

I. STRATEGIC CONTEXT

A. Country Context

1. **Jamaica is a small Caribbean island country with a population of 2.715 million people (2013) and gross national income per capita of \$5,220 (2013)**¹. The country is well endowed with natural resources – marine assets (fish, coral reefs and beaches), fertile soils and high value minerals. The key sources of foreign exchange are tourism (about 1.9 million tourists each year for the past 10 years), remittances, and bauxite mining (the fifth largest exporter of bauxite in the world.) The Millennium Development Goal of universal primary education has been achieved, life expectancy at birth is 73 years and the country is on track for eradicating extreme hunger. Jamaica's ranking on the United Nations' Human Development Index (HDI) in 2014 is 96th out of 187 countries with a score of 0.715, compared with the 1995 HDI of 0.728 and a ranking of 101 out of 159 countries.

2. **Jamaica's economic performance has been less than expected, despite Jamaica's rich endowment of natural assets, its proximity to US markets and foreign direct investment** (averaging 3.2% of GDP over the last five years). During 1973-2007, annual average economic growth was 0.8% while labor productivity declined by 1.5%. It is among the most indebted countries in the world with a public debt-to-GDP ratio at 137% in March 2015. The sustained, high public debt service obligations and associated large refinancing needs have spiked the country's risk premiums, partially crowding out and distorting private sector investment, and left the country vulnerable to shifts in market sentiment. Consequently, very low growth, high public debt, and serious social challenges have persisted over the past three decades.

3. **The poorest Jamaican households were disproportionately affected by the economic contraction.** Poverty continued to rise moving from 17.8% in 2010 to 19.9% in 2012. Among poor households, 52.3% was headed by females and the poverty rate for female-headed households also rose from 13.8% in 2010 to 15.9% in 2012. By region poverty remained highest in Rural Areas (21.3%) although it was slightly lower than in 2010 (23.2%). The unemployment rate was 14.3% in 2012 being higher among females (17.8%) than males (10.3%). Youth unemployment was high, 42.6% among young females compared to 27% among young males.

4. **Since May 2013, the Government of Jamaica (GOJ) has been undertaking strong macro-economic and financial sector regulatory reforms** to tighten fiscal policy and achieve increased local tax revenues, with support from an International Monetary Fund (IMF) US\$932 million Extended Fund Facility for the period of April 2013 to March 2017. The World Bank (WB) and the Inter-American Development Bank (IDB) each indicated support of US\$510 million to Jamaica for the same period. Together, the three multilateral organizations are supporting a set of ambitious structural reforms designed to stabilize the economy, reduce debt and create the conditions for growth and resilience. The GOJ is also implementing a comprehensive debt management strategy including the take out of high interest Government bonds with lower yielding, longer term debt, aimed at reducing public debt and containing public sector interest costs.

¹ World Development Indicators, The World Bank.

B. Sectoral and Institutional Context

5. **Jamaica is one of 18 countries² participating in the Pilot Program for Climate Resilience (PPCR).** The PPCR—a funding window of the Climate Investment Funds (CIF)—helps developing countries integrate climate resilience into development planning, provides incentives for scaled-up action, and initiates a shift from “business as usual” to broad-based strategies for achieving climate resilience at the national and regional levels. As Phase I of the PPCR, Jamaica developed the Strategic Program for Climate Resilience (SPCR) to assess sectoral vulnerabilities to climate impacts, identify priority sectors and action plans, and propose investment components for PPCR finance. The proposed Project is the first of the three investment projects identified under the SPCR. The Jamaica SPCR including the financing to these projects was approved by the CIF in October 2011.

6. **Natural disasters and vulnerability to climate change have been identified as major challenge to economic growth of Jamaica.** The country lies within a region of traditionally high hurricane activity and experiences frequent direct impacts and indirect storm damages. Between 2001 and 2012 Jamaica experienced 11 storm events (including 5 major hurricanes) and several flood events. These events combined resulted in loss and damage amounting to approximately J\$122 billion³. In one case (Hurricane Ivan, 2004) the loss was equivalent to 8.0% of GDP. The damage and losses result in a heavy fiscal burden, increased indebtedness, and redirection of resources from medium-term development plans. Approximately 82% of the population lives in coastal towns and communities located within 5 km of the 1,022 km long coastline. The coastal zone contains an estimated 75% of productive industries and service sectors and is responsible for contributing an estimated 90% to the country’s GDP. Settlement patterns and location of major infrastructure along the coast increase vulnerability to natural hazard impacts. Also, inadequately managed urban growth has contributed to unplanned settlements in marginal and environmentally sensitive lands in flood plains and on unstable slopes. Environmental degradation of watersheds and coral reefs has decreased the ability to provide critical environmental services such as coastal protection from storm surge.

7. **Jamaica’s vulnerability to global climate change will likely increase in a number of ways.** Based on recent projections by the Intergovernmental Panel on Climate Change (2013), small island countries such as Jamaica will be severely threatened by the direct and indirect impacts of climate change, most of which are projected to accelerate in the coming decades. Jamaica is estimated to have a high economic risk exposure to two or more natural hazards: 96.3% of the national population is exposed to two or more hazards, as is 94.9% of the national territory and 96.3% of the country's GDP⁴. The World Bank’s *Turn Down the Heat Report No. 3* (2014) identifies key climate risks in the Caribbean region to include higher El Niño Southern Oscillation (ENSO) and tropical cyclone frequency, precipitation extremes, drought, and heat waves. Data

² The Caribbean countries participating in the PPCR are: Jamaica, Haiti, St Lucia, Grenada, Dominica, and St. Vincent and the Grenadines. The PPCR is being implemented by the WB, the IDB, and other multilateral organizations and involves both public and private sector entities and Non-Governmental Organizations (NGOs).

³ Derived from Damage and Loss Assessment Reports for various events, PIOJ.

⁴ Disaster Risk Management in Latin America and the Caribbean Region: GFDRR Country Notes, Jamaica, 2010, Global Facility for Disaster Reduction and Recovery (GFDRR)/the World Bank.

from climate models downscaled⁵ for Jamaica as part of the SPCR also indicates that the country likely will experience significant changes in temperature, precipitation and sea level rise by 2050. The models predict that by 2050 increased climate variability likely will result in 20% increase in the frequency of intense rains. Flooding of interior basins is common after intense rainfall due to a distinctive drainage pattern characterized by the mountainous interior surrounded by mostly narrow coastal plains. On the other hand, the country will be drier in the mean (up to 60% by 2080) due to a decrease in rainfall during the traditional wet period (May through November). These will lead to risks of reduced water availability, crop yields, food security, and coastal safety. Furthermore, the country will likely suffer from accelerated coastal erosion in some areas caused by sea level rise; increased flood risk leading to loss of land and disruption to productive sectors and social infrastructure, most importantly health centers and hospitals which directly impacts the population during and after major climate-related events; saline intrusion into coastal water tables; loss of protective coastal systems such as coastal vegetation and coral reefs partly due to higher ocean surface temperatures and acidification; consequently loss of livelihoods, especially in climate-and weather-sensitive sectors such as tourism, agriculture and fisheries. Slope instability is characteristic of many areas, and intense rainfall combined with deforestation and inappropriate land use practices gives rise to degraded conditions to make landslide vulnerability another feature of Jamaica's hazard profile.

8. The poor are particularly vulnerable to climate change impacts due to the heavy reliance on climate sensitive sectors. Groups that are vulnerable to climate change impacts include the rural population including farmers whose economic productivity are weather-dependent, providing the bulk of labor in food production activities and are most likely to be directly impacted by food security issues. Especially, a large proportion of the poor in Jamaica lives in upland areas and are engaged in climate-sensitive small-scale agriculture. Among the rural population (46% of total), poverty remains relatively high (21.3% in 2012) and women, who make up 48.1% of the rural poor, provide the bulk of labor in food production activities, and are the primary vendors of crops and of fish, are most likely to be directly impacted by food security issues. Also a large population of the poor living in coastal areas is exposed to risks of hurricanes and storm surges, and those living in watersheds are prone to water shortage or flooding. Moreover, poor areas have lower levels of protective infrastructure, and housing is of low quality and is much less likely to withstand a flood or hurricane. Climate-related disasters and climate change impacts will likely exacerbate existing gender inequalities as poor women are amongst the hardest hit by the effects.

9. The proposed Project would establish the critical foundation for the country's efforts to integrate climate change in decision-making process by improving hydro-met data collection and capacity to deliver relevant information services. Jamaica's current capacity to develop appropriate climate adaptation measures is critically limited due to inadequate capacity and resources to collect reliable climate data. Jamaica's hydro-met system managed principally by the Meteorological Service Jamaica (MSJ) and the Water Resources Authority (WRA) has deteriorated over time as a consequence of inadequate financial resources for appropriate levels of

⁵ Global Circulation Models (GCMs) used for climate projections are run at coarse spatial resolution and need to be downscaled to better represent the influence of topography and regional climate patterns, especially for small islands, on both the average and variation in climate and to more accurately and completely assess future climate impacts.

maintenance or for replacement and expansion of the capital stock of equipment. The original network of 23 climatological stations has dwindled to six functioning stations⁶. The 16-year old Doppler Weather Radar at Cooper's Hill managed by MSJ is obsolete and subject to periodic malfunctions. Capacity to process hydro-met data, develop products, and deliver information and services is not at sufficient level. Upgrading these systems and providing necessary training to these public hydro-met data providers will greatly enhance the capacity of the country to predict and prepare for various climate-related and natural hazards. This is paramount for increasing the resilience of Jamaica to climate impacts and ultimately for promoting sustainable economic growth of the country.

10. **The health sector as well as agriculture and water sectors are among the priority sectors identified in the SPCR as vulnerable to climate change.** The proposed Project would support the preparation of vulnerability assessments of the selected priority sectors, particularly the health sector by supporting the preparation of a costed resilience strengthening plan for climate-proofing the nation's health facilities and operations. Jamaica's 2.7 million people are served by a health-care system comprising 313 health centers and 23 hospitals. The climate-proofing of the sector is currently marginal, resulting in substantial structural damages and disruption to business continuity in the event of hurricanes and natural disasters. Furthermore, the country has experienced many outbreaks of vector borne diseases, particularly dengue fever, and more recently, the Chikungunya Virus which are spread by mosquitoes. The climate is conducive to the development of the larvae which require sufficiently high temperatures and rainfall. Further increases in temperature coupled with unpredictable rainfall patterns are likely to exacerbate these conditions and result in increased incidence of diseases.

11. **The focus on agriculture and water sectors is equally critical** since (a) some of the most vulnerable and poor communities in Jamaica are farmers, (b) food security in Jamaica is closely linked to the impacts of climate variability and change (e.g., pests and increasingly longer droughts, floods, storms) which affect productivity, and (c) Jamaica is increasingly faced with either too much water (due to heavy and intense rainfall leading to floods) or too little water (due to frequent droughts). The economy-wide knock-on effects of reduced agricultural productivity and or too little/too much water tend to be negative almost always and in most cases increases the vulnerability of poor communities/households to climate related hazards. Jamaica's SPCR clearly articulated some of these issues and the Project is designed to contribute to implementing measures in areas that were consultatively identified in the SPCR as priority sectors.

12. **The methodologies and outcomes obtained under the proposed Project would be shared with and replicated by the Government and other players in other priority sectors identified in the SPCR** through the companion projects and other climate and disaster risk management initiatives in Jamaica. The other project proposed under the SPCR is *the Adaptation Program and Financing Mechanism for the PPCR Jamaica project* (formerly *the Institutional Mainstreaming and Sectoral Adaptation project* and *the Climate Change Adaptation and Disaster Risk Reduction Financing project*) (US\$10 million in loan and US\$7.90 in grant) supported by the IDB. The other complementary operations in Jamaica include *Enhancing the Resilience of the Agriculture Sector and Coastal Areas to Protect Livelihoods and Improve Food Security* (Adaptation Fund, US\$9.97 million grant), *the Promoting Community-based Climate Resilience in the Fisheries Sector Project* (WB P151302, US\$5 million grant), *the Adaptation Program and*

⁶ Under Phase I of the PPCR, the expansion and upgrading of the network commenced.

Financing Mechanism for the PPCR Jamaica Project (IDB, US\$17.9 million grant and loan), and the Caribbean regional-track PPCR project (IDB, US\$10.5 million grant) (see Annex 2 for more details).

C. Higher Level Objectives to which the Project Contributes

13. **The proposed Project would directly contribute to the Government's national strategy in addressing climate change—*Vision 2030 Jamaica - National Development Plan*, specifically Outcome No. 14: Hazard Risk Reduction and Adaptation to Climate Change.** *Vision 2030 Jamaica* – National Development Plan sets out that this is to be achieved through “greater emphasis on hazard risk management activities and programmes for reducing our existing and future vulnerability. ...[I]ncorporate climate change scenarios in future economic and land use planning and provide a framework to ... reduce the risks associated with natural hazards by integrating hazard considerations into our country's development planning”.

14. **The Project objective is aligned with the PPCR's objective to pilot and demonstrate ways in which climate risks reduction and resilience building may be integrated into core development policies and plans at the national and local levels.** The proposed activities are also in concert with the five thematic areas of the Jamaica SPCR, namely (i) mainstreaming climate change into Jamaica's planning and policy formulation processes; (ii) strengthening institutional arrangements to ensure the effective mainstreaming of climate change; (iii) building capacity for climate data management, forecasting and planning; (iv) facilitating sectoral adaptation measures; and (v) climate change education and awareness. The Project's awareness program will use proven innovative approaches including the use of demonstration projects and the creative music/arts. The PPCR financing will cover the additional costs of “public good” benefits from the proposed activities to update and rehabilitate of hydro-met networks, flood and drought early warning messaging, and strategic sector planning of pre-emptive humanitarian responses.

15. **The Project's goal to help the country transform to a climate resilient development path is consistent with the PPCR objective and the WB's twin goals to end extreme poverty within a generation and boost shared prosperity in a sustainable manner** by directly supporting the vulnerable groups of the Jamaican population to be able to utilize improved climate and weather information and to adapt current and future livelihood activities to the variability brought about by climate change (see Paragraph 7 for the description of vulnerable groups.)

16. **The proposed Project is also consistent with the World Bank Group's Country Partnership Strategy (CPS) for Jamaica FY2014-2017** (Report No. 85158-JM, discussed by the Executive Directors on April 29, 2014) that underscores the need to addressing climate change vulnerabilities as a condition for fostering sustained improvements in shared prosperity. The proposed Project would contribute to achieving the CPS' Theme 3: Social and Climate Resilience, Outcome 8: Improved institutional capacity to plan and respond to climate change events and natural disasters, in particular (i) building institutional capacities to identify, assess and understand disaster and climate risks in terms of their economic and fiscal impacts.

II. PROJECT DEVELOPMENT OBJECTIVES

A. PDO

15. The Project Development Objective (PDO) is to improve the quality and use of climate related data and information for effective planning and action at local and national levels.

B. Project Beneficiaries

16. **The main beneficiaries of the proposed Project would be public sector providers of weather, climate, and hydrological data and related information services, and its users in Jamaica and elsewhere.** The primary public sector provider is the Ministry of Water, Land, Environment and Climate Change (MWLECC), in particular the Meteorological Service Jamaica (MSJ) and the Water Resources Authority (WRA) which are responsible for data collection, processing, management, and operation and maintenance (O&M) of equipment. MSJ and WRA would benefit from capacity building and direct investments to be made in new and replacement equipment. These investments also would benefit the data collection needs of the Rural Agricultural Development Authority (RADA) in the Ministry of Agriculture and Fisheries (MOAF) and the information management capacity of the climate and risk data node of the National Spatial Data Management Division (NSDMD) under the MWLECC.

17. **Various end users with different intentions would benefit from hydro-met and agro-met data and information services,** including the agricultural commodity boards and farmers, the Ministry of Health and health facilities, tourism centers (hotels), civil aviation authority and airlines, and the Coast Guard. It would also provide the data sets needed for the economic activities of the private sector such as insurance, construction, and engineering companies. More broadly, given the public goods nature of hydro-meteorological services, the population as a whole would benefit from better warnings of hydro-meteorological hazards and more accessible, timely and quality-assured climate information and services (see Annex 3 for more details).

18. **Climate-related disasters and climate change impacts may exacerbate existing gender inequalities as women,** especially poor women, lacking capital assets buffers⁷ and access to credit, are often times amongst the hardest hit by the effects. In Jamaica, most of the women involved in agriculture are practicing subsistence farming and many are involved in the services sectors and so are at higher risk than men to unemployment and income loss as a result of climate change impacts. Improvement in the climate information database and institutional mechanisms for effectively disseminating early warning messages and agricultural knowledge and adaptation interventions would assist poverty reduction and food security issues and by extension, be of direct benefit to both male and female-headed households, agricultural workers and fishers/fish vendors.

19. **There would also be considerable benefits to the international hydro-met community** which would be able to access more reliable observation data from the Jamaica territory, contributing to more accurate regional forecasting and planning throughout the Caribbean region. Particularly, the partners of the PPCR Caribbean Regional-track project, including University of West Indies (UWI), Caribbean Institute for Meteorology and Hydrology (CIMH), Caribbean Meteorological Organization (CMO), Caribbean Agricultural Research and Development Institute

⁷ The average land space utilized by female farmers is 1.4 hectares in comparison to an average of 2.6 hectares of land cultivated by male farmers.

(CARDI), Caribbean Regional Fisheries Mechanism (CRFM), Caribbean Environmental Health Institute (CEHI), and Caribbean Disaster Emergency Management Agency (CDEMA) would directly benefit from the outcomes of the Project.

C. PDO Level Results Indicators

20. The key performance indicators for the proposed Project are the following:
- (i) Increased satisfaction of the users of improved climate data and information services⁸;
 - (ii) Integration of climate data and information into a health sector plan⁹; and
 - (iii) Number of people (disaggregated by gender) supported by the Project to cope with climate change and risks, specifically through targeted early warning messaging for vulnerable groups and other measures¹⁰.

III. PROJECT DESCRIPTION

A. Project Components

21. **Component 1: Upgrading Hydro-Meteorological Data Collection, Processing and Forecasting Systems (US\$4.009 million).** This component will support investments for upgrading and providing critically needed new equipment, systems, and operator training for data collection, and processing for improved hydro-meteorological and agro-meteorological forecasts in order to ultimately enhance the availability and reliability of data for climate change scenario modelling, risk analysis and warning systems, and knowledge sharing. The Project will support carrying out activities to upgrade existing and/or provide new systems for hydro-meteorological data collection, processing and forecasting, including: (a) supplying and installing equipment for sea-level monitoring, meteorological, hydrological, and agro-meteorological activities, provision of training for staff of MSJ, WRA, RADA and voluntary observers of the monitoring network on operation and maintenance of the equipment; and purchasing of spare parts; (b) replacing the outdated weather Doppler radar, including rehabilitation of the Cooper's Hill station facility and training of MSJ staff in operation and maintenance of the new radar; (c) strengthening the capacity of staff of MSJ, WRA and RADA on data management, quality assurance of data collection, processing, and weather forecasting through provision of consulting services and training.

22. **Component 2: Climate Resilient Planning and Hydro-meteorological Information Services (US\$1.386 million).** This component will provide technical assistance support to promote Jamaica's readiness for climate events through: (a) updating the downscaled high resolution¹¹ climate change scenarios and using said scenarios to prepare the State of the Jamaican Climate 2015 and 2019 reports (including the summary for policy makers); and provision of

⁸ This contributes to PPCR Core Indicator #4: Extent to which vulnerable households, communities, businesses and public sector services use improved PPCR supported tools, instruments, strategies and activities to respond to climate variability or climate change.

⁹ This contributes to PPCR Core Indicator #1: Degree of integration of climate change in national, including sector, planning.

¹⁰ This contributes to PPCR Core Indicator #5: Number of people supported by the PPCR to cope with the effects of climate change.

¹¹ The country specific modeling would be to a 10 km² grid with some mid-century time slices at 4 km² grid where possible. The resolution will depend on available data and cost.

training on sector specific climate resilient planning based on said scenarios; (b) preparing national vulnerability assessments in selected priority sectors to complement the modeling outputs mentioned above and to define priorities and actions on climate resilience; (c) preparing detailed health sector vulnerability assessments and costed resilience strengthening plans to assist health facilities and operations withstand and respond to climate related hazards; (d) carrying out a community-based risk profiling to assess the communities' vulnerability to various climate related hazards and developing early warning messaging for vulnerable groups; and (e) upgrading the multi-agency climate and natural risk data and information sharing system to integrate climate data and making the data user friendly and accessible to the public.

23. **Component 3: Climate Change Education and Awareness towards Behavioral Change (US\$0.725 million).** This component will provide technical assistance support to promote climate change awareness at the national and local levels through (a) carrying out climate change information, education and communication (IECC) campaigns, and (b) conducting targeted attitude and behavioral change initiatives to address climate change adaptation needs and influence behavioral change of targeted groups, as part of the Communications Strategy Action Plan developed under the PPCR Phase 1. Campaigns are aimed at influencing and bringing about changes in attitudes and behavioral practices to assist targeted groups to adopt practical means of coping with severe weather events, climate variability and climate change.

24. **Component 4: Project Management, Monitoring and Evaluation (US\$0.68 million).** This component will provide support to PIOJ for Project implementation, including overall technical management, financial management, procurement, environmental and social safeguards implementation, monitoring and evaluation of Project activities, data collection, supervision of works through the provision of consulting services, non-consulting services, goods, and Operating Costs.

B. Project Financing

25. The Project would be financed by the PPCR under the Strategic Climate Fund Grant of the Climate Investment Funds in the amount of US\$6.8 million and in-kind contribution by the Government in the amount of US\$0.7 million. The financing instrument would be an Investment Project Financing.

Table 1: Project Cost and Financing (US\$ million)

Project Components	Total Project Cost	PPCR Financing	% Financing
1. Upgrading Hydro-Meteorological Data Collection, Processing and Forecasting Systems	4.009	4.009	100
2. Climate Resilient Planning and Hydro-meteorological Information Services	1.386	1.386	100
3. Climate Change Education and Awareness towards Behavioral Change	0.725	0.725	100
4. Project Management, Monitoring and Evaluation	1.38	0.68	49%
Total Costs			
Total Financing Required	7.5	6.8	91%

26. Withdrawals up to an aggregate amount not to exceed \$300,000 equivalent may be made for payments made prior to the date of the Grant Agreement but on or after May 22, 2015, for Eligible Expenditures.

C. Lessons Learned and Reflected in the Project Design

27. **It is important to engage partner agencies and community groups from the beginning of the project preparation in order to foster their buy-in.** (EU/Global Climate Change Alliance: Climate Change Adaptation and Disaster Risk Reduction Project in Jamaica¹².) Since the proposed Project will be implemented by multiple agencies, a Focal Point and a core team in each Technical Implementing Agency have been designated. The Planning Institute of Jamaica (PIOJ) managed the Project Preparation Grant for the proposed Project and has gained the capacity to handle the fiduciary responsibilities which will be conducive to the readiness for the Project implementation. As part of Project preparation, Panos Caribbean—a non-governmental organization (NGO) specialized in mass communication on sustainable development issues—was involved to advance communication and awareness raising activities.

28. **The readiness and ability of countries to increase their resilience to climate change impacts greatly depends on the institutional capacity, knowledge of vulnerabilities and risks and their preparedness to reduce these vulnerabilities and risks.** (WB: Mainstreaming Adaptation to Climate Change Project, 2009, Report number: ICR00001163). These are the core design of the proposed Project. The proposed Project has already developed a Communications Strategy Action Plan in order to foster true partnership of various stakeholders and create strong country ownership.

29. **The Project-funded behavioral change campaigns would consider different strategies for men and women** based on their different needs and circumstances and will make use of lessons learnt from recent climate change awareness projects to reach vulnerable groups. (USAID/Jamaica Rural Economy and Ecosystems Adapting to Climate Change Project, the Voices for Climate Change, and EU Communication Project)

30. **In 2005, a baseline knowledge, attitudes and practices (KAP) survey was carried out to ascertain knowledge and views in Jamaica regarding the causes and impacts of climate change and the measures people could take in their own lives to adapt.** A subsequent KAP survey was carried out in 2012 under Phase 1 of the PPCR. Recommendations emerging from the results of the 2005 and 2012 surveys indicated that there was need for “creative and bold” messaging to change present behavioral practices, to foster stronger inter-agency collaboration and partnership to implement climate readiness strategies and to formulate practical interventions for changed practices. The proposed Project would focus on influencing changes in attitudes and promoting specific behavioral practices amongst targeted groups to adopt practical means of coping with climate change.

¹² <http://www.gcca.eu/national-programmes/caribbean/gcca-jamaica>

IV. IMPLEMENTATION

A. Institutional and Implementation Arrangements

30. **The Planning Institute of Jamaica (PIOJ)**, a statutory body within the Ministry of Finance and Planning, is the executing agency for the proposed Project. The PIOJ plays a number of critical roles including sustainable development planning, overseeing the implementation of *Vision 2030 Jamaica – National Development Plan*, and is the national Focal Point for the PPCR and for the implementation of the proposed Project developed under the SPCR¹³. As the executing agency, the PIOJ will establish a central executing and fiduciary services unit (PIU) to be responsible for coordinating all activities of the proposed Project and to provide fiduciary support to the Technical Implementing Agencies.

31. **The Government has established an umbrella PPCR Steering Committee (PPCR-SC)** to serve as the main body responsible for providing advice and oversight to the implementation of PPCR and other associated projects. Under the proposed Project, the PPCR-SC would serve as the Project Steering Committee to be responsible for ensuring that the Project is effectively and expeditiously implemented in line with its development objectives, results framework and budget, and for ensuring coordination among the various agencies and addressing any inter-agency strategic level issues and risks that may adversely affect the implementation of the Project. The PPCR-SC will review relevant Project documents for endorsement on an ‘absence of objection’ basis (AOB) within a defined timeframe, not to exceed 8 working days in order to ensure expeditious execution of the Project. The PPCR-SC is chaired by the PPCR Focal Point—currently the Deputy Director General, Sustainable Development and Regional Planning of the PIOJ. Members of the PPCR-SC are drawn from a cross-section of stakeholders with technical interest in and knowledge of natural hazards, risk and climate change issues, including relevant Government Ministries, Departments and Agencies, private sector bodies, academia, and civil society. International development partners are offered observer status on the Committee.

32. **Direct responsibility for and technical oversight of the various components of the Project will be assumed by the respective Technical Implementing Agencies**, namely MSJ, WRA, Climate Change Division (CCD) and NSDMD under the MWLECC, RADA under the MOAF, the Office of Disaster Preparedness and Emergency Management (ODPEM) under the MLGCD, and the Emergency, Disaster Management and Special Services Branch (EDMSS) under the Ministry of Health (MOH). Each Technical Implementing Agency has nominated a Project Focal Point to coordinate and oversee day-to-day Project activities and report to the PIU.

B. Results Monitoring and Evaluation

33. **The PIOJ through the PIU in collaboration with the Technical Implementing Agencies will be responsible for the overall monitoring and evaluation (M&E) of the Project activities.** The M&E plan will form a part of the annual work plan of the PIU and the Technical Implementing Agencies. The M&E indicators, targets, data collection methodology, etc. are presented in Annex 1 Results Framework. M&E of Project implementation will be conducted

¹³ In addition to the three PPCR-funded projects, the PIOJ managed the recently completed EU-funded *Climate Change Adaptation and Disaster Risk Reduction Project* and is currently managing Jamaica’s Adaptation Fund Program: *Enhancing the Resilience of the Agriculture Sector and Coastal Areas to Protect Livelihoods and Improve Food Security*.

through: (a) routine activities of the PIU and the Technical Implementing Agencies; (b) semi-annual progress reviews by the PPCR-SC; (c) progress reviews during World Bank implementation support missions; (d) mid-term review of Project implementation; and (e) terminal evaluation to be conducted jointly by the PIOJ/PIU and the Technical Implementing Agencies, and the PPCR-SC. The Implementation Completion and Results Report (ICR) will be prepared within six months after closing of the Grant based on, among other things, the terminal evaluation report prepared by the Government.

C. Sustainability

34. **The sustainability of the proposed Project is expected to be high.** This is because the Project is designed as part of a larger climate resilience program for Jamaica, namely the PPCR, to complement the other PPCR projects and the Caribbean Regional-track project. This would provide the proposed Project a better chance of sustainability than being a stand-alone operation. The Project's outcomes would also contribute to the on-going and future WB investment projects on climate resilience, disaster risk management and community development. These projects altogether would build long-term climate resilience of Jamaica's economy and society (see Section B and Annex 2).

35. **Ultimately, it is the demand from users (other government agencies and the public at large) for useful end-products that will ensure sustainability of the investments.** To this end, detailed technical studies were undertaken and recommendations agreed with the Implementing Agencies as part of Project preparation, e.g., required specifications for hydro-met equipment based on the international standards, the coverage needs of various types of equipment; the standardization of equipment (for ease of operators and holding of spare parts); the introduction, where appropriate, of specialized open-source software; and the coordinated record keeping for long term/historic data collection.

36. **Also, the Project would seek to secure increased resources for the data provider agencies (MSJ, WRA, and RADA) for the operation and maintenance (O&M) of the modernized observing system to ensure its sustainability.** This is a critical issue which is often overlooked in many developing countries, leading to inadequate conditions after the Project financing ends. Considering the current fiscal constraints, it might affect the sustainability of the Project investments. However, the Government has been securing the O&M budget in the past for more than 20 years and continues to show its willingness to support the O&M costs. Additionally, updating the equipment with newer technologies would indeed result in less O&M costs.

V. KEY RISKS AND MITIGATION MEASURES

A. Overall Risk Rating and Explanation of Key Risks

37. **The overall risk rating of the Project is Moderate.** Due to strong macroeconomic and financial sector regulatory reforms currently taking place in the country, the macroeconomic risk is considered substantial. Although the budget for the Project has been programmed in Jamaica's Public Sector Investment Program for the next five years in which the Project is expected to be implemented, a fiscal space in the Capital Budget will need to be secured and authorized by the Ministry of Finance and Planning (MOFP) for the planned project activities each fiscal year. If the fiscal space is not sufficient, it could potentially cause delay in procurement processes,

consequently in implementation progress. The Planning Institute of Jamaica (PIOJ) will work closely with the Ministry of Finance and Planning early on in the budgeting process each year to secure the necessary fiscal space.

38. **Investments are straightforward and build on existing hydro-met data collection networks**, proven regional scale climate modeling techniques and vulnerability assessments, and pre-project phases of public information, education and communications campaigns. The PIOJ has a robust system for fund management. The multi-sectoral PPCR-SC will regularly oversee Project management. Lack of experience and coordination among different implementing agencies are considered a moderate risk. The capacity risk would be mitigated by establishing and locating a dedicated executing unit (PIU) in the PIOJ staffed with the requisite managerial and fiduciary competencies to service all the Technical Implementing Agencies and designating a Focal Point in each Technical Implementing Agency. The PIOJ has successfully executed and coordinated the Project Preparation Grant of the proposed Project and several World Bank-funded projects in the past, and so is able to provide leadership and guidance to the Technical Implementing Agencies. In addition, the PPCR-SC will ensure inter-agency coordination and address cross-sectoral matters requiring higher level management attention.

VI. APPRAISAL SUMMARY

A. Economic and Financial Analysis

38. **Even with the most conservative set of assumptions, including an assumption that no climate change takes place and that the benefits of the Project only last for 5 years, the benefit-cost ratio for the Project is 3.2, i.e., the expected benefits from the Project are 3.2 times higher than the expected costs of US\$6.8 million (in present value terms)** (see Annex 5 for details). Extending the period over which the benefits of the Project accrue from five years to a more plausible 10 years or 15 years increases the benefit-cost ratio to 6.6 and 8.7 respectively with the same assumption that no climate change takes place. Thus, the estimates derived indicate that the Project is economically justified even in the absence of climate change. Acknowledging climate change, and the concomitant increase in the frequency or severity of extreme meteorological events, simply increases the benefit-cost ratios for the Project, increasing its estimated economic justification.

39. **The impact of the Project's financing on Jamaica's debt sustainability would be positive given that the Project is fully grant funded.** The Grant for the Project is US\$6.8 million over a 5 year period with no repayments or commitment fee required. The time scale of the PPCR Grant aligns favorably with the structural reform program aimed at swapping external debt. One of the first tasks of the PIU will be to work with each of the Technical Implementing Agencies to finalize their respective work plans taking into account not only the capacities of each agency but also, with guidance from the PIOJ, annual expenditure ceilings set for the country.

B. Technical

40. **The proposed Project investments are technically sound.** The Project design was informed by previous research carried out under PPCR Phase 1 and by a detailed hydro-met assessment of the existing data collection network and capabilities of the responsible agencies. The Project's three main components reflect the needs of MSJ, WRA, RADA, CCD, ODPEM and

NSDMD to improve their hydro-met services in a comprehensive manner, including replacement of obsolete hydro-met equipment, capacity building and serving the users of climate data with more accurate and timely information.

41. **Design parameters of the meteorological and hydrological instruments will follow the World Meteorological Organization (WMO) standards.** The performance of the forecasting and hydro-met system will be benchmarked to internationally recognized measures. Technical specifications for the major equipment purchases were scoped during preparation and will be completed by the Technical Implementing Agencies in consultation with regional authorities during the first 12 months of implementation. During Project preparation, emphasis was placed on the specifications and location of hydro-met equipment that will not only underwrite MSJ's and WRA's existing weather forecasting capabilities but also fill spatial and temporal gaps in climate data that is needed for verifiable climate change scenario modeling at a country scale. The Project will support investments in robust climate modeling and vulnerability assessments that will involve knowledge exchange between the Government agencies and the University of the West Indies (Mona) and other leading regional scientific institutes.

C. Financial Management

42. **The Planning Institute of Jamaica (PIOJ) will be responsible for the Project fiduciary functions.** A Financial Management (FM) capacity assessment of the FM arrangements existing at the PIOJ was conducted by the Bank during the Project preparation. The FM arrangements were deemed to be adequate and are acceptable as per the requirements of the WB Operational Policy (OP) 10.00 (Investment Project Financing). The FM function will be intertwined with the PIOJ's existing FM structure. The current segregated USD designated account used for the PPF will be used for this grant, and a Project local currency account will be opened once it becomes effective. Annual external audits of the Project's financial statements covering the period ending March 31st are required and should be submitted to the World Bank within 6 months after period end. Quarterly Unaudited Interim Financial Reports (IFRs) should be submitted to the Bank 45 days after each quarter period end. The Bank will monitor the project FM risk during Project implementation (see details in Annex 3).

D. Procurement

43. **The Bank conducted an assessment of the capacity of the PIOJ during the Project preparation as the entity to implement procurement actions under the Project.** The assessment reviewed the organizational structure for implementing the Project and the interaction between the PIOJ with related Project agencies in terms of organizing evaluation committees. The assessment found that there is adequate capacity in the PIOJ to carry out the procurement. The PIOJ confirms that the Bank's procurement policies and procedures will be used for the implementation of the proposed Project. Procurement under the Project will be carried out by the PIOJ Internal Procurement Committee, supported by the PIU in line with the Bank Guidelines (see details in Annex 3).

E. Social (including Safeguards)

44. **Given that generation and use of hydro-met data is a public good, the entire population of Jamaica may be expected to benefit from or be impacted by the Project.** Project

design drew on the extensive coverage and findings of the 2005 and 2012 *Climate Change Knowledge, Attitude and Behavioral Practice (KAP) Surveys*. Also, as part of Project preparation, communication and awareness raising activities were successfully implemented by Panos Caribbean—a non-governmental organization (NGO) specialized in mass communication on sustainable development issues. Information generated and made accessible under the Project will be transmitted through the community access points at schools, public libraries, post offices and other centers across the country in order to reach the vulnerable groups throughout the country. Targeted groups, including teachers, school children, and farmers (small and large scale) will receive tailored awareness raising messages and tools to address their specific adaptation needs. The public will also participate in the monitoring and evaluation through the user surveys to measure satisfaction of the data and information produced and made available under the Project. Although the social impact of the Project is expected to be positive, as a precaution, preliminary screening was carried out during Project preparation and it is not anticipated that the Project will result in any negative social impacts.

45. **No involuntary resettlement will take place under the Project, thus the WB OP 4.12 (Involuntary Resettlement) is not triggered.** At most the Project will only involve minor civil works associated with the installation of weather recording equipment and refurbishment of existing radar and tidal gauge equipment and structures. During Project preparation, the sites for Project activities were screened for potential resettlement impacts, and none were identified.

46. **In Jamaica, men and women play different roles within the private and public spheres and are affected differently by climate-related disasters and impacts.** The vulnerability assessments supported by the proposed Project will take into consideration gender aspects and differential vulnerability profiles depending on socio-economic background. Also, the attitude and behavioral change campaigns will target both men and women and be tailored specifically for that purpose.

F. Environment (including Safeguards)

47. **The Project is classified as an Environmental Risk Category B project.** The WB OP/BP 4.01 (Environmental Assessment) applies to the Project. Works and activities that could have potential negative impacts were identified during Project preparation, which include refurbishment of an existing radar facility and upgrading of existing hydro-met stations. Since most of the activities will involve upgrading of existing equipment at existing sites, the expected environmental footprint of any installations would be minimal/negligible, with standard measures adequate for management of any environmental issues arising.

48. **During Project preparation, consultations took place with all of the Technical Implementing Agencies (generators of data and providers of information) and the National Environment and Planning Agency (NEPA).** Site inspections were made to the replacement radar equipment (Cooper's Hill) and installation of a tidal gauge (Port Royal or other suitable locations), as well as select hydro-met monitoring stations. A preliminary screening was carried out in the field to guide the preparation of an Environmental Management Framework (EMF) in accordance with OP/BP 4.01. The public consultations for the EMF were held at the PIOJ in January 2014 and the National Volunteer Center of Council of Voluntary Social Services in March 2014. Participants included sector representatives, community development agencies, community based groups, non-governmental organizations, citizens of affected communities, statutory

agencies of the GOJ, Parish Council, and departments of the University of the West Indies. Although natural habitats and physical cultural resources are not expected to be affected, exclusion criteria were developed in the EMF to ensure that no activities that negatively impact natural habitats or physical cultural resources are financed by the project. In addition, chance finds procedures are also included in the EMF.

49. **Many of the activities funded are consultancy studies and technical assistance with minimal adverse environmental impacts.** Environmental concerns that may arise are related to Component 1 where the Project will finance minor civil works associated with the upgrading of hydro-met monitoring stations and refurbishment of an existing radar facility. The adverse environmental impacts associated with the small works are expected to be limited, short lived and can either be avoided altogether through careful designs and good construction practices, or reversed or otherwise effectively mitigated as they occur during construction by use of environmental mitigation requirements that will be attached to all works contracts.

50. **As the precise location of any new hydro-meteorological equipment to be installed will only be known during Project implementation, an EMF was prepared by the GOJ, approved by the Bank and disclosed by the GOJ as part of Project preparation.** The EMF requires each sub-component to undergo environmental screening of its location and type of activity, in order to identify relevant environmental concerns and, as needed, to prepare environmental requirements to be attached to all small works contracts. The Technical Implementing Agencies (i.e., MSJ, RADA and WRA) will manage the screening and monitoring of civil works activities using the EMF, and the Project will be subjected to two environmental evaluations by the Bank in the mid-term review and last year of implementation.

G. World Bank Grievances Redress

51. Communities and individuals who believe that they are adversely affected by a WB-supported project may submit complaints to existing project-level grievance redress mechanisms or the WB's Grievance Redress Service (GRS). The GRS ensures that complaints received are promptly reviewed in order to address project-related concerns. Project-affected communities and individuals may submit their complaint to the WB's independent Inspection Panel which determines whether harm occurred, or could occur, as a result of WB non-compliance with its policies and procedures. Complaints may be submitted at any time after concerns have been brought directly to the WB's attention, and Bank Management has been given an opportunity to respond. For information on how to submit complaints to the WB's corporate GRS, please visit <http://www.worldbank.org/GRS>. For information on how to submit complaints to the WB Inspection Panel, please visit www.inspectionpanel.org."

Annex 1: Results Framework and Monitoring

JAMAICA: IMPROVING CLIMATE DATA AND INFORMATION MANAGEMENT PROJECT

Project Development Objective: To improve the quality and use of climate related data and information for effective planning and action at local and national levels.

Indicator Name	Core	Unit	Cumulative Target Values						Frequency	Data Source/ Methodology	Responsibility for Data Collection
			Baseline	YR1	YR2	YR3	YR4	End Target			
Project Development Objective Indicators											
Increased satisfaction of the users of improved climate data and information services	Contributes to PPCR Core Indicator 4	% increase	TBD in YR 3 when the information platform and other systems are upgraded			Baseline TBD (Platform and other systems upgraded)	+10% of baseline	+15% of baseline	Annual starting in YR3	Survey	NSDMD, CCD
Integration of climate data and information into a health sector plan	Contributes to PPCR Core Indicator 1	Yes/ No	Climate lens noted but not in detail			A Health Sector Vulnerability Assessment developed		Phased and costed investment plan developed	Annual starting in YR3	Project progress reports	EDMSS
Number of people (disaggregated by gender) supported by the Project to cope with climate change and risks, specifically through targeted early warning messaging for vulnerable groups and other measures	☒ Contributes to PPCR Core Indicator 5	Number of people	0			TBD (of which 30% is women)	TBD (of which 30% is women)	TBD (of which 30% is women)	Annual starting in YR3	Project progress reports	RADA, MSJ, WRA, CCD, ODPEM, NSDMD, EDMSS
Intermediate Results Indicators: Component 1: Upgrading Hydro-Meteorological Data Collection, Processing and Forecasting Systems											
1.a: Improved quality (i.e. accuracy, lead time, and coverage ¹⁴) of extreme weather forecasts ¹	Contributes to PPCR Core Indicator 3	% increase	TBD (No verification system in place)	Introduce forecast verification system	24h forecast: +1% of baseline	24h forecast: +2% of baseline	24h forecast: +3% of baseline	24h forecast: +5% of baseline	Annual	Project progress reports	MSJ

¹⁴ Coverage means reducing gaps of coverage.

1.b: Improved quality ¹⁵ (i.e. data from weather stations reaching data processing center in line with WMO performance standard) of climate recording network and data collection instruments	Contributes to PPCR Core Indicator 3	% increase	MSJ - TBD; WRA - TBD	Equipment procured and installed	+3% of baseline	+7% of baseline	+ 11% of baseline	+ 15% of baseline	Annual	Project progress reports	MSJ, WRA, RADA
1.c: Technical staff and other personnel (e.g., voluntary observers) trained under the Project	☒	number of people	0	100	150	200	250	300	Annual	Project progress reports	MSJ, WRA, RADA
1.d: Percentage of meteorological, hydro-met and agromet equipment installed and operational	Contributes to PPCR Core Indicator 3	% of planned procurement	0	20%	75%	100%	-	100%	Annual	Project progress reports	MSJ, WRA, RADA
1.e: Doppler Radar installed and operational	Contributes to PPCR Core Indicator 3	Yes/No	Radar is obsolete	Specs defined	Yes	-	-	Yes	Annual	Project progress reports	MSJ
Intermediate Results Indicators: Component 2: Climate Resilient Planning and Hydro-meteorological Information Services											
2.a: Accurate and high resolution national and sectoral climate change scenarios developed	Contributes to PPCR Core Indicator 3	Yes/No	Low resolution (50 km) scenarios available		High resolution CC scenarios for short-, mid- and long-term developed		Update the scenarios with more data	Accurate and high resolution CC scenarios for 2030, 2050 and 2080 available	MTR and EOP	Project progress reports	PIOJ
2.b: Improved access to early warning messaging for targeted vulnerable groups	Contributes to PPCR Core Indicator 3	# of targeted vulnerable groups	TBD			TBD (to be defined in YR1)		TBD (to be defined in YR1)	Annual	Project progress reports	ODPEM, RADA

¹⁵ Quality improvement is measured by calibration of equipment as a proxy.

Intermediate Results Indicators: Component 3: Climate Change Education and Awareness towards Behavioral Change											
3.a: % increase in climate change knowledge, attitude and practice (KAP)	<i>Contributes to PPCR Core Indicator 4</i>	% increase	2012 KAP survey			+10% of baseline		+20% of baseline	MTR and EOP	KAP survey	CCD

NOTES:

1: Verified using standard methods for forecast verification WMO WWRP-WCRP.

Annex 2: Detailed Project Description

JAMAICA: IMPROVING CLIMATE DATA AND INFORMATION MANAGEMENT PROJECT

1. **Jamaica, a small island developing state, is particularly vulnerable to climate change and climate related disasters.** Over the 12 year period 2001-2012, hydro-meteorological hazards alone have caused damage and losses estimated at US\$1.24 billion. On average over this period, the damage and loss suffered amounted to approximately 1-2% of national Gross Domestic Product (GDP). Approximately 82% of the population of 2.7 million people lives in coastal towns and communities located within 5 km of the 1,022 km long coastline. The coastal zone contains an estimated 75% of productive industries and the service sectors and is responsible for contributing an estimated 90% to the country's GDP. At the same time, a large proportion of the poor lives in upland areas and are engaged in climate-sensitive small-scale agriculture. The mountainous interior is surrounded by mostly narrow coastal plains and gives rise to a distinctive drainage pattern. The central backbone acts as the major drainage divide between north and south flowing rivers. The island's geology is dominated by limestone and the resulting karstic features dominate much of the landscape and interior drainage characteristics. Flooding of interior basins after prolonged rainfall is common and the consequent disruption of agriculture, tourism and other productive sectors and social infrastructure will likely be exacerbated by the projected increase in intensity and variability of extreme weather events as a result of climate change. Slope instability is characteristic of many areas, and intense and prolonged rainfall combined with deforestation and inappropriate land use practices has given rise to degraded conditions, making landslide vulnerability another feature of Jamaica's hazard profile. The Kingston metropolitan area, in which there is a large concentration of critical infrastructure including the international harbor and airport, is built on reclaimed land and is prone to sea level rise and storm surge.

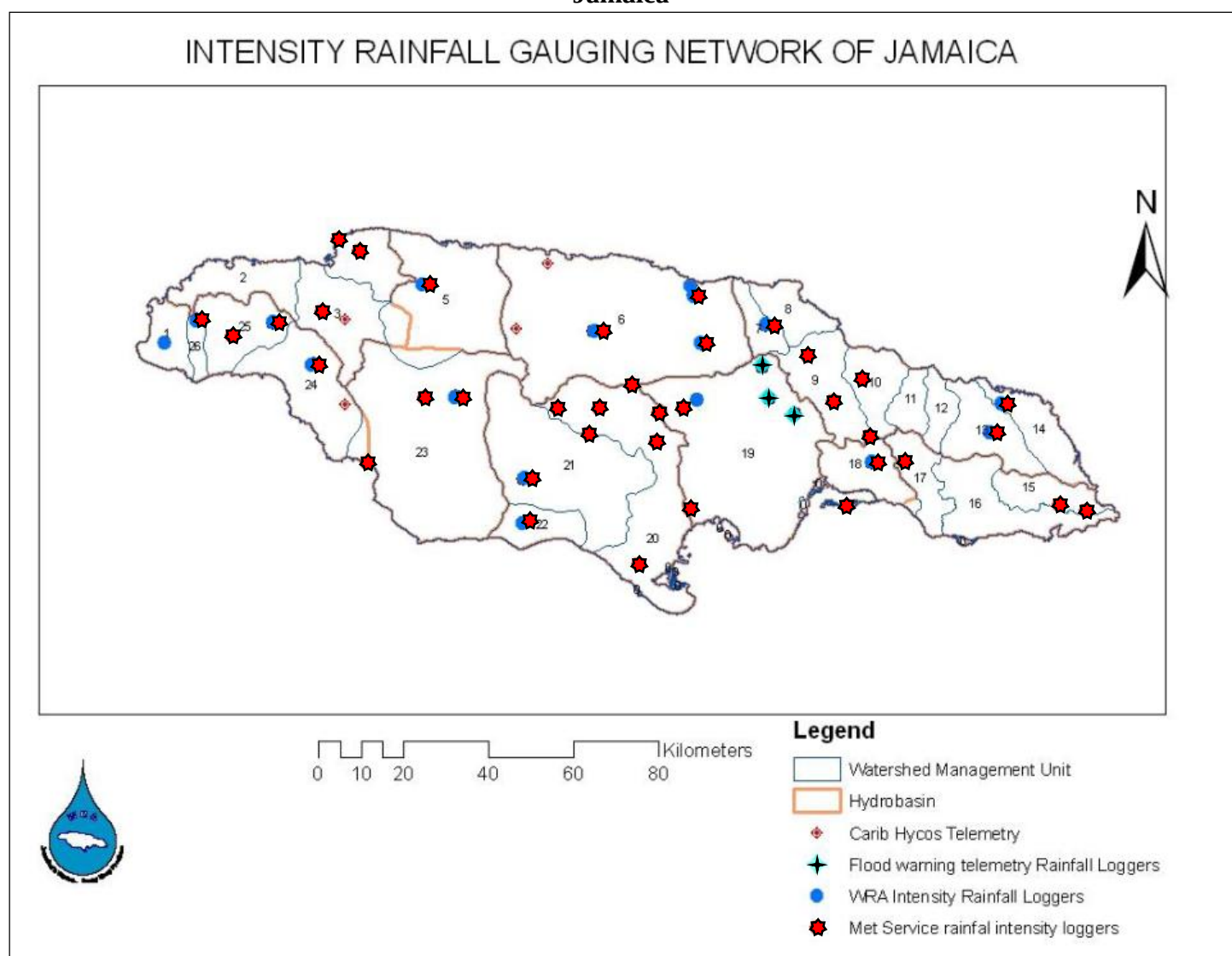
2. **Jamaica likely will experience significant changes in temperature, precipitation and sea level rise by 2050** according to data from global climate models downscaled for the development of the Strategic Program for Climate Resilience (SPCR). In summary, the models have indicated increased climate variability likely will result in: a) 7-8% decrease in the length of the rainy season; b) 6-8% increase in the length of the dry season; and c) 20% increase in the frequency of intense rains towards the end of the century. Consequently, more impacts and damages are anticipated: sea level rise leading to accelerated coastal erosion in some areas; increased flood risk and loss of land; saline intrusion into coastal water tables; increased destructiveness of tropical storms; loss of protective coastal systems, such as coastal vegetation and coral reefs partly due to higher ocean surface temperatures; and loss of livelihoods, especially in climate-and weather-sensitive sectors such as tourism, agriculture and fisheries.

3. **Therefore, improving the country's capacity to accurately monitor, model and predict and build in adaptation measures to the impacts of climate change is a priority for the Government of Jamaica (GOJ).** Failure to implement adaptation measures will likely impede the achievement of the country's sustainable development goals as set out in *Vision 2030 Jamaica – National Development Plan*. By integrating climate risk management into the national level, the proposed Project seeks to transform the long-term resilience of vulnerable populations and the country's assets to climate-related stresses. The Project will allow climate change considerations

to be integrated into Jamaica's future national planning for climate resilience, thus providing the basis for long-term transformational change in the country.

4. **A challenge constraining the development of appropriate climate adaptation measures in Jamaica is the limited capacity, obsolete equipment, and lack of coordination and data exchange among the agencies responsible for hydro-met data collection and information services.** Indications are that Jamaica's hydro-met system has deteriorated over time as a consequence of inadequate financial resources for either appropriate levels of maintenance or for replacement and expansion of the capital stock of equipment. The original network of 23 climatological stations has dwindled to six functioning stations. The 16-year old Doppler weather radar at Cooper's Hill is obsolete and subject to periodic malfunctions. Of the 27 WRA gauges, 19 of them are within less than 10 km of a MSJ gauge, and 7 are within 5 km of a MSJ gauge. This represents considerable overlap in the two rain gauge networks.

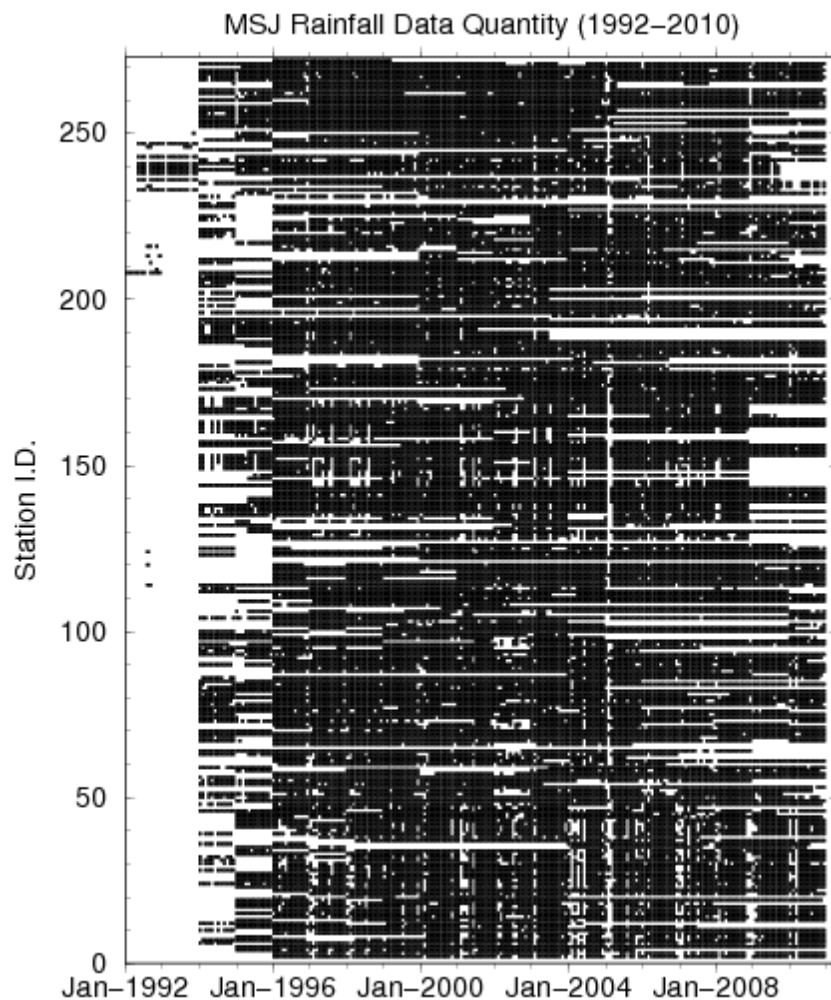
Figure A2.1: Distribution of MSJ meteorological station and WRA rain gauges across Jamaica



Map produced by Water Resources Authority of Jamaica, August 30, 2013.

5. Data gaps must be greatly reduced to be of use for climate change modeling. For the purposes of spatial and statistical analyses, having a long period of data is essential. A fire destroyed many paper rainfall records at MSJ in 1992. This loss included a large number of rainfall records. Beginning in 1992 MSJ started installing automatic recording meteorological stations to improve data quality. The MSJ monthly rainfall data from 1992-2010 include many periods of missing data. Figure A2.2 below shows the nature of the monthly rainfall database by plotting months with/without data for each of the 271 stations over the period of record. Data infilling is one partial solution, depending upon the distance to nearby stations. The current rainfall network is adequate for infilling of monthly values except above 600 m elevation, but is likely inadequate for infilling of daily values in many locations, and hourly values in most locations. Depending upon the integration interval (hourly, daily, monthly), data gap filling is difficult without several nearby stations within the correlation length for that time interval.

Figure A2.2: Tapestry plot showing quantity of data in MSJ' monthly rainfall database



Note: Each small black square denotes one monthly value of rainfall at one station. Missing squares (white spaces) denote missing data. There were intermittent network-wide gaps, especially before 1996 and after 2009 when a significant number of stations were discontinued.

6. **Improving Jamaica's hydro-met data collection and monitoring network will allow for the generation of products, archival records and potential research areas to provide highly-relevant information to policy makers regarding the impacts of climate change.** The Project Development Objective is to improve the quality and use of climate related data and information for effective planning and action at local and national levels. The Project will support the improvement of weather, climate and hydrological data collection and the development of a number of products based on climate change scenarios that are relevant at the scale of individual watersheds. It will also support strengthening of early warning capacity for severe weather events to reduce human and property losses incurred by such events. These products will allow evaluation of risk and testing of proposals to improve the nation's response and resilience to climate change. In order to develop these products, a sufficient quantity of high-quality hydro-meteorological data must be available to support the complex modelling.

7. The Project will support four components, as described below:

8. **Component 1: Upgrading Hydro-Meteorological Data Collection, Processing and Forecasting Systems (US\$4.009 million).** This component will support investments for upgrading and providing critically needed new equipment, systems, and operator training for data collection, and processing for improved hydro-meteorological and agro-meteorological forecasts in order to ultimately enhance the availability and reliability of data for climate change scenario modelling, risk analysis and warning systems, and knowledge sharing. The Project will support carrying out activities to upgrade existing and/or provide new systems for hydro-meteorological data collection, processing and forecasting, including: (a) supplying and installing equipment for sea-level monitoring, meteorological, hydrological, and agro-meteorological activities, provision of training for staff of MSJ, WRA, RADA and voluntary observers of the monitoring network on operation and maintenance of the equipment; and purchasing of spare parts; (b) replacing the outdated weather Doppler radar, including rehabilitation of the Cooper's Hill station facility and training of MSJ staff in operation and maintenance of the new radar; (c) strengthening the capacity of staff of MSJ, WRA and RADA on data management, quality assurance of data collection, processing, and weather forecasting through provision of consulting services and training.

9. ***Sub-component 1.1: Acquisition of sea-level monitoring, meteorological, hydrological, and agro-meteorological equipment, including installation, spare parts and training of MSJ, WRA and RADA staff.*** The sub-component will support procurement of meteorological, hydrological, and agro-meteorological equipment and high priority spare parts, installation, calibration, and training for staff of MSJ, WRA and RADA on the operation of equipment. Based on the assessment by the three agencies, the equipment of high priority has been identified and is described as follows:

- 26 all-weather stations and spares (including universal towers and bases, calibration equipment, and data transmitter);
- 8 agro-meteorological stations;
- Upgrades to (real-time) data transmission system of the existing stations;
- 25 automatic recording rain gauges (including stands, batteries and associated equipment) to augment/replace the existing manual gauges;

- stream flow/river gauging loggers for flood and drought forecasting (6 new¹⁶, 9 replacements and upgrades¹⁷);
- upgrades to the rainfall intensity gauging network¹⁸;
- 11 ground water monitoring loggers;
- 14 soil moisture probes¹⁹ for drought and landslide risk; and
- 2 back-up power supplies (1 for MSJ, 1 for WRA).

10. During the initial stage of implementation, the specificity of equipment and locations for installation will be further examined and agreed by the three agencies in order to avoid redundancy and maximize the efficiency of the investment.

11. Under this sub-component, a state-of-the-art tidal gauge with complete weather monitoring station and data logger will also be purchased and installed at Port Royal, Kingston Harbor (or an alternative location based on the existing EMF). It will come with water level sensor, seawater temperature, air temperature, barometric pressure and wind speed and direction high resolution measuring capabilities, run from an internal rechargeable sealed battery. The instrumentation is required for the purpose of monitoring sea level rise brought about by climate change and will be capable of acquiring, storing and reporting water level measurements to a high degree of accuracy. Telemetry will be by telephone modem and/or satellite transmission using GOES and/or GMS systems.

12. ***Sub-component 1.2: Replacement of the outdated weather Doppler radar, including rehabilitation of the Cooper's Hill station facility, and training for MSJ staff in operation and maintenance of the new radar.*** The sub-component will replace the existing timeworn S-band weather radar system with Doppler capabilities that was acquired in 1999 and sited at Cooper's Hill, northwest of Kingston. The system is an older model and is subject to periodic malfunctions. Spare parts are hard to obtain, and occasionally must be custom made. In addition to the new radar equipment, a structural assessment of the Cooper's Hill station facility, including the supporting tower, office facility, and water supply, will be conducted and the necessary rehabilitation will be carried out.

13. During the Project preparation, a detailed technical analysis on the weather radar was conducted and the following minimum specifications were recommended:

- S-band, coherent transmitter with 750-850kW peak transmit power;
- Dual polarization;
- Doppler signal processor;
- 1-degree nominal half-power beam-width steerable antenna, with first side lobe < -27dB;
- Pedestal with rotation speed up to 8 degrees per second. Vertical angle range from -1 to 60 degrees;
- >460 km max range with 1.0 km max gate spacing;
- >220 km unambiguous velocity retrievals with 1.0 km max. gate spacing;

¹⁶ New stream flow loggers at Montego River, Rio Nuevo, Spanish River, Plantain Garden River, Gut Alligator Hole and New Savannah River.

¹⁷ Replacement and upgrade stream flow loggers at Lucea River [2], Rio Bueno White River [2], Milk River [1], Black River [2], and Deans Valley River [2].

¹⁸ Rainfall intensity gauging upgrade includes 5 loggers at Lucea River, Spanish River, Swift River, Drivers River and Morant River and 13 telemetric rain gauges using cell phone transmission technology (GSM).

¹⁹ Soil moisture probes will be placed in each parish.

- Signal processing software with full remote operation, velocity azimuth display (VAD), plan position indicator (PPI), and range height indicator (RHI) display;
- Disk-based data archive/retrieval system based on redundant array of independent disks (RAID) technology;
- Compressed data storage system with filtering of insignificant returns;
- Archival storage of selectable scan images in non-compressed image format (e.g. Graphics Interchange Format (gif);
- Engineered tower designed for category 5 hurricane;
- Back-up diesel power system for radar site with 4 day capacity;
- Back-up power system for remote operations site with 4 day capacity;
- Secure wireless Ethernet network control link;
- Essential spares for power, transmitter, receiver, and signal processor electronics;
- Robust earthing (grounding) system to prevent damage from lightning strike; and
- On site operator training and warranty service for first year of operation.

14. Considering a number of factors summarized below, the replacement of the existing radar system at Cooper's Hill was chosen to be a suitable option over a new location to be developed under the Project. The existing radar at Cooper's Hill has the disadvantage of being relatively close to the Blue Mountains that rise to 2,300 m elevation and cause significant beam blockage towards the East. Increasing the antenna elevation angle to 2-degrees so as to 'look over' the obstruction would reduce the blocked sector to 30-degrees but causes the beam height to increase to over 13 km at a range of 250 km. Siting of additional all weather stations in the vicinity was considered but would not address the limitations of the blind spot regarding approaching weather. The beam blockage problem therefore requires that MSJ continue to obtain data from the Cuban authorities to obviate the 'blind spot' limitations of the site. Notwithstanding this limitation, the new radar equipment will reduce the current significant risks of an extended downtime as the current equipment is no longer easily serviceable. Also, the Cooper's Hill site requires minimum additional works (e.g., a structural assessment for the existing tower and repair, replacement of existing fence, refurbishment of existing office and water supply) and no resettlement issues are involved as it is on the parcel leased by the Government.

15. The analysis also looked at alternative site options to assess the validity of the Cooper's Hill site. The alternative sites had been identified by MSJ and were located in southeast St. Ann and Trelawny parishes (See Table A2.3).

Table A2.1: Geographic coordinates and elevations of the three radar sites evaluated.

Site	Latitude	Longitude	Elevation (m)
Cooper's Hill, St. Andrew parish	18:04:23N	76:51:10W	761
St. Ann parish	18:15:17N	77:16:27W	809
Trelawny parish	18:13:41N	77:30:26	982

Note: Optimal locations determined using Google Earth, and verified against SRTM topography data.

16. The St. Ann site suffers much less from beam blockage than the Cooper's Hill site. The St. Ann's site is approximately 60 km North of May Pen in the Cockpit Country on a privately owned, undeveloped piece of land. The site is 2-3 hours' drive from the MSJ offices in Kingston and one km from an existing access road, requiring the construction of an all-weather access road. Given

that the site is undeveloped, an environmental impact assessment would be required to identify the environmental and social impacts of the new development and environmental mitigation measures would need to be put in place before any works could commence. With these issues, the economic costs of the associated civil works are estimated at over US\$ 1.2 million which is higher than the Cooper's Hill site. In addition, the costs for staff to travel a long distance from Kingston must be considered. As MSJ only has four engineering technicians on its staff to cover the whole country, it is not possible to station one staff full time at St Ann's to oversee operations of the equipment.

17. The Trelawny site has no beam blockage at 0.5-degrees beam elevation angle. However, the site is located towards the western end of Jamaica which diminishes the ability to see tropical systems approaching the island from the east, the most common direction of hurricane approach. For that reason it was not considered further.

18. ***Sub-component 1.3: Provision of training and technical assistance to improve data management, quality assurance, and weather forecasting.*** The sub-component will complement the equipment investments (Sub-components 1.1 – 1.2 above) with a number of activities to (i) fill current spatial and temporal gaps in the climate data records (data rescue²⁰, data infilling software and data back-up arrangements where appropriate²¹); and (ii) staff training and mentoring on hydro-meteorological data quality assurance, data management and weather forecasting, including the exploration, introduction and appropriate use of proven open-source database software (such as mySQL, PostgresSQL and the CUAHSI hydrologic information system database).

19. Data quality assurance is an institutional performance target of the key Technical Implementing Agencies. All data collection personnel in the field require an understanding of what the data being collected should look like and be able to note and report on any equipment and sensor malfunctions. Non-telemetered data need to be examined by office staff for consistency, and telemetered data need to be passed through a checking program to identify potential problems with data or sensors. Values that are out of the expected range would generate an alert and follow up by an appropriately qualified technician or district office on a daily basis. Similarly, data processing personnel in the agencies need to be responsible for editing, flagging suspect or bad data, and applying calibration factors or shifts to the constant flow of incoming data so as to prevent any backlogs in data processing.

20. Provision of data products and services using information technology is variable between agencies. WRA is presently providing data online, and has been for some time, while other agencies anticipate building capacity in this area in the near term. To optimize online data provision services, reduction of duplication efforts in the interest of consistency and quality is important. This will ultimately improve linkages with climate resilience programs throughout the region. The Project's focus will be on information management skills, and the value of online data availability for optimal use of water resources, energy savings, education and outreach. The Project will support provision of consultancy to mentor, give guidance, and train MSJ, WRA, and RADA staff in order to build capacity to operate, coordinate and maximize the use of both

²⁰ Data rescue and digitization of historic data (microfiche) is being undertaken by MSJ with the International Environmental Data Rescue Organization.

²¹ For example, use of cost-effective cloud computer services provided by reputable vendors to ensure data permanence and regular transfer of basic data to approved agencies such as WMO or U.S. National Climatic Data Center for archival storage.

monitoring networks, quality assurance of data collection processes, and defining the specifications of equipment to be procured under Component 1.

21. **Component 2: Climate Resilient Planning and Hydro-meteorological Information Services (US\$1.386 million).** This component will provide technical assistance support to promote Jamaica's readiness for climate events through: (a) updating the downscaled high resolution²² climate change scenarios and using said scenarios to prepare the State of the Jamaican Climate 2015 and 2019 reports (including the summary for policy makers); and provision of training on sector specific climate resilient planning based on said scenarios; (b) preparing national vulnerability assessments in selected priority sectors to complement the modeling outputs mentioned above and to define priorities and actions on climate resilience; (c) preparing detailed health sector vulnerability assessments and costed resilience strengthening plans to assist health facilities and operations withstand and respond to climate related hazards; (d) carrying out a community-based risk profiling to assess the communities' vulnerability to various climate related hazards and developing early warning messaging for vulnerable groups; and (e) upgrading the multi-agency climate and natural risk data and information sharing system to integrate climate data and making the data user friendly and accessible to the public.

22. ***Sub-component 2.1: Updating downscaled high resolution climate change scenarios to prepare the State of the Jamaican Climate 2015 and 2019 reports and to develop training in sector specific climate resilient planning based on said scenarios.*** Building on methodologies developed as part of Project preparation, the sub-component will support: (a) updating statistically downscaled high resolution climate change scenarios, (b) building capacity for sector specific climate resilient planning based on the scenarios produced, and (c) updating the *State of the Jamaican Climate* report.

(a) ***Updating downscaled high resolution climate change scenarios.*** The PPCR supported to develop a near-term climate scenarios for Jamaica, using the dominant method called "statistical downscaling", which involves using statistical correlation between large scale climate features (temperature, precipitation) and small scale features adjusted for local conditions (topography, slope, aspect, and vegetation). The Project will update these downscaled high resolution (10-4 km² blocks²³) climate change scenarios and produce results at time slices 2030s, 2050s, and 2080s, taking into account available data, costs and watershed size, to be applied in priority sector development plans. The balance is between when a climate change signal has establish itself and when variability (inter-annual and decadal) still dominates, especially for rainfall. For the 2020s, the discussion for Jamaica should center around the decadal signal which will likely have a dominant and profound effect through variation of the Atlantic Multi-decadal Oscillation and changes in the frequency of the ENSO phenomenon. Discussion for the 2020s however based more on variability than climate change modelling. By 2030s, it begins to see climate change added on top of that in a clearer way hence choice of time slices for modelling. Downscaling require high-quality surface hydro-meteorological measurements data over long periods of time, at enough points to describe spatial variability, at consistent intervals and locations, over a long time period. Therefore, consistent, continual, data collection of indefinite

²² The country specific modeling would be to a 10 km² grid with some mid-century time slices at 4 km² grid where possible. The resolution will depend on available data and cost.

²³ The modelling will be done primarily at 10 km. Some mid-century time slices may be offered at 4 km. The resources to do a continuous 100 year run at 4 km are too costly presently.

duration is required and the Component 1 investments and staff training/mentoring are aimed at filling the spatial and temporal gaps in the country's hydro-meteorological data.

(b) ***Preparation of State of the Jamaican Climate 2015 and 2019.*** The *State of the Jamaican Climate 2012* report was prepared under the PPCR Phase 1 to present an initial reference point for a description of Jamaica's climate, its variability and trends and future projections. It served key sectors and persons who wished to engage in climate change adaptation work with respect to Jamaica and who needed to determine the climate state being adapted to. It was also intended to be an initial reference point for persons seeking out other sources of information which documented how key sectors for Jamaica might be influenced by climate change. The sub-component will update the report and prepare *State of the Jamaican Climate 2015 and 2019*. The former will build upon data up to 2015 (both historical and modelled). The latter will include the high resolution modeling that will start in 2016.

(c) ***Training in sector specific climate resilient planning based on climate scenarios.*** Subsequently, manuals and guidelines will be developed and training for professionals will be provided in sector specific climate resilient planning and design based on the climate scenarios produced. Applying a climate lens to sector planning will involve examining (i) the extent to which a strategy/policy/plan/program would be vulnerable to risks arising from climate variability and change; (ii) the extent to which climate change risks have been taken into account during the formulation of the particular strategy/policy/plan/program; (iii) the extent to which the strategy/policy/plan/program might increase vulnerability or, alternatively, might miss important opportunities arising from climate change; and (iv) when existing strategies/policies/plans/ programs are under review, what amendments might be called for in order to address climate risks and opportunities. By applying a climate lens to upstream sector strategies/policies preparation and reviews would result in enhanced climate-resilient programs and on-the-ground projects and investments.

23. ***Sub-component 2.2: Preparation of vulnerability assessments in selected sectors.*** The sub-component will support the preparation strategic vulnerability assessments in selected priority sectors identified in the SPCR, such as agriculture and water, based on climate change scenarios developed under Sub-component 2.1 for a better understanding of the impacts of climate change to the sector (for example, changes in rainfall and temperature, increase in extreme weather events and coastal erosion, sea level rise, and similar). The vulnerability assessments will complement the climate change modeling outputs of Sub-component 2.1 and so are to be incorporated into the preparation of manuals and guidelines for sector specific climate (and natural hazard) resilient planning and design. The vulnerability assessments will take into consideration gender aspects and differential vulnerability profiles depending on socio-economic background, e.g., some basic gender concepts including examination of the household as a site of uneven gender power relations. The analysis then considers the direct and indirect impact of climate-related events attempting to quantify the unrecorded losses that accrued to women specifically.

24. Under Jamaica's SPCR, the Government and other players are expected to replicate the methodologies and outcomes obtained under the proposed Project to other sectors (e.g., infrastructure) through companion projects. These projects include the *Adaptation Programme and Financing Mechanism for the PPCR Jamaica project* (supported by the IDB) which will facilitate the incorporation of climate change in development planning, institutional capacity building to address climate change within the government entities, community vulnerability

assessments, a knowledge management program including dissemination of climate change information, and also the implementation of some adaptation measures in two critically degraded, yet important watersheds—Rio Minho and Rio Bueno. It will also improve access by small and medium-scale operators in the agribusiness and related sectors to resources for financing adaptation initiatives through competitive loans and trust funds. *The PPCR Promoting Community-based Climate Resilience in the Fisheries Sector of Jamaica project* (supported by the WB) will strengthen the fisheries policy and regulatory framework including making it climate-smart, develop viable alternative livelihoods that enhance sustainable fisheries, and build capacity and raise awareness among the fishing communities. Jamaica also participates in *the Caribbean regional-track PPCR*. The Regional PPCR will develop land use plans in strategic coastal zones of the participating pilot countries including Jamaica, including maps, action plan and recommended regulations; enhancement of regional climate data collection networks and near real-time transmission of data; and development and implementation of appropriate adaptation interventions in agriculture for climate risk reduction and resilience, measuring climate change impacts on fishing communities and marine resources, promoting water augmentation and harvesting for resilience, and establishing early warning system to reduce dengue outbreak. *Enhancing the resilience of the Agriculture sector and coastal areas to protect livelihoods and improve food security* (Jamaica Adaptation Fund Project) will protect livelihoods and food security in vulnerable communities by: improving land and water management for the agricultural sector; strengthening coastal protection; and building institutional and local capacity against climate change risks.

25. ***Sub-component 2.3: Preparation of a detailed health sector vulnerability assessment and a costed resilience strengthening plan for climate-proofing the nation's health facilities and operations.*** Health facilities in the Caribbean are overwhelmingly affected by storm (75%) and flooding (21%) than any other disaster events²⁴. In Jamaica, Hurricane Gilbert in 1988 damaged or destroyed 24 hospitals and health centers, resulting in 5,085 hospital beds being lost. Under the WHO/PAHO “Safe Hospitals in the Caribbean” Project, the structural condition of Jamaica’s ten main hospitals²⁵ was assessed, primarily regarding their ability to withstand seismic risk. Eighty percent (80%) of the hospitals were found to have satisfactory structural resilience to various hazards but the functional safety of the hospitals is less satisfactory: 81% of hospitals do not have a functioning disaster committee; 57% do not have established evacuation procedures; and 48% of emergency routes are inaccessible, poorly labelled or obstructed.

26. Building on the Safe Hospitals assessments, this sub-component will support a Health Sector Vulnerability Assessment and encompass the following:

(i) Determine what aspect of the health sector is to be assessed and in what locations, for example:

- Major hospital – selected parish;
- Health facilities/clinics – selected parish;
- Central Government Capacity – MOH;
- Disease control - Vector identification and management;
- Parish focus - health facilities and services;

²⁴ WHO/PAHO, 2012 Annual Report: Emergency Preparedness and Disaster Relief.

²⁵ Annotto Bay, Black River, Bustamante, Cornwall Regional Hospital, Falmouth, Mandeville, Princess Margaret, Spanish Town, St Ann’s Bay, University Hospital of the West Indies.

- Emergency Response Capacity – parish, national; and
 - Public Health capacity /parish/urban center, rural towns.
- (ii) Hazard identification, for example:
- History of flooding at selected location(s) – incidence, impact on health facilities and supporting infrastructure;
 - Hurricane/Storm – history of impact at selected location – health facility, supporting infrastructure and services; and
 - Landslides – Disruption of road communication.
- (iii) Detailed vulnerability assessment, for example:
- Structural Vulnerability – Engage structural engineer to identify areas of weakness and to recommend mitigation measures;
 - Assess vulnerability of site to flooding;
 - Assess vulnerability of access routes to flooding and landslides;
 - For each facility, assess the following:
 - Emergency water supply – storage capacity , accessibility;
 - Emergency power supply – standby generation, fuel, battery availability, appropriateness of site;
 - Food supply – system for and safety of stores of non-perishables, access to supplies in event of emergency;
 - Pharmaceuticals/medicines – system for and safety of stores, system to access and preposition emergency supplies;
 - Other supplies – system for and safety of stores, system to access and preposition emergency supplies;
 - Waste management capacity – general waste, medical waste;
 - System for grounds management – removal of debris to facilitate access of emergency vehicles and staff;
 - Records management – safety, back-up; and
 - Emergency response capacity – staffing roster, vehicles, supplies.
- (iv) Phased and costed investment plan for implementing main recommendations.

27. ***Sub-component 2.4: Carrying out community risk profiling and developing targeted early warning messaging for vulnerable groups.*** The sub-component will support the scaling up of community risk profiling activities making use of facilitated, participatory planning approaches and resulting in local/sub-parish (district/community) level resilience mitigation and adaptation plans that can be self-resourced and implemented by communities. Early warning communication messages will be developed for targeted vulnerable groups (for example, low income groups living in unplanned settlements in hazard-prone locations, persons with disabilities, elderly, etc.).

28. An effective early warning system not only strengthens the country’s resilience to risks from current hydro-met hazards but also mitigates future risks of climate change and variability, thus it is considered as a cost effective investment. In addition, risk, vulnerability and exposure information to be obtained from the improved hydro-met data collection will contribute to the future development of “impact forecasting,” which facilitates the translation of hazard information into more actionable impact based messaging. These activities have been designed by taking into account the current system and filling identified gaps.

29. ***Sub-component 2.5: Upgrading a multi-agency climate and natural hazard risk data and information sharing system and clearing-house with public access.*** The sub-component will provide support for upgrading a multi-agency climate and natural hazard risk data-sharing platform and clearing-house with public access network, based on a detailed assessment of existing data collection agencies' mandated responsibilities and data collection and storage formats, protocols and metadata standards in use, and an assessment of end-user needs (with an especial focus on vulnerable communities) and desired formats. This activity will build on the Government's ongoing multi-agency, national networked geographical information system (GIS) for Jamaica and is aimed at strengthening the central clearing-house functions for climate and risk data sharing—the proposed Climate Change and Risk Information Data Node. A fully functioning portal will support data storage and integration of data from multiple organizations, and provide the users with one-stop interface to search, access, share and view the data collected. Measures such as cloud storage will be put in place for to ensure data security and continuity.

30. The National Spatial Data Management Division (NSDMD) under the MWLECC currently has responsibility for coordinating, implementing and managing Jamaica's National Spatial Data Infrastructure and provides metadata and geospatial data discovery, retrieval, update and management services via the Land Information Council of Jamaica (LICJ) WebMap. The LICJ was approved by Cabinet in 1992 and consists of over 50 member agencies from the Government, Parish Councils, private sector and academia and meets on a monthly basis. The Secretariat of the LICJ operates from within the NSDMD. The GOJ WebMap was originally developed to support the National Spatial Plan. Today, the database consists of around 260 datasets (including basic climate and risk data layers and attribute tables) that are sourced from and updated by the member agencies of the LICJ. It provides for the storage and management of Government entities' geospatial data and allows for search, retrieval, updates and management of metadata records and allows users to access a variety of geospatial data including environmental and climate change data from international geo-database repositories. The data is accessed free of cost by member agencies and also can be distributed by means of a free viewer for non-GIS users (or presented in ArcView's 'Layout View' suitable for Adobe Reader®). All users need to be registered with NSDMD which has a responsibility to ensure that any data is made available according to any restrictions set by the source-agency. Since 2008, the GeoData Sharing Access Council, assisted by NSDMD monitors and clears the release of Jamaican agency data for overseas users. The portal supports many activities such as site identification and selection, development approvals, management of land resources and for informing decisions affecting communities.

31. The NSDMD has immediate high priority needs to increase bandwidth to approximately 100mbps to improve upload and download speeds for users; to procure database management software to support various file formats; and to procure data discovery/portal management software to perform three fundamental functions: (i) discovery content; (ii) hosting and maintaining the index of content; and (iii) providing an application for end users. The design of the upgraded platform will need to take into account improved access between agencies and computerized entities and develop policies regarding cost recovery for raw and manipulated data by public sector agencies. Whilst agencies currently do provide data, it frequently is not in a format that is readily usable and may require cleaning of data sets before use (for example, conversion of data, projecting the map layers to new data frame coordinate systems, converting vector files to raster files, etc. requiring GIS-literacy that may not be available in every agency).

32. Whilst Jamaica has a supportive policy and legislative framework for accessing information (the Information and Communications Technology (ICT) Policy, 2011 and the Telecommunications (Amendment) Act, 2012), there is a relatively low level of broadband access²⁶ for the majority of the population (22.6% of households in 2012) and 68.5% of households in 2012 did not have access to a computer. Therefore the design of the upgraded platform also will need to incorporate and scale up connectivity with existing Parish and village level networks to facilitate public access to the data in appropriate formats. This might involve, for example, data being transmitted through the 205 community access points²⁷ at schools, public libraries, post offices and other centers across the country, public libraries; public broadcasting services; cell/mobile phone providers; the Jamaican Information Service; and farmers' organizations and extension services).

33. The upgrade of the multi-agency climate and risk data-sharing platform therefore will involve (i) meeting the immediate high priority equipment and software needs of NSDMD; (ii) a gap analysis/design of the existing platform to meet inter-agency protocols and public access to climate data in usable formats; and (iii) implementation of the dissemination network (including possible scale up of the use of the community access points).

34. **Component 3: Climate Change Education and Awareness towards Behavioral Change (US\$0.725 million).** This component will provide technical assistance support to promote climate change awareness at the national and local levels through (a) carrying out climate change information, education and communication (IECC) campaigns, and (b) conducting targeted attitude and behavioral change initiatives to address climate change adaptation needs and influence behavioral change of targeted groups, as part of the Communications Strategy Action Plan developed under the PPCR Phase 1. Initiatives are aimed at influencing and bringing about changes in attitudes and behavioral practices to assist targeted groups to adopt practical means of coping with severe weather events, climate variability and climate change. The approach is to implement simple, effective and targeted communication of the above-prepared climate change scenarios and risk assessments with structured messages for different target groups and audiences. Without effective mechanisms for timely dissemination of understandable and usable forecasts, as well as information on appropriate responses, the potential benefits associated with upgrading hydro-met systems will not be fully realized. Campaigns are aimed at influencing and bringing about changes in attitudes and behavioral practices to assist targeted groups to adopt practical means of coping with severe weather events, climate variability and climate change.

35. In 2005, a baseline knowledge, attitudes and practices (KAP) survey was carried out to assess knowledge and views in Jamaica regarding the causes and impacts of climate change and the measures people could take in their own lives to adapt. The KAP 2005 baseline survey involved the completion of 1,700 household interviews with an additional 300 done among representatives of the public and private sectors, media, international donor agencies and children. A subsequent KAP longitudinal survey was carried out in 2012 under Phase 1 of the PPCR. It encompassed a national survey of households (N = 1,484); a survey of online users of climate information (N = 503); and a focus-group based sector survey (N = 276) targeting agencies and

²⁶ About 786,680 broadband mobile subscription were recorded in 2013.

²⁷ The Community Access Point facilities are funded by the Universal Service Fund and are equipped with computers, associated equipment, and internet access. The services at the facilities are provided for free or at minimal cost.

specialists in the sectors of agriculture, construction (built environment and human settlements), energy, health, tourism and water.

36. In light of the KAP survey findings and recommendations, the Project will move beyond merely sharing information and spreading awareness, and will focus on influencing changes in attitudes and promoting specific behavioral practices amongst targeted groups to adopt practical means of coping with climate change, through development and use of materials such as cartoons, animation, and support materials for school curriculum, and training. The Project will also foster stronger inter-agency collaboration and partnership to implement climate awareness campaigns targeting specific groups so as to facilitate improved practices.

37. **Sub-component 3.1: Climate change information, education and communication campaigns (IECC).** The sub-component will build upon on-going initiatives such as “*Voices for Climate Change Education and Communication*” funded by a number of external partners. The initiative is a national communication and education strategy related to climate change and biodiversity issues and adaptation strategies. Since 2008, it has supported local popular artistes who have specially formulated climate change messages through song, dance performances, and drama to 24 community centers throughout the country. It has generated enthusiasm and “buzz and sizzle” at the community and national levels. The IECC will use creative arts to further promote climate awareness at the community and national levels.

38. **Sub-component 3.2: Implementation of targeted attitude and behavioral change initiatives.** Under the coordinating framework provided by the recently adopted comprehensive “*Communication and Climate Resilience 2012-2017: National Communication Strategy and Action Plan*”, the sub-component will develop and promote tailored awareness raising activities and practices to address the adaptation needs of specific targeted groups, including teachers, school children, and farmers (small and large scale) through development and use of materials such as cartoons, animation, and support materials for school curriculum, and training.

39. The Component will be implemented primarily by the Climate Change Division (CCD) under the MWLECC, including design, supervision and monitoring of the activities. The CCD will ensure that the activities are accurately based on the latest scientific knowledge generated by Components 1 and 2, and use proven social marketing techniques. A working group for awareness raising and behavioral change led by the CCD will be established early on to develop appropriate strategies for achieving behavioral change and for ensuring gender sensitivity and reaching vulnerable groups.

40. **Component 4: Project Management, Monitoring and Evaluation (US\$0.68 million).** This component will support to carry out the Project, including overall technical management, financial management, procurement, compliance with environmental and social safeguards, monitoring and evaluation of data collection, supervision of works through the provision of consulting services, non-consulting services, goods, and Operating Costs. Specifically, this component will support the PIOJ’s central executing and fiduciary services unit (PIU) in project management and implementation including, but not limited to, technical, administrative and fiduciary support, namely procurement, financial management, and environmental and social safeguards, monitoring and evaluation, reporting, stakeholder involvement and coordination. The PIU is to be located within the PIOJ, consisting of Project Manager, Project Accountant, Procurement Officer, and Project Assistant. The PIOJ will be responsible for executing the proposed Project in close collaboration with the Technical Implementing Agencies, namely the

MWLECC (MSJ, WRA, CCD and NSDMD), the MOAF (RADA), the MLGCD (ODPEM), and the MOH (EDMSS).

41. Specific budget for M&E will be secured to ensure project-level results are fully reflected into the program-level reporting of the PPCR core indicators at the country and regional levels. Since the objective of the PPCR is to pilot and demonstrate ways to integrate climate risk into core development planning and the proposed Project is deemed innovative, and building on what has been done during the Project preparation (e.g., innovative climate change awareness campaigns, robust near-term sector specific climate scenarios, the most sophisticated and candid economic evaluation of hydro-met systems, etc.), mechanisms for capturing and sharing lessons with the rest of the PPCR community and a wider WB portfolio would be formulated and implemented throughout the Project.

Annex 3: Implementation Arrangements

JAMAICA: IMPROVING CLIMATE DATA AND INFORMATION MANAGEMENT PROJECT

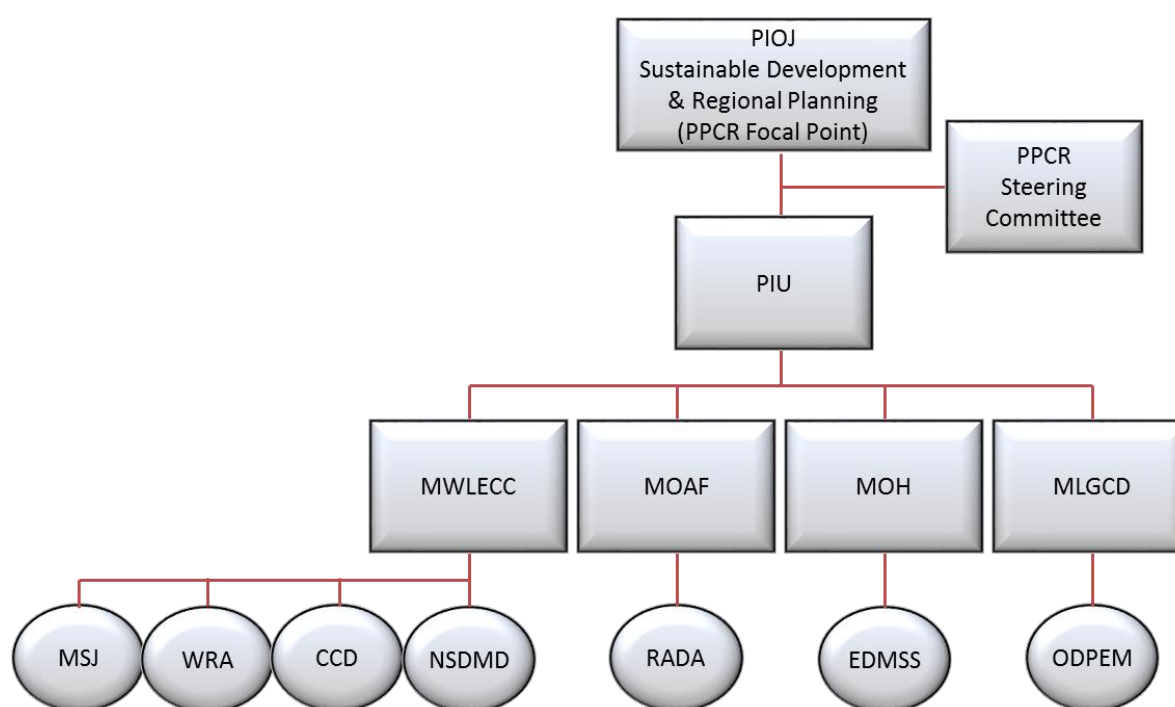
I. Organizational Structure and Roles and Responsibilities

1. **Planning Institute of Jamaica (PIOJ).** The PIOJ is a statutory body within the Ministry of Finance and Planning, and is the executing agency for the proposed Project. The PIOJ plays a number of critical roles including sustainable development planning, coordination of Jamaica's Development Plan, *Vision 2030 Jamaica*, and is the national Focal Point for the PPCR. The PIOJ managed the EU-funded *Climate Change Adaptation and Disaster Risk Reduction Project* (closed in December 2013) and is currently implementing the Jamaica's Adaptation Fund Program: *Enhancing the Resilience of the Agriculture Sector and Coastal Areas to Protect Livelihoods and Improve Food Security*.
2. As the executing agency, the PIOJ has established a central executing and fiduciary services unit (**PIU**) to be responsible for coordinating all activities of the Project and providing fiduciary support to the Technical Implementing Agencies, including procurement, financial management, environmental and social safeguards, and consolidated project reporting in accordance with the Grant Agreement and the POM. In addition, the Unit will act as secretariat to the PPCR Steering Committee. The PIU consists of the Project Manager, the Accountant, the Procurement Officer, and the Project Assistant. The Unit will report to the Project Coordinator, the Deputy Director General, Sustainable Development and Regional Planning, PIOJ.
3. **PPCR Steering Committee (PPCR-SC).** The Government has established an umbrella Steering Committee to serve as the main body responsible for providing advice and oversight to the implementation of PPCR. Under the proposed Project, the PPCR-SC would serve as the Project steering committee to be responsible for ensuring that the Project is effectively and expeditiously implemented in keeping its development objectives, results framework and budget and for addressing any inter-agency and strategic level issues and risks that may adversely affect the implementation of the Project. The PPCR-SC is chaired by the PPCR Focal Point—currently the Deputy Director General, Sustainable Development and Regional Planning of the PIOJ. Members of the PPCR-SC are drawn from a cross-section of stakeholders with technical interest in and knowledge of natural hazards, risk and climate change issues, including relevant Government Ministries, Departments and Agencies, private sector bodies, academia, and civil society. International development partners are offered observer status on the Committee.
4. **Implementation Agencies.** Direct responsibility for and technical oversight of the various components of the Project will be assumed by the respective Technical Implementing Agencies, namely MSJ, WRA, CCD and NSDMD under the MWLECC, RADA under the MOAF, the Office of Disaster Preparedness and Emergency Management (ODPEM) under the Ministry of Local Government and Community Development (MLGCD), and the Emergency, Disaster Management and Special Services Branch (EDMSS) under the Ministry of Health (MOH). Each Technical Implementing Agency has nominated the Project Focal Point to coordinate and oversee day-to-day Project activities and to report to the PIU. This includes ensuring that detailed Terms of References for consulting services and technical advisory work and specifications for goods (equipment) and small works are prepared in accordance with agency needs, sitting on evaluation

panels for the procurement of the goods/services and for checking and certifying the quality of inputs received before payment by the PIU is authorized.

5. The Project will be implemented in accordance with the Project Operational Manual (POM) and all relevant legal documents. The POM includes: (i) detailed descriptions of Project components and cost estimates; (ii) implementation and governance arrangement; (iii) funds flow mechanisms; (iv) detailed Project cost estimates; (v) a procurement plan; and (vi) an Environmental Management Framework (EMF). The POM is a ‘living document’ and will be amended periodically by the PPCR-Steering Committee to incorporate adjustments during Project implementation in agreement with the Bank.

Figure A3.1: Project Implementation Arrangements



6. The Project Organization Chart is shown in Figure A3.1. The findings of an assessment of the main Technical Implementing Agencies’ capacities to implement the Project are summarized below:

7. **Ministry of Water, Land, Environment and Climate Change (MWLECC).** MWLECC is a large complex ministry that was created in January 2012 and spans four functional areas, comprising several agencies/divisions, including MSJ, WRA, NSDMD, and CCD, involving reporting relationships with numerous internal and external stakeholders. The multi-layered executive management structure comprises the Permanent Secretary as well as a Director General and Chief Technical Director. The corporate governance structure is sound with an experienced and large senior management team, demonstrated strategic planning capacity, established reporting and oversight mechanisms, and an entrenched risk assessment.

8. **Meteorological Service Jamaica (MSJ)** under the MWLECC. MSJ is a division of approximately 60 persons that has an experienced management team headed by a Managing Director and organized into three branches, namely the Weather Branch, Climate Branch and the Administrative Branch. MSJ does not have its own finance, accounting, procurement or IT functions, which are managed by the Ministry. MSJ has experience in implementing donor-funded projects by the Global Environment Fund, and European Union. A project office was set up at MSJ to handle the latter but relied on additional support from the PIOJ project management unit.

9. **Water Resources Authority (WRA)** under the MWLECC. WRA is an organization headed by a Managing Director with a staff complement of approximately 50 persons. Corporate governance is sound with an experienced management team, demonstrated board oversight, good internal controls and a recognized history in providing quality on-line information. WRA has its own finance and accounts section headed by a Director, and the agency has a substantial prior record and apparent success in handling earlier projects funded by the World Bank, International Atomic Energy Agency, etc.

10. The activities under Component 1 to upgrade hydro-meteorological data collection, processing and forecasting system will be implemented primarily by the MSJ and WRA.

11. **Climate Change Division (CCD)** under the MWLECC. CCD was created in January 2012 with the mandate to implement the Climate Change Policy and to ensure the efficient coordination of climate change matters across the public sector, the NGO community, and the private sector. CCD will be the main driver to coordinate the dissemination and targeting of climate change awareness and behavioral change activities under Component 3 with messages derived from the robust, downscaled climate change modelling and vulnerability assessments under Component 2. It is also expected to provide inputs to the upgrading of the climate and natural hazard risk information platform proposed under Component 2.

12. **National Spatial Data Management Division (NSDMD)** under the MWLECC. The NSDMD is the government entity charged with the task of providing national strategic direction, policy development, leadership, management and implementation of Jamaica's spatial data infrastructure and provides metadata and geospatial data discovery, retrieval, updating, and management services via the Land Information Council of Jamaica (LICJ) WebMap. Its responsibilities make it central to the promotion and growth of Jamaica's geospatial sector and most importantly an enabler for national development. The NSDMD will lead the upgrading of the multi-agency climate and natural hazard risk data and information sharing system and clearing-house with public access under Component 2.

13. **Rural Agricultural Development Authority (RADA)** under the MOAF. The Ministry of Agriculture and Fisheries is a large ministry comprising several agencies, including the RADA, and a number of commodity boards. The corporate governance structure at the Ministry, which was an early adopter of the Performance Management Evaluation Systems, appears sound with demonstrated strategic planning capability, comprehensive reporting and oversight mechanisms, and an established risk assessment and internal audit process. RADA is an executive agency with its own board and management structure. RADA will assist in the scaling up of community risk profiles under Component 2, and will benefit from agro-met stations to be acquired under Component 1.

14. **Ministry of Health (MOH).** The MOH is a large ministry comprising several regional authorities and is required to manage a very complex staffing and infrastructural network. The