

# California Faces Chronic Inundation

In California and all along the US coastline, many cities and towns will experience high-tide flooding within the next few decades that will be chronic and extensive enough to force difficult choices. Because this persistent flooding can render neighborhoods, commercial districts, industrial zones, and recreational and other areas unusable, communities will face either major coastal defense investments or the prospect of retreat from affected places. The Union of Concerned Scientists (UCS) has identified hundreds of US communities at risk of this disruptive flooding as well as how much time remains before the flooding becomes chronic. UCS also recommends how to use this time wisely.

## “Chronic Inundation”

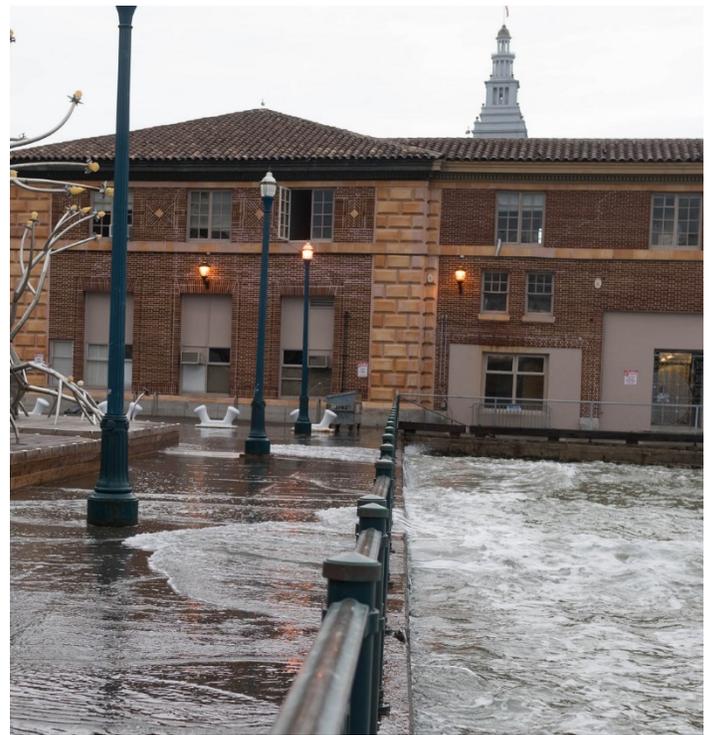
UCS analyzed the exposure of coastal communities to chronic flooding under three different sea level rise scenarios developed for the 2014 National Climate Assessment: intermediate-low (“low”), intermediate-high (“intermediate”), and highest (“high”) (for detailed information see [www.ucsusa.org/RisingSeasHitHome](http://www.ucsusa.org/RisingSeasHitHome)).

This analysis assumes that a community (defined as a US Census county subdivision) faces “chronic inundation” when high tide floods 10 percent or more of its usable, non-wetland area at least 26 times per year or, on average, every other week. Some cities, such as Annapolis, Maryland, and Miami Beach, Florida, currently experience flooding less extensive than this but are already investing heavily to cope with it.

UCS has identified three California communities that will face such chronic inundation by the end of the century, given the intermediate sea level rise scenario: Alameda and San Mateo in the San Francisco Bay Area and North Coast (home to Huntington Beach) in the greater Los Angeles region. However, given the faster level of sea rise in the high scenario, those three communities would experience such flooding by 2080, 20 years earlier. Alameda would experience chronic inundation of 35 percent of its area, including densely populated neighborhoods and industrial zones. The number of affected communities rises to seven by 2100. For a list of all inundated communities in California, visit [www.ucsusa.org/RisingSeasStateData](http://www.ucsusa.org/RisingSeasStateData).

## New Areas Exposed to Frequent Flooding

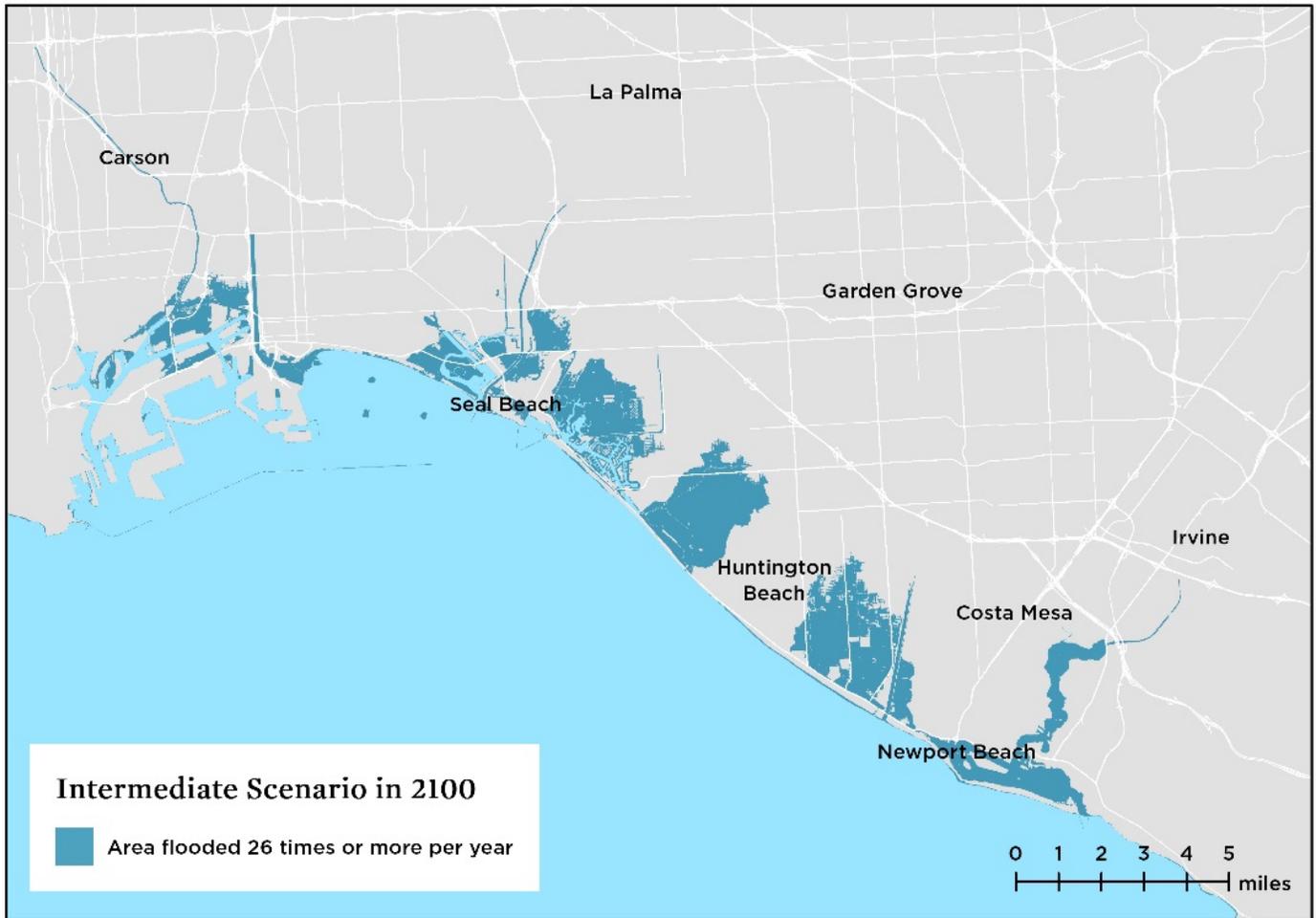
Many California communities do not meet the 10 percent threshold defined by this analysis but would be affected nonetheless. In the Los Angeles area, for example, given the high scenario, about eight percent of Huntington Beach’s land area would be chronically inundated by 2060 and 24 percent by 2100. Although the nearby towns of Long Beach, Costa Mesa, and Newport Beach would experience chronic inundation of less than 10 percent of their area by century’s end, important areas of these towns would frequently flood. For example, by 2100 in the intermediate scenario, the entirety of both Balboa Island in Newport Beach and Naples Island in Long Beach would flood every other week, on average.



**HIGH TIDE FLOODS SAN FRANCISCO'S EMBARCADERO IN 2016.** *Communities in the San Francisco Bay Area are projected to flood more extensively with regular tides as sea level rises. Photo credit: Dave Rauenbuehler.*

**FIGURE 1. Chronic Inundation in the Greater Los Angeles Region in 2100 in the Intermediate Scenario.**

Sea level is projected to rise by about four feet by the end of this century, bringing disruptive flooding to communities in the greater Los Angeles region. Long Beach, Seal Beach, Huntington Beach, and Newport Beach would all experience flooding of neighborhoods and other infrastructure, with nearly 15 percent of Huntington Beach’s land area flooding every other week, on average. Data Sources: OpenStreetMap 2017; NOAA 2017.

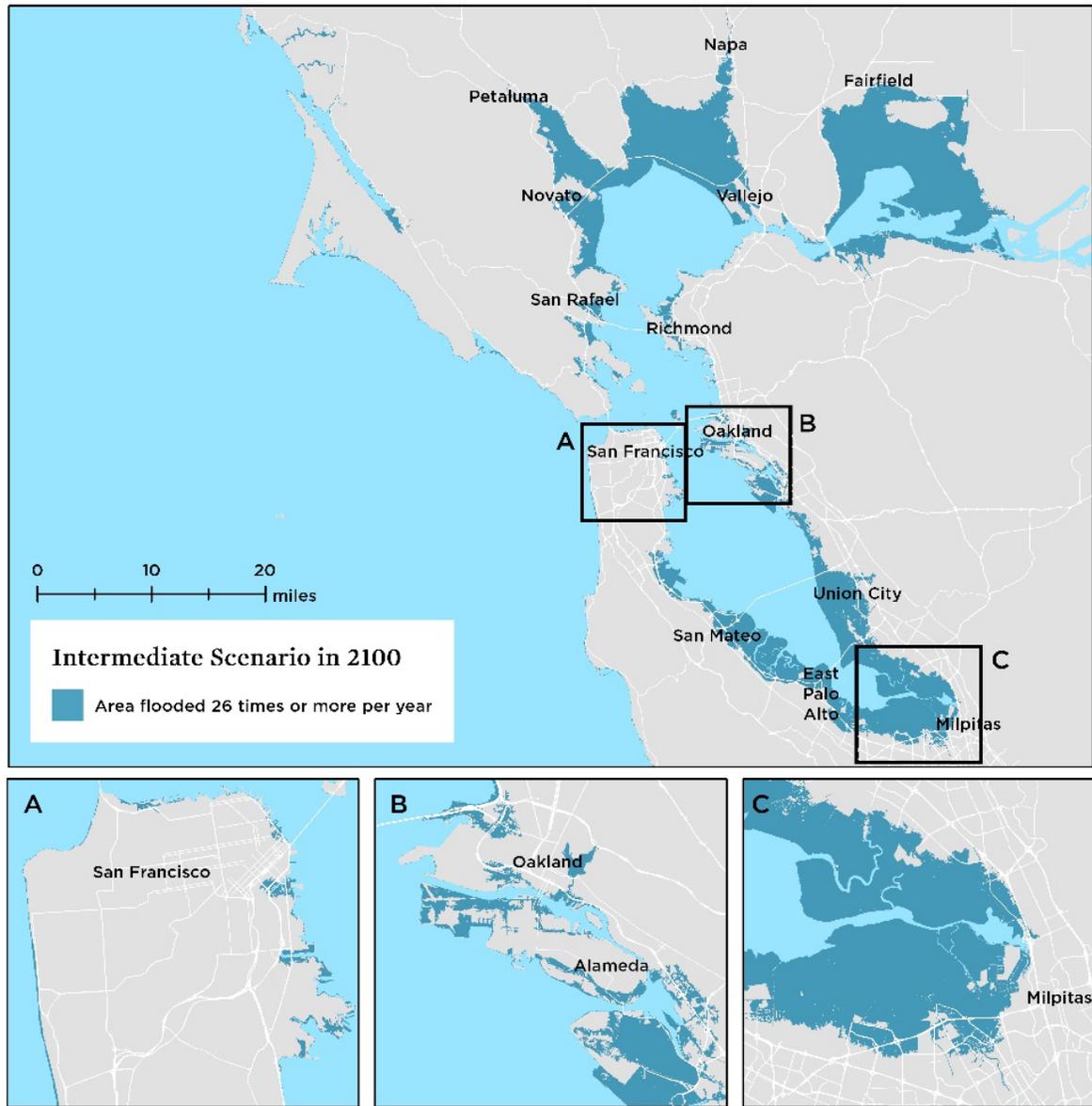


Owing to the large area of the San Diego census county subdivision, the percentage of the community’s area affected by chronic inundation this century remains small—less than two percent in the high scenario in 2100. Nevertheless, that small area contains many of the region’s military installations, which are of critical importance to US national security. By 2060 in the high scenario, the piers at Naval Station San Diego would be subject to frequent flooding. By 2080, more than one-third of the Silver Strand Training Complex would be chronically inundated. And by 2100, more than one-third of Naval Station San Diego and Marine Corps Recruit Depot San Diego would flood regularly, along with the majority of Naval Amphibious Base Coronado.

By 2100 in the intermediate scenario, disruptive flooding in San Francisco would reach deeply into the Mission Bay and

Hunters Point neighborhoods, two areas that have rapidly developed recently. Suburban communities such as Novato, Vallejo, Palo Alto, East Palo Alto, Alviso, and Milpitas would also experience twice-monthly flooding of neighborhoods, roads, and other infrastructure.

**FIGURE 2. Chronic Inundation in the San Francisco Bay Area in 2100.** Many bay-front communities in the San Francisco Bay Area would experience frequent, disruptive flooding by the end of the century, given the intermediate scenario. Alameda and San Mateo would see 29 and 10 percent, respectively, of their land area flooding every other week, on average. Some of San Francisco’s most rapidly developing neighborhoods as well as suburban communities such as Novato, Union City, and East Palo Alto would also see disruptive levels of flooding. Data Sources: OpenStreetMap 2017; NOAA 2017.



## A Chance for California Communities to Avoid Chronic Inundation

UCS used the low scenario as a proxy for sea level rise associated with a warming of about 1.8°C and found that curtailing future warming and sea level rise would limit the extent of chronic inundation such that no California community would experience flooding of 10 percent of its land area before the end of the century. The Paris Climate Agreement, ratified by most countries in November 2016 (although the Trump administration has announced US withdrawal), aims to limit future warming to 2°C or less above preindustrial levels through large-scale reductions in global warming emissions.

### Response Time: How to Use It Wisely

The limited time before chronic inundation sets in must be used to plan and prepare using a science-based approach that helps communities understand their risks, assess their choices, and implement adaptation plans while prioritizing equitable outcomes. Three categories of policy response are critical:

- **Halting or phasing out current policies that perpetuate risky coastal development.** We need to update flood risk maps using the latest climate science, limit development in flood-prone areas, safeguard flood-protective natural ecosystems, reform flood insurance premiums, and update building codes and infrastructure plans to reflect the latest projections of sea level rise.
- **Enhancing existing policy frameworks.** Current disaster response and predisaster investments—including FEMA’s Hazard Mitigation Grant Program, predisaster mitigation grants, Flood Mitigation Assistance, and the Public and Individual Assistance Programs—must be adequately funded. They must also take account of climate projections and emphasize advance actions to limit the impacts of flooding. We need to preserve existing budgets and increase investment in flood-risk mapping and flood-proofing measures, protection of natural ecosystems, large-scale home buyout programs, and implementation of robust flood-risk management standards and building codes. Other agencies that play important roles in our nation’s flood response (e.g., HUD, USACE, USDA, DOI, and

DOT) must also be adequately resourced.

- **Creating bold new policies and measures adequate for the scale of coastal risks.** Pioneering and well-funded programs will be needed to assist, for example, with retreat and relocation from chronically inundated areas and related needs. New economic opportunities and infrastructure investments will be required in the safer locations to which people and businesses relocate. Policies must be designed to preserve natural ecosystems and cherished aspects of cultural heritage. And innovative governance models that enable effective decisionmaking amidst challenging tradeoffs will also be essential.

Coordinated action by households, local and state leadership, and businesses is required. Federal resources and policymakers’ decisions will help determine whether coastal communities are resilient and continue to thrive. And even as the Trump administration seeks to withdraw from the Paris Agreement, we must work at state and local levels and with other nations to cut global warming emissions aggressively in order to help slow the pace of sea level rise.

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