SUNNY DAY FLOODING PROJECT

2024 Sunny Day Flooding Project Update

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THE UNIVERSITY of NORTH CAROLINA at CHAPEL HILL

NC STATE UNIVERSITY

Carolina Beach Town Council

July 23, 2024

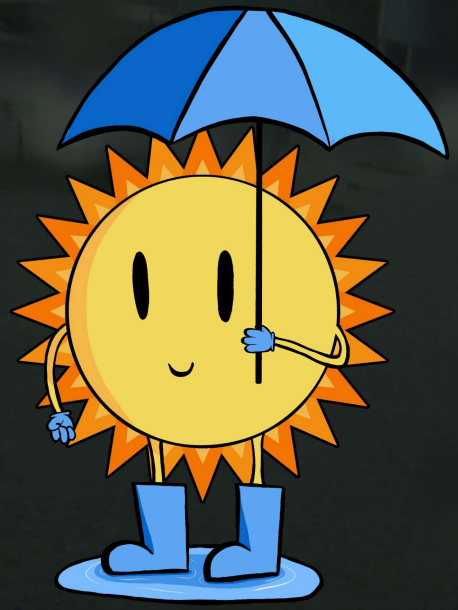
Today's talk, summarized in four questions

How often did it flood in Carolina Beach in the last year?

How important are tides vs. wind vs. rain in causing flooding?

How are floods impacting Carolina Beach residents?

What strategies to mitigate flooding are preferred by Carolina Beach residents?



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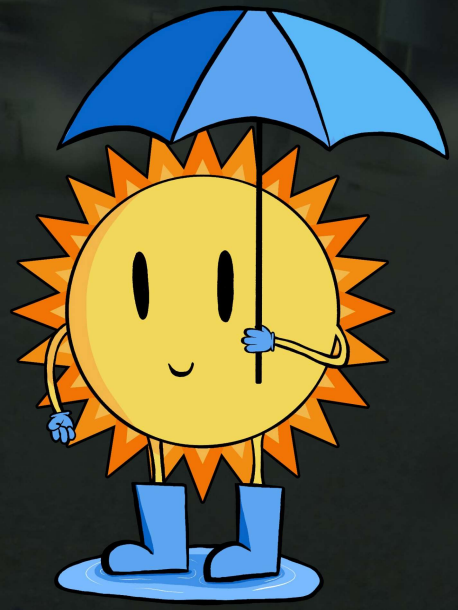


We currently maintain three flood sensors on Canal Drive

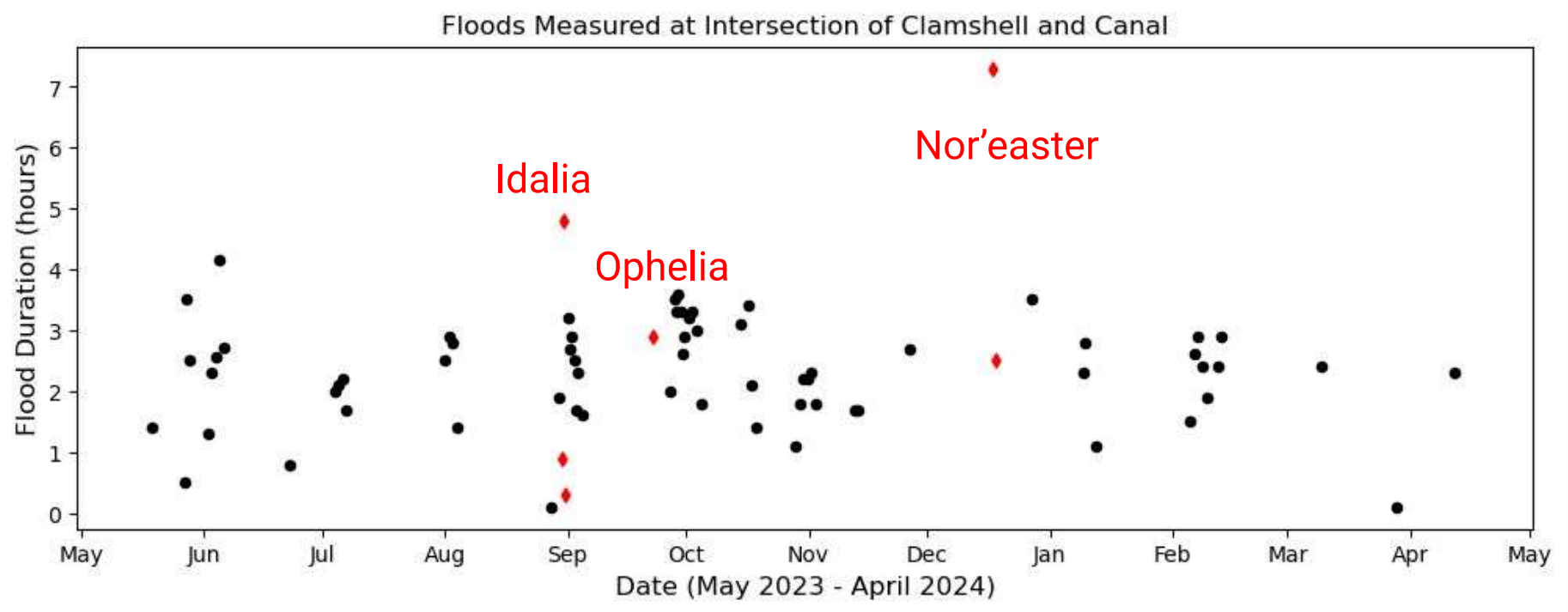
Real-time camera

Real-time water levels

go.ncsu.edu/cbflood

May 1, 2023 to April 30, 2024 – we measured 71 floods at Clamshell & Canal

Flood = any amount of water on the road
6 of the measured floods occurred during extreme storms



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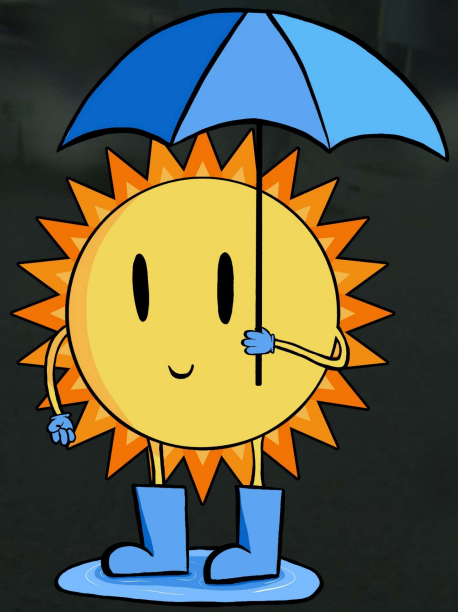

How important are tides vs. wind vs. rain? A deeper dive on 2022-2023 data

This manuscript is a non-peer-reviewed pre-print submitted to EarthArXiv. This manuscript has been submitted for publication in Water Research and is currently under review.

Wind and rain compound with tides to cause frequent and unexpected coastal floods

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Data from April 2022 to April 2023. Full report available here: https://eartharxiv.org/repository/view/7241/

Sensor data and model results allow identify the role of tides, wind, rain

Jan. 22, 2023: if we modeled **tides only**, water would not have reached Canal Dr.

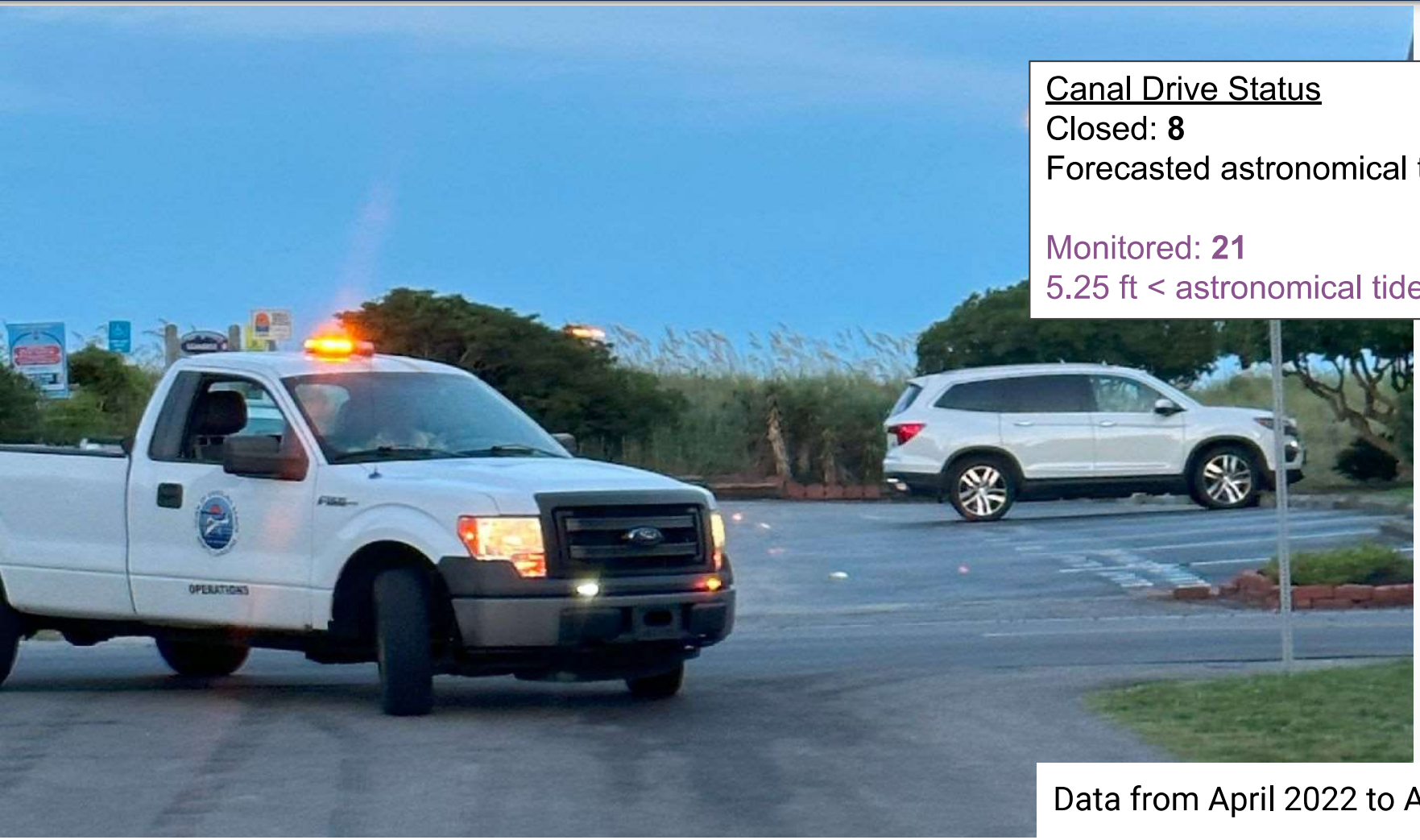
Jan. 22, 2023: when we add **wind**, flooding reaches Canal Dr.

20% of floods occurred at forecasted tides above the threshold for closing Canal Dr.

Canal Drive Status
Closed: **8**
Forecasted astronomical tide > 6 ft

Data from April 2022 to April 2023

An additional 50% of floods occurred at tides above the threshold for monitoring Canal Dr.



Canal Drive Status
Closed: **8**
Forecasted astronomical tide > 6 ft

Monitored: **21**
5.25 ft < astronomical tide < 6 ft

Data from April 2022 to April 2023

30% of floods were “unexpected” based on the tidal threshold

Canal Drive Status

Closed: **8**

Forecasted astronomical tide > 6 ft

Monitored: **21**

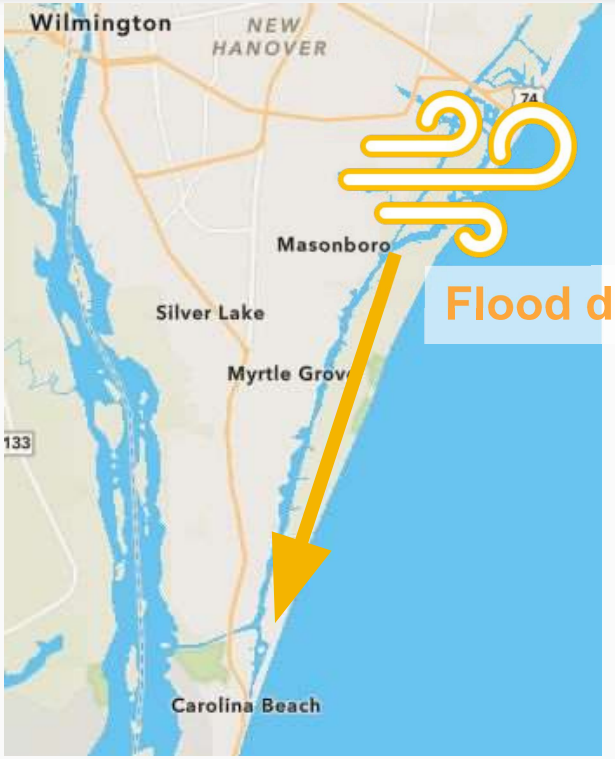
5.25 ft < astronomical tide < 6 ft

Not monitored: **14**

Forecasted astronomical tide < 5.25 ft

Data from April 2022 to April 2023

Wind and rain compound with tides to exacerbate flooding in Carolina Beach

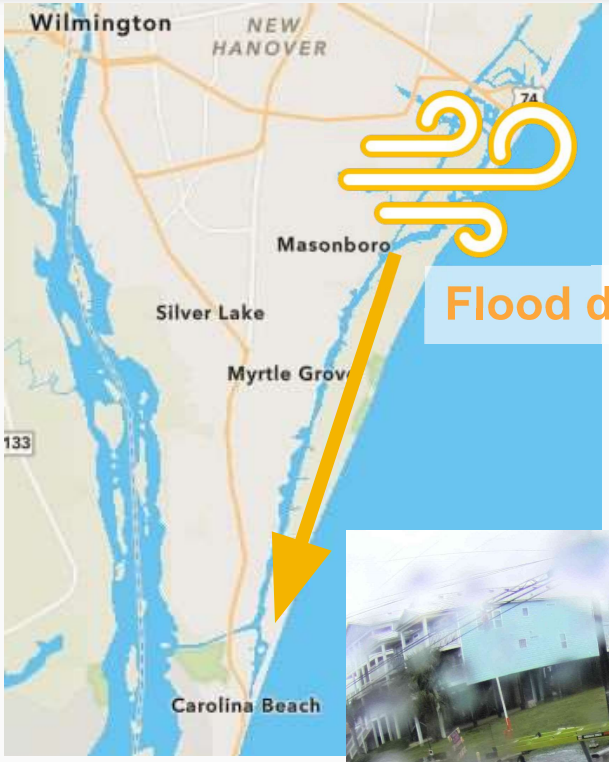


11 of 14 unexpected floods co-occurred with **wind of out the northeast**

The *6 deepest floods* we measured co-occurred with **wind of out the northeast**

Data from April 2022 to April 2023

Wind and **rain** compound with tides to exacerbate flooding in Carolina Beach



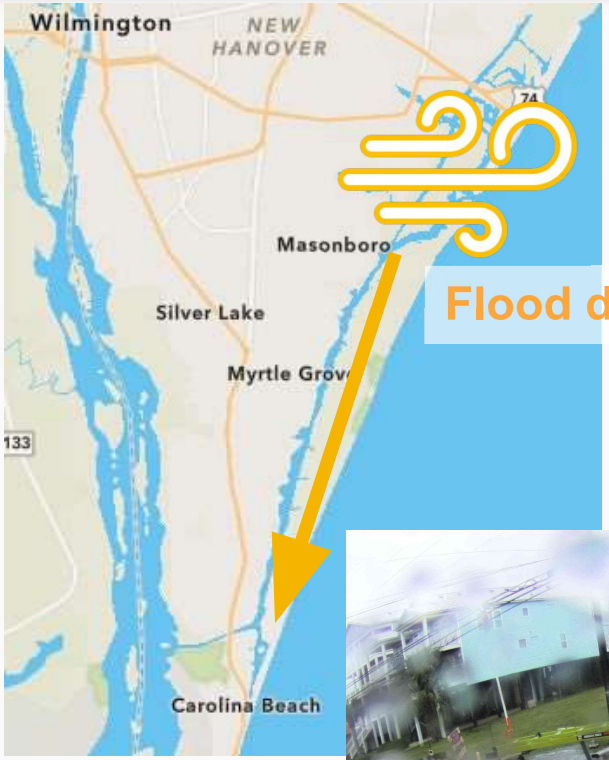
11 of 14 unexpected floods co-occurred with **wind of out the northeast**

The *6 deepest floods* we measured co-occurred with **wind of out the northeast**

7 of 14 unexpected floods co-occurred with **rainfall**

Data from April 2022 to April 2023

Takeaways relevant for flood monitoring and response



Findings confirm reports from Town staff and residents that wind and rain lead to flooding. Our findings can be used as:

- New evidence for grant applications
- Wind thresholds for monitoring

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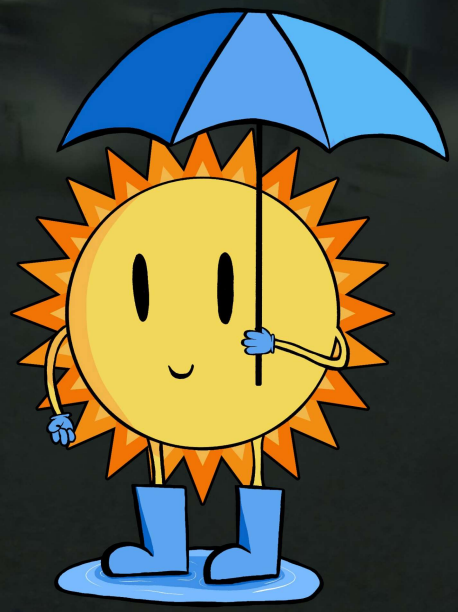
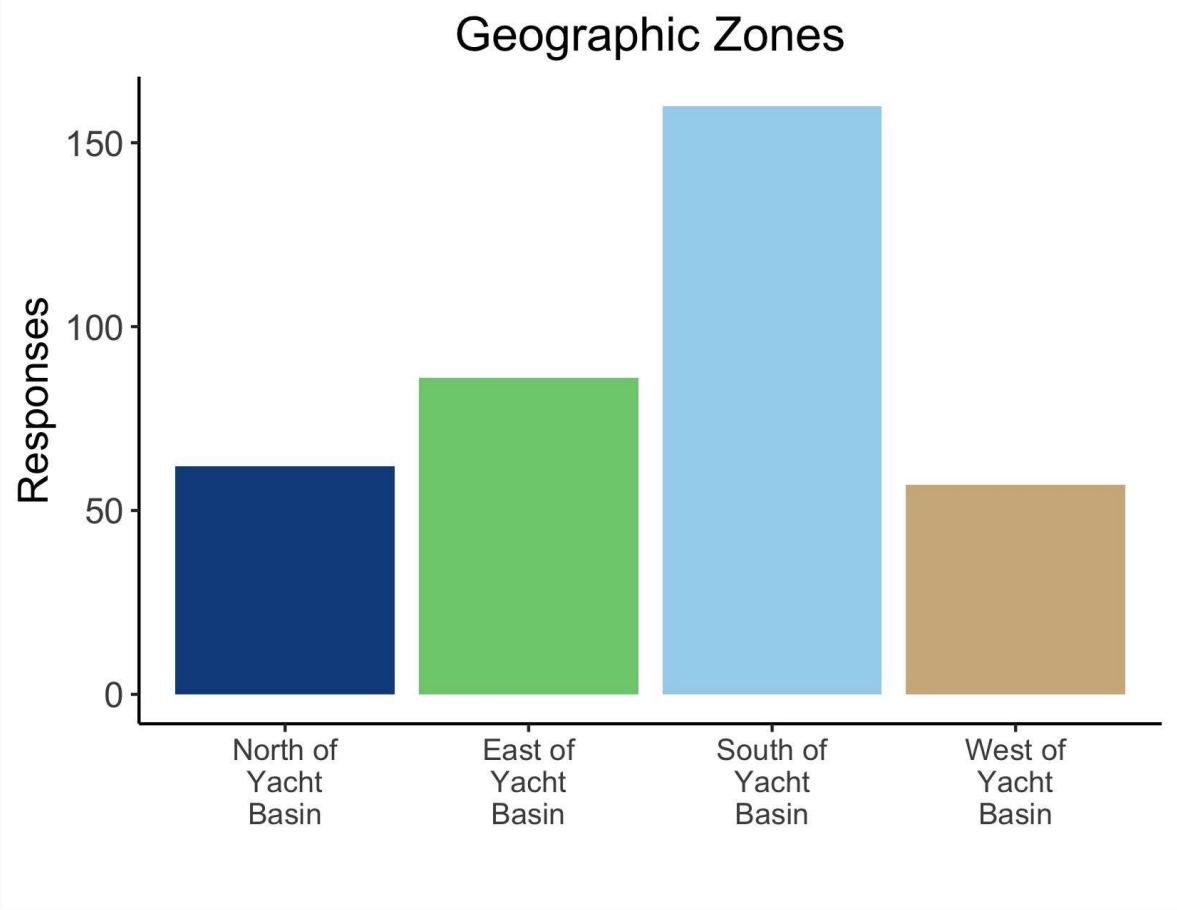
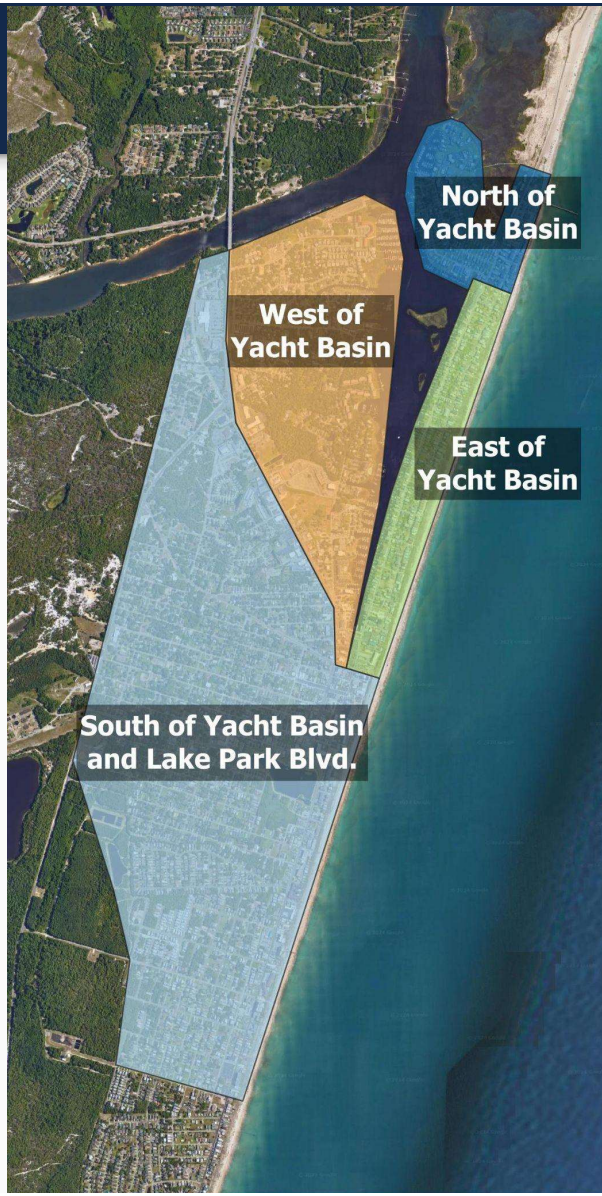


A survey to understand flooding impacts and preferred mitigation strategies

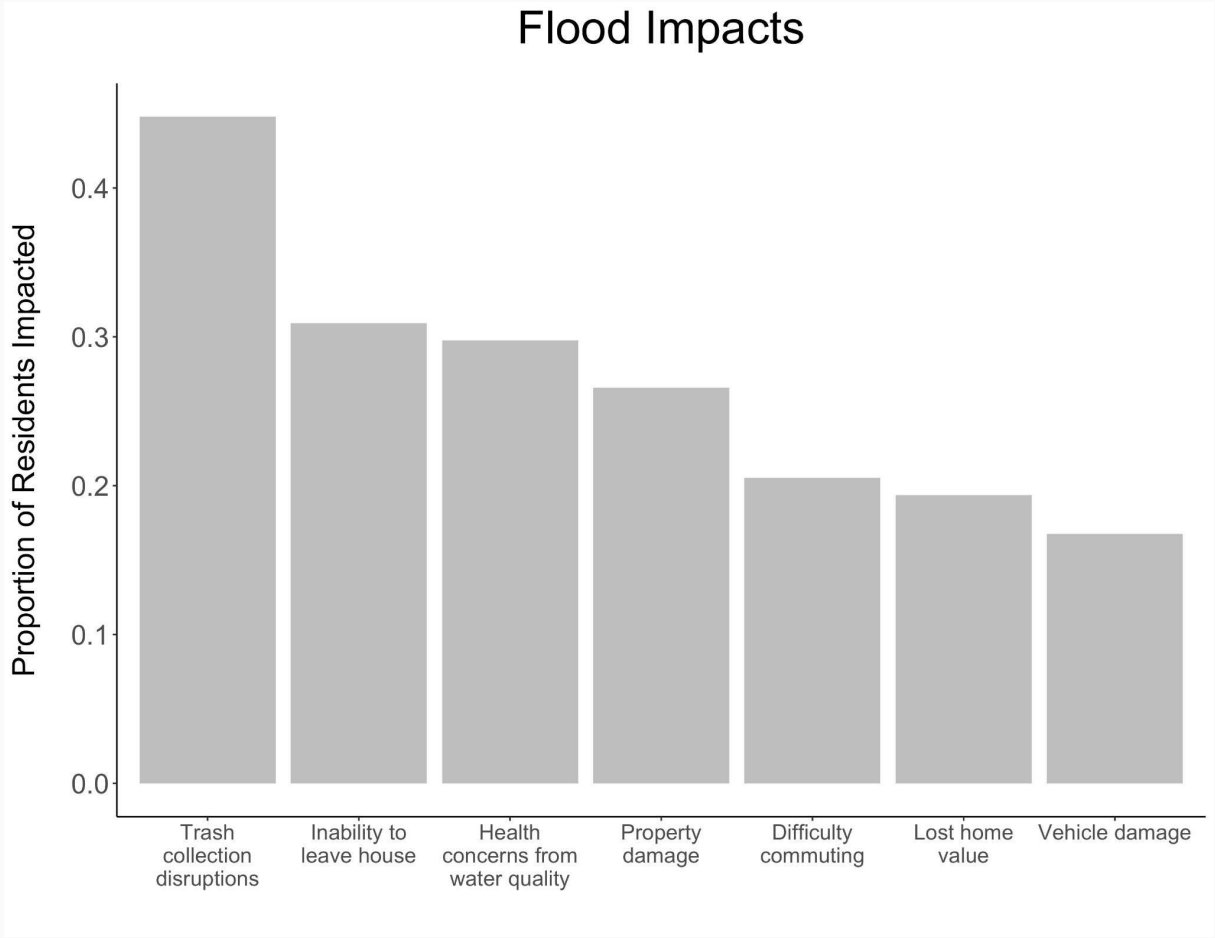
Flooding surveys mailed to all residential addresses in Carolina Beach in early 2024

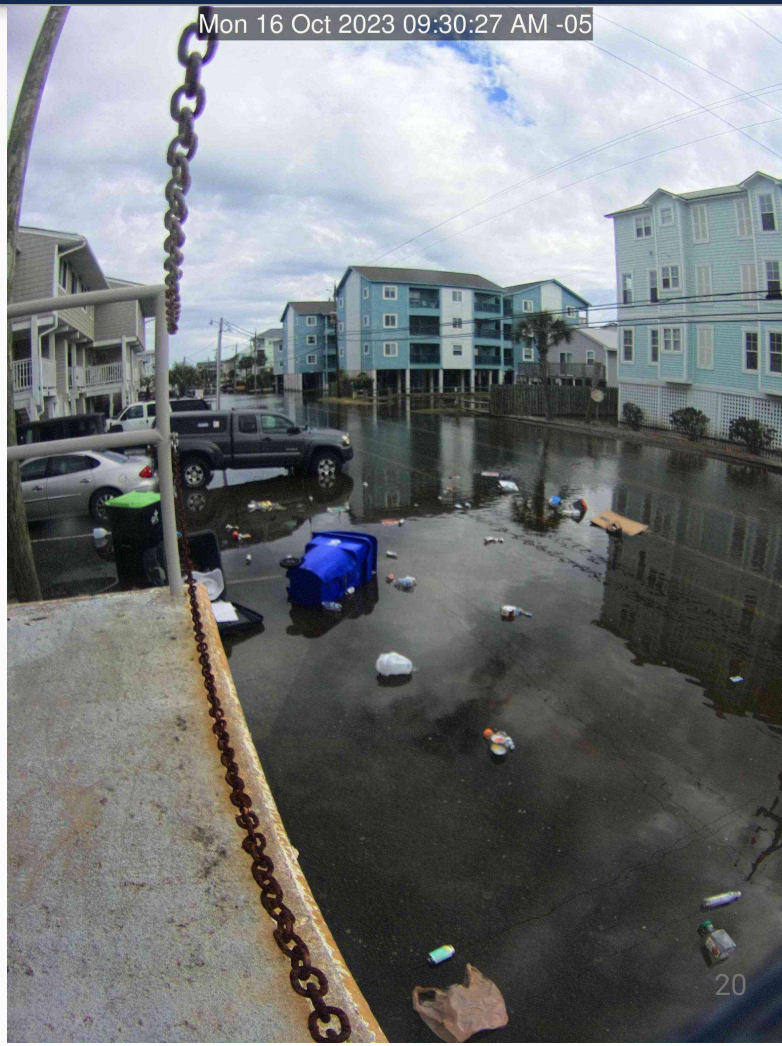
363 survey responses, well distributed across Carolina Beach



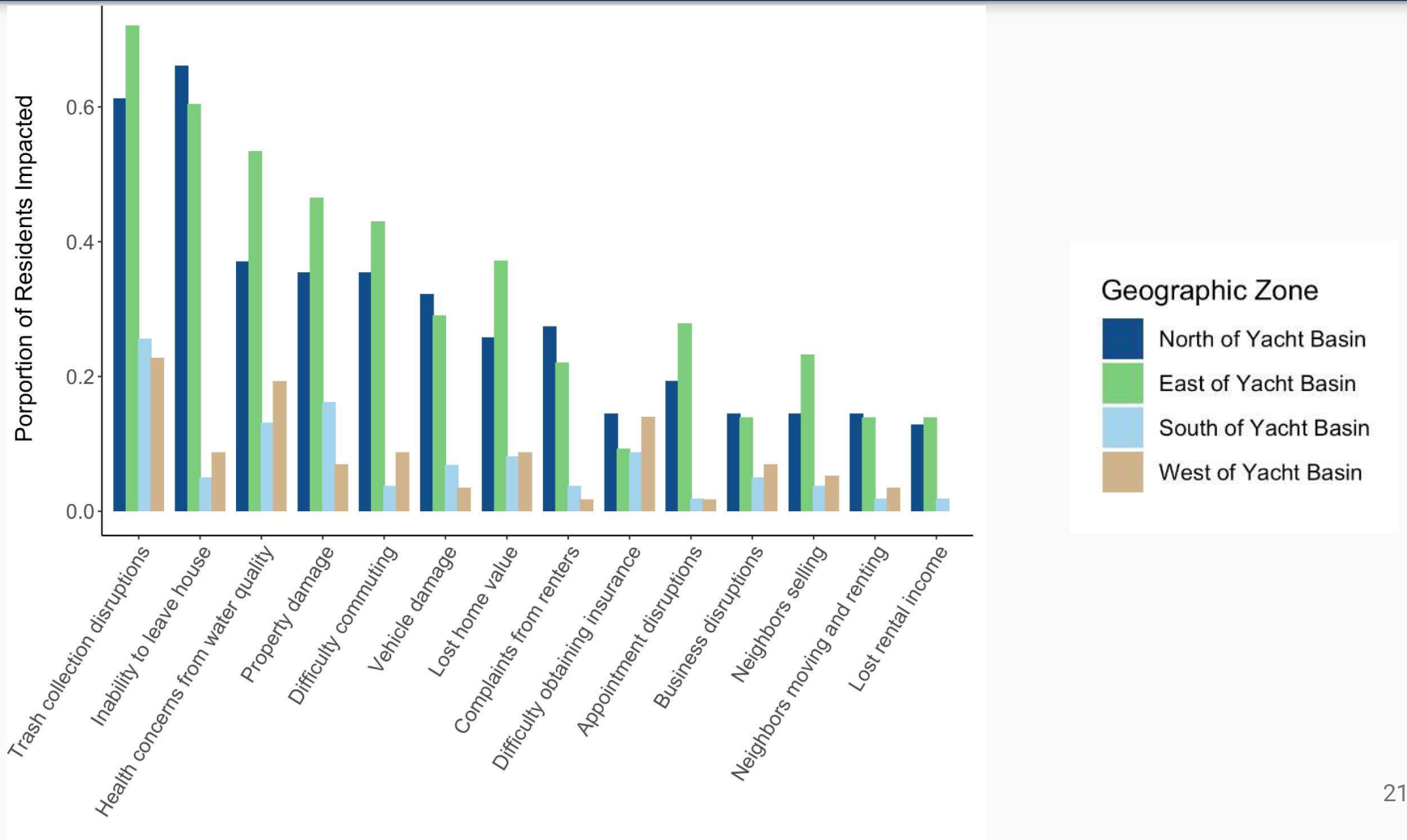


About 40% of respondents reported impacts from flooding



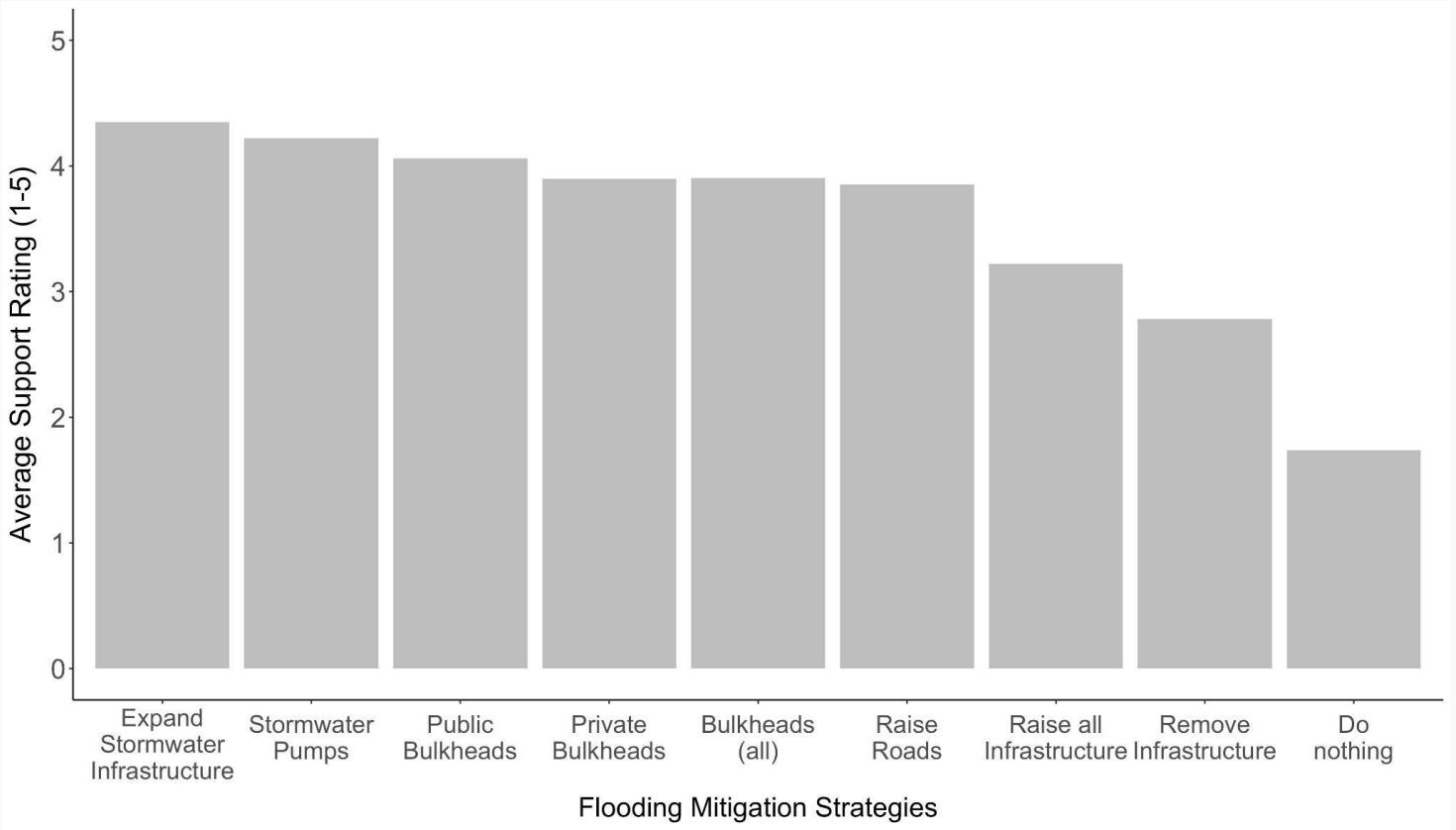


Flood impacts reported on and beyond Canal Dr.



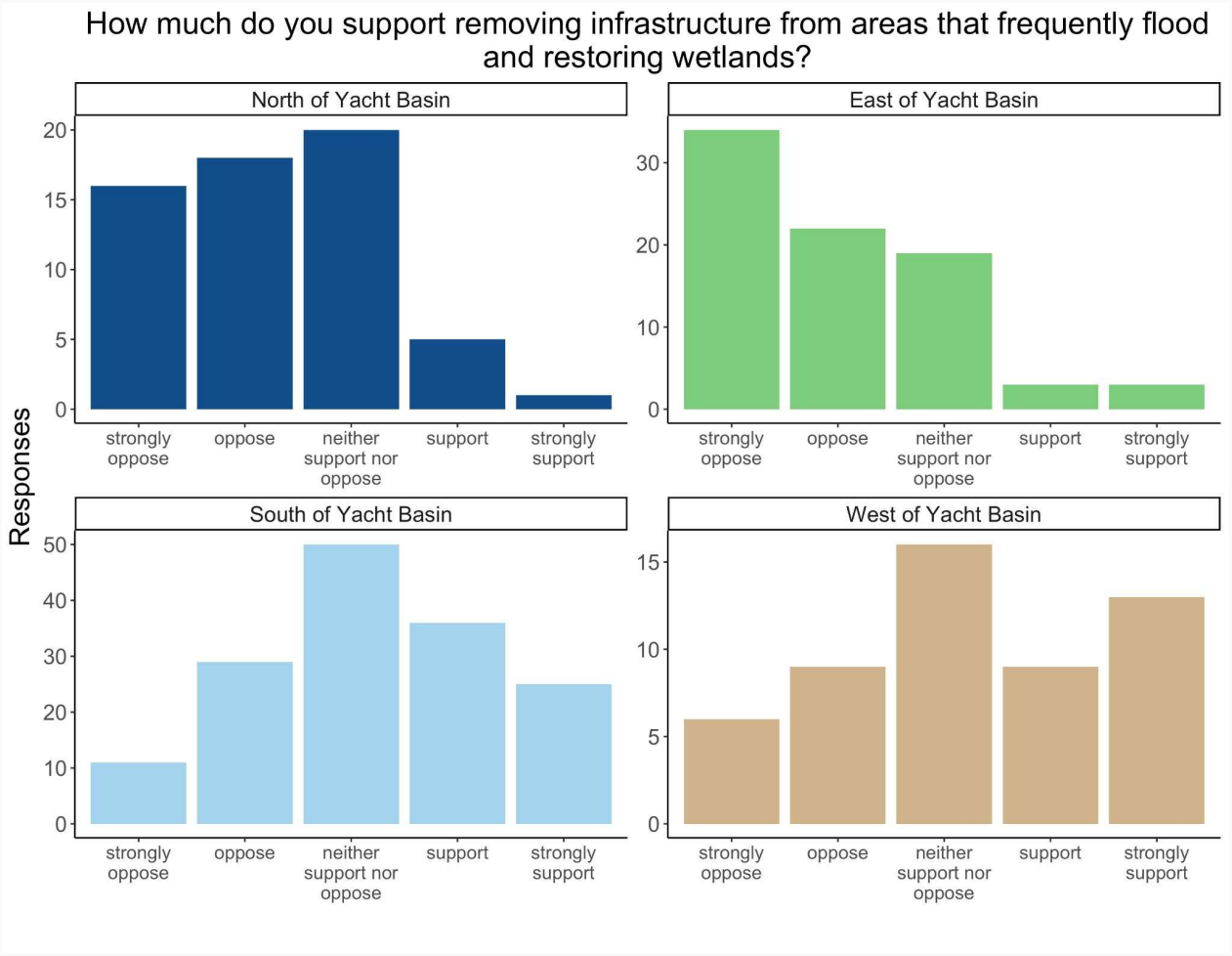
Flooding Mitigation Strategies: stormwater and bulkhead interventions were popular

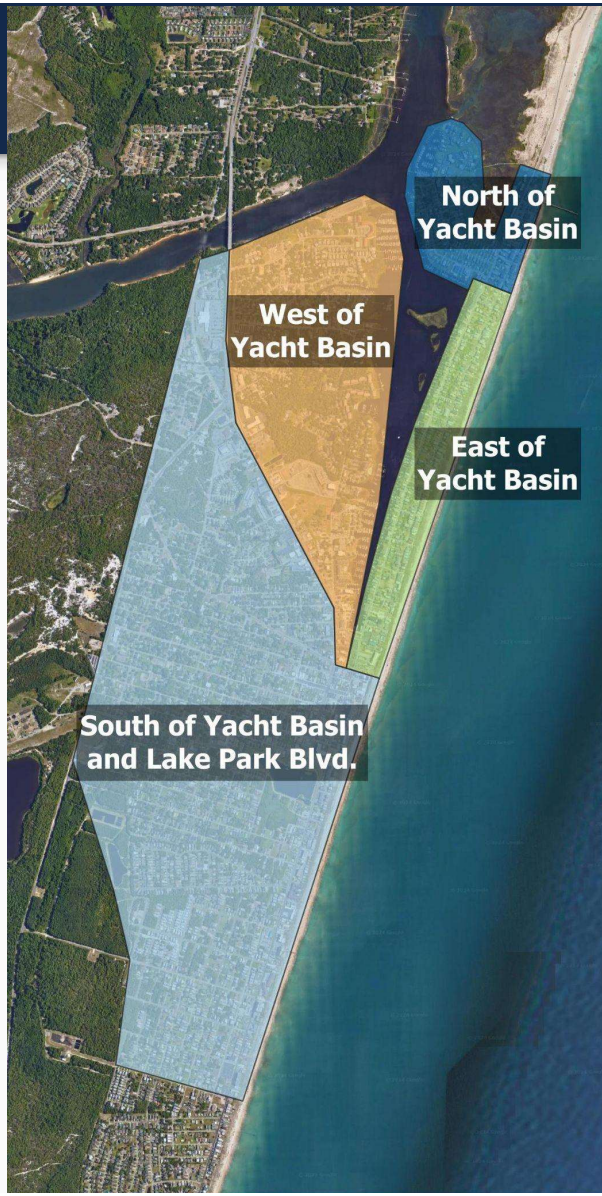
5 = Strongly Support
4 = Support
3 = Neither Support or Oppose
2 = Oppose
1= Strongly Oppose



Note: respondents were not asked to consider legal/permitting restrictions when stating preference for flood mitigation strategies

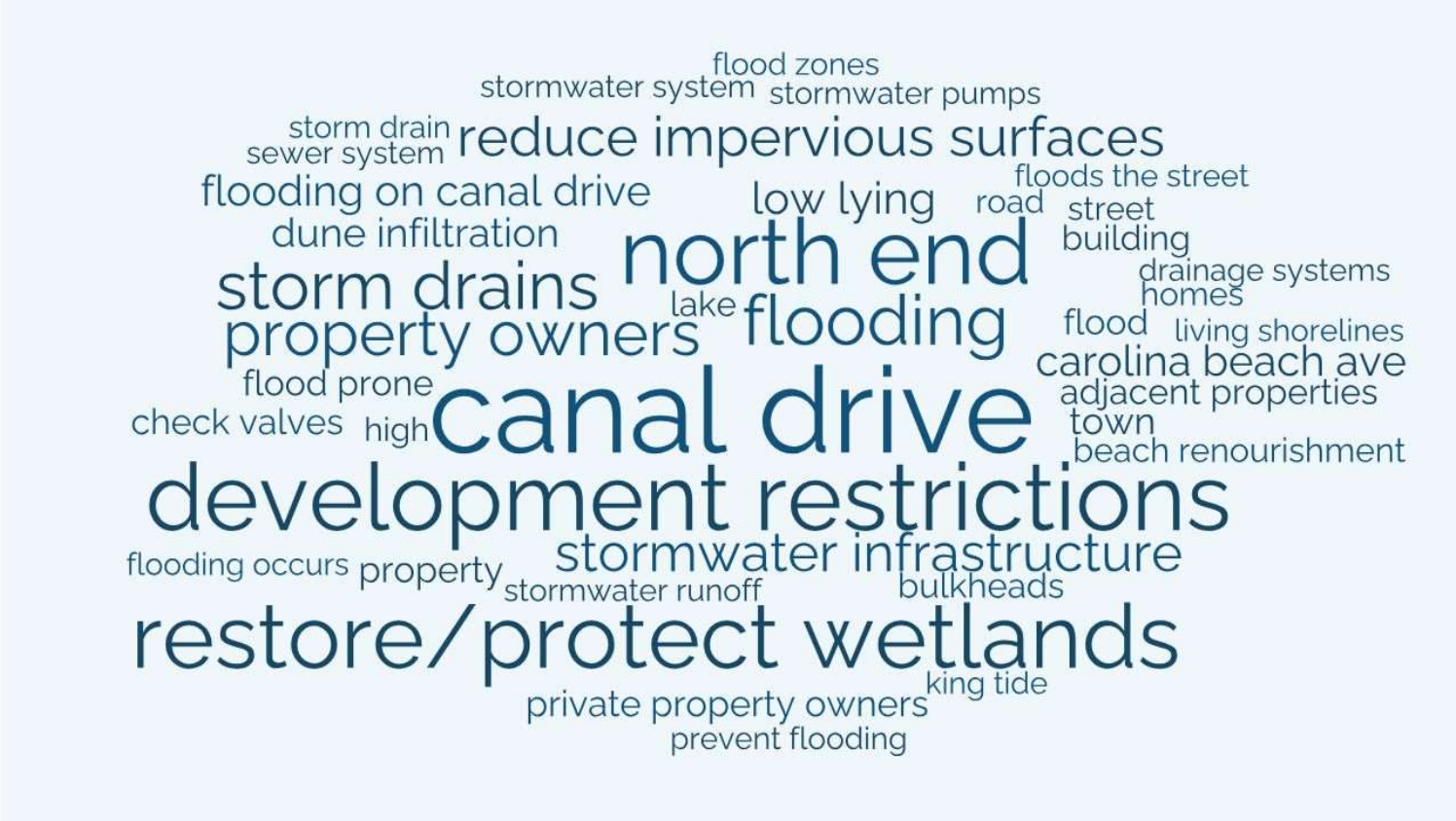
Support for removing infrastructure varied by location





Residents also suggested development restrictions, wetland protection, and dune infiltration

From survey question: What strategies not listed in the eight options given do you think should be considered for Carolina Beach?



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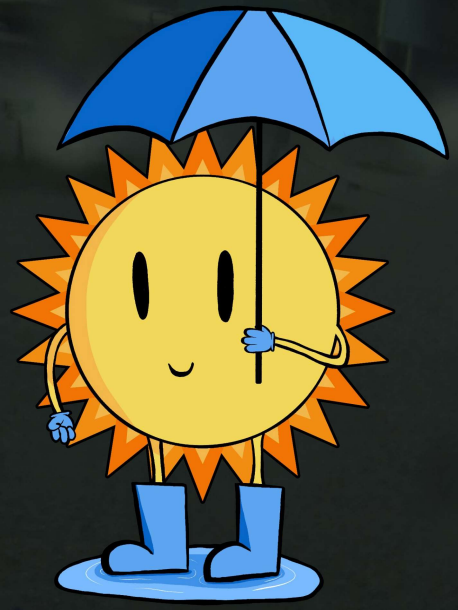


Envision Flood Resilience Workshops: Refining, testing flood mitigation strategies

Workshop goals:

1. Identify flood mitigation strategies that are in line with residents' preferences and values
2. Test the effectiveness of those strategies today and in the future

Details:

- First workshop was held on June 10
- 15 workshop participants randomly selected from interested survey respondents
- Subsequent workshops (four total) will take place from fall 2024 through spring 2025
- After the workshops are complete, a summary of results will be presented to Town Council and a report will be shared publicly

Workshop **scope**

- This is a research project, so presence or involvement of town staff does not imply that a strategy will be implemented
- We are not evaluating financial or technical feasibility of specific strategies
- Some strategies may not currently be permissible or legal under state/federal regulations
  - Example: a mandatory, minimum bulkhead elevation around the Yacht Basin

GENERAL ASSEMBLY OF NORTH CAROLINA
SESSION 2021

H **1**

HOUSE BILL 1163

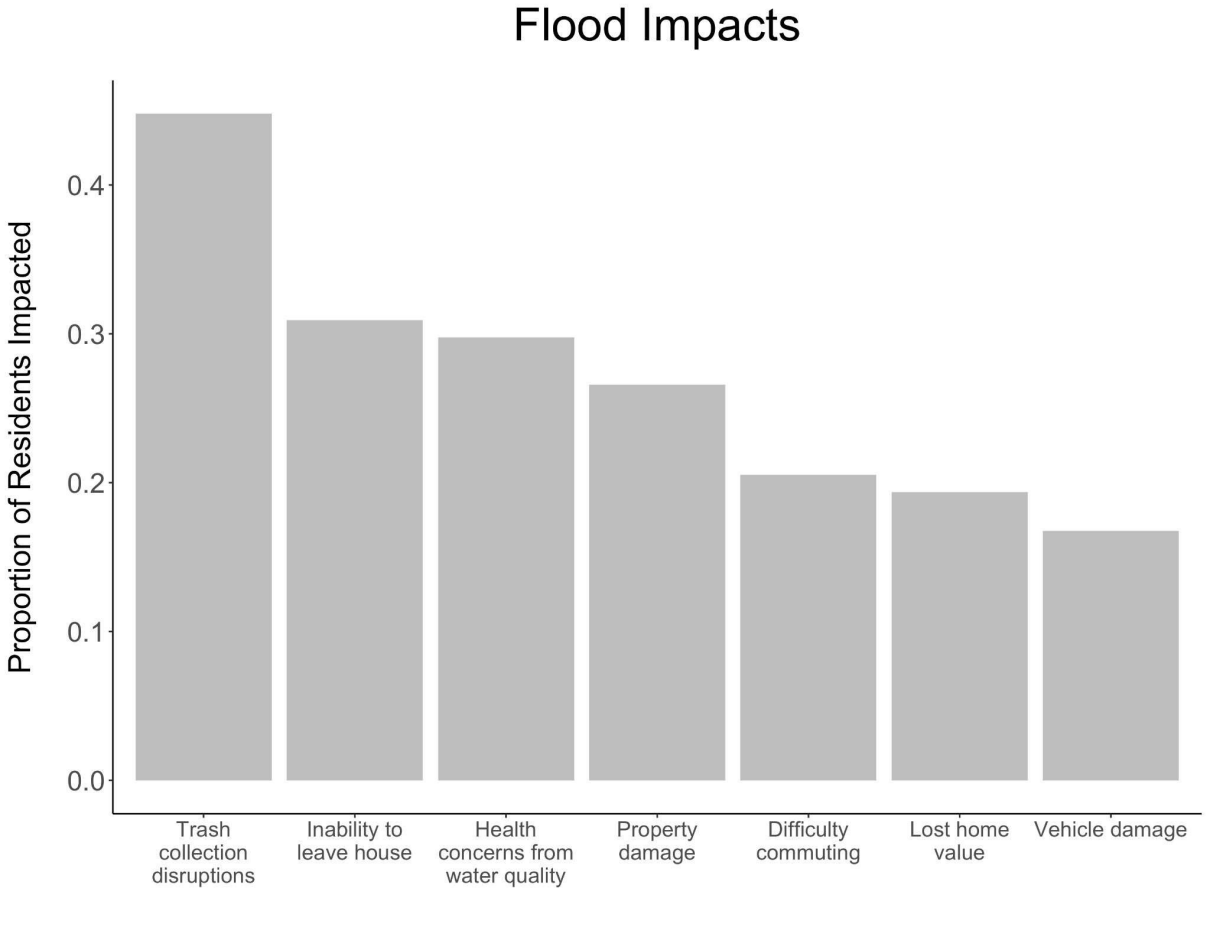
Short Title:	Bulkhead Authority for Carolina Beach.	(Local)
Sponsors:	Representative Miller. *For a complete list of sponsors, refer to the North Carolina General Assembly web site.*	
Referred to:	Local Government, if favorable, Rules, Calendar, and Operations of the House	

June 2, 2022

Recap from workshop #1

The first workshop included:

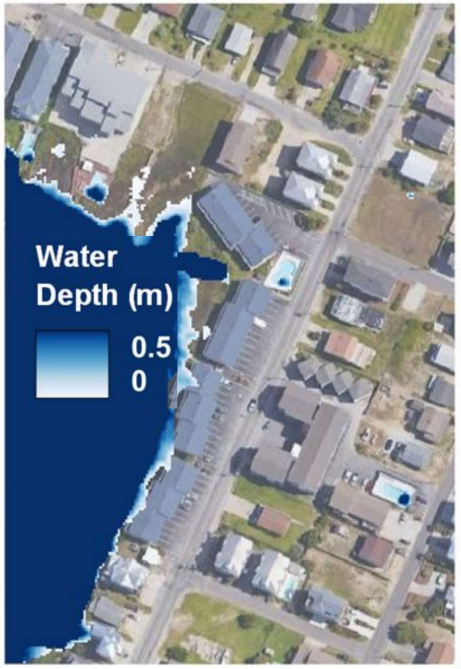
- Review of survey results



Recap from workshop #1

The first workshop included:

- Review of survey results
- Explanation of model capabilities for testing flood mitigation strategies
- Discussion and mapping of flood mitigation strategies preferred by survey respondents and workshop participants



Tides* and *wind
Present-day sea levels
Higher bulkheads

*Tides, wind, **rain***
Present-day sea levels
Higher bulkheads

Next steps following workshop #1

We are distilling the results of the first workshop into specific strategies that can be tested in our flood model, such as:

- Pumping floodwaters (to ocean or infiltration areas)
- Continuous bulkhead around Yacht Basin
- Reconfigurations of Canal Drive
- Increasing infiltration within flooded areas (e.g., with permeable pavements)

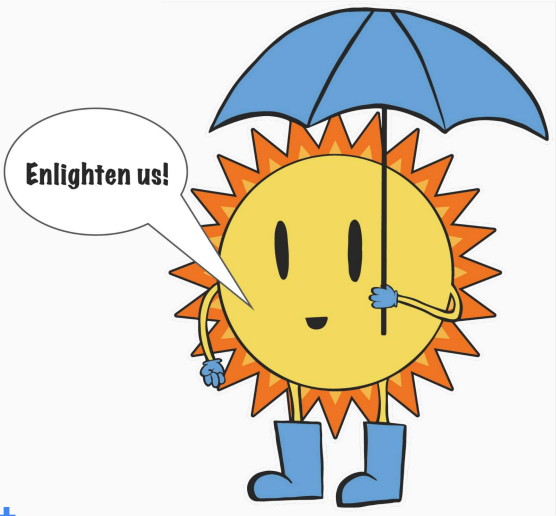
In future workshops, we will:

- Discuss effectiveness of different strategies for various flood drivers (rain, tides, etc.) and time periods
- Refine a set of preferred flood mitigation strategies based on the results

Thanks for your attention! Questions and feedback?

Are there ways that we can make this data more useful to the town?

Any other concerns or questions for us?



Live Carolina Beach flood sensor data available at *go.ncsu.edu/cbflood*

COASTAL RESILIENCE CENTER
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Sea Grant North Carolina

DEEPP Dynamics of Extreme Events People and Places

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