ATKINS

Alexander Avenue Planning Study

Final

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FINAL ALEXANDER AVENUE PLANNING STUDY

July 6, 2012

Prepared for:

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Table of Contents

List of Figures

List of Tables

List of Appendices

List of Acronyms

AASHTO	American Association of State Highway and Transportation Officials
ADA	Americans with Disabilities Act
ADT	Average daily traffic
APE	Area of potential effect
AWSC	All-way stop controlled
BADM	Bay Area Discovery Museum
Caltrans	California Department of Transportation
CDC	Concrete box culvert
CDFG	California Department of Fish and Game
CEQA	California Environmental Quality Act
CFLHD	Central Federal Lands Highway Division
CNDDB	California Natural Diversity Database
EIS	Environmental impact statement
FHWA	Federal Highway Administration
Fps	Feet per second
FY	Fiscal year
GGBHTD	Golden Gate Bridge, Highway, and Transportation District
GGNRA	Golden gate National Recreation Area
GGT	Golden Gate Transit
HCM	Highway Capacity Manual
HW	Headwater
LOS	Level of service
Mph	Miles per hour
NEPA	National Environmental Policy Act
NPS	National Park Service
PGBSO	Pacific Great Basin Support Office

PWR	Pacific West Region
RWQCB	Regional Water Quality Control Board
SFMTA	San Francisco Municipal Transportation Agency
SSD	Stopping sight distance
TMC	Turning movement count
TWSC	Two-way stop controlled
USACE	U.S. Army Corps of Engineers
USFWS	U.S. Fish and Wildlife Service
USGS	U.S. Geological Survey
WD AM	Weekday morning
WD PM	Weekday evening
WE	Weekend

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ES.0 EXECUTIVE SUMMARY

The Executive Summary presents the process that was followed to develop the study, the existing conditions of the corridor, the improvement strategies that were considered, the strategies that were selected to be carried forward for implementation, and discusses the next steps to implement the selected strategies.

ES.1 PROCESS OVERVIEW

The Alexander Avenue Planning Study was conducted to identify corridor deficiencies and develop multi-modal improvement strategies for Alexander Avenue from the north end of the Golden Gate Bridge to the Sausalito city limits. The project goal is to identify ways to improve and enhance multi-modal use and access through and within the Alexander Avenue corridor. The study was conducted by the Federal Highway Administration (FHWA), Central Federal Lands Highway Division (CFLHD), in cooperation with the National Park Service (NPS), Pacific West Region (PWR), and the Golden Gate National Recreation Area (GGNRA). The key stakeholder agencies involved in the study were:

- FHWA–CFLHD
- NPS–PWR
- GGNRA
- City of Sausalito
- The California Department of Transportation (Caltrans)
- Golden Gate Bridge Highway, and Transportation District (GGBHTD)
- County of Marin

The process began by determining and analyzing existing conditions. In coordination with the key agency stakeholders, the project goal and objectives were developed to address corridor issues and concerns. Potential improvement strategies were then reviewed and strategies that were selected to be carried forward for implementation were summarized. A phased implementation plan of the selected strategies was then developed.

ES.1.1 Existing Conditions

An existing conditions analysis of the corridor was performed and included analysis of traffic conditions, geometric and structural conditions, hydrology and hydraulics, geotechnical conditions, and environmental conditions.

The existing traffic conditions analysis reviewed existing average daily traffic (ADT), turning movement counts, and intersection operations. ADT counts were collected from Alexander Avenue north of Danes Drive, south of Danes Drive, and Danes Drive west of Alexander Avenue. Traffic, bicycle, and pedestrian counts for the study were conducted October 14 to 20, 2009. Additional vehicle, bicycle, and pedestrian counts were obtained in October 2010. An additional intersection count was obtained in October 2011. Turning movement counts were collected in 2009 from the following intersections:

- Alexander Avenue and Conzelman Road
- Alexander Avenue and the northbound US 101 ramps
- Alexander Avenue and the southbound US 101 ramps

- Alexander Avenue and Danes Drive
- Alexander Avenue and East Road
- Danes Drive and Bunker Road

Existing volumes of each from the 2009 data can be summarized as:

- Vehicles
  - 8,700 weekday ADT on Alexander Avenue south of Danes Drive
  - 13,050 weekend ADT on Alexander Avenue south of Danes Drive
- Bicycles
  - 240 bicycles were counted during a Saturday 3:00 p.m. to 5:00 p.m. at Alexander Avenue/Danes Drive (collected in October 2009 by Atkins)
  - 490 bicycles were counted during a peak hour Saturday (collected in May 2008 by CFLHD)
- Pedestrians
  - At most, 28 pedestrians per hour were counted on a Saturday at Alexander Avenue and East Road
  - At all of the intersections, with the exception of the weekend peak hours at Alexander Avenue and East Road, the pedestrian volumes were minimal when the counts were collected (typically 0 to 10 pedestrians per hour)

Vehicle volumes were compared to bicycle volumes along the corridor during when peak hour counts were conducted. During the morning weekday peak the percentage of bicycles compared to total traffic (bicycles plus vehicles) is 5 to 7 percent along the corridor. During the evening peak period, the percentage of bicycles ranges from 8 percent on the south end of the corridor to 16 percent near Sausalito. On weekends, the percentage of bicycles ranges from 16 percent on the south end of the corridor to 33 percent near Sausalito.

Existing intersection operations at all intersections along the corridor operate at level of service (LOS) C or better during the weekday morning and evening peak hours. During the weekend peak hour, the Alexander Avenue/US 101 northbound ramps intersection operates at LOS F and the Alexander Avenue/Conzelman Road intersection operates at LOS E.

The existing geometric and structural conditions noted several deficiencies. The corridor is posted at three separate speed limits over its length of approximately 1.1 miles. These speeds are 45 miles per hour (mph) near US 101 and decreases to 35 mph, then 25 mph as the corridor approaches the City of Sausalito. Shoulder widths, horizontal sight distances, and clear zones were deficient when compared to design speeds of 35 and 45 mph. Superelevation rates are near or exceeding design limits.

The major structure deficiency noted was the Alexander Avenue/US 101 underpass due to its narrow width and horizontal sight distance issues.

There were no major hydrologic or hydraulic issues noted. There are several locations where inlets do not provide enough capacity to capture the 10-year storm frequency. There are also several locations where roadside ditches or swales do not provide the capacity to convey the 10-year design storm without spreading to the roadway.

The geotechnical conditions identified five areas of potentially unstable slopes along the corridor. Rockfall was noted in areas of the corridor. Recommendations to address rockfall include wire mesh on the face of slopes or wide ditches/run-out zones to allow rocks to collect, minimizing the rocks on the roadway pavement.

The asphalt pavements on Alexander Avenue exhibit signs of distress and failure including longitudinal and transverse cracks, block cracking, raveling, potholes, and separation of pavement layers. Longitudinal and transverse cracking was observed throughout the project area. Raveling was observed at most locations along Alexander Avenue. Potholes were observed at several isolated locations along the corridor.

The environmental scan identified that minor wetland areas occur north of Alexander Avenue and east of Danes Drive. For threatened and endangered species, based on the habitat types present, only five plants (Tiburon mariposa-lily—federally listed threatened, Santa Cruz tarplant—federally listed threatened, Tiburon jewel-flower—federally listed endangered, white-rayed pentachaeta—federally listed endangered, and Tiburon paintbrush—federally listed endangered), one invertebrate (Mission blue butterfly—federally listed endangered), and one amphibian (California red-legged frog—federally listed threatened) have any potential to occur in the project area.

Cultural and historical resource review identified that Alexander Avenue is a contributing structure to the Fort Baker, Barry, and Cronkhite Historic District. Alexander Avenue is also associated with the Golden Gate Bridge, which has been determined eligible for listing as a National Historic Landmark [15:3]. Evaluation of bridge-associated motor roads, such as Alexander Avenue, is incomplete at this time.

ES.1.2 Project Issues and Concerns

Through several pre-scoping and scoping meetings, the stakeholders developed numerous issues and concerns related to all modes of transportation through the corridor, including specific location issues and larger corridor-wide issues. The following summary list defined the problem:

- Conflicts may arise among bicycle, pedestrian, transit, and vehicle access and movements
- Variable demands between weekday and weekend peaks for commuter, daily, and recreational users
- Significant grade, limited sight distances, and narrow roadways to accommodate all users
- Traffic volumes and patterns have changed in the corridor

ES.1.3 Project Goal and Objectives

Based on corridor issues, the stakeholders prepared the following problem statement:

> To address safe multi-modal use, corridor efficiency, and access to multiple locations from Alexander Avenue, the study seeks to provide potential strategies that enhance safe multi-modal use, maintain travel times, and facilitate access to accommodate the changing use of the Alexander Avenue corridor for the design year of 2035.

To address these issues, the study team evaluated several groups of strategies through a sequential screening process, eventually settling on a recommended package for implementation composed of those strategies that best met the stated objectives and evaluation criteria.

Four evaluation criteria were developed from this problem statement, which were then used to evaluate and screen strategies:

- Enhance safe multi-modal use by vehicles, bicycles, pedestrians, and transit
- Maintain current travel times
- Facilitate access to be equitable between modes and efficient
- Consider implementation considerations such as environmental impacts, minimizing construction disruption, and funding potential

ES.1.4 Future Traffic Conditions

Future traffic volumes for the build year (2012) and the future (2035) conditions were developed based on a 1-percent annual growth rate. Future 2035 volumes were 11,300 weekday ADT on Alexander Avenue south of Danes Drive and 17,000 weekend ADT on Alexander Avenue south of Danes Drive.

Recent improvements to the Conzelman Road and East Road intersections with Alexander Avenue and the Alexander Avenue/Danes Drive intersection improvement project have been accounted for in the build year and future traffic conditions analysis.

Bicycle and pedestrian volumes were not projected to 2035 due to their variable nature of use in the corridor. Their volume fluctuation is highly dependent on variable factors such as weather and seasonal use (recreation and tourism). It was, however, clearly evident through the study process the volumes of bicycles using the corridor are significant and anticipated to increase in the future. The City of Sausalito and County of Marin are both anticipating and planning transportation improvements to accommodate increased bicycle use.

Pedestrian use through the corridor must be accommodated as Alexander Avenue is the shortest route from the Golden Gate Bridge to downtown Sausalito.

Intersection LOS was analyzed for future 2035 conditions. During the weekday, the Alexander Avenue/US 101 northbound ramps intersection operates at LOS F, while all other intersections operate at LOS C or better. For weekend conditions, all intersections operate at LOS F, except the Alexander Avenue/East Road intersection, which operates at LOS C.

ES.2 ALTERNATIVES CONSIDERED

Improvement strategies fell into three transportation mode groups—roadway, bicycle and pedestrian, transit—in an attempt to find solutions for each mode. As strategies were reviewed, compatibility features between modes were investigated.

Seventeen roadway strategies were reviewed and were further broken down to address specific identified issues into the following:

- Alexander Avenue/northbound US 101 intersection strategies
- Alexander Avenue/US 101 underpass strategies

- Alexander Avenue/US 101 interchange strategies
- Corridor-wide traffic operation strategies

Nineteen bicycle and pedestrian strategies were reviewed. These strategies investigated new routes, improving existing routes, and providing enhanced features to better accommodate bicycles and pedestrians.

Twelve transit stop locations were considered. The stop locations included existing stop locations and potential stop locations based on user destinations and compatibility with roadway strategies.

Alternatives were coordinated with the Alexander Avenue/Danes Drive intersection improvement project that is planned for construction in fiscal year 2013 and includes extending the left turn lane, reconfiguring the intersection to a “T” intersection, and shoulder widening.

ES.3 ALTERNATIVES RETAINED

Through the process of evaluating improvement strategies against the stated screening criteria, certain strategies within each modal group addressed the problem statement better than others and rated higher using the screening criteria. Additionally, some bicycle and pedestrian strategies were further refined to produce complete routes.

Of the 17 roadway improvement strategies, nine strategies were carried forward for implementation.

Of the 19 bicycle and pedestrian improvement strategies, 12 strategies were carried forward and refined to develop complete routes from the Golden Gate Bridge to the City of Sausalito. Two routes were identified—one route through Fort Baker and another route along Alexander Avenue. Each of these routes provides access to the east and west sides of the Golden Gate Bridge.

Eight of the 12 transit stop locations were carried forward for potential implementation. Implementation efforts would need to coordinate with GGBHTD and GGNRA. Pending the outcome of ongoing studies and a market demand determination, transit strategies were not reviewed further. Existing stop locations were identified to be improved until these studies can be completed.

ES.4 RECOMMENDED IMPROVEMENT STRATEGIES AND NEXT STEPS

The recommended improvement strategies are shown on Figure ES-1. These strategies are:

Roadway Improvement Strategies (see Section 5.3.1 on page 80)

- Signalize Alexander Avenue/US 101 northbound ramps intersection (Strategy R-A1)
- Replace the Alexander Avenue/US 101 underpass as its useful life deteriorates or continued increased multi-modal use on Alexander Avenue warrants (Strategy R-B1)
- Improve geometry of the northbound US 101 off-ramp (Strategy R-C1 and R-C2)

- Improve geometry and acceleration length of the northbound US 101 on-ramp (Strategy R-C4)
- Improve deceleration length of the southbound US 101 off-ramp (Strategy R-C5)
- Improve intersection turning radii to assist larger vehicles. Improve wayfinding, signing, pavement markings, and traffic calming to increase driver understanding and expectation (Strategy R-D1)
- Signalize additional two intersections (Strategy R-D2) at Alexander Avenue/US 101 southbound off-ramp and Alexander Avenue/Danes Drive
- Implement event management techniques (Strategy R-D4) during Fort Baker events
- Implement permanent traffic counters to gather data on vehicle, bicycle, and pedestrian use

Bicycle and Pedestrian Improvement Strategies (see Section 5.3.2 on page 105)

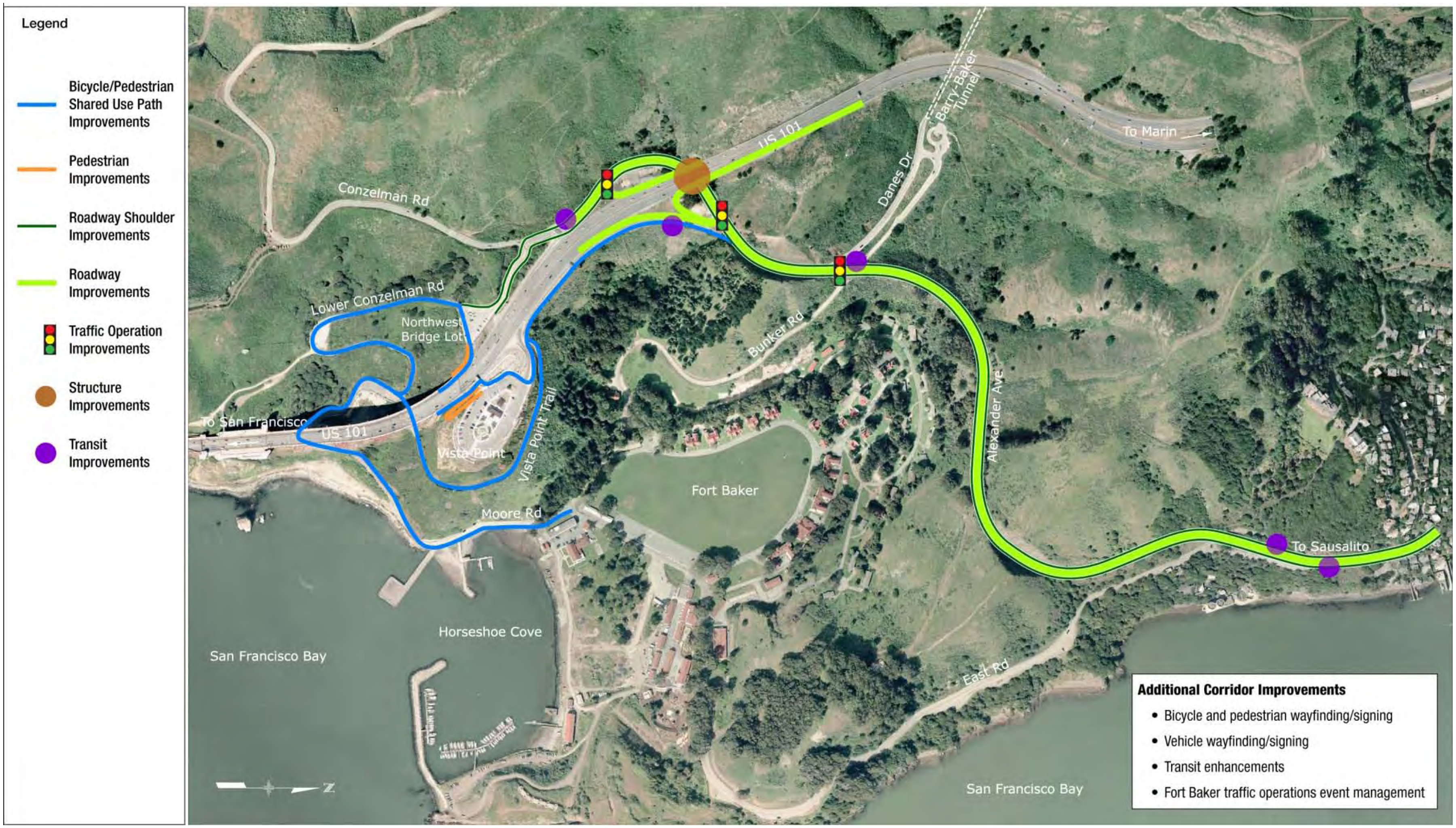
- Improve Vista Point Trail (Strategy BP-C1)
- Improve Lower Conzelman Road (Strategy BP-D)
- Improve Moore Road (Strategy BP-P1 and BP-P2 in Section 5.5.2 on page 149)
- Improve shared use paths between Vista Point and Alexander Avenue (Strategy BP-Q1 and BP-Q2 in Section 5.5.2 on page 152)
- Improve Golden Gate Bridge walkway access (Strategy BP-A and BP-B)
- Improve corridor wide wayfinding and signing (Strategy R-D1 for bicycles and pedestrians)
- Improve transit stop connectivity with bicycle, pedestrian, or other transit facilities (in collaboration with transit strategies)
- Improve typical section to ensure maximum use of available space to accommodate bicycle, pedestrian, vehicle, and transit travel modes (Strategy BP-TS2)
- Improve lighting, signing, and pavement marking within and in the immediate vicinity of the Alexander Avenue/US 101 undercrossing (Strategy BP-G)

Transit Improvement Strategies (see Section 5.3.3 on page 121)

- Improve existing stop access and design consistency if the stop is within a roadway improvement strategy area during implementation
- Coordinate with GGNRA, GGBHTD, and San Francisco Municipal Transportation Agency (SFMTA) for enhanced future services and changes to existing stop locations

The anticipated construction cost to implement the overall recommended strategy is approximately $18,710,000. These costs do not include environmental clearance, preliminary engineering, construction engineering, or right of way.

Figure ES–1
Overall Recommended Improvement Strategies



The strategies were then separated into implementation phases based on benefits and challenges related to engineering and environmental analysis. Three phases were identified based on the following criteria:

- Phase 1 (short-term) improvements are defined as strategies that could be implemented relatively easily within 0 to 3 years that will improve existing conditions and are low-cost strategies. The anticipated cost for Phase 1 is approximately $2,030,000. Phase 1 strategies are:
  - Improve corridor wide bicycle, pedestrian, and vehicle wayfinding, signing, pavement markings, turning radii, and traffic calming to increase user (bicyclists, pedestrians, and vehicle drivers) understanding and expectation (Strategy R-D1).
  - Implement event management techniques during Fort Baker events (Strategy R-D4). Techniques should be coordinated internally within NPS, Prior to implementation, and follow recommendations made in the Fort Baker EIS and ROD.
  - Implement traffic signals at Alexander Avenue/US 101 northbound ramps, including intersection geometry modifications to eliminate the existing northbound free right onto Alexander Avenue and widening the shoulder to accommodate the bicycle and pedestrian traffic (Strategy R-A1).
  - Improve Vista Point Trail. This strategy will include widening and paving operations to provide suitable pavement conditions for bicycle and pedestrian users (Strategy BP-C1).
  - Improve Lower Conzelman Road. This strategy will include milling and paving operations and sawcutting and full depth replacement of shoulder to provide suitable pavement conditions for bicycle and pedestrian users (Strategy BP-D).
  - Improve Moore Road. This strategy will include milling and paving operations to provide suitable pavement conditions for bicycle and pedestrian users. This strategy does not include improvements associated with implementation of strategies BP-C1 and BP-D (Strategy BP-P1 and BP-P2).
  - Improve lighting, signing, and pavement marking within and in the immediate vicinity of the US 101 underpass structure (Strategy BP-G).
  - Add traffic and bike counters (Moore Road and on path north of Vista Point before Alexander Avenue).
- Phase 2 (mid-term) improvements are defined as strategies that could be implemented with moderate efforts within 3 to 5 years, may require more extensive environmental clearance efforts, are moderate-cost strategies, and would provide the most benefit to all users. The anticipated cost for Phase 2 is approximately $8,120,000. Phase 2 strategies are:

- Improve typical section to ensure maximum use of available space to accommodate bicycle, pedestrian, vehicle, and transit travel modes. This strategy will not include improvements or costs associated with the Alexander Avenue/Danes Drive intersection. This intersection will be completed through other funding sources. This strategy will require widening the roadway 1 to 2 feet for the entire length, reconstructing the roadway, adjusting superelevations to meet current design guidelines for runoff length (superelevation on Curve 6 will be excluded due to the impacts to the structure at this location), and rehabilitating asphalt pavement. This strategy does not include improvements associated with implementation of strategy R-B1 (Strategy BP-TS2).
- Improve geometry of the northbound US 101 off-ramp to accommodate additional storage for left turns. This strategy will require a retaining wall structure on the east side to accommodate a reconfigured ramp and additional width to match in with the multi use path recommended in BP-Q1 over the steep fill slope (Strategy R-C1 and RC-2). The retaining wall quantity will be in addition to the retaining wall required for Strategy BP-Q1.
- Improve shared use paths between Vista Point and Alexander Avenue. This strategy will require a retaining wall structure east of the shared-use path adjacent to US 101 to accommodate widening over the steep fill slope. This strategy does not include improvements associated with implementation of strategies BP-TS2 and R-B1 (Strategy BP-Q1 and BP-Q2).
- Improve Golden Gate Bridge walkway access. This strategy will require a retaining wall structure over the steep fill slope to connect the walkway access to the East Vista Point parking lot (Strategy BP-A and BP-B).
- Improve transit connectivity with coordinated operations between local and regional transit agencies, and include such features as bus shelters and sidewalk at bus stop locations (in collaboration with roadway strategies).
- Improve existing transit stop access and design consistency if the stop is within a roadway improvement strategy area during implementation (in collaboration with roadway strategies).
- Coordinate with GGNRA and GGBHTD for enhanced future transit services.

- Phase 3 (long-term) improvements are strategies that would ensure the corridor meets 2035 anticipated use, are moderate to high-cost strategies, and require more extensive study, design, and clearances. The anticipated cost for Phase 3 is approximately $8,560,000. Phase 3 strategies are:
  - Improve geometry and acceleration length of the northbound US 101 on-ramp. This strategy will require a retaining wall structure on the east side of the ramp to accommodate widening into the steep cut and fill slopes (Strategy R-C4).
  - Improve deceleration length of the southbound US 101 off-ramp. This strategy will require a retaining wall structure on the west side of the ramp to accommodate extending the deceleration length into the steep cut slope. Widening of the US 101/Alexander Avenue structure will be required to implement this strategy. Costs for the widening of this structure are included in strategy R-B1 (Strategy R-C5).

- Implement traffic signals at two intersections (Strategy R-D2) along the Alexander Avenue corridor:
  - Alexander Avenue/US 101 southbound off-ramp
  - Alexander Avenue/Danes Drive
- Replace the US 101/Alexander Avenue structure as its useful life deteriorates or continued increase in bicycle and pedestrian use warrants (Strategy R-B1) to achieve:
  - Typical section width
  - Improved sight distance
  - Widening for bike and pedestrian use
  - Improved vertical clearance for buses and trucks
  - Seismic standards
- Coordinate with GGNRA and GGBHTD for enhanced future transit services.

Figures ES-2, ES-3, and ES-4 show the phased implementation.

These recommended strategies should be reviewed more thoroughly and cleared for construction through the NEPA and CEQA processes. A Caltrans Project Study Report is anticipated for improvements made to the Alexander Avenue/US 101 interchange. These processes would take the planning level strategy layouts and include additional conceptual layouts and variations of the strategies to develop a more complete design, understanding of potential impacts, and compatibility between modal uses.

In addition to clearing the recommended improvement strategies through the environmental process, other implementation steps are necessary to carry these improvements forward:

- Funding needs to be identified for each project through the appropriate agency with jurisdiction.
- Coordinate with GGBHTD to review reducing the posted speed of the corridor to 40 mph.
- Field surveys need to be performed to produce base mapping for design of improvements.
- Design reviews within Caltrans must be performed and coordinated with the appropriate departments.
- Bicycle volumes should be monitored annually to ensure that volumes do not exceed acceptable limits, triggering the need for further improvements.

Figure ES–2
Phase 1 Improvement Strategies

Note: Structure improvements include lighting, signing, and pavement markings only.

Figure ES–3
Phase 2 Improvement Strategies

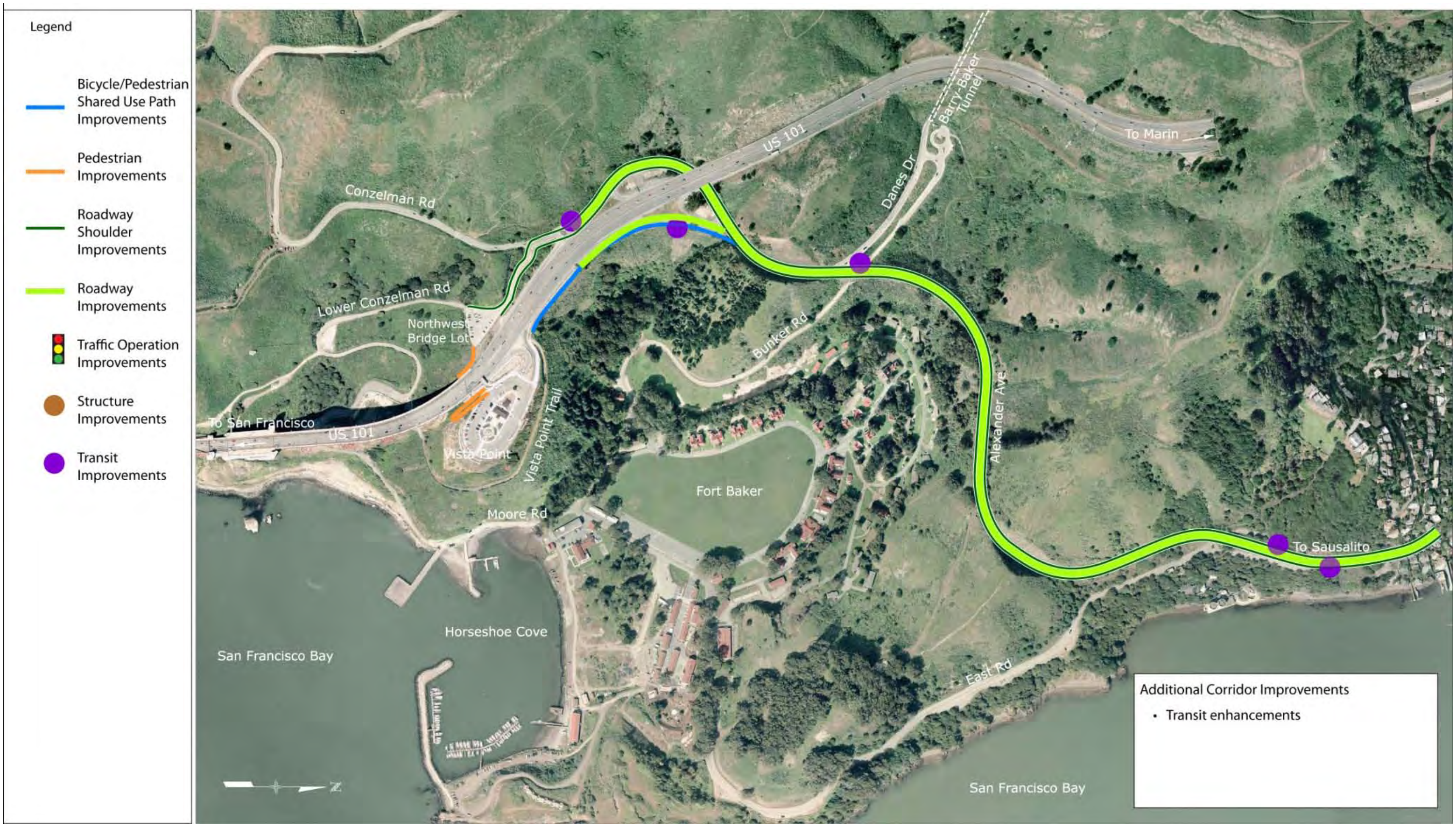


Figure ES–4
Phase 3 Improvement Strategies

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1.0 INTRODUCTION

The Alexander Avenue Planning Study is being conducted before beginning National Environmental Policy Act (NEPA) or California Environmental Quality Act (CEQA) studies. The work was developed for the Federal Highway Administration (FHWA), Central Federal Lands Highway Division (CFLHD), and the National Park Service (NPS), Golden Gate National Recreation Area (GGNRA) and Pacific West Region (PWR).

The work was performed in association with representatives from seven key stakeholder agencies:

- FHWA–CFLHD
- NPS–PWR
- GGNRA
- City of Sausalito
- The California Department of Transportation (Caltrans)
- Golden Gate Bridge Highway, and Transportation District (GGBHTD)
- County of Marin

The intent of the study is to identify corridor deficiencies and develop multi-modal improvement strategies for Alexander Avenue, from the north end of the Golden Gate Bridge to the Sausalito city limit.

1.1 PROJECT BACKGROUND

Alexander Avenue, originally named the Sausalito Lateral, was constructed in Marin County, California, in 1936 by the Works Progress Administration to connect the harbor area of Sausalito with the Golden Gate Bridge approach. GGBHTD and Caltrans own and operate the roadway through an easement agreement with NPS. Caltrans owns and operates the southern portion of the route from the Conzelman Road intersection to north of the US 101 interchange. GGBHTD owns and operates the remaining northern portion of the route to the City of Sausalito boundary.

Alexander Avenue is a principal arterial route proceeding in a north-south direction through the GGNRA. For this study, Alexander Avenue begins at the intersection with Conzelman Road, just north of the Golden Gate Bridge, and ends at the Sausalito boundary. The project includes approximately 1 mile of roadway and couples as a shared-use facility with bicyclists and pedestrians traveling on the shoulder. Several bus routes also serve the area. Alexander Avenue, within the study limits described, is primarily a two-lane road with a median left-turn lane at the intersection of Alexander Avenue and Danes Drive.

The Alexander Avenue corridor is shown in Figure 1.

Two initial project development meetings were held to better understand the scope of the planning study. The meeting minutes for these two meetings are in Appendix A.

1.1 PROJECT GOAL

The project goal is to identify ways to improve and enhance safe multi-modal use and access through and within the Alexander Avenue corridor. This project goal was developed in cooperation with the key stakeholder agencies and is documented in a partnering agreement signed by the key stakeholders. The partnering agreement is included in Appendix A.

1.2 STUDY PROCESS

The study process began with two initial project development meetings held to determine the issues, concerns, and potential improvements to the corridor. From these meetings, FHWA–CFLHD developed a scope of work to conduct a planning study of the corridor. This scope of work included a partnering meeting with the key stakeholders to provide a forum for each agency's corridor issues and concerns to be heard and ensure that the results of the study can be supported by the members of the partnership.

The formal study process began with documenting the existing conditions of the corridor. Next, the issues and concerns were further refined. Improvement strategies were then developed, reviewed, and screened. Finally, the remaining strategies were coupled with each other to produce a recommended strategy for implementation. A draft planning study document was then prepared for key stakeholder review and comment.

At each stage of work throughout the study process, in addition to the partnering meeting, four progress meetings with the key stakeholders were held to discuss work completed to date, to update the key stakeholders on progress, and to obtain input.

Figure 1
Corridor Map

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2.0 STAKEHOLDER INVOLVEMENT AND PROJECT GOALS

This chapter discusses pre-scoping activities, issues and concerns, the project problem statement, and screening criteria.

2.1 PRE-SCOPING ACTIVITIES

Two initial project development meetings were held to better understand the scope of the planning study. The meeting minutes for these two meetings are included in Appendix A.

In May 2008, representatives from NPS, GGBHTD, and FHWA–CFLHD conducted a field review of Alexander Avenue and identified a preliminary list of improvements. During that meeting it was noted that all of the stakeholder agencies (agencies with direct jurisdiction, management, or operational roles within the study area) were not in attendance and it was agreed to have another meeting to review the identified alternatives with the full stakeholder team. The review of those preliminary concepts was the primary focus of this meeting.

In December 2008, a meeting was held to discuss the planning study with the stakeholder agencies, verify support for the study, and review and finalize elements to be included in the study. The meeting was held at the Golden Gate Bridge District Tolling Plaza Building and was attended by representatives of Caltrans, the City of Sausalito, GGBHTD, FHWA–CFLHD, NPS–GGNRA, NPS–Pacific Great Basin Support Office (PGBSO), Atkins, and Yeh and Associates.

Two related documents were used during the development of the planning study for reference and gathering information:

- *Marin Headlands and Fort Baker Transportation Infrastructure and Management Plan* (Marin Headlands EIS) [1]
- *Fort Baker Plan Environmental Impact Statement and Record of Decision* (Fort Baker EIS) [2]

2.2 ISSUES AND CONCERNS

The issues and concerns were developed and defined during the development of the project goal and pre-scoping phases of this study in cooperation with the stakeholders. Through the partnering agreement among the stakeholders, the following features of the current problem were identified:

- Conflicts may arise among bicycle, pedestrian, transit, and vehicle access and movements
- Variable demands between weekday and weekend peaks for commuter, daily, and recreational users
- Significant grade, limited sight distances, and narrow roadways to accommodate all users
- Traffic volumes and patterns have changed in the corridor

The following project issues and concerns were developed from the review of the two initial project development meeting minutes and site visits between May 2008 and January 2010. They have been grouped into categories; however, many issues overlap categories. The full meeting minutes are in Appendix A.

Bicyclists. The following issues related specifically to bicyclists are summarized from meeting materials and minutes:

- Rental bicycles are a concern because they are being left in Sausalito due to full or unavailable ferries to return riders back to rental facilities; therefore, many bicycles are abandoned.
- There has been a rapid increase in bicycle and pedestrian trips, but the volume of bicycles has increased significantly more than pedestrians. On a good weather day, there can be more than 5,000 bicyclists.
- A wayfinding plan and signage is needed, particularly for different skill levels (i.e., recreational/non-training, rental, and commuter/training riders).
- Access to all visitor areas, particularly Fort Baker and Marin Headlands, needs to be improved. Access and safety to and from the bridge also needs to be improved.
- Width and grade of the roadway are constraints. Speeds of steep down grades are of particular concern, as well as shoulder widths compared to standard bicycle designs.
- Bicycle accidents outnumber vehicle accidents. Based on statements by the GGBHTD, bicycle/bicycle accidents and single bicycle accidents are highest in the early morning on the Golden Gate Bridge.
- Vista Point Road could be an alternative to Alexander Avenue, but needs pavement, a safety railing evaluation, and security changes.
- Going toward Sausalito, there are problems with bus mirrors encroaching on shoulders with bicycles and pedestrians. Narrower lanes were also recommended for traffic calming.
- If a US 101 underpass is to be considered, Caltrans support is needed early on and ADT and traffic numbers will need to be obtained.
- Natural resource protection needs to be balanced with safety concerns. Safety concerns include limited sight distance, variable vehicle and bicycle speeds, and variable use of the shoulder due to debris in the shoulder.

Pedestrians. The following issues related specifically to pedestrians are summarized from meeting materials and minutes:

- Bicycle and pedestrian conflicts are primarily due to the increased number of pedestrians and rental bicycles crossing the bridge and converging on the Alexander Avenue exit. In general, there has been a rapid increase in bicycle and pedestrian trips; however, the volume of bicyclists increased significantly more than pedestrians.
- Access to all visitor areas, particularly parks, needs to be improved. Access and safety to and from the bridge also needs to be improved.
- According to the Americans with Disabilities Act (ADA), grades will be an issue. The width and grade of the roadway are also constraints.
- A path is needed from the coastal path on Lower Conzelman to the bus stop.
- Vista Point Road needs pavement and railing.
- There is no identified pedestrian accommodation and there is a lack of transit stops.
- There are differences in pedestrian activity between weekday and weekend/holiday activity

Transit. The following issues related specifically to transit are summarized from meeting materials and minutes:

- Transit stops are inadequate. All bus stops, routes, and times need to be identified. Additional bus stops or moving bus stops are needed toward Sausalito; however, a shuttle may eliminate the need for additional stops. San Francisco Municipal Transportation Agency (SFMTA)/Golden Gate Transit (GGT) could share stops—all bus operators are stakeholders. Also, bus stops at Danes Drive/Alexander Avenue need to be coordinated to be included in the design project.
- A path is needed from the coastal path on Lower Conzelman to the bus stop.
- The width and grade of the roadway are constraints. The turning radius for the northbound US 101 entrance and exit is a concern for 45-foot long GGT buses and tour buses.
- Signage needs to improve, particularly bus signing for the drop off northbound at Alexander Avenue traveling to Vista Point.
- There are a lot of accidents under US 101, but it is not considered a high accident area; however, there is seemingly high potential for fatal accidents. There is also a high percentage of RVs and buses, which seems to be a pinch point.
- Access to parks needs to be improved.
- Going toward Sausalito, there are problems with bus mirrors encroaching on shoulders with bicycles and pedestrians. Narrower lanes were also recommended for traffic calming.
- The Fort Baker bus study and this planning study need to coordinate. GGT has a passenger survey that is currently ongoing as well.

Vehicles (cars, trucks). The following issues related specifically to vehicles are summarized from meeting materials and minutes:

- The tunnel under US 101 is substandard and has a lot of accidents, despite not being considered a high accident area. There is seemingly a high potential for fatal accidents in this area as well as a high percentage of RVs and buses, which create a pinch point. Traffic needs to be calmed and all possible alternatives should be reviewed. There is an option for lane sharing if traffic is slowed. Another option is to post a stop sign before entering with sharrows.
- Roadway width and grade are constraints. Other roadway concerns are on- and off-ramps and merge lane, as well as guardrails.
- Going toward Sausalito, there are problems with bus mirrors encroaching on shoulders with bicycles and pedestrians. Narrower lanes were also recommended for traffic calming.
- The left-turn lane onto Danes Drive is inadequate for queuing. Queues at stop signs are also backing up onto US 101.
- Signing and access to all visitor areas needs to be improved.
- Limited sight distance and variable speeds for vehicles and bicycles are of concern.

Other issues. The following other issues are summarized from meeting materials and minutes:

- Natural resource protection needs to be balanced with safety concerns.

- Access to all visitor areas needs to be improved.
- Roadway widening next to the Knob Hill alignment is restricted to one side due to geology
- Approval processes through key stakeholder agencies and agreements with agencies take a long time

The listed issues and concerns were reviewed with the stakeholders at the March 25, 2010, progress meeting. Meeting materials and minutes are in Appendix A. The progress meeting yielded the following additional issues and concerns:

- Ferries cannot take enough riders back at times. Two ferry services serve Sausalito: one to Market Street and one to Fisherman's Wharf. The City of Sausalito sees the bicycle/ferry interface as a city management issue.
- Bus shelters and stops must meet ADA.
- A possible improvement strategy is for bicycle rental companies to shuttle riders back.
- Bicycle/pedestrian conflict areas include the Vista Point overlook area and the US 101 ramp terminal area.
- More information and/or discussion regarding how the north end of the bridge works for users is needed. What time of day are pedestrians and bicycles entering/exiting the bridge?
- Overall improved wayfinding for bicycles is needed.
- Site visit notes include:
  - Vista Point Road may have sight distance issues and will require a barrier on the outside due to steep slopes.
  - Bicycle and pedestrian congestion occurs at the north end of Vista Point where the attached path becomes separated next to US 101. This is a narrow section of path as bicycles and pedestrians enter and exit Vista Point.
  - Pedestrian and bicycle interaction within Vista Point and the Trailhead Parking Lot can be improved by allowing for more definition/separation of facilities.
  - The intersection of US 101 northbound exit/entrance ramps and Alexander Avenue is a key movement. Bicycles turning left to get to the path take various routes including going wrong way on ramp, crossing at undesignated areas, and using the existing asphalt path.
  - In the Baker-Barry Tunnel there is not enough time for the bicycles to get through the tunnel with current timing. Improve the bicycle detection system or lighting to better illuminate bicycles and pedestrians within the tunnel.
  - Congestion occurs at the entrance/exit at Sausalito. Grades, utility elements, narrow roadway, and driveway interaction contribute to the congestion.
  - County Bike Route 5 is currently Lower Conzelman Road. Discussions have occurred to potentially change this to Alexander Avenue.
  - Contact Dianne Steinhauser at the Transportation Authority of Marin to discuss the study and potential funding options.(An informal status meeting was held with TAM on June 8, 2010)

- Marin County Bicycle Coalition is working with rental bike companies to get county bike routes on their maps.
- David Hoffman from the Marin County Bicycle Coalition stated a commonly accepted bike accident reporting ratio is 1 in 10 accidents are recorded—partly due to the minor cost of accident repair.

2.3 PROJECT PROBLEM STATEMENT

The NPS, GGNRA and PWR, working with the FHWA–CFLHD, has identified a need for improvements to the Alexander Avenue corridor. This problem statement presents the project need and provides an introduction and foundation for improvement strategies developed and analyzed as part of this Alexander Avenue Planning Study.

The problem statement is comprised of elements identified from the pre-scooping activities and issues and concerns. These issues and concerns were developed in coordination with the stakeholder agencies identified in Chapter 1, Introduction.

Few changes or improvements have been made to the roadway alignment, cross section, and structures since the original construction, but the modal use and traffic volumes have changed substantially. Traffic volumes collected in 2009 show an ADT of 13,000 vehicles, a 33 percent increase from the volumes measured in 2002. In addition, many visitors are recreational users in the Golden Gate Bridge, Sausalito, and GGNRA Marin Headlands area. These recreational users travel via cars, buses, bicycle, and by foot. Additional corridor issues and concerns are:

- Increased levels of bicycle, pedestrian, and vehicle traffic
- Mixture of travel modes resulting in speed differentials in constrained spaces
- Congested conditions on many weekends
- Narrow roadway shoulders
- Narrow shared use facilities
- Lack of wayfinding and signing for bicycles, pedestrians, and vehicles
- Inconsistent and deficient transit stop accommodations
- Deficient roadway geometry for posted speed limits

While Alexander Avenue is operated and maintained by the GGBHTD and Caltrans, Alexander Avenue is mostly unrelated to their operational diligence. The GGBHTD's primary role is to operate the Golden Gate Bridge, GGT, and the Golden Gate Ferry, while Caltrans' primary role in this area is to manage US 101. As a result, Alexander Avenue has been a low priority investment for both agencies.

Alexander Avenue is the only access to the Marin Headlands and Fort Baker within the GGNRA and provides the southern entrance and exit for the City of Sausalito. It serves as emergency access for these areas.

The problem statement of this study is to address multi-modal use, corridor efficiency, and access to multiple locations from Alexander Avenue. The study seeks to provide potential strategies that enhance multi-modal use, maintain travel times, and facilitate access to accommodate the changing use of the Alexander Avenue corridor for the design year of 2035. These three primary goals are further discussed in the following section.

2.4 SCREENING CRITERIA

The following subsections discuss the screening criteria for the goals identified in the problem statement.

2.4.1 Enhance Multi-Modal Use

Travel modes studied were vehicle, bicycle, pedestrian, and transit. The improvement strategies should provide improved facilities for each mode. Improved facilities should reduce congestion and conflicts between and within modes and provide enhanced visitor experience and travel options.

2.4.2 Maintain Travel Times

Current travel times through the corridor should be maintained where possible. Peak hour existing conditions vary widely based on time of year, special events, and weekend weather patterns. Improvement strategies should provide consistent travel times through and within the corridor. Strategies should also seek to eliminate excessive queuing on approaches to Alexander Avenue.

2.4.3 Facilitate Access

Alexander Avenue provides immediate access to the GGNRA, Fort Baker, Marin Headlands, City of Sausalito, US 101, and the Golden Gate Bridge. Alexander Avenue also provides access to southern Marin County. Access to each of these locations should be equitable between travel modes and occur efficiently. Strategies should also consider accessibility improvements and information regarding possible travel routes.

2.4.4 Implementation Considerations

Implementation of strategies should be sensitive to agencies that rely on Alexander Avenue and users of the corridor. Environmental impacts of strategies need to be cleared through CEQA and NEPA processes. Construction of strategies will disrupt use, travel times, and access, but should seek to minimize disruption through construction methods and construction time constraints. Funding sources will need to be identified once recommended strategies are agreed upon.

3.0 EXISTING CONDITIONS

This chapter discusses the existing traffic, geometric and structural, hydrology and hydraulics, geotechnical, and environmental conditions along Alexander Avenue and Danes Drive.

3.1 EXISTING TRAFFIC CONDITIONS

An existing conditions analysis was performed to determine the current conditions along Alexander Avenue and Danes Drive. This provides an understanding of the existing roadway network (geometry, configuration, and characteristics) and how the arterial and intersecting local streets operate.

3.1.1 Roadway Characteristics

The project area includes Alexander Avenue from Conzelman Road on the south end to the City of Sausalito boundary on the north end, as well as Danes Drive from Alexander Avenue to the Baker-Barry Tunnel, as shown in Figure 2. Alexander Avenue and Danes Drive are two-lane roads within the project limits. Alexander Avenue has one lane in each direction between Conzelman Road and the City of Sausalito, and the posted speed limit varies from 25 to 45 miles per hour (mph). There are no existing signalized intersections in the project area except for the signal controlling the one-lane Baker-Barry Tunnel on Danes Drive. Both roads are shared with bicycles and pedestrians and, at times, only a minimal shoulder is present. There are typically pedestrians and bicycles traveling along Alexander Avenue, with high pedestrian and bicycle volumes on peak weekends. Bus service is provided by GGT, and the existing bus stop locations along the corridor are shown in Figure 2. SFMTA also operates bus service through the area to Fort Cronkhite.

3.1.2 Traffic Volumes

New traffic data were collected for the existing conditions analysis between October 14 and 20, 2009. October was considered one of the best months to collect “typical” traffic conditions because there are higher volumes of tourist traffic during the weekends. August and September are typically peak tourist periods. The Goblin Jamboree event was held on October 17, 2009, in Fort Baker the weekend that counts were performed. Daily traffic counts were performed over seven days on Alexander Avenue north of Danes Drive and south of Danes Drive, and on Danes Drive west of Alexander Avenue. It was determined that the ADT volumes on Alexander Avenue were approximately 6,100 and 7,600 vehicles per day during the week and the weekend, respectively, north of Danes Drive. South of Danes Drive, the volumes are approximately 8,700 (weekday) and 13,000 vehicles per day (weekend). On Danes Drive between the Baker-Barry Tunnel and Alexander Avenue, traffic volumes average 3,100 vehicles per day during the week and 5,500 over the weekend. Figure 3 shows the average hourly weekday/weekend traffic volumes at each location where bi-directional counts were collected. The charts showing the hourly traffic trends are in Appendix B.

The GGBHTD provided data for traffic counts collected from September 30, 2010 through October 6, 2010 (Thursday through Wednesday). These counts included daily traffic data. No specific turning movement counts were provided. These counts were collected on Alexander Avenue north of Danes Drive. This information is included in Appendix B. In summary, the ADT was approximately 7,650 and 8,100 vehicles per day during the week and the weekend, respectively.

Additional turning movement counts (TMC) were collected at Danes Drive and Alexander Avenue over a two hour period on a typical non-event peak season weekend in October 2011. These counts were collected based on stakeholder comments to the draft report expressing a desire to analyze the weekend data with non-event volumes. Based on the data collected, the overall corridor volumes were within 5.7 percent of one another for the "peak weekend" and "non-event" weekend. It was determined, based on a level of service (LOS) comparison, that there is insignificant difference between the volumes and that the entire study area would not have new data collected because new analysis on the corridor is not warranted. More detail comparing the data from both the October 2009 and October 2011 intersection counts is in Section 3.1.6.

Figure 2
Project Area

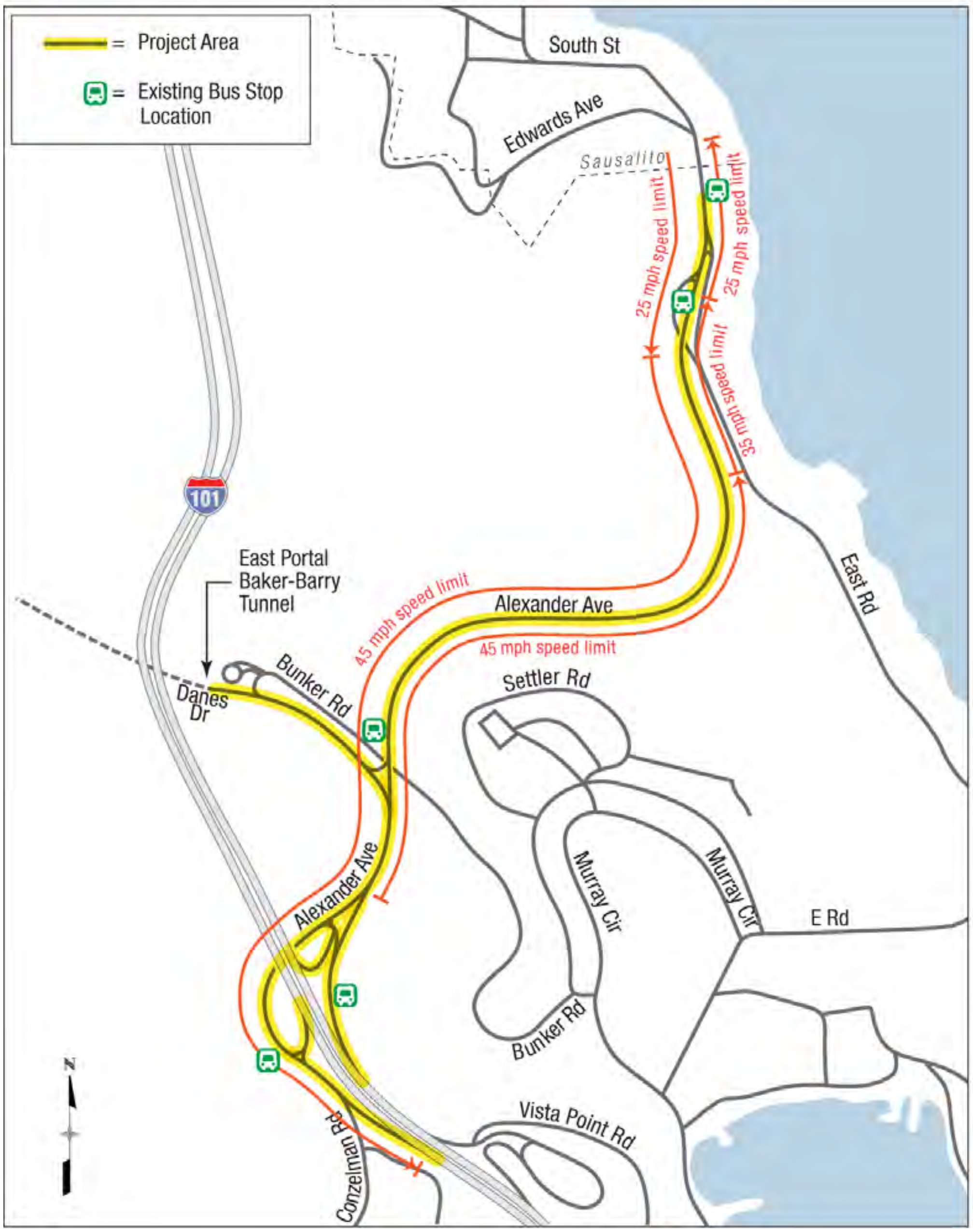
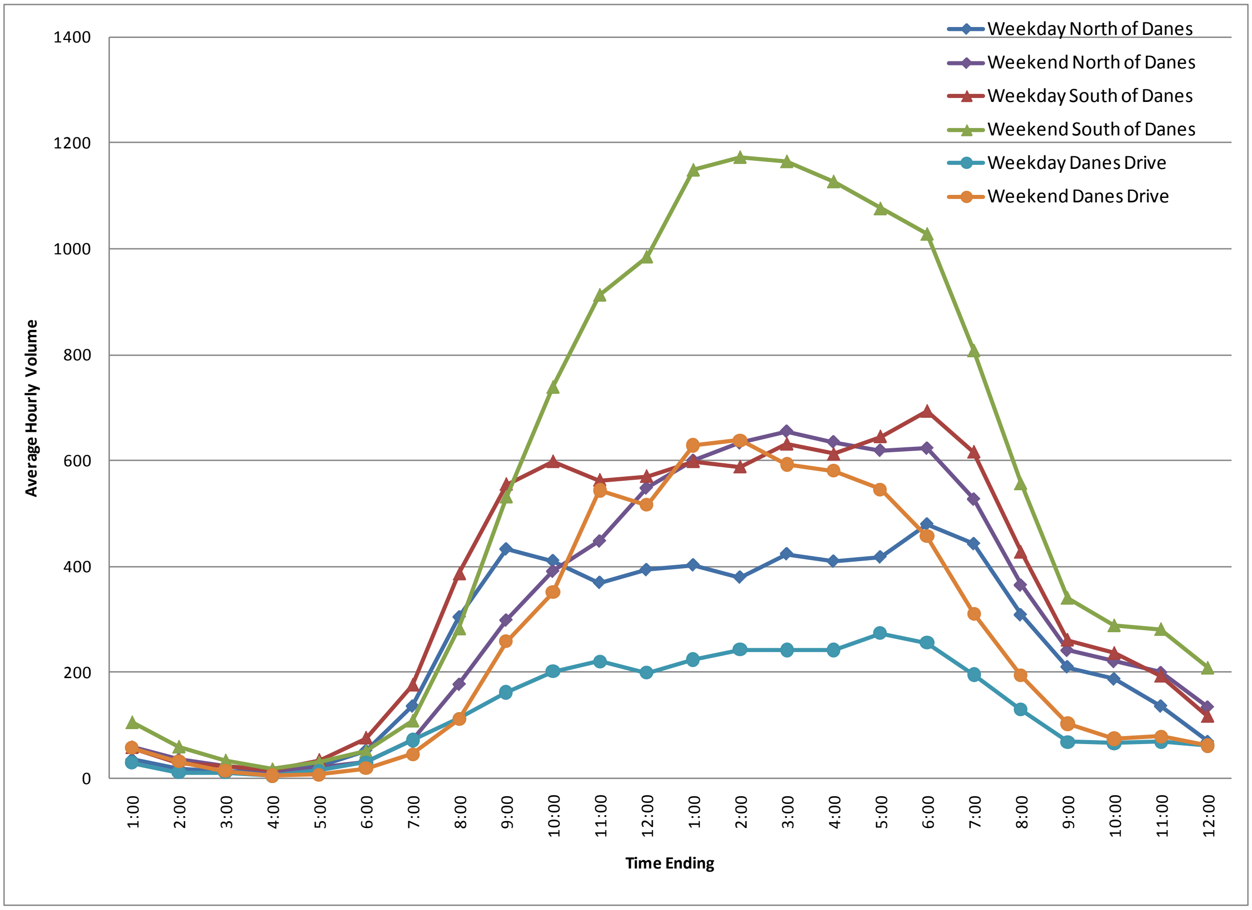
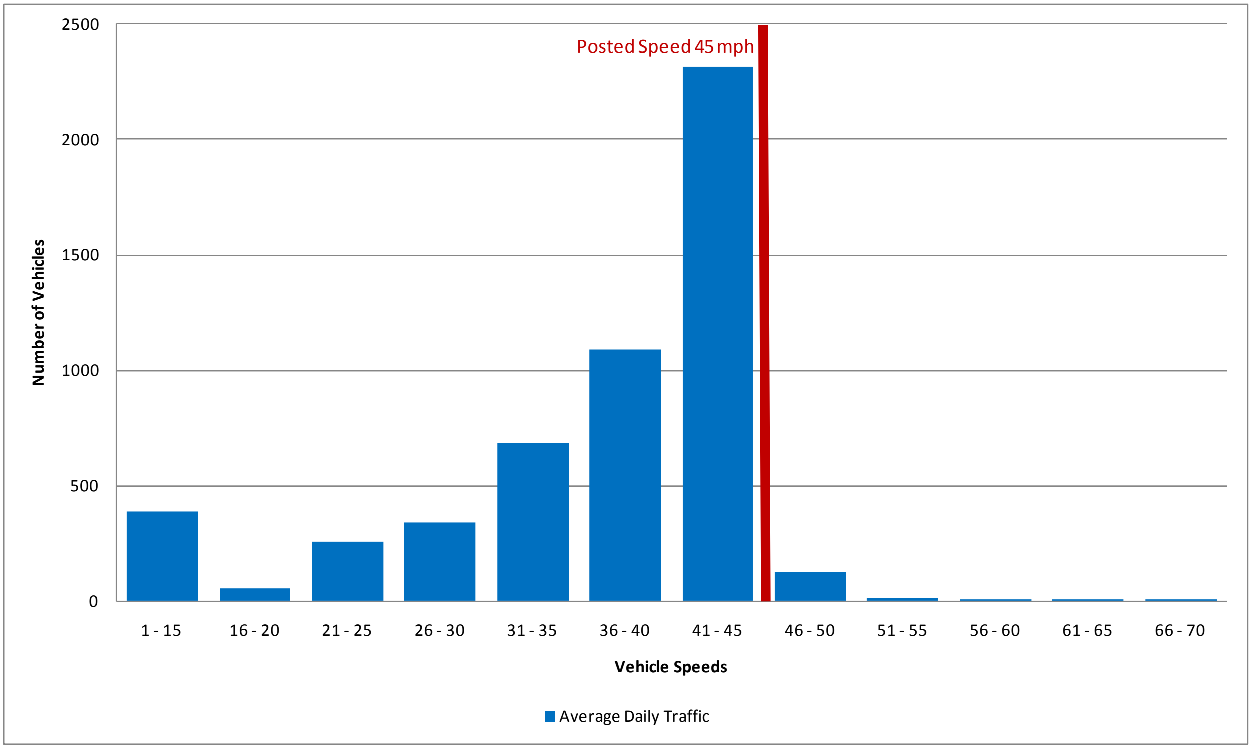


Figure 3
Study Area Average Hourly Traffic Volumes (October 14 to 20, 2009)



A speed survey was conducted on Alexander Avenue with the data collected in October 2009 halfway between the US 101 northbound off-ramp and Danes Drive (approximately 350 feet north of the stop sign on northbound Alexander Avenue) to determine typical traffic speeds along the corridor. The public and stakeholders expressed concern regarding high speeds of traffic traveling northbound from the US 101 ramp. Figure 4 shows the traffic speeds of northbound traffic, where the posted speed limit is 45 mph. As shown on the figure, the majority of traffic (97 percent) travels at or below the posted speed limit at this location. Data for this study were collected in 5 mph bins, so the 85th percentile speed falls between 41 and 45 mph. A speed study of southbound traffic at this location showed similar speeds, with 97 percent of traffic also traveling at or below the posted speed limit.

Figure 4
Northbound Alexander Avenue Speed Distribution

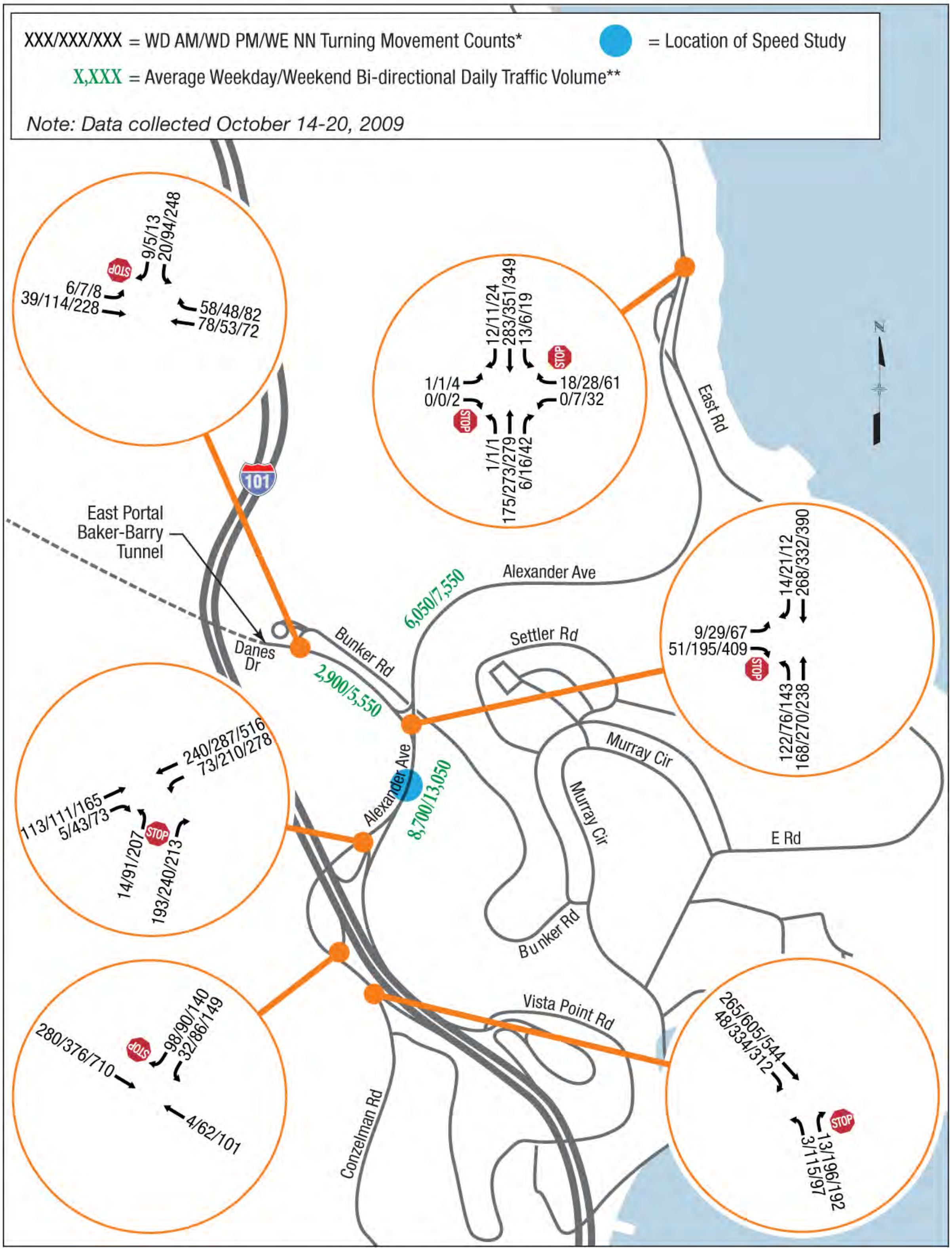


TMCs were collected during the weekday morning and evening peak periods as well as during the peak weekend afternoon period. TMCs were collected at the following locations:

- Alexander Avenue and Conzelman Road
- Alexander Avenue and the northbound US 101 ramps
- Alexander Avenue and the southbound US 101 ramps
- Alexander Avenue and Danes Drive
- Alexander Avenue and East Road
- Danes Drive and Bunker Road

All of the weekday counts were conducted during the morning peak period between 8:00 a.m. and 9:30 a.m., and during the evening peak period from 4:30 p.m. to 6:30 p.m. of a typical weekday (Thursday, October 15, 2009). The weekend counts were performed on a Saturday between 3:00 p.m. and 5:00 p.m. (October 17, 2009). When the TMCs were collected, the weather was slightly overcast during the weekday counts and sunny during the weekend counts. Figure 5 shows the existing TMCs used to complete the existing conditions analysis.

Figure 5
Existing 2009 Vehicle Volumes and Intersection Control



When the study was initially scoped, queues westbound at the Baker-Barry Tunnel were noted as a common traffic problem; therefore, vehicle queue counts were collected for 2 hours during a typical peak weekend traffic condition on a Sunday between 10:45 a.m. and 12:45 p.m. The counts identified queues that varied from 3 to 12 cars westbound at the signalized approach to the tunnel. Queues were also counted at the northbound left turn from Alexander Avenue onto Danes Drive. These queues were typically noted to be two to four vehicles long, with seven as the longest recorded vehicle queue.

Classification counts were collected on Alexander Avenue north of Danes Drive in October 2009, which identified that approximately 1 percent motorcycles, 1 percent buses, 97 percent cars and two-axle vehicles, and less than 1 percent heavy vehicles (three axles or more) typically drive on Alexander Avenue north of Danes Drive. On Danes Drive, 1 percent motorcycles, 98 percent cars and two-axle vehicles, and less than 1 percent buses and heavy vehicles make up the traffic composition.

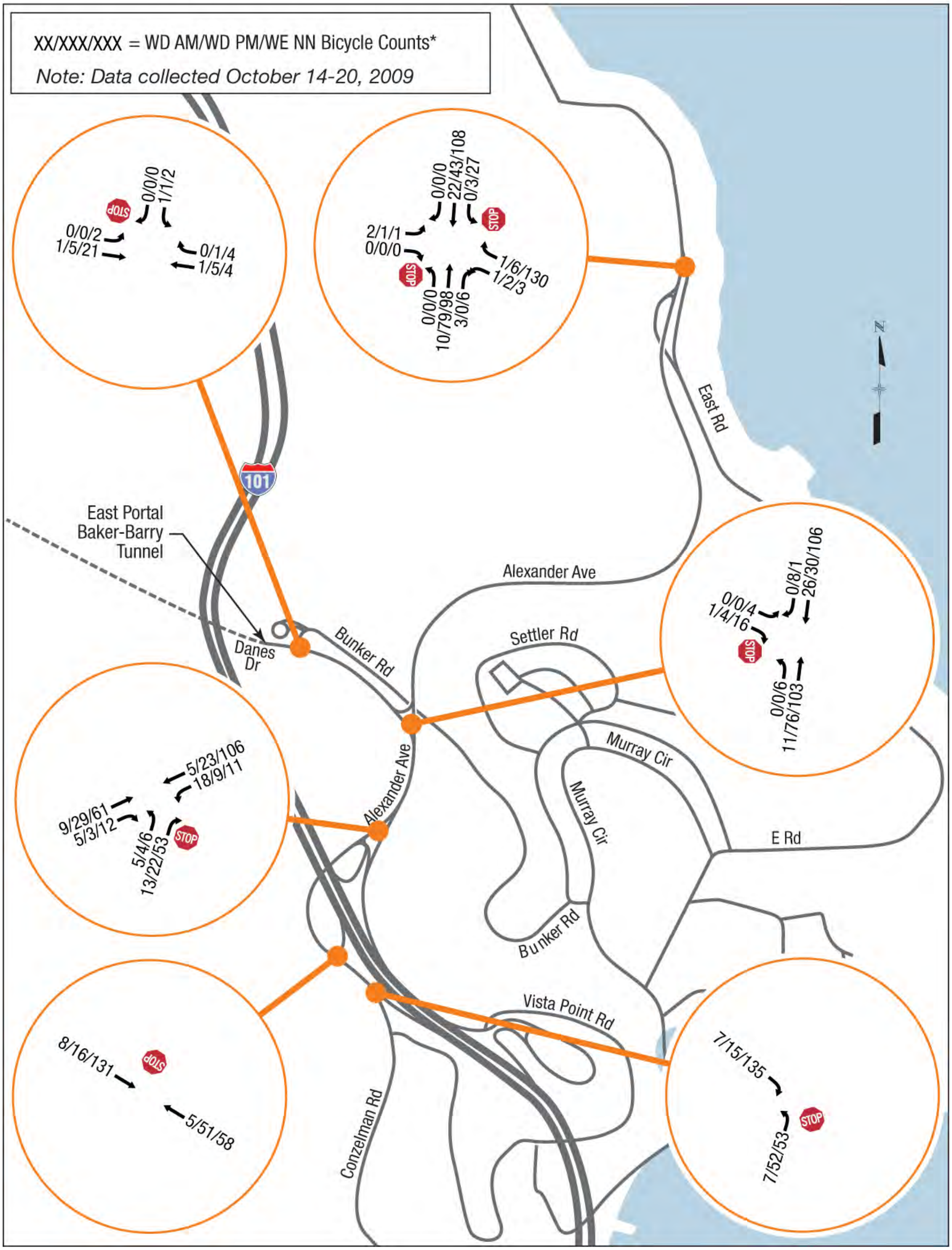
3.1.3 Bicycle and Pedestrian Volumes

The Alexander Avenue corridor is an important facility for commuter and recreational bicycle traffic. In addition, pedestrians often use the shoulder of the road to travel along Alexander Avenue. Bicycle and pedestrian counts were collected at the study area intersections during weekday morning and evening peak vehicle traffic periods and during the peak vehicular weekend afternoon traffic periods. The bicycle count information is shown in Figure 6. The counts were collected at the same time as the vehicle counts between October 14 and 20, 2009. Bicycle classification counts were not collected as part of the data collection for this study; however, data collected by FHWA-CFLHD staff on a weekend in May 2008 was obtained to compare types of bicyclists. The bicyclists were categorized as “commuter/training,” “recreational/non-training,” and “rental” based on the type of bicycle. Commuter/training bicyclists are experienced, travel at higher speeds, are more likely to be comfortable mixing with vehicle traffic, and generally will not use bicycle facilities unless they are very convenient. Recreational/non-training bicyclists are less experienced, prefer routes along lower volumes and lower speeds, and are not very comfortable mixing with higher speed vehicles. The data were collected on a Saturday and Sunday at the following locations:

- Alexander Avenue and northbound US 101 ramp
- Alexander Avenue and Danes Drive
- Danes Drive and Bunker Road

The data collected shows that during the peak hour, there are approximately 250 bicycles at the northbound US 101 ramp and Alexander Avenue. The Sunday bicycle volumes show there was a breakout of 83 percent commuter/training bicycles, 10 percent recreational/non-training bicycles, and 7 percent rental bicycles. On a Saturday at Alexander Avenue and Danes Drive, there were a total of 490 bicycles during the peak hour, and an average of 68 percent commuter/training bicycles, 11 percent recreational/non-training bicycles, and 21 percent rental bicycles. This breakout of types of bicycles is expected to be significantly different on weekdays compared to weekends. A site visit was conducted in June 2010 on a weekday, and it was noted that a majority of the bicycle types were rental bicycles or recreational/non-training bicycles. During the field visit (approximately 3:00 p.m.) there were much fewer commuter/training bicyclists on the corridor and very few pedestrians on the corridor.

Figure 6
Existing 2009 Bicycle Volumes



At all of the intersections, with the exception of the weekend peak hours at Alexander Avenue and East Road, the pedestrian volumes were minimal when the counts were collected (typically 0 to 10 pedestrians per hour). At Alexander Avenue and East Road, there were at most 28 pedestrians per hour on a Saturday. This may have been due to a couple factors. Some pedestrians may not cross the road at intersections (i.e., they may only walk along the shoulder or cross Alexander Avenue near a bus stop instead of at an actual intersection) or pedestrians may be more likely to travel along the corridor outside of the times of day counted. Pedestrian counts, therefore, may inaccurately identify the actual pedestrian volumes. In addition, October is not considered the peak season for recreational traffic; therefore, at other times of year pedestrian volumes may be higher. The counts do not show high volumes of pedestrians at any of the intersections during the weekday peak hours.

Despite minimal pedestrian counts during the counting time period, accommodations should be made with future improvements at intersections and transit stop locations for pedestrian use.

Accommodating multiple modes of transportation is a key element of this project. Vehicle volumes were compared to bicycle volumes along the corridor when peak hour counts were conducted. During the morning weekday peak period, the percentage of bicycles compared to total traffic (bicycles plus vehicles) is 5 to 7 percent along the corridor. During the evening peak period, the percentage of bicycles ranges from 8 percent on the south end of the corridor to 16 percent near Sausalito. On weekends, the percentage of bicycles ranges from 16 percent on the south end of the corridor to 33 percent near Sausalito.

Additional data was provided by GGBHTD for bicycles and pedestrian counts from both a weekday (Thursday, September 30, 2010) and a weekend (Saturday, October 2, 2010) between 7:00 a.m. and 6:00 p.m. The data were collected along Alexander Avenue north of Danes Drive and are summarized in Table 1. The table shows that there are significantly higher volumes of both pedestrians and bicycles on the weekend day when data was collected compared to the weekday. The highest hourly volume of bicycle traffic was 314 vehicles per hour during the Saturday the counts were collected. The GGBHTD counts are consistent with the data collected by Atkins and FHWA showing that non-motorized transportation use is high on the corridor, especially on weekend days.

Table 1
Summary of GGBHTD Data

GGBHTD Summary	Weekday	Weekend
Total Pedestrians (7:00am - 6:00pm)	50	305
Total Bicyclists (7:00am - 6:00pm)	1222	2221

3.1.4 Collision Data

According to the collision history along the Alexander Avenue corridor, there were a total of 28 reported and documented collisions between 1999 and 2009, which is an average of fewer than three collisions per year on the mile-long segment of roadway. There were no fatalities within the time period. Information was not provided on collision causes, roadway conditions, types of vehicles involved, or whether bicyclists or pedestrians were involved in any of the collisions.

The data were provided by GGBHTD, and it is not known if it includes all agencies that report collisions on the corridor (such as, the Sausalito police and California Highway Patrol).

3.1.5 Operating Conditions

The peak hour during the weekday morning (8:00am—9:30am) and evening peak (4:30pm—6:30pm) periods and weekend peak (Saturday 3:00pm—5:00pm) traffic scenarios were modeled to determine the intersection and arterial operating conditions in the study area. SYNCHRO modeling software was used to analyze the intersection and arterial levels of service (LOS) using the 2000 *Highway Capacity Manual* (HCM) [3] methodology. The model includes the six intersections where TMCs were collected, the Baker-Barry Tunnel, and the US 101 on- and off-ramps. The models were calibrated using travel time studies that were performed along the Alexander Avenue corridor during each of the time periods modeled.

Traffic volumes on US 101 were obtained from GGBHTD for the same week that counts were collected along Alexander Avenue. The automated traffic counters for northbound US 101 were not providing accurate data; therefore, only southbound US 101 volumes were used for this study. The directional factors were obtained from the "Peak Hour Volume Data Report" [4] found on the Caltrans website. The directional split was determined to be approximately 34/64 northbound/southbound during the morning peak and 61/39 northbound/southbound during the afternoon and evening peak periods. The directional factors were applied to the southbound traffic volumes to calculate the northbound peak hour traffic.

The signal timing for the Baker-Barry Tunnel was obtained from NPS and was incorporated into the SYNCHRO model.

Intersection Level of Service

Traffic operations for each of the study area intersections were analyzed using the methods described in the 2000 HCM for un-signalized intersections and were reported from the SYNCHRO model output. According to the 2000 HCM, the overall performance of an intersection is determined based on the level of control delay experienced by motorists at the intersection. Depending on the level of delay that is experienced, each intersection can be scored on an LOS scale and given a letter grade from "A" to "F," with LOS A being the best possible grade for the intersection. For two-way stop controlled (TWSC) intersections, each minor approach is given a separate LOS and the worst LOS is reported as a single rating for the intersection. Table 2 shows the criteria for establishing the LOS for TWSC intersections in the study area.

Table 2
Un-signalized Intersection Level of Service Criteria

LOS	Control Delay per Vehicle (sec/veh)
A	0-10
B	>10-15
C	>15-25
D	>25-35
E	>35-50
F	>50

Table 3 shows the results of the existing conditions LOS analysis along with the average vehicle delay for the worst leg approach of the intersection, which is how LOS is reported for un-signalized intersections. Under existing conditions, all of the study area intersections operate at an overall LOS B or better during the weekday peak hours with the exception of the northbound US 101 off-ramp, which operates at LOS C during the evening peak. During the weekend peak hour, the northbound left turn at Conzelman Road to Alexander Avenue operates at a LOS E and the northbound left turn onto Alexander Avenue from the northbound US 101 ramp operates at a LOS F. Due to the high traffic volumes on Alexander Avenue, there are few gaps provided for vehicles making a left turn onto the road from the approach streets.

Table 3
Existing Project Area Intersection Level of Service

Arterial	Intersecting Road	WD AM Peak Hour		WD PM Peak Hour		WE Peak Hour	
		Overall Delay (sec/veh)	Overall LOS	Overall Delay (sec/veh)	Overall LOS	Overall Delay (sec/veh)	Overall LOS
Alexander Avenue	Conzelman Road	10.1	A	12.9	B	35.8	E
Alexander Avenue	SB US 101 off-ramp	9.1	A	10.6	B	16.5	C
Alexander Avenue	NB US 101 ramp	11.9	B	21.9	C	227.4	F
Alexander Avenue	Danes Drive (north leg)	11.7	B	14.0	B	15.3	C
	Danes Drive (south leg)	10.0	B	11.9	B	19.7	C
Alexander Avenue	East Road (west leg)	11.8	B	13.8	B	13.4	B
	East Road (east leg)	9.3	A	11.2	B	13.1	B
Danes Drive	Bunker Road	9.3	A	10.3	B	15.0	C

WD AM = weekday morning
WD PM = weekday evening
WE = weekend

Arterial Level of Service

Arterial LOS is another measure used to determine corridor traffic conditions, and is based on the average travel speed experienced along a segment of the corridor. Based on the characteristics of the roadway, including spacing between signals, free-flow speeds, overall roadway geometry, and using the definitions provided in the 2000 HCM, Alexander Avenue was classified as a Class II Urban Highway in the project area. Table 4 shows the speed criteria for establishing arterial LOS.

Table 4
Arterial Segment Level of Service Criteria

LOS	Class II Urban Highway
	Travel Speed (mph)
A	>35
B	>28-35
C	>22-28
D	>17-22
E	>13-17
F	≤ 13

Travel speeds were determined by simulating all of the peak hour traffic flow using the traffic simulation software SimTraffic. The model was calibrated using travel time studies performed along Alexander Avenue during all of the peak time periods. The analysis was repeated for three unique modeling traffic seed numbers and to determine average travel speeds for the corridor. The existing mainline LOS and average speed (mph) on the mainline during the peak periods is presented in Table 5. Within the project limits, Alexander Avenue currently operates at a LOS A in both directions with free-flow speeds averaging 35 to 39 mph. Vehicles on Alexander Avenue do not stop or experience significant delay at the un-signalized locations, with the exception of northbound Alexander Avenue at the northbound US 101 merge.

Table 5
Existing Alexander Avenue Speeds and LOS

Direction	Link	WD AM Peak Hour		WD PM Peak Hour		WE Peak Hour	
		Average Speed (mph)	**LOS**	**Average Speed** (mph)	**LOS**	**Average Speed** (mph)	**LOS**
Northbound	Conzelman Road to East Road	35.5	A	36.4	A	34.3	B
Southbound	East Road to Conzelman Road	42.6	A	40.6	A	38.8	A

WD AM = weekday morning
WD PM = weekday evening
WE = weekend

3.1.6 Traffic Volume Comparison

In 2002, an intersection study at Alexander Avenue and Danes Drive was performed to analyze intersection configuration improvements. Data from this study were used for the development of this report. The study collected peak hour traffic counts at the intersections of Danes Drive and Alexander Avenue and at Danes Drive and Bunker Road. Daily counts were collected on Danes Drive and on Alexander Avenue both north and south of Danes Drive. The daily traffic volumes from September 2002 were compared to the traffic counts collected in October 2009. Table 6 shows the traffic volume comparison. Many factors could represent the differences in traffic volumes shown, such as:

- Seasonal fluctuations in tourist and recreational use
- Weather during each specific time period counted
- Goblin Jamboree weekend that occurred October 17, 2009
- Redevelopment of Fort Baker
- Increased use of the US 101 Sausalito exit to the north of the US 101 Alexander Avenue exit to enter Sausalito

Table 6
Traffic Volume Comparison

Roadway Segment	Weekday Average Volume		Weekend Average Volume	
	2002	2009	2002	2009
Alexander Avenue north of Danes Drive	8,402	6,038	9,264	7,567
Alexander Avenue south of Danes Drive	9,129	8,682	9,802	13,052
Danes Drive west of Alexander Avenue	1,657	2,867	2,001	5,534

Note: 2002 volumes counted during September 2002.
2009 volumes counted during October 14–20, 2009. Goblin Jamboree occurred at Fort Baker on October 17, 2009.

A growth rate needs to be determined for the corridor to effectively model the future alternatives. Comparing 2002 to 2009 volumes will not be useful due to the fluctuations related to the new traffic patterns; therefore, additional studies that have been performed in the area were consulted to establish a similar growth rate for Alexander Avenue.

Freeway Performance Initiative memorandums for the Marin/Sonoma 101 Corridor by Dowling Associates [5] were consulted for growth factors along US 101 near the study area. Growth rates were projected from 2005 to 2030 during weekday peak periods and it was determined that traffic will increase by 0.998 percent annually during the morning peak hour and 0.95 percent annually during the evening peak hour on US 101.

The Marin Headlands EIS states that parklands traffic growth is expected to average a 0.7-percent increase per year through 2023 in southwestern Marin County.

Updated Weekend 2011 Turning Movement Counts

To address stakeholder concerns that traffic volumes were higher the weekend of the original counts in October 2009 due to the Goblin Jamboree, updated traffic counts were collected at one intersection: Danes Drive and Alexander Avenue. The counts were performed during the same time period on a Saturday between 3:00 p.m. and 5:00 p.m., the same as when data were collected in October 2009. The data collection occurred on October 22, 2011, which was a sunny day. The overall volume of traffic entering the intersection during the peak hour was 5.7

percent lower in October 2011 than the October 2009 counts. This shows that even though the Goblin Jamboree was a special event, overall the traffic volumes changed only by 70 vehicles per hour on a non-event weekend day. It should be noted that the eastbound Danes Drive right-turn movement was significantly lower for the counts collected in 2011 (212 vehicles fewer per hour), which may be attributed to higher volumes of traffic exiting the Museum for the Goblin Jamboree in 2009. However, many of the other movements approaching the intersection were significantly higher in 2011 than in 2009.

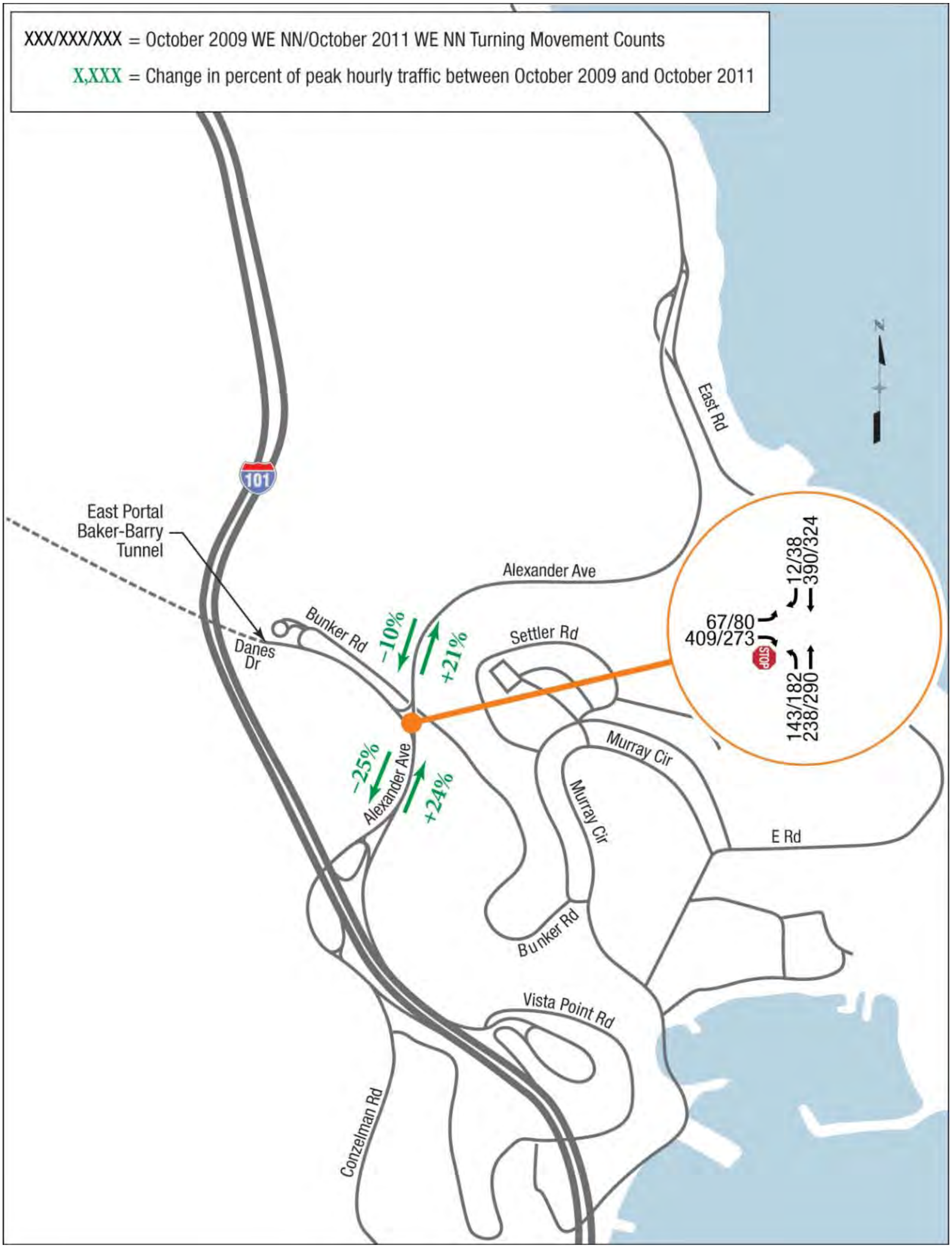
Figure 7 shows a comparison of the turning movements between 2009 and 2011 at Alexander Avenue and Danes Drive, as well as the change in the percentage of traffic on the approaches to the intersection. The southbound volumes approaching Danes Drive decreased by 10 percent between 2009 and 2011, and decreased by 25 percent south of Danes Drive. The volumes in the northbound direction increased by 24 percent approaching Danes Drive, and increased by 21 percent north of Danes Drive. The updated traffic counts were only collected at one intersection to determine whether the volumes were significantly different on the corridor, and a variance of 5.7 percent has minimal impacts to the LOS and delay at the intersection. Analyzing this intersection with the updated 2011 volumes results in a reduction of 5 seconds of delay for the right-turn movement from Danes Drive onto Alexander Avenue compared to the 2009 counts, as shown in Table 7. The left-turn movement from Danes Drive onto Alexander Avenue has a slightly higher delay (less than one second) due to higher turning volumes and higher northbound though traffic volumes.

Table 7
Traffic Volumes Comparison for October 2009 and October 2011

Movement at Alexander Avenue	October 2009 Weekend		October 2011 Weekend	
	Delay	LOS	Delay	LOS
Danes Drive eastbound right	19.7	C	13.5	B
Danes Drive eastbound left	15.3	C	15.7	C

The data collected at Alexander Avenue and Danes Drive was applied to the intersection of Alexander Avenue and the northbound US 101 ramp to perform a similar comparison of 2009 and 2011 volumes. If the southbound volumes are assumed to be 25 percent lower than 2009 and the northbound volumes are 24 percent higher than 2009, per the information shown in Figure 7, this would still result in a failing LOS at the northbound US 101 off-ramp location. As noted previously, the overall reduction in traffic between 2009 and 2011 does not significantly change the operational assessment of the corridor.

Figure 7
Turning Movement Count Comparison



3.2 EXISTING GEOMETRIC AND STRUCTURAL CONDITIONS

3.2.1 Roadway Design Criteria Comparison

Alexander Avenue is classified as a principal arterial. This classification can be used to determine design standards and guidelines to evaluate the roadway. Due to the multi-jurisdictional authority of the study area, several design standards and guidelines are available for use in the strategy development. These include AASHTO, Caltrans, and NPS design manuals. During the stakeholders meetings and due to the GGBHTD legal aspects, it was decided that AASHTO design standards would be the preferred design method for all roadway improvement options. Design options which included improvements to the US 101 ramps were designed per Caltrans Highway Design Manual [6]. Table 8 compares each of the available design standards and guidelines. Design exceptions to these elements must be well documented and approved by the owner agency.

Table 8
Thirteen Controlling Design Elements

Element Description	Existing	AASHTO	Caltrans	NPS
Design Speed	35 mph - 40 mph	40 mph - 45 mph	40 mph - 45 mph	40 mph - 45 mph
Lane Width	12 ft	12 ft	12 ft	12 ft
Shoulder Width	Varies (2 ft -5 ft)	5 ft (min.)	5 ft (min.)	8 ft
Bridge Width	24 ft	24 ft	24 ft	-
Structural Capacity	HS-20	HL-93	P-13	HS-15
Horizontal Alignment				
Curve Radius	295 ft - 689 ft	381 ft (min.)	550 ft (min.)	400 ft (min.)
Vertical Alignment				
K-value (Crest)	49.1 - 55.2	44 - 61	-	60-80
K-value (Sag)	44.2 - 66.4	64 - 79	-	60-70
Grade	0.30 % - 6.10%	7%-8% (max.)	7% (max.)	8%-9% (max.)
Stopping Sight Distance	119 ft - 345 ft	305 ft - 360 ft	305 ft - 360 ft	275 ft - 325 ft
Cross Slope	Varies (1.67% - 4%)	1.5%-3%	2%	1%-3%
Superelevation	Varies (4% - 12%)	11%-12% (max.)	6% (max.)	12% (max)
Vertical Clearance	Varies (14.3 ft - 21.3 ft)	14 ft	15 ft	14 ft
Horizontal Clearance	Varies (3 ft - 7 ft)	Varies (1.5 ft - 3 ft)	Varies (4 ft - 10 ft)	-

3.2.2 Design/Posted Speed

Posted speeds vary traveling northbound on Alexander Avenue. At the southern end of the corridor, posted speeds are 45 mph. North of the Danes Drive/Alexander Avenue intersection, the posted speed lowers to 35 mph. Approaching the East Road/Alexander Avenue intersection and the Sausalito city limits, the posted speed drops to 25 mph. Motorists traveling the corridor are subject to three speed limit adjustments within a short distance.

For southbound traffic leaving Sausalito city limits, the posted speed limit is 25 mph. The posted speed increases to 45 mph beginning just south of East Road.

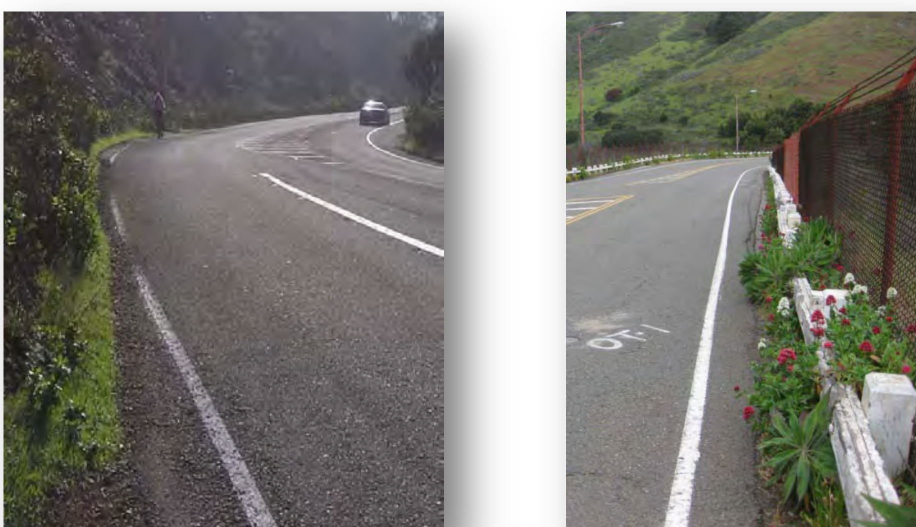
3.2.3 Existing Travel Lane

Alexander Avenue is a two-lane corridor with short left-turn lanes at the Danes Drive intersection and the northbound US 101 off-ramp intersection. Each lane measures 12 feet wide with varying shoulder widths on either end. The American Association of State Highway and Transportation Officials (AASHTO) recommends a lane width of 12 feet for urban arterials that operate at free-flowing conditions. The existing travel way width is considered adequate by current design standards.

3.2.4 Existing Shoulder

The conditions and widths of existing shoulders on Alexander Avenue vary throughout the corridor. Segments of the corridor have 4- or 5-foot shoulders on either side. In multiple locations, the shoulder has degraded to a point that pedestrians and cyclists are required to enter the travel way to continue along the corridor. Rock material from the side slopes, loose gravel, narrow widths, and cracked pavement have also made it difficult for users to travel in the shoulder. Figure 8 shows the degraded and narrow shoulder. The AASHTO *Guide for the Development of Bicycle Facilities* [7] standards require that at least 5 feet of mixed-use shoulder be provided if a separate lane cannot be dedicated to the cyclist, while Caltrans *Highway Design Manual* standards require at least 4 feet of mixed-use shoulder if no gutter is present. If curb and gutter are installed, the shoulder needs to be 3 feet wide and a gutter needs to be 2 feet wide. The shoulders also act as a facility for pedestrians to enter the Sausalito city limits from Vista Point and other transit locations.

Figure 8
Existing Shoulder Condition



3.2.5 Horizontal Alignment

The horizontal alignment is a number of interrelated design elements that ensure a comfortable and safe ride for its users. Alexander Avenue has several horizontal curves that are controlled by design elements such as speed, cross slope, and superelevation. The analysis was conducted with the use of existing survey and topography information. In past documentation, the functional classification of Alexander Avenue was an urban arterial. The characteristics of Alexander Avenue gathered from the existing conditions information confirm that the functional classification is an urban arterial road. The following subsections describe the controlling features that have been used to determine the existing horizontal alignment elements. The horizontal curve numbers along the alignment are shown on Figure 9.

Cross Slope

The purpose of a cross slope is to provide a mechanism to direct water off of the traveled way. An accumulation of water can lead to hydroplaning or other problems, increasing the likelihood of an accident. Typically, a peak point (or normal crown) is established in the center of the roadway for which the paved width on either side is sloped equally. There is no consistent cross slope or normal crown throughout the corridor, as most of the alignment is made of superelevated horizontal curves and short tangents that do not provide sufficient length to transition from full superelevation to a normal crown at the current AASHTO standards for runoff between horizontal curves. The AASHTO *A Policy on Geometric Design of Highways and Streets (Green Book)* [8] recommends cross slopes between 1.5 percent and 2 percent.

Superelevation

Superelevation is a portion of roadway that rises in vertical feet over a certain horizontal distance. This banking effect of the roadway is used to offset the centripetal forces (a force that keeps a body moving with a uniform speed along a circular path and is directed along the radius towards the center) developed as a vehicles maneuver around a curve. Varying superelevation rates can be seen throughout the corridor. Several curves have a superelevation rate of between 10 percent and some exceed 12 percent. Table 9 shows the superelevation rates at each horizontal curve based on a “best-fit” radius of the centerline.

Table 9
Existing Horizontal Geometry

Horizontal Curve Number	Radius (ft)	Superelevation Rate, e_{max} (%)	Posted Speed (mph)	Calculated Speed (mph)
1	492	10	35	40
2	295	10	35	35
3	509	10	45	40
4	574	11	45	40
5	499	>12	35	**40**
6	492	12	35	**40**
7	689	9	25	40

Note: Bolded values represent a design deficiency

Based on Exhibit 3-34, Limiting Superelevation Rates from the AASHTO *Green Book,* it is recommended that a limiting superelevation rate of 11 and 12 percent is used for design speeds of 40 and 45 mph, respectively. The limiting superelevation threshold is exceeded for horizontal curve numbers 5 and 6.

The tangent-to-curve transition, or superelevation runoff, is an important element when superelevated curves are used. Table 10 shows the runoff length between each horizontal curve throughout the corridor. As shown in the table, the corridor, except for curve number 7, does not provide sufficient superelevation runoff length. The measured superelevation runoff length is the distance measured between each horizontal curve; at least double the value would be necessary to end one superelevated curve and begin another. The proportion of runoff length placed on the tangent was assumed to be 0.8.

Table 10
Superelevation Runoff

Horizontal Curve Number	Posted Speed (mph)	Superelevation Rate, e_{max} (%)	Superelevation Runoff (per AASHTO)(ft)[a]	Superelevation Runoff (Measured)(ft)
1	35	10	194	**201**
2	35	10	222	**116**
3	45	10	222	**238**
4	45	11	244	**366**
5	35	>12	267	**458**
6	35	12	232	**392**
7	25	9	151	318

Note: Bolded values represent a design deficiency
[a] *A single lane rotated*

Figure 9
Horizontal Curves

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Horizontal Sight Distances

Horizontal sight distance is a safety measure that identifies a minimum horizontal radius required to avoid obstructions such as retaining wall, cut slopes, bridge piers, or abutments from the motorist's line of sight around a curve. The horizontal sight distances on the curves are limited due to the poor visibility from obstructions within the corridor. Steep cut slopes and tight radii have minimized the motorist's line of sight around several curves. Table 11 shows which horizontal curves do not provide adequate sight distances for motorists traveling the corridor.

Table 11
Horizontal Stopping Sight Distance (SSD)

Horizontal Curve Number	Posted Speed (mph)	Radius (ft)	Required SSD	Calculated SSD
2	35	295	250	**119**
3	45	509	360	**256**
4	45	574	360	**225**
5	35	499	250	**219**

Note: Bolded values represent a design deficiency

Horizontal curve number 2 has limited visibility as motorists exit the southbound US 101 off-ramp and continue northbound on Alexander Avenue. Vehicles entering the undercrossing are limited by the angle and length of the radius of the undercrossing. The narrow structure width and lack of shoulders contribute to the deficiency of this movement for motorists, bicyclists, and pedestrians.

Heading southbound around horizontal curve number 3 the rock slope makes it difficult to see pedestrians or bicyclists traveling in the shoulder.

Traveling northbound around horizontal curve number 4, the motorist's line of sight is blocked by large trees. The entrance grade into this horizontal curve is one of the steepest throughout the entire corridor.

Horizontal curve number 5 is a similar condition to curve number 3 as motorists travel southbound around this curve. The rock slope makes it difficult to see pedestrians or cyclists traveling in the shoulder.

Clear Zones

Clear zone is the total area, starting at the edge of the travel way, available for safe use by errant vehicles. This area may consist of the shoulder and a recoverable or non-recoverable slope. The AASHTO *Roadside Design Guide* [9] states that clear zone limits required on a roadway designed between 45 to 50 mph should have 20 to 28 feet of clear zone on foreslopes ranging between 1V:6H to 1V:4H. Clear zone limits on backslopes require 14 to 22 feet ranging between 1V:3H to 1V:6H. Areas of Alexander Avenue with posted speeds of 45 mph have up to 14 feet of clear zone space to the backslope. The measured clear zone is deficient by current design requirements.

The clear zone limits required on a roadway designed at 40 mph or less is 14 to 18 feet on foreslopes ranging between 1V:6H to 1V:4H. Clear zone limits on backslopes are 14 to 16 feet ranging between 1V:3H to 1V:6H. Areas of Alexander Avenue with posted speeds of 35 mph have 14 to 16 feet of clear zone on foreslopes and 10 to 12 feet on backslopes. The clear zone threshold required is met for foreslopes and deficient on backslopes.

A number of obstacles, including light poles, fencing, and embankment material are located within the clear zone in areas along the corridor. Light poles, fencing, and foreslopes that have encroached in the clear zone are generally protected by timber guardrail, which serves as a barrier between the motorists and obstruction. Backslopes that encroach into the clear zone are typically not protected by barrier because they offer some redirection capability.

Ramps

The existing Alexander Avenue/US 101 interchange is a modified L-7 configuration with tight hook on/off-ramps operated and maintained by Caltrans. The Caltrans *Highway Design Manual* criteria will be used to evaluate the existing conditions of the interchange on- and off-ramps. The existing ramp geometry is shown in Figure 10.

Figure 10
Existing Ramp Geometry

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On-Ramps

Both the northbound and southbound US 101 on-ramps carry traffic from Alexander Avenue to US 101. The northbound on-ramp configuration consists of a hook ramp and a redirect taper, with virtually no acceleration length, that feeds directly into northbound US 101. The southbound on-ramp is a tangent redirect taper that funnels traffic southbound towards the Golden Gate Bridge.

Caltrans requirements for a single-lane freeway entrance state that taper rates of 50:1 for convergence with through traffic while maintaining a minimum of 12-foot lanes and 8-foot shoulders shall be used. Table 12 compares Caltrans requirements for a single-lane freeway entrance against existing on-ramp conditions.

Table 12
US 101 On-Ramp Geometry

	Acceleration Length (ft)	**Taper Rate**	**Maximum Profile Grade** (%)	**Lane Width** (ft)	**Shoulder Width** (ft)
Design requirements	1067 (min.)	50:1	8 6 (loop ramp)	12	8
NB on-ramp (loop ramp)	**426**	**30:1 – 19:1**	**14**	14-22	**4-8**
SB on-ramp	**663**	**46:1**	6	12	10

Note: Bolded values represent a design deficiency

Acceleration length for the northbound on-ramp loop configuration is insufficient to provide motorists a safe transition into the through movements of northbound US 101. The on-ramp consists of radii that measures 31 and 44 feet. Caltrans recommends that radii for loop ramps range between 150 and 200 feet, while the ramp profiles should not exceed 6 percent. The profile grade ranges for the northbound US 101 on-ramp vary between 6 and 14 percent.

The southbound US 101 on-ramp geometry does not meet the requirements necessary per the Caltrans *Highway Design Manual*. Sufficient acceleration length is not provided for travelers to safely merge onto the ramp with the through lanes of US 101; however, adequate lane and shoulder widths are maintained through the transition.

Off-Ramps

Traffic using the off-ramps come from US 101, with the exception of the northbound off-ramp, which includes travelers coming from the Vista Point parking lot. A weaving section developed from the Vista Point on-ramp onto US 101 continues as the off-ramp lane to Alexander Avenue. The southbound US 101 off-ramp consists of a short redirect taper that feeds into a tight hook ramp. Table 13 compares Caltrans requirements for a single-lane freeway exit to the existing off-ramp conditions.

Table 13
US 101 Off-Ramp Geometry

	Deceleration Length (ft)	**Maximum Profile Grade** (%)	**Lane Width** (ft)	**Shoulder Width** (ft)
Design requirements	See Table 14	8 6 (loop ramp)	12	8
NB off-ramp	846	3	12	8
SB off-ramp (loop ramp)	**53**	6	12-60	8

Note: Bolded values represent a design deficiency

Because the northbound off-ramp is on a curve, criteria from Table 14 must be met for the minimum deceleration length before entering the curve for the exit ramp. The existing compound radius of over 900 feet for the off-ramp requires a minimum of 420 feet in deceleration length before entering the curve. Caltrans suggests that deceleration lengths should be extended if descending, short radius curves, or if sustained downgrade is apparent.

Table 14
Minimum Deceleration Length on Curves

Curve Radius (ft)	**Minimum Deceleration Length** (ft)
< 300	570
300 – 499	470
500 – 999	420
1,000 & over	270

Source: Figure 504.2B, Single Lane Freeway Exit [6]

Similarly, because the southbound US 101 off-ramp is on a curve, conditions from Table 14 must also be met. The existing exit curve radius for the hook ramp is 49 feet. A minimum of 570 feet deceleration length must be met before entering the curve. Currently, only 53 feet is provided before entering the curve. The ramp width begins as a 12-foot lane and widens to 60 feet, which accommodates a left- and right-turn lane with a stripped median at the Alexander Avenue/southbound US 101 off-ramp intersection.

For a single-lane freeway exit, Caltrans requires a minimum length of 525 feet between the exit nose and the end of the ramp for a full stop at the end of the ramp. The off-ramps at this interchange are stop controlled. The southbound US 101 ramp falls short of this requirement at 472 feet.

The existing weave lane before the northbound US 101 off-ramp allows motorists to maneuver from the northbound US 101 on-ramp at Vista Point onto the through lanes of US 101. The weave lane before the northbound US 101 off-ramp is approximately 575 feet, which falls short of the Caltrans requirement of a minimum weave length of 1500 feet.

3.2.6 Vertical Alignment

The vertical alignment is dictated by conditions such as the terrain, grade, and sight distance. These controlling elements will identify the conditions that exist on Alexander Avenue. The vertical alignment of Alexander Avenue is made up of several curves with steep grades, and the natural topography of Alexander Avenue is classified as rolling terrain. A vertical profile of the corridor is in Appendix C.

Grade

Grade is the tangent slopes to and from the vertical curve that the motorist is traversing. This tangent slope is a reference line by which the elevation of the pavement and other features of the roadway are established. Several vertical curves can be identified throughout the Alexander Avenue corridor. The vertical curves were laid out using CADD software and are shown in Table 15.

Table 15
Existing Vertical Geometry

Vertical Curve Number	**Vertical Curve Length** (ft)	**Grade** (%)	**Posted Speed** (mph)	**Interpolated Speed** (mph)
		2.05		
1	450		45	**40**
		-6.10		
2	385		45	**30**
		2.62		
3	425		35	40
		-6.03		
4	420		25	40
		0.30		

Note: Bolded values represent a design deficiency

The data from Table 15 provided sufficient information to interpolate speeds at each vertical curve. When measured against posted speeds, the difference was between 5 and 10 mph. At vertical curve location 1 and 2, the K-value is not adequate with existing geometry. The K-value is the ratio of the vertical curve length over the absolute value of the difference in entrance and exit grades ($|G_{ENTRANCE} - G_{EXIT}|$). This property defines the horizontal distance required to effect a change in the slope of the vertical curve. Table 16 compares the calculated K-values against the required values. The grades between each vertical curve are within the threshold of Exhibit 7-10, Maximum Grades for Urban Arterials, from the AASHTO *Green Book*. The maximum grades for design speeds of 30, 35, 40 and 45 mph is 7 to 9 percent.

Table 16
K-Value

Vertical Curve Number	Minimum K-Value (Design)	Minimum K-Value (Calculated)
1	61 (Crest)	**55.2** (Crest)
2	64 (Sag)	**44.2** (Sag)
3	29 (Crest)	49.1(Crest)
4	26 (Sag)	66.4 (Sag)

Note: Bolded values represent a design deficiency

Stopping Sight Distance

Stopping sight distance (SSD) is a safety feature that provides drivers with sufficient sight distance to safely sop their vehicle to avoid collisions with objects obstructing their forward motion. The SSD varies depending on whether the curve is a sag or crest. Table 17 compares the SSD between the interpolated speed and posted speed. The difference in speeds has a direct impact on SSD. At vertical curve 1 and 2 sufficient SSD is not available on the existing geometry.

Table 17
Stopping Sight Distance

Vertical Curve Number	Posted Speed SSD	Interpolated Design Speed SSD*
1	360	**345**
2	305	**231**
3	250	325
4	155	316

Note: Bolded values represent a design deficiency
** The interpolated design speed SSD is the SSD of the speeds interpolated from Table 15.*

3.2.7 Structures

Four structures are present on Alexander Avenue. These structures are connectors to US 101, Sausalito, and Fort Baker, and were constructed in the 1930s. US 101 is owned and maintained by Caltrans, while the Bunker and East Road tunnels are owned and maintained by GGBHTD. Caltrans Structure Maintenance and Investigations logs are included in Appendix D.

Alexander Avenue/US 101 Undercrossing

The Alexander Avenue/US 101 undercrossing, shown in Figure 11, was originally built in 1935, just before the completion of the Golden Gate Bridge, as a means of providing a grade separation between existing Sausalito Road and the US 101 highway realignment connecting the City and County of San Francisco and County of Marin. The structure was widened on the east side in 1954, and the west portal and associated parapets were modified in 1968. It is a three-sided, reinforced concrete box (tunnel) supported on spread footings. The structure is defined as an undercrossing, and its narrow opening (24 feet) is presently used by vehicle bicycle, and pedestrian traffic.

Figure 11
Alexander Avenue/US 101 Undercrossing

East side

West side

<u>Structure Geometrics</u>
The existing structure is a single-span bridge, 28 feet out to out, with a 24-foot clear span opening. Built along a curved alignment, the structure is approximately 122.7 feet long, as it passes under US 101. The existing vertical clearance is posted as 14 feet 4 inches. Caltrans design criteria recommends a minimum vertical clearance of 15 feet over local facilities.

Structural Design Loading and Ratings
The original construction, plus the east/west portal modifications and widening, were designed for the standard 36-ton truck loading. Information from Caltrans regarding structure sufficiency and load are unknown at this time.

Bunker Road Arch Tunnel

The Bunker Road Arch Tunnel, shown in Figure 12, connects Fort Baker to both Alexander Avenue and Danes Drive. The structure was constructed in 1938 and is a reinforced concrete arch (tunnel) supported on spread footings. The structure is defined as an undercrossing, and allows Bunker Road to cross under Alexander Avenue. The Caltrans off-system local agency bridge list shows this structure as “functionally obsolete.”

Figure 12
Bunker Road Arch Tunnel

Structure Geometrics
The existing arched tunnel structure is 28 feet 6 inches out to out, with a 24-foot clear span opening. Running north-south, the structure is approximately 39 feet long, as it passes under Alexander Avenue. The existing vertical clearance is approximately 21 feet 4 inches at the center of the arch, but only about 14 feet 3 inches at the edge of traffic way. Caltrans design criteria recommends a minimum vertical clearance of 15 feet over local facilities.

Structural Design Loading and Ratings
The original tunnel construction was designed for the standard 36-ton truck loading. Caltrans “Structures Maintenance & Investigations (Local Agency Bridges)” [10] lists the inventory load as 21.9 tons (19.9 metric tons), the operating load as 36.9 tons (33.5 metric tons), with a 67.8 FHWA/AASHTO bridge sufficiency rating.

East Road Arch Tunnel

The East Road Arch Tunnel (see Figure 13) connects Alexander Avenue to the East Road intersection. The structure, constructed in 1938, is a reinforced concrete T-beam (tunnel) supported on spread footings. The structure is defined as an undercrossing, and allows part of East Road to cross under Alexander Avenue.

Figure 13
East Road Arch Tunnel

Structure Geometrics

The existing structure is flat roof tunnel, 28 feet 6 inches out to out, with a 24-foot clear span opening. Running north-south, the structure is approximately 36 feet long, as it passes under Alexander Avenue.

Structural Design Loading and Ratings

The original tunnel construction was designed for the standard 36-ton truck loading. Caltrans Structures Maintenance & Investigations lists the inventory load as 25 tons (22.7 metric tons), the operating load as 34 tons (30.8 metric tons), with a 75.6 FHWA/AASHTO bridge sufficiency rating.

Sausalito Cantilever Structure

The Sausalito cantilever structure is located at the Sausalito city limits and is shown in Figure 14. It allows Alexander Avenue to maintain a consistent width of two lanes and a parking lane at its location. Utilities are attached to the underside of the cantilever area.

Figure 14
Sausalito Cantilever Structure

Guardrail

The existing guardrail system along the corridor is timber rail and W-beam. The physical condition of the timber rail suggests that the structural inadequacies would require a system upgrade throughout the corridor. Figure 15 shows the condition of the timber rail and W-beam.

Lighting

The existing lighting along Alexander Avenue consists of cobra-head style highway lighting and site-specific light poles and luminaires that match lighting on the Golden Gate Bridge.

Figure 15
Existing Guardrail

Timber rail

W-beam

3.3 EXISTING TRANSIT SERVICE NEAR ALEXANDER AVENUE, FORT BAKER, AND MARIN HEADLANDS

There are three main public transit service providers near Alexander Avenue Corridor, Fort Baker, and the Marin Headlands: Golden Gate Transit (GGT), Marin Transit Agency and SFMTA. Transit is provided by these agencies in the form of bus service and ferry service. The Fort Baker Shuttle and the Blue and Gold Ferry are two additional services, but are considered private or commercial operations. The Fort Baker Shuttle is only available to guests of Cavallo Point Lodge, while the Blue and Gold Sausalito Ferry is operated by a commercial company as a sightseeing tour and costs substantially more than the public transit alternative.

Table 18 provides a summary of current transit service routes operated in or near the study area.

Table 18
Existing Transit Service to Alexander Avenue, Fort Baker, and the Marin Headlands

Provider	Route Number	Route Description	Days of Operation	Hours of Operation (approximate)	Frequency (approximate)
Golden Gate Transit	10	Basic service between San Francisco and Marin City via Sausalito	Weekday	6:30 a.m.–7:30 p.m.	1 hour
			Weekend/ holiday	8:00 a.m.–6:00 p.m.	1 hour
Golden Gate Transit	Ferry service	Service between Sausalito Ferry Terminal and the Golden Gate San Francisco Ferry Terminal	Weekday	7:00 a.m.–8:00 p.m.	9 round trips a day
			Weekend/ holiday	10:30 a.m.–7:00 p.m.	6 round trips a day
Golden Gate Transit	2, 4, & 92	Commuter route service only between Marin City, Sausalito, and downtown San Francisco	Weekday only	Peak hour service only; Approximately 5:00–9:00 a.m. & 4:00–9:00 p.m.	30 minutes

Table 18
Existing Transit Service to Alexander Avenue, Fort Baker, and the Marin Headlands

Provider	Route Number	Route Description	Days of Operation	Hours of Operation (approximate)	Frequency (approximate)
Marin County Transit	22	Service between San Rafael and Sausalito	Weekday	5:30 a.m.–8:30 p.m.	30 minute to 1 hour (varies by time of day)
			Weekend/ holiday	7:00 a.m.–9:00 p.m.	1 hour
SFMTA	76	Service between Marin Headlands and downtown San Francisco	Sunday & holidays only	10:30 a.m.–6:30 p.m.	1 hour; 9 inbound and outbound trips
NPS/GGT/Marin County Transit Partnership	Muir Woods Shuttle	Service between Sausalito Ferry Terminal, Marin City, and Muir Woods; westbound includes stop at Pohono Street and eastbound includes stop at Manzanita Parking Lot	May through September only	9:30 a.m.–7:00 p.m.	20–30 minutes
FOBA shuttle service	Sausalito Ferry	Service for Cavallo Point Lodge guests to Sausalito Ferry	7 days a week	7:00 a.m.–7:30 p.m.	2 hours
FOBA shuttle service	Spencer Avenue/ Airporter stop	Service for Cavallo Point Lodge guests to Airporter shuttle stop	7 days a week	7:00 a.m.–7:30 p.m.	2 hours
Blue and Gold Fleet	Sausalito Ferry	Service between Pier 41 in San Francisco and Sausalito Ferry Terminal	7 days a week	10:00 a.m.–7:00 p.m.	3 round trips on weekdays; 5 round trips on weekends

3.4 EXISTING HYDROLOGY AND HYDRAULICS

Specific hydrologic and hydraulic components of the scope of this planning study will include developing the applicable criteria, identifying and evaluating the existing drainage facilities, documenting existing hydraulic conditions, identifying and evaluating potential floodplain encroachments and channel stability issues, supporting the planning process with water quality recommendations, and developing recommendations for proposed conditions as the study progresses.

3.4.1 Drainage Criteria

Drainage analysis and design work associated with the proposed improvements are in accordance with the methods, guidelines, and criteria set forth by NPS, CFLHD, AASHTO, and Caltrans highway design standards. Of these agencies, CFLHD and Caltrans have developed drainage criteria manuals establishing guidance or references to aid in the design process and or specific design standards:

- Federal Lands Highway *Project Development and Design Manual* (PDDM) [11]
- Caltrans *Highway Design Manual*

A design matrix was developed with criteria from both agencies and criteria were applied based on the more stringent criteria, and is included in Appendix E. The approved *Hydrologic and Hydraulic Criteria and Computation Methods Technical Memorandum* is in Appendix E as well.

3.4.2 Existing Hydrology

Hydrology was developed for each basin using the Rational Method. Basin delineations are shown in Appendix E and are summarized in Table 19. Sub-basins were defined to separate areas of ditch flow. These basins include B-27and B-8 that drain toward Alexander Avenue and then drain along Danes Drive to Design Point (DP) 24, which then contributes to B-11. Also, basins that contribute from US 101 are included as sub-basins. These basins include B-9 and B-10, which drain from US 101 and outfall into B-11.

Table 19
Existing Drainage Basins

Basin ID	Design Point	Area	Q10	Q50	Q100
B1	1	5.62	2.81	4.55	5.28
B2	2	4.23	2.31	3.75	4.34
B3	3	33.09	15.89	25.78	29.88
B4	4	5.11	7.55	12.25	14.17
B5	5	0.07	0.29	0.41	0.46
B6	6	0.06	0.21	0.34	0.39
B7	7	2.75	1.84	3.00	3.47
B8	8	3.57	6.08	9.86	11.41
B9	9	7.62	4.15	6.73	7.80
B10	10	17.28	13.01	21.16	24.51
B11	11	55.29	46.83	75.95	88.05
B12	12	0.62	1.96	2.92	3.25
B13	13	0.23	0.96	1.36	1.51
B14	14	0.45	0.59	0.96	1.11
B15	15	0.52	0.33	0.54	0.63
B16	16	4.00	1.91	3.10	3.59
B17	17	6.90	3.26	5.30	6.14
B18	18	3.74	2.27	3.68	4.26
B19	19	3.41	2.24	3.64	4.22
B20	20	6.68	3.39	5.51	6.38
B21	21	15.01	7.73	12.56	14.56
B22	22	3.02	1.72	2.79	3.24
B23	23	0.03	0.12	0.18	0.20
B24	24	11.92	12.81	20.79	24.04
B25	25	0.12	0.50	0.71	0.79
B26	26	0.22	0.79	1.28	1.48
B27	27	0.19	0.24	0.39	0.45
B28	28	0.16	0.67	0.95	1.05

3.4.3 Hydraulic Analysis

Existing hydraulic structures that were identified along Alexander Avenue consist of drop inlets, paved ditches, and culverts. Survey located inlets, culverts, and paved ditches but did not include detailed information such as structure elevations, inlet type, all pipe sizes, size or geometry of paved ditches or storm system layouts. Therefore, site visits were made to evaluate existing hydraulic structures along Alexander Avenue. A map of existing drainage structures is in Appendix E. A description of structure types found on the field visit and the methods used for analysis are included in the following subsections.

Inlets

Based on site visits, existing inlets are either a grate inlet or modified curb inlet. Only inlet capacity and efficiency was evaluated because pipe information and storm system information was not identified in the survey. The existing roadway geometry consists of two 12-foot lanes with shoulders varying from 4 to 5 feet. There is curb that begins on the northbound lane just south of Danes Drive and ends approximately 800 feet north of Danes Drive. Approximately 200 feet north of the end of the curb and gutter, a dike can be found. Based on the existing roadway analysis, there is not a consistent cross slope or normal crown throughout the corridor. Because of this irregularity and to simplify the analysis, a consistent cross slope was assumed for analysis purposes. The roadway cross slope shown in Caltrans Figure 307.2, Geometric Cross Sections for Two-Lane Highways [9] was used. This typical section uses a roadway cross slope of 2 percent and a shoulder cross slope of 5 percent. To analyze spread onto the roadway it was assumed there was consistently a 4-foot shoulder along the corridor. Caltrans standard details were used for inlet analysis.

For grate inlets located on the roadway, Detail D77B for Bicycle Proof Grate was used. Grate inlets located in medians were analyzed based on Revised Standard Plan RSP D77A, Grate Type 24-9. Based on photographs taken of the curb inlets and comparison to Caltrans standard details, it was determined that the existing curb inlets would be evaluated as modified curb inlets. The inlet has a corrugated metal frame with an approximate curb opening of 18 inches with no depression. The inside pipe connection measures approximately 8 inches and is a plastic pipe. Figure 16 is a photograph of a grate D77B at design point 4, representative of a grate inlet located on the roadway. Figure 17 is a photograph of RSP D77A, an example of grate inlet in a median, located at design points 2 and 3. The photographs in Figure 18 show the modified curb inlet found at several locations along the project corridor.

Figure 16
Grate Inlet on Roadway

Figure 17
Grate Inlet in Median

Figure 18
Modified Curb Inlet

Inlets were evaluated for the 10-year storm frequency using Bentley's FlowMaster. Table 20 summarizes the results.

Table 20
Existing Inlet Summary

Basin ID	Design Point	Inlet Type	Spread to Road
B1	1	Grate in swale	No
B2	2	Grate in swale	No
B3	3	Grate in swale	Yes
B4	4	Roadway in-sag	Yes
B5	5	Roadway on-grade	No
B6	6	Roadway on-grade	No
B12	12	Roadway on-grade	No
B15	15	Modified curb inlet	No
B18	18	Grate in swale	Yes
B25	25	Modified curb inlet	No
B26	26	Modified curb inlet	No
B28	28	Modified curb inlet	No

Culverts

There are two culverts identified along the corridor. The first is located at design point 1. Survey and field visits identified that the inlet is buried and the size of the pipe could not be determined. This culvert is shown in Figure 19. The pipe was analyzed as an 18-inch plastic pipe using HY8 Culvert Analysis software. Inverts are approximate because the inlet is buried and outfall is not known.

Figure 19
Design Point 1

The second culvert is identified on survey as approximately a 9-foot by 4-foot concrete box culvert (CBC). Additional survey notes at this crossing state that there are multiple utility pipes exposed and under the road the culvert goes to a 30-inch pipe. Field visits could not locate an outfall for this pipe to verify the size. Because the outlet conditions of this culvert are not clear it was evaluated for multiple conditions. It was analyzed as a 9-foot by 4-foot CBC, a 30-inch corrugated metal pipe with inlet control and a 30-inch corrugated metal pipe with outlet control for the 100-year design storm using HY8 Culvert Analysis software. Table 21 summarizes the results of the analysis.

Table 21
Existing Culvert Summary

Basin ID	Design Point	Size	Roadway Elevation (ft)	Design HW	Road Overtopping
B1	1	18 inches	272.00	271.43	No
B11	11	9-foot by 4-foot CBC	195.63	145.34	No
		30-inch Inlet Controlled		157.46	No
		30-inch Outlet Controlled		157.95	No

HW = Headwater

3.4.4 Ditches

Survey identified paved ditches along the corridor, and the geometry of the ditches was verified on site visits. Paved ditches at design points 5, 6, 23 and 27 are V-shaped with a top width of approximately 3.5 feet and a depth of approximately 3 inches, as shown in Figure 20. Paved ditches at design points 12 and 13 are also V-shaped with an approximate top width of 1.0 to 1.5 feet and an approximate depth of 9 inches, and are also shown in Figure 20. Slopes were determined based on the surveyed contours. Typically, these ditches drain to a grate inlet or modified curb inlet, but in some cases drained offsite or back onto the roadway at the termination of the ditch.

Figure 20
Paved Ditch

Design points 5, 6, 23, and 27

Design points 12 and 13

Roadside vegetated ditches were not identified in the survey, but a typical section based on site visits was used to analyze ditch conveyance along the road. There were two typical situations that were repeated along the corridor. In Scenario 1, drainage runs off steep slopes and along the road in a shallow V-ditch ending at a low point behind the roadway. The low point is significantly lower than the roadway and there is no drainage structure to carry runoff under Alexander Avenue. In Scenario 2, runoff drains from steep slopes and is conveyed along the roadway to an inlet or culvert. Based on site visits the geometry is V-shaped with side slopes of approximately 3:1 to 4:1 with a varied depth between 2 to 6 inches. Existing vegetated ditches scenarios 1 and 2 are shown in Figure 21.

Figure 21
Vegetated Roadside Ditch

Scenario 1

Scenario 2

Grate inlets located in medians have a vegetated swale that carries runoff to the inlet, as shown in Figure 17. The existing geometry for the swales were analyzed as a trapezoidal section with a 2-foot bottom width and 5:1 side slopes with a varied depth between 6 and 12 inches. Vegetation at these locations is minimal and has potential to transport sediment to the inlets.

Ditches were analyzed for the 10-year design storm. Table 22 summarizes the paved and vegetated ditches.

Table 22
Existing Ditch Summary

Basin ID	Design Point	Type	Spreads to Roadway
B1	1	Vegetated Ditch	Yes
B2	2	Vegetated Swale	No
B3	3	Vegetated Swale	Yes
B4	4	Vegetated Swale	No
B5	5	Paved Ditch	No
B6	6	Paved Ditch	No
B7	7	Vegetated Ditch	Yes
B8	8	Vegetated Ditch	Yes
B12	12	Paved Ditch	Yes
B13	13	Paved Ditch	Yes
B14	14	Vegetated Ditch	No
B15	15	Vegetated Ditch	No
B16	16	Vegetated Ditch	No
B17	17	Vegetated Ditch	No
B18	18	Vegetated Ditch	No
B19	19	Vegetated Ditch	No
B20	20	Vegetated Ditch	No
B22	22	Vegetated Ditch	No
B23	23	Paved Ditch	No
B25	25	Vegetated Ditch	No
B26	26	Vegetated Ditch	No
B27	27	Paved Ditch	No

3.4.5 Summary

The analysis of the existing drainage structures was completed based on a combination of survey information and site visits, which was then evaluated based on current criteria outlined by Caltrans *Highway Design Manual* and Federal Lands Highway PDDM. There are several locations where inlets do not provide enough capacity to capture the 10-year storm frequency. There are also several locations where roadside ditches or swales do not provide the capacity to convey the 10-year design storm without spreading to the roadway. It is recommended that inlets, roadside ditches, and culverts be improved to meet current design standards of Caltrans and FHWA and to facilitate the movement of all traffic.

3.5 EXISTING GEOTECHNICAL CONDITIONS

The preliminary geotechnical investigation included research and observations of existing conditions pertaining to site geology, geologic hazards, anticipated excavations and structures, roadways, material sources, and general constructability of the project. A site reconnaissance was performed on February 13 and 14, 2010.

3.5.1 Geologic Setting

The rocks of the Franciscan Complex that underlie the project site and much of coastal Northern California were formed in a subduction zone. The Pacific Plate and the Pacific Ocean floor were subducted beneath the North American Plate depositing the Franciscan Complex onto the North American Plate as an accretionary wedge. The Franciscan Complex primarily consists of greywacke sandstone and argillite, with lesser amounts of greenstone (altered submarine basalt), radiolarian ribbon chert, limestone, serpentine, and a variety of metamorphic rocks. These rocks have become fractured, dislocated, and blended together on a local scale to form a mixture or mélange. The project site is in a part of the Franciscan Complex known as the Marin Headlands Terrane. The rocks in the Marin Headlands Terrane consist of about 20 to 25 percent altered submarine pillow basalt, 50 percent thinly bedded ribbon chert, and 25 percent clastic rocks. Figure 22 is a geologic map of the site, adapted from the U.S. Geological Survey (USGS) map.

Bedrock outcrops observed in the project limits consist mainly of ribbon chert and greenstone basalt. An outcrop of greywacke sandstone is located at the top of the ridge between US 101 and Alexander Avenue, outside the planning study area. Outcrops of serpentine bedrock, which can contain asbestos minerals, were not observed along the corridor.

The project is located in a Site Class B seismic activity zone. The site classification and peak ground acceleration (PGA) for the Alexander Avenue/Danes Drive location were obtained using the 2007 AASHTO bridge design guidelines [12] and the 2007 USGS publication for PGA (%g) with a 7-percent Probability of Exceedance (PE) in 75 years. The PGA for the subject site, assuming a latitude of 37.83 and a longitude of -122.48, is 66.9 %g.

3.5.2 Potentially Unstable Slopes

Clayey soils overlay the shallow bedrock on steep slopes west of US 101, south of Danes Drive and at two locations along the west side of Alexander Avenue. These soil deposits, and possibly the underlying bedrock, are susceptible to sliding when weakened by high subsurface moisture conditions. The area west of US 101 is a large landslide complex that has been active in the relatively recent past and currently shows signs of shallow surface slumping failures. The landslide features are identified as **Qlo** (older landslide deposits) and **Qly** (younger landslide deposits) on Figure 22. Subsurface horizontal drains have been installed near the toe of the slide and water was flowing from the drains during the site visit. Excavation for roadway widening at the toes of these slopes should be avoided.

The steep fill slope between Alexander Avenue and East Road indicates potential instability including distressed vegetation and shallow failures near the toe. Additional geotechnical investigation, including subsurface exploration, is recommended before locating embankment fills or retaining structures above this slope. Figure 23 identifies the locations of the potentially unstable slopes.

Over-steepened cut slopes on the west side of Alexander Avenue, near the north end of the project area could become unstable due to construction. Proposed road cuts that occur in the slope debris and ravine fill depicted on Figure 22 as **Qsr** should be graded relatively flat and re-vegetated or supported by retaining structures to provide long-term stability.

3.5.3 Rock Excavations

Seismic tomography was used during the geotechnical investigation for the Alexander Avenue and Danes Drive intersection to obtain average seismic velocities of the chert and basalt bedrock at the rock cut on the east side of the intersection. The bedrock types are identified on Figure 22 as **KJc** (chert) and **KJg** (greenstone). The recorded seismic velocities provide an indication of the properties of the material through which the seismic waves are traveling. In this case, the thinly laminated and weathered chert bedrock has relatively low wave velocities due to extensive fracturing and clay inclusions within the rock mass. The tomograph data for the Alexander Avenue and Danes Drive intersection site indicated a P-wave velocity in the chert between about 1000 feet per second (fps) and 2400 fps. The velocity in the underlying “greenstone” basalt appears to be between about 2600 fps and 4300 fps. Materials with these seismic velocities should be rippable per the Caterpillar *Handbook of Ripping* [13]. Isolated areas of harder rock that may be encountered in rock cuts and could require blasting. Pre-blast and post-blast surveys of nearby structures should be performed if blasting is required. Damage to structures can be prevented by requiring limits to blast related vibrations and monitoring small trial blasts to establish safe blasting procedures during excavation. Generally, rock cuts for roadway widening should be located on the east side of Alexander Avenue. Because the terrain slopes down toward the east, rock slope heights will be lower on the east side. Cuts on the east side will avoid previously identified potentially unstable slopes.

3.5.4 Rockfall Hazards

Recommendations to mitigate rockfall hazards that were provided in the geotechnical investigation report for the Alexander Avenue and Danes Drive intersection will likely be appropriate for proposed rock cuts throughout the corridor. The mitigation measures include excavation to stable slope configurations; rock scaling after excavation to remove loose or unstable rocks; rockfall mesh to control the materials that fall from the face over time; and wide ditches or run-out zones at the toes of the slopes to collect rocks before they enter the travelled way. Rockfall from rock cuts at locations where the proposed cut slopes will have heights lower than approximately 15 to 20 feet can probably be mitigated by rock scaling and run-out zones. Rock cuts at the east side of the US 101 underpass, northeast of Danes Drive and in the area near the East Road intersection, may meet this height criterion. Where rock cut heights exceed 20 feet, rockfall mesh should be included as a mitigation measure. The thinly bedded chert weathers more rapidly than the greenstone basalt rock. Rockfall from cuts in the chert is expected to occur more frequently, but rock sizes will typically be smaller than rockfall from cuts in the greenstone. The rockfall hazard from both rock types is significant and should be mitigated using the methods discussed previously. Rockfall mitigation measures should be designed on a site-by-site basis.

Figure 22
Geology of the San Francisco North Quadrangle, California

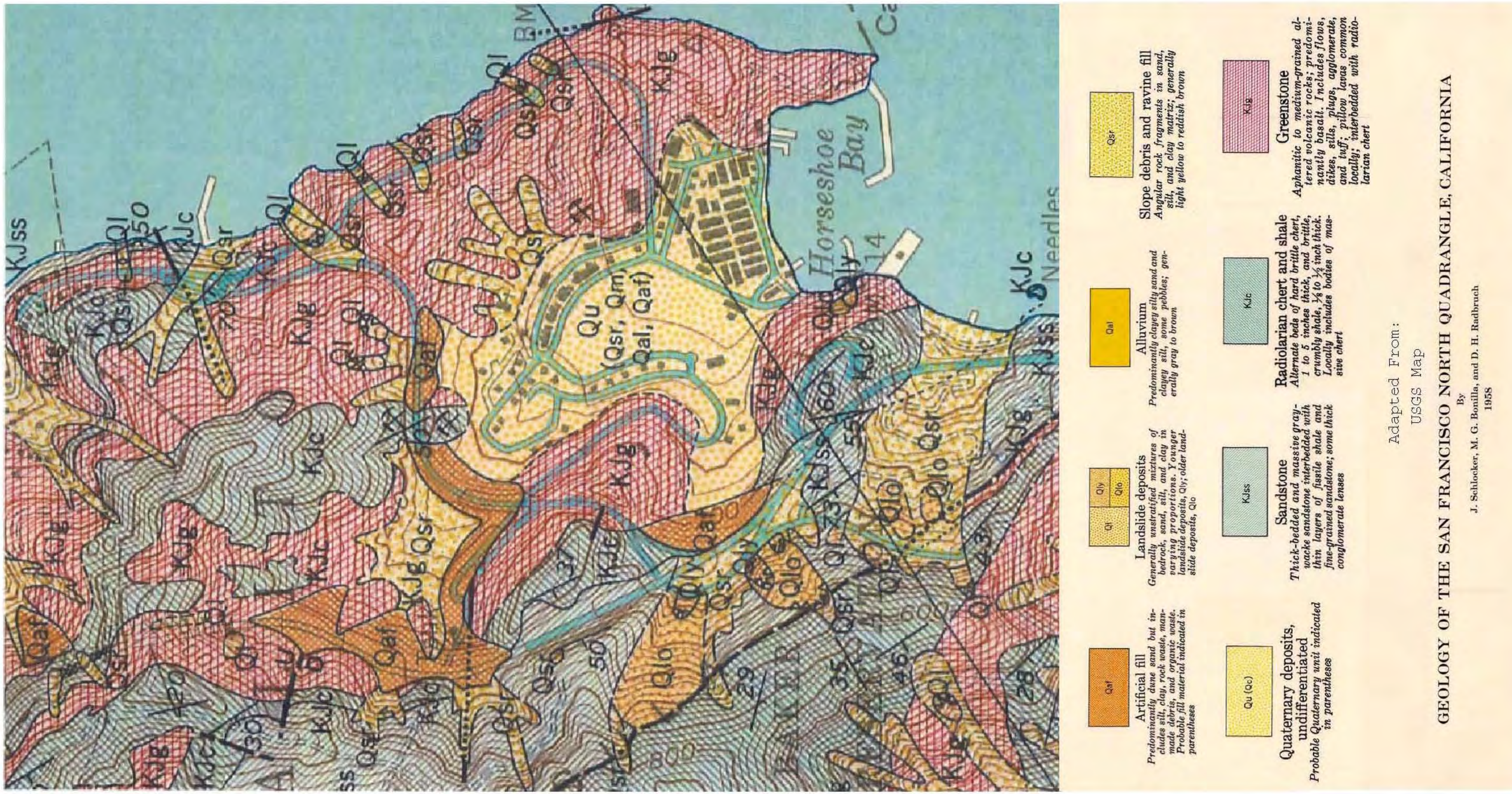
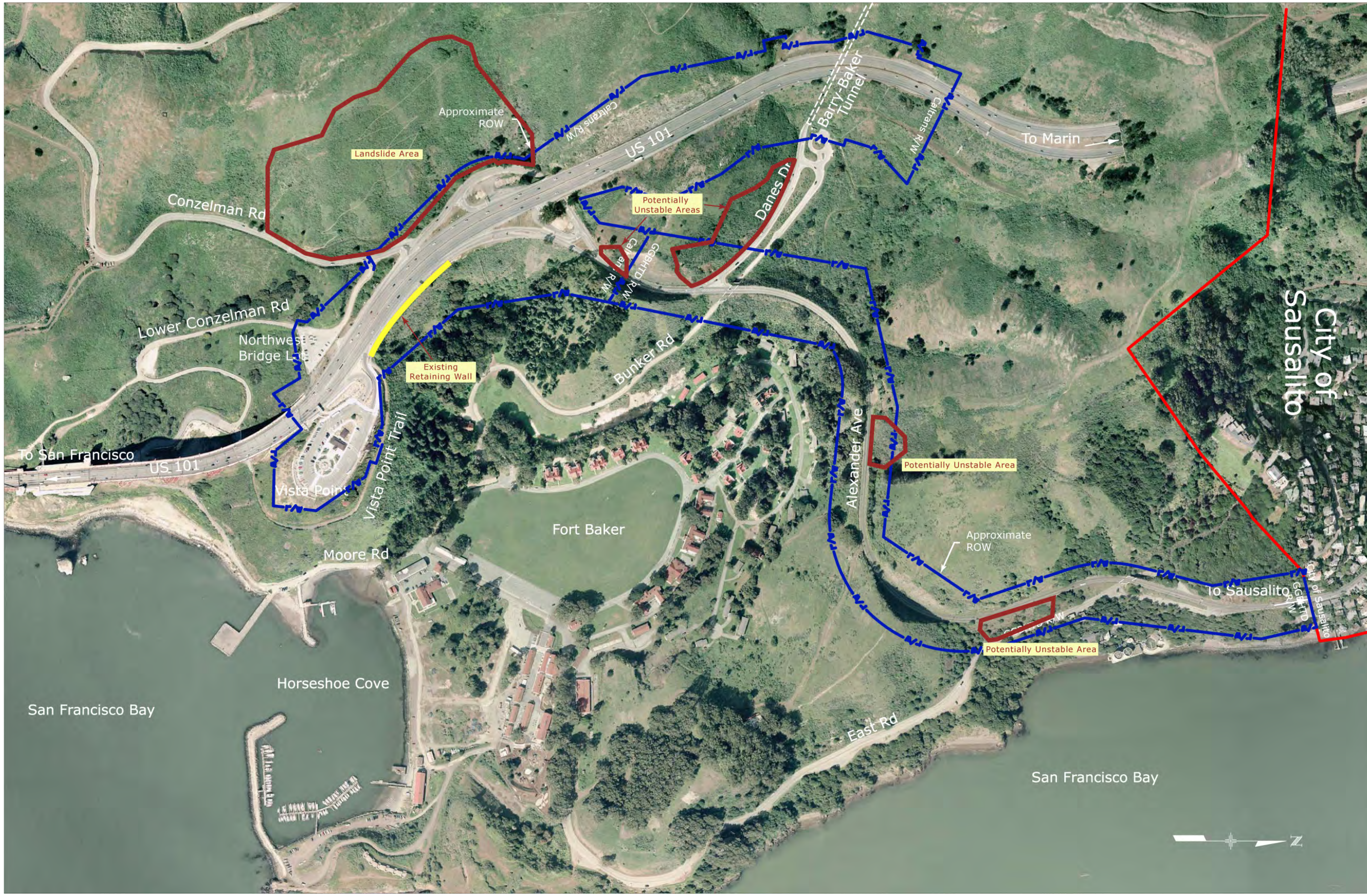


Figure 23
Geotechnical Features



3.5.5 Structures

The potential structures to be modified, protected, or constructed within the corridor are:

- Alexander Avenue/US 101 undercrossing
- Bunker Road Arch Tunnel
- East Road Underpass
- Retaining walls at the east and west sides of the north end of the Golden Gate Bridge
- Other retaining walls at four miscellaneous locations

US 101 crosses Alexander Avenue on an existing reinforced concrete bridge that was constructed in 1935 and was widened in 1968. This structure is described in Section 3.2.6. As-built plans for the 1968 modifications show the structure is supported on a spread footing foundation. Bedrock outcrops (chert) are visible at the north end of the structure and it is likely that the foundations bear on bedrock. No indications of geotechnical related distress to the structure or movement of the adjacent retaining walls was observed. Damage apparently caused by vehicle impacts was noted at the south entrance.

The Bunker Road Arch Tunnel allows Bunker Road to pass below Alexander Avenue, north of the Danes Drive intersection. The tunnel was constructed in 1938 and as-built drawings show it is supported by spread footing foundations bearing on bedrock. The structure has been rated by Caltrans as functionally obsolete in accordance with FHWA criteria. Indications of significant damage or distress were not observed.

A single-span concrete bridge carries Alexander Avenue over East Road. The bridge was constructed in 1938 according to Caltrans records. A chert bedrock outcrop was observed near the west corner of the south abutment, indicating that the bridge foundations probably bear on bedrock. No signs of geotechnical related structure distress were observed.

An existing bin wall or crib wall is located below the northbound auxiliary lane between Vista Point and Alexander Avenue. The wall extends from the Vista Point parking area northward for about 300 to 400 feet. The approximate wall location is shown on Figure 23. Foundation soils for the wall appear to be embankment materials placed during construction of US 101.

Anticipated retaining walls west of US 101 will likely retain shallow soils and weathered bedrock south of Conzelman Road. North of Conzelman Road, the retained materials would be clayey soils at the toe of the existing landslide. Cuts at the toe of the landslide should be avoided unless retaining structures such as soil nail or tieback systems that will mitigate the landslide are included in the design.

The design of proposed structures should consider potential earthquake loads in accordance with AASHTO design specifications [12]. Special geotechnical design consideration should also be given to structures that retain natural soil slopes and structures near landslide areas. Landslides can be initiated on unstable slopes or re-activated in existing slide areas by seismic activity.

3.5.6 Pavements

The asphalt pavements on Alexander Avenue exhibit signs of distress and failure including longitudinal and transverse cracks, block cracking, raveling, potholes, and separation of pavement layers. Longitudinal and transverse cracking was observed throughout the project area. Longitudinal crack spacing generally ranges from 1 to 5 feet with crack lengths of several hundred feet. Transverse crack spacing is typically 5 to 30 feet. Where the cracks are closely spaced, the failure mode is termed “block cracking.” These types of failures are usually caused by material and climate properties. As the asphalt pavements age, they become less flexible and crack. The severity of the damage is increased by moisture infiltration, high traffic volumes and heavy wheel loads.

Raveling occurs when the pavement surface is worn away by dislodging of the aggregate particles and loss of binder. This type of failure indicated the binder has hardened significantly with age. Raveling was observed at most locations along Alexander Avenue.

Potholes were observed at several isolated locations along the corridor. Although most of the potholes have been patched, the moist climate and heavy precipitation have increased pothole severity and caused patches to dislodge.

Water was observed seeping from longitudinal cracks in the pavement surface at super-elevated sections. The source of the water appears to be surface runoff that has infiltrated through unpaved shoulders and migrated between pavement layers to exit at the cracks. This is an indication that separation of the asphalt layers has created voids that will eventually result in potholes and pavement failure.

Alexander Avenue has received multiple asphalt pavement overlays. Records show removal of the surface and replacement with new asphalt occurred in 1977. Signs of more recent overlay and large area patches were also observed. Test borings in the area of Danes Drive encountered two to three pavement layers, depending on location.

The surface cracking and raveling pavement distress can usually be mitigated by pavement overlay; however, because it appears that voids are present between the existing asphalt layers to the extent that water is flowing through the pavement, in-place pulverization of the existing asphalt and re-use of this material as base course is recommended. A new pavement surface consisting of 5 to 6 inches of hot asphalt concrete pavement should be anticipated for conceptual design.

3.6 EXISTING ENVIRONMENTAL CONDITIONS

The preliminary investigation into existing environmental conditions included wetlands and waters of the United States, threatened and endangered species, sensitive species of special concern, and historical and cultural resources. All environmental conditions and potential effects of improvement strategies should be coordinated with the NPS as strategies are developed and implemented.

3.6.1 Wetlands and Waters of the United States

Wetlands and waters of the United States are protected under Sections 401 and 404 of the Federal Clean Water Act, which are administered by the Regional Water Quality Control Board (RWQCB) and U.S. Army Corps of Engineers (USACE) respectively. Lakes, streams, and rivers receive additional protection under Sections 1600–1616 of the California Fish and Game Code, which is administered by the California Department of Fish and Game (CDFG). To the extent feasible, the project should be designed such that all encroachment of any wetlands or waters of the United States are avoided. If these wetlands and other waters cannot be avoided, then a permit under Clean Water Act Section 404 from USACE, and a Water Quality Certification from the RWQCB must be obtained before any disturbance of the wetland or other water of the United States. Additionally, if the wetland feature is a stream or lake, then a Streambed Alteration Agreement from the CDFG must be obtained before any disturbance within the stream zone.

Site reconnaissance was performed on February 25, 2010. The reconnaissance survey consisted of walking and/or driving the limits defined by the area of potential effect (APE) map. No wetlands or other waters of the United States occur along the existing paved areas. There is a small stream running near Danes Trail north of Alexander Avenue and east of Bunker Road. The existing Danes Trail crosses this stream at an existing crossing of the dirt/gravel path just before its eastern terminus where it flows into a culvert passing under Alexander Avenue. This feature would be categorized as riverine/upper perennial to intermittent under the “Classification of Wetlands and Deepwater Habitats of the United States” [13]. No other wetlands or waters of the United States were observed during the survey.

Further studies and coordination with NPS should be conducted to determine the exact limits of jurisdiction of the stream along Danes Trail, and to ensure that no other wetland features are present in the APE. Wetland delineation should be performed using the “Classification of Wetlands and Deepwater Habitats of the United States.” The approximate location of the existing stream is in Appendix F. In the event the stream should be affected by the improvement options developed in this study, coordination between NPS, USACE, RWQCB, and CDFG will be necessary.

3.6.2 Threatened and Endangered Species

Habitat in the APE consists of urban (developed and/or landscaped), non-native annual grassland, coastal bluff scrub, coastal scrub (disturbed), oak woodland, non-native woodland (stands of Monterey pine, Monterey cypress and Eucalyptus), and estuary. Appendix F shows the areas of habitat in the APE. The majority of the alignment occurs within either existing paved roads or existing dirt/gravel paths, minimizing the impact on the existing habitats. An undeveloped land in the APE is in the eastern segment of Danes Trail, north of Alexander Avenue and east of Bunker Road. This segment passes through non-native annual grassland and disturbed coastal scrub. The second such location is the Knob Alignment, south of Alexander Avenue, and west of Danes Drive. The Knob Alignment (Strategy BP-H) and the Danes Trail (Strategy BP-I) are potential improvement strategies discussed in Section 5.3.2 and shown in Figure 55 and Figure 56, respectively.

Based on a query of the California Natural Diversity Database (CNDDB) and the U.S. Fish and Wildlife Service (USFWS) online database of threatened and endangered species, 26 state- or federally-listed threatened or endangered species have the potential to occur in the region surrounding the APE. This total includes 14 plants, four invertebrates, two fish, one amphibian, three birds, and two mammals. Based on the habitat types present, only five plants (Tiburon mariposa-lily, Santa Cruz tarplant, Tiburon jewel-flower, white-rayed pentachaeta, and Tiburon paintbrush), one invertebrate (Mission blue butterfly), and one amphibian (California red-legged frog) have any potential to occur there. Habitat for threatened or endangered plants occurs in grassland and coastal scrub habitats throughout the APE; habitat for Mission blue butterfly is mapped in grassland and coastal scrub habitats largely outside areas influenced by the proposed project. Habitat for California red-legged frog occurs in the small stream running roughly parallel with Danes Trail on the east side of the existing trail. Further investigations should be conducted to determine if habitat for any of these species is occupied by those species, and if so, will the project have any potential to affect habitat for those species.

The following list includes the results of the CNDDB and USFWS database queries.

Plants

- Marsh sandwort (*Arenaria paludicola*)
- Presidio manzanita (*Arctostaphylos hookeri* ssp. *ravenii*)
- Tiburon mariposa-lily (*Calochortus tiburonensis*)
- Tiburon paintbrush (*Castilleja affinis* ssp. *neglecta*)
- Presidio clarkia (*Clarkia franciscana*)
- Marin western flax (*Hesperolinon congestum*)
- Santa Cruz tarplant (*Holocarpha macradenia*)
- Beach layia (*Layia carnosa*)
- San Francisco lessingia (*Lessingia germanorum*)
- San Francisco popcorn-flower (*Plagiobothrys diffusus*)
- White-rayed pentachaeta (*Pentachaeta bellidiflora*)
- North Coast semaphore grass (*Pleuropogon hooverianus*)
- Tiburon jewel-flower (*Streptanthus niger*)
- Showy Rancheria clover (*Trifolium amoenum*)

Invertebrates

- San Bruno elfin butterfly (*Callophrys mossii bayensis*)
- Bay checkerspot butterfly (*Euphydryas editha bayensis*)
- Mission blue butterfly (*Plebejus icarioides missionensis*)
- Callippe silverspot butterfly (*Speyeria callippe callippe*)

Fish

- Tidewater goby (*Eucyclogobius newberryi*)
- Coho salmon - central California coast ESU (*Oncorhynchus kisutch*)

Amphibians

- California red-legged frog (*Rana draytonii*)

Birds

- California black rail (*Laterallus jamaicensis coturniculus*)
- California clapper rail (*Rallus longirostris obsoletus*)
- Bank swallow (*Riparia riparia*)

Mammals

- Southern sea otter (*Enhydra lutris nereis*)
- Salt-marsh harvest mouse (*Reithrodontomys raviventris*)

3.6.3 Sensitive Species of Special Concerns

Habitats observed during this survey are described in Subsection 3.6.2, Threatened and Endangered Species. Based on a query of the CNDDB and USFWS online threatened and endangered species databases, 72 special-status species have the potential to occur in the region surrounding the project area. This total includes 43 plants, 8 invertebrates, 1 amphibian, 1 reptile, 12 birds, 7 mammals, and 4 sensitive natural communities. Based on the habitat types present in the area, however, only those plant species associated with grassland and scrub habitats have potential to occur there. Invertebrates potentially occurring in the project area include Monarch butterfly, Marin hesperian (a terrestrial snail), and the leaf cutter bee. No suitable habitat for either western pond turtle or foothill yellow-legged frog was observed. Large eucalyptus, Monterey pine, and Monterey cypress trees could provide rookery sites for the herons and egrets, though no such structures were observed during the survey. Tree hollows, bridge structures, and older buildings could provide habitat for the pallid bat, and the foliage of large eucalyptus trees may provide roosting habitat for hoary bat and western red bat, but no habitat for any of the other mammal species is present. Further investigations should be conducted to determine if habitat for any of these species is occupied by those species, and if so, will the project have any potential to affect habitat for those species.

Plants

- Napa false indigo (*Amorpha californica* var. *napensis*)
- Mt. Tamalpais manzanita (*Arctostaphylos hookeri* ssp. *montana*)
- Marin manzanita (*Arctostaphylos virgata*)
- Small groundcone (*Boschniakia hookeri*)
- San Francisco Bay spineflower (*Chorizanthe cuspidata* var. *cuspidata*)
- Mt. Tamalpais thistle (*Cirsium hydrophilum* var. *vaseyi*)
- San Francisco collinsia (*Collinsia multicolor*)
- Tiburon buckwheat (*Eriogonum luteolum* var. *caninum)*
- Marin checker lily (*Fritillaria lanceolata* var. *tristulis*)
- Blue coast gilia (*Gilia capitata* ssp. *chamissonis*)
- San Francisco gumplant (*Grindelia hirsutula* var. *maritima*)
- Bristly sedge (*Carex comosa*)
- Thin-lobed horkelia (*Horkelia tenuiloba*)
- Tamalpais lessingia (*Lessingia micradenia* var. *macradenia*)
- Franciscan manzanita (*Arctostaphylos franciscana*)
- Alkali milk-vetch (*Astragalus tener* var. *tener*)
- Seaside tarplant (*Hemizonia congesta* ssp. *congesta*)
- Franciscan thistle (*Cirsium andrewsii*)
- Round-headed Chinese-houses (*Collinsia corymbosa*)
- Point Reyes bird's-beak (*Cordylanthus maritimus* ssp. *palustris*)
- Minute pocket moss (*Fissidens pauperculus*)
- Fragrant fritillary (*Fritillaria liliacea*)
- Dark-eyed gilia (*Gilia millefoliata*)
- Diablo helianthella (*Helianthella castanea*)
- Kellogg's horkelia (*Horkelia cuneata* ssp. *sericea*)
- Rose leptosiphon (*Leptosiphon rosaceus*)
- Marsh microseris (*Microseris paludosa*)
- Choris' popcorn-flower (*Plagiobothrys chorisianus* var. *chorisianus*)

- Marin County navarretia (*Navarretia rosulata*)
- hairless popcorn-flower (*Plagiobothrys glaber*)
- Marin knotweed (*Polygonum marinense*)
- San Francisco owl's-clover (*Triphysaria floribunda*)
- Marin checkerbloom (*Sidalcea hickmanii* ssp. *viridis*)
- Santa Cruz microseris (*Stebbinsoseris decipiens*)
- Mount Tamalpais bristly jewel-flower (*Streptanthus glandulosus* ssp. *pulchellus*)
- Adobe sanicle (*Sanicula maritima*)
- Oregon polemonium (*Polemonium carneum*)
- Tamalpais oak (*Quercus parvula* var. *tamalpaisensis*)
- Point Reyes checkerbloom (*Sidalcea calycosa* ssp. *rhizomata*)
- San Francisco campion (*Silene verecunda* ssp. *verecunda*)
- Tamalpais jewel-flower (*Streptanthus batrachopus*)
- Suisun Marsh aster (*Symphyotrichum lentum*)
- Coastal triquetrella (*Triquetrella californica*)

Invertebrates

- Sandy beach tiger beetle (*Cicindela hirticollis gravida*)
- Bumblebee scarab beetle (*Lichnanthe ursine*)
- Robust walker (*Pomatiopsis binneyi*)
- Mimic tryonia (=California brackishwater snail) (*Tryonia imitator*)
- Monarch butterfly (*Danaus plexippus*)
- Tiburon micro-blind harvestman (*Microcina tiburona*)
- Marin hesperian (*Vespericola marinensis*)
- A leaf-cutter bee (*Trachusa gummifera*)

Amphibians

- Foothill yellow-legged frog (*Rana boylii*)

Reptiles

- Western pond turtle (*Actinemys marmorata*)

Birds

- Great egret (*Ardea alba*)
- Short-eared owl (*Asio flammeus*)
- Snowy egret (*Egretta thula*)
- Saltmarsh common yellowthroat (*Geothlypis trichas sinuosa*)
- San Pablo song sparrow (*Melospiza melodia samuelis*)
- Black-crowned night heron (*Nycticorax nycticorax*)
- Great blue heron (*Ardea herodias*)
- Northern harrier (*Circus cyaneus*)
- White-tailed kite (*Elanus leucurus*)
- Alameda song sparrow (*Melospiza melodia pusillula*)
- Double-crested cormorant (*Phalacrocorax auritus*)

Mammals

- Pallid bat (*Antrozous pallidus*)
- Western red bat (*Lasiurus blossevillii*)

- Hoary bat (*Lasiurus cinereus*)
- Salt-marsh wandering shrew (*Sorex vagrans halicoetes*)
- Point Reyes jumping mouse (*Zapus trinotatus orarius*)
- Angel Island mole (*Scapanus latimanus insularis*)
- American badger (*Taxidea taxus*)
- San Pablo vole (*Microtus californicus sanpabloensis*)

Sensitive Communities

- Coastal Brackish Marsh
- Northern Coastal Salt Marsh
- Coastal Terrace Prairie
- Serpentine Bunchgrass

3.6.4 Historical and Cultural Resources

Alexander Avenue is located within the GGRNA and acts as the main transportation artery for pedestrian, bicycle, and motor traffic connecting the Marin Headlands, Fort Baker, Golden Gate Bridge, and Sausalito. Situated in the hills above Fort Baker, Alexander Avenue is also a contributing structure to the Fort Baker, Barry, and Cronkhite Historic District; the Fort Baker, Barry, and Cronkhite Historic District was listed on the National Register of Historic Places in 1973. The period of significance for the Fort Baker, Barry, and Cronkhite Historic District is 1866 to 1949 [15:4, 28; 16:5]. Alexander Avenue is also associated with the Golden Gate Bridge, which has been determined eligible for listing as a National Historic Landmark [15:3]. Evaluation of bridge-associated motor roads, such as Alexander Avenue, is incomplete at this time.

The following two documents served as the primary resources for background research concerning cultural resources in the project area: the *Cultural Landscape Report for Fort Baker Golden Gate National Recreation Area* [15], which documents the rich history of the area and identifies specific historic elements; and the *Historic Road Characterization Study, Supplemental Work Marin Headlands, Golden Gate National Recreation Area*. [16], which discusses the history and character-defining features of specific road segments of the GGRNA, including Alexander Avenue. Figure 24 is an overview of Alexander Avenue and Fort Baker.

Figure 24
Alexander Avenue and Fort Baker Overview

On February 26, 2010, a field visit was made to the Marin Headlands portion of the GGNRA to record and assess the existing conditions of the project area (see Figure 2). The field visit was made by a consultant biologist. The entire length of Alexander Avenue and portions of potential bicycle/pedestrian trails along Danes Drive, Danes Trail, Vista Point Road, and East Road were reviewed through a combination of windshield and pedestrian surveys. Other areas identified within the project area as potential bicycle/pedestrian trails could not be physically assessed due to restricted access, slope, and heavy vegetation. These included the northwestern portion of Danes Trail, the portion of Danes Trail under Alexander Road, Knob Alignment, and the western portion of Vista Point Road under Golden Gate Bridge. These improvement strategies are discussed in Section 5.3.2. As part of this cursory review, preliminary background information was gathered from the *Cultural Landscape Report* [15]. This document also contains treatment recommendations and design guidelines for historic resources that are associated with Fort Baker. No prehistoric or historic archaeological sites were identified during the survey, and no indigenous archaeological sites have yet been identified within the Fort Barry vicinity [15:42].

Only three of the areas surveyed contain visible cultural resources. These areas are Alexander Avenue, Danes Trail, and Vista Point Road.

Alexander Avenue, originally named Sausalito Lateral, was constructed between 1935 and 1936 by the Works Progress Administration as an alternate means of civilian vehicular access between Sausalito and the Golden Gate Bridge [15:34, 57]. Alexander Avenue is also designated as a contributing structure (FBR715) to the Fort Baker, Barry, and Cronkhite Historic District

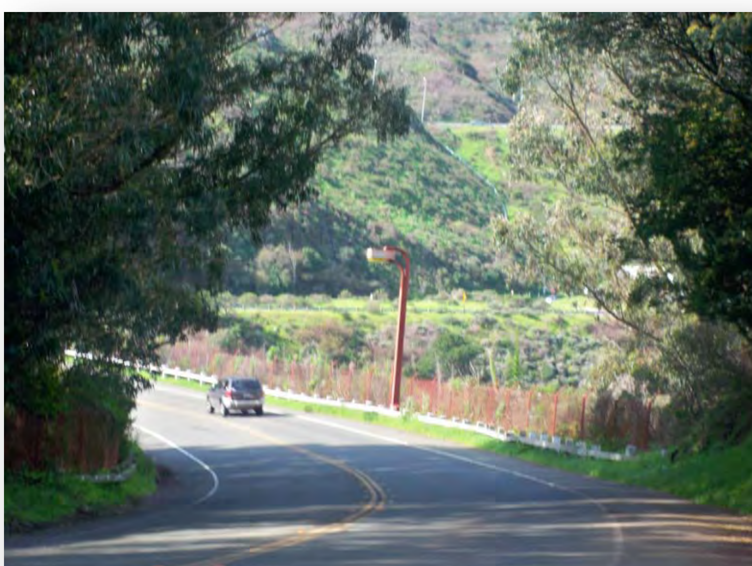
[15:125]. Alexander Avenue is approximately 1 mile in length and extends from the easement of the Golden Gate Bridge to the city of Sausalito.

The *Historic Road Characterization Study, Supplemental Work* lists eight character-defining features of Alexander Avenue that date to the period of significance for the Fort Baker, Barry, and Cronkhite Historic District. These characteristics are considered “sensitive to change:”

- Road alignment
- Its role as a connector between US 101 and Sausalito
- Extensive cut and fill grading to accommodate high speed alignment
- Exposed rock faces from initial blasting during construction
- Light fixtures in same palette as Golden Gate Bridge (circa 1936)
- White post and timber railing along road edge (circa 1936)
- Distant vistas out
- Paved shoulders

All eight of the character-defining elements listed were observed during the field survey on February 26, 2010. Background research and field observation suggest that no adverse changes or improvements have been made to the initial road alignment, to the original width of the road or shoulders, to the cut and fill, or to the rock faces since the original construction. Further, it appears minimal to no changes (other than upkeep) have been made to the other characteristics, including the streetlights and white post and timber railing (see Figure 25). The chain link fence present along the non-rock cut areas of the road was not listed in the 2004 report and its origin is not known at this time. The chain link fence is painted the same color as the Golden Gate Bridge.

Figure 25
Existing Defining Characteristics on Alexander Avenue



The tunnels/overpasses at Bunker Road (FB0576A) and East Road (FB0576B) (see Figure 26) are already listed as contributing structures to the Fort Baker, Barry, and Cronkhite Historic District (15:123). Initial coordination with NPS indicates these structures are historic, and consultation with NPS on the treatment of these structures related to improvement strategies should occur to make recommendations for mitigating effects.

Figure 26
Bunker Road Arch Tunnel and East Road Underpass

East Road Underpass

Bunker Road Arch Tunnel

Danes Trail extends in an eastward direction from Danes Drive parking area located at the termini of Bunker Road and Danes Drive. The Danes Trail is shown in Figure 56 in Section 5.3.2. The western portion of the trail consists of an old two-track access road that leads to Building 578, a 1909 water pump station [15:32]. A second cement structure is located directly behind this building, but its identity and function are undetermined at this time. Building 578 is listed as a contributing structure to the Fort Baker, Barry, and Cronkhite Historic District (FB0578) [15:123].

Building 578, shown in Figure 27, is not located within the proposed trail's boundaries; however, increased traffic to the area may require consultation with an architectural historian to review potential mitigation measures to prevent potential effects. The drainage swale located along the north side of the trail may also date to the period of significance for the historic district and should also be evaluated by an architectural historian.

Figure 27
Building 578

Vista Point Road, shown in Figure 28, forms part of the access from the west side of the GGRNA into Fort Baker. Three water tanks are located on the hillside above the medial section of the road. All were installed in 1913. Two are iron 30,000 gallon water tanks and the third is a 100,000 gallon iron water tank [15:19, 32]. The tanks are listed as contributing structures FB421, FB422, and FB423 respectively [15:122]. These tanks are located well above the trail surface and are not likely to be affected by the proposed changes to Vista Point Road circulation. Vista Point Road was not evaluated in the 2004 Feierabend [16] report.

Figure 28
Vista Point Road Overview

Based on the results of the environmental scan, it is evident that several historic resources, including those already listed on the National Register of Historic Places as contributing structures to a historic district, are located within the APE for the Alexander Avenue Planning Study. Because they are already listed on the National Register of Historic Places, these structures are considered historic resources/properties under NEPA, CEQA, Section 4(f) regulations, and Section 106 of the National Historic Preservation Act. To ensure that these and other unidentified historic resources are not adversely affected by the proposed project, a formal record search, Native American consultation, National Historic Preservation Act Section 106 review, evaluation by a qualified architectural historian, and NPS design scoping reviews are recommended.

4.0 FUTURE TRAVEL CONDITIONS

4.1 FUTURE TRAFFIC CONDITIONS ANALYSIS

The Alexander Avenue Planning Study is analyzing both the build year of 2012 when all construction of planned and funded projects will be complete as well as projected future conditions and needs of the corridor until the year 2035. The alternatives proposed on the corridor are consistent with the Marin Headlands EIS completed in March 2009.

4.2 FUTURE CORRIDOR GROWTH RATE

A growth rate had to be identified for the corridor to effectively model the future alternatives. Simply developing a comparison between 2002 to 2009 volumes was not useful due to several potential factors as described in Section 3.1.6, Traffic Volume Comparison. Therefore, additional studies that have been performed in the area were consulted to establish a similar growth rate for Alexander Avenue.

The Freeway Performance Initiative memoranda for the Marin/Sonoma 101 Corridor were consulted for growth factors along US 101 near the study area. Growth rates were projected from 2005 to 2030 during weekday peak periods and it was projected that traffic will increase by 0.998 percent annually during the morning peak hour and 0.95 percent annually during the evening peak hour on US 101.

The Marin Headlands EIS states that parklands traffic growth is expected to average a 0.7-percent increase per year through 2023 in southwestern Marin County [1].

Based on the available information, an annual growth rate of one percent from existing conditions (2009) to 2035 was agreed upon by the stakeholders. This equated to a growth factor of 1.3 in the 26 year timeframe between existing and future conditions.

4.3 FUTURE TRAFFIC VOLUMES

Future traffic volumes for the build year (2012) and the future (2035) conditions were developed based on the one percent annual growth rate. The resulting growth factor was applied to all movements at all of the study intersections. Weekday morning (8:00 a.m. to 9:00 a.m.), weekday evening (4:30 p.m. to 5:30 p.m.), and weekend afternoon peak hours (3:30 p.m. to 4:30 p.m.) were analyzed for the future operational analysis.

Average Daily Traffic

ADT volumes from the 2009 counts were factored up to 2012 and 2035 volumes based on the 1-percent annual growth rate. Figure 29 and Figure 30 show the build year and future conditions ADT volumes within the study area.

Turning Movement Counts

The weekday morning and evening peak hours and the weekend afternoon peak hour were analyzed for the 2012 and 2035 traffic conditions. The projected growth factor on the corridor is 1.03 by 2012 and 1.3 for the year 2035. This growth factor was applied to all turning movements on the corridor to account for the increased traffic volumes. Figure 29 and Figure 30 show the build year and future conditions TMC within the study area.

Figure 29
Build Year 2012 Traffic Volumes

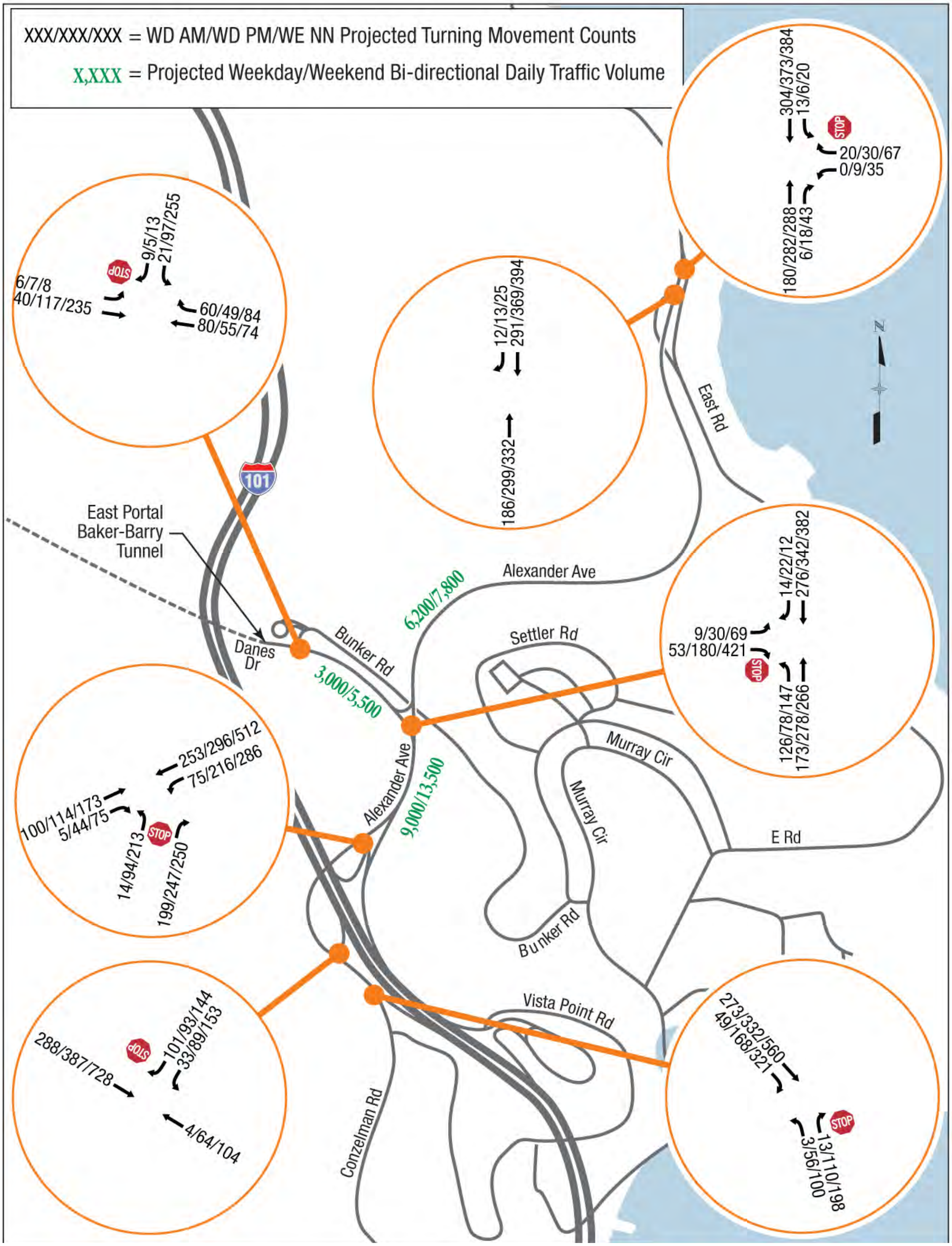
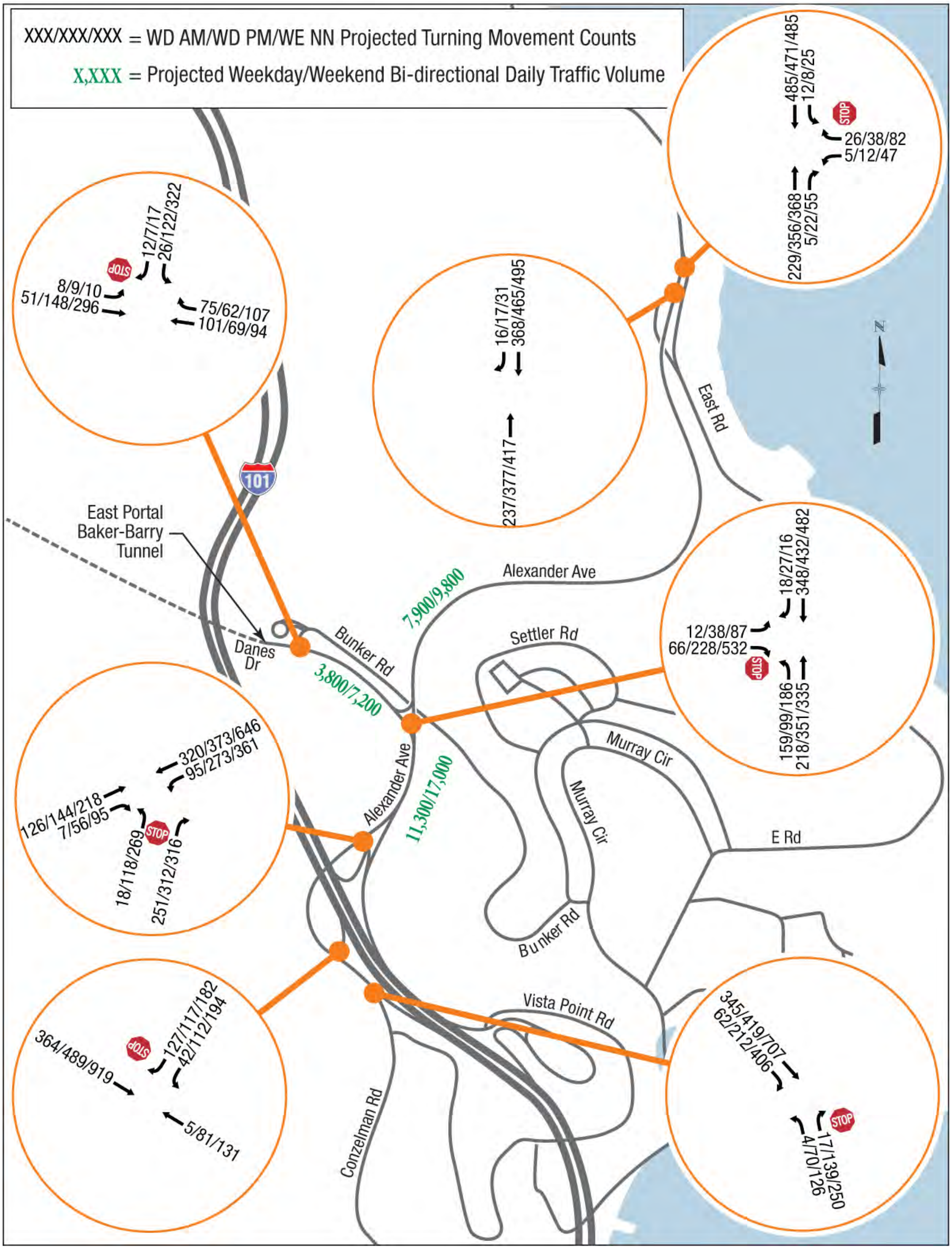


Figure 30
Future 2035 Traffic Volumes



Heavy Vehicle Percentages

Future land uses are not anticipated to change significantly in the future within the project area. Therefore, heavy vehicle percentages on Alexander Avenue are expected to remain at approximately 2 percent in the future, which is consistent with existing conditions.

4.4 BUILD YEAR (2012) TRAFFIC OPERATIONS

Improvements along the corridor have already been identified and approved at several intersections. The improvements that were included in the build year analysis are:

- Construct a 130-foot, right-turn auxiliary lane on Conzelman Road northbound at Alexander Avenue. (Completed in 2011.)
- Construct a 350-foot, right-turn auxiliary lane on Danes Drive westbound approaching Bunker Road. (Completed in 2011).
- Extend the left-turn auxiliary lane on northbound Alexander Avenue at Danes Drive. (Anticipated to be complete in 2014).
- Convert East Road west of Alexander Avenue to a one-way right-in and left-in movement only. (Completed in 2011).

It is assumed that these safety improvements will be in place regardless of which option is recommended as part of the planning study.

4.4.1 Build Year (2012) Intersection Level of Service

As part of the build year analysis, the LOS for all of the intersections within the study area was determined for both the morning and evening peak weekday periods as well as the weekend afternoon peak hour. Table 23 shows the results of the analysis along with the average vehicle delay for the worst leg approach. The observed peak hour factor was input for all existing conditions traffic, but for all future conditions analyses, a peak hour factor of 0.92 was applied to all traffic movements to be consistent with HCM recommendations.

Under build year conditions, all of the study area intersections operate at overall acceptable LOS during all peak periods with the exception of the northbound US 101 ramp during the weekend peak period. The LOS improves between the existing conditions and build year improvements at Alexander Avenue and Conzelman Road because of the planned right-turn lane improvements.

Table 23
Build Year (2012) Alexander Avenue Intersection LOS

Arterial	Intersecting Road	WD AM Peak Hour		WD PM Peak Hour		WE Peak Hour	
		Overall Delay (sec/veh)	Overall LOS	Overall Delay (sec/veh)	Overall LOS	Overall Delay (sec/veh)	Overall LOS
Alexander Avenue	Conzelman Road	10.2	B	12.2	B	22.7	C
Alexander Avenue	SB US 101 off-ramp	9.1	A	10.8	B	19.9	C
Alexander Avenue	NB US 101 ramp	12.3	B	25.1	D	>300	F
Alexander Avenue	Danes Drive	11.9	B	14.5	B	22.2	C
Alexander Avenue	East Road (East leg)	9.4	A	11.5	B	13.7	C
Danes Drive	Bunker Road	9.2	A	10.1	B	14.2	B

WD AM = weekday morning; WD PM = weekday evening, WE = weekend

4.4.2 Build Year (2012) Mainline Level of Service

The build year mainline LOS and average speeds are presented in Table 24 for Alexander Avenue. Alexander Avenue will remain a Class II Urban Highway within the project area. With the build year improvements, Alexander Avenue is projected to continue to operate at an acceptable LOS along the mainline in both directions during the weekday morning and evening peak periods, and during the weekend peak.

Table 24
Build Year (2012) Alexander Avenue Mainline LOS

Direction	Link	WD AM Peak Hour		WD PM Peak Hour		WE Peak Hour	
		Average Speed (mph)	LOS	Average Speed (mph)	LOS	Average Speed (mph)	LOS
Northbound	Conzelman Road to East Road	34.2	B	35.5	A	33.9	B
Southbound	East Road to Conzelman Road	42.4	A	40.3	A	37.8	A

WD AM = weekday morning; WD PM = weekday evening; WE = weekend

4.5 FUTURE BASELINE (2035) TRAFFIC OPERATIONS

An operational analysis was performed to determine the performance measures for the Baseline Alternative. SYNCHRO software was used for all intersection and arterial LOS analysis within the study area. The future baseline model was developed by using the calibrated existing condition model as a base condition and updating it with the 2035 projected volumes. Roadway geometry was modified to include the improvements listed in the Build Year Alternative, and the intersection of Danes Drive and Alexander Avenue was converted to a T-intersection.

The Future Baseline Alternative is considered to be the no-build option regarding any improvement strategies recommended by this study because these improvements are anticipated to occur regardless of the recommendations of the planning study. Results from the Future Baseline Alternative analysis are used as the comparison to quantify the benefits of the various improvements contained within the evaluated improvement strategies.

4.5.1 Intersection Level of Service

As part of the baseline condition analysis, the LOS for the signalized and un-signalized intersections along Alexander Avenue was determined for both the morning and evening peak periods. Table 25 shows the results of the baseline condition LOS analysis along with the average vehicle delay for the overall intersection and the worst leg approach. The LOS calculations were only performed for intersections with public roads with no analysis performed for the driveways along the corridor.

Under the future baseline conditions, several of the study area intersections are projected to operate at unacceptable LOS during the weekend peak hour. During the weekday morning and evening peak periods, nearly all of the intersections will operate acceptably with the exception of the northbound US 101 off-ramp at Alexander Avenue during the evening peak.

Table 25
2035 Baseline Alexander Avenue Intersection LOS

Arterial	Intersecting Road	WD AM Peak Hour		WD PM Peak Hour		WE Peak Hour	
		Overall Delay (sec/veh)	Overall LOS	Overall Delay (sec/veh)	Overall LOS	Overall Delay (sec/veh)	Overall LOS
Alexander Avenue	Conzelman Road	11	B	14	B	**56**	**F**
Alexander Avenue	SB US 101 off-ramp	9	A	12	B	**63**	**F**
Alexander Avenue	NB US 101 ramp	14	B	**57**	**F**	**>300**	**F**
Alexander Avenue	Danes Drive	21	C	25	D	**70**	**F**
Alexander Avenue	East Road (East leg)	10	A	13	B	18	C
Danes Drive	Bunker Road	10	A	11	B	20	C

WD AM = weekday morning; WD PM = weekday evening; WE = weekend

An additional intersection analysis was performed at Alexander Avenue and Danes Drive based on the supplemental data collected in October 2011 at the intersection. Applying the 1-percent annual growth rate to this intersection results in a LOS F at the intersection with a control delay 146 seconds in 2035, which is a greater delay than the delay projected based on the 2009 data (70 seconds projected based on 2009 volumes). The delay is projected to be higher, based on the 2011 volumes, because there was a higher total volume of eastbound left turning vehicles and a higher volume of northbound through vehicles in 2011, which results in longer delays for the controlling movement (eastbound to northbound left turn). Because the volumes and results are similar, the original 2009 analysis is recommended for identifying improvement strategies.

4.5.2 Mainline Level of Service

The Future Baseline Alternative mainline LOS and average speeds for Alexander Avenue are listed in Table 26. Alexander Avenue will remain a Class II Urban Highway in the future within the project area. Including the Baseline Alternative improvements, the corridor is expected to operate at LOS B in the northbound direction and at LOS A in the southbound direction during both the morning and evening weekday peak hours, as well as during the weekend peak. It should be noted that the mainline LOS does not account for queued traffic waiting to enter Alexander Avenue; therefore, while the mainline LOS shows acceptable future performance, there may be other movements with unacceptable delays.

Table 26
2035 Baseline Alexander Avenue Mainline LOS

Direction	Link	WD AM Peak Hour		WD PM Peak Hour		WE Peak Hour	
		Average Speed (mph)	LOS	Average Speed (mph)	LOS	Average Speed (mph)	LOS
Northbound	Conzelman Road to East Road	35.0	B	34.7	B	33.9	B
Southbound	East Road to Conzelman Road	42.0	A	39.4	A	37.0	A

WD AM = weekday morning; WD PM = weekday evening; WE = weekend

4.5.3 Vehicular Traffic Improvements

The intersection of Alexander Avenue and the northbound US 101 off-ramp is projected to perform poorly in the future during the weekday evening peak and during the weekend peak hour based on the projected 1-percent annual growth rate of traffic. Several improvement strategies were analyzed at this location. In addition, during the weekend peak periods, the intersections of Alexander Avenue with Conzelman Road, the southbound US 101 off-ramp, and Danes Drive will experience failing LOS. Because the poor LOS is only anticipated during non-standard peak times, the stakeholders at the project meetings were unsure whether mitigation should be proposed at these intersections. For this reason, improvement strategies were broken into two subsections: one group of strategies discusses the options for mitigating only Alexander Avenue and the northbound US101 off-ramp, which is the only intersection proposed to fail in the future during the weekday peak, and the second group of strategies discusses options for improving the entire corridor’s operations that would alleviate issues during all times of the week. These two subsections of improvement strategies are discussed in detail in Chapter 5, Improvement Strategy Analysis.

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5.0 IMPROVEMENT STRATEGY ANALYSIS

This chapter discusses the process of developing improvement strategies, pre-scoping activities, initial and qualitative screening, refined improvement strategies, and final alternative compilation.

5.1 PROCESS

The development of the improvement strategy analysis will combine a number of efforts to assess the viability of strategies to improve areas of concerns and deficiencies recognized in the existing conditions. The development of strategies was through a series of coordinated project development and project progress meetings with the stakeholders. These meetings addressed potential improvement strategies along with benefits and issues. The recommendations from the stakeholder meetings translated into the strategies development that grouped strategies by roadway, traffic, bicycle, pedestrian, structures, corridor-wide, and transit improvement strategies.

The initial screening and refinement of improvement strategies followed the strategy development with input and critique received from the stakeholders. The qualitative screening evaluated and further refined strategies against multiple screening criteria derived from the project problem statement. The final alternative compilation suggests a series of improvement strategies within each respective area compiled from the alternatives analysis process.

5.2 PRE-SCOPING ACTIVITIES

Project development meetings were held with the stakeholders in May 2008 and December 2008. These meetings are described in Section 2.1, Pre-Scoping Activities. During these meetings, strategies were discussed for roadway, bicycle, pedestrian, and transit improvements. Roadway and transit strategies developed during this project development meeting for the corridor are shown in Table 27. The table also shows what option the strategy became in the planning study process to ensure all strategies were reviewed (note that in the option callout XX-XX, the first two letters represent the option category of R=roadway, BP=bicycle and pedestrian, T=transit, and the second one, two, or three letters/numbers represent the option designation within the category)**.**

Table 27
Suggested Potential Improvement Strategies from December 2008 Project Development Meetings

Element	Location	Proposed Improvement	Benefit	Issues	Becomes Planning Study Strategy
Structure	Trailhead Lot to Vista Point	Ramps at existing stairs to catwalk under north end of Golden Gate Bridge	ADA access and improved bike access to/from Vista Point	Golden Gate Bridge Security	BP-A and BP-B
		Improved guide signs directing non-motorized traffic to Vista Point, and Sausalito via Vista Point	Improve public awareness		Included in BP-P1 and BP-P2

Table 27
Suggested Potential Improvement Strategies from December 2008 Project Development Meetings

Element	Location	Proposed Improvement	Benefit	Issues	Becomes Planning Study Strategy
Path	Vista Point Road	10-foot wide non-motorized path along existing Vista Point Road, connecting Vista Point to Ft. Baker	Non-motorized alternative to Alexander Avenue	Steep grade; potential resource impacts	BP-C1
Path	Trailhead Lot to Lower Conzelman	Improved guide signs directing to Ft. Baker, and Sausalito via Ft. Baker	Improve public awareness		Included in BP-P1 and BP-P2
Intersection	Conzelman Road Intersection	Realign intersection (FY 2009 project)	Reduce grade at stop		N/A (included in FY 2009 project)
Roadway	Conzelman Road Intersection to Alexander Tunnel	5-foot bike lanes/shoulders	Separate lanes for vehicles and bikes		BP-TS2
		Bus transit pullout (SB) at Conzelman Road with sidewalk from Trailhead Lot	Dedicated bus and passenger access	Cut slope impacts	T-2
Structure	Alexander Avenue Tunnel	Option 1: Widen Alexander Avenue tunnel below SH 101	Improve sight distance, and horizontal and vertical clearance, separate lanes for vehicles and bikes	Impacts to US 101	R-B1 and BP-L
		Option 2: New non-motorized tunnel adjacent to existing tunnel	Non-motorized alternative to Alexander Avenue Tunnel	Impacts to US 101	BP-J
		Option 3: Install warning signs, improved lighting, and centerline delineation	Improve public awareness	Inconsistent roadway width, non-motorized must merge with travel lane	BP-G
Intersection	Southbound US 101 on-ramp	No improvements discussed			N/A
Intersection	Southbound US 101 off-ramp	Extend deceleration lane	Improve stopping distance	Impacts to US 101	R-C5
		Warning sign to watch for bikes from Upper Conzelman	Improve bicycle safety		Included in BP-Q1 and BP-Q2
Roadway	Alexander Tunnel to northbound US 101 intersection	5-foot bicycle lanes/shoulders	Separate lanes for vehicles and bicycles		BP-TS-2

Table 27
Suggested Potential Improvement Strategies from December 2008 Project Development Meetings

Element	Location	Proposed Improvement	Benefit	Issues	Becomes Planning Study Strategy
Intersection	Northbound US 101 intersection	Replace northbound US 101 merge onto Alexander Avenue with T-intersection	Decrease conflict between NB 101 off ramp, or Vista Point, and Alexander NB traffic	Stop condition could cause traffic back up on NB US 101 off ramp	R-A5
		Bus transit pullout (NB) at NB US 101 intersection	Dedicated bus and passenger access		T-4
		Extend acceleration lane	Improve acceleration/merge distance	Impacts to US101	R-C4
Roadway and Path	Northbound US 101 intersection to Danes intersection	5-foot bicycle lanes/shoulders	Separate lanes for vehicles and bicycles	Cut slope impacts	BP-TS2 and included in FY 2013 project
		10-foot wide non-motorized path along “Knob” alignment, from northbound US 101 intersection to Danes Drive	Non-motorized alternative to Alexander Avenue	New alignment; potential resource impacts	BP-H
Intersection	Danes intersection	Extend NB left turn lane (FY 2013 project)	Improve stopping distance and queue storage length	Widen over Bunker Tunnel	N/A (included in FY 2013 project)
		Bus transit pullout (NB)	Dedicated bus and passenger access	Cut slope impacts	T-6
		Bus transit pullout (SB)	Dedicated bus and passenger access	Cannot impact unstable slope	T-7
		Extend right turn lane from Danes WB to West Bunker Road (FY 2009 project)	Reduce conflict with Baker-Berry tunnel queue	Widen over Bunker Tunnel (see below)	N/A (included in FY 2009 project)
		Replace substandard white guardrail (FY 2013 project)	Replace with crash tested guardrail	Could be historic	See note
Structure	Bunker Tunnel	Widen over Bunker Tunnel	Separate lanes for vehicles and bikes, guardrail shy distance	Tunnel built in 1930s historic?	BP-TS2

Table 27
Suggested Potential Improvement Strategies from December 2008 Project Development Meetings

Element	Location	Proposed Improvement	Benefit	Issues	Becomes Planning Study Strategy
Path	Danes Trail	New 10-foot wide non-motorized path to Fort Baker and Alexander Avenue	Improved non-motorized access between Marin Headlands (via Baker-Berry tunnel) and Ft. Baker, connect to Alexander Avenue and new bus transit pullout (SB)	Potential resource impacts	BP-I
Roadway	Danes Intersection to City of Sausalito	Replace substandard white guardrail	Replace with crash tested guardrail	Could be historic	See note
Intersection	East Road intersection	Bus transit pullout (NB) (FY 2009 project)	Dedicated bus and passenger access		T-11
		Bus transit pullout (SB)	Dedicated bus and passenger access	Potential source of impacts	T-12

Note : Not included as separate option to address problem statement. Safety features such as guardrail should be improved to current standards with most applicable project.
FY = fiscal year

5.3 STRATEGY DEVELOPMENT AND INITIAL SCREENING

A high-level review was initially conducted of the suggested December 2008 proposed improvements to determine which would be viable and further analyzed. These improvements were grouped into travel modes based on which mode would benefit most from the improvement.

Strategies were developed individually to address roadway and traffic operations, structures associated with roadway and bicycle strategies, bicycles and pedestrians, and transit improvements throughout the study area. The transport modes were analyzed individually in an attempt to determine the most optimal solution for each mode. Once the most optimal strategy was determined for each mode, the compatibility of these strategies used together was reviewed to produce recommended improvement strategies.

Refined December 2008 strategies along with additional improvement strategies were introduced to address specific concerns with future traffic volumes and LOS, existing deficiencies, and project objectives.

5.3.1 Roadway Improvement Strategy Components

Roadway strategies were further broken down into components to isolate specific areas of concerns. Multiple strategies were investigated related to:

- Alexander Avenue/northbound US 101 intersection strategies (R-A1 to R-A6)

- Alexander Avenue/US 101 underpass strategies (R-B1 and R-B2)
- Alexander Avenue/US 101 interchange strategies (R-C1 to R-C5)
- Corridor-wide traffic operation strategies (R-D1 to R-D4)

Alexander Avenue/Northbound US 101 Intersection Strategies

Strategies R-A1 through R-A6 were developed to address traffic operational issues at this intersection, which projects failing levels of service in 2035 during both the weekend evening peak and during peak weekend hours. Initial intersection improvement strategies were reviewed with the stakeholders and refined. Many of the intersection improvement strategies developed are in conjunction with options such as stop controls, signalized intersections, and traffic calming measures. Some strategies remained the same, some were enhanced, and additional strategies were developed to respond to issues encountered during initial analysis:

- **Baseline.** Intersection is configured the same as existing conditions.
- **Strategy R-A1.** Signalize the intersection of the US 101 northbound ramp and Alexander Avenue; extend left-turn storage bay lengths on southbound Alexander Avenue and on the off-ramp.
- **Strategy R-A2.** Convert the intersection to all-way stop-controlled (AWSC).
- **Strategy R-A3.** Construct a one-lane roundabout.
- **Strategy R-A4.** Construct a roundabout with the southbound Alexander Avenue movement converted to two lanes and all other movements to one lane.
- **Strategy R-A5.** Add a southbound through lane on Alexander Avenue approaching the northbound US 101 ramp, and convert the intersection to AWSC.
- **Strategy R-A6.** Barrier-separate the southbound Alexander Avenue through lane at the intersection and carry two southbound lanes through to Conzelman Road. Convert all other movements to an all-way stop at the intersection.

Strategy R-A1 (Signalized Intersection)

Strategy R-A1 installs a traffic signal at the northbound US 101 ramps and Alexander Avenue intersection. The intersection configuration remains essentially the same as the existing, with minor improvements to install the signals and pedestrian crosswalks. Table 28 and Table 29 and the discussion after the strategy descriptions analyze this strategy. Section 5.4, Qualitative Screening evaluates this strategy and recommends this strategy to be carried forward.

Figure 31
Strategy R-A1

Strategy R-A2 (AWSC)

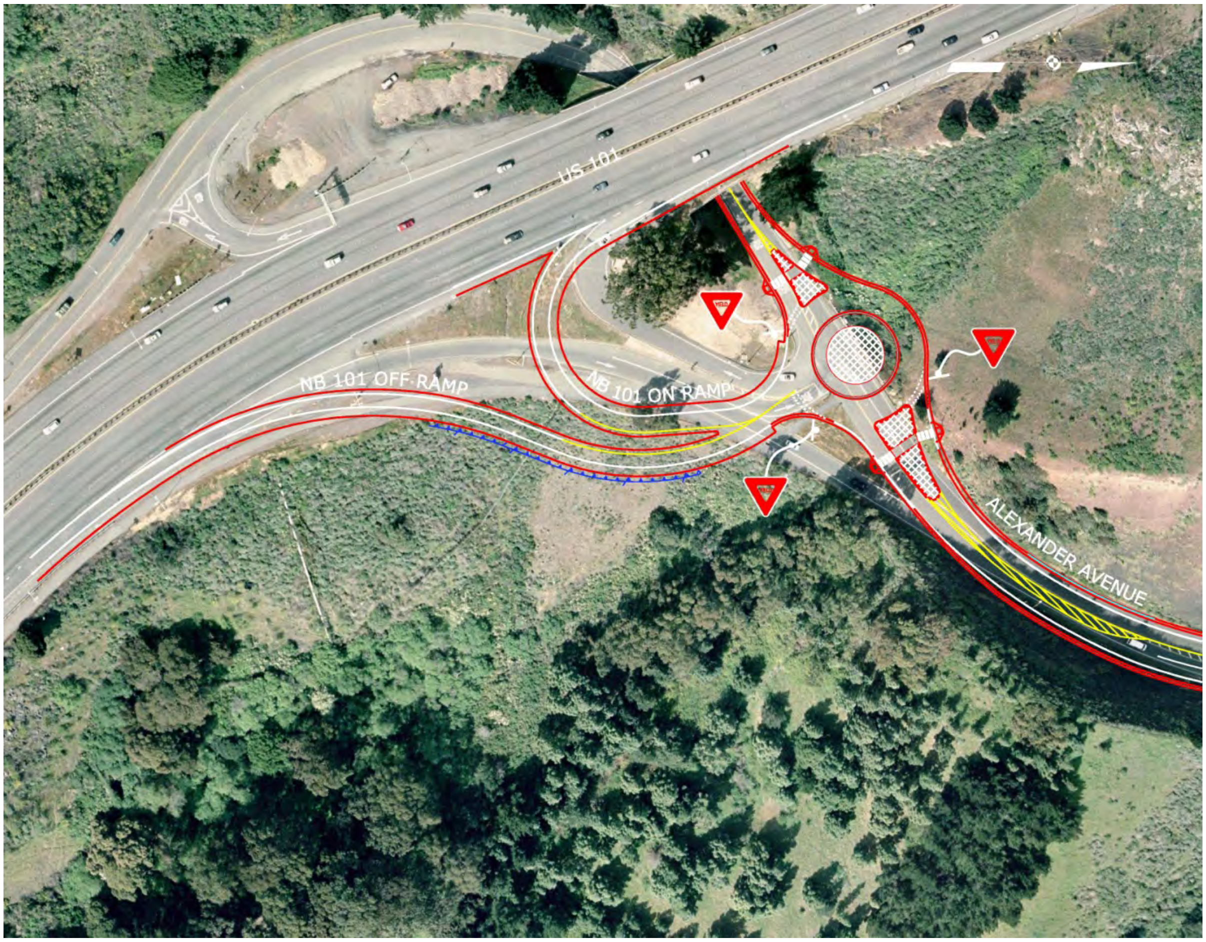
Strategy R-A2 installs stop signs on all approaches to the northbound US 101 ramps and Alexander Avenue intersection. The intersection configuration remains the same as the existing. Table 28 and Table 29 and the discussion after the strategy descriptions analyze this strategy. Section 5.4, Qualitative Screening evaluates this strategy and recommends this strategy to be eliminated.

Figure 32
Strategy R-A2

Strategy R-A3 (Single-lane Roundabout)

Strategy R-A3 constructs a roundabout at the northbound US 101 ramps and Alexander Avenue intersection. The roundabout is a single-lane roundabout and is considered a traffic calming measure to control volumes and operations. The on- and off-ramps to northbound US 101 will be reconfigured to improve geometry into the roundabout and onto northbound US 101. The northbound US 101 off-ramp will require a retaining wall on the east side of the ramp along the steep section of fill approaching the roundabout. Table 28 and Table 29 and the discussion after the strategy descriptions analyze this strategy. Section 5.4, Qualitative Screening evaluates this strategy and recommends this strategy to be eliminated.

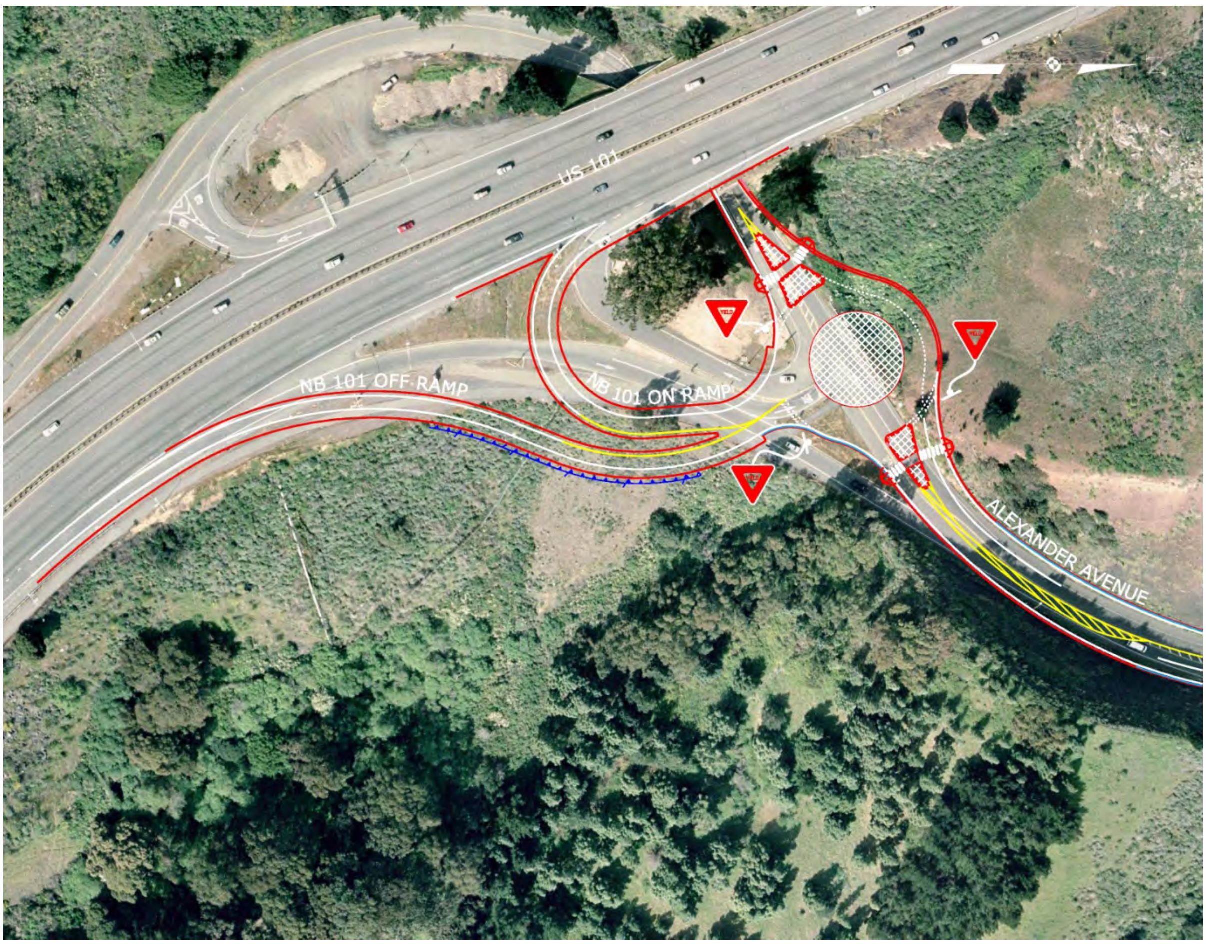
Figure 33
Strategy R-A3



Strategy R-A4 (Two-lane Roundabout for Southbound Alexander Avenue)

Strategy R-A4 constructs a roundabout similar to Strategy R-A3, but is a two-lane roundabout for the southbound Alexander Avenue movement into the roundabout and is considered a traffic calming measure to control volumes and operations. The on- and off-ramps to northbound US 101 will be reconfigured to improve geometry into the roundabout. The northbound US 101 off-ramp will require a retaining wall on the east side of the ramp along the steep section of fill approaching the roundabout. Table 28 and Table 29 and the discussion after the strategy descriptions analyze this strategy. Section 5.4, Qualitative Screening evaluates this strategy and recommends this strategy to be eliminated.

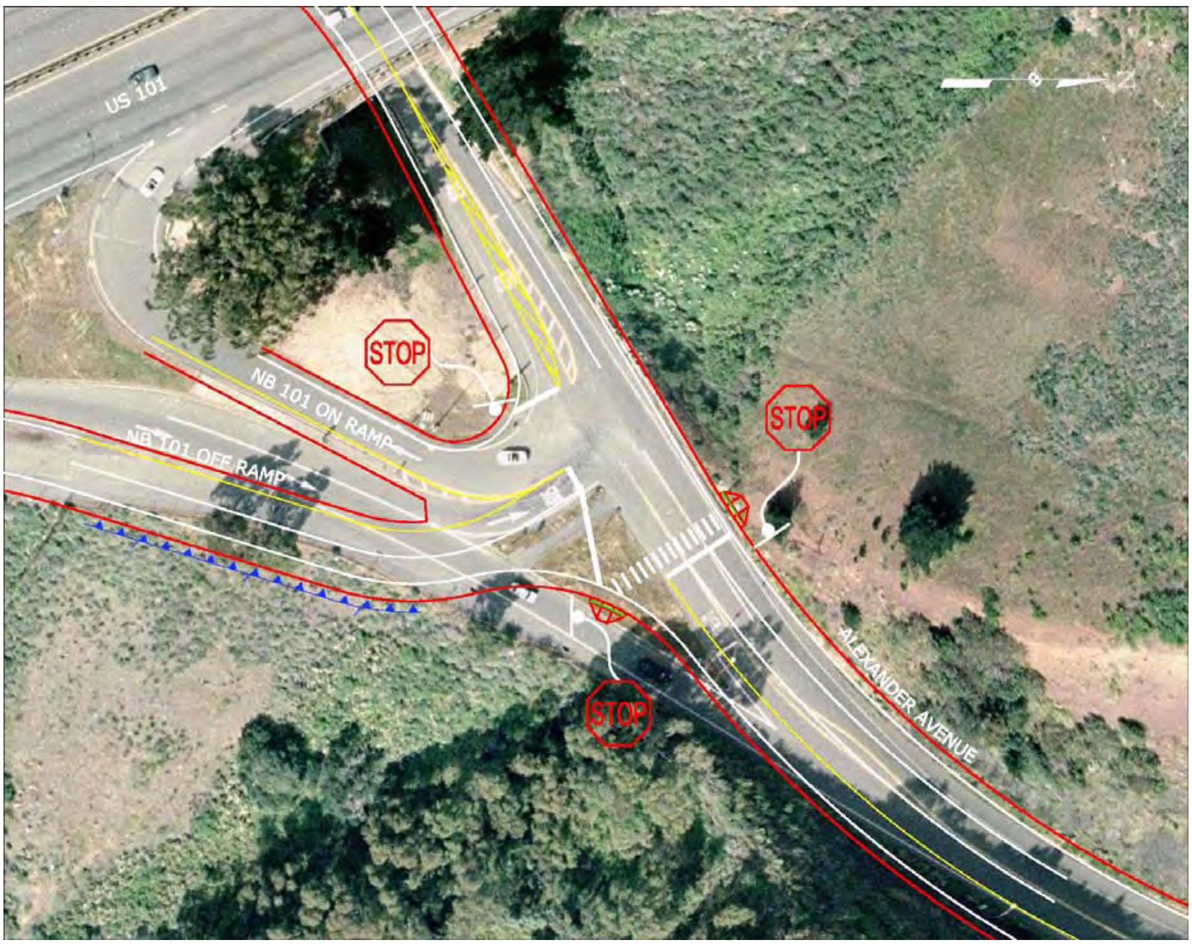
Figure 34
Strategy R-A4



Strategy R-A5 (AWSC with Two Southbound Alexander Avenue Lanes)

Strategy R-A5 installs stop signs on all approaches to the northbound US 101 ramps and Alexander Avenue intersection, similar to Strategy R-A3. An additional southbound Alexander Avenue through lane is also included. This additional lane would require the widening of the Alexander Avenue underpass under US 101. Similarly this option would also require reconfiguring the northbound US 101 off-ramp and installing a retaining wall on the east side of the ramp along the steep section of fill. Table 28 and Table 29 and the discussion after the strategy descriptions analyze this strategy. Section 5.4, Qualitative Screening evaluates this strategy and recommends this strategy to be eliminated.

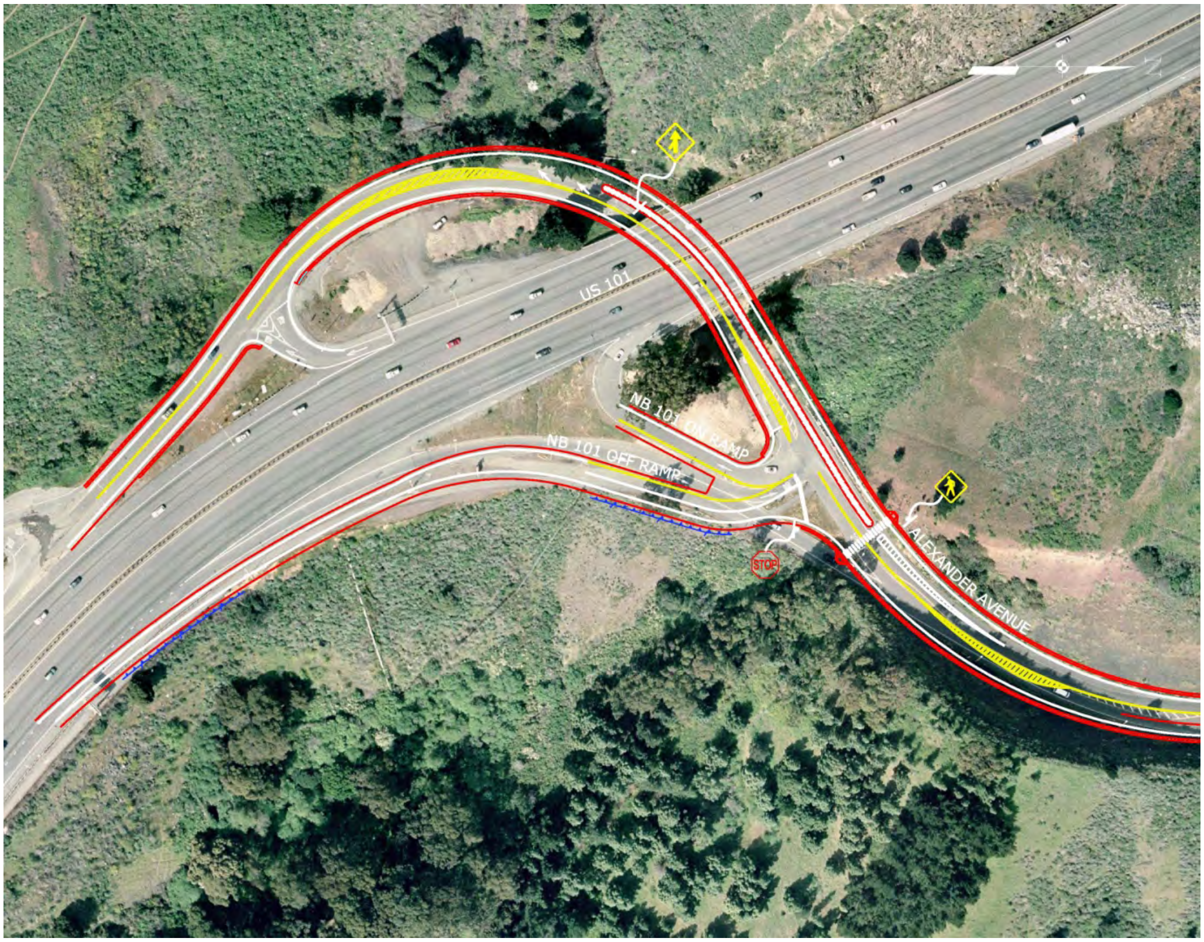
Figure 35
Strategy R-A5



Strategy R-A6 (Barrier-separated Southbound Alexander Avenue with AWSC)

Strategy R-A6 physically separates a dedicated southbound Alexander Avenue through lane from the intersection by a barrier or median. While the separated southbound movement is uncontrolled the barrier acts as a traffic calming measure to control volumes and operations. A southbound left-turn lane onto the northbound US 101 on-ramp is included as well. All intersection approaches are stop controlled, except the dedicated southbound lane. This additional dedicated lane would require the widening of the Alexander Avenue underpass under US 101. Table 28 and Table 29 and the discussion after the strategy descriptions analyze this strategy. Section 5.4, Qualitative Screening evaluates this strategy and recommends this strategy to be eliminated.

Figure 36
Strategy R-A6



Each of the roadway improvement options were modeled in SYNCHRO/SimTraffic and RODEL (for the roundabout option only), and evaluated to determine operational performance measures similar to existing conditions and the Baseline Alternative. Table 28 summarizes the weekday evening and weekend peak hour LOS and delays for each option. Because the volumes are significantly lower at all of the study area intersections during the morning weekday peak than the weekday evening and weekend hours, they were not analyzed for the future options. This information was obtained from SYNCHRO using HCM methodology and from RODEL for the roundabout analysis. The analysis assumed that a LOS D or better would be desirable in 2035 and operations of a LOS E or LOS F were not considered acceptable.

Table 28
Comparison of 2035 Alternatives Intersection LOS for Alexander Avenue and Northbound US 101 ramp

Strategy	Description	WD PM Peak Hour		WE Peak Hour	
		Delay (sec/veh)	LOS	Delay (sec/veh)	LOS
Existing	Existing 2009	22	C	227	F
Baseline	2035 Baseline	**57**	**F**	**>300**	**F**
Strategy R-A1	Signalize	9*	A	15*	B
Strategy R-A2	AWSC	14	B	**122**	**F**
Strategy R-A3	Roundabout	4*	A	12*	B
Strategy R-A4	Roundabout with two lanes on SB Alexander Avenue segment	2*	A	3*	A
Strategy R-A5	AWSC with two SB through lanes on Alexander Avenue	17	C	**38**	**E**
Strategy R-A6	Barrier separate SB Alexander Avenue through movement	14	B	23	C

** LOS and delay shown for overall intersection delay*
WD PM = weekday evening; WE = weekend

Several strategies reduce the weekday delay at the intersection to a LOS D or better, but the intersection remains at a failing LOS during the weekend peak hours. The strategies to signalize the intersection, construct a roundabout, and to construct a barrier-separated movement will all operate acceptably during both the weekday and weekend peak periods. Strategy R-A5 that provides two southbound through lanes on Alexander Avenue will operate at close to acceptable levels during the weekend peak, and if future volumes are slightly lower than anticipated, it will operate at an acceptable LOS D. It should be noted that standard practice for roundabouts is to report the 50^{th} percentile confidence level output for LOS and delay, which is shown in Table 29. The 85^{th} percentile confidence level output should also be considered in design, which shows the single-lane roundabout operating a LOS A (5.7 seconds delay) during the weekday evening peak and at a LOS F (54.7 seconds delay) during the weekend peak, which creates excessive queues for southbound traffic on Alexander Avenue because the southbound leg of the roundabout is nearing capacity. For this reason, the roundabout configuration with a two-lane section for southbound Alexander Avenue traffic was added to the analysis. The 85^{th} percentile confidence level for the double-lane roundabout operates at a LOS A (2.8 seconds delay during the weekday evening peak and at a LOS A (3.8 seconds delay) during the weekend peak.

Corridor operations within the project limits for the Baseline Alternative and each option are summarized in Table 29. This information was obtained from SimTraffic and reports the arterial LOS along Alexander Avenue between East Road and Conzelman Road.

Table 29
Comparison of 2035 Alternatives Arterial LOS for Alexander Avenue and Northbound US 101 Ramp

Strategy	Description	Segment	2035 WD PM		2035 WE	
			Average Speed (mph)	LOS	Average Speed (mph)	LOS
Baseline	2035 Baseline	Conzelman to East Road (NB)	35	B	34	B
		East Road to Conzelman (SB)	39	A	37	A
Strategy R-A1	Signalize	Conzelman to East Road (NB)	33	B	29	B
		East Road to Conzelman (SB)	37	A	33	B
Strategy R-A2	AWSC	Conzelman to East Road (NB)	35	B	33	B
		East Road to Conzelman (SB)	35	B	24	C
Strategy R-A3	Roundabout	Conzelman to East Road (NB)	35	B	34	B
		East Road to Conzelman (SB)	35	B	19	D
Strategy R-A4	Roundabout with two lanes on SB Alexander Avenue segment	Conzelman to East Road (NB)	34	B	34	B
		East Road to Conzelman (SB)	34	B	34	B
Strategy R-A5	AWSC with two SB through lanes on Alexander Avenue	Conzelman to East Road (NB)	34	B	29	B
		East Road to Conzelman (SB)	36	A	34	B
Strategy R-A6	Barrier separate SB Alexander Avenue through movement	Conzelman to East Road (NB)	34	B	30	B
		East Road to Conzelman (SB)	33	B	30	B

WD PM = weekday evening; WE = weekend

Several of the options from Table 29 show a negligible difference compared to baseline conditions. Signalizing the intersection (Strategy R-A1) would impact average arterial speeds from 2 to 5 mph in both the northbound and southbound direction during the peak periods. Converting the intersection to AWSC (Strategy R-A2) would not impact northbound operations, but would degrade southbound speeds by 5 mph in the evening peak and by 13 mph during the weekend peak.

For a one-lane roundabout (R-A3), traffic operations are slightly improved in the northbound direction, but decrease by 5 mph during the evening peak and by 18 mph during the weekend peak. For the two-lane roundabout (R-A4), traffic operations are the same as with a one-lane roundabout in the northbound direction, but the added capacity for the southbound movement improves the southbound operations to 34 mph in the southbound direction during both the evening and weekend peak hours.

Strategy R-A5, which adds a southbound lane of traffic approaching the intersection and carries it through the tunnel, would degrade operations in the southbound direction by 3 mph over baseline conditions in the southbound direction and by 1 to 5 mph in the northbound direction.

Barrier separating southbound through traffic (Strategy R-A6) would create a negligible difference in southbound traffic operations because traffic would remain free-flowing, and would slightly decrease northbound operations by up to 3 mph. Strategy R-A6, however, would create an undesirable weaving issue because the majority of vehicles making a left turn from the northbound US 101 off-ramp would then turn right at Conzelman Road, and much of the southbound through traffic on Alexander Avenue would use the US 101 on-ramp, which would be accessed from the left lane.

Strategies R-B1 (Two Lanes) and R-B2 (Three Lanes) (Alexander Avenue/US 101 Underpass Strategies)

The Alexander Avenue/US 101 underpass does not meet current design criteria for shoulder width, sight distance, and vertical clearance. To improve the underpass and coordinate with strategies R-A4a, R-A5 and R-A6, two underpass strategies were developed R-B1 and R-B2. Note that both of these strategies overlap with strategy BP-L.

Strategy R-B1 (Two Lanes)

Strategy R-B1 includes structure improvements to provide adequate shoulder widths, sight distance, and vertical clearance for strategies that include two travel lanes on Alexander Avenue. Figure 37 represents a potential layout for this strategy. It also includes a representation of the potential additional structure needed to accommodate an improved southbound US 101 off-ramp at Alexander Avenue (Strategy R-C5). Section 5.4, Qualitative Screening evaluates this strategy and recommends this strategy to be carried forward.

Strategy R-B2 (Three Lanes)

Strategy R-B2 includes structure improvements to provide adequate shoulder widths, sight distance, and vertical clearance for strategies that include three travel lanes on Alexander Avenue. It also includes a representation of the potential additional structure needed to accommodate an improved southbound US 101 off-ramp at Alexander Avenue (Strategy R-C5). Figure 38 represents a potential layout for this strategy. Section 5.4, Qualitative Screening evaluates this strategy and recommends this strategy to be eliminated.

Figure 37
Strategy R-B1
(Two 12-foot Lanes with 8-foot Bicycle lanes)

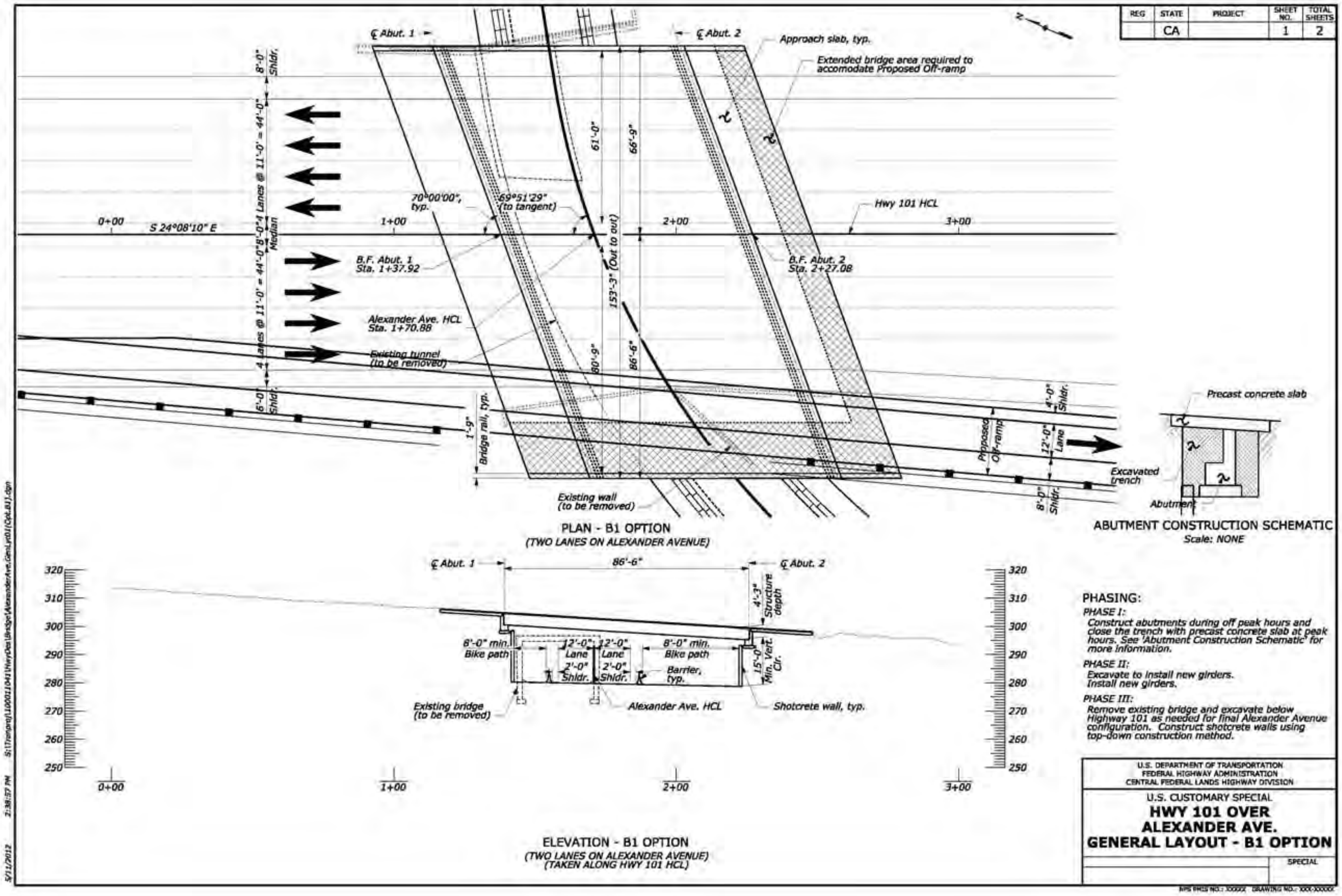
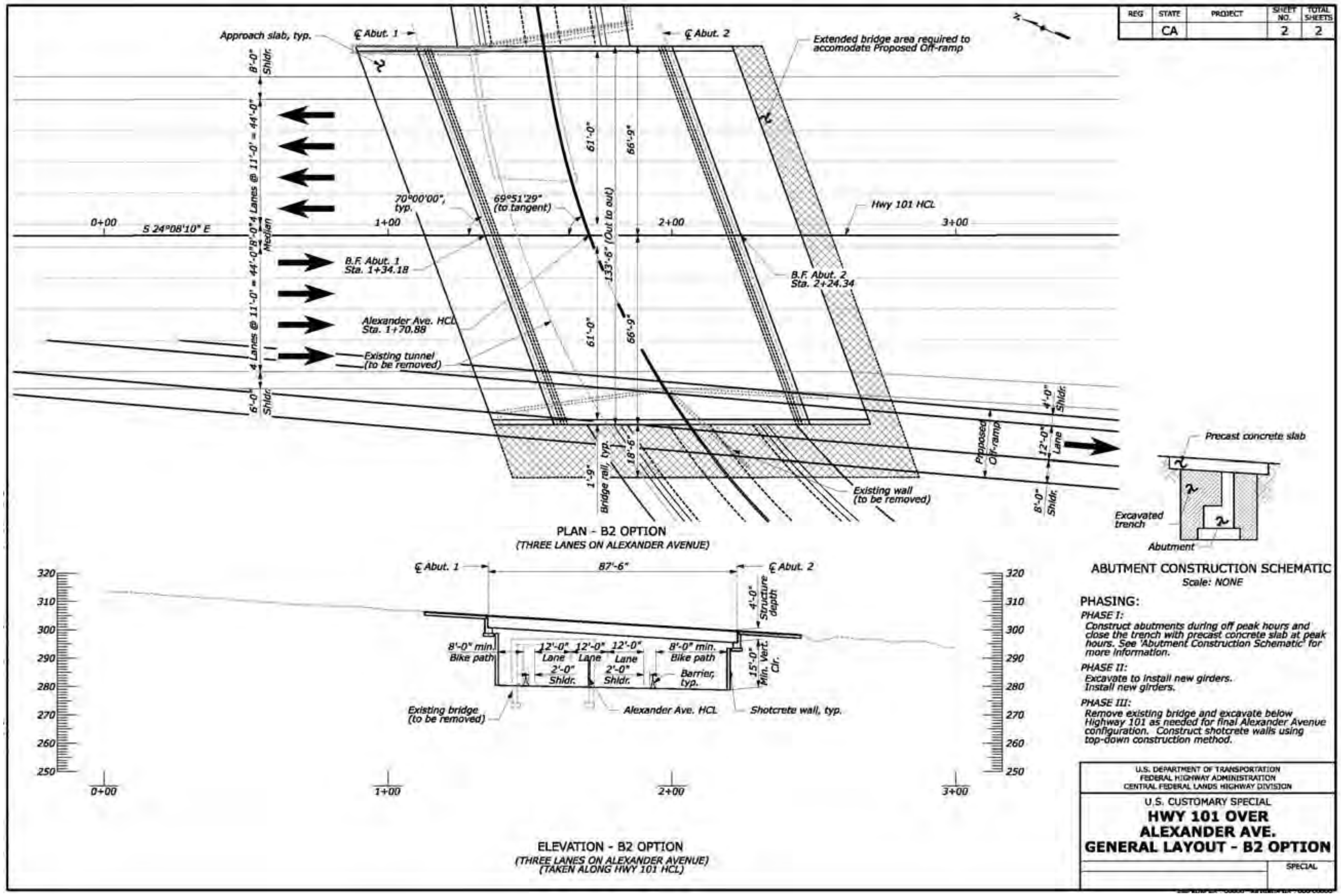


Figure 38
Strategy R-B2
(Three 12-foot Lanes with 8-foot Bicycle Lanes)



The existing US 101 has four 11 foot lanes in each direction with wide shoulders and has a high ADT throughout the year. US 101 is a local and regional lifeline route. Closure of the highway for construction will cause significant traffic backup and would not be a preferred construction method. Given the traffic volumes it carries, reduction in lanes during peak travel demand periods is not desirable. Minimization of delay to US 101 users was determined to be the primary design constraint for this structure.

Bedrock was seen at the site. Spread footings were used for the existing bridge. No seismic data are available for this project at the time of writing this report. Based on site observation and geotechnical information available in the as built plans of existing structure, spread footings could be anticipated for the proposed structure.

An important consideration for the construction of the structure is maintaining vehicular access along US 101 and Alexander Avenue. Minimizing the US 101 highway user delay requires consideration of various method of construction, which in turn, determines the structure alternatives. One potential method of construction is discussed below.

A replacement structure composed of precast adjacent box beams with concrete overlay can be built within a very limited construction time during off-peak hours. Stub abutments supported on spread footing foundations can be installed across the width of US 101 in multiple transverse phases. It can be either cast-in-place or precast. The abutment trench can be closed by precast slabs to allow US 101 traffic during the day. Once these abutments are complete, adjacent box beams can be placed in single or multiple transverse phases (depending on the rate at which excavation occurs) to create a fully self-supporting bridge structure. Excavation for the widened Alexander Avenue typical section can then commence in a top-down fashion with no further effect on US 101 traffic. Shotcrete walls can be used to retain earth. Demolition of the existing concrete portal frame top slab will require a limited closure of Alexander Avenue. The new width of the proposed Alexander Avenue typical section can be used during construction of the structure to keep Alexander Avenue open to limited traffic during construction. For phasing notes, see Figure 37 and Figure 38.

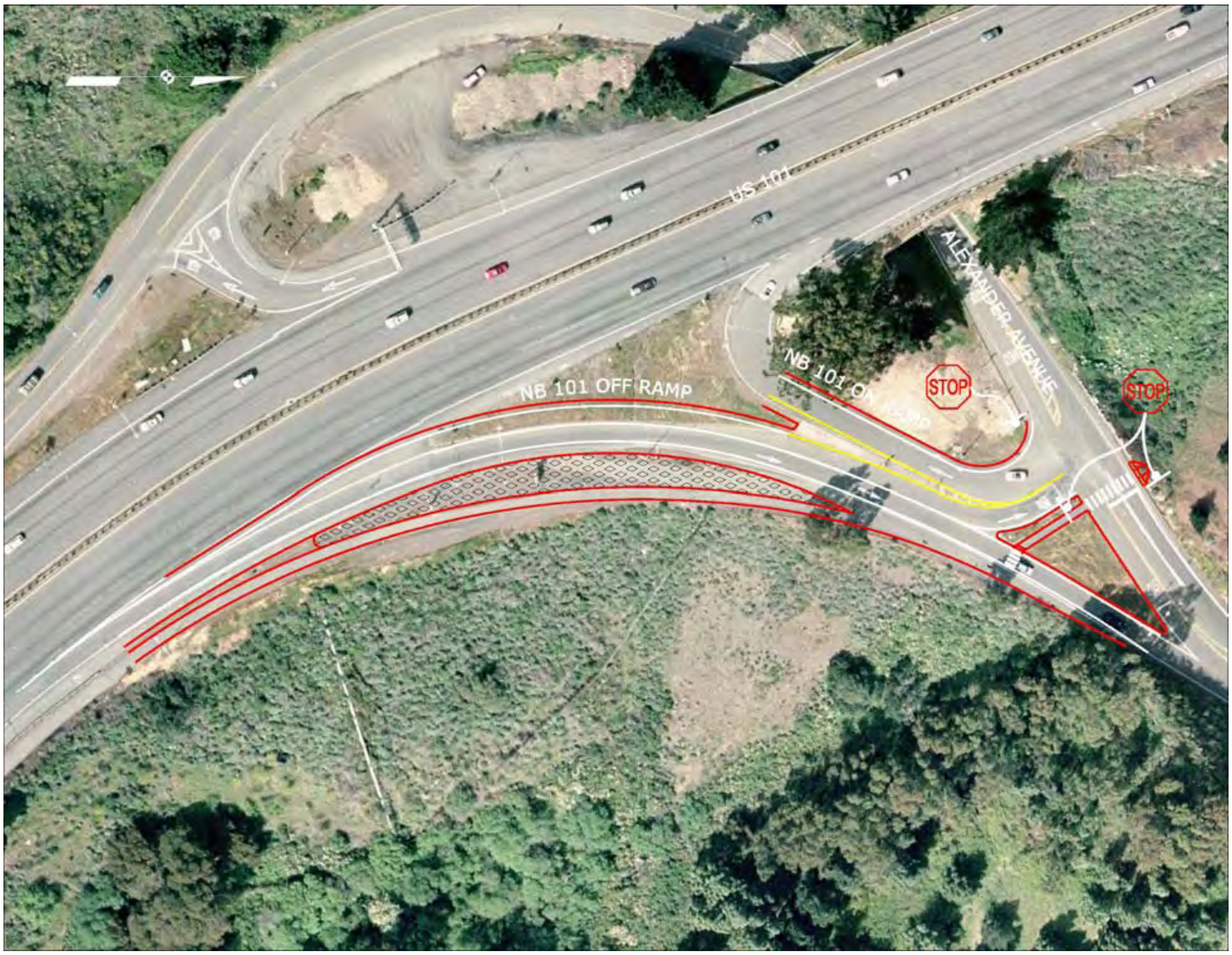
Strategies R-C1 to R-C5 (Alexander Avenue/US 101 Interchange Strategies)

Interchange strategies for the Alexander Avenue/US 101 interchange focused on improving ramp geometry where appropriate, the northbound acceleration lane, and the southbound deceleration lane as these were the key deficiencies noted during the existing conditions analysis.

Strategy R-C1

Strategy R-C1 extends the northbound US 101 off-ramp auxiliary lane to provide additional storage for vehicles turning left onto southbound Alexander Avenue. The intersection configuration remains the same as existing. Strategy R-C1 is shown in Figure 39. Section 5.4, Qualitative Screening evaluates this strategy and recommends this strategy to be carried forward.

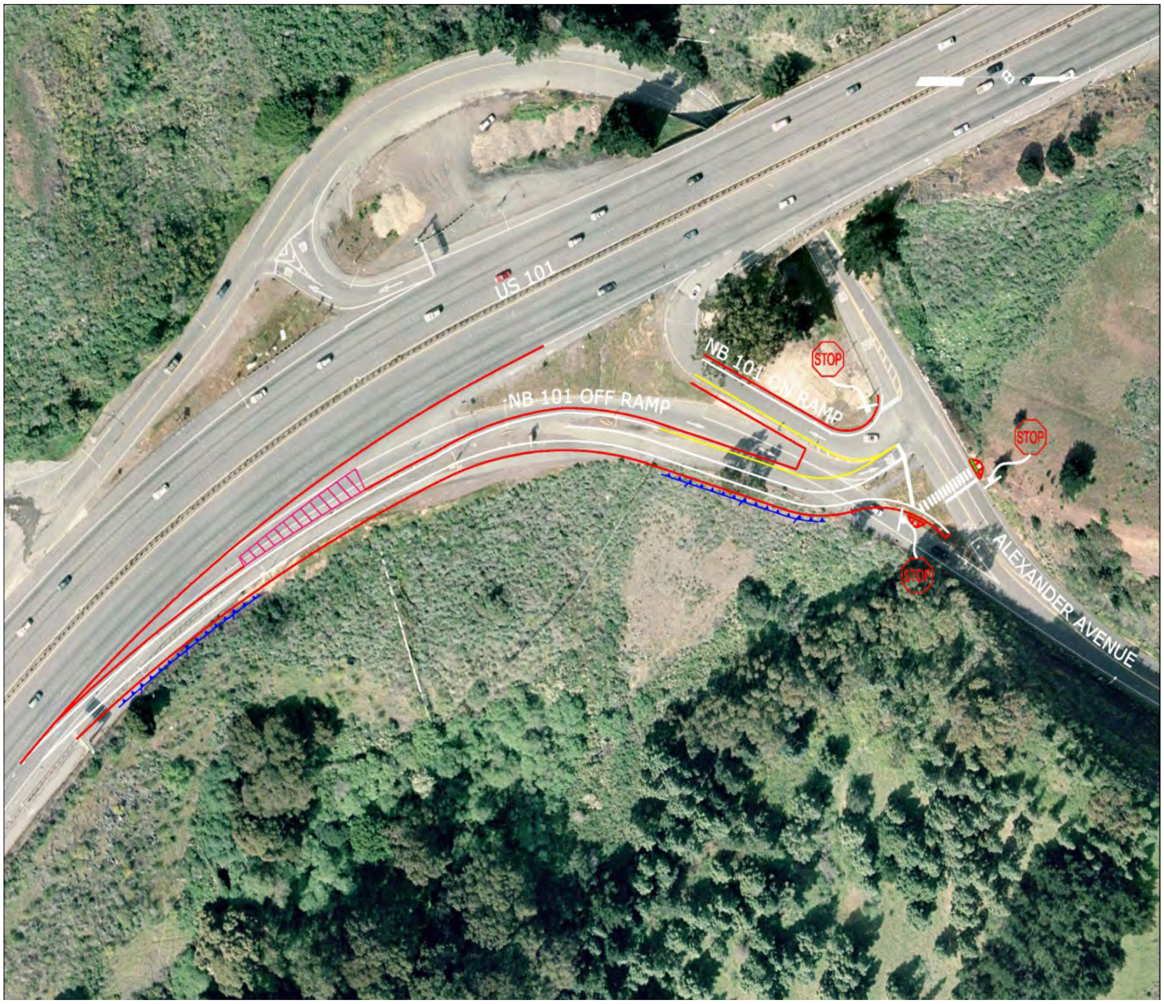
Figure 39
Strategy R-C1



Strategy R-C2

Strategy R-C2 reconfigures the northbound US 101 off-ramp to provide better geometry at the Alexander Avenue intersection, extends the auxiliary lane to provide additional storage for vehicles turning left onto southbound Alexander Avenue, and eliminates the free right onto southbound Alexander Avenue. Strategy R-C2 is shown in Figure 40. Section 5.4, Qualitative Screening evaluates this strategy and recommends this strategy to be carried forward.

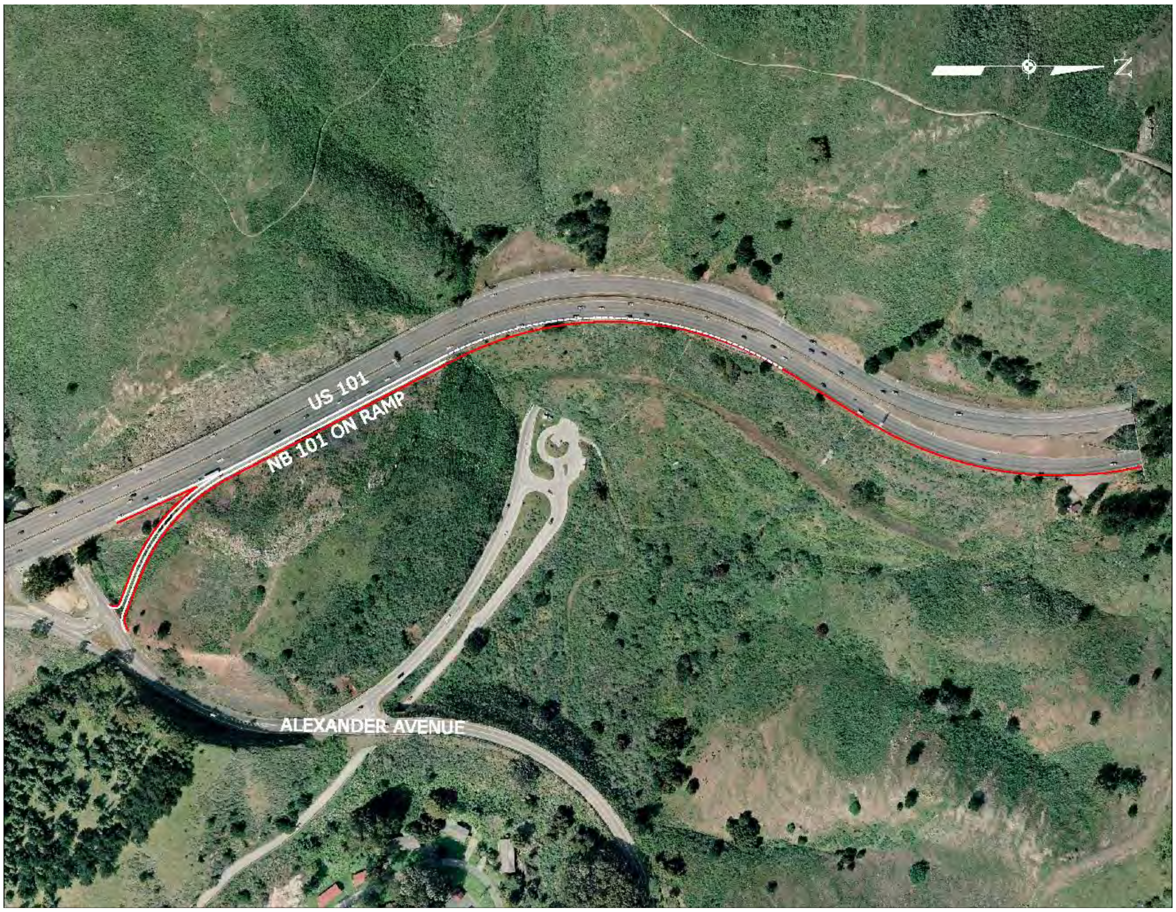
Figure 40
Strategy R-C2



Strategy R-C3

Strategy R-C3 reconfigures the northbound US 101 on-ramp to a diamond configuration and extends the acceleration lane to current standards. The intersection control at Alexander Avenue could be AWSC, signal, or a roundabout. Strategy R-C3 is shown in Figure 41. Section 5.4, Qualitative Screening evaluates this strategy and recommends this strategy to be eliminated.

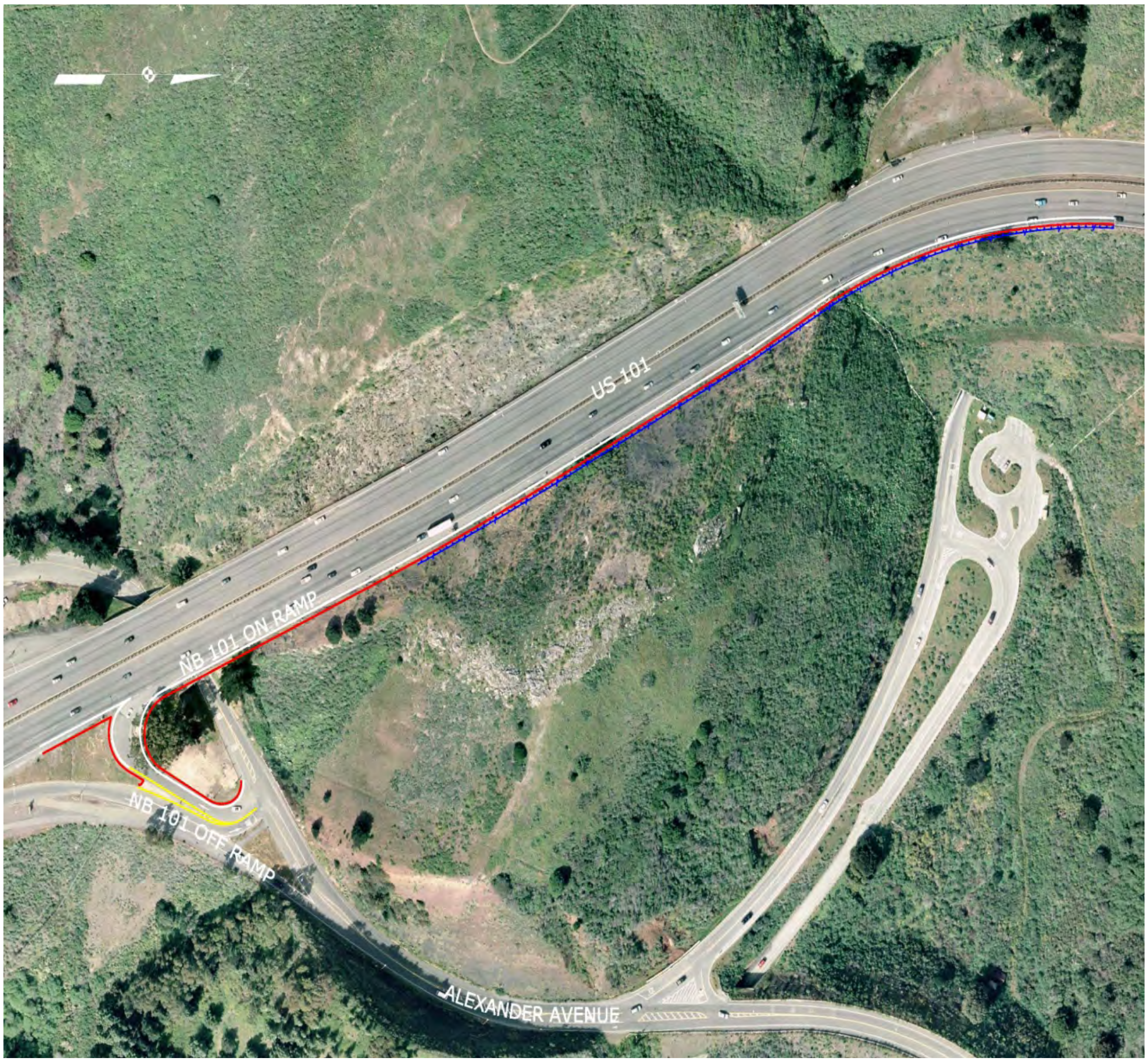
Figure 41
Strategy R-C3



Strategy R-C4

Strategy R-C4 extends the existing acceleration lane to current design standards. The geometry of the hook ramp would remain the same. The intersection control at Alexander Avenue could be AWSC, signal, or a roundabout. Strategy R-C4 is shown in Figure 42. Section 5.4, Qualitative Screening evaluates this strategy and recommends this strategy to be carried forward.

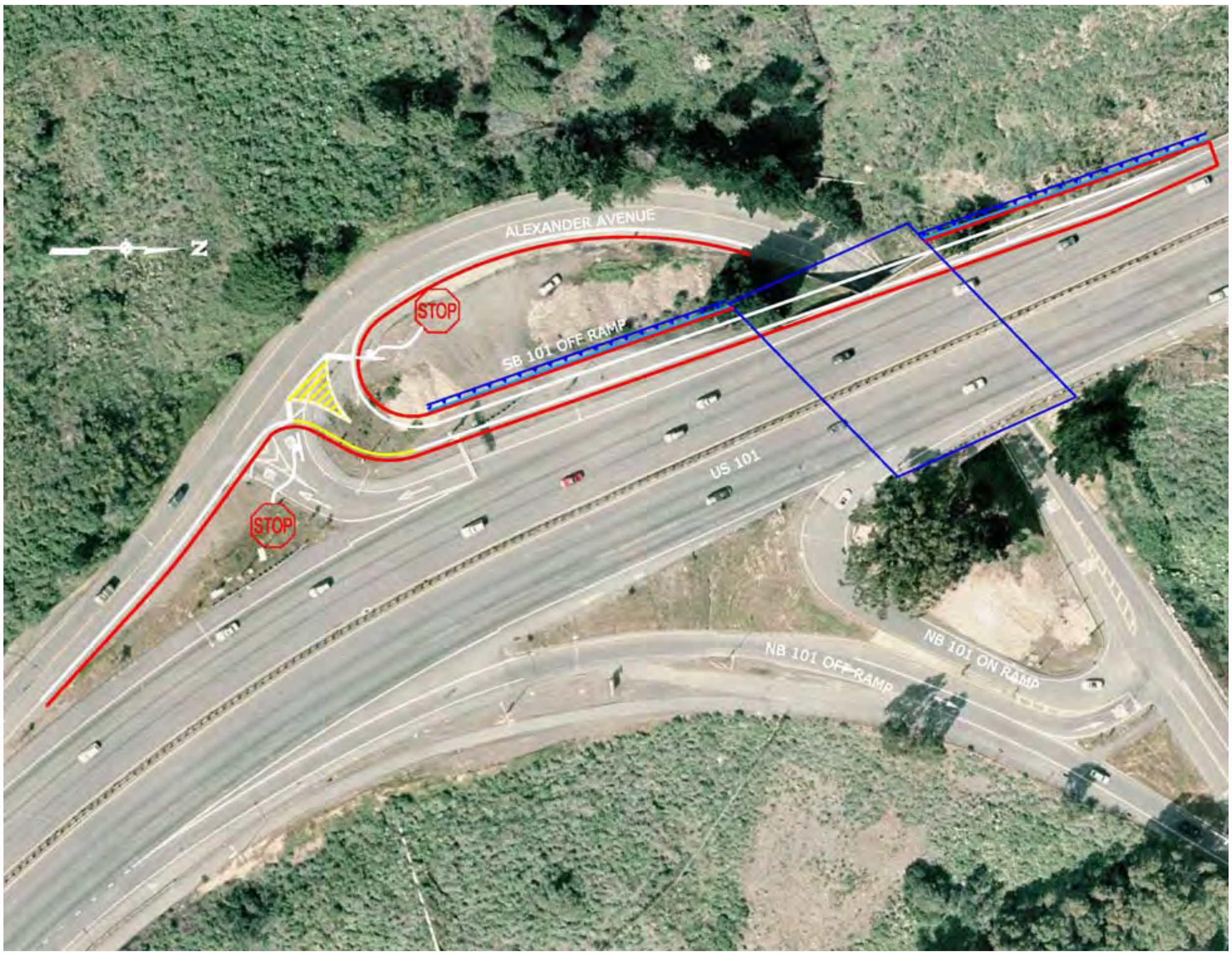
Figure 42
Strategy R-C4



Strategy R-C5

Strategy R-C5 extends the existing southbound US 101 off-ramp deceleration lane to maximize available area. Due to the large rock cut slope on the west side of US 101, there are limitations on the deceleration length that can be provided. In addition, the US 101/Alexander Avenue structure will need to be widened to accommodate the realigned off-ramp. Strategy R-C5 is shown in Figure 43. Section 5.4, Qualitative Screening evaluates this strategy and recommends this strategy to be carried forward.

Figure 43
Strategy R-C5



Corridor-wide Roadway Strategies (R-D1 to R-D4)

Corridor-wide roadway strategies seek to review specific strategies that would improve the entire corridor or longer sections of the corridor, rather than one intersection or structure. Four corridor-wide strategies were developed for review:

- **Strategy R-D1.** Improved wayfinding and warning signage, channelization, turning radii, and traffic calming.
- **Strategy R-D2.** Signalized corridor.
- **Strategy R-D3.** Additional southbound Alexander Avenue travel lane
- **Strategy R-D4.** Event management.

Strategy R-D1

Strategy R-D1 provides recommended posted speeds, general improved informational wayfinding and warning signage, channelization and pavement markings for vehicle and bicycle, improved turning radii at intersections where needed, and traffic calming measures at critical areas along the corridor.

Posted speeds. It is recommended that the posted speed not be higher than the design speed of Alexander Avenue. Based on the existing conditions design review presented in Section 3.2, the geometric alignment suggests a design speed of 40 mph throughout the majority of the corridor. In the vicinity of the US 101 interchange, the geometric alignment suggests a 35 mph design speed.

Near the City of Sausalito from East Road to the city limits, it is suggested that a 25 mph design speed be used due to the change in roadway characteristics within the city limits.

Wayfinding signage. The NPS is in the process of implementing wayfinding for the GGNRA locations. These signs should be incorporated into roadway strategies as improvements are implemented. Wayfinding should also provide signing at a level for bicycles and pedestrians at key decision locations. For example, informational signing at the north end of Vista Point where bicycles and pedestrians would make a decision to use the Vista Point Trail (Strategy BP-C1) or Alexander Avenue (Strategy BP-O). Informational signing could include length of route, elevation gain/loss with a profile, and interesting points along the route.

Wayfinding for vehicles should be limited to GGNRA locations only. The City of Sausalito and Caltrans worked successfully together in the past to address operational issues with using Alexander Avenue as a main entrance point to the city. Due to the sharp curves, steep grades, narrow roadway width, and local resident traffic, Alexander Avenue functions differently for vehicles within the city limits than it does between US 101 and the city limits. Wayfinding to direct bicycles and pedestrians to the city should be incorporated into the strategy.

Warning signs. This component of the strategy reviews and improves warning sign placement for bicycles, pedestrian, and vehicles to warn each other of conflict points, sharp curves, steep grades, and other potential hazards. For example, a conflict point identified during the study process was for southbound US 101 on-ramp traffic at Alexander Avenue conflicting with bikes traveling northbound from Upper Conzelman Road.

All signing should avoid sign clutter such as at the Sausalito city limits and the US 101 underpass. Maintaining overgrowth of vegetation would also help signing be more effective.

Channelization and pavement markings. Throughout the corridor, channelization for vehicles should be well-defined and consistent and allow for bicycle markings where appropriate. For example, two major conflict points identified during the study process. The first is where southbound Alexander Avenue bicycles traveling on the shoulder turn left at the US 101 northbound off-ramp to get to the shared use path on the east side of US 101 to Vista Point. The second is where vehicles, bicycles, pedestrians, and parked vehicles converge as they enter the Sausalito city limits traveling northbound on Alexander Avenue.

Improved turning radii. As strategies are implemented, turning radii for buses should be reviewed to ensure improvements are properly designed. Bus movements occur throughout the corridor.

Traffic calming. With the unique user characteristics of the corridor, at the time of preliminary design of improvement strategies, traffic calming measures should be reviewed for incorporating appropriate measures at key locations. These locations would be:

- Northbound Alexander Avenue approach the Sausalito city limits
- Both directions of Alexander Avenue between Danes Drive and Conzelman Road

Potential traffic calming options are:

- Narrowed lanes (Narrow lanes are reviewed in Strategies BP-TS1 through BP-TS4)
- Cautionary signs
- Portable speed limit sign and radar speed trailer
- Permanent dynamic speed display signs
- Center islands
- Police enforcement

Section 5.4, Qualitative Screening evaluates this strategy and recommends this strategy to be carried forward.

Strategies R-D2 to R-D4 analyze the effects that several intersection-related improvements would have on the corridor. These strategies could be pieced together differently, but in order to look at corridor-wide options, they were grouped together to show how various options would affect the entire study area. Because all of the intersections, except the northbound US 101 ramps, operate acceptably during the weekday peak hours and because overall volumes are highest on the weekends, only weekend traffic was analyzed for these alternatives.

The intersections anticipated to have failing movements during the 2035 weekend peak hours, even with the auxiliary lane improvements that will be implemented by 2012, are:

- Alexander Avenue and Conzelman Road
- Alexander Avenue and southbound US 101 off-ramp

- Alexander Avenue and northbound US 101 ramps
- Alexander Avenue and Danes Drive

Strategy R-D2

Strategy R-D2 signalizing the northbound US 101 ramps was modeled, and the intersections of Alexander Avenue with the southbound US 101 off-ramp and Danes Drive were also signalized. This results in a LOS C or better at all of the corridor intersections with the exception of Conzelman Road, and results in an arterial LOS of C in both the northbound and southbound directions. This strategy can be seen in Figure 44. Section 5.4, Qualitative Screening evaluates this strategy and recommends this strategy to be carried forward.

Strategy R-D3

Another strategy considered for the corridor, Strategy R-D3, was to construct a three-lane through section with two lanes in the southbound direction along Alexander Avenue from approximately 400 feet south of Danes Drive to Conzelman Road. This option was combined with the northbound US 101 ramp, Strategy R-A5, and the intersection of Alexander Avenue and the northbound US 101 ramps was converted to AWSC. This alternative does not mitigate Danes Drive and Alexander Avenue, and results in a LOS E at the northbound US 101 ramps; however, the two-lane section south of the northbound ramp results in intersection operations of LOS C and B at the southbound US 101 ramps and at Conzelman Road, respectively. In addition, the corridor-wide operations are a LOS B in both directions. This strategy would require the existing US 101 underpass to be reconstructed to accommodate an additional southbound lane of traffic. This strategy is shown in Figure 45. Section 5.4, Qualitative Screening evaluates this strategy and recommends this strategy to be eliminated.

Figure 44
Strategy R-D2 (Signalized Corridor)

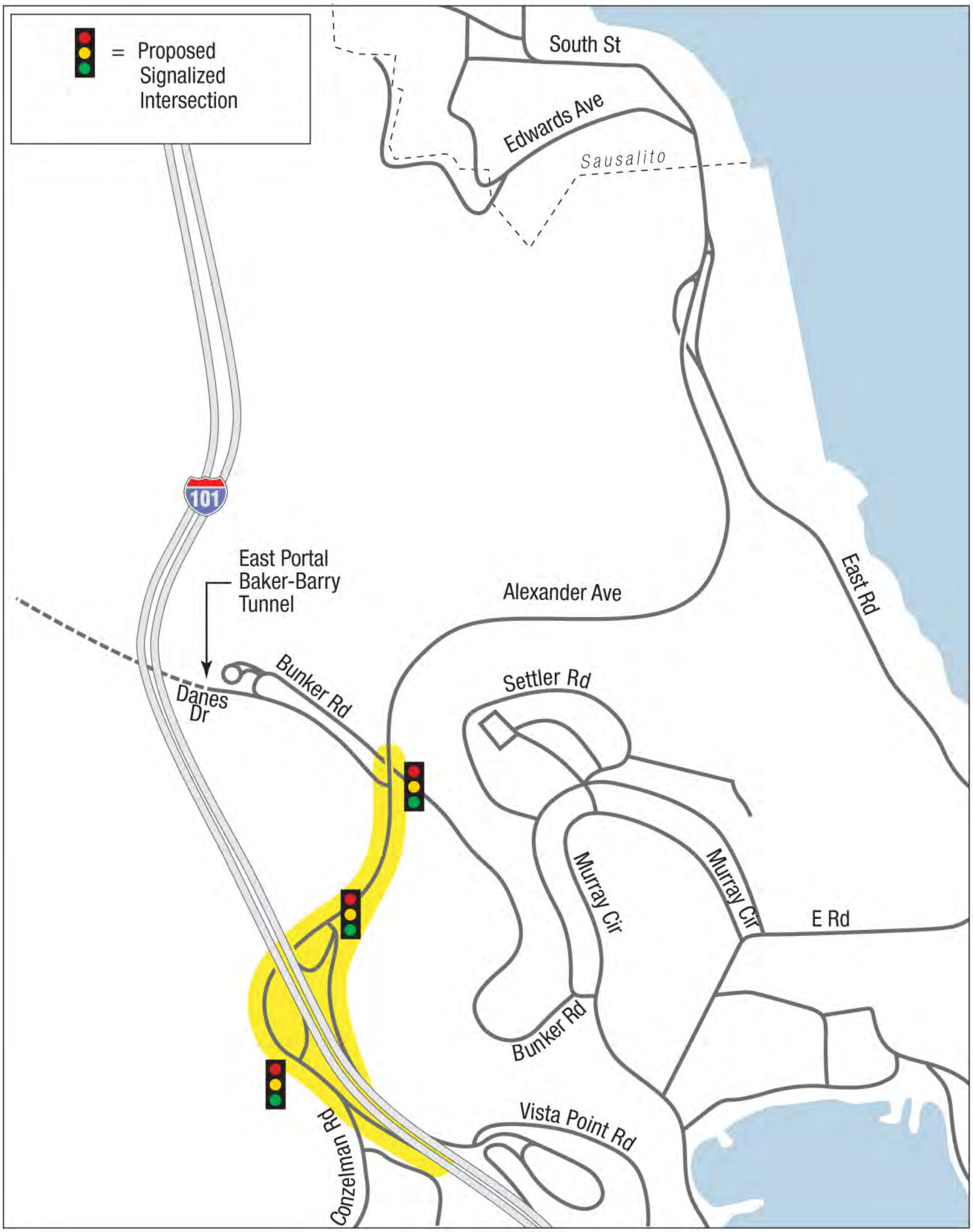
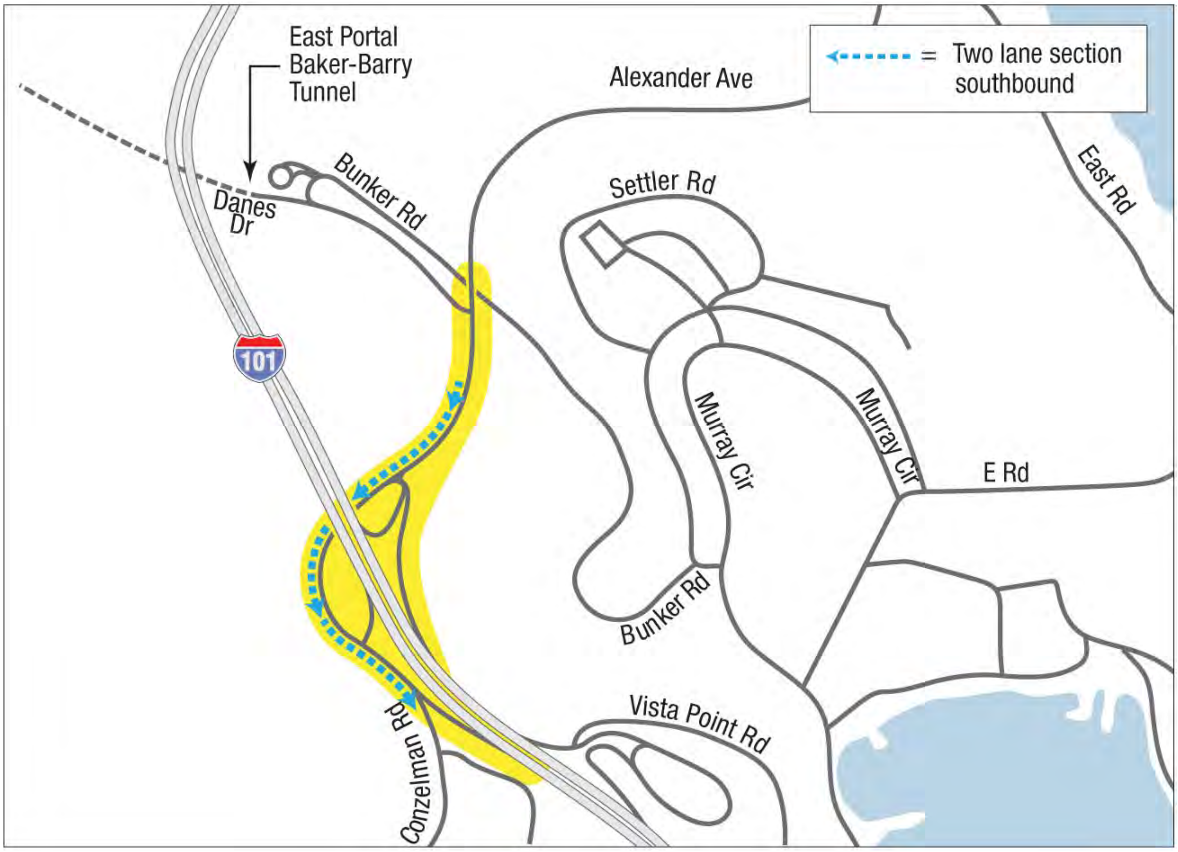


Figure 45
Strategy R-D3 (Two Southbound Lanes)



Strategy R-D4

Strategy R-D4 implements special event traffic management plans within Fort Baker on Bunker Road and East Road during peak weekend times. Event management is a technique that allows agencies to proactively manage and control traffic for planned special events. Special events can cause congestion and unexpected delays to users above and beyond normally expected peak periods. While there are many alternatives to manage special event traffic volumes, one scenario was analyzed to quantitatively compare it to other alternatives. Traffic exiting Fort Baker was only allowed to use East Road (assumed the west leg was converted to one-way for exiting traffic only during special event periods), and Bunker Road at Danes Drive was converted to an entrance only. Left turns from Danes Drive onto Alexander Avenue would also be restricted during peak weekend times. This alternative was paired with the roundabout, Strategy R-A4, for a two-lane roundabout on the southbound Alexander Avenue segment. This strategy significantly reduced the delay at the intersection of Danes Drive and Alexander Avenue, and resulted in a corridor LOS B in both the northbound and southbound directions. This alternative did not consider improvements at the southbound US 101 exit ramp or Conzelman Road. If a second southbound lane could be added to Alexander Avenue from south of the US 101 underpass to Conzelman Road, the overall LOS would be improved at these intersections. This strategy can be seen in Figure 46. Section 5.4, Qualitative Screening evaluates this strategy and recommends this strategy to be carried forward.

Figure 46
Strategy R-D4 (Event Management)

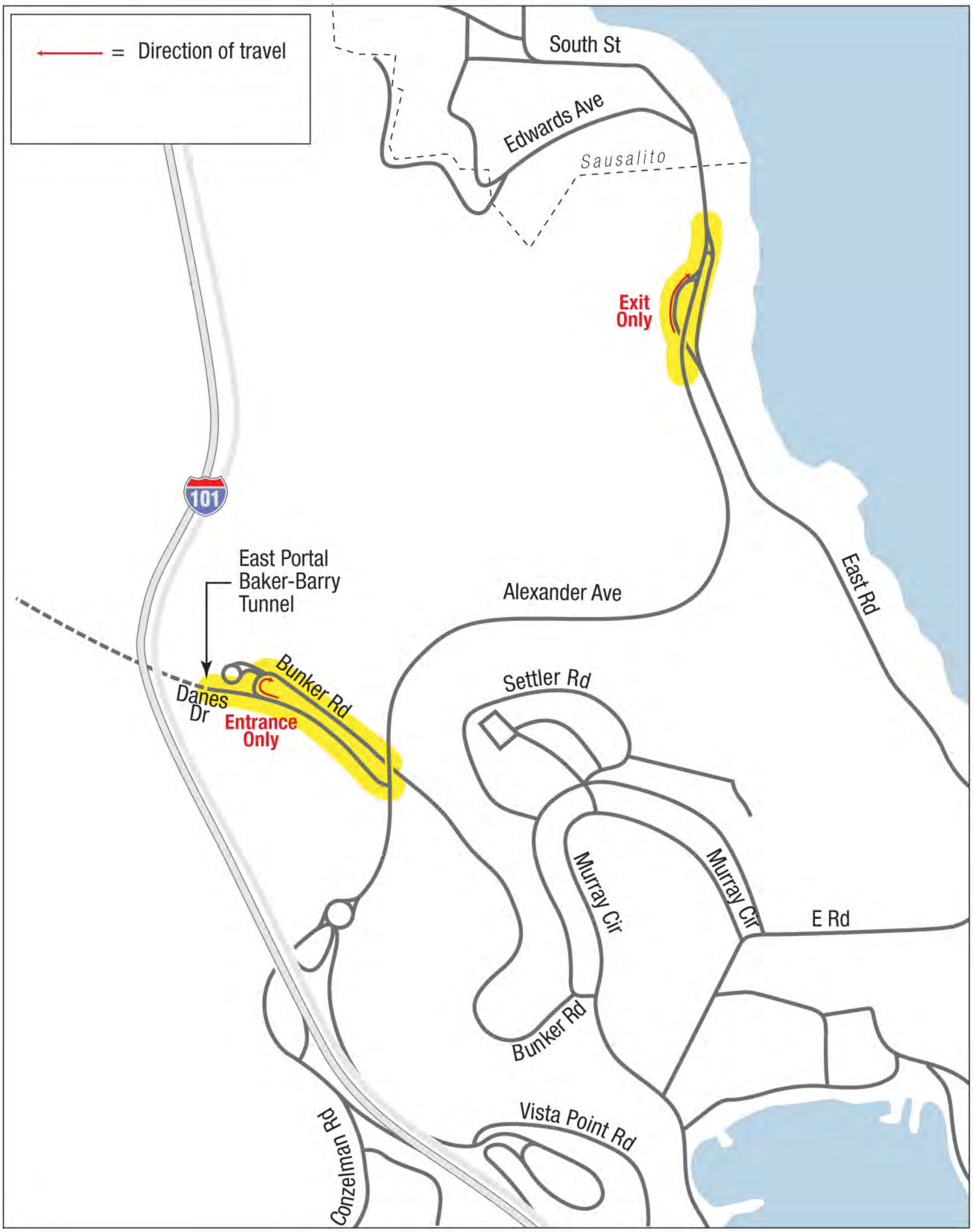


Table 30 summarizes the study intersections LOS and delay for each of the corridor strategies. Table 31 compares arterial LOS for each corridor strategy.

Table 30
2035 Intersection LOS Alternatives for Corridor Improvements

Intersection	Baseline		Strategy R-D2 (Signalized corridor)		Strategy R-D3 (Two SB lanes)	
	Overall Delay (sec/veh)	Overall LOS	Overall Delay (sec/veh)	Overall LOS	Overall Delay (sec/veh)	Overall LOS
Alexander Ave/Conzelman Road	**56**	**F**	47	E	27	D
Alexander Ave/SB 101 off-ramp	**63**	**F**	16	B	17	C
Alexander Ave/NB 101 ramp	**>300**	**F**	22	C	38	E
Alexander Ave/Danes Drive	**70**	**F**	20	B	132	F
Alexander Ave/East Road (east leg)	18	C	17	C	17	C
Danes Drive/Bunker Road	20	C	9	A	9	A

Table 31
2035 Arterial LOS for Corridor Improvements

Strategy	Description	Segment	2035 WE	
			Average Speed (mph)	LOS
Baseline	2035 Baseline	Conzelman to East Road (NB)	34	B
		East Road to Conzelman (SB)	38	A
R-D2	Signalize Danes Drive, NB 101 ramps, and SB 101 ramps	Conzelman to East Road (NB)	24	C
		East Road to Conzelman (SB)	23	C
R-D3	Two southbound Alexander Ave lanes	Conzelman to East Road (NB)	29	B
		East Road to Conzelman (SB)	33	B

5.3.2 Bicycle and Pedestrian Improvement Strategies

Bicycle and pedestrian strategies were broken down into components to isolate specific areas of concern. Strategies BP-A through BP-O were initially developed for review. Additionally, Alexander Avenue typical sections that improve the corridor to specifically address pedestrian and bicycle use were developed. The typical section strategies are BP-TS1 through BP-TS4.

Bicycle and Pedestrian Components

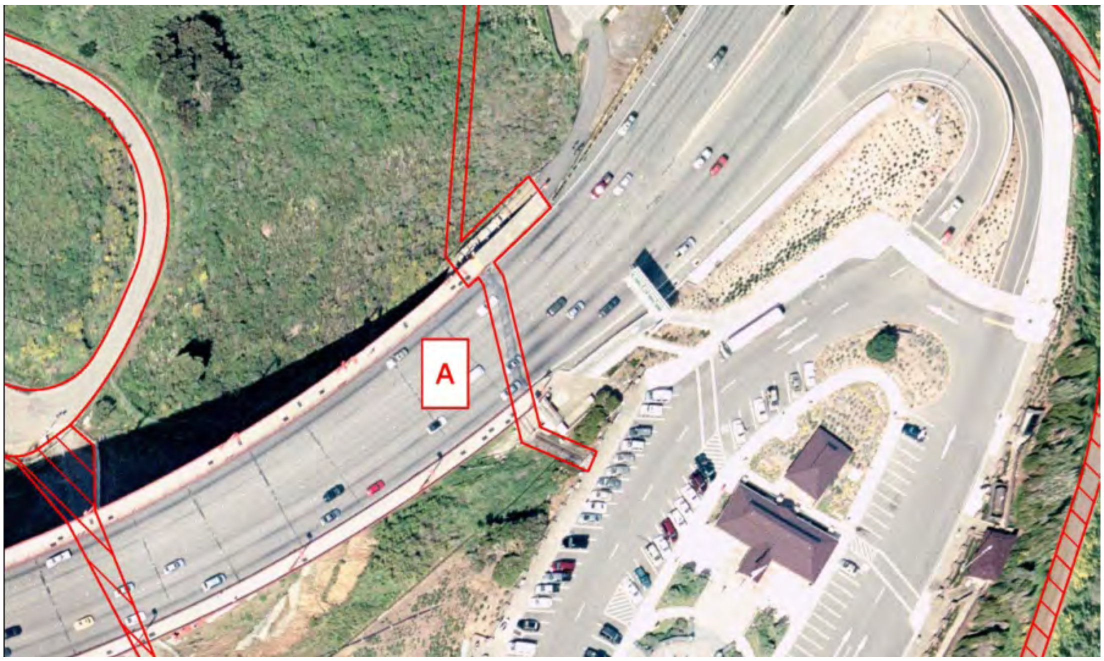
Figure 47 shows an overview of conceptual alignments for bicycle and pedestrian improvement strategies.

Figure 47
Bicycle and Pedestrian Improvement Strategy Components

Strategy BP-A

Strategy BP-A provides ramped access to Vista Point on the east side of the existing Golden Gate Bridge walkway between the northwest bridge parking lot and Vista Point. Ramped access is potentially a ramp on grade or a ramp on structure. Currently, there is only stairway access. Bicyclists must dismount and either carry their bicycles or use existing running boards to walk bicycles down the stairway. Figure 48 shows the location of the ramped access.

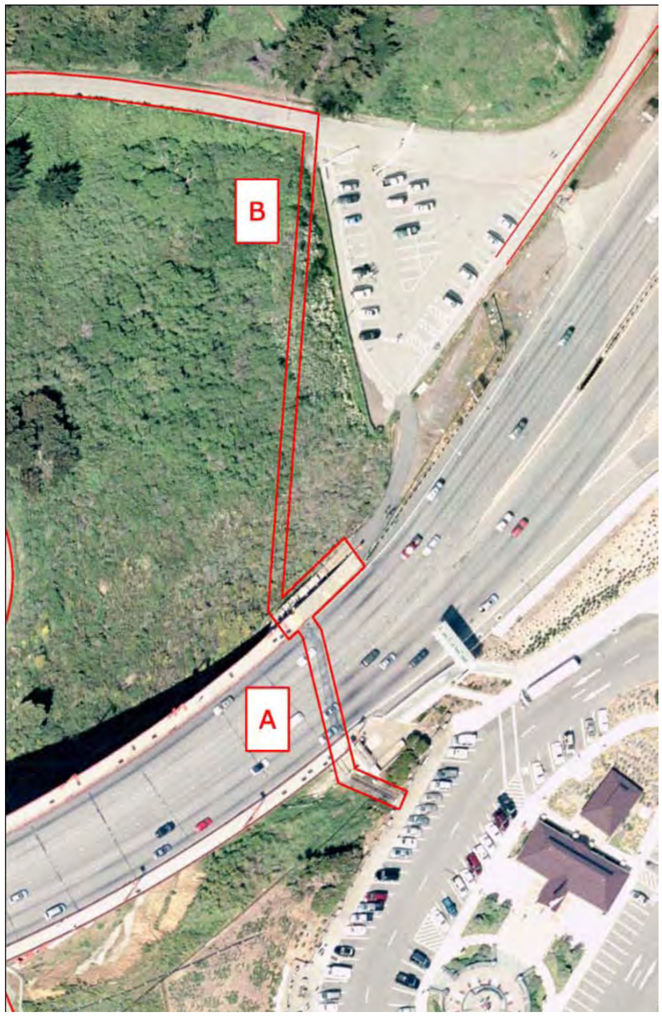
Figure 48
Strategy BP-A (East Side Golden Gate Bridge Walkway Ramp Access)



<u>Strategy BP-B</u>

Strategy BP-B provides ramped access to the northwest bridge parking lot on the west side of the existing Golden Gate Bridge walkway between the northwest bridge parking lot and Vista Point. Currently, there is only stairway access. Bicyclists must dismount and either carry their bicycles or use existing running boards to walk bicycles down the stairway. Figure 49 shows the location of the ramped access.

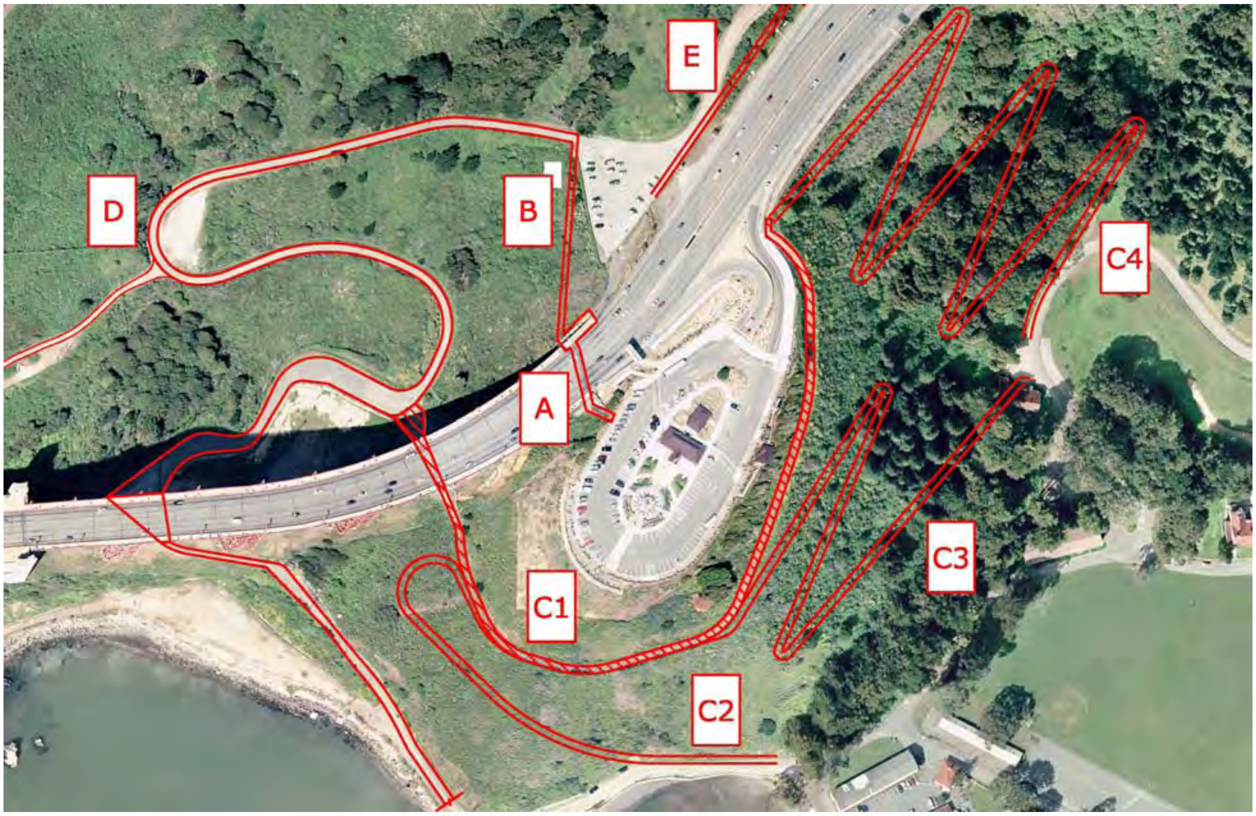
Figure 49
Strategy BP-B (West Side Golden Gate Bridge Walkway Ramp Access)



Strategies BP-C1 to BP-C4

Strategy BP-C1 through BP-C4 provides access to Fort Baker from Vista Point. Currently, there is no direct connection to Fort Baker from Vista Point. Users must use Lower Conzelman on the west side of US 101 or use the Alexander Avenue/Danes Drive/East Bunker Road route. Figure 50 shows potential routes reviewed.

Figure 50
Strategy BP-C1 through BP-C4 (Fort Baker Access from Vista Point)



Strategy BP-D

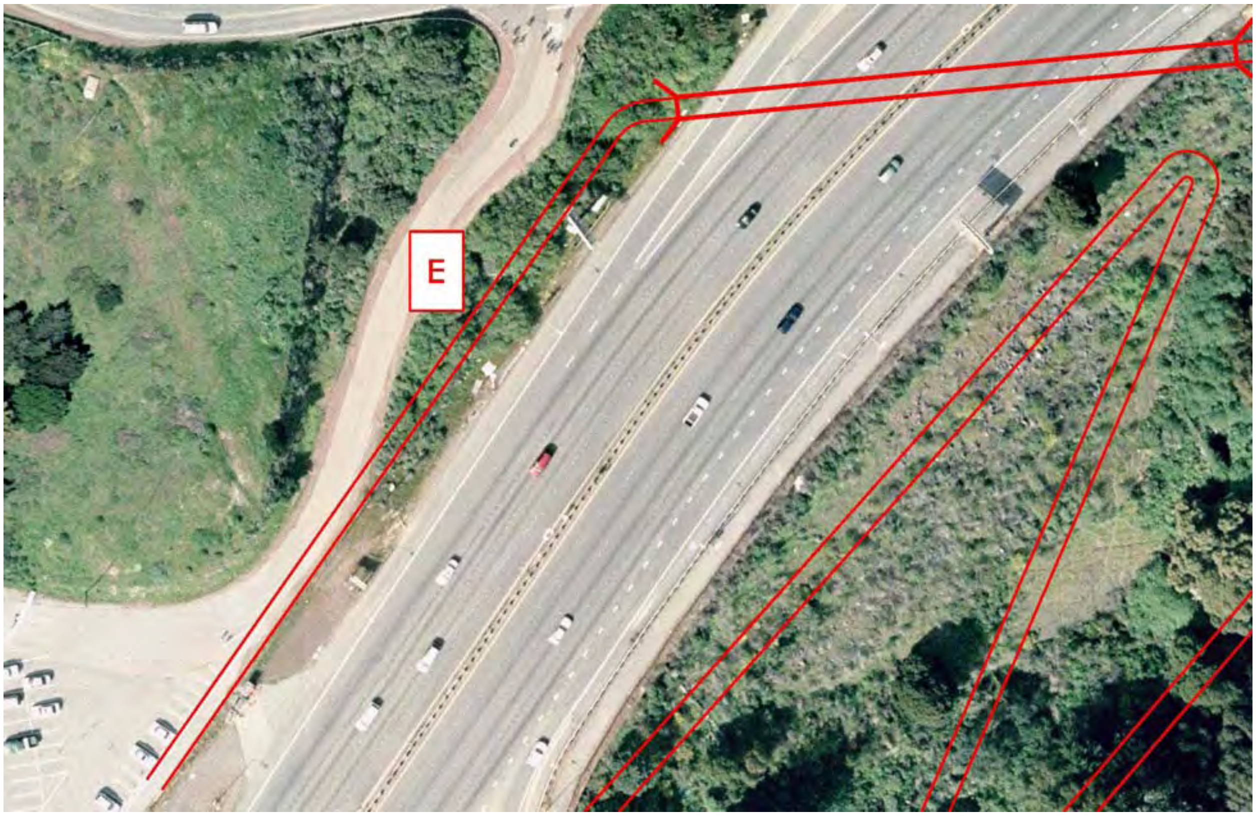
Strategy BP-D provides access to Fort Baker via Lower Conzelman Road from the northwest bridge parking lot. Currently, access is restricted to bicycles, pedestrians, and authorized vehicles. This route is currently designated as Marin County Bike Route 5. Figure 51 shows this strategy.

Figure 51
Strategy BP-D (Fort Baker Access via Lower Conzelman Road)

<u>Strategy BP-E</u>

Strategy BP-E provides access from the northwest bridge parking lot to Lower Conzelman Road. Potential access routes include along the shoulder of existing parking lot access or along the southbound US 101 on-ramp. Figure 52 shows this strategy.

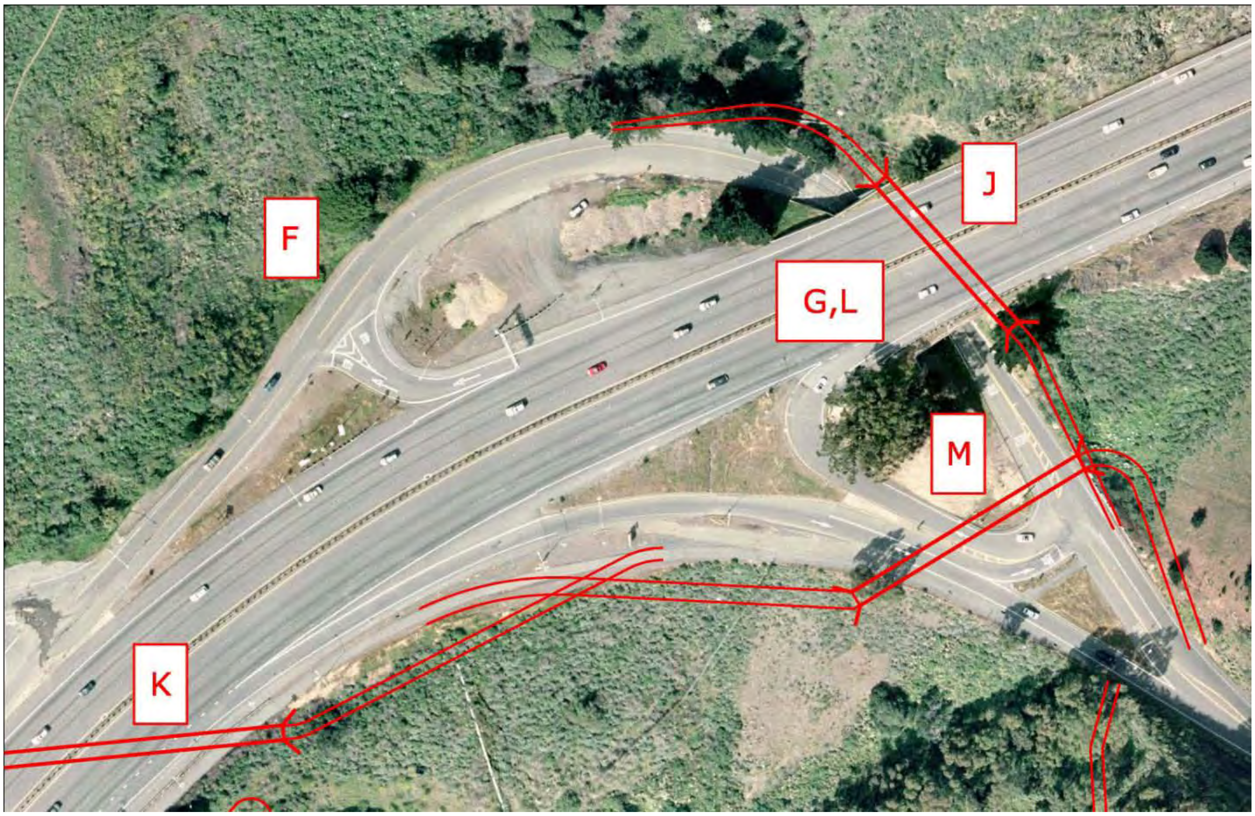
Figure 52
Strategy BP-E (Access from Northwest Bridge Parking Lot to Lower Conzelman Road)



Strategy BP-F

Strategy BP-F provides widened shoulders on Alexander Avenue between Lower Conzelman Road and the Alexander Avenue/US 101 underpass. Widened shoulders would occur on both sides of Alexander Avenue. This strategy overlaps with strategies BP-O and BP-TS2. Figure 53 shows the location of this strategy.

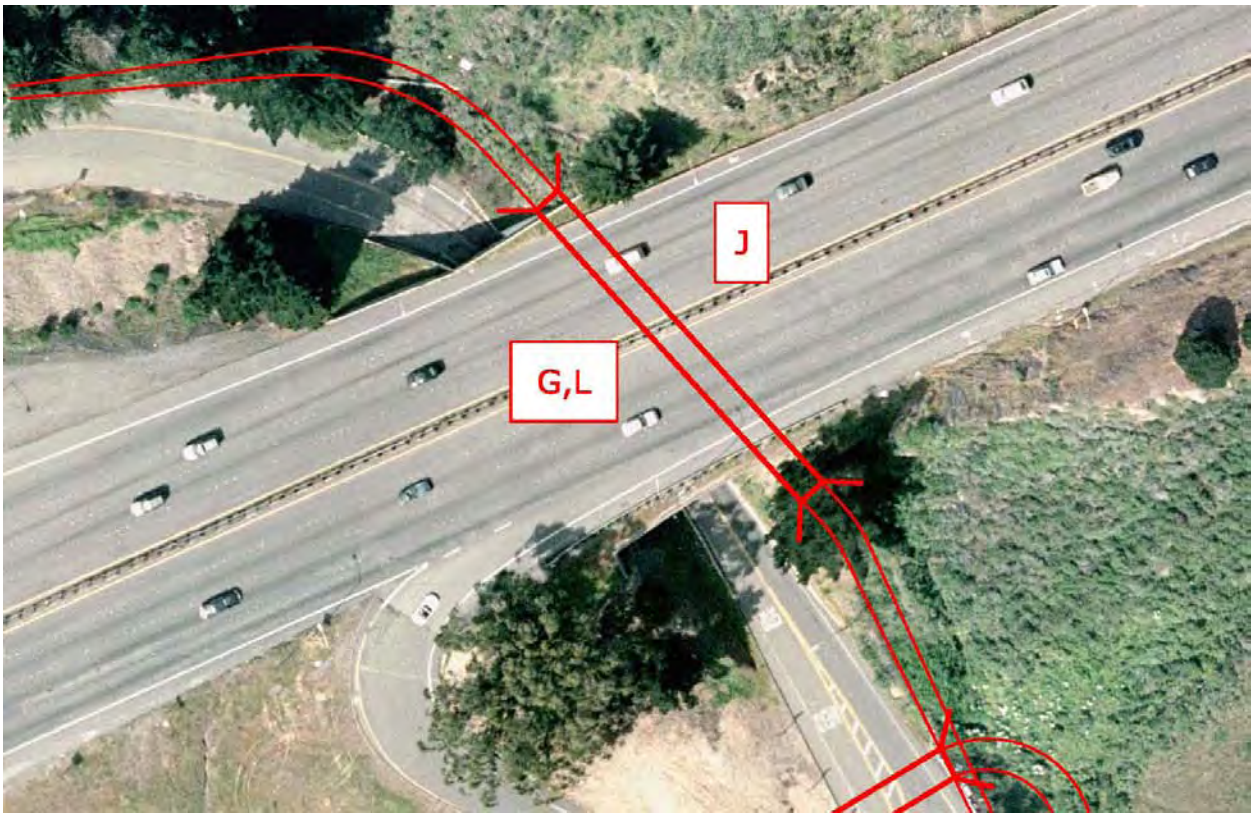
Figure 53
Strategy BP-F (Widened Shoulders between Lower Conzelman and Alexander Avenue/US 101 Underpass)



Strategy BP-G

Strategy BP-G improves lighting and user awareness at the Alexander Avenue/US 101 underpass. Vehicles and bicycles use the underpass and bicycles must use travel lanes through the underpass. Due to limited sight distances and narrow roadway width, vehicle use should travel at slow speeds. Signing and pavement markings could be included to identify shared use lane conditions. This strategy would be a short-term strategy prior to implementing strategy R-B1 or R-B2. Figure 54 shows the location of this strategy.

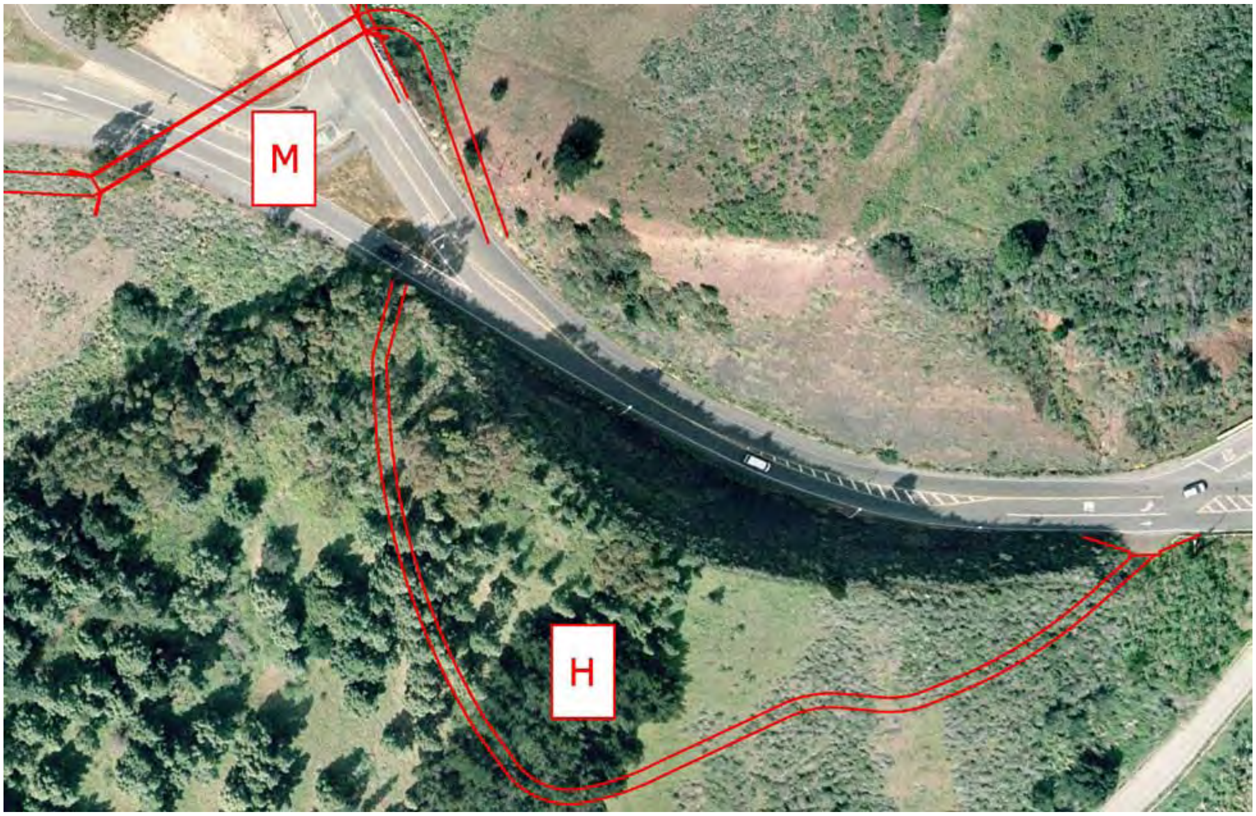
Figure 54
Strategy BP-G (Improved Lighting and User Awareness at the Alexander Avenue/US 101 underpass)



Strategy BP-H

Strategy BP-H provides a separated route between the Alexander Avenue/northbound US 101 off-ramp shoulder and Danes Drive. This route has been referred to as the Knob Trail Alignment. Figure 55 shows the location of this strategy.

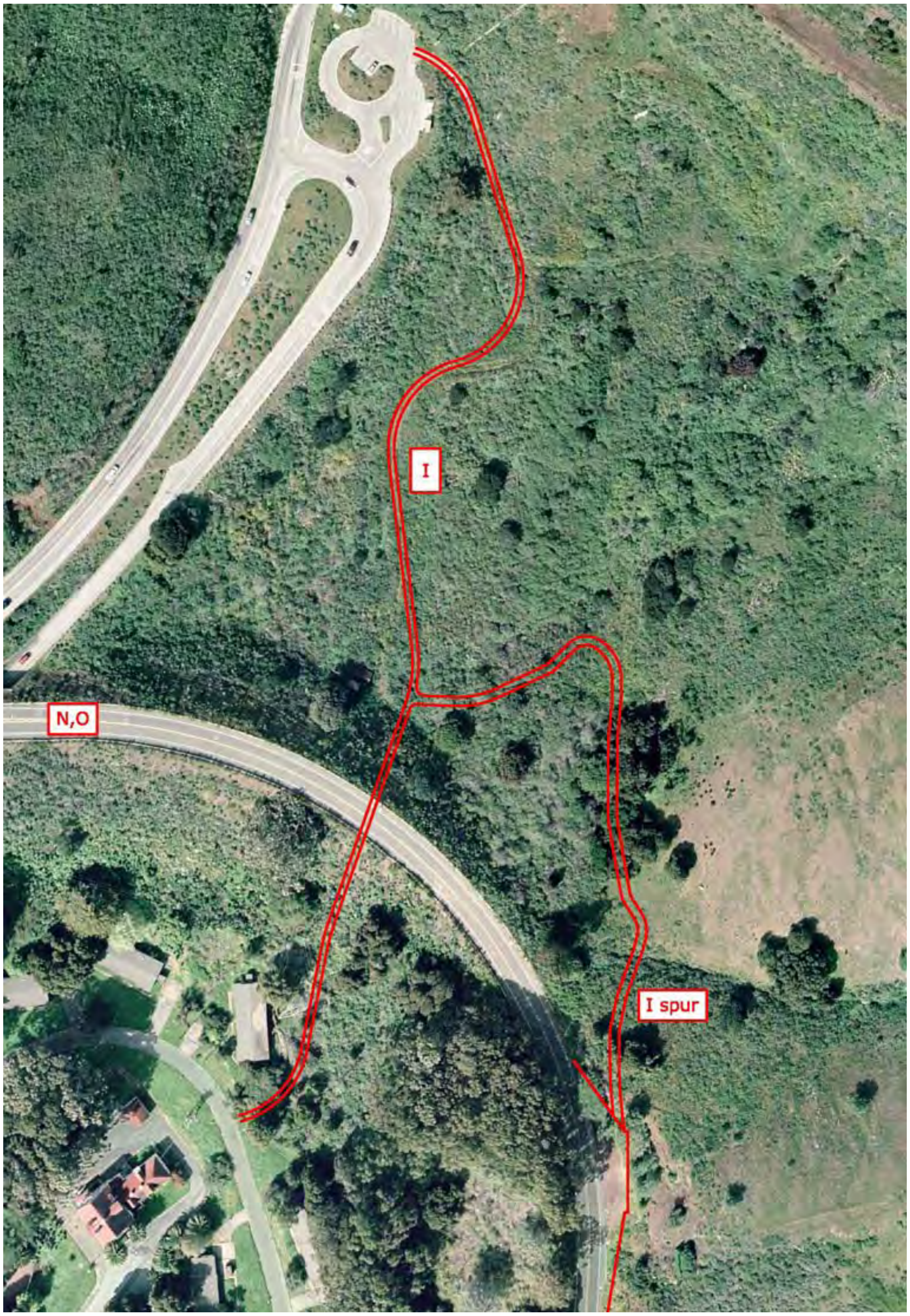
Figure 55
Strategy BP-H (Knob Trail Alignment)



<u>Strategy BP-I</u>

Strategy BP-I provides access from the Danes Drive parking lot to Fort Baker. This strategy was included in the Marin Headlands EIS and referred to as the Danes Trail. The intent is a separated facility to provide connectivity from potential transit stop locations. This strategy would require a proposed grade separated underpass beneath Alexander Avenue. The spur connects a potential transit stop location to the main route. Figure 56 shows the location of this strategy.

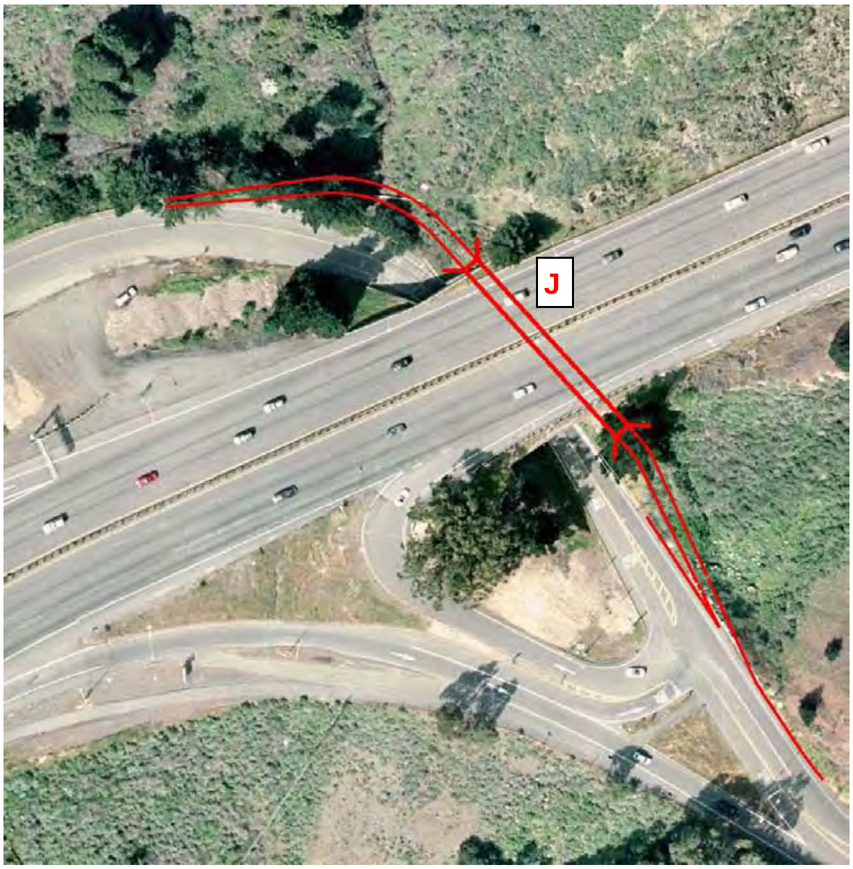
Figure 56
Strategy BP-I (Danes Trail)



Strategy BP-J

To allow a separated facility for bicycles and pedestrian under US 101, Strategy BP-J provides a proposed underpass adjacent to Alexander Avenue/US 101 underpass. Figure 57 shows the location of a proposed structure on the north side of Alexander Avenue. Similarly, a structure could be provided on the south side of Alexander Avenue. The intent of this strategy is to eliminate the need to provide a new vehicular structure for the Alexander Avenue/US 101 underpass.

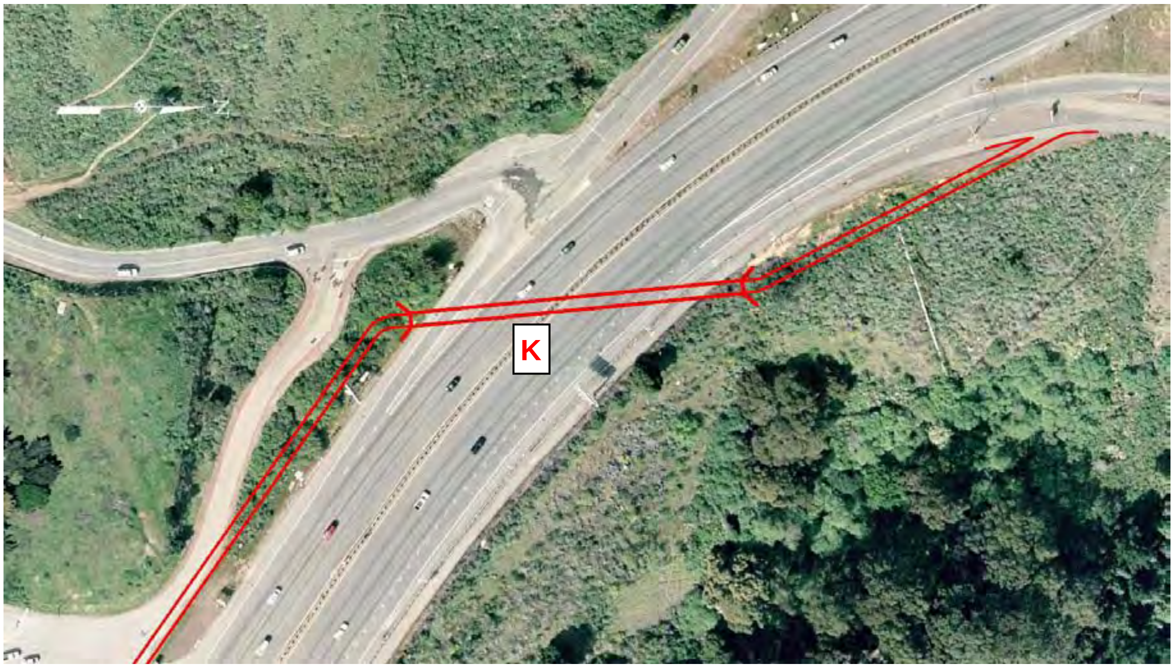
Figure 57
Strategy BP-J (Adjacent Alexander Avenue Underpass Structure)



Strategy BP-K

To allow a separated facility for bicycles and pedestrian away from Alexander Avenue under US 101, Strategy BP-K provides a proposed underpass south of Alexander Avenue. Figure 58 shows the location of the proposed structure.

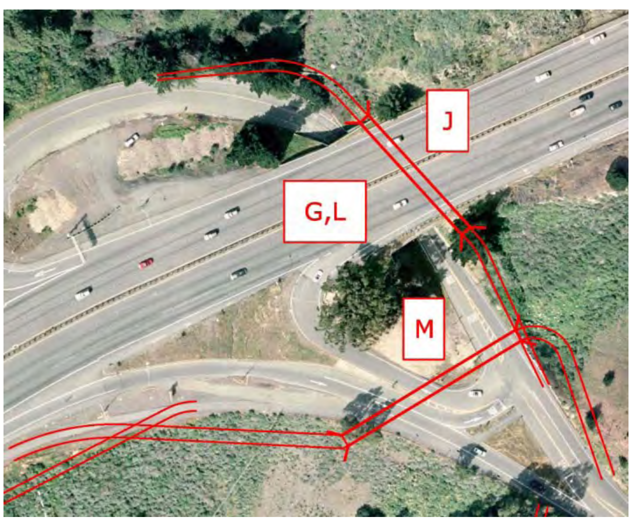
Figure 58
Strategy BP-K (New US 101 underpass south of Alexander Avenue)



Strategy BP-L

Strategy BP-L provides widened shoulders for bicycles and pedestrian use through the Alexander Avenue/US 101 underpass. This would require widening or replacement of the underpass as shown in Strategy R-B1 or R-B2. Figure 59 shows the location of this strategy.

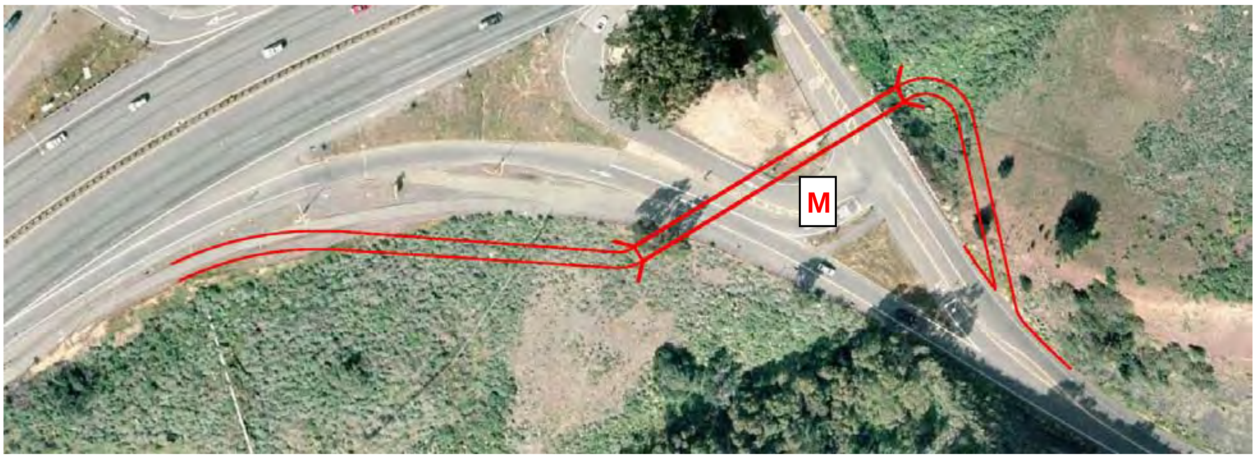
Figure 59
Strategy BP-L (Widened Shoulders through the Alexander Avenue/US 101 Underpass)



Strategy BP-M

Strategy BP-M provides a grade separated facility beneath the Alexander Avenue/northbound US 101 ramp intersection. An overpass at this location is also a potential option for grade separation. The intent of this strategy is to remove the conflict point of mainly vehicles and bicycles. Southbound Alexander Avenue bicycles traveling on the shoulder turn left at the US 101 northbound off-ramp to get to the shared use path on the east side of US 101 to Vista Point. Figure 60 shows the location of this strategy.

Figure 60
Strategy BP-M (New Grade-separated Facility at the Alexander Avenue/Northbound US 101 Ramp Intersection)



Strategy BP-N

Strategy BP-N provides a Class I separated shared use path adjacent to Alexander Avenue from the Alexander Avenue/northbound US 101 ramp intersection to the Sausalito city limits. This strategy was included for study as Strategy BP-TS1.

Strategy BP-O

Strategy BP-O provides Class II bicycle lanes on Alexander Avenue from Conzelman Road to the Sausalito city limits. This strategy was included for study as Strategy BP-TS2. The decision to designate the shoulders of Alexander Avenue as bicycle lanes or shoulders was discussed during the planning study. Due to bike speeds attained by experienced riders, user width required to operate bikes as higher speeds, and slower pedestrians and less experienced bicyclists that would also be using the shoulder, it is highly likely that bicyclists would use travel lanes throughout the corridor to travel along Alexander Avenue or pass other users. Traffic laws should be reviewed regarding use of bicycle lanes before designating the shoulders as bicycle lanes.

Alexander Avenue Typical Sections (Strategies BP-TS1 to BP-TS4)

The typical section presented in this section will identify potential typical sections along Alexander Avenue. These typical sections primarily aim to address improvements related to bicycles and pedestrians. There are many options for widths of the components (travel way width, shoulder width, sidewalk width, and path width) of the typical sections. The typical sections presented aim to focus on the overall character of the typical section and not each component width.

During a June 2010 site visit, field measurements of the pavement width and roadway bench width were taken along the corridor north of Danes Drive. South of Danes Drive, due to the improvement project for the left-turn lane from Alexander Avenue to Danes Drive, no measurements were taken as the rock slope on the east side will require excavation. This left-turn lane improvement was included as a commitment in the Marin Headlands EIS and is currently scheduled for construction in FY 2013.

The pavement widths measured at six locations between the Sausalito city limit and Danes Drive included distances of 36.4 feet, 35.4 feet, 35.7 feet, 36.1 feet, 36.4 feet, and 36.1 feet for an average pavement width of 36.0 feet. The roadway bench width measured at five of these same locations included distances of 44.8 feet, 38.4 feet, 42.6 feet, 41.3 feet, and 45.9 feet for an average roadway bench width of 42.6 feet. The difference between the average pavement width and average roadway bench width is 6.6 feet or, approximately 3.3 feet on each side of Alexander Avenue.

As these measurements relate to potential typical sections, the roadway bench width must also accommodate drainage ditches in cut areas, guardrail, fence, signs, and lighting. For the purposes of this planning study, it is anticipated that typical section improvements may be able to widen the shoulders of Alexander Avenue between 1 and 2 feet on each side. This potential widening allows the pavement width to expand from an existing average of 36 feet to a range of 38 to 40 feet, without the need for major cut or fill operations. Narrow width areas include the East Road Underpass and the Sausalito Viaduct, which do not have roadway bench width available for widening.

Each of the typical sections would include rockfall catchment ditches due to hazards associated with excavating rock slopes, if rock slopes require excavation. The catchment ditch serves as an area to contain any rockfall from the slope face. Rockfall mitigation measures should be designed on a site-by-site basis. See Section 3.5.4 for further discussion on rockfall and wire mesh requirements.

All typical sections are compatible with each roadway improvement option in Section 5.3.1. Table 32 identifies the range of potential typical sections. Figure 61 to Figure 64 show the potential typical sections.

Table 32
Typical Section Strategies along Alexander Avenue

Strategy	Description	Travel Way Width (see note)	Shoulder Width
BP-TS1	14 ft Class I bicycle path adjacent to Alexander Avenue	Two 12-foot lanes	5 feet
BP-TS2	Widened shoulders with 11 of 12-foot travel lanes on Alexander Avenue	Two 11 or 12-foot lanes	5 to 9 feet
BP-TS3	8 ft sidewalk adjacent to northbound Alexander Avenue	Two 11 or 12-foot lanes	5 feet
BP-TS4	5 ft pedestrian path on both sides behind guardrail adjacent to Alexander Avenue	Two 11 or 12-foot lanes	3 feet

Note: 10-foot travel lanes were not reviewed due to two-way transit use and roadway geometry.

Figure 61
Strategy BP-TS1 (Class I separated path)

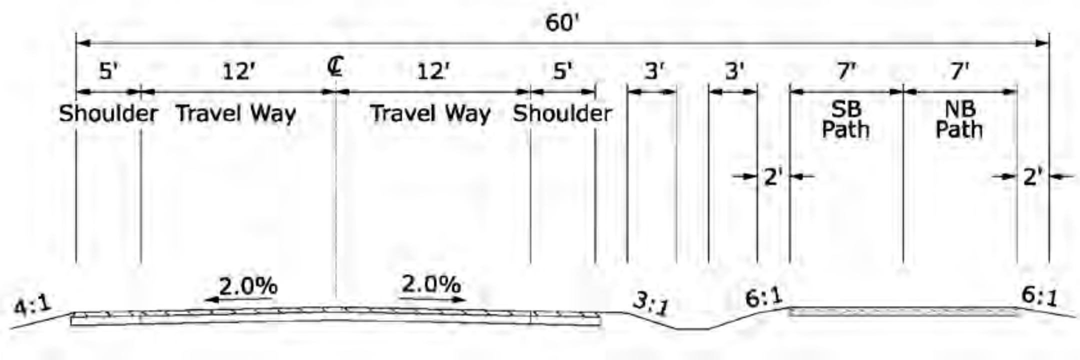


Figure 62
Strategy BP-TS2 (Widened shoulders)

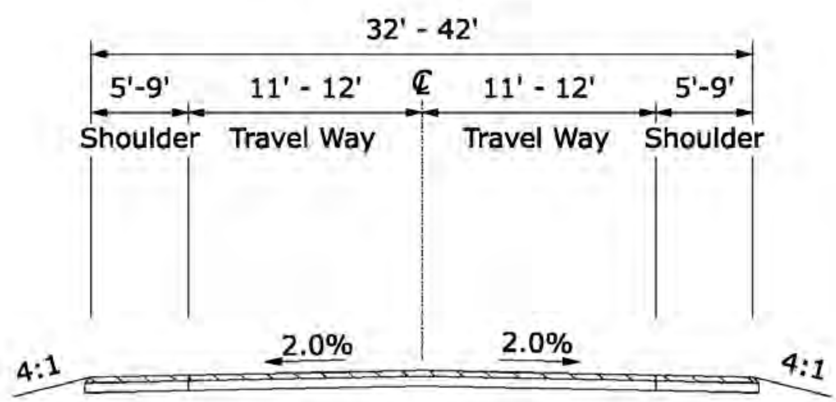


Figure 63
Strategy BP-TS3 (Attached northbound sidewalk)

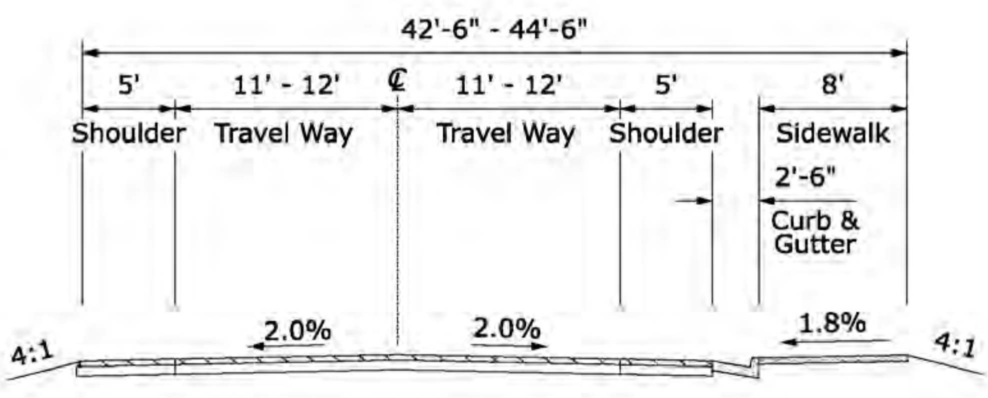
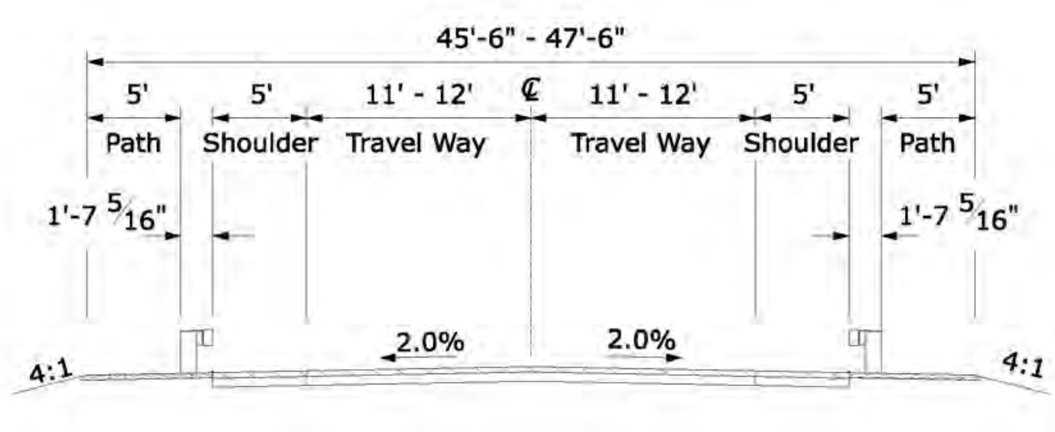


Figure 64
Strategy BP-TS4 (Separated shoulders and path)



5.3.3 Transit Outlook

Discussions with NPS staff and area transit providers and review of existing or planned transit service identified the following issues for future transit service.

Gaps in Existing Service

Existing service to this area is predominantly regional, cross-bridge service and does not provide direct or coordinated access to primary park destinations. A transit rider travelling to the Alexander Avenue corridor could encounter multiple operators, transfers, and service schedules, which are confusing for tourists. There is limited service between San Francisco and the Alexander Avenue corridor, and direct connections to park sites are limited to the Marin Headlands via SFMTA's Route 76. There is currently no direct public transit service to Fort Baker.

Filling the gaps in these services will need to be an ongoing, joint effort between the NPS and local transit providers. Primary park destinations have a significant local demand. For example, the SFMTA's draft Transit Effectiveness Program (TEP) recommends increasing service to the Marin Headlands from Sundays and holidays only to Saturday, Sunday, and holiday service, due to high demand. GGNRA is working with SFMTA on a long-term plan for this service. GGNRA will continue to expand coordination with local operators to provide sustainable transit services of mutual benefit.

Transit Audiences

There are two primary audiences requiring improved transit service, NPS/Park Partner employees and visitors. The transit needs for these two groups varies. Employees of NPS can work seven days a week and a variety of hours. The Fort Baker EIS included an employee survey looking at current transportation behavior and desire for transit. It found 77 percent of employees drove alone and only 5 percent reported taking public transit at least one day a week. Forty-one percent of employees reported that they would consider taking transit if there was a shuttle that connected their place of employment with a nearby transit stop. The most stated reasons that would prevent respondents from using a shuttle were "work late or irregular hours," "service may not be frequent enough," and "need to make stops on the way to work or home." While the top three factors that would likely to encourage combined use of public transit and a shuttle included “financial incentives,” “guaranteed ride home in an emergency,” and “work schedule flexibility.”

Alexander Avenue, Fort Baker, and the Marin Headlands receive year-round visitation. While increased visitation generally occurs between April and September, visitation numbers vary only slightly month to month. Depending on the weather, it is not uncommon between October and March to experience visitation numbers as high as those between April and September[1]. In general, visitors are travelling to the area on weekends, or outside of a typical work day peak-travel schedule. As such, NPS is faced with transit service needs seven days a week, including holidays and throughout the whole day; however, demand is highest during weekends.

No Stable Source of Revenue to Expand Transit Service Operation Exists

Current transit providers have indicated no demand for increased or expanded transit service to this area exists. As such, these transit agencies have no plans to increase service to the area in the next decade. Even if rider demand did exist, they have no operational funds available to increase service to meet this demand.

The Marin Headlands EIS identified fee parking as a primary means of generating stable revenue for transit operations to park sites. Recently, NPS examined instituting a parking fee in the short term; however, it is currently being viewed as a longer-term strategy as other alternatives are pursued. There is an existing NPS-authorized franchise fee on overnight guests of the Cavallo Point Lodge at Fort Baker. Part of this fee is to be dedicated to providing transit service as a traffic mitigation measure for the increased draw of visitors to Fort Baker. This fee has the potential to collect up to $200,000 per year; however, recent revenues have been lower than expected, resulting in approximately $75,000 a year from this fee revenue, which also supports utility costs for Fort Baker.

The *Golden Gate National Recreation Area Long Range Transportation Plan (LRTP)*, currently under development, will consider future sources of both capital and operational funding that could be available to expand or improve transit service throughout the recreation area. The plan will identify different approaches to incrementally improve service to primary park destinations. The plan will identify critical transportation needs, the most cost-effective transportation solutions, and the most strategic approach to apply limited funding to implement the most critical needs.

In the sections that follow, research and previous transit studies are summarized. Infrastructure improvements and transit service opportunities highlighted have been examined against the three issues above, and narrowed here to the most feasible future transit service opportunities for the Alexander Avenue area.

5.3.4 Transit Service Opportunities

This section looks at three areas related to increasing transit service in the study area: 1.) infrastructure or stop additions necessary to accommodate improved or additional transit service; 2.) the most feasible transit opportunities that could increase or improve service to the area; and

1 National Park Service Public Use Statistics Office. *Golden Gate NRA Visitation by Month/Year* http://www.nature.nps.gov/stats, 2012.

3.) estimated operation costs for several increased service opportunities. This section is meant to highlight the most feasible transit opportunities to explore further.

Infrastructure Improvements: Potential Transit Stop Location Additions on Alexander Avenue

As part of this planning study, new transit stops and the potential to connect them to existing or future service were reviewed. The potential transit stop improvements are shown on Figure 65. Transit stop improvements that are carried forward for implementation should be compatible with roadway and pedestrian strategies. Connectivity between stop locations and key park destinations should be reviewed during future design development. Features promoting connectivity could include shoulder width, sidewalks, paths, crosswalks, and buffers between pedestrians and vehicles. Also note, all successful transit strategies would include Strategy R-D1, improved wayfinding.

Figure 65
Potential Transit Stop Locations

As shown in Figure 65, the following potential transit stop locations were evaluated:

- Strategy T-1 (Vista Point) would re-route northbound transit through Vista Point and provide a stop location. There is no existing transit stop at this location.
- Strategy T-2 (Conzelman Road/southbound Alexander Avenue) provides a transit stop at the Alexander Avenue/Lower Conzelman Road intersection. There is an existing transit stop at this location.
- Strategy T-3 (Along northbound US 101 off-ramp) provides a transit stop along the northbound US 101 off-ramp to Alexander Avenue. There is an existing transit stop at this location.
- Strategy T-4 (Along northbound US 101 ramps at Alexander Avenue) provides a transit stop at the Alexander Avenue/northbound US 101 ramp intersection along the northbound side. There is no existing transit stop at this location.
- Strategy T-5 (Northbound US 101 ramps/southbound Alexander Avenue) provides a transit stop at the Alexander Avenue/northbound US 101 ramp intersection along the southbound side. There is no existing transit stop at this location.
- Strategy T-6 (Danes Drive/northbound Alexander Avenue) provides a transit stop at the Alexander Avenue/Danes Drive intersection along the northbound side. There is no existing transit stop at this location.
- Strategy T-7 (Danes Drive/southbound Alexander Avenue, south side) provides a transit stop at the Alexander Avenue/Danes Drive intersection along the southbound side on the south side of Danes Drive. There is no existing transit stop at this location.
- Strategy T-8 (Danes Drive/southbound Alexander Avenue, north side) provides a transit stop at the Alexander Avenue/Danes Drive intersection along the southbound side on the north side of Danes Drive. There is an existing transit stop at this location.
- Strategy T-9 (Danes parking lot) provides a transit stop at the Danes Drive parking lot. This transit stop could replace the existing transit stop at Danes Drive (T-8).
- Strategy T-10 (Southbound Alexander Avenue) provides a transit stop along southbound Alexander Avenue between Danes Drive and East Road. There is no existing transit stop at this location.
- Strategy T-11 (East Road/southbound Alexander Avenue) provides a transit stop along southbound Alexander Avenue at East Road. There is an existing transit stop at this location.
- Strategy T-12 (East Road/northbound Alexander Avenue) provides a transit stop along northbound Alexander Avenue at East Road. There is no existing transit stop at this location.

Table 33 summarizes the outcome of evaluating the 12 transit stops along or near Alexander Avenue, and in varying degrees, carries eight forward for further consideration.

Table 33
Summary of Pros and Cons for Potential Transit Stop Locations

Transit Stop	Pros	Cons	Recommendation
T-1	If this stop were to become part of GGT's and SFMTA's existing service, it would create an enhanced northbound stop compared with current conditions. It would more directly improve access to bike/pedestrian enhancements that are identified in this study. Additionally, this stop would create more incentive for the park to pursue connecting service to the Headlands and Ft. Baker. Note: it is recommended either this stop or T-3 is used, but not both.	This node is congested and adding a stop could significantly increase bus travel times and operational costs.	Carry forward for further consideration.
T-2	Possibility to move the stop to the newly improved Northwest Bridge Lot. It would become the southbound pairing to the new stop being considered in T-1. If enhanced, this stop could become more attractive for GGT to add a stop to connect with San Francisco visitors via SFMTA and bring hikers and bikers from Marin	Current location is substandard due to the space and limitations at the intersection.	SFMTA will continue to serve this stop. If enhanced service from SFMTA or GGT is ever going to be possible, the stop needs to be moved to the suggested alternate location in the Northwest Bridge Lot.
T-3	Stop functions fine for the current level of demand and there is plenty of room to make enhancements, like trail linkages, shelter, and travel or interpretive information. SFMTA currently uses T-2 as its stop for both inbound and outbound drop-off; however, T-3 would be a better alternative for inbound drop-off. Note: It is recommended either this or T-1 be used, but not both.	This stop as a drop-off would add a much longer walk for riders who want to access sites on the westbound side of the Golden Gate Bridge	Carry forward for further consideration.
T-4	None identified	Creates conflict potential at the intersection between buses and vehicles	Eliminate due to lack of space and increased traffic conflicts.
T-5	There is currently enough space to put in a stop.	Could be NEPA issues with building a stop here. T-1 and T-2 remain better options.	Carry forward for further consideration.
T-6	Creates northbound stop closer to Fort Baker	Creates roadway crossing for pedestrians to access sidewalk	Eliminate, poor location.
T-7	Creates far sidestop and reduces conflicts for Alexander Avenue southbound right turns.	Creates roadway crossing for pedestrians to access sidewalk	Eliminate, poor location

Table 33
Summary of Pros and Cons for Potential Transit Stop Locations

Transit Stop	Pros	Cons	Recommendation
T-8	GGT will continue to serve this stop but an alternate location would be necessary if any increased service is considered.	Although there is a stop at this location, it is substandard due to the space limitations at that intersection.	Carry forward for further consideration. (As part of FY 2013 project, improvements will be made to upgrade to design standards, but it will not be a formal pullout.)
T-9	It could become the much improved southbound alternative to T-8.	To become viable as a stop, there would need to be some type of connecting service and increased travel demand.	Carry forward for further consideration.
T-10	There is currently enough space to put in a stop.	Competes with T-9 for the southbound stop location.	Eliminate, poor location
T-11	The southbound stop exists. Should consider stops at this location.		Carry forward for further consideration.
T-12	Northbound not currently a stop. Should consider stops at this location		Carry forward for further consideration.

Transit Service Opportunities

Along with identifying the viability of possible transit stops along Alexander Avenue, it is important to lay out the types of enhanced transit service that could run through some combination of the eight stops described previously. This section summarizes the transit route concepts identified through previous studies. This summary highlights transit services that would have or meet the most critical visitor demand, and considered most feasible because they are expansions or links to existing transit services.

Then a summary of additional routes currently operated by both public and private transit providers is presented. These routes do not currently stop or have limited stops within the Alexander Avenue, Fort Baker, and Marin Headlands areas, but rather traverse the region via US 101 or other major arterials. As such, these routes offer further opportunities for the park to work with the providers to add more stops in closer proximity to the study area.

The Marin Headlands EIS and the *Fort Baker Transit Operations Plan, Summary of Work Completed* [17] identified numerous opportunities for increased transit service. Table 34 summarizes those considered the most viable and feasible to improving transit service to the area.

Table 34
Increased Transit Opportunities for Alexander Avenue, Fort Baker, and the Marin Headlands

Route Service Concept or Transit Improvement	Concept Description	Implementation Feasibility
Extend Marin County Transit Local Route 22 from Sausalito to Fort Baker Bay Area Discovery Museum (BADM)	The conceptual route extension would provide extended service from Sausalito Ferry Terminal to the Fort Baker BADM bus turnaround via Bridgeway Boulevard and East Road for one morning trip and one evening trip. This would be an employee service focused route.	If operating revenue were available, could be done in the near-term. Note: BADM turnaround dimensions for Golden Gate Bridge buses should be verified.
Extend Marin County Transit Local Routes 17 or 71 from Marin City to Fort Baker Bay Area Discovery Museum	The conceptual route extension would provide extended service from the Marin Transit Center to the Fort Baker BADM bus turnaround via Bridgeway Boulevard and East Road for one morning trip and one evening trip. This would be an employee service focused route.	Note: BADM turn radius dimensions for Golden Gate Bridge buses should be verified.
Create a new Route from San Rafael Transit Center to Fort Baker BADM via Marin City and Sausalito (2 Trips/Day & 4 Trips/Day Options)	The conceptual new route would provide service from San Rafael to Fort Baker BADM bus turnaround via Red Hill Ave, Sir Francis Drake Blvd, Magnolia Ave, Hwy 101, Bridgeway Boulevard and East Rd. This would be an employee service focused route.	Note: BADM turn radius dimensions for Golden Gate Bridge buses should be verified.
Realign Golden Gate Transit Route 2, 10 or 60 through Fort Baker BADM	Conceptual route alignment would involve a diversion through Fort Baker via East/West Bunker Road, Center Road, and East Road. This would be an employee service focused route.	Large transit buses could experience constraints at Bunker Road because of the tight curve. Note: BADM turnaround dimensions for Golden Gate Bridge buses should be verified.
Expanded Loop: Terminus of the former Sausalito SALLY shuttle	Provide service between Fort Baker, the Sausalito Ferry Terminal and the terminus of the former SALLY shuttle.	Considered a desirable intermediate to long-term service. Requires more examination to evaluate feasibility.
Expanded Loop Terminus at Muir Woods Shuttle parking lot:	Provide service between Fort Baker, the Sausalito Ferry Terminal, the former terminus of the SALLY shuttle and the primary point of origin for the Muir Woods Shuttle (Donahue Street and Terners Drive) via Alexander Ave., Bunker Road, Bridgeway Boulevard and Donahue Street	Considered a desirable intermediate to long-term service. Requires more examination to evaluate feasibility.
Expanded Loop: Terminus at Vista Point/Marin Headlands	Provide service between Fort Baker and the Sausalito Ferry Terminal with a return trip serving Vista Point and Marin Headlands hiking trails via Alexander Ave., Bunker Road and Conzelman Road	Considered a desirable intermediate to long-term service. Requires more examination to evaluate feasibility.

Table 34
Increased Transit Opportunities for Alexander Avenue, Fort Baker, and the Marin Headlands

Route Service Concept or Transit Improvement	Concept Description	Implementation Feasibility
Joint Basic Service	Connect Fort Baker to Downtown Sausalito and the Sausalito Ferry Terminal, Marin City (where connections to the Muir Woods Shuttle are available), Vista Point and the Golden Gate Toll Plaza via Alexander Avenue, Bunker Road, East Road, Bridgeway Boulevard, Donahue Street, and the Golden Gate Bridge. This route would connect to several GGT and SFMTA routes, as well as the PresidiGO shuttle.	Considered a desirable intermediate to long-term service. Requires more examination to evaluate feasibility.
Fort to Fort Services	Connect Fort Baker to Fort Cronkhite in Marin Headlands via Alexander Avenue and Bunker Road. This route would connect to GGT service.	Considered a desirable intermediate to long-term service. Requires more examination to evaluate feasibility.
Expansion of the existing SFMTA Route 76 service in the Marin Headlands	Route would be encouraged on Saturdays, with a 30-minute service frequency on weekends. This route could also be extended to the new bus turnaround at the Point Bonita trailhead on Field Road.	This recommendation identified in the SFMTA's Draft TEP. GGNRA is currently working with SFMTA to implement recommendation.

As previously mentioned, existing transit providers are not seeing the demand needed to expand services to Marin Headlands, Alexander Avenue, or the Fort Baker areas. Even if the demand were there, the revenue might not be. While they are interested in working with NPS to expand transit options, they will look to NPS to help provide operations funding for any expansion of service. NPS anticipates there will continue to be limited funding available to do this. As such, NPS should also explore opportunities to connect to other existing service coming up US 101 or farther north in Marin County.

Table 35 lists potential opportunities GGNRA could further explore for future improved transit service.

Table 35
Existing Transit Service near Alexander Avenue, Fort Baker, or Marin Headlands

Provider	Route Number	Route Description	Days of Operation	Hours of Operation	Frequency
GGT	101	Service between Santa Rosa and San Francisco	Weekday	5:00 a.m.–8:00 p.m.	1 hour
			Weekends (Saturday only)	NB: 11:30 a.m.–6:30 p.m. SB: 7:00 a.m.–1:00 p.m.	1 hour
GGT	70/70	Service between Novato and San Francisco	Weekday	5:00 a.m.–11:00 p.m.	30 minutes
			Weekend & holidays	5:00 a.m.–11:00 p.m.	30 minutes
Marin County Transit	17	Service between Marin City and San Rafael via Mill Valley	Weekday	5:30 a.m.–8:30 p.m.	30 minutes
			Weekend & holidays	7:30 a.m.–8:30 p.m.	1 hour
Marin County Transit	19	Service between Tiburon and Marin City; route continues beyond this as the 17	Weekday	Peak hour service only; approximately 7:00–10:00 a.m. & 2:00–9:00 p.m.	1 hour
			Weekend & holidays	Peak hour service only; approximately 7:00–10:00 a.m. & 2:00–8:00 p.m.	1 hour
Marin County Transit	Stagecoach 61	Service between Bolinas and Marin City	Weekday		2 AM and 2 PM trips
			Weekend & holidays		1 AM & 3 PM trips; add 3 additional trips a day for March to December
Marin County Transit	Stagecoach 68	Service between Inverness and San Rafael	7 days a week		4 trips a day; 5 on Tuesday, Thursday, & Saturday
Hop-on Hop-off Services	Multiple	Commercial services from San Francisco to Sausalito; currently most have stops on both sides of the bridge and in Sausalito	7 days a week	Variably depending on company; generally 9:00 a.m.–5:30 p.m.	Approximately every 30 minutes from San Francisco

The last option in Table 35 is a fairly common service offered by multiple commercial providers in the Bay Area. *Hop-On, Hop-Off* services establish a route and stops to allow passengers the flexibility to get off and back on at the established stops at their leisure. A passenger can usually buy a one- or two-day pass for a cost between $30 and $50, depending on the route and number of days they want to use the service. As the service has established service hours, the passenger must plan, just as with public transit, to ensure they get a bus back before service ceases for the day. Current *Hop-On*, *Hop-Off* routes offered in the Alexander Avenue area only include stops on both sides of the Golden Gate Bridge and Sausalito. Some routes are using Alexander Avenue, so opportunity exists to work with them to add stops.

Finally, the park may want to look at transit service options for event management purposes. Many of the previously mentioned service opportunities could be considered first only for event management. The park could contract with a public or private provider to provide transit service during an established event schedule for one or multiple areas. The advantages of establishing event management transit service include reduced operational cost to the park, guaranteed demand for the park and provider, and the ability to reduce congestion during peak days. Further piloting service during events could build demand and momentum for more regular service in the future.

Estimated Operation Costs for NPS to Expand Existing Transit Service

Any expansion of existing transit service may require NPS to contribute some or all of the operations funding needed. A review of Marin County Transit and other NPS units with transit services was conducted to identify a reasonable range of operating service hour costs for transit operations. This hourly cost estimate reflects all operation costs associated with running buses to serve the hours, miles, and headways desired. This cost range was then applied to multiple expansion scenarios, as outlined in Table 36. This table is meant to give NPS staff rough cost estimates by which they can further consider funding needs to move forward expanded transit service opportunities discussed in this section.

5.3.5 Next Steps

While transit service opportunities have been explored here and in previous studies, prioritization and additional work is necessary for the park to move these forward. Through the LRTP, currently in development, the park will consider future sources of both capital and operational funding that could be available to expand transit service. It will also identify different approaches to incrementally improve service to primary park destinations.

In light of the operating environment constraints, the park will want to conduct a closer market demand analysis of the routes they consider highest priority. They will need to look more closely at the market that desires service, the markets they want to encourage transit use from, and for both, what real demand exists or can be increased if transit service is offered. Identifying the demand will also need to more closely analyze this demands impact on current service travel time and operating parameters. All expansion to existing service will need to include benefit for the provider, including minimizing negative impacts to their current operation and maintenance environment.

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Table 36
Examples of Transit Service Expansion GGNRA and Operating Cost Estimates

Expanded or Improved transit Service Segment	Breakdown of Service Elements												Estimated Operation Costs		
	Roundtrip Mileage	Service time Span		Travel Speed[1]	Round trip Run Time (min)	Cycle Time (min.)[2]	Headway (min.)	Vehicles Needed	Span	Daily Hours	Operating Service		Total Service Hours in a Year	Total Operating/ Service Cost: Low	Total Operating/ Service Cost: High
		Start	End								Cost/Day: Low	Cost/Day: High			
Addition of Saturday Service for SFMTA Route 76 60-minute headways	26	9:30 a.m.	6:30 p.m.	15	104	125	60	3	9	27	$2,025	$3,915	1404 (52 Saturdays a year)	$105,000	$204,000
Extended Marin County Transit Route 22 from Sausalito to Fort Baker Bay Area Discovery (employee focused) 6 trips a day: 3 in AM; 3 in PM; each 1 hour apart	3	6 trips a day		15	16	19	60	1	6	6	$450	$870	2190 (365 days a year)	$164,000	$318,000
Expansion of Muir Woods Shuttle to include stop at Fort Baker[3] 30-minute headways	15	10:00 a.m.	7:00 p.m.	15	60	72	30	3	9	27	$2,025	$3,915	891 (approximately 33 days from end of May to Labor Day)	$67,000	$129,000
Service between Sausalito Ferry and Fort Baker 60-minute headways	4	8:15 a.m.	8:15 p.m.	15	16	19	60	1	12	12	$900	$1,740	4380 (365 days a year)	$329,000	$635,000

Assumptions:
1. Travel speeds include platform dwell time. Actual travel speeds between stops are higher.
2. Cycle times include 20 percent layover.
3. Muir Woods Shuttle Expansion assumes costs only for the new amount of service (approximately 10 miles roundtrip)
4. Cost per Operating Service Hour Scenarios (Low & High) are based on review of Marin County Operational Cost Data and other NPS units running transit services operated by partner/concessioner

Low Cost per Service Hour Scenario (estimated)	$75
High Cost per Service Hour Scenario (estimated)	$145

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5.4 QUALITATIVE SCREENING

The qualitative screening will evaluate the improvement strategies developed in Section 5.3 as discussed and presented to the stakeholders. The qualitative screening process will review the strategies against the project objectives. These objectives are to enhance modal use, maintain travel times, facilitate access, and consider implementation issues such as potential environmental impacts, constructability, and funding opportunities. The initial screening will discuss improvement strategies classified by roadway, bicycle and pedestrian, and transit improvements.

During the screening process, some strategies were further refined to develop more comprehensive improvement strategies for review.

5.4.1 Roadway Improvement Strategies

After presenting and discussing potential improvement strategies with the stakeholder group and additional planning level analysis, strategies were either carried forward or were not reviewed further. The disposition taken on improvement strategies were based on reviewing strategies against the project objectives and more specifically: traffic operations, roadway geometry, constructability, compatibility with bicycle, pedestrian, and transit strategies, and potential environmental impacts and planning level costs. Table 37 summarizes all roadway strategies and includes whether the strategy is carried forward for further review.

Table 37
Roadway Strategies Summary

Option	Location	Strategy Description	Disposition
R-A1	NB 101 ramps and Alexander Avenue intersection	Signalize intersection	Carry forward
R-A2	NB 101 ramps and Alexander Avenue intersection	Convert to AWSC	Not forwarded
R-A3	NB 101 ramps and Alexander Avenue intersection	Construct one-lane roundabout	Not forwarded
R-A4	NB 101 ramps and Alexander Avenue intersection	Construct roundabout with the SB Alexander Avenue movement converted to two lanes and all other movements one lane	Not forwarded
R-A5	NB 101 ramps and Alexander Avenue intersection	Convert to AWSC and add a SB through lane	Not forwarded
R-A6	NB 101 ramps and Alexander Avenue intersection	Convert to AWSC and add an uncontrolled median-separated SB through lane	Not forwarded
R-B1	Alexander Avenue underpass under US 101 (two travel lanes)	Widen underpass for shoulders, sight distance, vertical clearance	Carry forward
R-B2	Alexander Avenue underpass under US 101 (three travel lanes)	Widen underpass for second SB through lane (Options A5 and A6), shoulders, sight distance, vertical clearance	Not forwarded
R-C1	NB US 101 off-ramp	Extend NB US 101 off-ramp left-turn lane	Carry forward
R-C2	NB US 101 off-ramp	Reconfigure NB US 101 off-ramp	Carry forward

Table 37
Roadway Strategies Summary

Option	Location	Strategy Description	Disposition
R-C3	NB US 101 on-ramp	Reconfigure NB US 101 on-ramp to a diamond configuration	Not forwarded
R-C4	NB US 101 on-ramp	Extend NB US 101 on-ramp acceleration lane	Carry forward
R-C5	SB US 101 off-ramp	Extend SB US 101 off-ramp deceleration lane	Carry forward
R-D1	Corridor wide	Improved wayfinding and warning signing, channelization and pavement markings, turning radii, and traffic calming	Carry forward
R-D2	Corridor-wide (Danes Drive to Conzelman Road)	Signalized corridor	Carry forward
R-D3	Corridor-wide (Danes Drive to Conzelman Road)	Second SB through lane from Danes Drive to Conzelman Road	Not forwarded
R-D4	Corridor-wide	Event management	Carry forward

Planning level costs were estimated for roadway strategies. Anticipated costs from $0 to $1,000,000 were determined to be low cost strategies. Costs from $1,000,000 to $5,000,000 were determined to be moderate cost strategies. Costs above $5,000,000 were determined to be high cost strategies.

Alexander Avenue/Northbound US 101 Intersection Strategies (R-A1 to R-A6)

Strategy R-A1 (Signalized intersection) was carried forward for further review. Considerations during review against the project objectives were:

- **Enhance modal use.** Allows for dedicated bicycle and pedestrian crossing phases within the traffic signal timing.
- **Maintain travel times.** Accommodates all future (2035) weekday and weekend peak hour periods. Provides opportunity to limit queuing onto US 101.
- **Facilitate access.** Allows access to be more consistent and efficient by managing traffic and queuing.
- **Implementation considerations.** Potential visual impacts due to no other traffic signals in the GGNRA, expect for the Baker-Barry tunnel. Minimal disturbance area. Low cost strategy.

Strategy R-A2 (AWSC) was not carried forward for further review. Considerations during review against the project objectives were:

- **Enhance modal use.** Provides improved bicycle and pedestrian crossing due to southbound Alexander Avenue stop sign. Does not provide dedicated crossing opportunity.
- **Maintain travel times.** Accommodates future (2035) weekday peak hour periods. Does not accommodate future (2035) weekend peak hour period. Southbound Alexander Avenue queues are large during weekend peak period.

- **Facilitate access.** Allows access to be more consistent and efficient by providing opportunity for US 101 off-ramp vehicles to make left turn due to AWSC.
- **Implementation considerations.** Minimal visual impacts. Minimal disturbance area. Low cost strategy.

Strategy R-A3 (Single lane roundabout) was not carried forward for further review. Considerations during review against the project objectives were:

- **Enhance modal use.** Does not provide controlled bicycle and pedestrian crossing. Left turn from southbound shoulder to east side shared use path is not improved for bicycles.
- **Maintain travel times.** Accommodates all future (2035) weekday and weekend peak hour periods for 50th percentile confidence. For the 85th percentile confidence, the weekend peak period operates at LOS F.
- **Facilitate access.** Improves intersection geometry and northbound US 101 on-ramp geometry. Allows access to be more consistent and efficient by providing opportunity for US 101 off-ramp vehicles to enter the roundabout and the southbound Alexander Avenue vehicles must yield to this movement.
- **Implementation considerations.** Provides potential gateway feature opportunity. Moderate disturbance area. Potentially impact geotechnical concern area. Retaining wall required. Moderate cost strategy.

Strategy R-A4 (Two-lane roundabout for southbound Alexander Avenue) was not carried forward for further review. Considerations during review against the project objectives were:

- **Enhance modal use**. Does not provide controlled bicycle and pedestrian crossing. Left turn from southbound shoulder to east side shared use path is not improved for bicycles.
- **Maintain travel times.** Accommodates all future (2035) weekday and weekend peak hour periods for 50th percentile confidence. For the 85th percentile confidence, the weekend peak period operates at LOS A.
- **Facilitate access.** Improves intersection geometry and northbound US 101 on-ramp geometry. Allows access to be more consistent and efficient by providing opportunity for US 101 off-ramp vehicles to enter the roundabout and the southbound Alexander Avenue vehicles must yield to this movement.
- **Implementation considerations.** Provides potential gateway feature opportunity. Moderate disturbance area. Potentially impact geotechnical concern area. Retaining wall required. Moderate cost strategy.

Strategy R-A5 (AWSC with two southbound Alexander Avenue lanes) was not carried forward for further review. Considerations during review against the project objectives were:

- **Enhance modal use.** Provides improved bicycle and pedestrian crossing due to southbound Alexander Avenue stop sign. Does not provide dedicated crossing opportunity. Four-lane cross section to cross at intersection.
- **Maintain travel times.** Accommodates future (2035) weekday peak hour periods. Provides poor operations for future (2035) weekend peak hour period. Much shorter queues than strategy R-A2.

- **Facilitate access.** Allows access to be more consistent and efficient by providing opportunity for US 101 off-ramp vehicles to make a left turn due to AWSC.
- **Implementation considerations.** Moderate disturbance area. Requires implementation of strategy R-B2 (Alexander Avenue/US 101 underpass three-lane typical section). High cost strategy due to requiring strategy R-B2.

Strategy R-A6 (AWSC with barrier separated southbound Alexander Avenue lane) was not carried forward for further review. Considerations during review against the project objectives were:

- **Enhance modal use.** Does not provide dedicated crossing opportunity. Does not improve bicycle crossing due to free-flow southbound Alexander Avenue.
- **Maintain travel times.** Accommodates future (2035) weekday and weekend peak hour periods.
- **Facilitate access.** Allows access to be more consistent and efficient by providing opportunity for US 101 off-ramp vehicles to make a left turn due to AWSC.
- **Implementation considerations.** Moderate disturbance area. Requires implementation of strategy R-B2 (Alexander Avenue/US 101 underpass three-lane typical section). High cost strategy due to requiring strategy R-B2.

Alexander Avenue/US 101 Underpass Strategies (R-B1 and R-B2)

Strategy R-B1 (Widen Alexander Avenue/US 101 underpass for two travel lanes) was carried forward for further review. Considerations during review against the project objectives were:

- **Enhance modal use.** Provides opportunity for widened shoulders for pedestrian and bicycles. Provides additional horizontal and vertical clearance for buses.
- **Maintain travel times.** Provides widened shoulder to assist in maintaining travel speeds.
- **Facilitate access.** Provides opportunity for widened shoulders for pedestrian and bicycles, which could be incorporated with pedestrian routes related to transit stop locations.
- **Implementation considerations.** Minimal disturbance area. Major potential traffic impacts to US 101. Constructability issues related to maintaining access on Alexander Avenue during construction timeframes. Moderate cost strategy.

Strategy R-B2 (Widen Alexander Avenue/US 101 underpass for three travel lanes) was not carried forward for further review. This strategy is required for strategies R-A4, R-A5, and R-A6 to be implemented, and because those strategies were not forwarded for further review, this strategy was removed from consideration. Considerations during review against the project objectives were:

- **Enhance modal use.** Provides opportunity for widened shoulders for pedestrian and bicycles. Provides additional horizontal and vertical clearance for buses.
- **Maintain travel times.** Provides widened shoulder to assist in maintaining travel speeds.

- **Facilitate access.** Provides opportunity for widened shoulders for pedestrian and bicycles, which could be incorporated with pedestrian routes related to transit stop locations.
- **Implementation considerations.** Minimal disturbance area. Major potential traffic impacts to US 101. Constructability issues related to maintaining access on Alexander Avenue during construction timeframes. Moderate cost strategy.

Alexander Avenue/US 101 Interchange Strategies (R-C1 to R-C5)

Strategy R-C1 (Extend northbound US 101 off-ramp left-turn lane) was carried forward for further review. Considerations during review against the project objectives were:

- **Enhance modal use.** Does not improve or degrade modal use.
- **Maintain travel times.** Provides additional left turn storage length for vehicles turning onto southbound Alexander Avenue; therefore, allowing northbound vehicles to bypass longer queue lengths.
- **Facilitate access.** Does not facilitate or degrade access.
- **Implementation considerations.** Minimal disturbance area. Low cost strategy.

Strategy R-C2 (Reconfigure northbound US 101 off-ramp left turn lane) was carried forward for further review. Considerations during review against the project objectives were:

- **Enhance modal use.** Does not improve or degrade modal use.
- **Maintain travel times.** Provides additional left turn storage length for vehicles turning onto southbound Alexander Avenue; therefore, allowing northbound vehicles to bypass longer queue lengths. Provides improved ramp geometry.
- **Facilitate access.** Does not facilitate or degrade access.
- **Implementation considerations.** Minimal disturbance area. Requires embankment and retaining wall on east side. Moderate cost strategy.

Strategy R-C3 (Reconfigure northbound US 101 ramps to a diamond configuration) was not carried forward for further review. Considerations during review against the project objectives were:

- **Enhance modal use.** Adds additional crossing for southbound Alexander Avenue bicycles.
- **Maintain travel times.** Improves acceleration length for northbound US 101 on-ramp. Eliminates left turn for southbound Alexander Avenue, but northbound Alexander Avenue would be required to turn left to enter the on-ramp.
- **Facilitate access.** Does not facilitate or degrade access.
- **Implementation considerations.** Requires major rock excavation and retaining walls. Costs were not determined for this strategy.

Strategy R-C4 (Extend northbound US 101 on-ramp acceleration lane) was carried forward for further review. Considerations during review against the project objectives were:

- **Enhance modal use.** Improves acceleration length for buses entering US 101.

- **Maintain travel times.** Improves acceleration length for northbound US 101 on-ramp traffic.
- **Facilitate access.** Does not facilitate or degrade access.
- **Implementation considerations.** Requires retaining walls. Requires Alexander Avenue/US 101 underpass extension. Costs were not determined for this strategy.

Strategy R-C5 (Extend southbound US 101 off-ramp deceleration lane) was carried forward for further review. Considerations during review against the project objectives were:

- **Enhance modal use.** Improves deceleration length for buses exiting US 101.
- **Maintain travel times.** Does not improve or degrade travel times. Provides additional area for queuing for peak weekends.
- **Facilitate access.** Improves deceleration length for vehicles exiting US 101.
- **Implementation considerations.** Potentially requires retaining wall. Requires Alexander Avenue/US 101 underpass extension. Costs were not determined for this strategy.

Corridor-wide Roadway Strategies (R-D1 to R-D4)

Strategy R-D1 (Improved wayfinding and warning signing, channelization and pavement markings, turning radii, and traffic calming) was carried forward for further review. Considerations during review against the project objectives were:

- **Enhance modal use.** Improves bicycle and pedestrian signing and pavement markings. Improves turning radii for buses. Provides traffic calming for vehicles which benefits pedestrians and bicycles.
- **Maintain travel times.** Does not improve or degrade travel times.
- **Facilitate access.** Improves bicycle, pedestrian, and vehicle signing and pavement markings. Improves turning radii for buses.
- **Implementation considerations.** Minimal disturbance area. Low cost strategy.

Strategy R-D2 (Signalized corridor) was carried forward for further review. Considerations during review against the project objectives were:

- **Enhance modal use.** Allows for dedicated bicycle and pedestrian crossing phases within the traffic signal timing at three intersections.
- **Maintain travel times.** Accommodates all future (2035) weekday and weekend peak hour periods. Provides opportunity to limit queuing onto US 101.
- **Facilitate access.** Allows access to be more consistent and efficient by managing traffic and queuing.
- **Implementation considerations.** Potential visual impacts due to no other traffic signals in the GGNRA, expect for the Baker-Barry tunnel. Minimal disturbance area. Low cost strategy.

Strategy R-D3 (Second southbound travel lane from Danes Drive to Conzelman Road) was not carried forward for further review. This strategy further enhances strategies R-A4, R-A5, and R-A6, and because those strategies were not forwarded for further review, this strategy was removed from consideration. Considerations during review against the project objectives were:

- **Enhance modal use.** Provides improved bicycle and pedestrian crossing due to southbound Alexander Avenue stop sign. Does not provide dedicated crossing opportunity. Four lane cross section to cross at intersection.
- **Maintain travel times.** Accommodates future (2035) weekday peak hour periods. Provides poor operations for future (2035) weekend peak hour period. Second lane is extended to Conzelman Road which improves southbound US 101 and Conzelman Road intersections.
- **Facilitate access.** Allows access to be more consistent and efficient by providing opportunity for US 101 off-ramp vehicles to make left turn due to AWSC.
- **Implementation considerations.** Moderate disturbance area. Requires implementation of strategy R-B2 (Alexander Avenue/US 101 underpass three lane typical section). High cost strategy due to requiring strategy R-B2.

Strategy R-D4 (Event management) was carried forward for further review. Considerations during review against the project objectives were:

- **Enhance modal use.** Implementing event management techniques removes congestion on the corridor more efficiently which will return the corridor to normal operating conditions sooner. During active event management, delays for bicycles and pedestrians may occur.
- **Maintain travel times.** Seeks to return Alexander Avenue to normal operating conditions as soon as possible. Some movements within the corridor would be restricted, which would result in out of direction travel.
- **Facilitate access.** Seeks to minimize impacts to operating conditions on Alexander Avenue. Some movements within the corridor would be restricted.
- **Implementation considerations.** Requires staffing for setup and takedown operations. Low cost strategy.

5.4.2 Bicycle and Pedestrian Improvement Strategies

After presenting and discussing potential improvement strategies with the stakeholder group and additional planning level analysis, strategies were either carried forward or were not reviewed further. The disposition taken on improvement strategies were based on reviewing strategies against the project objectives and more specifically: constructability, compatibility with roadway and transit strategies, and potential environmental impacts. Table 38 summarizes all bicycle and pedestrian strategies and includes whether the strategy is carried forward for further review.

Table 38
Bicycle and Pedestrian Strategies Summary

Option	Location	Strategy Description	Disposition
BP-A	Bridge walkway (east side)	Provide ramp structure to replace or augment stairs to Vista Point/Northwest Bridge Parking Lot underpass	Carry forward
BP-B	Bridge walkway (west side)	Provide a path to replace or augment stairs to Vista Point/Northwest Bridge Parking Lot underpass	Carry forward
BP-C1	Vista Point Trail	Connect Vista Point and Fort Baker with a shared use path	Carry forward

Table 38
Bicycle and Pedestrian Strategies Summary

Option	Location	Strategy Description	Disposition
BP-C2	Vista Point Trail	Connect Vista Point and Fort Baker with a shared use path	Not forwarded
BP-C3	Vista Point Trail	Connect Vista Point and Fort Baker with a shared use path	Not forwarded
BP-C4	Vista Point Trail	Connect Vista Point and Fort Baker with a shared use path	Not forwarded
BP-D	Lower Conzelman Road	Fort Baker access via Lower Conzelman Road	Carry forward
BP-E	Northwest Bridge Parking Lot to Lower Conzelman Road	Separate path from the Northwest Bridge Parking Lot to Lower Conzelman Road	Carry forward
BP-F	Lower Conzelman Road to Alexander Avenue underpass	Widen shoulders from Lower Conzelman Road to Alexander Avenue/US 101 underpass	Carry forward
BP-G	Alexander Avenue underpass under US 101	Improve lighting and user awareness at the Alexander Avenue/US 101 underpass	Carry forward
BP-H	Knob Trail along US 101/Alexander Avenue to Danes Drive	Path to remove pedestrian from Alexander Avenue	Not forwarded
BP-I	Danes Trail between Fort Baker and the Danes Drive Lot	Shared use path with underpass under Alexander Avenue	Carry forward
BP-J	Alexander Avenue underpass under US 101	Add a bicycle/pedestrian underpass under US 101 adjacent to Alexander Avenue	Not forwarded
BP-K	US 101 south of Alexander Avenue	Add a bicycle/pedestrian underpass under US 101 south of Alexander Avenue	Not forwarded
BP-L	Alexander Avenue underpass under US 101	Widen the Alexander Avenue underpass below US 101	Carry forward
BP-M	NB 101 ramps and Alexander Avenue intersection	New Grade-separated Facility at the Alexander Avenue/Northbound US 101 Ramp Intersection	Carry forward
BP-N	Corridor-wide	Add a separated Class I bicycle path adjacent to Alexander Avenue	Combined with BP-TS1, Not forwarded
BP-O	Corridor-wide	Add Class II bicycle lanes on Alexander Avenue	Combined with BP-TS2, Carry forward
BP-TS1	Corridor-wide	14 ft Class I bicycle path adjacent to Alexander Avenue	Not forwarded
BP-TS2	Corridor-wide	Widened shoulders with 11- or 12-foot travel lanes on Alexander Avenue	Carry forward
BP-TS3	Corridor-wide	8 ft sidewalk adjacent to northbound Alexander Avenue	Not forwarded
BP-TS4	Corridor-wide	5 ft pedestrian path on both sides behind guardrail adjacent to Alexander Avenue	Not forwarded

Bicycle and pedestrian components were developed to specifically address each of the project objectives; therefore, for the purposes of screening components, all components BP-A through BP-O and BP-TS1 through BP-TS4 meet the project objectives with minimal negative impacts. Screening of bicycle and pedestrian components will focus on implementation considerations.

Bicycle and Pedestrian Components (BP-A to BP-O)

Strategy BP-A (East side Golden Gate walkway ramp access) was carried forward for further review. This strategy would provide an accessible route when paired with strategy BP-B between Vista Point and the northwest bridge parking lot. Implementation considerations are:

- Determine most applicable ramp design—ramp access via switchbacks using retaining walls, a circular metal structure, or a switchbacked metal structure. Based on a conceptual review, there appears to be enough space to fit a ramp structure in the area.
- Ramp access should augment stair access.
- Ramp access should minimize impacts to the existing Vista Point rock wall at the connection point and connect as close as practical to the existing stairway.
- Visual impacts should be coordinated with the NPS.

Strategy BP-B (West side Golden Gate walkway ramp access) was carried forward for further review. This strategy would provide an accessible route when paired with strategy BP-A between Vista Point and the northwest bridge parking lot. Implementation considerations are:

- Ramp access should seek to tie into the northwest parking lot as soon as possible.
- Ramp access should augment stair access.
- Retaining walls will be required.
- Visual impacts should be coordinated with the NPS.

For strategies BP-C1 through BP-C4 (Connect Vista Point to Fort Baker), strategy BP-C1 was carried forward for further review. Strategies BP-C2 through BP-C4 were removed from further consideration due to potential visual impacts and amount of disturbance area. Implementation considerations for strategy BP-C1 are:

- Uses existing alignment.
- Gate for access beneath Golden Gate Bridge must remain open.
- Space allocation for bicycles and pedestrians and potential for minor widening and railing.
- Sight distance and speed for downhill bicycles traveling from Vista Point to Fort Baker.
- Drainage considerations on the uphill side.
- Threatened and endangered species considerations.

Strategy BP-D (Fort Baker access via Lower Conzelman Road) was carried forward for further review. Implementation considerations are:

- Uses existing alignment.
- Space allocation for authorized vehicles, bicycles, and pedestrians.
- Sight distance and speed for downhill bicycles traveling from Vista Point to Fort Baker.

- Drainage considerations on both sides to formalize ditches. There is pavement edge cracking due to drainage issues and insufficient lateral support. A recent paving project by the GGBHTD in 2012 addressed some of these issues.
- Sharp curves and steep grades.

Strategy BP-E (Separate path from the northwest bridge parking lot to Conzelman Road) was carried forward for further review. Two potential access routes were initially reviewed and included the shoulder of existing parking lot access or along the southbound US 101 on-ramp. Reconstruction of the northwest bridge lot and access road in 2011 provided space for pedestrians and bicycles within the parking lot and a bike lane from the parking lot to Conzelman Road. Currently, Strategy BP-E is considered implemented, but should be reviewed for possible improvements as adjacent projects are completed. Initial implementation considerations of the two routes were:

- Shoulder of the existing parking lot route
  - Widening of the shoulder or shared use of the existing parking lot access lane.
  - Minimal disturbance area.
  - Requires more profile effort than US 101 on-ramp option.
- US 101 on-ramp route
  - Contra-flow condition would require physical separation, potentially with barrier.
  - Requires excavation of slope.
  - Sight distance from Lower Conzelman to see bicycles coming from right.
  - Northbound bicycles would not be permitted to cross uncontrolled across US 101 on-ramp and would have to enter the stop condition from Lower Conzelman to Alexander Avenue.
  - If southbound bicycles would be permitted to use path, entering the path across the Lower Conzelman intersection would conflict with northbound bicycles using the stop condition to northbound Alexander Avenue.
  - Lane assignment of left turning bicycles from Lower Conzelman to northbound Alexander Avenue.

Strategy BP-F (Widen shoulders from Lower Conzelman Road to Alexander Avenue/US 101 underpass) was carried forward for further review. This strategy overlaps with strategies BP-O and BP-TS2. The implementation consideration is:

- Widening to west impacts geotechnical concern area.

Strategy BP-G (Improve lighting and user awareness at the Alexander Avenue/US 101 underpass) was carried forward for further review. Implementation considerations are:

- Coordination with potential Caltrans project to occur once funding is in place to provide minimal improvements.
- Upgrade lighting to current design standards.
- Develop comprehensive signing, pavement marking, and traffic calming design to install on both sides of the underpass.

Strategy BP-H (Knob Trail alignment) was not carried forward for further review. Implementation considerations that removed this strategy from further consideration are:

- Visual impacts.
- Potential impact to Mission Blue Butterfly habitat.
- Disturbance area.

Strategy BP-I (Danes Trail) was carried forward for further review. This strategy was included in the Marin Headlands EIS. Implementation considerations are:

- Location of underpass beneath Alexander Avenue. An underpass structure at the bottom of the deep fill near the drainage culvert would be approximately 277 feet long. The underpass would have to be tunneled or jacked. Consideration should be given to moving the underpass to a more easily constructed location such as near the transit stop location T-10.
- Implementation would be timed to correspond with transit strategies T-9 and/or T-10, if implemented.
- Potential wetland impacts.

Strategy BP-J (Underpass adjacent to Alexander Avenue/US 101 underpass) was not carried forward for further review. Implementation considerations that removed this strategy from further consideration are:

- Adds another structure beneath US 101.
- Requires excavation and potential retaining walls on the west side of US 101.
- May conflict with future Alexander Avenue/US 101 underpass replacement.
- Traffic impacts to US 101 during construction.

Strategy BP-K (US 101 underpass south of Alexander Avenue) was not carried forward for further review. Implementation considerations that removed this strategy from further consideration are:

- Adds another structure beneath US 101.
- Requires excavation and retaining walls on the west side of US 101.
- Requires embankment and retaining walls on the east side of US 101.
- Traffic impacts to US 101 during construction.
- Connection issues to existing shared use path on east side due to grade differences.

Strategy BP-L (Widen Alexander Avenue/US 101 underpass) was carried forward for further review and combined with strategy R-B1. See strategy R-B1.

Strategy BP-M (New grade-separated facility at the Alexander Avenue/northbound US 101 ramp intersection) was carried forward for further review. Implementation considerations are:

- Requires embankment and retaining walls on the east side of the northbound US 101 off-ramp.
- Traffic impacts to Alexander Avenue during construction.

- Connection issues to existing shared use path on east side due to grade differences.
- Use of underpass if crossing at-grade at intersection appears more efficient.

Strategy BP-N (Class I bicycle path adjacent to Alexander Avenue) was combined with strategy BP-TS1 and was not carried forward for further consideration. See strategy BP-TS1.

Strategy BP-O (Class II bicycle lanes on Alexander Avenue) was combined with strategy BP-TS2 and was carried forward for further consideration. See strategy BP-TS2.

Alexander Avenue Typical Sections

Strategy BP-TS1 (Class I bicycle path adjacent to Alexander Avenue) was not carried forward for further review. Implementation considerations that removed this strategy from further consideration are:

- Large disturbance area.
- Large amounts of embankment and excavation required to construct and potentially large retaining walls.
- Potential visual impacts.
- Some bikes would still use Alexander Avenue.
- Fourteen-foot width reviewed is near the minimum width needed. Desirable design of bi-directional shared use path with steep grades would likely be wider.

Strategy BP-TS2 (Widened shoulders on Alexander Avenue) was carried forward for further review. Implementation considerations are:

- Space allocation for vehicles, bicycles, and pedestrian within the available existing transportation bench width.
- Allows bicycles and pedestrians to maximize use of shared shoulder width while only one mode is present.
- Narrow width locations due to structures.

Strategy BP-TS3 (Sidewalk adjacent to northbound Alexander Avenue) was not carried forward for further review. Implementation considerations that removed this strategy from further consideration are:

- Width of typical section needed to accommodate sidewalk would require embankment and excavation and potentially retaining walls beyond the existing transportation bench width.
- Change to Alexander Avenue defining feature of paved shoulder and white post and timber railing along road edges as defined in Section 3.5.4, Historical and Cultural Resources by the *Historic Road Characterization Study, Supplemental Work.*
- Potential visual impacts.

Strategy BP-TS4 (Path on both sides behind guardrail adjacent to Alexander Avenue) was not carried forward for further review. Implementation considerations that removed this strategy from further consideration are:

- Width of typical section needed to accommodate shoulders and path would require embankment and excavation and potentially retaining walls beyond the existing transportation bench width.
- Provides minimum shoulder width for bicycles.

5.4.3 Transit Improvement Strategies

Transit service opportunities are discussed in Section 5.3.4, which provides the qualitative screening of transit improvement strategies. Table 39 summarizes all transit improvement strategies and includes whether the strategy is carried forward for further review.

Table 39
Transit Improvement Strategies Summary

Strategy	Location	Strategy Description	Disposition
T-1	Vista Point	Transit stop	Carry forward
T-2	Conzelman Road/SB Alexander Avenue	Transit stop	Carry forward
T-3	Along NB US 101 off-ramp	Transit stop	Carry forward
T-4	Along NB US 101 ramps at Alexander Avenue	Transit stop	Not forwarded
T-5	NB US 101 ramps/SB Alexander Avenue	Transit stop	Carry forward
T-6	Danes Drive/NB Alexander Avenue	Transit stop	Not forwarded
T-7	Danes Drive/SB Alexander Avenue, south side	Transit stop	Not forwarded
T-8	Danes Drive/SB Alexander Avenue, north side	Transit stop	Carry forward
T-9	Danes parking lot	Transit stop	Carry forward
T-10	SB Alexander Avenue	Transit stop	Not forwarded
T-11	East Road/SB Alexander Avenue	Transit stop	Carry forward
T-12	East Road/NB Alexander Avenue	Transit stop	Carry forward

5.5 REFINED IMPROVEMENT STRATEGIES

5.5.1 Roadway Improvement Strategies

The remaining roadway strategies after the qualitative screening process are shown in Table 40.

Table 40
Remaining Roadway Strategies after Qualitative Screening

Option	Location	Strategy Description	Disposition
R-A1	NB 101 ramps and Alexander Avenue intersection	Signalize intersection	Carry forward
R-B1	Alexander Avenue underpass under US 101 (two travel lanes)	Widen underpass for shoulders, sight distance, vertical clearance	Carry forward
R-C1	NB US 101 off-ramp	Extend NB US 101 off-ramp left-turn lane	Carry forward
R-C2	NB US 101 off-ramp	Reconfigure NB US 101 off-ramp	Carry forward
R-C4	NB US 101 on-ramp	Extend NB US 101 on-ramp acceleration lane	Carry forward
R-C5	SB US 101 off-ramp	Extend SB US 101 off-ramp deceleration lane	Carry forward

Table 40
Remaining Roadway Strategies after Qualitative Screening

Option	Location	Strategy Description	Disposition
R-D1	Corridor wide	Improved wayfinding and warning signing, channelization and pavement markings, turning radii, and traffic calming	Carry forward
R-D2	Corridor-wide (Danes Drive to Conzelman Road)	Signalized corridor	Carry forward
R-D4	Corridor-wide	Event management	Carry forward

These strategies were determined to be appropriate for recommendation for this planning level study since no two strategies directly conflict with each other. A review of these strategies shows that each strategy can be coordinated for implementation to develop the overall recommended strategy. For example, the signalized intersection design (R-A1) should be coordinated with northbound US 101 off-ramp improvements (R-C1 and/or R-C2) and improved signing and pavement markings (R-D1).

5.5.2 Bicycle and Pedestrian Improvement Strategies

The remaining bicycle and pedestrian strategies after the qualitative screening process are shown in Table 41.

Table 41
Remaining Bicycle and Pedestrian Strategies after Qualitative Screening

Option	Location	Strategy Description	Disposition
BP-A	Bridge walkway (east side)	Provide ramp structure to replace or augment stairs to Vista Point/Northwest Bridge Parking Lot underpass	Carry forward
BP-B	Bridge walkway (west side)	Provide a path to replace or augment stairs to Vista Point/Northwest Bridge Parking Lot underpass	Carry forward
BP-C1	Vista Point Trail	Connect Vista Point and Fort Baker with a shared use path	Carry forward
BP-D	Lower Conzelman Road	Fort Baker access via Lower Conzelman Road	Carry forward
BP-E	Northwest Bridge Parking Lot to Lower Conzelman Road	Separate path from the Northwest Bridge Parking Lot to Lower Conzelman Road	Carry forward
BP-F	Lower Conzelman Road to Alexander Avenue underpass	Widen shoulders from Lower Conzelman Road to Alexander Avenue/US 101 underpass	Carry forward
BP-G	Alexander Avenue underpass under US 101	Improve lighting and user awareness at the Alexander Avenue/US 101 underpass	Carry forward
BP-I	Danes Trail between Fort Baker and the Danes Drive Lot	Shared use path with underpass under Alexander Avenue	Carry forward

Table 41
Remaining Bicycle and Pedestrian Strategies after Qualitative Screening

Option	Location	Strategy Description	Disposition
BP-L	Alexander Avenue underpass under US 101	Widen the Alexander Avenue underpass below US 101	Carry forward
BP-M	NB 101 ramps and Alexander Avenue intersection	New Grade-separated Facility at the Alexander Avenue/Northbound US 101 Ramp Intersection	Carry forward
BP-O	Corridor-wide	Add Class II bicycle lanes on Alexander Avenue	Carry forward, combined with BP-TS2
BP-TS2	Corridor-wide	Widened shoulders with 11 of 12-foot travel lanes on Alexander Avenue	Carry forward

Based on discussions with the stakeholders and further analysis, the initial options were combined with each other to develop complete routes between the Golden Gate Bridge and the Sausalito city limit, both through Fort Baker and along Alexander Avenue. The routes include routes to and from the Golden Gate Bridge east and west sides. These routes could be picked up anywhere along Alexander Avenue or within Fort Baker. While pedestrians are only allowed on the east side of the Golden Gate Bridge, bicycles are permitted to use the west side at certain times. Table 42 summarizes all refined improvement strategies and includes whether the strategy is carried forward for further review.

Providing two routes allows for bicyclists and pedestrians to chose. The Fort Baker route is considered the less-direct, less-congested (including vehicles), and more scenic route. Bicyclists using this route are anticipated to be less experienced and have slower travel speeds. The Alexander Avenue route is considered to be more direct and congested (including vehicles). Bicyclists using this route are anticipated to be more experienced and travel at higher speeds.

Due to existing weekend bicycle and pedestrian travel and anticipated growth in these travel modes, facilities should be designed to desirable design standards and should seek to reduce conflict points with vehicles where possible.

Table 42
Refined Improvement Strategies Summary

Option	Location	Strategy Description	Disposition
BP-P1	Through Fort Baker	Complete Fort Baker bicycle and pedestrian route from the Golden Gate Bridge to Sausalito (to east side of Golden Gate Bridge)	Carry forward
BP-P2	Through Fort Baker	Complete Fort Baker bicycle and pedestrian route from Sausalito to the Golden Gate Bridge (to west side of Golden Gate Bridge)	Carry forward
BP-Q1	Along Alexander Avenue	Complete Alexander Avenue bicycle and pedestrian route from the Golden Gate Bridge to Sausalito (to east side of Golden Gate Bridge)	Carry forward
BP-Q2	Along Alexander Avenue	Complete Alexander Avenue bicycle and pedestrian route from Sausalito to the Golden Gate Bridge (to west side of Golden Gate Bridge)	Carry forward

Fort Baker Routes (Strategies BP-P1 and BP-P2)

The Fort Baker routes include routes to and from the east and west sides of the Golden Gate Bridge through Fort Baker by the use of Lower Conzelman Road, Vista Point Trail, Moore Road, and East Road. Strategy BP-P1 is the complete route through Fort Baker to and from the east side of the Golden Gate Bridge. Strategy BP-P2 is the complete route through Fort Baker to and from the west side of the Golden Gate Bridge. All of these roadways should be updated with bicycle signs and/or pavement markings. Segments of the routes would need to be improved, such as Vista Point Trail (Strategy BP-C1) and Moore Road. Conceptual typical sections of the Vista Point Trail are included in Figure 66. These overall Fort Baker routes are shown in Figure 67. The estimated costs of the Fort Baker routes are moderate.

Along the Fort Baker route to and from the east side of the Golden Gate Bridge, the Vista Point Trail, as shown in Figure 66, may require a retaining wall on the east and south sides of the path. This will depend on drainage and path width considerations. The wall would likely require pedestrian railing along the entire stretch of path in this area. Both routes would resurface Moore Road to provide a smooth paved surface. Currently, the Moore Road asphalt pavement is in poor condition with multiple patching from utility work and potholes.

Strategy BP-P2 along Lower Conzelman Road is currently signed as Marin County bicycle route 5.

Figure 66 shows two options that were reviewed. Option 2 is recommended due to the anticipated use of the path (both low speed and higher speed pedestrians and bicycles), potential for higher speed downhill bicycles, sight distance for bicycles, and reducing conflicts between pedestrians and bicycles.

It is anticipated that the additional impacts to implement a wider shared use path will be minor compared to the potential benefits to the pedestrian and bicycle user. Engineering considerations include horizontal sight distance, ditch hydraulics, and potential pedestrian railing.

Figure 66
Typical Section of Vista Point Trail (Strategy BP-C1 and BP-P1)

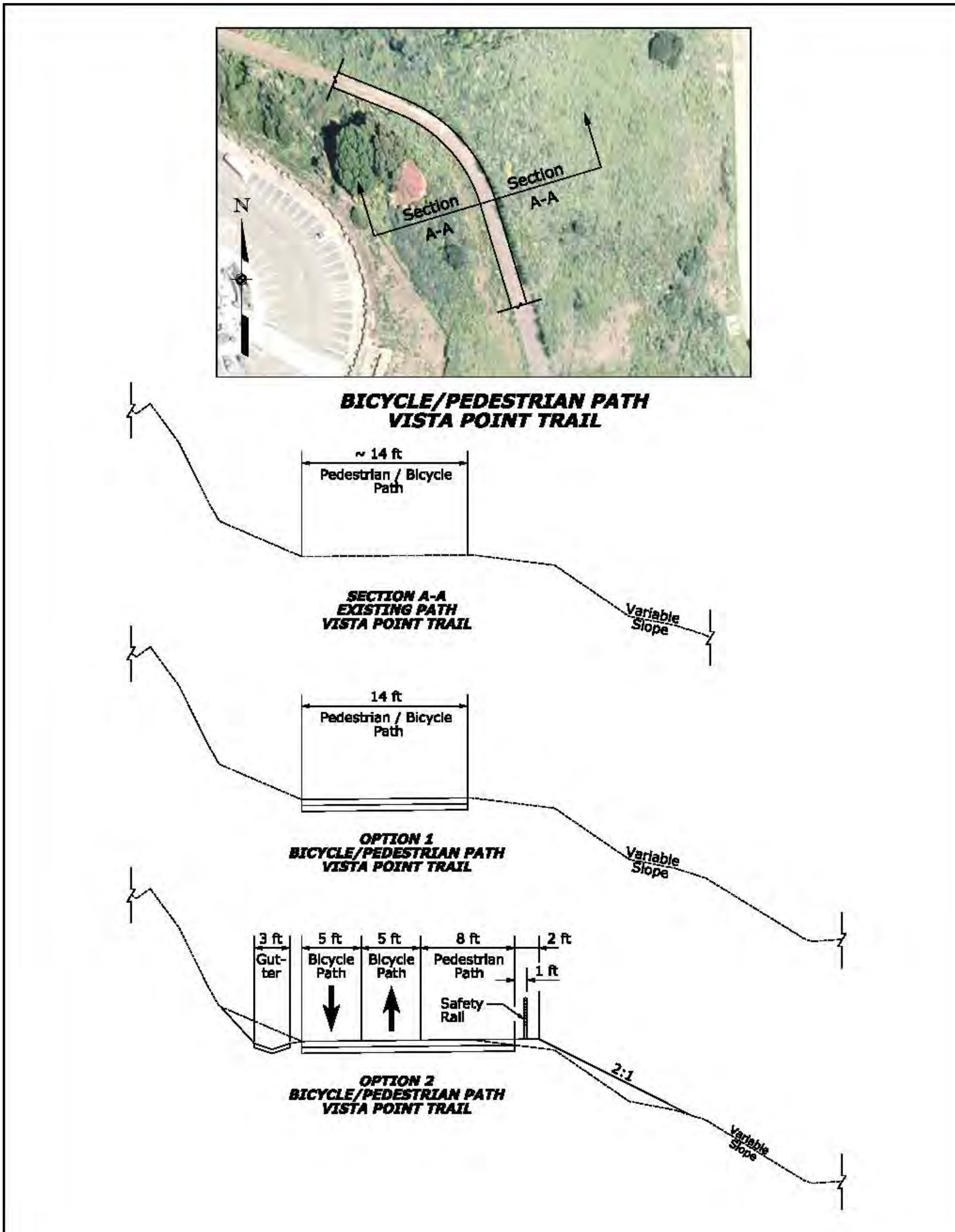

Figure 67
Fort Baker Routes to and from the East and West Sides of the Golden Gate Bridge (Strategies BP-P1 and BP-P2)

Alexander Avenue Route (Strategies BP-Q1 and BP-Q2)

The Alexander Avenue routes include routes to and from the east and west sides of the Golden Gate Bridge along Alexander Avenue by the use of Alexander Avenue, Conzelman Road, Lower Conzelman Road, existing shared use paths, and Vista Point. Strategy BP-Q1 is the complete route to and from the east side of the Golden Gate Bridge. Strategy BP-Q2 is the complete route to and from the west side of the Golden Gate Bridge. All of these roadways and paths should be updated with bicycle signs and/or pavement markings. Segments of the routes would need to be improved, such as shoulders along Alexander Avenue (Strategy BP-TS2), the existing shared use path, and the Alexander Avenue/US 101 underpass (Strategy R-B1). Conceptual typical sections of the improvements to the existing shared use path are included in Figure 68. The overall Alexander Avenue routes are shown in Figure 69. The estimated costs of Alexander Avenue routes are moderate to high, depending on the widening of the Alexander Avenue/US 101 underpass.

Along the Alexander Avenue route, the structures include the Alexander Avenue/US 101 underpass and a retaining wall along the east side of the existing shared use path between Vista Point and Alexander Avenue.

To reduce conflicts at the northbound US 101 off-ramp and Alexander Avenue intersection, a grade separated underpass could be constructed for bicyclists and pedestrians beneath the existing intersection. This underpass is strategy BP-M.

Figure 68
Typical Section of Existing and Proposed/Improved Shared Use Path Vista Point to Alexander Avenue (Strategy BP-Q1 and BP-Q2)

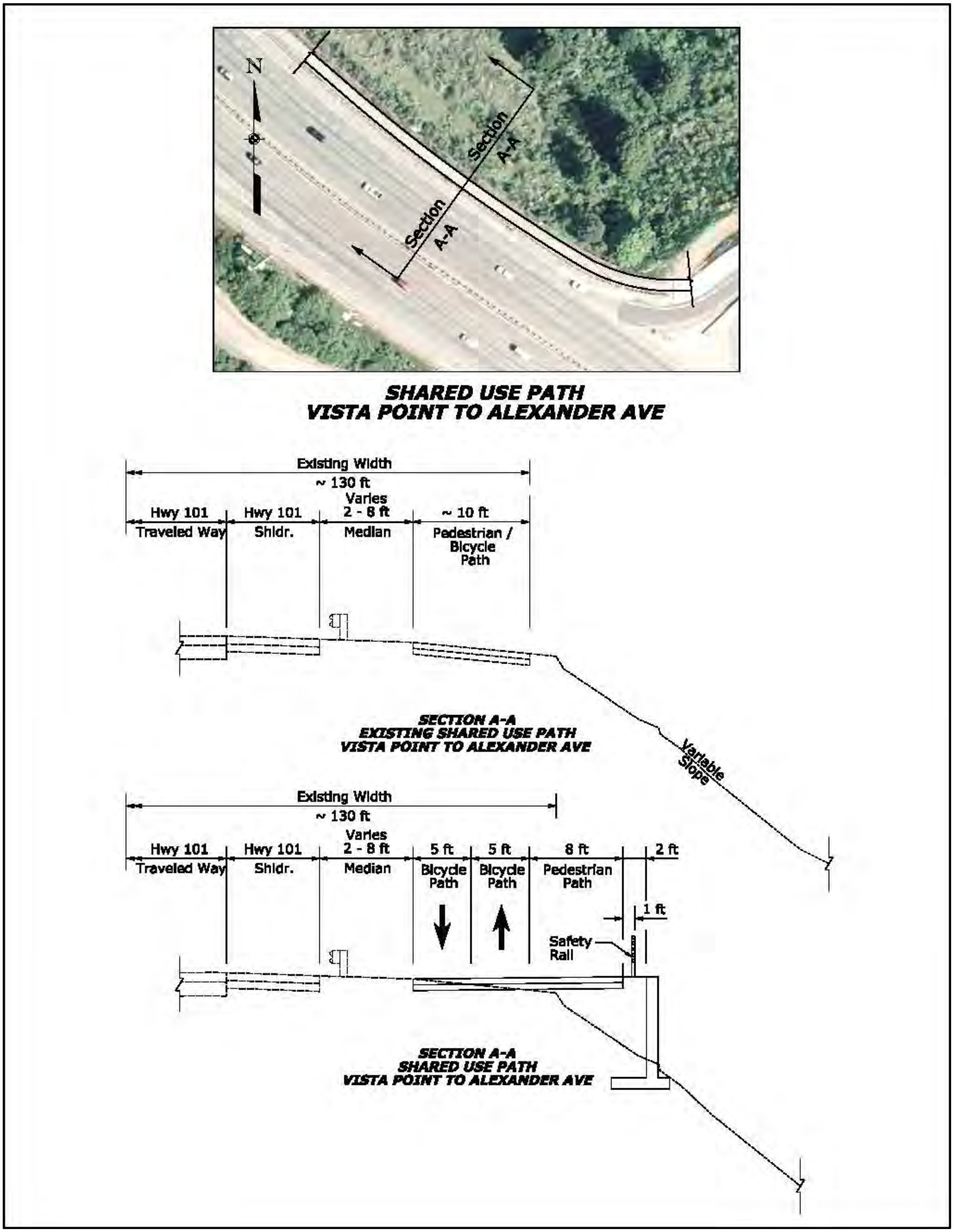

Figure 69
Alexander Avenue Routes to and from the East and West Sides of the Golden Gate Bridge (Strategies BP-Q1 and BP-Q2)

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5.5.3 Transit Improvement Strategies

No refinements were made to transit improvement strategies, as shown in Table 39 in Section 5.4.3.

5.6 FINAL ALTERNATIVE COMPILATION

The final alternative compilation will recommend alternatives that successfully underwent the qualitative screening process. This compilation will suggest alternatives based on each respective category of improvement, which includes roadway, bicycle and pedestrian, and transit components. Figure 70 shows the overall recommended improvement strategies.

5.6.1 Roadway Improvement Strategies

Roadway strategies include improvements to geometry, typical section, signing, and pavement marking elements of roadways. These strategies are:

Intersection Strategies

- Signalize Alexander Avenue/US 101 northbound ramps intersection (Strategy R-A1).

Underpass Strategies

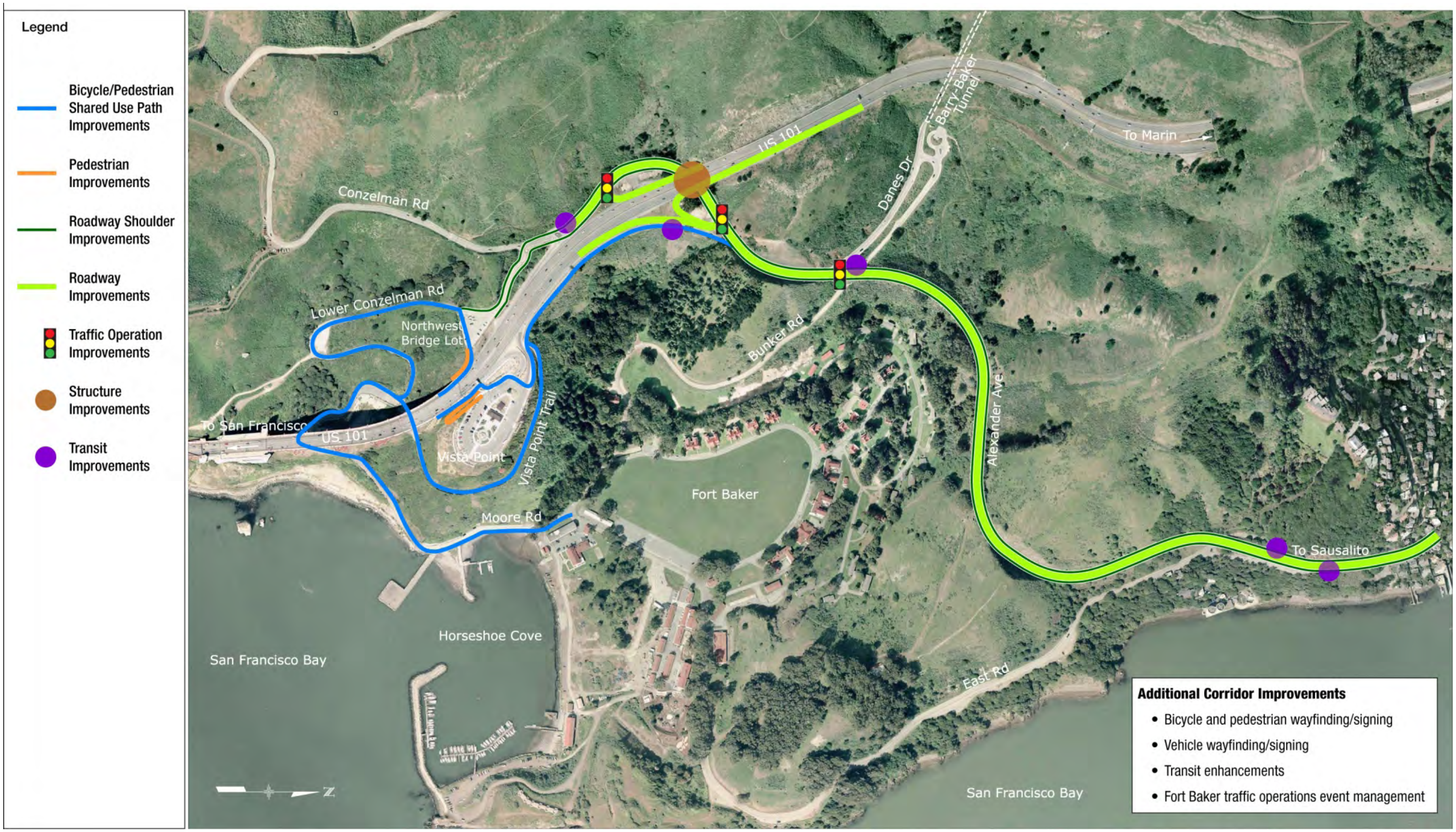
- Replace the structure as its useful life deteriorates or continued increased multi-modal use on Alexander Avenue warrants. Replacement of the structure will improve sight distance, height requirements, typical section width, multi-modal use, and be designed to current seismic standards (Strategy R-B1).

Interchange Strategies

- Improve geometry of the northbound US 101 off-ramp (Strategy R-C2).
- Improve geometry and acceleration length of the northbound US 101 on-ramp (Strategy R-C4).
- Improve deceleration length of the southbound US 101 off-ramp (Strategy R-C5).

Strategies R-C4 and R-C5 are improvements strategies for US 101. Caltrans should review these concepts for implementation as they do not directly affect Alexander Avenue, but have been determined to a beneficial improvement in the immediate area.

Figure 70
Overall Recommended Improvement Strategies



Corridor-wide traffic operations Strategies

- Improve intersection turning radii to assist larger vehicles (Strategy R-D1).
- Improve wayfinding, signing, pavement markings, and traffic calming to increase driver understanding and expectation (Strategy R-D1).
- Signalize additional two intersections (Strategy R-D2) at:
  - Alexander Avenue/US 101 southbound off-ramp
  - Alexander Avenue/Danes Drive
- Implement event management techniques (Strategy R-D4) during Fort Baker events:
  - Restricted two-way travel
  - Reduced access points
  - Prohibited turn movements
- Implement permanent traffic counters to gather data on vehicle, bicycle, and pedestrian use.

5.6.2 Bicycle and Pedestrian Improvement Strategies

Bicycle and pedestrian strategies include improvements to shared use paths corridor wide and at specific locations. These strategies are:

- Improve Vista Point Trail (Strategy BP-C1).
- Improve Lower Conzelman Road (Strategy BP-D).
- Improve Moore Road (Strategy BP-P1 and BP-P2).
- Improve shared use paths between Vista Point and Alexander Avenue (Strategy BP-Q1 and BP-Q2).
- Improve Golden Gate Bridge walkway access (Strategy BP-A and BP-B).
- Improve corridor wide wayfinding and signing (Strategy R-D1 for bicycles and pedestrians).
- Improve transit stop connectivity (in collaboration with transit strategies).
- Improve typical section to ensure maximum use of available space to accommodate bicycle, pedestrian, vehicle, and transit travel modes (Strategy BP-TS2).
- Improve lighting, signing, and pavement marking within and in the immediate vicinity of the structure (Strategy BP-G).

5.6.3 Transit Improvement Strategies

Transit strategies include improvements to existing transit stop locations and potential added services. These strategies are:

- Improve existing stop access and design consistency if the stop is within a roadway improvement strategy area during implementation.
- Coordinate with GGNRA, GGBHTD, and SFMTA for enhanced future services and changes to existing stop locations.

6.0 IMPLEMENTATION

6.1 PHASING OF IMPROVEMENTS

The recommended improvement strategies were separated into phases for implementation based on benefits and challenges related to engineering and environmental analysis. These improvements could be implemented by any of the key stakeholders in partnership with others.

Phase 1 (short-term) improvements are defined as strategies that could be implemented relatively easily within 0 to 3 years that will improve existing conditions and are low-cost strategies. Phase 2 (mid-term) improvements are defined as strategies that could be implemented with moderate efforts within 3 to 5 years, may require more extensive environmental clearance efforts, are moderate-cost strategies, and would provide the most benefit to all users. Phase 3 (long-term) improvements are strategies that would ensure the corridor meets 2035 anticipated use, are moderate to high-cost strategies, and require more extensive study, design, and clearances.

All phases will require funding discussions with the stakeholders and design efforts will need to be closely coordinated with each stakeholder. Because the GGBHTD and Caltrans have jurisdiction for maintenance and improvement within their rights-of-way, designs will require formal approvals from these agencies.

The GGBHTD, as of the date of the planning study, is in the process of conducting an engineering and traffic study to determine the appropriate speed limit for Alexander Avenue. Implementation efforts should coordinate with the GGBHTD for the results of the study.

Caltrans indicated at the September 29, 2010, progress meeting that they plan to implement minor improvements to the US 101 underpass when funding becomes available. These improvements would include signing and striping, and potentially minor lighting improvements. Implementation efforts should coordinate with Caltrans for these improvements.

NPS and the key stakeholders should coordinate efforts to implement projects in approved documents and projects that are already planned/programmed.

6.1.1 Phase 1

The following Phase 1 improvement strategies are shown in Figure 71:

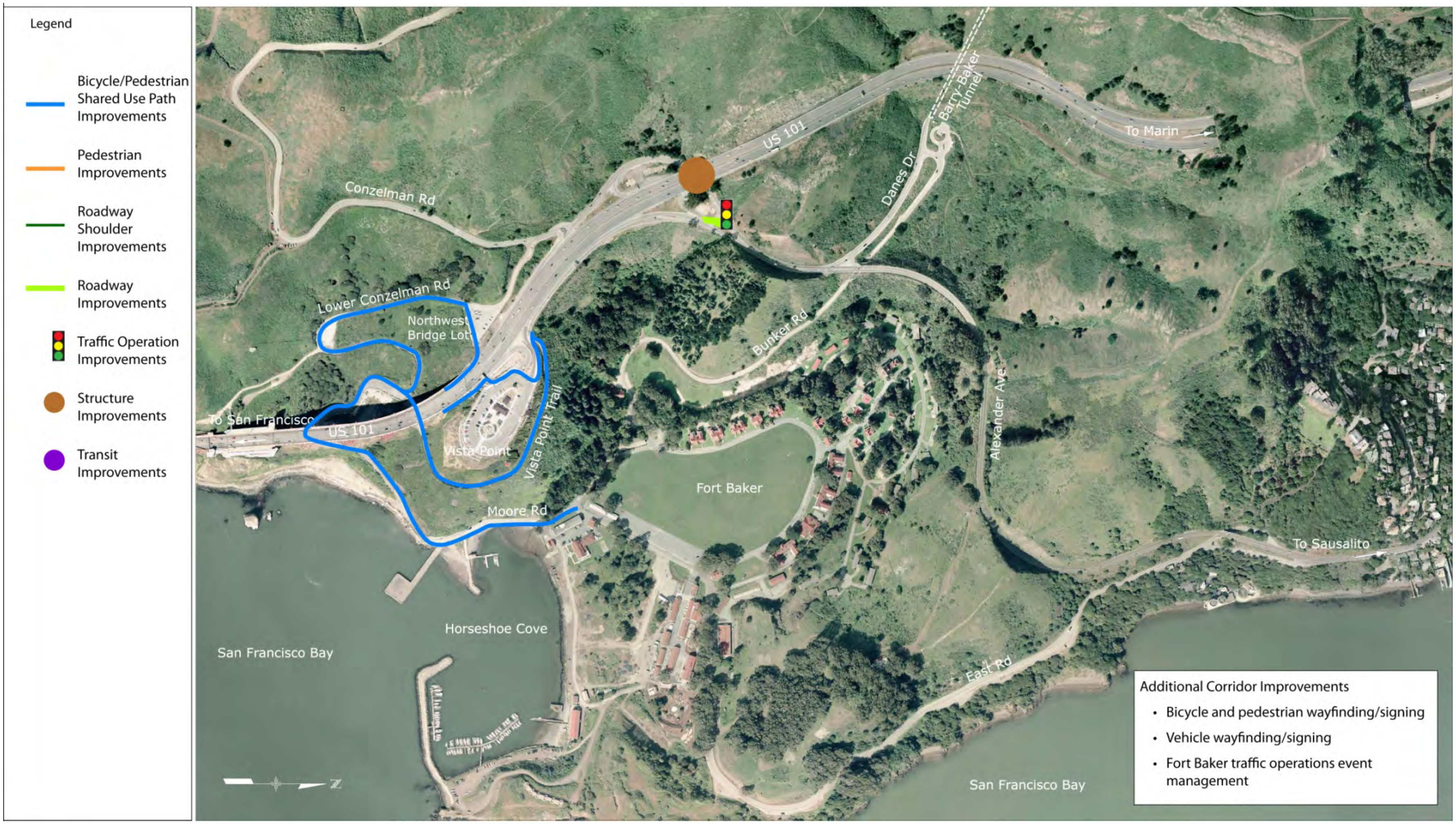
- Improve corridor wide bicycle, pedestrian, and vehicle wayfinding, signing, pavement markings, turning radii, and traffic calming to increase user (bicyclists, pedestrians, and vehicle drivers) understanding and expectation (Strategy R-D1).
- Implement event management techniques during Fort Baker events (Strategy R-D4). Techniques should be coordinated internally within NPS, prior to implementation, and follow recommendations made in the Fort Baker EIS and ROD.
- Implement traffic signals at Alexander Avenue/US 101 northbound ramps, including intersection geometry modifications to eliminate the existing northbound free right onto Alexander Avenue and widening the shoulder to accommodate the bicycle and pedestrian traffic (Strategy R-A1).
- Improve Vista Point Trail. This strategy will include widening and paving operations to provide suitable pavement conditions for bicycle and pedestrian users (Strategy BP-C1).
- Improve Lower Conzelman Road. This strategy will include milling and paving operations and sawcutting and full depth replacement of shoulder to provide suitable pavement conditions for bicycle and pedestrian users (Strategy BP-D).
- Improve Moore Road. This strategy will include milling and paving operations to provide suitable pavement conditions for bicycle and pedestrian users. This strategy does not include improvements associated with implementation of strategies BP-C1 and BP-D (Strategy BP-P1 and BP-P2).
- Improve lighting, signing, and pavement marking within and in the immediate vicinity of the US 101 underpass structure (Strategy BP-G).
- Install permanent traffic and bicycle counters (Moore Road and on path north of Vista Point before Alexander Avenue)

Table 43
Phase 1 Estimated Construction Costs

Improvement Strategy	Estimated Cost
R-D1	$100,000
R-D4	$10,000 per event
R-A1	$590,000
BP-C1	$490,000
BP-D	$580,000
BP-P1 and BP-P2	$80,000
BP-G	$180,000
Phase 1 Total	$2,030,000

Estimated cost shown is construction cost only. Costs do not include environmental clearance, preliminary engineering, construction engineering or right of way.

Figure 71
Phase 1 Improvement Strategies



Note: Structure improvements include lighting, signing, and pavement markings only.

6.1.2 Phase 2

The following Phase 2 improvement strategies are shown in Figure 72:

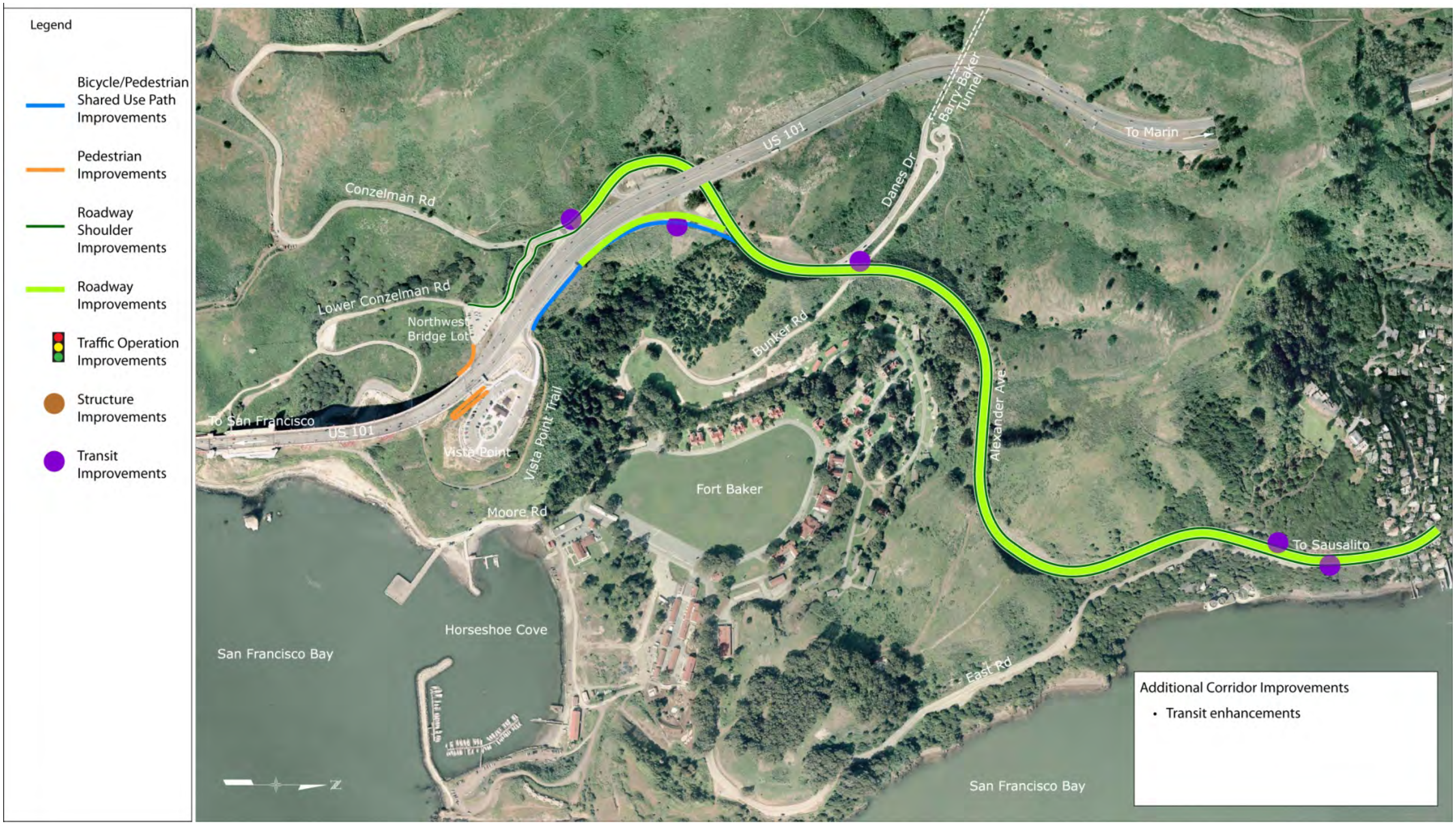
- Improve typical section to ensure maximum use of available space to accommodate bicycle, pedestrian, vehicle, and transit travel modes. This strategy will require widening the roadway 1 to 2 feet for the entire length, adjusting superelevations to meet current design guidelines for runoff length (superelevation on Curve 6 will be excluded due to the impacts to the structure at this location), and rehabilitating asphalt pavement. This strategy does not include improvements associated with implementation of Strategy R-B1 or improvements associated with the Alexander Avenue/Danes Drive intersection improvements project (Strategy BP-TS2).
- Improve geometry of the northbound US 101 off-ramp to accommodate additional storage for left turns. This strategy will require a retaining wall structure on the east side to accommodate a reconfigured ramp and additional width to match in with the shared use path recommended in BP-Q1 over the steep fill slope (Strategy R-C1 and RC-2). The retaining wall quantity will be in addition to the retaining wall required for Strategy BP-Q1.
- Improve shared use paths between Vista Point and Alexander Avenue. This strategy will require a retaining wall structure east of the shared-use path adjacent to US 101 to accommodate widening over the steep fill slope. This strategy does not include improvements associated with implementation of strategies BP-TS2 and R-B1 (Strategy BP-Q1 and BP-Q2).
- Improve Golden Gate Bridge walkway access. This strategy will require a retaining wall structure over the steep fill slope to connect the walkway access to the East Vista Point parking lot (Strategy BP-A and BP-B).
- Improve transit connectivity with bicycle, pedestrian, and other transit facilities with coordinated operations between local and regional transit agencies, and include such features as bus shelters and sidewalk at bus stop locations (in collaboration with roadway strategies).
- Improve existing transit stop access and design consistency if the stop is within a roadway improvement strategy area during implementation (in collaboration with roadway strategies).

Table 44
Phase 2 Estimated Construction Costs

Improvement Strategy	Estimated Cost
BP-TS2	$2,610,000
R-C1 and R-C2	$2,670,000
BP-Q1 and BP-Q2	$1,400,000
BP-A	$420,000
BP-B	$520,000
Transit strategies	
T-2	$100,000
T-3	$100,000
T-8	$100,000
T-11	$100,000
T-12	$100,000
Phase 2 Total	$8,120,000

Estimated cost shown is construction cost only. Costs do not include any environmental clearance, preliminary engineering, construction engineering, or right of way.

Figure 72
Phase 2 Improvement Strategies



6.1.3 Phase 3

The following Phase 3 improvement strategies are shown in Figure 73:

- Improve geometry and acceleration length of the northbound US 101 on-ramp. This strategy will require a retaining wall structure on the east side of the ramp to accommodate widening into the steep cut and fill slopes (Strategy R-C4).
- Improve deceleration length of the southbound US 101 off-ramp. This strategy will require a retaining wall structure on the west side of the ramp to accommodate extending the deceleration length into the steep cut slope. Widening of the US 101/Alexander Avenue structure will be required to implement this strategy. Costs for the widening of this structure are included in strategy R-B1 (Strategy R-C5).
- Implement traffic signals at two intersections (Strategy R-D2D2) along the Alexander Avenue corridor:
  - Alexander Avenue/US 101 southbound off-ramp
  - Alexander Avenue/Danes Drive
- Replace the US 101/Alexander Avenue structure as its useful life deteriorates or continued increase in bicycle and pedestrian use warrants (Strategy R-B1) to achieve:
  - Typical section width
  - Improved sight distance
  - Widening for bike and pedestrian use
  - Improved vertical clearance for buses and trucks
  - Seismic standards

Before implementing traffic signals, an updated traffic study should be performed to ensure the signal is warranted and no undesirable effects result from implementation.

Coordinate with Caltrans for implementation of US 101 on and off ramp improvements. Strategies R-C4 and R-C5 must be coordinated with Strategy R-B1.

Table 45
Phase 3 Estimated Construction Costs

Improvement Strategy	Estimated Cost
R-C4	$2,150,000
R-C5	$1,140,000
R-D2	$1,100,000
R-B1*	$3,970,000
Two Transit strategies	$200,000
Phase 3 Total:	$8,560,000

**Temporary traffic control costs are not included. Further discussion with Caltrans and GGBHTD is needed.*
Estimated cost shown is construction cost only. Costs do not include any environmental clearance, preliminary engineering, construction engineering, or right of way.

Figure 73
Phase 3 Improvement Strategies

6.2 FURTHER STUDIES

The improvement strategies recommended for implementation identify those concepts that were reviewed and discussed with the stakeholders and provide solutions that address the project goal and objectives. These recommended strategies should be reviewed more thoroughly and cleared for construction through the NEPA and CEQA processes. A Caltrans Project Study Report is anticipated for improvement made to the Alexander Avenue/US 101 interchange. This review would take the planning level strategy layouts and include additional conceptual layouts and variations of the strategies to develop a more complete design, understanding of potential impacts, and compatibility between modal uses.

6.3 OTHER STEPS

Funding sources should be explored through local, regional, state, and federal sources to develop an ongoing funding stream for design, construction, and continual maintenance of improvements.

Improvement strategies within Caltrans right-of-way should be coordinated with departments within Caltrans to ensure engineering design criteria and design approval processes are met.

Coordinate with GGBHTD to review reducing the posted speed of the corridor to 40 mph.

Field survey of improvement strategies should begin to allow further development of recommended strategies.

Bicycle volumes should continue to be monitored yearly to ensure the corridor shoulders do not become too congested with bicycles. Potential improvements approaching and beyond 2035 may include:

- Implementation of underpass beneath Alexander Avenue at the US 101 northbound ramps to allow a grade separated crossing from the southbound Alexander Avenue shoulder to the east side shared use path (Strategy BP-M)
- Shared use travel lanes for vehicles and bicycles
- Convert Alexander Avenue to one-way southbound between East Road and Danes Drive. Access to Sausalito from Alexander Avenue would use Danes Drive, Bunker Road, and East Road

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7.0 LIST OF PREPARERS AND COMMENTERS

The following table is a list of preparers for the *Alexander Avenue Planning Study*.

Name	Agency	Discipline
Sam Abraham	Atkins	Structural
Sam Bacchini	Atkins	Environmental resources
Amy Finseth	Atkins	Water resources
Anna Smith	Atkins	Traffic
Lacey Taplin	Atkins	Technical editing
Matt Wessell	Atkins	Project Manager
Aron Zerezghi	Atkins	Roadway design
Tom Allen	Yeh & Associates	Geotechnical
Nate Allen	FHWA CFLHD	Project Manager
Elijah Henley	FHWA CFLHD	Transit
Laurie Miskimins	FHWA CFLHD	Transit

The following table is a list of commenters for the draft *Alexander Avenue Planning Study* submitted March 25, 2011.

Agency	Names
FHWA CFLHD	Nate Allen
Caltrans	Michael Jones, Joseph Aguilar, Highway Operations
NPS GGNRA	Nancy Horner, Rick Foster, Paul Scolari
NPS PWR	Justin DeSantis
City of Sausalito	Jonathon Goldman (by letter dated October 8, 2010)
GGBHTD	Raymond Santiago, Harvey Katz

A progress meeting was held on May 19, 2011; these meeting minutes are in Appendix A.

The following table is a list of commenters for the draft *Alexander Avenue Planning Study* submitted May 18, 2012.

Agency	Names
FHWA CFLHD	Nate Allen, Laurie Miskimins, Elijah Henley
County of Marin	Dan Dawson
GGBHTD	Raymond Santiago

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