

MAKING THE ECONOMIC CASE FOR RESILIENCE IN TAMPA BAY

UNDERSTANDING THE ECONOMIC
IMPLICATIONS OF FLOODING AND
SEA LEVEL RISE AND THE BENEFITS
OF ADAPTATION

T A M P A B A Y
PARTNERSHIP



ACKNOWLEDGMENTS

PREPARED FOR:

T A M P A B A Y PARTNERSHIP

Tampa Bay Partnership is a coalition of regional business leaders, joined by a shared commitment to improving the personal and economic well-being of Tampa Bay residents. Through its foundation, the Partnership conducts objective, data-driven research to identify the region's greatest challenges and measure progress toward shared community goals.

CONSULTANT TEAM:



Brizaga is a multi-disciplinary civil and coastal engineering firm built to solve complex problems by strategically leveraging science, communications, and policy. We design, plan, engineer, and communicate innovative and practical adaptation solutions in the face of more frequent flooding, rising tides, and a changing environment. Our team believes in building a lasting relationship with our clients and serving as the partner on their adaptation journey. Learn more at brizaga.com and [@BrizagaHQ](https://twitter.com/BrizagaHQ).



AECOM is the world's premier infrastructure consulting firm, delivering professional services throughout the project lifecycle – from planning, design, and engineering to program and construction management. On projects spanning transportation, buildings, water, energy, and the environment, our public- and private-sector clients trust us to solve their most complex challenges. Our teams are driven by a common purpose to deliver a better world through our unrivaled technical expertise and innovation; a culture of equity, diversity, and inclusion; and a commitment to environmental, social, and governance priorities.



The Tampa Bay Regional Planning Council (TBRPC) brings together governments to coordinate planning for the community's future and provide an opportunity for sharing solutions among the local government jurisdictions in the six-county Tampa Bay region. The TBRPC mission is to serve our citizens and member governments by providing a forum to foster communication, coordination, and collaboration in identifying and addressing issues and needs regionally.

FUNDED BY:

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The Partnership and Consultant Team would like to thank the members of the Project Advisory Group that included staff from cities within the six counties represented in the study.



WELCOME LETTER

As the lightning capital of North America, Tampa Bay is no stranger to the power of Mother Nature. Afternoon thunderstorms during the summertime put on a lightning display that can brighten the darkest sky. Beyond the flashes across the sky, the deluge of rain can also temporarily flood our streets and disrupt our daily lives. These inconveniences are accepted as part of our lives as Floridians.

Phrases like “King Tides” and “Sunny Day Flooding” have entered our vocabulary, reminding us that the impacts of climate change are increasingly affecting our lives. Sea levels continue to rise and, without significant action, there will be more flooding, and more damage to our infrastructure. Eventually, large areas of our community could see flooding so frequently that they will no longer be desirable places to live. We can and must adapt to become more resilient.

Resilience is the ability to thrive and flourish during adverse events. We are all aware of the risk of the “big one” - a catastrophic major hurricane making landfall. However, our region must become more resilient to frequent flooding events and our understanding of how these frequent flooding events will impact our economy has to improve. One purpose of this report is to highlight how damaging the science tells us these flooding events will be to our jobs, our property, and our overall economy.

So, is there any good news? Indeed, there is. This report also makes clear that the benefits of adapting to frequent flooding events – King Tides, tidal flooding, and coastal storms that frequently hit our region – outweigh the cost severalfold. While the costs of adapting – of building greater resiliency – are not small, it is clear that these investments are necessary and have very positive returns.

Understanding this, we can now ask the question: What does adaptation look like for our region? We must strengthen our natural protection along the coast, raise and replace our seawalls, renourish our beaches, and improve critical infrastructure over time.

We must take an “all of the above” approach. Ultimately, we need global solutions to reduce the overall warming of our planet – but, here in Tampa Bay, we cannot afford to wait to act. We must keep front of mind that we are locked into several feet of sea level rise in the coming decades – and we must create a comprehensive plan to adapt and prepare our region for that inevitability.

Building resilience will not be cheap, and we must consider how these challenges and costs will affect our vulnerable and socioeconomically disadvantaged community members. This will require a sustained community conversation and thoughtful decision-making. The Tampa Bay Partnership is committed to being a strong private sector partner working to address our regional adaptation challenges, as well as climate change more broadly. We’ve long thought about what we can do from a business-oriented perspective, and now it is the time to act.

Brian Auld

President, Tampa Bay Rays
Chair, Tampa Bay Partnership
Resilience Task Force



ABOUT THE REGION

Tampa Bay is a powerful and important economic engine and the major population center along the Gulf Coast of Florida. Home to over 3 million people, the region includes the cities of Tampa, St. Petersburg, and Clearwater. It is a world-class tourist destination, and often ranked among the top places to live in terms of quality of life. Tampa International Airport sees over 10 million passengers per year with 175 daily departures.¹ Our study area also includes Port Manatee and Port Tampa Bay, which is the largest port in the state with an economic impact of over \$15 billion.² The University of South Florida, University of Tampa, and MacDill Air Force Base are also major economic drivers of the region.

The region also boasts world-class cultural events, including outdoor water festivals. Tampa Bay is home to major sporting events and several professional sports teams, including the Buccaneers, Lightning, Rays, and Rowdies.

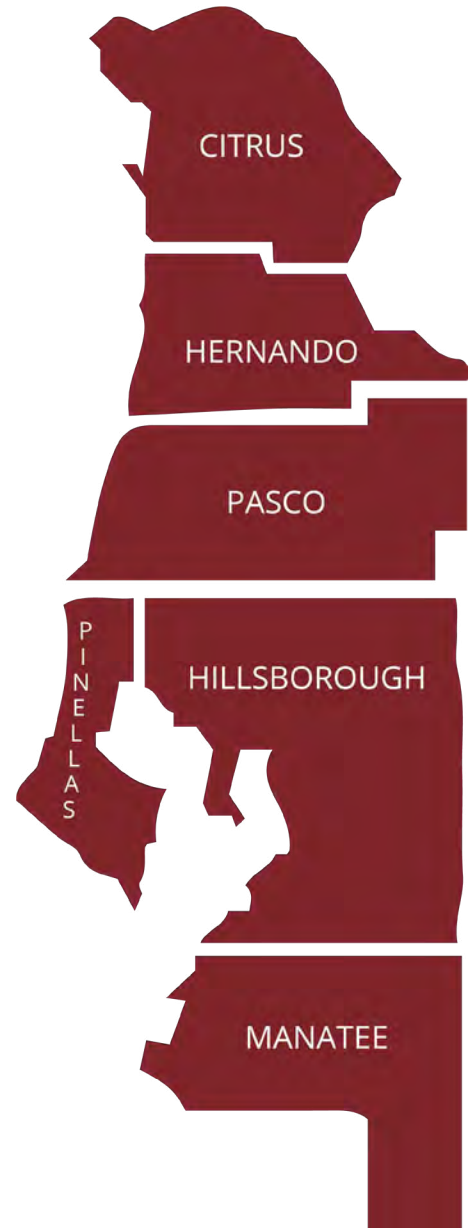
For the Tampa Bay region, the environment is inextricably linked to the economy. Tampa Bay is Florida's largest open-water estuary and home to diverse marine life including bottlenose dolphins, manatee, oysters, scallops, shrimp, and crab. The natural beauty further enhances the tourism of the region.

The water that is so integral to the region also puts it at significant risk of flooding. Climate change and increasing flood risk will greatly impact Tampa Bay and the surrounding area physically, environmentally, and economically. However, the region is organizing to address these challenges.

To learn more about the analysis, a full technical report is available that highlights all of the project findings.

TAMPA BAY REGIONAL ECONOMIC CONTEXT

	\$205 Billion		3.8 Million
	Total Gross Regional Product (GRP)		Population
			2.0 Million
			Jobs



This report estimates the economic and fiscal consequences in Tampa Bay from sea level rise and high frequency coastal storms. It also quantifies the costs and benefits of adaptation to better understand the return on investment of resiliency improvements.

WHAT IS AT RISK IN 2045?

By 2045, daily tidal inundation may result in \$2.9 billion in property value loss.

Permanent sea level rise may result in \$34 million in sales, tourism, and property tax losses annually.

In a 10-year storm tide event, there could be \$2.9 billion in property damages and \$9.7 million in sales and tourism tax losses.

WHAT IS AT RISK IN 2070?

By 2070, daily tidal inundation may result in \$16.9 billion in property value loss.

Permanent sea level rise may result in \$238 million in sales, tourism, and property tax losses annually.

In a 10-year storm tide event, there could be \$6.4 billion in property damages and \$27 million in sales and tourism tax losses.

WHAT IS TAMPA BAY'S BENEFIT-COST RATIO?

Benefit-cost ratio (BCR) is the total present value of benefits conveyed by adaptation divided by the total present value costs of adaptation. For the Tampa region, the return on investment for adaptation is \$2.27 saved for every \$1 spent.



2.27

BENEFIT-COST RATIO

IF ADAPTATION INVESTMENTS TAKE PLACE, THERE COULD BE:

26,410

Total Job Years*
Created In 2020-2024

16,690

Total Job Years*
Created In 2045-2049



*Job years: A job year is equivalent to one year of work for one person. For example, a new construction job that lasts two years will equate to two job years.



PROJECT GOALS

Understanding the economics of sea level rise, flooding, and resilience is essential to encouraging continued action to address the challenges facing communities in the Tampa Bay region. Beyond the physical implications of rising seas, the economic implications of these impacts are an essential component of making informed decisions on how to invest in adaptation and resilience.

To further understand the economic case for resilience in the Tampa Bay region, this study explores:

- **the economic consequences** of flooding and the augmentation of those consequences due to rising sea levels;
- **the economic benefits of adaptation** as a function of risk reduction and avoided economic losses and the opportunities associated with resilience investments; and
- strategies to advance **economic resilience**.



PROJECT OVERVIEW

In order to develop an understanding of the benefit-cost ratio of adaptation, it is necessary to estimate the cumulative costs and benefits associated with taking action to mitigate the modeled coastal hazard risks over the period of analysis (from 2020 to 2070). The economic justification for the modeled scenarios is presented in the form of a benefit-cost ratio whereby the total economic benefits conveyed by adaptation are divided by the total costs of adaptation (in present value). When the ratio of benefits to costs is greater than one, an investment can be considered economically justified. The steps taken to estimate the benefit-cost analysis (BCA) of adaptation are described below:

- (1) Estimate the consequences to assets directly exposed to the modeled coastal hazard conditions in a no action scenario.
- (2) Estimate the costs of adaptation.
- (3) Estimate the residual consequences after investments in adaptation are made.
- (4) Subtract the estimated consequences with adaptation from the estimated consequences in a no-action scenario to calculate net benefits.
- (5) Apply financial discounting to net benefits and costs, and compare a subset of net benefits suitable to BCAs with the costs of adaptation.

CLIMATE CHANGE

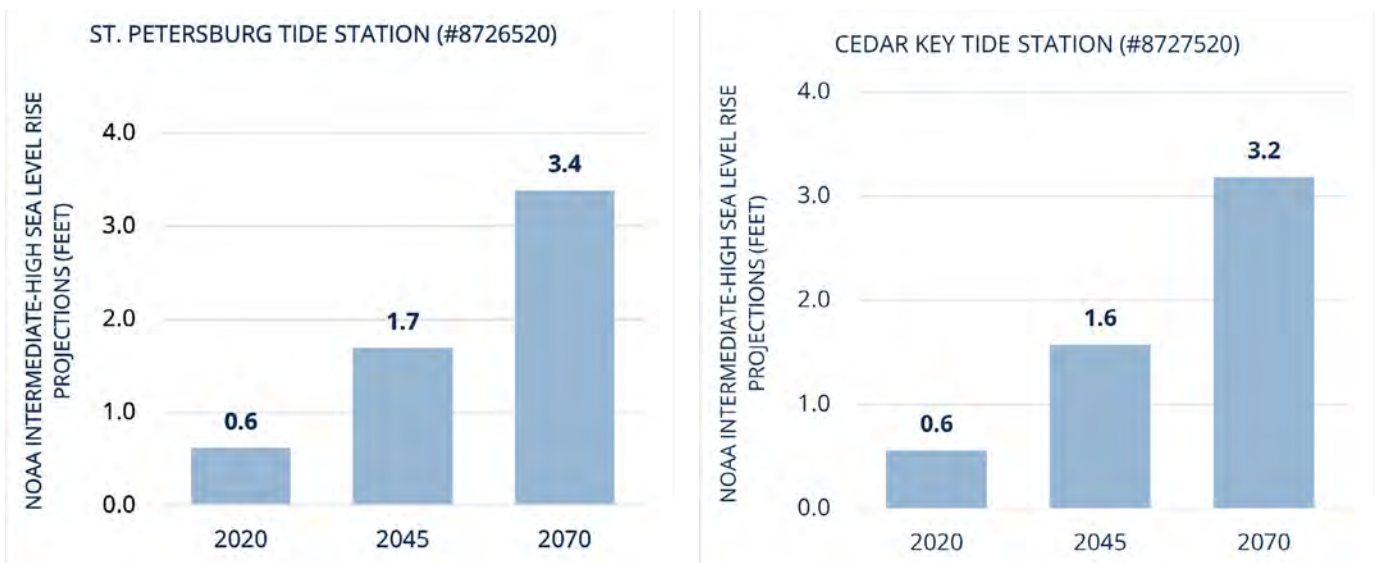
Climate change is caused by heat-trapping gases that warm our atmosphere, creating long-term changes in our natural environment. Human activity has long affected our environment - both directly and indirectly. However, the industrialization of the economy has been powered substantially by the burning of fossil fuels, which release more of these heat-trapping gases. From the type of car you drive to the type of food you consume, each activity has a related greenhouse gas emission. This catalyzes a series of global changes, from the melting of ice caps causing sea levels to rise to rampaging wildfires and the loss of critical ecosystems.

SEA LEVEL RISE

With greenhouse gases warming the atmosphere, melting glaciers are causing sea levels to rise and encroach on previously dry land. In addition to causing the melting of ice, warmer atmospheres also result in our oceans expanding. Known as thermal expansion, water increases in volume when exposed to hotter temperatures. These two mechanisms are the primary cause of sea level rise. Rising sea levels will exacerbate existing flooding types, making it a threat multiplier.

Since the 1930s, tidal stations local to Florida have monitored water levels and have provided essential data towards changing sea level elevations. As part of this report, both the St. Petersburg and the Cedar Key tide station were utilized. The NOAA Intermediate High sea level rise projection was selected to align with criteria defined in the Statewide Flooding and Sea Level Rise Resilience law passed in 2021 (Fla. Stat. § 380.093).

The charts below show the expected increase in sea level, measured in feet, compared to the 2000 baseline for the two tide stations relevant to the Tampa Bay region.



The purpose of this report is to understand the implications of sea level rise on our economy, society, and overall well-being. Specifically, we explore how sea level rise and flooding impacts may be avoided through climate adaptation while fostering the development of policy changes and collaborative action. Eight recommendations are provided to increase economic resilience related to catalyzing local action in reducing greenhouse gas emissions, fortifying the relationships between the public and private sector, and developing strategies toward mitigating flood risk and business disruptions, amongst others.

8 **Adaptation Recommendation #8** details the importance of reducing greenhouse gas emissions. By taking action to mitigate emissions, such as adopting renewable energy technologies, local governments can reduce their economic losses associated with climate change, decrease their future costs of adaptation, and move toward a cleaner future.

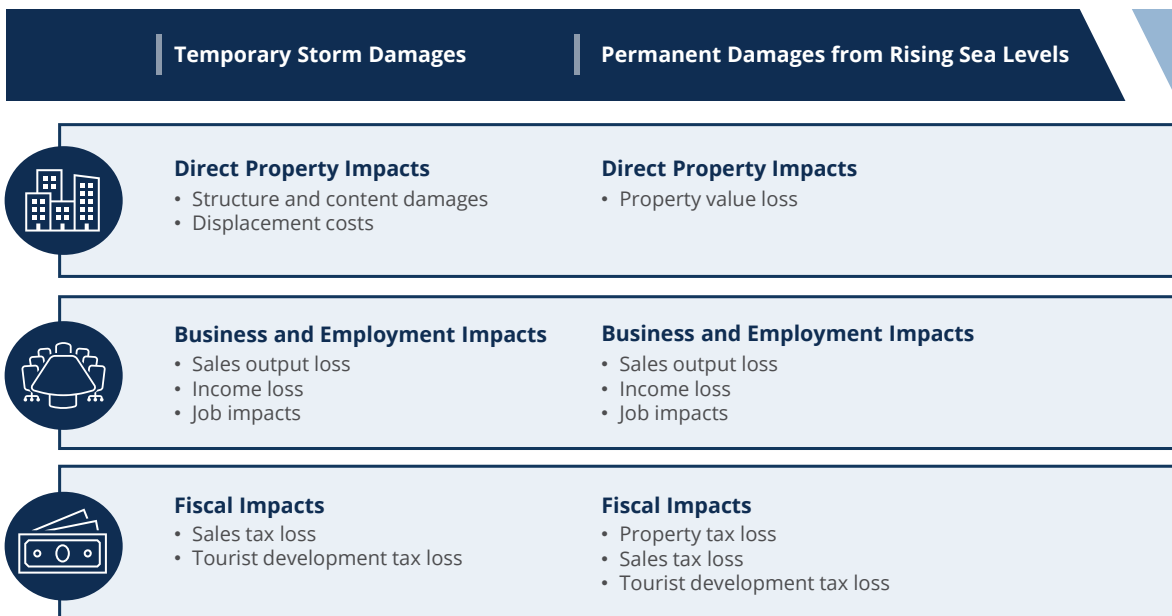
WHY ARE WE AT RISK?

While this study focuses on the economic consequences over the next 50 years, continual sea level rise may occur throughout this century and beyond. It is not necessary, nor likely financially feasible, to adapt all at once to the most extreme hazard scenarios, but it is important to consider that increasing risks can have cascading effects. For example, sea level rise and coastal flooding could undermine the strength of Florida's real estate market and alter the desirability to live and work in coastal communities, which in turn could result in the redistribution of populations and investments, all of which can have significant impacts to the local, regional, and state economy.

HOW IS RISK ASSESSED?

Throughout this study, two primary assessment types were calculated: permanent damages from sea level rise and temporary storm damages. Permanent damages are those associated with mean higher high water (MHHW) or daily tidal inundation. Temporary storm damages are those that are related to the 1-Year tide or 10-Year storm tide event, which is an isolated event. To examine these conditions, a tool called the Flood Master Tool Suite, developed by the Tampa Bay Regional Resilience Coalition was used.

The tool created flooding and inundation maps that could inform which public and private assets are exposed to the modeled high-frequency coastal conditions. The economic implications of these frequent events are not as readily understood. These events will get noticeably worse as sea levels rise. However, adaptation can substantially reduce flooding from these higher frequency events.



TAMPA BAY'S REGIONAL COMMITMENT TO RESILIENCE

The Tampa Bay region is working collectively to address climate change, flooding, and sea level rise. The Tampa Bay Regional Planning Council (TBRPC) is leading regional coordination on resilience planning, including through the Tampa Bay Regional Resilience Coalition (TBRRC). The Resilience Coalition currently includes 32 members comprised of Citrus, Hernando, Hillsborough, Manatee, Pasco, Pinellas and Sarasota Counties and 25 municipalities, who come together to develop regional resilience goals and strategies. TBRPC is developing a Regional Resiliency Action Plan, and has received grants from the Florida Department of Environmental Protection to coordinate resilience planning across the region.



FLOOD TYPES

At face value, it is difficult to identify the source of flooding if not directly seeing rain falling from the sky or waves crashing onto normally dry land. Flooding occurs in many different processes, but is generally linked to rainfall, tides, or strong storms, such as hurricanes.



Tidal Flooding/King Tides

Associated with seasonal high tides, this type of flooding, also known as sunny day flooding, is subject to changing weather conditions, as well as phases of the moon. As sea levels rise, so too will tides, exacerbating flooding in low-lying coastal areas.



Rainfall-Induced Flooding

This refers to flooding associated with rain events, such as thunderstorms, tropical systems, and cold fronts. A changing climate is exacerbating the abundance of rain events.



Hurricanes and Storm Surge

As more frequent and stronger storms occur, hurricanes bring high-speed winds that drive waves ashore, known as storm surge, which can flood inland areas.

FLOOD RISK

The Tampa Bay region is known for its beautiful waterfront, welcoming atmosphere, and vibrant community. Protecting the integrity of the Tampa Bay region, especially the well-being of its citizens and assets, is integral as sea level continues to rise. What makes Tampa Bay inherently vulnerable to these challenges is its low-lying coastline, which is subject to tidal flooding and storm surge. While there is often talk of the big storm – the catastrophic major hurricane – the frequent flooding analyzed in this report can have major economic consequences for the region.

The economic implications of frequent flooding events are less understood than potential catastrophic events. This is in part because sea level rise is a relatively new phenomenon. However, these are exactly the type of events in which infrastructure investments geared toward adaptation can greatly reduce the impact. Investments in resilience warrant the opportunity to minimize flood risk and provide substantial protection in both the short and long term.

The investments, adaptation recommendations, and approaches to managing flooding position Tampa Bay with an unparalleled opportunity to advance toward a more resilient, sustainable, and equitable future. However, it is crucial that the management of flood risk is not in the hands of solely one sector, government, or community. Public and private partnerships are requisite to combat these increasing challenges, along with the sharing of resources and knowledge, so that everyone may work toward a more climate-ready future.



REGIONAL ECONOMIC IMPACTS AVOIDED WITH ADAPTATION

There is a compelling case to make for Tampa Bay to invest in resilience right now. Resilience investments in infrastructure, utilizing both green and gray engineering practices, provide considerable protection to the region's assets. If no adaptation action takes place, the economic losses are substantial to each of the six counties. However, as detailed in the charts below, investments in adaptation infrastructure are anticipated to prevent over 80 percent of these economic losses outright.

COUNTY	PROPERTY IMPACTS
CITRUS	\$4,828,850,000
HERNANDO	\$1,566,550,000
HILLSBOROUGH	\$16,200,150,000
MANATEE	\$19,170,050,000
PASCO	\$4,152,250,000
PINELLAS	\$35,688,100,000
TAMPA BAY TOTAL	
\$81,605,950,000	



84%
TOTAL IMPACTS
AVOIDED WITH
ADAPTATION

COUNTY	SALES AND TOURISM TAX IMPACTS
CITRUS	\$108,800,000
HERNANDO	\$4,250,000
HILLSBOROUGH	\$595,000,000
MANATEE	\$151,300,000
PASCO	\$28,050,000
PINELLAS	\$406,300,000
TAMPA BAY TOTAL	
\$1,293,700,000	



82%
TOTAL IMPACTS
AVOIDED WITH
ADAPTATION

COUNTY	SALES OUTPUT IMPACTS
CITRUS	\$1,317,500,000
HERNANDO	\$148,750,000
HILLSBOROUGH	\$6,525,450,000
MANATEE	\$2,869,600,000
PASCO	\$629,000,000
PINELLAS	\$5,151,850,000
TAMPA BAY TOTAL	
\$16,642,150,000	



83%
TOTAL IMPACTS
AVOIDED WITH
ADAPTATION

COUNTY	PROPERTY TAX IMPACTS
CITRUS	\$38,250,000
HERNANDO	\$11,900,000
HILLSBOROUGH	\$162,350,000
MANATEE	\$416,500,000
PASCO	\$23,800,000
PINELLAS	\$330,650,000
TAMPA BAY TOTAL	
\$983,450,000	



82%
TOTAL IMPACTS
AVOIDED WITH
ADAPTATION

UNDERSTANDING ADAPTATION



Seawall Replacement: As the first line of defense against storm surge, seawalls protect assets on land through their ability to prevent erosion. Seawalls require replacement after they have served their lifespan, typically 40 to 50 years, and would result in the replacement of a new seawall in front of the old wall.



Seawall Raising: As new land use ordinances come to light, the raising of a seawall cap will be required to combat rising sea levels.



Berm Construction: Berms are raised and rounded soil barriers that separate one area from another. New berms would be required to protect impacted development inland of soft/natural shorelines.

Berm Raising: The purpose of raising a berm is to add enhanced protection to an area as sea levels rise.



Beach Nourishment: Considered a soft engineering practice, beach nourishment is the practice of replenishing beaches through the addition of sand or sediment that naturally enhances the beach's ability to mitigate erosion, and provides a healthy and aesthetically pleasing environment.



Elevate Structures: This permanent solution raises structures and other assets above flood levels, ensuring that it has a raised finish floor elevation. This may result in reductions to flood insurance costs through the National Flood Insurance Program (NFIP).



Floodproof Structures: Wet and dry floodproofing are modifications of existing or new buildings that prevent water from entering a specific area. It usually needs to be designed to include a temporary system that allows property or building access during normal conditions.

THE COST OF ADAPTATION

The impacts from flooding will affect all six counties in Tampa Bay substantially if no adaptation action takes place. However, there are opportunities to adapt. The below shows the costs of adaptation for select adaptation strategies modeled for the six counties in two investment phases.

THE COST PER ADAPTATION STRATEGY FOR EACH COUNTY (2021 DOLLARS)

ADAPTATION STRATEGY	CITRUS	HERNANDO	HILLSBOROUGH	MANATEE	PASCO	PINELLAS
IMPLEMENTATION START YEAR = 2021, LEVEL OF PROTECTION = 2045						
SEAWALL REPLACEMENT	\$323,000,000	\$277,000,000	\$682,000,000	\$610,000,000	\$533,000,000	\$1,820,000,000
SEAWALL RAISING	\$0	\$0	\$0	\$0	\$0	\$0
BERM CONSTRUCTION	\$575,000,000	\$108,000,000	\$839,000,000	\$875,000,000	\$306,000,000	\$751,000,000
BERM RAISING	\$0	\$0	\$0	\$0	\$0	\$0
NOURISHMENT	\$0	\$0	\$3,000,000	\$12,000,000	\$0	\$16,000,000
ELEVATE STRUCTURES	\$38,000,000	\$9,000,000	\$23,000,000	\$22,000,000	\$7,000,000	\$16,000,000
FLOODPROOF STRUCTURES	\$1,000,000	\$0	\$0	\$0	\$0	\$1,000,000
TOTAL	\$937,000,000	\$394,000,000	\$1,547,000,000	\$1,519,000,000	\$846,000,000	\$2,604,000,000
TAMPA BAY TOTAL	\$7,848,000,000					
IMPLEMENTATION START YEAR = 2045, LEVEL OF PROTECTION = 2070						
SEAWALL REPLACEMENT	\$3,000,000	\$14,000,000	\$177,000,000	\$79,000,000	\$78,000,000	\$366,000,000
SEAWALL RAISING	\$239,000,000	\$205,000,000	\$505,000,000	\$452,000,000	\$369,000,000	\$1,349,000,000
BERM CONSTRUCTION	\$38,000,000	\$0	\$0	\$291,000,000	\$127,000,000	\$441,000,000
BERM RAISING	\$93,000,000	\$18,000,000	\$117,000,000	\$142,000,000	\$50,000,000	\$122,000,000
NOURISHMENT	\$0	\$0	\$0	\$12,000,000	\$0	\$16,000,000
ELEVATE STRUCTURES	\$63,000,000	\$5,000,000	\$49,000,000	\$44,000,000	\$15,000,000	\$49,000,000
FLOODPROOF STRUCTURES	\$2,000,000	\$0	\$2,000,000	\$1,000,000	\$0	\$2,000,000
TOTAL	\$438,000,000	\$242,000,000	\$850,000,000	\$1,021,000,000	\$639,000,000	\$2,345,000,000
TAMPA BAY TOTAL	\$5,537,000,000					

**TAMPA BAY TOTAL ADAPTATION COSTS
FROM 2021-2070: \$13,385,000,000**

IMPACT TO LOCAL GOVERNMENTS



Fiscal impacts are those that directly impact the finances of a local government. Fiscal impacts under a no-action scenario are shown below, categorized by sales tax losses, tourism tax losses, and property tax losses. These three tax mechanisms are essential sources of revenue for the local governments. Property tax loss is only examined under a permanent sea level rise scenario. The gray shaded boxes are calculations not identified as part of this report.

EVENTS-BASED FISCAL IMPACTS, NO ACTION SCENARIO (2021 DOLLARS)

COUNTY	2020 CONDITIONS		2045 CONDITIONS			2070 CONDITIONS		
	1-YEAR TIDE	10-YEAR TIDE	MHHW	1-YEAR TIDE	10-YEAR TIDE	MHHW	1-YEAR TIDE	10-YEAR TIDE
CITRUS COUNTY								
SALES TAX LOSS	\$7,000	\$216,000	\$1,042,000	\$1,000	\$314,000	\$1,742,000	\$5,000	\$2,633,000
TOURISM TAX LOSS	\$6,000	\$180,000	\$869,000	\$0	\$262,000	\$1,451,000	\$4,000	\$2,195,000
PROPERTY TAX LOSS			\$1,003,000			\$3,086,000		
HERNANDO COUNTY								
SALES TAX LOSS	\$17,000	\$18,000	\$44,000	\$0	\$19,000	\$44,000	\$0	\$27,000
TOURISM TAX LOSS	\$13,000	\$14,000	\$34,000	\$0	\$25,000	\$34,000	\$0	\$21,000
PROPERTY TAX LOSS			\$183,000			\$1,166,000		
HILLSBOROUGH COUNTY								
SALES TAX LOSS	\$678,000	\$799,000	\$4,080,000	\$2,000	\$782,000	\$51,459,000	\$2,000	\$3,531,000
TOURISM TAX LOSS	\$542,000	\$639,000	\$3,264,000	\$2,000	\$626,000	\$41,167,000	\$1,000	\$2,824,000
PROPERTY TAX LOSS			\$3,249,000			\$14,667,000		
MANATEE COUNTY								
SALES TAX LOSS	\$53,000	\$661,000	\$2,088,000	\$0	\$221,000	\$4,291,000	\$0	\$493,000
TOURISM TAX LOSS	\$41,000	\$508,000	\$1,606,000	\$0	\$170,000	\$3,301,000	\$0	\$380,000
PROPERTY TAX LOSS			\$7,722,000			\$36,982,000		
PASCO COUNTY								
SALES TAX LOSS	\$54,000	\$141,000	\$174,000	\$5,000	\$372,000	\$1,071,000	\$3,000	\$545,000
TOURISM TAX LOSS	\$31,000	\$81,000	\$99,000	\$3,000	\$213,000	\$612,000	\$2,000	\$312,000
PROPERTY TAX LOSS			\$308,000			\$3,042,000		
PINELLAS COUNTY								
SALES TAX LOSS	\$227,000	\$545,000	\$2,214,000	\$202,000	\$3,611,000	\$15,040,000	\$282,000	\$7,632,000
TOURISM TAX LOSS	\$195,000	\$467,000	\$1,897,000	\$173,000	\$3,095,000	\$12,892,000	\$242,000	\$6,542,000
PROPERTY TAX LOSS			\$3,552,000			\$45,894,000		
TAMPA BAY TOTAL	\$1,864,000	\$4,269,000	\$33,428,000	\$388,000	\$9,710,000	\$237,941,000	\$541,000	\$27,135,000

BENEFIT-COST OF ADAPTATION

In order to develop an understanding of the benefit-cost ratio of adaptation, it is necessary to estimate the cumulative costs and benefits associated with taking action to mitigate the modeled coastal hazard risks over the period of analysis (i.e., from 2020 to 2070). The economic justification for the modeled scenarios is presented in the form of a benefit-cost ratio, whereby the total present value of benefits conveyed by adaptation are divided by the total present-value costs of adaptation. When the ratio of benefits to costs is greater than one, an investment can be considered economically justified.

 <p>COMMUNITY-WIDE ADAPTATION</p>	<ul style="list-style-type: none"> • Beach nourishment / Dune restoration • Seawall construction/Raising • Berm construction 	<p>This scenario involves a combination of soft and hard engineering investments at the shoreline. These strategies were applied to areas with higher density of impacted development and a subset of critical facilities.</p>
 <p>BUILDING-LEVEL ADAPTATION</p>	<ul style="list-style-type: none"> • Dry and wet floodproofing • Elevating structures 	<p>This scenario involves a combination of structural improvements to property, the application of which is dependent on building type and FEMA principles and procedures. These strategies were applied to impacted buildings in areas of low-density impacted development.</p>

 **THERE IS A 2.27 BENEFIT-COST RATIO FOR ADAPTATION IN THE TAMPA BAY REGION**

PUBLIC-PRIVATE PARTNERSHIP FOR RESILIENCE INVESTMENTS

The cost burden is too significant for any one sector to carry alone, and there are many impacted parties. Adaptation to climate change does not fit well within jurisdictional boundaries or property lines. For example, as roadways are raised, so too are driveways and other portions of private property. Overall, high-level estimates were made to determine the split of private vs. public investing.



JOB CREATION WITH ADAPTATION



If adaptation action takes place, there could be:

In 2020-2024
Total Job Years Created = 26,410

In 2045-2049
Total Job Years Created = 16,690

The table below highlights the impacts to the economy on employment for each county for the two modeled phases of adaptation investments. Overall, it is anticipated that investing in adaptation will support a significant number of jobs, primarily in the construction industry and supporting professional services.

ECONOMIC INDICATORS FOR COMMUNITY-WIDE ADAPTATION SCENARIO SHOWN IN TWO PHASES

ECONOMIC INDICATORS	INVESTMENTS IN FIRST PHASE (2020 THROUGH 2024)	INVESTMENTS IN SECOND PHASE (2045 THROUGH 2049)
	COMBINED DIFFERENCE FROM BASELINE	COMBINED DIFFERENCE FROM BASELINE
CITRUS COUNTY		
JOB YEARS	3,060	3,020
HERNANDO COUNTY		
JOB YEARS	670	710
HILLSBOROUGH COUNTY		
JOB YEARS	12,860	7,820
MANATEE COUNTY		
JOB YEARS	3,270	2,930
PASCO COUNTY		
JOB YEARS	1,730	1,360
PINELLAS COUNTY		
JOB YEARS	4,820	850
TAMPA BAY (TOTAL) JOB YEARS	26,410	16,690

JOB YEARS: A JOB YEAR IS EQUIVALENT TO ONE YEAR OF WORK FOR ONE PERSON. FOR EXAMPLE, A NEW CONSTRUCTION JOB THAT LASTS TWO YEARS WILL EQUATE TO TWO JOB YEARS.

ECONOMIC AND SOCIAL EQUITY CONSIDERATIONS

The impacts of climate change will not be felt by everyone equally. Vulnerable populations and disadvantaged communities will feel the impacts of climate change first and hardest, and are often referred to as frontline communities. A major theme superimposed throughout this study is the consideration of equity within every stage of the assessment process. Viewing equity through a resilience lens fosters a comprehensive outlook of the opportunities and challenges that arise when investing in resilience. Being mindful of the potential cost implications of adaptation on frontline communities alongside social resilience strategies that benefit all Tampa Bay residents, is a primary objective of this assessment.

It is crucial that an investment or action taken to advance resilience does not alternatively harm or inhibit a certain community from advancing alongside the investment benefits. Protective investments can help to minimize the shocks from coastal hazards, but they will not address underlying chronic stresses present in local and regional economies (e.g., social equity, poverty, unemployment, lack of industry diversification) that will affect the capacity of communities to respond to and recover from immediate and more distant coastal hazard risks. Driving transparency and prompting open, honest conversations, enables a holistic decision-making process that heeds socially sensitive issues, any major discrepancies, and the ranging spectrum of equity from the very start of an action.

Communities must identify the underlying structural factors that will affect their ability to be resilient to changing conditions. This includes developing an understanding of the strengths and weaknesses of local and regional economies, and identifying opportunities for improving business-as-usual practices so communities do not just survive but are best positioned to thrive. This will require investment in strategic policies, programs, and projects that can enhance the quality of life in communities, including improved access to housing and jobs and the strengthening of institutions that can facilitate these gains.

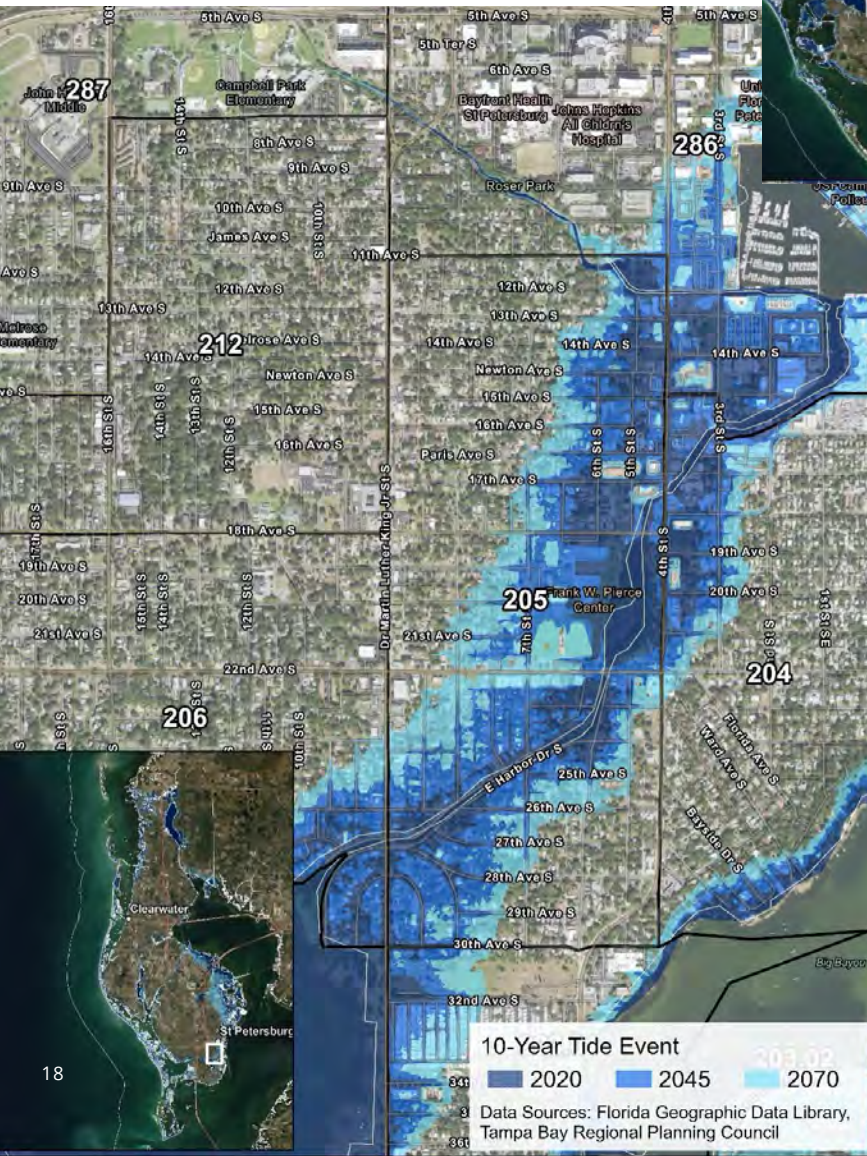
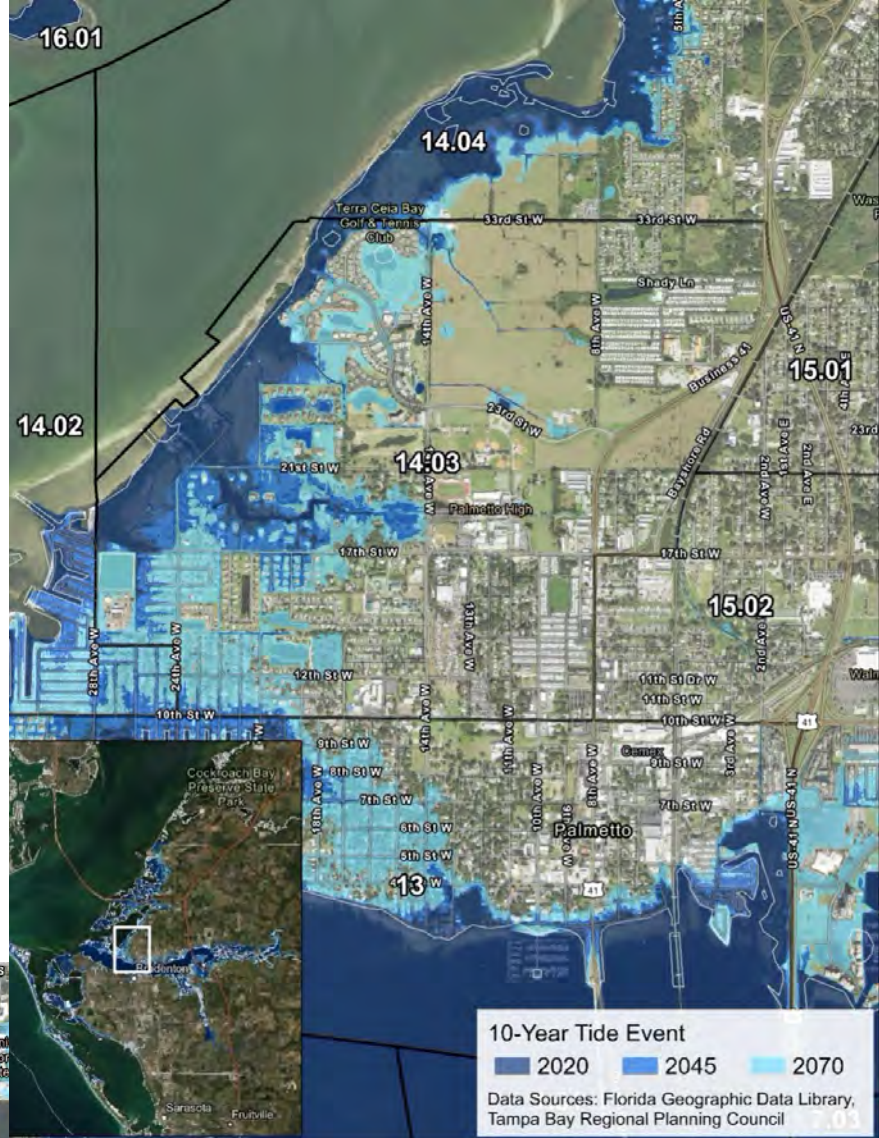


EQUITY SNAPSHOTS

PALMETTO, MANATEE COUNTY

Housing Type & Transportation Focus

Census tract 14.03 in the City of Palmetto was ranked the eighth highest for the AECOM Social Equity and Flood Index ranking for the 2070 10-year storm tide event in Manatee County. This neighborhood includes the manufactured housing community of Palmetto Mobile Home Club and falls in the 91st percentile for concentration of mobile homes as a share of all housing units. Mobile homes are typically more vulnerable to coastal hazards compared to non-mobile homes, as a lack of a strong basement can increase flooding and geographic isolation can limit transportation accessibility.³ In the 2070 10-year storm tide event, this tract would suffer over 30 percent inundation.



BARTLETT PARK, PINELLAS COUNTY

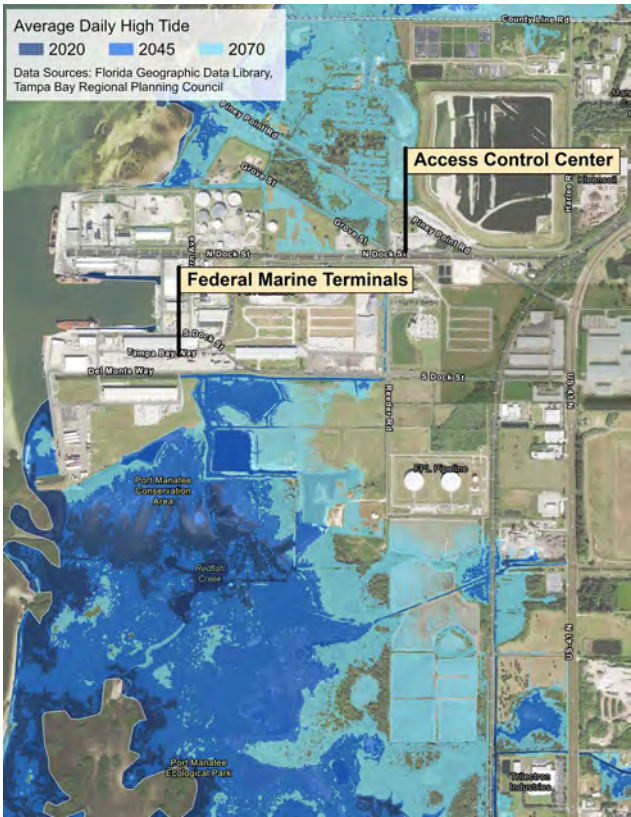
Socio-Economic, Minority & Language Status and Housing Type & Transportation Focus

Census Tract 205 in the Bartlett Park neighborhood ranked sixth for the AECOM Social Equity and Flood Index ranking for the 2070 10-year storm tide event in Pinellas County. Social vulnerability in this neighborhood is driven by the share of population living in group quarters (89th percentile), living in poverty (98th percentile), and percent minority (all people except white, non-Hispanic) (89th percentile). In the 2070 10-year storm tide event, inundation from the rising waters of Salt Creek (which connects Tampa Bay to Lake Maggiore) results in nearly 57 percent inundation of this socially vulnerable

CASE STUDIES

Case studies were conducted to better understand at a more localized level the impacts of a storm event, and to bring in other information specific to economic impacts of key destinations. Additional case studies were assessed and can be found in the full technical analysis.

PORT MANATEE



The map indicates the extent of flooding for average daily high tide for Port Manatee.

Both Port Tampa Bay and Port Manatee represent major infrastructure assets, important global hubs, and strategic economic drivers in the Tampa Bay region. In the fiscal year 2020, Port Manatee processed over 88,000 TEUs (over 9 million tons) including almost 400 million gallons of fuel. Port Manatee supports over 3,500 on-site jobs and over 27,000 in the region.⁴ Port Manatee’s contribution to the regional economy totals \$17 billion in economic output, in addition to over \$600 million in state and local taxes.⁵

Both Port Tampa Bay and Port Manatee are particularly susceptible to both flooding and high winds due to their location and the fact that a majority of their operations occur outdoors. These maps show flooding for 10-year storm tide events for Port Tampa Bay and Port Manatee respectively. Both maps show that while the container terminals are safe from flooding even during a 10-year storm tide event in 2070, the access control center and several access roads are susceptible to flooding, thereby affecting the ability of workers to access the container terminals and disrupting the intermodal cargo

DOWNTOWN TAMPA



The map indicates the extent of flooding for annual tide events for the Port Tampa Cruise Terminal in the Downtown Tampa area.

Downtown Tampa is a growing economic center in the region and a destination for many out-of-region and out-of-state visitors. Economic landmarks include the Tampa Bay Convention Center as well as several of Port Tampa Bay Cruise terminals. Temporary closure of Tampa Bay Cruise Terminals and the Tampa Convention Center could have cascading effects to the local economy, and in particular, to the hospitality industry. Three indicators of economic losses are further explained in the main report including: business revenue losses, wage losses, and decreased consumer spending in the region as a result of fewer out-of-region visitors.

A disruption in cruise terminal operations has three economic consequences to the region. First, by stopping operations, Port Tampa does not receive revenue from the ship. Revenue categories include docking fees, services to assist with docking and undockings, garbage disposal, and security. The revenue lost per ship (assuming the average ship size of 4,200 passengers) totals \$1.2 million.⁶ The second component is the loss of the direct and indirect wages associated with the docking ship. Direct wages refer to jobs performed on-site and indirect wages are for jobs related to the ship but performed off-site, such as travel agency commissions or land transportation.

RECOMMENDATIONS

1. PRIORITY SOCIAL EQUITY IN PLANNING AND RESPONSE

Identifying and acknowledging the disparate impact of both disasters and disaster response programs is the first step to establishing equitable climate-resilient solutions. Coastal hazards often impact certain communities and populations disproportionately, especially communities of color, low-income individuals, people with disabilities, youth, elderly, and incarcerated individuals. One approach to incorporating equity in resilience planning is to reconsider the traditional approach to benefit-cost analysis, which is often a key part of the decision-making for weighing different investments.

2. MITIGATE FLOOD RISK THROUGH LAND USE AND INFRASTRUCTURE PLANNING

Cities and regions can reduce the exposure and vulnerability of households, businesses, and properties during a flood by carefully considering and addressing the risk of flood damage in land use and infrastructure planning decisions, as well as in zoning, building codes, and other local regulations. Another approach is to use incentive zoning to encourage developers to build in lower-risk areas and take actions to improve resilience. In areas where adaptation is not sufficient to protect people and properties, managed retreat can help facilitate transitions away from vulnerable areas. Best practice recommendations for incorporating social justice considerations into program design include: establishing transparent criteria for deciding which properties are eligible for buyout; intentionally considering where residents will relocate to; and involving low-income and minority communities in participatory planning processes.

3. INCREASE AWARENESS ABOUT CLIMATE RISK TO INFORM REAL ESTATE INVESTMENT DECISIONS

At some point in the future, economic and financial realities will demand that climate risk is better accounted for in investment decision-making. One way the public sector can help is by establishing uniform tools and standards for assessing risk. The public sector can also encourage investors to consider climate-related risks by requiring or incentivizing flood risk disclosure in real estate transactions.

4. FOCUS ADAPTATION MEASURES ON KEY SECTORS OF THE ECONOMY

Industry vulnerabilities to climate hazards can stem both from location (e.g., for firms that operate near the coast) and from the interdependencies among industries. Businesses located further inland may be less vulnerable to coastal flooding but may still be at risk of inland flooding or dependent on tourists who come to the region primarily because of coastal and ocean attractions. At the level of individual firms and institutions, economic anchors (e.g., large corporations, hospitals, universities, sports franchises, leisure and culture institutions) play an outsized role in the economy through their employment, spending and investment, generation of knowledge and incubation, and support for new businesses.

5. ENGAGE WITH AND PROVIDE SUPPORT TO THE SMALL BUSINESS COMMUNITY

Assisting small businesses with disaster preparedness and recovery is critical. This includes conducting outreach to small businesses before a disaster occurs to better understand their needs; making use of technology to improve communications before, during, and after disasters; and developing partnerships between the public sector and local chambers of commerce, trade associations, civic associations, and other trusted measures. Beyond improving communications and outreach, economic development agencies can assist businesses in preparing for disasters by providing technical assistance to aid with business continuity planning. Business continuity plans should account for both on-site vulnerabilities to coastal hazards, as well as off-site vulnerabilities such as impacts to lifeline infrastructure that can affect the ability of employees to get to work.

6. ESTABLISH A ROADMAP TO A RESILIENT WORKFORCE

Communities should develop coordinated workforce and economic development strategies. In particular, a coordinated “roadmap to a resilient workforce” could focus on developing career pathways and providing workforce training aimed at transitioning vulnerable workers to higher-paying jobs, including jobs in high-growth and emerging “green” industries, growing the local labor pool capable of providing the services needed to prepare for and recover from coastal hazard events, and reducing gender and race inequality in labor force participation and earnings.

7. DEVELOP STRATEGIC IMPLEMENTATION PLANS AND MONITOR EFFECTIVENESS OVER TIME

Public agencies should work with non-governmental organizations, the business community, and philanthropic and civic institutions to develop strategic implementation plans that include clear criteria for project prioritization, identify appropriate funding and financing tools, and assign responsibilities for implementation. Project prioritization criteria should be transparent, standardized, and responsive to local community needs. For example, criteria can be tailored to consider factors such as funding availability, local job creation, directing investments to historically disinvested communities, supporting sustainable development patterns and the region’s overall economic competitiveness, and maintaining the continuity of community lifeline services such as energy, water, transportation, communications, infrastructure, and emergency shelter. Potential adaptation investments should be evaluated for potential tradeoffs as well as co-benefits (e.g., providing community amenities, access to open space).

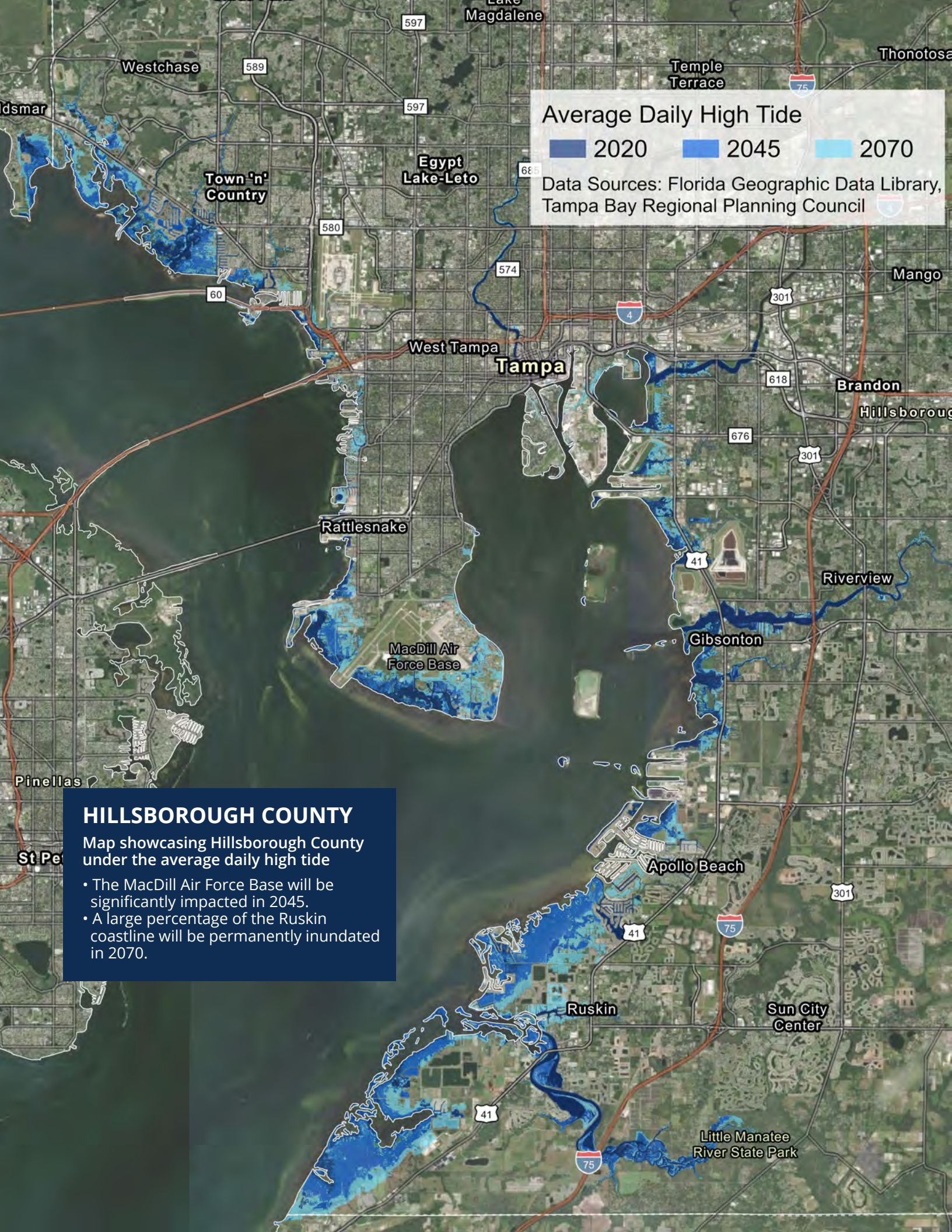
8. TAKE LOCAL ACTION TO REDUCE GREENHOUSE GAS EMISSIONS

Both global mitigation (or GHG emission reduction) efforts as well as local adaptation (or resilience) strategies will ultimately be necessary to reduce the risk and help avoid economic losses due to flooding in the Tampa region and around the world. When combined with an increased level of federal action, state and local actions could potentially reduce U.S. emissions by 49 percent by 2030 – a level that is consistent with the goal of limiting global warming to 1.5°C. The City of Tampa is preparing to conduct an updated GHG inventory in 2021 and develop a Climate Action and Equity Plan to guide future efforts to adopt clean energy technologies.⁷

An aerial photograph of a city, likely Miami, showing a dense urban area with numerous skyscrapers and buildings. A large river or canal winds through the city, with a large cruise ship docked at a pier. The sky is blue with some clouds. A dark blue rectangular box is overlaid on the center of the image, containing white text.

MAPPING THE IMPACT

Maps depicting each flooding type for each county in the study area are included in the full technical analysis.



Average Daily High Tide

2020 2045 2070

Data Sources: Florida Geographic Data Library,
Tampa Bay Regional Planning Council

HILLSBOROUGH COUNTY

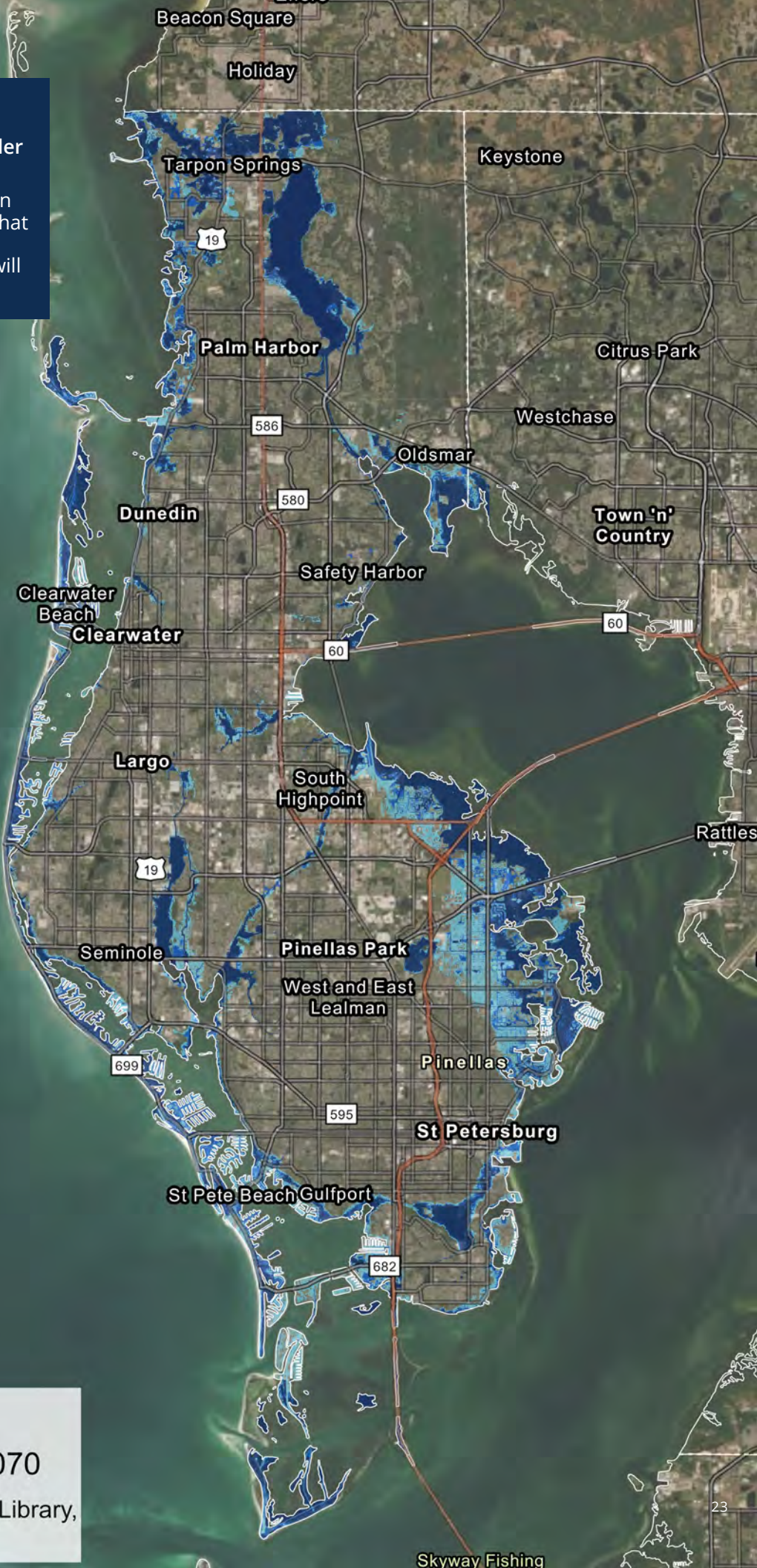
Map showcasing Hillsborough County under the average daily high tide

- The MacDill Air Force Base will be significantly impacted in 2045.
- A large percentage of the Ruskin coastline will be permanently inundated in 2070.

PINELLAS COUNTY

Map showcasing Pinellas County under the 10-year storm tide event

- There is a significant low-lying portion of the peninsula along the bayfront that will be impacted by the storm event.
- Even areas along inland waterways will experience impacts.



10-Year Tide Event

2020 2045 2070

Data Sources: Florida Geographic Data Library,
Tampa Bay Regional Planning Council

Average Daily High Tide

■ 2020 ■ 2045 ■ 2070

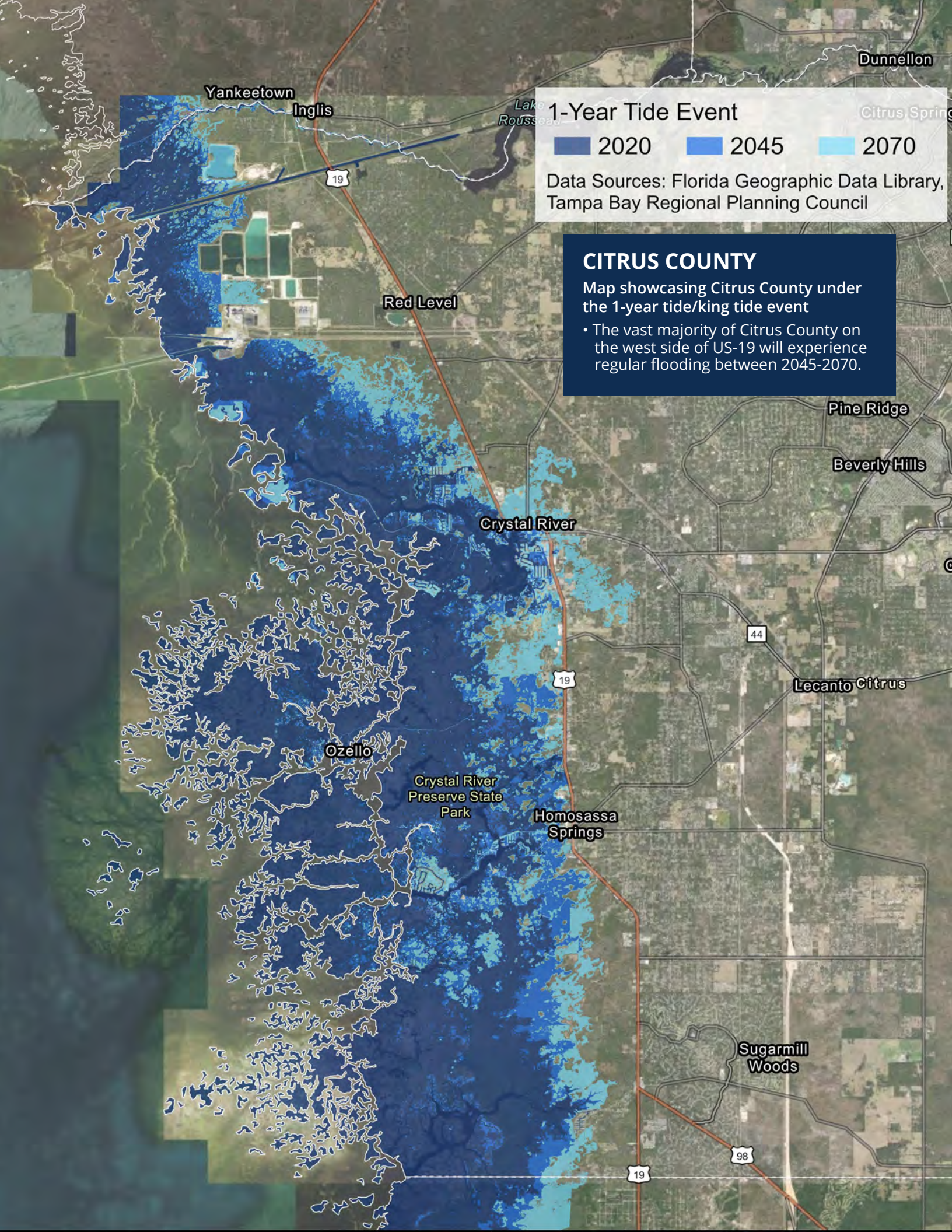
Data Sources: Florida Geographic Data Library,
Tampa Bay Regional Planning Council

PASCO COUNTY

Map showcasing Pasco County under the average daily high tide

- The vast majority of Pasco County on the west side of US-19 will experience regular flooding between 2045-2070.





1-Year Tide Event

2020 2045 2070

Data Sources: Florida Geographic Data Library, Tampa Bay Regional Planning Council

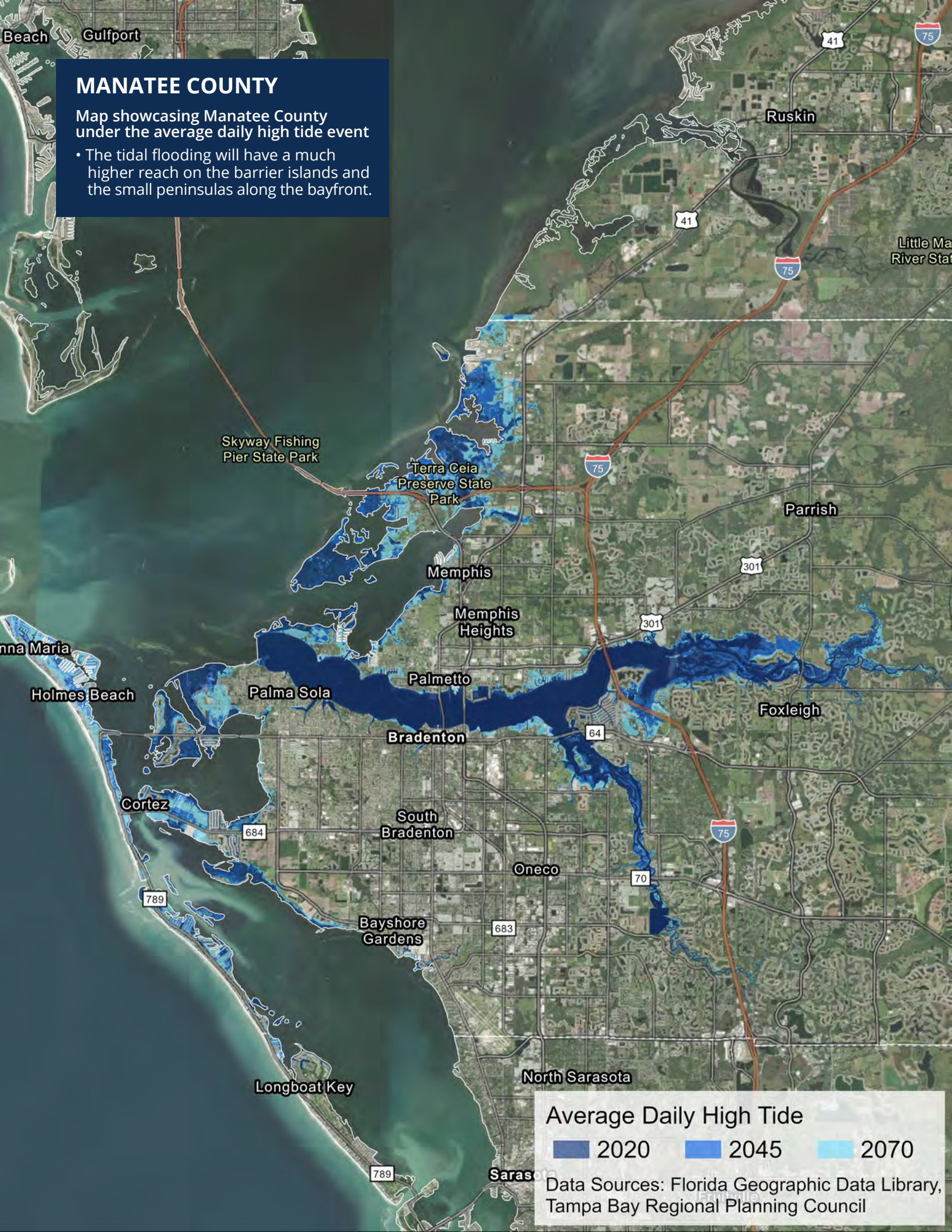
CITRUS COUNTY
Map showcasing Citrus County under the 1-year tide/king tide event

- The vast majority of Citrus County on the west side of US-19 will experience regular flooding between 2045-2070.


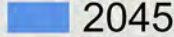
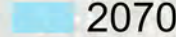
MANATEE COUNTY

Map showcasing Manatee County under the average daily high tide event

- The tidal flooding will have a much higher reach on the barrier islands and the small peninsulas along the bayfront.



Average Daily High Tide

 2020	 2045	 2070
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Data Sources: Florida Geographic Data Library, Tampa Bay Regional Planning Council

Chassahowitzka

HERNANDO COUNTY

Map showcasing Hernando County under the 10-year storm tide event

- The natural shoreline offers significant protection against the 10-Year Tide event throughout most of the county.

Commercial Way

19

Pine Island

GlenLakes

Brook

Cooglers Beach

Cortez Blvd

Weeki Wachee Gardens

Weeki Wachee Springs State Park

Berkeley

Weeki Wachee Acres

Hernando Beach

Timber Pines

Spring Hill

Hunters Lake

Aripeka

10-Year Tide Event

2020

2045

2070

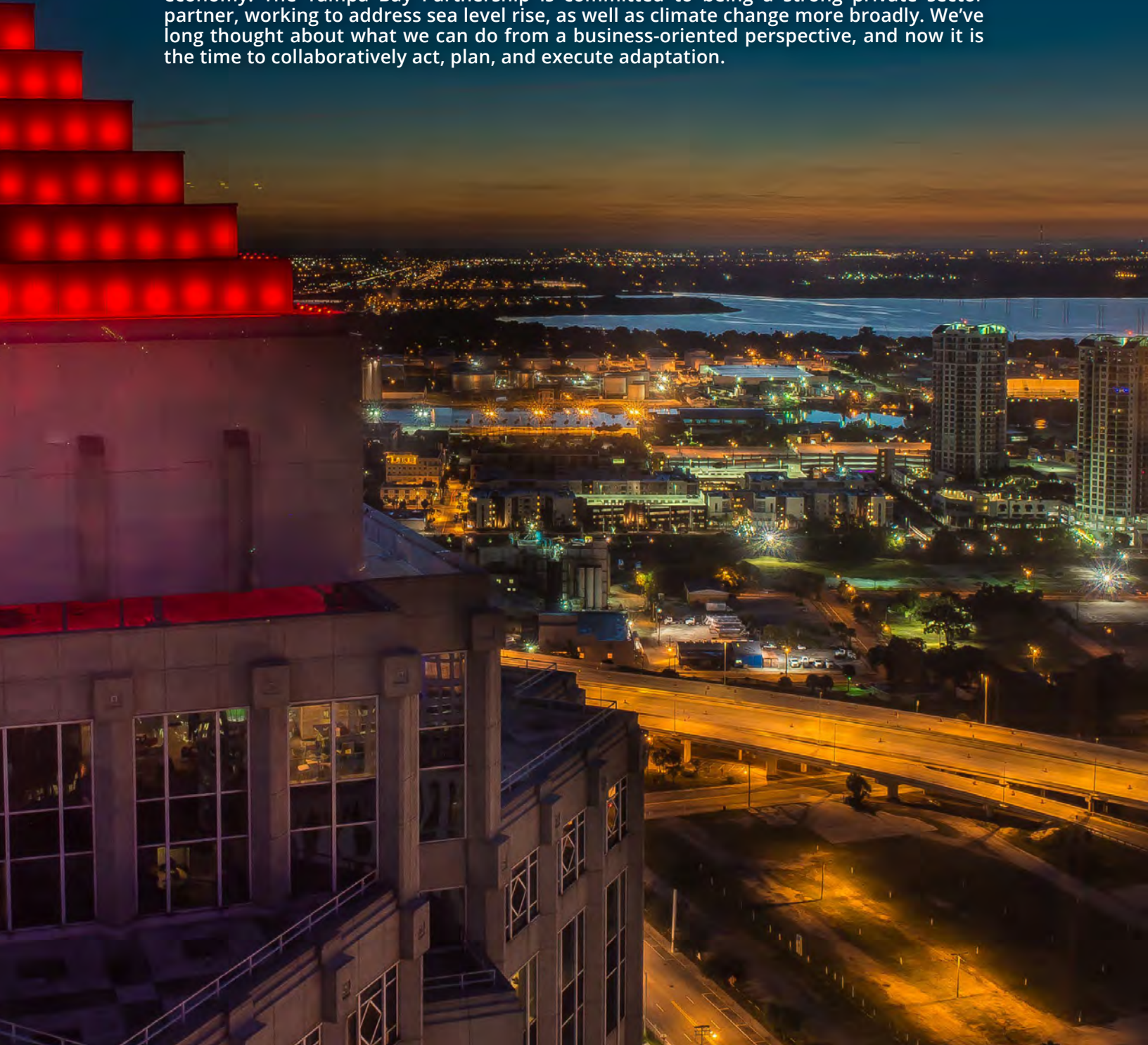
Data Sources: Florida Geographic Data Library, Tampa Bay Regional Planning Council

LOOKING FORWARD

The Tampa Bay region is globally recognized for its dynamic culture, vibrant activities, and lively atmosphere welcoming locals and guests alike. Protecting the vitality of the region is essential as we collectively face the impacts of sea level rise and more frequent flooding.

Understanding the economics of sea level rise, identifying the fiscal impacts, and weighing the costs and benefits of adaptation investments, while developing tailored adaptation strategies to these challenges, is only the beginning for a future climate-ready Tampa Bay. In fact, benefits showcased in this report are a conservative estimate as the study examines just three types of flood events that can occur in our region instead of all the possible flooding events.

There is no doubt the region must adapt to sea level rise. Building the economic case for action only enhances the case for adaptation. The public and private sectors must work collaboratively, through proactive planning and risk management, to ensure the protection of infrastructure and assets, while also working to enhance the region's overall economy. The Tampa Bay Partnership is committed to being a strong private sector partner, working to address sea level rise, as well as climate change more broadly. We've long thought about what we can do from a business-oriented perspective, and now it is the time to collaboratively act, plan, and execute adaptation.



NOTES

CITATIONS

1. Tampa International Airport Fact Sheet (2021). <https://www.tampaairport.com/sites/default/master/files/FactSheet-0621.pdf>
2. Port Tampa Bay. (2016) The Local and Regional Economic Impacts of Port Tampa Bay. <https://www.porttb.com/home>
3. Bathi, J., & Das, H. (2016). Vulnerability of Coastal Communities from Storm Surge and Flood Disasters. *International Journal of Environmental Research*, 13(2), 239. <https://doi.org/10.3390/ijerph13020239>
4. Port Tampa Bay. (2016) The Local and Regional Economic Impacts of Port Tampa Bay. <https://www.porttb.com/home>
5. Port Tampa Bay. (2019). Port Tampa Bay Exceeds One Million Cruise Ship Passengers for Second Time in a Row. <https://www.porttb.com/posts?id=940929AF-8765-4122-B90B-A3348BADF392>
6. Ibid.
7. City of Tampa. (2020, December 1). Greenhouse Gases Reduction. City of Tampa. <https://www.tampa.gov/greenampa/greenhouse-gas-reduction>

KEY TERMS

Avoided Impact: This value represents the difference between the estimated impacts under a no-action scenario to the estimated impacts for the modeled adaptation scenarios. This metric reflects the amount of impact mitigated as a result of investment in adaptation.

Benefit-Cost Ratio: The economic justification for the modeled scenarios is presented in the form of a benefit-cost ratio (BCR), whereby the total present value of benefits conveyed by adaptation are divided by the total present-value costs of adaptation. When the ratio of benefits to costs is greater than one, an investment can be considered economically justified.

Business Recapture: This study incorporates the assumption that a portion of the business-related losses resulting from the modeled coastal hazards can be recaptured. Industry-specific recapture factors developed by Federal Emergency Management Agency (FEMA) for use in natural hazard assessments were incorporated, accounting for the ability of businesses to shift their operations off-site and/or find ways to increase productivity at a later date.

Cumulative Impacts: The estimated impacts for each year in the period of analysis, which account for the likelihood of the modeled coastal hazards occurring, are summed to develop an estimate of cumulative impacts.

Event-Based Impacts: This metric reflects the amount of impacts that could be expected if the modeled hazard events were to occur in the Tampa Bay region today. Essentially these results reflect the superimposition of future environmental conditions on the existing built environment and economy. These results are not adjusted to account for the probability of an event (e.g., 10-year storm tide event) occurring in the discrete time horizon years (i.e., 2020, 2045, 2070).

Job Years: A job year is equivalent to one year of work for one person. For example, a new construction job that lasts two years will equate to two job years.

Net Impacts: The net impacts are calculated by subtracting the cumulative present value costs of adaptation from the cumulative present value of benefits (or impacts avoided) conveyed by investing in adaptation. Financial discounting is used to estimate the expected present-value costs and benefits.

Primary Consequence vs. Secondary Consequence Modeling: A multi-step modeling process was undertaken to estimate results. To distinguish between these two modeling phases, this study refers to direct impacts to property and assets that are exposed to the modeled coastal hazards as primary consequences, while secondary consequences is used to account for economy-wide direct, indirect and induced economic impacts. Primary and secondary consequences in some cases can overlap to a degree and should not be added together.

Temporary vs. Permanent Impacts: Property and assets exposed to tidal inundation from sea level rise are considered to be permanently impacted and taken out of the assessment of temporary event-based storm impacts, even if the same property and asset may be exposed to event-based storm conditions simultaneously. Permanent impacts captured in this report can include both one-time and recurring annual impacts.

Mean Higher High Water (MHHW): The average of the highest high tides of the year and can be thought of as permanently inundated. This is a permanent impact due to sea level rise.

1-Year Tide: The highest expected tide of the year, which is colloquially known as the King Tide.

10-Year Storm Tide: Coastal storms that have a 10% annual chance of occurrence. This is referred to as a temporary event, meaning that the economy can recover after it occurs.

T A M P A B A Y
PARTNERSHIP

