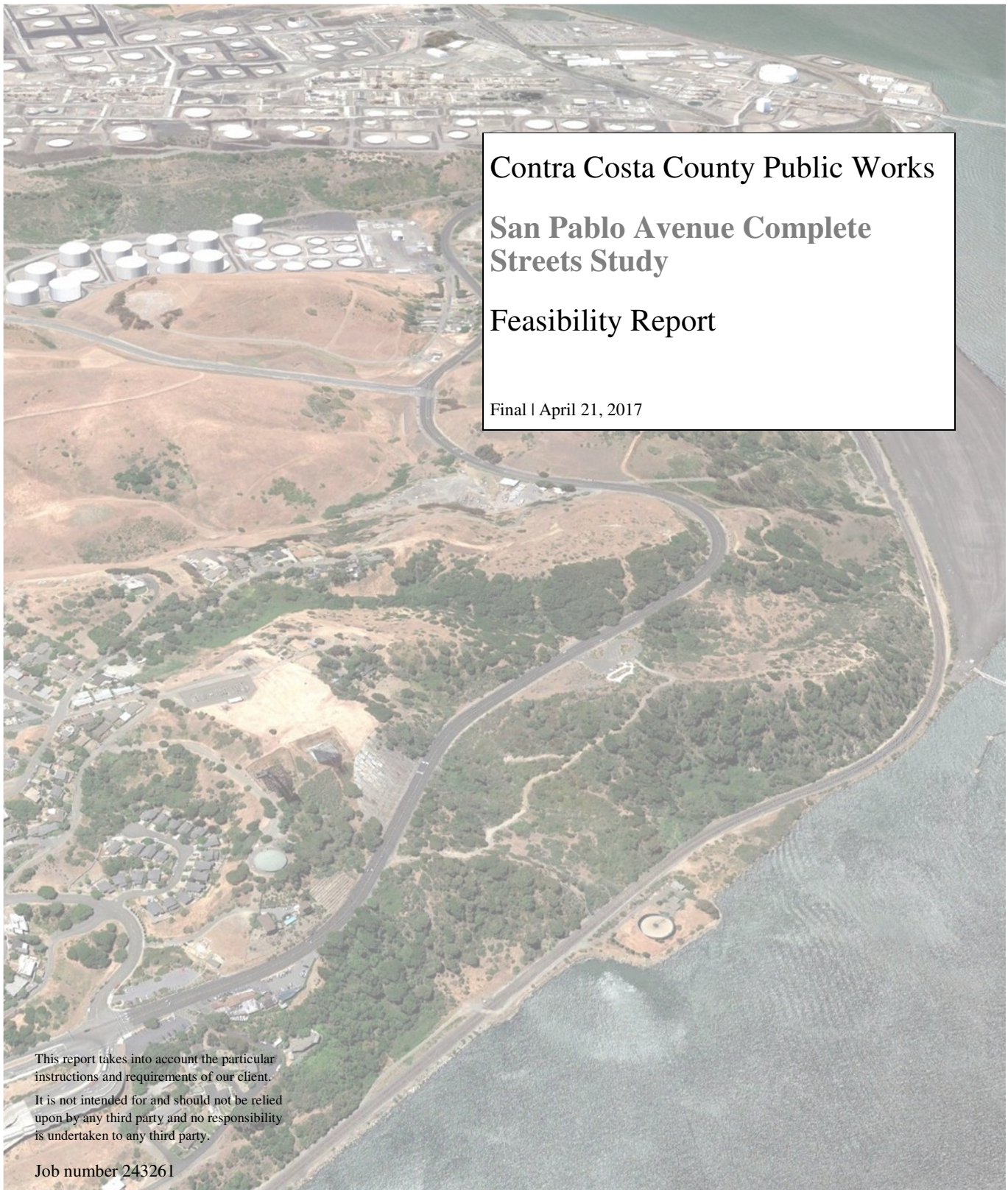

# Contra Costa County Public Works

## San Pablo Avenue Complete Streets Study

## Feasibility Report

Final | April 21, 2017



Job number 243261

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# Contents

# 1 Executive Summary

This report assesses the feasibility of implementing a Complete Street design to improve safety on a three-mile segment of San Pablo Avenue between the communities of Rodeo and Crockett in unincorporated Contra Costa County. Complete Streets are a transportation policy and design approach that strives for streets to be planned, designed, operated, and maintained to enable safe, convenient, and comfortable travel for all users (including pedestrians, cyclists, motorists, and transit riders). Both the State of California and Contra Costa County have adopted Complete Streets Policies that require jurisdictions to integrate the needs of all users into street design. In addition to improving bicycle and pedestrian access and safety, a Complete Street design along this segment of San Pablo Avenue would fill a gap in the San Francisco Bay Trail network. Contra Costa County initiated this study through a Priority Development Area (PDA) grant from the Contra Costa County Transportation Authority (CCTA). Throughout the development of the project, the local community has been involved through activities including public meetings, workshops, and internet surveys.

The study has the three primary objectives:

- **Assess alternatives for implementing a "Complete Street" that provides bicycle, pedestrian and transit facilities and enhances safety for all users along a three-mile segment of San Pablo Avenue from Lone Tree Point to the Alfred Zampa Bridge.** The Alfred Zampa Bridge is the suspension bridge that carries the westbound I-80 travel lanes from Vallejo to Crockett over the Carquinez Strait. Currently, this segment of San Pablo Avenue has very limited sidewalks and bicycle lanes on approximately 10% of the segment. Three alternatives for improving facilities, in addition to the existing condition, were evaluated. A Complete Street is a transportation facility that is planned, designed, operated, and maintained to provide safe mobility for all users, including bicyclists, pedestrians, transit vehicles, trucks, and motorists.

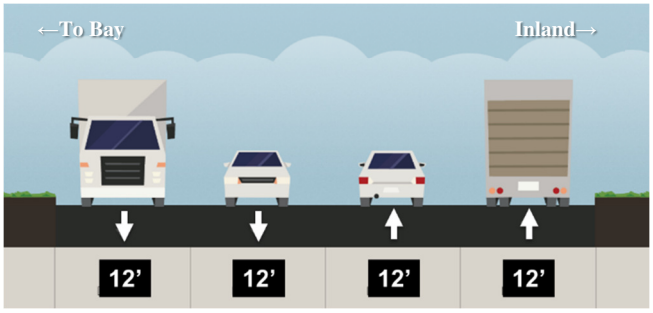
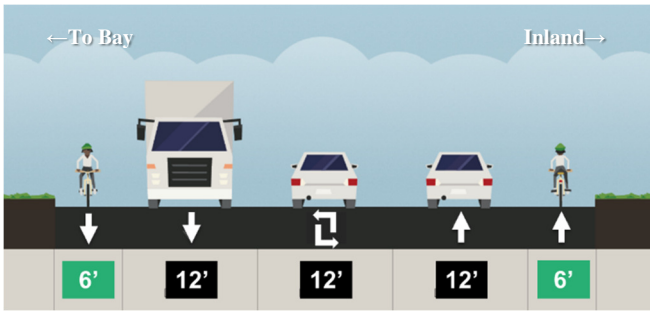
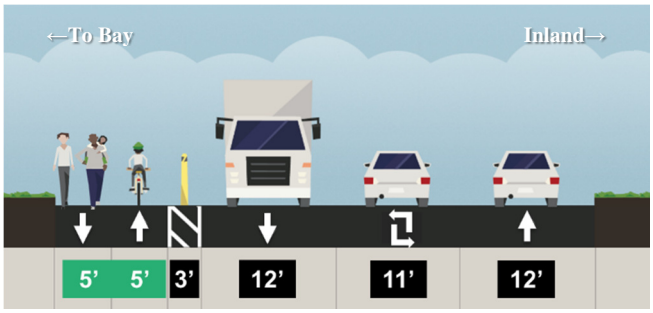
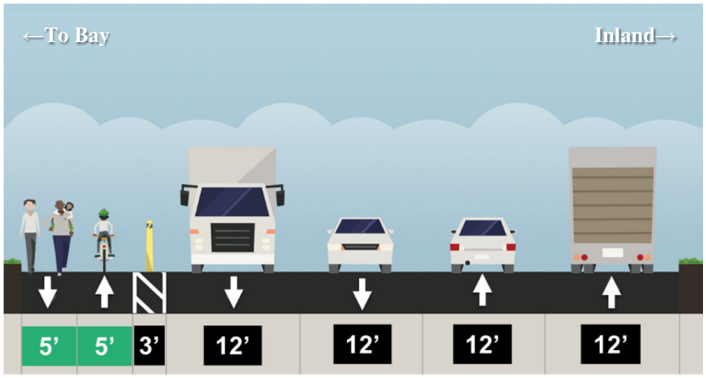
- **Close an existing gap in the Bay Trail.** The Bay Trail is a 500-mile regional walking and cycling trail that is planned around the perimeter of San Francisco and San Pablo Bays. The three-mile study segment represents the largest gap in the Bay Trail between Oakland and Vallejo. This segment would link the shared pedestrian/bicycle ("shared-use") path on the Alfred Zampa Bridge with a proposed segment in Hercules.

- **Identify a preferred alternative and the ultimate set of improvements desired for its implementation on the roadway.** The analysis evaluated the three alternatives and the existing condition against a range of criteria, including: consistency with Complete Street design "best practices," qualification as a Bay Trail segment, enhanced safety and experience for all users, maintenance of acceptable traffic operations, physical and environmental impacts, and cost-effectiveness.

This feasibility study incorporated a series of technical studies, field work, public outreach, and engineering design. The following are some of the primary findings used to develop the alternatives:

- The observed and forecasted traffic volumes on San Pablo Avenue represent approximately 25% of the roadway capacity for the four lane undivided arterial. Therefore, there is an opportunity to implement a "road diet," which is a low-cost way to enhance safety and mobility for all road users that involves removing a vehicle travel lane by re-striping the roadway and re-allocating the space saved for bicycle and pedestrian users. A road diet is typically achieved staying within the existing roadway right-of-way. In the case of San Pablo Avenue, this would result in one travel lane in each direction with a center lane for left turns and truck climbing lanes.
- While traffic volumes are generally low, there are a higher than typical percentage of trucks (approximately 25%) on the road segment between Cummings Skyway and Refinery Road that serve the Phillips 66 refinery and NuStar Energy. There are several sections with steep grades and tight curves, which will require solutions to allow for passing lanes and physical barriers to provide separation between pedestrians and cyclists and traffic. Separating road users and accommodating passing lanes for slower moving traffic will improve safety for vehicles, cyclists, and pedestrians alike.
- The technical studies indicate that the road diet concept can be implemented without any adverse effects on existing or future traffic operations.
- Public outreach, which included community meetings and online surveys, indicated a wide range of existing usage of the roadway and a diversity of opinions toward any potential changes such as the road diet and the continuous pedestrian and bicycle facilities.
- There are several significant engineering challenges along the corridor: narrow roadway shoulders, steep hillsides, steep grades, and refinery infrastructure in close proximity to the road.

The figure below presents the typical roadway cross-sections for the existing configuration and the three study alternatives.

| | |
|---|---|
| **Existing Conditions**<br>The existing roadway consists of four 12' travel lanes with minimal shoulders, no bike lanes, sidewalks, or truck climbing lanes. The existing condition represents the "No Build" alternative. |  |
| **Alternative 1:**<br>**Bike Lanes**<br>Implement a "road diet," removing one travel lane and adding two 6' striped on-street bike lanes. Convert the center lane to a two-way left-turn lane, median, or truck climbing lane as necessary at different points along the roadway. This alternative does not add new sidewalks or pedestrian facilities. |  |
| **Alternative 2:**<br>**Shared Use Path**<br>Implement a "road diet," removing one travel lane and adding a 10' two-way shared use path for pedestrians and cyclists on the north side of the roadway, separated by vehicle traffic by a physical barrier. Convert the center lane to a two-way left-turn lane, median, or truck climbing lane as necessary at different points along the roadway. |  |
| **Alternative 3:**<br>**Widened Shared Use Path**<br>Widen the existing roadway to add a 10' two-way shared use path for pedestrians and cyclists on the north side of the roadway, separated by vehicle traffic by a buffer. The vehicle lane configuration will remain the same as the existing roadway (two-lanes in each direction) from Lone Tree Point to Cummings Skyway. From Cummings Skyway to the Alfred Zampa Bridge, implement the same road diet configuration with shared use path as presented in Alternative 2. |  |

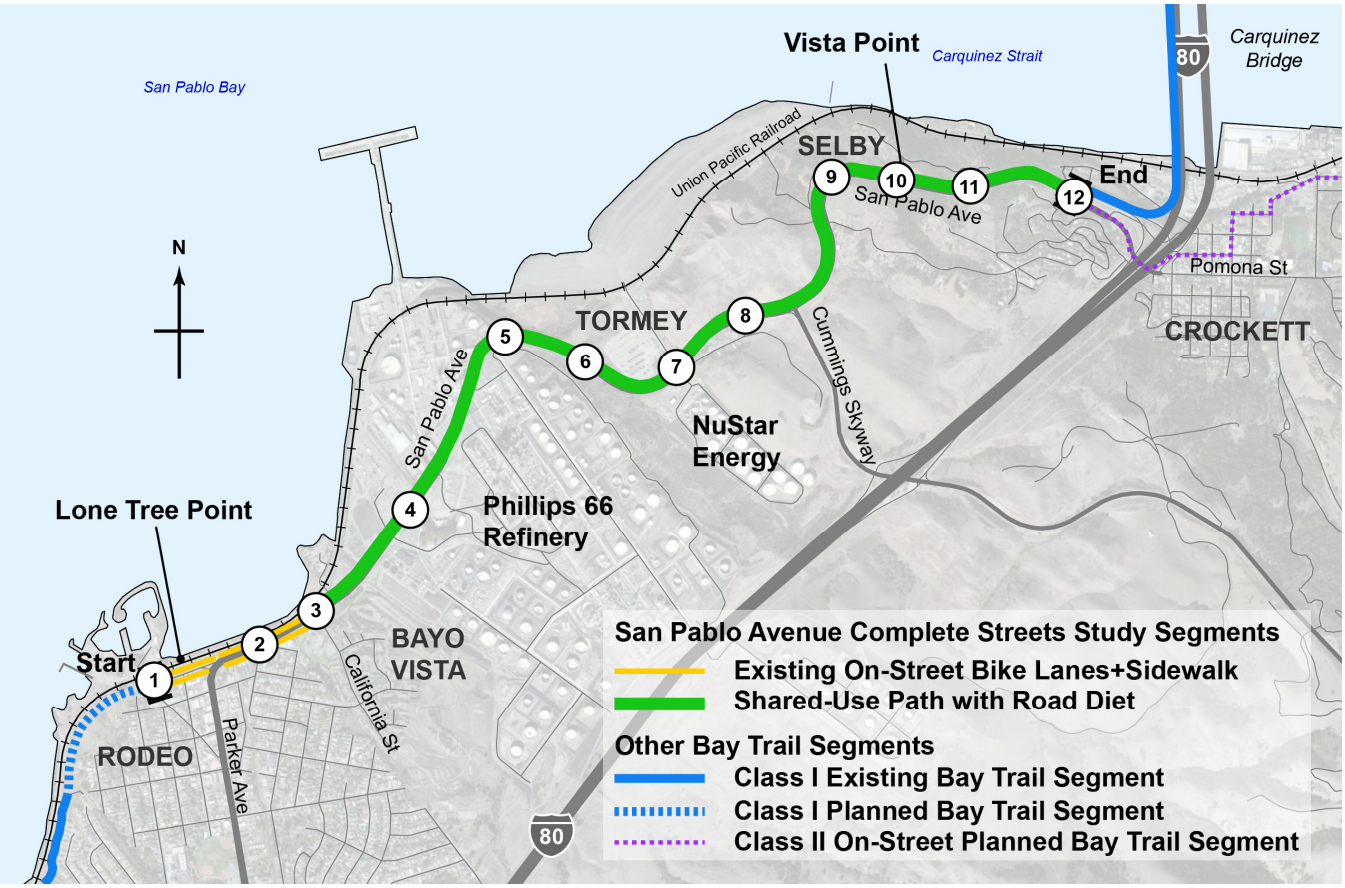
When assessed using the study evaluation criteria, the alternatives provide a range of results:

- The **Existing ("No Build")** condition does not provide continuous dedicated facilities for cyclists or pedestrians along the entire segment. It also does not qualify as part of the Bay Trail.
- The **Bike Lanes** alternative (Alternative 1) implements bike lanes only, therefore it does not qualify as a Bay Trail segment and does not meet several key goals of the study. The bike lanes provide a more comfortable experience compared to the existing condition. However, only selected portions of the roadway have space to accommodate minimal barriers to separate the bike lanes from the travel lanes. Therefore, the improvement in bicycle safety is only moderate. It is the least expensive and the easiest to implement.
- The **Shared Use Path** alternative (Alternative 2) has the best overall performance as it provides a way to accommodate pedestrians and cyclists safely along the entire corridor, provides a range of safety benefits for all other modes, and qualifies as part of the Bay Trail. Alternative 2 is more expensive than the Bike Lanes alternative, however, it offers significant additional benefits to users with minimal impacts.
- The **Widened Shared Use Path** alternative (Alternative 3) provides similar performance to Alternative 2, but has a very high cost and the potential for significant environmental and private property impacts as the result of widening the roadway to accommodate the path.

**Recommended Alternative**

The technical studies, outreach, and alternatives analysis provided the basis for selecting a modified Alternative 2 as the recommended set of improvements (see Figure 1). The Recommended Alternative retains the shared use path design from Alternative 2 east of California Street. This design removes one travel lane and adds a 10' two-way shared use path for pedestrians and cyclists on the north side of the roadway, separated from vehicle traffic by a physical barrier. The physical barrier included in the design and cost estimates includes a modular concrete barrier often referred to as "jersey barrier" or "K-rail". These barriers would prevent vehicles from crossing over into the shared use path. The type of concrete physical barrier will need to be evaluated further in the detailed design stage if the project moves forward. West of California Street, in order to minimize impacts to local business owners, the Recommended Alternative retains the existing roadway layout, which includes on-street parking, bicycle lanes, and one travel lane in each direction. However, by providing continuous sidewalks and bicycle lanes, the alternative would meet the study's Complete Streets goal.

**Figure 1: San Pablo Complete Streets Study Recommended Improvements**




Locating the shared use path on the north side reduces the number of major intersections it crosses. West of California Street, the Recommended Alternative reflects the design of Alternative 1, which adds bicycle lanes and sidewalks—where needed—between California Street and Lone Tree Point where it would connect to the planned Bay Trail segment.

The Recommended Alternative is expected to cost $8.2 million. To phase delivery of the project, the cost estimate is divided into three segments, as follows:

- Alfred Zampa Bridge to Cummings Skyway ($1.8 million)
- Cummings Skyway to California Street ($4.3 million)
- California Street to Lone Tree Point ($2.1 million)

While the Recommended Alternative proposes a conceptual complete streets solution, detailed design work must be completed before any alternative is implemented. Key points along the corridor (keyed to numbered items in Figure 1) include:

1. Study area start. Construct bike lanes plus a sidewalk through Lone Tree Point from Pacific Avenue to Parker Avenue. Connect this to the proposed Bay Trail segment to Hercules.

2. Utilize the existing on-street bike lanes and sidewalk on San Pablo Avenue from Parker Avenue to California Street.
3. Provide a high visibility crossing for pedestrians and cyclists at California Street.
4. Implement the shared-use path (Alternative 2) concept from California Street to the Alfred Zampa Bridge. Utilize a physical barrier to separate the path from the travel lanes.
5. Provide a wide painted buffer between the opposing travel lanes at the summit point east of the refinery to increase the separation between opposing traffic.
6. Provide a truck climbing lane in the westbound direction.
7. Install a HAWK beacon (High-Intensity Activated crossWalK beacon) at the A Street intersection. A HAWK beacon is a traffic control device used to stop road traffic and allow pedestrians to cross safely.
8. Provide a truck climbing lane in the eastbound direction.
9. Provide a wide painted buffer between the opposing travel lanes at the summit point east of Vista Point Road to increase the separation between opposing traffic.
10. Provide a left-turn lane into the Vista Point.
11. Provide a truck climbing lane in the westbound direction.
12. Study area end. Provide pedestrian and bicycle improvements in front of the Dead Fish restaurant and connect to the path on the Alfred Zampa Bridge.

**Implementation and Next Steps**

This recommended alternative best satisfies the goals of the study, minimizes project impacts, and provides a cost-effective solution. County staff will utilize the findings in this feasibility report to ultimately make a recommendation to the Board of Supervisors about next steps and whether further detailed design should continue.

After public review, if the Board approves a preferred alternative, a number of steps remain to implement the chosen alternative:

1. Complete final design: Select a consultant to prepare final design documents. Funding for this study must be identified.
2. Environmental review process: Select a consultant to complete appropriate environmental review documents to comply with the California Environmental Quality Act (CEQA). Funding for this study must be identified.
3. Construction funding: Explore funding options for construction, such as the county's capital improvement program, regional grants, state and/or federal funding.
4. Construct project, whole or in phases.

# 2 Introduction

Contra Costa County is evaluating the feasibility of implementing a Complete Street design with improved pedestrian, bicycle, and transit facilities on a three-mile segment of San Pablo Avenue between the communities of Rodeo and Crockett in unincorporated Contra Costa County. Complete Streets are designed to enable safe access for all users, including pedestrians, bicyclists, motorists and transit riders of all ages and abilities. Both the State of California and Contra Costa County have adopted Complete Streets Policies that require jurisdictions to integrate the needs of all users into street design. This segment of San Pablo Avenue is also identified as a potential portion of the San Francisco Bay Trail.

The San Pablo Avenue study corridor extends from Pacific Avenue and Lone Tree Point in Rodeo to the base of the Alfred Zampa Memorial Bridge (previously known as the Carquinez Bridge) bicycle and pedestrian shared-use path (SUP) in Crockett. Figure 2 presents the San Pablo Avenue study area, the study intersections included in the traffic analysis, and six key segments along the corridor.

Table 1 provides a summary of each of the six segments.

**Figure 2: San Pablo Avenue Complete Streets Study Area**

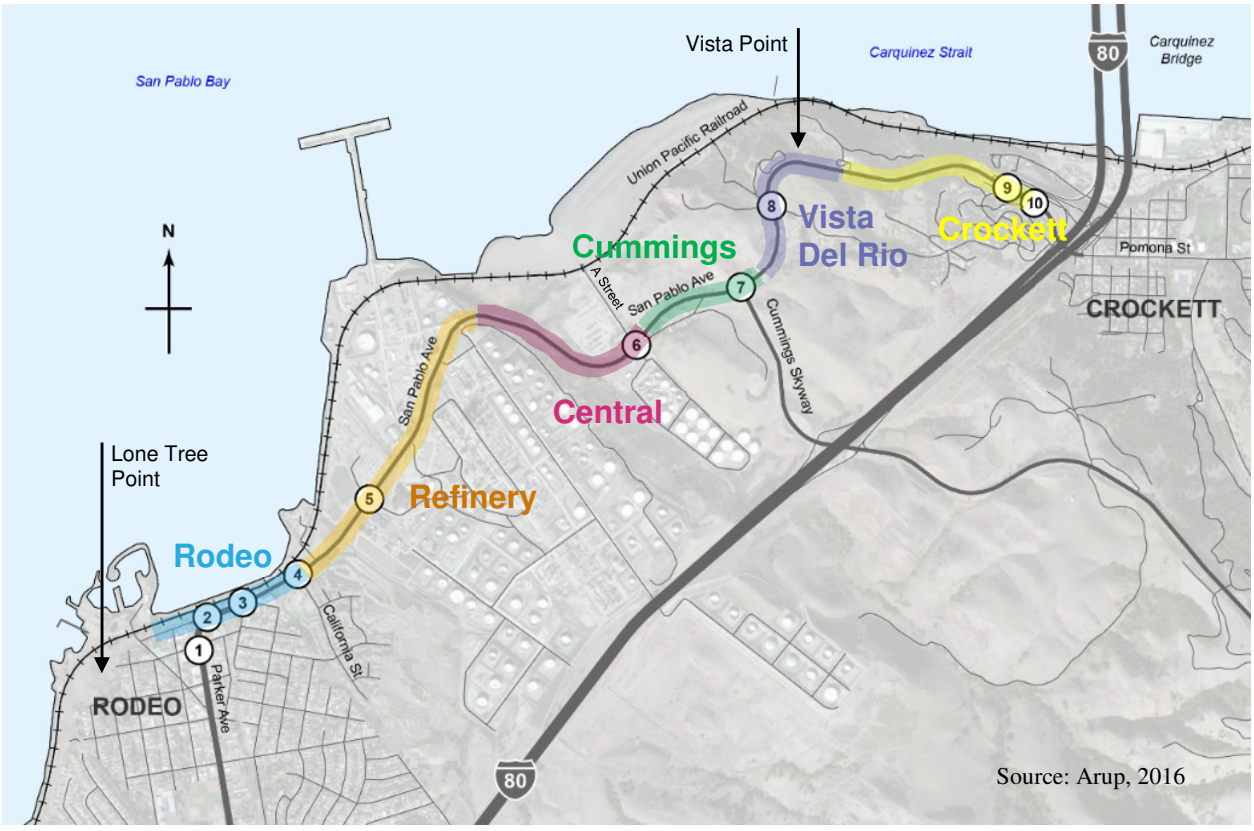


**Table 1: Description of Corridor Segments**

| Segment | Existing Street Description/Land Use Context |
|---|---|
| **Rodeo**<br>Lone Tree Point to California St | • Bike lanes on Parker Avenue with sidewalks<br>• Local commercial uses with multiple driveways, on-street parking |
| **Refinery**<br>California St to the summit east of Phillips 66 | • No bike lanes or sidewalks<br>• Oil refinery and heavy industrial uses<br>Steep grades east of Refinery Rd |
| **Central**<br>Summit to east of A St | • No bike lanes or sidewalks<br>• Petroleum storage at A St; some rural residential<br>• Some moderate grades |
| **Cummings**<br>A St to Cummings Skwy | • No bike lanes or sidewalks<br>• Long steep sustained grades with moderate truck volumes |
| **Vista Del Rio**<br>Cummings Skwy to Vista Point | • No bike lanes or sidewalks<br>• Long steep sustained grades with low truck volumes |
| **Crockett**<br>Vista Point to I-80 Ramps/Merchant St | • No bike lanes or sidewalks<br>• Major on and off-ramps serving I-80<br>• A large restaurant traffic generator near the ramps<br>• Some moderate grades approaching the ramps |

Along most of the study corridor, San Pablo Avenue is a four-lane (two lanes each direction) undivided arterial with a 45 mph speed limit and very limited sidewalks and dedicated bicycle facilities. All four travel lanes are 12 feet wide for a total traveled way of 48 feet. The roadway travels parallel to Interstate 80 (I-80) between Oakland and Crockett.

Through the study area, San Pablo Avenue travels through a range of residential, industrial, unincorporated, and rural areas, and has significant topographic features and steep grades. The roadway is a public street and the County is responsible for its maintenance within the study area. The Phillips 66 petroleum refinery and NuStar Energy occupy the largest parcels in the center of the study area, with the residential and commercial areas of Rodeo and Crockett on the west and east ends of the corridor. The roadway also passes by Selby Slag, a former smelting site located on the San Pablo Bay shoreline north of NuStar Energy. The Selby Slag is designated as a California hazardous waste and substances site, and a remediation plan and environmental impact report are under development and expected to be issued for public comment in 2017.

The Contra Costa County Public Works Department and Arup have completed a range of planning and technical studies, conceptual designs, cost estimates, and public outreach as part of the feasibility study. County staff and Arup have developed and evaluated several alternatives using a range of criteria related to design, safety, pedestrian and bicycle access, transit, traffic operations, and cost.

## 2.1 Study Objectives

The three primary study objectives are:

- **Incorporate a "Complete Street" with bicycle, pedestrian, and transit facilities on San Pablo Avenue between Rodeo and Crockett.** Providing continuous pedestrian and bicycle facilities where they do not currently exist will promote these transportation modes through the study area and will provide enhanced safety for all users.

- **Close an existing gap in the Bay Trail.** The 3-mile study segment is the longest gap in the Bay Trail between Vallejo and Oakland.
- **Identify a preferred alternative and ultimate set of improvements for the roadway.** County staff will use the findings from the feasibility report to make a recommendation for a preferred alternative from a range of alternatives. The preferred alternative will be used to identify a set of improvements for further design and funding.

## 2.2 Study Context

This study was commissioned by Contra Costa County Public Works through a Priority Development Area (PDA) Planning Grant from the Metropolitan Transportation Commission (MTC) and Contra Costa County Transportation Authority (CCTA). The study also made use of Community-Based Transportation Planning funds from the West Contra Costa Transportation Advisory Committee (WCCTAC) for the community outreach process. The entire length of San Pablo Avenue in Contra Costa County is designated as a PDA. Contra Costa County and Arup began work on the study in May 2015.

The PDA grants are awarded to jurisdictions that:

> *Increase walking, bicycling, carpooling and car-sharing by effectively managing parking and driving while promoting multimodal connections for residents, employees and visitors within the PDA.*

This study's stretch of the San Pablo Avenue corridor has been recognized in numerous previous planning documents as a key route and targeted for multi-modal improvements. The County's General Plan (2005) designates this portion of the corridor as a Scenic Route, given its surrounding landscape and views of San Pablo Bay, the Carquinez Strait, and the Briones Hills. The Countywide Bicycle and Pedestrian Plan (2009) proposes a class II bicycle facility on this portion of San Pablo Avenue, and notes that this facility is part of the county's larger bicycle and pedestrian network. Finally, the West Contra Costa Transportation Advisory Committee (WCCTAC) Action Plan (2014) designates the San Pablo Avenue corridor as a Route of Regional Significance, which means that it has multi-modal transportation service objectives that must be met. The Action Plan calls for bicycle and pedestrian facilities on the three-mile stretch from Rodeo to Crockett.

In 1994, Unocal Corporation owned the refinery parcels adjacent to San Pablo Avenue now owned by Phillips 66. Their land use permit at that time required that they construct a bike trail and walking path along the property frontage and dedicate a portion of an existing security road at the northeastern boundary for the same purpose. In lieu of constructing the improvements, Unocal deposited funds towards the construction of a trail along its property and agreed to work with the County's Public Works Department to implement the trail. A copy of the letter from Unocal is located in Appendix G. The study seeks to implement this trail along San Pablo Avenue.

The study is also informed by adopted local policy and statewide legislation mandating the implementation of Complete Streets. The State of California adopted the Complete Streets Act of 2008 (Assembly Bill No. 1358), which requires the legislative body of each county and city to:

> *"Accommodate the safe and convenient travel of users of streets, roads, and highways in a manner that is suitable to the rural, suburban, or urban context of the general plan, and in doing so to consider how appropriate accommodation varies depending on its transportation and land use context."*

The Contra Costa County Board of Supervisors adopted in 2008 a General Plan Amendment that incorporated "Complete Streets" principles into the General Plan. In July 2016, the County adopted a specific Complete Streets policy that identifies a set of principles, implementation processes, and exceptions. The County's 2016 policy requires:

> *"All departments and agencies of Contra Costa County shall work towards making Complete Streets practices a routine part of everyday operations, approach every relevant project, program, and practice as an opportunity to improve streets and the transportation network for all categories of users/modes, and work in coordination with other departments, agencies, and jurisdictions to maximize opportunities for Complete Streets, connectivity, and cooperation.*

This policy stipulates that a Complete Street design represents the design standard, and exceptions to providing a Complete Street design require an exemption granted by the Director of Public Works or Director of Conservation and Development and based on findings. The County's policy requires that all plans and projects incorporate complete streets infrastructure, sensitive to local conditions. Contra Costa County's General Plan and Complete Streets Policy establish that streets should be designed to accommodate all users, be sensitive to local context, and balance multiple demands.

## 2.3 What are Complete Streets?

Complete streets are streets for everyone. While every complete street has a different design and features, each aims to balance the needs of all users, recognizing that public infrastructure should ideally accommodate a diverse range of modes and users. Making room on our streets for pedestrians and cyclists not only enables healthier active lifestyles, but is also safer for these road users and can help reduce vehicle trip making and greenhouse gas emissions. Complete Streets come in various designs and configurations. Figure 3 shows a variety of designs that differ based on their local context (urban, suburban, rural, and industrial) and user demands.

**Figure 3: Complete Street Examples**


These Complete Street examples illustrate the wide variety of options for integrating pedestrian and cycling facilities into existing roadways. These facilities can be on-street (within the roadway) or off-street, physically separated by a wide buffer or a physical barrier such as a curb, pylons or bollards, and can serve pedestrians and cyclists separately in exclusive facilities (e.g., a sidewalk adjacent to an exclusive bicycle path) or in a shared facility where pedestrians and cyclists share the space.

Figure 4 presents several types of standard bicycle and shared use facilities. Class I, II, and III facilities are specified in Chapter 1000 of the California Highway Design Manual (HDM). California has recently endorsed the National Association of Transportation Officials (NACTO) Urban Street Design Guide and Urban Bikeway Design Guide as resources that Caltrans and local entities can reference when making planning and design decisions, as long as they are thoroughly documented. A Class IV facility, which is an on-street protected bike lane or "cycle-track", is now a common design implemented across California.

## Figure 4: Types of Bicycle Facilities

**Class I: Off-Street Paths or Trails**

**These facilities are separate from roadways and are usually shared by both pedestrians and cyclists.**

**Class II: On-Street Bike Lanes**

These facilities are designated on-street bike lanes with no physical barrier or protection. The width of the bike lane varies, but is typically five to six feet in width. If space is available, a wide painted separation buffer is recommended.

**Class III: Bicycle Routes**

Bicycle routes are “preferred” routes for cyclists, but do not provide any dedicated lanes. They are often marked by signs identifying the route including “sharrows”. Sharrows are shared-lane markings that are indicated with a double chevron and bicycle stencil. They are used to designate that vehicles and bicycles should share roadway space.

**Class IV: Protected On-Street Bike Lanes**

A protected on-street bike lane or “cycle-track” is a facility that is physically separated from the vehicle travel lane by a barrier. Barriers can include flexible pylons, bollards, or permanent concrete barriers. California State Assembly Bill 1193 created this new class of bikeway facilities in 2014. Protected bike lanes provide the most protection and comfort for people on bikes and do the most to encourage a broad range of users.

Source: Silicon Valley Bicycle Coalition

## 2.4 The Bay Trail

The San Francisco Bay Trail is a 500-mile regional walking and cycling path that is planned around the perimeter of San Francisco and San Pablo Bays. California Senate Bill 100 (1989) mandated the creation of the Bay Trail to provide connections to recreational opportunities and to serve as a regional transportation link. The Bay Trail is managed and planned by the Association of Bay Area Governments (ABAG). The Bay Trail Plan proposes a trail system consisting of three components:

1. The spine trail is the main alignment, intended as a continuous recreational corridor encircling the Bay and linking the shoreline of all nine Bay Area counties. In some areas, constraints force the spine trail inland.
2. Where the spine trail does not follow the shoreline, spur trails provide access from the spine to points of natural, historic and cultural interest along the waterfront.
3. Connector trails link the Bay Trail to inland recreation sites, residential neighborhoods and employment centers, or provide restricted access to environmentally sensitive areas. Some connector trails link the Bay Trail and the Ridge Trail, another regional trail network, which travels inland, mostly along the ridges of the Bay Area's hills. The spine trails, encircling the Bay and creating a continuous recreational corridor which links all nine Bay Area counties.

Figure 5 shows the entire Bay Trail with existing and planned facilities.

Figure 6 presents the Bay Trail alignment within the vicinity of the study area. This alignment was included in the original Bay Trail plan of 1989 and in the more recent *San Francisco Bay Trail Project Gap Analysis Study* (ABAG, 2005), which provides a detailed inventory of gaps in the Bay Trail system. ABAG identified the on-street alignment on San Pablo Avenue between Lone Tree Point and the Alfred Zampa Bridge as the planned Bay Trail segment. The San Pablo Avenue segment will eventually connect with the planned segment to Shoreline Park in Hercules.

**Figure 5: San Francisco Bay Trail (Source: ABAG)**

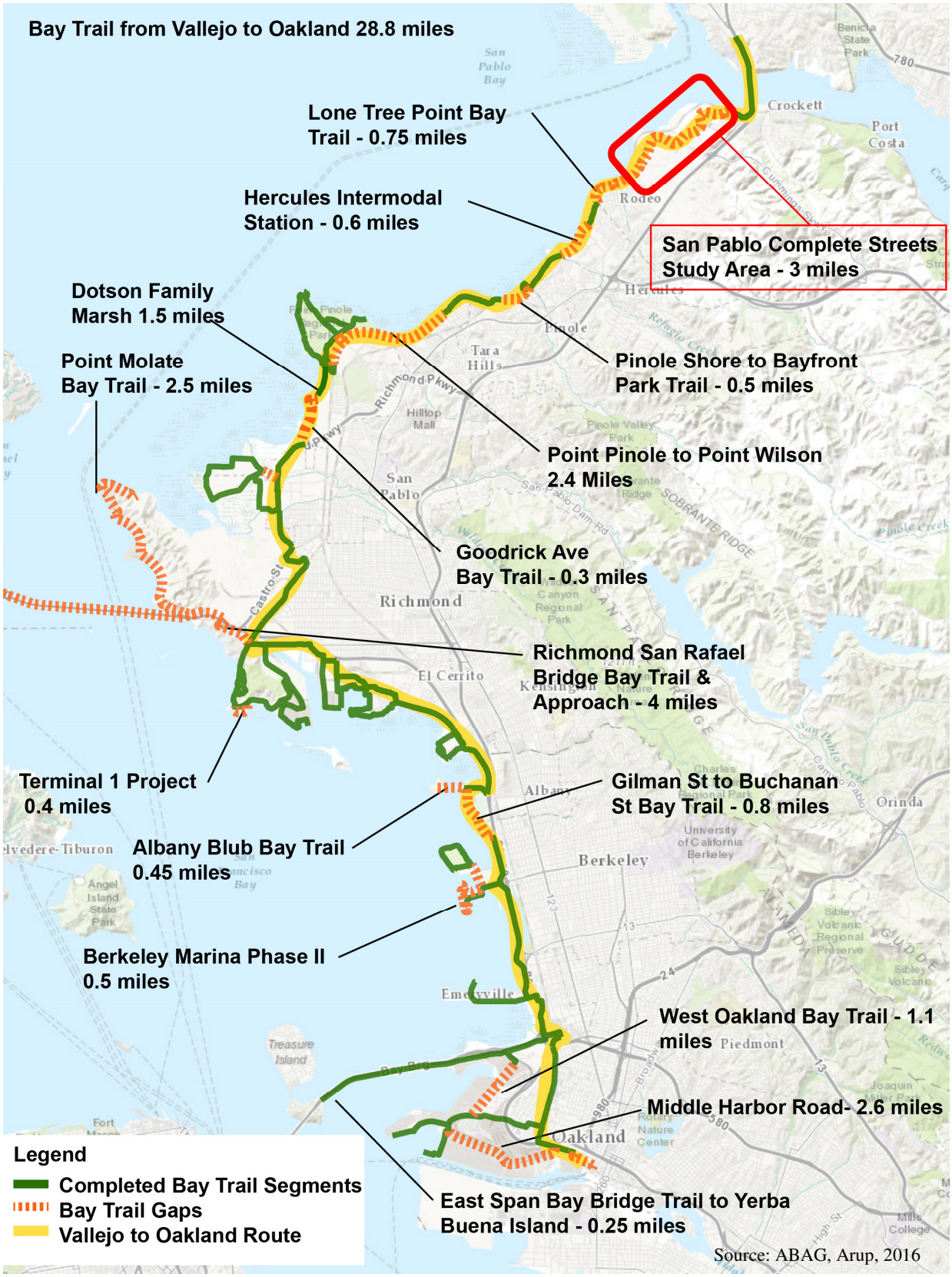

Source: ABAG, 2016

**Figure 6: Bay Trail Segments within the Study Area**

Source: ABAG, 2016

Figure 7 shows the location of planned and proposed Bay Trail projects between Oakland and Vallejo. The 3-mile San Pablo Avenue study corridor represents the longest missing gap in the Bay Trail between Vallejo and Oakland – a distance of approximately 30 miles. Currently, there are 14 active projects between Vallejo and Oakland totaling over 15 miles of new Bay Trail facilities. When completed, there will be over 77 miles of continuous Bay Trail in the East Bay.

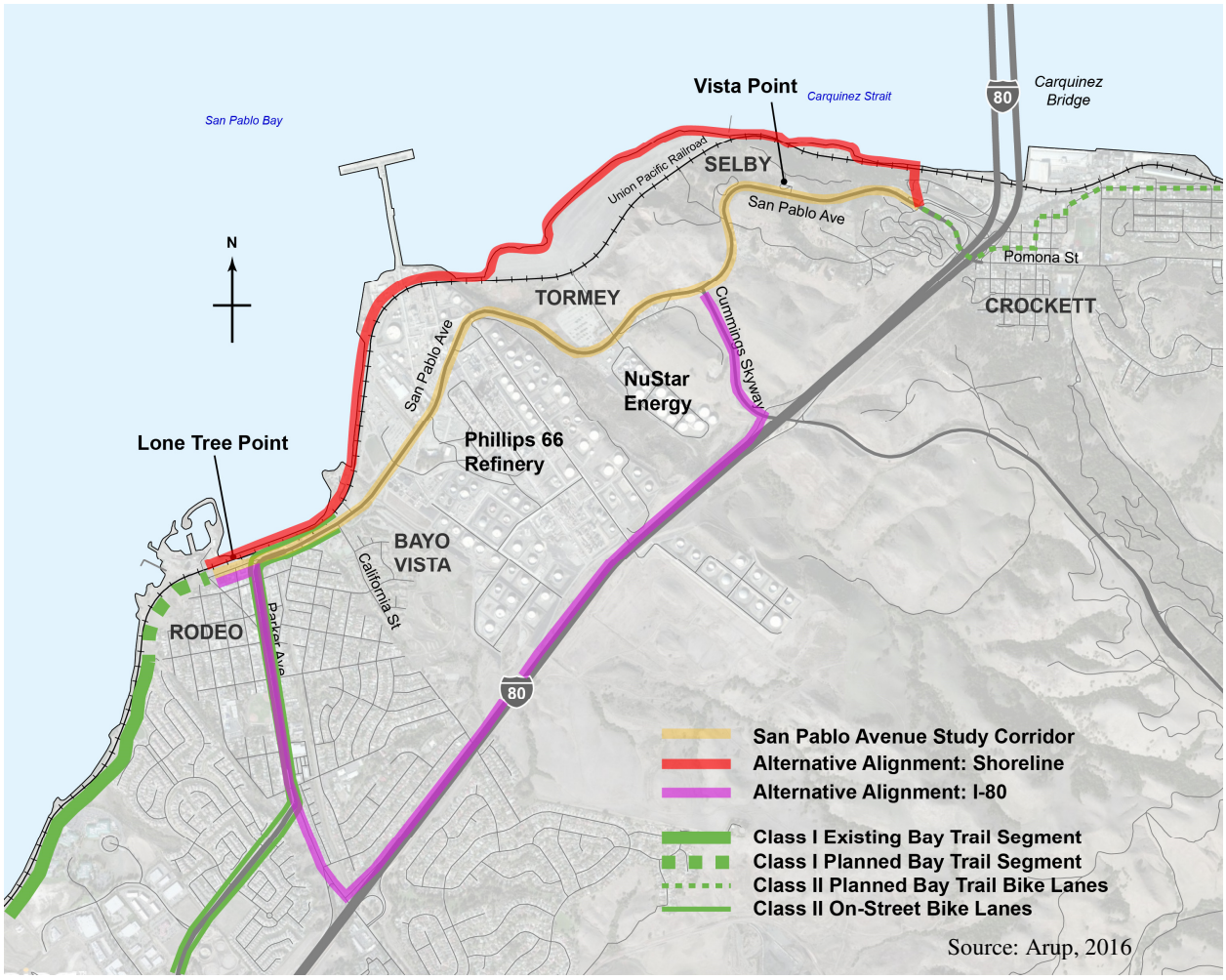
**Figure 7: Planned/Proposed Bay Trail Projects Between Oakland and Vallejo**



## 2.5 Alternative Bay Trail/Study Corridor Alignments

Alternative alignments for this segment of the Bay Trail through the study area have been raised by the public as part of this study. Figure 8 illustrates the two alternative alignments, which are described below:

**Figure 8: Alternative Bay Trail Alignments**




- **I-80 Alignment (Cummings Skyway to Willow Avenue):** This alignment would route the Bay Trail along Cummings Skyway to I-80, where it would follow an alignment along the freeway between Cummings Skyway and Willow Avenue. The I-80 alignment from Cummings Skyway to Lone Tree Point, where it would connect up with future Bay Trail segments, is approximately 3.6 miles, which is almost twice as long as the 1.9 miles along the San Pablo Avenue route.

This alignment has several constraints, including: the route is considerably longer than the San Pablo Avenue route; designing a bike and pedestrian path along I-80 would require widening into hillsides and retaining walls at several locations to maintain the number of travel lanes and shoulders on the freeway; steep grades on Cummings Skyway; the ramps at Cummings Skyway and Willow Avenue would need to be widened to allow pedestrians and cyclists to exit the freeway alignment; and Willow Avenue under I-80 would need to be widened to accommodate bike lanes and additional sidewalks between the freeway and Parker Avenue. The I-80 freeway and ramps are under Caltrans jurisdiction and a freeway alignment would need to be analyzed by Caltrans to determine feasibility.

- **Shoreline Alignment (Lone Tree Point to Alfred Zampa Bridge path):** This alignment would route the Bay Trail along the Shoreline and parallel to the Union Pacific (UP) railroad tracks, through the Phillips 66 refinery and the Selby site just to the east, and connect up to the Alfred Zampa path in Crockett. The constraints to this alignment include: there is very limited right-of-way adjacent to the UP tracks for a path; a significant safety barrier between the tracks and the path would be required; the path would travel directly through the Phillips 66 refinery and very close to active refinery activities; easements and additional security through the refinery and the Selby site would be required; very steep hillsides east of the Selby site would pose an engineering challenge; and routing the path up the steep hillsides to connect to the Alfred Zampa Bridge path would be very challenging and would likely require the path traveling through Crockett.

The scope of this study is to evaluate the feasibility of Complete Streets pedestrian and bicycle improvements along San Pablo Avenue, which was the alignment identified in ABAG's 2005 Gap Analysis Study. Evaluating other alignments is not a part of this study. The Bay Trail's goal is to develop a shoreline, multi-use separated trail, but where that is not possible, on-street alignments are acceptable. Due to the corridor's shoreline uses and topography, implementing bicycle and pedestrian facilities on San Pablo Avenue is an opportunity that balances Bay Trail objectives with surrounding site constraints and that provides easy connections to the Bay Trail segments at Lone Tree Point and the Alfred Zampa Bridge.

## 2.6 Feasibility Study Approach

The feasibility study included the following steps:

1. Reviewed previous policies, plans, and technical reports.
2. Analyzed engineering drawings, topographic maps, and aerial photography of the corridor.
3. Conducted field work, which included numerous site visits as well as a bicycle trip of the corridor.
4. Collected traffic, truck, accident data and utility information.
5. Conducted a series of technical studies to evaluate traffic conditions and to identify opportunities and constraints at key locations.

6. Conducted outreach activities, which included public and stakeholder meetings and surveys, before and after the alternatives development process.
7. Developed conceptual designs and cost estimates for three "Build" alternatives, which include a range of pedestrian and bicycle facilities.
8. Performed an alternatives analysis to understand how the three Build alternatives compare to the Existing Conditions (i.e., "No Build") alternative.

This report summarizes the findings of the feasibility study and the alternatives analysis. Additional detail is provided in the appendices.

# 3 Existing Conditions

San Pablo Avenue today is predominantly a four-lane roadway through a mostly rural area with significant topography. In most cases, the roadway does not have shoulders, guardrails or other infrastructure to enhance automobile safety or support walking or cycling. Along the study area, access to San Pablo Avenue is limited due to a relatively low number of intersections, and street lighting is limited along much of the corridor.

For automobiles, San Pablo Avenue serves as a parallel route for the I-80 freeway. It has a speed limit of 45 mph, but with wide 12' lanes and limited access, speeds along the roadway are typically much higher than the legal limit. Traffic varies along the corridor, highest in the southern portion at Parker Avenue with 4,700 average daily traffic (ADT) and lowest east of Cummings Skyway, with 2,200 ADT. With a four-lane roadway, there is ample room for automobiles to pass trucks and other slow moving vehicles.

Supporting industrial uses along the corridor, a significant amount of truck traffic travels the corridor. For the portion west of Cummings Skyway, 23% of vehicles are trucks, while only 12% are trucks to the east of Cummings Skyway. Truck traffic can make left turns from the center left travel lane, which provides a sufficient turning radius for large vehicles. Right turns are made from dedicated right-turn lanes or the right travel lane. However, turning vehicles can block through-traffic movements on the roadway, as there are no dedicated left-turn lanes.

Conditions for active transportation modes are poor on San Pablo Avenue. Much of the roadway lacks pedestrian infrastructure; sidewalks and bicycle lanes exist only from Parker Avenue to California Street, only approximately 10% of the entire corridor. The remainder of the roadway lacks sidewalks and in many cases the shoulder is insufficient for safe pedestrian use. Crosswalks do exist at all signalized intersections. Similarly, the remainder of the corridor lacks dedicated bicycle facilities and the shoulders are similarly too narrow for safe cycling. Given the high speed limit and the even higher real-world travel speeds on the corridor, the roadway is not a safe place for even avid cyclists.

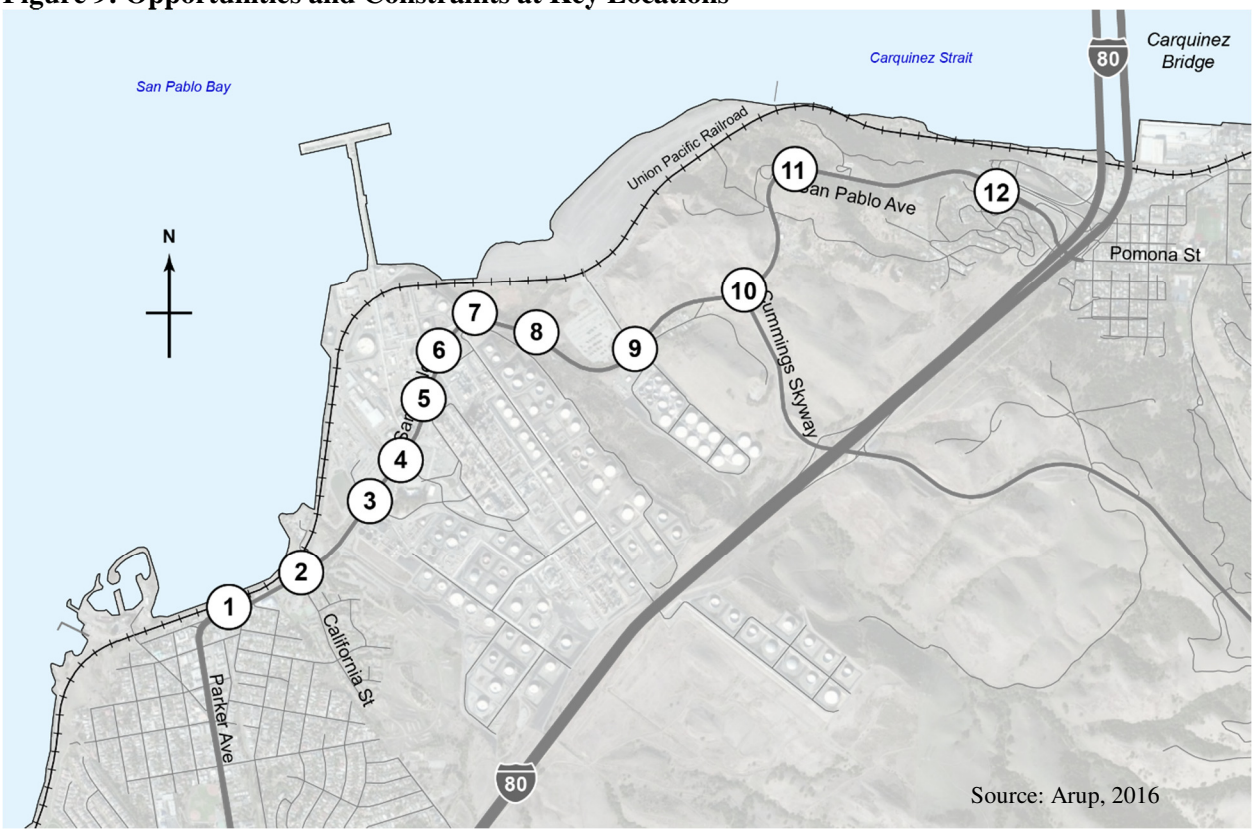
Finally, limited transit service is offered along the corridor. WestCAT has four bus stops along the study corridor, at the following locations: California Street, Road Number 4 at the Phillips 66 refinery, A Street, and the Merchant Street Park and Ride lot. Only one stop includes improvements such as a shelter and bench, while the remainder are simply signed roadside areas. Buses either stop in the right travel lane and block traffic or pull into unpaved shoulders.

Additionally, the John Swett Unified School District busses students along San Pablo Avenue between schools in Rodeo and Crockett. One school bus stop is located along the study corridor at A Street/NuStar Energy.

# 4 Key Corridor Features

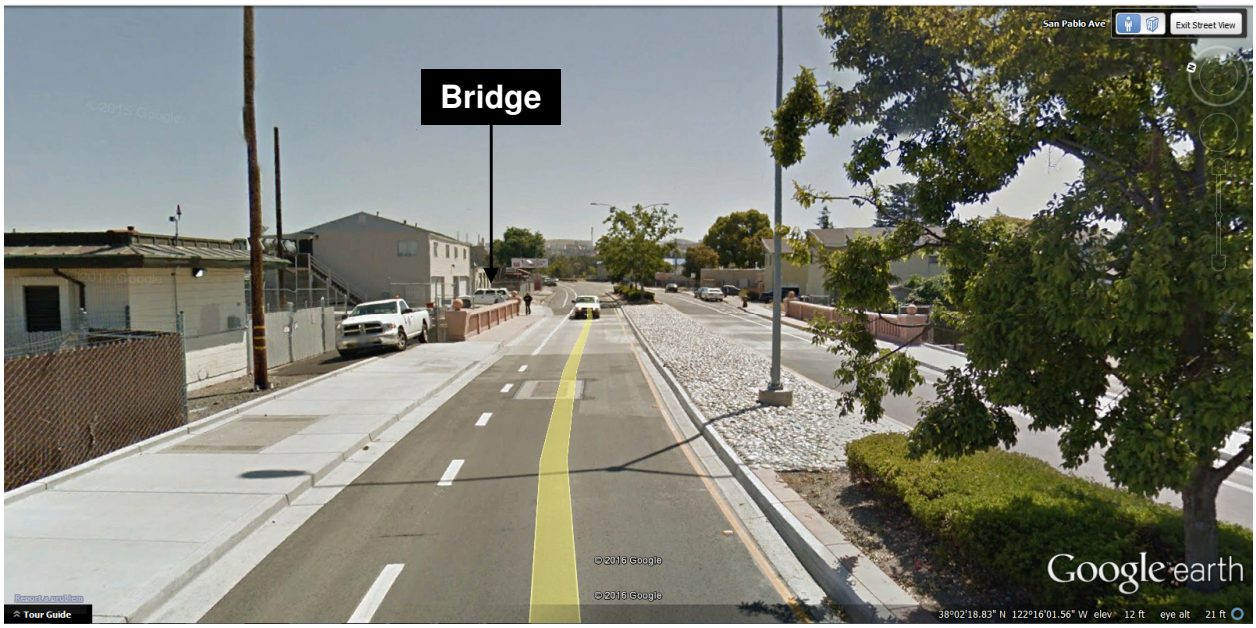
The initial field work and review of existing documents yielded various findings at key locations along the corridor. These were documented and assessed to help understand the key features that the Complete Streets designs would need to respond to. Figure 9 identifies the key locations, which are followed by Google Earth Streetview images detailing the specific opportunities and constraints.

**Figure 9: Opportunities and Constraints at Key Locations**



## 1 San Pablo Avenue and Parker Avenue (looking east)

- Opportunity to tie into existing bicycle lanes; sidewalks are incomplete in many areas
- Bridge constrains the right-of-way and was replaced in 2014




## 2 San Pablo Avenue and California (looking west)

- The roadway cross-section on San Pablo Avenue west of California Street provides on-street bike lanes and dedicated left-turn lanes with on-street parking on both sides

## 3 San Pablo Avenue and Refinery Road (looking east)

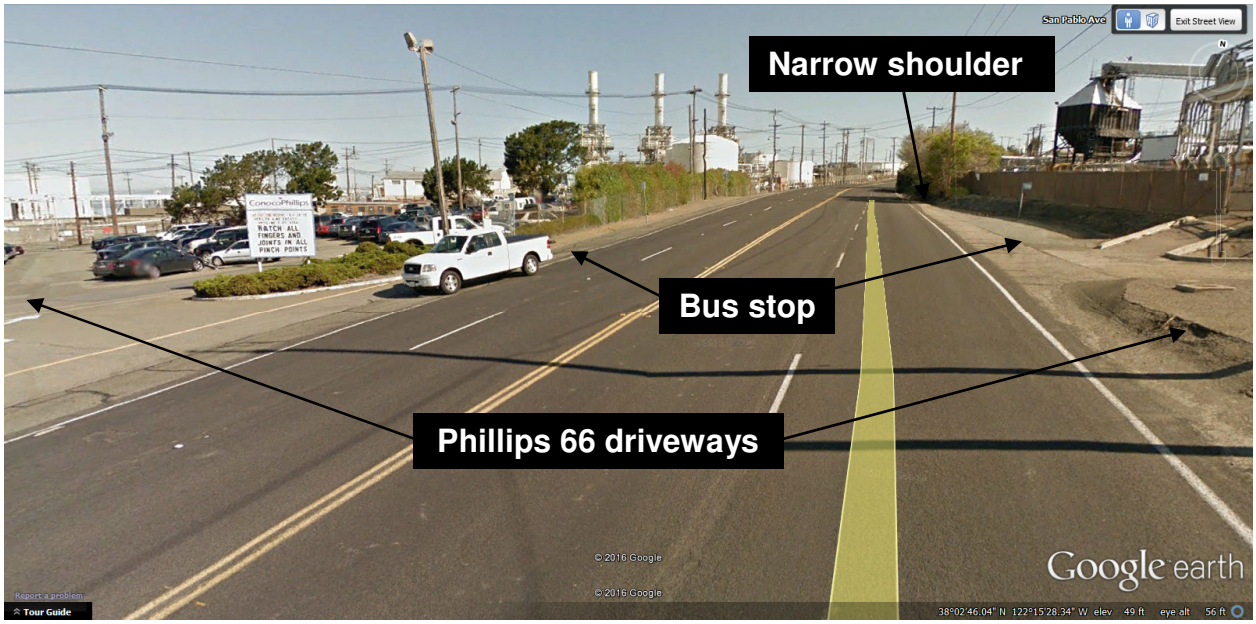
- Minimize impacts to signal equipment and Phillips 66 property
- Maintain large radius turn lanes for trucks


## 4 San Pablo Avenue east of Refinery Road (looking east)

- Utility poles, pipelines, and other infrastructure present right-of-way constraints
- Narrow cross-section with no shoulder and pipelines crossing under the road

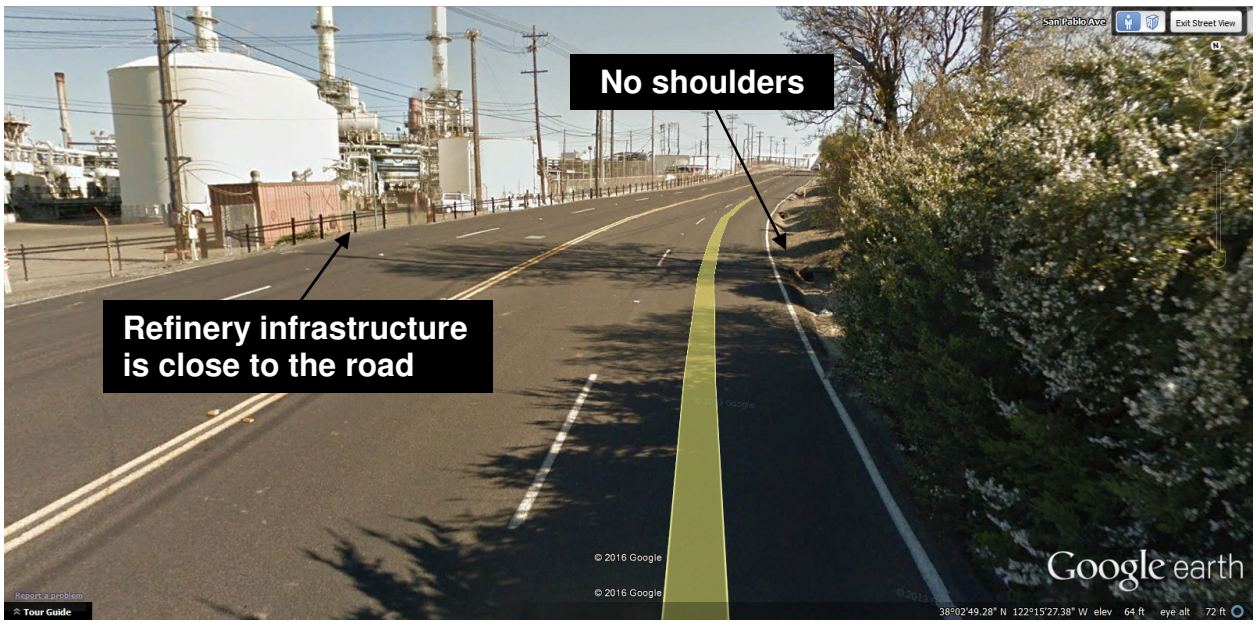
## 5 San Pablo Avenue at Main Driveway (looking east)

- Driveways and a major truck access point for Phillips 66



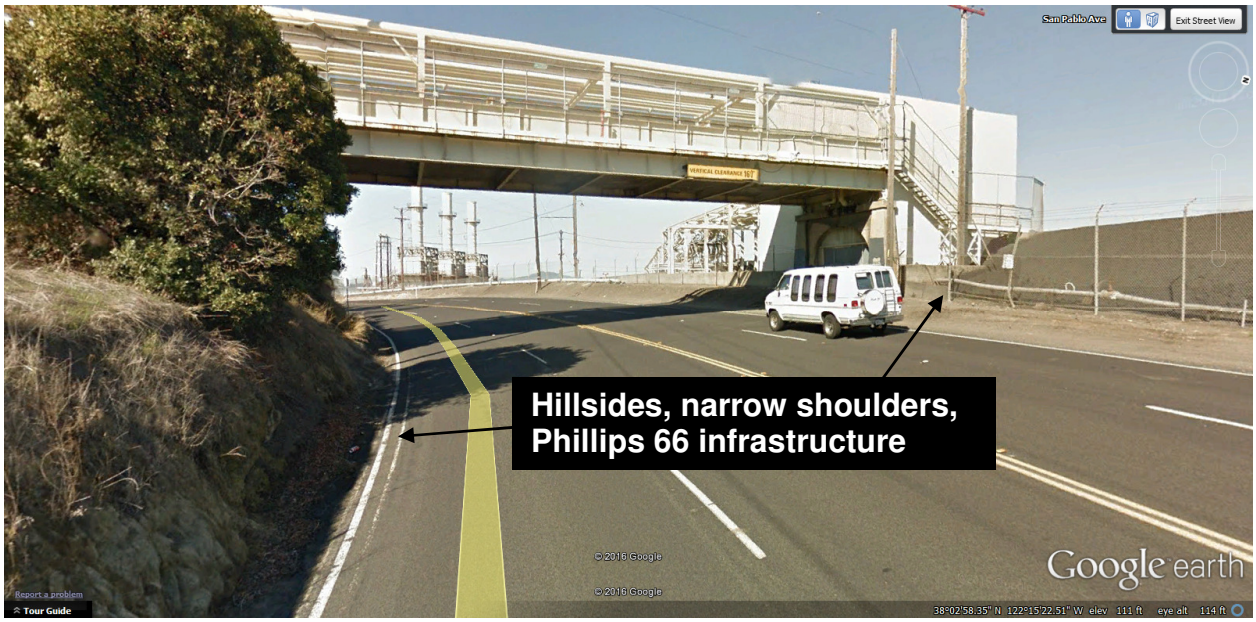

## 6 San Pablo Avenue at east of driveway (looking east)

- No shoulders
- Adjacent refinery infrastructure



## 7 San Pablo Avenue at the refinery summit (looking west)

- Narrow section with no shoulder and adjacent hillside
- Overhead utility/pipeline structure

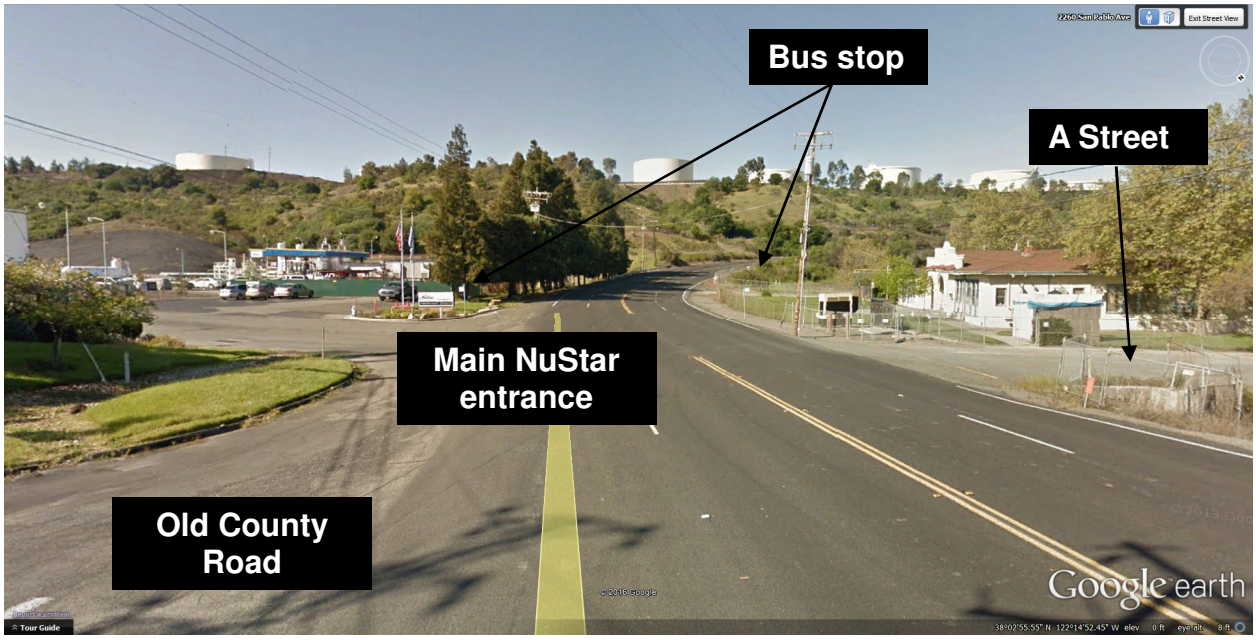



## 8 San Pablo Avenue approaching Cummings Skyway (looking east)

- Adjacent steep hillside, guardrail with steep drop, no shoulders

## 9 San Pablo Avenue at A Street (looking west)

- Maintain truck access into NuStar and improve access to bus stops and Old County Road




## 10 San Pablo Avenue at Cummings Skyway (looking east)

- Avoid impacts to signal poles
- Maintain the large turning radius for trucks heading to/from Cummings Skyway
- Adjacent hillside with narrow shoulders

## 11 San Pablo Avenue east of Cummings Skyway at second summit (looking west)

- Guardrail with a steep drop and narrow shoulders


## 12 San Pablo Avenue at Merchant Street (looking west)

- Angled parking for the Dead Fish Restaurant just to the outside of the travel lanes
- Narrow shoulders and limited sidewalks

# 5 Outreach

The County and Arup developed a range of outreach efforts to obtain strategic direction, technical guidance, and feedback from the public and stakeholders at multiple points during the study. The project team strived to collect a broad range of comments and opinions from the public and key stakeholders using a variety of methods, including comments made at public meetings, email correspondence, and web-based surveys. The following summarizes the outreach process:

- **Technical Advisory Committee (TAC):** A TAC was formed to provide strategic guidance to the study. The TAC has met several times throughout the study. The committee consisted of 19 members from a cross-section of stakeholders, including County staff, representatives from staff of the Contra Costa County District V Supervisor Federal Glover, Contra Costa Health Services, Contra Costa County Employment and Human Services, Western Contra Costa Transit Authority (WestCAT), Caltrans, the West Contra Costa County Transportation Advisory Committee (WCCTAC), the Metropolitan Transportation Commission (MTC), Caltrans, the East Bay Regional Parks District, ABAG, Phillips 66, NuStar, Bike East Bay, and local residents from Rodeo and Crockett.


- **Community Workshops:** Two public meetings were held to inform residents and stakeholders on the study. The first was held on February 8, 2016 at the Rodeo Senior Center. The project team presented an overview of the project, presented initial concepts for two alternatives (bike lanes and shared-use path), presented the traffic study findings, received public comments, and responded to questions from the public. At the second meeting, on September 29, 2016 at the Crockett Community Center, the project team presented the alternatives and received input and feedback on the preliminary layouts.

- **Stakeholder Meetings:** Stakeholder meetings were conducted with representatives from Phillips 66, NuStar Energy, and the office of Federal Glover, Supervisor for Contra Costa County. The study team also conducted additional stakeholder outreach to obtain information and feedback from the Crockett-Carquinez Fire Department, Rodeo-Hercules Fire District, John Swett Unified School District, WestCAT, and the Dead Fish restaurant.

- **Website:** County staff established a website for the project at the following URL: http://www.co.contra-costa.ca.us/6006/San-Pablo-Avenue-Complete-Streets-Project. All documents, presentations, meeting information, and surveys (more details below) are being posted to this website for the public.
- **Collaborative Map**: Arup also set up a "Collaborative Map" for the corridor that allows users to drop pins on problem areas and provide comments. The Collaborative Map URL is https://www.collaborativemap.com/SanPabloAve/.
- **Web surveys**: Arup developed a web survey for the study that was launched at the February 8th public meeting.. The County has a link to the website at this URL: http://arup.polldaddy.com/s/san-pablo-avenue-complete-streets-project-survey.
- **Comment cards:** County staff developed comment cards for each public meeting. The cards were printed on postcards and distributed at the public meetings to obtain feedback and allow attendees to provide written comments.

## 5.1 Survey Results

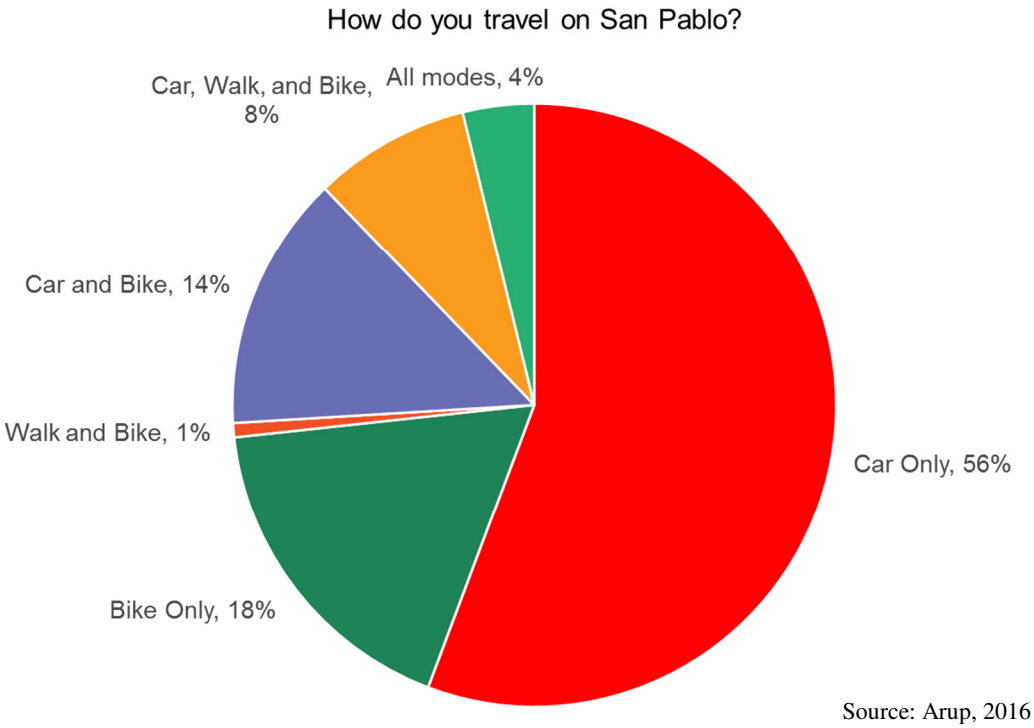
The web surveys are meant to capture the general public sentiment regarding the project and are included in the design process as one of the key inputs alongside the policy priorities, technical findings, and cost estimates. The survey results indicate a broad range of sentiment and usage along the study corridor. The web survey received 143 valid responses from a range of local residents and businesses, regional stakeholders, as well as regular and occasional users. The full survey detail and results are available in the Appendix.

Figure 10 presents the results to the question: "How do you travel on San Pablo Avenue?"

Just over half of the respondents use "Car Only". However, 44% use non-auto modes or a combination of modes to travel along the corridor. Figure 11 presents the results to the question: "Which pedestrian/bicycling facilities would you use along San Pablo Avenue if they were available?"

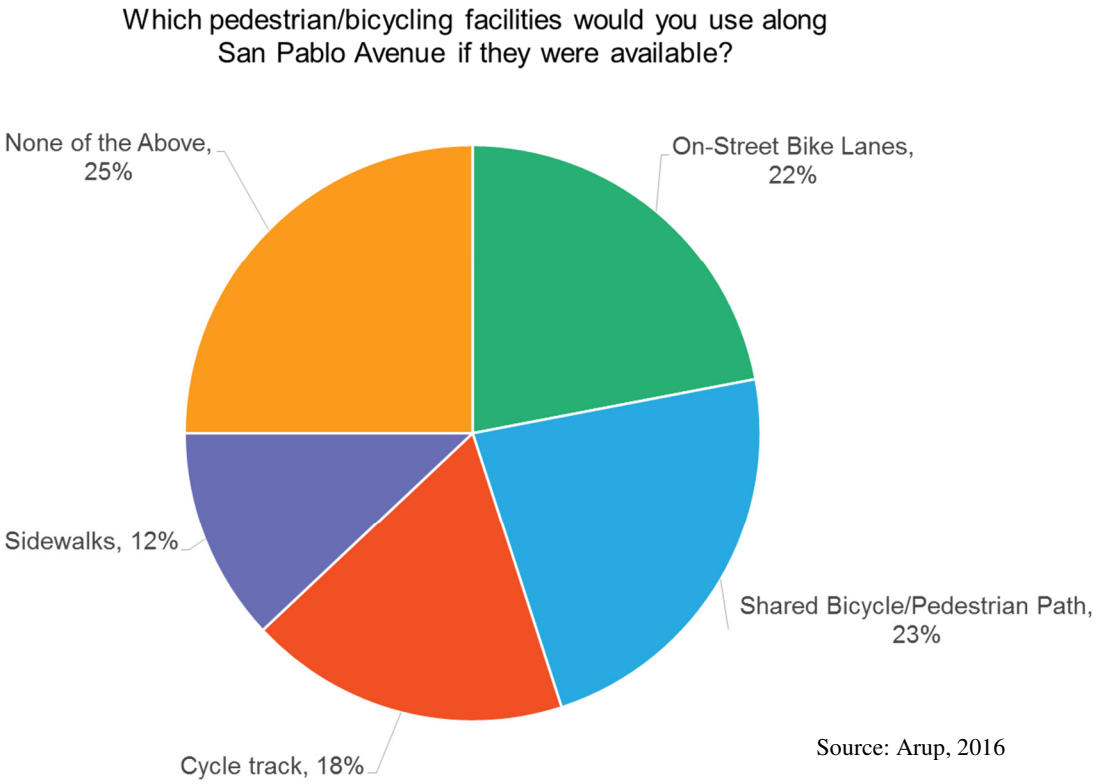
These results indicate a broad range of sentiment related to what type of pedestrian and/or cycling facilities the public and stakeholders would like to see along the corridor. One quarter stated "None", while almost equal percentages were interested in "On-Street Bike Lanes" or a "Shared Bicycle/Pedestrian Path". There was greater support for a cycle track alone than for sidewalks alone.

**Figure 10: Travel Along San Pablo Avenue**




Source: Arup, 2016

**Figure 11: Question Regarding Sentiment on New Pedestrian/Bicycling Facilities**




Source: Arup, 2016

# 6 Traffic and Safety Analysis

This section provides a summary of the traffic and safety analysis conducted for the study. The detailed traffic study is available in the Appendix. The analysis methodologies presented in this report are consistent with best practices and are consistent with relevant analysis guidelines published in *Technical Procedures* (Contra Costa Transportation Authority, 2013).

The initial traffic assessment of the study corridor indicated the following:

- San Pablo Avenue is a four-lane undivided arterial street with very few left-turn lanes, no dedicated bicycle facilities, and sidewalks along approximately 10% of the corridor
- Low traffic volumes, but with higher than normal truck volumes
- A low level of congestion on most days
- Observed speeds higher than the posted 45 mph speed limit

## 6.1 Existing Traffic Conditions

To identify existing traffic conditions, traffic counts were collected at multiple locations during the week of May 12, 2015. Machine "tube" counts, which record hourly volumes in each direction over a 24-hour period, were collected at three locations in the study corridor:

- Parker Avenue, South of 1st Street (this is outside of the study area, but included as for comparison purposes)
- San Pablo Avenue, West of Cummings Skyway
- San Pablo Avenue, East of Cummings Skyway

Table 2 summarizes the average daily traffic (ADT) volumes for the three count locations.

**Table 2: Average Daily Traffic (ADT) at Three Locations Along the Corridor**

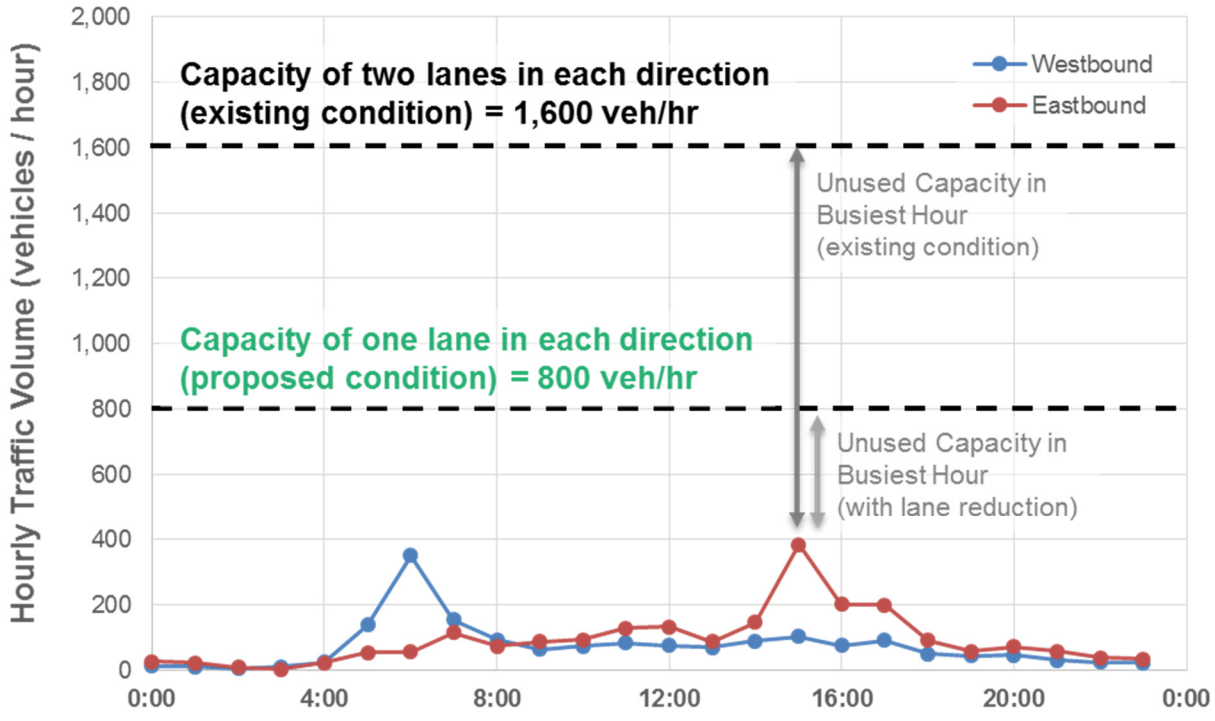
| Location | Average Daily Traffic (vehicles) |
|---|---|
| Parker Ave, South of 1st Ave (one-lane each direction, center left-turn lanes) | 4,700 |
| San Pablo Ave., West of Cummings Skyway (two-lanes each direction, no dedicated left-turn lanes) | 3,900 |
| San Pablo Ave., East of Cummings Skyway (two-lanes each direction, no dedicated left-turn lanes) | 2,200 |
| San Pablo Ave., North of John Muir Parkway (two-lanes each direction, one left-turn lane in each direction) | 32,000 |
| Source: Arup, 2016 | |

Parker Avenue at 1st Avenue has the highest observed daily traffic volumes, although this location is outside of the study corridor. San Pablo Avenue west of Cummings Skyway carries

approximately 75% more traffic and trucks than the segment east of Cummings Skyway. Most trucks use Cummings Skyway to travel between Phillips 66 and NuStar and I-80. The segment east of San Pablo Avenue has significantly lower observed traffic volumes compared to the other two locations. However, the overall observed traffic volumes on all three of these segments are low for a four-lane road, even after accounting for higher truck activity (trucks are approximately 25% of the observed traffic volumes). As a comparison, San Pablo Avenue in Hercules, which is also a four-lane roadway, carries approximately 32,000 vehicles a day.

One high-level measure of traffic capacity is to compare the observed hourly volumes to standard lane capacities. Engineering studies typically utilize lane capacities of 800 vehicles per hour per lane for arterial roadways with the characteristics of San Pablo Avenue. Figure 12 compares the observed hourly volumes in each direction (eastbound and westbound) on San Pablo Avenue to the estimated capacity of the existing roadway (two lanes each direction) and a roadway with a road diet (one travel lane in each direction with left-turn lanes).

**Figure 12: Observed Hourly Traffic Volumes and Capacity on San Pablo Avenue West of Cummings Skyway**




Source: Arup, 2016

This graph shows how westbound traffic volumes peak at 400 vehicles per hour between 6 and 7 AM, while the eastbound traffic volumes peak at approximately the same hourly volume between 3 and 4 PM. These peaks occur one hour before the typical morning and evening peak hours for the Bay Area, which reflects earlier shift times at the refinery. The capacity for two travel lanes in each direction is approximately 1,600 vehicles per hour and 800 vehicles per hour for one travel in each direction. This graph indicates that approximately 25% of San Pablo Avenue's capacity is used today. Implementing the road diet would still leave approximately 50% available capacity.

## 6.2 Intersection Traffic Analysis

A Synchro traffic operations model was developed to analyze the ten study area intersections in greater detail and to assess the feasibility of removing a travel lane to provide space for pedestrian and bicycle improvements. To address the various peak periods along the corridor, intersection turning movement counts were collected for eight hours on a typical weekday to capture the "regional" Bay Area peak and the localized "refinery" peak.

For the regional peak, intersection turning movement counts were collected at ten locations in the AM (7 AM – 9 AM) and PM (4 PM – 6 PM) periods during a mid-week day in May 2015. Most locations in the Bay Area experience peak activity during these times. The study intersections in Rodeo and east of Cummings Skyway experience this typical regional peak and the intersection LOS analysis reflects this "worst case" condition.

The refinery peak occurs earlier than the typical Bay Area peak, which reflects when their work shifts change. The refinery peak counts were collected for the "early AM" and "early PM" periods (5 AM – 7 AM and 2 PM – 4 PM, respectively) to coincide with this peak refinery activity. The remainder of the study intersections peak during the refinery period and the intersection LOS analysis reflects this "worst case" condition.

The analysis uses methodologies published in the *2000 Highway Capacity Manual* (Transportation Research Board, 2000) to determine the intersection level-of-service (LOS). The LOS methodologies estimate delay at the intersection and then assign a qualitative LOS rating that characterizes overall traffic operations. Table 3 summarizes the HCM intersection LOS criteria.

**Table 3: Intersection LOS Criteria**

| LOS | Signalized Intersections |
|---|---|
| A | Delay of 0 to 10 seconds. Most vehicles arrive during the green phase and do not stop at all. |
| B | Delay of 10 to 20 seconds. More vehicles stop than with LOS A, but many drivers still do not have to stop. |
| C | Delay of 20 to 35 seconds. The number of vehicles stopping is significant, although many still pass through without stopping. |
| D | Delay of 35 to 55 seconds. The influence of congestion is noticeable, and most vehicles have to stop. |
| E | Delay of 55 to 80 seconds. Most, if not all, vehicles must stop and drivers consider the delay excessive. |
| F | Delay of more than 80 seconds. Vehicles may wait through more than one cycle to clear the intersection. |
| Source: Transportation Research Board | |

Three traffic scenarios were analyzed for the "regional" peak hour and the "refinery" peak hours:

- **Existing (2015) Conditions:** observed traffic volumes with existing lane configurations
- **Cumulative No Project (2040):** future traffic volumes with existing lane configurations
- **Cumulative + Reduced Lanes (2040):** future traffic volumes with a "road diet" reduce from two to one travel lane in each direction at each intersection; provide dedicated left-turn lanes at intersections

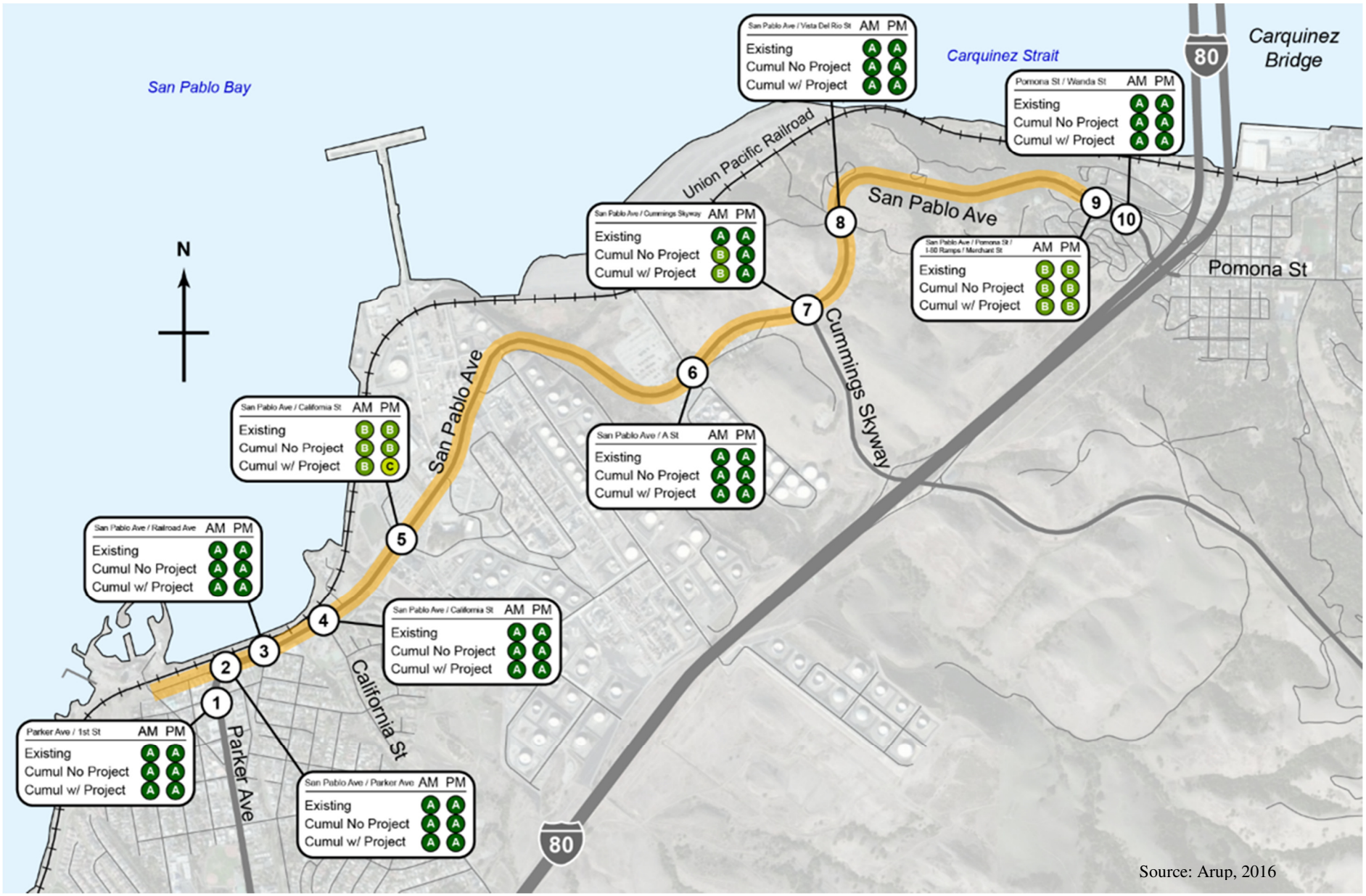
The CCTA Countywide Travel Model (2010) was used to determine forecasted traffic growth in the study corridor. The CCTA model takes into account changes to future land use and the transportation network.

Figure 13 presents the intersection traffic LOS results for the 10 study intersections. The detailed LOS tables and the technical calculations are provided in the Appendix. The figure shows the LOS rating for AM and PM peak hour (regional or refinery, whichever is higher) under existing and the two future Cumulative scenarios (No Project and Reduced Lanes). The County's standard for rural roads is a "high" LOS D.

The major findings of the intersection traffic analysis are:

- All intersections operate at LOS A or B under Existing and Cumulative No Project conditions.
- Under the Cumulative + Reduced Lanes scenario only one intersection, San Pablo Avenue / Refinery Road, goes to LOS C and this would occur in the PM peak hour only. LOS C is well within acceptable operating thresholds.
- The reduction of one travel lane in each direction does not negatively impact traffic operations at any location under any peak hour scenario.

## Figure 13: Intersection Traffic LOS Results



## 6.3 Additional Traffic Considerations

### San Pablo Avenue as a Bypass Route for I-80

Additional concerns regarding the usage of San Pablo Avenue as a bypass route to avoid congestion on I-80 between the Alfred Zampa Bridge and Willow Avenue have been raised by the public. Several sources of traffic data have been utilized to understand the level of congestion on both routes and the likelihood of traffic diversion. These sources include Google Maps Traffic service, which can summarize data in real-time or for a "typical" day based on historic data collected from cell phones and other navigation system devices. Also, Caltrans Freeway Performance Management System (PeMS) also provides data collected from in-pavement road sensors. Figure 14 shows typical AM conditions on a Wednesday morning at 8 AM from Google Maps Traffic and typical PM conditions for a Wednesday afternoon at 4 PM.

The figure shows that I-80 operates reasonably well on the segment between Willow Avenue and the Alfred Zampa Bridge during both the AM and PM commutes. Most of the congestion is located south of the State Route 4 (SR 4) interchange in Hercules. The section of I-80 from Willow Avenue to the Alfred Zampa Bridge was recently widened in 2011 from three to four lanes to accommodate a High Occupancy Vehicle (HOV) lane in both directions.

**Figure 14: Typical AM Conditions (8 AM) from Google Maps Traffic Application**

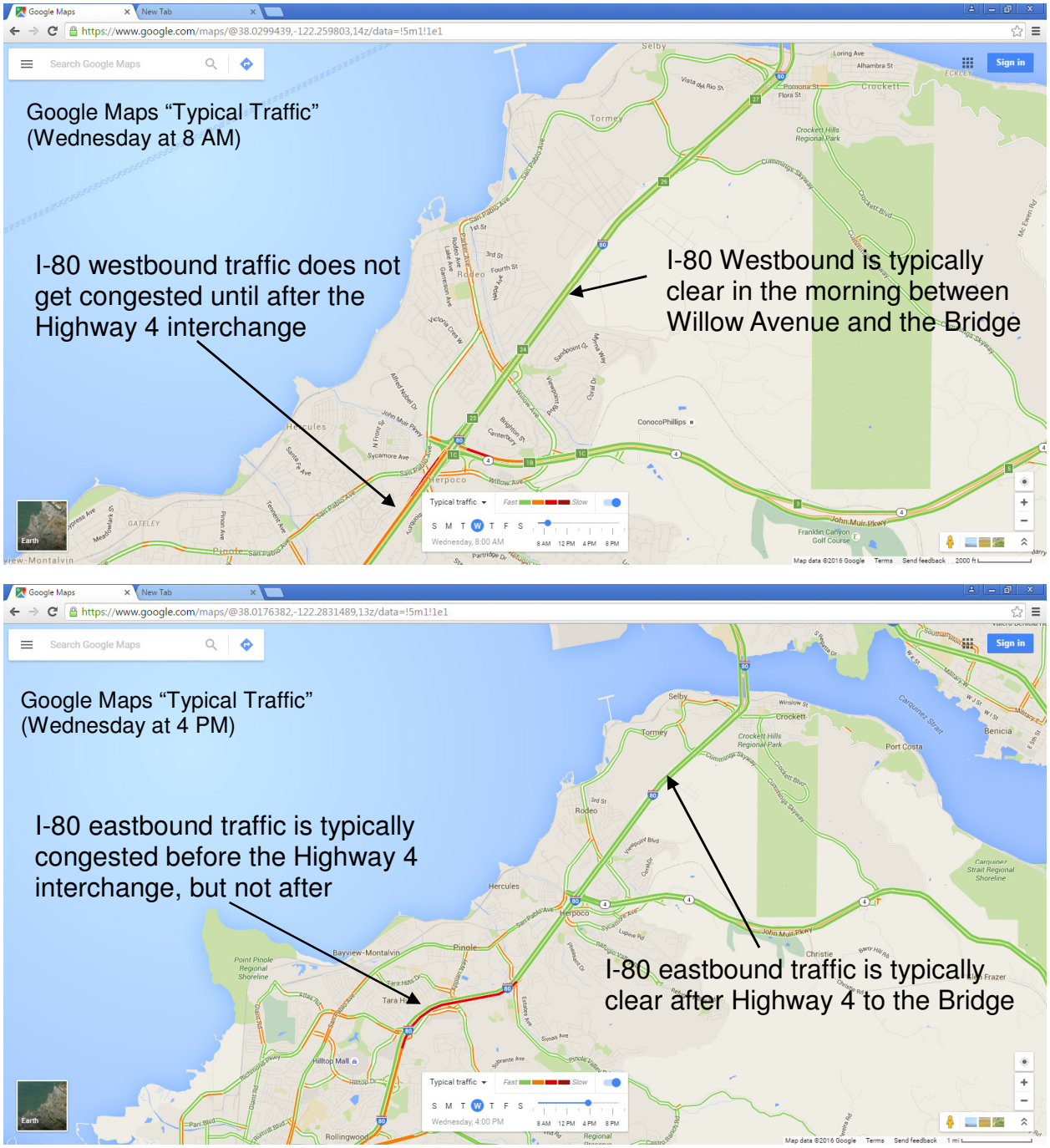
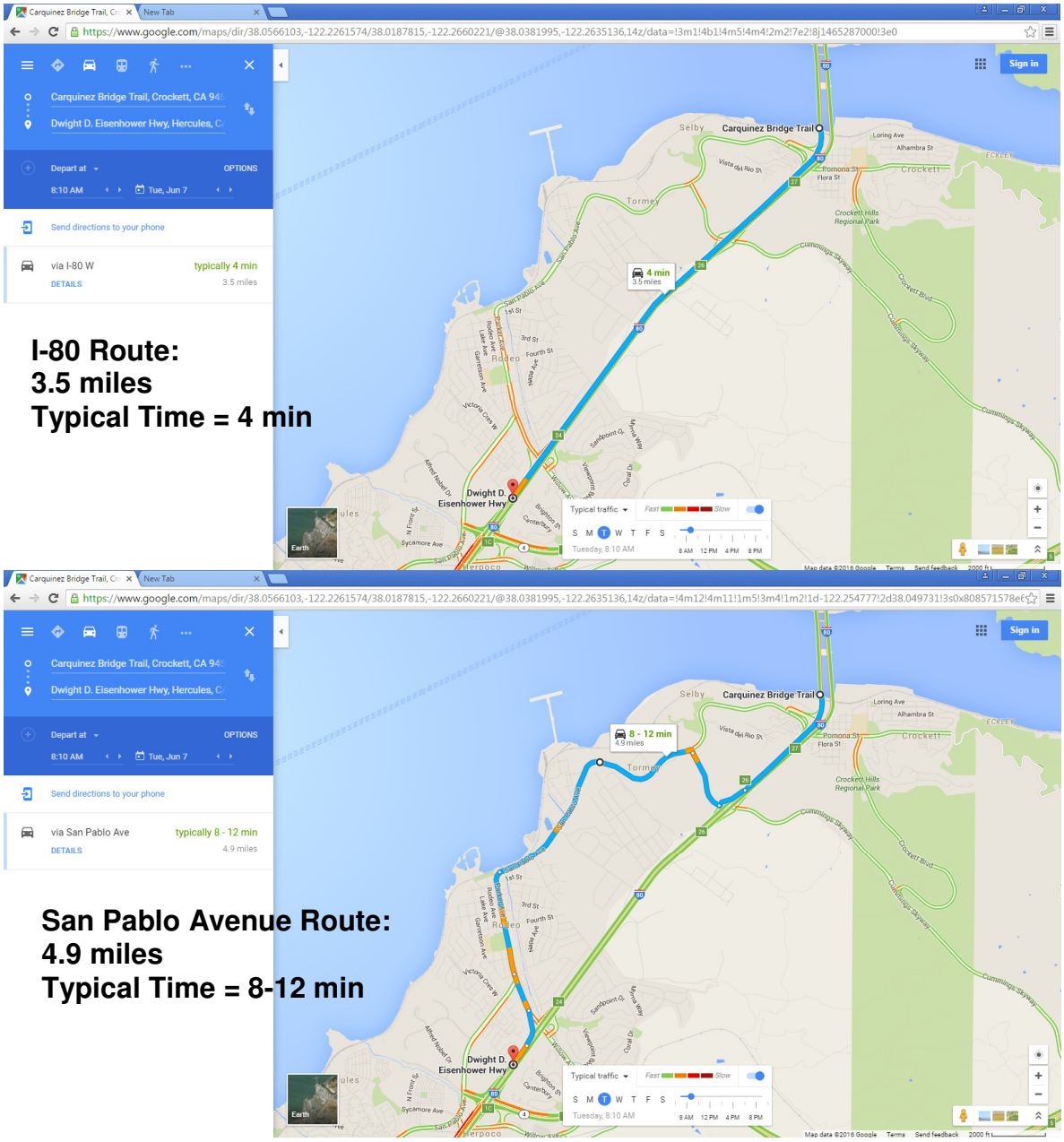



Figure 15 shows the travel distance and typical AM travel times from Google Maps Traffic between the Alfred Zampa Bridge and Willow Avenue using I-80 and San Pablo Avenue. This figure shows that I-80 is the shortest and typically the fastest route.

## Figure 15: Travel Times on I-80 and San Pablo Avenue (AM Morning Commute)




These data indicate the following:

- I-80 between the Bridge and Willow Avenue operates reasonably well during the AM and PM commute periods.
- The addition of the fourth travel lane (HOV) on I-80 has increased capacity and improved travel time reliability.
- The travel times on I-80 between the Bridge and Willow Avenue are typically two to three times faster than San Pablo Avenue.

- This segment of San Pablo Avenue is used very infrequently as a bypass route.

## Refinery Operations and Turnarounds

The Phillips 66 refinery employs approximately 650 to 700 people for normal day-to-day operations. In addition to normal operations, the refinery schedules "turnarounds" for major plant upgrades and maintenance several times per year. A typical turnaround occurs four to eight times per year and involves 100 to 400 additional employees per day. The smaller events last two to three weeks, with larger events lasting six weeks or more. Depending on the number of contractors working during the turnaround, the event may have staggered day and night work shifts. The increased traffic window occurs from 5:00 AM to 7:00 AM and 5:00 PM to 7:00 PM.

The refinery operates three larger turnarounds every three to five years that involve 800 to 1,700 additional employees working on staggered shifts. The increased traffic window occurs from 5:00 AM to 9:30 AM and 5:00 PM to 9:30 PM. The larger traffic window better spreads the number of peak period auto trips on the study area roadways. For the larger turnarounds, workers may be transported via bus from the refinery's Selby parking lot to the site.

A traffic analysis of the San Pablo Avenue / Refinery Road intersection under the Cumulative + Reduced Lanes (2040) Refinery Peak scenario (assumes the road diet concept) was performed to assess the potential impacts of a typical turnaround with 400 employees driving to the refinery. This analysis assumed the following:

- Arrival/departure rates: 50% of the employees arrive during the AM and PM peak hour. This is a conservative assumption given the staggered shifts.
- Average vehicle occupancy: 1.2 persons per vehicle. This is the average Bay Area vehicle occupancy and reflects some carpooling activity.
- The number of additional peak direction vehicle trips (inbound AM or outbound PM) is 170 vehicle trips (400 employees * 1.2 persons per vehicle = 170 vehicle trips). In addition, 20 off-peak direction trips (approximately 10%) were also added into the analysis. These trips were added to the San Pablo Avenue / Refinery Road intersection and analyzed under 2040 conditions with the Refinery Peak.

The additional vehicles associated with a 400 person turnaround would result in LOS C operations with 24.7 seconds of delay for the PM Refinery peak hour under the Cumulative + Reduced Lanes scenario. The turnaround trips do not negatively impact LOS and cause only a small increase in delay compared to the traffic analysis results presented in section 6.2 above. Without the additional turnaround trips, the intersection LOS at San Pablo Avenue / Refinery Road is LOS C with 21.5 seconds of delay.

The larger turnarounds were not analyzed because they are so infrequent.

## Truck Routes

Caltrans has determined that large STAA trucks will not be permitted to use the eastbound I-80 on-ramp from Pomona Street because of the ramp's design. The other I-80 ramps at Pomona Street are unaffected. Therefore, STAA trucks from the C&H refinery heading east on I-80 will need to use San Pablo Avenue and the eastbound on-ramp at Cummings Skyway to access I-80. Trucks traveling to C&H from the west can still use the eastbound off-ramp to Pomona Street. Based on conversations with C&H, the number of eastbound STAA trucks that would need to use San Pablo Avenue and southbound Cummings Skyway to access eastbound I-80 is approximately 100 trucks per day. This equates to a peak hour truck volume of approximately 10 trucks, or one truck every six minutes and would not have a significant impact to traffic along San Pablo Avenue under any of the traffic scenarios analyzed.

## Emergency Response and Evacuation

Concerns have also been raised regarding emergency response and evacuation plans. For emergency response, the road diets will not have a negative impact on the response time for police and fire. While the road diet will result in slower speeds for automobiles, the difference in drive times as a result of speeds slowing from 45 to 35 mph is only one minute over the entire 3 mile segment. The analysis indicates that there is sufficient excess capacity, so access to key locations along the corridor would still be maintained even with an unusually severe traffic event.

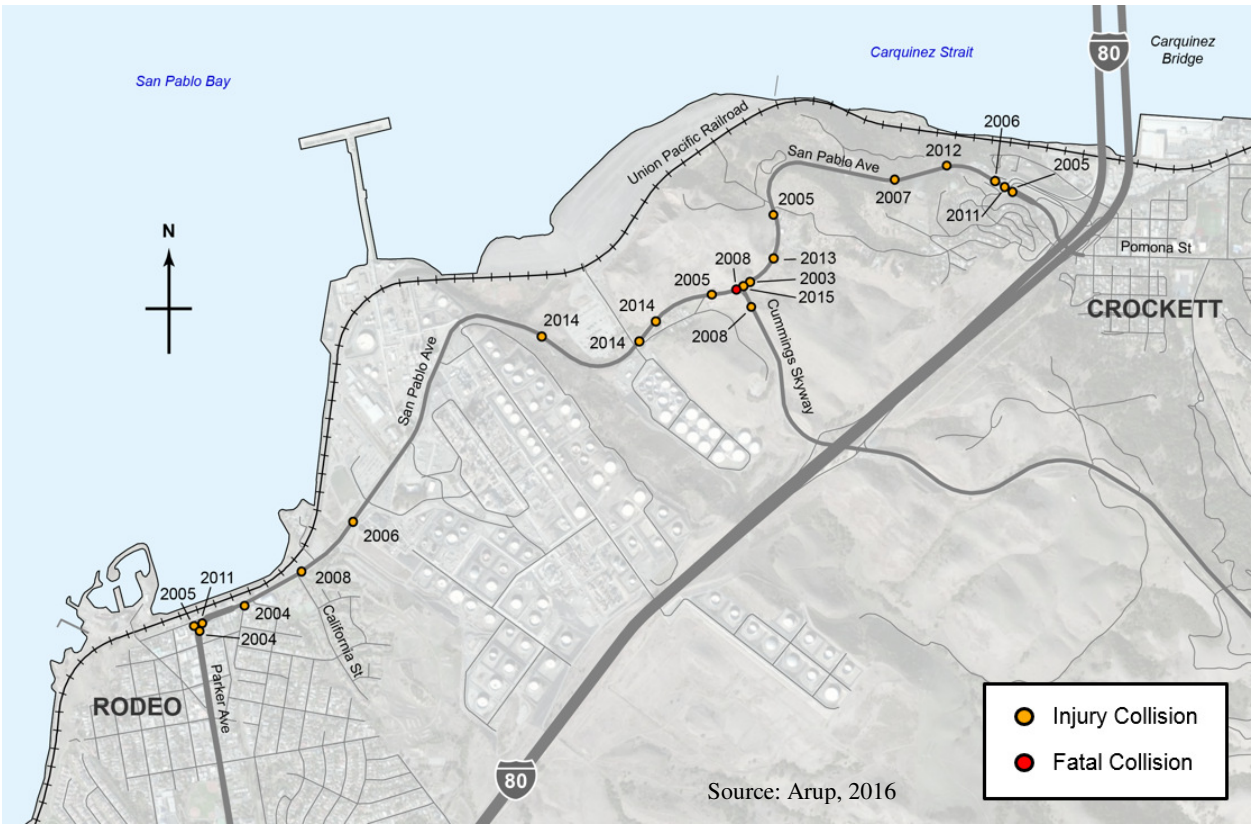
## I-80 Integrated Corridor Management Project

San Pablo Avenue is slated to receive improvements as part of the I-80 Integrated Corridor Management (ICM) Project, which will make improvements to both the freeway and local arterials. On I-80, the project includes ramp metering, incident management, and other improvements from the Alfred Zampa Bridge to the Bay Bridge in Oakland. On San Pablo Avenue, the project includes upgraded traffic signal hardware, software and interconnect enhancements, and installation of arterial management components such as closed-circuit television (CCTV) cameras, trailblazer signs, changeable message signs (CMS) and communication and detection equipment from MacArthur Boulevard in Oakland to Cummings Skyway in Contra Costa County. These signal improvements on San Pablo Avenue will help manage queuing and traffic flow when incidents cause a partial or full shutdown of I-80 through Crockett, Rodeo, and Hercules. These systems will help maintain safe traffic operations and ensure that emergency response or evacuation plans are not affected.

## 6.4 Collision Analysis

To assess the safety of the study corridor, the frequency of injury and fatality collisions along San Pablo Avenue were assessed. Incident data was obtained from County staff and the Statewide Integrated Traffic Records System (SWITRS). Collisions include incidents involving vehicles with other vehicles or with pedestrians and cyclists. The incident results were mapped and collision rates were generated using methodologies published by Caltrans. Collision rates are normalized for traffic volumes and are reported as "incidents per million vehicle-miles". These rates were compared to other roadways with similar characteristics (e.g., lanes, grade, curvature, etc.). Figure 16 plots the injury and fatal collisions in the vicinity of the study area from 2003 through 2015 using the SWITRS data. The total number of injury and fatal collisions in this period totaled 23.

**Figure 16: Study Corridor Injury and Fatality Collisions, 2003-2015**




Source: Arup, 2016

Over two-thirds of the collisions did not involve other vehicles. These collisions included vehicles hitting objects or they overturned. Only three of the incidents involved head-on collisions. Over half of the collisions involved unsafe turning movements and unsafe speed and one-quarter of the collisions involved driving under the influence (DUI). The majority of the collisions involve unsafe driver behavior and most involve hitting other objects along the road (e.g., utility poles, trees, etc.).

Table 4 provides the calculated accident rates for fatal accidents and fatality and injury accidents for San Pablo Avenue, comparable roadways in the region, and California overall. The analysis indicates that the accident rates for the San Pablo Avenue study corridor are higher than the California average for a rural, 4-lane undivided road. Improving the safety for road users is another factor in considering the implementation of a road diet along the study corridor.

**Table 4: Collision Analysis (2003-2015)**

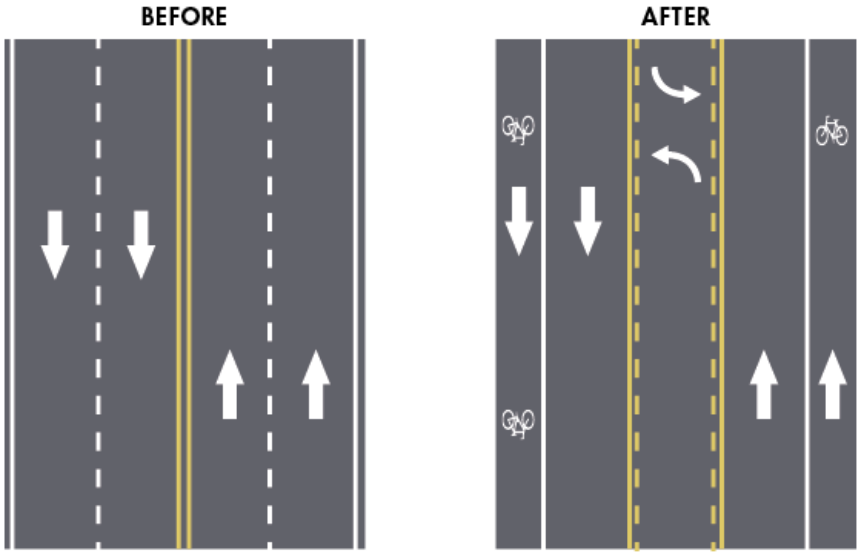
| | **Collision Rate (collisions per million vehicle-miles)** | |
|---|---|---|
| **Corridor** | **Fatality** | **Fatality + Injury** |
| **San Pablo Avenue (Rodeo to Crockett)** | **0.020** | **0.56** |
| **SR 12 in Solano County (4-lane, divided)** | 0.004 | 0.50 |
| **Richmond Parkway (Castro St to Giant Rd)** | 0.006 | 0.19 |
| **California Average (rural, 4-lane undivided roads)** | 0.018 | 0.35 |
| **I-80 Freeway (SR 4 to Alfred Zampa Bridge)** | 0.005 | 0.24 |
| Source: CHP SWITRS, Caltrans, Arup, 2016 | | |

Due to the nature of the collisions along the study corridor, road diets and enhanced safety and design measures that slow travel speed should help reduce the number and severity of traffic accidents. Improving safety for all users (motorists, trucks, pedestrians, and cyclists) is a key objective of the study.

## 6.5 Addressing Safety via a Road Diet

One way to incorporate pedestrian and bicycle facilities along existing roadways is to remove one of the travel lanes and reconfigure the roadway to accommodate the sidewalks, bike lanes, or shared use facilities. This process of removing a travel lane and reconfiguring the roadway to stay within the same is known as a “road diet”. Figure 17 presents one type of road diet conversion. This figure shows how a four-lane undivided street with two travel lanes in each direction and no left-turn lanes or bicycle facilities (San Pablo Avenue’s configuration) can be converted to a three-lane roadway with one travel lane in each direction, a center two-way left-turn lane, plus bike lanes.

**Figure 17: Typical Before and After for a Road Diet**




Source: FHWA Road Diet Informational Guide

The following summarizes the benefits of road diets:

- Four-lane undivided arterials typically have higher crash rates than other roadway configurations because of higher speeds.
- Road diets help to slow speeds, which reduce collision severity.
- The separation with a two-way left-turn lane, center medians, and/or other physical barriers keeps opposing through traffic further apart.
- The two-way left-turn lane or dedicated left-turn pockets at intersections provide a safer place for left turning vehicles to queue that is separated from the predominant traffic stream.
- The Federal Highway Administration (FHWA) has identified road diets as a proven safety measure and shown them to be more effective on rural than urban roads[1].
- The FHWA studies indicate that crashes are reduced by 29% and vehicles traveling over the speed limit are reduced by 30%[1].

A road diet would provide a number of opportunities to reconfigure the roadway to accommodate pedestrian and bicycle improvements without widening the roadway.

[1] *Evaluation of Lane Reduction "Road Diet" Measures on Crashes* (FHWA, 2010)

In 2006, the County implemented a road diet along Parker Avenue in Rodeo, transforming it from a four-lane undivided arterial to a two-lane roadway with median islands, bike lanes, and sidewalks. Construction began in 2006 and was completed in 2008. With implementation of the Parker Avenue Reconstruction Project, this segment of Parker Avenue experienced a 20% to 40% decrease in traffic volumes and a 56% decrease in the total number of collisions (see Table 5). The project study area lies just north of Parker Avenue and has lower existing average daily traffic volumes compared to Parker Avenue.

**Table 5: Parker Avenue Reconstruction Project Traffic and Injury Results**

| Parker Avenue | Average Daily Traffic (vehicles) | Total Collisions over 3-year period | Total # Injured | Total # Killed |
|---|---|---|---|---|
| Before Road Diet | 6,500 – 12,000 | 34 (2003-2005) | 16 | 0 |
| After Road Diet | 5,000 – 9,500 | 15 (2009-2011) | 3 | 0 |

# 7 Alternatives Development

Based on the policy analysis, field work, and technical studies, a series of design principles were created to guide the development of alternatives for providing bicycle and pedestrian facilities along the San Pablo Avenue study corridor.

The principles include:

1. Implement a Complete Street design to balance the needs of all users
2. Qualify for the Bay Trail to fill a key gap between Oakland and Vallejo
3. Enhance pedestrian safety and experience
4. Enhance bicycle safety and experience
5. Enhance automobile safety and experience
6. Enhance truck safety and experience
7. Enhance transit safety and experience
8. Maintain acceptable traffic operations
9. Minimize physical and environmental impacts
10. Provide a cost effective solution

The objective was to develop alternative concepts that satisfy as many of these design principles as possible. The alternatives analysis section uses these principles as a way to evaluate the designs.

## 7.1 Basis of Design

A number of guidelines and standards were used to develop the preliminary design of the alternatives and to insure that best practices were applied. The following documents are the basis of the design criteria used in this study:

- Bay Trail Guidelines, 2016
- Caltrans Class IV Bikeway guidance, 2015
- Caltrans Highway Design Manual, 2015
- Caltrans Traffic Manual, Chapter 7 Traffic Safety Systems, 2012
- Contra Costa County Standard Plans
- AASHTO Geometrics Design of Highways and Streets, 2011
- FHWA Separated Bike Lane Planning and Design Guide, 2015
- FHWA Designing Sidewalks and Trails for Access, 1999
- NACTO Urban Bikeways Design Guide, 2013
- NACTO Transit Street Design Guide, 2016

### Shared Use Path Width

Both the NACTO Urban Bikeways Design Guide and the FHWA Designing Sidewalks and Trails for Access recommends a desired minimum of 12 feet for shared use paths and two way cycle tracks, with an 8 foot width used in constrained situations.

### Roadway Separation Width

Both the NACTO Urban Bikeways Design Guide and the Caltrans Class IV Bikeway Guidance recommends a minimum of 3 feet of separation between moving vehicles and the shared use paths and two way cycle tracks. The Caltrans Class IV Bikeways guidance also recognizes that 2 feet of separation can be used in constrained situations.

### Median Improvements

The Caltrans Traffic Manual provides guidance on design standards for the implementation of physical median barriers and other devices and treatments to minimize the likelihood of cross-median collisions by vehicles traveling in opposite directions. Physical barriers include an array of solutions from rigid concrete barriers to flexible cable barriers. Section 7-04.4 provides a list of improvements other than barriers that should be considered due to environmental considerations, right-of-way purchases, and impacts to adjacent properties. These include painted median buffer zones, rumble strips, and surface mounted channelizers (see Figure 18).

**Figure 18: Wide Striped Median Buffer Zone with Rumble Strips**

Source: FHWA

## Path-Roadway Separations

Caltrans Class IV Bikeway Guidance specifies that separated bike facilities are required to have at least one of the following treatments: grade separation, flexible posts, inflexible physical barriers such as jersey barriers of K-rail, on-street parking, or raised islands. The use of on-street parking as a roadway separation is not appropriate for this design.

Figure 19 presents a range of separation options that could be deployed between the travel lanes and the shared use path. Jersey barriers have been included in the design alternatives and cost estimates. These concrete barriers would prevent vehicles from crossing over into the shared use path. The physical barrier will be evaluated further in the detailed design if the project moves forward.

**Figure 19: Examples of Path-Roadway Separation Options**


*Clockwise from top left: flexible pylons and striping; curb and gutter island; Jersey barrier ("K-Rail"); and inflexible bollards*

## Bike Lane Width

Caltrans Class II Bikeways (bike lanes) design standards were obtained from the Caltrans Highway Design Manual. Caltrans standards specify that the width of a bike lane on a roadway where posted speeds are greater than 40 mph shall be 6 feet. The minimum legal minimum width for a bicycle lane is 4 feet.

## Bus Stop Design

The FHWA and the NACTO Transit street design guidelines both recommend routing bicycles behind the bus platform. This type of design avoids conflicts with transit vehicles but doesn't create conflicts with pedestrians who must cross the bike lane/shared use path to access the transit stop. 8 feet is the recommended minimum for a bus boarding islands, but in constrained circumstances 5 feet wide by 8 feet long of clear space may be used to accommodate deployment of an accessible ramp from equipped buses.

## Vehicle Lane Width

Contra Costa County Standard Plans requires vehicle lane widths on rural roads with an ADT greater than 400 to be 12' wide.

### Turning Truck Movements

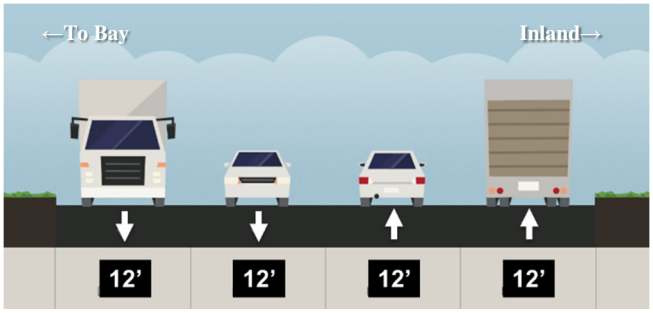
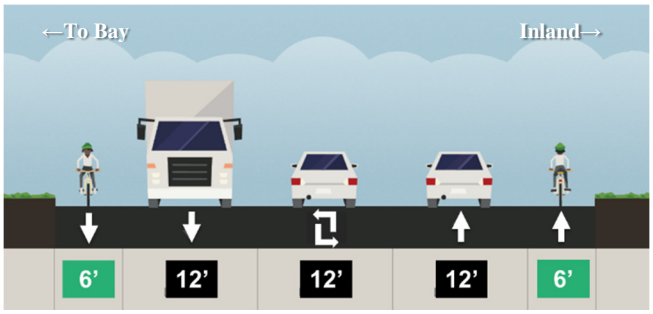
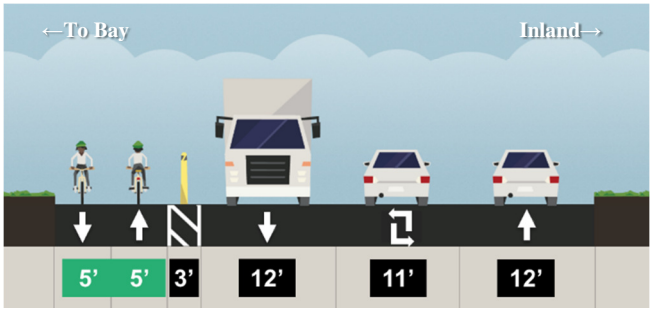
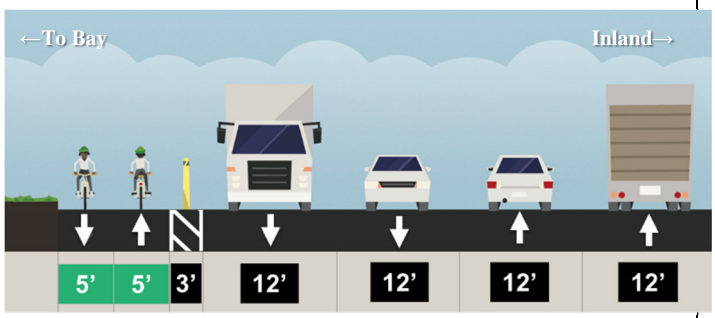
The San Pablo Avenue corridor has a high percentage of truck traffic that require large turning radii at intersections and driveways. A swept path analysis was conducted along the corridor with special consideration taken at the major intersections to ensure that trucks, as well as large emergency response vehicles, could be accommodated in the design. The swept path analysis utilized AASHTO 2011vehicle standards and was conducted with the design vehicle: WB-67, which has a width of 8.5 feet, a length of 73.5 feet, a minimum turning radius of 45 feet and a centerline turning radius of 41 feet. See Appendix B for more information.

## 7.2 Alternative Complete Streets Concepts

Three alternative concepts were developed to provide a Complete Street with enhanced pedestrian and bicycle facilities for the San Pablo Avenue study corridor.

Figure 20 presents a comparison of street cross-sections and a description for the three alternatives, along with the existing or “No Build” alternative. Detailed drawing sets for the three alternatives are provided in Appendix A.

## Figure 20: Complete Street Alternatives for San Pablo Avenue

| | |
|---|---|
| **Existing Conditions**<br>The existing roadway consists of four 12' travel lanes with minimal shoulders, no bike lanes, sidewalks, or truck climbing lanes. The existing condition represents the "No Build" alternative. |  |
| **Alternative 1:**<br>**Bike Lanes**<br>Implement a "road diet," removing one travel lane and adding two 6' striped on-street bike lanes. Convert the center lane to a two-way left-turn lane, median, or truck climbing lane as necessary at different points along the roadway. This alternative does not add new sidewalks or pedestrian facilities. |  |
| **Alternative 2:**<br>**Shared Use Path**<br>Implement a "road diet," removing one travel lane and adding a 10' two-way shared use path for pedestrians and cyclists on the north side of the roadway, separated by vehicle traffic by a physical barrier. Convert the center lane to a two-way left-turn lane, median, or truck climbing lane as necessary at different points along the roadway. |  |
| **Alternative 3:**<br>**Widened Shared Use Path**<br>Widen the existing roadway to add a 10' two-way shared use path for pedestrians and cyclists on the north side of the roadway, separated by vehicle traffic by a buffer. The vehicle lane configuration will remain the same as the existing roadway (two-lanes in each direction) from Lone Tree Point to Cummings Skyway. From Cummings Skyway to the Alfred Zampa Bridge, implement the same road diet configuration with shared use path as presented in Alternative 2. |  |

A summary of the alternatives is presented below.

## No Build Alternative

The No Build alternative would make no changes to the existing roadway.

## Alternative 1 – Bike Lanes

Alternative 1 provides continuous bike lanes by implementing the road diet and removing one travel lane to make space for the bike lanes. However, it does not provide any additional sidewalks, therefore it would not qualify as a Bay Trail segment. It takes advantage of existing on-street (Class II) bike lanes along San Pablo Avenue in Rodeo. The bike lanes improve bicycle safety by creating a dedicated space for cyclists to ride, separating them from vehicle traffic. This design also provides truck climbing lanes on three of the steepest sections, a two-way center left-turn lane and left-turn pockets. The addition of the two-way left turn lane provides increased separation between opposing traffic and provides a safe place for left turning vehicles to queue that is separate from the main travel lane. At several locations a wide striped median is possible, which would further separate oncoming traffic and provide additional safety for drivers. This alternative requires the least amount of construction as it consists of mostly restriping the roadway.

## Alternative 2 – Shared Use Path

Alternative 2 also implements the road diet, which provides a continuous 10 foot shared use path for pedestrians and cyclists along the entire corridor with a three foot buffer. The path is planned for the north side of San Pablo Avenue. Both sides were considered. However, the north side provides the best connections to the Alfred Zampa Bridge, Vista Point, and Lone Tree Point; has the best views of the Carquinez Strait; and would provide easier crossings at Cummings Skyway and A Street. Alternative 2 would qualify for the Bay Trail, as it provides for both pedestrians and cyclists. The path is separated from the outside travel lane by a three foot striped buffer and will require a significant physical barrier to protect cyclists and pedestrians from oncoming traffic.

This alternative also incorporates enhanced bus stops and improved pedestrian facilities to access the bus stops. Truck climbing lanes are also incorporated along three of the steepest uphill sections of roadway to allow passenger vehicles to pass trucks. A two-way left-turn lane is also included in this alternative, along with left-turn pockets at intersections. Typical barriers used for cycle tracks are being considered along with other forms of more permanent barriers. At several locations a wide striped median between the opposing travel lanes is possible, which would further separate oncoming traffic and provide additional safety for drivers. Physical barriers between the travel lanes at key locations are also under consideration.

## Alternative 3 – Widened Shared Use Path

Alternative 3 does not incorporate a road diet, but would include the same path described in Alternative 2 and maintain a four-lane undivided roadway by widening San Pablo Avenue 10 to 11 feet from Refinery Road to Cummings Skyway. East of Cummings Skyway, this alternative will implement a three-lane road diet configuration. The shared use path would provide the same

pedestrian and bicycling amenities and bus stop improvements as Alternative 2. This alternative would require acquiring additional right-of-way from the refinery and private property owners, relocating utilities and refinery equipment, rebuilding bridges, and constructing new retaining walls along sections with steep hillsides. This alternative requires a significant amount of construction due to the widening of the roadway and will have significant impacts.

# 8 Alternatives Evaluation

The three alternative concepts were evaluated for how well they achieve the study's goals and the design principles described in the previous section. The alternatives evaluation uses a series of quantitative and qualitative measures to evaluate the design principles.

Table 6 describes the criteria and the scoring ranges used to evaluate each of the alternatives.

**Table 6: Alternative Evaluation Criteria**

| Metric | Description | Score Range | | |
|---|---|---|---|---|
| **Overall Complete Streets assessment** | To what degree does the alternative accommodate all road users? | **POOR** Does not accommodate all users | **MODERATE** Accommodates some users | **GOOD** Accommodates all road users |
| **Bay Trail qualification** | Does the alternative meet the criteria to be part of the Bay Trail? | **NO** Does not provide both pedestrian and bicycle facilities | | **YES** Provides both pedestrian and bicycle facilities |
| **Safety and experience for major road users (pedestrian, cyclist, auto, truck, transit)** | To what degree does the alternative provide safe and comfortable facilities for a given road user? | **POOR** Lacks adequate safety provisions and does not improve the user experience | **MODERATE** Provides adequate safety features and creates an improved user experience | **GOOD** Provides substantial safety features and creates an excellent user experience |
| **Traffic Level of Service (LOS)** | What is the expected future traffic level of service? | **POOR** Level of service exceeding County standards (LOS D) at many intersections | **MODERATE** Level of service at or above County standard (LOS D) at most intersections | **GOOD** LOS A, B, or C at most intersections |
| **Property and right-of-way impacts** | To what degree will the alternative impact adjacent property and/or require additional roadway right-of-way? | **SIGNIFICANT** Significant roadway widening and property rights required | **MODERATE** Moderate amount of roadway widening required | **MINIMAL** Little or no roadway widening required |
| **Utilities Infrastructure impacts** | To what extent will the alternative impact existing utilities infrastructure? | **SIGNIFICANT** Substantial impact on utility and signal poles, adjacent pipeline, stormwater/drainage | **MODERATE** Limited impacts to utility and signal poles, stormwater/drainage | **MINIMAL** Little or no impact on existing utilities, stormwater/drainage |
| **Environmental impacts** | To what extent will the alternative lead to significant environmental impacts (e.g. biological, cultural, and other impacts)? | **SIGNIFICANT IMPACTS LIKELY** Numerous significant impacts requiring additional study and/or mitigation measures expected | **SIGNIFICANT IMPACTS POSSIBLE** Few significant impacts expected | **SIGNIFICANT IMPACTS UNLIKELY** No significant impacts expected. |
| **Estimated Cost** | Includes capital costs, construction costs, and soft costs. | **$ Millions (2016)** | | |

## 8.1 Alternatives Matrix

**Figure 21: Alternatives Matrix**

| San Pablo Avenue Complete Streets Study: Alternatives Matrix | | | | |
|---|---|---|---|---|
| **Metric** | **Existing Condition / No Build**<br>**Existing (4 vehicle lanes)** | **Alternative 1**<br>**Bike Lanes (3 vehicle lanes with bike lanes)** | **Alternative 2**<br>**Shared Use Path (3 vehicle lanes with path)** | **Alternative 3**<br>**Widened Shared Use Path (4 vehicle lanes with path)** |
| **Project Components** | • 48' existing pavement<br>• Four 12' travel lanes<br>• Minimal shoulders<br>• No bike lanes and very limited sidewalks<br>• No truck climbing lane | • 48' existing pavement<br>• Two 12' travel lanes (one each direction)<br>• Center lane for left turns, median, or truck climbing lane<br>• Two 6' bike lanes<br>• Barrier or curb separating bike lanes from vehicles along much of the corridor<br>• Road diet, reducing the number of vehicle lanes from four to two with a center turn/climbing lane | • 48' existing pavement<br>• Two 12' travel lanes (one each direction)<br>• Center lane for left turns, median, or truck climbing lane<br>• 10' (minimum) shared use path (north or south side)<br>• 3' barrier or curb separating shared use path from vehicles<br>• Road diet, reducing the number of vehicle lanes from four to two with a center turn/climbing lane | • Four 12' travel lanes (two each direction)<br>• 10' (minimum) shared use path (north or south side)<br>• 3' barrier or curb separating shared use path from vehicles<br>• Road diet (partial): reduce to three lanes east of Cummings Skyway (same as Shared Use Path alternative) |
| **Overall Complete Streets Assessment** | **POOR** | **MODERATE** | **GOOD** | **GOOD** |
| **Bay Trail qualification** | **NO**<br>**No existing bicycle facilities and very limited pedestrian facilities.** | **NO**<br>**Does not provide continuous pedestrian facilities along the entire corridor.** | **YES**<br>**Provides bicycle and pedestrian facilities along the entire corridor.**<br>• This design is coordinated with the proposed East Bay Regional Parks District (EBRPD) off-street shared use path at Lone Tree Point (from Pacific Avenue to Parker Avenue)<br>• The path was designed for a seamless transition to the Alfred Zampa Bridge Trail | **YES**<br>**Provides bicycle and pedestrian facilities along the entire corridor.**<br>• This design is coordinated with the proposed East Bay Regional Parks District (EBRPD) off-street shared use path at Lone Tree Point (from Pacific Avenue to Parker Avenue)<br>• The path was designed for a seamless transition to the Alfred Zampa Bridge Trail |
| **Pedestrian safety and experience** | **POOR**<br>• Sidewalks exist from Parker Avenue to California Street only (approximately 0.3 miles of the entire 3.0 mile corridor)<br>• Crosswalks exist at all signalized intersections on San Pablo Avenue | **POOR**<br>• Pedestrian improvements limited to selected portions of the north side of the street between Pacific Avenue and California Street.<br>• Significant portions of the roadway will continue to lack pedestrian facilities. | **GOOD**<br>• Provides continuous sidewalks on the north side of the street between Pacific Avenue and California Street.<br>• Provides a two-way shared use path on the north side of the street, separated from vehicle traffic.<br>• Separated, buffered path provides the greatest safety benefit for cyclists and pedestrians.<br>• By separating cyclists and pedestrians from vehicular traffic and implementing a barrier, there will be fewer chances for conflicts and collisions.<br>• Path is shared with bicycle traffic.<br>• Path would connect to the proposed EBRPD off-street shared use path at Lone Tree Point and the Alfred Zampa Bridge path. | **GOOD**<br>• Provides continuous sidewalks on the north side of the street between Pacific Avenue and California Street.<br>• Provides a two-way shared use path on the north side of the street, separated from vehicle traffic.<br>• Separated, buffered path provides the greatest safety benefit for cyclists and pedestrians.<br>• By separating cyclists and pedestrians from vehicular traffic and implementing a barrier, there will be fewer chances for conflicts and collisions.<br>• Path is shared with bicycle traffic.<br>• Path would connect to the proposed EBRPD off-street shared use path at Lone Tree Point and the Alfred Zampa Bridge path. |

**San Pablo Avenue Complete Streets Study: Alternatives Matrix**

| Metric | Existing Condition / No Build<br>Existing (4 vehicle lanes) | Alternative 1<br>Bike Lanes (3 vehicle lanes with bike lanes) | Alternative 2<br>Shared Use Path (3 vehicle lanes with path) | Alternative 3<br>Widened Shared Use Path (4 vehicle lanes with path) |
|---|---|---|---|---|
| **Bicycle safety and experience** | **POOR**<br>• Predominantly lacking exclusive bicycle facilities; On-street bike lanes exist on San Pablo Avenue from Parker Avenue to California Street (0.3 miles of the 3.0 mile corridor).<br>• Cyclists share the travel lanes with autos and trucks<br>• San Pablo Avenue has very narrow shoulders that provide limited riding space for cyclists | **MODERATE**<br>• Provides bicycle lanes on both sides of the street, offering dedicated space for cyclists apart from vehicle traffic within existing pavement.<br>• Retains eastbound bicycle lane from Parker Avenue to California Street.<br>• Areas with steep uphill grades and fast-moving adjacent vehicles present a safety concern for cyclists. The dedicated roadway space will enhance safety.<br>• Pavement markings across intersections with side roads helps raise drivers' awareness of the bicycle lanes. | **GOOD**<br>• Provides a two-way shared use path on the north side of the street, separated from vehicle traffic.<br>• A separated, buffered path will reduce the chances for conflicts and collisions.<br>• Locating the path on the north side rather than the south side provides better access to Lone Tree Point and the Alfred Zampa Bridge as well as better views of the bay.<br>• Path is shared with pedestrian traffic<br>• Path would connect to the proposed EBRPD off-street shared use path at Lone Tree Point and the Alfred Zampa Bridge path.<br>• Retains eastbound bicycle lane from Parker Avenue to California Street.<br>• Pavement markings across intersections with side roads helps raise drivers' awareness of the shared use path. | **GOOD**<br>• Provides a two-way shared use path on the north side of the street, separated from vehicle traffic.<br>• A separated, buffered path will reduce the chances for conflicts and collisions.<br>• Locating the path on the north side rather than the south side provides better access to Lone Tree Point and the Alfred Zampa Bridge as well as better views of the bay.<br>• Path is shared with pedestrian traffic<br>• Path would connect to the proposed EBRPD off-street shared use path at Lone Tree Point and the Alfred Zampa Bridge path.<br>• Retains eastbound bicycle lane from Parker Avenue to California Street.<br>• Pavement markings across intersections with side roads helps raise drivers' awareness of the shared use path. |
| **Automobile safety and experience** | **MODERATE**<br>• Two travel lanes in each direction provides ample room for autos to pass trucks and other slow moving vehicles<br>• Minimal shoulders and guardrails<br>• A collision analysis presented in the Traffic Impact Analysis indicates that this study segment experiences incidents at a rate slightly higher than the California average for four-lane undivided roads. | **GOOD**<br>• Truck climbing lanes are provided on two of the three steepest incline segments between Summit 1/Phillips 66 and Cummings Skyway. These lanes provide ample room for autos to pass slower moving trucks.<br>• Reducing the number of travel lanes from two to one with the road diet eliminates a passing lane for motorists to pass slower moving trucks on uphill and downhill segments. This could tempt drivers to change lanes into oncoming traffic to pass trucks.<br>• This alternative adds turn pockets and acceleration or deceleration lanes for key side streets and driveways.<br>• The center turn lane provides vehicles a safe place outside of the traffic stream to wait before making left-turns.<br>• Wide striped medians in segments with sharp curves provide increased separation and safety from head-on collisions. | **GOOD**<br>• Truck climbing lanes are provided on two of the three steepest incline segments between Summit 1/Phillips 66 and Cummings Skyway. These lanes provide ample room for autos to pass slower moving trucks.<br>• Reducing the number of travel lanes from two to one with the road diet eliminates a passing lane for motorists to pass slower moving trucks on uphill and downhill segments. This could tempt drivers to change lanes into oncoming traffic to pass trucks.<br>• A physically separated shared use path will reduce the number of interactions between motorists and cyclists/pedestrians.<br>• This alternative adds turn pockets, acceleration or deceleration lanes for key side streets and driveways.<br>• The center turn lane provides vehicles a safe place outside of the traffic stream to wait before making left-turns.<br>• Wide striped medians in segments with sharp curves provide increased separation and safety from head-on collisions. | **MODERATE**<br>• The lane configuration between Refinery Road and Cummings Skyway is largely the same as existing (two travel lanes in each direction) but includes the path. Therefore, safety for motorists should remain largely unchanged.<br>• Lane arrangement east of Cummings Skyway are reduced to two travel lanes with a center turn lane for left turns and climbing lanes.<br>• A physically separated shared use path will reduce the number of interactions between motorists and cyclists/pedestrians. |

**San Pablo Avenue Complete Streets Study: Alternatives Matrix**

| Metric | Existing Condition / No Build<br>Existing (4 vehicle lanes) | Alternative 1<br>Bike Lanes (3 vehicle lanes with bike lanes) | Alternative 2<br>Shared Use Path (3 vehicle lanes with path) | Alternative 3<br>Widened Shared Use Path (4 vehicle lanes with path) |
|---|---|---|---|---|
| **Truck safety and experience** | MODERATE<br>• Two travel lanes in each direction provides ample room for autos to pass trucks and other slow moving vehicles<br>• Minimal shoulders and guardrails<br>• Trucks make left turns from the left travel lane, which provides adequate turning radius for large vehicles. Right turns are made from dedicated right-turn lanes or from the right travel lane.<br>• Vehicles turning from travel lanes can block through traffic movements on San Pablo Avenue. | GOOD<br>• The project includes climbing lanes on two of the three steepest incline sections, which will provide safe passing distance for vehicles. Downhill sections are less of a concern because the speed differential between autos and trucks is less pronounced.<br>• Turn pockets and acceleration/deceleration lanes are provided for key side streets and driveways to provide enhanced access.<br>• Increased shoulder width for the bike lanes provides area for trucks to stop in case of emergency.<br>• The road diet will tighten the turning radius for left turning trucks | GOOD<br>• The project includes climbing lanes on two of the three steepest incline sections, which will provide safe passing distance for vehicles. Downhill sections are less of a concern because the speed differential between autos and trucks is less pronounced.<br>• Turn pockets and acceleration/deceleration lanes are provided for key side streets and driveways to provide enhanced access.<br>• Bicycle and pedestrians are separated from truck traffic<br>• The road diet will tighten the turning radius for left turning trucks | MODERATE<br>• No turn pockets, refuges, acceleration or deceleration lanes for left turn movements. Autos and trucks will need to make left turns from the left travel lane, which could block vehicles traveling through on San Pablo Avenue.<br>• Bicycle and pedestrians are separated from truck traffic |
| **Transit safety and experience** | MODERATE<br>• There are four transit stops serving WestCAT bus service within the study area:<br>  ○ California Street<br>  ○ Road Number 4 at the Phillips 66 refinery<br>  ○ A Street<br>  ○ Merchant St Park and Ride lot in Crockett<br>• There is one school bus stop at A Street/NuStar Energy (Tormey/Selby)<br>• The bus stop in the eastbound direction at California Street includes a shelter and bench, while the other stops do not.<br>• Buses either stop in the right travel lane and block traffic or pull into the unpaved and narrow shoulder. | MODERATE<br>• Improves bus stops at four locations:<br>  ○ California St: extend sidewalk on north side<br>  ○ Road Number 4: Add bus stop platforms (both sides)<br>  ○ A St: Add bus stop platforms (both sides)<br>  ○ Merchant St: No change<br>• No physical barriers near bus stops, allowing bus vehicles to pull aside for passengers to board and disembark.<br>• Stopped transit vehicles may temporarily block the bicycle lanes if they pull out of the travel lane. | GOOD<br>• Improves bus stops at four locations:<br>  ○ California St: extend sidewalk and add floating bus island on north side<br>  ○ Road Number 4: Add floating bus islands (both sides)<br>  ○ A St: Add floating bus islands (both sides)<br>  ○ Merchant St: No change<br>• Floating bus islands allow transit passengers to board and disembark without bus vehicles blocking the shared use path of travel. | GOOD<br>• Improves bus stops at four locations:<br>  ○ California St: extend sidewalk add floating bus island on north side<br>  ○ Road Number 4: Add bus islands (both sides)<br>  ○ A St: Add floating bus islands (both sides)<br>  ○ Merchant St: No change<br>• Floating bus islands allow transit passengers to board and disembark without bus vehicles blocking the shared use path. |

**San Pablo Avenue Complete Streets Study: Alternatives Matrix**

| Metric | Existing Condition / No Build<br>Existing (4 vehicle lanes) | Alternative 1<br>Bike Lanes (3 vehicle lanes with bike lanes) | Alternative 2<br>Shared Use Path (3 vehicle lanes with path) | Alternative 3<br>Widened Shared Use Path (4 vehicle lanes with path) |
|---|---|---|---|---|
| **Traffic Level of Service (LOS) under future conditions** | **GOOD**<br>• **LOS A/B** at all study intersections. This level of service equates to generally free flow traffic conditions.<br>• Traffic volumes are not expected to increase significantly in the future. | **GOOD**<br>• **LOS B/C** at all study intersections with the road diet and the removal of one travel lane. LOS C is better than the county's rural roadway standard. This level of service equates to stable or reasonably free flow traffic conditions.<br>• San Pablo Avenue at Refinery Road will be reduced from LOS B to LOS C during the "refinery" PM peak only.<br>• San Pablo Avenue at Cummings Skyway will be reduced from LOS A to LOS B in the future, both with and without the project. | **GOOD**<br>• **LOS B/C** at all study intersections with the road diet and the removal of one travel lane. LOS C is better than the county's rural roadway standard. This level of service equates to stable or reasonably free flow traffic conditions.<br>• San Pablo Avenue at Refinery Road will be reduced from LOS B to LOS C during the "refinery" PM peak only.<br>• San Pablo Avenue at Cummings Skyway will be reduced from LOS A to LOS B in the future, both with and without the project. | **GOOD**<br>• **LOS A/B** at all study intersections**.** No lane reductions are included in this alternative. This is above the county's rural roadway standard, and matches today's conditions. This level of service equates to reasonably or fully free flow traffic conditions. |
| **Property and Right-of-Way impacts** | **N/A**<br>• Existing right-of-way: 69' to 82' | **MINIMAL**<br>• This alternative will not require widening outside of the existing right-of-way. | **MINIMAL**<br>• This alternative will require approximately 7,000 square feet of additional right-of-way at the intersection with Refinery Road to widen the roadway and construct the shared use path<br>• A modest amount of roadway widening is necessary in order to retain the existing left and right turn pockets.<br>• Adjacent to Lone Tree Point, this alternative includes 15,000-20,000 square feet of new sidewalk and 7,000-12,000 square feet of new pavement.<br>• Angle parking in front of The Dead Fish restaurant will be converted to parallel parking because the shared use path will block direct pull-in vehicle access from the roadway; this results in a net loss of approximately seven parking spaces. The restaurant will still have more than sufficient parking per county code. | **SIGNIFICANT**<br>• This alternative will require approximately 56,000 square feet of additional right-of-way to widen the roadway between Refinery Road and Cummings Skyway to accommodate the shared use path and maintain the existing travel lanes.<br>• Approximately 30,000 square feet of additional right-of-way are needed near Refinery Road<br>• The alternative includes 15,000-20,000 square feet of new sidewalk and 60,000-65,000 square feet of new pavement for the widening as well as the section through Lone Tree Point. This can be accommodated within the existing right-of-way<br>• This alternative will also require 4,000 linear feet of new retaining walls in several locations.<br>• Angle parking in front of The Dead Fish restaurant will be converted to parallel parking because the shared use path will block direct pull-in vehicle access from the roadway; this results in a net loss of approximately seven parking spaces. The restaurant will still have more than sufficient parking per county code. |

**San Pablo Avenue Complete Streets Study: Alternatives Matrix**

| Metric | Existing Condition / No Build<br>Existing (4 vehicle lanes) | Alternative 1<br>Bike Lanes (3 vehicle lanes with bike lanes) | Alternative 2<br>Shared Use Path (3 vehicle lanes with path) | Alternative 3<br>Widened Shared Use Path<br>(4 vehicle lanes with path) |
|---|---|---|---|---|
| **Utilities Infrastructure impacts** | **N/A**<br>• Utility poles run along much of the portion of the roadway east of Cummings Skyway, and the area east of Vista Point<br>• Limited portions of the roadway in Rodeo have street lights<br>• Pipelines run along portions of the roadway, including near the Phillips 66 refinery<br>• Only limited stormwater infrastructure exists along the roadway today, particularly east of California Street | **MINIMAL**<br>• This alternative will not impact existing utilities. | **MINIMAL**<br>• This alternative is expected to have minimal impact on existing utilities, as only very limited sections will have changes to the roadway pavement. | **SIGNIFICANT**<br>• This alternative will impact approximately 18 to 20 existing utility poles, which will have to be relocated due to roadway widening.<br>• Impacted utility poles are concentrated near the refinery, between California Street and the pipeline overcrossing northeast of the refinery.<br>• The traffic signals at Refinery Road and Cummings Skyway might also have to be reconfigured. This could require relocating signal poles, mast arms, cabinets, and other elements.<br>• Pipelines along approximately 500 feet of roadway will have to be relocated in order to accommodate roadway widening and the shared use path. |
| **Environmental impact likelihood** | **N/A**<br>• The environmental assessment will include all potentially affected environmental factors, per the California Environmental Quality Act (CEQA). This analysis is ongoing. | **SIGNIFICANT IMPACTS UNLIKELY**<br>• Significant environmental impacts are not anticipated, since improvements would be within the existing roadway and many impacts would be considered beneficial.<br>• This alternative would likely qualify for a Categorical Exemption under 15304(h), creation of bicycle lanes on existing rights-of-way and a Statutory Exemption under 15282(j), restriping streets. | **SIGNIFICANT IMPACTS UNLIKELY**<br>• Significant environmental impacts are not anticipated, since improvements would be largely within the existing roadway and many impacts would be considered beneficial.<br>• An Initial Study could be completed to assess environmental impacts and determine if significant impacts would occur as a result of this alternative. | **SIGNIFICANT IMPACTS POSSIBLE**<br>• Significant environmental impacts could result from the project due to extensive grading work and retaining wall construction required to widen the roadway, including grading in natural, vegetated areas. Additionally, the project would add new impervious surface.<br>• An EIR could be prepared to determine if significant impacts would occur as a result of the project. An EIR would provide a better standard of review than an Initial Study, lowering risk. |
| **Estimated construction costs** | n/a | $3.3 million | $8.8 million | $23.2 million |

## 8.2 Evaluation Summary

Table 7 summarizes the conclusions of the evaluation. The detailed Alternative Analysis table is provided in the Appendix, along with technical detail on traffic, utilities, and environmental (e.g., biological, air, noise, etc.) impacts.

**Table 7: Alternative Evaluation Matrix Summary**

| Metric | Existing / No Build (4 vehicle lanes) | Alternative 1: Bike Lanes (3 lanes+bike lanes) | Alternative 2: Shared Use Path (3 lanes+path) | Alternative 3: Widened Shared Use Path (4 lanes+path) |
|---|---|---|---|---|
| **Overall Complete Streets Assessment** | **POOR** | **MODERATE** | **GOOD** | **GOOD** |
| **Bay Trail Qualification** | **NO** | **NO** | **YES** | **YES** |
| Pedestrian Safety and Experience | **POOR** | **POOR** | **GOOD** | **GOOD** |
| Bicycle Safety and Experience | **POOR** | **MODERATE** | **GOOD** | **GOOD** |
| Automobile Safety and Experience | **MODERATE** | **GOOD** | **GOOD** | **MODERATE** |
| Truck Safety and Experience | **MODERATE** | **GOOD** | **GOOD** | **MODERATE** |
| Transit Safety and Experience | **MODERATE** | **MODERATE** | **GOOD** | **GOOD** |
| Traffic Level-of-Service (Future Conditions) | **GOOD** | **GOOD** | **GOOD** | **GOOD** |
| Right-of-Way Impacts | **NONE** | **MINIMAL** | **MINIMAL** | **SIGNIFICANT** |
| Utilities Infrastructure Impacts | **NONE** | **MINIMAL** | **MINIMAL** | **SIGNIFICANT** |
| Environmental Impact* Likelihood | **NONE** | **UNLIKELY** | **UNLIKELY** | **POSSIBLE** |
| Cost | **$0** | **$3.3 million** | **$8.8 million** | **$23.2 million** |
| Source: Arup, 2016 | | | | |

The three alternatives provide a range of results:

- The **Existing ("No Build")** condition does not represent a "Complete Streets" design, as it does not provide continuous dedicated facilities for cyclists or pedestrians along the entire segment. It also does not qualify as part of the Bay Trail.
- The **Bike Lanes** alternative (Alternative 1) implements bike lanes only, therefore it does not qualify as a Bay Trail segment and does not meet several key goals of the study. The bike lanes provide a more comfortable experience compared to the existing condition. However, only selected portions of the roadway have space to accommodate minimal barriers to separate the bike lanes from the travel lanes. Therefore, the improvement in bicycle safety is only moderate. It is the least expensive and the easiest to implement.

- The **Shared Use Path** alternative (Alternative 2) has the best overall performance as it provides a way to accommodate pedestrians and cyclists safely along the entire corridor, provides a range of safety benefits for all other modes, and it qualifies as part of the Bay Trail. Alternative 2 is more expensive than the Bike Lanes alternative, however, it offers significant additional benefits to users with minimal impacts.
- The **Widened Shared Use Path** alternative (Alternative 3) provides similar performance to Alternative 2, but has a very high cost and has the potential for significant environmental and private property impacts as the result of widening the roadway to accommodate the path.

# 9 Recommendations

The technical studies, outreach, and alternatives analysis provided the basis for selecting a modified Alternative 2 as the recommended set of improvements (see Figure 22). The recommended alternative best satisfies the goals of the study, minimizes project impacts, and provides a cost-effective solution. County staff will utilize the findings in the feasibility report to ultimately make a recommendation to the Board of Supervisors about next steps and whether further detailed design should continue.

The recommended alternative:

- Implements the Shared Use Path concept (based on Alternative 2) from California Street to the Alfred Zampa Bridge by converting one of the existing four travel lanes to a ten-foot shared-use path on the north side of San Pablo Avenue, separated from vehicle traffic by a concrete physical barrier. This would result in one lane in each direction with the center lane use for left turns, truck climbing lanes, or painted median buffer zones.
- Incorporates a truck climbing lane on two steep segments between the Phillips 66 refinery and Cummings Skyway.
- Uses wide painted median buffer zones to improve safety in the two “summit” sections, which feature tight curves and steep grades.
- Implements the Bike Lanes concept (based on Alternative 1) from Lone Tree Point to California Street. In order to minimize impacts to local business owners, the on-street parking will be maintained between Parker Avenue and California Street. Given the existing constraints, no change in the street cross-section is proposed and the existing roadway layout will be retained. The only changes would include the construction of a sidewalk through Lone Tree Point and on-street bike lanes from Pacific Avenue to San Pablo Avenue. This section would provide continuous sidewalks and bike lanes and meet the Complete Streets study goal.
- Provides a high visibility crossing at California Street to allow pedestrians and cyclists to cross San Pablo Avenue and to access the shared-use path.
- Jersey barriers have been included in the design and cost estimates. These concrete barriers would prevent vehicles from crossing over into the shared use path.

**Figure 22: Recommended Alternative**

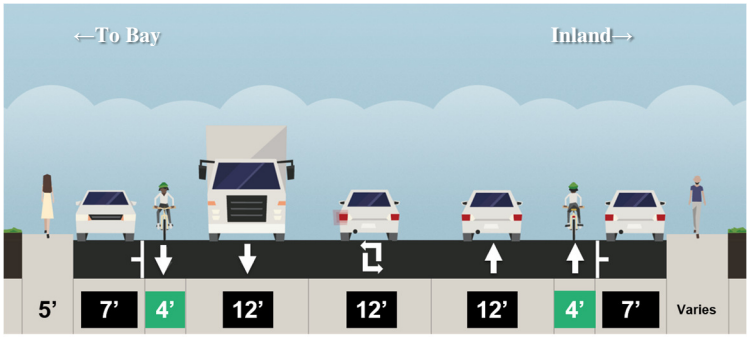
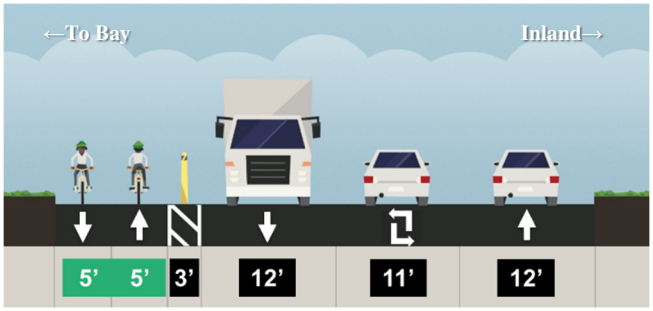
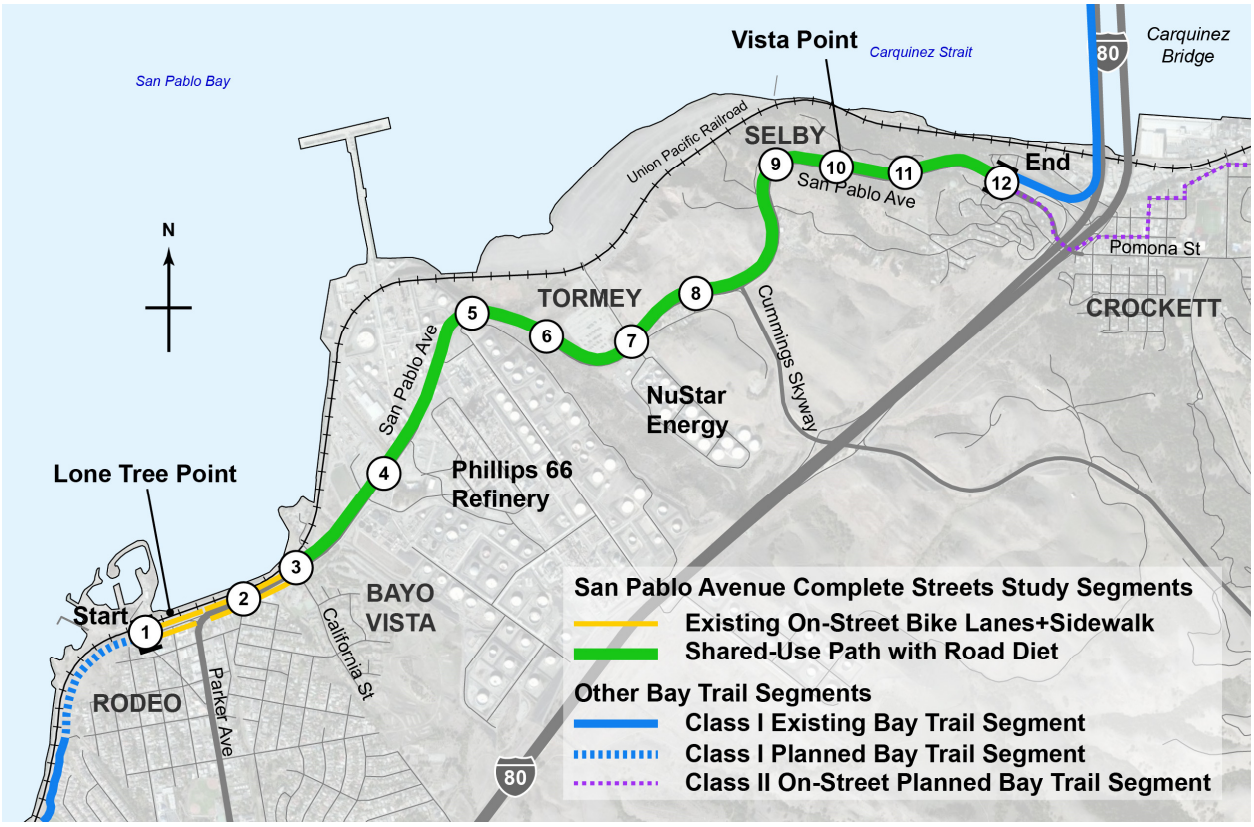
| | |
|---|---|
| **West of California Street: Bike Lanes**<br>Implement the bike lanes concept from Alternative 1 from Lone Tree Point to California Street. Add bicycle lanes and sidewalks to close gaps in existing facilities where necessary. |  |
| **East of California Street: Shared Use Path**<br>Implement the "road diet" concept from Alternative 2. Remove one travel lane and add a 10' two-way shared use path for pedestrians and cyclists on the north side of the roadway, separated by vehicle traffic by a physical barrier. Convert the center lane to a two-way left-turn lane, median, or truck climbing lane as necessary at different points along the roadway. |  |

Figure 23 illustrates the different segments as proposed along the San Pablo Avenue corridor, and is followed by a description of key points along the corridor.

**Figure 23: San Pablo Complete Streets Study Recommended Improvements**




1. Study area start. Construct bike lanes plus a sidewalk through Lone Tree Point from Pacific Avenue to Parker Avenue. Connect this to the proposed Bay Trail segment to Hercules.
2. Utilize the existing on-street bike lanes and sidewalk on San Pablo Avenue from Parker Avenue to California Street.
3. Provide a high visibility crossing for pedestrians and cyclists at California Street.
4. Implement the shared-use path (Alternative 2) concept on the north side of San Pablo Avenue from California Street to the Alfred Zampa Bridge. Utilize a physical barrier to separate the path from the travel lanes.
5. Provide a wide painted buffer between the opposing travel lanes at the summit point east of the refinery to increase the separation between opposing traffic.
6. Provide a truck climbing lane in the westbound direction.
7. Install a HAWK beacon (High-Intensity Activated crossWalK beacon) at the A Street intersection. A HAWK beacon is a traffic control device used to stop road traffic and allow pedestrians to cross safely.
8. Provide a truck climbing lane in the eastbound direction.

9. Provide a wide painted buffer between the opposing travel lanes at the summit point east of Vista Point Road to increase the separation between opposing traffic.
10. Provide a left-turn lane into the Vista Point.
11. Provide a truck climbing lane in the westbound direction.
12. Study area end. Provide pedestrian and bicycle improvements in front of the Dead Fish restaurant and connect to the path on the Alfred Zampa Bridge.

## Cost and Phasing

The Recommended Alternative is expected to cost $8.2 million (see Appendix C for more detail). To phase delivery of the project, the cost estimate is divided into three segments, as follows:

- Alfred Zampa Bridge to Cummings Skyway ($1.8 million)
- Cummings Skyway to California Street ($4.3 million)
- California Street to Lone Tree Point ($2.1 million)

## Implementation and Next Steps

The Recommended Alternative best satisfies the goals of the study, minimizes project impacts, and provides a cost-effective solution. County staff will utilize the findings in this feasibility report to ultimately make a recommendation to the Board of Supervisors about next steps and whether further detailed design should continue.

After public review, if the Board approves a preferred alternative, a number of steps remain to implement the chosen alternative:

1. **Complete final design:** Select a consultant to prepare final design documents. Funding for this study must be identified.
2. **Environmental review process:** Select a consultant to complete appropriate environmental review documents to comply with the California Environmental Quality Act (CEQA). Funding for this study must be identified.
3. **Construction funding:** Explore funding options for construction, such as the county's capital improvement program, regional grants, state and/or federal funding.
4. **Construct project, whole or in phases**.