

Designing with Water

community-centered and nature-based designs for resilient water management in Charleston



Photo courtesy of www.charlestonwater.com

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Presentation by B.D. Wortham-Galvin, MRUD Program, Clemson University. Photos Courtesy of *Post and Courier*.

Dutch Dialogues™ Charleston



September 2019



Dutch Dialogues Charleston was held in Spring & Summer 2019; cohosted by the Resilient Urban Design Program at the Clemson Design Center in Charleston.



Design Team Studying Historic Development Models of the City
Credit: Marquel Coaxum



Team Geologist Taking Water Samples



Workshop Drawing
Team member draws over a large format map.
Credit: Marquel Coaxum



Design Team Site Visit to West Ashley Park



Design Team During Workshop
Waggonner & Ball team member leading discussion.



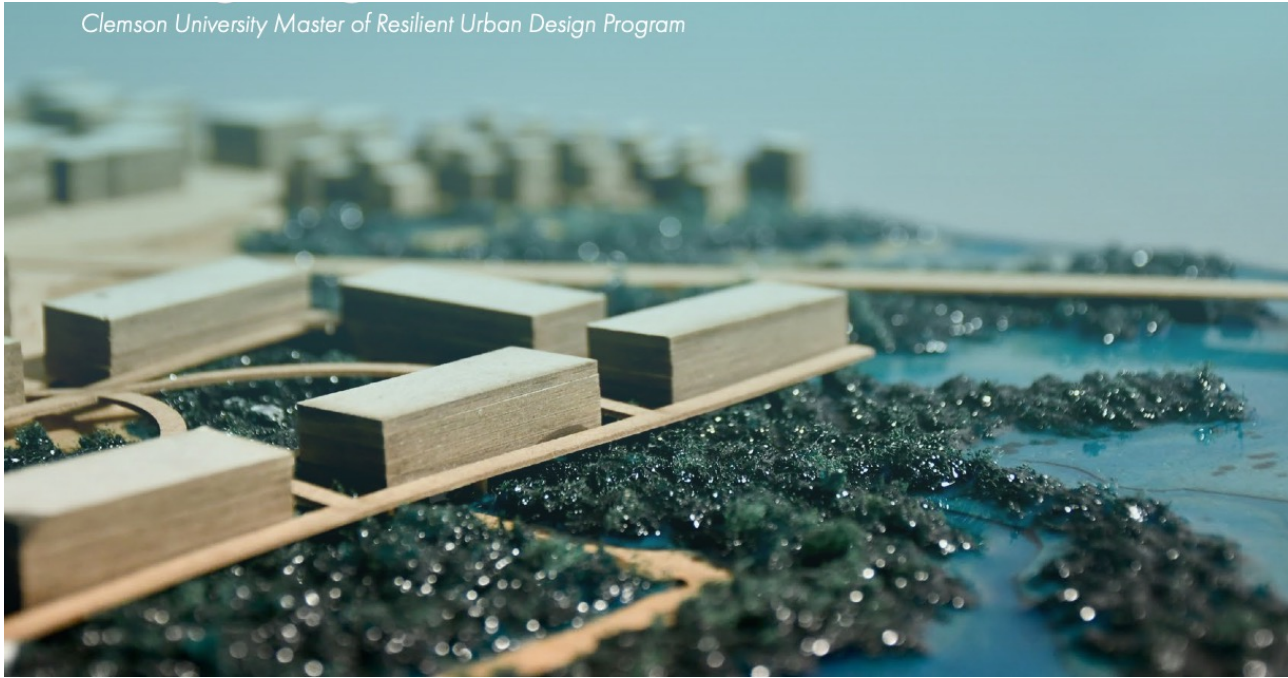
Workshop Review
Team members discuss in progress work.
Credit: Marquel Coaxum



Multidisciplinary Team
Designers, engineers, and other experts collaborate to work across disciplines.
Credit: Marquel Coaxum

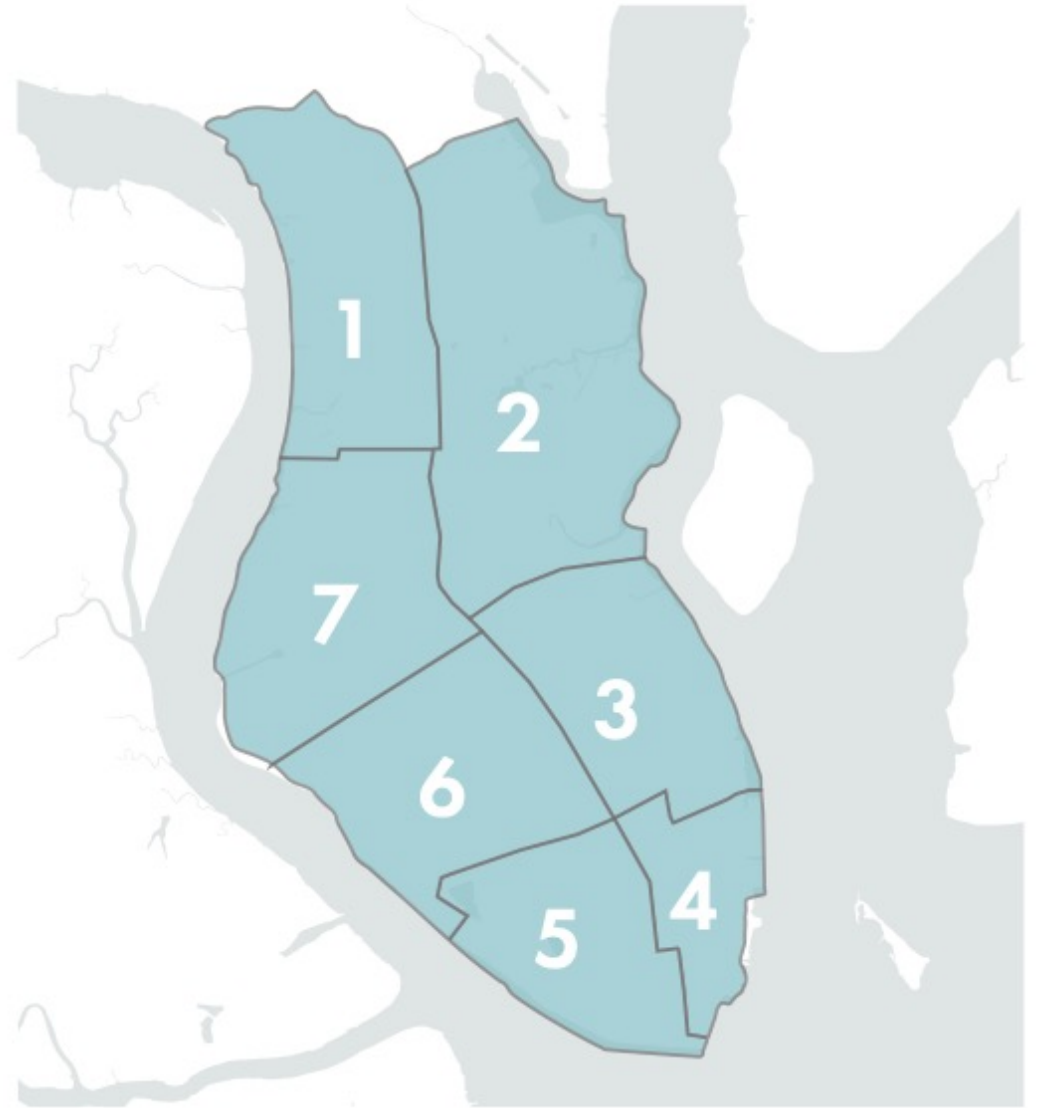


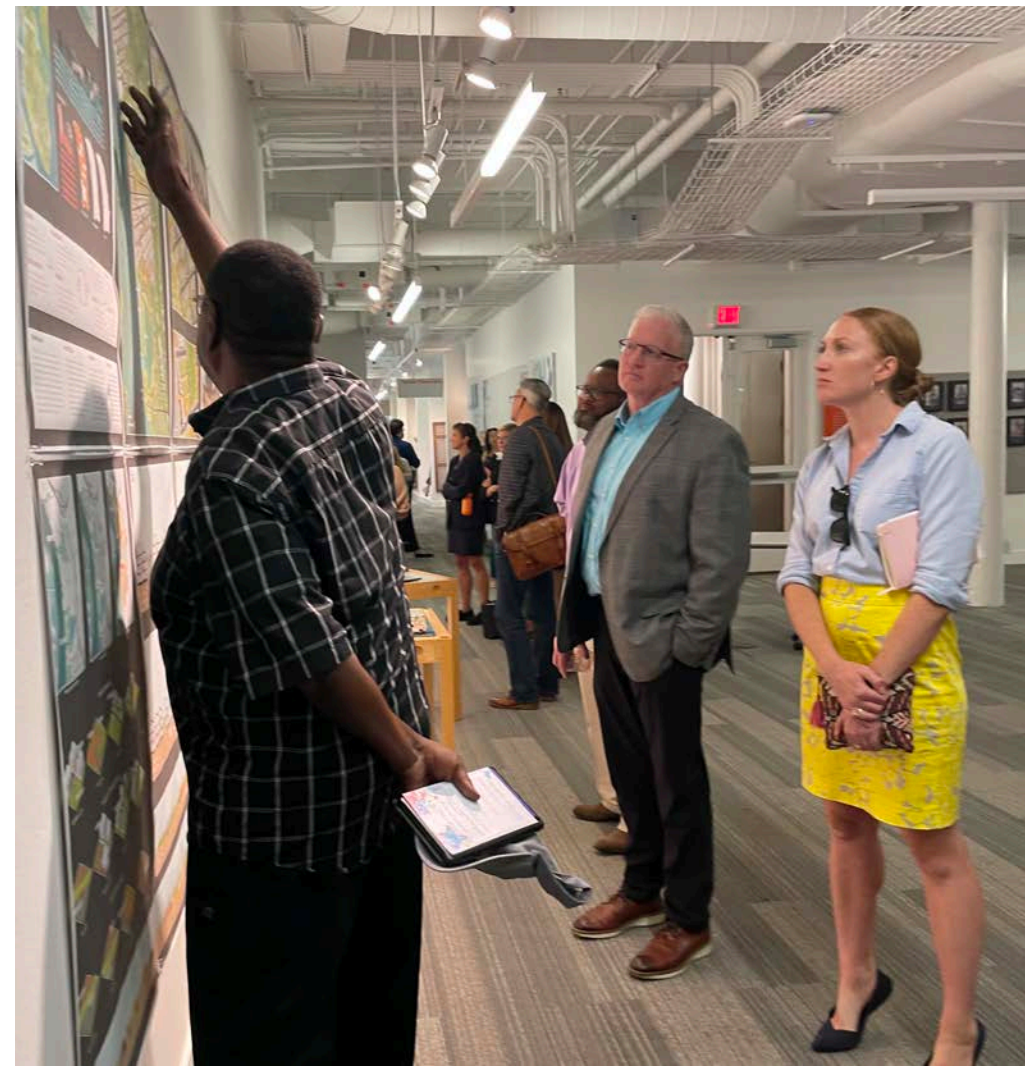
Workshop Discussion
Broad conversations across a range of issues.
Credit: Marquel Coaxum



In Spring-Summer 2021, the City of Charleston asked the Master of Resilient Urban Design Program (MRUD) at the Clemson Design Center in Charleston to study the same area as the USACE.

MAP OF STUDY AREAS





MRUD 3x3x3 alternate process

Presentation by B.D. Wortham-Galvin, MRUD Program, Clemson University. Photos Courtesy of *Robinson Design Engineers & Post and Courier*.

SECTION 1

Located in the Upper Neck of the Chesapeake Peninsula on the Ashley River side, the segment area has a long and varied history with industry, pollution, commerce, and community. What follows is the envisioning of a new, interactive permeable protection system that will allow new communities to grow and existing communities to become more resilient.



CASE STUDIES

RESILIENT BRIDGEPORT

Located in Bridgeport, Connecticut, this case study¹ looked at reducing the risk of flooding by strengthening the natural habitat. Creating more natural methods of managing flooding was crucial in a place that has a 25% chance of hurricanes and 42 inches of rain annually. By restoring wetland habitats and connecting barrier islands, the city could more easily reduce the risk of storm surge and flooding. Several design strategies were considered in addition to wetland restoration, including a perimeter levee, raised roads, and elevated buildings.

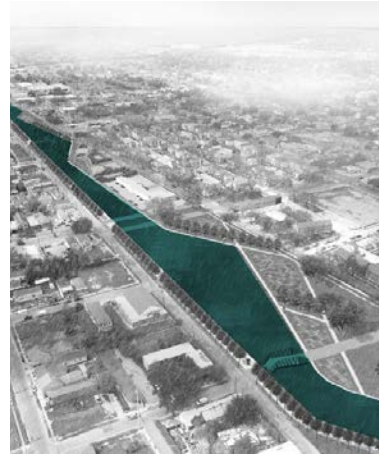
BRIDGEPORT, CONNECTICUT



LIVING WITH WATER

New Orleans has been at the forefront of storm surge and sea level rise for centuries. It especially faces a problem with subsidence, as the city has been sinking because of the lack of water permeating into the soil. This case study² looked into how a city could stay resilient and enthusiastic in spite of a disastrous history. Some design strategies used were the implementation of permeable pavers on pedestrian pathways, adapting transit networks to function in events of flooding, and treating water as an asset rather than a nuisance.

NEW ORLEANS, LOUISIANA



SOUTH BAY SPONGE

Faced with the threat of sea level rise, the South Bay area has looked into an integrative vision³ to develop natural systems for collecting, filtering, and dispensing excess water. Without a plan, 90 species of animals are threatened and 85% of tidal wetlands are expected to disappear. More than \$10 billion dollars are projected to be lost annually due to sea level rise, which threatens the local economy. Some design strategies used were to swap developed land for conservation purposes, the introduction of green infrastructure, absorptive landscapes, and a protected shoreline park.

SUPER LEVEES

This case study⁴ provided a tremendous example in how a significant piece of infrastructure can become an interactive space. The Super Levees in Tokyo, Japan, have been designed to withstand strong floods and storm surges. However, these levees are not standalone from the urban environment; the urbanism of the city has been integrated into the super levee structure. This means that commercial, residential, and mixed-use buildings are attached to the same structure that helps mitigate flooding impacts. In addition, many of these super levees contain park spaces that improve the riverside environment.

SAN FRANCISCO, CALIFORNIA



TOKYO, JAPAN



SECTION 2

located in the Upper Peninsula spanning from King Street to the Copper River, this segment is largely undeveloped. It is home to some heavy industry, and has large amounts of healthy marsh along the edges. What follows is a framework for resilient development that is sensitive to both time and place.

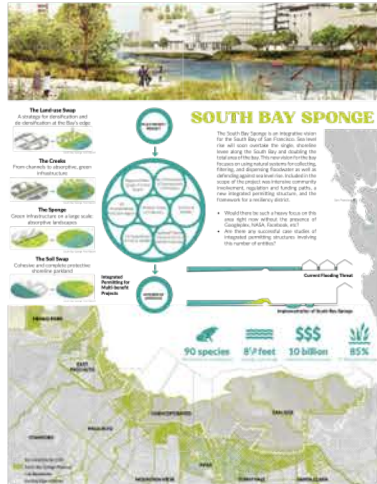


CASE STUDIES

SOUTH BAY SPONGE

The South Bay Sponge¹ is an integrative, nature-based vision for the South Bay of San Francisco. Sea level rise will soon overtake the single, shoreline levee along the South Bay, nearly doubling the total area of the bay. This new vision for the bay focuses on using natural systems for collecting, filtering, and dispersing floodwater as well as defending against sea level rise. Included in the scope of the project was intensive community involvement, regulation and funding paths, a new integrated permitting structure, and the framework for a resilient district. These four strategies are estimated to protect 10 billion dollars a year in projected losses.

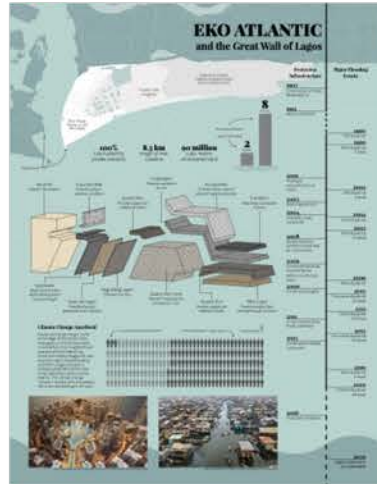
SAN FRANCISCO, CALIFORNIA



EKO ATLANTIC

Located in Lagos, Nigeria, Eko Atlantic² is a case study that provides some important reminders about the relationship between sea level rise and equity. This is a fully "grey" solution, meaning that it is traditional infrastructure. The wall being built will create a new, fortified district on fabricated land, but little is being done to protect existing neighborhoods that experience regular flooding. People previously living in slums at the edge of the project area were given a 72-hour evacuation notice before their neighborhood was demolished. Remaining slums and nearby villages are now experiencing increased flooding and storm surges as water is simply pushed around the new, luxury waterfront district of Eko Atlantic. This climate change "solution" only benefits the wealthy few and is devastating to the poor.

LAGOS, NIGERIA



HAFENCITY

This case study is an example of a flood wall that incorporates other structures into the wall itself. Here, the flood wall and buildings blend together showing how development could improve the overall resiliency of a city. This is opposed to the usual typology where a separate structure is required to protect development. In addition to buildings being incorporated into the flood wall, public parks and a promenade are also included.

HAMBURG, GERMANY



Poster by Kim Morganello

RESILIENT BRIDGEPORT

The city of Bridgeport, Connecticut has many factors similar to Charleston that make it a great place to look to for guidance in this process. Bridgeport experiences heavy rainfall and hurricanes, is a peninsula city, and has a historic fabric that requires protection. The Rebuild By Design process³ resulted in a plan that partners nature-based solutions with improved infrastructure across the entire city for a more resilient future.

BRIDGEPORT, CONNECTICUT



Poster by Amy Nguyen

SECTION 1

Located in the Upper Neck of the Charleston Peninsula on the Ashley River side, the segment area has a long and varied history with industry, pollution, conservation, and community. What follows is the embodiment of a new, interactive, participatory protection system that will allow new communities to grow and existing communities to become more resilient.



EXISTING CONTEXT

PHYSICAL

This study area on the Charleston peninsula is composed mostly of the neighborhoods of Rosemont and Silver Hill/Magnolia. It includes small areas of Wagener Terrace, Kiawah Homes, and Joseph Floyd Manor. It is bordered on the west by the Ashley River and on the east by Meeting St. To the north, it is bordered by the Charleston city limits. There are several places that are not part of any neighborhood; these areas are mostly zoned as industrial.

ECOLOGICAL

The wetlands are located on the perimeter of the study area, between the Ashley River and the Upper Neck. The size fluctuates based on tides and storms. These wetlands are thriving compared to the wetlands in other parts of the peninsula. Thanks to centuries of industrial usage, this area has been left mostly undeveloped. The wetlands have also been allowed to grow in some areas, as noted by the "Modern Marsh" soil typology. These areas contain a diverse variety of animal and plant species.

CULTURAL

The Ashley River - Upper Neck area has always been distinctly separate from the rest of the peninsula. First as a major industrial center, then as a divided community separated by the interstate, and now as an emerging development right next to the water. Its geography and narrow location has defined what it is today. While it faces many struggles related to industrial pollution, walk-ability, and a lack of public spaces, this community has proved resilient throughout the years.

PHYSICAL CONTEXT



Map denoting the physical infrastructure: buildings, roads, and railroads.

ECOLOGICAL CONTEXT



Map denoting the environmental context: tree cover, animal sightings, EPA environmental remediation sites.

CULTURAL CONTEXT



Map denoting the local culture: places of interest, economy, amenities.

CURRENT ZONING STRUCTURE

Zoning laws are varied in the neck of the peninsula. There are 612 properties containing 694 buildings. Out of 684 acres, 38.5 acres are dedicated to commercial space and 82.5 acres are dedicated to residential space. Mixed use accounts for 29 acres and is mostly restricted to the area between I-26 and Meeting St. The total acreage dedicated to industrial use is 282.5 acres. A further 179 acres has been planned for development, while 72.5 acres is zoned as a conservation area.

HISTORY

Prior to limited residential development beginning in 1936, this study area has remained almost exclusively agricultural and industrial. The main agricultural tract was located in the south by Wagener Terrace; in an area known as "Dr. Geiger's Farm" on an 1883 map. North of this, the study area was divided between 5 major industrial corporations: Pacific Guano Co., Ashepoo Phosphate Works, Atlantic Phosphate Works, Siono Phosphate Works, and Wando Phosphate Works.

DEMOGRAPHICS

The total population of this area is 985 people, with the median age being 44. The predominant ethnic group is African-American, consisting of 50-70% of the total population. There is a large number of people receiving disability benefits, at 18.22%. 32.24% of people live below the poverty line, and 17.65% of people are veterans. 70.78% of people have Internet access, while only 61.28% have computer access. The median home value is \$177,200, while the annual per capita income is only \$24,241.

ZONING



Commercial (5.6%)	Residential (12%)	
GB	DR-1	
LB	DR-4	
CT	DR-9	
Mixed Use (4%)	SR-1	
UP	SR-2	
Industrial (41.4%)	Other (37%)	
HI	PUD	
II	C	

SECTION 2

located in the Upper Peninsula spanning from King Street to the Cooper River, this segment is largely undeveloped. It's home to some heavy industry, and has large amounts of healthy marsh along the edges. What follows is a framework for resilient development that is sensitive to both time and place.



EXISTING CONTEXT

PHYSICAL CONTEXT

The Charleston Neck was historically outside the limits of Charleston and has maintained a physically unique character from the rest of the peninsula. This was an area that was used as a retreat from the big city with lush vegetation. As the city grew, so did it's demand for industry. Factories and other undesirable programs, such as powder magazines and cemeteries were developed in the neck and away from everyday life. Charleston kept expanding, pushing to the edges of the industrial core. Today, much of this land is contaminated¹⁰ and still occupied by industrial buildings. Where currently possible, a large array of development projects have been completed or are planned.¹¹

PHYSICAL



ECOLOGICAL



CULTURAL



ECOLOGICAL CONTEXT

Elevation and geology are two essential elements to understanding the ecological impacts of water on this site. When looking at sea level rise, a greater percentage of land in this area is at higher elevations than the rest of the peninsula¹². There are still areas where sea level rise and storm surge pose a risk within the next 50 years, but risk will be greater in the 50-100 year range.

The geology of this area is mostly artificial fill with some areas of sand and clayey sand.¹³ Because of the high level of urban impact, all of this area is poorly drained and absorbs little to no water. Artificial fill and tidal-marsh deposits are also "soft soils", meaning there is higher hazard risk in these areas during seismic activity.

CULTURAL CONTEXT

Historically, the East Neck of the Charleston Peninsula was a place of refuge for slaves with lower rent and distance from their owners in the city.¹⁴ With the phosphate boom in the 1860's-1890's, the land became industrialized but was still overlooked as a residential area. Up until 1920, there was still only one road through the neck. The King Street Extension, and then Highway 26, allowed for greater mobility but also sealed the fate of the neck as somewhere to only pass through as opposed to a destination. As the City of Charleston grew, the neck shrank and was gradually incorporated into the city.¹⁵ By reducing the space available for low-income residents, pressure has been put on them at-risk communities. Gentrification of the neck continues today as the land continues to rise in value, contacting vulnerable populations.

DREDGING CONSIDERATIONS

Dredging is essential to the survival of the multiple ports in Charleston. In many areas, dredging ports border the land's edge. In these areas it will be critical to consider the impacts of a wall or equivalent intervention. In the study area, both the Cooper River and Shipyard Creek are dredged to support industry in the area as well as Columbus Terminal to the South and Hugh F. Leatherman Terminal to the North.¹⁶

ENGINEERED WATERSHEDS

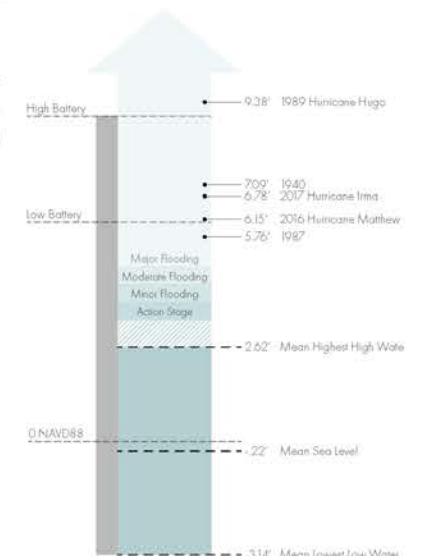
The natural watersheds were redefined when pumps were implemented to drain water off of the peninsula.¹⁷ While this system was mildly successful for some time, it is now failing. Lessons about the differences between seeing water as something to control and hide versus something to be celebrated and harmonized with can be learned from past actions.

UNDERSTANDING TIDAL DATUMS

The North American Vertical Datum of 1988, NAVD88, is the baseline vertical datum used to measure elevations on land.¹⁸ Tide and water depth generally use a different baseline, mean lowest low water (MLLW), but this datum changes based on location. In Charleston, MLLW is 3.14' below NAVD88.¹⁹ This means that to convert a tide forecast to a land elevation, 3.14' is subtracted from the tide measurement.

CRITTERS OF THE MARSH

The Lowcountry salt marsh is one of the most diverse and productive ecosystems in the world.²⁰ The marsh provides a full-time residence to many species but the marsh is also a vital stop along bird migration paths. Long-term disregard for the importance of the marsh, paired with the threats of sea level rise and pollution, have put many of these species in danger. Many species are now endangered, threatened, or on the watchlist.²¹



SECTION 1

Located in the Upper Neck of the Charleston Peninsula on the Ashley River side, the segment area has a long and varied history with industry, pollution, commerce, and community. What follows is the envisioning of a new, interactive permeable protection system that will allow new communities to grow and existing communities to become more resilient.



CONCEPTUAL IDEAS

NATURE-BASED DESIGN

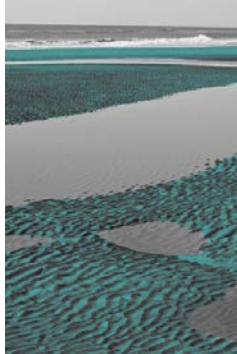
The first iteration of the Blue Line looked specifically at nature-based solutions to mitigate storm surge and sea level rise.

Charleston, SC, has been expanding for centuries: from its early days with landfill projects to the modern era with the expansion of the port. Today, this expansion into the sea has been halted due to suburban sprawl and climactic changes. Faced with the threat of rising sea levels and increased storm surges, Charleston must expand again to better prepare it for future growth.

TYPOLOGICAL APPROACH

The Blue Line is a multi-concept proposal that seeks to integrate Blue Infrastructure around the peninsula. This new infrastructure will be able to combat rising seas and storm surges through a nature-inspired design approach. In addition to flood walls and levees, this proposal will include new typologies inspired directly by things found in nature. These typologies will provide flood control as well as a new amenity to recreational areas.

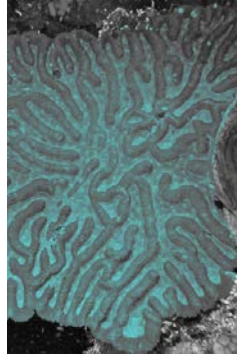
TIDAL POOLS



DUNES



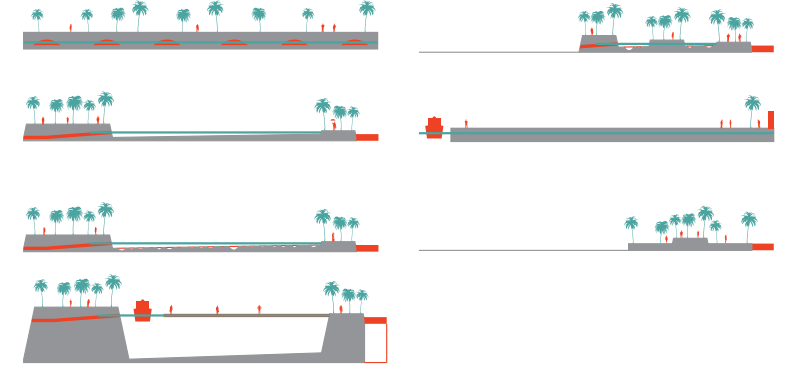
CORAL PATTERNS



INTEGRATING INFRASTRUCTURE

One of the biggest challenges to this project is creating infrastructure that can hold back water while allowing for boating access. This typology proposes a canal system on the western side of the peninsula to accommodate the ever-growing market for boats. Under this proposal, the Port will be expanded and raised to account for rising sea levels. A system of flood walls will also be installed. While the majority of the Blue Line is located along the coast of the peninsula, this section is located inland by the neck. This piece will build up the earth to create a linear mound that can also function as an interactive park.

CONCEPT SECTIONS



SECTION 2

located in the Upper Peninsula spanning from King Street to the Copper River, this segment is largely undeveloped. It is home to some heavy industry, and has large amounts of healthy marsh along the edges. What follows is a framework for resilient development that is sensitive to both time and place.



CONCEPTUAL IDEAS

ADAPTIVE MEMORIALS

This reinterpretation of a wall incorporates the historic narrative of Charleston in a way that pushes us to consider how the past influences the future. Adaptive Memorials explores how the past can be respected and honored while also understanding the necessity of change. Time is experienced visually as you pass through different series of spaces. Here, the impacts of climate change are reflected upon and opportunity is provided for adaptation.

A continuous boardwalk encompasses the peninsula, transforming the wall into a recreational amenity. Three experiential typologies are situated along the boardwalk: park, preserve, and exhibit.



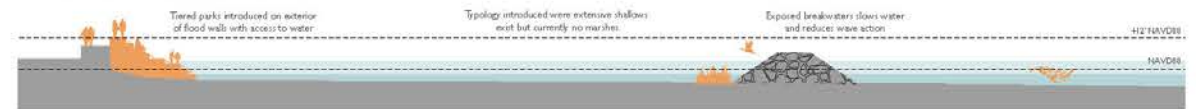
DESIGNING WITH WATER



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PARK

The "park" typology encourages physical interaction with the water and creates a new recreational amenity currently missing from the peninsula. It should be implemented where there is currently no marsh and long stretches of shallows.



EXHIBIT

Utilized in places such as the aquarium, "exhibits" encourages an educational experience and puts you below the surface of the water for a unique experience.



PRESERVE

In places along the peninsula where there is still healthy marsh, the "preserve" typology highlights this natural resource with a passive park experience.



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DESIGNING WITH WATER

SECTION 1

Located in the Upper Neck of the Charleston Peninsula on the Ashley River side, the segment area has a long and varied history with industry, pollution, community, and commerce. What follows is the envisioning of a new, interactive parkwater protection system that will allow new communities to grow and existing communities to become more resilient.



PROJECT PROPOSAL



SECTION 1

Located in the Upper Neck of the Charleston Peninsula on the Ashley River side, the segment area has a long and varied history with industry, pollution, commerce, and community. What follows is the envisioning of a new, interactive perimeter protection system that will allow new communities to grow and existing communities to become more resilient.



PROJECT PROPOSAL

DESIGN GOALS

The first goal of the Blue Line is to incorporate a healthy balance of natural and artificial ways of mitigating storm surge and sea level rise. The main focus of the perimeter protection system is a 15' high Elevated Dune, inspired by barrier island sand dunes. Other nature-inspired design practices include a Coral Network system, which will allow marsh to migrate into the landscape, and Tidal Pools, which will help retain water and reduce subsidence.

LANDSCAPE

The new development will include resilient design strategies such as rain gardens, bioswales, green roofs and green walls. These strategies will be crucial in the management and usage of water. Both landscaped and softscaped public places are featured prominently throughout the design, creating a better system for the environment as well as future residents. Pedestrian paths will cut through blocks and create new connections.

EXPERIENCE

The design includes hierarchy and diversity by prioritizing pedestrian and transit networks. All strategies will be interactive to enhance the experience of the space. The Elevated Dune will feature a pedestrian path and bike lane, in addition to attached Mixed Use buildings. Tidal Pools and the Coral Network will become a place of recreation and learning, while the Marsh Boardwalks will transform the connection between people and ecology.

AERIAL



PENINSULA



SEGMENT



FOCUS-HOLLY



FOCUS-ROSEMONT



FOCUS-MAGNOLIA



COMMUNITY

There is a strong sense of a community in places that are already inhabited in the Upper Neck. This design proposal seeks to strengthen that sense and develop it further by creating pedestrian-centric developments. In addition to the revitalization of Rosemont, two new communities will be built adjacent: Holly and Magnolia. These communities will have reliable access to public transportation as well as new amenities and spaces to experience.

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PROJECT PROPOSAL

HOLLY

Consisting of more than 100 acres, Holly is a new development located just north of Rosemont. More than 500 buildings are proposed for this development, featuring a variety of Mixed Use, Commercial, and Residential areas. The focus point of this area is a commercial corridor that features transit stops for the new streetcar system. There are also many parks and public spaces featured throughout, which will elevate the experience.

PERSPECTIVE—TRANSIT



ROSEMONT

Rosemont is strong and resilient within the plan for the Blue Line. The design proposal addresses many issues that the community faces, including flooding and a lack of access to amenities. Within this plan, all housing in Rosemont will be elevated to adapt to flooding. Bike lanes will be added in the streets to increase mobility options. Pedestrian paths will wind through the perimeter of the marsh, creating a new amenity for the residents.

PERSPECTIVE—ELEVATE



SECTION 1

Located in the Upper Neck of the Charleston Peninsula on the Ashley River side, the segment area has a long and varied history with industry, agriculture, commerce, and community. What follows is the envisioning of a new, interactive pedestrian/greenway system that will allow new communities to grow and existing communities to become more walkable.



PROJECT PROPOSAL

MAGNOLIA

Magnolia is a planned community in the Upper Neck that has yet to be developed. This proposal seeks to create a new plan with smarter choices that will benefit future residents. In addition to multiple transit stops and commercial corridors, the new Magnolia will feature hardscaped pedestrian spaces, public parks, bike lanes, and paths to break up the grid. The centerpiece of this new development will be a new five-story public library.

PERSPECTIVE—LIBRARY



ELEVATED DUNE

The Blue Line is composed mostly of the Elevated Dune typology. To create this, a levee system is constructed alongside the riverfront, where it is then elevated 15' above sea level into an integrated system that includes bike paths, trails, and trees. The Elevated Dune also includes many tidal gate features that allow water to enter the marsh in a controlled manner during high tide and storm surges. This system is also fully integrated with tidal pools and mixed-use buildings.

PERSPECTIVE—PATH



TIDAL POOLS

Tidal pools are formed naturally by the ocean. While commonly found on rocky coasts, they can also be found on sandy beaches during low tide. These are capable of retaining water and providing an environment for birds, coral, and fish. In this typology, Tidal Pools will be capable of allowing water to enter the soil, reducing the risk of subsidence. This typology will also transform threats from storm surges into an interactive environment for the community.

PERSPECTIVE—EXPERIENCE



SECTION 1

Located in the Upper Neck of the Charleston Peninsula on the Ashley River side, the segment area has a long and varied history with industry, pollution, commerce, and community. What follows is the envisioning of a new, interactive pedestrian protection system that will allow new communities to grow and existing communities to become more walkable.



ZONING AND CODES

TYPOLOGY

The 2021 Regulating Plan for the Ashley River – Upper Peninsula (ARUP) designates four main zoning typologies. Each of these typologies contains numerous sub-designations in relation to both low- and high-density planning. These four overarching typologies are Commercial (blue), Mixed (purple), Public (orange), and Residential (green). The following map highlights these new zoning typologies within the overall masterplan. The goal of the 2021 Regulating Plan is to bring density to an underdeveloped area on the Charleston peninsula and to create an equitable, walkable environment for its users.

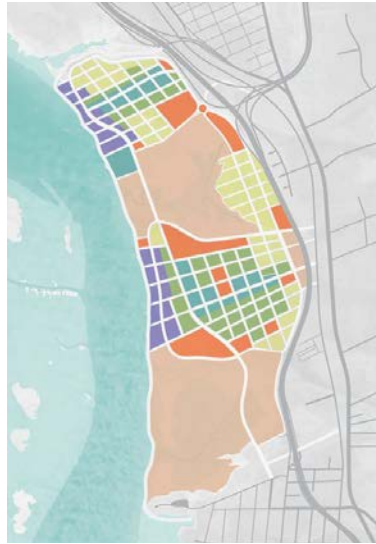
COMMERCIAL CORRIDORS

Commercial zoning corridors will activate spaces and bring people new amenities. In conjunction with the Public zoning typology, new pedestrian squares and plazas are planned to enhance this experience. There are three primary Commercial corridors located within the masterplan. The first will be located in central Holly along an East-West axis. These blocks have been broken up by former rail lines, which are now pedestrian spaces that will enhance the experience of users. The second will be located in Magnolia, along Milford Blvd. The third will be located on a North-South axis.

MIXED USE

Mixed-use zoning will allow residents the opportunity to work in the same spaces that they live. As per the zoning requirements, the ground floor should operate as a commercial space with standard business hours. Any floors above should function as residential spaces. There are two linear strips of Mixed-use zoning within the Regulating Plan: one in both Holly and Magnolia. Mixed-use zones adjacent to the Elevated Dune will be required to be designed as a townhouse typology.

ZONING



- Mixed-Use
- Commercial
- Public Space
- Conservation
- High-Density Residential
- Low-Density Residential

PUBLIC SPACE

Public zoning consists of parks, squares, libraries, schools, and other public infrastructure. It is defined as any block that receives a significant portion of funding from taxpayer dollars to operate. Due to the nature of the pedestrian spaces, many blocks within the Regulating Plan have been broken up into different uses to accommodate these spaces. It will be normal to have multiple zoning typologies on a single block.

RESIDENCES

Residential zoning contains the largest variation of sub-designations to meet the goals of the Regulating Plan. Low-density Residential zoning typologies can be found primarily in Rosemont and surrounding both Holly and Magnolia. These are single-family homes, varying in size and form, designated to stimulate the growth of communities in the Upper Neck. Rosemont has been purposely surrounded with this zoning typology in order to integrate new communities within the same urban fabric.

AFFORDABLE AND WORKFORCE HOUSING

Within the framework for ARUP is a plan for more affordable housing. Affordable, low-income housing units will be used as a way to attract people of a diverse economic background to the Upper Neck. Many of the housing units adjacent to Rosemont will be affordable housing units. These housing units will be kept within the same block in order to promote a role of preservation. Currently, there is an alarming amount of vacant land within Rosemont, and these new units will help the community grow and preserve itself.

PUBLIC SPACE



- Public Space
- Transit Routes

SECTION 1

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ZONING AND CODES

FORM-BASED CODE

Form-based Codes help define the appearance and experience of the built environment. While many blocks have been designated for a single use (i.e. High-density Residential), there exists a buy-in program to convert use types from Residential to Mixed-use, should all residents within a block agree to create it.

As per the form-based codes, housing in Rosemont will be required to be elevated. This will be paid for without private funding, using an added tax generated from the commercial corridors. The six blocks adjacent to Rosemont in the south will be affordable housing units for families.

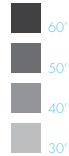
BUILDING HEIGHT

Differentiating from the Upper Peninsula Initiative, where buildings are allowed to max out at twelve stories, the floor limit in ARUP for a single-use type is six stories. Most high-density residential blocks will be built at three or four stories, with tax incentives to build higher should the developer create more amenities on the block. Commercial zoning types will be required to have on-street parking as well as an inviting storefront. High-density Residential zoning exists within much of Holly and Magnolia. It represents the backbone of community development with a diverse variety of sub-designations for multi-family housing, student housing, townhomes, and affordable housing for teachers.

RESILIENCY REQUIREMENTS

Low-density Residential zones will be required to implement Rain Gardens and other nature-based solutions to capture and recycle water. Within Rosemont, there will be tax incentives offered to residents to adopt these more resilient practices. High-density Residential zones must be built with Green Roofs. Mixed-use zoning types alongside the Elevated Dune will be required to be of a townhouse typology with a pitched roof. They must also provide exterior pedestrian access to and from the Elevated Dune. Hardscaped pedestrian spaces within the Public zoning typology will be constructed with a built-in stormwater system to filter water before it is released back into the river.

BUILDING HEIGHT



DEVELOPMENT

There are three developments located within the ARUP area: Holly, Rosemont, and Magnolia. Within each of these developments are numerous smaller district types, as seen on the following map. There also exists special districts devoted to Conservation in the marsh, where development is not allowed outside of smaller recreational structures constructed and maintained by the city. In addition, there are also overlapping District Overlays pertaining to amenities and recreation.

DISTRICTS

Holly contains six district overlays: one Mixed-use, one Commercial, and four Residential. The Residential zones are further divided into two each of both High-density and Low-density Residential. The Low-density Residential districts in Holly give local parking a higher priority at the parks. The Commercial district overlay prefers small businesses, giving tax credits for locally-owned stores. Rosemont contains two district overlays: one for Residential and another for Conservation in the surrounding marsh.

DISTRICTS

Magnolia contains nine district overlays: one Mixed-use, one Conservation, two for Commercial, three for High-density Residential, and two for Low-density Residential. The residential districts in this development encourage biking, giving tax credits to locals that bring their bikes in to local shops to be serviced. The centrally-located High-density Residential zone prioritizes education, increasing the budget by 25% and giving free access to the Library for its residents.

DISTRICT OVERLAYS



SECTION 1

Located in the Upper Neck of the Charleston Peninsula on the Ashley River side, the segment area has a long and varied history with industry, pollution, commerce, and community. What follows is the envisioning of a new, interactive perimeter protection system that will allow new communities to grow and existing communities to become more resilient.



STREETSCAPES

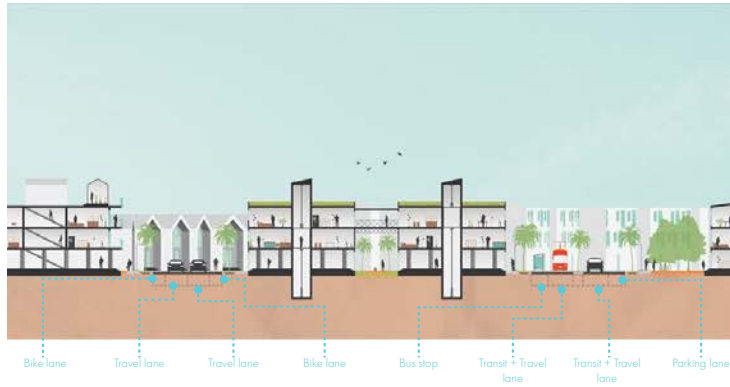
TRANSIT

The variety of mobility options within the new development also creates many new typologies in terms of streetscapes. Each street within each development is different and responds to a number of different conditions. Commercial corridors will have more transit-oriented streets with the new streetcar system. Many of these transit streets are also tiered transit streets, meaning the streetcar network will share the road with other motor vehicles in a safe, secure manner.

BICYCLE LANES

The vast majority of streets in this proposal include infrastructure for bicycles. This not only improves the mobility of residents and visitors, but also their health and well-being. It is possible to bike from the edge of Magnolia to the edge of Holly. The Elevated Dune perimeter protection system also includes infrastructure for bicycles.

HOLLY AVE.



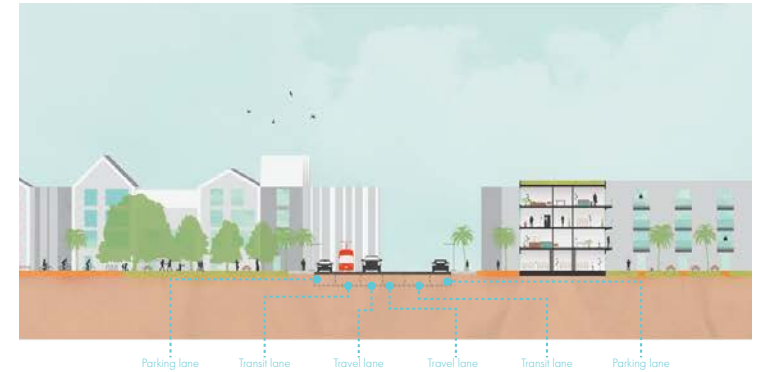
SIDEWALKS

Sidewalks range in width from 10' at the shortest to 20' at the largest. This range is actually included within a hierarchical system that favors larger sidewalks for spaces with public amenities. Commercially-zoned lots will find a great benefit in having larger sidewalks, which promotes the use of outdoor spaces.

PEDESTRIAN PATHS

Pedestrian paths provide the best experience for residents and visitors to the new development. While some of these paths exist alongside the street network, most of them cut through it, creating new avenues and side alleys that are accessible only to pedestrians. This enhances the experience of the space and allows for many new opportunities to explore. These paths are based on connections within the development and also historical railroad lines overlaid onto the street network. These paths will be either hardscaped or softscaped, depending on the context.

PETTY ST.



SECTION 1

Located in the Upper Neck of the Charleston Peninsula on the Ashley River side, the segment area has a long and varied history with industry, pollution, commerce, and community. What follows is the envisioning of a new, interactive pedestrian-protection system that will allow new communities to grow and existing communities to become more walkable.



STREETSCAPES

TRAVEL LANES

While pedestrian-friendly infrastructure is important, it is also important to ensure that the new development is still accessible by motor vehicles. No street within the new development will have a maximum speed higher than 35 mph. Some streets will also not allow for motor vehicles to pass each other. These proposals allow for the streets to be drivable in a safe manner.

CURB EXTENSIONS

Streetside parking exists along much of the commercial corridor. However, in order to reduce the risk of accidents, curb extensions are planned for the edge of the sidewalk. These extend 10' from the edge of the sidewalk to shorten the travel distance to the other side of the street. Curb extensions also act as a visual marker for drivers to slow down. This typology also helps give hierarchy to the pedestrian.

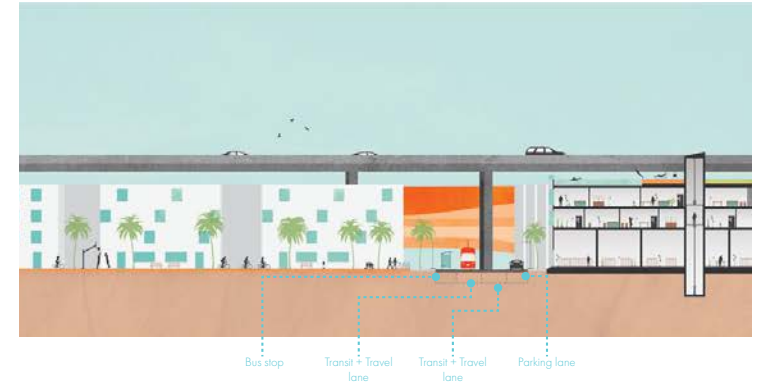
AUSTIN AVE.



URBAN FURNITURE

Included on each street will be many different types of urban furniture, such as lamp posts, bike stops, and benches. These amenities remove the hostile element of a blank slate and allow the space to be populated with a more pedestrian-friendly environment. Covered benches will also be included at each of the transit stops, which will provide the maximum amount of comfort to riders.

MILFORD ST.



SECTION 1

Located in the Upper Neck of the Charleston Peninsula on the Ashley River side, the segment area has a long and varied history with industry, pollution, communities, and connectivity. What follows is the envisioning of a new, interactive, permeable protection system that will allow new communities to grow and existing communities to become more resilient.



BROWNFIELDS AND GREENFIELDS

ENVIRONMENTAL CLEANUP

There are a total of 40 sites within the study area that are currently being monitored by the Environmental Protection Agency³. The high concentration of sites is mostly due to the former industrial areas and phosphate mining operations. 23 of these sites have been designated as containing hazardous waste and another 10 have air monitoring sites. 6 have contamination severe enough to require environmental remediation. There is 1 wastewater discharge site that empties into the wetlands.

INDUSTRIAL POLLUTION

This area has been home to many industrial uses. According to the Post and Courier, more than \$100 million dollars has been spent by both Federal and State agencies to clean up centuries of hazardous materials⁴. Some of the hazardous materials include Arsenic, Dioxin, Pentachlorophenol (PCP), Creosote, and Lead; all of which are byproducts of Fertilizer and Phosphate production. These contaminants are not only found in the soil, but have also leaked into the groundwater.

MAGNOLIA DEVELOPMENT IN 2021



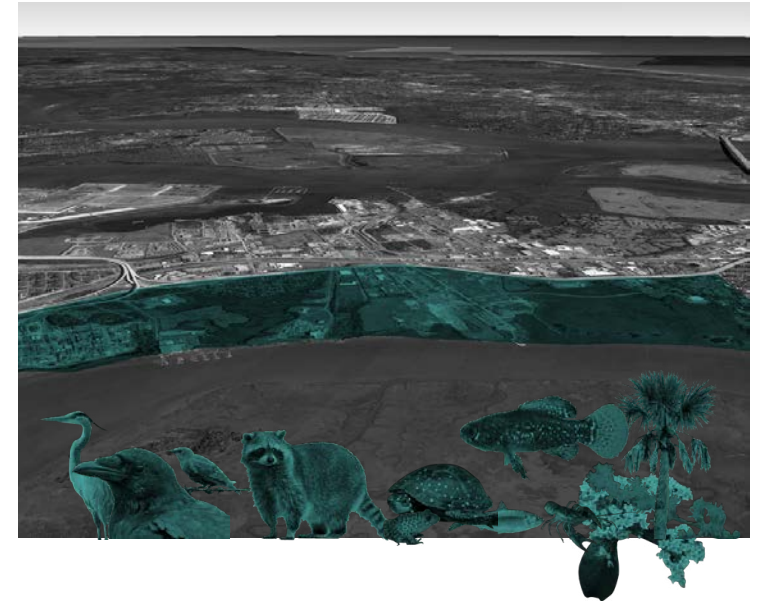
FAUNA

There are hundreds of bird, mammal, amphibian, and fish species native to the Charleston area. These species are not exclusive to the study area. According to local birdwatchers there have been 146 individual species observed in the Neck area¹¹. The Charleston Waterkeeper organization reports that the estuary habitat supports 250 species of birds, 570 species of fish, and 67 species of mammals¹¹.

FLORA

Tree cover in this area of the peninsula is abundant, particularly at the northern border. These trees are mostly Southern Live Oak, Crape-Myrtle, and Sabal Palmetto, which comprise 64% of all tree species on the peninsula. According to the Clemson Yards Plant Database, there are 262 species of plants and flowers located within the coastal zone of Charleston. Some of the most common species of plants and trees are Inkberry, Indian Grass, Coral Honeysuckle, Loblolly Pine, and Eastern Red Cedar¹².

SEGMENT AREA



SECTION 1

Located in the Upper Neck of the Charleston Peninsula on the Ashley River side, the segment area has a long and varied history with industry, pollution, community, and commerce. What follows is the envisioning of a new, interactive pedestrian protection system that will allow new communities to grow and existing communities to become more resilient.



LANDSCAPE STRATEGIES

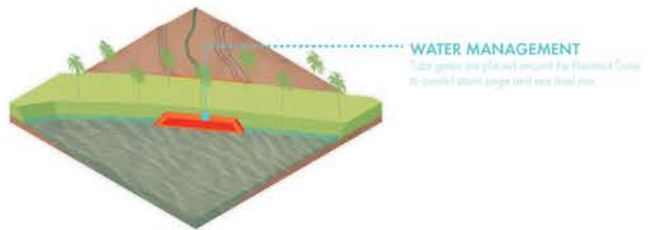
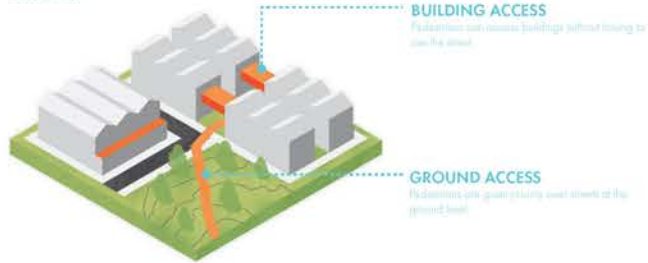
PEDESTRIAN ACCESS

The access of space is multi-tiered for the benefit of pedestrians. Paths on the ground level wind throughout the development so that it is possible to experience the space without ever having to do so from a motor vehicle. In Holy, these paths were created from the former railroad lines and help break up the grid structure, providing variation and opportunities for new experiences. In Magnolia, these paths were created by bringing the perimeter of the roads inward toward a new large public space. Pedestrian access is not limited to just the ground, however, as many buildings feature bridges that connect to each other in the upper levels. This ensures a pedestrian connection to buildings was during major weather events.

TIDAL GATE

The Tidal Gate is a unique feature to the Elevated Dose. It exists at the mouth of creeks in the marsh and also alongside the Tidal Pool typology. This gate feature allows for water to enter the marsh at high tide and replenish the ecosystem, while still holding back water in the event of a major weather event.

DIAGRAMS



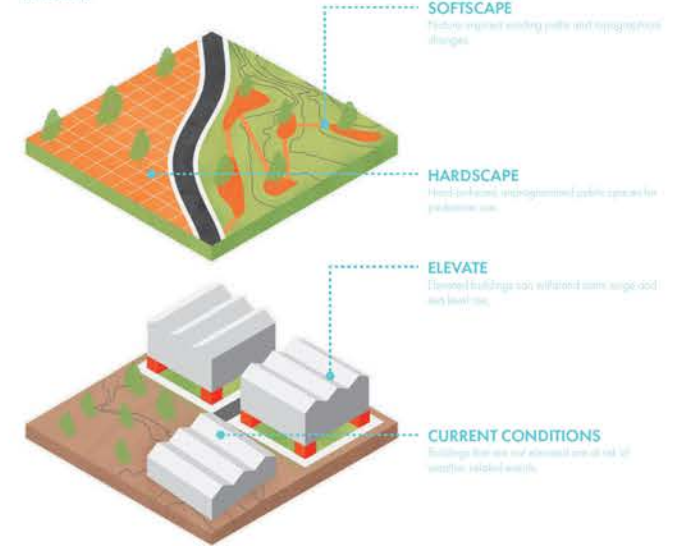
HARDSCAPE AND SOFTSCAPE

There are many public squares and parks located within the new development. Some of these spaces are hardscaped—meaning their materiality is defined by hard surfaces—and some are softscaped—meaning their materiality is defined by what already exists in nature. Hardscaped public spaces will be found in front of commercial areas, intended to stimulate growth for businesses. Softscaped public spaces will be found on the periphery, located adjacent to more ecologically-sensitive areas.

ELEVATED BUILDINGS

Elevating buildings within the segment area will provide many benefits. In Rosemont, this allows the residents a method of retreating from storm surges without significantly altering the local ecosystem. Elevating buildings also increases floor space—meaning motor vehicles can now fit under the building and space normally set aside for vehicles can be used for other purposes.

DIAGRAMS



SECTION 1

Located in the Upper Marsh of the Charleston Peninsula on the Ashley River side, the segment area has a long and varied history with industry, pollution, community, and commerce. What follows is the envisioning of a new, interactive permeable protection system that will allow new communities to grow and existing communities to become more resilient.



LANDSCAPE STRATEGIES

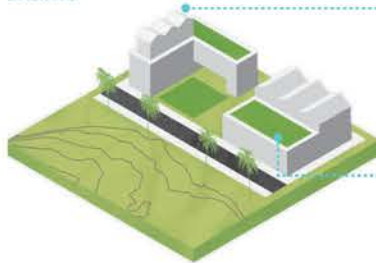
GREEN ROOFS

Green roofs are the elevation of the original ecological conditions onto the roof of a structure. Due to the nature of the new building typologies in the development, this presents a unique opportunity to create entire new spaces with green roofs. These green roofs can be adopted in a variety of ways, including but not limited to the planting of native species and grasses. In some cases, multi-family residences will include greenhouses on their rooftops, giving residents a new way of experiencing the rooftop.

RAIN GARDENS

Rain Gardens allow for residents to capture and store rainwater in their own backyards. In combination with native plant species, this will artificially create a more natural ecosystem reminiscent of what existed prior to development. Native plants will be able to hold stormwater more easily and filter it, which is much better than a traditional stormwater system.

DIAGRAMS

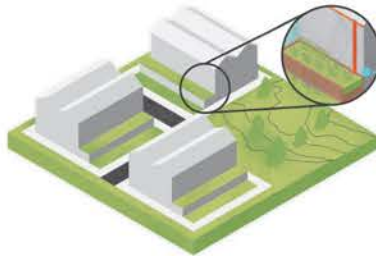


GREENHOUSE

In addition to vegetation, buildings will be allowed to have greenhouses on the roof to provide food for the residents.

VEGETATION

Native grasses and plants will help absorb stormwater and cool the building during hot summer months.



RECYCLE

By recycling rain water into green roofs, stormwater systems will not be overwhelmed with excess water and pollution.

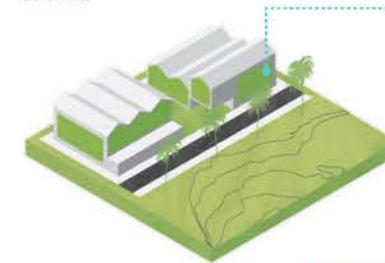
GREEN WALLS

Green Walls are the inverse of Green Roofs. Instead of planting native grasses on a roof, this method uses planting vines and other foliage along a lattice structure. Green Walls take the longest to develop out of these two typologies, but the result is that it provides a different method of greening the space—one that can be seen from the ground level. This typology also helps significantly reduce the heat of a building during the hot summer months.

BIOSWALES

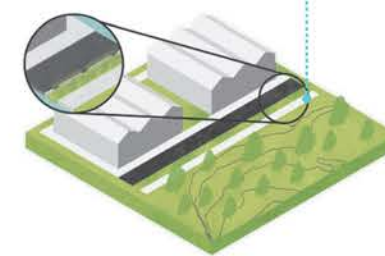
Bioswales are similar to Rain Gardens, however they are usually located alongside roads. They are used to capture and treat runoff from motor vehicles and the road itself. This typology will provide a major benefit to the new development and will help protect the ecologically-sensitive areas such as the Marsh.

DIAGRAMS



VERTICAL GARDENS

Vertical gardens allow climbing organisms, like vines, to grow alongside structures.



REPLENISH

Excess water at the street level will be used to replenish where vegetation can grow.

SECTION 1

Located in the Upper Neck of the Charleston Peninsula on the Ashley River side, the segment area has a long and varied history with industry, pollution, commerce, and community. What follows is the envisioning of a new, interactive parkway protection system that will allow new communities to grow and existing communities to become more resilient.



LANDSCAPE STRATEGIES

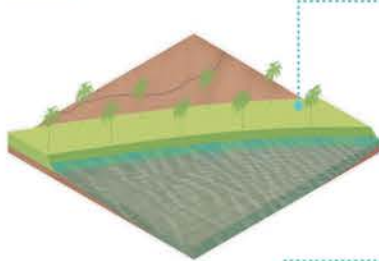
ELEVATED DUNE

The elevated Dune is the primary line of defense against storm surge and sea level rise. This system exists along the entire waterfront and rises 15' from sea level to protect the new development. This system is also interactive and habitable. The Elevated Dune contains trails for walking and infrastructure to support bike lanes. In Holly and Magnolia, there are also sections of attached mixed-use housing, which provide a unique experience to the marsh.

TIDAL POOL

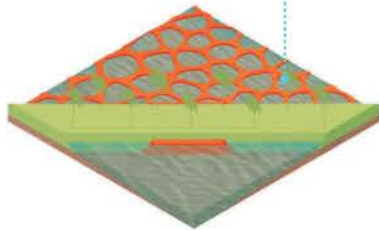
The Tidal Gate is a unique feature to the Elevated Dune. It exists at the mouth of creeks in the marsh and also alongside the Tidal Pool typology. This gate feature allows for water to enter the marsh at high tide and replenish the ecosystem, while still holding back water in the event of a major weather event.

DIAGRAMS



INTERACTIVE SPACE

The Elevated Dune segment has been designed to include space for human activity.



STORE

A system of tidal pools will allow water to permeate the soil and also create a new habitat for various and exotic species.

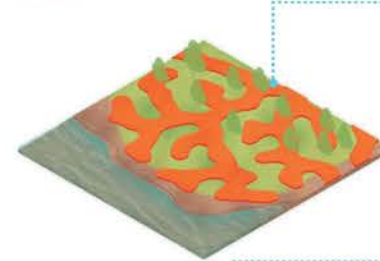
CORAL NETWORK

The Coral Network is inspired by the forms found along certain coral groups offshore from Charleston. These patterns, when applied to the perimeter of the marsh, will allow for the ecosystem to migrate in a controlled manner—while still protecting existing or new development from water-related threats.

MARSH BOARDWALK

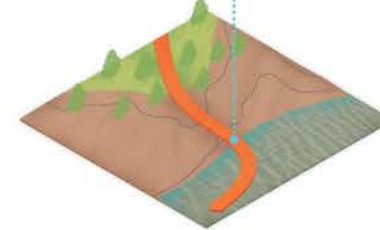
The Marsh Boardwalk allows for people to walk through the marsh on an elevated platform. The marsh is a sensitive ecosystem that usually would not allow for a large concentration of human activity, but this typology will do that in a manner that is not damaging to the Marsh.

DIAGRAMS



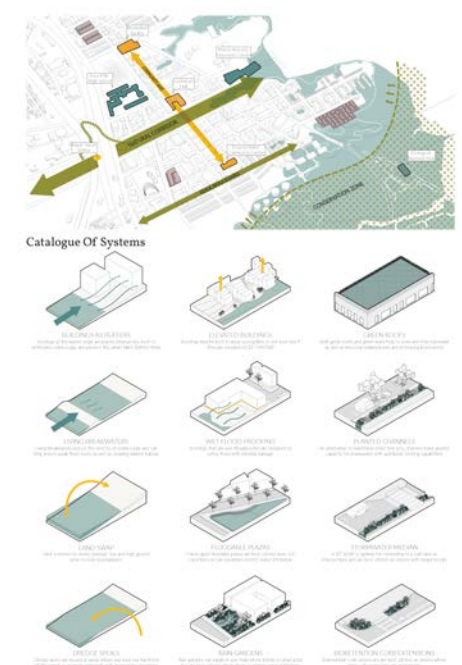
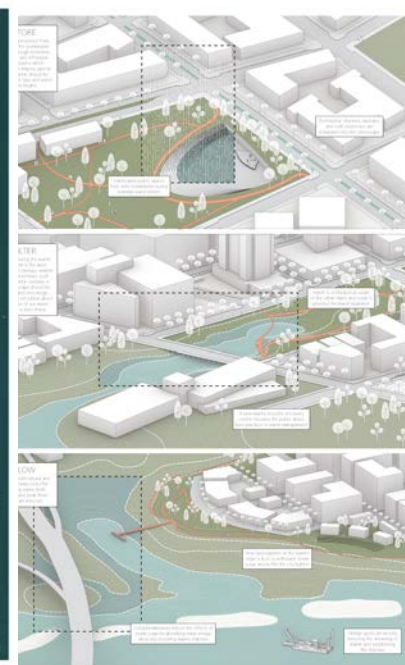
MARSH MIGRATION

Forms found on coral will allow the marsh to migrate inland.



EXPERIENCE

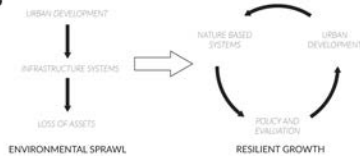
Experiences through the marsh will allow people to experience the special landscape.



Temporal Adaptations

A framework for resilient growth

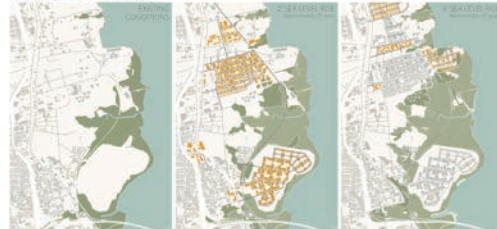
In this vision for the upper peninsula, new development is implemented in tandem with nature-based systems and policy reforms instead of building a wall. Resiliency is built into the new urban fabric, adapting over time minimizing the surrounding changing landscape.



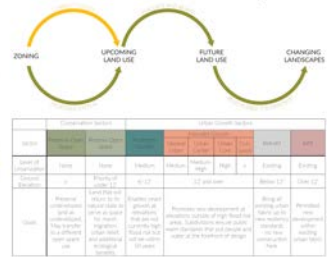
DESIGN GOALS
Address multiple flooding issues, not just storm surge
Leverage the unique transitional period in this area and plan for future development
Making time, change, and adaptation tangible and visible to the community
Together past, present, and future



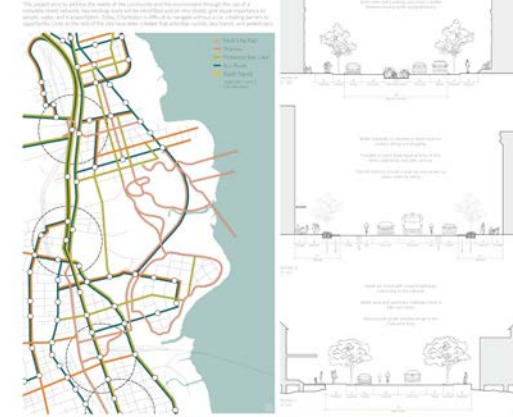
Development Phasing



Rethinking Zoning with an ecological-based code



Complete Streets designed for people, water, and transit



Presentation by B.D. Wortham-Galvin,
MRUD Program, Clemson University.
Graphics courtesy of Courtney Wolff.

SECTION 2



SECTION 2

located in the Upper Peninsula spanning from King Street to the Copper River, this segment is largely undeveloped. It is home to some heavy industry, and has large amounts of healthy marsh along the edges. What follows is a framework for resilient development that is sensitive to both time and place.



PROJECT PROPOSAL

FRAMEWORK FOR RESILIENT GROWTH

In this vision for the upper peninsula, new development is implemented in tandem with nature-based systems and policy systems instead of building a wall. Resiliency is built into the new urban fabric, adapting over time and mending the surrounding, changing landscape. The design goals for this proposal are to:

- Address multiple flooding issues, not just storm surge
- Leverage the unique transitional period in this area and plan for future development
- Make time, change, and adaptation tangible and visible to the community
- Tie together past, present, and future.

NOT A WALL

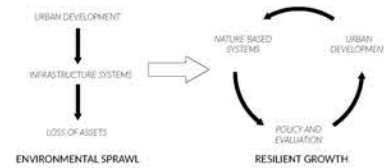
While a wall may seem like a permanent solution, it is only a short-term fix to a very long-term problem. The life span of a sea wall is only 50 years. In this time, there is a 40 percent chance that a wall would fail.¹⁴ But conditions creating the need for a protection system, such as sea level rise and the increased severity and frequency of storms, are not disappearing at the end of that wall's life span of 50 years. On the contrary, sea level rise will become only more of a risk. This project aims to alter our antiquated view of land and urban design as something that is set in stone. Instead, a life-cycle approach is implemented which has the ability to adapt over time.



SEGMENT AREA



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DESIGN STRATEGIES

This project explores how past and present can be respected and honored while also understanding the necessity of change. It pushes the community to consider how the past has influenced the present and therefore how the present can be molded to positively impact the future. Some of the primary strategies for achieving this include:

- All new development is implemented in tandem with resiliency and landscape strategies
- A hill zoning restructuring that revolves around a new ecological-based code
- Investing in two-way community outreach, both to receive feedback and to educate about best practices

FOCUS AREA: FOUR MILE



49

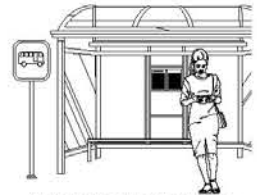
SECTION 2

located in the Upper Peninsula spanning from King Street to the Copper River, this segment is largely undeveloped. It's home to some heavy industry, and has large areas of healthy marsh along the edges. What follows is a framework for resilient development that is sensitive to both time and place.



PEOPLE FIRST

The upper peninsula has historically been a place of refuge; slaves were able to live here with lower rent and greater distance from their owners in the city.¹⁷ Pressure has been put on this refuge as the city has grown over the years. As development occurs in this area, it is important to honor all stories of this place and the meaning it holds for different people. Below are just some of the different stories this project aims to honor.



"All of the affordable housing and transit options has allowed me to move closer to my job on the peninsula"



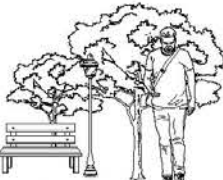
"All of the classes from my community land trust has enabled me to start my own business right near home"



"We love having our own little community of friends, right on the park... and our granddads enjoy that too"



"We love visiting here, both of us have our perfect photo spot!"



"My daily commute is so much more enjoyable without sitting in traffic!"



"Our family loves to spend weekends adventuring in the wetlands park!"

COMMUNITY SUPPORT

Traditional methods of community engagement such as online surveys or public meetings are not always an option for everybody, especially for vulnerable communities. Car ownership, childcare, and access to internet can all be barriers to these commonly used methods of community outreach. To better support the community, this project embedded tangible moments of education, outreach, and support into the urban fabric.

Disaster Relief Community Center:
This space typically operates as a standard community center but with a focus on disaster resiliency. During a disaster, supplies are distributed from the center and it can also temporarily provide shelter to those in need.

Craftsman's Hall:
Here, small business owners can rent stalls to sell their goods. Community members can also sign up for finance seminars, craft classes, and receive coaching on transitioning their business to a brick and mortar establishment.

Recreation Facility:
A central hub of physical activity. This facility partners with the neighboring high school to provide a greater range of amenities to the community.

Marine Industry Discovery Center:
A cross between children's museum, laboratory, and summer camp, the Marine Industry Discovery Center makes learning fun for the whole family. Hands-on exhibits educate about the working relationship between water and industry as well as how everybody can do their part in keeping our oceans healthy.

Ecological Research Hub:
The main goal of this resource is to monitor the progress and success of the surrounding marsh restoration. In this way, Charleston can be an example for best practices and work towards being a leader in coastal resiliency.

NORMALIZING OUTREACH

Community engagement is often utilized as a way to gain input and feedback about a specific topic, but creating tools for community-wide education is equally important. This project proposes that engagement, education, and feedback become a part of every day life through tools that have tangible benefits and uses. The creation of the app below normalizes two-way communication that is not only helpful to both the citizen and the city, but is also fun for the user.



TRANSIT-ORIENTED DEVELOPMENT



SALT MARSH DISCOVERY BOARDWALK



SECTION 2

located in the Upper Peninsula spanning from King Street to the Cooper River, this segment is largely undeveloped. It is home to some heavy industry, and has large amounts of healthy marsh along the edges. What follows is a framework for resilient development that is sensitive to both time and place.



AFFORDABLE HOUSING

COMPARING DEMOGRAPHICS

The historic cultural context of the study area has significant impacts on the current demographics. The Peninsula Neck is home to a large percentage of Charleston's most vulnerable communities: people of color, people experiencing poverty, and single mothers.²⁷ This difference between the Neck and the rest of the peninsula can also be seen through some of societies standard measures of success. People who live in the study area are less likely to have graduated from college, own a car, or have access to the Internet. This impacts of this comparison is far-reaching: implications include the necessity of alternative transportation and diverse community outreach.

COMMUNITY LAND TRUSTS

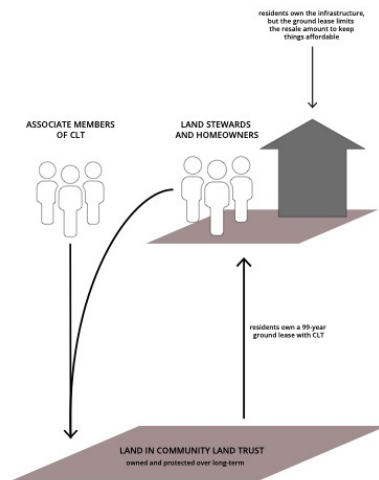
Community land trusts (CLTs) are an equitable finance mechanism where a non-profit ensures long-term ownership of land.²⁸ The CLT purchases, or is granted, land and then sells the building to an eligible buyer. In this proposal, eligibility restrictions include:

- Limits on income to no greater than 80% AMI
- Preference given to families who work in the community
- Preference given to first time homebuyers

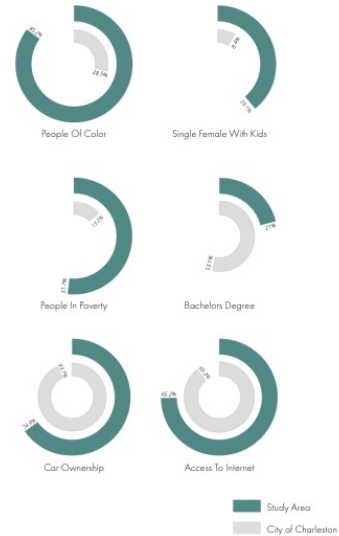
The implementation of CLTs prior to new development is crucial. By doing this, gentrification can be preemptively combated by reserving this space in perpetuity for affordable housing.

Education and support is also incorporated into the structure of a CLT. This includes classes and resources for property maintenance, fiscal education, and responsible water management.²⁷

COMMUNITY LAND TRUST



DEMOGRAPHICS

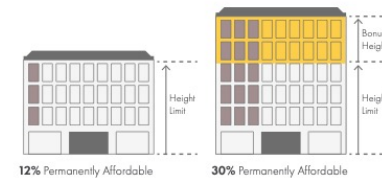


MIXED INCOME

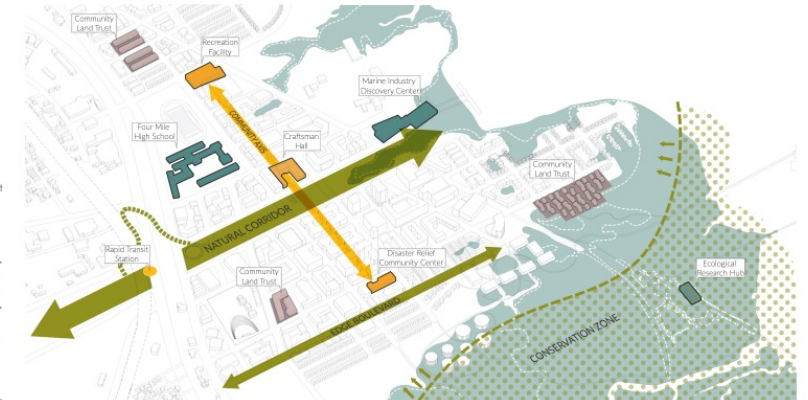
Promoting economic diversity is a key component of this proposal. By encouraging mixed-income development, social stigmas of low-income communities can be resisted and acceptance of affordable housing can increase. Residents of mixed-income developments also gain access to higher quality services and amenities, engage in a wider range of social interactions, and have a closer proximity to a wider range of job opportunities.

HEIGHT BONUSES

Height bonuses are an affordability incentive targeted towards developers. If a developer chooses to increase the percentage of units that are permanently affordable within a building, they will be permitted to add additional stories past what zoning allows.²⁹



COMMUNITY SUPPORT



Space has been reserved for community land trusts at a variety of elevations with different water relationships at each. All CLTs are also located near transit lines with walkable access to community resources and support.

SECTION 2

located in the Upper Peninsula spanning from King Street to the Copper River, this segment is largely undeveloped. It is home to some heavy industry, and has large amounts of healthy marsh along the edges. What follows is a framework for resilient development that is sensitive to both time and place.



STREETSCAPES

COMPLETE STREETS

This project aims to address the needs of the community and the environment through the use of a complete street network.²⁹ Key existing roads will be retrofitted and all new streets give equal importance to person, water, and transportation. Today, Charleston is difficult to navigate without a car, creating barriers to opportunity. Links to the rest of the city have been created that prioritize cyclists, bus transit, and pedestrians.

STREETS FOR PEOPLE

A network of multi-use paths weave through the focus area which encourages a walkable lifestyle. The new street network has a minimum sidewalk width of 8' but expands on commercial streets for outdoor shopping and dining. The streets also carry on the Charleston tradition of maintaining view corridors to the water. Other features to enhance pedestrian safety and experience are:

- Curb extensions at crosswalks
- Pedestrian islands
- Road tables at midblock crossings
- Public plazas and parks

STREETS FOR TRANSIT

Within the new street network there are both streets with protected bike lanes as well as sharrows (bike oriented streets). All of the major multi-use paths also have cyclist tracks, including the new pedestrian overpass connecting to the lowcountry Rapid Transit stop at Millard Street. King Street, Meeting Street, and East Bay Street also include bike lanes in their retrofits. Roads with bus routes have stops and shelters located at expanded curb extensions for convenience and safety.

STREETS FOR WATER

Every new street incorporates water storage and filtration through planted channels, stormwater medians, or biofiltration curb extensions. Safety and accessibility during extreme water conditions have also been at the forefront of design; streets are at a minimum elevation of 12' NAVD88. This has been achieved through raising elevations, elevating roads, and incorporating bridges and pedestrian dock systems.



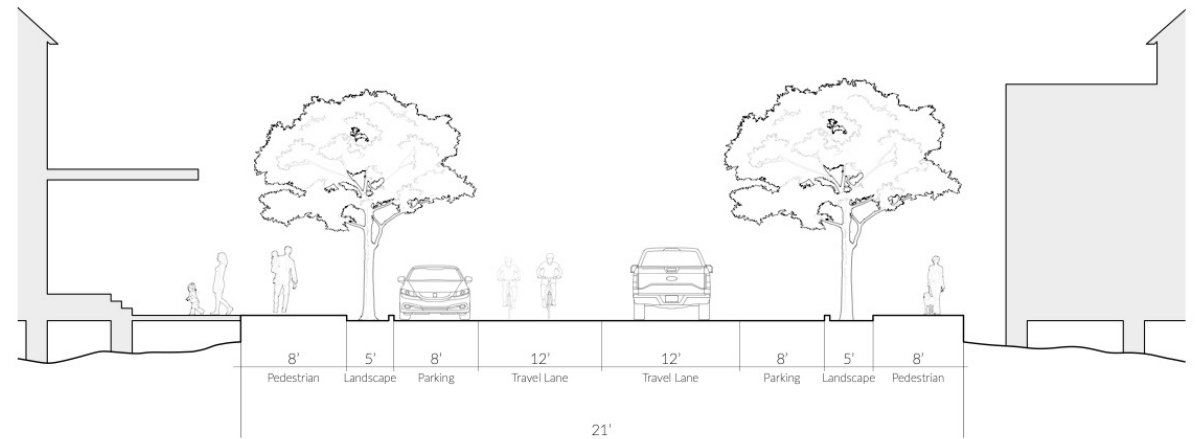
Elevated walkways connect to the sidewalk over marsh that is integrated with the urban fabric, slowing and filtering water.



Wider lanes with pavement markings create a bike-safe street within a larger, city-wide network.



Street trees planted at distances to create a continuous canopy provide shade and refuge in the Charleston heat.



21'

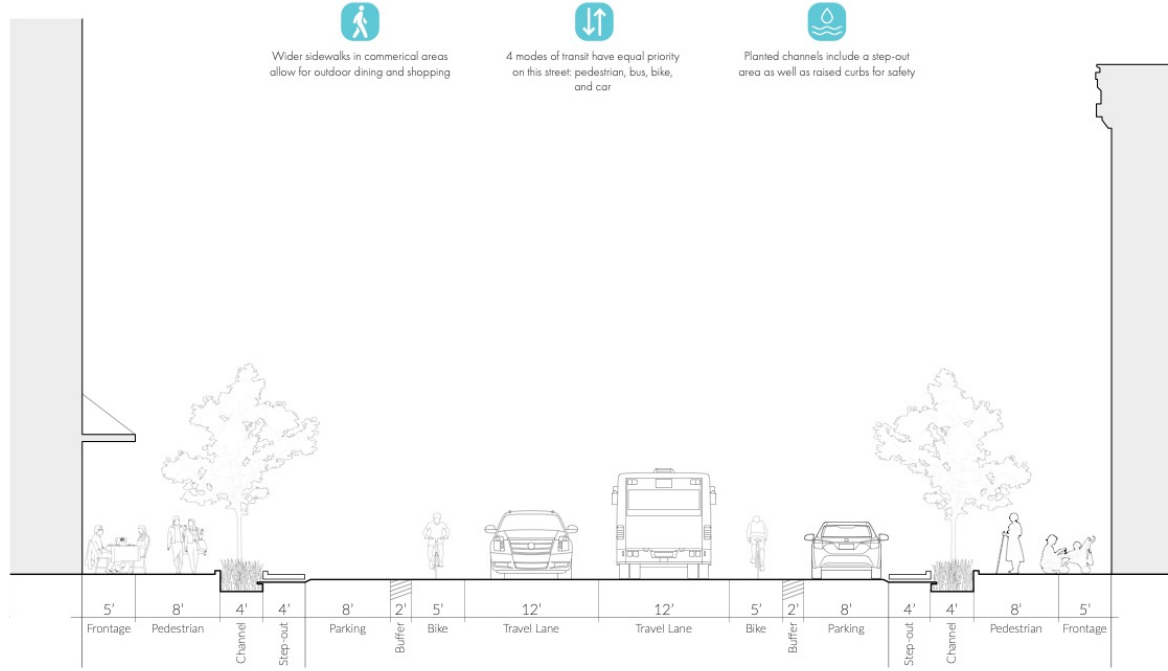
Presentation by B.D. Wortham-Galvin, MRUD Program, Clemson University. *Graphics courtesy of Courtney Wolff.*

SECTION 2

located in the Upper Peninsula spanning from King Street to the Copper River, this segment is largely undeveloped. It is home to some heavy industry, and has large amounts of healthy marsh along the edges. What follows is a framework for resilient development that is sensitive to both time and place.

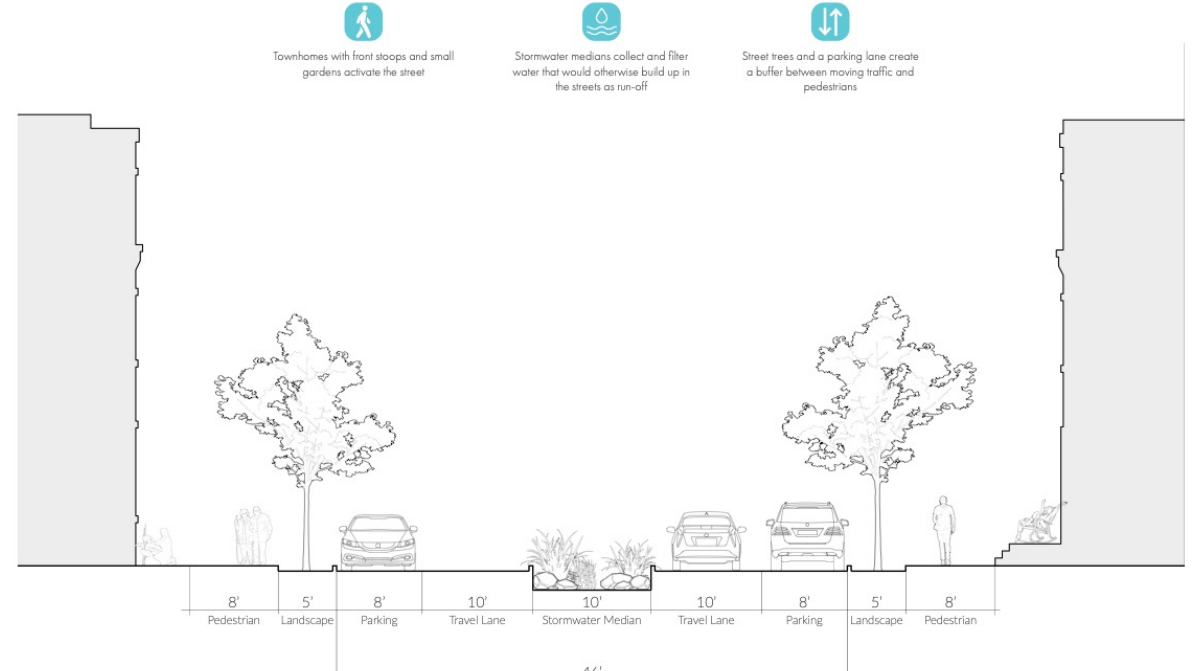


SECTION 2



DESIGNING WITH WATER

58



46'

59

DESIGNING WITH WATER

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BROWNFIELDS & GREENFIELDS

CURRENT CONDITIONS

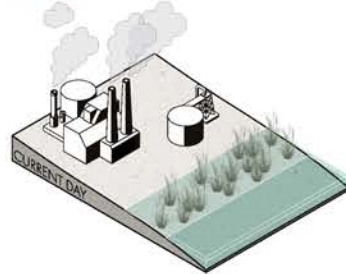
A majority of the study area is currently home to a variety of industrial uses. Many of these sites are on the EPA watch list² and monitored for wastewater discharge, hazardous waste, and/or air pollution as shown on the map below. While some environmental remediation will be required before the land can be re-purposed, very few of the sites are designated brownfields, allowing for less intensive clean-up methods such as phytoremediation.

PHYTOREMEDIATION FOR MARSH MIGRATION

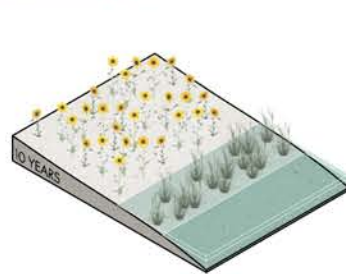
As sea levels rise, marsh is drowning. As water reaches new land or higher elevations, toxins stored within the soil are released into the water. The pollutants the oceans even after the pollutants are gone. Phytoremediation uses plants to clean the land, pulling the toxins out of the soil. This reclaimed land then provides space for marsh migration.



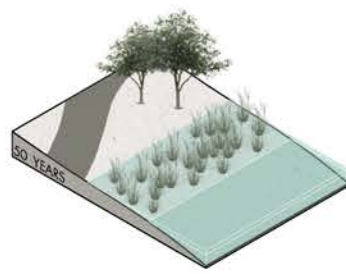
TOXIC LAND



PLANTS REMOVE TOXINS



RECLAIMED LAND



MARSH MIGRATION



IMPLEMENTATION OVER TIME

The proposed street grid has been developed to allow for a phased implementation. It has been assumed that parcels with the same owner would be sold as a group, informing development patterns. In doing this, time can be allowed for individual areas to undergo environmental remediation as needed.

GREENFIELDS, BROWNFIELDS, AND ZONING

Within the zoning proposal are two conservation sectors: preserve open space and reserve open space. Preserve open space protects the few greenfields remaining in this area while reserve open space promotes the conversion of brownfields and greyfields back into greenfields.

PUBLIC PRIVATE PARTNERSHIPS

Finding environmental clean-up is often expensive and ambiguous; it can be unclear who the fiscal burden belongs to. Much of the land within the study area will require some level of remediation but without the larger governmental support that comes with designated brownfields. Public-private partnerships²² between the City of Chatham and private developers can help spur initial remediation and development within this area. One example is the Nisrael Corridor Park running through the center of new development. It is beneficial for developers on adjacent blocks to help fund clean-up, construction of new streets, and establishing the park blocks. These amenities will raise the market value of buildings that front on the park - making it fiscally beneficial for the developer.

EXISTING CONDITIONS



Large amounts of industrial land with only a few, scattered buildings. The road network in this area is sparse and disconnected.

30 YEARS FROM NOW



Shown here is 2' of sea level rise approximately 30 years from now. Proposed development assumes that only Kinder Morgan and Chevron remain out of the study area.²³ Large industrial development²⁴ is already planned and other development occurs on city-owned property.

60 YEARS FROM NOW



Shown here is 4' of sea level rise approximately 60 years from now. Proposed development assumes the remaining industry moves out of the study area.

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ECOLOGICAL CONSIDERATIONS

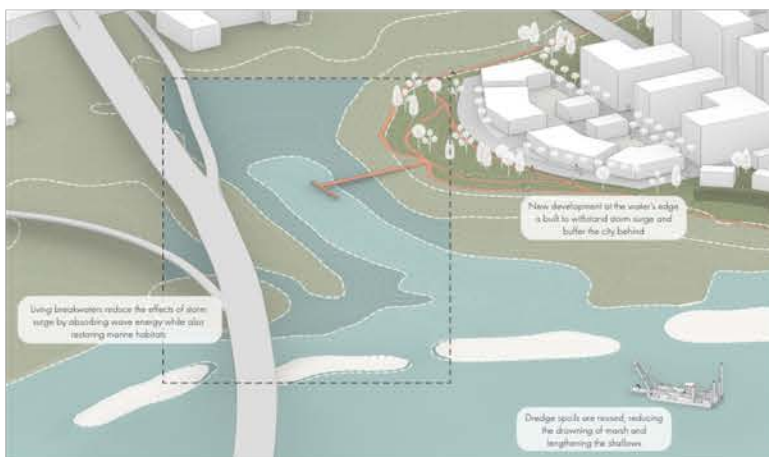
THE APPROACH

In this project, natural systems are layered with projected development to create a long-term water management for the focus area. Three main approaches to water are being proposed: store, filter and slow. Each of these approaches are implemented through multiple design strategies at a variety of scales.

THE IMPORTANCE

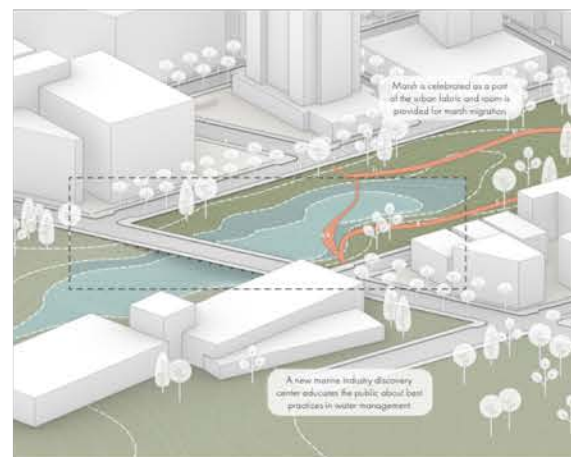
While all of the proposed design strategies play a significant role in water management, there are also numerous additional benefits of these strategies. In general, nature-based solutions such as the ones being implemented also:

- Restore damaged ecosystems and create new habitat for at-risk species
- Provide recreation opportunities such as hiking, paddling, and bird-watching
- Capture carbon dioxide from the atmosphere, helping to slow global warming
- Filters out dangerous pollutants from both soil and water
- Reduce the urban heat island effect which results in lower energy costs, air pollution levels, and heat-related illness



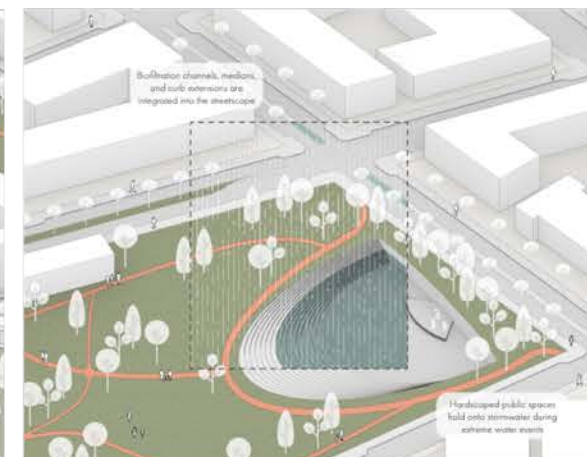
SLOW

Both velocity and peak flood levels are reduced by using natural and artificial forms to buffer incoming water.



FILTER

While fostering the marsh ecosystem is the most widespread strategy, smaller scale interventions such as biofiltration systems in the streetscape should be incorporated into design. Community education about proper use of our water systems is also critical.



STORE

Water is prevented from entering the stormwater system through detention, retention, and infiltration. To determine which strategy to employ, special consideration should be given to soil type and water table height.

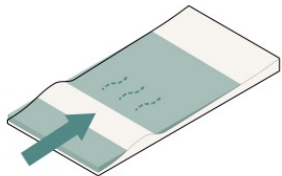
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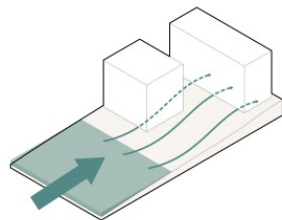


LANDSCAPE STRATEGIES

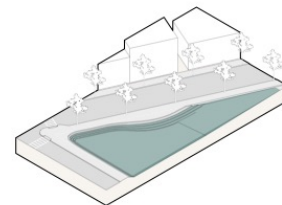
SECTION 2



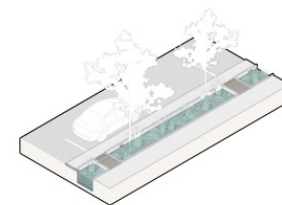
LIVING BREAKWATERS
Living breakwaters reduce the velocity of storm surge and can help reduce peak flood levels as well as creating marine habitat.



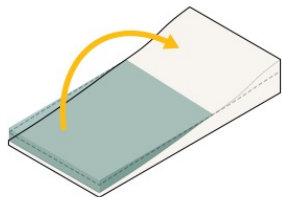
BUILDINGS AS BUFFERS
Buildings at the water's edge protect the urban fabric behind them by being placed strategically and built to withstand storm surge.



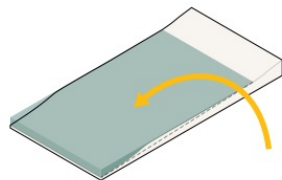
FLOODABLE PLAZAS
Hardscaped floodable plazas are best utilized where soil conditions or low elevations restrict water infiltration.



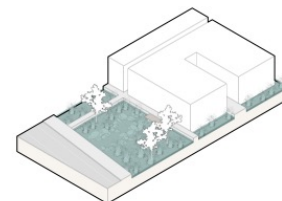
PLANTED CHANNELS
An alternative to traditional street tree pits, channels have greater capacity for stormwater with additional filtering capabilities.



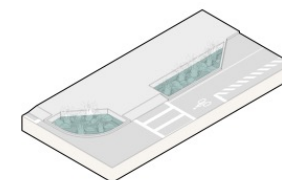
LAND SWAP
Land is moved to create strategic low and high ground prior to new development.



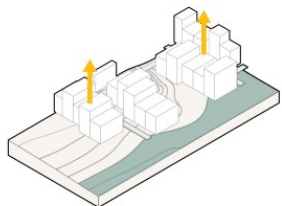
DREDGE SPOILS
Dredge spoils are reused in areas where sea level rise has killed off the marsh to promote regrowth with appropriate elevations.



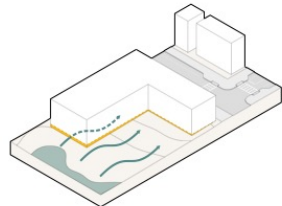
RAIN GARDENS
Rain gardens can range in size from whole blocks to small plots but are best utilized where there is optimal water infiltration.



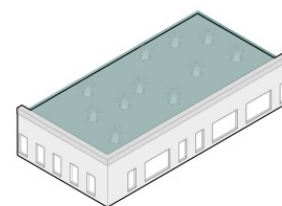
BIORETENTION CURB EXTENSIONS
Bioretention curb extensions are best utilized on streets where large curb extensions are appropriate and street trees are preferred along the sidewalk.



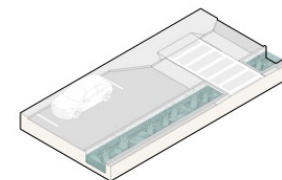
ELEVATED BUILDINGS
Buildings may be built in areas susceptible to sea level rise if they are elevated to 12' NADV88 and have the ability to be elevated higher in the future.



WET FLOODPROOFING
Buildings that are wet floodproofed are designed to safely flood with minimal damage.



GREEN ROOFS
Both green roofs and green walls help to slow and filter rainwater as well as reducing temperatures and increasing biodiversity.



STORMWATER MEDIANS
Stormwater medians can vary in size, but 10' is optimal for converting to a turn lane at intersections and are best utilized on streets with longer blocks.

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ZONING AND CODES

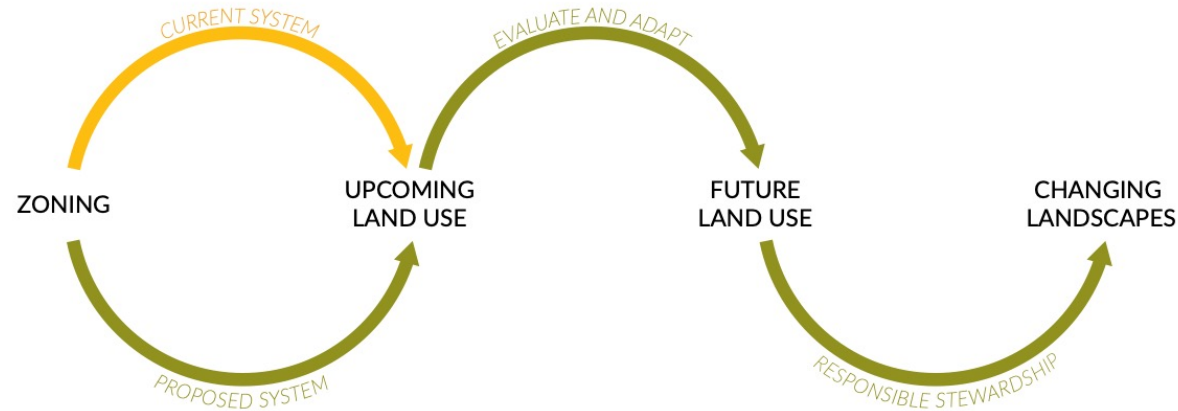
EXISTING ZONING ISSUES

The City of Charleston currently uses euclidean base zoning districts with overlapping overlay zones.¹⁸ This segment area currently consists of large amounts of heavy industrial as well as Charleston's new Upper Peninsula zoning district. This euclidean zoning system, created and established in the 1920s,¹⁹ is a template based on the upcoming land use. Simply put, what activities should happen there? To increase flexibility, ambiguous, complex zoning districts such as PUD have been introduced. However, these districts can have a domino effect of unintended consequences.

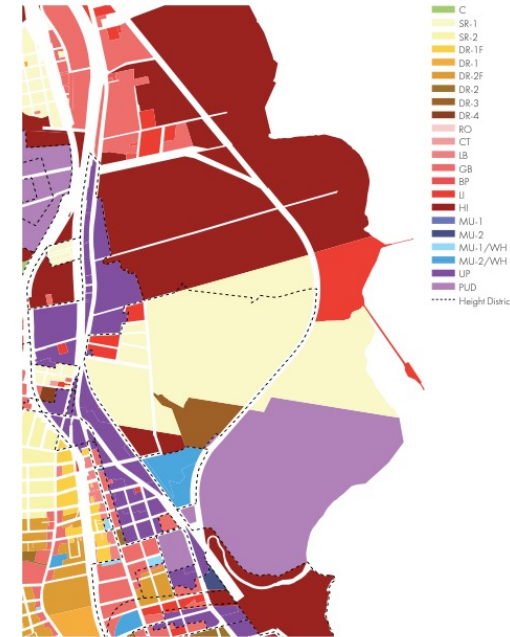
RETHINKING ZONING WITH AN ECOLOGICAL-BASED CODE

By only focusing on the upcoming land use, it is impossible to fully consider the future impacts of development. This proposal aims to implement a life-cycle approach to zoning which has the ability to adapt over time. By understanding that Charleston is within a changing landscape, zoning can enable responsible stewardship of the land.

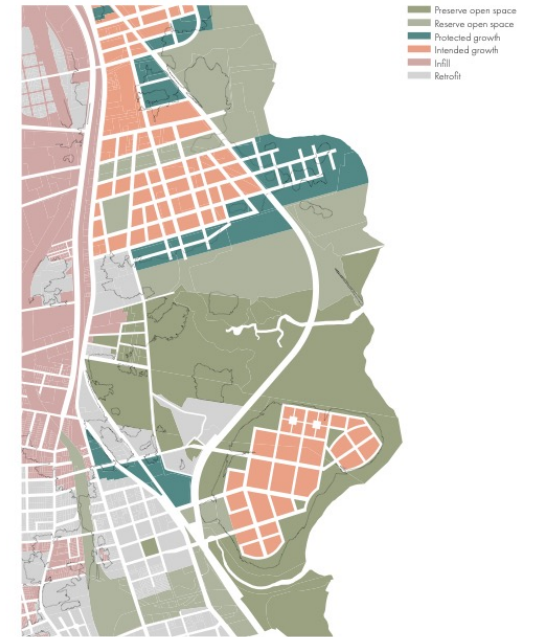
Instead of zones based solely on upcoming land use, sectors are proposed that relate to ground elevation, level of urbanization, future land use, and upcoming land use.



EXISTING ZONING



PROPOSED ZONING



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THE SECTORS

Preserve open space: Existing parks, cemeteries, marsh, and undeveloped land will either stay as is or transfer to another open space use.

Reserve open space: While not currently open space, this is land that will be returned back to natural uses. Much of the land in this sector is low-lying, marsh-adjacent, and currently zoned as Heavy Industrial. By reserving this land as open space within the zoning code, there is room for marsh migration as the sea level rises.

Protected growth: This sector is intended to enable smart development at elevations that are not currently at the water's edge but will be within 50 years. All development within the protected growth sector must have the structural ability to buffer storm surge with incentives for orienting buildings to provide even greater protection to the rest of the urban fabric.

Intended growth: All new development areas at elevations over 12' NAVD88 fall within the intended growth sector. This sector is further divided into 4 categories:

- General urban
- Urban center
- Urban core
- Civic space

These categories ensure public realm standards that put people and water at the forefront of design.

Retrofit: Much of the existing urban fabric is at an at-risk elevation (below 12' NAVD88), some of which already suffers from flooding. In this sector, incentives exist to bring all buildings and infrastructure to meet new resiliency standards. All new construction must meet the same standards as the protected growth sector.

Infill: Land over 12' NAVD88 will have updated resiliency standards but without the same restrictions on new construction as the retrofit sector.

DETERMINING THE SECTOR

Sector	Conservation Sectors		Urban Growth Sectors						
	Preserve Open Space	Reserve Open Space	Protected Growth	Intended Growth				Retrofit	Infill
				General Urban	Urban Center	Urban Core	Civic Space		
Level of Urbanization	None	None	Medium	Medium	Medium-High	High	x	Existing	Existing
Ground Elevation	x	Priority of under 12'	6'-12'	12' and over				Below 12'	Over 12'
Goals	Preserve undeveloped land as undeveloped. May transfer to a different open space use	Land that will return to its natural state to serve as space for marsh migration, urban relief, and additional ecological benefits	Enables smart growth at elevations that are not currently high flood risk, but will be within 50 years	Promotes new development at elevations outside of high flood risk areas. Subdivisions ensure public realm standards that put people and water at the forefront of design				Bring all existing urban fabric up to new resiliency standards - no new construction here	Permitted new development within existing urban fabric

GENERAL TO ALL DEVELOPMENT

Due to the time-based nature of this code, reevaluation will occur every 10 years. This will ensure appropriate elevation requirements to reflect sea level rise and enable the incorporation of the most up-to-date water management strategies.

All new construction is required to use a Base Design Elevation of 12' NAVD88 for first floor elevations.

Pedestrian comfort should be a primary consideration of Thoroughfare design and dimensions. Design conflict between vehicular, bicycle and pedestrian movement should be decided in favor of the pedestrian.

A story is a maximum fourteen (14) feet in height from finished floor to finished floor. Basements are not considered stories for the purposes of determining building height. A ground level retail story may exceed this limit up to a total of twenty-five (25) feet.

The height of buildings, fences and walls shall be measured from the average sidewalk elevation in the Intended Growth and Infill sectors. In the Protected Growth and Retrofit sectors, the Base Design Elevation shall be used instead.

DEVELOPMENT STANDARDS

	Preserve Open Space	Reserve Open Space	Protected Growth	Intended Growth			
				General Urban	Urban Center	Urban Core	Civic Space
Street Typologies and special elements	Boardwalks and multi-use paths with exception of cemeteries	Boardwalks and multi-use paths only	Boardwalks, docks, bridges All parking off-site	Sharrows, residential alleyways, neighborhood residential, parkways with medians Minimum 6' pedestrian right of way	Neighborhood main street, downtown mixed-use, downtown commercial, protected bike lanes, sharrows Minimum 8' pedestrian right of way	Downtown commercial, downtown mixed-use, boulevard with medians, transit priority, protected bike lanes Minimum 10' pedestrian right of way	Pedestrian mall, downtown civic No on-street parking Minimum 10' pedestrian right of way
Building Typologies	Park amenities/support	Park amenities/support, post-industrial remnants	Residential on stilts, floating homes, commercial first floor with wet-flooding	Small footprint mixed-use, single family detached, single family attached 1-5 stories	Mixed-use first floor public use/retail space, grocery, community amenities 4-10 stories	Mixed-use first floor public use/retail space, parking structures, hotel 6 stories and over	Fire and police, city municipality, schools, museums, learning centers, community amenities, additional mixed-use
Special ecological considerations	Extends past existing zoning boundaries outwards into water Protection for cemeteries	Room for marsh migration Urban relief	Building orientation and structural ability for wave attenuation Time of construction to prevent loss of existing marsh	Elevation of water table and soil conditions for decisions about ground infiltration and landscaping vs landscaping water management strategies			

Designing with Water

community-centered
and nature-based
designs for resilient
water management
in Charleston



Presentation by
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What's Next?

Charleston's Water Plan



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