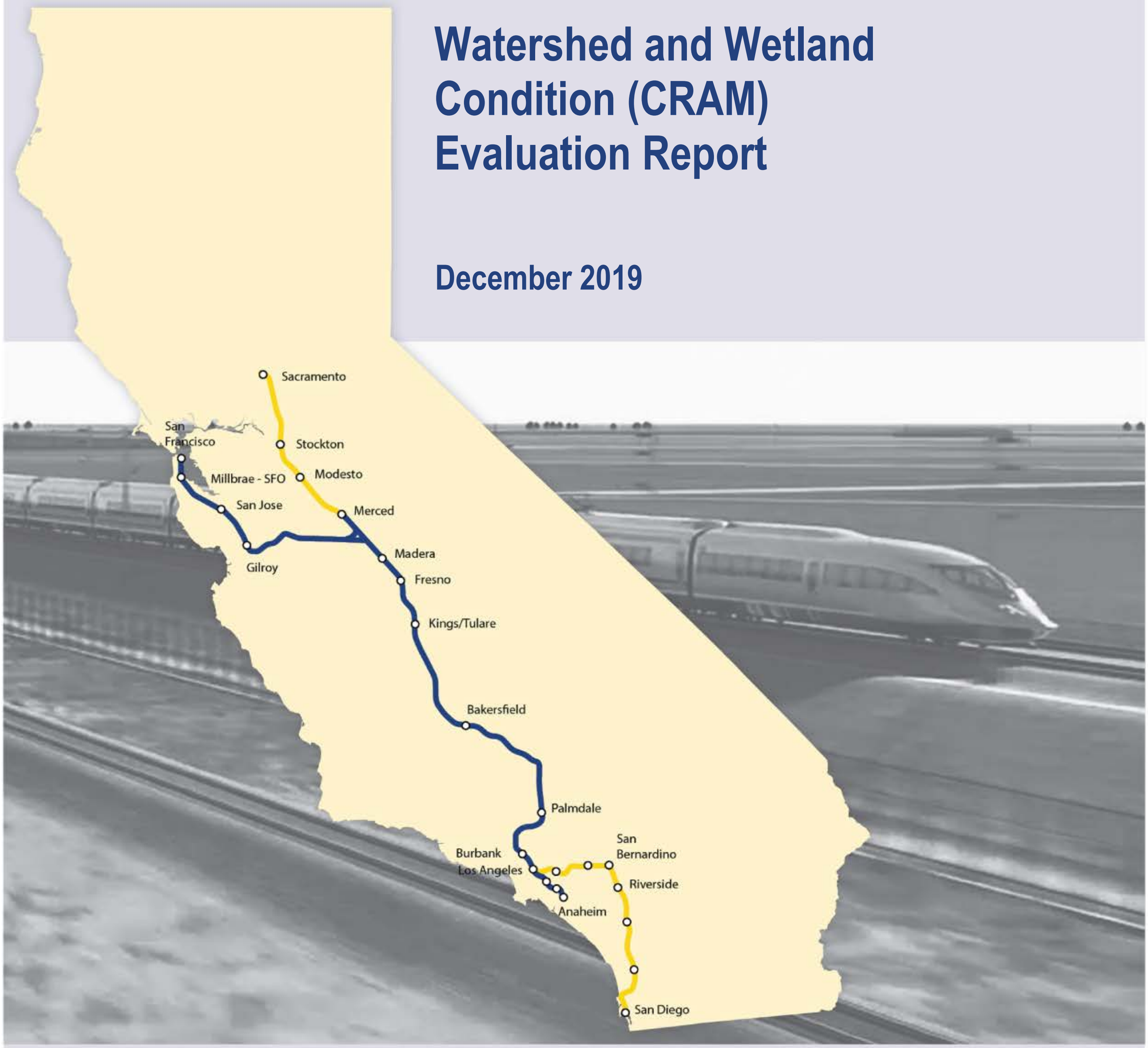
APPENDIX A: WATERSHED AND WETLAND CONDITION (CRAM) EVALUATION REPORT

California High-Speed Rail Authority

San Francisco to San Jose Project Section

Watershed and Wetland Condition (CRAM) Evaluation Report

December 2019



CALIFORNIA
High-Speed Rail Authority

The environmental review, consultation, and other actions required by applicable federal environmental laws for this project are being or have been carried out by the State of California pursuant to 23 U.S.C. 327 and a Memorandum of Understanding dated July 23, 2019, and executed by the Federal Railroad Administration and the State of California.

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ACRONYMS AND ABBREVIATIONS

°F	degrees Fahrenheit
AA	assessment area
Authority	California High-Speed Rail Authority
ATC	automatic train control
BART	Bay Area Rapid Transit
Bay Area	San Francisco Bay Area
CEQA	California Environmental Quality Act
C.F.R.	Code of Federal Regulations
CP	control point
CRAM	California Rapid Assessment Method
DTX	Downtown Extension Project
EIR	environmental impact report
EIS	environmental impact statement
FRA	Federal Railroad Administration
GIS	geographic information system
HSR	high-speed rail
HUC	hydrologic unit code
LEDPA	Least Environmentally Damaging Practicable Alternative
LMF	light maintenance facility
MOU	Memorandum of Understanding
mph	miles per hour
MT	mainline track
MUNI	San Francisco Municipal Railway
NEPA	National Environmental Policy Act
NRCS	Natural Resources Conservation Service
OCS	overhead contact system
OHWM	ordinary high water mark
PCEP	Peninsula Corridor Electrification Project
Project Section, project	San Francisco to San Jose Project Section
PTC	positive train control
PTE	permission to enter
SamTrans	San Mateo County Transit District
SFO	San Francisco International Airport
SFTC	Salesforce Transit Center
SR	State Route

US	U.S. Highway
USACE	U.S. Army Corps of Engineers
USEPA	U.S. Environmental Protection Agency
USGS	U.S. Geological Survey
WER	watershed evaluation report
WETS Tables	Climate Analysis for Wetlands Tables

1 INTRODUCTION

This combined watershed evaluation report (WER) and California Rapid Assessment Method (CRAM) report for the California High-Speed Rail (HSR) project focuses on the San Francisco to San Jose Project Section (Project Section, or project). It was prepared in support of environmental reviews required under the National Environmental Policy Act (NEPA) and California Environmental Quality Act (CEQA).

1.1 Background of the HSR Program

The California High-Speed Rail Authority (Authority) proposes to construct, operate, and maintain an electric-powered HSR system in California, connecting the San Francisco Bay Area (Bay Area) and Central Valley to Southern California. When completed, the nearly 800-mile train system would provide new passenger rail service to more than 90 percent of the state's population. More than 200 weekday trains would serve the statewide intercity travel market. The system would be capable of operating speeds up to 220 miles per hour (mph) in certain HSR sections, with state-of-the-art safety, signaling, and automatic train control (ATC) systems. The California HSR System would connect and serve the state's major metropolitan areas, extending from San Francisco to Los Angeles and Anaheim in Phase 1, with extensions to Sacramento and San Diego in Phase 2.

The Authority and Federal Railroad Administration (FRA) commenced their tiered environmental planning process with the *Final Program Environmental Impact Report/Environmental Impact Statement (EIR/EIS) for the Proposed California High-Speed Train System* (Statewide Program EIR/EIS) (Authority and FRA 2005), followed by the *Bay Area to Central Valley High-Speed Train Final Program EIR/EIS* (Authority and FRA 2008). These documents established the HSR sections constituting the California HSR System and evaluated the effects of proposed HSR corridors. After completion of the first-tier programmatic environmental documents, the Authority and FRA approved the HSR system, selected corridors and stations for further study, and began preparing second-tier project environmental evaluations for sections of the statewide HSR system. Chapter 2, San Francisco to San Jose Project Section, of this technical report provides details of the project and the alternatives under consideration.

1.2 Purpose and Regulatory Context of this Technical Report

This technical report serves a dual purpose: a watershed evaluation and an analysis of the aquatic resource condition. A watershed-level analysis of aquatic resources and their current condition within the Project Section has been conducted in conformance with the U.S. Army Corps of Engineers (USACE) and U.S. Environmental Protection Agency (USEPA) April 10, 2008 *Final Rule for Compensatory Mitigation for Losses of Aquatic Resources* (Final Rule) (33 Code of Federal Regulations [C.F.R.] Parts 325 and 332 and 40 C.F.R. Part 230) and California's Level 1-2-3 framework for wetland monitoring and assessment. This two-part evaluation accomplishes the following tasks:

- **Level 1 Analysis**—The amount of aquatic resources (acreage, linear feet, or both) (WER):
  - Develops a data layer of land use types that represent disturbance categories
  - Inventories the aquatic resources within hydrologic unit code (HUC)-8 watershed units (per land use type)
- **Level 2 Analysis**—The condition of aquatic resources (CRAM):
  - Determines the relative condition of aquatic resources within the watershed units and within the footprints of the project alternatives
  - Evaluates the relative impact of the alternatives on aquatic resources within the watershed context

The report describes the methods and analysis used in the Level 1 and Level 2 analyses, including to develop a watershed profile, identify the existing conditions of the aquatic resources, estimate direct and indirect impacts on aquatic resources, and estimate the post-project condition of aquatic resources. This information will assist in identifying the regional setting of the aquatic resource impacts expected to result from project implementation.

This document evaluates the wetlands and waters at two different scales and therefore two different study areas. The watershed evaluation was conducted at the watershed level while the CRAM analysis was conducted at the project level. The WER Study Area looks at the wetlands and waters throughout the two watersheds that intersect the project, the Coyote watershed and the San Francisco Bay watershed, and evaluates the quality of these waters based on the overlapping land use intensity. This analysis provides a regional context for the conditions of waters impacted by the project. The CRAM analysis assesses the conditions of the specific wetlands and waters that overlap the HSR project footprint. The land use intensities overlapping the aquatic resources in each watershed as identified through the WER analysis are ultimately combined (in Chapter 8, Net Watershed Condition) with the condition and identified stressors identified through the CRAM analysis to further characterize aquatic resources across the watersheds.

The NEPA/Section 404/408 Integration Process Memorandum of Understanding (MOU) between the Authority, FRA, USACE, and USEPA (FRA et al. 2010) outlines the requirements for the Checkpoint C: Preliminary Least Environmentally Damaging Practicable Alternative (LEDPA) Determination for the California High-Speed Rail project. This watershed and wetland condition report provides information and analysis to support the determination of functions and services of the aquatic resources within the study area. In accordance with the MOU and discussions with the project's technical working group—composed of members from the regulatory agencies, FRA, Authority, and regional consultants—these determinations are to be made by conducting a "detailed (rapid assessment or better) assessment of the functions and services of special aquatic sites and other waters of the U.S." (FRA et al. 2010). In addition to supporting the least environmentally damaging practicable alternative decision, these data can also be used during the permitting process with the USACE, which requires an evaluation of impact and mitigation sites to determine final mitigation ratios.

For the purposes of this evaluation, the team used the CRAM as the tool for assessing the condition of aquatic resources (CWMW 2013a). To date, CRAM has been used across all HSR project sections, thereby providing a uniform approach for assessing the functions and services (health) of wetlands and other aquatic features. A detailed description of CRAM is not included in this report, but is available on the CRAM website (www.cramwetlands.org) and in the *California Rapid Assessment Method for Wetlands and Riparian Areas: User's Manual*, Version 6.1 (CWMW 2013a), which includes background information on the development, application, and implementation of CRAM. Additional information on how CRAM was conducted is contained in the *Draft Checkpoint C: LEDPA Determination: Methodology for Wetland Condition Assessment Using CRAM* that was prepared for the entire statewide HSR system (Authority and FRA 2011).

This report summarizes the results of CRAM conducted in the study area during summer 2019 (September 9–12). Because access to properties and impact areas were limited at the time of the fieldwork, the evaluation includes an extrapolation of field-collected CRAM scores to the larger study area.

1.3 Organization of this WER-CRAM Report

This WER-CRAM report is comprised of the following sections in addition to this introductory chapter:

- Chapter 2 describes the currently proposed project alternatives.
- Chapter 3, Project Setting, describes the physical landscape setting and biological conditions of the Project Section
- Chapter 4, Watershed Evaluation Methods, identifies methodology and procedures for conducting the watershed evaluation
- Chapter 5, California Rapid Assessment Method, identifies methodology and procedures for conducting CRAM
- Chapter 6, Results of Watershed and California Rapid Assessment Method Analysis, presents the Level 1 watershed profile for the watersheds and ecoregions of the study area and Level 2 CRAM scores from the condition assessment conducted in the study area
- Chapter 7, Summary by Alternative, provides a summary of the watershed profiles and CRAM scores for each alternative
- Chapter 8 presents the net watershed condition
- Chapter 9, References, provides a list of the references cited in this technical report
- Chapter 10, Preparer Qualifications, lists individuals who assisted in the preparation of this report

Additional details are provided in:

- Appendix A, Supplemental WER Data Tables
- Appendix B, Maps of Assessment Areas, provides individual maps of the assessment areas (AA) evaluated
- Appendix C, Summary Table of CRAM Data, summarizes the results for the AAs
- Appendix D, Assessment Area Data Forms, provides the data forms for each AA
- Appendix E, Photo Log, provides site photographs of each AA

2 SAN FRANCISCO TO SAN JOSE PROJECT SECTION

The Project Section would provide HSR service between San Francisco and San Jose as part of the statewide HSR system. HSR stations would be located at 4th and King Street[1] in San Francisco and at Millbrae. HSR service would share tracks with Caltrain along approximately 43 miles of blended system infrastructure primarily within the existing Caltrain right-of-way. The Project Section would include a light maintenance facility (LMF) in Brisbane. Two project alternatives are evaluated in this technical report—Alternative A and Alternative B. This chapter describes the common design features of the two project alternatives, followed by descriptions of each alternative.

What does "blended" mean?

Blended refers to operating the high-speed rail trains with existing intercity and commuter and regional rail trains on common infrastructure.

2.1 Common Design Features

The project would extend along the existing Caltrain right-of-way through urban cities and communities in San Francisco, San Mateo, and Santa Clara Counties, including San Francisco, Brisbane, South San Francisco, San Bruno, Millbrae, Burlingame, San Mateo, Belmont, San Carlos, Redwood City, North Fair Oaks, Atherton, Menlo Park, Palo Alto, Mountain View, Sunnyvale, and Santa Clara. The Project Section would be comprised of the following four geographic subsections: San Francisco to South San Francisco, San Bruno to San Mateo, San Mateo to Palo Alto, and Mountain View to Santa Clara (Figure 2-1).

San Francisco to San Jose Project Subsections

- San Francisco to South San Francisco—10 miles from 4th and King Street Station in San Francisco to Linden Avenue in South San Francisco
- San Bruno to San Mateo—8 miles from Linden Avenue in South San Francisco to 9th Avenue in San Mateo
- San Mateo to Palo Alto—16 miles from 9th Avenue in San Mateo to San Antonio Road in Palo Alto
- Mountain View to Santa Clara—9 miles from San Antonio Road in Palo Alto to Scott Boulevard

Operating on the two-track system primarily within the existing Caltrain right-of-way, the project would use existing and in-progress infrastructure improvements developed by Caltrain for its Caltrain Modernization Program, including electrification of the Caltrain corridor between San Francisco and San Jose as part of the Peninsula Corridor Electrification Project (PCEP) and positive train control (PTC). These improvements would provide consistent and predictable travel between San Francisco and San Jose. The blended system would accommodate operating speeds of up to 110 mph for up to four HSR trains and six Caltrain trains per hour per direction in the peak period.

Operation of the blended system would require additional infrastructure improvements and project elements beyond the Caltrain Modernization Program to accommodate HSR service. Design elements common to both alternatives include track modifications to support higher speeds while maintaining passenger comfort; station and platform modifications to accommodate HSR trains passing through or stopping at existing stations; and modifications to the overhead contact system (OCS) (a series of wires strung above the tracks by poles) and traction power facilities installed by Caltrain as part of the PCEP. The project alternatives would implement safety improvements at existing at-grade roadway crossings and at Caltrain stations and platforms, as well as security modifications such as the installation of perimeter fencing along the right-of-way. The project would also include an LMF to accommodate planned operational needs for high-capacity rail movement and communication radio towers located at approximately 2.5-mile intervals.

[1] The 4th and King Street Station would serve as an interim station until completion of the proposed Transbay Joint Powers Authority's Downtown Extension Project (DTX). The DTX would extend the electrified peninsula rail corridor in San Francisco from the 4th and King Street Station to the Salesforce Transit Center (SFTC). HSR would utilize the track constructed for the DTX to reach the SFTC.

Source: Authority 2019

MAY 2019

Figure 2-1 Proposed San Francisco to San Jose Project Section

2.1.1 Track and Station Modifications

Definition of Hold-Out Rule

Hold-Out Rule is the rule enforced at Caltrain stations that requires passengers to board and alight the train from between the active tracks. An oncoming train is stopped outside of the station until the passengers are clear of the active tracks.

Depending on the alternative selected, between 7 and 10 of the existing 23 Caltrain stations between 4th and King Street in San Francisco and Scott Boulevard in Santa Clara would require varying degrees of modifications to accommodate HSR trains passing through or stopping at the stations. HSR trains would stop at the 4th and King Street and Millbrae Stations, requiring dedicated HSR platforms and associated passenger services to be provided at these stations. Other stations would also be modified to accommodate track adjustments, remove the hold-out rule, and build project features such as the Brisbane LMF and passing track.

The blended system would require curve straightening, track center modifications, and superelevation[2] of existing Caltrain tracks along approximately 33 percent of the project corridor to support higher speeds of up to 110 mph. These track modifications are described under Section 2.2, Alternative A, and Section 2.3, Alternative B, and illustrated on Figures 2-8, 2-13, 2-17, 2-18, 2-19, 2-20, and 2-22. Where horizontal track modifications would be greater than 1 foot, the OCS poles and wires would require relocation. Where track modifications would occur at existing Caltrain stations, adjustments to existing platforms would be required. Track modifications at San Bruno Station and Hayward Park Station under Alternatives A and B would require modifying or realigning the existing station platforms.

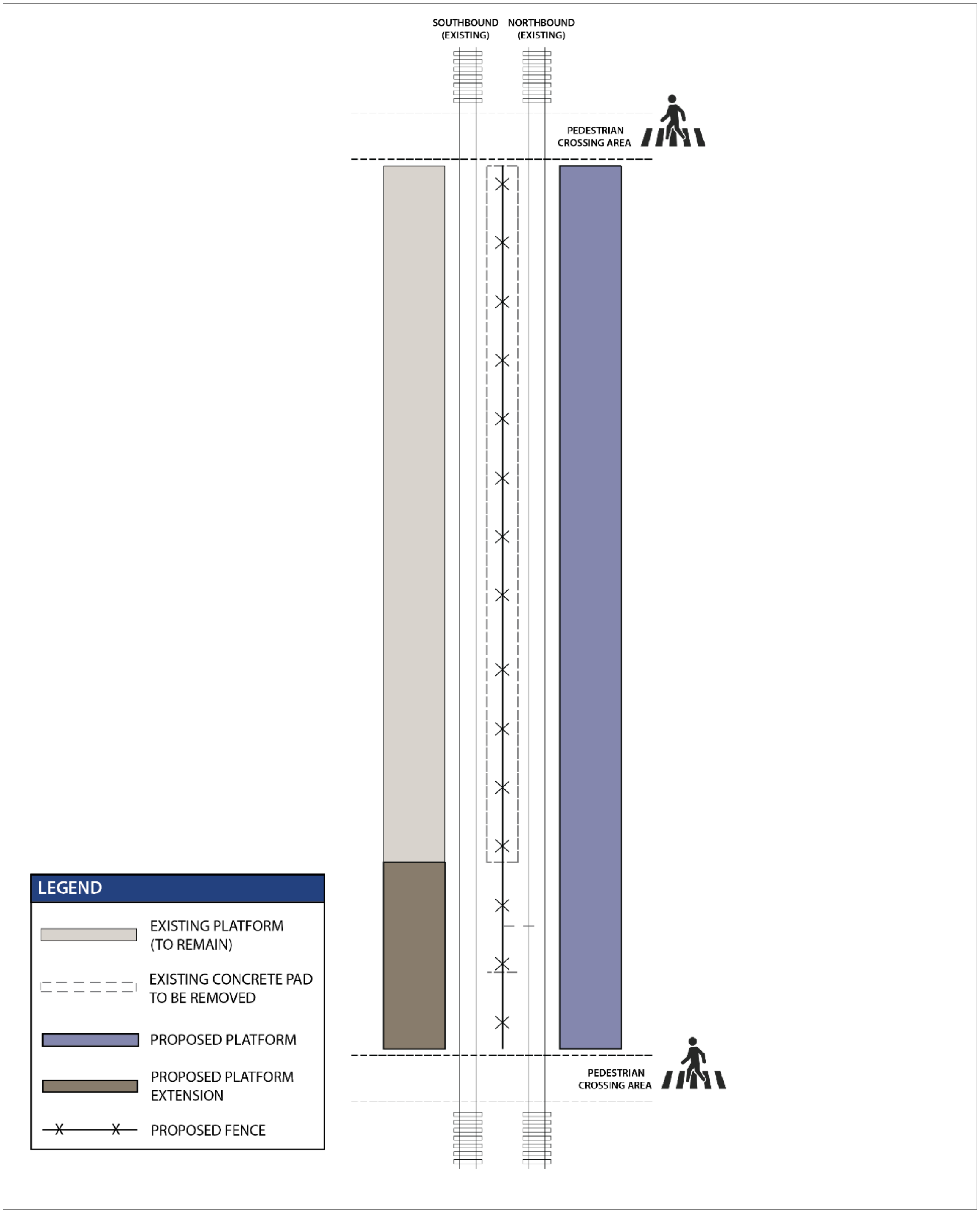
Two existing Caltrain stations—Broadway and Atherton Stations—would be modified as part of the blended system improvements to remove the existing hold-out rule. As illustrated on Figure 2-2, new outboard platforms would be built at these stations to eliminate the need for passengers to cross between the tracks. The Brisbane LMF would require relocation of a station platform and pedestrian overpass at the Bayshore Station in Brisbane.

2.1.2 Safety and Security Modifications to the Right-of-Way

Consistent with FRA safety guidelines for HSR systems with operating speeds of up to 110 mph, the blended system would implement safety improvements at the at-grade crossings to create a “sealed corridor” that would reduce conflicts with automobiles and pedestrians. Safety improvements would include installing four-quadrant gates extending across all lanes of travel and median separators to channelize and regulate paths of travel. These gates would prevent drivers from traveling in opposing lanes to avoid the lowered gate arms. Pedestrian crossing gates also would be built parallel to the tracks, and aligned with the vehicular gates on either side of the roadway.

Depending on the configuration of the existing at-grade crossing, one of six different four-quadrant gate applications (illustrated on Figures 2-3 through 2-5) would be installed at each of the 38 at-grade crossings currently without four-quadrant gates along the Project Section. Table 2-1 identifies the number and locations of four-quadrant gate applications. These applications would specify the improvements at each at-grade crossing, including the number of vehicle and pedestrian gates, and the need for channelization or raised medians.

[2] *Superelevation* is the vertical distance between the height of the inner and outer rails at a curve. Superelevation is used to partially or fully counteract the centrifugal force acting radially outward on a train when it is traveling along the curve.



Source: Authority 2019

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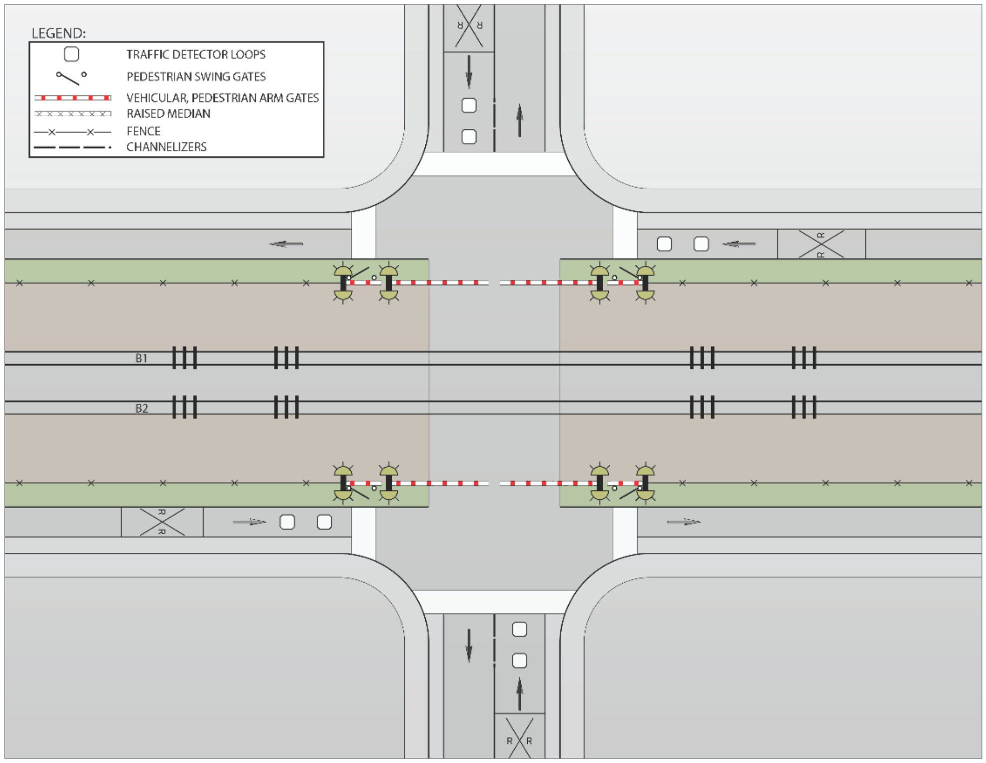
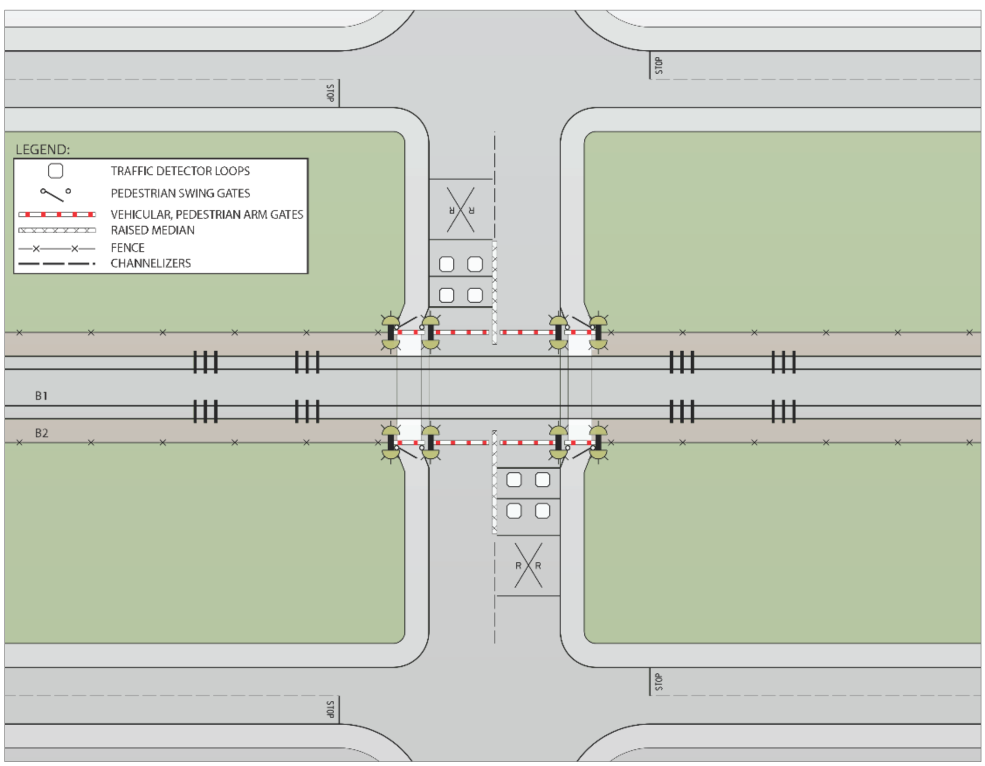
Figure 2-2 Illustration of Hold-Out Rule Stations

Option A



Option B



Source: Authority 2019

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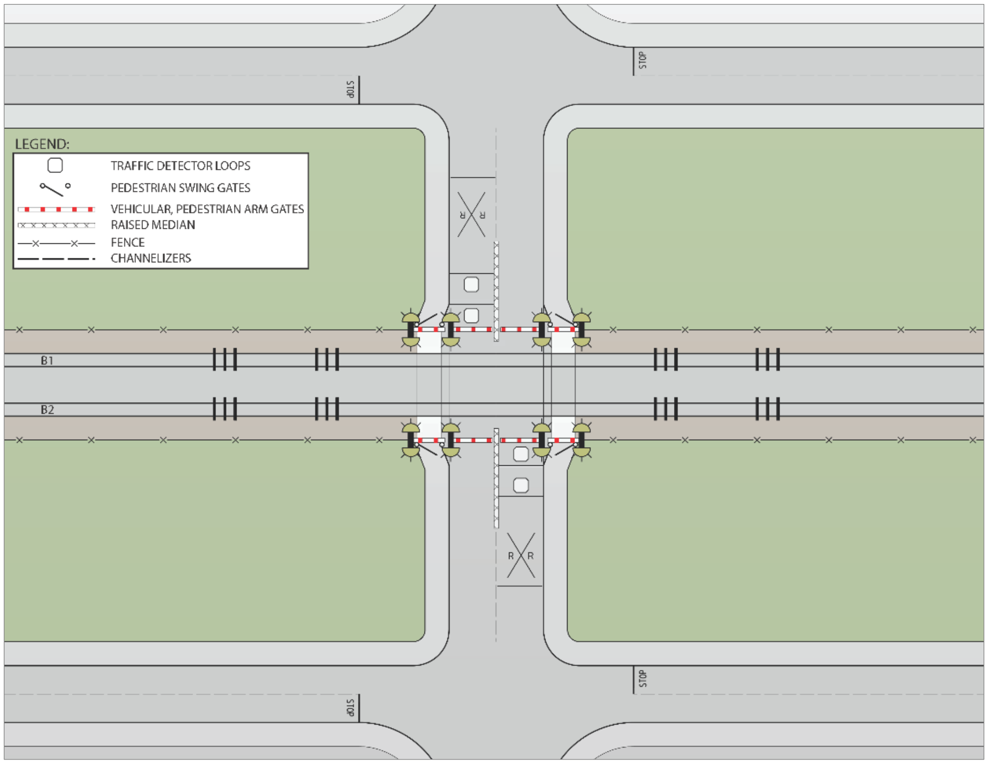
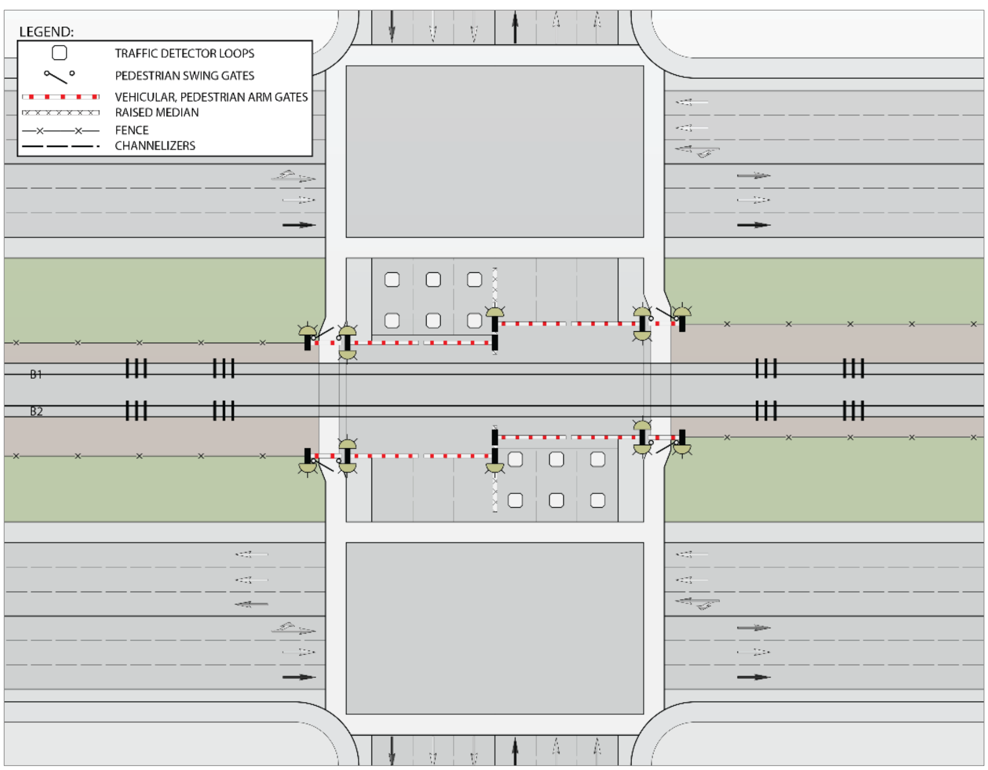
Figure 2-3 Applications of Four-Quadrant Gates (Options A and B)

Option B1



Option C



Source: Authority 2019

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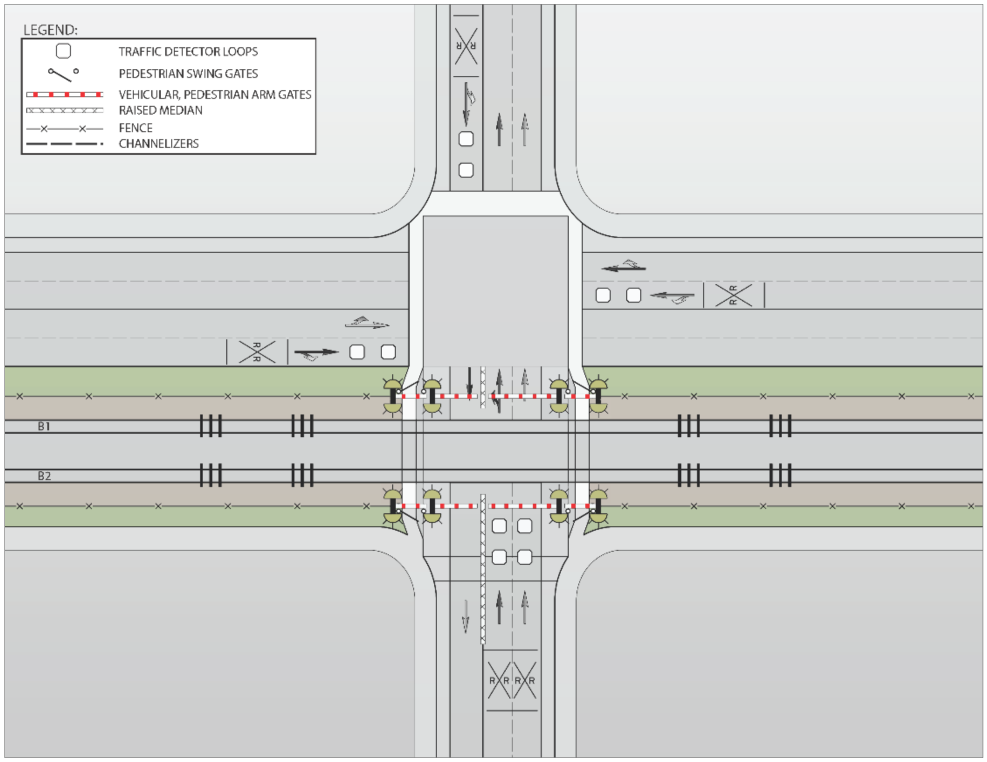
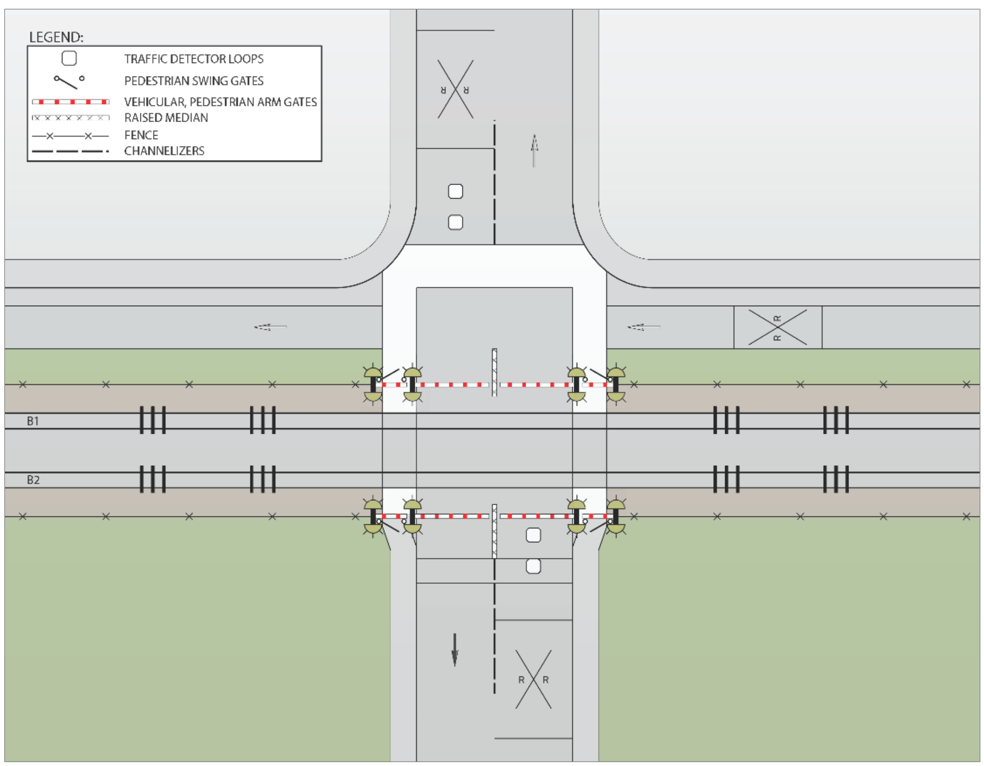
Figure 2-4 Applications of Four-Quadrant Gates (Options B1 and C)

Option D



Option E



Source: Authority 2019

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Figure 2-5 Applications of Four-Quadrant Gates (Options D and E)

Table 2-1 Number and Locations of Four-Quadrant Gate Applications within the Project Section

Application	Number of At-Grade Crossings	Location of At-Grade Crossings
A	7	Mission Bay Drive and 16th Street (San Francisco); 4th Avenue and 5th Avenue (San Mateo); Oak Grove Avenue and Ravenswood Avenue (Menlo Park); and Mary Avenue (Sunnyvale)
B	11	Center Street (Millbrae); Oak Grove Avenue, North Lane, Howard Avenue, Bayswater Avenue, and Peninsula Avenue (Burlingame); Villa Terrace and Bellevue Avenue (San Mateo); Chestnut Street (Redwood City); Encinal Avenue (Menlo Park); Alma Street (Palo Alto)
B1	2	Scott Street (San Bruno); Watkins Avenue (Atherton)
C	4	Broadway (Burlingame); Whipple Avenue (Redwood City); Rengstorff and Castro Street (Mountain View)
D	7	Linden Avenue (South San Francisco); Brewster Avenue and Broadway (Redwood City); Churchill Avenue, Meadow Drive and Charleston Road (Palo Alto); Sunnyvale Avenue (Sunnyvale)
E	7	1st Avenue, 2nd Avenue, 3rd Avenue, and 9th Avenue (San Mateo); Maple Street, Main Street (Redwood City); and Glenwood Avenue (Menlo Park)
Total	**38**	N/A

Source: Authority 2019
N/A = not applicable

In addition to four-quadrant gates, the Authority would install fencing at the at-grade crossings and along the perimeter of the Caltrain corridor. Consistent with Caltrain's design standards, existing fencing would be extended to adjacent structures to close any gaps. Figure 2-6 depicts photographs of existing perimeter fencing of railroad rights-of-way.

SEPTEMBER 2018

Figure 2-6 Photographs of Perimeter Fencing of Right-of-Way

2.1.3 Train Control and Communication Facilities

HSR would install a radio-based communications network to maintain communications and share data between the HSR trains and the operations control center. Each communications radio towers would consist of an 8-foot by 10-foot communications equipment shelter and a 6- to 8-foot-diameter communications tower extending 100 feet above top-of-rail at approximately 2.5-mile intervals. Where possible, these facilities would be co-located at an existing Caltrain traction power substation, switching station, paralleling station, or Caltrain station as illustrated on Figure 2-7. Where communications towers cannot be co-located with other Caltrain facilities, the communications facilities would be sited in an approximately 20-foot by 15-foot fenced area near the Caltrain corridor. For the purposes of environmental clearance, some of the standalone locations have two identified site options but only one would ultimately be implemented.

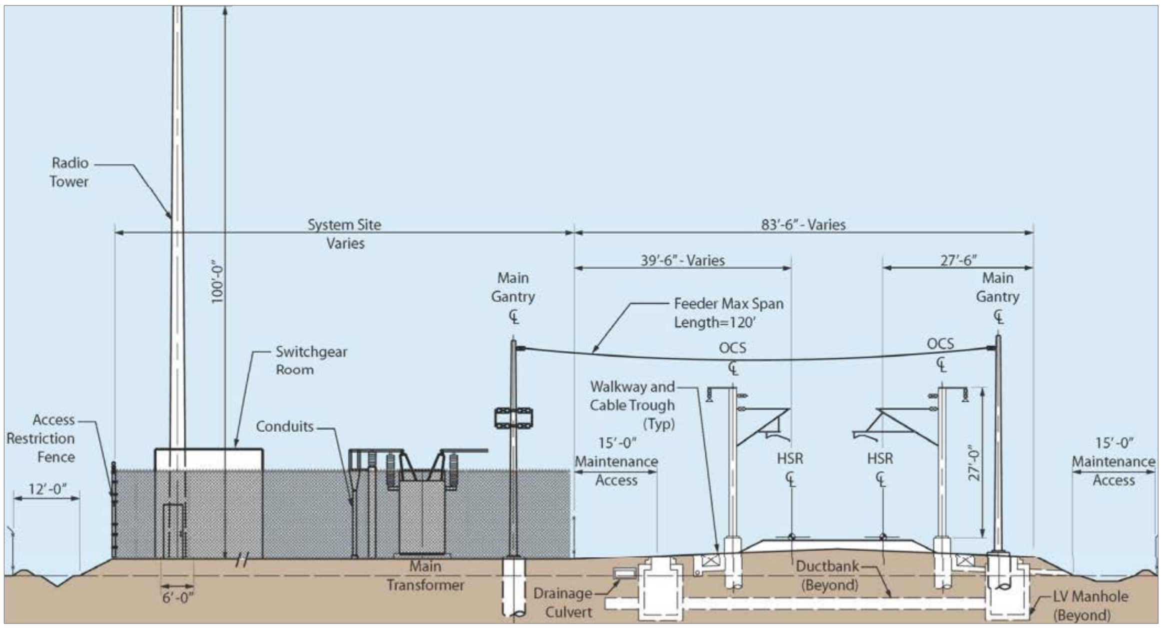

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Figure 2-7 Typical Cross Section of At-Grade Profile with an Adjacent Communications Radio Tower Co-Located with a Traction Power Substation

2.1.4 Traction Power Distribution

The blended system would use the traction power distribution system installed by Caltrain as part of the PCEP, which would install 130 to 140 single-track-miles of OCS between San Francisco and San Jose for the distribution of electric power to the trains. The OCS would consist of a series of mast poles approximately 23.5 feet higher than the top of the rail, with contact wires suspended from the mast poles. The train would have an arm, called a pantograph, to maintain contact with this wire, providing power to the train. The OCS would be powered from a 25-kilovolt, 60-Hertz, single-phase, alternating current supply system consisting of traction power substations, one switching station, and paralleling stations.[3]

Relocation of the OCS poles and wires installed by Caltrain as part of the PCEP would be required as part of the HSR project where track modifications would shift tracks more than 1 foot

[3] Traction power substations are typically 150 feet by 200 feet in size and include transformers that step down the voltage of power provided by the utility to that needed for the OCS. Switching stations are typically 80 feet by 160 feet in size and would be installed at the midpoint between traction power substations as a phase break to ensure power supplies from each traction power substation are isolated from each other. Paralleling stations are typically 40 feet by 80 feet and would be installed between traction power substations and switching stations to maintain the autotransformer system and system operating voltages. Traction power substations, switching stations, and paralleling stations would be equipped with circuit breakers, switching equipment, and oil-filled transformers.

horizontally. Additionally, the project would build new OCS poles and wires for dedicated HSR infrastructure associated with the Brisbane LMF.

Beyond the infrastructure installed as part of the PCEP, HSR trains may require additional equipment (e.g., transformers) to handle HSR electrical loads at the PCEP traction power distribution facilities. Any additional equipment installed at these facilities would be similar in terms of size and capacity to the Caltrain equipment.

2.1.5 Light Maintenance Facility

The Project Section would include an approximately 100- to 110-acre LMF in the city of Brisbane, which would support the San Francisco terminal station operations by dispatching freshly inspected and serviced trains and crews to begin revenue service throughout the day. The LMF would also be the location for daily, monthly, and quarterly maintenance of HSR trainsets. Maintenance activities would include train washing, interior cleaning, wheel truing, testing, and inspections. These activities may occur between runs or as a pre-departure service at the start of the revenue day. Additionally, the LMF would be used as a service point for any trains in need of emergency services. Two LMF site options for the Brisbane LMF, located east and west of the mainline Caltrain tracks, are evaluated in this document as part of the two project alternatives and described in more detail in Section 2.2 and Section 2.3.

2.2 Alternative A

Alternative A would modify approximately 14.5 miles of existing Caltrain track, predominantly within the existing Caltrain right-of-way, build the East Brisbane LMF, modify seven existing stations or platforms to accommodate HSR, and install safety improvements and communication radio towers. Caltrain has several locations of four-track segments where trains can pass; no additional passing tracks would be built under Alternative A. Table 2-2 presents a summary of the alternative’s design features, followed by a more detailed description by subsection.

Table 2-2 Summary of Design Features for Alternative A

Feature	Alternative A
Length of existing Caltrain track (miles)[1]	42.9
Length of modified track (miles)[1]	14.5
Length of track modification <1 ft (miles)[1]	5.1
Length of track modification >1 ft and <3 ft (miles)[1]	2.2
Length of track modification > 3 ft (miles)[1]	7.2
Length of OCS pole relocation (miles)[1, 2]	9.4
Includes additional passing tracks	No
LMF	East Brisbane
Modified stations	
Modifications to HSR stations	4th and King Street; Millbrae
Modifications to Caltrain stations due to the LMF	Bayshore (relocated)
Modifications to Caltrain stations due to track shifts	San Bruno; Hayward Park
Modifications to Caltrain stations to remove hold-out rule	Broadway; Atherton
Number of modified or new structures[3]	14
New structures	2
Modified structures	7
Replaced structures	2
Affected retaining walls	3

Feature	Alternative A
Number of at-grade crossings with safety modifications (e.g., four-quadrant gates, median barriers)	38
Length of new perimeter fencing (miles)[1]	7.3
Communication radio towers	20

Source: Authority 2019
LMF = light maintenance facility
OCS = overhead contact system
[1] Lengths shown are guideway mileages, rather than the length of the northbound and southbound track.
[2] OCS pole relocations are assumed for areas with track shifts greater than 1 foot.
[3] Structures include bridges, grade separations such as pedestrian underpasses and overpasses, tunnels, retaining walls, and culverts.

2.2.1 San Francisco to South San Francisco Subsection

The San Francisco to South San Francisco Subsection would extend approximately 10 miles from the 4th and King Street Station in downtown San Francisco to Linden Avenue in South San Francisco, through the cities of San Francisco, Brisbane, and South San Francisco. The existing Caltrain track in this subsection is predominantly two-track at grade, with four two-track tunnel segments in San Francisco, and a four-track at-grade section through Brisbane. As illustrated on Figure 2-8, this alternative would modify the existing 4th and King Street and Bayshore Stations, build the East Brisbane LMF and associated track modifications, reconfigure Tunnel Avenue, install four-quadrant gates at three existing at-grade crossings, and install six communication radio towers. Additional right-of-way would be required in San Francisco and Brisbane to accommodate track modification, the East Brisbane LMF, Tunnel Avenue reconfiguration, four-quadrant gates, and communication radio towers.

Source: Authority 2019 MAY 2019

Figure 2-8 San Francisco to South San Francisco Subsection—Alternative A

2.2.1.1 4th and King Street Station

The existing 4th and King Street Station would serve as the interim terminal station for the Project Section until the Downtown Extension (DTX) provides HSR access to the Salesforce Transit Center (SFTC). Figure 2-9 depicts the site plan for the interim station. Station improvements would include installing a booth for HSR ticketing and support services, adding HSR fare gates, and modifying existing tracks and platforms. Until the DTX can provide service to the SFTC, passengers would be required to use alternative methods of transportation to get there (e.g., San Francisco Municipal Railway [MUNI], ride-share program, or walk). Figures 2-10 and 2-11 present a cross-section view of the HSR tracks and platforms at 4th and King Street Station looking northeast.

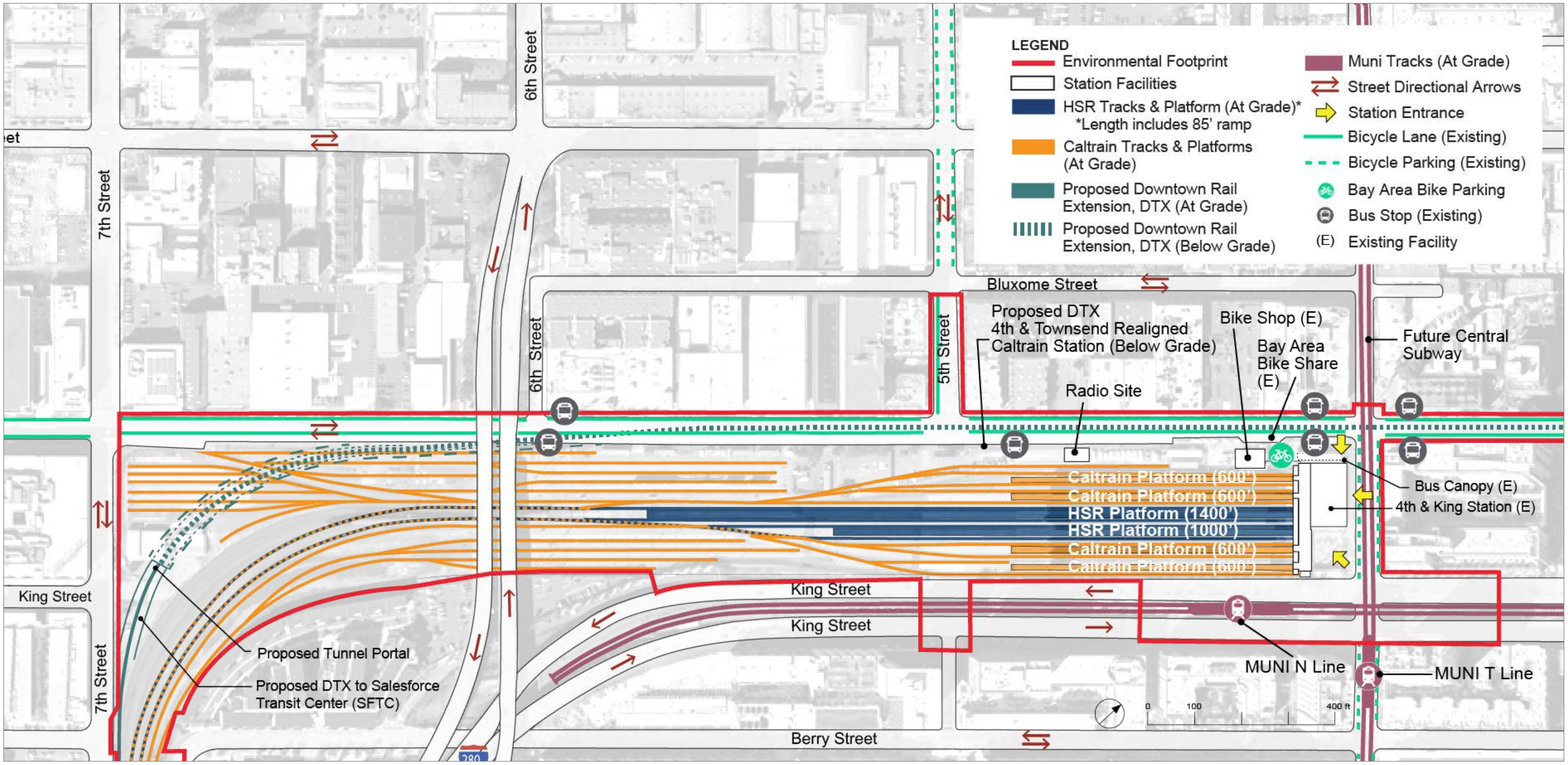
To support HSR operations, two existing Caltrain platforms in the center of the station yard would be raised and lengthened to serve four northbound and southbound HSR tracks. The HSR platforms would be approximately 4.25 feet high, with lengths of 1,000 feet for the platform on the east and 1,400 feet for the platform on the west. Ramps would be installed to provide pedestrian access from the station building to the raised platforms. Four existing Caltrain platforms, 600 feet or 800 feet long, would remain on either side of the HSR platforms to serve eight Caltrain tracks.

2.2.1.2 East Brisbane Light Maintenance Facility

The East Brisbane LMF would be built south of the San Francisco tunnels on approximately 100 acres east of the Caltrain corridor. Direct HSR mainline track access would be provided along double-ended yard leads that would cross over the mainline track on an aerial flyover at the north end, with an at-grade track entering the LMF from the south. Transition tracks (approximately 1,400 feet long) would allow trains to reduce or increase speed when entering or exiting the East Brisbane LMF.

The East Brisbane LMF (Figure 2-12) would include a maintenance yard with 17 yard tracks adjacent and parallel to a maintenance building containing eight shop tracks with interior access and inspection pits for underside and truck inspections. The maintenance building would provide storage areas for reserve equipment, workshops, and office space. A power generator, sewage system, cistern, collection point, and electrical substation would be north of the maintenance building with a 400-space surface parking lot for automobiles and trucks east of the maintenance building. An access road would connect the facility to the realigned Tunnel Avenue.

The track modifications associated with the East Brisbane LMF would require relocating the Bayshore Caltrain Station (described in Section 2.2.1.3, Track and Station Modifications), relocating the Tunnel Avenue overpass, widening the bridge crossing of Guadalupe Valley Creek in Brisbane, and relocating control point (CP) Geneva. The reconstructed Tunnel Avenue overpass would connect to Bayshore Boulevard at its intersection with Valley Drive (north of its existing connection) and would provide a roadway extension connecting Valley Drive to Old Country Road. The widened Guadalupe Valley Creek Bridge would support the East Brisbane LMF lead tracks where they cross the creek. Track modification near CP Geneva could require relocating the overhead signal pole.



Source: Authority 2019

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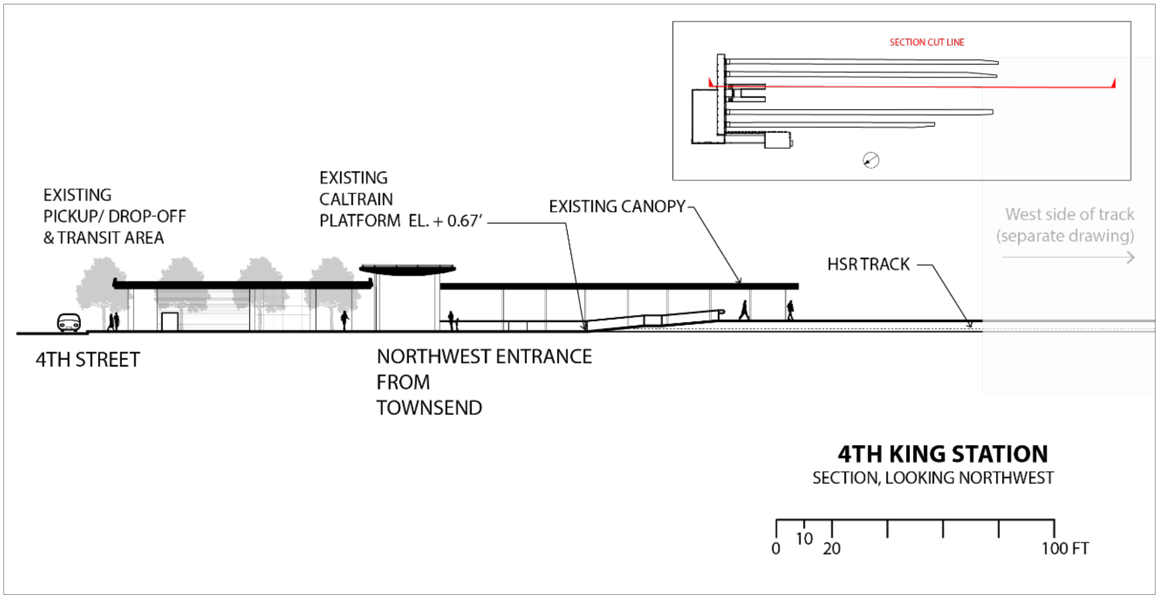
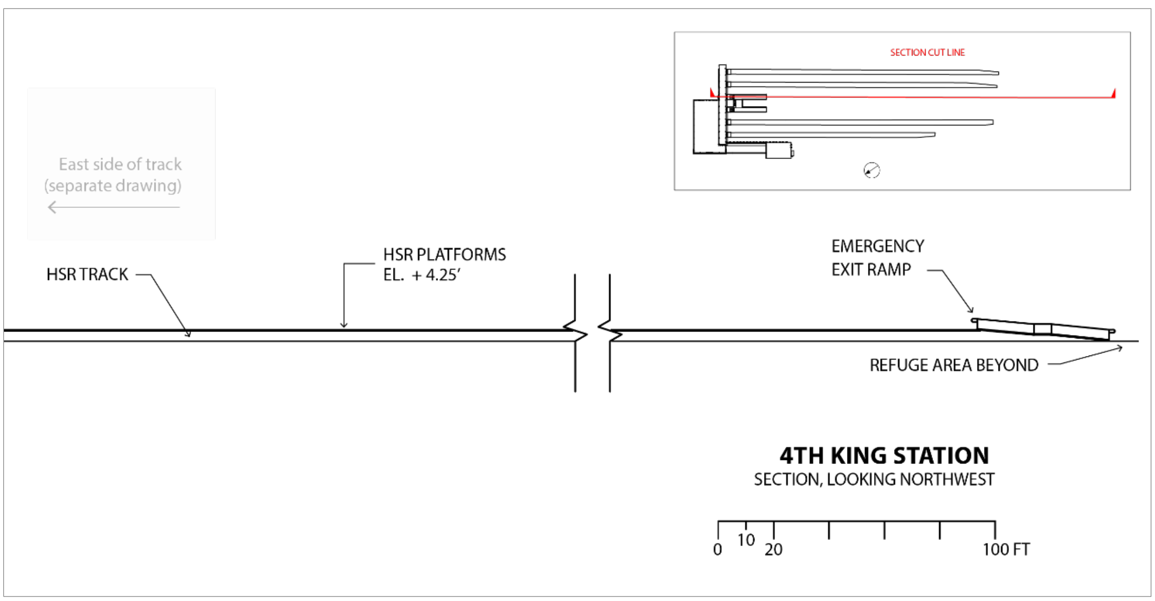
Figure 2-9 4th and King Street Station Site Plan—Alternatives A and B



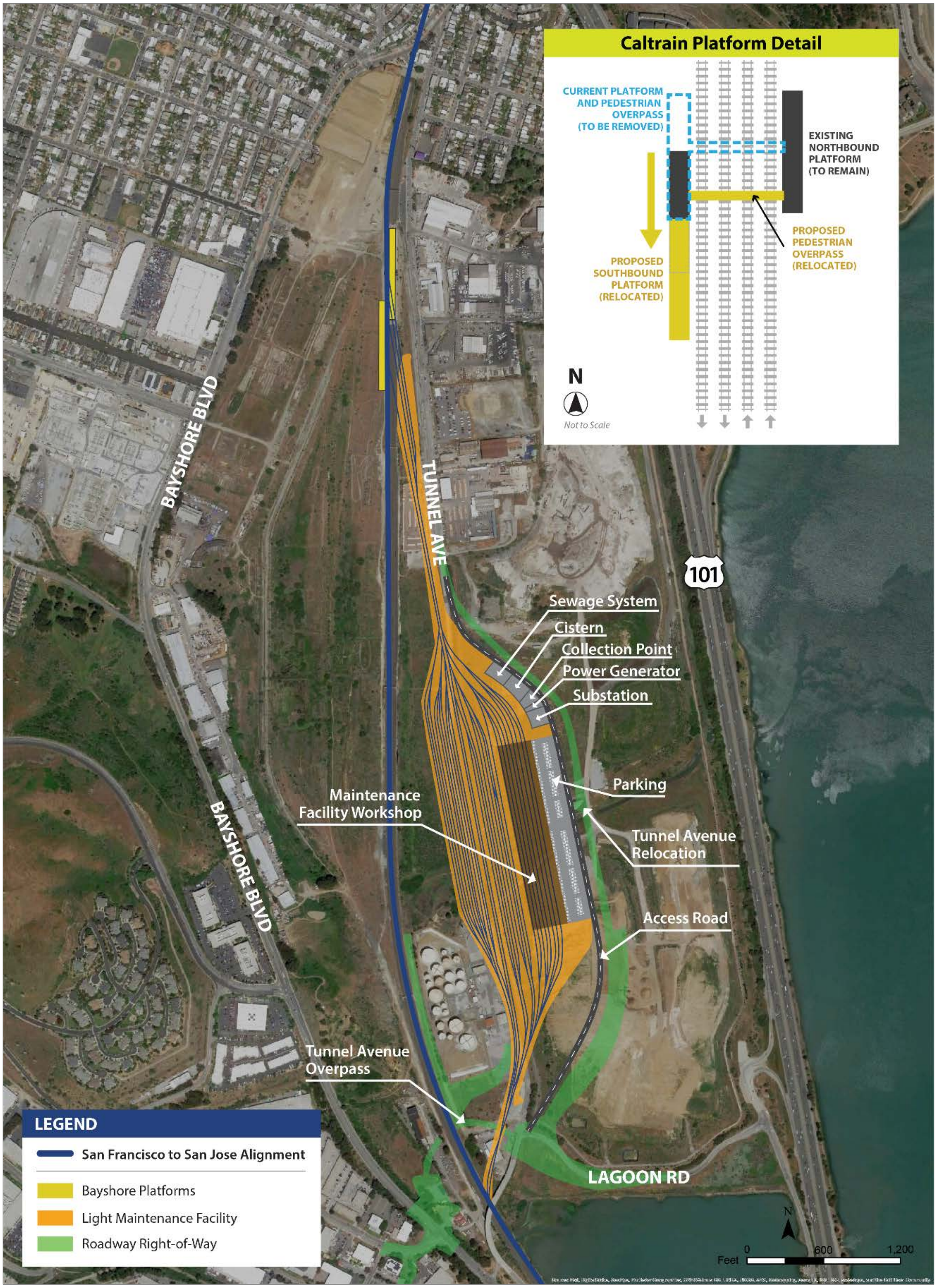
Source: Authority 2019 MAY 2019

Figure 2-10 4th and King Street Station Cross Section (Northern Portion)—Alternatives A and B



Source: Authority 2019 MAY 2019

Figure 2-11 4th and King Street Station Cross Section (Southern Portion)—Alternatives A and B



Source: Authority 2019

MAY 2019

Figure 2-12 East Brisbane Light Maintenance Facility Layout—Alternative A

2.2.1.3 Track and Station Modifications

Track and station modifications in the San Francisco to South San Francisco Subsection (Figure 2-8) are predominantly associated with the 4th and King Street Station modifications and the East Brisbane LMF. To accommodate the realignment of the mainline tracks for the East Brisbane LMF, the Bayshore Caltrain Station and associated surface parking lot, southbound platform, and a new pedestrian overpass would be reconstructed approximately 0.2 mile south of the existing station (inset on Figure 2-12). A new pedestrian overpass would access the reconstructed station by connecting to Tunnel Avenue on the east and the planned local roadway network envisioned in the Draft Brisbane Baylands Specific Plan on the west (City of Brisbane 2011). The relocated Bayshore Caltrain Station would be closer to the planned Geneva Avenue extension, which would extend from Bayshore Boulevard to U.S. Highway (US) 101.

Track modifications not associated with the 4th and King Street Station, the approach to the 4th and King Street Station, and East Brisbane LMF would be limited to minor track shifts of less than 1 foot within the existing right-of-way in San Francisco and South San Francisco, and track modifications in South San Francisco to accommodate the planned South San Francisco Caltrain Station Improvement Project being implemented by Caltrain in coordination with the City of South San Francisco. Expected to be built by 2019, the improvement project would replace the existing South San Francisco Station platforms (which are subject to the hold-out rule) with a standard center boarding platform connected to a pedestrian underpass, to improve safety and eliminate the hold-out rule. The project would shift tracks up to 27 feet, install crash barriers at the Grand Avenue overpass, and replace columns that support the US 101 overpass with a pair of solid pier walls.

2.2.1.4 Safety and Security Modifications to the Right-of-Way

To improve safety, four-quadrant gates would be installed at three at-grade crossings in the subsection—Mission Bay Drive, 16th Street, and Linden Avenue (Figure 2-8). Table 2-1 specifies the four-quadrant gate application for each at-grade crossing, and Figures 2-3, 2-4, and 2-5 illustrate the configurations of these applications. Perimeter fencing (Figure 2-6) would be installed along the right-of-way where it does not already exist.

2.2.1.5 Train Control and Communication Facilities

There would be six communication radio towers in this subsection (Figure 2-8). Two site options are evaluated for each standalone communications radio tower, with the exception of a single site option at 4th and King Station and at Blanken Avenue; however, only one site would be selected for construction at each site:

- Standalone radio tower at the 4th and King Street Station in San Francisco (one site option)
- Co-located radio tower at Caltrain's Paralleling Station 1 in the Potrero Hill neighborhood of San Francisco
- Standalone radio tower in the Bayview neighborhood of San Francisco (either at Jerrold Avenue or Newcomb Avenue)
- Standalone radio tower at Blanken Avenue in Brisbane (one site option)
- Standalone radio tower in Brisbane adjacent to Bayshore Boulevard (two site options)
- Co-located radio tower at Caltrain's Traction Power Substation 1 in South San Francisco

2.2.2 San Bruno to San Mateo Subsection

The San Bruno to San Mateo Subsection would extend approximately 8 miles from Linden Avenue in South San Francisco to Ninth Avenue in San Mateo through South San Francisco, San Bruno, Millbrae, Burlingame, and San Mateo. The existing Caltrain track in this subsection is predominantly two-track at grade on retained fill with a three-track at-grade section south of the Millbrae Caltrain Station. As illustrated on Figure 2-13, this alternative would modify the existing San Bruno, Millbrae, and Broadway Caltrain Stations; modify track; install four-quadrant gates at

16 existing at-grade crossings; and install three communication radio towers. Additional right-of-way would be required in Millbrae, Burlingame, and San Mateo associated with communication radio towers, the Millbrae Station modifications to accommodate HSR service, track modifications, roadway relocations, and four-quadrant gates.

2.2.2.1 Millbrae Station

New HSR infrastructure would be constructed at the existing Millbrae BART/Caltrain Intermodal Station. As illustrated on Figure 2-14, new HSR station facilities on the west side of the existing Caltrain corridor would include a new station entrance hall with ticketing and support services along El Camino Real. The station area design provides intermodal connectivity with Caltrain and BART via an overhead pedestrian crossing that would extend from the new station entrance over the extension of California Drive, connecting to the existing station concourse with vertical circulation elements (stairs, escalators and elevators) providing access to HSR, Caltrain, and BART platforms.

The primary access to the Millbrae HSR Station is intended to be by transit (Caltrain, BART, San Mateo County Transit District [SamTrans]), bicycles, walking and vehicle pick-up and drop-off. Pick-up and drop-off facilities for vehicles would accommodate shuttles, taxis, car sharing, network transportation services and private vehicles.

Enhanced automobile access would be provided on the west side of the station through the extension of California Drive to Victoria Avenue. Curbside passenger pick-up and drop-off facilities west of the station would be located along the new extension of California Drive and El Camino Real; facilities east of the station would be located on the first level of the BART parking structure. Replacement parking for displaced Caltrain and BART parking would be provided at four surface parking lots on the west side of the alignment, with a fifth parking area at Murchison Drive with 37 parking spots for HSR passengers. HSR passengers desiring to drive and park would be able to use available long-term commercial parking located off-site or at the San Francisco International Airport (SFO) and arrive at the station by shuttle.

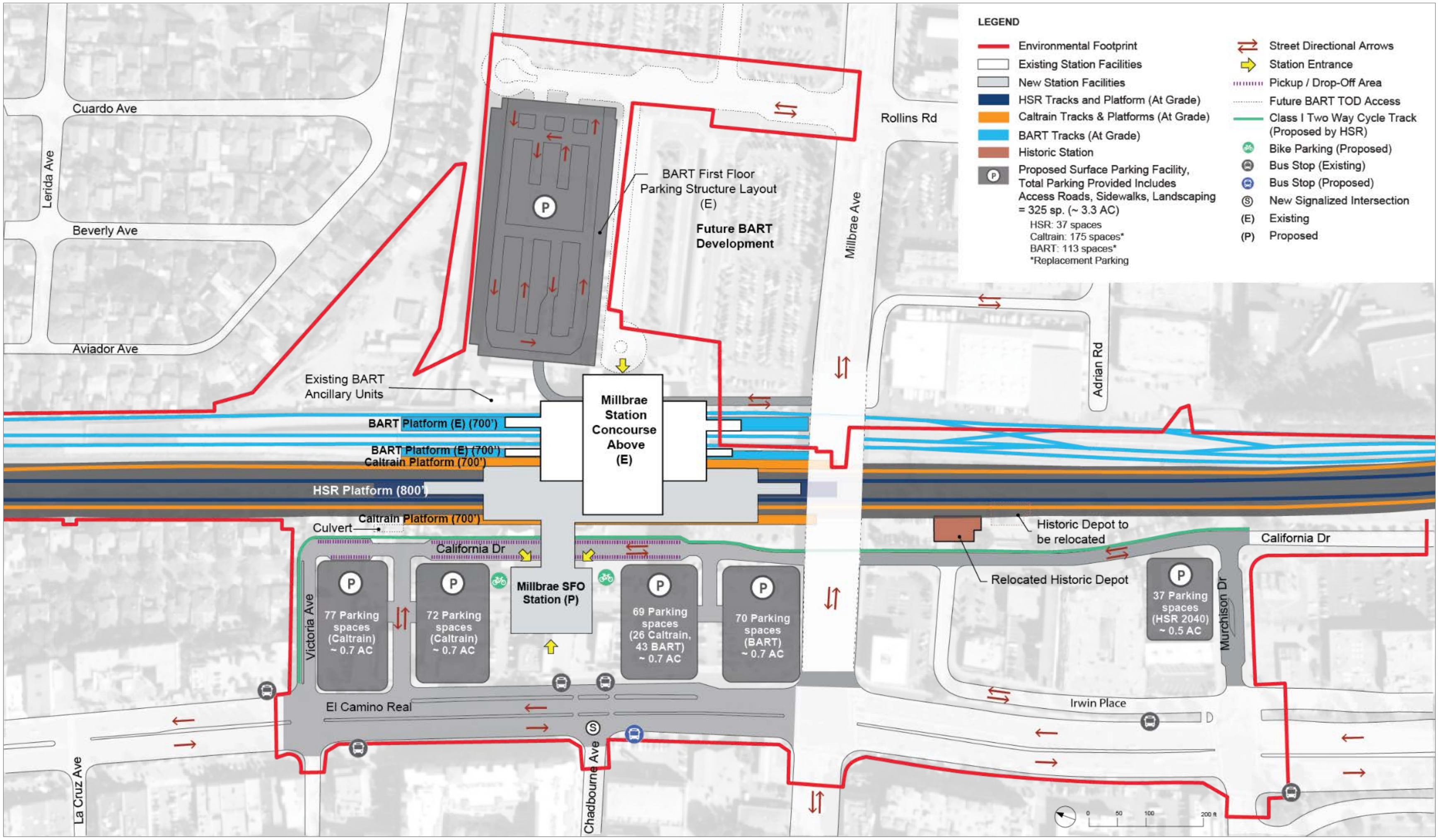
The SamTrans bus stops would be located along El Camino Real at the new signalized intersection and pedestrian crossings at Chadbourne Avenue, with direct access to the station. A new dedicated bike path would provide west side bicycle access to the station. Figures 2-15 and 2-16 illustrate cross-section views of the Millbrae Station looking south.

Track modifications extending approximately 1 mile north and south of the station would require additional right-of-way along the west side of the Caltrain corridor and modification of existing Caltrain tracks, station platforms, and structures. Constructing two new tracks would require widening the Hillcrest Boulevard underpass north of the Millbrae Station. At the station, the existing BART tracks and platforms and the easternmost Caltrain track (mainline track [MT]1) and platform would remain unchanged. The westernmost Caltrain track (MT2) would be shifted west by up to 40 feet for construction of two new tracks serving an 800-foot-long center HSR platform and a new Caltrain MT2 outboard platform. The historic Southern Pacific Depot/Millbrae Station (previously relocated to accommodate station improvements) and associated surface parking along California Drive would be relocated to accommodate these track modifications.

Source: Authority 2019

MAY 2019

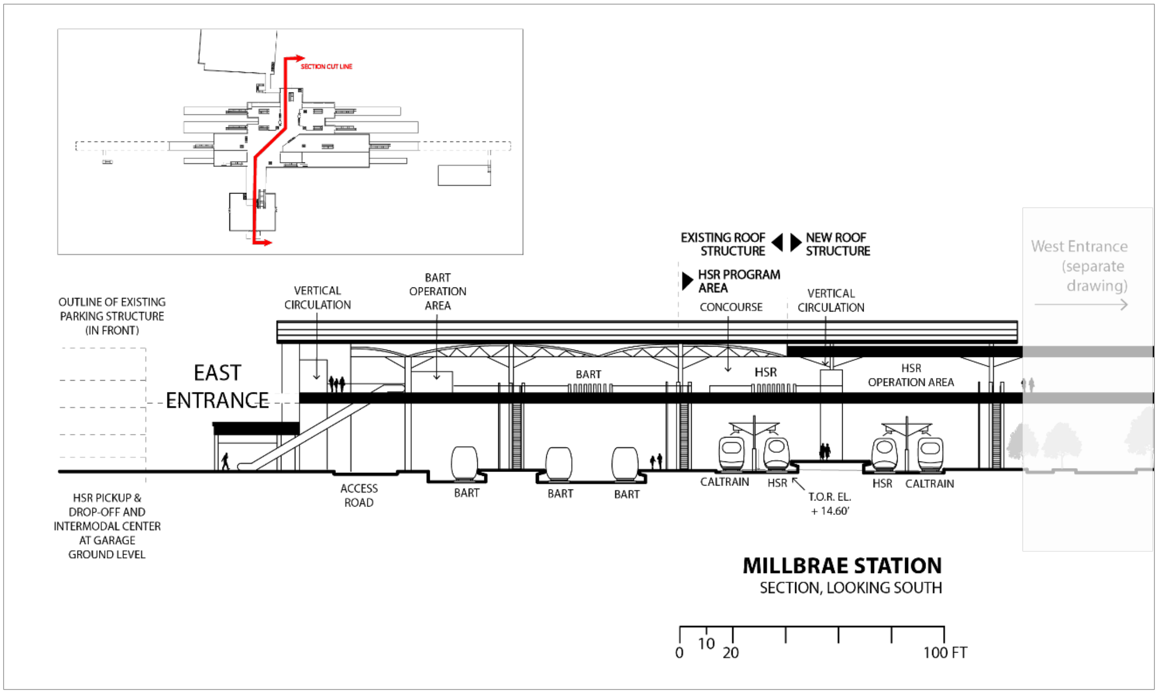
Figure 2-13 San Bruno to San Mateo Subsection—Alternatives A and B



Source: Authority 2019

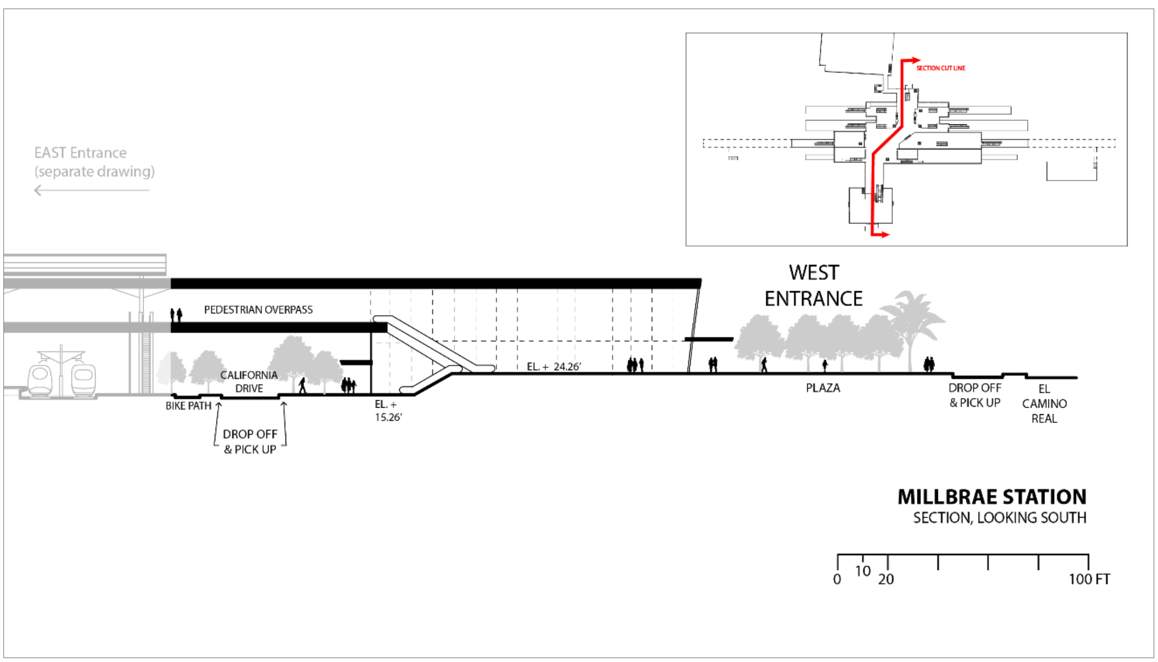
MAY 2019

Figure 2-14 Millbrae Station Site Plan—Alternatives A and B



Source: *Authority 2019* MAY 2019

Figure 2-15 Millbrae Station Cross Section (East Entrance)—Alternatives A and B



Source: *Authority 2019* MAY 2019

Figure 2-16 Millbrae Station Cross Section (West Entrance)—Alternatives A and B

2.2.2.2 Track and Station Modifications

Track and station modifications in this subsection include curve straightening near the San Bruno Station, platform modifications at the Broadway Station to eliminate the hold-out rule, and several minor track shifts in San Bruno and San Mateo. The curve straightening at the San Bruno Station would require an extension of the existing platforms approximately 145 feet south, and relocation of the existing stairs/ramps from the northern to southern side of the northbound platform. The Euclid Avenue pedestrian underpass, just north of the San Bruno Station, would be widened to support the realigned tracks, and the concrete retaining wall along the east side would be modified to accommodate the realigned tracks. Safety-related modifications would be made to the Broadway Station, including platform upgrades that would eliminate the hold-out rule by adding a second outboard platform to serve the northbound track and extending the southbound platform (Figure 2-2). The southbound platform extension would affect the station's surface parking along California Drive, and minor track shifts south of the Broadway Station would require widening of the Sanchez Creek and Mills Creek Culverts.

2.2.2.3 Safety and Security Modifications to the Right-of-Way

To improve safety four-quadrant gates and channelizers would be installed at 16 at-grade crossings: Scott Street, Center Street, Broadway, Oak Grove Avenue, North Lane, Howard Avenue, Bayswater Avenue, Peninsula Avenue, Villa Terrace, Bellevue Avenue, First Avenue, Second Avenue, Third Avenue, Fourth Avenue, Fifth Avenue, and Ninth Avenue. As illustrated on Figure 2-13, most of these crossings are in Burlingame and San Mateo. Table 2-1 specifies the four-quadrant gate application for each at-grade crossing, and Figures 2-3, 2-4, and 2-5 illustrate the configurations of these applications. Perimeter fencing (Figure 2-6) would be installed along the right-of-way where it does not already exist.

2.2.2.4 Train Control and Communication Facilities

Three communication radio towers would be built in the subsection. Locations of these facilities—a new standalone radio tower near SFO (at either San Marco Avenue or Santa Lucia Avenue), a co-located radio tower at Paralleling Station 3 in Burlingame, and a new standalone radio tower in San Mateo near Cypress or 2nd Avenue—are illustrated on Figure 2-13. Two site options are evaluated for each stand-alone communications radio tower; however, only one site would be selected for construction.

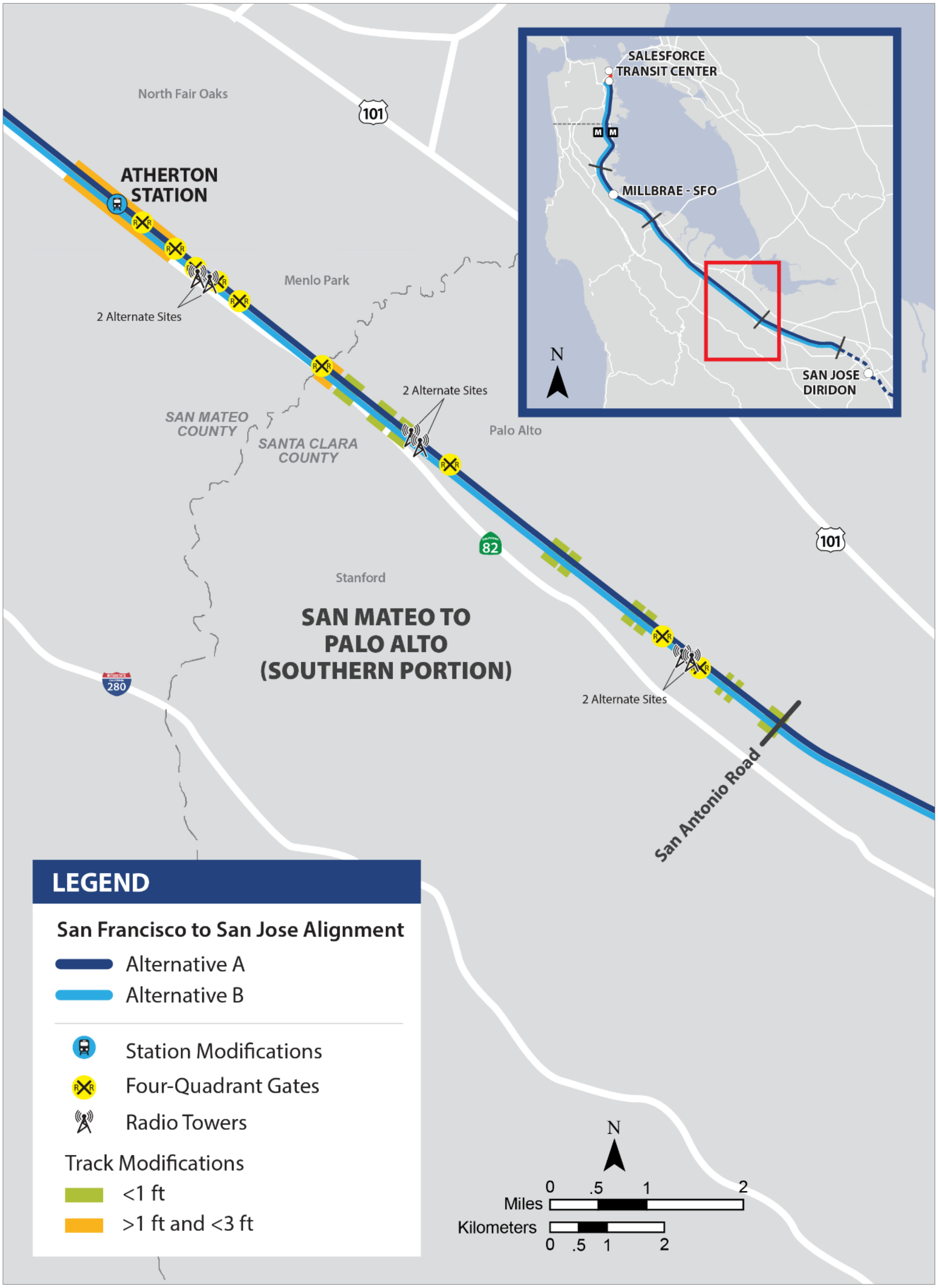
2.2.3 San Mateo to Palo Alto Subsection

The San Mateo to Palo Alto Subsection would extend approximately 16 miles from Ninth Avenue in San Mateo to San Antonio Road in Palo Alto through San Mateo, Belmont, San Carlos, Redwood City, Atherton, Menlo Park, and the northern portion of Palo Alto. The existing Caltrain track in this subsection is predominantly two-track at grade on retained fill. As illustrated on Figures 2-17 and 2-18, this alternative would modify platforms at the existing Hayward Park and Atherton Stations, modify tracks, install four-quadrant gates at 15 existing at-grade crossings, and install 7 communication radio towers. Minor amounts of additional right-of-way would be required in San Mateo, Belmont, San Carlos, Redwood City, Menlo Park, and Palo Alto for the siting of four-quadrant gates and communication radio towers.

Source: Authority 2019

MAY 2020

Figure 2-17 San Mateo to Palo Alto Subsection (Northern Portion)—Alternative A



Source: Authority 2019

MAY 2019

Figure 2-18 San Mateo to Palo Alto Subsection (Southern Portion)—Alternatives A and B

2.2.3.1 Track and Station Modifications

Track and station modifications in this subsection (Figures 2-17 and 2-18) consist of curve straightening predominantly in San Mateo, Belmont, San Carlos, and Palo Alto, platform modifications at the Hayward Park Station to accommodate curve straightening, and platform modifications at the Atherton Station to remove the hold-out rule by extending the southbound platform and adding a second outboard platform to serve the northbound track. In several locations, these track modifications would result in modifications to existing Caltrain structures; track shifts south of Ralston Street in Belmont and north of Holly Street in San Carlos would require the modifying the existing retaining walls along the west side of the Caltrain corridor to accommodate the shifted track. The HSR project would be compatible with Caltrain and the City of San Mateo's planned 25th Avenue Grade-Separation Project. This grade-separation project, expected to be built by 2020, would elevate the existing at-grade track between State Route (SR) 92 and Hillsdale Boulevard to provide a grade-separated undercrossing of 25th Avenue, build new east-west crossings under the track corridor at 28th and 31st Avenues, and relocate Hillsdale Station. No design changes to the 25th Avenue Grade-Separation Project are expected to result from the blended system.

2.2.3.2 Safety and Security Modifications to the Right-of-Way

To improve safety four-quadrant gates and median barriers would be installed at 15 at-grade crossings: Whipple Avenue, Brewster Avenue, Broadway Street, Maple Street, Main Street, Chestnut Street, Watkins Avenue, Encinal Avenue, Glenwood Avenue, Oak Grove Avenue, Ravenswood Avenue, Alma Street, Churchill Avenue, Meadow Drive, and West Charleston Road. As illustrated on Figures 2-17 and 2-18, most of these crossings are in Redwood City, Menlo Park, and Palo Alto. Table 2-1 specifies the four-quadrant gate application that would be applicable to each at-grade crossing, and Figures 2-3, 2-4, and 2-5 illustrate the configurations for these applications. Perimeter fencing would be installed along the right-of-way where it does not already exist (Figure 2-6).

2.2.3.3 Train Control and Communication Facilities

Seven communication radio towers would be built (Figures 2-17 and 2-18). Two site options are evaluated for each standalone communications radio tower; however, only one site would be selected for construction at each location:

- Co-located radio tower at Caltrain's Paralleling Station 4 south in San Mateo
- Standalone radio tower near the Belmont Station (either Middle Road or Ralston Avenue)
- Standalone radio tower in San Carlos (either near El Camino Real/Central Avenue or Center Street)
- Co-located radio tower at Caltrain's Switching Station 1, Option 2 in Redwood City
- Standalone radio tower in Menlo Park (either at Derby Lane or Ravenswood Avenue)
- Standalone radio tower in Palo Alto north of Embarcadero Road
- Standalone radio tower in Palo Alto north of West Charleston Road

2.2.4 Mountain View to Santa Clara Subsection

The Mountain View to Santa Clara Subsection would extend approximately 9 miles from San Antonio Road in Palo Alto to Scott Boulevard in Santa Clara through Palo Alto (southern portion), Mountain View, Sunnyvale, and Santa Clara. The existing Caltrain track in this subsection is predominantly two-track at grade (except for the four-track section from North Fair Oaks to north of Bowers Avenue) and there are no major project features in this subsection. As illustrated on Figure 2-19, this alternative would make minor track modifications, install four-quadrant gates at four at-grade crossings, and install four communication radio towers. Minor amounts of additional right-of-way would be required in Palo Alto, Mountain View, Sunnyvale, and Santa Clara for communication radio towers.

2.2.4.1 Track and Station Modifications

Minor track shifts of less than 1 foot would be required in several locations in Mountain View, Sunnyvale, and Santa Clara. The largest track shift in this subsection would be a shift of 2.5 feet near Bowers Avenue in Santa Clara. None of these track shifts would require modifying existing Caltrain structures or stations.

2.2.4.2 Safety and Security Modifications to the Right-of-Way

To improve safety, four-quadrant gates and median barriers would be installed at four at-grade crossings in Mountain View and Sunnyvale: Rengstorff Avenue, Castro Street, Mary Avenue, and Sunnyvale Avenue (Figure 2-19). Table 2-1 specifies the four-quadrant gate application for each at-grade crossing, and Figures 2-3, 2-4, and 2-5 illustrate the configurations of these applications. Perimeter fencing would be installed along the right-of-way where it does not already exist.

2.2.4.3 Train Control and Communication Facilities

Four communication radio towers would be installed (Figure 2-19). Two site options are evaluated for each stand-alone communications radio tower; however, only one site would be selected for construction at each location:

- Stand-alone radio tower in Mountain View
- Stand-alone radio tower in Sunnyvale east of SR 237
- Co-located radio tower at Caltrain’s Paralleling Station 6 near the Sunnyvale Station
- Stand-alone radio tower in Sunnyvale east of County Road G2

Source: Authority 2019

MAY 2019

Figure 2-19 Mountain View to Santa Clara Subsection—Alternatives A and B

2.3 Alternative B

Alternative B would modify approximately 17.4 miles of existing Caltrain track, predominantly within the existing Caltrain right-of-way, build the West Brisbane LMF and a four-track passing track, modify 10 existing stations or platforms to accommodate HSR, and install safety improvements and communication radio towers. Table 2-3 summarizes the alternative's design features, followed by a more detailed description by subsection.

Table 2-3 Summary of Design Features for Alternative B

Feature	Alternative B
Length of existing Caltrain track (miles)[1]	42.9
Length of modified track (miles)[1]	17.4
Length of track modification <1 ft (miles)[1]	4.3
Length of track modification >1 ft and <3 ft (miles)[1]	1.9
Length of track modification > 3 ft (miles)[1]	11.2
Length of OCS pole relocation (miles)[1, 2]	13.1
Includes additional passing tracks	Yes
LMF	West Brisbane
Modified stations	
Modifications to HSR stations	4th and King Street; Millbrae
Modifications to Caltrain stations due to the LMF	Bayshore (relocated)
Modifications to Caltrain stations due to the passing tracks	Hayward Park; Hillsdale; Belmont; San Carlos (relocated)
Modifications to Caltrain stations due to track shifts	San Bruno
Modifications to Caltrain stations to remove hold-out rule	Broadway; Atherton
Number of modified or new structures[3]	35
New structures	3
Modified structures	18
Replaced structures	7
Affected retaining walls	7
Number of at-grade crossings with safety modifications (e.g., four-quadrant gates, median barriers)	38
Length of new perimeter fencing	8.7
Communication radio towers	20

Source: Authority 2019
LMF = light maintenance facility
OCS = overhead contact system
[1] Lengths shown are guideway mileages.
[2] OCS pole relocations are assumed for areas with track shifts greater than 1 foot.
[3] Structures include bridges, grade separations such as pedestrian underpasses and overpasses, tunnels, retaining walls, and culverts.

2.3.1 San Francisco to South San Francisco Subsection

The Alternative B characteristics in this subsection would be predominantly the same as those described for Alternative A in Section 2.2.1, San Francisco to South San Francisco Subsection. Siting the LMF on the west side of the Caltrain corridor (West Brisbane LMF) would require different track, roadway, and Bayshore Station modifications than described for Alternative A. Locations of track modifications, safety and security improvements, and communication radio towers in this subsection are illustrated on Figure 2-20.

Source: Authority 2019

MAY 2019

Figure 2-20 San Francisco to South San Francisco Subsection—Alternative B

2.3.1.1 West Brisbane Light Maintenance Facility

The West Brisbane LMF would be built south of the San Francisco Caltrain tunnels on approximately 110 acres west of the Caltrain corridor. Direct mainline track access would be along double-ended yard leads that would cross over the mainline track on aerial flyover and would enable north and south movements. The four existing mainline tracks would be shifted west by up to 16.5 feet, and new yard leads connecting to the West Brisbane LMF would be constructed east and west of the existing tracks. The yard leads east of the existing tracks would cross over the realigned four-track alignment on an aerial flyover to avoid train operations on the mainline track, converging with the yard leads on the west side of the track alignment. Transition tracks (approximately 1,400 feet long) would allow trains to reduce or increase speed when entering or exiting the LMF.

The West Brisbane LMF (Figure 2-21) would include a maintenance yard with 17 yard tracks parallel to a runaround track and a maintenance building with shop tracks. A power generator, sewage system, cistern, collection point, and an electrical substation would be located north of the maintenance building. A 400-space surface parking lot would be provided west of the maintenance building with truck and vehicle access to Industrial Way, which parallels and connects to Bayshore Boulevard.

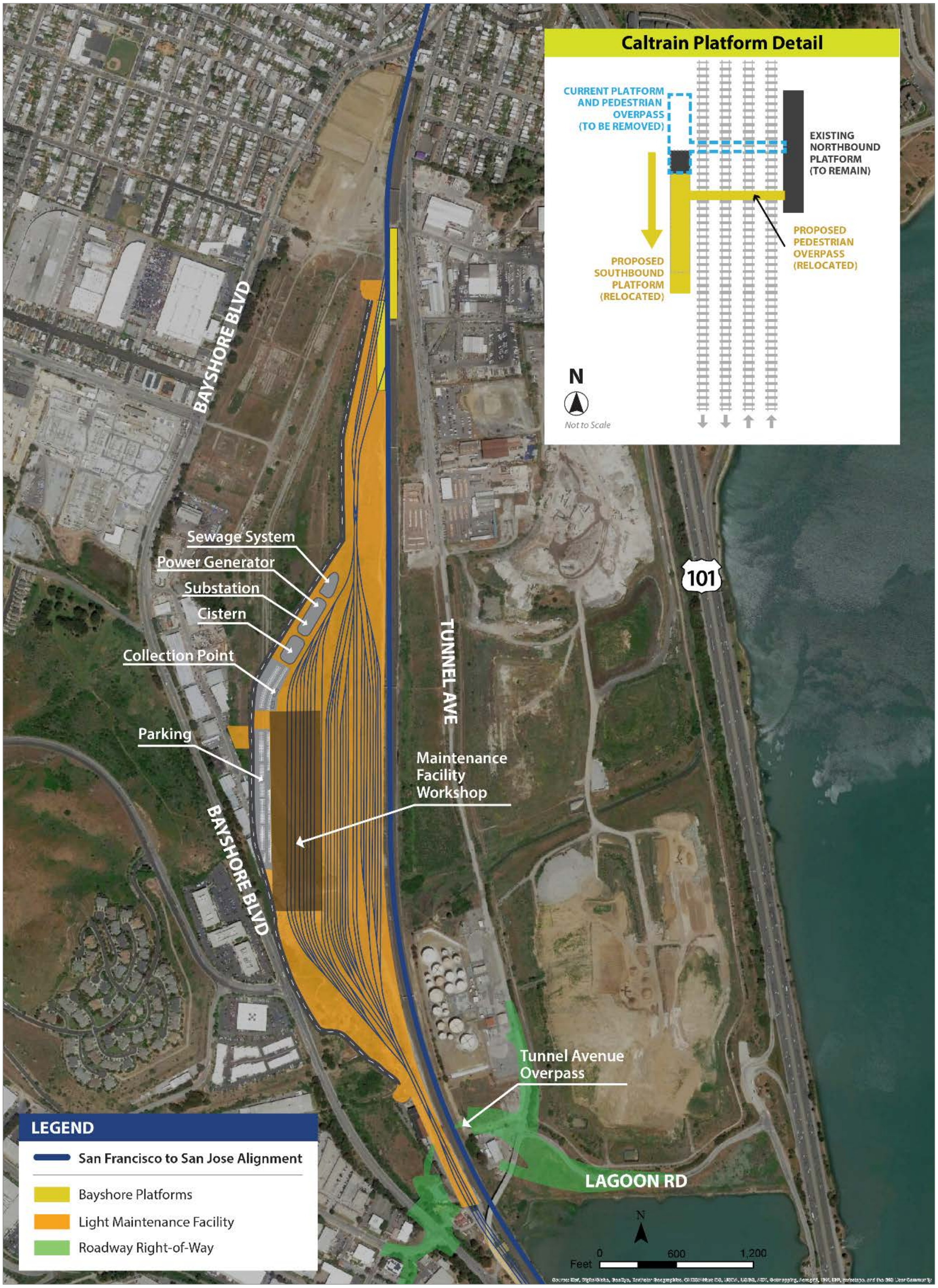
Track modifications associated with the West Brisbane LMF would require relocating the Tunnel Avenue overpass, widening the bridge crossing Guadalupe Valley Creek in Brisbane, relocating CP Geneva at its intersection with Valley Drive, and providing a roadway extension connecting Valley Drive to Old Country Road. The widened Guadalupe Valley Creek Bridge would support the West Brisbane LMF lead tracks where they cross the creek. Track modification near CP Geneva could require relocating the overhead signal pole.

2.3.1.2 Track and Station Modifications

Track and station modifications in the San Francisco to South San Francisco Subsection for Alternative B (Figure 2-20) would predominantly be associated with the West Brisbane LMF. The realignment of the mainline tracks for the West Brisbane LMF would require relocation of the Bayshore Caltrain Station and removal of the existing Bayshore Station pedestrian overpass. The Bayshore Caltrain Station and associated surface parking lot, southbound platform, and a new pedestrian overpass would be reconstructed approximately 0.2 mile south of the existing station (inset on Figure 2-21). The new pedestrian overpass would provide access to the reconstructed station by connecting to Tunnel Avenue on the east and the planned local roadway network envisioned in the *Draft Brisbane Baylands Specific Plan* on the west (City of Brisbane 2011). The Bayshore Caltrain Station would be closer to the planned future Geneva Avenue extension, which would extend from Bayshore Boulevard to US 101.

2.3.2 San Bruno to San Mateo Subsection

The characteristics of the San Bruno to San Mateo Subsection of Alternative B would be the same as those described for Alternative A in Section 2.2.2, San Bruno to San Mateo Subsection. The track and station modifications, safety and security improvements, Millbrae Station, and communication radio towers in this subsection are illustrated on Figure 2-13.



Source: Authority 2019

MAY 2019

Figure 2-21 West Brisbane Light Maintenance Facility Layout

2.3.3 San Mateo to Palo Alto Subsection

In the San Mateo to Palo Alto Subsection, Alternative B would build a passing track through San Mateo and San Carlos and modify the Hayward Park, Hillsdale, Belmont and San Carlos Stations to accommodate the additional passing tracks. As illustrated on Figures 2-18 and 2-22, this alternative would modify existing track, install four-quadrant gates at 15 existing at-grade crossings, and install 7 communication radio towers. The platforms at the existing Atherton Station would be modified to eliminate the hold-out rule. While the northern portion of this subsection (Figure 2-22) differs from Alternative A because of the passing tracks and associated track and station modifications, the characteristics of the southern portion of the San Mateo to Palo Alto Subsection would be the same as those described for Alternative A in Section 2.2.3, San Mateo to Palo Alto Subsection (Figure 2-18). Additional right-of-way would be required in San Mateo, Belmont, San Carlos, Redwood City, Menlo Park, and Palo Alto associated with four-quadrant gates, communication radio towers, passing tracks, and the reconfiguration or relocation of existing Caltrain stations.

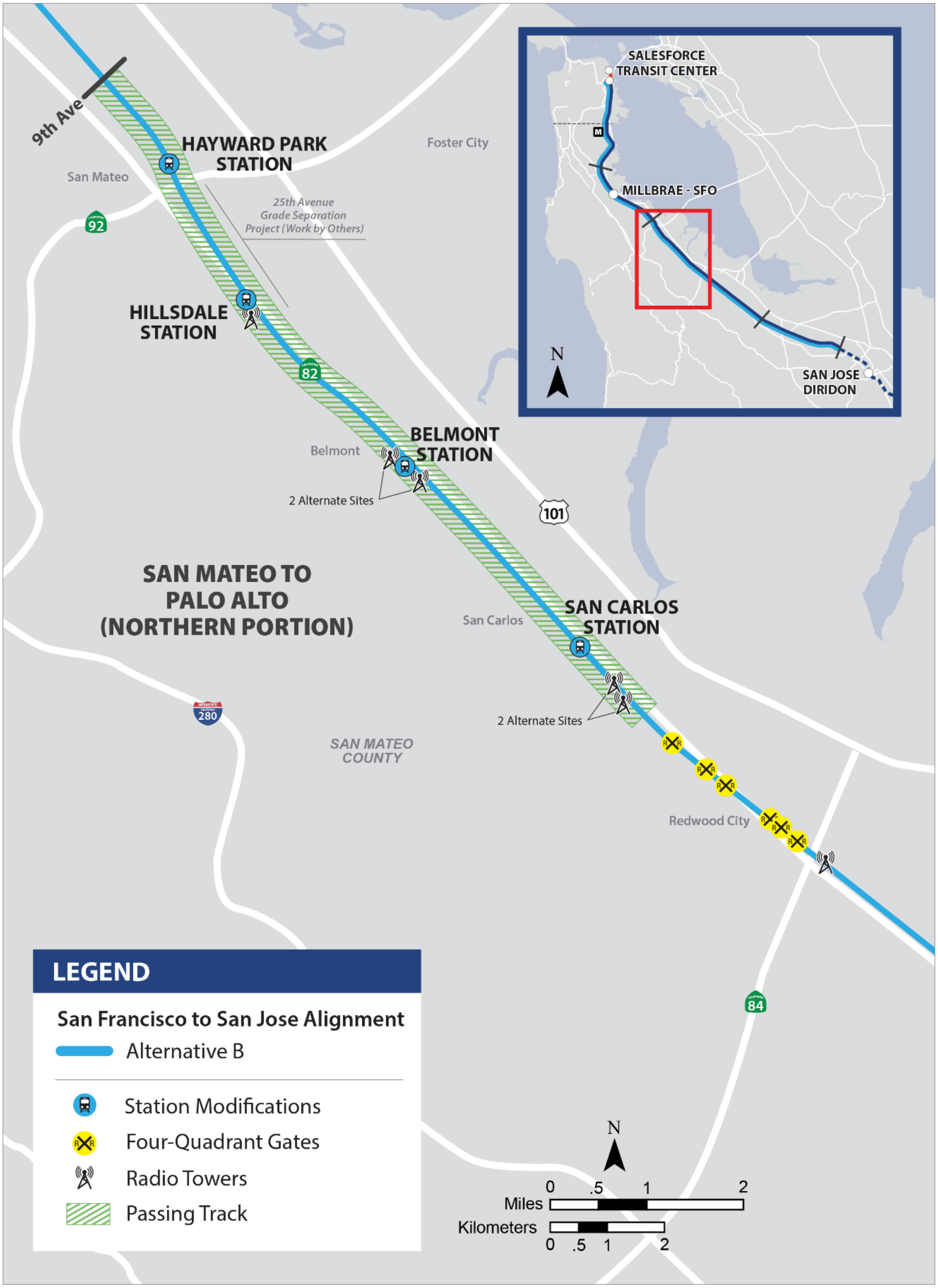
2.3.3.1 Passing Tracks

The approximately 6-mile-long passing track would extend through San Mateo, Belmont, San Carlos, and into the northern portion of Redwood City. South of Ninth Avenue in San Mateo, the two-track alignment would diverge to four tracks continuing at grade and on retained fill. The existing tracks would be realigned predominantly within the existing right-of-way to accommodate the new four-track configuration. Additional right-of-way would be required in some areas with particularly narrow existing rights-of-way or where curve straightening would be necessary to achieve higher speeds.

25th Avenue Grade Separation Project

This grade-separation project, which is being undertaken by Caltrain in coordination with the City of San Mateo, would elevate the existing at-grade track between State Route 92 and Hillsdale Boulevard to provide a grade-separated undercrossing of 25th Avenue, build new east-west crossings under the track corridor at 28th and 31st Avenues, and relocate the Hillsdale Station. Construction is expected to be completed in 2020.

Beginning in Hayward Park north of the SR 92 crossing, the tracks on retained fill would be shifted up to 46 feet, requiring acquisition of additional right-of-way. New outboard platforms, a pedestrian underpass at the Hayward Park Caltrain Station, and a new structure south of the SR 92 overpass would be built to carry the reconfigured four-tracks over the Borel Creek Culvert. South of the Hayward Park Station, the passing tracks would use the infrastructure installed by the planned 25th Avenue Grade Separation Project (see text box). A new retaining wall would be installed between SR 92 and Hillsdale Boulevard to match the elevation of the 25th Avenue Grade Separation Project, along with new bridge structures for the two new tracks at Borel Creek and 25th, 28th, and 31st Avenues. Additionally, a northbound Hillsdale Station platform would be built, eliminating some existing parking at the Hillsdale Station. At Hillsdale Boulevard, the existing underpass structure would be widened to accommodate the realigned tracks, along with widening of the existing Laurel Creek underpass to the south.



Source: Authority 2019

MAY 2019

Figure 2-22 San Mateo to Palo Alto Subsection (Northern Portion)—Alternative B

South of Hillsdale Boulevard, the passing tracks would ascend to a four-track aerial viaduct. Between Hillsdale Boulevard and Whipple Avenue, the following structures or facilities would be replaced or rebuilt: CP Ralston tie-in points, Belmont Station platforms, and San Carlos Station and platforms. The Belmont Station and platforms would be reconstructed to accommodate the new four-track configuration. The San Carlos Station and platforms would be relocated approximately 2,260 feet south of their currently location to Arroyo Avenue and a pedestrian underpass would be constructed. The following structures would be removed and replaced or modified: 42nd Avenue underpass, Belmont Caltrain Station pedestrian underpass, Ralston Avenue underpass, Harbor Boulevard underpass, F Street pedestrian underpass, Holly Street and San Carlos Station pedestrian underpass, Arroyo Avenue pedestrian underpass, Brittan Avenue, and Howard Avenue. South of Howard Avenue, Alternative B would descend to grade and converge back to a two-track configuration.

2.3.3.2 Track and Station Modifications

The track and station modifications under Alternative B would vary from those described for Alternative A in Section 2.2.3 in the northern portion of the subsection between Ninth Avenue in San Mateo and Whipple Avenue in Redwood City. In this portion of the subsection, the addition of two passing tracks would result in modifications to the existing Hayward Park, Hillsdale, Belmont, and San Carlos Caltrain Stations. Alternative B would modify and realign station platforms at the Hayward Park Caltrain Station, build new platforms at the Hillsdale and Belmont Caltrain Stations, and relocate the San Carlos Caltrain Station approximately 2,260 feet south of its existing location (Figure 2-23).

South of Whipple Avenue, the track and station modifications in the southern portion of this subsection would be the same as those described for Alternative A. Safety-related modifications would be made to the Atherton Station, including platform upgrades that would eliminate the hold-out rule by extending the southbound platform and adding a second outboard platform to serve the northbound track (Figure 2-2).

2.3.4 Mountain View to Santa Clara Subsection

The characteristics of the Mountain View to Santa Clara Subsection under Alternative B would be the same as those described for Alternative A. The locations for track modifications, safety and security improvements, and communication radio towers within this subsection are illustrated on Figure 2-19.

Source: Authority 2019

MAY 2019

Figure 2-23 San Carlos Station Relocation—Alternative B

3 PROJECT SETTING

The project, located on the west side of the San Francisco Bay, passes through two major geophysical regions (distinct landscapes)—the San Francisco Peninsula and the Santa Clara Valley. The project overlaps the entire existing Caltrain rail corridor. The dominant land cover/land use is urban land consisting of residential and commercial development. Elevations range from 1 foot below to 74 feet above mean sea level.

3.1 Vegetation Communities

The study area contains natural and semi-natural vegetation types, agricultural lands, and developed areas. Detailed land cover mapping was conducted by using a combination of reconnaissance-level fieldwork, review of existing geographic information system (GIS) land cover mapping data, and interpretation of aerial photographs. The classification of the land cover and vegetation communities were adapted from previous HSR project sections and the PCEP Preliminary Delineation of Wetlands and other Waters of the United States report (PCJPB 2015) or identified using the *Manual of California Vegetation (version 2)* (Sawyer et al. 2009).

The natural vegetation types present in the study area consist of both upland and aquatic vegetation communities. Upland vegetation communities are California annual grassland, coyote brush scrub, disturbed/barren, mixed riparian, mixed woodland, oak woodland, ornamental woodland, ruderal, and urban. Wetland vegetation communities are freshwater emergent wetland, saline emergent wetland, scrub/shrub wetland, and seasonal wetland. Nonwetland waters (e.g., rivers and streams) are present as inclusions in these land cover types: they comprise constructed basins, constructed watercourses, constructed basins, natural watercourses, and open water. Chapter 5 provides descriptions of the wetland communities.

3.1.1 Developed Lands

Six developed land cover types were identified in the study area: constructed basin, constructed watercourse, disturbed/barren, ruderal, ornamental woodland, and urban. Of these land cover types, constructed basin and constructed watercourse are considered aquatic resources. Developed areas in the study area include various types of developed land use, such as commercial and industrial buildings, transportation corridors, and barren and ruderal areas where vegetation has been heavily disturbed or removed. Because of the highly developed and disturbed character of the study area, all land cover types have been affected in some way by urban development (e.g. erosion, urban runoff, habitat fragmentation).

3.1.2 Upland Natural and Semi-Natural Vegetation

The terms *natural* and *semi-natural* refer to native and non-native (introduced) terrestrial vegetation communities, respectively. Areas mapped as upland natural and semi-natural habitats are not considered waters of the U.S. because they lack one or more of the federal wetland criteria (i.e., wetland hydrology, hydric soil, and hydrophytic vegetation) (Environmental Laboratory 1987: page 11; USACE 2010).

The mixed riparian vegetation community is located above the ordinary high water mark (OHWM) of natural watercourses, including streams, sloughs, rivers and, in some cases, along constructed waterways, where they form transition zones between terrestrial and aquatic ecosystems. Some of the mixed riparian areas are characterized by a prevalence of hydrophytic vegetation but do not meet the other federal criteria for wetlands. These types of mixed riparian areas are above the OHWM and therefore would not be classified as waters of the U.S.

Other upland natural vegetation communities in the study area include coyote brush scrub, mixed woodland, and oak woodland. Coyote brush scrub is a type of northern coastal scrub dominated by coyote brush (*Baccharis pilularis*). This vegetation community is typically found on exposed, rocky soil and on river terraces with species such as California sagebrush (*Artemisia californica*), sticky monkeyflower (*Diplacus aurantiacus*), and poison-oak (*Toxicodendron diversilobum*). Both mixed woodland and oak woodland are dominated by tree species. Oak woodland habitat can contain only one species of oak, a variety of oak tree species where no species is clearly dominant, or where different types of oak woodland are present in small-scale mosaics (County of Santa Clara et al. 2012). Mixed woodland is characterized by a variety of tree species, both native and nonnative, such as Monterey pine, oak species, California buckeye, Eucalyptus species, and Peruvian pepper tree.

The most common semi-natural habitat in the study area is California annual grassland, which is characterized by nonnative annual grasses such as ripgut brome (*Bromus diandrus*), soft chess brome (*Bromus hordeaceus*), wall barley (*Hordeum murinum*), and common wild oats (*Avena fatua*). Native annual and perennial herbaceous species may also be present in the California annual grassland community.

3.1.3 Waters of the U.S.

Potential waters of the U.S. mapped in the study area are constructed basin, constructed watercourse, freshwater emergent wetland, natural watercourse, open water, saline emergent wetland, scrub/shrub wetland, and seasonal wetland. These resources may be grouped into two categories: (1) wetlands (all of which are either palustrine or estuarine wetlands) and (2) nonwetland waters.

Palustrine wetlands are a broad class of nontidal wetlands that include marshes, swamps, bogs, fens, and prairies (Cowardin et al. 1979: page 10). In the study area, freshwater emergent wetland, scrub/shrub wetland, and seasonal wetland are considered palustrine wetlands. The only other wetland land cover type in the study area, saline emergent wetland, is classified as an estuarine wetland. This category of wetlands consists of tidal wetlands that are semi-enclosed by land but have at least some tidal connection to the ocean (Cowardin et al. 1979: page 10).

Nonwetland waters are aquatic features that do not meet the wetland criteria established by the USACE, but do meet requirements (i.e., have an OHWM) to be considered nonwetland waters of the U.S. In the study area, constructed basins, constructed watercourses, natural watercourses, and open water are considered nonwetland waters. A description of each type of aquatic resource mapped in the study area is provided in Section 3.1.3.1, Wetlands, and Section 3.1.3.2, Nonwetland Waters.

3.1.3.1 Wetlands

Freshwater Emergent Wetland

Freshwater emergent wetlands are nontidal, flooded, depressional wetlands. They are designated as palustrine emergent semi-permanently flooded wetlands in Cowardin et al. (1979). Freshwater emergent wetlands are semi-permanently flooded areas that typically support perennial emergent vegetation such as cattails, sedges, and rushes. Freshwater emergent wetlands are found on floodplains, backwater areas, and within the channels of rivers and sloughs.

Seasonal Wetland

Seasonal wetlands support a variety of both native and nonnative wetland plant species and may occur in a variety of landforms where there is seasonal saturation or inundation. In the most manipulated areas, inundation is hydrologically controlled by pumps, weirs, and storm drain systems. In less manipulated systems, natural inundation or saturation occurs during the winter and spring seasons, and the seasonal wetlands are dry during the summer and fall.

Saline Emergent Wetland

Saline emergent wetlands are characterized as salt or brackish wetlands subject to tidal action. They are characterized by perennial grasses and forbs ranging in height from less than 1 foot to approximately 7 feet, along with algal mats on moist soils. Saline emergent wetlands occur along the margins of bays, lagoon estuaries, and creeks sheltered from wave action. The plants often occur in zones based on elevation and salinity, and vegetation cover is extremely dense except where creeks or sloughs intersect the habitat. Characteristic or distinctive vascular plant species include pickleweed (*Salicornia pacifica*), coastal gumweed (*Grindelia stricta*), and alkali heath (*Frankenia salina*) (Springer 1988).

Scrub/Shrub Wetland

Scrub/shrub wetlands are dominated by woody vegetation consisting of true shrubs, young trees, and trees or shrubs that are small or stunted because of environmental conditions. All water regimes except subtidal are included (Cowardin et al. 1979). Scrub/shrub communities in the study area typically consist of scattered willows (*Salix* sp.), mulefat (*Baccharis salicifiolia*), and Himalayan blackberry (*Rubus armeniacus*) adjoining creeks and streams (County of Santa Clara et al. 2012). Scrub/shrub wetlands may represent a successional stage leading to forested wetland, or they may be relatively stable communities.

3.1.3.2 Nonwetland Waters

Constructed Basin

Constructed basins in the study area (nonwetland waters of the U.S.) consist of constructed stormwater retention basins and artificial ponds. Constructed basins are highly disturbed and may be routinely managed through vegetation removal and dredging. Depending on substrate and management regimes, vegetative type and cover varies, although most constructed basins lack wetland vegetation or may support upland vegetation. Hydrology also varies in relation to precipitation events and management objectives. Cowardin et al. (1979: page 14) classifies constructed basins as palustrine unconsolidated bottom deepwater habitats. Palustrine wetlands may be associated with constructed basins at their margins and in shallow areas where deep water does not preclude vegetation establishment.

Constructed Watercourse

Canals, ditches, and streams in the study area (nonwetland waters of the U.S.) are channelized water features that have been highly modified or constructed primarily for flood control or water conveyance. Most of these features are linear watercourses, ranging in size from small, shallow ditches (e.g., 10 feet wide and 3–4 feet deep) to broad channels (e.g., 50 feet wide and 10 feet deep). Scattered emergent vegetation is present in some areas, but most constructed watercourses are routinely cleared of vegetation, sprayed with herbicides, or both. Constructed watercourses, like natural watercourses, are classified as nonwetland riverine systems under the Cowardin system; palustrine or estuarine wetlands may also be associated with these constructed features (Cowardin et al. 1979: page 7). However, an altered hydroperiod and routine maintenance of constructed watercourses for conveyance function limits the establishment and function of these wetland types.

Natural Watercourse

Natural watercourses in the study area are perennial streams and several intermittent to ephemeral sloughs and creeks. Additionally, natural watercourses can have ephemeral hydrology either because of their small watershed size or because their upstream flow has been impounded or diverted into other watercourses.

Open Water

Open water consists of deep, perennial, nonvegetated (i.e., less than 5 percent vegetated) pools, such as ponds, lagoons, playas, borrow pits, small reservoirs, and open water areas within marshes or swamps (Cowardin et al. 1979; SFEI 2011). When open water areas are located within wetlands, they are typically smaller than 20 acres and less than 6.5 feet deep (Cowardin et al. 1979).

3.2 Topography and Climate

Elevations in the study area range from approximately 1 foot below sea level at the northern end of the project to 74 feet above sea level in the southern part of San Francisco. Most of the slopes are nearly level to gentle.

The project is located within one ecological section—Central California Coast (McNab et al. 2007; Griffith et al. 2016)—and four ecological subsections—the San Francisco Peninsula subsection, the Bay Flats subsection, the Leeward Hills subsection, and the Santa Clara Valley subsection.

The San Francisco Peninsula ecological subsection, at the northern end of the peninsula, includes large areas of Quaternary marine and sand dune deposits, with recent alluvium and large areas of fill next to San Francisco Bay. There are some small serpentine rock outcrops and bluffs. Nearly the entire area is urbanized (Griffith et al. 2016).

The Bay Flats ecological subsection includes the near-water flats around San Pablo Bay in the north and those around the southern end of the San Francisco Bay. Elevations range from sea level to about 10 feet above mean sea level. The Bay Flats are underlain by Quaternary silty and clayey sediments (Griffith et al. 2016).

The Leeward Hills ecological subsection consists of mountains and hills, characterized by steep and moderately steep side and narrow canyons inland from the wetter Santa Cruz Mountains subsection. Elevations range from 200 to approximately 3,700 feet.

The Santa Clara Valley ecological subsection consists of an alluvial plain in the Santa Clara Valley that extends from Hollister to San Francisco Bay and an alluvial plain along the southwestern side of San Francisco Bay. Elevations range from sea level up to approximately 250 feet on the alluvial plains and up to about 1,000 feet on the hills west of Hollister (Miles and Goudey 1998).

The Mediterranean climate typical of the region consists of cool, wet winters and hot, dry summers. Mean annual temperatures in the project extent range from a low of 47.5 degrees Fahrenheit (°F) in December to a high of 71.3°F in July in Redwood City and from a low of 51.7°F in December to a high of 70.9°F in July in San Jose. The Natural Resources Conservation Service (NRCS) Climate Analysis for Wetlands Tables (WETS Tables) (USDA-NRCS 2018a) show a growing season (defined as a 50 percent probability of temperatures at or above 28°F) of 324 days in Redwood City. Average annual precipitation in Redwood City is 19.60 inches. Approximately 79 to 85 percent of the annual rainfall occurs from November to March (USDA-NRCS 2018a).

3.3 Hydrology

This section discusses the study area's watersheds and hydrology, including wetland hydrology, and provides a brief description of the growing season.

3.3.1 Watersheds and Hydrology

The study area is divided almost evenly into two U.S. Geological Survey (USGS) HUC-8 watershed subbasins—San Francisco Bay (HUC 118050003) in the north and Coyote (HUC 18050003) in the south (Figure 3-1) (USGS 2018a). The watershed divide between the San Francisco Bay watershed and the Coyote watershed is in the Palo Alto area. The natural hydrology of both watersheds has been substantially altered by dense urbanization.

Most watercourses in these watersheds are perennial, flowing year-round except in times of drought. Outside the study area, the mid-to-upper reaches of tributary streams are intermittent or perennial in summer, depending on the characteristics of local aquifers. However, historically (i.e., before urbanization), most watercourses in the area were dry during the summer (SFEI 2012). As patterns of water use and water importation have evolved, many watercourses have experienced increased summer flow (Santa Clara Basin Watershed Management Initiative 2000). Today, some watercourses are perennial in their lower reaches as a result of urban runoff or high groundwater, while others flow because of artesian wells, springs, and water releases. Reservoir operators and water managers release some flows in the summer to promote groundwater recharge, contributing to the perennial nature of streams in the project vicinity.

Surface runoff in the vicinity discharges into a network of underground and surface drainage pathways (including the combined sewer system in San Francisco). Generally, these pathways converge into larger underground storm drains, drainage culverts, streams, or creeks, which become progressively larger as the runoff moves downstream, eventually reaching a common discharge location, often near the San Francisco Bay.

Named watercourses in the study area are provided in the following list, in alphabetical order by watershed and presented on Figure 3-1:

San Francisco Bay Watershed

- Atherton Channel
- Belmont Creek
- Borel Creek
- Burlingame Creek
- Colma Creek
- Cordilleras Creek
- Easton Creek
- El Zanjon Creek (aka Cupid Row Canal)
- Guadalupe Valley Creek
- Highline Creek
- Laurel Creek
- Leslie Creek
- Mills Creek
- Ojo De Agua
- Pulgas Creek
- Redwood Creek
- San Mateo Creek
- Sanchez Creek
- Visitacion Creek

Coyote Watershed

- Adobe Creek
- Barron Creek
- Calabazas Creek
- Matadero Creek
- Permanante Creek
- San Francisquito Creek
- San Tomas Aquinas Creek
- Stevens Creek
- Sunnyvale East Channel

Source: USGS 2016

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Figure 3-1 Watersheds and Major Hydrological Features

3.3.2 Historical Hydrology

The extensive development in the Bay Area has altered natural hydrology and drainage patterns. Historically, small watercourses in the study area flowed primarily from west to east, draining to the San Francisco Bay. However, as the region urbanized, most of the watercourses in the study area were channelized and covered over and now function as underground drains. Consequently, there are few remaining freshwater bodies or streams in the study area that retain natural conditions (Hermstad et al. 2009; SFEI 2012). Additionally, development has obscured and modified the historic watershed boundaries.

Historically, streams in the study area were discontinuous in contrast to the present-day drainage network, where each major creek is now connected by engineered channels extending to the San Francisco Bay. For example, streamflow in every creek in western Santa Clara Valley historically either percolated into gravelly soils or discharged onto slowly permeable basin soils. No creek maintained a continuous, single thread channel between the hills and the San Francisco Bay. In addition, many creek reaches were more sinuous prior to modification; creeks were straightened to accommodate development and flood control and to maintain navigability (SFEI 2010).

Similarly, the tidal marsh landscape along the San Francisco Peninsula has been greatly altered by urban development. From the late 19th through the early 20th century, levees were built along the San Francisco baylands to drain and convert tidal marsh habitat to agricultural land. For example, by the mid-20th century, the lower San Francisquito Creek channel had been completely rerouted and flanked with flood control levees to convey flood flows more rapidly to San Francisco Bay and to remove tidal wetland areas from regular tidal inundation. Altering the San Francisco baylands allowed for wetland filling and the building of roads and residential and commercial structures, resulting in a considerable decrease in their overall extent and impairing the physical processes that sustained the baylands ecosystem (SFEI 2016).

3.3.3 Wetland Hydrology

Alterations to both surface and groundwater in the region have resulted in a decline in historical wetland areas, especially along the San Francisco Bay. This decline is reflected in “drained” or “partially drained” hydric soils that have been mapped in the area.

Hydrologic conditions in the study area have been highly manipulated in urban areas. Most of the surface water in the study area is diverted by the numerous constructed and natural watercourses that are found throughout the San Francisco Peninsula and Santa Clara Valley. Consequently, most of the surface water in the study area is found either in canals, ditches, reservoirs, or in water retention and detention basins but is occasionally found in streams or precipitation-fed wetlands. Many of the remaining wetlands in the study area are largely unrelated to historical floodplains or regional aquifers.

3.3.4 Growing Season Analysis

The growing season is defined as the period when the soil temperature at a depth of 12 inches below the ground surface is above 41°F. The duration of the growing season is typically approximated using an air temperature threshold of 28°F at a frequency of 5 years in 10 (i.e., 50 percent) (USACE 2010).

The Redwood City climate station in the study area provides growing season data (USDA-NRCS 2018a) and estimates the length of the growing season days. To meet the USACE criterion for wetland hydrology, the required minimum number of days of continuous soil saturation in the major part of the root zone or inundation to the surface is approximately 17 days, or 5 percent of the 333- to 338-day length of the local growing season at a temperature threshold of 28°F. Observations of soil saturation or inundation during the early spring would be strong indicators for meeting the wetland hydrology criterion, assuming that soil temperature is in the typical range.

3.4 Soils

Table 3-1 lists the general soil map units that occur in the study area, their county of occurrence, and the landforms upon which they occur. Each of the generalized landforms found in the study area is described in this section. The extent of the soil associations in the study area is illustrated on Figure 3-2.

Table 3-1 General Soil Map Units Intersected by the Alternatives in the Aquatic Resource Study Area

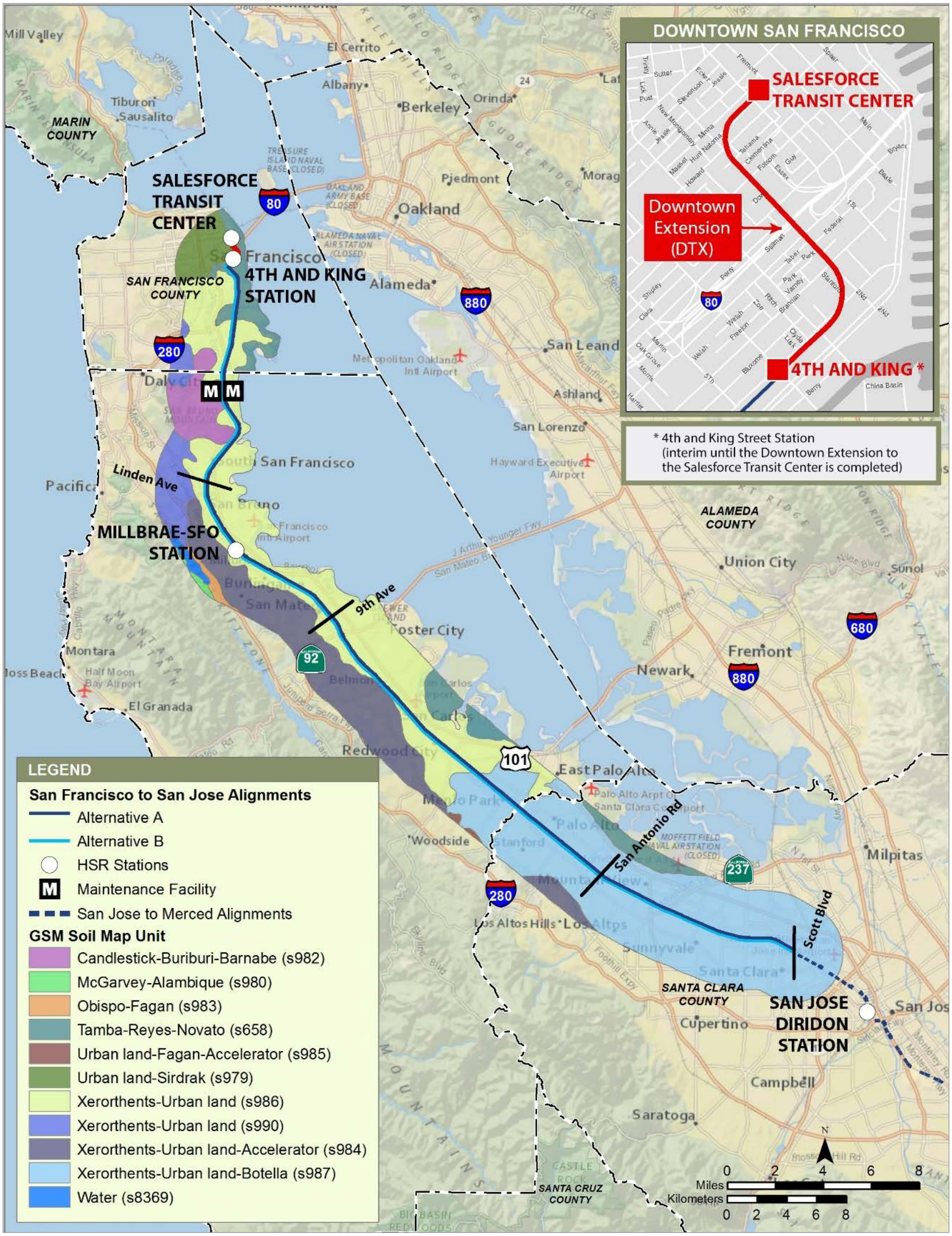
General Soil Map Unit (map symbol)	County of Occurrence	Landform
Tamba-Reyes-Novato (s658)	San Francisco	Tidal marshes
Urban land-Sirdrak (s979)	San Francisco	Dunes
Xerorthents-Urban land (s986)	San Francisco, San Mateo	Recent alluvial fans and floodplains
Candlestick-Buriburi-Barnabe (s982)	San Mateo	Uplands and mountain slopes
Xerorthents-Urban land-Accelerator (s984)	San Mateo	Recent alluvial fans and floodplains
Xerorthents-Urban land-Botella (s987)	San Mateo, Santa Clara	Recent alluvial fans and floodplains

Source: USDA-NRCS 2018b

Many of the soils in the study area have been disturbed or overcovered by urban development. These soils have been leveled, drained, or protected from flooding for urban and commercial development.

3.4.1 Tidal Marshes

Tidal marshes are the lowest landform in the study area. Under natural conditions, this landform lies on the borders of saline or freshwater bodies whose water level fluctuates and deposits fine-textured sediments along the banks. In the study area, tidal marshes now include developed areas that were once part of the San Francisco Bay and adjacent tidal flats. Some of the areas presently mapped as Urban land-Orthents, reclaimed complex, 0 to 2 percent slopes developed on this landform (USDA-NRCS n.d.). This map unit consists of soils that have been highly altered and can contain fill soil (i.e., imported earthy soil), concrete, asphalt, waste, and mud. They are typically deep, well drained with very high runoff, and have moderate salinity (USDA-NRCS n.d.). In undeveloped areas, where the hydrologic connection to the San Francisco Bay has been impeded, the soil still contains the salinity necessary to produce muted marsh landscape.



Source: USDA-NRCS 2018b

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Figure 3-2 General Soil Map Units in the Aquatic Resource Study Area

3.4.2 Recent Alluvial Fans and Floodplains

This landform lies between the tidal marsh landform and the uplands and mountain slopes landform. Most floodplains and alluvial fans are nearly level to gently sloping surfaces, consisting of alluvium that was deposited more than 12,000 years ago, but in areas adjacent to active stream channels, the alluvium can be much younger. The soils are weakly to moderately developed, with the most mature among them having a subsoil layer of clay accumulation (i.e., an Argillic horizon), such as part of the soils that make up the Botella-Urban land complex (USDA-NRCS n.d.).

3.4.3 Uplands and Mountain Slopes

Most areas of the uplands and mountain slopes in the study area are moderately sloping to steep (between 5 and 75 percent). The soils formed from weathered bedrock or colluvium, are generally well drained, shallow to moderately deep, and weakly to moderately developed. Common soil map units on uplands and mountain slopes in the study area are the Orthents, cut and fill, 15 to 75 percent slopes and Candlestick-Kron-Buriburi complex (USDA-NRCS n.d.). Wetlands are mostly absent on this landform. Typically, only the lower foothills of uplands and mountain slopes are found within the study area, such as along San Bruno Mountain.

3.4.4 Dunes

The dunes landform is very limited in the study area, occurring only in San Francisco. Slopes in this landform are shallow to moderately sloping. The soils formed from eolian (i.e., wind-deposited) sand. They are somewhat excessively drained, very deep, and very weakly developed. The Sirdrak series is the primary soil series in this landform (USDA-NRCS n.d.). Wetlands are very likely absent on this landform.

4 WATERSHED EVALUATION METHODS

A Level 1 Watershed Profile was developed to support an analysis and description of the two HUC-8 watersheds that intersect the project. For each watershed, the profile includes a description of the major aquatic features and associated land uses. In the analysis, land use is a proxy for determining wetland condition to distinguish higher-quality aquatic features from features that are likely degraded. Aquatic features in high-intensity land use types were considered to be degraded based simply on surrounding land uses. Conversely, aquatic features in low-intensity and natural land use types were considered less disturbed. The land uses for each watershed were identified using an existing dataset that was developed by the U.S. Department of the Interior: LANDFIRE (accessed March 12, 2019) (LANDFIRE 2016).

The various land uses were assigned land use intensity in the following categories: (1) relatively undisturbed (natural), (2) low-intensity agriculture, (3) high/moderate-intensity agriculture, and (4) developed (see Figure 4-1). These categories were assigned based on the LANDFIRE data attribute entitled “EVT_GP_N” (Existing Vegetation Type Group Name) as listed below:

High/Moderate-Intensity Agriculture

- Agricultural-Bush fruit and berries
- Agricultural-Close Grown Crop
- Agricultural-Orchard
- Agricultural-Row Crop
- Agricultural-Row Crop-Close Grown Crop
- Agricultural-Vineyard
- Agricultural-Wheat

Low-Intensity Agriculture

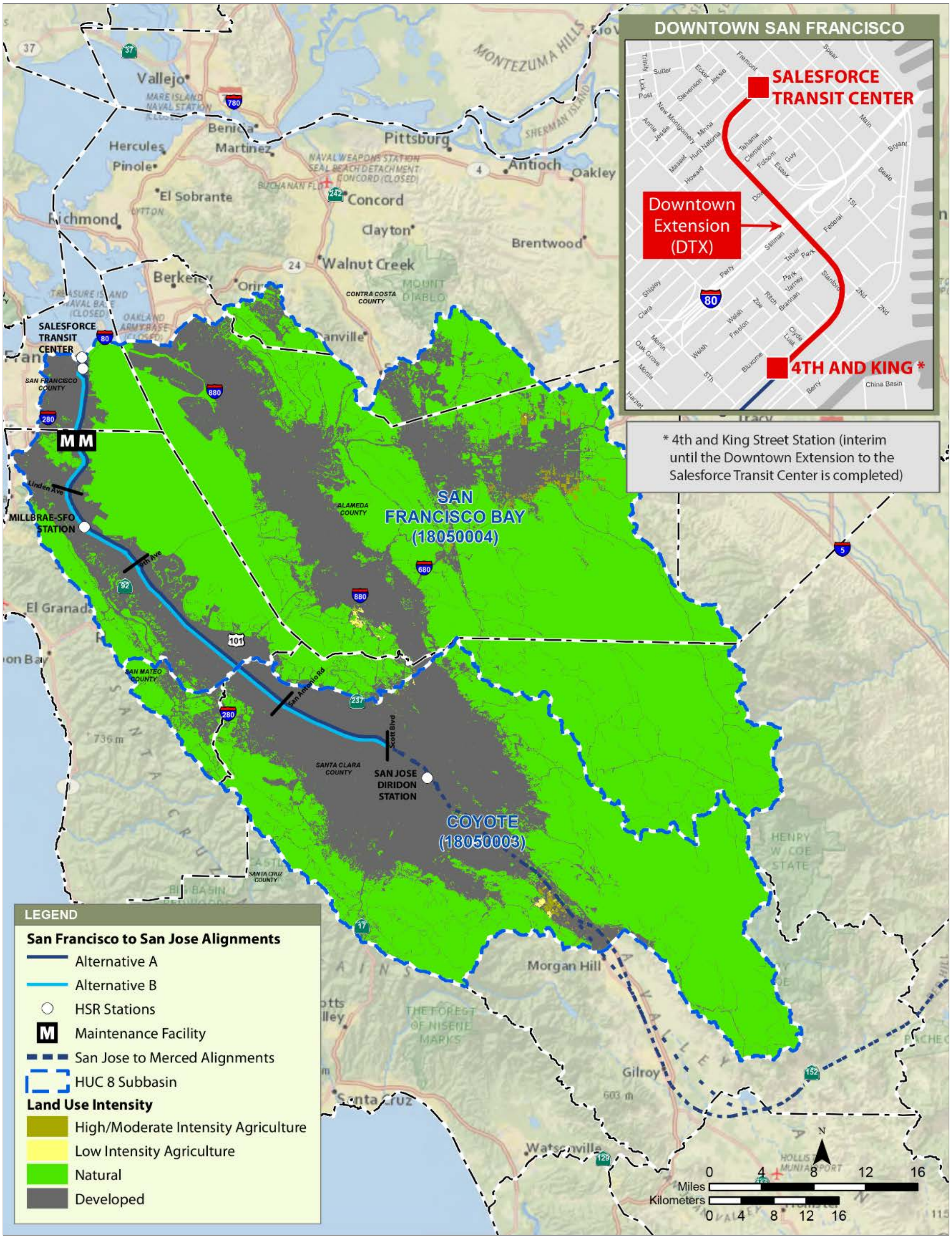
- Agricultural-Fallow/Idle Cropland
- Agricultural-Pasture and Hayland

Developed

- Any features where the group name included ‘Developed’ or ‘Quarries’ in the description

Natural

- All other features (includes barren, chaparral, grasslands, marsh, open water, scrubs, woodlands, and other land uses not classified as developed or agriculture)



Source: LANDFIRE 2016

MAY 2019

Figure 4-1 Landcover Categories

Aquatic features within each watershed were mapped using several available databases that are widely accepted and used for understanding the locations and types of aquatic resources within a given region. Aquatic resources were identified using the following sources:

- The National Wetlands Inventory (USFWS 2011) identifies the approximate location and type of wetlands at the project level. This dataset was used to calculate acreage and map locations of the following wetland types within each watershed:
  - Emergent wetland – herbaceous marsh, fen, swale, or wet meadow
  - Forested/shrub wetland – forested swamp or wetland shrub bog or wetland
  - Freshwater pond – pond
  - Lake – lake or reservoir basin
  - Other wetland – farmed wetland, saline seep, or other miscellaneous wetland
  - Riverine – river or stream channel
- The National Hydrography Dataset (USGS 2016) identifies the approximate locations and types of rivers, streams, canals, and ditches in each watershed. In maps and tables, this dataset is divided into natural features (stream/river) and constructed or altered features (canals/ditches). Results from this dataset were used to calculate linear miles of these feature types.

A combination of the land use and aquatic feature databases was used to provide a profile for each of the watersheds that intersect the project. The Level 1 Watershed Profile lists:

1. The types of aquatic features
2. The extent or amount of each aquatic feature within a watershed
3. The relative condition of the aquatic features within each of the watersheds

Because of the significant variation in topography, soil, vegetation, and land uses in the watersheds crossed by the project, the types, extent, and conditions vary greatly. To provide a more meaningful analysis of the watershed profile as it relates to the project, the watershed profile was divided into ecological sections based on the USDA's ecological subregions (McNab et al. 2007).

Both the types and extent of aquatic features present in each watershed were generated directly from the aquatic feature databases. The extents of some aquatic features are represented as polygons, with units of acres; other features, typically linear features, are represented as line features, with units of miles.

The assessment of the condition of an aquatic feature in a watershed was based on the location of the aquatic feature within a given land use type. The ecological condition of the aquatic feature was categorized as either poor, fair, or good based on the land use type and intensity intersecting the feature. A feature in relatively undisturbed (natural) land was given a condition of good. A feature in a low-intensity agricultural area was considered fair, and a feature in a high-intensity agricultural/developed land area was considered poor. The land use types are as follows:

- Aquatic features in high-intensity land use types (e.g., orchard and vineyard, croplands, urban) are subject to a number of significant human-induced alterations, inputs, and constraints and are typically in poor ecological condition. High-intensity land uses:
  - Provide limited or no buffers to aquatic resources
  - Often control or significantly alter the natural hydrology
  - Have limited wildlife and biological value
  - Often remove the physical structure of aquatic features and often include artificial features

- Aquatic features in low-intensity land use types (e.g., pasture/hayland) are subject to limited human-induced alterations, inputs, and constraints and are typically in fair ecological condition. Low-intensity land uses:
  - Provide some buffers to aquatic resources
  - May mildly to significantly alter the natural hydrology
  - Have some wildlife and biological value
  - Often retain the natural physical structure of aquatic features, though some characteristics may be removed or altered
- Aquatic features in natural land use cover types (e.g., annual grassland, alkali desert scrub, blue oak woodland) are generally subject to minor human-induced alterations, inputs, and constraints and are typically in good ecological condition. Natural land uses:
  - Provide important buffers to aquatic resources
  - Typically have natural or near-natural hydrology, though upstream or downstream land uses may affect aquatic features
  - Have considerable wildlife and biological value
  - Retain natural physical structure, though historical land use practices have reduced or altered some of the natural characteristics

In general, these databases may over- or underestimate the extent of natural aquatic features in urban or agricultural regions; such regions are subject to constant manipulation, and even though the data presented are relatively current, the data may not reflect present-day conditions.

5 CALIFORNIA RAPID ASSESSMENT METHOD

The methodology for conducting CRAM is described in the *California Rapid Assessment Method for Wetlands: User's Manual, Version 6.1* (CWMW 2013a). This section provides details on pre-field preparations, the CRAM team for the Project Section, and field methods and limitations particular to this Project Section.

5.1 Wetland Classification

CRAM uses a wetland classification derived primarily from the functional classification described in the Hydrogeomorphic Method (USACE 1993). The CRAM typology includes five wetland types: riverine wetlands, depressional wetlands, estuarine wetlands, lacustrine wetlands, and slope wetlands. Based on the resources within the study area, riverine wetlands, depressional wetlands, slope wetlands, and estuarine wetlands types and their associated subtypes were used in the CRAM assessment for the project.

The *San Francisco to San Jose Project Section Aquatic Resources Delineation Report* (Authority 2020) described aquatic resource types identified in the study area using the Cowardin system (Section 3.1, Vegetation Communities). This system is similar but not equivalent to the standard CRAM typology. A "crosswalk" was used to standardize the aquatic feature terms to standard wetland classification in accordance with CRAM (Table 5-1).

Table 5-1 Crosswalk of Standard Terms Used for Wetland Condition Assessment

Aquatic Resources Delineation Report	CRAM Type
Constructed basin	Depressional wetlands (subtype: depressional)
Constructed watercourse	Riverine wetlands (subtype: confined and nonconfined riverine)
Freshwater emergent wetland	Depressional wetlands (subtype: depressional) or slope wetlands (channelized wet meadow)
Natural watercourse	Riverine wetlands (subtype: confined and nonconfined riverine) [1]
Open water	Lacustrine wetlands [1]
Seasonal wetland	Depressional wetlands (subtype: depressional) or slope wetlands (channelized wet meadow)
Saline emergent wetland	Estuarine wetlands (subtype: perennial saline)
Scrub/shrub wetland	Riverine wetlands (subtype: confined and nonconfined riverine) or slope wetlands (nonchannelized forested slope)

Source: Authority 2020
CRAM = California Rapid Assessment Method
[1] Not assessed by CRAM because access was not granted.

5.2 California Rapid Assessment Method Team Members

Four trained CRAM practitioners conducted 27 CRAM assessments within the Project Section. The team consisted of ICF biologists R.J. Van Sant, Marissa Maggio, Marty Lewis, and Donna Maniscalco. Linnea Spears-Lebrun (CRAM trainer and task coordinator) conducted the field preparatory work.

5.3 Procedures for Using California Rapid Assessment Method

CRAM evaluates wetlands by scoring four key attributes: buffer and landscape context, hydrology, physical structure, and biotic structure. All CRAM modules assess these four attributes using various metrics and submetrics to address wetland class-specific relationships. In all modules, the CRAM "Index Score," or overall score, is calculated as the average of the four attribute scores. The condition assessment of wetlands for the Project Section used CRAM according to the most recent field books for four modules: riverine (CWMW 2013b), depressional (CWMW 2013c), estuarine (CWMW 2013d), and slope (CWMW 2017).

5.4 Assessment Areas

In CRAM, the conditions attributed to wetland areas in a site or region are based on the conditions sampled in AAs, which are chosen to represent the wetlands within the site or region. The AAs in the study area were identified by the CRAM team and GIS staff in areas without site access constraints, and were reviewed by Linnea Spears-Lebrun, the CRAM task coordinator. The features being assessed were assigned a CRAM wetland type and subtype to determine the CRAM module to be used in the field for each AA. Previously mapped land use and wetland categories were helpful in the assignment of the CRAM wetland type but these exact boundaries were not used in the CRAM assessment. For example, a natural watercourse surrounded by shrub/scrub wetland would have been combined into one riparian CRAM feature and assessed as a whole. Before conducting CRAM fieldwork, a field packet was created for each prospective AA, which included maps at necessary scales that showed a preliminary boundary for each AA, as well as a field book with necessary text and work tables for conducting CRAM.

Figure 5-1 shows the location of all AAs in the study area. Appendix B provides individual maps of the AAs evaluated for this report.

Source: Authority 2019

OCTOBER 2019

Figure 5-1 CRAM Assessment Area Locations

5.5 Sample Size

The 2009 Technical Bulletin *Using CRAM to Assess Wetlands Projects* (CWMW 2009) describes the process for establishing a project-based sampling protocol to (1) establish a separate map of the study area showing all the aquatic features of each wetland type (i.e., the sample frame for that type), (2) identify possible AAs within each sample frame for the study area, and (3) sample a subset of AAs. To confirm that the sample size accurately describes the real variation in condition in each sample frame, the Technical Bulletin states that one AA should be randomly selected and compared to the average index score of the other AAs. If the randomly selected AA's index score differs from the average index score of the other AAs by more than 10 CRAM points, additional samples should be added and the process repeated until the difference is less than 10 CRAM points.

The sample frames (the set of wetlands of each type from which the sample of AAs is drawn) for the study area were determined by the locations of aquatic features of each wetland type that intersected with the footprints of the two project alternatives. However, the total number of possible wetland features to include in the CRAM analysis was restricted by the properties with permission to enter (PTE). It is an unavoidable consequence of the arrangement of aquatic features that the combination of proximity and property access limited the locations and numbers of AAs that could be sampled.

5.6 Field Assessment

The field team conducted CRAM assessments for the project alternatives September 9 through September 12, 2019. This timing corresponds to the appropriate assessment window for riverine, depressional, estuarine and slope wetlands.

As required by CRAM, the field team modified AA boundaries during fieldwork to better capture the conditions present in the AAs at the time of the assessment. For example, AA11 was adjusted in the field to remove upland areas, which are not a suitable habitat type for CRAM assessments. Additionally, some AAs were shifted during the field investigations to more appropriate locations that better represented the target wetlands. For example, AA19 and AA20 were shifted to correctly align with the ephemeral drainage. The revisions to AA boundaries made in the field were used by the GIS analysts to update the CRAM maps. The results and maps provided in this report reflect the AAs and field conditions identified by the field team at the time that CRAM fieldwork was conducted.

The final CRAM score for each AA consists of four main attribute scores (buffer and landscape context, hydrology, physical structure, and biotic structure), which are based on the metric and submetric scores (i.e., measurable components of an attribute) (Table 5-2). CRAM practitioners assign a letter rating (A–D) for each metric/submetric based on a defined set of condition brackets ranging from an “A,” representing the theoretical best case achievable for the wetland class across California, to a “D,” representing the worst case achievable. Each metric/submetric condition level (A–D) has a fixed numerical value (A=12, B=9, C=6, D=3), which, when combined with the other metrics, results in a score for each attribute. That number is then converted to a percentage of the maximum score achievable for each attribute and represents the final attribute score, which can range from 25 to 100 percent. The final overall CRAM score is the sum of the four final attribute scores and can range from 25 to 100 percent. The final score can then be categorized as poor (25–50), fair (51–75), and good (76–100).

Table 5-2 CRAM Attributes and Metrics

<table>
<tr><th colspan="2">Attributes</th><th>Metrics and Submetrics</th></tr>
<tr><td colspan="2" rowspan="5">Buffer and Landscape Context</td><td>Aquatic Area Abundance</td></tr>
<tr><td>Buffer:</td></tr>
<tr><td>Percent of Assessment Area with Buffer</td></tr>
<tr><td>Average Buffer Width</td></tr>
<tr><td>Buffer Condition</td></tr>
<tr><td colspan="2" rowspan="3">Hydrology</td><td>Water Source</td></tr>
<tr><td>Hydroperiod</td></tr>
<tr><td>Hydrologic Connectivity</td></tr>
<tr><td rowspan="8">Structure</td><td rowspan="2">Physical</td><td>Structural Patch Richness</td></tr>
<tr><td>Topographic Complexity</td></tr>
<tr><td rowspan="6">Biotic</td><td>Plant Community Composition:</td></tr>
<tr><td>Number of Plant Layers</td></tr>
<tr><td>Number of Codominant Species</td></tr>
<tr><td>Percent Invasion</td></tr>
<tr><td>Horizontal Interspersion and Zonation</td></tr>
<tr><td>Vertical Biotic Structure</td></tr>
</table>

CRAM = California Rapid Assessment Method

In addition to calculating attribute and overall CRAM index scores, CRAM includes a stressor checklist. A *stressor* is defined in the CRAM User's Manual as "the consequence of anthropogenic events or actions that measurably affect conditions in the field" (CWMW 2013a). The stressor checklist can be used to explain low CRAM scores by identifying specific human-caused impacts on the landscape, hydrology, or physical or biotic structure of an AA. Some examples of stressors are point source discharge, flow diversions or unnatural inflow, dikes/levees, grading/compaction, excessive runoff from watershed, trash or refuse, mowing/grazing, excessive human visitation, urban residential areas, intensive row-crop agriculture, and transportation corridors. In some cases, a single stressor may be the primary cause of low-scoring conditions, though conditions are usually caused by interactions among multiple stressors (CWMW 2013a)). The stressor checklist was completed for each AA assessed.

5.7 Field Conditions and Limitations

All AAs identified for assessment were assessed in the field. No issues of access or safety arose in the field. Table 5-3 shows the number of AAs assessed in each wetland type.

Table 5-3 Numbers of Assessment Areas by Wetland Type

Aquatic Resources Delineation Report Type	CRAM Type	Number of Assessment Areas
Constructed basin	Depressional wetlands—constructed	9
Freshwater pond, freshwater marsh	Depressional wetlands—natural	2
Constructed watercourse, mixed riparian	Riverine wetlands—constructed	11
Saline emergent wetland	Estuarine wetlands—perennial	2
Freshwater marsh/seasonal wetland	Slope wetlands (subtype: channeled wet meadow)	2
Scrub/shrub wetland	Slope wetlands (subtype: nonchanneled forested slope)	1
Total		**27**

5.8 Post-Field Data Evaluation

After completion of the fieldwork, a CRAM team member entered the scores for each attribute into an Excel spreadsheet and then the CRAM coordinator reviewed them. Team members compared the spreadsheet with the field data forms for quality assurance purposes (i.e., to identify and correct any potential data entry and computational errors). The Excel spreadsheet provides the basis for this summary report. The spreadsheet and the original field data forms are provided as Appendices C and D, respectively. Additionally, Appendix B provides AA boundary maps and Appendix E provides site photographs of each AA.

5.9 Extrapolation Methodology

Data from the 27 surveyed sites were used to extrapolate the evaluations of surveyed sites to all wetlands within the footprint (impact area) of the project alternatives (Table 5-3). CRAM index scores for the wetland types assessed in the study area were analyzed for obvious breaks in the data. CRAM scores for depressional features displayed a difference between natural and constructed features (as might be expected), with natural features scoring an average of 51 and constructed features scoring an average of 45. In addition, constructed wetlands (whether depressional or riverine) scored lower on average than non-constructed wetlands, with the lowest scoring wetland types being constructed watercourse and constructed basin. Constructed watercourses scored the lowest among all the wetland types, not surprisingly since the majority of the watercourses were earthen ditches immediately adjacent to the project alignment and existing Caltrain tracks. Analysts further reviewed data for each wetland type to note any distinct breaks that would justify multiple condition classes (i.e., low, medium, and high). Mostly likely due to the small sample size, no distinct condition classes were identified. Therefore, the average CRAM scores were used for extrapolation, as described in the following paragraphs.

The average CRAM score was used for constructed watercourses and constructed basins. While it was assumed that there were only two constructed basins based on the land cover mapping, most freshwater emergent marsh in the Caltrain alignment were actually constructed basins, therefore those features mapped as freshwater emergent marsh that were not directly assessed received the average constructed basin CRAM score.

No natural watercourse features were directly assessed because of access limitations. Therefore, the average natural watercourse CRAM score (70) for the San Jose to Merced Project Section was used to extrapolate to the natural watercourses in the current study area. Because the San Jose to Merced Project Section is geographically adjacent to the current study area, the natural watercourse features of the San Francisco to San Jose Project Section are expected to be of similar condition.

Saline emergent wetland features not directly assessed received the average CRAM score of the saline emergent wetland features that were assessed. Those features mapped as scrub/shrub wetlands were found to be constructed basins within the Caltrain alignment, so all remaining scrub/shrub wetland features not directly assessed received the average CRAM score for constructed basins.

6 RESULTS OF WATERSHED EVALUATION AND CALIFORNIA RAPID ASSESSMENT METHOD ANALYSIS

6.1 Level 1 Watershed Profile

The Project Section is associated with two basin/subbasin units—Coyote watershed (HUC-8 code 18050003) and San Francisco Bay watershed (HUC-8 code 18050004) (shown on Figure 3-1). Figure 4-1 displays the four categories of land use intensity throughout the two watersheds.

As shown in Table 6-1, both watersheds are more than half natural land and have very little agriculture. The larger of the two watersheds, the San Francisco Bay watershed, has the largest percentage of natural lands. In contrast, the smaller of the watersheds, Coyote watershed, has the largest percentage of developed land.

Table 6-1 Land Use Intensity by Watershed

Land Use Intensity	Coyote Watershed		San Francisco Bay Watershed	
	Area (acres)	Percent of Watershed	Area (acres)	Percent of Watershed
Developed	196,587.67	42.65	263,545.89	30.89
High/moderate-intensity agriculture	1,189.46	0.26	2,331.02	0.27
Low-intensity agriculture	416.04	0.09	584.95	0.07
Natural	262,778.06	57.01	586,681.60	68.77
Total	**460,971.23**	**N/A**	**853,143.47**	**N/A**

Sources: USGS 2016; LANDFIRE 2016
N/A = Not applicable

Tables in Appendix A detail aquatic features (stream type, waterbody type, and wetland type, respectively) by watershed and land use intensity. The miles of stream length in each watershed reflects the size of the watershed. Coyote watershed has fewer stream miles while San Francisco Bay watershed has more stream miles. The types of land use surrounding the streams follows the pattern of the overall watershed with San Francisco Bay having a greater percentage of streams of all types in natural land use, and Coyote having the greatest percentage of all stream types in developed land use. A great majority (77 to 85 percent) of both waterbodies and wetlands of all types are found in natural land use in the two watersheds. Individual stream and waterbodies by land use type are included in Appendix A.

6.1.1 Coyote Watershed

The Coyote watershed encompasses approximately 460,971 acres. This watershed has a larger percentage of developed land of the two watersheds. Similarly, Coyote watershed has a larger percentage of streams, waterbodies, and wetlands within developed land uses compared to the San Francisco Bay watershed.

The principle streams are Coyote Creek, the Guadalupe River, Los Gatos Creek, Saratoga Creek, and Steven Creek. Major lakes and reservoirs are Anderson Lake, Coyote Lake, Calero Reservoir, and Lexington Reservoir. Table 1 and Table 3 in Appendix A show details of the linear features (rivers and streams) and waterbodies (lakes and ponds) in the Coyote watershed, respectively.

Using land use intensity as the main indicator, 65 to 83 percent of each type of aquatic resource within the Coyote watershed are in a relatively undisturbed (natural) condition (Table 6-2). Land use intensity also indicates that the main anthropogenic impact on aquatic resources in this watershed is development with almost all of the remaining aquatic resources classified as developed (approximately 17 to 34 percent). Land use intensity of aquatic resources by ecological subregion is shown in Table 6-3. See Tables 1, 3, and 5 in Appendix A for additional details.

Table 6-2 Percentage of Land Use Intensity in Coyote Watershed by Aquatic Resource Type

Land Use Intensity	Streams/Rivers	Waterbodies	Wetlands
Developed	34.37%	16.62%	29.28%
High/moderate-intensity agriculture	0.16%	0.17%	0.33%
Low-intensity agriculture	0.11%	0.07%	0.14%
Natural	65.36%	83.03%	70.25%

Sources: LANDFIRE 2016; USGS 2016; USFWS 2011

Table 6-3 Land Use Intensity of Aquatic Resources in Coyote Watershed by Ecological Subregion

Ecological Subregion	Land Use Intensity	Streams/Rivers (miles)	Waterbodies (acres)	Wetlands (acres)
Diablo Range	Developed	0.35	–	1.93
	High/moderate-intensity agriculture	–	–	–
	Low-intensity agriculture	–	–	–
	Natural	45.81	2.28	134.83
	Subtotal	*46.16*	*2.28*	*136.77*
East Bay Terraces and Alluvium	Developed	38.48	71.65	405.18
	High/moderate-intensity agriculture	0.03	3.19	15.07
	Low-intensity agriculture	0.06	0.46	7.60
	Natural	1.07	20.76	87.23
	Subtotal	*39.64*	*96.06*	*515.08*
Fremont-Livermore Hills and Valleys	Developed	49.91	134.23	304.75
	High/moderate-intensity agriculture	0.01	–	0.04
	Low-intensity agriculture	–	–	0.01
	Natural	151.46	1,536.85	2,250.93
	Subtotal	*201.38*	*1,671.08*	*2,555.74*
Leeward Hills	Developed	78.71	91.42	307.64
	High/moderate-intensity agriculture	0.41	1.96	3.20
	Low-intensity agriculture	0.28	1.49	1.83
	Natural	158.60	611.97	1003.17
	Subtotal	*237.99*	*706.84*	*1,315.83*

Ecological Subregion	Land Use Intensity	Streams/Rivers (miles)	Waterbodies (acres)	Wetlands (acres)
Santa Clara Valley	Developed	237.60	251.77	1,206.17
	High/moderate-intensity agriculture	1.47	1.21	5.53
	Low-intensity agriculture	1.14	0.79	2.79
	Natural	22.12	335.64	515.16
	Subtotal	*262.33*	*589.41*	*1,729.65*
Santa Cruz Mountains	Developed	39.86	55.28	247.44
	High/moderate-intensity agriculture	0.02	–	0.001
	Low-intensity agriculture	–	–	–
	Natural	170.48	415.47	951.44
	Subtotal	*210.36*	470.74	*1,198.88*
Western Diablo Range	Developed	11.59	15.82	64.62
	High/moderate-intensity agriculture	0.20	0.0001	4.73
	Low-intensity agriculture	0.01	–	0.001
	Natural	318.51	156.58	1,144.90
	Subtotal	*330.30*	*172.41*	*1,214.25*
Coyote Watershed Total		**1,328.15**	**3,708.82**	**8,666.20**

Sources: LANDFIRE 2016; McNab et al.2007; USGS 2016; USFWS 2011

6.1.2 San Francisco Bay Watershed

The San Francisco Bay watershed encompasses approximately 853,143 acres. San Francisco Bay watershed has a large percentage of natural lands and minimal agricultural land.

The principle streams in the San Francisco Bay watershed are Alameda Creek, Isabel Creek, San Antonio Creek, and Arroyo Valle Creek. Major lakes and reservoirs are Lake del Valle, Calaveras Reservoir, and San Antonio Reservoir. In Appendix A, Tables 2 and 4 show details of the linear features (rivers and streams) and waterbodies (lakes and ponds) within the San Francisco Bay watershed, respectively.

Using land use intensity as the main indicator, aquatic resources within the San Francisco Bay watershed are approximately 68 to 89 percent natural (Table 6-4). Land use intensity also indicates that the main anthropogenic impact on aquatic resources in this watershed is development with approximately 11 to 32 percent of the aquatic resources classified as developed. High/moderate intensity agriculture represents approximately 0.2 and 0.08 percent of aquatic resources, with the remaining 0.02 to 0.08 percent classified as low-intensity agriculture. Land use intensity of aquatic resources by ecological subregion is included in Table 6-5. See Tables 2, 4, and 6 in Appendix A for additional details.

Table 6-4 Percentage of Land Use Intensity in San Francisco Bay Watershed by Aquatic Resource Type

Land Use Intensity	Streams/Rivers	Waterbodies	Wetlands
Developed	31.62%	11.14%	15.76%
High/moderate intensity agriculture	0.21%	0.08%	0.08%
Low intensity agriculture	0.08%	0.02%	0.10%
Natural	68.09%	88.77%	84.05%

Sources: LANDFIRE 2016; USGS 2016; USFWS 2011

Table 6-5 Land Use Intensity of Aquatic Resources in San Francisco Bay Watershed by Ecological Subregion

Ecological Subregion	Land Use Intensity	Streams/Rivers (miles)	Waterbodies (acres)	Wetlands (acres)
Diablo Range	Developed	12.89	8.84	55.03
	High/moderate-intensity agriculture	0.01	0.09	0.06
	Low-intensity agriculture	–	–	–
	Natural	351.61	169.24	1,374.79
	Subtotal	*364.52*	*178.17*	*1,429.88*
East Bay Hills-Mt. Diablo	Developed	94.84	109.37	463.50
	High/moderate-intensity agriculture	0.28	6.75	7.16
	Low-intensity agriculture	0.01	–	0.15
	Natural	270.13	1,093.64	2,394.10
	Subtotal	*365.26*	*1,209.76*	*2,864.91*
East Bay Terraces and Alluvium	Developed	320.84	3,169.45	6,204.14
	High/moderate-intensity agriculture	0.28	3.26	17.35
	Low-intensity agriculture	1.57	7.83	59.88
	Natural	299.74	29,238.89	3,6278.40
	Subtotal	*622.43*	*32,419.42*	*4,2559.77*
Eastern Hills	Developed	13.55	2.24	69.19
	High/moderate-intensity agriculture	0.25	0.12	1.19
	Low-intensity agriculture	0.02	0.15	0.21
	Natural	32.82	25.94	151.89
	Subtotal	*46.64*	*28.45*	*222.48*
Fremont-Livermore Hills and Valleys	Developed	212.66	907.14	1,543.04
	High/moderate-intensity agriculture	4.05	2.87	16.69
	Low-intensity agriculture	0.39	–	1.14
	Natural	367.89	3,014.07	4,313.59
	Subtotal	*584.99*	*3,924.07*	*5,874.47*

Ecological Subregion	Land Use Intensity	Streams/Rivers (miles)	Waterbodies (acres)	Wetlands (acres)
Leeward Hills	Developed	71.79	55.11	425.48
	High/moderate-intensity agriculture	0.02	–	0.14
	Low-intensity agriculture	0.02	–	0.05
	Natural	17.27	130.75	832.59
	Subtotal	*89.11*	*185.86*	*1,258.26*
Santa Clara Valley	Developed	55.05	146.17	382.52
	High/moderate-intensity agriculture	–	–	–
	Low-intensity agriculture	–	–	–
	Natural	7.59	101.88	466.39
	Subtotal	*62.64*	*248.05*	848.91
Santa Cruz Mountains	Developed	8.66	64.58	124.19
	High/moderate-intensity agriculture	0.13	1.11	2.07
	Low-intensity agriculture	–	–	–
	Natural	53.32	1,636.05	2,187.80
	Subtotal	*62.11*	*1,701.74*	*2,314.06*
Western Diablo Range	Developed	6.65	98.20	51.12
	High/moderate-intensity agriculture	0.24	17.43	3.92
	Low-intensity agriculture	–	–	–
	Natural	315.93	941.37	1,689.89
	Subtotal	*322.82*	*1,057.00*	*1,744.93*
San Francisco Watershed Total		**2520.51**	**40,952.53**	**59,117.67**

Sources: LANDFIRE 2016; McNab et al. 2007; USGS 2016; USFWS 2011

While vernal pools are not located within the study area they are found in the San Francisco Watershed. Vernal pools are a type of seasonal wetland characterized by annual forbs and grasses. Vernal pools occur as depressions in soils with a very slowly permeable layer that causes a shallow perched water table to form, which fills the depression, and gradually evaporates in the spring and summer until the pool is completely dry.

Table 6-6 provides the acreage of vernal pool complexes present within the watershed by categories based on vernal pool cover, density, diversity, and amount of large pools. The San Francisco Bay vernal pool complexes occur within two ecological subsections: Eastern Hills and Fremont-Livermore Hills and Valleys. Holland vernal pool complex data shown in Table 6-6 includes areas of high vernal pool density across the landscape and do not represent the acres of vernal pool wetland polygons. There are a variety of vernal pool resources in the San Francisco Bay watershed ranging from individual pools to complexes of varying densities and diversity, some with large pools present.

Table 6-6 Vernal Pool Complexes in the San Francisco Bay Watershed

Vernal Pool Type	Vernal Pool Percent Cover	Vernal Pool Density	Vernal Pool Diversity	Amount of Large Pools	Area within Watershed (acres)
Vernal pool matrix	<2% cover vernal pools	Low	Low	>1 per 640 acres	198.86
				None in polygon	211.64
	<2% cover vernal pools subtotal				*410.50*
	>10% cover vernal pools	Med	Med	4+ per 640 acres	132.76
	>10% cover vernal pools Subtotal				*132.76*
	2–5% cover vernal pools	Low	Low	>1 per 640 acres	262.72
				None in polygon	33.96
		Med	High	1-3 per 640 acres	188.64
			Med	None in polygon	651.05
	2–5% cover vernal pools Subtotal				*1,136.37*
Grand Total					**1,679.63**

Source: USFWS 2014

6.2 Level 2 California Rapid Assessment Method Scores

6.2.1 Depressional Wetlands

Constructed basins, freshwater marsh, and freshwater pond were the wetland types assessed using the depressional wetland module. Ten constructed depressions and one natural depression were evaluated. There was no discernable difference in score between the constructed and natural depressions; the overall score was within 1 point. However, because only one natural depression was assessed, it is difficult to make any comparisons of constructed and natural depressions. Figure 6-1 shows the average CRAM index scores and attribute scores for constructed depressions and natural depressions evaluated using the depressional wetland module.

The majority of the depressional wetlands sampled were adjacent to existing rail tracks and, therefore, scored low in the buffer and landscape context attributes. The second lowest scoring category was the physical structure category, which includes structure patch richness and topographic complexity. Because most of the depressions are constructed it is not surprising scores were low for this attribute.

The constructed basins surveyed were generally near existing tracks and the one natural depression was just east of a rail track but far enough away that the effect of the existing tracks on the AA was less than on most of the constructed depressions. Because the natural depression was also farther away from other development, it scored higher than the constructed depressions regarding the buffer and landscape context. Overall, the depressional wetlands scored in the poor category (25–50 overall score).

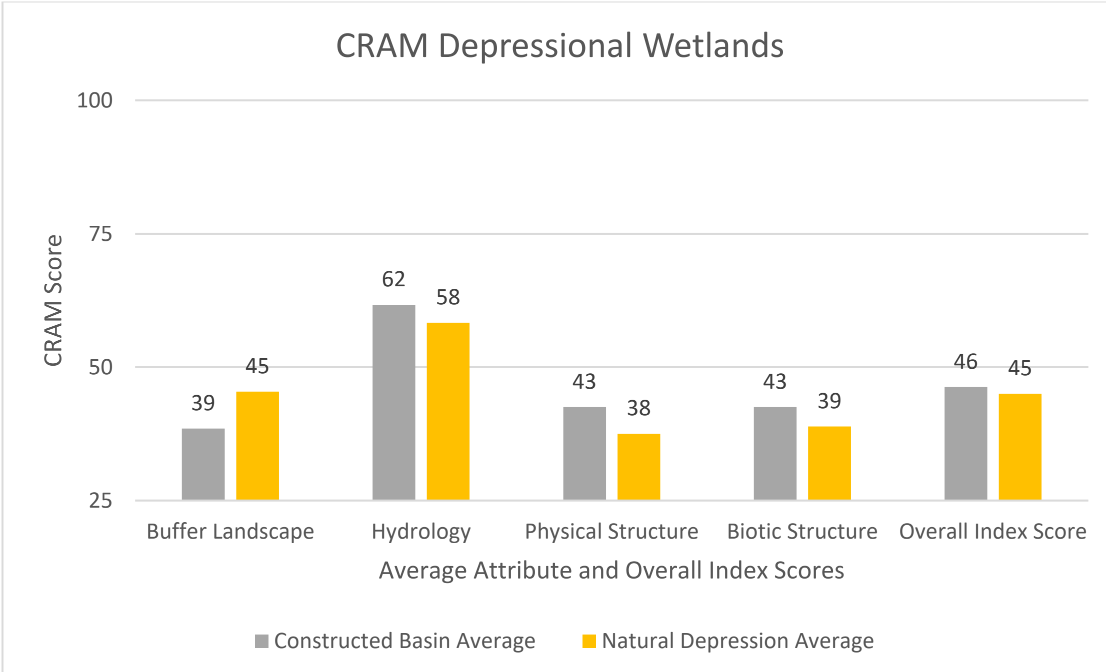


Figure 6-1 Average Attribute and Overall Index Scores for Depressional Wetland Assessment Areas

6.2.2 Riverine Wetlands

The CRAM team evaluated 11 AAs using the riverine module for a single wetland type: constructed watercourses. No natural watercourses were evaluated because PTE access was not granted by property owners and therefore the CRAM team could not access these features Buffer and landscape context scored fairly low, which was expected given the majority of the AAs were drainage ditches adjacent to an existing railroad track. The hydrology attribute scored the highest among all the attributes, partially because some of the channels were lined with concrete and thus scored well for channel stability. In addition, many of the channels were not entrenched and scored well for hydrologic connectivity. Physical structure and biotic structure scored low because of little vegetation and minimal riverine physical processes occurring. Overall, the riverine wetlands scored in the poor category (25–50 overall score). Figure 6-2 shows the average CRAM index scores and attribute scores for constructed riverine wetlands evaluated using the riverine wetland module.

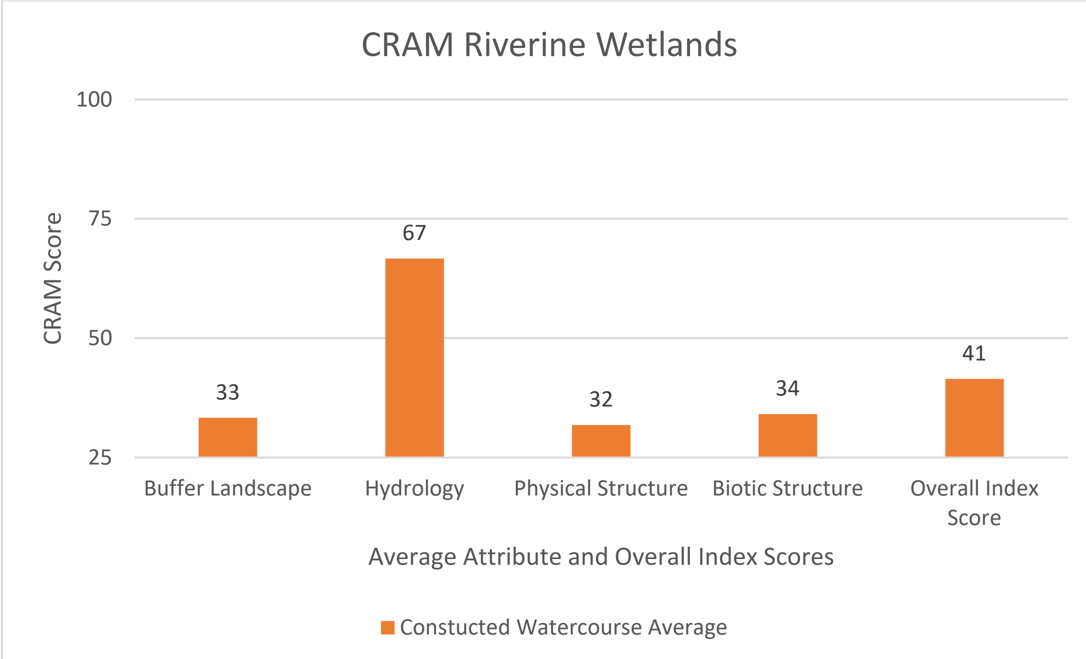


Figure 6-2 Average Attribute and Overall Index Scores for Riverine Wetland Assessment Areas

6.2.3 Slope Wetlands

The CRAM team evaluated two land cover types: freshwater marsh/seasonal wetland and scrub/shrub wetland with the slope wetland module. Two AAs were completed within the freshwater marsh/seasonal wetland land cover and used the slope subtype, channeled wet meadow module and one AA was completed within the scrub/shrub wetland land cover and used the slope subtype, forested module. Slope wetlands are a broad category of groundwater-dominated wetlands in which groundwater may emerge into the root zone or across the ground surface seasonally or perennially, but they are mainly inundated by surface water and have unidirectional flow (CWMW 2017).

Slope wetlands can resemble depressional wetlands in aerial imagery, but no distinct topographic low is present. Channeled wet meadows often have a zone of woody riparian vegetation such as willow or alder species, which other meadows may not have. They also have more complex topography than nonchanneled wet meadows because of the variation in elevation from channels, floodplain benches, oxbows, natural levees, or other riverine features. These types of meadows are sometimes called "riparian meadows" because they occur along streams or rivers. Forested slope wetlands do not contain a stream or river channel, are dominated by groundwater throughflow or surface water sheet flow, and have greater than 30 percent woody vegetation cover.

The channeled wet meadows scored higher in the buffer and landscape attribute and hydrology attribute but lower in the biotic attribute than the forested slope wetland. The scores were identical in the physical structure attribute. The slope wet meadow had a higher overall CRAM score than the forested slope wetland; however, because only three AAs were assessed it is difficult to make any definitive comparisons. Overall the slope wetlands scored in the fair category (51–75 overall score). Figure 6-3 shows the average CRAM index scores and attribute scores for channeled wet meadow and forested wetlands evaluated using the slope wetland module.

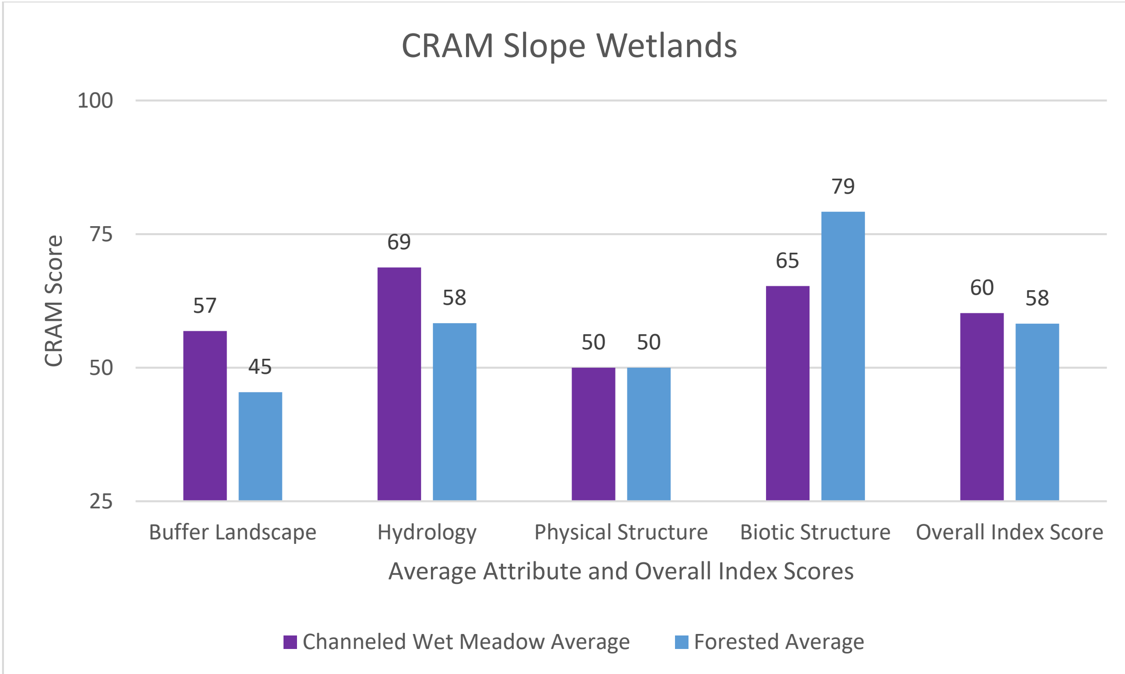


Figure 6-3 Average Attribute and Overall Index Scores for Slope Wetland Assessment Areas

6.2.4 Perennial Estuarine Wetlands

The CRAM team evaluated two AAs using the perennial estuarine wetland module. One AA was a distinct tidal channel (AA13) surrounded by upland areas and the other was a saline emergent marsh. The saline emergent marsh scored higher in all attribute categories, primarily because the tidal channel AA was located within and adjacent to a former landfill and the saline emergent marsh was in a more natural and undisturbed state. The estuarine wetlands scored well in the hydrology attribute, particularly in the hydroperiod metric due to a relatively natural tidal prism, but scored poorly in the buffer landscape attributes due to the small buffer width and poor buffer condition. Overall, the perennial estuarine wetlands scored in the fair category (51–75 overall score). Figure 6-4 shows the average CRAM index scores and attribute scores for estuarine wetlands evaluated using the perennial estuarine wetland module.

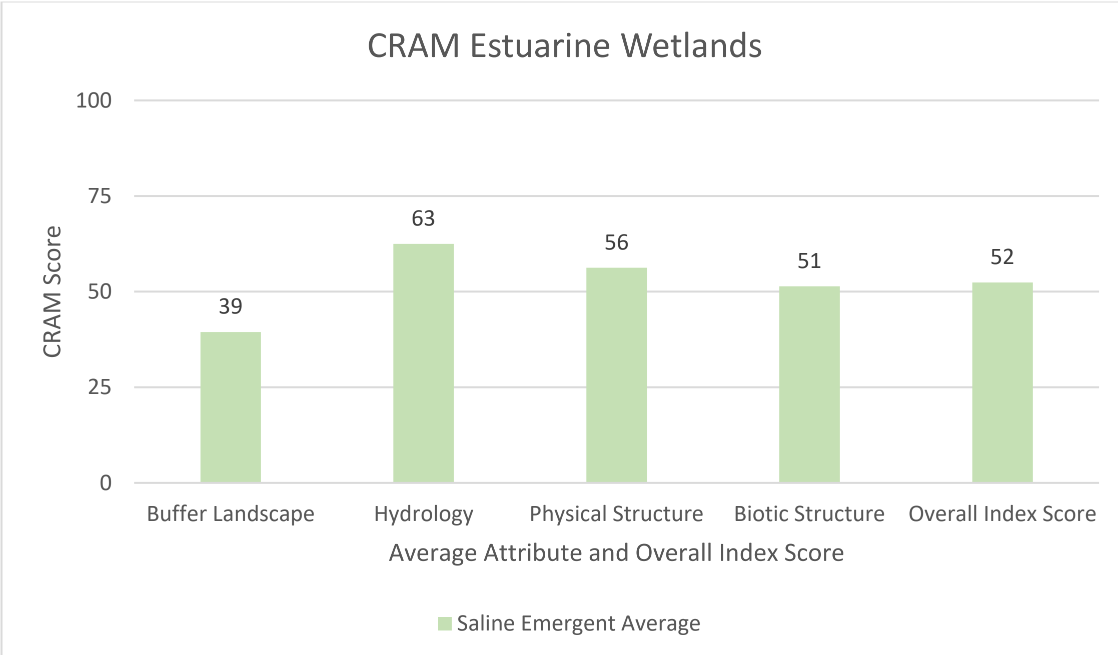


Figure 6-4 Average Attribute and Overall Index Scores for Perennial Estuarine Wetland Assessment Areas

6.2.5 Stressors

Constructed watercourse wetlands had the highest average number of stressors (16) of any of the wetland types (Table 6-7). The remaining wetland types were similar in the number of stressors. The most common type of stressors observed were physical stressors such as excessive runoff from the watershed, nutrient impaired, pesticides, bacteria and pathogens, and trash. Buffer and landscape stressors such as urban residential, industrial/commercial and transportation corridor stressors were also common. The high occurrence of stressors was not unexpected given the development (urban and commercial/industrial) in the study area, and the stressor evaluation further supports the observations of overall fair to poor scores for all wetland types.

Table 6-7 Stressors Observed by CRAM Wetland Type

CRAM Wetland Type	Average Number of Stressors	Attribute Stressors			
		Buffer and Landscape Stressors	Hydrology Stressors	Physical Stressors	Biotic Stressors
Depressional—constructed basin	10.2	2.11	1	5	2
Depressional—natural	9	2	1	5	1
Riverine—constructed watercourse	16.09	3.09	1	7	5
Estuarine	10.5	2.5	2	5	1
Wet meadow slope	12	2	2	6	2
Forested slope	12	2	2	6	2

CRAM = California Rapid Assessment Method

6.3 Sample Size

After surveying was complete, a sample size analysis, as described in Section 5.5, Sample Size, was performed for each wetland type with more than three surveyed AAs to determine if the sample size was adequate to describe the aquatic resources. One AA was selected from each wetland type using a random number generator. The overall CRAM score of the selected AA was compared to the average overall score of the remaining AAs in that wetland type. Only constructed watercourses and constructed basin features had more than three AAs; for these wetland types analysts could perform a sample size analysis. The randomly chosen AA differed by fewer than 10 points from the average overall CRAM score of the remaining AAs for constructed watercourses. These results indicate that although sampling was limited by access, an adequate sampling was achieved to capture the variability in wetland condition for constructed watercourses within the study area.

For constructed basins, the randomly chosen AA differed by more than 10 points from the average overall CRAM score of the remaining AAs. This result indicates that more samples would be needed to ensure that the variability in wetland condition for constructed basins is captured.

Sample size analysis could not be performed for natural depression, slope wet meadow, forested slope, or perennial estuarine CRAM wetland types because their sample sizes were fewer than three AAs. The low sample size was due to lack of access to these features as the total number of possible wetland features to include in the CRAM analysis was restricted by the properties with PTE. It is an unavoidable consequence of the arrangement of aquatic features that the combination of proximity and property access limited the locations and numbers of AAs that could be sampled.

7 SUMMARY BY ALTERNATIVE

Tables 7-1 and 7-2 show the CRAM results for each of the project alternatives: wetland type, the number of times a wetland type is intersected by an alternative, the number of features that were directly surveyed (assessed with CRAM), the number of features that have been assigned extrapolated CRAM scores, and the average CRAM score for each wetland type, as well as totals in each category. Alternative A has a slightly lower average overall CRAM score (46) compared to Alternative B (48). This indicates that Alternative A has wetland features with a slightly poorer wetland condition than Alternative B.

Alternative A has fewer intersections (74) than Alterative B (81). This summary does not take into account acreage, but rather the number of interactions between the project alternative and the existing wetland features in the study area. Alternative A would also result in fewer intersections with higher-scoring wetland features, as Alternative A (46) has a lower average overall CRAM score than Alternative B (48).

Table 7-1 Summary of CRAM Results for Alternative A

Wetland Type	Intersected Features			Average CRAM Score
	Surveyed	Extrapolated	Total	
Constructed basin	10	11	21	46
Constructed watercourse	11	28	38	41
Natural watercourse	0	7	7	70
Saline emergent wetland	2	5	7	46
TOTAL	**22**	**52**	**74**	**46**

CRAM = California Rapid Assessment Method

Table 7-2 Summary of CRAM Results for Alternative B

Wetland Type	Intersected Features			Average CRAM Score
	Surveyed	Extrapolated	Total	
Constructed basin	5	12	17	47
Constructed watercourse	11	32	43	41
Freshwater emergent wetland	4	0	4	56
Natural watercourse	0	11	11	70
Saline emergent wetland	1	5	6	53
TOTAL	**21**	**60**	**81**	**48**

CRAM = California Rapid Assessment Method

8 NET WATERSHED CONDITION

This chapter discusses the waters present in each watershed and how the CRAM analysis and stressors characterize aquatic resources across the watersheds. The CRAM scores reported in Chapter 7 provide a snapshot of watershed conditions in the study area. The waters present in each watershed and land use intensity are discussed in Section 6.1, Level 1 Watershed Profile.

8.1.1 Coyote Watershed

Waters in the Coyote watershed are within land uses that are approximately 57 percent natural, 43 percent developed, and 0.35 percent agricultural (0.26 percent high intensity and 0.09 percent low intensity). As Table 8-1 shows, predominant streams in the Coyote watershed are ephemeral streams within natural land uses, predominant waterbodies are perennial lakes and ponds within natural land uses, and predominant wetlands are lakes within natural land uses.

Table 8-1 Summary of Waters and Land Uses in the Coyote Watershed

Wetland/Water Category	Wetland/Water Type	Land Use				Total
		Developed	High/Moderate-Intensity Agriculture	Low-Intensity Agriculture	Natural	
Streams (miles)	Artificial path	26.54	0.09	0.11	40.61	67.35
	Canal ditch	55.03	1.01	1.26	13.32	70.61
	Connector	10.56	0.07	–	1.34	11.97
	Ephemeral stream	89.53	0.40	0.05	506.03	596.01
	Intermittent stream	178.15	–	–	121.52	299.68
	Perennial stream	70.73	0.57	0.06	183.17	254.52
	Streams total	*430.54*	*2.14*	*1.48*	*865.99*	*1,300.14*
Waterbodies (acres)	Intermittent lake/pond	53.14	–	–	66.80	119.94
	Perennial lake/pond[1]	469.63	3.16	2.29	2,988.50	3,463.58
	Reservoir	13.51	–	–	0.38	13.89
	Nonearthen reservoir[2]	28.29	–	–	0.45	28.74
	Evaporator reservoir	6.73	–	–	1.84	8.57
	Treatment reservoir	35.86	3.19	0.45	14.06	53.57
	Swamp/marsh	13.00	–	–	7.53	20.53
	Waterbodies total	*620.16*	*6.35*	*2.74*	*3,079.56*	*3,708.82*

Wetland/Water Category	Wetland/Water Type	Land Use: Developed	Land Use: High/Moderate-Intensity Agriculture	Land Use: Low-Intensity Agriculture	Land Use: Natural	Total
Wetland (acres)	Estuarine and marine deepwater	5.38	–	–	0.76	6.14
	Estuarine and marine wetland	95.57	–	0.17	16.27	112.01
	Freshwater emergent wetland	263.06	5.88	0.29	364.59	633.82
	Freshwater forested/ shrub wetland	651.12	1.52	0.10	642.66	1,295.40
	Freshwater pond	411.21	16.32	7.64	477.69	912.86
	Lake	251.98	2.31	1.50	2,785.12	3,040.91
	Other	33.27	–	–	25.57	58.84
	Riverine	826.13	2.55	2.53	1,774.99	2,606.21
	Wetlands total	*2537.72*	28.58	12.23	6,087.65	8,666.19

Sources: USGS 2016; USFWS 2011

[1] Includes perennial lake/pond with stage = to date of photography and stage = spillway elevation

[2] Includes reservoir type = water storage

Within the Coyote watershed, CRAM analysis was conducted on one AA (AA26) in a constructed watercourse in the Caltrain alignment. This constructed watercourse scored 46, which is considered poor. Because it was a single AA, the results cannot be extrapolated further. Although 57 percent of the waters within the watershed have a natural land use intensity, the project footprint is in the more developed portions of the watershed.

Because of the number of stressors likely to be present, wetlands and waters within these developed areas would also be expected to have a poor CRAM score. Wetlands and waters within natural land uses would be expected to score within the fair to good range. Because more than half of the watershed is natural, most the waters within the watershed would likely be characterized as fair to good.

8.1.2 San Francisco Bay Watershed

Waters in the San Francisco watershed are within land uses that are approximately 69 percent natural, 31 percent developed, and 0.34 percent agricultural (0.27 percent are high intensity and 0.07 percent are low intensity). As Table 8-2 shows, predominant streams in the San Francisco watershed are ephemeral streams within natural land uses, predominant waterbodies are evaporator reservoirs within natural land uses, and predominant wetlands are lakes within natural land uses.

Table 8-2 Summary of Waters and Land Uses in the San Francisco Watershed

Wetland/ Water Category	Wetland/Water Type	Land Use				Total
		Developed	High/Moderate-Intensity Agriculture	Low-Intensity Agriculture	Natural	
Streams (miles)	Artificial path	42.30	0.43	0.48	132.38	175.59
	Aqueduct	8.85	–	0.09	1.17	10.11
	Canal ditch	170.97	0.65	0.93	143.42	315.97
	Coastline	74.22	–	–	91.62	165.84
	Connector	25.71	0.03	–	7.08	32.81
	Ephemeral stream	174.25	2.58	0.32	898.01	1,075.15
	Intermittent stream	132.18	0.41	0.07	214.81	347.47
	Perennial stream	107.75	0.33	0.08	180.34	288.50
	Streams total	*736.23*	*4.43*	*1.96*	*1,668.81*	*2,411.44*
Waterbodies (acres)	Intermittent lake/pond	138.14	–	0.21	124.07	262.42
	Perennial lake/pond[1]	1,414.25	28.37	0.22	7,962.96	9405.79
	Reservoir	92.27	–	–	152.68	244.95
	Evaporator reservoir[2]	1,379.44	1.00	0.40	23,181.29	24562.13
	Treatment reservoir	349.89	2.25	3.49	–	578.99
	Water storage reservoir[3]	169.52	–	–	17.77	187.45
	Swamp/marsh	1017.42	–	3.66	223.36	5710.80
	Waterbodies total	*4,561.08*	*31.62*	*7.98*	*36,351.84*	*40,952.53*
Wetland (acres)	Estuarine and marine deepwater	496.75	–	0.43	2,525.77	3,022.95
	Estuarine and marine wetland	2,634.39	1.82	10.84	8,850.96	11,498.01
	Freshwater emergent wetland	1,268.33	18.10	34.50	2,224.76	3,545.69
	Freshwater forested/shrub wetland	451.00	2.79	0.13	1,641.09	2,095.02
	Freshwater pond	1,130.48	5.36	8.95	1,434.85	2,579.64
	Lake	1,994.31	12.77	2.38	29,913.16	31,922.62
	Other	0.96	–	–	8.66	9.62
	Riverine	1,341.99	7.73	4.21	3,090.20	4,444.13
	Wetlands total	*9,318.22*	*48.58*	*61.43*	*49,689.44*	*59,117.67*

Sources: USGS 2016; USFWS 2011
[1] Includes perennial lake/pond with stage = average water elevation; stage = to date of photography; stage = normal pool; stage = spillway elevation; stage = normal pool
[2] Includes construction material = earthen
[3] Includes construction material = nonearthen

Within the San Francisco watershed, CRAM analysis was conducted on the following 26 AAs:

- AA01_CW-02946
- AA02_FEM-02962
- AA03_CW-02862
- AA04_FEM-01594
- AA05_FEM-03037
- AA06_FEM-03043
- AA07_FEM-02975
- AA08_FEM-02978
- AA09_SSW-02983
- AA10_SSW-02955
- AA11_FEM-03116
- AA12_SSW-03960
- AA13_CW-02846
- AA14_CB-03129
- AA15_CB-03128
- AA16_FEM-02972
- AA17_SEW-03891
- AA18_CW-02939
- AA19_CW-02864
- AA20_CW-02863
- AA21_CW-02944
- AA22_CW-02848
- AA23_CW-02869
- AA24_CW-02906
- AA25_FEM-02969
- AA27_FEM-02966

Most of these AAs are within the Caltrain right-of-way and are highly disturbed. The AAs in this watershed had an average overall CRAM score of 46, which is considered poor. While 69 percent of the waters within the watershed have a natural land use intensity, the project footprint is in the more developed portions of the watershed.

Because of the number of stressors likely to be present, wetlands and waters within the developed areas would be expected to have a poor CRAM score, similar to those assessed directly. Wetlands and waters within natural land uses would be expected to score within the fair to good range. Because a large majority of the watershed is natural, most of the waters within the watershed would likely be characterized as fair to good.

9 REFERENCES

California High-Speed Rail Authority (Authority). 2019. *San Francisco to San Jose Project Section Record Preliminary Engineering for Project Definition*. April 2019.

———. 2020. *San Francisco to San Jose Project Section Aquatic Resources Delineation Report.* Prepared by ICF. April 2020. Sacramento, CA.

California High-Speed Rail Authority (Authority) and Federal Railroad Administration (FRA). 2005. *Final Program Environmental Impact Report/Environmental Impact Statement (EIR/EIS) for the Proposed California High-Speed Train System*. August 2005. Sacramento, CA and Washington, DC.

———. 2008. *Final Bay Area to Central Valley High-Speed Train (HST) Program Environmental Impact Report/Environmental Impact Statement (EIR/EIS)*. May 2008. Sacramento, CA and Washington, DC.

———. 2011. *Draft Checkpoint C: LEDPA Determination: Methodology for Wetland Condition Assessment Using CRAM*. August 2011.

California Wetlands Monitoring Workgroup (CWMW). 2009. *Using CRAM (California Rapid Assessment Method) to Assess Wetlands Projects As an Element of Regulatory and Management Programs: Technical Bulletin*. October 13, 2009.

———. 2013a. *California Rapid Assessment Method for Wetlands: User's Manual*. Version 6.1. April 2013.

———. 2013b. *California Rapid Assessment Method (CRAM) for Wetlands: Riverine Wetlands Field Book*. Version 6.1. January 2013.

———. 2013c. *California Rapid Assessment Method (CRAM) for Wetlands: Depressional Wetlands Field Book*. Version 6.1. February 2013.

———. 2013d. *California Rapid Assessment Method (CRAM) for Wetlands: Perennial Estuarine Wetlands Field Book*. Version 6.1. January 2013.

———. 2017. *California Rapid Assessment Method (CRAM) for Wetlands: Slope Wetlands Field Book*. Version 6.2. October 2017.

City of Brisbane. 2011. *Brisbane Baylands Specific Plan*. Draft. February 2011. www.brisbaneca.org/specific-plan-and-infrastructure-plan (accessed November 11, 2016).

County of Santa Clara, City of San Jose, City of Morgan Hill, City of Gilroy, Santa Clara Valley Water District, and Santa Clara Valley Transportation Authority (County of Santa Clara et al.). 2012. *Santa Clara Valley Habitat Plan*. Final. Prepared by ICF International. August 2012. http://scv-habitatagency.org/178/Santa-Clara-Valley-Habitat-Plan (accessed January 7, 2019).

Cowardin, L.M., V. Carter, F. Golet, and E. LaRoe (Cowardin et al.). 1979. *Classification of Wetlands and Deepwater Habitats of the United States*. Version 04DEC1998. Washington, DC. http://pubs.er.usgs.gov/publication/2000106.

Environmental Laboratory. 1987. *Corps of Engineers Wetlands Delineation Manual*. Final. Report No. Y-87-1. January 1987. Vicksburg, MS.

Federal Railroad Administration, California High-Speed Rail Authority, U.S. Environmental Protection Agency, U.S. Army Corps of Engineers (FRA et al.). 2010. *Memorandum of Understanding: National Environmental Policy Act (42 U.S.C. 4321 et seq.) and Clean Water Act Section 404 (33 U.S.C. 1344) and Rivers and Harbors Act Section 14 (33 U.S.C. 408) Integration Process for the California High-Speed Train Program*. November 2010.

Griffith, G.E., J.M. Omernik, D.W. Smith, T.D. Cook, E. Tallyn, K. Moseley, and C.B. Johnson (Griffith et al.). 2016. *Ecoregions of California*. Report No. 2016-1021. Reston, VA: U.S. Geological Survey. https://pubs.er.usgs.gov/publication/ofr20161021 (accessed October 20, 2018).

Hermstad, D., K. Cayce and R.M. Grossinger (Hermstad et al.). 2009. *Historical Ecology of Lower San Francisquito Creek Phase 1*. San Francisco Estuary Institute: Oakland, CA.

LANDFIRE. 2016. Existing Vegetation Type Layer, LANDFIRE 1.4.0. www.landfire.gov/evt.php (accessed March 12, 2019).

McNab, W.H., D.T. Cleland, J.A. Freeouf, J.E. Keys, Jr., G.J. Nowacki, and C.A. Carpenter (McNab et al.). 2007. *Description of Ecological Subregions: Sections of the Conterminous United States.* Report No. WO-76B. January 2007. Washington, DC. www.edc.uri.edu/atmt-dss/report_forecast/landscape_dynamics/SectionDescriptions.pdf (accessed March 2018).

Miles, S.R. and C.B. Goudey, eds. 1998. *Ecological Subregions of California: Section and Subsection Descriptions.* Publication No. R5-EM-TP-005. May 1998. San Francisco, CA: USDA Forest Service, Pacific Southwest Region.

Peninsula Corridor Joint Powers Board (PCJPB). 2015. *Peninsula Corridor Electrification Project, Preliminary Delineation of Wetlands and Other Waters of the United States*. Prepared by ICF International. January 2015. San Francisco, CA.

San Francisco Estuary Institute (SFEI). 2010. *Historical Vegetation and Drainage Patterns of Western Santa Clara Valley: A Technical Memorandum Describing Landscape Ecology in Lower Peninsula, West Valley, and Guadalupe Watershed Management Areas.* November 2010. Oakland, CA. www.sfei.org/sites/default/files/HistoricalEcology_of_Western_SantaClaraValley_SFEI_111910.pdf (accessed November 2011).

———. 2011. *Standards and Methodology for Stream Network, Wetland and Riparian Mapping*. Wetland Regional Monitoring Program. August. www.sfei.org/sites/default/files/general_content/SFEI_MAPPING_STANDARDS_08092011_v8_0.pdf (accessed October 12, 2018).

———. 2012. *Upper Penitencia Creek Historical Ecology Assessment*. SFEI Publication No. 664. June 2012. Richmond, CA.

———. 2016. *San Francisquito Creek Baylands Landscape Change Metrics Analysis*. Publication No. 784. June 2016. Richmond, CA.

Santa Clara Basin Watershed Management Initiative. 2000. "Volume One: Watershed Characteristics Report." In *Watershed Management Plan*. May 2000. www.scbwmi.org/PDFs/watershed-characteristic-d8.pdf (accessed October 10, 2018).

Sawyer, J.O., T. Keeler-Wolf, and J.E. Evens (Sawyer et al.). 2009. *A Manual of California Vegetation*. Second Edition. Sacramento, CA: California Native Plant Society.

Springer, P.F. 1988. "Saline Emergent Wetland." In *A Guide to Wildlife Habitats of California*. Edited by M.E. Mayer and W.F. Laudenslayer. Sacramento, CA.

U.S. Army Corps of Engineers (USACE). 1993. *A Hydrogeomorphic Classification for Wetlands*. Final. Technical Report No. WRP-DE-4. Prepared by M.M. Brinson. August 1993. Vicksburg, MS.

———. 2010. *Regional Supplement to the Corps of Engineers Wetland Delineation Manual: Western Mountains, Valleys, and Coast Region*. Version 2.0. May 2010. Vicksburg, MS.

U.S. Department of Agriculture, Natural Resources Conservation Service (USDA-NRCS). 2018a. *Climate Analysis for Wetlands by County (Historical Climate Information)*. Redwood City Station, CA. www.wcc.nrcs.usda.gov/climate/navigate_wets.html (accessed October 19, 2018).

———. 2018b. *U.S. General Soil Map (STATSGO2)*. https://websoilsurvey.sc.egov.usda.gov/App/WebSoilSurvey.aspx (accessed October 10, 2018).

———. n.d. *Soil Survey Geographic Database (SSURGO) for Santa Clara, San Mateo, and San Francisco Counties, California* [Online]. https://websoilsurvey.sc.egov.usda.gov/App/WebSoilSurvey.aspx (accessed October 10, 2018).

U.S. Fish and Wildlife Service (USFWS). 2011. *National Wetlands Inventory (NWI)*. Washington, DC. www.fws.gov/Wetlands/Data/DataDownload.html (accessed April 4, 2019).

———. 2014. *Changes in the Distribution of Great Valley Vernal Pool Habitats from 2005 to 2012*. Sacramento, CA. Prepared by C. Witham, R. Holland, and J. Vollmar. October 14, 2014. Sacramento, CA.

U.S. Geological Survey (USGS). 2016. National Hydrography Dataset. https://viewer.nationalmap.gov/basic/?basemap=b1&category=nhd&title=NHD%20View (accessed November 2, 2016).

———. 2018a. *The National Map Viewer*. https://viewer.nationalmap.gov/basic/ (accessed November 9, 2018).

10 PREPARER QUALIFICATIONS

This section lists individuals who assisted in the preparation of this report and provides a summary of their qualifications, roles, and responsibilities.

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