

Testimony to Legislature

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A successful climate change adaptation program in the Virgin Islands would help our people, institutions and community to be able to survive and thrive in a changing environment that impacts all aspects of life. In order to address the challenges and opportunities we will face in a changed environment, the US Virgin Islands will need data and information from assessments in support of decision-making for necessary policy changes, coordinated actions among institutions and communities, and effective communication among all stakeholders. The impacts of climate change - on our health, economic activity like tourism, local agriculture and food security, and the infrastructure that supports life in our community - will change the way we plan and develop as a territory beginning today and into decades to come.

The islands are vulnerable to a number of climate related natural hazards, and past events have resulted in loss of life and property damage. There has been a dramatic history of major hurricanes, with particularly devastating storms occurring in 1867, 1871, 1916, 1989 and 1995. There is an average interval of 12 to 15 years between major hurricanes. The value of damages from Hurricane Hugo (1989) which concentrated on St. Croix was in excess of US\$1.5 billion; estimate of the damage from Hurricane Marilyn (1995) exceeded US\$ 2.3 billion. The damage caused by Hurricane Marilyn was mostly incurred by private homeowners, but all other sectors were significantly impacted. In most events all critical facilities have suffered severe damage, especially sewage, power and telephone distribution systems. The Territory however, has not been affected as significantly since 1995 and recovery time for all other events has been much shorter.

Inland flooding due to large amounts of rainfall over short periods of time are considered to be the most significant natural hazard in the Territory in terms of frequency. The Territory is impacted by two types of flooding:

- a) Urban flooding due to large number of impermeable surfaces and an inadequate stormwater drainage system
- b) Flooding outside of the urban areas due to the lack of maintenance and respect to the natural guts and flood plains. The guts are often filled with debris and trash.

Runoff is also exacerbated by the islands' steep topography, non-porous rock base, thin clayey soils and loss of natural vegetation. The Virgin Islands has experienced 11 major flood events since 2003; damage from the November 2003 flood alone cost the Territory over \$19 million.

The Caribbean has been considered especially vulnerable to the effects of climate change due to the region's exposure to extreme weather events, its geographic and economic scale, and its reliance on tourism and imported goods. The natural hazard history of the USVI that I summarized demonstrates the vulnerability of the Territory to the effects of climate change.

The projected climate changes of most concern to the USVI are rising temperatures, changing rainfall patterns, stronger hurricanes and rising sea level. The Territory's coastal zone is particularly at risk to climate change impacts because of the concentration of hotels, businesses, critical infrastructure, and residential development. This increases their exposure to storm surge and sea level rise.

In a table below I have identified potential and existing climate change impacts on the USVI.

The USVI has an extensive disaster management program coordinated by the V.I. Territorial Emergency Management Agency. However, preparing for climate change involves more than disaster management. It requires multi-hazard assessments that consider both acute and chronic climate stressors and cross-sector approaches to reduce risks and integrate adaptation measures into all planning and implementation operations, a concept known as "mainstreaming climate change". The USVI has not established a climate change program, although some of the public sector disaster management and natural resource management agencies have initiated discussions regarding such a program.

Recently, an institutional analysis was conducted of past and present climate change or risk reduction programs, projects and initiatives by territorial and federal institutions and found that the Territory has an assortment of existing planning and operating programs that create the basic foundation needed for integrating risk reduction, climate adaptation and climate mitigation measures either through standalone, climate-explicit projects or by mainstreaming climate change into regular operations and policies. Very few of these programs have begun addressing climate change directly, with exceptions in the natural resources sector.

However, a review by the CLCC, found many federal and a few non-governmental entities already have guidance, products, tools, assessments and to a lesser extent, implementation funding, available to the Territory. A larger climate change program framework and technical and human resource assistance is needed to pull the pieces together and advance the Territory's agencies and partners abilities to assess risks and vulnerabilities, and prioritize adaptation strategies at a meaningful scale for effective decision making.

Similarly, a number of nonprofit, nongovernmental organizations have developed climate change initiatives, which could be linked into a territorial program. Coordinated efforts among government agencies to understand vulnerabilities to climate change and take actions that reduce risk represent a positive step in responding to climate change. Currently, agencies and departments often make independent assessments of vulnerabilities for adaptation actions, focusing only on a subset of affected resources, services, or economic sectors. This compartmentalization makes integrated planning and responses more difficult and governmental policy and incentives do not align in a way that makes the most efficient use of resources. As such there is a strong need to develop a comprehensive base of information and a coordinated set of partnerships and relationships among agencies in order for any one agency to most effectively deliver support for climate adaptation projects.

Given the level of concern, vulnerability and risks associated with climate change in the Territories, **Governor Kenneth Mapp in October 2015 signed Executive Order No. 474-2015: Preparing the Virgin Islands of the United States for Adapting to the Impacts of Climate Change.** The order calls for all agencies of the territorial government to 1) assess vulnerabilities and risks to their operations and mission that are associated with climate change, 2) develop agency specific adaptation plans and report annually on progress, 3) develop decision support systems for climate change adaptation, and 4) establish the Virgin Islands Climate Change Council.

We requested technical assistance funding through the Department of the Interior which explicitly supports the actions of the executive order and will establish processes and implement vulnerability and risk assessments in support of the production of a climate change adaptation strategy for the U.S. Virgin Islands.

The likelihood of new and increased public health, economic development, infrastructure, and community education challenges requires an agreed on approach and strategy to manage these risks and responsibilities. **The Executive Order of the Governor of the Virgin Islands** sets the territorial response within the context of deliberate preparation, close cooperation, focused communications, and coordinated planning by the Government of the US Virgin Islands and community stakeholders.

The goals of the VI climate change adaptation strategy are to facilitate Federal, local, private and the nonprofit-Sectors efforts to improve climate preparedness and resilience; help safeguard our economy, infrastructure, environment, and natural resources; and provide for the continuity of executive departments, agencies and all instrumentalities of the Government of the U.S. Virgin Islands operations, services, and programs.

First, we must determine the level of vulnerability and risk in its current infrastructure and community systems to the multiple aspects of climate change. Then, agree on a framework outlining the processes and strategies appropriate for supporting adaptation measures that will increase the resiliency of the territory.

Existing knowledge related to both acute and chronic vulnerabilities will be compiled and each sector will be assessed by the appropriate territorial agencies using the best available scientific knowledge in order to develop a Territorial strategy that will greatly reduce risks, increase capacity, and build resilience in these sectors:

- **Human Health and safety:** Including human well-being, safety and security, infectious diseases, records and access to health care, clean air and clean water;
- **Critical infrastructure:** Including housing, hospitals, utilities, flood control, transportation, education, and industry;
- **Economic Development:** Including economic competitiveness, education and workforce development, infrastructure, environment and quality of life, health care, and government support systems;
- **Food Security:** Including agriculture, forest products, fisheries, freshwater availability, livestock and dairy, soils, market chains, and supplies;

- Tourism: Including infrastructure, transportation, cultural and historical resources;
- Natural Resources: Including water, corals and seagrass systems, wetlands, cays systems, endemic and endangered species, landscapes, seascapes, viewsapes and soundscapes.

Potential and existing Climate Change Impacts (adapted from Burnett, Penn, 2011) related to the sectors identified in this proposal

IMPACT AREAS	POTENTIAL AND EXISTING CLIMATE CHANGE IMPACTS
NATURAL RESOURCES	<ul style="list-style-type: none"> ✓ Coral reefs experiencing increased bleaching, structural damage, disease and death ✓ Landward migration or inundation of mangroves and increased mortality ✓ Decreased growth of seagrass beds and increased stress and mortality ✓ Increase in likelihood of flood events ✓ Decrease availability of rainwater leading to greater dependent on the public water supply system and an increased threat of water shortage in emergencies ✓ Increase in cost of desalinated water
CRITICAL INFRASTRUCTURE	<ul style="list-style-type: none"> ✓ Road network, critical facilities, utilities, developable lands and the sewerage system (especially coastal) at greater risk of damage
FOOD SECURITY: AGRICULTURE	<ul style="list-style-type: none"> ✓ Decrease in agricultural yield (or increased costs of production) due to decrease in rainwater ✓ Increase in agricultural pests, weeds, disease and invasive species ✓ Decrease in agricultural produce (or increase in costs). Less rainwater for agriculture ✓ Soil degradation, resulting in reduced yield ✓ Increase in crop damage and disruption of production cycles ✓ Increased stress to livestock, resulting in decreased productivity ✓ Changes in imported food availability, cost, and equity
FOOD SECURITY: FISHERIES	<ul style="list-style-type: none"> ✓ Loss of critical fish habitat and changes in plankton food resources ✓ Migration of some fish species to cooler water ✓ Potential changes in spawning opportunities and rates of mortality and disease ✓ Increase in opportunities for establishment of marine invasive species ✓ Increased damage to landing sites, on-shore facilities, boats and equipment
FORESTRY & BIODIVERSITY	<ul style="list-style-type: none"> ✓ Decline in health and abundance of marine resource ✓ Decline in turtle nesting activity and creation of long-term reproduction issues ✓ Shrinking unpaid forests and reduction of associated biodiversity ✓ Disruption of bird migration and reproduction patterns. Increased mortality ✓ Increase in opportunities for establishment of invasive species
HUMAN HEALTH & SAFETY	<ul style="list-style-type: none"> ✓ Increased physical and psychological trauma as a result of storms and other manifestations of increasingly hostile oceanic and atmospheric phenomena ✓ Increase in dengue fever outbreaks (frequency and severity) ✓ Increase in prevalence of ciguatera (fish poisoning) ✓ Increase in respiratory diseases, such as asthma ✓ Increase in risk of diarrhea and other environmentally transmitted illness ✓ Increased potential for heat stress ✓ Increase in risk of damage to health care facilities ✓ Greater threat of epidemics and pandemics
TOURISM	<ul style="list-style-type: none"> ✓ Loss of, or more costly damage to, tourism infrastructure and projects ✓ Diminished natural attraction, e.g. coral reefs, beaches, and wildlife, resulting in reduced demand by tourists

IMPACT AREAS	POTENTIAL AND EXISTING CLIMATE CHANGE IMPACTS
	<ul style="list-style-type: none">✓ Rising overheads in energy, water, and insurance✓ Deterrents to travelers, e.g. warmer winters, less comfortable and stable VI climate, higher airfares, and increased dengue fever outbreaks✓ More tourists seeking carbon neutral or energy efficient destinations

Sector Review

The Review of the Economics of Climate Change (RECC) assessment of the economic impact of Climate Change on the coastal and marine sector of The Virgin Islands up to 2050 alone conservatively estimates an impact ranging from 68% to 286% of 2008 GDP under a relatively high carbon emissions scenario and an impact ranging from 30% to 189% of 2008 GDP under a relatively low carbon emissions scenario. This equates to cumulative losses to 2050 ranging from \$671 million to \$2.8 billion and from \$301 million to \$1.8 billion by 2050 respectively. Cost impacts to the other sectors affected are yet to be determined for The Virgin Islands, but regional studies show high costs as well. In addition, there is the cost incurred from disaster events which are expected to intensify with Climate Change.

The effects of predicted climate change depend on regional and site specific environmental and social factors. Environmental factors include mean temperature and precipitation shifts, changing diurnal extremes, changing seasonality, extreme weather events, increased carbon dioxide levels, hydrologic changes, and the subsequent effects on flora and fauna physiology and interactions. Social factors encompass socio-economic, political, cultural, and other human dynamics in which these environmental changes are occurring, including regulatory economic factors that affect how regional residents are able to respond and adapt to changing conditions.

Combining the environmental and social conditions can be used to gauge the vulnerability of a given community or sector. System disturbances include environmental disasters, economic downturns, supply chain failures, public health crises, political conflict, or upheaval, or a number of other events. Often these stressors precipitate or build on each other in what can become a system-wide negative feedback loop. These stressors vary considerably across time and space, and therefore it is important for vulnerability assessments and subsequent actions to be timely and based on a combination of social and biophysical knowledge. This project is therefore aimed at considering both the environmental as well as social conditions.

A review of individual sectors indicates that there are several programs and projects active by territorial agencies in each sector however, many of them do not include climate change. This presents a challenge for proper climate change adaptation and mitigation to take place in the USVI. The proposed sectors for this project come from the 2015 Executive Order on Climate Change and are human health, critical infrastructure, food security, economic development, tourism, and natural resources. They have been reviewed, especially as it relates to the integration of climate change. A summary of the findings is presented below.

Human Health- According to the National Institute of Health, a changing climate impacts health and wellbeing. The major public health organizations of the world have indicated that climate change is a critical public health problem. Climate change can exacerbate existing diseases and health conditions, but it may also introduce new pests and pathogens into new regions or communities. The most vulnerable people—children, the elderly, the poor, and those with underlying health conditions—are at increased risk for health effects from climate change. Climate change also stresses the health care infrastructure and delivery systems¹. These assertions are consistent with what VI experts from the VI Department of Health and the University of the Virgin Islands recently presented in a health panel at the Climate Change in the Caribbean 2015: Puerto Rico & U.S. Virgin Islands Conference².

There has been limited published scholarly research that addresses health issues and health disparities in the U.S. Virgin Islands. The available studies are primarily national surveys such as the Behavioral Risk Factor Surveillance System (BRFSS) that have included participants from the USVI^{1,2}. The USVI has several health programs/ outputs but none have addressed the direct impacts of climate change on the health sector³. However, new guidance, national strategies, and resources from the Federal Government for Healthy People 2030 from the U.S. Department of Health and Human Services and an assortment of agencies' environmental justice strategies and programs are potential opportunities for the territorial agencies responsible for health and wellbeing services to address climate change.

Critical Infrastructure- The Territory's critical infrastructure provides essential services that are vital to public confidence and the islands' safety, prosperity and well-being. There appears to be some amount of inclusion of climate change vulnerability in some programs/ projects related to key infrastructure development, such as a 2005 study completed by Dr. Aurelio Mercado funded by the Puerto Rico Sea Grant College Program, and climate mitigation actions included in the VI Department of Public Works Proposed 2030 Master Transportation Plan. A non-governmental study led by The Nature Conservancy using funding from the National Oceanic and Atmospheric Administration⁴ used input from workshop participants and applied mapping tools available at coastalresilience.org. The study found that ten coastal areas were identified in the territory as most vulnerable to climate change and likely to respond: Two Brothers (142), Demarara (124), Kings Quarter (120), Honduras (109), Nadir (81),

¹ <http://www.niehs.nih.gov/research/programs/geh/climatechange/>

² Casper M, Nwaise I, Croft JB, Hong Y, Fang J, Greer S *J Am Coll Cardiol*. 2010 Jan 26; 55(4):294-9.

³ Mercado. 2005. Final Report: An evaluation of the main ports and bays in Puerto Rico and the U.S. Virgin Islands as to their exposure to hurricane wave attack. Sea Grant College Program. Available upon request.

⁴ Schill, S., J. Brown, A. Justiniano, A. Hoffman. 2014. US Virgin Islands Climate Change Ecosystem-based Adaptation: Promoting Resilient Coastal and Marine Communities. The Nature Conservancy and NOAA Coral Reef Conservation Program.
https://www.conservationgateway.org/ConservationPractices/Marine/crr/library/Documents/USVI%20EBA%20Guidance_Final.pdf

East Street (78), Mount Pleasant and Retreat (72), Bovoni (70), and Enighed (63). A storm surge atlas developed for the USVI by the Caribbean Coastal Ocean Observing System illustrates various levels of risk under impact by different categories of hurricanes and, by implication, by sea level rise and tsunamis⁵. These studies are a good start for the Territory, but many more like these are needed that focus on identifying specific critical infrastructure assets vulnerable to multiple climate parameters and viable solutions for mitigating those risks.

Economic Development - The Fifth Assessment Report of the Intergovernmental Panel on Climate Change found that the impacts of climate change will be felt by every sector of the economy and are relevant to all investors, financial services and businesses⁶. The VI Economic Development Authority (VI EDA), a semi-autonomous government organization responsible for the promotion and enhancement of economic development in the United States Virgin Islands, currently does not have a climate change policy or risk and vulnerability assessment publicly available; however, the VI EDA administers a number of programs that work to build resiliency into the territories economy. Additionally, the federal programs that provide funding and technical assistance to territorial programs, like the US Department of Commerce, recognizes the importance of factoring climate change impacts into its planning and grant processes. The Federal Economic Development Administration (US EDA) is helping to build resiliency in communities by providing grant-based investments to communities and regions suffering from economic distress. These investments range from strategic economic development planning to public infrastructure construction.

According to the Bureau of Economic Research (BER) Comprehensive Economic Development Strategy (CEDS 2015)⁷, the USVI is at a “critical juncture of economic crisis and change, after three successive years of economic decline...” The strategy recognizes the natural and human resources of the islands as core strengths for economic development as well as identifying the need to invest in ‘infrastructure, environment and quality of life’, but does not make specific mention of climate change. Programs aimed at incorporating climate change vulnerabilities and solutions into existing and emerging development strategies as well as diversifying the economy of the USVI represent important strategic opportunities for this sector.

Food Security- Public and private efforts have been made to strengthen the agricultural sector within the US Virgin Islands in recent years. The United States Department of Agriculture (USDA) invested

⁵ Storm Surge Atlas for the USVI: <http://www.caribbeanoceanobserving.org/>

⁶ IPCC. 2014. Summary for policymakers. In: Climate Change 2014: Impacts, Adaptation, and Vulnerability. Part A: Global and Sectoral Aspects. Contribution of Working Group II to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change [Field, C.B., V.R. Barros, D.J. Dokken, K.J. Mach, M.D. Mastrandrea, T.E. Bilir, M. Chatterjee, K.L. Ebi, Y.O. Estrada, R.C. Genova, B. Girma, E.S. Kissel, A.N. Levy, S. MacCracken, P.R. Mastrandrea, and L.L.White (eds.)]. Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA, pp. 1-32. <http://www.ipcc-wg2.gov/AR5/>

⁷ USVI CEDS: <http://www.usviber.org/CEDS%20Plan%202015.pdf>

over \$535 million in the US Virgin Islands in the six-year period from 2009-2014. The USDA also invested \$15.6 million in research efforts designed to improve agricultural and natural resources in the face of challenges such as climate change and growing populations. Some of these funds were invested in partnership with local entities such as the US Virgin Islands Department of Agriculture and the University of Virgin Islands Cooperative Extension Service in order to promote new farmers and sustainable cultivation practices. In 2015 the UVI-CES hosted the 31st West Indies Agricultural Economics Conference with the theme of “Mitigating Climate Change Effects to Ensure Food Security” along with the Caribbean Agro-Economic Society, University of the West Indies Department of Agricultural Economics, the University of the Virgin Islands Cooperative Extension Service and Agricultural Experiment Station, the V.I. Department of Agriculture, the V.I. Department of Tourism, and the Caribbean Food Crops Society – V.I. Chapter.

The Virgin Islands Department of Agriculture (VIDOA) 2016 budget includes several drought impact mitigation efforts including the purchase of additional water storage tanks and water delivery trucks.³ In partnership with the Geographic Information Systems (GIS) division of the Lt. Governor’s office, the UVI’s Conservation Data Center and the GeoCAS Institute of the University of the Virgin Islands, a digital map and information system of all of the government agricultural land is being developed. This will allow the department to have a better grasp of our farmland inventory and to develop a more efficient and effective land management and distribution strategy⁸. This partnership project will also have the added benefit of contributing to the VICCC’s ability to assess potential impacts to the agricultural sector. There are also several federal programs in the USVI that address climate change impacts and vulnerabilities on the sector. The Virgin Islands is only at the start of what is needed to secure food supplies and develop a resilient agricultural sector.

Tourism- The Caribbean and international community have a plethora of research and case studies on how climate change will affect tourism, some even quantifying the GDP lost from climate impacts, and how governments, tourism concessioners, hotels and other tourism infrastructure providers can implement innovative solutions. A review of the VI Department of Tourism, the VI Economic Development Authority, the VI State Historic Preservation Division within the VI Department of Planning and Natural Resources, the VI Port Authority, the VI Hotel and Tourism Association, and the VI Chambers of Commerce did not result in finding any programs, projects or strategies directly related to climate change. However, as in many of the other sectors, a wide host of tourism projects were found that could indirectly contribute to climate adaptation or mitigation initiatives, such as infrastructure improvements

⁸ Robles, Carlos. September 1, 2015. Testimony of Commissioner Carlos Robles of the VI Department of Agriculture to the 31st Legislature – Committee on Finance.
<http://www.legvi.org/CommitteeMeetings/31st%20Legislature%20Committees/COMMITTEE%20OF%20FINANCE/FY2016%20Budget%20Process/09-01-2015%20-%20DOA,%20DLCA,%20Election/Testimony%20-%20DOA.Carlos%20Robles.Commissioner%20Designee.FY2016.pdf>

and natural resource protection (the 2015 Comprehensive Economic Development Strategy 2015⁹ specifically cites the importance of natural assets to the USVI tourism product). Being that tourism is one of two main industries in the Territory (the second being an oil refinery) special attention must be given to conducting assessments, planning and implementing climate adaptation projects immediately. Two territorial government representatives, one from the VI Department of Tourism, stated at a recent climate workshop on St. Thomas, “the VI needs to expand our tourism products to include options away from the coasts to adapt to climate change” and “the climate challenge calls for reimagining our tourism products.”¹⁰ A lot of work remains to determine the specifics of how to do just that.

Natural Resources. The natural resources of the USVI are of paramount importance to the islands continued cultural and economic vitality. Territorial authorities are working with federal partners on a number of terrestrial and marine based programs to help adapt to changes already being felt and prepare for future scenarios. Preserving and restoring ecosystem health across the islands will minimize vulnerability and risk in the face of climate change. The territories’ coral reefs are an invaluable asset that provides a number of critical ecosystem services such as healthy fisheries, protection from storm surges and tourism opportunities. The health of these reefs is tied to climate, management and development practices across the islands.

The Virgin Islands Department of Planning and Natural Resources (DPNR) serves as the agency responsible for the administration and enforcement of all laws pertaining to the preservation and conservation of fish and wildlife, trees and vegetation, coastal zones, cultural and historical resources, water resources, and air, water and oil pollution. DPNR is also responsible for oversight and compliance of land survey, land subdivision, development and building permits, code enforcement, earth change permits, zoning administration, boat registration, and mooring and anchoring of vessels within territorial waters. Two DPNR divisions work directly to study and plan for the effects of climate change: the Division of Coastal Zone Management and the Division of Fish and Wildlife. The divisions work in partnership with NOAA’s Office of Coastal Management and Coral Reef Conservation Program and the U.S. Fish and Wildlife Service. The mission of the agency and the programs its division implements is critical to maintaining and restoring healthy marine and terrestrial ecosystems that will be resilient to stresses from climate change. A variety of other federal programs such as U.S. Geological Survey, National Park Service, and U.S. Environmental Protection Agency play a strong role working with DPNR and other territorial agencies to protect natural resources. A review shows that all of these federal agencies have climate-explicit programs completed or are in-development in USVI. These efforts are complimented by programs currently being administered by the Virgin Islands Department of Agriculture (VIDOA) in partnership with the US Forest Service, the University of the Virgin Islands Cooperative Extension Service, the Natural Resource Conservation Service (NRCS), and various other

⁹ <http://www.usviber.org/CEDS%20Plan%202015.pdf>

¹⁰ Climate Matters Workshop at the University of the Virgin Islands in partnership with the University of the West Indies Mona Climate Studies Group. January 12 and 13, 2016. Organized by the Caribbean Green Technology Center’s Director Dr. Wayne Archibald. First quote by Annice Canton of the VI Department of Tourism and the second by Senator Tregenza Roach.

USDA entities aimed at improving agricultural and land management practices that have a direct impact on biodiversity, water quality, and overall natural resource health.