# Social-Ecological History Supporting a Resilient Hampton, Virginia, USA

The Pennsylvania State University's entry into the Coastal and Estuarine Research Federation Design Competition

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Project Team (alphabetical by last name)

Mak (Minh Anh Kieu), 4th year Emily Bernhardt, 4th year Madison Borsos, 4th year Zimeng Chen, 3rd year Bryce Craig, 3rd year Jiani Dai, 3rd year Seth Esterly, 3rd year Nina (Christina) Flores, grad Katherine (Qiannan) Guo, 4th year Selena Hinojos, grad Jack (Won Byoung) Kang, 4th year Alex Keim, grad Emily Miller, 3rd year Lauren Taylor, 4th year Jake (John) Tiernan, 5th year

Peter Stempel, Studio prof., Competition Team Faculty Jessica Fegley, Studio Teaching Assistant Andy Cole, Competition Team Co-Faculty Caitlin Grady, Faculty Contributor Michael Thurston, Outside Expert – History Alanna Casey, Outside Expert – Interpretation Vivek Shrikrishnan, Expert consultant – Deep Uncertainty

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# Abstract

The Pennsylvania State University Team (Team Penn State) entry into the Coastal and Estuarine Research Federations Design Competition understands Hampton Virginia as an evolving social ecological system that has undergone repeated transformations intertwining ecology and culture. We demonstrate that excavating and understanding these transformations is an essential part of adaptation planning because it provides insight into cultural dimensions of adaptation and reveals opportunities to redress injustice. Team Penn State uses these analyses in combination with more conventional analysis of physical and social vulnerability, policy analysis, and visioning to propose a series of concrete near-term actions that support the longer-term resilience and reformation of the city.

# Summary of Project Team Effort

The team effort began with pre-project organization by professors Stempel, Cole, and Grady. The bulk of the team's work, including background research and preparation and evaluation of designs, took place in the Spring of 2021 and was conducted by student members of the team with input from the team organizers and experts as is customary in a studio classroom. All policy, statistical, and technical analysis was conducted by students, except for downscaling ocean model data. Work took place remotely via zoom and asynchronous collaboration. This remote work continued through summer of 2021.

Student texts were compiled into documents by professors Stempel, Grady, and Cole. Editing was done by students Madison Borsos, Emily Miller, and Lauren Taylor. Final edits by student Madison Borsos and Professor Stempel. Image design, compilation and editing throughout was by student, Minh Anh Kieu. The background, recommendations, proposals, and designs are the products of the students. All graphics and visuals are credited within the text. Three diagrams/graphics created by faculty are there identified in the text.

## Students

Contributions to Design Report: [W] work general, [G] graphics, [R] research, [C] compilation and editing, [P] intended presenter [DNC] did not continue after Spring 21 semester end.

Mak (Minh Anh Kieu), 4th year [W,G,R,C,P] Emily Bernhardt, 4th year [W,G,R] Madison Borsos, 4th year [W,G,R,C,P] Zimeng Chen, 3rd year [DNC] Bryce Craig, 3rd year [DNC] Jiani Dai, 3rd year [W,R] Seth Esterly, 3rd year [W, G, R] Nina (Christina) Flores, grad [W,R] Katherine (Qiannan) Guo, 4th year [W,R] Selena Hinojos, grad [W,G,R,C,P], vulnerability index lead Jack (Won Byoung) Kang, 4th year [W,G,R,C,P] Alex Keim, grad [W,G,R,C,P] Emily Miller, 3rd year [W,G,R,C] Lauren Taylor, 4th year [W,G,R]

## Faculty and Experts

Peter Stempel, Studio prof., Competition Team Faculty Andy Cole, Competition Team Co-Faculty Jessica Fegley, Studio Teaching Assistant Caitlin Grady, Faculty Contributor Michael Thurston, Outside Expert – History Alanna Casey, Outside Expert – Interpretation Vivek Shrikrishnan, Expert consultant – Deep Uncertainty

# **Project Description**

# Introduction

The Pennsylvania State University team (Team PSU) approach to addressing the question of coastal resilience in Hampton, Virginia combines team members focused on ecology, physical science, civil engineering, and landscape architecture. Additionally, team members engaged with outside experts with expertise in history and changing interpretation of historic resources to explore how their engagement might inform resilience processes. These historians assisted the student team with moving beyond shared narratives of regional heritage.

Hampton Virginia stands at the nexus of indigenous, African American, and Colonial histories that have shaped the present-day social and ecological conditions (e.g., Mann 2005, Hannah-Jones 2019). Pragmatic concerns related to present day impacts of climate and sea level change on stakeholders intersect with these histories and raise larger questions regarding the relationship between coastal resilience and addressing structural racism and historic injustice. Pragmatic processes that are presumed to be neutral often embed and perpetuate structural inequality and racism (Hardy, Milligan, and Heynen 2017). Processes that do not actively address these issues risk perpetuating what has been termed as the "slow violence" of colorblind planning that and magnifies historic injustice (Hardy, Milligan, and Heynen 2017).

Team PSU's approach was therefore an active exploration of how incorporating developments in historical scholarship and interpretation can inform pragmatic approaches and reveal new possibilities for addressing both coastal resilience and historic injustice. Although some of these insights pertain directly to history, reframing the region's dynamic and evolving social and ecological history also informed recognizable approaches to coastal resilience such as analyses of policy, social and physical vulnerability analysis, and visioning of future scenarios (Figure 1).



Figure 1, a schematic of how we've come to understand the outcome of Team PSU's experiment. Diagram by Peter Stempel

We conclude that while the range of our more conventional analyses point to conscientious retreat (the "**what**"), that the deep historical analysis contributes greatly to **how** it takes place. That inspired a set of tactical proposals centered around two themes:

- **Imagining** new relationships with water and aesthetic sensibilities that are aligned with the culture of Hampton.
- **Creating** new social and ecological spaces that carry cultural meanings and redress historic injustice through re-interpretation of the past.

Taken together, team PSU's work offers a set of immediate tangible actions to facilitate both near and far-term strategies. Although we represent proposals in concrete terms, we define them as tactical due to our distance from Hampton necessitated both by the limitations of pandemic travel and limitations of the competition process. These proposals nonetheless reveal potential pathways and opportunities that a pragmatic approach alone may not have revealed.

## Background

## The social ecological history of Hampton VA

Resilience is defined as the ability of a system to maintain its essential function in the face of disturbance or stressor. Resilience is not invulnerability; the system may transform and be reorganized (Walker et al. 2004, Berkes 2007). The history of Hampton and its environment is already a story of constant transformation as is evidenced by the unfolding of its history. Following this past, we envision Hampton's future as inventive, adaptive, and dynamic.

#### Colonization and transformation of the landscape

The evolution of indigenous cultures follows the larger climactic trajectory of the North American continent, with 'paleo'-era inhabitants occupying a significantly colder climate (~12,000-10,000 years). 'Archaic' and later 'woodland' populations utilized the bounty of the Chesapeake Bay fisheries and the flora and fauna of the region. *The name "Chesapeake" a reference to the Chesepian People, and likely the Algonquian word Chesepiaoc, referring to a village by a large river.* What is vernacularly regarded as 'wild' or 'natural' today has little resemblance to the landscape encountered by colonists (Hargis Jr 2003, Cuker and Maccormick 2020)(Figure 2). This landscape was characterized by towering chestnut forests with cleared understories, agriculture, and extensive wetlands with diverse vegetation and microtopography. The Grandview Nature Preserve, characterized by tidal creeks, marshes, and beaches, is the closest analog for the landscape in and around Hampton at the time of colonization (Cuker and Maccormick 2020).



Figure 2, an imagined landscape depicting what might have been based on historic accounts. Montage: Alex Keim.

Narratives regarding colonization frequently portray Indigenous persons both as monolithic and extinct and fail to capture both the diversity of indigenous persons and cultures, their agency during the period of colonization, and their current presence and agency (Gallivan, Moretti-Langholtz, and Woodard 2011). The State of Virginia presently recognizes eleven tribes (the first recognized in 2016). Of those tribes seven are federally recognized, and only two, the Mattaponi and Pamunkey, retain their reservation lands from the 17<sup>th</sup> century. There were as many as thirty Algonquian speaking tribes at the time of the arrival of the English, and while many of these tribes were part of the Powhatan confederacy, there were also independent tribes. There is thus no singular indigenous approach or identity (Pargellis 1959, Gallivan, Moretti-Langholtz, and Woodard 2011).

Deliberate forms of erasure and cultural genocide and changes in the patterns of economy and movement transformed the physical environment (Gallivan, Moretti-Langholtz, and Woodard 2011). The Gulf Stream current in the Atlantic Ocean, combined with the trade winds to the south, powered the arrival of both slaves and settlers, and later drove the triangle trade of slaves, sugar, and rum (Ulanski 2008). The harbor on the southern side of Hampton was sheltered from winter storms by Hampton's land mass, and tannic water from the Great Dismal Swamp to the south was prized for keeping on long sea voyages, due to its anti-bacterial properties (Traylor 2010). Hampton's geographic location thus positioned it as an arrival port for slaves and a center for trading timber and other goods between the Indigenous and European cultures, leading to the simultaneous exploitation of both people and natural resources. The story of Hampton thus cannot be separated from climatological factors, the region's wetland ecology, and the social history of indigenous, African, and colonial cultures (Nevius 2020b). These transformations are revealed in the form of the landscape (Figure 3).



Figure 3, Comparing changes in the form of the landscape over time between Hampton and the Great Dismal Swamp. We argue that the development in Hampton relied on the natural resources and labor in the Great Dismal Swamp. Graphics: Madison Borsos.

Ditching, and efforts to 'reclaim' the Great Dismal Swamp for use as plantation lands were ongoing, though not extensively successful until the evolution of steam powered equipment made it possible to dig the Chesapeake and Albemarle canal (1856-1860) on the eve of the United States Civil War (US Civil War) (1861-1865) (Nevius 2020b, Hansen 2010). In the years leading up to that time the Great Dismal Swamp acted as a transitional space between cultures, providing refuge for displaced indigenous persons and escaped slaves who founded Maroon colonies often in the ruins of indigenous settlements. "Maronage" refers to the way persons who escaped slavery used the isolation and remoteness of the wetland landscape as a form of protection from recapture and enslavement. These Maroon colonies formed a significant pool of labor that traded with colonial and early American cultures, and even provided furniture and other finished goods for export. The Great Dismal Swamp, and wetlands to the northeast of Hampton, formed a significant part of the route from slavery to freedom for many enslaved people (Nevius 2020a).

The Civil War marked a substantial turning point in the socio-ecological history of the region. Emancipation brought about the dispersion of Maroon colonies, and canals and railways transformed the economy. Fortifications that began as outposts looking to the interior of the continent turned to outward coastal defense after the war of 1812. In the years following the Civil War the projection of outward power became increasingly important. The expansion of ship building during the first world war (WWI) and the founding of Naval Station Norfolk in the wake of the war would further expand the relationship between Hampton and the military. That relationship continues to drive the local economy and historically drove the significant expansion of land development that drained much of the remaining local wetlands in the latter half of the twentieth century (Fairfax 2005).

During the Civil War enslaved people sought refuge in Fort Monroe and were granted asylum as "contraband slaves". The fort was soon overwhelmed by formerly enslaved people seeking refuge. Being turned away, they formed the "Grand Contraband Camp" in the ruins of the city (Figure 4). During the

war, the Union Army provided refuge, pay, and rations to "contraband slaves" in the former confederacy. Formerly enslaved people in Hampton turned to fishing, oystering, and other ecological resources afforded by Hampton (VanHecke 2014). Although the boundaries of this settlement have scarce physical markers today, many structures in Hampton today retain elements of this encampment.



*Figure 4, Historic Boundaries of the Grand Contraband Camp. Visualization by Jake Tiernan.* 

Waves of refugees streaming into Union occupied Hampton were educated by Mary Peake in the shadow of what has become known as the Emancipation Oak. Mary Peake was born free in Norfolk Virginia and had been educated until an 1839 law forbade the education of African Americans. She educated others in secret until the Civil War when she became one of the few teachers who was officially sanctioned by the Union Army. Her cottage classroom is now recognized as the first facility of what became Hampton University (Taylor 2005, Welch 2018). The Emancipation Oak and the Algernon Oak, a tree that is said to have stood witness to the arrival of the first Africans on the continent, are significant socio-ecological resources presently under threat from sea level rise (Figure 5).



Figure 5, A montage of the African American History of Hampton, Montage: Minh Anh Kieu

Hampton retained a significant Black middle class despite the surge of white supremacy in the wake of reconstruction and the dissolution of protections for Black participation in civic life. At the end of the 19<sup>th</sup> century Hampton offered one of the few Atlantic coast resorts, Bayshore, that was open to African Americans. It drew visitors from as far away as New York and Georgia on summer weekends. By 1925 this summer vacation destination grew to include seventy-room Bay Shore Hotel, a pavilion, amusement park, and boardwalk along its 275-foot waterfront. By 1930, the Bay Shore Beach and Resort rivaled the all-white Buckroe Beach Amusement Park, and, in fact, the two facilities sat side by side with a fence separating the properties that extended across the beach and into the Chesapeake Bay. Though the fence legally separated Black and White beachgoers from each other, performances from famous artists at the Bay Shore Beach and Resort often led White tourists from the Buckroe Beach quickly integrated, yet both White and Black resorts suffered as beach goers shifted to Virginia Beach east of Norfolk and because of competition from Bush Gardens in nearby Williamsburg. By 1985 the Bay Shore Beach Resort Hotel closed and was torn down in 1991 (Fairfax 2005).

Segregation was coupled with disinvestment in the African American community. Beginning in the 1930's "neighborhood raters" made block by block maps that guided the distribution of federally backed housing loans during the Great Depression. One factor mattered more than anything else: Race. White neighborhoods were almost never redlined, and Black neighborhoods almost never escaped it. Amid this practice, Hampton saw the construction of the Aberdeen Gardens, a New Deal planned community initiated by Hampton Institute (now Hampton University), designed specifically for the resettlement of Black workers in Newport News and Hampton. The 440-acre subdivision was finished in 1937 and includes 158 single family homes; one school; and a vital commercial center (Carroll 2004, Fairfax 2005).



Figure 6. A montage of scenes depicting Aberdeen Gardens. Montage by Selena Hinjos

#### Present conditions, vulnerability index, and policy

#### Physical and ecological vulnerability

Hampton's physical development accelerated and increased significantly in the later 20<sup>th</sup> century (Figure 7). Increasing physical vulnerability to sea level rise thus reflects both the expanding development envelope of the late 20th century and the increasing rate of sea level rise in the late 20th century and early 21st century.



Figure 7, A comparison of historic maps and aerial image from the year 2000, from left to right, 1862, 1895, 1944, 1964, 2000. Composite by Won Byong Kang, Minh Anh Kieu, and Peter Stempel



Figure 8, A diagram showing how the rotation of cyclonic storms disadvantages Foxhill and Grandview. Diagram: Peter Stempel

A spatial and physical analysis conducted by the team indicated the application of conventional coastal defense strategies, including walls and other barriers, are difficult to implement in Hampton due to the low elevation of the city, the need to preserve navigation, and the counterclockwise rotation of cyclonic storms that push water behind the shorefront (The Back River), neutralizing the effectiveness of walls. Like the classic horror film "When a stranger calls", the 'call' is coming from inside the building (Figure 8).

Repetitive loss zones, increases in 'sunny day flooding', and implementation of no-wake zones on streets to prevent inundation of nearby homes all reflect the immediate sea level Impacts that are tangible (Ezer 2020). Ecological impacts are also evident. This includes the emergence of 'ghost forests' where snags and dead standing trees draw our attention to the changing water table

(Kirwan and Gedan 2019). It also includes the attenuation of the ecologically important intertidal zone. This is evident by a loss of marsh zonation and distinction between high and low marsh, the shortening of beaches, and the implementation of barriers. Attenuation of the intertidal zone and the steepening shorefront substantially limits potential ecological responses such as living shorelines at the edge (Horton et al. 2018, Kirwan, Temmerman, et al. 2016, Kirwan, Walters, et al. 2016). Team PSU also recognizes that traditional coastal defense measures, like seawalls, breakwaters, groins, jetties, and sand nourishment are not sufficiently effective and should be avoided in future coastal defense decisions/investments. These are either highly engineered structures that are not adaptable in the face of sea level change or erode easily during storms (Bush 2001, Bush et al. 1999). A more flexible approach is therefore needed.

#### Coastal and social vulnerability index analysis

This analysis sought to answer (1) which areas in Hampton represent the most socially and physically vulnerable to coastal sea level rise, storm surges, and inundation, and (2) to foster equitable distribution of economic resources for adaptation. We combined a social vulnerability index with a coastal physical vulnerability index to determine the census block groups that should be prioritized for future sea level rise prioritization. Further detailed methods are included in Appendix 1

#### Social Vulnerability Index

The social vulnerability index was formed by identifying relevant social indicators from peer-reviewed literature that might influence a person's overall vulnerability (e.g., Cutter et al. 2009). These included characteristics of socio-economic status, household composition, race, language, housing, and transportation. These variables were then used with Principal Component Analysis to create factors and sum relevant scores into one index. There are areas of high vulnerability between Buckroe and Phoebus, with low social vulnerability near the Foxhill and Grandview areas towards Fort Monroe (Figure 9).

#### Coastal Vulnerability Index

The coastal index is made up of 6 variables spanning geologic, socio-economic, and physical categories. These included elevation, land Use, repetitive loss area, road networks, population density, and FEMA flood zone. Each variable was mapped and broken into several categories and the ranks summed and averaged for a final coastal vulnerability index value (Figure 9).



Figure 9, Social and Coastal Vulnerability analyses that formed the combined index. Analysis and Mapping by Selina Hinjos.

These two indices can then be combined (Figure 10). This allows for Identification of socially and physically vulnerable communities within Hampton. It can be used as a strategy and mapping tool by stakeholders as well as assist in determining resource allocation, adaptation options, and outreach.



Figure 10, combined index showing composite of social and coastal vulnerability. Analysis and Mapping by Selena Hinjos.

This analysis, combined with the previous analyses points towards needed investment in Phoebus and the potential need for density exchange and workable frameworks for managed retreat in the highly vulnerable but less dense areas, thus focusing Team PSU's policy analysis on supporting this likelihood.

#### Policy

Team PSU supports the ability for residents to remain in their homes for as long as physically possible. Even before inundation occurs, abandonment of some properties is likely to begin based on compromised septic and sewer infrastructure as water tables continue to rise (Cahoon and Hanke 2017, Cox et al. 2020). As difficult as this prospect is to confront, **not addressing the possibility of retreat leaves homeowners vulnerable to unmitigated financial losses**. It is important to provide a plan for retreat before financial loss becomes unavoidable to protect current property owners. Moreover, platted but undeveloped parcels leave the City of Hampton vulnerable to takings lawsuits should downzoning take place, putting the city in the unenviable position of potentially having to approve development that increases physical vulnerability. Having clear mechanisms to support compensation or density exchange provides Hampton a means to address these potentially hazardous lots while reducing legal exposure. A summary of proposed policy changes is included in the recommendations section of this document. Tables of policies to be modified are included in appendix 2.

#### The future under deep uncertainty

Whether retreat occurs in several years or at a longer time-frame hinges on unknowable factors. Although the Commonwealth of Virginia and the Hampton Roads Planning District Commission have adopted statutory guidelines and standards related to sea level rise, projections of the rate of sea level rise by scientists are highly varied. These variations reflect deep uncertainties regarding human responses to climate change, and factors where science is still evolving, such as ice sheet response. "Deep uncertainty" refers to situations where multiple plausible outcomes exist, and probabilities are difficult to calculate. In light of this, plans themselves need to be resilient, and able to cope with different rates of sea level progression (Ruckert, Srikrishnan, and Keller 2019).



Figure 11, precise comparison of three scenarios (shown for 2100), downscaled for Hampton. Wong and Keller, left, Kopp et. al. middle, and Sweet et. al. right. Analysis performed by Penn State Earth and Environmental Systems Institute, and published in Ruckert, Srikrishnan, and Keller 2019. Visualizations by Peter Stempel based on data by the cited authors.

The most extreme projections suggest that the Hampton of the 22<sup>nd</sup> century could be very different than the Hampton of today (Figure 12). As difficult as such extremes are to imagine, developing a vision for this distant future provides insights into small steps today that have large implications for the future. For instance, Current zoning limitations protecting the flight path for Joint Base Langley have created a zone of low and no-development that might someday be equivalent to Central Park for a future, denser, version of Hampton Virginia. Recognizing these possibilities, and the prevalence of higher ground suggests the possibility of shifting density to novel places. This supports team PSU's near-term emphasis on addressing unmitigated financial losses and facilitating density transfer.



Figure 12, We propose that Hampton will survive the most extreme scenario, and that significant infrastructure will remain while the city itself moves and densifies. The current fly-over zone for Joint Base Langley becomes Hampton's Central Park, while much of old Hampton becomes a functional wetland, protecting the city, and maintaining it's connection to recreation and environment.

Deep reformation of the city also points to the possibility of redressing historic injustices, whether in considering who should own and manage retreated lands, and how retreated lands should be interpreted. Numerous public buildings stand around the former grand contraband camp, for instance. As will be discussed in subsequent recommendations, addressing sea level rise provides an opportunity to re-consider the meanings of these sites and structures in relationship to the larger cultural context.

## Recommendations

Effectively engaging diverse stakeholders often depends on reflecting their concerns, and acknowledging differences in stakeholders conception of history and how history should be conserved (Hendricks et al. 2018). Team PSU's social ecological history points to a city undergoing continual and sometimes radical transformation, including extensive destruction during the US Civil War. Sea Level Rise is currently one of many issues concerning local stakeholders. We thus argue that the cities adaptation to SLR impacts cannot be siloed away from other transformations taking place, such as the United States' current reckoning with Racial Justice and economic injustice. We thus propose that the pragmatically indicated managed retreat needs to be managed and contextualized with our subsequent recommendations to imagine a new relationship with water and to create landscapes that speak to and address past forms of the landscape and potentially redress injustice. We address these in turn.

#### Managed retreat

As previously discussed, Stakeholders view retreat as a last resort reserved for the distant future. Team PSU nonetheless urges the city to adopt policies that help protect citizens from unmitigated losses and to facilitate density transfer. Areas that are abandoned or retreated from then afford critical spaces that will buffer remaining properties from damage (Figure 13).



Figure 13, Hampton during managed retreat is very similar to the Hampton of today. More subtle transformations of the landscape are discussed in a subsequent section. I-64 at Phoebus before and after (above). Buckroe before and after (below). Photo composites by Lauren Taylor with images from Google Earth.

Achieving this will require statutory changes as based on our analysis:

• Expand the scope and purposes of Virginia Statutes that allow downzoning in exchange for tax credits to include sea level rise, and specifically to support zones identified as being vulnerable in the near and middle term.

- Expand the scope of and limitations of Virginia Statutes enabling transferable development rights (TDR) to facilitate the implementation of TDRs for sea level rise. This includes restricting transfers to sea level rise vulnerable areas.
- Expand or create adjunct requirements for flood hazard mapping in the Virginia Statewide Building Code (USBC) to reflect hazard zones and projections adopted by the Hampton Roads Planning District Commission.
- Expand public uses within eminent domain processes to include mitigation of sea level related impacts with the addition of an alternative housing requirement designed to keep communities intact. Current law defines redevelopment as an allowable purpose. The proposed revision adds mitigation of sea level related impacts to this definition.

The full range of proposed statutory modifications is summarized in appendix 2. As useful as these changes are, these pragmatic proposals hinge on imagining "how" this transformation takes place in order to address stakeholder values and the perception of the landscape.

#### Imagine a new physical and aesthetic relationship to water

The larger socio-ecological history of Hampton demonstrates how use of the land has changed the ecology, primarily by extracting resources and draining the landscape to allow for ever increasing human occupation. It is notable that many residents of Hampton, especially those in Foxhill and Grandview define their identities in relationship to water as communicated by stakeholders. This includes both heritage and lifestyle centered around fishing and other outdoor activities.

Increasing levels of inundation during high tides and flooding from storm surges will slowly return these and other places to a wetland state. As previously described, this includes shifts in the water table affecting drainage and vegetation communities as water returns and transforms the ecology again. Shaping these changes and developing new aesthetic paradigms will enable continued occupation of these sites and foster a new wetland identity for these spaces. Although this will require a gradual shift in values associated with the landscape (e.g., reduced lawn areas, different plant communities), we see the following proposals as a first step in making that happen. Investing in and embracing new ecological and vegetative paradigms will allow Hampton to transform into a place that more effectively lives with water as expressed in the following examples.

#### Giving water someplace to go, reconnecting disconnected drainage.

Current water flows are confined to ditches in many places with narrow culverts. As water is slowed and confined the depth and volume of water in any one given place increases, a process known as a "hydraulic jump". Ensuring capacity of water courses, and connecting water courses, will allow water to move more effectively, reducing the level of hydraulic jumps and thus reducing local flood impacts, especially those of wind driven surges pushing water into tributaries. The ability to move water compliments strategies that detain and delay water on higher ground to minimize flood impact.

In some locations this means transforming currently dry ground into water courses. Although this requires ceding currently dry ground, it creates recreational opportunities, wildlife habitat, and potentially reduces damaging nutrient pollution by creating vegetated buffers. Encroachments on private property will require the cultivation of new aesthetic norms and implementing effective compensation programs through statutory changes that allow for fair compensation and other benefits

to residents and property owners. The ultimate benefit, however, is preserving the ability of residents to remain in their homes if possible.



Figure 14, Creating more effective pathways for water, and embracing a wetter landscape at the junction of Back River and Hampton River. Design by Seth Esterly.



Figure 15, Reimagining ditches into ecosystems. Design by Seth Esterly.

#### Embracing ecological succession

In contemporary times the terms 'wild' and 'natural' often refer to landscape that is not cultivated or intensively managed. The history of Hampton, however, demonstrates that the shape of the landscape

reflects management decisions. In recent years this has centered around moving water away from infrastructure and previous efforts to ditch and dry the landscape. As the climate warms, water temperature increases, and the landscape is re-watered, there will be a distinctive shift in plant species. Just as fish populations in the mid-Atlantic are shifting northward, plant species are shifting too. By some estimations, the Hampton of 2100 could become host to mangroves.

Deliberately diversifying and shifting the species of cultivated plants and increasing the predominance of wetland and salt tolerant plants will help mitigate the effects as other plant communities shift northwards. This may mean for instance, that cherished species such as oaks become less prevalent, even as new landscapes emerge. A comparison of Hampton's plant list and Virginia Climate modeling is presented in Appendix 3.



Figure 16, For many residents staying in Hampton may mean accepting different species and landscapes. Montage by Emily Bernhardt.

This paradigm shift affects both suburban landscapes, and cherished cultural landscape such as the greens at Hampton University between the Hampton River and Virginia Cleveland Hall (Figure 17). Directing this change to gradually include and establish wetland species will aid in the preservation of the land and maintain occupancy of the buildings for as long as possible. Even in the eventuality that such spaces are abandoned or moved, the development of the landscape provides an opportunity to interpret the present form of the university in conversation with the larger ecology of the region. This points to Team PSU's final recommendation that encourages consideration of how these transformations resonate with past cultural landscapes and provide the opportunity to create new meanings as Hampton transforms.



Figure 17, Directing the change in landscape between the Hampton River (A) and Virginia Cleveland Hall (B), through the gradual introduction of wetland species that retain land and create new social-ecological spaces. Design and renderings by Minh Anh Kieu.

#### Create new cultural- ecological spaces

People living in various locations throughout the region left distinct impacts on the landscape as described in our social-ecological history. Their actions, and the ways in which they used the land, are reflected in the patterns of the vegetation and the way the land is used. Team PSU proposes that understandings of past cultural landscapes and land-uses (e.g., the location of the Grand Contraband Camp, Figure 4) be used to inform designs and the way adaptation is carried out (Figure 18).



Figure 18, Examples of spatial patterns in the landscape informed by culture and social ecological history. Diagrams by Madison Borsos.

These land use patterns can inform future design decisions. As a major public space at risk of sea level rise, for instance, Buckroe Park offers an opportunity to restore a culturally and historically significant

landscape while improving resilience against sea level rise. The solutions aim to balance the park's current uses, while creating moments where the visitors can experience a landscape that suggests the seclusion experienced by the Maroons. This acts to reflect on the deeper history of the region as the ecology is transformed by sea level (Figure 19, Figure 20).

Near-term ~2050



2100 low-level SLR



2100 low-level SLR with high water



In high-water conditions, such as storms, or as sea level continues to rise, the rest of the site will flood, leaving the shelters isolated and finishing the recreation of the Maroon landscape

Elevate two picnic shelters, create amphitheater for the As sea level rises, the amphitheater should be pavilion to later capture water Reforest park to reduce runoff and create the isolation

of the Maroon landscape

In low-water conditions, the picnic shelters are still accessible.



revegetated to protect water guality



Figure 20, sections of proposed changes to Buckroe Park (an example of implementing forms from historic cultural landscapes). Design and rendering by Madison Borsos.

While the solutions at Buckroe Park reflected on a historically significant landscape, the exploration of Finns Point Lane addresses the loss of landscapes and neighborhoods in which residents are actively living. The Grandview area of Hampton is at severe risk of sea level rise, even in some of the lowest projections. The residents have embraced the risks and their associated hassles, but eventually a time will come when this area becomes inhabitable. To recognize and validate the loss of community, the proposed solutions anticipate the conditions before they occur, and offer ways to slowly address the

change, rather than awaiting a devastating event. These solutions nod towards the experiences residents may have had while living there and aim to allow these experiences to persist even once the area is no longer permanently habitable (Figure 21, Figure 22).

Near-term ~2040



Low water far-term ~2080



High water far-term

In anticipation of future conditions, promote living shorelines and acquire parcels through buyouts or work with landowners to create conservation easements.

As sea level rises, the area will only be accessible in lowwater conditions. The roads can be used for biking and

In the high-water conditions, the area is no longer accessible. By allowing access in low-water, community walking, since maintenance for cars is no longer worthwhile. members can visit and slowly release their connection

Figure 21, Imagining Finns Point Lane in a way that respects current use and cultural form of the landscape. Design and rendering by Madison Borsos.



Figure 22, Sections of Finns Point Lane depicted in Figure 21. Design and renderings by Madison Borsos.

#### Reconsidering spaces to create justice

Lastly, and perhaps most important, reconsideration of the past challenges emphasis on current uses in adaptation planning. The potential of reflecting mode deeply on history is most evident within the boundaries of the former Grand Contraband Camp where a court and jail, infrastructure of the carceral state, stand in a place that was once an area of refuge and escape, and is vulnerable to sea level rise (Figure 23). Team PSU proposes that sea level rise provides an important impetus to not only consider

the question of addressing functional adaptation but should also inspire reconsideration of these overlaps, and, whether a prison or jail of any kind should exist in the former space of the Grand Contraband Camp. Moreover, the employment of policies such as buyouts, eminent domain, and other property transfer regimes raises the question of whether these lands may be re-purposed or used in some way to compensate descendants of the Grand Contraband Camp. Although any reconsideration of these spaces should be driven from within the community, Team PSU proposes that the Grand Contraband Camp be marked and memorialized by identifying its boundary, and that remaining significant locations such as the First Baptist Church be formally recognized as a means to begin these conversations within Hampton (Figure 24). Although such designations may challenge conventional definitions of historic districts that privilege in-tact and original structures (material that is more likely to represent the dominant culture), reconsideration of these norms is a significant part of addressing historic injustice (Gibson, Hendricks, and Wells 2019).



Figure 23, Effects of sea level rise in the boundaries of the Grand Contraband Camp. Visualization by Jake Tiernan.



Figure 24, Proposed reconsideration of the Grand Contraband Camp. Proposal and Visualization by Jake Tiernan.

# Conclusion

#### The future we wish to enable

Conscious retreat and reinvention can create a Hampton that is the same and very different at the same time. The Team PSU proposal seeks to bridge the very real and present needs of the community with a future that is both more equitable and ecologically sound. It is not enough that our solutions respond to the changes being experienced in Hampton now; we must also anticipate changing conditions and lay the foundation for the physical and social conditions we'd like to foster in the future. Team PSU's concrete proposals, such as addressing policy gaps, promoting new aesthetic values, and engaging history by marking the boundaries of the grand contraband camp, all support the gradual transformation of Hampton's larger social ecological system and build a resilient and more equitable future for us all.

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# Appendices

# Appendix 1: Methods for Coastal and Social Vulnerability Index Analysis

This analysis consisted of three parts. First, we created a social vulnerability index based on demographic census data that employed principal component analysis to reduce the dimensionality of variables. Additionally, we then created a coastal vulnerability index using coastal geologic, physical, and socio-economic variables across census block groups in Hampton. Finally, these results were visualized using spatial comparisons and ArcGIS.

## Social vulnerability index

To create the social vulnerability index (SoVI), 19 social vulnerability indicators were identified that would influence a person's overall vulnerability to natural hazards and coastal pressures (Table 1). Broadly the social vulnerability indicators span topics of socio-economic status, household composition and disability, minority status and language, and housing type and transportation. The Source column in the table below details the literature that highlight that demographic variable as an important indicator of some type of vulnerability.

Category	Variable	Source	Data Source	Spatial
Socio-economic	Poverty	[1] [2] [3] [4]		
status	Unemployed	[2] [3]		
	Receiving social security	[2]		
	People 25 Years and Over w/ less than 12 Years Education	[1] [2] [3] [4]		
Household	Aged 65 or older	[1] [2] [3] [4]		
Composition and	People with disabilities (all	[1] [4]		
Disability	types)			
	5 years old and under	[1] [2] [3] [4]		
	Female headed household	[2] [3]		
	Single-mother households	[1]	ACS 2019	Census
Minority Status	Black or African American	[2] [3]	5-Year	Block
and Language	Asian	[1] [2] [3]	Estimates	Groups
	Native Hawaiian and Other Pacific Islander	[2]	[5]	
	American Indian and Alaska Native	[2] [3]		
	Hispanic	[2] [3]		
	Speaks English "Not Well"	[1]		
Housing Type	Renting housing	[1] [2] [3]		
and	Mobile homes	[2] [4]		
Transportation	No vehicle	[1] [2] [4]	1	
	No Telephone	[1]	1	

Table 1, Composition of index. Key: [1] (Kleinosky et al., 2007) [2] (Fucile-Sanchez & Davlasheridze, 2020) [3] (Bjarnadottir et al.,2011) [4] (Notre Dame, 2018) [5] (ACS Data, 2019) (all referenced below).

The social vulnerability indicator data was derived from the 2019 American Community Survey (ACS) 5-Year Estimates from the U.S. Census Bureau (ACS Data, 2019). The Block Groups (BGs) geographical unit was selected as this is the smallest spatial scale for which the Bureau publishes data for the household level, allowing for a more in-depth social vulnerability analysis and comparability to flood risk.

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# Appendix 2: Tables of Proposed Statutory Changes

As described in the text, policy changes are an important step in facilitating retreat when it becomes necessary and should be in place to prevent unmitigated financial losses. Team PSU's policy recommendations fall into the categories of downzoning, building code, takings, and transferable development rights. In many cases changes are comparatively minor, and facilitate expanding existing policy to SLR application, or harmonizing policy between entities. We present an overall policy framework (Table 2) and examples from each portion of the policy framework (Table 3 - Table 6).

#### **Overall Policy Framework**

Table 2, Overall Policy Framework. Analysis and Graphic by Lauren Taylor.



#### Downzoning

Table 3, Policy details and main points related to downzoning. Analysis and graphics by Lauren Taylor.

Downzoning: Policy Details		
	Current Policy:	Suggested Revision(s):
Code of Virginia Section 15.2-2283	Specifies purposes of zoning ordinances	Purpose of zoning ordinances should be expanded to include protection of developed areas as a result of flooding or sea level rise
Code of Virginia Section 15.2-2284	Specifies matters to be considered in drawing and applying zoning ordinances and districts	Zoning ordinances and districts shall be drawn and applied with reasonable consideration for the protection of life and property from threats posed by climate change and sea level rise
Code of Virginia Section 15.2-2286	Allows the locality to enter into a voluntary agreement with a landowner to downzone their undeveloped or underdeveloped property in exchange for a tax credit	Allows the locality to downzone the landowner's property to low-density residential, commercial, or mixed-use development in exchange for a tax credit, provided that the landowner's property is located in an area of long-term projected SLR as adopted by the HRPDC Allows the locality to downzone a landowner's
		property to agricultural, parks, or conservation lands use in exchange for a tax credit if their property is located in an area of near-term or mid- term projected SLR as adopted by the HRPDC

# Downzoning: Main Points

Current Policy:	Suggested Revision(s):	
Scope/purpose doesn't include sea level rise considerations	Scope/purpose protects against threats posed be SLR to life and property	
Allows downzoning in exchange for a tax credit	Allows for downzoning of properties in long-term phase of SLR to low-density residential, commercial, or mixed use in exchange for a tax credit	
	Allows for downzoning of properties in near- or mid-term phase of SLR to agricultural, park, or conservation use in exchange for a tax credit	

## Building code

Table 4, Policy details and main points related to statewide building code. Analysis and graphics by Lauren Taylor.

Revise Uniform Statewide Building Code: Policy Details			
	Current Policy:	Suggested Revision(s):	
USBC Section 503	Requires the governing authority to adopt a flood hazard map and supporting data	Revise hazard zones to reflect HRPDC SLR projections	
	Requires substantial repairs or construction of structures in flood hazard areas to comply with flood design requirements	Place stricter rebuilding and repair restrictions on structures that suffer repetive severe losses	
	uesign requirements	<ul> <li>i.e. "Properties that incur at minimum \$xxxx in damages from a flooding event x times in the near-term phase will no longer receive grant funding for rebuilding/repairs"</li> </ul>	
		i.e. "Properties that incur at minimum \$xxxx in damages from a flooding event x times in the near-term phase must relocate within x years."	
USBC Section 1002	Requires structures moved into a flood hazard area to comply with standards in the Code of Virginia	Prohibit structures from being moved into flood hazard or SLR hazard areas unless a proposal is submitted and approved under consideration of unique circumstances	

# Revise Uniform Statewide Building Code: Main Points

Current Policy:		Suggested Revision(s):
Requires map of flood hazard areas	}	Updates flood hazard zones to include sea level rise hazard areas
Requires repaired or rebuilt structures to meet flood design standards	;	Places stricter limitations on structures that suffer multiple severe losses
Allows structures to be moved into flood hazard areas	;	Prohibits structures from being moved into flood or SLR hazard areas unless they meet strict criteria

## Takings

Table 5, Policy details and main points related to takings policy. Analysis and graphics by Lauren Taylor.

Takings: Po	licy Details	
	Current Policy:	Suggested Revision(s):
Code of Virginia Section 25.1-101	Allows a state institution to acquire land or material for constructing or repairing a road for public use	Allows a state institution to acquire land or material for the purpose of discontinuing a road or highway as part of that institution's managed retreat plan provided that other routes are available to reach existing properies
Code of Virginia Section 25.1-406	Requires a state institution to make fair and reasonable payments when acquisition of a property results in displacement	Put procedures in place that make it possible for individuals to find comparable alternative housing
Code of Virginia Section 36-3	Outlines definitions related to housing	Define an area of managed retreat as an area designated by a state institution that is located in an area of projected SLR, such projections as which are adopted by that institution's managed retreat plan
Code of Virginia Section 36-49.3	None existing	Empowers an authority to delineate areas of managed retreat and acquire property within the boundaries of the areas of managed retreat

# Takings: Main Points

Current Policy:		Suggested Revision(s):	
Allows state to acquire land for building or maintaining roads	;>	Allows discontinuation of a road or highway located in an area of projected SLR	
Allows acquisition of a property if state agency makes fair and reasonable payments	;>	Put procedures in place for individuals whose property is taken to find comparable alternative housing	
Allows creation of redevelopment or conservations areas and acquisition of property within these areas	}	Allows creation of areas of managed retreat and allows acquisition of properties within these areas	

#### Transferable Development Rights

Table 6, Policy details and main points related to Transferable Development Rights (TDRs). Analysis and Graphic by Lauren Taylor.

		Policy Details
	Current Policy:	Suggested Revision(s):
Code of Virginia Section 15.2-2316.2	Allows a locality to establish standards for the transfer of development rights within its jurisdiction	Add a provision for prioritization of the transfer of development rights of properties that are identified in the locality's managed retreat plan
	Requires a locality to create a map or other description of areas designated as sending and receiving areas for the transfer of development rights	Map should be required to reflect near-term, mid- term, and long-term phases of SLR projections as adopted by the HRPDC
	Requires a locality to identify parcels within a receiving area that are inappropriate as receiving properties	Identify parcels within the boundaries of projected SLR as inappropriate as receiving properties
	None existing to protect against displacement	Prohibit property owners within sending zones from selling their development rights if it would displace individuals unless they are given fair notice and fair compensation. Prohibit property owners within receiving zones from buying development rights for the purposes of beginning development if it would displace individuals, unless they are given fair notice and fair compensation.

## Transferable Development Rights: Main Points



#### References for policy framework

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# Appendix 3, Plant list comparison

Table 7, Comparison of City of Hampton Plant list (2015) and Virginia Climate Modelling showing potentially vulnerable species. Percentages represent area of suitable habitat mapped by Virginia Climate Vulnerability Assessment. Analysis by Emily Bernhardt.

City of Hampton	Virginia's Climate	Modeling and	Current	Expected
Landscape	Species Vulnerability			Mid 21 <sup>st</sup>
<b>Requirements Plant List</b>	Assessment			Century.
https://hampton.gov/Docu	https://www.nwf.c	org/~/media/PDFs	-	
mentCenter/View/2746/Ci	/Global-Warming/Climate-Smart-			
ty-of-Hampton-Landscape-	Conservation/Virginias%20Climate%			
GuidelinesSept-	20Vulnerability%20Assessment0823			
2015?bidId=	13.ashx			
Live Oak (Quercus	Similar Species	Southern Red	50.80%	30.9%
virginiana)		Oak		
Willow Oak (Quercus		White Oak	96.60%	0%
phellos)		Black Oak	91.60%	0%
Northern Red Oak	Northern Red Oak		87.60%	0%
(Quercus rubra)				
Patented Red Maple (Acer				
rubrum cultivar)				
Red Maple (Acer rubrum)				
River Birch (Betula nigra)	Similar Species	Yellow Birch	98.00%	100.00%
Tulip Tree (Liriodendron	-			
tulipifera)				
Japanese Maple (Acer				
palmatum)				
Japanese Privet (Ligustrum				
japonicum)				
Budford Holly (Ilex cornuta				
'bufordii')				
Nellie R. Stevens Hollu (Ilex				
cornuta 'Nellie R. Stevens')				
Wax Myrtle (Myrica				
cerifera)				
Photinia (Photinia fraseri)				
White Pine (Pinus strobus)	White Pine		25.10%	0.00%
Virginia Pine (Pinus	Similar Species	Shortleaf	31.60%	0.00%
virginiana)				
Loblolly Pine (Pinus taeda)				
Crabapple (Malus hybrida)				
Kwanzan Cherry (Prunus				
serrulata)				
Yoshino Cherry (Prunus				
yedoensis)			1	
Dogwood (Cornus florida)	Similar Species	Flowering	87.2%	0%
Crape Myrtle				
(Lagerstroemia indica)	ļ			
Eastern Redbud (Cercis				
canadensis)				