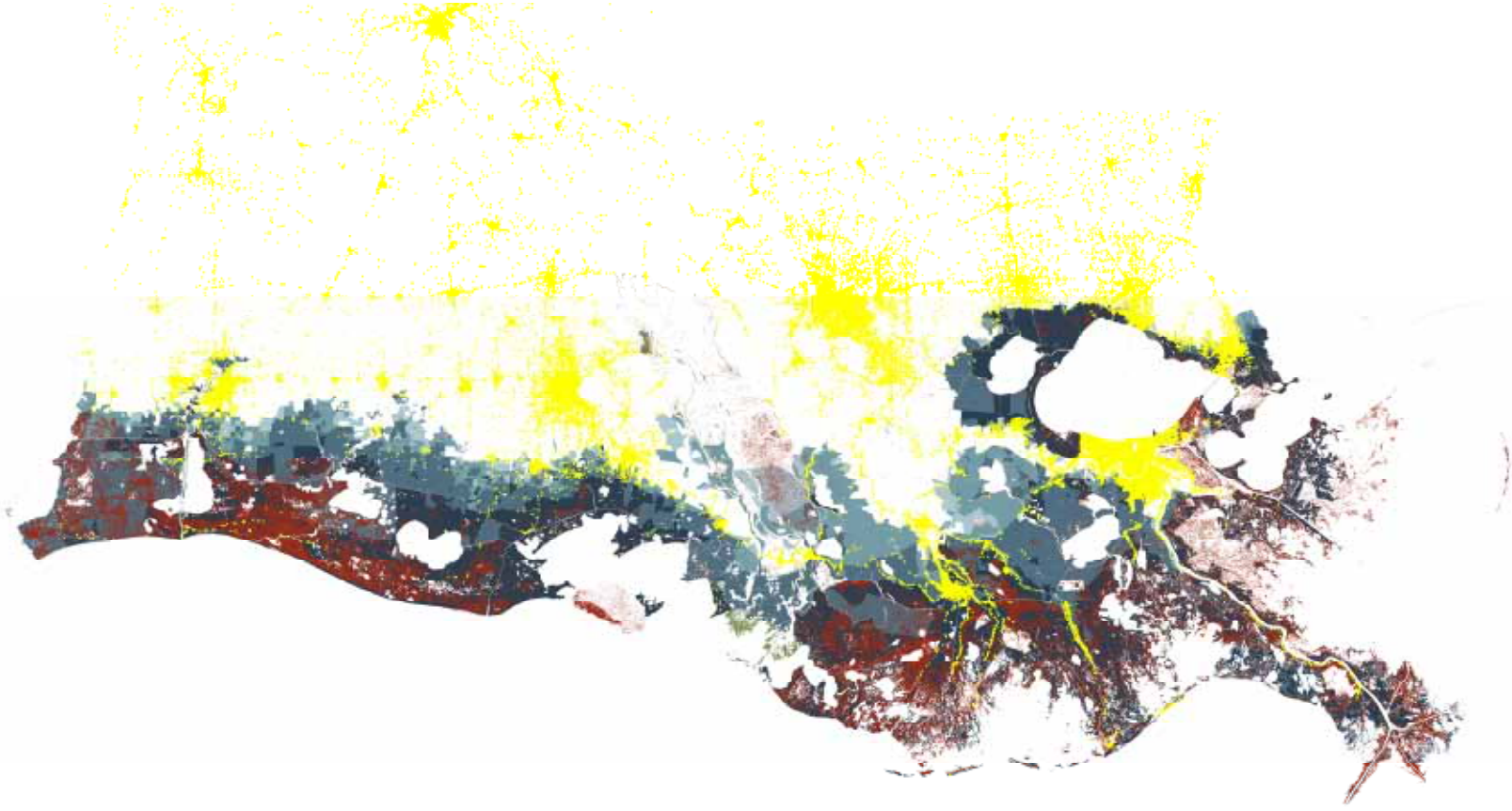
Executive Summary

Economic Evaluation of

Coastal Land Loss in Louisiana



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Coastal Land Loss in Louisiana

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From 1932 to 2010, Louisiana lost approximately 1,880 square miles of land, and another 1,750 square miles are at risk of being lost by 2060 (U.S. Geological Survey, 2011; CPRA, 2012). Through the land loss process, wetland habitat becomes open water, the shoreline retreats, and dry upland areas subside. This process will impact infrastructure and economic activity connected to coastal Louisiana in the absence of private and public actions to guard against it. The economic impact of coastal land loss will be felt most severely in Louisiana, but these impacts will reverberate through the rest of the country and the world. This report presents the findings from joint research conducted by Louisiana State University and the RAND Corporation on the economic consequences of land loss to Louisiana and the rest of the nation, focusing on physical capital stock and economic activity at risk due to land loss in a future without action to protect and restore Louisiana's coast.

Coastal land loss directly affects some areas, but also increases storm damage to areas further inland, and this study considers both. Some land that currently holds valuable capital stock, such as homes and businesses, will be inundated over time and will diminish in value. In addition to those things directly threatened by a shifting coastline, Louisiana is losing its valuable coastal wetlands, which provide a natural buffer between storm surges and inland areas. As Louisiana's shoreline migrates inward and the remaining landscape degrades, more developed areas further inland will face greater risk of damage due to the loss of storm protection services currently provided by that land.

Land loss will affect or put at risk natural and manmade assets generating costs through damage to capital stock, disruption of economic activity, and changes in ecosystem services. The analysis in this report includes estimates of damage to physical capital stocks, including residential and non-residential structures and network infrastructure, such as roads, rail, waterways, and oil and gas transportation systems. We also estimate how land loss could affect economic activity, such as business operations or employment, and how these disruptions extend to commodity and trade flows linking coastal Louisiana to the rest of the country and the rest of the world. Finally, land loss may have important effects on ecosystem services, and although we do not calculate specific damages we classify the major categories and describe the regional economic activity in sectors directly related to ecosystem services, including fisheries and recreation.

Methodology

Land loss is a long term challenge; any analysis of coastal land loss and related storm damage effects must deal with uncertainty over the location, timing, and severity of land loss, as well as characteristics of future storms. There is a great deal of uncertainty inherent in efforts to model land loss over many years. As the basis of our analysis, we take as given estimates of land loss at 25 and 50 year time horizons from Louisiana's 2012 Coastal Master Plan. At each time horizon, we assess both "moderate" and "less optimistic" environmental scenarios from the Coastal Master Plan. Finally, to assess increased storm damage associated with land loss, we use estimates of increases in flooding with and without land loss for three hypothetical storm alternatives drawn from models used in the 2012 Coastal Master Plan, with each case illustrating distinct impacts on Louisiana's capital stock and economic activity.

The goal of this report is to provide methodologically sound estimates of the potential economic costs associated with anticipated coastal land loss, and the LSU-RAND team developed an analytical approach that achieved these goals while balancing scope and feasibility. The analysis has two main components and the methodology for each is related but distinct. The basis for this analysis is the economic landscape as it exists today and maps of land loss and storm surge projections from the 2012 Coastal Master Plan. To study direct land loss, we compiled data on capital stock and activities that currently rest on land that is predicted to be lost in a future without action. Those are "at risk" capital stock and activities. For storm damage effects, we combined current economic data with storm surge and flood data, using simulation models to calculate the increase in estimated storm damage after land loss relative to the expected damage from the same storm with today's coast. We did not simulate future changes in economic patterns of activity or population movement in Louisiana, given the level of uncertainty involved in making such predictions.

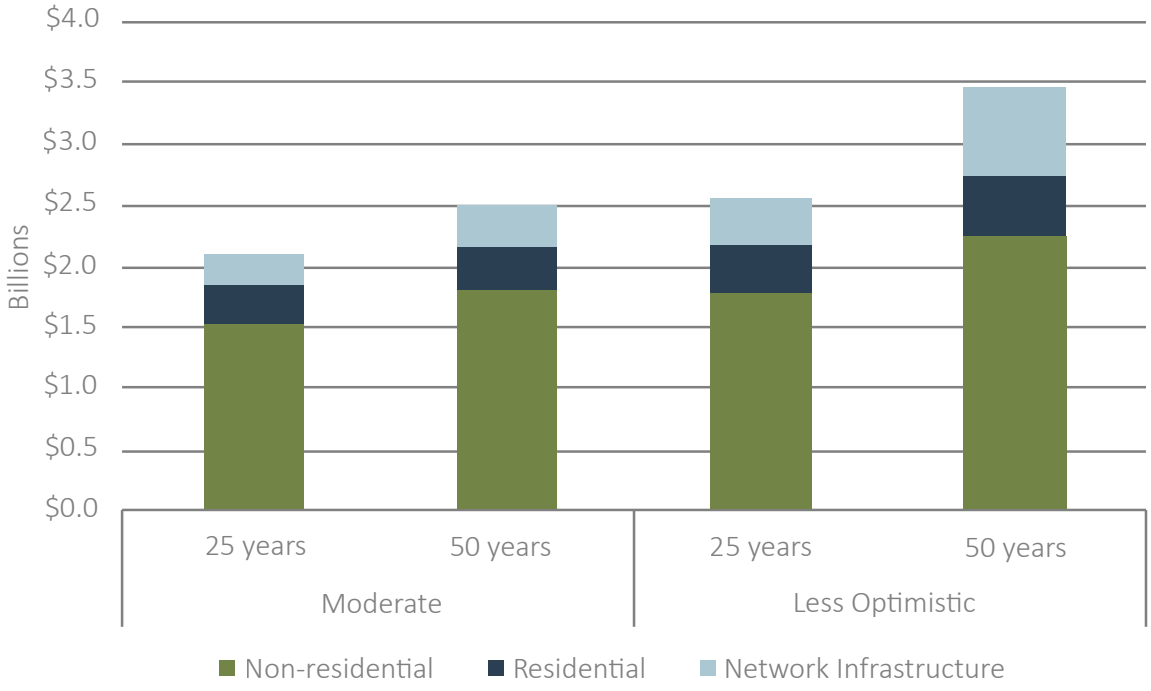
Disruptions to economic activity in coastal Louisiana can affect the economy throughout the rest of the state and the nation. We use IMPLAN, an input-output model, to document the economic contributions of businesses at risk from direct land loss and increased storm damage on the state of Louisiana and the rest of the country. We also analyze the effects of storm damage on gasoline prices, given Louisiana's important role in the production and distribution of refined petroleum products.

The result of this analysis is a set of estimates of the replacement cost of economic capital stock and value of activities that are "at risk" in a future without action from (1) land loss and (2) increased storm damage. We break down the results further by major categories, including residential and non-residential structures, network infrastructure, and economic activity. Where possible, we calculate the expected monetary costs. In some cases, it is not feasible to calculate monetary damages, and in those cases we report quantities or describe the potential land loss effects, depending on the information available. Because some costs cannot be added to others (e.g. lost wages and damage to roads) there is not a single damage figure associated with any combination of environmental scenario, time horizon, and storm track. Instead, we aggregate numbers to the extent possible and then report the resulting set of estimates that characterize damage in each case.

Results

The estimated replacement cost of capital stock directly at risk from land loss ranges from approximately $2.1 billion to $3.5 billion. Figure ES.1 illustrates the major components of capital stock damage associated with each combination of time horizon and environmental scenario. Between 60% and 75% of the costs are associated with non-residential structures, with approximately 1,200 structures at risk in the less optimistic 50 year case. Beyond these damage estimates, the report provides information on pipeline infrastructure potentially impacted through miles of infrastructure in land loss areas, because accurate cost estimates were not feasible. Estimated replacement costs are not annual but instead reflect the total replacement cost of capital stock at-risk. These values may differ from actual future costs to capital stock owners depending on actions taken by those owners in response to the threat.

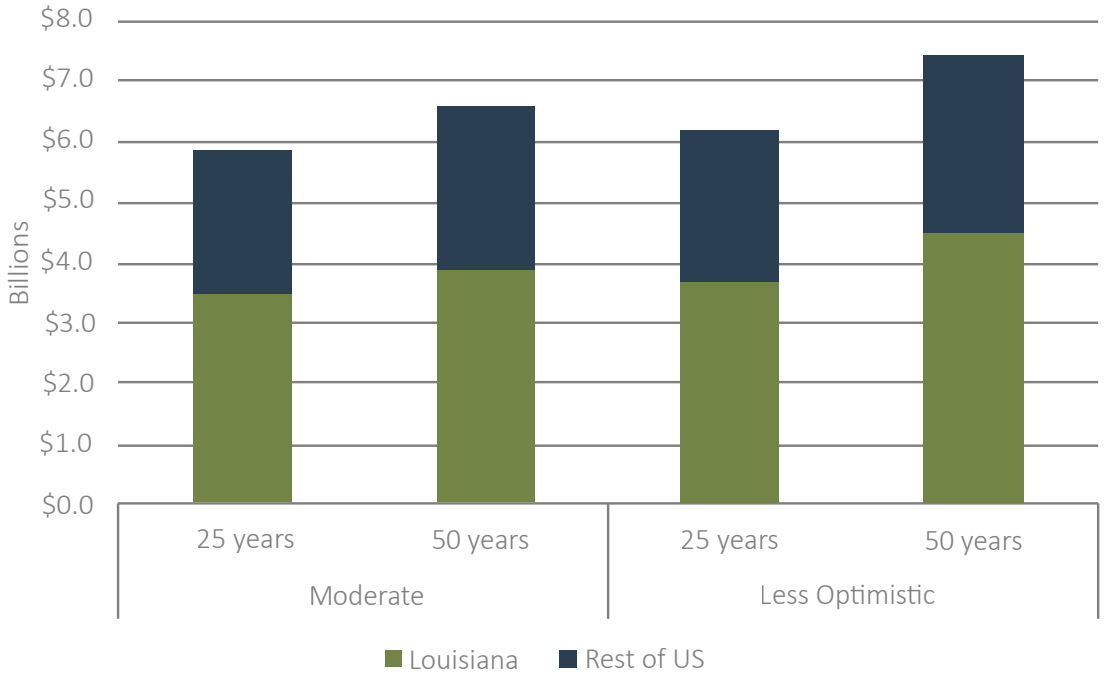
Figure ES.1: Total Replacement Costs Associated with Capital Stock at Risk from Land Loss



Note: Network infrastructure estimates include only road and rail infrastructure. All results presented in 2012 dollars.

Land loss also directly affects economic activity with estimated total activity at risk ranging from $5.8 billion to $7.4 billion in output. Louisiana is a major trade hub, and the coastal parishes import $160 billion and export $156 billion annually; petroleum and chemical products constitute a large share of this activity. Louisiana is connected to and services other states through an extensive transportation system, including waterways, roads, rail and pipelines. Including indirect and induced impacts to the rest of the state and the nation, total annualized output directly at risk from each land loss case is shown in Figure ES.2. This reduction in output is driven by land loss impacting between 800 and 1,200 establishments, depending on the specific land loss case. The at-risk establishments produce between $2.4 and $3.1 billion in annual sales, and their associated payroll is approximately $400 million to $575 million. These direct impacts are estimated to generate a total impact of between $3.4 and $4.5 billion in output in Louisiana and an additional $2.4 to $2.9 billion in output in the rest of the United States. In a future without action, some of the economic activity from at-risk establishments may be able to relocate, which could take more or less than the one-year time horizon of economic activity estimates provided in this report. These annual numbers provide context for the scale of current activity at-risk. For example, the establishments in coastal Louisiana that are at-risk in the 50 year, less optimistic case are roughly 0.7% of all establishments statewide and reflect a similar share of annual sales volume.

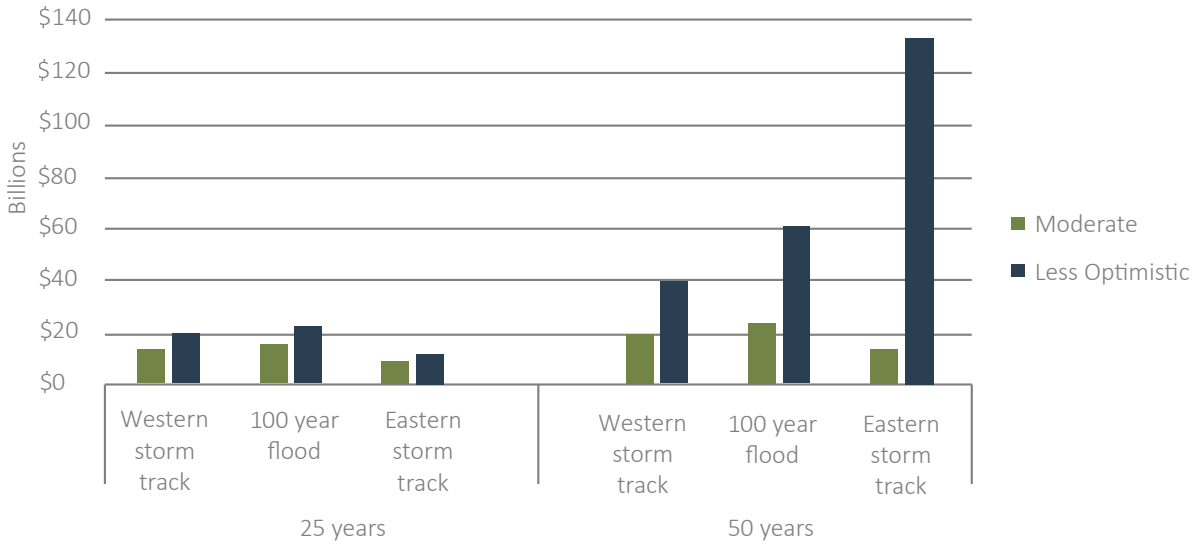
Figure ES.2. Total Annual Output at Risk from Land Loss



Note: All results presented in 2012 dollars.

Increases in storm damage to capital stock range from less than $10 billion to as much as $133 billion. These costs cannot simply be aggregated with the damages to at-risk capital stock because each storm event has only a limited probability of occurring within the context of a specific land loss case. The storm damage estimates are larger than the direct land loss estimates which reflects the location of capital stock across different parts of the Louisiana coast and the widespread impacts of flood damage further inland associated with severe storms. Figure ES.3 shows the increased storm damage to capital stock from each combination of land loss and storm event considered. Increases in damage range from approximately $9 billion for the eastern track storm in the moderate scenario at 25 years to over $130 billion for the less optimistic scenario at 50 years for the same storm track. This wide range of estimates for the eastern storm is driven by the enhanced storm protection built around New Orleans after Katrina that leads to less damage in the moderate scenario at 25 years and the predicted levee breaches in the less optimistic scenario at 50 years.

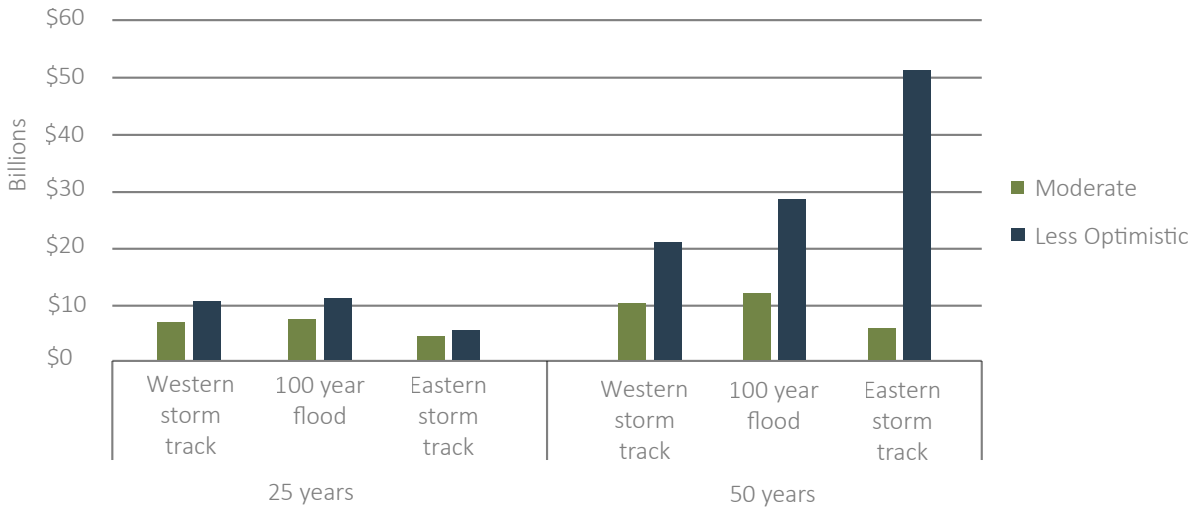
Figure ES.3. Increases in Storm Damage to Capital Stock



Note: Capital stock includes non-residential buildings, residential buildings, and network infrastructure. Network infrastructure estimates include only roads and rail. All results presented in 2012 dollars.

Increased storm damage caused by land loss also disrupts economic activity leading to an additional $5 billion to $51 billion in total lost output including indirect and induced effects. As with damage to capital stock, the estimates of business disruption are heavily influenced by whether or not levees are predicted to fail in the New Orleans area due to reduced natural storm protection caused by land loss. In the less optimistic scenario at 50 years, we estimate that the eastern track storm would affect an additional 26,000 establishments and 320,000 employees relative to a similar storm hitting the current coast. This type of disruption would directly generate between $140 million and $6.4 billion in lost wages and between $340 million and $23 billion in lost sales, depending on the land loss case, storm and model assumptions. Finally, because Louisiana serves as a hub for production and transportation of refined petroleum products, we analyze the effect of potential short term supply disruptions caused by major storms on national gasoline prices, which can add approximately $2.3 billion to $2.6 billion in additional costs to the nation.

Figure ES.4. Total Output Lost to Increased Storm Damage



Note: All results presented in 2012 dollars.

Ecosystem services offer significant value to Louisiana and the nation including their role in supporting a significant portion of the economic activity we document in the report. While we do not estimate a total monetary value of ecosystem service changes associated with land loss, we summarize the types of ecosystem services that exist in coastal Louisiana, describe their roles, and where possible, report the expected qualitative effects of land loss. Fisheries are an important source of economic activity that reflect a critical ecosystem service of coastal Louisiana. We expect fisheries catch to increase initially as marsh edge increases with land loss. But in the long run, catch rates may decrease as the amount of marsh edge ultimately falls due to coastal land loss. Land loss will also affect public lands, including state parks, and associated tourism and recreation activities. Depending on the land loss case, we estimate that between 1.5 and 13% of wildlife management areas, reserves, and parks are at risk from land loss. Due to a lack of data linking recreation demand with detailed geographic locations along the coast, we are not able to calculate quantitative impacts of land loss on these activities. However, we estimate that outdoor recreational activities in Louisiana provide approximately $4 billion of total value statewide with much of that activity concentrated in coastal areas. Finally, storm protection is a critical ecosystem service provided by Louisiana's coast. One way to value this ecosystem service is by quantifying the costs of increased storm damage brought on by land loss as is done in this study.

Study Limitations and Future Analysis

Our goal was to provide broad-based, informed estimates of the cost of land loss in coastal Louisiana, but we acknowledge a range of limitations in our analysis and final estimates. These limitations are both built into our approach and the natural consequence of data limitations encountered during our work. The reader should be aware of these limitations when interpreting our approach and results.

Economic systems are responsive, and we do not try to account for how the economy or individuals will respond to adverse conditions. Individuals or firms with capital stock or economic activity at risk from land loss may be able to reduce that risk through a variety of mitigating actions. For example, firms and individuals can relocate to other areas along the coast, other areas within Louisiana, or outside of the state. Rebuilding capital stock in any of these other areas would have costs that may be greater or less than the total value of the asset at-risk. For economic activities that can be relocated to other areas, the time needed to reestablish those activities elsewhere will vary and actual disruptions may be more than or less than the one-year estimates of economic activity provided in this report. In the same way, some firms that are indirectly impacted by activities at risk due to increased storm damage may be able to identify alternate customers, which would reduce the indirect costs associated with increased storm damage. Similarly, we do not account for changes in the scale of future economic activity. While a future without action could lead to long-run declines in investment and economic activity, this is far from certain. Similarly, a robust coastal protection and restoration effort could stimulate continued investment and growth, but failures could lead to longer-term declines. To achieve a stated goal of this analysis in informing those decisions, we avoid specific assumptions about economic growth or decline.

We provide guidance on the uncertainty inherent in our overall approach, but we do not explicitly treat uncertainty in all calculations. The variation in modeled time horizons, environmental scenarios, and storms provide a wide range of

cost estimates, and for some parameters—such as how quickly establishments rebound after a hurricane—we offer alternative values and show the implications. But we do not take a comprehensive approach to assessing uncertainty, such as calculating confidence bands around estimates.

The results we report focus on the entire Louisiana coast and should not be interpreted to imply changes to or impacts on any specific piece of land, infrastructure asset, or industry. We use disaggregated data on population, the location of structures, and business activity, but the results should not be interpreted at that level of disaggregation. This is partially because the effects of land loss are uncertain, especially at a fine geographic scale. It is also because capital investments will vary over time, and industries will respond accordingly, so we cannot estimate the effect on any one industry.

The report covers a wide range of economic effects associated with land loss, but there are some categories of damages for which we did not try to calculate monetary damages. For example, although our analysis accounts for some broad-based ecosystem services, such as the storm buffering benefits of coastal marsh land, there are major categories of ecosystem services that were outside the scope of our analysis. Related to ecosystem services, we do not directly account for cultural or other "existence" values that individuals and groups may place on land that is lost under a future without action. These losses are difficult—although not impossible—to estimate, but doing so requires dedicated analysis of individual resources or classes of resources. We summarize some of the major types of cultural values and report total economic values, but we do not calculate the change in value due to coastal land loss.

Future analysis could address some of these limitations by expanding the analytic scope, conducting additional data collection, or carrying out case studies for specific sectors. Although using today's fixed economic landscape helped simplify and clarify the analysis, future work could account for changes in the location and scale of economic activity over time. Similarly, it would be beneficial to model how the economy is likely to respond through feedback mechanisms, which could be accomplished through a general equilibrium approach. Finally, there are some important damage categories, such as broad ecosystem services, that could be estimated in a more comprehensive way. These expansions would add complexity to the analysis and results, but they would provide additional information for policymakers and other stakeholders.