Technical Cooperation (TC) Document

I. Basic Information for TC

▪ Country/Region:	BAHAMAS
▪ TC Name:	Climate Resilience Diagnosis and Mitigation Plan for Public Infrastructure in The Bahamas
▪ TC Number:	BH-T1100
▪ Team Leader/Members:	Scholl, Patricia Lynn (INE/TSP) Team Leader; Persaud, Christopher (INE/TSP) Alternate Team Leader; Aiello, Roberto Gabriel (INE/ENE); Alberto Elizalde Baltierra (INE/ENE); Betty Villegas (INE/TSP); Daniela Acevedo (LEG/SGO); Hori, Tsuneki (CSD/RND); Lewis, Gilroy Francis (INE/WSA); Lucien Chung (INE/TSP); Oh, Jiwon (INE/TSP); Roberts, Syreta (CCB/CBH); Roca, Maria Eugenia (CCB/CBH); Seungyeon Kim (INE/TSP)
▪ Taxonomy:	Client Support
▪ Operation Supported by the TC:	N.A
▪ Date of TC Abstract authorization:	28 Feb 2023.
▪ Beneficiary:	Ministry of Works and Utilities, The Commonwealth of the Bahamas
▪ Executing Agency and contact name:	Inter-American Development Bank
▪ Donors providing funding:	Korea Poverty Reduction Fund(KPR); OC SDP Window 2 - Infrastructure(W2B)
▪ IDB Funding Requested:	Korea Poverty Reduction Fund (KPR): US$120,000.00 OC SDP Window 2 - Infrastructure (W2B): US$250,000.00 Total: US$370,000.00
▪ Local counterpart funding, if any:	US$0
▪ Disbursement period (which includes Execution period):	36 Months
▪ Required start date:	June, 2023
▪ Types of consultants:	Firms
▪ Prepared by Unit:	INE/TSP-Transport
▪ Unit of Disbursement Responsibility:	CCB/CBH-Country Office Bahamas
▪ TC included in Country Strategy (y/n):	Yes
▪ TC included in CPD (y/n):	Yes
▪ Alignment to the Update to the Institutional Strategy 2020-2023:	Social inclusion and equality; Productivity and innovation; Institutional capacity and rule of law; Environmental sustainability; Gender equality

II. Objectives and Justification of the TC

2.1 The objective of this non-reimbursable Technical Cooperation (TC) is to assess the climate risks posed by increased variability in climate change related weather patterns and to support the planning and implementation of adaptation measures to improve the resilience of public infrastructure to climate change impacts. Specifically, the aim is to map the degree of severity of climate risks[1] posed to critical transport corridors and associated energy and water infrastructure along those corridors posed by climate change, and to create a prioritized set of risk mitigation investments and costs for the Government of The Bahamas (GoBH).

2.2 The analysis will build upon existing models for New Providence in order to simulate hydrometeorological risks for a range of climate hazards and potential future damages along road corridors and by extension adjacent public infrastructure (i.e., energy, water and sanitation, health, and education infrastructure). Based on the results of the modeling exercises, an investment plan of the interventions and financial needs will be prepared to ensure an adequate climate-resiliency upgrade of current infrastructure stock, including a focus on increasing the stock of sustainable and inclusive infrastructure systems, and requirements to create the enabling policy environment and institutional conditions needed to scale up, sustain, and replicate resilient and environmentally sustainable infrastructure projects in the country.

2.3 The most recent evidence on the effects of climate change reveals that natural disasters crises have significant socioeconomic implications for Small Island Developing States (SIDS).[2] The concentration of population centers and infrastructure along mostly in coastal areas, leads to high risks to exposure to storm surges and flooding. Their reliance on sectors such as tourism renders these countries vulnerable to changes in consumption patterns and commodity prices resulting from macroeconomic disruptions. SIDS are likely to continue suffering significant economic and social impacts from these events' given that their exposure is high and their preparedness levels insufficient. According to the International Monetary Fund (IMF), the average annual estimated GDP loss from natural disasters and climate change for small states in Latin America and the Caribbean (LAC), 16%, with 11% of the population affected (versus 2.5% GDP loss and 1% of population affected for larger countries).[3] Latest estimates show that the largest damages in Caribbean islands have been associated with Tropical Cyclones that have resulted in damages of 82% of GDP on average over the period of 1950-2014.[4]

2.4 An archipelagic nation made up of 700 low lying islands and cays of which 30 islands are inhabited, is located in the Atlantic Ocean and north Caribbean Sea, The Bahamas is one of the most vulnerable countries in the Latin America and Caribbean region to climate hazard events.[5] In the Caribbean, additional warming could lead to a drier region (5–15% less rain than present day). [6]

2.5 In the past two decades (2000-2020), the country has been hit by 15 major disasters, mainly hurricanes (EM-DAT, 2021). The high winds and flooding from heavy rains and

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1 Including natural hazards as a result of increased variability in weather patterns and extreme climate events.

2 Climate Change and Small Island Developing States, Adelle Thomas, April Baptiste, Rosanne Martyr-Koller, Patrick Pringle, Kevon Rhiney, Annual Review of Environment and Resources 2020 45:1, 1-27 https://www.annualreviews.org/doi/10.1146/annurev-environ-012320-083355

3 Average for 1950-2014, see IMF Policy Paper, "Small states' resilience to natural disasters and climate change", 2016.

4 IMF Working Paper, "Gone with the wind: Estimating hurricane and climate change costs in the Caribbean", 2016.

5 Caribbean Studies, "Climate change and the Caribbean: review and response", 2012. https://www.jstor.org/stable/41917607

6 ECLAC, 2011, An Assessment of the Economic Impact of Climate Change on the Tourism Sector in The Bahamas, October 22, 2011. http://repositorio.cepal.org/bitstream/handle/11362/38601/1/LCCARL315_en.pdf

storm surges from these disasters have in total resulted in more than US$6 billion in public infrastructure and housing losses (EMDAT, 2021). Moreover, The Bahamas is expected to experience rising temperatures and reduced rainfall.[7] Combined with a drier climate, more extreme weather events can place additional stress on infrastructure. Damaged transport assets, as infrastructure structural integrity, operational capacity, from increased variability and extreme weather events, that in turn can lead to reduced mobility and access to key destinations, disrupted power, and lead to loss of life, and can represent a sizable portion of economic losses. Moreover, increases in temperatures and the frequency and duration of heat waves are predicted pose increasing and substantial challenges to transport infrastructure and operations, including to the safety/health of transport road users, public transit passengers, and pedestrians (UNCTAD, 2020).[8]

2.6 Infrastructure coverage, capacity, quality, and resilience are essential to enabling access to opportunities and services, reducing poverty and inequality, promoting security, and fostering productivity. However, infrastructure assets in The Bahamas are likely to be severely affected by increased intensity of climate events and may be unable to accommodate heavy rain and storms.[9] Given that most of the country is only a few meters above mean sea level, it is more vulnerable to sea level rise and storm surge associated with increasing intensity of extreme climate events. Recently, The Bahamas has experienced unusually heavy short duration rainfalls[10] where almost 12 inches of rain fell in 24 hours causing widespread localized flooding or roads disrupting vehicle movements and[11] causing damage, reducing accessibility to public services, disruption of the provision of public services and reduction in mobility for vulnerable parts of the population that use non-vehicular modes of transportation.

2.7 In addition, vulnerable and disadvantaged populations, such as low-income populations, persons with disabilities[12], children and the elderly are more exposed and vulnerable to impacts of climate change in The Bahamas. For example, in the capital city, Nassau, although a high proportion of the population depends on private vehicles (73% of the population use cars as their primary mode of transport), the remainder rely on walking and public transit. However, poor-quality infrastructure and services for public transport (31% of Nassau residents rate the public transport service as very poor or poor) and for lower income and vulnerable groups who depend on public transport and walking as their principal modes of transportation can result in their experiencing long travel times leave them more exposed to harsh climate conditions such as extreme heat and during climate hazards such as floods.

2.8 **Sector knowledge.** The IDB has implemented (or is in the process of implementing) the following TCs and loans projects on disaster risk management (DRM) and climate resilience which are relevant to the framework of this project: (i) the TC “Capacity

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7 UNFCCC, 2014, The Second National Communication of the Commonwealth of The Bahamas Under the United Nations Framework Convention on Climate Change, September, 2014, https://unfccc.int/sites/default/files/resource/bhsnc2.pdf

8 See: https://unctad.org/system/files/official-document/dtltlb2019d1_en.pdf

9 USAID, “Barbados and the Eastern Caribbean – Climate Vulnerability Profile”, 2013. And Cepal, “An Assessment of the economic impact of climate change on the tourism sector in Barbados”, 2011

10 Nassau received 12 inches of rain in 6 hours from a non-hurricane weather system. https://ewnews.com/supercell-flooding-new-providence-records-over-12-inches-of-rainfall

11 The Nassau Guardian article “$8mil price tag for flooding remediation, https://thenassauguardian.com/8-mil-price-tag-for-flooding-remediation/

12 According to the 2010 Census12 in The Bahamas there is a total of 10,138 people with disabilities (5,250 men and 4,888 women). People with disabilities often require assistance and additional time in order to prepare for a disaster or flooding. They are more likely to be left behind or abandoned during evacuations and disasters because of a lack of planning and preparation, as well as facilities, services, and transportation systems that are not accessible.

Strengthening for a More Resilient Bahamas (ATN/JF-17982-BH, US$600,000, approved in 2020) which financed, among other consultancies, the DRM governance diagnostics and institutional technical capacity strengthening (ii) “Climate Resilient Coastal Management and Infrastructure Program” (4363/OC BH, US$35 million), aimed at building coastal resilience to climate risks through sustainable coastal protection infrastructure, including nature-based infrastructure, and the institutional strengthening required to implement integrated coastal zone management; (iii) “Country Disaster Risk Profile for The Bahamas” (ATN/MD-15800-RG, US$300,000 for The Bahamas), which assessed the human and economic losses of hurricanes, coastal flooding, and coastal erosion; (iv) the TC “Feasibility Study for a Climate Resilient Integrated Coastal Zone Management Program” (ATN/OC-14250-BH, US$795,000), which assessed the feasibility of investments to protect socioeconomic activities in coastal areas from climate risks; (v) the TC “Capacity Strengthening, Technical Support and Knowledge Transfer of Disaster Risk Management and Health Risk Management in The Bahamas (ATN/OC-19552-BH, ATN/OC-19553-BH), as a pilot, in response to the impact of Dorian and later COVID-19, to support the execution of the Disaster and Health Risks Management activities in The Bahamas; (vi) the PBL “Strengthening Disaster Risk Management GoBH” (BH-L1056), aiming to improve the country’s governance for Disaster Risk Management (DRM); (vii) the TC “Capacity Strengthening, Technical Support and Knowledge Transfer of Disaster Risk Management (DRM) and Health Risk Management (HRM) in The Bahamas that has provided very important knowledge in terms of (DRM) (BH-T1094) and (viii) the TC “Support policy reform in comprehensive disaster risk management” (BH-T1096), aiming to provide technical support to the GoBH in the design, implementation, and evaluation of a series of policy reform programs.

2.9 Of these projects, the study that is particularly relevant to this TC is the "Country Disaster Risk Profile for The Bahamas" mentioned in (iii) above. The study estimates that a hurricane with a 100-year return period, considering the effects of climate change, would cause up to US$6 billion in economic damage if it made landfall in the Bahamas.[13] The report also noted that Dorian-class hurricanes were calculated to occur once every 50 to 100 years in the past but are now estimated to occur once every 25 years due to the effects of climate change. Therefore, this TC builds on the findings from the Country Disaster Risk Profile for The Bahamas to further refine this and identify specific and effective priority investment options to reduce the climate risk.

2.10 **Strategic alignment.** This TC is consistent with the Update to the Institutional Strategy 2020-2023 (AB-3190-2) in the challenges of: (i) Social Inclusion and Equity, for its contribution to mitigate the risks for minority groups; and (ii) Productivity and Innovation, as it improves availability and access to information, knowledge, and efficient technologies, by developing and applying instruments such as AI technology. In addition, the TC will also strengthen the Bank's work with the cross-cutting issues of (i) Climate Change and Environmental Sustainability, by fostering more sustainable and inclusive infrastructure that is resilient to climate change; (ii) Gender Equality and Diversity, by promoting a gender perspective and inclusion in the development of infrastructure, and (iii) Institutional Capacity and Rule of Law, by strengthening the institutions of GoBH in their work to develop infrastructure. Finally, the TC aligns as well with the IDB Country Strategy (2018-2022) working in 3 areas: (i) Enhancing public sector effectiveness; (ii) Supporting resilient infrastructure for growth; and (ii)

[13] See: https://publications.iadb.org/en/disaster-risk-profile-bahamas

Fostering an enabling environment for private sector competitiveness, with an emphasis on innovation.

2.11 The TC is aligned with the OC-SDP Window 2 – Infrastructure(W2B) as it directly supports the fund's priority areas of (i) Climate Change and Environmental Sustainability, (ii) Sustainable and Resilient Infrastructure, and (iii) Inclusive Social Development by strengthening the public capacity to respond to natural disasters, enhancing the quality of design and sustainability of transportation infrastructure, while encompassing activities to promote mobility of vulnerable groups.

2.12 Likewise, it is also consistent with the Korea Poverty Reduction Fund (KPR) created to support vulnerable and economically disadvantaged groups, as it contributes to improving living conditions and mobility of vulnerable people exposed to climate hazards through assessing the impacts of natural disasters on them and strengthening climate resilient infrastructure.

III. Description of activities/components and budget

3.1 **Component 1. Research design for strengthening infrastructure resiliency and sustainability in New Providence (US$100,000).** This component will develop a conceptual and research framework and design a model for the assessment of the risks posed by climate change to infrastructure in the island of New Providence in The Bahamas using the HydroBID as an implementation tool.[14] This component will support the development of a methodology that will enable the planning and prioritization of interventions to strengthen infrastructure climate resilience, the design of methodology, indicators, assessment models, tools, and review of literature to support the framework design. It is expected that this framework will be based upon data driven solutions and include principles of social inclusion as core elements (including the promotion of gender quality, the consideration of needs of people with disabilities, poverty, children, elderly). It will serve as an input to Component 2, but also will support the application of similar assessment and planning exercises in the family islands of The Bahamas.

3.2 **Component 2. Assessment of infrastructure resiliency and sustainability in New Providence (US$150,000).** Based upon the framework developed and data collected in Component 1, this component will assess the effects of climate hazards such as flooding and storm surges on transport, energy, and water and sanitation infrastructure,[15] examining both slow-onset hazards, such as those likely to occur from increased intensity of rainfall and sea-level rise, and episodic hazards, due to extreme weather events.[16] These studies will utilize both data from existing and information regarding topology, precipitation levels and critical infrastructure assets to analyze risk scenarios and identify and update current inventories of climate related vulnerabilities in the transport network capacity, and by extension, the impacts on access to schools, hospitals, government service centers.[17] It will also assess the impacts of these climate

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[14] Hydro-BID is a simulation tool created by the Inter-American Development Bank (IDB) to support the management and planning of water resources in the Latin America and the Caribbean region. An integrated and quantitative system to simulate hydrology and water resources management in the LAC region, under scenarios of change (e.g., climate, land use, population) which allows the evaluation of the quantity and quality of water, infrastructure needs, and the design of strategies and adaptive projects in response to these changes.

[15] This component will also examine the role of including coastal infrastructure and sea level rise on critical infrastructure (i.e. roads, and utility poles along roadways, etc), and in low-lying areas of the island, it will consider the impacts of sea level rise on drainage capacity near transport corridors

[16] Using IPCC climate change scenarios See: https://ar5-syr.ipcc.ch/topic_futurechanges.php

[17] The analysis will benefit from analysis and plans generated from BH-L1043, *Climate Resilient Coastal Management and Infrastructure Program,* such as shoreline management plans where critical transport infrastructure is located.

hazards on vulnerable groups including low-income populations, women, children, persons with disabilities, and the elderly.

3.3 It will also support a vulnerability assessment of existing power infrastructure along transport corridors to identify the critical weakness vis a vis potential extreme weather events and to identify the key measures needed to strengthen the power system's resilience to increased severity and variability in weather patterns as a result of climate change. This will enable the identification and prioritization of transportation infrastructure (road corridors and road drainage facilities) and power facilities located by the degree of climate hazard and flooding risk and relative impacts on infrastructure service reliability.

3.4 It will present solutions, investment plans, and policy recommendations to foster socially inclusive, sustainable, and resilient infrastructure including strategies to mitigate the risks of and respond to flooding with attention on poor and low-income populations, women, children, persons with disabilities, and the elderly. Further, the studies will analyze opportunities for improving infrastructure sustainability, such as retrofits of roads and adjacent utilities to provide for increased quality, coverage, connectivity, and resilience of infrastructure for low-carbon modes of transport, such as walking, cycling, and public transport. Based on these inputs, an investment plan for resilient, inclusive, and environmentally sustainable infrastructure and funding scenarios will be proposed.[18] This plan will include a prioritized list of interventions, investments, nature-based solutions, and policies to improve the resilience of transport as well as and access to adjacent public infrastructure such as government services, health care, schools, farms, and markets in their jurisdictions.

3.5 **Component 3. Piloting drone-based hydrology modeling, dissemination, and institutional strengthening (US$120,000).** This component will develop an institutional analysis and plan for capacity building to enable the scaling up of the adoption of the climate risk assessment tool and for identifying needs and priorities for resilient, inclusive, and sustainable transport infrastructure. Based upon this plan, it will implement a capacity building workshop to support government officials from New Providence and other family islands of The Bahamas to learn about the assessment and how to apply the methodology. It will also finance the following: (i) pilot project to introduce drone and AI technology-based hydrology modeling targeting a critical area in The Bahamas ii) dissemination of the methodology and results of pilot project as well as components 1 and 2 (iii) knowledge transfer workshop to present Korea's technology and practices regarding sustainable and climate resilient transport infrastructure. A capacity building workshop will also be held to demonstrate the method and results of pilot project in The Bahamas, so as to share Korea's technologies focusing on drone-based hydrology modeling and infrastructure assessment techniques. It will also include webinars, events, media materials, such as technical notes, blogs, and infographics.

3.6 **Budget.** The indicative budget of the TC will be US$370,000.00. Of this, US$250,000 will be financed by the Window 2 of the Strategic Development Program financed with the Bank's Ordinary Capital OC-SDP-W2B (GN-2819-14). The other US$120,000 will be financed by the Korea Poverty Reduction Fund (KPR). There will be no counterpart. The distribution of costs is presented in the following table:

[18] Prioritization of proposed interventions will consider cost and time and the severity of impacts of on the most vulnerable (severity of impact and number of people impacted).

Indicative Budget

Component	Description	IDB/W2B Fund	IDB/KPR Fund	Total Funding
Component 1	Research design for strengthening infrastructure resiliency and sustainability in New Providence	US$100,000		US$100,000
Component 2	Assess the effects of climate hazards such as flooding on transport infrastructure.	US$150,000		US$150,000
Component 3	Piloting drone-based hydrology modeling, dissemination, and institutional strengthening		US$120,000	US$120,000
Total		**US$250,000**	**US$120,000**	**US$370,000**

IV. Executing agency and execution structure

4.1 At the request of the GoBH, the TC will be executed by the IDB through its Transport Division. The IDB's execution is based in the additional value that the Bank's knowledge and experience on the execution of TC resources brings. This execution structure will facilitate enhanced coordination among the various Ministries and Agencies within The Bahamas, while the close collaboration with MW&U other relevant authorities throughout the preparation, design and successful execution of the program will help ensure coherence with overall objectives to map at risk public infrastructure and prepare an investment plan. The IDB Transport Division has in the past successfully implemented TC (BH-T1048) in the recent past in The Bahamas.

4.2 The TC will be executed by the Bank through the hiring of consultants to carry out each study. The Bank will contract the services of individual consultants, consulting firms and non-consulting services in accordance with the policies and procedures in force at the Bank. The activities to be executed under this operation are included in the Procurement Plan (Annex IV) and will be executed in accordance with the Bank's established procurement methods, namely: (i) hiring of individual consultants, as established in the AM-650 standards; (ii) contracting of consulting firms for services of an intellectual nature in accordance with GN-2765-4 and its associated operating guidelines (OP-1155-4); and (iii) contracting of logistics services and other non-consulting services, in accordance with policy GN-2303-28. For its part, financing the purchase of goods (including software/platforms/applications and their development) is limited by GN-2765 policy to 10% of the value of the contract. The Bank will be responsible for: (i) identifying the studies and technical work necessary to structure the project; (ii) selecting and hiring consultants to provide the necessary services; and (iii) managing the execution and delivery of consulting services.

V. Major issues

5.1 **Risk of low engagement from the beneficiaries.** The primary risk associated with TC, rests in its dependence on coordination and collaboration within Ministries and Government agencies. Even though there is a well-established need and drive to improve the infrastructure resilience in The Bahamas, there is a risk of low engagement from public officials and stakeholders, principally due to limited execution capacity and conflicting timetables and priorities. A technical working group with government-appointed representatives from the relevant Ministries will be established to provide input in TC activities and maintain momentum within Government.

VI. Exceptions to Bank policy

6.1 No exceptions to the Bank policy are considered for this TC.

VII. Environmental and Social Strategy

7.1 This TC does not intend to finance pre-feasibility or feasibility studies for specific investment projects or environmental and social studies associated with them; therefore, the requirements of the Bank's Environmental and Social Policy Framework (ESPF) do not apply to this TC.

Required Annexes:

Request from the Client - BH-T1100

Results Matrix - BH-T1100

Terms of Reference - BH-T1100

Procurement Plan - BH-T1100