Florida Sea Level Scenario Sketch Planning Tool Extension for Custom Analysis

Executive Summary, June 2023

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The nation's transportation systems are facing significant threats from the impacts of climate change, in particular from increasing heat, coastal flooding and sea level rise, and heavy precipitation (Jacobs, et al., 2018). To protect against the most severe impacts of climate change, data regarding future conditions and climate extremes must be incorporated into the transportation planning, design, and construction process. The goal of this project was to build a tool to mainstream such data and information into the transportation planning process.

In this project, the University of Florida GeoPlan Center ("the research team") developed an online screening tool (the "Resilience Report") to systematically and rapidly conduct flood vulnerability assessments for transportation projects. The Resilience Report summarizes and displays analyses of current and future flood exposure for a user-specified area of interest (AOI) anywhere in the State of Florida, though the majority of the current data is coastal flooding. This new tool will assist FDOT and its local and regional partners as they prepare the transportation system for the impacts of climate change.

Specifically, the project had three objectives:

1. Design and build a geospatial framework and infrastructure (hardware and software) to support project level analysis of multiple flood datasets;
2. Identify and test existing flood risk data sources;
3. Pilot test the new tool with user groups.

This project builds off of two ongoing collaborative projects of the research team and the Florida Department of Transportation (FDOT). The Environmental Screening Tool (EST) is a web application that facilitates the evaluation of potential impacts to human, natural, and cultural resources from proposed transportation projects. The research team assisted with the initial EST development in the early 2000s and has continued to maintain and update the geospatial data, databases, and servers to support the EST. In 2013, the research team launched the Sea Level Scenario Sketch Planning Tool ("Sketch Tool"), an online geospatial tool for evaluating transportation asset exposure to current flooding and future SLR. The Sketch Tool provides planning-level analyses, but does not allow for project-level scoping and has limited datasets.

This project sought to leverage the strengths of these two tools (EST and Sketch Tool) to facilitate project level screening for flood exposure and assist transportation professionals with resilience decision making. During the early phases of this project, it was determined that the products developed herein would be incorporated into the EST to leverage the existing user base and computing infrastructure (instead of deploying the Resilience Report from the Sketch

Tool mapping application). Specifically, the EST's Area of Interest (AOI) Tool was used as a model for triggering and running the Resilience Report.
This research project was completed under five major tasks:

1. Review of tools for assessing vulnerability of infrastructure to climate change.
2. Identification and assessment of existing flood data sources.
3. Development of hardware and software infrastructure.
4. Pilot testing of the new tool.
5. Technology transfer: developing user guides and conducting technical training.

The development of the Resilience Report was informed by robust research on existing and emerging data and tools for assessing infrastructure vulnerability to climate change (Tasks 1 and 2). The review of tools revealed the common characteristics of similar tools, including climate stressors and data, tool functionality, and data visualizations. This review narrowed the focus for assessing data sources (Task 2, Chapter 3) and identified visualization features and tool functionality to pursue (Task 3, Chapter 4). The majority of tools reviewed were developed to visualize and communicate the results of climate vulnerability assessments and did not offer project level analysis, which this project aims to do.

The assessment of existing data sources (Task 2, Chapter 3) revealed the common data sources available for vulnerability assessments and the lack of widespread spatial data representing future inland flood risks and future storm surge. The research team curated a pilot list of available datasets, though not all were included in the Resilience Report. The final Resilience Report includes four types of flood data, some with multiple datasets:

- Sea Level Rise:
    - NOAA 2022 SLR scenarios
    - NOAA 2017 SLR scenarios
- High Tide Flooding (HTF):
    - Three datasets showing spatial extent of minor, moderate, and major HTF
    - One dataset indicating the number of projected days of annual minor HTF under future SLR scenarios
- Storm Surge: SLOSH model outputs for hurricane categories 1-5
- Flood Hazard Areas: Federal Emergency Management Agency (FEMA) special and moderate flood hazard areas from the national flood hazard layer.

The data assessment (Task 2, Chapter 3) also revealed that future climate data is still emerging. Hence, the research team focused on designing and developing a framework for storing, analyzing, and displaying analysis results with the flexibility to rapidly ingest new data (according to minimum specifications and standards discussed in Chapter 3). Additionally, the research team sought to create data visualizations (e.g. interactive charts, graphs) to summarize the analyses for quick interpretation.

The Resilience Report leverages the EST's enterprise database software (Oracle), database server, and application servers as the foundational for the geospatial framework and technical infrastructure. Additional components were developed to support the new data and geospatial

analyses in the tool. A software not used in the EST, Oracle APEX, is used to display the results of the resilience overlay analyses. This software was chosen due to its tight integration with the Oracle database, powerful visualization capabilities (charts, tables, and maps), and its ease of rapid deployment of new analyses.

The Resilience Report is requested through the EST Map Viewer's AOI Tool, which requires users to have an EST account with AOI access. Once logged into the EST, a user can draw on the map their desired area for analysis (either point, line, or polygon) using the AOI Tool. After submitting basic information and drawing one or more alternatives (features), the user can request a "Resilience Report". Once requested, automated database processes run spatial overlays of each flood layer with the AOI, which takes approximately 1-3 minutes. After the analyses are complete, the AOI Tool will display a link to the results page.

The beta version of the Resilience Report was demonstrated for a few user groups. In total, the bets version was presented to approximately 35 people, some of whom tested the tool and provided feedback and comments. Many of the comments were addressed within this project, while others will be considered for future enhancements. After launching the production version of the Resilience Report, the research team developed user guides and technical training materials to build capacity (Task 5, Chapter 6). Two training webinars were offered virtually, where 129 people attended. In the first two weeks since the training webinars, resilience reports were submitted for 16 AOIs across six FDOT districts and one additional organization, indicating high initial interest.

The benefits of this project include streamlined access to resilience and flooding data for better screening of potential impacts and better project scoping. The Resilience Report can assist in data gathering for PD&E and/or corridor studies and can provide resilience screening for LRTP projects. The Resilience Report could also be used to identify areas in need of more refined analysis (e.g. engineering-level studies). This project supports FDOT's Resiliency Policy 000-525-053 by developing geospatial tools to facilitate the identification of risks related to SLR, flooding, and storms and assessment of potential impacts. Additionally, this project supports the FTP 2045 Goal of Agile, Resilient, and Quality Transportation Infrastructure.

The research team considers the Resilience Report developed in this project as "Version 1" and plans to continue enhancing the tool with additional data and functionality, as funding and agency priorities permit. New data and analyses to be considered include updated SLR inundation depth grids, updated elevation data, exposure and criticality data, and other climate stressors. New functionality to be considered includes developing a summary report, adding support for ranking and project prioritization, adding guidance for choosing scenarios, and adding identification of tipping points to support adaptation pathways. Increasing the functionality and utility of the Resilience Report will depend on partnerships with FDOT, MPOs, and others to use the tool in context of their needs and/or specific projects. The research team is actively pursuing partnerships to develop detailed use cases to demonstrate how to use the Resilience Report and incorporate future flood information into the planning and design process.