



Options and Qualitative Evaluation Report



Blending technical expertise and active community participation to define adaptation options for the low-lying North San Pedro Road through China Camp State Park

October 2019

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Cover photo by Marilyn Bagshaw



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Blending Technical Expertise and Active Community
Participation to Define Adaptation Options for the Low Lying
North San Pedro Road Through China Camp State Park**

**China Camp State Park Component of the
San Francisco Bay National Estuarine Research Reserve**

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Options and Qualitative Evaluation Report: Blending Technical Expertise and Active Community Participation to Define Adaptation Options for the Low Lying North San Pedro Road Through China Camp State Park

China Camp State Park Component of the San Francisco Bay National Estuarine Research Reserve

1 Introduction

North San Pedro Road runs along the shoreline of China Camp State Park in San Rafael, Marin County, California (Figure 1). China Camp is a unique landscape in the San Francisco Estuary – it is one of the very few remaining ancient tidal marshes in the Estuary, and one of only two places left where the ancient tidal marshes sit astride hillsides that remain undeveloped natural lands. This special setting is why China Camp was included as one of two sites in the San Francisco Bay National Estuarine Research Reserve (SF Bay NERR)¹, the other site being Rush Ranch Open Space Preserve in Suisun Marsh. This special setting also drives the importance of crafting environmentally appropriate road adaptation options while striving to achieve as many of the adaptation goals as possible.

About a mile and a half of the Marin County-owned North San Pedro Road in the Park and immediately adjacent to its northwest entrance is low-lying (Figure 2), currently floods on king tides and winter storms, and will increasingly flood with climate change-driven sea level rise and greater storm intensity. This road also crosses through the 240-acre (95 hectare) acre tidal marsh, leaving two inland marshes muted to the tides at Back Ranch and Miwok Meadows (20 acres/8 hectares total). The road is also a thoroughfare between Central and North San Rafael, connecting the Peacock Gap and Santa Venetia neighborhoods at each Park entrance. The road is used for recreational access to the Park, daily commuting, and emergency vehicles. The road is also an evacuation route. When U.S. Highway 101 and its adjacent frontage road get traffic clogged, China Camp is the shortest alternate north-south route through Marin County, with the few other routes being miles away in West Marin (Figure 3).

The SF Bay NERR applied for and received a federal “catalyst” grant from the NERR System Science Collaborative² to work with Marin County (Public Works, Parks, elected officials), California State Parks

¹ To learn about the SF Bay NERR, go to www.sfbaynerr.org.

² The Science Collaborative's primary goal is to support the co-development and application of relevant and usable knowledge to address critical coastal management issues identified by the NERRS in order to improve the long-term stewardship of the nation's estuaries. Catalyst grants support activities that advance collaborative science by facilitating the development of *new* collaborative science ideas; amplifying or enhancing *existing* collaborative research; or synthesizing NERRS System Wide Monitoring Program (SWMP) data for a regional or national

(State Parks), and a suite of stakeholders³ to begin developing sea level rise adaptation options. Marin County Supervisor Damon Connolly convened and the SF Bay NERR led this community stakeholder process. We utilized a community-based “bottom up” approach that was professionally facilitated and expert supported. We worked step-wise through 1) generating shared understanding of the landscape context, 2) establishing adaptation goals and implementation feasibility criteria, 3) generating adaptation options, 4) working through a qualitative comparative evaluation designed to elucidate how well options may achieve adaptation goals and be implementable, and 5) making recommendations to State Parks and the County on which alternatives to carry forward (Figure 4). State Parks and the County are the landowners and have ultimate say on which adaptation alternative to implement. Importantly, the idea is to carry forward to the next planning phase – feasibility study – *all* those adaptation alternatives that have merit to consider further. “Merit” means achieves all or as many goals as possible and is reasonably feasible to implement. “Feasibility” at the qualitative level we applied here in advance of any feasibility study data is by necessity an approximation that incorporates professional judgment and subjectivity.

This report is one of two presenting the outcomes of this community stakeholder process. This report addresses adaptation alternatives. The other report (SF Bay NERR 2019b) covers what steps follow in the near term and beyond to bring an adaptation project to implementation. Accompanying these two reports is a separate Existing Conditions Report (SF Bay NERR 2019c).

This report is organized as follows:

- **Section 1, Introduction**
- **Section 2, Framing Adaptation** – sea level rise and storm intensity, planning time horizons, road flooding and deterioration, the road within the local and regional transportation network, and the environmental setting of China Camp State Park frame adaptation goals, project feasibility, serve to spur creative thinking around options, and guide comparative evaluations.
- **Section 3, Goals, Feasibility Criteria, Design Considerations** – presents the suite of intended outcomes for any road reconfiguration option, a suite of feasibility criteria that affect the ability to implement any option, and other design considerations that are desired to factor in.
- **Section 4, Adaptation Alternatives** – these are the full suite of ideas generated by all the participating stakeholders, with as much “lumping” as viable for evaluation purposes.
- **Section 5, Screening-Level Alternatives Evaluation** – describes and applies the evaluation framework and identifies the relative merits of all alternatives.
- **Section 6, Alternatives Selected** – presents the alternatives selected to carry forward to feasibility assessment under a future funding source.

application. To learn about the NERRS Science Collaborative, go to <http://nerrsciencecollaborative.org/>. Documents related to this project can be accessed at: <http://nerrsciencecollaborative.org/project/Siegel18>

³ Stakeholders included State Parks, Marin County, park operator Friends of China Camp, City and County public works and emergency services, adjacent neighborhoods, conservation groups, and state and federal regulatory and resource agencies. See complete list in Appendix A.

Next Steps

The companion to this Alternatives Evaluation is the *Road Map to Implementation* report (SF Bay NERR 2019b). It details the next steps to move from the selection of alternatives to carry forward as presented in this report through all the additional planning, design, community participation, funding, and construction activities that conclude in a built outcome. In summary, these steps are:

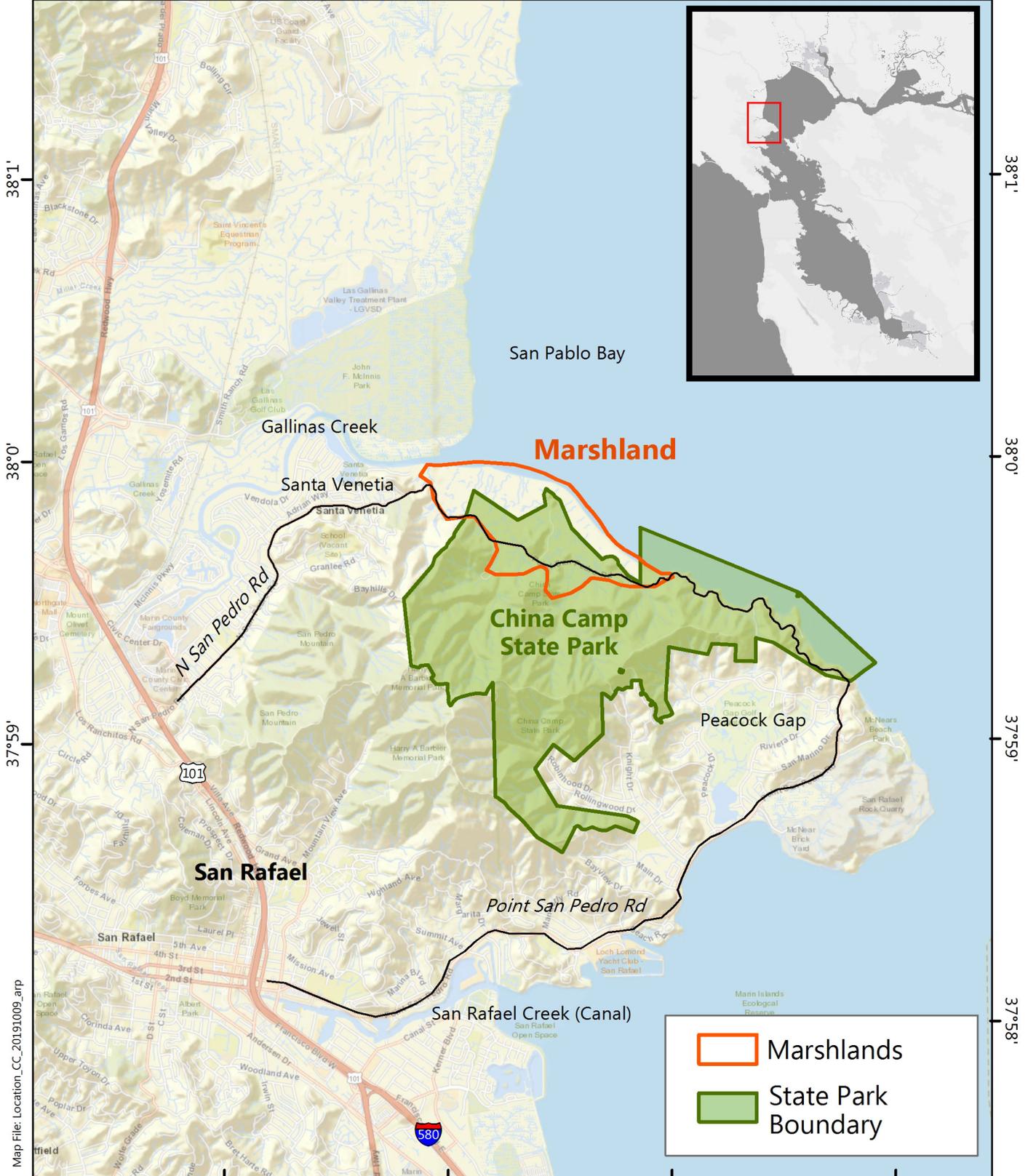
- 1) **Feasibility study** of all the alternatives recommended for advancement in this report. These studies will cover engineering issues, biological resources, cultural resources, recreation, topographic surveys, hydrologic studies and more as determined to be needed.
- 2) **Select a preferred alternative** based on feasibility study findings.
- 3) **Develop preliminary design** at the level suitable for carrying out environmental impact assessment.
- 4) **Conduct environmental impact assessment** (CEQA and possibly NEPA) and project **permitting**.
- 5) **Prepare engineering plans and specifications** suitable for bid and construction.
- 6) **Construct the project** according to plans.
- 7) **Assess outcomes** according to an Adaptive Management and Monitoring Plan that will have to be prepared in order to obtain state and federal permits.

Necessarily, funds will need to be raised to carry out all these activities, with funding most effectively sought in increments. Throughout all these activities, continue the stakeholder engagement and participation in defining the adaptation project and carrying it through to completion.

Access to Project Information

All project reports and a variety of related background and project materials are available online here: <http://nerrsciencecollaborative.org/project/Siegel18>

122°30' 122°29' 122°28' 122°27'



Map File: Location_CC_20191009_arp

Data Sources: Marshland Boundaries (NERR 2017);
 Parks Boundary (Parks 2018); Roads (US Census
 TIGER Product 2013); Coastline (National Hydrography
 Dataset 2017); Basemap (ESRI, HERE, Garmin, OpenStreetMap)

China Camp Vicinity Map

Marin County, CA

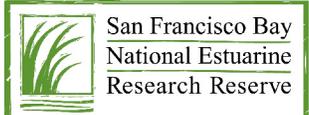
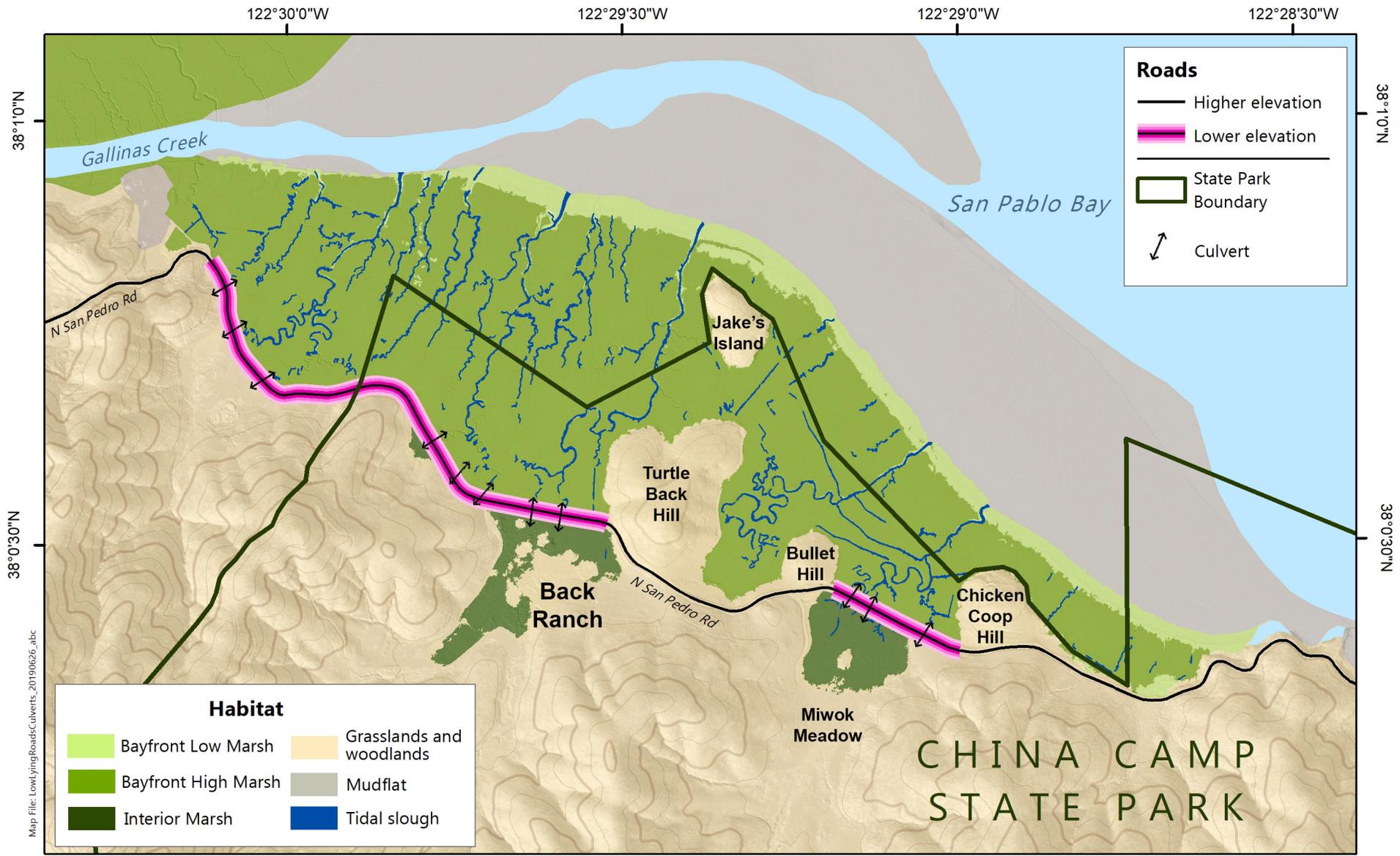
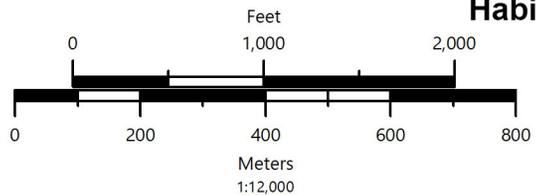


Figure 1



Map File: LowLyingRoadsCulverts_20190626_abc

Data Sources: Habitats, NERR 2006; Coastline, National Hydrography Dataset 2017; Road, US Census 2018; Mudflats, SFEI EcoAtlas; Hillshade, Marin County 2013; Park Boundary, State Parks 2018



**Habitats, North San Pedro Road, and Culverts
Northwest China Camp State Park**

Marin County, CA

Figure 2

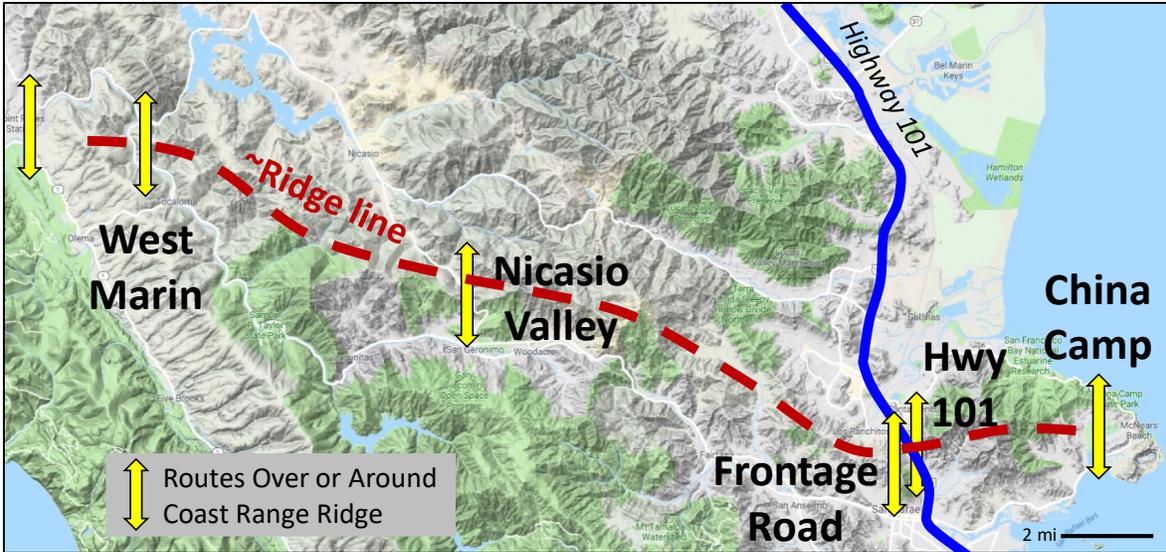


Figure 3. Alternate Transportation Linkages Over San Pedro Ridge

Six routes cross or go around the Coast Range ridge of central Marin County. If Highway 101 and its frontage road are blocked and China Camp is not passable, the only options are miles to the west along two-lane roads.

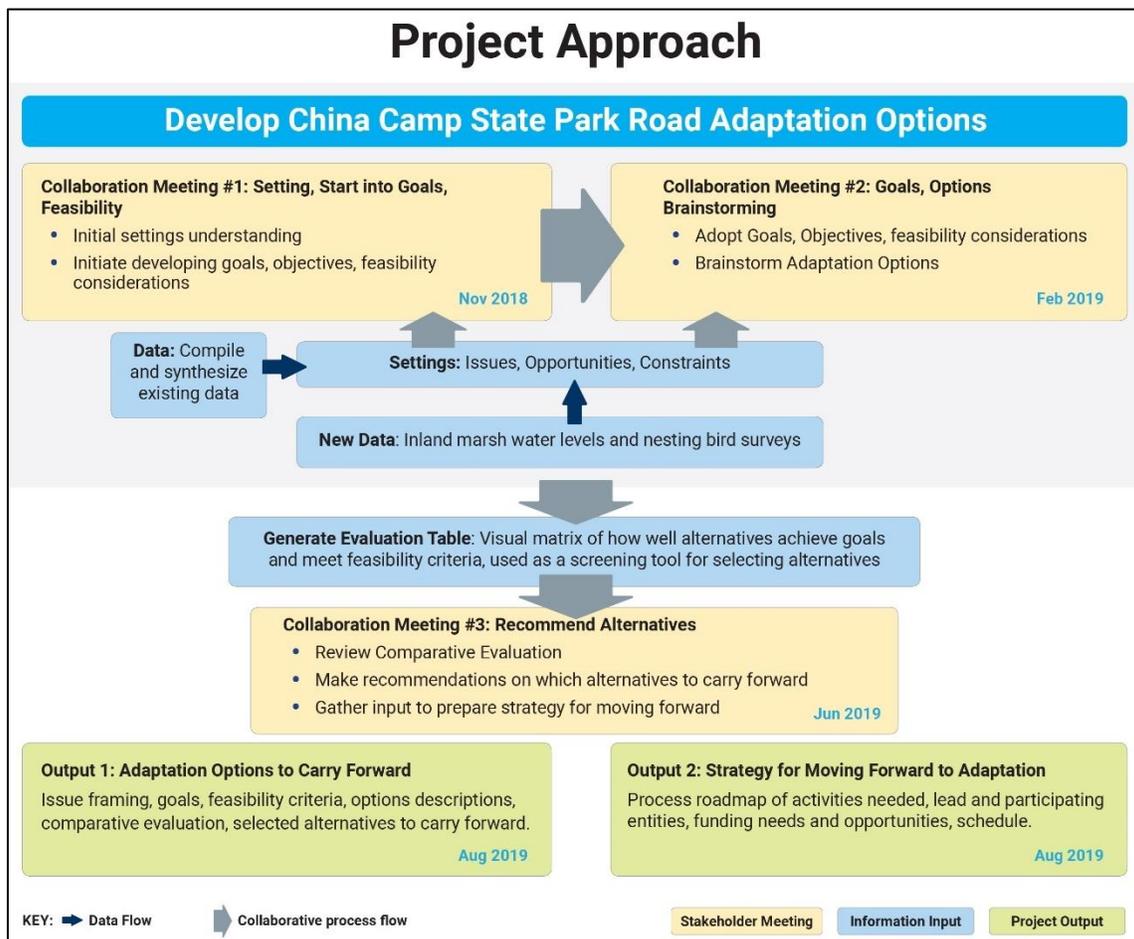


Figure 4. Adaptation Planning Process Overview

2 Framing Adaptation

Sea level rise and storm intensity, planning time horizons, road flooding and deterioration, how North San Pedro Road fits into the local and regional transportation network, and the environmental setting of China Camp State Park frame adaptation goals and project feasibility, serve to spur creative thinking around options, guide comparative evaluations, and guide selecting and implementing an adaptation project.

2.1 Sea Level Rise, Storms, and Planning Time Horizons

Sea Level Rise. The California Ocean Protection Council (OPC 2018) sea level rise projections are the most current values to apply. New projections will certainly be made in the near term, be it from OPC, the Intergovernmental Panel on Climate Change (IPCC), or other sources. Figure 5 plots the OPC (2018) projections for the Golden Gate and are used for this project. Figure 6 shows the geographic extent of these sea level rise projection values across the landscape at China Camp State Park.

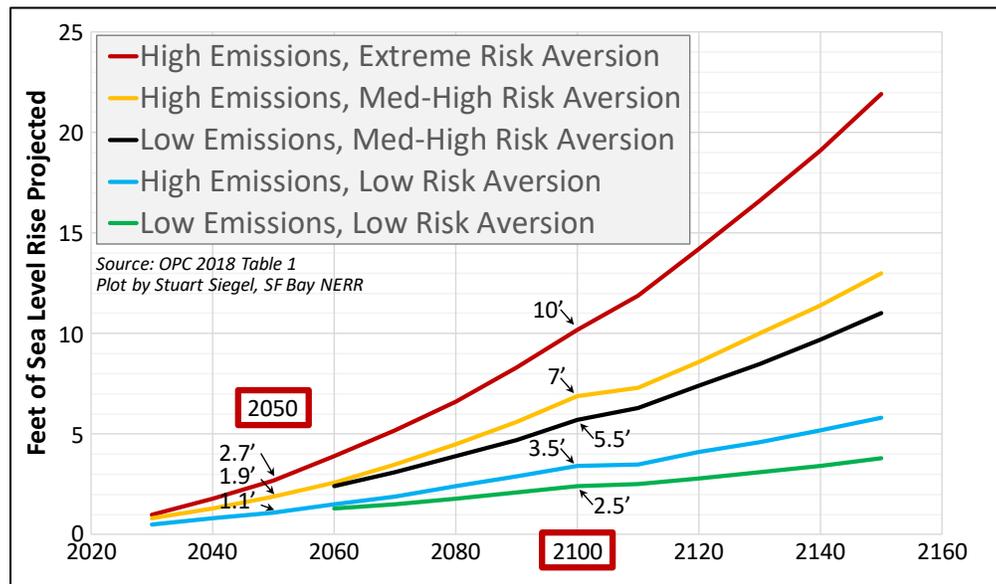
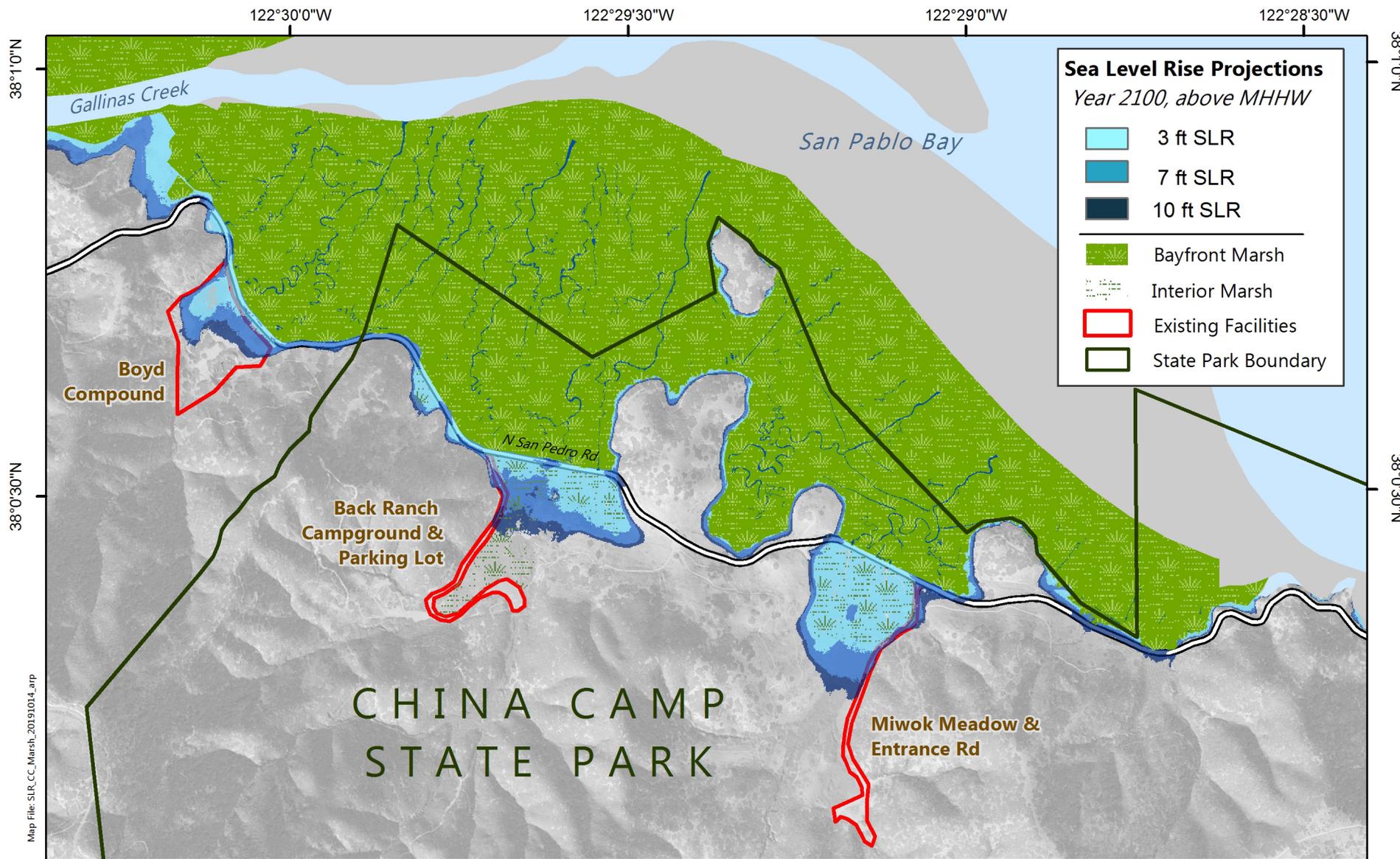


Figure 5. Sea Level Rise Projections from Ocean Protection Council (2018)

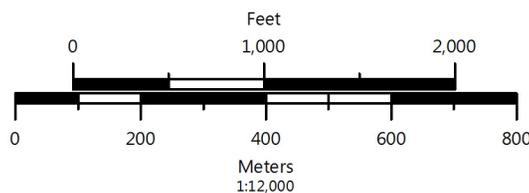


Data Sources: DEM, Marin County 2013; Coastline, National Hydrography Dataset 2017; Road, US Census 2017; Mudflats, SFEI EcoAtlas; Park Boundary, State Parks 2018;

Projected Sea Level Rise at Northwest China Camp State Park

Marin County, CA

Figure 6



Storms. According to the California 4th Climate Change Assessment (Bedsworth et al. 2018) and a recent Scripps Institute study (Gershunov et al. 2019), climate change will result in increased storm intensity mainly associated with atmospheric rivers, more extremes of drought and flooding, and about the same or more total precipitation though total precipitation change has less certainty. Subsequent adaptation planning efforts will examine how these effects may translate to China Camp State Park and the region more generally, especially regarding local watershed runoff and sediment transport. Observations from winter 2019, one of the wettest since record-keeping began in California, highlight road flooding, sediment transport into the upper reaches of the interior marshes and meadows, and landslide risk.

Planning Time Horizon. Discussion at and follow up to the Feb 19, 2019 stakeholder meeting established that this project will consider “medium-term” and “longer-term” planning horizons (Table 1). Much of the meeting conversation was around the planning time horizon that seems feasible to address at the present while keeping a clear focus on long-term sea level rise projections and incorporating regulatory requirements from the Bay Conservation and Development Commission (BCDC) to consider flooding from the 100-year (1 percent) storm in addition to projected sea level rise.

Table 1. Medium- and Longer-Term Planning Horizon Attributes for North San Pedro Road

Attributes of Planning Horizon	Medium Term Horizon	Longer Term Horizon
Time period ¹	Now to about 2050 (~30 yr)	About 2050 to 2100 (~30-80 yr)
Sea level rise projection used here ²	3 feet	7 feet
Storm event planning ³	1 percent (100 year)	1 percent (100 year)

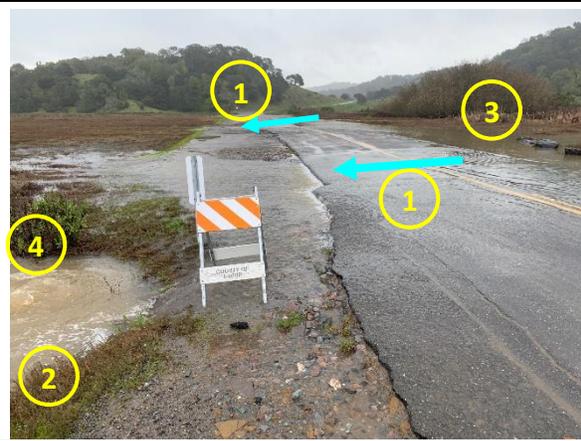
1. *Obtaining permits requires consideration of project functionality at 2100.*
2. *For 2050, BCDC stated they ask applicants to use 1.9 feet of sea level rise. The group adopted a more cautious 3 ft target in context of implementation costs.*
3. *BCDC stated that they require accounting for storm flows.*

2.2 Road Flooding and Deterioration

Each winter, king tides flood low-lying sections of North San Pedro Road. These yearly high tides often coincide with heavy winter rains and often multi-day storms, confounding how much of the road floods at any flood event (see Figure 2 for the extent of low-lying sections). The road can also flood from watershed stormwater runoff in absence of king tides, as observed in February 2019 (Photograph 1). Photograph 2 illustrates a winter king tide flooding event. Duration and depth of each flooding event and whether flooding occurs thus depends on how high the king tides rise, on amount of watershed runoff, and how quickly or slowly water drains through the culverts under North San Pedro Road and through the bayside tidal marsh to the bay. Commonly, flooding occurs around Back Ranch and Miwok Meadows and sometimes the flooding also occurs between Bucks Landing and the Park entrance.



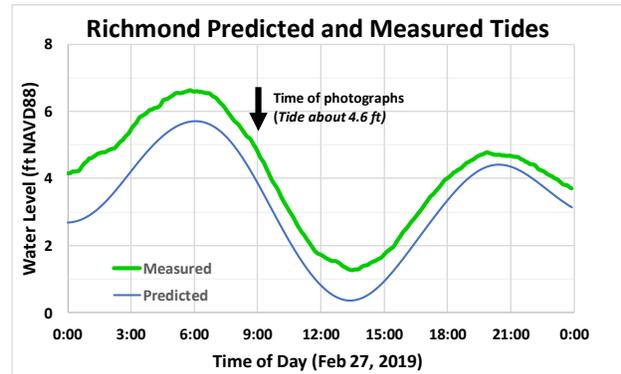
Watershed runoff at Back Ranch Road. State Parks reported about a foot of sediment deposition in the marsh higher up near the campground.



(1) Watershed flows flooding over road at Back Ranch Road culverts. (2) Tidal slough water level well below the road. (3) Extensive ponding inland of road. (4) Culvert was gurgling loudly from its outflows, indicating how undersized culverts are for storm flows.



(1) Flooding debris across road in front of Boyd property west of State Park entrance. (2) High pond water level.



Tide level at time of photographs (9am Feb 27, 2019), as measured at National Ocean Service Richmond station.

All photographs by Stuart Siegel, SF Bay NERR

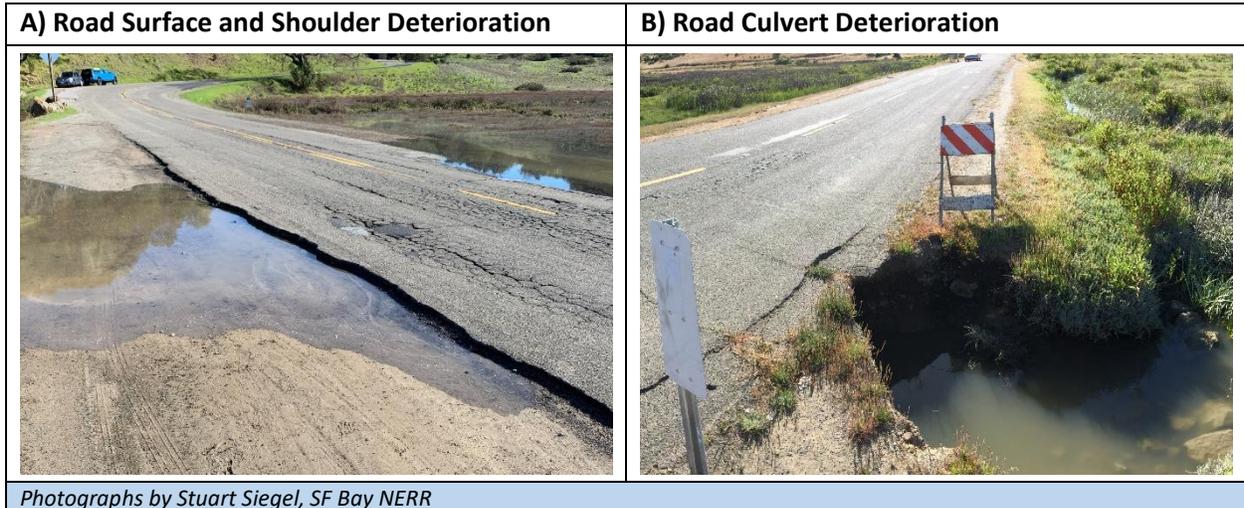
Photograph 1. Road Flooding from Stormwater Runoff, February 27, 2019



Photo by Marilyn Bagshaw

Photograph 2. Road Flooding from High Tides

There are two consequences of road flooding in relation to the road itself. First, the pavement shoulder and surface crack and deteriorate, making uneven road surfaces and abrupt drops onto the shoulder. Second, the existing aged culverts erode to the edge of the road, creating vehicular, bicycle, and pedestrian hazards. Marin County Department of Public Works is anticipating to complete repairs to several of these culverts in fall 2020.



Photograph 3. Road Shoulder and Culvert Deterioration

2.3 Functions of North San Pedro Road through China Camp

North San Pedro road serves multiple key functions. Current flooding impedes these functions and sea level rise and storms will further impair or eliminate these functions. During the stakeholder meetings, these functions and the associated community interests in them were identified.

2.3.1 The Road within Context of the Local and Regional Transportation Network

North San Pedro Road is a segment of the route that connects Central and North San Rafael around Point San Pedro (Figure 7). This route connects neighborhoods on both sides of the park and is the only local alternate north-south route to U.S. Highway 101 and its frontage road. The only other north-south routes across the coast range mountains through Marin County are far to the west (Figure 3).

One early suggestion during stakeholder meetings was to create two dead ends that would access the most popular ends of the park but not provide a full transportation option to the entire area. Though this might benefit wildlife and nature may force this outcome at some point in time, a majority of stakeholders expressed their views that it is critical to have the road persist as full corridor access from north to south, for all of the reasons listed below.

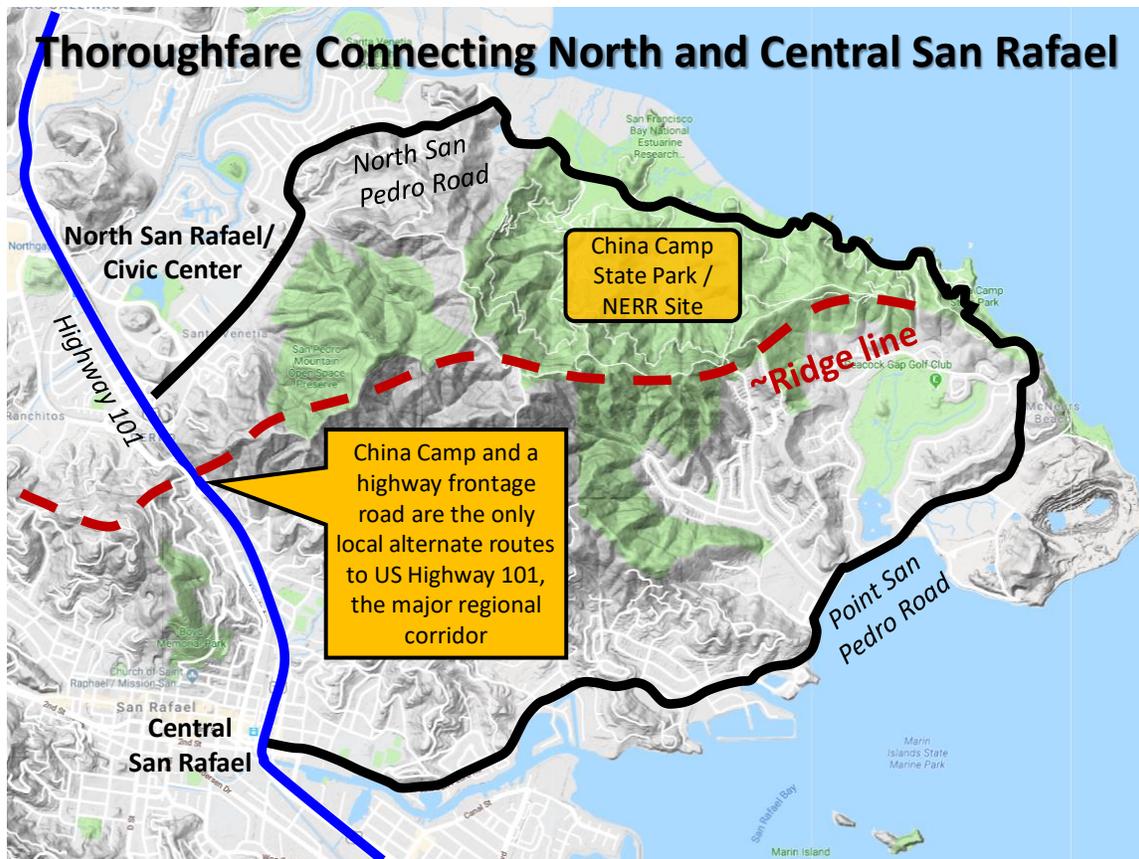


Figure 7. Road Setting Within the Local Central to North San Rafael Transportation Network

2.3.2 Recreation Access to China Camp State Park

China Camp State Park provides a myriad of recreational opportunities, including mountain biking, hiking, equestrian riding, camping, wildlife viewing, beach going, swimming, boating, education, picnicking, and more. The road being operable is key to accessing these recreational opportunities.

2.3.3 Commuting

In the case of extreme traffic on the Highway 101 corridor, and for residents adjacent to the park, the route through the park is often the preferred route. Both neighborhoods, Santa Venetia to the northwest and Peacock Gap to the south, have active neighborhood groups, Santa Venetia Neighborhood Association (SVNA) and Point San Pedro Road Coalition (PSPRC), respectively. Representatives from both were very involved in this process. Both groups stressed strong community interest in maintaining a viable through corridor relatively similar to current conditions.

We were provided an example of the critical nature of maintaining the full corridor for commuting, evacuation and emergency response when there was a traffic accident this past spring on Pt. San Pedro Road a few miles west of the south entrance to China Camp State Park. The accident blocked the road and closed all through traffic for several hours on a busy weekday morning for multiple San Rafael

neighborhoods. The only egress was through the Park. Had it coincided with a flooding event, egress would have been limited to those willing to drive through the water.

2.3.4 Evacuation

During emergencies the current flooding would slow if not prevent transit through the Park. In the case of fire or other emergency, the road through the park provides the best and, in some instances, only evacuation route.

2.3.5 Emergency Response Alternate Routes

We have become all too familiar with wildfire in this area and in the case that the Highway 101 corridor became clogged, the route through the park would provide the shortest possible alternative for emergency response vehicles. The Tubbs fire in fall 2017 and the Kincadee fire in fall 2019, both in Sonoma County, exemplify the importance of maintaining this north-south route through Marin, which applies equally to other north-south at-risk segments in Marin County.

2.4 China Camp State Park Setting

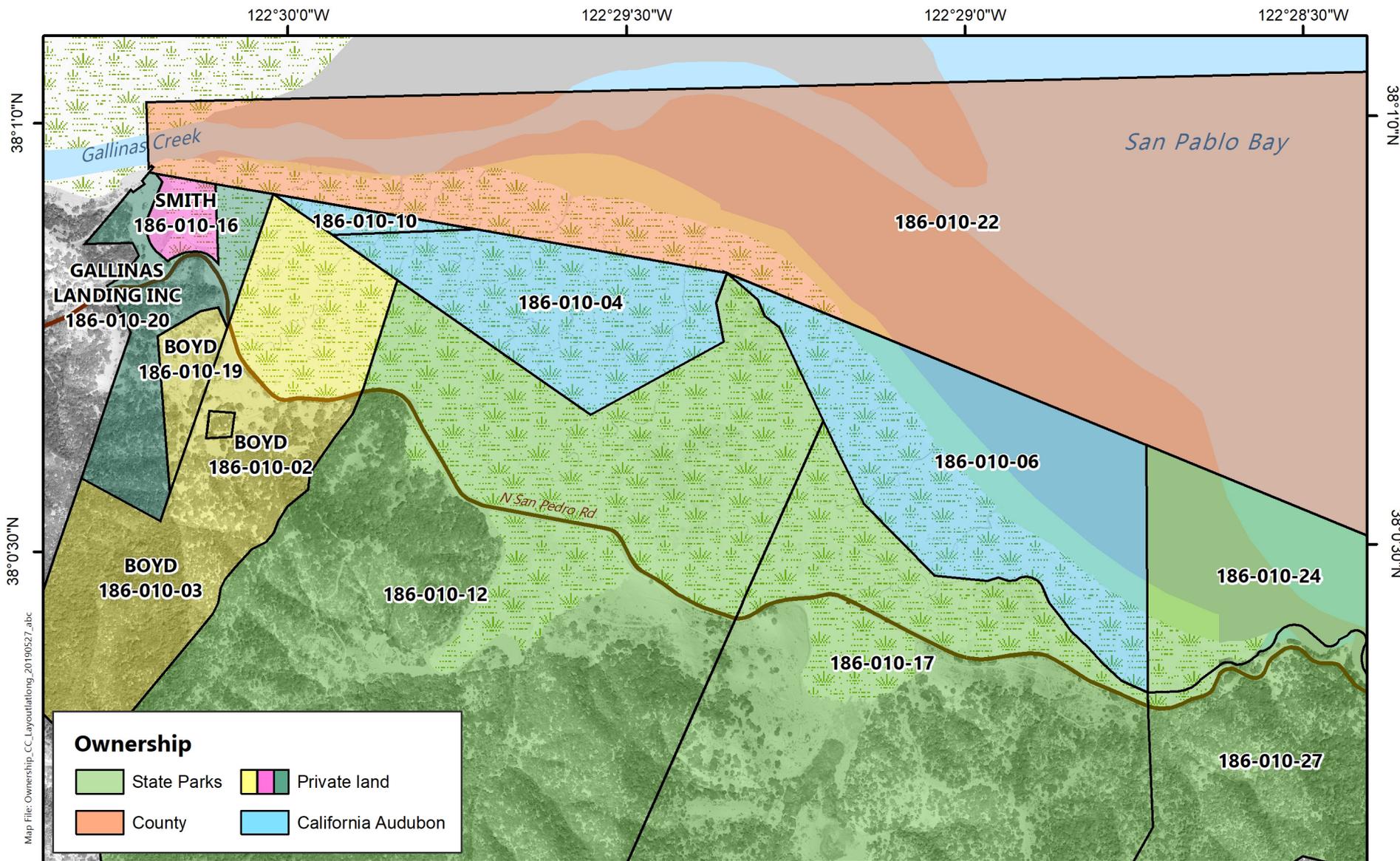
This section covers aspects of the China Camp State Park setting that directly influence adaptation planning: land ownership, physical environment, ecology modern and historical, cultural resources, and recreation.

2.4.1 Land Ownership

There are multiple ownerships in and around China Camp State Park (Figure 8):

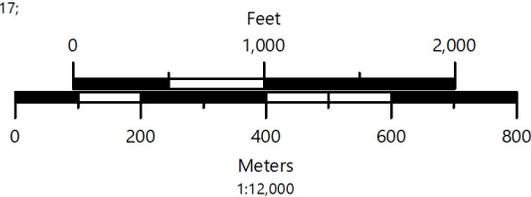
- **California State Parks** owns China Camp State Park itself, except for the road.
- **Marin County** owns North San Pedro Road, with a 50-foot wide road and shoulder right-of-way, and it owns portions of the bayside tidal marsh as well as portions of the open bay beyond the marsh.
- **California Audubon** owns three parcels of the bayside tidal marsh.
- The **Boyd family** owns the land to the immediate west of the Park entrance, including lands on both sides of North San Pedro Road.
- The **Gallinas Landing Company** owns Bucks Landing including lands on both sides of North San Pedro Road.
- The **Smith family** owns low-lying lands immediately east of Bucks Landing.

As planning proceeds, engagement with these other landowners may or will become necessary depending on which adaptation alternative is ultimately pursued.



Map File: Ownership_CC_layoutlatlong_20190527_abc

Data Sources: Ownership, Marin County 2018; Coastline, National Hydrography Dataset 2017; Road, US Census 2017; Mudflats, SFEI EcoAtlas; Imagery, NAIP 2016



Land Ownership Northwest China Camp State Park

Marin County, CA

Figure 8

2.4.2 Physical Environment (Geology, Soils, Geomorphology, Hydrology)

China Camp State Park is located on Point San Pedro in San Rafael, California. Local topography consists of California Coastal Range hills up to 1,000 feet elevation fringed by alluvial plains and tidal marshlands that, except for at the Park itself, have largely been urbanized (Figure 9). The hillslopes are Franciscan complex sandstone and shale from the late Cretaceous (100 to 66 million years ago). The alluvium, found in and around Back Ranch and Miwok Meadows, is of Pleistocene (2.6 million to last 12,000 years) or Holocene (last 12,000 years to the present) origin. The marine and marsh deposits of bay mud are of Holocene origin. North San Pedro Road itself is built atop Novato Clay soils in its low-lying areas and atop Tocaloma-McMullin Complex along its slopes above the bay. There are three local watersheds that drain to this section of North San Pedro Road, one at the Boyd property (100 acres), one at Back Ranch (330 acres), and one at Miwok Meadows (275 acres) (Figure 9). Table 2 shows the range of the tides (tidal datums) for China Camp State Park, as determined from externally published data.

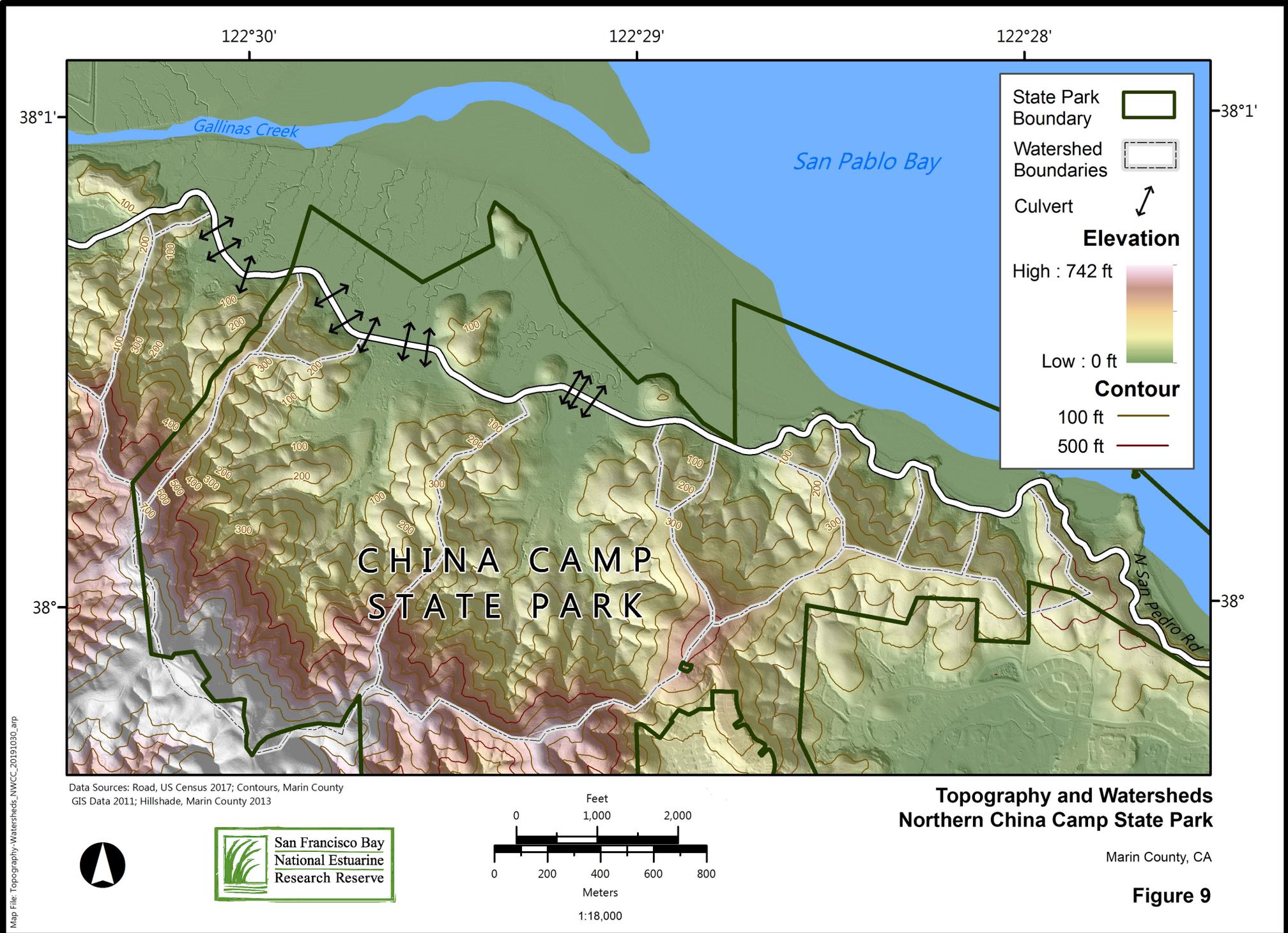
This physical setting guides feasibility considerations for addressing the low-lying sections of North San Pedro Road through and adjacent to the Park. Alternatives that retain the current road alignment must address local soils conditions (Novato Clay, the local version of “bay mud”) and its engineering properties challenges. Alternatives that consider rerouting the road further up into or around the local watersheds must address the local geology (Franciscan Formation) in the context of slope stability. All options must consider each of the three watershed’s stormwater runoff and sediment transport potential as well as the range of the tides today and accounting for future sea level rise.

Table 2. Tidal Datums

National Ocean Service (NOS) Station	Tidal Datum Elevations (NAVD88)					
	Gallinas Creek		Hamilton AFB Outside		Richmond Chevron Oil Pier (NWLON station ¹)	
NOS Station ID	941-5052		941-5124		941-4863	
Data Period	Aug-Oct 1979		Feb-Mar 2000		Oct 1995-Sep 2011	
Datum	(m)	(ft)	(m)	(ft)	(m)	(ft)
HOWL (2/6/1998)					2.637	8.65
MHHW ²	1.868	6.13	1.906	6.25	1.847	6.06
MHW	1.684	5.52	1.726	5.66	1.661	5.45
MTL	1.028	3.37	1.063	3.49	1.002	3.29
MSL	1.020	3.35	1.050	3.44	0.994	3.26
MLW	0.373	1.22	0.396	1.30	0.343	1.13
MLLW	0.065	0.21	0.064	0.21	0.000	0.00
LOWL (1/11/2009)					-0.764	-2.51
Spring Tide Range (MHHW-MLLW)	1.803	5.92	1.842	6.04	1.847	6.06
Highest observed range					3.401	11.16

Notes:

1. The Richmond station is one of five NOS long term continuous tide stations in the San Francisco Estuary.
2. For purposes of mapping simplicity, MHHW of 6 ft NAVD88 is utilized.

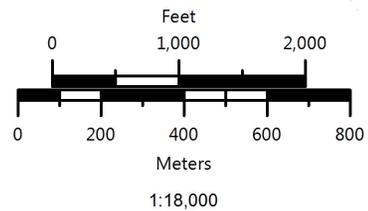


Data Sources: Road, US Census 2017; Contours, Marin County GIS Data 2011; Hillshade, Marin County 2013

Topography and Watersheds Northern China Camp State Park

Marin County, CA

Figure 9



Map File: Topography-Watersheds_NWCC_20191030.apr

2.4.3 Ecology (Habitats, Special Status Species, Invasive Species)

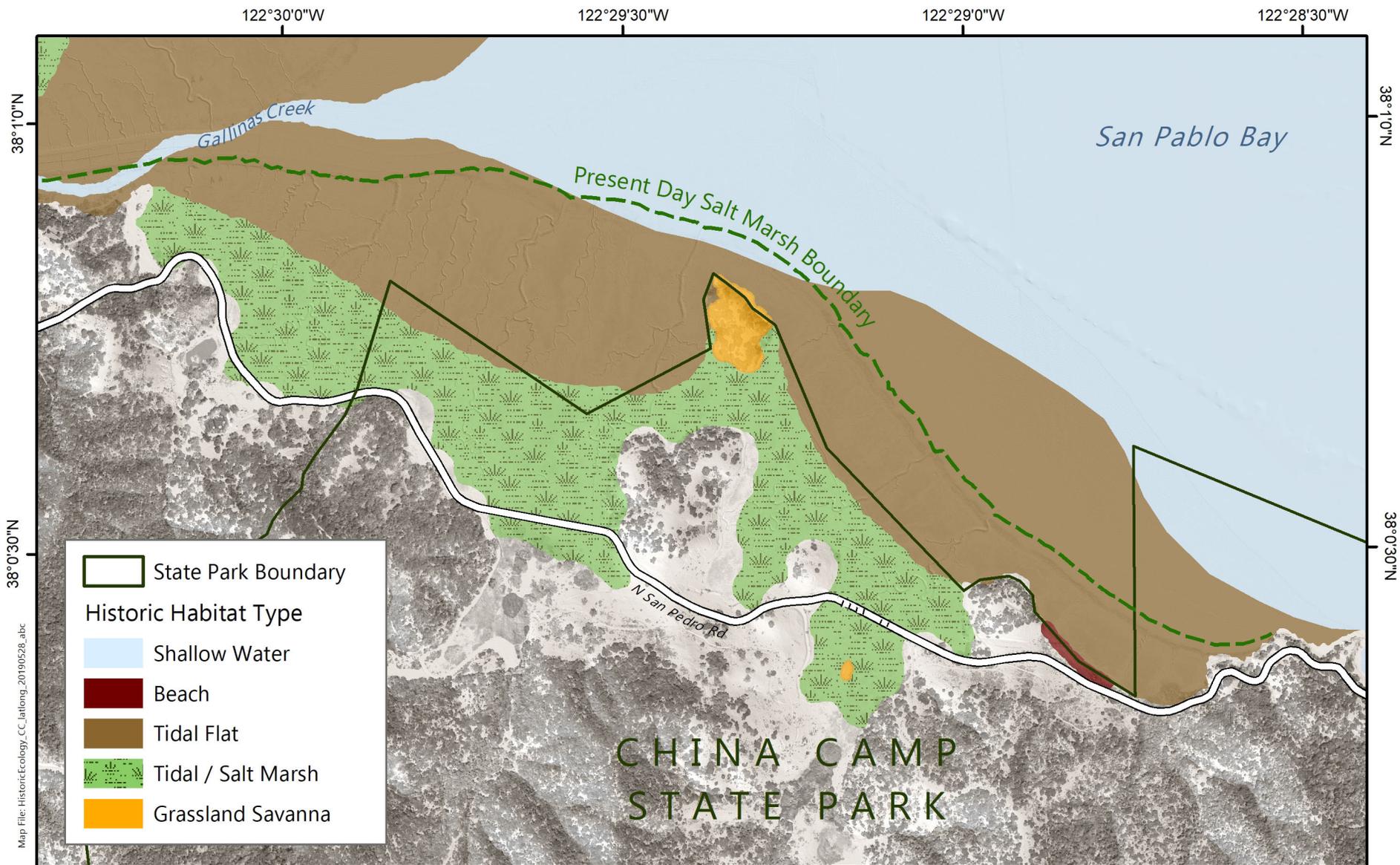
China Camp State Park supports four broad habitat types (Figure 2):

- **Grasslands and woodlands on the hillsides and alluvial fans.** Most of the 1,640-acre Park is comprised of hillsides covered with mixed evergreen forest, oak woodland, and chaparral, as well as some native grassland. The hills slope steeply, approaching a ridgeline comprised of chaparral and dry woodland, including coast live oak, manzanita, madrone, and California black oak. Meadows and hillsides also contain forbs such as lupine, Indian paintbrush, California milkwort, buckeye, and orange sticky monkeyflower. These areas support a diversity of wildlife, including songbirds and mammals. Northern Spotted owls, a listed species, utilize these habitats.
- **Interior marsh and adjacent meadows.** Located on the inland side of the road at Back Ranch and Miwok Meadows, with some smaller patches elsewhere along North San Pedro Road, these marshes receive muted tides (i.e., tides that are reduced in range due to undersized culverts that limit tidal flows). The Back Ranch and Miwok Meadows interior marshes also receive freshwater runoff from the watershed, and may also have groundwater seeps that feed them (though this is not established). Next to these marshes are meadows supporting a mix of freshwater wetlands, grasslands, shrubs, trees, and riparian corridors. Concurrent with this adaptation planning work, SF Bay NERR contracted with Point Blue Conservation Science to conduct field surveys to identify breeding bird uses of these areas. Point Blue concluded that the avian community reflects the unique habitat features of the interior marsh and meadows, which are not represented in other portions of China Camp State Park. These areas provide high quality post-fledging habitat for Song Sparrows due to the proximity to the tidal marsh and presence of taller dense vegetation such as California blackberry. Riparian focal bird species such as Wilson’s Warblers, Warbling Vireo, and Tree Swallows, as well as Common Yellowthroat and Virginia Rail currently benefit from the reduced tidal action in the interior marshes (Elrod and Wood, 2019).
- **Bayfront tidal marsh and sloughs.** The tidal marshes of China Camp State Park comprise a mix of remnant historic marshes and marshes that formed beginning in the later 1800s with deposition of hydraulic mining debris washed down from gold mining in the Sierra Nevada mountains, known commonly as “centennial marshes” (Figure 2, Figure 10). These marshes are open to full tidal exchange, with the tides entering through the many bayfront channels and the higher tides flooding directly over the bayfront edge of the entire marsh. Channels are much straighter in the “centennial” marsh near the bayfront, and very sinuous (winding) in the ancient marsh. The marsh plain vegetation is dominated by the common marsh plant pickleweed (*Salicornia pacifica*), with the channels ringed by marsh gumplant (*Grindelia stricta*) atop their banks and cordgrass (*Spartina foliosa*) along the banks. A variety of other marsh plant species are found intermixed with the pickleweed and along the wetland-upland edges. These tidal marshes support two endangered species (Ridgway’s Rail and salt marsh harvest mouse) plus several other special status species.

- **Mudflat and bay.** At the bayward edge of the tidal marsh are intertidal mudflats that grade into the open waters of San Pablo Bay. These areas support migratory shorebirds and waterfowl foraging (waterfowl use evidenced by the duck blinds sitting out on the mudflat) as well as a variety of fish species found in the San Francisco Estuary.

Collectively, these habitats, the many species they support, the natural resource protections they require, and the opportunities for their enhancement provide a range of factors to consider during alternatives evaluation.

Figure 10 shows the “historical” estuarine habitats present at China Camp State Park – mapped roughly as of California statehood (Goals Project 1999). As noted above, much of the modern-day tidal marsh was historically tidal mudflat. Hydraulic mining debris generated from gold mining in the Sierra Nevada mountains in the 1860s through 1880s washed downstream and deposited extensively around the margins of San Pablo Bay, expanding tidal marshes bayward across what were tidal mudflats and shallow bay. These marshes are commonly referred to as “centennial marshes.”

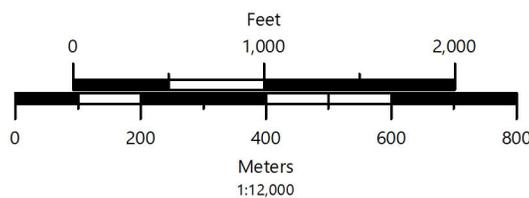


Data Sources: Historic Habitats, SFEI EcoAtlas 1998; Coastline, National Hydrography Dataset 2017; Road, US Census 2017; Park Boundary, State Parks 2018

Historic Ecology of Northwest China Camp State Park

Marin County, CA

Figure 10



2.4.4 Cultural Resources

China Camp State Park presents a rich archeological and cultural history. The area was inhabited by the indigenous Coast Miwok people for thousands of years prior the arrival of the Spanish in 1775. With the establishment of missions San Francisco de Asís in San Francisco in 1776 and San Rafael Arcangel in San Rafael in 1817, the Miwok population dramatically declined, as the mission system drastically changed the traditional, subsistence lifestyle of the Coast Miwok and introduced foreign disease. During the period of Spanish settlement, a 21,679-acre land grant known as Rancho San Pedro, Santa Margarita y Las Gallinas was established. In 1869, a large portion of the Rancho San Pedro was purchased by the McNear brothers from Sonoma County. These two businessmen began by establishing a 2500-acre dairy ranch and later a quarry and a brickyard (the latter two of which remain in operation today). Many Chinese immigrants worked at the brickyard located near the tip of Point San Pedro. In their off hours, they began shrimp fishing as they had in their native region of China. Over time, a sizable shrimp fishing village was established in this area. By the 1880's, approximately 500 people occupied the shrimp fishing village known as China Camp. Similar to the Coast Miwok who sought shelter along the rugged, isolated shores of Point San Pedro, China Camp was also isolated and most easily accessed by boat. The current village, pier, and museum have largely been preserved since the park was acquired in 1976. Today, China Camp State Park is treasured for its rich cultural history and is an active gathering place for both Native American and Chinese cultures.

Native American uses of China Camp State Park have historical and modern contexts. Native Americans extensively used the shorelines around many parts of San Francisco Bay and specifically at China Camp. As such, archaeological sites are known and probable along the bay margins in the park including up each local drainage such as Back Ranch and Miwok Meadows. Any ground-disturbing work as part of road adaptation would likely require archaeological assessments and associated protection measures. Native American cultural use of China Camp State Park persists today and includes ceremonies and ethnobotanical collecting. Similarly, road adaptation planning will need to assess how these uses may be affected. NERR and State Parks staff met with representatives of the local tribe, the Federated Indians of the Graton Rancheria, in May 2019 to begin the process of engaging with them and developing a relationship fir working collaboratively moving forward.

2.4.5 Recreation

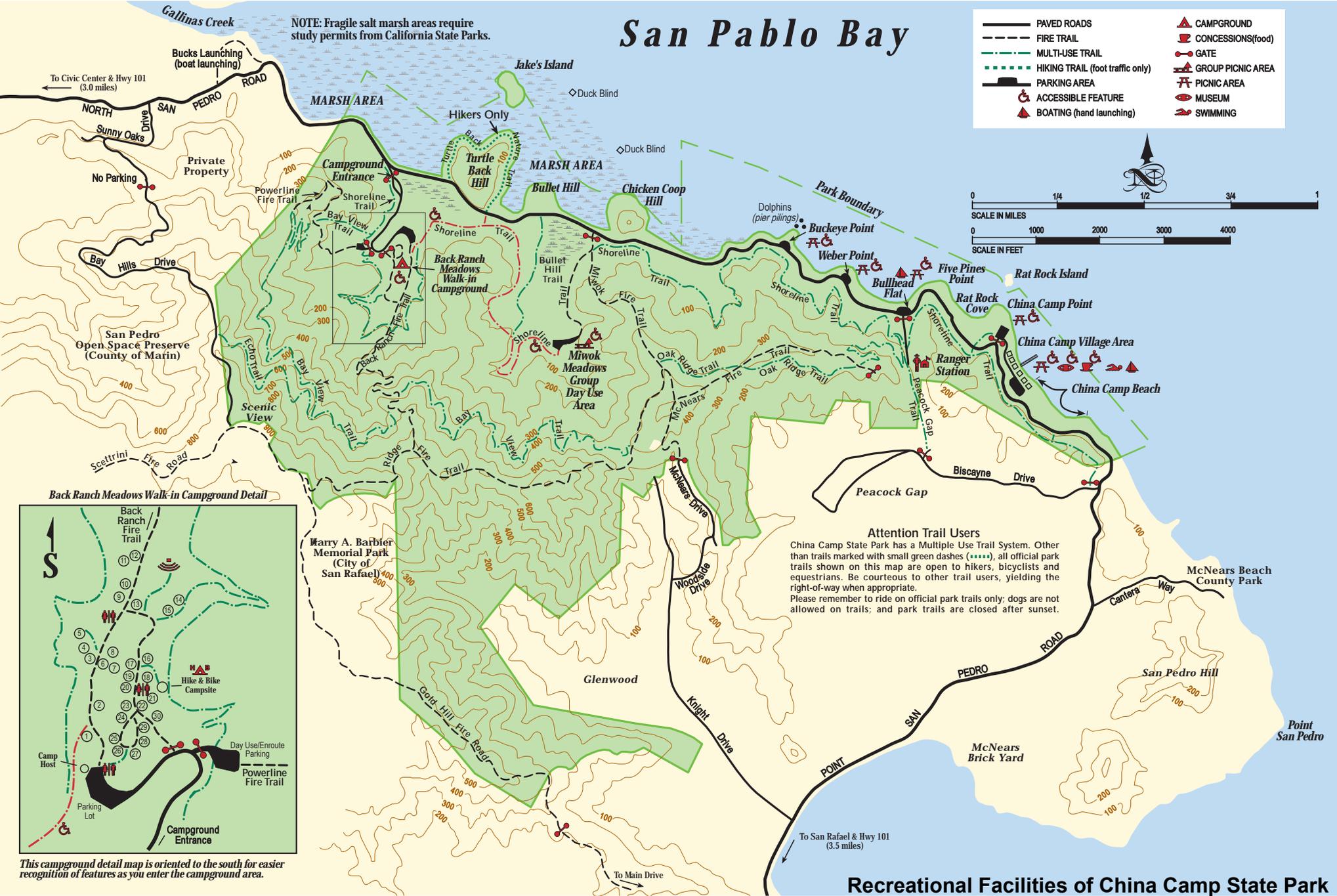
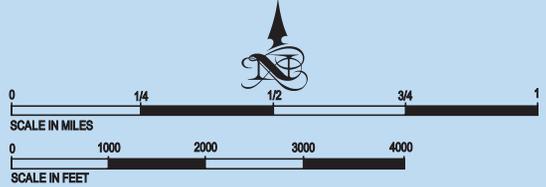
China Camp State Park is a 1,640-acre state park owned by California State Parks. The Park is operated largely by Friends of China Camp while State Parks manages natural and cultural resources. It offers some of the best mountain biking in Marin County, and is popular for hiking, camping and picnicking (Figure 11). The beaches at the village are used by swimmers and boaters. The extensive intertidal salt marsh, meadow, and oak woodlands provide excellent habitat for wildlife and their viewing. The varied views and landscapes make the park an ideal respite from the hustle of the city.

Preserving and enhancing the recreational experience at the Park is an integral goal of this road adaptation effort. How people get to and from the Park, how they utilize the Park safely, and how their uses are protective of the natural and cultural resources of the Park are all essential factors in understanding the relative effectiveness of different adaptation approaches.

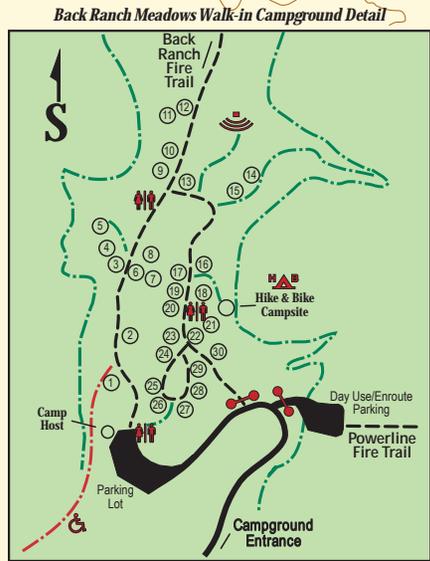
San Pablo Bay

NOTE: Fragile salt marsh areas require study permits from California State Parks.

- | | | | |
|--|----------------------------------|--|-------------------|
| | PAVED ROADS | | CAMPGROUND |
| | FIRE TRAIL | | CONCESSIONS(food) |
| | MULTI-USE TRAIL | | GATE |
| | HIKING TRAIL (foot traffic only) | | GROUP PICNIC AREA |
| | PARKING AREA | | PICNIC AREA |
| | ACCESSIBLE FEATURE | | MUSEUM |
| | BOATING (hand launching) | | SWIMMING |



Attention Trail Users
 China Camp State Park has a Multiple Use Trail System. Other than trails marked with small green dashes (.....), all official park trails shown on this map are open to hikers, bicyclists and equestrians. Be courteous to other trail users, yielding the right-of-way when appropriate. Please remember to ride on official park trails only; dogs are not allowed on trails; and park trails are closed after sunset.



This campground detail map is oriented to the south for easier recognition of features as you enter the campground area.

Recreational Facilities of China Camp State Park
 Figure 11

2.4.6 Education

China Camp State Park is also used for environmental education. K-12 and adult education programs are run by the SF Bay NERR and by Friends of China Camp. The unique features of the Park and its close proximity to urban centers makes it an especially attractive and valuable venue for these activities.

3 Goals, Feasibility Criteria, Design Considerations

Goals express intended outcomes and serve to help us identify and develop adaptation solutions. Feasibility criteria allow us to consider practical aspects of moving an idea to implementation. Design considerations capture elements that we want to account for as we get into advancing alternatives.

3.1 How We Formulated Goals, Feasibility Criteria and Design Considerations

Formulating goals was a critical and complicated component of this planning effort yet essential to complete before generating adaptation options (i.e., decide the destination before getting on the road). Similar though less complicated were formulating feasibility criteria and design considerations. With this effort, our process has aimed to bring in two elements – the technical expertise of the SF Bay NERR, Marin County Public Works, and State Parks (collectively, the Project Team), and the interests and requirements of the many stakeholders. With that in mind, here is what took place:

- 1) **First draft goals:** SF Bay NERR staff prepared the first draft goals based on conversations held during the 2017-2018 “short term” road adaptation stakeholder meetings and follow up conversations with key partners (State Parks, Marin County, Friends of China Camp).
- 2) **First discussion at November 30, 2018 stakeholder meeting #1:** At this stakeholder meeting, SF Bay NERR staff presented the goals and the group discussed and offered refinements. This topic represented a large portion of that meeting’s agenda and SF Bay NERR staff used this discussion to update the goals.
- 3) **Second draft goals discussion at February 19, 2019 stakeholder meeting #2:** Between the first and second stakeholder meetings, the Project Team discussed and refined that goals. At the second stakeholder meeting, SF Bay NERR staff presented the updated goals and participants discussed and further refined the goals. At that meeting, it became clear that the more broadly worded “road corridor” goal was not capturing the range of stakeholder perspectives. The stakeholder group also discussed approaches to incorporating planning time horizons into the goals during this meeting.
- 4) **Third draft goals March 25, 2019 memo:** SF Bay NERR staff refined goals further following the February 2019 stakeholder meeting. Refinement included adding a fourth goal incorporating planning time horizons and adding specificity to the language of the road corridor goal. During this time, NERR project staff met with State Parks and Marin County, conferred with Friends of China Camp, and prepared and circulated for stakeholder comment a March 25, 2019 memorandum providing background about goal refinement and proposed language of refined

goals. SF Bay NERR staff received stakeholder comments from Point San Pedro Road Coalition, City of San Rafael, Marin Conservation League, Bay Conservation and Development Commission, Regional Water Quality Control Board, and Gallinas Watershed Council.

- 5) **Adoption of goals at June 12, 2019 stakeholder meeting #3:** the final step was “adopting” the goals at the June 12, 2019 stakeholder meeting. Based on discussion at that meeting and the comments received on the March 25, 2019 memorandum, the Project Team believes it and the participating stakeholders found the goals presented below to be acceptable.

3.2 Goals

Road adaptation goals are at the heart of this adaptation planning effort. Not surprisingly, goals can be challenging to capture the diverse interests of the many stakeholders, and here the Project Team has captured these differences. Finally, this project also has a process goal about how we carry out this entire effort.

3.2.1 Road Adaptation Goals

Table 3 presents the goals and key context about each. It is important to recognize that it may not be possible to achieve all goals and thus future challenging choices may have to be made.

Table 3. Road Adaptation Goals

Goal	Context
<p>Recreation Maintain functionality of and access to China Camp State Park recreational resources.</p>	<p>This language addresses vehicular, pedestrian, and bicycle access from both directions and vehicular parking</p>
<p>Natural Resources Protect and enhance all the natural resources of China Camp State Park, especially marsh habitats along North San Pedro Road.</p>	<p>This language addresses tidal marsh bayward of North San Pedro Road, muted tidal marsh interior of the road, and other habitats</p>
<p>Sea Level Rise Adaptation Provide a road corridor that functions:</p> <ol style="list-style-type: none"> 1) In the medium term (to ~2050) and three (3) feet of sea level rise, and 2) To the extent practical, in the longer term (to ~2100) and seven (7) feet of sea level rise <p>and with both time frames also accommodating the 1 percent (100 year) storm event.</p>	<p>This language intends to capture medium- and long-term planning horizons and adaptability of the adaptation. Note that it is entirely possible some alternatives viable in the medium term may be viability-challenged in the long term.</p>
<p>Road Corridor Preservation In the face of sea-level rise, maintain an alignment of North San Pedro Road as a through road corridor between Peacock Gap and Santa Venetia that supports:</p> <ol style="list-style-type: none"> A. Recreation access to China Camp State Park B. Commuting C. Evacuation D. Emergency Response Alternate Route(s) E. Full corridor <p>recognizing that meeting all uses at all times over the medium and longer term may not be achievable, and considering compatibility with future planning efforts for the full North San Pedro Road-Point San Pedro Road corridor.</p>	<p>This language explicitly defines specific uses, services and geographies. It allows clarity on how alternatives are evaluated, including specifically about alignment choices:</p> <ul style="list-style-type: none"> • Vehicular access – effectively equal or not to current conditions? • Daily commute – relatively similar or not to current conditions? • Evacuation routes – vehicular transit out of each neighborhood to 101 on the “other side” of China Camp State Park • Emergency responders – relatively “fast” transit corridor around Point San Pedro as alternate route to 101 and Los Ranchitos/Lincoln

3.2.2 Acknowledging Different Stakeholder Perspectives on Adaptation Goals

Given that the stakeholders represent a diverse range of interests, it should be of no surprise that differing perspectives exist amongst the stakeholders. Further, achieving all goals may not be possible and thus choices between goals could well have to be made. Thus, the following elements raised by some stakeholders helps to inform future discussions around making such choices:

- **Minimizing Road Adaptation Environmental Impacts** – The State Parks General Plan for China Camp identifies protection of the ancient tidal marsh as its top priority. Further, State Parks has

clear policy guidance to minimize such impacts. At issue is being attentive to potential impacts to tidal marsh in the event that there is a medium-term solution to the road and a subsequent different longer-term solution that leads to a new suite of future implementation impacts.

- **Disaggregating routine daily from irregular road uses** – routine daily road uses are recreational access to trails, campgrounds, and day use areas at the Park and commuting. Irregular road uses are evacuation/egress when problems along North San Pedro Road or Point San Pedro Road require or encourage drivers to go through the Park, and emergency responders access to points near the Park or as an alternate route around Point San Pedro if Highway 101 and its frontage road are backed up or impassable. Part of adapting to climate change and sea level rise can be infrastructure based and part can be behavioral changes. Today when the road floods on king tides, people adjust their behavior by not using the road, or they elect to drive through the water at their own risk.
- **Continuity of the Entire Point San Pedro-North San Pedro Road Corridor** – Beyond the scope of this current effort is the need for a separate planning effort to examine the entirety of the road corridor around all of Point San Pedro from Central San Rafael to the Civic Center (Figure 7). There are other low sections of road and adapting the North San Pedro Road-Point San Pedro Road corridor road through China Camp State Park is part of the larger road corridor sea level rise adaptation fix. A future planning effort would include the City of San Rafael and Marin County as well as many additional stakeholders. We included compatibility consideration with such a future planning effort into the Road Corridor Goal.

3.2.3 Process Goal

Process Goal

- **Provide a model for other adaptation planning projects** that focuses on supporting and applying a “bottom up” community engagement approach to developing sea level rise adaptation solutions.

This project’s main focus is addressing the low-lying road sections of North San Pedro Road through China Camp State Park, but it is also about the process employed to achieve that outcome. Sea level rise adaptation efforts are being developed throughout the San Francisco Bay Area as well as in many other places around the United States and beyond. How we go about doing this work is very important, as we are working to protect and enhance the places where people live, work, recreate, relax, and enjoy. There are many examples where lack of community engagement kept adaptation efforts from being developed or moving forward. Real community participation is vital.

As such, this effort employed a “bottom-up” approach – allow those with “skin in the game” to be part of developing solutions to their local challenge of adapting to sea level rise. Stakeholders we have defined as those who are affected by, have interest in, and regulate adaptation efforts and the environments within or affected by adaptation or lack thereof. It also includes leads and funders of adaptation projects. This approach requires engaging stakeholders early, creating the opportunity for stakeholders to be active contributors of ideas through the entire planning and decision-making process, seeking stakeholder feedback on Project Team developed materials, and bringing technical expertise

and professional facilitation to the effort to support well informed and effective engagement. We accomplished this approach by holding a series of stakeholder meetings, discussions amongst various parties between meetings, and soliciting stakeholder input between meetings when issues rose up needing an extra level of attention. Key outcomes of this approach are adaptation goals that capture the diverse interests inherent amongst any group of stakeholders, original ideas for adaptation solutions, and well-founded choices of adaptation approaches worth pursuing for implementation.

3.3 Feasibility Criteria

Feasibility criteria help to assess the relative ease (“opportunities”) or difficulty (“constraints”) of bringing any alternative through to implementation. These criteria are intended to reflect a wide range of factors that commonly arise in the planning, design and permitting process and, also in this effort, issues of importance to the stakeholders. Feasibility criteria emerge from the experience of the Project Team with projects of this type in combination with understandings of the project setting, and from stakeholder input on matters of interest and importance.

SF Bay NERR staff initiated the feasibility criteria discussion with a first-round list developed from the “short-term actions” stakeholder meetings that took place earlier in 2018, from discussions with State Parks and County staff, and from past project experience. Part of the first stakeholder meeting on November 30, 2018 focused on discussing, refining, and augmenting these criteria. These were further discussed and refined at the second stakeholder meeting on February 19, 2019 and from input after that meeting. Finally, the Project Team sorted them thematically, added some details to aid in alternatives evaluation, and developed a *proposed* weighting system to reflect those criteria with proportionately greater effect on project feasibility. Table 4 presents the current iteration of the Feasibility Criteria and provides some explanatory context.

Cost estimates, developed at a very preliminary level by Marin County Public Works, carry a strong caveat. The cost estimates are broad and based on best available comparison data. They are intended to allow comparative evaluation and rough order of magnitude, not to assign actual dollar cost to each alternative. The next phase of this project will include cost estimate refinement for the alternatives carried into the feasibility study.

Table 4. Feasibility Criteria

Feasibility Criteria	Proposed Weighting Factor	Context
Implementation – Cost		
• Construction	10/High	Construction funds are highly competitive
• Operations and maintenance		Long-term consideration
• Mitigation		Offsetting resource impacts in endangered species habitats can be costly and difficult to achieve
Implementation – Regulatory Compliance		
• Complexity	3/Medium	Impact assessment and avoidance, mitigation needs, and policy consistency derive from design
• Cost of CEQA and permit compliance	1/Baseline	Level of effort scales with level of analysis needed, agency coordination, and public involvement for CEQA and permit acquisition
Implementation – County & Parks Consistency and Approval		
• County road mission consistency	1/Baseline	County's mission is to maintain safe, functional roadways for all users
• Compliance with Parks mission and ease of receiving approvals	3/Medium	Parks owns land on behalf of people of California (public trust obligations) and has established procedures for land use modifications in any park
Resource Protection		
• Protection of natural resources – marsh	10/High	China Camp State Park General Plan places protection of ancient tidal marsh as highest priority
• Protection of natural resources – uplands	1/Baseline	Woodlands and grasslands host far fewer listed species than the marshlands
• Protection of cultural resources	3/Medium	Archaeologists have identified lower elevations of China Camp as more likely to have cultural resources requiring protection
• Avoid hillside growth inducement	1/Baseline	Road alignments that provide access to currently inaccessible or poorly accessible unprotected lands could spur development on those lands
• Trail Relocation Avoidance	1/Baseline	Need for relocating and/or crossing recreational trails triggers Parks approval process and can impair recreational experience
Environmental Outcomes		
• Carbon footprint	1/Baseline	Net greenhouse gas balance of construction and long-term operations
• Sea level rise adaptability	1/Baseline	Can solution be modified in future with ongoing sea level rise
• Maximize environmental benefits	1/Baseline	Extent to which widest variety of environmental benefits are incorporated

3.4 Design Considerations

At the November 30, 2018 stakeholder meeting, we elicited the “interests” of all the groups represented. Some we catalogued as “design considerations” that one or more entities would like to see included. These design considerations are either already integrated into the alternatives described in Section 4 or will be integrated at a later design development stage.

- Improve ecological condition of interior marshes

- Avoid impacts to threatened and endangered species
- Enhance fire roads and trails at park
- If road relocated, maintain current roadway as non-vehicular recreation pathway
- Parking will be an issue to contend with
- Protect and enhance watershed and riparian area
- Marin County Department of Public Works needs a plan that doesn't impact budget long term
- Utilize local watershed sediment supply to extent possible
- Impacts on water quality-inland marshes and roadside parking
- Design life
- Coordination is KEY

One topic arose that will require further consideration: the pros and cons of enhancing tidal exchange between bay-side and interior marshes. The interior marshes were once part of the tidal marshes of China Camp State Park, before the road was built in the 1890s (Figure 10). The road and culverts dampen the tidal exchange of these interior marshes, prolong drainage of storm water runoff, and consequently alter their ecological functions. One approach is to enhance the level of tidal exchange to promote a full or less restricted tidal exchange, thereby allowing natural hydrologic processes to restore tidal marsh functions. Improving tidal exchange may also remove impediments to storm water runoff. Allowing greater or full tidal exchange would promote landward expansion of tidal marsh over time with sea level rise. Another approach is to take into account the distinct ecological functions these interior marshes serve today in their altered state. Though altered, their setting is very rare in the estuary today even though such ecological settings were relatively common historically. Preserving these functions in the face of sea level rise could prove difficult, would probably require some degree of ongoing management and hydrologic intervention, and could impede natural landward expansion of marsh with sea level rise. Exploring these issues in greater depth will be part of the next phase of adaptation project planning.

4 Road Adaptation Alternatives

4.1 How We Developed Adaptation Alternatives

The second stakeholder meeting, in February 2019, focused on soliciting adaptation ideas through a facilitated discussion informed with expert technical input and grounded in the landscape setting covered in the first stakeholder meeting in November 2018. We also held public king tides walks in January and February 2019 at which we solicited ideas from those who attended. Following the February 2019 meeting, the Project Team organized the ideas into as few alternatives as possible plus a “no action” alternative, grouped them thematically, and added descriptive information about what the alternatives would likely entail.

Table 5 lists the resulting alternatives, grouped thematically. Each are described below. In support of these alternatives, stakeholders also identified specific features that should reasonably be common to several or all of the options.

Table 5. List of Alternatives

No.	Name
Theme 1: Raise-in-Place Alternatives	
1	Raise road on current alignment via solid fill
2	Raise road on current alignment via modular causeway
3	Floating (pontoon) roadway
Theme 2: Reroute Alternatives	
4	Low Road – around Back Ranch and/or Miwok Meadows
5	Middle Road – higher up within the Park and its watershed
6	High Road – over the ridge
Theme 3: Maintain or Slightly Improve Existing Road Alternatives	
7	Retain current road and improve marsh hydrology
8	Lower road and improve marsh hydrology
9	Maintain status quo – allow existing road to persist with minimal maintenance, no replacement road

4.2 Theme 1: Raise-in-Place Alternatives

Alternative 1: Raise Road on Current Alignment via Solid Fill

- Fill could be earthen or perhaps in combination with lightweight fill or other technology to offset the need for deep foundations which increase project costs.
- Road engineered to balance multiple competing interests: 1) keeping footprint as narrow as possible to minimize wetland fill potential, 2) if possible, staying within the current 50' County-owned right-of-way, 3) avoid steep bayside slopes that could promote wave reflection and consequent marsh erosion, 4) provide wetland-upland transition habitat.

- Culverts replaced with much wider and taller culverts at current locations to remove flow constrictions for tidal and storm flows. Could be arch, box, etc. Details about culvert sizing and how they would integrate with a raised road have not been developed.
- Vehicle lanes and pedestrian and bicycle paths as narrow as possible, to minimize fill. Variances may be needed from standard road specifications.
- Inclusion of pedestrian and bike lane on at least one side. Future planning would address whether to have separate pedestrian and bike lanes to promote user experiences.
- Possible inclusion of “turnouts” for public access, viewpoints, interpretation, etc.
- Some stakeholders suggested a design approach of reducing to a single-lane road with light signal control (like Marin Headlands tunnel) plus pedestrian and bike lane, to minimize fill extent. This approach would require additional consideration as it would be a significant change from the current road operational configuration.

Alternative 2: Raise Road on Current Alignment via Pile-Supported Modular Causeway

- Likely to be designed to higher sea level rise target than 3 feet, due to high cost driving need to ensure longer life cycle.
- Design would incorporate best available “modular” design that facilitates future raising at lowest possible cost (though likely still expensive).
- Culverts would be unnecessary.
- Lanes as narrow as possible, to minimize volume and footprint of fill and to minimize extent of structures needed to support roadway.
- Inclusion of pedestrian and bike lane on at least one side. Future planning would address whether have separate pedestrian and bike lanes to promote user experiences.
- Possible inclusion of “turnouts” for public access, viewpoints, interpretation, etc.
- Possible design as single-lane road with light signal control (like Headlands tunnel) plus pedestrian and bike lane, to minimize volume and footprint of fill and to minimize extent of structures needed to support roadway.
- How an open road is maintained during construction will have to be determined, could be a bypass road, a one lane road that could see short term closures or periods of closure.

Alternative 3: Floating (Pontoon) Roadway

- (Details not discussed at stakeholder meetings. The following are prospective elements)
- “Pontoon bridge” or “pontoon road” is the most common version and encompasses a wide range of design approaches. pontoons are hollow, water-tight vessels. A pontoon road can be comprised of few large or many smaller pontoons. Pontoon displacement capacity defines the weight load that can be accommodated. Pontoon materials here would need to be durable to saline waters (e.g., made of concrete). Some form of anchors, mooring lines, or posts are needed to hold pontoon roads in place.

- Pontoon roads are less costly than a traditional bridge but can still be costly. They are not well suited to areas of high wind and strong wave action.
- Further research would be needed into engineering design options capable of supporting existing levels and types of vehicle use.
- Design can be made adaptive to ongoing sea level rise by adding sections at the ends. Anchor structure to uplands at ends of each low-lying reach.
- Pontoon spacing would be wide enough to allow ample tidal flow to promote marsh hydrologic connectivity. Initially that connectivity would be for high tides and over time with SLR it would be more frequent.
- To promote marsh hydrologic connectivity at the outset, this alternative would likely include widening existing culverts (see Alternative 7 below).
- The pontoons would be sitting on the ground much of the time and floating only during high tides. The bay mud foundation underlying the current road is a very soft substrate and with pontoons designed specifically to have space between, raises potential for vehicle loads to cause active undulation which in turn could compromise the road surface. These issues would require considerable engineering analysis to evaluate and address.
- Enhanced tidal flows to interior marshes, achieved through enlarged culverts and/or removing culverts entirely and enlarging channels in place of culverts.

4.3 Theme 2: Reroute Alternatives

Alternative 4: The “Low Road” Relocation Around Back Ranch and/or Miwok Meadows

- The road relocation would be along a low-elevation contour, above long-term sea level projections. In essence, it would be similar to the remainder of the road through the Park that runs along the bluff.
- This alternative could include relocating around Miwok Meadows and/or Back Ranch.
- The relocated road would utilize Back Ranch campground and Miwok Meadows access roads and shoreline trail to the extent possible. Exact routes have not been identified.
- Alignments anticipated to require some combination of hillside cuts, fill placement, retaining walls, and related road engineering elements including possible exemptions to road standards such as sight distances and curvature.
- May include short bridges or causeways and/or culverts to cross lower reaches of watersheds.
- Fate of low-lying shoreline road reaches: see below.
- Relocating some displaced trails will likely be necessary where a road alignment would overlap an existing trail.
- This routing is at least in part within the tribal and archaeological resource sensitivity areas of the Park, highlighting the concern and potential for cultural resource impacts.

Alternative 5: The “Middle Road” Reroute Higher up Within the Park and its Watershed

- Follow a route higher up the hillside from that considered in Alternative 4, but still within the existing watersheds of China Camp State Park.
- The location of such a route has not been examined. By staying within the watershed, it would not be an over-the-ridge route. This route would include the road climbing the hill from the shoreline road up to whatever elevation the relocated road is placed at.
- Alignments would require some combination of hillside cuts, fill placement, retaining walls, and related road engineering elements including possible exemptions to road standards such as sight distances and curvature. Measures to design in accord with the landslide-prone local geology would have to be incorporated.
- May include short bridges, causeways and/or large culverts at creek crossings.
- Fate of low-lying shoreline road reaches: see below.
- Relocating some displaced trails and/or adding trail crossings would likely be necessary.
- This routing is at least in part within the tribal and archaeological resource sensitivity areas of the Park.

Alternative 6: The “High Road” Reroute Over the Ridge

- Follow a route over Point San Pedro Mountain that utilizes existing residential and fire roads to greatest extent possible.
- Start and end points have not been established and thus how those points align with the Peacock Gap and Santa Venetia neighborhoods has not been established.
- Alignments would require some combination of hillside cuts, fill placement, retaining walls, and related road engineering elements including possible exemptions to road standards such as sight distances and curvature. Measures to design in accord with the landslide-prone local geology would have to be incorporated.
- Fate of low-lying shoreline road reaches: see below.

Fate of the Decommissioned Existing Road for Alternatives 4, 5 and 6

These three alternatives all involve intentionally decommissioning some or all of the low-lying sections of road. The fate of the decommissioned sections would have to be determined.

- Decommissioned sections of road would be closed to vehicular traffic once maintaining its current condition becomes infeasible for Marin County in the face of external drivers such as sea-level rise.
- Interests expressed for converting decommissioned road reaches:
 - Preserve as pedestrian and bicycle path. May require constructing boardwalks across low-lying reaches.
 - Restore and enhance tidal marsh
 - Remove or enlarge culverts depending on how designed

4.4 Theme 3: Maintain or Slightly Improve Existing Road Alternatives

Alternative 7: Retain Current Road and Improve Marsh Hydrology

- Road elevation would be retained at current elevation.
- Culverts would be considerably widened, such as with arch or box culverts, but not raised, to increase channel flow.
- Road surface maintenance would continue over time.
- Marsh hydrology would see increased overbank flooding frequency with SLR which would improve (but not necessarily fully achieve unimpeded) marsh hydrologic connectivity.
- Shoulder parking would be relocated.
- Road use would be progressively more limited as SLR occurs due to increased frequency and duration of flooding. After some level of SLR when flood frequency and depth would be too impactful for vehicle use, road would (probably) be closed at which time one of the above alternatives could be considered.

Alternative 8: Lower Road and Improve Marsh Hydrology

- Road elevation would be lowered specifically to increase high tide connectivity to the interior marshes. Amount of lowering to be determined but assume roughly one to two feet.
- Culverts would be widened as in Alternative 7 but not raised to increase channel flow.
- Road surface maintenance would continue over time.
- Marsh hydrology would see increased overbank flooding frequency with SLR which would improve (but not necessarily fully achieve unimpeded) marsh hydrologic connectivity.
- Shoulder parking would be relocated.
- Road use would be progressively more limited as SLR occurs due to increased frequency and duration of flooding. After some level of SLR when flood frequency and depth would be too impactful for vehicle use, road would (probably) be closed at which time one of the above alternatives could be considered. By intentionally lowering the road, this point in time would be reached sooner than for Alternative 7.

Alternative 9: Maintain Status Quo (“No Action”)

- This alternative includes the County maintaining the current road configuration, without raising the road, enlarging any of the culverts, and so forth. The County would keep the road at its current level of “maintenance priority” relative to all the other roads it maintains. Resurfacing would occur on a periodic basis, culverts would be maintained as needed, shoulder conditions would be maintained as needed.
- Tidal and storm flooding of the road would continue and increase in frequency. Flooding damage to the road would continue.
- At some indeterminate time, road and/or culvert deterioration and/or frequency of flooding will result in road temporary/indefinite/permanent closure.

4.5 Elements Likely Common to Most or All “Action” Alternatives

There are a number of design elements that would be “added” onto most or all of these alternatives depending on how specific configurations would play out. Essentially, these elements incorporate the principle of “promote multi-benefit opportunities.” Stakeholders identified these elements in the online survey response ahead of the November 2018 meeting, at the November 30, 2018 meeting, and at the February 19, 2019 meeting. This list is not necessarily complete and additions welcome.

- Provide replacement parking for lost shoulder parking (this could be either within China Camp State Park as allowed by the Park General Plan, or potentially nearby outside the Park).
- Protect and enhance watershed, wetland, and riparian areas, recognizing that these habitats themselves are dynamic natural systems and will be subject to other climate change-related pressures and that flexibility in approaches to their protection and enhancement is integral to achieving such outcomes.
- Allow for road closures that would initially be infrequent and brief from extreme tide and storm events and over time would become more frequent and less brief.
- Enhance fire roads and trails elsewhere at China Camp State Park where they may be impacted by implementation of whichever adaptation solution is adopted.

5 Alternatives Screening

Here we present the screening-level evaluation of the nine alternatives. The purpose is to inform decision making about which of the nine adaptation alternatives to carry forward for further planning. Specifically, this evaluation seeks to identify the road reconfiguration alternative(s) that best achieve the goals and are most feasible to implement.

This evaluation achieves its informative capacity by viewing all nine alternatives comparatively against each of the four project goals and thirteen feasibility criteria. It utilizes a *relative* scoring system to highlight differences. It includes a weighting system to draw attention to goals or feasibility criteria that the Project Team and stakeholders identified to be of particular significance. Finally, it provides multiple approaches to aggregating findings to support decision making, as no single approach necessarily captures the true nuances that exist (i.e., there are many “apples-to-oranges” comparisons).

SF Bay NERR staff built out this evaluation with careful review and input by State Parks and Marin County Public Works. SF Bay NERR staff presented and used the evaluation at the June 12, 2019 stakeholder meeting, first explaining and answering questions about the methods, next examining how the alternatives compared in achieving project goals, and concluding with highlights and key aspects of how each compared across the feasibility criteria.

Importantly, there is no restriction or pre-determined number of alternatives that “perform well.” The intent is to identify *all* alternatives that have real potential for yielding meaningful outcomes while having an acceptable degree of feasibility.

The evaluation consisted of a four-step process:

- Step 1: establish a scoring system
- Step 2: populate the scoring in the evaluation table
- Step 3: integrate scoring across all goals and feasibility criteria
- Step 4: presentation and discussion at the June 12, 2019 stakeholder meeting #3

Step 1: Establish a Scoring System

SF Bay NERR project staff took the first pass at establishing a scoring system which we then discussed with State Parks and Marin County Public Works. We settled upon the following scoring system and visual color scheme shown in Table 6.

Table 6. Evaluation Scoring System – Numerical and Color Coding

Score Value	Applied to Goals	Applied to Feasibility Criteria	Color Code
2	fully achieves the goal	high feasibility	Dark green
1.5	partially to fully achieves the goal	medium to high feasibility	Light green
1	partially achieves the goal	medium feasibility	Yellow
0.5	nominally achieves the goal	low to medium feasibility	Orange
0	does not achieve the goal	low feasibility	Red
-1	NA	impediment to feasibility	Dark red

Note the “-1, impediment to feasibility” scoring option. We identified that certain aspects of some alternatives could be an active feasibility impediment and wanted to bring attention to those issues.

Step 2: Populate the Scoring in the Evaluation Table

- Scoring is the identification of performance of each alternative *in comparison to other alternatives*. It applies the alternatives descriptions.
- Since the purpose is to compare alternatives, we determined that scoring is best accomplished by going “one at a time” through each goal and feasibility criterion for all alternatives.
- SF Bay NERR project staff took the first pass at populating the relative scoring.
- SF Bay NERR project staff and State Parks and Marin County Public Works staff then worked through these determinations in several iterations through meetings and over email to arrive at a place where we all concurred on the applied scores.

Of crucial importance during this process, Marin County Public Works developed estimated ranges of implementation costs. None of the alternatives have any further definition than what is described in Section 4 above, thus these cost estimate ranges are meant as rough guideposts. They assist in

comparing between alternatives. Importantly, they also give a sense of absolute costs, which are valuable in considering whether seeking those levels of implementation funds has a reasonable chance of success especially in a regional context of competition for sea level rise adaptation dollars.

Step 3: Integrate Scoring Across all Goals and Feasibility Criteria

This step is perhaps the most difficult. The goals and feasibility criteria reflect a diverse suite of topics. Goals express distinct community interests and it is entirely possible that no or few alternatives can achieve all the goals. Feasibility criteria express numerous distinct factors affecting implementation. As shown in Table 4 above, we have applied weighting factors to certain goals and feasibility criteria to draw attention to the importance of certain factors over others.

We considered a range of integrated scoring approaches:

- 1) **Simple weighted addition cumulatively across all goals and feasibility criteria** – multiply each score by its weighting factor and calculate total score. We rejected this approach because it does not distinguish between goals and feasibility criteria.
- 2) **Rely solely upon the color scheme** – use the visual cue of relative amount of green vs. red across all goals and feasibility criteria to see which stands out. We partially rejected this approach because it doesn't capture the weighting factors readily, though it is highly informative generally.
- 3) **Weighted cumulative scoring of goals separate from feasibility criteria** – calculate and consider the cumulative weighted scores separately for goals from feasibility criteria. This approach keeps goals and feasibility criteria scoring discrete which is essential. It captures weighting factors. Its downside is that cumulative scoring glosses over the substantive differences between the substance of each goal and feasibility criterion. We are electing to apply this approach within the stakeholder review context as one analytical element, with the caveat that to account for those substantive differences, decision making explicitly incorporates examining each goal and criterion alongside the cumulative scores.

Step 4: Presentation and Discussion at June 12, 2019 Stakeholder Meeting #3

The third and final stakeholder meeting under this current phase of project development took place on June 12, 2019. The primary purpose of this meeting was to apply the evaluation results to selection of alternative(s) with merit to carry forward into the next phases of planning, leading to the selection in the future of an alternative to pursue for implementation. At that meeting, SF Bay NERR staff walked the group through the process and evaluation findings (Table 7) and the group had a facilitated question-and-answer discussion much of which centered around the concepts underlying the weighting schemes and arriving at the place of applying the scoring system and considering but not relying solely on the weighting system.

TABLE 7 - ALTERNATIVES EVALUATION MATRIX

Scoring 2 1.5 1 0.5 0 -1	ROAD ADAPTATION GOALS Scoring: 2 = Fully Achieves, 1 = Partially Achieves, 0 = Does not Achieve					FEASIBILITY CRITERIA Scoring: 2 = Higher Feasibility, 1 = Moderate Feasibility, 0 = Low Feasibility, -1 = Impediment										SCORE									
	Recreation	Natural Resources A) Marsh B) Uplands	Road Corridor Function A) Recreation B) Commuting C) Evacuation D) Emergency E) Full corridor	Road Corridor Sea Level Rise A) 3 ft B) 7 ft	SCORE	Implementation					Resource Protection					Environmental Outcomes			Implementation	Resource Protection	Environ. Outcomes	TOTAL	RANK		
						COST* 30 yr Construction O&M Mitigation	Regulatory Compliance Complexity	Regulatory Compliance Cost of CEQA & Permit Compliance	County Road Mission Consistency	Parks Approval	Natural Resource Protection Marsh	Natural Resource Protection Uplands	Cultural Resource Protection	Avoid Hillside Growth Inducement	Trail Relocation Avoidance	Carbon Footprint	Sea Level Rise Adaptability	Maximize Environ. Benefits							
																								10	3
Weighting Factor -->	1	Marsh - 5 Uplands - 1	1 (average of all functions)	1 (average of A&B)	18	RANK																			
RAISE-IN-PLACE ALTERNATIVES																									
1	Raise road on current alignment, solid fill				67%	6**	\$5-10 M														50%	59%	33%	53%	5
2	Raise road on current alignment, causeway				100%	1	\$10-20 M														61%	75%	83%	69%	3
3	Floating roadway				79%	5	\$5-30M														15%	75%	67%	45%	6
REROUTE ALTERNATIVES																									
4	Relocate around Miwok Meadows &/or Back Ranch				89%	2	\$25-50M														-14%	72%	67%	30%	7
5	Higher route within Park watershed				83%	4	\$25-50M														-32%	89%	67%	28%	8
6	High road over the ridge				85%	3	\$50-100M														-35%	83%	50%	23%	9
MAINTAIN OR SLIGHTLY IMPROVE EXISTING ROAD ALTERNATIVES																									
7	Retain grade and improve hydrology				65%	7	~\$5M														72%	83%	83%	78%	2
8	Lower grade and improve hydrology				67%	6**	\$5-10M														57%	73%	83%	66%	4
9	Maintain Status Quo				19%	8	~\$1M														92%	67%	83%	80%	1

** tied scoring

* Cost Estimates are broad and rough

6 Alternatives Selected for Advancement to Feasibility Assessment

Selecting alternatives for advancement to the next phase of the project, a feasibility assessment, took place at and following the June 12, 2019 stakeholder meeting.

The following activities took place at the meeting:

- Five breakout groups discussed all the alternatives comparatively and arrived at group recommendations for each alternative of “yes, no, or maybe” carry forward.
- The meeting concluded with each attendee “voting” yes, no, or maybe for each of the nine alternatives, utilizing one flip chart for each alternative onto which attendees placed one sticker per alternative.

Following the June 2019 stakeholder meeting, Project Team members from SF Bay NERR, State Parks and the County met to finalize the selections. Two issues were addressed: decisions on the alternatives that fell into the “maybe category” and review of all the “rejected” alternatives to make sure we were not leaving behind an alternative that warranted carrying forward alongside those recommended by the stakeholders.

Table 8 presents the outcomes of the alternatives selection process. It shows the preliminary alternatives selection at stakeholder meeting #3 and the finalization of alternatives carried out jointly by SF Bay NERR, State Parks, and Marin County DPW after that meeting. Five alternatives have been identified for feasibility assessment. Alternative 1, initially rejected at the stakeholder meeting, has been included because it represents a typical approach to incremental raising of low elevation roads in Marin County (and many other localities) and serves to meet the County’s mission of maintaining safe, functional roadways for all users.

Table 8. Alternatives Selected to Carry Forward into Feasibility Assessment

ALTERNATIVES		Voting at 6/12/19 Stakeholder Meeting						FINAL	
		Breakout Groups			Individual				
No.	Name	Yes	Maybe	No	Yes	Maybe	No	Yes	No
Raise-in-Place Alternatives									
1*	Raise Road on Current Alignment via Solid Fill and Improve Marsh Hydrology	0	0	5	1	0	23	Y	
2	Raise Road on Current Alignment via Pile-Supported Modular Causeway	5	0	0	25	0	0	Y	
3	Floating (Pontoon) Roadway	0	2	2	9	3	13		N
Reroute Alternatives									
4	The “Low Road” Relocation Around Back Ranch and/or Miwok Meadows	1	3	1	14	3	8	Y	
5	The “Middle Road” Reroute Higher up Within the Park and its Watershed	1	2	2	8	2	15		N
6	The “High Road” Reroute Over the Ridge	0	1	4	0	3	21		N
Maintain or Slightly Improve Existing Road Alternatives									
7	Retain Current Road and Improve Marsh Hydrology	4	1	0	20	1	3	Y	
8	Lower Road and Improve Marsh Hydrology	0	1	4	2	0	21		N
9	Maintain Status Quo	Required (no action)						Y	

* Alternative 1 was retained following NERR-State Parks-County DPW conversations to include design approaches commonly considered around the SF Bay Area. Noted that marsh hydrology improvement in Alternative 7 may not have been clear for Alternative 1, so alternative name modified for clarity.

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Special thanks go to Marin County Supervisor Damon Connolly and his staff, Susannah Clarke, for all their efforts to convene and support the stakeholder group and to host discussions with State Senator Mike McGuire, Congressman Jared Huffman, and California Audubon.

California State Parks staff were also integral to this effort, with appreciation to Cyndy Shafer, Bree Hardcastle, and Kate Green.

Marin County Public Works devoted important staff time to support this effort, with special thanks to Ernest Klock for his input, participation, and cost estimating. The Marin County Parks and Open Space District also provided valuable inputs relating to its efforts around China Camp State Park.

Dave Ceppos of the Collaboration and Consensus Program at Sacramento State University provided invaluable facilitation and mediation support for all three stakeholder meetings as well as supporting the Project Team throughout its efforts.

And a round of appreciation to all the stakeholders who participated (see Appendix A).

References

- Bedsworth, Louise, Dan Cayan, Guido Franco, Leah Fisher, Sonya Ziaja. (California Governor's Office of Planning and Research, Scripps Institution of Oceanography, California Energy Commission, California Public Utilities Commission). 2018. Statewide Summary Report. California's Fourth Climate Change Assessment. Publication number: SUM-CCCA4-2018-013.
- California State Parks. 1979. China Camp State Park General Plan. Natural Resources Agency, Department of Parks and Recreation, Sacramento.
- Elrod, M. and J. Wood. 2019. Summary memorandum: China Camp Meadows Breeding Bird Surveys. Point Blue Conservation Science, Petaluma, CA. June 24.
- Gershunov A.; Tamara Shulgina ; Rachel E. S. Clemesha ; Kristen Guirguis ; David W. Pierce ; Michael D. Dettinger ; David A. Lavers ; Daniel R. Cayan ; Suraj D. Polade ; Julie Kalansky ; F. Martin Ralph. 2019. Precipitation regime change in Western North America: The role of Atmospheric Rivers. *Nature Scientific Reports* 9(1): pp.1-11
- Goals Project. 1999. Baylands Ecosystem Habitat Goals. A report of habitat recommendations prepared by the San Francisco Bay Area Wetlands Ecosystem Goals Project. U.S. Environmental Protection Agency, San Francisco, Calif./S.F. Bay Regional Water Quality Control Board, Oakland, CA.
- Ocean Protection Council. 2018. State of California Sea Level Rise Guidance 2018 Update. Natural Resources Agency, Sacramento. Available at: http://www.opc.ca.gov/webmaster/ftp/pdf/agenda_items/20180314/Item3_Exhibit-A OPC SLR Guidance-rd3.pdf
- SF Bay NERR (San Francisco Bay National Estuarine Research Reserve). 2018. Management Plan 2018-2023. Available at: <http://www.sfbaynerr.org/resource-library/reserve-plans-reports/sf-bay-final-management-plan-2018-2023/>
- _____. 2019b. Road Map for Advancing Adaptation Project Planning: Blending Technical Expertise and Active Community Participation to Define Adaptation Options for the Low Lying North San Pedro Road Through China Camp State Park. San Francisco State University Estuary & Ocean Science Center, Tiburon, CA.
- _____. 2019c. Existing Conditions Report: Blending Technical Expertise and Active Community Participation to Define Adaptation Options for the Low Lying North San Pedro Road Through China Camp State Park. San Francisco State University Estuary & Ocean Science Center, Tiburon, CA.

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Appendix A. Stakeholder Engagement Summary

As noted in Section 3 of this report, this project included a “process” goal around how SF Bay NERR, California State Parks, and Marin County engaged with a wide range of stakeholders to participate actively in this effort. The goal stated, “**provide a model for other adaptation planning projects** that focuses on supporting and applying a “bottom up” community engagement approach to developing sea level rise adaptation solutions.” Here we describe what took place towards achieving this process goal, and we include one stakeholder commendation letter regarding the process. Refer to Figure 4 for a visual diagram of the steps used in this process.

This project actively engaged a large group of stakeholders representing a variety of interests to develop and help evaluate prospective road reconfiguration options. We utilized a community-based or “bottom up” approach that was professionally facilitated and expert supported. We worked step-wise through 1) generating shared understanding of the landscape context, 2) establishing adaptation goals and implementation feasibility criteria, 3) generating adaptation options, 4) working through a qualitative comparative evaluation designed to elucidate how well options may achieve adaptation goals and be implementable, and 5) making recommendations to Parks and the County on which alternatives to carry forward. Table A-1 summarizes all the broad stakeholder engagement activities to date of this report (we have not listed all the one-on-one and small meetings and calls along the way) and Table A-2 lists all the participating stakeholders. This process began in October 2017 with the Gallinas Watershed Symposium put on by the SF Bay NERR to bring together local community stakeholders, agency staff, and scientists to explore the range of environmental and climate change issues facing the lower Gallinas Creek Watershed including China Camp State Park and to initiate thinking around addressing those issues. Following that symposium, the SF Bay NERR in collaboration with Marin County Supervisor Damon Connolly hosted three public stakeholder meetings centered around developing strategies for addressing near-term road issues through China Camp State Park, including deteriorating road surface, failing culverts, public notices in advance of king tide road flooding. These meetings set the stage for applying for and receiving the NERR Science Collaborative Catalyst grant to support the current project by helping to identify long-term road issues, sharing stakeholder perspectives, and gaining momentum for tackling longer term issues. The Catalyst grant provided support for the project team which includes NERR staff from multiple sectors, State Parks and the County of Marin.

This current project has adopted a collaborative approach including three public meetings in addition to project team meetings. Along the way opportunity was provided for document draft review and an intense process to gather and apply input from the stakeholder community all focused on generating and evaluating the road reconfiguration alternatives presented in this report. Throughout the year stakeholders were consulted and engaged in one on one meetings, via phone conferences, in small groups and at larger public meetings 1-3. Not only did this maintain a high level of participation but allowed the process to be guided by their needs, and provided multiple opportunities for expert advice, support and technical guidance by project team. Not only was this process valuable to this project but the hope is that it can serve as a model for other regional or more complex adaptation planning projects. So much so that it was in fact one of our stated goals.

Table A-1. Stakeholder Engagement Activities Summary Preceding, During and Following This Effort

Date	Name	Description
Oct 19, 2017	Gallinas Watershed Symposium	One-day symposium organized by SF Bay NERR to educate local stakeholders and agency staff on range of issues around lower Gallinas Creek and China Camp State Park. Funding support from NERRS Science Collaborative via a Capacity Building grant.
Dec 13, 2017	Short-Term Road Solutions Stakeholder Meeting 1	Series of three stakeholder meetings aimed at identifying near-term actions to address more immediate issues.
Feb 23, 2018	Short-Term Road Solutions Stakeholder Meeting 2	
Jun 4, 2018	Short-Term Road Solutions Stakeholder Meeting 3	
Jun 15, 2018	Congressman Jared Huffman	Site visit with Congressman Huffman, State Parks, Supervisor Connolly, Audubon California, and SF Bay NERR to brief the Congressman on the project
Sep 1, 2018 to Aug 31, 2019	NERRS Science Collaborative Award	Small grant to cover one year of funding to initiate this stakeholder engagement process
Nov 5-7, 2018	NERR System Annual Meeting	Poster presentation of current long-term road reconfiguration project summarized in this report
Nov 30, 2018	Long-Term Road Reconfiguration Stakeholder Meeting 1	<ul style="list-style-type: none"> • Introduce Stakeholder Group process and participants. • Describe existing conditions at project area. • Define participant interests and concerns. These interests and concerns were captured in project goals, feasibility criteria, and design considerations. • Discuss, revise and refine project goals. In advance of the meeting, NERR prepared draft goals and reviewed them with State Parks. • Begin brainstorming solutions. • Meeting notes package distributed
Dec 10-12, 2018	Restore America’s Estuaries Annual Conference	Poster presentation of current long-term road reconfiguration project summarized in this report
Dec 18, 2018	King Tide Public Walk	Educational public opportunity held at high tide
Jan 21, 2019	King Tide Public Walk	
Jan 22, 2019	Information Pop-up	SF Bay NERR staff stationed along road during King Tide Flooding to answer questions
Feb 19, 2019	Long-Term Road Reconfiguration Stakeholder Meeting 2	<ul style="list-style-type: none"> • Preliminary road flooding water level data collected by NERR. • Review and discuss project goals and implementation feasibility criteria. Original intent was to adopt following input at first stakeholder meeting. Discussion at this meeting proved robust and pointed to the need for further refinement

Date	Name	Description
		<p>after the meeting to arrive at outcomes that all stakeholders could get behind.</p> <ul style="list-style-type: none"> • Overview of road types and associated standards • Review and adopt design considerations • Brainstorm road reconfiguration adaptation options. • Overview of next steps.
Feb-Jun 2019	SF Bay NERR – County – State Parks discussions	Several discussions to work through project goals, feasibility criteria, and details of the evaluation approach
Mar 21, 2019	Marin County Adaptation Projects Forum	Hosted by Marin County. State Parks described the China Camp efforts as part of its Marin County adaptation portfolio
Mar 25, 2019	Input request memo to stakeholders	Request from NERR project team for input on goals, implementation feasibility criteria, sea level rise planning time horizons, adaptation alternatives
Apr 17, 2019	State Senator Mike McGuire	Meeting with Senator McGuire, Supervisor Connolly, and SF Bay NERR staff to brief the Senator on the project
May 28, 2019	Federated Indians of the Graton Rancheria	Meeting with FIGR, State Parks, SF Bay NERR to discuss cultural resource considerations
Jun 5, 2019	Draft report for stakeholder review in advance of next stakeholder meeting	Opportunity for stakeholders to review an early draft of this final report, to see how information is being applied
Jun 12, 2019	Long-Term Road Reconfiguration Stakeholder Meeting 3	<ul style="list-style-type: none"> • Present and discuss the approach used to conduct the evaluation • Present and discuss the nine alternatives that resulted from the February 19, 2019 stakeholder meeting and input received since that meeting • Present and discuss the alternatives evaluation • Vote on the alternatives and identify those to carry forward for further evaluation and as initial concept descriptions to support seeking the next round of funding to carry out feasibility investigations and move into the environmental review and planning process.
Sep 9, 2019	National webinar – discuss lessons learned about how best to accelerate learning and transfer related to climate resilience and adaptation across the coastal management community.	<p>The National Estuarine Research Reserve System Science Collaborative brought together four projects they funded around the United States to present a webinar viewed internationally. Available here to view and obtain related documents: http://nerrsciencecollaborative.org/resource/management-brief-climate-resilience</p>
Nov 18-21, 2019	NERR System Annual Meeting	Poster presentation of outcome of long-term road reconfiguration project described in this report
Dec 2019	Marin Magazine	Article on sea level rise adaptation with China Camp State Park as one of its case studies.

Table A-2. Stakeholder and Project Partner Participation at Stakeholder Meetings 1, 2 and 3 Supported by this Grant.

Note: 1 means present, 0 is not present, many on list were engaged at other times but unable to attend public meetings

First	Last	Organization	#1 11/30/18	#2 2/19/19	#3 6/12/19
Tom	Boss	Marin County Bike Coalition (MCBC)	1	1	1
Cory	Bytof	City of San Rafael, Sustainability Director	0	0	1
Dave	Ceppos	Facilitator, Collaboration and Consensus Program, Sacramento State University	1	1	1
Chris	Choo	Planning, County of Marin	0	0	0
Susannah	Clark	Supervisor Aide, Marin County	1	1	1
Kate	Colin	City Council, San Rafael	0	0	0
Damon	Connolly	Supervisor, Marin County	1	1	1
Holly	Costa	U.S. Army Corps of Engineers (USACE) San Francisco District Regulatory Division	0	0	0
Anna	Deck	San Francisco Bay National Estuarine Research Reserve (SF Bay NERR)	1	0	1
Chris	DeGabriele	Las Gallinas Valley Sanitary District (LGVSD)	0	1	0
Walt	Deppe	San Francisco Bay Conservation and Development Commission (BCDC)	1	1	1
Nicole	Fairley	San Francisco Bay Regional Water Quality Control Board (RWQCB)	1	1	1
Xavier	Fernandez	San Francisco Bay Regional Water Quality Control Board (RWQCB)	1	1	0
Matt	Ferner	San Francisco Bay National Estuarine Research Reserve (SF Bay NERR)	1	1	1
Sarah	Ferner	San Francisco Bay National Estuarine Research Reserve (SF Bay NERR)	1	1	1
Shannon	Fiala	San Francisco Bay Conservation and Development Commission (BCDC)	1	0	1
Doug	George	California State Parks	0	0	1
Aimee	Good	San Francisco Bay National Estuarine Research Reserve (SF Bay NERR)	1	1	1
Bill	Guerin	Public Works Director, City of San Rafael	1	1	1
Gina	Hagen	Santa Venetia Neighborhood Association (SVNA)	1	1	1
Bree	Hardcastle	California State Parks	0	1	1
Laura	Hollander	San Francisco State University Estuary & Ocean Science (EOS) Center	1	1	0
Jared	Huffman	U.S. Congressman, California District 2	0	0	0
Ernest	Klock	Marin County Department of Public Works	1	1	0
Max	Korten	Marin County Parks	0	1	0
Roger	Leventhal	Marin County Department of Public Works	0	0	0
Martin	Lowenstein	Friends of China Camp	1	1	1
Brenna	Mahoney	National Oceanic and Atmospheric Administration Sentinel Site Cooperative	1	1	0

First	Last	Organization	#1 11/30/18	#2 2/19/19	#3 6/12/19
Kevin	McGowan	City Engineer, City of San Rafael	0	0	0
Mike	McGuire	California State Senate, District 2	0	0	0
Eric	Miller	Marin County Department of Public Works	0	1	1
Kati	Miller	Point San Pedro Road Coalition	1	1	1
Roberta	Morganstern	U.S. Army Corps of Engineers (USACE) San Francisco District Regulatory Division	1	0	0
Maria	Mowrey	California State Parks	1	1	0
Ryan	Olah	U.S. Fish and Wildlife Service (USFWS)	1	0	0
Kate	Powers	Marin Conservation League (MCL)	1	0	1
Mike	Prinz	Las Gallinas Valley Sanitary District (LGVSD)	0	0	1
James	Raives	Marin County Parks	0	0	1
Rojas	Raul	Marin County Department of Public Works	1	0	0
Rodney	Rushkin	Point San Pedro Road Coalition	1	0	0
Matt	Sagues	Marin Municipal Water District (MMWD)	1	1	0
Barbara	Salzman	Marin Audubon Society	0	1	1
Judy	Schriebman	Gallinas Watershed Council, Las Gallinas Valley Sanitary District (LGVSD)	0	0	0
Rebecca	Schwartz-Lesberg	California Audubon	0	0	0
Cyndy	Shafer	California State Parks	1	1	1
Stuart	Siegel	San Francisco Bay National Estuarine Research Reserve (SF Bay NERR)	1	1	1
Bob	Sinnott	San Rafael Fire Department	1	1	0
Carl	Somers	Marin County Parks	0	0	0
Susan	Stompe	Marin Conservation League	0	0	1
Ann	Thomas	Marin Conservation League	0	1	0
Christina	Toms	San Francisco Bay Regional Water Quality Control Board (RWQCB)	1	0	1
Mike	Vasey	San Francisco Bay National Estuarine Research Reserve (SF Bay NERR)	1	1	1
Mark	Wallace	Santa Venetia Neighborhood Association (SVNA)	1	1	1
Deborah	Waller	California Department of Fish and Wildlife (CDFW)	1	1	0
Karen	Weiss	California Department of Fish and Wildlife (CDFW)	0	0	0
Julian	Wood	Point Blue Conservation Science	1	1	0



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San Francisco Bay National Estuarine Research Reserve
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Tiburon, CA 94920

Comments on Project: *Bringing Together End Users and Stakeholders to Identify and Evaluate Sea Level Rise Adaptation Options to Solve Road Flooding in China Camp State Park*

Attn: Stuart Siegel and Aimee Good

As community representatives of the neighborhoods closest to the Gallinas Creek watershed, the Santa Venetia Neighborhood Association (SVNA) was happy to support and participate in this project. Two SVNA board members, Gina Hagen and Mark Wallace, participated in the full series of meetings and review cycles for the project. We enthusiastically worked with representatives from other nearby communities and many relevant public agencies to better understand the issues and options for adapting North San Pedro Road to current flooding conditions and expected sea level rise. We would particularly like to thank Marin County Supervisor Damon Connolly and Susannah Clark for providing the necessary organization, support, and meeting facilities to allow the project meetings to proceed with thorough participation. The SF Bay NERR conducted a broad-reaching, highly inclusive, and factually accurate process to move this effort forward. China Camp and its contiguous marshland, extending into Gallinas Creek, are some of our communities' most prized environmental assets, and we deeply appreciate the SF Bay NERR's efforts to build a plan to both preserve the marsh and protect our ability to experience this treasure.

Overall, the SVNA representatives concur with SF Bay NERR's conclusions of adaptation alternatives that are most worth advancing. We would like to add the following comments:

We are glad that realistic alternatives for a lower cost, limited length causeway over the most frequently flooded parts of the road will be considered in the next phase. Keeping the road functional and safe for recreation and emergency use is a high priority for our community and visitors to China Camp State Park. At the same time, we are sensitive to cost issues: expensive solutions would imply more concrete and more use of heavy equipment. We would

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like the process of adaptation to sea level rise to also consider the carbon footprint of the project itself.

We also feel that any alternatives should recognize the need for better water flow in and out of the marshlands inland of the existing road. Improving existing culverts and adding new areas for tides and storm runoff to move freely under (rather than over) the road should be a part of any future plan.

The SVNA does not consider retiring the road to be a good environmental alternative. Doing so would isolate China Camp State Park, endanger nearby communities in emergency situations, and prevent public use of some of the Bay Area's best-preserved marshland. The road is currently used at least as much by cyclists and runners as it is by motor vehicles, and we expect a future trend toward fewer gas-powered vehicles on the road. In our view, letting "nature take its course" and allowing the road to subside into the marsh would leave an environmental mess for future generations, and would discourage the current users of China Camp State Park to take ecology seriously.

The SVNA represents a community on the forefront of many issues around environmental adaptation. We appreciated the opportunity to learn from the many experts representing participating agencies. We would like to make an important point about community participation in activities that help adapt to climate change: learning how to adapt, how to do it well, and how to engage people and resources from the local community should continue be a primary goal of this project moving forward. We know that sea level rise with subsidence of the road through China Camp is one of the first of many adaptation challenges our community will face. What we learn from this project will likely apply to other parts of the same road system in the near future. Since we recognize that future generations will continue the adaptation effort, our approach to this project is as important as the final result. It is important to:

- (1) Engage the community and raise awareness of the problems and processes of adaptation.
- (2) Encourage and incent the community to support and help directly with the project.
- (3) Be conscious of carbon footprint and global impacts of local activities. Where possible, give preference to lower carbon technologies and approaches.
- (4) Allow a process where the community can directly contribute resources and labor, and benefit from better understanding the process of adaptation.

In closing, we would like to thank Aimee Good, Stuart Siegel and the other representatives of SF Bay NERR for the way in which they conducted this process, as well as the other attendees from Marin County, the State of California, and other Bay Area agencies that offered their wisdom and enthusiasm while discussing a productive path forward to adapt the China Camp road.

Sincerely,

Gina Hagen and Mark Wallace
Santa Venetia Neighborhood Association (SVNA)

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Appendix B. Education Resources

https://www.youtube.com/watch?time_continue=80&v=OdiPjxRzqRQ

The NOAA BWET-funded teacher workshop series created a short video of field trip to China Camp State Park it features middle and high school science teachers from Marin County.

The Reserve's Education Coordinator led interpretive walks during extreme high tides over the winter (King Tides) on December 18, 2018 and January 21, 2019; both of the walks concluded with the participants brainstorming solutions to protecting the marsh in the face of climate change and solving the road flooding problem. Nearly 50 people participated in the conversations, but many came up with the same solutions. The conversations were collaborative and positive, and no ranking or critique of others' ideas was conducted. Below is a list of all of the ideas generated, in no particular order:

- Build a causeway (or bridge) over the marsh.
- "Re-open" the fire road up and over the hill. Convert privately-owned road into county-maintained road as an incentive for the homeowners.
- Provide solar-powered hovercraft.
- Build a tunnel under the marsh.
- Install a flood barrier.
- Build a road along the contour of the fill, following existing trails.
- Create a floating road or "pontoon bridges".
- Pave the road in permeable material (or "crushed rock"), following the example at Leo T. Cronin Fish Viewing Point.
- Design two different solutions for the different sections that flood, because one floods so much more frequently than the other.
- Build a boardwalk instead of the road.
- Convert the road into bike lane and increase public transportation and bike options. The solution to increased sea level rise flooding is to give up personal cars.
- Provide shuttle buses inside the Park.
- Improve drainage using French drain system around the road.
- Close the Park during high tide flooding.
- Install one-way timed lights and reduce the width of the road to a single lane.
- Raise the elevation of the road.
- Increase the size of the culverts.
- Prohibit parking along the sides of the road.