BECKER- URI
DHS Coastal Resilience Center
Year 6 Research Project Workplan
[July 1, 2020 – June 30, 2021]

1. **Title**. Hazard Consequence Threshold Models for Emergency Management and Response Decision Making
2. **Principal Investigator**. Austin Becker, University of Rhode Island (URI) Marine Affairs
3. **Other Participants/Partners**. Pam Rubinoff, URI Coastal Resources Center; Christopher Damon (URI Environmental Data Center); Peter Stempel (Penn State University), Isaac Ginis (URI/GSO); Sam Adams (URI Public Safety and President of RI Emergency Managers Association)
4. **Short Description**

   This Year 6 project will deliver a Hazard Consequence Modeling System (HCMS), developed through effort in Years 1-5, that demonstrates functional capabilities for transition to operation at Rhode Island Emergency Management Agency (RIEMA) and subsequent scaling to other end users. This near real-time hazard and impact prediction system for hurricanes and nor'easters in Southern New England will run on existing ArcGIS systems typically in use at Emergency Operation Centers (EOCs) around the country. It integrates end-user knowledge and concerns as model inputs into the ADCIRC-Surge Guidance System. It provides predictions of cascading consequences of extreme weather (i.e., surge, wind, flooding, waves) impacting critical infrastructure (e.g., wastewater treatment facilities, sewer systems, airports, and seaports). Our approach addresses the challenges inherent in collection and dissemination infrastructure data by partnering with critical lifeline sector leads and leveraging existing technology in use at EOCs.
5. **Abstract**

   Emergency managers need relevant, local-scale information about potential consequences of extreme events in *advance* of a storm's landfall. In Year 1-5 with the Ginis project, we developed, tested, and refined a novel approach to collecting such storm consequence data (Witkop et al. 2019) and coupling it with ADCIRC high-resolution storm model outputs (Stempel et al. 2018). Through several focus groups conducted in partnership with end-user agencies, including RIEMA, the Rhode Island Department of Health (RIDOH) and Providence Emergency Management Agency (PEMA), we created an end-user vetted methodology for collecting local and regional consequences of infrastructure damage, at the site-specific scale, and for integrating these data with the type of near real-time predictive storm models already in use at Emergency Operation Centers (EOCs) around the country (e.g., ArcGIS Enterprise and WebEOC).

   In Year 1-2, we piloted our approach in Westerly, RI (Witkop et al. 2019), where we collected 102 "consequence thresholds" from 11 critical facilities. In Year 3-5, we expanded and refined our approach in Rhode Island's capital city (Providence) in close collaboration with a steering committee (Table 1). In Providence, our research team identified 306 "consequence thresholds" (for wind, surge, flooding) collected from managers of 45 critical infrastructure facilities located along the city's 500-year floodplain. At the end of Year 6, a

demonstration system utilizing Providence data will be in use at RIEMA with tools, training materials, and procedures in place to continue data collection from critical lifeline sectors in Rhode Island on a regular basis in future years.

Our approach allows critical facility managers' expertise about impacts to be integrated in model outputs in the same way that "damage functions" are traditionally utilized to model potential structural or economic damages. By identifying wind/surge/wave/flooding thresholds for critical infrastructure failure, the identified concerns may be directly linked to the storm prediction models in near real-time or for planning purposes. The concerns collected directly from end-users of the model make outputs directly relevant to emergency managers as they allocate resources and anticipate the challenges of an imminent storm at the Emergency Operations Center (EOC).

In order to operationalize and scale the HCMS, we must develop four key components in Y6, as follows:

1) an underlying secure database structure that provides an interface between the Esri ArcGIS Enterprise GIS system used in most Emergency Operations Centers (EOCs) and storm models outputs run at University of North Carolina or elsewhere (e.g., ADCIRC);

2) a web-based, geospatial, self-reporting tool (e.g., ArcGIS Collector or Survey 123) customized for ongoing, regular data collection and updates from critical infrastructure facilities;

3) training programs and exercises for use of the data collection tool and use of the final modeling tools;

4) mainstreaming our system into existing data collection protocols and procedures, tailored to the needs of the various DHS critical lifeline sectors.

Each of these components will be developed in an iterative process, together with our steering committee and with regular feedback from key partner organizations.