



Guyana Hydrometeorological Service
National Strategic Plan
&
Framework for Weather, Water and Climate
Service
2022-2026

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PREFACE

Guyana, a South American country is exposed to extreme weather events such as coastal floods, sea level rise and seasonal flooding resulting from heavy rains. Reliable and timely weather and climate information and forecasts can enhance safety and livelihoods of all people living in Guyana.

The National Strategic Plan (NSP) for 2022-2026 provides a course for the Guyana Hydrometeorological Service over the next five years in providing effective weather, water and climate services and to support the sustainable development of Guyana and the wellbeing of its population. The NSP includes a national governance structure, with a purpose to enable a platform to effectively address the needs and requirements in development and application of weather, water, climate, and ocean services in Guyana. The Action Plan outlines specific actions to improve weather, water and climate services with roles, responsibilities, timelines and budgets.

Together, the National Strategic Plan for 2022-2026, the Framework for Weather, water, climate, and ocean Services and the Action Plan will support realization of intended improvements in weather, water and climate services. It will thereby enable the public and weather and climate sensitive productive sectors to manage the risks and maximise on opportunities presented by climate variability and change.

ACRONYMS AND ABBREVIATIONS

AF	Adaptation Funds
AWS	Automatic Weather Stations
CDC	Civil Defence Commission
CIMH	Caribbean Institute for Meteorology and Hydrology
CMO	Caribbean Meteorological Organization
CREWS	Climate Risk and Early Warning Systems
DECC	Department of the Environment and Climate Change EEZ Exclusive Economic Zone
EU	European Union
EWS	Early Warning Systems
FWWCS	Framework for Weather, Water, and Climate Services
GCF	Green Climate Fund
GDP	Gross Domestic Product
GEF	Global Environment Facility
GFCS	Global Framework for Climate Services
GHMS	Guyana Hydrometeorological Service
GOG	Government of Guyana
GTS	Global Telecommunication System
ICT	Information and communication technology
M&E	Monitoring and Evaluation
NCOF	National Climate Outlook Forum
NMHS	National Meteorological and Hydrological Services
RCC	Regional Climate Centre
SDG	Sustainable Development Agenda and Goals
SOP	Standard Operating Procedures
SWFDP	Severe Weather Forecasting Demonstration Project
SWOT	Strength, Weaknesses, Opportunities and Threats
UNFCCC	United Nations Framework Convention on Climate Change
USAID	United States Agency for International Development
WMO	World Meteorological Organization

EXECUTIVE SUMMARY

The Government of Guyana has formulated institutional and legislative frameworks for sustainable development to meet its obligations to various bilateral and multilateral

economic and environmental agreements. Guyana's Low Carbon Development Strategy is a guiding policy that aims to transform the country's economy on to a low carbon, sustainable development trajectory, while simultaneously combating climate change. The realization of community wellbeing as well as the 2030 Agenda for Sustainable Development, the Paris Agreement on Climate Change, and the Sendai Framework for Disaster Risk Reduction is critically dependent upon actionable, accessible, and authoritative weather, water and climate services.

The National Strategic Plan for 2022-2026 charts a course for the Guyana Hydrometeorological Service over the next five years in providing effective weather, water and climate services. It is developed based on the public feedback from various severe weather events in the past and upon consultation with key stakeholders.

The strategic framework consists of goals, strategies and objectives to be achieved in the five year period. It sets out four long-term goals:

- **Strategic goal 1:** Ensure that the Guyana Hydrometeorological Service has an enabling policy and institutional environment;
- **Strategic goal 2:** Strengthen the Guyana Hydrometeorological Service's infrastructure capacity to deliver effective weather and climate services
- **Strategic goal 3:** Strengthen partnerships with stakeholders to improve service delivery, increase the use of meteorology, hydrology, marine and climate products, and ensure successful risk identification and communication
- **Strategic goal 4:** Strengthen the Guyana Hydrometeorological Service's human capacity, performance management, and operational efficiency.

The strategic goals and its objectives form the basis of the five-year Action Plan for implementation by the Guyana Hydrometeorological Service with support from the Government of Guyana, development partners and a broad range of stakeholders.

A total of **USD 4.65 million** was estimated for implementing the activities in the Action Plan (Table E1). A monitoring and evaluation plan will be used to evaluate each activity at the specified interval by the responsible organization, as the results-based reporting ensures the successful implementation of the National Strategic Plan for 2022-2026.

Table E1 – Strategic plan and budget

Strategic goals	USD
Improved institutional environment and capacity to deliver effective weather, water and climate services	\$650,000
Strengthened infrastructure capacity of GHMS to deliver effective weather, water and climate services	\$2,800,000
Strengthened partnerships with stakeholders and inter-agency coordination and communication	\$750,000
Improved human capacity of GHMS to deliver effective weather, water and climate services	\$560,000
Total	\$4,760,000

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1. INTRODUCTION

Guyana is located in the north-east of South America. It has a low-lying, narrow coastal belt, hilly tropical forest and high savannah uplands. Guyana is exposed to extreme weather events such as coastal floods, sea level rise and seasonal flooding resulting from heavy rains and backwater effect in some rivers. Approximately 90% of its population is located along the coast or along the river basins and are therefore highly vulnerable to flooding. Guyana has a humid tropical climate due to its equatorial position and has experienced significant changes in its climate since the 1960s. Climate models indicate that these changes will exacerbate over the forthcoming century.

It has been acknowledged that improvements in weather, water and climate services require global, regional and national coordination. A robust institutional and policy framework has been developed at all levels to support effective delivery and usage of these services. At the global level, the World Meteorological Organization (WMO) in collaboration with other United Nations (UN) agencies and development partners formulated the Global Framework for Climate Services (GFCS) to strengthen production, availability, delivery and application of science-based weather, water and climate services.

At the regional level, WMO has established regional offices to coordinate technical and institutional support to National Meteorological and Hydrological Services (NMHSs) and facilitate cooperation between them. The Caribbean Meteorological Organization (CMO) is a specialized agency of the Caribbean Community that coordinates the joint scientific and technical activities in weather, climate and water related sciences in 16 English-speaking Caribbean countries and provides the framework for regional and international cooperation.

At the national level, NMHSs are charged with providing weather, water and climate services to diverse audiences across the countries. The Guyana Hydrometeorological Service (GHMS) is a department within the Ministry of Agriculture. Guyana is a member of the WMO, the CMO and its associated entities.

The CMO is supporting development and endorsement of strategic plans for NMHSs, a Framework for Weather, Water, and Climate Services (FWWCS) and a complementary Action Plan for Anguilla, Antigua and Barbuda, Dominica, Grenada, Guyana, Jamaica, St. Kitts and Nevis, and St. Vincent and the Grenadines. These are policy and institutional instruments, which, when successfully implemented, will drive competitive advantage for businesses and accumulate significant benefits for the whole community.

1.1. Purpose of Strategic Plan for Meteorological Services

The Government of Guyana (GOG) has formulated institutional and legislative frameworks for sustainable development to meet its obligations to various bilateral and multilateral economic and environmental agreements, including the United Nations Framework Convention on Climate Change (UNFCCC), the United Nations

Convention of Biological Diversity and the United Nations Convention to Combat Desertification.

Guyana's Low Carbon Development Strategy developed in 2009 is a guiding policy that aims to transform the country's economy on to a low carbon, sustainable development trajectory, while simultaneously combating climate change. The LCDS is currently under review to accommodate changes and to develop strategies for the next term.

The National Climate Change Policy and Action Plan (NCCPAP) 2020–2030 is another important policy which lays out Guyana's climate action vision, high-level goals and guiding principles to combat the impact of climate change.

The realization of community wellbeing as well as the 2030 Agenda for Sustainable Development, the Paris Agreement on Climate Change, and the Sendai Framework for Disaster Risk Reduction is critically dependent upon actionable, accessible and authoritative weather, water and climate services providing information on how environmental conditions and associated hazards may affect socioeconomic activities and the environment.

The GHMS is charged with providing public weather, water and climate services to diverse audiences and all sectors across Guyana. It aspires to observe, archive and understand Guyana's weather and climate and provide meteorological, hydrological and oceanographic services in support of national needs and international obligations.

The purpose of GHMS Strategic Plan (NSP) for 2022-2026 is to chart a course for the GHMS over the next five years in providing effective weather, water and climate services and thus supporting sustainable development in Guyana and the general wellbeing of its population. The FWWCS includes a national governance structure, intended to provide a platform to effectively address the needs and requirements in development and application of weather, water, climate, and ocean services in Guyana. The complementary Action Plan outlines specific actions to be implemented to improve weather, water, climate, and ocean services with agreed clear roles, responsibilities, timelines and budgets.

Together, these policy and strategy instruments will support the realization of intended improvements in weather, water and climate services to enable the public and weather- and climate-sensitive productive sectors to better manage the risks and utilize opportunities derived from climate variability and change at all levels.



Figure 1-1: Map of Guyana (Source: OCHA Services¹)

The process for the development of a baseline study for the NSP for 2022-2026, FWWCS and Action Plan is summarized here. The history, structure and achievements of the GMHS are discussed in Section 2. Section 3 presents the results of an environmental scan, including Strength, Weaknesses, Opportunities and Threats (SWOT) analysis, PESTLE analysis, stakeholder analysis, baseline analysis, and policy and legislations. Section 4 describes the GMHS' vision, mission and core values. Section 5 presents the summarized strategic framework and Section 6 outlines the monitoring and evaluation framework.

¹ Source: https://reliefweb.int/sites/reliefweb.int/files/resources/guy_refmap_adm1_aq.pdf

2. BACKGROUND

The Government of Guyana developed the Low Carbon Development Strategy (LCDS) to transform the country's economy on to a low carbon, sustainable development trajectory, while simultaneously combating climate change. LCDS examine the ways to deploy the Guyana's forest in mitigating climate change while gaining financial support, to move along a low carbon strategy, and to protect the country from the effects of Climate Change.

The National Climate Change Policy and Action Plan (2020-2030) has important components ensuring the impact of climate change is factored into national development planning. Structurally, it consists of 19 policy objectives addressing adaptation, mitigation, resilience building and risk reduction. These objectives are clustered into nine policy directives, out of which six directives are significant for the GHMS:

- Establish climate resilient infrastructure and physical development;
- Sectoral climate change mainstreaming for a healthy, educated society;
- Build a diversified, climate-ready, low carbon Guyanese economy;
- Drive climate change decision making that is based on leading-edge scientific evidence;
- Develop and access finances and resources to achieve national climate change goals;
- Encourage and promote cooperation on climate action between the public and private sectors.

Supported by WMO and NMHSs, the CMO drafted a Strategic Plan for the period 2020-2023 for strengthening capacity, adding value, and building resilience in the meteorological and hydrometeorological services of member states. This CMO strategy is designed to assist GMHS in delivering its mandate, and at the same time enabling the GOG, and development partners to help GMHS improve its capacities and services. This Strategic Plan is focused on addressing the most pressing developments and needs during 2020-2023, as part of fulfilling the long-term UN Sustainable Development Goals out to 2030. The Plan, which articulates expected outcomes and clear benefits to members, will be focused on these overarching priorities, which are aligned with the WMO Strategic priorities for 2020-2023:

- Enhancing disaster preparedness and reducing loss of life and property from extreme hydrometeorological events and severe weather.
- Supporting climate smart decision making to build resilience and adaptation to climate risk.
- Supporting the strengthening and maintenance of observation networks and information services as critical components of disaster risk reduction and sustainable development frameworks.
- Enhancing the socioeconomic and national security value of weather, climate, hydrological, and related environmental services.

The country-specific strategic plan for weather, water and climate services and action plan will guide GMHS in delivering on its mandate, and at the same time enabling the GOG and development partners to help GMHS improve its capacities and services.

2.1. Organization History

The GMHS was created under the Ministry of Public Works and Hydraulics and is now established within the Ministry of Agriculture, under the Water and Sewerage Act 2002. The collection of rainfall data began as early as the 19th Century, but this was done under the auspices of the various ministries and sugar estates. The Hydrometeorological Service was established on 05 October 1965, based on the recommendation of the WMO's representative. Having been established under the Ministry of Public Works and Hydraulics, the Service changed hands to the Ministry of Agriculture in 1992.

The Department's general responsibility is to monitor and evaluate the weather and water resources in Guyana and to actively support the government in disaster risk management and aeronautical, water, agriculture, engineering and other activities for the socioeconomic development of the country. It is the official provider of weather, water and climate information and related products and services in Guyana.

The mission of GHMS is to observe, archive and understand Guyana's weather and climate and provide meteorological, hydrological and oceanographic services in support of national needs and international obligations. This mission evolves from separate basic activities:

- Monitoring - Observation and data collection to meet the needs of future generations for 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, as well as international bases; and
- International - Coordination of Guyana's involvement in regional and international hydrology, meteorology, oceanography and related conventions.

The purpose of GHMS is to contribute to Guyana's social, economic, cultural and environmental goals through the performance of the functions of a NMHS in the public interest generally and in particular, for the purposes of assisting persons and authorities engaged in primary production, industry, trade and commerce; for the purposes of navigation and shipping and of civil aviation; and for the purposes of the Guyana Defence Force.

The functions of the Department are:

- To monitor the atmospheric and water resources in Guyana and its exclusive economic zone (EEZ);
- To collect, process, archive and make available data and information on weather, climate, hydrology and oceanography;
- To coordinate hydrometeorological activities of the GOG;
- To establish and maintain networks of climatic, synoptic and water monitoring stations in Guyana and its EEZ;
- To routinely provide the governmental and nongovernmental agencies with information on composition of the atmosphere, quantity and quality of surface and ground water and sea surface temperature, waves, swells, ocean currents and other parameters;

- To work along with other agencies in promoting environmentally sound economic and social activities;
- To conduct research and systematic monitoring of activities in furtherance of Guyana's commitments under international related conventions;
- To promote public awareness of the atmospheric and water resources of Guyana and their importance to the socioeconomic development of Guyanese;
- To advise the Minister on matters of general policy relating to the hydrological, meteorological and oceanographic aspects of the atmosphere and water resources in Guyana and its EEZ; and
- To perform such other functions pertaining to the monitoring of the atmospheric and water resources of Guyana and its EEZ as may be assigned by the Minister or under any enactment.

GHMS provides useful outputs to varied users, top of the list being agriculture, education and aviation sectors. It contributes to the World Weather Watch and World Climate Programs. Services such as climate and weather forecasts, water resources monitoring, high tide alerts, and daily weather forecasts are disseminated via radio, television, newspapers, internet, bulletins and facsimile. GHMS has links with two regional institutions: CMO Headquarter's Unit and the Caribbean Institute for Meteorology and Hydrology (CIMH), both arms of the CMO. On the international level, GMHS is connected with the WMO. It also relates to the International Civil Aviation Organization on matters relating to operational meteorology for aviation. Local weather and monthly climatology were exchanged for international consumption and aviation on the Global Telecommunication System (GTS) and the Aeronautical Fixed Telecommunications Network coordinated by WMO and the International Civil Aviation Organization. In addition, the Hydromet Service is the focal point for Vienna Convention and the Montreal Protocol through its National Ozone Action Unit.

2.2. Organization Structure

The GHMS has a total of 108 staff, with six fully qualified meteorologist and less qualifications than four years meteorological degree of five staff. There are 21 meteorological observers and eight engineers and technicians within the organization. The organization structure is shown in Figure 2-1.

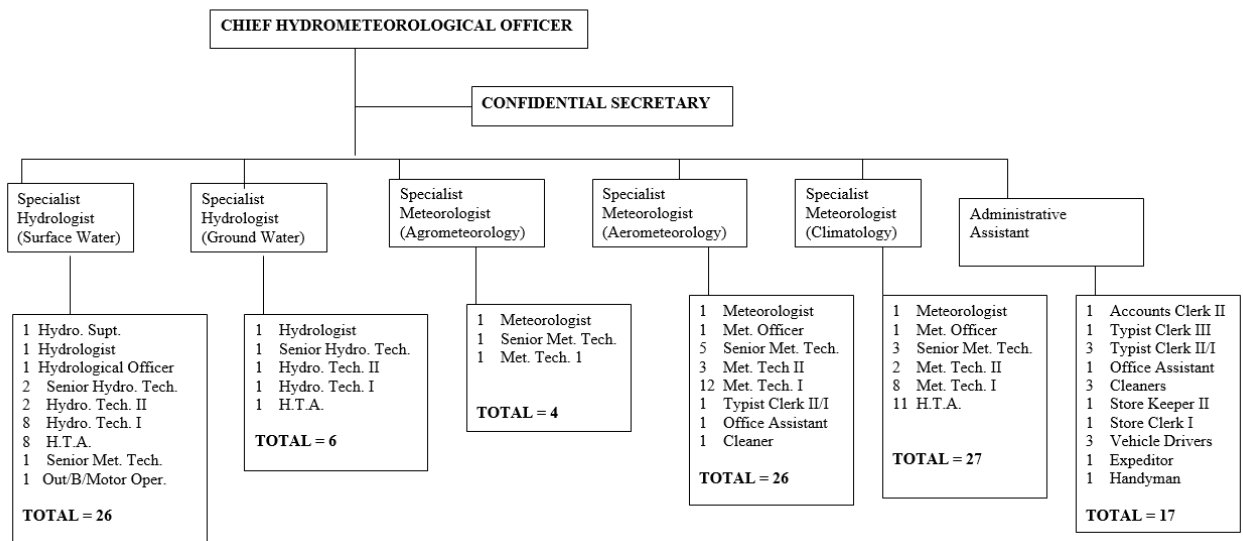


Figure 2-1 GMHS Organization Structure (Source: GMHS, 2020)

GMHS operates forecaster workstations (e.g., COROBOR, SmartMet) supported by Finish Meteorological Institute and MOROCOM. SmartMet provides visualizing and editing support of weather forecasts products. GMHS also proposed a new organization structure with more stuff and divisions are shown in Annex-5.

3. ENVIRONMENTAL SCAN

An environmental scan was completed by gathering facts and analyzing trends that give an objective picture of where GMHS stands in the “world” of hydrometeorology and the external and internal pressures and factors likely to affect its future and achievement of its goals and objectives. It included three standard analysis: SWOT analysis, PESTLE and stakeholder analysis.

3.1. Policy and Legislation

This strategic plan is prepared in response to the increasing turmoil of climate change impacts and growing needs for enhancing climate change adaptation and resilience through integration of climate services across sectors. As such, it is linked to international frameworks and agreements, such as the Intergovernmental Panel on Climate Change (IPCC), UNFCCC (1992), Paris Agreement (2015), Sendai Framework for Disaster Risk Reduction 2015–2030 (2015), UN Sustainable Development Goals (2015), and S.A.M.O.A Pathway (SIDS2 Accelerated Modalities of Action Pathway) (2014). Guyana is a signatory to the UNFCCC and a member of the Caribbean Planning for the Adaptation to Climate Change. Guyana has a National Ozone Action Unit within the GHMS, acceded to the Vienna Convention for the Protection of the Ozone Layer and the Montreal Protocol on Substances that Deplete the Ozone Layer.

The planning and policy environment for addressing climate change in Guyana evolved since the year 2000 from research, analysis and planning toward financing and implementation. Actions supporting this focus include the Green State Development Strategy, the Low Carbon Development Strategy, the Second National Communication to the UNFCCC, the National Integrated Disaster Risk Management Plan, and the National Adaptation Strategy to Address Climate Change in the Agricultural Sector.

National Climate Change Policy and Action Plan (2020-2030) provides a framework for addressing the issues that Guyana faces and will face in the future due to climate change. It supports national climate change adaptation, resilience and mitigation actions. The policy implementation plan sets out a ten-year framework and is meant to be a ‘living’ document to be updated regularly to address emerging concepts, new scientific evidence and Guyana’s societal needs as the country progresses along a low carbon emissions development pathway.

Low Carbon Development Strategy (LCDS) is aimed to transform the country’s economy on to a low carbon, sustainable development trajectory, while simultaneously combating climate change. LCDS examines the ways to deploy the Guyana’s forest in mitigating climate change while gaining financial support, to move along a low carbon strategy, and to protect the country from the effects of Climate Change. . Guyana’s surface water comes from 14 main river basins. Water deficit is not an issue, but potable water is more of an issue when it comes to management of available water resources. Groundwater wells, water treatment plants which derive potable water from streams and springs are what provides most of the potable water to the Guyanese people. Climate change provides a serious threat to recharge of available potable water supply.

The Water and Sewerage Act (2002) governs water resources in Guyana. A major function of this act is to guide the development and the implementation of a national water policy. The Water and Sewerage Act 2002 mandated the creation of a National

Water Council comprised of experts in drainage and irrigation, water management, conservation, engineering, environmental economics, and hinterland areas. The council would be responsible for collecting and collating data to analyse water use, threats, alternative sources and solutions to problems encountered. However, the Council has not really functioned since the Water and Sewerage Act (2002) was assented to in 2002. The Act also outlines GHMS's role in water management through the development of monitoring networks for surface and groundwater, and licensing of developments and water users.

Guyana has a Low Carbon Development Strategy (2013) where five priorities are emphasized including climate resilience and water management, supporting high potential low carbon sectors, hinterland and Amerindian development, center for biodiversity and a clean transportation programme.

Guyana's draft Climate Resilience Strategy and Action Plan (2016) identified the risks associated with the observed and projected future changes in climate through a stakeholder consultation process (Ministry of the Presidency, 2016). The Action Plan proposes four fast-track projects for climate change adaptation: building climate resilient agricultural systems, enhancement and maintenance of Guyana's sea defence, public health adaptation to climate change and strengthening existing drainage and irrigation systems.

3.2. SWOT Analysis: Assessment and Analysis of the Organization's Strengths, Weakness, Opportunities and Threats

A SWOT analysis of GMHS was conducted to assess internal capacities and stakeholder needs vis-à-vis organizational responsiveness and the contextual realities in which the GMHS operates. The analysis provided insights on the gaps between current performance and what the GMHS aims to achieve.

Strengths

The GMHS has significant tangible and intangible attributes that it can use to its competitive advantage. It has highly qualified personnel and an operational service, on a 24/7 basis, which obtains accurate and early hydrometeorological information covering the entire country. It has great collaboration and holistic coordination of activities throughout all ministries and line departments, including with the CDC. The GHMS's involvement with different government forums enables the government to acknowledge the role and services of GHMS in terms of disaster risk reduction and climate change adaptation. The GHMS has the support and cooperation of the CMO and it is also part of international and regional treaty obligations which encourage progress in local policy making. There are plans for multi-hazard public awareness and education campaign which will reduce vulnerability to hazards in the future. There are also several research and operation projects to enhance the weather, water and climate service in Guyana such as the National Flood Early Warning System, Resilience Action Guyana: Increasing Climate Resilience of Vulnerable Ecosystem and Rural Communities in Coastal Areas.

Weaknesses

There is an inadequate technological and financial resource base dedicated to sustained implementation and evaluation of weather, water and climate services. A limited network infrastructure that is largely conventional inhibits the GMHS from delivering an efficient MHEWS. This is impacted by a limited annual budget with limited network maintenance, upgrade, and expansion. This is further compounded by an extremely small ICT infrastructure.

Particular attention is required in research, public education, policy strengthening, advocacy, network infrastructure, expanding the range of tailored services, climate and subseasonal forecasting, oceanographic services, quality management system implementation, water resources management, hydrological forecasting and demonstration projects. There is inadequate opportunity for timely reviews and evaluation of the planning process. In terms of enforcement, there is a lack of monitoring and enforcement of legislation. There is limited public and private engagement at present. Additionally, while the top tier of the GMHS are sufficiently qualified and trained, there is a need for increasing the capacity of mid and lower level staff to ensure that the foundation upon which services are developed and delivered is beyond questioning.

Opportunities

There are international treaties to develop weather and climate monitoring systems with an emphasis on early warning system. The GMHS may capitalize on the treaties and get sufficient support from government, regional organizations, and donors to design and implement stronger multi-hazard early warning system. Capacity building can greatly enhance the success of GHMS. Collaboration with external funding agencies can be beneficial in order to establish and expand current system. Public engagement and awareness can inspire preparedness at the community level.

Besides, collaboration with local and regional universities can strengthen its research agenda. There is also an opportunity to capitalize on the emerging oil and gas sector in Guyana, in which there should sufficiently resources to establish a Marine Services Section within the GHMS. At the same time, these opportunities also afford the strengthening of public-private partnerships.

Threats

A major threat to the GMHS is the poor salaries and remuneration on offered by the GOG to highly trained technical staff. Over the years the GMHS has been experiencing extremely high staff attrition rates as staff leave the Service for more lucrative remuneration packages on offer throughout the Caribbean Region. If this is not immediately addressed, the gains made in recent years will be lost in the short to medium term. The Service also has a structure that may not allow it to easily adjust to the demands of its regional and international partner obligations. While partners are evolving to meet current demands, the GMHS is straddled with a 1965 structure/institutional framework.

Political unrest can lead to civil unrest and halt any unified progress to accomplish goals. The organization can become complacent or lethargic due to unavailability of binding legislation and mandates as well as lack of political will and inadequate funding sources for projects. Future administration's manifestos can largely decide the way forward. Finally, the COVID-19 pandemic has definitely slowed down GMHS activities and, if prolonged, may more severely affect its work in future.

INTERNAL	
Strengths	Weaknesses
• Highly qualified personnel • An operational service on a 24/7 basis, covering entire country • International and regional treaty obligations which encourage progress in local policy making • Holistic coordination of activities throughout all ministries • Gender issues are addressed in the National Climate Change Policy and Action Plan 2020-2030	• Technological deficiencies • Financial constraints • Lack of monitoring and enforcement of legislation • No national Action Plan for weather, water and climate services • Limited information and use of crops and integrated systems that are climate resilient • Inadequate water management and actions for soil and water conservation to reduce risk of flooding and drought
EXTERNAL	
Opportunities	Threats
• Capacity building can greatly enhance the success of an organization • Multi-hazard early warning system can ensure a comprehensive assessment of risk • Public engagement and awareness can inspire preparedness at the community level	• Future administration's manifestos and inadequate funding sources for projects • Political unrest can lead to civil unrest and halt any unified progress to accomplish goals. • Poor salaries and remuneration

3.3. PESTLE Analysis

A PESTLE analysis was undertaken to inform understanding of the GMHS's external environment, political, economic, sociocultural, technological, legal and environmental (ecological) factors.

Political factors - Guyana has great support from regional bodies, however it has a weak political capital. Ambiguous legal framework and limited capacity led to inconsistencies and overlapping in implementation of regional and international mandates. A number of plans and policies were made with little follow through. There is weak institutional capacity.

Economic factors – The emerging oil and gas sector has significantly enriched the economy.. However, this may reduce the drive for renewable energy as there will be a cheaper supply of fossil fuels. The country is highly dependent on the world market, causing projects to be incomplete when funding waivers.

Sociocultural factors - People are less inclined to follow rules when enforcement is lacking; weak enforcement also contributes to poor international image. People need to be kept updated and aware, they need to know their worth as a stakeholder in the GHMS - when people are more aware, they will be better prepared. The recent political instability with elections can incite instability at the local level. Gender inequality will have a negative impact on establishing a strong public system.

Technological factors – Adoption of new technology is limited due to insufficient financial resources. Revenue from oil exports can be redirected into this sector.

Legal factors - Implementation of legislation and policies to combat water resource management and climate change is tied to political will. Updating of legislation will improve institutional capacity, once the legislation is updated and relevant, there will be more avenues to plan and implement important programs.

Environmental and ethical factors – Encouraging greater corporate social responsibility, where greater enforcement in protecting the environment will produce a more favorable view by international agencies who are more likely to consider funding initiatives. Protection of the environment should be seen as critical. The laws and general implementation of new technology should assist in the reduction of the country's carbon footprint. Comprehensive assessment of multi-hazard risk can reduce vulnerability to a greater extent. A weak monitoring and enforcing of environmental protection regulations may cause irreparable damages to the ecosystem, but stricter enforcement can ensure sustainability. Most plans are limited to a few geographic locations, without considering the most vulnerable areas.

3.4. Stakeholders Analysis

Provision of weather, water and climate services requires partnerships and collaboration among stakeholders from various sectors at the national, regional and global levels. It enhances cooperation among Caribbean nations to strengthen the GHMS and address transboundary weather, water and climate impacts.

Key stakeholders that are, directly or indirectly, involved in implementation of the NSP and NFWCS include:

- Central government organizations (Ministry of Agriculture and its agencies; Ministry of Public Works; Guyana Civil Aviation Authority; CDC;, Ministry of Local Government (Municipalities/Regional and Community Authorities); Guyana Geology and Mines Commission; Guyana Water Incorporated; Maritime Administration; Transport and Harbours Department; Ministry of Health; Ministry of Tourism, Industry and Commerce; Guyana Energy Agency; Guyana Forestry Commission; Guyana Lands and Survey Commission; Department of Environment and Climate Change; Environmental Protection Agency;; Ministry of Amerindian Affairs);
- Development organizations (Iwokrama International Center);
- UN organizations (WMO and its regional organizations; World Health Organization (WHO/PAHO); FAO/CARDI; CARPHA);
- Regional meteorology and hydrology services (CMO);
- Media agencies;
- Nongovernmental organizations (Guyana Red Cross; World Wildlife Fund);
- Businesses (construction and engineering, tourism, agriculture, fisheries, energy, health, and water and transport operators); and
- Community members.

They have important roles in enhancing access to and using weather, water and climate services to reduce risks associated with hazards. They are critical for facilitating delivery of weather, water and climate products and services. Development and dissemination of climate services will contribute to availability and accessibility of multi-hazard early warning as outlined in the Sendai Framework.

Development partners are essential in resource mobilization and enhancing cooperation with stakeholders at the regional and global levels to enable adequate delivery of weather, water and climate services. They can help in engaging policy makers in sustainable implementation of the framework.

Indigenous populations are among the most vulnerable and marginalized groups in Guyana. They are also less likely to access social services and are suffering from the effects of environmental degradation and climate change on their health and wellbeing (UNICEF LACRO, 2015).

The most important economic activities in Guyana are agriculture, tourism, and mining, with sugar, bauxite, rice, and gold accounting for 70–75% of export earnings. The provision of timely and accurate weather, water and climate information will reduce climate change impacts through preparedness and planning. The following provides an overview of the critical economic sectors in Guyana and their need for tailored weather, water and climate information.

Agriculture

Agricultural livelihoods depend significantly on the natural resource base, particularly soil and water. The agricultural sector accounts for about 20% of the national Gross Domestic Product (GDP) and is the largest employer responsible for 33% of direct employment (MoA, 2013). Its largest exports include sugar and rice and other crops, including fruits and vegetables, and marine products. Consequently, several effects of natural hazards and climate change can potentially affect agriculture and rural development. Because of climate change, productivity of land and marine resources will be insufficient to meet the needs of a growing population. The scarcity of agricultural products will force people to rely on imported food. The impacts of climate variability and change can seriously and disproportionately affect the communities heavily reliant on these resources.

There are three major institutions within the Ministry of Agriculture that are key stakeholders at the national level for water management in the agriculture sector: the GHMS, the National Drainage and Irrigation Authority and Mahaica-Mahaicony-Abary Agriculture Development Authority (MMA/ADA). The National Agricultural Research and Extension Institute is responsible for agricultural extension and research. While the Guyana Livestock Development Authority delivers public services related to animal production, animal health, animal genetics, marketing, training and extension services, the Fisheries Department supports services related to development and maintenance of fisheries programmes and activities.

Tourism

The Tourism sector is expanding, with the country continuing to take more and more shares of the market for Caribbean tourism. Over the past years, the Guyana Tourism Authority has worked on raising the profile of 'Destination Guyana' through increased product development, awareness raising activities and niche marketing. It is one of the key productive sectors driving SDG achievement. The sector is dependent on marine resources, which are affected by the rise in temperature and ocean acidification.

Health

Health risks associated with climate change and disasters are a growing concern for Guyana. Many infectious diseases have seasonal cycles that are influenced by changes in spatial and temporal prevalence. The seasonality of the diseases is driven by changes in weather and climate elements such as rainfall, temperature and humidity. Protection of public health from an increasingly variable and changing weather and climate is a priority for the health sector.

Energy

The energy sector is characterized by a high dependence on fossil fuels which is typical of the region. However, extreme events such as floods, drought and extreme temperature significantly affect energy production, transmission and supply. Protection of energy sector from an increasingly variable and changing weather and climate is a priority for the sector.

Water

Several natural hazards arise from hydrological factors. Disasters triggered by natural hazards such as floods can destroy or severely damage water infrastructure, affecting water supply and adversely affecting the immediate environment and development. The coastal regions (where 90% of Guyana's population and 43% of its GDP earnings are located) are exposed to significant flooding risk (GoG, 2013). For example, drought can reduce surface or groundwater flows, flooding, and can divert groundwater. Water resources degradation causes or worsens environmental risks arising from natural hazards. Degradation of watersheds can adversely induce or

exacerbate flooding and landslides. Unsustainable water resources use affects productivity and weakens the resilience of communities at risk. Farmers lack planning and organization for fighting common problems related to water, agriculture, and climate change impact and there is some limited coordination among interagency.

Transport

Guyana's transport sector includes land, marine and air transport and refers to the movement of people, goods and services, largely using motorized vehicles and local shipping, together with their fuels such as petrol, diesel and lubricant oils. Guyana is particularly vulnerable to the effects of climate change on oceans due to proximity to the sea and reliance on the ocean for resources and transportation. Seaports are facilitating international travel and are vital for domestic and international trade. Ports and associated infrastructure are vulnerable to coastal flooding caused by sea level rise, increased erosion and storm surges. Weather and climate information is crucial in supporting effective response and minimizing disruption to the transport sector.

Telecommunication

National Data Management Authority, responsible for advancing e-governance services, design new information channels for precision crop, soil and water management using information and communication technology (ICT) such as tablets and innovative digital agriculture tools (such as telephones and field sensors) and create a two-way feedback loop between climate service providers and farmers. Under the "RE-ACT (Resilient Action Guyana) project" information will be collected, managed and sent by farmers through these technological tools and they will in turn receive advice for timely irrigation, disease control and related actions to enhance resilience and productivity. This system will provide feed back to the national information system to improve understanding of what is useful to farmers and what needs to be improved. Smart phones can be used for data collection, monitoring and information sharing (agro-climatic and soil moisture monitoring, precision irrigation scheduling) through private sector collaboration.

STAKEHOLDER	INTERESTS	EXPECTATIONS	POTENTIAL
Guyana Civil Aviation Authority	To receive accurate and timely information to ensure the safety of the passengers and staff in the aviation industry	To be the main source of credible information in the event of a weather and severe weather events for aviation	Provide GMHS with internal aviation data and observations
Department of the Environment and Climate Change (DECC)	Development and implementation of national policies and actions for climate change mainstreaming	Timely and location-specific climate information	Ensure policy and plan reflect the weather, water and climate services
Civil Defence Commission	Receiving of early warning information from the meteorological services and facilitating dissemination of said information	Timely and accurate information and data to facilitate a coordinated response	Partner with research initiatives, translating weather and climate information to exposure and vulnerability assessment

Media	Being a credible source of alerting and dissemination of information to the public Assisting in public education	Timely and accurate information to broadcast Continuous two-way information sharing	Being an outreach agency and important link between sender and receiver of information
Government agencies and Ministries	Using information resulting from the NMHS research to promote sustainable government practices and policy directives	Information to inform their policies and practices and to promote awareness through the various government ministries. Collaboration to ensure that their proposals are sustainable	Provision of statistics. Partnering in creating common goals and objectives.
Guyana Water Incorporated	Utilizing research and information from the NMHS to better manage water supply and combat challenges	They can be proactive in policy making and ensure water sustainability	Sharing of data and research information
Guyana Red Cross	Receiving and facilitating dissemination of early warning information	Using information to inform response and awareness	Data sharing and collaboration. Community capacity building.
Community	To be made aware of their risks and mitigation efforts	To be a partner in deciding strategies which can help mitigate the risks associated with climate change	Being a partner means they can make an active contribution to realistic policies which can be implemented. Provide feedback on the success of implemented policies and programs.

3.5. Baseline Analysis of Institutional, Human and Infrastructure Capacity

Baseline data on five key areas is gathered and used as a starting point for gauging progress toward the goals and objectives identified in this strategic plan and measuring the level and direction of change. Evaluation of the five areas establishes a basis for comparing the situation before and after an intervention, which can be used to better understand the contributions or evaluate the effectiveness of a specific activity. The capacities were assessed using these five pillars:

- I. User interface platform: a structured means for users, researchers and climate service providers to interact at all levels to ensure that user needs for climate services are met.
- II. Climate services information system: a mechanism through which information about climate (past, present and future) is routinely collected, stored and processed to generate products and services that inform often complex decision making across a wide range of climate-sensitive activities and enterprises.
- III. Observations and monitoring: essential infrastructure for generating, managing and disseminating the necessary climate data supported by metadata, to meet the needs of users.
- IV. Research, modelling and prediction: timely delivery and usefulness of science-based products and services offered to different socio-economic sectors and regions.
- V. Capacity development: capacity of a country to apply and generate climate information and products relevant to its concerns - policies and institutions with their human resources with the right skills or practices to enable them to take advantage of new or existing climate data and products or create national user interface groups to establish national dialogue on these issues (this pillar can be seen as a foundation that links and supports the other pillars).

User Interface Platform

A user interface platform that provides a structured means for users, researchers and climate information providers to interact at all levels is an important aspect of climate services. Currently, the GHMS acts as an information sharing platform. Coordination for climate services is led by the DECC within the Office of the President and CDC coordinates national system of disaster management.

The GHMS engages its stakeholder twice yearly before the primary and secondary rainfall season respectively at the National Climate Outlook Forums (NCOFs). The NCOF provides a national coordinated process of climate services, and serves as a key platform for promoting a regular dialogue between relevant stakeholders in Guyana. The GHMS is responsible for leading the forum and providing climate information from observed and forecast data, to establish a comprehensive and regular climate service to the all sectors. Staff of the GHMS are active members on the Boards of the National Climate Change Committee and the CDC. They submit different reports to the Ministry of Agriculture and the Ministry of Finance, including annual reports (all departmental activities and budget implementation); budget proposals; quarterly reports; half-year reports; monthly public sector investment program reports; and key performance indicators. It also reports annually to the Parliament through the Ministry of Agriculture. Among its products and services are: daily weather forecasts; five-day weather forecasts; a suite of aviation services; tidal outlooks; drought bulletins; seasonal climate bulletins; farmers' bulletins; national climate outlook forums; media specific forecasts; and hydrometeorological data, data analysis and information.

There has been discussions and work in progress in downscaling the national climate outlook forums to four regional climate outlook forums per region. The downscaling assists in focusing on region specific problems to promote discussion on needs and priorities, and to manage and govern the guidelines for soil and water conservation; water harvesting and aquifer recharge; improve water management on irrigated and rainfed farms including drainage and flood control, as well as related issues such as energy saving (solar power), wastewater and salinity management (water quality control) and gender and governance. The outcome from the regional forums will be taken to the national climate outlook forums, with the participation of local representatives (including women and indigenous people), for developing the national

integrated water in agriculture strategy and its implementation plan, which will include assessment of financial needs and fundraising possibilities. There are also farmer and water associations at the local level and needs further strengthening.

Climate Products

Climate information systems are an important factor in operationalization of the FWWCS. They provide mechanisms through which climate data is routinely collected, quality controlled, archived and processed to generate and deliver climate information and products through operational mechanisms, technical standards, communication, and authentication. The WMO defines a climate service as a “continuum of provision, delivery and consumption of climate information and products” and reports that climate services should have the “properties of being available, dependable, usable, credible, responsive, flexible and sustainable” (WMO, 2012b). Here, the simplified concept of climate services is composed of three separated but mutually dependent parts: observations, products and delivery. Each subsequent component depends on the one preceding it, however at the same time, observations and products, to have any value, depend on service delivery.

The GMHS is currently providing a ‘Farmer’s Monthly Weather Bulletin’, including relevant information about expected climate variability that will affect farming activities. Farmers can access the information on the GHMS’s webpage. However, there are also issues with the accessibility of climate information since climate services often do not reach the farming community without internet access.

Observation and Monitoring

Effective climate services require historical and real-time climate observations well distributed in spatial and temporal scales. This ensures integration of climate information and other socioeconomic data to meet the needs of climate services for minimizations of losses due to climate variability and change as well as managing natural and human systems effectively.

The WMO’s Global Climate Observing System is made up of two types of measurement: in situ and space based. Observations can be recorded in situ— atmospheric (upper air, surface, and composition), terrestrial (surface and subsurface), oceanic (surface and subsurface)—or from space (proxies sensed through satellite imagery). WMO’s Global Observing System’s Information Center determined the essential climate variables that are required to adequately monitor climate.

Currently, the GHMS has 9 manual synoptic stations, 8 climate stations, 180 rainfall stations and 37 Automatic Weather Stations (AWS) which report daily. The GMHS has its own radar and satellite receiving system which receive satellite imagery over the internet data from IRI Data Library and NOAA’s FTP. The GMHS also produces a high resolution (5km) gridded seasonal climate forecast using the Climate Predictability Tool (CPT) supported by the IRI Columbia University. Proposed Green Climate Fund projects also have plans for the procurement and installation of additional AWSs.

The GMHS operates two forecaster workstations from COROBOR and SmartMet supplied by MOORCOM and Finish Meteorological Institution, respectively. However, they do not yet have a mechanism to verify any forecast. The GMHS receives funding and support mainly from government, with occasional donor support.

National Data Management Authority is responsible for advance e-governance services, development of new information channels for precision crop, management of soil and water using ICT such as tablets and innovative digital agriculture tools (such as telephones and field sensors) and creating a two-way feedback loop between climate service providers and farmers.

Research, Modeling and Prediction

The basic requirement of NMHSs is to analyse and package observation data to meet the end users' needs. The results of their analyses and packages from monitoring to warning to climate proofing are the products defined below (many are verbatim) in the illustrative non-exhaustive list detailing how observation data become climate products:

- Monitoring: situ and space-based observations
- Modeling: calibrating, blending, etc.
- Predictions: forecasts, outlooks, etc.
- Projections and downscaling
- Communications: warnings, watches, etc.
- Other: climate proofing, tailored products, etc.

The DECC and the GMHS are the primary agencies for weather, water and climate change research. GFC conducts research in preparing Guyana for REDD+ (mitigation). The University of Guyana also conducts some research on weather, water and climate services. The National Agricultural Research and Extension Institute is responsible for agricultural extension and research and; as one of the newest agencies under the Ministry of Agriculture, the Guyana Livestock Development Authority delivers public services related to animal production, animal health, animal genetics, marketing, training and extension services

Capacity Development

Currently there are a total of 108 staff working at the GMHS. Of this number,, six meteorologists have graduate degrees and five have lesser qualifications than four-year degree. There are 21 meteorological observers and eight technicians engaged in equipment repair and maintenance, including three engineers. However, in few positions there are requirements for more staff. Eight more meteorologists and five more meteorological observers are required for better functioning. The biggest challenge in recruiting new staff is unavailability of qualified personnel and the inability to retain staff is largely due to the comparatively low remuneration packages on offer. The GMHS's Aeronautical Meteorology Section developed a training plan in 2019 to ensure continuity in competencies and service delivery under various training initiatives such as initial training, on the job training, recurrent training and specialized training. There are huge demands to enhance the capacity building of staff in atmospheric sciences, hydrology, IT, ocean sciences, water quality, climate modelling and other essential subdisciplines.

3.6. Emerging Issues

Climate change is already being observed in Guyana. Mean annual precipitation has increased at an average rate of 4.8 mm per month (2.7% per decade) and observations since 1960s indicate that the mean annual temperature in the country has risen by 0.3°C (McSweeney et al., 2010).

In Guyana, the agricultural sector accounts for about 20% of the national GDP and is the largest employer in the country responsible for 33% of direct employment, while 70% of the population depends directly or indirectly on agriculture. Thus weather, water and climate service are highly critical for the country. There are also farmer and water users' associations at the local level that need further strengthening.

Factors such as adequate quality data, simple language, and availability of the information is critical for successfully deliver. For accurate weather and climate information, adequate and quality data is necessary. Likewise, technical weather and climate information needs to be translated into simple language for all the sectors and public to understand and apply them into actionable implications. Moreover, information needs to be made available to sectors through accessible and effective communication means.

3.7. Conclusions from Environmental Scan

Guyana has made important investments in coastal development – in industry, agriculture, conservation, afforestation and rural livelihoods, but these are not yet systematically addressing weather, water and climate service. The environmental scan identifies gaps and needs to increase GMHS' capacity, including:

- There is a lack of financial resources dedicated to the projects and policies and has little to no community integration initiatives. More targeted funding from internal and external donors can help build the GHMS into a stronger organization;
- Climate information products are not well incorporated into sectoral advisory services, and they are not tailored to sector specific needs. For example-farmers and other agricultural decisionmakers lack access and understanding on the disseminated information;
- There is a limited national coverage by AWS;
- A streamlined focus on strengthening technological capacity and data collection along with interagency collaboration can be really useful for weather, water and climate services in Guyana;
- There is a need of developing a Meteorological Act for Guyana which can be operational at both local and national level;
- Gender disparities are addressed in all current policies and plans. The implementation of these inclusive plans on the local level will be both a challenge and an opportunity;
- Ensuring capacity building of current staff, ensuring that all met observers undertake minimum entry-level meteorological observation and refresher trainings, and providing regular career progression opportunities within GMHS;
- Design and implement community outreach programs for improved weather forecasting services and early warning;
- The major water management problem in the coastal regions is the changes in water levels in the major water conservancies, which can significantly affect the various industries (e.g. agriculture);
- Water management in the southern region is also a problem, as rainfall season between May and August in the south cause flooding and associated damages. For the other 8 months there is a water deficit with almost drought-like conditions. Mechanisms to store water from the May/Aug period for the other 8 months must be considered. However, issues of water management are a national problem, not only regarding water conservancies, but lack of data on

quantity and quality of surface and groundwater can cause hindrances to other sectors dependent on water.

- Strengthen collaboration with media outlets at the national level;
- Organize training for forecasters to improve public weather and marine forecasting (no funding is required);
- Collect, document, evaluate and use traditional knowledge in weather and climate forecast.

4. ORGANIZATIONAL VISION, MISSION AND CORE VALUES

4.1. Vision

The vision of GHMS is reflected in its purpose: to contribute to Guyana's social, economic, cultural, and environmental goals through the performance of the functions of a national hydrometeorological service in the public interest generally and in particular:

- For the purposes of assisting persons and authorities engaged in primary production, industry, trade and commerce;
- For the purposes of navigation and shipping and of civil aviation;
- For the purposes of the Guyana Defence Force
- For the purposes of reducing the impacts of climate change and enhancing climate resilience across sectors
- For the purposes of disaster risk reduction

4.2. Mission

Mission statement of GHMS: To observe, archive and understand Guyana's weather and climate and provide meteorological, hydrological and oceanographic services in support of Guyana's national needs and international obligations.

4.3. Core Values

GHMS' core values: accuracy, efficiency, partnerships, information sharing, reliability, and regional and global contributions.

5. STRATEGIC FRAMEWORK

5.1. Goals, Objectives, and Strategies

5.1.1. Goals

To support the agreed vision (impact), this NSP consists of a set of goals (outcomes) that will be achieved through specific objectives (outputs) and activities, that have timelines and assigned responsibilities:

- **Strategic goal 1:** Ensure that GHMS has an enabling policy and institutional environment;
- **Strategic goal 2:** Strengthen the GHMS' human and infrastructure capacity to deliver effective weather and climate services;
- **Strategic goal 3:** Strengthen partnerships with stakeholders to improve service delivery, increase the use of meteorology, hydrology, marine and climate products, and ensure successful risk communication;
- **Strategic goal 4:** Strengthen the GHMS' human capacity, remuneration, conditions of employment, performance management, and operational efficiency.

Goal 1 encompasses the desire for a strong and purposeful policy and institutional framework to support the hydromet value chain. As WMO is working on strengthening hydrometeorological and early warning services in the Caribbean through the Climate Risk and Early Warning Systems (CREWS) project in collaboration with CMO Head Quarter Unit, CIMH, and CDEMA. Endorsement of the National Hydrometeorological Bill (currently in draft) by the Cabinet, facilitating its passage through the National Assembly and linking it with other acts and policies would enhance weather, water and climate services in Guyana. Developing a concept of operation and Standard Operating Procedures (SOPs) for weather, water and climate services will ensure operations are consistent and effective.

Goal 2 is focused on improving the services infrastructure to improve service delivery by the GHMS. The GHMS seeks to improve the effectiveness of observational data and support data processing and data sharing capability (including electronic hardware, operating systems, and data analysis software to process and analyze signals).

Data integration software and data management systems are essential for enhancing the GHMS capabilities. Monitoring and hazard detection tools and data integration software need to be compatible within the national office as well as with global and regional networks.

Provision of data processing and visualization software platforms for the GHMS will facilitate easier processing of information and better understanding of prevailing and upcoming hazards and ensure a higher forecasting quality in terms of timeliness and accuracy. The wider availability of information collection, storage, retrieval, and dissemination by electronic means facilitates more effective exchange of information and allows the GHMS to widely disseminate to the various sectors for enhanced disaster preparedness and response.

Developing tailor made weather, water, climate, and ocean information based on the needs of stakeholders of different sectors will ensure better decision making during emergencies. For instance, modeling agro-ecological, drought, and crop scenarios

along with water quality index would benefit farmers in selecting the appropriate crop techniques and intensifying productions.

The GHMS envisages that robust communication, dissemination and notification tools should be in place to ensure delivery of impact based forecasts. This can be achieved through developing infrastructure and processes for three types of communications systems:

- Communication of earth data observations and hazard detection;
- Communication of technical risks posed by a natural hazard to decision makers and stakeholders with responsibility for disaster risk reduction in communities;
- Communication with the public and local communities.

Goal 3 recognizes the critical role that partnerships between the GHMS and stakeholders play in the delivery of weather, water, climate, and ocean services. The GHMS strives to develop effective risk communication through community engagement and education. Engagement with communities is of utmost importance to raise public awareness, tailor warnings to ensure appropriate interpretation of key messages and adequate resourcing of response plans and evacuation procedures. Systems of risk communication must be well established, ensuring all stakeholders are notified, including government, private, public, community and community leaders and tourists. Channels of communication and procedures for monitoring the warning must be understood by all parties and systems regularly checked.

The GHMS will work toward impact-based forecasting and warning informed through hazard assessment, vulnerability assessment, risk assessment, impact assessment and studies of risk perception. This will allow the GHMS to consider the impact of the hazard, rather than the hazard itself, in their communication.

Strengthened inter-agency coordination between the GHMS, CDC, DECC and other government departments will ensure appropriate systems are in place for strengthened information and to foster innovation.

Goal 4 is focused on strengthening the operation of the GHMS to be recognized as a certified national weather, water, climate, and ocean services provider. Performance management, improved working conditions and operational efficiency will ensure business continuity and assist the GHMS in making use of the strengthened policy and legislation, infrastructure, and partnerships with stakeholders that are developed as part of Goals 1, 2 and 3. Critical to these improvements is the capacity of GHMS staff to provide technical, managerial, and other support for the delivery of weather, water and climate services.

5.1.2. Objectives

In line with these goals, the GHMS developed objectives to be achieved through 2022-2026:

Strategic goal 1: Ensure that the GHMS has an enabling policy and institutional environment

- 1.1. Endorse legislation, regulation, and policy on weather, water, climate, and ocean services
- 1.2. System design plan for weather, water and climate services
- 1.3. Develop concept of operations for weather, water, climate, and ocean services and enhance SOPs for weather, water, climate and ocean hazards detection, assessment, and dissemination

Strategic goal 2: Strengthen the GHMS' infrastructure capacity for delivery of effective weather, water, climate, and ocean services

- 2.1. Enhance the GHMS' infrastructure capacity for delivery of effective weather, water, climate, and ocean services through enhanced observational network, modeling, forecasting, hazard detection and hazard assessment infrastructure
- 2.2. Upgrade observation (meteorology, hydrology, environment, and ocean) data management system, ICT and early warning systems
- 2.3. Ensure that weather and water level observation system is well maintained
- 2.4. Develop customized information based on key sector needs

Strategic goal 3: Strengthen partnerships with stakeholders to improve service delivery, increase the use of meteorology, hydrology, marine and climate products, and ensure successful risk communication

- 3.1. Educate stakeholders and communities to understand impact based forecasts and warnings
- 3.2. Improve partnerships between different entities (for example: DECC and CDC)
- 3.3. Collaborate with media and community-based organisations for effective information dissemination

Strategic goal 4: Strengthen the GHMS' human capacity, remuneration and conditions of employment, performance management, and operational efficiency

- 4.1. Improve the GHMS quality management system
- 4.2. Strengthen GHMS staff capacity in observation, hazard detection and assessment
- 4.3. Enhance capacity of staff involved in science, technology, and engineering disciplines

5.1.3. Strategies

High-level planning strategies have been developed, associated with the goals and objectives (Table 5-1).

Table 5-1: GHMS Strategies

Strategic goal 1: Ensure that the GHMS has an enabling policy and institutional environment				
Objectives	Strategies	Outputs	Timeframe	Responsibilities
1.1. Endorse legislation, regulation, and policy on weather, water, climate, and ocean services	Policy and legislation approved by the Cabinet/National Assembly and shared with stakeholders	Legislation, regulation, and policy endorsed	2022-2023	GHMS, GOG, WMO
1.2. System design plan for weather, water, climate Services	Use WMO guidelines	End-to-end impact based multi-hazard early warning system in place	2022-2023	GHMS, CDC
1.3. Develop concept of operations for weather, water, climate, and ocean services and enhance SOPs for weather, water, climate and ocean hazards detection, assessment, and dissemination	Developing/improving documents for SOPs	Concept of operations developed, and SOPs are improved	2022-2024	GHMS
Strategic goal 2: Strengthen the GHMS' infrastructure capacity for delivery of effective weather, water and climate services				
2.1. Enhance the GHMS' infrastructure capacity for delivery of effective weather, water, climate, and ocean services through enhanced observational network, modeling, forecasting, hazard detection and hazard assessment infrastructure	Support from development partners and budget allocation or strengthened weather, water, climate, and ocean services infrastructure	Observation, modeling, forecasting, hazard detection and hazard assessment infrastructures capacity enhanced	2022-2025	GHMS, GOG, Development partners
2.2. Upgrade observation (meteorology, hydrology, environment, and ocean) data management system, ICT, and early warning systems	Introduce modern equipment and monitoring system	Upgraded observation (meteorology, hydrology, environment, and ocean) data management system, ICT, and early warning systems functioning and operational	2022-2026	GHMS, GOG, Communication, CDC, and Development partners
2.3. Ensure existing weather and water level observation	Increase annual maintenance cost	Weather and water level observation	2022-2026	GHMS

system is well-maintained		systems well-maintained		
2.4. Develop tailor made information based on key sector needs	Budget allocation for developing tailor made information	Tailor made information developed	2022-2025	GHMS, CIMH, and other relevant stakeholders (Agriculture, Public Health, Energy, Tourism, etc.)
Strategic goal 3: Strengthen partnerships with stakeholders to improve service delivery, increase the use of meteorology, hydrology, marine and climate products, and ensure successful risk communication				
3.1. Educate stakeholders and communities to understand impact-based forecasts and warnings	Regular users vs providers interaction and community engagement	Stakeholders and communities understand early warnings and impact-based forecasts, and acts accordingly	2022-2026	GHMS, GOG, CDC, CIMH, and other relevant stakeholders
3.2. Improve partnerships between different entities	Regular interactions	Partnerships improved with between different entities (for example, DECC, Civil Defence Commission and other key partners)	2022-2026	GHMS, GOG, DECC
3.3. Collaborate with media and community-based organisations for effective information dissemination	Education and training	Media and community-based organizations engaged	2022-2024	GHMS, GOG, CDC
Strategic goal 4: Strengthen the GHMS' human capacity, performance management, and operational efficiency				
4.1. Improve the GHMS quality management system	Implement ISO 9001:2015	Quality management system implemented	2022-2024	GHMS
4.2. Strengthen GHMS staff capacity in observation, hazard detection and assessment	Training for personnel	Capacity for observation, hazard detection and assessment improved	2022-2026	GHMS, GOG, WMO
4.3. Enhance capacity of staff involved in science, technology, and engineering disciplines	Training for personnel	Telecommunication and engineering staff capacity enhanced	2022-2025	GHMS, GOG

5.1.4. Logical Framework

The logical framework (**Table 5-3**) collates the strategies and objectives and groups them according to similar results and outcomes. Specific detail relating to the

development of technical capability of the plan is referenced in the objectives. It is structured to attain the impact: increased resilience of households, communities, businesses, sectors and society to climate variability and change.

Table 5-2: Logical Framework for GHMS NSP 2022-2026

Impact: Increased resilience of households, communities, businesses, sectors and society to climate variability and change				
Outcome	Output	Objectively verifiable indicators	Source of verification	Assumptions
1. Improved policy and institutional environment and the capacity to deliver effective weather, water, climate, and ocean services	1.1. Legislation, regulation, and act endorsed	Endorsed Hydrometeorological Act; Linked Hydrometeorological Act to other acts and policies; Ground water and surface water observation and uses licensed;	Endorsed acts; Licenses; GHMS report to Government of Guyana	Sufficient funding and support from Government; Willingness of donors to support this initiative Political willingness to endorse policies. Available human resources with necessary know-how.
	1.2. End-to-end impact based multi-hazard early warning system in place	Early warning system includes multiple hazards	Feasibility study for investment Procurement and implementation plan GHMS report to Government of Guyana	Sufficient funding and support from Government Willingness of donors to support this initiative; Available human resources with necessary technical capability.
	1.3. Concept of operations developed, and SOPs are improved	Concept of Operations and SOP in place	Published Concept of Operations and SOPs; GHMS report to Government of Guyana	Adequate budget Available human resources with the requisite skills.
2. Strengthened infrastructure capacity of GHMS to deliver effective weather, water, climate, and ocean services	2.1. Observation, modeling, forecasting, hazard detection and hazard assessment infrastructures capacity enhanced	Hazard detection and assessment is at the advance level	GHMS report to Government of Guyana	Sufficient funding and support from Government; Willingness of donors to support this initiative; Available human resources with the requisite skills.
	2.2. Upgraded observation (meteorology,	Integrated data acquisition, model viewing and forecasting platform set up;	GHMS report to Government of Guyana	Sufficient funding and support from Government;

	hydrology, environment, and ocean), data management, and IT system functioning and operational	Database operational; Indigenous knowledge collected and integrated in the database; Strengthened CAP Protocols; Enhanced SMS warning dissemination; Improved drought monitoring systems; Climate smart livestock early warning system developed; GHMS website and mobile app upgraded;		Willingness of donors to support this initiative Stakeholder willingness to cooperate; Adherence to protocols established.
	2.3. Weather and water level observation systems well-maintained	Maintenance and operational plan with budget developed; Routine assessments of weather and water level observation network conducted;	Maintenance logbook; GHMS report to Government of Guyana	Sufficient funding and support from Government; Available human resources with the requisite skills.
	2.4. Tailor made information developed	Sector-based information dissemination. Drought modeling/crop modeling/agro-ecological modeling/ heat impact/ hydrological/aquifer modelling developed; Developed farmers database and tailored climate information; Water Quality Index developed;	GHMS report to GOG	Adequate budget Available human resources with the requisite skills.
3. Strengthened partnerships with stakeholders	3.1. Stakeholders and communities understand early warnings and impact based forecasts, and acts accordingly	Training for NGO, and private stakeholders conducted; Schools and community educated; Awareness campaign on climate smart livestock early warning system conducted; Awareness programmes on policies, acts and associated	GHMS report to GOG	Willingness of stakeholders and communities to learn. Sufficient funding and support from Government; Willingness of donors to support this initiative

		licensing processes and other activities conducted		
	3.2. Partnerships improved with between different entities (for example, DECC, Civil Defence Commission and other key partners)	Routine interactions; Formal links; Workshops and training opportunities; Alliance; Joint projects;	GHMS report to GOG	Willingness of stakeholders to collaborate.
	3.3. Media and community-based organisations engaged	Engagement with media; Collaboration with community focused organizations; Workshops and trainings conducted;	GHMS report to Government of Guyana	Willingness of stakeholders and communities to learn. Sufficient funding and support from Government; Willingness of donors to support this initiative
4. Improved human capacity of GHMS to deliver effective weather, water and climate services and strengthened inter-agency coordination and communication	4.1 Quality management system implemented	GHMS certified for compliance with ISO 9001:2015; endorsed certification process undertaking by water quality laboratory	Certification documents GHMS report to Government of Guyana	Sufficient funding and support from Government. Available human resources with the requisite skills/competencies.
	4.2. Capacity for observation, hazard detection and assessment improved	Staff available and trained	GHMS organizational structure reviewed GHMS report to Government of Guyana	Sufficient funding and support from Government; Willingness and availability of staff to learn; Available human resources and training providers. Willingness of donors to support this initiative
	4.3. Telecommunication and engineering	Staff available and trained	GHMS report to Government of Guyana	Sufficient funding and support from Government; Willingness and availability of staff to learn;

	staff capacity enhanced			Available human resources and training providers.
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5.1.5. Risk Assessment

This section provides information on the risks and suggested mitigation measures for implementation of the GHMS strategic plan.

Table 5-3: Risks to Project Initiatives

Objectives	Risks	Impact if risk is not controlled	Probability	Mitigating measure
1.1. Endorse legislation, regulation, and policy on weather, water, climate, and ocean services	Endorsement by the stakeholders and cabinet, passage through the National Assembly and Presidential assent all in a reasonable time	Unclear mandate, roles and responsibilities due to the lack of legislation and policy	Medium	Avoid: Attain reliable funding sources
1.2. System design plan for weather, water, climate Services	Insufficient funding	Insufficient early warning systems and staff capacity	Medium	Reduce: create appealing positions (e.g., remuneration, opportunities to upskill or progress), target existing staff for upskilling
1.3. Develop concept of operations for weather, water, climate, and ocean services and enhance SOPs for weather, water, climate and ocean hazards detection, assessment, and dissemination	Lack of funding and technical staff availability to prepare SOP and concept of operations	Undermaintained systems may fail or not perform	Low	Avoid: Attain reliable funding sources
2.1. Enhance the GHMS' infrastructure capacity for delivery of effective weather, water, climate, and ocean services through enhanced observational network,	Lack of funding and technical staff availability	Reliance on external meteorology information; Insufficient observation, hazard assessment network for fully functional early warning system	Medium	Reduce: create appealing positions, target existing staff for upskilling Reduce: Coordination with government and network suppliers

Objectives	Risks	Impact if risk is not controlled	Probability	Mitigating measure
modeling, forecasting, hazard detection and hazard assessment infrastructure				
2.2. Upgrade observation (meteorology, hydrology, environment, and ocean) data management system, ICT, and early warning systems	Insufficient funding Technical issues/internet connectivity problems	Insufficient communications systems for fully functional early warning system Inadequate database and information sharing	High	Reduce: Coordination with government and network suppliers
2.3. Ensure existing weather and water level observation system is well-maintained	Remoteness and vandalism. Insufficient funding.	Under maintained systems may fail or not perform	Low	Avoid: Attain reliable funding sources
2.4. Develop tailor made information based on key sector needs	Insufficient funding and technical staff availability Inadequate collaboration between parties	Irrelevant information communicated to key sectors; Key sectors unable to interpret the information	Medium	Avoid: Secure sufficient funding Coordination and buy in from key groups
3.1. Educate stakeholders and communities to understand impact-based forecasts and warnings	Inadequate collaboration between parties. Insufficient funding	Minimal trust and application of forecasts in the decision making; Inadequate risk communication and data dissemination	Medium	Reduce: Coordination and buy in from key groups
3.2. Improve partnerships between different entities	Inadequate collaboration between parties	Unclear mandate, roles, and responsibilities; possible dissemination of irrelevant information	Medium	Reduce: Coordination and buy in from key groups
3.3. Collaborate with media and community-based organisations for effective information dissemination	Inadequate collaboration between parties	Unclear mandate, roles, and responsibilities; unclear information dissemination	Medium	Reduce: Coordination and buy in from key groups

Objectives	Risks	Impact if risk is not controlled	Probability	Mitigating measure
4.1. Improve the GHMS quality management system	Insufficient funding Lack of technical staff availability	Unstandardized early warning systems	High	Reduce: Coordination and buy in from key groups Attain reliable funding sources
4.2. Strengthen GHMS staff capacity in observation, hazard detection and assessment	Lack of technical staff availability Insufficient funding	Reliance on external meteorology services; inadequate risk information dissemination	Medium	Reduce: Create appealing positions, target existing staff for upskilling; Reduce: Coordination and buy in from key groups
4.3. Enhance capacity of staff involved in science, technology, and engineering disciplines	Lack of technical staff availability Insufficient funding	Unclear/ inadequate risk information dissemination	Medium	Reduce: create appealing positions, target existing staff for upskilling; Reduce: Coordination and buy in from key groups

5.2. Communicating the Strategic Plan

GHMS has primary reporting responsibilities toward the GOG. Reporting to Government will occur upon initiation of objective-related initiatives, through regular progress updates and at completion of key milestones. Funding applications for implementation of the plan must pass through the Government, which will ensure oversight and alignment of funding applications with key goals and objectives outlined in the plan.

Other communication objectives will be met through implementation of the plan. Engagement with key stakeholders and the wider community are important elements within the strategic objectives of this plan. This communication plan will ensure the strategic plan is followed and successfully implemented. The activities listed in this communication strategy and implementation plan will be communicated by the Public Relations Officer of GHMS. The cooperation of other Sectional Heads is also crucial for the success of this strategy.

Table 5-4: Communication Plan

What groups to serve?	What do they need to hear from us?	How to communicate?	When to communicate?	How will we know if they have heard our message?
Local community	Education and engagement	Community based workshops	In the development of hazard response strategies	Direct engagement with community leaders
Hinterland community				
Agriculture and fisheries	Engagement on sector needs for early warning	Reporting, direct communication, and workshops	Throughout duration of strategic plan	Direct engagement with sector leaders and extension workers
Education				
Transport (aviation/marine)				
Health				
Energy				
Water				
Tourism				
GOG	Strategic plan reporting	Reporting	Project initiation and key milestones	Funding approval and initiative endorsement
	Annual reporting	Annual meeting	Annually	Inter-agency communication and partnership
DECC	Relevant actions	Direct communication, workshops	Project initiation and key milestones	Direct engagement
CDC	Relevant actions	Direct communication, workshops	Regularly	Participation in group
Sectoral/community-based committees	Timely and accurate weather,	Using CAP and direct communication	Before floods/	Feedback mechanism

What groups to serve?	What do they need to hear from us?	How to communicate?	When to communicate?	How will we know if they have heard our message?
	water and climate related risk and warning	(SMS, call), media	droughts and emergencies	using SMS or phone calls

5.3. Financing the Strategic Plan

Financial, technological, and technical support from the international community will be necessary to ensure effective implementation of the NSP.

National Funds

National funds for GHMS are generally minimal and the annual budget is not adequate for enhancing the services to the extent envisaged in the NSP; however, partnerships with the Civil Defence Commission (CDC) and other key stakeholders may enable access to finance. Apart from the national funds, GHMS may source funds from donor development agencies or climate funds.

Climate Change Funds

Climate change funds may support GHMS within the context of climate change agreements, particularly the UNFCCC and the Paris Agreement.

Access to the Green Climate Fund (GCF), the world's largest climate fund, mandated to support programs, projects, policies, and initiatives in developing countries using thematic funding windows through which a balanced share of multilateral funding for adaptation and mitigation is channeled. GCF could be considered as a funding source to finance the activities listed in the action plan.

The Global Environment Facility (GEF), an international partnership organization that provides funding to tackle environmental issues globally, has provided funding of USD 2 million to several climate change related projects in Guyana. "Mainstreaming Low-emission Energy Technologies to Build Guyana's Green Economy", "Sustainable Energy Program" and "Enabling Guyana to Prepare its First National Communication in Response to its Commitments to UNFCCC" are some of the projects funded by GEF in collaboration with agencies such as UNDP, The World Bank, etc.

The Adaptation Funds also provides financing for adaptation programs and projects in developing countries and can be counted as a funding source.

WMO and UN Agencies

Initiatives and projects of WMO such as the "Severe Weather Forecast Program" and "Implementing the Global Framework for Climate Services at Regional and National Scales" aim at strengthening capacity of NMHS on operational forecasting and warning services. Agencies such as UNDP, UNDRR and FAO assist with a number of development projects in relation to enhancing the observation network and climate change initiatives. Other initiatives such as FAO's interventions in Guyana, focuses on national capacities to enhance food and nutrition security; increased availability, access to and use of local food; and capacities for environmental management and resilience.

Multilateral Development Agencies

Multilateral development agency funding is crucial for implementation of the NSP. The World Bank Group is an important source of funds for environmental protection and natural resources management. The support has been in the form of grants or loans. The World Bank Group funding is directed to environmental projects and capacity building. The World Bank Group has given Guyana nearly USD 596.42 million in International Bank for Reconstruction and Development (IBRD) loans and International Development Association (IDA) credits and grants for projects such as "GY Flood Risk Management" and "Poverty Reduction Support Credit Project" (World Bank Group, 2020).

Caribbean Development Bank (CDB) is a potential funding source for procuring finances for implementing the activities listed in the action plan. CDB assists in financing the social and economic programs in the Caribbean nations. Recently, CDB provided USD 12 million as an Emergency Relief fund to support Guyana with their relief efforts following the floods in May 2021.

Caribbean Catastrophe Risk Insurance Facility-segregated portfolio company (CCRIF SPC) is an insurance agency that focus on optimising disaster risk management and climate change adaptation practices supporting long-term sustainable development. With their vested interest in disasters and climate change, CCRIF SPC could be approached for funding the activities of this National Strategic Plan 2022-2026.

Bilateral Development Agencies

Bilateral donors provide direct assistance to a recipient country for development purposes, and typically include federal ministries, departments and agencies which give grants, loans, in-kind services and expertise to other governments, civil societies and multilaterals. There are a number of bilateral partners who provide support to Guyana for climate change and disaster risk reduction.

The European Union (EU) has an established partnership with Guyana to support the country's efforts to increase competitiveness, promote sustainable growth and poverty alleviation. The EU allocated EUR 34 million to improve Guyana's protection against sea damage through sea defences and integrated coastal management through the European Development Fund.

The Government of Canada designed an initiative to support small-scale, high-impact projects in developing countries through Canada Fund for Local Initiatives in Guyana.

The Government of Finland funded the "SIDS-Caribbean Project: Preparedness to Climate Variability and Global Change in Small Island Developing States of the Caribbean Region" along with the WMO, to provide tools for enhanced sustainable development in the Caribbean Region.

USAID can be approached for financing the projects in Guyana. USAID funded the "Programme for building regional climate capacity in the Caribbean" to establish a sustainable Regional Climate Center (RCC) for the Caribbean Region housed at the CIMH.

Regional Development Agencies

Regional development agencies such as CMO, CIMH, and CDEMA could be approached for gathering finances for implementing the actions presented in this plan. These agencies can access funding from either development partners or from member states.

CMO is the regional meteorological organisation charged with supporting member states with the provision of weather, climate, and water related services in the Caribbean region through Severe Weather Forecasting Demonstration Project (SWFDP) and by installing a weather radar in Guyana and other islands.

CIMH can be beneficial for Guyana in identifying funding sources. CIMH in collaboration with WMO are implementing projects such as "Develop Capacities for Climate Services in the Caribbean and the South Western Pacific Ocean Region" and "Program for building regional climate capacity in the Caribbean"

CDEMA is a regional inter-governmental agency for disaster management in Caribbean Community and can be approached for identifying funding sources for financing the activities of this National Strategic Plan 2022-2026.

6. MONITORING AND EVALUATION

Monitoring and Evaluation (M&E) is an essential component of the WMO result-based management system and ensures the sustainability of GHMS. It is one of eight steps of the WMO capacity development strategic plan development processes. Efficient and transparent M&E will ensure that targets are properly tracked/monitored and will provide information for improvements on where targets are not being met for effective capacity building. It helps to improve performance and achieve results, contributes to more informed decision making, promotes learning and shared knowledge creation, collects valuable feedback from stakeholders, which can be used to improve performance and learning and ensures accountability.

The success of the Guyana climate services will rely on this M&E framework (**Table 6-1**) to ensure an efficient and effective climate service that is continually improved over time. This will help to increase resilience to climate induced impacts across every relevant sector within Guyana.

Table 6-1: GHMS Performance Measurement Framework

1: Strengthened policy and legislative framework for effective weather, water and climate services						
Outputs	Indicators	Baseline	Target	Source of data	Frequency of evaluation	Responsibilities
1.1. Legislation, regulation, and act endorsed	Endorsed Hydrometeorological Act; Linked Hydrometeorological Act to other acts and policies; Ground water and surface water observation and uses licensed;	Inadequate	Endorse hydrometeorological Act by 2023; License ground water and surface water observations and uses by 2023	GHMS's report to GOG	Annual	GHMS, GOG
1.2. End-to-end impact based multi-hazard early warning system in place	Early warning system includes multiple hazards	Inadequate	Design impact based multi-hazard early warning system by 2022; Upgrade GHMS's ICT systems for effective early warning system by 2023	Feasibility study for investment Procurement and implementation plan GHMS's report to GOG	Annual	GHMS, GOG
1.3. Concept of operations developed, and SOPs are improved	Concept of Operations and SOP in place for multi-hazard (total number of CONOPS will be defined based on the detailed needs assessment)	Inadequate	Develop concept of operations by 2023; Develop SOP by 2024;	GHMS's report to GOG	Annual	GHMS, GOG
2: Improved infrastructure capacity of GHMS to deliver effective weather, water and climate services						
2.1. Observation, modeling, forecasting, hazard detection and hazard assessment	Hazard detection and assessment is at the advanced level	Insufficient	Establish data and forecast repository for weather, water and climate change as well as historical disaster data by 2024;	GHMS organizational structure review GHMS's report to GOG	Annual	GHMS, GOG, WMO

infrastructures capacity enhanced			Conduct detailed risk assessment and roadmaps for multiple hazards mitigation, ground water and surface water risk to climate change by 2025; Strengthen marine weather observation by 2025			
2.2. Upgraded observation (meteorology, hydrology, environment, and ocean), data management, and IT system functioning and operational	Integrated data acquisition, model viewing and forecasting platform set up; Database operational; Indigenous knowledge collected and integrated in the database; Strengthened CAP Protocols; GHMS website and mobile app upgraded;	Inadequate	Expand AWS, agro stations, water quality sensor and water level gauges by 2024; Conduct routine assessment of data management and IT systems by 2026; Establish fully operational comprehensive database by 2023; Gather indigenous knowledge and incorporate it in the database by 2024; Enhance IT systems by 2026; Improve GHMS' ICT systems by 2024; Strengthen CAP protocols by 2022; Enhance SMS warning dissemination by 2022; Improve drought monitoring systems by 2025;	GHMS's report to GOG	Annual	GHMS, GOG, Business, ICT, WMO

			Develop climate smart livestock early warning systems by 2025; Upgrade GHMS website/mobile app by 2022			
2.3. Weather and water level observation systems well-maintained	Maintenance and operational plan with budget developed	Inadequate	Develop maintenance and operational plan by 2023; Conduct routine assessment of weather and water level observations by 2026	Maintenance logbook GHMS's report to GOG	Annual	GHMS
2.4. Tailor made information developed	Sector-based information dissemination; Drought modeling/crop modeling/agro-ecological modeling/ heat impact developed; Developed farmers databased and tailored climate information; Water Quality Index developed;	Inadequate	Collaborate with key sectors by 2022; Develop farmers database by 2025; Develop drought modeling/crop modeling/agro-ecological modeling/ heat impact/ hydrological/aquifer modelling by 2024; Develop water quality index by 2024; Develop systems to disseminate information to key sectors by 2023;	GHMS's report to GOG	Annual	GHMS
3: Strengthened partnerships with stakeholders						
3.1. Stakeholders and communities understand the warnings and acts appropriately	Training manuals for early warning and emergency response disseminated; Business continuity plans in place; Schools and community educated;	Insufficient	Educate communities and schools by 2026; Training and workshops for NGOs and Private enterprises by 2025; Conduct workshops by 2022;	GHMS's report to GOG	Annual	GHMS, GOG, businesses

	Workshops conducted; (total number of workshops and training will be defined based on the detailed needs assessment)					
3.2. Partnerships improved with between different entities (for example, DECC, Civil Defence Commission and other key partners)	Routine interactions; Formal links; Workshops and training opportunities; Alliance; Joint projects; (total number of workshops and training will be defined based on the detailed needs assessment)	Inadequate	Increase interactions by 2026; Establish partnerships by 2024; Create alliance projects by 2024	GHMS's report to GOG	Annual	GHMS, GOG
3.3. Media and community based organisations engaged	Engagement with media; Collaboration with community focused organizations; Workshops and trainings	Insufficient	Engage with media by 2023; Collaborate with community focus organizations by 2024	GHMS's report to GOG	Annual	GHMS, GOG
4: Improved institutional capacity of GHMS to deliver effective weather, water and climate services and strengthened inter-agency coordination and communication						
4.1. Quality management system designed and implemented	GHMS certified for compliance with ISO 9001:2015	None	Obtain certification of compliance with ISO 9001:2015 by 2023; Endorse the certification process by water quality laboratory by 2022;	Certification documents GHMS's report to GOG	Annual	GHMS, GOG
4.2. Staff capability in observation, data management, modeling, hazard detection and assessment,	Staff available and trained	Insufficient	Train 32 employees by 2024; Educate media by 2026;	GHMS's report to GOG	Annual	GHMS, GOG, WMO

forecasting and dissemination processes strengthened						
4.3. Telecommunication and engineering staff capacity enhanced	Staff available and trained	Insufficient	Train 5 employees by 2025	GHMS's report to GOG	Annual	GHMS, GOG, WMO

Regular evaluation and review of the M&E plan is critical to the successful implementation of the strategic plan. The GHMS will hold the primary responsibility for undertaking the activities in the plan and will be required to submit its reports to GOG for evaluation.

Results-based reporting will ensure successful implementation of the GHMS Strategic Plan 2022-2026. The M&E plan (**Table 6-1**) shall be used to evaluate each activity proposed under the strategic plan at the specified interval. Most activities have been recommended to be evaluated on an annual basis.

The M&E plan should be updated with current progress and specific activities as progress is made. This will be used to inform annual reporting, where each objective will be the responsibility of the owner identified in **Table 6-1**. The overall annual reporting is to be coordinated by the GHMS and submitted to GOG for evaluation.

Upon completion of the strategic plan a results-based reporting assessment is recommended. This assessment will help to inform future planning. The results-based reporting should be based on collecting the following information:

- What is different after activities have been completed? (this refers to outcomes).
- Who was directly involved and what are they now doing differently? (this refers to outcomes).
- Over time, what changes in an organization or community can you observe? Who is being affected? (this refers to impact).
- How do you know any person, organization or situation has changed from the baseline situation? (this refers to indicators).
- What helped or hindered the achievement of results? (this refers to challenges or best practices); Did anything unexpected occur?
- What should be done differently in subsequent activities or projects in order to improve such programming? (this refers to lessons learned).

7. ANNEXES

ANNEX 1: STRATEGIC PLANNING METHODOLOGY AND SCHEDULE

This NSP with an action plan and NFCS has been developed using a methodology recommended by the WMO guidelines (2018).

Table 0-1. Steps for establishing a NSP and NFCS

Assess hydrometeorological services	Develop NSP	Design NFCS	Develop action plan	Launch NSP and NFCS
Assess the baseline conditions of a hydrometeorological value chain, by determining: •Key stakeholders, their expectations and roles •Capacity of GHMS and relevant institutions •Weather and climate services and gaps	Develop NSP by: •Consultations with stakeholders via interviews and an online survey •Literature review	Establish a NFCS as an institutionalized mechanism to coordinate the hydrometeorological value chain at the national level	Develop and endorse an action plan	Launch the NSP and action plan, together with a Decree about creating the NFCS

The first step, the baseline assessment of GHMS and relevant institutions, is in line with the WMO Integrated Strategic Planning Handbook (WMO-No. 1180) and the Step-by-step Guidelines for Establishing a National Framework for Climate Services (WMO-No. 1206). Data for the assessment have been collected from secondary sources (available literature) and primary sources (telephone interviews and online survey). Due to the COVID-19 crisis resulting in travel restrictions, stakeholder consultations are carried out virtually. Data triangulation and verification have been conducted comparing multiple information sources (insights from data from literature have been validated through telephone conferences with key government counterparts). This assessment has led to identifying gaps to co-produce, deliver, communicate, use and evaluate salient weather and climate services as well as opportunities for improvement. It also resulted in establishing a baseline for M&E.

The second step is development of a NSP with an annexed action plan detailing costs and timelines for implementing the strategic plan. To ensure that the SNP supports the GMHS vision for risk-informed sectoral development, it is built on the insights from national consultations. The strategic and action planning template and guidelines from WMO have been used. The following alignment and scenario planning models have been followed:

- Alignment model, with the underlining thinking to align the GHMS' resources with its mission to ensure effective operations, used following steps: define vision, mission, and core values; conduct SWOT analysis; identify what is working well and what needs adjustment; identify how these adjustments should be made; include adjustments as strategies in the NSP; translate strategies into actions, indicating timelines and assign responsibilities; and develop a budget as well as a monitoring, evaluation and reporting system.

- Scenario planning model provides a framework for thinking about complex factors that influence decision making by answering “what if” questions, and included following steps: define vision, mission, and core values; identify external forces and their likely impacts; consider strategies to respond to possible changes; identify the most reasonable strategies; translate strategies into actions, indicating timelines and assign responsibilities; and develop a budget as well as a monitoring, evaluation and reporting system.

ANNEX 2: BASELINE QUESTIONS

CAPACITIES TO DELIVER AND USE WEATHER AND CLIMATE SERVICES

Joint GFCS Partner Advisory Committee baseline capacity assessment tool – assessing baseline capacities for the co-production, communication and use of weather and climate services at the national level. The main audience for this baseline assessment is national stakeholders with a role in the chain for weather and climate services, linking weather and climate knowledge to action at the national level. This includes NMHSs and technical sector experts, natural partners of NMHSs, across different climate-vulnerable sectors (agriculture, civil protection, health, water resource management, energy, transport, infrastructure, etc.) that are involved in the process of generating, tailoring and communicating weather and climate services. The sector specific knowledge of vulnerability and exposure of these partners helps to tailor weather, climate and hydrological forecasts received from NMHSs, transforming information (such as forecast of a heavy rain event) into a service (translation of what a heavy rain event will mean given the local context and advice on preventive measures to adopt). Other stakeholders to engage are professional communicators, extension agents, research institutes, provincial- and district-level planners and community based organizations, who all play a role in the national value chain for weather and climate services.

Weather and climate services thus encompass a range of activities that deal with information about past, present and future climate and on the impacts on natural and human systems. Weather and climate services include the use of simple information like historical climate datasets as well as more complex products such as weather forecasts and predictions on monthly, seasonal or decadal timescales and trends, also making use of climate projections over multiple decades according to different greenhouse gas emission scenarios. Finally, for them to constitute a true service, weather and climate services must provide advice and support on how to use weather and climate information in the decision making processes. Users of information produced by meteorological and hydrological services, in collaboration with their technical partners across the different climate vulnerable sectors, include national level planners and community level decision makers.

Weather and climate services rely on collaboration of multiple stakeholders and institutions at the national level, working together in a coordinated national value chain for weather and climate services, linking knowledge to action.

Capacity Requirements	Questions	
	National Level	Local Level (province/district/community)
National legislation on weather and climate services	Is there national legislation or a mandate organizing the delivery of weather and climate services?	Are there legal provisions regarding the delivery of weather and climate services at the local level?
Strategy/policy /plan	Is there an NSP /policy for weather and climate services? • Is it fully or partially enacted? • Does it have clear goals and responsibilities?	

	• Are roles and responsibilities for the generation, tailoring and communication of climate services at central and local levels clearly outlined? Is there a national Action Plan for weather and climate services? • Is it fully articulated with relevant plans of action (disaster risk reduction, food security, agriculture)? • Does it specify coordination mechanisms among national stakeholders including line ministries, sectoral users, NMHSs? • Does it set clear and achievable timelines by which activities must be finalized? • To what extent are gender issues addressed by national legislation/policy/strategy on weather and climate services?	
National Framework for Weather and Climate Services	What is the institutional position of the NMHS in the country? What are the institutional arrangements regarding the provision of weather and climate services at the national level (mandate, framework, coordination with other mechanisms)?	What is the institutional position of the NMHS at the local level? What are the institutional arrangements regarding the provision of weather and climate services at the local level?
Coordination mechanism	Is there a national coordination mechanism for weather and climate services? <i>If yes, please describe it</i> Is the national institution/service in charge of meteorological, climate and hydrological services a member of another coordination mechanism?	

	<i>If yes, please describe its roles and responsibilities</i>	
Early warning systems (EWSs)	Does a multi-hazard national EWS exist at the national level? What mechanisms are in place to support coordination of EWSs at both national and local levels? What is the position of NMHSs in the coordination mechanism for the EWS?	Does a multi-hazard national EWS exist at the local level?
User interface platforms	Does a framework exist enabling regular interaction among line ministries/sectors and NMHSs? Are interactions among NMHSs, sector technicians and national level users institutionalized or ad hoc?	Does a framework exist enabling regular interaction among local level users and NMHSs? Are interactions among local NMHS agents, sector technicians and local users institutionalized or ad hoc?
Role of research	Does a memorandum of understanding exist between meteorological and climate research universities/laboratories and NMHSs, enabling links among research and operational weather and climate services delivery? Which institutions are involved in weather and climate services research? What are the main weather and climate research projects ongoing? Are meteorological and climate research priorities driven by end user needs? Are coordination mechanisms in place with stakeholders involved in the national chain for weather and climate services delivery (NMHSs, line ministries)?	
Private providers	Are there other organizations (private, commercial, etc.) providing climate and/or hydrological services?	

	What is the institutional structure, at both national and local levels, for provision of early warnings?	
Resources	Are there adequate resources (office space, equipment, finance) at the disposal of the different agencies providing weather and climate services?	Are there adequate resources (office space, equipment, financial) at the disposal of the different local agencies providing weather and climate services?
Budget	Is the national Action Plan/policy/strategy on weather and climate services funded from the national budget or supported by donors? Is it adequately funded? Are there funding gaps?	

ANNEX 3: ACTION PLAN

Key				
High priority to be addressed immediately				
Medium priority, to be addressed following high priority items				
Low priority, to be addressed in due course				
Outcome 1: Improved institutional environment and capacity to deliver effective weather, water, climate, and ocean services				
Key indicators: 1 Act endorsed, licensed ground water and surface water observations, concept of operations and SOPs prepared				
Outputs	Activities	Time frame	Responsibility	Cost (USD)
1.1. Legislation, regulation and act endorsed	Endorse Hydrometeorological Act and ensure linking it to other acts and policies	2022-2023	GHMS, GOG, WMO	\$50,000
	License ground water and surface water observation and uses	2022-2023	GHMS	\$50,000
1.2. End-to-end impact based multi-hazard early warning system in place	Design end-to-end impact based multi-hazard early warning systems	2022	GHMS	\$100,000
	Develop procurement and implementation plan for end-to-end impact based multi-hazard early warning systems	2022-2023	GHMS	\$200,000
	Establish plans to upgrade existing GHMS’s ICT systems for effective early warning system	2022	GHMS	\$100,000
	Develop concept of operation for weather, water and climate service	2022-2023	GHMS	\$100,000

1.3. Concept of operations developed, and SOPs are improved	Develop/documentation of SOPs for Weather, Water and Climate related hazards	2022-2024	GHMS	\$50,000
Outcome 2: Strengthened infrastructure capacity of GHMS to deliver effective weather, water, climate, and ocean services				
Key indicators: AWS, agro stations, and water level gauge installed, Risk assessment for multiple hazards conducted, database operational, indigenous knowledge recorded, nationwide SMS dissemination, drought monitoring systems improved, climate smart livestock early warning system developed water quality index developed				
2.1. Observation, modelling, forecasting, hazard detection and hazard assessment infrastructures capacity enhanced	Establish data and forecast repository for weather, water and climate change as well as historical disaster data	2022-2024	GHMS, GOG	\$100,000
	Conduct detailed risk assessment and roadmaps for multiple hazards mitigation, ground water and surface water risk to climate change	2022-2025	GHMS, GOG	\$250,000
	Strengthen marine weather observation	2022-2025	GHMS, GOG	\$50,000
2.2. Upgraded observation (meteorology, hydrology and ocean, data management, IT, and early warning system) functioning	Expand AWS, agro stations, water quality sensor and water level gauges by installing new equipment's in the areas that has limited coverage	2022-2024	GHMS	\$350,000
	Conduct routine assessment of data management and IT systems	2022-2026	GHMS	\$70,000
	Establish fully operational comprehensive database that collects weather, climate and water related information along with other hazard-related information	2022-2023	GHMS, GOG	\$200,000
	Gather indigenous knowledge on weather, water, climate, and ocean forecast and incorporate it in the database	2023-2024	GHMS	\$100,000

	Enhance IT systems by upgrading or introducing new technology if needed	2022-2026	GHMS, GOG	\$300,000
	Enhance the information disseminated in the warnings (accurate and easy to understand)	2022	GHMS, ICT	\$30,000
	Improve GHMS' ICT systems for effective early warnings	2023-2024	GHMS, WMO	\$250,000
	Strengthen CAP protocols to ensure linkage multiple communications such as mass SMS, FB, twitter, etc	2022	GHMS, GOG, CDC	\$30,000
	SMS warning dissemination system to be enhanced for sending timely warning across the nation	2022	GHMS	\$100,000
	Improve drought monitoring system	2023-2025	GHMS	\$50,000
	Develop climate smart livestock early warning systems	2023-2025	GHMS	\$100,000
	Upgrade GHMS's website/ mobile app	2022	GHMS	\$100,000
2.3. Weather and water level observation systems well-maintained	Develop maintenance and operational plan with approved funding application	2022-2023	GHMS	\$20,000
	Conduct routine assessment of weather observation networks	2022-2026	GHMS	\$50,000
	Conduct routine assessment of water level observation networks	2022-2026	GHMS	\$50,000
2.4. Tailor made information developed	Collaborate with sectoral users to capture their needs on weather, water, climate, and ocean services	2022	GHMS	\$50,000

	Develop farmers database, and provide tailored climate information	2023-2025	GHMS, Ministry of Agriculture	\$50,000
	Develop drought modelling/crop modelling/agro-ecological modeling/ heat impact/ hydrological/aquifer modelling	2022-2024	GHMS, CIMH	\$200,000
	Develop water quality index	2022-2024	GHMS, CIMH	\$100,000
	Develop systems to disseminate information to the key stakeholders tailored based on their needs	2022-2023	GHMS	\$200,000
Outcome 3: Strengthened partnerships with stakeholders and inter-agency coordination and communication				
Key indicators: Training for NGO, and private stakeholders conducted, Schools and community educated, Awareness campaign on climate smart livestock early warning system conducted, Routine interactions, Formal links, Workshops and training opportunities, Alliance, Joint projects				
3.1 Stakeholders and communities understand early warnings and impact based forecasts, and acts accordingly	Educate communities on early warning systems and impact based forecasting	2022-2026	GHMS, CDC	\$50,000
	Provide education to schools on early warning systems and impact based forecasting	2022-2026	GHMS, CDC	\$50,000
	Conduct training and workshops for private stakeholders and NGOs on forecast and information dissemination to community in partnership with regional and international organization	2022-2025	GHMS, CIMH, and other relevant stakeholders	\$100,000
	Conduct workshops for establishing collaboration between the users and providers of weather, water, climate, and ocean services	2022	GHMS, CIMH, and other relevant stakeholders	\$50,000

	Conduct awareness campaign on climate smart livestock early warning system	2022-2026	GHMS, GOG	\$30,000
3.2. Partnerships improved with different entities	Increase routine interactions with all stakeholders on weather, water, climate, and ocean change	2022-2026	GHMS	\$20,000
	Establish formal partnership between the GHMS and offshore oil and gas industry to provide weather, water, climate, and ocean services	2022-2024	GHMS, and other relevant stakeholders	\$100,000
	Establish strong formal links with DECC involved in climate information management services to enhance seamless data integration for impact based forecast	2022-2024	GOG, CDC, DECC	\$100,000
	Create alliance between Department of Environment and Climate Change and CDC and other organizations for collaborative approaches to pursue joint projects	2022-2024	GHMS, GOG	\$100,000
3.3. Media and community based organisations engaged	Engage with media for effective dissemination of early warnings and impact based forecasting	2022-2024	GHMS, GOG	\$50,000
	Collaborate with community focused organisations to assist in capacity building	2022-2024	GHMS, CDC	\$100,000
Outcome 4: Improved human capacity of GHMS to deliver effective weather, water and climate services				
Key indicators: ISO certification, Train 37 staff, education to media, workshop				
4.1 Quality management system implemented	Obtain certification of compliance with ISO 9001:2015 and endorse it	2022-2024	GHMS	\$100,000

	Endorse the certification process undertaken by water quality laboratory	2022	GHMS, GOG	\$10,000
4.2. Capacity for observation, hazard detection and assessment improved	Train 5 employees on hydrological/water quality/ecological modeling	2022-2024	GHMS, GOG, WMO	\$50,000
	Train 2 staff on data management	2022-2024	GHMS	\$20,000
	Train 5 staff on calibration of observation stations	2024	GHMS, GOG	\$50,000
	Train 10 staff on weather forecasting	2022-2023	GHMS, GOG	\$100,000
	Train 10 staff on climate modeling/impact assessment	2022-2023	GHMS, GOG	\$100,000
	Educate media on warning dissemination to improve public awareness	2022-2026	GHMS, GOG	\$50,000
	Provide refresher training to Met observers on meteorological observation	2022-2024	GHMS, GOG	\$50,000
4.3. Telecommunication staff's capacity enhanced	Train 5 telecommunication and engineering staff for effective dissemination of forecasts and other-related information	2022-2025	GHMS, GOG	\$30,000
Total				4,760,000

ANNEX 4: LIST OF PERSONS/ORGANIZATIONS CONSULTED

Name	Organization
Haymawattie Danny	GMHS
Lt. Col. Craig Kester	Civil Defence Commission
Garvin Cummings	GMHS
Mr. Gavin Agard	Ministry of Natural Resources
Natasha Beerjit-Deonarine	Ministry of Agriculture
Raja Gokhul	Office of the President
Nasheta Dewnath	Guyana Forestry Commission
Denzil Roberts	Fisheries Department, Ministry of Agriculture
Salim October	Civil Defence Commission
Mrs. Janelle Christian	Department of Environment and Climate Change
Ms. Harris	Telecommunication
Mr. Baksh	Water resource
Adrian Trotman Roché Mahon	CIMH
Arlene Laing	CMO
Rodney Martinez Guingla	WMO



ANNEX 6: REFERENCES

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