Thesis Project Portfolio

Quantifying and Designing Infrastructure for Nonstationary Flood Risks

(Technical Report)

Sociotechnical Analysis of Flood Infrastructure Development in Virginia

(STS Research Paper)

An Undergraduate Thesis

Presented to the Faculty of the School of Engineering and Applied Science

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Bachelor of Science, School of Engineering

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Sociotechnical Synthesis

The capstone technical project addresses the issue of increasing flood risks in the United States which is primarily due to climate change effects. These effects lead to flood risks predominantly because of the rising intensity and frequency of major storm events. With a localized focus on the Meadow Creek tributary of the Rivanna River in Charlottesville, Virginia, the project addresses the flood issue with the implementation of CMIP6 climate projection scenarios into a multiobjective robust decision-making modeling tool called Rhodium-SWMM. This modeling software proposes Pareto sets of non-dominated solutions containing five user-selected green infrastructures to meet user-defined objectives for cost, runoff reduction, and environmental co-benefits. Rhodium-SWMM also has the capability to include a user-defined social objective function, which can be employed to target areas and people groups disproportionately affected by floods. It is important to consider human social dimensions of this technology because many people and people groups are disproportionately affected by floods, which threatens their safety and wellbeing.

For my research, I examined the Virginia Judicial Branch's court rulings on flood-related topics. To do this, I accessed the Nexis Uni legal database and analyzed the 4 sufficiently relevant cases of the 22 returned cases from a search containing keywords "flood" and "Code 10.1." After removing the keyword which searched for cases citing the Conservation section of the Code of Virginia, over 700 cases were returned. Out of the top 125 case files as defined by the database's "Relevance" sorting option, I selected 41 that were sufficiently relevant as a sample of the total population of cases returned. I analyzed these 45 cases using three technological dimensions introduced by Star: scope, embodiment of standards, and fixed in

modular increments. This research revealed some incomplete growth in the judicial rulings over time to prioritize the management of the social impacts of flood infrastructure through the engineering and construction of that infrastructure.

The capstone project and STS research investigate a common theme of the importance of the social implications of flood management technology. The major flooding concerns that face much of the United States, especially coastal urban centers like Hampton Roads, can be and should be addressed from many angles, including technical innovation and environmental law. Ultimately, these projects address the same issue that can only be managed by the cooperation of many different influential stakeholders in society.