VIRGINIA TECH - USA

IGC

Protect environmental vitality and manage the economic prosperity

This project aims to redevelop the Lynnhaven Bay area of Virginia Beach with an understanding of the current problems for storm surge and sea-level rise (SLR).
The project work toward creating a resilient and sustainable community without grossly displacing its inhabitants. To achieve this vision, the project team focus on four main goals:
first, utilizing nature-based solutions to address Sea-Level Rise and flooding. This is largely addressed through the redevelopment of heavily inundated areas into marshlands and living shorelines.
Second, providing comparable, high-quality housing to those inhabitants who will ultimately be displaced. This comes through the development of many mixed-use communities in communities that are low-risk flood zones, developing communities with amenities for people of all ages with essential places like grocery stores consistently within walking distance, and redeveloping communities that are as close to the existing inundated communities as possible so that residents, particularly those who have lived in the Lynnhaven bay area their entire lives.
Third, utilizing conservation areas for public education and enjoyment. This could be done by expanding ecological tourism areas, developing more walking and biking trails in those areas, and encouraging the expansion of the work of the Brock Center and similar entities.
Fourth, Creating a resilient economy for Virginia Beach. This could be done by creating more opportunities for urban agriculture through the development of community gardens and for water-based agriculture through the redevelopment of oyster reefs.
Fifth, improving public transit connectivity and accessibility, and developing mixed-use communities to relocate businesses affected by inundation and directly geographically connect businesses with their patrons.
Finally, utilizing recycled materials from deconstructed homes within areas of sea-level rise to minimize the footprint of this ecological conversion.

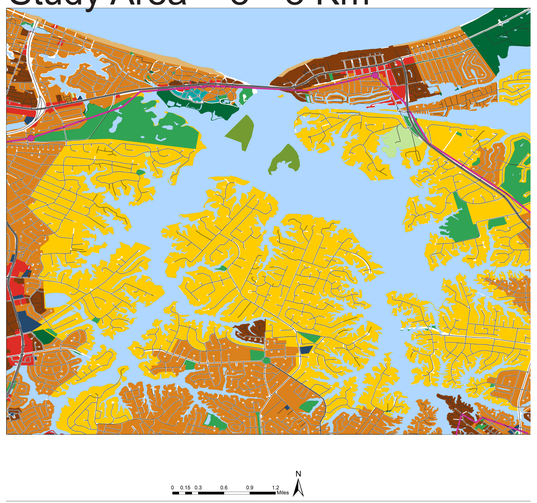
Requirements and Assumptions

-The current population is 53,777. The total Population in 2050 will not change.
-Additionally, 5,000 people will displace by 3-ft SLR requiring new housing.
-Higher density residential housing in less-risk areas for SLR.
-15-20 % conservation areas.
-Natural sand dune must be conserved.
-Population over the age of 65 or older will be 25% of population

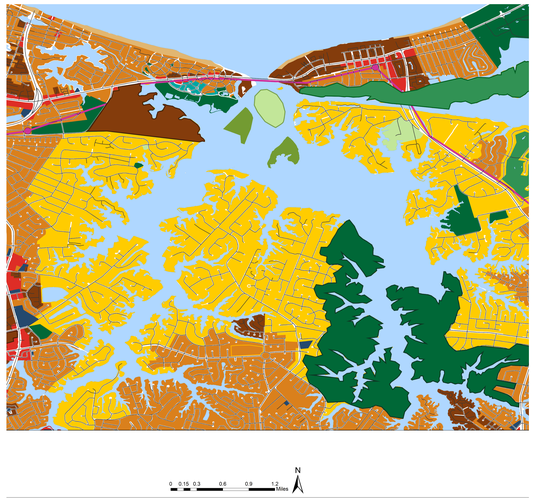
Major Innovations Employed

-WAT 2035/2050 3: Agricultural Water Conservation
-AGR 2050 11: Urban Farming – Urban Agriculture
-AGR 2050 18: Controlled-environment Agriculture (CEA)
-GRN 2035/2050 1: Resilient Landscape Infrastructure
-ENE 2050 1: Renewable Energy Sources
-TRA 2035/2050 15: Integrated Transportation and Energy Infrastructure
-RES 2035/2050 11: Adaptable Modular Housing
MIX 2035/2050 10: Managing High Density Locally
-MIX 2035/2050 1: Mixed Use Development
-INS 2050 11: Diversification in Entertainment Venues

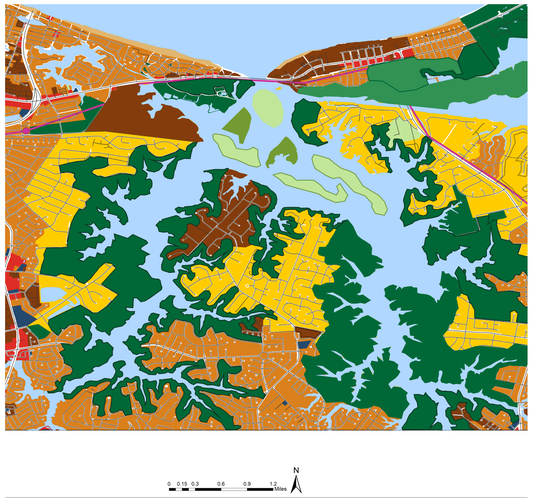
Lynnhaven Bay area-Virginia Beach
Study Area= 8 * 8 Km



Existing 2020



Early Adopter 2035

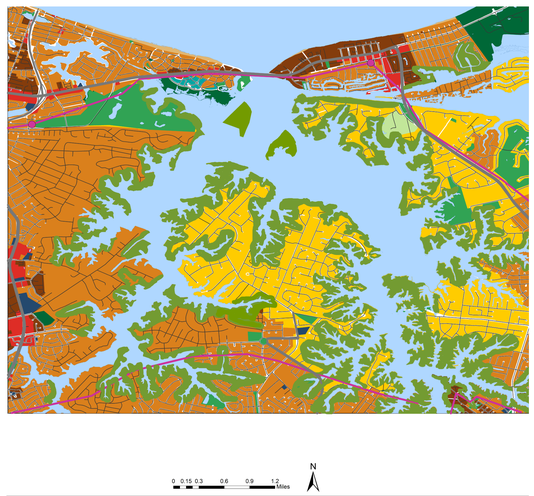


Early Adopter 2050

The early adopter scenario proposes the most effective ways to preserve and develop the site considering the existing infrastructure and projected SLR and storm surge over the next thirty years. The first map shows the Virginia Beach site as it currently stands before any changes are made.
The second map shows changes that could be made by 2035 with planning starting in 2020. The third map shows changes that could be made by 2050 with planning starting in 2020.

The results:
By 2035, Most heavily inundated areas will convert into preservation areas. Also, agriculture will expand by re-introducing oyster reefs to the bay, more a preservation area will be created to promote ecological tourism and mitigate flooding, and a golf course will be redeveloped into a mixed-use community to relocate those inhabitants affected by inundation.
By 2050, further inundated areas will be developed into preservation areas by expanding oyster reefs areas.
- Low-density housing will redevelop into higher-density mixed-use communities.
- An ecologically-friendly golf course will redevelop to help mitigate floodwaters and create more community space.

Project Surroundings



Non and Late Adopter 2035

Late Adopter 2050

The late adopter scenario projects the probable future of the land and what it may look like if the city wait to make a change, and how that changes for the future adjustments could be made.
The first map shows the projection of the site in 2035 before any changes have been made, the second map shows changes that could be made in 2050 with planning starting in 2035.

The results:
By 2035, the Storm surge and SLR will start to chronically inundate areas in flood zones to the point in which they become less inhabitable.
- More energy infrastructure will be built
By 2050, The Brock Center will be expanded to another conservation area to adapt to the increasing storm surge and SLR.
Also, Additional conservation areas will be developed in chronically inundated areas.
-A golf course and adjacent park (among other areas) will be redeveloped into mixed-use community to relocate those inhabitants affected by inundation
- Agriculture areas will be expanded by re-introducing oyster reefs to the bay
- low-density housing will be redeveloped into medium-density housing.

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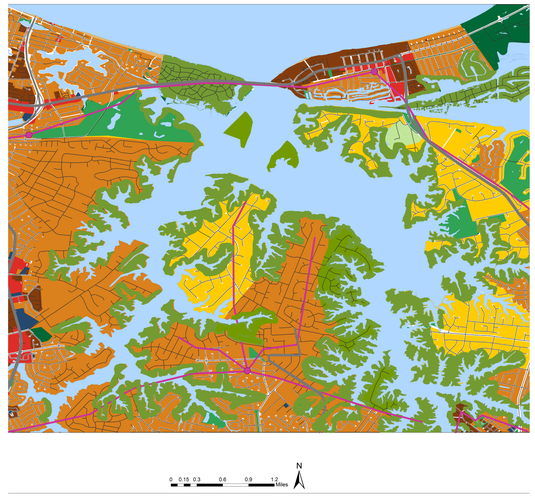
Coastal community located with the Chesapeake Bay watershed.

Characteristics:
Residential neighborhoods line the center spine of the subject area – Shore Drive.
The area in green is the Shore Drive Overlay District.
Challenges:
Stormwater, Bay Island redevelopment – FEMA grant program to elevate residential structures, redevelopment of commercial real estate along Shore Drive corridor, loss of marsh island at mouth of inlet.
Resiliency Analysis:

- Water Infrastructure
- Agriculture
- Green Infrastructure
- Transport Infrastructure
- Institutional
- Energy Infrastructure
- Conservation Landscape
- Commercial
- Residential-Low Density
- Residential- Medium Density-Mixed
- Residential- High-Density-Mixed

•Green infrastructure:
-Opportunity in the redevelopment of the Shore Drive corridor to integrate stormwater with connectivity.
-Preservation and creation of marsh islands to reduce storm surge.
-Land-use of Bay Island.



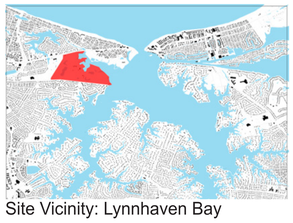
Non Adopter 2050

The non-adopter scenario projects the probable future of the land and what it may look like in 2050 if the city continues to not make a change.

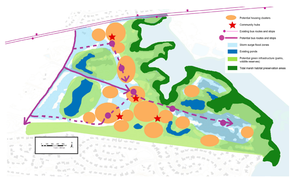
Results
By 2050
- The energy infrastructure will greatly increase.
-Transportation infrastructure will slightly increase.
- Storm surge and SLR will start to chronically inundate areas in flood zones to the point in which they become less inhabitable.
- Communities will become increasingly densely populated.
- Agriculture and local ecosystems will continue to suffer.

City Scale Design & District Scale

Living in the Urban to Natural Transect



Site Vicinity: Lynnhaven Bay



The concept sketch

Concept
• Create a design that embodies the urban to rural transect within the context of a tidal city.
• Create a sustainable community that is resilient to storm surge and SLR and that engages with the tidal ecosystem of Virginia Beach.
• Create appealing high density and medium density living - including a plaza with shops, a park with trails and playgrounds, and a bayside boardwalk with a small beach.

Sustainable Development Goals	Most beneficial (3)	Beneficial (1)	Neutral (0)	Detrimental (-1)	Most detrimental (-3)
1: No Poverty					
2: Zero Hunger					
3: Good Health and Well-being					
4: Quality Education					
5: Gender Equality					
6: Clean Water and Sanitation					
7: Affordable and Clean Energy					
8: Decent Work and Economic Growth					
9: Industry, Innovation and Infrastructure					
10: Reduced Inequality					
11: Sustainable Cities and Communities					
12: Responsible Consumption and Production					
13: Climate Action					
14: Life Below Water					
15: Life on Land					
16: Peace and Justice Strong Institutions					
17: Partnerships to achieve the Goal					

Early adopter

SDG	WAT	AGR	GRN	ENE	TRA	IND/COM	INS	(MIX	RES	CONS	SUM
1	3	3	3	0	1	0	1	3	3	3	14
2	1	3	3	1	1	0	3	1	1	1	13
3	3	1	3	1	0	1	0	1	0	0	10
4											
5											
6	3	1	3	0	0	0	0	3	3	3	10
7	1	1	1	0	0	0	0	1	1	0	4
8	3	1	1	1	0	1	1	3	3	3	11
9	3	3	3	0	-1	-1	-1	0	0	1	6
10											
11	3	3	3	1	0	1	0	3	3	3	14
12	1	3	3	-3	1	0	0	1	1	0	6
13	3	3	3	1	0	0	1	3	3	3	14
14	3	1	1	-3	0	-1	0	1	1	3	2
15	1	3	1	-1	-1	0	-3	1	3	3	1
16											
17											
	28	26	28	-2	1	1	2	21	22	23	105

Late adopter

SDG	WAT	AGR	GRN	ENE	TRA	IND/COM	INS	(MIX	RES	CONS	SUM
1	1	3	3	0	1	0	1	1	1	3	10
2	0	1	1	0	1	0	3	1	1	3	7
3	3	1	3	1	0	0	-1	1	0	0	8
4											
5											
6	1	1	3	1	0	0	0	3	3	1	9
7	0	0	0	0	0	0	0	1	1	0	1
8	3	1	1	1	0	1	1	3	1	-1	11
9	1	1	3	0	-1	-1	-1	1	0	1	3
10											
11	3	1	3	1	0	0	-1	3	3	1	10
12	1	1	1	-3	0	-1	0	1	1	1	0
13	3	1	3	-1	0	-1	-1	1	1	1	5
14	3	1	0	0	0	0	0	1	1	0	5
15	1	0	1	0	-1	0	-3	1	1	1	-1
16											
17											
	20	12	22	0	0	-2	-2	18	14	11	68

Non-adopter

SDG	WAT	AGR	GRN	ENE	TRA	IND/COM	INS	(MIX	RES	CONS	SUM
1	0	3	3	1	1	0	0	0	0	1	8
2	-1	1	1	-1	1	0	1	-1	0	1	1
3	1	1	1	-1	1	-1	0	-1	-1	0	1
4											
5											
6	1	1	1	1	0	0	0	3	3	1	7
7	0	0	-1	0	0	0	0	1	1	0	0
8	3	1	1	1	0	1	1	3	1	-1	11
9	1	1	3	1	-1	-1	-1	1	0	1	4
10											
11	1	0	1	0	3	-3	-1	1	1	1	2
12	1	1	1	-3	0	-1	0	0	0	1	-1
13	3	1	1	-1	1	-1	-1	1	1	1	4
14	1	1	0	0	0	0	0	1	1	-1	3
15	0	0	0	0	1	0	-3	1	1	0	-1
16											
17											
	11	11	12	-2	7	-6	-4	10	8	5	39

Sustainable Development Goals

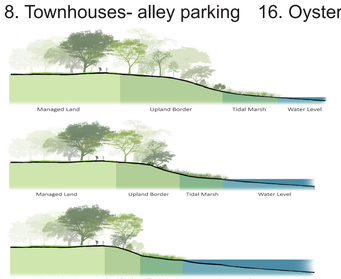
Based on the guidelines of the IGC, The United Nations-sanctioned sustainable development goals (SDGs) has been adopted as the standard format for assessing the impacts of the 2050 scenario-based designs—Early-adopter, Late-adopter, and Non-adopter. The SDGs are assessed in five levels ranging from most beneficial to most detrimental. Based on the matrix we could compare the outcomes in each scenario to reveal the positive and negative contributions to SDGs for the project.
For early adopter, the total score is the highest 105 which reveals a more positive contribution to SDGs. The more influential SDGs are as the following: 1. Sustainable Cities and Communities, 2.No Poverty, 3.Zero Hunger, 4.Decent Work and Economic Growth, 5.Climate Action, 6.Clean Water and Sanitation, 7.Good Health and Well-being, and 8.Responsible Consumption and Production.
For Late adopter, the total score decreases to 68 which reveals less contribution to SDGs. The more influential SDGs are to provide decent work and economic growth, protect Sustainable Cities, and Communities and prevent Poverty.
For Non-adopter scenario, the total score is the lowest 39 which reveals the negative contributions to SDGs.

Goals and Objectives:
1.Providing quality housing for 2,000 of the 5,000 people displaced by the 3 ft sea-level rise.
  a.Creating a mixed-use community with high-density residential housing that is at low risk of flooding.
  b.Providing appropriate amenities for all ages.
  c.Creating opportunities for urban agriculture.
  d.Improving public transit connectivity and accessibility.
2.Creating a green infrastructure network that improves quality of life and ecological viability.
  a.Implementing green infrastructure that connects residents to businesses.
  b.Utilizing conservation areas for public education and non-invasive recreation such as walking and biking trails.
3.Using nature-based solutions to address SLR and flooding.
a.Dedicating 15% of the site to conservation areas in critical flood zones.
  b.Preserving existing tidal ecosystems.
  c.Restoring lost or damaged coastal ecosystems such as oyster reefs and tidal marshes.

Site Plan

Section

Design Program:
1. Connection to existing shore drive and bike trails
2. Assisted living apartments
3. Parking Garage
4. Apartments with ground-floor businesses
5. Community plaza
6. Bus stop
7. Townhouses with driveway parking.
8. Townhouses- alley parking
9. Community park with trails
10. Playground for preschool aged children
11. Playground for schoolaged children
12. Pavilions
13. Boardwalk access to marsh preservation
14. Living shoreline beach
15. Fishing pier
16. Oyster reefs



Current Sea Level

3 Feet Sea Level-Rise (2050)

6 Feet Sea Level-Rise (2100)

Sources:

1. The City of Virginia Beach - Mapping & Spatial Analysis: https://gis.data.vbgov.com/
2. GIS Data: City of Virginia Beach, Virginia Shoreline Management Model: https://scholarworks.wm.edu/data/109/
3. AdaptVA.org: - http://adaptva.org/index.html
4. Comprehensive Sea Level Rise and Recurrent Flooding Response Plan: https://www.vbgov.com/government/departments/public-works/comp-sea-level-rise/Pages/default.aspx
5. Virginia Beach Master Plans, Comprehensive Plan and all Amendments: https://www.vbgov.com/government/departments/planning/2016Comprehensive-Plan/Pages/Comprehensive%20Plan.aspx

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