

Encroaching Tides in the Florida Keys

Investing in Preparedness to Save Money and Manage the Impacts of Rising Seas

HIGHLIGHTS

Escalating tidal flooding in the Florida Keys is a visible sign of rising sea levels. Without adaptive measures, the dangers will multiply as the reach of tides expands, according to a UCS analysis of projected tidal flooding for Key West, Marathon, and Big Pine Key. Using an Army Corps of Engineers scenario, the analysis suggests that the frequency, extent, and duration of tidal flooding will all increase over the next 15 to 30 years, resulting in damage to the Keys' economy, infrastructure, and ecology. Aware of the threat, the region has made strides to reduce some of its vulnerability to rising sea levels. With further local, state, and federal commitments and innovation, the Keys can become a national leader in adapting to this global threat.

By 2045, the sea level in the Florida Keys will rise 15 inches, according to a projection by the U.S. Army Corps of Engineers (SFRCCC Sea Level Rise Working Group 2015). As a result, the city of Key West—the economic powerhouse of Monroe County, Florida—would see more than 300 tidal flooding events per year within the lifetime of today's 30-year mortgages. The flooding that wreaks periodic havoc on the city's small business hubs like Duval Street, for example, would occur regularly. Key West already suffers from flooding during extreme high tides, with water washing into streets, businesses, and homes, particularly when those tides combine with rainfall (Sweet et al. 2014).

The flooding will worsen as the sea level rises, threatening the county's primary economic driver: a \$2.2 billion tourism industry that attracts almost 3 million people to the Keys each year (Monroe County 2014; Monroe County n.d.). Moreover, the intrusion of salt water that can accompany rising sea levels threatens the region's unique ecosystems and the Keys' primary freshwater supply (Obeysekera et al. 2011). And storms riding on higher seas can flood larger areas, putting more residential and commercial property at risk. Yet some of this vulnerability can be reduced: investing in coastal preparedness measures can go a long way toward protecting the infrastructure, private property, and livelihood of Keys residents.



Parts of Key West's famous Duval Street now fail to drain after rainstorms.

What Flooding Means for the Keys

Today, parts of Key West's Old Town—the city's central business district and a main tourist destination—flood during extreme high tides, hurting commerce. This flooding is expected to become more frequent and disruptive as the sea level rises, further threatening Monroe County's tourism industry, which supports more than 32,000 jobs in a county with a total population of 77,000 (Leeworthy and Ehler 2010). Many of these jobs are tied to industries like hospitality, food services, retail, and entertainment, all of which can be affected during floods.

"The last time it flooded, we opened later than usual," says seventh-generation Key West resident Zachary Arnold and manager of IT'SUGAR, a candy shop on Duval Street. "When I came in, there was no business, no customers, and we'd been open for two hours. The flooding definitely affects us, as it does every store out here in Key West. People don't want to put on their waders to get candy" (Arnold 2015).

This flooding also creates new infrastructure challenges for local governments whose budgets are already stretched thin. Of prime importance, the county's two main points of access, Key West International Airport and U.S. Route 1, are less than a foot above sea level in places. Maintaining access to the Keys will require action as the rising tide closes that one-foot gap (Steves 2015; Allen 2013; FDOT 2013; SFRCCC 2012).

"With the tides, we're seeing more and more instances where the water has no place to go," says George Neugent, Monroe County Commissioner (R-District 2). "We're getting more complaints for what is now a more pronounced threat" (Neugent 2015).

According to Neugent, the challenge is countywide. "We have a list of about 40 county roads throughout the Keys that need to be elevated," he says. "Right now, we don't have the money to do it" (Neugent 2015).

Estimating the Impact of Rising Sea Levels

What would a sea-level rise of one foot mean to Monroe County's infrastructure and real estate? Here are a few examples cited by the Southeast Florida Regional Climate Change Compact, formed in 2010 to coordinate mitigation and adaptation activities across Broward, Miami-Dade, Monroe, and Palm Beach counties:

- 75 percent of hospitals, 71 percent of emergency shelters, and 65 percent of schools have property that would be inundated (SFRCCC 2012).
- \$2.76 billion of taxable property and 3,000 homes would be vulnerable to flooding (SFRCCC 2012; Climate Central n.d.).



High-tide flooding in the Keys will worsen as the sea level rises, affecting businesses and Key West International Airport. "I've been here since 1988, and it's getting harder and harder to move the water out of here," says Peter Horton, who was Monroe County's director of airports from 1999 to 2014. "The airport is at capacity with high tide and two inches of rain. I'm very concerned about the long-term prognosis for this airport and the rest of Key West" (Horton 2015).

- Two-thirds of unincorporated land would be inundated, including areas designated for industrial, commercial, and residential development (SFRCCC 2012).

Moreover, saltwater intrusion caused by rising sea levels threatens vital aquifers and thus the Keys' drinking water. Currently, the Keys get nearly all of their drinking water from well fields in southern Miami-Dade County. However, the combination of South Florida's porous limestone geology, low elevation, and rising sea levels creates the potential to contaminate the drinking supply not only for residents of the Keys but also for millions of other Floridians (Cheon 2015; Monroe County 2011; Miller 1990; FCAA n.d.a; FCAA n.d.b).

While essentially all Monroe County residents live in the Keys, about 87 percent of the land area is on the mainland, where it is part of the Everglades and managed by Everglades National Park and Big Cypress National Preserve (SFRPC 2014; MCHD 2013). This land, too, must be protected from rising sea levels so it can continue to play its critical role in South Florida's hydrology. "In the coastal Everglades, inches of sea-level rise translate to miles of habitat change," according to Dr. Stephen Davis, wetland ecologist at the Everglades Foundation. "For every two-inch increase in sea level, we can expect to see about a one-mile-wide strip of freshwater Everglades wetland exposed to saltwater. Restoring the Everglades helps preserve mangroves and sawgrass habitats that provide storm-surge protection and will help slow the intrusion of saltwater into aquifers, ensuring a safe and sustainable water supply for our residents and visitors" (Davis 2015).

High-Tide Flooding in the Florida Keys, 2015 and 2045

Already, tidal flooding inundates several parts of the Keys during extreme high tides. Several times a year, the gravitational pulls of the sun and moon combine to drive tides slightly higher and lower than normal. This phenomenon, known as a “king tide,” can cause coastal flooding. With the increase in sea level projected for the Keys by 2045, high tides on top of these normal tidal variations will reach farther inland and cause more frequent flooding (Spanger-Siegfried, Fitzpatrick, and Dahl 2014). UCS’s analysis using the Army Corps of Engineers scenario projects that:

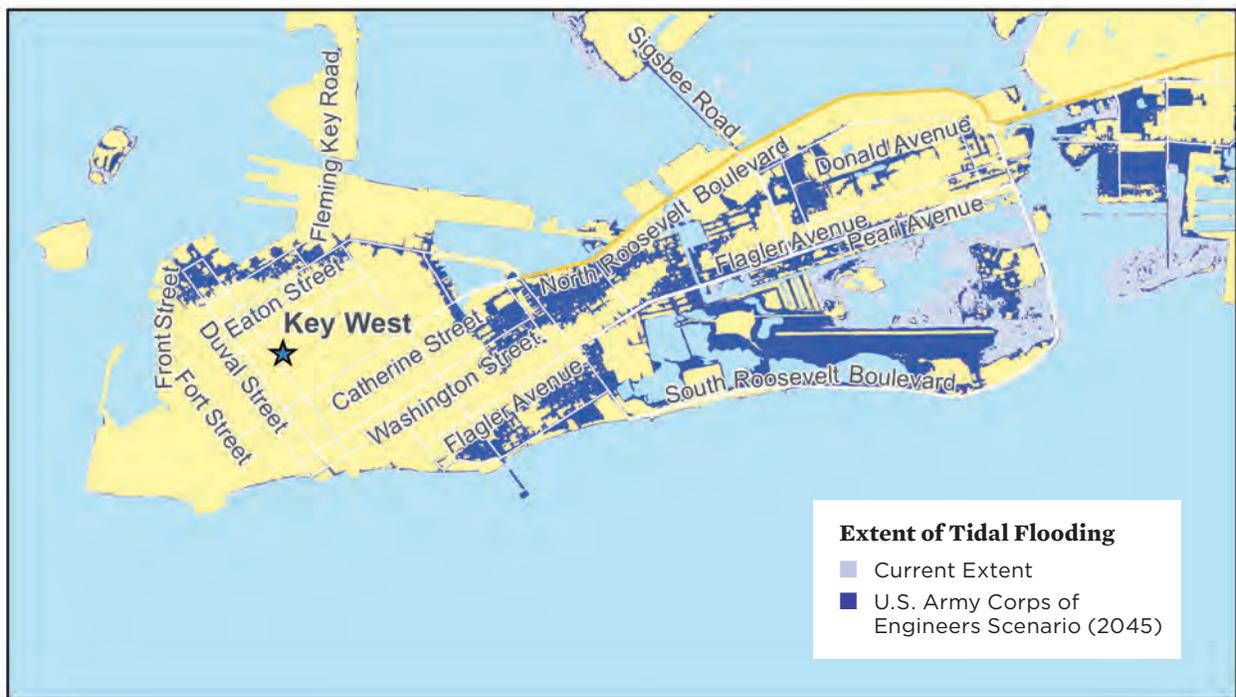
- Tidal flooding will occur in Key West 114 times a year by 2030 and 375 times a year by 2045, when flooding would essentially occur with daily high tides on many days; and
- Tidal flooding will occur in Big Pine Key and Marathon (Vaca Key) 23 times a year by 2030 and about 180 times a year by 2045.

As the seas rise, some tidal floods will create ever more serious damage than those today. The maps on the following pages

illustrate how the Army Corps of Engineers’ projections of the rise would expand tidal flooding zones. Lavender-colored areas represent typical tidal flooding today during an extreme tide. Indigo represents possible flooding during that same tide in 2045. Green designates natural areas. Another scenario examined by the compact is available online at www.ucsusa.org/encroachingtidesfloridakeys.

Tidal flooding is projected to occur in Key West 114 times a year by 2030 and 375 times a year by 2045, when flooding would essentially occur with daily high tides on many days.

FIGURE 1. Key West Extreme High Tide Flooding Today and in 2045



Note: These maps can serve for discussion and research purposes but are not appropriate for detailed analyses. For more information, see the supporting technical document online at www.ucsusa.org/encroachingtides.

SOURCES: UCS ANALYSIS; MAP BASED ON DATA FROM NOAA 2014; OPEN STREET MAP FOUNDATION 2014; U.S. CENSUS BUREAU 2013.

FIGURE 2: Big Pine Key Extreme High Tide Flooding Today and in 2045

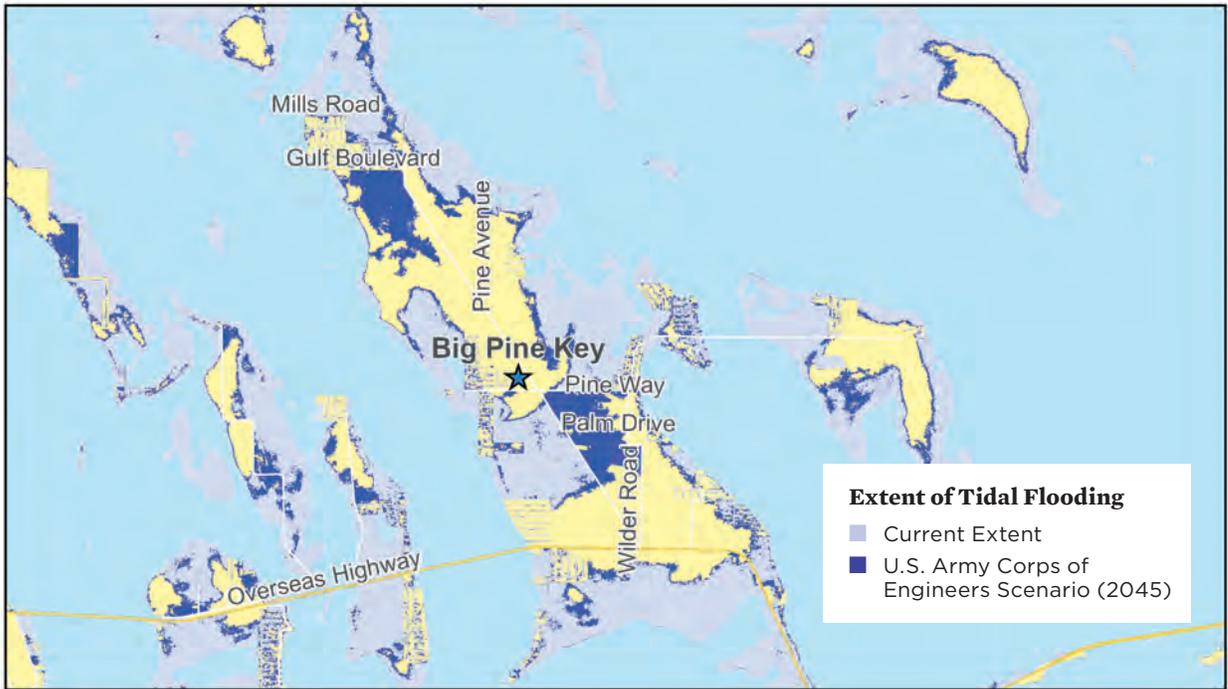
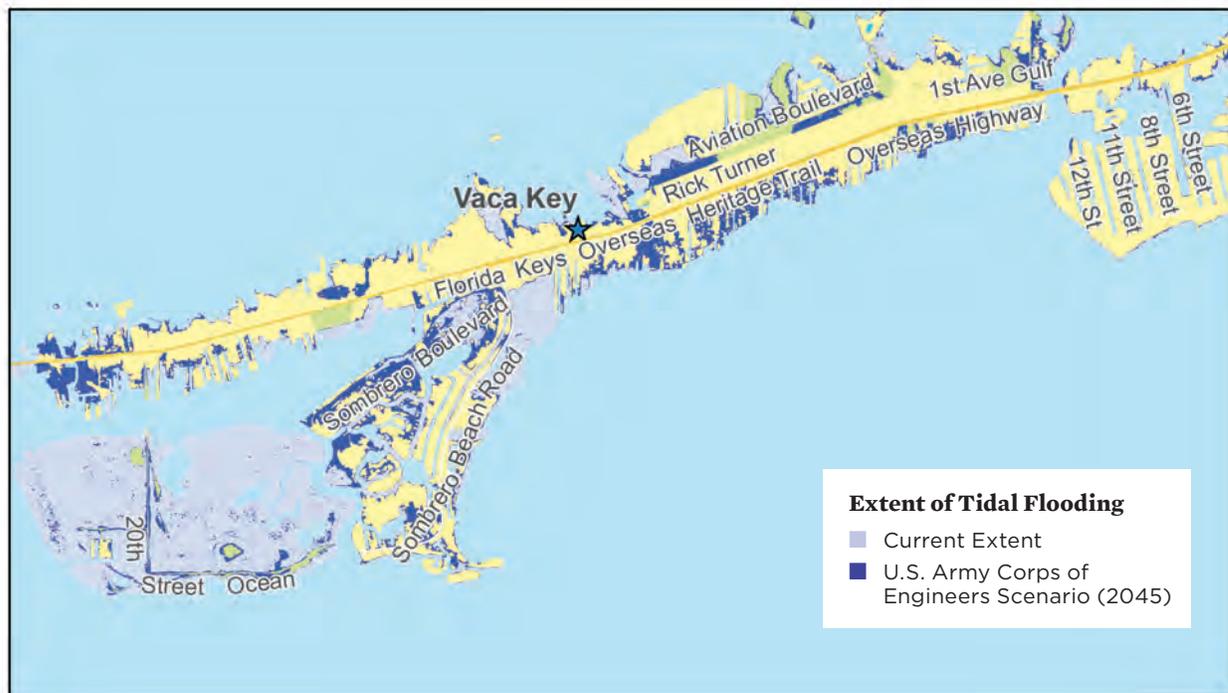


FIGURE 3: Marathon (Vaca Key) Extreme High Tide Flooding Today and in 2045



Note: These maps can serve for discussion and research purposes but are not appropriate for detailed analyses. For more information, see the supporting technical document online at www.ucsus.org/encroachingtides.

SOURCES: UCS ANALYSIS; MAP BASED ON DATA FROM NOAA 2014; OPEN STREET MAP FOUNDATION 2014; U.S. CENSUS BUREAU 2013.

“I will no longer be here when it gets to where people are having to leave their homes due to sea-level rise, but I do care about my kids and grandkids. I would like to set a firm foundation for them to work from so they don’t say, ‘Grandma didn’t do anything.’”

— Sylvia Murphy (R-District 5), Monroe County Commissioner (Murphy 2015)

Opportunities for Action: Increasing Resilience in the Florida Keys

A secure, economically vibrant future for the Florida Keys depends on the quality and comprehensiveness of local, state, and federal responses to climate change. Most important, reducing emissions from burning fossil fuels can, over the long term, lessen the rate at which sea levels rise and thus reduce the frequency and intensity of the resulting floods.

Investments in resilience will be critical as well. A robust commitment on all levels to building resilience can lessen the risks to property, livelihoods, and the regional economy. Monroe County elected officials are taking leadership on this issue. “I will no longer be here when it gets to where people are having to leave their homes due to sea-level rise, but I do care about my kids and grandkids,” says County Commissioner Sylvia Murphy (R-District 5). “I would like to set a firm foundation for them to work from so they don’t say, ‘Grandma didn’t do anything’” (Murphy 2015).



The low elevation and limited land area of the Florida Keys make them vulnerable to damage from sea level rise and tidal flooding. Local leaders—through government, community, and other initiatives—are taking proactive steps to protect the vibrant culture and ecology of their home.

Local action is not enough, though. The future for Monroe County requires federal action on two fronts: reducing global warming emissions and increasing investments in preparedness. A national commitment on both fronts in the near term could reduce the costs of action over the long term, while creating jobs for residents of the Florida Keys. For example, a state study suggests that hazard-mitigation activities can provide economic benefits to Floridians in terms of both employment and economic stabilization following a disaster. Between August 2004 and February 2011, hazard-mitigation activities implemented in Florida created 12,206 full-time-equivalent jobs (FDEM 2012).

Moreover, investing in preparedness is fiscally responsible. Multiple national and regional studies have concluded that pre-disaster investments save money in avoided damage and reduced recovery costs (Schneider 2015; FDEM 2012; Rose et al. 2007).

Monroe County Taking Action

Over the last five years, Monroe County has taken significant steps toward reducing its vulnerability to rising sea levels and other impacts of climate change. In 2010, the county was among the founders of the Southeast Florida Regional Climate Change Compact. Shortly thereafter, it appointed the Climate Change Advisory Committee, which makes recommendations to commissioners regarding mitigation and adaptation policies, and it has mapped areas of vulnerability to rising sea levels. In 2013, the county developed a climate action plan, and Key West enacted building codes to make new construction more resilient. Monroe County also has made it a priority to educate residents about rising sea levels, it encourages them to collaborate on preparedness through community workshops, and it uses the Army Corps of Engineers scenario for planning.

Yet much more work is needed at all levels, as outlined in the Climate Change Compact’s 2015 State Energy and Climate Legislative Program (SFRCCC 2015).

Opportunities for Federal Action

Even with vigorous actions at the local level, the effectiveness of the Climate Change Compact's efforts will depend heavily on strong federal leadership and a federal commitment to prepare for climate change and reduce emissions from fossil fuels. Recommendations for federal action include:

- Increase funding for improving coastal resilience, including funding for FEMA's Flood Mitigation Assistance, Pre-Disaster Mitigation, and Hazard Mitigation Assistance grant programs, as well as for the National Oceanographic and Atmospheric Administration's (NOAA's) Regional Coastal Resilience Grant Program.
- Increase funds for restoring the Everglades and acquiring and protecting critical Keys habitats.
- Reform national disaster policy to increase incentives to prepare for rising sea levels and to increase accountability for inaction.
- Supplement existing federal hazard-mitigation programs and create a national preparedness fund.
- Increase funding for monitoring key trends, gathering data, and creating and using planning tools and other resources.
- Encourage the use at all levels of the best available science in planning and in making infrastructure decisions.

Providing resources for flood mitigation, investing in making the infrastructure more resilient, expanding the arsenal of scientific data and planning tools, and other similar actions can help determine the future of the Florida Keys. Resilience measures can create local jobs and a safer business environment, lessen disruptions to essential municipal services and infrastructure, and protect this unique and treasured region.

“We need help with financial resources at the federal level to plan and build a resilient county so the beautiful yet fragile Florida Keys will be here for a long time.”

— Rhonda Haag, Sustainability Program Manager, Monroe County (Haag 2015)



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As the sea level rises, the low-lying Keys are increasingly at risk.

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