The Unstoppable Ocean: 10 stories from the edge of Maine

Along Maine's stunning coastline, vulnerable communities wrestle with the inevitable rise of the sea caused by the warming ocean. Aerial photographer Alex MacLean and reporter Kate Cough found that each community has a different strategy to prepare and adapt.

Story By Kate Cough | Photos By Alex MacLean | October 9, 2022. Midcoast locations (with asterisks) flown by Point of View Helicopter Services.

Photo: Point of View Helicopter Services

Alex MacLean

Pilot and photographer Alex MacLean has flown his plane over much of the United States documenting the landscape. His powerful and descriptive images provide clues to understanding the relationship between the natural and constructed environments. MacLean's photographs have been exhibited widely in the United States, Canada, Europe, and Asia, and are found in private, public and university collections. His headshot is courtesy of www.pointofviewhelicopterservices.com .

Our Locations

- Blue Hill *
- Camden *
- Damariscotta *
- Machias
- Portland
- Saco
- South Portland
- Stonington *
- Vinalhaven *
- Wells

Damariscotta plans to build a three-foot seawall along the parking lot to help protect it from storm surge and rising seas. “It’s a huge issue, not only for Damariscotta but for the region generally,” said Isabelle Oechslie, who works as town planner for Boothbay and Damariscotta. Photo by Alex MacLean.

Pulitzer Center

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Click on the icons or list of community names in the map above to read how each of these 10 coastal communities will be impacted by sea level rise. For those unable to click on the icons or names, see the list of towns at the end of the story.

A parking lot that rarely flooded three decades ago, now underwater during storms. A causeway clogged with rockweed after high tide. Brackish water pouring from a tap after the ocean infiltrates a freshwater aquifer.

The seas are rising, and the signs are turning up in communities up and down Maine's thousands of miles of serpentine coastline, from the soft, sandy beaches of Saco and Wells to the sloping pink granite of Stonington and the foreboding bluffs of the Cutler coast.

The ocean has been slowly rising for centuries. But it is the pace that is now alarming, particularly when combined with storms that are more frequent and more intense. The rate of sea level rise more than doubled from 0.06 inches per year throughout most of the 20th century to 0.14 inches annually between 2006 and 2015, according to the National Oceanic and Atmospheric Administration. Meanwhile, high tide flooding is between four and 10 times more frequent than 50 years ago.

In Maine, a single foot of sea level rise (which scientists say will likely happen within the next three decades) will bring 10 times more frequent nuisance flooding and coastal storm impacts, according to the Maine Climate Council.

The council predicts that more than 40 percent of the state's dry beach area (already a rare and precious resource) will disappear with the 1.6 feet of sea level rise expected by 2050, devastating seaside communities that rely on those beaches for recreation and tourism. The group recommends that communities manage for 1.5 feet of rise by 2050 and four feet by 2100.

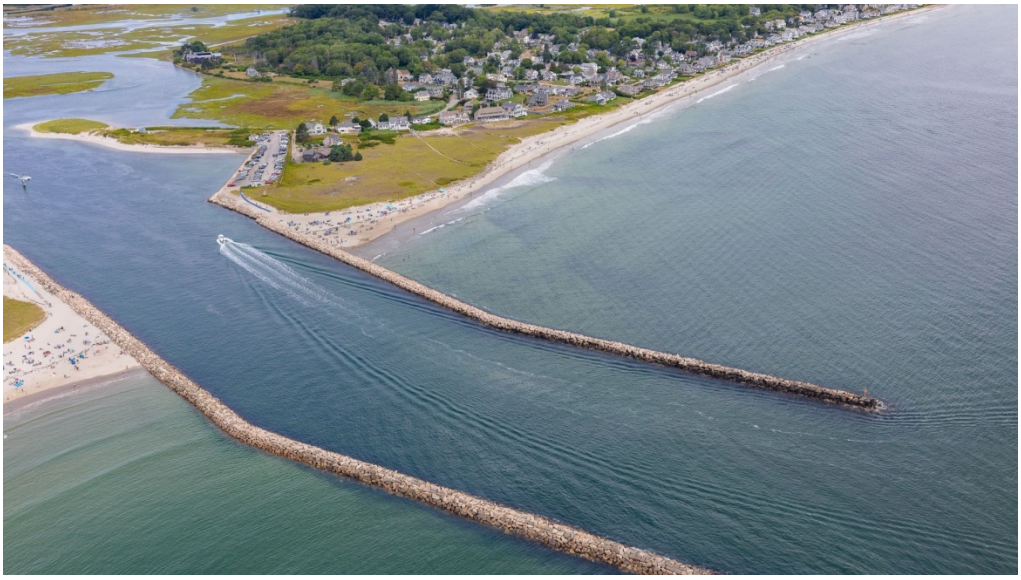
The Maine Climate Council predicts that the 1.6 feet of sea-level rise expected by 2050 will result in the loss of more than a million yearly visitors and $136 million in annual tourism revenue, as popular beach destinations in southern Maine disappear under the waves. Photo by Alex MacLean.

Communities up and down the coast are already being forced to make costly upgrades to vulnerable infrastructure and, in some cases, rethink ways and patterns of life they have had for generations. Livelihoods will be altered, and land and houses lost. Vital habitat and ecosystems, from marshes to sand dunes and eelgrass beds, will be forced to migrate or, stymied by development along the shore, be swallowed by the sea.

The list of options is short, said Peter Slovinsky, the state marine geologist who has studied changes to Maine's coast and coached communities on planning for sea level rise for more than 15 years. "Do nothing, avoid, accommodate, adapt, protect and relocate."

The state's approach has been piecemeal, a "patchwork, kind of like a quilt," said Slovinsky. Until five or 10 years ago there were just a handful of people working on planning for sea level rise. "You only have so many hours in a day and you only have so many places you can put yourself at one time. Something's got to give, and in the past it's usually been planning for climate change."

"It was literally impossible," Slovinsky continued, "for (me) to run around 242 coastal communities and give them a spiel on sea level rise and start the conversation about what to do about it. We still do a lot of that, but one of the biggest changes is there's so many other organizations now involved … that are able to bring a lot of different capacity to the plate, which we just didn't have before."



The jetties at the approach to Wells harbor. Photo by Alex MacLean.

The Governor's Office of Policy Innovation and the Future, created by Gov. Janet Mills shortly after taking office in 2019, has become the organizational lead on many fronts, said Slovinsky. But Maine, unlike some other states, does not have a dedicated office or department for dealing with sea level rise. That's in part because of the state's "networked" regulatory structure, with different agencies and departments playing a role in permitting and planning, said Slovinsky, and in part because Maine is a strong home rule state, with a lot of autonomy ceded to local authorities.

But that patchwork approach means some communities will have more seamless access to the available resources than others.

"It's coming at us faster than they can unroll (the Maine Climate Action Plan)," said Kathleen Billings, town manager of Stonington, referring to a plan unveiled in 2020. "How are we going to be able to get the help as towns and cities? … I can't hire an engineer on staff all the time." A meeting with the Maine Department of Transportation about one of the island's vital causeways — now swamped during high tides and storms — left her frustrated. "I told the group afterwards — do your own planning because you're not going to be able to rely on them."

Slovinsky acknowledged that resources are unevenly distributed. "We still have a lack of capacity at the state level and at some of the regional planning levels to be able to bring the right

amount of technical assistance that's needed by these communities. It's something we're going to continue to struggle with."

The solutions that do emerge will not be simple or cheap, nor will they be the same from one place to the next. Sorting out the knotty web of interests of private property owners and the public, historical enthusiasts and developers, will take time. It will be messy. In the following pages you will find stories of 10 communities grappling with those decisions, trying to figure out how to protect their residents and resources from the ravages of the ocean. Some are building seawalls and raising roads, some are preserving marshland, others are tracking tides.

"A lot of these things are built on the concept of holding the line. We're going to be able to do that for a certain amount of time. When you know when sea level rises, and maybe one or two feet, we'll be able to do that," said Slovinsky. "But once it rises beyond that — " he paused. "It's going to be a challenge."

All featured communities:

Blue Hill: The sea threatens a final resting place

In a 2020 study, a task force identified the Seaside Cemetery as one of the pieces of critical infrastructure in Blue Hill most at risk from rising seas and storm surges.

Story By Kate Cough | Photos By Alex MacLean | October 9, 2022

The Seaside Cemetery in Blue Hill is already experiencing erosion, with several graves at risk. Some will likely need to be moved within the next few years. Photo by Alex MacLean.

The Seaside Cemetery in Blue Hill is a lovely place to spend eternity. Lying just east of a short smattering of downtown shops, the graveyard is perched on a small finger of land reaching out into the tidal flats of Mt. Desert Narrows, overlooking the rocky outcroppings of Sand and Wiley Islands, popular hangouts for harbor seals and their pups.

“It’s a big part of the pace and the rhythm of Blue Hill,” said Brittany Courtot, a schoolteacher and historian, who gives tours of Seaside in the summer and fall. Residents walk dogs there, or come to enjoy the view and the quiet. “It’s kind of got this magical quality to it. It’s so peaceful.”

In a 2020 study, a task force identified Seaside as one of the pieces of critical infrastructure in Blue Hill that’s most at risk from rising seas and storm surges. The shoreline bluff it sits on is soft gravel and dirt. Tides have been nibbling away at the base for decades, and increasingly powerful rain events and storm surges have hastened the erosion of the bluff in recent years.

“There are at least two gravestones that seem, within the next year or two, that we really need to move,” said Ellen Best, who serves as chair of the Blue Hill Select Board. There are between 10 and 15 likely at risk within the next decade, said Best.

The Seaside Cemetery in Blue Hill, established around 1815, sits at the water's edge. Photo by Alex MacLean.

Of the more than 3,500 former Blue Hill residents buried at Seaside, one of the most at risk in the immediate future is the famous pianist and composer Ethelbert Nevin, who built a sprawling Italianate estate in the area and whose family stayed nearby for generations. "He and his wife are buried almost on the edge. It's kind of scary," said Courtot.

Moving a grave can be complicated and expensive, requiring permission from both the municipality and relatives who may have long ago moved away and be difficult to reach. Cemetery budgets are tight, supported by scarce donations and the sale of the occasional plot (the town appropriated just $57,000 for the several cemeteries under its care in 2021), and there is rarely the kind of funding required for anything other than routine maintenance.

In downtown Blue Hill, the town's wastewater treatment facility, fire department, wharf, and a number of roads are at risk. The town is looking at spending roughly $5 million in the next few years to fortify the wastewater treatment plant against sea-level rise, and it will likely need millions more in coming decades. Photo by Alex MacLean.

And despite their cultural and historical significance, it's a hard sell to prioritize the interests of the dead over those of the living. The building housing the Blue Hill Fire Department is already experiencing flooding during high tides and storm surges, as is the town landing, and the wastewater treatment facility sits less than a foot above the highest annual tide, and is already having trouble with outflow when the water is high. The town expects to spend $5 million on fixes for the plant within the next few years, and around $20 million in total to prepare it to last at least a few more decades.

Adapting "any kind of governmental infrastructure is just hugely expensive," said Best. "But we really don't have any choice."

Convincing residents to spend money preserving cultural and historical sites is often much more difficult. But those sites mean something, not just because they provide a connection to an area's heritage, said Courtot. Generations of families are buried there, an important touchstone for children and grandchildren, and even those who don't have family at Seaside get solace from the peace and quiet. "Seaside is pretty central to Blue Hill history and the everyday grind," said Courtot. "It's got this energy to it. It's embedded."

Camden: A waterfront gem threatened

One report found that $16 million worth of Camden's waterfront property would be at risk if the sea level rises one foot.

Story By Kate Cough | Photos By Alex MacLean | October 9, 2022

Camden harbor is one of the most iconic ports in Maine, but much of the historic town infrastructure is already being regularly flooded during high tide. “There’s a tipping point here,” said Alison McKellar, who serves as vice chair of the Camden Select Board. “Even an inch of sea level rise can make a really big difference.” Photo by Alex MacLean.

Camden Harbor is known to sailors on the Maine coast to be two things: one of the prettiest harbors, and one of the most uncomfortable. Curtis Island and the ledges do little to blunt the force of the rollers swinging in to the outer harbor from Penobscot Bay. The earliest inhabitants of the land, the Penobscot, dubbed the harbor *Megunticook*, which translates roughly to “great swells of the sea,” for the immense waves that sweep through during storms.

But it is also this nearness to the sea that gives the town its magic. At high tide, diners cracking lobster shells at one of the wharfside restaurants can reach over the rail and nearly touch the glittering water, and guests aboard any of the numerous elegant sailboats slipped in the inner harbor need amble only a few feet to their berths after indulging in one too many dark n’ stormys.

On a warm and windy afternoon in July, Alison McKellar was standing on the wharf with her nine-year-old son. He was trying to catch pogies — the small, silvery fish often used as lobster bait — using a cast net, which, when held up by its tapered end, looks a bit like a witch’s hat made of soft white mesh.

Spending time by the water, McKellar noticed something that surprised her. Several times a month, the ocean would overtop the granite seawall separating the Megunticook River and Harbor Park, submerging the legs of the picturesque waterfront benches and flooding the parking lot of the harbormaster’s office.

“I kind of became obsessed with it,” said McKellar, who serves as vice chair of the Camden Select Board. She began venturing down to the harbor anytime the tide was high – at night and in the winter, when seas sloshed into parking lots filled with piles of muddy snow. She saw areas where the grass stopped growing because it was too full of salt water. The more time she spent, the more alarmed she grew.

A historic granite seawall along the riverwalk no longer keeps the water at bay and is frequently underwater at high tides. “The granite blocks are constantly sort of sliding in and we have to drag them back,” said Alison McKellar. “But it’s a really difficult thing because it’s an area of Camden that is so historic and widely photographed, and people like it, and they’re used to it — they hear about a plan to do something different or get rid of the benches or let the river run down through there and it sounds crazy.” Photo by Alex MacLean.

Even using the most conservative projections, sea level rise will flood eventually much of Camden’s picturesque waterfront during high tide. Add storm surges and more frequent and intense rainfall events, and the town is facing the potential for millions of dollars in property damage and loss, as well as higher flood- insurance rates and the risk to town infrastructure not designed for saltwater.

A foot and a half of sea level rise would put large swathes of the town’s harbor parking lot, where residents and visitors gather to watch the striking yachts and historic schooners glide in and out of their berths, underwater during annual King Tides. A number of waterfront buildings would also be periodically swamped: a 2017 report by the Watershed School found that $16 million worth of Camden’s waterfront property, accounting for roughly $260,000 in annual property taxes, would be at risk with just a foot of sea level rise.

A one-foot rise is all but certain. State officials have said towns and cities should commit to managing for 1.5 feet of relative sea level rise within the next 30 years, and they recommended preparing for double that. At three feet, $32.8 million worth of coastal property would be at risk of being lost or damaged, along with $528,444 in annual property taxes. Storms could push the water even higher.

Some residents told McKellar she was overreacting. Property owners swore that the kind of dramatic flooding she was seeing happened once, maybe twice a year, and even then it was predicted, the result of a supermoon or a heavy rain. “As if, because it was predicted,” McKellar marveled, “it’s not a problem.”

To prove the skeptics wrong, McKellar began documenting the overflowing tides. They happened monthly, sometimes several times a month. Many occurred at night, without witnesses, so she made it a point to come to the waterfront even after dark, filling her phone with images of the swelling sea.

As she photographed, she talked: to business owners, visitors, diners, sailors, seasonal residents and those who had lived in Camden their whole lives. To McKellar, most people seemed more inconvenienced than concerned.

“I’m sure they would say sea level rise is real and humans are causing it,” said McKellar. “But they somehow think we’re not going to actually need to make any infrastructure changes here.”

One-and-a-half feet of sea level rise would put large swathes of the town's harbor parking lot underwater during annual King Tides. A 2017 report by the Watershed School found that $16 million worth of Camden's waterfront property, accounting for roughly $260,000 in annual property taxes, would be at risk with just a foot of sea level rise. Photo by Alex MacLean.

The conversation is changing, said Town Manager Audra Caler, but translating high-level policy into action is complicated, particularly in such a historic place where development has continued to intensify.

Camden saw a huge influx of new residents during the pandemic, many of whom have been building out properties along the coast, said Caler, even as town officials warned that zoning ordinances do not account for sea level rise. "They're investing in extremely expensive infrastructure that isn't going to hold up in the future." In June, the town put in place a moratorium on all new piers, floats and docks on private property, in an effort to slow development while ordinances are updated.

"It's difficult. It's political," Caler continued. "You have people who, you know, spent a great deal of money acquiring these properties, and now they want to invest in them … It's sort of a hard road to go down for a municipality, even if there's a really good reason to do it, like climate change resiliency."

A proposal to remove a historic dam on the harbor front and replace it with a living seawall is a recent high-profile example. Residents have been arguing over the plans for years, even as granite blocks meant to hold the water at bay have to be periodically dragged back into place after being displaced by storms.

"It's really easy to say that you're supportive of planning for climate change," said Caler. "But when you have to give up your own property rights, or give up a value that you hold dear, or a configuration of a piece of public infrastructure that you find to be appealing or important — that's, that's where it becomes difficult." She paused. "We've got this immediate crisis but we just don't have a system to be able to respond to it quickly enough."

Damariscotta: A road to the hospital imperiled

“Sometimes the rain is damaging enough. We have to close it down and have it come to be assessed by an engineer, and we have had to have work done to it.”

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The view of Damariscotta's downtown. The town plans to build a three-foot seawall along the parking lot to help protect it from storm surge and rising seas. Photo by Alex MacLean.

It’s a long way from the pretty, protected waters of Christmas Cove, a tranquil mooring field at the outlet of the Damariscotta River, to that river’s namesake town, 14 miles north. Those who arrive by boat — after running the gauntlet of lobster buoys and aquaculture gear (the river is one of Maine’s most productive oyster-growing spots) – will eventually reach the twin villages of Newcastle and Damariscotta, former mill and fishing towns that now boast a lively trade in summer tourism.

But the journey upriver is not a long way for the swells of the ocean, which periodically crest up and over Damariscotta’s parking lot and swamp the low-lying Miles Street causeway connecting one of the area’s most vital pieces of infrastructure, the campus of LincolnHealth hospital, to the mainland.

“We pay close attention to (a high tide) if we’re on the outskirts of a hurricane or there are big rains coming,” said Cindy Wade, the hospital’s president, “because it can quickly become a problem.”

In recent years, flooding and storm surge have forced the town to close the main road to the LincolnHealth hospital several times a year. Photo by Alex MacLean.

The sprawling campus, perched on the edge of picturesque Days Cove, houses the typical hospital offerings — emergency room, outpatient services, primary care — as well as a continuum of senior-living facilities. There is another entrance, off Schooner Road, but it’s a smaller, one-lane road, said Wade, more difficult and less direct for emergency vehicles to use. In recent years, with stronger storms and higher tides, the town has been forced to close the main road to the hospital several times a year, and the rising river has been eroding the edges of the causeway.

“Sometimes the rain is damaging enough,” said Wade. “We have to close it down and have it come to be assessed by an engineer, and we have had to have work done to it.”

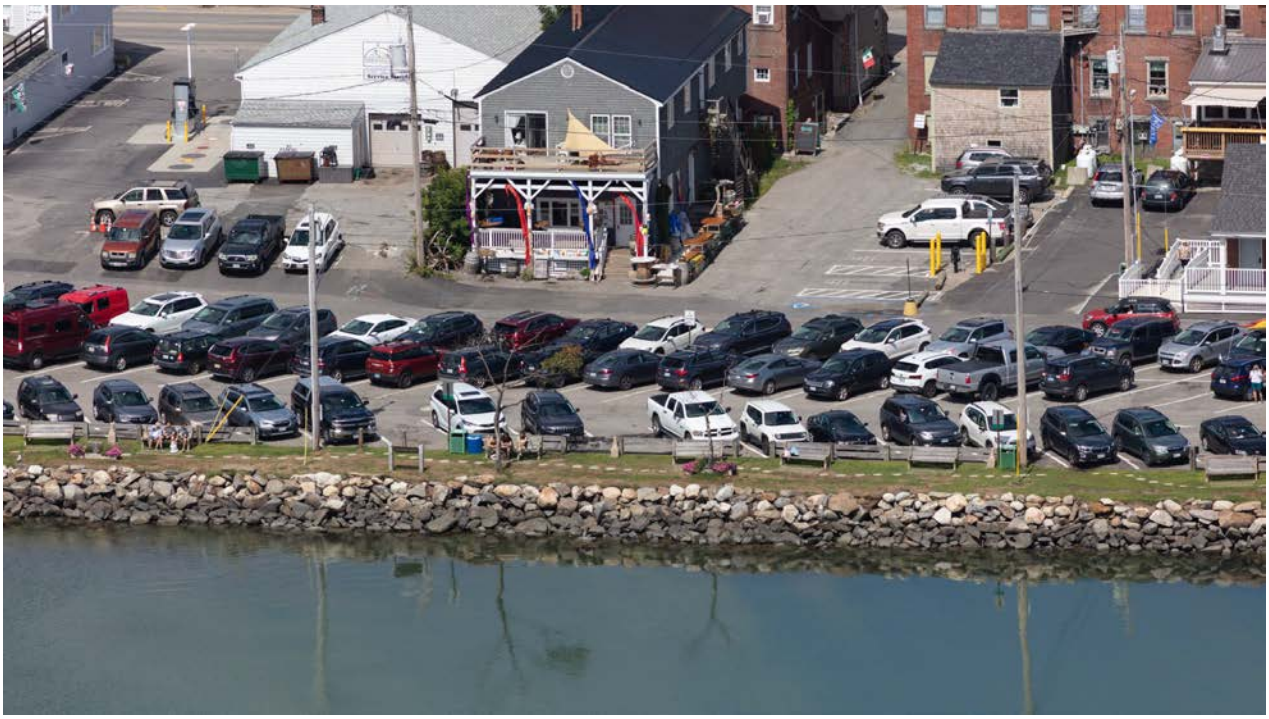
“It’s a huge issue, not only for Damariscotta but for the region generally,” said Isabelle Oechslie, who works as town planner for Boothbay and Damariscotta.

The rising river has already eroded large sections of the Miles Street causeway, enroute to LincolnHealth. Photo by Alex MacLean.

The town and hospital came up with a plan to raise the road a foot higher than its current height, which is already above the 100-year high-tide mark, said Wade. But after a bit more analysis, engineers decided it would be best to raise it two feet to account for sea level rise, storm surges and increased rainfall. The town and hospital have set aside up to $600,000 for the project, which has yet to go to bid.

The hospital isn't the only infrastructure at risk in Damariscotta. High tides during storms already push the river up and over the parking lot downtown and occasionally into the first floors of businesses in the town's most important economic and historic corridor, said Oechslie. Even 14 miles upriver, Damariscotta is one of the most vulnerable towns on the coast to sea level rise, according to a recent adaptation study conducted by state and federal agencies.

Flooding downtown is only expected to get worse in the coming decades. With 3.9 feet of sea level rise, which is expected by the end of the century (if not before) nearly the entire parking lot will be submerged during King Tides. The study advised planning for flooding five feet above the harbor parking lot. That amount of water would inundate sections of Main Street, along with the basements and ground floors of roughly 16 of Damariscotta's 22 historic brick buildings, which are listed on the National Register of Historic Places.



With predicted sea-level rise and storm surge of 1 to 3 feet over the next 50 years, Damariscotta is planning for flooding five feet above the harbor parking lot. Photo by Alex MacLean.

To protect the area, officials have settled instead on building a three-foot seawall along the shoreline. Storm drains also will be replaced with one-way valves, allowing water to flow out but not in.

But implementing the plan is proving more expensive than expected, particularly in the chaotic post-COVID construction era.

“It’s sort of on pause as we continue to seek additional funding,” said Oechslie, and these funds can be especially challenging to access in rural communities. The town had most of the estimated $4.4 million in hand as of last fall and hoped to start construction this spring, but the most recent estimates came in closer to $5 million, forcing the town to hold back. “That’s part of what makes this difficult.”

Stonington: Causeways and fresh water supply at risk

The town risks saltwater intrusion in its wells, and also faces a longer-term threat to the vital roads onto the island.

Story By Kate Cough | Photos By Alex MacLean | October 9, 2022

The Deer Isle Bridge (top right) connects the archipelago to the mainland. The main link between Little Deer Isle and Deer Isle is a half-mile-long causeway that already sees frequent flooding during storms. Photo by Alex MacLean.

Kathleen Billings sees the change mostly clearly in the high tide lines along the ledges encircling Southeast Harbor. “There used to be black lines around the ledges where the tide would be,” said Billings, who serves as town manager for Stonington, and was born and raised in the archipelago. “That is way up underneath the trees now.”

But evidence of sea level rise is everywhere in the chain of islands. A stone walkway that runs along the causeway connecting Deer Isle and Little Deer was once submerged only in storms; now it’s underwater at most high tides. The marsh in Oceanville is also frequently awash in seawater, and the aluminum gangways on the fish piers get “twisted all to pieces,” as Billings put it, in the high spring tides. Storms bring the ocean sloshing up and over the low-lying, half-mile causeway connecting the two main islands, depositing rockweed and stones along the road.

“It’s definitely visible,” said Billings. “It’s definitely evident here.”

The most pressing problem in recent years hasn’t been saltwater but fresh water. With more and more seasonal residents and visitors, and longer periods without rain, Stonington’s aquifers have struggled to keep up with demand. This year the town has been bringing in between four and five truckloads of fresh water each day to satisfy daily demand in the high summer season.

Finding fresh water on any island can be challenging, said Billings, and the problem is likely to get worse as the ocean rises. Stonington draws potable water from aquifers recharged by rain. But because the island is mostly rock, with very little soil to hold and store rainwater, officials must be cautious about how much they pump. If they pump too much, saltwater could seep into the wells, contaminating the supply for years.

The Deer Isle Causeway serves as the primary connection point to Deer Isle and Stonington. “They need to either really need to beef that up, raise it up some or figure out some other means,” said Stonington Town Manager Kathleen Billings, “because [its loss] will change our economy, our businesses and everything that we do here.” Photo by Alex MacLean.

The problem will intensify as the seas creep up from below, approaching the underground fresh water pools. “Basically the freshwater sits on top of the saltwater. The deeper you have to go, the more problems you’re going to have with saltwater intrusion,” said Billings, adding that some shoreside residents are already finding saltwater in their wells.

The town is in the midst of conducting a hydrology study, said Billings, to figure out where it might be able to safely drill another well to accommodate demand. But in the meantime officials are looking for what she described as “low-hanging fruit,” asking residents to cut back on watering lawns or showering numerous times a day and educating homeowners on water-saving measures, like installing low-flow toilets.

Potable water won’t be the only concern, of course. A vulnerability study released in 2021 identified hundreds of businesses and residents that would be cut off from emergency services during various storm surge and sea level rise scenarios, as they are down roads with no other way in or out.

It’s already a long drive down narrow, winding roads from the Stonington Fire Department to many of the island’s residences. The department is a volunteer outfit whose crewmembers hail from all over the island, meaning they, too, could have trouble reporting for duty in the event of a storm. In certain areas, a flooded road would mean emergency crews would be trapped, unable to reach those needing help. Elevating sections of the five highest priority roads would cost around $2 million, although that’s likely a low estimate, given the spiraling costs of construction, said Billings.

Sea level rise could cut off hundreds of businesses and residents from the mainland. Photo by Alex MacLean.

But that's cheaper than doing nothing: The National Institute of Building Sciences has estimated that every $1 invested in pre-disaster risk reduction results in $6 of avoided disaster damage.

In the meantime, while the town looks for funds for adaptation projects and works to rewrite zoning ordinances, it's likely that the bigger challenge will be enticing residents and visitors to shift their behavior to use less water and limit new construction on the picturesque island.

"This island is only so big, and it's only going to be able to stand so much building and water waste," said Billings. "I'm hopeful we get to a point where people understand that you can't waste your natural resources."

Vinalhaven: Changing tides and changing minds

Members of a citizens group take matters into their own hands, measuring tides around the island to gauge the impacts of coastal flooding.

Story By Kate Cough | Photos By Alex MacLean | October 9, 2022

Looking west from downtown Vinalhaven. Photo by Alex MacLean.

The idea that Maine has a longer coastline than its leggy western cousin, California, seems, on its face, ridiculous. But it's true. Sandwiched between Eliot and Eastport lie 3,478 meandering miles, a sandy, craggy mix of inlets and ledges, coves and bays, rivers and creeks. The tide wanders in and out among them, rising against the fjard walls of Somes Sound and rolling over the soft sands of Scarborough Beach.

Yet for all those many miles, there are just five long-term tide gauges collecting historical data, said Gayle Bowness, municipal climate action program manager at the Gulf of Maine Research Institute.

The complexity of the coastline also means that the height of the tide at a particular spot may be higher or lower, or happen an hour later or earlier, than what is predicted by a tide gauge tens of miles away. That's a problem, especially for communities that are designing complicated, expensive infrastructure projects around predictions that may be off by either height or timing.

Fishing boats moored in Vinalhaven Harbor. Photo by Alex MacLean.

A few years ago, the Vinalhaven Sea Level Rise Committee set out to solve the problem with a citizen science project. It was obvious that areas of the island were flooding more often than in the past during high tides and storm surges. But just how often, and by how much? Were the tides higher or lower than the predictions made by the nearest tide gauge, in Bar Harbor, several bays away?

The committee, a mix of seasonal and year-round residents, chose seven locations around the island that were particularly susceptible to the impacts of coastal flooding. They focused on those places that were associated with critical infrastructure, like the ferry that provides a lifeline to the mainland, and that could be safely accessed by volunteers, who would eventually be driving or walking to them during high tides, often in the middle of the night, to collect data.

Looking to the North Carolina King Tides Project for inspiration, the committee calculated the mean high-water level (the average of all the high-water heights measured from 1983 to 2001, according to the National Oceanic and Atmospheric Administration) for each chosen location. That would be the “zero point.” Then members pasted printed decals — essentially giant rulers, marked in one-inch increments — to PVC boards. The giant rulers, installed in September 2020, allow for measuring tides up to six feet above mean high water.

The ferry, the primary link to the mainland, is periodically canceled when storm surge and high tide make it difficult to get off the boat. “When the tide’s too high, they just can’t get [the ramp] to land on the deck of the boat,” said Margaret Qualey, a longtime resident whose husband formerly captained the ferry. Photo by Alex MacLean.

After carefully marking the zero point at each chosen location, volunteer “TideTrackers’” used stainless-steel screws to affix the gauges to pilings and utility poles around town. In the meantime, the Knox County Emergency Management Agency set up a platform for data collection using the ArcGIS Survey 123 app, which would allow the TideTrackers to easily submit photos, tide data, weather observations and other information.

“We wanted to see what our actual data was and the change over time,” said Margaret Qualey, who moved to the island with her husband in 1996 when he took a job as the ferry captain.

Seeing trends in the data will take years, said Qualey. In the meantime, the committee hopes the project will engage local residents and students in “citizen science” and make changes more readily visible. Some summer residents, for instance, may not realize that the downtown parking lot floods during high tides and spring storms, said Qualey. Photos taken by TideTrackers can easily convince those skeptics. “It’s the social impact of getting people to even talk about it,” said Qualey.

Even in the short time since the gauges have been installed, the TideTrackers have found that tides in some areas are quite different than what’s predicted. “Tides in different areas can be an hour after predicted tide,” said Qualey, “because the water has to go up a cove and around the corner. So it’s been sort of very enlightening that way.” Accurate information is vital for a community that lives by the tides and the weather, she added.

Sections of Main Street could become impassable by 2050 unless the town takes adaptation or relocation measures. Photo by Alex MacLean.

Accurate data is also essential not only in planning for infrastructure to manage sea level rise but for convincing state and federal agencies to fund those projects, said Hannah Baranes, a postdoctoral researcher at the Gulf of Maine Research Institute. She's working on a project she hopes will help communities better predict tides and flooding up and down the coast.

"To really get good, spatially continuous information on flooding," said Baranes, "you need to have a really dense distribution of tide gauges, which we really don't have right now."

Even in Portland, which has a historical tide gauge, said Baranes, tides and flooding often look very different than predictions, depending on where you're standing. Tides in Back Cove, for instance, may be different than predicted for the Ocean Gateway pier.

"If it's hands on and you go out and you can actually see it for yourself," said Qualey, "It somehow has a bigger effect on you."