SHRP2 Product Testing

State Highway Corridor Planning
California Case Study

Road Ecology Center
University of California, Davis
http://hwy37.ucdavis.edu

California Pilot Test of the Ecological Approaches to Environmental Protection Developed in Capacity Research Projects C06A and C06B

Contributors to the Project and to the Report

Fraser Shilling, Project Lead
Mary Campbell
David Waetjen
Abby Monroe
Susana Cardenas

Road Ecology Center
& Department of Environmental Science and Policy
University of California

Helene Le Maitre
Ecoloe Nationale des Travaux Publics de l'Etat
Lyon, France

Erik Alm, Joseph Aguilar, Jeffrey Jensen, Joseph Peterson, Robert Bregoff, Stefan Galvez, Chuck Morton, Jeanne Gorham
District 4, California Department of Transportation

Katie Benouar
Director's Office, California Department of Transportation

Caitlin Cornwall
Sonoma Ecology Center

Wendy Eliot & Julian Meisler
Sonoma Land Trust

Leigh Sharp
Napa County Resource Conservation District

Susan Haydon and Leandra Swent
Southern Sonoma County Resource Conservation District

TABLE OF CONTENTS

EXECUTIVE SUMMARY

Like much of the US, California relies upon 3 scales of planning for transportation – project, corridor, and region. Each scale informs the others, leading to the development of state programming of projects, described in corridor and regional plans. Highway 37 in the San Francisco Bay Area is currently the subject of corridor planning by the California Department of Transportation, District 4 (Caltrans). The current C21 project "Highway 37 Stewardship Study" is the test-case for the California evaluation of CO6 A&B (and other TRB) products. It will also inform the development of the corridor plan and model behaviors that Caltrans would like to include in future corridor plans. For example, the stakeholder process developed as the basis for the project could become *de riguer* for Caltrans' future corridor planning. The project relies upon 3 inter-dependent processes: a stakeholder process to support scenarios descriptions and negotiated planning outcomes, a regional context description and assessment, and valuation/crediting approach to support scenarios comparison. Each of these project components links to a CO6 A&B product (e.g., the regional ecological framework). They are also foundational pieces for the development of a stewardship-oriented corridor plan, the first of its kind in California.

The lessons learned from this process included issues specific to CO6 and CO1 tools, as well as larger-frame issues with combining transportation planning and environmental stewardship. For example, typically-long timeframes for planning and project delivery did not suit stakeholder expectations for getting started on obvious problems. Although the complete architecture of the Transportation for Communities (TCAPP) web site and the CO6 reports were not useful to project participants, they may be useful libraries of important pieces of information. Team members felt that the contents of CO1 and CO6 should be available, but were not confident about their actual day-to-day use by transportation planners or other stakeholders, primarily because of the sheer amount of material. One important lesson from the potential application of CO1 or CO6 tools was that planning is best done in bite-sized pieces (e.g., focusing on a project study report), rather than the complete decade-long process from problem identification to programmed project. There are implications from this finding for how EcoLogical capacity-building and training should occur: Through web sites, or through continuing "Academies"? Overall, the ecological framework provided a useful and understandable rubric for organizing information and thinking about decision-making.

The integrated ecological framework in CO6 suggests 9 planning steps to improve the process of delivering transportation projects with early inclusion in planning of stakeholder interests and environmental information. The table below (table 1) summarizes how we followed each of the first 7 steps and our general findings from each.

Table 1: Steps of the Eco-Logical Framework SHRP2 C06

Step	**Findings**
Step 1: Build and Strengthen Collaborative Partnerships, Vision	The planning region boundary included the study highway and portions of 5 counties and several other state highways and interstates that share traffic with the highway. Stakeholders within this planning region were included within the stakeholder team and process. We had difficulty representing all highway stakeholders and recommend that Step 1 encourages including the majority of affected party types.
Step 2: Characterize Resource Status. Integrate Conservation, Natural Resource, Watershed, and Species Recovery and State Wildlife Action Plans	We used the stakeholder process to educate stakeholders about the content and availability of regional plans and data, but did not need to generate new information. The most significant data gaps are related to uncertainty around the predicted rate of sea level rise and the lack of accurate and detailed levee and berm topographic and location data. The conservation strategy for regional ecosystem processes and attributes was folded into the scenario development for the corridor, the corridor context description, and the regulatory-process foundation.
Step 3: Create Integrated Ecosystem Framework (Conservation Strategy +Transportation Plan)	The project team adopted the term "Corridor Context" instead of "Integrated Ecological Framework" to broaden the types of information and values we included. The corridor context includes parallel recognition of community, transportation, environmental, and economic systems and values in decision-making about highways. Using these parallel categories for collecting and organizing information, in partnership with stakeholders and the community, and describing how well transportation plans support their values in these categories, reinforces the broad context in eventual project prioritization. To improve planning outcomes , we recommend that more values are included in the Framework, such as local economy, community identity, environmental justice, climate adaptation, carbon budget, and possibly greenhouse gas emissions, and/or life cycle analysis.

Step 4: Assess Land Use and Transportation Effects on resource conservation objectives identified in the IEF	We used the Road Effect Zone concept to capture potential effects of new projects on the environment. We modeled traffic noise impacts as a specific case. Environmental regulatory agencies were also asked to consider different possible management scenarios for the corridor and speculate on the kinds of impacts that could occur, the permissibility of the scenarios and the mitigation that might be required under each scenario. Most regulatory staff stated that they had little ability to provide specific and formal input unless it is related to a regulatory action, such as a permit of environmental review. We recommend that guidance be provided for how to assess transportation effects. We further recommend that the liaison program be expanded to provide supported regulatory agency staff time to participate in the assessment phase of early planning, to improve connection between assessment and permits.
Step 5: Establish and Prioritize Ecological Actions	Based on their knowledge of environmental conditions, conservation objectives, and the connection between these and transportation infrastructure and plans, stakeholders and partners identified future scenarios for the corridor that supported these objectives. There did appear to be some agreement that raising the highway onto elevated causeway was environmentally-preferable, but many questions remained and key stakeholders were not present. In the absence of a clearly defined preferred alternative and specific recommendations from regulators, it is difficult to identify and establish mitigation priorities. Stewardship-conservation priorities may be more easily met in combined transportation & conservation planning.
Step 6: Develop Crediting Strategy	An overall valuation approach was used to frame credits, which captures a stewardship and community involvement ethos as well as mitigation activity. Two approaches were used to develop a "credits" system for positive action: 1) Choosing a valued path: Community preferences were quantified for specific possible future actions on the corridor, based on the actions' support for community values. 2) Developing credits within a path: Impacts on adjacent habitats and urban areas were quantified for each corridor scenario to support a unit impacted area approach to credits.
Step 7: Develop Programmatic Consultation, Biological Opinion or Permit	The foundation for this step was laid with multiple meetings between transportation agency and regulatory agency staff. Because the process of early inclusion is atypical, it took a fair amount of persuasion to draw regulatory entities in. This could be improved by providing incentives to regulatory agencies and requirements for early regulatory involvement to transportation agencies receiving federal funds.

INTRODUCTION

Corridor planning is an important geographic and time-scale intermediate step between regional & long-range planning and project delivery. We chose this scale because it provides opportunities for including regional and local ecological, economic, transportation, and community information and needs early in transportation planning and project development.

In California, corridor plans form the basis for further study and development into pre-project initiation documents, the project initiation documents (PIDs) sponsored by either Caltrans or local agencies. The corridor plans and PIDs are used to develop the purpose and need for projects. A more thorough assessment of the facility development options, environmental mitigation needs and stakeholder plans and needs in the corridor plan process can ensure that a more comprehensive development of multimodal alternatives are developed in the early stages and that the necessary valuation is given to alternate modes and environmental enhancement. The purpose and need statement can benefit from a better understanding of the environmental and community needs that develop from the ecological approach and from bringing NEPA considerations and knowledge into the planning process. The PID purpose and need proceeds to the project development, design and delivery stages in Caltrans. For our specific test case (highway 37), this is key to designing and implementing a facility that considers the tidal marshes, preservation and recreation needs, as well as the safety needs of the public.

California and federal government agencies and private organizations have invested millions of dollars in restoring marshlands in the North San Francisco Bay (North Bay). These coastal marshlands are among the most endangered habitat types in the US and home to a diverse assemblage of plants and animals, including species listed under state and federal Endangered Species Acts (ESA). Highway 37 was built as a conduit between inland and East Bay areas (Richmond, Oakland, Berkeley, Solano County) and the North Bay communities and counties (Napa, Sonoma, Marin). It currently serves multiple transportation purposes: goods movement, inter-county commuting, and recreational travel (Figure 1). It also passes through the marshes of the North Bay, separating the marshes from tidal influence and affecting natural flows and processes (Figure 2). Highway 37 is one of the lowest-elevation highways in the Bay Area and at its lowest elevation, the roadbed is currently just below sea level. As climate change results in sea level rise, this highway is likely to face erosion, more frequent flooding during storms, and gradual inundation by the sea.

Highway 37 bisects the city of Vallejo, which is struggling economically and has a large minority and low-income population. The highway provides access to other areas and effectively divides the community geographically. Besides suffering economically, a recent study (Shilling et al., 2010) has shown that Vallejo residents also have little access to parks compared to nearby wealthier communities. Highway 37 could provide a solution to this as it enters one of the largest potential recreation areas in the vicinity, North Bay marshlands.

These issues and the circulation requirements for the highway make it an ideal test case for an integrated ecological assessment framework and collaborative plan development among a wide range of stakeholder types.

WHO: PARTNERS

The project was led by UC Davis' Road Ecology Center, in partnership with Caltrans. UC Davis sub-contracted to partner organizations who are leaders in their respective urban and rural communities in planning, conservation, and stakeholder process.

Caltrans, District 4
UC Davis Road Ecology Center (http://roadecology.ucdavis.edu)
Sonoma Ecology Center (http://www.sonomaecologycenter.org)
Sonoma Land Trust (http://sonomalandtrust.org)
Southern Sonoma County Resource Conservation District (http://sscrcd.org)
Napa County Resource Conservation District (http://naparcd.org)

WHO: KEY STAKEHOLDERS

Our partnership includes over 100 individuals and organizations that have joined us at one of our seven stakeholder meetings. Their effort and input helped shape this study and understand how using the CO6 tools *in situ* results in transportation and ecological system stewardship. The stakeholder process has resulted in a cadre of committed individuals and organizations who attend stakeholder meetings and provide guidance and feedback for ways that regional concerns can be considered and addressed (Appendix 1). Their input was critical to the development of the Regional Ecological Framework and description of plausible scenarios for the highway, which will become the foundation for crediting and agreements with regulators and others. In other words, our successful stakeholder process was a hallmark of the success we had carrying out Step 1 of the CO6 process and set the

stage for an expanded version of COR-1, where the role of decision-maker is more broadly defined than in TCAPP.

STEP 1: PLANNING REGION AND STAKEHOLDERS

Build and Strengthen Collaborative Partnerships, Vision. *Build a vision of what is most needed for natural resources in the region and commit to integrate and utilize transportation and environmental regulatory processes to address these greatest conservation and restoration needs and goals*.

We implemented this step by identifying and inviting a broad range of stakeholders to participate in a joint learning and visioning process. This included land-use, conservation, transportation and other agencies and interests. The stakeholder process involved 7 face-to-face meetings, a few conference calls and a field trip. The process was used to define the planning region, conservation and transportation issues, and potential combined transportation and conservation solutions.

STEP 1A. THE PLANNING REGION

The North San Francisco Bay region includes Marin, Sonoma, Napa, and Solano counties. Highway 37 traverses Sonoma County, between Solano and Marin Counties, skirting Napa County on its Southern boundary. It crosses the lower Napa River, Sonoma Creek, Petaluma River, and other small watersheds that feed into the North Bay. It traverses urban, agricultural, woodland, grassland, and wetland habitats, connecting Interstate 80 and State Highway 101.

The highway itself approximates a curve through the North Bay (red box, Figure 1). The study area is larger, roughly a rectangle (pink square, Figure 1) bounded on the west by the east edge of the city of Petaluma, on the north by the south edge of the city of Napa, on the east by the intersection of SR-12 and I-80, and on the south by the city of Albany. This area includes other highways potentially affected by sea level rise and decision-making about highway 37. For example, planned or catastrophic reduction or elimination of traffic from the current right-of-way would displace traffic to state highway 29, 12, and 121 to the North and Interstate 580 to the South.

One finding from the planning region definition was that it was possible to walk transportation and conservation-oriented people through the development of a scale that was useful for both types of activities. This planning region scale may be useful in future implementation of CO6 and other Eco-Logical approaches because it should be possible to combine several corridors within the region into one over-arching planning process, even if each corridor still covered by an individual planning report.

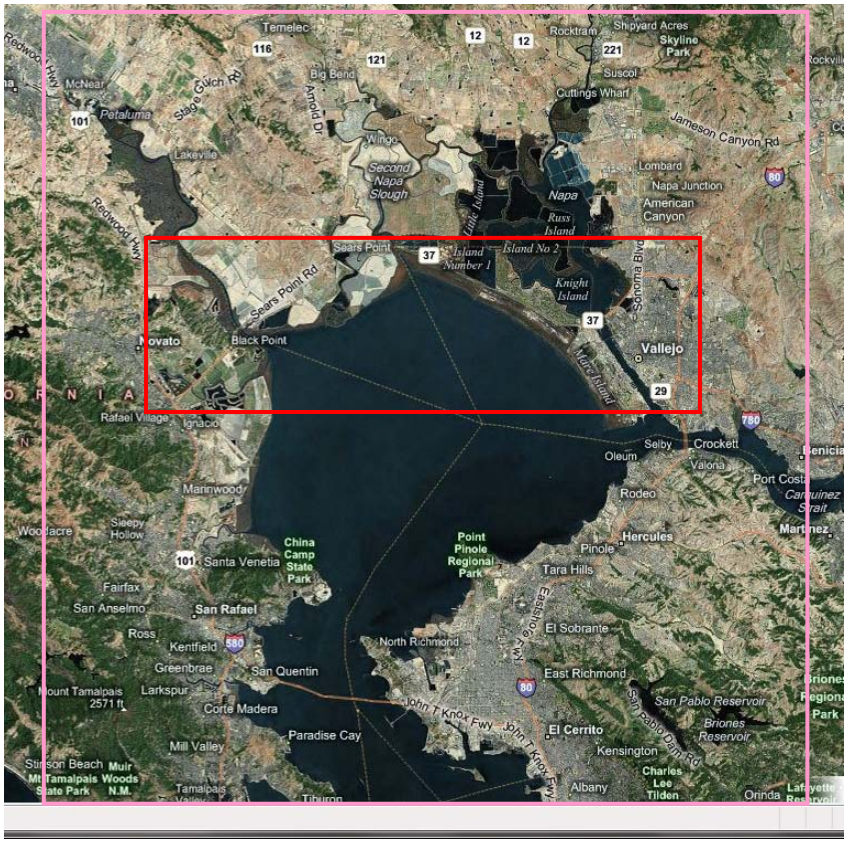


Figure 1. Highway 37 (within red box insert) in the North San Francisco Bay planning region (pink box insert).

STEP 1B. STAKEHOLDER INVOLVEMENT

Critical to the development of our corridor context, valuation approach, and foundation for agreements with regulatory agencies was the inclusion of stakeholders early in the process (Appendices 1 & 2). Over one hundred individuals and organizations participated in our stakeholder process. We held seven stakeholder meetings, including the World Café workshop (see below). At successive meetings we encouraged people to share their needs and desires for corridor planning, understanding of the issues facing the transportation corridors, ecological and community well-being issues that should be considered, and values for the corridor. This information sharing has been very important in getting and keeping transportation and environmental regulatory interests at the table.

PARTNERS

The intent of this study was to provide opportunities for internal collaboration among DOT Offices and Divisions, as well as external collaboration between the DOT and local agencies and organizations. Explicit support was provided at the proposal stage through the initial stages of the project from several DOT Offices, including System Planning, Environmental, and Maintenance. Similarly, partner organizations included two Resource Conservation Districts (Napa County and Southern Sonoma County), a land trust (Sonoma Land Trust) and an environmental non-profit (Sonoma Ecology Center). This formal, structured partnering was intended to facilitate the working collaboration among the partner offices and agencies.

This partnership created a core group (hereafter called the "team") who collaborated to broadly consider the best ways to move forward on the effort.

KICKOFF METHODS

The core team decided that instead of hosting an official "kickoff" for a corridor that spans several counties and landscapes, it was more effective to host sequential "briefing" meetings that gathered data on participants' interests, and offered opportunities for stakeholders to learn about the effort and ask questions. The first three stakeholder meetings began with a substantive "briefing" theme to introduce new stakeholders to the study purpose and expected activities. At the conclusion of this C21 study, Caltrans has proposed to continue the stakeholder process to integrate findings from the C21 study process, foster increase communication among the stakeholders, and further develop potential corridor scenarios.

COLLABORATION METHODS

Core Team Membership

This project used collaborative methods both through the project administration via a core team of agencies local organizations, and through the overall involvement of stakeholders that range from private landowners to federal regulators to tribal representatives. Core team membership includes the California Department of Transportation, the University of

California, the Sonoma Ecology Center, the Sonoma Land Trust, the Southern Sonoma County Resource Conservation District, and the Napa County Resource Conservation District. The diverse constitution of the core team encouraged both broad outreach to stakeholders and also a range of views and experience in overseeing the project. That being said, the diversity did not extend to ethnic or community representation as we were distinctly lacking in members of the communities of color that anchored the eastern end of the corridor. This seems to be a pervasive problem for many stakeholder planning processes and deserves special attention.

Meeting Location

To be responsive to differing travel distances, the core team decided to have the stakeholder meetings at varying locations along the highway 37 corridor, thus encouraging greater participation. The meetings were held in Novato (far west end of highway), Infineon Raceway (middle segment of highway), and Vallejo/Mare Island (far east end of highway).

Website

The core team determined that having a publicly accessible website was important in supporting stakeholder involvement and access to project-related resources. The University of California at Davis created a Highway 37 Corridor website using open-source software: http://hwy37.ucdavis.edu. The web site is the sharing point for meeting materials, study reports, associated literature and reports, and the spatial and non-spatial datasets used in the study. UC Davis has committed to maintaining the web site until Caltrans or a consortium of agencies interested in highway 37 can take it over.

ORGANIZATIONAL STRUCTURE

The core team held monthly conference calls to consider project goals and structure. After the May 24th, 2011 stakeholder briefing, the core team divided itself into three subgroups to more effectively address project goals outside of the monthly conference calls. The three subgroups were: Process, Development of a Regional Ecological Framework, and Development of a Crediting and Valuation Approach. The team's composition allowed it to seek feedback from transportation, conservation/environmental, and land-use institutions. Having this internal network connected to external networks was incredibly valuable in rapidly identifying potential future problems and fielding potential solutions.

Initially, the core team targeted key stakeholders in particular organizations to brief them on the project and invite their participation. The core team recognized that these people may not be the actual attendees, but that they would need to designate staff who could attend, thereby supporting the overall meeting series. Initial letters were sent to state and federal environmental regulators, local and regional transportation agencies, local and regional government representatives, and non-governmental organizations. The core team hosted an initial briefing on March 10, 2011 at the Schell-Vista Fire Station in Sonoma County, and 17 participants (including core team members) attended. Following this initial meeting, the core team broadened their contact list and on April 28th, 2011, sent out a formal invitation letter to key stakeholders. This letter, sent from and signed by Caltrans Deputy District Director Lee Taubeneck, included the notes from the March meeting, a participant list, and an overall project briefing. Recipients were largely the same who received the previous, less formal invitation. Following the dispatch of this letter, core team members began personally contacting stakeholders to invite their attendance at subsequent meetings.

Thirty-five people (including core team members) participated in the May 2011 meeting at Mare Island, demonstrating that the personal follow-up calls to stakeholders were effective in building strong attendance. At this meeting, core team participants presented the overall framework of the project and opened a discussion to further identify stakeholder interests and concerns. At this meeting, in addition to regulatory, transportation and environmental interests, participants included tribal representatives and private landowners.

World Café ("Collaborative Partnerships" & "Prioritize Actions")

In order to find out more about what various organizations and stakeholders value about the highway corridor and associated community and natural values, we engaged them in a café-style discussion (Appendix 3). This approach was developed for just such an occasion and elicited value statements about possible future scenarios for the highway corridor. The expressed values were useful for developing the valuation and crediting approach. Association of values with different scenarios assists in developing possible ecological actions and overall stewardship of the corridor and related natural and human systems.

Caltrans is exploring options for the future of highway 37. This scenic roadway links travel to the East & West San Francisco Bay regions and the Napa/Sonoma Wine Country. Commuters, truckers, tourists and many others travel on highway 37, passing through cities, endangered species habitat, rare marshlands, and rich farmland. Flooding risks on the highway are increasing due to rising sea levels, and increased traffic continues to impact all who use this roadway, as well as the surrounding environment. Caltrans wants to work with others interested in the well-being of this corridor to create a plan and a vision that everyone can support. This vision must consider endangered species and their habitats; agriculture; increasing traffic; and sea level rise. It must also provide increased transportation choices and enhanced public access.

Highway 37 improvement options as part of corridor planning discussions have generally emphasized capacity expansion at key bottleneck locations. While not excluding other non-highway considerations, such considerations have not been the focus of mobility improvement discussions. The corridor is an important East-West highway connector in the Bay Area and its existing congestion is projected to increase over the next 25 years. Even though it is a secondary highway compared to the interstates and state highways it is parallel and networked with, it relieves pressure on these other routes. At the same time, it passes through very sensitive lands and is itself at risk of flooding in the future. Corridor planning for this highway informs the regional transportation planning process; the primary planning document for this process is the Regional Transportation Plan (RTP). Any major improvement project needs to be in the RTP to be considered for funding. Thus, the current corridor planning step is one of the earliest at which transportation demand, environmental constraints, and community preferences can be used to define strategies for improving transportation and stewardship of valued natural and human systems.

Making stewardship decisions for complex systems requires organizing similarly complex information about the systems. The Regional Ecological Framework from CO6A provides a useful mechanism to organize information about

natural systems to help inform transportation planning. The framework is oriented toward spatial information about locations of species and habitats of concern, waterways, and other ecological attributes and processes that may be affected by transportation projects. We have adapted and expanded the Framework concept to include more information about other aspects of the integrated human and natural systems in our study area. The CO6 planning steps also provide a useful process for describing issues and using a stakeholder process to frame these issues in terms of combined transportation and environmental stewardship.

Special Issue: Sea Level Rise

Climate change brings with it sea level rise, which can impact natural and human communities in coastal areas. Because the study highway ranges from one or two meters above current sea level to slightly below sea level, the project rise of >1 meter in the next 90 years poses a threat to the highway itself. The highway also acts as a levee between the rising Bay and thousands of acres of marshes that must be allowed to adapt to changing sea levels to survive. These marshes are both nationally important and habitat for endangered species, so the role of the highway in their adaptation must be considered in corridor planning.

Regionally, there is broad political and institutional acceptance of the possibility of rising sea levels requiring adaptive action in the near future. This was true in our stakeholder process where partner agencies and community members expressed concern that marsh adaptation be considered in new capacity planning. This resulted in broad support for a causeway option for the corridor, despite this being one of the more expensive possible constructed scenarios. This abandonment of the low-lying alignment was favored over armoring the existing footprint, which makes this an interesting case study for coastal areas in the US which are considering the same questions. It remains to be seen whether or not funding can be found to raise the alignment and thus reduce risk of the highway flooding and allowing the marshes to adapt to sea level rise.

> "Move highways and railroads that are barriers to marsh migration where there is otherwise space for marsh expansion/migration" (One Climate Change Adaptation Strategy Recommendation in EPA report, 2011 on SF Estuary. Page T-11)

STEP 2. CHARACTERIZE REGIONAL PLANS AND DATA

Develop an overall conservation/restoration strategy that integrates conservation/restoration priorities, data, and plans, with input from and adoption by all conservation and natural resource stakeholders identified in Step 1, addressing all species, all habitats, and all relevant environmental issues.

Highway 37 runs along the edge of San Pablo Bay (North San Francisco Bay Area) and the corridor is adjacent to wetlands, upland grasslands, oak woodlands, and riparian areas. It is recognized regionally and nationally as a unique and ecologically important landscape of natural beauty and ecological diversity. It is characterized by its lack of intensive development and, along with the South Bay, is recognized as the part of San Francisco Bay that offers the most opportunity for wetland restoration.

HISTORICAL SETTING

The San Francisco Bay region, including San Pablo Bay, includes the most important estuary on the continental Pacific Coast for birds and a critical link in the Pacific Flyway. Historically, tidal marshes fringed San Pablo Bay and provided habitat for many species of fish, bird, and plants, many of which are now rare or extinct. Over 85 percent of the Bay's and over 82 percent of the North Bay's historic tidal wetlands were lost to land reclamation, with a dramatic reduction in the wildlife populations that depended on them. Many animal and plant species have become threatened or endangered as a result of this habitat loss.

Approximately 55,000 acres of tidal marsh existed in the North Bay before they were diked, drained and converted to agricultural lands. Today fewer than 10,000 acres remain. Restoration of historic wetlands and the preservation of existing open space are considered by local, state, and federal agencies as a critical step toward successfully implementing restoration and endangered species recovery efforts in the Bay-Delta and have been endorsed as a major goal by every government agency and organization interested in conservation and restoration of San Francisco Bay. For example, the *Baylands Ecosystem Habitat Goals Report* (1999) prepared by the San Francisco Bay Area Wetlands Ecosystem Goals Project, the San Francisco Bay Joint Venture *Implementation Strategy* (2001), and the Bay Area Open Space Council's *Conservation Lands Network Report* (2011) have developed specific goals to protect and restore Baylands and their watersheds in the North Bay.

CONSERVATION AND RESTORATION

San Francisco Bay's tidal marshes are valued, protected and restored in recognition of their ecosystem services, which include: high productivity and habitat provision supporting the food web leading to fish and wildlife; buffer against storm wave damage; shoreline stabilization; flood water storage; water quality maintenance; biodiversity preservation; carbon storage and socio-economic benefits such as recreation. These services contribute to the Bay area economy and quality of life. Many state, federal and regional public agencies and nongovernmental organizations include among their objectives acquisition and restoration of wetlands along San Pablo Bay and many properties in the Region have significant restoration potential and therefore have been identified as high acquisition priorities. These agencies and organizations may acquire fee and/or easement interests in property either directly or through a grant to another conservation organization. The decision to convert agricultural land to seasonal or tidal wetlands is made on a case by case basis and based on economics, landowner goals, availability of acquisition and restoration funding, and the sustainability of agricultural operations in the corridor and in the region. For years, scientists have recognized that restoration of the ecological vitality of the San Francisco Bay depends upon the restoration of many thousands of acres of tidal marshes around the Bay. The ecological benefits of conservation work in this region are widely acknowledged. Today, conservationists and scientists are also advocating for the restoration of tidal wetlands to provide an important natural buffer to anticipated sea level rise, which has important economic and conservation benefits.

In the last three decades, 30 wetland restoration projects have been constructed and 25 more are planned within Sonoma, Napa, and Marin counties. These alone total over 21,000 acres of restoration already completed or planned. There are potentially thousands of acres available in this area for restoration. Because many of the agricultural lands that were reclaimed from marshes remain largely undeveloped, the technical requirements for their restoration to tidal marsh are relatively straightforward: build a new flood protection levee and breach and grade down the existing levees that hold back the Bay. This process has been utilized during restoration of the Sonoma Baylands, Napa-Sonoma marshes, and other locations along San Pablo Bay where there were willing landowners and public agencies.

Selected key plans and policies for the Highway 37 corridor.

- San Francisco Bay Joint Venture: "Roadway planning should strongly consider the San Francisco Bay Joint Venture's partnership (27 member agencies and organizations) and federal executive order to meet its restoration objectives met through incentives and non-regulatory techniques."

- Focus: A Development and Conservation Strategy for San Francisco Bay, a partnership of ABAG, Metropolitan Transportation Commission, Bay Area Air Quality Management District, and BCDC.
- Baylands Ecosystem Habitat Goals Project. Published in 1999, the Baylands Goals are being updated to incorporate climate change and sea level rise.
- Change Hits Home: Adaptation Strategies for the San Francisco Bay Area, 2011. San Francisco Planning and Urban Research Association.
- Living with a Rising Bay: Vulnerability and Adaptation in San Francisco Bay and on the shoreline. 2011. San Francisco Bay Conservation and Development Commission:

STEP 3. DEVELOPMENT OF INTEGRATED ECOLOGICAL FRAMEWORK

Integrate the conservation and restoration strategy (data and plans) prepared in Step 2 with transportation and land use data and plans (LRTP, STIP, and TIP) to create the Integrated Ecosystem Framework (IEF).

The idea of the integrated ecological framework (CO6A) is that it captures the environmental context of transportation infrastructure, in order to improve stewardship of ecosystems associated with transportation systems. By developing and populating the framework, parties involved in discussions of planning for specific facilities can start from the same knowledge base.

For this study a sub-group of the core team met and discussed development of the IEF. Ultimately we devised a different name for the Framework. Our project focused on corridor planning and had no obvious, direct intersection with existing land-use planning. Ideally the Framework as implemented in corridor planning should extend beyond ecological and transportation issues. After discussing concerns on connotations of "corridor" (not just used for transportation, but wildlife) and "regional" (Bay Area wide), the consensus was to name this framework the "Highway 37 Corridor Context". Other possible names discussed were "SR-37 Corridor Assessment Framework" and "Route 37 Context." The Highway 37 Corridor Context thus continues much of the intent of the IEF, while expanding its database and mission to include environmental, transportation, agricultural land-use, community, and economic considerations and information (Appendix 4).

The purpose of the Corridor Context is to create a shared understanding of the context of

highway 37, with a common way of viewing information, to inform options and improve the ability to address stakeholder interests. The Corridor Context includes current conditions and likely or desired future conditions. In Caltrans terms, the Corridor Context serves as a "corridor assessment."

- The types of content that are part of the Corridor Context includes:
    - Quantified/mapped traffic patterns and noise model products
    - Lists/maps of attributes that stakeholders value
    - Narratives for topics that can't be readily mapped; e.g. restoration history of wetlands, issue of appraised land value for agricultural formerly tidal lands, etc. Trends in conditions that may be hard to map.
    - Information that is better conveyed as graphs and diagrams.

REGIONAL OBJECTIVES

The corridor cuts across the "Baylands" area of the San Francisco Bay, the predominant objective for which is large-scale restoration of tidal and other marshes to benefit native species, ecological processes, and to a lesser extent to buffer the effects of storms and sea level rise on coastal infrastructure. Caltrans objectives are to provide access to communities and other amenities via the corridor, mobility and safety along the corridor, while minimizing impacts to environmental and community conditions adjacent to the corridor. These objectives overlap in the restoration and protection of natural landscapes in the region of the corridor.

It is not the job of the environmental agencies to protect the transportation function of the corridor. Nor is it the job of the transportation agencies to restore ecosystems, unless their degradation is linked to transportation infrastructure and traffic. However, there is general agreement in the North Bay that transportation agencies can play a stewardship role in the region by both avoiding new impacts and contributing to restoring existing and legacy impacts of the highway.

In the context of the corridor management plan, different scenarios for the corridor may quantifiably or relatively contribute more or less to each of the environmental and transportation objectives. A stewardship approach encourages selection of a scenario, or portfolio of approaches, that demonstrably minimizes, avoids, and potentially restores impacts, while providing a basic level of safe accessibility and mobility.

DESCRIPTION OF CORRIDOR CONTEXT

Several main types of information were included in the corridor context – 1) spatial data about the distribution and composition of natural and human communities and 2) narrative descriptions of the surroundings and issues facing the corridor. The spatial data and tabular traffic data were made available for download on the project web site: http://hwy37.ucdavis.edu.

WETLANDS

Highway 37 is surrounded by salt-water, brackish, and fresh-water wetlands along approximately half of it its length. The highway cuts across the Bay-side of many wetlands that otherwise would be subject to tidal flows. Because these wetlands vary in elevation relative to the sea, certain wetland areas are maintained artificially in fresh-water or brackish conditions when they would otherwise be salt-water tidal marshes, or mudflats. The marshes are often adjacent to agricultural, urban, and other natural lands. Many are connected to nearby creeks, rivers, and the Bay through a network of artificial and natural sloughs and drains. (Appendix 4)

The Napa-Sonoma Marsh (Marsh) is a complex of tidal marshes, sloughs, rivers and reclaimed marsh used as agricultural lands. It is located at the northern edge of San Pablo Bay and covers roughly 73 square miles (Madrone Associates 1977). This marsh has an area of 48,000 acres, of which 13,000 acres are abandoned salt evaporation ponds. The US government has designated 13,000 acres in the Marsh as the San Pablo Bay National Wildlife Refuge. The Marsh is fed by Sonoma Creek, Tolay Creek, and the Napa River. Most of the Marsh is only accessible by boat. Agricultural lands occupy almost half of the Marsh and are largely reclaimed lands that support oats, hay and grains, and cattle and sheep. Salt production is the largest industrial use of the marsh, covering approximately 20% of the area.

The status of marshlands in the San Francisco Bay Delta Area has changed considerably. Around 1860, the Marsh was one of the most productive wetlands of the Pacific Coast, providing habitat for millions of birds. By the mid-1980s, the San Francisco Bay perimeter had lost over 91 percent of its wetlands. Approximately 85% of the original tidal marshes in the area have been lost due to creation of salt ponds, conversion to agricultural and industrial/urban use, and water diversion and management (Marshall & Dedrick 1994). Currently, the Marsh represents one of the few coastal marshland areas where restoration

is feasible and is actively promoted by the California Coastal Conservancy, the California Department of Fish and Game and the Point Reyes Bird Observatory.

The close interaction among hydrological regimes, soil characteristics and vegetation is what governs the maintenance, functions and services provided by tidal marshes. Currently and in the future, there could be two opposing threats: insufficient tidal flooding (due to restriction), or excessive flooding (due to subsidence and sea level rise) tidal flooding. Artificial infrastructure, including roads or berms, has an impact on marsh hydrological regime by causing inadequate provision of tidal flows (Boumans et al 2002). Constrained flows hinder ecosystem functions by disrupting the natural interactions among vegetation, soil and hydrology. The lack of saltwater tidal exchange in restricted salt marshes has 1) promoted spread of invasive species that are less tolerant to salt water; 2) restricted nekton distribution, 3) promoted the oxidation of sediment organic matter leading to subsidence or loss of elevation, and 4) decoupled the natural sedimentation process in marshes for adaptation to sea level rise.

ECOSYSTEM FUNCTIONS AND SERVICES PROVIDED BY NAPA-SONOMA MARSH

Table 1 provides a list of general functions and services provided by wetlands (Schuyt and Brander 2004). The different wetland types vary in function, contour, biota, tidal action, water quality, and in their respective contribution to the marine food chain. Wetland functions are the result of physical and biological processes and interactions. The main wetland functions that have global significance for the service they provide in tidal marshes are:

a. Biodiversity Support

The Marsh is a productive estuarine ecosystem providing habitat for a wide diversity of flora and fauna, including numerous rare endangered species and migratory species, many of which are attracted by the presence of water, high plant productivity and other habitat qualities. Special status mammals and water birds include the salt marsh harvest mouse, the California clapper rail and the black rail. Main endangered fish found are the Delta smelt, Sacramento splittail, steelhead trout, and Chinook salmon. Other aquatic animals include the endangered California freshwater shrimp, the Dungeness crab, and other benthic and planktonic invertebrates. Because of its bird diversity, the Marsh is one of only seven marshes selected for intensive study by the Point Reyes Bird Observatory (based on a total of 50 discrete marshes similar to the San Francisco Bay).

b. Water Quality Improvement

Tidal wetlands improve degraded waters by recycling nutrients, processing chemical and organic wastes and capturing sediment loads; the cleansed water helps maintain aquatic organisms. These ecosystems undoubtedly provide water storage services and improved water quality in the Napa River and San Francisco Bay.

c. Disturbance regulation and protection

Marshes act like giant sponges, as they form a protective barrier for coastal urbanized areas, buffering buildings and transportation networks from wave impacts during storm surges. Marshes and floodplains are critical in mitigating flood damage, as they store large quantities of water, effectively reducing the height of flood peaks and the risk of flooding. Disturbance regulation saves high economic costs associated with flood damages in areas where wetlands are preserved and restored.

d. Carbon regulation and management

Thick layers of carbon-rich peat play a role in the global carbon cycle by binding poorly decomposed plant material into the substrate. The sequestration rate in wetlands is significant considering that carbon is buried in the sediment at rates up to 50 times higher than those observed on land, and these rates can be maintained for centuries or more.

e. Food-web and nursery habitat maintenance

The decomposed detritus from marsh vegetation contributes to the base of the food chain of estuarine and marine environments. The rich out-flowing of dissolved nutrients, organic debris and invertebrate larvae, carried off by tidal currents, provide a food resource upon which many marine species rely, including commercially important fish. Anadromous fish, such as shad, sturgeon, salmon, steel head trout and striped bass use these areas year-round for feeding or during spring migration, and also use the area as a nursery ground during their juvenile stages (Madrone Associates 1977).

f. Recreation and cultural services

Public protected areas provide several recreation opportunities including fishing, bird watching, hunting and environmental education. Waterfowl species recreation and hunting is well-known in marshlands around San Francisco Bay.

Each of these tidal marsh services will have an impact when loss of marsh acreage occurs. Because hydrologic conditions define wetlands, any alteration of water volume (increases, decreases, or timing of high and low waters) threatens the area and integrity of wetlands

(Zedler and Kercher 2005). And because the quality of the water further defines the type of wetland, increases in nutrient loadings (eutrophication) often threaten wetland integrity.

Due to the existence of several non-linearities in the quantification of ecosystem functions and services, the effect of development on specific services itself could show unexpected changes. For example, marsh drowning will result in an increase in un-vegetated intertidal habitat (i.e., mudflats), as will the inevitable erosion of low marsh habitat, especially along bay margins. This may or may not counteract expected mudflat losses within the open San Francisco Bay but should at least provide new foraging habitats for shorebirds, waterfowl, and other water-birds. Thus, although the loss of vegetated marsh would have negative consequences for marsh dependent species, there are likely to be benefits for other species and services associated with these species including recreation, fishing and hunting. As a result, restoration and conservation planning in the face of SLR will necessarily involve an evaluation of ecological trade-offs, as is already the case for current restoration planning efforts.

ENDANGERED SPECIES

The wetlands, waterways and grasslands surrounding the corridor are habitat for a wide variety of native fauna and flora, including several state and federally-protected species (Figure 2). Protected species include: the Delta smelt, green sturgeon, Sacramento splittail, steelhead trout, and Chinook salmon, California black rail, California clapper rail, and salt marsh harvest mouse. These species all raise permitting issues in conventional transportation planning and project delivery (Appendix 5). One thing that is noteworthy is that environmental regulatory agencies described one future scenario for the corridor as "self-mitigating" when it came to endangered species – the causeway option.

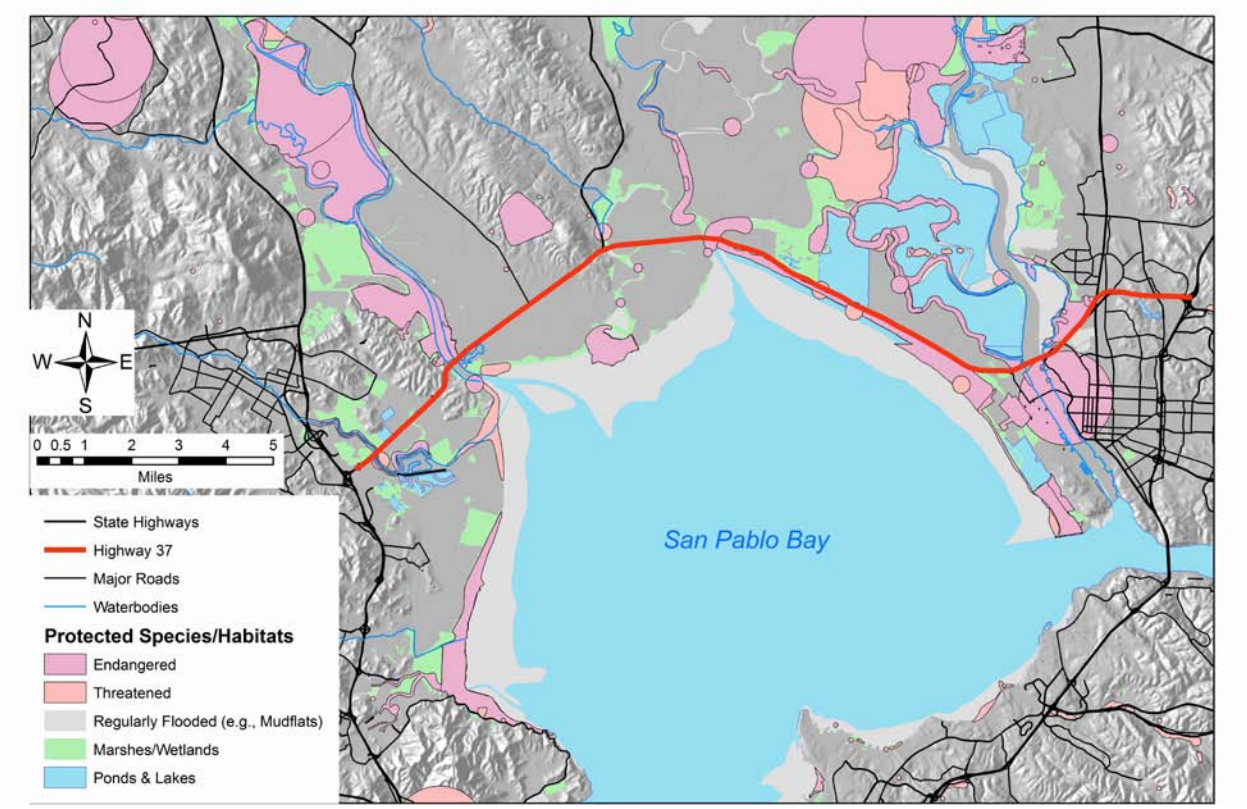


Figure 2 Protected species and habitats near highway 37. Species and habitat spatial data from the California Natural Diversity Database. These areas represent past occurrences, but not all, or current occurrences.

LAND-USE

There are three main land-uses along the corridor, in descending order of extent: conservation/restoration, agriculture, and urban (commercial and residential). There are two main types of agriculture – growing hay and raising dairy-cows. In the larger North Bay region, there are other kinds of field crops, vineyards/wine-making, and orchards. Highway 37 probably contributes to the movement of agricultural goods within and out of the region. Either end of the corridor is anchored by small cities that are part of the larger urban area of the San Francisco Bay.

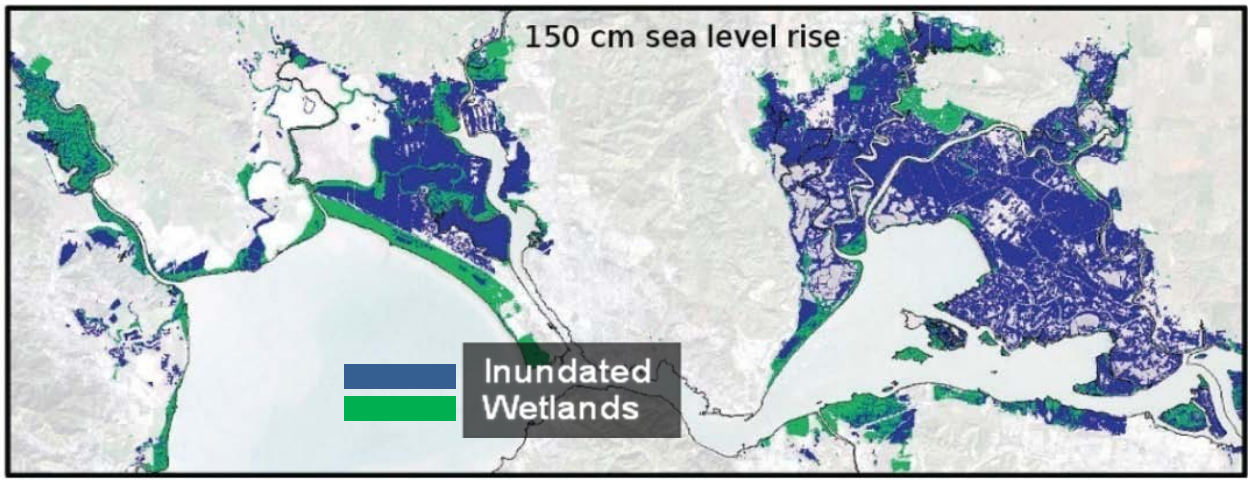
Changing land-use at the fringes of the Bay Area, primarily residential development, impacts the developed lands and surrounding areas, as well as areas such as along the highway 37 corridor, which provide commuting pathways for exurban residents to urban jobs. Highway 37 is anchored at the west end by Marin County, which is one of the most

expensive places to live in the US. Jobs-housing imbalances contribute to service and industrial workers driving from inland areas along Bay Area highways, including highway 37, to jobs in Marin and Sonoma Counties (Hickey, 2011). Because new developments are slow to be approved (for legitimate environmental reasons) and house/apartment prices unlikely to become affordable, the imbalance is likely to continue and worsen with regional population growth. Expanded capacity along highway 37 is unlikely to make things better and may even exacerbate the situation if it becomes easier to commute from inland areas to Marin and Sonoma Counties.

SEA LEVEL RISE

As a coastal highway, this corridor is under threat from sea level rise. It also poses a threat to the ability of nearby marshes to adapt to sea level rise. A state agency that is responsible for land-use and conservation planning in the Bay Area (the Bay Conservation and Development Commission, BCDC) recently developed a model of the inundation that could occur under likely climate change scenarios. This model shows much of the lowland North Bay wetlands and agriculture landscape under water, including most of the highway 37 corridor (Figure 3A). This "bathtub model" did not take into account the locations and elevations of berms and levees and therefore provides only an approximation of where sea level rise impacts might occur. However, when released it garnered a lot of negative and positive attention because of the risk that was apparent to various kinds of infrastructure and land-ownership. More recent, high-resolution elevation modeling by the US Geological Survey (Figure 3B) makes it obvious which segments of highway and areas of wetlands are most at risk from future sea level rise. The USGS is using these data to develop high-resolution, coastal sea level rise models.

A



B

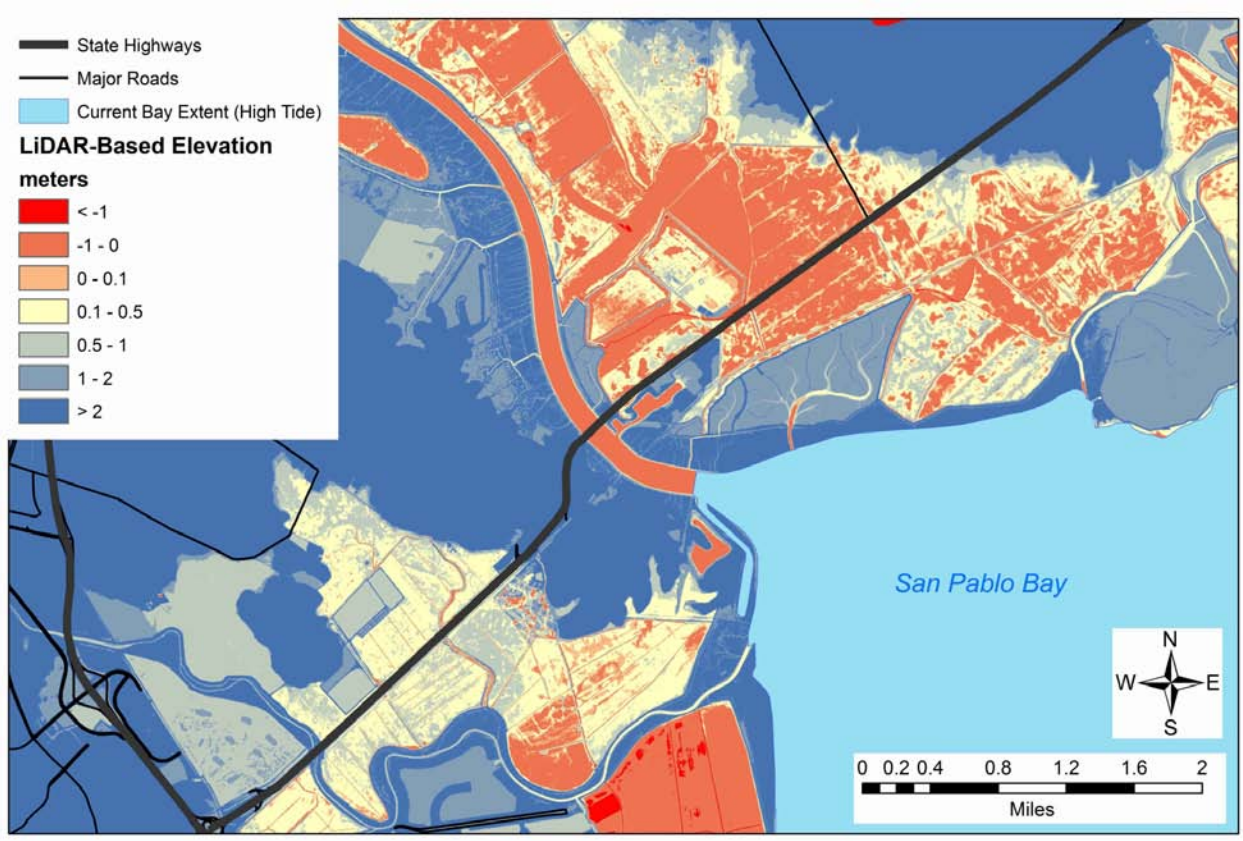


Figure 3 Areas in the North San Francisco Bay potentially at risk from sea level rise. A. Model commissioned by the Bay Conservation and Development Commission, showing 150 cm rise by year 2100. B. Areas adjacent to part of the highway below current sea level (<0 m elevation) and below future sea level at 2100 (<1-2 m elevation).

Highway 37 constitutes a major regional east-west vehicular transportation corridor in the northern Bay Area, connecting the North Bay from US 101 in Marin County to Interstate-80 (I-80) in Solano County (Figure 4). Stretching west to east for approximately 22 miles, Highway 37 is anchored by Novato in Marin County and Vallejo in Solano County. Highway 37 runs along the northern shore of San Pablo Bay. It primarily serves commute and recreational traffic between Marin, Sonoma, and Solano Counties.

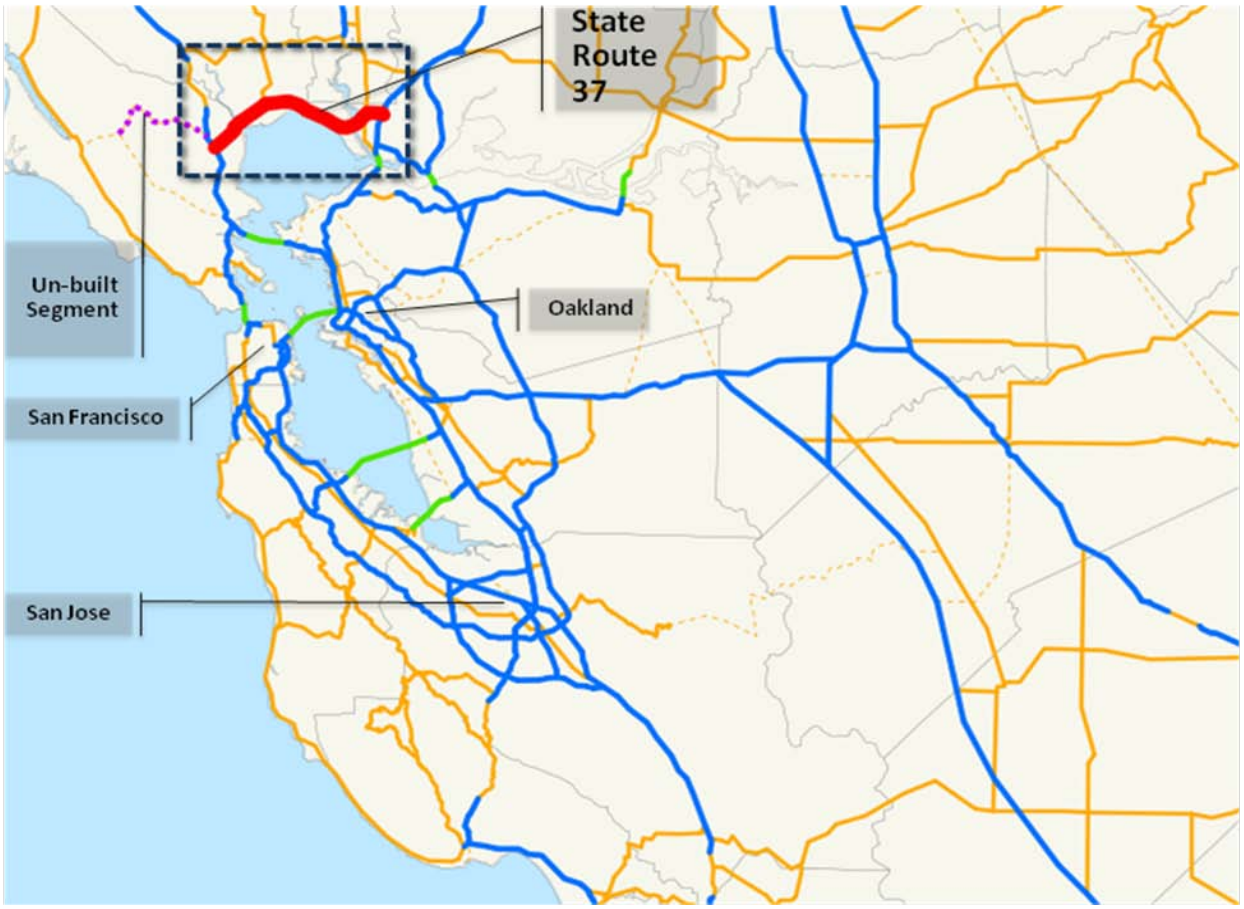


Figure 4 Position of the corridor in the Bay Area regional network of highways.

Traffic volumes are currently below capacity for the entire length of the corridor (Table 2). Without capacity enhancement, segments of the corridor are anticipated in 2035 to operate significantly above capacity. Increasing capacity is expected to alleviate congestion along segment B, which is the segment that runs without intersection through the marshes, between I-80 and State Highway 121.

Caltrans regularly collects traffic data along state highways. In addition, the agency and local agencies model projected future traffic volumes, based on current conditions, highway capacities, and changing land-use. Future traffic demand was modeled for the highways in the study region. The Marin County Travel Demand Model was used for this exercise (see Appendix 5 for detailed methods). Year 2035 forecasted volumes for highway 37 were estimated for the existing facility configuration as well as a possible future four-lane freeway facility for the entire corridor length. In addition, a year 2035 model run was performed with existing highway 37 removed from the model network west of highway 29 (to simulate a realignment of highway 37 along existing highway route alternatives because of rising sea level). For this scenario, year 2035 volumes were provided for key highway segments that provide an alternative to east-west travel on highway 37.

Travel Demand Model Capabilities and Limitations

Results from a Travel Demand Model are for use in high-level planning analyses of long-term improvements, and do not represent comprehensive analysis of existing and future traffic conditions within a travel corridor. Travel demand models have specific analytical capabilities, such as the prediction of travel demand and general representation of traffic flow in a regional highway network. They use mathematical models to forecast future travel demand based on current conditions and future projections of household and employment characteristics. They are not designed to evaluate system management strategies, such as intelligent transportation systems (ITS) or specific operational improvements.

Average Annual Daily Traffic, Peak Hour Traffic and Volume-to-Capacity Ratios

Average Annual Daily Traffic (AADT) is a typical TDM performance measure showing the total number of vehicles that traverse a segment of highway for a year divided by 365 days. As a result it averages out seasonal variations in traffic volume, providing a general indicator of the volume of traffic accommodated by the highway segment. Another typical TDM performance measure is peak hour traffic, which shows the highest number of vehicles that traverse a highway segment during the single hour of highest peak traffic (usually noting if it is the AM or PM peak hour).

A vehicle-to-capacity (V/C) ratio compares the actual or projected number of peak hour vehicles shown to be travelling through the mainline highway lanes against the assumed full capacity of the same mainline highway segment. For example, a typical freeway lane is often assumed to accommodate 2,000 vehicles per hour per lane, so a 2-lane freeway would have a full capacity of 4,000 vehicles per hour. If that freeway had 3,150 vehicles

per hour, it would be operating with a V/C ratio of 0.79. Any highway segment with a V/C ratio under 1.0 is assumed to operate under full capacity on a typical day. This does not necessarily mean there is no congestion or operational problems, just that the amount of travel demand is less than its theoretical capacity. While any V/C ratio over 1.0 is not physically possible, in a TDM output this simply represents a theoretical traffic demand beyond the full capacity of the highway segment.

Table 2 Traffic volumes as average annual daily travel (AADT) for the 3 segments of the highway corridor. "2035 (existing)" refers to the highway with its existing capacity. "2035 (inc. capacity)" refers to the highway with increased capacity in segment B (2 lanes to 4 lanes). The orange highlight indicates traffic volumes that exceed capacity at peak times.

		2010	2035 (existing)	2035 (inc. capacity)
Segment Description	Segment	AADT	AADT	AADT
US-101 to SR121	Segment A	37,933	67,823	72,181
SR121 to Mare Island in Vallejo	Segment B	36,970	66,145	72,896
Mare Island to I-80	Segment C	92,382	114,932	119,366

(Exceeds peak volume/capacity ratio of 1)

STEP 4. ASSESS LAND USE AND TRANSPORTATION EFFECTS ON RESOURCE CONSERVATION OBJECTIVES IDENTIFIED IN THE REF

The corridor provides commuting access between residential areas inland of the San Francisco Bay and service and commercial jobs in coastal Marin and Sonoma Counties. It also serves goods movement among agricultural, processing, and industrial facilities. Over the next 25 years, traffic on the highway (and other regional routes) is projected to increase by 30,000 AADT (between 30% and 80% increase), related to increased land development in the San Francisco Bay Area and adjacent areas. Expanding the capacity of the highway is projected to result in an additional 12% increase in traffic (Table 2), which may be related to the availability of an improved facility.

In the present study, the existing and projected traffic volumes were used to assess current and potential future effects on surrounding natural areas, as well as urban areas. The assessment was based on the "road effect zone", which is the area around a given roadway affected by the presence of the infrastructure and the traffic.

Road/highway effects from the existence and use of infrastructure are pervasive throughout developed landscapes, but seldom measured, modeled, visualized, and/or used in planning and transportation decision-making. This means that the evaluation of potential transportation alternatives, potential impacts, and potential mitigation activities are not based on the actual distribution of effects from the transportation infrastructure. The environmental impacts of roads and road networks vary in type and degree based on the physical properties of the roadway, the activities associated with the road, and the sensitivity of the local environment. The local environment affected by the road surface and traffic has been termed the "road effect zone" (Forman and Deblinger, 2000; Forman et al., 2002a). Although there is a rapidly growing literature on specific environmental impacts within this zone (stormwater runoff effects, biological invasions, noise, wildlife barriers), there have been few tests of the extent of the road effect zone, how various impacts are interrelated, and how these impacts could be minimized through pavement and roadside management activities, and how the zone could be used in transportation planning.

Road effects on aquatic ecosystems can consist of chemical inputs to waterways (Gjessing et al., 1984; Hoffman 1981; Bell and Ashenden 1997; Ziegler and Giambelluca 1997), alteration of aquatic community processes (Wilcox 1986; Maltby et al., 1995), impacts upon the physical characteristics (e.g., channelization) and processes of stream systems, and their ability to recover from land-use impacts (Meyers and Swanson 1995). Riparian roads can cause reduced riparian bird species richness and density (Rottenborn 1999) and overall species richness in wetlands (Findlay and Houlahan 1997). Roads can also affect terrestrial biodiversity directly through loss of habitat and increased mortality, as well as indirectly by causing ecological changes in the "road-effect zone," hindering habitat connectivity and fragmenting habitat patches (Jonsen and Fahrig 1997, Chapin et al., 1998, Rosenberg et al., 1999, Baker and Knight 2000). Road and land development can cause fragmentation with varying impacts (Yahner 1988, Theobald et al., 1997, Lidicker 1999). Fragmentation and disturbance impacts from roads may exacerbate threats of extinction from other factors through impacts on migration and habitat quality (Fahrig 2001). Not only do roads create artificial habitat edges, but they also pose a barrier to species dispersal and migration through aversion effects ("habitat alienation", e.g., Mac et al., 1996), direct mortality from traffic (Madsen 1996, Putman 1997, Rubin et al., 1998), and traffic noise-induced effects (Reijnen et al., 1997, Gill et al., 1996). The combination of edge and barrier can reduce the effective area for species that depend on intact habitat in the interior of patches.

Roads can affect people too. Traffic noise has been shown to be connected with increased incidence of hypertension and specific heart ailments (Lercher et al., 2011). This problem increases with age and is inversely related to education and income.

Table 3 Examples of effects distances from the scientific literature. These distances represent the furthest measurable distance of each effect in the cited study.

Road Effect	**Effect Distance (m)**	**Citation**
Amphibian occupancy	1000	Eigenbrod et al., 2009
Sensitive birds occupancy	1200	Forman et al., 2002
Large mammals movement	600	Gagnon et a., 2007
Soil contamination	30	Backstrom et al., 2003
Wetlands processes	500	Findlayand Houlahan, 1996
Human health	400	Raaschou-Nielsen, 2011; Spira-Cohen et al., 2011

The "road effect zone" (Forman et al. 2002a) provides an efficient way to delineate, describe, and communicate about the interactions between roadways and natural systems and processes. This zone extends from the immediate road-side environment out to the extent of effects from individual roadways and road systems. Partial delineation and use of this zone concept has been used for tortoises (Boarman and Sazaki, 2006) and frogs (Lesbarreres et al., 2003). However, there is very little development of the zone concept in the literature, despite the fact that it is robust and measurable and that it would be very useful to guide road ecology research and transportation planning and management strategies.

As a proof of concept for modeling specific effects of transportation, we focused on one of the more challenging components, accurately calculating the traffic noise envelopes around roads. Traffic noise effects occur at intermediate distances compared to near-road effects (e.g., weed-seed dispersal) and long-distance effects (e.g., NOx emissions impacts on regional plant communities) We used the noise model, System for the Prediction of Acoustic Detectability (SPreAD) version 2.0, developed at the Center for Landscape Analysis (UC Berkeley) by Sarah Reed, now at Colorado State University. The output of the

model was a map of a part of the road effect zone and was used in discussions about road effects and ways to develop impact assessments and crediting strategies.

MODELING NOISE EFFECTS

The sound model, System for the Prediction of Acoustic Detectability (SPreAD), is an ArcGIS toolbox plug-in for modeling sound propagation from a single point source across the landscape. SPreAD was originally a spreadsheet routine developed by the U.S. Forest Service and the Environmental Protection Agency to study recreational noise in US National Parks and Forests. The Center for Landscape Analysis in San Francisco updated the model, converting the lookup tables to formulas. The model calculates noise propagation at a given frequency from a point-source, based on land-cover, topography, and climatic conditions. The road network totals 202 km and was broken into thirteen (13) road segments, which were in turn further represented by points 250 m apart. Noise propagation from the points within each segment was analyzed, resulting in a raster representing noise intensities (in dBA). We used current (2010) and projected (2035) average annual daily travel (AADT) traffic volumes and traffic composition (e.g., % heavy trucks) to calculate sound intensities (in dBA) at the highway. Traffic noise was estimated using the Federal Highway Administration's Traffic Noise Model, v2.5 (FHWA, 2004). Noise at the point of origin (highway), a digital elevation model (DEM), land cover (i.e., vegetation and developed areas), and climatic conditions were used to model sound propagation across the landscape.

The output of the sound model was a raster with a gradation of values from a peak at the roadway (>80 dBA) to background noise (~35 dBA). Two cutoffs were used to understand potential impacts of traffic noise: >40-50 dBA, for sensitive birds (Parris and Schneider, 2009; Dooling and Popper, 2007), and 50 dBA, for multiple effects on human health (reviewed in Lercher et al., 2011). The raster extent at 40 dBA was intersected with the California Vegetation map (CalVeg) to assess potential effects on sensitive wildlife living in different habitat types. The raster map extent at 50 dBA was intersected with the National Land Cover Dataset, urban areas, to approximate effects on human health. This type of intersection provides transportation planners and environmental regulatory agencies with a way of estimating the impacts of current and proposed transportation projects on species and habitats of management concern.

Traffic noise can affect both natural and human system well-being. Estimating traffic noise impacts on highways in a region with varying traffic intensities provides a mechanism for both calculating total transportation impacts, as well as understanding trade-offs inherent

in developing different transportation corridors. In the North San Francisco Bay region, traffic noise impacts vary considerably among highways with different traffic volumes and in different natural settings and communities (Figure 5B). These varying impacts are critical to understand if regional highway-specific and cumulative impacts are to be understood and used in transportation planning.

Detailed modeling methods are provided in Appendix 5

NOISE EFFECTS FINDINGS

There are various ways that noise effects can be accounted for to inform credits, valuation, and decision-making. The easiest and crudest is in terms of habitat area affected. This doesn't necessarily measure harmful outcomes, so much as provide an estimate of impact in land-units, which are a familiar currency in transportation and land-use decision-making. The impacts to wildlife and people can be derived from the area-affected, if there is knowledge about how many individuals, or what species, live in the affected area.

Traffic noise can affect sensitive birds down to a sound intensity of 40 dBA. This is about the noise level of a suburban neighborhood, which is still higher than the noise level in a quiet grassland or forest (~20 - 25 dBA). Noise affects most wildlife, birds, and humans at levels above 50 dBA, with more severe effects as the noise level goes up toward 100 dBA, levels which can cause physiological harm. We estimated the habitat-area affected by traffic noise from highway 37 and from the regional highways (Figure 5), under different improvement/expansion scenarios (Table 4). These scenarios are described in "Step 5" below and in Appendix 5. Scenarios B & C involve expanding the highway to 4 lanes upon a raised footprint (B), or a causeway (C), for which traffic is expected to increase. Scenario D involves removing the majority of the current alignment and co-aligning the highway with interstate 80 to the south.

Under current conditions, >14,000 people may be affected by traffic noise (>50 dBA) from highway 37 (Figure 6, Table 4). This number goes up to >23,000 by 2035, due to traffic increases. Removing the stretch of highway 37 that goes across the marshes reduces the traffic through the neighboring urban area and thus the number of people affected by noise (7,800).

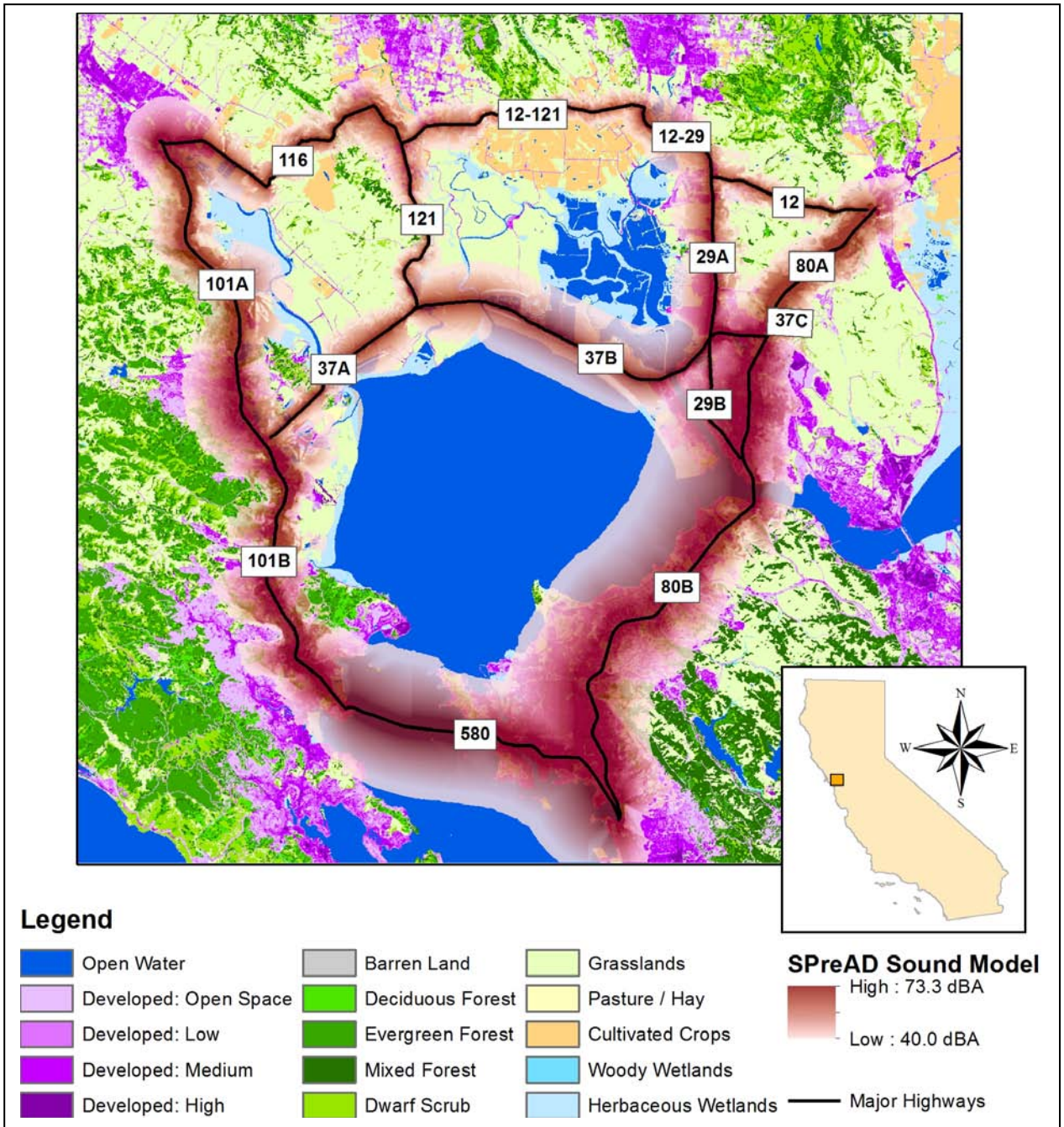


Figure 5 Noise impacts from traffic on planning region highways. Traffic noise dissipation was estimated using the model SPreAD. Land-cover is represented using the National Land Cover Dataset.

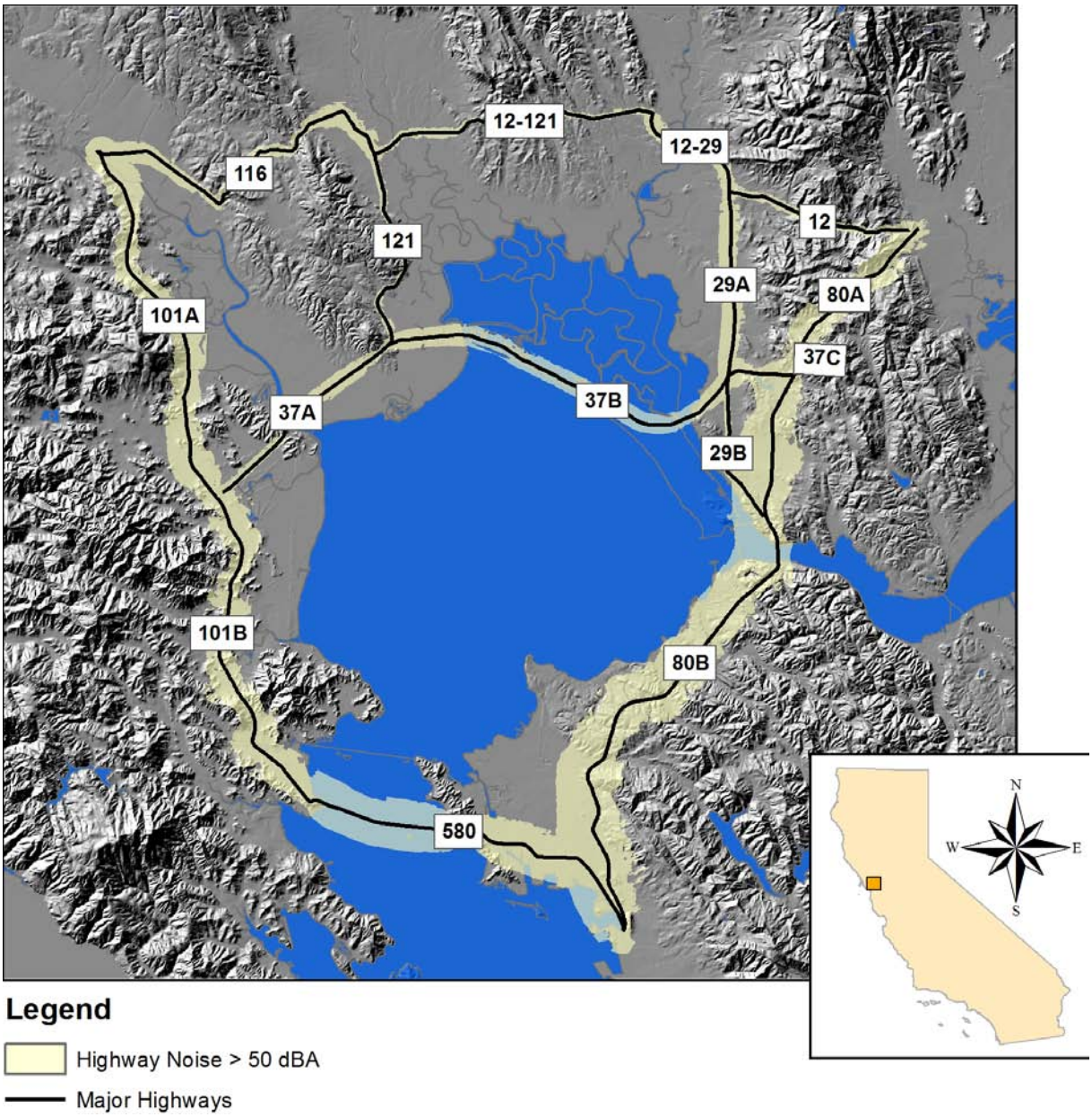


Figure 6 Traffic noise impact area for sound intensities >50 dBA.

Table 5 Traffic noise affected areas under different timeframes and improvement scenarios. Area is in hectares (Ha). The number of people affected in urban areas was calculated by taking the average population density in the area (25/Ha) and multiplying by the affected area in Ha.

Habitat Type	2010 Affected Area Ha (≥40 dBA)	2010 Affected Area Ha (≥50 dBA)	2035, Scenarios B & C Affected Area Ha (≥40 dBA)	2035, Scenarios B & C Affected Area Ha (≥50 dBA)	2035, Scenario D Affected Area Ha (≥40 dBA)	2035, Scenario D Affected Area Ha (≥50 dBA)
Open Water	2038	415	2590	701	140	13
Annual Grass	1502	165	2509	307	205	15
Coastal Oak Woodland	189	23	313	37	0	0
Urban (# of people affected)	1994	575 (14,375)	2852	947 (23,675)	1306	312 (7,800)
Saline Marshes	1491	573	1923	799	125	13
Freshwater Marshes	752	278	869	407	10	4
Blue Oak Woodland	49	9	71	14	11	7
Cropland/ Pasture	2223	610	2668	988	0	0
Total	**8,244**	**2,073**	**10,943**	**3,253**	**491**	**52**

As noted above, traffic noise contributes to hypertension and specific heart conditions (Lercher et al., 2011). One way to think about noise impacts is in terms of economic cost of induced health effects. Without knowing the actual number of affected people in the traffic noise zone, an estimate can be made of number of people and annual costs of traffic noise-induced hypertension. Hypertension costs on average $1,598/year medical costs (Trogdon, 2007) + $300/year employee-productivity loss (Goetzel, 2004) = $1,898/year. Approximately 1 out of 3 adult Americans have diagnosable and treatable hypertension (CDC, www.cdc.gov/bloodpressure/facts.htm). Using the estimate of noise affected population near highway 37, one type of health cost associated with noise can be calculated:

2010 (Current condition)	14,375 people X $1,898/year-person X 1/3 = $9,085,489/year
2035 (Scenarios B & C)	23,675 X $1,898/year-person X 1/3 = $14,963,405/year
2035 (Scenario D)	7,800 X $1,898/year-person X 1/3 = $4,929,865/year

Traffic noise is not the only cause of hypertension. Similarly, these are not the only costs that could occur from noise effects on health, or noise-annoyance. They are also not the only impacts that could have costs associated with them. For example, noise effects on habitat quality and occupancy would change the "value" of habitat adjacent to highways, to wildlife and to people.

STEP 5. ESTABLISH AND PRIORITIZE ECOLOGICAL ACTIONS

Caltrans is currently developing a Corridor Management Plan for state highway 37. This plan will be informed by this study and stakeholder process. The approach we took for this step was to combine the idea of transportation system modification with ecological protection and improvements to create an overall portfolio of stewardship actions. To make this more concrete in terms of the highway, future scenarios were created that reflected the discussion within the project team and with stakeholders. These scenarios provided a more grounded discussion of impacts and benefits to different constituencies, environmental impacts and permits, cost and feasibility, and potential corresponding ecological and mitigation actions. The scenarios were presented several times after development and feedback, including in the survey sent out to stakeholders and communities near the highway. It was important to note that the Plan does not yet have formally-described alternatives.

FIVE POSSIBLE FUTURES FOR THE CORRIDOR

During discussion within Caltrans and among stakeholders in this study, five high-level scenarios have arisen as possible futures for highway 37. These 5 are intended to provide alternative scenarios suitable for future transportation needs and also recognize the sensitivity of the environment in the area surrounding this transportation corridor. In developing the scenarios, consideration was given to multi-modal travel, impacts to tidal and brackish marsh habitat in San Pablo Bay, adjacent land-uses, traffic flows, climate change-induced sea level rise, and what constitutes "sustainable transportation". Appendix

6 contains additional detail about activities, impacts, and benefits associated with each scenario.

a) "No Highway Expansion": Caltrans would continue to manage the corridor with maintenance and repair activities and minor operational improvements (but no significant change in the footprint or capacity). This scenario has the least new permitting and regulatory requirements. Although regulatory agencies saw this scenario as having few new impacts, they recognized that existing impacts would continue and impacts from repairs were likely to increase over time.

b) "Expanded Footprint": The height and width of the corridor through the marshes would double and the corridor would be expanded to 4 lanes to address current and projected future traffic. This was originally the default choice of Caltrans for expanding the highway – by both reducing impacts from sea level rise and flooding and increasing capacity. Through the study, Caltrans staff have recognized that other scenarios should be explored. Regulatory agencies expressed the opinion during meetings that this was the scenario least-likely to receive the necessary environmental permits because of its high-level of continued and new impacts.

c) "Napa-Sonoma Causeway": The corridor (2 or 4 lanes) would be elevated onto a causeway across the tidal marshes (option 1) or across the San Pablo Bay (option 2) between Vallejo and Novato. Despite the expense that is likely to construct this option, it has remained the main focus of discussion among all stakeholders, including transportation and conservation organizations. Existing and new impacts would be reduced compared to scenario (b) and possibly (a). Some regulators described the project as self-mitigating, while others recognized that the elevated roadway would still project traffic noise into sensitive habitats.

d) "Strategic Co-alignment": The corridor would be re-aligned away from marshes & wetlands between Vallejo and Novato, with I-80 and 580 to the south, or with Highways 29 and 12/121/116 to the north. This novel approach would require de-construction of the existing road-bed and combination of the numbered highway (37) with another regional highway. Improvements to this alternate combined route may need to be made. Regulators regarded this scenario as having the least impact, with agencies expressing concern over displaced impacts to other highways.

e) "San Pablo Bay Tunnel": The corridor would be routed through a tunnel at the shortest feasible distance between the Vallejo and Novato areas. This scenario was suggested by a Caltrans environmental scientist because of its technological feasibility and relatively low environmental impact. However, this may be the highest cost scenario and is generally regarded by stakeholders as infeasible from that point of view. Regulators had trouble discussing this scenario because of perceived infeasibility but described it as having very-low post-construction impact.

These scenarios describe fairly exclusive and different possible futures. However, it is possible that various components of these scenarios could be combined to better address key issues identified by stakeholders during this study (such as multi-modal travel, sea level rise, agriculture, re-establishment of tidal flow, ecosystem and habitat restoration and protection).

TRANSPORTATION-ASSOCIATED STEWARDSHIP AND MITIGATION

The project team saw many options for corridor projects that provide ground-breaking environmental benefits. Maximizing environmental benefits will require planning discussions with local organizations, since partner organizations are already working on these issues and locations.

From an environmental review perspective, the project should be evaluated based on the net improvement it provides in environmental values. The project may have substantial short-term negative impacts, but for all scenarios, the long-term environmental benefits, if any, should be considered and in some cases those long-term benefits may far outweigh any short term impacts.

Some possible specific actions to pursue are listed here:

- Floodplain and Bayland enhancement, and wildlife habitat connectivity, as part of watershed-wide multi-benefit projects. Numerous parties in all affected counties are in the process of designing multi-benefit water projects for funding by the Department of Water Resources through the Bay Area Integrated Regional Water Management Plan.
- Spend mitigation money on actions consistent with the objectives put forth by the San Francisco Bay Joint Venture, Baylands Ecosystem Habitat Goals, Conservation Lands Network, FOCUS and other consensus plans for the region. These are primarily related to marshlands acquisition and restoration.
- Repair fish passage barriers, including those created by Caltrans' own infrastructure. Plant along streams or for other bird or animal habitat.
- Fund fish and wildlife monitoring projects. The streams crossing under Highway 37, in general, support several protected species of fish, yet it has been impossible to find grant funding to determine their diversity or numbers.
- Conduct habitat enhancement on agricultural properties. For example, install bird boxes for a variety of species or implement riparian restoration projects.

- The north Baylands are unique in the bay region, and provide bay-wide benefits. It may be possible to enhance mitigation resources for the north bay by using mitigation money from projects around the Bay.

To be considered stewardship actions, as defined here, these actions may receive resources from Caltrans, but not for mitigation of proposed projects. Even without any infrastructure projects, the existing highway footprint has un-mitigated impacts on wildlife and natural processes, which will be exacerbated with sea level rise. Improving travel may involve supporting multi-modal travel, rather than highway expansion. Improving environmental conditions in the corridor may involve moving/re-aligning the highway away from the marshes, or otherwise allowing the Bay and marshes to re-connect.

Mitigation for proposed expansion or repair of the highway could involve the proposed ecological actions above, or "self-mitigating" construction actions, like re-aligning the highway, raising it onto a causeway, or replacing the footprint with a tunnel under the Bay. Minimizing and avoiding impacts should be the first mitigation actions considered and for certain future scenarios for this corridor, may be all that is needed. Compensatory mitigation is considered the last-resort by environmental regulatory agencies, but is often the primary consideration of transportation and other infrastructure agencies. For this corridor, compensatory actions could be based on the impact assessment in the next step.

STEP 6. DESCRIPTION OF CREDIT AND VALUATION APPROACH

The crediting system described by CO6 Step 6 is intended to provide a consistent approach to measuring impacts and using a formal equivalent to impacts (e.g., acres) as an exchange unit in a crediting system. The crediting system then forms one basis for negotiations over mitigation requirements and tradeoffs between ecological and transportation functions. Our implementation of this concept was based on two approaches: 1) The first involved statement of values and corridor scenario preferences, elicited using formal surveying of stakeholder-advisors and community members, as well as documentation of value statements made at stakeholder meetings (particularly the October World Café meeting in Vallejo). This approach does not allow calculation of "credits" per se, but it does provide a broad view of socially-preferable directions and rankings of possible alternatives for the corridor. 2) The second approach involved a method developed by the Road Ecology Center and Sustainable Transportation Center at UC Davis, under contract with Caltrans. It was refined during this study in collaboration with a visiting scholar from the French Ministry of Transportation (Appendix 7). The approach is based on twin pillars of accurately

measuring impacts of transportation on ecological and human systems and using stakeholder and community preferences as one way to value attributes of the overall system and prioritize among possible choices or scenarios. Impacts of transportation were estimated using the "road effect zone" approach, which is a geographically-explicit expression of road effects for a given roadway and landscape. The output of the impacts assessment is measured in area units, providing an exchange currency for transportation planning.

APPROACH 1: STAKEHOLDER VALUATION OF CORRIDOR CONTEXT AND PLAN ALTERNATIVES

The stakeholder process for the project was extensive and included many interested parties. This process used stakeholder meetings and a "World Café" style workshop to both discover important values on the corridor and to identify those values which are irreplaceable in any planned scenario. However, it did not include the broader community, so the process was augmented using a standardized survey made available to interested community members.

STAKEHOLDER ADVISORY PROCESS

Values for existing uses and objectives for the corridor and associated ecosystems and communities were compared among the future scenarios. In the first step, World Café stakeholder participants applied their values to different transportation, wetlands, open space, and management attributes (A). In addition, changes in indicators for these attributes are quantified for each scenario, to facilitate scenario comparison (B).
Café participants were asked to compare their values for each of 4 types of concern (and specific concerns): Transportation systems (congestion, regional system impacts, safety), Wetlands (wetland habitat, wildlife, sea level rise adaptation), Open Space (open space, agriculture, recreation), and Management (decision reversibility, cost). The votes for each type of concern were summed to give an estimate of how much stakeholders valued the different ways of viewing the corridor. Despite the fact that only one environmentalist was present among the 58 participant stakeholders, the dominant concern was for wetlands as habitat for wildlife and for the capacity of the tidal marshes to adapt to sea level rise.
The value of this finding is primarily in developing weights for the valuation approach. One way to calculate weights would be to compare the relative values for each type of concern in the "high" category (Figure 7). This calculation results in the following: Wetlands, 45; Transportation, 28; Management, 15; and Open Space/Ag, 12. Another approach is to

multiply the number of votes in each category by the value (from 1 to 5), then sum the weighted votes within each type of concern. This calculation results in the following: Wetlands, 30; Transportation, 26; Management, 23; and Open Space/Ag, 22. With either approach, the relative ranking among types of concern stays the same, but the differences are smoothed out by taking into account lower value categories.

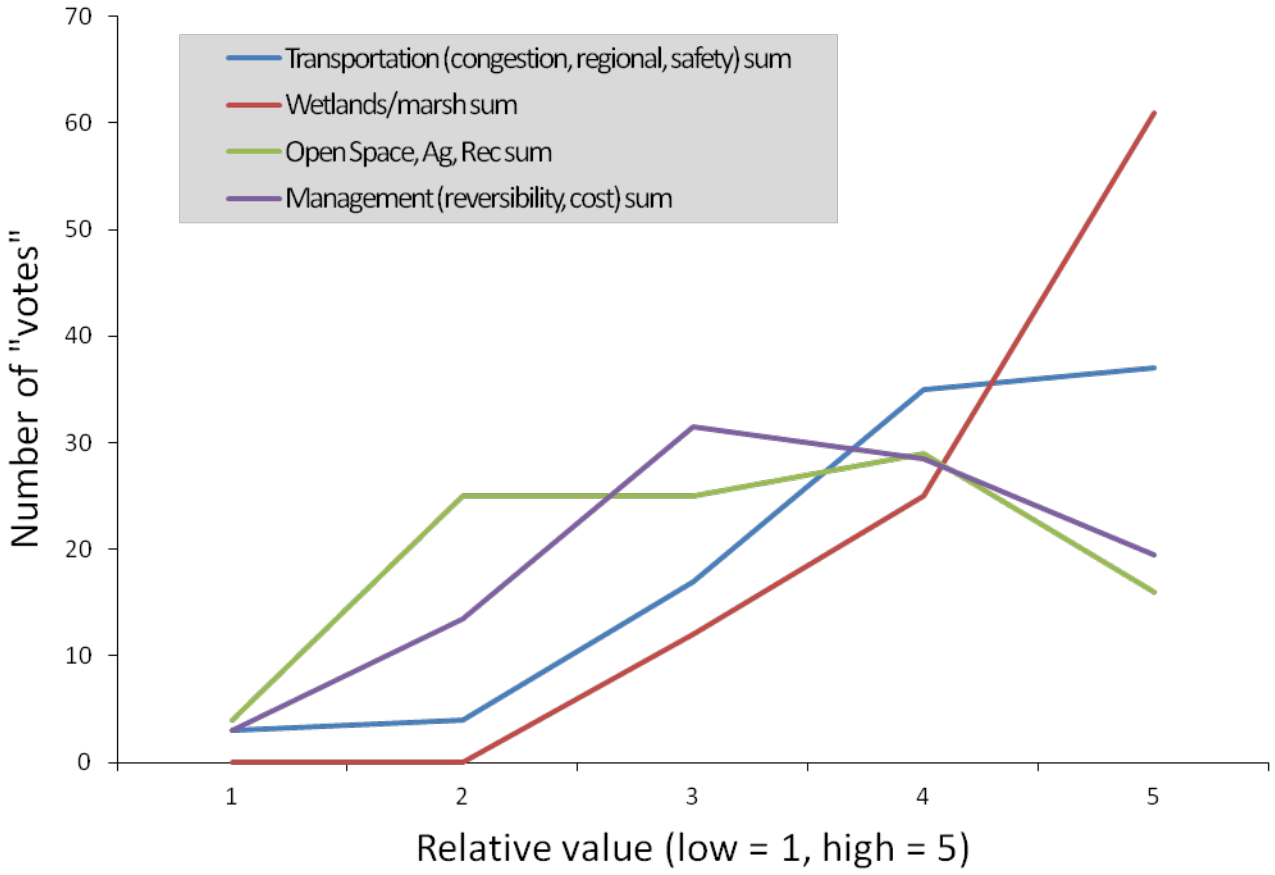


Figure 7 Relative value among types of concern along the corridor.

COMMUNITY ACTIVITY, VALUES AND PREFERENCE SURVEY

The purpose of conducting a community survey was to reach the greatest possible diversity of people who will be affected by changes to Highway 37 (within the budget of the project). Despite advertising the stakeholder meetings through partner channels, only a small group of people who would be impacted by changes to Highway 37 was aware that a planning process was under way. Additionally, the meetings were held during normal business hours and in different locations due the large land area that Highway 37 spans. Therefore,

even those that were aware of the meetings may not have been able to attend them. The community survey was able to reach an additional set of stakeholders whose views are significant to this corridor plan and who may have otherwise been overlooked.

Community members living near the corridor were randomly selected and sent a postcard during February, 2012, asking them to complete a web-based survey describing their activities and preferences for the corridor (n = 529 completed surveys). The preferences questions began with getting them to describe their feelings about traffic conditions, environment, rural character, and highway management. Then participants were asked their opinions about specific future scenarios for the highway and how well they felt these scenarios supported different possible values for the corridor context. Stakeholder process participants were also invited to take the survey (n = 49 completed surveys).

Survey Details

The community survey contained 47 questions divided into the following question groups: "Your Travel and Experience with Highway 37", "Your Vision for Highway 37's Future", "Proposed Changes to Highway 37 and General Comments".

The community survey was anonymous. Only the respondent's zip code was collected so that data analysis by city would be possible. The first section, "Your Travel and Experience with Highway 37", included general questions about travel behavior and the respondent's awareness of sea-level rise and local wetland health. Questions were also asked about the respondent's willingness to take public transit as an alternative to driving on Highway 37. The second question group was designed to capture how each respondent values individual components of a potential corridor plan. Survey respondents were asked to rate the importance of each item in the table below on a five-point scale:

Rural Character
Preservation of open space and views
Support for regional agriculture
Public access to the water and wetlands for recreation and education
Transportation
Traffic congestion relief
Minimal impact [during construction] to the existing transportation system
Safety, emergency access and maintenance vehicle access
Providing public transportation options
Providing a bicycle/pedestrian path (or bike lanes)
Minimal or no impact to the natural environment
Environment

Protection of wildlife and their habitat *Restoring the Bay marshes and the natural processes related to them* *Wetland health and adjustment to sea-level rise* *Restoring tidal action now blocked by the highway structure* *Providing safer animal migration*
Highway Planning and Management *A travel option that can easily be changed if needed* *Minimal financial cost* *Provides access to work, recreational, and other destinations*

Respondents were also asked to rank the criteria listed above for overall importance, by selecting the top five planning components that were most valuable to them.
The third set of questions used the same criteria as listed in the table above, but asked each respondent to consider each planning criteria again as it relates to one of the five possible scenarios for the future of Highway 37. Respondents rated each scenario's ability to support each planning criteria on a five-point scale.

The scenarios are as follows:

A) **No Highway Expansion** - Manage the corridor with maintenance and repair activities and minor operational improvements (no significant change in the footprint or capacity)
B) **Expanded Footprint** - Height and width of the corridor through the marshes would double and the corridor would be expanded to 4 lanes to address current and projected future traffic volumes
C) **Napa-Sonoma Causeway** - Option 1: over existing footprint at areas of low elevation Option 2: across San Pablo Bay between Novato & Vallejo
D) **Strategic Re-alignment** - corridor would be re-aligned away from marshes & wetlands between Vallejo and Novato, with I-80 and 580 to the south, or with Highways 29 and 12/121/116 to the north
E) **San Pablo Bay Tunnel** - corridor would be routed through a tunnel at the shortest feasible distance between the Vallejo area and the Novato area

In the last section, respondents were asked to rank the five corridor scenarios overall, as well as their willingness to pay a toll to assist with the expense of any changes to Highway 37. General comments were also welcomed.

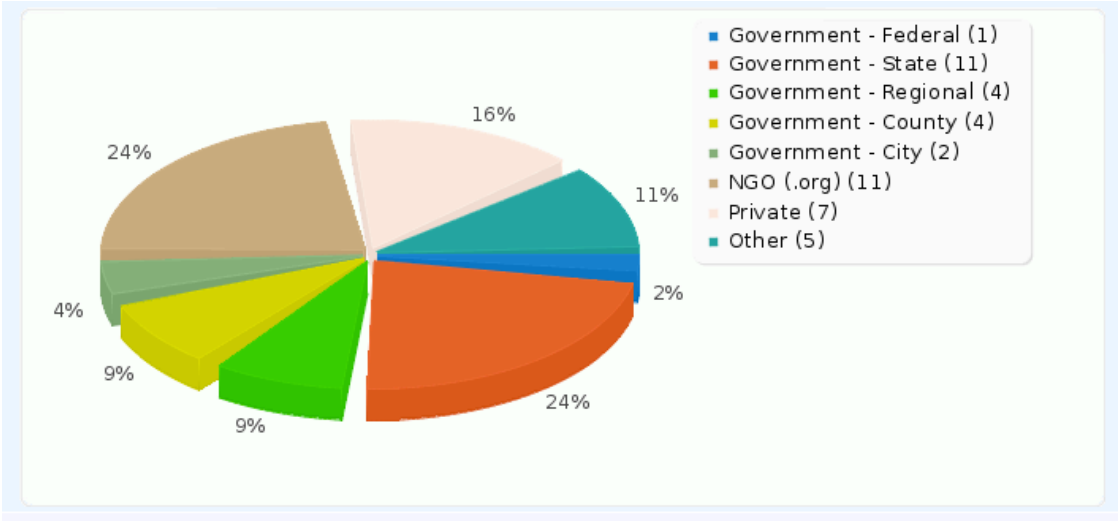
Survey Results

The results of the survey provided a way to both gauge broad community and stakeholder-advisor support for different values that could come into play along the corridor, as well as how different constructed highway alternatives might serve different needs.

Stakeholder Process Representation

Institutions and Interests A stakeholder process is often considered to be a proxy system for including broad social values and inputs in planning. Our stakeholder process included a slice of these values, as represented by institutional interests that participated in our process. Figure X shows the organizational and sectoral representation of stakeholder process participants who completed the survey. Approximately half of respondents represent a government agency of some kind (Figure 8A), but many different types of interests are represented (Figure 8B).

A



B

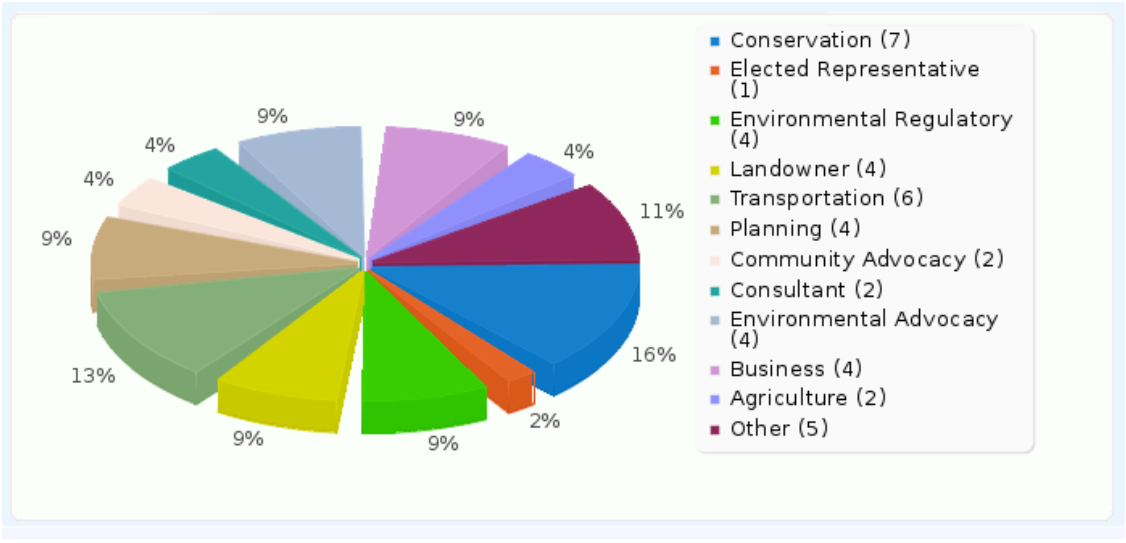
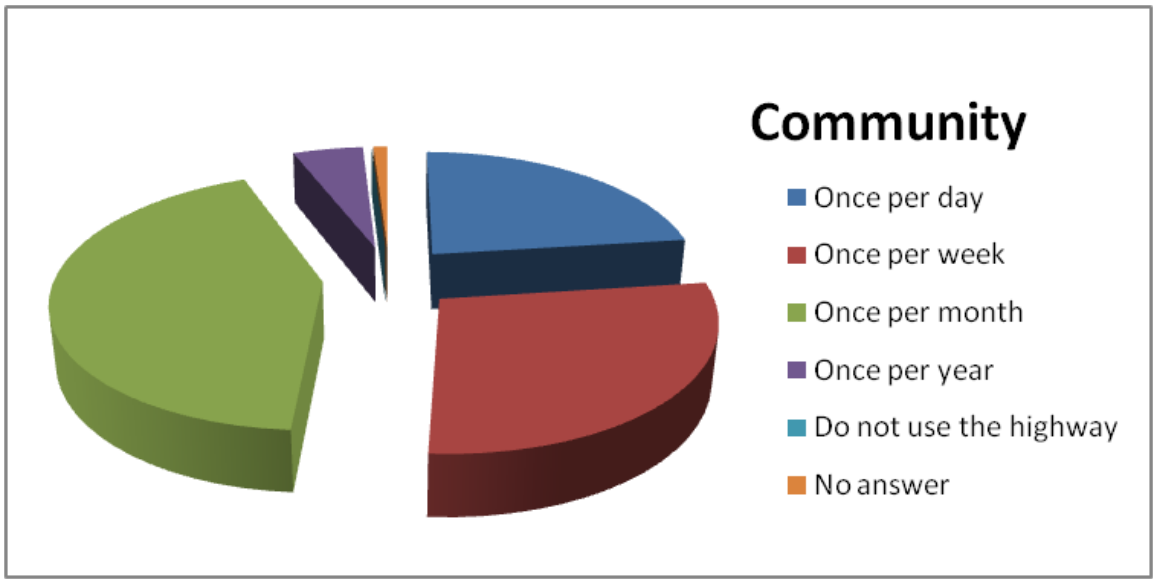
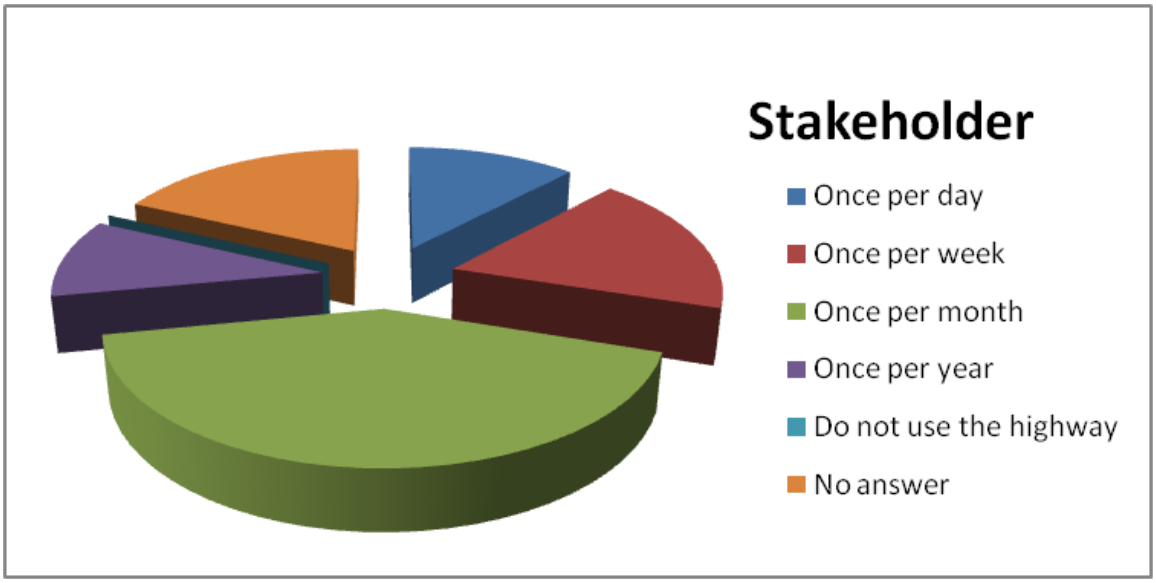


Figure 8 Institutional and sector representation of stakeholder respondents.

Travel Behavior One way to compare the stakeholder process participants with the community at large is based on their responses to the survey. Survey respondents were queried about their travel use of highway 37. Their use of the highway was slightly different – 50% of community members used the highway once per week or more often, compared to 30% of stakeholders (Figure 9).



A



B

Figure 9 Frequency that A) community members and B) stakeholder process participants drive on highway 37.

Sea Level Rise and Wetlands Another way to compare community members and participants in the stakeholder process is based upon their knowledge and familiarity with

sea level rise and wetlands. Both of these concepts played a large role in discussions about future scenarios for the highway. In general, stakeholders had greater familiarity/knowledge of sea level rise and wetlands than respondents to the community survey (Table 6).

Table 6 Familiarity of stakeholder process participants and community members with sea level rise from climate change and wetlands.

Sea Level Rise (SLR)	**Stakeholder**	**Community**
Don't believe SLR is occurring	0%	10%
Unfamiliar	6%	20%
Somewhat familiar	24%	43%
Very familiar	54%	22%
I'm an expert	0%	1%
Wetlands and Their Role		
Unfamiliar	0%	9%
Somewhat familiar	21%	53%
Very familiar	46%	33%
I'm an expert	16%	2%

Stakeholder and Community Values and Choices

Respondents to the survey were asked about the components of the corridor context that they valued (Table 7). These values were then used to refine their selection of transportation scenarios, insofar as the scenarios supported their values.

Table 7 The percentage of stakeholder process and community survey respondents who find each of the listed values or planning criteria "somewhat important" or "very important".

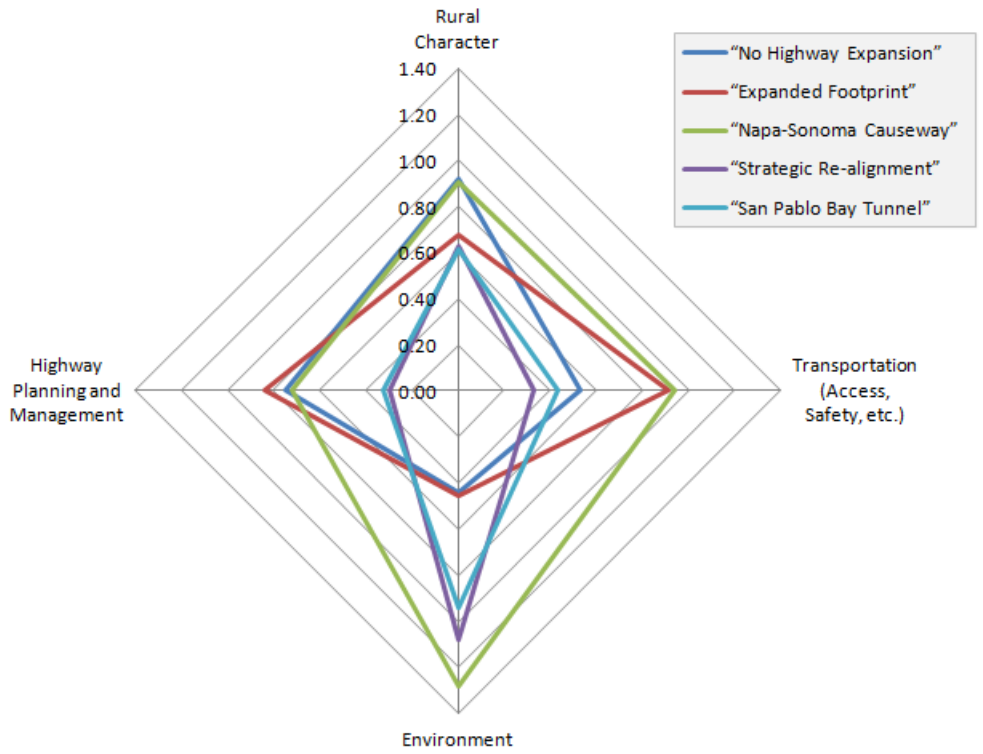
Rural Character	**"Stakeholder"**	**"Community"**
Preservation of open space and views	*90%*	*82%*
Support for regional agriculture	*85%*	*79%*
Public access to the water and wetlands for recreation and education	*81%*	*73%*

Transportation		
Traffic congestion relief	*76%*	*92%*
Minimal impact [during construction] to the existing transportation system	*59%*	*79%*
Safety, emergency access and maintenance vehicle access	*86%*	*90%*
Providing public transportation options	*72%*	*62%*
Providing a bicycle/pedestrian path (or bike lanes)	*68%*	*47%*
Minimal or no impact to the natural environment	*91%*	*73%*
Environment		
Protection of wildlife and their habitat	*90%*	*82%*
Restoring the Bay marshes and the natural processes related to them	*90%*	*69%*
Wetland health and adjustment to sea-level rise	*88%*	*69%*
Restoring tidal action now blocked by the highway structure	*79%*	*50%*
Providing safer animal migration	*86%*	*63%*
Highway Planning and Management		
A travel option that can easily be changed if needed	*53%*	*75%*
Minimal financial cost	*50%*	*70%*
Provides access to work, recreational, and other destinations	*92%*	*93%*

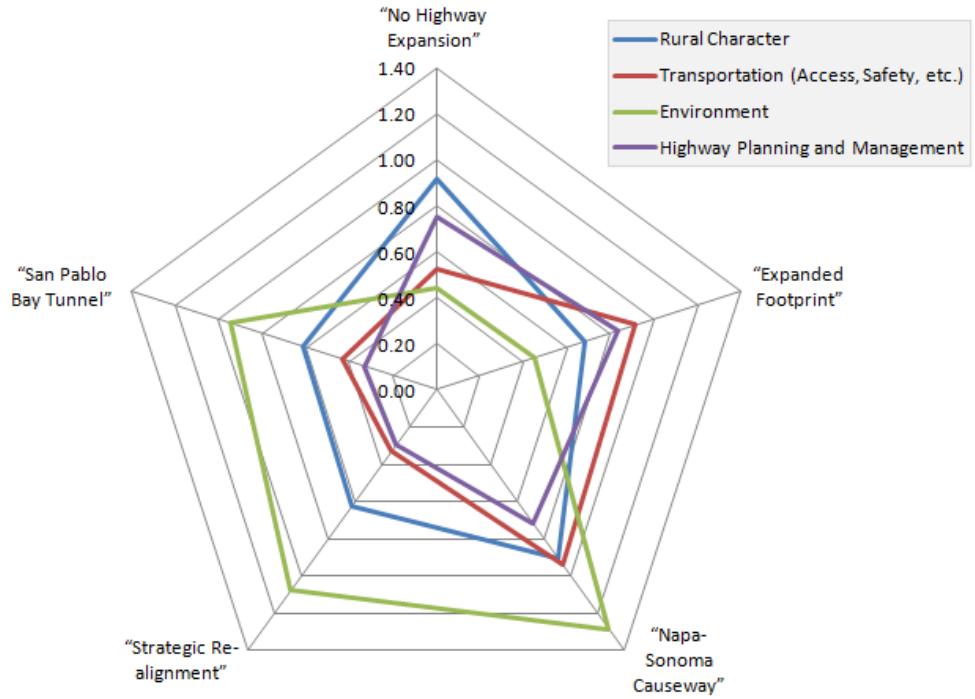
The results in the table show that traffic congestion, safety concerns and access are the most valued criteria for community members. Open space and wildlife protection are also highly valued, but less so than the transportation concerns. The results are slightly different for institutional participants in the stakeholder process, as they appear to value the environmental criteria more, which is consistent with the findings from the World Café. Asking community respondents to rank the planning criteria relative to each other offers slightly different results. Traffic congestion was the overwhelming concern, ranked first by 40%. Wetlands health (14%) and wildlife protection (11%) came in a distant second and third place.

Values and Future Scenarios

The role of values for the corridor context in selecting future scenarios can be presented in two ways, both representing the same idea of how much each future scenario supports each main value area. The first way (Figure 10A) is to look at how each scenario contributes to each value area (Rural Character, Transportation, environment, and Planning and Management). The second way (Figure 10B) is to look at the overall contribution of each scenario to all value areas simultaneously. Respondents ranked each scenario for its support of different values and these ranks were coded as follows: does not support = 0, somewhat supportive = 1, supports = 2. The weighted-average support "score" was calculated for each scenario-value combination (e.g., environment and scenario B). These values were used to create Figure X.



A



B

Figure 10 Support from each future scenario for different values. (A) Contribution of each value to each scenario. (B) Contribution of each scenario to each value.

The causeway (C) and no highway expansion (A) were most supportive of rural character, scenarios A,B, & C were all moderately supportive of planning and management, B and C were seen as most supportive of transportation needs/desires, and C, D, & E were seen as most supportive of the environment (Figure10A). Seen in a slightly different way, the causeway, scenario C, was most supportive of environmental needs, relative to other values; the expanded footprint, scenario B, was most supportive of transportation needs, relative to other values. When these two scenarios are looked at side by side, both are seen to support transportation needs, but there is a clear perceived difference between their support for environmental needs. According to the community and stakeholder survey respondents, the scenario that supports the most planning criteria is the Napa-Sonoma Causeway.

Table 8 The project team estimated relative cost for each scenario, shown here as relative ranks, for the sake of comparison.

Scenario	**"Stakeholder"**	**"Community"**	**Relative Cost***
A) **No Highway Expansion** – third most favored	8%	17%	4
B) **Expanded Footprint** – second most favored	20%	29%	3
C) **Napa-Sonoma Causeway** – most favored	66%	45%	2
D) **Strategic Co-alignment** – least favored	4%	4%	5 (lowest)
E) **San Pablo Bay Tunnel** – fourth most favored	0%	5%	1 (highest)

* "Cost" is a relative estimate for each scenario and does not reflect actual cost

Although estimated relative cost was not shared during the surveying process, it's probably safe to assume that most people will realize that the tunnel (E) and causeway (C) are likely to be the most expensive and no expansion (A), or removing the highway footprint (D) are likely to be the least expensive (Table 8). The scenarios that may be the least feasible (D & E) were ranked lowest. The most feasible expansion option with the least environmental impact (the causeway, C) was the highest ranking, despite its likely high price tag. When asked if they would be willing to pay a toll to assist with the expense of any change to Highway 37, an nearly equal number of community respondents said yes and no. 46% of

stakeholders are willing to pay a toll to see improvements made to the Highway 37 corridor.

Approach 2: Measuring Impacts ("Assess Transportation Effects")

We used the "Road Effect Zone" model to measure the effects of the highway corridor and associated highways in the region. One type of effect is excess noise from traffic. We modeled traffic noise for all highways in the region that provide similar access and mobility as highway 37. We used traffic projections for 2035 to anticipate traffic noise impacts in order to improve valuation of the noise impact for future highway capacity scenarios. Traffic noise impacts wildlife and people, though at different sound intensities and frequencies. In addition, a high-level assessment of expected traffic impacts was conducted using a County-level Travel Demand Model. A more detailed traffic simulation model is needed to advance this element of traffic impacts in the study area.

Valuation

The proposed valuation approach is a combination of weighted values among concerns and quantification of the concerns among alternative scenarios (Appendix 7). By combining what stakeholders value with quantification of impacted benefits (e.g., wetland function) among alternative futures for the corridor should improve the social/political acceptability of the decision outcome, as well as the potential environmental-stewardship benefits.

STEP 7. DEVELOP PROGRAMMATIC CONSULTATION, BIOLOGICAL OPINION OR PERMIT

Develop Memoranda of Understanding (MOUs), agreements, programmatic 404 permits or ESA Section 7 consultations for transportation projects in a way that documents the goals and priorities identified in Steps 5 & 6 and the parameters for achieving these goals.

Our approach to this step was to bring environmental regulators into an informal consultation process much earlier than is typical. This was in order to anticipate any conflicts that could arise early in planning, rather than at the later project-environmental review stage. Our primary finding from this exercise was that environmental regulators and transportation agency staff were able to find common grounds for discussions, though

sometimes it was a struggle because of the lack of a specific project to discuss. In addition, US Fish and Wildlife Service staff that were funded by the liaison program (FHWA) were told by their liaison coordinator at Caltrans that they could not bill time spent on this project to the liaison contract. This created difficulties as they were the staff that would eventually review and permit any projects in the corridor. Ultimately, every regional, state, and federal agency that would have a permitting role in the corridor, participated in at least one meeting to discuss regulatory and permitting issues on the corridor.

Highway 37 traverses one of the largest wetlands complexes on the West Coast and is likely to face high regulatory hurdles for almost any transportation projects. Transportation agency staff have said that this has contributed to a lack of desire to pursue expansion of the highway, despite its growing congestion and linkage role in the larger highway network. Pursuant to state and federal regulatory laws, Caltrans would need to prepare various technical studies and environmental reports for any future transportation improvement on highway 37. The following sections describe the inclusion of regulatory agencies in the early phases of Step 7 and permitting issues for the corridor that would be the basis for further progress on this Step.

REACTION/INVOLVEMENT/INTEGRATION OF REGULATORY AGENCIES TO APPLICATION OF ECOLOGICAL METHODS

We approached the involvement of regulatory agencies in the study by first interviewing them, then holding a joint meeting where they could discuss potential regulatory and permitting issues associated with potential actions along the corridor. We used a basic template of questions for each interview. In several cases, we spoke to more than one staff person from each agency.
We worked first with environmental permitting staff at Caltrans to develop and review a list of contacts for the agencies. As a result, the final list of contacted and interviewed agencies was: a) Federal -- U.S. Army Corps of Engineers (ACOE), U.S. Environmental Protection Agency (EPA), National Oceanic and Atmospheric Administration (NOAA), and U.S. Fish and Wildlife Service (USFWS); and b) State -- San Francisco Bay Conservation and Development Commission (BCDC), California Department of Fish and Game (CDFG), and San Francisco Regional Water Quality Control Board (RWQCB).

Early Participation
Most permitting agencies are not used to a process of early engagement with infrastructure agencies to improve planning and decision-making. Generally, the responses to our query regarding early participation in corridor planning fell along a continuum ranging from

great interest in early involvement to little interest until a strategy was defined. NOAA and USFWS were enthusiastic about being involved in the development process. EPA was interested, and still learning about the project. CDFG was also interested in early involvement, and their regular attendance at the meetings confirmed this. USFWS and NOAA both expressed their support for any efforts to discuss projects earlier, noting this had not been the norm, and they welcomed the opportunity to work on potential ideas at the formative stages. The RWQCB has a strong preference toward certain strategies (causeway, strategic realignment of highway), but noted their real interest is how any idea affects water quality - roadway runoff in particular. BCDC expressed a desire to be "circumspect" in their participation, and did not want to help frame a project they would be permitting. While they have been more involved in other projects, BCDC staff felt the magnitude of this effort warranted that strategies come from county boards of supervisors, local communities, and others more directly affected by the results. ACOE noted a strong preference to wait until there was a specific plan in place, along with identified impacted acres, before it would be worthwhile to offer their opinion.

One-on-One Meetings

Most of the agencies noted that it was not necessary to meet separately prior to the World Café, since this meeting was "the first bite of the apple." Once there were some ideas on the table, most staff said that would be the better time to consider direct meetings. USFWS said they would welcome early, direct conversations any time about how to work together better. Their staff has a strong interest in seeing some up-front studies that will help Caltrans have more information now for implementing measures later for the project, particularly as they relate to wildlife connectivity. Despite the federally-funded liaison program, USFWS noted that for some time, there has been increasing tension between Caltrans and USFWS, and it would be extremely helpful to identify policy measures now that could provide some context for various transportation-related conservation efforts rather than addressing each issue through a separate biological opinion later. USFWS staff who are Caltrans liaisons assigned only to Caltrans projects, though willing to participate in stakeholder meetings, had no Expenditure Authorization (EA) to which they are allowed to bill their time for this project. One of the Caltrans Chiefs noted that not having an EA makes it more difficult to assign his own staff to participate. Having some mechanism to support staff, both at regulatory agencies and within Caltrans, is essential in supporting earlier communication and participation for transportation projects.

Attendance at an early December stakeholder meeting focused on regulators

Without exception, all contacted agencies participated in a stakeholder meeting in early December to discuss the strategic ideas that emerge from the World Café in October. ACOE noted that the more detailed the proposal, the more ACOE could commit to time for

comments. ACOE noted that even if adding details would mean meeting a month later, it might be worthwhile to wait and discuss a more refined proposal. Other agencies seemed comfortable commenting on draft strategies in general, and did not emphasize specificity understanding their comments would be general as well.
USFWS noted that one benefit of a stakeholder meeting with regulatory issues as the focus is that stakeholders can better understand how much Caltrans actually does to mitigate impacts. This person noted that there is a perception that all projects are bad for the environment, when in fact Caltrans is under strict requirements to take measures to mitigate impacts. Such a public meeting may help with the overall understanding that Caltrans does in fact do many good things in association with a project. CDFG noted that having all the regulatory staff in the room at the same time with the permit applicants is ideal because it avoids inter and intra-agency confusion about impacts and allows for potential collective mitigation strategies among agencies.

Environmental Review

If future projects on highway 37 include federal dollars, environmental studies and permits must be prepared in compliance with both the National Environmental Policy Act (NEPA) and the California Environmental Quality Act (CEQA). Federal Highway Administration's (FHWA) responsibility for environmental review, consultation, and any other action required in accordance with NEPA and other applicable federal laws for this project will be carried out by Caltrans under its assignment of FHWA responsibilities pursuant to 23 USC 327.

Section 4(f)

The Department of Transportation Act (DOT Act) of 1966 included a special provision - Section 4(f) - which stipulates that the FHWA and other DOT agencies cannot approve the use of land from publicly owned parks, recreational areas, wildlife and waterfowl refuges, or public and private historical sites unless there is no feasible and prudent alternative to the use of the land; or the action includes all possible planning to minimize harm to the property resulting from use.

Section 4(f) consideration would most likely be part of the environmental documentation for one or more of the alternative scenarios discussed for the corridor due to the presence of parks and protected lands in the vicinity of highway 37. The San Pablo Bay National Wildlife Refuge, managed by the U.S. Fish and Wildlife Service, is also located in Sonoma and Solano counties. Recently, approximately 3,300 acres of the former Skaggs Island Naval facility were transferred from the U.S. Navy to the U.S. Fish and Wildlife Service to be included in the San Pablo Bay National Wildlife Refuge. In Marin County highway 37 sits adjacent to the Petaluma Marsh Wildlife Area. This land is managed by the California Department of Fish and Game. In Sonoma County, highway 37 is located adjacent to the Napa-Sonoma Marshes Wildlife Area which is also managed by the California Department of Fish and Game. The areas noted above are also designated in the San Francisco Bay Plan as wildlife refuge priority use areas. A map indicating the location of 4(f) properties has been included as Appendix X. Caltrans would be responsible for determining whether 4(f) is triggered and preparing the appropriate level of documentation.

Regulatory Approvals

Obtaining regulatory approvals can take anywhere from three to twelve months, or longer depending on the complexity of the project and the type and number of resources affected. As a federal and state lead agency, permit applications for capital improvement projects are typically prepared and submitted by the Caltrans District 4 Office of Biological Sciences and Permits. Permits are prepared based on information from consultation with state and federal resource agencies, species experts, literature searches, plant and wildlife surveys, wetland delineations, and impact analyses. The District biologist serves as the key liaison with resource and regulatory agency staff regarding the impacts to environmental resources. Agencies providing permits for this corridor could request information on the following items as they relate to proposed improvements:

- Wetland delineations
- Species surveys
- Habitat assessments
- Cultural resource assessments
- Hydrological studies
- Plans that include existing culverts and engineering drawings of new water crossings which must be assessed for fish passage barriers (pursuant to Senate Bill 857)
- Staging and access areas
- Construction equipment and methodology
- Bay fill
- Public access
- Dredging
- Excavation
- Maintenance
- Avoidance and minimization efforts
- Best management practices (BMPs)
- Compensatory mitigation

During the Caltrans Project Approval and Environmental Document (PA&ED) phase and prior to the Ready to List (RTL) phase, permits would be negotiated and secured from state and federal resource and regulatory agencies (Table 9). These permits are required for the Plans, Specifications, and Estimate (PS&E) bid package to ensure that potential contractors are aware of any permit conditions that may restrict the manner, methods, or timing of construction activities that could affect their bid offer. Caltrans ensures that permit

conditions are "buildable and biddable" and are reasonable and appropriate given the type and extent of potential effects to natural resources.

Table 9 Agencies and corresponding permits are likely to be required for actions along the highway 37 corridor.

Agency	Permit Required	Type of Permit	Statutory Authority	Permitting Issue
BCDC	Yes	Major Permit	McAteer-Petris Act	All alternatives may have bay fill and impacts to wetlands and public access.
CDFG	Yes	1602, 2080.1, 2081(b), 3053	DFG Code, CEQA/CESA, Native Plant Protection Act	Threatened/Endangered species are present along SR 37 and SR 12. All alternatives may have lakebed/stream/river alterations.
RWQCB	Yes	401/402	Clean Water Act, Porter-Cologne Act	The Department must obtain a state certification that all discharges comply with provisions of the CWA.
CSLC	Yes	Lease may be required.	Common Law Public Trust	The State Lands Commission has jurisdiction over all ungranted tidelands and submerged lands.
USCG	Yes	Bridge Permit	FESA (Section 9), Rivers and Harbors Act, General Bridge Act	There are navigable waters located within the vicinity of SR 37 and SR 12.
USACE	Yes	404, Individual	Clean Water Act, Rivers and Harbors Act	All alternatives may require dredging and may have impacts to wetlands.
USFWS	Yes	B.O	FESA (Section 7)	All alternatives will have impacts to threatened and endangered species, ground disturbance, noise disturbance, changes in water quality and quantity, air quality, and lighting.
NOAA	Yes	B.O	FESA (Section 7), Marine Mammal Protection Act, Magnussen-Stecenson Act	Threatened/Endangered species are present along SR 37 and SR 12. Some alternatives require pile driving and dredge disposal. All alternatives may affect fish passage. Some alternatives may affect marine mammals.
CDOT	Yes	4(f)	Department of Transportation Act	All alternatives will have impacts to public park lands and wildlife refuges.

There were several interesting outcomes of the stakeholder process that included regulatory agencies: 1) The causeway scenario (C) was described as "self-mitigating" by one regulatory agency because, although it would have traffic noise and construction-related impacts", the benefits realized from elevating the roadway above the marshes were significant enough to out-weigh these impacts.

2) Non-regulatory stakeholders felt that regulatory agency participation in early discussions and planning for the corridor was critical to eventual successes on the corridor. This was because of the obvious benefits of getting regulatory input early in choosing among potential competing ideas for future scenarios for the corridor. There was little patience or understanding among stakeholders for why this approach wasn't already the case.

CO6 AND CO1 TOOLS ASSESSMENT

Most project team members reported difficulty with taking advantage of the SHRP-2 materials available either as reports from CO6, or on the TCAPP web-site. However, at the same time, all project team members thought the overall CO6 process, as implemented, was both an excellent way to get stakeholders and partner agencies involved in transportation planning and a suitable way of framing ecological, transportation, and community data and interests. The overall finding was that the web (TCAPP) and report (CO6) materials themselves may have limited utility, but that they describe an important way of conducting transportation business.

This finding has important implementation implications. Rather than assuming that just passively making materials available on the web will be effective in transforming transportation planning, it may be more effective to actively engage DOT personnel in learning processes. This could occur as "Academies" sponsored by FHWA where invited DOT staff participate in workshops on applying CO6 and other SHRP-2 products. Alternatively, trainers could travel among state DOTs, or regional get-togethers of DOT staff, and provide training using CO6 materials.

Partner Feedback on CO6 and TCAPP Tools

Below are specific comments on the first five CO6 steps. Project partners did not use the TCAPP or CO6 tools as an everyday guide to the planning process. In part, this is because transportation planning jargon is still unfamiliar to many with a role in transportation planning. For example, the differences between corridor planning, visioning, programming, long range transportation planning—all the types of processes that might occur before detailed construction planning—are not clear to all concerned parties. Transportation partners also did not make frequent use these tools as intended or requested. Partners reported that CO6 provided some useful approaches and tools that were easy to understand and that provided important advances in planning. After repeated requests and inquiries from the project lead, no partner reported success or interest in using TCAPP,

including after the winter, 2012 revision. This was reported as being because of the relative opacity of the site for most planner-users. Although the information could be found, the lack of apparent connection between the information and the day-to-day planning and project delivery needs of state and local transportation agency staff reduced the motivation to do anything with TCAPP beyond politely experimenting with the site because of TRB's interest that the project partners do so. The good news is that most people involved in this C21 project found ways to include the important concepts in CO1 and CO6 in their planning and assessment process. This alternative to cultural change may be more effective than expecting people to adopt new processes wholesale.

CO6 Steps

Step 1: Build and Strengthen Collaborative Partnerships, Vision. *Build a vision of what is most needed for natural resources in the region and commit to integrate and utilize transportation and environmental regulatory processes to address these greatest conservation and restoration needs and goals.*

Prior to the C21 project, there was no engagement of partner organizations in developing transportation or environmental alternatives for the corridor. Over the last year, the project has contributed to stakeholders voicing their visions of what the future could hold for the corridor. The majority of partners and stakeholders believe that the current condition and habitat value of the marshes is a critical filter through which to view the highway and potential capacity projects associated with the corridor. At the same time, there is a distinct time-frame disconnect between people's expectations for change along the highway and the rate at which projects are likely to proceed through conventional corridor-regional-project pathways. For example, most stakeholders are concerned that the ability of the surrounding marshes and the highway itself to survive sea level rise would be jeopardized by planning that took longer than the next 10 years. In contrast, transportation agency partners consider a 25 year horizon to be adequate and have stated that this corridor is well back in line for funded enhancement compared to other network highways.

Additional feedback on Step 1 is covered in the Appendix X on Stakeholder Engagement.

Step 2: Characterize Resource Status. Integrate Conservation, Natural Resource, Watershed, and Species Recovery and State Wildlife Action Plans. *Develop an overall conservation/restoration strategy that integrates conservation/restoration priorities, data, and plans, with input from and adoption by all conservation and natural resource*

stakeholders identified in Step 1, addressing all species, all habitats, and all relevant environmental issues.

The corridor location, at the edge of San Francisco Bay, an estuary of national significance, benefits from a wealth of credible, detailed plans for conservation and recovery of species, habitats, and ecosystem functions in the corridor vicinity. These plans include clear goals and prioritized action steps to achieve those goals and the plans and associated data are readily available. These plans are described in more detail in Appendix X. There are also detailed regional and county-level plans for increasing recreational access to the Baylands, although the scope of these plans appears to vary greatly depending on the funding environment that existed when they were most recently approved. We used this C21 process to educate stakeholders about the content and availability of plans and data, but did not need to generate new information. The most significant data gaps are related to uncertainty around the predicted rate of sea level rise and the lack of accurate and detailed levee and berm topographic and location data. Recently-available LIDAR data may be helpful in identifying areas of vulnerability to sea level rise. We found an additional data gap in the area of plans for sustaining local agriculture, for sustaining local economies, or for meeting the needs of the corridor's low-income users. [If these plans exist we are not aware of them.] While the stakeholder process included good representation from the local agricultural community, it did not capture other users, such as low-income and commuter populations. It was beyond the budget of the project and the expertise of the project team to locate or produce such plans and/or reach out to the under-represented communities, though this was an important missing component of our stakeholder process. The conservation strategy for regional ecosystem processes and attributes was folded into the scenario development for the corridor, the corridor context description, and the regulatory-process foundation. In the case of the last, Caltrans staff developed a report describing the various environmental issues that would require permitting under the different future corridor scenarios (Appendix X).

Step 3: Create Regional Ecosystem Framework (Conservation Strategy + Transportation Plan)

Integrate the conservation and restoration strategy (data and plans) prepared in Step 2 with transportation and land use data and plans (LRTP, STIP, and TIP) to create the Regional Ecosystem Framework (REF).

The project team adopted the term "Corridor Context" instead of "Regional Ecological Framework" to broaden the types of information and values we included. The corridor context includes parallel recognition of community, transportation, environmental, and economic systems and values in decision-making about highways. Using these parallel

categories for collecting and organizing information, then seeking feedback from stakeholders and the community about how well transportation plans support their values in these categories, reinforces the broad context in eventual project prioritization. We echo Appendix 1 on stakeholder/regulatory engagement in saying that the CO6 steps focus too narrowly on traditional approaches to recognizing and protecting environmental values in transportation planning. We recommend that planning outcomes will be better if more values are included such as ecosystem stewardship (not just mitigation), local economy, community identity, environmental justice, climate adaptation, carbon budget, and possibly greenhouse gas emissions, and/or life cycle analysis. Some of these important values are difficult to map. For highway 37, for example, the issue of sustaining agriculture in the North Bay has emerged as a critical issue for stakeholders, but this issue falls outside the CO6 framework. The TCAPP Decision Guide is more complete in this respect.

Step 4: Assess Land Use and Transportation Effects on resource conservation objectives identified in the REF. *Identify preferred alternatives that meet both transportation and conservation goals by analyzing transportation and/or other land use scenarios in relation to resource conservation objectives and priorities utilizing the REF developed in Step 3 and models of priority resources*.

We have spent a great deal of time on this step, working over many options with an array of stakeholders. Based on their knowledge of environmental conditions, conservation objectives, and the connection between these and transportation infrastructure and plans, stakeholders and partners identified future scenarios for the corridor that supported these objectives. In addition, environmental regulatory agencies were asked explicitly to consider different possible management scenarios for the corridor and speculate on the permissibility of the scenarios and the mitigation that might be required under each scenario. This conversation was very important for transportation partners to witness at this stage because responding to this feedback is more likely to result in development of planned projects that provide the stewardship benefits sought under one interpretation of the Eco-Logical rubric. As stated in Appendix 1 on stakeholder/regulatory engagement, it may be wise to include the development of draft scenarios earlier in the decision-making process than is currently prescribed by either CO6 or TCAPP. For this project, some stakeholders had a hard time focusing solely on values and goals, in the absence of tangible scenarios for the highway. Discussions on values and goals were too abstract, and came to a halt in a short time, whereas discussions that included possible scenarios were vigorous and creative. It was relatively easy to draw out values and goals from the discussions about scenarios. It was difficult for the regulatory stakeholders to provide more than speculative comments on various scenarios because of the lack of detailed information about the impacts on resources and the long planning time frame. Most regulatory staff stated that

they had little ability to provide specific and formal input unless it is related to a regulatory action, such as a permit of environmental review. While the discussions were useful and generated comments (reflected in the meeting summaries) we did not solicit or receive detailed comments on various alternatives or mitigation strategies.

Step 5: Establish and Prioritize Ecological Actions *Establish mitigation and conservation priorities and rank action opportunities using assessment results from Steps 3 and 4*.

After 6-9 months of explicit discussion of particular strategies and future scenarios for the corridor, there did appear to be some consensus that raising the highway onto an elevated causeway was environmentally-preferable, but many questions remained and some key stakeholders were not present. In the absence of a clearly defined preferred alternative and specific recommendations from regulators, it is difficult to identify and establish mitigation priorities. What we do know is that the conservation and restoration strategy for the corridor is well articulated in regional plans and these plans are being implemented by local, state and federal organizations. It seems likely that these plans can serve as the blueprint for understanding transportation project impacts on wetlands and potentially how those impacts could be mitigated (avoided or reduced). There will be additional project impacts on agricultural lands and these were not addressed in much detail during the process.

Step 6: Develop Crediting Strategy. *Develop a consistent strategy and metrics to measure ecological impacts, restoration benefits, and long-term performance, with goal of having analyses throughout the life of the project be in the same units*.

Two approaches were used to address this step: 1) measuring stakeholder and community values and preferences, and 2) measuring transportation system impacts. Caltrans had previously contracted with UC Davis, Road Ecology Center, to develop a valuation protocol to use in project, corridor, and regional planning. This approach was adapted in collaboration with a visiting scholar from the French Ministry of Transportation (Appendix X). This approach was used as the basis for using measures of ecological impacts. This step was partially completed, primarily because of challenges associated with bringing partners and stakeholders into what can be a conceptually and technically challenging topic. Most partners and stakeholders understood the value of stating values and preferences, as well as the importance of measuring impacts. How that information should be used to inform decision-making about transportation and ecological actions remained opaque because of the lack of a planning or statutory vehicle for doing so.

Step 7: Develop Programmatic Consultation, Biological Opinion, or Permit. *Develop Memoranda of Understanding (MOUs), agreements, programmatic 404 permits or ESA Section 7 consultations for transportation projects in a way that documents the goals and priorities identified in Steps 5 & 6 and the parameters for achieving these goals.*

The primary progress that was made in this step was formalizing the inclusion of regulatory agencies with an eventual permitting role early in corridor planning. Typically, this does not occur (at least in California), with regulatory involvement only taking place once projects have been described and programmed. A foundation was developed for what is likely to be at least a decade of discussion about how capacity or modal improvements could be made on this corridor, while improving, or at least not harming the nearby environment.

TCAPP Steps

This section contains feedback and comments from the project on the decision-making guidance provided by the Corridor Planning portion of the Decision Guide for TCAPP (Transportation for Communities—Advancing Projects through Partnership). The guidance describes 9 key decisions, numbered COR-1 through COR-9.

In general, TCAPP lists only public agencies as "partners." In our process, however, non-agency entities such as non-governmental organizations and local agencies such as Resource Conservation Districts have represented natural system issues more consistently than most agencies have. These entities have attended all stakeholder meetings, and have been the main communicator of environmental issues, values, and datasets to Caltrans. However, these entities were only able to take this role because the SHRP-2 grant paid for their time to participate. It appears that, if these entities were not consistently at the table, important land use issues might not have seen the light of day, such as the issue of supporting and sustaining local agricultural livelihoods, or the flood-protection role of privately-maintained levees. It also appears that, because normally Caltrans consults only with the regulatory side of natural resource agencies, not the conservation side, without the non-agency participants, Caltrans might not have seen the magnitude of the opportunities for ecological restoration that improvement of the corridor provides.

COR-1. Approve Scope of Corridor Planning Process

We did not pursue a formal approval of scope. From the beginning, the entire length of the highway 37 corridor was the focus. In addition, networked routes were also included in the scope of the study, because they are connected through traffic flows and could experience increased traffic if highway 37 was abandoned or flooded. We spent time identifying relevant datasets and information sources associated with any actions on the corridor.

COR-2 Approve Problem Statements and Opportunities

Much feedback on planning and infrastructural deficiencies and opportunities arose from our stakeholder meetings. Caltrans provided traffic data that highlighted transportation deficiencies, and Sonoma Land Trust and Southern Sonoma County RCD took the lead on describing the deficiencies in terms of marsh restoration and agricultural operations, respectively. Opportunities were represented primarily by existing large-scale restoration plans described in previous sections of this memo.

COR-3 Approve Goals for the Corridor

This project focused on eliciting values, not goals, and they seem similar enough for the project's purposes. We obtained a great deal of input on goals and values, from the public, business community, NGOs, RCDs, and a lesser degree from local transportation agencies. The World Café format worked well for eliciting goals and values. For example, it became clear that Napa and Sonoma Counties are firmly committed to preventing increasing capacity or traffic on the alternative routes 12/121/116. Similarly, most agency/stakeholder identified marsh restoration and adaptation to sea level rise as critical conservation goals, which was reflected in the community survey.

Part of the TCAPP guidance is that natural resource agencies' role is to "Provide input on the most important environmental needs in the planning area and where partners may be able to work together to make a difference across multiple resources of concern." However, it often appeared opportunities needed to comply with a valid regulatory interpretation to be seen as feasible. This orientation was apparent both within the resource agencies and within Caltrans.

COR-4 Reach Consensus on Scope of Environmental Review and Analysis

We did not carry out this step.

COR-5 Approve Evaluation Criteria, Methods and Measures

There was no formal adoption of criteria, methods, or measures primarily because most transportation partners saw this as an early stage in a corridor planning process, in contrast to conservation concerns, which were looking for shorter-term action.

COR-6 Approve Range of Solution Sets

We found that describing a range of possible future scenarios for the highway was necessary, to get stakeholders to engage mentally in such a long-term planning process. Therefore, early in the project, simultaneously with COR-3, we began publicly discussing 5 scenarios, at least 1 of which is quite unlikely (i.e., tunnel). It was easier for people to identify their goals and values when considering specific scenarios than when considering

the corridor as it already exists. See below for more detail on the scenarios, which also appear elsewhere in this report.

COR-7 Adopt Preferred Solution Set

This step has not been taken formally by Caltrans, but the project team did see consensus emerge on a preferred construction scenario – a causeway across the marshes. This consensus construction scenario is not yet enshrined in Caltrans planning, and there is no assurance that the agreement among stakeholders will survive the next planning or fundraising phases.

The results of this C21 study's stakeholder discussion on scenarios will be included in an updated TCR for highway 37. The TCR serves as early documentation of Caltrans' long-term corridor vision, an early step in informing the regional transportation planning process.

LITERATURE CITED

Backstrom, M., U. Nilsson, K. Hakansson, B. Allard, and S. Karlsson. 2003. Speciation of heavy metals in road runoff and roadside total deposition. Water, Air, and Soil Pollution, 147: 343-366.

Baker, W. L., and R. L. Knight. 2000. Roads and forest fragmentation in the Southern Rocky Mountains. Pages 97–122 *in* R. L. Knight, F. W. Smith, S. W. Bruskirk, W. H. Romme, and W.I. Baker. Eds, forest fragmentation in the Southern Rocky Mountains. University of Colorado Press, Boulder, Colorado.

Bell, S., and T. W. Ashenden. 1997. Spatial and temporal variation in nitrogen dioxide pollution adjacent to rural roads. *Water Air and Soil Pollution* 95(1–4):87–98.

Boarman, William I., and Marc Sazaki. 2006. A highway's road-effect zone for desert tortoises (Gopherus agassizii). Journal of Arid Environments 65:94-101..

Boumans, R. M., D. M. Burdick, and M. Dionne. 2002. Modeling habitat change inn salt marshes after tidal restoration. Restoration Ecology 10 (3): 543-555.

Chapin, T. G., D. J. Harrison, and D. D. Katnik. 1998. Influence of landscape pattern on habitat use by American marten in an industrial forest. *Conservation Biology* 12(6):1327–1337.

Dooling, R.J. and A.N. Popper. 2007. The effects of highway noise on birds. Report prepared for Caltrans, contract #43A0139.

Eigenbrod, F., S.J. Hecnar, and L. Fahrig. 2009. Quantifying the road-effect zone: Threshold effects of a motorway on Anuran populations in Ontario, Canada. Ecology and Society, 14(1): 24. http://www.ecologyandsociety.org/vol14/iss1/art24/

Fahrig, L. 2001. How much habitat is enough?. *Biological Conservation* 100:65–74.
Federal Highway Administration (FHWA) 2004. FHWA Traffic Noise Model version 2.5 look-up tables user's guide. Prepared for FHWA by John A. Volpe National Transportation Systems Center. FHWA-HEP-05-008.

Findlay, C.S. and J. Houlahan. 1996. Anthropogenic correlates of species richness in Southeastern Ontario wetlands. Conservation Biology, 11(4): 1000-1009.

Forman, R. T. T., D. Sperling, J. A. Bissonette, A. P., Clevenger, C. D. Cutshall, V. H. Dale, L. Fahrig, R., France, C. R. Goldman, K. Heanue, J. A. Jones, F., J. Swanson, T. Turrentine, and T. C. Winter. 2002a. Road Ecology: Science and Solutions. Island Press. Washington, D.C. 424 pp.

Forman, R. T. T., Reineking, B., and Hersperger, A. M. (2002b). Road traffic and nearby grassland bird patterns in a suburbanizing landscape. Environmental Management, 29, 782-800.

Gagnon, J.W., T.C. Theimer, N.L. Dodd, S. Boe, and R.E. Schweinburg. 2007. Traffic volume alters elk distribution and highway crossings in Arizona. Journal of Wildlife Management, 71(7):2318–2323. AND Storlie 2006

Gill, J. A., W. J. Sutherland, and A. R. Watkinson. 1996. A method to quantify the effects of human disturbance on animal populations. *Journal of Applied Ecology* 33(4):786–792.

Gjessing, E., E. Lygren, L. Berglind, T. Gulbrandsen, and R. Skanne. 1984. Effect of highway runoff on lake

Hickey, R. 2011. Driving home economic recovery. Report for the Non-Profit Housing Association of Northern California.

Hoffman, R. W., C. R. Goldman, S. Paulson, and G. R. Winters. 1981. Aquatic impacts of deicing salts in the central Sierra Nevada Mountains, California. *Water Resources Bulletin* 17:280–285.

Jonsen, I. D., and L. Fahrig. 1997. Response of generalist and specialist insect herbivores to landscape spatial structure. *Landscape Ecology* 12:185–197.

Lercher, P., D. Botteldooren, U. Widmann, U. Uhrner, and E. Kammeringer. 2011. Cardiovascular effects of environmental noise; Research in Austria. Noise and Health, 13 (52): 234-250.

Lesbarreres, D., A. Pagano, and T. Lode. 2003. Inbreeding and road effect zone in a Ranidae: the case of Agile frog, Rana dalmatina Bonaparte, 1840. C.R. Biologies, 326: S68-S72.

Lidicker Jr, W. Z. 1999. Responses of mammals to habitat edges: an overview. *Landscape Ecology* 14:333–343.

Mac, R. D., J. S. Waller, T. L. Manley, L. J. Lyon, and H. Zuuring. 1996. Relationships among grizzly bears, roads and habitat in the Swan Mountains, Montana. *Journal of Applied Ecology* 33(6):1395–1404.

Madrone Associates Environmental Consultants. 1977. Natural Resources of Napa Marsh. Assisted by: James Michaels, Wildlife Biologist Region 3, Department of Fish and Game Under Contract to: California Department of Fish and Game.

Madsen, A. B. 1996. Otter *Lutra lutra* mortality in relation to traffic, and experience with newly established fauna passages at existing road bridges. *Lutra* 39(2):76–88.

Maltby, L., A. B. A. Boxall, D. M. Farrow, P. Calow, and C. I. Betton. 1995. The effects of motorway runoff on freshwater ecosystems. 2. Identifying major toxicants. E*nvironmental Toxicology and Chemistry* 14:1093–1101.

Marshall, J.T. and K.G. Dedrick. 1994. Endemic Song Sparrow and Yellowthroats of San Francisco Bay. Pp316-327 in N.K. Johnson & J. Jehl (eds.), A Century of Avifaunal Change in Western North America. Studies in Avian Biology 15.

Meyers, T. J., and S. Swanson. 1995. Impact of deferred rotation grazing on stream characteristics in central Nevada: a case study. *North American Journal of Fisheries Management* 15(2):428–439.

Parris, K.M. and A. Schneider. 2009. Impacts of traffic noise and traffic volumes on birds of roadside habitats. Ecology and Society, 14(1): 29 [online] URL: http://www.ecologyandsociety.org/vol14/iss1/art29/

Putman, R. J. 1997. Deer and road traffic accidents: options for management. *Journal of Environmental Management* 51(1):43–57.

Raaschou-Nielsen, O., Z.J. Andersen, M. Hvidberg, S.S. Jensen, M. Ketzel, M. Sorensen, J. Hansen, S. Loft, K. Overvad, A. Tjonneland. 2011. Air pollution from traffic and cancer incidence: a Danish cohort study. Environmental Health, 10:67 doi:10.1186/1476-069X-10-67.

Reijnen, R., R. Foppen, and G. Veenbaas. 1997. Disturbance by traffic of breeding birds: evaluation of the effect and considerations in planning and managing road corridors. *Biodiversity and Conservation* 6(4):567–581.
Rosenberg, K. V., J. D. Lowe, and A. A. Dhondt. 1999. Effects of forest fragmentation on breeding tanagers: a continental perspective. *Conservation Biology* 13(3):568–583.

Rottenborn, S. C. 1999. Predicting the impacts of urbanization on riparian bird communities. *Biological Conservation* 88(3):289–299.

Rubin, E. S., W. M. Boyce, M. C. Jorgensen, S. G. Torres, C. L. Hayes, C. S. O'Brien, and D. A. Jessup. 1998. Distribution and abundance of bighorn sheep in the Peninsular Ranges, California. *Wildlife Society Bulletin* 26(3):539–551.

Schuyt K, Brander L. 2004. The Economic Value of the World's Wetlands. World Wildlife Fund, Gland/Amsterdam, Neth. 32 pp

Shilling, F.M. C. Cornwall, F. Knapczyk, R. Zlomke, D. DiPietro, J. Sharp, R. Adams, J. Hemmert, L. Komoroske, D. Waetjen, A. Hollander, E. Aalto, and K. Keightley. 2010.

Application and findings of the North Bay-Delta transect watershed assessment framework. Final Report to California Department of Water Resources. 322 pages.

Spira-Cohen, A., L.C. Chen, M. Kendall, R. Lall, and G.D. Thurston. 2011. Person exposures to traffic-related air pollution and acute respiratory health among Bronx schoolchildren with asthma. Environmental Health Perspectives, 119 (4): 559-565.

Theobald, D. M., J. R. Miller, and N. T. Hobbs. 1997. Estimating the cumulative effects of development on wildlife habitat. *Landscape and Urban Planning* 39(1):25–36.

Wilcox, D. A. 1986. The effects of deicing salts on vegetation in Pinhook Bog, Indiana. *Canadian Journal of Botany* 64:865–874.

Yahner, R. H. 1988. Changes in wildlife communities near edges. *Conservation Biology* 2(4):333–339

Zedler JB, Kercher S. 2005. Wetland resources: status, trends, ecosystem services, and restorability. Annual Review of Environmental Resources 30: 39.

Ziegler, A. D., and T. W. Giambelluca. 1997. Importance of rural roads as source areas of runoff in mountainous areas of northern Thailand. *Journal of Hydrology* 196(1-4):204–229.

APPENDICES

APPENDIX 1: HIGHWAY 37 CORRIDOR STUDY STAKEHOLDER LIST

Appendix 1: Stakeholder List

First Name	Last Name	Title	Agency / Affiliation	Affiliation Type
Joseph	Aguilar	District Branch Chief	Caltrans	Governmental - State - Transportation - System Planning
Erik	Alm	District Branch Chief	Caltrans	Governmental - State - Transportation - System Planning
Robin	Amatya	Hydraulics	Caltrans	Governmental - State - Transportation - Hydraulics
Joyce	Ambrosius		NOAA	Governmental - Federal - Environmental Regulatory
Betty	Andrews	Principal Engineer	ESA PWA	Private - Consultant
Abdullah	Arakozie		Caltrans	Governmental - State - Transportation - Environmental Planning
Gary	Arnold	District Branch Chief	Caltrans District 4	Governmental - State - Transportation - Local Development Review
Hank	Barner		Black Point Improvement Club	NGO - Community Advocacy
Tom	Bartee	District Director	Michael Allen, Assemblymember, 7th District	Governmental - State - Elected Representative
Robert	Batha	Chief of Permits	BCDC	Governmental - Regional - Environmental Regulatory
Katie	Benouar	Chief of Staff	Caltrans	Governmental - State - Transportation - Director's Office
Mark	Biddlecomb	Director of Conservation Program	Ducks Unlimited	NGO - Conservation
Steven	Bobzien	East Bay Regional Biologist	East Bay Reg'l Park District	Governmental - Regional - Environmental Regulatory
John	Bradley	Deputy Project Leader	USFWS - San Francisco Bay National WR	Governmental - Federal - Landowner
Brian	Brandert	Env. Planner Biologist	Caltrans	Governmental - State - Transportation - Local Development Review

Robert	Bregoff	Assoc. Trans Planner	Caltrans	Governmental - State - Transportation - System Planning
Scott	Briggs		Sonoma County	Governmental - County
Don	Brubaker	Refuge Manager	USFWS - San Francisco Bay National WR	Governmental - Federal - Landowner
Mary	Campbell	Analyst	UC Davis	Educational
Steve	Carroll		Ducks Unlimited	NGO - Conservation
Joel	Casagrande		NOAA	Governmental - Federal - Environmental Regulatory
Rey	Centeno	Regional Project Manager/Supervising T.E.	Caltrans	Governmental - State - Transportation - Project Management
Ron	Chastain		CHP	Governmental - State
Devon	Chatoian		FIGR	Tribal
Dan	Cherrier	Project Delivery Manager	TAM (Transportation Authority of Marin)	Governmental - Regional - Transportation
John	Clecker	Contract Biologist	USFWS	Governmental - Federal - Environmental Regulatory
Jo Anne	Cohn		Michael Allen, Assemblymember, 7th District	Governmental - State - Elected Representative
John A.	Coleman	Executive Director	Bay Planning Coalition	NGO - Conservation
Caitlin	Cornwall	Biologist & Development Officer	Sonoma Ecology Center	NGO - Conservation
Mike	Costanza	Executive Director	Napa Valley Bike Coalition	NGO - Transportation (non-motorized) - Advocacy
Anne	Crealock		Sonoma County Water Agency	Governmental - County
Christine	Culver	Executive Director	Sonoma County Bike Coalition	NGO - Transportation (non-motorized) - Advocacy
Richard	Dale	Administration	Sonoma Ecology Center	NGO - Conservation
Curt	Davis	Interim District Office Chief	Caltrans	Governmental - State - Transportation - System Planning
Max	Delaney	Coastal Program Analyst	BCDC	Governmental - Regional - Environmental Regulatory

Christopher	Devick		Moffatt and Nichol	Private - Consultant
Deanne	DiPietro	GIS Manager	Sonoma Ecology Center	NGO - Conservation
Tim	Doherty		BCDC	Governmental - Regional - Environmental Regulatory
Leah	Dreger	Planner Coastal Planning and Development Leader	Weston Solutions, Inc.	Private - Business
Steve	Ehret	planner	Sonoma County Regional Parks	Governmental - County
Wendy	Eliot	Conservation Director	Sonoma Land Trust	NGO - Conservation
Nicolas	Endrawos	Regional Project Manager	Caltrans	Governmental - State - Transportation - Project Management
Melissa	Escaron	Caltrans Liaison	California Department of Fish and Game	Governmental - State- Environmental Regulatory
Erin	Foresman	Env. Scientist & Policy Coord.	USEPA	Governmental - Federal - Environmental Regulatory
Maureen	Gaffney	Senior Bay Trail Planner	ABAG	Governmental - Regional
Karen	Gaffney	Dir Strategic Initiatives	So Co Agric. Pres & Open Space Dist.	Governmental - Regional - Conservation
Stefan	Galvez	District Branch Chief	Caltrans	Governmental - State - Transportation - Environmental Planning
Bill	Gamlen		Sonoma Marin Area Rail Transit	NGO - Transportation Advocacy
Tom	Gandesbery		Coastal Conservancy	Governmental - State - Landowner and Conservation
Jo Allen	Gause		Transportation Research Board	Governmental - Federal - Transportation
Shiwei	Gen		CDFG	Governmental - State - Environmental Regulatory
Ina	Gerhard		Caltrans	Governmental - State - Transportation - Landscape Architecture
Roberta	Gerson		USFWS	Governmental - Federal - Environmental Regulatory
Gary	Giacomini		Hanson Bridgett LLP	Private - Business

Paula	Gill	Caltrans Liaison	ACOE	Governmental - Federal - Environmental Regulatory
Suzanne	Gilmore		CDGF	Governmental - State - Environmental Regulatory
Jeanne	Gorham	Office Chief/Landscape	Caltrans	Governmental - State - Transportation - Landscape Architecture
Robert	Guerrero	Planner	Solano Transportation Authority	Governmental - Regional - Transportation
Jim	Haire	Farmer	Landowner	Private - Landowner
Sean	Hamlin	Assemblyman Allen's Office	Michael Allen, Assemblymember, 7th District	Governmental - State - Elected Representative
Susan	Haydon		Southern Sonoma County RCD	Governmental - Regional - Conservation
Joe	Heublein		NOAA	Governmental - Federal - Environmental Regulatory
Jane	Hicks	Division Chief	ACOE	Governmental - Federal - Environmental Regulatory
Michelle	Hightower	Dir of Planning	City of Vallejo	Governmental - City
Kelly	Hirschberg	Regional Project Manager	Caltrans	Governmental - State - Transportation - Project Management
Kathy	Hoffman	Senior Field Representative	Congressman George Miller	Governmental - Federal - Elected Representative
Marc	Holmes	Restoration Prog Mgr	The Bay Institute	NGO - Conservation
Junko	Hoshi		CDFG	Governmental - State - Environmental Regulatory
Tom	Huffman	Wildlife Habitat Supervisor/Land Mgmnt	CDFG	Governmental - State - Environmental Regulatory
Beth	Huning	ED	SFBay Joint Venture	NGO - Conservation
Eliot	Hurwitz		Napa Country Transportation and Planning Agency	Governmental - County - Transportation
Amy	Hutzel	SF Bay Program Manager	Coastal Conservancy	Governmental - Landowner and Conservation

Jeffrey	Jensen	Office Chief Biologist Sciences and Permits	Caltrans	Governmental - State - Transportation - Environmental Planning
David	Jones	Officer	CHP (Marin)	Governmental - State
Bill	Keene	Gen'l Manager	So Co Agric. Pres & Open Space Dist.	Governmental - Regional - Conservation
Steve	Kinoshita		CHP	Governmental - State
Kenneth	Kirkey	Planning Director	Association of Bay Area Governments	Governmental - Regional
Bernhard	Krevet	Board President	Friends of the Napa River	NGO - Community Advocacy
Tracy	Krumpen		Senator Noreen Evan's Office	Governmental - State - Elected Representative
Joseph	La Clair	Chief Planner	BCDC	Governmental - Regional - Environmental Regulatory
Michael	Land	Director	Felidae Conservation Fund	NGO - Conservation
Robin	Leong		Napa-Solano Audubon	NGO - Environmental Advocacy
Liz	Lewis	Principal Planner	Marin County Public Works	Governmental - County
David	Lewis	ED	Save the Bay	NGO - Environmental Advocacy
Jean	Likeover			
Susan	Lindsay	Landscape Branch Chief (SON/SOL counties	Caltrans	Governmental - State - Transportation - Landscape Architecture
Jeremy	Lowe		ESA PWA	Private - Consultant
Patrick	Lowe	Dept. Plan.Dir. Wetlands conserve.	Napa County	Governmental - County
Dominic	MacCormack	Regulatory Project Manager	ACOE	Governmental - Federal - Environmental Regulatory
Rick	Marshall	Deputy Director of Public Works	Napa County	Governmental - County
Greg	Martinelli	Water Conservation Supervisor	CDFG	Governmental - State - Environmental Regulatory
Ron	Matheson	Sanitation and Flood Control	Vallejo Sanitation and Flood Control	Governmental - Regional
Robert	McCaulay	Director of Planning	Solano Transportation Authority	Governmental - Regional - Transportation

Brac	McCrae	Regulatory Program Director	BCDC	Governmental - Regional - Environmental Regulatory
Zara	Mcdonald	Executive Director	Felidae Conservation Fund	NGO - Conservation
Mary	McEachron		Buck Institute	NGO - Educational
Linda	Meckel	Associate Planner	Sonoma-Marin Area Rail Transit District	NGO - Transportation - Advocacy
Julian	Meisler	Baylands Program Manager	Sonoma Land Trust	NGO - Conservation
Abby	Monroe	Graduate Student	UC Davis	Educational
Steve	Moore	Civil Engineer	Nute Engineering	Private - Consultant
Susan	Moore		USFWS	Governmental - Federal - Environmental Regulatory
Tom	Moritz		Sonoma Valley Heritage Coalition	NGO - Community Advocacy
Chuck	Morton		Caltrans District 4	Governmental - State - Transportation - Maintenance
Ray	Mulas	Asst Chief	Schellville Fire Dept	Governmental - Regional
Carolyn	Mulvihill	NEPA Review	USEPA	Governmental - Federal - Environmental Regulatory
Cynthia	Murray	President and CEO	North Bay Leadership Council	NGO - Community Advocacy
John	Nemeth		Sonoma Marin Area Rail Transit	NGO - Transportation Advocacy
Doanh	Nguyen	Division Chief Project Mngnt. North Region	Caltrans	Governmental - State - Transportation
Wajahat	Nyaz	Supervising T.E.	Caltrans	Governmental - State - Transportation - Project Management
Rolf	Ohlemutz		City of Vallejo Sanitation District	Governmental - City
Ryan	Olah	Coast Bay/Forest Foothills Division Chief	USFWS	Governmental - Federal - Environmental Regulatory
Gilbert	Osuna	Sergeant	CHP	Governmental - State - Environmental Regulatory

Steve	Page	President & General Manager	Infineon Raceway	Private - Business
Pete	Parkinson	Planning Director	Sonoma County Permit and Resource Management Department	Governmental - County
Andy	Peri		Marin County Bicycle Coalition	NGO - Transportation (non-motorized) - Advocacy
Joseph	Peterson	Chief Engineering Services II	Caltrans	Governmental - State - Transportation - Hydraulics
Paul	Price	Director	Napa County Transportation and Planning Agency	Governmental - County - Transportation
David	Raleigh	Lieutenant	CHP	Governmental - State - Environmental Regulatory
Steiner	Rita	District Conservationist	NRCS	Governmental - Federal - Conservation
Jerry	Roe	CT Liaison	USFWS	Governmental - Federal - Environmental Regulatory
Keith	Rogal			Private - Business
Susanne Von	Rosenberg	President of Gaia Consultant	GAIA	Private - Consultant
Lorelle	Ross	Tribal Vice-Chair	FIGR	Tribal
Maggie	Rufo		Hungry Owl Project	
Barbara	Salzman		Marin Audubon	NGO - Environmental Advocacy
Greg	Sarris	Tribal Chair	FIGR - Federated Indians of Graton Rancheria	Tribal
Tito	Sasaki	Director	North Bay Agricultural Alliance	NGO - Community Advocacy
Karen	Schwinn	SF Bay Delta Management Lead	USEPA	Governmental - Federal - Environmental Regulatory
Melissa	Scianni	Wetlands Regulatory Office	USEPA	Governmental - Federal - Environmental Regulatory
Leigh	Sharp	Executive Director	Napa County RCD	Governmental - Regional - Conservation
Fraser	Shilling		UC Davis	Educational

Eric	Shott	Fishery Biologist, Area Office Section 7 Coordinator	NOAA	Governmental - Federal - Environmental Regulatory
Mike	Sipes	Fish and Wildlife Tech.	CDFG	Governmental - State - Environmental Regulatory
Suzanne	Smith	Exec Dir	Sonoma County Transportation Authority (SCTA)	Governmental - County - Transportation
Renee	Spenst	Regional Biologist	Ducks Unlimited	NGO - Conservation
Janet	Spilman		Sonoma County Transportation Authority (SCTA)	Govermental - County - Transportation
Danielle	Stanislaus		MTC	Governmental - Regional - Transportation
Jere	Starks	V.P. of Facilities & Construction	Infineon Raceway	Private - Business
Dianne	Steinhauser	P.E Executive Director	TAM	Governmental - Regional - Transportation
Mendel	Stewart	Project Leader	USFWS - San Francisco Bay National WR	Governmental - Federal - Landowner
Lee	Taubeneck	District 4 Deputy District Director	Caltrans	Governmental - State - Transportation - Planning and Local Assistance
Karen C.	Taylor	Assoc. Wildlife Biologist	CDFG	Governmental - State - Environmental Regulatory
Louis	Terrazas		USFWS - San Pablo Bay NAR	Governmental - Federal - Landowner
Joseph	Terry		USFWS	Governmental - Federal - Environmental Regulatory
Brendan	Thompson	Environmental Specialist	San Francisco Estuary Project/Water Board	Governmental - Regional - Environmental Regulatory
Laura	Thompson		ABAG / Bay Trail	Governmental - Regional
Ken	Tipon	Sacred Sites Protection	FIGR	Tribal
Dilip	Trivedi		Moffatt and Nichol	Private - Consultant
Matthew	Tuggle	Engineering Manager	Solano County	Governmental - County
Bill	Tuikka	Community Development	City of Vallejo	Governmental - Regional - City

Diane	Vargas		Napa County Transportation Planning Agency	Governmental - County - Transportation
Dave	Vautin	Transportation Planner	MTC	Governmental - Regional - Transportation
Sam	Veloz		Point Reyes Bird Observatory	NGO - Conservation
Philip	Vermeulen	Governmental Relations	California	Private - Business
Leslie	Vivian	board member	Trout Unlimited, Redwood Chapter	NGO - Environmental Advocacy
Peter	Vorster	Hydrogeographer	The Bay Institute	NGO - Conservation
Maggie	Weems		NBAA / Canalways	?
Karen	Weiss		BCDC	Governmental - Regional - Environmental Regulatory
Carl	Wilcox	Water Branch Chief	CDFG	Governmental - State - Environmental Regulatory
Laurie	Williams		Marin County Public Works	
Scott	Wilson		CDFG	Governmental - State - Environmental Regulatory
Bruce	Wolfe	Executive Director	San Francisco Bay Regional Water Board	Governmental - Regional - Environmental Regulatory
Tom	Yarish		Friends of the Esteros	NGO - Community Advocacy
Norm	Yenni	Farmer	Landowner	Private - Landowner
Vanessa	Young		Bay Planning Coalition	NGO - Conservation
Ryan	Young		Felidae Conservation Fund	NGO - Conservation

APPENDIX 2: STAKEHOLDER PROCESS

APPENDIX 2: STAKEHOLDER/REGULATORY ENGAGEMENT PROCESS AND APPLICATION TO CO6 STEPS

Prepared by UC Davis Road Ecology Center (Mary Madison Campbell & Fraser Shilling)

for the Strategic Highway Research Program – 2, Transportation Research Board

TABLE OF CONTENTS

INTRODUCTION TO PROJECT/CONTEXT

The overall goal of this project was to conduct a test of tools developed by the Transportation Research Board, Strategic Highway Research Program 2 (SHRP2), using as a case study a multi-functional and multi-agency collaborative process on the future concept for California State Highway (Highway) 37 (see Table 1). This study convened transportation, natural resource protection agencies and community stakeholders to develop a vision and concept for highway 37. This approach, which will be used to update and support the existing Caltrans corridor management planning process for highway 37, provided an example of best practices for future corridor planning efforts. While there are several areas of this study, this technical report will discuss only the stakeholder/regulatory engagement portion.

This study utilized existing research on approaches and tools for systematically integrating environmental, economic, and community requirements into the analysis, planning, and design of new highway capacity. This is part of a federal initiative called Eco-Logical that provides a process for collaborative planning among natural resources protection agencies and infrastructure agencies. The study tested tools and techniques for conducting collaborative studies that the TRB developed in earlier research, including balancing environmental stewardship and mitigation with mobility goals.

The project lead was the University of California at Davis Road Ecology Center (Road Ecology Center). Study partners are the California Department of Transportation (Caltrans), the Napa County Resource Conservation District (RCD), the Southern Sonoma County RCD, Sonoma Ecology Center, and the Sonoma Land Trust.

The objectives of this effort were as follows:

- Convene stakeholders in collaborative effort.
- Identify issues and constraints of the corridor, including sea level rise and marsh restoration.
- Develop corridor purpose and need to guide future planning and project development.
- Recommend a range of potential solutions to meet mobility, safety and environmental goals.

In 2006, eight federal agencies drafted and signed *Eco-logical: An Ecosystem Approach to Developing Infrastructure Projects* (Eco-Logical). In this document, the drafting agencies expressed their desire for a cross-agency ecosystem approach to conservation and transportation planning. The overall goal was to coordinate transportation and regulatory agencies early in the decision-making process to allow for: early insight into potential conflicts; more flexibility for regulatory agencies to meet conservation objectives; early designation of funding for environmental solutions; early buy-in on transportation and conservation solutions; and development of programmatic approaches that meet local and regional conservation priorities. While the goals of Eco-Logical were clear, the document did not have concrete steps in place to help participating partners reach the desired collaborative results.

In 2008, the SHRP2 funded two projects to develop tools to implement the principles of Eco-Logical. These projects were: C06A (Integration of Conservation, Highway Planning, and Environmental Permitting Environmental Permitting Using an Outcome-Based Ecosystem Approach); and C06B (Integration of Conservation, Highway Planning, and Environmental Permitting Through development of an Outcome-based Ecosystem-scale Approach and Corresponding Credit System). The resulting assessment tools were distilled into a nine-step implementation Eco-Logical Assessment Framework (EAF)(Venner Consulting 2011):

Table 1: Outline and Steps of the Eco-Logical Assessment Framework SHRP2 C06

Step	**Purpose**
Step 1: Build and Strengthen Collaborative Partnerships, Vision	Build support among a group of stakeholders to achieve a statewide or regional planning process that integrates conservation and transportation planning.
Step 2: Characterize Resource Status. Integrate Conservation, Natural Resource, Watershed, and Species Recovery and State Wildlife Action Plans	Develop an overall conservation strategy that integrates conservation priorities, data, and plans, with input from and adoption by all conservation and natural resource stakeholders identified in Step 1 that addresses all species, all habitats, and all relevant environmental issues.
Step 3: Create Regional Ecosystem Framework (Conservation Strategy +Transportation Plan)	Integrate the conservation and restoration strategy (data and plans) prepared in Step 2 with transportation and land use data and plans (LRTP, STIP, and TIP) to create the Regional Ecosystem Framework (REF).
Step 4: Assess Land Use and Transportation Effects on resource conservation	Identify preferred alternatives that meet both transportation and conservation goals by analyzing transportation and/or other land use scenarios in

objectives identified in the REF	relation to resource conservation objectives and priorities utilizing the REF and models of priority resources.
Step 5: Establish and Prioritize Ecological Actions	Establish mitigation and conservation priorities and rank action opportunities using assessment results from Steps 3 and 4.
Step 6: Develop Crediting Strategy	Develop a consistent strategy and metrics to measure ecological impacts, restoration benefits, and long term performance – with the goal of having the analyses be in the same language throughout the life of the project.
Step 7: Develop Programmatic Consultation, Biological Opinion or Permit	Develop MOUs, agreements, programmatic 404 permits or ESA Section 7 consultations for transportation projects in a way that documents the goals and priorities identified in Step 6 and the parameters for achieving these goals.
Step 8: Implement Agreements and Adaptive Management. Deliver Conservation and Transportation Projects	Design transportation projects in accordance with ecological objectives and goals identified in previous steps (i.e., keeping planning decisions linked to project decisions), incorporating as appropriate programmatic agreements, performance measures and ecological metric tools to improve the project.
Step 9: Update Regional Integrated Plan/Ecosystem Framework	Update the effects assessment to determine if resource goal achievement is still on track. If goal achievement gaps are found, reassess priorities for mitigation, conservation, and restoration in light of new disturbances that may impact the practicality/utility of proceeding with previous priorities. Identify new priorities if warranted.

This nine-step guide was then integrated into the SHRP2's Capacity Project called Transportation for Communities (TCAPP), and is part of the approach for collaborative decision making presented on the TRB-sponsored website: http://www.transportationforcommunities.com

The TCAPP website utilizes a Decision Guide that the website presents to assist with the following types of planning processes:

- Long Range Transportation Planning,
- Programming,
- Corridor Planning, and

- Environmental Review/National Environmental Protection Act assessments merged with permitting.

Within the description of each of the Decision Guide steps on the TCAPP website, the authors note how the EAF steps (*Table 1, above*) are linked to the recommended processes. For Corridor Planning, the TCAPP Decision Guide lists the following steps for decision-making:

- Approve the Scope of Corridor Planning Process
- Approve Problem Statements and Opportunities
- Approve the Goals for the Corridor;
- Reach Consensus on Scope of Environmental Review and Analysis;
- Approve Evaluation Criteria, Methods and Measures;
- Approve Range of Solution Sets;
- Adopt Preferred Solution Set;
- Approve Evaluation Criteria, Methods and Measures for Prioritization of Projects; and
- Adopt Priorities for Implementation.

RELATIONSHIP OF HIGHWAY 37 PROJECT TO CO6 APPROACHES

The goal for the Highway 37 Stewardship effort was to utilize the steps of the EAF as part of a corridor planning process and share the resulting observations of this case study. This technical appendix will focus only on the stakeholder/regulatory engagement aspect of the project. Also, because the nine steps of the EAF were the basis for this effort, they will be the reference point for how the steps were applied. The TCAPP website uses a variation of the EAF steps in its Corridor Planning process, so in addition to the EAF steps applied, this report will also note corresponding steps from the TCAPP Decision Guide.

APPLICATION OF C06 STEPS

The development of a corridor management plan, as is noted on the TCAPP website, is a process that lies somewhere between long-range planning processes and a project-centered, environmental review process. It is a focused examination of a specific geographic area and its potential problems and solutions, and it identifies a vision for

that area that can then be translated into specific actions, plans and projects. While it is not a legally-binding process, the findings in the corridor plan can be the foundation for many binding agreements involving roadway improvements, environmental mitigation and regional transportation planning.

Prior to the implementation of this study, Caltrans had already begun creating a draft Corridor Plan for highway 37. Because Caltrans was open to improving their planning process, the agency stopped its own corridor planning process and allowed the TRB-funded study to take its place. With the completion of this study, Caltrans will continue to move towards a final plan for highway 37 utilizing the knowledge and relationships built through this study, so the application of the EAF steps becomes not only a useful case study for TRB, but also a way for Caltrans District 4 to broaden its own practices to better embrace the principles of the Eco-Logical agreement.

APPLICABLE C06 STEPS

Although stakeholder and regulatory involvement is inherently a part of all nine EAF steps, three of the steps are more directly related to the process of engaging participants and regulatory partners, and so those steps will be the focus of this technical report. The steps that are most applicable are:

Step 1. Build and Strengthen Collaborative Partnerships, Vision: Build support among a group of stakeholders to achieve a statewide or regional planning process that integrates conservation and transportation planning.

Step 7. Develop Programmatic Consultation, Biological Opinion or Permit: Develop MOUs, agreements, programmatic 404 permits or ESA Section 7 consultations for transportation projects in a way that documents the goals and priorities identified in Step 6 and the parameters for achieving these goals.

Step 8. Implement Agreements and Adaptive Management. Deliver Conservation and Transportation Projects: Design transportation projects in accordance with ecological objectives and goals identified in previous steps (i.e., keeping planning decisions linked to project decisions), incorporating as appropriate programmatic agreements, performance measures and ecological metric tools to improve the project.

IMPLEMENTATION OF C06 STEP 1

According to the CO6 recommendations, there are five implementation sub-steps for the building and strengthening of a collaborative partnership and vision:

- **1a. Identify preliminary planning region (**e.g., watersheds, eco-regions, political boundaries). Drivers may be environmental factors such as water quality needs or

303(d) listings, species' needs, watershed restoration needs, or rare wetlands.

- **1b. Identify counterparts and build relationships among agencies, including local government and conservation NGOs** (stakeholders).
- **1c. Convene a team of stakeholders, share aspirations, define, and develop commonalities.** Build an understanding of the benefits of a watershed/ecosystem/recovery planning approach and develop a shared vision of regional goals for transportation, restoration, recovery, and conservation.
- **1d. Record ideas and develop MOU on potential new processes for increasing conservation, efficiency, and predictability.**
- **1e. Initially explore funding and long-term management options** to support conservation and restoration actions and long-term management.

SUB-STEP 1A. IDENTIFY PRELIMINARY PLANNING REGION

Caltrans had already begun a corridor planning process for the SR 37 corridor, so the geographic boundaries for this project were defined prior to the implementation of the study. However, because the highway is part of a transportation network, serves commuters in the region, and passes through a large, valued area (the Napa Sonoma Marsh), the boundaries of the planning region were defined more broadly than just the surroundings of the corridor (Figure 1).

Highway 37 runs 21 miles along the northern shore of the San Pablo Bay. The roadway lies between the cities of Novato to the west and Vallejo to the east. It runs through the southern tips of Sonoma and Napa counties and is an important link to the four counties of the North Bay Area. This corridor is an important transportation corridor for commercial business within the region. Safety issues have been a particular concern for areas of the corridor that are two-lane, although the construction of a median barrier for one section in 1995 has reduced head-on collisions. Portions of highway 37 are built close to existing sea level, and are subject to flooding and damage due to seasonal storms. The height of the roadway is of particular concern given that projections for sea level rise by 2050 range from 26-43 cm (Sea Level Rise Task Force 2010). Because of these and other issues, various proposals to widen highway 37 to freeway standards and otherwise protect highway 37 from damage have been presented and strongly debated since the early 1950's. Highway widening has not occurred largely due to neighborhood opposition and environmental concerns. A more recent concern for the future of highway 37 is how to adapt to rising sea level in the face of climate change.

SUB-STEP 1B. IDENTIFY COUNTERPARTS AND BUILD RELATIONSHIPS

As part of a larger strategy to build local relationships for this project, the Road Ecology Center asked several local agencies to join the core planning team for this study. Members of Napa County RCD, Southern Sonoma County RCD, Sonoma Ecology Center,

and Sonoma Land Trust joined the project team to assist with identifying and engaging local partners and to help develop a collective data set of information indigenous to the project study area. These agencies, whose members live and work in the study area, have trusted relationships with local community residents and businesses. Even when the project team called organizations about participating, several asked if someone from the RCDs or Sonoma Land Trust were involved, and noted that their involvement was important to local residents.

In addition to local organizations, Caltrans District 4 is a primary partner in the study. Caltrans staff brought in relationships with regional transportation planning organizations and regulatory partners, as well as expertise in future traffic needs, maintenance, planning and project development. Caltrans would ultimately be the agency signing permits and other agreements with regulators, so their involvement throughout the study was crucial not only in identifying and building relationships with key partners, but also in ensuring these relationships translate into long-term agreements after the conclusion of the study.

Caltrans staff from a wide variety of functional units (*See Appendix 1, for list of participating functional units*) have participated throughout the study, which provided broad expertise for responding to stakeholder questions and issues.

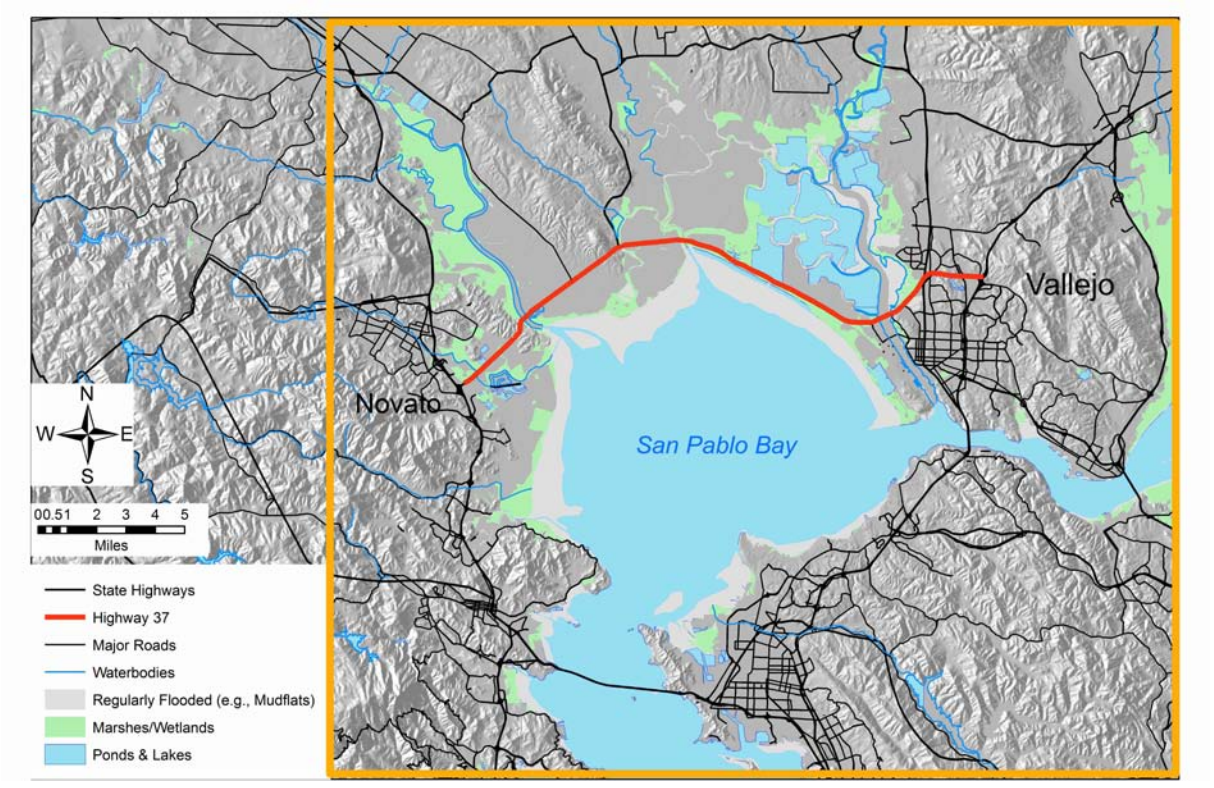


Figure 1: Project Study Area

SUB-STEPS 1C. CONVENE A TEAM OF STAKEHOLDERS; 1D. RECORD IDEAS AND DEVELOP MOU ON POTENTIAL NEW PROCESSES FOR INCREASING CONSERVATION, EFFICIENCY, AND PREDICTABILITY; AND 1E. INITIALLY EXPLORE FUNDING AND LONG-TERM MANAGEMENT OPTIONS

These three sub-steps were implemented through the stakeholder meeting process as described below.

Creating the Stakeholder List

The core team worked to identify and engage a variety of stakeholders from community, regulatory, environmental and business interests along the corridor. Initially, core team members identified groups and individual landowners in the project vicinity that might be interested and contacted them directly both immediately prior to and during the first few months of the study. As part of the feedback process during the third stakeholder meeting, the evaluation/feedback form included a question asking for guidance regarding other groups or participants that might be good to contact. After the fourth meeting, the entire stakeholder group was sent a list of participating groups and asked to identify any additional groups to contact (Note: this yielded only one reply).

In addition to asking feedback from stakeholders, the Road Ecology Center looked for and contacted environmental and community groups in the area. The team looked for underserved communities, particularly in the City of Vallejo, but had difficulty finding groups there to engage. The City of Vallejo Community Development Director did not have any recommendations for groups to contact. One telephone number for a community organization had been disconnected. The City of Vallejo recently declared bankruptcy and is facing severe economic issues, so this may have contributed to the difficulty in finding local groups to participate. In addition, the corridor management planning process has a timeline of several decades, and one of the challenges throughout this process has been effectively visioning for a future that could be twenty or more years in coming to fruition. Engaging community members who may be struggling economically can be a challenge if there is no perceived benefit to attending the stakeholder meetings. Core team members suggested calling local community organizations like the Elks and Kiwanis Clubs. It is not clear yet if working through these local organizations will yield additional participants.

It is relevant to note that the core team had some internal disagreement about contacting environmental advocacy groups, commercial business interests, and individuals who utilize the corridor on a regular basis. There was a desire to seek input from the typically underserved (e.g., communities of color, renters, less affluent) and specific environmental advocacy groups that may be more litigious.. Ultimately, several environmental advocacy groups were added to the stakeholder list, there were continued efforts to reach out to local organizations and businesses of all kinds, and a mail survey was sent to random households in the vicinity of SR 37 in order to be as

balanced as possible in the constituency of the stakeholder group and to help provide a balanced representation of stakeholder interests.

Stakeholders noted that it would be important to accurately incorporate feedback from regular users of the roadway, such as commuters, who might not be reached through local organization contacts or household surveys. Some proposed ideas for engaging this constituency include roadside signs advertising links to a survey, roadside surveyors who talk to drivers during traffic backups, and license plate surveys. While these practices were not part of this effort, future planning efforts would likely want to consider techniques to capture feedback from these user groups.

Building a Vision

Corridor management planning is largely about creating a shared vision for the future. As noted earlier, creating a vision that may be decades ahead is intrinsically challenging. One of the ways the core team managed this challenge was to first build a core base of understanding, then balance discussions around long-term and short-term topics.

Meetings 1-3: Briefings

The first three stakeholder meetings were called "briefings" since they were largely presentations by Road Ecology Center and Caltrans staff about the study itself, Caltrans' planning processes, current roadway statistics and issues, and the potential effects of sea level rise on the roadway. After the presentations (and during), participants asked questions and offered their ideas on topics such as additional data for the study, clarification of study tools, hydrology, agriculture and what issues mattered most for this meeting series. Attendance at these meetings, which were held bi-monthly, increased steadily from 17 at the first briefing (including core team members) to 43 at the third meeting. The meetings were held at different locations along the highway corridor to better accommodate participants along its 21-mile span.

Meeting 4: World Café - Building a Collective Vision and Recording Ideas

The fourth meeting was the first dedicated opportunity for stakeholders to spend several hours in small groups discussing their views regarding five future scenarios and a vision for the roadway. In addition, participants were asked to rate a list of corridor-related values and consider how these values guided their preferences for future actions on the roadway. This meeting, done using the World Café meeting process, gave the 62 participants three discussion rounds in groups of 4-5 people to share ideas. Each table also had a set of maps for the corridor that showed major transportation routes and natural conditions in the area. Following the small-group discussions, the group met in a plenary session and shared the results of their table meetings. More detailed results of this meeting are in the *World Café Summary* (Appendix 3).

The World Café meeting was a key follow-up to the earlier briefings, as it let stakeholders offer and share feedback after they had an opportunity to learn about the issues and the study over a period of time. The goals of the study and Caltrans' longer-term planning process were repeated at the beginning of the World Café as well to ensure everyone had a shared context. It was at this meeting where the shared vision of the participants began to emerge, as their ideas about what might and might not be feasible became visible to the larger group. Despite the great variety of participants, there was emerging consensus on potential future actions and values driving these actions. From this initial understanding of a longer-term picture, and in response to stakeholder feedback, the core team decided to focus on both clarification of the potential future actions as well as more information about shorter-term actions that could be addressed in the context of the emerging long-term vision.

While the recording of the discussions regarding scenarios and vision were not called an "MOU" specifically (as it is called in Sub-step 1.d, above), the World Café process meets similar goals. The resulting discussions frame the consideration of new approaches for conservation, efficiency and predictability, and helped determine topics for the following meeting, which focused on how emergency responses might be better understood and implemented to support the longer-term strategies for the roadway.

Meeting 5: Short- and Medium-Term Considerations for the Corridor

As noted earlier, one of the challenges in long-scale corridor planning is how to balance the long-term view with the shorter-term and perhaps more concrete issues. For this study, one of the questions that arose was how to deal with storm repairs to the roadway prior to the adoption of any specific projects to improve it in the future. Another issue was a desire to have more specific information about construction activities related to potential scenarios to alter the roadway so that there was greater understanding about potential impacts. These topics speak to the bigger issue of potential funding and long-term management. If there is no political will to support improvements to the corridor, then funding is unlikely. If there is not an understanding of how to address repairs over the next decade within the context of the longer-term vision, it will be more difficult and costly to implement changes in the future.

To address the first and part of the second issue, meeting five focused on a discussion of short- and medium-term issues related to the roadway, including emergency response. At this meeting, the Road Ecology Center presented the results of the World Café, and also results of interviews/calls with regulatory agencies (discussed below). Caltrans presented an overview of the Corridor Planning Process and how emergency responses occur and how they are funded. After this, the participants met in smaller groups to identify topics for clarification/discussion that could be addressed in the nearer future, given that large improvement projects might be decades away. This led to a better understanding of the shorter-term emergency response process, its limitations, and the role of regional transportation agencies in scoping the longer-term view. Participants identified a number of data gaps that would be helpful to fill, including current slated projects for the region, vulnerability analyses, and more information about construction activities related to potential changes to the roadway. Based on this feedback, the

subsequent meeting focused on more specifics regarding the proposed scenarios for the roadway. Once there is greater clarification regarding associated potential impacts from construction, stakeholders can better decide what option they prefer, and can collectively consider potential funding and mitigation opportunities well in advance.

Meeting 6: Regional Planning and Corridor Scenarios

An important part of CO6 and this study was the development of a Framework containing the information important for making stewardship-based decisions for the corridor. This meeting focused in part on the goals of the study – to assist TRB in developing better planning processes while also collecting information important for planning on the test corridor. Road Ecology Center staff presented the results of information collection to develop the "Corridor Context". This has become the repository for spatial and non-spatial data important for corridor assessment and planning. Mapping sea level rise and its potential impacts was the primary concern of stakeholders that were present. So much of the landscape of concern, including parts of the highway, are at or below the estimated 140 cm sea level rise by 2100. Because of this, there were concerns about the accuracy of models that display inundation in the region of the corridor.

A critical piece of the CO6 steps is consideration of social needs and preferences in transportation planning. In order to bring in more stakeholder concerns into the process, the Road Ecology Center conducted a survey of communities adjacent to the corridor. Even with the size of this surveying effort, there were concerns expressed that the effort needed to be more extensive to include commuters and businesses that rely upon the highway for commuting and goods movement.

As in previous meetings, small groups broke out to discuss ways that the overall corridor planning process could be improved. Several main points were made: 1) transit needed to be a more integral part of the discussion but at the same time it was important to not make assumptions about transit use; 2) a more complete surveying and inclusion of highway users and other stakeholders was needed; 3) need to tie jobs-housing imbalance and growth-inducing impacts of widening to corridor planning.

Finally stakeholders discussed the 5 future scenarios. The discussion revolved around feasibility, costs, and timelines for the scenarios. Some stakeholders expressed a desire to limit the scenarios to raising the roadbed and expanding capacity. A few expressed support for private funding for highway improvements, including an attorney representing a group with funding to carry out any of the constructed alternatives. The final discussion revolved around the long time-frames that characterized public transportation planning and project development.

Meeting 7: Short- and Medium-Term Next Steps for the Corridor

This was the final stakeholder meeting for the study. Although project partners and Caltrans committed to helping continue the process, there is currently no funding to do

this. The meeting focused on near-term and longer-term next steps that transportation partners and others could take to advance the work that was initiated through the study. The Road Ecology Center committed to maintaining the project website that serves as the repository for stakeholder process materials, spatial and non-spatial data, and other resources useful to corridor planning.

There was animated discussion of the different future scenarios, in particular the idea of including scenarios that some considered to be infeasible for political or cost reasons. One stakeholder suggested that TRB should consider developing guidance for how to define starting places for similar planning processes – what constitutes a sufficiently broad suite of possible transportation and ecological actions, how does a stakeholder group decide among them? Since a lot of the decision-making about scenarios seems to hinge on projected sea level rise (SLR), what if SLR does not occur?

One of the successes of the project was setting up a process where stakeholders expected to continue the planning, assessment, valuation, and agreement-reaching process in partnership with transportation agencies. In the near-term several modeling and data collection efforts were identified to fill gaps in the Corridor Context and to inform project development and permitting decision-making. These included: 1) improved and high-resolution modeling of the potential effects of SLR on infrastructure and marshes; 2) estimates of costs associated with each future scenario; 3) travel behavior studies (e.g., license plate survey for commuting habits); and an assessment of overall environmental impact of the highway. Over the long-term, stakeholders said that clearly action was needed and many expressed frustration at the typically long time lag between early corridor planning discussions and project alternatives descriptions and analyses. Transportation agencies described the steps that were needed over the next decade as being conducting a Feasibility Study that leads to a Project Study Report (PSR). The study would focus on many of the information needs generated during the present C21 study. The PSR would describe the programmable actions that could be taken to benefit transportation and ecosystems. A critical gap that was identified was the lack of local champions. Many in transportation see highway 37 as a very hard problem requiring long-term solution building. Many stakeholder see immediate issues that need to be addressed. Although the stakeholder process helped with information sharing and majority agreement on a causeway option, there was no obvious group of agencies to include projects in the regional transportation plan (RTP).

HOW THE IMPLEMENTATION OF STEP 1 COINCIDES WITH THE TCAPP DECISION GUIDE

The TCAPP Decision Guide, available at http://www.transportationforcommunities.com/shrpc01/framework_application_kdps/3/0 provides a complementary range of steps for implementing a corridor plan, as noted above. Generally, the Decision Guide recommends gathering approval of the scope, problem statements/opportunities and goals for the corridor. The next step is to come to consensus on the scope of environmental review and analysis, followed by

approval of a range of solution sets. In our study, the first scope was initially identified through the Corridor Planning Process that Caltrans had already started. The first three briefings in this study helped identify problems, opportunities, and goals for the corridor. The range of solutions (scenarios) was introduced before the official scoping phase of environmental analysis in order to help define the main issues and data gaps. The scenarios were presented as a straw-person to allow some focal points for discussion rather than having small groups start from all possible options. The result from the World Café showed that some stakeholders are interested in a blend of options, so the scenarios provided a starting point that has helped to understand information gaps associated with different construction and de-construction alternatives. As more information comes forth, the range of solutions will necessarily change to meet stakeholder preference. From there, the process can move forward to adopt a preferred solution set, and prioritize implementation.

IMPLEMENTATION OF CO6 STEP 7 (DEVELOP PROGRAMMATIC CONSULTATION, BIOLOGICAL OPINION OR PERMIT)

While Step 1 of the C06 protocol addresses engaging all relevant stakeholder, Steps 7 and 8 focus on how to work specifically with regulatory partners to link project development with environmental mitigation requirements as early as possible. This early engagement allows regulatory partners to comment on and participate in the project design to better prevent ecological losses and to capture opportunities for more effective and efficient mitigation, sometimes even before the project occurs. This kind of partnership gives the regulators certainty that concerns are addressed and gives project developers more certainty that the project will move forward with fewer delays.

As noted earlier, the CO6 sub-steps apply more exactly to situations involving discrete projects rather than a corridor management planning process, but the policy behind the sub-steps is directly applicable to this study. The sub-steps for Steps 7 and 8 are not as directly applicable to the corridor management planning process as the sub-steps for Step 1, so we focus here on framing the policy behind their application.

According to the Assessment Framework developed through the SHRP2-sponsored projects, the purpose of Step 7 is to "Develop MOUs, agreements, programmatic 404 permits or ESA Section 7 consultations for transportation projects in a way that documents the goals and priorities identified in Step 6 (Crediting Strategy) and the parameters for achieving these goals." The purpose of Step 8 is to "Design transportation projects in accordance with ecological objectives and goals identified in previous steps (i.e., keeping planning decisions linked to project decisions), incorporating as appropriate the programmatic agreements, performance measures and ecological metric tools to improved the project."

The policies enunciated in these objectives are to have projects that are consistent with the regional ecological goals and frameworks that are developed through the stakeholder process and are consistent with regulatory requirements for avoidance, and

if necessary, mitigation. While creating the vision for a corridor management plan may not be detailed to the level of a defined crediting strategy with exact metrics, there are identifiable concerns and issues that can be discussed as part of the bigger vision of the Plan. As part of this study, Caltrans developed an initial description of the permitting issues they saw as associated with the different future scenarios (Appendix 8). As the full stakeholder groups began to define values and strategies for the corridor, the regulators needed to have the opportunity to weigh in on the merits or challenges of potential plans and whether or not these strategies were feasible from a regulatory point of view. From these early conversations, transportation project developers can start to develop projects that are consistent with the larger stakeholder vision and that meet regulators' identified environmental concerns.

REGULATORY DISCUSSIONS

To facilitate engaging regulators as early as possible, the Road Ecology Center interviewed seven agencies that had permitting authority for transportation projects along SR 37. Representatives spoke first privately to the interviewer and then all the agencies were invited to participate in a conference call where they could share their comments with their peers and further discuss questions or concerns about the proposed scenarios for the SR 37 Corridor Management Plan. Finally, representatives of every relevant regulatory and transportation agency participated in a field trip along the highway to discuss the permitting issues associated with different highway scenarios and segments.

In the initial one-on-one interview, regulatory agency participants talked about what would support their early engagement with the Corridor Planning Process, if they desired any private meetings with Caltrans to facilitate this participation, and if they would be interested in presenting at a stakeholder meeting regarding regulatory challenges and opportunities associated with the presented scenarios for SR 37. In the conference call that followed, the agency representatives discussed the five scenarios as a group, and had a chance to hear each others' concerns or ideas about the draft proposals. The initial interviews preceded the stakeholder meeting number four (the World Café) where the full group also considered the scenarios. The conference call occurred following the World Café meeting, so some of the participants in that call had also attended the World Café, and all the participants had a chance to read the summary from the World Café.

It was interesting to note that there was a spectrum of agency responses to how early they wished to engage in the project development process (*For full summary of calls, see Attachment, Agency Interviews*). Some agencies wanted to be a part of the very initial discussions of ideas for the corridor, while others preferred to have Caltrans decide on a proposal and come to them with a fully developed plan and description of the affected area. Some agencies preferred to be somewhere in the middle of that spectrum. Time and funding were a big factor in the amount of resources an agency could allocate to the planning process. Given budget cuts and project demands, staff have little time to attend

meetings or participate in planning processes that are more in the realm of creating a long-term vision rather than address the needs for a project that is defined, funded and have measurable impacts. As was noted earlier, this is the balance and challenge in developing a 25-year vision rather than managing a project that is slated for construction in the next five years. However, even given these constraints, there was considerable agency participation for the interviews, the conference call, the stakeholder meetings, and the field trip.

In the conference call, it was helpful to have all the agencies represented, and for Caltrans staff (who also joined the call) to hear which scenarios might be "self-mitigating" (the causeway, tunnel, and co-alignment) and which might not be "permittable" (the highway footprint expansion). Just as the stakeholders had noted, agency representatives also said that having more specifics about the associated construction activities and potential projects would make it easier to provide more feedback. While early engagement was certainly appreciated, any formal agreements would require much more detail. So while these dialogues are not able to translate into a formal document at this stage, the inclusivity of the conversations helps set the stage for future project development that can more effectively incorporate regulatory agency concerns.

HOW THE IMPLEMENTATION OF STEP 7 COINCIDE WITH THE TCAPP DECISION GUIDE

As noted earlier, the TCAPP Decision Guide, available at http://www.transportationforcommunities.com/shrpc01/framework_application_kdps/3/0 does not follow the C06 Steps exactly. In this study, regulatory partners have been included both in the stakeholder discussions and through individual interviews to ensure their ability for early engagement. Regulatory partners have contributed to the early scoping and visioning process as part of the general stakeholder discussions, and they have also separately helped identify specific concerns for the proposed scenarios so that Caltrans and the stakeholder group has an understanding of the regulatory issues that might occur with the scenarios. This fits nicely within the Decision Guide's recommendation to gather approval of the scope, problem statements/opportunities and goals for the corridor, and well as the later recommendations to build consensus for the approval of a range of solution sets. The early identification of potential permitting issues can help eliminate or modify scenarios that might have been supported by the larger stakeholder group but later proven to be untenable from a regulatory view. As more information comes forth, the range of solutions will necessarily change to satisfy both stakeholder and regulatory goals. From there, the process can move forward to adopt a preferred solution set, and prioritize implementation.

As discussed above, many of the C06 steps do not readily apply to comprehensive visioning and planning processes, such as the development of a corridor management plan. The C06 steps seem targeted toward specific projects with shorter timelines, and with a greater opportunity to develop specific crediting strategies with regulatory partners. A corridor management plan involves the development of a long-term vision that is not legally binding, but that also leads to project development. The specifics of a crediting strategy are not as applicable to a large scoping process that is building political will for projects that may take decades to implement. Such projects typically do not have the specifics in place that allow for regulatory agencies to make mitigation agreements. The current regulatory and funding structure for project mitigation is a difficult fit for a longer-term visioning process.

As a result, regulatory participation differed among agencies. Some regulators were interested in participating in the early visioning, but others preferred to wait until specific impacted ecosystem components were identified before becoming involved. This is due to both the prevailing culture of the agency as well as the resources to support staff in long-term planning. The idea of looking far into the future is not currently part of the "norm" for some regulatory partners, and their funding (as well as Caltrans' project funding) may not support developing a shared long-term vision via consensus planning exercises. Funding that supports Caltrans liaisons to participate in meetings is linked to specific project-related activities, and because corridor planning lacks specific projects, some regulatory partners lack funding to attend meetings.

Having noted the general disjunction between the C06 steps and corridor planning, it is important to add that Step 1 (developing a shared vision) and the sub-steps for this step are quite applicable to corridor planning, and in this study, we applied those principles with great success. The development of the study area, relationships, a stakeholder group, and agreed values was core to the Highway 37 Study.

For corridor planning, the vision encompasses not only environmental, but community and transit concerns that need to be discussed with not only the environmental regulators and stakeholders, but also with the transportation agencies that would be recommending and implementing any future projects. It could be useful to broaden the references in the C06 to be more inclusive of non-environmental partners so that the steps can be more applicable to broader efforts like corridor planning.

Because of its breadth in scope, the Transportation for Communities Decision Guide contained applicable guidance for visioning processes like the Highway 37 Study. As noted elsewhere, the COR steps seemed more appropriate in developing a vision versus specific mitigation crediting strategies. One difference in how the steps were applied in our study is that we introduced scenarios early in the discussion. This ended up being necessary to give some concrete parameters to allow stakeholders and regulators to consider both the values related to the corridor as well as what data gaps were present.

The development of data for the corridor is moving forward based on the feedback from the draft scenarios. This is a departure from the recommended steps, but it allowed for better targeting of desired information that hopefully will serve the development of the corridor plan in the long-term.

SOME TOPICS TO CONSIDER IN STAKEHOLDER PROCESSES

This study was designed to implement the C06 Ecological Assessment Framework and consider the challenges and opportunities of this application. For the stakeholder and regulatory engagement processes, in addition to the application of the C06 steps, here are some challenges and opportunities identified thus far:

FUNDING

Stakeholder processes can be cost-intensive in a number of ways. If meetings are in-person, there are associated costs for room rental, snacks, and any potential technical needs. In this study, we were able to utilize regional community centers or rooms at local organizations with minimal costs, but that required significant searching. Depending on the location of the study, a project needs to consider associated costs for venues that can accommodate large groups comfortably.

Because time and travel can be rationed commodities for stakeholders, it can be helpful to utilize new technology to allow for virtual meetings. These technologies are relatively expensive at the present time, and so were beyond the financial scope of this project. If a project proponent wants to consider using some of the newer virtual tools to engage groups in large planning efforts, then such costs need to be researched and included as part of the total proposed budget. We will be initiating a virtual survey for both a random group of households as well as the full stakeholder list, but these costs have been donated to this project and were not part of the original scope of work.

For some regulatory partners, there is little or sometimes no funding for participating in planning processes. This is especially true of Caltrans liaisons, who may need project-specific Caltrans funding to attend meetings. Because Corridor Planning does not attach to a single proposed project, some regulatory partners were attending meeting in the spare time, unfunded. It would be helpful in setting up future efforts to consider how to prioritize larger planning processes for regulatory liaisons so that their early participation can support more efficient, project-specific engagement later.

Finally, funding for studies that are applying the C06 Framework to planning processes may require a longer timeline than other projects. Depending on the size and scope, a Corridor Planning Process may necessitate many meetings over time and likely requires a multi-year time horizon to successfully build a collective vision. Within the scope of

this project, the core team created a strong stakeholder list and built valuable relationships with a broad constituency. One of the particular challenges for this roadway is identifying and capturing feedback non-residential stakeholders such as commuters and trucking organizations. Developing methods for accurately incorporating this information is both a logistical and financial consideration for developing a broad stakeholder base. This will be one of the challenges that Caltrans will consider as they continue to develop the corridor plan in the long term.

TIMING

There is an inherent dilemma in building a stakeholder process that blends agency presenters/participants with local organizations/private citizens. Agency staff were not able to meet outside business hours, which meant all meetings occurred during the day on a weekday. Daytime meetings do not always work for local residents. It could be helpful to include some evening or weekend meetings as part of the full stakeholder engagement process, but because agencies like Caltrans are often involved, this takes agreement from agency staff.

Timing is also an issue for long-term planning processes because visioning necessarily is more abstract than a short-term discrete project. The project team recognized the continuing balance of discussing big-picture topics and more specific topics. Learning to recognize and accommodate this challenge is an important part of engagement and success over time.

CITATIONS AND RESOURCES

Marie Venner Consulting and URS Corporation. “SHRP2 C06A Guide to the Integrated Ecological Framework.” January 2011.

Sea Level Rise Task Force. “State of California Sea-Level Rise Interim Guidance Document.” October 2010, p. 4.

ATTACHMENT: INTERVIEWS WITH REGULATORS

Calls to Permitting Agencies as of 9/1/11

Status of Calls

As of 8/31/11, REC has contacted all the permitting agencies we listed (with exceptions discussed below), and have completed full discussion calls to one or more staff member from each agency except CA Department of Fish and Game (DFG). DFG is initiating a conference call in September and we are currently finalizing a date and time for that conversation. REC worked first with Stefan Galvez to review my list of contacts and refine or add per Stefan's advice. Stefan noted that the San Francisco Bay Wildlife Refuge and the San Pablo Bay Natural Area Reserve (both managed though the U.S. Fish and Wildlife Service) are not permitting entities. Caltrans coordinates with them, but does not need a permit from them. So we waited to call the their managers. As a result, the final list of contacted agencies is: U.S. Army Corps of Engineers (ACOE); San Francisco Bay Conservation and Development Commission (BCDC), California Department of Fish and Game (CDGF); U.S. Environmental Protection Agency (EPA); National Oceanic and Atmospheric Administration (NOAA), San Francisco Regional Water Quality Control Board (RWQCB); and U.S. Fish and Wildlife Service (FWS).

REC used a basic template of questions shown on page 4. In several cases, we spoke to more than one staff person from each agency. We found that while Stefan had identified many of the correct contacts for this project, there were a number of staff persons we identified and added through the calls. Please see Table 1 (*Updated Regulatory Matrix*) for the list of regulatory contacts and associated notes. Once Stefan identified initial contacts, we were able to speak to at least one person from each agency over a period of about two weeks. Timing the calls during August always raises the challenge of people being out on vacation, which was indeed the case. But after repeated calls and emails, everyone responded.

Results:

Early Participation

Generally, the responses to REC query regarding early participation in strategy development fell into a continuum ranging from great interest in early involvement to little interest until a strategy was defined. NOAA and FWS were enthusiastically interested in being involved in the development process. EPA was interested, and still learning about the project. Based on our discussions with FWS, we believe CDGF is also interested in early involvement, and their regular attendance at the meetings thus far seems to confirm this theory. FWS and NOAA both expressed their support for any efforts to discuss projects earlier, noting this had not been the norm, and they welcomed the opportunity to work on potential ideas at the formative stages. The RWQCB has a strong preference toward certain strategies (causeway, realignment), but noted their real interest is how any idea affects water quality - roadway runoff in particular. BCDC expressed a desire to be "circumspect" in their participation, and did not want to frame a project they would be permitting. While they have been more involved in other projects, the staff we spoke with felt the magnitude of this effort warranted that strategies come from the Boards of Supervisors, landowners, and others more directly affected by the results. ACOE noted a strong preference to

wait until there was a specific plan in place, along with identified impacted acres, before it would be worthwhile to offer their opinion.

One-on-One Meetings
Most of the agencies noted that it was not necessary to meet separately prior to the World Café, since this meeting is "the first bite of the apple." Once there are some ideas on the table, most staff said that would be the better time to consider direct meetings. BCDC would like a presentation regarding this study for their staff in November. This will help Karen Weiss, the point person on this project, to better hand it off to someone else when she exits for maternity leave in December. FWS said they would welcome early, direct conversations any time about how to work together better. Their staff has a strong interest in seeing some up-front studies that will help Caltrans have more information now for implementing measures later for the project, particularly as they relate to wildlife connectivity. FWS noted that for some time, there has been increasing tension between Caltrans and FWS, and it would be extremely helpful to identify policy measures now that could provide some context for various connectivity efforts rather than addressing each issue through a separate biological opinion later.

Attendance at the World Café
All the contacted agencies, with the exception of ACOE, expressed interest in participating in the October 4th World Café. ACOE felt it was too early in the process and did not want to influence the direction of strategy development. The CDFG staff noted their liaison is out on maternity leave, so they have limited resources. Karen Taylor is interested because her role is more as a landowner than permitter, so she wants to have early involvement in decisions. The other CDFG staff think it would be best to have some rough proposals in place before they participate.

FWS staff who are Caltrans liaisons assigned only to Caltrans projects, though willing to attend, have no identifiable Expenditure Authorization (EA) to which they are allowed to bill their time for this project. One of the Caltrans Chiefs noted that he also does not have an EA to assign for his own staff to participate. Having some mechanism to support staff, both at regulatory agencies and within Caltrans, is essential in supporting earlier communication and participation for transportation projects.

Attendance at an early December stakeholder meeting focused on regulators
Without exception, all contacted agencies were interested in participating in a stakeholder meeting in early December to discuss the strategic ideas that emerge from the World Café in October. ACOE noted that the more detailed the proposal, the more ACOE could commit to time for comments. ACOE noted that even if adding details would mean meeting a month later, it might be worthwhile to wait and discuss a more refined proposal. The other agencies we spoke with seemed comfortable commenting on draft strategies in general, and did not emphasize specificity.

FWS noted that one benefit of a public meeting with regulators as the focus is that stakeholders can better understand how much Caltrans actually does to mitigate impacts. This person noted that there is a perception that all projects are bad for the environment, when in fact Caltrans is under strict requirements to take measures to mitigate impacts. Such a public meeting may help with the overall understanding that Caltrans does in fact do many good things in association with a project. CDFG noted that having all the regulatory staff in the room at the same time with

the applicants is ideal because it avoids intra-agency confusion about impacts and allows for potential collective mitigation strategies among agencies.

Table 1: Updated Regulatory Matrix

Agency	**Contact Mary Interviewed**	**Date Called**	**Email**	**Number**	**December Mtg Interest**
ACOE	Dominick MacCormack (regulatory project manager)	8/17/11	Dominic.MacCormack@usace.army.mil	(415) 503-6784	More likely if thoroughly sketched proposal
BCDC	Joe La Claire and Karen Weiss	8/25/11	joel@bcdc.ca.gov karenw@bcdc.ca.gov	JLC: (415) 352-3656 KW: (415) 352-3669	Would like a presentation in November at BCDC at their staff meeting
CDFG	Greg Martinelli, Suzanne Gilmore and Karen Taylor	9/26/11	Sgilmore@dfg.ca.gov GMartinelli@dfg.ca.gov kctaylor@dfg.ca.gov	ReadyTalk Conference call	Interested in December. Suzanne and Greg would be attendees. Karen is more in land management than permitting.
EPA	Carolyn Mulvihill	8/23/11	Mulvihill.Carolyn@epamail.epa.gov	(415) 947-3554	Interested in December meeting
NOAA	Joyce Ambrosius	8/22/11	Joyce.Ambrosius@noaa.gov Joe.Heublein@noaa.gov Joel.Casagrande@noaa.gov	(707) 575-6064	Yes, Joe Heublein or Joel Casagrande would be the attendees since they are CT liaisons (both attended World Café)
SF Bay Reg'l Water Quality Control Board	Bruce Wolfe and Brendan Thompson	8/26/11	bthompson@waterboards.ca.gov bwolfe@waterboards.ca.gov	(510) 622-2506	Interested in Dec meeting. Start with Brendan.
USFWS	Jerry Roe and John Cleckler	8/24/11 and 8/29/11	John_Cleckler@fws.gov jerry_roe@fws.gov ryan_olah@fws.gov	JR: (916) 414-6684 JC: (916) 414-6600	Interested (might need CT funding authorization) Jerry Roe and Ryan Olah attended World Cafe

Template for Calls:

Calls to Regulatory Agencies:

Date:

Contact:

Number:

Goal: Develop identify challenges/opportunities early in the corridor planning process. Ultimately will give voice to regulators earlier and can assist with better foundation for agreements/permits in long-term.

1. What would be help you to be involved earlier in the permitting process? What information would you like to have? If you could ask CT to change something in process, what would that be?

APPENDIX 3: WORLD CAFÉ DISCUSSION OF STAKEHOLDER VALUES AND FUTURE CORRIDOR SCENARIOS

Appendix 3:

Summary of the Highway 37 Corridor World Cafe

October 4, 2011
Vallejo, CA

Caltrans

UC DAVIS
UNIVERSITY OF CALIFORNIA

Highway 37 Focus:

What strategies provide the best future for the people, practices and ecosystems of this corridor?

On October 4, 2011, the University of California at Davis (UCD) and the California Department of Transportation (Caltrans) hosted a stakeholder meeting to discuss strategies for Highway 37 corridor as it faces rising sea levels. This meeting was part of a UCD study sponsored by the Transportation Research Board (TRB), that focuses on the application of recently-established protocols for engaging stakeholders and developing recommendations on issues involving transportation and environmental resources. The results of this stakeholder process will inform Caltran's development of a Corridor Management Plan for Highway 37. The October 4th meeting followed three earlier stakeholder briefings on April 10th, May 24th, and July 19th. The October meeting used the World Café meeting format, and was the first opportunity for stakeholders to meet in small groups to discuss and brainstorm on potential options for the corridor. The World Café format is ideal for creating an opportunity for a group of stakeholders with different perspectives to consider and discuss ideas on a shared topic (*see sidebar for more information on this meeting format*).

Process

Sixty-two people attended the meeting (*see Attendee List, page 10*), including ten table "hosts," a facilitator and three staff assistants. The focus question for the meeting was, "*What strategies provide the best future for the people, practices and ecosystems of this corridor?*" The meeting opened with Fraser Shilling, Co-director of the UCD Road Ecology Center, presenting an overview of the project, a continuum of potential scenarios, and a list of the underlying values that seemed to frame this topic. Participants then focused their discussion in small groups at ten tables, with a table host facilitating and tracking each table. Each small group had two maps to assist their discussion. One focused on the land uses for the corridor (*see map, p. 8*) and the other showed a regional view of the transportation network to which Highway 37 belongs (*see map p. 7*). Each table was covered with butcher paper to allow the host and participants to draw and take notes directly onto the table paper.

Acknowledgements: This report was drafted by Mary Madison Campbell based on table host notes and plenary discussion. All photos are by Abbey Monroe, except Mary Campbell's photo on p. 10. All charts and graphs prepared by Mary Campbell except Chart 3 on p.5, which Fraser Shilling prepared. All maps (including cover) prepared by Sonoma Ecology Center.
A very special THANK YOU to the Vallejo Moose Lodge, which hosted our event, as well as to all the hosts for their time and effort. Attendees are listed on page 10.

Stakeholders at each table discussed the focus question for about 45 minutes. Then everyone in the room took a break. During the break, participants had to move to a new table with a new configuration of people to discuss the focus question again. Table hosts remained at their original table to brief the new group about the previous discussion at that table. After a second round of discussion, the group took another break and moved to yet another table, with hosts remaining at their original table. After a third round of conversation, the group paused for a plenary review of what each table had discussed. During this plenary session, each host noted the most prominent values and strategies that emerged from the three conversations.

Typical table set up at Cafe

What is a World Café?

The World Café is a meeting format that allows a group to explore questions that matter and consider these questions both broadly and deeply.

Developed by a San Rafael couple who work with group communication dynamics, the Café process creates informal, intimate opportunities for clusters of 4-5 people to investigate an issue in intervals of 30-40 minutes. After the discussion, which is chronicled by a "host" at each table, participants take a break and then move to a new table to explore either the same question or examine a different facet of a larger theme with a new set of people. Hosts at each table stay at the same table for all the discussion rounds, and they relay the previous table discussion to the new incoming group. This allows participants to either build on the previous discussion or branch out in a new direction.

After 2-3 discussion rounds, everyone gathers to hear the group's "harvest" of ideas, drawings, themes and interests as they emerged during the smaller discussions. It is helpful to have a break before the group harvest to allow hosts to organize and summarize the rounds and also to connect in small groups with other hosts to share themes.

One of the greatest benefits of the World Café is that itcreates a tremendous networking opportunity for people to connect. By the end of the Café, everyone has met and gotten to know a new face, a new idea and perhaps a new way of looking at an issue. In addition, each participant gets multiple opportunities for hands-on problem-solving in small groups. People remark that it is energizing, awakening, fun, and in some cases, enlightening about how to work on issues.

Following the meeting, each table host organized their table notes according to the values discussed and the continuum of scenarios presented at the beginning of the meeting. Each participant was also invited to fill out a meeting evaluation that asked them to rate the presented values from 1-5, which 1 being "least important" and 5 being "most important."

Values and Strategies

Prior to the small group discussions, Fraser Shilling reviewed the values that had emerged from the three previous briefings and asked participants to reflect on what potential strategies would honor these values as well as any additional values they would like to add to the list (*See list on top right*). Shilling then reviewed the current five scenarios that would frame the table discussions (*See list on bottom right*). Hosts were asked to investigate underlying values for their table discussions as participants weighed various options. After three discussion rounds, the room debriefed in a plenary session. Each table host discussed the top values and strategies that emerged from the three conversations.

Values in Plenary Discussion

In the plenary discussion, the value that was most emphasized was the importance of taking a long-term view as to how to approach this issue. This value may have been a different way of emphasizing the earlier value concerning the ability to change course if needed. Participants also emphasized that the long-term view included looking at this issue broadly to include strategies that would support strong job/housing ratios and would accommodate multiple transit options including rail, ferry, bicycle and pedestrian traffic. Participants also emphasized the importance of wetland functions generally as well as the ability for wetlands/landscapes to adapt to sea level rise. The phrase "Make way for the Bay," was used to used to describe a desire to allow natural processes to continue as sea level increases.

Participants expressed a strong desire to consider options that would support wildlife and their habitats, and public access both for education and recreation. Congestion relief was also highly valued, followed by farms and ranch practices. Congestion relief was also embodied in the idea of multi-modal transit options, and were inherent in considering options that supported a jobs/housing that would reduce overall commuting need. Safety and fiscal cost were seen as important, but not as highly ranked as values discussed above. However, these values emerged as important in framing certain strategy options, as cost and safety concerns seemed to particularly dampen participant interest in considering the tunnel scenario.

(Cont'd on page 4)

Initial and Added Values List

- Open space and views
- Congestion relief
- Wildlife and habitat needs
- Farms and ranches
- Public access to the water and wetlands for
- recreation and education
- Concern about the ability to change course if the wrong option is chosen
- Wetlands and functions related to them
- Wetland/landscape adaptation to sea level rise
- Impacts on transportation network in the region
- Fiscal cost
- Safety
- ADDED: Long-term view for all values
- ADDED: Sustainable communities (jobs/housing/alternative transit/multimodal
- ADDED: Access to Highway 37/Keeping the corridor

Participants in discussion

Initial Scenario List

- **No Highway Expansion**: Caltrans continues to manage the corridor with maintenance and repair activities and minor operational improvements (but no significant change in the footprint or capacity).
- **Expanded Footprint:** The height and width of the corridor through the marshes would double and the corridor would be expanded to 4 lanes to address current and projected future traffic volumes.
- **Napa-Sonoma Causeway**: The corridor (2 or 4 lanes) would be elevated onto a causeway across the tidal marshes (option 1) or across the San Pablo Bay (option 2) between Vallejo and Novato.
- **Strategic co-alignment**: The corridor would be co-aligned away from marshes & wetlands between Vallejo and Novato, with I-80 and 580 to the south, or with Highways 29 and 12/121/116 to the north.
- **San Pablo Bay Tunnel**: The corridor would be routed through a tunnel at the shortest feasible distance between the Vallejo area and the Novato area.

Values as Individually Rated

That values rated from 1-5 via the meeting evaluation generally reflected the plenary session results. However, there was additional emphasis on wildlife/habitat and safety compared to the large group discussion. Thirty-three people handed in individual ratings for the listed values, along with ones they felt should be added. Not every participant rated every value (*see Table 1 on right*). As in the plenary, evaluation respondents wrote in values such as "long-term sustainability," "multi-modal," "alternative transit options," and "maintaining the corridor."

Overall, the highest marks (4s and 5s) went toward congestions relief, wildlife/habitat, wetlands (both function and adaptation ability) and safety. The lowest marks (1s and 2s) went toward farms/ranches and public access. Open space/views, reversibility of a decision, transportation network impacts and fiscal cost were all considered important, but not "most" important. Charts 1&2 (*bottom right*) shows the listed values graphed by their rating. Chart 3 (*top left*) compares combined values.

Values in Table Discussions

Below are the synthesized comments from the table hosts for the listed and added values.

Open Space and Views: While not as much a focus as other values, stakeholders recognize that the view is valuable in connecting people to the rural North Bay, and it may be that the magnitude of this value is embodied in the lack of support for using a tunnel as a strategy.

Congestion Relief (could be linked to increased use of alternative transit such as trains): This was an important value. Participants repeatedly noted the challenges of having a 2-lane road sandwiched between 4-lane segments, and specific trouble with the 121/37 interchange. This route is also a major truck route for the Central Valley as well as for agricultural practices along Highway 37. Participants noted that congestion relief embodies multi-modal values, and that any expansions would need to accommodate non-vehicular transit. Congestion relief could also include rail and buses. This value includes a concern that increasing capacity could ultimately just lead to the corridor "filling up" as fast as it expands.

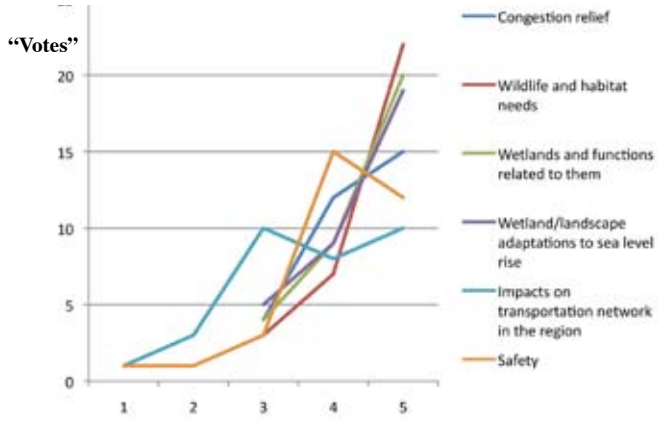
Wildlife and Habitat Needs: This was another highly rated value. Stakeholders included wildlife movement and animal mortality within this value, and see potential advantages in scenarios that may actually help de-list some current endangered species. This value also encompasses potential permitting

(Cont'd next page)

Table 1: Ratings of Values from 1-5

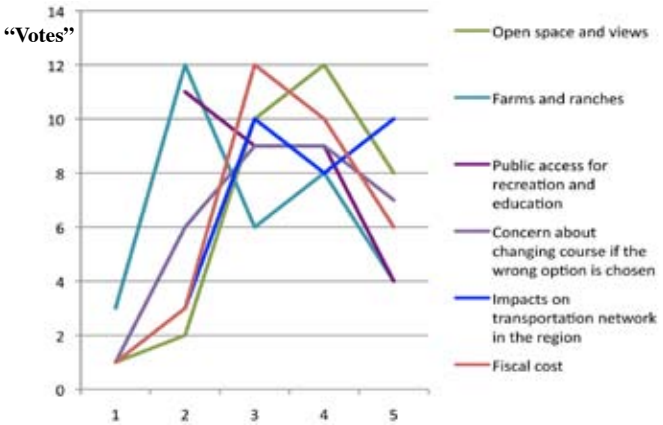
Reason/Motivation	1	2	3	4	5	Total
Open space and views	1	2	10	12	8	33
Congestion relief	1		4	12	15	32
Wildlife and habitat needs			3	7	22	32
Farms and ranches	3	12	6	8	4	33
Public access to the water and wetlands for recreation and education		11	9	9	4	33
Concern about the ability to change course if the wrong option is chosen	1	6	9	9	7	32
Wetlands and functions related to them			4	9	20	33
Wetland/landscape adaptations to sea level rise			5	9	19	33
Impacts on transportation network in the region	1	3	10	8	10	32
Fiscal cost	1	3	12	10	6	32
Safety	1	1	3	15	12	32

Chart 1: Higher-Rated Values (Rated from 1-5)



Rating: 1=least important 5=most important

Chart 2: Lower-Rated Values (Rated from 1-5)



Rating: 1=least important 5=most important

Chart 3: Summed Values (Rated from 1-5)

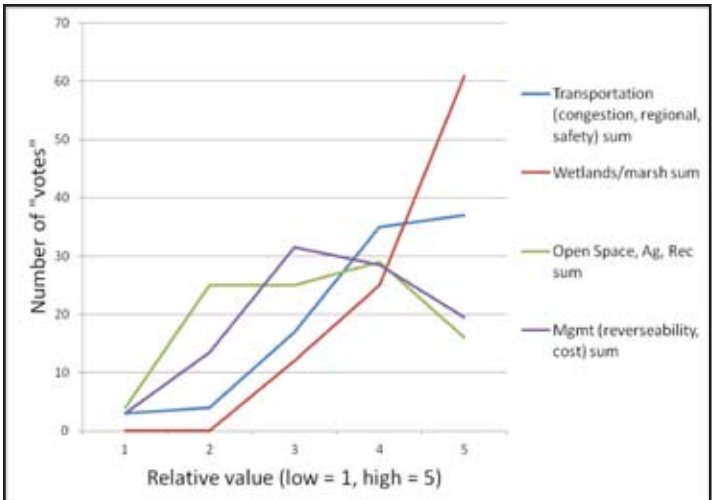


Chart of values combined. If three values combined, shows total votes. If two values combined, shows total votes multiplied by 1.5

hurdles if the roadbed is expanded, and the consideration of a wetland to upland gradient as part of any strategy so that there is refuge habitat at high tides and with sea level rise.

Farms and Ranches: While this was not a highly rated value, stakeholders noted support for retaining farmland practices in the short-term. Long-term, however, many participants noted agricultural practices may not be feasible. However, roadway-changing impacts would be less in agricultural lands, and there could be some strategies that blend increased tidal flow with protection of some agricultural lands. Stakeholders also noted there needs to be assistance to help maintain the levees that protect the highway and adjacent lands.

Public Access for Education and Recreation: Though this was not highly rated in the evaluations, stakeholders noted that having access to restoration areas and ways for people to connect with nature would create more public support for these types of projects and create a voting constituency for the outdoors. Participants noted that recreational access such as through the Bay Trail or a bike path would be important to include in any strategies for the corridor.

Reversibility of a Strategic Decision: This value, given a "somewhat important" rating overall, did not merit much discussion at the tables. However, when stakeholders added a value for "long-term sustainability," that may have better captured the concerns about being able to change any strategy over time. Participants wanted long-term ideas that would support future sea level rise, travel demands, and would not need to be changed. One participant noted that it would be better to "do it right the first time," rather than be concerned about reversing a decided path.

Wetland and Functions Related to Them: This was a highly rated value, both to protect existing restoration investments and to create additional contiguous tidal marsh for increased aquatic biomass, recovery of endangered species and as a buffer for flooding.

Wetland/Landscape as Adaptation Tool: Like the previous wetland-related value, this was also highly rated. This was also described as the "Make Way for the Bay" option. Stakeholders noted that wetlands need space and natural processes, like tidal flux, to adapt to sea level rise. A secondary benefit from marsh adaptions is that the marshes could continue to add resiliency to the Bay ecosystems and help the region adapt to sea level rise as it squeezes marshes upward and inward. Strategies that allow for a connection between marshes and the Bay will help with current silting (important for marsh adaptations) concerns and increasing flooding.

Impacts on the Regional Transportation System: This value was seen as important, though not as much as others. Stakeholders expressed an interest in maintaining the rural character of other road networks in the region. Widening 37 may meet future travel demand, but it is not clear if new capacity will relieve rural roads, nor is it clear if overall vehicle miles travelled would increase, reduce or stay the same. The connection to SR 121 and Lakeville Highway is important; any strategies need to consider this. Participants noted that SMART rail and Highway 37 planning should occur in tandem.

(Cont'd next page)

Participants in discussion

Fiscal Cost (and Fairness of Cost Burden): This value was also seen as important. Many noted that massive investments seem inevitable, and that delays now would mean higher costs later. Many saw co-benefits in certain strategies, since allowing more tidal flow could reduce the current costs of pumping and dredging, as well as maintenance of a failing infrastructure. Some suggested that certain strategies could be "self-mitigating" if they created additional habitat. Several noted that landowners currently pay for pumping that also benefits the public. Cost-sharing options should be considered to ensure that beneficiaries, both public and private, share the financial burden of pumping and maintaining levees. Participants also discussed that strategies could include revenue-positive options such as nature centers for marsh-adjacent towns, increased freight rail, and tolls.

Safety: This was a highly rated value individually, though some tables talked about it more than others. While there were significant safety improvements in the 90's, there currently are many safety issues on the corridor, particularly in 2-lane segments, the 121 interchange, and segments without areas for emergency vehicles.

Long-term View/Sustainable Communities: This value was added via the discussion as well as to several evaluations. Stakeholders seemed to agree about the magnitude of this undertaking, and there was a shared desire to develop strategies that considered not just transportation needs, but also those of communities and ecosystems. Participants want to see the corridor developed for the long-term, in ways that address linkages between jobs and communities as well as strategic habitat restoration goals. This process should be seen as part of a broader planning effort, and include partnerships with all adjacent landowners, railroads, Bayside residents, and other affected groups. Participants also expressed a corollary to this value: the need to plan for short-term emergencies effectively. But they don't want the emergency response to be the solution; they simply want to make sure there is planning for it.

Multi-modal: This value came up both in the plenary and on the evaluations. It is linked to sustainability and impacts to transit in that strategies which consider alternative transit options can reduce vehicle miles travelled and better link commuter routes with lower greenhouse gas emissions. Participants expressed a strong desire that any strategy would consider and accommodate multiple transit options, including rail, ferry, bicycle, bus and pedestrian choices.

Desire to Preserve Corridor Generally: This value emerged in both the plenary and on the evaluations. Stakeholders affirmed that Highway 37 is important as a regional transportation route, and that there are limited options for East-West transit. This corridor is an important link to all the North Bay counties, and there was strong support to recognize its inherent value.

Strategies

While the discussion on values provides a necessary foundation for considering strategies, stakeholders primarily wanted to discuss the tangible strategies that could be employed. Hosts noted that it is a natural inclination for people to want to move into the problem-solving mode, and therefore while understanding and talking about values provides insight, the general focus of the table discussions was on strategies.

The map on page 7 shows the corridor with a focus on transportation, while the map on page 8 shows the region with a focus on land uses and where potential sea level rise may occur. Both of these maps were provided to each table to support their discussions, and referencing them is helpful in understanding how the strategies could be applied.

Plenary

In the plenary discussion, hosts were asked to name the top three strategies the emerged at their tables. While there was the most agreement about how to work with the eastern segment of the corridor, the big take home message was that a single strategy was not appropriate for the entire roadway. It was best to consider the roadway in segments and weigh approaches that fit the geography, land uses and communities for that section.

Nearly all hosts reported that there was most consensus around the benefit of a causeway for the eastern portion of the corridor from Mare Island to the 121 interchange. A causeway would allow tidal flow and support the existing marshes, accommodate future sea level rise, and address flooding that was already problematic. There was some support for widening the road that would be a causeway, and strong support for including multi-modal accommodations on it and any other strategies for the corridor. The Yolo causeway was cited several times as a good example of what this could look like. Improvement to the 121 interchange was also deemed important, though ideas for this varied.

For portions of the corridor that lay west of 121, there was less overall agreement on an exact strategy, but most wanted to see the road elevated. There were several ideas for elevating the roadway that included notching underneath or hydraulic barriers that could be manipulated to allow selective tidal action. Some wanted to see the elevated road co-aligned with rail and other travel modes. Some suggested the use of selected causeways through this western segment. There was support to build up the roadway to protect active agricultural practices, while allowing increased tidal flow around these lands.

Aside of elevating in place, one resulting strategy was to align the highway across the San Pablo Bay, but also retain access to SR 121 and local lands.

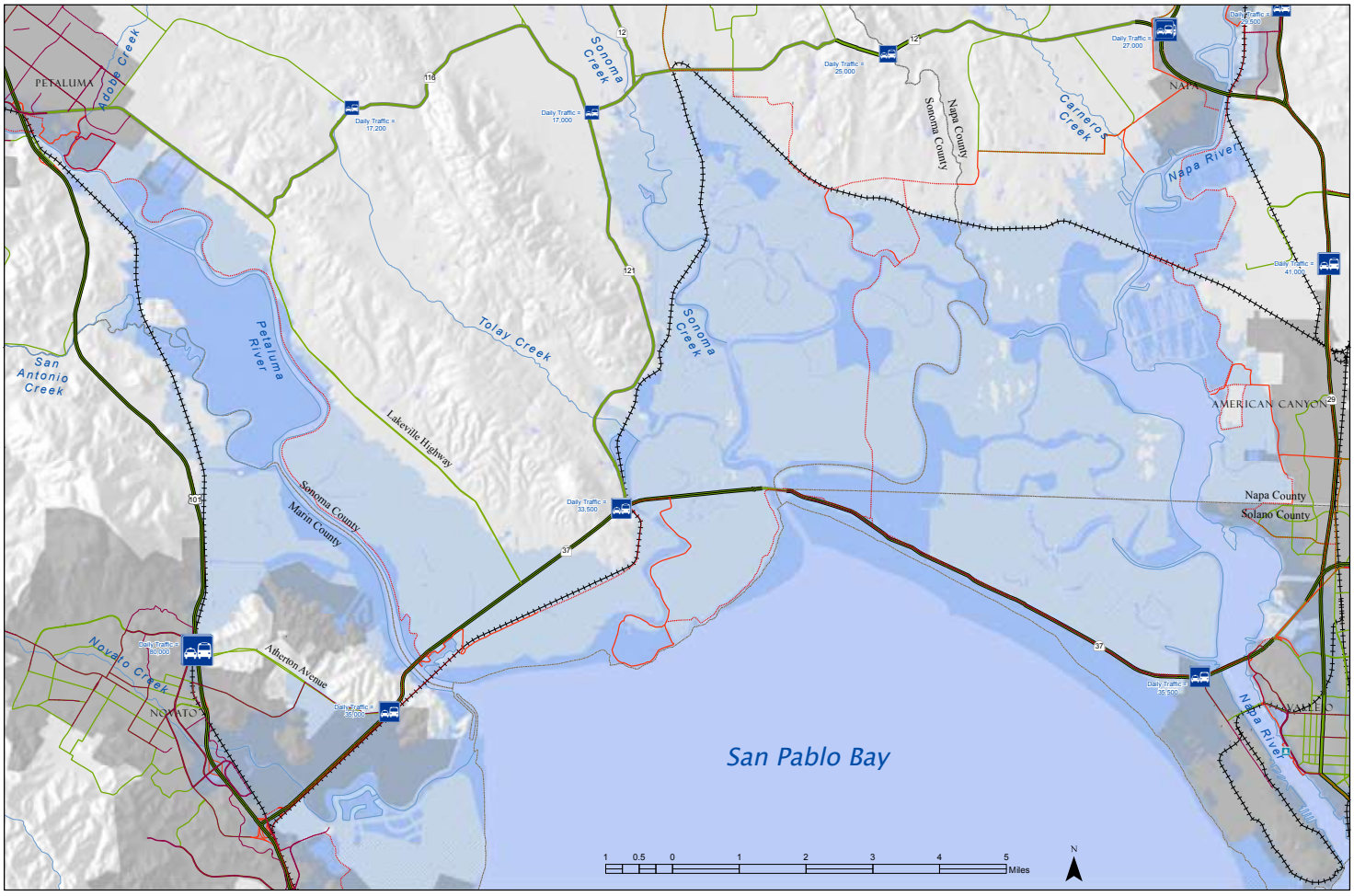
As noted earlier, there was agreement that any of these strategies needed to consider the regional context of job/housing, sustainability, multi-modes, and long-term transit needs. Some cited the benefit of using tolls as a funding mechanism, though someone noted this could lead to increased traffic on rural road to avoid the fee.

Strategies in Table Discussions

There was great appreciation of the diverse viewpoints shared at each table, and for the respectful tone with which stakeholders from very different perspectives were able to share ideas and learn from each other. Conversations were enthusiastic, articulate and productive. Hosts grouped their specific notes about the fives presented scenarios.

No Highway Expansion: It seemed that stakeholders arrived with an intention to discuss potential changes to the corridor, so this scenario was not favored. Some noted that doing nothing but maintenance would eventually become prohibitively expensive due to sea level rise and storm damage. Current flooding at Tolay Creek was also noted

(Cont'd next page)



Highway 37 Corridor
Transportation

Major Roads
Road Type
2 Lane
2-Lane/Divided
Multi-Lane
Multi-Lane/Divided

Daily Traffic Counts
Annual Avg Daily Traffic
10,000
50,000
100,000

Bay Trails
2011 Status
Existing
Proposed
Other Bike Ways
Railroads
Ferry Terminals

Potential Inundated Area, 2050
City Limits

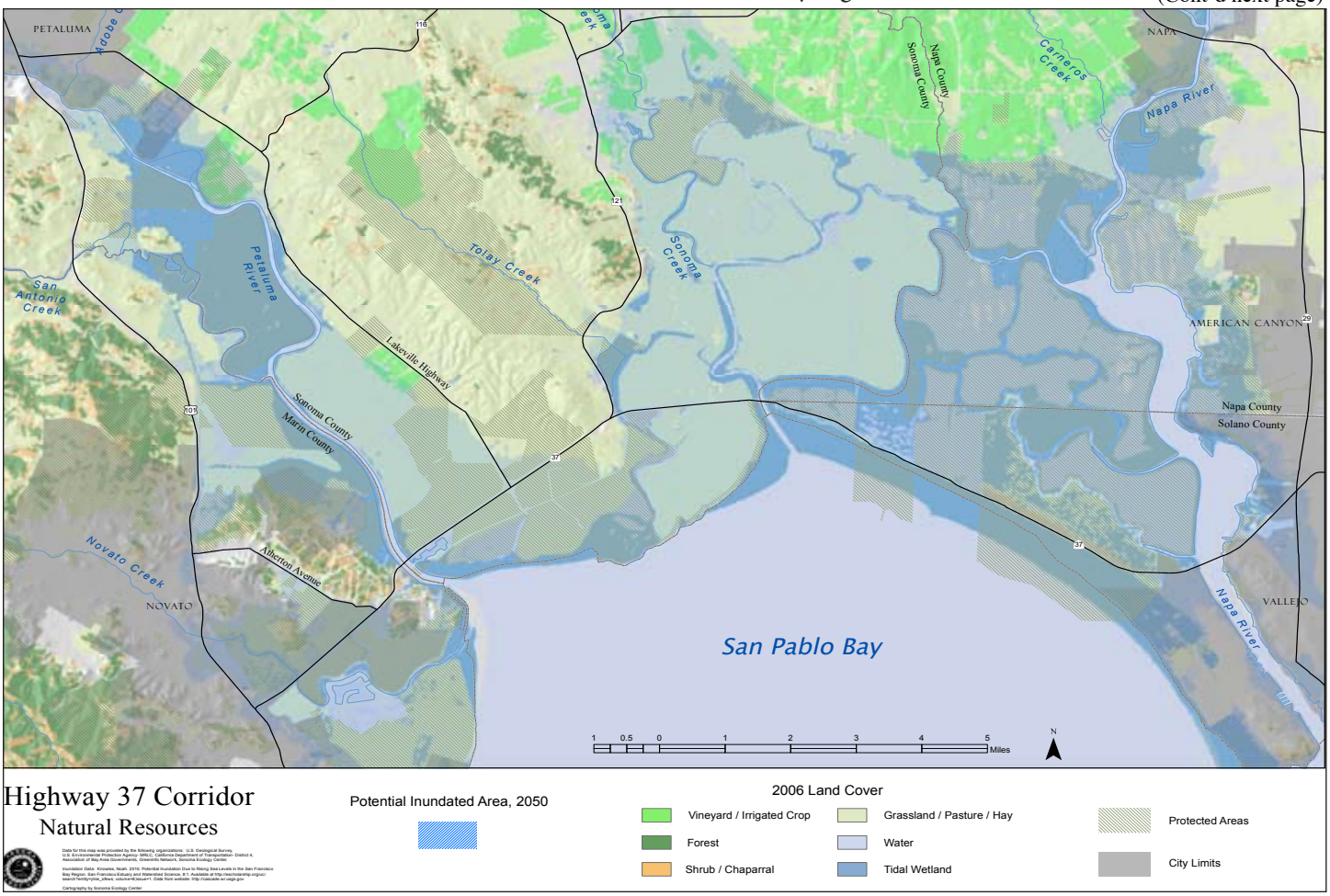
as a reason this scenario would not be effective. It was seen as a band-aid approach. However, in the near-term, some participants recommended changes to the 37/121 interchange, because it is a bottleneck by design, and was impacted by raceway and other traffic. Also in the near-term, stakeholders need to be engaged regarding emergency response strategies while longer-term strategies are put in place.

Expanded Footprint: Some noted here that raising the highway and expanding the highway should be discussed separately, as the impacts related to each can be different. There was great concern over the impacts from this scenario, and that it was not a long-term solution that addressed the discussed values. When considering build up and/or expansion, it is important to address safety, wildlife crossings, and support of the marshlands. Some participants seemed more open to this scenario for some segments rather than others.

Some stakeholders felt that the highway should remain on grade between Sonoma Creek and Petaluma River, because Tubbs Island (between Sonoma and Tolay Creeks) is currently farmed so tidal action is undesirable, and because the railroad's presence prohibits letting the tide in between Tolay Creek and Petaluma River. However, many noted that eventually farming will disappear from this area and that it would be better if the railroad could also be raised above the land. If this option is chosen, stakeholders felt that the roadway should be raised at least over Tolay and Novato Creeks, where flooding and maintenance problems are already severe.

Some felt road elevation might work for the segment between the Petaluma River and 121, and could be more environmentally feasible if the railway and the roadway were co-located on a single levee with a very low gradient so it could provide a range of habitats from tidal to uplands, and would be more resilient to rising sea levels. There was discussion about using culverts/hydraulic gates to regulate the timing, amount and velocity of water movement to more effectively inundate lands north of the roadway. Vallejo Waste Disposal and Flood Control wanted to make sure access is maintained to farmland where the city spreads partially treated solid waste to be used as fertilizer for non-food crops. Fiscally, this scenario might be the most cost-effective, but the mitigation costs could be high if they are not measures to accommodate impacts. So some hybrid of option might best address the competing values if this was used for any segment.

(Cont'd next page)



This scenario was not seen as acceptable for the eastern segment of the roadway from Mare Island to SR 121.

Napa-Sonoma Causeway: For many stakeholders, this scenario seemed to offer the adaptation for sea level rise while supporting wildlife movement and natural processes. A 4-lane causeway or low bridge, with several locations along the route for safety/emergency access and recreational access to the marshlands, was noted by many as the best option between Vallejo and Sonoma Creek. Between the Petaluma River and 101, many stakeholders, including those from Marin County transportation agencies, wanted the highway raised on a causeway to avoid dredging costs and other problems with Novato Creek and other waterways and wetlands. It was reiterated that it would be better if the railroad could also be raised above the land, so that in the longest view, raising all infrastructure above grade along the entire corridor was preferred, with the exception of the hills at Sears Point and Atherton Avenue. Some noted the impacts could be self-mitigating because the project would create additional habitat. As noted earlier, many cited the Yolo Bypass as a good example for a causeway reference, especially due to it multi-modal accommodations. Also the use of a causeway on selected segments would reduce current dredging costs for some entities. Some cited the potential use of a toll to pay for all or segments of the project.

There was some discussion of a potential causeway across the San Pablo Bay, and generally it was not supported. Some considered a bridge across the bay infeasible and expensive. It was also clear how connections to Lakeville and Highway 121 would be made to a bridge.

Strategic co-alignment: There was generally little confidence in this scenario. Stakeholder concerns included traffic impacts to adjacent roadways, opposition from northern landowners, and safety concerns. Any further investigation of this option would need additional study regarding impacts to the regional transportation network, and an examination of the costs for enhancing other roadways to address increased traffic. One table noted there was some support for a co-alignment south as long as access to 121, most farms and local open space could be maintained.

San Pablo Bay Tunnel: There was not only a lack of support, but actual distaste for this scenario in some groups. Stakeholders did not like the aesthetics of driving in a tunnel; there were safety concerns regarding seismic events, multi-modal transit would be difficult to accommodate, and it would be prohibitively expensive.

Miscellaneous: There was some support for expanded ferry service between Solano and Marin to reduce traffic. Some stakeholders expressed a desire to have some big picture fiscal data for each scenario, and for maps to distinguish between grasslands and pasture/hay as these are significantly different uses.

Conclusions

Amidst this group of stakeholders, there was a strong appreciation of the ecosystem service value of the wetlands both as habitat and as an adaptation tool for rising sea level. While it was not pronounced in the plenary session, safety, congestion, and public access are also strong values that need to be addressed in any strategy. There was strong agreement that strategies need to address the long-term horizon, and promote sustainable, multi-modal options. Agricultural practices are valued, and participants want to support current practices. There was some agreement, however, that in the long-term, these practices may not be feasible.

Stakeholders generally agree that some kind of causeway, which may include 4 lanes, is a good strategy for the eastern segment of the corridor. For the western segment, participants discussed a variety of strategies, and it may be best to consider each segment and what options best serve the values related to that stretch of the highway. There was some agreement that elevating the roadway (with a low slope gradient) in certain portions could be feasible, and that there could be notches, hydraulic gates, or culverts that could help manipulate tidal flows. There was not consensus regarding a bridge across San Pablo Bay, a tunnel, or co-alignment of the road. Response for these strategies varied greatly. The idea of "doing nothing" was generally not supported throughout the discussions.

Next Steps

The next stakeholder meeting is slated for early December 2011. At this meeting, permitting agencies will be invited to comment on the results of the World Cafe and discuss challenges and opportunities related to the strategies discussed at the World Cafe.

Attendees to the October 4, 2011 Highway 37 Corridor World Cafe (*Table Hosts are marked with an "**"*)

Attendee		Affiliation
*Joseph	Aguilar	Caltrans D4, System Planning
*Erik	Alm	Caltrans D4, System Planning
Betty	Andrews	ESA PWA
Gary	Arnold	Caltrans D4, Local Dev. Rev.
Tom	Bartee	Michael Allen, Assemblymember, 7th District
Jackie	Bjorkman	UC Davis
John	Bradley	USFWS - San Francisco Bay National WR
*Robert	Bregoff	Caltrans D4, System Planning
Don	Brubaker	USFWS - San Francisco Bay National WR
Mary	Campbell	UC Davis
Joel	Casagrande	NOAA
Anne	Crealock	Sonoma County Water Agency
Dan	Cherrier	TAM
*Caitlin	Cornwall	SEC
Curt	Davis	Caltrans, System Planning
*Wendy	Eliot	SLT
Nicolas	Endrawos	Caltrans D4, Project Mgmnt
Maureen	Gaffney	ABAG
Stefan	Galvez	Caltrans D4, Biology
Tom	Gandesbery	California Coastal Conservancy
Roberta	Gerson	USFWS
*Jeanne	Gorham	Caltrans D4, Landscape Archit.
*Mary	Gray	FHWA Headquarters
Shiwei	Gen	CDFG
Robert	Guerrero	STA
Susan	Haydon	SSCRCD
Joe	Heublein	NOAA
Tom	Huffman	CDFG
Beth	Huning	SF Bay Joint Venture
Junko	Hoshi	CDFG
Eliot	Hurwitz	NCTPA
David	Jones	Marin CHP
Liz	Lewis	Marin County Public Works
Jeremy	Lowe	ESA PWA
Rick	Marshall	Napa County
Ron	Matheson	City of Vallejo
Julian	Meisler	Sonoma Land Trust
Abby	Monroe	UC Davis
Tom	Moritz	Sonoma Valley Heritage Coalition

Participants in discussion

Attendee		Affiliation
Steve	Moore	Nute Engineering
*Chuck	Morton	Caltrans D4, Maintenance
John	Nemeth	SmartRail
Ryan	Olah	USFWS
Jerry	Roe	USFWS
Barbara	Salzman	Marin Audubon
Tito	Sasaki	N. Bay Agricultural Alliance
Eric	Shott	NMFS
*Leigh	Sharp	NCRCD
*Fraser	Shilling	UC Davis
Renee	Spenst	Ducks Unlimited
Jere	Starks	Infineon Raceway
Dianne	Steinhauser	TAM
Karen C.	Taylor	CDFG
Brendan	Thompson	San Francisco Estuary Project/ Water Board
Dilip	Trivedi	Moffatt and Nichol
Bill	Tuikka	City of Vallejo
Sam	Veloz	Point Reyes Bird Observatory
Kevin	Ward	UC Davis
Karen	Weiss	BCDC
Carl	Wilcox	CDFG
Norm	Yenni	Landowner

APPENDIX 4: LAND-USE AND CONSERVATION ISSUES IN THE CORRIDOR VICINITY

APPENDIX 4: CORRIDOR CONTEXT (REGIONAL ECOLOGICAL FRAMEWORK)

Contributors: Sonoma Ecology Center

Sonoma Land Trust

Southern Sonoma County Resource Conservation District

Napa County Resource Conservation District

University of California, Davis, Road Ecology Center

Contacts: Caitlin Cornwall, Sonoma Ecology Center, (707) 996-0712 x105, caitlin@sonomaecologycenter.org. Fraser Shilling, UC Davis Road Ecology Center, (530)-752-7859, fmshilling@ucdavis.edu

CONTENTS

INTRODUCTION

This memorandum was prepared as part of the *California Pilot Test of the Ecological Approaches to Environmental Protection Developed in Capacity Research Projects C06A and C06B*. The overall purpose of this memorandum is to convey the findings from the pilot test of the "ecological framework" concept. Other purposes include 1) communicating recommendations, issues, opportunities, and concerns regarding the future of the Highway 37 corridor that might not be apparent to entities working at a regional or county level and 2) commenting on the transportation decision-making guidance provided by the CO6 projects of the Transportation Research Board's Strategic Highway Research Program 2 and the subsequent Decision Guides of the Transportation for Communities project (TCAPP). The contributors, and many other local stakeholders, individuals and organizations, are involved in the Highway 37 planning process now, but may not be in the future. The decision-making process modification of the Highway 37 transportation corridor is prolonged, nonetheless the current stakeholder process yielded a wealth of information and opinion from local individuals and organizations. This memorandum will serve as an organization and record of important ecological, community, transportation, and local economy information that can and should inform the planning process now and in the future. We recommend that local stakeholders continue to be invited to share information in the corridor context framework and engage in the planning process to ensure a robust and more successful process. Preparation of this Technical Memorandum included a concerted effort to capture local stakeholder input. While our intent is to provide a comprehensive report, we recognize that there may be information and opinions that are unintentionally not captured.

CORRIDOR CONTEXT

The integrated ecological framework from CO6 provides one tool for organizing information about the environment surrounding a transportation feature. It provides a context for considering interactions between the feature and surrounding natural processes and systems. These interactions could include impacts to endangered species, fragmentation of habitat, pollutant inputs to waterways, soil and the atmosphere, and other effects.

When faced with using the ecological framework to organize thinking about impacts and benefits from transportation infrastructure, the core team and the stakeholder advisors

decided to modify this approach and develop a concept called the "corridor context". This includes the same kinds of information as the ecological framework, but also includes community values and economic activity (Figure 1). This conceptual model was used to organize thinking about impacts and benefits, types of information, and domains for optimizing alternative scenarios for the transportation corridor. Understanding the corridor context begins with an examination of the history of the immediate region around the corridor, then consideration of current processes and values interacting with the corridor, and finally with supporting stakeholder and transportation agency decision-making about the alternative scenarios for the corridor.

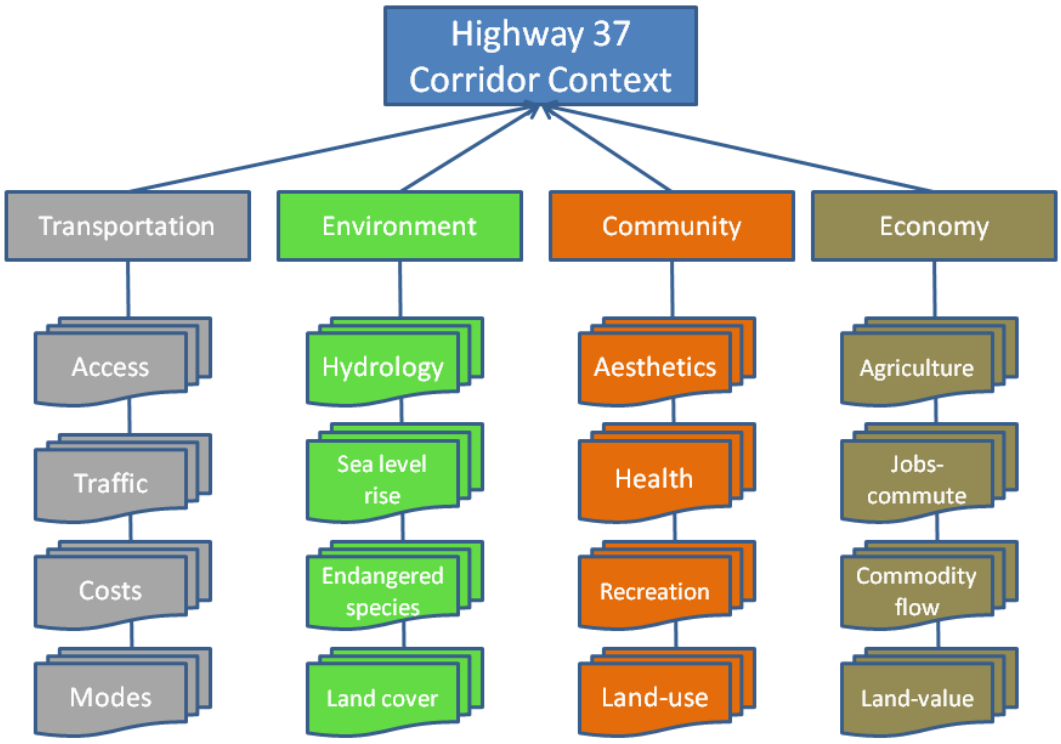


Figure 1 Corridor context organizational approach.

LANDSCAPE HISTORY

The Highway 37 corridor (the corridor) includes the lands around San Pablo Bay that are now or were historically submerged by the tides. Conversion of tidelands to farm land occurred under the Swamp Land Act of 1849 (modified in 1850 and 1860). Private individuals were offered land at no cost, provided that they would drain and develop these

wetlands, which were defined as "wet and unfit for cultivation." Landowners installed a system of levees to keep tidewater out and ditches and pumps to remove storm water making it possible to farm productively. (This Federal wetlands policy was reversed in 1988 when the "no net loss" of wetlands policy was adopted.) This resulted in establishing a robust regional agricultural economy supporting hay, grain, pasture, and vineyards. Highway 37 was constructed in the early 1900s as the primary transportation link across the North Bay and it served/serves local agricultural producers and connects communities and long distance travelers to the North Bay.

Sea level in the San Francisco Bay has risen almost 8 inches over the last 100 years. Recent projections from the Intergovernmental Panel on Climate Change and other climate scientists predict a wide range of possible sea level rise over the next 50-100 years, from 16-20 inches by mid century to 50-70 inches by the end of the century. The sea level rise anticipated from climate change has the potential to submerge historic wetlands and existing agricultural properties and threaten public infrastructure, including Highway 37 and the nearby freight/passenger railroad unless the historic flood protection infrastructure (levees, ditches and pumps) is maintained.

ECOLOGICAL SETTING, CONSERVATION AND RESTORATION

Highway 37 runs along the edge of San Pablo Bay (North San Francisco Bay Area) and the corridor is adjacent to wetlands, upland grasslands, oak woodlands, and riparian areas. It is recognized regionally and nationally as a unique and ecologically important landscape of natural beauty and ecological diversity. It is characterized by its lack of intensive development and, along with the South Bay, is recognized as the part of San Francisco Bay that offers the most opportunity for wetland restoration.

The San Francisco Bay region, including San Pablo Bay, includes the most important estuary on the continental Pacific Coast for birds and a critical link in the Pacific Flyway. Historically, tidal marshes fringed San Pablo Bay and provided habitat for a multitude of fish, bird, and plant species, many of which are now rare or extinct. Over 85 percent of the Bay's and over 82 percent of the North Bay's historic tidal wetlands were lost to land reclamation, with a dramatic reduction in the wildlife populations that depend on them. Many animal and plant species have become threatened or endangered as a result of this habitat loss.

For years, scientists have recognized that restoration of the ecological vitality of the San Francisco Bay depends upon the restoration of many thousands of acres of tidal marshes around the Bay. The ecological benefits of conservation work in this region are widely acknowledged. Today, scientists are also advocating for the restoration of tidal wetlands to provide an important natural buffer to anticipated sea level rise. In addition, the economic benefits derived from creating buffers against sea level rise are increasingly being recognized.

Approximately 55,000 acres of tidal marsh existed in the North Bay before they were diked, drained and converted to agricultural lands. Today fewer than 10,000 acres remain. Restoration of historic wetlands and the preservation of existing open space are considered by local, state, and federal agencies as a critical step toward successfully implementing restoration and endangered species recovery efforts in the Bay-Delta and have been endorsed as a major goal by every government agency and organization interested in conservation and restoration of San Francisco Bay. For example, the *Baylands Ecosystem Habitat Goals Report* (1999) prepared by the San Francisco Bay Area Wetlands Ecosystem Goals Project, the San Francisco Bay Joint Venture *Implementation Strategy* (2001), and the Bay Area Open Space Council's *Conservation Lands Network Report* (2011) have developed specific goals to protect and restore Baylands and their watersheds in the North Bay.

San Francisco Bay's tidal marshes are valued, protected and restored in recognition of their ecosystem services, which include: high productivity and habitat provision supporting the food web leading to fish and wildlife; buffer against storm wave damage; shoreline stabilization; flood water storage; water quality maintenance; biodiversity preservation; carbon storage and socio-economic benefits such as recreation. These services contribute to the Bay area economy and quality of life. Many state, federal and regional public agencies and nongovernmental organizations include among their objectives acquisition and restoration of wetlands along San Pablo Bay and many properties in the Region have significant restoration potential and therefore have been identified as high acquisition priorities. These agencies and organizations may acquire fee and/or easement interests in property either directly or through a grant to another conservation organization. The decision to convert agricultural land to seasonal or tidal wetlands is made on a case by case basis and based on economics, landowner goals, availability of acquisition and restoration funding, and the sustainability of agricultural operations in the corridor and in the region.

In the last three decades, 30 wetland restoration projects have been constructed and 25 more are planned within Sonoma, Napa, and Marin counties. These alone total over 21,000 acres of restoration already completed or planned. There are potentially thousands of acres available in this area for restoration. Because many of the agricultural lands that were

reclaimed from marshes remain largely undeveloped, the technical requirements for their restoration to tidal marsh are relatively straightforward: build a new flood protection levee and breach and grade down the existing levees that hold back the Bay. This process has been utilized during restoration of the Sonoma Baylands, Napa-Sonoma marshes, Carl's Marsh and other locations along San Pablo Bay where there were willing landowners and willing public agencies.

Selected key plans and policies for the Highway 37 corridor.

- San Francisco Bay Joint Venture: "Roadway planning should strongly consider the San Francisco Bay Joint Venture's partnership (27 member agencies and organizations) and federal executive order to meet its restoration objectives met through incentives and non-regulatory techniques."
- Focus: A Development and Conservation Strategy for San Francisco Bay, a partnership of ABAG, Metropolitan Transportation Commission, Bay Area Air Quality Management District, and BCDC.
- Baylands Ecosystem Habitat Goals Project. Published in 1999, the Baylands Goals are being updated to incorporate climate change and sea level rise.
- Change Hits Home: Adapation Strategies for the San Francisco Bay Area, 2011. San Francisco Planning and Urban Research Association.
- Living with a Rising Bay: Vulnerability and Adaptation in San Francisco Bay and on the shoreline. 2011. San Francisco Bay Conservation and Development Commission:

Tidal and Flood Protection Infrastructure

Most levees and berms in the corridor were built to withstand tides, not necessarily designed for major flood protection. Few, if any, are designed to, or meet, federal agency standards. Therefore, the term "berm" is used to identify these locally built, non-federal structures. The levees and berms in the highway 37 corridor study area are linear, mounded earthen structures created to restrict tidewaters and have been created and maintained for decades under a variety of weather and storm conditions. In addition, a series of tide gates (flap gates) and pumps exist in connection with the system of berms to manage the waters. The condition of these levees and berms varies due to the responsible party's ability to maintain them and the stresses brought to bear by recurrent storms and

constant, regular tidal and wind action. Pumps and levees/berms are old and in varying conditions, some in poor shape and others in good shape. Repair work is typically not eligible for emergency repair funds. The costs of maintaining the levee and pump infrastructure is borne by landowners in the region, including farmers, ranchers and other private landowners and federal, state and local government and nongovernmental organizations. (See Levee Map)

The highway as a structure, acts as a levee in some areas, reducing flooding of adjacent low-lying land, but is also vulnerable in places to storm flooding, partly because it's elevation is below projected sea levels. Highway 37 has not experienced any major levee failures or other dramatic short-term problems, but localized flooding does occur regularly during extreme high tide (9 feet or higher) and storm events. Currently the highway is closed less than 20 hours / year. However, the likelihood, extent, and precise location of flood occurrences are unpredictable due to several factors including storm duration, intensity, timing of tides, physical constraints in conveyance and because there is no current, accurate knowledge of the location, height, and strength of berms and levee-like structures.

There have been efforts to convert portions of the highway to a toll road and to widen the segment between Sears Point and Vallejo from 2 lanes to 4, but these efforts were unsuccessful. In the 1960s, a levee breach flooded the White Slough area of Vallejo and the U.S. Army Corps of Engineers repaired the damage and levee. When the levee failed again in 1977, the Corps declined responsibility for the levee repair, stating that it was the responsibility of the local landowners. This area rapidly converted to wetlands.

The California Department of Water Resources (DWR) is managing a statewide, county-by-county effort to map levees/berms and other similar structures as part of the California Levee Database (CLD) Overview. An initial meeting to begin Sonoma County's participation in the program was held in 2009, hosted by the Southern Sonoma County Resource Conservation District, with multiple agencies and landowners interested in participating and assisting with the mapping program. At present, it is unknown the status of DWR's current efforts in collecting county data, DWR has promised that a web-based levee profile viewer, levee information viewer, and technical resources viewer will be developed and released to public in the near future. Local landowners, organizations and agencies could benefit greatly from this.

The berms located in the Marin and Sonoma County portions of the highway 37 corridor are self-maintained by property owners where the annual maintenance activities are

performed subject to permit restrictions under a Regional General Permit, issued by the US Army Corps of Engineers. Maintenance work, if needed, is conducted in accordance with seasonal and locational restrictions that are sensitivity to endangered species habitat. Accurate GIS level spatial data on location and elevation of berms is not available. The Southern Sonoma County Resource Conservation District holds the Regional General Permit on behalf of 32 permittees.

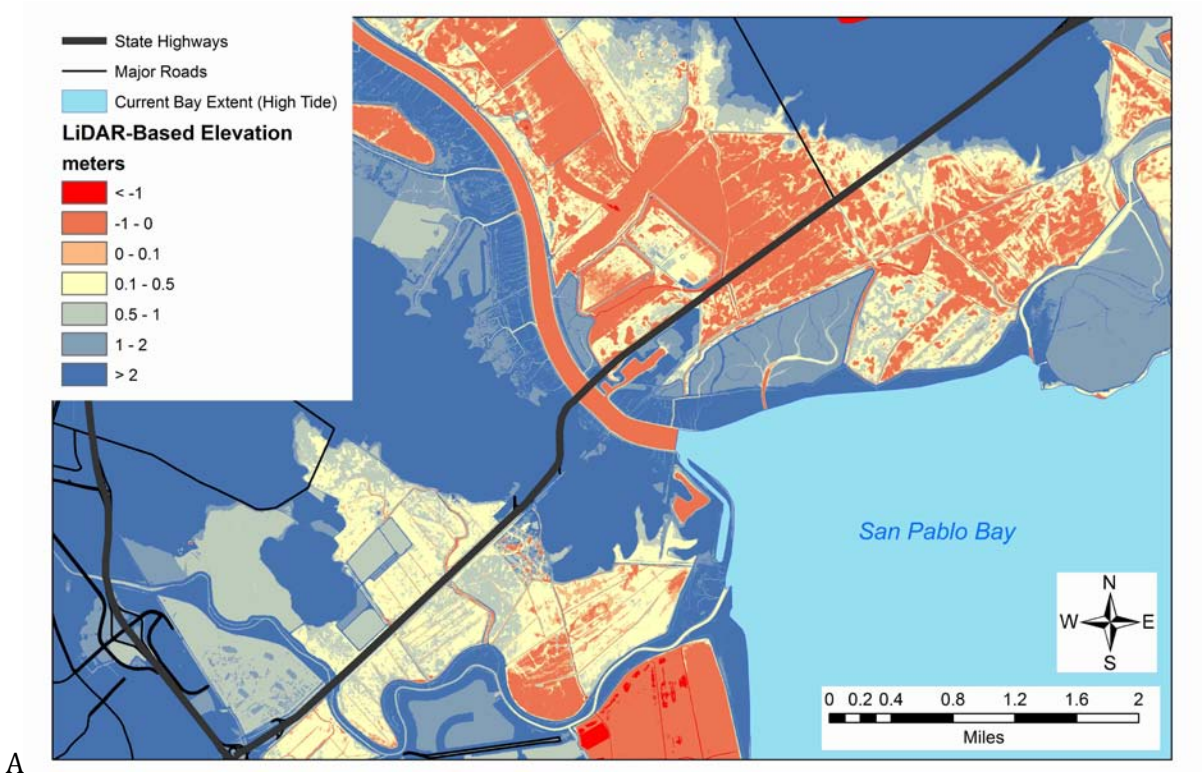
The study area's matrix of public and private flood protection infrastructure (roads, levees, pumps) supports privately owned property, but also provides flood protection to public and shared uses and activities, such as travel, recreation, business, residences, and agriculture. The relationships between private and public landowners are critical in being able to maintain access and flood protection collectively in the system for both private and public good. To some degree, the public benefits from uncompensated expenditures by property owners, public and private, who regularly maintain berms to prevent flooding. However, these landowners should not be expected to bear the full financial and legal responsibility for preventing flooding of infrastructure in a changing world. The costs of flood protection include levee maintenance, ditch cleaning to remove vegetation that slows movement of water to the pumps, pump maintenance and electricity to run pumps. In addition, some farmers have a portable diesel pump that used during major storms when the stationary pumps are insufficient to handle stormwater removal. Finally, some landowners, like SLT, stockpile sandbags on site to be used in the event of emergencies. Routine and emergency work needs vary for each property and as such, costs to the property owner are extremely variable. On-going costs for maintaining and operating pumps and gates are rising at a time when profits from farming are falling and public resource agencies have little or non-existent operations and management funds.

It would be very helpful for conservation planning, agricultural preservation, and infrastructure planning to have a legal analysis of who is responsible for protecting lands and public rights of ways against sea level rise, the legal repercussions for a landowner if a levee break on their property floods infrastructure on their property that is owned by another entity, and the legal repercussions for a landowner if a levee break on their property causes flooding for a landward neighbor, including state highway 37.

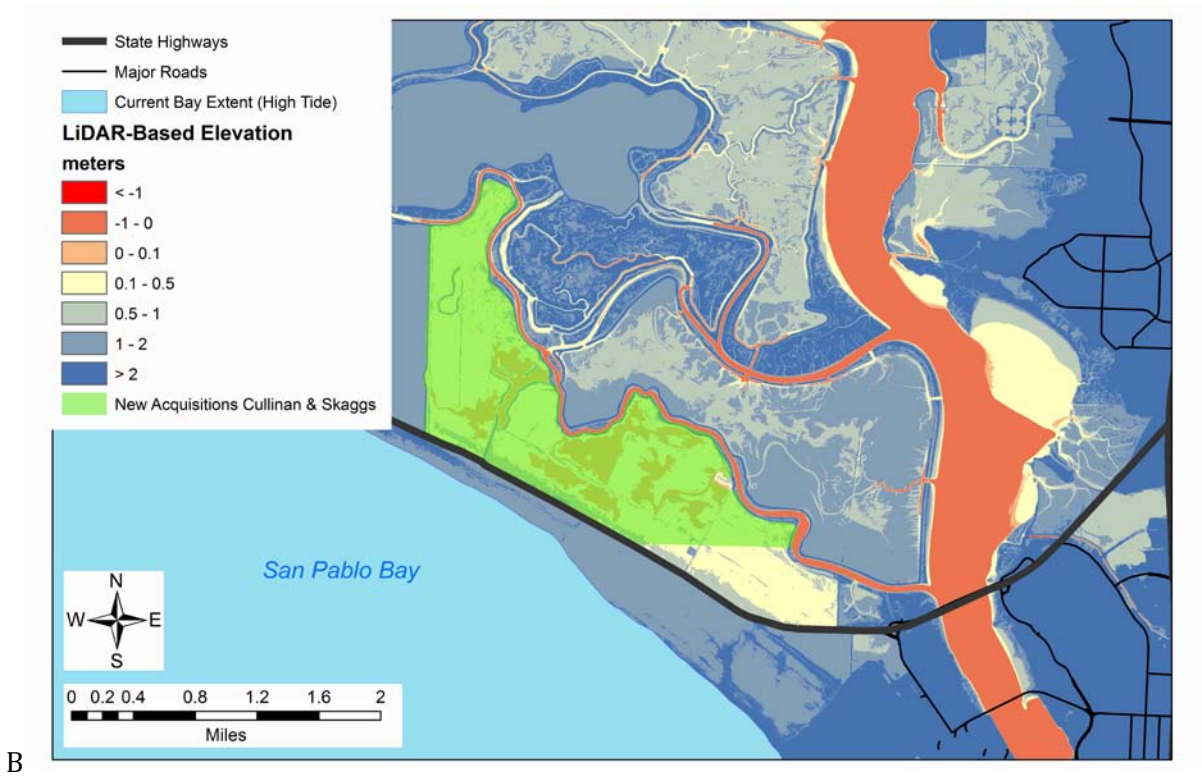
LANDSCAPE ELEVATION AND SEA-LEVEL RISE

One of the most critical environmental issues facing the highway corridor is sea-level rise due to anthropogenic climate change. As oceans expand due to overall global warming and as ice-sheets melt, sea level is expected to rise beyond the 8 inches already measured in the

Bay. This has consequences for both the highway as transportation infrastructure and as a levee buffering inland areas from tidal flux and future inundation.



A



B

Figure 2 Land elevation above mean sea level. (A) Highway 37 between the intersection with highway 101 and Sear's Point. (B) Highway 37 near Vallejo and Mare's Island.

Portions of the highway are actually below current mean sea level (Figure 2) and are protected by a series of privately and publicly-maintained levees (as described above). Climate change is projected to increase the frequency and severity of storms and flooding and cause sea level rise, all of which increase the chance that state highway 37 will temporarily fail at its current location and elevation. For example, at the western end of highway 37, there are stretches of the highway that are between current sea level and almost 1 meter below current sea level (Figure 2A). These stretches are protected by a combination of public and privately-maintained levees. At the other end of the highway, there is a well-known restoration site (Figure 2B, Cullinan Ranch) that is between 0.5 meter below and +0.5 meter above current sea level, where the highway is between 0.5 and 1 meter above sea level.

With continuing climate change, sea level rise in the San Francisco Bay is predicted to be approximately 0.5 meters higher by 2050 and 1.4 meters higher by 2100 (Knowles, 2010). Even the 0.5 meter rise will put considerable pressure on berms and levees, tidally-influenced marshes, and the highway prism itself along stretches exposed to the Bay (Figure 2B).

TIDAL MARSHES AND ECOSYSTEM SERVICES

Wetlands worldwide are experiencing significant losses and structural changes mainly caused by several anthropogenic factors related to population growth, urban development and expansion of economic activities. In addition, global disturbances such as climate change and its associated sea level rise are considered to be the other main factors that will alter wetland ecosystems. Due to their ecological and economic value, understanding how wetlands will respond to global sea level rise together with other anthropogenic disturbances has been identified as a scientific and management priority (Intergovernmental Panel on Climate Change, 2007).

The increasing demand for transportation infrastructure in the San Francisco Bay Delta Area is one example of management measures to be evaluated through a comprehensive analysis of what the impacts could be on wetlands. Current plans for widening Highway 37 are likely to affect the Napa-Sonoma tidal marsh ecosystem. Highway 37 traverses the southern boundary of the marsh in an east-west direction. Any expansion of the highway 37 footprint would require a significant amount of fill which would encroach on marshlands and affect marsh ecosystem functions and services. The goals of this section are to summarize the special characteristics of tidal marshes and to provide updated

scientific information regarding how the functions and services of these ecosystems would be compromised by infrastructure development and sea level rise.

THE NAPA-SONOMA MARSH – A THREATENED TIDAL MARSH ECOSYSTEM

The Napa-Sonoma Marsh is a complex of tidal marshes, sloughs, rivers and reclaimed marsh used as agricultural lands. It is located at the northern edge of San Pablo Bay and covers roughly 73 square miles (Madrone Associates 1977). This marsh has an area of 48,000 acres, of which 13,000 acres are abandoned salt evaporation ponds. The United States Government has designated 13,000 acres in the Napa Sonoma Marsh as the San Pablo Bay National Wildlife Refuge. The marsh is fed by Sonoma Creek, Tolay Creek, and the Napa River. Most of the marsh is only accessible by boat. Agricultural lands occupy almost half of the Napa Marsh and are largely reclaimed lands that support oats, hay and grains, and cattle and sheep. Salt production is the largest industrial use of the marsh, covering approximately 20% of the area.

The status of marshlands in the San Francisco Bay Delta Area has changed considerably. Around 1860, the Napa Sonoma Marsh was one of the most productive wetlands of the Pacific Coast, providing habitat for millions of birds. By the mid-1980s, the San Francisco Bay perimeter had lost over 91 percent of its wetlands. Approximately 85% of the original tidal marshes in the area have been lost due to creation of salt ponds, conversion to agricultural and industrial/urban use, and water diversion and management (Marshall & Dedrick 1994). Currently, the Napa Sonoma Marsh represents one of the few marshland areas where restoration is feasible and is actively promoted by the California Coastal Conservancy, the California Department of Fish and Game and the Point Reyes Bird Observatory.

THE NAPA-SONOMA MARSH – MAIN BIOPHYSICAL CHARACTERISTICS

The Napa-Sonoma marsh is an estuarine tidal marsh. This region shows an elevational gradient where differences in factors including tidal inundation, exposure, and salinity cause a pattern of zonation that is reflected by different vegetational associations. Depending on the salinity of the flooding water, there are areas of freshwater, brackish and saline tidal marshes. The marsh is also commonly zoned into low marshes (intertidal) and high marshes, each of them with different elevation and characteristic vegetation.

A major factor in the hydrological dynamics of the Napa Marsh is the tidal influence of San Pablo Bay (Madrone Associates 1977). Twice daily, the waters of the Bay extend into the marshlands flooding the mudflats, and enter the Napa River system with an influence that continues to a point about one-half mile above the City of Napa. Those portions of the Napa and Sonoma rivers which receive tidal flow can be considered estuaries, subject to exchange of fresh and saline waters. The Napa Marsh system receives freshwater inflow from three major streams that spread through Solano, Sonoma and Napa counties. However, when freshwater inflow is minimal, especially in dry weather, little circulation or flushing occurs in parts of the estuarine river system. Salinity in the marsh is a function of tidal influence, solar evaporation, precipitation and runoff.

The tidal marsh is one of the main habitats of the Napa Marsh complex. Tidal marshes are dynamic systems. Sub-habitats intergrade with one another, forming a dynamic continuum that is characteristic of tidal marshes. There are 5 sub-habitats: flowing water; standing water; lower marsh(less inundation occurs, Pickleweed dominates only the southern portion of the marsh where tidal influence and salinity are at their greatest, especially south of Highway 37, and west of Napa River); higher marsh (where tidal waters seldom reach, a foot higher than lower marsh, has more native herbs and grasses with dominant plants being Pickeweed and saltgrass); and marsh berms (low, naturally formed levees, their formation is due mostly to the deposition of sediment occurring with tidal action). Among all these sub-habitats, the higher marsh habitat outstands as a place to look for native plants and animals, including black rails, salt marsh harvest mouse, California vole. Also, a plant called narrow soft bird's beak (*Cordyzanthus mozlis*) endemic to San Pablo Bay and considered endangered is found in the high marsh. This species has drastically declined in numbers, generally from gradual reduction of its habitat in coastal salt marshes north of San Francisco Bay (Madrone Associates 1977).

The close interaction among hydrological regimes, soil characteristics and vegetation is what governs the maintenance, functions and services provided by tidal marshes. There could be cases of insufficient tidal flooding (due to restriction) or cases of excessive flooding (due to subsidence and sea level rise) tidal flooding.

EFFECT OF INFRASTRUCTURE ON MARSH ECOSYSTEMS

Artificial infrastructure, including roads or berms, has an impact on marsh hydrological regime by causing inadequate provision of tidal flows (Boumans et al 2002). Constrained flows hinder ecosystem functions by disrupting the natural interactions among vegetation, soil and hydrology. The lack of saltwater tidal exchange in restricted salt marshes has 1)

promoted spread of invasive species that are less tolerant to salt water; 2) restricted nekton distribution, 3) promoted the oxidation of sediment organic matter leading to subsidence or loss of elevation, and 4) decoupled the natural sedimentation process in marshes for tracking sea level rise.

Tidal flow restriction by infrastructure has a significant effect on marsh sedimentation processes. High bulk densities and low C and N concentrations were found at depth in flow-restricted marsh cores, which can be attributed to a period of organic matter oxidation, sediment compaction, and marsh surface subsidence upon installation of flow restrictions (between 100 and 200 years before the present, depending on the marsh). Recent sedimentation rates at flow-restricted marshes were positive and averaged 78% and 50% of reference marsh sedimentation rates.

In addition, other impacts of highway construction involve effects of runoff and more contaminants distributed to marsh systems nearby due to more transportation corridors. When sea levels rose during pre-modern times, tidal marshes gradually migrated into adjacent uplands. Today levees, development, roads, parking lots and other barriers prevent that movement, threatening the future of tidal marsh habitat and dependent wildlife.

In general, alterations in marsh geomorphology consist of a reversal of the hydrological and marsh building processes (Hartig et al 2002). Boumans et al (2002) showed that even after removal of flow restrictions the natural functions of marsh will not return to optimal conditions and should be managed with caution. They developed and applied the Marsh Response to Hydrological Modifications model (MRHM). An important conclusion of their simulations is that after partial or total removal of a tidal restriction, the tidal range will increase dramatically and may lead to extended inundation; therefore it is important to have an advanced knowledge of the tidal ranges expected after restoration.

EFFECT OF SEA LEVEL RISE ON MARSH ECOSYSTEMS

Analyses of tide gauges and bio-stratigraphic indicators worldwide suggest that the rate of sea level rise has doubled or tripled since the late 19th century, and will continue to accelerate throughout the 21st century. A mean global sea-level rise (SLR) of 1.8 mm/yr has been generally agreed to have occurred since the early 1900s. SLR will mainly cause coastal submergence scenarios, during which coastal wetlands may shrink, expand, or remain constant in area depending on sedimentation rates on the wetland surface in comparison with rates of submergence (Phillips 1986). Hartig et al (2002) correlated

accretion and mineral deposition rates with sea level rise to determine and compare historical sea level rise. They observed a long-term acceleration in accretion and mineral deposition rates that is remarkably similar to estimates of GSLR and temperature change. These findings indicate that a signal of climate change is discernible and unquestionable over a background of natural variability in wetlands studied.

Changes in the composition of the marsh vegetation assemblage and the consequent impacts on the marsh community are important effects of a sea level rise scenario. Under a rising sea level the more aquatic wetland types are likely to gain in extent as the intertidal zone becomes submerged. Thus, responses of wetland plant communities to sea-level rise include shifts from high marsh to low marsh, shifts from low marsh to coastal shoals and mudflats, and migration of marshes inland. Warren and Niering's (1993) study demonstrates that modest rates of sea-level rise, of even less than 3mm/yr can have a detectable and ecologically significant effect on salt marsh composition, high marsh being replaced by low marsh. Tidal flooding is the dominant force in determining species location in marshes (Bertness 1991). However, in lower regions of the marsh physical and chemical forces dictate the species composition, whereas higher up in the marsh inter-specific competition determines the plant community. All these species interactions are modified once coastal submergence take place due to SLR, being that it is also dependant on the extension and availability of types of habitat (Hartig et al 2002).

Sea level rise also increases salt water inundation and erosion affecting coastal wetlands and the wildlife they support. The primary mechanism of marsh loss due to SLR will be from formation of extensive interior ponds accompanied by general tidal bank erosion. Even though, tidal marshes require some sea level rise to maintain themselves as a self-regulating process, if marsh vegetation become inundated for more hours in the tidal cycle than can be tolerated, vegetation growth will not be sustained. Oxygen deprivation, root death and vegetative losses increases as sea level outpaces the ability of the marsh to maintain elevation. As these pools are enlarged over time, total biomass production by the marsh will be reduced. Some of this loss may be compensated by productivity of aquatic organisms. Additionally, while marshes can withstand wave action to a certain degree, erosion may escalate with more frequent storm surges superimposed on a higher sea level (Rosenzweig et al. 2008).

Stralberg et al (2011) presented an assessment of San Francisco Bay tidal marsh sustainability under different sea level rise scenarios. The draft on the State of California planning guidelines recommend planning for 0.41 m of rise in the next 50 years and 1.4 m in the next 100 year. The study evaluated eight scenarios by combining different levels of three factors: a) two levels of suspended sediment concentration (SSC); b) two levels of organic material accumulation (OM), and two rates of sea level rise (0.52 m and 1.65 m

per century (2010 to 2110). Their main conclusions indicate that under a low rate of SLR and intermediate SSC (100 mg/L), low marsh elevations would be sustained for 100 years, while mid marsh would last up to 80 years with high OM accumulation rates. Under a high SLR rate and intermediate SSC, low marsh elevation loss would be expected within 40 years. With 150 mg/L, mid marsh sustainability throughout the next century was projected for a low SLR rate; only low marsh with at least 2 mm/year OM accumulation would be sustainable under a high rate of SLR. At 200, 250, and 300 mg/L, mid marsh was sustainable under a high rate of SLR for progressively longer periods of time (up to 80 years with 300 mg/L SSC), but not over the full 100-year period. Higher OM accumulation rates (2–3 mm/year) would not extend sustainability for more than a 20- year period. Only under the most optimistic scenario (low SLR, high SSC), however, was mid marsh habitat projected to continue increasing until the end of the century, both in terms of currently tidal and potential restoration areas. The area of high marsh was projected to decrease dramatically over the next century across all scenarios examined – more than any other habitat type. Future (100-yr) spatial habitat projections for mid marsh were highly dependent upon SSC and SLR assumptions. Low marsh habitat was projected to increase—due to a combination of mid marsh loss in some areas and new habitat creation in others—under all scenarios except for high SSC and low SLR. In this case, the decrease represented primarily a conversion to mid marsh, as low elevation areas would continue to accrete sediment.

In the case of Napa-Sonoma Marsh the average of factors analyzed range between 100-150, 150-300 mg/L for SSC and 1-3 mm/yr for OM. The North Bay was projected to experience a net gain in mid marsh habitat by the end of the century under all scenarios

The authors of the study do recognize a level of uncertainty in the model considering that some factors as wave effect, storm projections and effect of vegetation are not included. These effects could imply some overestimation for the case of low marsh and underestimation for high marsh scenarios.

ECOSYSTEM FUNCTIONS AND SERVICES PROVIDED BY NAPA-SONOMA MARSH

Figure 3 provides a list of general functions and services provided by wetlands (Schuyt and Brander 2004). The different wetland types vary in function, contour, biota, tidal action, water quality, and in their respective contribution to the marine food chain. Wetland functions are the result of physical and biological processes and interactions. The main wetland functions that have global significance for the service they provide in tidal marshes are:

a. Biodiversity Support

The Napa-Sonoma marsh is a productive estuarine ecosystem providing habitat for a wide diversity of flora and fauna, including numerous rare endangered species and migratory species, many of which are attracted by the presence of water, high plant productivity and other habitat qualities. Special status mammals and water birds include the salt marsh harvest mouse, the California clapper rail and the black rail. Main endangered fish found are the Delta smelt, Sacramento splittail, steelhead trout, and Chinook salmon. Other aquatic animals include the endangered California freshwater shrimp, the Dungeness crab, and other benthic and planktonic invertebrates. Because of its bird diversity, the Napa Sonoma Marsh is one of only seven marshes selected for intensive study by the Point Reyes Bird Observatory (based on a total of 50 discrete marshes relevant to the San Francisco Bay).

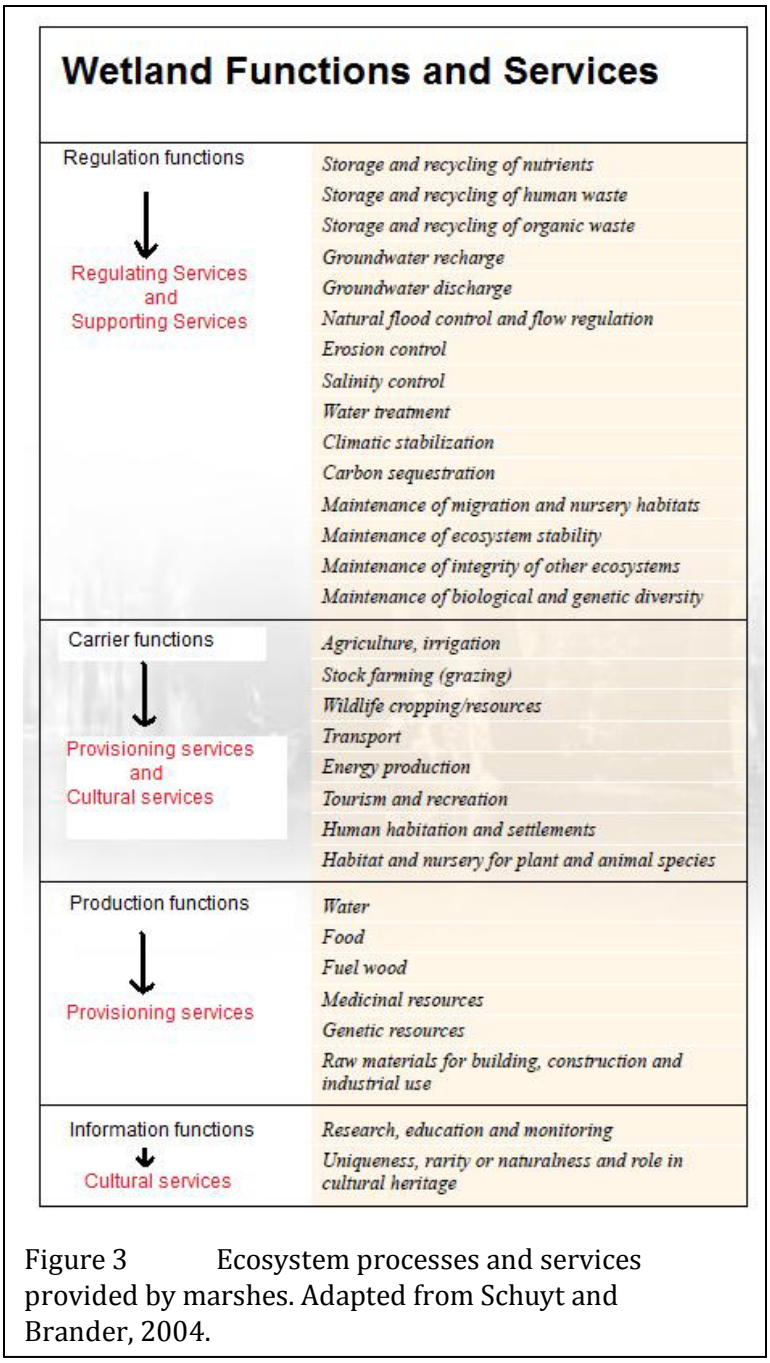


Figure 3 Ecosystem processes and services provided by marshes. Adapted from Schuyt and Brander, 2004.

b. Water Quality Improvement

Tidal wetlands improve degraded waters by recycling nutrients, processing chemical and organic wastes and capturing sediment loads; the cleansed water helps maintain aquatic organisms. These ecosystems undoubtedly provide water storage services and improved water quality in the Napa River and San Francisco Bay.

c. Disturbance regulation and protection

Marshes act like giant sponges, as they form a protective barrier for coastal urbanized areas, buffering buildings and transportation networks from wave impacts during storm surges. Marshes and floodplains are critical in mitigating flood damage, as they store large quantities of water, effectively reducing the height of flood peaks and the risk of flooding. Disturbance regulation saves high economic costs associated with flood damages in areas where wetlands are preserved and restored.

d. Carbon regulation and management

Thick layers of carbon-rich peat play a role in the global carbon cycle by binding poorly decomposed plant material into the substrate. The sequestration rate in wetlands is significant considering that carbon is buried in the sediment at rates up to 50 times higher than those observed on land, and these rates can be maintained for centuries or more.

e. Food-web and nursery habitat maintenance

The decomposed detritus from marsh vegetation contributes to the base of the food chain of estuarine and marine environments. The rich out flowing of dissolved nutrients, organic debris and invertebrate larvae, carried off by tidal currents, provide a food resource upon which many marine species, including commercially important fish. Anadromous fish, such as shad, sturgeon, salmon, steel head trout and striped bass use these areas year-round for feeding or during spring migration, and also use the area as a nursery ground during their juvenile stages (Madrone Associates 1977).

f. Recreation and cultural services

Public open and protected areas provide several recreation opportunities including fishing, bird watching, hunting and environmental education. Waterfowl species recreation and hunting is well-known in marshlands around San Francisco Bay.

Each of these tidal marsh services will have an impact when loss of marsh acreage occurs. Because hydrologic conditions define wetlands, any alteration of water volume (increases, decreases, or timing of high and low waters) threatens the area and integrity of wetlands (Zedler and Kercher 2005). And because the quality of the water further defines the type of wetland, increases in nutrient loadings (eutrophication) often threaten wetland integrity.

Due to the existence of several non-linearities in the quantification of ecosystem functions and services, the effect on specific services itself could show unexpected changes. For example, marsh drowning will result in an increase in un-vegetated intertidal habitat (i.e., mudflats), as will the inevitable erosion of low marsh habitat, especially along Bay margins. This may or may not counteract expected mudflat losses within the open bay but should at least provide new foraging habitats for shorebirds, waterfowl, and other waterbirds. Thus,

although the loss of vegetated marsh would have negative consequences for marsh dependent species, there are likely to be benefits for other species and services associated with these species including recreation, fishing and hunting. As a result, restoration and conservation planning in the face of SLR will necessarily involve an evaluation of ecological trade-offs, as is already the case for current restoration planning efforts.

AGRICULTURE

In Napa and Solano counties, agriculture is currently not prevalent as much of the lands have been or are being converted back to tidal marsh. In Sonoma County, lands along the corridor support agricultural cover in hay and grain, pasture for livestock grazing, and open space lands. Many of the open space lands continue to support agriculture as a component of managing and stewarding these working landscapes that are considered emblematic of Southern Sonoma County. Sonoma County is a "right to farm" county and sustainable agriculture is supported by multiple agencies, public sales tax measures, regional and countywide goals and policies.

Agricultural land uses along the corridor and in the adjoining watersheds of Petaluma River, Tolay Creek, Sonoma Creek, and Napa River (west to east) contribute importantly to the economy, industry, and identity of North Bay residents and to the "brand" of the Bay Area. The high quality oat hay, grain crops, and pasture lands form a supply loop that provide feed for livestock and food production in the North Bay region. Currently, the following grain crops are cultivated: triticale, wheat, barley, oats and oat hay, rye grass, and oat seed. Grassland pasture and grain produced in the corridor are purchased by local dairies and meat producers and therefore, hay producers grow specific crops and utilize methods for highest quality grain to meet local demands for livestock and equestrian feed and for high value milk, cheese, and meat products. This locally-produced seed and grain feedstock, which is fresh and used within the region, contributes to the local agricultural economies supply loop by supporting local dairies and feed for grazing livestock. Local cultivation helps minimize the carbon and ecological footprint that would otherwise be more significant if the grain products were mostly shipped out of the region or needed to be imported. Many of the agricultural lands in the region are farmed seasonally, with some vineyards and croplands flooded occasionally in winter during peak storm events. Vineyards contribute to the world class, premium wine grape industry featuring wines, food pairing, and growing agri-tourism, which is directly supported by Highway 37. Grain is farmed on both sides of highway 37 and safe access, use and crossing the busy highway with agricultural vehicles and equipment is a concern.

There is concern that increasing costs of doing business coupled with the challenges of maintaining berms for agricultural use and sea level rise in the vicinity will take agricultural acreage out of production. As previously implied, farmers and ranchers in the area, with their equipment, their rotational, sustainable grazing practices, their pumping know-how, and their presence (living on the lands they manage) are preserving the agricultural mosaic of the landscape. When balancing the needs of the corridor it is important to recognize that the diverse landscape mosaic can vary in space and in time. For example, it might work for the same piece of land to be flooded in winter and produce oat hay in the dry season. At least one local family is already operating in this manner.

An important stakeholder group in the corridor, the North Bay Agricultural Alliance, is active and engaged in a variety of issues affecting the land, it's uses, function, and the area's agricultural role. Membership is comprised of landowners (private and public agencies including CDFG, USFWS) and other stakeholders from Marin, Sonoma, Napa an Solano counties, representing over 50,000 acres in wetlands and agricultural uses.

COMMUNITY

Highway 37, as a transportation corridor is valued by the community. This was confirmed at stakeholder meetings conducted for this project (specifically the World Cafe held in October 2011) and is evidenced in various community documents. Statements concerning the Highway 37 corridor and the 12/121/116 route appear in the following General Plan documents:

<u>Sonoma County:</u>

- designates State Highway 37 as a scenic corridor and the surrounding lands as scenic landscape units. Highway 37 is identified as a Rural Principal Arterial in the Circulation and Transit Element.
- designates Class II bikeways forming a loop on highway 37, Lakeville Highway, Highway 116, and Highway 121. The bikeway designation calls for another transportation mode (likely recreational) on highway 37 which can be co-located with vehicles utilizing the future roadway corridor.
- supports work with Caltrans to make improvements to highways 37, 116 and 121
- reduce congestion.

Napa County

- Although highway 37 is not in Napa County, the General Plan discourages commuter traffic from passing thought the County on all roadways except I-80 and supports improvements to alternative facilities outside the County (e.g., specifically State Route 37).

Marin County

- Marin County has several funded and unfunded proposed transportation system improvements directly related to highway 37, indicating that this is an important and valued component of Marin County's transportation system.

RECREATION AND PUBLIC ACCESS

There are many opportunities for public access and recreation within the corridor, including hiking, fishing, hunting, wildlife observation and boating on public lands. Some elements are linked to regional systems, such as The Bay Trail and the San Francisco Water Trail. The Bay Trail, a planned recreational corridor that, when complete, will encircle San Francisco and San Pablo Bays with a continuous 500-mile network of bicycling and hiking trails. It will connect the shoreline of all nine Bay Area counties, link 47 cities, and cross the major toll bridges in the region. To date, approximately 310 miles of the alignment - over 60 percent of the Bay Trail's ultimate length - have been completed, including 8.1 miles along the Corridor. The San Francisco Bay Trail identifies a network of access sites that will serve non-motorized small boats such as kayaks.

CORRIDOR PLANNING AND PROCESS

In stakeholder conversations there was general agreement that planning efforts being conducted now should consider the long term needs of the region, particularly in terms of environmental benefits, congestion relief, and safety. Several other important aspects/values related the corridor have also been identified by local stakeholders including: open space and views, congestion relief, wildlife and habitat needs, viability and economic value of farms and ranches, value of roadway corridor in supporting economies in region and provision of key travel corridor linking jobs and housing, public access for education and recreation, adaptability of future facilities to meet future needs/conditions, wetlands and related functions, impacts on the regional transportation system, fiscal cost

and fairness, safety, multi-modal transportation demand, and community character. Many other important aspects of highway planning and detailed notes/discussion that warrant consideration throughout the planning process are included in meeting summary notes from October 4, 2011 (World Cafe).

In addition to long term needs, for the first several months of the project, many local stakeholders expressed a desire to work with Caltrans to develop and/or understand short term strategies, including emergency actions, in order to avoid expensive or irreversible actions that might be in conflict with long-term desired outcomes. For example, there is a recognized need to raise the roadway over Tolay Creek and, to a lesser extent, over Sonoma Creek, due to existing flooding and potential failure. It was hoped that proactive emergency plans could be put into place so that, in the event of major damage at these locations, Caltrans could rebuild the roadway in these locations consistent with long-term desired outcomes. However, through the planning process of this project we learned that—unfortunately—federal funding for emergency response prohibits any construction except to replace what was there prior to the emergency. We also learned that the current regulatory process may be a disincentive for Caltrans to develop proactive emergency response plans. There still remains a real and practical need to clarify responsibilities and determine informational and protocols needed to proactively prepare for emergencies and effectively respond to them.

Beyond these issues of short and long-term planning, many stakeholders participated in planning meetings and provided valuable comments and opinions throughout the project term. Summary notes from each meeting are captured in separate project documents and any future planning process should incorporated the valuable input of the stakeholders that were engaged in this process.

Ultimately, based upon review of stakeholder input to the project to date, it appears that most--but not all--stakeholders that have provided input would support a vision for the Corridor that protects and restores a complex landscape of tidal marshes, seasonal wetlands, upland habitats, and agriculture along a Highway 37 transportation corridor that is safe and well maintained. Nested within this vision are these goals:

- Protect the scenic, rural character of the landscape and create connections between protected lands.
- Restore and enhance the region's natural systems, focusing on tidal wetlands and riparian systems.

- Actively manage the land to protect and enhance natural values and biodiversity, especially for threatened and endangered native species, and to protect the significant cultural resources.
- Support sustainable local agriculture and healthy, working landscapes.
- Provide opportunities for public recreation, environmental education for all ages, and for activities that help the community develop and retain a connection to the land, this ecosystem, and their place within it.
- Provide a well-functioning transportation corridor to meet local and regional transportation demands.

It should be noted here that all identified stakeholder groups did not participate in this planning project. This could be for several reasons such as, difficulty with reaching certain stakeholders and the planning horizon for improvements to Hwy. 37 (as far out as 40 years). Among the specific stakeholders that the project team unsuccessfully sought input from were community members, especially from the city of Vallejo. This city is predominantly working class and includes large communities of color. Their perspectives on agricultural lands, transportation, and the environment might have been quite different that the views that tended to predominate in the meetings.

The team was partially successful in including several of the regulatory agencies that will ultimately need to review project designs and plans and consider issuance of project permits. Early input was sought from these agencies in the hopes of informing a better project outcome. Representatives from many of the regulatory agencies participated in several meetings. However, they did express difficulty in appropriating time, energy and ideas to a planning process with such a long planning horizon.

Based upon conversations with some regulatory staff, several stakeholders have concerns about the ability of regulatory agencies, or some regulatory agencies, to support innovative, pro-active planning. The prospect of returning tidal action to thousands of acres of the North Bay should galvanize natural system agencies. Theoretically, strong support from regulatory agencies willing to partner with Caltrans should make it easier to plan a highway that incorporated tidal restoration. We believe that regulatory agencies should actively engage in proactive planning and partner with Caltrans to remove barriers to restoration and incentivize a re-imagined highway. The goal of regulation should be to create a better habitat-landscape, not to retain today's remnant habitat fragments. If regulators can actively support a re-imagination of the highway, they will be part of an historic opportunity to meet important restoration goals related to tidal marsh restoration

in the North Bay. Unless there is compelling environmental support for a new and better Highway 37, scarce highway construction dollars are likely to flow to highways with more traffic that are at high risk of flooding.

ISSUES SPECIFIC TO THE STATE HIGHWAYS 12/121/116 CORRIDOR

One of the alternative scenarios for Hwy 37 is co-alignment of Hwy 37 with an existing route (Hwy. 580 or Hwys. 12/121/116) and strategic demolition of the current Hwy. 37 infrastructure. Caltrans' models show that if the current alignment of Highway 37 was closed down, the large majority of traffic would flow onto Interstates 80 and 580. However, the small portion of traffic that would flow onto Highways 12/121/116 would still be a large increase for those highways and neighboring communities where congestion already exists and is predicted to increase into the future. Local communities recognize existing and future congestion of highways 12/121/116 and despite congestion, are opposed to expanding the corridor. However, these communities were not posed with the question of whether or not they would support re-alignment of the highway if it brought about recovery of the Napa Sonoma Marsh complex. Highways 12/121/116 are already very busy, serving visitors, commuters, local businesses, including vineyards and wineries, and residents. The economic value of this collection of east-west highways is precisely in its rural character. If this series of highways were transformed into wider, faster, commuter-oriented, access-limited highways, the surrounding communities and economies would be harmed. This is recognized in Napa County, for example, as evidenced by the preferred response to traffic increases, which is, not to expand capacity, but to let the congestion reduce traffic by discouraging use and by encouraging use of the existing highway 37. It is hard to tell if this preference acknowledges the impacts experienced by the communities adjacent to I-80 and highway 37, such as Vallejo, who's backyard does experience large volumes of commuter traffic.

Sonoma and Napa Counties' general plans describe, as one of their top few objectives, retaining the rural and agricultural character of their communities. It is also important to note that the highway 12/121/116 route is already vulnerable to flooding and in its existing state would not provide a reliable transportation route for east-west travel.

The majority of participating stakeholders in this project, recognized the values inherent in a restored and functioning Napa-Sonoma Marsh, but were opposed to the co-alignment strategy for carrying out this restoration. Stakeholder concerns included traffic impacts to adjacent roadways, opposition from northern landowners, and safety concerns. It was recognized that any further investigation of this option would need additional study regarding impacts to the regional transportation network, and an examination of the costs for enhancing other roadways to address increased traffic. A minority of stakeholders expressed some support for a co-alignment option.

Corridor Configuration Recommendations

Stakeholders were provided with a range of options for modifying Highway 37 including:

1. No Highway Expansion: Manage the corridor with maintenance and repair activities and minor operational improvements (no significant change in the footprint or capacity)
2. Expanded Footprint: height and width of the corridor through the marshes would double and the corridor would be expanded to 4 lanes to address current and projected future traffic volumes
3. Napa-Sonoma Causeway
    a. Option 1 - over existing footprint at areas of low elevation
    b. Option 2 - across San Pablo Bay btw Novato & Vallejo
4. Strategic Co-alignment: corridor between Vallejo and Novato would be co-aligned with I-80 and 580 to the south, or with Highways 29 and 12/121/116 to the north. Current highway 37 infrastructure would no longer be maintained as a highway corridor.
5. San Pablo Bay Tunnel: corridor would be routed through a tunnel at the shortest feasible distance between the Vallejo area and the Novato area San Pablo Bay Tunnel

The majority of stakeholders participating in the process agreed that a causeway, which may include 4 lanes, is a good strategy for the corridor (approximately between Sears Point and Vallejo). For the western segment (approximately Highway 101 to Sears Point), participants also discussed a variety of strategies, leading to our conclusion that it may be best to consider each segment and what options best serve the values related to that stretch of the highway. There was some stakeholders that suggested that elevating the roadway (with a low slope gradient) in certain portions could be feasible, and that there could be notches, hydraulic gates, or culverts that could help manipulate tidal flows. There was not consensus regarding a bridge across San Pablo Bay, a tunnel, or co-alignment of the road (which was true of all scenarios). Response for these strategies varied greatly. Highway 37 is an important regional highway in terms of roadway travel and for commerce and economic vitality in the North Bay region, and in some cases, acts as a berm to protect land from flooding. In addition, stakeholders noted that the experience of the drive, provides fantastic aesthetics in terms of views and sightings and promotes appreciation of

the wetland and agricultural landscapes characteristic of the area. It is extremely environmentally sensitive and vulnerable to rising tides, so doing nothing was not supported by stakeholders. Stakeholders uniformly expressed concern about the sluggish planning process and some suggested that one way to accelerate the timeline is to consider the option of a toll road, allowing a private party or establish a public/private partnership to fund construction improvements, causeway or bridge elements. Stakeholders noted that historically, the original roadway was operated via toll. Other stakeholders pointed out that with limited alternative routes, as advocated by Napa County, a toll road may be unfair and potentially illegal because it would force commuting service and commercial workers to pay a daily toll.

Stakeholders in the February 10, 2012 meeting said:

We need to be aware that by not doing something, we can be missing important opportunities. Resource agencies and conservation organizations are implementing restoration projects constrained by the highway and railroad location and their vulnerability to flooding. There are significant efficiencies associated with coordination of restoration and transportation projects, but would not be doing this if railroad and highway were co-located. Therefore, inefficiencies and wasting of monies may occur if we wait too long to take action.

Corridor planning should include feasibility of other transit options, HOV lanes if widening, and consider freight as a component in roadway uses. Stakeholders expressed need to acknowledge the fact of people's personal choices in terms of where we live/work/commute/play and routes for regional travel. Often there is value placed on travel on a 2-lane highway and/or on one that provides such positive aesthetics and connection to the natural environment.

Recommendations for Corridor Planning

There are many miles of highway in the Bay Area at risk of flooding due to sea level rise. The highway 37 project could help inform transportation planning since the Bay Area can expect to see many similar projects in the future. We suggest making a presentation about the highway 37 corridor planning process to all or some of the members of the Joint Policy Committee (Bay Conservation & Development Commission, Association of Bay Area Governments, Metropolitan Transportation Commission). The corridor planning process is inherently long-term and considers multiple strategies. Building political support is key.

Developing a realistic timeline for planning, alternatives review, design and fund development needs to be addressed.

Valuation and crediting, by whatever name, should account for the following:

- indirect or third-party impacts, positive or negative, including the effects of scenarios on publicly and privately owned or operated levees and pumps,
- foregone opportunities; e.g. the opportunity to restore Baylands that is lost if the highway is elevated on a levee, the economic activities that are affected if the current highway infrastructure is abandoned and the highway is co-aligned with an alternate route,
- a scenario in which no physical change is made to the highway overall, but Caltrans reduces flood risk by shouldering some of the cost of operating and maintaining private levees and pumps (possibly by buying land) and/or raising the highway where it crosses Tolay Creek.
- socio-economics, agricultural-economics, and commerce (including industry, business and eco-tourism) supported by the transportation corridor, including jobs/housing balances and corridor planning. Economics can become the driver on many issues, so need to incorporate data and analysis as fundamental step in corridor planning.
- loss or gain of agricultural operations and related requirements, such as maintaining berms
- ecotourism benefits or dis-benefits of various scenarios
- non-motorized access for travel and for recreation
- effects on ecosystem services and benefits

So far, the project has not engaged low-income people who might be affected by changes to highway 37, particularly people who live in Vallejo and use the highway to get to work. In our experience, the project team will need to research and attend existing meetings of the individuals and organizations serving these populations. They are unlikely to attend, or participate fully, in the larger stakeholder meetings that the project has conducted so far.

Many stakeholders expressed the following points of view:

- Overall, the stakeholder process has been positive and productive in engaging folks in a more collaborative conversation.
- Some stakeholders should have been involved more and earlier, such as business, agriculture, local communities and commuters.
- The planning process needs more information about whom the corridor serves, why and when people use it, and need to know this before we assume a public transportation option is warranted or planned. Current use data is important and various options and suggestions were made to capture this.
- The project needs a diversity of methods to reach stakeholders (such as tabling at events). The UC Davis online survey provoked many questions by stakeholders. Some questioned its usefulness in terms of who the sample group was, and incorrectly noted that businesses and typical roadway users were not queried. The people randomly contacted for the survey included local businesses.

Other stakeholders recommended:

- That the planning process coordinate with the Blueprint and with SR 29 corridor planning,
- That the Association of Bay Area Governments land-use projections be vetted before assuming that they should be the basis for traffic projections.

The Federated Indians of Graton Rancheria asked for a government-to-government relationship with Caltrans during corridor planning. This meeting did not take place.

MITIGATION

This section contains recommendations related to maximizing the environmental benefits of the built project.

Some members of the team saw many options for a project that could provide ground-breaking environmental benefits. Maximizing environmental benefits will require planning discussions with some of our organizations, since we are working on these issues and locations already.

From an environmental review perspective, the project should be evaluated based on the net improvement it provides in environmental values. The project may have substantial short-term negative impacts, but for all scenarios, the long-term environmental benefits, if any, should be considered and in some cases those long-term benefits may far outweigh any short term impacts. In addition the project should be evaluated against current conditions.

Some possible mitigation avenues to pursue are listed here:

- Floodplain and Bayland enhancement, and wildlife habitat connectivity, as part of watershed-wide multi-benefit projects. Numerous parties in all affected counties are in the process of designing multi-benefit water projects for funding by the Department of Water Resources through the Bay Area Integrated Regional Water Management Plan.
- Choose transportation scenarios that reverse, avoid and minimize impacts to the Bay, mudflats, marshes, sloughs, endangered habitats and species, and communities
- Spend stewardship money on actions consistent with the objectives put forth by the San Francisco Bay Joint Venture, Baylands Ecosystem Habitat Goals, Conservation Lands Network, FOCUS and other consensus plans for the region.
- Repair fish passage barriers, including those created by Caltrans' own infrastructure. Plant along streams or for other bird or animal habitat.
- Fund fish counting projects. The streams crossing under Highway 37, in general, support several protected species of fish, yet it has been impossible to find grant funding to determine their diversity or numbers.
- Conduct habitat enhancement on agricultural properties. For example, install bird boxes for a variety of species or implement riparian restoration projects.
- The north Baylands are unique in the bay region, and provide bay-wide benefits. It may be possible to enhance mitigation resources for the North Bay by using mitigation money from projects around the bay.

Other recommendations arising from this project

Over the years, it has been difficult to know how local organizations conducting natural resource work can engage productively with Caltrans. We hope to leverage the highway 37 project to improve partnerships with Caltrans and thereby improve long-range decision-

making. We suggest a conversation with Caltrans Headquarters and District 4 related to the following:

- Provide guidance on how locals organizations can remain engaged with Caltrans after this project ends, particularly considering the rapid turnover of Caltrans staff.
- Find ways for Caltrans' environmental decisions to be made with more detailed, local, current information. For example, how does an infrastructure agency decide when less infrastructure actually gives more benefit? who keeps lists of potential mitigation projects or project proponents? How are projects submitted?
- Explore initiating and supporting an ongoing meeting of multiple regulators with multiple North Bay organizations, to see that mitigation funds go to the best use and permitting decisions are informed. Marin County may serve as a model.

CITATIONS

Boumans, R. M., D. M. Burdick, and M. Dionne. 2002. Modeling habitat change inn salt marshes after tidal restoration. Restoration Ecology 10 (3): 543-555.

Costanza R, d'Arge R, de Groot R, Farber S, Grasso M, et al. 1997. The value of the world's ecosystem services and natural capital. Nature 387: 253–260.

Craft C, Clough J, Ehman J, Joye S, Park R, et al. 2009. Forecasting the effects of accelerated sea-level rise on tidal marsh ecosystem services. Front Ecol Env 7:73–78.

Fallon, D. and F. Mushacke. 1996. Tidal Wetlands Trends in Shinnecock Bay, New York 1974 to 1995. Division of Fish, Wildlife and Marine Resources, New York State Department of Environmental Conservation, East Setauket, NY, USA

Hartig, E.K., Gornitz, V., Kolker, A., Mushacke, F. and D. Fallon (2002). Anthropogenic and Climate-Change Impacts on Salt Marshes of Jamaica Bay, New York City. Wetlands 22(1)71-89.

Hartig, E.K., F. Mushacke, D. Fallon, and A. Kolker. 2000. A wetlands climate change impact assessment for the metropolitan East Coast region. Draft for public review. http://metroeast_climate. ciesin.columbia.http://metroeast_climate.ciesin.columbia.edu/reports/wetlands.pdf

Koch, E. W., E. B. Barbier, et al. (2009). "Non-linearity in ecosystem services: temporal and spatial variability in coastal protection." Frontiers in Ecology and the Environment 7(1): 29-37.

Kolker, A.S., M. Kirwan, S. Goodbred and J. Cochran. 2010. Global climate changes recorded in coastal wetland sediments: Empirical observations linked to theoretical predictions. GEOPHYSICAL RESEARCH LETTERS, VOL. 37, L14706, doi:10.1029/2010GL043874.

Kirwan, M. L., A. B. Murray, et al. 2008. "Temporary vegetation disturbance as an explanation for permanent loss of tidal wetlands." Geophys. Res. Lett. 35(5): L05403

Kirwan, M. L. and G. R. Guntenspergen. 2010. "Influence of tidal range on the stability of coastal marshland." J. Geophys. Res. 115(F2): F02009.

Kirwan, M. L., G. R. Guntenspergen, et al. 2010. "Limits on the adaptability of coastal marshes to rising sea level." Geophys. Res. Lett. 37(23): L23401.

MADRONE ASSOCIATES Environmental Consultants. 1977. Natural Resources of Napa Marsh. Assisted by: James Michaels, Wildlife Biologist Region 3, Department of Fish and Game Under Contract to: California Department of Fish and Game.

Kazimierz Więski, Hongyu Guo, Christopher B. Craft, Steven C. Pennings. 2010. Ecosystem Functions of Tidal Fresh, Brackish, and Salt Marshes on the Georgia Coast. Estuaries and Coasts 33:1, 161-169

LSA Associates Inc. 2007. Solano HCD 2007 (Working draft). Solano County Water Agency.

Marshall, J.T. and K.G. Dedrick. 1994. Endemic Song Sparrow and Yellowthroats of San Francisco Bay. Pp316-327 in N.K. Johnson & J. Jehl (eds.), A Century of Avifaunal Change in Western North America. Studies in Avian Biology 15.

Park R, Trehan MS, Mausel PW, Howe RC. 1989. The effects of sea level rise on U.S. coastal wetlands. U.S. EPA Office of Policy, Planning, and Evaluation. Available: http://www.epa.gov/globalwarming/ climatechange/effects/downloads/rtc_park_wetlands.pdf. Accessed 2011 June 03.

Peterson CH, Able KW, DeJong CF, et al. 2008. Practical proxies for tidal marsh ecosystem services: application to injury and restoration. ADVANCES IN MARINE BIOLOGY, VOL 54, 221-266.

Rosenzweig, C., D. Karoly, M. Vicarelli, P. Neofotis, Q. Wu, G. Casassa, A. Menzel, T.L. Root, N. Estrella, B. Seguin, P. Tryjanowski, C. Liu, S. Rawlins, and A. Imeson, 2008: Attributing physical and biological impacts to anthropogenic climate change. *Nature*, 453, 353-357

Schuyt K, Brander L. 2004. The Economic Value of the World's Wetlands. World Wildl. Fund, Gland/Amsterdam, Neth. 32 pp

Stralberg, D., M. Brennan, et al. (2011). "Evaluating Tidal Marsh Sustainability in the Face of Sea-Level Rise: A Hybrid Modeling Approach Applied to San Francisco Bay." PLoS ONE 6(11): e27388.

Warren, R. S. AND W. A. Niering. 1993. Vegetation change on a Northeast tidal marsh: Interaction of sea-level rise and marsh accretion. Ecology 74:96-103.

Zedler JB, Kercher S. 2005. Wetland resources: status, trends, ecosystem services, and restorability. Annu Rev Env Resour 30: 39.

APPENDIX 5: DESCRIPTION OF HIGHWAY 37 FUTURE SCENARIOS

SR 37 SCENARIO	Relative Cost *	Construction-Related Activity	Traffic Operations Impacts	Regional Transportation Impact	Community Impacts	Environmental Impacts
A) No Highway Expansion *Manage the corridor with maintenance and repair activities and minor operational improvements (no significant change in the footprint or capacity)*	$$	• Maintenance issues / landscape control • More emergency response / repairs from flood events and eventual sea level rise	• Existing congestion queues worsen at bottlenecks (121 and Mare Island) from increased demand • More frequent road closures from floods/emergency repair • Some congestion relief at 121 if operational improvements made at this intersection independent of any broader 37 corridor improvements	Maintenance of existing rates of change in congestion, periodic flooding-based displacement of traffic to 80/580 (majority) and 12/116	Feeling that infrastructure is falling apart and being swallowed by bay. Continued impact to Vallejo and Novato from traffic noise and emissions.	Very large missed opportunity for restoration. Continued impacts to marsh and other habitats. Inhibition of hydraulic connectivity of marshes to Bay; failure to adapt to sea-level rise.
B) Expanded Footprint *height and width of the corridor through the marshes would double and the corridor would be expanded to 4 lanes to address current and projected future traffic volumes*	$$$	• Construction staging areas; may bring construction materials by barge or by existing roadway. Need at least 50' on each side for construction access. • Dredging for fill material • Dig out mud, build up embankment with rock and fill material • Discharge prevention activities from construction area • No temporary alignment needed; put traffic on one side of road while building the other side.	• Congestion relief at 121 and Mare Island with upgrade to 4 lanes between those points; assumes operational improvements at connections. • Local road access retained, assumes upgrades to local road connections.	Temporary drop in congestion (10 years) on highway, then continued increase, potential attraction of 80/580 and 12/116 traffic and thus increase in traffic on 37	Increased impact to Vallejo and Novato from traffic noise and emissions (minor).	Makes marsh restoration more difficult and expensive in future. Increased impacts to marsh and other habitats. Inhibition of hydraulic connectivity of marshes to Bay.
C) Napa-Sonoma Causeway *Option 1 - over existing footprint at areas of low elevation Option 2 - across San Pablo Bay btw Novato & Vallejo*	$$$$	• Construction staging areas; may bring construction materials by barge or by existing roadway. Need at least 50' on each side for construction access. • Build tressle; causeway built along existing alignment • Piledriving of main supports and falsework piles • Removal of old alignment segments • Discharge prevention activities from construction area	• Option 1 – Congestion relief at 121 and Mare Island with upgrade to 4 lanes between those points; assumes operational improvements at connections. • Local road access retained, assumes upgrades to local road connections. • Option 2 – Access to 121 and Lakeville broken; local access to SR 37 disrupted • Congestion relief at 121 and Mare Island with upgrade to 4 lanes between those points; assumes operational improvements at connections.	Temporary drop in congestion (10 years) on highway, then continued increase, potential attraction of 80/580 and 12/116 traffic and thus increase in traffic on 37	Unknown positive impact of improved habitat quality, such as ecotourism. Increased impact to Vallejo and Novato from traffic noise and emissions.	Allows bay water back into former baylands and restoration of large natural areas; which creates buffer against sea level rise and storm surge. Improves opportunities for and effectiveness of marsh restoration.
D) Strategic Re-alignment *corridor would be re-aligned away from marshes & wetlands between Vallejo and Novato, with I-80 and 580 to the south, or with Highways 29 and 12/121/116 to the north*	$/$$	• Cooperative agreement and legislation possibly needed to coordinate relinquishment of old alignment • Removal of old alignment segments	• Increased traffic on alternative routes could result in demand for traffic relief projects along those routes • Local decision to keep portions of existing roadway intact for local uses	Increase in traffic displaced to 80/580 (major) and 12/116 (minor), then continued increase	Potentially degrades rural character of communities on 12/121/116 due to increased traffic (noise, emissions). Potential economic harm to commuters from increased travel time and to certain local businesses without through traffic on former SR 37. Unknown positive impact of improved habitat quality, such as ecotourism. Reduced noise and emission impacts to Vallejo and Novato.	Allows bay water back into former baylands and restoration of large natural areas; which creates buffer against sea level rise and storm surge. Improves opportunities for and effectiveness of marsh restoration.
E) San Pablo Bay Tunnel *corridor would be routed through a tunnel at the shortest feasible distance between the Vallejo area and the Novato area*	$$$$$	• Construction staging areas; may bring construction materials by barge or by existing roadway. Need at least 50' on each side for construction access. • Bay fill/soil removal • Dam needed to keep water out of above-ground construction activities. Dig tunnel alignment from above, then cover it up and restore after construction. • Removal of old alignment segments	• Congestion relief at Mare Island with upgrade to 4 lanes at that point • Access to 121 and Lakeville broken; local access to SR 37 disrupted	Temporary drop in congestion (10 years) on highway, then continued increase, potential attraction of 80/580 and 12/116 traffic and thus increase in traffic on 37	Unknown positive impact of improved habitat quality, such as ecotourism. Reduced noise and emission impacts to Vallejo and Novato.	After construction, allows bay water back into former baylands and restoration of large natural areas, which creates buffer against sea level rise and storm surge. During construction, inhibition of hydraulic connectivity of marshes to Bay.

* Relative Cost is on scale of $ to $$$$$; cost is relative to other scenarios and is meant to include ongoing operation & maintenance cost.

Scenario D (Strategic Realignment) is undefined in terms of necessary improvements.

APPENDIX 6: DETAILED TRAFFIC DEMAND AND NOISE MODELING METHODS

UC DAVIS
UNIVERSITY OF CALIFORNIA

Caltrans

APPENDIX 6: DETAILED TRAFFIC DEMAND AND NOISE MODELING METHODS

Prepared by UC Davis (Fraser Shilling and David Waetjen) for the Strategic Highway Research Program – 2, Transportation Research Board

TRAFFIC MODELING SUMMARY

The Marin County Travel Demand Model was used to estimate traffic volumes for the year 2035, for different scenarios for highway/state route 37 (SR 37). The model was used to provide various outputs (AADT, directional peak hour volumes, truck %, truck volume, volume/capacity ratio) for 2010 and 2035 by route segments as defined in the Draft SR 37 Corridor Plan. The purpose of these Travel Demand Model (TDM) outputs is to inform the SR 37 Stewardship Study and a subsequent update of the Draft SR 37 Corridor Plan.

For this exercise, 2035 forecasted volumes for SR 37 were provided for the existing facility configuration as well as a possible future four-lane freeway facility for the entire corridor length. In addition, a 2035 model run was performed with existing SR 37 removed from the model network west of SR 29 (to simulate a realignment of SR 37 along existing highway route alternatives because of rising sea level). For this scenario, 2035 volumes were provided for key highway segments that provide an alternative to east-west travel on SR 37.

INTRODUCTION & METHODS

Travel Demand Model Capabilities and Limitations

Results from a Travel Demand Model, as was conducted here, are for use in high-level planning analyses of long-term improvements, and do not represent comprehensive analysis of existing and future traffic conditions within a travel corridor. Travel demand models have specific analytical capabilities, such as the prediction of travel demand and general representation of traffic flow in a regional highway network. They use mathematical models to forecast future travel demand based on current conditions and future projections of household and employment characteristics. They are not designed to evaluate system management strategies, such as intelligent transportation systems (ITS) or specific operational improvements.

Average Annual Daily Traffic, Peak Hour Traffic and Volume-to-Capacity Ratios

Average Annual Daily Traffic (AADT) is a typical TDM performance measure showing the total number of vehicles that traverse a segment of highway for a year divided by 365 days.

As a result it averages out seasonal variations in traffic volume, providing a general indicator of the volume of traffic accommodated by the highway segment. Another typical TDM performance measure is peak hour traffic, which shows the highest number of vehicles that traverse a highway segment during the single hour of highest peak traffic (usually noting if it is the AM or PM peak hour).

A vehicle-to-capacity (V/C) ratio compares the actual or projected number of peak hour vehicles shown to be travelling through the mainline highway lanes against the assumed full capacity of the same mainline highway segment. For example, a typical freeway lane is often assumed to accommodate 2,000 vehicles per hour per lane, so a 2-lane freeway would have a full capacity of 4,000 vehicles per hour. If that freeway had 3,150 vehicles per hour, it would be operating with a V/C ratio of 0.79. Any highway segment with a V/C ratio under 1.0 is assumed to operate under full capacity on a typical day. This does not necessarily mean there is no congestion or operational problems, just that the amount of travel demand is less than its theoretical capacity. While any V/C ratio over 1.0 is not physically possible, in a TDM output this simply represents a theoretical traffic demand beyond the full capacity of the highway segment.

An important limitation in any V/C-based TDM assessment is the assumption that traffic stays in the same distribution across commute times. In reality, people shift their travel times and travel mode choice based on experience in high traffic conditions (and the availability of travel alternatives). More detailed and comprehensive corridor analysis is possible using more complex operational and transportation/land use models. However, this level of additional analysis requires a great deal more time and resources than is available for the SR 37 Stewardship Study and most Caltrans long-range system planning assessments. As a result, the AADT and V/C ratios presented here should be taken as high-level indicators of traffic volume and travel demand, not as firm numbers based on a detailed operational analysis.

FINDINGS

Comparison of traffic volumes and V/C ratios for existing facility and four-lane freeway alternative

2010 volumes for SR 37 are highest in Vallejo (Mare Island to I-80) where the route is already a four-lane freeway. V/C ratios approach full capacity (0.96) eastbound in the afternoon from Mare Island to Vallejo (Segment C), as well as 0.95 in the 2-lane conventional highway segment from SR 121 to Mare Island (Segment B). This high demand combined with key bottlenecks at SR 121 and Mare Island are the primary causes of

recurrent congestion in these areas. 2010 V/C ratios do not go above 0.55 in the segment between US 101 and SR 121, confirming the relative lack of SR 37 traffic problems related to travel demand in the Novato area.

2035 volumes on existing SR 37 are expected to increase an average of 48% over 2010 volumes. With the existing facility configuration, 2035 V/C ratios are well above full capacity both directions during both peak periods in the two-lane segment B (between 1.07 and 1.79) Segment C will also be above full capacity in the afternoon peak in both directions (between 1.06 and 1.25). Only Segment A remains below full capacity in 2035 (0.44 to 0.89). The 2-lane conventional highway segment combined with existing bottlenecks make this segment simply unable to accommodate expected future traffic volumes.

2035 volumes on SR 37 are forecast to increase 58% over existing 2010 volumes if SR 37 were a four lane freeway for its entire length. V/C ratios drop significantly in Segment B where the most significant facility upgrade occurs (from 2-lane conventional to 4-lane freeway). The forecasted V/C ratio falls to between 0.5 to 0.88 in the eastbound afternoon peak as a result of new capacity accommodating expected traffic increases and assumed elimination of traffic bottlenecks. In Segments A and C, V/C ratios remain very similar to the 2035 existing facility forecasts. Expected traffic problems on Segment B are addressed with a four-lane freeway upgrade at the expense of attracting additional traffic volume to the upgraded facility.

<u>Comparison of traffic volumes and V/C ratios for key SR 37 alternative routes with and without SR 37</u>

A 2035 model run was performed with SR 37 removed from the model network west of SR 29 (to simulate the realignment of SR 37 along existing highway route alternatives because of rising sea level). The results are shown in Table 1 are for key highway segments that provide an alternative to east-west travel on SR 37.

Table 1. 2035 AADT for key SR 37 alternative highway segments, with and without SR 37 on network

Highway Segment	2035 AADT - existing SR 37	2035 AADT – without SR 37	AADT increase	% increase
I-80 (I-780 to I-680)	134,543	134,289	-254	-0.2%
I-80 (Carquinez Bridge)	161,253	177,593	16,340	10.1%

I-580 (Richmond-San Rafael Bridge)	100,770	148,259	47,489	47.1%
US 101 (I-580 to SR 116)	211,016	226,056	15,040	7.1%
SR 116 (US 101 to Arnold Dr.)	41,049	42,135	1,086	2.6%
SR 121 (SR 12 to SR 29)	39,992	63,423	23,431	58.6%
SR 29 (SR 12 to SR 121)	52,357	55,149	2,792	5.3%
SR 12 (SR 29 to I-80)	41,569	42,617	1,048	2.5%
I-780 (I-80 to I-680)	84,334	80,203	-4,131	-4.9%

Without SR 37 (west of SR 29) on the network, the **high traffic volume increases** are seen on the two nearest toll bridges to the southeast of SR 37 in Vallejo (Carquinez and Richmond-San Rafael Bridges at **16,340 AADT and 47,559 AADT** increases respectively). This pushes 2035 V/C ratios during the AM peak on these bridges already at capacity (0.99 and 1.22 respectively) well beyond capacity (1.08 and 1.85 respectively). A high traffic volume increase (**23,431 AADT**) is also seen on SR 121 to the north of SR 37. This pushes the 2035 V/C ratio from below capacity at the PM peak (0.88) to well beyond its capacity (1.47).

This alternative scenario analysis suggests the highest volume of SR 37 traffic diversion would take a southerly route, while a significant amount of traffic would divert to a northerly route. Neither the southerly or northerly route has the ability to accommodate the increased volume of such a realignment of SR 37 to existing highway routes on the current transportation network.

NOISE MODELING SUMMARY

The sound model, System for the Prediction of Acoustic Detectability (SPreAD), is an ArcGIS toolbox plug-in for modeling sound propagation from a single point source across the landscape. SPreAD was originally a spreadsheet routine developed by the U.S. Forest Service and the Environmental Protection Agency to study recreational noise in US National Parks and Forests. The Center for Landscape Analysis in San Francisco updated

the model, converting the lookup tables to formulas within an ArcGIS extension. The model calculates noise propagation at a given frequency from a point-source, based on land-cover, topography, and climatic conditions. The road network totals 202 km and was broken into thirteen (13) road segments, which were in turn further represented by points 250 m apart. Noise propagation from the points within each segment was analyzed, resulting in a raster representing noise intensities (in dBA). We used current (2010) and projected (2035) average annual daily travel (AADT) traffic volumes and traffic composition (e.g., % heavy trucks) to calculate sound intensities (in dBA) at the highway. Traffic noise was estimated using the Federal Highway Administration's Traffic Noise Model, v2.5 (FHWA, 2004). Noise at the point of origin (highway), a digital elevation model (DEM), land cover (i.e., vegetation and developed areas), and climatic conditions were used to model sound propagation across the landscape.

The outputs of the sound model were raster maps with a gradation of values from a peak at the roadway (60-80 dBA) to background noise (~35 dBA). Two cutoffs were used to understand potential impacts of traffic noise: 40-50 dBA, for sensitive birds (Parris and Schneider, 2009; Dooling and Popper, 2007), and >50 dBA, for multiple effects on human health (reviewed in Lercher et al., 2011). The raster extent at 40 dBA was intersected with the California Vegetation map (CalVeg) to assess potential effects on wildlife living in different habitat types. The raster map extent at 50 dBA was intersected with the National Land Cover Dataset, urban areas, to approximate effects on human health.

STUDY AREA

The focal highway in this study is highway 37. Making changing to a highway such as this one would have profound effects on the surrounding roadways. Therefore, we chose to build a sound model for highways functioning in a travel network centered around highway 37.

CLIMATIC CONDITIONS

We choose to model the sound conditions at two climatically different times during the year, a summer (July) day and a winter (January) night. These two times were selected based mostly on the ability of the sound modeling software to accept different environmental conditions, changing the way that sound dissipates across space. These two scenarios represented two extreme cases to develop baseline models from which to compare other future modifications to the input parameters.

SPreAD

SPreAD generates raster GIS layers whose values represent sound propagation (in decibels dBA) across space from a single sound source (for example, an engine). As audible sound wave spectrum ranges from approximately 50 Hz to 20000 Hz, the sound model allows the user to choose the frequency in which to run the model. Certain species of animals are affected at different frequency ranges, so this tool models sound propagation at different frequencies. With the frequency chosen for the model run, one can calculate an ambient sound layer based on coefficients for different land-cover types that can be found in the academic literature. The ambient sound data layer is an important layer in the model because you can subtract this layer from the sound source's baseline noise propagation to generate an excess noise layer, isolating the contribution made from the single point sound source (e.g., the highway).

Modeling Sound with SPreAD: From a Single Point Source to a Multi-Point Roadway

SPreAD calculates sound dissipation or propagation from a single point source. The SPreAD package offers a routine for running multiple points, which is essentially a macro for running the single-point routine multiple times. The multi-point file used as the input was points evenly spaced along a highway, which when combined, represent the noise from traffic on a road. The following information is collected to properly run this sound propagation routine:

- Points representing the sound source – In ESRI Shapefile format.
- The extent of the model, which is a defined area for which to run the model, which would be a subset of the greater landscape.
- Sound frequency (Hz)
- Sound source level (dBA)
- Elevation dataset
- Land Cover dataset – the NLCD data assembled with land cover types defined as in the SPreAD user guide.

- Air Temperature (°F) –an average temperature for that region, based on the seasonal conditions selected.
- Relative humidity (%)
- Prevailing wind direction (degrees, 0-360 where 0 is north)
- Wind speed (mph)
- Seasonal conditions – enter a combination of the following for environmental factors, including clear or cloudy, windy or calm, summer or winter, and day or night.
- Ambient sound conditions layer

Data Requirements

Elevation Model

A Digital Elevation Model (DEM) is a raster-based geospatial data layer whose pixel values represent the elevation (in meters) of the landscape. This data layer provides the terrain and geomorphological features which act as barriers and prevent sound from propagating outward; the sound model does not account for sound moving around such objects. But when we ran this model using multiple points down a roadway, the other points compensate for this minor shortcoming.

These data were downloaded from the USGS Seamless Server[1] at a 10 meter resolution. The resolution needed to run SPreAD is 100 feet (approximately 30.5 meters), so this layer needed to be resampled to change the scale and make it align with the NLCD layer. The formula needed to build the raster (from the Raster Calculator found in the Spatial Analysis Tools):

[new_dem] = resample([rez_dem.tif, 30.0008771, cubic)

This resample uses a cubic convolution matrix to determine the size of the larger grid cell.

Land-cover

The National Land Cover Database (NLCD) is a representation of various land cover types across the landscape, including open water, urban areas, grasslands and herbaceous shrubs,

1 http://seamless.usgs.gov/

forests, wetlands and riparian regions. This dataset can be downloaded from the USGS Landcover Institute[2] (LCI).

Spread Type	NLCD Code	NLCD Value	Ambient Sound Value (dB)
Water (WAT)	11	Open Water	30
Urban (URB)	21	Residential (Open Space)	40
Urban (URB)	22	Residential (Light)	40
Urban (URB)	23	Residential (Medium)	40
Urban (URB)	24	Residential (Heavy)	40
Barren Land (BAR)	31	Barren Land	24
Hardwood or Deciduous Forest (HWD)	41	Deciduous Forest	21
Coniferous Forest (CON)	42	Evergreen Forest	29
Hardwood or Deciduous Forest (HWD)	43	Mixed Forest	21
Shrubland (SHB)	52	Shrub / Scrub	25
Herbaceous or Grassland (HEB)	71	Grasslands / Herbaceous	23
Herbaceous or Grassland (HEB)	81	Pasture / Hay	23
Herbaceous or Grassland (HEB)	82	Cultivated Crops	23
Shrubland (SHB)	90	Woody Wetlands	25
Herbaceous or Grassland (HEB)	95	Emergent Herbaceous Wetland	23

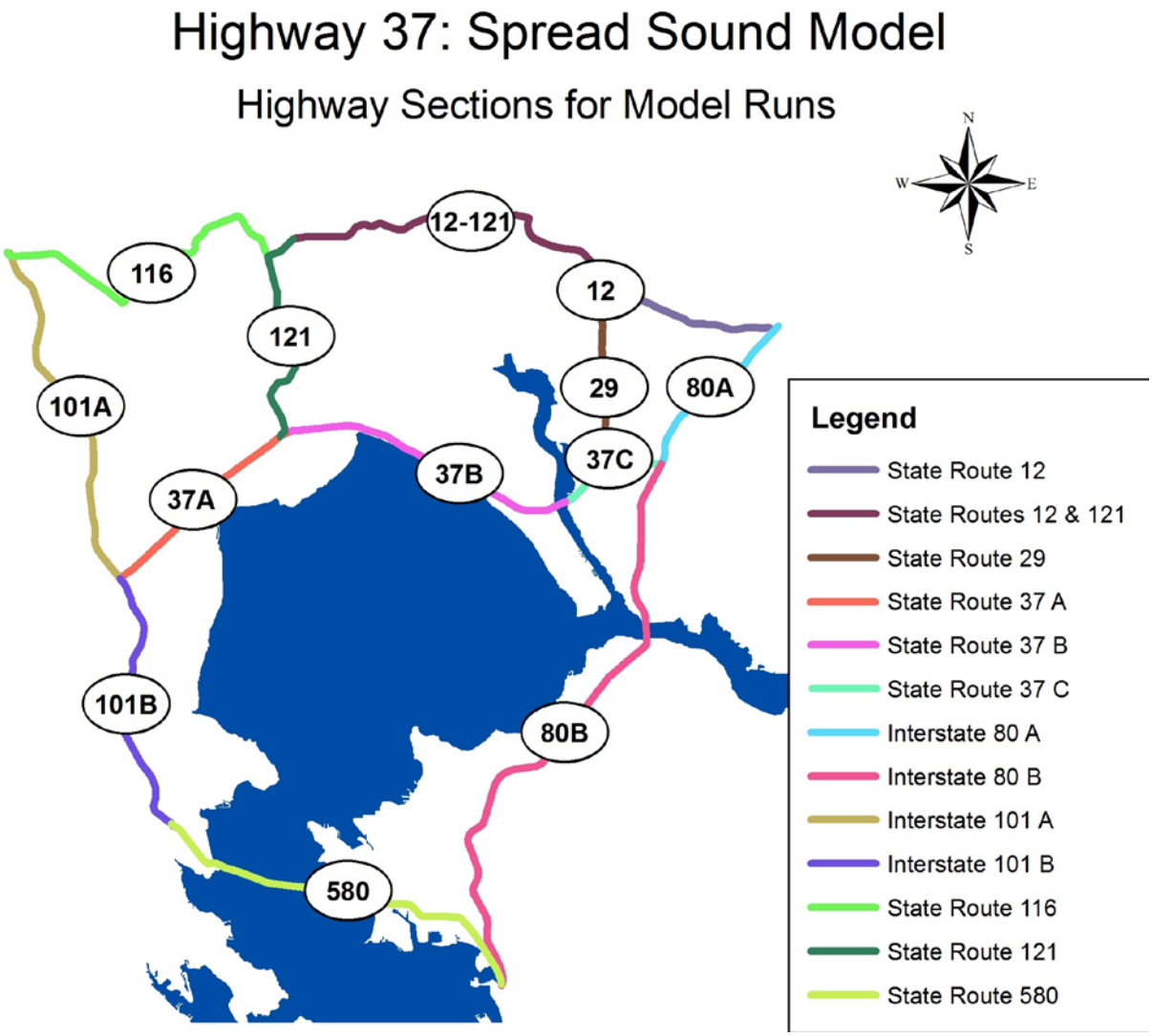
Highways

The region's highways were divided into segments based on the edge of the study area and on the highway intersections. The following table describes each of the thirteen (13) sections of highway modeled.

2 http://landcover.usgs.gov/

Hwy Code	Highway Name	Route or Segment Description
12	State Route 12	This section of highway runs from the junction of Interstate 80 to the east, and the junction of State Route 29 to the west. American Canyon road intersects with this section of highway.
12-121	State Route 12 and State Route 121	This section combines State Route 12 and State Route 121, starting from the junction of State Route 12 and State Route 29 and continuing westward to the junction of State Route 116 and State Route 121.
29	State Route 29	This section's northern end point is at the junction of State Route 29 and State Route 12 and has a southern endpoint at the junction of State Route 29 and State Route 37.
37A	State Route 37 Section A	The eastern end point of this section is at the junction of Interstate 80 and State Route 37 and the western point is at the junction of State Route 37 and Mare Island (to the north side of the Napa River, not crossing the bridge).
37B	State Route 37 Section B	This section starts from the point where 37A ends (State Route 37 and the Napa River) to the junction of State Route 37 and State Route 121 (Sears Point). State Route 37 (Hwy37) crosses marshland and is built on top of a levy. This levy supports a two lane highway (one lane each direction) from the intersection of Hwy37 and State Route 121 (named Sears Point, the location of Infineon Raceway) and Mare Island, where Hwy 37 crosses the bridge over the Napa River into Vallejo.
37C	State Route 37 Section C	Section C is the western most section of State Route 37. It goes from the Junction of State Route 37 and State Route 121 (Sears Point) to the junction of State Route 37 and Interstate Highway 101 at the city of Novato.
80A	Interstate 80 Section A	This segment begins at the intersection with highway 12 and terminates at the intersection with highway 37.
80B	Interstate 80 Section B	This segment begins at the intersection with highway 37 and extends to the intersection with I-580.
101A	Highway 101 Section A	This section begins in Petaluma at the intersection with highway 116 and extends to the intersection with highway 37 in Novato.
101B	Highway 101 Section B	This section of highway extends from the intersection with highway 37 in Novato to the intersection with I-580.
116	State Route 116	This highway extends from highway 101 in Petaluma to the west to highway 121 in the east
121	State Route 121	This segment of 121 extends from the intersection between 12-

Hwy Code	Highway Name	Route or Segment Description
		121 and 116 and the intersection with highway 37.
580	State Route 580	This section of highway starts where Interstate 80 and State Route 580 meet in Albany and crosses the Richmond-San Rafael Bridge to the Junction of State Route 580 and Highway 101.



Highway Points

To mimic the sound of a freeway, we ran the SPreAD model along a series of points, linearly referenced, along a stretch of road. If the points were frequent enough, the single points, when summed together, would form a line of noise similar to that of a road.

Hawth's Tools (Beyer, 2004) Animal Movement function was used to generate points along a line segment. Because the roads layer was originally many line segments, it was difficult to linear reference the points—to make the points evenly spaced. To accomplish this, we first converted the vector roads to a raster equivalent, and then re-generated continuous (single) line segments for the road. In rasterizing the roads, a cell size of 1 (the smallest) was used to provide the best accuracy since there is some loss in moving from vector to raster and back to vector again.

Highway Code	Number of points	Length of highway
12	38	9.4 km
12-121	79	19.6 km
29	38	9.3 km
37A	25	6.1 km
37B	68	16.5 km
37C	45	11.6 km
80A	40	10.0 km
80B	133	33.1 km
101A	79	19.5 km
101B	59	14.7 km
116	75	18.6 km
121	51	12.5 km
580	85	21.2 km

Traffic Noise

Hwy Code	AADT 2010	dBA	AADT 2035 (4 lane)	dBA	AADT 2035 (w/o 37)	dBA
12	34,940	73.3	41,569	74.1	42,617	74.2
12-121	20,439	71.4	21,607	71.7	19,596	71.3
12-29	44,082	74.3	53,049	75.0	55,797	75.3
29A	55,753	75.4	67,695	76.2	71,529	76.5
29B	13,200	68.7	14,971	69.3	63,431	75.6
37A	37,933	73.3	72,181	76.0	0	0

Hwy Code	AADT 2010	dBA	AADT 2035 (4 lane)	dBA	AADT 2035 (w/o 37)	dBA
37B	36,970	73.8	72,896	76.7	0	0
37C	92,314	77.6	119,366	81.6	37,708	76.6
80A	114,501	81.4	134,543	82.2	134,289	82.0
80B	184,103	83.4	225,284	84.2	259,436	84.9
101A	81,187	79.8	122,433	81.6	129,476	81.9
101B	171,151	82.9	211,016	83.8	226,056	84.1
116	39,946	74.8	43,106	75.1	54,734	76.2
121	34,812	73.4	39,992	74.0	63,423	76
580	73,110	79.5	100,770	80.9	148,259	82.6

Note: All dB values are when vehicles are traveling at 80 kph (50 mph) except on 80 (A,B), 101 (A, B), and 580 when 100 kph (62 mph) values were used.

Temperature

This study uses the PRISM (Parameter-elevation Regressions on Independent Slopes Model) climate mapping system, developed by Dr. Christopher Daly, PRISM Group director. PRISM uses point measurements for precipitation and temperature to produce continuous grids for the entire United States at 30-arcsecond resolution, approximately 800 meters per unit. These data are delivered as monthly and yearly averages over a twenty nine year span, 1971-2000.

To calculate the average temperature for the summer and winter scenarios, we used the average maximum temperature for the month of July and the average minimum temperature for the month of January, to represent an average summer day and an average winter night respectively. The average temperature was calculated by producing a five kilometer (5 km) buffered region around each road segment, and then using the climate grids to determine the average for eachhttps://lists.ucdavis.edu/sympa/review/ice buffered region. This exercise produced the following results in the table shown below (with the exception of the conversion from Celsius to Fahrenheit, which is needed because PRISM provides temperatures in degrees Celsius while the SPreAD model wants temperature in the Fahrenheit scale.

Road	PRISM	Avg C	Avg F	SD	Median C
12	TMAX 07	29.14	84.45	1.68	29.11
12	TMIN 01	3.52	38.34	0.60	3.15
12-121	TMAX 07	28.13	82.63	1.19	27.90
12-121	TMIN 01	3.35	38.03	0.44	3.17
29	TMAX 07	27.47	81.45	1.06	27.16
29	TMIN 01	3.46	38.23	0.52	3.24
37A	TMAX 07	27.10	80.78	0.92	26.91
37A	TMIN 01	3.62	38.52	0.47	3.46
37B	TMAX 07	26.14	79.05	0.74	26.09
37B	TMIN 01	3.53	38.35	0.27	3.50
37C	TMAX 07	26.55	79.79	0.92	26.44
37C	TMIN 01	4.07	39.33	0.51	4.01
80A	TMAX 07	29.05	84.29	1.53	28.71
80A	TMIN 01	3.64	38.55	0.56	3.40
80B	TMAX 07	25.52	77.94	2.41	26.04
80B	TMIN 01	4.37	39.87	0.80	4.24
101A	TMAX 07	27.70	81.86	0.88	27.82
101A	TMIN 01	3.88	38.98	0.67	3.66
101B	TMAX 07	25.96	78.73	1.56	26.03
101B	TMIN 01	4.60	40.28	0.35	4.53
116	TMAX 07	28.36	83.05	0.82	28.19
116	TMIN 01	3.40	38.12	0.41	3.29
121	TMAX 07	27.33	81.19	1.28	27.19
121	TMIN 01	3.54	38.37	0.39	3.47
580	TMAX 07	23.18	73.72	1.66	22.73
580	TMIN 01	5.17	41.31	0.45	5.15

Humidity, Wind Speed, and Wind Direction

These three environmental condition variables are required by SPreAD to model sound from a single point. The Western Regional Climate Center[3] provides statewide values for these three environmental variables. The following pages held the data used in this study:

- Average Wind Speeds by State
- Average Wind Direction by State
- Mean Monthly and Annual Percent Relative Humidity – Morning
- Mean Monthly and Annual Percent Relative Humidity – Afternoon

Use the Napa County airport prevailing wind direction for the month of January, which is East (90 degrees).

Existing Condition 2010

Highway Code	Freq (Hz)	Sound level (dB)	Distance (ft)	Temp (°F)	Humidity (%)	Wind direction (deg)	Wind speed (mph)	Seasonal Settings
12	400	72.6	30	84.5	63	225	11.5	Summer, Clear, Calm, Day
12	400	72.6	30	38.3	84	90	6.75	Winter, Clear, Calm, Night
12-121	400	69.5	30	82.6	63	225	11.5	Summer, Clear, Calm, Day
12-121	400	69.5	30	38	84	90	6.75	Winter, Clear, Calm, Night
29	400	74.7	30	81.5	63	225	11.5	Summer, Clear, Calm, Day
29	400	74.7	30	38.25	84	90	6.75	Winter, Clear, Calm, Night

3 http://www.wrcc.dri.edu/

37A	400	74.3	30	80.75	63	225	11.5	Summer, Clear, Calm, Day
37A	400	74.3	30	38.5	84	90	6.75	Winter, Clear, Calm, Night
37B	400	74.9	30	79	63	225	11.5	Summer, Clear, Calm, Day
37B	400	74.9	30	38.5	84	90	6.75	Winter, Clear, Calm, Night
37C	400	74.9	30	79.8	63	225	11.5	Summer, Clear, Calm, Day
37C	400	74.9	30	39.3	84	90	6.75	Winter, Clear, Calm, Night
80A	400	81.1	30	84.3	63	225	11.5	Summer, Clear, Calm, Day
80A	400	81.1	30	38.5	84	90	6.75	Winter, Clear, Calm, Night
80B	400	83.2	30	78	63	225	11.5	Summer, Clear, Calm, Day
80B	400	83.2	30	39.9	84	90	6.75	Winter, Clear, Calm, Night
101A	400	79.4	30	81.9	63	225	11.5	Summer, Clear, Calm, Day
101A	400	79.4	30	39	84	90	6.75	Winter, Clear, Calm, Night
101B	400	84	30	78.75	63	225	11.5	Summer, Clear, Calm, Day
101B	400	84	30	40.25	84	90	6.75	Winter, Clear, Calm, Night
116	400	71	30	83	63	225	11.5	Summer, Clear, Calm, Day
116	400	71	30	38	84	90	6.75	Winter, Clear, Calm, Night
121	400	70.4	30	81.2	63	225	11.5	Summer, Clear, Calm, Day
121	400	70.4	30	38.4	84	90	6.75	Winter, Clear, Calm, Night
580	400	78.8	30	73.75	63	225	11.5	Summer, Clear, Calm, Day

580	400	78.8	30	41.3	84	90	6.75	Winter, Clear, Calm, Night

REFERENCES

Beyer, H. L. 2004. Hawth's Analysis Tools for ArcGIS. Available at http://www.spatialecology.com/htools.

APPENDIX 7: VALUATION APPROACH

UC DAVIS
UNIVERSITY OF CALIFORNIA

Caltrans

APPENDIX 7: CREDIT AND VALUATION APPROACH

Prepared by UC Davis (Helene Le Maitre and Fraser Shilling) for the Strategic Highway Research Program – 2, Transportation Research Board

CONTENTS

1. SUMMARY

Describing credits for different transportation and ecological actions was an intent of CO6 and the C21 test of CO6. No specific methods were described in CO6, so we limited our investigations to conceptual discussions of crediting and valuation with transportation and other stakeholders. This introductory and conceptual approach is appropriate at this point because the field of valuation and economic valuation of environmental attributes (including benefit/cost analysis) is relatively new in transportation planning and decision-making.

The approach described here formed the basis for presentations and discussions with transportation and other stakeholders in this C21 project. It also formed the basis for how two valuation approaches were conducted: 1) preference surveys to quantitatively describe stakeholder value systems and 2) impacts analysis conducted with impacted-area as the currency of valuation.

Because there were no specific projects defined in this study, there was no credits system developed or tested. However, we felt that the concepts were sufficiently well-introduced and supported by both Caltrans' previous research into valuation and guidance from TRB/FHWA that it is possible that corridor management could adopt this form of decision-support in the future.

2. WHAT ARE CREDITS?

In order to plan for infrastructure development in complex social-ecological systems, it may be necessary to create devices that draw equivalencies among non-like objects. Credits are one type of device that use units of measure that are native to part of the system (e.g., Ha of land), or derived from financial calculations (e.g., $-equivalents), or that are normalized on a preference scale of some kind (usually from least to most preferred). In the current study, credits are units of value whereby dissimilar attributes of the Highway 37 Corridor Context can be compared in planning, impacts analysis, programming, and mitigation budgeting.

Credits in this study are proposed as scores on a scale from 0 to 100 given to alternatives for 5 themes: Transportation, Environment, Cost, Community and Reversibility. Each theme is accompanied by indicators of impact within each theme, which allows the development of stewardship-oriented scenarios, as well as evaluation of the actual impacts that accompany each scenario. The normalization of impacts to a 0 to 100 credit scale can serve as an intermediate step for subsequent conversion to fiscal equivalents for system attributes for which fiscal equivalents are known. Because these equivalents are approximate at best, the unit-less credit scale permits valuation without the inexactness of monetizing benefits and dis-benefits (including costs) of various project choices. For the environmental theme for this corridor, the nearby tidal and

freshwater wetlands provide both constraints and opportunities for stewardship planning. Because of the unique potential for wetland restoration in the State Route (SR) 37 Corridor Context, there may be few possibilities for mitigation bank strategies or payment of ecosystem services. However, even if mitigation banking might not be appropriate in this corridor, if wetlands around SR 37 are restored, these activities could confer credit benefits to other project areas.

3. WHAT IS VALUATION? CHOICE OF THE VALUATION METHOD

3.1. TWO VALUATION METHODS CONSIDERED: CREDITING STRATEGY AND MONETARY VALUATION

In its application to pilot test the tools from CO6A&B, UC Davis proposed to use two approaches for the sixth step, develop crediting strategy. The first approach is to use one of the products of the CO6B project: a credit system, as one accounting system for ecological, economic, and equity effects of decisions. To be functional in this system, the accounting or credit system would provide a way to both indicate relative or absolute effects or impact and to measure potential performance of credits, usually in the context of mitigation. In our case, this valuation will be based on a value given by normalization and aggregation of indicators on a defined scale (0 to 100 for instance). An alternative framework based on Caltrans' existing valuation approach for impacts, developed in collaboration with the UC Davis Road Ecology Center and Sustainable Transportation Center is also proposed, and this method is based on monetary values to evaluate impacts. The aim with the combined approach is to contribute to a more complete accounting of environmental, economic, and equity impacts of transportation early in decision-making, including describing a crediting strategy. We describe in the next sections how each of these two methods works. However, for our study, we will use only the valuation approach based on a crediting strategy, for reasons developed bellow.

3.2. USE OF MONETARY VALUES FOR SR37

The use of monetary value gives a common scale for the valuation of impacts. Such dollar values for some impacts (emissions for instance) are already used for Cost Benefit Analysis (CBA) by Caltrans, more precisely in life-cycle benefit/cost analysis. Such analysis is performed using a model called Cal-B/C[1] and impacts such as accidents or vehicles emissions are monetized in this type of analysis. But others impacts such as noise or water pollution should be monetized as well. Many wetland functions for instance result in goods and services that are not traded in markets and therefore remain un-priced. It is then necessary to value these goods or services using non-market valuation technique. For SR 37, monetization of wetlands would be a key step and we will discuss its implementation as an example of how we could give a dollar value to

[1] http://www.dot.ca.gov/hq/tpp/offices/ote/LCBC_Analysis_Model.html

impacts for our project. The first step for monetary valuation is to understand what characteristics of the wetland can be valued, so we will first summarize the functioning, uses and values of wetlands. Then we will present valuation methods and why they cannot be implemented in our project.

3.2.1. Monetization process for wetlands

FUNCTIONING, USES AND VALUES OF WETLANDS

The functioning of the wetland comes from different ecological processes (e.g. photosynthesis), characteristics (e.g. water depth) and structure (e.g. fauna and flora). Then, wetland uses result from the functioning of the wetland (figure 1). Wetlands uses contain both wetlands services (e.g. flood control) and goods (e.g. fisheries). It is at this stage that connection is made between ecology and economy since wetland uses can be monetized because links can be made between wetland uses and human activity. Yet monetization of wetland uses is not direct and it depends on what type of use is considered. In addition, decision-making regarding wetlands does not have to rely upon monetization as the only way to include wetlands' value in decision-making.

- Goods provided by wetlands have a direct use value, so they can be monetarized with market analysis, contingent analysis, mitigation costs, etc.
- Indirect use value can be found for some wetlands services. For instance, flood control can be monetarized by the costs of maintenance of levees. Contingent analysis or hedonic prices can also be used to monetize these services.
- Some services, like knowing that the wetland exists, don't have a use value. Therefore, contingent valuation must be used for these services.

Main economic valuation techniques are described in the next section.

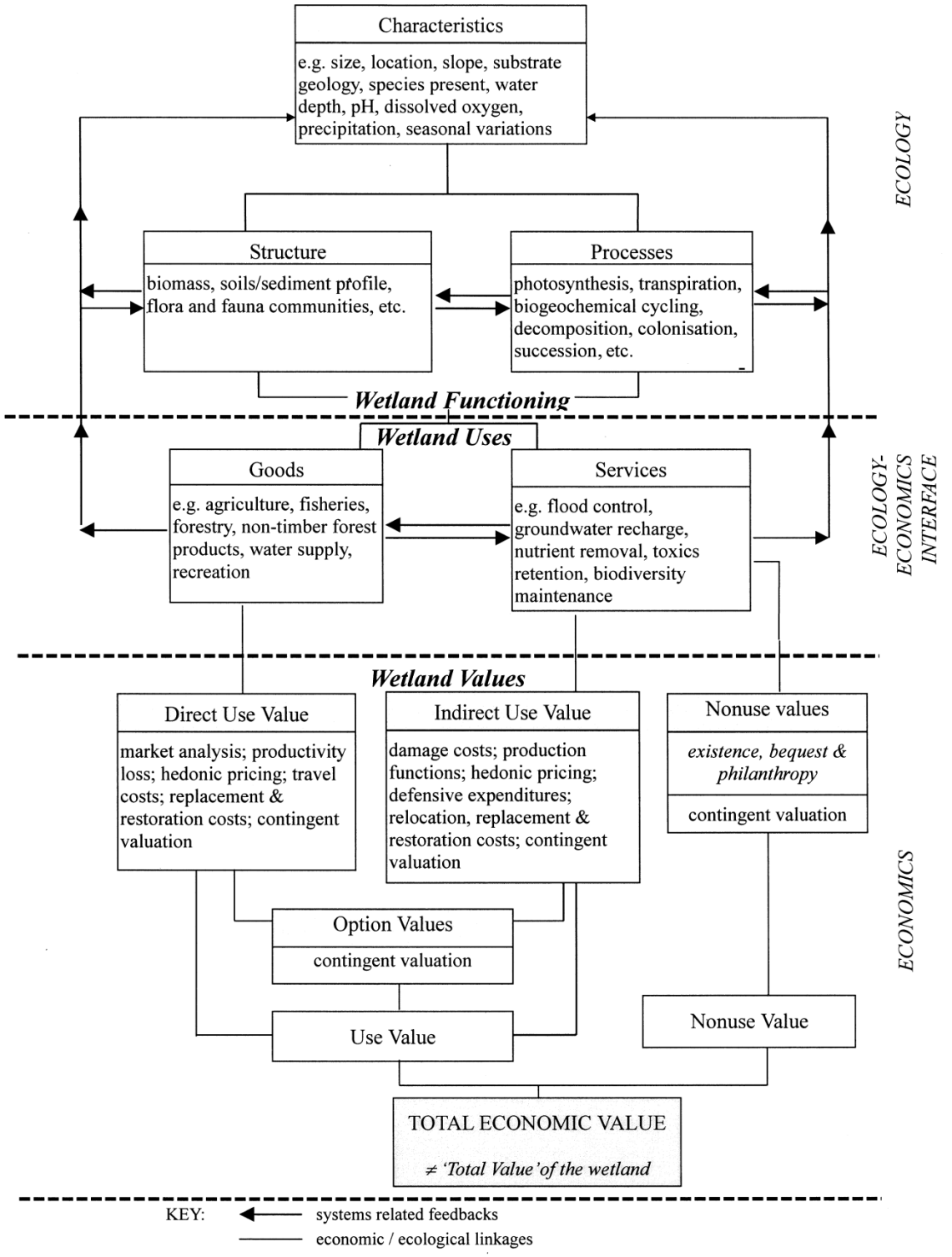


FIGURE 1 : CONNECTIONS AMONG WETLAND FUNCTIONS, USES AND VALUES (TURNER ET AL. 2000)

3.2.2. VALUATION METHODS

Three valuations methods that we could use to value wetlands are revealed and stated preference methods, contingent analysis or benefit transfers

REVEALED AND STATED PREFERENCE APPROACHES

The two main types of valuation for non market goods (wetland services in our case) are the revealed preference methods and the stated preference methods. Revealed preference approaches depend on a connection between the non-market good of interest (for instance, noise) and a market good (for instance, housing). The method uses data revealed by behavior related to actual decisions (for instance, changes in prices of housing). The major problem of this method is that it is based on existing conditions and so the possibilities of alternatives are limited. In contrast, stated preference techniques are based on hypothetical situations and surveys that are used to determine people willingness to pay for a situation.

Contrary to revealed preference methods, stated preference methods can be used for environmental goods like a wetland where we have both use and non-use values.

THE CONTINGENT VALUATION METHOD

Contingent valuation method is a stated preference method and it is usually used to estimate the value of an environmental change scenario. The method implies the use of a survey which begins with a statement describing the change in environmental goods or services. Then it asks individuals to reveal how much they are willing to pay for the change. For example, we could ask people how much they are willing to pay to restore wetlands surrounding Highway 37. In theory this method can be used to estimate values for environmental resources and ecosystem services, including those supporting both use and non-use values, which is what we need to get a valuation of wetlands. However, respondents must understand the nature of what is being valued as well as be able to know how they would be willing to trade off between changes in the environmental attribute and their income. This is a major difficulty for the contingent valuation method which can vary a lot between places and respondents. It especially depends on people income. Another issue with contingent valuation is that this method is time and resource consuming, since it is based on surveys. In our case, the time limit does not allow for a contingent valuation of wetlands.

BENEFIT TRANSFERS FOR WETLANDS

Benefit transfer is defined as the transfer of existing estimates of non-market values to a new study which is different from the study for which the values were originally estimated it is a secondary approach for valuation. This method is often used mainly because it saves time and resources. Usually, benefit transfer is best suited for tasks where the need for accuracy is low and it is generally considered a “second best” valuation method because benefit transfers involve reusing existing data, and a benefit transfer does not provide an error bound for the value in the new application after the transfer.

Since contingent valuation method would be time and resource consuming, benefit transfers were considered for our study. However, "*A recent review by Heimlich et al. (1998) lists 33 studies over the last 26 years with per acre values ranging from US$0.06 to US$22050. Even within the same study looking at a single ecosystem function, Batie S.S., and Wilson (1978) find values per acre that differ by two orders of magnitude from one site to another*."(Woodward et al., 2001). This study shows that variability comes from the methodology used for the evaluation and insists that in-site studies should still be used, knowing the potential biases of valuation methods. Therefore, it is less desirable to use benefits transfer to estimate wetland's value either and we will only use the valuation method based on credits proposed in CO6B.

3.3.CREDITING STRATEGY IN CO6B APPROACH

Although CO6 proposed a list of steps to be followed (table 1), the choice of the methodology was broad because these steps were not detailed and they can be seen as a list of what the evaluation should include rather than a precise guideline. Therefore it leaves a lot of possibilities as how the evaluation will be conducted.

TABLE 1 : PURPOSE AND IMPLEMENTATION OF STEP 6 FROM CO6B PROJECT (TRB, 2011)

Step 6: Develop Crediting Strategy
Purpose: Develop a consistent strategy and metrics to measure ecological impacts, restoration benefits, and long term performance – with the goal of having the analyses throughout the life of the project be in the same language. *Implementation Steps*: **6a. Diagnose the measurement need.** Examine the ecological setting (including regulated resources and frameworks, non-regulated resources, and ecosystem services); examine the regulatory and social setting, and identify additional opportunities. **6b. Evaluate ecosystem and landscape needs and context to identify measurement options.** **6c. Select or develop units and rules for crediting** (e.g., rules for field measurement of ecological functions, approved mitigation/conservation banking, outcome-based performance standards using credit system)**.** **6d. Test applicability of units and rules in local conditions.**

6e. Evaluate local market opportunities for ecosystem services.

6f. Negotiate regulatory assurance

The crediting strategy can be seen as a multi-criteria analysis as we can see in our implementation of Step 6 to SR 37 study described below.

3.3.1. CHOICE OF THE CREDITING STRATEGY APPROACH

If we use a valuation approach, we look at economic values of environmental impacts and we have to use contingent valuation for different types of values, which demands time and resources. The difference with a crediting strategy (multi-criteria analysis) is that the crediting strategy uses indicators from the wetland structure and characteristics and not only its uses. This approach can be linked to strong sustainability as opposed to the valuation approach which is closer to weak sustainability: when we use economic valuation, we do not take the irreversibility factor into account. Giving an economic value to a wetland might also mean that the benefits from this wetland are the same as benefit from another ecosystem, which we can buy through mitigation banking. But what is not considered here is the irreversibility of the damage caused to the wetland and factors like the uniqueness of the considered wetland. Therefore, economic value as it is used here only considers part of the total value of the wetland.

Definitions (Joumard et al. 2010):

Weak sustainability : "According to the weak approach of sustainable development, the natural capital is a component of the total capital composed by all the productive goods, so-called productive capital, the human capital and the stock of knowledge and know-how of the people, so-called social capital, and the resources and natural goods, renewable or not, so-called natural capital. These different types of capital are supposed measurable and equivalent. The annuities due to the use of the natural capital by the present generation can be reinvested in the form of a reproducible economic capital, to be transmitted to the future generations. […] In these conditions, the sustainable development of an economic sector is not limited by an ecological constraint."

Strong sustainability : "The second variant of sustainable development is the strong approach, which claims the irreducible character of the natural capital. It means that the sustainable development should comply with the ecological constraints due to the preservation of the quantity and the quality of the natural capital, i.e. the nature."

Also, the aim of our study is to help decision making by stakeholders through a better knowledge of impacts, and indicators might be a better approach as they are more transparent and can be easily understood, unlike economic valuation. Economic valuation is made through methods like contingent valuation and then uses concepts such as discounting which are not as easy to understand as a range of indicators. Thus, it might be easier for stakeholders to discuss a rather simple evaluation in which they can discuss different objectives described by indicators and weights of indicators. This would help decision making more than an economic valuation because stakeholders can easily discuss every points and by that process get a better understanding of potential impacts and concerns.

4. RELATIONSHIP TO CO6 APPROACHES

The general methodology chosen for this study is described below. We divided it into the substeps developed by CO6 team and adapted to our project (figure 2).

SUBSTEPS

For each of substep, we will give a summary of CO6B recommendations and describe how we will implement them in the SR 37 study.

STEP 6A: DIAGNOSE THE MEASUREMENT NEED : EXAMINING THE ECOLOGICAL SETTING, THE REGULATORY AND SOCIAL SETTING, IDENTIFYING ADDITIONAL OPPORTUNITIES

CO6B RECOMMENDATIONS

This first substep is targeted at diagnosing the resource measurement needs. It is divided into three parts. The first part is the ecological setting : examining natural

environment and resources in the area. The second part is the regulatory and social setting, which can be examined through a historical review of stakeholder's experiences and a forward looking review that evaluates potential regulations or social expectations from projects. The third part, additional opportunities, can be evaluated by examining ongoing efforts and conservation programs.

APPLICATION ON SR 37 STUDY

The draft Caltrans Corridor Plan for SR 37 was used as a basis for this step as it already provided a description of the corridor including its transportation characteristics (current and forecasted), environmental constraints, and previous and potential future projects. The regulatory setting is already described in the Corridor plan.

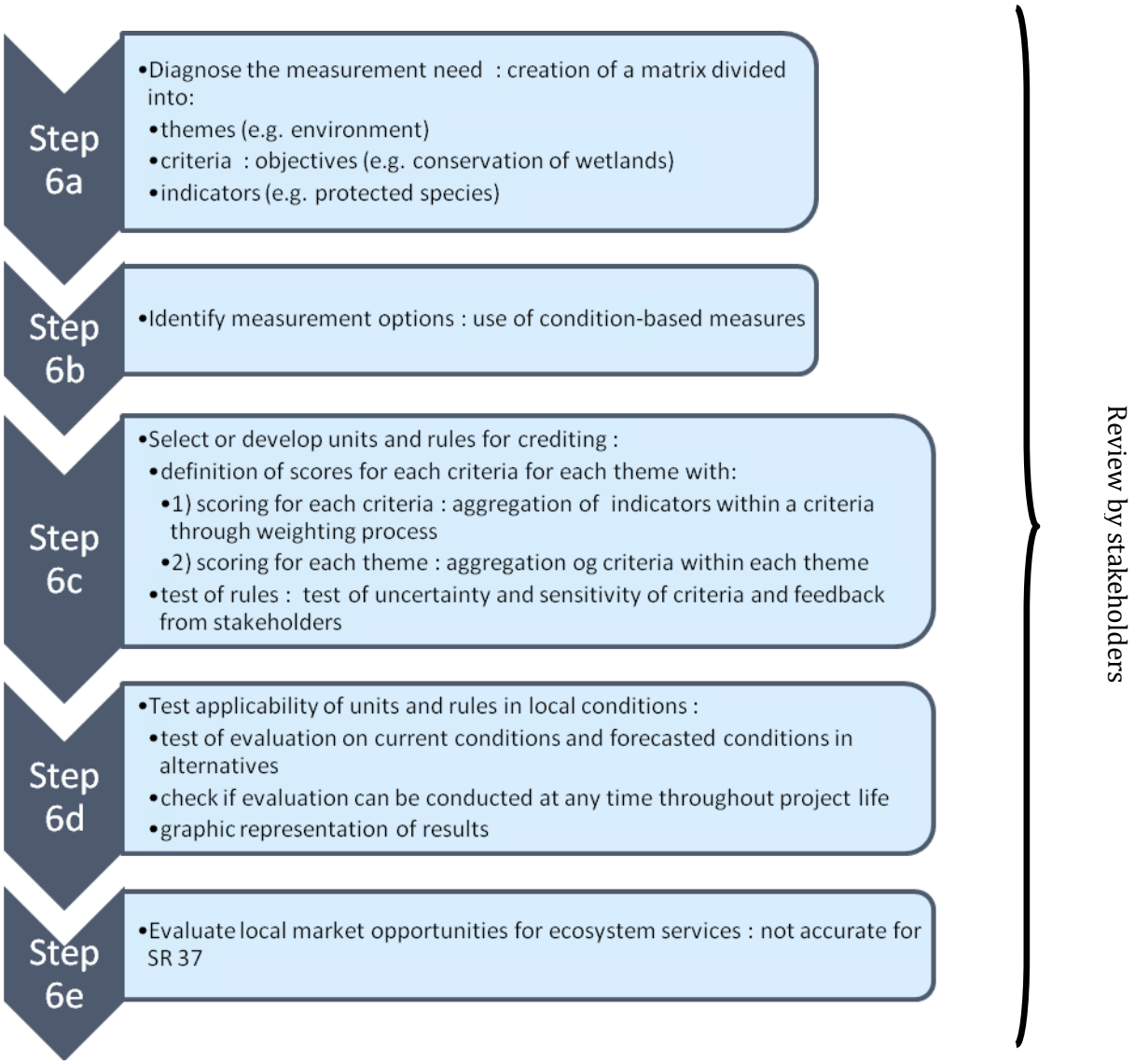


FIGURE 2 : APPLICATION OF CO6B FRAMEWORK FOR STEP 6 TO SR 37 STUDY

In order to get a global image of ecological and social setting, we developed a matrix divided into themes, objectives (or criteria) and indicators (figure 3).

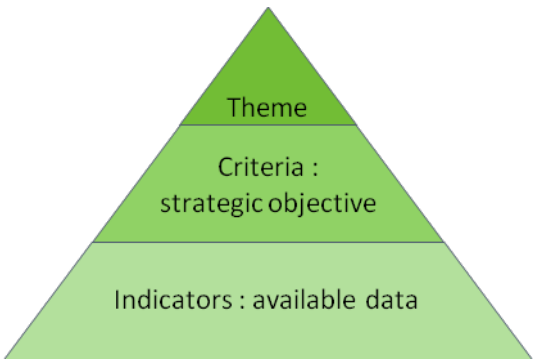


FIGURE 3 : HIERARCHY OF THEMES, CRITERIA AND INDICATORS

- **Definition of themes and objectives**

The matrix was first organized into different themes and objectives listed by TCAPP: environment, transportation, cost, economy, community, and adapted to the SR 37 study. Other themes and objectives were added to match the SR37 study, like objectives concerning wetlands. Objectives will be used as criteria for each theme. For this step, meetings and feedback from stakeholders can help with getting to know different impacts that were not previously listed, as agricultural impacts linked to sea level rise and wetland restoration. Also this matrix can be compared to and, if needed, completed by the lists of impacts listed in Caltrans' existing valuation approach for environmental impacts developed in collaboration with UC Davis Road Ecology Center and Sustainable Transportation Center.

- **Definition of indicators for each criteria**

With help from the TCAPP website and depending on available data, each criterion (impact/measure listed) will then be linked to one or several indicators that can be provided for which data can be provided. TCAPP web tool also includes lists of existing studies for several indicators. That can eventually be carefully transferred to SR 37 study if we have a lack of data and if a transfer is consistent with both the existing study and SR 37 characteristics.

STEP 6B: IDENTIFY MEASUREMENT OPTIONS

This step mainly aims at defining units for managing the resources.

CO6B RECOMMENDATIONS

In this section, various existing measures used in environmental management settings are presented : condition based measurements, model based measurements and function based measurement.

Condition based measurements

Condition based measurements focus on quantifying changes in the status of the regulated resource. For instance, species of concern would be measured through population surveys. These systems also include pollutant load measurements, which are normally defined by quantifying specific amounts of criteria pollutants added or removed from the system. Condition based examples include water quality measurements, and indices of biological integrity. Two forms of condition based measures are indices of environmental quality and observation-based systems.

Model-based measurements

This type of measures relies on data to estimate species or ecosystem response and on a set of rules and conditions that are expected to result in an environmental outcome. Model-based systems are similar to condition-based measurements systems, but are

usually employed for planning purposes because they focus not only on sample-based data but also on the elements of the ecosystem that can be affected by human action.

Function-based measurements

These measures focus on habitats, structures and processes as the basis for measuring the environment. Function based systems are not species specific, and are used when rare or unique resources need measures, but that are not easily measured with one species. Model based measurements can start to combine elements of a function based measure and a conditions-based systems where the model relies on habitat or field data to estimate habitat use and densities. To truly get at a measurement for use in transportation projects the results need to tie the natural impacts back to specific actions at a site. This is needed for the full suite of mitigation decisions: avoidance, minimization, and compensation. These concerns need to guide the selection or development of a measure.

APPLICATION FOR THE SR 37 STUDY

Given the sensitivity of resources, SHRP2 guide recommends that functional measures are used in the study. This approach should provide "a common unit of measurement for biological, chemical and physical processes". The dollar could have been this common unit, as recommended by Caltrans' existing valuation approach for environmental impacts developed in collaboration with UC Davis Road Ecology Center and Sustainable Transportation Center. The reasons why we won't use this approach were explained earlier.

As for model-based measures, it could be an appropriate measurement option for SR 37 study. Caltrans provides forecasts for transportation data, and we also have models ecological on impacts, such as noise. But a major challenge for the ecological impact concerns wetlands and wetlands are a very complicated ecological system. Not all of its functioning is well understood, especially when hydrology is concerned. Therefore, it remains difficult to conduct model-based measures for wetlands because it is difficult to find out exactly how indicators of wetlands well-being will react to alternatives. Therefore, we will use condition-based measures in our study: for instance, species of concern would be measured through population surveys.

STEP 6C: SELECT OR DEVELOP UNITS AND RULES FOR CREDITING

CO6B RECOMMENDATIONS

In this section, CO6B provides recommendations to develop custom measurement system for multi-resource crediting: define the spatial unit, develop a conceptual diagram, generate attributes (criteria) and scores, check attributes, and check that measures can work at any point of time. All rules developed during this process must be agreed upon.

APPLICATION ON SR 37 STUDY

The method proposed here and summarized in figure 3 is rather simple and transparent. These qualities were needed here because they will help the discussion between stakeholders who can discuss every indicator.

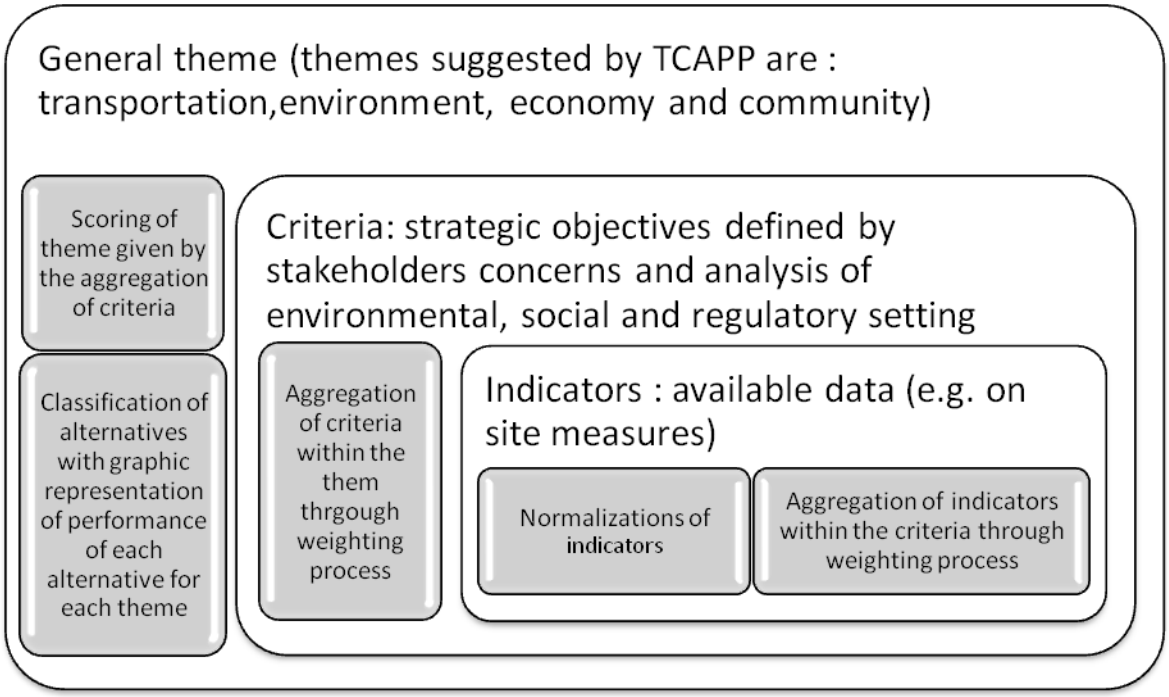


FIGURE 3 : IMPLEMENTATION OF STEP 6C

In the matrix of impacts constructed earlier, each theme will be equally-weighted. Each criterion inside each theme will then be weighted. A conceptual diagram was developed with the matrix of impacts and can eventually be used to help with the choice of weights or to show how weights are distributed, following CO6 recommendations. The issue with these diagrams that we have is that some impacts like water quality that appear at different points of the diagram (for instance, as a consequence of runoff water or as a consequence of vehicles emissions). Therefore weighting cannot be based on the conceptual diagram because we would have too much double counting, but it will help stakeholders to have a more comprehensive understanding of the system.

Each criterion will then get a score depending on the performance of the alternative considered for this criterion through a normalization process of its indicators explained later. When we have the scores, we can calculate a score for each theme. No global score will be given for each alternative because the idea of the evaluation is to help dialogue among stakeholders and between Caltrans and regulators. Thus, the most important part of this work is to give stakeholders the best possible knowledge of potential impacts of different alternatives in order for them to make the best decision. That's why

it may be more important to discuss different weighting options and aggregation options than to have a final score. The final result of the evaluation study should give a good idea of both positive and negative impacts of alternatives, which should ultimately help stakeholders weight their own concerns regarding the other stakeholders' concerns and then hopefully come to an agreement on the alternatives.

One issue about this approach is that weights of themes and criteria are decided before the valuation and therefore the results of the valuation depend on how each theme was previously weighted. However, different weight options can be used in order to represent different approaches or points of view on the project.

The normalization process and the weighting will be reviewed for uncertainty and sensitivity. Uncertainty tests look how the uncertainty of an indicator can spread and affect the global evaluation and sensitivity tests focuses on how much a single indicator affects the evaluation. Sensitivity tests for these two parts of the evaluation will be made to check the consistency of the indicators. Then, stakeholders should review the results to agree on results and values used in normalization and weighting.

The selections of criteria and indicators will be discussed with stakeholders as well as each weight and determination of benefits and dis-benefits during the evaluation process could be useful as this can be a basis to determine credits and then develop negotiation for ways to deal with the benefits and dis-benefits.

STEP 6D: TEST APPLICABILITY OF UNITS AND RULES IN LOCAL CONDITIONS

CO6B RECOMMENDATIONS

The application is recommended in three steps: determine baseline condition using on-site data, generate alternative scenarios, and evaluate future conditions.

APPLICATION FOR SR 37 STUDY

A current and future condition evaluation is generated for each alternative considered. This means that a precise definition of the alternatives should be produced at this point or earlier by stakeholders. Defining alternatives earlier could be useful because it can help determine objectives and needed data.

STEP 6E: EVALUATE LOCAL MARKET OPPORTUNITIES FOR ECOSYSTEM SERVICES

CO6B RECOMMENDATIONS

Market opportunities include existing conservation/mitigation banking systems or payment for ecosystem service (PES). PES programs are negotiated contracts with landowners to maintain a certain level of environmental performance to maintain or enhance ecosystem services. Examples of PES can be found in Forest Trends and Ecosystem Marketplace, 2008.

Developing ecosystem metrics and tracking project impacts using those measures can make it easier to access any operating regional ecosystem markets and if ecosystem markets are available and if metrics were developed from previous step, then the ecosystem measurement system should be well-suited to ecosystem market use.

Ecosystem markets present various benefits for departments of transportation :

- First, it removes the risk of uncertainty of the project linked to the needed approval by environmental agencies. Projects are often slowed or stopped by deficient environmental analysis like the Environmental Impact Report (EIR) required by federal and state laws : National Environmental Policy Act (NEPA), California Environmental Quality Act (CEQA) or Clean Water Act for instance.
- Second, ecosystem markets include a transfer of liability: the liability for the restoration or conservation success is placed on the banker and not on the department of transportation.
- Third, this system produces a better alignment of mission since instead of road constructors, restoration professional build mitigation sites.
- Fourth, ecosystem market can produce improved ecosystem outcomes because bankers can have more comprehensive and meaningful projects to address ecosystem priorities.

But although PES systems have great potential power for ecosystem preservation, according to Redford and Adams, seven major criticisms can be listed (Redford and Adams, 2009), including the risk that economic arguments about services valued by humans will overwrite and outweigh noneconomic justifications for conservation and the concern that there is no clear way to track the performance of the system. Therefore, ecosystem markets must be only one of several tools aiming at preserving ecosystems.

APPLICATION TO SR 37 STUDY

The unique potential for wetland restoration in SR 37 setting might not make bank strategies or PES sufficient mitigation strategies in this case. Indeed, in the geographic setting of SR 37 there is a low housing density and development (cf. urban areas in

figure 4). This makes this place a unique opportunity of wetland restoration for the Bay Area and this nationally-important estuary.

Therefore, since the ecosystem is unique, banking systems or PES might not be a satisfying approach for this project because it implies that mitigation or restoration projects can be equivalent to the impacts, which is not the case for unique systems. Indeed, widening highway 37 would have irreversible impacts that cannot be compensated by another wetland project because no other wetland project has the same potential benefits in the Bay Area.

However, if mitigation banking might not be sufficient for this project, if the removal alternative or the causeway alternative is considered, these wetlands could become a mitigation bank themselves and receive money from crediting strategies from other projects. It would also be a way to pay for the extensive wetland restoration.

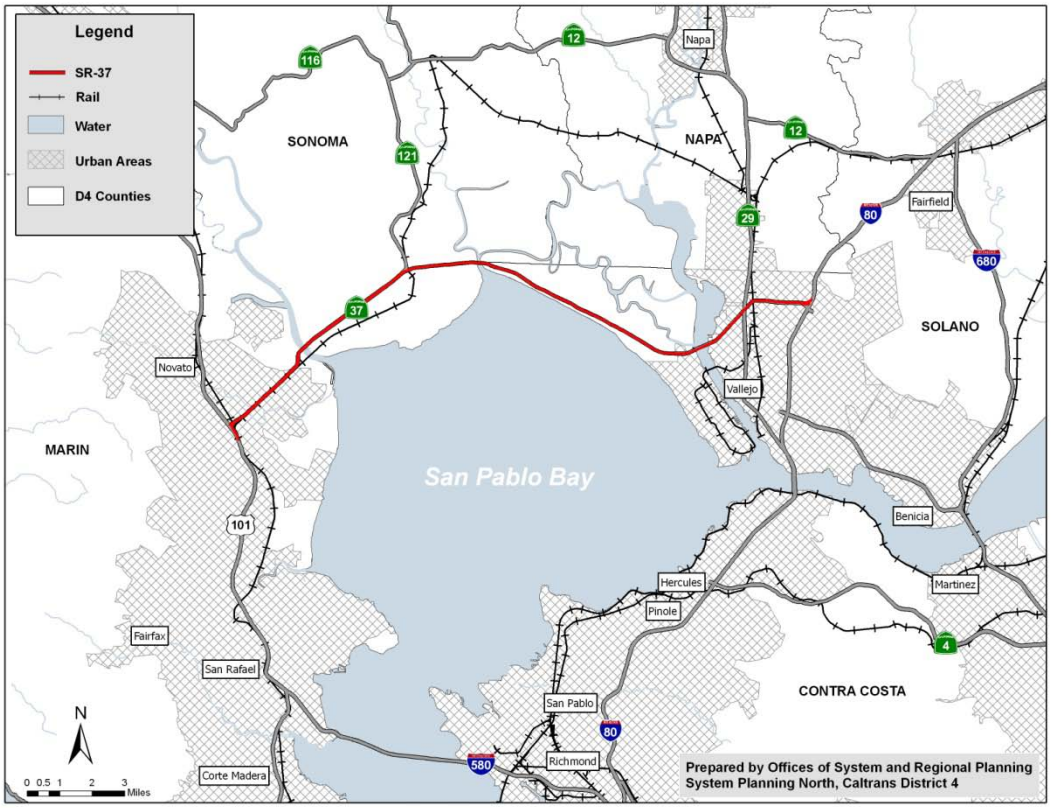


FIGURE 4: GEOGRAPHICAL SETTING OF HIGHWAY 37 (CALTRANS DRAFT CORRIDOR PLAN, 2010)

STAKEHOLDERS ROLE IN THE EVALUATION PROCESS

Stakeholders are supposed to participate at every step of the evaluation. The crediting strategy described here is designed to get a maximum involvement of stakeholders. Discussion about objectives will help identifying and discussing each other's concerns, discussion about criteria will help sharing data and discussion about weighting will help getting a shared agreement on priorities.

The construction of alternatives will also necessitate the involvement of stakeholders, because of the various issues that have to be addressed. Stakeholders at this point will help constructing better alternatives because they can share their own expertise that other stakeholders may not have. Construction of alternatives is an important step and it will also lead to better knowledge of concerns and potential impacts. Therefore, this step can help defining objectives and criteria and thus it should take place early in the process.

Finally, the final outcomes of the evaluation should also help understanding how benefits and negative impacts are distributed among alternatives. This will help to understand how we can optimize alternatives, who are the winners and losers and how losses can be compensated.

5. IMPLEMENTATION OF THE METHOD

5.1.CHOICE OF THEMES AND OBJECTIVES

Themes and objectives are the two levels under which the project will be evaluated. Therefore, this choice is a very important step. The question here is what do we want to measure? Stakeholders have various goals, for instance, Caltrans wants to reduce congestion, Sonoma Land Trust wants to restore wetlands, the Bay Trail wants bikes paths, US Fish and Wildlife Service want to preserve biodiversity and protect listed species, land-owners want levees to protect their land from flooding etc. Themes and objectives must reflect all these different intents in order to inform agreements. TCAPP proposes a list of themes and objectives on its web tool. It can be used as a basis and adapted to SR 37 after feedbacks from stakeholders.

Themes for SR 37 could be Transportation, Environment, Cost, Community and Reversibility :

- Transportation could include objectives like reducing congestion and delays, reducing the risk of injury-causing accidents, and improving accessibility.
- Environment could include wetland conservation, tidal wetland adaptation to sea level rise, air and water quality, preservation of habitat and biodiversity, and noise pollution.
- Cost could include infrastructure and mitigation costs, cost effectiveness and economic impact, and avoidance of future catastrophic costs from sea-level rise.
- Community could include objectives like land preservation, historic preservation, equitable distribution of transportation costs and benefits, access to recreation, community cohesion, and public health.
- Reversibility would measures the "possibility of re-orienting, or cancelling the project once finished, according to future choices" (Joumard et al. 2010).

5.2.CRITERIA FOR THE CHOICE OF INDICATORS

Quality of basic data affects the quality of the overall evaluation. Several dimensions, listed in OECD Handbook (Nardo et al. 2005), need to be considered while selecting data:

- RELEVANCE

The relevance of data is a qualitative assessment of the value contributed by these data. Value is characterized by the degree to which statistics meet current and potential needs of the users.

- ***Accuracy***

The accuracy of data is the degree to which they correctly estimate or describe the quantities or characteristics that they are designed to measure. Accuracy is usually measured in terms of the error, or the potential significance of error.

- ***Timeliness***

The timeliness of data products reflects the length of time between their availability and what they describe. The punctuality of data is also important, it depends upon the existence of a publication schedule and reflects the degree to which data are released in accordance with it.

- ***Accessibility***

The accessibility of data products reflects how readily the data can be located and accessed. It implies for instance distribution channels, pricing policy, affordability, copyright, and suitability of the form in which the data are available.

- ***Interpretability***

The interpretability of data products reflects the clarity with which the user may understand and analyze the data. It reflects how well the indicator varies with what it represents and how it is influenced by uncertainties. It should move in an analogue fashion to the phenomenon.

The choice of basic data mainly depends on its availability in the area of concern and the quality of the overall evaluation depends on the coherence between indicators and not only on the quality of each single indicator. However, these criteria will be used as guidance when a choice between indicators can be made.

DOUBLE COUNTING

The problem if the evaluation is based on objectives is the potential double counting because the same criteria can be used to assess different objectives. For instance, water quality can be an indicator for the preservation of wetland or wildlife, but it can also be used for the objective of human health. But even though evaluation based on objectives can lead to double counting, it might be more important to see how far each objective is reached with different alternatives than how many times an indicator was used.

Also we can consider than double counting is useful to some extent because if a resource is a valid indicator for different objectives, then maybe it should be counted twice because it serves two different objectives.

5.3.NORMALIZATION OF INDICATORS

Once we have our criteria and indicators, the next step is to normalize them to a common value scale. Several normalization processes are described

CHOICE OF THE TYPE OF NORMALIZATION

Different methods exist for normalization, although none of them is totally satisfying. The table below summarizes the main methods, their advantages and disadvantages.

TABLE 2: COMPARISON OF METHODS FOR NORMALIZATION

Method	
Advantages	Disadvantages
Empirical normalization Min max method gives the 0 value (Min) to the most unfavorable observed value and 1 or 10 (Max) to the best recorded value. All intermediary values are calculated based on the formula: Y = X – Min/(Max – Min).	
Simple and efficient to compare alternatives with an initial state	Variability of Min and Max values that depend on observed values, new observation outside the previous limits will lead to new normalization. Extreme

	values/or outliers could distort the transformed indicator
Axiological normalization Close to the empirical approach with *min* and *max* limits. The limits are not statistically identified, being chosen based on the undesirable situation, which receives the "0" value, and on the ideal situation, which can or cannot correspond to a strategic objective and which receives the value "1". Alternatives to min and max here are : • **distance to a reference method** that takes the ratios of the indicator to a value of mean reference for this indicator: $Y=X/X_{expected}$ • **Indicators above or below the mean** : this transformation considers the indicators which are above and below an arbitrarily defined threshold, *p*, around the mean $X_{expected}$: $$Y = \begin{cases} 1 \; if \; \frac{X}{X_{expected}} > (1+p) \\ 0 \; if \; (1-p) < \frac{X}{X_{expected}} < (1+p) \\ -1 \; if \; \frac{X}{X_{expected}} < (1-p) \end{cases}$$	
Simple and efficient to compare alternatives. Reduced impact of extreme values	Might be less realistic than the empirical approach because limits depend on objectives, not on observations
Mathematical normalization Transformation of data by means of a mathematic function in order for the values to range between an upper and a lower limit	
	Lack of transparence for the user and possible change of initial distribution of values
Statistical normalization All values are expressed in standard deviation, so that the variables average is equal to zero	
Does not depend on min and max values determined by strategic objectives or statistics	Does not depend on min and max values determined by strategic objectives or statistics

Since the aim of the study is to get stakeholders involved in a more comprehensive process, transparency is important. Therefore, an axiological or empirical normalization would be better here because stakeholders can easily understand and discuss indicators since they understand the normalization process. An empirical normalization is preferred for our study because we aim at having few alternatives (3 to 5), and therefore an axiological normalization could distort the reality of the impacts of each alternative by comparing them on a reduced scale.

POSITIVE VS. NEGATIVE COUNT OF IMPACTS

Another question here is to choose how we want the indicator to be read: more is better or less is better. The appreciation by stakeholders might be different for some indicators. For instance, congestion can seen as a "less is better" indicator because drivers earn time when the road is less congested and this is counted as positive impact with a positive value of time which derived from the observation that people are willing to pay to save time. However we can look at congestion from another point of view: congestion might be an indicator for which more is better because if the road is congested people might want to avoid congestion by using other modes or by car sharing, if these alternatives are available. Or they might also want to live closer to their work which would limit urban sprawl. In that case loss of time consequent to a transportation project can be seen as a positive impact from a transportation and accessibility point of view. Therefore, the direction of each indicator (more is better or less is better) must be derived from the objectives.

5.4.AGGREGATION OF INDICATORS AND CRITERIA

CHOICE OF THE AGGREGATION METHOD

Aggregation is the process through which several indicators are summarized into a single index. The questions related to aggregation are: Do all indicators have the same weight? If not, how weights should be determined? What mathematical function will we use to aggregate indicators? In our study, a simple and transparent method is preferred since it is necessary to get stakeholder's involvement. Therefore we will calculate the mean of aggregated indicators.

CHOICE OF THE WEIGHTING METHOD

TABLE 3: ADVANTAGES AND DISADVANTAGES OF SOME WEIGHTING METHODS

Weighting method	
Advantages	**Disadvantages**
Hierarchical Weighted Total (aggregation on tree)	
When criteria can be organized in a tree, weights are attributed to each single	

indicator and to all combinations of indicators belonging to the same node, at all different levels of the aggregation tree.	
• Simple to use and transparent	•Difficulty in constructing the tree • The creation of a tree is not always possible
Public Opinion Similar to budget allocation, people are asked to express their degree of concern (*e.g.* great or small) about issues, as measured by indicators	
• Allows all stakeholders to express their preference and creates a consensus for policy action	• Implies the measurement of "concern" (see discussion on the Budget Allocation). • Could produce inconsistencies when dealing with a high number of indicators (see discussion on the Budget Allocation)
Budget Allocation Experts on a given criteria are asked to allocate a "budget" of 100 points to the indicator set, based on their experience and subjective judgment of the relative importance of the respective indicators. Weights are calculated as average budgets.	
• Weighting is based on expert opinion and not on technical manipulations. •Transparent, relatively straightforward nature and short duration • Expert opinion can increase the legitimacy of the evaluation	• Weighting reliability : Weights could reflect specific local conditions (e.g. in environmental problems), so expert weighting may not be transferable from one area to another • Allocating a certain budget over a too large number of indicators may produce inconsistencies (for a number of indicators higher than 10) • Weighting may not measure the importance of each individual indicator but rather the urgency or need for political intervention for the individual indicator concerned
Analytic Hierarchy Process Pairwise comparisons of indicators are made and then the relative weights of the individual criteria are calculated using an eigenvector.	
• Can be used both for qualitative and	• Requires a high number of pairwise

quantitative data. • Weighting is based on expert opinion and not on technical manipulations. • Expert opinion is likely to increase the legitimacy of the composite and to create a forum of discussion in which to form a consensus for policy action.	comparisons and thus can be computationally costly. • Results depend on the set of evaluators chosen, therefore not reproducible.
Conjoint Analysis Surveys are conducted asking for an evaluation (a preference) of a set of alternative scenarios. A scenario might be a given set of values for the individual indicators. The preference is then decomposed by relating the single components (the known values of individual indicators of that scenario) to the evaluation.	
• Weights represent trade-offs across indicators. • Takes into account the socio-political context and the values of respondents.	• Time and resource consuming • Depends on the sample of respondents chosen and on how questions are framed. • Could produce inconsistencies when dealing with a high number of alternatives (see previous discussion on the Budget Allocation). • Requires a large sample of respondents and each respondent may be required to express a large number of preferences. • Estimation process is rather complex

The weighting method that seems the most accurate for our study is the budget allocation method, because of its transparency and easiness to implement. This method could include some stakeholders as experts. The idea is to ask stakeholders how they would weigh the criteria in their field: transportation criteria should be weighted be transportation stakeholders, environmental criteria by environmental agencies, etc. and then average weight could be used as weights. However, we need not to have too much difference between weights for the same criteria, so the given weights might need to be transformed in order to get an arbitrarily defined standard deviation for weights, or we could change the criteria if standard deviation is too high because this might show that criteria is not accurate.

5.5.SENSITIVITY AND UNCERTAINTY TESTS

Several subjective choices have to be made during the evaluation process including :

- Choice of indicators
- Definition of criteria
- Choice of aggregation process
- Choice of weighting model

We cannot suppress the subjective factor of our evaluation and the message given by the final evaluation results is determined by these choices. The uncertainty test aims to quantify the overall uncertainty in themes rankings as a result of the uncertainties in the model input. The aim of sensitivity analysis is to assess the evaluation impacts associated with the subjective choices taken. Sensitivity analysis studies how the variation in the outcome can be caused, qualitatively or quantitatively, by different sources of variation in the indicators. Sensitivity analysis and uncertainty analysis are thus closely related. Using both uncertainty and sensitivity analysis can help:

- to assess the robustness of the final ranking
- to increase its transparency
- to identify which themes or objectives are favored or weakened under certain choices
- to help frame a debate around the index

These tests also help to identify benefits and dis-benefits in the evaluation process: if we change one weight, how does that affect each stakeholder?

5.6.GRAPHIC REPRESENTATION OF EVALUATION OUTCOMES

Alternatives are evaluated under several themes, which are themselves divided itself into several objectives, and these objectives are evaluated through a range of indicators (cf. figure 3: implementation of step 6c). Therefore we can disaggregate the evaluation into three levels. The outcomes of our study should be the two main levels :

- Evaluation of alternatives general performance related to each theme

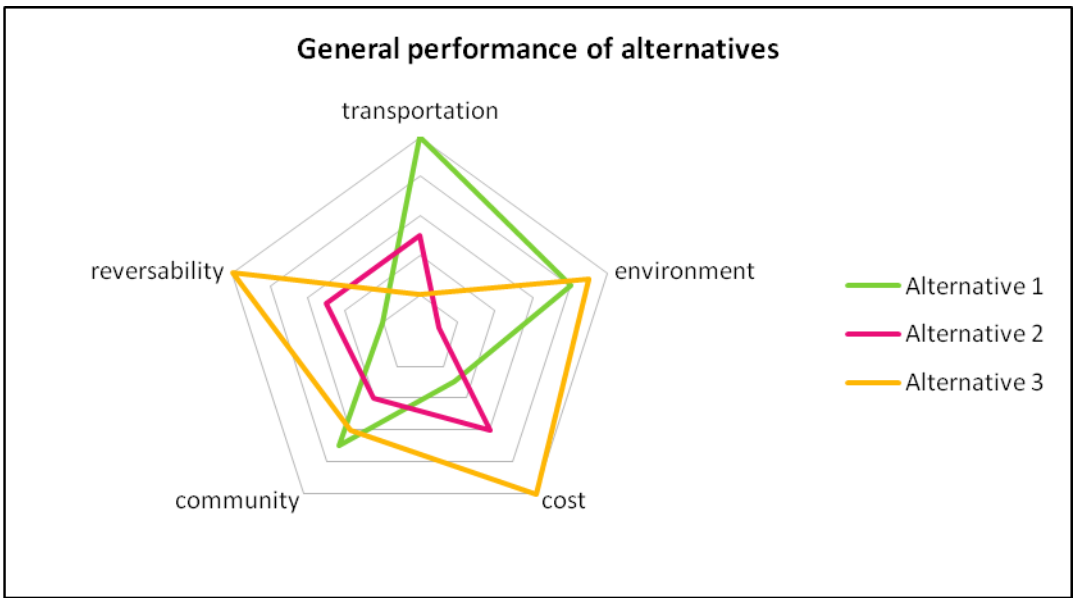


FIGURE5: EXAMPLE OF SPIDER DIAGRAM FOR THEMES

- Evaluation of performance of alternative for the objectives within the theme

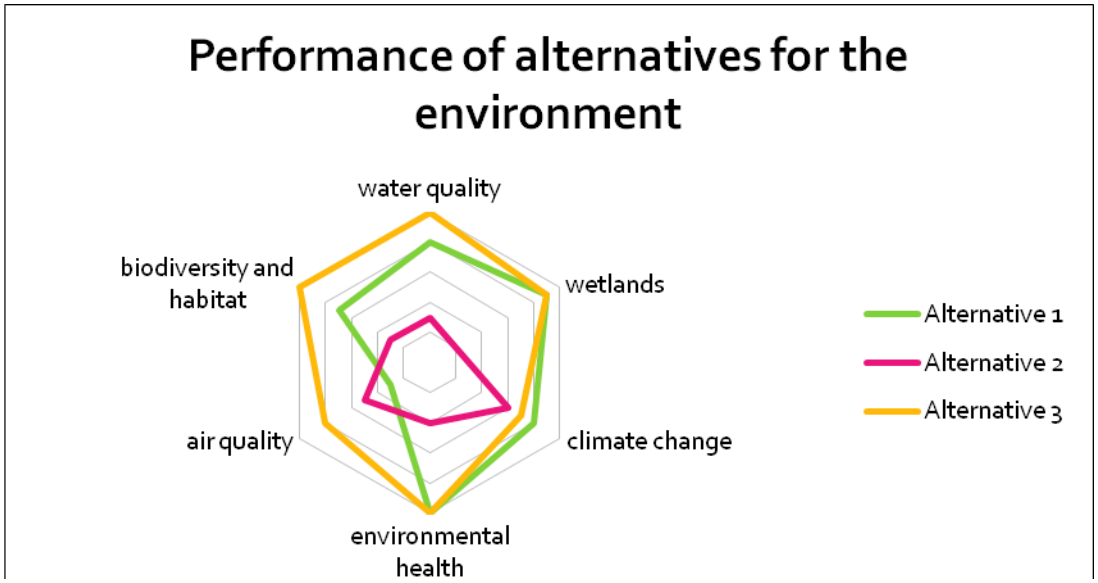


FIGURE 6 : EXAMPLE OF SPIDER DIAGRAM FOR ENVIRONMENTAL OBJECTIVES

The combination of these two levels will give a good sense of how each alternatives performing and it will also make it easier to discern benefits and dis-benefits. The use of spider diagrams like these is clear and it permits one to see how different alternatives are performing on multiple criteria and clearly distinguish strong and weak points of each alternative.

COMPARISON OF ALTERNATIVES

As shown in figures 5 and 6, we can compare alternatives with a spider diagram. Within the framework of sustainable development, the most circular alternative will be preferred as it shows equilibrium among criteria. A weak point of spider diagrams is that a change in the order of criteria can affect the perception of the performance. In order to mitigate this weakness, a number of criteria shown on the diagram must remain small (less than 8) and a matrix summarizing the evaluation will be presented in addition to spider diagrams.

At this point of the evaluation process, an identification of benefits and dis-benefits in each alternative could be made by identifying each stakeholder with his/her objectives. However, this might also not be useful in the decision process as some stakeholders will be characterized as beneficiaries which might lead to opposition to them by non-beneficiaries. In the crediting strategy proposed by CO6B however, designation of who benefits and does not is useful as this can be a basis to determine credits and then develop negotiation among relative beneficiaries.

6. CITATIONS AND RESOURCES

San Francisco Bay Conservation and Development Commission (BCDC), Draft Staff Report. Living With A Rising Bay: Vulnerability And Adaptation In San Francisco Bay And On the Shoreline, 2009. 175 pages.

Boulanger P.-M., Les indicateurs de développement durable : un défi scientifique, un enjeu démocratique. Les séminaires de l'Iddri,2004, n°12, Paris, avril 2004, p. 24.

Carraro C. , F, Ciampalini, C. Cruciani, S. Giove, E. Lanzi, Aggregation and Projection of Sustainability Indicators: a New Approach, Paper prepared for the OECD 3rd World Forum, 27-30 October 2009, Busan, Korea.

Department for Communities and Local Government: London. Multi-criteria analysis: a manual. 2009. 168 pages.

Forest Trends and Ecosystem Marketplace. Payments for Ecosystem Services: Market Profiles. PROFOR. 2008. 35 pages.

Groot, S. D. Environmental functions as a unifying concept for ecology and economics. Environmentalist, 1987. 7(2):105-109

Joumard R. and Gudmundsson H. (eds), Indicators of environmental sustainability in transport: an interdisciplinary approach to methods, INRETS report, Recherches R282, Bron, France, 2010. 422 p

Joumard R., Mancebo Quintana, S., Arapis, G., Zacharz, T., Chains of causalities of environmental impacts. Seminar COST 356 EST ‘‘Towards the definition of a measurable environmentally sustainable transport’’, 20 February 2008, Oslo, Norway. Proceedings, Institute of Transport Economics/TOI ed., Oslo, 2008, pp.9–21 (http://cost356.inrets.fr).

Joumard, Nicolas. Transport project assessment methodology within the framework of sustainable development. Ecological indicators, 2010, Volume 10, pages 136–142

Kerry Turner, Jeroen C. J. M. van den Bergh, et al., Ecological-economic analysis of wetlands: scientific integration for management and policy, Ecological Economics, 2000, Volume 35, Issue 1, October 2000, Pages 7-23

Lee, J.F.J., M. Springborn, S.L. Handy, J.F. Quinn and F.M. Shilling. Approach for economic valuation of environmental conditions ad impacts. Prepared for Caltrans. 2010. 124 pages

Mogridge, M. J. H., The self-defeating nature of road capacity policy. 1997. Transport Policy, Vol. 4, No. I, pp. 5-23

Nardo M., Saisana M., Saltelli A., Tarantola S., Hoffman A. and Giovannini E., Handbook on constructing composite indicators: methodology and users guide, 2005, OECD-JRC joint publication, OECD Statistics Working Paper, STD/DOC(2005)3, JT00188147, 108 p.

Navrud, S., and G. J. Pruckner. Environmental Valuation - to Use or Not to Use? A Comparative Study of the United States and Europe. Environmental and Resource Economics, 1997, 10:1-26.

NRC (National Research Council). Valuing Ecosystem Service. Washington, D.C.: The National Academies Press. 2005.

Redford, K. H. and W. M. Adams., Payment for ecosystem services and the challenge of saving nature. Conservation Biology, 2009. 23(4):785-787.

Singh, R. K., Murty, H. R., Gupta, S. K., & Dikshit, A. K. An overview of sustainability assessment methodologies. Ecological Indicators,2009, volume 9, pages 189-212.

Transportation Research Board, PROJECT C06(B): Development of an Ecological Assessment Process and Credits System for Enhancements to Highway Capacity, 2010, 88 pages

Transportation Research Board, Integration of Conservation, PROJECT C06(A): Highway Planning, and Environmental Permitting Using an Outcome-Based Ecosystem Approach, 2011, 189 pages

Woodward, Yong-Suhk Wui, The economic value of wetland services: a meta-analysis, Ecological Economics, 2001. Volume 37, Issue 2, May 2001, Pages 257-270

APPENDIX 8: ENVIRONMENTAL PERMITTING

Environmental Permitting for State Route 37 Alternatives

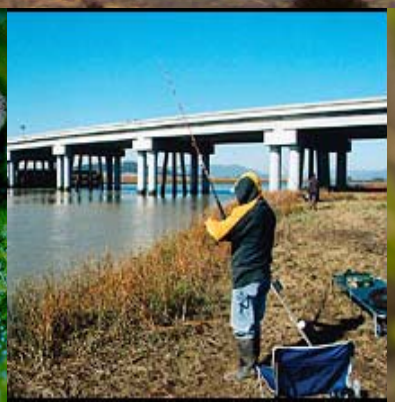
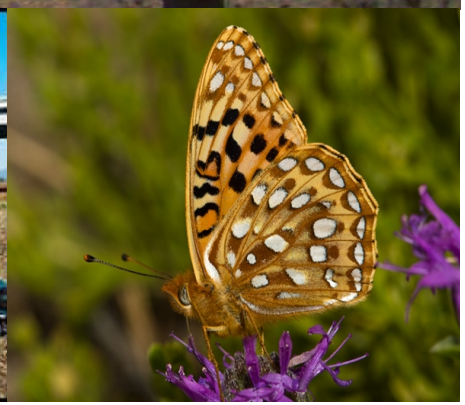
Office of Biological Sciences and Permits

Caltrans District 4

April 3, 2012

Image from en.wikipedia.org



SR 37 Alternatives

Marin, Sonoma, Solano
STATE OF CALIFORNIA
Department of Transportation

Prepared By: _____ Date: 04/03/12
Abdullah Arakozie, Associate Biologist
(510) 719-7493
Office of Biological Sciences Permits
District 4/California Department of Transportation

Reviewed By: _____ Date: 4/3/12
Stefan Galvez-Abadia, District Branch Chief
(510) 867-6785
Office of Biological Sciences Permits
District 4/California Department of Transportation

Approved By: _____ Date: 4/3/2012
Jeffrey G. Jensen, Office Chief
(510) 622-8729
Office of Biological Sciences Permits
District 4/Department of Transportation

Introduction

In January 2011 the State Route 37 (SR 37) Stewardship Study group, led by the University of California (UC) Davis Road Ecology Center, was established. Its role is to examine environmental and transportation-related issues critical for understanding and managing future sea level rise along SR 37 in Marin, Sonoma, and Solano counties in California. The study is funded by the Transportation Research Board (TRB) Strategic Highway Research Program. Primary research for this paper was conducted by the California Department of Transportation (Caltrans) District 4, Environmental and Transportation Planning staff. Stakeholders interested in identifying issues and constraints along the SR 37 corridor include environmental resource agencies, transportation agencies, and community groups. Envisioned as a starting point to facilitate discussions, this paper covers a brief review of sea level rise predictions in the Bay Area, the current environmental regulatory setting, anticipated permits, and mitigation for potential improvements to SR 37.

A broader goal of this study is to establish a framework for future estuary transportation corridor planning along SR 37 within the context of predicted sea level rise. Illustration of potential project impacts and considerations of permitting requirements can serve as a roadmap for design alternatives that minimize effects to the built and natural environment. Timely and informed interagency coordination is a key part of this process.

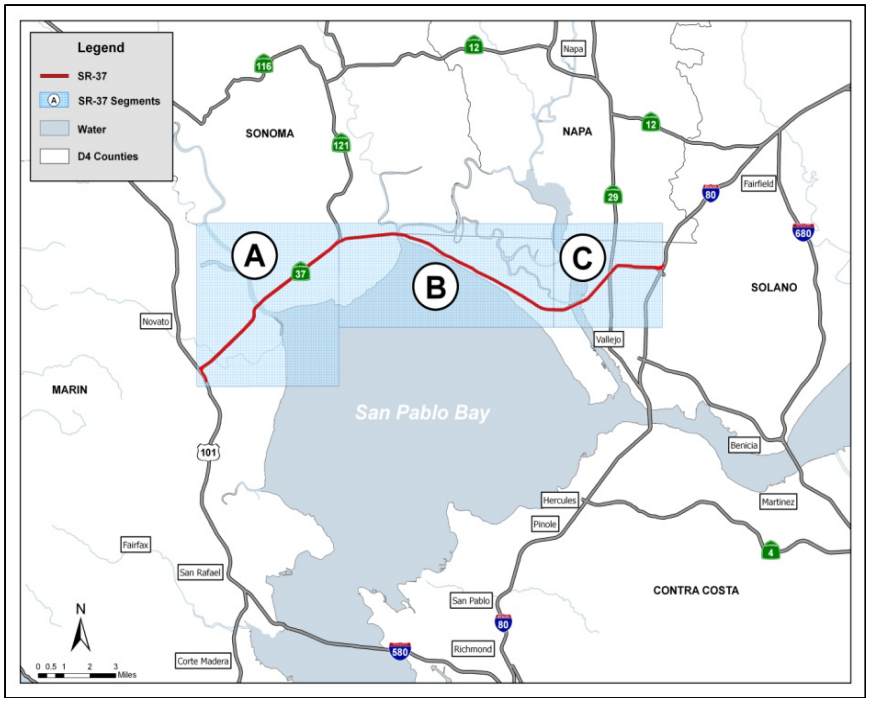
The environmental assessments in this report are conceptual and are intended as a first step in the planning process. As such, they should be considered general in nature and not project specific.

Project Location

SR 37 constitutes a major regional east-west vehicular transportation corridor in the northern Bay Area, connecting the North Bay from US 101 in Marin County to Interstate-80 (I-80) in Solano County. Stretching west to east for approximately 22 miles, SR 37 connects Novato in Marin County to Vallejo in Solano County. SR 37 runs along the northern shore of San Pablo Bay. It primarily serves commute and recreational traffic between Marin, Sonoma, and Solano Counties. San Pablo Bay and the San Pablo Bay National Wildlife Refuge are located to the north and south of SR 37. SR 37 runs through low-lying, lush marshlands that are home to endangered species such as the salt marsh harvest mouse and California clapper rail. The flourishing sloughs along SR 37 are also home to numerous migratory birds. SR 37 crosses wide, flowing rivers containing numerous haul outs sites that unite marine mammals and fish in San Pablo Bay. SR 37 bisects the Petaluma, Sonoma, and Napa Rivers. Numerous housing developments, ranches, vineyards, and recreational areas such as the Infineon Raceway are also located adjacent to SR 37.

Study Segments

Although specific designs to modify SR 37 have not been formally proposed, this study will consider a limited number of potential options. For analysis purposes, the existing route has been divided into three segments as shown on the map on the following page. Section A is a four-lane expressway. Section B is a two-lane conventional highway. Section C is a four-lane freeway.



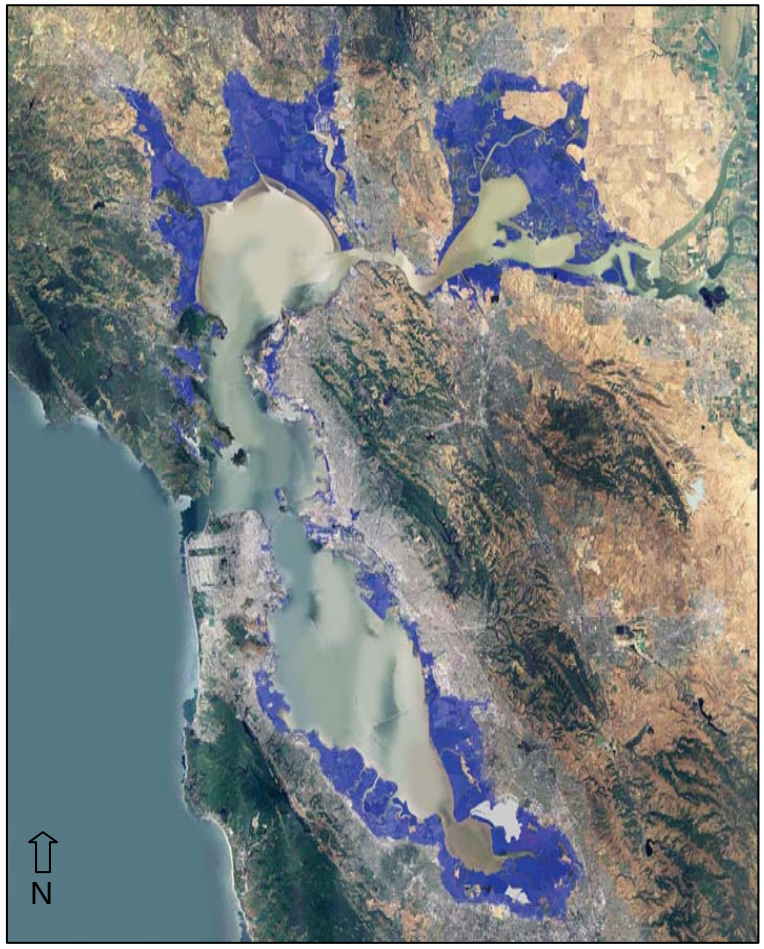
SR 37 divided into three segments.

Sea Level Rise

Future sea level rise poses a serious threat to residents and existing infrastructure in California, including the San Francisco Bay Area. On November 2008, Governor Schwarzenegger signed Executive Order S-13-08, directing state agencies planning construction projects in areas vulnerable to sea level rise to begin planning for potential impacts by considering a range of sea level rise scenarios for the years 2050 and 2100. On March 2011 Caltrans participated in the development of the first set of statewide sea level rise scenarios. These projections were adopted by the Ocean Protection Council. The projections estimated a 14 inch rise in sea levels by 2050, and a rise between 40-55 inches by 2100. Caltrans guidance on sea level rise and project development is documented in Guidance on Incorporating Sea Level Rise May 2011. This document was prepared by the Caltrans Climate Change Workgroup, and the Headquarters Divisions of Transportation Planning, Design, and Environmental Analysis, the document is used for the planning and development of Project Initiation Documents.

The concern over global warming has brought to the forefront future impacts of rising sea levels and related storm activity on land use and transportation facilities along SR 37, as well as in other areas around the San Francisco Estuary. Efficient management and future planning for SR 37 has been made more complex by sea level rise predictions. To protect public safety and natural ecosystems in areas that are vulnerable to future flooding, ideally all new transportation projects should be designed to be resilient to sea level rise projections. Resilient plans should include existing infrastructure, as well as the adjacent environment. Areas that are both vulnerable to future flooding and sustain significant habitats or wildlife species, or possess conditions that are suitable for ecosystem enhancement, should be given special consideration for preservation and habitat enhancement. There are a number of existing habitat restoration projects already established or underway near SR 37 for which any potential plans might need to consider.

Caltrans, the Metropolitan Transportation Commission (MTC), and the San Francisco Bay Conservation and Development Commission (BCDC) and other state agencies have already initiated discussions to formulate a regional sea level rise adaptation strategy for protecting shoreline areas. This study should serve as a component of the development of adaptive planning strategies for sea level rise in Marin, Sonoma, and Solano counties and the Bay Area region.



BCDC map projecting vulnerable areas, denoted in blue, in the case of a 55-inch end-of-century rise in sea levels. This BCDC map predicts what the Bay Area may look like in the year 2100.

Alternatives

The five conceptual alternatives for realignment of SR 37 considered in this paper to address future sea level rise include:

Alternative 1 – No highway expansion: manage the corridor with maintenance and repair activities and minor operational improvements;

Alternative 2 – Expanded footprint: the height and width of the corridor through SR 37 would double and the corridor would be expanded to four lanes to address current and projected future traffic volumes;

Alternative 3 – Napa-Sonoma causeway: Option 1 – the causeway may span over the existing footprint at areas of low elevation. Option 2 – the causeway may span across the San Pablo Bay between Novato and Vallejo;

Alternative 4 – Strategic re-alignment: The corridor would be re–aligned away from marshes & wetlands between Vallejo and Novato, with I–80 and 580 to the south, or with Highways 29 and 12/121/116 to the north; and

Alternative 5 – San Pablo Bay Tunnel: The corridor would be routed through a tunnel at the shortest feasible distance between Vallejo and Novato.

The five conceptual alternatives described above are identified only for preliminary discussion purposes. Other alternatives may be identified through public scoping, planning, and the environmental study process.

SR 37 near Infineon Raceway at Sears Point.

Studies

Pursuant to state and federal regulatory laws, Caltrans would prepare various technical studies and environmental reports for future transportation improvement on SR 37.

Environmental Review

If future projects include federal dollars, environmental studies and permits must be prepared in compliance with both the National Environmental Policy Act (NEPA) and the California Environmental Quality Act (CEQA). Federal Highway Administration's (FHWA) responsibility for environmental review, consultation, and any other action required in accordance with NEPA and other applicable federal laws for this project will be carried out by Caltrans under its assignment of FHWA responsibilities pursuant to 23 USC 327. This is referred to as NEPA Delegation.

NEPA

In August 2005, President Bush signed into law a federal transportation reauthorization bill called the Safe, Accountable, Flexible, Efficient Transportation Equity Act: A Legacy for Users (SAFETEA-LU). Two sections of the law allow Caltrans to assume FHWA responsibilities under NEPA and other federal environmental laws such as the Endangered Species Act and Section 106 of the National Historic Preservation Act. These programs offer the opportunity to test a streamlined environmental process.

Under the Section 6005 NEPA Delegation Pilot Program Memorandum of Understanding (MOU), Caltrans is now responsible for FHWA's responsibilities under NEPA as well as consultation and coordination responsibilities under other federal environmental laws. These responsibilities became effective July 1, 2007. Caltrans' Standard Environmental Reference was updated to reflect these responsibilities. To date, the pilot program has been extended until August 10, 2012.

Caltrans, under NEPA delegation serves as the lead federal agency under NEPA and as the state CEQA lead. Caltrans would typically prepare a joint NEPA-CEQA document. NEPA requires all federal agencies to consider environmental factors through a systematic interdisciplinary approach before committing to a course of action. The NEPA process is an overall framework for the environmental evaluation of federal actions. When preparing a joint document, the alternatives analysis must meet the NEPA standard. NEPA requires that all alternatives be analyzed and discussed to the same level of detail and is focused on the overall effects of the project as a whole. The level of document type is determined as early as possible during the scoping phase. For NEPA, if a project is determined to have significant effects on the quality of the human environment then an Environmental Impact Statement (EIS) will be prepared.

CEQA

CEQA, requires the project proponent identify each "significant effect on the environment" resulting from the project and ways to potentially mitigate each significant adverse effect. If the project may have a significant adverse effect on an environmental resource, or result in significant public controversy, then an Environmental Impact Report (EIR) may be prepared. Each and every significant effect on the environment must be disclosed in the EIR and mitigated, if feasible. In addition, the CEQA Guidelines list a number of mandatory Findings of Significance, which also require the preparation of an EIR.

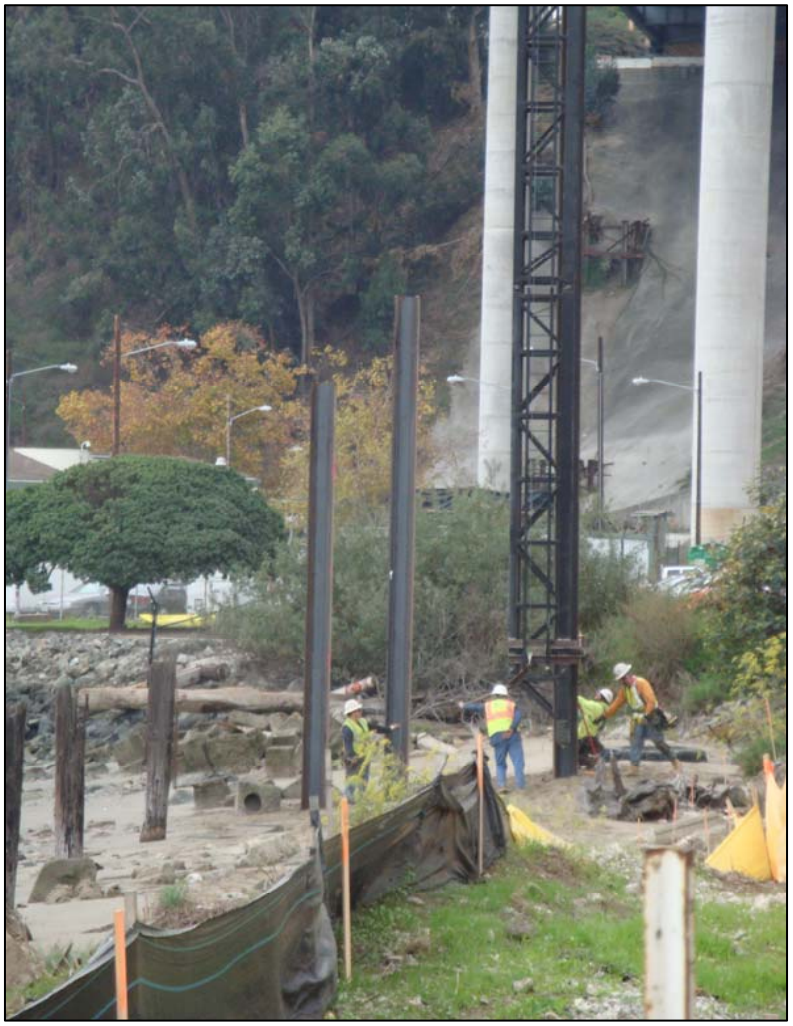
Section 4(f)

The Department of Transportation Act (DOT Act) of 1966 included a special provision - Section 4(f) - which stipulates that the FHWA and other DOT agencies cannot approve the use of land from publicly owned parks, recreational areas, wildlife and waterfowl refuges, or public and private historical sites unless there is no feasible and prudent alternative to the use of the land; or the action includes all possible planning to minimize harm to the property resulting from use.

In August 2005, Section 6009(a) SAFETEA-LU, made a key revision to Section 4(f). Section 6009, which amended existing Section 4(f) legislation at both Title 49 U.S.C Section 303 and Title 23 U.S.C. Section 138, simplified the process and approval of projects that have only de minimis impacts on lands impacted by Section 4(f). Under the new provisions, once the US DOT determines that a transportation use of Section 4(f) property results in a de minimis impact, analysis of avoidance alternatives are not required and the Section 4(f) evaluation process is complete. Section 6009 also required the US DOT to issue regulations that clarify the factors to be considered and the standards to be applied when determining if an alternative for avoiding the use of a Section 4(f) property is feasible and prudent.

4(f) consideration would most likely be part of the environmental documentation for one or more of the alternatives discussed here due to the presence of parks and protected lands in the vicinity of SR 37. The San Pablo Bay National Wildlife Refuge, managed by the U.S. Fish and Wildlife Service, is also located in Sonoma and Solano counties. Recently, approximately 3,300 acres of the former Skaggs Island Naval facility were transferred from the U.S. Navy to the U.S. Fish and Wildlife Service to be included in the San Pablo Bay National Wildlife Refuge. In Marin county SR 37 sits adjacent to the Petaluma Marsh Wildlife Area. This land is managed by the California Department of Fish and Game. In Sonoma County, SR 37 is located adjacent to the Napa-Sonoma Marshes Wildlife Area which is also managed by the California Department of Fish and Game. The areas noted above are also designated in the San Francisco Bay Plan as wildlife refuge priority use areas. A map indicating the location of 4(f) properties has been included as Attachment 1. Caltrans would be responsible for determining whether 4(f) is triggered and preparing the appropriate level of documentation.

The San Pablo National Wildlife Refuge is home to salt marsh harvest mice, black rails, and many other migratory shorebirds.



Pile driving, shown above, is one of the impacts that Caltrans mitigated for on the San Francisco-Oakland Bay Bridge Project.

Regulatory Approvals

Obtaining regulatory approvals can take anywhere from three to twelve months, or longer depending on the complexity of the project and the type and number of resources affected. As a federal and state lead agency, permit applications for capital improvement projects are typically prepared and submitted by the Caltrans District 4 Office of Biological Sciences and Permits. Permits are prepared based on information from consultation with state and federal resource agencies, species experts, literature searches, plant and wildlife surveys, wetland delineations, and impact analyses. The District biologist serves as the key liaison with resource and regulatory agency staff regarding the impacts to environmental resources. Agencies may request information on the following items as they relate to proposed improvements:

- Wetland delineations
- Species surveys
- Habitat assessments
- Cultural resource assessments
- Hydrological studies
- Plans that include existing culverts and engineering drawings of new water crossings which must be assessed for fish passage barriers (pursuant to Senate Bill 857)
- Staging and access areas
- Construction equipment and methodology
- Bay fill
- Public access
- Dredging
- Excavation
- Maintenance
- Avoidance and minimization efforts

- Best management practices (BMPs)
- Compensatory mitigation

Attachment 2 lists specific information that may be requested by regulatory and resource agencies for proposed improvements.

Surveys and studies may be conducted to obtain baseline information on natural resources that could be affected directly and indirectly by the proposed project. During the Caltrans Project Approval and Environmental Document (PA&ED) phase and prior to the Ready to List (RTL) phase, permits would be negotiated and secured from state and federal resource and regulatory agencies. These permits are required for the Plans, Specifications, and Estimate (PS&E) bid package to ensure that potential contractors are aware of any permit conditions that may restrict the manner, methods, or timing of construction activities that could affect their bid offer. Caltrans ensures that permit conditions are “buildable and biddable” and are reasonable and appropriate given the type and extent of potential effects to natural resources.

Permits from the following agencies may be required:

California Department of Fish and Game

Under Section 1600 of the Fish and Game Code, the California Department of Fish and Game (CDFG) regulate activities that would alter the flow, bed, channel or bank of streams and lakes by issuing Streambed Alteration Agreements. In riparian areas, jurisdiction is usually limited by the tops of the stream or lake banks or the outer edge of riparian vegetation, whichever is wider. Because it is an agreement rather than a permit, both parties must stipulate that they agree to the terms and conditions.

CDFG also regulates all native species of fishes, amphibians, reptiles, birds, mammals, aquatic invertebrates, and plants, and their habitats. Species and habitats that are threatened with extinction and those experiencing a significant decline which, if not halted, would lead to a threatened or endangered designation, will be protected or preserved under the California Endangered Species Act (CESA). CDFG works with Caltrans to protect and preserve such sensitive resources and their habitats.

Caltrans worked with CDFG to mitigate for temporary and permanent impacts to giant garter snake habitat for the Antioch Bridge Seismic Retrofit Project.

Section 2080 of the Fish and Game Code prohibits "take" of any species that the Commission determines to be an endangered or threatened species. Take is defined in Section 86 of the Fish and Game Code as "hunt, pursue, catch, capture, or kill, or attempt to hunt, pursue, catch, capture, or kill."

CESA allows for take incidental to otherwise lawful development projects. CESA emphasizes early consultation to avoid potential impacts to rare, endangered, and threatened species and to develop appropriate mitigation to offset potential losses of state listed species and their essential habitats.

The classification of 'fully protected" was the state's initial effort in the 1960s to identify and provide additional protection to those animals that were rare or faced possible extinction. Fully protected species may not be taken or possessed at any time and no licenses or permits may be issued for their take except for collecting these species for necessary scientific research. Measures to avoid impacts to fully protected species can include specific work windows throughout the year, maintenance of habitat/fish passage during construction, erosion control, Best Management Practices, avoidance and minimization measures, and other water quality protective measures. In addition, impacted habitat for fully-protected species must be restored and/or new habitat must be created following construction. No permit may authorize the take of fully protected species. If a project is planned in an area where a fully-protected species occurs, an applicant must design the project to avoid all take, CDFG cannot provide take authorization for the species under CESA.

Compensatory mitigation may occur at different ratios for temporary and permanent impacts to federally and state-listed species. On-site restoration is generally preferred for temporary/permanent impacts to listed species. However, if mitigation ratios exceed a 1:1 ratio, the remaining mitigation for impacts may be provided by preservation or restoration of an off-site area. The off-site habitat must be suitable to the listed species that may be impacted as a result of a project.

Caltrans is required to comply with the California Fish and Game Code and CESA. Caltrans must contact CDFG regarding any potential Section 1600and CESA impacts. CDFG approvals for Section 1600 and CESA issues are coordinated through the Caltrans Office of Biological Sciences and Permits.

Owl boxes were placed on site at the Antioch Bridge Seismic Retrofit Project to mitigate for owls that may have lost roosting habitat, such as this barn owlet, as a result of the project.

State Water Resources Control Board and Regional Water Quality Control Boards

The State Water Resources Control Board (SWRCB) administers water rights, water pollution control, and water quality function throughout the state. Regional Water Quality Control Boards (RWCQB) are responsible for protecting beneficial uses of water resources within their regional jurisdiction using planning, permitting, and enforcement authorities to meet this responsibility.

The 401 permit certifications are obtained from the RWQCB, dependent on the project location, and are required before USACE issues a 404 permit.
In some cases the RWQCB may have specific concerns with discharges associated with a project. As a result, the RWQCB may issue a set of requirements known as Waste Discharge Requirements (WDRs) under the State Water Code that define

activities, such as the inclusion of specific features, effluent limitations, monitoring, and plan submittals that are to be implemented for protecting or benefiting water quality. WDRs can be issued to address both permanent and temporary discharges of a project.

RWQCB also administers the Construction General Permit (CGP). Under the CGP Caltrans is required to develop storm water pollution prevention plans to implement sediment, erosion, and pollution prevention control measures; and to obtain coverage under the CGP.

The CGP separates projects into Risk Levels 1, 2, or 3. Risk levels are determined during the planning and design phases, and are based on potential erosion and transport to receiving waters. Requirements apply according to the Risk Level determined. A Risk Level 3 project (highest risk), which would be most likely for the conceptual alternatives being discussed, would require compulsory storm water runoff pH and turbidity monitoring, and before construction and after construction aquatic biological assessments during specified seasonal windows. Caltrans would also be required to develop and implement an effective Storm Water Pollution Prevention Plan (SWPPP) in accordance with Caltrans Standard Specifications

San Francisco Bay Conservation and Development Commission

The San Francisco Bay Conservation and Development Commission (BCDC) was created by the California Legislature in 1965 in response to broad public concern over the future of San Francisco Bay. Through the McAteer-Petris Act BCDC addresses issues such as shoreline public access and recreation, terrestrial and marine habitat protection, visual resources, landform alteration, agricultural lands, commercial fisheries, industrial uses, water quality, and transportation development design.

Section 66605 (a) of the McAteer-Petris Act finds and declares, in part, " that further filling of the San Francisco Bay should be authorized only when public benefits from fill clearly exceed public detriment from the loss of the water areas and should be limited to water-oriented uses such as ports, water-related industry, airports, bridges, wildlife refuges, water-oriented recreating, and public assembly, water intake and discharge lines for desalinization plants and power generating plants requiring large amounts of water for cooling purposes or minor fill for improving shoreline appearance or public access to the Bay."

Section 66605 (b) states that "fill in the Bay and certain waterways for any purpose should be authorized when no alternative upland location is available for such purpose."BCDC has regulatory authority over Bay fill, dredging, and development in the Bay along a 100-foot shoreline band. In addition, BCDC regulates priority use areas for ports, wildlife and recreation. These are areas that have been reserved in the San Francisco Bay Plan for such uses to avoid future filling of San Francisco Bay. BCDC also administers the Suisun Marsh Protection Plan and various special area plans. All of these policies and plans comprise BCDC's federally mandated Coastal Zone Management Plan.

For the Sonoma Creek Bridge Widening Project Caltrans created a vista point for wildlife viewing adjacent to SR 37.

The BCDC permit process ensures that development projects are consistent with the policies set forth in the San Francisco Bay Plan and other area plans. The BCDC permit process is used to protect Bay-related resources and may require that impacts to Bay-related resources be minimized and/or avoided, or mitigated. Caltrans is required to obtain a major or minor permit for most activities within BCDC jurisdiction.

A major permit is issued for work that is more extensive than a minor repair or improvement. A public hearing is held on an application for a major permit and the application may be reviewed at hearings held by a 27 member commission. A minor permit can be issued for an activity that qualifies as a minor repair or improvement in a relatively short period of time and without a public hearing on the application.

BCDC approvals for Bay fill or development will be limited due to Section 66605 of the McAteer-Petris Act. BCDC has not authorized solid fill for a roadway as roadways are not considered to be water-oriented uses or consistent with the Public Trust Doctrine. However, BCDC has authorized solid fill for bridges as bridges are defined as water oriented uses.

Development standards within BCDC jurisdiction address the use of shoreline, public access, and appearance. These standards may result in certain BCDC permit conditions. For example, BCDC may require access for all users, including bicyclists and pedestrians, for construction of a new bridge. Other requirements may include permanent dedication of public access and/or viewing areas near the Bay or other natural resources, additions to the Bay Trail, or signage to improve way-finding around the shoreline. Caltrans may also be required by BCDC to mitigate the potential impacts to public access, open space, or natural resources with ecological value. Mitigation measures may include the creation, enhancement, or funding of public access, open space, wildlife habitat or the removal of Bay fill. In the Bay Plan, BCDC has designated SR 37 as a scenic drive and numerous areas to the north and south of SR 37 as wildlife refuge priority use areas.

Public access improvements along the San Francisco Bay provided by Caltrans.

United States Fish and Wildlife Service

The United States Fish and Wildlife Service (USFWS) mission is to protect wildlife resources. Through the effective enforcement of the federal Endangered Species Act, USFWS works to recover endangered species, conserve migratory birds, preserve wildlife habitat, safeguard fisheries, combat invasive species, and promote international wildlife conservation.

The Endangered Species Act (ESA) directs all federal agencies to work to conserve endangered and threatened species and to use their authorities to further the purposes of the Act. Section 7 of the Act, called "Interagency Cooperation," is the mechanism by which federal agencies ensure the actions they take, including those they fund or authorize, do not jeopardize the existence of any listed species.

Under Section 7, as the federal lead agency, Caltrans may consult with USFWS when any action it carries out, funds, or authorizes (such as through a permit) *may affect* a listed endangered or threatened species. This process usually begins as informal consultation. Caltrans, in the early stages of project planning, approaches USFWS and requests technical assistance. Discussions between the two agencies may include the types of listed species that may occur in the proposed action area, and what effect the proposed action may have on those species.

If Caltrans, as the federal lead agency, determines the proposed action has no effect on federally listed species no further action is required.

If Caltrans, after discussions with USFWS, determines the proposed action is not likely to adversely affect any listed species in the project area, and if USFWS concurs in writing, the informal consultation is complete and the proposed project moves ahead. If it appears that the proposed action may affect a listed species, Caltrans may then prepare a Biological Assessment to assist in its determination of the project's effect on a species.

When Caltrans determines, through a Biological Assessment or other review, that its action is *likely to adversely affect* a listed species, Caltrans submits to USFWS a request for formal consultation. During formal consultation, USFWS and Caltrans share information about the proposed project and the species likely to be affected. Formal consultation may last up to 90 days, after which USFWS will prepare a Biological Opinion (BO) on whether the proposed activity will *jeopardize* the continued existence of a listed species. USFWS has 45 days after completion of formal consultation to write and issue the BO.

Caltrans, CDFG, and USFWS worked collaboratively to protect two clutches of barn owlets that successfully fledged during construction at the Antioch Bridge Seismic Retrofit Project. Barn owls are not a listed species, however since they are subject to the Migratory Bird Treaty Act a 250-ft no work buffer was maintained throughout construction.

In making a determination on whether an action will result in jeopardy, USFWS begins by looking at the current status of the species, or "baseline." Added to the baseline are the various effects – direct, indirect, interrelated, and interdependent – of the proposed action. USFWS also examines the cumulative effects of other actions that may occur in the action area, including state, tribal, local, or private activities that are reasonably certain to occur in the project area.

USFWS analysis is then measured against the definition of jeopardy. Under the ESA, jeopardy occurs when an action is reasonably expected, directly or indirectly, to diminish a species' numbers, reproduction, or distribution so that the likelihood of survival and recovery in the wild is appreciably reduced.

When USFWS makes a jeopardy determination, it also provides Caltrans with reasonable and prudent alternative actions. These alternatives are often developed with input and assistance from the federal agency. Alternatives must:

- Be consistent with the purpose of the proposed project;
- Be consistent with Caltrans' legal authority and jurisdiction;
- Be economically and technically feasible; and
- Avoid jeopardy.

In some cases, USFWS finds that an action may adversely affect a species, but not jeopardize its continued existence. When this happens, USFWS prepares an incidental take statement for the proposed project. Under most circumstances, the ESA prohibits take, which is defined as harming (includes killing) or harassing a listed species. Incidental take – take that results from a federal action but is not the purpose of the action – may be allowed when USFWS approves it through an incidental take statement. The statement includes the amount or extent of anticipated take due to the action, reasonable and prudent measures to minimize the take, and terms and conditions that must be observed when implementing those measures.

After USFWS issues its BO, Caltrans then decides how to proceed. With a BO that determines adverse effects, Caltrans can adopt the reasonable and prudent measures outlined in an incidental take statement and proceed with the project. If USFWS makes a jeopardy determination, which is rare, Caltrans has several options:

- Implement one of the reasonable and prudent alternatives;
- Modify the proposed project and consult again with USFWS;
- Decide not to undertake (or fund, or authorize) the project;
- Disagree with the opinion and proceed; and
- Apply for an exemption.

A multi-species Biological Assessment would likely be completed for any of the alternatives to SR 37 since federally-listed species are within the potential action area and may be subject to incidental take. The Biological Assessment must be submitted to USFWS during the PA&ED phase and the final BO must be issued to finalize the environmental document.

A Peregrine falcon at the Antioch Bridge Seismic Retrofit Project.

The USFWS also administer the Migratory Bird Treaty Act (MBTA), the law of migratory bird conservation and protection in the United States. The MBTA implements four treaties that provide for international protection of migratory birds. It is a strict liability statute wherein proof of intent is not an element of a taking violation. Wording is clear in that most actions that result in a "taking" or possession (permanent or temporary) of a protected species can be a violation. State transportation projects adjacent

to SR 37 may have potential impacts to migratory birds. Caltrans is required to comply with the MBTA. The MBTA prohibits the taking, killing, possession, transportation, import and export of migratory birds, their eggs, parts, and nests, except when specifically authorized by the Department of the Interior." The word "take" is defined as "to pursue, hunt, shoot, wound, kill, trap, capture, or collect, or attempt to pursue, hunt, shoot, wound, kill, trap, capture, or collect."

National Oceanic Atmospheric Administration—National Marine Fisheries Service

The National Oceanic and Atmospheric Administration's National Marine Fisheries Service (NOAA – NMFS), administers the Magnuson-Stevens Fishery Conservation and Management Act (MSA). The MSA establishes jurisdiction over marine fisheries through Fishery Management Plans with provisions for Essential Fish Habitat (EFH). EFH includes waters and substrate necessary to fish for spawning, breeding, feeding, or growth to maturity. EFH evaluations clearly identify and distinguish from other consultation information, such as that for Section 7 ESA.

NOAA-NMFS and the USFWS share responsibility for implementing the ESA. Generally, USFWS manages land and freshwater species, while NMFS manages marine and "anadromous" species. NOAA-NMFS has jurisdiction over 82 listed species. Anadromous fish such as steelhead and green sturgeon occur within the waterways adjacent SR 37.

NMFS also administers the Marine Mammal Protection Act (MMPA), which prohibits the taking of marine mammals. The MMPA was amended in 1994 to establish a process to apply for an authorization to incidentally take small numbers of marine mammals by "harassment" (Incidental Harassment Authorizations or IHA's). IHA's entail monitoring and reporting, including requirements for the independent peer-review of proposed monitoring plans where the planned activity may affect the availability of a species or stock for taking for subsistence uses. An IHA is not a permit to conduct an activity; rather it is an authorization to incidentally take marine mammals that are otherwise prohibited by the MMPA.

Caltrans is required to comply with the Magnuson-Stevens Fishery Conservation and Management Act and the Marine Mammal Protection Act.

United States Coast Guard

Federal law prohibits the construction of any bridge across navigable waters of the United States unless first authorized by the United States Coast Guard (USCG). USCG approves the location and clearances of bridges through the issuance of bridge permits or permit amendments, under the authority of the General Bridge Act of 1946, Section 9 of the Rivers and Harbors Act of 1899, and other statutes. This permit is required for new construction, reconstruction or modification of a bridge or causeway over waters of the United States. Issuance of a permit is dependent on the applicant receiving 401 Water Quality Certification, Biological Assessment/Opinion, and NEPA documentation. A bridge permit may be required for state projects that will occur on SR 37 adjacent to or over the Petaluma River, Napa River, and Sonoma River. All proposed alternatives at this point in time will have improvements adjacent to these bodies of water.

The Carquinez Bridge Seismic Retrofit Project required permits from USCG and USACE. These permits will likely be required for work along SR 37.

United States Army Corps of Engineers

In 1977 Congress enacted the Clean Water Act (CWA) to restore and maintain the chemical, physical, and biological integrity of the nation's waters. One of the mechanisms adopted by Congress to achieve that purpose is a prohibition on the discharge of any pollutants, including dredged or fill material, into "navigable waters" except in compliance with other specified sections of the Act. In most cases, this means compliance with a permit issued pursuant to CWA §401, §402 or §404. The Act defines the term "discharge of a pollutant" as "any addition of any pollutant to navigable waters from any point source" and provides that the term 'navigable waters' means the waters of the United States, including the territorial seas.

Section 401 of the CWA requires all applicants for a federal license or permit to conduct any activity that may result in a discharge to navigable waters, controlled by the USACE, must acquire a Section 401 certification. The certification declares that the discharge will comply with applicable provisions of the Act, including water quality standard requirements.

Section 402 implements the National Pollutant Discharge Elimination System (NPDES). Under this system a permit is required for all discharges of pollutants from a point source into jurisdictional waters of the United States.

Section 404 of the CWA establishes permit programs administered by the USACE regulating the discharge of dredged or fill material into waters of the United States (including wetlands). Guidelines for implementation are referred to as the Section 404 (b) (1). Guidelines and were developed by the Environmental Protection Agency (EPA) in conjunction with USACE (40 CFR Parts 230). The guidelines allow the discharge of dredged or fill material into the aquatic system only if there is no practicable alternative that would have less adverse impacts.

Section 10 of the Rivers and Harbors Act is administered by USACE. This section requires permits in navigable waters of the U.S. for all structures such as riprap and activities such as dredging.

The Petaluma, Sonoma, and Napa Rivers are all navigable waters. Navigable waters are defined as those subject to the ebb and flow of the tide and susceptible to use in their natural condition or by reasonable improvements as a means to transport interstate or foreign commerce. USACE grants or denies permits based on the effects on navigation. Most activities covered under this act are also covered under Section 404 of CWA.

A Section 404 permit is required from USACE when a project requires fill or other modification of waters, including wetlands. There are two types of permits issued by USACE, individual and general. Individual permits are the most complex. They cover projects affecting more than three acres, resulting in potentially significant impacts. The process of obtaining an individual permit usually takes several months. Special conditions of the permit

may include mitigation for impacts to jurisdictional wetlands that need to be monitored for a five to ten year period for the most complex and/or controversial projects. There are two types of general permits, nationwide and regional. Nationwide permits cover a wide variety of activities with minimal impacts (less than three acres, 500 feet of lineal stream). Nationwide permits may take two to three months, or more, to obtain. Regional permits are wide ranging, blanket permits used to cover roadside ditch maintenance activities, for example, for a designated geographic area. Regional permits may take months to prepare; however, they save time in the long run for small activities such as routine maintenance.

Initiation of a request for a USACE permit to affect wetlands involves other resource and regulatory agencies as a part of the interagency review process. USACE submits permit applications to the EPA, CDFG, NMFS, and USFWS for review and comment. Time periods and extent of commenting required by these agencies varies depending upon the permit type. Individual permits are the most lengthy and involved.

Proposed improvements to SR 37 would require a permit from USACE. All alternatives would require widening of the existing route, or placing fill in USACE jurisdictional areas. Caltrans must comply with Federal and State environmental laws and regulations designed to protect all biological resources in all phases of project planning and development, construction, permitting, and maintenance. This includes, but is not limited to the CWA and Section 10 of the Rivers and Harbors Act.

A table with additional permitting agencies, permits and statutory authorities has been included in this document as Attachment 3.

California Office of Historic Preservation

All of the proposed alternatives would need to be surveyed for cultural resources (archaeological and architectural history) pursuant to Section 106 of the National Historic Preservation Act. Identification efforts would include an assessment of the significance of any known resources within the project limits, identification of new or previously unknown resources, and appropriate Native American consultation. Caltrans studies would include a Historic Properties Survey Report, Archaeological Survey Report, and a Historic Resources Inventory Report. If planned impacts for the project have the potential to adversely affect significant resources, consultation will be required with the State Historic Preservation Officer (SHPO) at the Office of Historic Preservation (OHP). In the case of an Adverse Effect determination, additional documents including a Finding of Effect, Memorandum of Agreement, and a Data Recovery Plan may be appropriate. Mitigation and minimization measures could include, but are not limited to, environmentally sensitive area fencing and/or data recovery activities. Execution of studies through concurrence from the SHPO on the project findings may take up to twenty-four months. There is no statutory time limit for the approval of a Memorandum of Agreement with the State Historic Preservation Officer.

The OHP administers state and federal historic preservation programs and provides technical assistance to federal, state, and local government agencies, organizations, and the general public with regard to historic preservation programs designed to *identify*, *evaluate*, *register*, and *protect* California's historic resources.

Caltrans staff screens dirt for artifacts on an archaeological excavation as part of a testing phase for determination of eligibility for the National Register of Historic Places.

OHP also serves as staff to the State Historical Resources Commission (SHRC), a state review board appointed by the governor, which is responsible for reviewing nominations to the four federal and state registration programs administered by OHP.

Created by the National Historic Preservation Act of 1966, OHP is funded by an annual grant from the Historic Preservation Fund (HPF) administered by the National Park Service, Department of the Interior, with matching funds from the State of California. OHP reviews and comments on federally sponsored projects annually pursuant to Section 106 of the National Historic Preservation Act and state programs and projects pursuant to Sections 5024 and 5024.5 of the Public Resources Code. OHP also reviews and comments on local government and state projects pursuant to the California Environmental Quality Act (CEQA).

The National Historic Preservation Act, as amended (NHPA) sets forth national policy for protecting historic properties. Under Section 106 of NHPA, federal agencies are mandated to take into account the effect of federal under-takings on historic properties owned by federal agencies or affected by federally funded or federally approved undertakings.

For most projects, Caltrans uses an alternative process for compliance with Section 106. On January 1, 2004 the *Programmatic Agreement Among the Federal Highway Administration, the Advisory Council on Historic Preservation, the California State Historic Preservation Officer, and the California Department of Transportation Regarding Compliance with Section 106 of the National Historic Preservation Act as it Pertains to the Administration of the Federal-Aid Highway Program in California (Section 106 PA)* went into effect. It streamlines the Section 106 process for FHWA-assisted state and local projects in California. All actions taken under the Section 106 PA must be conducted by or under the supervision of Caltrans Professionally Qualified Staff. Consultants who conduct studies and prepare Section 106 reports are encouraged to consult with Caltrans Professionally Qualified Staff early in the process.

Data recovery excavation of an archaeological feature at a prehistoric site.

Compensatory Mitigation

Federal and state laws generally require that new projects must protect the environment. Caltrans must avoid and minimize impacts to sensitive natural resources. If impacts cannot be avoided or minimized, Caltrans may be required to enhance, restore or create habitat as compensatory mitigation. If it is not possible to mitigate natural resource impacts on-site, off-site mitigation may be appropriate. Compensatory mitigation may include purchasing credits at a mitigation bank on-site or off-site. This may be a one-time payment for the purchase of the credits, or require management of the site. Management of the site may be for a specific number of years or in perpetuity. Resource agencies and Caltrans may negotiate ratios for compensation and the duration of management/monitoring based on the level of impacts, the type of impacts, the location of the impacts, and the sensitivity of the affected environmental resources. Mitigation ratios for purchasing credits can range from 1:1 to 3:1. Generally if mitigation is on-site the ratios will be at a lower level. Compensation for impacts must often be executed prior to the start of construction or commensurate with project impacts. Caltrans must complete assessments for all of the proposed alternatives. Once the impacts are quantified, mitigation sites must be found and secured to offset unavoidable impacts to specific environmental resources.

Impacts on the Antioch Bridge Seismic Retrofit Project were limited to giant garter snake habitat. Prior to construction, giant garters snake credits were purchased by Caltrans at the Beach Lake Mitigation Bank. (Source: Defenders Magazine, fall 08)

Constraints

Significant environmental constraints exist within or adjacent to SR 37 and the areas considered for the conceptual alternatives. The Office of Biological Sciences and Permits would perform initial reviews of the existing environmental baseline as well as pre and post-construction surveys to determine potential impacts to environmental resources. Early awareness of environmental constraints facilitates identifying avoidance and minimization measures and design strategies during the project development for each alternative. The project's schedule, cost and

environmental document type are directly related to environmental impacts. Development of environmentally-friendly alternatives ensures impacts and mitigation are minimized. Potential impacts associated with the improvements to SR 37 must be explored for each alternative. Consideration of environmental constraints will help to reduce the risk of increasing cost, or altering project schedule, scope, and alternatives late in the project development process.

Wetlands

Under the Clean Water Act, the term wetlands means "those areas that are inundated or saturated by surface or groundwater at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions. Wetlands generally include swamps, marshes, bogs and similar areas."

USACE, EPA, and USFWS have developed the definition most commonly used by federal, state, and local agencies. The USACE and EPA definition for a wetland is used most often throughout the United States because of the USACE's direct permit authority over development in wetlands and deepwater areas.

The USACE definition is often referred to as a "three-parameter definition" because three key parameters: hydrology, soil, and vegetation must all occur and meet the defined characteristics in order for a location to be classified a wetland.

Executive Order 11990, Protection of Wetlands, establishes a national policy to avoid adverse impacts on wetlands whenever there is a practicable alternative. On federally funded projects, impacts on wetlands must be identified in the environmental document. Alternatives that avoid wetlands must be considered. If wetland impacts cannot be avoided, then all practicable measures to minimize harm must be included.

Environmental constraints of the surrounding wetlands will create a complex regulatory environment. Wetlands are protected by state and federal agencies under the McAteer-Petris Act, Native Plant Protection Act, Public Trust Doctrine, Porter-Cologne Act, and the Clean Water Act. Altering or modifying wetlands, habitats, and public lands requires coordination with state and federal resource and regulatory agencies, environmental interest groups, landowners, property managers, and local businesses.

Bay fill for roadways

BCDC has regulatory authority over Bay fill, dredging, and development in the Bay and along a 100-foot shoreline band. BCDC approvals for Bay fill or development will be limited due to Section 66605 of the McAteer-Petris Act which states that further filling of San Francisco Bay should be limited to water-oriented uses such as ports, water-related industry, airports, bridges, wildlife refuges, water-oriented recreation, water intake and discharge lines for desalinization plants and power generating plants requiring large amounts of water for cooling purposes or minor fill for improving shoreline appearance or public access to the Bay. Solid bay fill for roadway improvements is not allowed under the McAteer Petris Act. However, fill for bridges is permissible as these are water-oriented uses. Solid fill for some alternatives may require special legislation.

Listed species/habitat

Additional environmental constraints to this project also include threatened and endangered species and their habitats. Threatened and endangered species are protected under the state and federal Endangered Species Acts. The presence of these species must be considered and may induce specific avoidance and minimization measures. Threatened and endangered species and their habitats adjacent to SR 37 will have to be protected from direct and indirect impacts that may be as a result of improvements to SR 37. Permitting agencies would

expect to see measures which minimize and avoid take of habitat and species for each alternative.

Salt marsh harvest mouse (source: http://en.wikipedia.org/wiki/Salt_Marsh_Harvest_Mouse)

Alternatives 2, 3, and 5 would all likely have direct and indirect impacts on listed species located within the vicinity of SR 37. All three alternatives would likely require staging, dewatering, excavation, pile-driving, and placing fill in the Bay. Species that may be affected include but are not limited to:

- Delta smelt
- Green sturgeon
- California black rail
- California clapper rail
- Salt marsh harvest mouse

Alternative 4 would abandon or relinquish SR 37 and reroute traffic to SR 12 and SR 116 to the north, or I-80 and SR 580 to the south and may require improvements to these facilities. Listed species that are located within the vicinity of these two facilities include, but are not limited to:

- Steelhead
- Delta smelt
- California freshwater shrimp
- California red-legged frog
- Salt marsh harvest mouse
- Swainson's hawk
- Contra Costa goldfields

Haul out sites

Seals and other marine mammals have been documented on the Petaluma, Sonoma, and Napa Rivers as well as in San Pablo Bay. Marine mammals such seals live in temperate coastal habitats and use rocks, reefs, and beaches as haul out and/or pupping sites. Seals haul out on land for rest, thermal regulation, social interaction, and to give birth. Seals also haul out to avoid predators. A habitat assessment will be required to determine where specific habitat and haul out sites may exist adjacent to any state transportation projects along SR 37 and Caltrans may need to implement measure to protect seals and haul out sites under the Marine Mammal Protection Act.

California clapper rail. (source: pauldonahue.net)

Wildlife refuges

Numerous wildlife refuges exist along SR 37. In Marin county SR 37 sits adjacent to the Petaluma Marsh Wildlife Area. This land is managed by the California Department of Fish and Game. In Sonoma County, SR 37 is adjacent to the Napa-Sonoma Marshes Wildlife Area which is managed by the California Department of Fish and Game. The San Pablo Bay National Wildlife Refuge, managed by the U.S. Fish and Wildlife Service is also located in Sonoma and Solano counties. Recently, approximately 3,300 acres of former Skaggs Island Naval facility were transferred from the U.S. Navy to the U.S. Fish and Wildlife Service to be included in the San Pablo Bay National Wildlife Refuge.

Consideration of adjacent landowners

Transportation improvements on SR 37, or the realignment of SR 37, may require the acquisition of new right-of-way. Potential impacts to adjacent property owners may include an increase in noise, visual impacts, effects to resident's daily lives, and disruption to agricultural operations. Rights-of-entry permits will be required to complete initial studies for environmental evaluations of any alternatives.

Existing public access

Public access required by BCDC is an integral component of development and usually consists of pedestrian and other non-motorized access to and along the shoreline of San Francisco Bay. It may include certain improvements, such as pathway landscaping, street furniture, viewpoints, and public parking. Public access may allow for additional uses, such as bicycling, fishing, picnicking, observation of nature, or educational purposes. Visual access to the Bay is also a critical part of public access. SR 37 has been designated as a scenic highway. This route affords incredible views of the San Francisco Bay, to avoid impacts to these views design solutions must incorporate plans of a new route that contains analogous views of the adjacent wildlife refuges as well as the San Francisco Bay. In projects that cannot provide on-site public access due to safety or use conflicts, including significant adverse effects on wildlife, in-lieu public access may be appropriate. BCDC has adopted advisory "Public Access Design Guidelines" to assist in the design of public access to San Francisco Bay. Public access is reviewed and approved by BCDC's Design Review Board. The Design Review Board was formed in 1970 of professional designers to advise the Commission on the adequacy of public access of proposed projects in accordance with the San Francisco Bay Plan. This board would be responsible for reviewing the preferred alternative

project design. Caltrans would be required to provide the maximum feasible public access consistent with the project.

Priority use areas

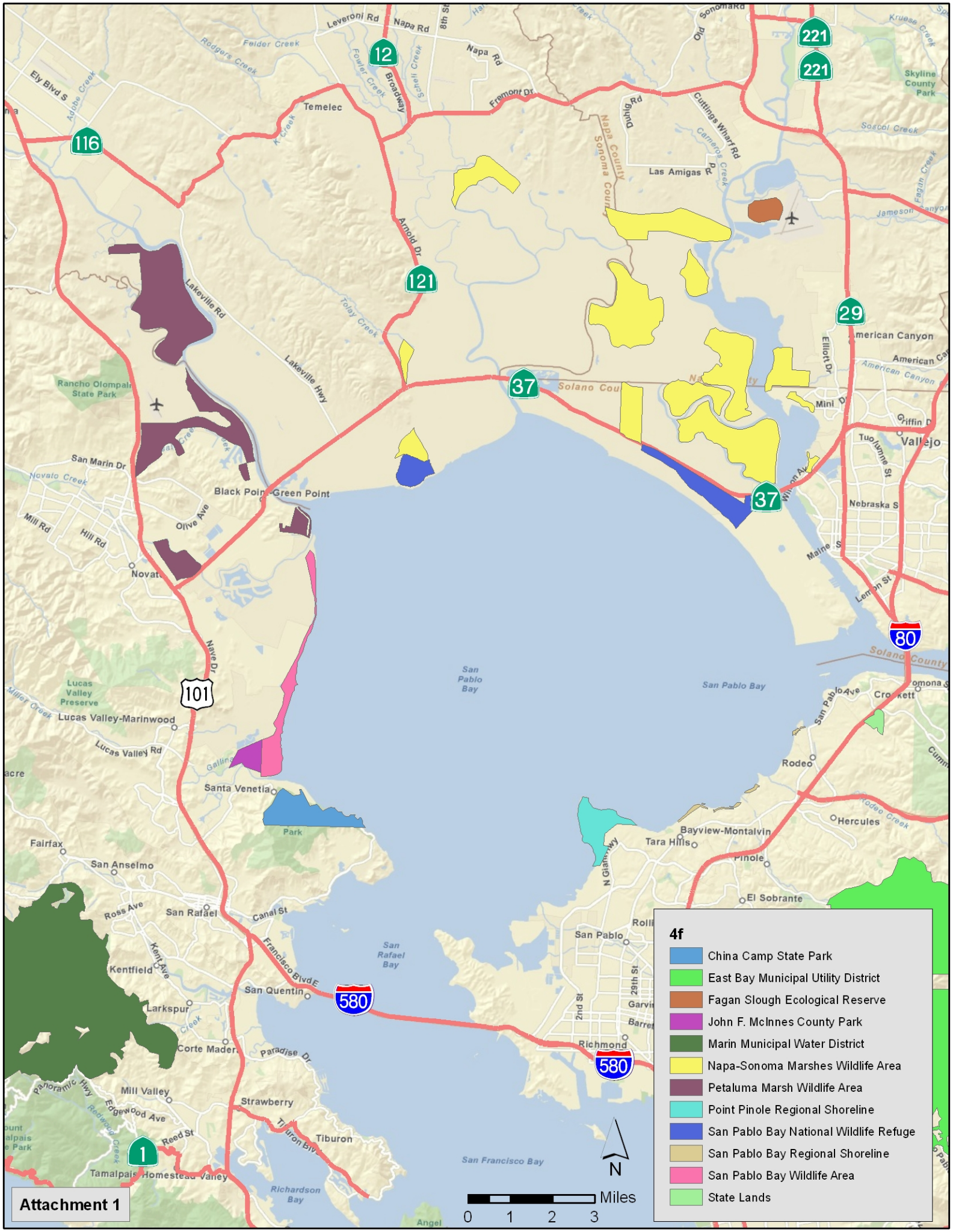
The San Francisco Bay Plan outlines numerous priority use areas in the Bay Area. To prevent losses of large natural resource areas BCDC has designated shoreline areas suitable for priority uses such as ports, water-related industry, airports, wildlife refuges, and water-related recreation. These priority use areas exist only in limited amounts, and should be reserved for these purposes. Transportation improvements may impact wildlife priority use areas adjacent to SR 37 and must be designed to be consistent with the underlying priority use area designation. BCDC may require compensatory mitigation measures to offset unavoidable adverse impacts to the environment.

Caltrans provided eight million dollars to the U.S. Navy to clean up Skaggs Island as mitigation for the San Francisco-Oakland Bay Bridge Project. Approximately 3,300 acres of Skaggs Island was transferred from the U.S. Navy to USFWS and is now part of the San Pablo Bay National Wildlife Refuge.

Above is a restoration project at White Slough. This restoration project required the creation of 14.8 acres of mudflats and subtidal sloughs, 29.1 acres of tidal wetland habitat, and 5.6 acres of upland refugia habitat. The restoration was for impacts to wetlands as a result of widening a two-lane highway to four lanes to reduce existing and projected traffic congestion along SR 37 in the City of Vallejo.

Attachment 1

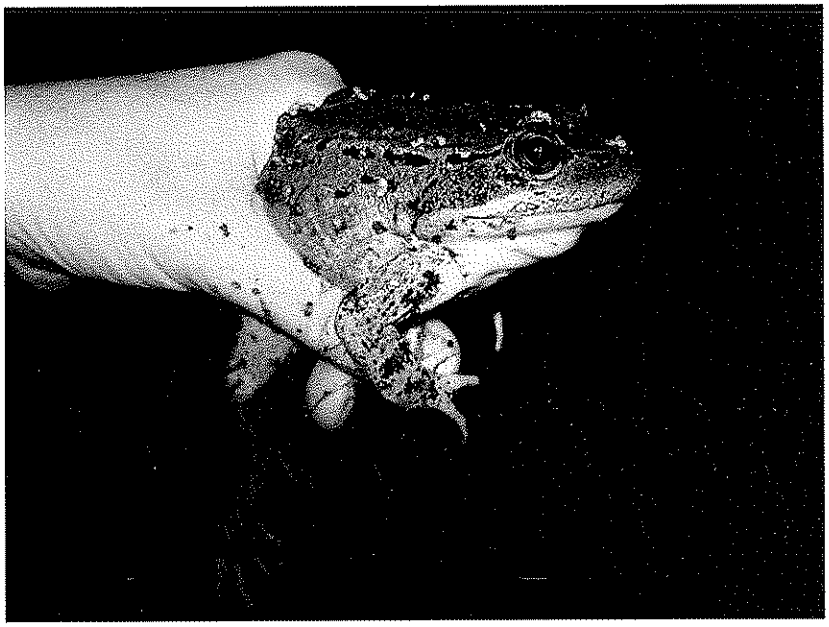
4f Map


4f
China Camp State Park
East Bay Municipal Utility District
Fagan Slough Ecological Reserve
John F. McInnes County Park
Marin Municipal Water District
Napa-Sonoma Marshes Wildlife Area
Petaluma Marsh Wildlife Area
Point Pinole Regional Shoreline
San Pablo Bay National Wildlife Refuge
San Pablo Bay Regional Shoreline
San Pablo Bay Wildlife Area
State Lands
N
Miles
0 1 2 3
Attachment 1

Attachment 2

Biological Assessment Project Checklist

District 4 Biological Assessment Checklist



Alameda, Contra Costa, Marin, Napa, San Francisco, Santa Clara, Solano and Sonoma Counties

December 2009

STATE OF CALIFORNIA
Department of Transportation

Prepared By: Amy L. Sparks Date: 12/16/2009
Amy L. Sparks, Branch Chief
(510) 286-5506
Office of Biological Sciences and Permits
District 4

Approved By: Jeffrey G. Jensen Date: 12/16/09
Jeffrey G. Jensen, Office Chief
(510) 622-8729
Office of Biological Sciences and Permits
District 4

This Biological Assessment (BA) Checklist is based on the Biological Assessment Template provided by Caltrans Headquarters. Items were added through a review of 30-day response letters requesting additional information, and consultation with Caltrans specialists and natural resource regulatory agencies such as the U.S. Army Corps of Engineers, U.S. Fish and Wildlife Service, National Marine Fisheries Service, and California Department of Fish and Game.

This BA Checklist is a general checklist only. Certain items may not be applicable to your specific project and/or additional items may be required in consultation with state and federal resource agencies.

This is not a formatting template. For the current BA formatting template, please see the shared drive for the Office of Biological Sciences and Permits.

CHAPTER 1. INTRODUCTION

Project History

- ❑ Project location, county, route, post-mile, USGS quads, UTM coordinates.
- ❑ Project purpose and need.
- ❑ Other pertinent history.
- ❑ Map of project location/vicinity.

Project Description

The project description should in general, describe "what" is being proposed and "how" it will be accomplished, including construction schedule, construction methodology/equipment, and future ongoing maintenance activities. Remember that the Service(s) staff person reviewing the BA is not an engineer, and may not be familiar with Caltrans or engineering terminology. Therefore, please use plain language for construction or engineering related terminology.

The following is a general checklist of items to include in the Project Description, [Project Descriptions do not need to be (and should not be) in the following order]. Please note the "Project Description" of the BA must be consistent with the Project Description in the environmental document and Draft Project Report.

GENERAL CHECKLIST

Action Area

- ❑ Action Area including staging, traffic staging, parking areas, turn outs, haul roads, access, borrow/disposal/stockpile sites, utility relocation areas, and any other areas to be directly or indirectly disturbed by the project need to be included in the Action Area.
    - o The Action Area is the geographic reach of all potential direct and indirect affects. For additional information on the USFWS use of "Action Area" see: http://www.fws.gov/Midwest/endangered/section7/ba_guide.html.
- ❑ Clearly distinguish between and define the terms "Action Area," "biological study area," "project area," etc.

- ❑ Project footprint in a shapefile format.
- ❑ Mapping of project vicinity, project location, and Action Area.
    - o Best to provide design layout with project footprint on aerial photo background in addition to standard CADD drawings.
- ❑ Photos of the Action Area.
- ❑ Total acreage of the Action Area.
- ❑ Interrelated or interdependent projects.
    - o These should be consistent with those included in the environmental document. If not, an explanation is needed.
- ❑ Culverts running under the existing roadway, or other passage, if applicable, for a description of existing wildlife crossings.
- ❑ Environmentally sensitive areas (such as wetlands) within the project.

Indirect and Direct Effects

- ❑ The Action Area should include all potential direct and indirect affects (see above "Action Area" for additional information). Within the Action Area, each project action should be assigned a duration as either temporary or permanent. Please note these are not species specific effects.
- ❑ Figures of construction-related actions and permanent actions.
- ❑ Extent of the direct and indirect affects.
- ❑ For construction activities classified as a direct but "temporary effect;"
    - o Rationale as to why effects in these areas are considered temporary;
    - o Length of time before restored areas are expected to provide baseline habitat values. The USFWS usually does not accept construction related disturbance (access, staging, etc) as a temporary effect if the action does not provide baseline habitat values for more than a year, and if the area is not going to be managed for the species in perpetuity;
    - o Construction-related disturbed areas to be restored following construction should have a clearly defined restoration plan that discusses how the site will be restored (recontouring, planting, etc.), how success of the restored site will be determined and when the site will provide baseline habitat values.
- ❑ Quantities and acreage/square footage of earth moving, fill removal or project additions and improvements.
- ❑ Acreage/square footage and/or linear feet of ground disturbance of utility removal, addition or relocation.

Construction Equipment and Methods

- ❑ Start and end dates, duration, and sequencing of construction. For large, multi-phased projects, include sequencing of phases or contracts.
    - o Verify that any start/end dates, durations, sequencing are consistent with the environmental document.
- ❑ Number of days of construction.
- ❑ Construction windows/work limitations. (See *Seasonal Work Restrictions for Special –Status Species*).

- ❑ Whether construction will take place only during the day, night, or both, and a description of any artificial lighting.
- ❑ Types of construction equipment and materials that will be used.
- ❑ Details of construction methods to be used.
    - Pictures of similar activities or construction equipment.
- ❑ Location for disposal of material and vegetation, and containment methods.
- ❑ Post-construction Best Management Practices (BMPs), including bio-filtration swales and strips, whether or not swales or strips can attract sensitive species, and maintenance activities to occur at bio-filtration swales and strips.

Avoidance and Minimization Efforts

- ❑ How sensitive resource exclusionary fencing, or other sensitive species procedures/avoidance and minimization efforts, will be accomplished. This includes but is not limited to: preconstruction surveys, contractor educational awareness, etc.
- ❑ Design changes made for the purpose of avoiding or minimizing impacts to sensitive species.
    - Verify consistency with the environmental document.
    - Please meet with the Generalist to discuss adding design changes to the Environmental Commitments Record (ECR) if warranted.
- ❑ Function of standard BMPs, and how BMPs will avoid or minimize affects.
- ❑ List of proposed conservation measures.

Restoration of Disturbed Areas and Erosion Control

- ❑ Type of erosion control to be used.
    - Include seed mix if applicable.
    - Include erosion control blanket mesh size if applicable.
- ❑ Timing of erosion control measures.
- ❑ For restoration, include a discussion of success criteria, and length of time before restored areas are expected to provide baseline habitat values.
- ❑ Dust controls to be utilized, such as tackifies and watering the site.

Project Operation and Maintenance

- ❑ Description of the completed project's operation.
- ❑ How the facility will be maintained, as well as maintenance of restored areas.

Compensatory Mitigation

- ❑ Statutory authority (laws/regulations/policies) under which on or off-site compensation is being proposed.
- ❑ Site location.
- ❑ Map of site location.
- ❑ Compensatory mitigation ratio.
- ❑ Acreage of site.
- ❑ Habitat values to be replaced at site.
- ❑ Timeline for installation of site (if applicable).
- ❑ Success criteria for site.

- ❑ Endowment for long-term maintenance and monitoring.
- ❑ Transfer of site to third-party public agency.
- ❑ Mitigation bank credits to be purchased and when they will be purchased.

WATER WORK CHECKLISTS

Pile-Driving

- ❑ Maximum allowable peak and cumulative noise levels as agreed to by the FHWA. The latest criteria are from June 12, 2008, see http://www.dot.ca.gov/hq/env/bio/files/fhwgcriteria_agree.pdf. Please make sure these criteria are the most recent.
- ❑ The total distance from piles required to meet the dual metric threshold criteria.
- ❑ Number of permanent and temporary piles.
- ❑ Type of pile, e.g., concrete, CISS, sheet pile, "H", etc.
- ❑ Diameter of piles.
- ❑ Length of piles.
- ❑ Duration of pile driving, both daily and overall.
- ❑ Start and end dates of pile driving.
- ❑ Re-tap period.
- ❑ For temporary falsework, please include additional information, such as
  - o Will the piles left in place during consecutive seasons,
  - o Removal, e.g., will the piles be cut-off below the mud-line.
- ❑ Size of hammer to drive piles.
- ❑ Type of hammer to drive piles.
- ❑ Number of pile strikes per pile.
- ❑ Number of piles to be driven per day.
- ❑ Depth of water piles will be driven in.
- ❑ Substrate piles will be driven into.
- ❑ Sound Assessment regarding peak and cumulative levels without sound attenuation (the Sound Assessment will need to be prepared by a consultant).
- ❑ Sound attenuation devices to be used.
- ❑ Methodology and construction procedure of sound attenuation.
- ❑ Assessment of sound levels after attenuation.
- ❑ Sound monitoring and reporting to resource agencies that will occur during project construction.
- ❑ Methodology for any marine mammal monitoring zones, if applicable.

Water Diversion and Sedimentation/Turbidity

- ❑ Diversion controls and de-watering.
- ❑ Measures to keep fish/wildlife out of de-watering devices (prevent fish/wildlife entrapment), if applicable.
- ❑ Fish relocation plans, if applicable, and qualifications of those relocating fish.
- ❑ Sediment/turbidity reduction BMPs, and turbidity testing.
- ❑ If water will be pumped to a settling pond/tank, and how water will be tested prior to returning it to its natural flow.
- ❑ If sediment or structure is to be removed, quantify the volume of material to be removed below the OHWM.

- ❑ Whether the action will affect salinity concentrations of the water body to which may be de-watered or have water added.
- ❑ Whether water activities will cause a change in pH.

Culverts/Bridges, especially in Rivers/Streams

- ❑ Size and locations of existing culverts and other crossings.
- ❑ Details of in-stream work and construction access into the stream.
- ❑ Engineering drawings of new creek crossings.
- ❑ Plans with cross-sections of culverts, bridges and grade control measures.
- ❑ De-watering and fish relocation plans (see "Water Diversion and Sedimentation" above).
- ❑ Define terms such as "pre-cast" and "cast-in-place."
- ❑ Whether new culverts will provide terrestrial wildlife crossing, especially during high water events.
- ❑ Volume of fill material (such as RSP) to be placed below the OHWM.
    - For NMFS – total volume of fill for the project; including both above and below OHWM, or ML or MH in tidal/marsh areas.
        - Areas along the banks, shorelines, etc., that are affected need to be included.
- ❑ RSP-type, size, and method of installation.

Fish Passage

The items in the checklist below are vey comprehensive. On a case by case basis, close coordination between Caltrans engineers and biologists, and resource agency engineers and biologists will most efficiently determine which information listed below will be needed to determine if designs are acceptable in terms of fish passage.

- ❑ Hydraulic calculations indicating the new culvert/bridge is sized to meet NMFS fish passage criteria (Caltrans Hydraulics or a specialist consultant will need to prepare these calculations).
    - Include the target species for the fish passage design as well as the lifestage, i.e. juveniles.
- ❑ Existing structure.
    - Dimensions, slope, fill, perch.
    - Materials, condition.
    - Structure skew to stream and road.
- ❑ Channel morphology.
    - Channel type.
    - Natural channel alignment.
    - Longitudinal profile.
        - Stable endpoints.
        - Residual pool depths/scour potential.
        - Natural channel elevation, gradient, and vertical adjustment potential.
    - Cross sections.
        - Bankfull width.
        - Bank height.

        - Flood-prone zone width.
        - Flood-plain roughness.
        - Cross-sections for backwater model.
    - Bed material.
        - Pebble count or other estimate of gradation.
        - Armoring.
        - Key features; size and mobility.
    - Soils/foundation materials.
    - Groundwater.
- ❑ Channel Stability.
    - Channel response to existing structure.
    - Vertical adjustment potential.
    - Lateral adjustment potential.
    - Plugging potential.
- ❑ Annotated site sketch.
    - Including: geomorphic features; road features; significant vegetation; land ownership; utilities; potential lateral adjustment; potential construction access; photo points.

Summary of Consultation to Date

- ❑ Summarize discussions with regulatory or other partners that are relevant to the technical studies.
    - Verify consistency with the environmental document.
    - Include the NEPA/CEQA document type and status including the end date of the public/agency comment period.
        - Consider noting any comments received from resource/regulatory agencies in the Summary of Consultation to date section.

Document Preparation History

- ❑ History of document preparation as necessary to give credit to those who contributed to the document.
    - When a project has a long history and several dated documents have been prepared, whether or not they were released to the public, cite the completed documents as references.
    - Documents that were not completed or dated may be considered works in progress, and need not be cited.
- ❑ Basic preparer and contact information.

CHAPTER 2. SPECIES LISTED OR PROPOSED FOR LISTING OBTAINED FROM THE USFWS SPECIES LIST DATABASE

- ❑ USGS quads for which federally protected species were obtained from the USFWS database or CNPS databases.
- ❑ Table of all federally listed species that appear in the surveyed USGS quads (Note to preparer: a recent species list must be used.) In the table include:
    - Scientific name.
    - Common name.

- Status.
- General habitat description.
- General habitat present/absent.
- Rationale for habitat presence/absence.

❑ Identify those species considered to have a potential to occur in the Action Area, and which will be considered further in the Biological Assessment.

CHAPTER 3. STUDY METHODS

❑ Tools used to identify required studies/surveys:
- Mandatory FWS species list .
- Additional information that may be obtained through agency coordination, CNDDB, FESA, CESA, Environmental Setting, etc.
- Recent publications/journal articles/agency data and technical reports that may be used and cited. Include local information relative to the project vicinity, views of recognized experts, and results from recent studies, life history, population dynamics, trends and distribution. Reference field notes, unpublished data, research in progress, etc. Include local population info.
- Any recovery plan implementation that is occurring in the project area, especially priority action items from recovery plans. Include recovery area and recovery unit (provide unit name or number).
- Methods used to define the Biological Study Area (BSA). If potentially controversial or non-standard, discuss the rationale for the definition(s).
- Methods used to do surveys – protocols, guidelines, etc., the qualifications of those completing the surveys; and if protocol surveys were conducted, whether there was agency buy off on the protocol or modifications to protocol.
- Modifications and justifications, if any, to the survey methods. Provide a risk statement for the chosen methods.

❑ Personnel and Survey dates.
- Personnel, qualifications, permit numbers.
- Survey method(s) or protocol(s) used, and survey dates.

❑ Agency coordination and professional contacts.

❑ Limitations and constraints.

CHAPTER 4. RESULTS: ENVIRONMENTAL SETTING

❑ Land owners – private or public lands, land use, list and map.

❑ Aerial photos of the project area (if many, put in appendix).

❑ Topographical features.

❑ Topographic map of the project area.

❑ Map and/or text description of soil and geologic information if pertinent.

❑ Hydrological resources.

❑ Natural communities.

❑ Vegetation communities.

❑ Dominant plant species.

❑ Common animal species.

- ❑ Migration and travel corridors.
- ❑ Aquatic resources.
- ❑ Invasive species.
- ❑ Mapping as appropriate.

CHAPTER 5. RESULTS: BIOLOGICAL RESOURCES, DISCUSSION OF IMPACTS AND MITIGATION

Discuss those federally listed plant or animal species identified as potentially occurring in the Action Area. Include the following for each species:

Species Account

- ❑ Utilize the best available scientific and commercial information.
- ❑ Aspects of biology that relate to the impact of the project, such as sensitivity to dust, noise, stress, desiccation, inundation, fire, fragmentation, and predators. For example, discuss species sensitivity to loud sounds or vibration, and whether your project involves loud tools or equipment.
- ❑ Relevant aspects of target species biology.
- ❑ Habitat condition and habitat designations, such as:
  - o Critical habitat (provide unit name or number).
  - o Breeding habitat.
  - o Feeding habitat.
  - o Dispersal habitat.
  - o Resting habitat.
- ❑ Habitat use patterns, including seasonal use, home range, dispersal and migration (if relevant), and identify habitat needs such as breeding, feeding, and sheltering.
- ❑ Quantify the listed-species' habitat remaining in the project area. GIS layers are useful here, as are land ownership patterns--especially local land trusts and open space designations.
- ❑ Changes in population trends related to the project.

Survey Results

- ❑ Closest known populations.
- ❑ Results of field surveys.
- ❑ Habitat conditions when the species is not found.
- ❑ Potential for the species to be present but not found.
- ❑ If inferring species presence, there must be a supportable and reasonable expectation that a species is present in the project area and will be affected by the work. When inferring species presence, you must use and follow the Federal Highway Administration guidance on inferring presence: http://www.dot.ca.gov/ser/downloads/memos/FHWA_IF_letter.pdf, and the Inferred Presence Determination template, http://www.dot.ca.gov/ser/downloads/templates/Inf_Pres_TE_RPT_Final.doc.

Critical Habitat

- ❑ Discuss/describe critical habitat designated for the species and the primary constituent elements of critical habitat.

- ❑ Map of critical habitat.

Modifications to the Project to Mitigate Effects

- ❑ Modifications made to the project to avoid and/or minimize effects to the species.

Avoidance and Minimization Efforts

- ❑ Avoidance and minimization efforts applicable to the species.
  - o Verify consistency with the environmental document.
  - o These measures should be incorporated into the ECR.

Project Effects

- ❑ Elaborate on each effect, including direct, indirect, interrelated and interdependent effects.
  - o Effect determinations must be consistent with the type of project in the project description, the biology in the species accounts, and the habitat status and existing environment.
  - o Under the ESA, direct effects are those that are caused by the proposed project and occur at the time of the project. Indirect effects are those that are caused by the proposed project and are later in time, but still are reasonably certain to occur.
  - o Interrelated projects are those that are part of a larger project and depend on the larger project for their justification–i.e., this project would not occur "but for" a larger project. Describe the larger project and its effects.
  - o Interdependent projects are those that have no independent utility apart from the project that is under consideration–i.e., other projects would not occur "but for" this project. Describe the interdependent projects and their effects.
- ❑ Examples of effects to be addressed as appropriate.
  - o Loss of habitat--direct and indirect.
  - o Mortality.
  - o Harassment.
  - o Disrupted reproduction and/or loss of reproduction.
  - o Loss of forage and/or foraging potential.
  - o Loss of shelter/cover.
  - o Loss of access through adjacent habitat/loss of corridors.
  - o Loss of breeding habitat.
  - o Noise/light during construction.
  - o Noise/light after construction.
  - o Fragmentation of habitat.
  - o Urbanization induced or facilitated by the project.
  - o Increased predation, including predation by pets and feral animals.
  - o Impacted water quality (increased runoff, sedimentation, altered hydrology, or reduction in water quality).
  - o Introduction of barriers.
- ❑ Reference consultations for related or adjacent projects and provide the Fish and Wildlife Service file number(s), if known.

Compensatory Mitigation

- ❑ Statutory authority (law/regulation/policies) under which compensation is being proposed.
- ❑ Mitigation ratio.
- ❑ Whether mitigation will be on or off-site, in-lieu fee, conservation easements, or banking.
- ❑ Site location.
- ❑ Map of site location.
- ❑ Acreage of site.
- ❑ Habitat values to be replaced at site.
- ❑ Timeline for installation of site (if applicable).
- ❑ Success criteria for site.
- ❑ Provisions for long-term maintenance and monitoring.
- ❑ Transfer of site to third-party public agency.

Cumulative Effects

- ❑ List relevant projects within the Action Area that may contribute to cumulative effects.
    - o Magnitude of cumulative effects that are reasonably certain to occur should be considered in the biological assessment.
        - ▪ Cumulative effects include the effects of future state, tribal, local or private projects.
        - ▪ Future federal actions are not considered in this section because they will be subject to separate consultation pursuant to Section 7 of the ESA.
- ❑ List relevant minimization or avoidance measures and mitigation provided by relevant projects.
- ❑ Identify rationale or conclusion as to why the project will or will not result in cumulative effects.

CHAPTER 6. CONCLUSIONS AND DETERMINATIONS

- ❑ One of the following determinations should be made for each listed or proposed species on the project specific species list:
    - o No effect;
    - o May affect, but is not likely to adversely affect;
    - o Likely to adversely affect, but not jeopardize the continued existence;
    - o Likely to benefit; or
    - o Jeopardy.
- ❑ One of the following determinations should be made for each listed or proposed species' critical habitat:
    - o Adverse modification; or
    - o No adverse modification.
- ❑ Logic and rationale that supports the determination.

Attachment 3

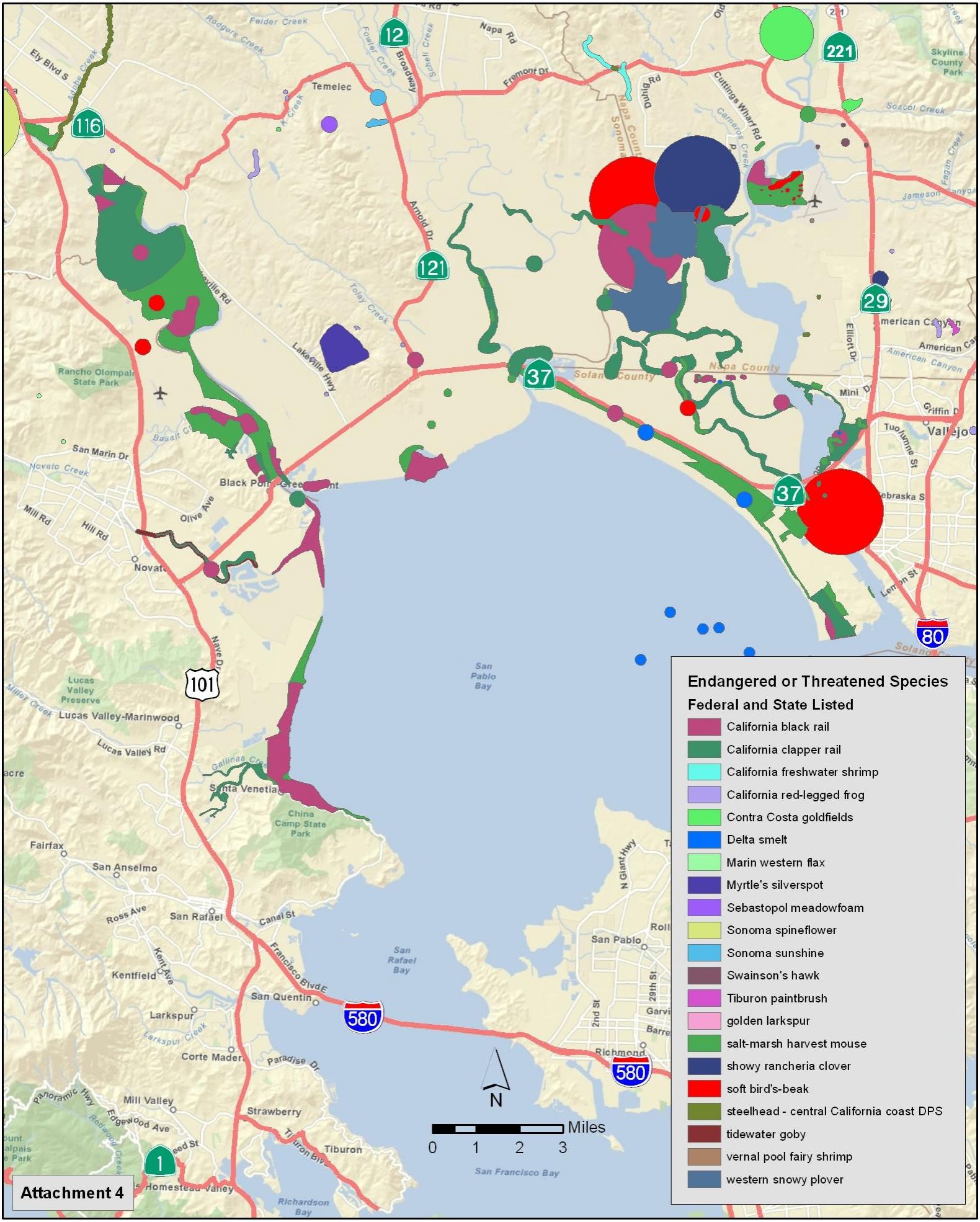
Permits

Permits

Agency	Permit Required	Type of Permit	Statutory Authority	Permitting Issue
BCDC	Yes	Major Permit	McAteer-Petris Act	All alternatives may have bay fill and impacts to wetlands and public access.
CDFG	Yes	1602, 2080.1, 2081(b), 3053	DFG Code, CEQA/CESA, Native Plant Protection Act	Threatened/Endangered species are present along SR 37 and SR 12. All alternatives may have lakebed/stream/river alterations.
RWQCB	Yes	401/402	Clean Water Act, Porter-Cologne Act	The Department must obtain a state certification that all discharges comply with provisions of the CWA.
CSLC	Yes	Lease may be required.	Common Law Public Trust	The State Lands Commission has jurisdiction over all ungranted tidelands and submerged lands.
USCG	Yes	Bridge Permit	FESA (Section 9), Rivers and Harbors Act, General Bridge Act	There are navigable waters located within the vicinity of SR 37 and SR 12.
USACE	Yes	404, Individual	Clean Water Act, Rivers and Harbors Act	All alternatives may require dredging and may have impacts to wetlands.
USFWS	Yes	B.O	FESA (Section 7)	All alternatives will have impacts to threatened and endangered species, ground disturbance, noise disturbance, changes in water quality and quantity, air quality, and lighting.
NOAA	Yes	B.O	FESA (Section 7), Marine Mammal Protection Act, Magnussen-Stecenson Act	Threatened/Endangered species are present along SR 37 and SR 12. Some alternatives require pile driving and dredge disposal. All alternatives may affect fish passage. Some alternatives may affect marine mammals.
CDOT	Yes	4(f)	Department of Transportation Act	All alternatives will have impacts to public park lands and wildlife refuges.

Attachment 4

Listed Species Map



Listed Species Map