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What's being done to protect Marin's coastal lands from the effects of climate change?

A Rising Tide

With confident strides, Stuart Siegel leads me along the muddy shore of China Camp State Park's expansive wetlands. As the coastal resilience specialist with the San Francisco Bay National Estuarine Research Reserve and a research professor of Earth and Climate Science at San Francisco State University, Siegel has walked this path countless times.

In contrast, my steps are tentative as I envision my next footfall will send me reeling into the muck.

We have left our cars on the edge of North San Pedro Road, the narrow passage that winds through the park. Siegel has invited me here to discuss a timely subject — the challenges sea level rise will bring to Marin County.

This remote salt marsh and lonely road may seem inconsequential given the troublesome topic, but as Siegel points out, this back road represents the heart of the problem.

The Risks for Marin

"North San Pedro Road has a long history of flooding during king tides," he says, referring to the extreme high tides that arrive during the winter solstice. "When the road is underwater, it is effectively closed." If an accident or related flooding blocks the other end of the road that continues into Central San Rafael, Siegel adds, "then Peacock Gap and the other hillside neighborhoods become isolated. If someone needs an ambulance, it's either wait for the flooding to recede or they'll be requesting a helicopter."

While the entire county's peninsula is known for rural beauty, Marin's scenic coastline draws the most visitors. It is, after all, a unique patchwork of small harbors and seaside towns, solitary beaches and picturesque bays. It is a place of calm estuaries and rugged headlands. Few counties in the state can claim such an interwoven relationship with the sea.

This distinctive geography also means Marin is one of California's most vulnerable waterfront areas when it comes to sea level rise.

Extreme high tides are not new to Marin. Like China Camp, Coyote Creek Watershed at the foot of Tamalpais Valley also suffers from the effects of king tides. Their onset impedes traffic along Shoreline Highway and the northbound on-ramp to U.S. Highway 101. While these events are disruptive, they are temporary.

Melting glaciers and thermal expansion of the ocean, on the other hand, will push the Pacific higher onto the outer coast and farther into the waters of San Francisco, San Rafael, San Pablo and Richardson bays. The increase in average tidal heights will not only transform Marin's coastline but will significantly alter its economic and social spectrum.

Thinking Ahead

"A lot of what we have been trying to do is get people to come together and plan how to solve or at least to address the problem," says Kate Sears, county supervisor for Southern Marin's District 3 and one of the most outspoken local advocates for climate crisis preparedness. "I think 'solve' is a word that has limited meaning going forward," she adds. "But at least we are talking about measures we can take in a collaborative way."

Working to involve Marin's residents, county officials developed two community outreach programs — Bay Waterfront Adaptation and Vulnerability Evaluation (BayWAVE) and

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Collaboration: Sea Level Marin Adaptation Response Team (C-SMART). While BayWAVE focuses on adaptations for the bay side of the county, C-SMART concentrates on strategies for our peninsula's open coast.

To understand how rising seas will likely affect Marin, the planners aligned the county's infrastructure data with the statewide sea level study "Our Coast, Our Future" (OCOF). The OCOF program is an ongoing collaboration between Petaluma-based Point Blue Conservation Science group, the U.S. Geological Survey and a number of other agencies. It uses various probability models to determine how sea level change will alter California's coastal region.

From this analysis, the planners created two reports: the "Sea Level Rise Vulnerability Assessment" for the bay side and the "Marin Ocean Coast Sea Level Rise Adaptation Report," which focuses on uncertainties along the western coast.

Taking into account projected sea level rise and probable storm events, the reports divide the next 80 years into near-, mid- and long-term intervals. With extensive charts and diagrams, they illustrate what residents, business owners and the commuting public might expect as the ocean makes its ascent.

In the near term, a timeline from now until 2030, sea level is projected to rise between 10 and 12 inches over current tidal heights. By midcentury, areas of Marin will likely see a 20-inch increase. For the longer term, from 2050 to the end of the century, the forecast is less certain. There are too many variables regarding how the northern glaciers will handle a continuing increase of greenhouse gases and how much water the glaciers might release. Current projections, however, point to Northern California facing sea heights of at least five feet above present-day norms.

"It is not surprising that Marin is very vulnerable," says Chris Choo, the county's principal planner for the public works department and project manager for BayWAVE. "And it is not vulnerable just in a couple of places. The way this county is configured, sea level rise is going to be a permanent problem."

Nature-Based Solutions

BayWAVE's assessment identified several exposed communities, with some having more options for recourse than others. One of the strategies to offset sea level rise and storm surge is to restore the county's historical wetlands. Appropriately, salt marsh areas, referred to as green infrastructure, often incorporate fabricated reef systems placed offshore to diffuse damaging seas.

"People have described these tidal marshes as horizontal levees," says Jeff Melby, project manager for the California State Coastal Conservancy. He has spent the last five years shepherding the Hamilton Wetlands Restoration Project, a plan to reestablish one of the county's most extensive wetlands.

With grants from U.S. Fish and Wildlife Service and the Association of Bay Area

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Governments adding to the funding, the Coastal Conservancy recently gave a $20 million green light to the project, which, when complete, will renew 2,600 acres of the wetlands bordering the low-lying communities of Hamilton Field and Bel Marin Keys.

"In terms of flood protection, marshes are critical," Melby says. "They give the water someplace to go, essentially acting like a sponge. They will also reduce storm surge and destructive wave action."

San Rafael's Canal district is another susceptible area where a nature-based strategy can help. Nestled in the corridor between San Rafael Creek and U.S. Highway 101, the community contains a dense mix of multifamily housing and light industry, and any degree of sea level rise will be disruptive, especially since the area is already prone to high-tide events.

Fortunately, the Canal district has Tiscornia Marsh at the mouth of San Rafael Creek, the waterway that flows through the area. The marsh has 20 acres of wetlands that will help reduce near-term flooding. Managed by the Marin Audubon Society, the renewal project recently received a grant from the San Francisco Bay Restoration Authority, the state agency designated to disperse bond measure funds for wetland restoration. The Tiscornia project will raise the current earthen levee and restore an additional 10 acres of wetlands lost to decades of natural erosion.

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Other Defenses

Many other Marin neighborhoods, however, are not located behind natural wetlands, or they lack waterfront topography that might lend itself to establishment of protective marshes — including parts of Tiburon and Belvedere. Facing the open bay, Tiburon will need to use other methods to defend its historic Main Street area against flooding and storm surges. Belvedere Lagoon currently relies on tide gates and a pumping system to protect its luxury waterfront homes. By midcentury it could face property loss if sea level tops its levees as they exist today.

The county's western shores lack defenses too. While much of the coast is part of the uninhabited Point Reyes National Seashore managed by the U.S. Park Service, there are residential and recreational areas of unincorporated Marin that will find the Pacific Ocean a progressively tenacious neighbor.

Over the next 20 years, C-SMART's report projects the long sliver of Stinson Beach and its Seadrift community could see over 200 buildings flood when sea level rise is amplified by the annual storm surge. Likewise, residents of Bolinas will need to protect their downtown buildings and beachfront properties during the same time frame. And while the long inlet of Tomales Bay may be safe from storm-generated sea waves, the mounting tide threatens numerous buildings as well as the low-lying thoroughfares of Shoreline Highway and Sir Francis Drake Boulevard. These narrow roadways edge the bay and are the only means of vehicle access.

A common misconception about sea level rise is that those who live or work outside the affected areas will not be troubled by its consequences. In truth, whether or not one resides in the upper valleys or commutes in or out of Marin on Highway 101, nature's reshaping of the peninsula will become a concern for everyone.

"When you start looking at 12 inches of sea level rise, you begin to see which roads are impacted," Choo notes. "It does shut down the possibility of moving through the county, and that is not just roads for commuters. It is the transit system and our emergency vehicles." Residents outside the flooded areas cannot assume there will always be open avenues, she says: "Everyone will be taking the back roads, so you are talking about gridlock in a way that makes it a catastrophic failure for the entire county." If major thoroughfares are closed by tidal events, transporting goods also becomes problematic: food, medicine, fuel, construction supplies and mail will be difficult to deliver.

And roads are not the only things that make communities vulnerable. Most sewage systems, potable-water pipes and natural gas lines run beneath county streets, as do some telephone cables. Where phone and electrical lines are strung above the motorway, the power poles sustaining them require firm ground for support.

Perhaps the most disruptive possible strategy for adapting to sea level rise is planned retreat. That method calls for relocation or surrender of nonessential roads and buildings. It would not be an easy policy to implement, but it could become unavoidable in some areas.

And yet: while the slow progression of sea level rise will undoubtedly change Marin's landscape, the transformation need not be bleak.

Reason for Hope

"What is great is that Marin is ahead of the curve in thinking about this," says Maya Hayden, a senior ecologist and program leader at Point Blue, one of the many conservation groups focusing their efforts on helping the county address environmental threats.

Hayden notes that Marin's planners are not looking to build seawalls, but instead to use nature-based options wherever possible. "They are trying to maintain the natural features and use them to benefit the shoreline as it changes with sea level rise."

Kelly Malinowski, project manager and climate specialist with the Coastal Conservancy, concurs. "The green infrastructure buys us time," she says. Relying solely on "gray" measures such as seawalls or tall earthen levees may seem the easy way, but those hardened structures would be vulnerable to constant wave action and require continual maintenance. Green infrastructure and hybrid strategies, which combine walls and nature-based buffers, encourage benefits like carbon sequestration, habitat enhancement and preservation of a living, aesthetically pleasing seashore.

"No one wants to live in a place with a bunch of walls," Malinowski points out. "We all want to have public access to our bays and beaches despite climate change. And I think that is where Marin's planning is ahead of most counties around the bay."

While many plans and ideas are still in the early stages, the county's ongoing efforts reveal that Marin's officials are not ignoring the potential impact of sea level rise. Instead, they are working to find the best strategies to preserve this unique corner of San Francisco Bay.

Standing at the edge of the marsh where the tide is now rising through the pickleweed shrubs, Siegel sets his hands on his hips and looks across the bay. "Marin is very fortunate to have a community of organizations that are all looking at this issue," he says. "I think, in many ways, the concentration of interest and talent here is remarkable. And that's going to be the bellwether for finding solutions." M

Information Resources

COUNTY OF MARIN
Marin Sea Level Rise webpage
marinslr.org

MARIN MAP
Geographic Information System — interactive data
marinmap.org

POINT BLUE CONSERVATION SCIENCE
Our Coast, Our Future — interactive sea level rise map
data.pointblue.org/apps/ocof/cms

SAN FRANCISCO BAY CONSERVATION & DEVELOPMENT COMMISSION
California state planning and regulatory agency website
bcdc.ca.gov

BAY SHORELINE FLOOD EXPLORER
Data and maps developed by Adapting to Rising Tides, a program of the SF BCDC
explorer. adaptingtorisingtides.org

ELEVATE SAN RAFAEL
resilientbayarea.org/elevate-san-rafael

DRAWDOWN MARIN
drawdownmarin.org

SHORE UP MARIN
shoreupmarin.org

SAN FRANCISCO BAY NATIONAL ESTUARINE RESEARCH RESERVE
sfbaynerr.org

CALIFORNIA STATE COASTAL CONSERVANCY
scc.ca.gov