 1950s, sea defence problem areas were most pronounced in Leguan, Wakenaam and the Essequibo coast, particularly between Hampton Court and Bounty Hall. However, by 1958, heavy erosion started between Seafield and Kingelly on the West Coast Berbice.

In March of the same year, two breaches in the seawall occurred at Enmore and by 1959 the area of Strathspay/Elizabeth Hall was seriously affected. Other areas which were to be subjected to erosion and heavy wave attack were Friendship in 1960, Vigilance/Bladen Hall in 1961, La Reconnaissance in 1962, and Buxton in 1964. To a lesser extent, several areas on West Demerara became exposed and damaged, while on West Coast Berbice the erosion extended westward as far as Weldaad.

As a consequence of the major collapse of the sea defences in various parts of the country, a period of intense activity and attention, including training of personnel and provision of technical resources, developed. These included the following four major studies and reports:

- Demerara Coastal Investigation, 1960-1962, Hydraulics Lab. Delft (UNDP).
- Technical Review and Recommended Revision and Rehabilitation of Sea Defences in British Guiana, 1965, U.S. Army Corps of Engineers (USAID).
- A Proposed Programme of Sea Defence Works in Guyana, 1968, Hydraulics Division, Ministry of Works and Hydraulics (Government of Guyana).
- Report on Sea Defences Studies, 1972, NEDECO (IBRD).

These reports have served the planning process for sea defences well. However, with the passage of time and the lack of adequate, accurate and consistent data over the period, they must be used with the greatest caution.

Between 1960 and 1975, a cadre of Guyanese professionals emerged who, although trained overseas, developed an understanding of the requirements of sea defences in their country. The Public Works Department and later the Hydraulics Division, boasted the only team ever assembled here which was capable of monitoring, designing, constructing and maintaining sea defences in Guyana. New designs were established which considered the various factors

previously highlighted in reports and construction was undertaken throughout the sea coast of Guyana. These designs, different from Siccama's concepts, were ambitious and costly, but provided the sophistication required for an emerging nationhood.

Construction was undertaken either by the Government directly through a mechanism known as force account or by contractors. This period saw the emergence of local contractors who gained valuable experience in sea defence works.

One serious shortcoming created by the improvement in social welfare which took place during this period was the allocation of housing lots next to the sea defences. Formerly, sugar workers were housed in logies adjacent to sugar factories and cane fields located away from the sea defence lines. Land allocation by the sea defences at areas such as Tuschen, Ocean View and Annandale placed additional pressure on holding the line.

4. 1975 to 1990

The downturn of the economy during this period resulted in a curtailment of sea defence construction throughout Guyana, except for the continuation of a project team along the Essequibo Coast where severe erosion was experienced between Three Friends and Hampton Court areas.

In 1988, the Sea Defences Act and the Drainage and Irrigation Act were amended and transfer of function for the responsibility, maintenance, cost sharing and management in Regions was shifted to the Regional Democratic Councils. But the Councils did not perform creditably, due to their lack of finance and expertise. No new developments were made in sea defence designs.

The consequences of the de-emphasis in sea defence construction during this period were the resignation or reallocation of trained staff, the deterioration of existing structures that required upgrading, inadequate data collection for monitoring sea defence conditions, and unchecked erosion in non-protected areas that led to many breaches at the end of this period.

The expertise of the force account staff and the local contractors declined or disappeared since no major construction activities were undertaken. The pressure caused by land allocation along the sea defences was exacerbated through further encroachment, both legal and illegal.

B. Sea Defences: Current Policies

As noted, the responsibilities for the maintenance of sea defences were assigned to the Regional Democratic Authorities in 1988. Given their poor performance, these responsibilities were in turn handed over to the Hydraulics Division of the Ministry of Agriculture in 1992. The EC-funded Infrastructure Rehabilitation Programme (from 1988 to 1992) enabled the Hydraulics Division to carry out some emergency works. The Project Execution Unit for sea defences was formed in 1994 to manage donor agency programmes funded by EEC, IDA, IDB and CDB to the value of approximately US\$40 million.

The main objective of short-term planning has been to rehabilitate the critical coastal protection structures. The Government of Guyana received funding of approximately US\$40 million to rehabilitate approximately 26 kilometres of these works. This programme was for a duration of three years and a Project Executing Unit (PEU) was set up (1994) within the Ministry of Agriculture to manage and execute it. However, since the short-term provision is not sufficient to finance the 40 kilometres of critical sea defences, additional financial resources will need to be sought.

At presently, the Sea and River Defence Board attached to the Ministry of Public Works and Communication bears the legal responsibility for all declared sea and river defence matters. Physical execution of works is performed by the Hydraulics Division as agent to the Board. The Project Executing Unit formed during 1994 to manage donor agencies funding has no legal mandate but has been given a measure of self-accounting and procurement authority that is more liberal than that of the Public Service.

Developments along the shoreline as well as current studies indicate that rock armouring to clay embankments is the most suitable and cost-effective method of protection. Recent studies have examined various design details including crest elevation, toe elevation, extent of toe protection, and rock size and layer thickness.

The lifetime of the structure is the main factor determining the relative value of each of these. Clearly, a structure assigned a longer lifetime will be more costly in the construction stage but will require lower long-term maintenance.

The cost of rock supply and placement is the major item determining the overall costs of this type of construction.

In the medium term, issues of shoreline management will be addressed in an integrated and environmentally sound manner. The Inter-American Development Bank has proposed a 5-year programme to enable the Government to resolve these issues. The objectives of this programme are to:

1. Reduce and control avoidable environmental and economic losses due to shoreline erosion and flooding.
2. Promote environmentally sound land use decisions as a basis for sustainable development of the coastal zone.
3. Build a national capacity for integrated coastal zone management by improving the institutional and technical capacity for coastal zone management.

At the beginning of 1994, a consulting team commenced the preparation of a Design and Feasibility Study for this Shorezone Management Programme. An interim report presented during August 1994 identified a medium-term strategy for shorezone management.

It recommends the rehabilitation of the worst stretches of sea defence together with a monitoring programme for the shorezone. The latter programme will include geodetic releveling, bathymetric surveys, sediment and wave studies, sea level monitoring and the introduction of an early warning system. Other areas of activities identified included a public awareness programme, land use planning, mangrove management, environmental awareness, cost recovery, income generation and institutional strengthening. A model for the undertaking of an economic feasibility study is also proposed.

C. Drainage and Irrigation Policies

1. Past Policies

As far back as the earliest days of settlement in the then British Guiana, the proprietors of coastal land made their own arrangements for irrigation by empoldering their property and utilising the water collected in the swamps behind for irrigating during the dry months. Drainage was accomplished by means of outlets through the sea or river empolder dam.

As this development progressed, proprietors found it advantageous to band themselves together in order to obtain better protection from flooding from the swamps behind their property and to spread the cost of essential drainage over a large number of proprietors. Some of these were eventually formed into what were known as District Drainage Boards, which were virtually under the control of the proprietors of the District. This system eventually proved unsatisfactory due to poor management by the proprietors themselves; works carried out were not always based upon sound technical judgment and operation, maintenance and replacement costs were not always met. The end result was that maintenance was neglected.

As a result of this, the then Governor appointed a committee of six in 1939 to enquire into the financial aspects of the works under the control of the District Drainage Boards and to advise whether another system of management and control was desirable.

Consequent on this investigation and the report of the committee, the Government decided on the formation of a Central Drainage and Irrigation Board, and this was established under Ordinance No. 25 of 1940.

Under this Act, the D&I Board is charged with the sole control and management of all the works for drainage and irrigation within declared areas. Areas were declared as a result of requests from proprietors which were considered by the D&I Board and recommended to the Governor in Council, who could issue an order that an area to be investigated with a view to being declared a D&I area. The D&I Board then directed the construction of the infrastructure which was considered essential to protect the area from the effects of floods and droughts and to provide conditions under which the maximum benefit could be derived from the land.

However, it became evident that the declared drainage and irrigation areas functioning as separate entities did not solve the problem of flood control in the upper reaches of the river and creeks, and that drainage and irrigation had to be considered as a whole and not piecemeal. The services of F. Hutchinson, a colonial civil engineer, were obtained in 1949 to consider and advise on drainage, irrigation and flood control measures and to prepare programmes for overcoming

their difficulties. He recommended that the problem had to be tackled at its source, by endeavouring to impound flood waters by constructing conservancies in the upper reaches of the river and regulating the discharge to avoid flooding on the coastal plain.

Hutchinson submitted the following flood control and D&I projects to the Government:

- Tapakuma Project, covering the area between Annandale and Sommerset and Berks
- Boerasirie Extension Project, to command the area between the Demerara, Essequibo and Bonasika Rivers
- Mahaica Dam and Lamaha Conservancy Project to command the area between the Demerara River and the watershed between the Mahaicony and Mahaica Rivers
- Canje Project, to command the whole Berbice area from the Berbice River to the Corentyne River.

In addition, surveys were undertaken to obtain data for the MMA area.

Prior to the above, other works were in progress such as the Torani Canal and Block III, all part of the Corentyne Drainage and Irrigation project proposed by G.O. Case.

In 1953, Mr. Gerald Lacey was contracted by the Government of British Guiana to examine the Hutchinson and other D&I projects from the technical viewpoint and satisfy himself that the broad principles on which they were prepared were correct. He was also required to make proposals both in respect of water control legislation and departmental organisation which would ensure that any drainage and irrigation policy adopted by Government could be implemented.

In principle, Lacey agreed with the Hutchinson recommendations, but stressed the need for a separate D&I department with adequate and fully trained staff.

In 1955 provision was made in the Colony estimates for 44 administrative and technical officers and a number of other personnel to manage the new D&I Department. Funds were also provided for a new office building to accommodate staff at head office and in districts.

The Ministerial system of government introduced in 1953 resulted in D&I matters, which were still at that time a function of the Public Works Department, being placed under the portfolio of the Ministry of Communication and Works. However, when the D&I department was formed in 1955, it was placed under the portfolio of the Minister of Agriculture, Forests, Lands and Mines.

This arrangement continued until 1961 when D&I became a department within the recently formed Ministry of Works and Hydraulics. In 1978, the Hydraulics Division,

responsible for sea defences and D&I, was moved to the Ministry of Agriculture and was headed by a Chief Hydraulic Officer. During the above period, D&I policies remained the same.

However, in 1983 an important change in policy was effected in the D&I Board Transfer of Functions Act where responsibilities for the operation and maintenance (O&M) were extended to the Regional Administration for the 37 declared areas between the Pomeroon and Corentyne rivers. This decision eventually led to the complete decline of the D&I system, as the Regions did not have the required technical expertise to manage O&M.

However, capital programmes such as the Tapakuma Project and MMA Project Stage 1 were implemented, as well as open donor-financed rehabilitation programmes in Pomeroon, Leguan, Canals Polder, Vreen-en-Hoop/La Jalousie, Cane Grove and Black Bush Polder.

Nevertheless, the rehabilitated systems could not be maintained due to poor collection of rates by the Regions, and in 1994, the responsibility for D&I was once again transferred to a central Board renamed the National Drainage and Irrigation Board (NDIB).

2. Current Policies

In 1994, with the revision of the D&I Act, NDIB assumed responsibility for D&I. The main focus of the Board over the last four years has been the rehabilitation of existing systems. However, the functions of O&M are still being executed by the Regions and NDCs. Rates collection has not improved and there is urgent need to address issues related to ensuring that O&M is carried out on a sustainable basis.

The IDB is financing a three-year programme aimed at strengthening the NDIB and assisting the Board to implement D&I policy reforms, the three principal areas of which are: (a) simplification and modernization of the legal and institutional framework for management of D&I systems; (b) greater beneficiary participation in the operation and management of D&I systems and transfer of secondary D&I systems to Water Users' Associations; and (c) improved cost recovery for sustainable management of the D&I system.

III. Issues and Constraints

A. Issues

1. Sea Defences

a. Procurement

The interval between the identification of critical areas and the commencement of physical works is typically too long. The movement of mega mudbanks along the shoreline may result in dramatic changes at any location that require a quick response. Examples of these

include the high rate of accretion in the Hope/Clonbrook area over the past few years which will result in a large increase in excavation quantities under the IDA contract. Under current rules, any contract sum greater than G\$6 million must go through the Central Tender Board. This is often time-consuming and frequently leads to delays in project execution. Flexibility would help reduce such delays in the execution and implementation of project activities.

In the case of donor-funded projects, it takes about two years to commence the execution of physical works from the signing of the agreement.

Procurement of quarry products is a major item in sea defence works. Until recently, there have been only two major suppliers of quarry products in Guyana but a third has now started operations. It is hoped that the competition provided by this third quarry will bring down the very high prices of quarry material.

b. Institutional arrangements

Institutional arrangements have already been outlined in previous sections. To summarise: the Sea and River Defence Board has the legal responsibility for all declared sea and river defences, while the Hydraulic Division is the executing agency for the Board and comes under the Ministry of Public Works and Communication. Since these mechanisms share the institutional problems common to all Ministries, the Project Execution Unit was formed in 1994 to manage the donor agencies-funded programme and train counterpart staff; though it has no formal legal mandate, it was given some autonomy in accounting and procurement. Clearly effective management of this organisation is vital for the best use of the limited skills available. A longer-run concern is that the PEU was envisaged as a temporary unit, and that after the donor-supported rehabilitation of sea defences is completed there will be need for an effective, permanent agency to manage maintenance tasks and ensure that maintenance works are not neglected again. The lessons of the flood of 1855 and the breaches of the 1980s and early 1990s ought to be sufficient.

c. Cost recovery

New policies are needed to ensure adequate funding for maintenance of sea walls on a continuing basis. The lack of such funding in the past has led to severe deterioration of the structures and therefore to the current need to take recourse to external sources of funding for major rehabilitation. Annual allocations from the general budget of the Government should be adequate to meet the requirements of reasonably good maintenance.

d. Contractual arrangements

Because of the stringent preconditions of the donor agencies, local and regional contractors find it difficult to pre-qualify for some sea defence projects. The contractual arrangements should be examined and re-cast to suit local conditions. In addition, the acquisition of relevant skills by local contractors must be encouraged.

If competitive contractors are ranked according to their location and their ability to undertake works of various cost magnitudes, an approximate classification would be local contractors - less than US\$3 million, regional - \$3 - \$15 million, and international - over \$15 million.

The funding provided under the current donor agencies programme falls in the range of US\$6 - \$14 million. This has effectively excluded local contractors, although their inclusion is likely to result in substantial reductions in the cost per kilometre of rehabilitating sea walls.

e. Financing

The Government of Guyana has received funding of approximately US\$40 million from four donor agencies for the rehabilitation of approximately 26 kilometers of sea defences, but it continues to undertake emergency sea defence and maintenance works to the value of over US\$2 million annually from its own resources.

f. Accountability

Auditing of the self-accounting PEU is carried out by the Auditor General's Office. Expenditures are recorded under two headings: "local expenditure" and "specific expenditure". The Hydraulics Department's accounting is managed through the Ministry of Public Works and Communication, using the traditional Public Service accounting procedure. One system should be applied in both cases.

g. Planning horizons

Besides carrying out the donor-funded rehabilitation work, it is important that the institutional and technical bases for a programme that continues indefinitely into the future be laid now. For this purpose, responsibilities can be defined according to length of planning horizon:

(i) Short term (<5 years)

The short-term plan would involve the rehabilitation of the critical coastal protection structures identified under the donor agencies programme, the maintenance of the existing infrastructure, and the rehabilitation of emergency works currently being funded by the Government of Guyana.

(ii) Medium term (5-10 years)

The medium-term programme would be the rehabilitation of further lengths of sea defences and the establishment of a maintenance and shorezone management unit.

(iii) Long term (>15 years)

This programme would include data collection and monitoring programmes to determine critical areas along the sea defences for rehabilitation and continued maintenance.

h. Protection of mangroves

There are two principal reasons why the sea defences are in such a deteriorated state today: lack of performance of regular maintenance duties over the years, and failure to protect the mangrove and courida areas that were once very prevalent along the coast. These causes were also singled out by Baron Siccama more than a hundred years ago. It is urgent to protect the remaining mangrove zones and to carry out a gradual programme of reforestation of other areas in mangroves. Experience throughout the world has underscored the necessity of working closely with artisanal fishermen and local communities, in designing and implementing such programmes. Simple legal prohibitions against cutting mangroves do not work.

i. Data collection

Sea defence data need to be upgraded and a monitoring programme established. Immediate requirements are hydrographic surveys and wave measurements. Aerial photography to help in the determination of land use pattern, mangrove extent and sea defence locations should be undertaken and then repeated regularly to monitor changes. A programme for monitoring erosion and accretion should be put in place.

j. Costs

Guyana can ill afford to continue sea defence construction at present costs, and methods to reduce the financial requirements should be investigated.

2. Drainage and Irrigation

a. Legislation

Many pieces of legislation govern the management and operation of the D&I system in Guyana, but together they do not comprise a consistent body of legal regulations. Instead, the result is a set of complex and dissociated regulations that constrain the smooth operation of the D&I system. The Government is in the process of formulating new legislation to govern the drainage, irrigation and flood control sector. The objectives of the new Act are the following:

- (i) ensure that the drainage and irrigation system is operated and maintained in a sustainable manner;
- (ii) improve cost recovery for sustainable management of the drainage and irrigation system;
- (iii) establish an authority as the regulatory and central coordinating agency for the operation, maintenance, control and management of the drainage, irrigation and

flood control systems, in consultation with the beneficiaries and stakeholders, and to effectively harmonise activities to enhance agricultural production;

- (iv) to promote and encourage greater farmer and private sector participation in the operation, maintenance and management of the secondary drainage and irrigation systems.

b. Multitude of institutions with divided administration

As mentioned above, there is a multiplicity of agencies with a role to play in the management and operation of Guyana's drainage and irrigation system. The institutional framework is characterised by lack of clear policy objectives, inadequate supervision and coordination, multiple overlapping jurisdictions, significant variations among Regions in organisation and effectiveness, and imprecise roles of the various agencies. The institutions are also different in professional capability, modern technology and managerial infrastructure.

c. Shortage of resources

(i) Technical capacity

The level of technical education in water sciences in the regional engineering departments is poor, as is the level of education in the accounts sections. There is no separate academic programme for hydrology or water resources. There is also no short- or long-term training programme for middle level water sector professionals, sub-professionals, or other support functionaries.

(ii) Physical resources

The newly established National Drainage and Irrigation Board needs reinforcement in many departments. It also needs a separate building to provide modern facilities. In addition, it should be linked with international centres of excellence in water sector management to exchange experts, knowledge and information.

(iii) Non-participation of farmers within the system

The present system allows for minimal direct involvement of farmers, although they are the assumed beneficiaries of the D&I system. They have almost no representation or voice in planning and very little participation in maintenance. Thus, the group that has the greatest incentive to be involved in developing an efficient system is excluded from it. In spite of Cabinet Guidelines (1994) to involve farmers in the management of the D&I system, their direct participation in the system management is still to be put on the ground.

(iv) Lack of coordination with the rest of Guyana's water management institutions

Little consideration has been given to the role of D&I in the context of the country's entire hydraulic system, and its impact on the water balance of the country. The interaction is only at the top level and that, too, is not very effective.

d. Financing

The key to the deterioration of the infrastructure is the failure to secure financing for operation and maintenance. The financing of operation and maintenance depends on the collection of drainage and irrigation rates, with the added complication of conservancy and land development scheme rates. The rates are low and collection is poor. Rate collection is currently only about 30 percent. Farmers are unwilling to pay for the poor quality of services currently being provided by public agencies, while the main reason for the poor services is the severe financial constraints experienced by these public agencies.

3. The Hydrometeorological Service

a. Maintenance and operation

The National Meteorological and Hydrological Station Network has been affected over the past two decades by a lack of spare parts and a rapid loss of skilled staff. This has resulted in the closure of several important stations in the approved World Meteorological Organisation Network Design and the consequential loss of data. In addition, most stations are in remote hinterland areas accessed only by aircraft and other expensive means of transportation.

b. Institutional Development and Capacity Building

The unit handling the hydrometeorological services needs strengthening both in terms of institutional infrastructure and personnel capacity-building. The unit should have equipment, data collection mechanisms, analytical and predicting techniques, and public information tools in place for short term weather forecasts, medium term/seasonal weather forecasts, and hydrological drought and flood forecasts.

c. Cost recovery

Approval has been given to institute a system of charges for data supplied by the Hydrometeorological Service. It is a service-oriented organisation and forecasts have generally been issued free of cost to the media and all interested agencies/individuals. However, charges are usually applied to specialised data requests, helping to offset expenditures for these special investigations and field analyses. Overall, cost recovery has been very low and ways need to be sought to increase it.

d. Financing

The Service has been receiving funds to cover recurrent operating expenditures directly from the Ministry of Finance. The nominal capital funds from the public sector have been used mainly to improve working conditions, and to purchase much needed automated equipment and other items to maintain the basic operational status of existing networking stations.

The European Union has been approached to examine a proposal for funding a weather radar to improve the accuracy of forecasts. However, the acquisition would depend upon the priority placed on this project by the Government of Guyana. The World Meteorological Organisation also funds equipment and technical aid packages to upgrade regional meteorological and hydrological services. Additional funding is needed, especially to reopen the stations obliged to close.

B. Constraints

The following list of constraints often summarises concerns already raised under "Issues".

1. Sea Defences

a. Procurement

The long and stringent tender procedures have been a constraining factor to the performance of the Hydraulics Division and the Project Execution Unit, lowering their rate of execution of projects and raising their costs.

b. Institutional arrangement

The lack of a formal legal mandate of the Project Execution Unit hinders its effective operation.

c. Cost recovery

Inadequate provisions for funding of maintenance in the past have directly contributed to the severe problems that the sea defence system is experiencing today. Lack of an adequate cost recovery mechanism for the sea defences also places considerable additional strain on an already tight fiscal situation. The cost for maintenance of the sea and river defences should be financed by the central Government, as they are a public good.

d. Contractual arrangements

The contractual arrangements for EC and IDA project-funded tenders restrict the selection of contractors to those classified as international. A revision of such arrangements may lead to more efficient and expeditious implementation of the projects.

e. Financing

With no specific mechanism in place for the cost of the continued maintenance work required by the sea defences, Guyana has been resorting to donor agencies funding to rehabilitate the critical areas. Nevertheless, only the most urgent needs are being met that way, and the

insufficiency of funds and low salaries have resulted in capable staff leaving the Hydraulics Division.

f. Environmental constraints

The widespread lack of public awareness of the value of mangroves for sustaining marine fisheries and preventing flooding and erosion of sea defences, has represented a major constraint in this sector. Equally, protection of coastlands against the sea has been hindered by the lack of a forward-looking programme based on developing a consensus with coastal communities on how best to manage mangroves.

2. Drainage and Irrigation

a. Technical capacity

The sector suffers from a major shortage of trained and qualified personnel. The fundamental reason for this is the lack of training and educational facilities in water sciences. The available trained personnel prefer working in the private sector, where salaries are higher.

b. Resource availability

The shortage of public funds has led to a severely slowed pace of infrastructural development in the D&I sector. This pace needs to be tripled if the full benefits of the available potential of the sector are to be realised in the near future.

c. Non-participation of farmers within the system

A major contributor to the dilapidation of the system is the distance between the users of the system (the farmers) and the administrators. The resulting sense of isolation among farmers contributes to low rate collection. When farmers do not perceive any control over how the rates are spent, they are far more reluctant to pay. Any new system has to overcome this central weakness. The rate levied should be rational, and adequate consideration must be given to equity and affordability.

d. Lack of institutional coordination

There is need for better coordination between the management of sea defences, the management of D&I systems, and the management of conservancies. This is vital, because all three deal with interlinked objectives. The management of the conservancies needs to be integrated into the National Drainage and Irrigation Board. In addition, the role of RDCs and NDCs in D&I management needs to be clearly defined and provided for in the relevant legislation.

e. Low rate collection

There is insufficient enforcement of payment regulations. Many farmers are defaulters, and although one reason for this is that the services provided are not considered worthy of rate payment, farmers also have little incentive to pay since they can often escape without paying. A confused land tenure system and weaknesses in the judicial system complicate the possibilities of rate collection.

f. Inadequate mapping

The NDIB, which is now the custodian of the D&I system of the country, does not have detailed documents showing the infrastructure of different areas on suitable maps. During the transfer of the Hydraulics Division from the Ministry of Agriculture to the Ministry of Works, all the maps and reports of the D&I system were retained by the Hydraulics Division. None is, therefore, available in the NDIB. They are also not available in the Regions. The drawings are also reported to be old and often do not show all vested works or residential areas. More seriously, works under the responsibility of the local authorities are not mapped, which represents a major drawback in assessing what the scope of rehabilitation works in the D&I areas should be. The NDIB thus does not have precise information of the assets which are supposed to be under its control. Clearly, this is an obstacle to scientific planning for development and management.

g. Operations of the Conservancy Boards

The Conservancy Boards are required to operate the head regulators on the conservancies but in practice, little control is exercised and water users have a lot of freedom to interfere with the gates. This is a serious problem, as the assessment of water availability and water needs should determine irrigation flow. In fact, the available information on the water potential of the conservancies relies heavily, both financially and technically, on the sugar estates. Consequently, the interest of one group of water users, the sugar growers, tends to guide decisions about water use. Ideally, a body that is independent of the water users or a representative group of farmers of all interests should undertake the distribution of water. However, without the support of the sugar estates, it is likely that the system would have collapsed totally. With the establishment of the National Drainage and Irrigation Board, it is appropriate that the conservancies now operate under this national institution.

3. The Hydrometeorological Service

Although there has been some increase in the funding available for this activity in recent years, lack of adequate finance is still the major constraint on its operations. Another important constraint has been the non-availability of suitably qualified professional staff to man the services. The low levels of salary do not attract suitable personnel to the institution which manages this service.

IV. Sectoral Objectives

A. Sea Defences

1. The main short-term objective is the rehabilitation of the existing infrastructure of sea defences. To achieve this objective, the external donor agencies are funding several programmes at an approximate cost of G\$1,500 million annually (1995 prices).

2. The medium-term objective is to create and maintain a comprehensive maintenance and replacement programme for sea and river defences. It is envisaged that the cost of this programme would be approximately G\$1000 million annually, with a gradual reduction to G\$500 million annually as rehabilitation improves the quality of the sea defences. This would be financed by the Central Government and donor agencies.

B. Drainage and Irrigation

The primary objective of the drainage and irrigation policies is to contribute to the national goal of rapid and equitable economic growth by facilitating increased agricultural production and other economic activities dependent on land and water availability. To achieve this primary objective, two subsidiary objectives have been identified:

1. Develop a system for the operation and maintenance of the drainage and irrigation system that is environmentally, fiscally, and institutionally sustainable.

2. To increase the current capacity of the drainage and irrigation system by improving existing infrastructure and expanding into new lands.

C. Hydrometeorological Service

The Hydrometeorological Service's main goals are: 1) to be the focal point for the collection, maintenance and operation of the meteorological and hydrological data collection network, 2) to provide improved services to users such as airports, the Sea and River Defences Board, agricultural and water organisations, other sectoral organisations, etc. The first goal will be achieved following the World Meteorological Organisation's guidelines and technical regulations. A development programme will be instituted as directed by the controlling agencies and the World Meteorological Organisation. Possible venues for expansion will also be identified and efforts to implement expansion will be pursued.

V. The Strategy

A. Overall Policy Imperatives

A National Water Commission, (NWC) responsible to a Cabinet Sub-committee, which shall oversee and co-ordinate the activities of all water related agencies, will be established. Representatives of the main water-users will be on the Commission. The NWC will also be

authorised to formulate the mechanisms for the implementation of the National Water Policy (NWP) and the provisions of this National Development Strategy pertaining to water and flood control.

A standardised national electronic water information system, with a network of data banks and compatible data bases allowing for exchange of data, will be established. Apart from the data on water availability and actual water use, the system will include a facility for comprehensive and reliable timely projections of future demands for water for diverse purposes.

Periodic assessments of both surface and ground water resources, and their utilizable component on a basin - wise basis, will be conducted.

There will be closer integration of water use and land use policies. The planning of water use will take into account land capability and will be supportive of land improvement.

Research and application efforts will be intensified in several areas, including hydrology, considering among other parameters the implications of climate change, geohydrology, river hydraulics, over land flow mechanics, ground water recharge, prevention of salinity ingress, crops and cropping systems, sedimentation of reservoirs, the safety and longevity of water-related structures, better water management practices, water use efficiency, and improvements in operational technology.

Legislation will be enacted to ensure that ground water is utilised only for domestic purposes, until additional exploitation is supported by confirmation of the sustainability of ground water supplies. Ground water is of immense value and a natural resource which may or may not be sustainable in Guyana. Until adequate recharge is assured, groundwater will be utilised for domestic uses only.

A public awareness strategy will be mounted to emphasise the value of both surface and ground water resources. Users will be encouraged to utilise more surface water as this is available abundantly in relation to the country's present and future needs. This strategy will not only conserve ground water, but will also prevent salt water intrusion in the coastal aquifers.

Surface water storage facilities for agricultural, domestic and other uses will be established. The available information indicates that there is competition for this commodity during times of scarcity. This competition is not due to inadequate rainfall, but to avoidable spillage and inadequate storage.

Cost recovery programmes will be adopted. However, the price charged for water will take into consideration the feasible level of recovery from the user.

Low rainfall areas will be made less vulnerable to drought-associated problems through soil moisture conservation measures and the transfer of surface water from surplus areas where feasible. The drainage of agriculture and homestead lands will be an integral component of water, urban and sea defence planning.

Water resource development projects will, as far as possible, be planned and developed as multipurpose projects, with the basin as the unit of planning. Hydropower development will receive prime consideration.

The erosion of land, and the ingress of salt water, whether by the sea in coastal areas or by river water inland, will be minimised by suitable cost effective measures.

A hydro-environmental strategy to address water quality protection, saline intrusion and sewage discharge, will be developed.

The institutions responsible for the development and management of water resources for different uses and purposes will be adequately strengthened in terms of modern technology and professional capability. Training programmes will be organised in the latest project planning and management methods.

Sectoral Policy Recommendations

1. Sea Defences

a. Institutional Policies

The Sea and River Defence Board will be reorganised as a policy-making Board, with representatives from the Ministry of Housing and the Ministry of Regional Development. It will be legally responsible for sea defences for the entire coastline. The Executing agency will be a Shorezone Management Unit which will be outside the Public Service, to allow it to attract qualified staff, provide higher salaries, and maintain its own financial regulation.

b. Contractual Arrangements

International donor-funded contracts will be split, wherever feasible, to allow regional and local contractors to participate. Local contractors will be encouraged and assisted to form joint ventures to tender for the larger projects.

c. Cost Recovery and Financial Management

A sea defence maintenance tax will be instituted. The revenue collected by way of this mechanism will be deposited in a special account for the maintenance of sea defences. The Sea and River Defence Board will monitor the collection and disbursement of revenues, and progress in maintenance work. It will also submit annual estimates to the Ministry of Finance for complementary funding required from the general budget until this Line item is phased out.

d. Areas to be Protected

The priority for the maintenance and repair of sea defences, until the system becomes routine and all sea defences are intact, will be based on the areas along the coastland that require immediate protection. Land use and shallow foreshore levels will be the main criteria used for selection, with housing areas being afforded the main priority. These areas will include the

Essequibo Coast between Supenaam and Maria's Delight, Wakenaam, Leguan, East Bank Essequibo, East and West Demerara and No. 78 and No. 83 on the Corentyne Coast.

In areas where there are no residences, retirement of the sea defence line, when breached, will be the main criterion for intervention. If a small section of an exposed coastline is protected, then continued erosion upstream and downstream will require additional lengths of the shoreline to be protected or a headland will be created.

e. Procurement

The experience has been that the time span between critical area identification and the commencement of physical works has been too long. The Project Executing Unit will maintain and update records of critical areas at appropriate intervals.

f. Other Sea Defence Programmes

Together with rock armouring protection, other viable methods of defence, including the management of mangrove forests and the placement of groynes, will be pursued. Mangrove management will be actively implemented in the areas between Mahaica and Rosignol and in the lower Corentyne areas.

g. Land for Houses

The construction of houses and other buildings, and the installation of supporting infrastructure, will be prohibited within a certain distance of the sea defences. This distance will vary along the country's coastline, but will not be less than 200 feet. At locations along the coast where there is no intensive housing development, any plans for such development will be re-assessed, taking into consideration the need for present and future sea defence protection. Future housing development will be restricted to areas south of the Public Road, as far as possible.

2. Drainage and Irrigation

In order to achieve the sustainable operation and maintenance of the drainage and irrigation system, the newly formed D&I Board will develop a simplified, two-tier institutional structure, which will be financially viable.

a. Local Level

Farmers themselves will determine the most appropriate institutional arrangement for managing the secondary systems in their localities, whether through the existing Local Government Authorities (LGAs) or through the Water Users' Associations (WUAs).

The Board will support and encourage the formation of associations of farmers who will be responsible for the operation and maintenance of secondary systems. Once fully operational, these WUAs will be self-financing, self-regulating, and self-governing, and will assume full

control over the secondary system in their localities. The Board will also propose a legislative framework within which the WUAs will operate.

Where farmers are satisfied with the current institutional arrangement, the Board will support and strengthen the capacity of the LGAs to administer the operation and maintenance of secondary systems by providing training, advice and support.

Water users, whether through WUAs or LGAs, will bear in full the costs of the operation and maintenance of drainage and irrigation of secondary systems. The rates set and collected by the WUA or LGA will eventually cover all costs associated with the secondary system. In addition, farmers will pay rates to cover costs for the operation and maintenance of primary irrigation canals, and to contribute to the operation and maintenance of conservancies.

The Board will establish standards for operation and maintenance, implementation and monitoring of the activities of the local level entities, and for ensuring that the secondary system functions satisfactorily, in an environmentally sound manner.

b. National Level (the Drainage and Irrigation Board)

(i) Administration

The new Water Board will assist the Government in developing policies, planning, coordinating, approving and regulating all public irrigation, drainage and flood control projects and districts. It will also ensure compliance with national policies and norms through monitoring and supervision of construction, operation and maintenance activities in the Regions.

The Board will employ its own managerial and technical staff to meet its responsibilities. A core staff will be employed immediately to help in carrying out functions under the Board's current legal mandate, and to execute the pilot programmes as a basis for implementing new policies.

(ii) Primary system operation and maintenance

The Board will develop the appropriate institutional arrangement for the planning, design, execution, and monitoring of physical works. It will also ensure that in this arrangement, management is accountable and all work is in line with national standards. Representative members of NDCs, WUAs, conservancy boards, and those involved with other aspects of water resource management will be represented in the decision-making process.

(iii) Drafting of new legislation

The Board will put in place new legislation for the drainage, irrigation and flood control sector.

c. Improving Drainage and Irrigation

In order to increase agricultural production and productivity in Guyana, D & I services will be improved and extended to include:-

- (i) rehabilitation and modernisation of the existing D & I system with façade drain and pumped drainage as integral components;
- (ii) the placement of D & I facilities in unserved areas that are already under cultivation;
- (iii) special schemes for the islands;
- (iv) modern D & I facilities in new potential agricultural area.

3. Hydrometeorological Service

Existing hydrometeorological stations which are not being utilised will be reactivated. In addition, the number of stations will be increased, in order to improve the design network for enhancing forecasting capabilities.

Staff skills will be improved through seminars, and on-the-job training. Research capabilities and other related skills will be further developed.

Real time data transmission from remote stations to the central station via satellite will be effected. Research capacity and other related skills will be developed.

The Hydrometeorological Service will be made functionally autonomous. It will continue, however, to receive funds from the public treasury.

The Service will determine prices to be charged for information, to offset the expenditures it incurs. It will begin to levy charges on users such as airport authorities and water related agencies which, to date, have been receiving these services free.

All development projects will be examined by the hydromet services with a view to assessing the relevant data/ information used in project planning/ design.

The Hydrometeorological Service will be a permanent member on the water boards and other related agencies.

VI. Legislative Changes

A. Sea Defences

In 1992, the Sea Defences Act was enacted, repealing the Sea Defences Act of 1988. However, this most recent legislation requires modification, as follows:

1. Short-Term

- a. Establishment of the legal basis for the special levies on imports and property along with the structure and functions of the trust account for these funds in the Central Bank.
- b. Merging of the Project Execution Unit with the Emergency Rehabilitation Programme.
- c. Establishment of an autonomous Shorezone Management Unit as the Executing agency, with the head of the Unit responsible for all sea and defence works. The head of the proposed Shorezone Management Unit should be responsible for all sea and river defence works.
- d. Revision of the terms of reference of the PEU to include maintenance, training, etc.
- e. Extension of the boundaries of the sea defences from 50 to 200 feet.

2. Medium-Term

- a. Modification of the sea defence laws.
- b. Extension of the areas of responsibility for sea and river defences to include the entire coast, and the coastal reaches of the major rivers.
- c. Restriction of the development of housing areas between the public road and the sea and river defences to maintain sufficient reserve.
- d. Establishment of an emergency committee for disaster preparedness for sea and river defences.

3. Long-Term

The bringing together of all the agencies dealing with water under the control of a unified national water body to be named the National Water Commission, which may report to the President or a Cabinet subcommittee or a Minister in charge of Water and the Environment.

B. Drainage and Irrigation

In the area of drainage and irrigation, the proposed new legislation will provide, *inter alia*, for the following:

1. Granting the NDIB responsibility for drainage, irrigation and flood control for the entire country, with its functions clearly specified to include policy, coordination, planning, supervision, norms and standards for all such infrastructure in the country;

2. Clear definition of the relationship and functions of the NDIB relative to such bodies as RDCs/NDCs, other regional entities, local authorities, and water users' associations.

3. Declaration of all publicly provided irrigation works and the land upon which they are located as under the jurisdiction of the NDIB and elimination of the confusing array of vested and non-vested works, and declared and undeclared areas.

4. Establishment of a formal advisory council for the NDIB, with representatives from each of the regional agencies, water users' associations, local authorities, the private sector, and those involved with other aspects of water resources management, will be established.

C. Hydrometeorological Service

Requirements in this area are:

1. Legislation to protect the data base, collection of data and revenue.
2. Incorporation of the legislation of the functional authority of the department as well as its relationship with other related organisations and projects.

VII. Preliminary Investment Programme

A. Sea Defences

The proposed investment programme is shown in Appendix I and regional details are given in Appendix II.

The Government of Guyana has been funding the maintenance and rehabilitation of sea defences works annually from its own resources. The IDA, CDB, IDB, and EEC have provided funds for the rehabilitation of critical sections of sea defences. It is envisaged that Government will have to access financing from the above-mentioned agencies and other donor agencies to cover the proposed medium- and long-term strategies.

1. Inventory of critical sea and river defence areas

a. Critical areas

The areas along the coast to be treated as critical are: Essequibo Coast between Supenaam and Maria's Delight, Wakenaam, Leguan, East Bank Essequibo, East and West Coast Demerara, Bel Air and Mon Chosi on the West Coast of Berbice and No. 78 to No. 83 villages on the Corentyne coast.

b. Costs of works

The approximate cost to maintain and rehabilitate sea defence works over the short term

would be about G\$1,500 million annually. Over the medium term it is envisaged that it would be approximately G\$1,000 million annually, and for the long term, approximately G\$500 million annually, all estimated at 1995 prices.

2. Proposed financing for a sea and river defence programme via a donor agency

The Inter-American Development Bank has proposed a 5-year plan to enable the Government to carry out a Shorezone Management Programme of approximately US\$25 million, and EEC is also proposing an additional sum of approximately US\$22 million for rehabilitation of sea defences.

B. Drainage and Irrigation

The drainage and irrigation system needs financing in two respects:

1. financing for operation and maintenance
2. financing for rehabilitation, modernisation and new works.

Cabinet has directed that financing for operation and maintenance has to be generated from the users of the system. The private good component should flow directly from the beneficiaries and the public good component should come from Government sources. For the declared areas of the country, the estimated cost of operation and maintenance in 1996 was G\$565 million (1996 price levels). This comprised G\$178 million as the public good component and G\$387 million as the private good component. The cultivated land under the declared areas is 185,034 acres. The private good component is to be realised from the farmers. Adding 20 percent as administrative expenses to the estimated private good component, the D&I rate per acre for the country as a whole should be G\$2400. In order to account for the variation between Regions in the cost of operation and maintenance, rates may be varied in the ten Regions. Further, the rate needs to be assessed every year on the basis of the prevailing prices of equipment, material, labour, etc. The rate now levied is extremely low and the collection is also poor.

Capital works as shown in Annex III are likely to cost US\$700 million. For a 50 year implementation period, the annual investment will be of the order of US\$14.0 million. Since these are capital intensive projects and since it may not be possible to provide full funding from internal sources, it would be necessary to explore the possibility of multilateral or bilateral sources of assistance. The projects can be grouped into short-term (up to ten years), medium-term (between 10 to 25 years) and long-term (between 25 to 50 years) categories. The rehabilitation of D&I system, MMA Phase II/Phase III and special projects for the islands are considered short-term projects. These should be taken up straightaway and sources of funding identified. Already some assistance from World Bank, IDB, USAID, CDB and Government of Italy are identified. It should be ensured that they are sufficient to meet the total cost.

Planning for the medium- and long-term projects should begin with preparation of feasibility reports and detailed project reports for each. Donor agencies need to be identified for

possible assistance and these reports submitted to them in time to ensure adequate funding for the actual implementation as scheduled. A Project Review Committee consisting of members from NDIB, the Ministries of Agriculture, Finance and Foreign Affairs and the Private Sector Commission should be constituted to monitor preparedness and fund availability for all the projects under these two categories. This committee can also explore the possibility of private sector participation in the development of these projects. Private sector participation should not be limited to planning, design and construction only but should consider the project as an overall business plan for investment.

Current Government funding for the capital D&I projects is of the order of G\$700 million annually. The annual expenditure on the identified projects is estimated to be 2.0 billion G\$. This Strategy thus requires a tripling of the investment. It also requires appropriate institutional strengthening and professional capacity building, including the capacity of the construction and consultancy sectors.

C. Hydrometeorological Service

Computers, office and communication equipment, meteorological and hydrological equipment necessary for the Department=s operation and data gathering activities have been purchased through the Public Sector Investment Programme.

The World Meteorological Organisation has also donated computers and software, and has funded project preparation and training to achieve some of the Hydrometeorological Department=s objectives.

1. Immediate Needs

For improving the quality of the services rendered:

- a. The most pressing short-term need is for the acquisition and installation of a radar.
- b. The acquisition of the following equipment has been identified as a medium-term objective:
 - (i) Satellite receiving equipment
 - (ii) Meteorological and hydrological data collection equipment
 - (iii) Radio sonde, upper air data collection system
 - (iv) Automatic picture transmission equipment
- c. In the longer term, the following steps are proposed:
 - (i) Total upgrade of existing equipment

- (ii) Establishment of other forecasting and data receiving and transmitting centres at strategic locations around the country.

d. Apart from sophistication in equipment and interpretational and predicational tools, the unit is in need of better qualified and trained staff in adequate numbers. Support facilities like vehicles, adequate office space and modern office facilities commensurate with the nature of the job handled by the unit are required. On an immediate basis, the unit needs the following additional staff to handle its present job in a satisfactory manner.

<i>QUALIFICATION</i>	<i>NUMBER</i>
M. Sc.	4
B. SC	5
Class II Meteorologist/Hydrologist	6
Class III Meteorologist/Hydrologist	8
Class IV Meteorologist/Hydrologist	26

e. The unit needs to develop its capacity in the following manner in the designated operational areas:

- (i) Aeronautical Meteorology

Capability to develop very short term forecasting (1-7 days):

- suitable computers
- software availability or experts to develop the software
- availability of real time data from National Network radar

Capability to develop medium-term and seasonal forecasts:

- suitable computers
- experts to develop and modify suitable application
- capability to ingest data into a data base

- (ii) Water Resource

Capability to develop and adopt hydrological flood and drought forecasting models:

- suitable computers
- experts to develop/calibrate the application
- availability of real time data from the National Network
- suitable communication between the radar and forecast work station

2. Short-Term Implementation Plan (up to 10 years)

a. Continue the programme to automate the climate observing network including a Data Collection Platform (DCP) that includes eight synoptic stations, five agro-climate stations and twenty hydrological stations.

b. Acquire two weather radars to provide rain estimates on an aerial basis and to improve very short range forecasts for aviation, construction and mining.

c. Continue the computerisation programme so that suitable and adequate computers are available for data storage, processing and other tasks.

d. Improve the TV forecast presentation and the newspaper forecasts.

e. Strengthen the unit in terms of staff, training facility, work environment and office support equipment.

3. Long-Term Implementation Plan (up to 30 years)

a. Implement a flood/drought warning system. This will include collection of real time data via DCP.

b. Develop computer-based forecast systems for weather and climate and flood and drought forecast generation.

c. Decentralize the department=s operations by establishing regional offices which will then be responsible for data collection in the Regions and will provide forecasts, etc. to regional users. Forecasts will still be made by the central offices but will be transmitted to regional offices in real time. This will become important as eco-tourism develops into a thriving economic activity in the country.

d. Expand the agricultural sub-programme so that hydrometeorological advisories be changed from general information to which satisfy particular needs such as rice, sugar, coffee, poultry, cattle, vegetable, etc.

4. Investment Strategy

The implementation plan outlined above will need adequate funding over the time horizon of 30 years. The immediate and medium-term investment estimate works out to US\$20.5 million, while the long-term investment, which comprises the cost of the total upgrade of all existing equipment and the establishment of other forecasting, data receiving and transmitting centres at strategic locations, is estimated at US\$18.0 million. Investment in the sector, spread over a period of 30 years, is thus proposed at US\$38.5 million. The sources of funding and support will be the Government of Guyana and bilateral/multilateral foreign assistance.

It is recognized that the unit will not be financially self-sustaining for quite some time in the future and it will not be possible to obtain foreign assistance for maintaining the services. This will require Government to supplement the funds generated by the unit.

For capital expenses of a major nature, efforts should be made to obtain foreign assistance. A committee consisting of a senior level representative of the Ministries of Foreign Affairs, Finance and Agriculture and the Head of the unit should be constituted as a permanent body to explore sources of funding for the designated programmes. The unit should continue to seek the help of WMO for major assistance, as hydrometeorology is recognized as a global concern and global participation is essential for understanding the weather, environment and climate.