



Swimmer Safety Breakwater



Atlantico Protectors

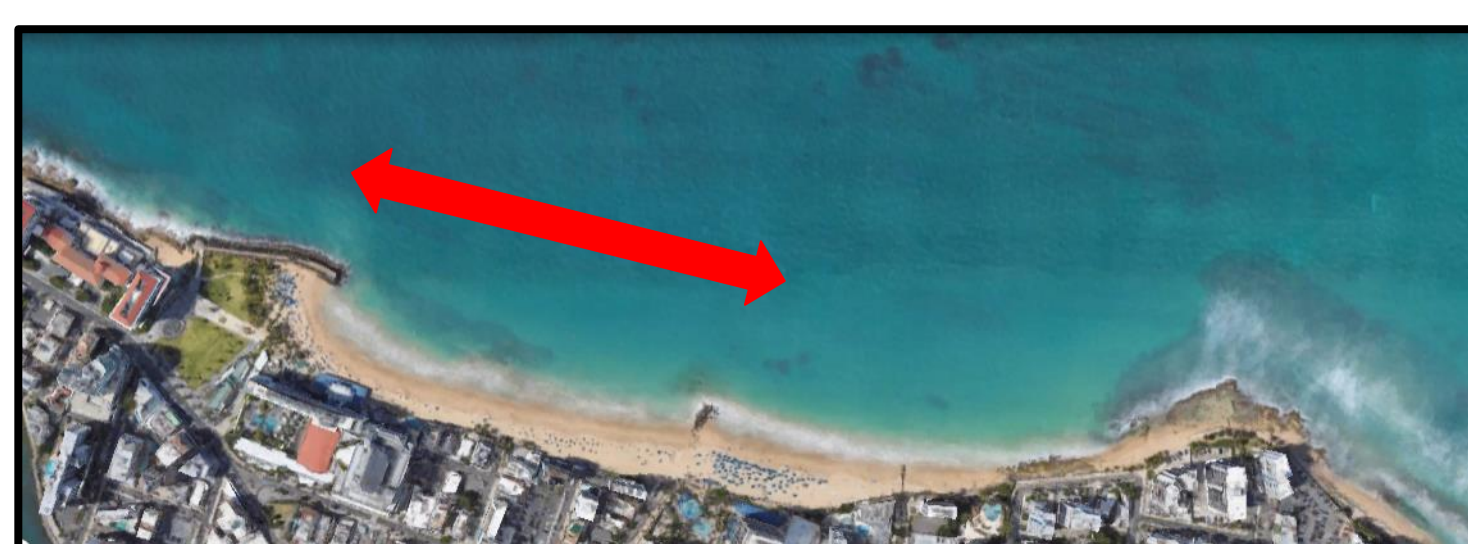
I/C Zack Sweatt

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Problem Statement

At Condado Beach in San Juan, PR, between Ventura Al Mar and Cervantes Street, hazardous rip currents and surf cause unsafe swimming conditions resulting in drownings.



Background

- Dangerous rip current and surf
- Drowning incidents occur year round
- Bathymetry consists of sandbars with channels that accelerate current velocity
- Constantly changing bathymetry due to strong cross-shore currents
- Average conditions still promote sporadic rip currents



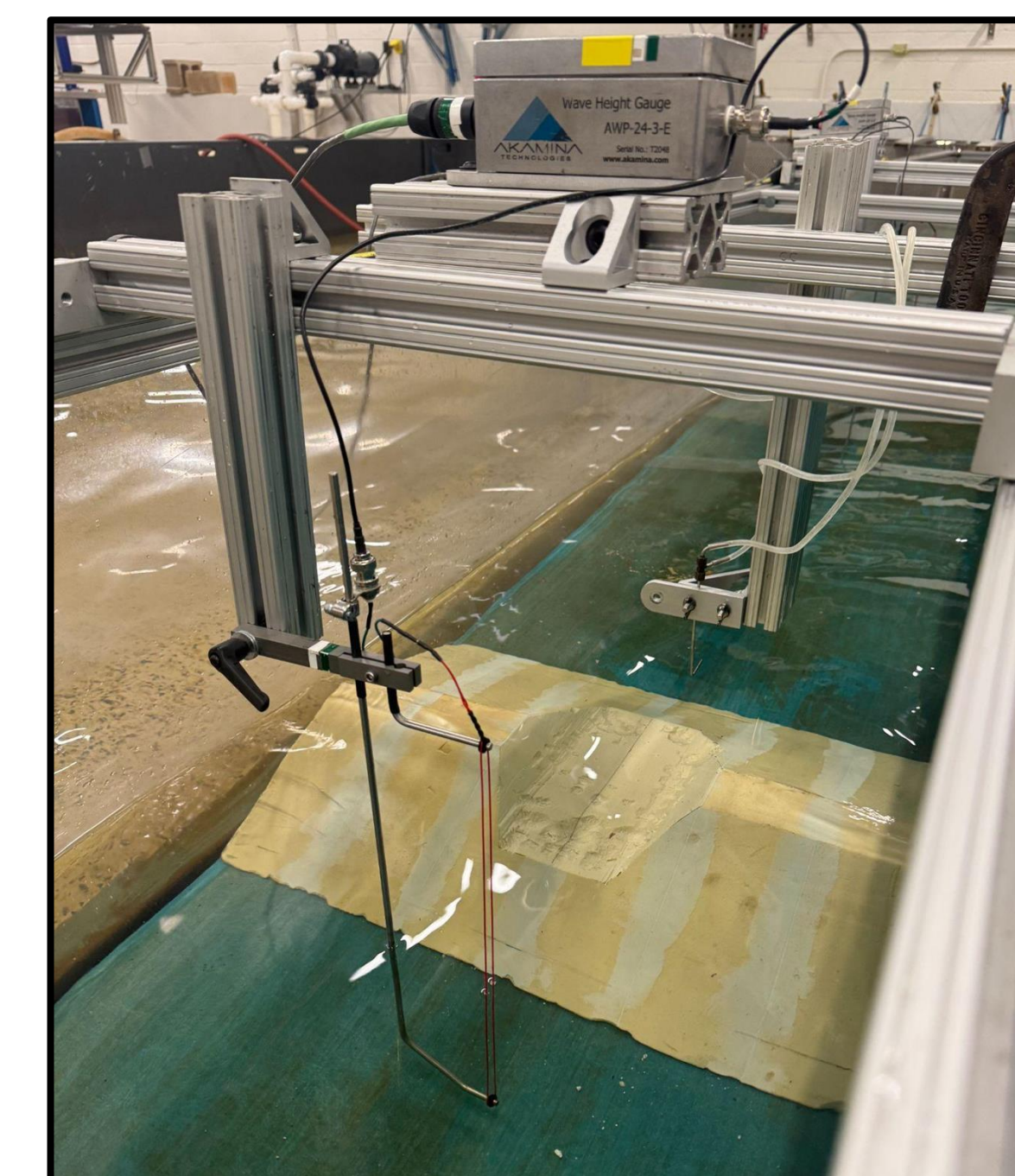
Approach

- Lab design replicated present sandbar conditions from site visit
- Site requires increase in beach safety monitoring measures (i.e. Lifeguards)
- Stabilizing the bathymetry with a coastal engineering mitigation system

Results

Our team discovered two designs that would mitigate rip currents. The Submerged Breakwater and the Beach Nourishment combined with a Submerged Breakwater proved to mitigate the rip current in lab testing. After cost and maintenance considerations, a Submerged Breakwater is our solution.

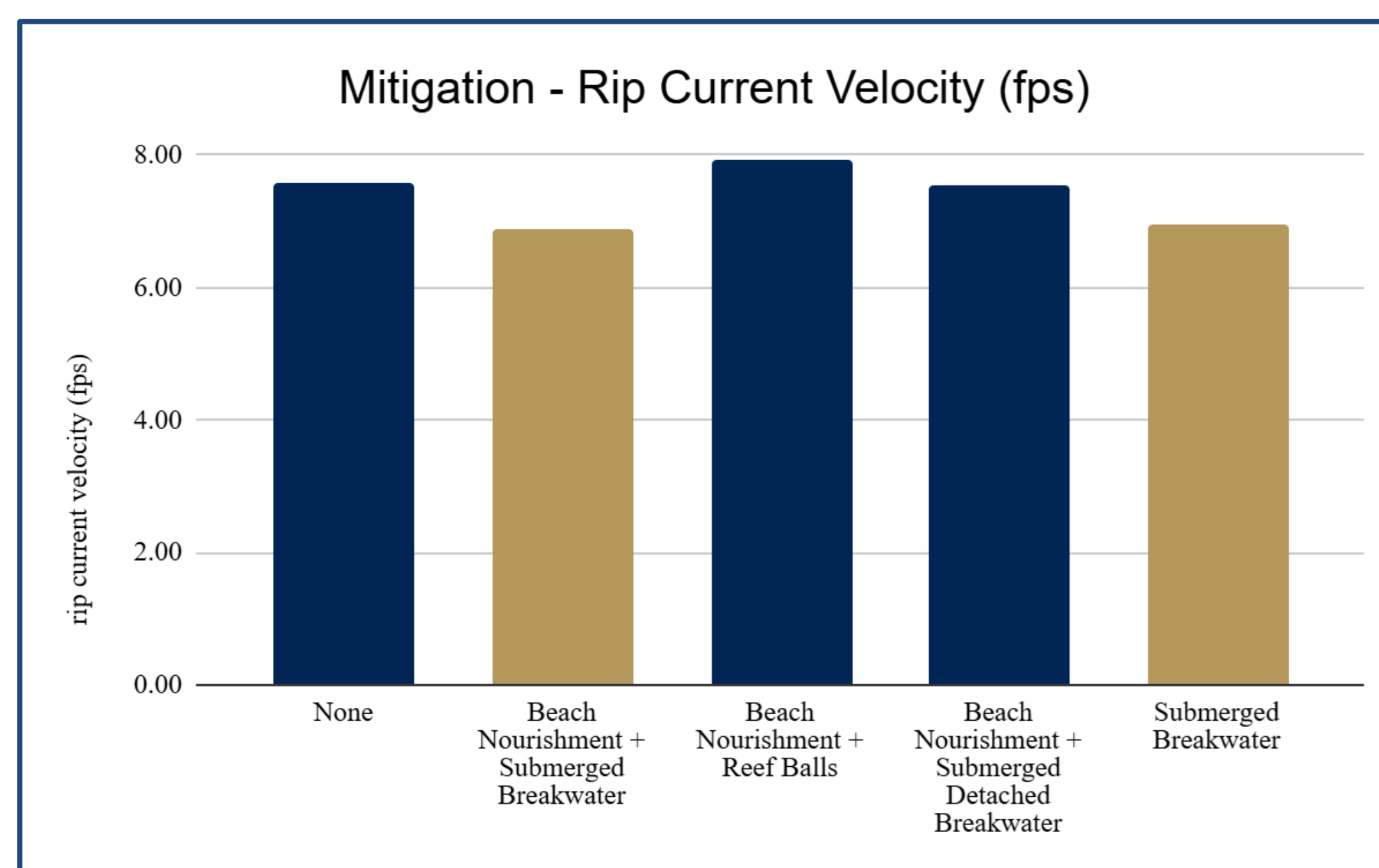
- Gold indicates the best mitigation strategies
- Blue indicates the less effective strategies
- Reef Balls proved suboptimal
- Beach Nourishment costly and high-maintenance
- Breakwater installation at 7 ft depth
- $d_{design} = 16ft$, $H_{design} = 10ft$, $T_{design} = 14s$
- Scale Factor = 61.35
- $d_{scale} = 9in$, $H_{scale} = 1.9in$, $T_{scale} = 1.8s$



Coastal Lab Setup

Real World Conditions $\lambda = 61.35$	Rip Current (fps)	Shore Wave Height (ft)	Deep Wave Height (ft)
No Mitigation	7.57 ft/s	7.79 ft	14.78 ft
Submerged Breakwater	6.96 ft/s	6.62 ft	15.26 ft
Nourishment + Breakwater	6.90 ft/s	6.53 ft	14.57 ft

Table comparing top mitigation methods to baseline conditions



Rip Current Mitigation Testing Completed in USNA Coastal Basin - Results show actual wave conditions



Gemini-Created Mockup of Submerged Breakwater at Condado Beach

Conclusion

- Condado Beach is pervated with sandbars and a volatile bathymetry driving sporadic rip current formation
- A Submerged Breakwater is the optimal solution to decrease rip velocity and stabilize beach conditions
- Post construction monitoring is critical



Acknowledgements

- Dr. Andrew Metzger
- CDR Kristofer Womack
- Dr. Victoria Johnson
- Dr. Anna Zaslov
- Dr. Melissa Moulton (U. Wash.)
- Mr. Michael Stanbro

References

- Please Scan The Following QR Code For Our References...

