PAGAN-TRINIDAD - UPRM
DHS Coastal Resilience Center
Year 6 Education Project Workplan
[July 1, 2020 – June 30, 2021]

1. **Title**. "Education for Improving Resiliency of Coastal Infrastructure" (Year 6 - Multi-hazard Capacity Building (MHCB) to Mitigate Risks in Vulnerable Communities in Puerto Rico – Resilient Reconstruction Phase After Hurricane María and the January 2020 Earthquake Sequence"(Department of Civil Engineering and Surveying - Civil Infrastructure Research Center-CIIC at the University of Puerto Rico at Mayagüez -UPRM)
2. **Principal Investigators**: Ismael Pagán Trinidad, Professor and Director; Carla López del Puerto, Professor in Construction Engineering Raúl E. Zapata López, Professor and Associate Director; Department of Civil Engineering and Surveying
3. **Other Participants/Partners**

   Potential Resources, Faculty at the Department of Civil Engineering and Surveying, other faculties at UPRM and externally that have participated or have the potential to participate in the future

   Department of Civil Engineering and Surveying Faculty

   Francisco Maldonado, PhD, Professor (Construction Costs), Lead for Construction Estimates and Validation; **Jorge Rivera Santos**, PhD, Professor (Hydrology and Hydraulics), Director-Water Resources and Environment Research Institute; **Walter Silva**, PhD, Professor (Hydrology and Hydraulics), Associate Director-Water Resources and Environment Research Institute; **Benjamin Colucci**, PhD, Professor (Transportation Engineering), Director-Transportation Technology Transfer Center; **Alberto Figueroa**, PhD, Professor (Resilient Transportation Infrastructure Design); **Luis Aponte**, PhD, Professor (Wind Engineering); **Ali Saffar**, PhD, Professor (Reliability and Resilience Engineering Analysis and Design); **Alesandra Morales**, PhD, Professor (Geotechnical Engineering), Director, Geotechnical Laboratory; **José Guevara**, PhD, Professor (Rehabilitation of Coastal Infrastructure); **Pedro Tarafa**, PhD, Professor (Environmental Engineering- Water, Air and Solid Waste Pollution); **Luis Suárez**, PhD, Professor (Structural Dynamics); **José Martínez Cruzado**, PhD, Professor (Structures-PR Strong Motion Program).

   Other UPRM Partners:

   Miguel Canals, PhD, Professor (Ocean and Coastal Engineering), PI-CARICOOS Project, Department of Materials Science and Engineering; **José Cedeño**, PhD, Professor (Cost Estimates and Validation – Power and Electrical Engineering), Department of Electrical and Computer Engineering; **Lionel Orama**, PhD, Professor (Alternative Energy Sources, Renewable Energy, and Microgrids), Electrical Engineering Department; **Ruperto Chaparro**, MS, Director and Lillian Ramírez, MS, Administrator, PR Sea Grant Program; **Marla Perez and Cecilio Ortiz**, INESI (Instituto Nacional de Energía y Sostenibilidad Isleña = "National Institute on Energy and Island Sustainability") and RISE Initiative; José Cedeño, PhD, Resilient Electric Infrastructure.

Agency Partners:

Ernesto Díaz, MS, Director, **PR Coastal Management Program, Department of Natural and Environmental Resources; President, PR Climate Change Council**.

EPA (Mehta-Sampath, Ameesha) and PR Chamber of Commerce (Jeannette Vázquez) : ***EPA-led Healthy Buildings Long-term Recovery Initiative (Homes/Public Housing/Schools/Buildings)***, PI is a Member of the Puerto Rico Healthy Building Task Force.

EPA (Mehta-Sampath, Ameesha), "**Innovative research project to increase radon monitoring capacity in Puerto Rico"**, UPRM-CRC as partner in this initiative.

Davis Pittman, Patrick Deliman, Carlos Ruiz, Evelyn Villanueva, **"Educational and Research Partnership (ERPA)"**, ERDC-US Army Corp of Engineers

PR Emergency Management Agency and USA FEMA

Association of Professional Engineers of PR

CRB (Community Resilient Building)

RE-IMAGINE Puerto Rico

RISE Network, Marla Pérez and Cecilio Ortiz, Senior Fellow, RISE National Council for Science and the Environment

PR Department of Transportation and Public Works and the State Highway and Transportation Authority

CRC Partner Researchers (to expand previous collaborations)

Gavin Smith, PhD, Professor, PI- NCSU North Carolina State University
Dan Cox, PhD, Professor, PI-Oregon State University
Robert Whalin, PhD, Professor, PI-Jackson state University
Tom Richardson, PhD, Professor, PI-Jackson State University
Scott Hagen, PhD, Professor, PI-Louisiana State University
Others researchers form CRC will be invited as guess speakers.

Short Description.

This project has the main goal of institutionalizing a Certificate in **Multi-hazard Capacity Building to Mitigate Risks in Vulnerable Communities in Puerto Rico – Resilient Reconstruction Phase After Hurricane María and the January 2020 Earthquake Sequences** to support the development of the multi-hazard resilience workforce education program and updating it to assist in the long term reconstruction of Puerto Rico. The certificate program will be institutionalized and hosted at the existing Civil Infrastructure Research Center (CIRC) at the Department of Civil Engineering and Surveying at UPRM. The certificate program will strengthen the Center's activities and leadership statewide under its focal thrust areas: Natural Disasters, Accidents and Civil Infrastructure in the areas of Structures, Transportation, Environmental and Water Resources, Geotechnical Engineering, Geospatial Analyses, and Construction. Multi-hazard Certificates based on contact-hours

achieved are envisioned to recognize participants' achievements. The certificate program expects to engage and develop 1) faculty as leaders, trainers and train-the-trainers, 2) students as trainees through both an updated core course curriculum, and alternative learning opportunities for their broad formation in civil engineering and related disciplines, 3) professionals as trainees and continuing education development, and 4) community leaders as trainees to provide the knowledge necessary to form community leaders and achieve educated involvement in the reconstruction process of Puerto Rico. This project is envisioned to institutionalize the long-term permanence of operational activities and leadership on capacity building at UPRM which will act as a partner supporting many other initiatives within and outside the university. It is envisioned that UPRM will be a leader in multi-hazard education and preparedness to face expected future catastrophic events in Puerto Rico and elsewhere.

4. **Abstract**.

This proposal focuses on building upon the first five years' accomplishments for supporting the educational needs for the long-term permanent reconstruction of Puerto Rico. Local communities face unprecedented social, environmental and economic challenges. These communities are lacking sustainable and resilient critical infrastructures (e.g., housing, water, access to reliable and cost effective power supply, appropriate and safe roads and accesses, reliable natural or built drainage systems, communication network, etc.) which are subjected to continuous natural hazards like hurricanes (winds, torrential rainfall, erosion, riverine and urban floods, nuisance floods, landslides), earthquakes (tsunamis, landslides, soil liquefaction), coastal floods (waves, hurricane storm surge, winter swells, astronomical tides), and droughts that result in risks of property and live losses. Almost all the critical infrastructure in Puerto Rico is extremely deteriorated, was built with old codes and regulations and is poorly maintained. There are many structures that were informally built or were built with outdated codes and regulations which do not comply with current engineering standards (Puerto Rico's 2018 building code represents a significant revision from earlier versions). Forty-four municipalities, including most of the major cities, are located in coastal areas. The rest are in steep lands, exposed to landslides, soil instabilities, erosion, and excessive humidity. The whole Island is exposed to extreme earthquakes. Nearly half a million people live in flood prone zones. Geotechnical challenges are frequently encountered due to soils subjected to steep slope landslides or coastal soil liquefaction.

Recent hurricanes in September 2017, namely, Irma and María, evidenced the deteriorated state of the infrastructure and the high level of vulnerability of the critical civil infrastructure. An estimated $94 billion in losses and 3000 fatalities were directly or indirectly associated with Hurricane Maria. The most recent seismic sequence has severely affected several municipalities but has a tremendous impact on the rest of the Island. These natural disasters evidenced the need for reconstructing a sustainable and resilient Puerto Rico. The PI's and other faculty from the UPRM have been actively involved in the assessment, evaluation, training, and educational process related to the reconstruction process in Puerto Rico.

Faculty has expertise in the analysis, design, assessment, inspection, construction, and management of multi-hazards of natural events. The proposed project aims to capitalize on our expertise to institutionalize a continuous capacity building and education program. This

will help attract, form and educate the new generation of educators and professionals in multi-hazard risk reduction that is needed to reconstruct and maintain the sustainable and resilient critical infrastructure that Puerto Rico needs. It is our goal to establish a **Capacity Building Center at UPRM which can serve Puerto Rico's** needs. Four main end users classifications will be impacted in the Program: 1) **University** (Faculty, Students and Administrators), 2) **Professionals**, 3) **Government**, and 4) the **Community**. Section 6 will describe their participation. It is expected that the faculty involvement will enhance UPRM presence and visibility at the federal, state, university and community levels. Students will be formally educated through a certificate program while they continue the pipeline towards the homeland security enterprise workforce. UPRM faculty will collaborate with North Carolina State University (NCSU) faculty in the development and implementation of experiential learning activities focusing on Puerto Rico.