U.S. Army Corps
of Engineers

Explore 5

The California Coastline
San Francisco Bay

The Year of the Coast

The beauty and physical diversity represented by California's coast, bays, harbors and estuaries are exceptional. Uniquely spectacular scenery features mountains dropping steeply to rocky shores, rolling headlands and bluffs, fertile marshes, wide sandy beaches and dramatic vistas extending some 1,100 miles from Oregon to the Mexican border.

The sea acts as the coast's chief architect, and continual changes take place as waves, rains and winds reshape shoreline contours. Currents and tides continually refresh and nourish coastal lands and waters, where life forms are as diverse as their habitats. Here the mighty whale and the tiniest of organisms, salt marsh plants and towering redwoods, live together with man in an intricately balanced state of interdependence.

The coast means something different to each individual. Some cherish the refreshing salt air, the sea breezes and the opportunities for contemplative solitude. Others enjoy coastal and bay waters and lands as a place to picnic and swim, to fish, sun and sail, while many choose to search for driftwood or study the mysteries of rocky pools. Many choose birdwatching in coastal bays, marshes and lagoons, while others value the potential for commercial and recreational development.

To the U.S. Army Corps of Engineers, California's bay and coastal areas mean a continuing dedication to management and preservation through effective coastal engineering, interdisciplinary investigations, exercise of regulatory authority, water quality and flood control activities, harbor development and protection, and fish and wildlife conservation.

To assist you in developing a greater knowledge and appreciation for California's coastline and its valuable resources, the Corps of Engineers has prepared a series of brochures which highlight both natural and manmade features. The sites included in each brochure were selected for their unique scenic significance, recreational opportunities and accessibility. Related information on various natural phenomenon such as tidal action, beach formation and movement of currents has also been included, along with reference to numerous indigenous plants and animals. Such detail provides the visitor with an opportunity to gain an increased understanding of the many fascinating aspects of bay and coastal areas.

Bring your camera and binoculars, your curiosity and sense of adventure and join us in exploring nature's wonderful gifts.

San Francisco Bay

The essence of San Francisco Bay is a fascinating composite of diversities. The extravagant beauty of its natural setting is among the most admired in the world. Its history and reputation lend an aura of enchantment to visitor and resident alike.

San Francisco Bay's relatively shallow waters extend approximately 50 miles in length and range in width from one to twelve miles. Included in the Bay system are Suisun and San Pablo Bays to the north, and San Francisco Bay itself which extends from Richmond to San Jose. Drainage from California's entire central basin flows into the Bay and passes through to the sea.

The land bordering San Francisco Bay ranges from sea level to an altitude of more than 4,000 feet. The shoreline configuration, adjacent valleys, mountains, islands and river deltas combine to create an ideal and highly-valued environment.

San Francisco Bay's floor is an ancient drowned valley produced through a complex series of cataclysmic geological events occurring over many millions of years. Many believe that the entire area was once part of a vast inland sea, an arm of the mighty Pacific. Equally fascinating to contemplate is an old Indian legend relating that a single, giant earthquake split coastal mountains, formed the Golden Gate, and allowed ocean waters to surge inland forming the Bay.

Because it is a landlocked harbor connected to the Pacific by the narrow, protective Golden Gate, early explorers quickly recognized the Bay's unique value. It remained concealed, however, to all but native Indian inhabitants for nearly 200 years after Spanish explorers first navigated coastal waters in 1542. The Pacific's rugged, rocky coastline and persistent fog made detection of the Gate virtually impossible.

Although the Bay's entrance was noted by the Portola expedition in 1769, it was not until 1775 that Juan Manuel de Ayala first navigated the surging waters of the Golden Gate and entered the Bay. A Spanish Presidio and mission were soon established. Discovery of gold in the Sierra in 1849 created the first impetus for rapid settlement. The Bay's natural harbor, surrounding rivers and plains served over the years as prime factors in man's settlement patterns. A pleasant climate has also contributed largely to the area's development, since weather remains moderate year around.

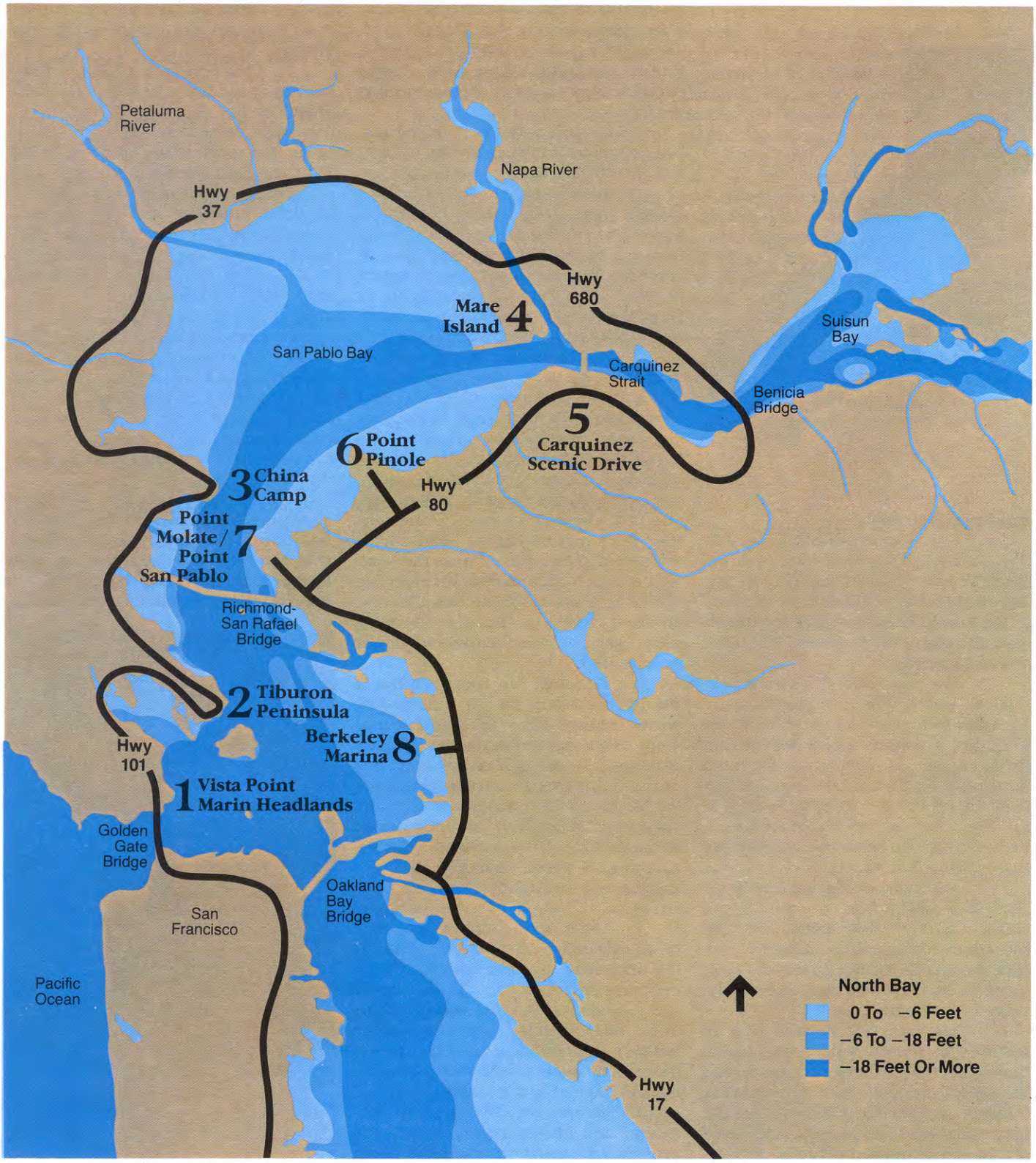
Although San Francisco Bay is world-renowned for its outstanding scenic beauty, many are perhaps unaware of the many fascinating qualities making up its physical composition and of the multitudes of varied and enchanting life-forms that inhabit its waters and shoreline. Many may be uninformed about the intricate and dynamic circulation system which maintains the Bay's natural and constantly changing environment.

The functioning of a delicately balanced ecological system is critical to the perpetuation of San Francisco Bay's creatures and plant life. The success of many human endeavors is dependent upon its life-giving waters. A large number of individuals, agencies and organizations are involved with maintaining and improving the health and future of San Francisco Bay. The carefully considered and intelligent actions of such groups will assist in the permanent preservation of one of the world's most beautiful and complex estuarian systems.

This brochure explores many important and interesting aspects of San Francisco Bay. It is hoped that the information presented will assist you in becoming more aware of some of the Bay's less well-known features, processes and interrelated elements. Several historical sidelights and references to current activities that impact the Bay's natural functioning are also included.

With the assistance of a road map, this brochure guides visitors around San Francisco Bay from the northern headlands of the Golden Gate, northward around San Pablo Bay, south along the East Bay shoreline and across the far reaches of the South Bay. The tour continues along the Bay's western edges through the Peninsula cities and San Francisco, returning once again to the Golden Gate.

We hope that you will enjoy exploring San Francisco Bay, that this brochure will picque your interest and that you will be encouraged to study further and appreciate more deeply its natural and highly-valued environment.


Petaluma River
Napa River
Hwy 37
Hwy 680
Mare Island 4
San Pablo Bay
Carquinez Strait
Suisun Bay
Benicia Bridge
5 Carquinez Scenic Drive
6 Point Pinole
Hwy 80
3 China Camp
Point Molate / Point San Pablo 7
Richmond-San Rafael Bridge
2 Tiburon Peninsula
Berkeley Marina 8
Hwy 101
1 Vista Point Marin Headlands
Golden Gate Bridge
Oakland Bay Bridge
San Francisco
Pacific Ocean
Hwy 17
North Bay
0 To −6 Feet
−6 To −18 Feet
−18 Feet Or More

Golden Gate Bridge
14 Fort Point
Oakland Bay Bridge
9 Port of Oakland
Alameda
13 San Francisco
Bay Farm Island
Oakland International Airport
Hwy 101
South San Francisco Bay
Hwy 17
San Francisco International Airport
San Mateo Bridge
12 Coyote Point County Park
Coyote Hills Regional Park 10
Hwy 84
Dumbarton Bridge
Hwy 101
11 Palo Alto Baylands Preserve
Pacific Ocean
South Bay
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1 Vista Point — Marin Headlands

What better place to begin a tour of marvelous San Francisco Bay than from Vista Point, a large parking and viewing area just north of the Golden Gate Bridge. Take a few moments to enjoy the sweeping Bay vistas: the San Francisco skyline, Alcatraz, Angel, Yerba Buena, and Treasure Islands, the Bay and Golden Gate Bridges, East Bay hills, and the northern and southern reaches of this magnificent landlocked harbor. Signs at Vista Point identify key points of interest and provide an introductory perspective of San Francisco Bay, one of the largest estuaries in the world.

From Vista Point, return to Highway 101 and follow the Alexander Avenue exit. Turn left under the freeway and follow signs just prior to the Golden Gate Bridge which lead up the hill to the headlands which dominate a large portion of the 34,000-acre Golden Gate National Recreation Area (GGNRA).

Approximately five miles seaward of the Golden Gate lies a crescent-shaped sand barrier known to navigators as the San Francisco Bar. It can often be recognized by the white-capped water produced by large breaking waves. The northern portion of the Bar, "Potatopatch Shoal," is only 24 feet deep. An old mariner's tale relates that the shoal's name derives from the imagined similarity to sailing over a sack of potatoes. In fact, schooners from Bodega Bay frequently lost deckloads of potatoes as they crossed the shoal's rough waters. The southern flank of the San Francisco Bar extends south to Ocean Beach. Through the middle of the Bar is a 2,000-foot wide, two-mile long navigation channel, maintained at a 55-foot depth by the U.S. Army Corps of Engineers. Approximately one million cubic yards of sand are annually dredged from this area and deposited on the southern portion of the Bar. Strong longshore currents transport the sand and continually feed downcoast beaches. Those with keen eyes can spot the buoys flanking the dredged channel.

Bayward from the Gate lies another sand bar known as "Presidio-Alcatraz Shoal" and "Point Knox Shoal." Both outer and inner bars are maintained in a state of dynamic equilibrium, as flood and ebb tides move through the Gate. When floods originating from winter rain and Sierra Nevada snow runoff rush into the Bay and out the Golden Gate, the offshore bar can move as much as a mile seaward. High waves caused by ocean storms move sand deposits back toward the Golden Gate.

Tides and Currents

The movement of tidal currents through San Francisco Bay serves as a massive circulatory system nourishing the thousands and thousands of life forms inhabiting Bay waters, mudflats and marshes. Tidal current movement results from two strong forces—the ocean to the west and the many rivers and streams that enter the Bay's perimeters.

As tides rise along the California coast, rapidly-moving waters funnel through the Golden Gate and move into the Bay's farthest corners. The greatest portion of tidal flow follows two well-defined channels through the Bay, extending north and south from the Gate. Rip tides, often marked by a line of foam, occur as currents meet and pass.

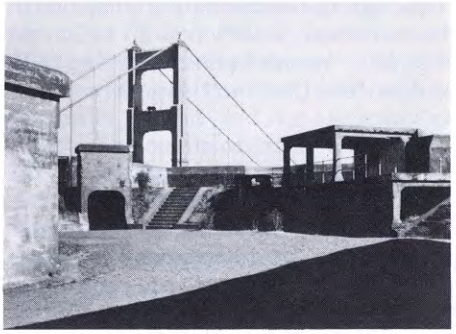
The Bay has unusual current patterns, many of which are caused by a delay between the time when tides at the Gate are high and the time these same waters spread to the Bay's extremities. The shallower, southern portion of San Francisco Bay is characterized by a *standing wave,* that more or less acts as water sloshing about in a bathtub. At the southern end, the time of high tide closely matches the time of slack water. South Bay waters ebb to the ocean as waters continue to flood into North Bay and Delta areas. The North Bay is characterized by a *progressive wave,* an actual wave that moves up into the Delta area during flood periods. North Bay tidal phasing is analogous to a wave progressing up a river, such that time of high water relates closely to the maximum tidal current velocity. The tidal actions in the North and South Bay areas are

The Golden Gate channel is almost 360 feet deep and about a mile wide at its narrowest point, at the Golden Gate Bridge. The channel bottom consists primarily of bare rock and cobbles, or stones, indicating rapid current movement. Moving outward on either side of the Gate, floor deposits become increasingly finer as currents fan out and dissipate, dropping sands and sediments on both the San Francisco Bar and Presidio-Alcatraz Shoal. Sediments on top of the bars measure 0.15 millimeters, on the average.

The channel is particularly treacherous for sailors because of powerful tidal currents, which include eddies and rips created by the floor's irregular bathymetry, or depth variation, rock pinnacle out-croppings and the Golden Gate Bridge itself.

Headland vista points provide excellent vantage points from which to watch ships, sailboats and fishing boats as they move between Bay and ocean. During flood, or incoming tides, smaller boats return to the Bay on rapidly moving currents through the Gate's main channel. During ebb, or outgoing tides, returning boats move eastward through the Bonita Channel around Bonita Point. They creep cautiously along the rocky northern shoreline to avoid forceful currents in mid-channel.

Water areas in the vicinity of the Golden Gate and Bars feature an unstable animal and plant community which supports only the organisms capable of tolerating high-energy current and wave environments. Surprisingly, the fragile appearing sand dollar thrives here; it buries its edge in the sand and rotates, exposing its mouth to nutrients moving with the oncoming current.



Long-abandoned gun emplacements, thick-walled bunkers and hundreds of underground rooms lie scattered along coastal bluffs from Point Reyes to Half Moon Bay. These facilities were, for a time, equipped and occupied in a state of military preparedness.

out of phase. At some periods the South Bay floods as the North Bay ebbs.

During rainy winter months, near the end of the North Bay's ebb tide period, fresh water from the Sacramento and San Joaquin Rivers moves into and flushes the South Bay. This flushing influence increases proportionately with the magnitude of Delta fresh water flow.

Tides reverse themselves four times each day at approximately six hour intervals. Tidal elevations can grow to a maximum of nine feet in height. The strongest tidal currents move at speeds of up to six knots, or 6.9 miles an hour.

Approximately one sixth of the Bay's waters flow through the Gate during an average ebb, or outgoing, tide at a rate of up to 300,000 cubic feet per second. As many as 390 billion gallons surge through the narrow channel during an average tidal change of about 4¼ feet.

Offshore Bars and Shipping Channels

The Golden Gate's inner and outer bars are formed as a result of sand deposition. Bar sands develop primarily as a result of coastal sand movement and from sediments brought into the Bay by rain-swollen rivers.

Sand bars and main ship channels are identified. Navigation channels are illustrated by east and westbound traffic lanes through the Gate, and north and southbound lanes leading to and from the Bay's northern and southern ports. The precautionary area to the east of Alcatraz Island is the Bay's major intersection.

Although not confirmed as a consistent phenomenon, sand waves up to 20 feet high have been observed moving back and forth on the floor through the Golden Gate.

In clear weather, search the horizon for the dark outlines of the Farallon Islands some 26 miles offshore. These islands, once part of a long land mass that stretched for about 200 miles north and south, provide important bird, sea lion and seal habitats and have been proposed as a marine sanctuary.

Two flashing lights can usually be observed seaward from the Marin Headlands. The nearest was once a light ship; it has been replaced by a lighted buoy. The buoy assists vessels arriving from both north and south, pointing out a straight line which leads to the dredged navigation channel across the San Francisco Bar. The farther light sits on the southernmost and largest of the Farallon Islands. These and other navigational aids are controlled and maintained by the U.S. Coast Guard.

Tidal measurements at the Golden Gate serve as a prime tidal gauge reference point of the National Oceanic and Atmospheric Administration (NOAA) on the West Coast. This means that tidal elevations up and down the central and northern California Coast are measured with reference to those occurring at the Gate.

It may be of interest to note the color differentiations on shoreline rocks, an illustration of the various tide levels which can raise channel waters as much as eight feet. The direction tilt of bottom-anchored buoys or channel markers serves as an indicator of ebb and flood tidal movement.

Leaving the awe-inspiring vistas of the Marin Headlands, visit picturesque Sausalito, an early-day ferry and railroad terminus located on Richardson Bay, which still conveys the romance of the village's renowned artist/fishing center heritage. While exploring Sausalito, visit the San Francisco Bay and Delta Model.

Fog over the Bay

Bay and Delta Hydraulic Model
To better understand San Francisco Bay tidal current and circulation patterns, changes in salinity distribution resulting from the management of fresh water, and other subjects critical to the future of the Bay, the Corps of Engineers has constructed a physical model of the Bay and Delta areas.

Housed in a warehouse recently renovated to accommodate a Visitor Center, the model occupies an area of about 47,000 square feet. This consists of an initial portion, which includes the ocean area and the Bay system upstream to the head of Suisun Bay, which was completed in 1957. It also includes an extension, completed in 1969, which incorporates 700 miles of waterways comprising the Sacramento-San Joaquin Delta. Constructed to a vertical and horizontal scale of one foot per 100 feet and one foot per 1,000 feet, respectively, the system allows a lunar tidal cycle of 24 hours and 50 minutes to be accurately reproduced in 14.9 minutes. Therefore, a long sequence of events can be monitored in a relatively short period of time. About 125,000 gallons of salt water and 12,000 gallons of fresh water are required to fill the model for operation.

Used extensively by federal, state, county and private agencies, the model allows researchers to study the impacts of various occurrences which affect the Bay, such as deepening of navigation channels, land reclamation, dispersion of pollutants, diversion and export of fresh water in the Delta, and movement of oil spills within the Bay system. The Visitor Center greatly enhances opportunities for better understanding the functioning of San Francisco Bay. For additional information, contact the Bay Model Visitor Center, 2100 Bridgeway Boulevard, Sausalito, by calling 332-3870.

Golden Gate Bridge
The towers of the Golden Gate Bridge rise nearly 750 feet above the water. Completed in 1937, the bridge is recognized as an engineering marvel spanning some of the world's most turbulent waters. For 25 years following its completion, the Golden Gate Bridge was the longest single span in the world. Its giant supporting cables measure 36.5 inches in diameter. Each is made up of 27,512 steel strands.

Golden Gate Bridge enveloped in summer fog

2 Tiburon Peninsula

Continuing north on Highway 101, follow the Tiburon exit to enjoy a curving, scenic drive around the Tiburon Peninsula. Visit the Richardson Bay Wildlife Sanctuary and Education Center, identified by a restored Victorian home on the right a short distance from the highway exit. This stop provides an opportunity to walk through grasslands and marshy areas and serves as an initial introduction to the prolific salt marshes that enhance a large portion of San Francisco Bay's shoreline. Bird watching opportunities are extraordinary here, and in winter, harbor seals can often be seen resting nearby.

From the Main Street Pier in downtown Tiburon, cross Raccoon Strait by ferry to Angel Island State Park, a half mile offshore. A climb to the top of the island's forested 700-foot hills provides an opportunity for enjoying unexcelled vistas of San Francisco and its environs. From this vantage point one can often observe water color differentiation illustrating the meeting of different tidal currents. This phenomenon is usually most visible in winter and spring months when a freshet, or fresh water runoff, laden with clay and silt moves into the Central Bay. Hiking and bicycling around the Island's 4.8-mile perimeter not only offer a fine orientation to both the North and South Bays, but provide an opportunity to visit the Island's early military facilities as well.

After returning to Tiburon, continue northeast around Paradise Drive, and note the location of an old cod fishery which, as early as 1876, served as a drying and packaging center for catches from as far upcoast as Alaska. The facility later served as a coal loading area for World War I naval vessels. Today the buildings house a fisheries laboratory of the National Marine Fisheries Service and the Tiburon Center for Environmental Studies.

A stop at Paradise Park, with its sloping grassy hillsides, sandy beaches and fishing pier provides another worthwhile opportunity for enjoying San Francisco Bay. Return to Highway 101 North through hills covered with manzanita, chaparral and oak. Watch for glimpses of San Pablo Bay beyond the Richmond-San Rafael Bridge. Across the water from the northern side of the Tiburon Peninsula is San Quentin State Prison.

Bay Marine Life

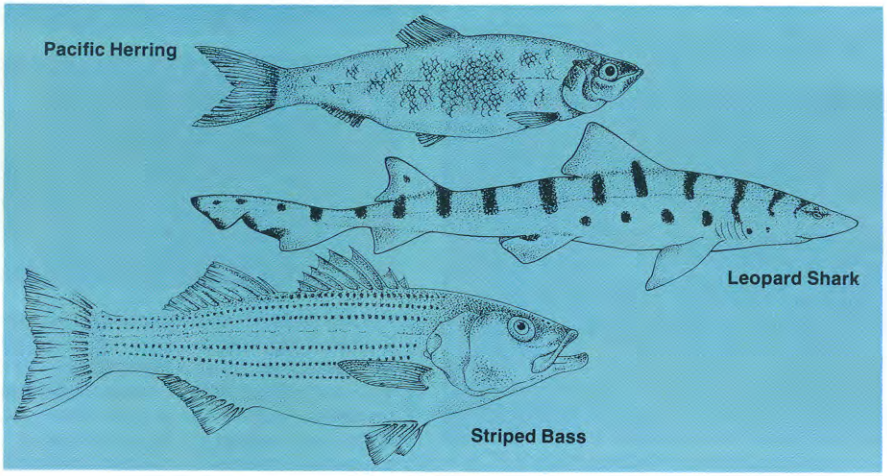
The fertile waters of San Francisco Bay support an almost endless variety of fish and shellfish. Millions of microscopic plants and animals provide the Bay's larger inhabitants with a well-rounded diet. The Pacific herring, leopard shark and striped bass are among the Bay's more familiar inhabitants.

An anadromous fish, the striped bass spawns in the fresh waters of the Sacramento and San Joaquin Rivers and matures in salty Bay and ocean waters. Average striped bass weigh between five and fifteen pounds.

The leopard shark, despite its rather savage appearance, is harmless. It is one of the numerous shark species inhabiting San Francisco Bay. Its dark gray body is covered with black lines and spots, and rarely exceeds six feet in length.

During winter and early spring, large schools of Pacific herring migrate through the Golden Gate and deposit their sticky eggs on seaweed and rocks around the Marin coastline, Richardson Bay and Point San Pablo. The herring typically grows to little more than 18 inches.

Crabs and clams are prevalent as are numerous other varieties of shellfish. Shad, salmon, anchovies and sole are also typical inhabitants. As many as 135 fish species have been identified in San Francisco Bay.



Gull surveying San Francisco Bay

Ferry returning from Angel Island to Tiburon

3 China Camp

The Central San Rafael exit from U.S. Highway 101, followed by a right turn on Second Street, leads to Point San Pedro Road, which winds around Point San Pedro near the water's edge. Visit McNear Beach, a delightful family recreational area, and continue to a sign identifying the entrance to China Camp. This marks the southern edge of China Camp State Park. Here salt marshes predominate the shallow, protected northern shoreline of Point San Pedro. The Point itself, together with Point San Pablo across the bay to the east, forms San Pablo Strait.

Because San Francisco Bay is a drowned valley, its varying contours and numerous rocky islands, such as "The Sisters," visible offshore from the southern portion of Point San Pedro Drive, result in challenging navigation hazards. Unusual eddy conditions produce the broken current patterns prevalent in the vicinity of such rocky obstructions.

Driving north along Highway 101 through Marin County's rolling hills, again note the beautiful chaparral, from the Spanish *el chaparro,* and the always-green scrub oak. Both are well adapted to summer drought and winter rain climatic patterns so typical of this region. California oak also dots the hillsides. Its shiny deep green foliage provides a sharp contrast with the nearly-year-around, golden-hued grasses. Here, quail and deer are often seen by the sharp-eyed observer.

To reach our next stop, Mare Island, marked by the Napa River to the north and Mare Island Strait to the east, follow Highway 37 northeast. Cross the lazily-meandering, marsh-bordered Petaluma River at its entrance to San Pablo Bay. Here a narrow channel has been dredged through Bay muds to accommodate commercial barges and recreational boaters making their way upriver to Petaluma. To the right, in San Pablo Bay, note several channel markers along the federal navigation channel leading to the Petaluma River.

To the left, notice an area of former salt marshes, now diked farmlands. This North Bay lowland area differs significantly from diked portions of the South Bay, which contain extensive salt evaporation ponds. North Bay dikes were constructed primarily by Chinese laborers following completion of the transcontinental railroad. Hay is the predominant crop of this farming area.

The many drainage channels in the vicinity of Sonoma Creek include a series of culverts which prevent salt

China Camp
China Camp is a most fascinating historic site. It was once a flourishing shrimp fishing settlement inhabited by hundreds of Chinese who originally emigrated to build railroads across the Sierra. Later, after working in the Sierra Mother Lode gold diggings, they gradually drifted back to the Bay Area. Opportunities for supplying shrimp to a burgeoning San Francisco population soon became apparent and a supply of nets and a few experienced fishermen were quickly brought in from China. Soon hundreds of Chinese immigrants were enjoying the benefits of the shrimp industry and, by the early 1900's, numerous shrimp fishing camps sprouted and thrived around the Bay.

China Camp was a center for shelling, cooking, drying and selling this tiny crustacean, which was both exported dried and sold fresh in San Francisco. Pollution nearly destroyed the area's shrimp fishing industry, and today only relics of another era remain.

North Bay Marshes
A large portion of the northern bay's shoreline comprises the North Bay Wildlife Refuge, managed by the Fish and Wildlife Service. Preserved areas lie within the Pacific Flyway, one of the four principal continental routes along which migratory fowl move south in fall and north in spring. The Bay system has been identified as the most important stop along the Pacific Flyway. As a result, birdwatchers are treated to the sight of numerous varieties of ducks and geese, shore birds such as willits, sandpipers and avocets, and marsh birds including rails, herons and white egrets. More than a million feathered visitors are believed to winter in the many protected marshes and mudflats of San Francisco Bay.

Tidal channels typifying the North Bay's extensive salt marshes

Ferries Old and New
This once-dignified ferry boat exemplifies the many dozens of passenger, automobile and railroad ferries that ran from San Francisco, Alameda, Oakland, Berkeley, Richmond, Tiburon and Sausalito. The 1920's and 30's were perhaps the days of greatest ferry activity.

water from flowing into reclaimed farm lands. As flood tides move salt water to the northern reaches of the Bay, waters move against a flap gate closing each culvert's end. As tides ebb, the fresh water which has filled the culvert opens the flap gate and waters flow into the Bay. In some drainage channels, various colored soils are visible, as a result of changing water levels. The white shade is salt residue.

East of Sonoma Creek is a U.S. Naval Reservation which serves as the center for a major Navy communications network.

4 Mare Island

Mare Island is the U.S. Navy's West Coast maintenance and repair facility for nuclear submarines and deep-draft vessels. Numerous vantage points from which to view the Naval Shipyard are accessible by taking the Wilson Avenue exit immediately east of the Napa River Bridge. A drive along the Mare Island Strait shoreline provides an interesting perspective of the area.

San Pablo Bay's Mare Island is perhaps one of the oldest established maritime facilities in the Bay Area. Following American occupation of Mexican territory, the Island was reserved for government use in 1850, and became a Navy facility four years later. In 1863, a full Russian squadron was repaired at Mare Island drydocks, and many U.S. Naval vessels were built and repaired here during World Wars I and II. Near the turn of the century, America's first two submarines were commissioned at Mare Island.

Submarine on route to Mare Island

Today, local residents and tourists enjoy a modern ferry system. The leisurely passage, the cool bay winds, the smell of salt spray and the wheeling gulls enjoyed by early-day ferry passengers still enchant today's tourists.

Corps of Engineers

In the 1850's, when West Point-trained engineers first arrived, the Corps of Engineers became involved with San Francisco Bay. The Corps' San Francisco District, formed in 1866, has become increasingly concerned with the conservation, protection and maintenance of the Bay's 280 miles of shoreline.

Studies relating to such key concerns as flood control, navigation, waste disposal and sediment deposition are continuously pursued in an effort to maintain a healthy Bay system. The Corps also serves in a regulatory capacity. Since it is charged with administering laws relating to water quality and navigation, the Corps reviews and processes all permits for work in Bay waters. Possible violations of construction activity regulations are investigated and rectified.

The most visible of the Corps' activities involves maintaining and improving navigation channels to ensure the safe passage of shipping vessels. Dredging operations remove approximately 5.5 million cubic yards of dredged materials annually. Two hopper dredges, the *Biddle* and the *Harding*, perform this operation. The majority of sediments dredged from navigation channels are deposited at Carquinez Strait and Alcatraz Island disposal sites. Debris removal is another key Corps responsibility. Two derrick boats, the *Raccoon* and the *Coyote*, continually patrol Bay waters collecting up to 60 tons of debris each day.

The "Raccoon" at Corps berthing facility

Hopper dredge "Biddle" maintaining a Bay navigation channel

5 Carquinez Scenic Drive

Following the drive along Mare Island Strait, catch Highway 680 southeast. Benicia, the site of California's capitol during 1853 and 1854, serves as a good first introduction to vitally important Carquinez Strait. Rich in history, Benicia also once served as the eastern terminus for a railroad ferry which crossed the Strait to Port Costa.

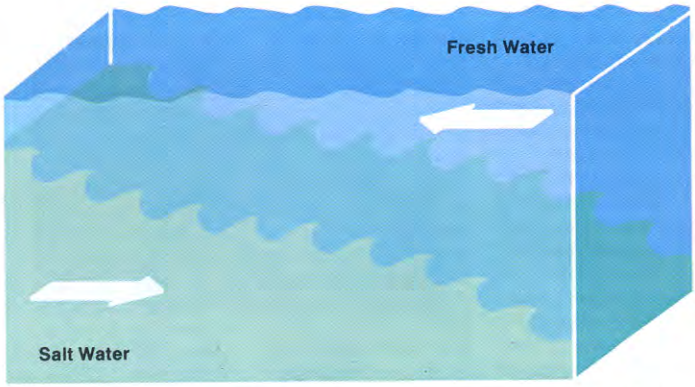
This narrow, curving 100-foot-deep channel connects Suisun Bay and San Pablo Bay. It carries not only fresh water runoff from the Sierra and Central Valley, but also the tidal flows from the Sacramento-San Joaquin Delta. Its waters flow fast and deep. Strong westerly winds, funneled by surrounding hills, may cause waters at the Strait's east end to rise to an elevation level a couple of feet higher than at the Strait's west end.

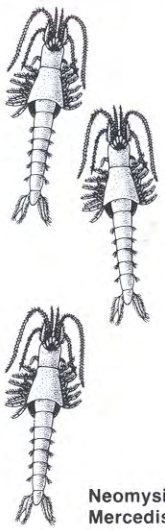
Leaving Benicia, cross the Benicia-Martinez Bridge. In Martinez, watch for signs pointing to Carquinez Scenic Drive. This lovely, winding roadway passes through gently sloping hills along the southern shoreline of Carquinez Strait, where observers will note an assortment of barges and ships moving to and from area ports. A stop in Port Costa, a prominent grain-shipping capitol during the 1880's and 1890's, offers a nostalgic glimpse into the past. As the roadway nears Crockett, note the many abandoned wharfs and old pilings, the relics of an earlier thriving industrial era. The Carquinez Scenic Drive ends in Crockett at the base of the Carquinez Bridge.

Leaving Crockett on Pomona Street, continue along the water's edge to a point near the top of the incline and enjoy extraordinary vistas of the Carquinez Bridge, Mare Island Strait, Mare Island's high, tree-covered tip, and to the west — San Pablo Bay. Note the training walls constructed near the end of Mare Island, installed for the purpose of separating tidal currents moving through the Mare Island and Carquinez Straits. Such walls assist in reducing siltation within the respective navigation channels.

The marshy area visible immediately north of the training wall extending into San Pablo Bay has resulted from the wall's entrapment of sediments brought across San Pablo Bay by waves and tidal currents. The sediment deposition slowly developed into mud flats and finally rose to an elevation capable of supporting marsh vegetation.

West of the Carquinez Bridge on the north side is the California Maritime Academy, which serves as a





Neomysis Mercedis

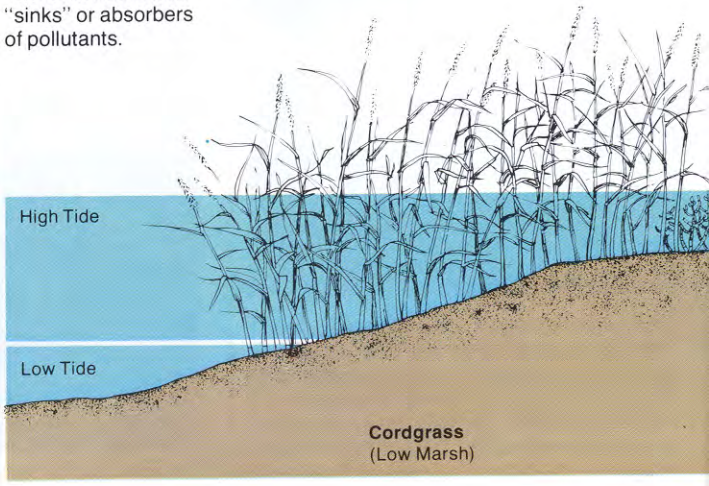
Salt Wedge
As fresh water flow from upland rivers meets the Bay's salt waters, a rather distinct boundary materializes. Turbulent eddies result as the two masses of water meet. The high concentration of suspended nutrients at this meeting point attracts millions of neomysis—tiny shrimp much in demand by small striped bass. Following the salt water wedge, striped bass move hungrily up and down the strait with the moving tides.

The salt wedge is a phenomenon common to most estuaries, or areas where fresh and salt water meet. During winter rains and spring runoff periods, lighter-weight fresh water forces itself along the surface of more saline waters to the Bay's southermost reaches. Outflow from the organically rich Suisun Bay marshes brings a nutrient soup of decomposed plant materials that provides a critically important food supply for hundreds of Bay marine species.

Salt Marshes
The dynamic, ever-changing salt marshes of San Francisco Bay play an integral role in the life of the entire Bay system. They serve not only as shoreline stabilizers, but also provide feeding, spawning and nursing areas for fish and wildlife. In addition, marshes provide a source of oxygen for marine inhabitants and act as "sinks" or absorbers of pollutants.

In spite of the marshes' fragile, delicately-balanced nature, plants here are hardy and uniquely adapted to their environment. Each has the ability to survive in varying levels of exposure to salinity and moisture. Three plants dominate Bay salt marshes, growing above mean tide. They are the *Spartina foliosa* or cordgrass, *Salicornia,* commonly known as pickleweed, and *Distichlis spicata* or saltgrass.

Cordgrass, which grows at lower intertidal zones, is the most common of the low marsh plants. It is capable of withstanding the stresses of erosion and regular inundation. The



center for training merchant marine officers. The Academy's large white training ship, the *Golden Bear,* is usually moored here.

Leaving the Pomona Road overlook, continue through low-lying hills replete with oil refinery facilities. The Sonoma hills are visible across San Pablo Bay. Proceed through Rodeo on San Pable Avenue and continue to Hercules, through an area dominated by eucalyptus trees. The eucalyptus, now common to California, was originally imported from Australia for the purpose of making railroad ties. As you drive along San Pablo Bay, attempt to visualize the virtually hundreds of once alien organisms and small crustaceans that, over the years, have made their way into San Francisco Bay attached to the hulls of ships from around the world.

6 Point Pinole

Continuing south along San Pable Avenue, watch for occasional small marshes. These wetland areas are created by shoreline land protrusions which offer protection from high currents and prevailing wind waves.

Signs direct the visitor to Point Pinole Regional Shoreline, the site of a former munitions manufacturing plant which today provides a highly valued open space area in the midst of an industrialized urban region. The 2,147-acre park covering Point Pinole was acquired by the East Bay Regional Park District in 1971. Opportunities for enjoying nature's beauty abound, and views of San Pablo Bay, Mt. Tamalpais and the Marin shoreline are exceptional.

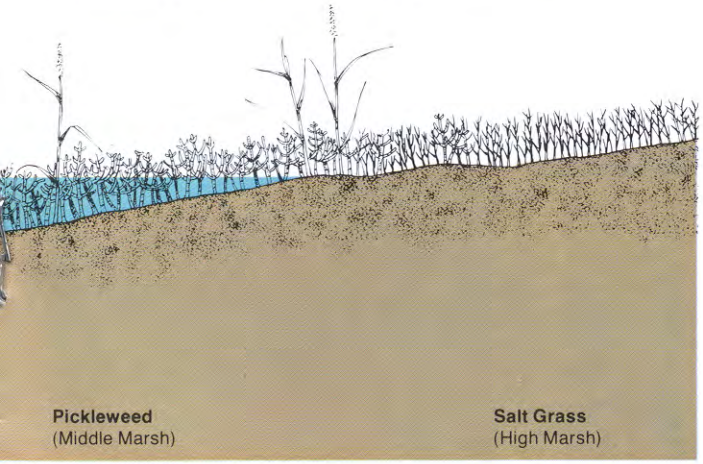
Perhaps one of the most interesting sites here is the large salt marsh area, another reminder of the character of many miles of San Francisco Bay's shoreline. The majestic groves of Blue Gum Eucalyptus trees provide a habitat for thousands of lively woodland birds. These groves were planted early in the century to protect surrounding areas in the event of accidental munitions explosions. Munitions operations were closed in the early 1960's.

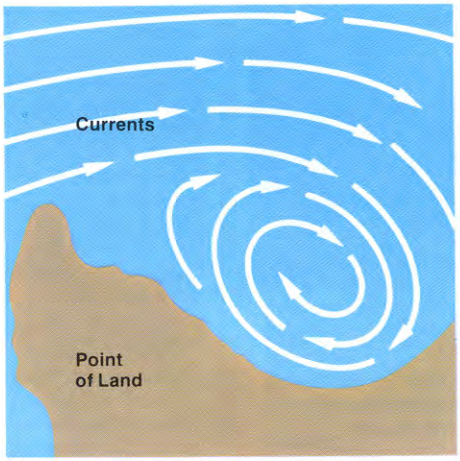
Long ago, local Indians frequently fished in the waters off Point Pinole. The Point was named for a nourishing porridge of acorn flour, seeds and wild grains which was an integral part of the Indian's diet.

grey-green pickleweed grows abundantly at the next higher elevations and, because of its succulent nature, is capable of storing large quantities of water. In autumn, the pickleweed's tips turn to shades of pink and red, increasing the marsh's beauty. Saltgrass, closely resembling Bermuda grass, grows in dense masses at higher marsh elevations. Close observation will reveal a salty crust on its blades, indicating the plant's method of dealing with life in a salt marsh.

The Bay's extraordinarily fertile marshes are one of nature's most productive environments. Decaying plants provide minute food particles for a variety of invertebrates and algaes.

The network of meandering waterways observable in many Bay marshes serves to channel tidal ebbs and floods as well as incoming fresh water streams. The configuration of these waterways is reminiscent of the structure of trees whose main trunks extend outward into increasingly smaller branches and twigs.





Eddies
Points of land extending into the Bay, such as Point Pinole, often causes eddies, or rotational water flows. The eddy's speed and size, and resulting navigational implications, depend upon the land's configuration, and the speed and direction of current movement.

This classic long wharf extends far into the Bay, facilitating the pumping of oil to and from moored tankers.

7 Point Molate/Point San Pablo

After visiting Point Pinole, proceed to Highway 17 West. Just before the Richmond-San Rafael Bridge toll plaza, follow a sign to Point Molate. The Point Molate/Point San Pablo area is historically fascinating and, in addition, provides a perspective of San Francisco Bay unfamiliar to most.

Along the Point Molate roadway are antique railroad cars restored by the Pacific Locomotive Association of San Francisco. Another point of interest, near the Point Molate Naval Field Depot entrance gate, is Winehaven, dominated by a large brick structure that once housed one of the world's largest wineries. A stop at 17-acre Molate Beach Park offers vistas of Richmond-San Rafael Bridge and evidence of extensive oil-related refining and shipping activities typical of this area.

Continuing around Point San Pablo, note the "The Brothers" islands and the picturesque lighthouse built in 1874 to guide ships through the strong currents of San Pablo Strait. Both light and foghorn were automated in 1969.

At the water's edge, just around the tip of Point San Pablo, are large deserted wooden buildings that until the mid-twentieth century served as the last whaling station on the West Coast.

Returning to Point Molate's entrance, look across San Pablo Strait to Point San Pedro and Mount Tamalpais in the distance. The 70-foot-deep Strait separates San Pablo Bay from Central San Francisco Bay and serves as a major navigation passage for oil tankers, freighters and barges serving port facilities in San Pablo Bay, Carquinez Strait and the Delta.

Shoreline oil refining facilities, Brothers Lighthouse and Marin coastline

Winehaven, built in 1908 by the California Wine Association, was closed by prohibition in 1919. During its peak years, 12 million gallons of 67 types of wine were produced here annually. Winehaven, listed on the National Register of Historic Places, now serves as the Naval Supply Center's fuel headquarters.

Land Fill

As a result of landfill and dike construction, San Francisco Bay, once more than 700 square miles in size, today consists of approximately 450 square miles. This map illustrates the Central Bay shoreline in the early 1800's, and where fill has since occurred.

Bay-dredged muds and sands, a refuse and sand mix, and compacted fill imported from onshore excavations are often used as fill.

Controls instituted as a result of formation of the Bay Conservation and Development Commission (BCDC) have dramatically reduced the occurrence of landfill on San Francisco Bay.

Richmond Harbor/Port of Richmond

Petroleum and petroleum products make up more than 90% of the cargo handled at Richmond Harbor, as a result of the area's extensive commercial petroleum refining and handling facilities and naval fuel depots.

A 10,000-foot-long training wall fronts the entire port area, protecting both inner harbor and entrance channels from sediment deposition and wind waves. The Richmond Long Wharf, just south of the entry to the Richmond Bridge, handles approximately two-thirds of the crude petroleum that tankers carry into the Bay.

Richmond Inner Harbor

Richmond Long Wharf and Mount Tamalpais across San Pablo Bay

Berkeley Marina fishing pier

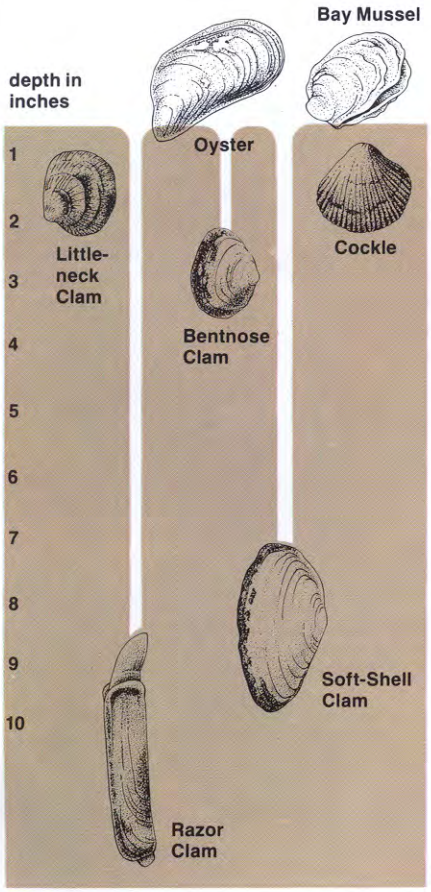
8 Berkeley Marina

Follow the University Avenue exit west from Highway 80 to our next stop, the Berkeley Marina. One of the most prominent and interesting features here is the fishing pier, the longest on San Francisco Bay. This pier originally provided land access to automobile ferries prevented by shallow waters from coming close to shore. Numerous similar piers extended from the East Bay shoreline to serve the Bay's bustling ferry system during pre-bridge days. The 3,000-foot nearshore portion of the Berkeley pier has been refurbished for the enjoyment of fishermen and sightseers.

A nearly adjacent area, known as "Great Field," has been described as a biological recovery site. Once a refuse heap, the area was covered with topsoil and now serves as a wildlife and shorebird habitat. It is a quiet place for birdwatching and strolling in the heart of a busy urban environment.

Returning to Highway 80, drive south and enjoy the whimsical gallery of sculptures on the Emeryville mud flats. Each was constructed from bits of scattered debris. This enchanting exhibit is ever changing.

The highway along this portion of the East Bay shoreline is built on landfill, as are many hundred of acres of former shallow Bay waters. A lagoon which was once part of the Bay can be seen to the left of the roadway. The rocks along this portion of the Bay's edge exhibit variations in color, representative of varying water levels brought by changing tidal elevations.



Mud Flats

The tidal, or mud flats, occupying about 25,000 acres of San Francisco Bay's shoreline, are predominantly located in the Bay's eastern and southern reaches. Exposed at low tides, these shallow flats are fed by a continual flow of nutrients and organisms brought by daily tides. For this reason, mud flats contribute substantially to the vital functioning of the Bay's delicately-balanced ecological community.

Thousands of wild birds, fish and small mammals rely upon these often unappreciated areas for their livelihood. Algae and microscopic plankton offer a reliable food source. Decomposing plants, together with bacteria and fungi, add to a continually-revolving food web. Clams, mussels, worms, cockles, shrimps, crabs and others feed on these tiny delicacies and, in turn, provide a diet for fish and birds.

The specific location of various creatures depends upon individual adaptability to low and high tide exposure, temperature variation and sediment oxygen levels. During high tides, such typically deep water life as rock fish, skates and sharks forage in tidal flats, enjoying an abundantly rich smorgasbord.

Sailboats on San Francisco Bay

Boating

Boating on San Francisco Bay, its straits and estuaries has long been enjoyed by both spectator and participant. Dozens of marinas, yacht harbors and mooring facilities dot the Bay's shores, and both powerboat races and sailing regattas are regular occurrences. To control vessel movement and minimize collisions, the U.S. Coast Guard's Vessel Traffic Service (VTS) has designated traffic lanes and restricted areas which apply to deep-draft vessels. VTS, which also requires recreational boaters to comply with firmly-enforced guidelines, operates its sophisticated radar and telecommunications devices 24 hours a day to maximize safety for all.

9 Port of Oakland

The Port of Oakland is an excitingly active and impressively modern facility where visitors can observe the comings and goings of container-laden vessels from around the world. The best vantage point for viewing vessel movement and the ship loading and unloading process is Port View Park located at the tip of the Port's Seventh Street Terminal. The park, accessible from the 14th Street exit off Highway 17, can be reached by taking a right on Cypress Street and another right on Seventh. The Park's 60-foot viewing tower, surrounded by picnic facilities, a fishing pier and other amenities, provides not only a fine Port perspective, but also a place for viewing San Francisco Bay.

The Bay Bridge, Treasure Island, San Francisco, Alameda Naval Air Station and the San Mateo Bridge to the south are important landmarks visible from this lookout. Note U.S. Coast Guard facilities on Yerba Buena Island, marked by revolving radar equipment which monitors movement of all vessels on the Bay.

The Port, consisting of the Outer, Middle and Inner Harbors, has developed from the early 1960's as a break-bulk handling facility to become one of the world's largest container ports. During this 20-year period, the Port of Oakland has gone from forklift pallet cargo movement through four generations of increasingly sophisticated containerized development. The story of the Port's progress began in the Outer Harbor, which served as a U.S. Army base during World War II.

Over the years, various types of loading cranes have been used, beginning with a mobile crane. Later an onboard-type crane capable of lifting containers out and over the sides of ships was devised. This and the apron-rail mounted crane together represented another advance in the sophistication of the containerized shipping industry. The need for a larger area to accommodate container storage yards resulted in the development of the Seventh Street Terminal, a landfill area totalling approximately 140 acres. Begun in 1965, this is the Bay's most recent large landfill project.

Across the Bay to the south, note tankers and deep-draft ships moored in the South Bay Anchorage Area. It is here that heavily-laden vessels await the high tides that will ease movement into less-deep North Bay navigation channels. Here also, oil tankers are often relieved of a portion of

Port View Park tower

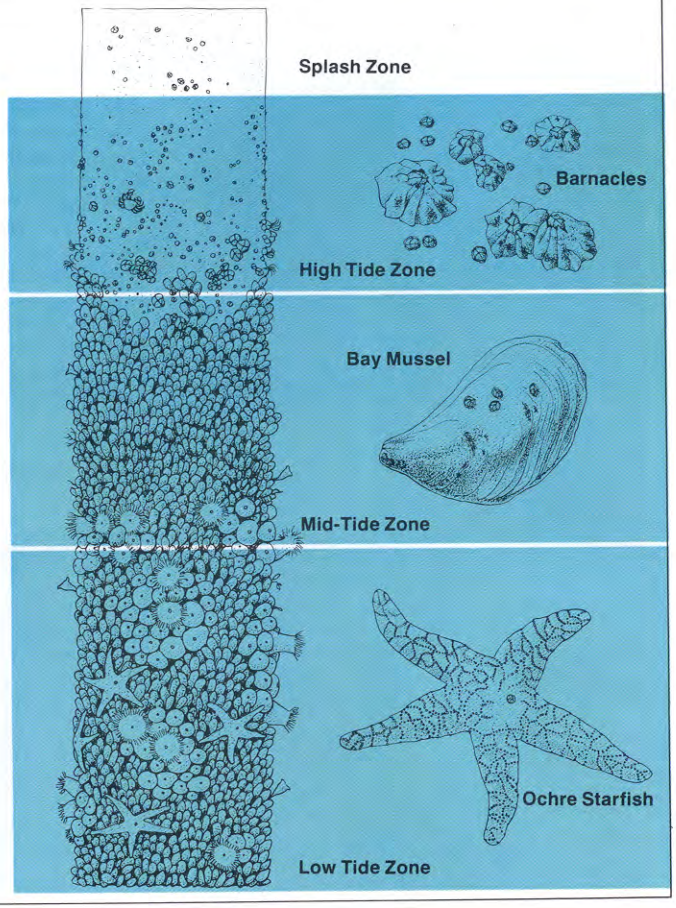
Low-profile container crane

The Ecology of a Piling

Pilings serve as ideal habitats for a vast number of organisms. As many as 100,000 microscopic organisms have been found to occupy a single square inch of surface.

Populations of worms and small crustaceans live between their larger neighbors. Each organism is positioned based on individual adaptability to the environmental qualities of splash, high, middle and low-tide zonations. Those illustrated represent some of the more visible occupants.

During World War II, the unexpected collapse of several harbor installations was believed to be the result of enemy infiltration. The collapses actually resulted from the insatiable hunger of the burrowing shipworm.



their loads by smaller oil carriers. As a result, tankers will ride higher in the water, making transport to North Bay refining facilities possible. Patient observers can often watch vessels moored in the Anchorage Area rotate around their anchors with the changing tides.

Leaving the Port of Oakland, return to Highway 17 and take the Broadway/Alameda Tube exit. The tube passes under the Oakland Inner Harbor Channel, a part of the long estuary which connects San Leandro Bay to Central San Francisco Bay. Follow Webster Street to Central, turn left, and then right to Westline Drive to visit Crown Memorial State Beach.

A stop along Alameda's Shoreline Drive offers an opportunity for beach strolling and fine Bay vistas. Also of interest is the fact that this area is exposed to eroding wind waves which cause a net longshore removal of sands toward the southeast. The Alameda shoreline, in fact, marks one of several national sites for erosion control experimentation. Sixteen alternative methods have been tested along this portion of the Bay. Sand filled bags and low breakwaters were among the materials used in erosion control experiments. Groins, structures built perpendicular to the shoreline, were also installed. Note areas where cordgrass has been planted in an attempt to stabilize sediments and produce the small marshes that will assist in reducing erosion.

Bay Farm Island jutting into the Bay to the south assists in protecting Alameda's vulnerable shoreline from wave action approaching from the southwest. A productive salt marsh has formed naturally at the southwest end of the beach. Endangered species such as the clapper rail inhabit this area, and salt marsh plants grow in great profusion.

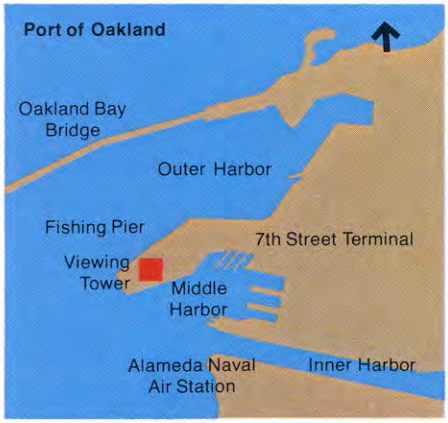
Leaving the Alameda shoreline, turn left on Park Street and right on Otis. Cross the San Leandro Channel to Bay Farm Island. Note the shallow, many-fingered San Leandro Bay to the left. Its marshy reaches are best exemplified by beautiful Arrowhead Marsh which, with surrounding grasses and mudflats, offers yet another wildlife refuge. Follow Doolittle Drive and stop at the sandy beach marking a portion of the San Leandro Regional Shoreline. Arrowhead Marsh is located directly across the channel. Return to Highway 17 south and drive through an area of fertile farmlands interspersed with residential development.

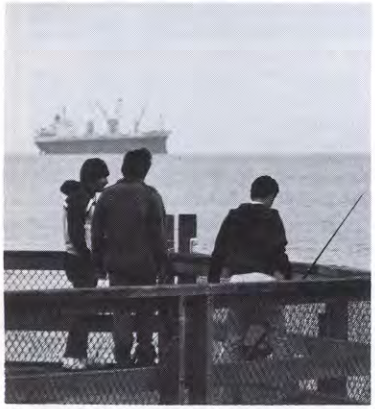
Containerization and Ports

Watching various types of container cranes in operation can be fascinating. Modern cranes vary in height from approximately 100 to 235 feet and can lift from 30 to 40 tons. The A-frame crane was the first used in Oakland, to be succeeded by a modified A-frame employing an even wider gauge than the earlier version. Crane heights have been restricted in the area adjacent to the Alameda Naval Air Station to accommodate naval flight paths. The Alameda Air Station serves as home port for a number of our country's massive aircraft carriers.

Today's most modern container ships can accommodate containers stacked three and four high. Containers measuring up to 40 feet in length are used to transport an endless variety of cargo including machinery, food products, glassware and antiques. Container ships serving many of the Bay's ports range up to 950 feet in length.

An interesting aspect of modern ports is the sophisticated computer systems used to ensure efficient loading and unloading of vessels. During the bulk-pallet loading era, four days were often required for loading or unloading a ship. Today, the same process can be accomplished in a matter of hours. Computerization not only controls the movement of containers between ship and shore, but also directs vessels to and from berthing areas to further facilitate efficiency and economy.





Port of Oakland fishing pier and vessel in South Bay Anchorage Area

Vista of Oakland Bay Bridge, Yerba Buena Island and bridge's eastern segment in background

Oakland Bay Bridge

The 8.5-mile-long San Francisco-Oakland Bay Bridge was completed in 1936. Consisting of two sections connected by a tunnel through Yerba Buena Island, the Bridge's western portion is actually two suspension bridges, joined end to end at a massive concrete pier in mid-Bay. The eastern portion is a combination of cantilever and truss types. The tunnel through Yerba Buena Island, carrying four lanes of traffic on each level, is the world's largest in diameter. The Bay Area Rapid Transit (BART) tube runs under the suspension span, connecting San Francisco and East Bay cities.

10 Coyote Hills Regional Park

In the City of Newark, exit on Jarvis Avenue, turn north on Newark Boulevard, and follow Patterson Ranch Road to Coyote Hills Regional Park. The Park's northern perimeter is marked by the Alameda Flood Control Channel. Formerly a narrow, regularly-flooding creek, it is now a Corp of Engineers-constructed channel designed to accommodate both low and high flows. It drains approximately 628 square miles of South Bay shorelands. Levees on either side provide pedestrian walkways. The northern levee also serves as an equestrian trail. The Corps has used a portion of this flood control area and an adjacent abandoned salt pond at the mouth of the creek as marsh plant experimentation areas. Here, various species and marsh development procedures have been evaluated for use in marsh renewal programs.

First opened to the public in 1968, the 1,000-acre Coyote Hills Regional Park rises out of salt flats east of San Francisco Bay, between the San Mateo and Dumbarton Bridges. The park has a rich and colorful history, beginning with habitation by a subtribe of the Costanoan Indians, who for centuries enjoyed a sumptuous diet of abalone, clams, salmon, venison, and other products of this fertile area. During the days of Spanish and Mexican rule, the region was known as *Potrero de los Cerritos,* or pasture of the little hills. Legend reports that today's name, Coyote Hills, came from coyotes howling in response to nearby train whistles. Now within the boundaries of the San Francisco Bay National Wildlife Refuge, the Park serves as a prized wildlife sanctuary.

The San Francisco Bay National Wildlife Refuge Interpretive Center is another worthwhile stopping place. It is located across the roadway from the Dumbarton Bridge toll plaza on Highway 84 at the west end of Thornton Avenue in the City of Fremont. The Center is situated on a small hill overlooking salt evaporation ponds, marshes and the South Bay. Numerous displays and interpretive programs are available Wednesday through Sunday year around.

Portion of Park shoreline

Coyote Hills Regional Park

Saltwater marshes, mudflats and diked salt evaporation ponds lie to the west of Coyote Hills. Freshwater marshes featuring redwing blackbirds, cattails, and a variery of grasses lie to the east. The park serves as another stop for birds migrating along the Pacific Flyway. As many as 20,000 sandpipers have been spotted on South Bay marshes in a single day, and it is estimated that some 250,000 fowl move through this and surrounding areas in a year's time. Many feed on brine shrimp and other organisms occupying neighboring salt evaporation ponds.

Hills are alive with small animals, adding to the abundantly vibrant atmosphere. Several high mounds in the Park's marshy eastern area are the only visible reminders of the Costanoan Indians' early day occupation.

Several trails and a boardwalk provide opportunities for quiet observation of this truly beautiful area.

Visitors enjoying the Park's superb nature walks

Salt pond dikes as seen from Park shoreline

Cattails in the area's fresh water marshes

Vista of salt ponds and marshes from the Interpretive Center

Shoreline fishing

11 Palo Alto Baylands Nature Preserve

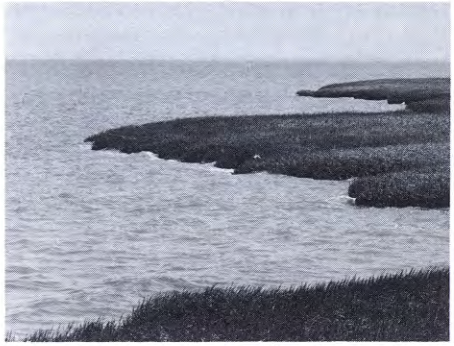
From the National Wildlife Refuge Interpretive Center proceed to the Dumbarton Bridge and cross this southerly portion of San Francisco Bay from Alameda County into San Mateo County. Catching the Bayshore Freeway, drive south toward Palo Alto and visit the Palo Alto Baylands Nature Preserve located at the east end of Embarcadero Boulevard. This 1,500-acre marshland sanctuary located near the Palo Alto Yacht Harbor, provides a year-round home for numerous species of local birds and serves as an important feeding and resting area for migratory waterfowl. An 850-foot boardwalk and an Interpretive Center, opened in 1969, introduce visitors to the fascinating habitat of salt marsh plants and animals.

Fall and winter months perhaps provide the optimum times for birdwatching, since more than a million shorebirds are believed to rest and feed in the area. The Great Blue Heron and the snowy-white American Egret, among the most majestic of salt marsh birds, are as prevalent here as in other Bay marshes.

The rare and endangered salt marsh harvest mouse also inhabits this area. It is unique in its ability to feed on the salty pickleweed, drink the marsh's highly-saline waters and cope with tidal fluctuations.

As you explore this unique ecological community, think about the sunlight-fed foodchain made up of salt marsh vegetation, micro-organisms, invertebrates and vertebrates, each depending upon the other for survival.

From Palo Alto's Bay Lands Nature Preserve, proceed north on Highway 101. In the Redwood City area, between roadway and shoreline, are thousands of acres of salt evaporation ponds, salt mounds and harvesting facilities. Here, too, are the Port of Redwood City, wildlife protection areas and salt marshes.



Fingers of salt marsh protruding from Baylands Nature Preserve shoreline

Salt Harvesting

The salt harvesting industry's solar evaporation ponds are one of the Bay's unique features. Ponds and harvesting facilities occupy some 47,000 acres of South Bay shores and provide an environment for aquatic life, small animals and waterfowl. Although displacing hundreds of acres of marsh and tidal flat areas, the ponds have become an integral habitat and an important element of the Bay's ecosystem.

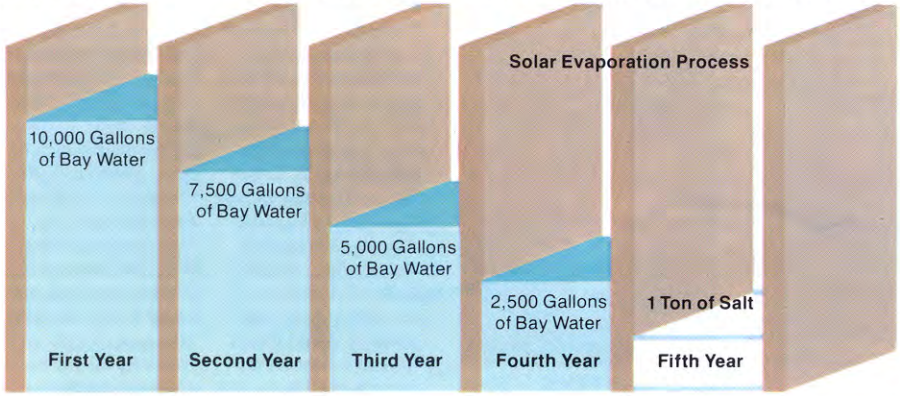
Long, sunny periods, a bountiful source of salt water, minimal rainfall, breezes, and low-lying land combine to make this area one of the country's few solar evaporation centers.

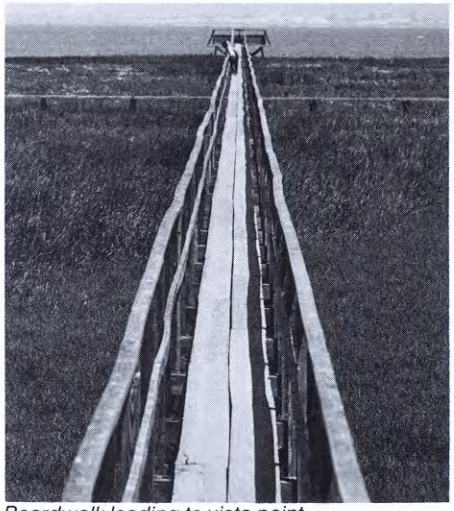
Some 10,000 gallons of Bay water yield a ton of salt. About nine billion gallons of salt water are processed annually to produce the one million tons of salt harvested by the area's major producer. About 350 miles of earthen dikes separate the ponds, which vary from 200 to 800 acres in size. The entire evaporation and crystallization process passes increasingly salty water through as many as 10 ponds over a period of five years. Harvesting occurs each fall just prior to the rainy season.

The unusually beautiful pink, red and mauve hues, particularly identifiable from the air, indicate the various types of algae that adapt to and grow in the changing levels of salinity.

Early Indians were the first to gather salt in Bay marshes. Cakes called "koyo" were baked, using the salty granules. In 1854, the first commercial solar evaporation pond was diked by an enterprising Gold Rush pioneer.

Only about 20% of the salt produced from San Francisco Bay waters is used for food-related purposes. The remaining 80% is used primarily for industrial purposes.





Boardwalk leading to vista point

Stockpiled salt near Redwood City Harbor

12 Coyote Point County Park

The 402-acre Coyote Point County Park is in San Mateo, accessible from Peninsula Avenue east of the highway. The park abounds with outdoor recreational opportunities. Once an island surrounded by a marsh, it now offers an exceptional natural history museum, a sandy beach, hiking trails, and a unique vantage point from which to view the hills of South San Francisco. Many stop here to watch planes approaching and leaving San Francisco International Airport, just across the water to the north.

13 San Francisco

Continuing north on Highway 101, follow the Broadway exit to Burlingame's Bayside Park, a pleasant area with a paved shoreline pathway. Return to the freeway and proceed north on Highway 101 through San Bruno and South San Francisco. Follow Highway 280 to San Francisco's downtown waterfront. Upon exiting Highway 280 continue straight ahead on Berry Street to drive along San Francisco's Embarcadero. Take a few moments to contemplate the Gold Rush days which gave San Francisco its rough and tumble beginnings. These were the days when this area first burst with activity.

While in San Francisco, take time to enjoy the numerous pleasures well known to more San Francisco visitors. Several points should be noted, however, that are of particular interest from the standpoint of Bay history.

The Ferry Building, still standing proudly along the Embarcadero at the foot of Market Street, once dominated the San Francisco shoreline and served as the terminus for the more than 25 ferry boat companies that provided cross-Bay transportation in the early 1900's.

Completed in 1898, the building was modeled after the Moorish-style Giralda Tower in Seville, Spain. Today it houses a World Trade Center and numerous government activities, including an outstanding state-owned geological museum and library. In 1958, the *Piedmont,* the last of the old ferries, made its final run from the Ferry building. The *Piedmont* was decked in black to signify the passing of an era. The Ferry Building's predecessor, a simple

San Francisco's Ferry Building

Maritime Museum

Golden Gate Promenade along Bay shoreline

Tugboats moored at Port of San Francisco pier

Commercial fishing boats at Fisherman's Wharf

San Francisco skyline from Treasure Island

Treasure Island

Treasure Island occupies some 400 acres of landfill in a formerly shallow area know as Yerba Buena Shoals. Designed for the 1939-1940 Golden Gate International Exhibition, the Island's construction began in 1937 when a three-mile rock enclosure was filled with 20 million cubic yards of Bay sands and silts. Total cost, including land reclamation, approximated $19 million. Just prior to the outbreak of World War II, Treasure Island became a military center, which serves today as a naval station, housing Pacific Fleet activities.

Visit the Navy/Marine Corps Museum near the Island's main gate. The museum traces Naval and Marine Corps history in the Pacific from 1813 to the present. Dramatic vistas of San Francisco, the Central Bay, Alcatraz and Angel Islands, and the Golden Gate and Bay Bridges are best enjoyed from a parking area just outside Treasure Island's entrance gate.

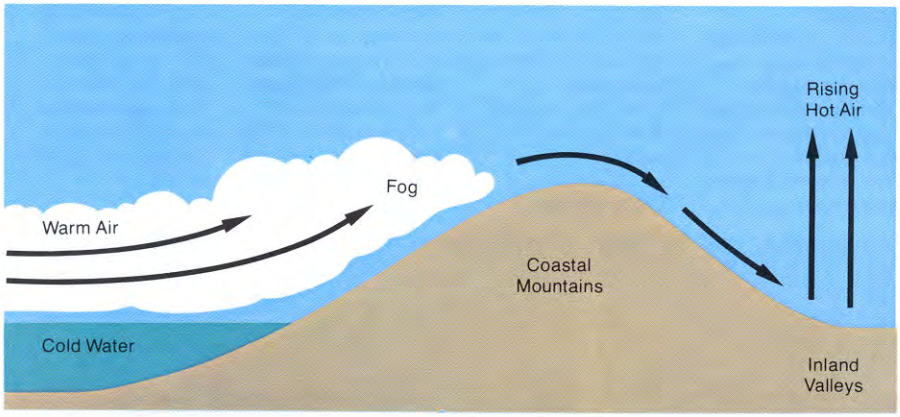
shed-like structure, marked the western end of the Central Pacific Railroad's transcontinental line.

Follow the Embarcadero past Fisherman's Wharf to the Hyde Street Pier, located to the east of Aquatic Park. Here visitors can explore a three-masted schooner built near the turn of the century and the ferryboat *Eureka* which ran from San Francisco to Sausalito, Tiburon and Oakland until it was retired in 1958.

Aquatic Park marks the beginning of the Golden Gate Promenade, a shoreline park that follows San Francisco's northern waterfront past the Maritime Museum and Fort Mason, then through the Presidio's Crissy Field to Fort Point, under the southern end of the Golden Gate Bridge. All are part of the Golden Gate National Recreation Area.

Fort Mason is a particularly interesting historical landmark. Spanish cannons were first placed at this defense point in 1797, and supplies were later stored there during the Spanish-American War. Following the 1906 earthquake, the Fort served for a time as a temporary home for thousands of quake victims. Serving as a center for the deployment of U.S. Army troops until 1963, Fort Mason is today a regional cultural center dedicated to the arts, humanities, recreation, education and ecology. It also houses the western national office of the Oceanic Society.

View of Gas House Cove and Fort Mason from Marina Green



Fogs
The summer fog so prevalent to San Francisco Bay varies from dramatically rolling clouds tumbling over coastal headlands to delicate mists sliding down grassy canyons. Persistent fog often funnels through the Golden Gate, retreating as sunlight dissipates its density. Foghorns on bridges, buoys and light stations boom a warning to navigators as heavy fogs move toward shore.

Bay fogs are a result of the combined effects of wind, water and heat. Fogs begin with prevailing northwest winds blowing across cold Pacific waters. In summer, as heated air from the inland valley rises, marine air is drawn inland to replace it. As winds cool, their water-holding ability is lost. Suspended drops of liquid form and fog develops. Because the Golden Gate is the coastal range's only complete natural break, it serves as the Bay's fog funnel.

Fog banks can range in width from a few hundred yards to more than a hundred miles. Heights vary from a hundred to more than 2,000 feet. It is believed that a million or more gallons of vaporized water a year move through the Golden Gate.

While usually appreciating its dramatic beauty, summer visitors are often surprised by the fog's wind-blown chill.

Penal Institutions
San Francisco Bay is surely one of the world's most beautiful spots. Incongruously, it has served as the site of a number of penal institutions and detention centers. Perhaps Alcatraz, from the Spanish word for pelican, is the most famous. It served as a Spanish fortress nearly 200 years ago and as a military and civil confinement center during Civil and World War I periods. Abandoned as a prison in 1964, Alcatraz now serves as a popular attraction for a curious public.

San Quentin, north of Corte Madera Creek in Marin County, is the only major penal institution still in existence on the Bay's shores. History reports the existence of numerous other local military and civilian prisons housed at such locations as Fort Point, The Presidio, Fort Mason and Angel Island.

"The Rock" as seen from Aquatic Park

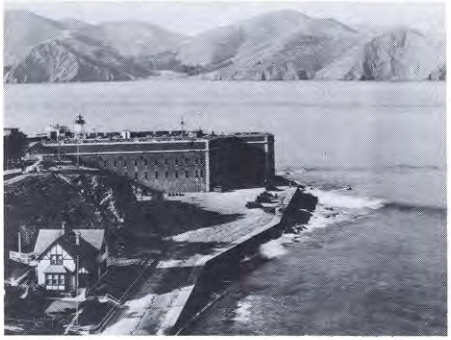
14 Fort Point

Protecting the valuable land-locked harbor of San Francisco Bay has been a defense concern since the early Spaniards discovered the Gate and established their first fort. Numerous U.S. forts and military strongholds were later built, including Forts Cronkhite, Baker, Barry, Mason, Scott and the Presidio. The San Francisco Presidio, the home of the U.S. Sixth Army, occupies 1,400 acres of the northern-most point of the San Francisco peninsula. Established by the Spanish in 1776, the Presidio played a major defense role through the Civil and Spanish American Wars and during World Wars I and II.

Fort Point, originally a pre-Civil War military compound known as Fort Winfield Scott, is situated at the water's edge just under the south arch of the Golden Gate Bridge. The first fort in the Bay Area, however, was *Castillo de San Joaquin,* an adobe built on the bluff area above the present fort in 1794. In 1853, the Spanish adobe was destroyed and the bluff was carved away to provide a base for today's Fort Point. Completed in 1861, its thick walls housed 600 soldiers, with space for 126 mounted cannon. Fort Point was abandoned as militarily obsolete in 1886.

During construction of the Golden Gate Bridge, however, the fort served briefly as an operations base, and was later a military post for a contingent of World War II soldiers. This handsome example of brick seacoast forts, dedicated as a national historic site in 1970, is identical to South Carolina's Fort Sumter. Its walls vary in thickness from five to twelve feet.

Excellent fishing grounds lie along the Fort Point seawall and the south tower of the Golden Gate Bridge. The area is a favorite surfing spot when heavy winter swells roll in through the Gate.



Fort Point prior to construction of Golden Gate Bridge

Caution

Although beautiful and often calm and placid in appearance, San Francisco Bay is not without its hazards. Waters are often capricious and unpredictable. Dense fogs can produce highly dangerous conditions. Using common sense and following a few words of caution will assist in ensuring a safe and memorable Bay experience.

Swimmers should be aware of the Bay's extremely cold waters which, even in more shallow, protected areas average 55° and rarely rise to a temperature above 65°F. Swimmers and boaters alike should be aware of the swift currents that accompany flood and ebb tides, and of dangerous eddy and rip tide conditions.

Stay well back from the edge of coastal cliffs where loose rocky materials can quickly slide to the waters below.

Bridges

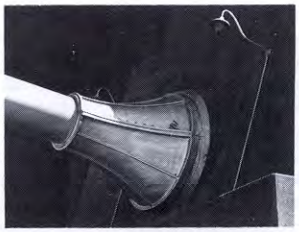
The first of the many bridges to span the Bay was built by Southern Pacific Railroad in 1906 between Dumbarton Point and Palo Alto. As early as 1869, however, San Francisco's eccentric "Emperor" Norton is rumored to have been the first man of foresight to declare, "A bridge shall be built."

Today, bridges of many types can be identified as one tours the Bay Area. Primary types include the cantilever, suspension, truss and the less typical bascule. The type used in each instance is based on engineering considerations pertinent to each site—length of the span, foundation, wind velocities and navigation requirements common to the vicinity.

Bascule bridge at China Basin in San Francisco

Richmond-San Rafael Bridge illustrating cantilever and truss construction

Carquinez Bridge, another example of a cantilever/truss bridge



Anchored end of massive cable supporting suspension portion of Oakland Bay Bridge

The Year of the Coast

In keeping with President Carter's declaration of 1980 as "The Year of the Coast," the U.S. Army Corps of Engineers has joined other public agencies and private organizations in focusing attention on the need to manage, preserve and protect our nation's coastal areas. To assist in this worthwhile objective, the San Francisco District of the Army Corps of Engineers will, throughout 1980 and 1981, publish a series of brochures highlighting key natural and manmade features of the California Coast. It is hoped that this series will both inform the public of coastal features and processes and assist in the development of a greater appreciation of the critical need to insure the protection and management of coastal resources.

For additional details on these brochures and other public information and education programs available from the Corps of Engineers, please contact the following Public Affairs Offices:

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San Francisco, CA 94111
(415) 556-5630

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