

WHAT'S WITH THE WEATHER?

Piermont copes with climate change

Experiencing climate-associated impacts in Piermont

- The major climate-associated impact experienced in Piermont is increased flooding from the Sparkill and the tidal Hudson.
- The Village's waterfront neighborhoods, business district and emergency services are all vulnerable to flood risk.
- Piermont's entire waterfront was seriously impacted by flooding during Tropical Storms Irene and Lee in 2011 and by a record-breaking storm surge during Hurricane Sandy.
- Beyond storm events, some waterfront areas are experiencing flooding during high tides, even during clear weather.



Signs of Climate Change in the Hudson River Valley



Extreme Precipitation

- As the surface of the planet warms, more water evaporates into the atmosphere and turns into clouds.
- More water in the atmosphere means more frequent and intense rain storms.
- Our current infrastructure cannot handle the volume of rain water, leading to flooding in places that normally stay dry.



Storm-Based Flooding

- Projected extreme rainfall means that more and more areas that normally stay dry will begin to experience flooding during storms events.
- According to the National Climate Assessment, there was a 71% increase in very heavy precipitation from 1958-2011.



Changing Temperature

- Summers may be hotter and winters colder because climate change increases air temperature and shifts in air currents.
- Urban areas covered with pavement and concrete contribute to even higher temperatures in the urban environments.



Sea Level Rise

- Ocean tides push into the Hudson River all the way to Troy, so if the ocean level rises, so does the river level.
- There are two causes of sea level rise: first, as the water gets warmer it expands. Second, land-based ice is melting due to rising temperatures.
- So, a melting ice shelf in Greenland can change the water level in Piermont.

Climate Change: A Global Phenomena

Causes

- Recent rapid climate change is caused by human emissions that stay in the atmosphere.
- These emissions - greenhouse gases – come from burning fossil fuels for energy, transportation, industry, and other human activities.

Effects

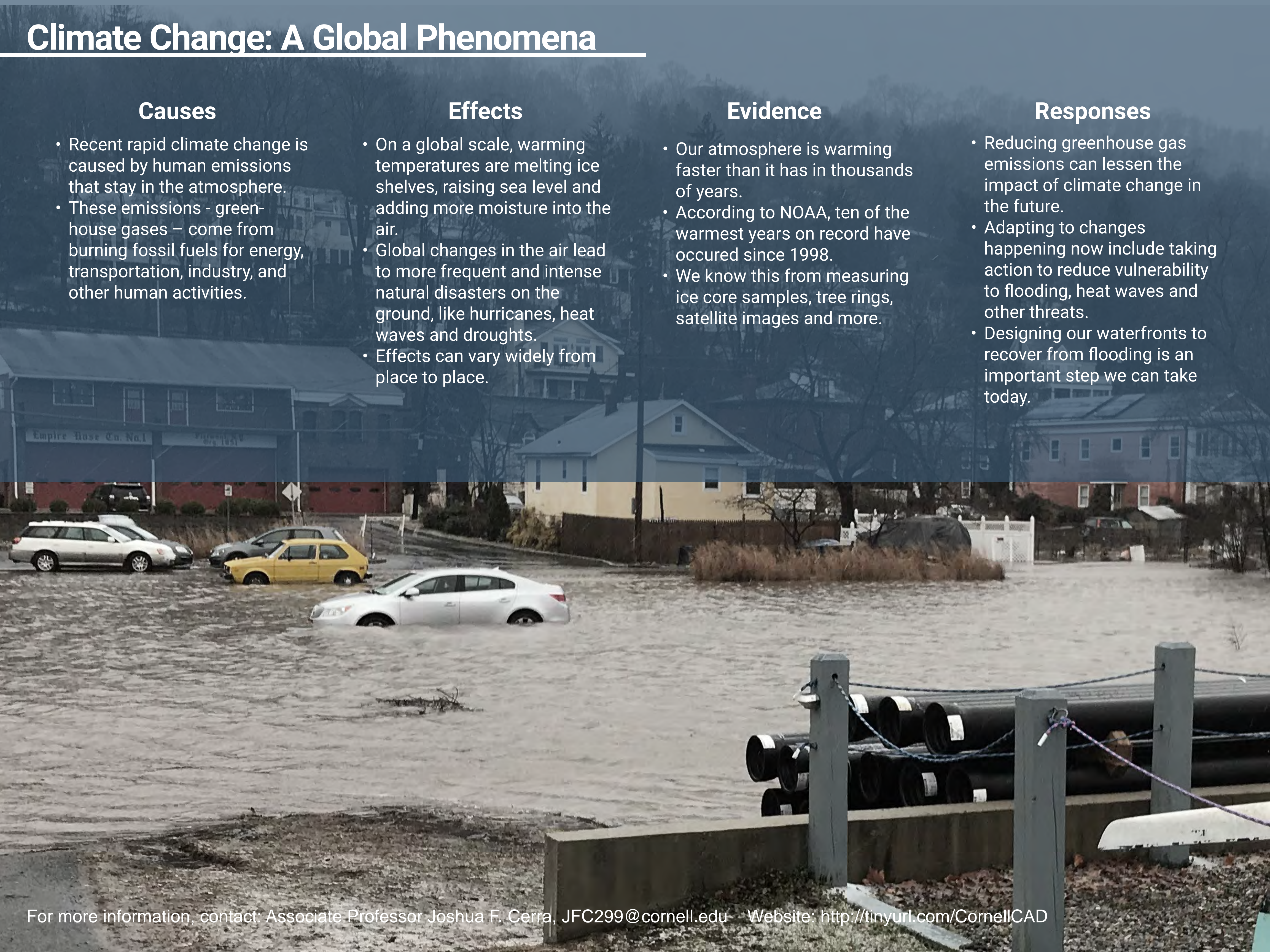
- On a global scale, warming temperatures are melting ice shelves, raising sea level and adding more moisture into the air.
- Global changes in the air lead to more frequent and intense natural disasters on the ground, like hurricanes, heat waves and droughts.
- Effects can vary widely from place to place.

Evidence

- Our atmosphere is warming faster than it has in thousands of years.
- According to NOAA, ten of the warmest years on record have occurred since 1998.
- We know this from measuring ice core samples, tree rings, satellite images and more.

Responses

- Reducing greenhouse gas emissions can lessen the impact of climate change in the future.
- Adapting to changes happening now include taking action to reduce vulnerability to flooding, heat waves and other threats.
- Designing our waterfronts to recover from flooding is an important step we can take today.

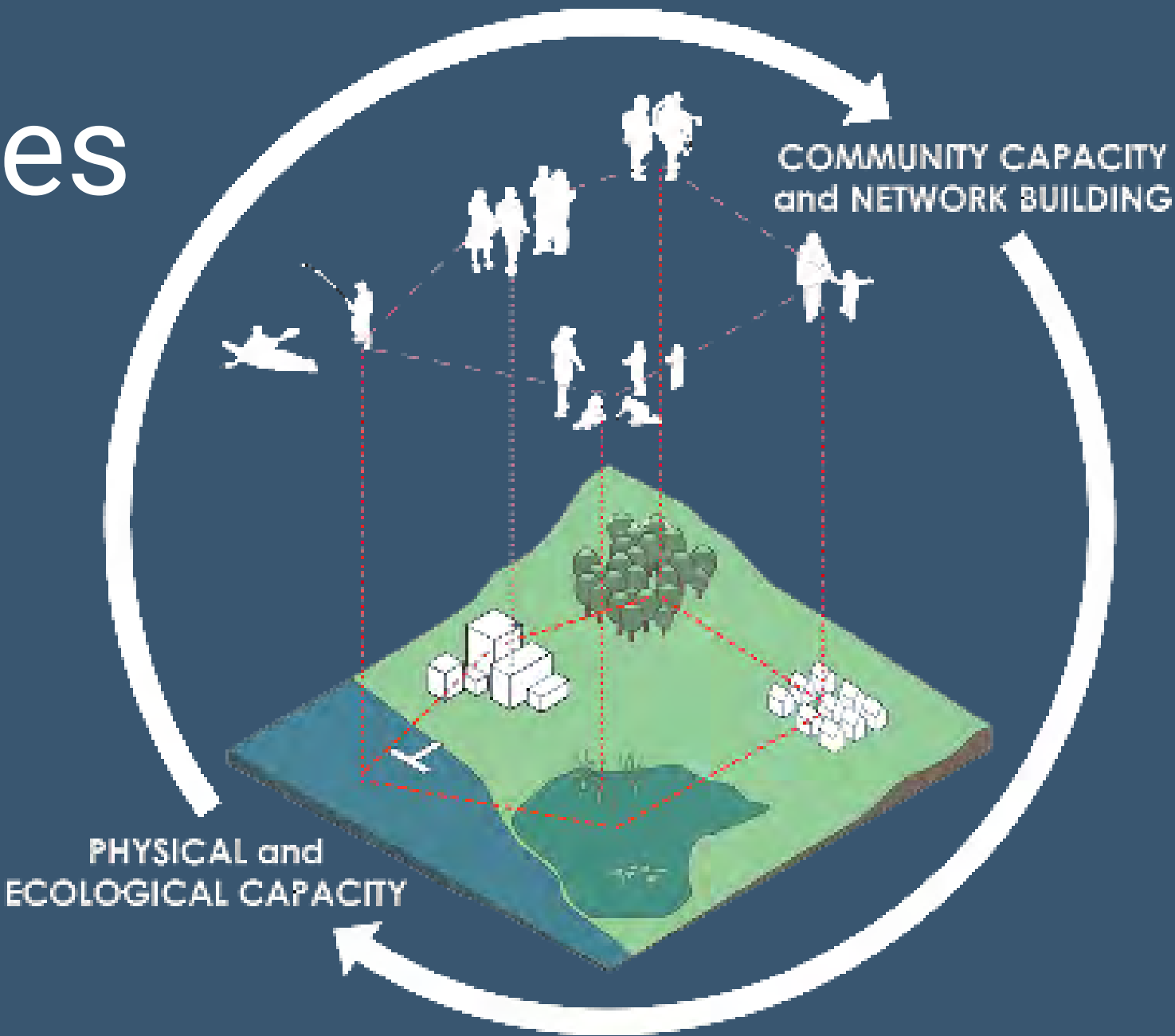


WHAT IS CLIMATE-ADAPTIVE DESIGN?

Envisioning vibrant waterfront communities

Creating designs for a more resilient future

The Cornell Climate-adaptive Design (CaD) studio is a design research program that links Cornell students in landscape architecture with Hudson Valley communities to explore design alternatives that envision more climate resilient waterfront communities. By working with both the studio process and the design products it creates, we seek to inspire climate awareness and action within the communities with whom we work.



1

The design process begins with an initial analysis of the site including **site visits** to better understand the place that we are working in, and meeting with the community to understand their vision for a future waterfront. This analysis allows us to identify current and future challenges and opportunities.



2

During the design process we continually meet with **stakeholders and community members** to share our initial ideas and design concepts, including an onsite stakeholder workshop. We are committed to finding design strategies that work for many, and seek ongoing participation from the community.



3

On our campus in Ithaca, NY we refine the **design concepts** based on the information and feedback gathered during our community and stakeholder meetings.



4

At the end of the semester we present our **final designs** to the community to inspire further discussion about the value of vibrant and resilient waterfront communities.



Partners

Associate Professor Joshua F. Cerra directs the Climate-adaptive Design studio at the Cornell Department of Landscape Architecture. We work closely

with our partners including Hudson River Estuary Program as part of the New York State Department of Environmental Conservation, Cornell Soil and Water Lab,

Cornell Cooperative Extension, Scenic Hudson, and critically, our key community partners which have included Kingston, Piermont, Catskill and Hudson since

2015. The CaD Studio also wants to thank the many students and research assistants that have worked on this project over time.



Hudson River Estuary Program



New York State
Water Resources Institute
Cornell University



Cornell CALS
College of Agriculture and Life Sciences

CAD STUDIO IN PIERMONT

Building on strong foundations to inspire change

CaD Studio in Piermont

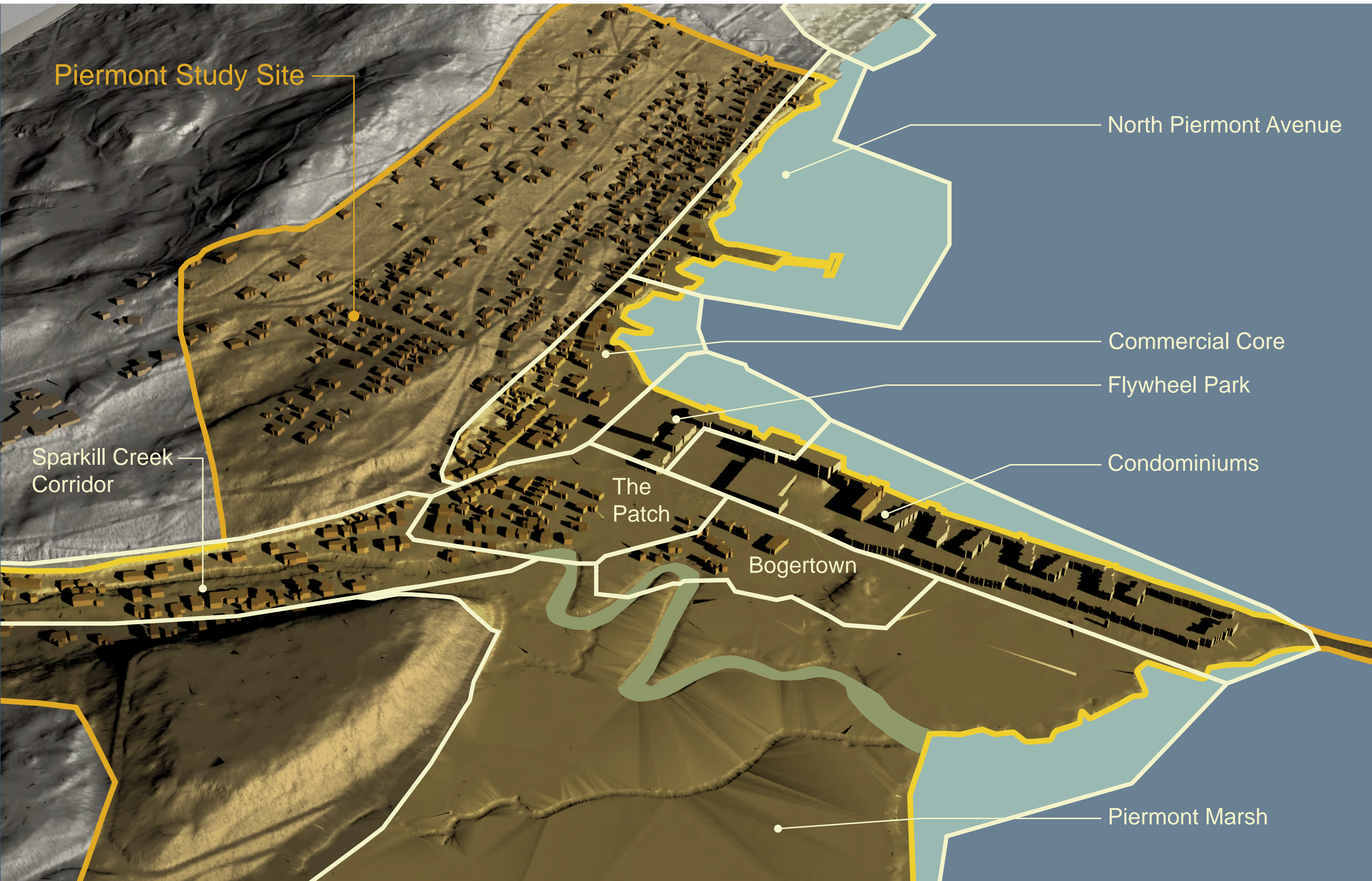
Piermont is located on the western shore of the Hudson River at the mouth of the Sparkill Creek near the northern edge of the Palisades, approximately 30 miles from NYC. The CaD studio took place in the Village of Piermont during the fall of 2017. A class of Cornell University

undergraduate design teams - which included students from the Landscape Architecture, Biological & Environmental Engineering, and Urban & Regional Studies departments - proposed strategies to provide Piermont with innovative approaches to flood resiliency.



The Study Area

The CaD studio study area included a large section of the Piermont waterfront, extending from Piermont Marsh to the marina on North Piermont Avenue. The study area included Piermont Pier, The downtown business district and residential neighborhoods. The study area extended west to NYS Route 9W to include areas with potential to accommodate strategic relocation of key assets out of the flood zone.



The Stakeholders

Piermont stakeholders who participated in the CaD Studio process included elected officials and village staff; members of the Piermont Waterfront Resilience Commission, Local Waterfront Revitalization Committee and Planning Board; and representatives of community organizations, including the fire department, Sparkill Creek Watershed Alliance, Piermont Landing Condominium Association and the Piermont Civic Association.

The Issues

Stakeholders described a community that considers the natural world to be part of its identity. There is a strong interest in protecting the marsh, and in investigating methods for improving water quality in the Sparkill Creek. Strengthening connections to the waterfront, maximizing the recreational potential of Piermont Bay and capitalizing on the arts for economic development were identified as priorities. Flooding is the primary climate-related concern for stakeholders. There is a need to address vulnerable building and infrastructure, as well as traffic circulation and roadway flooding to assure safe evacuation routes. Some stakeholders expressed a vision of a future for Piermont as the “Venice on the Hudson”, while others want to explore innovative options for flood-prone neighborhoods, including amphibious housing and strategic relocation.

DESIGN PRINCIPLES

Five Key Principles That Guide The Design Process



DESIGN A WATERFRONT

Maximize the value of what a waterfront can be

Designing a waterfront means:

- Taking advantage of and contributing to its waterfront location
- Emphasizing water-dependent and water-enhanced uses

Water-dependent Activities

“Activities that can only be conducted on, in, over, or adjacent to a body of water.”



Swimming



Boat Launching



Fishing



Kayaking



Sailing



Water Trail



Water-enhanced Activities

“Activities that do not require direct access to water, but whose waterfront location adds to the public’s use and enjoyment of the water’s edge.”



Hotel



Restaurant



Picnicking



Wildlife Watching



Scenic View



Hiking



Biking



Walking



Water-independent Activities

“Activities not requiring direct access to the water and whose waterfront location does not contribute to public use and enjoyment of the water’s edge.”



Parking



Fueling



Grocery



Field Sports

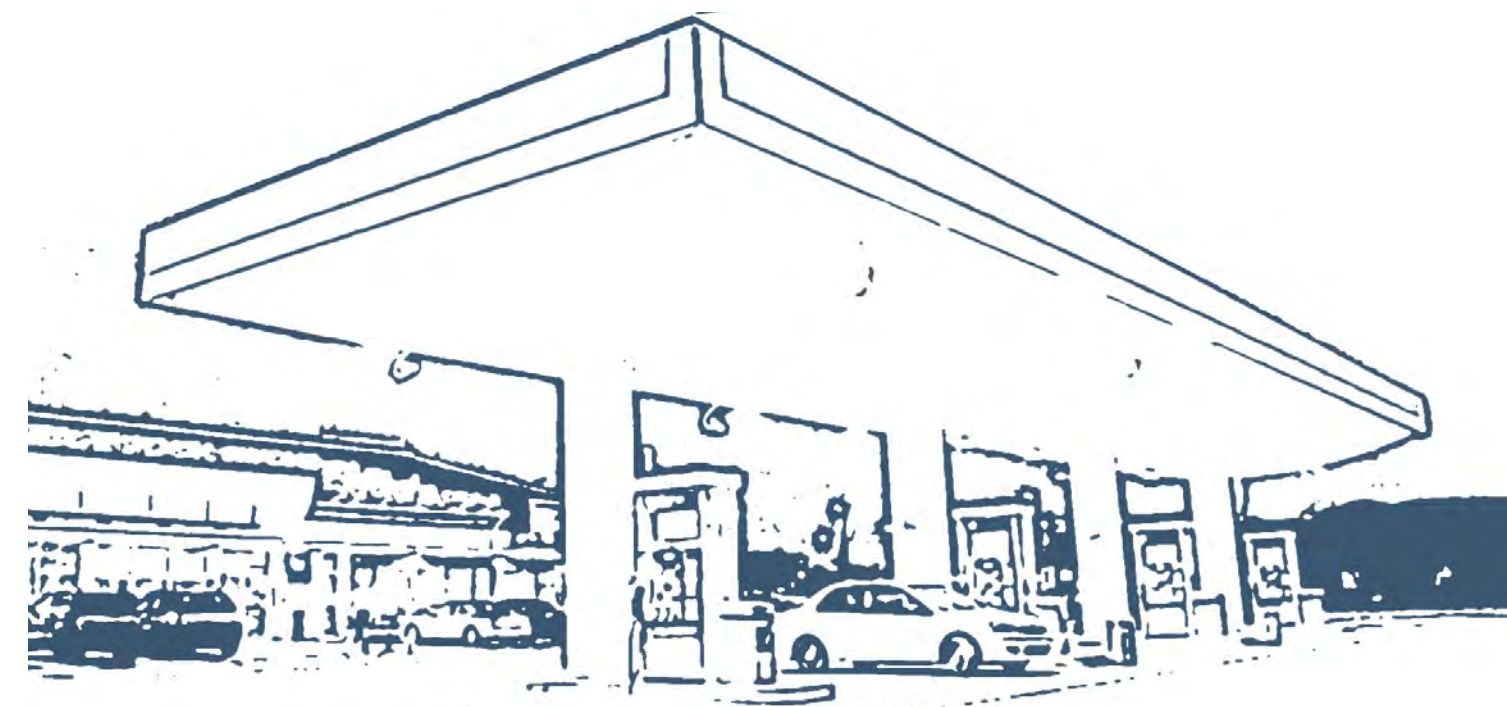


Storage



Auto Repair

Activity definitions quoted from Eisenman,T., J. Anzevino, S. Rosenberg, and S. Spector (eds.) 2016. *Revitalizing Hudson Riverfronts: Illustrated Conservation & Development Strategies for Creating Healthy, Prosperous Communities*. Scenic Hudson, Poughkeepsie, NY. p.32



CASE STUDY: Scenic Hudson’s Long Dock Park, NY



Courtesy of Reed Hildebrand Landscape Architecture

Located on the waterfront in Beacon, NY, this project showcases flood adapted structures and nature-based solutions for greater resilience. The site was once a transportation and industrial hub, and is now a destination for water-based activities. Long Dock Park features a floodable kayak pavilion, a beach for launching boats, a river overlook deck, a restored barn that is now a meeting and education center, a waterfront sculptural installation that highlights tidal changes, and trails that lead through rehabilitated wetlands and meadows.

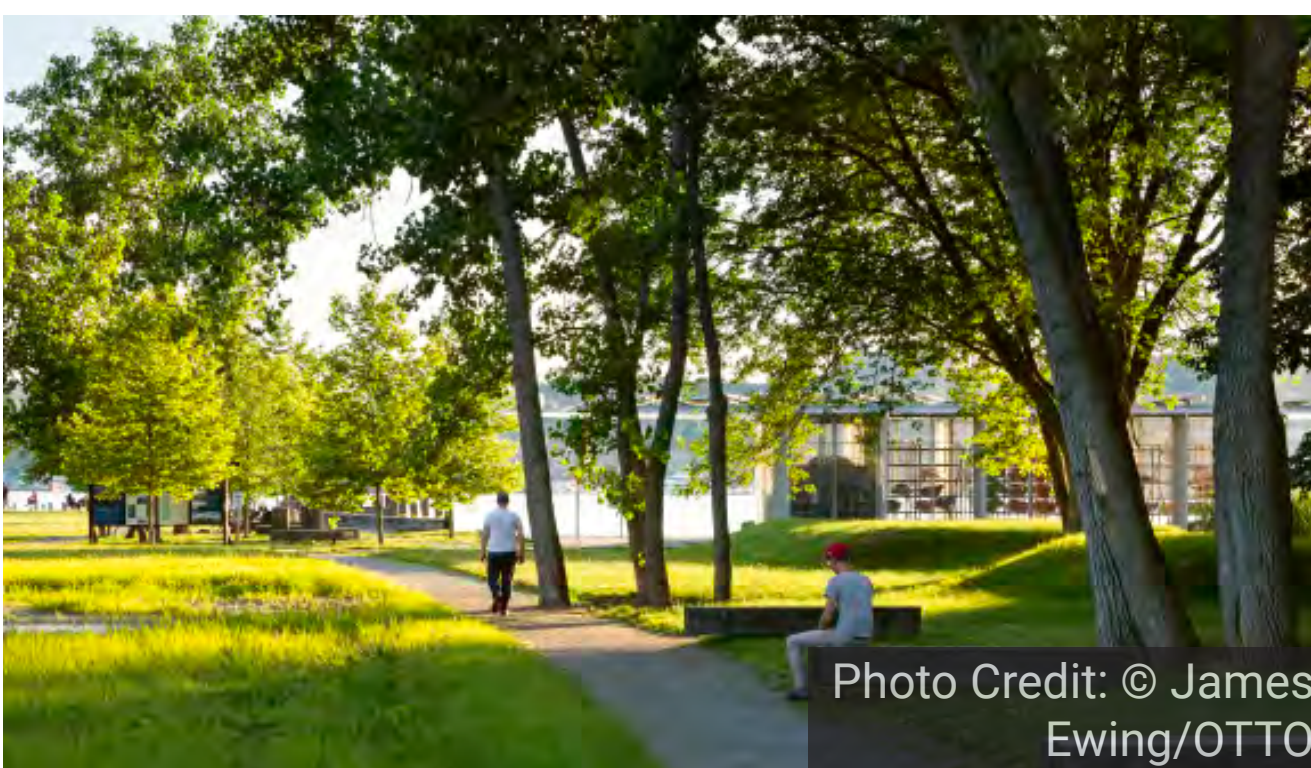


Photo Credit: © James Ewing/OTTO



Photo Credit: © James Ewing/OTTO

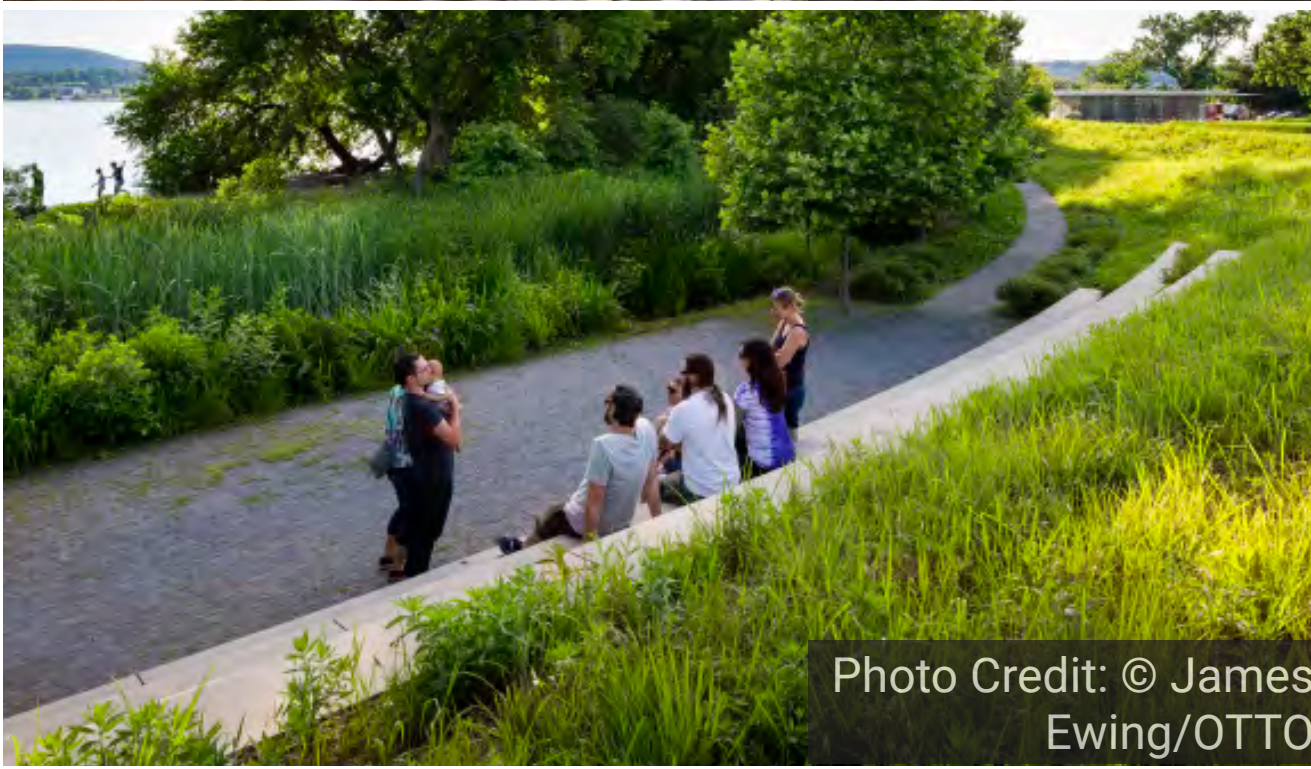


Photo Credit: © James Ewing/OTTO



Long Dock Park Masterplan from Reed Hilderbrand LLC
Source: <https://www.asla.org/2015awards/96213.html>



DESIGN FOR FLOODING

Working with water may be better than working against it

Design for flooding means:

- Understanding strategies for reinforcement, adaptation, and strategic relocation
- Making choices that minimize flood risk

Reinforcement

Techniques that exclude or limit water from entering locations, like levees, sea walls, and hardened shorelines. While sometimes used to protect important infrastructure or development at risk of flooding, these solutions also carry “residual risks” if reinforced infrastructure fails, for example by over-topping by water.



Public Domain image by Indolences: https://en.wikipedia.org/wiki/Levee#/media/File:Sacramento_River_Levee.jpg

Adaptation

Design techniques that incorporate uses and structures that can accomodate flooding, such as floodable landscapes and wet flood-proofed buildings.



Mill Race Park
Courtesy of MVVA, Inc.

Strategic Relocation

Design techniques that move important uses that cannot accomodate flooding out of the floodplain to places where they will not be impacted by water.



Lower Don River Port Land by MVVA
Courtesy of MVVA, Inc.



DESIGN FOR COMMUNITY

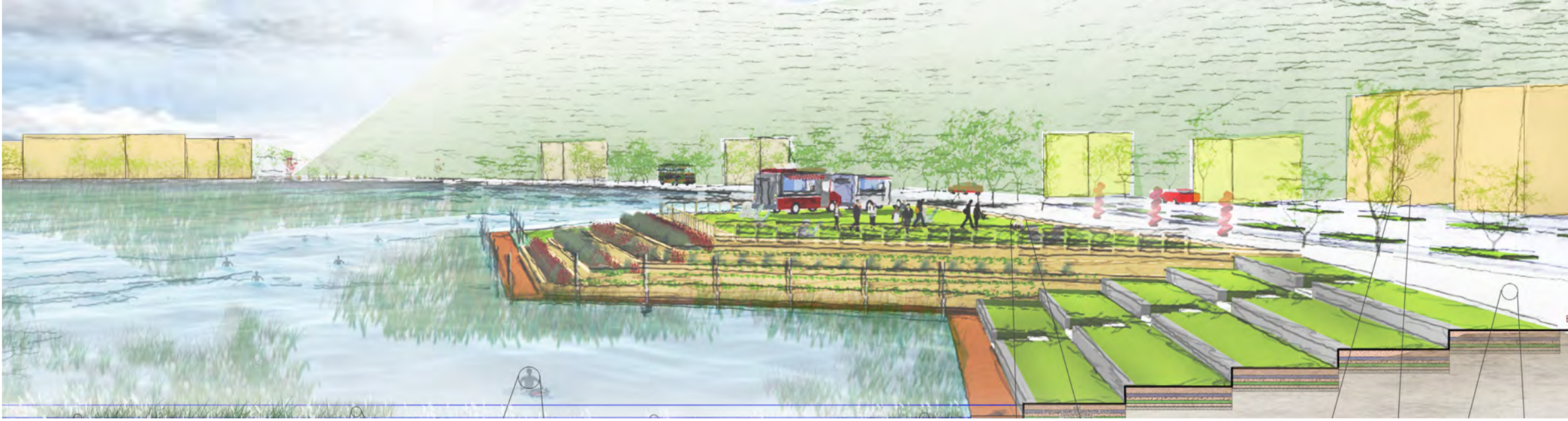
Waterfronts should be universally accessible and decidedly memorable

Designing for community means:

- Providing equitable access to waterfronts for the public benefit
- Creating a sense of place and destination



Mark J Hirshbeck, Ilia Savin,
Kingston CAD Studio I



Mark J Hirshbeck, Ilia Savin,
Kingston CAD Studio I



Rachel Yunyann Liu, Susan Rhodes, Samuel Packer
Catskill CAD Studio

- Contributing to the prosperity and vision for the community



Kelly Farrell, Yuting Liu, Kingston CAD Studio II

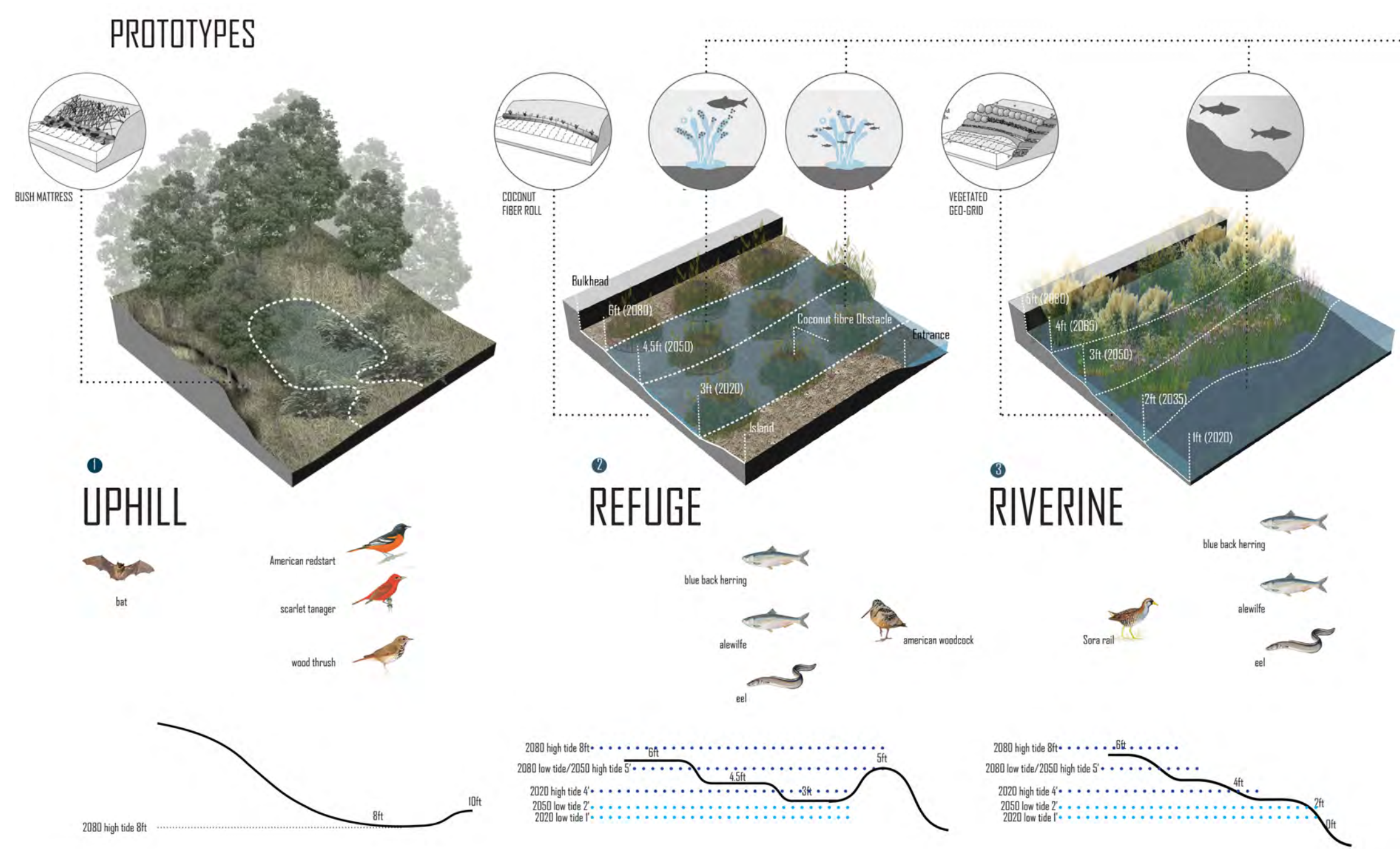


DESIGN WITH NATURE

A healthy Hudson is good for us and the greater ecology

Designing with nature means:

- Building a healthy Hudson by creating and maintaining healthy terrestrial and aquatic ecosystems



Shan Lin, Lijin Liu, Kingston CAD Studio III

- Helping habitat work for us- through ecosystem services

Interventions include:
Green Infrastructure
Living Shorelines
Assisted Marsh Migration
Canopy Connectivity

Benefits include:
Water Quality Enhancement
Shoreline Stabilization
Stormwater Management
Recreation
Shading and Temperature Regulation



Kimberly Blacutt, Ivy Wong, Kingston CAD Studio I

This constructed wetland concept captures runoff from storms to improve water quality while contributing to the character and aesthetic of its park setting.

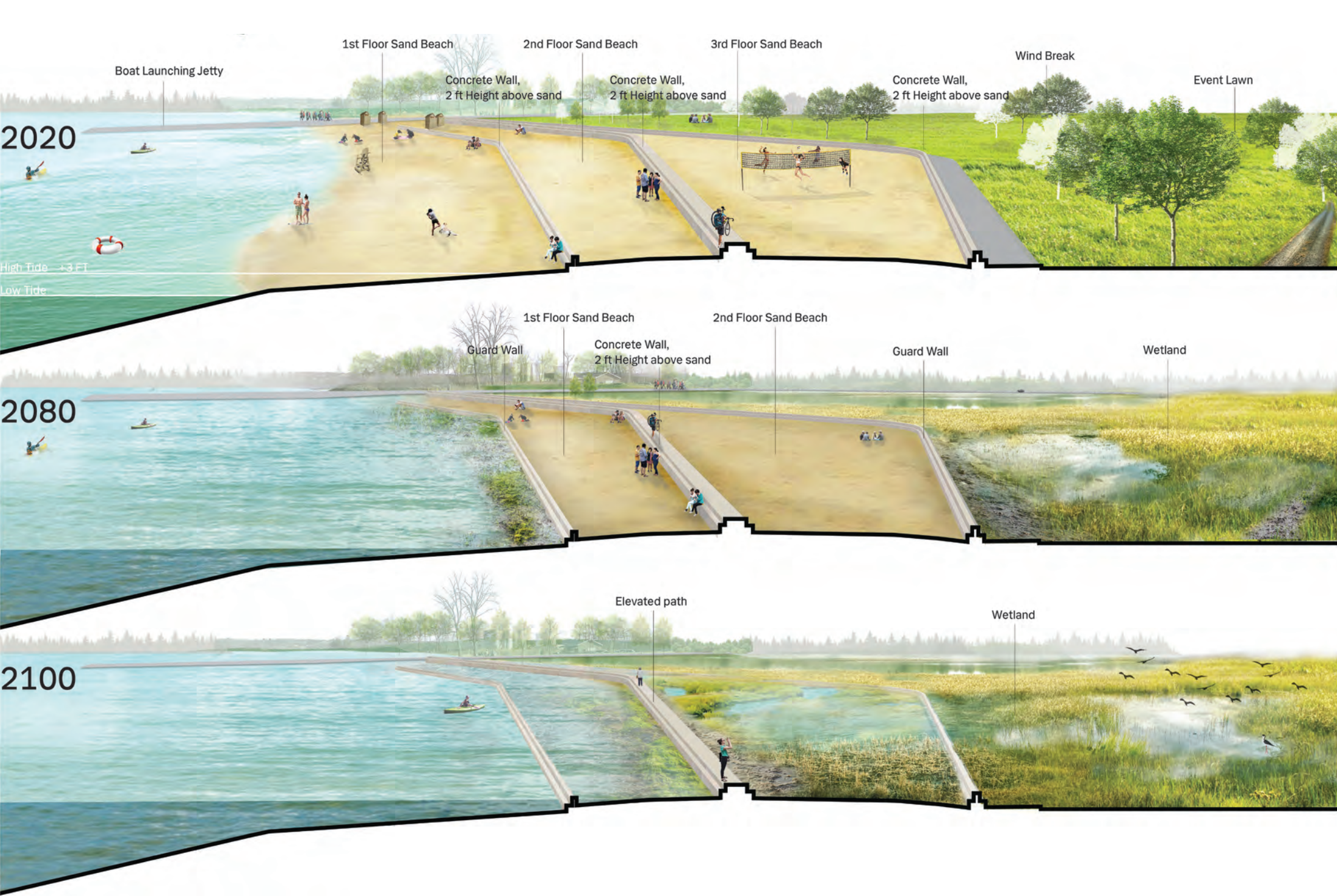


DESIGN FOR CHANGE

Build value into waterfronts as they change over time

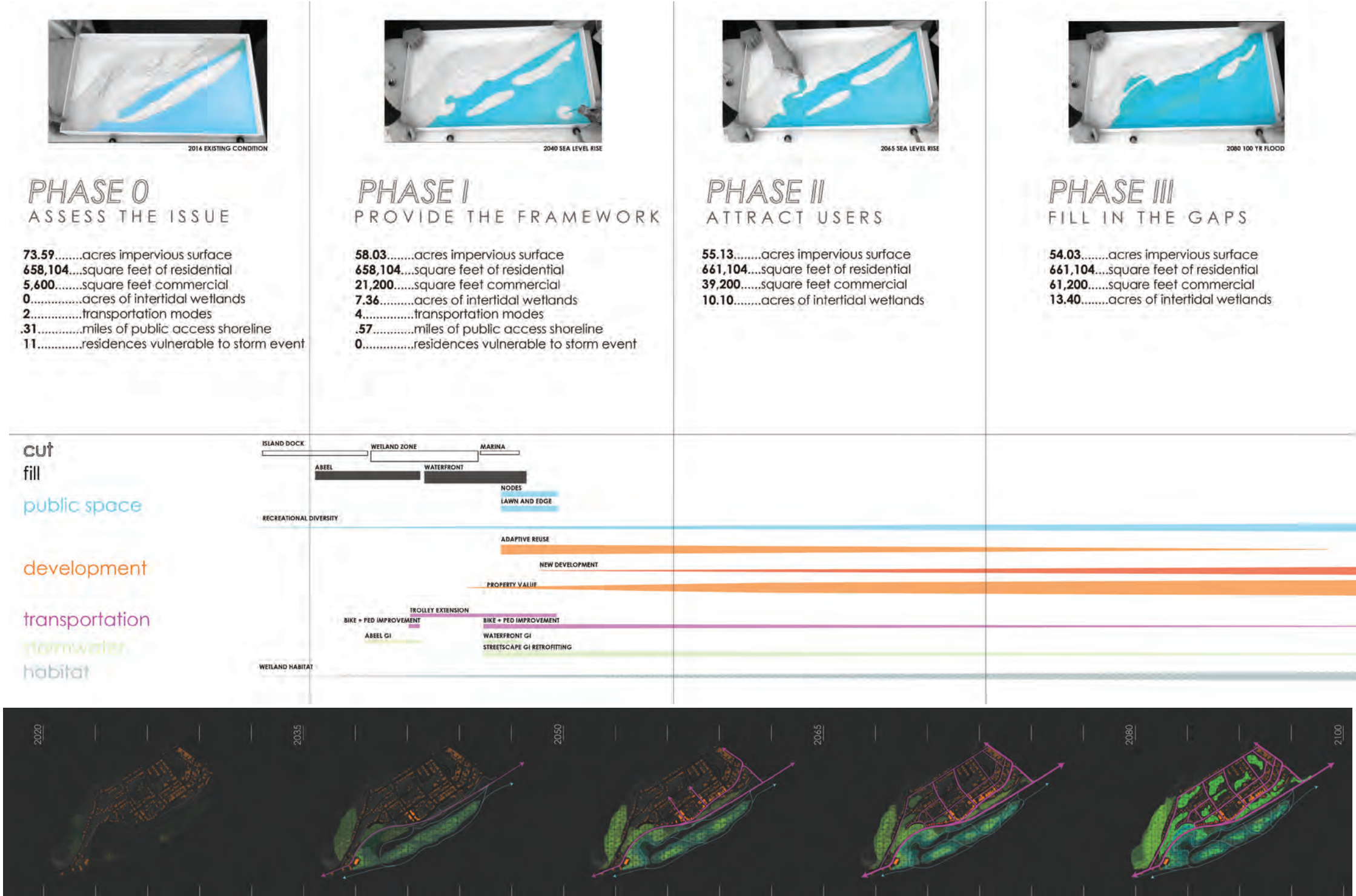
Designing for change means:

- Creating adaptable places that consistently provide value with changing conditions



Hong Gao, Luyao Kong, Qianli Feng, Kingston CAD Studio II

- Phasing in projects over time in ways that are both practical and visionary



Mark J Hirshbeck, Ilia Savin, Kingston CAD Studio I

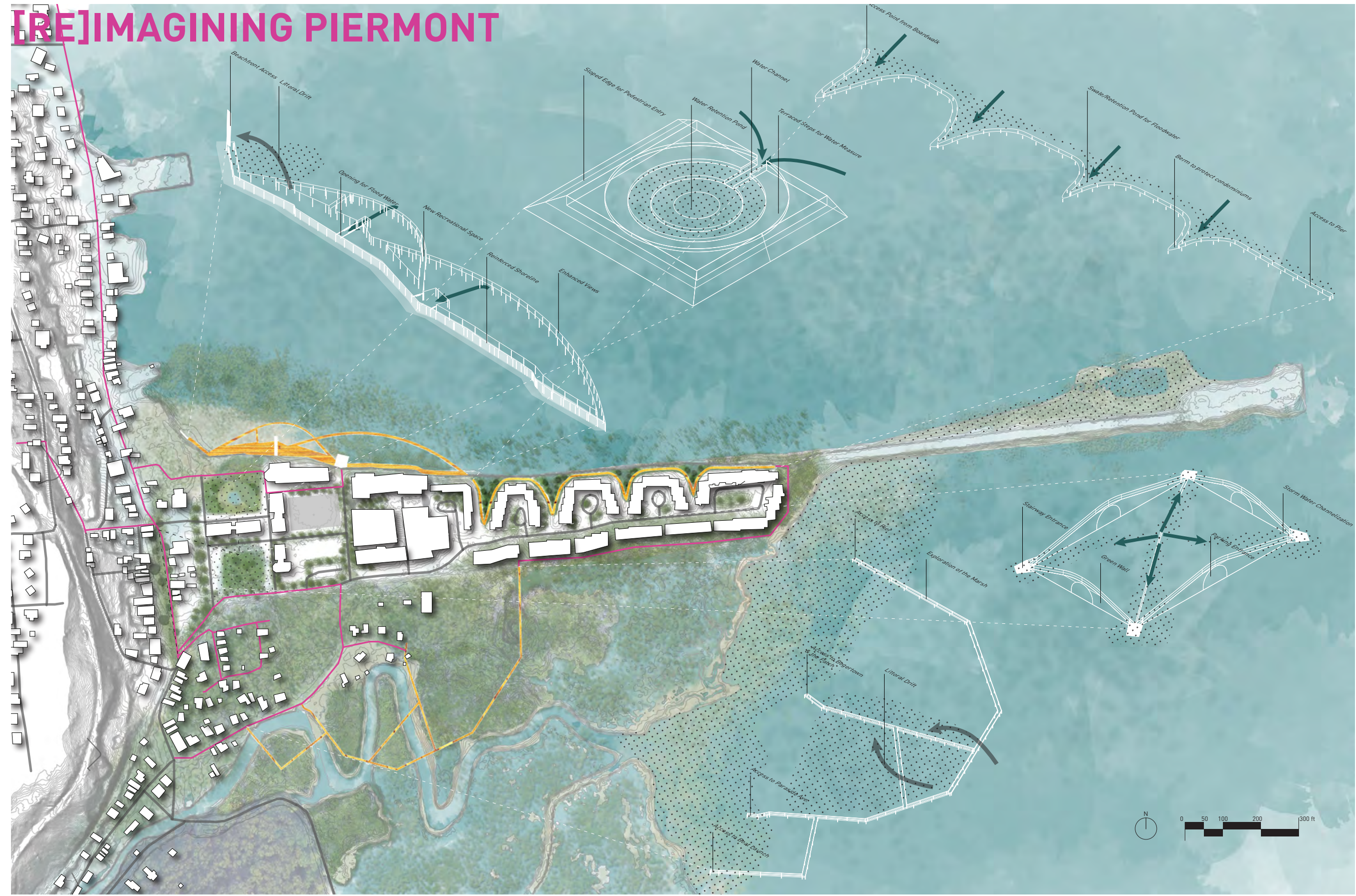


REAPPEARING PIERMONT

CaD Studio Design Team:
Blake Enos (BSLA '18)
Sage Magee (BSLA '18)
Jacob Kuhn (BS Urban & Regional Studies '18)

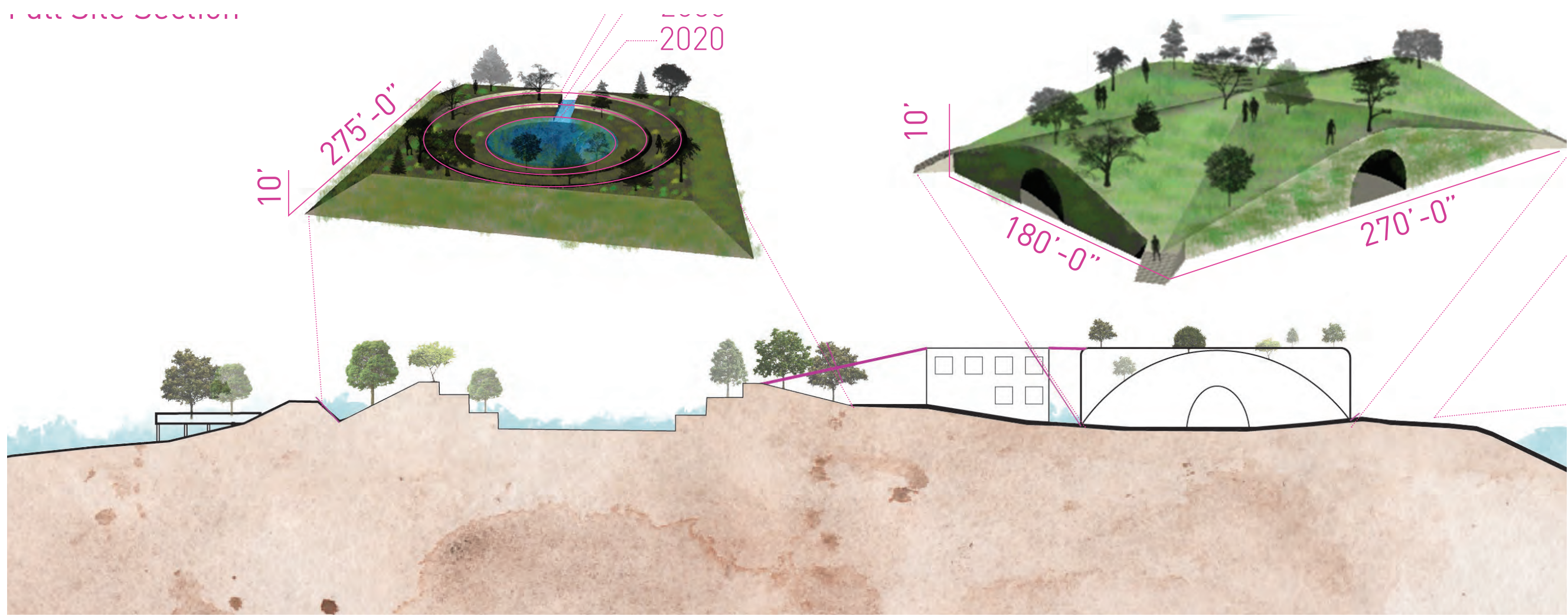
What is this project about:
“Piermont is a community situated amongst a natural landscape, deeply connected to the Hudson River. Our project aims to enhance Piermont’s relationship with nature and the Hudson through strengthening all of the places and connections that give Piermont its unique identity. In this way, we see Piermont as “reappearing” because it emerges as an example of a climate adaptive community that can withstand flood waters as they come.”
- Blake Enos, Sage Magee, and Jacob Kuhn

2080 Masterplan



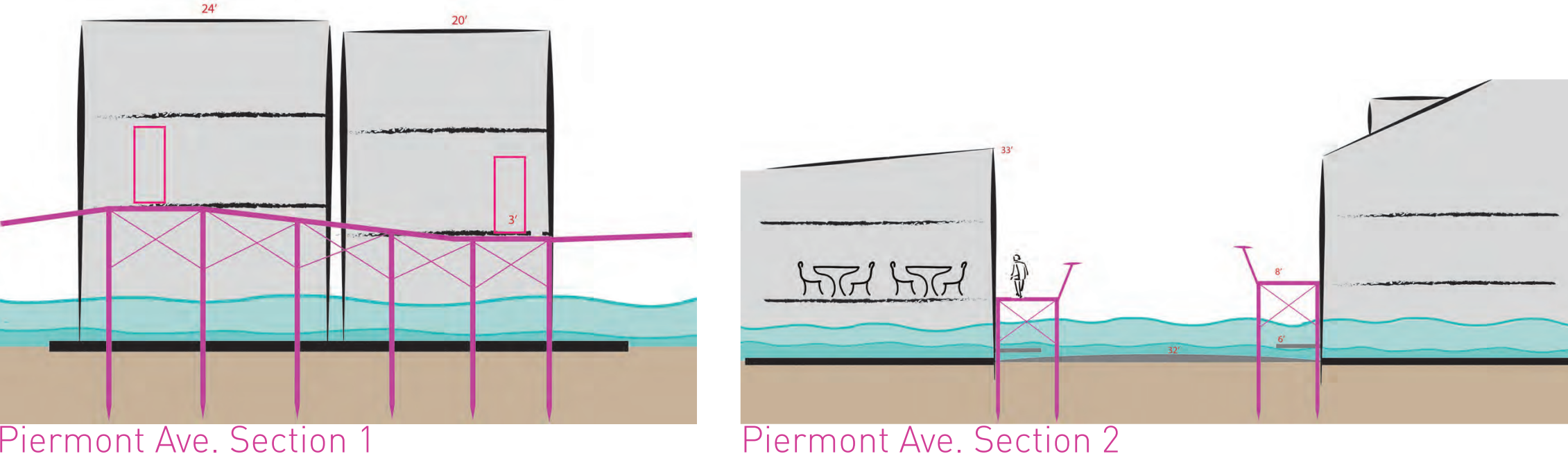
Emphasizing connections between people, water and the environment, this design concept features a combination of resilience techniques. By 2080, the Pier is protected by reinforcement of the shoreline with a pedestrian walkway atop a floodwall. The marsh is allowed to migrate inland, facilitated through strategic relocation of southeastern neighborhoods. An elevated walkway provides access to the second story of storefronts on Piermont Avenue, preserving the Village’s commercial core.

II. Water Connections



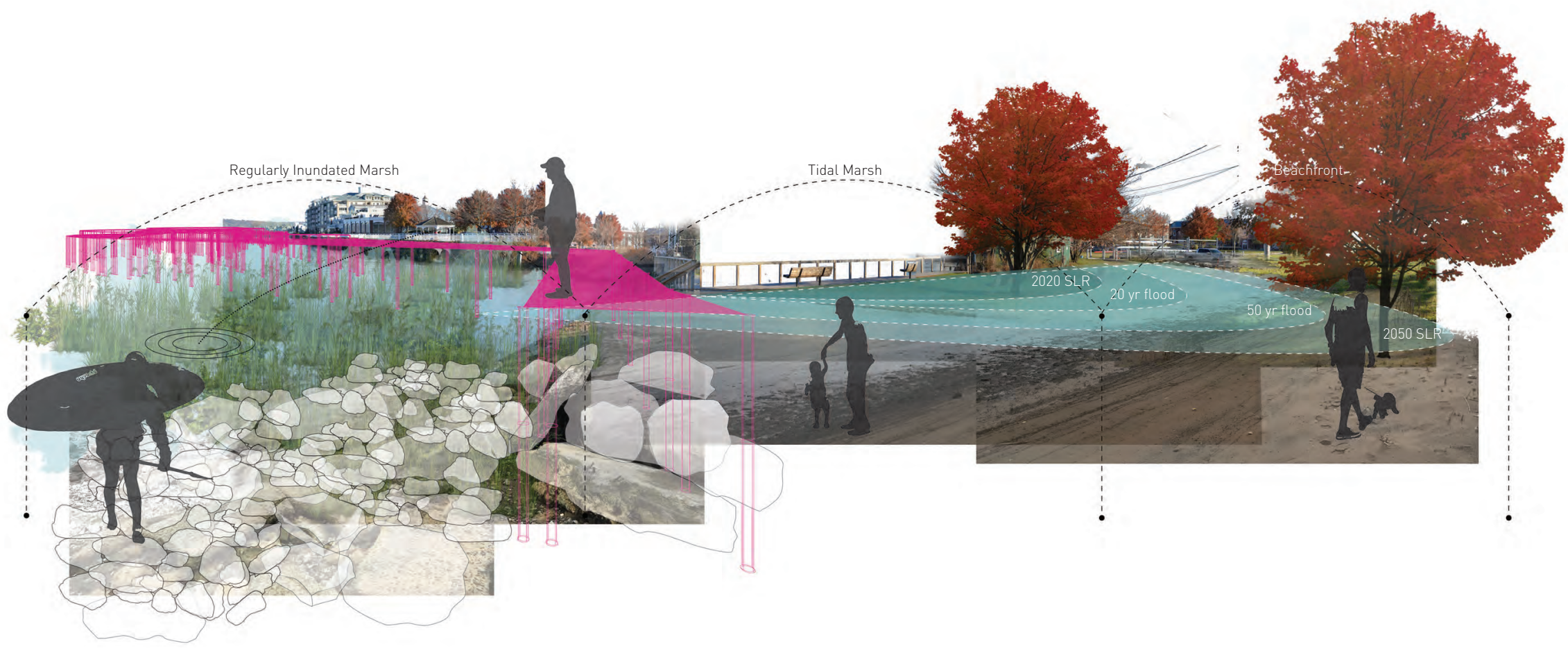
Two park areas are designed to illustrate Piermont’s relationship with water. One park is linked to the Hudson to exhibit changing water levels as sea level rises; a second park is sited above an existing parking lot that periodically floods, allowing for parking when not flooded with new green space permanently above it.

I. Green Connections



Piermont Avenue features a floodable green corridor that accommodates inland marsh migration while screening intertidal surfaces with vegetation.

III. People Connections



This design concept strives to keep people connected to the water under changing conditions. Permitting considerations for marsh boardwalks include minimizing impacts by constructing narrow walkways raised high on helical piles. Inland walkways that provide access to water-dependent uses are best.

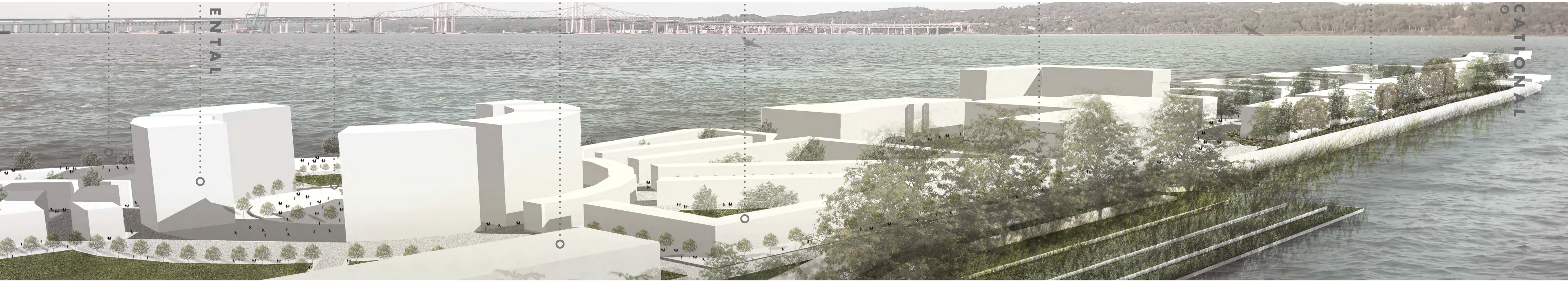


PIERMONT NEXUS

CaD Studio Design Team:
Woo Young Choi (BSLA '18), Yiren Du (BSLA '18), Shaun Wu (BS Urban & Regional Studies '19)

What is this project about:
“Piermont Nexus will transform the flood-prone village into a safe, vital, and attractive waterfront community, by improving its preparedness for sea-level rise and extreme storm events in the next six decades; strengthening its connectivity both within and without, for mankind as well as for wildlife; and enhancing its economic and cultural competitiveness.”
- Woo Young Choi, Yiren Du, and Shaun Wu

2080 Masterplan



This bold design concept envisions elevating the entire downtown area on a ‘megaberm’ of fill above frequent flooding levels. The foundation upon which the downtown would be sited features an ecological “edge” composed of green spaces, room for marsh migration and wildlife habitat.

I. Gathering at the Hub



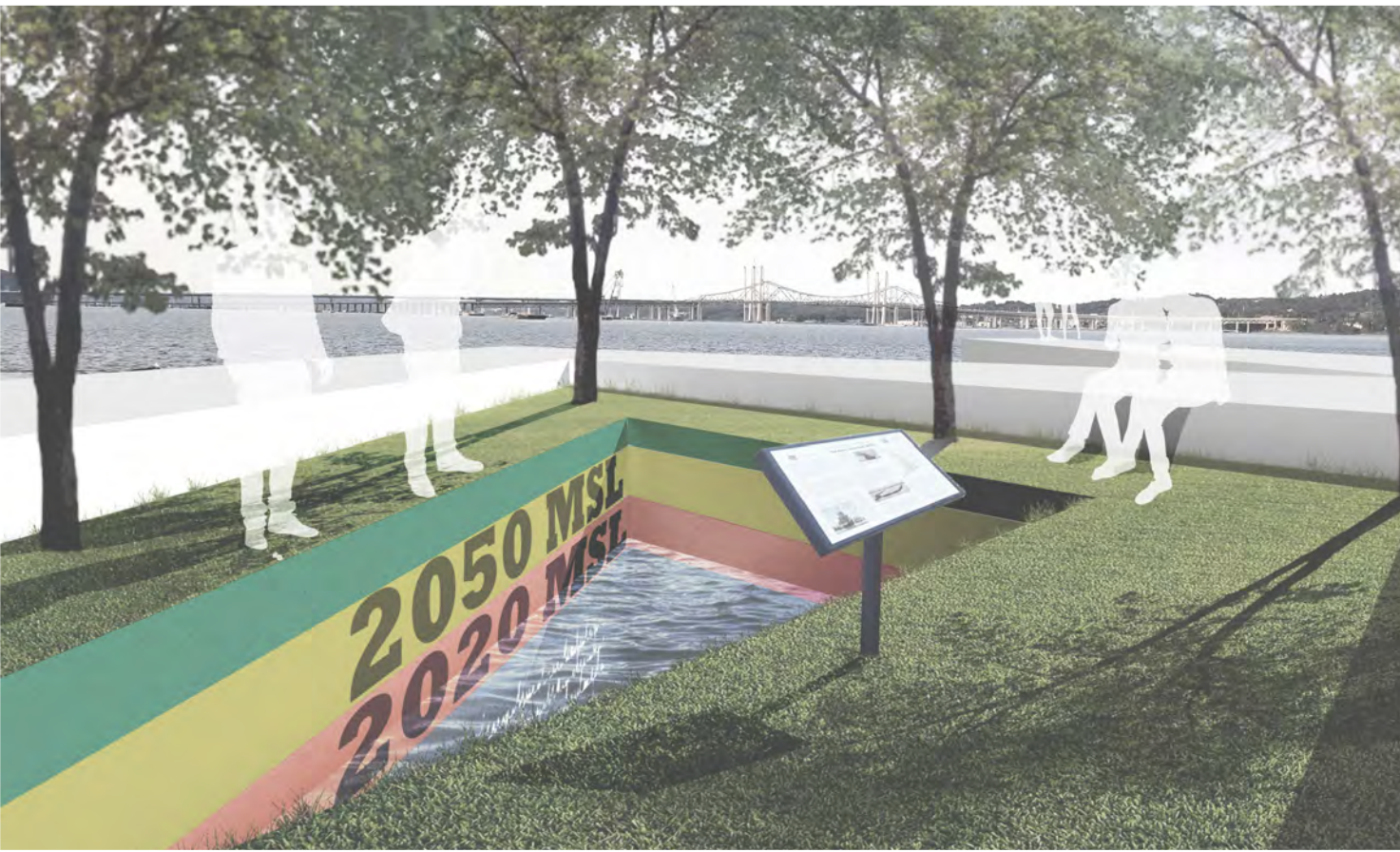
A New Urbanist “Hub” at Flywheel Park provides a mixed-use center with residences re-located from flooded neighborhoods, commercial outlets, and community gathering spaces to form a new town center, all elevated well above projected sea level rise and flooding from storm events.

II. Softening the Edge



Built on the Southeastern corner of the elevated intersection of Ferry Road and Piermont Avenue, the Terrace is envisioned as a series of artificial platforms planted vegetation. Further design development would be necessary to understand if such an intervention could be permitted, and how it would withstand wave action and ice shear while tying into the rest of the shoreline.

III. Measuring Sea Level Rise



The elevated Pier will provide non-automotive access to the Hudson River while featuring a floodable fishing facility and demonstrations that educate visitors about sea level rise. A water feature at the end of the Pier would register river levels relative to projections for sea level rise over time.



EVOLVE, CONNECT, REDEFINE

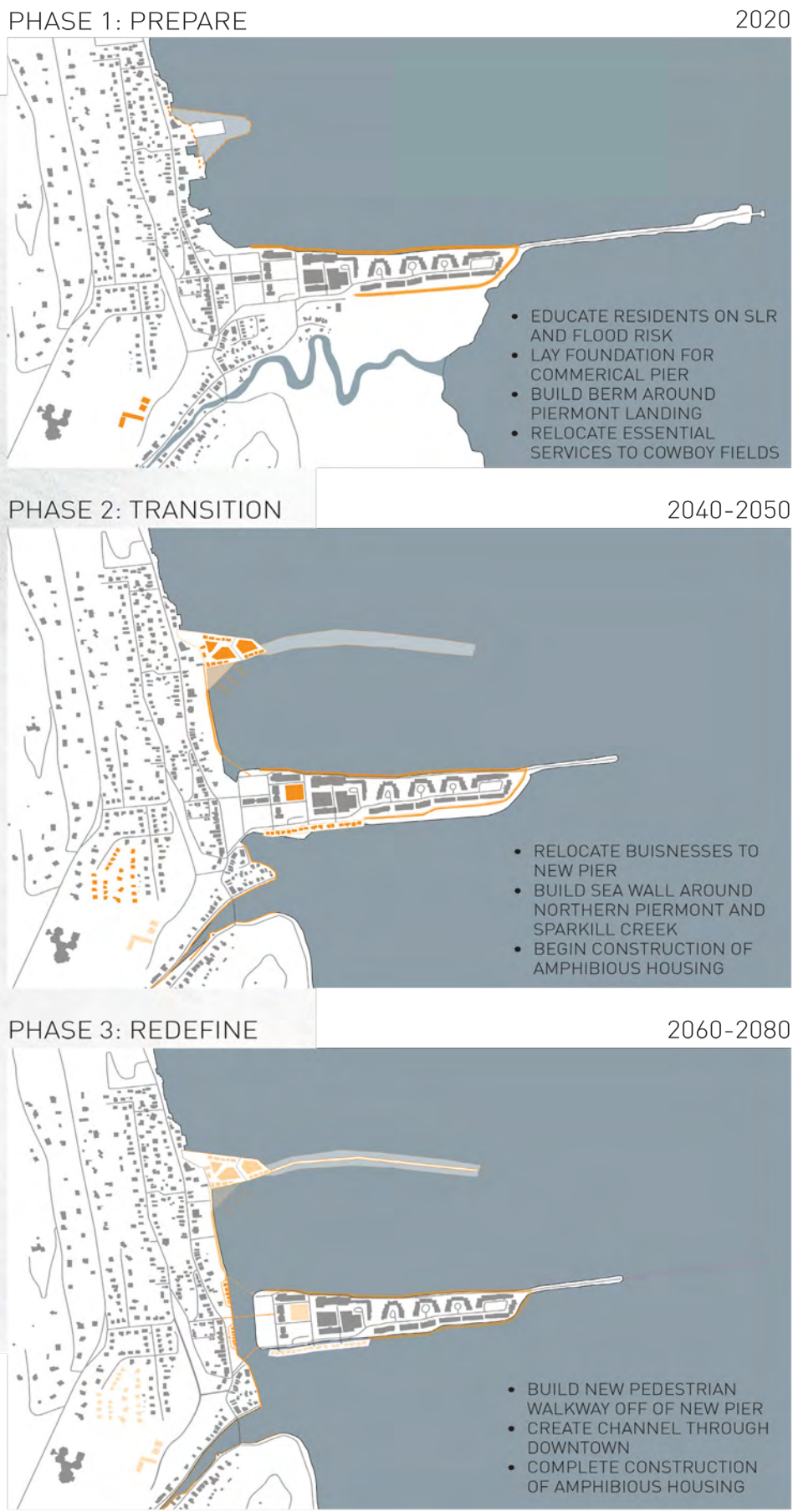
CaD Studio Design Team:
Trevan Signorelli (BSLA '18)
Erin Tou (BS Urban & Regional Studies '18)
Cristian Umana (BSLA '18)

What is this project about:
“By 2080, Downtown Piermont and housing at the southern end of the village of will be underwater due to sea level rise. Rejecting the notion that sea level rise is solely a threat, we work to redefine what it means to be a waterfront community by integrating water into the urban fabric of the village. This theme of connectivity plays a key role in our design: connections between people and nature are enhanced and new connections between residential and commercial areas are built. Through this cohesive network of interventions that build upon each other, we propose a design that addresses the identified needs of local stakeholders, is resilient to climate change, and fosters economic growth and expansion of open space.”
- Trevan Signorelli, Erin Tou, Cristian Umana

2080 Masterplan



The project seeks to balance strategic relocation of low elevation locations and uses with installation of levees to protect other neighborhoods. This approach is not without technical challenges and residual risks of flooding by overtopping or bank failure during a major flood. The Commercial Pier would provide business development opportunities while also serving as a barrier protecting Piermont from objects floating downstream during river flooding.



II. Protecting Piermont Landing

Flooding in Piermont Landing would be reduced by the installation of a berm with a pedestrian path on top and a bioengineered shoreline at the water's edge.



I. Creating the Downtown Channel



A canal separates downtown from the Pier, and is connected by bridges that span the channel. Elevated berms on either side of the channel protect developed areas from floodwaters. This design would require a system of pumps to remove water if berms were overtopped during flood events.

III. Exploring Amphibious Housing



In this concept, new housing would be built on stilts, yet able to adjust by floating with changing tidal and sea level rise elevations. This approach would require further development to investigate design efficacy, site suitability and permitting requirements.



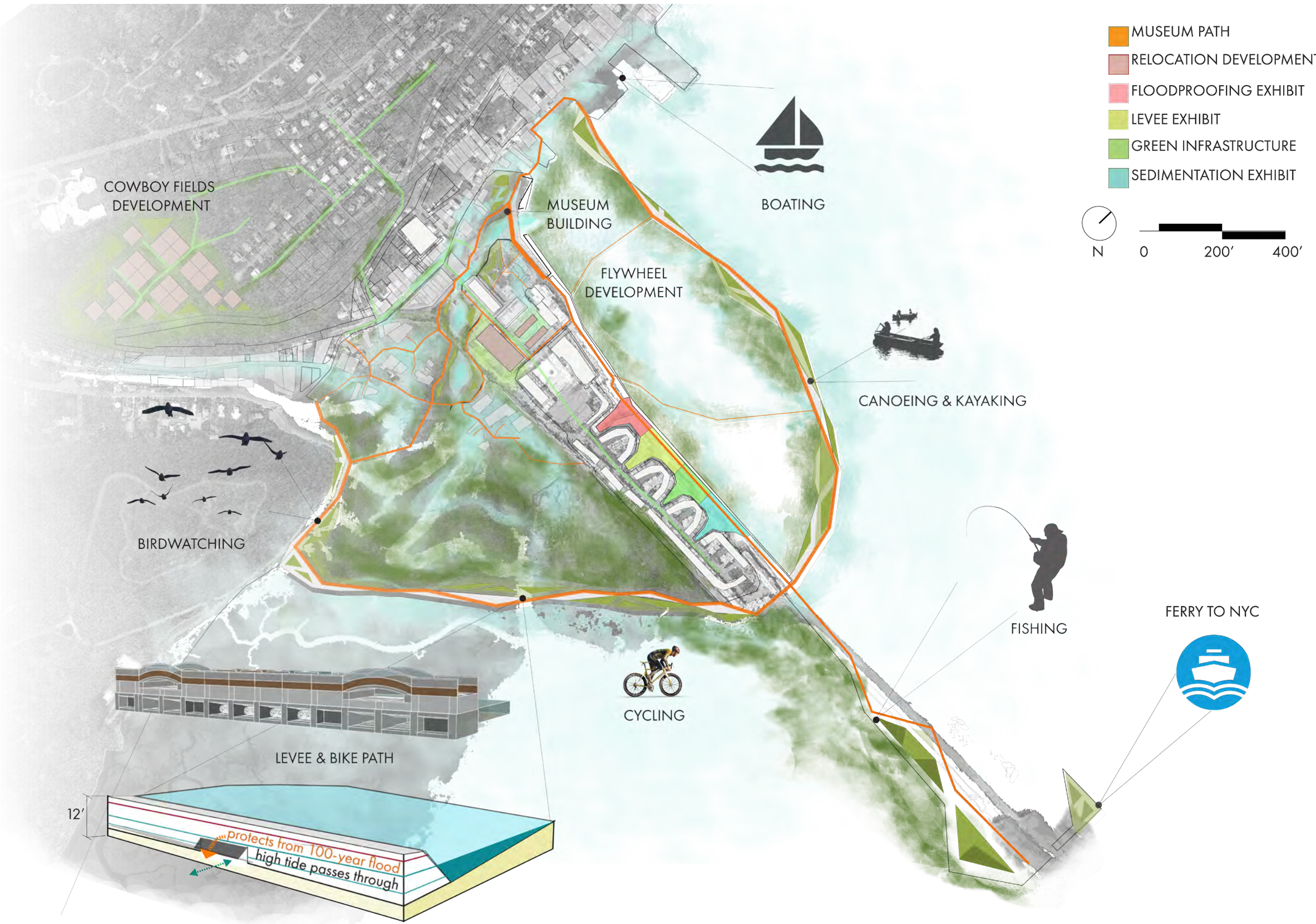
PIERMONT: THE NEW BEGINNING

CaD Studio Design Team:
Abdulaziz Alrifai (BSLA '18), **Lucas Bulger** (BS Urban & Regional Sudies '19), **Naixin Ren** (BSLA '19)

What is this project about:
“We envision a world-class resilience museum that expands beyond the scope of a building, becomes the center of Piermont’s community, educates residents and tourists on our design interventions, and solidifies Piermont as an international leader in climate adaptation.”
- Abdulaziz Alrifai, Lucas Bulger, Naixin Ren

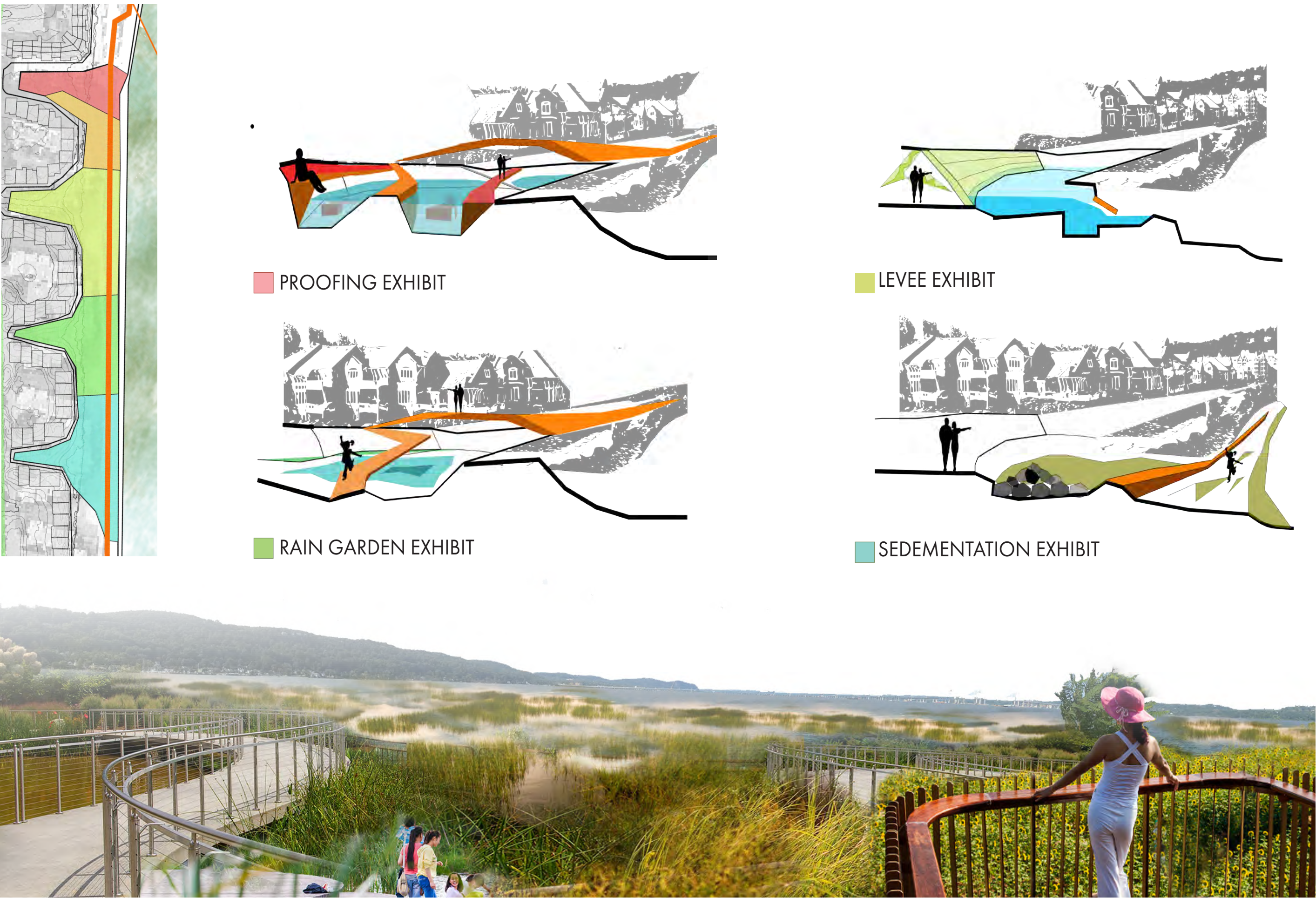
2080 Masterplan

This team acknowledged that Piermont has re-invented itself many times in its history, and recognized the community’s capacity to adapt to change. To this end, they proposed reconstructing a more resilient waterfront by providing limited flood protection while facilitating relocation of neighborhoods susceptible to projected sea level rise over time. A proposed levee would have an engineered weir to allow passage of creek flows and daily tidal fluctuation, while protecting against significant Hudson flood events. The levee would also serve as a bike path as part of a comprehensive bike plan. In response to stakeholder input, this team proposed a ‘resilience museum’ that would serve as both exhibition space and as a floodwall along the north end of the pier.



I. Attraction, Education, Preparation

The museum concept includes a flood-proofed building and incorporates demonstrations of best practices for flood resilience, as a sort of road map or “legend” for the Village itself as a showcase of adaptation strategies. Elevated walkways throughout the village and marsh offer a tour through different adaptation techniques, including flood-proofing, facilitated sediment accretion to encourage wetland creation, and green infrastructure.



II. Connect, Construct, Adapt, Expand

The proposed concept calls for a phasing of projects and policy that would allow implementation of the entire plan over time. Suggested techniques for facilitating strategic relocation included a gradual phase-in of zoning, transfer of development rights, re-building restrictions, tax-increment financing and buyouts. This design also included a breakwater north of the pier to create shallow water vegetated habitat that could also protect the north side of Piermont. From a practical standpoint, installation of a breakwater and/or levee would require review for feasibility and permitability should such interventions be actively pursued.

CONNECT LEVEE + BREAKWATERS + ZONE



CONSTRUCT WETLANDS + ROAD + ZONE



ADAPT DREDGE + ZONE



EXPAND WATERFRONT

