Natural, Nature-Based, and Hard Shorelines in Urban Settings: Analyzing Urban Flooding and Community Engagement

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Background

Natural Features: Create a habitat for wildlife and are naturally occurring

Nature-Based Features: Made to mimic natural shorelines but created through human intervention

Ecologically-Enhanced Hard Structural Features: Hard Structural features with areas that create habitats for wildlife within them

Hard Structural Features: Consists of seawalls and other features that don't allow for wildlife habitats

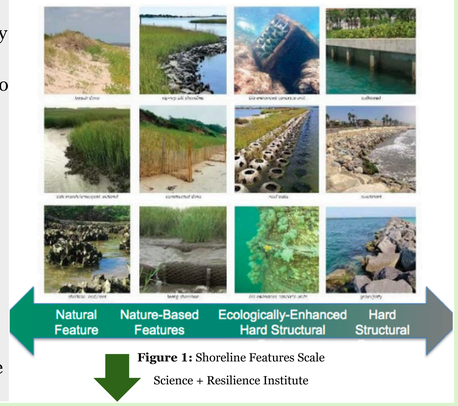

Figure 1: Shoreline Features Scale
Science + Resilience Institute

Research Objective

Our goal was to analyze the impacts of different shoreline features on their surrounding communities. Impact types included urban flooding, main reason for visiting a site (primary activity), average time spent at per park, and average frequency of visit per park.

Study Area

Our study area consisted of 16 shoreline sites throughout New York as well as one site in New Jersey. The majority of our sites are located along the Hudson River and the Harlem River, and the site at Port Bay is connected to Lake Ontario. Because of this, it is important to note that all of our research consisted of bodies of fresh water.

These sites consisted of four different types of shoreline features: hard structural, ecologically-enhanced hard structural, nature-based, and natural.

Methodology

Social assessment data was collected using an interview that included data on park users' thoughts on the parks, shorelines, and demographic information. This interview is part of a 'Measuring Success Protocol' that is being used to standardize the process of the larger project this is a part of: Measuring Success of Natural and Nature-based Features. This data was collected at each of our 17 sites and included data from regular park users between the years 2022 and 2025. We then put all of the interview data into an excel sheet to observe trends in relation to each park and shoreline (Figures 9 & 10). We also obtained flood data on New York City and we were able to use this data along with the geographic coordinates of our sites to generate a map on ArcGIS (Figure 8). We then analyzed this data and compared it to the different shoreline features at these sites in order to come to a conclusion about the effect of shoreline features on flooding (Figures 6 & 7).

Figure 2: Soundview Park

Pictures from social assessment collection and site exploration
Figure 3: Sherman Creek Park

Figure 4: Sherman Creek Park

Discussion

Through our data on shoreline features and flooding, we found that natural features are best for protecting surrounding communities from flooding compared to hard structural features such as flood walls. Natural and nature-based features help to absorb and filter water, which reduces coastal erosion. They also help to slowly reduce wave intensity using rocks and oyster castles, which break waves and provide habitats for marine life such as oysters and fish. On the other hand, seawalls can suddenly break the waves, contributing to more severe flooding issues.

During the data collection phase of this project, we faced difficulty in sorting through the data and identifying specific categories. For future studies involving the usage of social assessments, it is crucial for data collection methods to become standardized.

- Ease of Accessibility
  - Dropdowns should be used where necessary for efficiency during data collection
  - Language that clearly defines categories (e.g., Monthly vs. Occasionally vs. Rarely)
- Consistent Data
  - There should be more precautions put in place to ensure consistent data entry and collection. Answers to questions on social assessment surveys should be made mandatory for form submission to prevent parts of surveys from being submitted blank.

Results: Shoreline Features and Flooding

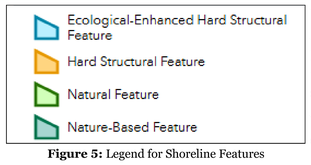

Figure 5: Legend for Shoreline Features

We observed that areas with natural features were more effective in preventing flooding compared to those with hard structural features. Figure 6 depicts heavy flooding at the outer shoreline, which is quickly combated by the natural features. In comparison, Figure 7, which consists of hard structures in the outer shoreline, has mostly 8-9.9 feet of flooding with areas that are over 12 feet until the point where there are natural features. It is important to recognize that part of the reason for this is elevation change, though the natural features also play a huge role in absorbing excess water. This exemplifies the importance of natural features in flood prevention in New York City.

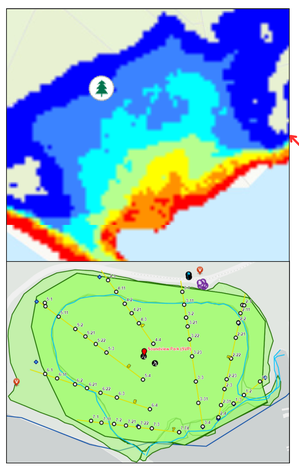

Figure 6: Flood Data vs Shoreline Feature at Soundview Park

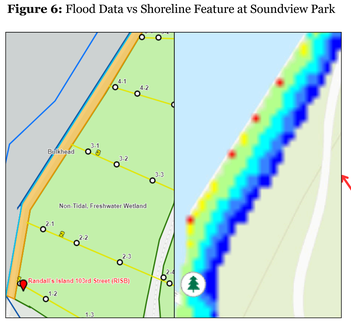

Figure 7: Flood Data vs Shoreline Feature at Randall's Island 103rd

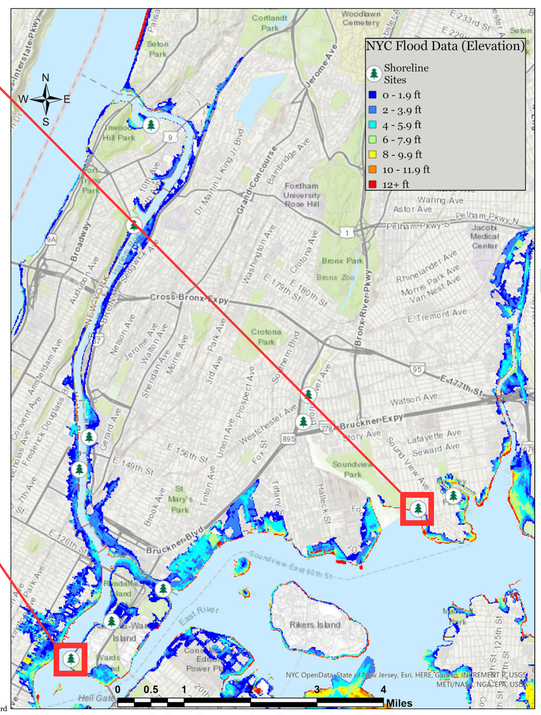

Figure 8: Flood Elevation Data Based on Base Flood Depth

Results: Social Assessment Data

Table 1: Legend depicting a numerical representation of visit frequency of the participants of the survey

Frequency of Visit	Numeric Value
Daily	5
Weekly	4
Monthly	3
Occasionally	2
Rarely	1

Table 2: Legend depicting shoreline features of each site

Site ID	Site Name	Shoreline Feature
HRP	Harlem River Park	Hard Structural
MMI	Muscota Marsh	Hard Structural
WCLS	Weehawken Cove Living Shoreline	Hard Structural
RISB	Randall's Island 103rd Street	Hard Structural
PBE	Port Bay East	Natural
PCP	Pugsley Creek Park	Natural
SVP	Soundview Park	Natural
WHG	Widows Hole Greenport	Natural
CPP	Concrete Plant Park	Nature-Based
CX	Coxsackie	Nature-Based
LHSM	Little Hell Gate Salt Marsh	Nature-Based
MPP	Mill Pond Park	Nature-Based
PCSF	Shorefront Park Patchogue	Nature-Based
RIBK	Randall's Island Bronx Kill	Nature-Based
SCP	Sherman Creek Park	Nature-Based
SLP	Starlight Park	Nature-Based

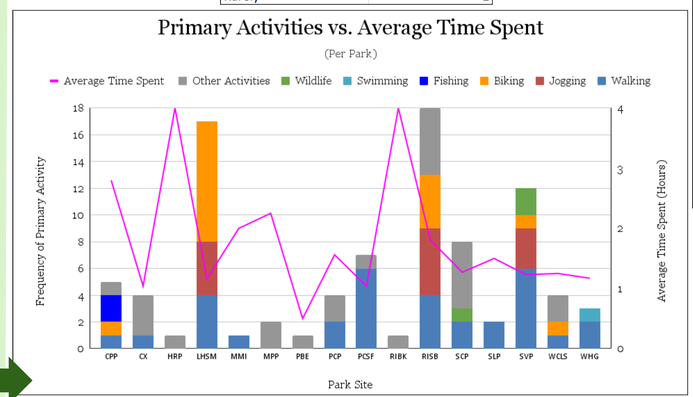

Figure 9: Chart of Primary Activity vs. Average Time Spent (Hours)

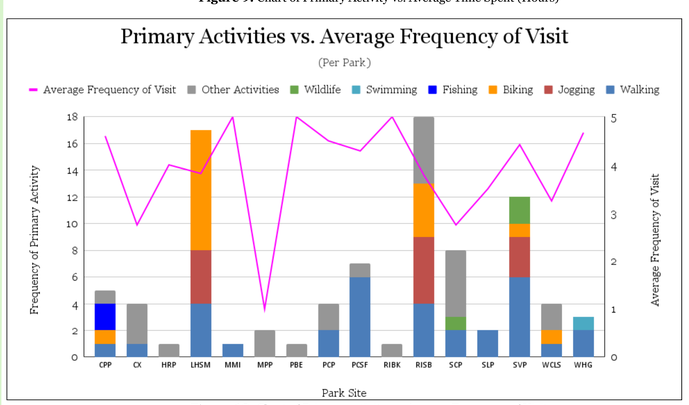

Figure 10: Chart of Primary activity vs. Average Frequency of Visit

When performing social assessments, 'primary activity' was introduced to participants as the main reason they were at the site that day. As seen in Figure 9, walking was the most common activity, appearing 32 times across all 93 surveys, and biking was the second most common, appearing 16 times. The parks with both activities appearing had an average time spent of 1.65 hours.

Table 1 shows a numerical representation of visit frequency, and Table 2 depicts the primary shoreline feature at each site. It is important to note that while each many of the sites have multiple shoreline features, only the primary one was used in the comparison.

By cross-referencing, it can be seen that sites with nature-based shorelines have a higher average frequency of visit compared to hard structural shorelines. Nature-based shorelines have an average of 4.52, translating to weekly-daily visits, while hard structural shorelines have an average of 3.79, translating to monthly-weekly visits. This means that visitors are more likely to return to sites with those features.

Future Studies

- Focus more on the impact of shoreline features on wildlife habitats and marine life. Through this, we could find more ways to provide habitats in nature-based features to mimic natural habitats.
- Analyze the impacts of different shoreline features on the safety of the sites, accessibility, or demographics of people visiting the sites.
- How do different amenities in each of the parks have an effect on the people and frequency of people visiting these parks?
- Additionally, we could go more in depth pertaining to flooding and how more recent floods have impacted each site based on their features
- We could also look at how the building of these features affected flooding data by looking at flooding data before and after each of these sites were built for comparison
- Analyzing plant species data and how different native versus invasive species have different effects on the shorelines and helping with water absorption and erosion

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Story Map

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