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Dania Beach: Economic Impacts of Sea Level Rise and Coastal Storms

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Prepared for:

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Executive Summary

Developing an understanding of the economic effects from future climate conditions is critical to inform decisions about how best to protect the communities, businesses, and natural resources that make Florida a world-class destination for life, work, and leisure. This information is especially relevant to communities in Florida like Dania Beach, where the economy is highly dependent on beach tourism and marine-service industries that are vulnerable to coastal hazards, and is primarily comprised of small businesses that may have fewer resources and less capacity to plan for and adapt to future climate risks.

This report presents estimates of economic costs that could occur from failing to take action to protect Dania Beach's business community from future storm surge and sea level rise impacts, as well as the economic benefits from adaptation actions that mitigate future coastal hazards to the City's commercial core. In addition to these estimates, findings are presented from a business community survey that characterizes local commerce and describes the business community's awareness of and concerns related to future climate change conditions. Together, these two data sources help to contextualize the local business community's vulnerabilities to climate change as well as potential benefits and drawbacks of specific adaptation investment approaches.

The research presented in this study builds on past work completed in the region (e.g., COAST 2015) by leveraging a robust economic modeling tool to forecast the economic costs and benefits of adaptation at multiple geographic scales. As illustrated in this report, sea level rise and coastal storm damages to Dania Beach's business community can have cascading effects to sales, employment, and tax revenues that extend beyond the City's borders to Broward County and the State of Florida. This report also describes the potential benefits from investing in adaptation using systemic strategies such as seawalls to keep rising seas at bay, and building-level strategies such as elevating structures to minimize damages from flooding.

In addition to consideration of the costs and benefits of protective investments to reduce future hazard risks, it is also important to more broadly consider the opportunities for advancing economic resilience in communities like Dania Beach. Resilience is generally framed as the ability to recover from or adjust quickly to changing circumstances. In the context of this study, economic resilience includes the ability of the economy to withstand and adapt to future coastal hazard conditions. This study illustrates that advancing economic resilience requires action by both the public and private sector at various geographic scales, and that there is a shared interest for both communities to partner on this front.

A number of characteristics of the local business community present significant challenges to developing economic resilience in the face of future coastal hazard risks. Dania Beach's businesses are highly dependent on labor and supplies from the broader region and state. Many are service-based, tourist serving, and small in size. Small businesses can be more vulnerable to natural hazards compared to their larger counterparts as they generally have fewer resources to develop an understanding of future risks and to have plans in place to respond and recover in the face of natural hazards. Small businesses are also vulnerable to impacts to regional infrastructure networks that can interrupt their supply chain and make it challenging for employees to get to work. Even when natural hazards do not impede the movement of goods and workers, many small businesses that experience direct damages to their structures lack the

capital reserves, access to financing, or insurance coverage necessary to absorb a loss of income and the additional expenses that come with rebuilding. Tourist-serving businesses may have increased difficulty recovering especially if their operations are compromised in peak-season.

While businesses in Dania Beach face a number of barriers to achieving economic resilience in the face of a changing climate, there are actions the business community can take to be better prepared for future coastal hazards. Businesses can improve their economic resilience by evaluating their vulnerability to future coastal conditions. Because many of Dania Beach's workers commute from outside of the City, businesses should consider how impacts to critical public infrastructure could affect the ability of employees to get to work. Businesses in Dania Beach can also review what their insurance policy covers to determine if they are covered for both direct as well as indirect hazard impacts. These types of considerations can be accounted for in a business continuity plan where potential physical and economic impacts as well as potential responses and recovery mechanisms are detailed.

Government, in particular, relies on revenues (e.g., sales, property, and income taxes) that are supported directly or indirectly by businesses. As such, both the public and the private sector have a shared interest in ensuring that the business community is economically resilient to a changing climate. As effective partners, government and other public institutions such as universities can continue to develop and communicate accessible and transparent information on coastal hazard risks. The public sector can also prioritize investment in resilient infrastructure that will support business continuity in a changing climate. In the event that disaster does strike, the public sector should consider the business case for building back better. From a built environment and redevelopment perspective, Dania Beach, as well as Broward County, can also consider more flood-resistant building standards for new development or substantial improvements to the existing capital stock.

Any adaptation strategy that is pursued should be evaluated for potential tradeoffs and, where feasible, adaptation strategies should be designed to produce co-benefits (e.g., community space). Strategies should also further support a resilient economy, such as investments in dependable transportation infrastructure, affordable housing, and sustainable natural resources. This systems-based view of planning and investment acknowledges what we already know: that when one element of the system is compromised, the entire system is weakened and resilience is compromised. It also emphasizes the importance of partnership and knowledge sharing in determining the most effective strategies for increasing economic resilience in Dania Beach. Specific recommendations in this report include:

- **Prioritize phased adaptation investments with an eye toward long-term risk**. Often, it is too costly to pay for projects that mitigate for long-term impacts, but full life-cycle cost assessments may help to inform when projects are better suited to address long-term risk. For example, when elevating a structure, elevate to the higher flood depth projections so that businesses only need to close once rather than twice.
- **Invest in regional strategies** such as improvements to the local road network to decrease interruptions from flooding. Regional strategies can expand the pool of potential funding sources thereby decreasing the burden on any one locality.
- **Establish an accessible data platform** for businesses to identify their potential vulnerabilities to both existing and future climate conditions. Dania Beach's business

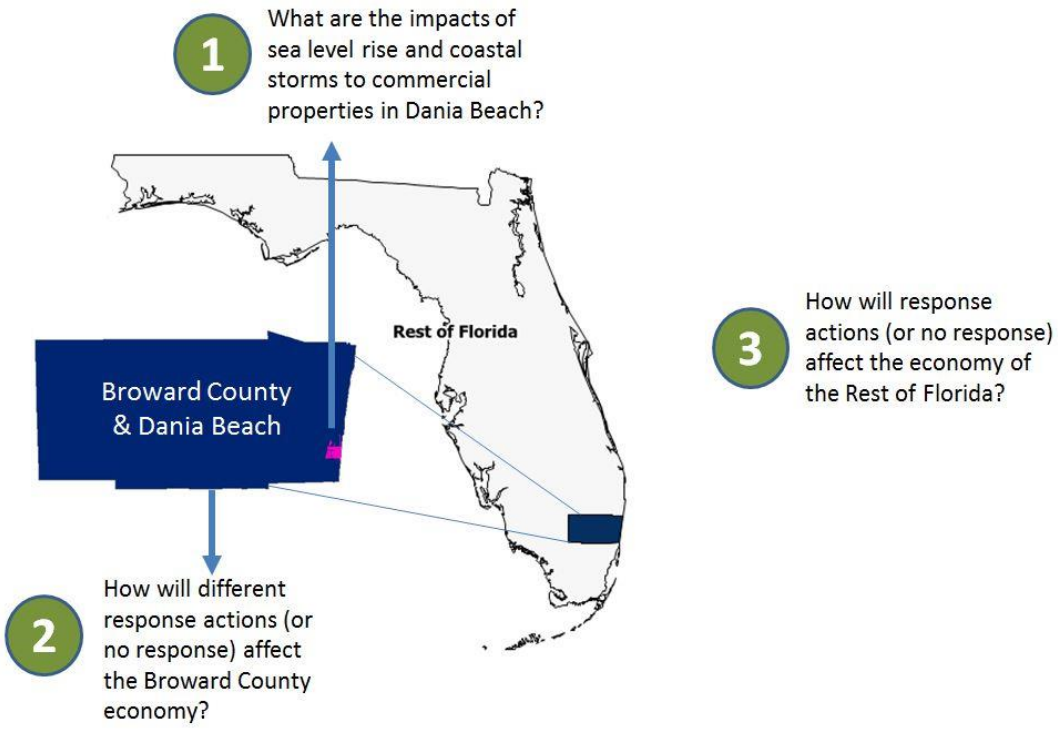
community is concerned about climate change but may not have access to the necessary resources to fully contextualize this risk and to better understand how adaptation investment and planning could decrease both their physical and economic exposure.

- **Improve disaster preparedness**. Develop business continuity plans to prepare for disaster and establish local partnerships to understand how other businesses are addressing adaptation.
- **Expand assessment of projected damages** beyond the local business community to include residential and public infrastructure to improve understanding of strategies that can offer co-benefits and the way in which the costs of adaptation can be shared by different groups of beneficiaries.

Summary Findings

This study addressed the three key questions shown in Figure 1. The first key question relates to the amount of direct damages that coastal storms and sea level rise could have on commercial properties in Dania Beach. These direct damages do not occur in a vacuum, however, and so it is important to understand their cascading effects through the regional and state economies. For example, business closure or displacement due to property damage can result in an increased cost of goods, decreased worker productivity, and/or a decline in the regional labor force. There can also be positive shocks to the economy such as the stimulus effect of rebuilding efforts post-disaster. To account for these complicated dynamics, estimates of direct damage are integrated into an economic linkage model, which was completed using the REMI economic model. The results from the REMI model help to answer the other key study questions, which address how different response actions (or lack of action) impact the Broward County economy and the economy of the rest of Florida.

Figure 1. Key Study Questions



Source: AECOM November 2018

Summary findings from the analysis are presented below. Findings are presented in two main categories as discussed above: (1) the direct damages to Dania Beach from coastal storm flooding and sea level rise; and (2) the secondary impacts to the county and state economy based on different response actions.

Note: All results are presented in constant 2018 dollars, unless noted otherwise. Further description of how these results are calculated is detailed later in this report.

Direct Damages to Dania Beach from Coastal Flooding and Sea Level Rise

Damages from Temporary Coastal Storm Events

Table 1 reports the damages for each future storm type modeled: the 3-year event and the 20-year event, accounting for an assumed frequency of the coastal storm event. It was assumed that the 3-year event will occur in 2030, 2040, 2060, and 2070 and that the 20-year event will occur in 2050.[1] These damages present a worst case scenario – i.e. what would happen if no action was taken. Results are broken out for each category of damage evaluated. The impacts of the two coastal storm events change over time to account for rising sea levels. As such, a 3-year event in 2060 is expected to have higher flood depths than a 3-year storm in 2030. Losses are assumed to only occur in the year of the storm. The damages of the modeled storms were discounted and summed to arrive at an estimate of cumulative net present damages.

Table 1. Cumulative Damages from Coastal Storm Events

Impact Type	Sum of Cumulative Damages (2030-2070)
Structure Damages	$164,800,000
Content and Inventory Losses	$538,500,000
Displacement Costs	$4,500,000
Sales Losses	$10,500,000
Sales and Tourist Development Tax Losses	$600,000
TOTAL	**$718,900,000**

Figures rounded to nearest $100,000. Shown in NPV with 5% discount rate, 40-year period of analysis.
Source: AECOM November 2018

Damages from Permanent Progressive Sea Level Rise

Summary results of direct impacts from sea level rise are presented in Table 2. These damages present a worst case scenario – i.e. what would happen if no action was taken. Results are broken out for each category of damage evaluated. For permanent progressive damages, it is assumed that properties subject to reoccurring or permanent tidal inundation have no market value or income-producing potential. These losses are accounted for via a one-time loss of property value and annual reoccurring sales and tax losses. As such, the sales losses represent the largest contributor to sea level rise damages. Expected permanent damages were calculated for each year and then discounted and summed to arrive at an estimate of cumulative net present damages.

Table 2. Cumulative Damages from Permanent Progressive Sea Level Rise

Impact Type	Sum of Cumulative Damages (2030-2070)
Market Value Loss	$61,900,000
Property Tax Loss	$4,900,000
Sales Losses	$1,044,100,000
Sales Tax and Tourist Development Tax Losses	$56,400,000
TOTAL	**$1,167,300,000**

Figures rounded to nearest $100,000. Shown in NPV with 5% discount rate, 40-year period of analysis.
Source: AECOM November 2018

[1] Changing the frequency of the storm events could significantly influence the estimated cumulative damages.

If no action is taken, as shown in Table 1 and Table 2, the Dania Beach business community faces greater economic vulnerability from unchecked rising sea levels compared to the exposure from coastal storms. However, it is important to note that these results are based on simulations, which assume the modeled storm and sea level rise scenarios were to occur as described in specified years. It is possible that storm events of both greater and lesser magnitude, and different rates of sea level rise, could occur from 2030 to 2070. It is also possible that the frequency and timing of events is different than as modeled.

For the purpose of comparison, the coastal storm impacts were also modeled using a probabilistic framework that accounts for the likelihood of both the 3-year and 20-year event occurring in every year over the period of analysis. This approach increases the cumulative damages to $1.62 billion, making the coastal storm impacts nearly one-half billion dollars greater than the permanent sea level rise damages. While the cumulative damages for storms increase using a probabilistic modeling approach that accounts for these events occurring every year rather than every tenth year, these damages are spread out across the period of analysis, and are not conducive to capturing shocks to the regional and state economy in the REMI model.

Economic Impacts to Broward County and the Rest of Florida

Four different response actions (project alternatives) were modeled and compared to a control projection: no action, relocate, fortify, and accommodate. Table 3 describes each of these project alternatives and if they were modeled for coastal storm impacts, sea level rise impacts, or both. The economic impacts that were modeled to Broward County and the rest of Florida include high level socioeconomic indicators, such as gross domestic product (GDP), employment, output, and population, among several others that are presented in Appendix D. Different funding breakdowns are explored (e.g. federal, state) but funding prioritization and consideration of the tradeoffs needed to make these investments are beyond the scope of this analysis.

When interpreting these results, it should be noted that it is assumed that all property owners implement the project alternatives that were modeled. The likelihood that this would occur is uncertain due to either technical considerations (e.g., a property is too old to be retrofitted, the location of a property makes retrofitting difficult or impossible) or financial considerations (e.g., a property owner does not have the means to retrofit; a property owner does not think the risk profile warrants the investment). Furthermore, during coastal storm events, much of the public realm (e.g., streets, sidewalks) could be flooded, which could result in business owners and prospective tenants receiving less utility or value from their real estate.

Table 3. Project Alternatives

Project Alternatives	Description	Temporary-Event Based Storm Scenarios	Permanent Progressive Sea Level Rise Scenarios
No Action	Nothing is done to mitigate future sea level rise and coastal storm conditions, but structures are rebuilt post-event	Applicable	Applicable
Relocate	Low-lying businesses subject to tidal inundation from sea level rise relocate to higher ground in Dania Beach or outside of the City boundaries	Not applicable	Applicable
Fortify	Construct a seawall to prevent low-lying business from being subject to tidal inundation from sea level rise	Not applicable	Applicable
Accommodate	Elevate structures so their first floor elevation is higher than the base flood elevations of modeled coastal storms	Applicable	Not applicable[1]

[1]The permanent "Accommodate" scenario is not applicable due to the assumption that surrounding infrastructure and properties are continually inundated; this results in a property losing its functionality making elevation not a viable investment strategy.
Source: AECOM November 2018

Results are shown in Table 4 for each scenario compared to a control, which projects regional conditions such as population and industry growth on to an economy without a storm or sea level rise event. The temporary no action project alternative is the only project alternative modeled in which the economy performs better than the control, with a net employment gain of 1,810 in Broward County and increase in GDP of $100 million. This is due to the assumption that there will be rebuilding efforts after each storm that will increase spending and local employment. However, this scenario also results in a net population loss for Broward County in part due to the increased cost of living as businesses' production costs increase in order to pay for the rebuilding efforts. The temporary accommodate project alternative has worse economic outcomes than the temporary no action project alternative. This is due in large part to the assumption that in the accommodate project alternative, businesses must close for the period of construction, which results in greater sales losses than business closure due to storm event damages. The model assumptions account for the potential for businesses to recapture a percentage of these lost sales, through measures such as temporarily working offsite. However, there are still limits to this assumption in that some businesses may develop a construction schedule whereby they are able to continue to operate in part of the structure during construction and have much lower output losses.

In the permanent no action project alternative, the employment and GDP forecasts decrease in both Broward County and the rest of Florida. Overall, it is estimated that there will be 36,400 fewer jobs and a nearly $5 billion decrease in GDP in Broward County. The rest of Florida also experiences negative economic impacts in this simulated project alternative, though of lesser magnitude, with a decrease in employment of 13,300 and a $1.7 billion decline in GDP compared to the control. In the permanent relocate project alternative, Broward County has nearly 15,000 fewer jobs and a decrease of $1.95 billion in GDP. In this project alternative, the rest of Florida has a positive gain in employment and a total GDP increase of $720 million over

the control due to the assumption that some of the businesses relocate elsewhere in Florida. The permanent fortify project alternative is the only project alternative in which outcomes are either neutral and/or positive to both Broward County and the rest of Florida. In this project alternative, the seawall investment both avoids economic losses and increases industry investment. Broward County employment increases by 200 over the control and GDP increases by $20 million. The rest of Florida experiences minimal impact.

Table 4. REMI Results by Project Alternative and Scenario as Compared to Control (Net Change 2030-2070)

Broward County						
Socioeconomic Indicators	Control	Temporary No Action	Temporary Accommodate	Permanent No Action	Permanent Relocate	Permanent Fortify
Total Employment Change	312,810	1,810	-6,830	-36,410	-14,930	200
Total GDP Change (Millions)	$131,150	$100	-$690	-$4,750	-$1,950	$20
Total Population Change	584,770	-8,580	-10,350	-41,210	-16,780	270
Rest of Florida						
Socioeconomic Indicators	Control	Temporary No Action	Temporary Accommodate	Permanent No Action	Permanent Relocate	Permanent Fortify
Total Employment Change	1,758,020	1,720	-2,060	-13,260	5,080	-30
Total GDP Change (Millions)	$918,090	$120	-$240	-$1,700	$720	$0
Total Population Change	3,520,990	1,140	-2,500	-18,800	5,560	-90

GDP is not discounted; figures are rounded.
Source: AECOM & REMI PI+ November 2018

1. Introduction

1.1 Study Overview

Dania Beach is representative of the older style of urban development present along much of the coastal corridor in South Florida. The small, lower-middle income community of about 30,000 people is situated between Port Everglades and Fort Lauderdale- Hollywood International Airport, and has an economy that is centered on tourism and marine industry. Dania Beach is ripe for redevelopment but faces challenges pertaining to serious climate change impacts, including rainfall and tidal flooding, saltwater intrusion, drainage limitations and the threat of extreme events as well as community health and equity issues. Despite these challenges, Dania Beach has significant natural resources including a barrier island beach and a mangrove wetland mitigation area that are critical to the community's economy. The community is also strategically located to capitalize on the expansion of the Fort Lauderdale International Airport, the forthcoming passenger rail, the expansion of Port Everglades as a part of the Post-Panamax plan, and the estimated 40 percent increase in the City's population over the next 20 years.

Adaptation measures that have been proposed for Dania Beach include both physical adaptations and green infrastructure, including but not limited to: enhancing the wetlands, constructing flood protection berms and pump systems around newer development, and utilizing the opportunity of redevelopment investments to physically build resilience into buildings, roads, and drainage systems. However, these measures have primarily been discussed in qualitative terms and limited research has been directed at evaluating the economic vulnerability of existing community assets to future coastal hazards, and the findings of such research can illuminate design considerations for future redevelopment.

This study evaluates the vulnerability of existing commerce in the City of Dania Beach to future climate conditions including sea level rise and coastal storms and assesses the benefits and costs of adaptation strategies that promote resilience in the City's business community under future hazard conditions. This study attempts to go beyond quantifying the total benefits and costs of investing in adaptation at the local level by honing in on the local and regional industries that stand to lose most from a changing climate. In addition, this study models the economic linkages between industries under potential coastal hazard scenarios, as well as the economic and fiscal outcomes associated with a joint commitment from the public and private sectors to invest in adaptation. These questions are informed in part by results from a survey of local business owners in the City of Dania Beach, as well as by other economic impact studies examining natural hazards (e.g., Kroll et al. 2018). Key questions addressed in this study include:

1. What are the direct impacts to Dania Beach from future sea level rise and coastal storm conditions?
2. What are the overall effects on gross domestic product (GDP) and employment from sea level rise and coastal storms, taking into account the direct output losses from damage to buildings, contents, and inventory associated with Dania Beach's business community, as well multiplier effects for firms in the region or elsewhere in the State of Florida?

3. How does recovery spending affect economic outcomes if no action is taken to mitigate future coastal hazard conditions, primarily those associated with coastal storm impacts?
4. How do losses in business output from sea level rise and coastal storms affect employment by sector?
5. What are the economic effects of investing in proactive adaptation investments at the system level (e.g., flood barriers) and building level (flood-resistant building design)?

1.2 Building Economic Resilience

A primary goal of this report is to support efforts that increase the resilience of Dania Beach's business community under changing climate conditions. Resilience is generally framed as the ability to recover from or adjust quickly to changing circumstances. In the context of this study, economic resilience includes the ability of the economy to withstand and adapt to future coastal hazard conditions. This study illustrates that advancing economic resilience requires action by both the public and private sector at various geographic scales, and that there is a shared interest for both communities to partner on this front.

A number of characteristics of the local business community present significant challenges to developing economic resilience in the face of future coastal hazard risks. Dania Beach's businesses are highly dependent on labor and supplies from the broader region and state. Many are service-based, tourist serving, and small in size. Small businesses can be more vulnerable to natural hazards compared to their larger counterparts. In fact, many small businesses have had to permanently shut their doors after a major disaster (Institute for Business & Home Safety, 2005). Small businesses generally have fewer resources to develop an understanding of future risks and to have plans in place to respond and recover in face of natural hazards. Small businesses are also vulnerable to impacts to regional infrastructure networks that can interrupt their supply chain and make it so employees are unable to get to work. Even when natural hazards do not impede the movement of goods and workers, many small businesses that experience direct damages to their structures lack the capital reserves, access to financing, or insurance coverage necessary to absorb a loss of income and the additional expenses that come with rebuilding. Tourist-serving businesses may have increased difficulty recovering if income may not be able to be earned again until the following season.

While businesses in Dania Beach face a number of barriers to achieving economic resilience in the face of a changing climate, there are actions the business community can take to be better prepared for future coastal hazards. Businesses can improve their economic resilience by evaluating their vulnerability to future coastal conditions, accounting for direct physical vulnerabilities on site, as well as downstream vulnerabilities to their suppliers. Because many of Dania Beach's workers commute from outside of the City, businesses should consider how impacts to critical public infrastructure could affect the ability of employees to get to work. Businesses in Dania Beach should also review what their insurance policy covers to determine if they are covered for both direct as well as indirect hazard impacts. Insurance can play a key role in offsetting recovery and rebuilding costs for local business owners. However, not all insurance policies cover impacts from natural hazards like coastal flooding, and may not extend to indirect impacts. For instance, a business can face interruption to their operations if the power grid goes dark for a prolonged period following a disaster. This loss of income may not be covered in a standard business insurance policy.

These types of considerations can be accounted for in a business continuity plan where potential physical and economic impacts as well as potential responses and recovery mechanisms are detailed. There are a number of resources that businesses can use to develop a continuity plan for disaster response, including information and tools developed by the U.S. Small Business Administration and the U.S. Department of Homeland Security. These resources can help business owners to identify key considerations for disaster preparedness planning, including, but not limited to, identifying an alternate location where work could be conducted, storing inventory in a location that is not subject hazards, having a geographically diverse supply chain, and making investments in a back-up power source. Additionally, businesses in Dania Beach can reach out to trade associations and other business organizations in their sector and/or industry to learn how others are thinking about how to prepare for and adapt to future climate risks.

Small businesses, which are highly vulnerable to disaster impacts, are foundational to the local, regional, state, and national economy, employing on aggregate nearly half of the workforce of the United State. If businesses in Dania Beach and beyond are not prepared for future hazard risk, the impacts will be felt broadly. Government, in particular, relies on revenues (e.g., sales, property, and income taxes) that are supported directly or indirectly by businesses. As such, both the public and the private sector have a shared interest in ensuring that the business community is economically resilient to a changing climate. Also, by demonstrating a commitment to climate resilience and bringing in input from the business community, the public sector can gain political support from an important and influential constituency.

As effective partners, government and other public institutions such as universities can continue to develop and communicate accessible and transparent information on coastal hazard risks. This information can help the business community be better prepared for potential impacts and support a shared dialogue on the types of solutions that may be most desirable and feasible to mitigate such impacts. In the event that disaster does strike, the public sector should consider the business case for building back better. While it is important that efforts are taken to help businesses resume their operations as soon as possible, such efforts should also take a longer-term view of the benefits that can be gained with investment in resilient infrastructure and projects that account for future risks.

The public sector can also prioritize investment in resilient infrastructure that will support business continuity in a changing climate. Building better, whether it be new development or redevelopment, will be critical to making Dania Beach a community with built-in resilience to a changing climate. In redevelopment efforts, Dania Beach, as well as Broward County, can consider more flood-resistant building standards for new development or substantial improvements to the existing capital stock, and also consider the role that land use and zoning can play in incentivizing development in areas that are less vulnerable to future hazard conditions. City Hall, the library, the forthcoming railway station, and the historic buildings are already located on the highest elevation; further investment along the coastal ridge can help to sustain property values while helping to minimize operational risk to the business community.

Any adaptation strategy that is pursued should be evaluated for potential tradeoffs and, where feasible, adaptation strategies should be designed to produce co-benefits (e.g., community space). Strategies should also further support a resilient economy, such as investments in dependable transportation infrastructure, affordable housing, and sustainable natural resources.

This systems-based view of planning and investment acknowledges what we already know: that when one element of the system is compromised, the entire system is weakened and resilience is compromised. It also emphasizes the importance of partnership and knowledge sharing in determining the most effective strategies for increasing economic resilience in Dania Beach.

1.3 Other Key Considerations & Recommendations

Paying for Adaptation

Investment in adaptation will require partnerships between the public and private sector, and a commitment to investment in such actions by both parties. The risks posed by a changing climate are too great for any one sector to take on alone, and the benefits provided by making investments in resilience are shared across sectors. It should be noted that the direct costs and benefits in this study were only modeled to Dania Beach's business community. Other public and private entities would also likely benefit from systemic adaptation investments like building a seawall to keep rising seas at bay and expand the magnitude of benefits. As such, considerations on how to fund and finance this type of adaptation should be made with an eye towards all of the entities that would benefit from such an investment.

Funding and financing adaptation and resilience can be particularly challenging due to the wide range of beneficiaries impacted by such an investment and the widespread benefits that adaptation projects can offer. It is difficult to identify the people who benefit and quantify the specific amount in which they benefit from any given project. Sometimes investment in one location may provide benefits to people in another jurisdiction; while other times, the full benefits of a project may not be realized until farther into the future when different populations are living in the region. As such, determining a strategy for who should pay for a project requires a better understanding of who will benefit and clear communication of these benefits to the stakeholders who may be expected to pay (e.g. taxpayers) (AECOM & Resources Legacy Fund 2018).

Accounting for Equity

Equity considerations are a key component of any adaptation investment strategy. In particular, practical and academic bodies of literature highlight the importance of incorporating equity when determining how to fundraise and how to spend money (Taylor 2004). Many funding tools can be regressive if not implemented strategically. Commonly-applied equity principles related to raising funds include: the benefits principle, in which charges are imposed relative to the services that are received, and the ability-to-pay principle, in which income is accounted for in determining appropriate charges. Relating to how money is spent, common principles include market equity, opportunity equity, and outcome equity. Market equity relates to whether the spending of the funds is proportional to who is paying for the project. Opportunity equity means spending is distributed evenly, such as equally between jurisdictions. Outcome equity means spending is based on the outcome for each payer, for example the same protection from sea level rise for each jurisdiction.

Disadvantaged Populations

Dania Beach is a small, lower-to-middle income community. Additionally, as illustrated in the survey of Dania Beach's business community, many of the employees working at these businesses are lower-income, make close to the minimum wage, and commute from outside of the City to work. The literature on natural hazard impacts (e.g., Bouston, et al. 2017, Kroll, et al. 2018) clearly demonstrates that higher-income households are better equipped to move forward following a disaster compared to lower-income households. When considering how to prioritize investments in proactive adaptation or rebuilding post-disaster, specific attention should be paid to the ways in which disadvantaged populations are affected by such decisions.

Opportunity Costs

This study models a suite of project alternatives, and includes assumptions about how these investments are funded. Systemic adaptation strategies like building a seawall are assumed to be funded with both public and private dollars. Whether the source be grant funds from the State or local property and sales taxes, it is important to acknowledge that there is an opportunity cost to using these monies to pay for adaptation. Regardless of who pays for adaptation, there is a tradeoff to using these funds for this purpose versus other community or personal needs. Small communities like Dania Beach, as well as business owners in the community, face challenges in paying for existing needs such as housing, public health, or business insurance. To this end, monies used to pay for adaptation can result in a decline in investment resources that could be directed to other goods or services. This consideration makes it critical that investments in adaptation provide co-benefits to people, the economy, and the environment.

Reputational Risks and Associated Impacts

Vulnerability to coastal hazards now and in the future can result in reputational risks and associated impacts such as: insurance premium increases, bond rating downgrades / increased borrowing costs, decreased tourism and associated spending, decreased public support which can hinder future efforts to raise funds in support of mitigation, and risk from increased liability. Quantifying reputational damages relies on understanding the financial fundamentals of risk as well as the less studied and harder to quantify behavioral *perceptions* of risk which reflect considerations of the performance of policies, systems, and infrastructure. Modeling reputational impacts, such as perceptions of future climate change risk, was beyond the scope of this analysis. Yet these are important and relevant considerations when interpreting the potential outcomes of the modeled project alternatives. Future research and analysis may provide additional quantitative insights into variations to this approach, and if this occurs, these findings should be updated.

2. Methodology

2.1 Key Concepts & Global Assumptions

Below is a description of key concepts and global assumptions that support interpretation of the analysis and results detailed in this report.

Impact Geography: This analysis is focused on evaluating economic and fiscal impacts to the City of Dania Beach, Broward County, and the State of Florida. Dania Beach and Broward County make up the Primary Impact Area, while the State of Florida represents the Secondary Impact Area. Direct economic damages are modeled for the City of Dania Beach, the results of which are introduced to the REMI platform to produce separate economic impact results for Broward County and the State of Florida.

Static Built Environment: This analysis superimposes potential future physical conditions on the existing built environment in Dania Beach in direct damage models. While it is likely that the built environment in Dania Beach will undergo changes between the present year and the end year of analysis in 2070, it is challenging to accurately model those changes without detailed information on future development plans at the building scale which was not readily available at the time of this analysis.

Effectiveness and Useful Life of Project Alternatives: Each project alternative is assumed to be able to neutralize all damages from the sea level rise and coastal storm scenarios being considered. This results in the benefits of each project alternative being equivalent to the damages that would be expected if no action was taken. Some of the project alternatives such as the introduction of a seawall are modeled using a phased approach whereby the design features meet the specified physical parameters in discrete future years. Benefits for the seawall are assumed to begin accruing in the base year of 2030 and continue to accrue until the end year of the analysis in 2070. It is possible that the Project could provide some level of benefits after 2070 but this would require additional consideration of the features of project alternatives to be effective beyond the period of analysis. It is assumed that best infrastructure management practices are implemented, thereby limiting deferred maintenance and the increased costs that are associated with infrastructure that does not function up to design standards.

Prior Damage: The analysis assumes no cumulative damage from previous storms.

Project Alternative Costs: Only the capital investment costs to implement each alternative are incorporated into this analysis. Additional life cycle costs for operations and maintenance and renewal and replacement are not included. The costing parameters used in this study were provided by staff from Broward County or were identified in other relevant technical reports.

Risk Model Types: There are two primary model types for evaluating hazard risk: *deterministic* models and *probabilistic* models. Deterministic risk models generally account for the effects of a single or event-based scenario; for example a 100-year storm event in a defined year. Probabilistic risk models account for uncertainty in physical and economic inputs, and include a wide range of scenarios, their likelihood, and the related effects. A deterministic model was primarily used to generate results for this report in part because of the limited number of scenario outputs available as well as the structure of the REMI economic impact modeling platform that was used. Results were also run using a quasi-probabilistic model to understand the sensitivity of storm interval occurrence on direct damages.

Results Reporting: The deterministic modeling framework results in the reporting of event-based and cumulative economic and fiscal impacts that account for the hazard scenarios and adaptation strategies modeled between 2030 and 2070. Event-based results are reported in current dollars, while cumulative results are reported in net present value terms, factoring in

principles of financial discounting that account for the time value of money. The reported results are not adjusted to account for the probability of such an event occurring. Consider, for example, a 10-year storm event, which has a 10% chance of occurring in any given year. If the damages are modeled at $100,000, then this value is multiplied by 0.1 (10% chance), resulting in expected annual damages of $10,000.

Assignment of Temporary vs Permanent Impacts: Results are organized in this report to avoid double counting any losses. To do this, if there is exposure to future tidal inundation from sea level rise, the loss is accounted for in the permanent progressive impacts and is taken out of temporary event-based storm damages, even if that same business may be exposed to storm conditions simultaneously. This risk profile transfer explains why damages may be greater for a specific hazard type in an earlier time horizon than what is reported in the similar hazard type in a future time horizon.

One-time vs Reoccurring Impacts: Permanent impacts captured in this report can include both one-time losses as well as reoccurring annual losses. In this report, a one-time loss relates to the market value or real property value at risk, whereas a reoccurring annual loss captures the output (e.g., sales) and fiscal revenues (e.g., taxes) associated with vulnerable assets. For example, there are one-time direct market value losses for a business vulnerable to permanent impacts as well as annual reoccurring sales losses equivalent to those that the business historically supported.

Economic Modeling Approaches: A variety of economic and fiscal modeling techniques were used to inform the results presented in this report, including: economic damage, economic impact, and fiscal impact. Because it is often confusing to distinguish between these distinct concepts, clarifying descriptions are provided below with some illustrative examples of how these concepts relate to this study.

Economic Damage: This measures the extent of lands and/or structures vulnerable to modeled hazards. For instance, the economic damage to a commercial business subject to storm-induced flooding would account for the cost to repair the damaged structure, replace damaged contents/inventory, and carry out any required clean-up activities.

Economic Impacts: This measures the flow of spending through an economy and the associated jobs and wages, among other items, associated with this spending. For instance, a commercial business that has to close for repairs due to storm-induced flooding will experience sales/output losses until they are able to resume their operations offsite at another location or resume operations onsite. This temporary closure directly impacts the jobs and wages of employees at the impacted business and can also result in secondary economic impacts to the various businesses and employees that support the impacted business.

Fiscal Impacts: This measures the net impact on government from a specific activity, accounting for changes in governmental costs and revenues. This type of analysis is generally conducted for understanding the financial impacts to a governmental entity that is exploring an action like the approval of a residential development. While residential development can bring in new revenues in the form of property and sales taxes as well as other fees, such a project could also necessitate new services or facilities like fire, police, schools, and parks which come with a cost. A fiscal impact analysis for a residential development would attempt to compare the total expected revenues to the total anticipated costs of a proposed project. This study is primarily focused on lost revenues to the City of Dania Beach and Broward County in the form of sales taxes, property taxes, and tourist development taxes.

Discount Rates: Federal guidance generally prescribes that a discount rate ranging from 3% to 7% can be used in an economic impact analysis of this type. The specific determination of what discount rate to use requires consideration of the nature of the project and how it affects private investment and consumption. For this analysis, a 5% discount rate is used to calculate the net present value of the costs and benefits associated with modeled alternatives unless noted otherwise.

Price Level: All costs and benefits have been normalized and are presented in 2018 constant dollars, unless noted otherwise.

Inflation: No general price inflation is included in the analysis.

Escalation: Construction-related costs are escalated to account for historical trends that have outpaced general price inflation.

2.2 Categories of Economic Impacts

The scope of an economic impact analysis can vary greatly. To determine the scope, considerations include, but are not limited to, time and resources, data quality and availability, and programmatic policies. This analysis is focused on a broad but standard set of economic impact types that are often considered in natural hazard risk assessments. The economic impact types that were evaluated in this analysis are listed in Table 5 and Table 6 below. This analysis assumes that different types of damages are expected from temporary storm- driven flooding compared to permanent progressive tidal inundation from sea level rise; therefore, separate impact assessment methodologies and categories of damages were evaluated for storm-driven flooding and permanent progressive tidal inundation from sea level rise.

Appendix A describes in detail the methodologies used to evaluate these categories of economic and fiscal impacts. These methodologies primarily draw upon technical guidance documents and economic and planning memoranda developed by federal agencies like the Army Corps of Engineers (USACE) and Federal Emergency Management Agency (FEMA). Much of this technical guidance has been developed by federal agencies to support the considerations of benefits and costs relevant to decision-making around infrastructure investments, including actions designed to mitigate the risks from natural hazards. While there are many similarities across these programmatic guidelines, there are also unique differences that reflect the nature of the benefit and cost accounting used. Other federal agencies like the Office of Management and Budget (OMB) have also developed protocols on how to evaluate the benefits and costs of policy decisions, and more recently, the U.S. Department of Housing and Urban Development (HUD) issued guidelines for conducting a benefit-cost analysis (BCA) for applicants that were pursuing Community Development Block Grant Disaster Recovery funding as part of the National Disaster Resilience Competition (NDRC). The BCA parameters set out by HUD follow the protocols set by OMB as well as recommended methods outlined by the U.S. Department of Transportation (DOT), the USACE, and FEMA.

Table 5: Impact Categories and Types Evaluated for Temporary Coastal Storms

Damage Category	Damages to be Assessed
Direct Property Impacts	Structure damage Content loss Inventory loss Cleanup costs
Displacement Impacts	Relocation Costs Additional Rental costs
Business and Employment Impacts	Sales loss
Fiscal Impacts	Sales tax loss Tourist development tax loss

Source: AECOM November 2018

Table 6: Impact Categories and Types Evaluated for Permanent Progressive Sea Level Rise

Damage Category	Damages to be Assessed
Direct Property Impacts	Market value loss
Business and Employment Impacts	Sales loss
Fiscal Impacts	Property tax loss Sales tax loss Tourist development tax loss

Source: AECOM November 2018

2.3 Physical Scenarios

The physical scenarios modeled in the study are listed below. The combined storm and sea level rise scenarios account for temporary event-based impacts. The mean higher high water (MHHW) scenarios account for progressive, permanent impacts from sea level rise in low-lying areas. Businesses in Dania Beach vulnerable to the temporary storm event scenarios were identified using results from the USACE-Broward Flood Risk Management Study (2018). Businesses in Dania Beach vulnerable to permanent tidal inundation from sea level rise were identified using GIS shapefiles developed by the NOAA Coastal Services Center.

Temporary Event-Based Coastal Storm Impacts

- 3-year coastal storm, king tide and 1 foot of sea level rise (~5.5 feet total water level NAVD88) in 2030 and 2040
- 3-year coastal storm, king tide and 2 feet of sea level rise (~6 feet total water level NAVD88) in 2060 and 2070
- 20-year coastal storm, king tide and ~2 feet of sea level rise (~6 feet total water level NAVD88) in 2050

The temporary event-based impacts were modeled at discrete 10-year time intervals in the future, starting in 2030 and ending in 2070. Because flooding is a random event, it is unlikely that the modeled events would occur at these intervals and frequencies in the real world. In fact, it is possible for multiple events of similar or greater magnitude than those modeled in this study

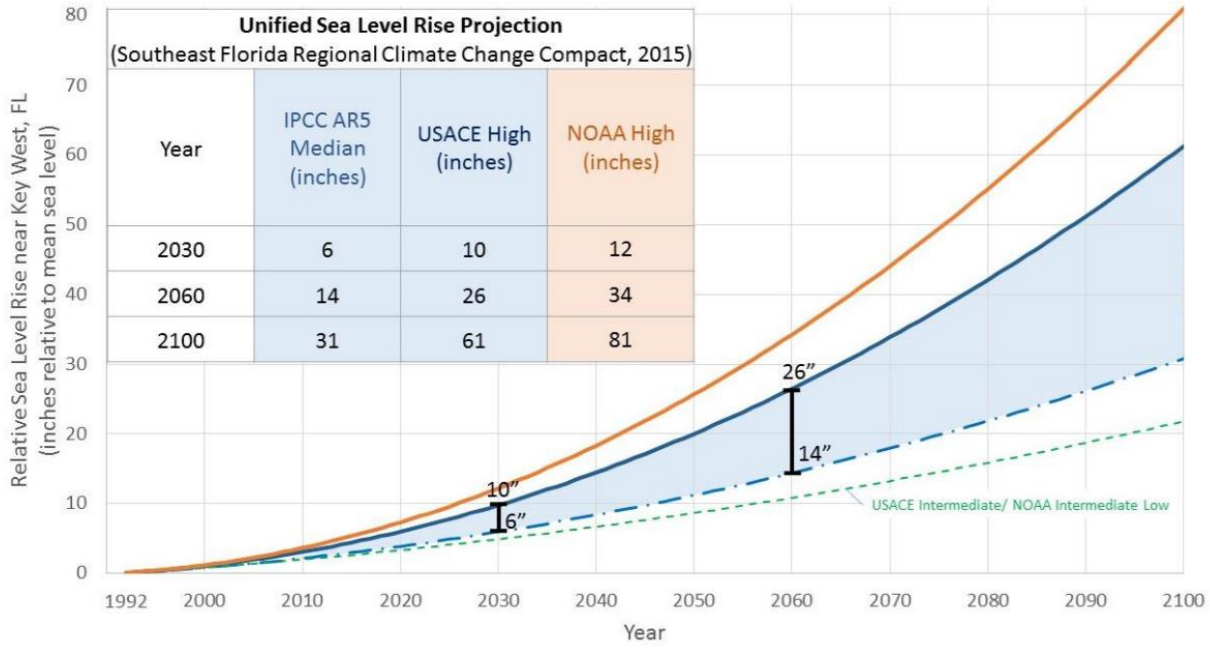
to occur in one or consecutive years, or for one of these events to happen only once every few decades. Basic probability theory was used to justify the model approach, showing that a 3-year event has over a 98% chance of occurring every 10 years and that a 20-year event has over a 87% chance of occurring over 40 years. Changing the timing of and frequency of these events could significantly alter results. This approach to modeling coastal storm impacts, while potentially conservative, was used to better capture the economic effects to the regional and state economy using the REMI model.

Permanent Progressive Sea Level Rise Impacts (MHHW)

- Mean higher-high water with one foot of sea level rise in 2030
- Mean higher-high water with two feet of sea level rise in 2060

The rates of sea level rise modeled in this study were informed using ranges provided in a 2015 report prepared by the Southeast Florida Regional Climate Change Compact Sea Level Rise Work Group (Compact 2015). It should be noted that no probabilities were assigned to these future sea level projections in this report.

Figure 2. Sea Level Rise Projections for Southeast Florida



Notes: These projections are referenced to mean sea level at the Key West tide gauge. The projection includes three global curves adapted for regional application: the median of the IPCC AR5 RCP8.5 scenario as the lowest boundary (blue dashed curve), the USACE High curve as the upper boundary for the short term for use until 2060 (solid blue line), and the NOAA High curve as the uppermost boundary for medium and long term use (orange solid curve). The incorporated table lists the projection values at years 2030, 2060 and 2100. The USACE Intermediate or NOAA Intermediate Low curve is displayed on the figure for reference (green dashed curve). This scenario would require significant reductions in greenhouse gas emissions in order to be plausible and does not reflect current emissions trends.
Source: Compact 2015

2.4 Project Alternatives

A set of project alternatives were modeled that account for the physical scenarios described above to illuminate the potential economic and fiscal impacts in the absence of action to make Dania Beach's business community more resilient to future sea level rise and coastal storms, as

well as the benefits conveyed through adaptation actions that mitigate future coastal hazards. The project alternatives parallel the framework outlined in the Broward County COAST report (2015) and are described in Table 7 below. These project alternatives were selected to evaluate the potential benefits and costs of implementing property-level building codes designed to mitigate the storm-induced flooding impacts as well as systemic-level adaptation from fortification of the coast to keep rising seas at bay. The relocate alternative was included to demonstrate an option where no action is taken to stop sea level rise and flood waters at vulnerable properties.

Table 7. Project Alternatives

Project Alternatives	Description	Temporary-Event Based Storm Scenarios	Permanent Progressive Sea Level Rise Scenarios
No Action	Nothing is done to mitigate future sea level rise and coastal storm conditions, but structures are rebuilt post-event	Applicable	Applicable
Relocate	Low-lying businesses subject to tidal inundation from sea level rise relocate to higher ground in Dania Beach or outside of the City boundaries	Not applicable	Applicable
Fortify	Construct a seawall to prevent low-lying business from being subject to tidal inundation from sea level rise	Not applicable	Applicable
Accommodate	Elevate structures so their first floor elevation is higher than the base flood elevations of modeled coastal storms	Applicable	Not applicable[1]

[1]*The permanent "Accommodate" scenario is not applicable due to the assumption that surrounding infrastructure and properties are continually inundated; this results in a property losing its functionality making elevation not a viable investment strategy.*
Source: AECOM November 2018

The assumptions in Table 8 were used to simulate impacts to the economy associated with the cost to implement project alternatives. These assumptions could change based on the availability of local, state and federal funding, and insurance payouts, as well as policy decisions related to how such investments should be funded.

Table 8. Funding Breakdown of Project Alternatives

Project Alternatives	Temporary-Event Based Storm Scenarios	Permanent Progressive Sea Level Rise Scenarios
No Action	100% property owner funding to rebuild	Not applicable
Relocate	Not applicable	25% state funding 75% individual funding
Fortify	Not applicable	Even split (i.e. 25%) between federal funding, state funding, property taxes, and sales taxes
Accommodate	100% property owner funding to elevate	Not applicable

Source: AECOM November 2018

2.5 Economic Impact Modeling Platforms and Concepts

There are a variety of approaches and tools available for modeling economic impacts of a policy decision/measure. Generally, an assessment of economic impacts will account for direct impacts to specific industries from a defined policy action, as well as the "ripple," secondary, or multiplier effects to supporting industries. The primary tools used to evaluate economic impacts include: (1) Regional Input-Output Model System; (2) Impact Analysis for Planning; and (3) Regional Economic Models, Inc. A summary of these tools can be found in Table 9 below and more detailed descriptions of these modeling platforms and their respective uses can be found in Goldenberg and Colasanti (2017).

Table 9. Economic Impact Tools Summary

Description	Most Appropriate Uses
RIMS II (Regional Input-Output Model System) • Linear I-O (input-output) model • Spreadsheet based	• Comparisons across regions, or comparing one industry to another • Scenarios when no customization is needed • Lends basic insights to relative industry strengths and connectivity • Projects with limited resources
IMPLAN (Impact Analysis for Planning) • Linear I-O (input-output) model • Web-based interface, exports to spreadsheets	• Large region or state level economic impacts at a single point in time • Comparing one industry to another, one region to another, or one investment to another • Evaluations of well-established industries • Projects with moderate budgets and existing baseline data • Analyses by professional economic modelers
REMI (Regional Economic Models, Inc.) • ESM (economic simulation model) • Software based	• Multi-factor scenarios with price changes, migration, investment, constraints on inputs, etc. • Tracking the effects of a shock over time • Projects with large budgets for evaluating the impacts of very large investments or infrastructure projects • Analyses by professional economic modelers

Source: Adapted from Goldenberg and Colasanti (2017)

2.6 REMI Modeling Approach

For this study, the REMI PI+ modeling platform was used. The REMI model is a robust economic analysis tool that integrates features of econometric, input/output, and computable general equilibrium models to estimate the impact of policy measures on local economies throughout the U.S. The REMI model is a useful tool because it can be used to understand the cascading effects of a particular change in the economy with multiple feedback loops (e.g., a change is modeled many times as it impacts additional economic sectors), and can be additionally tailored in detailed ways that reflect particular current and future demographic and economic conditions. This economic impact modeling platform is considered the most robust in the industry as it accounts for the common functions of an input-output model in addition to price elasticities and changes in consumer or industry behavior. Importantly, this dynamic model can forecast impacts into the future unlike other industry-standard models. Additionally, economic impacts of proposed mitigation investments/policy changes may also be modeled in REMI to identify positive shocks to the local economy and beyond. Additional details of the REMI model framework can be found in Appendix C.

Table 10 below shows the primary elements of the REMI model and their corresponding descriptions as applied in this study. The approach closely parallels aspects of a natural hazard assessment conducted using REMI to evaluate the economic impacts of a major earthquake in the San Francisco Bay Area (Kroll et al. 2018).

Table 10. REMI Modeling Framework for Dania Beach

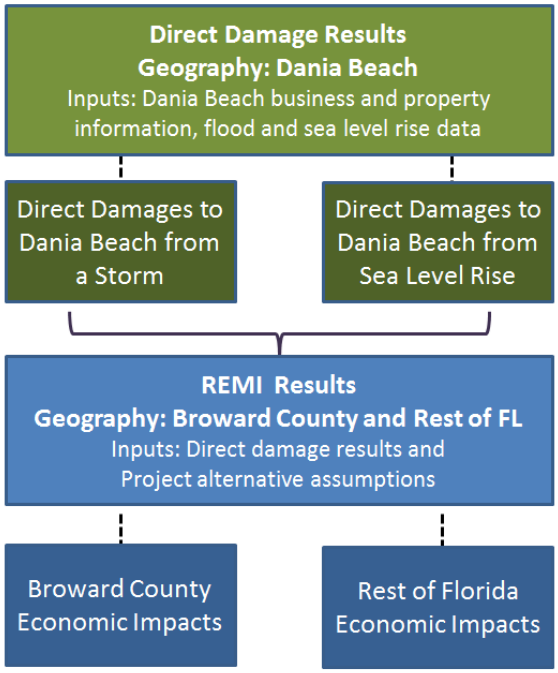
Elements	Description
Building Damage	Businesses subject to damage from coastal storms and sea level rise
Output Loss	Direct output loss resulting from building, content, and inventory damage
Employment Change	Employment loss due to disruption, gains from recovery efforts to rebuild or relocation of vulnerable businesses
Population Change	Combination of direct loss from damage, indirect loss from employment loss and other migration
Government Spending	Funding for rebuilding or relocating businesses has some boosts to the economy, but may be offset by cuts in other public services
Government Revenue Sources	Simulate increases to property taxes, sales taxes, and tourist development taxes, but may be offset by decline in other consumer spending

Source: Adapted from Kroll et al. 2018

2.8 REMI Model Application to Dania Beach

To use REMI, it was first necessary to develop direct damage models to understand the impacts of storms and sea level rise on businesses in Dania Beach. The outputs from these models are then integrated into the REMI modeling platform. For example, to determine what industries might pay for elevating their structures in the Accommodate project alternative, it was first necessary to determine which businesses were impacted. Figure 3 outlines this process.

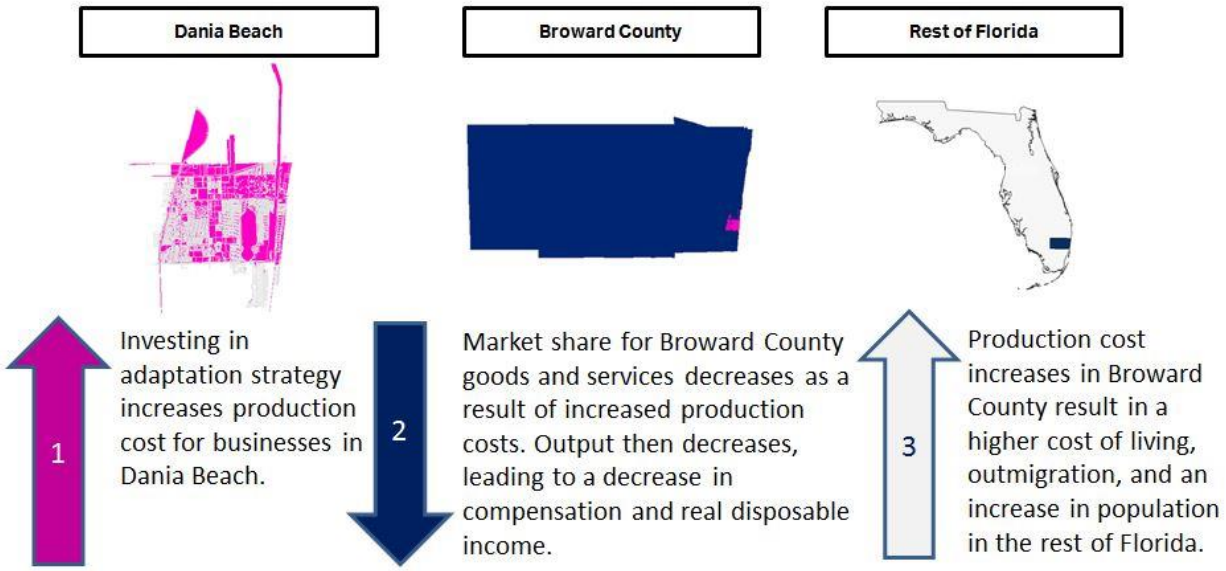
Figure 3. Relationship between Direct Damage and REMI Modeling



Source: AECOM November 2018

By using REMI, it is possible to understand how a policy or investment decision in Dania Beach can have cascading economic impacts to Broward County and the rest of Florida. Figure 4 demonstrates a simplified example of how a change to one variable in the local economy can affect the County and the rest of Florida. In this example, businesses in Dania Beach invest in a local adaptation strategy, such as elevating their buildings above the base flood elevation. This investment requires local businesses to increase their production costs to help pay off the investment cost. In many cases, this increased production cost is passed on to consumers, which could result in patrons spending their money elsewhere, ultimately decreasing the businesses' competitiveness in the market. Output decreases, resulting in a decrease in compensation and real disposable income for individuals in Broward County. In response to this increase in production costs, it is possible that Dania Beach and Broward County residents leave the county to find lower cost living, thus increasing the population in the rest of Florida.

Figure 4. Example of Interdependencies between Economic Geographies



Source: AECOM November 2018

There are numerous limitations to this simplified example. It is very possible that business owners in other geographies, such as in nearby Miami-Dade County, also decide to invest in adaptation strategies and must also increase their production costs, perhaps resulting in less of a decrease in the Broward County market share since the marginal difference in production costs is lower. Additionally, if business owners all along Florida's Atlantic coast decide to invest in adaptation strategies, such as elevating structures, there would be an increased demand for certain industries, such as construction, that could result in even higher costs for these goods and services more so than if only Dania Beach businesses are making this investment. Finally, it is important to also consider the benefits the investment will have on certain industries, such as the construction industry. Increased investment in certain industries, in turn, could result in more spending by these businesses and their workers, resulting in an overall mixed effect on the economy. Such feedback loops demonstrate the importance of understanding how changes in investment can get recirculated through the economy and whether there are overall net positive or negative impacts. Many of these considerations can be incorporated into the REMI model using different assumptions, as has been done for this report using different project alternatives.

3. Results

Summary results of the analysis are presented below. Results are separated into two main sections: Direct damage results, which were modeled outside of REMI and show the direct impact that storms and sea level rise will have on commercial properties in Dania Beach, and the project alternatives, which were modeled in REMI and show the cascading economic impacts to Broward County and the rest of Florida of the different modeled project alternatives.

3.1 Direct Damage Results to Businesses in Dania Beach

3.1.1 Single Event Coastal Storm Impacts

Single event coastal storm impact models help to understand the direct damages caused by a storm. Summary results of impacts from a single event for two storms are presented below: the 3-year storm and the 20-year storm with two feet of sea level rise. The single event damages shown below do not include businesses that are exposed to tidal inundation due to a rise in sea level.

Single event results reflect the degree of economic damage or loss that could be expected for commercially identified properties if one of the modeled future coastal storm event types were to occur in Dania Beach today. Essentially these results reflect the superimposition of future physical conditions on the existing stock of commercial property in Dania Beach. Results are shown in current 2018 dollars and are not discounted.

Table 11 shows storm-induced damages to properties, including the structural damages, the losses to contents and inventory, the cleanup costs, and the displacement costs. Damages are organized by the land use of the property. The majority of structural damages and content damages from coastal storm events occur on transportation / marina land use properties.

Table 11. Single Event Coastal Storm Impacts to Businesses: Structural Damages, Content and Inventory Losses, Cleanup Costs, and Displacement Costs

Land Use[1]	3-Year Storm			20-Year Storm		
	Structural Damages	Content / Inventory Losses & Cleanup Costs	Displacement Costs	Structural Damages	Content / Inventory Losses & Cleanup Costs	Displacement Costs
Transport/ Marina	$37,000,000	$308,700,000	$1,500,000	$37,000,000	$308,700,000	$1,500,000
Retail	$1,200,000	$10,400,000	$300,000	$3,700,000	$38,300,000	$500,000
Institutional	$4,300,000	$300,000	$1,100,000	$3,500,000	$200,000	$1,500,000
Government	$2,800,000	$5,000,000	$300,000	$2,800,000	$5,000,000	$300,000
Hotel/Motel	$2,500,000	$1,400,000	$200,000	$2,500,000	$1,400,000	$200,000
Mixed Use	$400,000	$100,000	$100,000	$1,700,000	$700,000	$200,000
Recreational/ Social	$200,000	$200,000	$0	$400,000	$500,000	$0
Office	$100,000	$0	$0	$200,000	$100,000	$0
Light industrial	$0	$0	$0	$100,000	$100,000	$0
Parking/Auto Service	$0	$0	$0	$0	$200,000	$0
Residential-Other/Mobile	$0	$0	$0	$100,000	$100,000	$0
TOTAL	**$48,500,000**	**$326,100,000**	**$3,500,000**	**$52,000,000**	**$355,300,000**	**$4,200,000**

[1] *Primary land use assignment informed by assessor data.*
Figures rounded to nearest $100,000.
Source: AECOM November 2018

In a storm, businesses will be closed due to the damages their structures endure. Business closures may not last the full duration of the rebuilding period, as some industries are expected to find temporary space after a certain period of time to resume their operations. The duration of time that businesses are assumed to not be able to function varies – ranging between 2 days and 120 days for the 20-year storm. Average business closure durations for businesses impacted by the 20-year storm are around two weeks. Table 12 shows single event coastal storm impacts to business sales by industry. The most impacted industries include arts/entertainment and recreation, retail trade, and accommodation and food services.

Table 12. Single Event Coastal Storm Impacts to Business Sales by Industry

Industry	3-Year Storm	20-Year Storm
Arts/Entertainment/Recreation	$947,000	$954,000
Retail Trade	$567,000	$691,000
Accommodation/Food Services	$386,000	$391,000
Wholesale Trade	$202,000	$214,000
Finance & Insurance	$8,000	$171,000
Transportation/Warehouse	$81,000	$81,000
Mgmt. of Companies/Enterprises	$73,000	$73,000
Information	$28,000	$32,000
Prof./Scientific/Tech Srv.	$22,000	$25,000
Health Care/Social Assistance	$17,000	$20,000
Other Srv excl. Public Admin.	$5,000	$12,000
Real Estate/Rental/Leasing	$4,000	$9,000
Manufacturing	$7,000	$7,000
Construction	$5,000	$5,000
Admin/Support/Waste Mgmt. & Remediation	$4,000	$4,000
TOTAL	**$2,356,000**	**$2,689,000**

Figures are rounded.
Source: AECOM & ESRI, November 2018

3.1.2 Impacts from Coastal Storms over Time

Because the timeframe of analysis is 2030-2070, it is important to consider the frequency of the 3-year and 20-year storm. Coastal storm impacts were modeled using two methods. The first method assumes specific years of storm events in which the damages occur. This method was used for the REMI model. Table 13 below reports the damages using this method in which it was assumed that the 3-year event would occur in 2030, 2040, 2060, and 2070 and that the 20-year event would occur in 2050. The impact of the coastal two storm events change over time to account for rising sea levels. As such, a 3-year event in 2060 is expected to have higher flood depths than a 3-year storm in 2030. Losses are assumed to occur in the year of the storm. The damages of the modeled storms were discounted and summed to arrive at an estimate of cumulative net present damages.

The second method uses a probability-based approach. Damages are multiplied each year by the probability of the storm occurring. Consider, for example, a 10-year storm event, which has a 10% chance of occurring in any given year. If the damages from this event are modeled at $1,000,000 then this value is multiplied by 0.1 (10% chance), resulting in expected annual damages of $100,000. Translating damages from their absolute one-time event value to their expected damage year-over-year is informative for the purpose of considering the average annual investment that could be considered cost-effective to mitigate such impacts. However, this approach to spreading out damages overtime is not conducive for capturing the follow-on impacts that result from a storm-event, such as shocks to the regional and state economy that are integrated into the REMI model. Results from this method are shown in Table 14. Expected annual damages for each year were discounted and summed to arrive at an estimate of cumulative net present damages. Overall, cumulative damages are more than twice as high when modeled using the second probabilistic method.

Table 13. Cumulative Damages from Coastal Storm Events with Assumed Event Occurrence

Impact Type	Sum of Cumulative Damages (2030-2070)
Structure Damages	$164,800,000
Content and Inventory Losses	$538,500,000
Displacement Costs	$4,500,000
Sales Losses	$10,500,000
Sales and Tourist Development Tax Losses	$600,000
TOTAL	**$718,900,000**

Figures rounded to nearest $100,000. Shown in NPV with 5% discount rate, 40-year period of analysis.
Source: AECOM November 2018

Table 14. Cumulative Damages from Coastal Storm Events with Annual Occurrence Probability

Impact Type	Sum of Cumulative Damages (2030-2070)
Structure Damages	$392,500,000
Content and Inventory Losses	$1,190,500,000
Displacement Costs	$9,700,000
Sales Losses	$23,900,000
Sales and Tourist Development Tax Losses	$1,300,000
TOTAL	**$1,617,900,000**

Figures rounded to nearest $100,000. Shown in NPV with 5% discount rate, 40-year period of analysis.
Source: AECOM November 2018

3.1.3 Permanent Progressive Sea Level Rise Impacts (MHHW)

Summary results of direct impacts from sea level rise are presented in Table 15. These damages present a worst case scenario – i.e. what would happen if no action was taken. Results are broken out for each category of damage evaluated. For permanent progressive damages, it is assumed that properties subject to reoccurring or permanent tidal inundation have no market value or income producing potential. These losses are accounted for with a one-time loss of property value and annual reoccurring sales and tax losses. While there is a significant amount of value tied to real property losses, these one-time losses are discounted and are small in comparison to the business impacts which accrue year-over-year until the end of the analysis. Expected permanent damages were calculated for each year and then discounted and summed to arrive at an estimate of cumulative net present damages.

Table 15. Cumulative Damages from Permanent Progressive Sea Level Rise

Impact Type	Sum of Cumulative Damages (2030-2070)
Market Value Loss	$61,900,000
Property Tax Loss	$4,900,000
Sales Losses	$1,044,100,000
Sales Tax and Tourist Development Tax Losses	$56,400,000
TOTAL	**$1,167,300,000**

Figures rounded to nearest $100,000. 5% real discount rate applied.
Source: AECOM November 2018

3.2 REMI Results to Broward County and the Rest of Florida

Simply modeling the direct damages of a storm or of sea level rise is not representative of the many manners in which the economy will respond to the event. For example, after a large storm, stimulus money could bring positive impacts to the local construction industry to rebuild damaged properties. As such, it is important to model storm and sea level rise damages in the context of the actions (or lack of action) that are taken in response to changing risk and damage profiles. This includes both proactive / adaptive actions, such as building a seawall and reactive actions, such as rebuilding after an event. Including the investment in adaptation and/or recovery sheds more light on the complex economic impacts of these events. The REMI analysis shows how activity in Dania Beach impacts Broward County and the rest of Florida; the model does not isolate impacts to Dania Beach itself, rather these impacts flow into the larger economic geographies reported. The results of the three permanent and two temporary impact scenarios are analyzed in comparison to the REMI control, which projects regional conditions such as population and industry growth on to an economy without a storm or sea level rise event.[2] The control projections for Broward County and the rest of Florida are presented first in section 3.2.1 to contextualize results.

3.2.1 Control

In 2030, the projected GDP of Broward County is nearly $116 billion with an employment level of 1.3 million. Between 2030 and 2070, Broward County is expected to experience an increase in employment of nearly 313,000 jobs and an increase in GDP of $131 billion. In the rest of Florida, employment increases to over 1.7 million between 2030 and 2070; GDP is forecasted to increase to more than $918 billion.

Table 16. Control: Industry Employment Forecasts for Broward County

Broad Industry Category	2030	2070
Services	656,200	919,500
Retail and Wholesale	211,000	218,400
Finance, Insurance & Real Estate	171,100	204,600
Government	116,400	121,500
Construction	71,300	74,300
Transportation and Public Utilities	49,200	56,100
Manufacturing	34,900	28,900
Natural Resources	2,000	1,800
Farm	1,000	900
All Industries	**1,313,100**	**1,626,000**

Source: AECOM & REMI PI+ November 2018

As shown in Table 16, services industries comprise the largest component of the Broward County employment forecasts, making up nearly 50% of the jobs in 2030. These industries include: information, management of companies and enterprises, education services; private,

[2] The REMI regional control forecasts draws primarily from the Bureau of Labor Statistics Employment Outlook. Other REMI employment data sources include information from the Bureau of Economic Analysis Local Area Personal Income (LAPI) and Census Bureau's County Business Patterns data. Other REMI housing price data sources include: Census of Housing, the American Community Survey, and the Federal Housing Finance Agency (FHFA).

arts/entertainment and recreation, healthcare and social assistance, accommodation and food services, administrative/support/waste management/ and remediation services, professional/scientific/and technical services, and other non-public administration services.

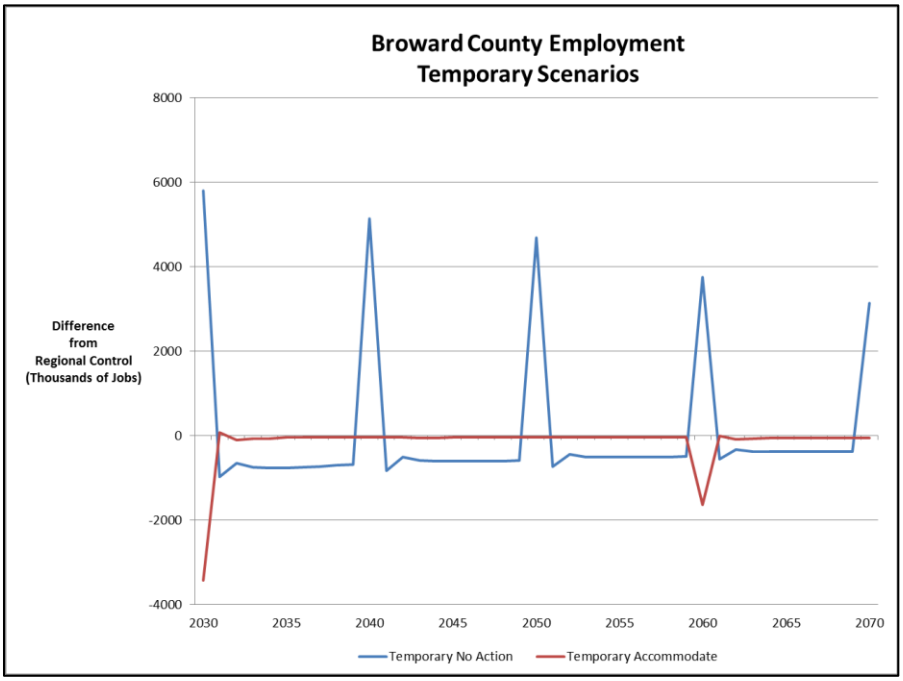
3.2.2 Temporary Event-Based Storm Results

The two temporary project alternatives were no action and accommodate (see Appendix B for more information on project alternatives). Figure 5 and Figure 6 show the impact to employment for each of these project alternatives as compared to the control for Broward County and the rest of Florida. The fluctuation of the blue line reflects the storm frequency in the temporary no action project alternative. In this project alternative, the model forecasts that properties will be restored to their prior value and condition within the year of the storm event. This results in a positive impact to employment levels and GDP in the year of the storm.

Figure 7 shows impacts by industry within Broward County as a percentage change relative to the control. The construction industry has the greatest positive percent change each storm year. After the years of the storms – and the rebuilding efforts – employment levels dip below the control and do not go back up until the next storm event as it is assumed business owners must repay the costs of rebuilding over time, which redirects investment resources that otherwise would have gone to suppliers and employees. GDP and output follow the same trend. In the rest of Florida, a similar pattern emerges but with smaller magnitude, as would be expected given the larger absolute levels of GDP, output, and employment.

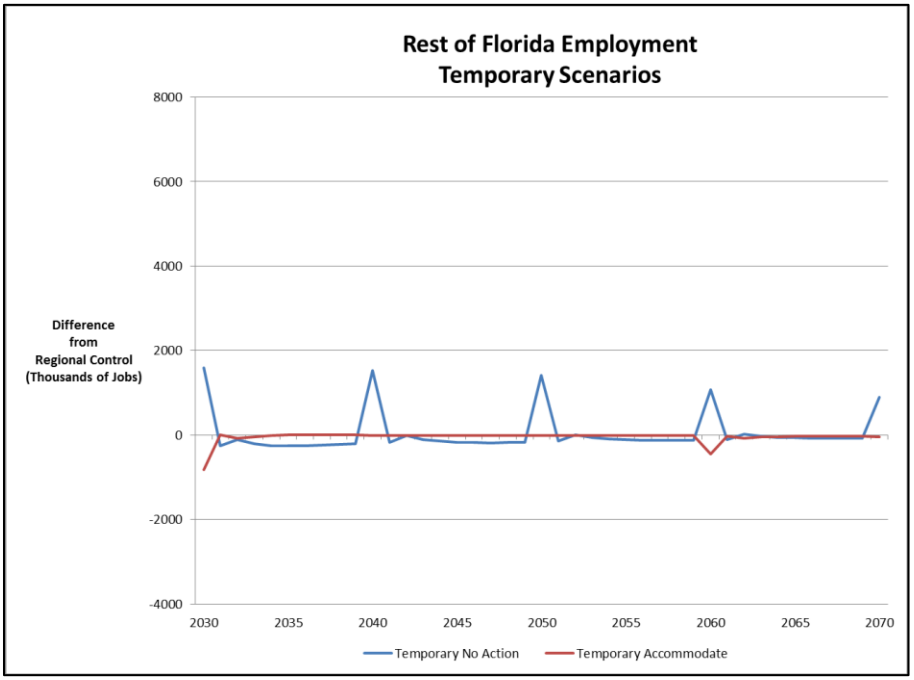
In the temporary accommodate project alternative, the closure of businesses during the construction period to elevate their structures leads to a negative employment in the year these actions are taken. This negative output outweighs the increased investment in the construction industry. As a result, both in 2030 and in 2060, employment levels, GDP, and output are below the control for Broward County and the rest of Florida. It is also assumed that production costs will remain higher for five years after construction for businesses to pay back the cost of elevating their structures. Therefore, in most years, the temporary accommodate project alternative results in employment and GDP slightly below the “business as usual” economic indicators in Broward County and the rest of Florida.

Figure 5. Broward County Employment: Temporary Scenarios



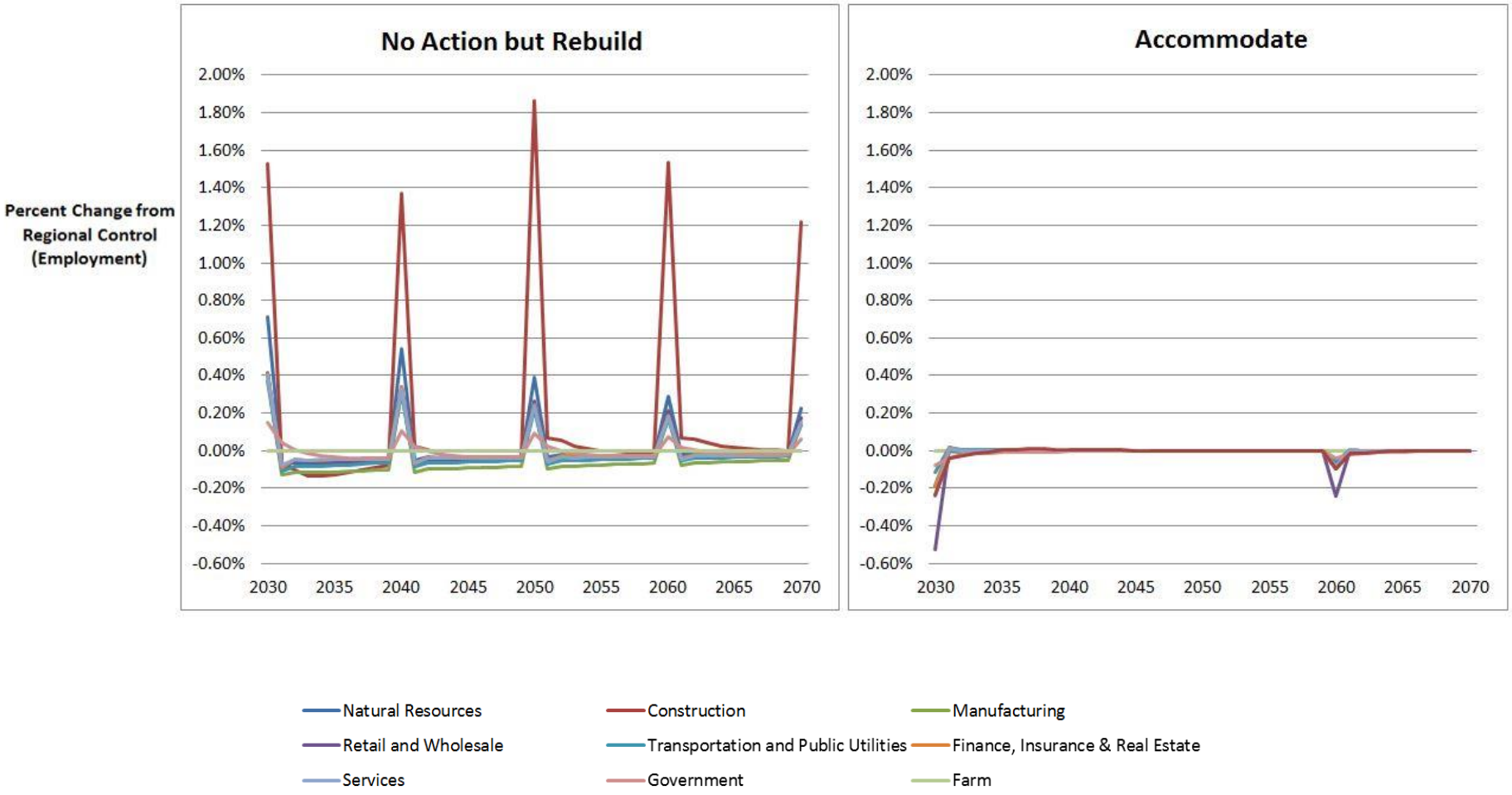
Source: AECOM & REMI PI+ November 2018

Figure 6. Rest of Florida Employment: Temporary Scenarios



Source: AECOM & REMI PI+ November 2018

Figure 7. Employment Changes to Broward County by Industry: Temporary Scenarios



Source: AECOM & REMI PI+ November 2018

The timing of damages and investment significantly affects whether economic indicators, such as employment and GDP, are positively or negatively impacted by the storm events. As such, Table 17 shows the net differences of each project alternative as compared to business as usual.

The fluctuations in the temporary no action project alternative over time have a positive net gain compared to the control in Broward County for GDP and employment. Employment increases by 1,810 jobs while GDP increases by $100 million. However, the population within Broward County actually decreases over time. This results from the fact that business owners must increase their production costs over the years following a storm to pay back losses – including property damages and inventory losses. This increase in production costs increases the cost of living, resulting in residents moving outside of Broward County. In the rest of Florida, employment increases by 1,720 jobs; GDP increases by $120 million, and population increases by 1,140 as compared to the control over the 2030-2070 timeframe.

In the temporary accommodate project alternative, overall losses compared to the control are greater than the no action project alternative for both Broward County and the rest of Florida. This is due to both the cost of elevating the structure and reduction in output during the closure of businesses to accommodate for construction. A future project alternative could be modeled in which the cost of elevation is paid in part through state or federal assistance. However, the losses due to business closure far outweigh the cost of elevation: in 2030 it is estimated that businesses would lose $238 million during elevation construction, while the cost to elevate is only $11 million (current dollars). In 2060, the cost to elevate is $8 million but business would lose $192 million during elevation construction (current dollars). In Broward County, it is estimated that employment overall would be 6,830 less than the control between 2030 and 2070 and that GDP would be $690 million less. In the rest of Florida, there is a decrease in employment by 2,060 and a $240 million decline in GDP compared to the control.

Table 17. Total Change from Control Levels of Temporary Scenarios

Broward County			
Socioeconomic Indicators *Net Change 2030-2070*	Control	Temporary No Action	Temporary Accommodate
Total Employment Change	312,810	1,810	-6,830
Total GDP Change (Millions)	$131,150	$100	-$690
Total Population Change	584,770	-8,580	-10,350
Rest of Florida			
Socioeconomic Indicators *Net Change 2030-2070*	Control	Temporary No Action	Temporary Accommodate
Total Employment Change	1,758,020	1,720	-2,060
Total GDP Change (Millions)	$918,090	$120	-$240
Total Population Change	3,520,990	1,140	-2,500

GDP is not discounted; figures are rounded.
Source: AECOM & REMI PI+ November 2018

3.2.3 Permanent Progressive Sea Level Rise Results (MHHW)

The three permanent project alternatives were: no action, relocate, and fortify. Figure 8 and Figure 9 show the impact to employment for each of these project alternatives as compared to the control. In the permanent no action project alternative, employment levels never reach the

control in both Broward County and the rest of Florida. In 2060, the impact of the additional foot of sea level rise decreases Broward County employment to nearly 2,500 below the control estimates for that year.

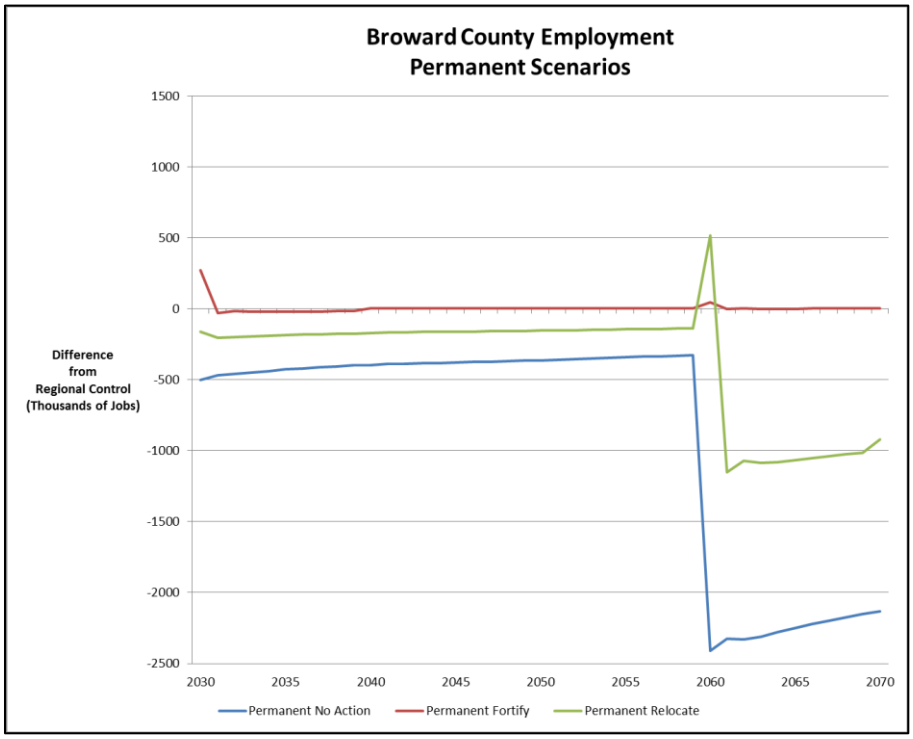
In the relocate project alternative, people and businesses in commercial-designated properties subject to sea level rise move and rebuild either elsewhere within Broward County or outside of the County. The relocation and rebuilding efforts are modeled to occur in 2030 and 2060 and help to stimulate the economy. The costs of rebuilding are shared among federal, state, and local stakeholders, thereby spreading the financial burden of the investment. The local portion is expected to be repaid by the owners of impacted industries over a 10-year time period.

Two feet of sea level rise impacts $109 million of commercial property in Dania Beach. Efforts to rebuild this capital stock elsewhere results in positive economic impacts in the year of construction followed by negative impacts from increased production costs that account for businesses paying down this investment over the next decade.

Figure 10 shows the impacts this has on jobs by broad industry category. The relocate project alternative has the greatest positive percent change of the three permanent scenarios, with a nearly 1.2% increase in employment in the construction industry in 2060 in Broward County. In the rest of Florida, the permanent relocate project alternative increases employment levels above the control for all years. While the cost for paying for a percentage of the rebuilding efforts decreases the amount of government funding available for other services, the increased investment in the construction and real estate industries as well as the increase in overall capital stock and businesses due to outmigration from Broward County increases employment levels overall.

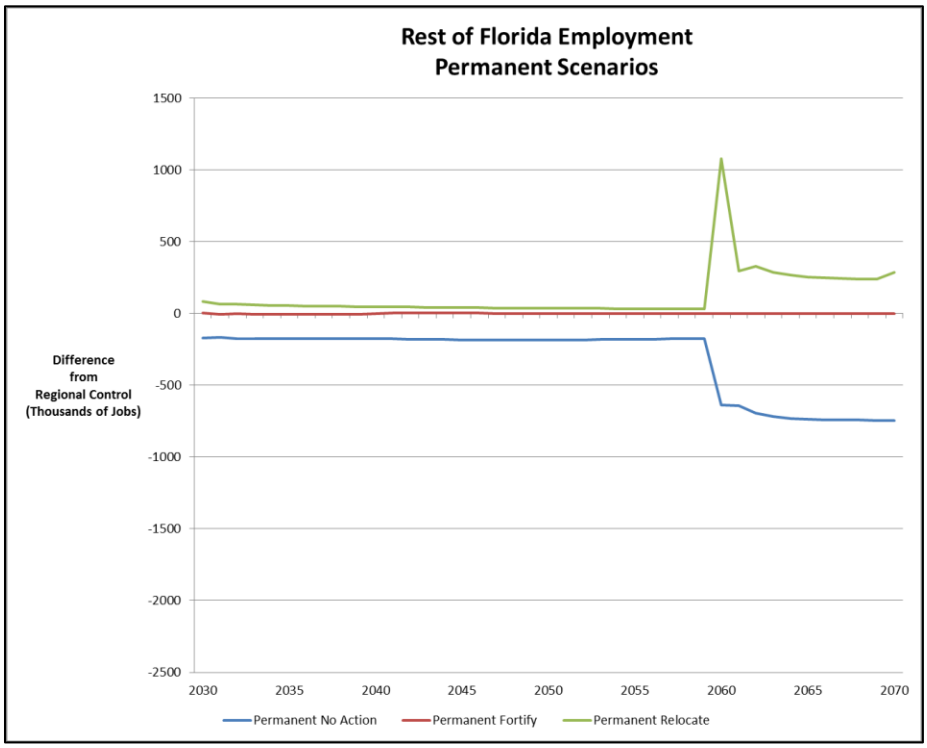
Finally, the permanent fortify project alternative is an investment in a local seawall that protects against all sea level rise damages modeled. This project alternative has the greatest positive impact on employment in the year 2030, when the majority of the expense is assumed to be spent; the construction industry is the largest beneficiary of this spending. To pay for the seawall, property and sales taxes are modeled to increase for the decade following the construction. This increase in taxes results in less expendable income for consumers to spend and support other industries, and overall employment levels decrease below the control for several years after the seawall construction in both Broward County and the rest of Florida after the initial major investment in 2030. The permanent fortify project alternative is the only alternative that results in an increase to Broward County’s population relative to the control.

Figure 8. Broward County Employment: Permanent Scenarios



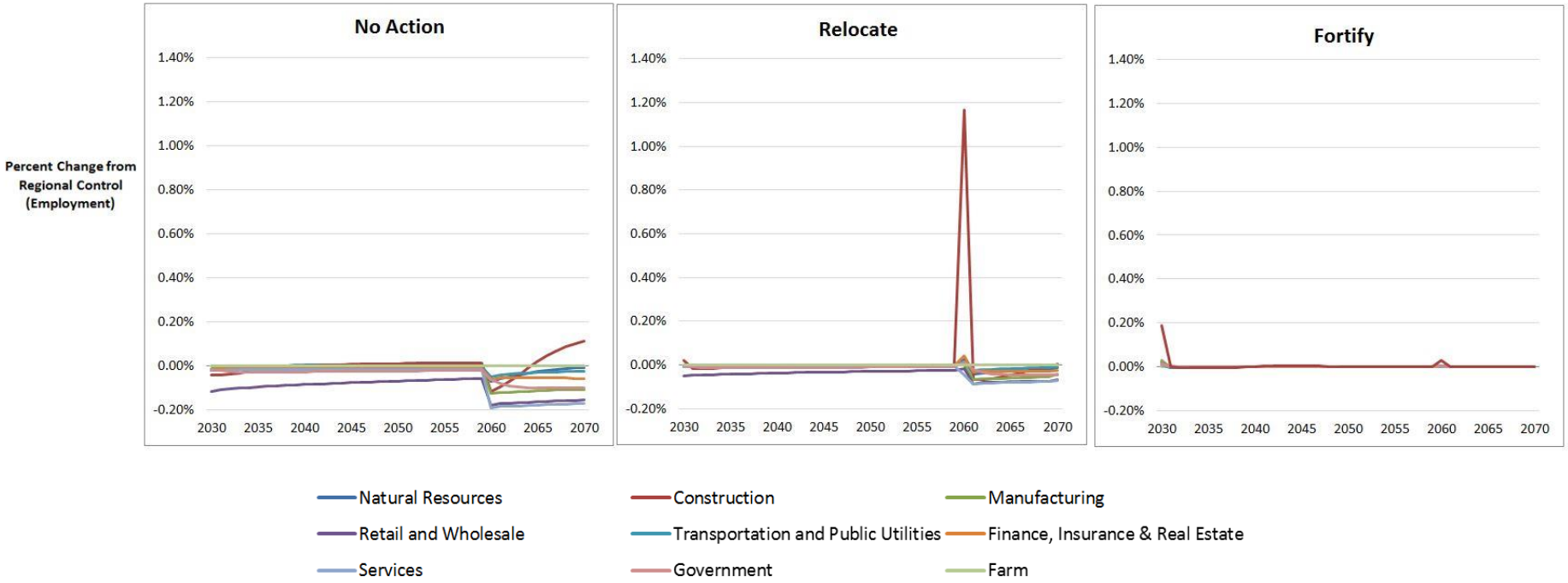
Source: AECOM & REMI PI+ November 2018

Figure 9. Rest of Florida Employment: Permanent Scenarios



Source: AECOM & REMI PI+ November 2018

Figure 10. Employment Changes to Broward County by Industry: Permanent Scenarios



Source: AECOM & REMI PI+ November 2018

The timing of damages and investment significantly affects whether economic indicators, such as employment and GDP, are net positive or negative. As such, Table 18 shows the net differences of each project alternative as compared to the control.

In the permanent no action project alternative, the employment and GDP forecasts decrease in both Broward County and the rest of Florida. Overall, it is estimated that there will be 36,400 fewer jobs and a nearly $5 billion decrease in GDP in Broward County. The rest of Florida also experiences negative economic impacts in this simulated project alternative, though of lesser magnitude, with a decrease in employment of 13,300 and a $1.7 billion decline in GDP compared to the control. In the permanent relocate project alternative, Broward County has nearly 15,000 fewer jobs and a decrease of $1.95 billion to GDP. In this project alternative, the rest of Florida has a positive gain in employment and a total GDP increase of $720 million over the control. The permanent fortify project alternative is the only project alternative in which outcomes are either neutral and/or positive to both Broward County and the rest of Florida. In this project alternative, the seawall investment both avoids economic losses and increases industry investment. Broward County employment increases by 200 over the control and GDP increases by $20 million. The rest of Florida experiences minimal impact.

Table 18. Total Change from Control Levels of Permanent Scenarios

Broward County				
Socioeconomic Indicators *Net Change 2030-2070*	Control	Permanent No Action	Permanent Relocate	Permanent Fortify
Total Employment Change	312,810	-36,410	-14,930	200
Total GDP Change (Millions)	$131,150	-$4,750	-$1,950	$20
Total Population Change	584,770	-41,210	-16,780	270
Rest of Florida				
Socioeconomic Indicators *Net Change 2030-2070*	Control	Permanent No Action	Permanent Relocate	Permanent Fortify
Total Employment Change	1,758,020	-13,260	5,080	-30
Total GDP Change (Millions)	$918,090	-$1,700	$720	$0
Total Population Change	3,520,990	-18,800	5,560	-90

GDP is not discounted; figures are rounded.
Source: AECOM & REMI PI+ November 2018

4. Dania Beach Business Community Survey Summary Findings

In 2018, staff from Broward County Environmental Planning and Community Resilience Division surveyed businesses in Dania Beach's main commercial corridor to better understand the characteristics of their businesses as well as their perceptions on how climate change could affect their future operations. A total of 22 businesses responded to the survey. The industries represented include: Accommodations and Food Services, Arts/Entertainment and Recreation, Finance and Insurance, Real Estate Rental and Leasing, Wholesale Trade, Retail Trade, and other private services. A majority of respondents classified their business as being in the Retail Trade industry. The survey results help to illustrate the features of Dania Beach's business community that make them more or less vulnerable to future climate conditions, including their ability to be resilient to physical impacts on site as well as to downstream impacts that can affect their workers and supply chain. Appendix E includes summary statistics for most survey questions.

Businesses report that they are already impacted by severe weather events and are concerned about climate change impacts that could increase risks to their operations now and in the future. Overall, results show that businesses are very concerned about the negative impacts resulting from an increase in storms and extreme rain events, though are less worried about the negative impacts from increasing temperatures. Over half of employees reported their commute as being currently impacted by flooding. Nearly 70% of respondents reported that their insurance has increased in recent years, and many are concerned about their ability to stay in business if insurance premiums continue to rise. Many respondents reported that an increase in their insurance premium would require them to change their business model. These changes could include passing on additional costs to consumers and/or decreased wages for employees. Such changes could make businesses less competitive and result in a loss of market share to industry counterparts to the extent that these industries can shift to other locations.

Businesses in Dania Beach that are vulnerable to coastal hazards could consider relocating, but this would likely come at the cost of reduced output due to moving farther away from key consumer activity at the nearby port and airport. Many businesses in Dania Beach reported that they are dependent on goods, services, employees, and clientele from outside the City. Nearly half of surveyed businesses reported that their goods and supplies are sourced outside of the County. Survey results show that nearly 70% of the businesses have less than a quarter of their staff residing in Dania Beach. Broad geographic dependency limits the effectiveness of local solutions and emphasizes the importance of investing in resilience measures to regional networks, such as transportation.

Low staff wages and profit margins limit employee and operational resiliency. Of surveyed businesses, 40% said that their profit margin is less than 25% for most of their goods and services. In many industries, profit margins may be higher than revenue generation. In general, smaller businesses have limited capital reserves that might be necessary in the event of a major storm. When asked what amount of special assessments or utility fees businesses could afford if infrastructure improvements were needed, two-thirds of businesses responded less than $1,000, the lowest option on the survey. A number of surveyed industries reported staff wages within $10 of the minimum wage. More than 50% of staff in businesses in the following surveyed

industries earn within $10 of the minimum wage: Accommodation and Food Services, Arts/ Entertainment and Recreation, Retail Trade, and Wholesale Trade. Employees that earn close to the minimum wage are likely more sensitive to work disruptions that could result in loss wages and commuter delays, both of which could increase if no action is taken to mitigate future impacts from coastal storms and sea level rise.

5. Conclusion

Dania Beach commercial properties are vulnerable both to coastal storm flooding and sea level rise impacts. Losses to content and inventory are of greatest magnitude for the coastal storm events modeled, while the permanent sea level rise scenario models result in the largest impacts to sales output. When coastal storms and sea level rise are considered within the context of the alternatives modeled, such as when rebuilding efforts are accounted for, the story becomes more nuanced: rebuilding after a storm results in benefits to the County's economy while elevating structures to mitigate storm damages results in negative economic impacts due to lost business output during construction. For properties vulnerable to sea level rise, a seawall that eliminates exposure to sea level rise provides the most protection and economic benefits to the County. Overall, the modeled scenarios demonstrate the potential for industry booms from rebuilding and fortification efforts – such as employment gains in the construction industry.

Survey data helps to contextualize the model results and provide a deeper understanding of the current concerns and vulnerabilities of local businesses to future climate conditions. Dania Beach's business profile is largely based on smaller retail and tourism-based industries. Often, businesses are reliant on their proximity to the port and the airport, with a high percentage of their supplies coming from outside Broward County. Employees and clientele are often coming from outside Dania Beach. All of these characteristics can have significant implications for vulnerability, adaptive capacity, and resilience investment prioritization.

When analyzed together, model and survey results can also demonstrate potential discrepancies between perceived and actual risk. Only two of the twenty-two surveyed businesses were identified as having risk to a 3-year or 20-year storm or to 1 or 2 feet of sea level rise, though it is possible that business owners are considering the potential for impacts from events that are greater in magnitude than those modeled in this study. Business owners in the Accommodation and Food Services industry may expect that an increase in storms and extreme weather events could benefit their business due to the potential increase in demand for temporary lodging and meals following extreme events, but the modeled coastal storm impacts illustrate that the Accommodation and Food Services industry could incur significant storm damages. The survey results showed that concerns over price changes in insurance premiums were common among Dania Beach business owners. However, investing in adaptation measures can actually result in decreased premiums if such actions can clearly demonstrate that they reduce potential risk exposure.

The local business community faces a number of barriers to achieving economic resilience. Dania Beach's business community faces financial restraints to investing in adaptation and imposing fees could add significant pressures to operations. Businesses are heavily reliant on resources from outside the jurisdiction and county.

Effective prioritization of strategies and a focus on industry knowledge sharing and partnerships with the public sector can help alleviate the burden and improve results. There is a shared interest between the public and private sector to thoughtfully pursue actions such as:

- **Prioritize phased adaptation investments with an eye toward long-term risk**. Often, it is too costly to pay for projects that mitigate for long-term impacts, but full life-cycle cost assessments may help to inform when projects are better suited to address long-term risk.

For example, when elevating a structure, elevate to the higher flood depth projections so that businesses only need to close once rather than twice.

- **Invest in regional strategies** such as improvements to the local road network to decrease interruptions from flooding. Regional strategies can expand the pool of potential funding sources thereby decreasing the burden on any one locality.
- **Establish an accessible data platform** for businesses to identify their potential vulnerabilities to both existing and future climate conditions. Dania Beach's business community is concerned about climate change but may not have access to the necessary resources to fully contextualize this risk and to better understand how adaptation investment and planning could decrease both their physical and economic exposure.
- **Improve disaster preparedness**. Develop business continuity plans to prepare for disaster and establish local partnerships to understand how other businesses are addressing adaptation.
- **Expand assessment of projected damages** beyond the local business community to include residential and public infrastructure to improve understanding of strategies that can offer co-benefits and the way in which the costs of adaptation can be shared by different groups of beneficiaries.

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Appendix A – Direct Damage Evaluation Methodologies

This economic and fiscal impact analysis draws from commonly-used guidance outlined by the federal agencies discussed in Section 2.2. The analysis also incorporates techniques from relevant academic and technical studies that address principles of accounting for economic and fiscal impacts in the natural hazard context. While standard economic methodologies underpin this analysis, effort was taken to ensure that model inputs reflected local—not national or regional—economic conditions where feasible to more accurately reflect on-the-ground conditions.

Note that different types of damages are expected from temporary storm- driven flooding compared to permanent progressive tidal inundation from sea level rise. Separate accounting methodologies were used to address these different types of impacts.

Temporary Event-Based Coastal Storm Impacts

Direct Property Impacts

Storm-induced flooding can cause direct physical damage to structures and their contents as well as result in costs to clean up damaged property. In the context of this analysis, structural damage applies to real property while content damage applies to personal property.

Methodology

Standard procedures outlined by the USACE and FEMA were used to estimate damages to structures and contents. The primary steps of the analysis include:

1. Identify structures that are at risk to flooding.
2. Determine the depth of flooding for at risk structures.
3. Estimate the replacement value of at risk structures.
4. Estimate content replacement value within at risk structures
5. Estimate the inventory replacement value within at risk structures
6. Relate depth of flooding and structure and content replacement values to occupancy-specific depth damage functions (DDFs).[3]
7. Calculate cleanup costs as a percentage of the estimated structure damage.

Inputs

A variety of data sources were used to carry out this analysis. An inventory of parcel lot and structure characteristics was developed using data catalogued by the Broward County Assessor's office. Depth of flooding was determined by overlaying hazard maps developed by the USACE on the spatially-explicit parcel and structure inventory. Building replacement values were estimated using local cost per square foot factors developed by RS Means. When local values were not available for specific occupancy types, default values from FEMA were incorporated. The DDFs and content to structure value ratios used in the analysis were

[3] DDFs account for the relationship between the depth of flooding within a structure and the extent of damage that could be expected, expressed as a percentage of the total building or content replacement value.

developed by the USACE. Inventory was calculated as a percentage of sales, based on FEMA percentages and sales data provided by ESRI Business Analyst.

These outputs were developed from observed coastal storm damages along the Gulf Coast by the USACE, similar to the approach used by GEI Consultants, Inc. (2015). Inventory DDFs were calculated using the ratio of inventory to content DDFs from curves developed for Galveston, Texas. In the no action project alternative, first floor elevations were assumed to be one foot above grade for a majority of properties. Cleanup costs were estimated on a percentage basis of the estimated structure damage per FEMA guidelines.

Key Assumptions and Considerations

A number of data processing techniques were required to progress through the methodological steps outlined above. The land use or occupancy types of parcels recorded by the Broward County Assessor had to be mapped onto the classifications used by RS Means and FEMA to estimate the appropriate replacement values. A similar exercise was also necessary to assign the most appropriate DDFs to each parcel and its structure(s).

Parcel data catalogued by the County Assessor serves as the building blocks for estimating direct property impacts. The properties that were analyzed were properties with businesses located on them as defined by County Assessor land use classifications.

Displacement Impacts

Storm-induced flooding resulting in property damage can displace businesses. Displacement can trigger a number of costs, such as one-time relocation costs and additional rental costs for the period of time that a property is being rehabilitated. In addition, businesses that are required to relocate can experience sales losses until they are back in operation at another location. Business and employment impacts are accounted for below.

Methodology

Standard procedures outlined by FEMA were used to estimate displacement and relocation costs. The primary steps of the analysis include:

1. Identify structures that are at risk to flooding.
2. Determine the depth of flooding for at risk structures.
3. Relate the depth of flooding to the degree of structural damage that is expected.
4. Calculate building rehabilitation time by considering the estimated degree of building damage.
5. Apply relocation costs and additional rental costs.

Inputs

The required inputs to determine the degree of flooding to buildings are outlined in the Direct Property Impacts discussion above. FEMA technical guidance documents outlined the additional information required to relate flood depth to the degree of structural damage. These documents also included values for restoration timelines, one-time relocation costs, and average renter and owner occupancy rates. Percent owner occupied came from FEMA technical guidance per HAZUS land use code. Rental costs and vacancy rates for different occupancy classes were identified in current real estate market studies (e.g., CoStar).

Key Assumptions and Considerations

This analysis further assumes that nearly all businesses that experience flooding impacts are able to relocate in the City of Dania Beach or elsewhere in Broward County. The few exceptions are for occupancy types where there are fewer substitute locations that could absorb specialized business operations (e.g., hotels). The relocation determinations are based on default factors developed by FEMA. More specific information on building occupancy and ownership rates in the Dania Beach and/or Broward County geography could result in changes to the applied relocation factors. This level of analysis is beyond the scope of this analysis, and would also be highly speculative considering the future time horizons being considered (i.e., from 2030 to 2070) and changes in land use and economic activity that could occur between now and the end of the period of analysis.

Business Impacts

Storm-induced flooding can damage structures and result in business losses during the time it takes for a building to be rehabilitated. If a business is closed, sales losses would be expected as well as the potential for lost employment and other associated fiscal impacts. Fiscal impacts that are related to temporary business closure are discussed separately below.

Methodology

Standard procedures outlined by FEMA were used to estimate business and employment impacts. The primary steps of the analysis include:

1. Determine the number of businesses in the study area and associate these businesses with the building data collected in the Direct Property Impact analysis.
2. Determine the annual sales for identified vulnerable businesses.
3. Assign each business to an NAICS industry code to determine what percentage of sales can be recaptured at a later date through increased productivity.
4. Using Direct Property Impact model outputs identify how many businesses will be impacted by structure damage and for how long they will experience an economic loss of function (LOF). Calculate the associated sales losses that cannot be recaptured. For occupancy types where there are fewer substitute locations that could absorb operations, assign the LOF timeframe to the total number of days required for the structure to be rehabilitated.

Inputs

Several data sources were used to inform this analysis. ESRI's Business Analyst was used to collect business data for the study area including: sales volume by business, address, and the North American Industry Classification System (NAICS) code for all businesses. Sales volume estimates (in dollars) are for the full year 2017 for each business and are based on a model that assigns sales estimates per employee using NAICS codes when specific data is not available. Companies that typically do not generate sales (e.g. educational institutions, government offices) are not assigned sales volumes in the ESRI/Infogroup model. Recapture rates came from FEMA. All businesses were then associated with the Direct Property Impact information. Loss of function estimates were identified in FEMA technical documentation.

Key Assumptions and Considerations

The economic loss of function (LOF) time is the amount of time a business is not capable of conducting its operations; it is shorter than the rehabilitation time of a damaged property as it assumes that businesses will rent alternative space during repairs and construction. LOF depends on the damage state, as determined by the percent of structure damage compared to the full building replacement value. Determinations on if a business is directly or indirectly impacted by flooding and the relative LOF timeline were made using similar considerations relating to flood depth and the number of stories in a building as described in above in Displacement Impacts methodology.

Fiscal Impacts

Storm-induced flooding that damages property can result in fiscal impacts in the form of reduced sales tax and tourist development tax revenues. Sales tax and tourist development tax losses are a function of the amount of time a business is unable to operate, as well as considerations relating to the ability of a business to recapture some of these earnings at a later date, as described in the Business and Employment Impacts methodology discussed above. It is also possible to have property tax losses that are a result of property being reassessed to account for direct structure impacts; however, as the study focused on commercial properties, homestead exemptions such as the Disaster Relief Credit for Homestead Properties, were not applied for temporary event-based coastal storm impacts. Fiscal impacts to the City of Dania Beach and Broward County are modeled with additional regional and state impacts included in the REMI model.

Methodology

Standard fiscal impact methodologies were used to assess sales and tourist development tax losses. The primary steps of the analysis include:

Sales Taxes:

1. Multiply sales losses as described in the Business and Employment Impacts methodology (discussed above) by an estimate of percent of total sales that are subject to taxes.
2. Apply estimate of taxable sales losses to the local sales tax rate.

Tourist Development Taxes:

1. Multiply sales losses for hotels and other establishments that provide overnight accommodations as described in the Business and Employment Impacts methodology above by an estimate of percent of total sales that are subject to tourist development taxes.
2. Apply estimate of sales subject to tourist development tax by the local tourist development tax rate.

Inputs

Tax rate data was identified from information published by the Florida Department of Revenue; sales taxes collected are assumed at a rate of 6% for sales tax and 6% for tourist development

tax. Sales and tourist development tax rates were applied to the sales data provided by ESRI by business and NAICS industry code.

Key Assumptions and Considerations

The percent of total sales that are subject to sales taxes was estimated at 90% for non-accommodations businesses. For hotel and overnight lodging businesses, it was assumed 90% of sales are subject to tourist development taxes and that the remaining sales are subject to sales tax.

Permanent Progressive Sea Level Rise Impacts

Direct Property Impacts

Property that is vulnerable to tidal inundation from a rise in sea level is assumed to be an asset with limited to no market value and income producing potential.

Methodology

The primary steps of the analysis to calculate the market value of parcels at risk include:

1. Identify parcels that are vulnerable to tidal inundation (e.g., MHHW)
2. Determine market value of land using publically available data from the county assessor or through standard real estate pro forma techniques when there are data gaps.

Inputs

The core inputs incorporated in the market value assessment are the market land and market improvement/structure values recorded by the Broward County Assessor's office.

Key Assumptions and Considerations

If a property is subject to tidal inundation following a rise in sea level, the market value of this property is assumed to be lost in addition to any future ability to generate income on that property (e.g.., business impacts). Because coastal hazards will gradually increase, there would likely be a steady decline in the market value of properties that stand in the path of tidal inundation, rather than a one-time complete market loss. Impacts were only modeled at the discrete future time horizon years of 2030 and 2060, therefore it is possible that some of the businesses would become subject to tidal inundation in an earlier year.

Thresholds were used to determine if properties will be subject to market value loss. For vacant land and parking lots if any percent of the property was inundated, it was assumed that the market value – equivalent to the assessed land value of the property - was lost. For properties with structures on them, the market value threshold is reached if there is any exposure to tidal inundation and if the structure footprint makes up greater than 50% of the parcel area. However, for parcels where the structure footprint is less than half the parcel area, the area exposed to tidal inundation must be greater than 10% for the market value loss threshold to be reached.

Business Impacts

Business properties that are vulnerable to tidal inundation from sea level rise are assumed to have limited or no potential to generate business and employment output.

Methodology

Standard procedures outlined by FEMA were used to estimate business impacts. The primary steps of the analysis include:

1. Identify what properties are vulnerable to tidal inundation and that are no longer considered functional assets based on damage thresholds being met as defined in the Direct Property Impacts methodology described above)
2. Determine the annual sales for identified vulnerable businesses.
3. Calculate the annual losses of sales.

Inputs

The core inputs for this analysis are the same as those used in the temporary storm business and employment impacts methodology discussed above.

Key Assumptions and Considerations

The key assumptions and consideration for this analysis are the same as those listed in the temporary event-based storm business and employment impacts methodology discussed above. The business and employment impacts are assumed to be equivalent to the sales and that would have been expected in a full calendar year. Consideration is given for the potential for these sales to be recaptured elsewhere in Dania Beach.

Fiscal Impacts

A business that is vulnerable to tidal inundation following a rise in sea level is assumed to be an asset with limited to no market value and income producing potential. When a property loses its market value and/or operating potential, fiscal impacts could occur in the form of lost sales tax, tourist development tax, and property tax. Sales and tourist occupancy tax losses are considered equivalent to the annual sales of a business that are subject to such taxes, as well as considerations relating to the ability of a business to permanently relocate and recapture these sales elsewhere. Property tax losses are a result of property no longer being functional and having no assessed value.

Methodology

Standard fiscal impact methodologies were used to assess sales and tourist development tax losses. The primary steps of the analysis include:

Sales Taxes:

1. Multiply sales losses of full annual sales of inundated businesses by an estimate of percent of total sales that are subject to taxes.
2. Apply estimate of taxable sales losses to the local sales tax rate.

Tourist Development Taxes:

1. Multiply sales losses for hotels and other establishments that provide overnight accommodations as described in the Business Impacts above by an estimate of percent of total sales that are subject to tourist development taxes.
2. Apply estimate of sales subject to tourist development taxes by the local tourist development tax rate.

Property Taxes:

1. Multiply the recorded assessed value of vulnerable property by the millage rate for vulnerable properties.

Inputs

The core inputs to assess lost sales and tourist development taxes are the same as those used in the temporary event-based storm fiscal impact description above. Millage rates published by the Broward County Proper Appraiser were used to determine property taxes.

Key Assumptions and Considerations

The key assumptions and considerations to assess fiscal losses differ from those used in the temporary event-based storm fiscal impact description above. Property taxes are calculated as an additional fiscal impact. For sales taxes and tourist development taxes, the total annual sales subject to these taxes was incorporated into the analysis assuming no recapture for impacted properties.

Appendix B – REMI Model Assumptions

Temporary Storm Surge Impact Scenarios

No Action

Project Alternative Description: This project alternative assumes that properties subject to storm surge but not sea level rise will be impacted by 3-year and 20-year storms between 2030 and 2070 and that the damages will be repaired after each storm.

Model Inputs: It is assumed that the 3-year storm occurs in 2030, 2040, 2060, and 2070 and that the 20-year storm occurs in 2050. After each storm, put 100% of the property damages as a negative in Broward County's capital stock. Assume that this loss is going directly to the construction industry for rebuilding efforts, so increase the output for the construction industry equivalent to the loss. During the storm, businesses will be impacted and need to close while their buildings are being repaired. Account for these sales and tax losses as a loss in output for impacted industries and loss in sales and tourist development taxes. Finally, the contents and inventory as well as cleanup costs will increase the financial burden on business owners who will need to replace damaged goods after a storm. Increase the production costs of impacted industries accordingly. No direct impacts are inputted for the Rest of Florida.

Table 19. Temporary No Action Alternative: REMI Model Parameters

Impact Type	Impact to Broward County	Impact to Rest of Florida	Frequency
Capital Stock	Loss equivalent to structure damages of storm	Not applicable	Year of storm
Output	Loss equivalent to sales losses from storm damage	Not applicable	Year of storm
Sales Tax	Loss equivalent to sales tax losses due to business closure	Not applicable	Year of storm
Tourist Development Tax	Loss equivalent to tourist development tax losses due to business closure	Not applicable	Year of storm
Production Cost	Loss equivalent to cleanup costs and content and inventory replacement expenses	Not applicable	Distributed over 10 years after each storm
Output – Construction Industry	Gain equivalent to structure damages of storm	Not applicable	Year of storm
Output – All Industries	Gain equivalent to cleanup costs and content and inventory replacement expenses	Not applicable	Year of storm

Accommodate

Project Alternative Description: This project alternative assumes that properties subject to storm surge but not sea level rise will be elevating their first floor to prevent all storm surge damages.

Model Inputs: It is assumed that properties that are impacted by a 20-year storm will elevate to one foot above their flood inundation depths in 2030 and 2060. It is assumed that businesses will close for half the year during construction but will be able to recapture some of their losses. Recapture factors account for the ability for employees to be able to conduct business off-site or for businesses to increase output rates upon reopening, such as through extended hours, to make up for losses during closure. The construction industry gains from the investment in elevation. The production cost increases for the industries at-risk that are elevating their structures. There is no change in capital stock. No direct impacts are inputted for the Rest of Florida.

Table 20. Temporary Accommodate Alternative: REMI Model Parameters

Impact Type	Impact to Broward County	Impact to Rest of Florida	Frequency
Output	Loss equivalent to percentage of sales losses during construction	Not applicable	One time in 2030 and 2060
Sales Tax	Loss equivalent to sales tax losses due to business closure	Not applicable	One time in 2030 and 2060
Tourist Development Tax	Loss equivalent to tourist development tax losses due to business closure	Not applicable	One time in 2030 and 2060
Production Cost	Loss equivalent to cost of elevation	Not applicable	Distributed over 5 years after investment
Output – Construction Industry	Gain equivalent to cost of elevation	Not applicable	One time in 2030 and 2060

Permanent Sea Level Rise Scenarios

No Action

Project Alternative Description: This project alternative assumes that there is no action taken to address the impacts of sea level rise on commercial properties. As a result, there is a permanent loss to Dania Beach's capital stock. There are annual losses of property, sales and tourist development taxes. Essentially, this project alternative assumes that those people and businesses impacted by sea level rise will leave Florida.

Model Inputs: In Broward County, reduce the total capital stock and output in 2030 equivalent to the market value of the properties subject to one foot of sea level rise. Input these losses for each subsequent year to 2059. In 2060, increase capital stock and output losses to account for

all properties subject to 2 feet of sea level rise, and input these losses for each subsequent year to 2070. Decreasing capital stock and output has cascading effects including reduction in property, sales, and tourist development taxes. No direct impacts are inputted for the Rest of Florida.

Table 21. Permanent No Action Alternative: REMI Model Parameters

Impact Type	Impact to Broward County	Impact to Rest Of Florida	Frequency
Capital Stock	Loss equivalent to value of impacted properties	Not Applicable	Annual
Property Tax	Loss equivalent to value of impacted properties	Not Applicable	Annual
Output	Loss equivalent to sales of impacted businesses	Not Applicable	Annual
Sales Tax	Loss equivalent to sales tax of impacted businesses	Not Applicable	Annual
Tourist Development Tax	Loss equivalent to tourist development tax of impacted hotel businesses	Not Applicable	Annual

Relocate

Project Alternative Description: This project alternative assumes that the people and businesses in commercial properties subject to sea level rise move either elsewhere within Broward County or outside of the County. It assumes that the State and Federal government provide financial support to assist with the loss capital stock and subsequent rebuilding. This project alternative assumes there is no net change in capital stock in the state; instead, the equivalent stock that was lost to sea level rise is rebuilt elsewhere, benefitting the real estate and construction industries.

Model Inputs: In Broward County, reduce the capital stock in 2030 equivalent to one-quarter of the market value of the properties subject to one foot of sea level rise. Input these losses and their additional property tax losses for each subsequent year to 2059. In 2060, increase capital stock and property tax losses to account for properties subject to 2 feet of sea level rise and input one-quarter of these losses to Broward County for each subsequent year to 2070. In the Rest of Florida, increase the capital stock and property tax income equivalent to the losses in Broward County.

Assume that 75% of businesses relocate within the County, but that they are only able to achieve 75% of their original output. This is due to the assumption that businesses that must move away from their current location would likely have less business and subsequent output if they moved to a location less strategic to their operations, such as farther from the port, airport or customer base. Assume that 25% of businesses relocate outside the County and that these businesses are able to return to 100% of their previous output rates.

To pay for these losses, this project alternative assumes that the Federal government pays for 25% of the value of lost capital stock and that the State pays for 25% - decreasing the financial burden on impacted business owners but also increasing the financial burden on State funding. It assumes individual business owners must pay for the remaining capital stock losses. As such,

this increases the production costs for these business owners. The real estate and construction industries benefit from the capital stock rebuilding investments.

Table 22. Permanent Relocate Alternative: REMI Model Parameters

Impact Type	Impact to Broward County	Impact to Rest of Florida	Frequency
Capital Stock	Loss equivalent to 25% of impacted properties' value	Gain equivalent to 25% of impacted properties' value	Annual
Property Tax	Loss equivalent to 25% of impacted properties' value	Gain equivalent to 25% of impacted properties' value	Annual
Output	25% loss of 75% of annual sales of impacted businesses	Gain equivalent to 25% of annual sales of impacted businesses	Annual
Sales Tax	25% loss of 75% of annual sales tax of impacted businesses	Gain equivalent to 25% of annual sales taxes of impacted businesses	Annual
Tourist Development Tax	25% loss of 75% of annual tourist development tax impacted businesses	25% gain of annual tourist development tax impacted businesses	Annual
Production Cost	Gain equivalent to 50% of 75% of capital stock losses	Gain equivalent to 50% of 25% of capital stock losses	Distribute over 10 years after 2030 and 2060
Output – Construction and Real Estate Industry	Gain equivalent to 75% of capital stock losses	Gain equivalent to 25% of capital stock losses	One time in 2030 and 2060
Government Spending	Not applicable	Loss equivalent to 25% of impacted properties' value	One time in 2030 and 2060

Fortify

Project Alternative Description: This project alternative assumes that a seawall is built and protects against 100% of damages. It assumes that the seawall is built to protect against 1 foot of sea level rise in 2030 and 2 feet of sea level rise in 2060. It assumes that the project will be funded by the Federal government (25%), State government (25%), local property taxes (25%) and local sales taxes (25%).

Model Inputs: In Broward County, increase sales for the industries that will be building the seawall, such as the construction industry and technical services industries, equivalent to the cost of the seawall. Assume that half of the total project cost will be paid for using property and sales taxes, imposed on all industries within Broward County. As such, increase the production costs for all industries equivalent to half of the total project cost. The only impact to the Rest of Florida is the state government spending, equivalent to one-quarter of the project cost. For a breakdown of project costs see Table 24.

Table 23. Permanent Fortify Alternative: REMI Model Parameters

Impact Type	Impact to Broward County	Impact to Rest of Florida	Frequency
Output	Gain equivalent to private industry investment in seawall to involved industries	Not applicable	One time in 2030 and 2060
Production Cost	Gain equivalent to sales and property tax increases to pay for seawall to all industries	Not applicable	Distributed over 10 years after 2030 and 2060
Government Spending	Not applicable	Loss equivalent to 25% of cost of seawall	One time in 2030 and 2060

Project Alternative Cost Assumptions

Table 24 lists the parameters that were used to estimate the construction cost of a seawall to keep rising seas at bay. The direct construction costs were provided by Broward County personnel, while the assumptions for respective markups, soft costs and other fees were informed by AECOM cost engineers. The 2060 values represent the cost to raise the seawall to protect against an additional foot of sea level rise.

Table 24. Seawall Cost Assumptions

Cost Considerations	2030	2060 Addition
Subtotal 1 (Includes direct construction costs and contractor markup)	$13,061,400	$1,044,900
+ Soft Costs: Engineering fees and construction management	$1,306,100	$104,500
+ Additional permitting	$391,800	$31,300
+ Public Agency Involvement	$653,100	$52,200
Subtotal 2 (Includes soft costs and permitting)	$15,412,500	$1,233,000
+ Contingency	$3,853,100	$308,200
Subtotal 3 (Apply construction escalation to this total)	$19,265,600	$1,541,200
TOTAL (Includes construction escalation)	**$27,905,800**	**$5,637,200**

Figures rounded to nearest $100.

Note: Direct construction costs for new seawalls were estimated at $1,250 per linear foot. The cost to raise seawalls an additional foot was estimated at $100 per linear foot. Seawalls were estimated to be constructed across approximately 2 miles of shoreline.

Table 25 below lists the parameters used to estimate the cost of elevating business structures at risk to coastal storms so they are one foot above the modeled base flood elevations. Unit costs were determined from similar cost profiles included in the Broward County COAST report (2015). Cost adjustments for building that are greater than one story were informed by FEMA technical guidance.

Table 25. Elevation Cost Assumptions

Cost Considerations		2030		2060 Addition	
	Unit Cost (per foot)[1]	Number of Buildings	Cost	Number of Buildings	Cost
BASE TOTAL	$80,000	32	$7,500,000	30	$2,300,000
TOTAL *Includes Construction Escalation*			**$10,900,000**		**$8,500,000**

[1]*A factor of 1.7 was applied if the business was greater than 1 story.*
Figures are rounded.

Appendix C – REMI Model Framework

The following narrative and figures was provided to AECOM by REMI staff.

The following core framework applies to all REMI model builds. The model integrates input-output, computable general equilibrium, econometric and economic geography methodologies. The model is dynamic, with forecasts and simulations generated on an annual basis and behavioral responses to compensation, price, and other economic factors.

The model consists of thousands of simultaneous equations with a structure that is relatively straightforward. The exact number of equations used varies depending on the extent of industry, demographic, demand, and other detail in the specific model being used. The overall structure of the model can be summarized in five major blocks: (1) Output and Demand, (2) Labor and Capital Demand, (3) Population and Labor Supply, (4) Compensation, Prices, and Costs, and (5) Market Shares. The blocks and their key interactions are shown in Figures 1 and 2.

Figure 1: REMI Model Linkages

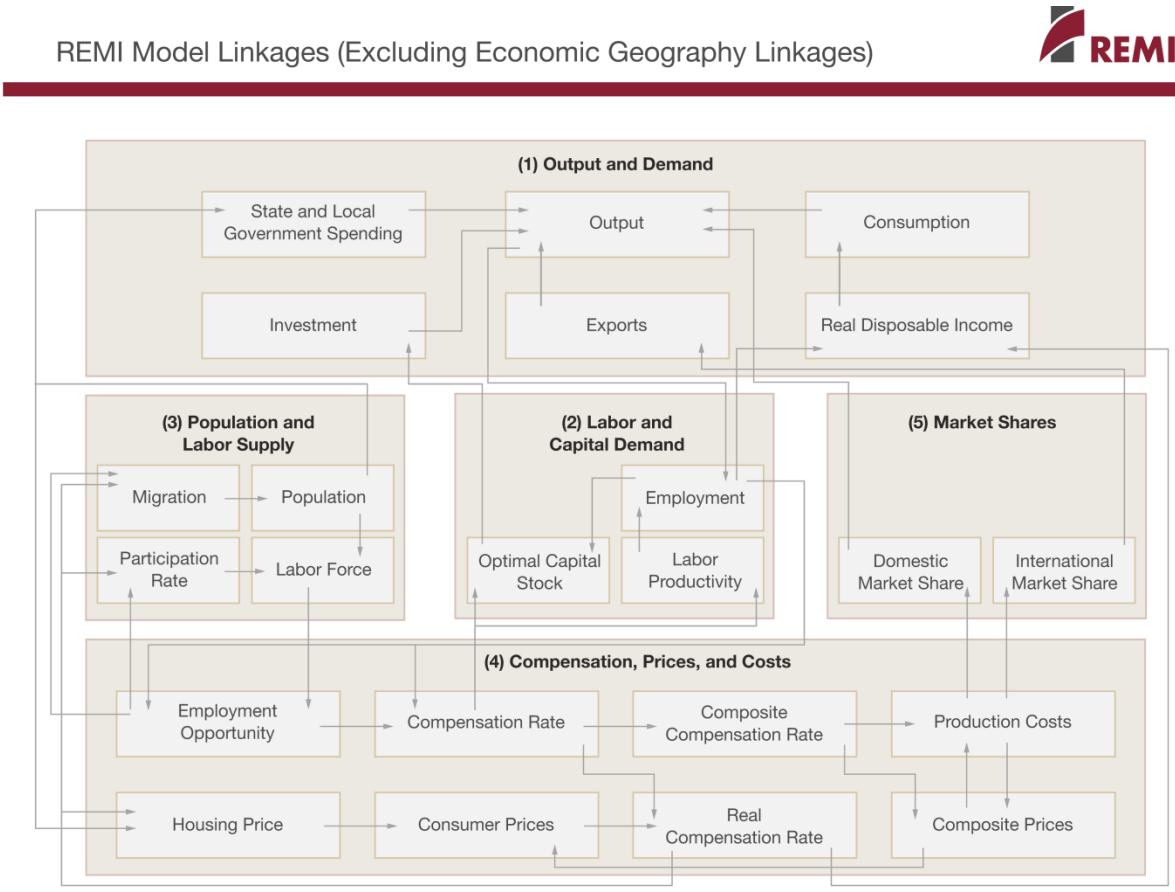
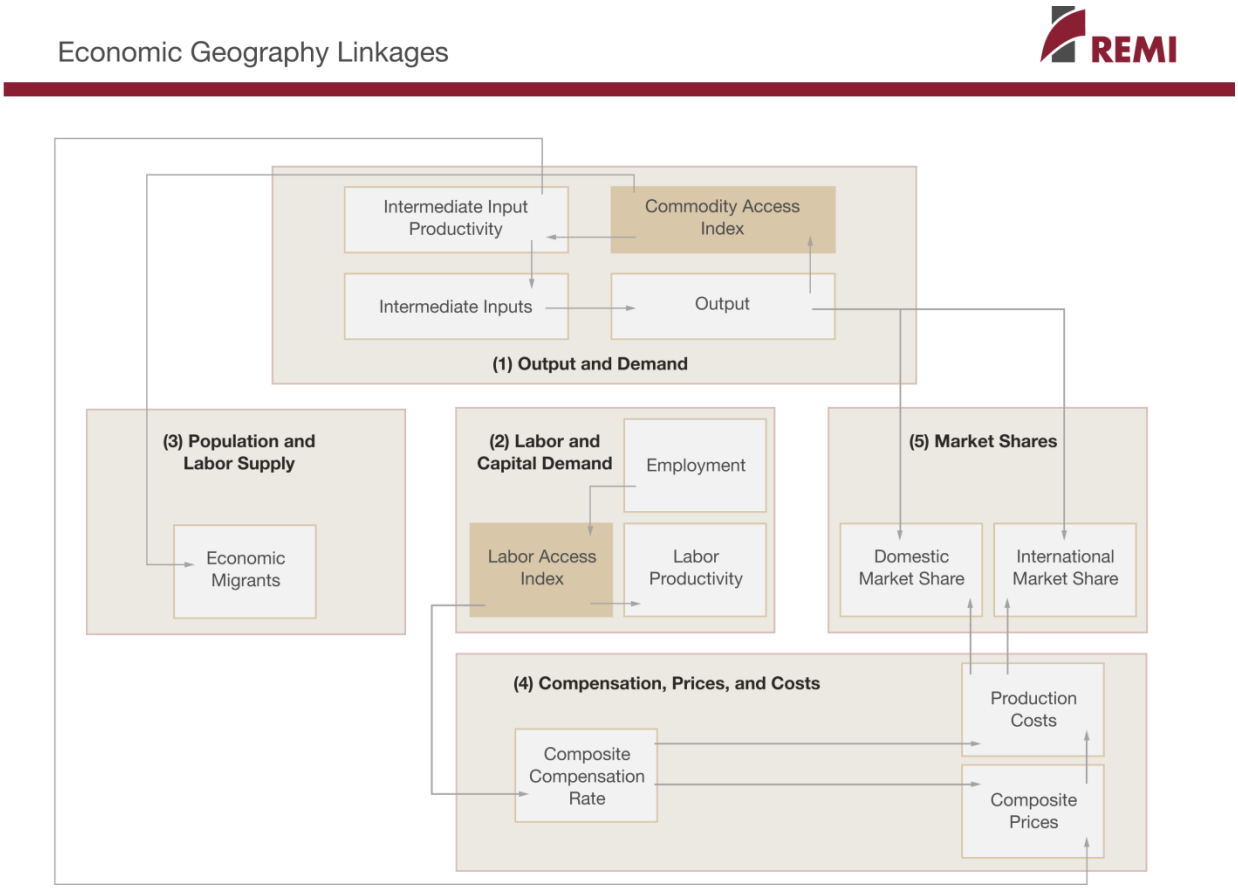


Figure 2: Economic Geography Linkages



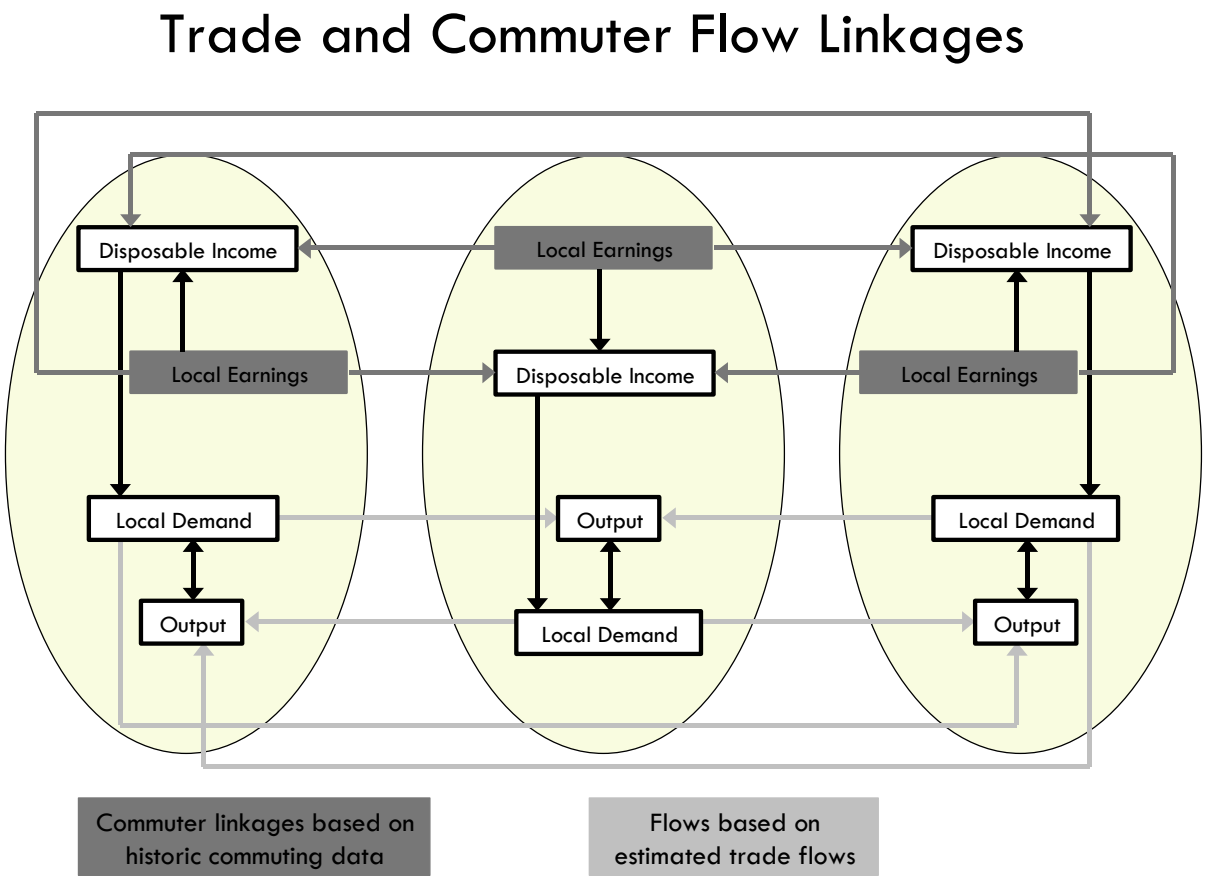
The Output and Demand block consists of output, demand, consumption, investment, government spending, exports, and imports, as well as feedback from output change due to the change in the productivity of intermediate inputs. The Labor and Capital Demand block includes labor intensity and productivity as well as demand for labor and capital. Labor force participation rate and migration equations are in the Population and Labor Supply block. The Compensation, Prices, and Costs block includes composite prices, determinants of production costs, the consumption price deflator, housing prices, and the compensation equations. The proportion of local, inter-regional, and export markets captured by each region is included in the Market Shares block.

Models can be built as single region, multi-region, or multi-region national models. A region is defined broadly as a sub-national area, and could consist of a state, province, county, or city, or any combination of sub-national areas.

Single-region models consist of an individual region, called the home region. The rest of the nation is also represented in the model. However, since the home region is only a small part of the total nation, the changes in the region do not have an endogenous effect on the variables in the rest of the nation.

Multi-regional models have interactions among regions, such as trade and commuting flows. These interactions include trade flows from each region to each of the other regions. These flows are illustrated for a three-region model in Figure 3.

Figure 3: Trade and Commuter Flow Linkages



Multiregional national models also include a central bank monetary response that constrains labor markets. Models that only encompass a relatively small portion of a nation are not endogenously constrained by changes in exchange rates or monetary responses.

Block 1. Output and Demand

This block includes output, demand, consumption, investment, government spending, import, commodity access, and export concepts. Output for each industry in the home region is determined by industry demand in all regions in the nation, the home region's share of each market, and international exports from the region.

For each industry, demand is determined by the amount of output, consumption, investment, and capital demand on that industry. Consumption depends on real disposable income per capita, relative prices, differential income elasticities, and population. Input productivity depends on access to inputs because a larger choice set of inputs means it is more likely that the input with the specific characteristics required for the job will be found. In the capital stock

adjustment process, investment occurs to fill the difference between optimal and actual capital stock for residential, non-residential, and equipment investment. Government spending changes are determined by changes in the population.

Block 2. Labor and Capital Demand

The Labor and Capital Demand block includes the determination of labor productivity, labor intensity, and the optimal capital stocks. Industry-specific labor productivity depends on the availability of workers with differentiated skills for the occupations used in each industry. The occupational labor supply and commuting costs determine firms' access to a specialized labor force.

Labor intensity is determined by the cost of labor relative to the other factor inputs, capital and fuel. Demand for capital is driven by the optimal capital stock equation for both non-residential capital and equipment. Optimal capital stock for each industry depends on the relative cost of labor and capital, and the employment weighted by capital use for each industry. Employment in private industries is determined by the value added and employment per unit of value added in each industry.

Block 3. Population and Labor Supply

The Population and Labor Supply block includes detailed demographic information about the region. Population data is given for age, gender, and race, with birth and survival rates for each group. The size and labor force participation rate of each group determines the labor supply. These participation rates respond to changes in employment relative to the potential labor force and to changes in the real after-tax compensation rate. Migration includes retirement, military, international, and economic migration. Economic migration is determined by the relative real after-tax compensation rate, relative employment opportunity, and consumer access to variety.

Block 4. Compensation, Prices and Costs

This block includes delivered prices, production costs, equipment cost, the consumption deflator, consumer prices, the price of housing, and the compensation equation. Economic geography concepts account for the productivity and price effects of access to specialized labor, goods, and services.

These prices measure the price of the industry output, taking into account the access to production locations. This access is important due to the specialization of production that takes place within each industry, and because transportation and transaction costs of distance are significant. Composite prices for each industry are then calculated based on the production costs of supplying regions, the effective distance to these regions, and the index of access to the variety of outputs in the industry relative to the access by other uses of the product.

The cost of production for each industry is determined by the cost of labor, capital, fuel, and intermediate inputs. Labor costs reflect a productivity adjustment to account for access to specialized labor, as well as underlying compensation rates. Capital costs include costs of non-residential structures and equipment, while fuel costs incorporate electricity, natural gas, and residual fuels.

The consumption deflator converts industry prices to prices for consumption commodities. For potential migrants, the consumer price is additionally calculated to include housing prices. Housing prices change from their initial level depending on changes in income and population density.

Compensation changes are due to changes in labor demand and supply conditions and changes in the national compensation rate. Changes in employment opportunities relative to the labor force and occupational demand change determine compensation rates by industry.

Block 5. Market Shares

The market shares equations measure the proportion of local and export markets that are captured by each industry. These depend on relative production costs, the estimated price elasticity of demand, and the effective distance between the home region and each of the other regions. The change in share of a specific area in any region depends on changes in its delivered price and the quantity it produces compared with the same factors for competitors in that market. The share of local and external markets then drives the exports from and imports to the home economy.

Appendix D – Additional REMI Results

A. List of Results Tables

1. REST OF FLORIDA POPULATION
2. REST OF FLORIDA EMPLOYMENT
3. REST OF FLORIDA GDP
4. REST OF FLORIDA OUTPUT
5. REST OF FLORIDA DISPOSABLE PERSONAL INCOME
6. REST OF FLORIDA LABOR FORCE
7. BROWARD COUNTY POPULATION
8. BROWARD COUNTY EMPLOYMENT
9. BROWARD COUNTY GDP
10. BROWARD COUNTY OUTPUT
11. BROWARD COUNTY DISPOSABLE PERSONAL INCOME
12. BROWARD COUNTY LABOR FORCE
13. BROWARD COUNTY EXPORTS OF GOODS AND SERVICES
14. BROWARD COUNTY IMPORTS OF GOODS AND SERVICES
15. BROWARD COUNTY PERSONAL CONSUMPTION EXPENDITURES

B. Rest of Florida Results Tables

1. REST OF FLORIDA POPULATION Difference from Control (Shown in 1,000s)						
	CONTROL	PERMANENT			TEMPORARY	
Year	Population	NO ACTION	FORTIFY	RELOCATE	NO ACTION	ACCOMMODATE
2030	22,545	-0.05	0.00	0.02	0.50	-0.26
2031	22,745	-0.10	0.00	0.03	0.28	-0.19
2032	22,935	-0.14	0.00	0.03	0.14	-0.16
2033	23,114	-0.17	0.00	0.04	0.01	-0.12
2034	23,283	-0.20	-0.01	0.04	-0.09	-0.09
2035	23,442	-0.21	-0.01	0.04	-0.17	-0.07
2036	23,591	-0.23	-0.01	0.04	-0.23	-0.05
2037	23,728	-0.24	-0.01	0.05	-0.26	-0.03
2038	23,855	-0.25	-0.01	0.05	-0.29	-0.02
2039	23,971	-0.26	-0.01	0.05	-0.30	-0.02
2040	24,076	-0.26	-0.01	0.05	0.37	-0.02
2041	24,173	-0.27	-0.01	0.05	0.20	-0.01
2042	24,261	-0.28	-0.01	0.06	0.12	-0.02
2043	24,342	-0.28	0.00	0.06	0.04	-0.02
2044	24,417	-0.29	0.00	0.06	-0.04	-0.02
2045	24,486	-0.29	0.00	0.06	-0.10	-0.02
2046	24,552	-0.29	0.00	0.06	-0.14	-0.02
2047	24,614	-0.30	0.00	0.06	-0.18	-0.02
2048	24,673	-0.30	0.00	0.05	-0.21	-0.01
2049	24,730	-0.30	0.00	0.05	-0.22	-0.01
2050	24,787	-0.30	0.00	0.05	0.38	-0.01
2051	24,839	-0.30	0.00	0.05	0.24	-0.01
2052	24,891	-0.30	0.00	0.05	0.17	-0.01
2053	24,946	-0.30	0.00	0.05	0.10	-0.01
2054	25,004	-0.30	0.00	0.05	0.04	-0.01
2055	25,067	-0.30	0.00	0.05	-0.02	-0.01
2056	25,133	-0.30	0.00	0.05	-0.06	-0.01
2057	25,201	-0.30	0.00	0.05	-0.09	-0.01
2058	25,272	-0.30	0.00	0.05	-0.12	-0.01
2059	25,345	-0.30	0.00	0.05	-0.13	-0.01
2060	25,421	-0.50	0.00	0.43	0.36	-0.20
2061	25,485	-0.66	0.00	0.40	0.23	-0.16
2062	25,549	-0.80	0.00	0.39	0.18	-0.14
2063	25,613	-0.92	0.00	0.38	0.12	-0.13
2064	25,677	-1.01	0.00	0.37	0.07	-0.11
2065	25,742	-1.09	0.00	0.36	0.03	-0.10
2066	25,806	-1.14	0.00	0.35	0.00	-0.09
2067	25,871	-1.19	0.00	0.35	-0.03	-0.08
2068	25,936	-1.22	0.00	0.35	-0.05	-0.08
2069	26,001	-1.25	0.00	0.36	-0.07	-0.08
2070	26,066	-1.27	0.00	0.38	0.33	-0.08

2. REST OF FLORIDA EMPLOYMENT Difference from Control (Shown in 1,000s)						
	CONTROL	**PERMANENT**			**TEMPORARY**	
Year	Employment	NO ACTION	FORTIFY	RELOCATE	NO ACTION	ACCOMMODATE
2030	11,415	-0.17	0.00	0.08	1.59	-0.82
2031	11,472	-0.17	-0.01	0.07	-0.25	0.00
2032	11,530	-0.17	0.00	0.06	-0.12	-0.08
2033	11,591	-0.18	-0.01	0.06	-0.21	-0.04
2034	11,655	-0.18	-0.01	0.06	-0.25	-0.02
2035	11,721	-0.18	-0.01	0.05	-0.26	0.00
2036	11,793	-0.18	-0.01	0.05	-0.25	0.00
2037	11,864	-0.18	-0.01	0.05	-0.24	0.00
2038	11,933	-0.18	-0.01	0.05	-0.22	0.00
2039	12,000	-0.18	0.00	0.05	-0.20	0.00
2040	12,065	-0.18	0.00	0.05	1.53	-0.01
2041	12,130	-0.18	0.00	0.05	-0.17	-0.01
2042	12,194	-0.18	0.00	0.04	-0.02	-0.02
2043	12,258	-0.18	0.00	0.04	-0.11	-0.02
2044	12,321	-0.18	0.00	0.04	-0.15	-0.02
2045	12,382	-0.18	0.00	0.04	-0.17	-0.02
2046	12,444	-0.18	0.00	0.04	-0.18	-0.02
2047	12,507	-0.19	0.00	0.04	-0.18	-0.02
2048	12,569	-0.19	0.00	0.04	-0.18	-0.01
2049	12,633	-0.19	0.00	0.04	-0.17	-0.01
2050	12,698	-0.19	0.00	0.04	1.42	-0.01
2051	12,712	-0.19	0.00	0.03	-0.14	-0.01
2052	12,729	-0.18	0.00	0.03	0.01	-0.01
2053	12,749	-0.18	0.00	0.03	-0.07	-0.01
2054	12,770	-0.18	0.00	0.03	-0.10	-0.01
2055	12,794	-0.18	0.00	0.03	-0.12	-0.01
2056	12,817	-0.18	0.00	0.03	-0.13	-0.01
2057	12,840	-0.18	0.00	0.03	-0.13	-0.01
2058	12,864	-0.18	0.00	0.03	-0.13	-0.01
2059	12,888	-0.18	0.00	0.03	-0.12	-0.01
2060	12,913	-0.64	0.00	1.08	1.07	-0.45
2061	12,939	-0.64	0.00	0.29	-0.11	-0.02
2062	12,965	-0.69	0.00	0.33	0.01	-0.07
2063	12,990	-0.72	0.00	0.29	-0.04	-0.05
2064	13,016	-0.73	0.00	0.27	-0.06	-0.04
2065	13,042	-0.74	0.00	0.25	-0.07	-0.03
2066	13,068	-0.74	0.00	0.25	-0.07	-0.03
2067	13,095	-0.74	0.00	0.24	-0.08	-0.03
2068	13,121	-0.74	0.00	0.24	-0.08	-0.03
2069	13,147	-0.74	0.00	0.24	-0.08	-0.04
2070	13,173	-0.75	0.00	0.28	0.89	-0.04

3. REST OF FLORIDA GDP Difference from Control (Shown in Billions of Fixed 2018 Dollars – No Discounting)						
	CONTROL	**PERMANENT**			**TEMPORARY**	
Year	GDP	NO ACTION	FORTIFY	RELOCATE	NO ACTION	ACCOMMODATE
2030	985	-0.01	0.00	0.01	0.14	-0.07
2031	998	-0.01	0.00	0.01	-0.02	0.00
2032	1,018	-0.02	0.00	0.01	-0.01	-0.01
2033	1,041	-0.02	0.00	0.01	-0.02	0.00
2034	1,064	-0.02	0.00	0.01	-0.02	0.00
2035	1,088	-0.02	0.00	0.01	-0.03	0.00
2036	1,115	-0.02	0.00	0.01	-0.03	0.00
2037	1,142	-0.02	0.00	0.01	-0.03	0.00
2038	1,170	-0.02	0.00	0.01	-0.02	0.00
2039	1,199	-0.02	0.00	0.01	-0.02	0.00
2040	1,228	-0.02	0.00	0.01	0.16	0.00
2041	1,257	-0.02	0.00	0.01	-0.02	0.00
2042	1,282	-0.02	0.00	0.01	0.00	0.00
2043	1,306	-0.02	0.00	0.01	-0.01	0.00
2044	1,331	-0.02	0.00	0.01	-0.02	0.00
2045	1,354	-0.02	0.00	0.01	-0.02	0.00
2046	1,378	-0.02	0.00	0.01	-0.02	0.00
2047	1,401	-0.02	0.00	0.01	-0.02	0.00
2048	1,423	-0.02	0.00	0.01	-0.02	0.00
2049	1,445	-0.02	0.00	0.01	-0.02	0.00
2050	1,467	-0.02	0.00	0.01	0.17	0.00
2051	1,483	-0.02	0.00	0.01	-0.02	0.00
2052	1,500	-0.02	0.00	0.01	0.00	0.00
2053	1,518	-0.02	0.00	0.01	-0.01	0.00
2054	1,536	-0.02	0.00	0.01	-0.02	0.00
2055	1,554	-0.02	0.00	0.01	-0.02	0.00
2056	1,572	-0.02	0.00	0.01	-0.02	0.00
2057	1,591	-0.02	0.00	0.01	-0.02	0.00
2058	1,610	-0.02	0.00	0.01	-0.02	0.00
2059	1,629	-0.02	0.00	0.01	-0.02	0.00
2060	1,648	-0.08	0.00	0.14	0.14	-0.06
2061	1,668	-0.08	0.00	0.03	-0.02	0.00
2062	1,687	-0.09	0.00	0.04	0.00	-0.01
2063	1,707	-0.10	0.00	0.03	-0.01	-0.01
2064	1,734	-0.10	0.00	0.03	-0.01	-0.01
2065	1,761	-0.10	0.00	0.03	-0.01	-0.01
2066	1,789	-0.11	0.00	0.03	-0.01	0.00
2067	1,817	-0.11	0.00	0.03	-0.01	0.00
2068	1,845	-0.11	0.00	0.03	-0.01	-0.01
2069	1,874	-0.11	0.00	0.03	-0.01	-0.01
2070	1,903	-0.11	0.00	0.03	0.13	-0.01

4. REST OF FLORIDA OUTPUT Difference from Control (Shown in Billions of Fixed 2018 Dollars – No Discounting)						
	CONTROL	**PERMANENT**			**TEMPORARY**	
Year	Output	NO ACTION	FORTIFY	RELOCATE	NO ACTION	ACCOMMODATE
2030	1,820	-0.03	0.00	0.02	0.26	-0.14
2031	1,846	-0.03	0.00	0.02	-0.04	0.00
2032	1,885	-0.03	0.00	0.02	-0.02	-0.01
2033	1,929	-0.03	0.00	0.02	-0.04	-0.01
2034	1,972	-0.03	0.00	0.02	-0.05	0.00
2035	2,017	-0.03	0.00	0.02	-0.05	0.00
2036	2,066	-0.03	0.00	0.02	-0.05	0.00
2037	2,115	-0.03	0.00	0.01	-0.05	0.00
2038	2,165	-0.03	0.00	0.01	-0.05	0.00
2039	2,216	-0.03	0.00	0.01	-0.04	0.00
2040	2,268	-0.03	0.00	0.02	0.30	0.00
2041	2,321	-0.03	0.00	0.02	-0.04	0.00
2042	2,366	-0.04	0.00	0.02	-0.01	0.00
2043	2,411	-0.04	0.00	0.02	-0.03	0.00
2044	2,458	-0.04	0.00	0.01	-0.04	0.00
2045	2,504	-0.04	0.00	0.01	-0.04	0.00
2046	2,552	-0.04	0.00	0.01	-0.04	0.00
2047	2,600	-0.04	0.00	0.01	-0.04	0.00
2048	2,649	-0.04	0.00	0.01	-0.04	0.00
2049	2,699	-0.04	0.00	0.01	-0.04	0.00
2050	2,750	-0.04	0.00	0.01	0.32	0.00
2051	2,791	-0.04	0.00	0.01	-0.04	0.00
2052	2,833	-0.04	0.00	0.01	0.00	0.00
2053	2,877	-0.04	0.00	0.01	-0.02	0.00
2054	2,921	-0.04	0.00	0.01	-0.03	0.00
2055	2,967	-0.04	0.00	0.01	-0.03	0.00
2056	3,013	-0.04	0.00	0.01	-0.04	0.00
2057	3,060	-0.04	0.00	0.01	-0.04	0.00
2058	3,107	-0.04	0.00	0.01	-0.04	0.00
2059	3,156	-0.04	0.00	0.01	-0.04	0.00
2060	3,205	-0.16	0.00	0.27	0.28	-0.12
2061	3,256	-0.17	0.00	0.06	-0.04	-0.01
2062	3,307	-0.18	0.00	0.07	0.00	-0.02
2063	3,359	-0.19	0.00	0.06	-0.02	-0.01
2064	3,425	-0.20	0.00	0.05	-0.02	-0.01
2065	3,492	-0.20	0.00	0.05	-0.02	-0.01
2066	3,561	-0.21	0.00	0.05	-0.03	-0.01
2067	3,631	-0.21	0.00	0.05	-0.03	-0.01
2068	3,703	-0.22	0.00	0.05	-0.03	-0.01
2069	3,776	-0.22	0.00	0.05	-0.03	-0.01
2070	3,851	-0.22	0.00	0.07	0.27	-0.01

5. REST OF FLORIDA DISPOSABLE PERSONAL INCOME Difference from Control (Shown in Billions of Fixed 2018 Dollars – No Discounting)						
	CONTROL	PERMANENT			TEMPORARY	
Year	Disposable Personal Income	NO ACTION	FORTIFY	RELOCATE	NO ACTION	ACCOMMODATE
2030	100	-0.01	0.00	0.00	0.11	-0.06
2031	101	-0.01	0.00	0.00	-0.04	0.01
2032	104	-0.01	0.00	0.00	-0.02	0.00
2033	108	-0.01	0.00	0.00	-0.03	0.00
2034	112	-0.01	0.00	0.00	-0.03	0.00
2035	115	-0.01	0.00	0.00	-0.03	0.00
2036	117	-0.01	0.00	0.00	-0.03	0.00
2037	119	-0.01	0.00	0.00	-0.03	0.00
2038	122	-0.01	0.00	0.00	-0.03	0.00
2039	124	-0.01	0.00	0.00	-0.02	0.00
2040	127	-0.01	0.00	0.00	0.13	0.00
2041	131	-0.01	0.00	0.00	-0.04	0.00
2042	134	-0.01	0.00	0.00	-0.01	0.00
2043	137	-0.01	0.00	0.00	-0.02	0.00
2044	140	-0.01	0.00	0.00	-0.02	0.00
2045	143	-0.02	0.00	0.00	-0.02	0.00
2046	146	-0.02	0.00	0.00	-0.02	0.00
2047	149	-0.02	0.00	0.00	-0.02	0.00
2048	152	-0.02	0.00	0.00	-0.02	0.00
2049	155	-0.02	0.00	0.00	-0.02	0.00
2050	158	-0.02	0.00	0.00	0.14	0.00
2051	161	-0.02	0.00	0.00	-0.03	0.00
2052	164	-0.02	0.00	0.00	-0.01	0.00
2053	167	-0.02	0.00	0.00	-0.01	0.00
2054	170	-0.02	0.00	0.00	-0.02	0.00
2055	173	-0.02	0.00	0.00	-0.02	0.00
2056	177	-0.02	0.00	0.00	-0.02	0.00
2057	180	-0.02	0.00	0.00	-0.02	0.00
2058	183	-0.02	0.00	0.00	-0.02	0.00
2059	186	-0.02	0.00	0.00	-0.02	0.00
2060	189	-0.07	0.00	0.07	0.12	-0.05
2061	193	-0.07	0.00	-0.01	-0.03	0.00
2062	196	-0.07	0.00	0.00	0.00	-0.01
2063	199	-0.07	0.00	0.00	-0.01	-0.01
2064	203	-0.08	0.00	0.00	-0.01	0.00
2065	207	-0.08	0.00	0.00	-0.01	0.00
2066	211	-0.08	0.00	0.00	-0.01	0.00
2067	215	-0.08	0.00	0.00	-0.02	0.00
2068	219	-0.08	0.00	0.01	-0.02	0.00
2069	223	-0.08	0.00	0.01	-0.02	0.00
2070	228	-0.08	0.00	0.02	0.12	0.00

6. REST OF FLORIDA LABOR FORCE Difference from Control (Shown in 1,000s)						
	CONTROL	PERMANENT			TEMPORARY	
Year	Labor Force	NO ACTION	FORTIFY	RELOCATE	NO ACTION	ACCOMMODATE
2030	10,319	-0.06	0.01	0.02	0.59	-0.31
2031	10,218	-0.10	0.00	0.02	0.25	-0.18
2032	10,192	-0.12	0.00	0.02	0.12	-0.14
2033	10,247	-0.14	0.00	0.02	0.00	-0.09
2034	10,334	-0.15	0.00	0.03	-0.09	-0.06
2035	10,421	-0.16	-0.01	0.03	-0.15	-0.03
2036	10,520	-0.16	-0.01	0.03	-0.18	-0.01
2037	10,612	-0.16	-0.01	0.03	-0.20	0.00
2038	10,704	-0.16	-0.01	0.03	-0.20	0.00
2039	10,808	-0.16	-0.01	0.03	-0.19	0.01
2040	10,911	-0.17	0.00	0.03	0.46	0.01
2041	11,015	-0.17	0.00	0.03	0.22	0.00
2042	11,091	-0.17	0.00	0.03	0.14	0.00
2043	11,165	-0.17	0.00	0.03	0.05	0.00
2044	11,242	-0.17	0.00	0.03	-0.02	0.00
2045	11,314	-0.17	0.00	0.03	-0.07	0.00
2046	11,386	-0.17	0.00	0.03	-0.10	-0.01
2047	11,457	-0.17	0.00	0.03	-0.12	-0.01
2048	11,521	-0.17	0.00	0.03	-0.14	-0.01
2049	11,588	-0.17	0.00	0.03	-0.14	0.00
2050	11,661	-0.17	0.00	0.03	0.44	0.00
2051	11,730	-0.17	0.00	0.03	0.22	0.00
2052	11,797	-0.17	0.00	0.03	0.16	0.00
2053	11,858	-0.17	0.00	0.03	0.08	0.00
2054	11,925	-0.17	0.00	0.03	0.02	0.00
2055	11,992	-0.17	0.00	0.03	-0.02	0.00
2056	12,061	-0.17	0.00	0.03	-0.05	0.00
2057	12,128	-0.17	0.00	0.03	-0.08	0.00
2058	12,187	-0.17	0.00	0.03	-0.09	0.00
2059	12,249	-0.17	0.00	0.03	-0.10	0.00
2060	12,311	-0.36	0.00	0.36	0.36	-0.17
2061	12,368	-0.48	0.00	0.28	0.18	-0.11
2062	12,423	-0.58	0.00	0.26	0.14	-0.10
2063	12,472	-0.65	0.00	0.23	0.08	-0.08
2064	12,501	-0.69	0.00	0.21	0.03	-0.06
2065	12,526	-0.72	0.00	0.20	0.00	-0.05
2066	12,548	-0.74	0.00	0.19	-0.02	-0.04
2067	12,568	-0.75	0.00	0.19	-0.04	-0.03
2068	12,582	-0.75	0.00	0.19	-0.05	-0.03
2069	12,596	-0.75	0.00	0.19	-0.06	-0.03
2070	12,613	-0.75	0.00	0.21	0.32	-0.03

C. Broward County Results Tables

7. BROWARD COUNTY POPULATION Difference from Control (Shown in 1,000s)						
	CONTROL	PERMANENT			TEMPORARY	
Year	Population	NO ACTION	FORTIFY	RELOCATE	NO ACTION	ACCOMMODATE
2030	2,301	-0.15	0.08	-0.05	1.62	-1.01
2031	2,323	-0.23	0.04	-0.09	0.63	-0.63
2032	2,344	-0.29	0.02	-0.12	0.29	-0.55
2033	2,365	-0.34	0.01	-0.14	-0.02	-0.47
2034	2,385	-0.38	0.01	-0.16	-0.25	-0.41
2035	2,405	-0.41	0.00	-0.17	-0.43	-0.36
2036	2,425	-0.43	-0.01	-0.18	-0.57	-0.33
2037	2,444	-0.46	-0.01	-0.19	-0.68	-0.30
2038	2,462	-0.47	-0.01	-0.20	-0.77	-0.27
2039	2,481	-0.49	-0.01	-0.21	-0.84	-0.25
2040	2,498	-0.50	-0.01	-0.21	0.83	-0.24
2041	2,515	-0.51	-0.01	-0.22	0.08	-0.22
2042	2,532	-0.52	0.00	-0.22	-0.14	-0.21
2043	2,549	-0.52	0.00	-0.22	-0.34	-0.19
2044	2,565	-0.53	0.00	-0.22	-0.49	-0.18
2045	2,580	-0.53	0.00	-0.23	-0.61	-0.17
2046	2,596	-0.53	0.00	-0.23	-0.72	-0.15
2047	2,611	-0.53	0.00	-0.23	-0.80	-0.14
2048	2,625	-0.53	0.00	-0.23	-0.86	-0.12
2049	2,639	-0.53	0.00	-0.23	-0.91	-0.11
2050	2,652	-0.53	0.00	-0.22	0.92	-0.10
2051	2,665	-0.52	0.00	-0.22	0.19	-0.09
2052	2,678	-0.51	0.00	-0.22	-0.03	-0.08
2053	2,690	-0.51	0.01	-0.21	-0.24	-0.07
2054	2,702	-0.50	0.01	-0.21	-0.40	-0.07
2055	2,713	-0.49	0.01	-0.21	-0.51	-0.06
2056	2,724	-0.49	0.01	-0.21	-0.60	-0.06
2057	2,735	-0.48	0.01	-0.20	-0.66	-0.06
2058	2,745	-0.47	0.01	-0.20	-0.71	-0.06
2059	2,755	-0.47	0.01	-0.20	-0.74	-0.06
2060	2,765	-1.21	0.02	0.04	0.79	-0.64
2061	2,777	-1.69	0.02	-0.42	0.22	-0.44
2062	2,789	-2.06	0.01	-0.68	0.04	-0.38
2063	2,801	-2.34	0.01	-0.89	-0.13	-0.33
2064	2,813	-2.55	0.01	-1.05	-0.25	-0.29
2065	2,825	-2.70	0.01	-1.17	-0.34	-0.25
2066	2,837	-2.82	0.01	-1.26	-0.41	-0.23
2067	2,849	-2.91	0.01	-1.32	-0.46	-0.21
2068	2,861	-2.98	0.01	-1.37	-0.50	-0.20
2069	2,874	-3.03	0.01	-1.41	-0.53	-0.19
2070	2,886	-3.07	0.01	-1.39	0.75	-0.19

8. BROWARD COUNTY EMPLOYMENT Difference from Control (Shown in 1,000s)						
	CONTROL	PERMANENT			TEMPORARY	
Year	Employment	NO ACTION	FORTIFY	RELOCATE	NO ACTION	ACCOMMODATE
2030	1,313	-0.50	0.27	-0.16	5.80	-3.42
2031	1,321	-0.47	-0.03	-0.20	-0.98	0.07
2032	1,329	-0.46	-0.02	-0.20	-0.66	-0.11
2033	1,338	-0.45	-0.02	-0.19	-0.76	-0.07
2034	1,347	-0.44	-0.02	-0.19	-0.77	-0.07
2035	1,357	-0.43	-0.02	-0.19	-0.76	-0.04
2036	1,368	-0.42	-0.02	-0.18	-0.75	-0.04
2037	1,379	-0.41	-0.02	-0.18	-0.73	-0.04
2038	1,390	-0.41	-0.02	-0.18	-0.71	-0.04
2039	1,401	-0.40	-0.02	-0.17	-0.69	-0.04
2040	1,412	-0.40	0.00	-0.17	5.14	-0.05
2041	1,422	-0.39	0.00	-0.17	-0.84	-0.05
2042	1,433	-0.39	0.00	-0.17	-0.52	-0.05
2043	1,444	-0.38	0.00	-0.16	-0.60	-0.05
2044	1,455	-0.38	0.00	-0.16	-0.61	-0.05
2045	1,465	-0.38	0.00	-0.16	-0.61	-0.05
2046	1,476	-0.38	0.00	-0.16	-0.61	-0.05
2047	1,487	-0.37	0.00	-0.16	-0.61	-0.04
2048	1,497	-0.37	0.00	-0.16	-0.60	-0.04
2049	1,508	-0.37	0.00	-0.16	-0.59	-0.04
2050	1,519	-0.36	0.00	-0.15	4.68	-0.04
2051	1,524	-0.36	0.00	-0.15	-0.73	-0.04
2052	1,528	-0.35	0.00	-0.15	-0.44	-0.04
2053	1,533	-0.35	0.00	-0.15	-0.51	-0.04
2054	1,538	-0.35	0.00	-0.15	-0.51	-0.04
2055	1,543	-0.34	0.00	-0.15	-0.51	-0.04
2056	1,548	-0.34	0.00	-0.14	-0.51	-0.04
2057	1,553	-0.33	0.00	-0.14	-0.51	-0.04
2058	1,558	-0.33	0.00	-0.14	-0.50	-0.03
2059	1,564	-0.33	0.00	-0.14	-0.50	-0.03
2060	1,569	-2.41	0.04	0.52	3.75	-1.64
2061	1,574	-2.33	0.00	-1.15	-0.56	-0.01
2062	1,580	-2.33	0.00	-1.07	-0.34	-0.09
2063	1,586	-2.31	0.00	-1.09	-0.38	-0.07
2064	1,591	-2.28	0.00	-1.08	-0.39	-0.06
2065	1,597	-2.25	0.00	-1.07	-0.38	-0.05
2066	1,603	-2.22	0.00	-1.05	-0.38	-0.05
2067	1,609	-2.20	0.00	-1.04	-0.38	-0.05
2068	1,614	-2.17	0.00	-1.03	-0.38	-0.05
2069	1,620	-2.15	0.00	-1.01	-0.37	-0.06
2070	1,626	-2.13	0.00	-0.92	3.14	-0.06

9. BROWARD COUNTY GDP Difference from Control (Shown in Billions of Fixed 2018 Dollars – No Discounting)						
	CONTROL	PERMANENT			TEMPORARY	
Year	GDP	NO ACTION	FORTIFY	RELOCATE	NO ACTION	ACCOMMODATE
2030	116	-0.06	0.02	-0.02	0.51	-0.26
2031	117	-0.06	0.00	-0.03	-0.08	0.01
2032	120	-0.06	0.00	-0.03	-0.06	-0.01
2033	123	-0.06	0.00	-0.03	-0.07	-0.01
2034	126	-0.06	0.00	-0.03	-0.07	-0.01
2035	129	-0.06	0.00	-0.03	-0.07	0.00
2036	132	-0.06	0.00	-0.03	-0.07	0.00
2037	136	-0.06	0.00	-0.03	-0.07	0.00
2038	140	-0.06	0.00	-0.03	-0.07	0.00
2039	143	-0.06	0.00	-0.03	-0.07	0.00
2040	147	-0.06	0.00	-0.03	0.54	0.00
2041	151	-0.06	0.00	-0.03	-0.09	-0.01
2042	155	-0.06	0.00	-0.03	-0.06	-0.01
2043	158	-0.06	0.00	-0.03	-0.07	-0.01
2044	161	-0.06	0.00	-0.03	-0.07	-0.01
2045	165	-0.06	0.00	-0.03	-0.07	-0.01
2046	168	-0.06	0.00	-0.03	-0.07	-0.01
2047	171	-0.06	0.00	-0.03	-0.07	-0.01
2048	174	-0.06	0.00	-0.03	-0.07	-0.01
2049	177	-0.06	0.00	-0.03	-0.07	-0.01
2050	181	-0.06	0.00	-0.03	0.55	0.00
2051	183	-0.06	0.00	-0.03	-0.09	0.00
2052	186	-0.06	0.00	-0.03	-0.06	0.00
2053	188	-0.06	0.00	-0.03	-0.07	-0.01
2054	191	-0.06	0.00	-0.03	-0.07	-0.01
2055	194	-0.06	0.00	-0.03	-0.07	-0.01
2056	197	-0.06	0.00	-0.03	-0.07	-0.01
2057	199	-0.06	0.00	-0.03	-0.07	-0.01
2058	202	-0.06	0.00	-0.03	-0.07	-0.01
2059	205	-0.06	0.00	-0.03	-0.07	-0.01
2060	208	-0.26	0.01	0.10	0.49	-0.21
2061	211	-0.26	0.00	-0.13	-0.08	0.00
2062	214	-0.26	0.00	-0.12	-0.05	-0.01
2063	217	-0.26	0.00	-0.12	-0.06	-0.01
2064	221	-0.26	0.00	-0.13	-0.06	-0.01
2065	225	-0.26	0.00	-0.13	-0.06	-0.01
2066	229	-0.26	0.00	-0.13	-0.06	-0.01
2067	234	-0.26	0.00	-0.13	-0.06	-0.01
2068	238	-0.27	0.00	-0.13	-0.06	-0.01
2069	242	-0.27	0.00	-0.13	-0.06	-0.01
2070	247	-0.27	0.00	-0.12	0.47	-0.01

10. BROWARD COUNTY OUTPUT Difference from Control (Shown in Billions of Fixed 2018 Dollars – No Discounting)						
	CONTROL	PERMANENT			TEMPORARY	
Year	Output	NO ACTION	FORTIFY	RELOCATE	NO ACTION	ACCOMMODATE
2030	209	-0.10	0.04	-0.04	0.94	-0.47
2031	213	-0.10	0.00	-0.04	-0.16	0.01
2032	217	-0.10	0.00	-0.04	-0.11	-0.02
2033	223	-0.10	0.00	-0.04	-0.13	-0.01
2034	229	-0.10	0.00	-0.04	-0.14	-0.01
2035	234	-0.10	0.00	-0.04	-0.14	-0.01
2036	241	-0.10	0.00	-0.04	-0.14	-0.01
2037	247	-0.10	0.00	-0.04	-0.14	-0.01
2038	254	-0.10	0.00	-0.04	-0.14	-0.01
2039	260	-0.10	0.00	-0.04	-0.14	-0.01
2040	267	-0.10	0.00	-0.04	0.99	-0.01
2041	274	-0.10	0.00	-0.04	-0.17	-0.01
2042	280	-0.10	0.00	-0.04	-0.11	-0.01
2043	286	-0.10	0.00	-0.04	-0.13	-0.01
2044	293	-0.10	0.00	-0.04	-0.13	-0.01
2045	299	-0.10	0.00	-0.04	-0.14	-0.01
2046	306	-0.10	0.00	-0.04	-0.14	-0.01
2047	312	-0.10	0.00	-0.04	-0.14	-0.01
2048	319	-0.11	0.00	-0.04	-0.14	-0.01
2049	326	-0.11	0.00	-0.04	-0.14	-0.01
2050	333	-0.11	0.00	-0.05	1.03	-0.01
2051	339	-0.11	0.00	-0.05	-0.18	-0.01
2052	345	-0.11	0.00	-0.05	-0.11	-0.01
2053	352	-0.11	0.00	-0.05	-0.13	-0.01
2054	358	-0.11	0.00	-0.05	-0.13	-0.01
2055	364	-0.11	0.00	-0.05	-0.13	-0.01
2056	371	-0.11	0.00	-0.05	-0.13	-0.01
2057	378	-0.11	0.00	-0.05	-0.13	-0.01
2058	385	-0.11	0.00	-0.05	-0.13	-0.01
2059	392	-0.11	0.00	-0.05	-0.13	-0.01
2060	399	-0.50	0.01	0.20	0.96	-0.40
2061	406	-0.49	0.00	-0.25	-0.16	0.00
2062	414	-0.50	0.00	-0.23	-0.10	-0.02
2063	421	-0.50	0.00	-0.24	-0.11	-0.02
2064	431	-0.51	0.00	-0.24	-0.12	-0.02
2065	441	-0.51	0.00	-0.25	-0.12	-0.02
2066	451	-0.51	0.00	-0.25	-0.12	-0.02
2067	461	-0.51	0.00	-0.25	-0.12	-0.02
2068	472	-0.52	0.00	-0.25	-0.12	-0.02
2069	482	-0.52	0.00	-0.25	-0.12	-0.02
2070	493	-0.53	0.00	-0.23	0.96	-0.02

11. BROWARD COUNTY DISPOSABLE PERSONAL INCOME Difference from Control (Shown in Billions of Fixed 2018 Dollars – No Discounting						
	CONTROL	PERMANENT			TEMPORARY	
Year	Disposable Personal Income	NO ACTION	FORTIFY	RELOCATE	NO ACTION	ACCOMMODATE
2030	100	-0.02	0.01	-0.01	0.15	-0.09
2031	101	-0.01	0.00	-0.01	-0.11	0.02
2032	104	-0.02	0.00	-0.01	-0.04	-0.02
2033	108	-0.02	0.00	-0.01	-0.05	-0.01
2034	112	-0.02	0.00	-0.01	-0.05	-0.01
2035	115	-0.02	0.00	-0.01	-0.06	-0.01
2036	117	-0.02	0.00	-0.01	-0.06	-0.01
2037	119	-0.02	0.00	-0.01	-0.06	-0.01
2038	122	-0.02	0.00	-0.01	-0.06	-0.01
2039	124	-0.02	0.00	-0.01	-0.07	-0.01
2040	127	-0.02	0.00	-0.01	0.16	-0.01
2041	131	-0.02	0.00	-0.01	-0.13	-0.01
2042	134	-0.02	0.00	-0.01	-0.05	-0.01
2043	137	-0.02	0.00	-0.01	-0.06	-0.01
2044	140	-0.02	0.00	-0.01	-0.06	-0.01
2045	143	-0.02	0.00	-0.01	-0.06	-0.01
2046	146	-0.03	0.00	-0.01	-0.06	-0.01
2047	149	-0.03	0.00	-0.01	-0.07	-0.01
2048	152	-0.03	0.00	-0.01	-0.07	-0.01
2049	155	-0.03	0.00	-0.01	-0.07	-0.01
2050	158	-0.03	0.00	-0.01	0.18	-0.01
2051	161	-0.03	0.00	-0.01	-0.13	-0.01
2052	164	-0.03	0.00	-0.01	-0.05	-0.01
2053	167	-0.03	0.00	-0.01	-0.06	-0.01
2054	170	-0.03	0.00	-0.01	-0.06	-0.01
2055	173	-0.03	0.00	-0.01	-0.06	-0.01
2056	177	-0.03	0.00	-0.01	-0.06	-0.01
2057	180	-0.03	0.00	-0.01	-0.06	-0.01
2058	183	-0.03	0.00	-0.01	-0.07	-0.01
2059	186	-0.03	0.00	-0.01	-0.07	-0.01
2060	189	-0.10	0.00	0.04	0.16	-0.08
2061	193	-0.09	0.00	-0.07	-0.11	0.01
2062	196	-0.10	0.00	-0.05	-0.04	-0.02
2063	199	-0.11	0.00	-0.05	-0.05	-0.02
2064	203	-0.11	0.00	-0.06	-0.05	-0.02
2065	207	-0.12	0.00	-0.06	-0.05	-0.02
2066	211	-0.13	0.00	-0.07	-0.05	-0.02
2067	215	-0.13	0.00	-0.07	-0.05	-0.02
2068	219	-0.14	0.00	-0.07	-0.06	-0.02
2069	223	-0.15	0.00	-0.08	-0.06	-0.02
2070	228	-0.15	0.00	-0.06	0.16	-0.02

12. BROWARD COUNTY LABOR FORCE Difference from Control (Shown in 1,000s)						
	CONTROL	PERMANENT			TEMPORARY	
Year	Labor Force	NO ACTION	FORTIFY	RELOCATE	NO ACTION	ACCOMMODATE
2030	1,175	-0.13	0.07	-0.04	1.45	-0.91
2031	1,166	-0.18	0.02	-0.07	0.38	-0.44
2032	1,166	-0.22	0.01	-0.09	0.11	-0.35
2033	1,174	-0.25	0.00	-0.10	-0.13	-0.26
2034	1,186	-0.26	0.00	-0.11	-0.28	-0.21
2035	1,198	-0.27	-0.01	-0.12	-0.39	-0.17
2036	1,211	-0.28	-0.01	-0.12	-0.46	-0.14
2037	1,223	-0.29	-0.01	-0.12	-0.51	-0.12
2038	1,236	-0.29	-0.01	-0.12	-0.54	-0.11
2039	1,250	-0.29	-0.01	-0.13	-0.57	-0.10
2040	1,264	-0.30	-0.01	-0.13	0.93	-0.09
2041	1,278	-0.30	0.00	-0.13	0.12	-0.09
2042	1,289	-0.30	0.00	-0.13	-0.05	-0.08
2043	1,301	-0.30	0.00	-0.13	-0.22	-0.08
2044	1,312	-0.30	0.00	-0.13	-0.32	-0.08
2045	1,322	-0.30	0.00	-0.13	-0.38	-0.08
2046	1,331	-0.30	0.00	-0.13	-0.41	-0.08
2047	1,340	-0.30	0.00	-0.13	-0.46	-0.07
2048	1,347	-0.30	0.00	-0.13	-0.49	-0.07
2049	1,355	-0.30	0.00	-0.13	-0.52	-0.06
2050	1,363	-0.30	0.00	-0.13	0.58	-0.06
2051	1,371	-0.29	0.00	-0.12	0.14	-0.06
2052	1,380	-0.29	0.00	-0.12	0.01	-0.05
2053	1,387	-0.29	0.00	-0.12	-0.13	-0.05
2054	1,395	-0.29	0.00	-0.12	-0.23	-0.05
2055	1,403	-0.28	0.00	-0.12	-0.30	-0.05
2056	1,411	-0.28	0.00	-0.12	-0.35	-0.04
2057	1,419	-0.28	0.00	-0.12	-0.40	-0.04
2058	1,426	-0.28	0.00	-0.12	-0.42	-0.04
2059	1,433	-0.27	0.00	-0.12	-0.45	-0.04
2060	1,441	-0.72	0.01	0.03	0.47	-0.38
2061	1,450	-1.00	0.01	-0.25	0.12	-0.26
2062	1,459	-1.22	0.01	-0.41	0.01	-0.22
2063	1,468	-1.38	0.01	-0.53	-0.09	-0.18
2064	1,473	-1.50	0.00	-0.62	-0.17	-0.15
2065	1,479	-1.58	0.00	-0.69	-0.22	-0.12
2066	1,484	-1.64	0.00	-0.73	-0.26	-0.11
2067	1,490	-1.68	0.00	-0.77	-0.29	-0.09
2068	1,495	-1.70	0.00	-0.79	-0.31	-0.08
2069	1,501	-1.72	0.00	-0.81	-0.32	-0.07
2070	1,506	-1.73	0.00	-0.79	0.44	-0.07

D. Additional Model Outputs for Broward County

13. BROWARD COUNTY EXPORTS OF GOODS AND SERVICES Difference from Control (Shown in Billions of Fixed 2018 Dollars – No Discounting)						
	CONTROL	PERMANENT			TEMPORARY	
Year	Exports of Goods and Services	NO ACTION	FORTIFY	RELOCATE	NO ACTION	ACCOMMODATE
2030	64	0.00	0.00	0.00	-0.04	0.00
2031	65	0.00	0.00	0.00	-0.02	0.00
2032	67	0.00	0.00	0.00	-0.03	0.00
2033	68	0.00	0.00	0.00	-0.03	0.00
2034	70	0.00	0.00	0.00	-0.03	0.00
2035	71	0.00	0.00	0.00	-0.03	0.00
2036	73	0.00	0.00	0.00	-0.02	0.00
2037	75	0.00	0.00	0.00	-0.02	0.00
2038	77	0.00	0.00	0.00	-0.02	0.00
2039	81	0.00	0.00	0.00	-0.02	0.00
2040	83	0.00	0.00	0.00	-0.01	0.00
2041	85	0.00	0.00	0.00	-0.03	0.00
2042	87	0.00	0.00	0.00	-0.03	0.00
2043	89	0.00	0.00	0.00	-0.03	0.00
2044	91	0.00	0.00	0.00	-0.03	0.00
2045	93	0.00	0.00	0.00	-0.03	0.00
2046	95	0.00	0.00	0.00	-0.03	0.00
2047	98	0.00	0.00	0.00	-0.03	0.00
2048	100	0.00	0.00	0.00	-0.02	0.00
2049	102	0.00	0.00	0.00	-0.02	0.00
2050	104	0.00	0.00	0.00	0.01	0.00
2051	106	0.00	0.00	0.00	-0.03	0.00
2052	108	0.00	0.00	0.00	-0.03	0.00
2053	109	0.00	0.00	0.00	-0.03	0.00
2054	111	0.00	0.00	0.00	-0.03	0.00
2055	113	0.00	0.00	0.00	-0.03	0.00
2056	115	0.00	0.00	0.00	-0.03	0.00
2057	117	0.00	0.00	0.00	-0.02	0.00
2058	119	0.00	0.00	0.00	-0.02	0.00
2059	121	0.00	0.00	0.00	-0.02	0.00
2060	119	0.00	0.00	0.01	0.00	0.00
2061	122	0.00	0.00	0.00	-0.02	0.00
2062	124	0.01	0.00	0.00	-0.02	0.00
2063	127	0.01	0.00	0.00	-0.02	0.00
2064	129	0.01	0.00	0.00	-0.02	0.00
2065	132	0.01	0.00	0.00	-0.02	0.00
2066	135	0.02	0.00	0.00	-0.02	0.00
2067	138	0.02	0.00	0.01	-0.02	0.00
2068	142	0.02	0.00	0.01	-0.02	0.00
2069	145	0.02	0.00	0.01	-0.02	0.00
2070	148	0.02	0.00	0.01	-0.01	0.00

14. BROWARD COUNTY IMPORTS OF GOODS AND SERVICES Difference from Control (Shown in Billions of Fixed 2018 Dollars – No Discounting)						
	CONTROL	PERMANENT			TEMPORARY	
Year	Imports of Goods and Services	NO ACTION	FORTIFY	RELOCATE	NO ACTION	ACCOMMODATE
2030	76	-0.02	0.01	-0.01	0.23	-0.11
2031	78	-0.02	0.00	-0.01	-0.05	0.00
2032	80	-0.02	0.00	-0.01	-0.02	-0.01
2033	82	-0.02	0.00	-0.01	-0.03	-0.01
2034	84	-0.02	0.00	-0.01	-0.03	-0.01
2035	86	-0.02	0.00	-0.01	-0.03	-0.01
2036	88	-0.02	0.00	-0.01	-0.04	-0.01
2037	90	-0.02	0.00	-0.01	-0.04	-0.01
2038	92	-0.02	0.00	-0.01	-0.04	-0.01
2039	96	-0.02	0.00	-0.01	-0.04	-0.01
2040	99	-0.03	0.00	-0.01	0.25	-0.01
2041	102	-0.03	0.00	-0.01	-0.05	-0.01
2042	105	-0.03	0.00	-0.01	-0.02	-0.01
2043	107	-0.03	0.00	-0.01	-0.03	-0.01
2044	110	-0.03	0.00	-0.01	-0.03	-0.01
2045	112	-0.03	0.00	-0.01	-0.04	-0.01
2046	115	-0.03	0.00	-0.01	-0.04	-0.01
2047	118	-0.03	0.00	-0.01	-0.04	0.00
2048	120	-0.03	0.00	-0.01	-0.04	0.00
2049	123	-0.03	0.00	-0.01	-0.04	0.00
2050	126	-0.03	0.00	-0.01	0.27	0.00
2051	128	-0.03	0.00	-0.01	-0.06	0.00
2052	130	-0.03	0.00	-0.01	-0.03	0.00
2053	132	-0.03	0.00	-0.01	-0.04	0.00
2054	134	-0.03	0.00	-0.01	-0.04	0.00
2055	137	-0.03	0.00	-0.01	-0.04	0.00
2056	139	-0.03	0.00	-0.01	-0.04	0.00
2057	141	-0.03	0.00	-0.01	-0.04	0.00
2058	144	-0.03	0.00	-0.01	-0.04	0.00
2059	146	-0.03	0.00	-0.01	-0.04	0.00
2060	145	-0.13	0.00	0.06	0.24	-0.09
2061	148	-0.13	0.00	-0.07	-0.06	0.00
2062	150	-0.15	0.00	-0.06	-0.03	-0.01
2063	153	-0.16	0.00	-0.07	-0.03	-0.01
2064	156	-0.17	0.00	-0.07	-0.03	-0.01
2065	159	-0.18	0.00	-0.08	-0.03	-0.01
2066	163	-0.19	0.00	-0.08	-0.03	-0.01
2067	166	-0.19	0.00	-0.08	-0.03	-0.01
2068	169	-0.20	0.00	-0.09	-0.03	-0.01
2069	173	-0.21	0.00	-0.09	-0.04	-0.01
2070	176	-0.21	0.00	-0.09	0.24	-0.01

15. BROWARD COUNTY PERSONAL CONSUMPTION EXPENDITURES Difference from Control (Shown in Billions of Fixed 2018 Dollars – No Discounting)						
	CONTROL	PERMANENT			TEMPORARY	
Year	Personal Consumption Expenditures	NO ACTION	FORTIFY	RELOCATE	NO ACTION	ACCOMMODATE
2030	91	-0.02	0.01	-0.01	0.13	-0.08
2031	92	-0.01	0.00	-0.01	-0.10	0.02
2032	94	-0.01	0.00	-0.01	-0.04	-0.01
2033	97	-0.01	0.00	-0.01	-0.04	-0.01
2034	99	-0.02	0.00	-0.01	-0.05	-0.01
2035	102	-0.02	0.00	-0.01	-0.05	-0.01
2036	105	-0.02	0.00	-0.01	-0.05	-0.01
2037	108	-0.02	0.00	-0.01	-0.05	-0.01
2038	111	-0.02	0.00	-0.01	-0.06	-0.01
2039	114	-0.02	0.00	-0.01	-0.06	-0.01
2040	117	-0.02	0.00	-0.01	0.15	-0.01
2041	121	-0.02	0.00	-0.01	-0.11	-0.01
2042	123	-0.02	0.00	-0.01	-0.04	-0.01
2043	126	-0.02	0.00	-0.01	-0.05	-0.01
2044	129	-0.02	0.00	-0.01	-0.05	-0.01
2045	132	-0.02	0.00	-0.01	-0.06	-0.01
2046	135	-0.02	0.00	-0.01	-0.06	-0.01
2047	138	-0.03	0.00	-0.01	-0.06	-0.01
2048	141	-0.03	0.00	-0.01	-0.06	-0.01
2049	144	-0.03	0.00	-0.01	-0.07	-0.01
2050	147	-0.03	0.00	-0.01	0.16	-0.01
2051	149	-0.03	0.00	-0.01	-0.12	-0.01
2052	152	-0.03	0.00	-0.01	-0.05	-0.01
2053	154	-0.03	0.00	-0.01	-0.05	-0.01
2054	157	-0.03	0.00	-0.01	-0.05	-0.01
2055	159	-0.03	0.00	-0.01	-0.06	-0.01
2056	162	-0.03	0.00	-0.01	-0.06	-0.01
2057	164	-0.03	0.00	-0.01	-0.06	-0.01
2058	167	-0.03	0.00	-0.01	-0.06	-0.01
2059	169	-0.03	0.00	-0.01	-0.06	-0.01
2060	172	-0.10	0.00	0.03	0.14	-0.07
2061	175	-0.08	0.00	-0.06	-0.10	0.01
2062	178	-0.09	0.00	-0.04	-0.04	-0.02
2063	180	-0.10	0.00	-0.05	-0.05	-0.02
2064	184	-0.11	0.00	-0.05	-0.05	-0.02
2065	187	-0.11	0.00	-0.06	-0.05	-0.01
2066	191	-0.12	0.00	-0.06	-0.05	-0.01
2067	195	-0.13	0.00	-0.06	-0.05	-0.01
2068	198	-0.13	0.00	-0.07	-0.05	-0.02
2069	202	-0.14	0.00	-0.07	-0.05	-0.02
2070	206	-0.15	0.00	-0.06	0.14	-0.02

Appendix E – Detailed Dania Beach Business Community Survey Results

Below is a summary of the aggregated survey results. Results of closed-ended survey questions are followed by a qualitative summary of open-ended survey question responses. Results are presented based on the data provided by Broward County as of August 2018 and may not include the full set of results if survey respondents submitted data post processing.

Note: Question numbering may not match the order of the original survey instrument due to separating open-ended and closed-ended questions.

Closed-Ended Questions

Question 1. What Services or products do you offer?

Response	Percentage
Accommodation and Food Services	9%
Arts, Entertainment, and Recreation	9%
Finance and Insurance	5%
Other Services (except Public Administration)	9%
Real Estate Rental and Leasing	23%
Retail Trade	32%
Wholesale Trade	14%
Total respondents (N)=22	

Question 2. How local is your clientele? Are they mostly:

Response	Percentage
Broward County	59%
Dania Beach	9%
Outside of Broward County	32%
N/A	0%
Total respondents (N)=22	

Question 3. What age groups do you serve? (Check all that apply)

Response	Percentage
Under 20	25%
20-40	70%
40-60	100%
60+	70%
Total respondents (N)=20	

Question 4. How local is the origin of your online sales? Are they mostly from:

Response	Percentage
Broward County	18%
Dania Beach	5%
Outside of Broward County	32%
N/A	45%
Total respondents (N)=22	

Question 5. Are your goods/supplies sourced locally? Are most from:

Response	Percentage
Broward County	41%
Dania Beach	0%
Outside of Broward County	45%
N/A	14%
Total respondents (N)=22	

Question 6. How local is your advertising strategy? Do you focus many on:

Response	Percentage
Broward County	44%
Dania Beach	17%
Outside of Broward County	39%
N/A	0%
Total respondents (N)=18	

Question 7. Does your business depend on?

Response	Yes	No
	Count	Count
Tourism	11	10
Events	9	10
Residents	14	7
Total respondents that answered “Yes” for any of the three options (N)=16 Total respondents that answers “No” for all three options (N)=6		

Question 8. Is your business seasonal?

Response	Percentage
No	67%
Yes	33%
Total respondents (N)=21	

Question 9. If your business is seasonal, what is your peak season?

Response	Percentage
Spring	5%
Winter	32%
Not Seasonal	64%
Total respondents (N)=22	

Question 10. What government projects or services does your business depend on? (Check all that apply)

Response	Percentage
Water & Sewers	47%
Trash Services	32%
Beach Nourishment	21%
Road Improvements	58%
Other (e.g. Police, Gas stations)	58%
Total respondents (N)=19	

Question 11. How long has this business been in Dania Beach?

Response	Percentage
Less than 5 years	23%
Between 6-10 years	23%
Between 11-20 years	9%
More than 20 years	45%
Total respondents (N)=22	

Question 12. What is the price range for most of your goods and services (per relevant unit)?

Response	Percentage
Between $10 - $100	33%
Between $100 - $1,000	48%
More than $1,000	19%
Total respondents (N)=21	

Question 13. What is the profit margin for most of your goods/services?

Response	Percentage
Less than 25%	40%
25-50%	40%
50-75%	20%
Total respondents (N)=20	

Question 14. What is your approximate annual revenue?

Response	Percentage
Less than $10,000	10%
Between $10,000-$50,000	19%
Between $50,000-$100,000	19%
Between $100,000-$1,000,000	19%
More than $1,000,000	33%
Total respondents (N)=21	

Question 15. What do you anticipate your annual revenue to be in 10 years?

Response	Percentage
Less than $10,000	0%
Between $10,000-$50,000	10%
Between $50,000-$100,000	25%
Between $100,000-$1,000,000	30%
More than $1,000,000	35%
Total respondents (N)=20	

Question 16. What do you anticipate your annual revenue to be in 30 years?

Response	Percentage
Less than $10,000	0%
Between $10,000-$50,000	11%
Between $50,000-$100,000	5%
Between $100,000-$1,000,000	37%
More than $1,000,000	47%
Total respondents (N)=19	

Question 17. Do you plan on selling your business or property?

Response	Percentage
No	43%
Yes, in next 5 years	22%
Yes, in next 10 years	26%
Yes, in next 20 years or more	9%
Total respondents (N)=23	

Question 18. What percentage of staff lives in Dania Beach?

Response	Percentage
Less than 25%	68%
25-50%	5%
50-75%	14%
More than 75%	14%
Total respondents (N)=22	

Question 19. Do you rely on contract or temporary labor?

Response	Percentage
No	74%
Yes	26%
Total respondents (N)=23	

Question 20. How many of your employees/contracted labor are seasonal? (% of Staff)

Response	Percentage
Less than 25%	94%
25-50%	6%
50-75%	0%
More than 75%	0%
Total respondents (N)=17	

Question 21. Do your seasonal workers leave Dania Beach/ Broward County in the off season?

Response	Percentage
Most likely, no	54%
Most likely, yes	31%
Not sure	8%
Probably 50%/50%	8%
Total respondents (N)=13	

Question 22. What percentage of your staff earns wages within $10 of minimum wage?

Response	Percentage
Less than 25%	53%
25-50%	12%
50-75%	12%
More than 75%	24%
Total respondents (N)=17	

Question 23. Have employees ever mentioned flooding issues affecting their commute to work?

Response	Percentage
No	45%
Yes	55%
Total respondents (N)=22	

Question 24. What ballpark amount of special assessments or utility fees could you afford if infrastructure improvements were needed?

Response	Percentage
Less than $1,000	67%
Between $1,000-$5,000	24%
Between $5,000-$10,000	5%
More than $50,000	5%
Total respondents (N)=21	

Question 25. Has your insurance changed in the past few years?

Response	Percentage
Yes, price increased	67%
Yes, price decreased	5%
No	29%
Total respondents (N)=21	

Question 26. Would an increase in premiums change your business model?

Response	Percentage
Yes	64%
No	36%
Total respondents (N)=22	

Question 27. How would higher temperatures (an increase in days above 95 degrees Fahrenheit) affect your business?

Response	Percentage
Positive	4%
Negative	48%
No impact	48%
Total respondents (N)=23	

Question 28. How would more storms (extreme rain events, tropical storms, hurricanes) affect your business?

Response	Percentage
Positive	9%
Negative	86%
No impact	5%
Total respondents (N)=22	

Open-Ended Questions

Question 1. What changes do you foresee in the business community and development in coastal Dania Beach?

- More traffic and congestion
- Increase in population
- More hotels and shopping centers resulting in more businesses
- More people walking and biking

Question 2. What changes are on the horizon for your industry?

- Increased demand for products/services
- No change

Question 3. How would an increase in premium change your business model?

- Increased cost of services/goods to consumers
- Decrease in wages for employees
- Unable to afford to stay in business