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INTEGRATED AND SUSTAINABLE MANAGEMENT OF TRANSBOUNDARY WATER RESOURCES IN THE AMAZON RIVER BASIN

GEF AMAZONAS PROJECT - ACTO/GEF/UNEP/OAS

Bolivia, Brazil, Colombia, Ecuador, Guyana, Peru, Suriname, Venezuela

Activity 1.1 Vision for the Basin and Transboundary Diagnostic Analysis



Final Report

NATIONAL VISION DOCUMENT



Hydrometeorological Service, Ministry of Agriculture

Georgetown - Cooperative Republic of Guyana

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Hydrometeorological Service
Ministry of Agriculture

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EXECUTIVE SUMMARY

INTRODUCTION: VISION AND OBJECTIVES

The Amazon Cooperation Treaty Organisation (ACTO) was established in 1978 by the Governments of Bolivia, Brazil, Colombia, Ecuador, Guyana, Peru, Suriname and Venezuela. Its goal was to plan for the sustainable development of the region's resources and people, and in 2004, a strategic plan for the years 2004-2012 was published. The plan defines a number of areas or themes for development; including the sustainable management of the region's water and soil resources.

The project Integrated and Sustainable Management of Transboundary Water Resources in the Amazon River Basin was prepared by the countries that are signatories to the Amazon Cooperation Treaty (ACTO): Bolivia, Brazil, Colombia, Ecuador, Guyana, Peru, Suriname, and Venezuela. The goal of this project was to strengthen the institutional framework for planning and executing, in a coordinated and coherent manner, activities for the protection and sustainable management of the land and water resources of the Amazon River Basin. The proposed project endeavoured to realize a shared vision for sustainable development in the region, based upon the protection and integrated management of transboundary water resources and its adaptation to climate changes. This will clearly be a long-term effort.

The development of an institutional structure for the coordinated management of the Amazon region is recent and still fragile. The challenge, in terms of its hemispheric scale and the number of countries sharing responsibility is great. All eight are developing countries, and their economic and technical capacities have evolved in very different ways, both in terms of scale as well as related institutional and legal frameworks.

Accordingly, the project is proposed to be divided into three four-year phases: the first for planning and development of institutional capacity; the second for implementation of jointly identified strategic activities; and the third for strengthening sustainable and integrated water resources management in the Basin, recognizing the likely impacts forecasted to arise as a consequence of ongoing changes to the global circulation and climatic regimes.

The current Project Development Facility - PDF Block B - is the preparatory phase of GEF Amazonas Project - OTCA/PNUMA/OEA, which must be executed over a period of 23 months (October 2005 to September 2007). It aims to prepare the full-sized Project Brief, where its components will be described in greater detail and a shared strategic vision for the sustainable development in the Amazon River Basin will be advanced, along with the institutional arrangements and partnerships for the subsequent execution of the project activities. The Project Brief will not only serve as a guideline for a new GEF grant request, but will also promote parallel actions in the basin countries and other stakeholders so as to strengthen the Basin Vision and its program of integrated resource management, including the adaptation to ecological and hydrological changes caused by global climate change.

In Guyana, the Hydrometeorological Service, Ministry of Agriculture has been given the mandate of coordinating efforts aimed at sustainably managing Guyana's water and soil resources in response to changes in global climatic conditions. However, Guyana's soil and water resources are affected by a number of other interest groups and activities, whose views must be taken into consideration when defining the country's vision.

Given the existence of a number of agencies and social actors with mandates and activities resulting in direct impact upon the country's soil and water resources, this paper attempts to summarise these factors of interest. In particular, this paper attempts to summarise the institutional arrangements and plans currently in place in Guyana for the management of its part of the Amazon. Specific emphasis is placed on the key institutions, legal frameworks, and the mandates of those stakeholders whose activities impact directly on the country's soil and water resources. Existing plans for water management and use and the impacts of these on the environment and society as well as the impact of climate change and the socio-economic conditions are also examined.

The Consensual Vision for the Basin will be defined based on the analysis of the current situation, as well as on the prognostics of future scenarios. The results of this effort would be used to guide the definition of the Consensual Vision for the Amazon Basin. It is hoped that these efforts would partially assist in the identification of issues of transboundary interest in the Transboundary Diagnostic Analysis – DAT of the Basin as a whole. As such, this paper attempts to map Guyana's current situation upon which the country's vision would be built.

1.0 CURRENT STATUS

Guyana is the only English speaking country on South America, and is located on South America's northeastern coast, between Venezuela which lies to its west and Suriname on its east. Guyana has an area of 214,970 km² of which nearly seventy-five percent is covered with natural vegetation. Physically, Guyana can be divided into four natural regions: (1) the Coastal Plain or a flat coastal belt; (2) a sand belt; (3) an undulating, Central Peneplain; and (4) a Highlands region.

1.1. The Basin of the Amazon River and its Sub-Basins

Guyana gets its name from the Amerindian word that translates to "land of many waters". As the name suggests, there is a complex system of rivers, creeks, lakes, waterfalls and other water bodies within the country's borders (see Figure 1).

1.1.1. Guyana's River Basins

Guyana's major River Systems are: the Essequibo River and its principal tributaries, the Mazaruni, Cuyuni, Potaro, Siparuni and Rupununi; the Corentyne, and its tributary the New River; the Berbice, and its tributary the Canje; the Waini, and its principal tributaries the Barama, Imotai and Arawapai; the Barima, and its principal tributaries the Aruka, Kaituma, Anabisi, Whanamaparu and Whanna; the Demerara river; and the Amacura river. Besides these main rivers, there are the Takutu River and its tributary the Ireng which form the south-western limits of the country. The Takutu flows into the Rio Branco, a tributary flowing into the Rio Negro which is a confluent of the Amazon River.

1.1.2. Hydrology

Guyana is one of eight countries sharing the Amazon Basin. Its main river, the Essequibo is one of the principal rivers of South America with a mean flow of 2100cu.m/s. In fact, the Essequibo is the largest river flowing into the Amazon between the Orinoco and Amazon rivers. Much of the Guyana's hinterland area is drained directly or by major tributaries of the Essequibo and fresh surface water is generally in plentiful supply for most of the year.

ξ Guyana's Water Resources

Even though Guyana is rich in water resources, most of the surface water and some of the groundwater requires treatment to make it potable. Most surface water is liable to contamination and many surface sources would disappear in the dry season.

ξ Interior Plains Area

The White Sands Formation, located in the northern Interior Plains region and in the southern Coastal Lowlands region, yields moderate to large quantities of fresh water from depths of less than 30m. This formation is centered in Linden (Region 10 Guyana) and also provides the origin of the groundwater percolating into the A and B sands aquifers used in Coastal areas. In the north-western coastal area region, large quantities of brackish to saline water are available for abstraction at depths ranging from 3 to 30m.

ξ Southern Plains and Western Highlands

Groundwater is generally plentiful from sedimentary and volcanic deposits in the southern and western regions of Guyana. There is a paucity of potable groundwater in the central mountainous area of the Hinterland known as the Guyana Shield where only fractures and small perched discontinuous aquifers produce water. The depth to the water table ranges from 3 to 300m depending on the location of the well or borehole and levels may also vary with the season.

1.1.3 Geology

Guyana lies within the Amazonian Craton, which forms part of the South American Continent (Brazil, Bolivia, French Guiana, Guyana, Suriname and Venezuela). The Amazon Craton is subdivided into two geographic shields, the Guiana Shield in the North (in which Guyana is situated) and the Central Brazil (Guapore) Shield in the south.

1.1.4 Guyana's Demography

The 2002 Population and Housing Census showed that the population of Guyana rose to 751,223 persons – higher than the 1991 census by a little more than 27,500 persons. This new count was in keeping with trends of population change for Guyana, which has shown an increase at each census; except for the 1991 census when – for the first time in history – the count was lower than that of the previous census.

1.2 Existing Plans and Programmes

1.2.1 Water Resource Plans and Climate Change Assessment

The Guyana Water Incorporated is currently preparing its Strategic Plan which should include data on the water supply and distribution system on Guyana's coast and hinterland

areas. The Water and Sewerage Act 2002, sets up the central legal framework for the management of water resources in Guyana.

1.2.2. Coastal Agricultural Water Supply

Water for supporting coastal agriculture comes from the country's Highland region. There is a complex drainage and irrigation network encapsulating three water conservancies established to capture, store and distribute rainfall water from the Guyana's Highlands to Coastal Guyana. These conservancies are relatively shallow but extensive reservoirs covering several hundred square miles. This system is monitored by the National Drainage and Irrigation Authority.

1.2.3. Water and Climate Management and Monitoring

The Hydrometeorological Service, Ministry of Agriculture operates the National Meteorological Station Network (NMSN) and the National Hydrological Station Network (NHSN).

By collecting, processing, archiving, retrieving and analysing the data from both Networks, Hydromet is able to provide information to those agencies that are planning and designing agricultural and water development projects, and maintaining the country's sea defences. It also analyses the lower and upper atmospheric weather data of the western hemisphere, and disseminates the information to the aviation and other sectors. The department maintains several databases with pertinent data on hydrology and meteorology, including the CLICOM database that is used for precipitation and meteorological data and HYDATA which is used for archiving streamflow data.

ξ Recent Climate Studies

Guyana has ratified the United Nations Framework Convention on Climate Change (UNFCCC). To achieve the objectives and meet its commitments of the UNFCCC, a Climate Change Action Plan was developed in 2002. The Action Plan recognised that it was imperative that climate change activities be developed to ensure that Guyanese were prepared to deal with the impacts of the consequences of global warming (Climate Change Action Plan, 2002).

Prior to the preparation of the Action Plan, Persaud and Persaud (1995) classified the rainfall regions of Guyana. Additional attempts at understanding Guyana's weather and climatic conditions were made by Mott MacDonald (2004) and Seulall (2005)

ξ Climate Change Impacts

The possible impacts of climate change in Guyana were discussed in the Initial National Communication (2001) and some of these are summarized here. The impact of climate change on water supply is not very clear. Decreasing rainfall and increasing evaporation can lead to lower water levels in the rivers. Extreme rainstorm events can allow for flood conditions especially during cold phase ENSO events. Sea level rise can result in salt water intrusions further up river. Ground water can also be vulnerable to this effect. Demand for water is expected to increase with increasing temperatures and the relative value of water for alternative uses would likely change as priorities are determined on the basis or urgency of needs.

The energy sector will also be affected. Demands for interior space cooling and possibly decreased hydro-generating potential supply from some river basins can pose some problems. In the agriculture sector, yield losses will affect sugar and rice, the country's two main crops. These losses may be triggered by increased water demands from crop transpiration and greater respiration losses as a consequence of higher temperatures.

A CO₂ –induced climate change can impact on the forestry sector in a similar way to that for agriculture. There would however, be a need to consider the impact of increased CO₂ fertilization on forest growth. If the dry seasons get drier, then this may impose severe constraints on forest growth and may be critical in determining species response. With a doubling CO₂ concentration, indications are that the forests in southern Guyana may be affected with the shrub savannah spreading southward to replace tall evergreen forest. With a tripling CO₂ concentration, the same areas can be affected. However, the northwest may also be affected by a change to shrub savannah types. Again, the sensitivity analysis must be guided by further studies.

The Coastal Zone is identified as being the most vulnerable part of Guyana because sea level rise will be expected to add to the direct impacts of temperature rise, rainfall decrease and evaporation increase. It is also the part of Guyana where adverse impacts will directly affect a large percentage of the Guyanese population.

1.3 Other Relevant Plans and Programmes

Guyana's vision for sustainably managing its part of the Amazon Basin would be built upon some past initiatives, including:

1.3.1. National Development Plans

Two key documents were produced recently that focused primarily on national development. The first is the National Development Strategy (NDS) produced in 2000 and which presented a policy framework for Guyana on critical areas of development, namely: Governance; Macro-economic strategy and the Management of the Economy; The Environment; Information Technology; Energy; Transport; Sugar; Rice; Agricultural Institutions; Non-Traditional Agriculture; Fisheries; Forestry; Water; Mining; Manufacturing; Education; Health; Tourism; Urban Development; Land; Housing; Amerindians; Gender Issues; The Family and Its most Vulnerable Members; Labour and Employment; The Private Sector; and Poverty Eradication.

The second document the Poverty Reduction Strategy Paper (PRSP) in 2005. The PRSP, like the NDS focused on a number of areas that needed addressing in order to reduce national poverty including water Resource Management Plans.

1.3.2. Resource Management Plans

1.3.2.1. National Protected Areas System

There are at least five (5) sites in Guyana that has been earmarked for protected area status: The Kanuku Mountains, Mount Roraima, Orinduik Falls, Shell Beach, and South-Eastern Forest. Once instituted, these sites would join the Kaieteur National Park and the Iwokrama

International Centre for Rainforest Conservation and Development on the list of national protected areas.

1.3.2.2. Natural Resource Management on Amerindian Lands

Amerindian communities that hold legal title to their lands, by virtue of their ownership of these lands have jurisdiction over all natural resources, with the limited exception of sub-surface resources and waterways. In recognition of the fact that they have control over these resources, the Village Councils have been charged under the Amerindian Act 2006 to put systems in place for the management of their natural resources. During 2005, sixteen communities in the North Rupununi of Guyana have initiated efforts aimed at formally managing their natural resources. These efforts attempt to institute management systems on Amerindian lands that are parallel to those existing on state lands adjacent to their communities and bringing sustainable benefits to their people and are documented under “By-Laws for the Management of Natural Resources by the Communities of the North Rupununi”.

1.3.2.3. The Rupununi Wetlands Project

The Rupununi Wetlands, just southeast of the Iwokrama Forest, includes the Rupununi, Rewa, and Essequibo Rivers, and many other smaller rivers, creeks and ponds. These wetlands contain high habitat diversity and support a vast array of wildlife. Through the collaborative efforts of the Darwin Initiative for the Survival of Species, Iwokrama, the University of Guyana, the Environmental Protection Agency and the North Rupununi District Development Board (NRDDB), the monitoring programme aims to develop a better understanding of the impacts of different land uses on the wetlands.

1.3.2.4. Hydropower Development

The Hydro-Electric Power Act 1956 provides the legal framework for the development of hydroelectric power generation in Guyana. A number of sites have been identified for the development of hydropower facilities in Guyana, of significant note are: Amalai in Region 7 where a 2000 Mega Watts (MW) facility is being explored, Marshall Falls in Region 7 (1100 MW) and Tumutumari (35 MW).

1.3.3. Soils and the Environment

The National Agricultural Research Institute (NARI) is currently spearheading research on soil and land use surveys, management of aquatic weeds and soil management. NARI also holds maps on soil types and structure throughout Guyana.

1.4. Biodiversity and Forests

1.4.1. Biodiversity

Guyana has remarkable diverse habitats and a rich flora (plant life) and fauna (animal life) which remains largely unexplored. It is unique in the world because the majority of its natural resources remain in a pristine state. While Guyana is one of the smaller countries of the wider Amazon region, it contributes significantly to the biodiversity, both in terms of number of species and number of endemics. Its natural ecosystems are relatively intact due mainly to low population pressure and to limited commercial activity. Guyana recently prepared a National Biodiversity Plan, which seeks to promote conservation and sustainable use of Guyana’s biodiversity.

1.4.2. Forests and Forestry

ξ The Forest Resources

The forest of Guyana covers some 16.45 million hectares or 75% of the total land area. Of this area only about half (8.7 million hectares) is considered accessible for economic exploitation. This forest is generally considered tropical moist evergreen rainforest, though represented by various forest types. The permanent State Forest Estate, which covers some 13.58 million hectares, is administrated by the Guyana Forestry Commission (GFC). The remaining forest areas are Private Property, Amerindian Community Titled Area or State Lands administered by the Guyana Lands and Surveys Commission.

ξ Classification of Guyana's Forests

Rain Forests

Rain forests occur in areas where the climate is wet, with rain occurring every month or where dry spells are short. Trees are numerous and stand in strata or layers, ranging from low shrubs to very tall dominant trees with large spreading crowns. Climbers and epiphytes are abundant. In Guyana, rain forests are the most common forest type, occurring from the north-west through to the south of the country. It is also the most important type for timber production.

Dry Forests

Dry forests occur where soil moisture is frequently limited either because the soil drains rapidly or where there is excessive evaporation due to strong winds. Examples of dry forest are found on the white sands of the Soesdyke-Linden highway and throughout the Pakaraima Mountains. Wallaba forests are common in the white sand regions.

Seasonal Forests

Swamp forests occur where drainage is impeded and soils are frequently waterlogged. This forest type includes the mangrove forest along the coastline and the Mora forests occurring in lowland swampy areas and along the interior. Mangrove forests provide protection to the shoreline against erosion and are an important habitat for marine life.

2.0. DYNAMICS OF CHANGE

It is well documented that the world freshwater resources are under threat from human development and anthropogenic activities and changes in global climate conditions. Due to these factors, it is extremely difficult to predict the state of the planet's water resources in the future. However, number of driving forces have been identified as driving forces behind global change.

2.1. Driving Forces of Change

There are a number of areas that have been identified as the major drivers propelling the global water scenarios: demographic – this includes population growth, migration pressures and urbanization; economic – economic outputs; trade; prosperity; water works investment; technological – hi-tech expansion; water efficiency; unit water pollution; adoption of new crops; water sanitation investment; number of desalinization plants; withdrawal efficiency;

social – lifestyles, poverty, inequity; governance – power structure ; level of conflict; globalization; environmental – water related diseases; soil salinity; groundwater; and ecosystem health.

Many of these driving forces are visible in Guyana and indeed the wider Amazon Basin, and therefore would need to be considered when shaping the scenarios for future management of the region's water resource. It would be important to have a preliminary assessment of the services provided by Guyana's freshwater resources in order to observe if some of these driving forces are active in this part of the Basin.

2.2 Future Scenarios

2.2.1 Overview

As stated earlier, the management of Guyana's freshwater resources would be built on the current situation. Future management strategies would be built upon the visions and programmes from the institutions and social actors whose mandates directly affect the country's water and soil resources and sustainable development. These key agencies took the opportunity presented by the National Vision workshop to share their current programmes and plans for the future, this allowing for plausible outcomes for the future sustainable management of Guyana's part of the Amazon Basin, with specific emphasis on water to be determined. The positions of the individual agencies were consolidated to arrive at a national position for the short, medium and long term.

It should be noted however, that even though special emphasis was placed on water, participants at the National Vision workshop engaged their energies on the various themes of sustainable development. The following section presents a summary of the scenarios developed at the National Vision workshop.

These scenarios are not to be used solely to estimate future supply and demand needs, but they should provide a starting point for evaluating various management options including, but not limited to:

1. Moderating water demand through demand management programs, changes in water prices, and efficiency programs and;
2. Increasing water supplies through urban water re-use facilities ground water reclamation, recharge, and conjunctive use, increased water storage and conveyance, and desalinization.

These scenarios presented below are written with the understanding that they are only likely futures and not forecasts, as clearly it would be impossible to forest cast how water management would evolve in the future.

2.2.2 Short term: 5-Year Scenarios

In the short term, it is expected that much of the current trends aimed at improving environmental management and the development of the national population of Guyana would continue.

The current policy aimed at improving the Water Sector with respect to the delivery of potable water to a wider cross-section of the Guyanese population would also continue. This would include changes in the system for water delivery with the likely implementation of more efficient systems of delivery, with customers being required to pay for potable water and off-setting production cost. This would be especially applicable to the Coastal plain and particularly in the vicinity of the capital city of Georgetown.

In the short term, it is likely that large portions of the country's water resources currently being utilized for environmental purposes would be directed towards agricultural and industrial activities (agricultural and urban water use) as these areas are developed.

The National Water Council is expected to begin functioning as mandated in the Water and Sewerage Act 2000, with the National Water Policy (NWP) being developed and implemented accordingly. The implementation of the Act would result in a greater role by the key agencies as stipulated by the legislation.

The Water and Sewerage Act (2000) has been developed to allow for a concerted effort at sustainably managing and protecting the country's hydrological resources, including monitoring climatic and other factors that may impact upon this resource. At the moment, however, the Act is not being implemented to its full force, thereby not allowing for many of its credible intentions to be achieved. In the short term, it is likely that there would be more effective implementation of the Act allowing for greater protection and sustainable utilisation of water resources in the Guyana. It is likely too that at the regional level, efforts would be made to harmonise water use legislation and management systems.

2.2.3 Medium-term: 10-Year Scenarios

From the discussions at the National Vision workshop, it appeared likely that in 10 years time Guyana would be aiming towards a resource use regime that is less resource intensive, and more focused on improving the efficiency in which natural resources are utilised.

The country's population may continue to grow, and more actions would be taken towards ensuring that more of the country's water resources are dedicated for environmental and ecosystem purposes. In the Forestry Sector, for instance, it is likely that all activities would be made to stringently adhere to instruments such as the Forest Code of Practice. Other forest use protocols would be adhered to - ensuring that waterways in the forests are protected and vegetation in catchment areas are not destroyed. More efforts would be made to ensure that forest and non-timber forest products are carefully utilised, with greater efforts for value added processing of timber products in order to bring lasting benefits to the Guyanese people and thus making a sound contribution to the global carbon equilibrium.

The demand for water would grow, making it necessary for investments in establishing more efficient systems for water delivery and potable water processing. This would, however, tend to result in improved equity, efficiency and sustainability of the Water Sector. It should be noted that the current trends in the Water Sector do strongly suggest that this is the direction in which the Water Sector is likely to move.

As the Water Sector expands, there would be higher prices and possibly increased investment in the Water Sector. These new developments would encourage the private sector to invest in research and development of the Water Sector. This renewed interest in research could result in greater involvement of research institutions such as the University of Guyana and make the role of the Hydrometeorological Service more critical in this era.

Ground water aquifers and coastal water supply would be areas that would receive increased research and interest as well. The current assessment of sea level rise and implications for Guyana's coast suggests the impacts of sea level rise are being observed along the coastline. It is also being suggested that Guyana's coastline is subsiding. This could have the likely impact of coastal aquifers being infiltrated by saline water from the Atlantic Ocean. Such impacts may become more pronounced in the medium term, giving even more importance to the role of the Hydrometeorological Services.

Changes in global climate and sea level rise would more than likely demand that greater attention be placed on improved water management and water productivity. For example, the Agricultural Sector would be affected and there would even be a need for developing new crops and examining the option of moving cultivation from coastal to inland Guyana. The introduction of new crops into areas that are currently covered in other vegetation types would mean that there is a shift in water use and demand. New crops would also require irrigation - removing water that would have previously been used for environmental purposes to agricultural areas. The movement of cultivation from coastal to inland Guyana would also require that new water storage areas be established inland as agriculture would demand that water storage facilities be in place to sustain economically viable crop production.

At the same time, the increasing population and the impact of current programmes aimed at improving the livelihood of Guyana's population would probably result in an increased demand for water. More of the population would require water for basic life functions, and the creation of new wealth could result in persons using more water for increased domestic comforts - for instance, swimming pools and Jacuzzis. Even though absolute poverty may be reduced, income inequalities may increase, and at the detriment of the environment.

The changing situation would require that the Water and Sewerage Act 2002 be fully implemented and that there is greater integration between the agencies' interested in water. In fact, it is likely that during this era the interconnectivity of all natural resources would be fully appreciated and management efforts would therefore aim to develop an integrated approach towards management. For instance, the Hydromet Service recognises that it would need to be strengthened with specific emphasis on: modernization and institutional development, expansion of monitoring network, and the hiring of more trained staff. There would be a need for co-operation/partnership between various organizations such as academia, Government Organizations, private sector, NGO's and so on; better decisions based on more complete and accurate weather, water and climate information; partnerships to provide better data coverage and information processing; higher resolution models and more precise and useful specialized products.

The foregoing suggests that there would be a dire need for the old paradigm of all natural resource extraction and monitoring occupying specific niches would be removed and all

would operate with an integrated agenda for the purpose of sustainably managing Guyana's water and natural resources.

In the Mining Sector, it is expected that more systematic exploration and mine planning would be done by Medium Scale Miners. It is likely that there would be a greater mix of Large, Medium and Small Scale Operations and a diversification in minerals exploited. Improvements in the Mining Sector and increased investment are likely to result in downstream value-added products such as alumina being produced. With greater efficiency in the sector's environmental practices are likely to improve, including reclamation and compliance with regulations. At some point in the medium term, as well, it is likely that Guyana Geology and Mines Commission (GGMC) would be able to decide how many Small and Medium Scale Operations would be allowed in an area. Further, it is likely that this era would see a greater appreciation for ecosystem functioning leading to more environmentally friendly mining. The sector may subscribe to the concept of Landscape Forest Management that positively addresses mining.

So whilst the short term is likely to see continued conflict between resource extraction activities such as forestry versus conservation, the medium term is likely to see some of these issues clarified at the national policy level.

2.2.4 Long-term: 20-Year Scenarios

In the long term, it is very likely that the national population would increase, and the current programmes to increase agricultural and industrial production would be bearing fruit. However, increased population would also mean that there would be a greater demand on the natural resources of the country. The current initiatives to improve environmental management would also be bearing their rewards and there would be greater environmental awareness by the population.

A better educated and informed population would be aiming to achieve more sustainable values and lifestyles. The current institutions for the management of natural resources, in particular water would probably become more open and focus more of their energies on including stakeholders' viewpoints in their decision making. The educated population may in fact demand that their views are fully incorporated into the decision making process.

It is likely that many of these actions would emanate at the community-level, driving action towards sustainable watershed management, rainwater harvesting and focusing on increasing mean-yield levels in irrigated and rainfed areas. Decision-making in the Water Sector is likely to be more transparent, involving all stakeholders. If this trend should prevail then it would become likely that ecological functions are recognized and maintained with human water use becoming sustainable.

It is during this era too that the current predictions on climate change and its impact would become noticeable in Guyana. The national population is likely to be more aware of weather related issues and take appropriate action in response to warnings. The increased demand for quality data to safeguard human well-being would probably determine that numerical prediction models for both hydrology and meteorology be developed along with more Hydrometeorological stations being set up across the country, with responsibility for

hydrological and meteorological programmes. If the impacts of global climate change and sea level rise begin to take effect then there would be a need for research on ground water resources of the coastal artesian basin.

In keeping with the likely increased education and awareness of the national population, it is likely that the population would request more information – geological, water quality, biological, watershed – and related databases, GIS etc. would lead to better management of mineral resources. It is likely too that the mining industry would become more diversified, and more miners would want to comply with regulations since they would then recognise the benefits.

Similarly, it is likely that operations in the forestry sector would pay great attention to environmental concerns and more operators in the sector would take action to ensure that their activities are having minimal impacts on the natural environment. The increased concern for the environment would require that there be more effective collaboration between Agencies and Sectors. There is likely to be greater effective participation in mining-friendly Landscape Forest Management. At this point too it is likely that capacity would be built for environmentally friendly mining and monitoring by GGMC, EPA, Miners and Communities.

Conclusions

These scenarios are plausible futures, not forecasts. They are differentiated by important assumptions about uncertainties in water and other resource conditions. Materially different future conditions can significantly affect the nature and outcome of various mixes of management strategies. Some management strategies may be effective and economical regardless of the future scenario. Other strategies may only be suited if specific conditions develop in the future.

Developing quantitative estimates of water demands and supplies for multiple future scenarios and management responses require using available data and assumed relationships. For Guyana, and the wider Amazon, we need to consider the current situation and the way the various stakeholders with direct impacts on water resources would like to design their various programmes. After all of these factors are taken into consideration, we can develop future scenarios that can be used to guide the sustainable management of Guyana's water resource and as an extension, the Amazon region for the short, medium and long term. indeed, the regional position must take into account the existing situation in each of the eight countries that are signatory to the Amazon Cooperation Treaty. This is so since the existing reality in each of the countries would have to be taken into consideration when shaping a regional position. this prospect would be extremely challenging, as no two countries would have the identical realities.

RELEVANT TRANSBOUNDARY ISSUES

3.1 Transboundary Issues and Identification of Hot Spots of Common Interest

3.1.1. Transboundary Issues

The following issues were identified as significant and relevant transboundary issues (in order of priority):

1. Global Climate Change

Global climate change has been identified as one of the most important issues that would confront the eight states of ACTO in the medium to long term. Climate change would impact the region's hydrological and freshwater resources more specifically in the long term. One of the impacts of climate change and sea level rise would be the intrusion into freshwater and coastal aquifers of saline water into coastal states such as Guyana and Suriname. This would have definite impacts on coastal existence and would lead to changes of the lifestyle in this part of the country.

Currently, approximately 90% of the Guyanese population occupy the Coastal Plain region. The impacts of climate change could force the Guyanese authorities to consider relocating the population inland to occupy the highland regions of the country. Should the Guyana's coastal population be forced to move as a result of climate change, this movement would impact directly on the forested catchment areas of the country, probably leading to deforestation as population movements in land would require new settlement to be developed with their associated services.

2. Population Growth/Transient Population

Increase in human population would have direct impact on the Amazon region's freshwater supply. An increase in the human population of Guyana would translate to more persons in need for freshwater and greater demand for quality freshwater. Transient population would also have an impact on the region's water supply. Sections of Guyana's hinterland population are known to be transient. The movement of people from one county to another could translate to the movement of attitudes towards water use and protection for the aquatic environment from one jurisdiction to another.

3. Health

Water borne diseases especially in the hinterland areas of Guyana could become a problem as the region faces climate change. Change in climatic conditions would create conditions that may predispose vectors of water borne diseases to proliferate. This could lead to an increase in flood related diseases, and diseases related with general sanitation.

4. Sedimentation and Pollution

Anthropogenic activities such as agriculture, mining, forestry, housing development, and tourism could have the likely impact of land degradation. When land is degraded it is easily eroded and could find itself into waterways. These sediments (and other pollutants) could then affect the aquatic life present in the watercourses. Guyana's forested areas are found on soils that are easily eroded once the forest cover is removed. The conversion of such land for agricultural purposes, in the absence of the most appropriate land management practices

would also lead to the loss of soil resources. Activities in the Mining, Forestry and agricultural sector lead to pollution of the country's water resources and watershed management.

5. Deforestation

The removal of forests in forestry and mining activities, and failure to replant same, would in the long term have an impact on the carbon sink potential of the country's forests and rainfall catchment areas.

6. Water Resources Use

GWI in its drive to bring potable water to a broad cross-section of the Guyanese population would need investment in water sanitation, water treatment facilities and improvements in water distribution systems to meet the needs of its customers. These investments would immediately affect the nature of water use and distribution in the country, increasing the cost of water delivery. Hydropower generation is receiving a great amount of national attention at the moment. These new developments would bring a new demand on the country's water resources, with water that is normally used for environmental purposes being transferred elsewhere.

7. Illegal activities including: fishing, wildlife, intellectual property rights

Some species of fish and wildlife, example *Arapaima gigas* moves freely between the Guyanese and Brazilian borders. The species is endangered in both countries, with regulation enforcement believed to be stricter in Brazil than Guyana. As a direct consequence, Brazilian fishermen are often reported to be in Guyana's territory in search of the Arapaima. This situation may gain even more importance as many of the country's indigenous communities claiming that fish populations are decreasing.

8. Energy

The ever increasing price for fossil fuels on the global market place would affect all the countries party to ACTO. There is therefore a need for the development of alternative sources of energy. Hydropower is a very likely source of this new energy and is certainly being pursued by some states, however, this source of energy also have environmental impacts.

9. Navigation

The rivers of the Amazon Basin serve as a significant navigation route. The movement of people and goods and services throughout the region has significant benefits as it can improve trade within the region. Free movement can, however, have negative impacts if not properly managed as this could allow for the movement of illegal materials. Indiscriminate movement of vessels within the rivers of the Basin could have the greatest impact, however, on the region's biodiversity and integrity of water courses.

10. Investigate transboundary off-site effects

Many parts of the Amazon Basin region are interconnected although hydrology is not the means by which the region is connected. This would suggest that there is a chance that the countries could be sharing the same sources for water –table, water cycle and spawning areas for aquatic species. Given that ecosystems may be contiguous and similar there is a good

chance that activities in one part of the region would affect another part. This is of particular concern and would require some more investigation.

3.1.2 Hot Spots

A number of biodiversity hotspots have been identified by Guyana for future management. Most of the areas highlighted here have been earmarked by the Government of Guyana for protected area status in the future given their high biodiversity importance. The sites that have been earmarked for protected area status are shown in Figure 18, whilst descriptions are given below.

The following hot spots were identified:

- § Kanuku Mountains
- § Mount Roraima
- § Shell Beach
- § South-Eastern Forest
- § Kaieteur National Park
- § Rupununi Wetlands
- § Amerindian Communities

3.2. Thematic Axes and Priority Themes for the Amazon Basin

At the national vision workshop, the following areas were identified as being critical for collaborative efforts between the countries signatory to ACTO. The following list have been prioritized for consideration.

3.2.1 Hydrometeorological Monitoring and Institutional Strengthening

Monitoring of hydrological and meteorological conditions is critical to the sustainable development of Guyana. The current system for monitoring needs to be strengthened so as to allow for accurate accounting for changes in national (Guyana) hydrological conditions. The Hydrometeorological Service has reported that the minimum requirement for operating the National Hydrological Network is a network comprising of at least seventy (70) stations. At the moment, Guyana NHN only has around seventeen (17) stations in operation. This system once operated with a much more comprehensive network of stations located throughout Guyana, and would certainly need to be restored to a position meeting the minimum requirements especially in face of global climate change observations.

A fully functional and comprehensive network would allow for comprehensive data collection. The analysis of such data could lead to the sound decision-making with respect to the impacts of climate change on the country's hydrology.

3.2.2 Domestic Water Supply and Demand

With the changes in the Water Sector over the years, water is now being treated as a commodity and traded like any other commodity on the market and is therefore influenced by market forces – demand and supply.

Big issue is efficiency of supply.

3.2.3 Agricultural Water Supply

As efforts are made to improve agricultural production at the national level drainage and irrigation would need to be addressed nationwide.

Changes in the agricultural sector would use water that was traditionally used for environmental purposes to agricultural purposes.

3.2.4. Land Administration and Land Use Planning

Land use planning is probably the most important aspect in drive towards sustainable development. In light of global climate change and Guyana's quest for sustainable development it is indeed crucial that the country's land resources be carefully administered and utilized to bring optimum benefits to the population.

3.2.5. Mining

Despite the positive economic benefits, mining remains an area of conflict and needs careful management.

3.2.6. Forestry

Similar to mining, activities in the forestry sector are a major threat to the environment especially catchment areas and biodiversity.

3.2.7. Housing and Development

The current trend along the coast of Guyana is for old sugar cane cultivated areas to be converted to housing areas. This trend is expected to continue in the near term. This may be so despite the fact that these areas may not be the most appropriate for housing. The development of roads to access settlements, forestry and agricultural areas are not necessarily done in a manner that has the minimal impact on the environment. For instance, roads are developed and sediments from excavation works would easily find their way into water courses. This direct sedimentation could result in impacts on aquatic organisms and ecosystems.

3.2.8. Population Growth

The Housing and Population Census (2002) strongly suggest that the national population is growing. The country's population growth is also being affected by immigration into the country's interior areas, especially mining sites, where persons from overseas enter to engage in mining activities.

3.2.9. Research

The focus of research at the University of Guyana is to improve the quality of environmental management decision making. Particular attention is paid to advancing the uptake of research information. It is recognised that improved linkages and interactions should be facilitated

between researchers and end-users, that is, policy and decision-makers. Specifically the areas of Ichthyology: Fisheries Studies, Inventory, Monitoring, Taxonomy and Secondary Succession of Aquatic Systems; Water Quality: Parameters, Development and Impacts and Monitoring and Indicators.

3.2.10. Energy

The current drive in the Energy Sector is to aggressively reduce the dependence on fossil fuels. It is expected that in the short term greater efforts would be made with respect to the development of renewable energy sources, including hydropower, solar and wind.

3.3. Priority Areas of Intervention and Actions to Minimize the Main Problems and Optimize the Potential for Integrated Water Resource Management

In recognition of the issues, and that that they are transboundary in nature, it would be necessary that in the near future that the countries that comprise ACTO seek to work together in order to address these and to allow for the sustainable development of the region. Some of the possible actions that should be considered could include:

1. Maintaining and establishing obligations to international and regional conventions, for instance, the Convention on Biological Diversity, United Nations Framework Convention of Climate Change, and the Amazon Cooperation Treaty. Such actions would allow for greater spatial coverage of areas of concern, allowing for a better understanding of the driving forces that may be impacting on natural resources and could give rise to comprehensive measures to deal with the same, and in particular the highly threatened fresh water resource. The Amazon Basin and the adjacent areas should now, for instance, be viewed as a single unit in space and treated accordingly. Management strategies should then be appropriately scaled and geared to allow for the management of the area as one unit. Such an approach is necessary and even though it would have to take into consideration the circumstances of the individual countries, is the only sure way to ensure that the regions resources are meaningfully managed in the face of global climate change.
2. Develop synergies between organisations – in addition to Memoranda of Understandings between agencies at the national and regional level, there is now a need for renewed efforts of cooperation between agencies with mandates in the natural resource sectors that would allow these agencies to work closely together and share information. Such efforts should not only occur at the level of individual countries, but it should also take place at the regional level. Various protocols for the sharing of efforts and indeed mechanisms for integrating efforts at natural resource management should be urgently pursued. It should be recognised that the natural resource sector is strongly interlinked and that each of the sectors could have impacts of water resources in the region. Once the interconnectivity of the area's natural resources is recognised, then an integrated approach to management should be relatively easy to justify. The area of Hydrometeorological Monitoring could be an area for consideration for future collaboration.
3. Build capacity building at all levels to deal with the environmental issues – the lack of properly trained personnel and the supporting infrastructure to deal with environmental

issues is an area that needs to be addressed urgently. This is particularly the case for Guyana, which has a very high rate of skilled personnel leaving the country. It is not clear if this is the case throughout the ACTO region, but the fact that the regions environment is reportedly threatened is probably a good suggestion that there is shortage of skills throughout. The quest for sustainable development would require significant investment; an investment in human resources should take a top priority for future efforts in the region.

4. Ensure technology transfer/adaptation – it is acknowledged that the eight countries that comprise ACTO are all developing countries. However, each of the countries is at varying levels of development at the moment and each is attempting to tackle its environmental issues in its own way. The problems that are facing the region's states are often not unique to any one state, and it is very possible that some states would have lessons learnt and experiences in dealing with specific issues from which their neighbours can benefit. Efforts should be made to understand the problems facing the countries and attempts be made to see how any one country in the region can benefit from another.
5. Foster harmonization of efforts with respect to resources use and management across border - there should be similar standards and codes of practices for the use of resources, both consumptive and non-consumptive, across the region. This area would be affected by the varying levels of economic development across the region – a fact that should be taken into consideration. However, this should not prevent countries from attempting to arrive at codes that would at the very minimum allow for the sustainable utilisation of natural resources. This is particularly urgent as more reports are coming forward on pressures that are being placed on the resources – especially forestry - of the Amazon Basin as states attempt to increase agricultural output.

4. INTEGRATED STRATEGIC VISION ON THE WATER USES AND USERS

4.1. Water Use Foreseen in the Amazonas River Basin

There are a number of areas that have been identified as the major drivers propelling the global water scenarios: demographic – this includes population growth, migration pressures and urbanization; economic – economic outputs; trade; prosperity; water works investment; technological – hi-tech expansion; water efficiency; unit water pollution; adoption of new crops; water sanitation investment; number of desalinization plants; withdrawal efficiency; social – lifestyles, poverty, inequity; governance – power structure; level of conflict; globalization; environmental – water related diseases; soil salinity; groundwater; and ecosystem health.

4.1.2. Services Provided By Guyana's Freshwater Resources

Guyana's water resources can be considered to be providing the following functions or occupying the following areas of water use.

4.1.2.1. Urban Users

Urban water demand includes the demand by households/residential, the commercial and industrial sectors, and the public. In order to accurately define the urban water demand of Guyana, the demand for each administrative region would need to be computed and the

resulting sum would represent the entire country. There are a number of factors that must be taken into consideration when the urban water demand is being computed, including **population** (housing growth, employment growth); **housing** (mean sizes of single family and multiple family homes, changes in the population living in homes); **water use coefficients** (indications of the amount of water demanded by each demand unit). In time water use coefficients may change in response to factors such as changes in the price of water and in consumer income, improvements in the efficiency of equipment related to water use, and active programs designed to accelerate these equipment upgrades; and **other demand losses**.

4.1.2.2. Agricultural Uses

Agricultural water use refers to the sum of water used for irrigation purposes, losses, and other uses. **Irrigation water** use depends upon the amount of land under irrigation, the amount of multicropping (planting more than one crop per year on the same land), and the water use per crop per planting. This area of water use also takes into account the changes in **agricultural land use over time** due to (1) conversion of agricultural land to urban uses, (2) new land becoming irrigated, (3) changes in the amount of multi-cropping, and (4) changes in the crops being irrigated. Every crop type would tend to have a different water demand coefficient. This aspect of water use also takes into consideration the evapotranspiration requirements of the crops referred to as **applied water**. Evapotranspiration varies by crop and growing conditions. It may be reduced by improving irrigation methods (by decreasing non-productive evaporation) and may be increased when yields are increased.

4.1.2.3. Environmental Water Use

Environmental water use can be classified as the amount of water purposefully permitted to flow through natural river channels and wetlands that are used for environmental purposes, instead of being diverted and used for urban or agricultural purposes. In real terms, it does not necessarily reflect all environmental needs, but attempts to reflect the fact that the various aspects of the natural environment require water for proper functioning.

In order to define the scenarios for the water uses and users in the short, medium and long term scenarios, it would be necessary to define the areas of water use and likely changes for the future time frames. Quantifying these areas of water use would also become important if the region's water resources are to be sustainably managed.

4.2. Strong and Weak Points, Opportunities and Threats identified in the Development of the Environmental Management of the Basin

4.2.1. Strengths for Environmental Management

There are a number of areas that can be identified as strengths for the environmental management of the Basin. The following are specific to Guyana at this stage:

- ξ Legislation- there exists a comprehensive suite of legislation aimed at the sustainable utilisation and protection of the environment and natural resource base in Guyana. The Environmental Protection Act, 1996 is the focal point legislation for environmental protection in Guyana. Similarly, the Water and Sewerage Act 2002, provides the tools for protecting and sustainably utilising the country's water resources. There is a Town and

Country Planning Act (1948) that provides the mechanism for physical development planning and land use control. The Lands and Surveys Commission Act (1999); National Parks Commission Act (1977); National Trust Act (1972); State Lands Act (1903); Amerindian Act of 2006; Local Government Act (1945); Mining Act (1991) govern and regulate access to the use of land and associated resources.

- Policy – there is a number of instruments in the form of policy documents, strategies and action plans aimed at supporting legislation. These include the National Development Strategy, National Land Use Policy, the National Biodiversity Action Plan, National Environmental Action Plan, National Strategy for the Conservation of Biological Diversity; National Environmental Education Strategy; National Mangrove Management Action Plan (2001); Poverty Reduction Strategy Paper (PRSP); Draft Management Plan for Arapaima in North Rupununi; Draft National Solid Waste Policy; Shorezone Management Programme (SMP); Integrated Coastal Zone Management Action Plan (2000); Strategic National Forest Action Plan; National Tourism Policy Document; Ministry of Housing Ten-Year Development Plan and Guyana Climate Change Action Plan (2002). These all support legislation aimed at environmental management and sustainable development.
- ξ Desire to achieve Sustainable Environmental Management – the fact that all of these legislations exist is a strong indication that there is a desire for environmental management in Guyana.

4.2.2. Weaknesses for Environmental Management

- ξ Inadequate Enforcement of Legislation – as shown in the section on strengths, there exists a good suite of legislations, but often the real challenge is in enforcing these legislations or as an extension, implementing legislations to the full extent.
- ξ Monitoring Environmental Change – this is particularly the case for the Hydrometeorological sector. The current network is not believed to be adequate to cover the spatial and temporal changes that may be occurring in the hydrology and climatology of Guyana.
- ξ Human Resource constraint– the lack of people to perform functions within critical departments is a deterrent to achieving environmental management. The example of the Hydromet comes to mind with its current state of under-staffing.
- ξ Availability of Financial Resources – it is probably obvious that if the financial resources were present then it would have been more likely that key vacancies at most of these agencies would have been filled.

4.2.3. Opportunities for Environmental Management

- Renewable Energy (wind) – there is great potential for the development of wind energy. Once developed, wind energy would allow for pressure to be removed from fossil fuels resulting in lower energy costs and lower greenhouse gas emissions.
- Hydroelectricity Generation- Guyana has an abundance of water that could allow for the development of sustainable hydroelectric power.
- Availability of Pristine Forests- there is a large supply of pristine forest that can be utilised in a number of ways, including, of course, a commodity in emissions trading agreements.

- Low Population Density – the low population density of Guyana can be viewed as a disadvantage as well as an advantage. It can be viewed as an advantage in this case since greater planning can be done in many parts of the country without affecting a great number of people.
- Protected Areas – there are only two protected areas in Guyana at the moment. The low population density leaves a number of areas of high biodiversity value uninhabited, which in turn, could allow for protected areas to be easily implemented.

4.2.4. Threats for Environmental Management

- Low Coastal Topography – Guyana’s coast is below sea level. This is a serious threat to environmental management when it is considered that sea level is currently changing. Any breach in the coastal defence will result in coastal aquifers and ecosystems being damaged by saline water.
- Demand for Water Resources - with an increase in industrial activities of agricultural production and increasing human population, the demand for water resources would be increased. Even though Guyana is called the land of many waters, a large quantity of the water available for human consumption requires treatment before it is potable.
- Pollution – pollution from solid waste is a concern in Guyana. Irrigation waterways along the coast are particularly vulnerable to indiscriminate disposal of solid waste. This not only impacts upon aquatic life in these waterways, but it also hinders the flow of water, leading to flooding.
- Population Concentration - 90% of population lives in areas “at risk” to flooding. In the event of a catastrophic event, a large percentage of the population would be vulnerable. In the long term, the impacts of climate change may begin to affect coastal Guyana. These impacts may determine that the coastal population be relocated inland. Such an activity would come with a very high cost.
- Accessibility to Hinterland Areas (high potential capital cost) – it is currently very expensive to access hinterland Guyana. Given the changes in global climate, and the possibility that the coastal population may be forced to move inland, then this cost could become a significant hindrance. The current high cost of movement, could also be held responsible for involvement of hinterland communities in national development efforts.
- Climate Change may adversely affect habitats and thus, faunal assemblages and diversity.
- Lack of Trained Capacity at all levels on biodiversity management.

4.3. National Vision to the Future

4.3.1. Vision Statement

“Recognising Guyana’s location and shared resources within the Amazon, the country commits itself unequivocally to pursuing a pattern of development that respects the integrity of all member states of Amazonia even as it seeks, through integrated approaches to sustainably use and conserve its natural resources in order to improve the quality of life of its peoples and that of the populations of the Amazon.”

4.3.2. Vision for the Future

The National Vision workshop has been described as a timely and important event for a number of reasons. Firstly, it is timely because Guyana must begin to recognise and capitalize on its unique setting with its intact tropical rainforest, and its abundant water and other natural resources; Guyana ranks as the World's 5th Most Water Rich Country (Water Poverty Index, UK Centre for Ecology & Hydrology, 2003). As part of the Guiana Shield, this region contributes 10-15% of the world's freshwater resources.

Secondly, it is timely because the world's resources are increasingly being depleted, whilst it is also being rapidly transferred northwards. In the New Economics Foundation's report "Growth Isn't Working" (2006), it is estimated that the average person in Europe requires 4.7 ha of biocapacity¹ space to maintain their lifestyle. If all of us were to live as in Europe, we need 2.1 Earths. If all of us were to live in the US, we would need nearly 5 Earths. Having an average of only 2.3 ha per capita available in the EU, the rest of the average footprint of a person from Europe therefore falls outside of Europe's borders and often on the Amazon Basin where the pressures of population density are not as severe as in most other tropical rainforest environments.

Thirdly, the National Vision Exercise is timely because of the ongoing work by ACTO in defining the geographical boundaries of Amazonia (initiated 2004); the process also coincides with the initiative of the WWF to develop a strategy for natural resource management of the Guiana Shield.

Fourthly, the National Visioning process is most timely, given the very significant climate change around the world that is driven by human kind's continued and unabated emissions of greenhouse gases.

Finally, the National Visioning Exercise is important as it provides a forum by which we can collectively understand and determine how our resources should be managed and used; it allows us to learn from the experiences of each other and develop a more holistic approach to our various mandates; and perhaps most importantly, it further inserts Guyana into the Amazon Basin – a fact that cannot be discounted when one observes the 10-year cycle of excessive flooding in the Rupununi Region, in which the waters of the River Takutu mingle with the waters of the Rio Branco.

A National Vision for the Sustainable Management of the Transboundary Water Resources in the Amazon River Basin must be motivated by the appreciation of the regional and global context of Guyana, located in the Guiana Shield and as part of the Amazon Basin. The Vision must also be placed within the context of ongoing national processes, such as the national land use planning, a new national biodiversity action plan, the Amerindian land titling process and of course the expansion of our natural resource extraction sector. All of these circumstances, except perhaps for land titling, while they lead to an increasing global (and national) value placed on our natural resources, do not necessarily translate into greater value to people who depend on these resources.

¹ Biocapacity is defined as areas of grassland, cropland, forests, fisheries and wetlands

It is this understanding of where Guyana is situated nationally, regionally and globally, and in the context of the ecological and social structures that must guide land use planning. We recognise that this is the first activity of a more substantial process ahead of us.

Following on the models provided by the programmes such as Iwokrama, it is the vision of Guyana to promote the conservation and sustainable and equitable use of tropical rainforests in a manner that will lead to lasting ecological, economic benefits to the people of Guyana and the Amazon Basin through the sharing of knowledge and dissemination of technologies.

Like Iwokrama's goal of expecting to become a leading international authority on development of models for commercially sustainable, practical and community-inclusive conservation businesses based on tropical forests and their 'natural assets, Guyana would thrive to become a State where all natural resource exploitation activities are kept within the principles of sustainability.

In the long term, it is hoped that models such as Iwokrama where baseline surveys for vertebrates, flora, commercial timber and non-timber forest products (NTFPs), archaeological remains and fungi have been done, would be used to guide the national sustainable development process. Throughout a decade of survey and inventory of the environmental assets, Iwokrama has engaged fully with local communities and other stakeholders in the development of operating frameworks for future business operations, including reduced impact logging (2000), wildlife management (2001), intellectual property rights (2001) and development of sustainable and equitable business partnerships (2001, 2006). It is hoped that in the long term Guyana's development drive would be completely people-centred with the views of local people being greatly integrated into the national development process.

Further, it is hoped that decisions for resource extraction and even non-consumptive natural resource use would be based upon sound understanding of the prevailing environmental conditions and the impacts of new activities on the environment.

It is clear from the discussions during the National Vision workshop that the current trend of resource extraction would not bring us the sustainable benefits and development we so much would like to achieve. The importance of working together, firstly, among ourselves at the national level in areas of common interest cannot be overemphasized. This point was stressed over and over again, as the various agencies recognised that in order to attain sustainable development; they need to work more closely with the objective of preserving Guyana's environmental integrity whilst achieving sustainable development.

At the regional Amazon Basin level, the purpose of sustainable development would be greatly served when the efforts of the individual countries are harmonizing and leading towards one goal, protecting the very foundation that lead to water resources being of a transboundary nature. Indeed, it is the Amazon Rainforest and its related components that must receive the attention, for without it, the meaning of the Amazon would take a completely different meaning.

So therefore, Guyana's vision is one that would seek for the development of the country and its people, but one that clearly recognises that the process, which would allow for sustainable development to be achieved, must strongly embrace the principles of sustainability. At the national level, the methods of resource extraction throughout the country must be done in a harmonious manner incorporating the positions of all stakeholders. For instance, in the Iwokrama example, efforts at management of natural resource management on Amerindian lands and national codes and programmes are aimed at sustainable natural resource utilisation (consumptive and non-consumptive). This example could be used to influence the national approach to sustainable development in Guyana, and the entire Amazon Basin.

5.0 INSTITUTIONS AND ACTORS

This section identifies the key institutions and social actors whose activities impact on Guyana's part of the Amazon, and water, soil resources and are involved in sustainable development initiatives within the region.

5.1 Governmental Agencies:

1. Hydrometeorological Service, Ministry of Agriculture
2. National Water Council
3. Environmental Protection Agency
4. Guyana Forestry Commission
5. Guyana Geology and Mines Commission
6. Guyana Water Incorporated
7. Guyana Lands and Surveys Commission
8. Guyana Energy Agency
9. Ministry of Foreign Affairs
10. Minister of Housing and Water
11. Ministry of Local Government and Regional Democratic Councils
12. Ministry of Legal Affairs
13. Institute of Applied Science and Technology
14. University of Guyana
15. Ministry of Amerindian Affairs and Village Councils
16. Ministry of Tourism
17. National Parks Commission

5.2 Non-Governmental Organisations:

1. Iwokrama International Centre for Rainforest Conservation and Development
2. Conservation International (Guyana)
3. Guyana Marine Turtle Conservation Society
4. Forest Products Association

6.0 CONCLUSIONS

Chapter 1

- ξ Guyana is the only English speaking country in South America, getting its name from the Amerindian word translated to land of many waters. The country has six major river basins: Essequibo, Courentyne, Berbice, Waini, Barima, Demerara and Amacura. In addition the Takutu River and its tributary the Ireng which form the south-western limits of the country and flows into the Rio Branco, a tributary flowing into the Rio Negro which is a confluent of the Amazon River, is also an important basin.
- ξ The 2002 Population and Housing Census showed that the national population rose to 751,223 and increase of 27,500 from the 1991 census.
- ξ The Water and Sewerage Act 2002 paved the way for the development of a national water policy and the subsequent establishment of water planning mechanism.
- ξ With direct reference to water resource management in the Guyana, the NWC as described in the Water and Sewerage Act 2000, in its constitution alone, strongly suggests that there is a clear recognition in Guyana that the management of the country's resources has to be a collaborative and integrated effort by all the national institutions whose mandates impact the country's water resources. In particular, the NWC has the responsibility of developing, implementing, amending and advising the Minister of Housing and Water on the NWP.
- ξ The NWP, which is developed in consultation with key institutions - the Lands and Surveys Commission, Hydromet, the Environmental Protection Agency, the Guyana and Geology and Mines Commission, the Guyana Forestry Commission and the Minister responsible for Agriculture, any other relevant Government Agency, Local Government authority including Amerindian Village Councils – should ensure that water is equitably allocated for the social and economic benefits for the people of Guyana.
- ξ The Hydrometeorological Service, Ministry of Agriculture operates the National Meteorological Station Network (NMSN) and the National Hydrological Station Network (NHSN) monitoring national meteorological and hydrological conditions.
- ξ The day to day responsibility of monitoring and reporting on the status of the country's water resources is the responsibility of the Hydromet, Ministry of Agriculture. The EPA through its mandate also has a role to play in the protection and management of the country's water resources. However, GWI is the sole agency in Guyana with the responsibility of ensuring that the country's population receives an adequate supply of potable water. The GWI has a key role in assessing the needs of the national population and ensuring that water is supplied to all communities throughout Guyana. The GWI, by virtue of being created by the Water and Sewerage Act 2000 works under the policy supervision of the Minister of Housing and Water.

- ξ The Hydromet through its role on the NWC can give a national perspective and recommendations on the state of the country's water resources. The NHSN administered by the Hydromet was once very comprehensive, but over the years many of the stations became unserviceable. This could be viewed as a weakness since data on water flow rates in the various waterways of the country would not have been collected from these stations. This would impact on the arriving at a better understanding of the country's hydrology.

The fact that the network did exist is a significant positive however, since a restored system for the management of the country's natural resources can be built on this foundation and the NWP can be guided accordingly with data generated from this network. Indeed the Water and Sewerage Act 2000 expressly states that one of the roles of the Hydromet is to establish a national system for the monitoring of the country's water resources.

The national system should allow for collection of data relevant to: the quantity of water in the water resources, the seasonal or temporal variations in water resources, the use of water resources, the rehabilitation of water resources, and the atmospheric conditions which may influence water resources. The Act also allows for the Hydromet to establish collaborative efforts of monitoring water resources with other agencies, similar to those already existing with agencies such as the Guyana Sugar Cooperation, to allow for a comprehensive data collection system to be in place.

- ξ The impacts of changes in climate and weather patterns on the country's water resources have received limited attention and require more attention. However, the initial national communication to the UNFCCC has pointed out the impacts climate change would have on the various natural resource sectors. These recent initiatives aimed at helping the country to deal with the impacts of climate change namely: Guyana Initial National Communication: in response to its commitments to the UNFCCC and the Guyana Climate Change Action Plan are important foundations upon which future activities aimed at dealing with the impacts of global climate change would be built.
- ξ There has been a significant amount of work in natural resource planning and planning for the country's socio-economic development. These include the National Development Strategy and the Poverty Reduction Strategy Paper. The process for creating a National Protected Areas System has commenced, and efforts are being made to put formalised systems in place for natural resource management on Amerindian lands.
- ξ The efforts over the past few months have shown that the major stakeholders in Guyana with mandates in the natural resource and environmental management sector recognise that they must pool their efforts if Guyana is going to achieve sustainable development. Most importantly the impacts of anthropogenic activities were recognised and acknowledged.
- ξ Capacity building for the adaptation to climate change has been identified as a critical area and has received a considerable amount of attention.

- ξ Anthropogenic activities, if not closely monitored can have significant and irreversible consequences on the country's and as an extension the water resources of the Amazon Basin.
- ξ The interconnectivity of the areas hydrology needs some further attention, as the recent overflowing of Brazil's *Rio Branco* and the subsequent flooding of Guyana's Lethem suggested.

Chapter 2

- ξ The future scenarios for water management in Guyana would be built on the current situation for water, environmental, and natural resource management. At the beginning of the process the scenarios were pessimistic, realistic and optimistic in nature, however, at the conclusion of the process it seemed more feasible to craft probabilistic position based on current trends. The current trends indicated that sustainable principles are at the centre of resource extraction efforts. However, there are areas of concern, for instance legislation aimed at sustainable resource extraction (Water and Sewerage Act 2002, but such legislation are not adequately implemented.

In the next five years if the current trend continues, serious impacts on the environment, including environmental degradation could begin to occur. This would probably lead to efforts at becoming more efficient in resource extraction in the medium term. This era might also see the introduction of more research into resource extraction especially water, to ensure that water utilisation is more efficient than current trends. In the long term, the increasing population could see more emphasis on the country's natural resource base. The national population could become more aware and attempt to play a greater role in determining how their resources are utilised.

- ξ The discussions that lead to the development of the future scenarios highlighted to a great extent the activities that could be conflicting with respect to sustainable management of the country's resources, for instance forestry and mining, and that would need careful attention and planning. Clearly these activities have a role to play in the national economy, but their operations should be governed by strong codes of practice to ensure that future generations of Guyanese could benefit from their extraction as well.

Chapter 3

- ξ Given that the eight countries of the Amazon Basin have similar areas of interest, there are going to be areas that would have to be addressed by all the countries to realize common goals. In the final analysis the success of the sustainable management of the region's resources would depend largely upon how well the eight states can harmonise their efforts and work towards these common goals. Collaboration at the national level would have to take into consideration national priorities and realities and would depend largely upon the harmonization of efforts at the national level, however, even though the momentum for achieving sustainable development must be created at the national level, this momentum must be based on sound inputs from the widest possible cross-section of stakeholders who must be involved in the process.

- ξ The main issues that came to the fore for the consideration by all eight states of ACTO at Guyana's National Vision workshop were: Global Climate Change, Population Growth/Transient Population, Health, Sedimentation and Pollution, Deforestation, Water Resource Use, Illegal activities including fishing, wildlife, and intellectual property rights, energy navigation and investigation of transboundary off-site effects.
- ξ The Kanuku Mountains, Mount Roraima, Shell Beach, South-Eastern Forest, Kaieteur National Park, Rupununi Wetlands, and Amerindian Communities were identified as Guyana's main hot spots.
- ξ Guyana's vision for the future would therefore be built on the current situation, which strongly suggests that the country would like to strive towards sustainability. There is tremendous potential for the country to achieve this goal, as its intact resources and ecosystems present a realistic opportunity.
- ξ The efforts over the past few months have shown that the major stakeholders in Guyana with mandates in the natural resource and environmental management sector recognise that they must pool their efforts if Guyana is going to address its sustainable development goals. Recognising at that this point in the country's history that there still remains a large quantity of intact natural resources, and that these resources can be seen as the country's natural capital it is widely accepted that resource exploitation needs to be done in a sustainable manner. There have already been efforts endorsing this position, for instance through the NDS and the PRSP, the National Biodiversity Action Plan, the Forestry Code of Practice and the Environmental Protection Act, but to name a few.
- ξ Capacity building for the adaptation to climate change has been identified as a critical area and has received a considerable amount of attention. A number of Guyanese nationals have been trained or are receiving training in climate change at the University of the West Indies. It is hoped that once these persons would have received their training, they would return to the share their expertise in allowing the country to be able to deal with the impacts of climate change. Anthropogenic activities, if not closely monitored can have significant and irreversible consequences on the country's and as an extension the water resources of the Amazon Basin. The interconnectivity of the areas hydrology needs some further attention, as the recent overflowing of Brazil's *Rio Branco* and the subsequent flooding of Guyana's Lethem strongly suggests.

Chapter 4

- ξ Much of Guyana's water resources are currently dedicated to environmental functions. However, the economic conditions of the country could change this situation. An increase in per capita income for the national population would mean most likely translate to more sophistication and an increased demand for fresh water for basic urban functions.

Interestingly, increased agricultural production and industrialization are likely to be the key drivers for improving economic fortunes. Increased agricultural production would require irrigation systems, thereby removing water that was previously dedicated for environmental purposes being transferred to satisfy agricultural demand. The difficulty in

these changing water uses would of course be in tracking how water from one area of use is being transferred to another area.

- ξ When the strengths, weaknesses, opportunities and threats in the development of environmental management is examined, it is clear that there are some very relevant legislation and policies that once implemented could be significant in terms of charting the course towards sustainable development. However, the challenge with these legal instruments is that they are not being adequately implemented.
- ξ Similarly there are some significant threats, for instance low coastal topography that if not properly managed, could lead to significant catastrophes. For example should the coastal sea defence mechanisms fail, large portions of the coast would be threatened, including biodiversity, settlements and coastal aquifers. Such an event would possibly push the coastal population inland, placing pressure on the biodiversity of the highland regions.
- ξ From the stakeholder consultations it was evident that much of the effort for the future in terms of development and natural resource utilisation would aim to build around the principles of sustainability. However, it is clearly recognised that balancing anthropogenic activities and environmental protection would be the greatest challenge.

7.0 RECOMMENDATIONS

1. The success of a regional (ACTO) programme to sustainably manage transboundary water resources would depend largely upon the strength of the individual countries making up the regional entity to successfully manage and implement programmes to manage their part of the region's resources.

In Guyana the Water and Sewerage Act 2002, sets a good foundation for Guyana to sustainably manage its water resources. However, the most challenging part of Guyana's plan is implementing the Act. The institutions that should play a critical role in shaping the national water policy need to be strengthened or at the least take some steps to advance their obligations as mandated by law. If these institutions are given the support and latitude they need to implement and make the legislation functional, then it would become easier for Guyana to make its contribution towards sustainably managing the region's freshwater resources.

Institutional strengthening should include empowering the Hydrometeorological Service with financial and human resources as well as physical infrastructure to perform the role effectively.

In the interest of the region's water resources, it would also be of significant benefit if the region's water resources are treated as one body legislation are harmonised to the best extent possible to ensure that programmes for resource protection and management are parallel to each from one state to another.

2. The existence of the Water and Sewerage Act 2002, is an important step towards the sustainable and integrated management of Guyana's water resources. At the policy level it was clear that there is a strong understanding of the requirements of the act, however, it was obvious that the Act was not being implemented in the way it should to bring sustainable benefits to the Guyanese people. It would seem extremely beneficial and certainly go a long way towards sustainable water management if the national population were aware of the legislation and its intended impacts on their livelihood. Some efforts should therefore be made in a public awareness programme to make the national population aware of the legislation, its intended impacts and the role they can play in making its implementation a reality.

Such an awareness programme should be led by the Hydrometeorological Service with support from the Ministry of Housing and Water and could include broadcast pieces in the electronic media, workshops and seminars throughout the ten administrative regions of Guyana and school-based (primary, secondary, tertiary, vocational) programme to give young people and schools children an opportunity to understand the legislation and the role they can play in its implementation and as an extension, the sustainable management of Guyana's Water Resources.

The awareness programme should also include details on the fact that Guyana is a part of the Amazon Cooperation Treaty Organisation and what are the implications of this fact on the lives of each and every Guyanese. The success and failure of future efforts aimed at protecting the region's ecosystem would depend largely upon how well the people of the region understand their wider ecosystem and how their lives would be impacted if they did not take care of it.

3. Some effort and emphasis should be placed upon trying to get a better understanding of the climate change that may be occurring in Guyana. Such research should be led by the country's research institutions with support from the Hydrometeorological Service. It was clearly recognised that sound decision making in the future must be based on the results of strategic research activities and that such research should be based on strong scientific practices, including precise and accurate data collection.
4. There is an urgent need for the harmonization of legislation for forest extraction and mining in the region and efforts should be pursued to immediately address this situation. At the earliest possible opportunity regional policy makers should attempt to compare standards, and with due consideration for their economic realities attempt to at least have their codes of practice meet an established minimum requirement across the region.
5. More research needs to be undertaken to determine the extent of impacts on the regions fresh water resources from anthropogenic activities such as mining and forestry.

6. The networks for hydrological and meteorological monitoring needs to be improved to allow for a comprehensive understanding of the impacts of climate variability of the regions fresh water resources. Implementing programmes for achieving a more comprehensive monitoring coverage must attempt to have as much as possible a bottom up approach with local people and communities playing a significant role in monitoring activities. Such involvement of local people would allow communities and people to own the process and better understand the impacts of activities within the region on climate variability.
7. There needs to be more studies aimed at understanding the linkages and connections between the regions hydrological system. Such an understand would allow for each country to better understand its role and responsibility for safeguarding the welfare of common resources.
8. There needs to be more studies to establish the changes in water use that may occur as a result of water being shifted from one use scenario to another. This is particularly important for water moving from environmental uses to water being used for urban purposes.
9. With respect to the issues of transboundary interest, the following are recommended:
 - a. Global Climate Change:
 - ξ Greater collaboration between the countries comprising the ACTO to ensure that there a uniform system for tracking climate change and improving the understanding the impacts of climate change at the regional, national and local levels e.g. understanding the impacts of climate change and sea level rise on coastal Guyana, Suriname, Ecuador and Venezuela;
 - ξ Once the impacts of climate change are understood, develop strategies for dealing with these impacts, for instance in Guyana once the impacts of climate change on the coast are that significant, then this country would need to consider measures for relocating coastal population to inland Guyana;
 - ξ Carry out studies to improve the understanding of the historic variability of the hydrological variables aiming at the forecast of the water availability;
 - ξ Assess the impact of climate variability on the energy sector in the Amazon Region;
 - ξ Improve long-term forecast with the goal of reducing the impact of the climate variability risk: verify the long-term forecast for the agriculture and energy sectors through a regional pilot project;
 - ξ Embark on a widespread programme for improving local people and local communities understanding of climate variability and including these stakeholders in assessing climate change and its impacts.
 - b. Population Growth/Transient Population:

- ξ More widespread education of national populations on their responsibilities with respect to water management, including the knowledge that the region's water resources are under threat and must be appropriately managed regardless of which country one may be in at a particular point in time;
- ξ Develop better systems for determining supply and demand and determining the most efficient manner of meeting demand at the national then regional levels so that water supply could be appropriately scaled to meet increasing human population;
- ξ Improved management and monitoring of the regional ecological systems to ensure that there sound understanding of water sources in the regional and the integrity of these are not compromised as population grows and the need for access to new agricultural lands for food production become necessary;
- ξ Ensure that there are designated fresh water resource use zones throughout the Amazon region, and that these resources are managed in a sustainable manner.

c. Health:

- ξ Develop an integrated system for understanding the impacts of climate variability on the life cycle of vectors of water borne diseases;
- ξ Develop an integrated regional system for sharing knowledge on dealing with water borne diseases and responding to emergency situations;
- ξ Ensure that water is treated properly to remove pathogens of water borne diseases before delivery to the final users and put in place a comprehensive system for ensuring that activities that would lead to the prevalence of water borne diseases are properly regulated.

d. Sedimentation and Pollution:

- ξ Building the capacity of miners, foresters, farmers and other stakeholders whose activities could result in sedimentation and pollution of water ways so that they are made aware of the detrimental effects of their activities on the regional water resources in light of a resources availability challenge;
- ξ Better application and compliance with national, international standards and codes of practice that determine the manner in which forestry and agricultural activities should be conducted to minimise impacts on the environment, with specific reference to fresh water resources;
- ξ Ensure that there is appropriate waste and pollution source management system in place. Ideally, this system should aim to tackle the problem from the pollutants' source, for instance materials such as Styrofoam and plastics should be reduced in use as these have the greatest impact on blocking and polluting water ways.

e. Deforestation:

- ξ Forestry activities better comply with national standards and activities of a developmental nature throughout the region made to comply with international conventions such as the United Nations Convention on Desertification;
 - ξ Design regional pilot projects for replanting areas deforested during mining, forestry and agricultural activities. Once these are successful, methodology and lessons learnt are used in the designing other such projects/programmes throughout the region.
- f. Water Resources Use:
 - ξ Invest in renewable sources of energy for generating power for running water treatment and delivery plants thereby reducing the cost of delivering safe water to customers;
 - ξ Carry out studies to determine the change in demand on water resources brought about by these new water uses. Studies should aim to determine exactly what amount of water is moved from environmental purposes to other uses so as to determine changes in water use and the responsible sector.
- g. Illegal activities including: fishing, wildlife, intellectual property rights:
 - ξ Develop regional regulatory mechanisms for wildlife trade, fishing, intellectual property rights. Once developed these regulations should be enforced with similar weight throughout the region;
 - ξ Design public awareness campaigns to educate the regional population on the state of regional wildlife populations and their responsibilities for ensuring that the status of these populations are not further compromised as a result of their activities.
- h. Energy:
 - ξ Develop regional programmes and strategies for understanding and developing renewable sources of energy such as hydro, solar, wind and geothermal as the primary source of energy in the region;
 - ξ Develop pilot projects throughout the region to demonstrate the development of renewable energy project and sharing lessons learnt throughout the region.
- i. Navigation
 - ξ Develop a regional code of practice for navigation throughout the region. The code should include territorial immigration and police organisations in the respective states so as to have total involvement from these entities thereby improving the chances of reducing the trade in threatened and endangered species as well as protecting the integrity of regional water ways and ecosystem;
 - ξ There should also be a regional code for materials that can be transported through the region's water ways. In particular the code should aim to prevent

hazardous and materials that can have detrimental impacts on water ways from being transported in navigation routes.

- j. Investigate transboundary off-site effects
 - ξ Carry out regional studies to determine the interconnectivity of regional water bodies;
 - ξ Carry out regional studies to understand the impacts of activities such as overfishing in one state on the fishery of another state;
 - ξ Develop a regional strategy for dealing with interconnected water bodies throughout the region so as to safeguard the integrity of these important ecosystems.
10. There needs to be additional national and regional awareness programmes on the activities and objectives of ACTO. Such activities should aim to captured the attention of a wide crossection of the regional population as possible so that they are aware of the activities of ACTO. Such initiatives would allow for support for the programme from the very foundations of the regional community.

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LIST OF ACRONYMS AND ABBREVIATIONS

ACT	Amazon Cooperation Treaty
ACTO	Amazon Cooperation Treaty Organisation
CI	Conservation International
CLICOM	CLImat COMputing Project (WMO)
CSBD	Centre for Study of Biological Diversity
DAT	Transboundary Diagnostic Analysis
EDWC	East Demerara Water Conservancy
ENSO	El Nino – Southern Oscillation
EPA	Environmental Protection Agency
FPA	Forest Products Association
FWS	First Wet Season
GCM	General Circulation Model
GDP	Gross Domestic Product
GEF	Global Environmental Facility
GFC	Guyana Forestry Commission
GGMC	Guyana Geology & Mines Commission
GIS	Geographical Information System
GL & SC	Guyana Lands and Surveys Commission
GMTCS	Guyana Marine Turtle Conservation Society
GOG	Government of Guyana
GPS	Global Positioning System
GWl	Guyana Water Incorporated
HadCM2GSAI	Hadley Centre Global Climate Model
HYDATA	Hydrological Database
Hydromet	Hydrometeorological Services, Ministry of Agriculture
ITCZ	Inter-Tropical Convergence Zone
MINTIC	Ministry of Tourism, Industry and Commerce
MOHW	Ministry of Housing and Water
MW	Mega Watt
NARI	National Agricultural Research Institute
NDS	National Development Strategy
NGO	Non-Governmental Organisation
NHSN	National Hydrological Station Network
NMSN	National Meteorological Station Network
NPC	National Parks Commission
NRDDB	North Rupununi District Development Board
NREAC	Natural Resources and Environment Advisory Committee
NTFP	Non Timber Forest Product
NWC	National Water Council
NWP	National Water Policy
OAS	Organisation of American States
PRSP	Poverty Reduction Strategy Paper
SDS	Second Dry Season
SFP	State Forest Permission
SOI	Southern Oscillation Index
T&HD	Transport & Harbours Department

TSA	Timber Sales Agreement
UECC	Upper Essequibo Conservation Concession
UG	University of Guyana
UNDP	United Nations Development Programme
UNEP	United Nations Environment Programme
UNFCCC	United Nations Framework Convention on Climate Change
WCL	Wood Cutting Lease
WMO	World Meteorological Organisation

INTRODUCTION: VISION AND OBJECTIVES

The Amazon Cooperation Treaty Organisation (ACTO) was established in 1978 by the Governments of Bolivia, Brazil, Colombia, Ecuador, Guyana, Peru, Suriname and Venezuela. Its goal was to plan for the sustainable development of the region's resources and people, and in 2004, a strategic plan for the years 2004 - 2012 was published. The plan defines a number of areas or themes for development; including the sustainable management of the region's water and soil resources. The strategic plan was built on the platform of the member countries arriving at a consensus position for the management of soil and water resources.

The project "Integrated and Sustainable Management of Transboundary Water Resources in the Amazon River Basin" was prepared by the countries that are signatories to the Amazon Cooperation Treaty (TCA): Bolivia, Brazil, Colombia, Ecuador, Guyana, Peru, Suriname, and Venezuela. The goal of this project was to strengthen the institutional framework for planning and executing - in a coordinated and coherent manner - activities for the protection and sustainable management of the land and water resources of the Amazon River Basin. The proposed project endeavoured to realize a shared vision for sustainable development in the region, based upon the protection and integrated management of transboundary water resources and its adaptation to climate changes.

This will clearly be a long-term effort. The development of an institutional structure for the coordinated management of the Amazon region is recent and still fragile. The challenge, in terms of its hemispheric scale and the number of countries sharing responsibility - eight countries within ACTO - is great. All eight are developing countries, and their economic and technical capacities have evolved in very different ways, both in terms of scale as well as related institutional and legal frameworks.

Accordingly, the project is proposed to be divided into three four-year phases: the first for planning and development of institutional capacity; the second for implementation of jointly identified strategic activities; and the third for strengthening sustainable and integrated water resources management in the Basin, recognizing the likely impacts forecasted to arise as a consequence of ongoing changes to the global circulation and climatic regimes.

The current Project Development Facility - PDF Block B - is the preparatory phase of GEF Amazonas Project - ACTO/UNEP/OAS, which must be executed over a period of 23 months (October 2005 to September 2007). It aims to prepare the full-sized Project Brief, where its components will be described in greater detail and a shared strategic vision for the sustainable development in the Amazon River Basin will be advanced, along with the institutional arrangements and partnerships for the subsequent execution of the project activities. The Project Brief will not only serve as a guideline for a new GEF grant request, but will also promote parallel actions in the basin countries and other stakeholders so as to strengthen the Basin Vision and its program of integrated resource management. It will include the adaptation to ecological and hydrological changes caused by global climate change.

In Guyana, the Hydrometeorological Service of the Ministry of Agriculture has been given the mandate of coordinating efforts aimed at the sustainable management of Guyana's water and soil resources in response to changes in global climatic conditions. However, Guyana's soil and water resources are affected by a number of other interest groups and activities, whose views must be taken into consideration when defining the country's vision.

This paper attempts to summarise these factors of interest, given the existence of a number of agencies and social actors with mandates and activities resulting in direct impact upon the country's soil and water resources,. In particular, this paper attempts to summarise the institutional arrangements and plans currently in place in Guyana for the management of its part of the Amazon. Specific emphasis is placed on the key institutions, legal frameworks, and the mandates of those stakeholders whose activities impact directly on the country's soil and water resources. Existing plans for water management and use and the impacts of these on the environment and society as well as the impact of climate change and the socio-economic conditions are also examined.

The Consensual Vision for the Basin will be defined based on the analysis of the current situation, as well as on the prognostics of future scenarios. The results of this effort would be used to guide the definition of the Consensual Vision for the Amazon Basin. It is hoped that these efforts would partially assist in the identification of issues of transboundary interest in the Transboundary Diagnostic Analysis – DAT of the Basin as a whole. As such, this paper attempts to map Guyana's current situation upon which the country's vision would be built.

1.0 CURRENT STATUS

Guyana is the only English speaking country on South America, and is located on South America's northeastern coast, between Venezuela, which lies to its west and Suriname on its east (see Figure 1). Guyana has an area of 214,970 km² of which nearly seventy-five percent is covered with natural vegetation. Physically, Guyana can be divided into four natural regions (see Figure 2), namely: (1) the Coastal Plain or a flat coastal belt which is approximately 1.4 metres below sea level, and is the area on which most of the country's agricultural activities occur; (2) the sand belt, which is located to the south of the coastal belt, and includes the country's Intermediate Savannas; (3) the undulating Central Peneplain which comprises more than half of the country's area, and in which are located lush, almost pristine, tropical forests, and extensive mineral deposits. This landform stretches from the sand belt to the country's southern boundary and encompasses, also, the Rupununi Savannas which borders Brazil; and (4) the Highlands which are to be found in the Midwestern area. This portion of the Guyana's highlands includes the Pakaraima mountain range (National Development Strategy, 2000).

This section of the paper presents a summary of Guyana's current status, including a description of its geography, geology, climate and demographics.

1.1 The Basin of the Amazon River and its Sub-Basins

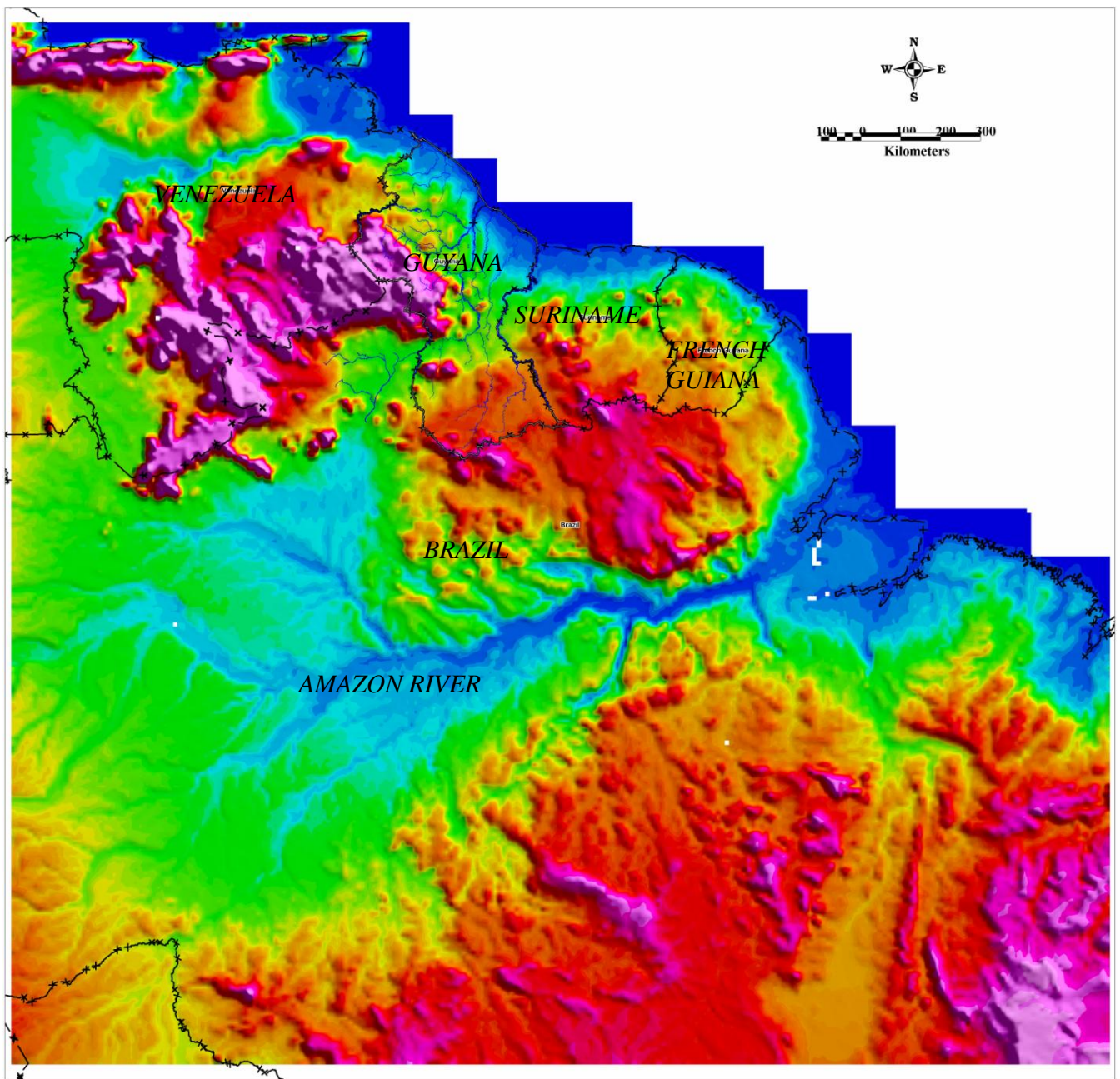
Guyana gets its name from the Amerindian word that translates to "land of many waters". As the name suggests, there is a complex system of rivers, creeks, lakes, waterfalls and other water bodies within the country's borders (see Figure 3). These water bodies are the backbone for a number of important economic functions, including the provision of transportation services, support for the country's irrigation and drainage system and the source of food-fish and drinking water for the population. The country's water resources, especially its rivers with associated waterfalls are gaining increasing importance as their potential for generating hydroelectric power is recognised. This is especially so as the demand for renewable sources of energy are being explored.

1.1.1 Guyana's River Basins

Guyana is made up of a number of River Systems. The main ones can be summarised as follows, with their respective sizes taking precedence.

- The Essequibo River and its principal tributaries, the Mazaruni, Cuyuni, Potaro, Siparuni and Rupununi.
- The Courentyne, and its tributary, the New River
- The Berbice, and its tributary, the Canje
- The Waini, and its principal tributaries, the Barama, Imotai and Arawapai
- The Barima, and its principal tributaries the Aruke, Kaituma, Anabisi, Whanamaparu and Whanna
- The Demerara river
- The Amacura river

Figure 1. Digital Elevation Model of South America showing the Location of Guyana in relation to the Amazon River



Source: Guyana Geology and Mines Commission , 2006

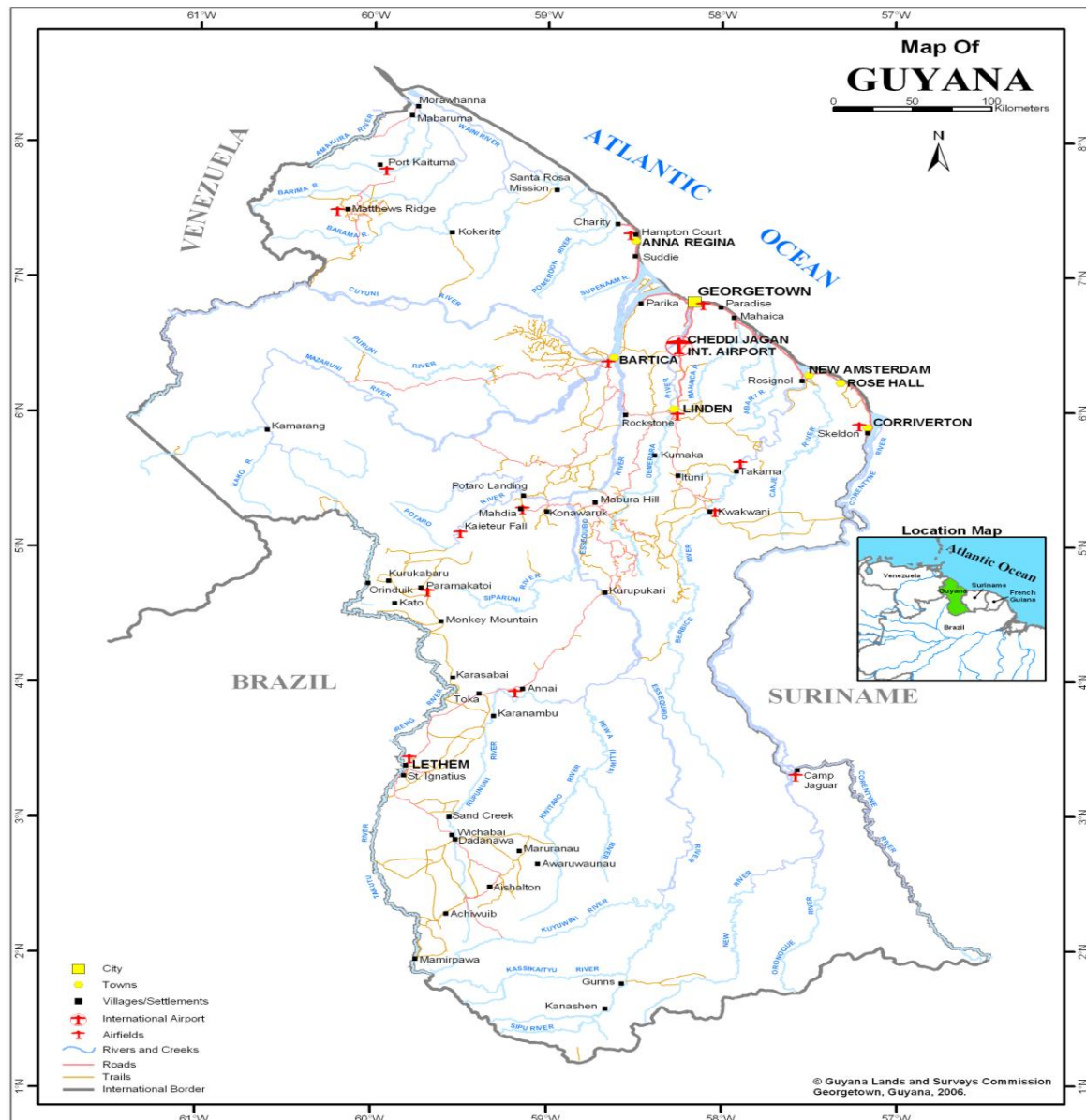
Figure 2. Guyana's Natural Regions



Source: Guyana Lands and Surveys Commission, 2006

All of these rivers flow to the Atlantic Ocean in addition to the following smaller ones, viz: the Pomeroon and Moruka, in the north-western part of the country, and the Boerasiri, Mahaica, Mahaicony and Abary, in the south-eastern part.

Figure 3. Hydrological Map of Guyana



Source: Guyana Lands and Surveys Commission, 2006

Besides these rivers, there are the Takutu River and its tributary, the Ireng, which form the south-western limits of the country. The Takutu flows thence to the Rio Branco, a tributary flowing into the Rio Negro which is a confluent of the Amazon River.

1.1.2 Guyana's Hydrology

Guyana is one of eight countries sharing the Amazon Basin. Its main river, the Essequibo is one of the principal rivers of South America with a mean flow of 2100cu.m/s. Much of the Hinterland area is drained directly or by major tributaries of the Essequibo and fresh surface water is generally plentiful for most of the year. There are a number of surface water sources including ponds, creeks and large rivers, although only 10% of Guyana's water comes from

such sources. A Multiple Cluster Survey (2001) found that 25% of people in the Interior reported using rainwater as an improved source (and a similar percentage in the rural Coast). But the potential of rainwater as a source of domestic water needs to be determined for each of the geographical sub-divisions.

Guyana's Water Resources

Even though Guyana is rich in water resources, most of the surface water and some of the groundwater requires treatment to make it potable. Most surface water is liable to contamination and many surface sources fail in the dry season. An understanding of water resources is necessary for planning both the quantity and quality of water to be supplied (Hinterland Strategy, 2004). The Hinterland Strategy (2004) further stated that water resources for the Hinterland can be divided into separate areas associated with the geographical sub-divisions:

ξ Interior Plains Area

The White Sands Formation, located in the northern Interior Plains region and in the southern Coastal Lowlands region, yields moderate to large quantities of fresh water from depths of less than 30m. This formation is centered in Linden and also provides the origin of the groundwater percolating into the A and B sands aquifers used in Coastal areas. In the north-western Coastal Area region, large quantities of brackish to saline water are available for abstraction at depths ranging from 3 to 30m. This groundwater is poor due to continuous saturation from tidal flooding.

ξ Southern Plains and Western Highlands

Groundwater is generally plentiful from sedimentary and volcanic deposits in the southern and western regions of Guyana. There is a paucity of potable groundwater in the central mountainous area of the Hinterland known as the Guyana Shield where only fractures and small perched discontinuous aquifers produce water. The depth to the water table ranges from 3 to 300m depending on the location of the well or borehole and levels may also vary with the season. Hinterland water sources currently include groundwater obtained from springs, shallow wells; deep hand dug wells and drilled boreholes.

1.1.3 Geology

Guyana lies within the Amazonian Craton, which forms part of the South American Continent (Brazil, Bolivia, French Guiana, Guyana, Suriname and Venezuela). The Amazon Craton is subdivided into two geographic shields, the Guiana Shield in the North (in which Guyana is situated) and the Central Brazil (Guapore) Shield in the south. The Guiana Shield is composed mainly of the Maroni-Itacaiunas Province which is a large continuous province present in French Guiana, Suriname, Guyana, North Brazil and Venezuela. The province contains rocks representing an early Proterozoic crust with a strong south-east structural fabric. It is sub-divided into two terrains, a granulitic and gneissic terrain and granite – greenstone terrain which covers a large proportion of Guyana. Guyana is geologically sub-divided into three provinces, the Northern Province, the Southern Province and, between them, the Takutu Graben (Guyana Geology and Mines, 2006).

Northern Province

The Northern Province is subdivided into three main geological units; the Greenstone Belts, the Roraima Group and the recent Tertiary/Quaternary deposits (see Figure 4).

Takutu Graben/Northern Savannahs Rift Valley

The Rewa Group, which includes the Takutu Formation and Apoteri volcanics, occupy the Takutu/Northern Savannahs Rift Valley, which is bounded by the Kanuku Mountains in the south and the Pakaraima Mountains in the north. The rift valley/graben extends for 180km into Brazil to the west and is up to 50km wide (see Figure 4).

Southern Province

The Southern Province is located in the central part of the Guiana Shield. The nucleus of the Guiana Shield is present in the Southern Province as an “Old Crystalline Basement” and the Proto-Kanuku Complex. The Proto-Kanuku Complex is composed of high metamorphic grade migmatitic gneisses and granulites, which were involved in the Imataca thermo-tectonic event. The Proto-Kanuku Complex forms a horst which is part of an east-northeast trending mobile belt known as the Central Guyana Granulite belt, which extends into Suriname to the east and Brazil to the west (see Figure 4).

1.1.4. Economic Deposits of Guyana

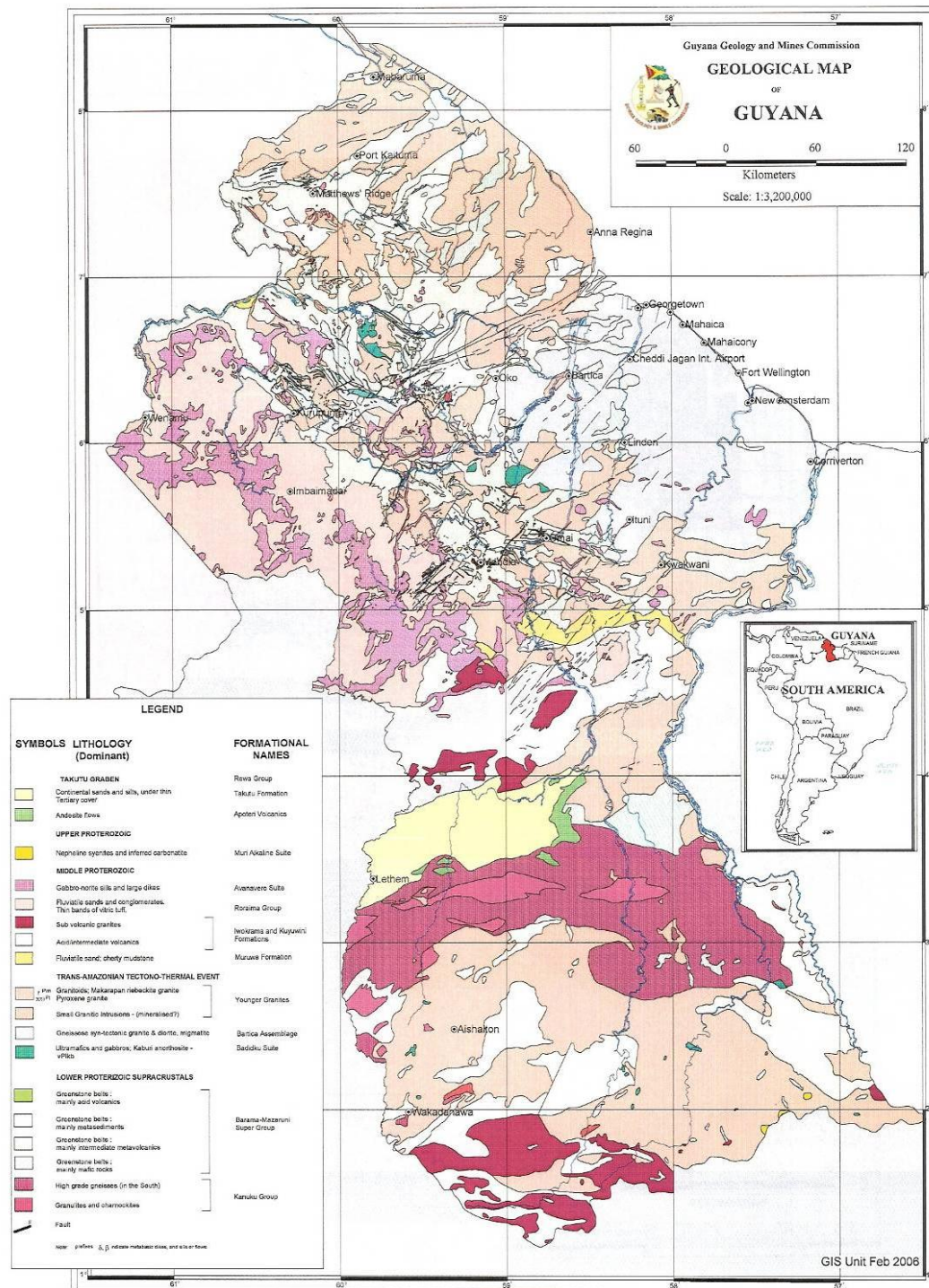
Several economic minerals are exploited in the Guiana Shield. The main economic minerals mined or that have potential for being mined in Guyana are: gold, diamonds and bauxite (see Figure 5).

1.1.5. Guyana’s Demography

Population Size

The 2002 Population and Housing Census showed that the population of Guyana rose to 751,223 persons – higher than the 1991 census by a little more than 27,500 persons (see Figure 6). This new count was in keeping with trends of population change for Guyana, which has shown an increase at each census, except for the 1991 census when – for the first time in history – the count was lower than that of the previous census. The population decline at census 1991 appeared consistent with the peak emigration flows recorded during the decade of the 1980s. The average annual rate of growth for the population has also reversed from its negative trend of the 1980s (seen in 1991), but the census survival ratios between 1980 and 2002 show a heavy influence of emigration on the distribution (Guyana Population and Housing Census, 2002).

Figure 4. Geological Map of Guyana

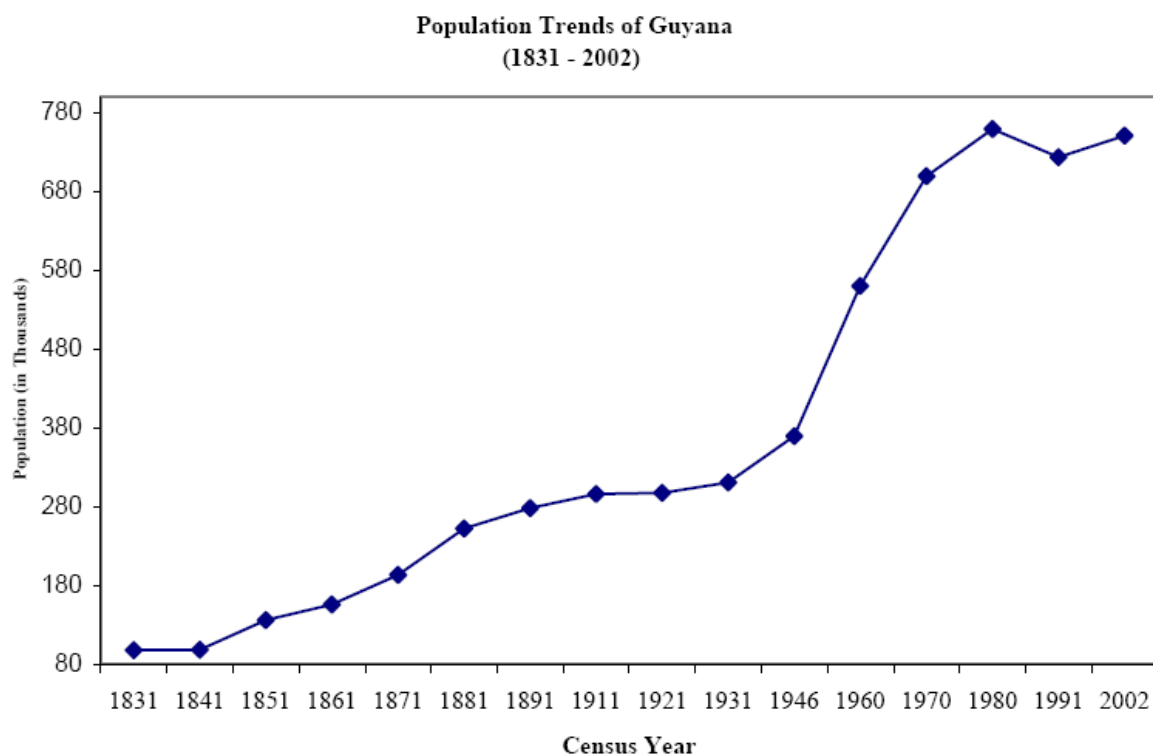


Source: Guyana Geology and Mines Commission, 2006

Source: Guyana Geology and Mines Commission, 2006



Figure 6. Guyana's Population Change Chart



Source: Guyana Population and Housing Census, 2002

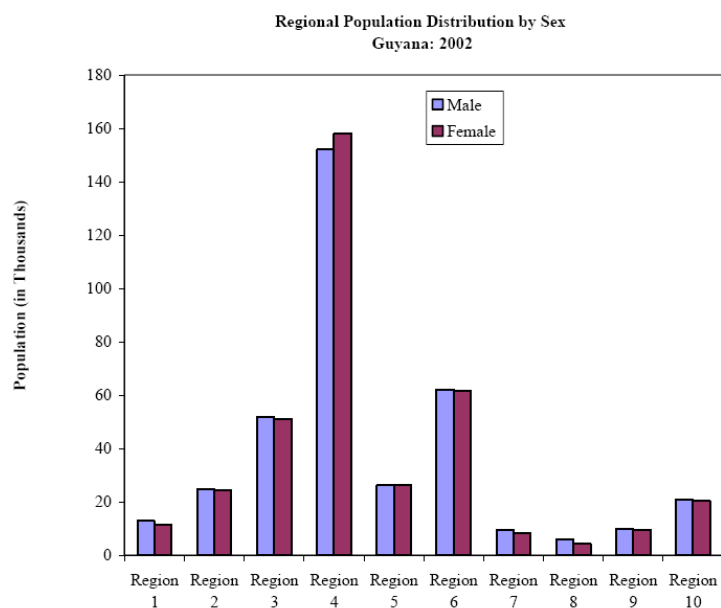
Regional Population

The 2002 Census report showed that the main areas of population concentration have not changed over the decades, although some of the sparsely populated regions had begun to grow (see Figures 7 and 8). Region 4, where the capital city – Georgetown is located, had over 40 percent of the population and Regions 3 and 6 combined had another 30 percent. The population of Region 8 though small, however, rose sharply – more than doubling its size, i.e., from 4,485 in 1980 to 10,095 in 2002. The four main hinterland Regions (1, 7, 8 and 9), though covering nearly three-quarters of the total land area of the country were sparsely populated and consisted of less than 10 percent of the population (Guyana Population and Housing Census, 2002).

Regional Population Density

The region with the highest population density was Region 4 (where the capital city is located) with 139 persons per square kilometre. Region 4 alone had about 41.3 percent of the population but contained only 1 percent of the land area. Next in rank were Regions 3, (27 per sq. km), Region 5 (13 per sq. km) and Region 6 (3 per sq. km). Regions 1, 7, 8 and 9 consisting about 67.6 percent of the land mass were sparsely populated (see Table 1 and Figure 9) (Guyana Population and Housing Census, 2002).

Figure 7. Guyana's Regional Population Distribution by Gender



Source: Guyana Population and Housing Census, 2002

Figure 8. Regional Population Growth Rates, Guyana: 1980-2002

Region	1980-1991	1991-2002
Region 1	0.05	2.43
Region 2	0.24	1.10
Region 3	-0.80	0.63
Region 4	-0.61	0.39
Region 5	-0.45	0.20
Region 6	-0.61	-1.25
Region 7	0.25	1.53
Region 8	2.04	5.17
Region 9	1.42	2.23
Region 10	0.22	0.33
Total	-0.44	0.33

Source: Guyana Population and Housing Census, 2002

Table 1. Regional Distribution of the Population, Guyana: 1980 -2002

Region	1980		1991		2002	
	Population	Percent	Population	Percent	Population	Percent
Region 1	18,329	2.4	18,428	2.5	24,275	3.2
Region 2	42,341	5.6	43,455	6.0	49,253	6.6
Region 3	104,750	13.8	95,975	13.3	103,061	13.7
Region 4	317,475	41.8	296,924	41.0	310,320	41.3
Region 5	53,898	7.1	51,280	7.1	52,428	7.0
Region 6	152,386	20.1	142,541	19.7	123,695	16.5
Region 7	14,390	1.9	14,790	2.0	17,597	2.3
Region 8	4,485	0.6	5,615	0.8	10,095	1.3
Region 9	12,873	1.7	15,057	2.1	19,387	2.6
Region 10	38,641	5.1	39,608	5.5	41,112	5.5
Total	759,567	100	723,673	100	751,223	100

Source: Guyana Population and Housing Census, 2002

1.2. Existing Plans and Programmes

ξ Water Resource Plans and Climate Change Assessment

The current period of research revealed no current or formal Water Resource Plans or Water Basin Plans *per se*. However, the Guyana Water Incorporated is currently preparing its Strategic Plan which should include data on the water supply and distribution system on Guyana's coast. The Plan is also expected to include data on the demand for water primarily along Guyana's coast and a description of the company's customer base and sources of water extraction (see Table 2). The work of the GWI is supported by the recommendations of the Poverty Reduction Strategy Paper (PRSP) 2004. These recommendations were to:

- ξ Drill wells in communities that lack access to potable water
- ξ Develop a National Rehabilitation and Maintenance Plan
- ξ Increase the budgetary allocation to procure chemicals, pumps and other essential parts necessary to improve water infrastructure
- ξ Expand public awareness programs on home treatment of potable water and water conservation

In the Hinterland of Guyana, access to water is limited due to thick vegetation, isolation of settlements and a lack of all-weather roads. The reliability and accessibility of water systems have been identified as a key health factor because when the more distant water systems fail, communities tend to revert to closer, frequently more polluted sources. The two most significant challenges for Hinterland water resources are seasonal variations and environmental pollution. The quality and reliability of surface water abstraction vary, with water quality in particular being regularly threatened by mining, forestry and the activities of the communities themselves. A number of the small creeks and shallow wells that many small and medium sized communities rely on for drinking water are seasonally unreliable (see Table 2 for drinking water sources).

Figure 9. Guyana's Regional Population Density, 2002

Source: Guyana Population and Housing Census, 2002

Table 2. Percentage of the population using different drinking water sources, Guyana, 2000²

Main source of water	Percentage	
	Improved	unimproved
Piped into dwelling	4.2	-
Piped into yard or plot	5.3	-
Public tap	1.2	-
Tube well/borehole with pump	1.0	-
Protected dug well	7.0	-
Protected spring	0.7	-
Rainwater collection	25.0	-
Bottled water	0.5	-
Unprotected dug well	-	15.1
Unprotected spring	-	4.7
River or stream	-	34.3
Tanker truck vendor	0.1	-
Other	-	0.9
Total	44.9	55.1

Source: Hinterland Strategy and Report, 2004

² Report of Multiple Cluster Survey, Guyana, Bureau of Statistics, July 2001.

This data is based on the survey carried out in 2000, during the implementation of the El Niño Emergency Assistance Project. (From: Hinterland Strategy, 2004).

The recent El Nino drought highlighted this issue, and as a result the United Nations Development Programme (UNDP) set up the El Nino Programme, through which deeper wells have been constructed for a number of communities throughout the interior. A particular concern in the Hinterland is the environmental damage caused to surface water sources by small scale alluvial gold mining. This type of mining tends to be immensely destructive of the water course itself, especially with the use of poisonous heavy metals to refine the gold recovered. Given the small scale and isolation of these sites, they are difficult to regulate and can seriously jeopardise water supplies.

ξ Coastal Agricultural Water Supply

It is also important to note that water for the supporting agriculture on the Coast comes from the country's Highland region. There is a complex drainage and irrigation network established to capture, store and distribute rainfall water from the Highlands of Guyana to Coastal Guyana. This system is monitored by the Drainage and Irrigation Authority, and was extensively described by Mott MacDonald (2004). In addition to the system of capturing rainfall water and storing it for later use, many of the country's rivers that pass through the country's coast line are utilized as natural irrigation and drainage systems.

ξ Water and Climate Management and Monitoring

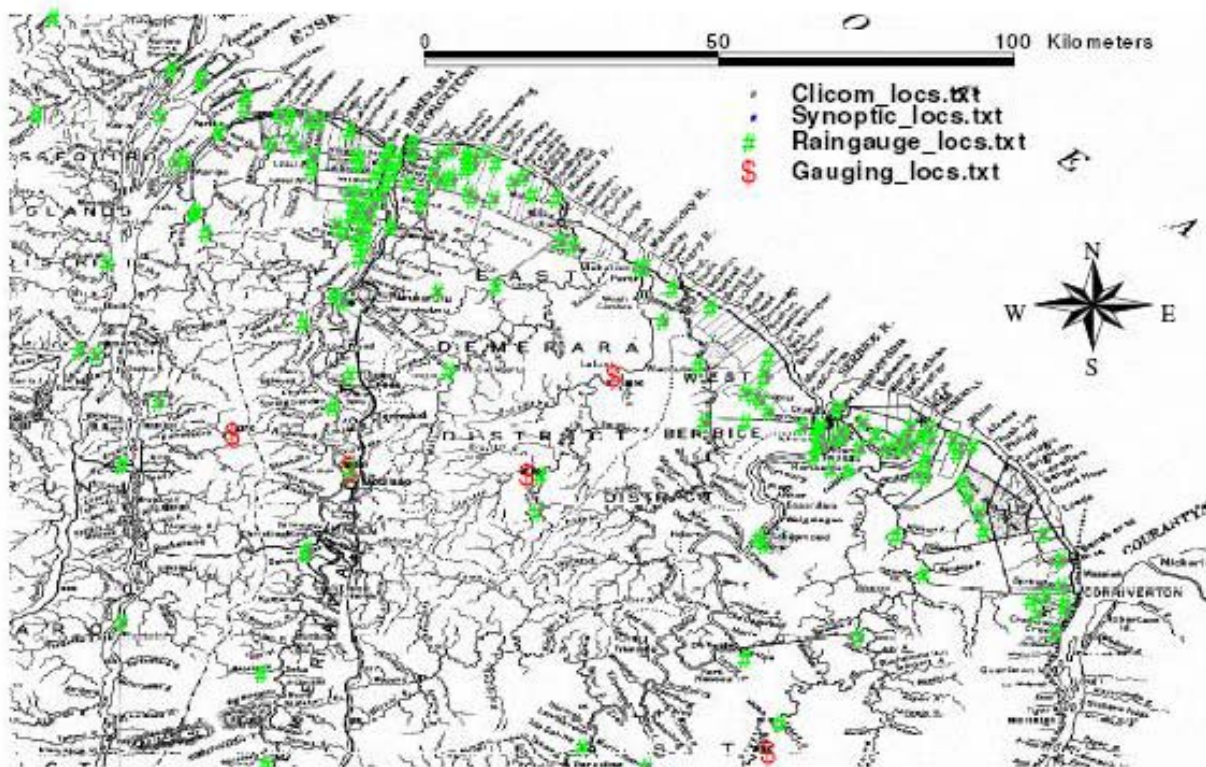
The Hydrometeorological Service, Ministry of Agriculture operates the National Meteorological Station Network (NMSN) and the National Hydrological Station Network (NHSN) (Mott MacDonald (2004). Figure 10 shows the Hydrometric Network for parts of Regions 3, 4, and 6. Hydromet has the responsibility of monitoring water bodies and climatology throughout Guyana. Maps for the National Hydrological Station Network are currently being developed for Hydromet with support from the Guyana Geology and Mines Commission.

By collecting, processing, archiving, retrieving and analysing the data from both Networks, Hydromet is able to provide information to those agencies that are planning and designing agricultural and water development projects, and maintaining the country's sea defences. It also analyses the lower and upper atmospheric weather data of the western hemisphere, and disseminates the information to the aviation and other sectors. The department maintains several databases with pertinent data on hydrology and meteorology, including the CLICOM database that is used for precipitation and meteorological data and HYDATA which is used for archiving streamflow data. The data collection network includes a number of organisations (e.g. Guyana Sugar Corporation) (Mott McDonald, 2004).

ξ Monitoring –Hydrology

Hydromet has established a comprehensive network for monitoring Guyana's hydrology with more than one-hundred and fifty (150) hydrological stations comprehensively covering Guyana's hydrological system. The NHSN includes a raingauge network and a streamgauging network (Mott McDonald, 2004). Data from these collection stations are held in the World Meteorological Organisation (WMO) compatible database HYDATA and the database contains data for most of these stations from the year 1950 – 2006. However, there are instances where data may be missing for some stations for periods of time; indeed there are currently only 17 stations in operation nationwide.

Figure 10. The Hydrometric Network of Regions 3, 4 and 6



Source: Mott McDonald, 2004

ξ **Monitoring – Climatology**

The Hydrometeorological Service monitors a network of Meteorological Stations throughout Guyana. There are currently 102 rainfall stations operating in Guyana (Appendix 2) and seven (7) of these are synoptic; meaning that they have the capacity to monitor the major parameters of weather and climate: temperature, rainfall, wind speed, etc. Hydromet publishes monthly bulletins on weather conditions in Guyana and provides advice to farmers on prevailing weather conditions and possible impacts of the weather on their agricultural practices.

ξ **Recent Climate Studies**

Guyana has ratified the United Nations Framework Convention on Climate Change (UNFCCC). A Climate Change Action Plan was developed in 2002 to achieve the objectives and meet Guyana's commitments of the UNFCCC. The Action Plan recognised that it was imperative for climate change activities to be developed to ensure that Guyanese were prepared to deal with the impacts of the consequences of global warming (Climate Change Action Plan, 2002).

Prior to the preparation of the Action Plan, Persaud and Persaud (1995) classified the rainfall regions of Guyana. More efforts at attempting to understand Guyana's weather and climatic conditions were made by Seulall (2005) and Mott MacDonald (2004). The following were results from these efforts:

1. Rainfall Distribution

McGregor and Nieuwolt, 1998 in Seulall (2005) reported that Guyana had a wet tropical climate. However, because of geographical influences such as mountains and ocean there was spatial variability of rainfall resulting in three major climate types. Three rainfall regimes were identified in Guyana (Persaud and Persaud, 1995) which can be divided into different subcategories in order to define different rainfall regions (see Figure 11). Persaud and Persaud (1995) showed that the highest annual rainfall occurred in the mountainous area of Guyana, with the lowest annual rainfall in the savannahs. Their work resulted in the classification of 17 rainfall-climatic regions. They further referred to the three major rainfall regimes as:

- ξ **Tropical savannahs or very dry regions** - Areas with annual rainfall less than 1788 mm. Such areas were located in the Rupununi Savannahs, the Intermediate Savannah (south of Guyana), the Upper Cuyuni (north west of Guyana) and the Corentyne Coast. The Corentyne Coast was found to be much drier than places further inland.
- ξ **Very wet tropical rainforest climate (very wet regions)** - These were areas with annual rainfall exceeding 2728mm. These regions were found in the Pakaraima Mountains, the upper Akarai Mountains and the sub coast.
- ξ **Wet/dry tropical rainforest (wet/dry regions)** - The remainder of country experienced this type of climate. These were areas with annual rainfall between 1778 mm and 2800 mm.

2. Mean Annual Temperature

Along the coast of Guyana, average daily maximum temperatures were 29.6°C, while the average daily minimum temperatures were 24.0°C. Diurnal variation of temperature was smallest here because the maritime effect was more pronounced (McGregor and Nieuwolt, 1998 in Seulall 2005). Seasonally, temperatures were higher in the dry periods with the highest temperatures occurring in September and October and the lowest in May and June. In the Highlands Regions, especially, over the Mountainous Region temperatures were the lowest (Seulall, 2005).

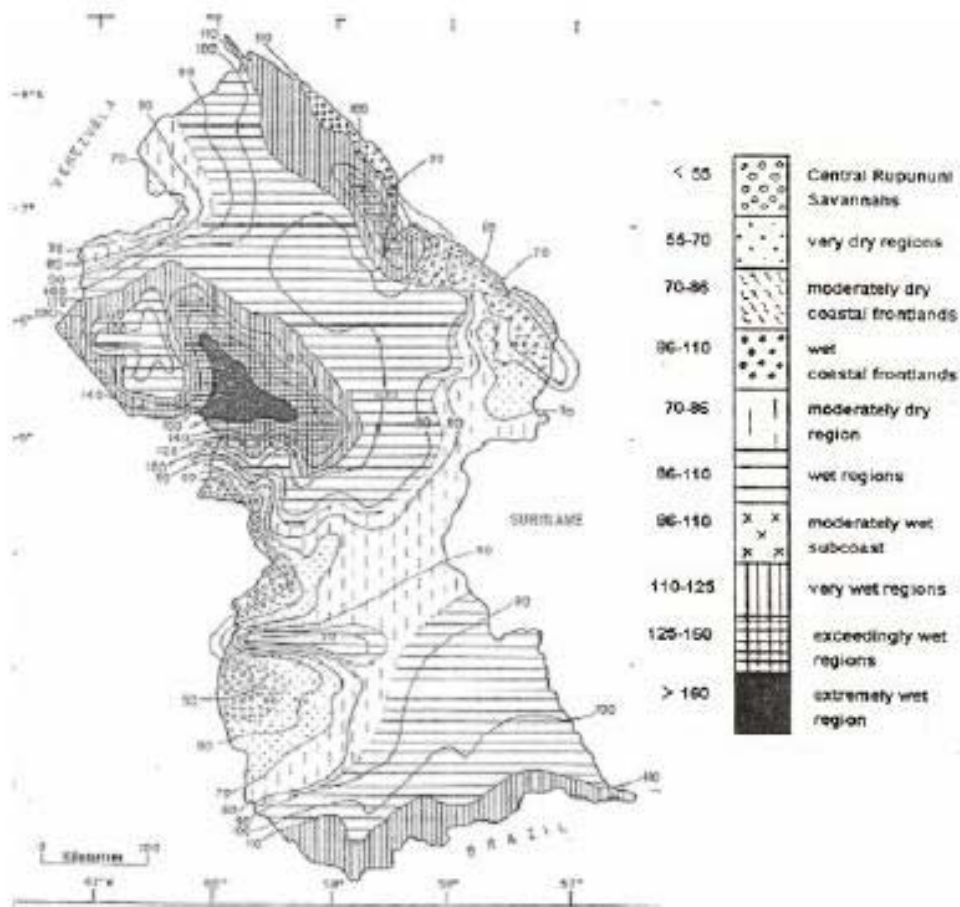
Seulall (2005) described four main mechanisms - Inter Tropical Convergence Zone (ITCZ), El Niño - Southern Oscillation (ENSO), Tropical Easterly Waves and Squall Lines that affects Guyana's climate.

3. Climatic Norms

Mott McDonald (2004) noted that the prevailing climatic and weather conditions may be impacted by climate change. Using available data for Region 3, 4 and 6, Mott McDonald (2004) made the following conclusions:

Temperature data for Timehri Airport were available from 1971, and sunshine data from 1987. Data at Georgetown Botanical Gardens were available for a much longer period, with some parameters being measured since the 1880's. Data plotted were for a common period 1962 – 2002. The climatic norms at Timehri Airport and at Georgetown Botanical Gardens showed little variability. Mean daily temperatures were generally between 26 °C and 27 °C, with higher temperatures being experienced in September and October when mean daily maximums exceeded 30 °C. The range in mean daily temperatures was lower at Georgetown Botanical Gardens than at Timheri Airport, reflecting the stronger maritime influence at

Figure 11. Very Wet Tropical Rainforest Climate or Very Wet Regions of Guyana

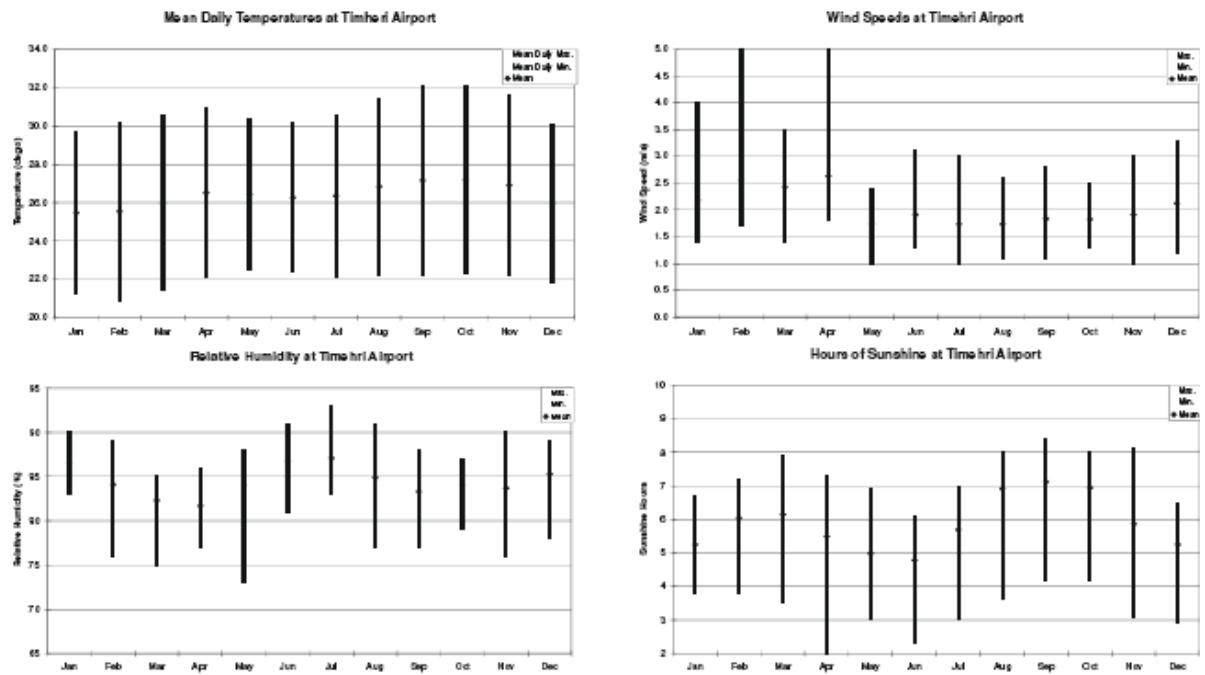


Source: Persaud and Persaud 1995

Georgetown. The recorded relative humidity values at Georgetown were lower than at Timehri, by about 5% on average. The maximum and minimum values of relative humidity and mean monthly values over the record period indicated inter-annual variability. There were lower values of relative humidity in February and March, and in September and October, corresponding with the two dry seasons. Wind speeds, like the other climatic parameters varied little throughout the year. Maximum wind speeds tended to occur in the period February to May. At the time of preparing this report, only a short period of historic wind speed records for Georgetown Botanical Gardens had been collated by the Hydromet Department - 1996 to 2001 (Note that continuous wind run data does not exist).

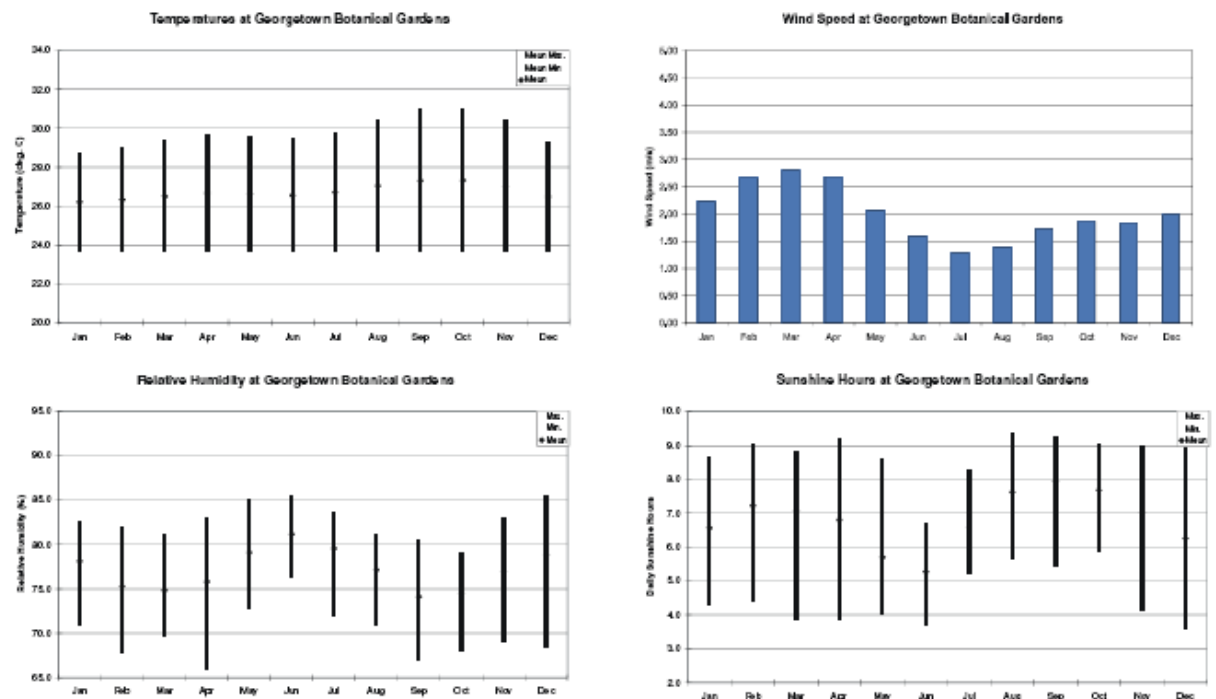
The pattern of daily sunshine hours showed maximums in the two dry seasons of February – March and August – October. Georgetown had more sunshine than Timehri Airport, and this in part explained the differences in relative humidity between these locations. The maximum and minimum values gave an indication of inter-annual variability. Mean annual rainfall in Georgetown is 2300 mm. It is of interest to note that the greatest variability in monthly rainfall occurred in the months of December and January (See Figures 12 and Figure 13).

Figure 12. Climatic norms at Timheri Airport 1991- 2002



Source: Mott McDonald, 2004

Figure 13. Climatic norms at Georgetown Botanical Gardens (1962-2002)



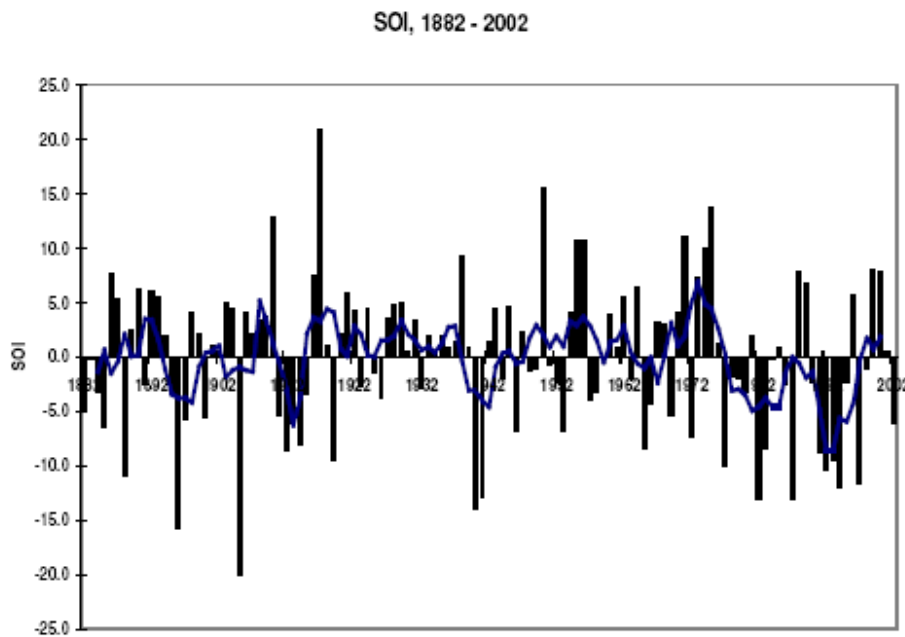
Source: Mott McDonald, 2004

4. Influence of El Nino

It was reported (Guyana National Communication: Monitoring and Understanding Climate Change and Impacts, 2002) that Guyana experienced droughts during El Nino events and heavy rainfall and flooding during La Nina events. The El Nino is a warm coastal current off the West Coast of South America and is associated with changes in the Walker Circulation System over the Pacific. During an El Nino event there is a weakening of the Walker circulation system, and during a La Nina event there is a strengthening of the Walker Circulation System. The variability of the Walker circulation system is measured by the Southern Oscillation Index (SOI), which is calculated by the difference in atmospheric pressure (at sea level) between Tahiti and Darwin.

The El Nino and the Southern Oscillation are thus two characteristics of the Walker Circulation System, and the combined term ENSO is often applied. The SOI provides an objective means of measuring the strength of ENSO activity. Figure 14 shows a time series plot of the SOI over the period for which rainfall records exist for Georgetown. Negative values of the SOI are associated with El Nino years.

Figure 14. The Southern Oscillation Index, 1882 – 2002



Source: Mott McDonald 2004

5. Possible Impacts of Climatic Change

Initially a brief review was undertaken of the General Circulation Model (GCM) predictions of future climate conditions in Guyana. The HadCM2GSal model was looked at in particular. The indication from this model was that precipitation in Guyana was likely to reduce under scenarios of future climate change. All models indicated a reduction in annual precipitation in the range of 5 – 10%, and an increase in temperatures of about 1.5 °C. All models and all scenarios indicated reduced rainfall in the months of September – December. December and January rainfalls have historically shown the greatest variability. The clear indication was

that between June and December it will become drier, and this will be of significance for irrigation during the September – November dry season, while reduced rainfall from June may lead to more severe drought conditions. The forecast changes were consistent throughout the year and the indication was that a temperature rise of 1.0 – 1.5 °C may be expected by the 2040s. A temperature rise of this order could increase evaporation by up to 5% if other parameters remained unchanged.

6. Sea Level Rise

A change in sea levels will influence the drainage characteristics along coastal Guyana. As relative sea level rises in Guyana, the result will be a reduction in the period of time for which gravity drainage can operate, which in turn may eventually lead to increasing dependency on pumped drainage.

In Guyana's "Initial National Communication: Monitoring and Understanding Climate Change (2002)", it was estimated that the current rate of relative mean sea level rise for Guyana was of the order of 10 mm/year on the basis of historic records. It was also reported that the results from the CGCM 1 model indicated a mean sea level rise along the Guyana coast of about 4 mm/year during the next century. Interestingly, the mean sea level published in tide tables for Georgetown, indicated that the mean sea level is now 0.158 m higher than it was in 1951. This equated to a rate of relative sea level rise of 3 mm/year. The Transport and Harbours Department (T&HD) established the change in mean sea level on the basis of their records of sea level and historic sea level records for Georgetown were provided by Hydromet. These records dated between 1951 and 1979. However, Hydromet have not until recently had a responsibility for sea level records, and with the exception of some very recent data with Hydromet, post 1979 data have not been located despite several avenues of investigation. A progressive rise in recorded maximum sea levels was noted between 1971 and 1976. This followed a four month period of missing data in 1970. It is therefore possible that following an instrument failure, or similar, the gauge datum changed or was unstable from 1971 onwards. Recent data for 2000 indicated that the 1971 – 1976 data was anomalous. The 2000 maximum level was close to the long term mean.

Monitoring will be essential to the planning of future coastal defence and drainage works. It was strongly recommended that procedures for sea level monitoring be strengthened. This is a key variable for Guyana and its importance is increasing as global sea levels rise.

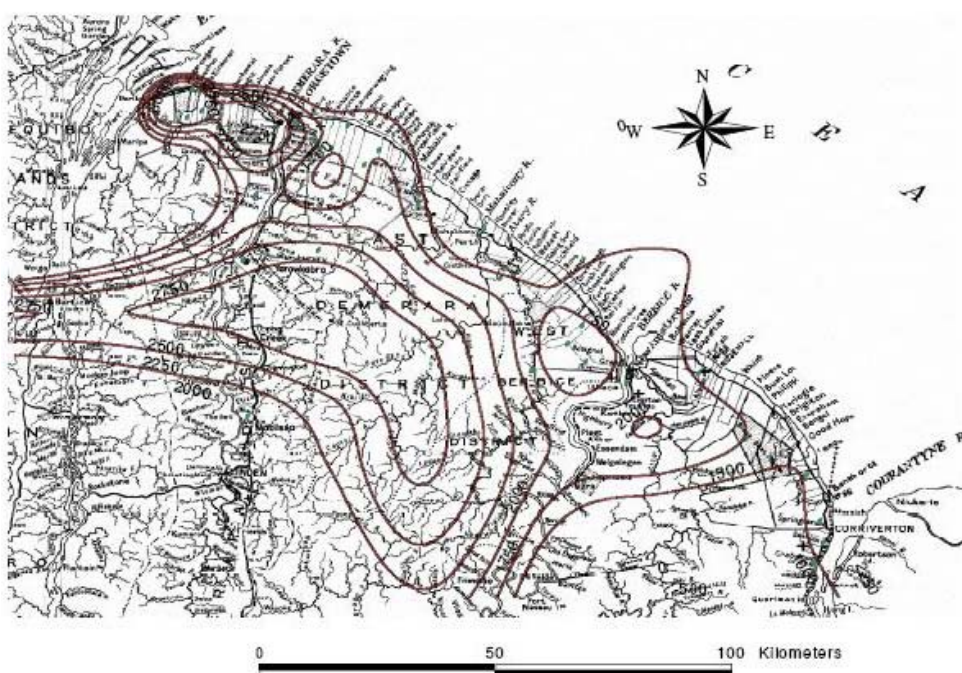
ξ Rainfall Characteristics

Mean annual rainfall was determined using a standard record period of 1974 – 2002, this being the most complete period of record in the Hydromet CLICOM database. No attempt was made to infill periods of missing data as the isohyetal plots of annual data were intended only to provide an impression of annual rainfall totals. Figure 15 shows mean annual rainfall for the 1974 – 2002 periods. Stations with significant periods of missing data were excluded from the analysis, and at many stations the sum of monthly means had to be used as there were too many incomplete years of annual totals. Rainfall in Region 3 was generally in excess of 2,500 mm, while in Region 6, annual rainfall was of the order of 1,750 mm (Mott McDonald, 2004). The impacts of global climate change are discussed in more detail later in this section.

ξ National Inventory on Greenhouse Gases

A national inventory was first conducted in 1994. It was revealed that Guyana was a Net Sink country for CO₂ where removals (26,664 Gg) greatly exceeded emissions (1446 Gg), that is, a removal balance of 25,218 Gg in the base year 1994. The Energy sector (fuel combustion activities) was the major emitter of CO₂ having CO₂ emissions of 1446 Gg in 1994, while the Land Use Change and Forestry sector was the major sink for CO₂, with the net removal sink of 26, 664.47 Gg in 1994. Carbon dioxide was the major Greenhouse Gas being emitted, accounting for 96.5 % (1446 Gg) of the total emissions of CO₂, CH₄ and N₂O in 1994. The Agricultural sector was the major source of CH₄ and N₂O emissions totaling 51 Gg and 1 Gg respectively in 1994.

Figure 15. Mean Annual Rainfall for Regions 3-6 for the years 1974 – 2002



Source: Mott McDonald, 2004

ξ Impacts of Climate Change and Sea Level Rise

While Guyana was reported as a net sink for greenhouse gases, it was most vulnerable to the impacts of climatic change. The records in Guyana suggested an increase of 1.0 °C in the mean annual temperature of Georgetown over the period 1909 to 1998. Cooling periods in the record appeared to be a result of the influence of major volcanic eruptions in several parts of the world. Prior to 1960, annual rainfall amounts were generally above or about normal. From 1960 and onwards, there has been a tendency for below normal rainfall. ENSO events have severely affected Guyana especially in the last decade of the twentieth century.

The Atmosphere Global Circulation Model (A-OGCM) of the Canadian Centre (CGCM 1) was used to develop predictions of rainfall, temperature, evaporation and water deficit for two scenarios of carbon concentration: doubling and tripling. For a doubling scenario, temperature was expected to rise by 1.2 °C in the period 2020 to 2040 from present. Highest

increases in excess of 1.5 °C were expected in southern Guyana in the Second Dry Season (August to October). Rainfall was expected to decrease by an average of 10 mm per month but the decrease in the First Wet Season and Second Dry Season (May to October) will be 12 mm per month or higher. Evaporation, however, appeared to show insignificant increases (less than 3 mm per month). Water deficit will be about 8 mm per month on average with larger deficits in southern Guyana.

With a tripling of CO₂ concentration in the latter part of the twenty-first century, Guyana could experience a temperature rise of 4.2 °C on average. Here again, southern Guyana may experience highest increases. Rainfall can decrease by an average of 21 mm per month with higher decreases in the First Wet Season (FWS) and Second Dry Season (SDS). Again, southern Guyana could be influenced by the highest decreases. Evaporation is likely to increase by about 3.3 mm per month. Southern Guyana may experience large water deficits in the First Wet Season and Second Dry Season while northern Guyana is likely to be affected by deficits in excess of 22 mm per month.

Similar predictions were made by the Hadley Centre A-O GCM for the tripling of CO₂, except that lower temperatures and more severe decreases in rainfall were expected especially in the First Wet Season.

ξ **Past Sea Level Rise**

Tidal gauge data in Guyana for the period 1951 to 1979 indicated a mean relative sea level rise of 10.2 mm per year. High tide change was calculated to be 9.7 mm per year with the low tide change being 11.1 mm per year. This was about 5 times the global average and suggested a mechanism other than sea level rise may be operating on Guyana's coast, such as subsidence due to water extraction, ocean floor sediment loading or plate tectonics. Plate tectonics did not appear to be contributing to this observation. But, subsidence and sediment loading may both be contributing to the high rises noted in Guyana.

ξ **Future Sea Level Change**

The Global Circulation Models (GCMs) indicate average rises of 2 to 4 mm per year in the first half of the twenty-first century and rises of 3 to 6 mm per year in the latter half. Therefore, in Guyana, sea level is projected to rise by about 40 cm by the end of the twenty-first century. If meltwater contribution from land ice is considered, then the rise can be about 60 cm. The predicted sea level rise coupled with extremes in rain events and storm surges and increased wave action can exacerbate an already critical situation where water accumulation off Guyana's coast has been resulting in breaching and overtopping of the sea defences.

ξ **Climate Change Impacts**

The impact of climate change on **water supply** is not very clear. Decreasing rainfall and increasing evaporation can lead to lower water levels in the rivers. Extreme rainstorm events can allow for flood conditions especially during cold phase ENSO events. Sea level rise can result in salt water intrusions further upriver. Ground water can also be vulnerable to this effect. The demand for water is expected to increase with increasing temperatures and the relative value of water for alternative uses would likely change, as priorities are determined on the basis or urgency of needs.

The **energy sector** will also be affected. Demands for interior space cooling and possibly decreased hydro-generating potential supply from some river basins can pose problems. Shifts in the seasonality of river discharges and reduced rainfall will have to be considered in determining hydropower sites and periods of water storage. In terms of hydropower generation, runoff potential and hence the hydro-generating capacity of certain drainage basins may decrease, in turn, decreasing Guyana's capacity to supply a widely available, cheaper and non-fossil fuel form of energy.

In the **agriculture sector**, using analyses based only on changes in climatic variables, yield losses will affect sugar and rice, the country's two main crops. These losses may be triggered by increased water demands from crop transpiration and greater respiration losses as a consequence of higher temperatures. There may be changes also in the yield quality due to a decreased diurnal temperature range, resulting in, for example, decreased sucrose content, with sugar as stated earlier being most affected. There is uncertainty in assessing the effect of fertilizers and pesticides on crop yield due to the projected increase in temperature. It is possible that the adjustment of levels of fertilization may be an effective stabilizing response in extreme years.

Spatial shifts may have to be considered as climate change takes effect. There may be the need for a substantial switch of crops or species of crops in particular areas. In addition, changes in farm profitability can be expected to affect non-agricultural sectors of the Guyanese economy. There would need to be studies to determine the advantages of increased CO₂ concentration and the effects of increased temperature, rainfall and evaporation on the major crops in Guyana.

A CO₂ – induced climate change can impact on the **forestry sector** in a similar way to that for agriculture. There would, however, be a need to consider the impact of increased CO₂ fertilization on forest growth. If the dry seasons get drier, then this may impose severe constraints on forest growth and may be critical in determining species response. With a doubling CO₂ concentration, indications are that the forests in southern Guyana may be affected by shrub savannah spreading southward to replace tall evergreen forest. With a tripling CO₂ concentration, the same areas can be affected. However, the northwest may also be affected by a change to shrub savannah types. Again, the sensitivity analysis must be guided by further studies.

The **Coastal Zone** is identified as being the most vulnerable part of Guyana because sea level rise will be expected to add to the direct impacts of temperature rise, rainfall decrease and evaporation increase. It is also the part of Guyana where adverse impacts will directly affect a large percentage of the Guyanese population. Two vulnerable zones have been identified in the coastal zone. **Impact Zone 1**, comprising the western Essequibo areas where the coast is not protected by man-made structures and **Impact Zone II** is the densely populated regions comprising Berbice, Demerara and the eastern part of Essequibo that are protected by man-made structures. In both zones, drainage is a problem. There would be a need to develop programmes to address the issues of coastal stress taking into consideration the impacts of climate change and sea level rise. Further, decisions would have to be made, on the basis of detailed analyses, about areas that shall be protected or accommodated or perhaps abandoned in the face of accelerated sea level rise. Since the coastal zone affects a large percentage of the population, it will be necessary to examine the implications of climate

change for water resources (effects of salinity on estuaries and aquifers), agriculture, fisheries, human settlements, human suffering and loss of lives, tourism and health.

Available evidence strongly suggests that Guyana has long recognised its bountiful natural resource wealth as capital for development. Probably the most profound action towards attempting to utilize this was the establishment of the Iwokrama International Centre in 1989. The creation of Iwokrama in many ways signaled that the country's focus was not only to use its resource to fuel the development process, but that it recognised that such development must be done in a manner that would have minimal impacts on the environment, whilst at the same time bringing lasting benefits to current and future generations of its people. The quest for development had to be tailored in such a way that the lessons learnt by other countries who had similar ambitions and who indeed had achieved some level of economic development, were duly acknowledged and capitalized on.

1.3. Other Relevant Plans and Programmes

Guyana's vision for sustainably managing its part of the Amazon Basin would be built upon past initiatives; some of these are highlighted in this section.

1.3.1. National Development Plans

Two key documents were produced over the past few years that focused primarily on national development. Both documents recognised that there was a need for development and that one of the ways to go about it was to focus on reducing poverty. The first of these was the National Development Strategy (NDS) which was released in the year 2000 and represented a comprehensive consultation process between the Central Government and Civil Society. The document presented a policy framework for Guyana on all the critical areas of development, namely: Governance; Macro-economic Strategy and the Management of the Economy; The Environment; Information Technology; Energy; Transport; Sugar; Rice; Agricultural Institutions; Non-Traditional Agriculture; Fisheries; Forestry; Water; Mining; Manufacturing; Education; Health; Tourism; Urban Development; Land; Housing; Amerindians; Gender Issues; The Family and Its most Vulnerable Members; Labour and Employment; The Private Sector; and Poverty Eradication.

Since the publication of the NDS a number of important policy documents have been developed, these included: a National Environmental Action Plan, a National Biodiversity Action Plan and a Forestry Code of Practice.

The second document of major significance that has been produced recently is the Poverty Reduction Strategy Paper (PRSP) in 2005. The PRSP, like the NDS, focused on a number of areas that needed addressing in order to reduce national poverty, including water, where it expressly stated:

“The Government's medium-term strategy in the Water Sector will be dedicated to improving the quality and delivery of services, ensuring good and effective regulation of the sector, and implementing a subsidy program to help poor households connect to the system and/or pay a portion of their monthly bill. Specifically, the objectives of the Water Sector will include (i) provision of access to safe water to 95 percent of the population; (ii) establishment of a Guyana Water Company to provide economies of

scale; (iii) streamlining of the activities in the Coastal Zone with emphasis on treatment of raw water; and (iv) implementation of a comprehensive rehabilitation and maintenance plan. In addition, more chemicals will be procured to treat raw water, maintain sanitary conditions in and around water conservancies, and the Ministry of Housing and Water (MOHW) will coordinate its program with the Drainage and Irrigation Department of the Ministry of Agriculture, as poor maintenance of Drainage and Irrigation schemes is partly blamed for the contamination of water systems. MOHW will also mount public awareness programs to educate families to conserve and treat water. Priority attention will be given to rehabilitation and maintenance of water infrastructure. In part, frequent damage to water mains due to old age, low water pressure, and low levels of maintenance compromise the quality and availability of water. To deal with these problems, the MOHW in collaboration with the water agency will prepare a multi-year comprehensive rehabilitation and maintenance program, for which an increased budgetary allocation will be granted. To improve access to water, about 100 wells will be drilled, 50 windmills constructed and over 400 pumps installed in hinterland areas in the medium term. Pumping stations will also be rehabilitated and/or constructed in several hinterland areas. In addition, Government will rehabilitate over 150 minor water systems, involving the replacement of pumps and engines and refurbishment of electro-mechanical systems in rural areas. These improvements will bring immediate benefits to over 200,000 residents. In municipal areas, the focus of the water program will be the construction of additional ground storage tanks, and the drilling of new wells.” (Poverty Reduction Strategy Paper, 2005).

(For more information please see <http://www.povertyreduction.gov.gy/index.html>)

1.3.2. Resource Management Plans

There are a number of initiatives aimed at managing Guyana’s natural resources and in general aimed at protecting the country’s biodiversity. Some of these are described below.

1.3.2.1. National Protected Areas System

There are at least five (5) sites in Guyana that has been earmarked for protected area status: The Kanuku Mountains, Mount Roraima, Orinduik Falls, Shell Beach, and the South-Eastern Forest. The following site descriptions were extracted from: www.epaguyana.org.

Kanuku Mountains

There is a distinctive type of vegetation on granite domes and steep cliffs in the Kanuku Mountains region, and it has been shown to be rich in birds including Harpy eagles and a diverse mammal fauna. Surveys revealed that 250 species (about 75% of all forest-based species in the country) occur within a few square kilometres of lowland evergreen forest. About 7 or 8% of these species are endemic to lowland forests in the Guianas. In all, 350 bird species are recorded in the region, which suggests that well over 60% of the country’s entire avifauna occurs in the Kanuku Mountains. Mammal surveys indicate that 80% of the country’s mammal fauna also occurs in the Kanuku region. The apparent high overall biodiversity of the region reflects the unusual diversity of habitats, which range from savannah, gallery forests, and semi-deciduous forests in the lowlands, to lowland and montane evergreen forests within an elevation range of approximately 150-900 m.

Mount Roraima

This area contains many elements of the Guiana Shield flora and fauna that are found nowhere else. Mount Roraima (2800 m) is the highest tepui in Guyana and mostly inaccessible from Guyana. These tepui mountains are poorly studied in Guyana but known to be rich in unusual plants and animals on the Venezuelan side. This area is located across the border from the National Park in Venezuela and the forests protect an important watershed that is vital to Guyana. Mount Roraima contains several vegetation types from lowland rainforest to elfin woodlands. This area has been proposed as a World Heritage Site, and as a national park.

Orinduik Falls

Located north of Lethem on the border with Brazil, Orinduik Falls is one of the oldest geological formations in the country and has scenic rapids, which interlink with plant communities. The falls are surrounded by dry savannahs. The area has been proposed as a national park, a natural monument and as an important site for conservation.

Shell Beach

Located at the mouth of the Waini River, the beach is a vast bank of shells, approximately 10 km in length. The area helps protect against drastic changes in the coastline. The area is one of the most important nesting areas in the world for four species of sea turtles that are being actively studied. However, the rest of the flora and fauna have not been studied and it is the only place left in Guyana with large intact mangrove, brackish water, and coastal swamp communities. Poaching of sea turtles still occurs, despite ongoing monitoring and conservation initiatives that involve local Amerindian communities. This area has been proposed as a wildlife sanctuary.

South-Eastern Forest

This is a vast area in southern Guyana on the border with Suriname and Brazil. The portion near Gunn's Landing has been visited a few times by botanists and mammalogists and preliminary data indicate that this forest is very different from the other forests found in Guyana. Two collectors, one for termites and ants, and the other for mammals have briefly visited the far eastern portion, the New River Triangle. These preliminary data suggest a rich and unexplored flora and fauna with many possible new records for Guyana and undescribed species. Both of these areas are believed to contain low elevation, high canopy rainforest. The New River Triangle has been proposed as a resource reserve and an important area for conservation.

(Please see www.epaguyana.org for more information)

There has been a significant amount of work done in the Kanuku Mountains with leadership from Conservation International (Guyana) and at Shell Beach with leadership from the Guyana Marine Turtle Conservation Society (GMTCS). When declared as Protected Areas, these areas will join the Kaieteur National Park and Iwokrama International Centre for Rainforest Conservation and Development on the list of National Protected Areas.

1.3.2.2. Natural Resource Management on Amerindian Lands

Amerindian communities that hold legal title to their lands, by virtue of their ownership of the land have jurisdiction over all natural resources, with the limited exception of sub-surface

resources and waterways that pass through their lands. In recognition of the fact that they have control over these resources, the Village Councils have been charged under the Amerindian Act 2006 to put systems in place for the management of their natural resources. In response, the Ministry of Amerindian Affairs has supported the communities of the North Rupununi, Region 9 to pilot a process that will lead to the development of a system for sustainably managing their natural resources.

The process and product have met the communities' expectations and they have now requested that the guidelines outlined for the development of the natural resource management system to be officially gazetted as by-laws – “By-Laws for the Management of Natural Resources by the Communities of the North Rupununi”. These guidelines have been reviewed by all the national agencies with responsibility for the management of natural resources in Guyana to ensure that they have met, at the very minimum, standards established for the management of natural resources on state lands. The Ministry of Amerindian Affairs plans to support the transmission of this system and the process that lead to the creation of this system to all other Amerindian communities in Guyana. This would attempt to ensure that the systems for the management of natural resources on Amerindian lands would be on par or even exceeding the standards established on state lands.

1.3.2.3 The Rupununi Wetlands Project

The Rupununi Wetlands, just southeast of the Iwokrama Forest, includes the Rupununi, Rewa, and Essequibo Rivers, and many other smaller rivers, creeks and ponds. These wetlands contain high habitat diversity and support a vast array of wildlife. Although only a small portion of the area has been surveyed, over 400 species of fish have been identified. This has led to estimates of up to 600 species for the area; remarkably high compared to other South American wetlands. The high fish species' richness results, in part, from seasonal flooding that links the Amazon basin to the flooded Rupununi Savannas. The Rupununi Savannas and mountain streams of the Pakaraima foothills are also major fish-breeding and feeding grounds during the high water period. The Rupununi Wetlands, like the Iwokrama Forest, are also home to healthy populations of rare and endangered giants including Giant River Turtles, Black Caiman, Arapaima, Giant Otters, and of course, water-loving Jaguars.

Through the collaborative efforts of the Darwin Initiative for the Survival of Species, Iwokrama, the University of Guyana, the Environmental Protection Agency and the North Rupununi District Development Board (NRDDDB), the monitoring programme aims to develop a better understanding of the impacts of different land uses on the wetlands. The project commenced in January 2004 and has approximately 30 study sites within the Iwokrama Forest, along the rivers and along the savannah of the North Rupununi. Monitoring efforts aim to observe seasonal changes in the vegetation, water chemistry and land use activities (www.iwokrama.org).

1.3.2.4. Hydropower Development

The Hydro-Electric Power Act, CAP 56:03 provides the legal framework for the development of hydroelectric power generation in Guyana. There are a number of sites in Guyana that have been identified for the development of hydropower facilities (Appendix 1). It has been estimated that Guyana has the potential to produce a total of 7000MW of power from hydropower (Kaehne, 2002). At the moment about five (5) of these sites are receiving significant attention from the Government of Guyana and its development partners for

establishing hydropower plants. Of significant note are Amalai in Region 7, where a 2000 Mega Watts (MW) facility is being explored. Marshall Falls in Region 7 (1100 MW) and Tumutumari (35 MW) are also receiving attention for developing hydropower facilities at this point in time (Honourable Samuel A. Hinds, Prime Minister, personal communication).

1.3.3. Soils and the Environment

The National Agricultural Research Institute (NARI) is the repository institution for soils in Guyana. NARI is currently spearheading research on soil and land use surveys, management of aquatic weeds and soil management. Soil surveys are in various stages of completion in Bonasilm, Leguan and Canal # 1 Polder; the results should provide information on the soil resources of these areas. The digitising of reconnaissance soil maps of Guyana, at 1:1,000,000 and 1:500,000 scales have been completed. A land evaluation exercise has been conducted of the Lima Sands area on the Essequibo Coast and recommendations have been made for management of these soils.

Aquatic weed management work has focussed mainly on collaborative activities with the East Bank Essequibo Development Project. Two herbicides have been identified as promising for aquatic weed control. Recommendations have also been made to use the herbicide Round-up (glyphosate) and Arsenal (Imazapyr) for vegetation control on the edges along embankments.

In soil physical management, two projects have been done to determine the effect of bed size on soil moisture utilization and the effect of organic waste material on soil physical properties and weed management. The bed size has no significant effect on moisture content, although the long dry season may have affected the results, whilst it appeared as though the organic matter improved the soil physical properties to some extent.

1.4. Biodiversity and Forests

1.4.1 Biodiversity

Guyana has remarkable diverse habitats and a rich flora (plant life) and fauna (animal life) which remains largely unexplored. It is unique in the world because the majority of its natural resources remain in a pristine state. While Guyana is one of the smaller countries of the wider Amazon region, it contributes significantly to the biodiversity, both in terms of number of species and number of endemics. Its natural ecosystems are relatively intact due mainly to low population pressure and to limited commercial activity. The importance of the Amazon Basin lies in its holding of more than half of the world's biodiversity, its collective magnitude of endemism, its role in ameliorating global climate and the hydrology of a large part of South America. Guyana is home to thousands of species of plants and animals, and it is widely suggested that many are unknown to scientists.

Current increase in entrepreneurial activity in the natural resources sectors, places pressure on the biological resource base and raises real possibilities of increased threat to biodiversity. The situation is compounded when it is considered that there is a limited knowledge of the country's animal species, some of which may be threatened with extinction.

The Centre for the Study of Biological Diversity (CSBD), a collaborative effort of the University of Guyana and the Smithsonian Institute, is the repository for the Guyana National

Herbarium and the University of Guyana's Zoological Museum. The CSBD holds the most comprehensive collection of specimens of plants and animals found in Guyana, Suriname and French Guiana. More than 25,000 plant specimens are housed in the National Herbarium. The Zoological Museum contains species of invertebrates such as insects, butterflies and moths, and vertebrates such as fish, birds, snakes and other reptiles, frogs and other amphibians, and mammals. It should be noted that The Smithsonian Institute holds data on the diversity of Guyana and the entire Guiana Shield and such data can be requested from the institute at: www.si.edu.

(Please see <http://www.sdn.org.gy/csbd> for more information).

There are a number of efforts aimed at building a tradition in support of participatory decision-making and establishment of a policy to conserve and sustainably use the country's natural resources. These policies are reflected at the national level in the signing of a number of international and regional treaties, conventions and other instruments relating to the conservation and sustainable use of natural resources. In keeping with this, Guyana's Cabinet recently approved a National Biodiversity Plan, which seeks to promote conservation and sustainable use of Guyana's biodiversity. The Environmental Protection Agency is being continually improved to ensure the conservation of Guyana's rich biodiversity (Guyana Initial National Communication, 2002), and recently has developed a Biodiversity Action Plan to deal with the sustainable management of the country's biodiversity.

1.4.2 Forests and Forestry

ξ The Forest Resources

The forest of Guyana covers some 16.45 million hectares or 76.6% of the total land area. Of this area only about half (8.7 million hectares) is considered accessible for economic exploitation. This forest is generally considered tropical moist, evergreen rainforest, though represented by various forest types. The permanent State Forest Estate, which covers some 13.58 million hectares, is administered by the Guyana Forestry Commission (GFC). The remaining forest areas are Private Property, Amerindian Community Titled Areas or State Lands administered by the Guyana Lands and Surveys Commission.

The forests are heterogeneous in nature. About 70 species of timber are regularly extracted, with another forty (40) species being extracted in a more irregular manner. The forestland is dissected by many large rivers that provide a means of transporting forest produce to the processing centers. Some of these rivers, however, are very difficult to navigate due to masses of rock outcrops in their channels and periodic low water patterns.

ξ Forest Values

Guyana's forest resources perform critical watershed services and contribute strongly to the preservation of the Amazon Basin Watershed. Water conservancies have been established for the supply of irrigation water upon which the agricultural industry is dependent. Watersheds that supply these conservancies are mostly white sand areas where much of the forest cover has been lost due to bauxite mining, agriculture and the intensive harvesting of fuelwood. Annual flooding of low lying coastal areas is a frequent problem attributed in part to this forest clearance. It is important that the watersheds are put under a multiple-use management regime with the primary management objective being the maintenance of good watershed characteristics.

The biodiversity of the forests has been the subject of a number of surveys and studies, mostly by foreign universities and institutions. The Smithsonian Institute which has co-operated with the Government of Guyana in the establishment of a Biodiversity Centre in Guyana has conducted systematic studies of the flora and fauna. A National Biodiversity Strategy has been approved by Guyana's Cabinet, which establishes national regulations governing the prospecting of biological and genetic resources and protects intellectual property, particularly of the indigenous Amerindian people.

ξ Administration of Forest Areas

Forests are allocated to loggers under a three-tiered system. Firstly, there is the State Forest Permission (SFP), which is granted for small, short-term operations (two years) and where no heavy investment is required. The SFP does not give exclusive rights to the area it covers. Holders of State Forest Permissions generally concentrate on the production of fuelwood (charcoal and firewood), posts and timber. Where the area exceeds 400 hectares, an acreage fee is payable.

Secondly, there is the Wood Cutting Lease (WCL) which grants rights to extract timber and other forest produce for periods between 3-8 years. Simple forms of Management Plans are required and a stipulated minimum royalty level is a vital obligation under this system. The areas granted are much larger than those under the State Forest Permission.

Thirdly, there is the Timber Sales Agreement (TSA), which is considered the major wood cutting license currently being granted to large operators. This level of operation requires large investment and sufficiently large areas (over 25,000 ha) to amortize the investments. These licenses (agreements) grant harvesting rights to the grantee for the period of 15-25 years. Under this system, it is essential that a detailed forest inventory and Management Plan be prepared and submitted to the Guyana Forestry Commission for approval. To date, approximately six (6) million hectares of accessible forest have been allocated, of which about 3.7 million hectares are under TSAs (see Figure 16 for allocation of National Forests).

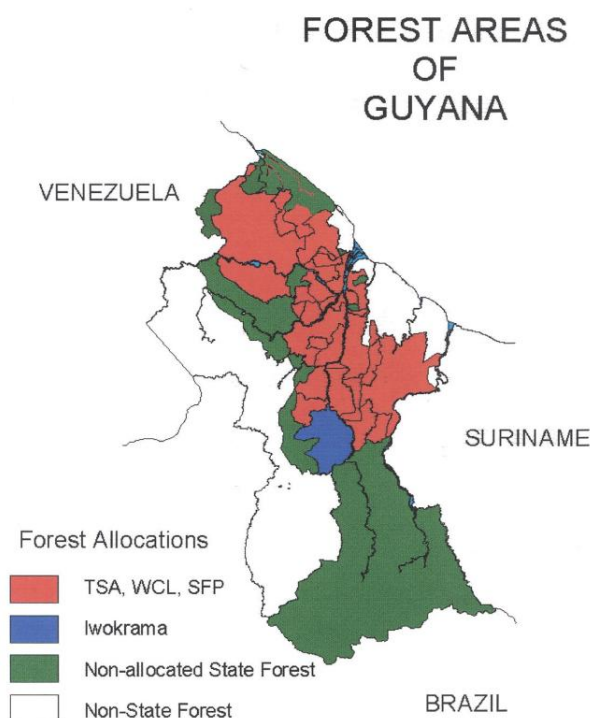
In Guyana, emphasis is placed on formulation and implementation of Forest Management Plans not only for exploitation, but to apply appropriate systems to ensure forest conservation, forest protection, forest for multiple benefits and long-term sustained supplies of wood for industrial and energy needs (Guyana Species Booklet, 2004). The GFC has also published a Code of Practice for Timber Harvesting which gives guidance to persons about the standards of harvesting state forests. This document and other GFC publications can be downloaded from www.forestry.gov.gy.

Classification of Guyana's Forests

ξ Rain Forests

Rain forests occur in areas where the climate is wet, with rain occurring every month or where dry spells are short. Trees are numerous and stand in strata or layers, ranging from low shrubs to very tall dominant trees with large spreading crowns. Climbers and epiphytes are abundant. In Guyana, rain forests are the most common forest type, occurring from the

Figure 16. Allocation of Guyana's Forested Areas



Source: www.forestry.gov.gy

north-west through to the south of the country. It is also the most important type for timber production. Seasonal forests (also known as monsoon forests) occur where there are regular dry seasons. Trees are not as tall and the top of the forest canopy is more even. In the dry season, the larger trees often lose their leaves. Climbers and epiphytes are less abundant. Seasonal forests are found in Guyana in the north Rupununi and the upper Berbice areas.

ξ **Dry Forests**

Dry forests occur where soil moisture is frequently limited either because the soil drains rapidly or where there is excessive evaporation due to strong winds. Examples of dry forest are found on the white sands of the Soesdyke-Linden highway and throughout the Pakaraima Mountains. Wallaba forests are common in the white sand regions.

ξ **Seasonal Forests**

Swamp forests occur where drainage is impeded and soils are frequently waterlogged. This forest type includes the mangrove forest along the coastline and the Mora forests occurring in lowland swampy areas and along the interior. Mangrove forests provide protection to the shoreline against erosion and are an important habitat for marine life. Removal of mangroves for fuelwood from the Essequibo River to the Corentyne has not only exposed lengths of coastline to erosion but also degraded these ecosystems, limiting their ability to act as nurseries for pelagic fish species. An estimated 75 percent of fish caught commercially spend some time in the mangroves or are dependent on food chains which can be traced back

to these coastal forests. Mangrove plants and sediments have also been shown to absorb pollution, including heavy metals. Mangroves along the north-west coast are still largely intact. An evaluation of the mangrove resource is to be carried out by the Guyana Forestry Commission and plans for its protection and management are to be developed. (Please see www.forestry.gov.gy for more information).

2.0. DYNAMICS OF CHANGE

It is well documented that the world freshwater resources are under threat from human development and anthropogenic activities and changes in global climate conditions. Due to these factors, it is extremely difficult to predict the state of the planet's water resources in the future. However, a number of forces have been identified as driving forces behind global change.

2.1. Driving Forces of Change

There are a number of areas that have been identified as the major drivers propelling the global water scenarios: demographic – this includes population growth, migration pressures and urbanization; economic – economic outputs; trade; prosperity; water works investment; technological – hi-tech expansion; water efficiency; unit water pollution; adoption of new crops; water sanitation investment; number of desalinization plants; withdrawal efficiency; social – lifestyles, poverty, inequity; governance – power structure ; level of conflict; globalization; environmental – water related diseases; soil salinity; groundwater; and ecosystem health.

Many of these driving forces are visible in Guyana and indeed, in the wider Amazon Basin, and therefore, would need to be considered when shaping the scenarios for future management of the region's water resource. It would be important to have a preliminary assessment of the services provided by Guyana's freshwater resources in order to observe if some of these driving forces are active in this part of the Basin

2.2. Future Scenarios

2.2.1. Overview

As stated earlier, the management of Guyana's freshwater would be built on the current situation. Future management strategies would be built upon the visions and programmes from the institutions and social actors whose mandates directly affect the country's water and soil resources and sustainable development. These key agencies took the opportunity presented by the National Vision workshop to share their current programmes and plans for the future that allow for the determination of plausible outcomes of the future sustainable management of Guyana's part of the Amazon Basin. Their positions were consolidated to arrive at a national position for short, medium and long term scenarios.

It should be noted that these scenarios did not only focus on the Water Sector, but they attempted to address the subject of sustainable development on the whole. The full presentations from these key institutions and social actors are presented in Annex 4, whilst

the following section presents a summary of the scenarios developed from the National Vision Workshop.

These scenarios are not to be used solely to estimate future supply needs, but they should provide a starting point from which to evaluate various management options including, but not limited to:

1. Moderating water demand through demand management programs, changes in water prices, and efficiency programs and;
2. Increasing water supplies through urban water re-use facilities ground water reclamation, recharge, and conjunctive use, increased water storage and conveyance, and desalinization.

2.2.2. Short term: 5-Year Scenarios

2.2.2.1. Overview

In the short term, it is expected that much of the current trends aimed at improving environmental management and the development of the national population of Guyana would continue.

In addition, the current policy aimed at improving the Water Sector with respect to the delivery of potable water to a wider cross-section of the Guyanese population would also continue. This would include changes in the system for water delivery with the likely implementation of more efficient systems of delivery, and also the likelihood that customers would be required to pay for the potable water, especially along the coastal plain and particularly around Georgetown.

Also, in the short term, it is expected that large portions of the country's water resources currently being utilized for environmental purposes would be directed towards agricultural and industrial activities (agricultural and urban water use) as these areas are developed. Some of the likely developments are summarised below:

2.2.2.2. Water Policy

The National Water Council is expected to begin functioning as mandated in the Water and Sewerage Act 2000, with the National Water Policy being developed and implemented accordingly. The implementation of the Act would result in a greater role from the key agencies with stipulated roles by the legislation.

The Act has been developed to allow for a concerted effort at sustainably managing and protecting the country's hydrological resources, including the monitoring of climatic and other factors that may impact upon this resource. At the moment, however, the Act is not being implemented to its full force, thereby not allowing for many of its credible intentions to be achieved. In the short term, it is hoped that there would be more effective implementation of the Act allowing for greater protection and sustainable utilisation of water resources in the Guyana.

2.2.2.3 Hydrometeorological Monitoring

Currently, the Hydrometeorological Service is in operation on a minimum of its human resource requirement (forty-five (45) persons). This shortage of staff is greatly affecting the

ability of the Service to meet all of its very important obligations. It is estimated that in order for the Service to fully meet its mandate it would need to have a staff of approximately one hundred and twenty (120) persons.

Nevertheless, in the short term, the Service hopes to improve its ability to forecast weather events through the acquisition of a new Doppler Radar. The Service also plans to improve its ability in hydrological monitoring.

The Service appreciates its role as current trends of greenhouse gas emission and global warming are expected to continue, which would accelerate the hydrological cycle and lead to an increase in the amount of carbon dioxide (CO₂) in the atmosphere. This increased CO₂ in the atmosphere would result in increased rainfall intensity, which in turn would lead to shorter wet seasons, longer dry seasons, higher temperatures and higher transpiration rates. Higher transpiration rates would result in plants using more water, whilst more intense rainfall would lead to a greater loss of top soil. These two conditions would require more irrigation water to be available for agricultural crops and food production and sedimentation of waterways. Further, increased sedimentation of waterways would also affect tourism activities such as navigation through the country's rivers.

If these current trends should continue, they would impact on agriculture in the short term and the shorter wet season would affect the planting seasons. This would place the country's farmers in a very difficult situation. The Service therefore hopes to continue its current policy of producing information bulletins to assist farmers in their planning. Because the Service clearly recognises that the helpfulness of such bulletins would depend on good quality data, it realizes that it must get its systems of monitoring in a position to deal with these changes.

2.2.2.4 Domestic Water Supply and Demand

With the changes in the Water sector over the years, water is now being treated as a commodity to be traded like any other commodity on the market and is therefore influenced by market forces – demand and supply.

The Guyana Water Authority (GWI) as the sole public supplier of water currently supplies approximately 85% of the country's urban water supply (see Figure 17). As a part of its plans, the GWI is working to improve potable water supply and within the next five years, the company aims to supply potable water to ninety percent (90%) of the population of coastal Guyana. It should be noted that in the same time frame, the GWI aims to bring potable water to eighty (80) percent of Guyana's hinterland population.

The Housing and Population Census (2002) suggested that the national population has fluctuated over the past twenty-two (22) years or so. However, the Census also suggested that there has been an increase in the national population. This would certainly translate into a greater demand for this precious resource. The national development initiatives are expected to begin bearing fruit in the short term with a larger portion of the population being better off and more likely increasing in their sophistication and taste resulting in greater demands for potable water.

2.2.2.5 Agricultural Water Supply

As a part of the national drive to improve agricultural productivity, the Drainage and Irrigation Authority would aim to improve drainage and irrigation facilities nationwide. Much work is expected to be undertaken during the short term to bring irrigation water to areas of the country that were not traditionally under cultivation. It is expected that the drainage and irrigation facilities in the traditional agriculture areas would be improved to aid increased agricultural production.

2.2.2.6 National Development Efforts

A number of efforts (National Development Strategy, Poverty Reduction Strategy) have been made in the past and a number of national programmes are working towards sustainable development in Guyana (see Section 1). Efforts would continue to build upon these initiatives in the short term, and it is expected that these programmes will begin to demonstrate tangible benefits to the citizens of Guyana.

2.2.2.7 Agriculture

Agriculture continues to occupy a very interesting space in the drive for national development. This is especially true with the growing demand for areas to be conserved, and biodiversity protected. This translates into a competition for space for non-agrarian activities. Nevertheless, it is clearly recognised that the provision of food for the national population is crucial to any efforts aimed at sustainable development. It is therefore important that agriculture and the impacts of agricultural activities on the sustainable development drive, and more specifically in the management of transboundary water resources, be taken into consideration in the overall planning activity.

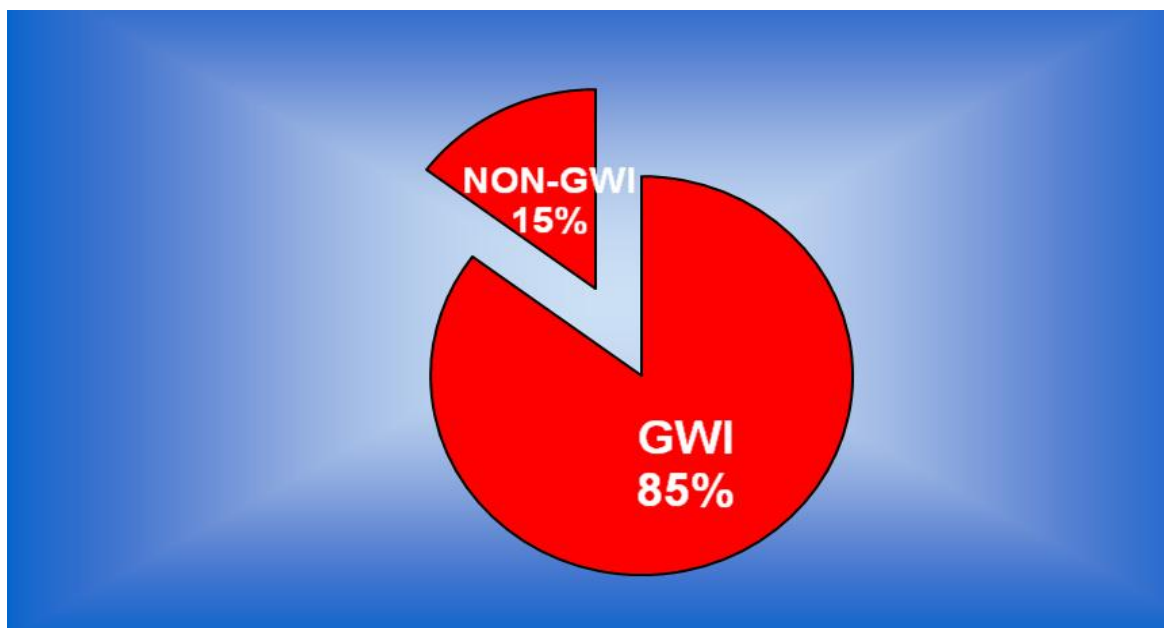
The planning activity should take into consideration that agriculture related activities would influence land degradation including: erosion and the leaching of chemicals into waterways. These impacts have been recognised and a number of initiatives have been taken to try to mitigate these impacts and are expected to bring results in the short term. These initiatives include demonstrations on: composting (where vegetation is converted to compost instead of being destroyed in traditional slash and burn agriculture), mulching, crop rotation, liming, drip irrigation, revegetation and fertilizer use.

2.2.2.8 Land Administration

Land use planning is probably the most important aspect in the planning for sustainable development. In light of global climate change and Guyana's quest for sustainable development it is indeed crucial that the country's land resources be carefully administered and utilized to bring optimum benefits to the population. Currently, the Guyana Lands & Survey's Commission (GL&SC) is responsible for the administration of land, including the granting of lands for consumptive and non-consumptive activities.

Over the past five (5) years the GL&SC has invested a considerable amount of resources towards building the capacity and system that would allow it to better serve its mission. Its achievements over this period included the completion of Land Use Policy and Land Use Plans for Regions 6 and 9 of Guyana.

Figure 17. Water Supply to the National Population by the Guyana Water Incorporated



Source: Guyana Water Incorporated, July 2006

In the short term, the GL&SC aims to develop Land Use Plans for each of Guyana's administrative regions. The GL&SC would also undertake baseline studies in support of policy development, to formulate policies on land tenure, land allocation, land markets and other land issues with a view of providing appropriate recommendations to the Government of Guyana. It would also identify and implement areas of cooperation among stakeholders with a view of ensuring sustainable land development.

It is expected, therefore, in the short term that greater attention would be placed on planning and that this would translate into sustainable utilization of natural resources at the national level.

2.2.2.9 Mining

The mining sector makes a significant contribution to the Guyanese economy, with the Gross Domestic Product (GDP) and employment creation being the main areas to benefit. Despite the positive impacts of mining to Guyana, the sector is still often chastised for its negative impacts on the environment. These negatives include water pollution from chemicals and pollution from run-off.

Recognising that the mining sector needs to take the environment into consideration, the Guyana Geology and Mines Commission (GGMC) has a number of short term plans aiming to monitor mitigation of these negative impacts: – encouraging the use of tailing ponds, safe use, handling and disposal of mercury and reclamation measures; establishing sustainability in training and capacity building; increasing research and information gathering; achieving compliance with regulations (as a prerequisite to effective compliance monitoring); developing and implementing environmental effects monitoring; introducing Cyanide use in medium scale gold mining; and introducing gold recovery techniques that are more efficient

and minimize or eliminate the use of mercury; working with communities through the employment of Community Rangers, District Mines Affairs Committees and projects to build skills in reclamation, alternative livelihoods and alternatives to carnivorous fish diets for pregnant/lactating women and children.

In addition, the GGMC would like to deepen collaborative partnerships with EPA, NARI, GFC, Hydromet, UG, Ministry of Amerindian Affairs, Ministry of Local Government, Ministry of Health and the Ministry of Agriculture.

2.2.2.10 Forestry

Currently, approximately fifty (50) percent of state forests have been allocated to logging companies. This is approximately 8.06 million hectares of the nation's forests. However, logging currently and in the short term would be strictly monitored by a number of instruments, including: the National Forest Policy, the National Forest Plan, the Forest Laws and the Code of Practice for Timber Harvesting.

The Forest Code of Practice provides guidance on how forestry resources can be extracted. The Code includes guidance on how trees are to be harvested in areas adjacent to waterways – rivers, creeks, gullies, swamps, lakes - so as to protect the integrity of these waterways. The Code also includes guidance on operational aspects of forestry, such as: road building, occupational health and safety and use of chemicals. The National Forestry Policy also encourages logging companies to attain forest certification.

In the short term, it is expected that a new Forestry Act would be passed allowing for greater environmental protection in forestry. More companies would be encouraged to attain forest certification and efforts would be made to protect the nation's water courses.

2.2.2.11 Population Growth

The Housing and Population Census (2002) strongly suggest that the national population was growing. The country's population growth is also being affected by immigration into the country's interior areas, especially mining sites, where persons from overseas enter to engage in mining activities.

2.2.2.12 Housing and Development

The current trend along the coast of Guyana is for old sugar cane cultivated areas to be converted into housing areas. This trend is expected to continue in the near term.

It is believed that the development of roads for reaching settlements, forestry and agriculture is not done in a manner that would result in minimal impacts on the environment. For instance, roads are developed and sediments from excavation works easily find their way into water courses. This could result in sedimentation in these waterways and impact on aquatic organisms and ecosystems.

2.2.2.13 Research

The focus of research at the University of Guyana is to improve the quality of environmental management decision making. Particular attention is paid to advancing the uptake of research information. It is recognised that improved linkages and interactions should be facilitated

between researchers and end-users, that is, policy and decision-makers. An understanding should be developed of how to create a favourable social environment - at national, district and regional levels - in which science can best be used. It is hoped that greater collaboration would be achieved between agencies in the short term, with research seeking to address questions raised by the other sectors. Specifically, the area of Ichthyology: Fisheries Studies, Inventory, Monitoring, Taxonomy and Secondary Succession of Aquatic Systems; Water Quality: Parameters, Development and Impacts and Monitoring and Indicators would be addressed.

2.2.2.14 Energy

The current drive in the energy sector is to aggressively reduce the dependence on fossil fuels. It is expected that in the short term greater efforts would be made with respect to the development of renewable energy sources, including hydropower, solar and wind.

Summary

In the short term, if the current trend continues, there is a good chance that many of the country's waterways could be affected by sedimentation and could face environmental degradation. There could be a loss of aquatic biodiversity and a reduction in water quality.

There is a good chance that the problems that currently exist in terms of low access to water supply and sanitation and the need for better food production practices and environmental degradation would not be resolved.

Continuing with the current trends would therefore lead to the natural and socioeconomic systems reaching their limits in the medium to long term. Increasing scarcity of renewable and accessible water resources and diminishing water quality would further narrow the resource base of healthy ecosystems. This could lead to chronic problems and a good chance that catastrophes could result which may trigger national crises.

2.2.3. Medium-term: 10-Year Scenarios

From the discussions, it appeared likely that in 10 years time Guyana would be aiming towards a resource use regime that is less resource intensive, and more focused on improving the efficiency in which natural resources are utilised. This change would be influenced primarily on the shortcomings presented by the Current Trends.

The country's population may continue to grow, and more actions would be taken towards ensuring that more of the country's water resources are dedicated for environmental and ecosystem purposes. In the forestry sector, for instance, it is likely that all activities would be made to stringently adhere to instruments such as the Forest Code of Practice. Other forest use protocol would be adhered to - ensuring that waterways in the forests are protected and vegetation in catchment areas are not destroyed. More efforts would be made to ensure that forest and non-timber forest products are carefully utilized in order to bring lasting benefits to the Guyanese people, with greater efforts for value added processing of timber products.

The demand for water would grow, making it necessary for investments in establishing more efficient systems for water delivery and potable water processing. This would, however, tend to result in improved equity, efficiency and sustainability of the water sector. It should be

noted that the current trends in the water sector do strongly suggest that this is the direction in which the water sector is likely to move.

As the water sector expands, there would be higher prices and possibly increased investment in the sector. These new developments would encourage the private sector to invest in its research and development. This renewed interest in research could result in greater involvement of research institutions such as the University of Guyana and make the role of the Hydrometeorological Service more critical in this era.

Ground water aquifers and coastal water supply would be areas that would receive increased research and interest as well. The current assessment of sea level rise and implications for Guyana's coast suggests the impacts of sea level rise are being observed along the coastline. It is also being suggested that Guyana's coastline is subsiding. The implications of this could be that the coastal aquifers will be infiltrated by saline water from the sea. These impacts may become more pronounced in the medium term, giving even more importance to the role of the Hydrometeorological Service.

These changes would more than likely demand that greater attention be placed on improved water management and water productivity. For example, the agricultural sector would be affected and there would even be a need for developing new crops and examining the option of moving cultivation from coastal to inland Guyana. This introduction of new crops into areas that are currently covered with other vegetation types would mean that there is a shift in water use. The introduction of crops would require irrigation - removing water that would have previously been used for environmental purposes to agricultural areas. The movement of cultivation from coastal to inland Guyana would also require that new water storage areas be established inland as agriculture would demand that water storage facilities be in place for proper crop support.

At the same time, the increasing population and the impact of current programmes aimed at improving the livelihood of the Guyana's population would probably result in an increased demand for water. More of the population would be requiring water for basic life functions, and the creation of new wealth could result in persons using more water for increased domestic comforts - for instance, swimming pools and Jacuzzis. Even though absolute poverty may be reduced, income inequalities may increase, and at the detriment of the environment.

The changing situation would require that the Water and Sewerage Act 2002 be put into full operation and that there is greater collaboration between the agencies' interest in water. For instance, the Hydromet Service recognises that it would need to be strengthened with specific emphasis on: modernization and institutional development, expansion of monitoring network, and the hiring of more trained staff. There would be a need for co-operation/partnership between various organizations such as academia, Government Organizations, private sector, NGO's and so on; better decisions based on more complete and accurate weather, water and climate information; partnerships to provide better data coverage and information processing; higher resolution models and more precise and useful specialized products.

In the mining sector, it is expected that more systematic exploration and mine planning would be done by Medium Scale Miners. It is likely that there would be a greater mix of Large, Medium and Small Scale Operations and a diversification in minerals exploited. Improvements in the mining sector and increased investments are likely to result in downstream value-added products such as alumina. With greater efficiency in the sector, environmental practices are likely to improve, including reclamation and compliance with regulations. At some point in the medium term, as well, it is likely that GGMC would be able to decide how many Small and Medium Scale Operations would be allowed in an area. Further, it is likely that this era would see a greater appreciation for ecosystem functioning leading to more environmentally friendly mining. The sector may subscribe to the concept of Landscape Forest Management that positively addresses mining.

2.2.4. Long-term: 20-Year Scenarios

In the long term, it is very likely that the national population would increase as the current programmes to increase agricultural and industrial production would be bearing fruit. However, increased population would also mean that there would be a greater demand on the resources of the country. The current moves to improve environmental management would also be bearing their rewards and there would be greater environmental awareness by the population.

A more educated population would be aiming to achieve more sustainable values and lifestyles. The current institutions for the management of natural resources, in particular, water, would probably become more open and focus more of their energies on including stakeholders' viewpoints in their decision making. The educated population may in fact demand that their views are fully incorporated into the decision making process.

It is likely that many of these actions would emanate at the community-level, driving action towards sustainable watershed management, rainwater harvesting and focusing on increasing mean-yield levels in irrigated and rainfed areas. Decision-making in the water sector is likely to be more transparent, involving all stakeholders as stated earlier. If this trend should prevail then it would become likely that ecological functions are recognized and maintained with human water use becoming sustainable.

It is during this era too that the current predictions on climate change and its impact would begin to take effect on Guyana. The national population is likely to be more aware of weather related issues and take appropriate action in response to warnings. The increased demand for quality data to safeguard human well-being would probably determine that numerical prediction models for both hydrology and meteorology be developed along with more hydrometeorological stations being set up across the country, with responsibility for hydrological and meteorological programmes. If the impacts of global climate change and sea level rise begin to take effect then there would be a need for research of ground water resources of the coastal artesian basin.

In keeping with the likely increased education and awareness of the national population, it is likely that the population would request more information – geological, water quality, biological, watershed – and related databases (GIS and GPS) that would lead to better management of mineral resources development. It is likely too that the mining industry

would become more diversified, and more miners would want to comply with regulations since they would then recognise the benefits.

The increased concern for the environment would require that there be more effective collaboration between Agencies and Sectors. There is likely to be greater effective participation in mining-friendly Landscape Forest Management. At this point too it is likely that capacity would be built for environmentally friendly mining and monitoring by GGMC, EPA, Miners and Communities.

These scenarios are plausible futures, not forecasts. They are differentiated by important assumptions about uncertainties in water and other resource conditions. Materially different future conditions can significantly affect the nature and outcome of various mixes of management strategies. Some management strategies may be effective and economical regardless of the future scenario. Other strategies may only be suited if specific conditions develop in the future.

Developing quantitative estimates of water demands and supplies for multiple future scenarios and management responses requires using available data and assumed relationships. For Guyana, and the wider Amazon, we need to consider the current situation and the way the various stakeholders with direct impacts on water resources would like to design their various programmes. After all of these factors are taken into consideration, we can develop future scenarios that can be used to guide the sustainable management of Guyana's water resource in the short, medium and long term.

3.0 RELEVANT TRANSBOUNDARY ISSUES AND PRIORITY THEMES

3.1 Transboundary Issues and Identification of Hot Spots of Common Interest

3.1.1. Transboundary Issues

The following were identified as being of significant relevant transboundary issues (in order of priority):

1. Global Climate Change

Global climate change has been identified as one of the most important issues that would confront the eight states of ACTO in the medium to long term. Climate change would impact the region's hydrological and freshwater resources more specifically in the long term. Guyana has identified a number of measures for dealing with the issue of climate change and these are highlighted in the National Communication to the UNFCCC. The first communication identified the various impacts that climate change would have on various aspects of the country's environment and human welfare. The second communication is currently being prepared and would seek to address any gaps that may have been present in the first communication and the UNFCCC requirements.

Climate change may determine that new crops be introduced for cultivation in Guyana. Such new crops would affect the agricultural water use (irrigation water demand) and would be a new factor to consider. The impacts of climate change, as described earlier in this paper would be very significant for the coastal state of Guyana. As was explained earlier, one of the

impacts of climate change and sea level rise would be the intrusion into freshwater and coastal aquifers of saline water. This would have definite impacts on coastal existence and would lead to changes of the lifestyle in this part of the country. At the moment, approximately 90% of the Guyanese population occupies the country's Coastal Plain region.

The impacts of climate change, providing they occur as gradual phenomena and not as one time events, would force the Guyanese authorities to consider relocating the population inland to occupy the highland regions of Guyana. This would impact directly on the forested catchment areas of the country, and would probably lead to deforestation since population movement would require new settlement development and associated services. The impact of climate change would undoubtedly be felt by all eight countries sharing the Amazon Basin. It is therefore essential that the monitoring of climate change occupy a top priority on the future activities of ACTO and its eight member countries.

2. Population Growth/Transient Population

Increase in human population would have direct impact on the Amazon region's freshwater supply. An increase in the human population of Guyana would translate to more persons in need for freshwater and greater demand for quality freshwater. This would impact directly upon the country's freshwater supply and could mean that water that is currently being used for environmental purposes would have to be taken up for the domestic/industrial water supply.

Transient population would also have an impact on the region's water supply. Sections of Guyana's hinterland population are known to be transient. The movement of people from one country to another could translate to the movement of attitudes towards water use and protection for the aquatic environment from one jurisdiction to another.

The push and pull factors that result in transient populations need to be understood and dealt with by each of the countries of the Amazon Basin. Further, some sections of Guyana's population also have different cultures and beliefs with respect to the water bodies in their communities, which would need to be understood for the future management of the country's, and as an extension, the region's water resources.

With the National Development Strategy and the Poverty Reduction Strategy working towards reducing poverty in Guyana, the end result would be a population that is better off, with more economic opportunities available to them. This new wealth would bring new desires and new levels of sophistication, which would more than likely translate to new demands on water resources and water use.

3. Health

Water borne diseases especially in the hinterland areas of Guyana could become a problem as the region faces climate change. Change in climatic conditions would create conditions that may cause predisposing vectors of water diseases to proliferate at high rates. This could lead to an increase in flood related diseases, and diseases related with general sanitation.

4. Sedimentation and Pollution

Anthropogenic activities such as agriculture, mining, forestry, housing development, and tourism could have the likely impact of land degradation. When land is degraded it is easily

eroded and could find itself into waterways. These sediments (and other pollutants) could then affect the aquatic life present in the watercourses. Guyana's forested areas are found on soils that are easily eroded once the forest cover is removed. The conversion of such land for agricultural purposes, in the absence of the most appropriate land management practices would also lead to the loss of soil resources. Activities in the mining and forestry sectors could also lead to pollution of the country's water resources and watershed management. Pollution by agro-chemicals can have additional impacts including eutrophication.

5. Deforestation

Ecosystem health and watershed management are also areas that need consideration. The removal of forests in forestry and mining activities, and failure to replant same, would in the long term have an impact on the carbon sink potential of the country's forests and rainfall catchment areas.

6. Water Resources Use

GWI in its drive to bring potable water to a broad cross-section of the Guyanese population would need investment in water sanitation, water treatment facilities and improvements in water distribution systems to meet the needs of its customers. These investments would immediately affect the nature of water use and distribution in the country, increasing the cost of water delivery, and logically such costs would need to be recovered by the company. Changes in this regard are already being observed – as not so long ago – water supply, albeit, with its limitations, were free of charge. This has changed with users in many areas of coastal Guyana being required to pay for every unit of water they use.

Hydropower generation is an area that is occupying a top priority for Guyana's renewable power generation. The development of such systems has tremendous potential in allowing for a reduction in the dependence on carbon based fuels and therefore reduces the cost of future power generation and emission of greenhouse gases. However, hydroelectric power generation would bring a new demand on the country's water resources, impacting on the water that is normally used for environmental purposes.

7. Illegal activities including: fishing, wildlife, intellectual property rights

This aspect includes the movement of people and wildlife from one jurisdiction to another. A good example of this situation is probably presented by the *Arapaima gigas*. This species of fish moves freely between the Guyanese and Brazilian borders. The species is endangered in both countries, with regulation enforcement believed to be stricter in Brazil than Guyana. As a direct consequence, Brazilian fishermen are often reported to be in Guyana's territory in search of the Arapaima.

The same situation may be applicable to other species of wildlife that may move between these countries, encouraging persons from either country to travel to capture wildlife. Similar situations may also be applicable for other member countries of ACTO.

While this free movement of people from one country to another is highly beneficial and should be encouraged, it would require careful management to ensure the physical environmental and ecosystem integrity are not compromised by such activities of a few citizens.

8. Energy

The ever increasing price for fossil fuels on the global market place would affect all the countries party to ACTO. There is therefore a need for the development of alternative sources of energy. Hydropower is a very likely source of this new energy and is certainly being pursued by some states. This source of energy also offers potential for sharing and collaboration between the countries.

9. Navigation

The rivers of the Amazon Basin serve as a significant navigation route. The movement of people and goods and services throughout the region has significant benefits as it can improve trade within the region. Free movement can, however, have negative impacts if not properly managed as this could allow for the movement of illegal materials. Indiscriminate movement of vessels within the rivers of the Basin could have the greatest impact on the region's biodiversity and integrity of water courses. Heavy traffic along the rivers could result in the banks of rivers being eroded leading to increase sedimentation and subsequent destruction of aquatic life. Noise levels from boats and traffic could also drive away birds and other species of tourism interest away from the river banks affecting the profitability of the tourism sector.

10. Investigate Transboundary Off-Site Effects

Many parts of the Amazon Basin region are interconnected although hydrology is not the means by which the region is connected. There are similarities in forest cover in some countries. This would suggest that there is a chance that the countries could be sharing the same sources for water – table, water cycle and spawning areas for aquatic species. Given that ecosystems may be connected and similar there is a good chance that activities in one part of the region would affect another part. This is of particular concern as it relates to the extraction of resources such as water and the capture of fish species. This appears to be a relatively gray area at the moment, and would therefore require some more investigation.

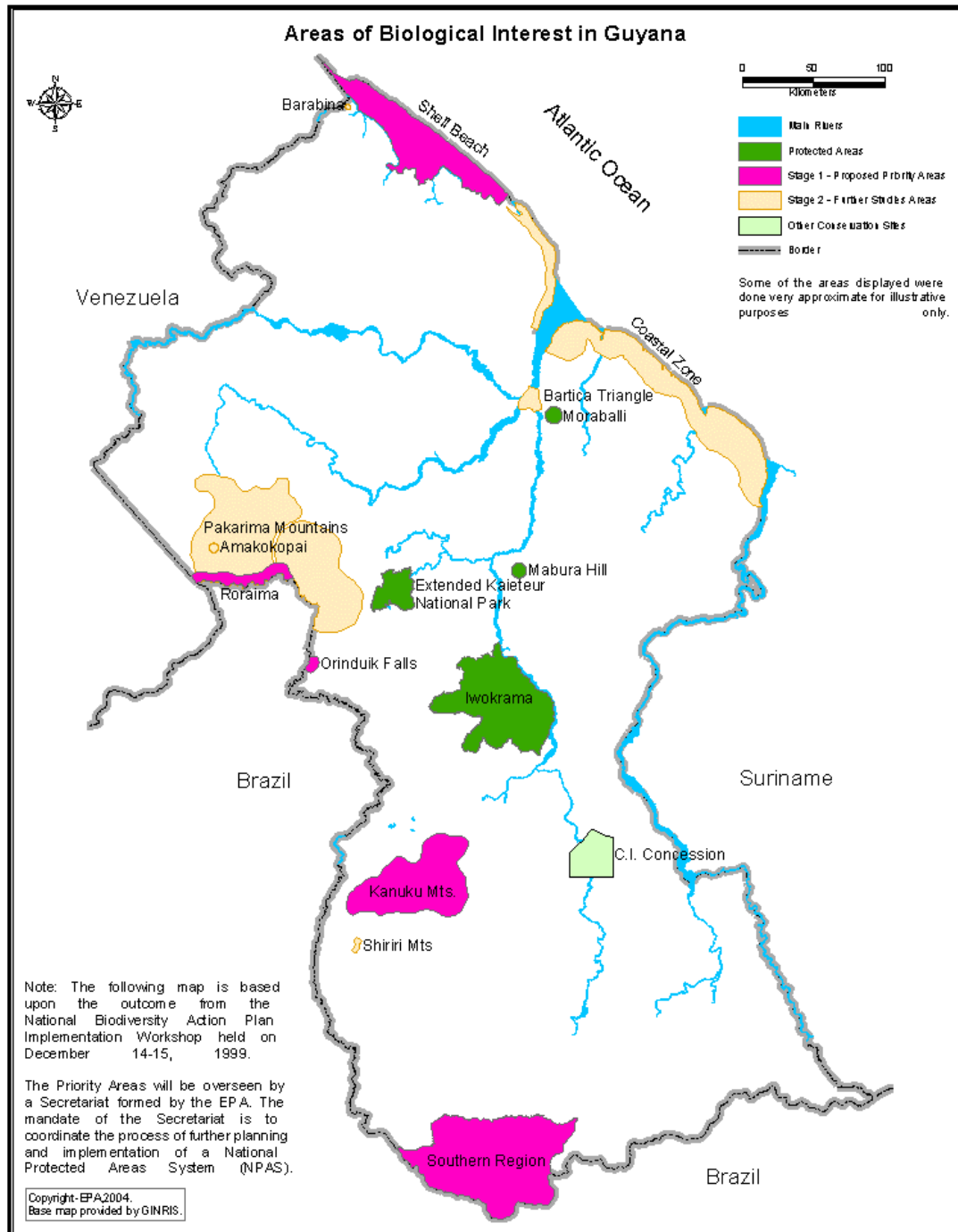
3.1.2 Hot Spots

A number of biodiversity hotspots have been identified by Guyana for future management. Most of the areas highlighted here have been earmarked by the Government of Guyana for protected area status in the future given their high biodiversity importance. The sites that have been earmarked for protected area status are shown in Figure 18, whilst descriptions are given below.

1. Kanuku Mountains

- ξ Rich in biodiversity: birds including Harpy eagles and a diverse mammal fauna.
- ξ 250 species (about 75% of all forest-based species in the country) occur within a few square kilometres of lowland evergreen forest.
- ξ About 7 or 8% of these species are endemic to lowland forests in the Guianas. In all, 350 bird species are recorded in the region, which suggests that well over 60% of the country's entire avifauna occurs in the Kanuku Mountains.
- ξ Mammal surveys indicate that 80% of the country's mammal fauna also occurs in the Kanuku region. The apparent high overall biodiversity of the region reflects the unusual diversity of habitats, which range from savannah, gallery forests, and semi-deciduous forests in the lowlands, to lowland and montane evergreen forests within an elevation range of approximately 150-900 m

Figure 18. Some of Guyana's Biodiversity Hotspots



Source: Environmental Protection Agency, August 2006.

§ Close proximity to Brazilian border

2. Mount Roraima

- § Contains many elements of the Guiana Shield flora and fauna that are found nowhere else.
- § Roraima contains several vegetation types from lowland rainforest to elfin woodlands. This area has been proposed as a World Heritage Site, and as a national park.
- § Borders with Brazil

3. Shell Beach

- § The area helps protect against drastic changes in the coastline.
- § The area is one of the most important nesting areas in the world for four species of sea turtles that are being actively studied.
- § However, the rest of the flora and fauna have not being studied and it is the only place left in Guyana with large intact mangrove, brackish water, and coastal swamp communities. Poaching of sea turtles still occurs, despite ongoing monitoring and conservation.
- § Could be a good area to observe the impacts of climate change and sea level rise

4. South-Eastern Forest

- § This is a vast area in southern Guyana on the border with Suriname and Brazil.
- § Preliminary data indicate that this forest is very different from the other forests found in Guyana.
- § Preliminary data suggest a rich and unexplored flora and fauna with many possible new records for Guyana and undescribed species.
- § The area is believed to be of low elevation with high canopy rainforest.

5. Kaieteur National Park

- § Kaieteur National Park is Guyana's oldest protected area.
- § Further details on Kaieteur are given in Section 5.

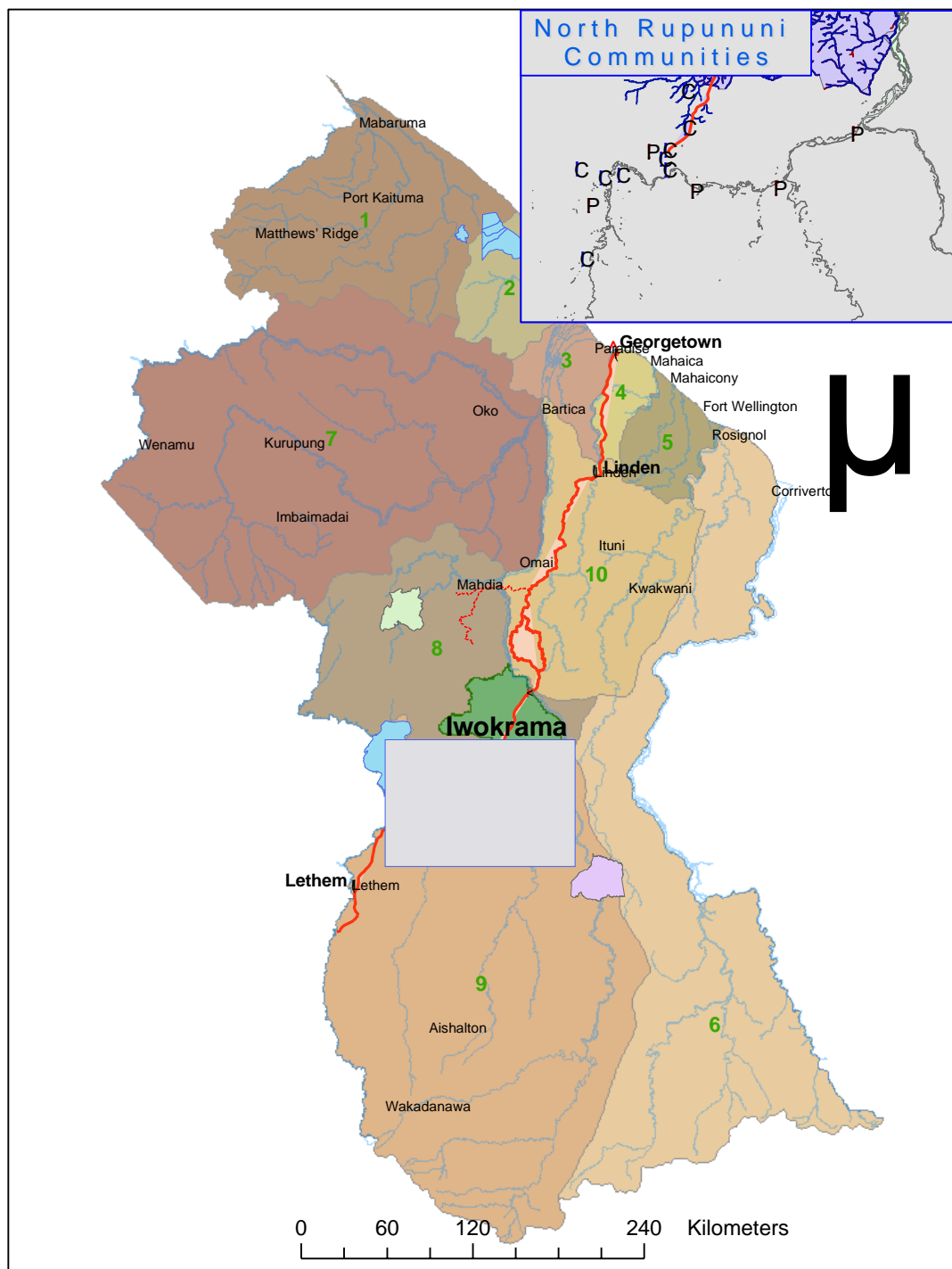
6. Rupununi Wetlands

- § The North Rupununi (See Figure 19) and Iwokrama Forest Wetlands are of global conservation significance with 88 bat species, over 400 types of fish and 500 bird species.
- § The area also supports endangered species such as Arapaima, Black Caiman, Giant Otter, Jaguar, Harpy Eagles and Giant River Turtles.
- § The area is the homeland of the Makushi Amerindians who rely on the wetlands natural resources and habitats for their survival.

7. Amerindian Communities

- § There are more that 100 titled Amerindian communities in Guyana in addition to a large number that are not legally titled.
- § Amerindian communities holding legal titles to the lands, have the authority to dictate its regime for natural resource management.

Figure 19. Rupununi Wetlands



Source: Iwokrama International Centre for Rainforest Conservation and Development, July 2006

- ξ Amerindian communities are distributed throughout Guyana (Figure 18) and are therefore critical in efforts aimed at sustainable environmental management, especially when an ecosystem approach is adopted.
- ξ Differences in resource use regimes on Amerindian lands and lands adjacent to Amerindian communities can result in a weakening in the national natural resource base, including fresh water resources.
- ξ Therefore, Amerindian communities must be fully integrated into all natural resource management plans, including those for water resource management.

3.2 Thematic Axes and Priority Themes for the Amazon

At the National Vision Workshop, the following areas were identified as being critical for collaborative efforts between the countries signatory to ACTO.

3.2.1 Hydrometeorological Monitoring and Institutional Strengthening

Monitoring of hydrological and meteorological conditions is critical to the sustainable development of Guyana and the Amazon region. The current system for monitoring needs to be strengthened so as to allow for accurate accounting for changes in the region's hydrological conditions. The need for strengthening monitoring networks is emphasised when it is considered that the Hydrometeorological Service in Guyana has reported that the minimum requirement for operating the National Hydrological Network is a network comprising of at least seventy (70) stations. At the moment, Guyana's NHN only has around seventeen (17) stations in operation. This system once operated with a much more comprehensive network of stations located throughout Guyana, and would certainly need to be restored to a position meeting the minimum requirements especially in face of global climate change observations.

A fully functional and comprehensive network would allow for comprehensive data collection and monitoring of climate variability throughout the region. The analysis of such data could lead to the sound decision-making with respect to the impacts of climate change on the country's hydrology, and could be linked with that of the wider Amazon region.

3.2.2 Domestic Water Supply and Demand

With the changes in the water sector over the years, water is now being treated as a commodity and traded like any other commodity on the market and is therefore influenced by market forces – demand and supply. Efficiency of supply is a big issue, and given that customers need to pay for these services it is mandatory that supply be efficient.

3.2.3 Agricultural Water Supply

As efforts are made to improve agricultural production at the national level, drainage and irrigation would need to be addressed nationwide. Water that was traditionally used for environmental purposes would be used for agricultural purposes because of changes in the agricultural sector.

3.2.4 Land Administration and Land Use Planning

Land use planning is probably the most important aspect in the drive towards sustainable development. In light of global climate change and Guyana's and the Amazon regional quest

for sustainable development, it is indeed crucial that the country's and region's land resources be carefully administered and utilized to bring optimum benefits to its people.

3.2.5 Mining

Despite the positive economic benefits, mining remains an area of conflict and needs careful management throughout the Amazon region. If this sector is not carefully managed, it could have detrimental impacts on the region's freshwater sources through sedimentation and contamination from chemicals used in the mining process.

3.2.6 Forestry

Similar to mining, activities in the forestry sector are a major threat to the environment especially catchment areas and biodiversity.

3.2.7 Housing and Development

The current trend along the coast of Guyana is for old sugar cane cultivated areas to be converted into housing areas. This trend is expected to continue in the near term. This may be so despite the fact that these areas may not be the most appropriate for housing

The development of roads to access settlements, forestry and agricultural areas are not necessarily done in a manner that has the minimal impact on the environment. For instance, roads are developed and sediments from excavation works would easily find their way into water courses. This direct sedimentation could result in impacts on aquatic organisms and ecosystems.

3.2.8 Population Growth

The Housing and Population Census (2002) strongly suggests that the national population is growing. The country's population growth is also being affected by immigration into the country's interior areas, especially mining sites, where persons from overseas enter to engage in mining activities.

3.2.9 Research

The focus of research at the University of Guyana is to improve the quality of environmental management decision making. Particular attention is paid to advancing the uptake of research information. It is recognised that improved linkages and interactions should be facilitated between researchers and end-users, that is, policy and decision-makers. Specifically the areas of Ichthyology: Fisheries Studies, Inventory, Monitoring, Taxonomy and Secondary Succession of Aquatic Systems; Water Quality: Parameters, Development and Impacts and Monitoring and Indicators.

3.2.10 Energy

The current drive in the energy sector is to aggressively reduce the dependence on fossil fuels. It is expected that, in the short term, greater efforts would be made with respect to the development of renewable energy sources, including hydropower, solar and wind.

3.3 Priority Areas of Intervention and Actions to Minimize the Main Problems and Optimize the Potential for Integrated Water Resource Management

In recognition of the issues and that they are transboundary in nature, it would be necessary in the near future for the countries that comprise ACTO to seek to work together in order to address these and to allow for the sustainable development of the region. Some of the possible actions that should be considered could include:

1. Maintain and establish obligations to international and regional conventions, for instance, the Convention on Biological Diversity, United Nations Framework Convention of Climate Change, and the Amazon Cooperation Treaty. Such actions would allow for greater spatial coverage of areas of concern, allowing for a better understanding of the driving forces that may be impacting on natural resources and giving rise to comprehensive measures to deal with the same, in particular, the highly threatened fresh water resource. The Amazon Basin and the adjacent areas should now, for instance, be viewed as a single unit in space and treated accordingly. Management strategies should then be appropriately scaled and geared to allow for the management of the area as one unit. Such an approach is necessary and even though it would have to take into consideration the circumstances of the individual countries, it is the only sure way to ensure that the regions resources are meaningfully managed in the face of global climate change.
2. Develop synergies between organizations. In addition to Memoranda of Understandings between agencies at the national and regional level, there is now a need for renewed efforts of cooperation between agencies with mandates in the natural resource sectors, which would allow these agencies to work closely together and share information. Such efforts should not only occur at the level of individual countries, but it should also take place at the regional level. Various protocols for the sharing of efforts and indeed mechanisms for integrating efforts at natural resource management should be urgently pursued. It should be recognised that the natural resource sector is strongly interlinked and that each of the sectors could have impacts of water resources in the region. Once the interconnectivity of the area's natural resources is recognised, then an integrated approach to management should be relatively easy to justify. The area of Hydrometeorological Monitoring could be an area for consideration for future collaboration.
3. Build capacity building at all levels to deal with the environmental issues – the lack of properly trained personnel and the supporting infrastructure to deal with environmental issues is an area that needs to be addressed urgently. This is particularly the case for Guyana, which has a very high rate of skilled personnel leaving the country. It is not clear if this is the case throughout the ACTO region, but the fact that the region's environment is reportedly threatened is probably a good suggestion that there is shortage of skills throughout. The quest for sustainable development would require significant investment; an investment in human resources should take a top priority for future efforts in the region.
4. Ensure technology transfer/adaptation. It is acknowledged that the eight countries which comprise ACTO are all developing countries. However, each of the countries is at varying levels of development at the moment and each is attempting to tackle its

environmental issues in its own way. The problems that are facing the region's states are often not unique to any one state, and it is very possible that some states would have lessons learnt and experiences in dealing with specific issues from which their neighbours can benefit. Efforts should be made to understand the problems facing the countries and attempts be made to see how any one country in the region can benefit from another.

5. Foster harmonization of efforts with respect to resources use and management across borders. There should be similar standards and codes of practices for the use of resources, both consumptive and non-consumptive, across the region. This area would be affected by the varying levels of economic development across the region – a fact that should be taken into consideration. However, this should not prevent countries from attempting to arrive at codes that would at the very minimum allow for the sustainable utilisation of natural resources. This is particularly urgent as more reports are coming forward on pressures that are being placed on the resources – especially forestry - of the Amazon Basin as states attempt to increase agricultural output.

4.0 INTEGRATED STRATEGIC VISION ON THE WATER USES AND USERS

4.1 Water Use Foreseen in the Amazonas River Basin

4.1.1 Overview

Guyana's water resource was described earlier in this paper. These resources perform various functions to many classes of users. For the householder, water is simply a turn of the tap that provides for different everyday purposes – cooking, washing and so on. For a farmer, it is a life giver - for the fields and other purposes. For the industrialist, it is a resource that is critical to the manufacturing process. The images of the uses, therefore, may differ for every Guyanese, and based on the category of user group in which they may fall, the usefulness of water would vary. In the final analysis, however, it would be fair to conclude that everyone would have some desire to see that there is a constant supply of freshwater for their everyday use since life is not possible without this precious commodity.

The ACTO Strategic Plan (2004) gives an assessment of the situation of Amazon water resources, highlighting key challenges that are facing the region's freshwater resources. What is clear from the analysis is that an integrated approach to water resource management - transcending all organizations, institutions, programmes/projects and national boundaries - is crucial in the development of any plan of action to facilitate sustainable water use.

Achieving the objective of sustainable water use would require concerted action at all levels of governance - from regional (Amazon) to local (country and local administration levels), and the involvement of all stakeholders, (regional to local stakeholders). To achieve this objective would require key actions, including: moving to full-cost pricing of water services for all human uses; increasing public funding for research and innovation in the public interest; recognizing the need for co-operation to improve international water resource management in the Amazon Basin; and increasing investments in water infrastructure, and demand-based management.

This section of the paper attempts to understand the current state of water use and the demand that is being placed on this resource and how these may possibly change in the future. Once these are understood, and all of the factors affecting the sustainable management of freshwater in each of the states of the Amazon Basin are noted, then it would be possible to develop plans for the long term management of this resource.

There are a number of areas that have been identified as the major drivers propelling the global water scenarios: demographic – this includes population growth, migration pressures and urbanization; economic – economic outputs; trade; prosperity; water works investment; technological – hi-tech expansion; water efficiency; unit water pollution; adoption of new crops; water sanitation investment; number of desalinization plants; withdrawal efficiency; social – lifestyles, poverty, inequity; governance – power structure; level of conflict; globalization; environmental – water related diseases; soil salinity; groundwater; and ecosystem health. Many of these driving forces are probably visible in Guyana and indeed the wider Amazon Basin, and therefore would need to be considered when shaping the scenarios for future management of the region's water resource. It would be important to have a preliminary assessment of the services provided by Guyana's freshwater resources in order to observe if some of these driving forces are active in this part of the Basin.

4.1.2 Services Provided By Guyana's Freshwater Resources

Guyana's water resources can be considered to be providing the following functions or occupying the following areas of water use.

4.1.2.1 Urban Users

Urban water demand includes the demand by households/residential, the commercial and industrial sectors, and the public. In order to accurately define the urban water demand of Guyana, the demand for each administrative region would need to be computed and the resulting sum would represent the entire country. There are a number of factors that must be taken into consideration when the urban water demand is being computed, including **population** (housing growth, employment growth); **housing** (mean sizes of single family and multiple family homes, changes in the population living in homes); **water use coefficients** (indications of the amount of water demanded by each demand unit). In time, water use coefficients may change in response to factors such as changes in the price of water and in consumer income, improvements in the efficiency of equipment related to water use, and active programs designed to accelerate these equipment upgrades; and **other demand losses**.

4.1.2.2 Agricultural Uses

Agricultural water use refers to the sum of water used for irrigation purposes, losses, and other uses. **Irrigation water** use depends upon the amount of land under irrigation, the amount of multicropping (planting more than one crop per year on the same land), and the water use per crop per planting. This area of water use also takes into account the changes in **agricultural land use over time** due to (1) conversion of agricultural land to urban uses, (2) new land becoming irrigated, (3) changes in the amount of multi-cropping, and (4) changes in the crops being irrigated. Every crop type would tend to have a different water demand coefficient. This aspect of water use also takes into consideration the evapotranspiration requirements of the crops referred to as **applied water**. Evapotranspiration varies by crop

and growing conditions. It may be reduced by improving irrigation methods (by decreasing non-productive evaporation) and may be increased when yields are increased.

4.1.2.3 Environmental Water Use

Environmental water use can be classified as the amount of water purposefully permitted to flow through natural river channels and wetlands that are used for environmental purposes, instead of being diverted and used for urban or agricultural purposes. In real terms, it does not necessarily reflect all environmental needs, but attempts to reflect the fact that the various aspects of the natural environment require water for proper functioning.

In order to define the scenarios for the water uses and users in the short, medium and long term scenarios, it would be necessary to define the areas of water use and likely changes for the future time frames. Quantifying these areas of water use would also become important if the region's water resources are to be sustainably managed.

Table 3. The Areas covered by Guyana Water Incorporated with Various Facilities

Well Facility	Region	Population & Household Census 2002		Customers served by GWI (number of HH)	Population served by GWI (calculation done using HH Avg.)
		HH	Population		
	1	4223	23204		
Borehole	2	11253	48,411	7,461	32,082
Water Treatment Plant	3	26057	101,920	6,392	24,929
Borehole				17,394	67,837
Water Treatment Plant	4	80445	309,059	43,356	164,753
Borehole				33,723	128,147
Borehole	5	12835	52,321	12,090	49,569
Water Treatment Plant	6	31681	122,849	9,458	36,886
Borehole				22,339	87,122
Water Treatment Plant	7	3748	15,935	1,742	7,491
	8	1781	9,211		
	9	3553	19,365		
Borehole	10	10224	39,766	3,773	14,715
Booster				566	2,207
Total		185800	742,041	158,294	615,737

Source: Guyana Water Incorporated, 2006

Table 4. The Total Amount of Water Abstracted from Various Sources - 2000 to 2004

Total Production from Dec 21, 2000 - Dec 31, 2004 (MI)				
Division	Sources			
	Surface Water	A Sands	B Sands	Total
	MI	MI	MI	MI
Division 1		15,499		15,499
Division 2	2,747	46,356		49,103
Division 3 - EBD		40,866		40,866
Division 3 -ECD		53,665	17,910	71,575
Division 3 - Linden	15,664	2,443		18,107
Division 3 - Georgetown	21,511	77,407	6,769	105,687
Division 4		31,340		31,340
Division 5		66,508		66,508
Total per Source	39,923	334,084	24,679	
Grand Total Abstracted				398,686

Source: Guyana Water Incorporated, 2006

4.2 Strong and Weak Points, Opportunities and Threats identified in the Development of the Environmental Management of the Basin

4.2.1 Strengths for Environmental Management

There are a number of areas that can be identified as strengths for the Basin environmental management. The following are specific to Guyana at this stage:

- ξ Legislation- there exists a comprehensive suite of legislation aimed at the sustainable utilisation and protection of the environment and natural resource base in Guyana. The Environmental Protection Act, 1996 is the focal point legislation for environmental protection in Guyana. Similarly, the Water and Sewerage Act 2002, provides the tools for protecting and sustainably utilising the country's water resources. There is a Town and Country Planning Act (1948) that provides the mechanism for physical development planning and land use control. The Lands and Surveys Commission Act (1999); National Parks Commission Act (1977); National Trust Act (1972); State Lands Act (1903); Amerindian Act of 2006; Local Government Act (1945); Mining Act (1991) govern and regulate access to the use of land and associated resources.
- ξ Policy – there is a number of instruments in the form of policy documents, strategies and action plans aimed at supporting legislation. These include the National Development Strategy, National Land Use Policy, the National Biodiversity Action Plan, National Environmental Action Plan, National Strategy for the Conservation of Biological Diversity; National Environmental Education Strategy; National Mangrove Management Action Plan (2001); Poverty Reduction Strategy Paper (PRSP); Draft Management Plan for Arapaima in North Rupununi; Draft National Solid Waste Policy; Shorezone Management Programme (SMP); Integrated Coastal Zone Management

Action Plan (2000); Strategic National Forest Action Plan; National Tourism Policy Document; Ministry of Housing Ten-Year Development Plan and Guyana Climate Change Action Plan (2002). These all support legislation aimed at environmental management and sustainable development.

- ξ Desire to achieve Sustainable Environmental Management – the fact that all of these legislations exist is a strong indication that there is a desire for environmental management in Guyana.

4.2.2 Weakness for Environmental Management

- ξ Inadequate Enforcement of Legislation – as shown in the section on strengths, there exists a good suite of legislations, but often the real challenge is in enforcing these legislations or as an extension, implementing legislations to the full extent.
- ξ Human Resource Constraint– the lack of people to perform functions within critical departments is a deterrent to achieving environmental management. The example of the Hydromet comes to mind with its current state of under-staffing.
- ξ Availability of Financial Resources – it is probably obvious that if the financial resources were present then it would have been more likely that key vacancies at most of these agencies would have been filled.

4.2.3 Opportunities for Environmental Management

- ξ Renewable Energy (wind) – there is great potential for the development of wind energy. Once developed, wind energy would allow for pressure to be removed from fossil fuels resulting in lower energy costs and lower greenhouse gas emissions.
- ξ Hydroelectricity Generation- Guyana has an abundance of water that could allow for the development of sustainable hydroelectric power.
- ξ Availability of Pristine Forests- there is a large supply of pristine forest that can be utilised in a number of ways, including, of course, a commodity in emissions trading agreements.
- ξ Low Population Density – the low population density of Guyana can be viewed as a disadvantage as well as an advantage. It can be viewed as an advantage in this case since greater planning can be done in many parts of the country without affecting a great number of people.
- ξ Protected Areas – there are only two protected areas in Guyana at the moment. The low population density leaves a number of areas of high biodiversity value uninhabited, which in turn, could allow for protected areas to be easily implemented.

4.2.4 Threats for Environmental Management

- ξ Low Coastal Topography – Guyana’s coast is below sea level. This is a serious threat to environmental management when it is considered that sea level is currently changing. Any breach in the coastal defence will result in coastal aquifers and ecosystems being damaged by saline water.

- ξ Demand for Water Resources - with an increase in industrial activities of agricultural production and increasing human population, the demand for water resources would be increased. Even though Guyana is called the land of many waters, a large quantity of the water available for human consumption requires treatment before it is potable.
- ξ Pollution – pollution from solid waste is a concern in Guyana. Irrigation waterways along the coast are particularly vulnerable to indiscriminate disposal of solid waste. This not only impacts upon aquatic life in these waterways, but it also hinders the flow of water, leading to flooding.
- ξ Population Concentration - 90% of population lives in areas “at risk” to flooding. In the event of a catastrophic event, a large percentage of the population would be vulnerable. In the long term, the impacts of climate change may begin to affect coastal Guyana. These impacts may determine that the coastal population be relocated inland. Such an activity would come with a very high cost.
- ξ Accessibility to Hinterland Areas (high potential capital cost) – this cost may become very important when the impacts of climate change begin to take its toll.
- ξ Climate Change may adversely affect habitats and thus, faunal assemblages and diversity.
- ξ Lack of Trained Capacity at all levels on biodiversity management.

4.3 National Vision to the Future

4.3.1 Vision Statement

“Recognising Guyana’s location and shared resources within the Amazon, the country commits itself unequivocally to pursuing a pattern of development that respects the integrity of all member states of Amazonia even as it seeks, through integrated approaches to sustainably use and conserve its natural resources in order to improve the quality of life of its peoples and that of the populations of the Amazon.”

4.3.2 Vision for the Future

The National Vision workshop has been described as a timely and important event for a number of reasons. Firstly, it is timely because Guyana must begin to recognise and capitalize on its unique setting with its intact tropical rainforest, and its abundant water and other natural resources; Guyana ranks as the World’s 5th Most Water Rich Country (Water Poverty Index, UK Centre for Ecology & Hydrology, 2003). As part of the Guiana Shield, this region contributes 10 - 15% of the world’s freshwater resources.

Secondly, it is timely because the world’s resources are increasingly being depleted, whilst it is also being rapidly transferred northwards. In the New Economics Foundation’s report “Growth Isn’t Working” (2006), it is estimated that the average person in Europe requires 4.7 ha of biocapacity³ space to maintain their lifestyle. If all of us were to live as in Europe, we need 2.1 Earths. If all of us were to live in the US, we would need nearly 5 Earths. Having an average of only 2.3 ha per capita available in the EU, the rest of the average footprint of a person from Europe therefore falls outside of Europe’s borders and often on the Amazon

³ Biocapacity is defined as areas of grassland, cropland, forests, fisheries and wetlands

Basin where the pressures of population density are not as severe as in most other tropical rainforest environments.

Thirdly, the National Vision Exercise is timely because of the ongoing work by ACTO in defining the geographical boundaries of Amazonia (initiated in 2004). The process also coincides with the initiative of the WWF to develop a strategy for natural resource management of the Guiana Shield.

Fourthly, the National Visioning process is most timely, given the very significant climate change around the world that is driven by human kind's continued and unabated emissions of greenhouse gases.

Finally, the National Visioning Exercise is important as it provides a forum by which we can collectively understand and determine how our resources should be managed and used; it allows us to learn from the experiences of each other and develop a more holistic approach to our various mandates; and perhaps most importantly, it further inserts Guyana into the Amazon Basin – a fact that cannot be discounted when one observes the 10-year cycle of excessive flooding in the Rupununi Region, in which the waters of the River Takutu mingle with the waters of the Rio Branco.

A National Vision for the Sustainable Management of the Transboundary Water Resources in the Amazon River Basin must be motivated by the appreciation of the regional and global context of Guyana, located in the Guiana Shield and as part of the Amazon Basin. The Vision must also be placed within the context of ongoing national processes, such as the national land use planning, a new national biodiversity action plan, the Amerindian land titling process and of course, the expansion of our natural resource extraction sector. All of these circumstances, except perhaps for land titling, while they lead to an increasing global (and national) value placed on our natural resources, do not necessarily translate into greater value to people who depend on these resources.

It is this understanding of where Guyana is situated nationally, regionally and globally, and in the context of the ecological and social structures that must guide land use planning. We recognise that this is the first activity of a more substantial process ahead of us.

Following on the models provided by the programmes such as Iwokrama, it is the vision of Guyana to promote the conservation and sustainable and equitable use of tropical rainforests in a manner that will lead to lasting ecological, economic benefits to the people of Guyana and the Amazon Basin through the sharing of knowledge and dissemination of technologies.

Like Iwokrama's goal of expecting to become a leading international authority on development of models for commercially sustainable, practical and community-inclusive conservation businesses based on tropical forests and their `natural assets, Guyana would thrive to become a State where all natural resource exploitation activities are kept within the principles of sustainability.

In the long term, it is hoped that models such as Iwokrama where baseline surveys for vertebrates, flora, commercial timber and non-timber forest products (NTFPs), archaeological remains and fungi have been done, would be used to guide the national

sustainable development process. Throughout a decade of survey and inventory of the environmental assets, Iwokrama has engaged fully with local communities and other stakeholders in the development of operating frameworks for future business operations, including reduced impact logging (2000), wildlife management (2001), intellectual property rights (2001) and development of sustainable and equitable business partnerships (2001, 2006). It is hoped that in the long term Guyana's development drive would be completely people-centred with the views of local people being greatly integrated into the national development process.

Further, it is hoped that decisions for resource extraction and even non-consumptive natural resource use would be based upon sound understanding of the prevailing environmental conditions and the impacts of new activities on the environment.

It is clear from the discussions during the National Vision Workshop that the current trend of resource extraction would not bring us the sustainable benefits and development we so much would like to achieve. The importance of working together, firstly, among ourselves at the national level in areas of common interest cannot be overemphasized. This point was stressed over and over again, as the various agencies recognised that in order to attain sustainable development; they need to work more closely with the objective of preserving Guyana's environmental integrity whilst achieving sustainable development.

At the regional Amazon Basin level, the purpose of sustainable development would be greatly served when the efforts of the individual countries are harmonizing and leading towards one goal, protecting the very foundation that lead to water resources being of a transboundary nature. Indeed, it is the Amazon Rainforest and its related components that must receive the attention, for without it, the meaning of the Amazon would take a completely different meaning.

So therefore, Guyana's vision is one that would seek for the development of the country and its people, but one that clearly recognises that the process, which would allow for sustainable development to be achieved, must strongly embrace the principles of sustainability. At the national level, the methods of resource extraction throughout the country must be done in a harmonious manner incorporating the positions of all stakeholders. For instance, in the Iwokrama example, efforts at management of natural resource management on Amerindian lands and national codes and programmes are aimed at sustainable natural resource utilisation (consumptive and non-consumptive). This example could be used to influence the national approach to sustainable development in Guyana, and the entire Amazon Basin.

5.0 INSTITUTIONS AND ACTORS

5.1 Overview

The management of the Guyana's environment is a matter that attracts the attention of highest level of Guyanese state management with His Excellency the President taking the responsibility for such matters. There is a Natural Resources and Environment Advisory Committee (NREAC) which comprises the heads of the relevant agencies and is chaired by the Honourable Prime Minister. Water and soil resources would therefore comprise a primary theme for deliberation by the NREAC. Given that the Amazon fresh's water

resources accounts for 20% of global freshwater, that freshwater accounts for only 2.5 percent of the planet's liquid mass (ACTO Strategic Plan, 2002) and that Guyana comprises a part of the Amazon Basin, the activities which would affect the country's freshwater and soil resources would be of interest to the NREAC.

This section identifies the key institutions and social actors whose activities impact on Guyana's part of the Amazon, and water and soil resources within the region.

Using the definition that all of Guyana is part of the Amazon Basin, it becomes necessary for the consultation process to include representation from all the institutions and social actors whose activities would have an impact on Guyana's soil and water resources on the whole. This invariably determined that a natural resource management approach be taken in developing the consultation process. As such, the main institutions and social actors who are involved in activities directly related to the country's natural resource base, consumptive or non-consumptive, are listed in this section with a brief explanation of their mandates. The roles and activities of these institutions will be used as part of the foundation for shaping the country's vision for managing its part of the Amazon Basin.

In the first instance, these institutions would be invited to share their views and vision for developing Guyana's vision for managing its part of the Amazon Basin. As a direct consequence, these institutions would have to identify and seek to address issues of a transboundary nature which would feed into developing the vision for managing the wider Amazon Basin.

These institutions are:

5.2 Governmental Agencies

5.2.1 The Hydrometeorological Service, Ministry of Agriculture

The Hydrometeorological Service (Hydromet) was established on 5 October 1965. The creation of this Division aimed to integrate existing governmental services in hydrometeorology that were then scattered throughout Divisions in several Ministries, namely:

- ξ Meteorological Section, Agricultural Division, Ministry of Agriculture
- ξ Meteorological Section, Department of Civil Aviation, Ministry of Communications
- ξ Hydrological Section, Hydraulics Division, Ministry of Works and Hydraulics
- ξ Geological Section, Pure Water Supply, Ministry of Works and Hydraulics.

Since 1992, the Hydromet has been a part of the Ministry of Agriculture. The functions of Hydromet were significantly enhanced by the Water and Sewerage Act 2000. The Act gave Hydromet the latitude to comprehensively monitor Guyana's water resources. Some of the key functions listed in the Act are:

- ξ To establish, monitor and operate national systems to monitor the availability, quality and use of surface water and ground water;
- ξ To establish, manage and operate national systems to monitor atmospheric conditions, climate change and water resources;

- ξ To establish and maintain forecasting competence including the competence in numerical models for weather, climate and water resources to satisfy policy directives and sustainable development, warnings and operational needs in: aviation, marine, agriculture, defence, waste management, mining, tourism, construction, and public recreation.

The mission of Hydromet reads:

“To observe, archive and understand Guyanese weather and climate and provide meteorological, hydrological and oceanographic services in support of Guyana's national needs and international obligations.”

This overall mission evolves from separate basic missions.

Monitoring	Observe and collect data to meet the needs of future generations of reliable, homogeneous national climatological, hydrological and oceanographic data;
Research	Research directed to the advancement of hydrological, oceanographic and meteorological sciences and the development of a comprehensive description and scientific understanding of Guyana's weather, climate and water resources;
Services	Provision of hydrological, meteorological, oceanographic and related data, information, forecasts, warnings, investigation and advisory services on a national basis and;
International	Coordination of Guyana's involvement in regional and international hydrology, meteorology, oceanography and related conventions.

The Act stipulates that Hydromet must establish national databases to manage its areas of operation.

The work of the Hydrometeorological Service is explained more in Section Five (Please see www.guyanaclimate.org for more details).

The wider Ministry of Agriculture has the mission of ensuring the formulation and implementation of policies and programmes which facilitate the development of agriculture and fisheries in Guyana, thereby contributing to the enhancement of rural life, the sustained improvement of incomes of producers and other participants in the agricultural production and marketing chain; and the maintenance of a sound physical and institutional environment for present and future productive activities.

5.2.2 National Water Council

The Water and Sewerage Act 2000 established the National Water Council (NWC). The NWC has a number of functions, all stated in the Act, and includes: implementing, establishing and amending the National Water Policy (NWP). In establishing that national water policy the NWC is to review the national water policy and recommend such amendments as may in the opinion of the Council be reasonable in order to ensure the conservation, protection, and wise use of water resources; to provide advice to Government Agencies on the incorporation of the NWP into their activities, programmes and policies; and

to provide the Minister with responsibility for Water with analyses of national and regional water use including threats to water resources and to recommend alternatives and solutions. In formulating the national policy, the NWC shall consult with Guyana Lands and Surveys Commission, Hydromet, Environmental Protection Agency, Guyana Geology and Mines Commission, Guyana Forestry Commission, the Minister with responsibility for Agriculture, any other Government Agencies whose functions would affect or be affected by the National Water Policy, Local Government Agencies including Village Councils of Amerindian villages.

5.2.3 The Environmental Protection Agency

The Environmental Protection Agency (EPA) was established under the Environmental Protection (EP) Act of 1996. The EPA's mandate is to promote, facilitate and coordinate effective environmental management and protection; and the sustainable use of Guyana's natural resources. The EPA has four main divisions namely: Administration; Education, Information & Training; Environmental Management; and Natural Resources Management. Therefore, any activities that would affect Guyana's natural environment would be of interest to the EPA. (Please see www.epaguyana.org for more information).

5.2.4 Guyana Forestry Commission

The Guyana Forestry Commission (GFC) is a semi-autonomous body set up in 1979 after the Forestry Department was dissolved. The Commission is legally mandated (under the Guyana Forestry Commission Act 1979) to manage and control the utilization of the state's forests; ensuring an optimum and sustained yield of forest produce and ensuring maintenance and improvement of the environment.

The Commission's Mission statement is *"To provide excellence in forestry management services to our stakeholders through the application of professional skills to contribute to our nation's development"*.

The policy of the Government of Guyana is that state forests should not be preserved at the expense of human development; rather forests should be utilized for the greater good of the Guyanese society. However, as the GFC mission suggests such utilization must be in keeping with accepted environmental standards and the principles of sustainability.

5.2.5 Guyana Geology and Mines Commission

The Guyana Geology and Mines Commission (GGMC) was created in 1979 (Guyana Geology and Mines Commission Act 1979) from the Department of Geological Surveys and Mines which itself was the successor to the Geological Survey of British Guiana. Currently GGMC is divided into the following divisions:

- § Geological Services
- § Mines
- § Environment
- § Petroleum

The Guyana Geology and Mines Commission's roles are:

- § To act as a development change agent in the diversification of the economic base of Guyana through its activities in the mineral sector;

- § To create the opportunities for rapid economic development that an expanding mineral sector is ideally suited to provide;
- § To act as a national repository for all information relating to geology and mineral resources which will facilitate an understanding of the resource base of the country;
- § To provide to the general public with the basic prospection information and advisory services, on the available economic mineral prospects;
- § To provide advice to the Government of Guyana on appropriate mineral policy matters so that Guyana's mineral resources can be rationally developed and utilized;
- § To regulate all activities in the mineral sector on behalf of the Government of Guyana.

The functions of the Commission are:

- § Promotion of mineral development;
 - § Provision of technical assistance and advice in mining, mineral processing, mineral utilisation and marketing of mineral resources;
 - § Mineral exploration;
 - § Research in exploration, mining, and utilisation of minerals and mineral products;
 - § Enforcement of the conditions of Mining Licences, Mining Permits, Mining Concessions, Prospecting Licenses (for Large Scale Operations), Prospecting Permits (for Medium and Small Scale operations) and Quarry Licences;
 - § Collection of Rentals, fees, charges, levies etc. payable under the Mining Act
- (Please see www.ggmc.gov.gy for more information)

5.2.6 Guyana Water Incorporated

The Guyana Water Incorporated (GWI) was created under the Water and Sewerage Act 2000 as a public company in accordance with the Companies Act 1991.

GWI's Mission is to deliver safe, adequate and affordable water and to ensure safe sewerage systems for improved public health and sustainable economic development. The vision of GWI is to ensure an efficient, sustainable and financially viable water and sewerage sector and to deliver a high quality service to customers.

A policy objective of GWI is to improve the water sector in Guyana so as to reduce poverty amongst the population. The GWI has been mandated to provide quality water to its customers throughout Guyana and is currently embarking on a 'Hinterland Strategy. This strategy aims to address the needs of the people in the Hinterland. The draft report provides a detailed analysis of the context, issues and approaches required. According to the license agreement of the document, the GWI has to ensure that safe water is supplied to 80% of all settlements in the hinterland, through sustainable and cost effective locally appropriate means, by no later than 2007. The strategy is community-based, where the community is given ownership of their water and supply resources. At the end of the project, the community should be able to manage and operate their water supply without outside help.

GWI is currently preparing its Strategic Plan.

5.2.7 Guyana Lands and Surveys Commission

The Guyana Lands and Surveys Commission (GL&SC) was established under the Guyana Lands and Surveys Commission Act 1999.

The mission of the GL&SC mission is to survey and map the land and water resources of Guyana, to be custodians of all public lands and administer these effectively in the national interest, and to provide land-based information to a broad range of public and private sector entities and interests. The GL&SC has four main areas of operation: Settlement Planning and Resource Planning, Land Information System, Land Policy and Land Use Planning. As a part of its programme the GL&SC prepares Land Use Plans for each of Guyana's administrative regions.

The key responsibilities of the GL&SC include: to advise the Government of Guyana on policy for land use; to ensure that management of State and Government lands is in accordance with legislation and Government policy; to coordinate and manage the Government's systems and procedures of the distribution of lands through an organised system of assessments, selection criteria and appeals processes; to advise Government on new areas to be mapped and the revision/reproduction of maps and plans; to issue land titles and leases for all purposes excluding forestry and mining; to assist in the development of State and Government Lands for agriculture and associated settlements through surveying and appropriately mapping land and water resources; to administer the Lands Surveyor's, River Navigation, Land Registry, State Lands and the Lands Department Acts, to coordinate with other agencies concerned with land-based resource management (Guyana Geology and Mines Commission, Guyana Forestry Commission, Central Housing and Planning Authority and Environment Protection Agency, etc.) with the objective of ensuring orderly and sustainable occupancy and use of lands; to upgrade the technologies and systems involved in surveying, mapping, land administration and the support services of the Department of Lands and Surveys.

(Please see www.agrinet.com/lands for more information).

5.2.8 Guyana Energy Agency

The Guyana Energy Agency (GEA) is the successor of the Guyana National Energy Authority (GNEA). The GEA came into operation on 1st June 1998 through the Guyana Energy Agency Act of 1997. The GEA is the agency within whose portfolio lies all energy related matters.

It is the mandate of the GEA *"To ensure the rational and efficient use of imported petroleum-based energy sources, while encouraging, where economically feasible and environmentally acceptable, increased utilization of indigenous new and renewable sources of energy."*

Guyana is a land of opportunity for hydropower investments. The Montreal Engineering Company conservatively estimated the potential as being somewhere in the vicinity of 7000 MW. Potential for the use of renewable energy sources also exists in wind, wood waste, biomass (one of Guyana's main export is sugar) and solar energy. Studies have been done up to the pre-feasibility level for all hydropower sites from 5 MW upwards.

Guyana is in the process of negotiating the establishment of an international electrical interconnection at the Guyana/Brazil border, utilizing power indirectly from Venezuela. While this will initially serve to meet the energy needs of Guyana, the physical interconnection will eventually be used to supply power to the international market. The

potential therefore for hydropower in Guyana not only spans the national market but also reaches out to the international community.

All renewable energy equipment and materials are free of taxations and duties. There is also a regime of fiscal incentives for the industrial development of Guyana including energy. The GEA is committed to the encouragement of private investment in the energy sector. The legal framework to promote foreign investment is already in place. (Please see <http://www.sdn.org.gy/gea> for more information).

5.2.9 Ministry of Foreign Affairs

The mission of the Ministry of Foreign Affairs is to promote and defend – worldwide – the interests of Guyana. Accordingly, the Ministry of Foreign Affairs is resolved to continuously pursue this objective through: the preservation of the sovereignty, territorial integrity, and independence of Guyana; the promotion of the economic and social development of Guyana; the provision of Consular Services both at home and abroad; the maintenance of friendly relations with the nations of the world; the assurance that Guyana's interests are made known and promoted in the International Community; and the promotion of the purposes and principles of the United Nations Charter.

This Governmental Agency is the formal link between the Government of Guyana and the Amazon Cooperation Treaty Organisation.

5.2.10 Ministry of Housing and Water

This Government Ministry has the overarching responsibility of implementing the Water and Sewerage Act 2000, in addition to the Acts for Housing and Settlements. The Ministry achieves its mandate through one programme area: Housing and Water. Housing and Water will provide Settlement Development, Water Resource Management and Regulation and Planning, as well as leadership and policy support to the Housing and Water sectors, through which projects and programmes will be implemented.

5.2.11 Ministry of Local Government and Regional Democratic Councils

The Ministry of Local Government and Regional Development is the institution established by the Government of Guyana with the responsibility of supporting the development of a fair, effective and participatory system of local and regional government. The Ministry promotes good governance; facilitates the development of better infrastructure; and creates an environment which fosters cooperation and collaboration between the various Government Agencies of Central Government and the different levels of Local Government. It follows therefore that the Mission of the Ministry is to:

“Supervise and maintain the legal regulatory framework of the system of local and regional administration and to encourage and facilitate the socio economic development of all the administrative regions in Guyana. For this purpose, the Ministry supports the development of local governance by building Local Government capacity, and maintaining an appropriate legislative, fiscal and regulatory framework for local governance.”

5.2.12 Ministry of Legal Affairs

The Ministry of Legal Affairs and Attorney General Chambers has the mission of ensuring an adequate system for the administration of justice, providing legal advice; providing

competent legal representation to the Government of Guyana; and drafting legislation that will give effect to the constitutional, political and social objectives of the Government of Guyana.

5.2.13 Institute of Applied Science and Technology

The Institute of Applied Science and Technology (IAST) was formed in 1977 as a Government of Guyana Industrial Research Institute, specifically targeted at the creation, acquisition and implementation of technologies related to the economic development of Guyana's natural and human resources, so that these resources can be gainfully developed and exploited for the benefit of the people of Guyana. In pursuit of its mission, the Institute's operational framework takes cognisance of national policies, plans and strategies especially the developmental thrust of the Government. This will ensure that the programmes and moreso research and development projects are clearly defined and prioritised in keeping with national development needs.

5.2.14 University of Guyana

The University of Guyana (UG) is Guyana's premier institution of learning. Established in 1963, UG plays a critical role in the development of national policy. The University has two campuses: Turkeyen, Greater Georgetown and Tain, Corentyne, East Berbice. There are six (6) faculties: Agriculture, Education and Humanities, Law, Natural Sciences, Health Sciences and Technology. The Faculty of Natural Sciences has strong interest in natural resource and environmental management.

5.2.15 Ministry of Amerindian Affairs and Village Councils

The Ministry of Amerindian Affairs gets its mandate from the Amerindian Act 2006. The mission of the Ministry of Amerindian Affairs is:

“To enhance the quality of life, promote social and economic opportunities and carry out the responsibility to protect and improve the rights and assets of the indigenous peoples of Guyana. We will accomplish this through a highly skilled and motivated staff in delivering quality social, economic and community services.”

Amerindians are the major inhabitants of Guyana's Hinterland region and naturally comes into the greatest contact with Guyana's watersheds, namely the forests and waterways. They depend heavily on the country's forest and water resources for their sustenance.

Amerindian communities are therefore an important stakeholder group in the management of Guyana's part of the Amazon. There are 105 Amerindian communities in Guyana, eighty (80) of which have been granted Titles to their lands (see Figure 21).

Village Councils

The Village Council holds legal title of land ownership for the benefit of the entire community. The Village Council is therefore - a local Government body and a body corporate under the Amerindian Act 2006, and serves as a trustee with the legal obligation of preserving and enhancing the land and resources for the benefit of the community. In its capacity as trustee, the Village Council is obligated to ensure that there is adequate

management of the land, its resources and the environment. It is only in so doing that they would be effectively carrying out their legal obligations to the community.

5.2.16 Ministry of Tourism

The Ministry of Tourism, Industry & Commerce (MinTIC) was formed in June 2001 - a redefinition of the previous Ministry with responsibilities in Trade, Tourism and Industry. There are three programmatic divisions:

- ξ The Main Office, including the Office of the Minister, the Office of the Permanent Secretary and semi-autonomous Agencies.
- ξ Administration, which provides support in terms of human resource management, performs accounting and budgeting functions in compliance with the Fiscal Management and Accountability Act, and provides general office support.
- ξ Tourism, Industry Commerce and Consumer Affairs.

The mission of the Ministry of Tourism is:

To formulate and provide an effective mechanism for the implementation, evaluation and improvement of policies, the aim of which will be to facilitate economic and social improvement through coordinating actions in areas of Commerce, Tourism, Industrial Development and Consumer Affairs.

(Please see <http://www.mintic.gov.gy> for more details)

5.2.17 National Parks Commission

The National Parks Commission (NPC) has the responsibility of managing the Kaieteur National Parks and other parks in Guyana. The Kaieteur National Park is Guyana's first national park, being declared a National Park in 1929 through the Kaieteur National Park Act 1929.

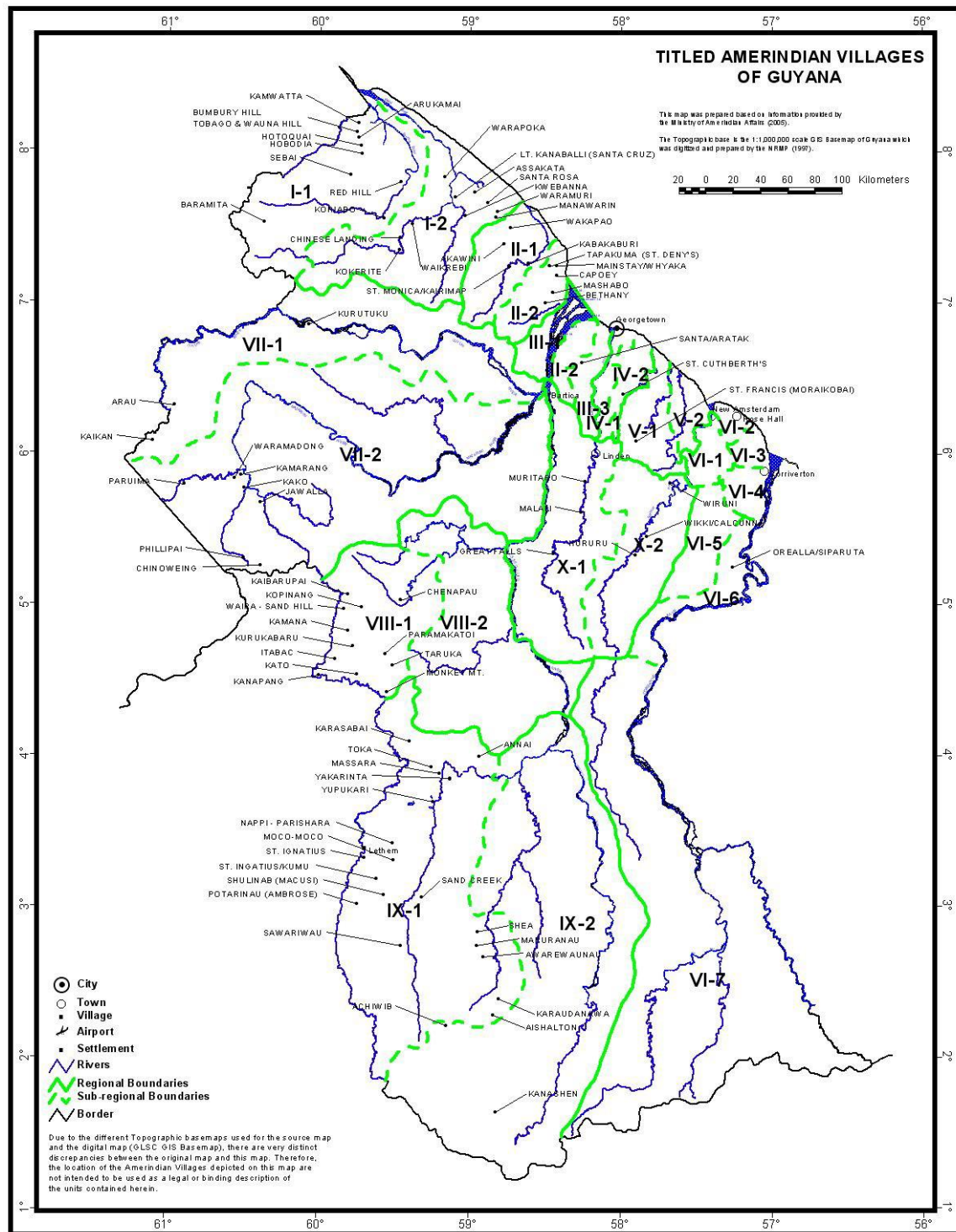
5.3 Non-Governmental Organisations

5.3.1 Iwokrama International Centre for Rainforest Conservation and Development

Iwokrama is an autonomous non-profit institution legally established by Guyana and the Commonwealth. The Centre manages nearly one million acres (371,000 hectares) of Tropical Rainforest in central Guyana. The primary objective of Iwokrama is to show how tropical forests can be conserved and sustainably used to provide ecological, social and economic benefits to local, national and international communities.

Iwokrama International Centre has its origins in an offer made by the Government of Guyana in 1989 on the occasion of the Commonwealth Heads of Government Meeting in Malaysia to give the portion of Tropical Forest to the international community. In 1993, the United Nations Development Programme (UNDP) through the Global Environmental Facility (GEF) signed an agreement to grant US\$3 million as seed funding to assist with the development of the Programme. By 1994, a functional field station was established in the Iwokrama Forest to enable research and training. On March 14, 1996 the National Assembly (Parliament) of

Figure 20. Titled Amerindian Villages in Guyana



Source: Guyana Lands and Surveys Commission, 2006

Guyana passed the Iwokrama International Centre for Rain Forest Conservation and Development Act with the unanimous approval of both sides of the house. The Act was signed into law on May 12, 1996. Iwokrama has a long standing relationship with the neighbouring Amerindian communities.

The mission statement of Iwokrama reads:

Promoting the conservation and the sustainable and equitable use of tropical rain forests in a manner that leads to lasting ecological, economic, and social benefits to the people of Guyana and to the world in general, by undertaking research, training, and the development and dissemination of technologies.

Iwokrama "learns by doing" builds partnerships with local communities and the private sector. These partnerships combine traditional knowledge, science and business to develop "green", socially responsible and sustainable forest products and services, like low-impact timber harvesting, ecotourism, training forest rangers and guides, and the harvesting of aquarium fish. Businesses provide local and national benefits, and so help maintain international biodiversity and climate. Iwokrama evaluates the social, economic and ecological changes that occur as a result of business development. The objective is to become a model for business development that results in the worldwide conservation of tropical forests. (Please see www.iwokrama.org for more information on this programme).

5.3.2 Conservation International (Guyana)

Conservation International (CI) has its Mission:

"To conserve the Earth's living natural heritage, our global biodiversity, and to demonstrate that human societies are better able to live harmoniously with nature."

CI has projects throughout the world. In Guyana, CIs goal is: *"To promote, assist and collaborate with the Government of Guyana and other stakeholders towards the establishment of a national system of protected areas."* They plan to achieve this goal through conservation via protected areas. Special emphasis is placed on the: Kanuku Mountains, Upper Essequibo Conservation Concession (UECC) and the Konashen Indigenous District protected areas. The efforts on protected areas are coupled with efforts towards promoting sustainable livelihoods as in the case of supporting the Nappi Balata Craft Group and partnering with the Government of Guyana (GOG) to assess and promote eco-tourism.

5.3.3 Guyana Marine Turtle Conservation Society

The Guyana Marine Turtle Conservation Society (GMTCS) is the lead agency in the process for developing the Shell Beach Protected Area. The GMTCS has five (5) thematic areas of work: Direct Turtle Conservation, Protected Areas, Education, Research and Community Development.

5.3.4 Forest Products Association

The Forest Products Association (FPA) of Guyana is non-Governmental Trade Organisation which was registered on February 4, 1944. The mission of the FPA is to contribute to forest

industry development and enhanced competitiveness and growth of the forestry sector in Guyana through advocacy, training, dissemination of technical, trade and other information, provision of accessible technical and business support services, by promoting sustainable practices and by networking with local, regional and international agencies.

Summary

From the wide missions and mandates of the institutions listed above, it is clear that the responsibility of managing Guyana's water and soil resources is one that must be shared by all of these institutions. It is therefore paramount that the process of shaping Guyana's vision for managing its part of the Amazon includes the visions of all of these entities. The larger National Vision could therefore be derived from the amalgamation of the individual visions.

6.0 CONCLUSIONS

Chapter 1

- ξ Guyana is the only English speaking country in South America, getting its name from the Amerindian word translated to land of many waters. The country has six major river basins: Essequibo, Courentyne, Berbice, Waini, Barima, Demerara and Amacura. In addition the Takutu River and its tributary the Ireng which form the south-western limits of the country and flows into the Rio Branco, a tributary flowing into the Rio Negro which is a confluent of the Amazon River is also an important basin.
- ξ The 2002 Population and Housing Census showed that the national population rose to 751,223 and increase of 27,500 from the 1991 census.
- ξ The Water and Sewerage Act 2002 paved the way for the development of a national water policy and the subsequent establishment of water planning mechanism.
- ξ With direct reference to water resource management in the Guyana, the NWC as described in the Water and Sewerage Act 2000, in its constitution alone, strongly suggests that there is a clear recognition in Guyana that the management of the country's resources has to be a collaborative and integrated effort by all the national institutions whose mandates impact the country's water resources. In particular, the NWC has the responsibility of developing, implementing, amending and advising the Minister of Housing and Water on the NWP.
- ξ The NWP, which is developed in consultation with key institutions - the Lands and Surveys Commission, Hydromet, the Environmental Protection Agency, the Guyana and Geology and Mines Commission, the Guyana Forestry Commission and the Minister responsible for Agriculture, any other relevant Government Agency, Local Government authority including Amerindian Village Councils – should ensure that water is equitably allocated for the social and economic benefits for the people of Guyana.
- ξ The Hydrometeorological Service, Ministry of Agriculture operates the National Meteorological Station Network (NMSN) and the National Hydrological Station Network (NHSN).

§ The day to day responsibility of monitoring and reporting on the status of the country's water resources is the responsibility of the Hydromet, Ministry of Agriculture. The EPA through its mandate also has a role to play in the protection and management of the country's water resources. However, GWI is the sole agency in Guyana with the responsibility of ensuring that the country's population receives an adequate supply of potable water. The GWI has a key role in assessing the needs of the national population and ensuring that water is supplied to all communities throughout Guyana. The GWI, by virtue of being created by the Water and Sewerage Act 2000 works under the policy supervision of the Minister of Housing and Water.

§ The wider monitoring of Guyana's water resources and weather and climatic conditions are the responsibility of the Hydromet. The Hydromet through its role on the NWC can give a national perspective and recommendations on the state of the country's water resources. The NWSN administered by the Hydromet was very comprehensive, but over the years many of the stations became unserviceable. This could be viewed as a weakness since data on water flow rates in the various waterways of the country would not have been collected from these stations. This would impact on the arriving at a better understanding of the country's hydrology.

The fact that the network did exist can be seen as a significant positive however, since a restored system for the management of the country's natural resources can be built on this foundation and the NWP can be guided accordingly with data generated from this network. Indeed, the Water and Sewerage Act 2000 expressly states that one of the roles of the Hydromet is to establish a national system for the monitoring of the country's water resources.

The national system should allow for collection of data relevant to: the quantity of water in the water resources, the seasonal or temporal variations in water resources, the use of water resources, the rehabilitation of water resources, and the atmospheric conditions which may influence water resources. The Act also allows for the Hydromet to establish collaborative efforts of monitoring water resources with other agencies, similar to those already existing with agencies such as the Guyana Sugar Cooperation, to allow for a comprehensive data collection system to be in place.

§ The impacts of changes in climate and weather patterns on the country's water resources have received limited attention and require more attention. However, the initial national communication to the UNFCCC has pointed out the impacts climate change would have on the various natural resource sectors. These recent initiatives aimed at helping the country to deal with the impacts of climate change namely: Guyana Initial National Communication: in response to its commitments to the UNFCCC and the Guyana Climate Change Action Plan are important foundations upon which future activities aimed at dealing with the impacts of global climate change would be built.

§ There has been a significant amount of work in natural resource planning and planning for the country's socio-economic development. These include the National Development Strategy and the Poverty Reduction Strategy Paper. The process for creating a National

Protected Areas System has commenced, and efforts are being made to put formal systems in place for natural resource management on Amerindian lands.

- ξ The efforts over the past few months have shown that the major stakeholders in Guyana with mandates in the natural resource and environmental management sector recognise that they must pool their efforts if Guyana is going to achieve sustainable development. Most importantly the impacts of anthropogenic activities were recognised and acknowledged.
- ξ Capacity building for the adaptation to climate change has been identified as a critical area and has received a considerable amount of attention.
- ξ Anthropogenic activities, if not closely monitored can have significant and irreversible consequences on the country's and as an extension the water resources of the Amazon Basin.
- ξ The interconnectivity of the area's hydrology needs some further attention, as the recent overflowing of Brazil's *Rio Branco* and the subsequent flooding of Guyana's Lethem suggested.

Chapter 2

- ξ The future scenarios for water management in Guyana would be built on the current situation for water, environmental, and natural resource management. At the beginning of the process the scenarios were pessimistic, realistic and optimistic in nature, however, at the conclusion of the process it seemed more feasible to craft probabilistic position based on current trends. The current trends indicated that there is some efforts make sustainable efforts a core theme of resource extraction efforts in Guyana. However, there are areas of concern, for instance legislation aimed at sustainable resource extraction (Water and Sewerage Act 2002), but such legislation are not adequately implemented. If the current trend continues, in the next five years, serious impacts on the environment, including environmental degradation could begin to occur. This would probably lead to efforts at becoming more efficient in resource extraction in the medium term. This era might also see the introduction of more research into resource extraction especially water, to ensure that water utilisation is more efficient than current trends. In the long term, the increasing population could see more emphasis on the country's natural resource base. The national population could become more aware and attempt to play a greater role in determining how their resources are utilised.
- ξ The discussions that lead to the development of the future scenarios highlighted to a great extent the activities that could be conflicting with respect to sustainable management of the country's resources, for instance forestry and mining, and that would need careful attention and planning. Clearly these activities have a role to play in the national economy, but their operations should be governed by strong codes of practice to ensure that future generations of Guyanese could benefit from their extraction as well.

Chapter 3

- ξ Given that the eight countries of the Amazon Basin have similar areas of interest, there are going to be areas that would have to be addressed by all the countries. In the final analysis, the success of the sustainable management of the region's resources would depend largely upon how well the eight states can harmonise their efforts and work towards common goals. Collaboration at the national level would have to take into consideration national priorities and realities and would depend largely upon the harmonization of efforts at the national level. However, even though the momentum for achieving sustainable development must be created at the national level, this momentum must be based on sound inputs from the widest possible cross-section of stakeholders who must be involved in the process.
- ξ The main issues that came to the fore for the consideration by all eight states of ACTO were: Global Climate Change, Population Growth/Transient Population, Health, Sedimentation and Pollution, Deforestation, Water Resource Use, Illegal Activities including fishing, wildlife, and intellectual property rights, energy navigation and investigation of transboundary off-site effects.
- ξ Kanuku Mountains, Mount Roraima, Shell Beach, South-Eastern Forest, Kaieteur National Park, Rupununi Wetlands, and Amerindian Communities were identified as hot spots.
- ξ Guyana's vision for the future would therefore be built on the current situation, which strongly suggests that the country would like to strive towards sustainability. There is tremendous potential for the country to achieve this goal, as its intact resources and ecosystems present a realistic opportunity.
- ξ The efforts over the past few months have shown that the major stakeholders in Guyana with mandates in the natural resource and environmental management sector recognise that they must pool their efforts if Guyana is going to address its sustainable development goals. Recognising at that this point in the country's history that there still remains a large quantity of intact natural resources, and that these resources can be seen as the country's natural capital, exploitation needs to be done in a sustainable manner. There have already been efforts endorsing this position, for instance, through the NDS and the PRSP, the National Biodiversity Action Plan, the Forestry Code of Practice and the Environmental Protection Act, but to name a few.
- ξ Capacity building for the adaptation to climate change has been identified as a critical area and has received a considerable amount of attention. A number of Guyanese nationals have been trained or are receiving training in Climate Change at the University of the West Indies. It is hoped that once these persons would have received their training, they would return to share their expertise in allowing the country to be able to deal with the impacts of climate change. Anthropogenic activities, if not closely monitored can have significant and irreversible consequences on the country's and as an extension, the water resources of the Amazon Basin. The interconnectivity of the area's hydrology needs some further attention, as the recent overflowing of Brazil's *Rio Branco* and the subsequent flooding of Guyana's Lethem strongly suggests.

Chapter 4

- ξ Much of Guyana's water resources are currently dedicated to environmental functions. However, the economic conditions of the country could change this situation. An increase in per capita income for the national population would mean most likely translate to more sophistication and an increased demand for fresh water for basic urban functions.

Interestingly, increased agricultural production and industrialization are likely to be the key drivers for improving economic fortunes. Increased agricultural production would require irrigation systems, thereby removing water that was previously dedicated for environmental purposes being transferred to satisfy agricultural demand. The difficulty in these changing water uses would of course be in tracking how water from one area of use is being transferred to another area.

- ξ When the strengths, weaknesses, opportunities and threats in the development of environmental management are examined, it is clear that there are some very relevant legislation and policies that once implemented, could be significant in terms of charting the course towards sustainable development. However, the challenge with these is that they are not being adequately implemented.
- ξ Similarly there are some significant threats, for instance, low coastal topography that if not properly managed could lead to significant catastrophes. Should the coastal sea defence mechanisms fail, large portions of the coast would be threatened, including biodiversity, settlements and coastal aquifers. Such an event would possibly push the coastal population inland, placing pressure on the biodiversity of the highland regions.
- ξ From the stakeholder consultations it was evident that much of the effort for the future in terms of development and natural resource utilisation would aim to build around the principles of sustainability. However, it is clearly recognised that balancing anthropogenic activities and environmental protection would be the greatest challenge.

7.0 RECOMMENDATIONS

1. The success of a regional (ACTO) programme to sustainably manage transboundary water resources would depend largely upon the strength of the individual countries making up the regional entity to successfully manage and implement programmes to manage their part of the region's resources.

In Guyana the Water and Sewerage Act 2002, sets a good foundation for Guyana to sustainably manage its water resources. However, the most challenging part of Guyana's plan is implementing the Act. The institutions that should play a critical role in shaping the National Water Policy need to be strengthened or at the least take some steps to advance their obligations as mandated by law. If these institutions are given the support and latitude they need to implement and make the legislation functional, then it would

become easier for Guyana to make its contribution towards sustainably managing the region's freshwater resources.

Institutional strengthening should include empowering the Hydrometeorological Service with financial and human resources as well as physical infrastructure to perform the role effectively.

In the interest of the region's water resources, it would also be of significant benefit if the region's water resources are treated as one body legislation and are harmonised to the best extent possible to ensure that programmes for resource protection and management are parallel to each from one state to another.

2. The existence of the Water and Sewerage Act 2002 is an important step towards the sustainable and integrated management of Guyana's water resources. At the policy level, it was clear that there is a strong understanding of the requirements of the Act. However, it was obvious that the Act was not being implemented in the way it should to bring sustainable benefits to the Guyanese people. It would seem extremely beneficial and certainly go a long way towards sustainable water management if the national population was aware of the legislation and its intended impacts on their livelihood. Some efforts should therefore be made in a public awareness programme to make the national population aware of the legislation, its intended impacts and the role they can play in making its implementation a reality.

Such an awareness programme should be led by the Hydrometeorological Service with support from the Ministry of Housing and Water and could include broadcast pieces in the electronic media, workshops and seminars throughout the ten administrative regions of Guyana. It could also include a school - based (primary, secondary, tertiary, vocational) programme to give young people and school children an opportunity to understand the legislation and the role they can play in its implementation and as an extension, the sustainable management of Guyana's Water Resources.

The awareness programme should also include details on the fact that Guyana is a part of the Amazon Cooperation Treaty Organisation and the implications of this fact on the lives of each and every Guyanese. The success and failure of future efforts aimed at protecting the region's ecosystem would depend largely upon how well the people of the region understand their wider ecosystem and how their lives would be impacted if they did not take care of it.

3. Some effort and emphasis should be placed upon trying to get a better understanding of the climate change that may be occurring in Guyana. Such research should be led by the country's research institutions with support from the Hydrometeorological Service. It was clearly recognised that sound decision making in the future must be based on the results of strategic research activities and that such research should be based on strong scientific practices, including precise and accurate data collection.

4. There is an urgent need for the harmonization of legislation for forest extraction and mining in the region and efforts should be pursued to immediately address this situation. At the earliest possible opportunity, regional policy makers should meet and compare standards, and with due consideration for their economic realities attempt to at least have their codes of practice meet an established minimum.
5. More research needs to be undertaken to determine the extent of impacts on the regions fresh water resources from anthropogenic activities such as mining and forestry.
6. The networks for hydrological and meteorological monitoring needs to be improved to allow for a comprehensive understanding of the impacts of climate variability of the regions fresh water resources. Implementing programmes for achieving a more comprehensive monitoring coverage must attempt to have as much as possible a bottom up approach with local people and communities playing a significant role in monitoring activities. Such involvement of local people would allow communities and people to own the process and better understand the impacts of activities within the region on climate variability.
7. There needs to be more studies aimed at understanding the linkages and connections between the regions hydrological system. Such an understand would allow for each country to better understand its role and responsibility for safeguarding the welfare of common resources.
8. There needs to be more studies to establish the changes in water use that may occur as a result of water being shifted from one use scenario to another. This is particularly important for water moving from environmental uses to water being used for urban purposes.
9. With respect to the issues of transboundary interest, the following are recommended:
 - a. Global Climate Change:
 - ξ Greater collaboration between the countries comprising the ACTO to ensure that there a uniform system for tracking climate change and improving the understanding the impacts of climate change at the regional, national and local levels e.g. understanding the impacts of climate change and sea level rise on coastal Guyana, Suriname, Ecuador and Venezuela;
 - ξ Once the impacts of climate change are understood, develop strategies for dealing with these impacts, for instance in Guyana once the impacts of climate change on the coast are that significant, then this country would need to consider measures for relocating coastal population to inland Guyana;
 - ξ Carry out studies to improve the understanding of the historic variability of the hydrological variables aiming at the forecast of the water availability;

- ξ Assess the impact of climate variability on the energy sector in the Amazon Region;
 - ξ Improve long-term forecast with the goal of reducing the impact of the climate variability risk: verify the long-term forecast for the agriculture and energy sectors through a regional pilot project;
 - ξ Embark on a widespread programme for improving local people and local communities understanding of climate variability and including these stakeholders in assessing climate change and its impacts.
- b. Population Growth/Transient Population:
- ξ More widespread education of national populations on their responsibilities with respect to water management, including the knowledge that the region's water resources are under threat and must be appropriately managed regardless of which country one may be in at a particular point in time;
 - ξ Develop better systems for determining supply and demand and determining the most efficient manner of meeting demand at the national then regional levels so that water supply could be appropriately scaled to meet increasing human population;
 - ξ Improved management and monitoring of the regional ecological systems to ensure that there sound understanding of water sources in the regional and the integrity of these are not compromised as population grows and the need for access to new agricultural lands for food production become necessary;
 - ξ Ensure that there are designated fresh water resource use zones throughout the Amazon region, and that these resources are managed in a sustainable manner.
- c. Health:
- ξ Develop an integrated system for understanding the impacts of climate variability on the life cycle of vectors of water borne diseases;
 - ξ Develop an integrated regional system for sharing knowledge on dealing with water borne diseases and responding to emergency situations;
 - ξ Ensure that water is treated properly to remove pathogens of water borne diseases before delivery to the final users and put in place a comprehensive system for ensuring that activities that would lead to the prevalence of water borne diseases are properly regulated.
- d. Sedimentation and Pollution:
- ξ Building the capacity of miners, foresters, farmers and other stakeholders whose activities could result in sedimentation and pollution of water ways so that they are made aware of the detrimental effects of their activities on the regional water resources in light of a resources availability challenge;
 - ξ Better application and compliance with national, international standards and codes of practice that determine the manner in which forestry and agricultural activities should be conducted to minimise impacts on the environment, with specific reference to fresh water resources;

- ξ Ensure that there is appropriate waste and pollution source management system in place. Ideally, this system should aim to tackle the problem from the pollutants' source, for instance materials such as Styrofoam and plastics should be reduced in use as these have the greatest impact on blocking and polluting water ways.
- e. Deforestation:
 - ξ Forestry activities better comply with national standards and activities of a developmental nature throughout the region made to comply with international conventions such as the United Nations Convention on Desertification;
 - ξ Design regional pilot projects for replanting areas deforested during mining, forestry and agricultural activities. Once these are successful, methodology and lessons learnt are used in the designing other such projects/programmes throughout the region.
- f. Water Resources Use:
 - ξ Invest in renewable sources of energy for generating power for running water treatment and delivery plants thereby reducing the cost of delivering safe water to customers;
 - ξ Carry out studies to determine the change in demand on water resources brought about by these new water uses. Studies should aim to determine exactly what amount of water is moved from environmental purposes to other uses so as to determine changes in water use and the responsible sector.
- g. Illegal activities including: fishing, wildlife, intellectual property rights:
 - ξ Develop regional regulatory mechanisms for wildlife trade, fishing, intellectual property rights. Once developed these regulations should be enforced with similar weight throughout the region;
 - ξ Design public awareness campaigns to educate the regional population on the state of regional wildlife populations and their responsibilities for ensuring that the status of these populations are not further compromised as a result of their activities.
- h. Energy:
 - ξ Develop regional programmes and strategies for understanding and developing renewable sources of energy such as hydro, solar, wind and geothermal as the primary source of energy in the region;
 - ξ Develop pilot projects throughout the region to demonstrate the development of renewable energy project and sharing lessons learnt throughout the region.
- i. Navigation
 - ξ Develop a regional code of practice for navigation throughout the region. The code should include territorial immigration and police organisations in the

respective states so as to have total involvement from these entities thereby improving the chances of reducing the trade in threatened and endangered species as well as protecting the integrity of regional water ways and ecosystem;

- ξ There should also be a regional code for materials that can be transported through the region's water ways. In particular the code should aim to prevent hazardous and materials that can have detrimental impacts on water ways from being transported in navigation routes.

j. Investigate transboundary off-site effects

- ξ Carry out regional studies to determine the interconnectivity of regional water bodies;
- ξ Carry out regional studies to understand the impacts of activities such as overfishing in one state on the fishery of another state;
- ξ Develop a regional strategy for dealing with interconnected water bodies throughout the region so as to safeguard the integrity of these important ecosystems.

10. There needs to be additional national and regional awareness programmes on the activities and objectives of ACTO. Such activities should aim to capture the attention of a wide cross-section of the regional population as possible so that they are aware of the activities of ACTO. Such initiatives would allow for support for the programme from the very foundations of the regional community.

8.0 DEMONSTRATION PROJECTS

This section gives three proposals for the development of demonstration projects in Guyana. The first project has been deemed as a top priority by the Hydrometeorological Service, Ministry of Agriculture and as such was developed in greater detail than the other two. Therefore the other two are only stated here as ideas, and would require further development.

1. Strengthening the capacity of Hydrological and Meteorological monitoring networks as a means of tracking climate change and sea level rise.

Justification: Guyana's National Hydrological Stations Network (NHSN) is currently performing well below its required capacity, both in terms of infrastructure and human resources. However, a review of the Service's records revealed that there once existed a comprehensive network of Hydrological Stations strategically distributed throughout the country. Over the years most of these stations have become unserviceable resulting in a lapse in data collection that could lead to possible analyses of changes in the country's hydrology and meteorology conditions. The result is that data collection is being carried out

by the Hydrometeorological Service does not allow for a comprehensive understanding of the country's hydrology and meteorology.

This is even more critical when it is considered that data collection by the Service is important for meeting its mandate, which include:

- ξ Assessment of Guyana's water quality and quantity, for example, for irrigation
- ξ Water distribution in time and space
- ξ Potential for water related development such as hydropower
- ξ Assessing the environmental and socio-economic impacts of different water related practices, for example, gold and silver mining
- ξ Assessing the impacts of other sectors on the country's water resources such as lumbering and deforestation
- ξ Flood and drought forecasting, especially since the Coastal Plain is a flood risk from both the Atlantic and the East Demerara Water Conservancy (EDWC).

These applications of hydrological data, which would include monitoring for changes in water quality as a result of sea level rise, are no doubt sufficient to justify why an equipped and highly functional hydrological network is essential for the success of Guyana's people and the country's competitiveness from a global perspective.

Further, and most importantly, the development of a comprehensive system for monitoring climate and hydrological variables at the national level would also have global significance. This is particularly so as it would allow for comparative analysis of climate variability to be observed between Guyana and its neighbours. Given that Guyana is primarily a coastal state, understanding the impacts of climate variability on the country's coastline could be used to benefit countries with similar geographic orientations as Guyana.

Objective: The objectives of this two-year effort are to strengthen the National Hydrological Stations Network (NHSN) and the Nation Meteorological Stations Network (NMSN):

- To serve to collect reliable and comprehensive data on Guyana's hydrology and meteorology
- To be able to track global climate change and sea level rise to serve as a global model, tracking lessons learnt for application in countries with similar geographic orientation as Guyana.
- To involve stakeholders in monitoring national climate thereby allowing them to better appreciate climate variability in the long term and serving as a global model demonstrating how local people and communities could be involved in monitoring a country's hydrology and climatology.

Implementation Partners: The project would be implemented with lead from the Hydrometeorological Service, Ministry of Agriculture in collaboration with National Agencies and NGO's, including Iwokrama, Conservation International and the Guyana Marine Turtle Conservation Society and communities. Funding for project implementation would be sought from GEF Amazonia's project and the Amazon Cooperation Treaty Organisation.

Areas of Focus: The project would seek to relocate the position of currently unserviceable Hydrometeorological and Meteorological Stations and assess how these can be brought back to full serviceability. An assessment of the parameters being monitored by each of these stations would be done to ensure that the system is assessing the widest and most relevant data for monitoring the country's hydrology and climatology. A monitoring network that provides comprehensive coverage of the coastal plane will allow for possible changes in sea level and its impacts to be readily observed and recorded including impacts on coastal aquifers.

Current Challenges:

Network: A recent World Meteorological Network study has shown that there are currently seventeen hydrological stations in operation, when the network should comprise a minimum of seventy stations.

Staffing: In the Surface Water Section of the Service, the staff complement can be summarised as follows:

Area of Specialisation	Post (s)	Vacancies
Specialist Hydrologist	2	2
Hydrologist	2	2
Hydrological Superintendent	1	-
Hydrological Officer	1	-
Senior Hydrological Technician	3	3
Hydrological Technician II	3	3
Hydrological Technician I	9	7
Hydrometeorological Technical Assistant	9	3
Total	30	22

Funding: The establishment of a comprehensive hydrological network would require a significant amount of funding. The estimated cost for the establishing a hydrological network that meets the minimal requirements as prescribed by the World Meteorological Organisation is given below, described in two phases: short term and long term.

ITEMS	SHORT-TERM (35 stations)	LONG TERM (25 stations)
	Cost (\$US)	Cost (\$US)
Materials	\$45,500	\$68,250
Transportation of material	\$3,500	\$5,250
Labour	\$37,450	\$56,175
Instrument	\$122,500	\$183,750
Transportation for technician	\$17,500	\$26,250
	\$226,450	\$339,675

Proposed Objectives, Activities and Outputs

Objective One: Assess Hydrological Network

“Hydrological Network assessed and gaps identified”

Activities:

1. Comprehensive assessment of the previous hydrological network to determine the location and spatial coverage of the current hydrological network.
2. Review of literature to determine the location of unserviceable hydrological stations
3. Assessment to determine whether some of the unserviceable hydrological stations could be restored to allow for comprehensive data collection from all of the country’s major water basins.
4. Identification of parameters to be monitored by each station in accordance with the WMO and in keeping with ACTO standards

Outputs:

1. Map and description of the current hydrological network, and description of the spatial coverage by the current network
2. Map showing the location of unserviceable hydrological stations and description of the stations to be restored to full serviceability and parameters to be monitored at each station

Objective Two: Install additional hydrological stations and develop data collection and analysis protocol

“Additional hydrological stations installed and data collection and analysis protocol developed”

Activities:

1. Installation of additional hydrological stations in accordance with guidance from WMO and ACTO requirements
2. Data collection and development of analysis protocol to be shared with potential partners

Outputs:

1. Installation of hydrological stations in strategic locations of Guyana
2. Data collection and development of analysis protocol to be shared with potential partners

Objective Three: Establish collaborative agreements between Hydrometeorological Service and other agencies, NGOs and local communities for hydrological data collection

“Collaborative agreements between Hydromet and other agencies, NGOs and local communities completed and protocol implemented”

Activities:

1. Completion of formal collaborative arrangements for hydrological monitoring between Hydromet and other agencies, NGOs and local communities

2. Sharing of protocol for data collection shared with partners and discussion of necessary capacity building issues

Outputs:

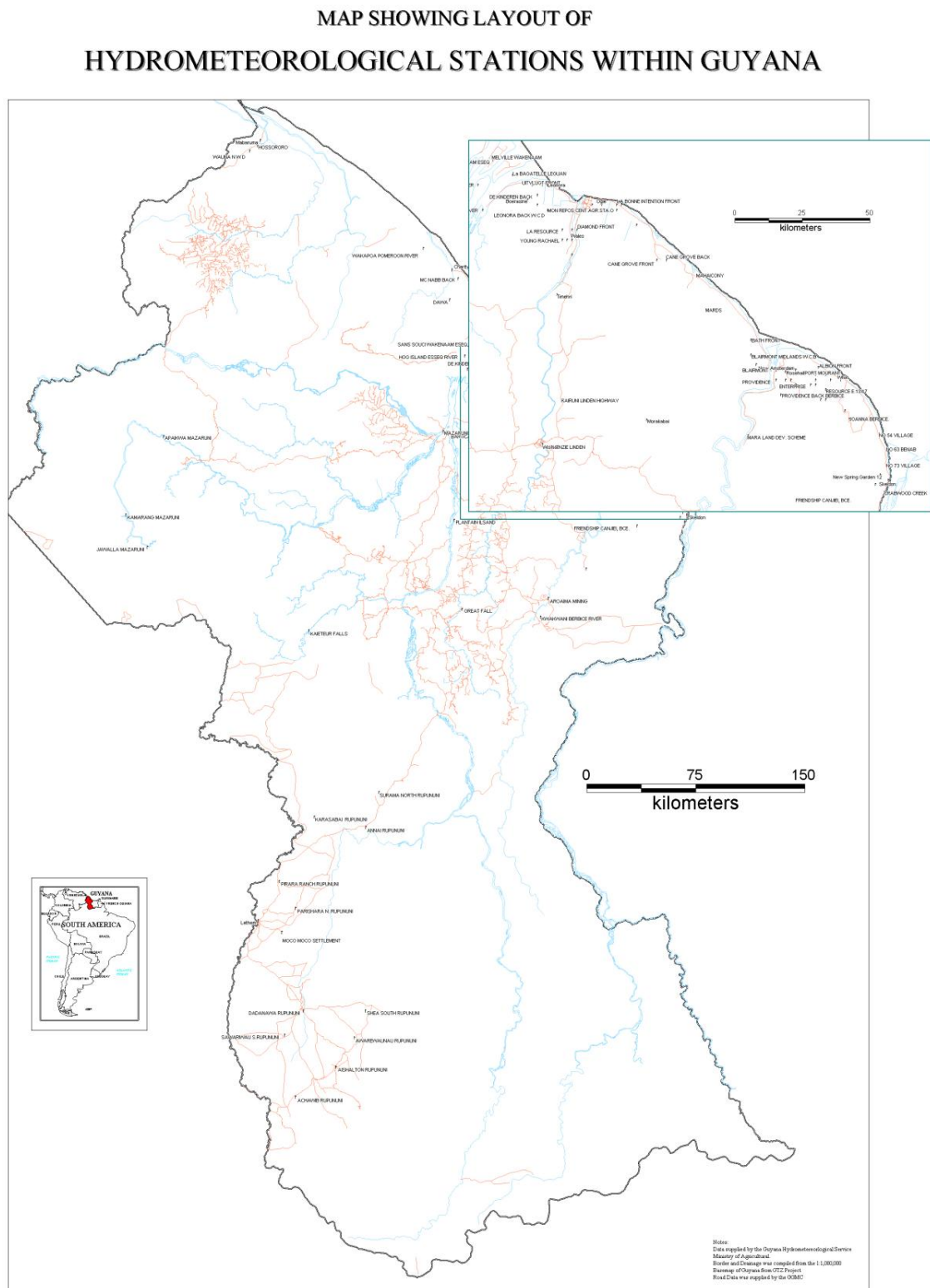
1. Completion of collaborative data collection agreements
2. Completion of relevant capacity building to allow for effective and efficient data collection with partners
3. The involvement of local people and communities in collecting, analyzing and interpreting hydrological and climatological data
4. Models of local people involvement documented and lessons learnt shared with other ACTO states and the global community

2. Coastal Forest Resuscitation and Replanting

Justification: Guyana's Coastal Plane is extremely vulnerable to the threats of global warming and sea level rise. Historically, the country's coast was protected by a zone of mangroves and coastal vegetation that served to keep out the harmful waves from the Coast thereby preventing flooding. In addition to decapitating waves arriving at the Coast, mangroves also serve the critical function of filtering runoff to the sea and serve as habitats for many forms of aquatic and terrestrial wildlife.

Over the years, this layer of mangrove has been removed mainly for fuel wood, to the extent that a great proportion of the country's coast is now devoid of this critical ecosystem. The end result is increased pressure on the man-made sea defence structure to prevent waves and sea water from reaching land. These man-made structures often fail leading to flooding and intrusion of coastal freshwater systems by saline water. In general, coastal Guyana has become more vulnerable to flooding and the intrusion of coastal aquifers by saline water is now a very realistic threat.

Figure 1: Map of Guyana showing the current Hydrometeorological Network



An effort to replant or resuscitate the mangroves on the coastal zone could serve to strengthen the coastal defence structure of the system as well as providing a habitat for various forms of biodiversity. A properly managed system can also bring sustainable benefits of costal ecotourism.

3. Develop National System for Emissions Trading: Greenhouse Gas Emissions Trading

One of Guyana's major assets is its bountiful forest cover. Close to seventy-five percent of the country is covered in forest. It is widely established that forests trap greenhouse gases, and can therefore play a critical role in emissions trading regime for instance those proposed by the Kyoto Protocol. This initiative is suggesting that a National System Emissions Trading: Greenhouse Gas Emissions Trading should be developed for Guyana. This process would allow interested local companies to purchase carbon credits from the state and private entities such as Amerindian communities to ensure that their respective companies are engaging in businesses that are environmentally and socially responsible.

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10 ANNEXES

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Annex 1: Potential Hydropower sites in Guyana

REF NO.	REGION	NAMES OF SITES	RIVERS	POWER (AV CONTINUOUS ENERGY)	COORDINATES		TOPOGRAPHIC SHEETS	COMMENTS
					LATITUDE	LONGITUDE		
1	1	HOSSORORO	KARIABO	.015 MW	80-08'-57"	590-40'-06"	1 SW, SE, NE	
2		MAURU	ARUNA	.01 MW	80-04'-30"	600-11'-50"		
3		DINDYAL	ARUKA	.005 MW	70-55'-06"	600-08'-30"		
4		ECLIPSE FALLS	BARIMA	4 MW	70-37'-06"	600-03'-24"	4 SE, SW, 5 SW, SE	
5		TOWAKAIMA	BARAMA	6 MW	70-18'-58"	590-57'-18"	9 NE, 10 NW, SW	
	2	NIL						
	3	NIL						
6	4	LOO CREEK	LOO CREEK	.01 MW	60-15'-00"	590-46'-30"		
	5	NIL						
7	6	BARRINGTON BROWN	NEW RIVER	7 MW	30-18'-04"	570-36'-37"	68 NE, SE, 69 NW, SW	
8		BARRINGTON BROWN FALLS	BARRINGTON BROWN	65 MW	360-19'-06"	570-39'-29"	68 NE, SW, NW	
9		AMARIPA	NEW RIVER	107 MW	30-07'-35"	570-36'-29"	68 SE, NE, 69 SW, 75 NW	

24	CHI-CHI KUMARAU	MAZARUNI	96 MW	50-34'-14"	600-13'-44"	33 NE, SE, SW, 34 SW	
25							
26							
	UPPER MAZARUNI DIVERSION SCHEME	MERUME	1320 MW	60-16'-42"	600-24'-17"	24 NE, NW, SE, SW	Government signed a Memorandum of Understanding with two Japanese organizations, which grants a period of exclusivity until November 15, 2006 for studies on the site.
27							
28							
29							
30	CHITIGOKENG	MAZARUNI	31 MW	60-11'-41"	600-37'-51"	23 SE, NE, 32 NE, SE	
31	SAND LANDING	MAZARUNI	650 MW	60-00'-28"	600-39'-44"	23 SE, 32 NE, SE	
32	No 1 DAM MAURU	MAURU	14 MW	50-36'-09"	610-03'-33"	31 SE, NE, 32 SW	
33	GREAT FALLS	KAMARANG	13 MW	50-41'-25"	610-07'-14"	31 SE, NE	
34	UTSHI	UTSHI	17 MW	50-46'-14"	610-10'-56"	31 NE, NW, SE	
35	PARUMA	KAMARANG	26 MW	50-47'-48"	610-02'-48"	31 NE, SW 32 NE, NW	
36	No 5 DAM EKREKU	EKREKU	1 MW	60-40'-47"	600-50'-39"	15 NW, SW, SE, 14 SE	
37	No 4 DAM EKREKU	EKREKU	20 MW	60-37'-43"	600-50'-11"	15 NW, SW, SE	
38	No 2 DAM EKREKU	EKREKU	1 MW	60-28'-40"	600-50'-07"	23 NW, 15 NW, SW, SE	
39	No 3 DAM EKREKU	EKREKU	5 MW	60-34'-10"	600-51'-09"	15 NW, SW, SE, 14 SE	
40	SAKAICA	EKREKU	17 MW	60-31'-55"	600-39'-48"	15 NW, SW, SE, 23 NW	
41	No 1 DAM EKREKU	EKREKU	6 MW	60-25'-38"	600-49'-38"	23 NW, 15 NW, SW, SE	

42		AIKWADUIK	EKREKU	5 MW	60-22'-14"	60-51'-06"	23 NW, 15 SW	
43		CHI-CHI DIVERSION TO THE POTARO RIVER	POTARO		50-19'-00"	59-53'-20"	42 NW, SW, SE	
44		AKOBENANG	POTARO	13 MW	50-04'-43"	59-40'-36"	42 NW, SW, SE	
45		IATUK	POTARO	77 MW	50-01'-59"	59-38'-20"	42 NW, SW, SE	
46		KAIETEUR	POTARO	216 MW	50-08'-49"	59-29'-08"	42 SE, 43 SW, NW	This site, which is one of Guyana's tourist attractions, is a protected area.
47		AMAILA	KURIBRONG	103 MW	50-21'-05"	59-33'-29"	42 NE, 43 NW, 35 SW	A detailed feasibility study of this site has been completed and an Interim Licence to develop the project has been granted to Synergy Holdings and Harza International jointly.
48		QUEEN DIAMOND	POTARO	29 MW	50-19'-38"	59-15'-19"	43 NE, NW, SE, SW	
49		KONAWAK	KONAWAK	.05 MW	50-18'-50"	60-56'-30"		
50		TUMATUMARI	POTARO	34 MW	50-21'-46"	59-00'-32"	43 NE, 44 NE, NW, SW	
51		ITABU	KONAWARUK	6 MW	50-14'-21"	59-01'-01"	43 NE, SE, 44 NW, SW	
52		KURUKABARU	CHIUNG	.01 MW	40-41'-45"	60-09'-50"		
53		KATO	CHIUNG	.3 MW	40-39'-00"	60-08'-18"		
54		MOCO-MOCO	MOCO-MOCO	0.1 MW	30-21'-41"	59-45'-00"	64 NE, NW, SE, SW	The government owns and operates a 0.5 MW hydroelectric power plant developed at this site. Recently that power plant was put out of service by a landslide in the vicinity.
55		KUMA	KUMA	0.1 MW	30-17'-48"	59-46'-50"	64 NE, NW, SE, SW	
56		COZIER	COZIER	0.1 MW	20-21'-09"	59-48'-04"	64 NE, NW, SE, SW	

57	9	WAMAKARU	WAMAKARU	2 MW	30-23'-53"	590-22'-33"	64 SE, 65 NE, NW, SW	
58		MAPARRI	MAPARRI	4 MW	30-19'-26"	590-17'-31"	64 SE, 65 NE, NW, SW	
59		REWA	REWA	8 MW	30-15'-30"	580-44'-00"	66 NE, NW, SE, SW	
60		KING GEORGE V	ESSEQUIBO	112 MW	30-08'-17"	580-17'-23"	67 NE, NW, SE, SW	
61		MANAROWA	ESSEQUIBO	63 MW	30-16'-50"	580-14'-21"	67 NE, NW, SE, SW	
62		KING WILLIAM IV	ESSEQUIBO	12 MW	30-18'-55"	580-15'-20"	67 NE, NW, SE, SW	
63		PATTERSON	ESSEQUIBO	10 MW	30-32'-38"	580-17'-03"	66 NE, NW, SE, SW	
64	10	TAKWARI	ESSEQUIBO	346 MW	40-58'-28"	580-51'-00"	51 NW, SW, SE, 44 SW	The Trinidadian firm ENMAN was initially granted a period of exclusivity to study this site but preliminary study shows that a vast area would have flooded including the Iwokrama Rainforest Development.
65		ANARIKA	ANARIKA	0.1 MW	60-00'-03"	580-31'-00"	27 SE, NE, 28 SW	
66		TIGER HILL	DEMERARA	15 MW	50-38'-57"	580-22'-26"	37 NE, NW, SE, SW	
67		ITABRU	BERBICE	6 MW	40-53'-51"	580-13'-56"	52 NE, NW, SE, SW	

Annex 2: List of Active Hydrometric Stations throughout the Ten Regions of Guyana

STATION NAME	DISTR	ICT	LON-Degrees	LON-Minutes	LAT-Degrees	LAT-Minutes
MABARUMA N.W.D.	Region	I	59	47	8	12
WAUNA N W D	Region	I	59	51	8	8
ANNA REGINA	Region	II	58	28	7	15
CAPOEY COMPOUND	Region	II	58	29	7	12
CHARITY POMEROON	Region	II	58	35	7	23
DAWA	Region	II	58	36	7	12
MC NABB BACK	Region	II	58	33	7	20
ONDERNEEMING ESSEQUIBO	Region	II	58	28	7	6
WAKAPOA POMEROON RIVER	Region	II	59	45	7	35
La BAGATELLE LEGUAN	Region	III	58	24	6	54
BOERASIRIE W.C.D	Region	III	58	21	6	49
DE.KINDEREN BACK W.C.D	Region	III	58	19	6	50
DE KINDEREN FRONT W.C.D	Region	III	58	20	6	52
FORT ISLAND ESSEQ RIVER	Region	III	58	30	6	47
HOG ISLAND ESSEQ RIVER	Region	III	58	31	6	52
LA RESOURCE W.B.D	Region	III	58	14	6	43
LEONORA BACK.W.C.D	Region	III	58	17	6	47
LEONORA CORNER W.C.D	Region	III	58	17	6	47
LEONORA FRONT.W.C.D	Region	III	58	17	6	52
MELVILLE WAKENAAM	Region	III	58	28	6	57
UITVLUGT BACK.W.C.D	Region	III	58	19	6	48
UITVLUGT FRONT W C D	Region	III	58	18	6	52
SANS SOUCI WAKENAAM ESEQ	Region	III	58	28	6	57
WALES FRONT W.B.D	Region	III	58	12	6	42
YOUNG RACHAEL W.B.D	Region	III	58	14	6	41
BLEYENDAAL BACK E.C.D	Region	IV	57	25	6	14
CANE GROVE BACK E C D	Region	IV	57	53	6	37
CANE GROVE FRONT E.C.D	Region	IV	57	55	6	37
DIAMOND FRONT E.B.D	Region	IV	58	11	6	43
GEORGETOWN BOT. GARDENS	Region	IV	58	8	6	48
KAIRUNI LINDEN HIGHWAY	Region	IV	58	14	6	9
La BONNE INTENTION BACK	Region	IV	58	5	6	45
LA BONNE INTENTION FRONT	Region	IV	58	3	6	48
LUSIGNAN BACK E.C.D	Region	IV	58	3	6	43
LUSIGNAN FRONT E.C.D	Region	IV	58	2	6	48
MON REPOS CENT.AGR.STA.O	Region	IV	58	3	6	47
OGLE AERODROME	Region	IV	58	6	6	48
TIMEHRI AIRPORT E.B.D	Region	IV	58	15	6	30
BATH FRONT	Region	V	57	36	6	21
BLAIRMONT #7 W.C.B	Region	V	57	35	6	16
BLAIRMONT MIDLANDS W.C.B	Region	V	57	36	6	18
BLAIRMONT FRONT	Region	V	57	32	6	15
M/CONY. ABARY RICE DEV.S	Region	V	57	45	6	27
MAHAICONY	Region	V	57	47	6	34
ST FRANCIS MISSION	Region	V	57	57	6	5
ADELPHI BERBICE	Region	VI	57	28	6	13
ALBION FRONT	Region	VI	57	22	6	15
ALBION 33,NIGG41	Region	VI	57	23	6	14
ALBION69\ NIGG92	Region	VI	57	23	6	12
ANKERVILLE.E.82	Region	VI	57	22	6	9
CRABWOOD CREEK	Region	VI	57	9	5	50
ENTERPRISE BACK BERBICE	Region	VI	57	24	6	12
ENTERPRISE FRONT BERBICE	Region	VI	57	27	6	12
JOANNA BERBICE.	Region	VI	57	16	6	4
JUBILEE3 \NIGG72	Region	VI	57	23	6	13
JUBILEE 1-9	Region	VI	57	18	6	13
LETTER KENNY BERBICE	Region	VI	57	18	6	12
LOCHABER BERBICE	Region	VI	57	29	6	13
MIBIKURI	Region	VI	57	17	6	6
MARA LAND DEV. SCHEME	Region	VI	57	36	6	1
NEW AMSTERDAM	Region	VI	57	31	6	14

STATION NAME	DISTR	ICT	LON-Degrees	LON-Minutes	LAT-Degrees	LAT-Minutes
NEW SPRING GARDEN 12	Region	VI	57	10	5	54
NIGG 58 C\TYNE	Region	VI	57	23	6	12
NO 54 VILLAGE BERBICE	Region	VI	57	10	6	1
NO 63 BENAB	Region	VI	57	9	5	58
NO 73 VILLAGE	Region	VI	57	8	5	55
PORT MOURANT FRONT	Region	VI	57	21	6	14
PROVIDENCE BACK BERBICE	Region	VI	57	30	6	10
PROVIDENCE FRONT BERBICE	Region	VI	57	31	6	13
RELIANCE BERBICE	Region	VI	57	27	6	15
RESOURCE E.13\17	Region	VI	57	21	6	11
RESOURCE .E.33\34	Region	VI	57	21	6	9
ROSE HALL FRONT	Region	VI	57	29	6	14
RESOURCE O.G.16	Region	VI	57	20	6	13
SKELDON 82/B1 BERBICE	Region	VI	57	11	5	52
SKELDON FRONT	Region	VI	57	8	5	52
WHIM \CORENTYNE	Region	VI	57	18	6	13
APAIKWA MAZARUNI	Region	VII	60	23	6	22
BARTICA DEM STATION	Region	VII	58	37	6	23
JAWALLA MAZARUNI	Region	VII	60	29	5	41
KAMARANG MAZARUNI	Region	VII	60	37	5	53
MAZARUNI PRISON	Region	VII	58	39	6	24
KAJETEUR FALLS	Region	VIII	59	29	5	10
ACHAWIB RUPUNUNI	Region	IX	59	34	2	17
ANNAI RUPUNUNI	Region	IX	57	7	5	57
AISHALTON RUPUNUNI	Region	IX	59	19	2	28
AWAREWAUNAU RUPUNUNI	Region	IX	59	12	2	39
DADANAWA RUPUNUNI	Region	IX	59	31	2	49
KARASABAI RUPUNUNI	Region	IX	59	27	4	1
LETHEM AIRSTRIP	Region	IX	59	48	3	22
MOCO MOCO SETTLEMENT	Region	IX	59	39	3	18
PARISHARA N. RUPUNUNI	Region	IX	59	34	3	27
PIRARA RANCH RUPUNUNI	Region	IX	59	40	3	37
SAWARIWAW S.RUPUNUNI	Region	IX	59	38	2	40
SHEA SOUTH RUPUNUNI	Region	IX	59	8	2	49
SURAMA NORTH RUPUNUNI	Region	IX	59	3	4	10
AROAIMA MINING	Region	X	58	0	5	22
EBINI LIVESTOCK STATION	Region	X	57	46	5	33
GREAT FALL	Region	X	58	32	5	18
KWAKWANI BERBICE RIVER	Region	X	58	3	5	15
PLANTAIN ILSAND	Region	X	58	35	5	51
WISMAR LINDEN	Region	X	58	18	6	0

Key:

	Synoptic Stations
	Climate Stations
	Rainfall stations

Annex 3 - National Vision Workshop Process and Results

A key activity in the National Vision process was a National Workshop aimed at allowing individual countries to arrive at a consensus position for the management of their part of the Amazon Basin. Guyana's National Vision workshop was convened on 6-7 July 2006 at the Foreign Service Institute, Ministry of Foreign Affairs (please see programme below). This section provides some key details on the national vision workshop including its process, structure, methodology, participation and results.

Participation

The National Workshop was opened by the Honourable Samuel A. Hinds, Prime Minister of Guyana and Chairman of the Natural Resource and Environmental Advisory Committee.

A total of nineteen (19) persons representing fifteen (15) stakeholder agencies attended the workshop. Of the key agencies directly involved in the management of country's water resources, only the National Drainage and Irrigation Authority (NDIA) was not represented, the Ministry of Housing and Water, the Hydromet Service and Guyana Water Incorporated were represented. Agencies not represented at the National Vision workshop (but who were consulted during the process) were: National Drainage and Irrigation Authority, Institute of Applied Science and Technology, Environmental Protection Agency, Guyana Energy Agency, Ministry of Local Government, Ministry of Agriculture, Ministry of Tourism, Ministry of Amerindian Affairs, Guyana Marine Turtle Conservation Society, and the Private Sector Commission).

Methodology

The workshop allowed for two modes of participation:

Presentations and Discussions

The key agencies involved in water resource management and sustainable development initiatives in Guyana presented their current work, plans and programmes for the future. These presentations were followed by discussion sessions. A facilitator was appointed for each session and guided the discussions. To encourage maximum participation, each of the facilitators represented a different agency.

Once these presentations were completed, group discussions were used to address the remainder of the workshop. Given the small size of the gathering, participants discussed issues in one group with a facilitator leading the discussion and a delegated scribe taking notes.

Results

The presentations from the key agencies coupled with the concept paper presented earlier in the project allowed for a foundation to be laid upon which future management efforts for Guyana's water resources could be based. The scenarios put forward in the Concept Paper could generally be categorized as pessimistic, realistic and optimistic views. At the end of the presentations and group discussions, it became apparent that the plans and programmes of the various agencies

present at the workshop could be shaped towards shaping scenarios that were more probabilistic and realistic in nature, than pessimistic.

The discussions also identified and prioritized transboundary issues, thematic issues (not prioritized), and strategic actions for dealing with these issues. A vision statement was also fashioned through these discussions and a vision for the future plotted.

National Vision Workshop Participants

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GEF



Guyana's National Vision Workshop Programme

Towards Defining a Vision for the Sustainable Management of Guyana's Part of the Amazon Basin

Hosted by the Hydrometeorological Services, Ministry of Agriculture with Support from the Amazon Cooperation Treaty GEF Amazonas Project

Date: 6 -7 July, 2006

Venue: Foreign Service Institute, Ministry of Foreign Affairs

Day 1: 6 July 2006 - The Current Situation

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| 08:30 | Registration of participants |
| 09:00 | Welcome – Mr. Zainool Rahaman |
| 09:15 | Remarks – Ms Joylyn Jaferally |
| 09:30 | Opening Remarks – Honourable Samuel A. Hinds, Prime Minister, Cooperative Republic of Guyana and Chairman of the Natural Resource and Environmental Advisory Committee |
| 09:50 | Workshop Objectives and Scope - Mr. Anthony Cummings |
| 10:00 | Coffee/Tea Break |
| 10:15 | Introduction of Participants |
| 10:25 | Overview of the GEF Amazonas Project, Activity 1.1 – DAT – Vision for the Management of the Amazon Basin
Presenter: Mr. Anthony Cummings |
| 10:35 | Session 1: Thematic Visions – Water and Climate
Representatives from National Agencies with mandates in areas affecting Water Management and Climate Monitoring make 10 minute presentations on their agencies programmes with specific emphasis on management for the 5, 10 and 20 year scenarios
Representatives of:
<ul style="list-style-type: none"> § Hydrometeorological Service, Ministry of Agriculture § Ministry of Housing and Water § Guyana Water Incorporated § National Drainage and Irrigation Authority Facilitator: Mr. Anthony Cummings |
| 11:15 | Discussion |
| 11:25 | Session 2: Thematic Visions – Environmental Management, Research and Energy |

Representatives from key institutions with mandates in areas affecting Environmental Management, Research and Energy make a 10 minute presentations on their agencies programmes with specific emphasis on management for the 5, 10 and 20 year scenarios
Representatives of:

- ξ Institute of Applied Science and Technology
- ξ University of Guyana
- ξ Environmental Protection Agency
- ξ Guyana Energy Agency
- ξ National Parks Commission

Facilitator: Ms Bhaleka Seulall

12:15 Discussion

12:30 Lunch

13:30 Session 3: Thematic Visions – Land and Soil Management and Administration
Representatives from key institutions with mandates in areas affecting Land and Soil Management and Administration make 10 minute presentations on their agencies programmes with specific emphasis on management for the 5, 10 and 20 year scenarios

Representatives of:

- ξ Guyana Lands and Surveys Commission
- ξ National Agricultural Research Institute
- ξ Ministry of Local Government
- ξ Guyana Geology and Mines Commission
- ξ Ministry of Agriculture

Facilitator: Ms. Joylyn Jaferally

14:20 Discussion

15:00 Tea/Coffee Break

15:10 Session 4 - Thematic Visions –Forestry, Biodiversity, and Tourism
Representatives from key institutions with mandates in areas affecting Biodiversity, Forestry and Tourism make 15 minute presentations on their agencies programmes with specific emphasis on management for the 5, 10 and 20 year scenarios

- ξ Guyana Forestry Commission
- ξ Ministry of Tourism
- ξ Iwokrama International Centre for Rainforest Conservation and Development
- ξ Ministry of Amerindian Affairs
- ξ Conservation International (Guyana)
- ξ Guyana Marine Turtle Conservation Society

Facilitator: University of Guyana Representative

16:10 Discussion

16:30 Summary of Day 1

Day 2: 7 July, 2006 - Plotting Guyana's Vision

08:30	Summary of Day 1 and Outline of Day 2 Activities Anthony Cummings
08:40	Group Work – Session 1: Consolidating Thematic Visions/Scenarios Participants placed into four (4) groups and each group construct alternative scenarios for the sustainable development of Guyana's part of the Amazon Basin considering the current situation, possible changes/evolution in key variables and where they would like to see the country going in the future. Specific emphasis is placed on change and the challenges to achieving the state of sustainable development with special attention paid to water and soil resources and the impacts and adaptation to climate variability and change for the short term scenarios (5 – years), medium term scenarios (10- years) and long term scenarios (20 – years). Facilitator: GFC Representative
10:10	Presentation of group work
10:30	Tea/Coffee Break
10:45	Group Work – Session 2: Identifying Issue of Transboundary Interest Participants returned to groups and each group identifies critical areas (hot spots) of common interest/concern for the Amazon Basin. These issues are listed and presented to the plenary. Facilitator: GGMC Representative
11:45	Group Presentation and Discussions
12:15	Lunch
13:30	Group Work – Session 3: Prioritising Transboundary Issues and Identifying Strategic Actions to address these issues
14:15	Groups Present issues by order of priority and strategic actions for addressing these to the plenary for discussion Facilitator: GWI Representative
14:30	Group Work - Session 4: Defining a vision statement for Guyana Participants placed into group and each group comes up with a vision statement for managing Guyana's part of the Amazon
15:00	Presentation of vision statements
15:30	Tea/Coffee Break
15:45	Consolidating vision statements Facilitator: Mr. Anthony Cummings
16:00	Next Steps - Anthony Cummings
16:05	Workshop Summary – Ministry of Foreign Affairs representative Closing Remarks – Honourable Samuel Hinds, Prime Minister
4:30	Adjourn