MORRO BAY
NATIONAL ESTUARY PROGRAM

# STATE OF THE BAY | 2026

*A report on the health of the Morro Bay Estuary*

# How healthy are the estuary and the lands that surround it?

Morro Bay is a unique area on California's Central Coast where fresh water from our creeks joins with the salty waters of the ocean to form an estuary, an ecologically rich area that supports abundant eelgrass beds, a thriving shellfish farming industry, and a bustling tourist destination that draws visitors from around the world.

The Morro Bay National Estuary Program is a local nonprofit that works to protect and restore Morro Bay and the lands that surround it for people and wildlife.

For thirty years, the program has conducted monitoring, restoration, and education efforts in collaboration with the community, government, nonprofits, and landowners. We work to preserve natural habitats while maintaining balanced uses of the bay.

Every three years, the Estuary Program creates a State of the Bay Report centered around some of the common questions we get about the health of the estuary and watershed.

## Questions Answered in This Report



*The Black Hill trail in Morro Bay State Park overlooks the Morro Bay tidal marsh. Photo courtesy of Marlin Harms.*

## Authored by Estuary Program staff


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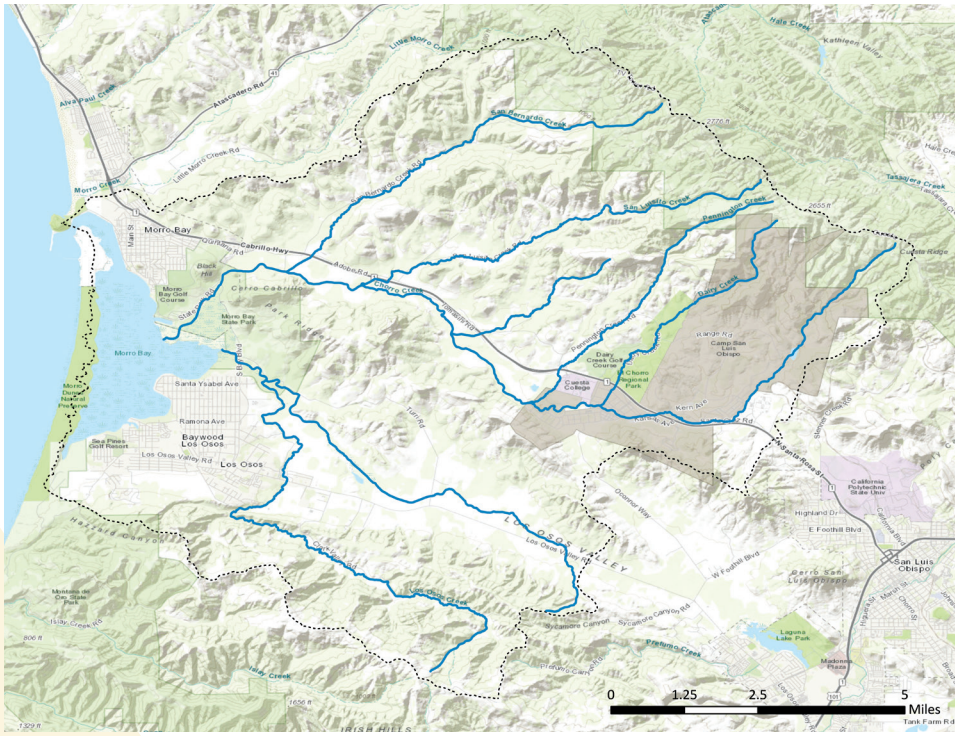
The Estuary Program sincerely thanks its many partners, volunteers, and committee members for their dedication to the Morro Bay estuary and their continued support. This report was funded in part by a grant from the U.S. EPA.


*Cover photo by Mike Jones, @AzHiAzIaM*

## The Morro Bay Estuary and its Watershed


Creeks

Watershed Boundary

The Morro Bay watershed contains a network of creeks that drain rainfall and other fresh water from 48,000 acres of land into Morro Bay. Fresh water from the land meets with salty water from the ocean to create a unique environment called an estuary. This connection between the land and the estuary means that what happens on the land has a large impact on the health of the bay.

## How to Read Estuary Health Symbols

The Estuary Health Symbols represent how the status of each question is changing over time. A round symbol indicates that the trend is stable. An up arrow (⇧) indicates an improving trend, while a down arrow indicates a worsening trend (⇩). The color of the rectangular base of the arrow indicates the status of historical data and the color of the point of the arrow indicates the status of the newer data. The color of the symbol indicates the status as follows: Good/Very Good (green), Fair (yellow), Poor (orange), Very Poor (red), and Unknown (gray).

This symbol indicates that the water quality was Very Poor and has improved to Poor.

This symbol indicates that the trend is stable but we lack adequate data to assign a quality indicator.

**Very Good/Good**

**Fair**

**Poor**

**Very Poor**

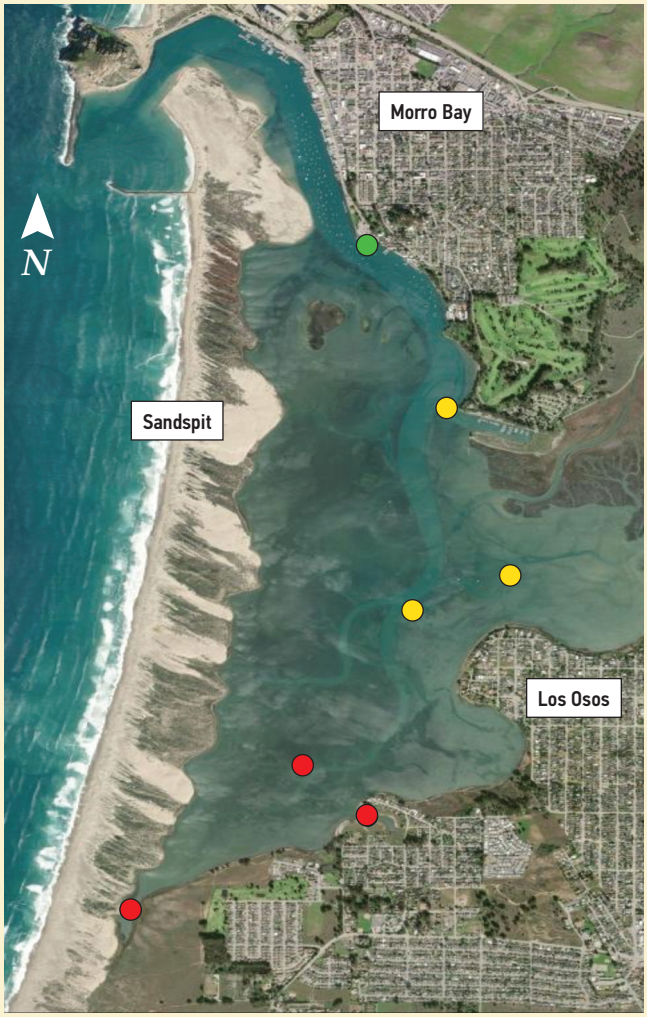
# Is water in the creeks and bay clean enough for fish and aquatic life?

## Some areas are healthy and others are degraded.

Fish and aquatic life require clean waters that have adequate oxygen and are free of pollutants. To better understand whether the waters of the bay and creeks support the most sensitive wildlife, Estuary Program staff and our dedicated volunteers conduct ongoing monitoring of oxygen levels, nitrate pollution, and creek health indicators.

- Bay Dissolved Oxygen
- Nitrates for Chorro Creek
- Creek Health

## Bay Oxygen Status



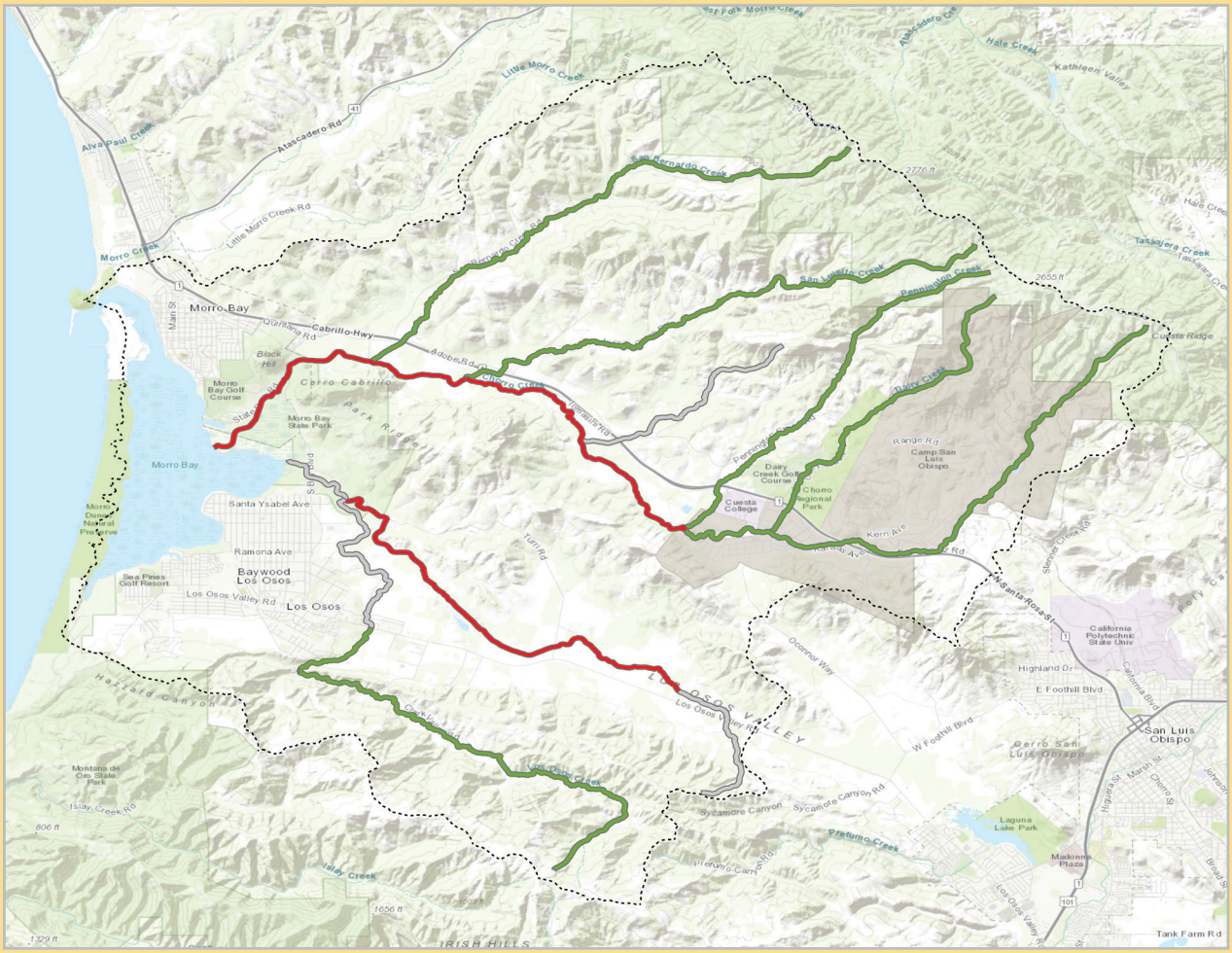

The waters of the Morro Bay estuary are home to fish, invertebrates, and other types of aquatic life, many of which require oxygen to thrive. To better understand the health of the bay, Estuary Program volunteers kayak out in the early morning hours to measure the lowest oxygen levels of the day at seven bay sites. This monitoring effort has been conducted for over 20 years, and the data consistently shows a trend of decreasing oxygen as you move from the front bay to the back bay. The deeper waters of the front bay easily mix with the cold, well-oxygenated water pushed in from the ocean by incoming tides. Conversely in the back bay, the shallow waters limit tidal mixing, leading to lower oxygen levels. Although lower than ideal, baywide oxygen levels have remained relatively stable over time. While conditions remain Very Poor at the furthest back bay sites, data indicate significant improvements in oxygen levels at the Sharks Inlet and Cuesta Inlet sites.

### Bay Oxygen Status

- Very Good/Good
- Fair
- Poor
- Very Poor

## Nitrates in the Watershed

Reports of algal blooms are becoming more frequent, with some of these blooms producing toxins harmful to people and animals. While these blooms can be influenced by factors like water temperature and currents, excess nutrients such as nitrates can also drive them. Nitrates can come from sources like agricultural and residential fertilizing, stormwater runoff, and wastewater treatment plants. Even if a bloom is not toxic, excess algae growth can crowd out beneficial plants and deplete oxygen from the water, making it harder for fish and other aquatic life to survive. Tracking nitrate levels in our local creeks is essential for understanding overall creek health.




The map shows an analysis of nitrate concentrations for creek segments throughout the Morro Bay watershed. Data indicate that Upper Los Osos Creek, Upper Chorro Creek, and the creeks that drain into Chorro Creek (Dairy, Pennington, San Bernardo, and San Luisito Creeks) have low, or Good, levels of nitrates, which supports a healthier aquatic environment. Middle and Lower Chorro Creek and Warden Creek score Very Poor for nitrate levels, although Chorro Creek has shown a marked improvement over time. High nitrate concentrations can cause imbalances in the water quality, resulting in low oxygen levels that can harm sensitive wildlife like steelhead trout. Grayed-out creek segments indicate areas without enough data for assessment.

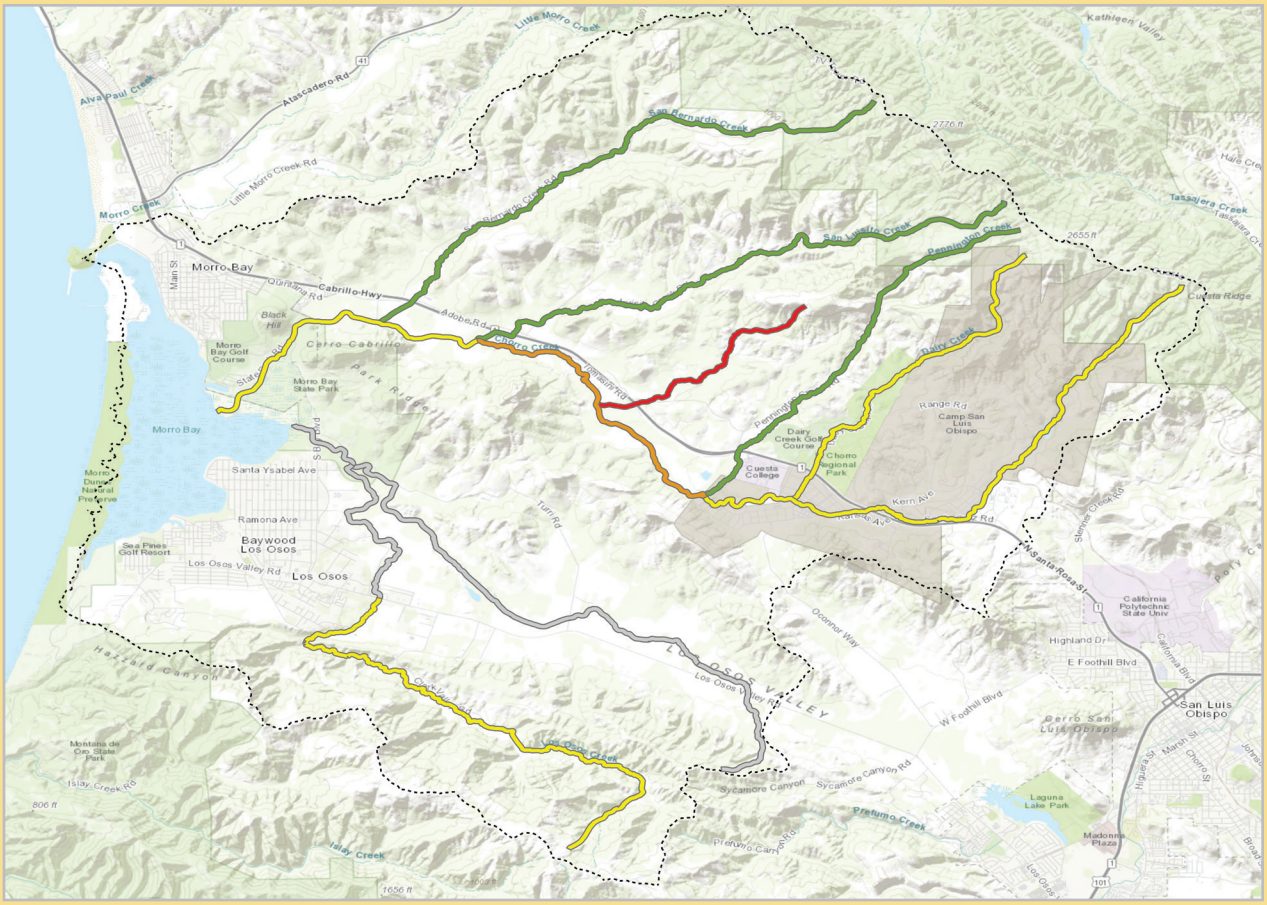
**Nitrate Status**

- Very Good/Good
- Fair
- Poor
- Very Poor
- Unknown
- Watershed Boundary

## Creek Health in the Watershed

***Trend status: Scores remain stable. No scores were available from areas that we suspect are heavily impacted (shown in gray).***

Water quality data help us understand whether a creek can support aquatic life. Another way to assess this is by monitoring the organisms living in the creek. By collecting and analyzing the macroinvertebrates (animals without a backbone that you can see with the naked eye) living in a creek, we can determine whether the habitat is suitable for sensitive species like steelhead trout. Some macroinvertebrate species are sensitive to pollution and will thrive only in clean waters, while others can tolerate very poor water quality conditions. Creeks with more pollution-sensitive species typically provide better habitat for aquatic life than creeks with more pollution-tolerant species.




The map illustrates the average health scores for each creek or stretch of creek in the Morro Bay watershed, using data going back nearly 30 years. The creek segments colored green have Good scores, meaning they have higher quality habitat that can support sensitive species of macroinvertebrates. Sections of creeks colored red have scored as Very Poor, meaning that the creek may not be able to support any sensitive macroinvertebrates. Factors such as water levels, water quality, plant cover, and sediment in the creek can influence habitat quality.

## Creek Health Recovery After Winter 2023

Storm events can play an important role for creek-dwelling macroinvertebrates since high-intensity storms and flooding can alter habitat conditions, making it challenging for sensitive species to thrive. Following the large storms of January 2023, creek health scores in the Morro Bay watershed indicated high levels of disturbance, especially in the tributaries of Pennington, San Bernardo, and Dairy Creeks. The series of photos below illustrates how the storms of January 2023 affected Pennington Creek. The high flows caused severe bank erosion and stripped away vegetation. By 2024, many of these sites were on the rebound, with Pennington, San Bernardo, and Dairy Creek scores improving by 50% or more. These improvements indicate a relatively quick recovery of sensitive macroinvertebrate species in these tributaries, despite the severe impacts of the 2023 storms.



*These photos show the same site on Pennington Creek before and after the large storms of early January 2023.*

## How We Monitor Creek Health

Each spring we collect macroinvertebrates and take measurements of the habitat to determine whether the creek would support sensitive species.


*To collect macroinvertebrate samples, we scrub the rocks and stir up the sediment on the creek bottom. This releases the macroinvertebrate larvae which drift with the current into our net.*

*After collecting our sample, we empty the contents of the net into a sieve to sort out the sticks, rocks, and leaves. The macroinvertebrates are then preserved and sent to a taxonomy lab for identification and counting. This sample from Dairy Creek contains a large stonefly larva, a species that typically indicates good water quality for sensitive aquatic life.*

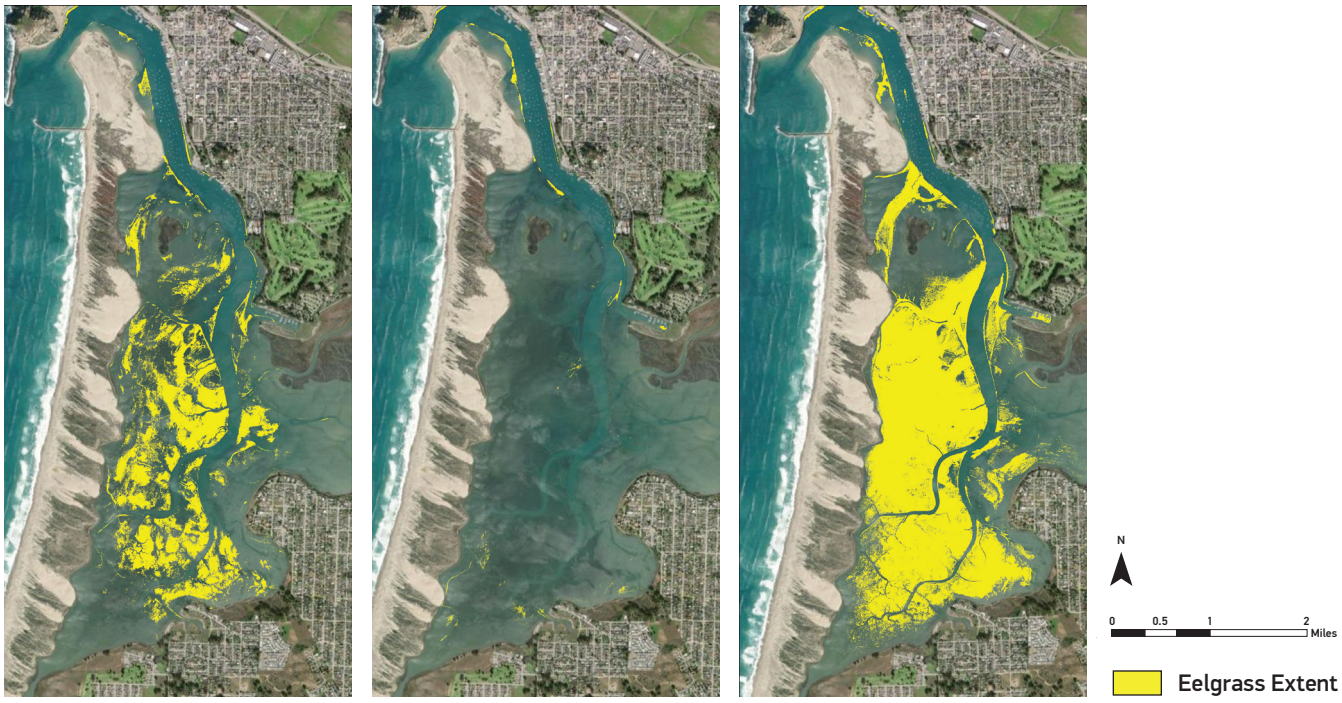
# Does Morro Bay support healthy eelgrass beds?

## Yes, the amount of eelgrass in the bay has increased rapidly over the last few years, with acreage surpassing pre-decline levels and likely exceeding the maximum levels that can be sustainably supported in the bay.

If you've spent any time on the bay lately, you've seen the long blades of eelgrass that are now abundant in our waters. This seagrass puts down roots in the bay floor, helping to reduce erosion and improve water quality. This plant also sequesters carbon and serves as habitat and a food source for wildlife. After the near total loss of eelgrass in Morro Bay, its current abundance is remarkable.

For over two decades, the Estuary Program has worked with partners to study and monitor eelgrass. Mapping efforts indicated an increase from just 13 acres in 2017 to 750 acres in 2023. The reasons for the decline and rapid recovery are complex and likely include many factors such as changes in water quality and elevation. The 2023 acreage likely exceeds what the bay can sustain long-term, and future maps are expected to show a slight decline to a more sustainable level.

## Eelgrass Acreage: 2007, 2017, and 2023




Fall 2007 (344 acres) | Fall 2017 (13 acres) | Spring 2023 (750 acres)

This series of maps clearly illustrates the large swings in eelgrass acreage (shown in yellow) observed in Morro Bay. Eelgrass acreage declined from 344 acres in 2007 to only 13 acres in 2017. Around this time, small patches of eelgrass began appearing in areas that had experienced loss. Eelgrass has been steadily increasing since then, with 750 acres mapped in 2023.

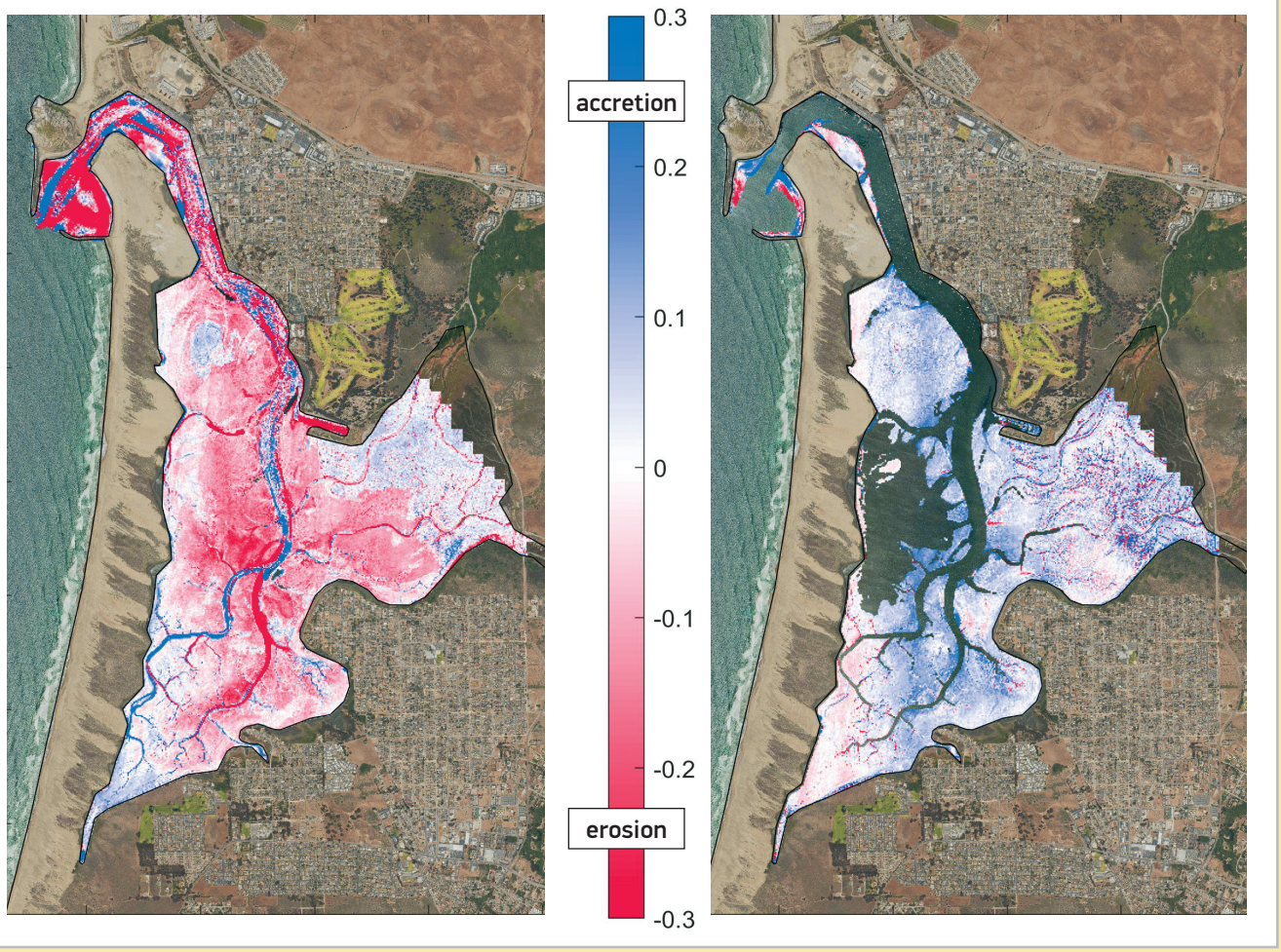
## Bay Elevation and Eelgrass

The Estuary Program partnered with Dr. Ryan Walter of Cal Poly's Physics Department to better understand the relationship between eelgrass and bay-elevation change. The figure on the left shows the differences in elevation from 2010 (pre-eelgrass decline) to 2019 (during eelgrass recovery). Following eelgrass loss, the areas shown in red indicate where erosion occurred and the bay floor became deeper. This is a common result of eelgrass loss since the plant's root structure stabilizes sediment on the bay floor, and the floating eelgrass blades help dampen the erosive effects of the currents and waves. This analysis showed erosion occurring at over 90% of the locations where eelgrass was lost.

It's possible that the erosion and deepening of large areas that had previously supported eelgrass was key in driving the plant's recovery. Eelgrass thrives in a "Goldilocks" depth range. If the waters are too deep, the plants can't get enough light for photosynthesis. But if the waters are too shallow, eelgrass may dry out when exposed at low tides. It is possible that the erosion and subsequent deepening returned parts of the bay to the right depth for eelgrass to survive and thrive. In areas where eelgrass returned to the bay, the analysis from 2019 to 2022 (illustrated in the figure on the right) shows that these parts of the bay (shown in blue) trapped sediment (became shallower) since eelgrass was once again stabilizing the bay floor.

**2010 to 2019 elevation change (m)**

**2019 to 2022 elevation change (m)**



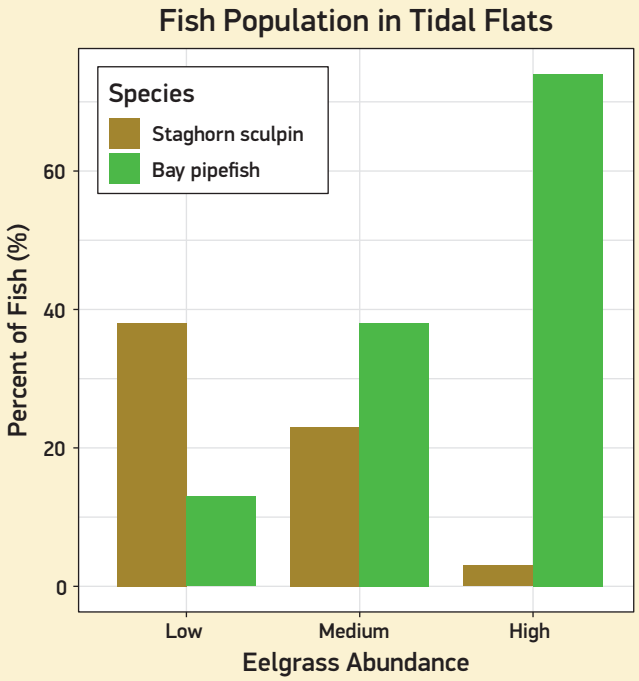

*This data is meant to be informational and should not be used for navigational, regulatory, or decision-making purposes.*

# Bay Fish Populations Shift with Eelgrass Abundance

Morro Bay's eelgrass beds provide essential shelter and nursery grounds for many species of fish. Monitoring efforts have assessed fish communities at different stages of eelgrass abundance, illustrating how fish species respond to changes in habitat. In 2006 and 2007, Dr. John Stephens of Occidental College conducted a baywide fish study when eelgrass covered approximately 344 acres of the bay. Nearly a decade later, Dr. Jennifer O'Leary of Cal Poly repeated this work when eelgrass had declined to only 13 acres. In 2023 and 2024, the Estuary Program completed similar monitoring when eelgrass was at a record high of nearly 750 acres.

During the most recent monitoring effort, over 8,000 fish representing 24 unique species were sampled near the shoreline, within the intertidal flats, and in Morro Bay's open channels. Bay pipefish, a slender green fish that resembles eelgrass, were the most abundant species. In contrast, during periods of low eelgrass acreage, species that prefer bare mud and sand, like speckled sanddab and staghorn sculpin, were much more common. These results highlight how eelgrass coverage has a direct influence on fish communities.

*Bay pipefish are long, green, slender fish. Their unique appearance allows them to blend in with eelgrass. Our surveys showed that these fish were more abundant during times of high eelgrass acreage.*




The graph shows the percent of two types of fish captured within tidal flats where eelgrass tends to grow. In times of low eelgrass abundance, species like staghorn sculpin that prefer bare mud and sand were dominant. In contrast, during times of high eelgrass abundance, species like bay pipefish that prefer eelgrass habitat were more prevalent.

*During 2023 and 2024, fish were sampled from Morro Bay's shoreline, intertidal flats, and open channels. For shoreline locations, like the one pictured above, nets called beach seines were used to collect fish. All fish collected during the study were identified, measured, and then safely released.*

# Is Morro Bay safe for swimming?

## Yes, most of the time in the locations we test.

Morro Bay is a jewel of the Central Coast, attracting residents and visitors for sailing, paddling, and swimming. These activities are a big part of what makes the bay special, but they can only be enjoyed safely when the water is clean. Pollutants like bacteria, viruses, and protozoa can cause illnesses in people and wildlife. Potential sources of these pollutants are pets, stormwater runoff, wildlife, wastewater spills, or boat waste holding tanks that are not operated properly.

For nearly 20 years, Estuary Program staff and volunteers have ventured out to the bay each month to monitor for indicator bacteria, which are microorganisms that indicate whether fecal contamination may be present. This long-term record helps us track trends in water quality and potential impacts on bay uses such as recreation and shellfish farming.

### A Healthy and Active Estuary: Monitoring Bay Use

In 2023, the Estuary Program began tracking recreational use at eight popular coastal-access sites on the bay. Cal Poly students and community volunteers conducted surveys to track how much time visitors spent and the main recreational activities they engaged in at each site. This information can be used to estimate each site's economic value and to track how bay use changes over time. When paired with water quality and site condition data, this information can indicate how people's use of the bay shifts with changing conditions and help us prioritize restoration for popular access sites.

*Coleman Beach is a popular recreation location in Morro Bay.*


This map shows the eight sites where the Estuary Program has monitored water quality monthly from 2005 through 2024. The green color of the circles indicates that bacteria levels are low and that these sites are typically safe for swimming. However, runoff from a storm can carry pollutants including bacteria into the bay, so public health officials recommend staying out of the water for 72 hours following a storm.

**Bay Bacteria Status**

- Very Good/Good
- Fair
- Poor
- Very Poor

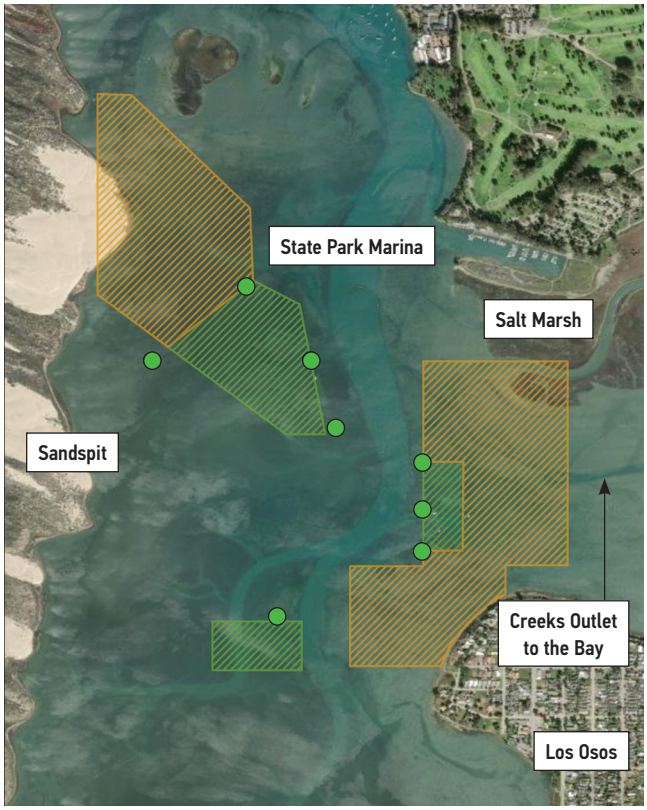
# Is the bay clean enough to support commercial shellfish farming?

## Yes, in active harvesting areas.

The tranquil waters of the Morro Bay estuary support a thriving aquaculture industry. The Morro Bay Oyster Company and Grassy Bar Oyster Company provide Pacific oysters to restaurants and grocery stores locally and beyond. Oysters spend about 12 to 18 months in the waters of Morro Bay before reaching market size. The California Department of Public Health oversees testing to ensure shellfish growing waters remain clean and safe.

The crosshatched portions of the map illustrate the lease areas where shellfish farming could potentially occur. Areas shown in green undergo ongoing water quality testing for bacteria to determine if the waters are clean enough for shellfish harvesting. All active shellfish farming operations occur within these areas. Orange areas indicate either historically poor water quality or insufficient data to assess conditions.

### Morro Bay Shellfish Growing Areas




*In Morro Bay, oysters are grown in mesh bags. If left undisturbed, oysters will grow in clumps. Traditionally, oyster farmers had to manually shake the bags to separate the shellfish. Instead of doing this by hand, oyster farmers in Morro Bay now use a clever method that lets the tides do this work. They string the oyster bags up on cables that are secured to posts anchored in the bottom of the bay. During low tides, the bags hang from the cables, but during high tides, floats on the bags rise and tip the oysters to the bottom of the bag. This periodic mixing of the oysters by the tides saves many hours of human labor.*

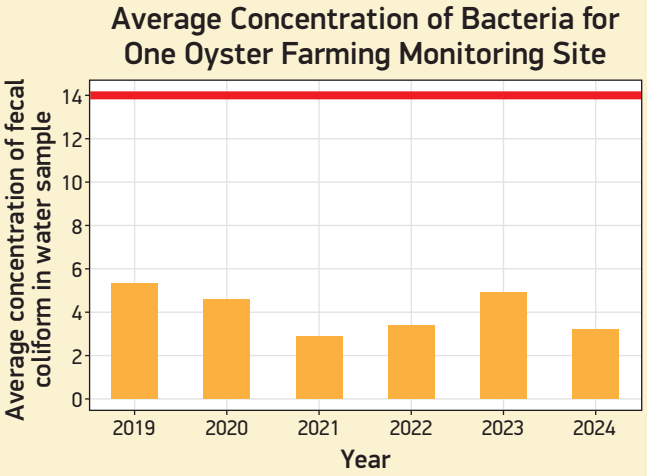
**Bacteria (Fecal Coliform) Status**

- Good
- Poor

**Shellfish Lease Status**

- Active Growing Area
- Inactive Growing Area

## Water Quality Data by Year

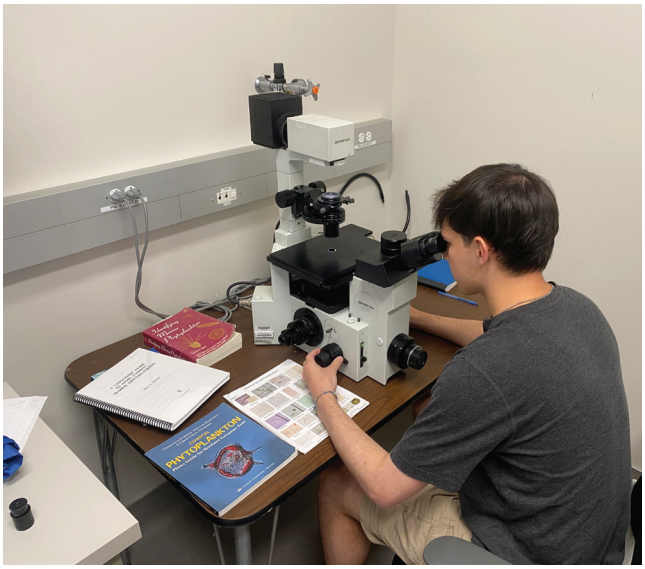



The graph shows the average bacteria levels in the water for each year at one of the monitoring sites shown on the oyster growing areas map. The bacteria levels must remain below the regulatory threshold (represented by the red line) for the shellfish to be safe for consumption. Bacteria levels at this site, as well as all sites pictured on the map, have been consistently safe over the last six years.

## Shellfish Farming Research Partnerships

Our partners at Cal Poly are leading multiple research efforts to support shellfish farming. Dr. Alexis Pasulka of the Biology Department works with the Estuary Program and our volunteers to collect bay water samples for phytoplankton identification and genetic analysis. Dr. Pasulka's research seeks to improve understanding of the factors driving harmful algal blooms to better predict the appearance of plankton species that can impact shellfish farms.

Dr. Kevin Johnson of the Biology Department and California Sea Grant is working to better understand the presence of native Olympia oysters (*Ostrea lurida*) in the bay. Once abundant, no Olympia oysters were found during surveys in 2009. More recent surveys identified Olympia oysters throughout the bay, and research now focuses on where and when reproduction occurs. A better understanding of their life cycle will guide restoration efforts to support recovery of this native species.




*A student examines a water sample to identify the plankton it contains. Certain species produce biotoxins that can harm wildlife, including shellfish growing at local farms, and people.*

*A graduate student places tiles in the bay where larvae of different marine animals, including Olympia oysters, will attach and grow. Photo courtesy of Kevin M. Johnson.*

# Do the estuary and watershed support a healthy population of steelhead?

## No, the local steelhead population continues to be threatened even with some habitat improvement.

The Morro Bay watershed is home to a unique species called steelhead trout (*Oncorhynchus mykiss*). These fish are born in freshwater streams like Chorro Creek. Some of these fish spend their entire lives in the creek and are known as resident rainbow trout. Others, known as steelhead, spend a few years in fresh water and estuarine environments before journeying to the ocean. Whether a fish becomes a steelhead trout or remains a resident rainbow trout depends on genetic and environmental factors.

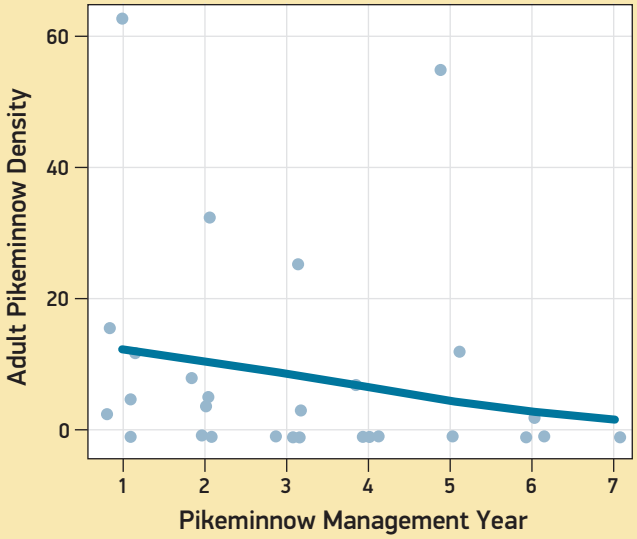
Steelhead require healthy creeks, estuaries, and ocean habitats throughout their life cycle. The Estuary Program works to protect creek habitat, water quantity, and water quality to benefit this threatened fish population.

*A juvenile steelhead trout swims along a creek bed in Los Osos Creek. Steelhead require clear, clean water to thrive.*

There are many environmental variables that can affect steelhead populations, like warming temperatures, available habitat, and the amount of water in creeks. The Estuary Program and our partners work to address as many of these factors as we can, and reducing the population of predators is one way we can help support our watershed's steelhead.

## Protecting Native Steelhead from Invasive Predators

Sacramento pikeminnow (*Ptychlocheilus grandis*) are invasive fish that compete with the steelhead in our watershed for habitat and food. Adult pikeminnow also consume juvenile steelhead. In 2017, we began pikeminnow management efforts to remove them from our creeks to support steelhead recovery. Our early work indicated that removing one pikeminnow can protect around 150 to 200 juvenile steelhead annually.




The dots on the graph show the density of adult pikeminnow (number of fish in a stretch of creek) at different Chorro Creek sites since our management efforts began in 2017. The solid line shows the decreasing trend in adult pikeminnow density after several years of suppression. The analysis indicates that with more years of pikeminnow removal, it becomes increasingly unlikely to find large pikeminnow at a site.

## Tracking Steelhead Growth and Movement

We recently completed a steelhead tracking study over two years of spawning seasons to monitor the growth and movement of steelhead to support our understanding of how and when these fish migrate between our creeks, the estuary, and the ocean. This helps us identify times of year when fish need enough water flowing through creeks to migrate and when we should avoid certain activities that might interfere with their movement.

*The method used to track fish for the project is called mark-recapture. Backpack electrofishers were used to temporarily stun and capture fish to be weighed and measured.*


*During initial capture, steelhead of sufficient size were anesthetized, implanted with a Passive Integrated Transponder (PIT) tag, and returned to the creek. These tags are small microchips that uniquely identify each fish, similar to the microchips used for dogs and cats.*

*As tagged fish move through the creeks and into the estuary, we monitor their movements with stationary PIT-tag antennas in lower Chorro Creek. This special type of antenna stretches across the creek so that fish can easily swim over it. As fish pass by it, their unique identifiers are recorded. If tagged fish were recaptured during the study period, we weighed and measured them to track their growth.*

A total of 1,225 steelhead trout were captured during the study, and 870 were large enough to tag. Of the 201 tagged fish detected at the antennas, nearly 60% were likely resident trout that would spend their entire lifespan in the creeks. The remaining 81 were fish that moved into the estuary to smolt (transition from freshwater to saltwater habitat), a process that occurred primarily between January and April. Most of these smolts left the creeks and did not return, while a handful moved back and forth between Chorro Creek and the estuary.

This study provided fascinating new information, and we hope to expand the effort to better understand how steelhead utilize other freshwater tributaries like San Bernardo, Pennington, and Dairy Creeks.

*This illustration shows two forms of a steelhead trout as it prepares for life in the ocean in a process known as smolting. As the fish move from freshwater to saltwater habitats, they lose their speckled appearance and dark spots (above) and become more silver (below), a change that allows for better camouflage in the estuary and ocean. Illustrations by Catie Michel.*

## Are the bay and creeks impacted by accelerated sedimentation?

**Yes. Analysis shows that large storm events can greatly alter and degrade creek habitat for sensitive species like steelhead. Sedimentation impacts are more complex in the estuary, where sea level rise could outpace marsh elevation increases, resulting in major shifts in habitat.**

The movement of sediment is a naturally occurring process in a watershed like Morro Bay. Erosion of stream banks and nearby lands can benefit habitat diversity by creating gravel bars that support steelhead or by forming sandbars that plants can colonize. However, excess erosion from events like intense rainfall after wildfire can have negative impacts on habitat by degrading water quality, clogging stream beds, and smothering eelgrass in the bay.

The Estuary Program works with partners to manage erosion and other causes of sedimentation that threaten the health of the creeks and estuary. Another factor to consider with sediment is its relationship to shifts in sea level. Rising waters across the globe present an emerging challenge to tidal marsh habitats like those in the Morro Bay estuary that are vulnerable to inundation. Although these areas increase in elevation as sediment from the watershed washes down Chorro and Los Osos Creeks and settles there, rising seas will eventually outpace this natural process. If marsh areas are continually inundated with water, analysis indicates that the plant and animal communities present in the marsh today will be replaced by plants and animals that can survive in mudflats by the end of the century. While both habitats have value, this would represent a loss of the estuary's unique and fragile tidal marsh ecosystem.

### Monitoring Elevation Change in the Morro Bay Salt Marsh: 2013 to 2025

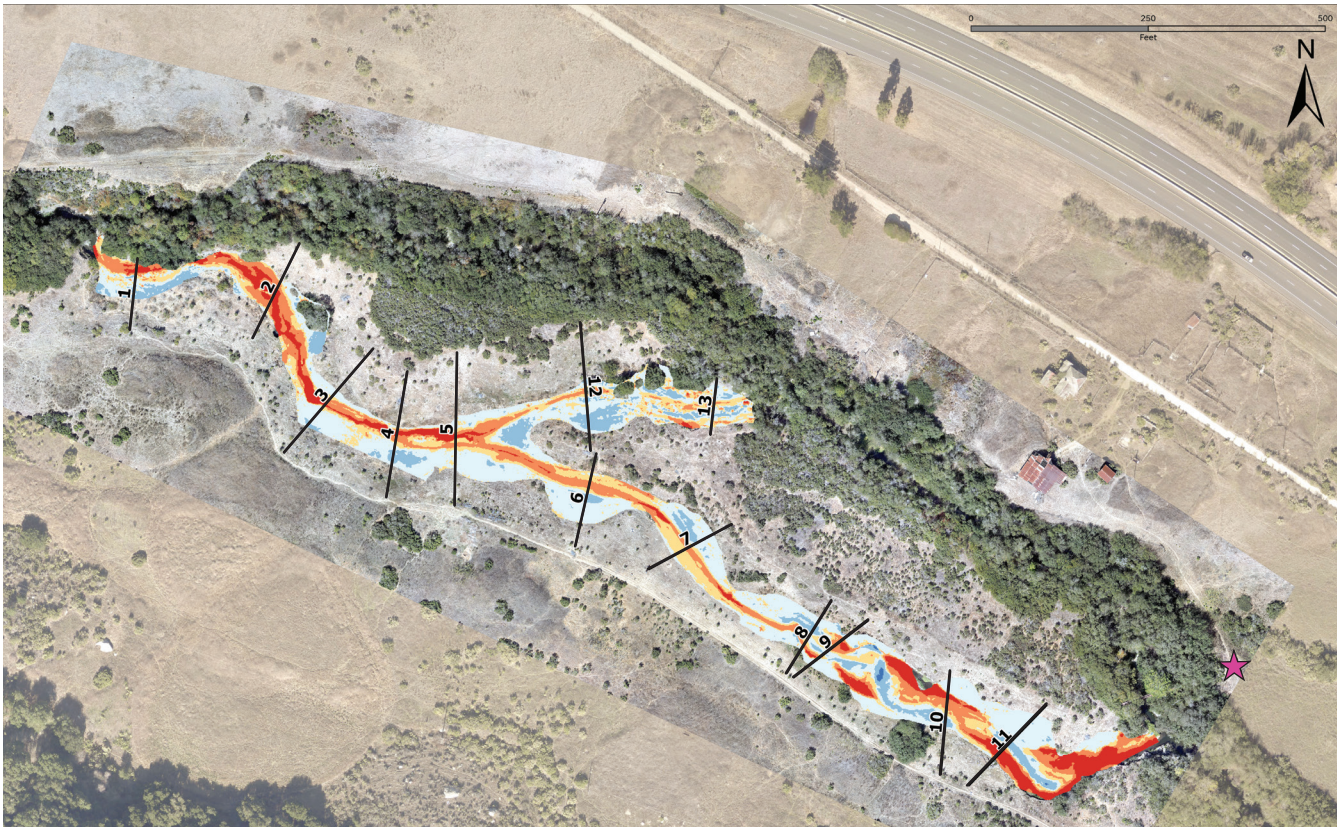
To track marsh elevation changes over time, the U.S. Geological Survey (USGS) monitors four sites in Morro Bay. This map shows the increase in marsh elevation at each site since 2013. Historical data indicates annual increases averaging 1.59 mm in the high marsh and 1.98 mm in the low marsh, enough to keep pace with the current rates of sea level rise. But if the rates of rising waters increase as they are projected to do, areas like Morro Bay's marsh habitat will flood more often and could eventually transition to mudflats or open water. The Estuary Program is working with USGS to develop adaptation strategies to reduce habitat loss and coastal flood risks.

## Weathering the Storms: Chorro Creek Ecological Reserve

Over the past twenty years, the Estuary Program has supported land acquisition, protection, restoration, and monitoring at the Chorro Creek Ecological Reserve at the foot of Hollister Peak. The goals of our floodplain restoration efforts are to reduce sediment flowing to the estuary, support water quality for fish and other wildlife, and help recharge groundwater. During large storms in 2021 and 2022, the site operated as designed by trapping sediment and slowing the flow of water to reduce flooding.

The next challenges came during the major storms of 2023. The largest storm that year was estimated to be a 100-year storm, meaning that a storm of that magnitude has a 1% chance on average of occurring in any given year. The area received nine inches of rain in the first three weeks of January. Water levels on Chorro Creek reached nearly 23 feet on January 9, the highest level recorded at this site since monitoring began in 1979.

Post-storm assessments of the site indicate that changes to channels in some restored areas could potentially impede the passage of fish through the creek. The site will require adaptive management to address areas of erosion, improve site stability, and ensure effective sediment trapping and habitat quality.




This aerial image of the Chorro Creek Ecological Reserve shows the creek channel and surrounding floodplain overlaid with elevation changes measured since 2021. The shades of orange and red denote areas where the elevation dropped, primarily in the creek channel where it was eroded by heavy storm flows. The shades of blue show where elevation increased. This was primarily in the floodplain areas where the flows spread out and slowed, leaving the sediment behind rather than carrying it down to the estuary. Figure courtesy of WRA, Inc.

# Are bird populations that depend on the bay and surrounding lands stable?

## Yes, the diversity of birds in the Morro Bay area appears stable, but some types of birds face difficult conditions or are changing their behavior due to forces such as habitat loss.

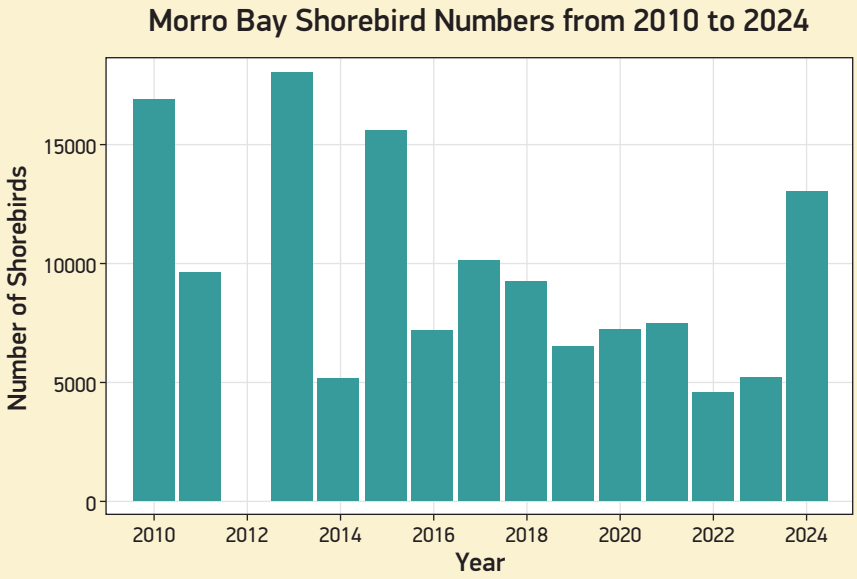
The Morro Bay estuary and watershed provide a variety of habitats that support a wide diversity of bird species. Understanding the health of bird populations is a crucial tool for tracking environmental health. Across the country, a third of U.S. birds need conservation action for protection, which safeguards both habitats and the economy. About 100 million Americans are birdwatchers, with bird-related expenditures reaching approximately $100 billion in 2022.

## Tracking Morro Bay Shorebirds

To help track Morro Bay's diverse shorebird population, Point Blue Conservation Science and the Morro Coast Audubon Society conduct annual surveys in the estuary, on the sandspit, and on Morro Strand. Volunteers venture out on foot and by kayak to designated survey areas where they can identify and count overwintering birds without disturbing them.

During the latest survey conducted in November 2024, marbled godwits and willets were the most common bird found in the front bay, western sandpipers dominated the mid-bay, and least sandpipers were most abundant in the back bay.

Since 2010, Morro Bay's survey results have contributed to a broader study to monitor shorebird populations across the Pacific Flyway from Chile to Canada. By monitoring shorebirds at their wintering areas in thirteen countries each year, these collaborative efforts generate species-level population trends for the Pacific Flyway to guide research, monitoring, management, and conservation efforts.




After steadily declining for years, Morro Bay shorebird abundance significantly increased in 2024. It is too early to tell whether this is a temporary change or an indication of recovery. Shorebirds from other areas can become temporarily displaced due to wildfire smoke, predators, and human disturbance. The displaced birds then contribute to short-term population increases in nearby areas. Future surveys will help determine if this population increase is sustained in Morro Bay and whether trends are similar across the Pacific Flyway.

## Monitoring Los Osos Bird Populations

To monitor land bird populations on State Parks property near Los Osos Creek, the Monitoring Avian Productivity and Survivorship (MAPS) program brings together local volunteers and birding experts. The Los Osos site, established nearly 20 years ago, is one of approximately 300 active stations across North America collecting valuable, long-term datasets.

The team sets up mist nets to safely catch birds. The birds are then identified, and the age class, sex, and breeding condition are recorded before birds are carefully banded and released. The team also gathers feathers for the Bird Genoscape Project for genetic sequencing. Taken together, this information helps scientists better understand migratory patterns and population connectivity.

Recent data from the Los Osos sites indicate that song sparrows and Wilson's warblers were the most abundant, collectively making up over a third of the birds captured and released. Wilson's warblers are unexpectedly successful at the Los Osos site, amidst the backdrop of a declining population throughout most of their range. These results highlight the importance of the collaborative aspect of the MAPS project, which brings together partner organizations throughout North and South America to better understand bird population dynamics and prioritize the conservation of at-risk species.

*A team of trained volunteers, students, and permitted bird banders gather each year to conduct surveys in Los Osos from May through August. Photo courtesy of Los Osos MAPS station participants.*

*Wilson's warblers were found to be abundant at the Los Osos site. Photo courtesy of Los Osos MAPS station participants.*

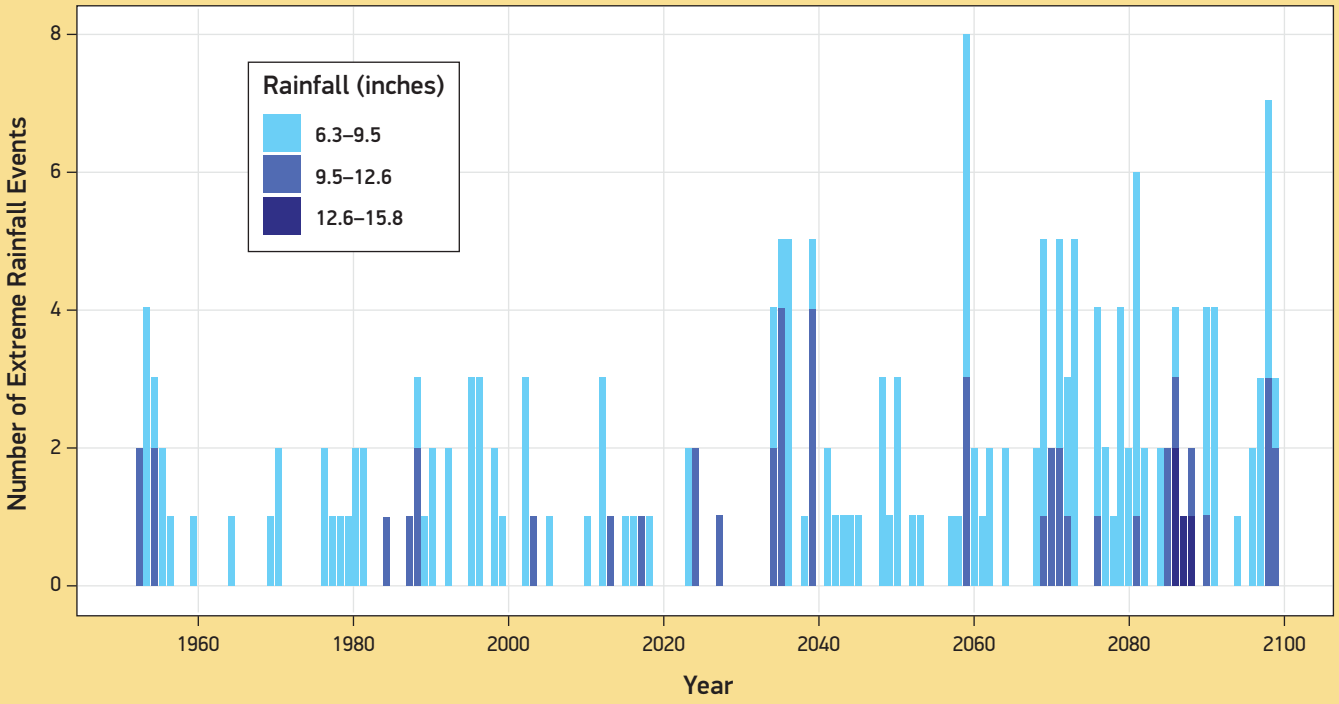
*Tree swallows are a relatively rare find at the Los Osos site. Photo courtesy of Los Osos MAPS station participants.*

# How will extreme weather events likely affect the Morro Bay watershed and estuary?

## More severe storms, flooding, extended periods of drought, increased wildfire risk, and other extreme weather events could have major impacts on humans, wildlife, and habitats in the watershed and estuary.

Floods, drought, heat waves, torrential rains — extreme weather events are becoming increasingly common around the globe. Changes in these types of weather events are not predictable, with shifts expected in the frequency and magnitude of the extremes. A year with record rainfall can be followed by several years of drought. Studying as well as planning and developing adaptation strategies for these extreme events is crucial to improving resiliency. The Estuary Program works with partners to improve understanding of these potential changes and develop adaptations to protect both human infrastructure and natural habitats.

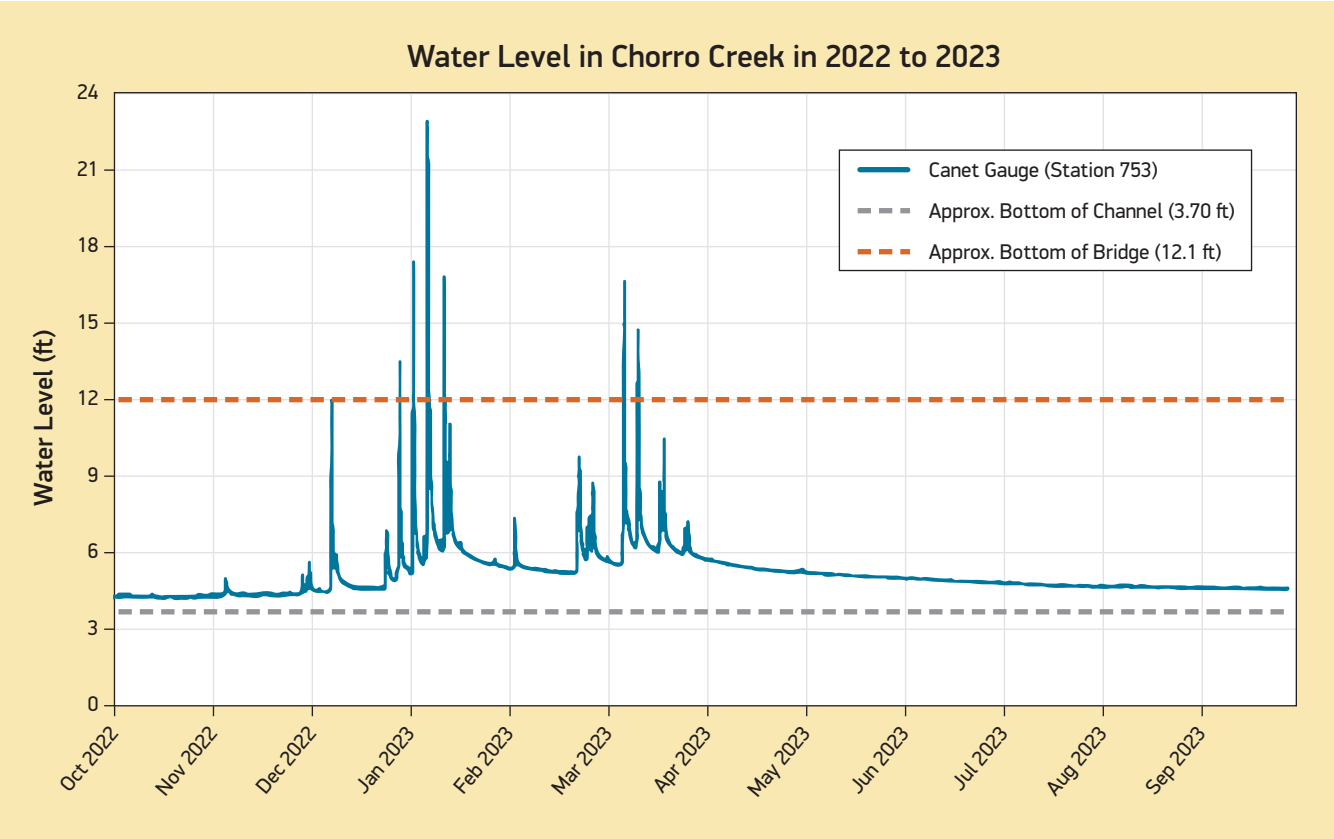
### Extreme Rainfall Events




Extreme precipitation events are expected to increase in frequency throughout the rest of the century. An extreme precipitation event is a four-day period with exceptionally high rainfall totals compared to historical data. The colors in the graph indicate the projected inches of rainfall per year for a four-day event, and the height of each bar indicates the number of extreme rainfall events per year in the Morro Bay area.

## Local Impacts of Winter 2023

The winter of 2023 is still fresh in the minds of local residents. The graph below shows the water levels in Chorro Creek at Canet Road, the site of a San Luis Obispo County water level gauge. A bridge over the creek provides access for residents living across the creek from Highway 1. When waters reach twelve feet, they hit the bottom of the bridge (represented by the orange dotted line). During the winter of 2022 to 2023, there were several storms that caused creek flow to overtop the bridge.




This series of photos shows changes in creek flows at Chorro Creek in January 2023. Between January 5 and January 10, the water level reached 23 feet, with the bridge under about ten feet of water. In the photo on the right, debris from the severe storm can be seen piled up against the bridge. A total of 5.35 inches of rain fell on January 9, the highest rainfall since historic flooding in March 1995 when 6.77 inches of rainfall were recorded.


*Chorro Creek at Canet Road in January 2023.*

## Safeguarding Infrastructure

With intense rainfall comes an increased risk of flooding. Low-lying infrastructure and natural habitats can be vulnerable when waters rise. The storms of 2023 highlighted the vulnerability of transportation corridors in the watershed when the community of Los Osos was temporarily cut off due to flooded roads. These vital roadways are central to community life, underscoring the need for the development of adaptations to protect them.

The San Luis Obispo Council of Governments (SLOCOG) launched a program with funding from Caltrans to develop solutions to improve car and bicycle transportation between Morro Bay and Los Osos and protect natural habitats. The project created an inventory of transportation infrastructure and habitats and developed a model to predict water movement and flow patterns. SLOCOG will create a summary of coastal hazards and vulnerability assessments to better understand risks in this area.

*This is the parking area at Windy Cove during an extreme high tide. If sea levels rise to the higher end of the predicted range, portions of South Bay Boulevard and State Park Road near Windy Cove could face daily tidal flooding like this by 2060.*

*The Virtual Planet tool shows potential flood impacts. The top image shows State Park Road during current high tide conditions, while the bottom image shows the same area under 1.8 feet of sea level rise. Tools like this help visualize future impacts to infrastructure and habitats.*

## Nature-Based Solutions to Reduce Flooding

The Coastal San Luis Resource Conservation District (CSLRCD) leads another effort to address flooding. This organization owns the Chorro Flats area, the floodplain adjacent to lower Chorro Creek (pictured on the right) that flooded during the January storms. The floodplain, which was restored in 1997, is thought to be close to its capacity for retaining sediment and reducing flooding. The CSLRCD is looking at nature-based solutions to increase floodplain capacity, including land acquisition and floodplain restoration.

*View of lower Chorro Creek and Chorro Flats from Black Hill.*

## Protecting Habitats for the Future

The 400-acre tidal marsh where Los Osos and Chorro Creeks enter the estuary provides a unique habitat for wildlife and plants adapted to saltwater inundation from incoming tides. Rising sea levels and coastal flooding threaten this area as higher water levels may drown marsh plants and reduce the habitat available for wildlife. The Estuary Program has partnered with USGS to develop strategies to help preserve the marsh and transition habitats for the wildlife that live there. This work involves using sediment and water-level monitoring data to model how water might move across the estuary with the tides as sea levels rise over time. The work helps identify potential ways to reduce damage to fragile ecosystems, such as providing upland space where the marsh could expand or adding sediment to raise marsh elevation.

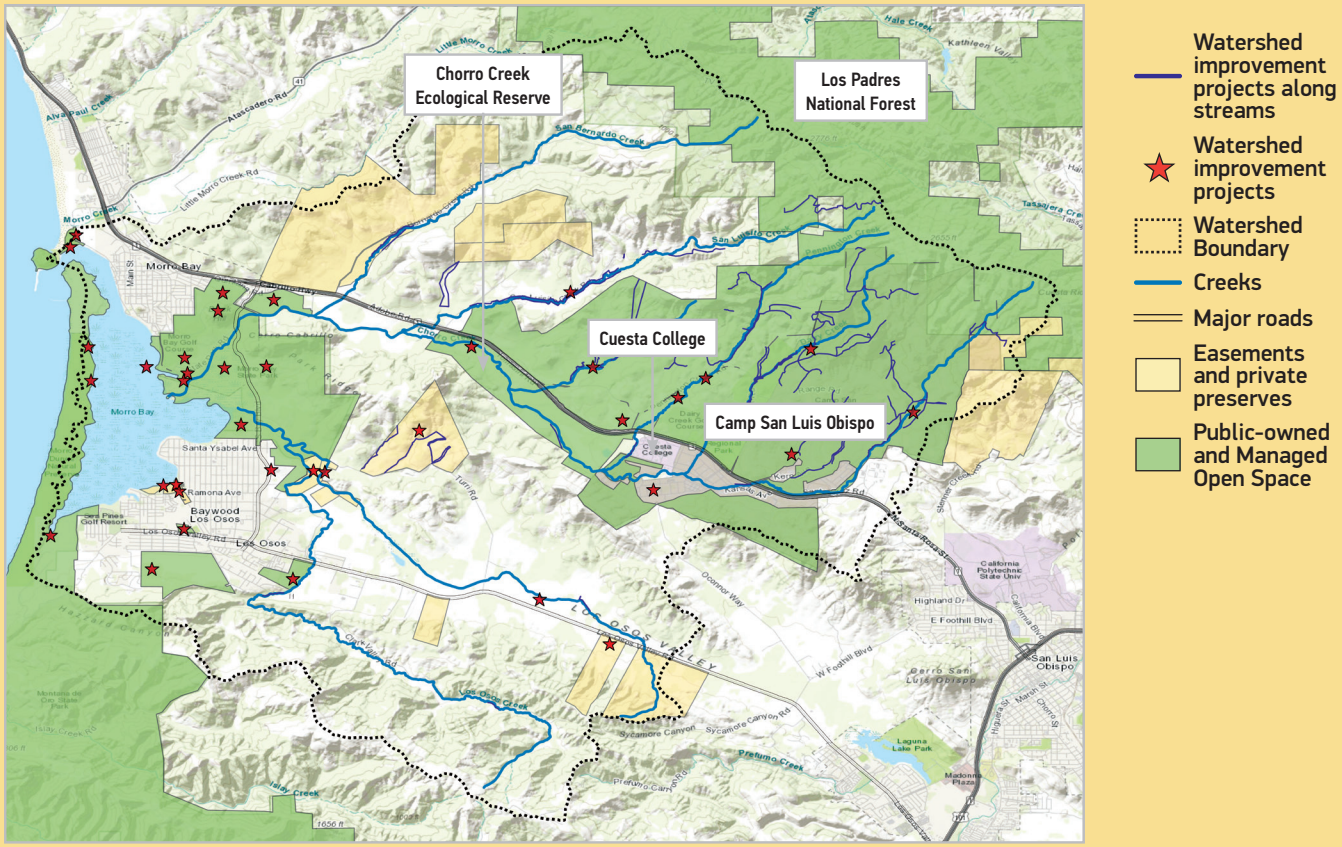
*USGS staff use surface elevation tables to measure elevation changes of the marsh surface. In general, the salt marsh is gaining in elevation as sediment is deposited from Chorro and Los Osos Creeks. But if the rate of sea level rise accelerates in the future, this sensitive marsh habitat may eventually transition into mudflats.*

# Are important natural areas being protected, enhanced, and restored?

## Yes, more than 5,400 acres have been protected, and thirty-eight projects have been completed to improve natural areas and water quality.

The Estuary Program works with many partners to protect, restore, and enhance habitat in the Morro Bay estuary and the lands that surround it. These efforts support open space, healthy habitats, clean water, and resilient lands for people and for wildlife.

### Morro Bay Watershed Habitat Protected, Enhanced, and Restored




This map shows the lands that are conserved and protected through public ownership, easements, and private preserves. The map also illustrates the locations of projects such as floodplain restoration, invasive plant removal, and stormwater management infrastructure.

# Projects to Protect Habitats

## Training the Next Generation of Land Stewards

Grasslands require active management to protect sensitive species and restore native habitat. Livestock grazing reduces the presence of invasive non-native plants and manages the fuel that can feed wildfires.

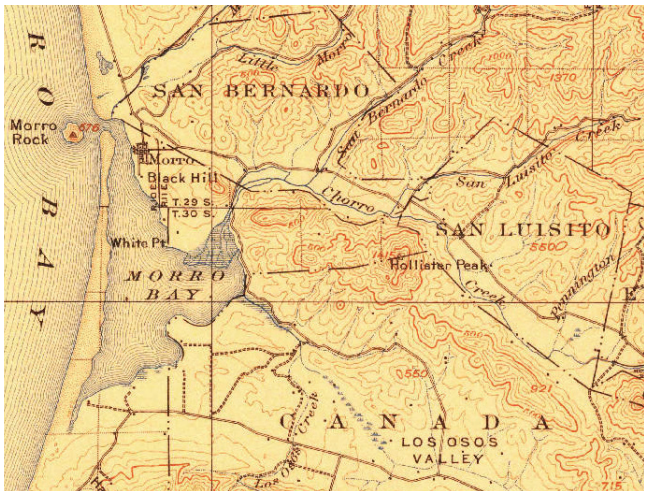
The Estuary Program recently provided funding for water infrastructure to help establish Cuesta College's Ranch Education Program on their 75-acre grassland property. This new program supports workforce development for sustainable ranch management practices and improves grassland habitat through livestock grazing. Each semester around thirty students are trained in hands-on agricultural skills, including sustainable grazing practices and methods to maintain and monitor ranch lands. This work enhances the health and fire resilience of grassland habitat in our watershed.

*Cuesta College's newly established Ranch Education Program is helping to train the next generation of ranchers in sustainable land management practices. Photo courtesy of Shelly Ingram.*

## Studying the Past to Create a Better Future

Understanding landscape conditions before major changes from Euro-American development provides valuable information for management and restoration efforts in our watershed. The Estuary Program has embarked on a three-year historical ecology study that involves collecting archival data such as photos, maps, and journals, compiling the information, and synthesizing it to create maps of historical habitat conditions. This effort documents information like the paths that waterways originally took, the types of plants and animals present, and Indigenous land management practices.

The project creates a habitat map of conditions in the late 18th through mid-19th centuries and a report describing landscape processes and ecological functions. Rather than attempting to recreate the past, the ultimate goal is to use this knowledge to inform sustainable land management and restoration.




*This USGS topographic map from 1900 shows the bay entrance when Morro Rock was an island, prior to construction of the causeway that connected it to the shoreline. This is an example of the type of material gathered to understand historical conditions in the Morro Bay area.*

## Protecting Dunes Through Invasive Plant Management

Iceplant, while a common sight on our coast, is not native to the Morro Bay watershed. Originally introduced in California in the early 1900s to stabilize soil along roads and railroad tracks, it quickly spread. Iceplant crowds out native plants and reduces dune resilience against storms and erosion. It also threatens local rare and federally listed species like California seablite and Western snowy plovers.

In partnership with the Coastal San Luis Resource Conservation District, California State Parks, University of California at Santa Barbara, California Dune Science Network, California Conservation Corps, and others, the Estuary Program has supported iceplant management and monitoring efforts on the dunes for the past three years. The effort improved more than 160 acres of dune habitat previously dominated by iceplant.

# Data Notes

*The data used in this report is the cumulative work of many organizations. The data is informational and not intended to be used for regulatory or decision-making activities. While every effort has been made to ensure accuracy, the Estuary Program and its partners assume no responsibility for errors and omissions, even if advised of the possibility of such damage.*

### Is water in the creeks and bay clean enough for fish and aquatic life?

The analysis for nitrates and bay oxygen utilized the Central Coast Regional Water Quality Control Board (Water Board) scoring method outlined in the California Central Coast Healthy Watersheds Project – Part 1, Report Cards for Scoring Water Quality Data to Characterize Health and Change. The analysis looked at all available data. The trend was determined by assessing data before and after January 1, 2014 for comparison. The nitrate indicator symbol was calculated for levels on lower Chorro Creek. For the creek health scores, the California Stream Condition Index was utilized, and scores for individual sites were averaged to represent conditions on each creek segment.

### Does Morro Bay support healthy eelgrass beds?

The eelgrass maps from 2007 and 2017 were created using multi-spectral imagery collected in the fall and an automated classification scheme. The map for 2023 was created using drone imagery and sonar data collected in the spring and an enhanced classification scheme. All three maps were ground-truthed by Estuary Program staff. The 2019 baywide topobathy lidar survey and 2022 lidar survey were conducted in partnership with NOAA's Office of Coastal Management. Analysis of the elevation changes in conjunction with eelgrass loss was conducted by Dr. Ryan Walter of Cal Poly. The results from the baywide fish studies utilize data collected by Occidental College, Cal Poly/Sea Grant, and the Estuary Program. The bars in the graph represent two particular species caught as a percent of total fish captured in that habitat type.

### Is Morro Bay safe for swimming?

The map includes enterococcus data collected and analyzed by Estuary Program volunteers from 2005 through 2024 using the IDEXX method. The scoring, status, and trends were based on the Water Board's method (see water quality section above for reference). The trend was determined by assessing data before and after January 1, 2014 for comparison. The recreational use monitoring effort follows methods developed by the EPA's Office of Research and Development. Data collected during four-hour continuous surveys aids in the development of visitation curves, from which daily visitation can be extrapolated by counting the number of parked cars at each site.

### Is the bay clean enough to support commercial shellfish farming?

Data and updates to the lease areas in the map were provided by the CA Department of Public Health. The bacteria data from 2019 through 2024 were analyzed for the geometric mean of the fecal coliform concentration.

### Do the estuary and watershed support a healthy population of steelhead?

Fisheries data collection and pikeminnow suppression efforts were conducted by Stillwater Sciences from 2017 to 2023 along Chorro Creek. The dots on the graph indicate the density of pikeminnow longer than 70 mm in segments of Chorro Creek where suppression efforts have been conducted annually since 2017 and does not reflect all data collected. The solid line indicates the overall trend in fish size. Stillwater Sciences developed the study protocol and conducted the steelhead growth study on Chorro and San Luisito Creeks from 2022 through 2024.

### Are the bay and creeks impacted by accelerated sedimentation?

The sediment elevation table data were collected and analyzed by the U.S. Geological Survey from 2013 to 2025. Analysis of storm impacts on Chorro Creek Ecological Reserve were conducted by WRA, Inc. The map uses the NAVD 88 vertical datum.

### Are bird populations that depend on the bay and surrounding lands stable?

National bird conservation statistics come from the North American Bird Conservation Initiative's (NABCI) 2025 State of the Birds Report. Morro Bay shorebird surveys follow methods outlined in Reiter et al. 2020. The shorebird abundance graph uses survey results provided by Point Blue Conservation Science. In this graph, no bar is present for 2012 because a survey was not conducted that year. Los Osos bird population data and trends were provided by the Powell II Monitoring Avian Productivity and Survivorship (MAPS) Station. Bird banding at the Los Osos station is conducted in collaboration with the Institute for Bird Populations, California Central Coast Joint Venture, and is facilitated by the California State Parks San Luis Obispo Coast District.

### How will extreme weather events likely affect the Morro Bay watershed and estuary?

The extreme rainfall projections come from Cal-Adapt. Results were projected for the future using the HadGEM2-ES model (warmer/drier) and the RCP 8.5 emission scenario (assumes emissions rise strongly until 2050 and plateau around 2100). The graph of water levels in Chorro Creek is from SLO County Public Works' Department web portal at https://wr.slocountywater.org/. Information on the SLOCOG project is available on their website. Sea level rise projections at Windy Cove are from Virtual Planet Technologies LLC.

### Are important natural areas being protected, enhanced, and restored?

The map includes publicly and privately protected lands and areas where restoration and conservation projects have occurred. The map includes projects by partners such as California State Parks, Coastal San Luis Resource Conservation District, The Land Conservancy of San Luis Obispo County, San Luis Obispo County, Morro Coast Audubon Society, and many others.

Maps in this report were created using ArcGIS Pro software. ArcGIS Pro is a trademark of Esri and is used by the Estuary Program under a maintained license. Base map and service layer data for maps throughout this report were provided by San Luis Obispo County, Bureau of Land Management, Esri, HERE, Garmin, GeoTechnologies Inc., USGS, METI/NASA, NGA, EPA, USDA, and Maxar.

For more details on these data sources, please visit our website at library.MBNEP.org

# What can you do to help Morro Bay?

## Develop Bay-Friendly Habits

Even small actions can make a difference. Here are some things you can do to help protect the bay and the lands that surround it.

**PICK IT UP.** Cleaning up pet waste helps keep harmful bacteria out of the bay and creeks, protecting the waters for people and wildlife.

**MANAGE THAT TRASH.** Put trash in the right receptacle so it doesn't end up in the bay where it can harm wildlife.

**WATCH WHAT GOES DOWN THE DRAIN.** Stormdrains direct runoff into the nearest waterway, whether that's a creek or the bay. Help keep chemicals, trash, and yard waste out of drains.

**BE A RESPONSIBLE BOATER.** Make sure that your boat's waste-holding tank is free of leaks and always dispose of your waste properly on shore.

*An Estuary Program volunteer collecting bay water quality data.*

## Help Keep Morro Bay Healthy

There are many ways you can support the Estuary Program's work to help keep Morro Bay clean and healthy.

**VOLUNTEER** with us and our partners to support monitoring, restoration, education, and research efforts. MBNEP.org/volunteer

**LEARN** more about this special place and how to help protect it by subscribing to our blog. MBNEP.org/blog

**DONATE** to support our program's work. Every donation, no matter the size, helps. MBNEP.org/donate

*Estuary Program volunteers monitoring flow on Chorro Creek.*

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