APPENDIX 3.8-B: SUMMARY OF HYDRAULIC MODELING FOR EXISTING AND PROPOSED CONDITIONS

1 INTRODUCTION

1.1 Overview of the San Jose to Central Valley Wye Project Extent

The San Jose to Central Valley Wye Project Extent (project extent or project) of the San Jose to Merced Project Section (Project Section) would be a critical link in the high-speed rail (HSR) system connecting San Francisco and the San Francisco Bay Area to Los Angeles and Anaheim. The Project Section would provide HSR service between the downtown San Jose Diridon Station and a station in downtown Merced, with a Gilroy station in either downtown Gilroy or east of Gilroy. The project extent would connect San Jose to the Central Valley portion of the HSR system—the portion of the system running north to Merced and south to Fresno and Southern California—at the Central Valley Wye in Merced County.

The project extent is an approximately 90-mile portion of the 145-mile-long Project Section, which includes dedicated HSR track and systems, and station locations at Diridon, Gilroy, and Merced; a maintenance of way (MOWF) facility in the Gilroy area; and an additional maintenance of way siding (MOWS) west of Turner Springs Road in the Central Valley. The project begins as a blended system north of the San Jose Diridon Station, transitioning to a fully dedicated system from approximately Interstate (I-) 880 south to Gilroy, then east through the Pacheco Pass to Carlucci Road, the western boundary of the Central Valley Wye. For a more detailed description of the project, the five subsections in the project section, and the three end-to-end alternatives, please refer to Chapter 2, Alternatives, of this Draft environmental impact report (EIR)/environmental impact statement (EIS). The design options associated with each alternative are shown in Table 1-1.

Table 1-1 San Jose to Central Valley Wye Design Options by Subsection

Subsection/Design Options	Alternative 1	Alternative 2	Alternative 3	Alternative 4
San Jose Diridon Station Approach				
Viaduct to Scott Boulevard		X	X	
Viaduct to I-880	X			
Blended, at-grade				X
Monterey Corridor				
Viaduct	X		X	
At grade		X		
Blended, at-grade				X
Morgan Hill and Gilroy				
Embankment to downtown Gilroy		X		
Viaduct to downtown Gilroy	X			
Viaduct to east Gilroy			X	
Blended, at-grade to downtown Gilroy				X
Pacheco Pass				
Tunnel	X	X	X	X
San Joaquin Valley				
Henry Miller Road	X	X	X	X

Source: Authority 2018

1.2 FEMA Flood Zones and Floodway

1.2.1 FEMA Flood Zones

The waterbodies with hydraulic models have floodplains and regulatory floodways delineated by the Federal Emergency Management Agency (FEMA) on Flood Insurance Rate Maps (FIRM). The floodplains in the project footprint are shown in Table 1-2. The FEMA flood hazard zones are shown in Table 1-3. FEMA flood hazard zones at specific locations in the project vicinity are discussed in more detail in Chapter 2, Overview of Hydraulic Modeling for Project Alternatives, Chapter 3, One-Dimensional Hydraulic Analysis, and Chapter 4, Combined One- and Two-Dimensional Hydraulic Modeling. Figure 1-1 through Figure 1-12 show the existing FEMA floodplains in the RSA.

Table 1-2 Floodplains in the Project Footprint

Floodplain ID	In Alt. 1	In Alt. 2	In Alt. 3	In Alt. 4	Flood Zone	BFE (feet)	Depth (feet)	FEMA-Designated Floodway	County	Managing Agency	FEMA FIRM Panel(s)
San Jose Station Approach Subsection											
San Tomas Aquino Creek	Yes	Yes	Yes	Yes	AO	N/A	1	No	Santa Clara	SCVWD	06085C0227H
Isolated Floodplain 1	Yes	Yes	Yes	Yes	AH	65	N/A	No	Santa Clara	SCVWD	06085C0227H, 06085C0231H
Isolated Floodplain 2	Yes	Yes	Yes	Yes	A	N/A	N/A	No	Santa Clara	SCVWD	06085C0231H
Isolated Floodplain 3	Yes	Yes	Yes	Yes	AH	63	N/A	No	Santa Clara	SCVWD	06085C0231H
Isolated Floodplain 4	Yes	Yes	Yes	Yes	AO	N/A	1	No	Santa Clara	SCVWD	06085C0233H
Isolated Floodplain 5	Yes	Yes	Yes	Yes	AO	N/A	1	No	Santa Clara	SCVWD	06085C0234H
Los Gatos Creek	Yes	Yes	Yes	Yes	A	N/A	N/A	No	Santa Clara	SCVWD	06085C0234H
Guadalupe River 1	Yes	Yes	Yes	No	AH	97	N/A	No	Santa Clara	SCVWD	06085C0234H
Guadalupe River 2	Yes	Yes	Yes	Yes	A	N/A	N/A	No	Santa Clara	SCVWD	06085C0234H
Guadalupe River 3	Yes	Yes	Yes	Yes	AO	N/A	2	No	Santa Clara	SCVWD	06085C0234H
Guadalupe River 4	Yes	Yes	Yes	Yes	AO	N/A	1	No	Santa Clara	SCVWD	06085C0234H
Guadalupe River 5	Yes	Yes	Yes	Yes	AO	N/A	2	No	Santa Clara	SCVWD	06085C0234H, 06085C0242H
Guadalupe River 6	Yes	Yes	Yes	Yes	AH	115-117	N/A	No	Santa Clara	SCVWD	06085C0234H, 06085C0242H
Monterey Corridor Subsection											
Isolated Floodplain 6	Yes	Yes	Yes	Yes	AH	131	N/A	No	Santa Clara	SCVWD	06085C0242H, 06085C0261H
Isolated Floodplain 7	Yes	Yes	Yes	Yes	AO	N/A	1	No	Santa Clara	SCVWD	06085C0261H
Isolated Floodplain 8	Yes	Yes	Yes	Yes	AH	131	N/A	No	Santa Clara	SCVWD	06085C0261H
Isolated Floodplain 9	Yes	Yes	Yes	No	AH	201	N/A	No	Santa Clara	SCVWD	06085C0261H

Floodplain ID	In Alt. 1	In Alt. 2	In Alt. 3	In Alt. 4	Flood Zone	BFE (feet)	Depth (feet)	FEMA-Designated Floodway	County	Managing Agency	FEMA FIRM Panel(s)
Morgan Hill and Gilroy Subsection											
Coyote Creek 1	Yes	Yes	Yes	No	AE	235-246	N/A	Yes	Santa Clara	SCVWD	06085C0407H, 06085C0426H, 06085C0428H
Coyote Creek 2	Yes	Yes	Yes	Yes	AE	239-249	N/A	No	Santa Clara	SCVWD	06085C0407H, 06085C0426H
Coyote Creek 3	Yes	Yes	Yes	Yes	AE	248-251	N/A	No	Santa Clara	SCVWD	06085C0426H
Coyote Creek 4	Yes	Yes	Yes	Yes	AE	249	N/A	No	Santa Clara	SCVWD	06085C0426H
Coyote Creek 5	Yes	Yes	Yes	No	AE	249-254	N/A	No	Santa Clara	SCVWD	06085C0426H, 06085C0428H
Coyote Creek 6	No	Yes	No	Yes	AE	249-251	N/A	Yes	Santa Clara	SCVWD	06085C0428H
Coyote Creek 7	No	Yes	No	No	A	N/A	N/A	No	Santa Clara	SCVWD	06085C0428H
Coyote Creek 8	No	Yes	No	No	AE	266	N/A	Yes	Santa Clara	SCVWD	06085C0428H
Coyote Creek 9	Yes	Yes	Yes	Yes	AE	298-306	N/A	No	Santa Clara	SCVWD	06085C0429H, 06085C0437H
Fisher Creek 1	Yes	Yes	Yes	Yes	AO	N/A	1	No	Santa Clara	SCVWD	06085C0437H
Coyote Creek 10	Yes	Yes	Yes	Yes	AO	N/A	1	No	Santa Clara	SCVWD	06085C0437H, 06085C0441H
Coyote Creek 11	Yes	Yes	Yes	Yes	AE	324	N/A	Yes	Santa Clara	SCVWD	06085C0437H
Coyote Creek 12	Yes	Yes	Yes	Yes	AE	319	N/A	No	Santa Clara	SCVWD	06085C0437H
Coyote Creek 13	Yes	No	Yes	Yes	AE	355	N/A	No	Santa Clara	SCVWD	06085C0441H
Fisher Creek 2	No	Yes	No	Yes	AE	324-336	N/A	No	Santa Clara	SCVWD	06085C0441H
Fisher Creek 3	No	Yes	No	Yes	AE	324-335	N/A	Yes	Santa Clara	SCVWD	06085C0441H
Fisher Creek 4	No	Yes	No	Yes	AH	354	N/A	No	Santa Clara	SCVWD	06085C0443H
Madrone Channel 1	Yes	No	Yes	No	AE	373	N/A	No	Santa Clara	SCVWD	06085C0444H

Floodplain ID	In Alt. 1	In Alt. 2	In Alt. 3	In Alt. 4	Flood Zone	BFE (feet)	Depth (feet)	FEMA-Designated Floodway	County	Managing Agency	FEMA FIRM Panel(s)
West Little Llagas Creek	No	Yes	No	Yes	AE	335-351	N/A	No	Santa Clara	SCVWD	06085C0443H, 06085C0444H, 06085C0607H
Madrone Channel 2	Yes	No	Yes	No	AE	361	N/A	No	Santa Clara	SCVWD	06085C0444H
Madrone Channel 3	Yes	No	Yes	No	AE	349	N/A	No	Santa Clara	SCVWD	06085C0444H
Madrone Channel 4	Yes	No	Yes	No	AE	342	N/A	No	Santa Clara	SCVWD	06085C0607H
Llagas Creek 1	No	Yes	No	Yes	AE	318-319	N/A	No	Santa Clara	SCVWD	06085C0607H, 06085C0626H
Llagas Creek 2	Yes	Yes	Yes	Yes	AE	309-317	N/A	No	Santa Clara	SCVWD	06085C0607H, 06085C0626H
Llagas Creek 3	No	Yes	No	Yes	A	N/A	N/A	No	Santa Clara	SCVWD	06085C0607H, 06085C0626H
Llagas Creek 4	No	Yes	No	No	AO	N/A	2	No	Santa Clara	SCVWD	06085C0626H
Llagas Creek 5	No	Yes	No	Yes	AE	308-312	N/A	No	Santa Clara	SCVWD	06085C0626H
Llagas Creek 6	No	Yes	No	No	AE	306-308	N/A	No	Santa Clara	SCVWD	06085C0626H
Llagas Creek 7	Yes	Yes	Yes	No	AE	303-305	N/A	No	Santa Clara	SCVWD	06085C0626H
Llagas Creek 8	Yes	Yes	Yes	No	AE	305-308	N/A	Yes	Santa Clara	SCVWD	06085C0626H
Llagas Creek 9	No	Yes	No	Yes	AE	208	N/A	No	Santa Clara	SCVWD	06085C0628H
Llagas Creek 10	No	Yes	No	Yes	AE	283-287	N/A	Yes	Santa Clara	SCVWD	06085C0628H
Llagas Creek 11	No	Yes	No	Yes	AE	286-289	N/A	No	Santa Clara	SCVWD	06085C0628H
Llagas Creek 12	No	Yes	No	Yes	AO	N/A	1	No	Santa Clara	SCVWD	06085C0628H
Llagas Creek 13	No	Yes	No	No	AE	258	N/A	No	Santa Clara	SCVWD	06085C0628H
Llagas Creek 14	No	Yes	No	Yes	AE	263	N/A	Yes	Santa Clara	SCVWD	06085C0628H
West Branch Llagas Creek 1	No	Yes	No	Yes	AE	245-247	N/A	Yes	Santa Clara	SCVWD	06085C0636H
West Branch Llagas Creek 2	No	Yes	No	Yes	AE	247	N/A	No	Santa Clara	SCVWD	06085C0636H

Floodplain ID	In Alt. 1	In Alt. 2	In Alt. 3	In Alt. 4	Flood Zone	BFE (feet)	Depth (feet)	FEMA-Designated Floodway	County	Managing Agency	FEMA FIRM Panel(s)
West Branch Llagas Creek 3	No	Yes	No	No	AE	224-247	N/A	No	Santa Clara	SCVWD	06085C0636H, 06085C0637H
West Branch Llagas Creek 4	Yes	Yes	Yes	No	AE	224	N/A	No	Santa Clara	SCVWD	06085C0637H
West Branch Llagas Creek 5	Yes	Yes	Yes	Yes	AO	N/A	1	No	Santa Clara	SCVWD	06085C0636H
Llagas Overbank 1	No	No	Yes	No	AE	187-203	N/A	No	Santa Clara	SCVWD	06085C0641H, 06085C0643H
Llagas Overbank 2	No	No	Yes	No	AE	185-203	N/A	Yes	Santa Clara	SCVWD	06085C0643H
Llagas Creek 15	No	No	Yes	No	AE	187-188	N/A	Yes	Santa Clara	SCVWD	06085C0643H
Llagas Creek 16	No	No	Yes	No	AE	187-188	N/A	No	Santa Clara	SCVWD	06085C0643H
Jones Creek	No	No	Yes	No	A	N/A	N/A	No	Santa Clara	SCVWD	06085C0643H, 06085C0645H
Uvas-Carnadero Creek 1	Yes	Yes	No	Yes	AH	193-195	N/A	No	Santa Clara	SCVWD	06085C0752H, 06085C0756H
Uvas-Carnadero Creek 2	Yes	Yes	No	Yes	A	N/A	N/A	No	Santa Clara	SCVWD	06085C0756H
Uvas-Carnadero Creek 3	Yes	Yes	No	Yes	AE	171-174	N/A	No	Santa Clara	SCVWD	06085C0756H
Uvas Creek West Overbank 1	Yes	Yes	No	Yes	AE	178-188	N/A	No	Santa Clara	SCVWD	06085C0756H
Uvas Creek West Overbank 2	Yes	Yes	No	Yes	AH	164	N/A	No	Santa Clara	SCVWD	06085C0756H
Uvas Creek West Overbank 3	Yes	Yes	No	No	AE	178	N/A	No	Santa Clara	SCVWD	06085C0756H
Soap Lake Floodplain 1 for Santa Clara County	Yes	Yes	Yes	Yes	A	N/A	N/A	No	Santa Clara	SCVWD	06085C0756H, 06085C0757H, 06085C0760H
Soap Lake Floodplain 2 for San Benito County	Yes	Yes	Yes	Yes	A	N/A	N/A	No	San Benito	San Benito County	06069C0075D
Pacheco Creek	Yes	Yes	Yes	No	A	N/A	N/A	No	Santa Clara	SCVWD	06085C0785H

Floodplain ID	In Alt. 1	In Alt. 2	In Alt. 3	In Alt. 4	Flood Zone	BFE (feet)	Depth (feet)	FEMA-Designated Floodway	County	Managing Agency	FEMA FIRM Panel(s)
Pacheco Pass Subsection											
Pacheco Creek	Yes	Yes	Yes	No	A	N/A	N/A	No	Santa Clara	SCVWD	06085C0700H, 06085C0805H
San Joaquin Valley Subsection											
San Joaquin River	Yes	Yes	Yes	Yes	A	N/A	N/A	No	Merced	Merced County	06047C0825G, 06047C0850G, 06047C0875G

Sources: FEMA 2009, 2010, 2014
Notes: In Santa Clara County, areas outside of the 100-year floodplain are generally Zone D.
Alt. = alternative
BFE = base flood elevation
FEMA = Federal Emergency Management Agency
FIRM = flood insurance rate map
SCVWD = Santa Clara Valley Water District

Table 1-3 FEMA Flood Hazard Zones

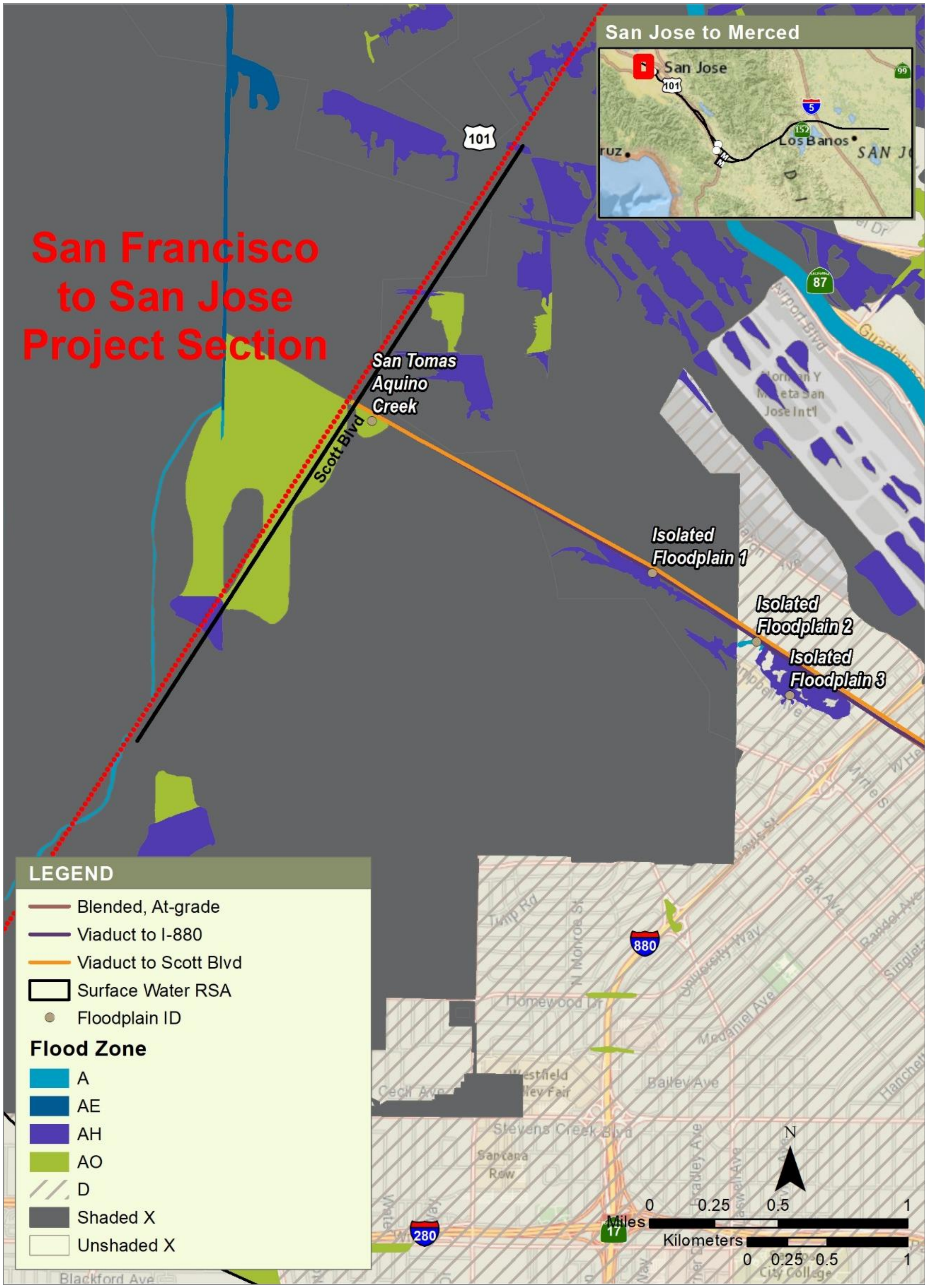
Zone	Flood Hazard
High-Risk Areas	
A	Areas with a 1% annual chance of flooding and a 26% chance of flooding over the life of a 30-year mortgage. Because detailed analyses are not performed for such areas, no depths or BFEs are shown within these zones.
AE	The base floodplain where BFEs are provided. AE Zones are now used on new format FIRMs instead of A1-A30 Zones.
AH	Areas with a 1% annual chance of shallow flooding, usually in the form of a pond, with an average depth ranging from 1 to 3 feet. BFEs derived from detailed analyses are shown at selected intervals within these zones.
AO	River or stream flood-hazard areas, and areas with a 1% or greater chance of shallow flooding each year, usually in the form of sheet flow, with an average depth ranging from 1 to 3 feet. Average flood depths derived from detailed analyses are shown within these zones.
Moderate- to Low-Risk Areas	
X (shaded)	Area of moderate flood hazard, usually the area between the limits of the 100-year and 500-year floods.
X (unshaded)	Area of minimal flood hazard, usually depicted on FIRMs as above the 500-year flood level.
Coastal Areas	
V	Areas within 100-year coastal floodplains that have additional hazards associated with storm surges and waves. Approximate hydraulic analyses are performed for these areas, so BFEs are known.
VE	Areas within 100-year coastal floodplains that have additional hazards associated with storm surges and waves. Detailed hydraulic analyses are performed for these areas.
Undetermined Risk Areas	
D	Areas with possible, but undetermined flood risks. No analysis of flood hazards has been performed in these zones.

Source: FEMA 1998
BFE = base flood elevation
FIRM = flood insurance rate map

1.2.2 FEMA Floodway

According to the Code of Federal Regulations Title 44 Section 59.1, regulatory floodway means the channel of a river or other watercourse and the adjacent land areas that must be reserved in order to discharge the base flood without cumulatively increasing the water surface elevation (WSE) more than a designated height.

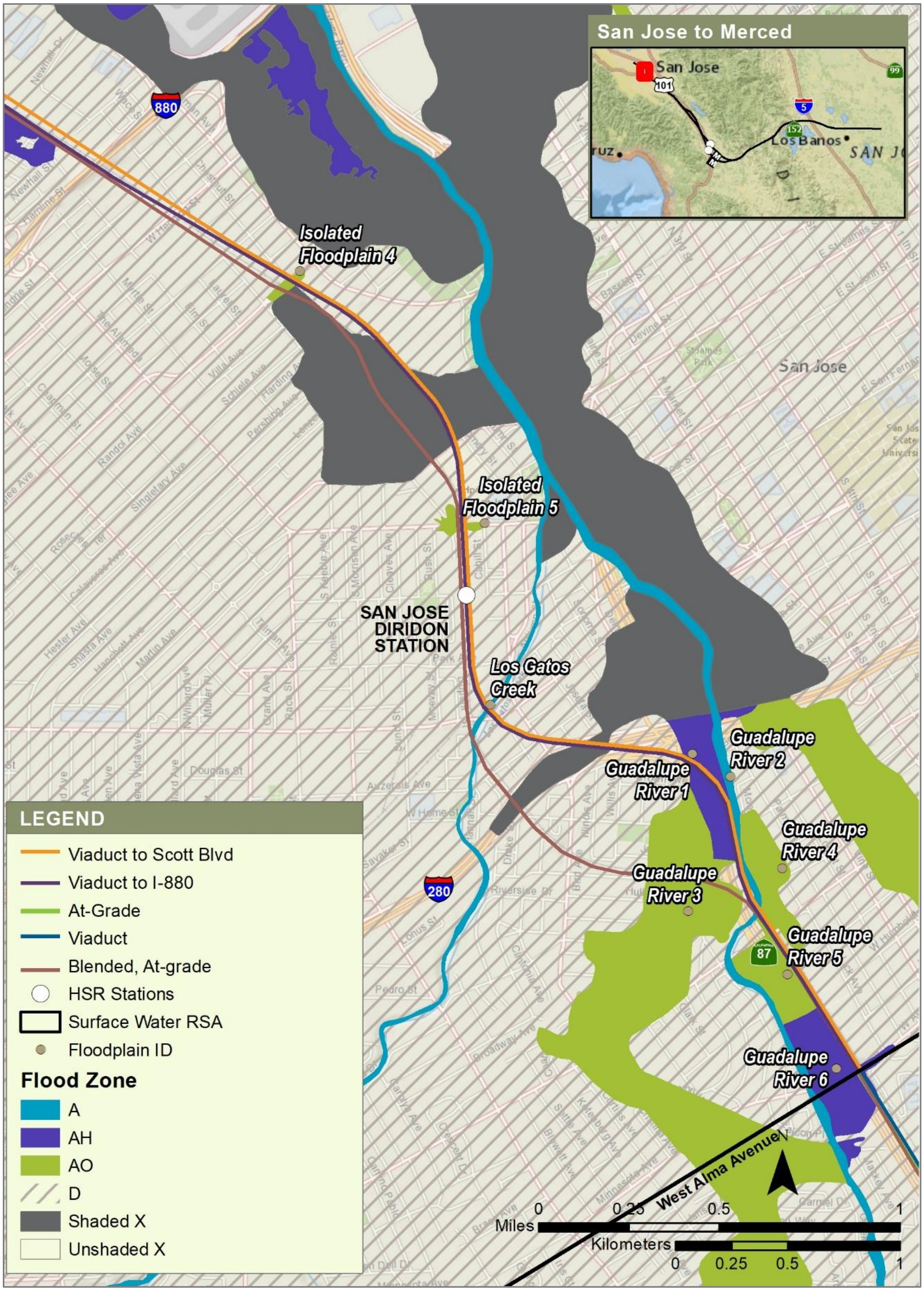
In project footprint, the FEMA FIRM assigned designated floodways to Coyote Creek, Fisher Creek, and Llagas Creek. The designated floodways in the project vicinity are discussed in Chapters 2 and 3.



Sources: FEMA 2009; Authority 2019

JANUARY 2019

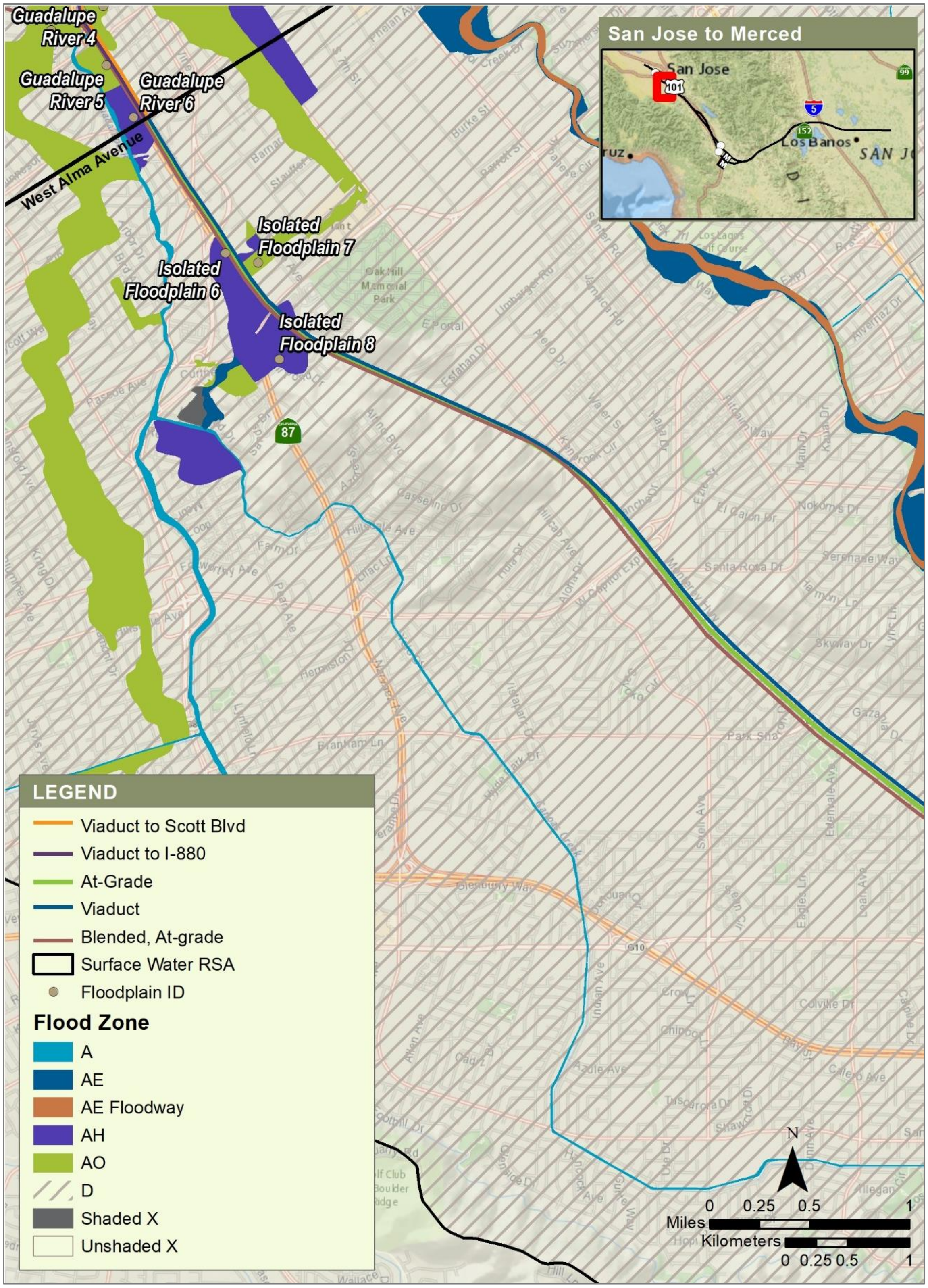
Figure 1-1 Floodplains, San Jose Diridon Station Approach Subsection (1 of 2)



Sources: FEMA 2009; Authority 2019

APRIL 2019

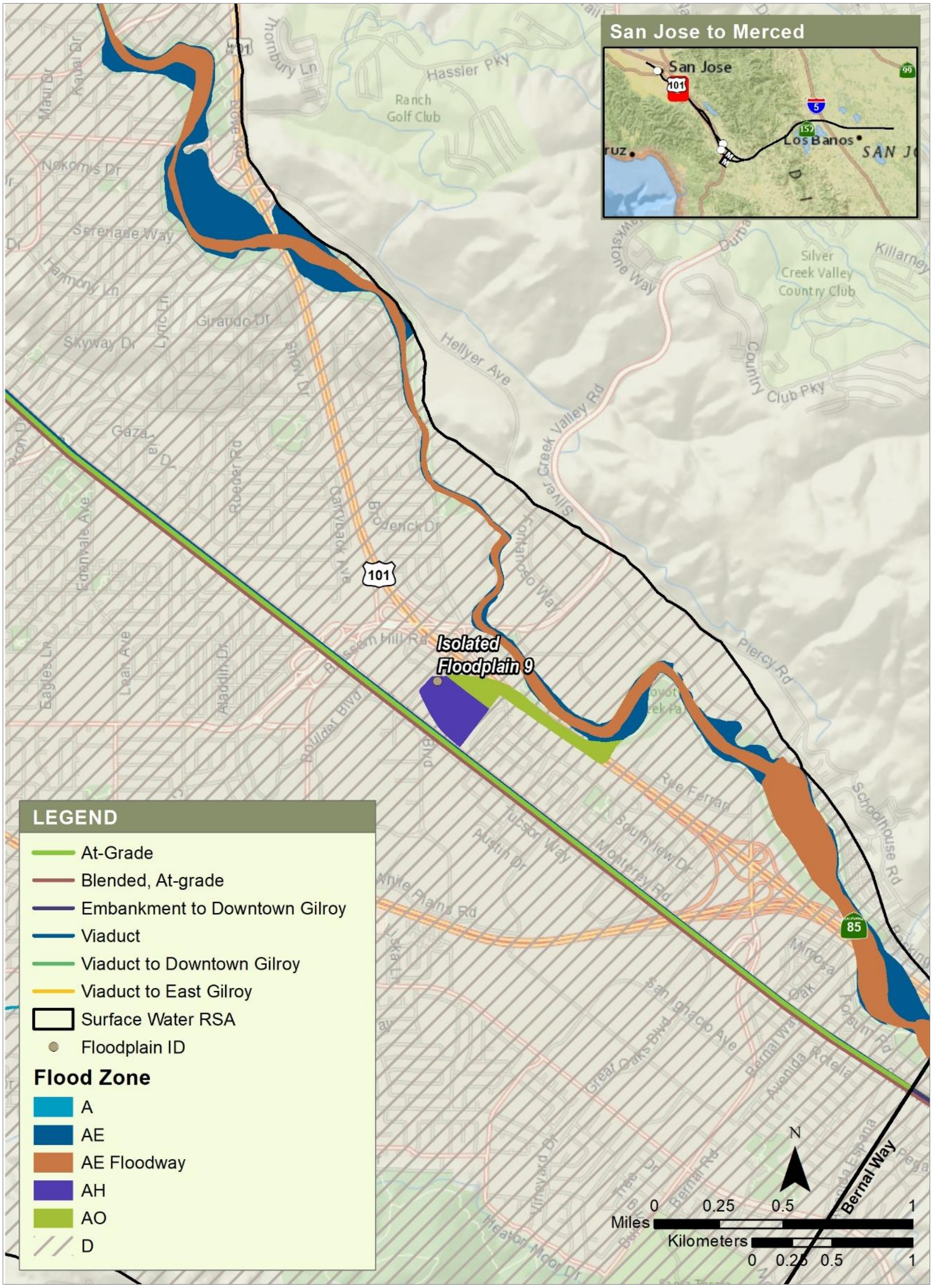
Figure 1-2 Floodplains, San Jose Diridon Station Approach Subsection (2 of 2)



Sources: FEMA 2009; Authority 2019

APRIL 2019

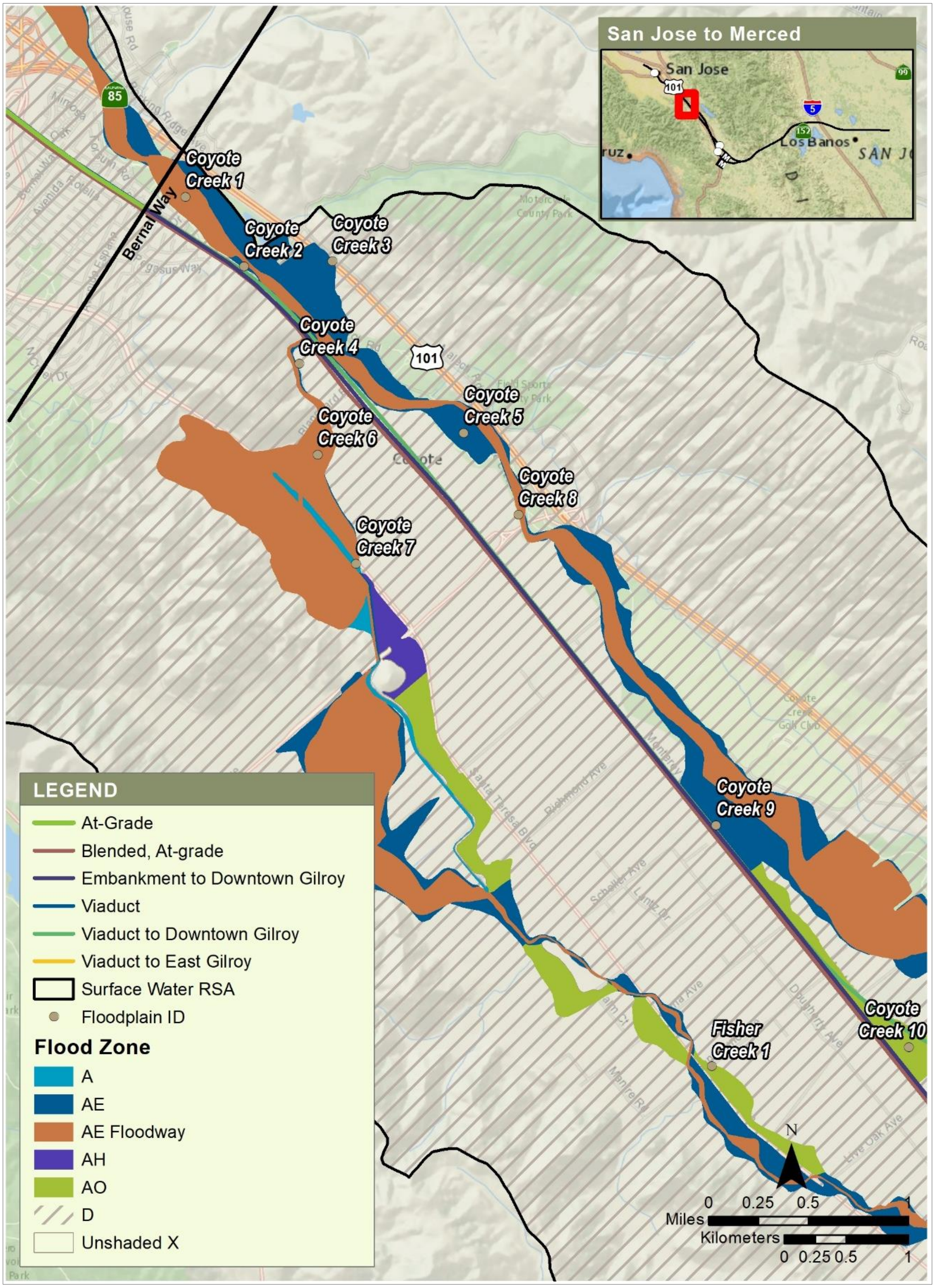
Figure 1-3 Floodplains, Monterey Corridor Subsection (1 of 2)



Sources: FEMA 2009; Authority 2019

JANUARY 2019

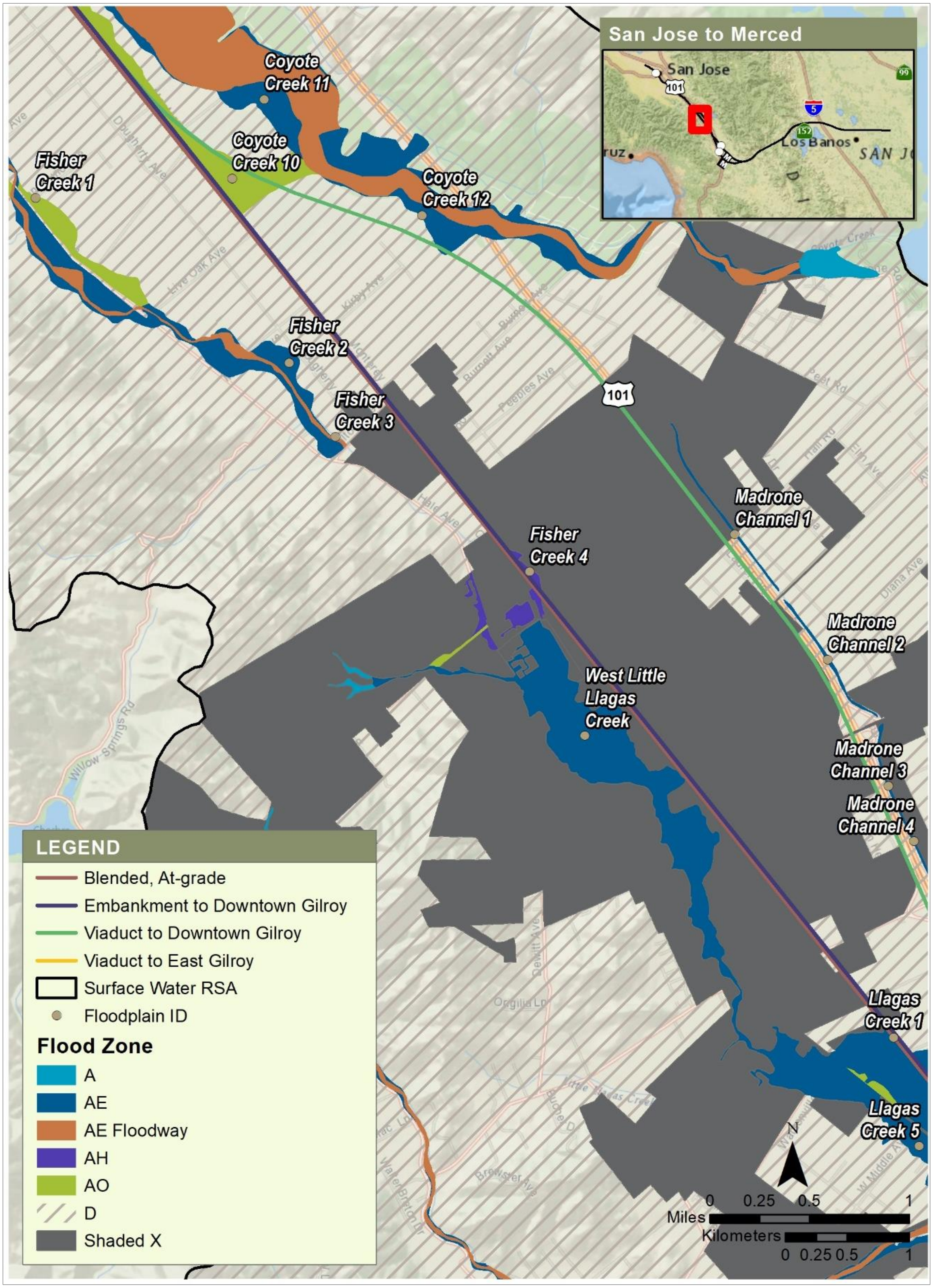
Figure 1-4 Floodplains, Monterey Corridor Subsection (2 of 2)



Sources: FEMA 2009; Authority 2019

JANUARY 2019

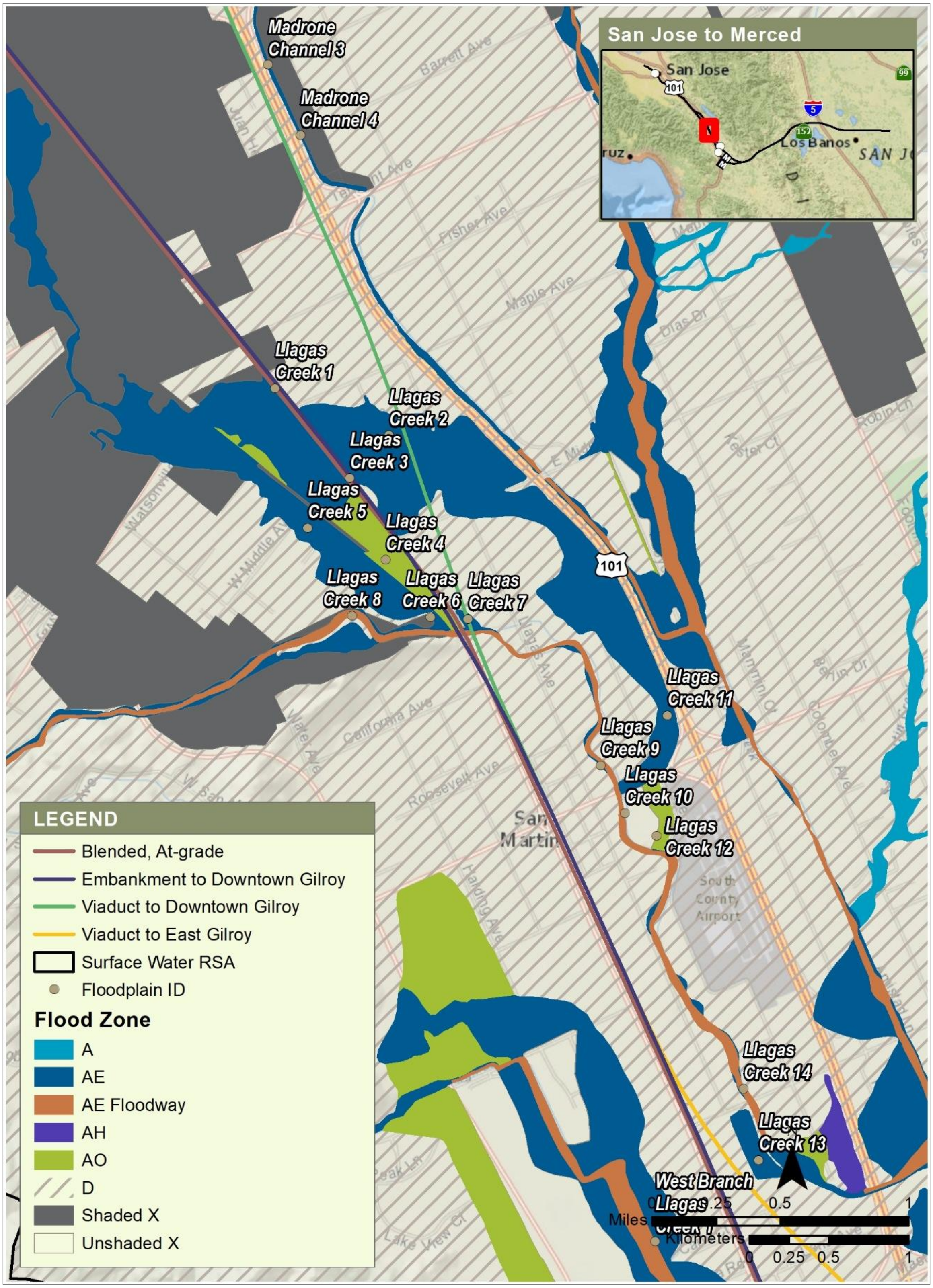
Figure 1-5 Floodplains, Morgan Hill and Gilroy Subsection (1 of 6)



Sources: FEMA 2009; Authority 2019

JANUARY 2019

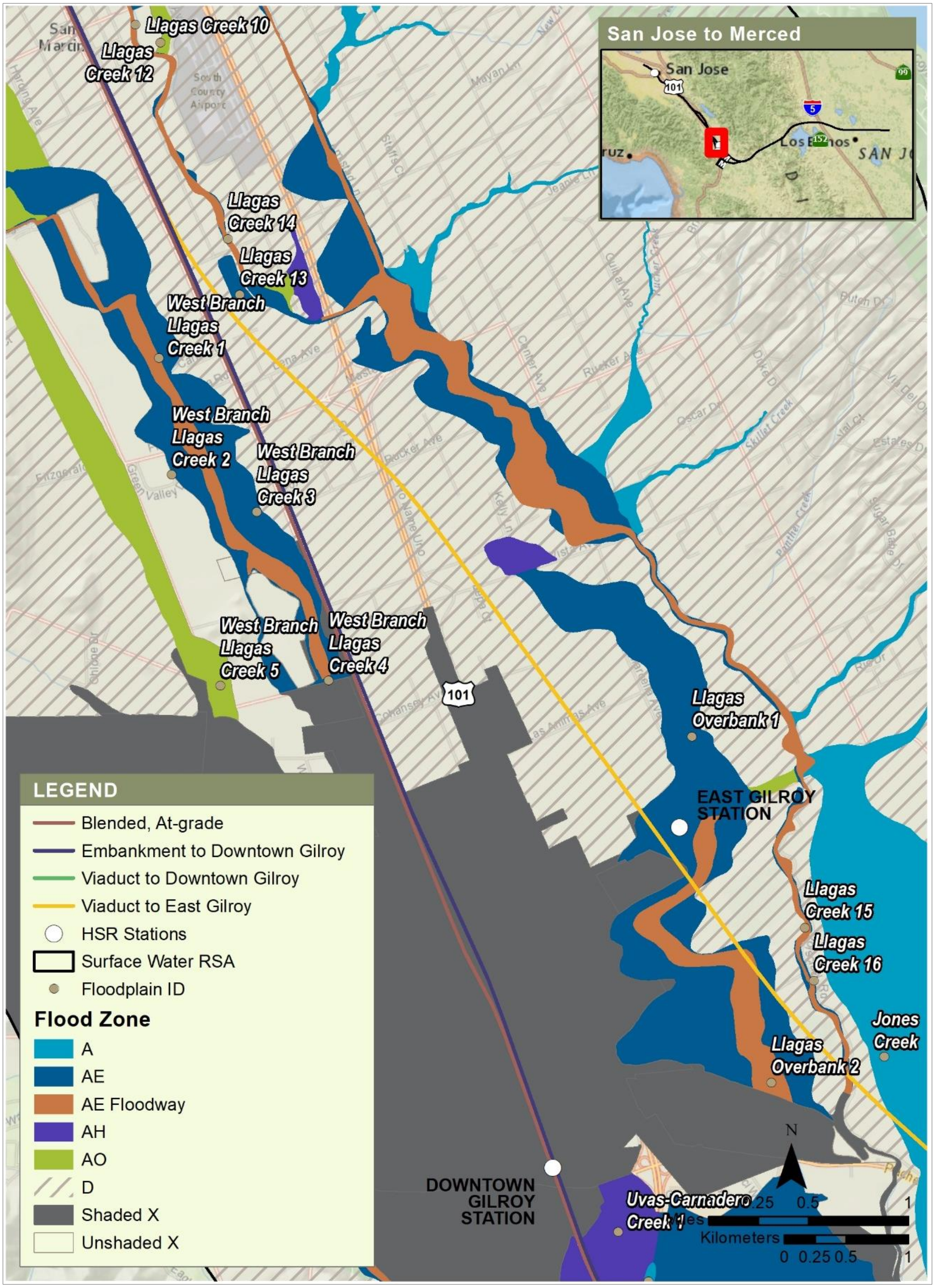
Figure 1-6 Floodplains, Morgan Hill and Gilroy Subsection (2 of 6)



Sources: FEMA 2009; Authority 2019

JANUARY 2019

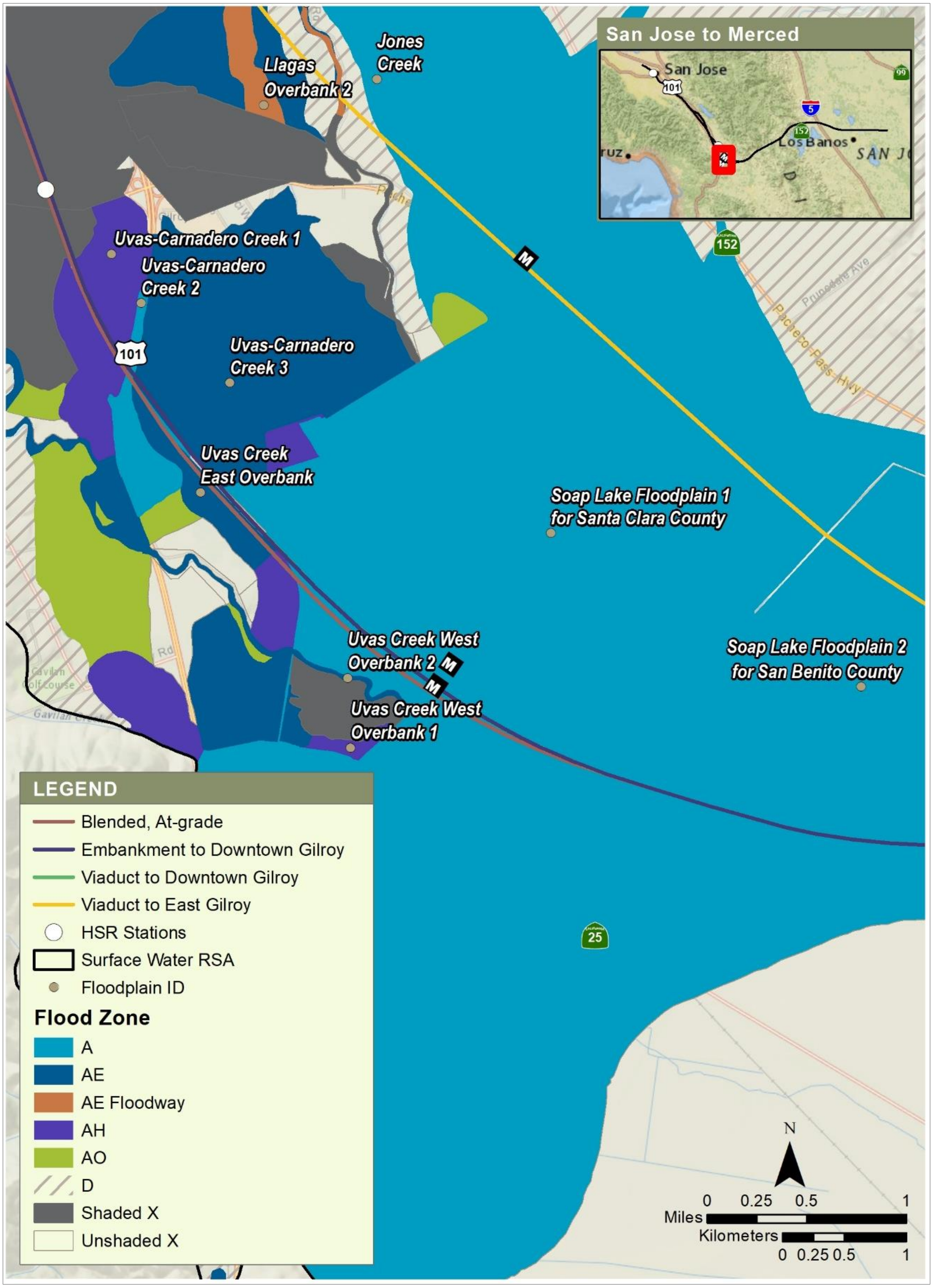
Figure 1-7 Floodplains, Morgan Hill and Gilroy Subsection (3 of 6)



Sources: FEMA 2009; Authority 2019

JANUARY 2019

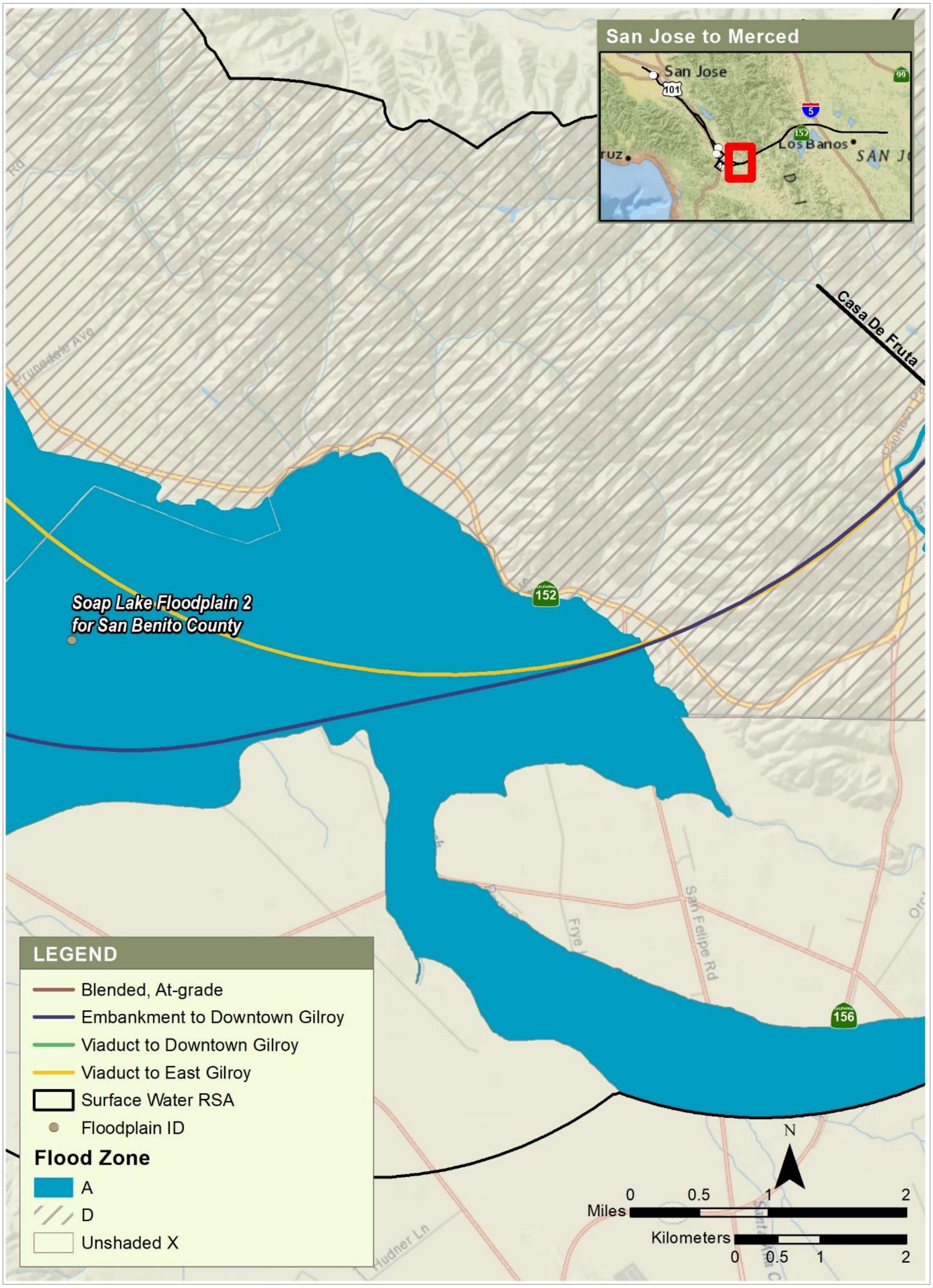
Figure 1-8 Floodplains, Morgan Hill and Gilroy Subsection (4 of 6)



Sources: FEMA 2009; Authority 2019

JANUARY 2019

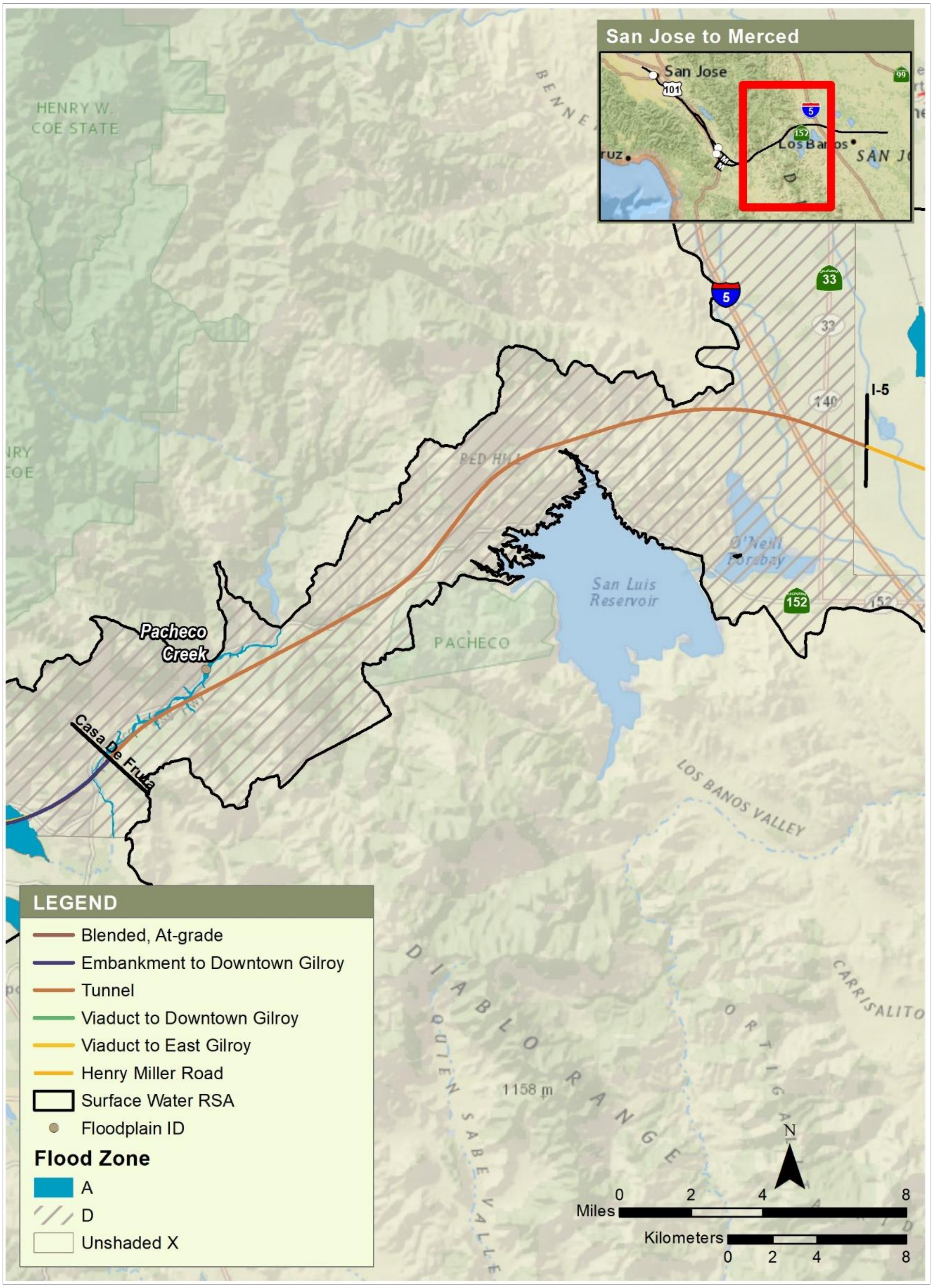
Figure 1-9 Floodplains, Morgan Hill and Gilroy Subsection (5 of 6)



Sources: FEMA 2009; Authority 2019

JANUARY 2019

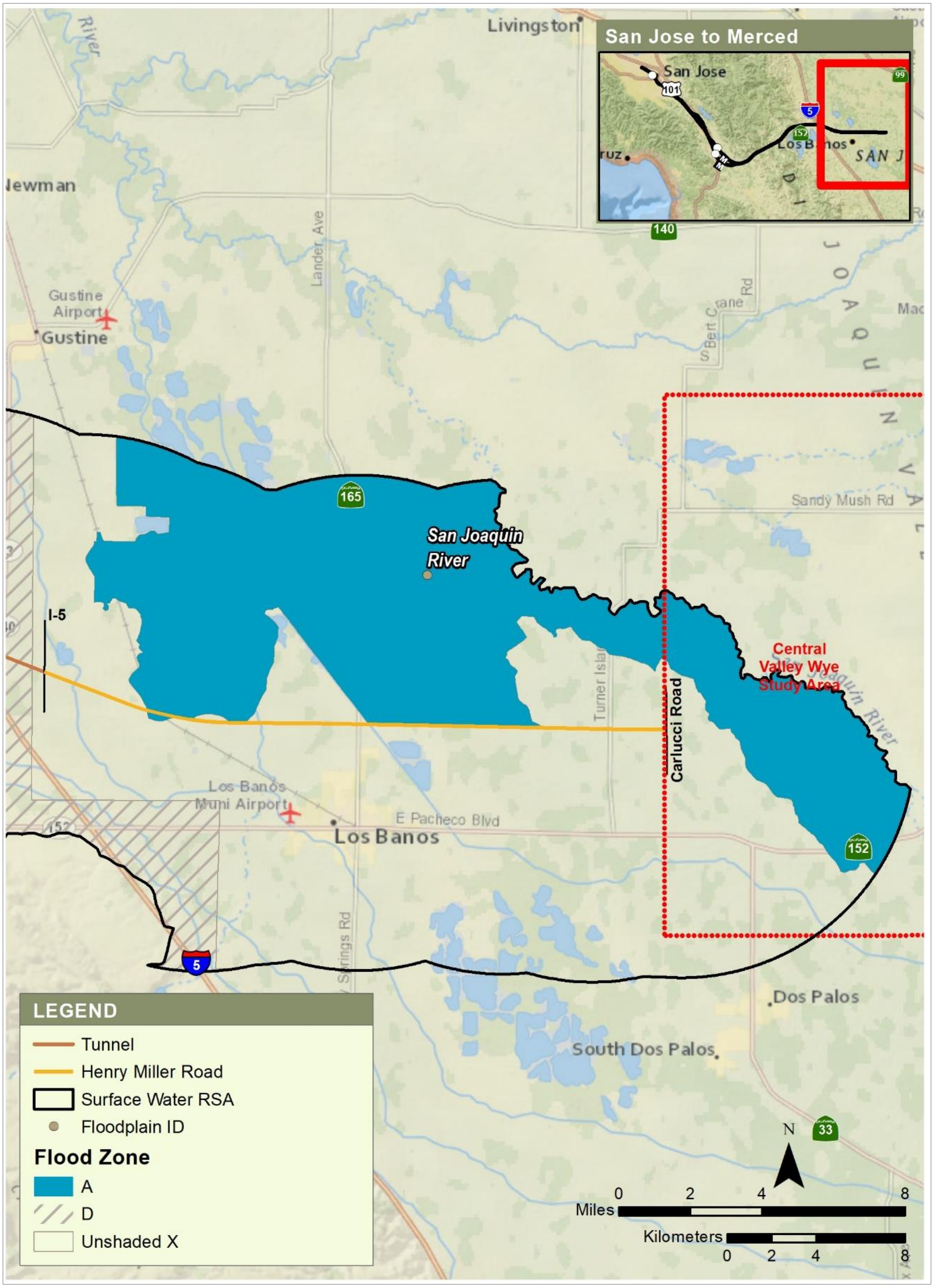
Figure 1-10 Floodplains, Morgan Hill and Gilroy Subsection (6 of 6)



Sources: FEMA 2008, 2009; Authority 2019

JANUARY 2019

Figure 1-11 Floodplains, Pacheco Pass Subsection (1 of 1)



Sources: FEMA 2008; Authority 2019

JANUARY 2019

Figure 1-12 Floodplains, San Joaquin Valley Subsection

2 OVERVIEW OF HYDRAULIC MODELING FOR PROJECT ALTERNATIVES

In the Project Section, there are 332 waterbodies in the footprint of the project alternatives. Of the 332 waterbodies, 7 waterbodies are in Zone A floodplains, 7 waterbodies are in Zone AE floodplains, 4 waterbodies are in Zone AE floodways, 5 waterbodies are in Zone AO floodplains, and 2 waterbodies are in Zone AH floodplains. Refer to Appendix 3.8-A, Waterbodies Crossed by the Project Alternatives, for a table that lists the waterbodies in the project footprint by subsection and alternative.

Under all project alternatives, construction of new embankment sections, viaduct sections, trench sections, and tunnel sections would be in or near these existing waterbodies and their associated floodplains. Proposed maintenance facilities would be in or near existing waterbodies and floodplains under all three alternatives. In addition to the new HSR tracks and facilities, the project would also require relocation of existing roadways (Alternatives 1, 2, and 3) and relocation of existing railroad track (Alternative 2) in or near waterbodies and floodplains.

To evaluate the project's potential effects on existing floodplains, a hydraulic analysis was performed by comparing the outputs of existing- and proposed-condition hydraulic models. A total of 16 hydraulic models were provided by FEMA, Santa Clara Valley Water District (SCVWD), and Pajaro River Watershed Flood Prevention Authority (PRWFPA), which covered 12 floodplains in the footprint of the project alternatives. The hydraulic model covering remaining 13 floodplains were not available. Hydraulic models provided by the Federal Emergency Management Agency are summarized in Table 2-1. Hydraulic Models provided by SCVWD and PRWFPA are summarized in Table 2-2.

Figure 2-1 through Figure 2-6 illustrate the limits of the Hydrologic Engineering Centers River Analysis Program (HEC-RAS) hydraulic models provided by FEMA. Figure 2-7 through Figure 2-15 illustrate the limits of the HEC-RAS hydraulic models provided by SCVWD and PRWFPA. Because the hydraulic models provided by SCVWD and FEMA are in Hydraulic Engineering Circular # 2 (HEC-2) file format because they did not include geo-referencing of the channel cross sections and the alignment of the floodplain. The alignment and limits of channel cross sections shown in these figures are taken from the alignment of channel cross sections and floodplains included in the FEMA digital FIRM. The FEMA effective hydraulic models are included in this study per request from the SCVWD to include the hydraulic analysis using the FEMA effective hydraulic models when they are available.

The existing condition hydraulic models provided by FEMA, SCVWD, and PRWFPA were in either one-dimensional or combined one-and two-dimensional hydraulic model formats. Because these two type of models require different modeling approaches, the discussion of the hydraulic analysis was sorted by the type of hydraulic analysis performed. In addition, the Soap Lake floodplain model that was developed by combining the existing available hydraulic models using different modeling approaches and assumptions is discussed in Section 5.5, Hydraulic Analysis. The discussion of the hydraulic analysis using one-dimensional hydraulic analysis are included in Chapter 3, which includes discussion of: Coyote Creek, West Little Llagas Creek, Llagas Creek (near San Martin, at East San Martin Avenue, and east of Gilroy), West Little Llagas Creek – Middle Avenue Overflow, and West Branch Llagas Creek. The discussion of the hydraulic analysis using combined one- and two- dimensional hydraulic analysis are included in Chapter 4, which includes discussion of Los Gatos Creek, Guadalupe River and Tributaries, Fisher Creek, and Uvas-Carnadero Creek. The hydraulic analysis of Soap Lake floodplain is included in Chapter 5 and shows report sections corresponding to the hydraulic models provided by FEMA, SCVWD, and PRWFPA.

Because the design of the HSR structures is not entirely finalized, and detailed surveys of the waterbodies in the footprint of the project alternatives are not available, all the hydraulic models used assumptions in conducting the hydraulic analysis; these assumptions are discussed in detail in Section 3.3, General Hydraulic Model Assumptions, for the one-dimensional steady-state hydraulic analysis, Section 4.2, Hydraulic Model Assumptions, for the combined one- and two-dimensional unsteady state hydraulic analysis, and in Section 5.5.5, HSR Structures and Assumptions in the Hydraulic Model, for the combined one-and two-dimensional unsteady-state hydraulic analyses of the Soap Lake floodplain. Consequently, all the hydraulic models will have to be revised when more detailed design plans and survey data become available. The hydraulic analyses of the remaining waterbodies without existing hydraulic models that are in or near the project footprint would be performed when the channel survey information becomes available.

Table 2-1 Hydraulic Models Provided by FEMA

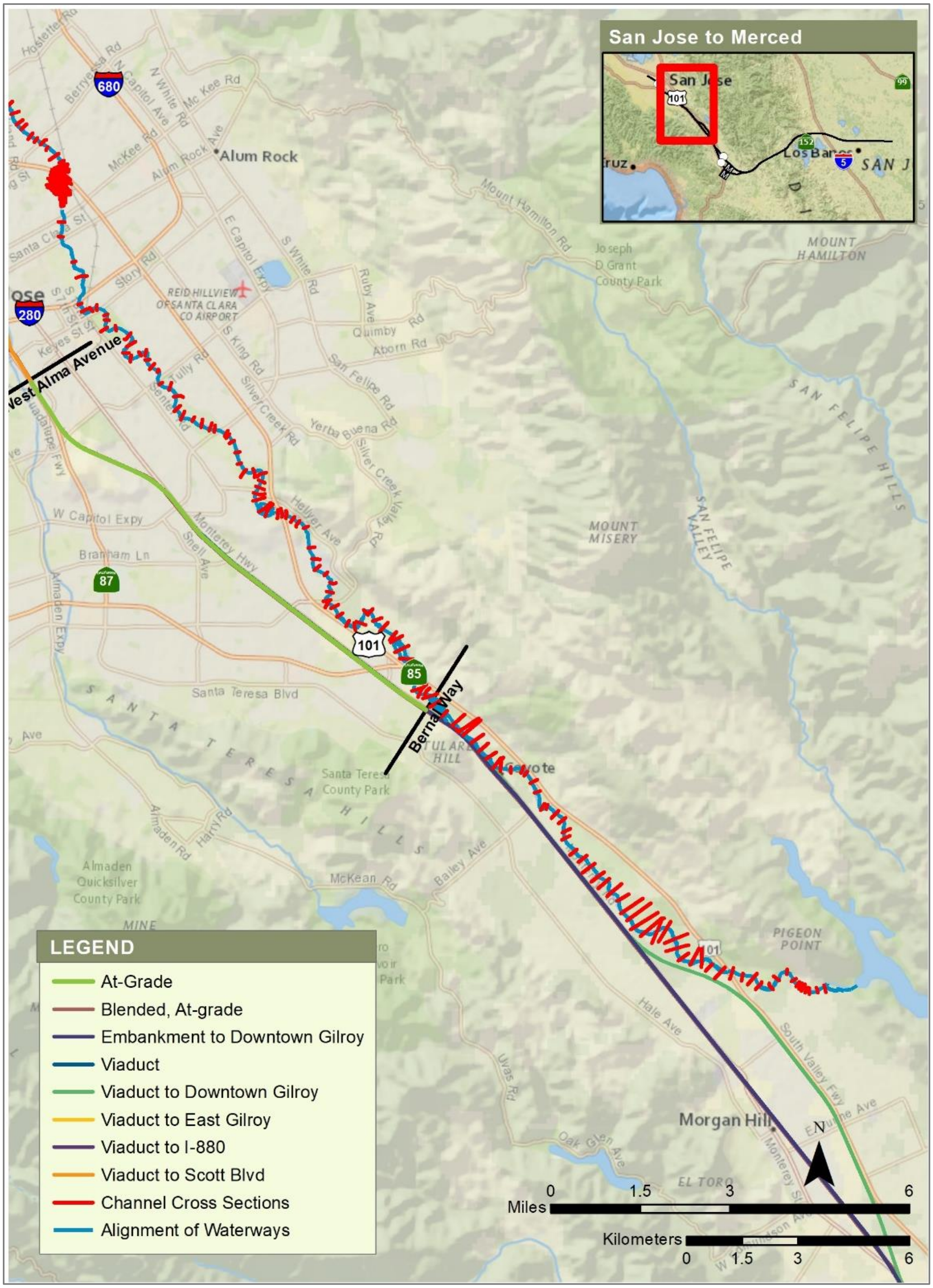
Floodplain	Date Received	Received Model Type	Figure for Model Footprint	Report Section
Coyote Creek	3/28/2018	HEC-2	Figure 2-1	3.4
West Little Llagas Creek	3/28/2018	HEC-2	Figure 2-2	3.5
Llagas Creek	3/28/2018	HEC-2	Figure 2-3	3.6, 3.7, & 3.10
West Branch Llagas Creek	3/28/2018	HEC-2	Figure 2-4	3.9
Llagas Overbank	3/28/2018	HEC-2	Figure 2-5	3.10
Uvas-Carnadero Creek	5/16/2018	HEC-RAS 1D/2D	Figure 2-6	4.6

Sources: FEMA 2018a 2018b, 2018c, 2018d, 2018e, 2018 f
FEMA = Federal Emergency Management Agency

Table 2-2 Hydraulic Models Provided by SCVWD and PRWFPA

Floodplain	Date Received	Received Model Type	Figure for Model Footprint	Report Section
Los Gatos Creek	12/13/2018	HEC-RAS 1D/2D	Figure 2-7	4.3
Guadalupe River and Tributaries	7/24/2018	HEC-RAS 1D/2D	Figure 2-8	4.4
Coyote Creek	6/3/2016	HEC-RAS 1D	Figure 2-9	3.4
Fisher Creek	6/3/2016	HEC-RAS 1D/2D	Figure 2-10	4.5
West Little Llagas Creek, Middle Avenue Overflow[1]	10/29/2018	HEC-2	Figure 2-11	3.8
Llagas Creek (with Tributaries)	1/5/2018	HEC-RAS 1D	Figure 2-12	3.6, 3.7, & 3.10
Llagas Creek (Pajaro to Buena Vista Road)	6/3/2016	HEC-RAS 1D	Figure 2-13	5
Uvas-Carnadero Creek	6/3/2016	HEC-RAS 1D/2D	Figure 2-14	4.6
Soap Lake (Pajaro River and Tributaries)	6/28/2016	HEC-RAS 1D	Figure 2-15	5

Sources: PRWFPA 2016; SCVWD 2012, 2014, 2015a, 2015b 2016, 2018a, 2018b, 2018c
SCVWD = Santa Clara Valley Water District
PRWFPA = Pajaro River Watershed Flood Prevention Authority
[1] This model provided by SCVWD is the FEMA effective hydraulic model.

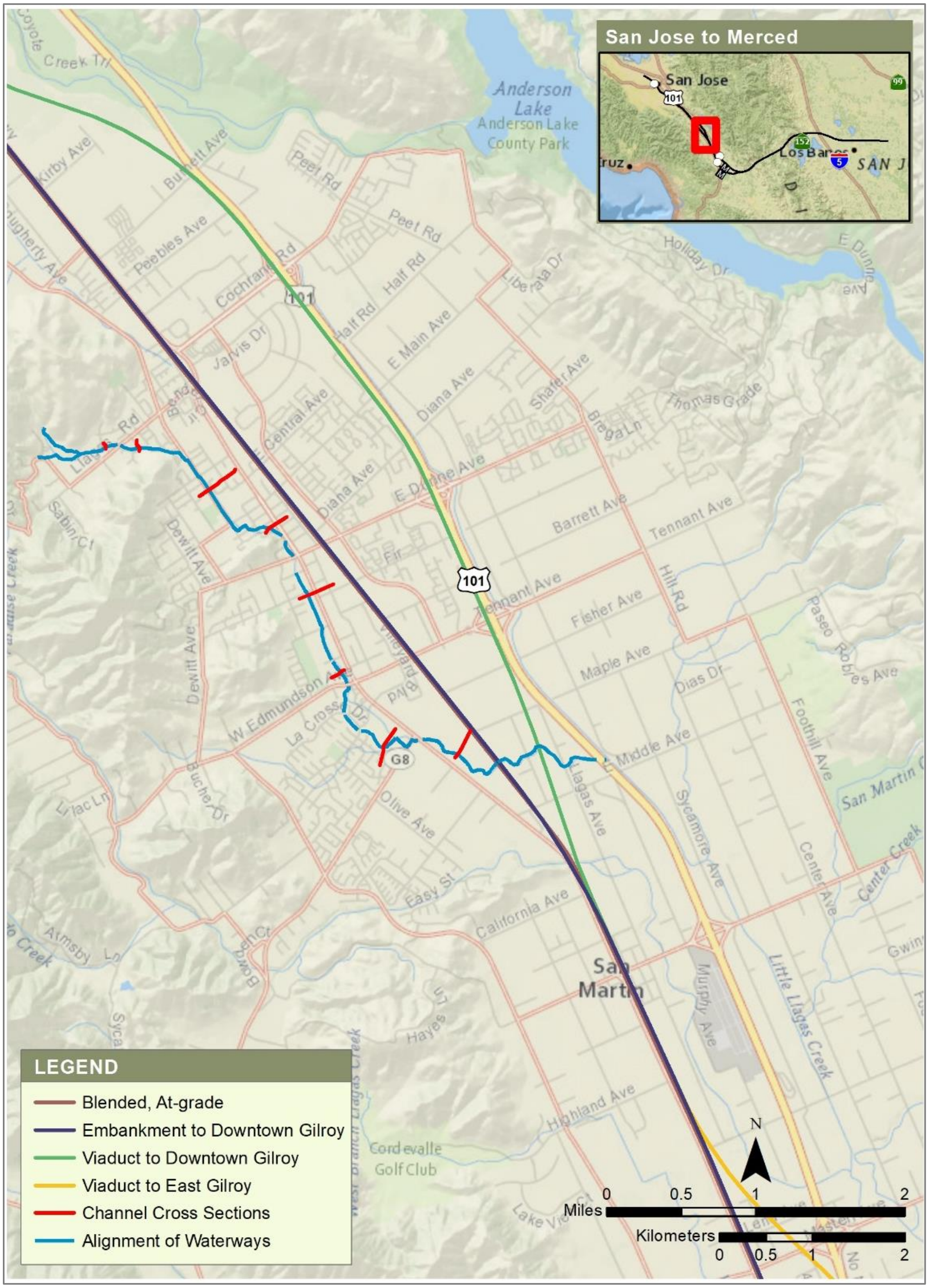


Sources: FEMA 2018a; Authority 2019

JANUARY 2019

Note: This figure is not showing all of the channel cross sections included in the hydraulic model.

Figure 2-1 Location and Limits of the Available Hydraulic Models: Coyote Creek, FEMA Model

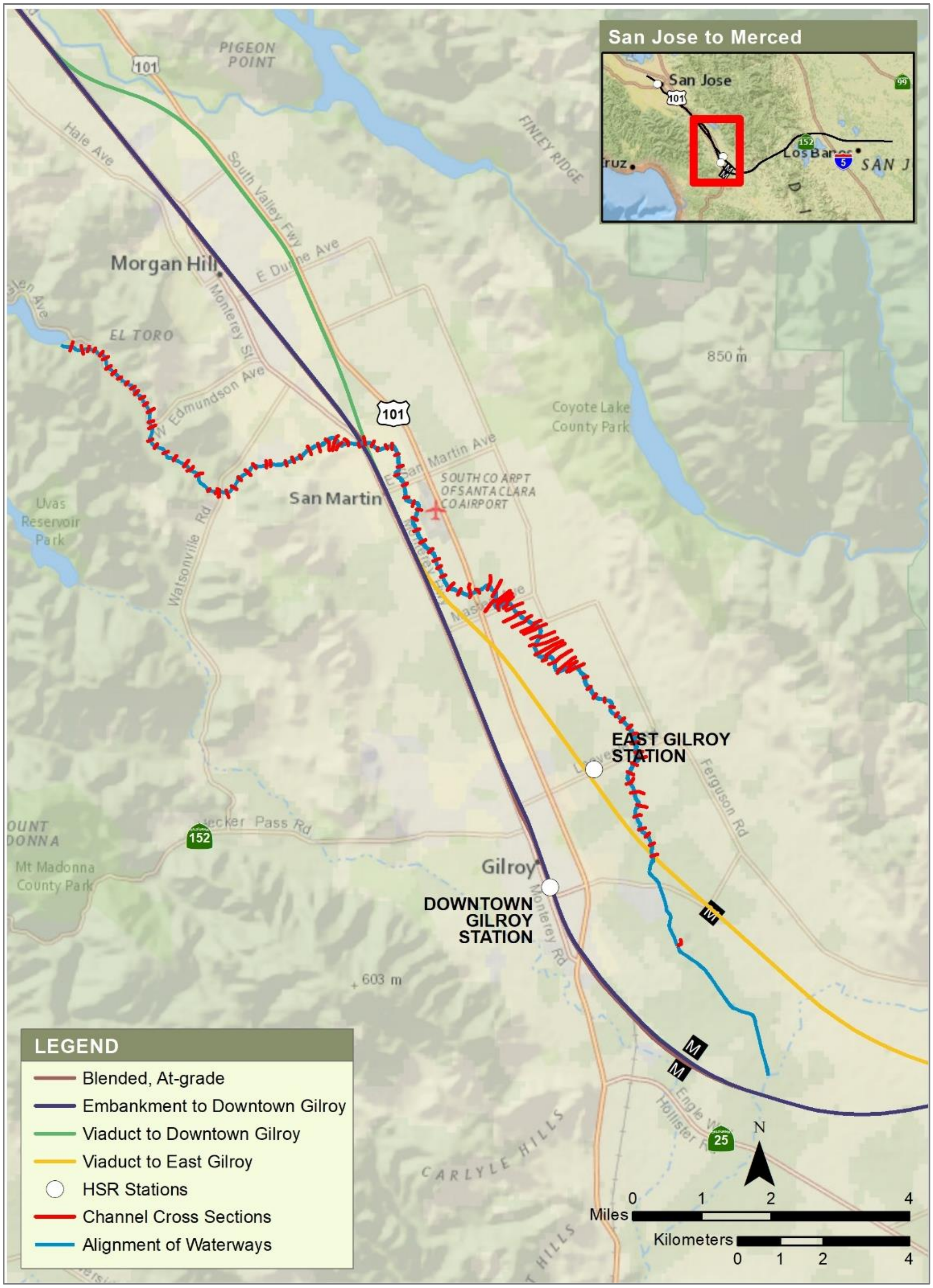


Sources: FEMA 2018b; Authority 2019

JANUARY 2019

Note: This figure is not showing all of the channel cross sections included in the hydraulic model.

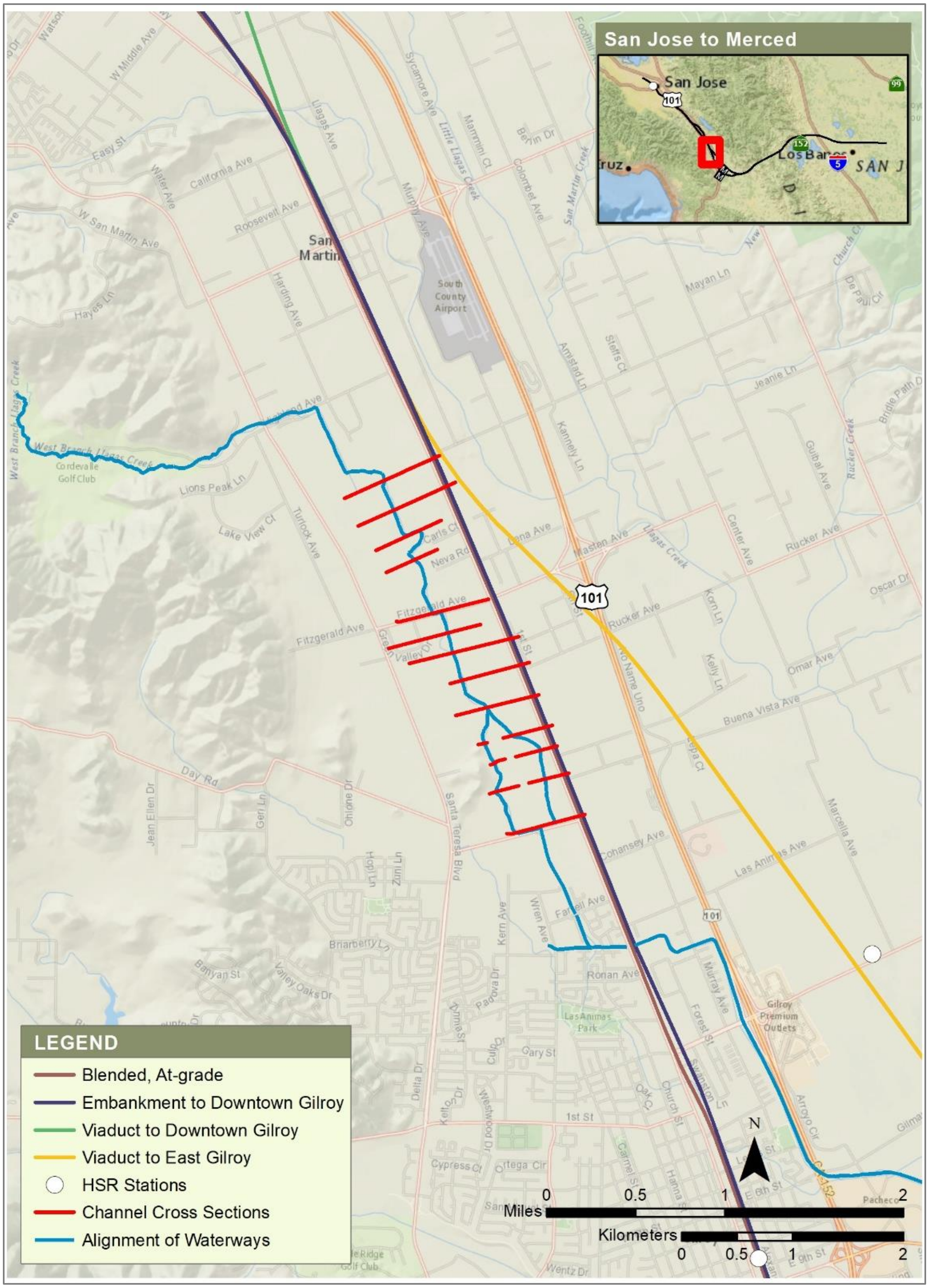
Figure 2-2 Location and Limits of the Available Hydraulic Models: West Little Llagas Creek, FEMA Model



Sources: FEMA 2018c; Authority 2019
Note: This figure is not showing all of the channel cross sections included in the hydraulic model.

JANUARY 2019

Figure 2-3 Location and Limits of the Available Hydraulic Models: Llagas Creek, FEMA Model

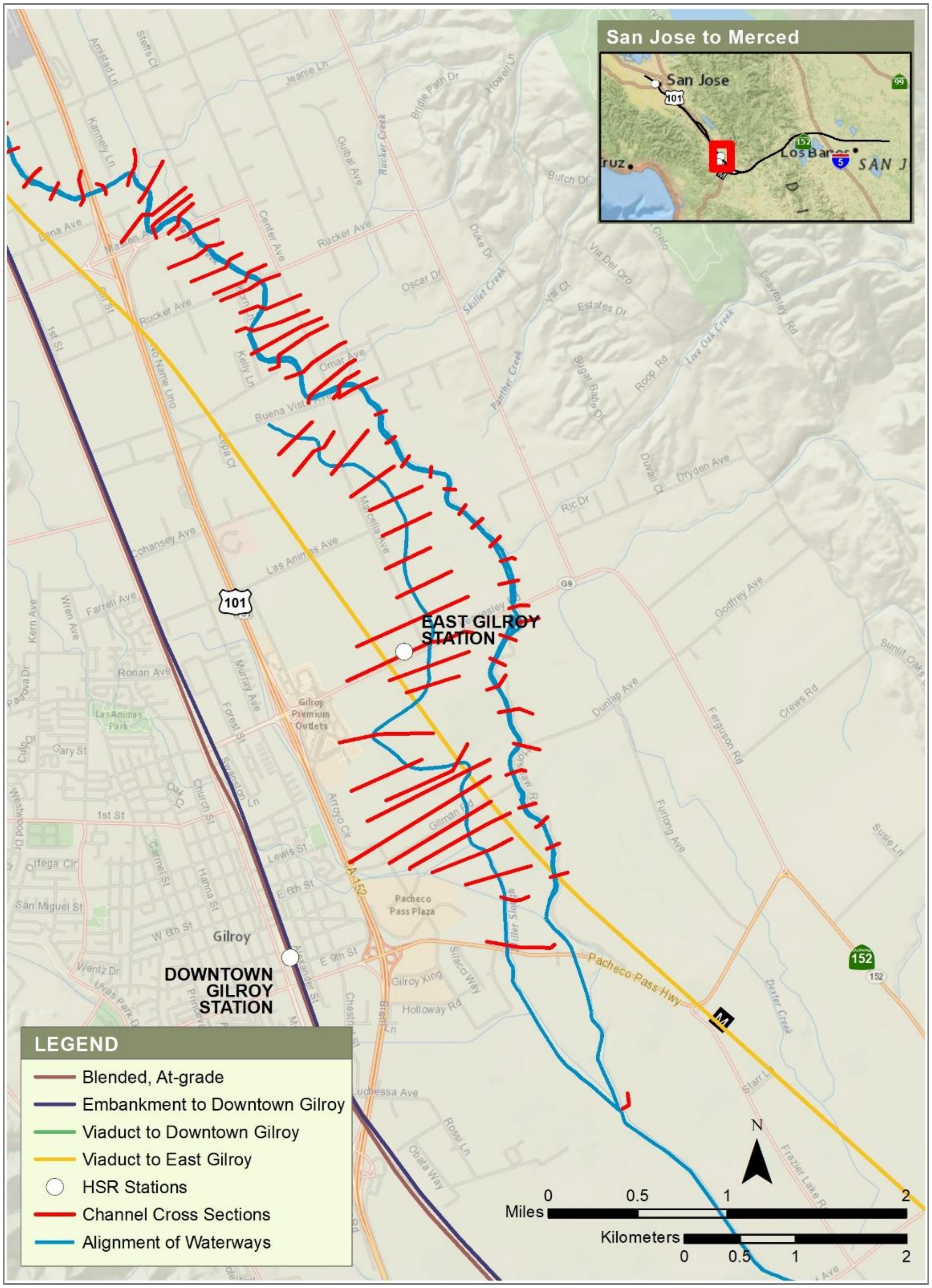


Sources: FEMA 2018d; Authority 2019

JANUARY 2019

Note: This figure is not showing all of the channel cross sections included in the hydraulic model.

Figure 2-4 Location and Limits of the Available Hydraulic Models: West Branch Llagas Creek (north of Gilroy), FEMA Model

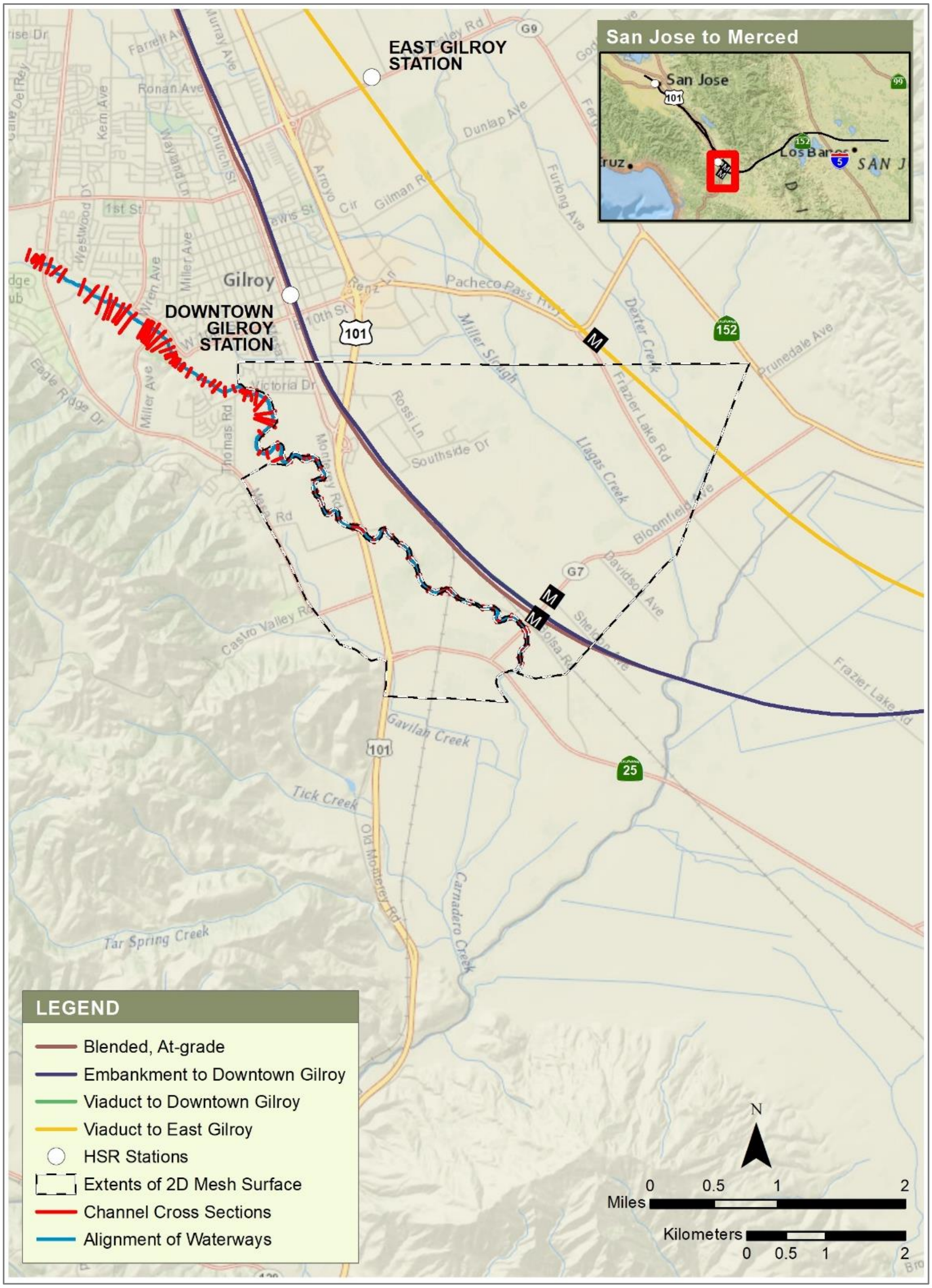


Sources: FEMA 2018c, 2018e; Authority 2019

JANUARY 2019

Note: This figure is not showing all of the channel cross sections included in the hydraulic model.

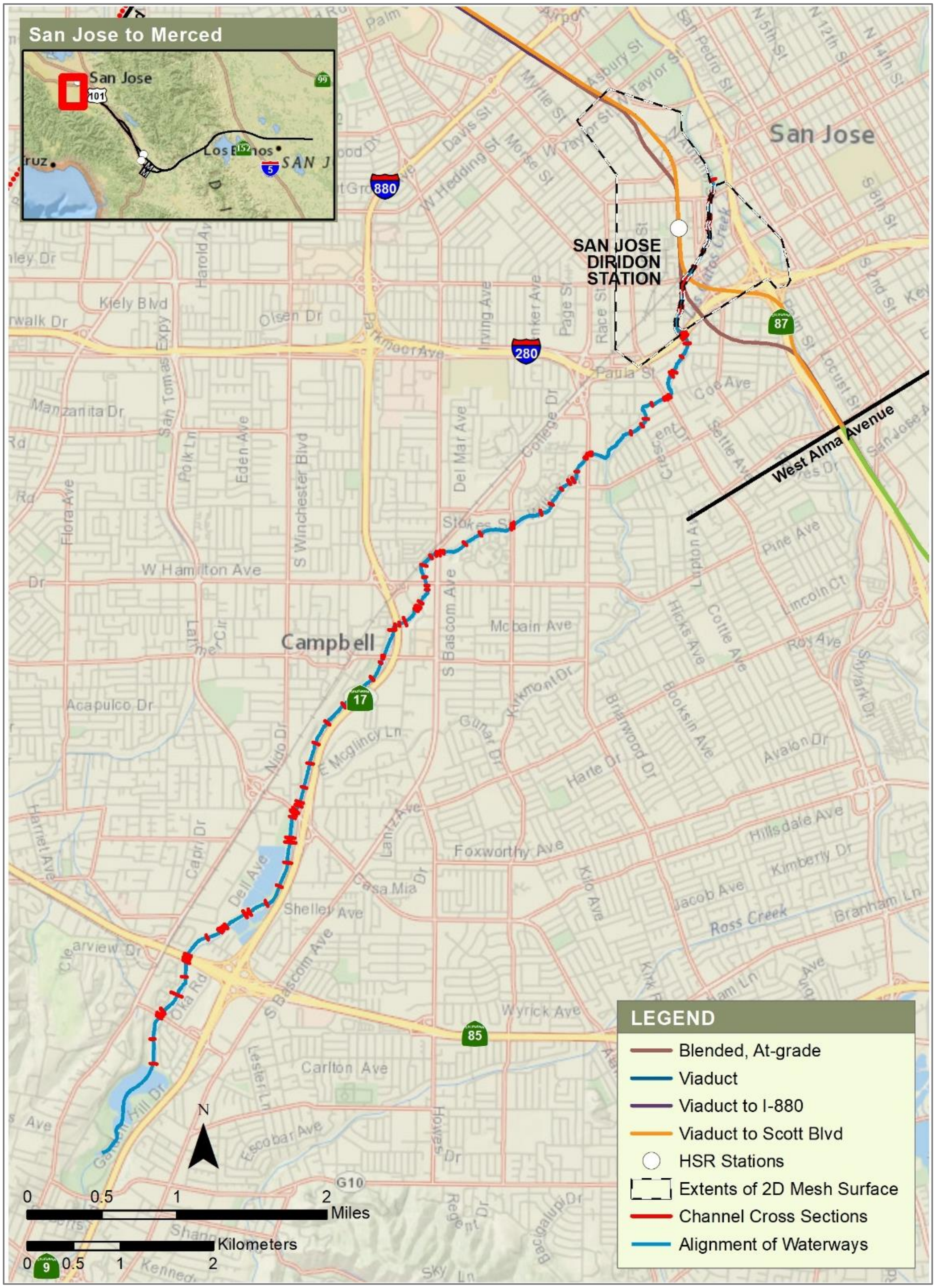
Figure 2-5 Location and Limits of the Available Hydraulic Models: Llagas Creek and Llagas Overbank (East of Gilroy), FEMA Model



Sources: FEMA 2018f; Authority 2019

JANUARY 2019

Figure 2-6 Location and Limits of the Available Hydraulic Models: Uvas-Carnadero Creek, FEMA Model



Sources: SCVWD 2018c; Authority 2019

JANUARY 2019

Figure 2-7 Location and Limits of the Available Hydraulic Models: Los Gatos Creek, SCVWD Model

Sources: SCVWD 2018a; Authority 2019

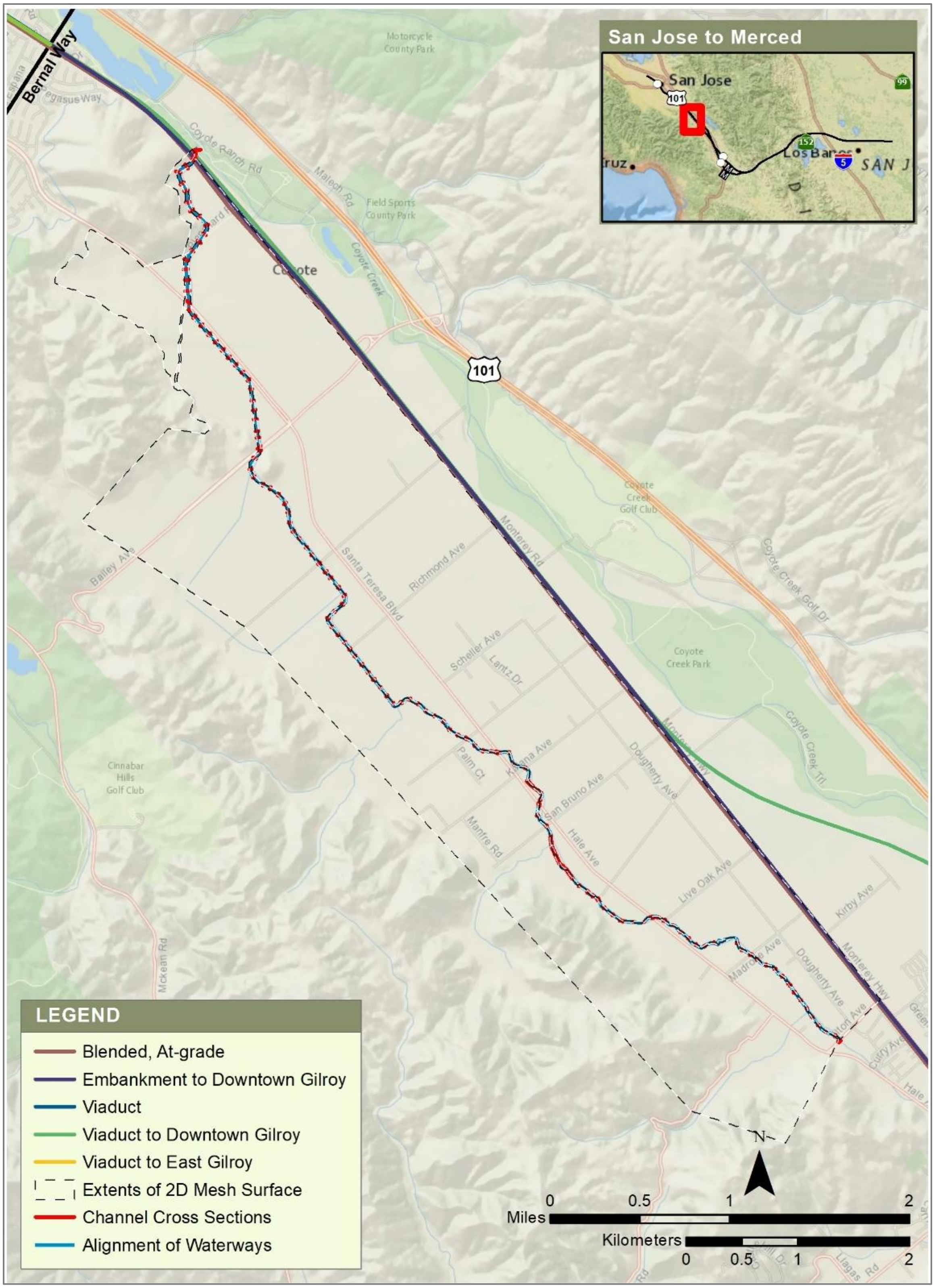
JANUARY 2019

Figure 2-8 Location and Limits of the Available Hydraulic Models: Guadalupe River and Tributaries, SCVWD Model

Sources: SCVWD 2014; Authority 2019

JANUARY 2019

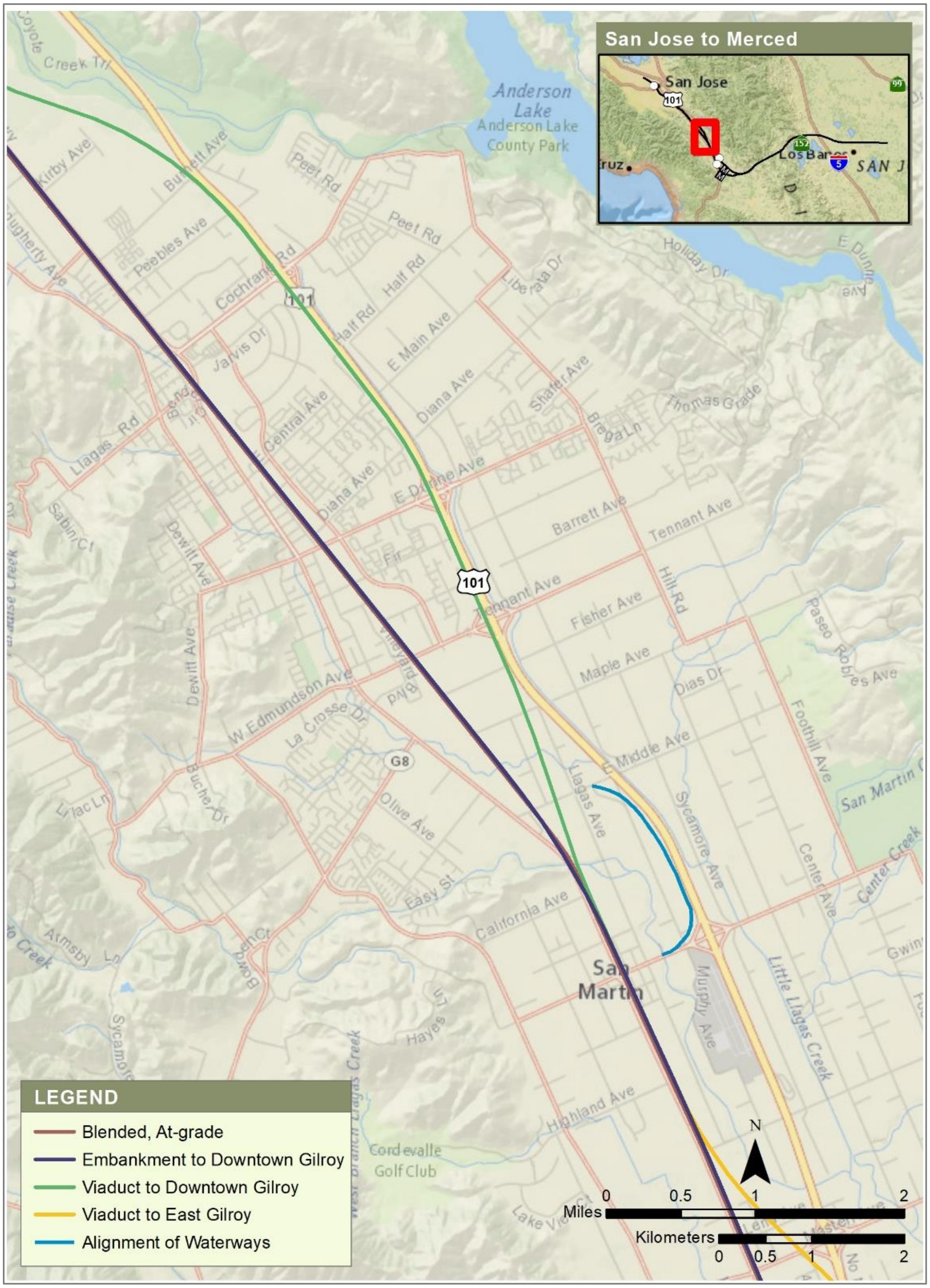
Figure 2-9 Location and Limits of the Available Hydraulic Models: Coyote Creek, SCVWD Model



Sources: SCVWD 2015a; Authority 2019

JANUARY 2019

Figure 2-10 Location and Limits of the Available Hydraulic Models: Fisher Creek, SCVWD Model

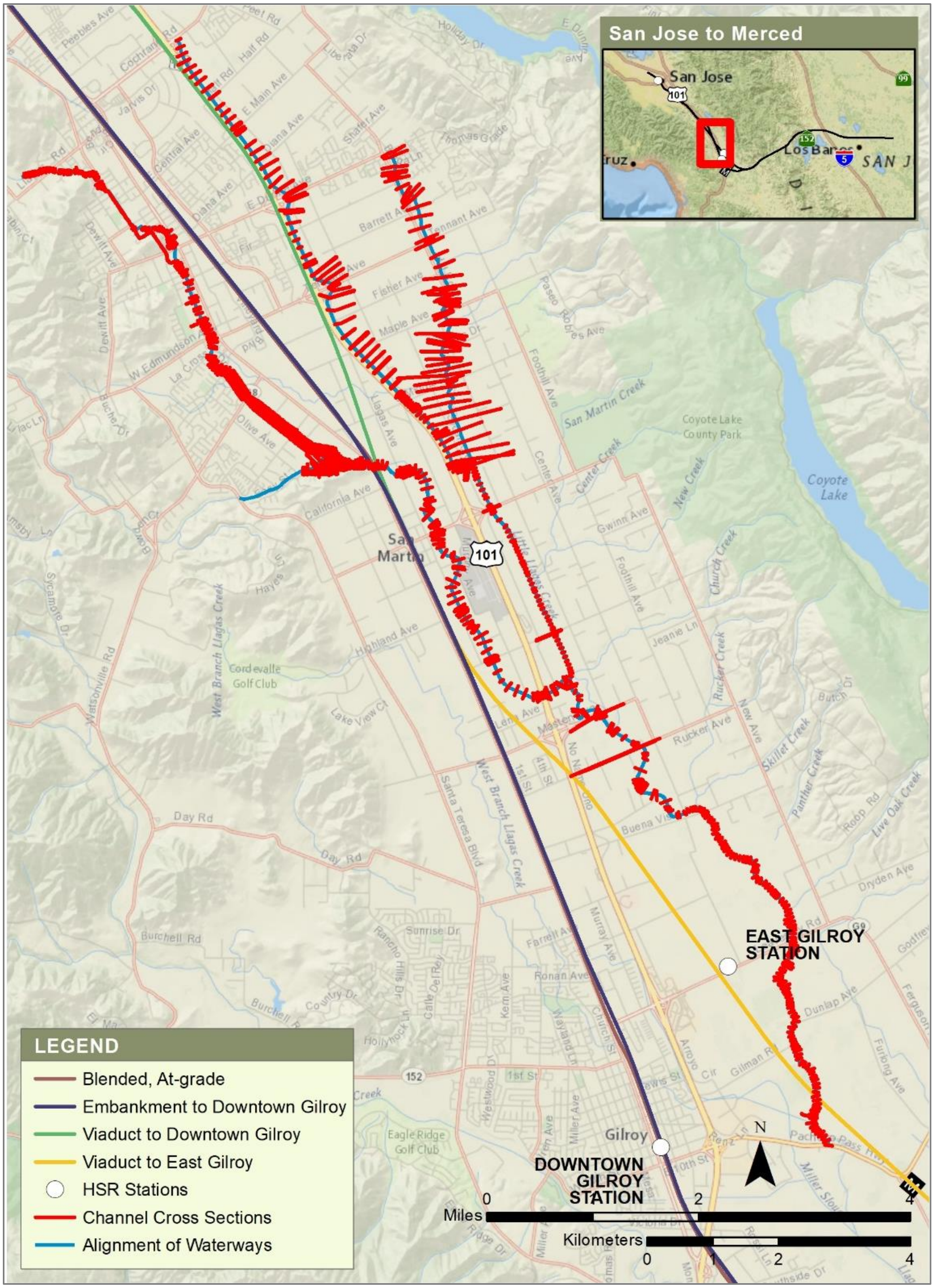


Sources: SCVWD 2018b; Authority 2019

JANUARY 2019

Note: There are no defined channel cross section locations in Middle Avenue Overflow.

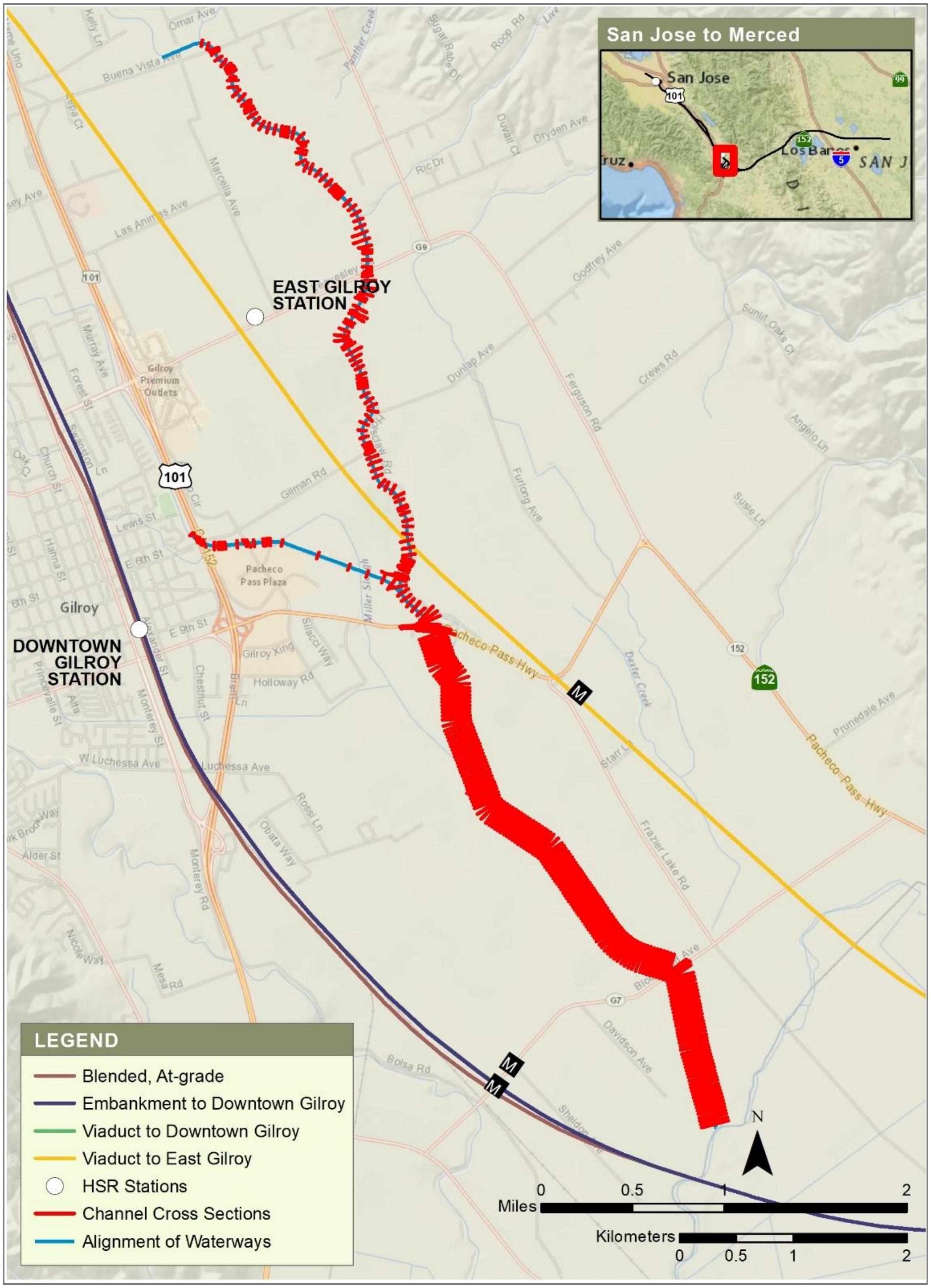
Figure 2-11 Location and Limits of the Available Hydraulic Models: West Little Llagas Creek – Middle Avenue Overflow, FEMA Model



Sources: SCVWD 2015b; Authority 2019

JANUARY 2019

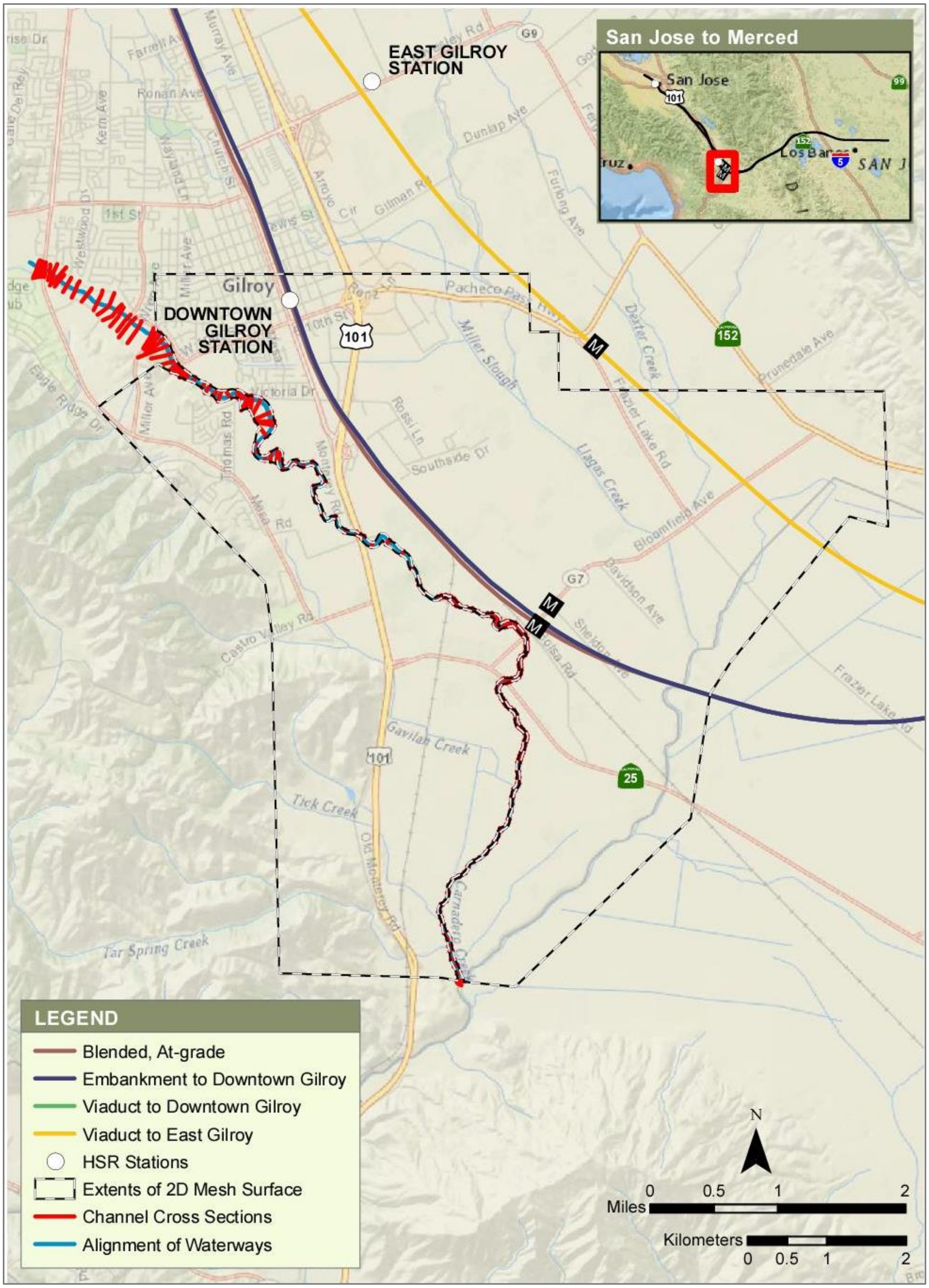
Figure 2-12 Location and Limits of the Available Hydraulic Models: Llagas Creek and Tributaries, SCVWD Model



Sources: SCVWD 2012; Authority 2019

JANUARY 2019

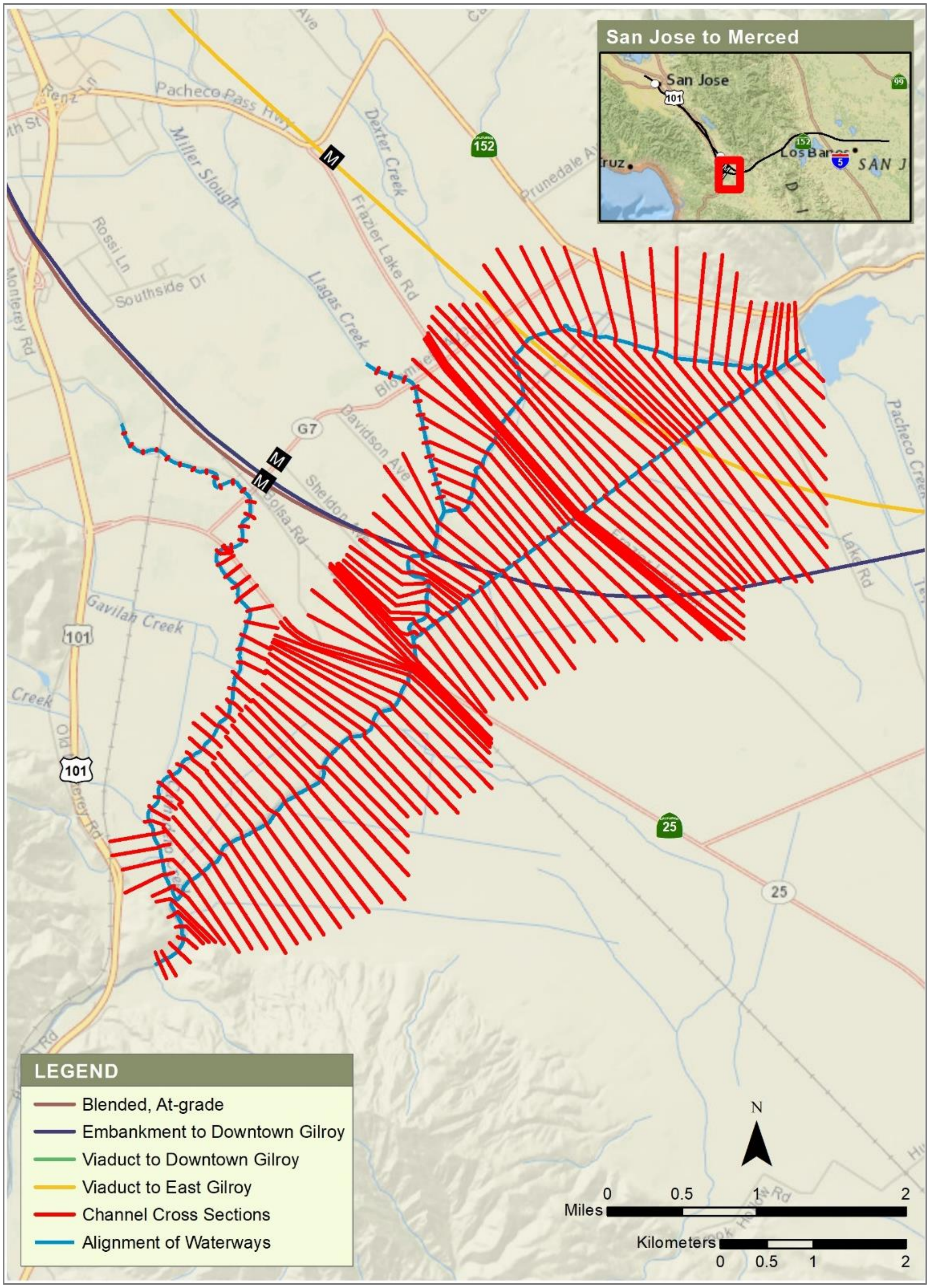
Figure 2-13 Location and Limits of the Available Hydraulic Models: Lower Llagas Creek, SCVWD Model



Sources: SCVWD 2016; Authority 2019

JANUARY 2019

Figure 2-14 Location and Limits of the Available Hydraulic Models: Uvas-Carnadero Creek, SCVWD Model



Sources: PRWFPA 2005; Authority 2019

JANUARY 2019

Figure 2-15 Location and Limits of the Available Hydraulic Models: Soap Lake (Pajaro River and Tributaries), PRWFPA Model

3 ONE-DIMENSIONAL HYDRAULIC ANALYSIS

A one-dimensional steady-state hydraulic analysis for the existing and proposed conditions were performed for the following four floodplains:

- Coyote Creek,
- West Little Llagas Creek (Mainline and Middle Avenue Overflow)
- West Branch Llagas Creek
- Llagas Creek (near San Martin, at East San Martin Avenue, at East of Gilroy, and Overbank)

This chapter provides a detailed discussion of the hydraulic analyses performed for these waterbodies for all four project alternatives.

For Coyote Creek, Llagas Creek (at San Martin, at East San Martin Avenue, at East Gilroy), the hydraulic model was provided by both FEMA and SCVWD. The hydraulic analysis was performed using both hydraulic models.

3.1 Design Tools

The HEC-RAS program, developed by the U.S. Army Corps of Engineers (USACE), was used to perform the hydraulic analyses of the four floodplains. For the hydraulic models provided in the USACE HEC-2 file format, HEC-RAS version 4.1.0 was selected to perform the hydraulic analysis.

3.2 Hydrology

The FEMA flood insurance study (FIS) for Santa Clara County, California, and Incorporated Areas, dated February 19, 2014, provided peak 100-year flow rates of the waterbodies near the project footprints. In addition, HEC-RAS hydraulic models provided by the SCVWD included 100-year flows.

The hydraulic analyses of the floodplain crossings were performed using peak 100-year flows, as specified in *Technical Memorandum 2.6.5, Hydraulics and Hydrology Design Guidelines* (Authority 2011b). Peak 100-year flows in FEMA's FIS for Santa Clara County and Incorporated Areas (last revised on February 19, 2014) (FEMA 2014) and hydraulic models provided by the SCVWD on June 3, 2016 and January 5, 2018, were compiled and reviewed (Table 3-1). The most conservative flow rates (i.e., highest) or best available data were used for the hydraulic analyses using the HEC-RAS hydraulic models. The hydraulic analysis was also performed using the FEMA effective hydraulic model and corresponding effective 100-year flood flows for the waterbodies in the FEMA detailed study. However, the FEMA effective hydraulic models may not represent the current channel condition of the floodplains, because it does not account for then recent channel improvements, new bridges, or other hydraulic structures constructed over the floodplain. Therefore, the outputs from the hydraulic analysis from the FEMA effective hydraulic models were not used to evaluate the project impacts for the waterbodies with more up-to-date hydraulic models to match the existing condition.

Table 3-1 Summary of 100-Year Flow Rates from FEMA and SCVWD

Floodplain	FEMA FIS Flow Rate (cfs)	SCVWD Flow Rate (cfs)	Type of Proposed Structures
Coyote Creek	12,630 to 15,000	15,000	New viaduct segment on the median of Monterey Road along left (west) bank of the creek and widening of Monterey Road (Alternatives 1 and 3) New embankment segment along left (west) bank of the creek and relocation of existing railroad track (Alternative 2) Share existing railroad track with UPRR and Caltrain. Second railroad track parallel to existing track would be installed at single-track segments. (Alternative 4)
West Little Llagas Creek	460 to 1,936	n/a	New viaduct segment over waterbody (Alternatives 1 and 3) New embankment segment with culvert opening over waterbody (Alternative 2) Second railroad track adjacent to existing railroad track would be installed at single-track segments (Alternative 4)
West Little Llagas Creek, Middle Avenue Overflow	658	n/a	Modifications to the roadway alignment (Alternative 2)
West Branch Llagas Creek	160 to 1,400	n/a	Modifications to the roadway alignment (Alternative 2)
Llagas Creek (at San Martin)	5,300	5,532	New viaduct segment over waterbody (Alternatives 1 and 3) New embankment segment with new bridge over waterbody, relocation of existing railroad bridge, and relocation of existing Monterey Road Bridge (Alternative 2) New 2-track railroad bridge on same alignment as existing railroad bridge (Alternative 4)
Llagas Creek (at East San Martin Avenue)	5,300	4,330	Modifications to the roadway alignment (Alternative 2)
Llagas Creek (at East Gilroy)	6,300	8,848 (17,800)[1]	New embankment segment with new bridge over creek (Alternative 3)
Llagas Overbank	900 to 7,500	n/a	New embankment segment (Alternative 3) Proposed Traction Power Switch Station (Alternatives 1 ,2 and 4)

Sources: SCVWD 2014, 2018a; FEMA 2014
FEMA = Federal Emergency Management Agency
SCVWD = Santa Clara Valley Water District
cfs = cubic feet per second
FIS = flood insurance study
UPRR = Union Pacific Railroad
[1] This flow rate of 8,848 cfs is flow remaining in the main channel of Llagas Creek at the project location. 100-year flow rate would be 17800 cfs with no spill flows on upstream of the project location.

3.3 General Hydraulic Model Assumptions

This section discusses assumptions used to perform the one-dimensional steady-state hydraulic analysis of the existing and proposed conditions. For all one-dimensional hydraulic analyses, the hydraulic model would have to be revised when more survey data and detailed project plans are available.

3.3.1 Vertical Datum (All Hydraulic Models)

Not all of the hydraulic models provided by the SCVWD provided the vertical datum referenced by the hydraulic model. Hydraulic models provided by the SCVWD without references to vertical datum were assumed to be referencing the North American Vertical Datum of 1988 (NAVD 88).

In addition, hydraulic models provided by the FEMA did not provide the vertical datum referenced by the hydraulic model. The inputs included in the FEMA hydraulic model were compared with the flood profiles included in the FEMA FIS for Santa Clara County, and it was assumed to be referencing the National Geodetic Vertical Datum of 1929 (NGVD 29) when the flood profiles from the hydraulic model are not matching with the flood profiles included in the FEMA FIS referencing NAVD 88 as vertical datum. All of the hydraulic models provided by FEMA were converted to reference NAVD 88 as vertical datum for this study.

3.3.2 Changes to Base Hydraulic Model (All Hydraulic Models)

The channel cross sections included in the HEC-2 HEC-RAS hydraulic models provided by FEMA, SCVWD, and PRWFPA were not always in the optimal locations to represent the upstream and downstream faces of the new and relocated bridges. In the proposed condition hydraulic model, the channel cross sections in the project footprint were interpolated, removed, or new cross sections were added based on available topographic information, to best represent the upstream and downstream faces of the existing and proposed bridges for all project alternatives. In this phase of the proposed project, it was assumed that these channel cross sections would best represent the channel characteristics of the waterbodies in the project footprint. These cross sections in the hydraulic models will be revised when detailed survey data becomes available.

3.3.3 Cut/Fill in the Channel Overbank Areas (All Hydraulic Models)

All four project alternatives propose modifications to the existing roadways in the project footprint. The extents of cut/fill and profile of proposed roadway were not available for all of the roadway crossings that were within the limits of the hydraulic model. Therefore, the proposed condition hydraulic model did not made changes to the channel geometry for the locations where detailed cut/fill information were not available.

3.3.4 HEC-2 Hydraulic Models

HEC-2 hydraulic model for Coyote Creek, West Little Llagas Creek, West Little Llagas Creek – Middle Avenue Overflow, West Branch Llagas Creek, Llagas Creek, and Llagas Overbank were provided to the Authority.

The hydraulic models for West Little Llagas Creek, West Little Llagas Creek - Middle Avenue Overflow, and West Branch Llagas Creek were provided to the Authority in electronical file format. These electronical files were converted into HEC-RAS version 4.1.0 to perform hydraulic analysis.

The hydraulic model for Coyote Creek, Llagas Creek, and Llagas Overbank were provided as pdf print of the inputs and outputs. The pdf print of the model inputs and outputs were compared with the hydraulic models available in the SCVWD's HEC-2/HEC-RAS library. When confirmed that they are identical, the electronic HEC-2 files from SCVWD HEC-2/HEC-RAS library are converted into HEC-RAS version 4.1.0 file format to perform hydraulic analysis.

All of the HEC-2 hydraulic models used to perform hydraulic analysis for this project were not georeferenced and did not provide alignment and limits of the channel cross sections and upstream/downstream limits of the floodplain. The upstream/downstream limits of the hydraulic model and the extents of the channel cross sections were estimated based on following available information:

- The alignments and limits of the floodplains and channel cross sections shown in the FEMA FIRM.
- Comparison of the river stations included in the HEC-2 hydraulic model and the river stations from the flood profiles included in FEMA FIS.

The alignments and limits of channel cross sections shown in the FEMA FIRM did not provide approximate location of all of the channel cross sections included in the FEMA effective hydraulic model. In addition, the width of the channel cross sections from the FEMA FIRM did not always match with the channel widths from the corresponding channel cross sections included in the FEMA effective hydraulic model. Therefore, the location of the proposed HSR structures included in the channel geometry of the proposed condition hydraulic model were based on the best estimate from the available information.

3.3.5 Upper Llagas Flood Protection Project

SCVWD's Upper Llagas Flood Protection Project would modify the alignment of floodplains and extents of the 100-year floodplain in the project footprint. This SCVWD project is divided into two phases, and first construction phase is anticipated to occur by spring 2019 (SCVWD 2018e). The start of construction for the second construction phase is not yet determined by the SCVWD.

The SCVWD hydraulic model of Llagas Creek and tributaries showed ultimate built-out condition for this project. The hydraulic model intermediate condition after completion of Phase 1 was not available. The Authority assumed Upper Llagas Flood Protection Project would be completed before the start of construction of the San Jose to Merced segment of HSR.

The FEMA effective hydraulic models for Llagas Creek (near San Martin [Section 3.6] and at East San Martin Avenue [Section 3.7]) did not include improved channels after completion of Upper Llagas Flood Protection Project, which was assumed as existing condition for the project. Therefore, hydraulic analysis outputs from FEMA effective model were not used to evaluate project's potential floodplain impacts. The outputs from the SCVWD hydraulic model were used to evaluate the project's potential floodplain impacts.

After completion of Upper Llagas Flood Protection Project, existing floodplains for West Little Llagas Creek (Section 3.5), West Little Llagas Creek – Middle Avenue Overflow (Section 3.8), and Llagas Overbank (Section 3.11) in the project footprint would not be classified as 100-year floodplain. Therefore, hydraulic analysis outputs from FEMA effective model were not used to evaluate project's potential floodplain impacts. Because these floodplains were not included in the SCVWD hydraulic model and would be outside of the 100-year floodplain, project's potential impacts on the floodplain were not evaluated for these three existing floodplain.

3.4 Coyote Creek

3.4.1 Background Information

3.4.1.1 Floodplain Location

Coyote Creek begins at its headwaters at Anderson Reservoir and Dam and runs through the cities of Morgan Hill and San Jose before draining to the San Francisco Bay (Authority 2011a). In Morgan Hill, Coyote Creek has remained natural and includes a multipurpose recreational trail and wetlands areas.

3.4.1.2 FEMA Floodplain

According to the FEMA FIRM Panel Numbers 60685C0407H, 60685C0426H, 60685C0428H, 60685C0429H, 60685C0437H, and 60685C0441H (FEMA 2009), the main channel of Coyote Creek in the project footprint is identified as Zone AE with floodway (Figure 3-1 and Figure 3-2).

Coyote Creek in project footprint is recognized as a floodway. Therefore, the project cannot raise the 100-year flood profile of Coyote Creek.

3.4.1.3 Project Alternatives in the FEMA Floodplain

The permanent project footprints for all four project alternatives are in the existing 100-year floodplain for Coyote Creek (Figure 3-1 and Figure 3-2). Coyote Creek flows toward the southwest in the project vicinity, and Monterey Road and existing railroad track parallels Coyote Creek in the project footprint. None of the alternatives would entail hydraulic structures spanning Coyote Creek.

The proposed HSR viaduct section (Alternatives 1 and 3) follows the southwestern bank of Coyote Creek. This alternative requires widening of Monterey Highway to construct pier columns for viaduct section in the median of Monterey Highway.

The proposed embankment section for Alternative 2 follows the southwestern bank of Coyote Creek. This alternative would require realignment of exiting Monterey Highway and railroad track to accommodate two railroad tracks for the HSR.

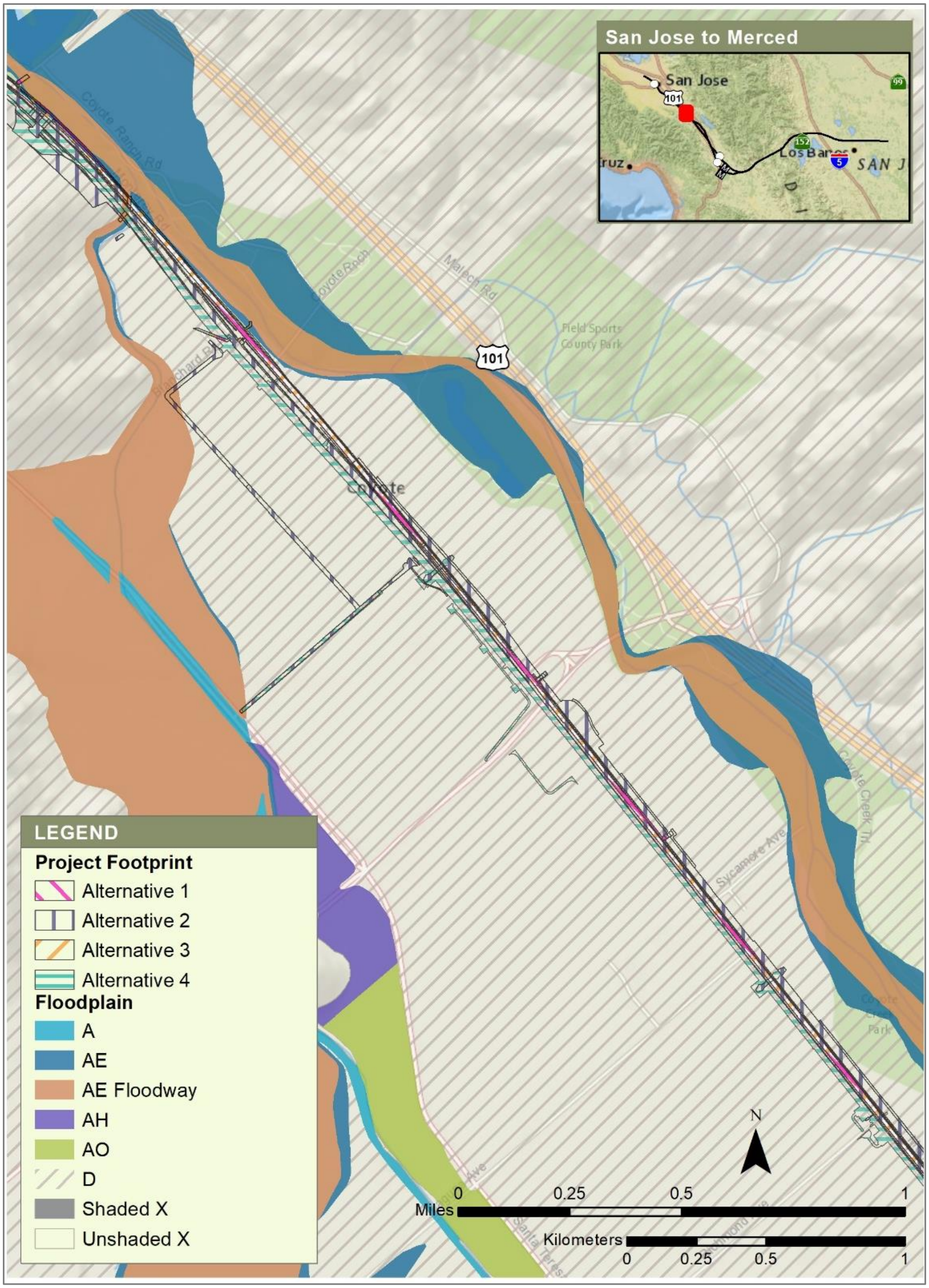
Alternative 4 proposes a blended at-grade track using the existing railroad track which is following the southwestern bank of Coyote Creek. This alternative require construction of additional railroad track at a single-track segment under the existing condition.

All project alternatives are proposing wildlife crossings under the existing railroad track and/or Monterey Highway.

3.4.1.4 Available Hydraulic Models

The FEMA effective hydraulic model and the SCVWD hydraulic model were available for this floodplain. Figure 3-3, Figure 3-4, and Figure 3-5 shows the approximate limits of the FEMA effective hydraulic model and the permanent project footprint for Alternatives 1 and 3, Alternative 2, and Alternative 4 along Coyote Creek, respectively. Figure 3-6, Figure 3-7, and Figure 3-8 shows the limits of the SCVWD hydraulic model and the permanent project footprint for Alternatives 1 and 3, Alternative 2, and Alternative 4 along Coyote Creek, respectively.

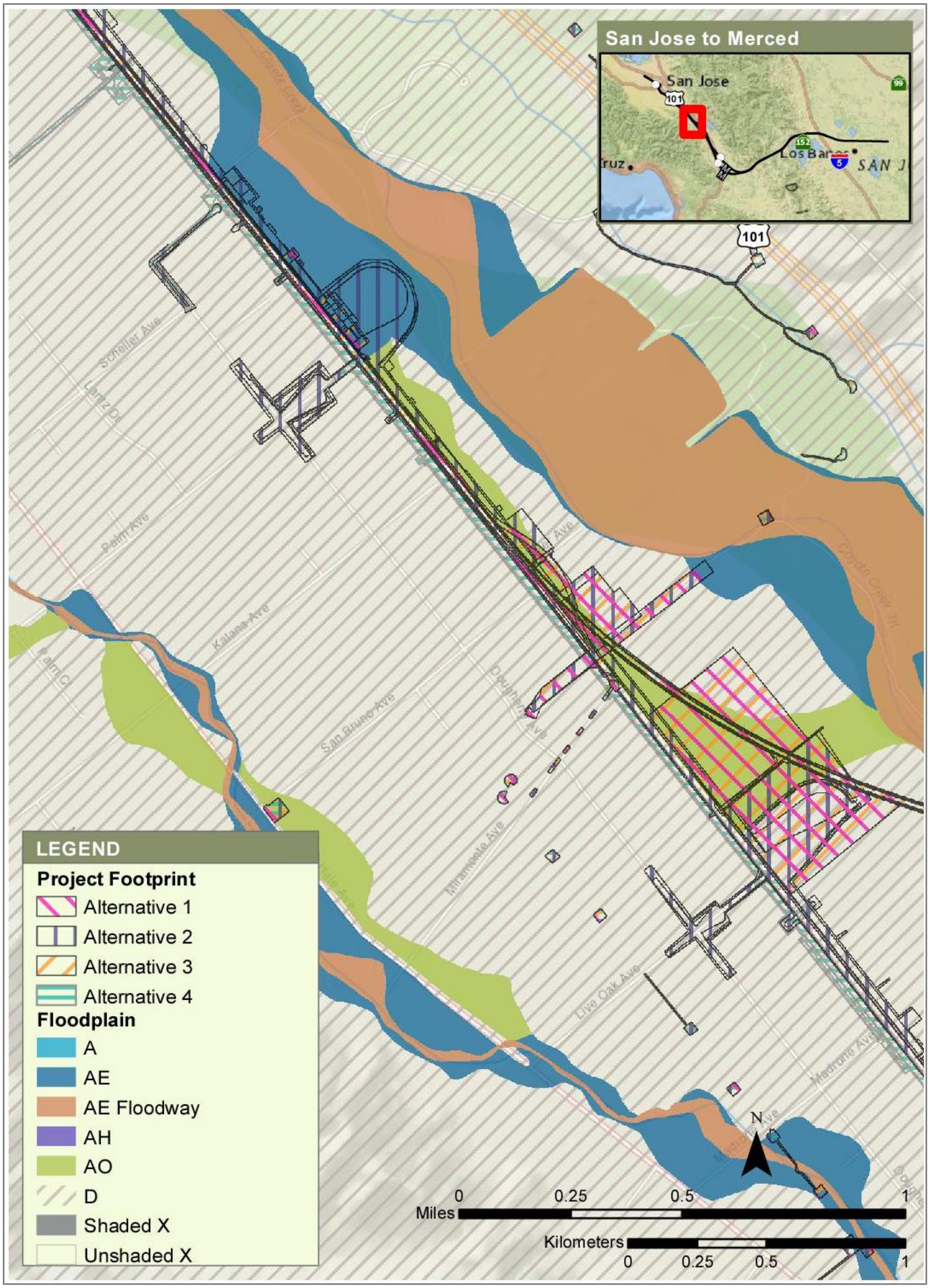
The FEMA effective hydraulic model provided does not include up-to-date available information that were included in the SCVWD hydraulic model. Therefore, the SCVWD hydraulic model was used to evaluate the project’s potential impacts.



Sources: FEMA 2009; Authority 2019 .

JANUARY 2019

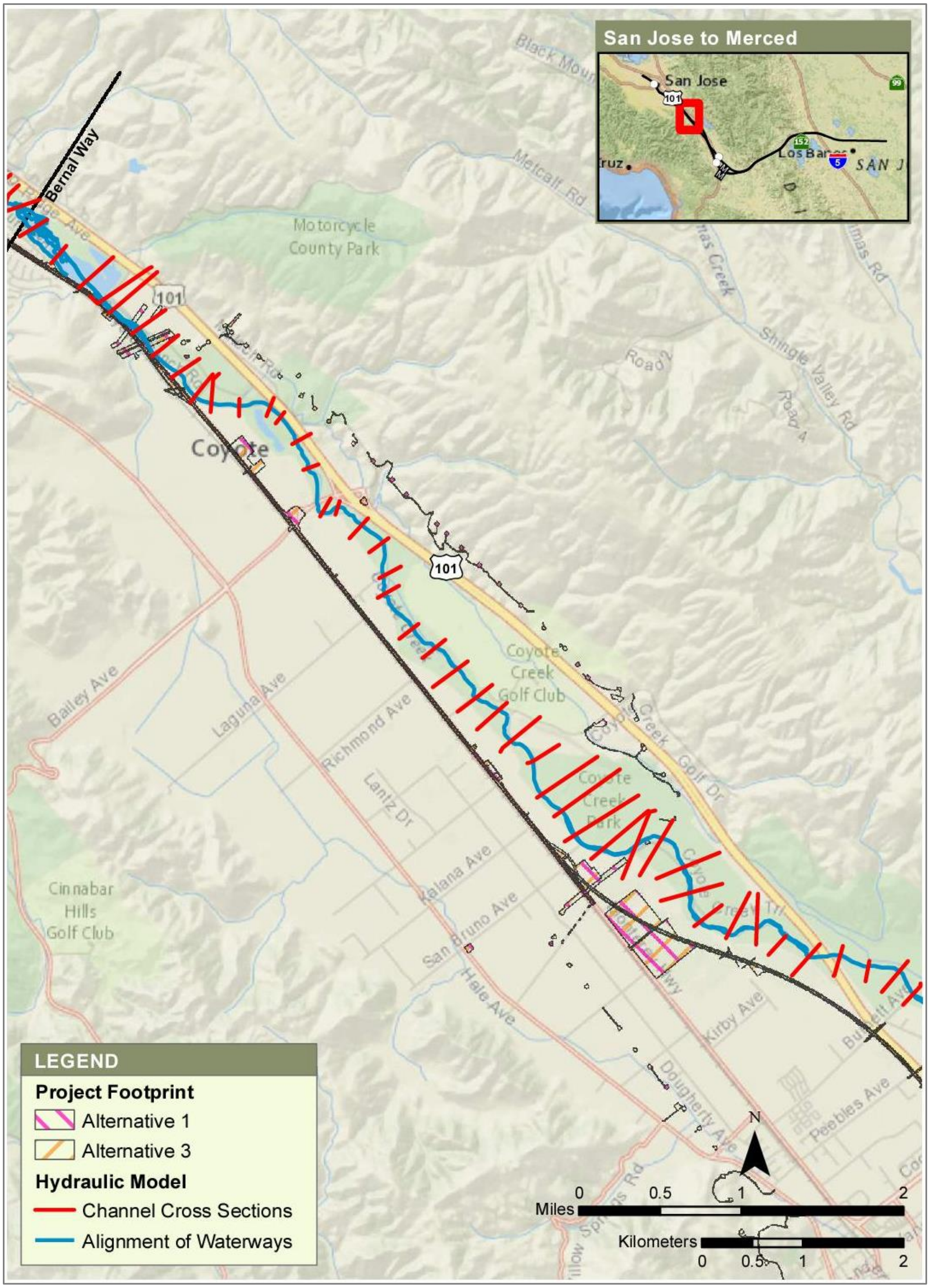
Figure 3-1 Coyote Creek, FEMA FIRM Overlay with Project Footprints for Alternatives 1, 2, 3, and 4, Page 1/2



Sources: FEMA 2009; Authority 2019 .

JANUARY 2019

Figure 3-2 Coyote Creek, FEMA FIRM Overlay with Project Footprints for Alternatives 1, 2, 3, and 4, Page 2/2

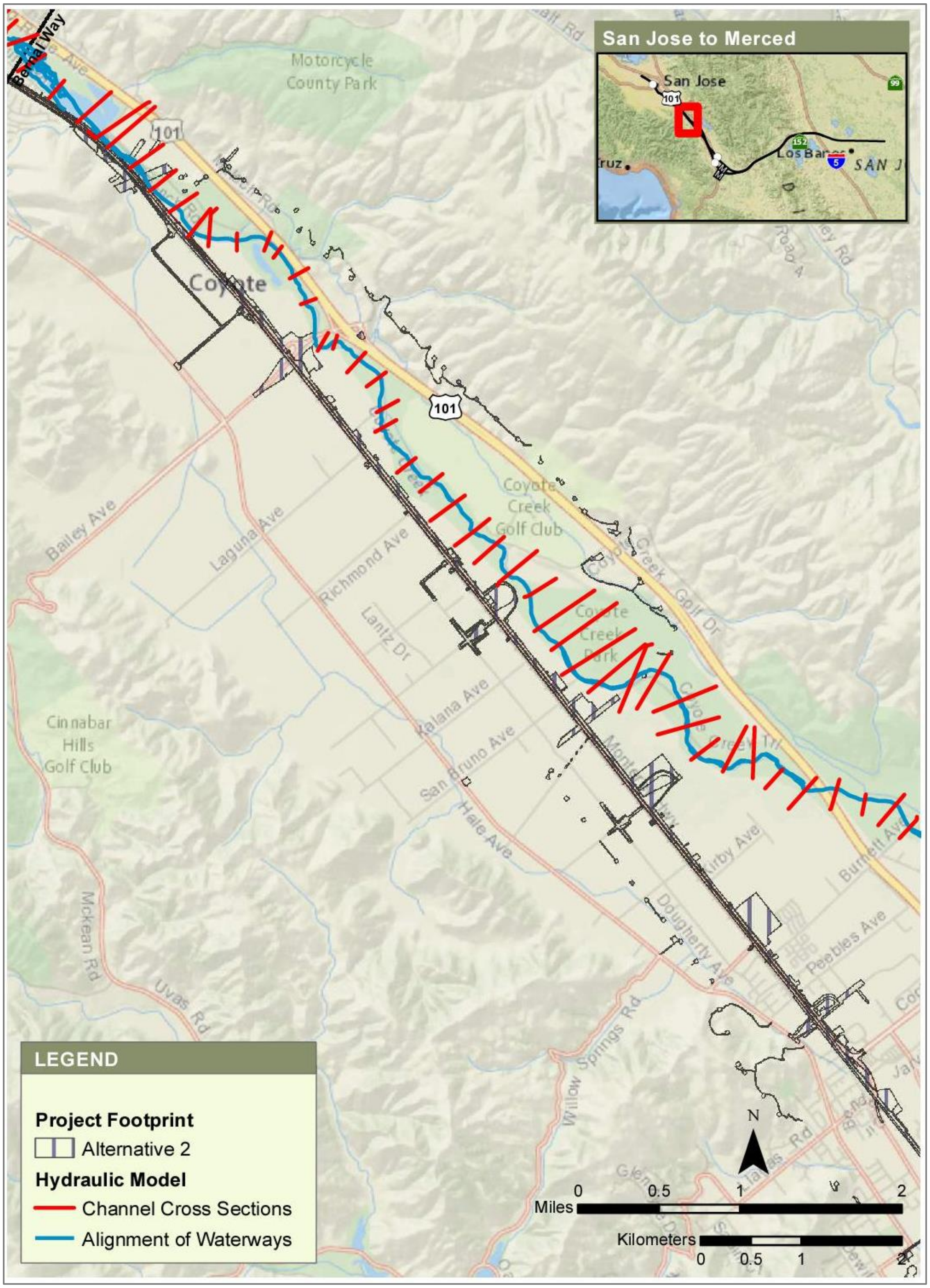


Sources: FEMA 2018; Authority 2019.

JANUARY 2019

Note: This figure does not display all channel cross sections included in the hydraulic model.

Figure 3-3 Coyote Creek, Plan View of FEMA Effective Hydraulic Model with Project Footprint for Alternatives 1 and 3

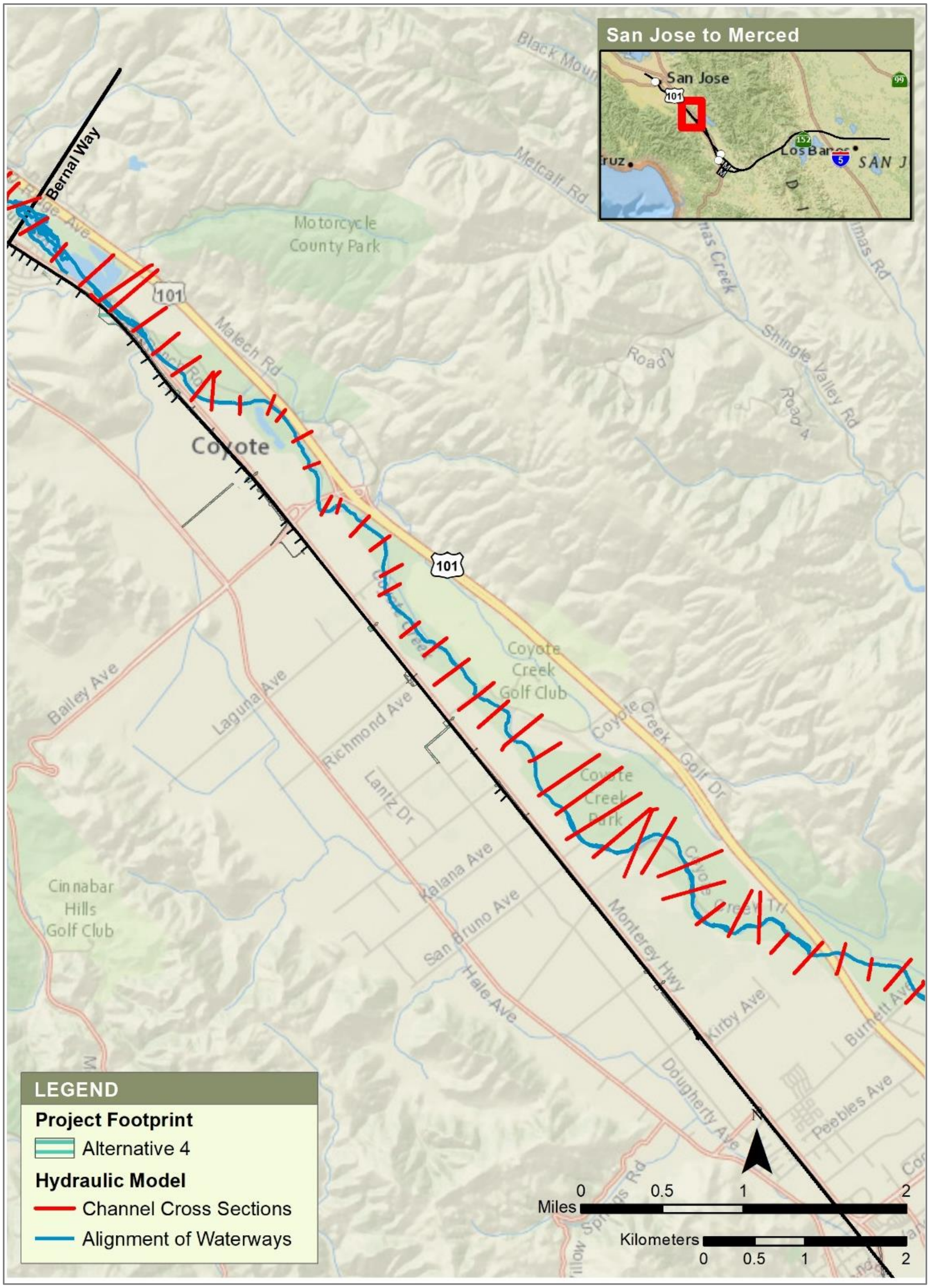


Sources: FEMA 2018; Authority 2019.

JANUARY 2019

Note: This figure does not display all channel cross sections included in the hydraulic model.

Figure 3-4 Coyote Creek, Plan View of FEMA Effective Hydraulic Model with Project Footprint for Alternative 2

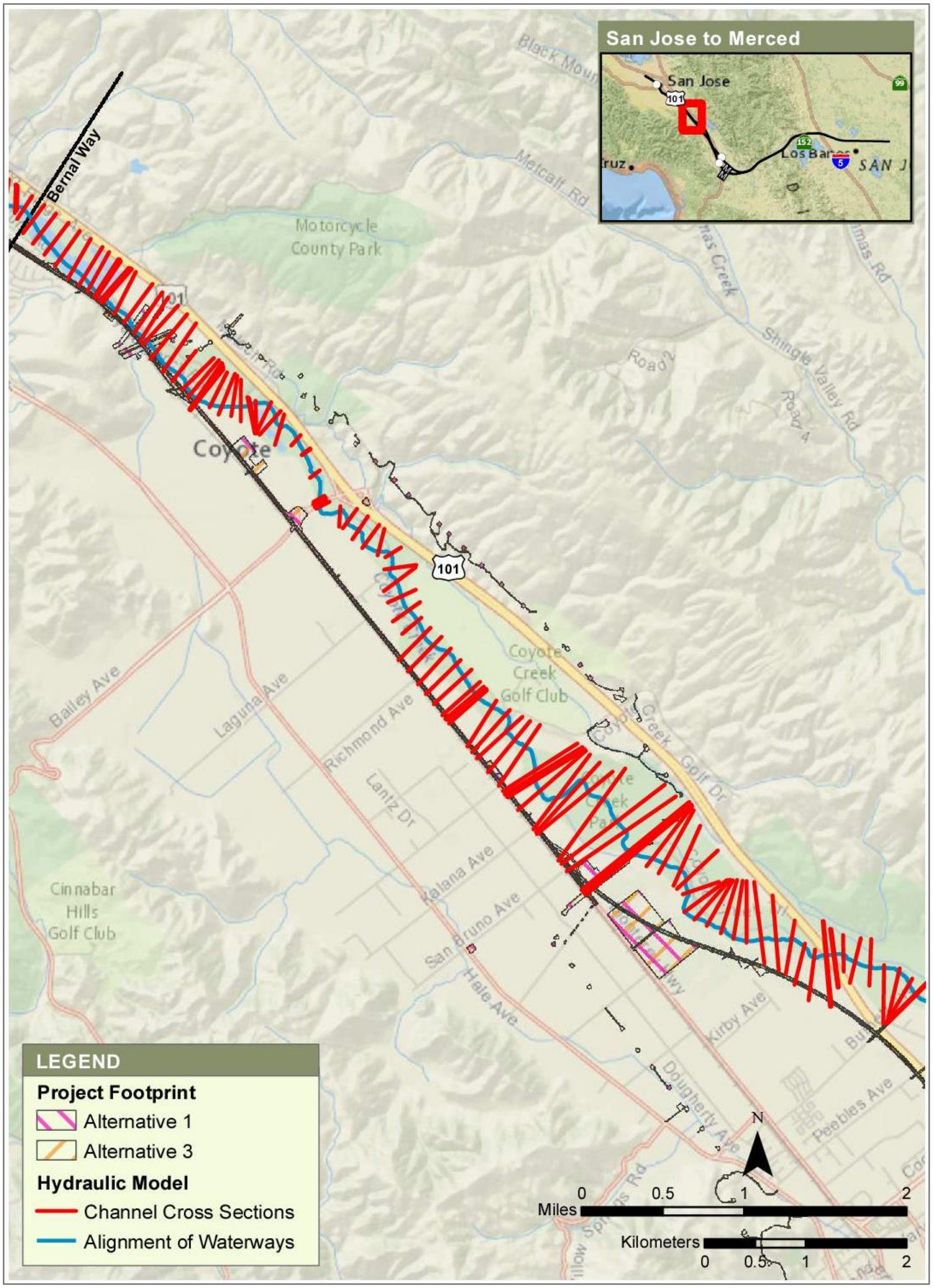


Sources: FEMA 2018; Authority 2019.

JANUARY 2019

Note: This figure does not display all channel cross sections included in the hydraulic model.

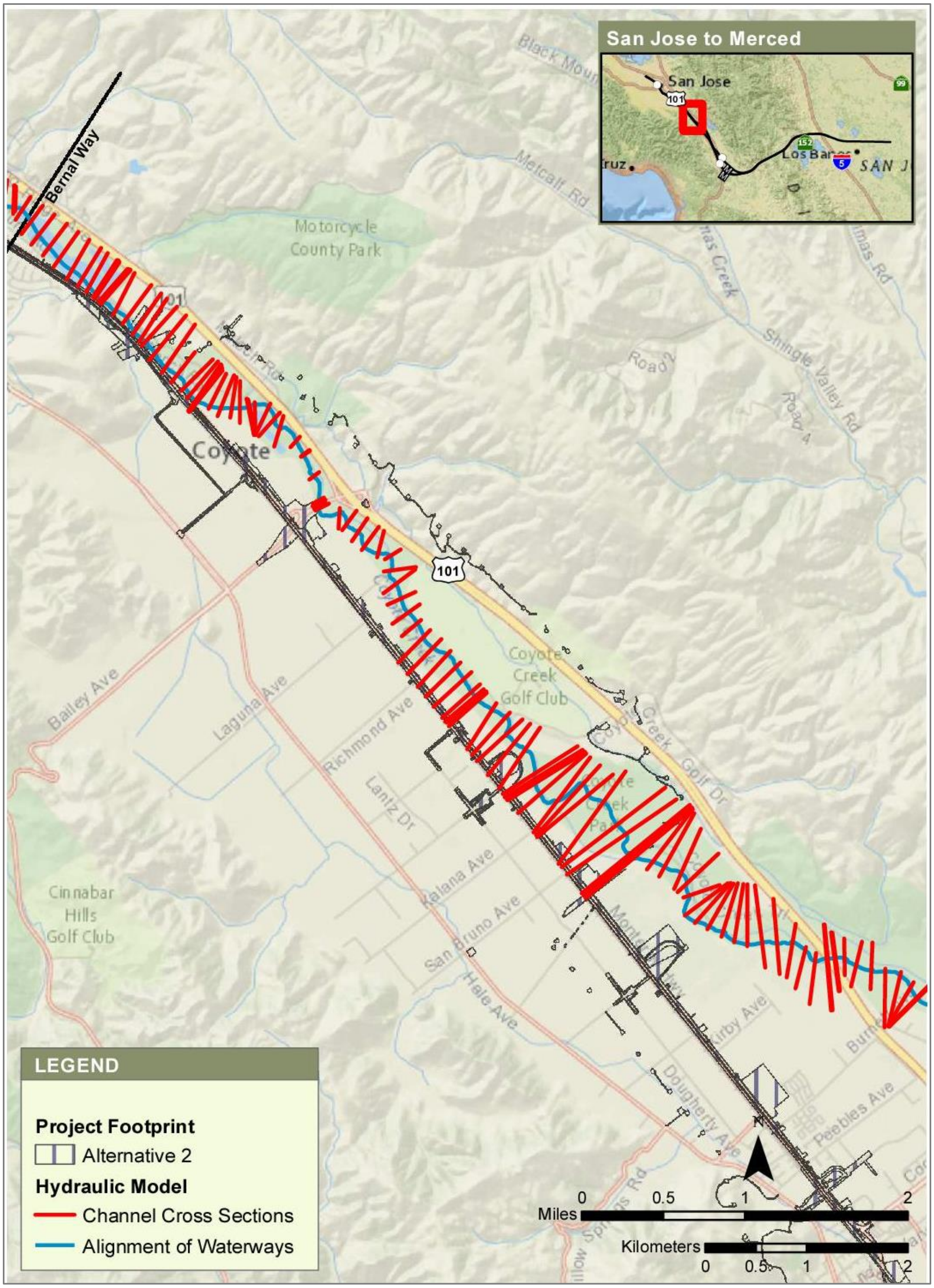
Figure 3-5 Coyote Creek, Plan View of FEMA Effective Hydraulic Model with Project Footprint for Alternative 4



Sources: SCVWD 2014; Authority 2019 .

JANUARY 2019

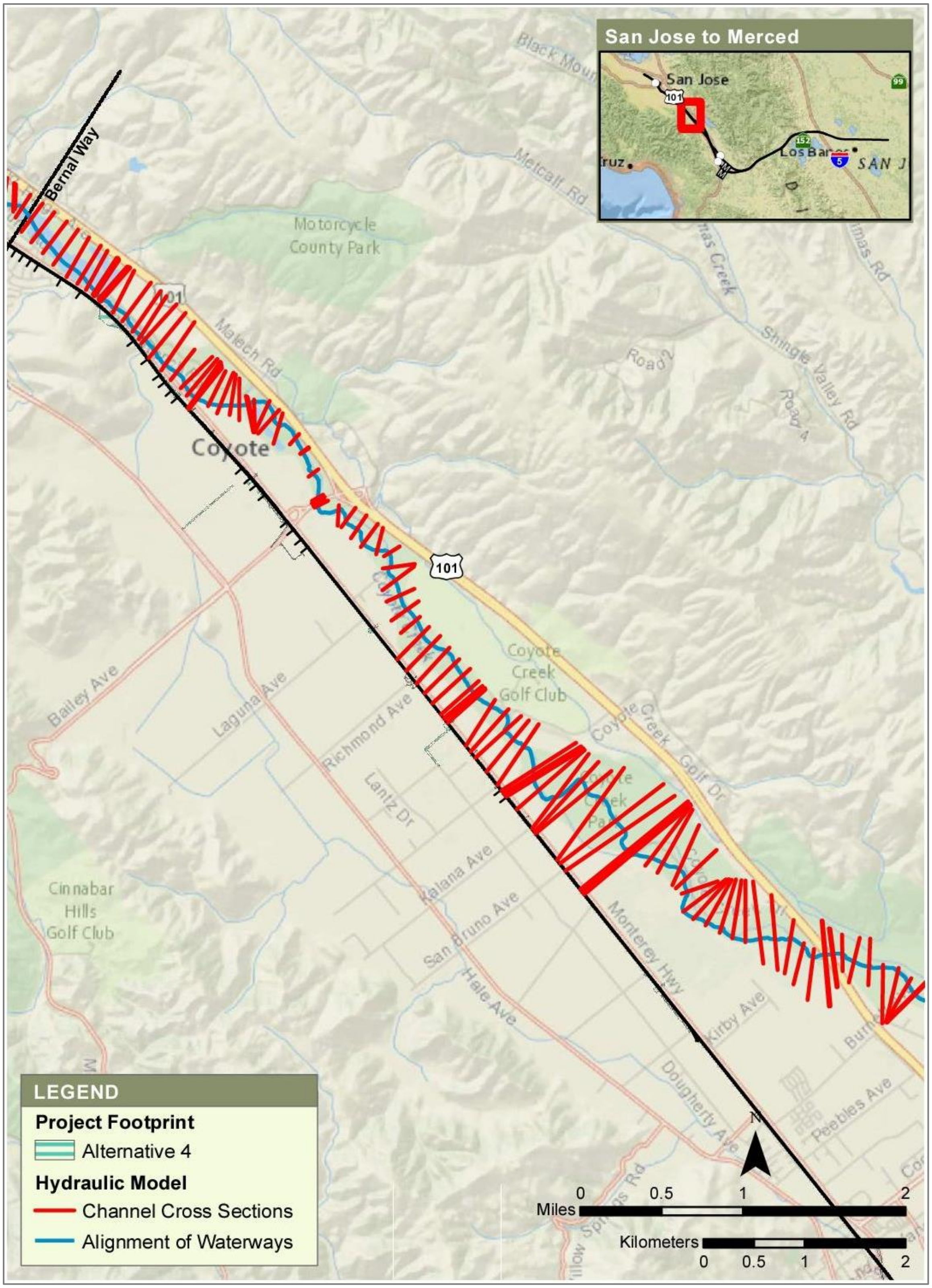
Figure 3-6 Coyote Creek, Plan View of SCVWD Hydraulic Model with Project Footprint for Alternatives 1 and 3



Sources: SCVWD 2014; Authority 2019 .

JANUARY 2019

Figure 3-7 Coyote Creek, Plan View of SCVWD Hydraulic Model with Project Footprint for Alternative 2



Sources: SCVWD 2014; Authority 2019 .

JANUARY 2019

Figure 3-8 Coyote Creek, Plan View of SCVWD Hydraulic Model with Project Footprint for Alternative 4

3.4.2 FEMA Effective Hydraulic Model

3.4.2.1 Overview of Hydraulic Model

The pier columns supporting the proposed viaduct segment on top of the Monterey Road for Alternatives 1 and 3 were represented in the proposed condition hydraulic model by adding piers into channel cross sections.

The limits of the FEMA effective model as shown in the channel information included in the FEMA digital FIRM for Santa Clara County extends into project footprint for Alternatives 2 and 4. However, the limits of the FEMA effective model where it extended into the permanent impact areas are at the locations where detailed grading plan is not available or areas with no fill inside the limits of the FEMA effective hydraulic model. Therefore, hydraulic analysis for Alternatives 2 and 4 were not performed using the FEMA effective hydraulic model.

3.4.2.2 Water Surface Elevations

The modeling results for the viaduct structure over Old Monterey Road (Alternatives 1 and 3), is shown in Table 3-2. The outputs for Alternatives 1 and 3 do not show increases in the 100-year flood profile inside the Coyote Creek main channel.

However, the flood profile of Coyote Creek from the hydraulic analysis is not representing the current condition of Coyote Creek, because it did not include the existing US 101/SR 85 Interchange Bridge over Coyote Creek located in the project vicinity. In addition, the extent of the channel cross sections in the southwestern overbank areas were not extended sufficiently to include the permanent project footprint for all proposed alternatives along Coyote Creek. Therefore, outputs from the hydraulic analysis using the FEMA effective hydraulic model was not used to evaluate the project's potential impacts on the existing 100-year floodplain.

Table 3-2 Hydraulic Modeling Results, Coyote Creek, Alternatives 1 and 3, FEMA Model

Location	Flow Rate (cfs)	Channel Bank Elevation (feet NAVD 88)	WSE—Existing Condition (feet NAVD 88)	WSE—Proposed Condition (feet NAVD 88)	Change in WSE (feet)
At Metcalf Rd	14,850	244.4	243.9	243.9	0.0
Upstream of Sycamore Avenue	15,000	270.5	268.5	268.5	0.0
At Coyote Creek Golf Drive	15,000	296.6	300.3	300.3	0.0
At Barnhart Ave	15,000	322.0	321.5	321.5	0.0
At US 101	15,000	355.5	348.4	348.4	0.0

Elevations are rounded to the nearest 0.1 foot.
FEMA = Federal Emergency Management Agency
cfs = cubic feet per second
NAVD 88 = North American Vertical Datum of 1988
WSE = water surface elevation
US = U.S. Highway

3.4.3 SCVWD Hydraulic Model

3.4.3.1 Overview of Hydraulic Model

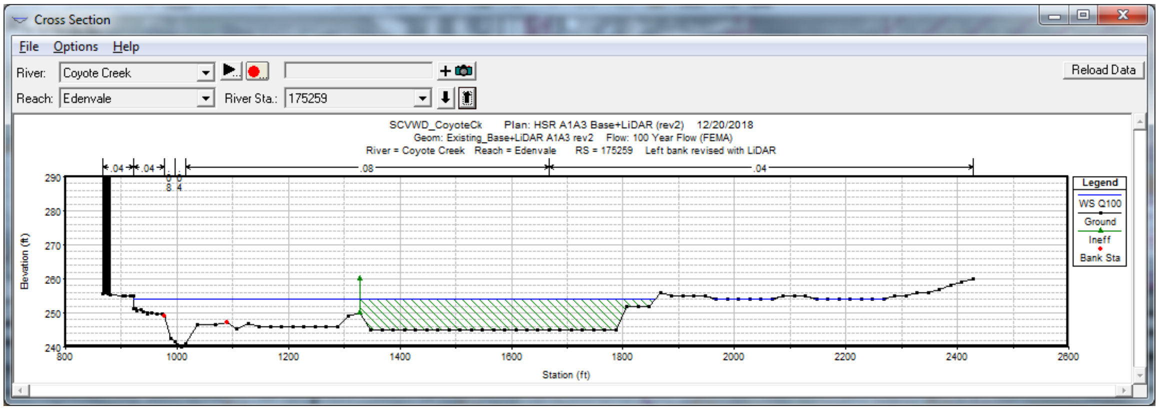
The upstream and downstream limits of the hydraulic model were outfalls from Anderson Reservoir and at the I-280 bridge, respectively. The distance between the upstream and downstream limits of the hydraulic model is approximately 22.4 miles and is represented by 371 channel cross sections. The extents of the channel cross sections for Coyote Creek in the SCVWD model along Monterey Highway is generally wider than the current effective FEMA model.

Anderson Reservoir is in unincorporated Santa Clara County just northeast of Morgan Hill. The reservoir outfall is located approximately 2 miles east of U.S. Highway (US) 101 and approximately 3 miles east of Old Monterey Road (Alternatives 1 and 3) and existing railroad track (Alternative 2). The I-280 bridge over Coyote Creek is approximately 2 miles east of the existing San Jose Diridon Station. Coyote Creek flows parallel to the proposed HSR alignment along the Monterey Corridor Subsection.

The pier columns supporting the proposed viaduct segment on top of the Monterey Road for Alternatives 1 and 3 were represented in the proposed condition hydraulic model by adding piers into channel cross sections. The cross-sectional geometry of the western bank that is in the footprint of Alternatives 1 and 3 were modified to represent the widening of the Monterey Road. Metcalf Road bridge included in the hydraulic model was modified to represent the proposed replacement of Metcalf Road bridge (Figure 3-9).

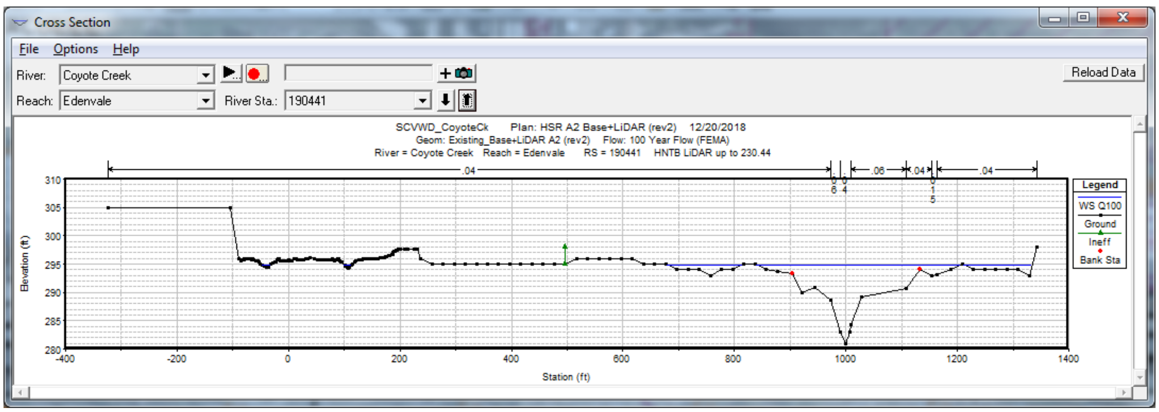
The proposed embankment sections for Alternatives 2 and 4 were represented in the proposed condition hydraulic model by adjusting the channel geometry of the channel cross sections in the footprint of Alternative 2 (Figure 3-10) and Alternative 4 (Figure 3-11). The hydraulic model for Alternative 2 also included the relocation of Monterey Road and the new overcrossing for Palm Avenue. The pavement elevation of Monterey Road in the Alternative 2 hydraulic model was assumed to be the same as the top of rail elevation.

Temporary - HEC-RAS Cross Sections



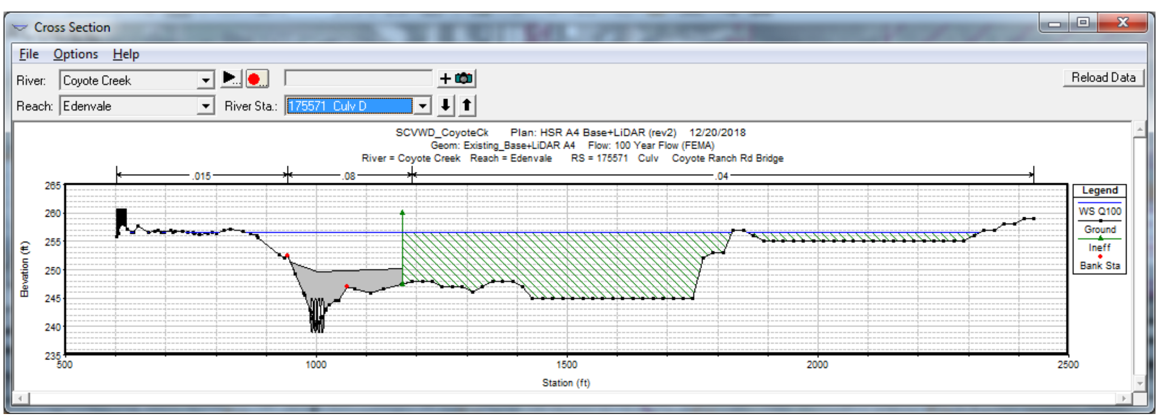
JANUARY 2019

Figure 3-9 Coyote Creek, HEC-RAS Channel Cross Section with Proposed Pier Columns for Alternatives 1 and 3



JANUARY 2019

Figure 3-10 Coyote Creek, HEC-RAS Channel Cross Section with Proposed Embankment Section for Alternative 2



JANUARY 2019

Figure 3-11 Coyote Creek, HEC-RAS Channel Cross Section with Proposed Embankment Section for Alternative 4

3.4.3.2 Water Surface Elevations

The modeling results for the viaduct structure over Old Monterey Road (Alternatives 1 and 3), the embankment structure between the existing railroad tracks and Old Monterey Road (Alternative 2), and existing and the additional railroad tracks (Alternative 4) are shown in Table 3-3, Table 3-4, and Table 3-5, respectively. The outputs for Alternatives 1, 3, and 4 showed increases to the vertical profile of Coyote Creek within the limits of the hydraulic model. The outputs for Alternative 2 showed a WSE increase of approximately 0.05 foot at the Palm Avenue overcrossing.

Table 3-3 Hydraulic Modeling Results, Coyote Creek, Alternatives 1 and 3

Location	Flow Rate (cfs)	Channel Bank Elevation (feet NAVD 88)	WSE—Existing Condition (feet NAVD 88)	WSE—Proposed Condition (feet NAVD 88)	Change in WSE (feet)
At SR85/US 101	15,000	228.0	228.5	228.5	0.0
At Metcalf Rd	15,000	247.5	243.8	243.5	-0.3
At Coyote Ranch Rd	15,000	257.1	256.6	256.6	0.0
At Bailey Ave	15,000	270.3	270.9	270.9	0.0
At Coyote Creek Golf Drive	15,000	301.0	299.9	299.9	0.0
At Barnhart Ave	15,000	321.6	320.5	320.5	0.0
At US 101	15,000	357.2	359.0	359.0	0.0

Elevations are rounded to the nearest 0.1 foot.
cfs = cubic feet per second
NAVD 88 = North American Vertical Datum of 1988
WSE = water surface elevation
SR= State Route
US = U.S. highway

Table 3-4 Hydraulic Modeling Results, Coyote Creek, Alternative 2

Location	Flow Rate (cfs)	Channel Bank Elevation (feet NAVD 88)	WSE—Existing Condition (feet NAVD 88)	WSE—Proposed Condition (feet NAVD 88)	Change in WSE (feet)
At SR85/US 101	15,000	228.0	228.5	228.5	0.0
At Metcalf Rd	15,000	247.5	243.8	243.8	0.0
At Coyote Ranch Rd	15,000	257.1	256.6	256.6	0.0
At Bailey Ave	15,000	270.3	270.9	270.9	0.0
At Coyote Creek Golf Drive	15,000	301.0	299.9	299.9	0.0

Location	Flow Rate (cfs)	Channel Bank Elevation (feet NAVD 88)	WSE—Existing Condition (feet NAVD 88)	WSE—Proposed Condition (feet NAVD 88)	Change in WSE (feet)
At Proposed Palm Avenue Overcrossing	15,000	303.8	306.61	306.66	+0.05
At Barnhart Ave	15,000	321.6	320.5	320.5	0.0
At US 101	15,000	357.2	359.0	359.0	0.0

Elevations are rounded to the nearest 0.1 foot.
cfs = cubic feet per second
NAVD 88 = North American Vertical Datum of 1988
WSE = water surface elevation
SR= State Route
US = U.S. highway

Table 3-5 Hydraulic Modeling Results, Coyote Creek, Alternative 4

Location	Flow Rate (cfs)	Channel Bank Elevation (feet NAVD 88)	WSE—Existing Condition (feet NAVD 88)	WSE—Proposed Condition (feet NAVD 88)	Change in WSE (feet)
At SR85/US 101	15,000	228.0	228.5	228.5	0.0
At Metcalf Rd	15,000	247.5	243.8	243.8	0.0
At Coyote Ranch Rd	15,000	257.1	256.6	256.6	0.0
At Bailey Ave	15,000	270.3	270.9	270.9	0.0
At Coyote Creek Golf Drive	15,000	301.0	299.9	299.9	0.0
At Barnhart Ave	15,000	321.6	320.5	320.5	0.0
At US 101	15,000	357.2	359.0	359.0	0.0

Elevations are rounded to the nearest 0.1 foot.
cfs = cubic feet per second
NAVD 88 = North American Vertical Datum of 1988
WSE = water surface elevation
SR= State Route
US = U.S. highway

3.5 West Little Llagas Creek

3.5.1 Background Information

3.5.1.1 Floodplain Location

West Little Llagas Creek is a tributary of Llagas Creek that flows through the City of Morgan Hill and San Martin (census-designated place). The confluence with Llagas Creek is immediately downstream of the US 101 cross culvert in San Martin, at 37° 6'21.22" North, 121°36'44.54"West. The existing railroad bridge over West Little Llagas Creek is located approximately 3,700 feet west of the US 101 cross culvert.

West Little Llagas Creek is in the footprint of Upper Llagas Flood Protection Project, and is potentially subject to the USACE Section 404 and 408 permitting process.

3.5.1.2 FEMA Floodplain

According to the FEMA FIRM Panel Numbers 60685C0607H and 60685C0626H (FEMA 2009, 2014), the main channel and overbank flow of West Little Llagas Creek in the project footprint for all four Alternatives is identified as Zone AE (Figure 3-12).

West Little Llagas Creek in the project footprint is recognized as FEMA 100-year floodplain. Therefore, project cannot raise the flood profile of West Little Llagas Creek by more than 1.0 foot.

SCVWD's Upper Llagas Flood Protection Project would reroute West Little Llagas Creek to flow southeast, west of Monterey Highway (see Reach 7a in Figure 3-13). With completion of Upper Llagas Flood Protection Project, rerouted West Little Llagas and the 100-year floodplain for West Little Llagas Creek would be located outside of the project footprint for all four alternatives (Figure 3-14). Therefore, project's potential floodplain impacts were not evaluated for the existing West Little Llagas Creek in the project footprint.

3.5.1.3 Project Alternatives in the FEMA Floodplain

The project footprints for all four project alternatives are in the existing 100-year floodplain for West Little Llagas Creek (Figure 3-12).

Alternatives 1 and 3 propose viaduct segment over the existing 100-year floodplain for West Little Llagas Creek at approximately station 1237+00 and approximately 1,800 feet west of the existing railroad crossing over the creek. The width of the Zone AE floodplain measured along the centerline of the proposed track alignment for Alternatives 1 and 3 is approximately 1,900 feet, and the proposed pier columns would be located inside the existing 100-year floodplain.

Alternative 2 proposes new embankment section adjacent to the east side of the existing railroad track. This alternative would remove existing railroad bridge over West Little Llagas Creek and replace it with the new cross culvert for below existing railroad track and proposed HSR embankment at approximately station 1307+50. The width of the Zone AE floodplain measured along the centerline of the proposed track alignment for Alternative 2 is approximately 2,700 feet.

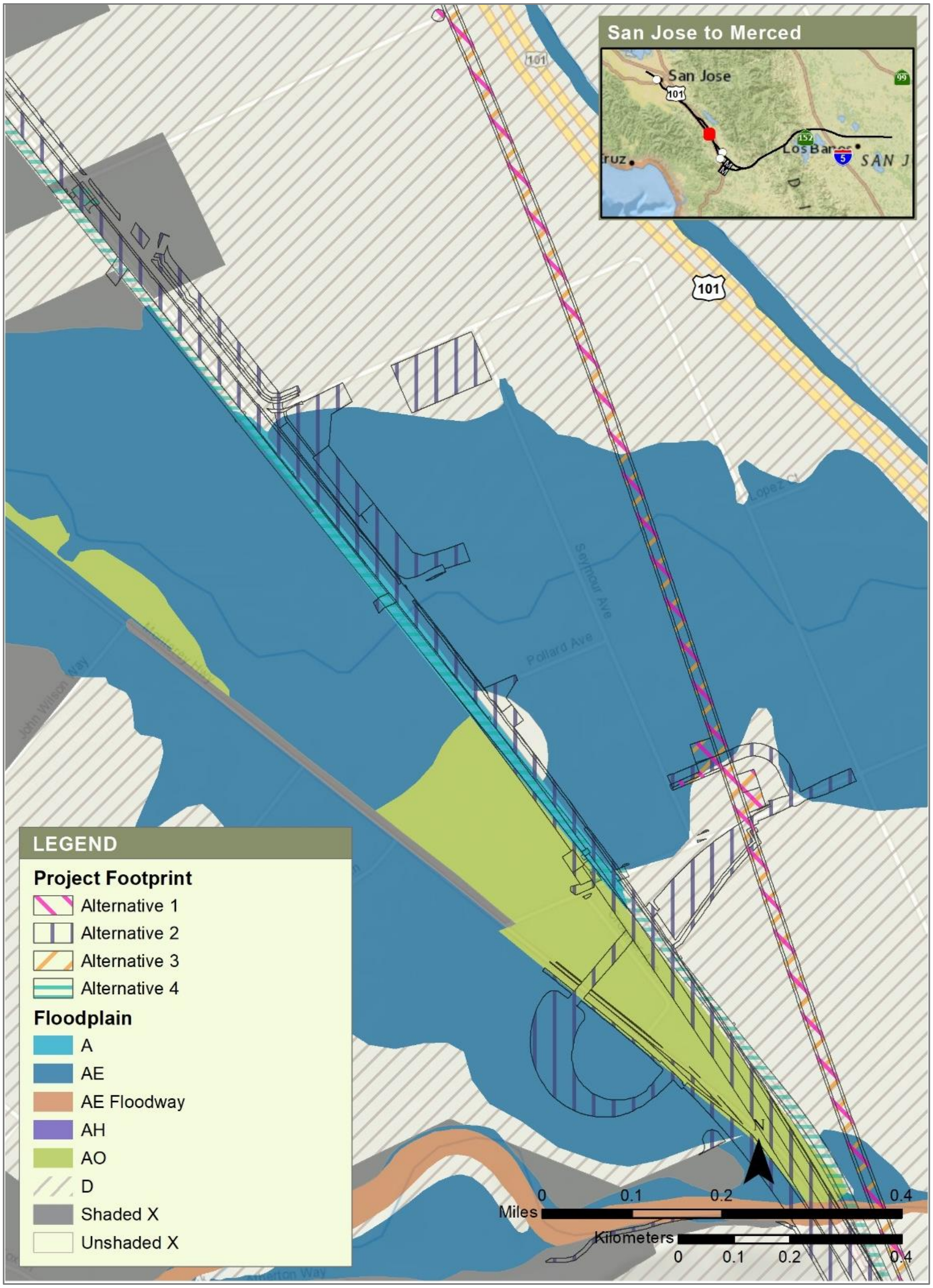
Alternative 4 proposes a blended at-grade segment using the existing railroad track, where existing single-track segment would be modified to double-track segment. This alternative would remove existing railroad bridge and replace it with new cross culvert at same location as the existing bridge, located at approximately station 1257+00. The width of the Zone AE floodplain measured along the centerline of the proposed track alignment for Alternative 4 is approximately 2,700 feet.

3.5.1.4 Available Hydraulic Models

The FEMA effective hydraulic model and SCVWD hydraulic model were available for West Little Llagas Creek.

Because the SCVWD hydraulic model only included the post-project condition for the Upper Llagas Creek Flood Protection Project, West Little Llagas Creek included in the hydraulic model was located outside of the project footprint. Therefore, SCVWD hydraulic model was not used to evaluate potential floodplain impacts from the project.

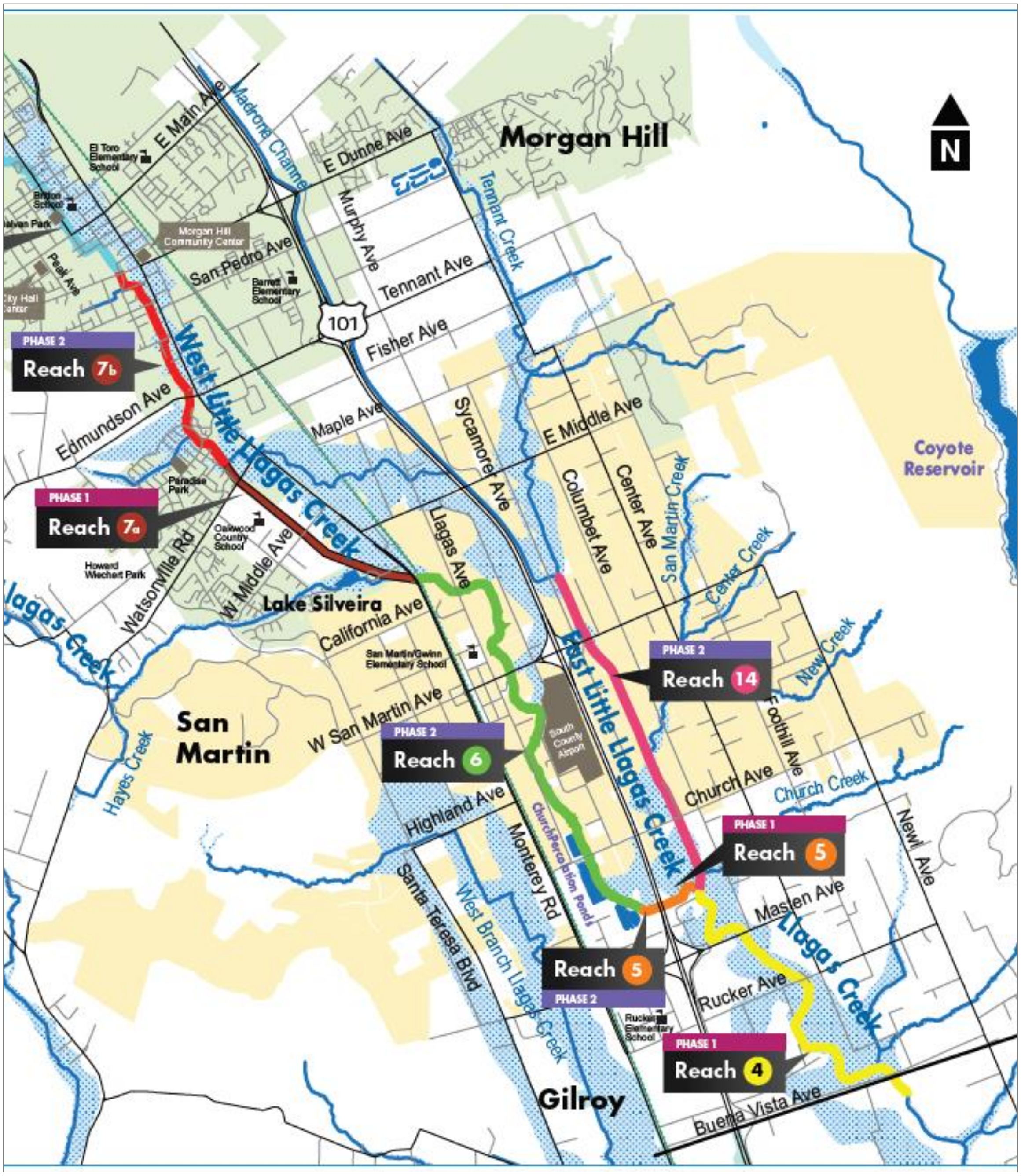
The hydraulic analysis was performed using FEMA's effective hydraulic model. Figure 3-15, Figure 3-16, and Figure 3-17 shows the approximate limits of the FEMA effective hydraulic model and the permanent project footprint for Alternatives 1 and 3, Alternative 2, and Alternative 4 at West Little Llagas Creek, respectively. However, because existing condition for HSR was assumed to be after completion of Upper Llagas Flood Protection Project, the outputs from the hydraulic analysis would not be used to evaluate the project's potential impact on the existing floodplain.



Sources: FEMA 2009; Authority 2019 .

JANUARY 2019

Figure 3-12 West Little Llagas Creek, FEMA FIRM Overlay with Project Footprints for Alternatives 1, 2, 3, and 4



Sources: SCVWD 2018e;

JANUARY 2019

Figure 3-13 Plan View of SCVWD's Upper Llagas Flood Protection Project

Sources: FEMA 2009; Authority 2019; SCVWD 2018f

January 2019

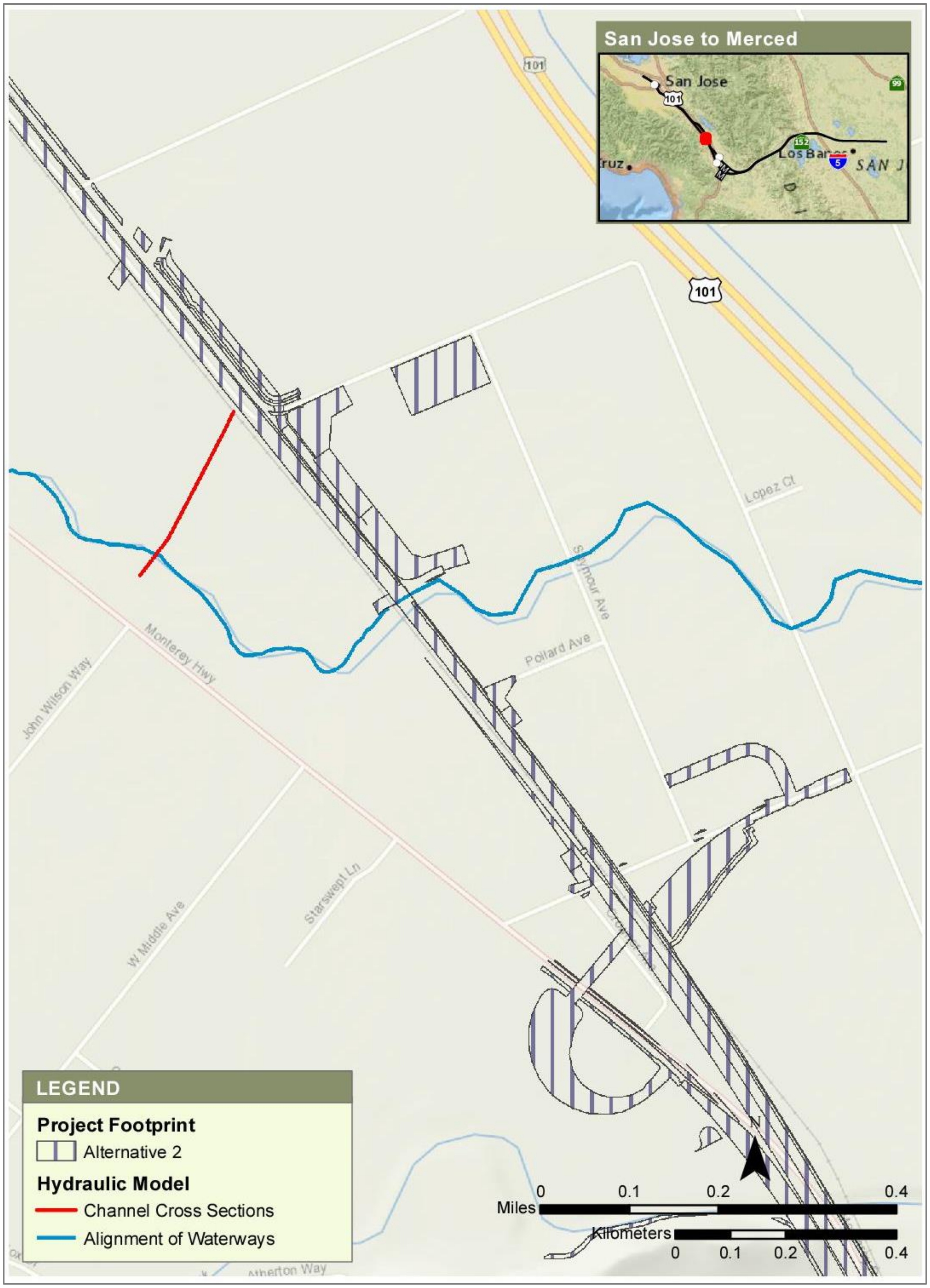
Figure 3-14 West Little Llagas Creek, Floodplain after Completion of Upper Llagas Flood Protection Project with Project Footprints for Alternatives 1, 2, 3, and 4

Sources: FEMA 2018; Authority 2019

JANUARY 2019

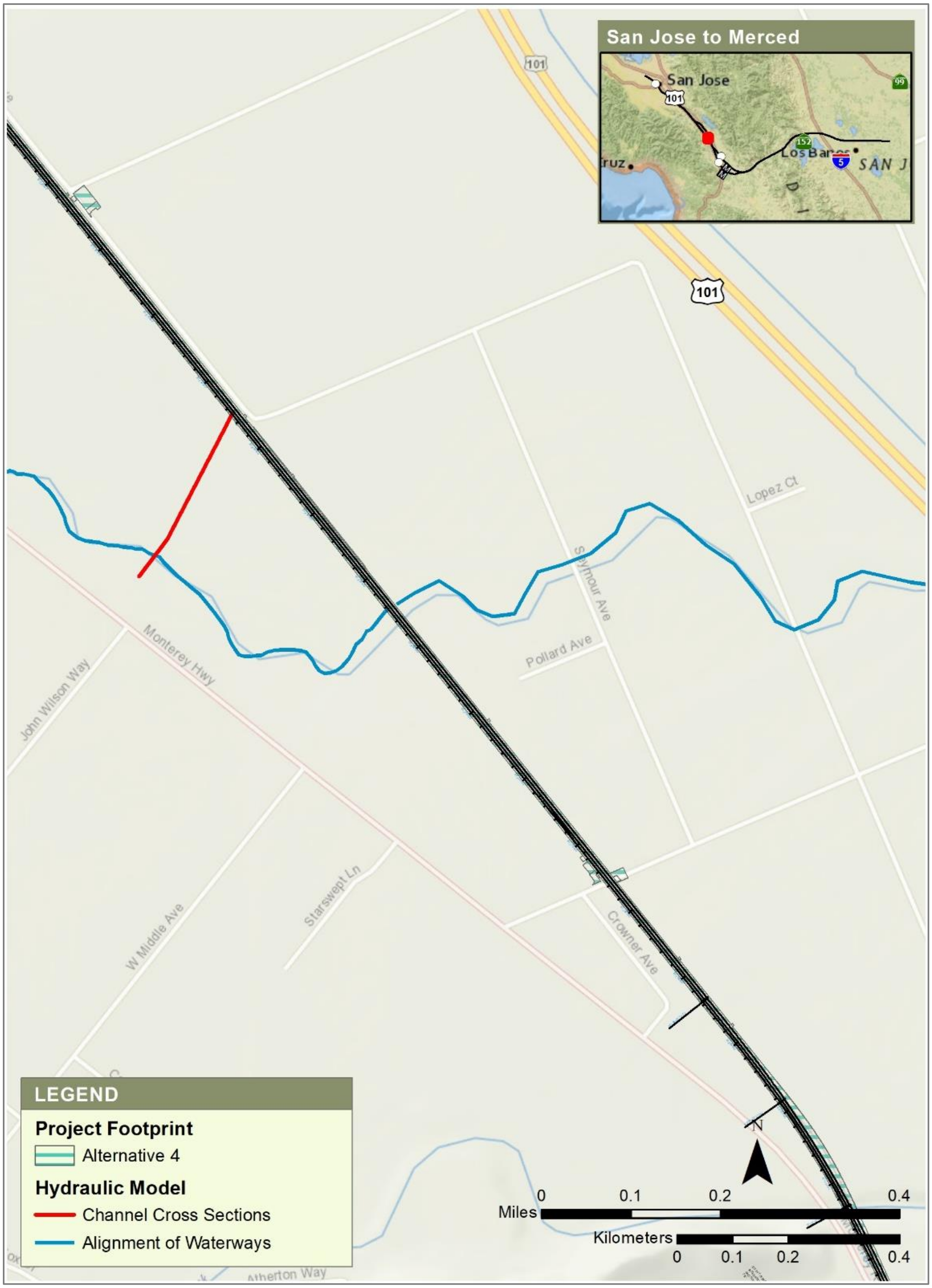
Note: this figure does not display all of the channel cross sections included in the hydraulic model.

Figure 3-15 West Little Llagas Creek, Plan View of FEMA Effective Hydraulic Model with Project Footprint for Alternatives 1 and 3



Sources: FEMA 2018; Authority 2019 . JANUARY 2019
Note: this figure does not display all of the channel cross sections included in the hydraulic model.

Figure 3-16 West Little Llagas Creek, Plan View of FEMA Effective Hydraulic Model with Project Footprint for Alternative 2



Sources: FEMA 2018; Authority 2019.

JANUARY 2019

Note: this figure does not display all of the channel cross sections included in the hydraulic model.

Figure 3-17 West Little Llagas Creek, Plan View of FEMA Effective Hydraulic Model with Project Footprint for Alternative 4

3.5.2 FEMA Effective Hydraulic Model

3.5.2.1 Overview of Hydraulic Model

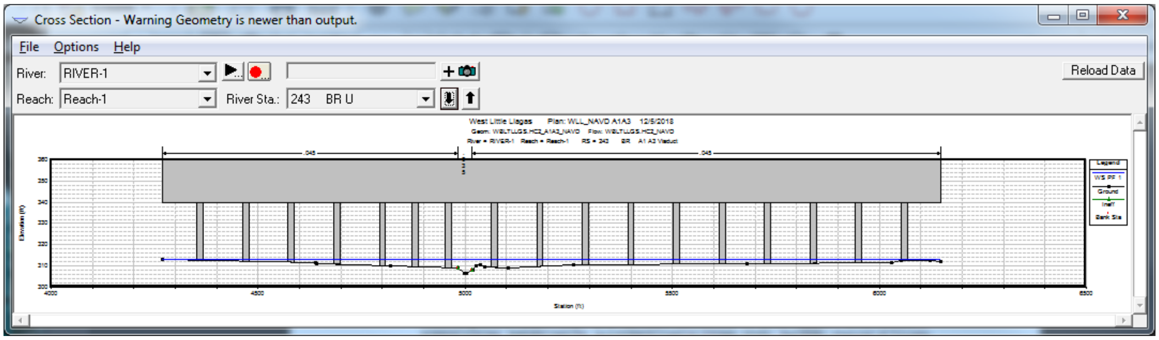
The upstream and downstream limits of West Little Llagas Creek in the FEMA effective hydraulic model were approximately 1,800 feet upstream of Llagas Road Bridge (approximately 22,590 feet upstream of the existing railroad bridge) and the outfall to Llagas Creek (approximately 4,420 feet downstream of the existing railroad crossing).

The pier columns supporting the viaduct segment over West Little Llagas Creek under Alternatives 1 and 3 were included in the proposed condition hydraulic model simulating the new proposed viaduct segment over the existing floodplain. The span length of the pier columns used in the hydraulic model was approximately 110 feet (Figure 3-18).

The embankment section immediately downstream (east) of the existing railroad track under Alternative 2 was represented in the hydraulic model by widening the footprint of the existing railroad bridge (Figure 3-19). The size of the bridge opening was set to be a 48-foot by 5-foot box culvert to match the proposed project plans for this alternative.

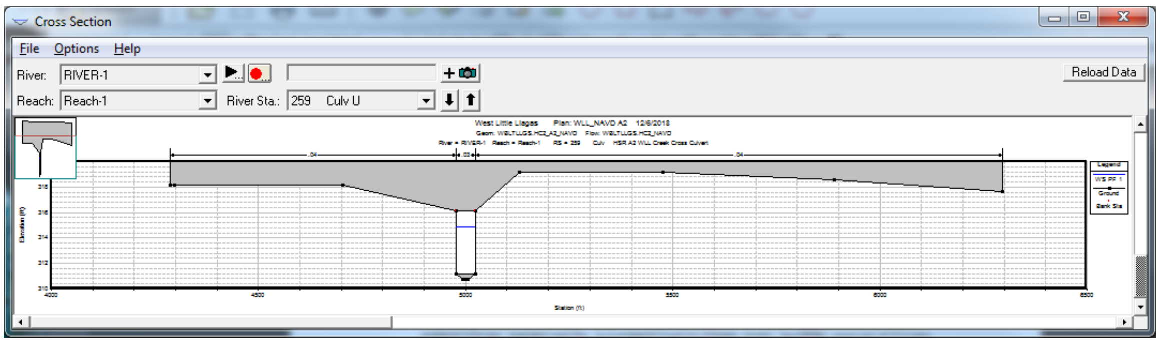
Alternative 4 would use the existing two-track segment near the existing West Little Llagas Creek bridge. There would be no changes to the vertical profile of railroad track near the existing West Little Llagas Creek bridge. The existing bridge structure would be replaced by a proposed 48-foot by 5-foot box culvert (width × height, Figure 3-20) in this alternative.

Sample RAS



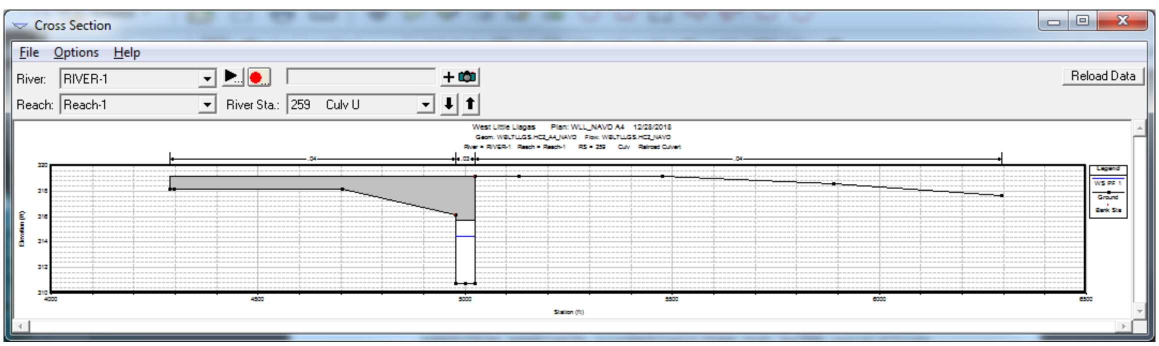
JANUARY 2019

Figure 3-18 West Little Llagas Creek, HEC-RAS Channel Cross Section with Proposed Pier Columns for Alternatives 1 and 3



JANUARY 2019

Figure 3-19 West Little Llagas Creek, HEC-RAS Channel Cross Section with Proposed Embankment Section for Alternative 2



JANUARY 2019

Figure 3-20 West Little Llagas Creek, HEC-RAS Channel Cross Section with Proposed Embankment Section for Alternative 4

3.5.2.2 Water Surface Elevations

The modeling results for Alternatives 1 and 3 are shown in Table 3-6. The proposed pier columns crossing the West Little Llagas Creek floodplain would not increase the 100-year flood profile of West Little Llagas Creek. The proposed railroad track is approximately 50 feet above the 100-year WSE of West Little Llagas Creek.

The modeling results for Alternative 2 are shown in Table 3-7. The proposed embankment section and new cross culvert proposed for Alternative 2 did not show increases in the 100-year flood profile of West Little Llagas Creek. The elevation difference between top of rail (approximately 323 feet NAVD) and 100-year WSE is approximately 6 feet.

The modeling results for Alternative 4 are shown in Table 3-8. The proposed embankment section and new cross culvert proposed for Alternative 4 did not show increases to the 100-year flood profile of West Little Llagas Creek. The elevation difference between top of rail (approximately 319.1 feet NAVD) and the 100-year WSE is approximately 2.1 feet. This elevation difference would not meet the HSR's design freeboard criteria for during the 100-year storm event.

Table 3-6 Hydraulic Modeling Results, West Little Llagas Creek, Alternatives 1 and 3

Location	Flow Rate (cfs)	Channel Bank Elevation (feet NAVD 88)	WSE—Existing Condition (feet NAVD 88)	WSE—Proposed Condition (feet NAVD 88)	Change in WSE (feet)
At Llagas Avenue	3,246	308.5	313.0	313.0	0.0
At proposed viaduct segment	3,280	309.0	313.1	313.1	0.0
At existing railroad bridge	1,936	316.2	319.2	319.2	0.0
At Monterey Highway	1,936	320.9	324.0	324.0	0.0

Elevations are rounded to the nearest 0.1 foot.
cfs = cubic feet per second
NAVD 88 = North American Vertical Datum of 1988
WSE = water surface elevation

Table 3-7 Hydraulic Modeling Results, West Little Llagas Creek, Alternative 2

Location	Flow Rate (cfs)	Channel Bank Elevation (feet NAVD 88)	WSE—Existing Condition (feet NAVD 88)	WSE—Proposed Condition (feet NAVD 88)	Change in WSE (feet)
At Llagas Avenue	3,246	308.5	313.0	313.0	0.0
At existing railroad bridge	1,936	316.2	319.2	317.0	-2.2
At Monterey Highway	1,936	320.9	324.0	324.0	0.0

Elevations are rounded to the nearest 0.1 foot.
cfs = cubic feet per second
NAVD 88 = North American Vertical Datum of 1988
WSE = water surface elevation

Table 3-8 Hydraulic Modeling Results, West Little Llagas Creek, Alternative 4

Location	Flow Rate (cfs)	Channel Bank Elevation (feet NAVD 88)	WSE—Existing Condition (feet NAVD 88)	WSE—Proposed Condition (feet NAVD 88)	Change in WSE (feet)
At Llagas Avenue	3,246	308.5	313.0	313.0	0.0
At existing railroad bridge	1,936	316.2	319.2	316.4	-2.8
At Monterey Highway	1,936	320.9	324.0	324.0	0.0

Elevations are rounded to the nearest 0.1 foot.
cfs = cubic feet per second
NAVD 88 = North American Vertical Datum of 1988
WSE = water surface elevation

3.6 Llagas Creek (near San Martin)

3.6.1 Background Information

3.6.1.1 Floodplain Location

Llagas Creek flows through the cities of San Martin, Morgan Hill, and Gilroy. West Little Llagas Creek, Madrone Channel, and East Little Llagas Creek meet to form Upper Llagas Creek (Authority 2011a). Buena Vista Avenue divides Upper and Lower Llagas Creek. Lower Llagas Creek meets West Branch Llagas Creek at SR 152 before it drains to the Pajaro River.

Llagas Creek near San Martin is subject to the USACE Section 404 and 408 permitting process.

3.6.1.2 FEMA Floodplain

According to the FEMA FIRM Panel Number 60685C0626H (FEMA 2009), the main channel and overbank flow of Llagas Creek near the Monterey Highway bridge and railroad bridge is identified as Zone AE and floodway (Figure 3-21). The width of the floodway varies from approximately 80 feet to 130 feet in the footprint of the project alternatives. On the north side of the main channel, the overbank flood flow from West Little Llagas Creek are designated as Zone AE and AO floodplains.

SCVWD's Upper Llagas Flood Protection project modify Llagas Creek at the Monterey Highway crossing and would modify the footprint of the Zone AE and floodway, but the limits of the 100-year floodplain would still remain in the project footprint for all four project alternatives (Figure 3-22).

Llagas Creek near San Martin in project footprint is recognized as a floodway. Therefore, the project cannot raise the 100-year flood profile of Llagas Creek.

3.6.1.3 Project Alternatives in the FEMA Floodplain

Alternatives 1 and 3 propose a viaduct segment, which would cross the main channel of Llagas Creek at approximately station 1280+00. The location of the crossing is approximately 140 feet downstream (east) of the existing railroad crossing over Llagas Creek. The width of the floodplain and floodway measured along the proposed track alignment of these alternatives is approximately 525 feet. After completion of the Upper Llagas Flood Protection Project, the width of the floodplain and floodway measures along the proposed track alignment would be reduced to approximately 210 feet.

The proposed embankment section with the railroad bridge over Llagas Creek under Alternative 2 would cross Llagas Creek at approximately station 1352+00. The location of the creek crossing is approximately 100 feet upstream (west) of the existing railroad crossing over Llagas Creek. The width of the floodplain and floodway measured along the proposed track alignment of this alternative is approximately 1,600 feet. After completion of the Upper Llagas Flood Protection Project, the width the floodplain and floodplain measure along relocated Monterey Highway, relocated Union Pacific Railroad (UPRR) track, and proposed HSR track, would be approximately 420 feet, 130 feet, and 110 feet.

Alternative 2 would also entail the relocation of the Monterey Road bridge and existing railroad bridge over Llagas Creek. The existing roadway and railroad bridges would be removed under this alternative. In addition, this Alternative would require modifications to the Llagas Creek channel that would be modified as part of the first phase of the Upper Llagas Flood Protection Project.

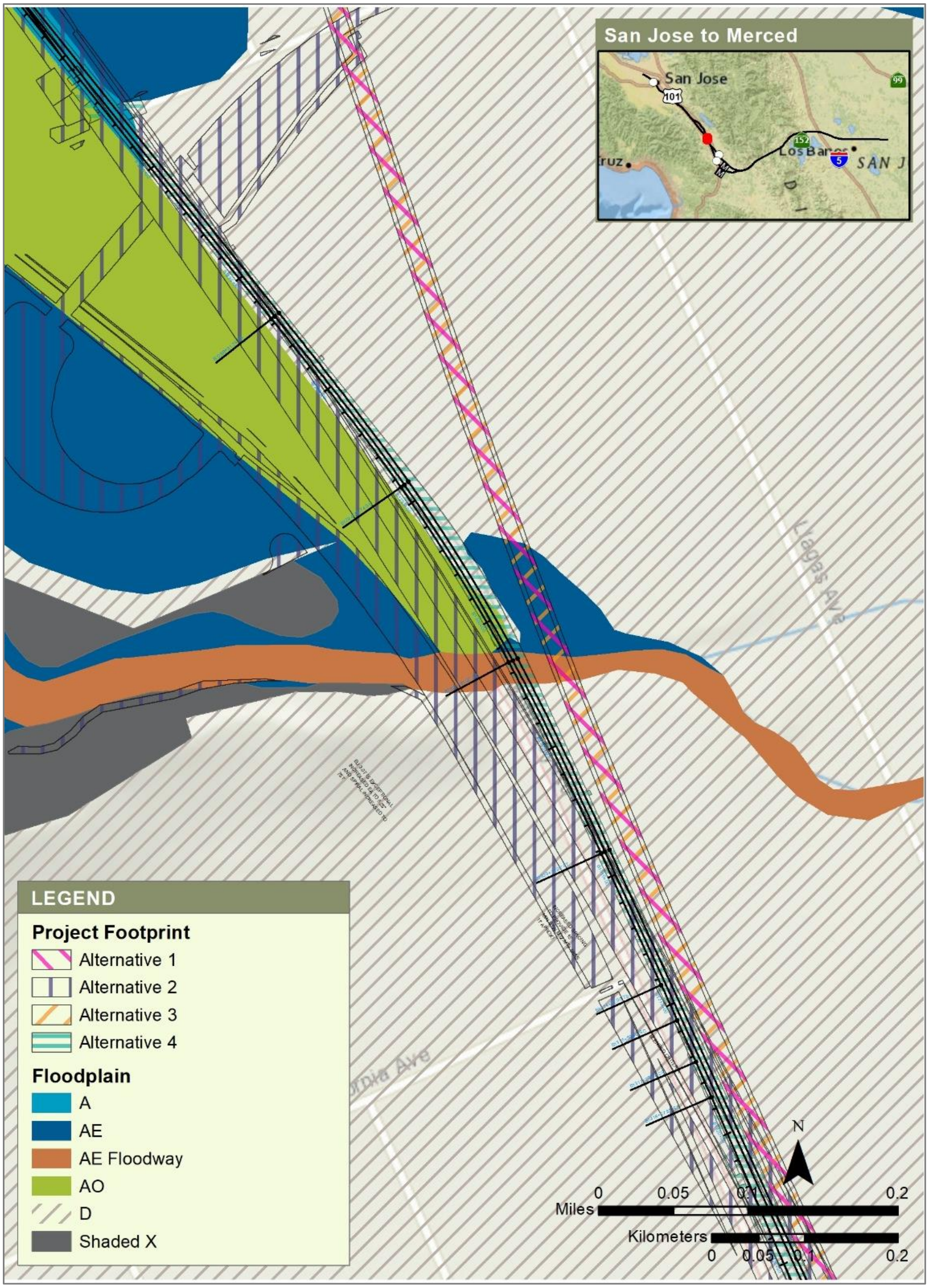
The proposed blended at-grade track with a railroad bridge over Llagas Creek for Alternative 4 would cross Llagas Creek at approximately station 1352+00. The existing single-track bridge over Llagas Creek would be replaced by a two-track bridge in the same alignment, extending to the west (upstream). There would be no changes to the vertical profile of railroad track on the bridge approach areas, and there would be no changes to Monterey Highway west (upstream) of the existing railroad bridge. The width of the existing FEMA floodplain and floodway measured along the existing railroad is approximately 500 feet. After completion of the Upper Llagas Flood Protection Project, the width of the floodplain and floodway measured along the proposed HSR track (shared with Caltrain and UPRR) would be approximately 130 feet.

3.6.1.4 Available Hydraulic Models

The FEMA effective hydraulic model and the SCVWD hydraulic model were available for this waterbody. Figure 3-23, Figure 3-24, and Figure 3-25 shows the approximate limits of the FEMA effective hydraulic model at Llagas Creek near San Martin with the project footprint for Alternatives 1 and 3, Alternative 2, and Alternative 4, respectively. Figure 3-26, Figure 3-27, and Figure 3-28 shows the limits of the SCVWD hydraulic model at Llagas Creek near San Martin with the project footprint for Alternatives 1 and 3, Alternative 2, and Alternative 4, respectively.

The FEMA effective hydraulic model provided does not include up-to-date available information that were included in the SCVWD hydraulic model. Therefore, SCVWD hydraulic model was used to evaluate the project's potential impacts.

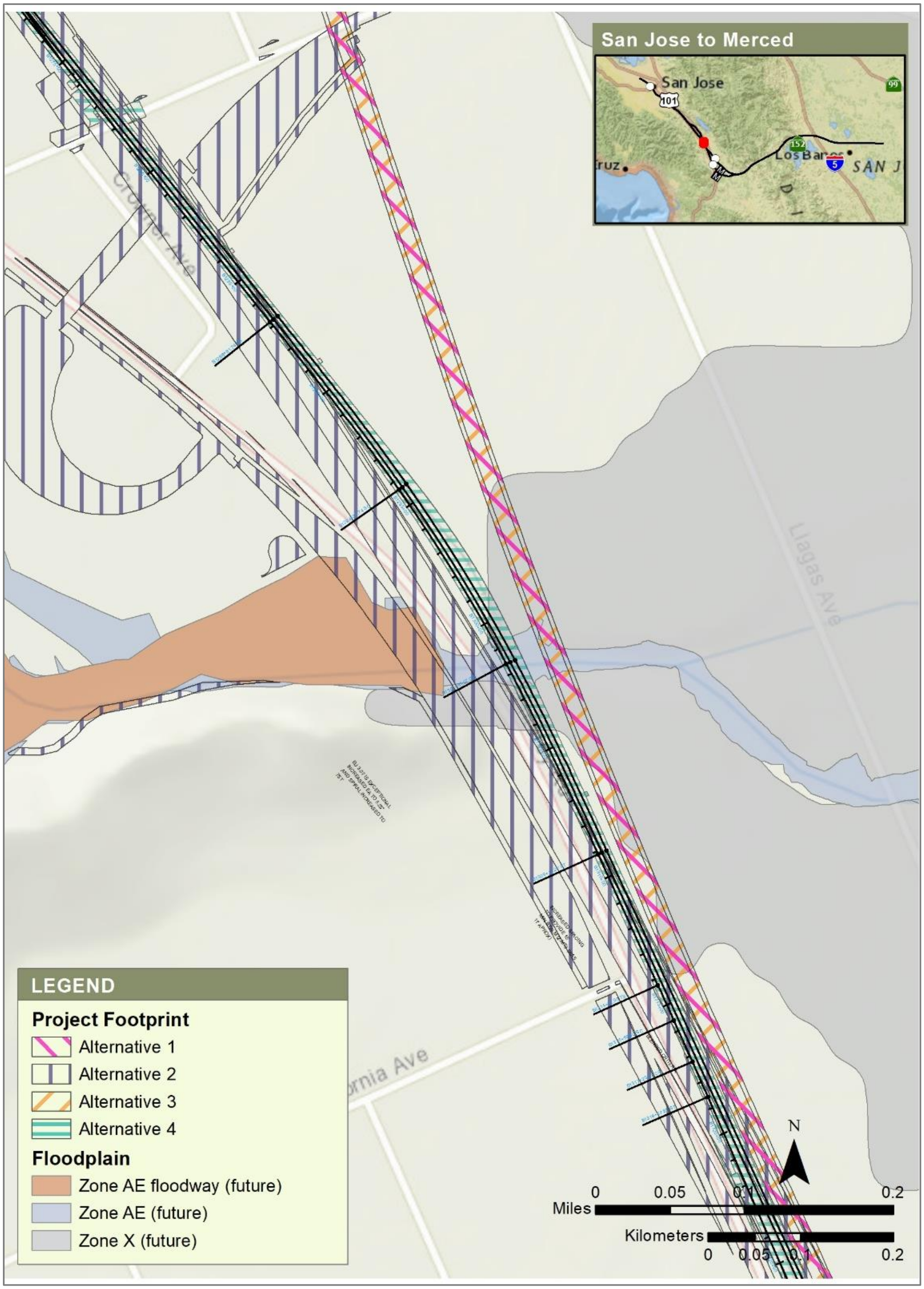
The FEMA effective hydraulic models for Llagas Creek (near San Martin) did not include improved channels after completion of Upper Llagas Flood Protection Project, which was assumed as existing condition for the project. Therefore, hydraulic analysis outputs from FEMA effective model were not used to evaluate project's potential floodplain impacts. The outputs from the SCVWD hydraulic model were used to evaluate the project's potential floodplain impacts.



Sources: FEMA 2009; Authority 2019

JANUARY 2019

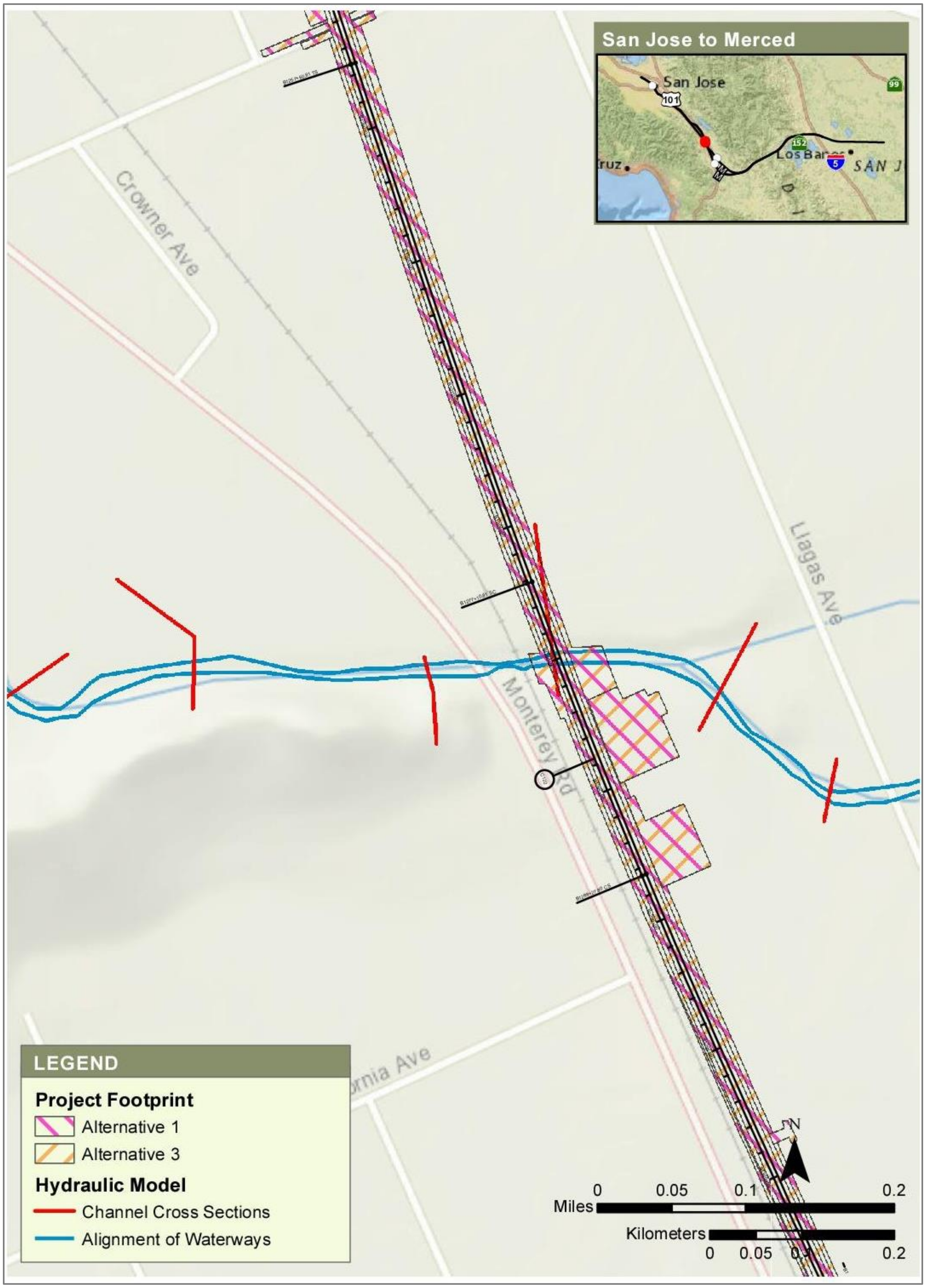
Figure 3-21 Llagas Creek near San Martin, FEMA FIRM Overlay with Project Footprints for Alternatives 1, 2, 3, and 4



Sources: SCVWD 2018f; Authority 2019

JANUARY 2019

Figure 3-22 Llagas Creek (near San Martin), Floodplain after Completion of Upper Llagas Flood Protection Project with Project Footprints for Alternatives 1, 2, 3, and 4

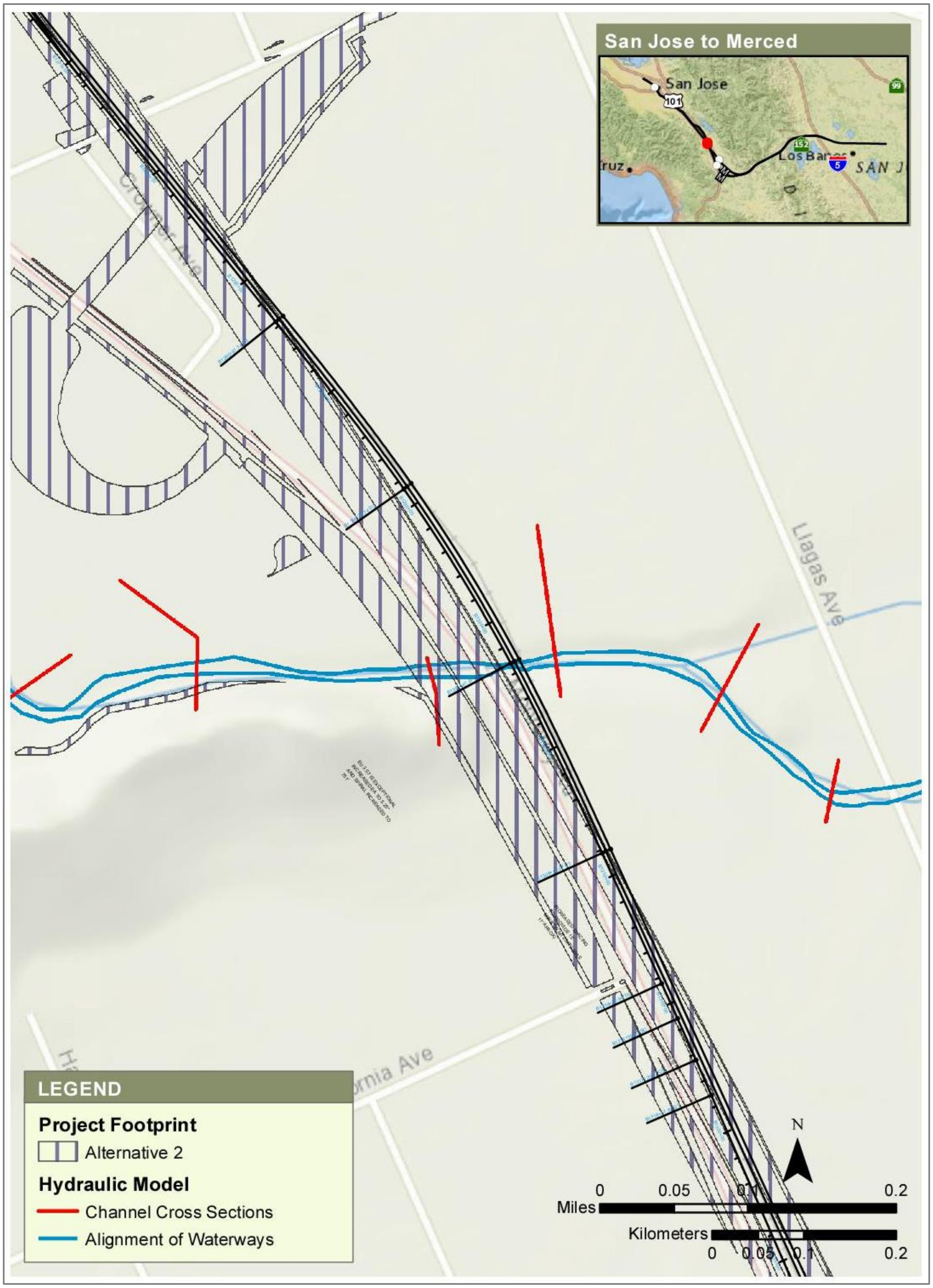


Sources: FEMA 2018; Authority 2019 .

JANUARY 2019

Note: this figure does not display all of the channel cross sections included in the hydraulic model.

Figure 3-23 Llagas Creek (near San Martin), Plan View of FEMA Effective Hydraulic Model with Project Footprints for Alternatives 1 and 3

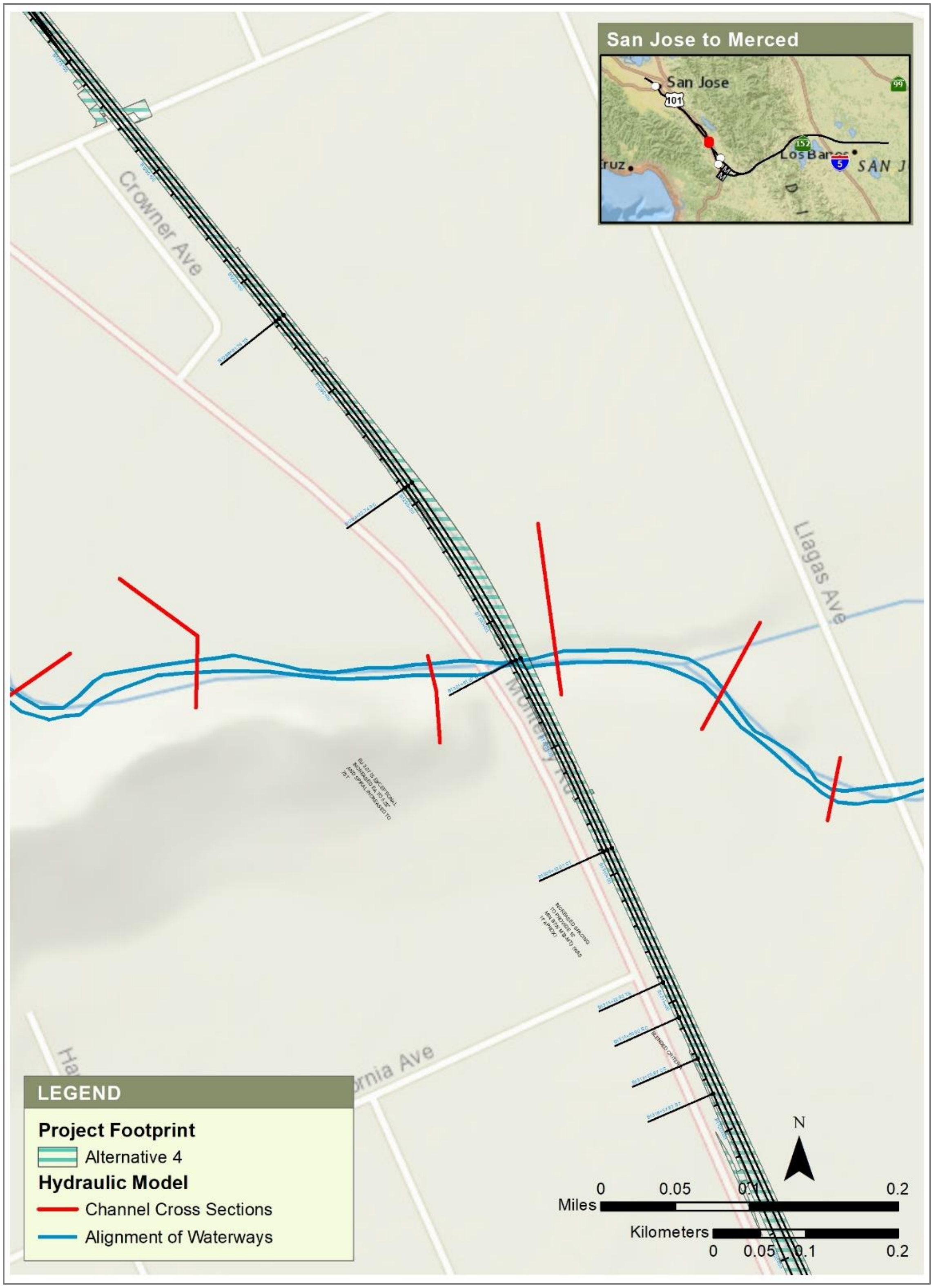


Sources: FEMA 2018; Authority 2019 .

JANUARY 2019

Note: this figure does not display all of the channel cross sections included in the hydraulic model.

Figure 3-24 Llagas Creek (near San Martin), Plan View of FEMA Effective Hydraulic Model with Project Footprint for Alternative 2



Sources: FEMA 2018; Authority 2019 .

JANUARY 2019

Note: this figure does not display all of the channel cross sections included in the hydraulic model.

Figure 3-25 Llagas Creek (near San Martin), Plan View of FEMA Effective Hydraulic Model with Project Footprint for Alternative 4

Sources: SCVWD 2015b; Authority 2019

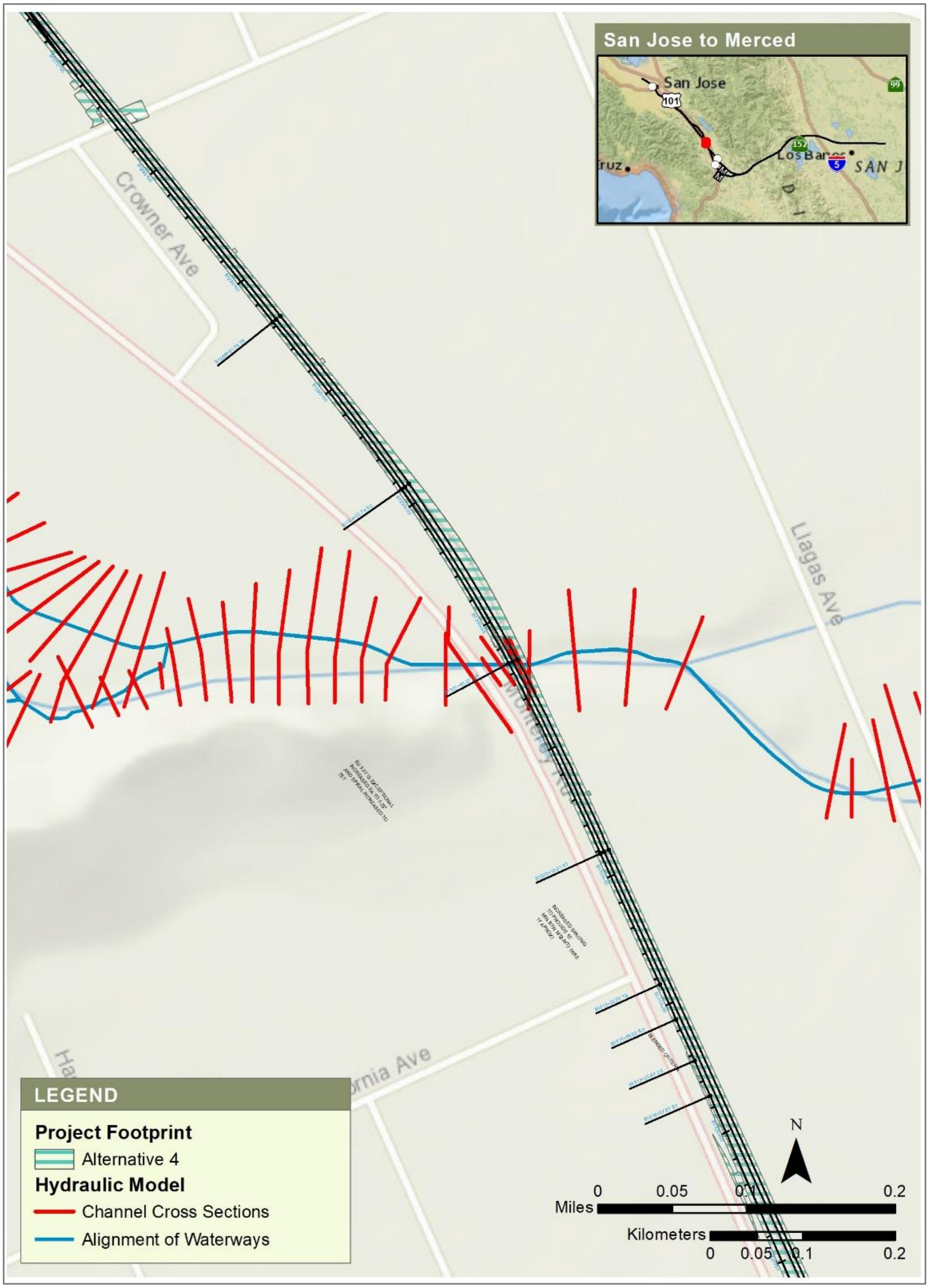
JANUARY 2019

Figure 3-26 Llagas Creek (near San Martin), Plan View of SCVWD Model at Proposed HSR Crossing, Alternatives 1 and 3

Sources: SCVWD 2015b; Authority 2019

JANUARY 2019

Figure 3-27 Llagas Creek (near San Martin), Plan View of SCVWD Model at Proposed HSR Crossing, Alternatives 2



Sources: SCVWD 2015b; Authority 2019

JANUARY 2019

Figure 3-28 Llagas Creek (near San Martin), Plan View of SCVWD Model at Proposed HSR Crossing, Alternative 4

3.6.2 FEMA Effective Hydraulic Model

3.6.2.1 Overview of Hydraulic Model

The upstream and downstream limits of the FEMA effective hydraulic model for Llagas Creek near San Martin were approximately 3,900 feet upstream of the existing railroad bridge and approximately 780 feet downstream of the existing railroad bridge.

The pier columns supporting the viaduct segment under Alternatives 1 and 3 were represented in the proposed condition hydraulic model for Alternatives 1 and 3 using the bridge function in HEC-RAS.

The relocated Monterey Road bridge, relocated existing railroad bridge, and proposed HSR bridge over Llagas Creek under Alternative 2 were represented in the proposed condition hydraulic model by adding interpolated channel cross sections and removing existing channel cross sections that were in conflict with the proposed bridge footprint.

The proposed condition hydraulic model for Alternative 4 replaced an existing single-track railroad bridge included in the base hydraulic model with the proposed two-track railroad bridge.

3.6.2.2 Water Surface Elevations

The modeling results for Alternatives 1 and 3 are shown in Table 3-9. The proposed pier columns crossing the Llagas Creek floodplain would increase the floodplain and floodway elevation by approximately 0.4 foot or less. (Table 3-9).

The modeling results for Alternative 2 are shown in Table 3-10. The relocation of the existing Monterey Road and railroad bridge and construction of a new bridge over Llagas Creek with a channel geometry not including improvements from the Upper Llagas Flood Protection Project would increase the 100-year flood profile of Llagas Creek upstream of the relocated Monterey Highway Bridge.

The modeling results for Alternative 4 are shown in Table 3-11. The proposed removal and replacement of existing single-track bridge with a proposed double-track bridge would raise the 100-year flood profile of Llagas Creek on upstream of the proposed railroad bridge.

The current effective FEMA hydraulic model assumed a smooth channel with minimal vegetation growth, but the existing channel shows moderate to dense vegetation growth in the main channel upstream and downstream of Monterey Road Bridge and the existing railroad bridge. In addition, Phase 1 of the Upper Llagas Flood Protection Project, expected to start construction in the Year 2019, would modify the creek channel upstream of the existing Monterey Bridge. Because the current effective FEMA hydraulic model does not represent these two existing project conditions, the hydraulic analysis of the existing and proposed conditions were also performed using the hydraulic model of Llagas Creek and tributaries provided by SCVWD as comparison, and is discussed in Section 3.6.3, SCVWD Hydraulic Model.

Table 3-9 Hydraulic Modeling Results, Llagas Creek (near San Martin), Alternatives 1 and 3

Location	Flow Rate (cfs)	Channel Bank Elevation (feet NAVD 88)	WSE—Existing Condition (feet NAVD 88)	WSE—Proposed Condition (feet NAVD 88)	Change in WSE (feet)
At downstream limit of hydraulic model	5,300	298.4	301.2	301.2	0.0
At proposed viaduct segment	5,300	301.1	301.4	301.8	+0.4
At existing railroad crossing	5,300	302.0	302.6	302.7	+0.1
At existing Monterey Rd	5,300	305.6	303.0	303.0	0.0

Location	Flow Rate (cfs)	Channel Bank Elevation (feet NAVD 88)	WSE—Existing Condition (feet NAVD 88)	WSE—Proposed Condition (feet NAVD 88)	Change in WSE (feet)
At upstream limit of hydraulic model	3,500	315.8	308.0	308.0	0.0

Elevations are rounded to the nearest 0.1 foot, except at immediately upstream of proposed viaduct segment
cfs = cubic feet per second
NAVD 88 = North American Vertical Datum of 1988
WSE = water surface elevation

Table 3-10 Hydraulic Modeling Results, Llagas Creek (near San Martin), Alternative 2

Location	Flow Rate (cfs)	Channel Bank Elevation (feet NAVD 88)	WSE—Existing Condition (feet NAVD 88)	WSE—Proposed Condition (feet NAVD 88)	Change in WSE (feet)
At downstream limit of hydraulic model	5,300	298.4	301.2	301.2	0.0
At existing railroad crossing (removed in Alt 2)	5,300	302.0	302.6	302.9	0.3
At upstream of proposed HSR bridge	5,300	305.6	303.0	302.8	(0.2)
At upstream of relocated Monterey Highway bridge	4,900	304.4	303.2	304.3	1.1
At upstream limit of hydraulic model	3,500	315.8	308.0	308.0	0.0

(Parentheses) indicate negative values
Elevations are rounded to the nearest 0.1 foot, except at immediately upstream of proposed viaduct segment
cfs = cubic feet per second
NAVD 88 = North American Vertical Datum of 1988
WSE = water surface elevation
HSR = high-speed rail

Table 3-11 Hydraulic Modeling Results, Llagas Creek (near San Martin), Alternative 4

Location	Flow Rate (cfs)	Channel Bank Elevation (feet NAVD 88)	WSE—Existing Condition (feet NAVD 88)	WSE—Proposed Condition (feet NAVD 88)	Change in WSE (feet)
At downstream limit of hydraulic model	5,300	298.4	301.2	301.2	0.0
At proposed HSR/UPRR/ Caltrain crossing	5,300	302.0	302.6	303.1	(0.5)
At existing Monterey Rd	5,300	305.6	303.0	303.5	0.0
At upstream limit of hydraulic model	3,500	315.8	308.0	308.0	0.0

(Parentheses) indicate negative values
Note: Elevations are rounded to the nearest 0.1 foot
cfs = cubic feet per second
NAVD 88 = North American Vertical Datum of 1988
WSE = water surface elevation
HSR = high-speed rail
UPRR = Union Pacific Railroad

3.6.3 SCVWD Hydraulic Model

3.6.3.1 Overview of Hydraulic Model

The upstream and downstream limits of Llagas Creek in the SCVWD hydraulic model were at Atherton Way Hidden Pond (approximately 3,440 feet upstream of the existing railroad bridge) and immediately upstream of State Route 152 (approximately 51,200 feet downstream of the existing railroad bridge), respectively (Figure 2-12).

The channel cross sections included in the base hydraulic model at the project location were not located to best represent the potential changes from the proposed project. Therefore, channel cross sections in the SCVWD hydraulic model upstream and downstream of the existing Monterey Highway Bridge and existing railroad bridge were replaced with the channel cross sections based on the proposed grading plan for the Upper Llagas Flood Protection Project provided by SCVWD on December 2017 (SCVWD 2017).

The setup of the viaduct segment crossing Llagas Creek for Alternatives 1 and 3 in the SCVWD hydraulic model is same as the setup for the proposed condition for FEMA effective hydraulic model.

The relocated railroad bridge and the proposed HSR bridge over Llagas Creek under Alternative 2 were added in between the new channel cross sections in the hydraulic model. The channel geometry was adjusted at the locations where Alternative 2 proposed changes to the channel geometry of Llagas Creek after completion of the Upper Llagas Flood Protection Project.

The proposed condition hydraulic model for the Alternative 4 replaced existing single-track railroad bridge included in the base hydraulic model with a proposed two-track railroad bridge.

3.6.3.2 Water Surface Elevations

The modeling results for Alternatives 1 and 3 are shown in Table 3-12. In the proposed conditions, the pier columns crossing the Llagas Creek floodplain would not increase the vertical profile and horizontal extents of the existing Llagas Creek 100-year floodplain at Monterey Highway. The outputs from hydraulic model shows the 100-year flow would be mostly contained in the main channel of Llagas Creek and the proposed pier columns would have minimal contact with the 100-year flow.

The modeling results for Alternative 2 are shown in Table 3-13. The relocation of the existing Monterey Road and railroad bridge and construction of a new bridge over Llagas Creek would not increase the vertical profile and horizontal extents of the existing Llagas Creek 100-year floodplain at Monterey Highway.

The modeling results for Alternative 4 are shown in Table 3-14. The proposed removal and replacement of the existing single-track bridge with a proposed double-track bridge would not increase the 100-year flood profile of Llagas Creek on the upstream side of the proposed railroad bridge.

Table 3-12 Hydraulic Modeling Results, Llagas Creek (near San Martin), Alternatives 1 and 3

Location	Flow Rate (cfs)	Channel Bank Elevation (feet NAVD 88)	WSE—Existing Condition (feet NAVD 88)	WSE—Proposed Condition (feet NAVD 88)	Change in WSE (feet)
At Llagas Ave	4,330	300.0	298.7	298.7	0.0
At proposed viaduct portion of the alignment	4,330	302.7	302.4	302.4	0.0
At existing railroad crossing	5,532	303.0	303.85	303.84	(0.01)

Location	Flow Rate (cfs)	Channel Bank Elevation (feet NAVD 88)	WSE—Existing Condition (feet NAVD 88)	WSE—Proposed Condition (feet NAVD 88)	Change in WSE (feet)
At Monterey Highway	5,532	307.8	305.3	305.3	0.0
Downstream of confluence with West Little Llagas Creek Diversion	5,532	310.0	307.7	307.7	0.0
At West Middle Avenue (West Little Llagas Creek Diversion)	1,890	319.3	313.9	313.9	0.0

(Parentheses) indicate negative values
Elevations are rounded to the nearest 0.1 foot, except at immediately upstream of proposed viaduct segment
cfs = cubic feet per second
NAVD 88 = North American Vertical Datum of 1988
WSE = water surface elevation

Table 3-13 Hydraulic Modeling Results, Llagas Creek (near San Martin), Alternative 2

Location	Flow Rate (cfs)	Channel Bank Elevation (feet NAVD 88)	WSE—Existing Condition (feet NAVD 88)	WSE—Proposed Condition (feet NAVD 88)	Change in WSE (feet)
At Llagas Ave	4,330	300.0	298.7	298.7	0.0
At existing railroad crossing	5,532	303.0	303.9	303.9	0.0
At upstream of proposed HSR bridge	5,532	307.8	305.5	304.9	(0.6)
At upstream of relocated Monterey Highway bridge	5,532	310.0	306.8	306.6	(0.2)
Downstream of confluence with West Little Llagas Creek Diversion	5,532	310.0	307.7	307.6	(0.1)
At West Middle Avenue (West Little Llagas Creek Diversion)	1,890	319.3	313.9	313.9	0.0

Elevations are rounded to the nearest 0.1 foot, except at immediately upstream of proposed viaduct segment
cfs = cubic feet per second
NAVD 88 = North American Vertical Datum of 1988
WSE = water surface elevation
HSR = high-speed rail

Table 3-14 Hydraulic Modeling Results, Llagas Creek (near San Martin), Alternative 4

Location	Flow Rate (cfs)	Channel Bank Elevation (feet NAVD 88)	WSE—Existing Condition (feet NAVD 88)	WSE—Proposed Condition (feet NAVD 88)	Change in WSE (feet)
At Llagas Ave	4,330	300.0	298.7	298.7	0.0
At proposed HSR/UPRR/ Caltrain crossing	5,532	303.0	303.9	303.6	(0.3)
At Monterey Highway	5,532	307.8	305.3	304.9	(0.4)
Downstream of confluence with West Little Llagas Creek Diversion	5,532	310.0	307.7	307.6	(0.1)
At West Middle Avenue (West Little Llagas Creek Diversion)	1,890	319.3	313.9	313.9	0.0

(Parentheses) indicate negative values
Note: Elevations are rounded to the nearest 0.1 foot
cfs = cubic feet per second
NAVD 88 = North American Vertical Datum of 1988
WSE = water surface elevation
HSR = high-speed rail
UPRR = Union Pacific Railroad

3.7 Llagas Creek (at East San Martin Avenue)

3.7.1 Background Information

3.7.1.1 Floodplain Location

Llagas Creek flows through the cities of San Martin, Morgan Hill, and Gilroy. West Little Llagas Creek, Madrone Channel, and East Little Llagas Creek meet to form Upper Llagas Creek (Authority 2011a). Buena Vista Avenue divides Upper and Lower Llagas Creek. Lower Llagas Creek meets West Branch Llagas Creek at SR 152 before it drains to the Pajaro River.

Llagas Creek at East San Martin Avenue would be subject to the USACE Section 404 and 408 permitting process.

3.7.1.2 FEMA Floodplain

According to the FEMA FIRM Panel Number 60685C0628H (FEMA 2009), the main channel and overbank flow of Llagas Creek near the existing East San Martin Avenue bridge is identified as Zone AE and floodway (Figure 3-29). This figure also shows Zone AE on east side of the mainline Llagas Creek, which would be discussed in details in Section 3.8, West Little Llagas Creek, Middle Avenue Outflow.

SCVWD's Upper Llagas Flood Protection Project would modify Llagas Creek at East San Martin Avenue and would modify the footprint of the Zone AE and floodway (Figure 3-30).

Llagas Creek near San Martin in the project footprint is currently recognized as a floodway. Therefore, the project cannot raise the 100-year flood profile of Llagas Creek.

3.7.1.3 Project Alternatives in the FEMA Floodplain

The project footprint for Alternative 2 is in the existing 100-year floodplain for Llagas Creek at East San Martin Avenue, before and after completion of Upper Llagas Flood Protection Project (Figure 3-29 and Figure 3-30).

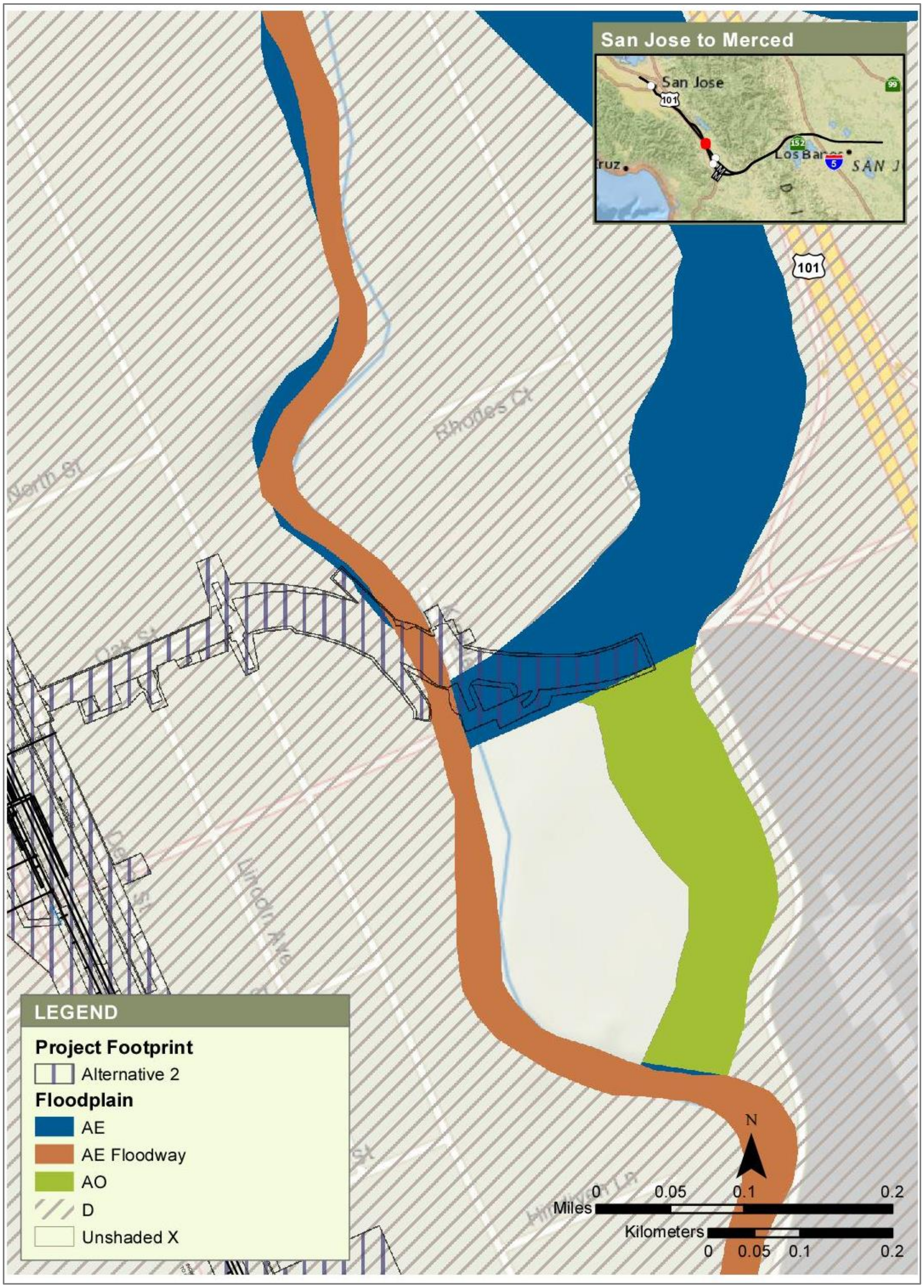
The project footprints for the remaining three alternatives are located outside of the limits of Llagas Creek floodplain/floodway at East San Martin Avenue, both before and after the completion of the Upper Llagas Flood Protection Project.

Alternative 2 proposes to change the alignment of East San Martin Avenue, which includes removal of the existing East San Martin Avenue bridge over Llagas Creek and construction of a new roadway bridge located approximately 300 feet upstream (north) of the existing bridge.

3.7.1.4 Available Hydraulic Models

The FEMA effective hydraulic model and the SCVWD hydraulic model were available for this waterbody. Figure 3-31 shows the approximate limits of the FEMA effective hydraulic model with the project footprint for Alternative 2. Figure 3-32 shows the limits of the SCVWD hydraulic model with the project footprint for Alternative 2.

The FEMA effective hydraulic models for Llagas Creek (at East San Martin Avenue) did not include improved channels after completion of Upper Llagas Flood Protection Project, which was assumed as an existing condition for the project. Therefore, hydraulic analysis outputs from FEMA effective model were not used to evaluate project’s potential floodplain impacts. The outputs from the SCVWD hydraulic model were used to evaluate the project’s potential floodplain impacts.



Sources: FEMA 2009; Authority 2019

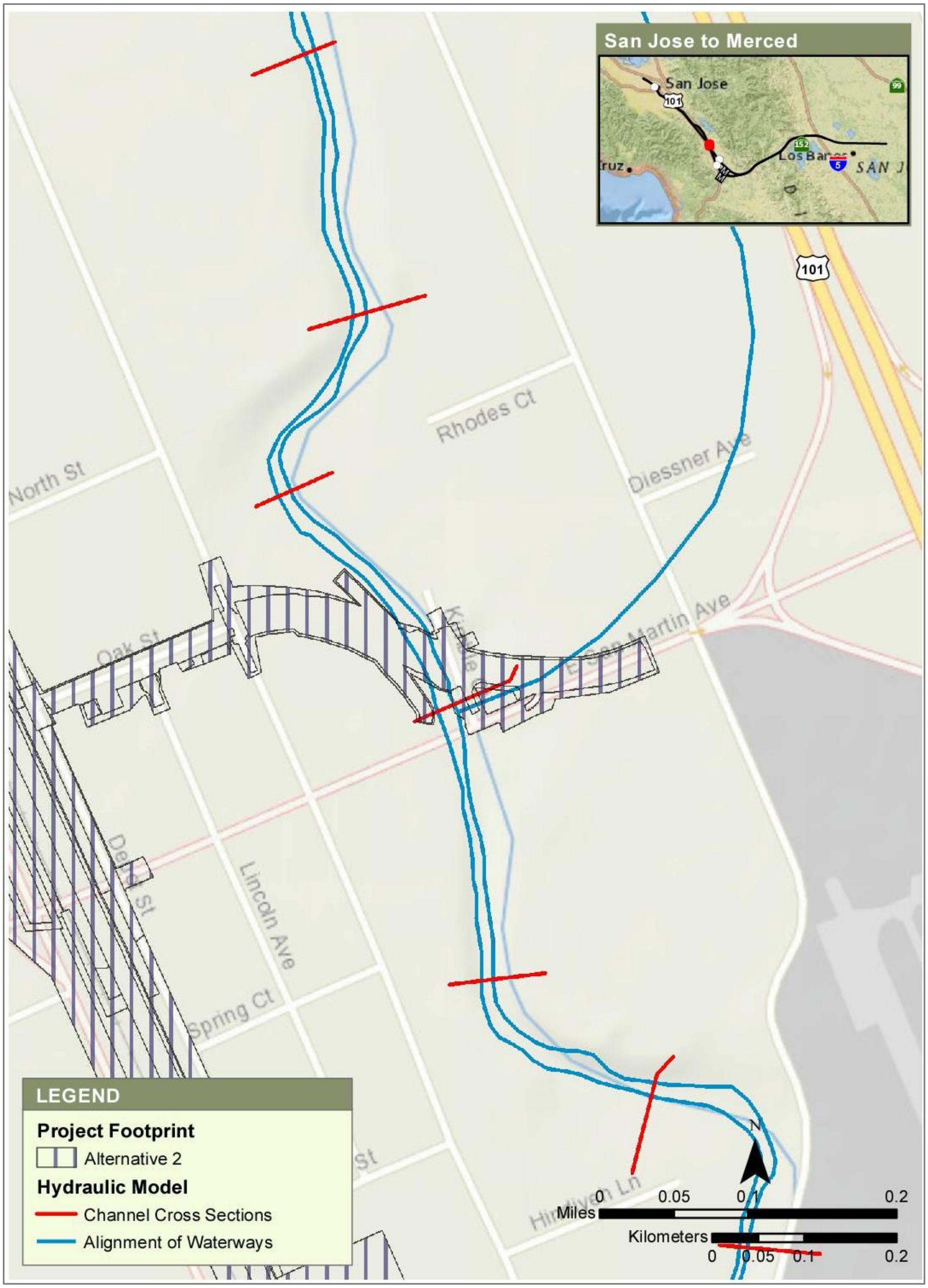
JANUARY 2019

Figure 3-29 Llagas Creek (at East San Martin Avenue), FEMA FIRM at Project Footprint for Alternative 2

Sources: SCVWD 2018f; Authority 2019

JANUARY 2019

Figure 3-30 Llagas Creek (at East San Martin Avenue), Floodplain after Completion of Upper Llagas Flood Protection Project with Project Footprint for Alternative 2



Sources: FEMA 2018; Authority 2019.

JANUARY 2019

Note: this figure does not display all of the channel cross sections included in the hydraulic model.

Figure 3-31 Llagas Creek (At East San Martin Avenue), Plan View of FEMA Effective Hydraulic Model with Project Footprint for Alternative 2

Sources: SCVWD 2015b; Authority 2019

JANUARY 2019

Figure 3-32 Llagas Creek (At East San Martin Avenue), Plan View of SCVVWD Hydraulic Model with Project Footprint for Alternative 2

3.7.2 FEMA Effective Hydraulic Model

3.7.2.1 Overview of Hydraulic Model

The upstream and downstream limits of FEMA effective hydraulic model for Llagas Creek at East San Martin Avenue were approximately 5,300 feet upstream of the existing East San Martin Road Bridge and approximately 21,920 feet downstream of the existing East San Martin Road Bridge.

For the proposed condition hydraulic model for Alternative 2, the existing East San Martin Road Bridge was removed and the new bridge was placed approximately 300ft upstream.

The proposed condition hydraulic model for Alternative 2 removed the existing East San Martin Road Bridge included in the base hydraulic model and added proposed East San Martin Road Bridge approximately 300 feet upstream (north).

The FEMA effective hydraulic model provided two flooding scenarios for the 100-year storm event. The first scenario allowed overbank flows to flow outside of the main channel of Llagas Creek within the model limits. The second scenario used the “Encroachment” function in HEC-RAS to force the flows to remain inside a narrower assigned area of Llagas Creek channel within the model limits. The hydraulic analysis of existing and proposed conditions were performed for both flooding scenario.

The Manning’s roughness coefficient assigned in the FEMA effective hydraulic model is 0.025 and 0.030, which represents smooth, well maintained channel with minimal vegetation growth and minimal obstructions to the flood flow. This input in the FEMA effective hydraulic model may not represent the existing site condition at the beginning of construction for project. The existing site condition shows moderate to dense vegetation growth in the main channel and embankment slopes of Llagas Creek near East San Martin Avenue Bridge, which would be represented using higher Manning’s roughness coefficient value.

3.7.2.2 Water Surface Elevations

The modeling results for the Alternative 2 near the proposed East San Martin Road Bridge are shown in Table 3-15 and Table 3-16 for without and with overbank flows. The outputs for Alternative 2 with overbank flows showed decreases in 100-year flood profile immediately upstream of the relocated East San Martin Road Bridge over Llagas Creek. However, the 100-year flood profile with no overbank flood flows showed increases in 100-year flood profile immediately upstream of the relocated East San Martin Road Bridge over Llagas Creek. The change in 100-year flood profile attenuated at the next upstream bridge crossing (Llagas Avenue) for both cases.

Table 3-15 Hydraulic Modeling Results, Llagas Creek (at East San Martin Avenue), Alternative 2, with Overbank Flow

Location	Flow Rate (cfs)	Channel Bank Elevation (feet NAVD 88)	WSE—Existing Condition (feet NAVD 88)	WSE—Proposed Condition (feet NAVD 88)	Change in WSE (feet)
At Church Avenue	4,330	264.1	259.2	259.2	0.0
At relocated East San Martin Avenue Bridge	4,330	288.3	288.4	286.6	(1.8)
At Llagas Avenue	4,330	300.8	298.8	298.8	0.0

Elevations are rounded to the nearest 0.1 foot.
cfs = cubic feet per second
NAVD 88 = North American Vertical Datum of 1988
WSE = water surface elevation

Table 3-16 Hydraulic Modeling Results, Llagas Creek (at East San Martin Avenue), Alternative 2, with No Overbank Flow

Location	Flow Rate (cfs)	Channel Bank Elevation (feet NAVD 88)	WSE—Existing Condition (feet NAVD 88)	WSE—Proposed Condition (feet NAVD 88)	Change in WSE (feet)
At Church Avenue	4,330	264.1	263.2	263.2	0.0
At relocated East San Martin Avenue Bridge	4,330	288.3	288.7	291.2	2.5
At Llagas Avenue	4,330	300.8	300.7	300.7	0.0

(Parentheses) indicate negative values
Elevations are rounded to the nearest 0.1 foot.
cfs = cubic feet per second
NAVD 88 = North American Vertical Datum of 1988
WSE = water surface elevation

When using the FEMA effective hydraulic model to determine the changes in the 100-year flood profile of Llagas Creek for Alternative 2, the potential floodplain impacts were controlled by the use of “Encroachment” function in HEC-RAS hydraulic model. In addition, the FEMA effective hydraulic models for Llagas Creek (near San Martin) would not represent the existing condition for the project.

Therefore, FEMA effective hydraulic model for Llagas Creek at East San Martin Avenue would not suitable to evaluate the project’s potential impacts on the existing 100-year floodplain. The hydraulic analysis was also performed using the SCVWD’s hydraulic model as a comparison.

3.7.3 SCVWD Model

3.7.3.1 Overview of Hydraulic Model

The SCVWD hydraulic model for Llagas Creek at East San Martin Avenue is same as the hydraulic model described in Section 3.6, Llagas Creek (near San Martin). The setup of the proposed condition hydraulic model for Alternative 2 is same as the FEMA effective hydraulic model described in Section 3.7.2, FEMA Effective Hydraulic Model.

3.7.3.2 Water Surface Elevations

The modeling results for the Alternative 2 near the proposed East San Martin Road Bridge are shown in Table 3-17. The outputs for Alternative 2 did not show increases in 100-year flood profile near the relocated East San Martin Road Bridge over Llagas Creek.

Table 3-17 Hydraulic Modeling Results, Llagas Creek at East San Martin Avenue, Alternative 2

Location	Flow Rate (cfs)	Channel Bank Elevation (feet NAVD 88)	WSE—Existing Condition (feet NAVD 88)	WSE—Proposed Condition (feet NAVD 88)	Change in WSE (feet)
At Church Avenue	4,330	264.0	263.3	263.3	0.0
At relocated East San Martin Avenue Bridge	4,330	286.0	287.1	287.0	(0.1)
At Llagas Avenue	4,330	300.0	298.7	298.7	0.0

(Parentheses) indicate negative values
Elevations are rounded to the nearest 0.1 foot.
cfs = cubic feet per second
NAVD 88 = North American Vertical Datum of 1988
WSE = water surface elevation

3.8 West Little Llagas Creek, Middle Avenue Overflow

3.8.1 Background Information

3.8.1.1 Floodplain Location

West Little Llagas Creek is a tributary of Llagas Creek that flows through the City of Morgan Hill and San Martin (census-designated place). The confluence with Llagas Creek is immediately downstream of US 101 cross culvert in San Martin, at 37° 6'21.22" North, 121°36'44.54"West. Existing railroad bridge over West Little Llagas Creek is located approximately 3,700 feet west of the US 101 cross culvert.

3.8.1.2 FEMA Floodplain

According to the FEMA FIRM Panel Numbers 60685C0626H and 60685C0626H (FEMA 2009, 2014), the main channel of West Little Llagas Creek downstream (east) of the existing railroad crossing does not have capacity to convey the 100-year flow, and the overbank flow on south side sheet flows south and does not re-enter the main channel of West Little Llagas Creek (Figure 3-33). The overbank flow outfalls into Llagas Creek near East San Martin Avenue Bridge.

West Little Llagas Creek in the project footprint is recognized as a FEMA 100-year floodplain. Therefore, project cannot raise the flood profile of West Little Llagas Creek by more than 1.0 foot.

SCVWD's Upper Llagas Flood Protection Project would reroute West Little Llagas Creek to flow southeast, west of Monterey Highway (see Reach 7a in Figure 3-13).

With completion of Upper Llagas Flood Protection Project, the rerouted West Little Llagas would outfall into Llagas Creek on west of Monterey Highway and would no longer travel at the locations where the existing FIRM shows overbank flood flow flowing south along the west side of US 101. West Little Llagas Creek – Middle Avenue Overflow would no longer be classified as 100-year floodplain after completion of the Upper Llagas Flood Protection Project (Figure 3-34).

3.8.1.3 Project Alternatives in the FEMA Floodplain

The project footprint for Alternative 2 is in the existing 100-year floodplain for West Little Llagas - Middle Avenue Overflow. The project footprints for the other three alternatives are located outside of the limits of the existing 100-year floodplain.

Alternative 2 proposes to change the alignment of East San Martin Avenue, which includes removal of the existing East San Martin Avenue bridge over Llagas Creek and construction of a new roadway bridge located approximately 300 feet upstream (north) of the existing bridge. The proposed eastern bridge approach would introduce fill inside the existing floodplain. This bridge approach area would not be classified as a fill inside the existing floodplain after completion of the Upper Llagas Flood Protection Project.

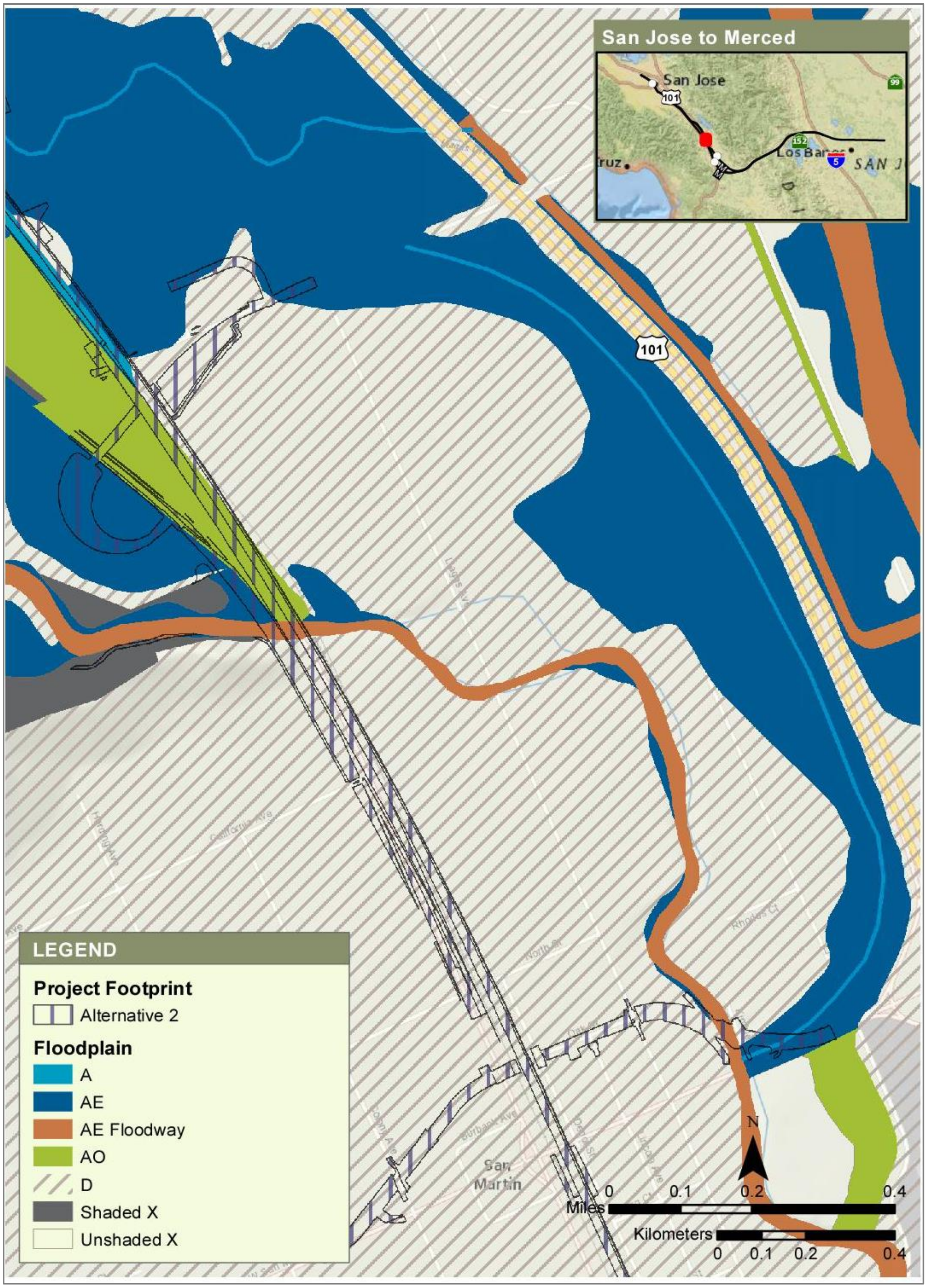
The project footprints for the remaining three alternatives are located outside of the limits of the 100-year floodplain for West Little Llagas - Middle Avenue Overflow, both before and after the completion of the Upper Llagas Flood Protection Project.

3.8.1.4 Available Hydraulic Models

FEMA effective hydraulic model was available to perform the hydraulic analysis of this waterbody and was used to perform the hydraulic analysis. Figure 3-35 shows the approximate limits of the FEMA effective hydraulic model and the permanent project footprint for Alternative 2 at West Little Llagas Creek Middle Avenue Overflow.

Upper Llagas Flood Protection Project would remove existing 100-year floodplain assigned to West Little Llagas Creek – Middle Avenue Overflow. Therefore, the SCVWD hydraulic model of Llagas Creek and tributaries for the Upper Llagas Flood Protection Project did not include West Little Llagas Creek – Middle Avenue Overflow. Hydraulic analysis of West Little Llagas Creek – Middle Avenue Overflow was not performed using the SCVWD hydraulic model.

As stated in Section 3.3.5, Upper Llagas Flood Protection Project, West Little Llagas Creek – Middle Avenue Overflow would not be recognized as a 100-year floodplain with completion of the Upper Llagas Flood Protection Project. The outputs from the hydraulic analysis were not used to evaluate the project's potential impact on the existing floodplain.



Sources: FEMA 2009; Authority 2019

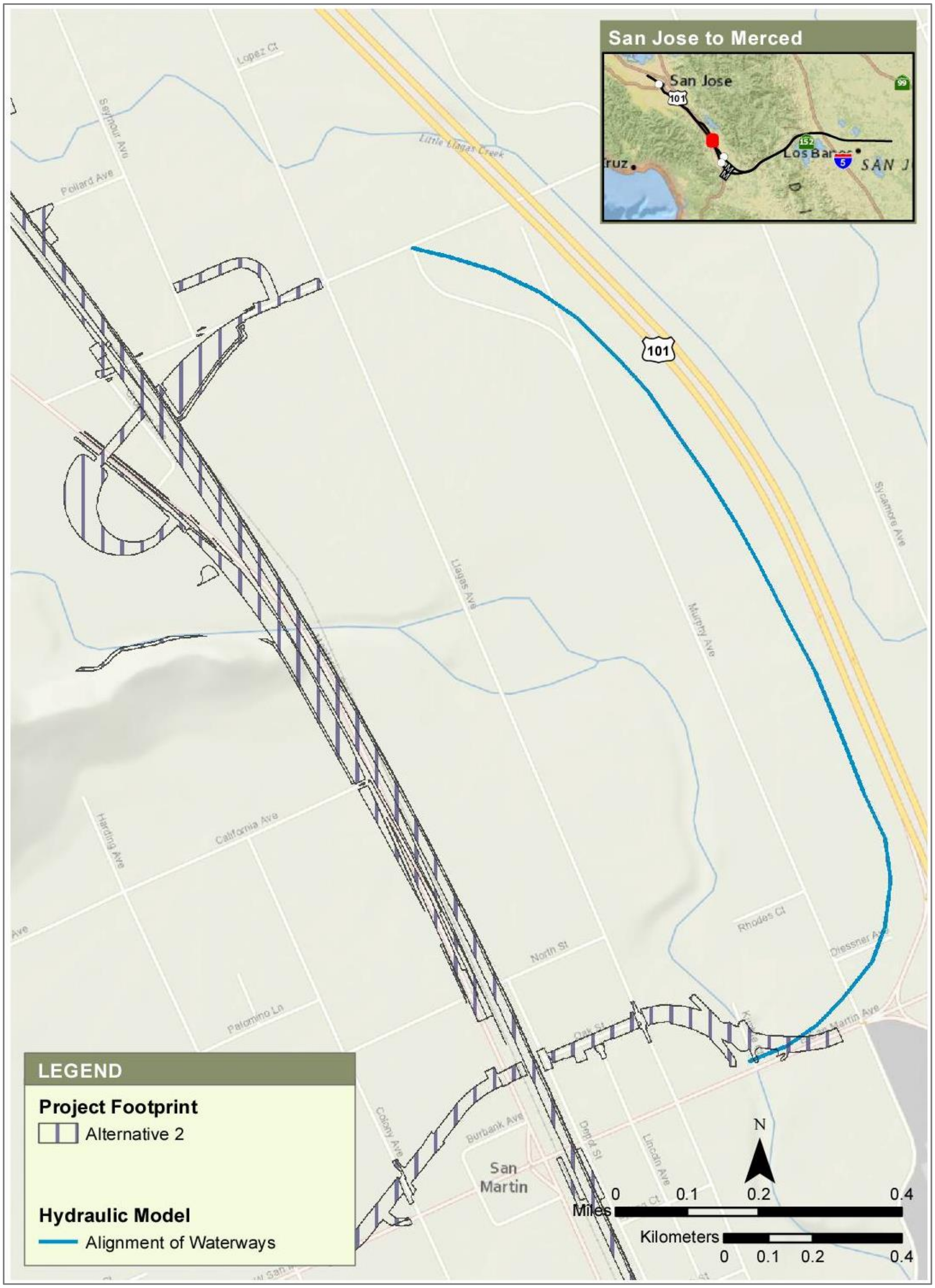
JANUARY 2019

Figure 3-33 West Little Llagas Creek Middle Avenue Overflow, Plan View of FEMA Effective Hydraulic Model with Project Footprint for Alternative 2

Sources: SCVWD 2018f; Authority 2019

JANUARY 2019

Figure 3-34 West Little Llagas Creek Middle Avenue Overflow, Floodplain after Completion of Upper Llagas Flood Protection Project with Project Footprint for Alternative 2



Sources: SCVWD 2018b; Authority 2019

JANUARY 2019

Note: this figure does not display channel cross sections included in the hydraulic model.

Figure 3-35 West Little Llagas Creek Middle Avenue Overflow, Plan View of FEMA Effective Hydraulic Model with Project Footprint for Alternative 2

3.8.2 FEMA Effective Hydraulic Model

3.8.2.1 Overview of Hydraulic Model

The FEMA FIRM and FIS for Santa Clara County did not provide location of the channel cross sections relative to the project footprint for Alternative 2. The channel cross sections included in the hydraulic model was replaced with channel cross sections with known locations to allow the comparison of the existing and propose conditions.

The proposed East San Martin Avenue Bridge over Llagas Creek and the bridge approach for Alternative 2 would be elevated from the existing grade to provide sufficient freeboard for the proposed bridge over Llagas Creek. The fill for the eastern bridge approach area that are within the limits of the FEMA effective hydraulic model were represented by adjusting the channel cross section.

3.8.2.2 Water Surface Elevation

The modeling results for West Little Llagas Creek – Middle Avenue Overflow for Alternative 2 near the proposed East San Martin Road Bridge are shown in Table 3-18. The outputs for Alternative 2 showed increases in 100-year flood profile immediately on upstream (east) of the areas obstructed by the proposed bridge approach area.

As stated in Sections 3.3.5 and 3.8.1, Background Information, the FEMA effective hydraulic model for West Little Llagas Creek – Middle Avenue Overflow would not represent the existing project conditions for the HSR. Because West Little Llagas Creek – Middle Avenue Overflow would not be classified as 100-year floodplain, mitigation measures would not be required.

Table 3-18 Hydraulic Modeling Results, West Little Llagas Creek, Alternative 2

Location	Flow Rate (cfs)	Channel Bank Elevation (feet NAVD 88)	WSE—Existing Condition (feet NAVD 88)	WSE—Proposed Condition (feet NAVD 88)	Change in WSE (feet)
At Outfall to Llagas Creek at East San Martin Avenue	658	n/a	286.0	286.0	0.0
500 feet upstream (east) of outfall	658	n/a	287.1	287.6	0.5
900 feet upstream (east) of outfall	658	n/a	289.5	289.6	0.1

Elevations are rounded to the nearest 0.1 foot.
This model represents overbank flood flow with undefined channel. There is no channel bank represented in the hydraulic model.
cfs = cubic feet per second
NAVD 88 = North American Vertical Datum of 1988
WSE = water surface elevation

3.9 West Branch Llagas Creek

3.9.1 Background Information

3.9.1.1 Floodplain Location

The West Branch Llagas Creek is tributary of Llagas Creek, flowing through the cities of San Martin and Gilroy on west side of Monterey Highway and existing railroad track.

3.9.1.2 FEMA Floodplain

According to the FEMA FIRM Panel Numbers 06085C0628H, 06085C0636H, and 06085C0637H (FEMA 2009), the main channel and overbank flow of West Branch Llagas Creek flowing parallel on the west side of Monterey Highway is identified as Zone AE and floodway (Figure 3-36).

3.9.1.3 Project Alternatives in the FEMA Floodplain

The permanent project footprint for Alternative 2 is in the existing 100-year floodplain for West Branch Llagas Creek (Figure 3-36). The permanent impact areas for the remaining three project alternatives are outside of the limits of the existing FEMA 100-year floodplain of West Branch Llagas Creek.

There are no existing/proposed railroad bridge over West Branch Llagas Creek. Alternative 2 proposes grade separation of the existing roadways crossing the existing railroad and realignment of Monterey Highway traveling parallel to the existing railroad track on the west side. In the footprint of the existing 100-year floodplain/floodway of West Branch Llagas Creek, Alternative 2 proposes ground excavation for the roadway grade separation of following roads undercrossing the proposed railroad track:

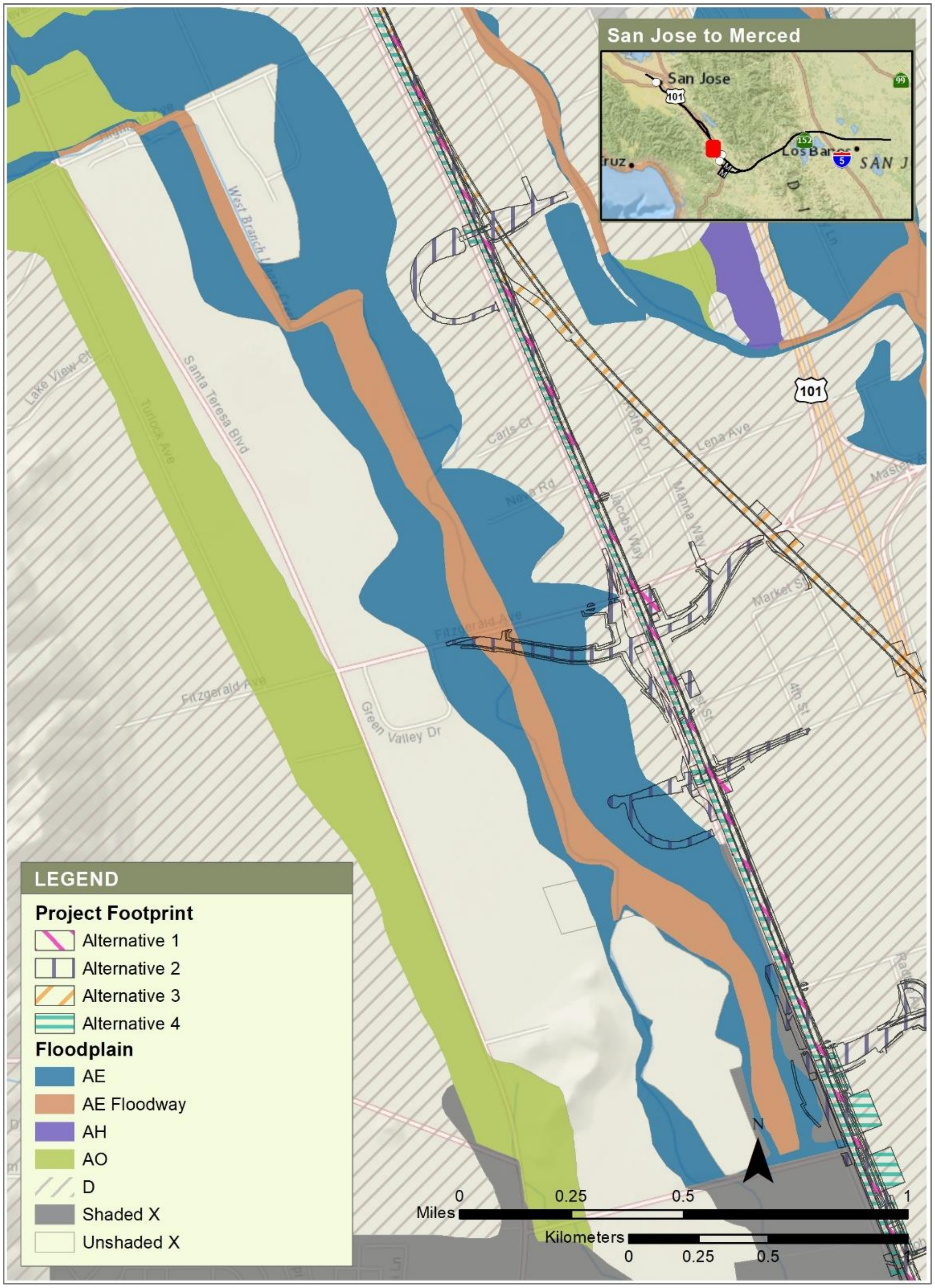
- Masten Avenue
- Rucker Avenue
- Buena Vista Avenue

This alternative would also require realignment and regrading of Monterey Highway, and portions of the realigned Monterey Highway would be in the existing 100-year floodplain for West Branch Llagas Creek.

3.9.1.4 Available Hydraulic Model

The FEMA effective hydraulic model was available to perform hydraulic analysis of this waterbody. Figure 3-37 shows the approximate limits of the FEMA effective hydraulic model and permanent project footprint for Alternative 2.

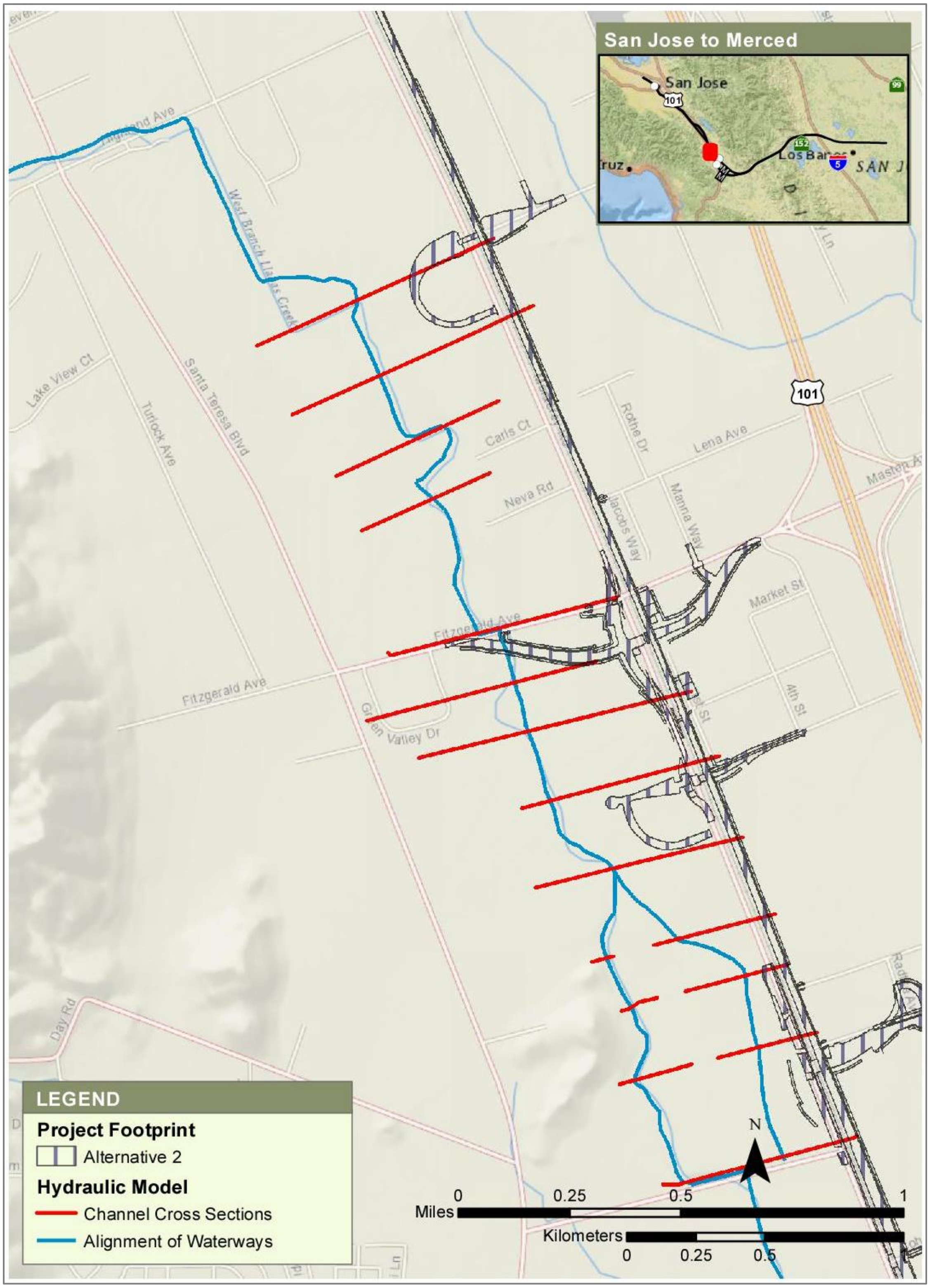
The SCVWD hydraulic model was not available for West Branch Llagas Creek. Therefore, hydraulic analysis was only performed using the FEMA effective hydraulic model.



Sources: FEMA 2009; Authority 2019

JANUARY 2019

Figure 3-36 West Brach Llagas Creek, Floodplain Map Zoomed to Project Location



Sources: FEMA 2018; Authority 2019.

JANUARY 2019

Note: this figure does not display channel cross sections included in the hydraulic model.

Figure 3-37 West Brach Llagas Creek, Plan View of FEMA Effective Hydraulic Model with Project Footprint for Alternative 2

3.9.2 FEMA Effective Hydraulic Model

3.9.2.1 Overview of Hydraulic Model

The upstream and downstream limits of FEMA effective hydraulic model for West Branch Llagas Creek were at Highland Avenue (at approximately Station B1437+00) and at Day Road (at approximately Station B1581+00).

The limits of the channel cross sections included the existing railroad track on embankment. The proposed condition hydraulic included the proposed embankment section for Alternative 2. The detailed grading of channel excavation for the roadways in the footprint of the existing 100-year floodplain for West Branch Llagas Creek was not available. Therefore, the proposed condition hydraulic model did not include the proposed channel excavation for the roadway grade separation project part of Alternative 2. This model setup would be revised in the design phase of this project.

3.9.2.2 Water Surface Elevation

The modeling results for the Alternative 2 near the West Branch Llagas Creek are shown in Table 3-19. The outputs for Alternative 2 did not show increases in 100-year flood profile near the West Branch Llagas Creek between West San Martin Avenue on north and Day Road on south.

Table 3-19 Hydraulic Modeling Results, West Branch Llagas Creek, Alternative 2

Location	Flow Rate (cfs)	Channel Bank Elevation (feet NAVD 88)	WSE—Existing Condition (feet NAVD 88)	WSE—Proposed Condition (feet NAVD 88)	Change in WSE (feet)
At Day Road	160	229.5	229.2	229.2	0.0
At Santa Clara Avenue	1,375	240.5	241.5	241.5	0.0
At Fitzgerald Avenue	1,375	244.3	246.9	246.9	0.0

Elevations are rounded to the nearest 0.1 foot.
cfs = cubic feet per second
NAVD 88 = North American Vertical Datum of 1988
WSE = water surface elevation

3.10 Llagas Creek (East of Gilroy)

3.10.1 Background Information

3.10.1.1 Floodplain Location

Llagas Creek flows through San Martin, Morgan Hill, and Gilroy. West Little Llagas Creek, Madrone Channel, and East Little Llagas Creek meet to form Upper Llagas Creek (Authority 2011a). Buena Vista Avenue divides Upper and Lower Llagas Creek. Lower Llagas Creek meets with West Branch Llagas Creek at SR 152 before it drains to the Pajaro River.

Llagas Creek east of Gilroy would require a permit process NRCS similar to the USACE Section 408 review and approval process.

3.10.1.2 FEMA Floodplain

According to the FEMA FIRM Panel Number 060685C0641H and 060685C0643H (FEMA 2009), the main channel of Llagas Creek in the project footprint is identified as Zone AE and a floodway (Figure 3-38). Llagas Creek at this location has levees on both sides of the main channel. The levees along the western bank are recognized by FEMA and appear in the FIRM #06085C0643H (FEMA 2009). The width of the effective Zone AE floodplain and floodway measured along the proposed railroad alignment for Alternative 3 is approximately 300 feet.

Llagas Creek east of Gilroy is outside of the Upper Llagas Flood Protection Project. There would be no changes to the channel geometry in this location, but changes in the flooding pattern would change the extents of the 100-year floodplain in the project footprint. The main channel of Llagas Creek would remain as Zone AE floodplain, but the width of the future Zone AE floodplain measured along the railroad alignment for Alternative 3 would change to approximately 330 feet (Figure 3-39).

Llagas Creek east of Gilroy in the project footprint is recognized as a floodway. Therefore, the project cannot raise the 100-year flood profile of Llagas Creek at East of Gilroy.

3.10.1.3 Project Alternatives in the FEMA Floodplain

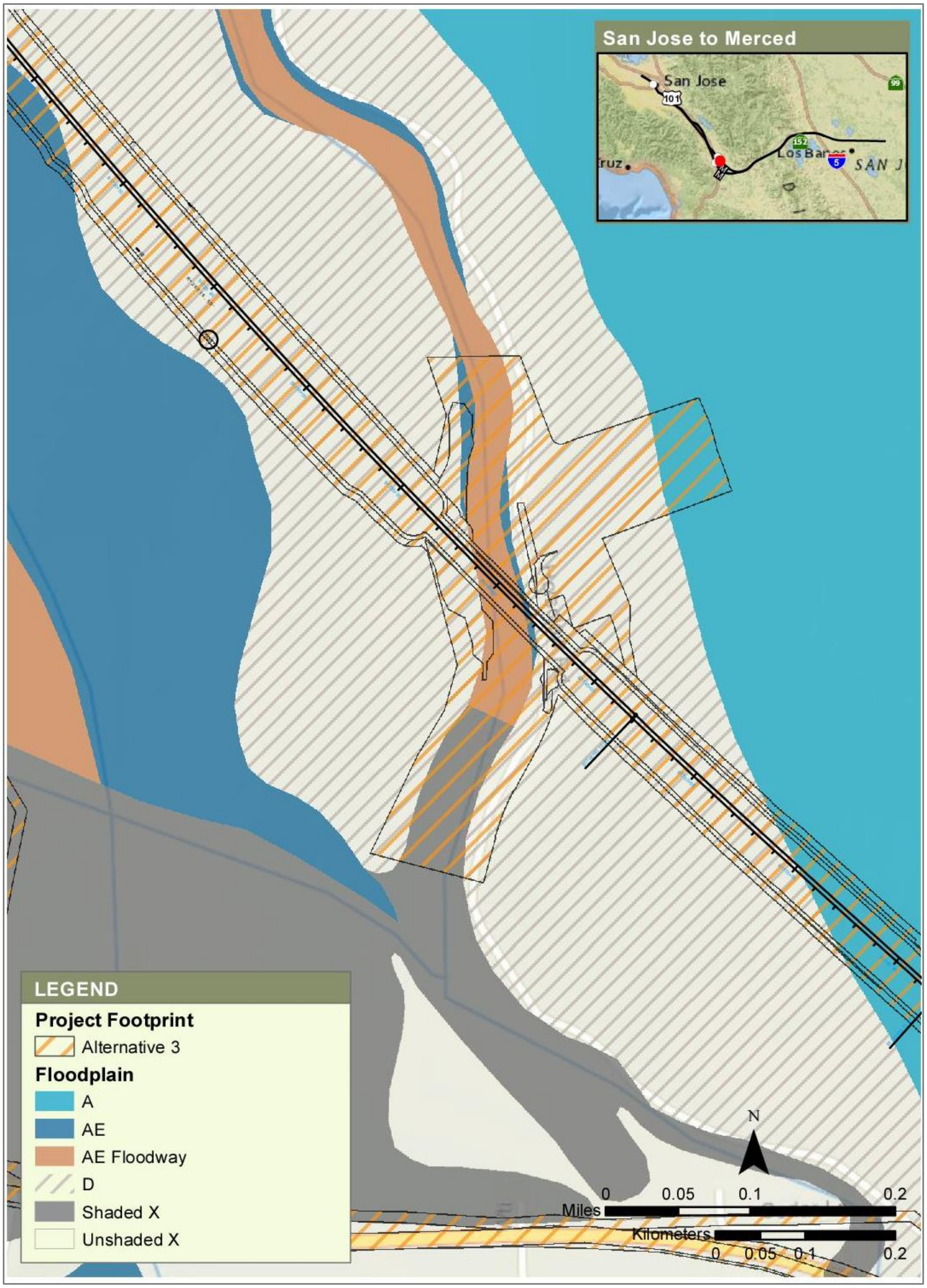
The project footprint for Alternative 3 is in the existing 100-year floodplain for Llagas Creek at East of Gilroy (Figure 3-38). The Upper Llagas Flood Protection Project would change the limits of the 100-year floodplain of Llagas Creek in the east of Gilroy (Figure 3-39), and the project footprint for Alternative 3 would still be within the modified 100-year floodplain. The permanent impact areas for the remaining three project alternatives are outside of the limits of the existing FEMA 100-year floodplain of Llagas Creek at East of Gilroy.

Alternative 3 would entail a new railroad bridge over Llagas Creek from approximately station 1736+00 to 1744+50. The proposed railroad bridge crossing would be located approximately 2,700 feet upstream (north) of the existing SR 152 bridge over Llagas Creek. The proposed pier columns in the main channel of Llagas Creek would obstruct the flood flow and could potentially increase the profile of the floodplain and floodway. The project would entail widening the channel by offsetting the levees to the outside to maintain the existing floodplain and floodway profile of Llagas Creek.

3.10.1.4 Available Hydraulic Model

The FEMA effective hydraulic model and SCVWD hydraulic model were available for this waterbody. Figure 3-40 shows the approximate limits of the FEMA effective hydraulic model with the project footprint for Alternative 2. Figure 3-41 shows the limits of the SCVWD hydraulic model with the project footprint for Alternative 2.

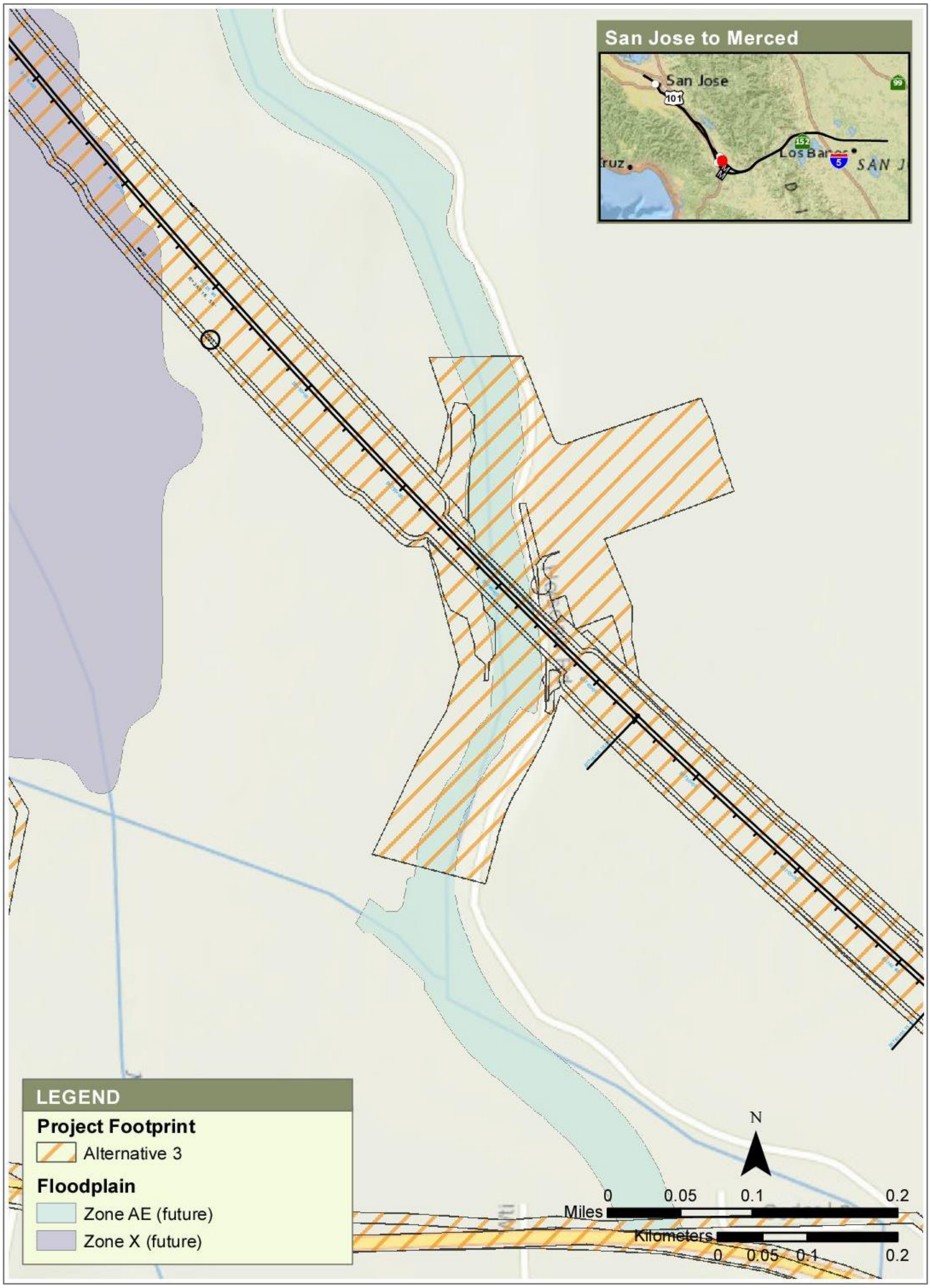
The FEMA effective hydraulic model provided does not include up-to-date available information that were included in the SCVWD hydraulic model. Therefore, the SCVWD hydraulic model was used to evaluate the project’s potential impacts.



Sources: FEMA 2009; Authority 2019

JANUARY 2019

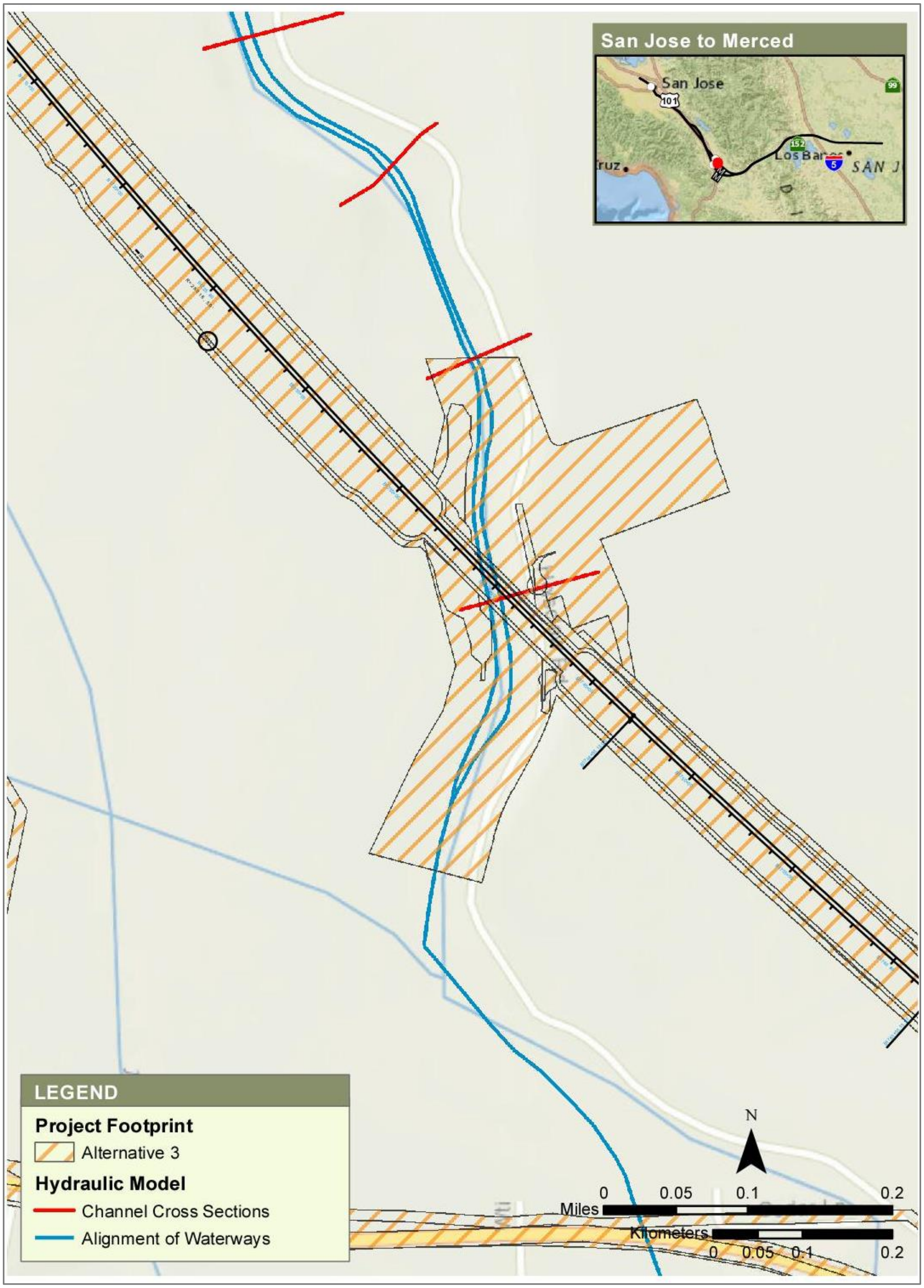
Figure 3-38 Llagas Creek (East of Gilroy), Plan View of FEMA Effective Hydraulic Model with Project Footprint for Alternative 3



Sources: SCVWD 2018f; Authority 2019

JANUARY 2019

Figure 3-39 Llagas Creek (East of Gilroy), Floodplain after Completion of Upper Llagas Flood Protection Project with Project Footprint for Alternative 3

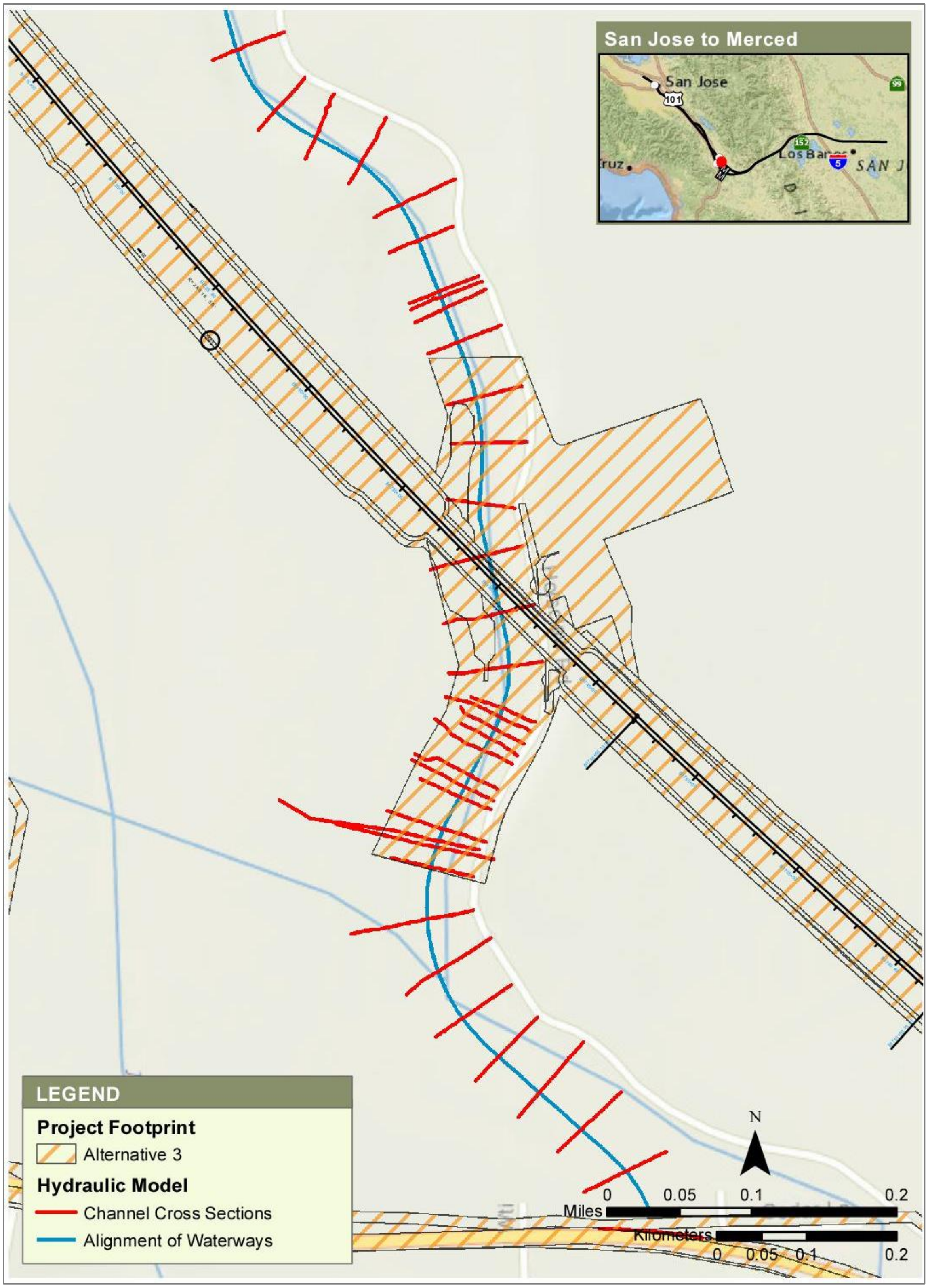


Sources: FEMA 2018; Authority 2019

JANUARY 2019

Note: this figure does not show all of the channel cross sections in the hydraulic model.

Figure 3-40 Llagas Creek (East of Gilroy), FEMA Hydraulic Model at Project Location



Sources: SCVWD 2015b; Authority 2019

JANUARY 2019

Figure 3-41 Llagas Creek (East of Gilroy), HEC-RAS Channel Cross Sections at Project Location

3.10.2 FEMA Effective Hydraulic Model

3.10.2.1 Overview of Hydraulic Model

The upstream and downstream limits of Llagas Creek east of Gilroy in the FEMA effective hydraulic model were approximately 3,400 feet upstream of Buena Vista Avenue Bridge (approximately 20,600 feet upstream of the proposed railroad bridge) and approximately 1,800 feet downstream of the Southside Drive Bridge (approximately 9,500 feet downstream of the proposed railroad crossing).

The channel width from the FEMA FIRM is approximately 400 to 500 feet (Figure 3-40), but the channel width of the FEMA effective hydraulic model at project location is approximately 12,000 feet. The footprint of hydraulic model includes Llagas Overbank on west and Zone A SHFA on east. Therefore, the setup of the FEMA effective hydraulic model would allow flood flow interaction between three independent floodplain. In addition, the current effective FEMA hydraulic model for Llagas Creek at the project location does include the changes to Llagas Creek and its tributaries resulting from SCVWD's Upper Llagas Creek Flood Protection Project.

3.10.2.2 Water Surface Elevations

The modeling results for Alternative 3 with the proposed creek widening are shown in Table 3-20. The outputs from hydraulic analysis showed the proposed Alternative 3 bridge would not increase the 100-year flood profile of Llagas Creek.

Table 3-20 Hydraulic Modeling Results, Llagas Creek (East of Gilroy), Alternative 3 with Creek Widening

Location	Flow Rate (cfs)	Channel Bank Elevation (feet NAVD 88)	WSE—Existing Condition (feet NAVD 88)	WSE—Proposed Condition (feet NAVD 88)	Change in WSE (feet)
At State Route 152 Bridge	5,800	183.8	179.9	179.9	0.0
At proposed railroad bridge for Alternative 3	6,300	188.7	191.1	191.1	0.0
At Gilman Rd	6,300	196.8	196.2	196.2	0.0

Elevations are rounded to the nearest 0.1 foot
cfs = cubic feet per second
NAVD 88 = North American Vertical Datum of 1988
WSE = water surface elevation

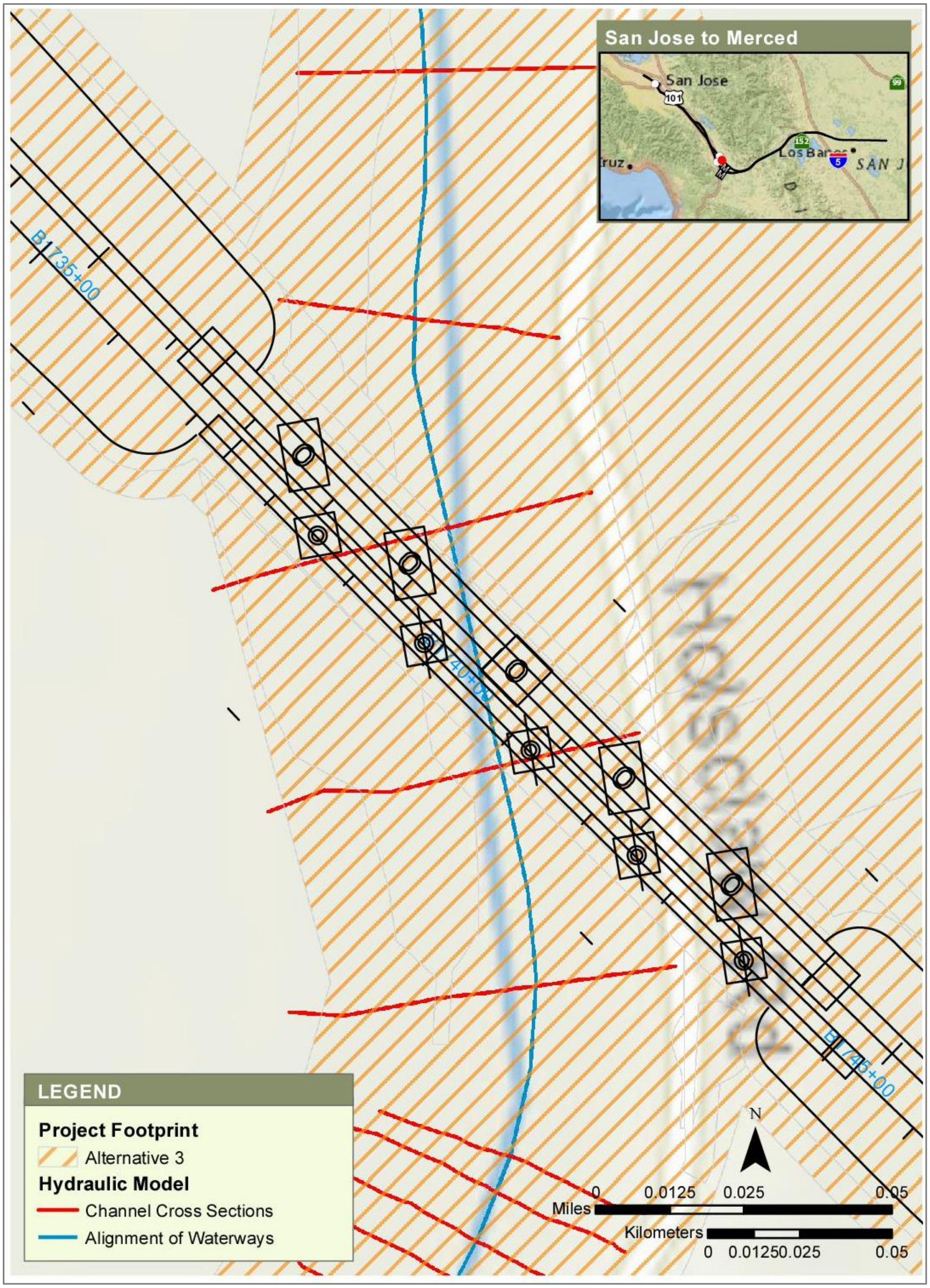
The current effective FEMA hydraulic model allow interaction between existing 100-year floodplain for Llagas Creek mainline, Llagas Overbank Flow on west, and Zone A floodplain on east of Llagas Creek mainline, even though FEMA FIRM does not show interaction between these three floodplains. Therefore, the outputs from the hydraulic analysis of the existing condition and Alternative 3 may not accurately represent the existing and proposed site conditions during the 100-year storm event, assuming Upper Llagas Flood Protection Project is completed prior to the beginning of construction for the HSR project. Therefore, hydraulic analysis was also performed using the hydraulic model of Llagas Creek and tributaries provided by SCVWD, and outputs from the SCVWD hydraulic model was used to evaluate the project's potential impacts on the existing 100-year floodplain.

3.10.3 SCVWD Hydraulic Model

3.10.3.1 Overview of Hydraulic Model

The SCVWD hydraulic model of Llagas Creek at East Gilroy (Figure 2-12) is same as the hydraulic models of Llagas Creek discussed in Section 3.6.3, SCVWD Hydraulic Model, (Llagas Creek near San Martin) and Section 3.7.3, SCVWD Model (Llagas Creek at East San Martin Avenue).

According to the preliminary bridge design for Llagas Creek bridge for Alternative 3, four piers would be inside the footprint of the hydraulic model and three piers would be inside the FEMA designated floodway (Figure 3-41). The three piers inside the designated floodway and one pier on outside of the western levee are included in the proposed condition hydraulic model for Alternative 3 (Figure 3-42). To represent the creek widening near the project footprint, the levees at the proposed bridge crossing in the hydraulic model were set back up to 50 feet to balance the potential floodplain and floodway impacts from the proposed pier columns inside the main channel of Llagas Creek.



Sources: SCVWD 2015b; Authority 2019

JANUARY 2019

Figure 3-42 Llagas Creek (East of Gilroy), HEC-RAS Channel Cross Sections, Zoomed to Proposed Llagas Creek Bridge for Alternative 3

3.10.3.2 Water Surface Elevations

The modeling results for Alternative 3 with the proposed creek widening are shown in Table 3-21. The proposed bridge piers for Alternative 3 in the main channel of Llagas Creek with the proposed creek widening would raise the 100-year WSE of Llagas Creek by 0.4 foot or less. HYD-MM#2, Maintain Existing 100-year Water Surface Elevations of the Llagas Creek Floodway near Holsclaw Road in East Gilroy, would be implemented to mitigate the impact of the bridge piers on the floodway. Mitigation could potentially include, but is not necessarily limited to, the following design solutions: optimizing the design of the piers supporting the proposed bridge or relocating the piers; relocating the existing levee in order to establish a wider channel and floodplain; and/or dredging the channel.

Table 3-21 Hydraulic Modeling Results, Llagas Creek (East of Gilroy), Alternative 3 with Creek Widening

Location	Flow Rate (cfs)	Channel Bank Elevation (feet NAVD 88)	WSE—Existing Condition (feet NAVD 88)	WSE—Proposed Condition (feet NAVD 88)	Change in WSE (feet)
At confluence with West Branch Llagas Creek	8,248	189.9	180.6	180.6	0.0
At proposed railroad bridge for Alternative 3	8,248	191.6	191.2	191.6	0.4
At Gilman Rd	8,248	195.9	193.6	193.7	0.1

Elevations are rounded to the nearest 0.1 foot
cfs = cubic feet per second
NAVD 88 = North American Vertical Datum of 1988
WSE = water surface elevation

3.10.3.3 Water Surface Elevations, Future SCVWD Hydrologic Condition

According to SCVWD, the design flow rate of 8,248 cfs used in their hydraulic model accounts for escape flows from Llagas Creek upstream of the project location. The future flood control project on lower Llagas Creek, following the Upper Llagas Flood Protection Project, would allow Llagas Creek to fully convey the 100-year flow, which would be approximately 17,800 cfs at the project location (SCVWD 2018g).

During the meeting in April, 26, 2018, SCVWD requested the Authority to design proposed Llagas Creek Bridge for Alternative 3 to handle the future 100-year flood flow rate of 17,800 cfs at the project location without raising the current 100-year flood profile of Llagas Creek. The preliminary hydraulic analysis for Alternative 3 with additional channel widening was performed o to show that the proposed Alternative 3 bridge over Llagas Creek has sufficient opening width to accommodate future 100-year flow of 17,800 cfs and without raising the current 100-year flood profile shown in the hydraulic model. In this conceptual future condition for Alternative 3, the channel cross sections of Llagas Creek from upstream of the proposed HSR Alternative 3 bridge and confluence with West Branch Llagas Creek was widened approximately 70 to 90 feet and with channel excavation between bridge upstream face to the existing drop structure.

The outputs from the hydraulic analysis for Alternative 3 in the future scenario with additional modifications to the main channel of Llagas Creek showed that proposed bridge opening is sufficient to convey the future 100-year flow of 17,800 cfs without raising the flood profile from the 100-year flood profile based on flow rate of 8,248 cfs.

3.11 Llagas Overbank (East of Gilroy)

3.11.1 Background Information

3.11.1.1 Floodplain Location

Llagas Creek flows through San Martin, Morgan Hill, and Gilroy. West Little Llagas Creek, Madrone Channel, and East Little Llagas Creek meet to form Upper Llagas Creek (Authority 2011a). Buena Vista Avenue divides Upper and Lower Llagas Creek. Lower Llagas Creek meets with West Branch Llagas Creek at SR 152 before it drains to the Pajaro River.

3.11.1.2 FEMA Floodplain

The FEMA FIRM Panel Numbers 06085C0637H, 06085C0641H, and 06085C0643H (FEMA 2009) shows overbank flood flows from Llagas Creek forms shallow overland flow traveling parallel to Llagas Creek approximately 2,000 to 3,000 feet west of the mainline Llagas Creek. The overbank flood flow from are designated as Zone AO, Zone AE, and floodway (Figure 3-43).

The 100-year flood elevation of the Llagas Overbank with the project footprint varies from approximately 205 feet NAVD 88 at the proposed HSR access road located approximately 2,000 feet upstream (north) of Leavesley Road crossing to approximately 185 feet NAVD 88 at Gilman Road.

The Llagas Overbank in the project footprint is recognized as a floodway in the current effective FEMA FIRM. Therefore, the project cannot raise the 100-year flood profile of Llagas Overbank.

SCVWD's Upper Llagas Flood Protection Project would modify the existing floodplain/floodway footprint of Llagas Overbank (Figure 3-44). With completion of Upper Llagas Flood Protection Project, Llagas Overbank would not be classified as outside of the 100-year floodplain.

3.11.1.3 Project Alternatives in the FEMA Floodplain

The project footprints for all four project alternatives are in the existing 100-year floodplain for Llagas Overbank.

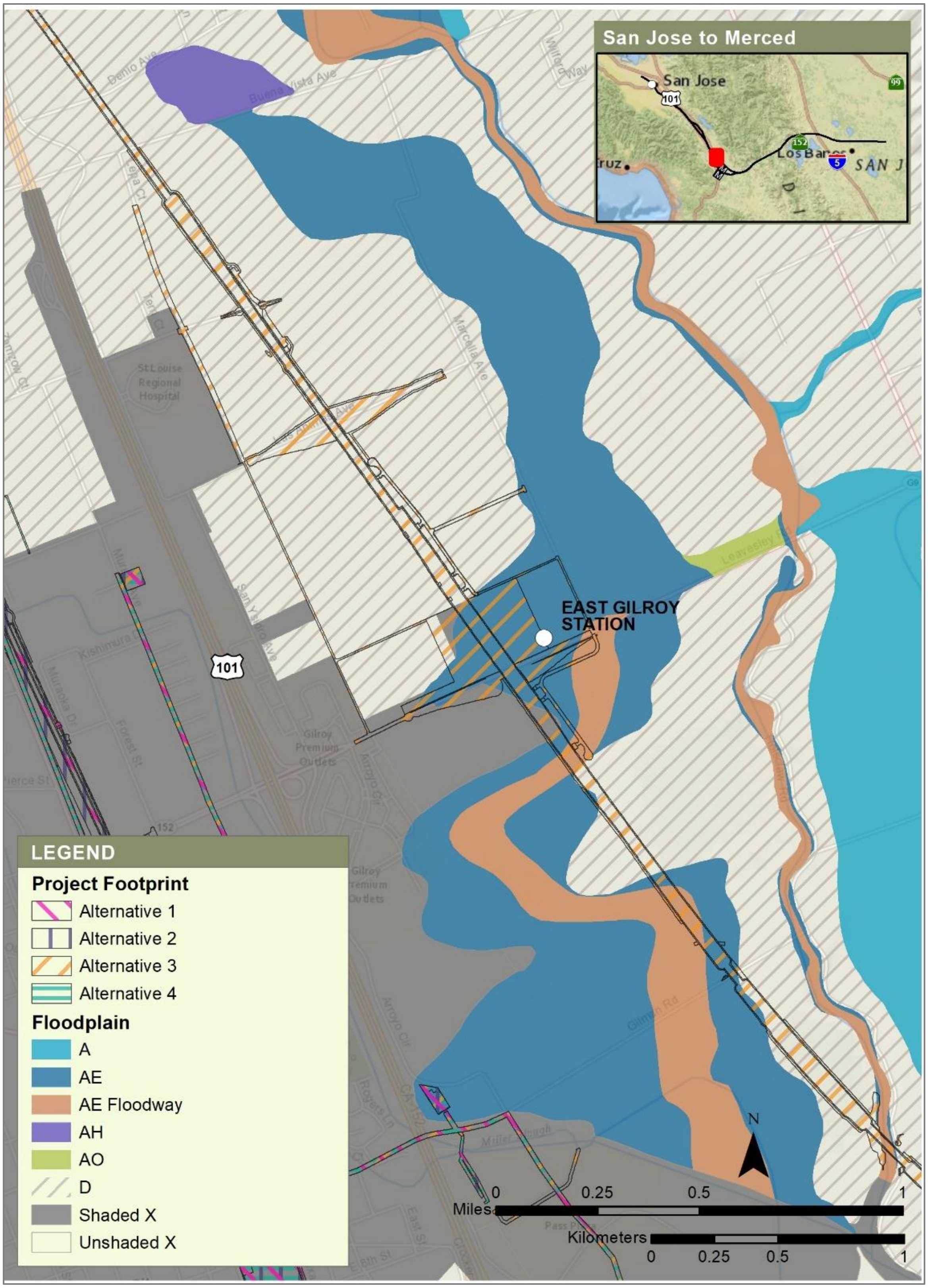
Alternatives 1, 2, and 4 propose a traction power switch station on Gilman Road would be in the limits of the existing 100-year floodplain. The base flood elevation (BFE) shown in the FEMA FIRM in the project footprint for Alternatives 1, 2, and 4 varies from 190 to 191 feet NAVD 88.

Alternative 3 would entail a new embankment segment over Llagas Overbank. Stations B1651+00 to B1684+00 and stations B1693+00 to B1720+00 would be inside the existing FEMA 100-year floodplain. Equalizers are proposed to maintain the existing flood pattern shown in the FEMA FIRM.

3.11.1.4 Available Hydraulic Models

FEMA effective hydraulic model was available to perform hydraulic analysis of this waterbody. Figure 3-45 shows the approximate limits of the FEMA effective hydraulic model with the project footprint for Alternatives 1, 2, and 4. Figure 3-46 shows the limits of the FEMA effective hydraulic model with the project footprint for Alternative 3. The SCVWD hydraulic model of Llagas Creek and tributaries for Upper Llagas Flood Protection Project did not include Llagas Overbank.

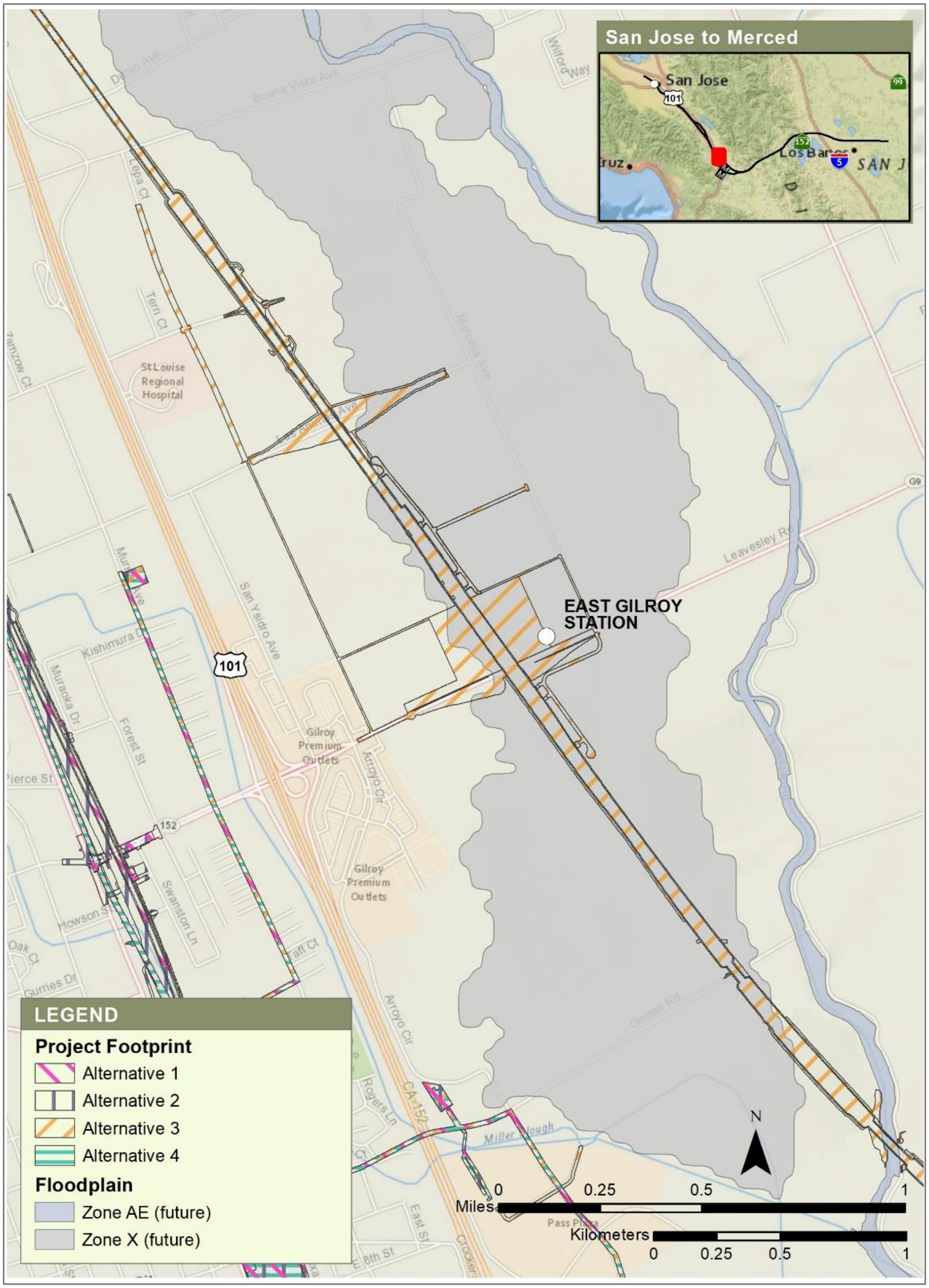
The hydraulic analysis was performed using FEMA effective hydraulic model. The hydraulic analysis outputs would not be used to evaluate the project's potential impacts on the 100-year floodplain, because Llagas Overbank would not be classified as 100-year floodplain after completion of the Upper Llagas Flood Protection Project.



Sources: FEMA 2009; Authority 2019

JANUARY 2019

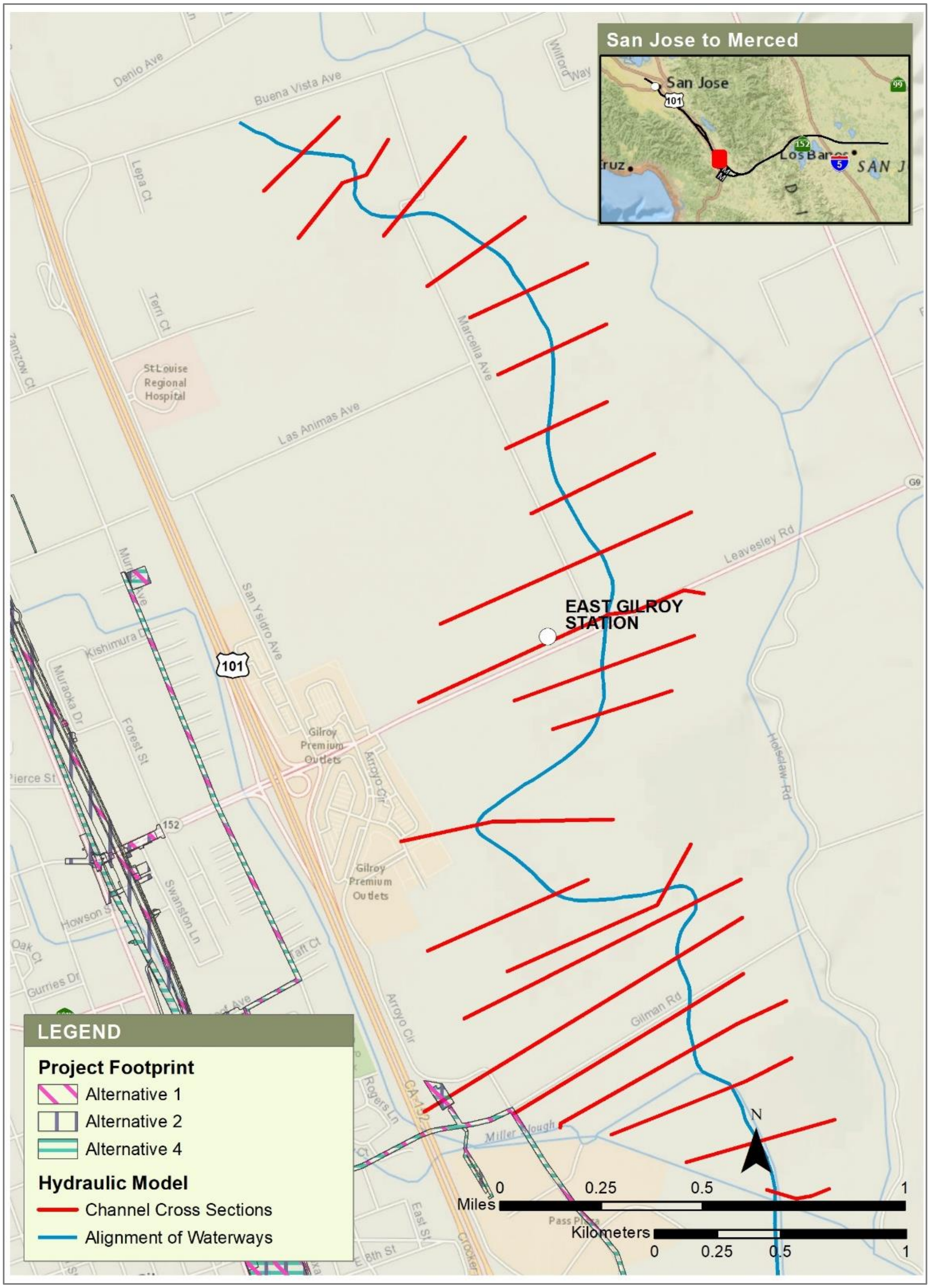
Figure 3-43 Llagas Overbank, FEMA FIRM Zoomed to Project Location



Sources: SCVWD 2018f; Authority 2019

JANUARY 2019

Figure 3-44 Llagas Overbank, Floodplain after Completion of Upper Llagas Flood Protection Project with Project Footprints for Alternatives 1, 2, 3, and 4

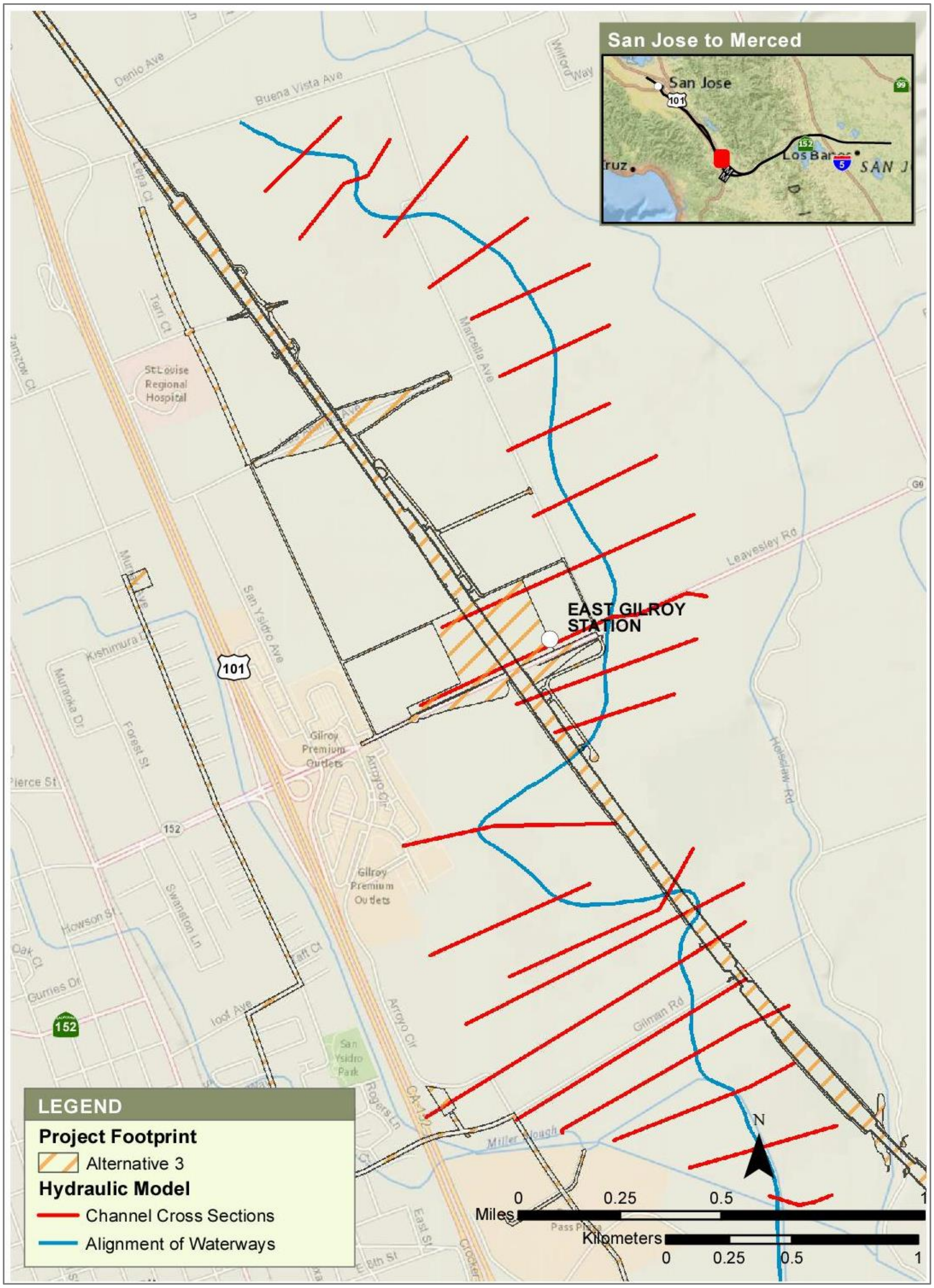


Sources: FEMA 2018; Authority 2019.

JANUARY 2019

Note: this figure does not display all of the channel cross sections included in the hydraulic model.

Figure 3-45 Llagas Overbank, Plan View of FEMA Effective Hydraulic Model with Project Footprint for Alternatives 1, 2, 3, and 4



Sources: FEMA 2018; Authority 2019.
Note: this figure does not display all of the channel cross sections included in the hydraulic model.

JANUARY 2019

Figure 3-46 Llagas Overbank, Plan View of FEMA Effective Hydraulic Model with Project Footprint for Alternative 3

3.11.2 FEMA Effective Hydraulic Model

3.11.2.1 Overview of Hydraulic Model

The upstream and downstream limits of Llagas Overbank in the FEMA effective hydraulic model were approximately 1,300 feet upstream of Buena Vista Avenue and approximately 1,800 feet downstream of the Southside Drive Bridge.

The proposed traction power switching station for Alternatives 1, 2, and 4 that is located inside the existing 100-year floodplain was represented in the hydraulic model by adding the flood flow obstruction with the same footprint as the proposed traction power switching station.

The proposed embankments for Alternative 3 that are in the footprint of the hydraulic model were represented using the obstruction feature equivalent to the footprint of the proposed structures. The width of obstruction assigned in channel cross sections varies from approximately 300 to 1,700 feet.

3.11.2.2 Water Surface Elevation

The modeling results for the Alternatives 1, 2, and 4 and Alternative 3 are shown in Table 3-22 and Table 3-23. The outputs for Alternatives 1, 2, and 4 did not show increases in 100-year flood profile of Llagas Overbank. The outputs for Alternative 3 showed elevation increase up to 0.3 foot in the project vicinity.

Table 3-22 Hydraulic Modeling Results, Llagas Overbank, Alternatives 1, 2, and 4

Location	Flow Rate (cfs)	Channel Bank Elevation (feet NAVD 88)	WSE—Existing Condition (feet NAVD 88)	WSE—Proposed Condition (feet NAVD 88)	Change in WSE (feet)
At Gilman Road	4,800	n/a	191.4	191.4	0.0
At Proposed Traction Power Switching Station	4,650	n/a	192.3	192.3	0.0
Approximately 1,000 feet downstream (South)of Leavesley Road	4,650	n/a	200.3	200.3	0.0
At Leavesley Road	4,650	n/a	201.2	201.2	0.0
At Buena Vista Road	300	n/a	223.8	223.8	0.0

Elevations are rounded to the nearest 0.1 foot
cfs = cubic feet per second
NAVD 88 = North American Vertical Datum of 1988
WSE = water surface elevation
Overbank flood flow at this location do not have defined channel.

Table 3-23 Hydraulic Modeling Results, Llagas Overbank, Alternative 3

Location	Flow Rate (cfs)	Channel Bank Elevation (feet NAVD 88)	WSE—Existing Condition (feet NAVD 88)	WSE—Proposed Condition (feet NAVD 88)	Change in WSE (feet)
At Gilman Road	4,800	n/a	191.4	191.4	0.0
At proposed traction power switching station	4,650	n/a	192.3	192.3	0.0
Approximately 1,000 feet downstream (South)of Leavesley Road	4,650	n/a	200.3	200.6	0.3
At Leavesley Road	4,650	n/a	201.2	201.2	0.0
At Buena Vista Road	300	n/a	223.8	223.8	0.0

Elevations are rounded to the nearest 0.1 foot
cfs = cubic feet per second
NAVD 88 = North American Vertical Datum of 1988
WSE = water surface elevation

4 COMBINED ONE- AND TWO-DIMENSIONAL HYDRAULIC MODELING

4.1 Hydrology

The FEMA and SCVWD combined one- and two-dimensional HEC-RAS models used to perform existing and proposed condition hydraulic analyses included the hydrographs for the 100-year storm event. The hydrographs included in the hydraulic model are discussed in details in each of the subsections "Inflow Hydrograph for Hydraulic Analysis", for each floodplain.

4.2 Hydraulic Model Assumptions

The assumptions for all of the one-dimensional hydraulic model discussed in Section 3.3, general Hydraulic Model Assumptions, are also applicable for the combined one- and two-dimensional unsteady-state hydraulic models. The modeling assumptions that are specific to each hydraulic model are discussed in each of the Overview of the Hydraulic Model subsections for each floodplain.

4.3 Los Gatos Creek

4.3.1 Background Information

4.3.1.1 Floodplain Location

Los Gatos Creek runs 24 miles through Santa Clara Valley's Guadalupe River watershed from the Santa Cruz Mountains, just south of Loma Prieta peak, north through the Santa Clara Valley until it reaches its confluence with the Guadalupe River in downtown San Jose (Authority 2011a). The Guadalupe River then continues to San Francisco Bay.

4.3.1.2 FEMA Floodplain

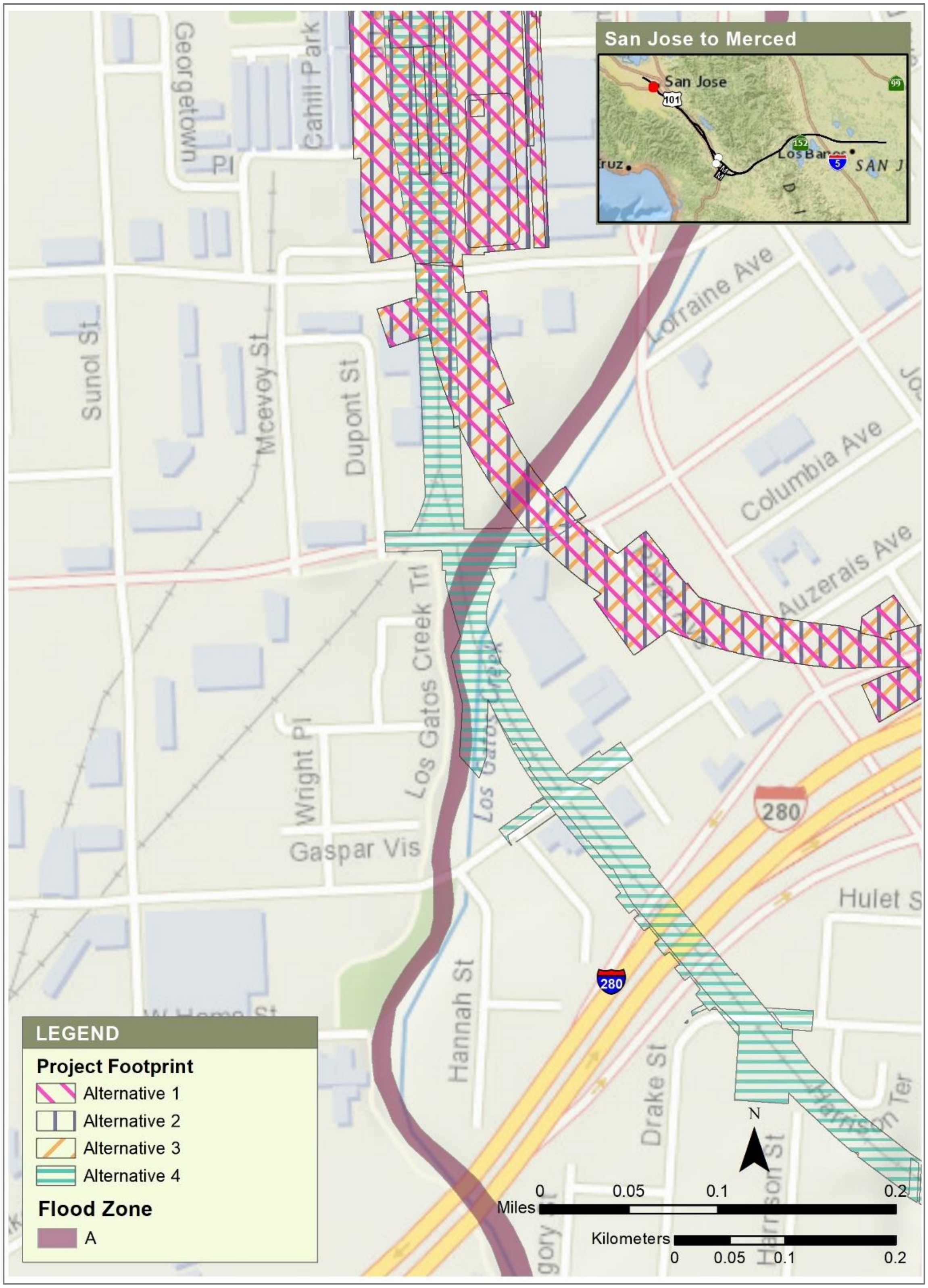
According to the FEMA FIRM Panel No. 60685C0234H (FEMA 2009), Los Gatos Creek in the project footprint is identified as Zone A (Figure 4-1). The FEMA FIRM does not show overbank flood flows in the project vicinity. The width of the Zone A measured along proposed track alignment is approximately 70 feet for Alternatives 1, 2, and 3 and approximately 130 feet for Alternative 4.

4.3.1.3 Project Alternatives in the FEMA Floodplain

The project footprints for Alternatives 1, 2, and 3 overlap with the existing 100-year floodplain for Los Gatos Creek. However, the proposed viaduct segment supported by pier columns for Alternatives 1, 2, and 3 would span over Los Gatos Creek and the proposed pier columns supporting the viaduct would be constructed outside the limits of the existing Zone A floodplain. The proposed railroad track profile over Los Gatos Creek would be approximately 60 feet above the existing channel bank elevation of Los Gatos Creek and would not be in contact with the 100-year flood flow as shown in the FEMA FIRM.

Alternative 4 proposes blended at-grade track using the railroad track currently used by Caltrain and UPRR, constructed in 2017. The HSR train would share the existing railroad bridge over Los Gatos Creek with Caltrain and UPRR. The modifications to the existing bridge structure are not proposed in this project alternative.

For all four project alternatives, no changes are proposed inside the existing FEMA 100-year floodplain of Los Gatos Creek.



Sources: FEMA 2009; Authority 2019

JANUARY 2019

Figure 4-1 Los Gatos Creek, FEMA FIRM Overlay with Project Footprints for Alternatives 1, 2, 3, and 4

4.3.1.4 Available Hydraulic Model

Los Gatos Creek in the project vicinity is identified as Zone A, which is assigned to floodplains determined by approximate methods. In addition, the date of the current effective FEMA FIRM (2009) is before the construction of the existing bridge in the year 2017, which would be used as the blended railroad track for HSR in Alternative 4. Therefore, the hydraulic analysis using FEMA's effective hydraulic model was not performed for Los Gatos Creek.

The more recent SCVWD hydraulic model was documented in this study. Figure 4-2 and Figure 4-3 shows the limits of the SCVWD hydraulic model and project footprint for Alternatives 1, 2, 3 and Alternative 4 at Los Gatos Creek, respectively.

4.3.2 SCVWD Hydraulic Model

4.3.2.1 Overview of Hydraulic Model

The upstream and downstream limits of Los Gatos Creek included in the hydraulic model were immediately downstream of Vasona Park Road Bridge in Vasona Reservoir (approximately 37,860 feet upstream of existing Caltrain/UPRR bridge over Los Gatos Creek) and confluence with Guadalupe River (approximately 4,100 feet downstream of the proposed HSR viaduct over Los Gatos Creek).

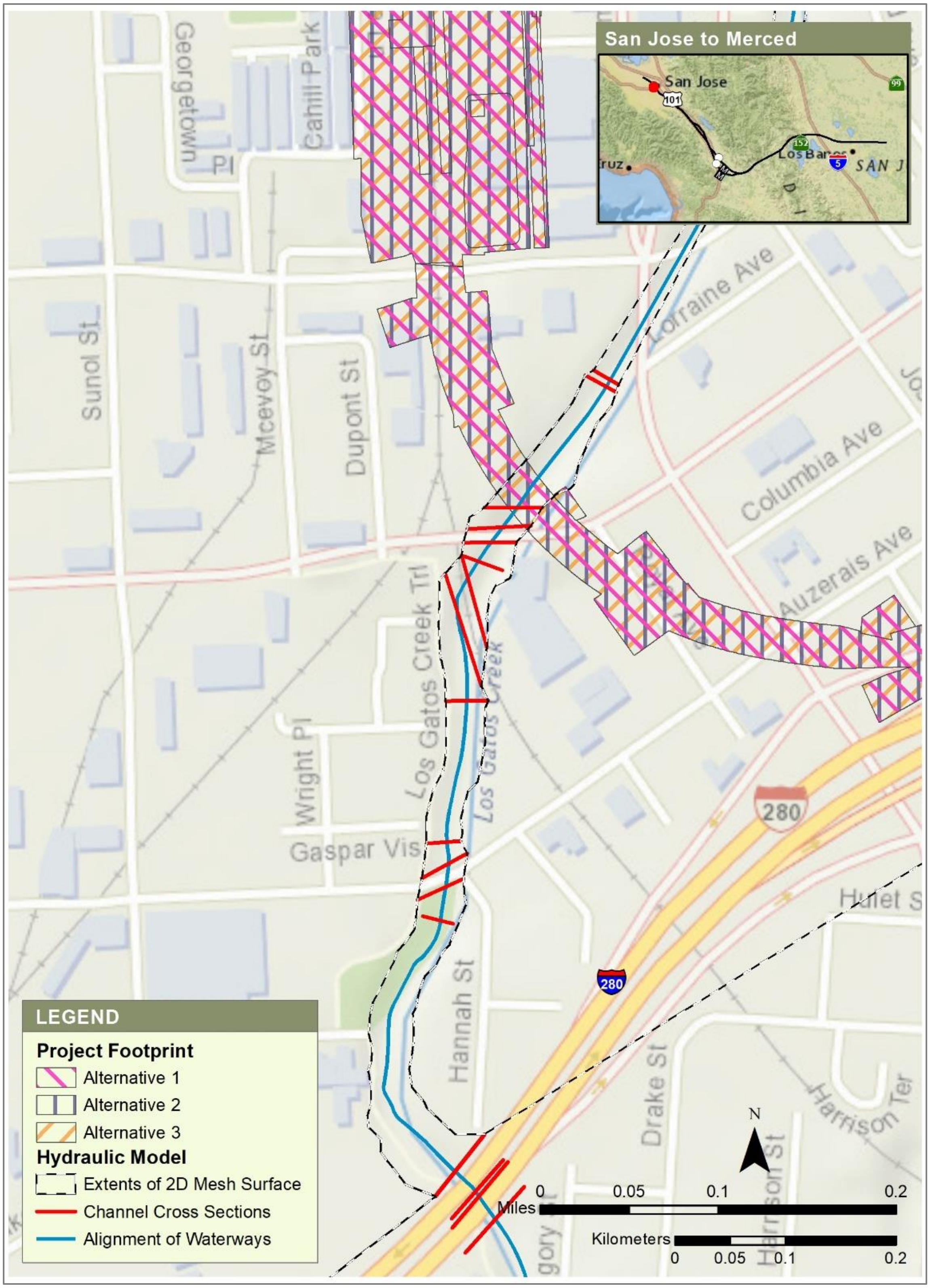
The two-dimensional mesh included in the hydraulic model used to represent the overbank flood flows, included areas roughly bounded by I-280 on south, I-87 on east, West Taylor Street on north, and The Alameda/Race Street on west. The area of the two-dimensional mesh included in the hydraulic model is approximately 836 acres.

The outputs from the existing condition hydraulic analysis showed that the existing railroad bridge over Los Gatos Creek would be overtopped during the 100-year storm event.

The proposed pier columns for Alternatives 1, 2, and 3 is located outside of the limits of the Los Gatos Creek main channel represented in one-dimensional riverine model. The hydraulic model for Alternatives 1, 2, and 3 did not make any modifications to the model inputs in the one-dimensional riverine component.

The proposed pier columns for Alternatives 1, 2, and 3 are within the limits of the two-dimensional mesh included in the hydraulic model, which represents the extents of the overbank flood flows from Los Gatos Creek within the model limits. The Manning's roughness coefficient of 1.0 was assigned in the footprint of the proposed piers columns for Alternatives 1, 2, and 3 to represent the additional obstruction from the proposed pier columns in the overbank area.

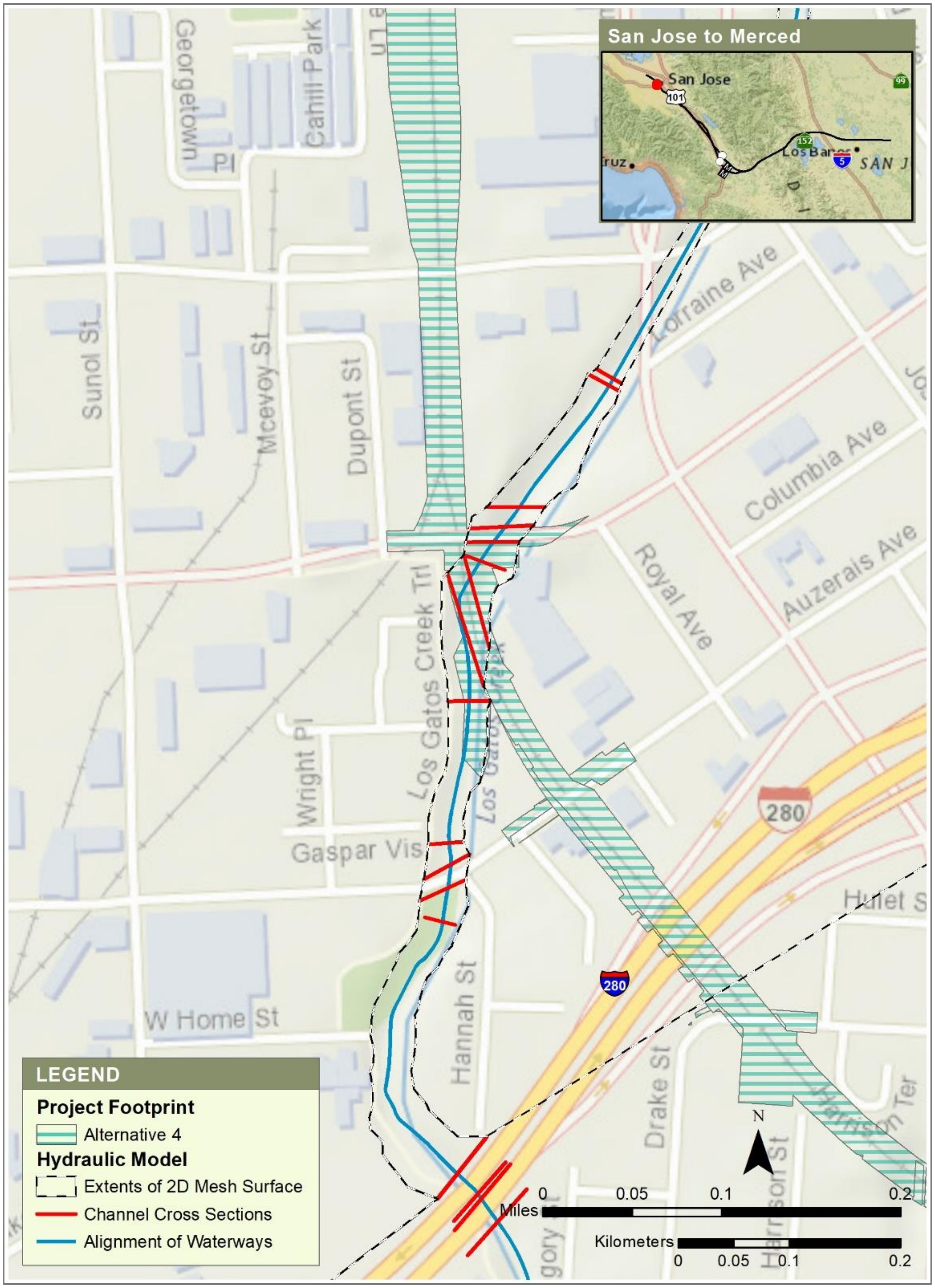
Alternative 4 does not proposed any improvements to the existing Los Gatos Creek bridge. Because detailed design of the removal/replacement Bird Avenue undercrossing proposed in this alternative is not available, hydraulic analysis for Alternative 4 was not performed in this phase of the proposed project.



Sources: SCVWD 2018c; Authority 2019

JANUARY 2019

Figure 4-2 Los Gatos Creek, Plan View of SCVWD Hydraulic Model with Project Footprint for Alternatives 1, 2, and 3



Sources: SCVWD 2018c; Authority 2019

JANUARY 2019

Figure 4-3 Los Gatos Creek, Plan View of SCVWD Hydraulic Model with Project Footprint for Alternative 4

4.3.2.2 Inflow Hydrograph for Hydraulic Analysis

According to SCVWD, flow hydrographs from the 2009 USACE Guadalupe Hydrology Report were used in the Los Gatos Creek HEC-RAS model (SCVWD 2018c). There were 11 locations in the hydraulic model with assigned inflows. The peak 100-year flows at each inflow location are summarized in Table 4-1. The inflow locations in the hydraulic model are shown in Figure 4-4.

Table 4-1 Peak 100-year Inflows into Los Gatos Creek Hydraulic Model

Location	Distance from Existing Railroad Bridge[1]	Peak 100-year Inflow (cfs)
RS 41962.09	37,860 feet upstream	7,730
RS 36755.72	32,660 feet upstream	511
RS 30400	26,300 feet upstream	130
RS 24499.3	20,400 feet upstream	130
RS 19915.39	15,820 feet upstream	107
RS 12899.16	8,800 feet upstream	107
RS 12591.04	8,490 feet upstream	107
RS 5087.607	990 feet upstream	267
RS 3953	150 feet downstream	36
RS 3363.051	740 feet downstream	36

Source: SCVWD 2018c
RS = River Station
cfs = cubic feet per second
[1] Rounded to the nearest 10 feet.

Source: SCVWD 2018c

JANUARY 2019

Figure 4-4 Inflow Locations in the SCVWD Hydraulic Model of Los Gatos Creek

4.3.2.3 Water Surface Elevations, Main Channel

The outputs from the existing condition and Alternatives 1, 2, and 3 are shown in Table 4-1 The outputs from hydraulic analysis shows the proposed pier columns for Alternatives 1, 2, and 3 placed in two-dimensional mesh area of the hydraulic model would not have an impact on the 100-year flood profile of Los Gatos Creek in the main channel.

Because there were minimal impacts on the existing 100-year floodplain, the existing railroad bridge would remain overtopped during 100-year storm event for Alternatives 1, 2, and 3. Alternative 4 does not proposed any improvements to the existing Los Gatos Creek bridge; the existing railroad bridge that would be shared by HSR, Caltrain, and UPRR would remain overtopped during 100-year storm event.

Table 4-2 Hydraulic Modeling Results, Los Gatos Creek, Alternatives 1, 2, and 3

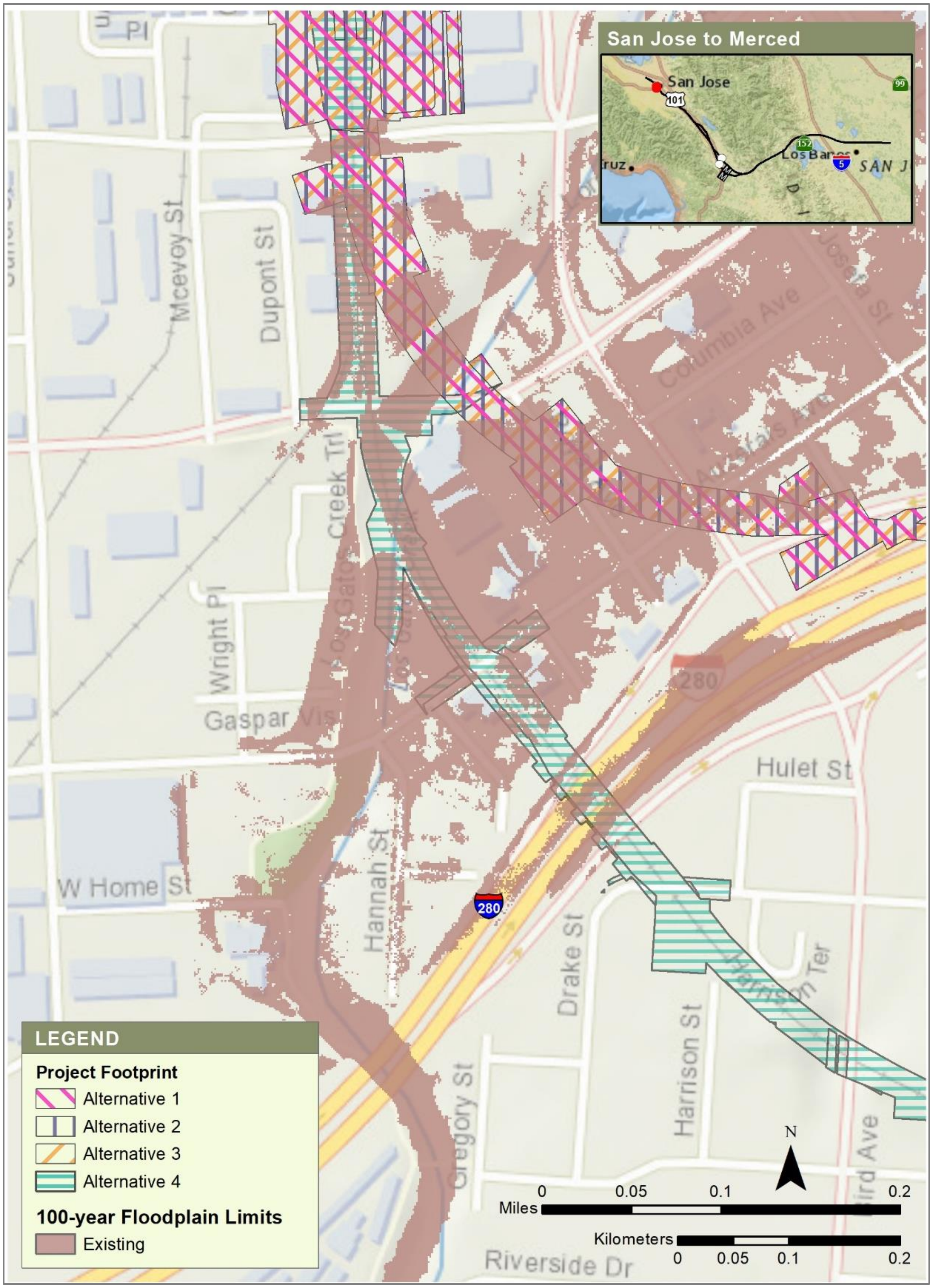
Location	Flow Rate (cfs)	Channel Bank Elevation (feet NAVD 88)	WSE—Existing Condition (feet NAVD 88)	WSE—Proposed Condition (feet NAVD 88)	Change in WSE (feet)
At Confluence with Guadalupe River	7,700	81.3	78.2	78.2	0.0
At proposed HSR viaduct crossing (66+00)	7,900	99.6	99.6	99.6	0.0
At exist Railroad Bridge	7,630	98.9	101.2	101.2	0.0
At Auzerais Avenue Bridge	8,030	103.7	105.9	105.9	0.0
At I-280 Bridge	8,260	109.2	109.5	109.5	0.0

cfs = cubic feet per second
NAVD 88 = North American Vertical Datum of 1988
WSE = water surface elevation
Elevations are rounded to the nearest 0.1 foot.
HSR = high=speed rail
I = Interstate
Flow rate shown in this table is for flood flows remaining inside the main channel, and is rounded up to the nearest 10 cfs.

4.3.2.4 Water Surface Elevations, Overbank Area

The outputs from the hydraulic analysis of the existing condition and Alternatives 1, 2, and 3 using the SCVWD hydraulic model showed overbank flood flows from Los Gatos Creek during 100-year storm event. The proposed pier columns for Alternative 1, 2, and 3 located outside of the main channel of Los Gatos Creek were in contact with the overbank flood flows.

The extents of the 100-year floodplain in the overbank area of the hydraulic model for the existing condition and Alternatives 1, 2, and 3 are shown in Figure 4-5. The proposed pier columns represented as areas with the Manning’s roughness coefficient of 1.00 in the overbank areas represented by two-dimensional mesh showed no substantial changes to the extents of the 100-year floodplain.



Sources: SCVWD 2018c; Authority 2019

JANUARY 2019

Figure 4-5 Extent of 100-Year Floodplain, Existing Condition and Alternatives 1, 2, 3, and 4

4.4 Guadalupe River and Tributaries

4.4.1 Background Information

4.4.1.1 Floodplain Location

Guadalupe River runs through downtown San Jose for 3 miles from I-280 to I-880 (Authority 2011a). The Guadalupe River's headwaters form in the Santa Cruz Mountains near the summit of Loma Prieta and Mount Umunhum. The river main stem begins on the Santa Clara Valley floor at the northern end of Lake Almaden, which is fed by Los Alamitos Creek and Guadalupe Creek, just downstream of Coleman Road in San Jose. From there, it flows north 14 miles through San Jose, emptying into San Francisco Bay at Alviso Slough. Historically, Guadalupe River was even shorter, originating several miles farther north at the downstream end of a large willow swamp that is now Willow Glen.

Guadalupe River in the project vicinity would be subject to the USACE Section 404 and 408 permitting process. The FEMA SFHA in the main channel of Guadalupe River that would be subject to USACE Section 404 and 408 permitting process is Zone A.

4.4.1.2 FEMA Floodplain

According to the FEMA FIRM Panel No. 60685C0234H (FEMA 2009), the main channel of the Guadalupe River in the project footprint is identified as Zone A with a width of approximately 150 feet (Figure 4-6). The FEMA FIRM also shows overbank flood flows from Guadalupe River and tributaries that are identified as Zone AO and AH (Figure 4-6 and Figure 4-7). The FEMA FIRM shows overbank flood flows from Canoas Creek overtopping the existing Caltrain track between Almaden Expressway and Curtner Avenue Bridges over the existing railroad track (Figure 4-7).

4.4.1.3 Project Alternatives in the FEMA Floodplain

The project footprints for all project alternatives are in the existing 100-year floodplain for Guadalupe River and Tributaries.

Under Alternatives 1, 2, and 3, a viaduct segment supported by pier columns would span the Guadalupe River and run along the top of the western channel bank. All project alternatives are identical near the Guadalupe River crossing. The proposed pier columns for the viaduct segment are inside FEMA SFHA Zones A, AO and AH.

Under Alternative 4, HSR would share the corridor with UPRR and Caltrain and would construct a new at-grade track adjacent to the existing track. Near the Guadalupe River bridge crossing, Alternative 4 is proposing a new single-track bridge structure over I-280, SR 87, and Guadalupe River on the south side of the existing bridge structure. The existing railroad track over I-280, SR 87, and Guadalupe River would remain. It also proposes to remove and replace existing underpasses for Bird Avenue and Delmas Avenue.

The FEMA FIRM shows that the overbank flow from Canoas Creek is overtopping the existing railroad track (Figure 4-7). The FEMA SHFA at this location is AH with an elevation of 131 feet NAVD 88.

The profile of the proposed railroad track for Alternatives 1, 2, and 3 are at the same level or lower than the existing railroad track profile adjacent to the proposed tracks, and has locations where the top of rail elevation is lower than the FEMA 100-year WSE at this location. The current plan for all Alternatives 1, 2, and 3 does not show any proposed hydraulic features to prevent the flooding on proposed HSR track during 100-year storm event. Therefore, portions in the proposed railroad track for HSR Alternatives 1, 2, and 3 would be submerged during the 100-year storm event.

Alternative 4 would be sharing the existing railroad track with Caltrain and UPRR at this location, and would maintain the existing railroad track profile at this location. Because there would be no changes to the existing track profile, proposed railroad track for HSR at this location is subject to flooding during the 100-year storm event, as shown in the current effective FEMA FIRM. The current plan for Alternative 4 does not show proposed hydraulic features to prevent the flooding on proposed HSR track during 100-year storm event. Therefore, the proposed railroad track for HSR Alternative 4 would be submerged during the 100-year storm event.

The vertical profile of the proposed railroad track would be controlled by the vertical clearance required at the Almaden Expressway and Curtner Avenue undercrossing and possess a constraint to the feasibility of raising the proposed railroad track to be raised above the existing FEMA 100-year flood elevation. Floodwalls have been incorporated into the project alternatives to prevent the proposed track to be flooded or overtopped during the 100-year storm event.

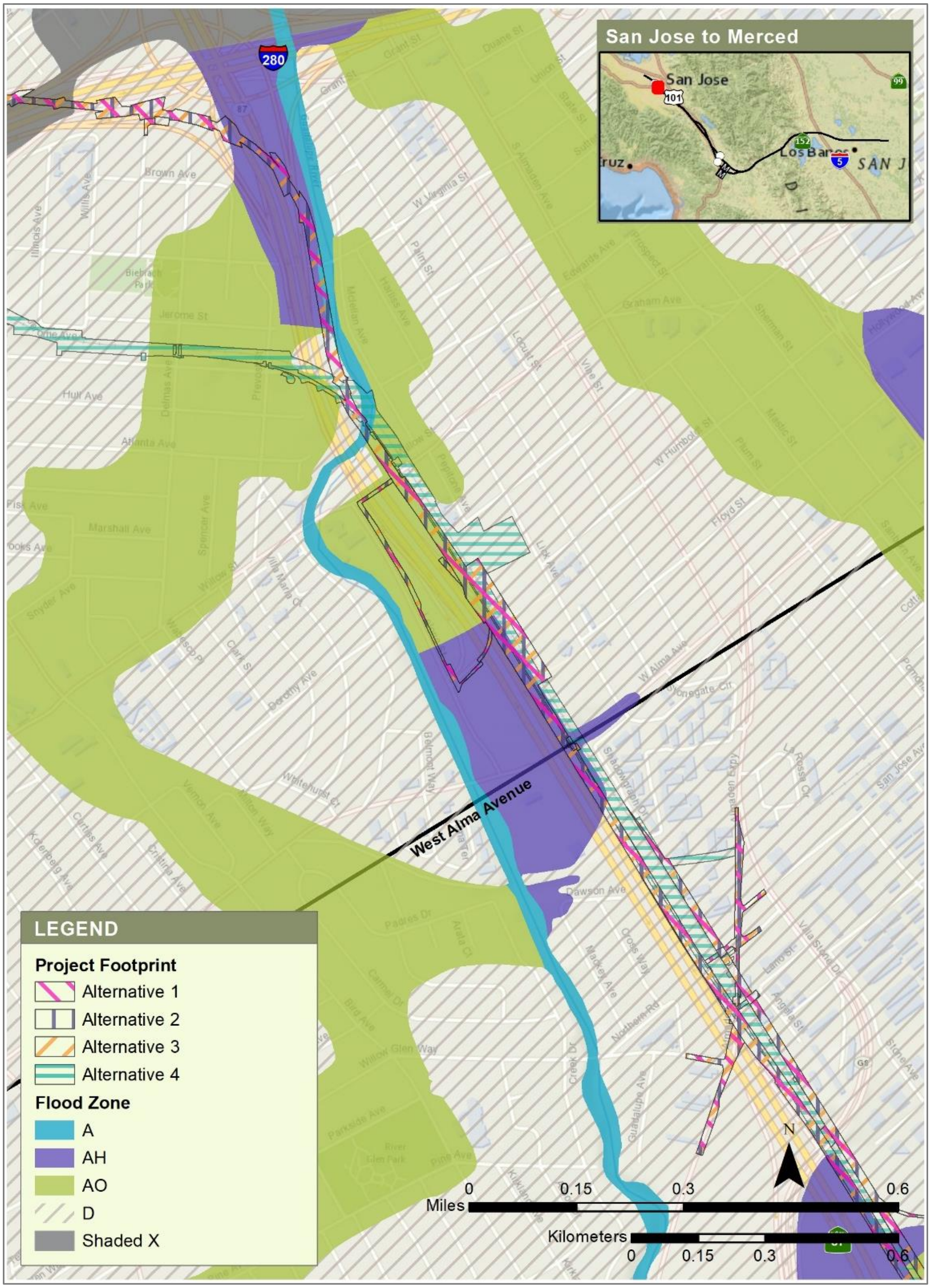
4.4.1.4 Available Hydraulic Model

The FEMA effective hydraulic model was not available because the existing floodplain is designated as Zone A, defined as FEMA SHFA determined by approximate methods.

The hydraulic model provided by SCVWD was available for this waterbody and was used to perform hydraulic analysis to determine project's potential impacts on the existing floodplain.

Figure 4-8 and Figure 4-9 show the limits of the SCVWD hydraulic model and project footprint for Alternatives 1, 2, and 3 and Alternative 4, respectively, near the existing railroad bridge over Guadalupe River. Figure 4-10 and Figure 4-11 show the limits of the SCVWD hydraulic model and project footprint for Alternatives 1, 2, and 3 and Alternative 4, respectively, near Almaden Expressway and Curtner Avenue bridges over the existing railroad track.

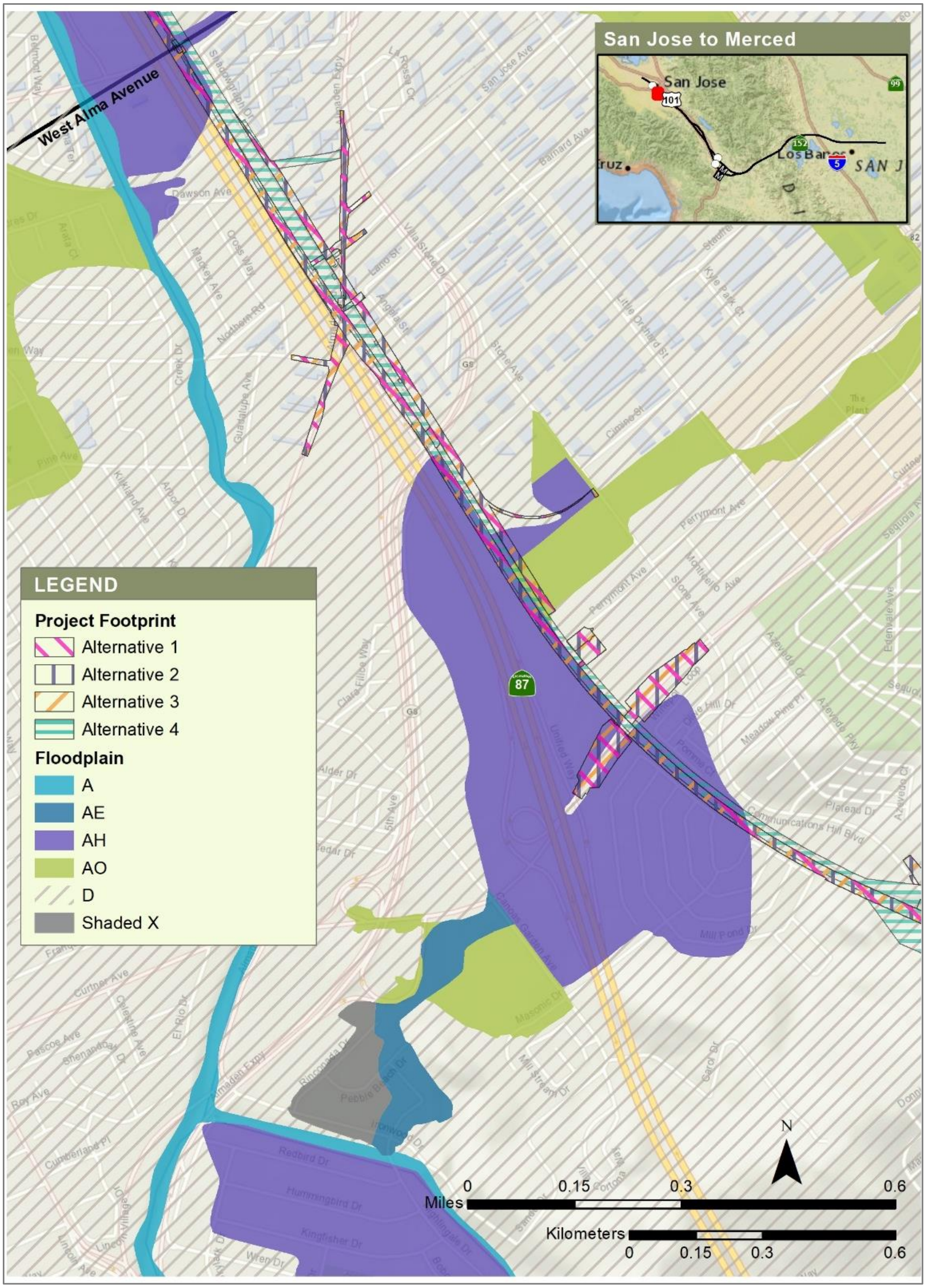
The existing and proposed conditions of the 100-year flood profile of Guadalupe River near the existing and proposed railroad bridges over Guadalupe River were compared. The extents of the overbank flood flow in Almaden-Curtner area were also compared between existing and proposed conditions.



Sources: FEMA 2009; Authority 2019

JANUARY 2019

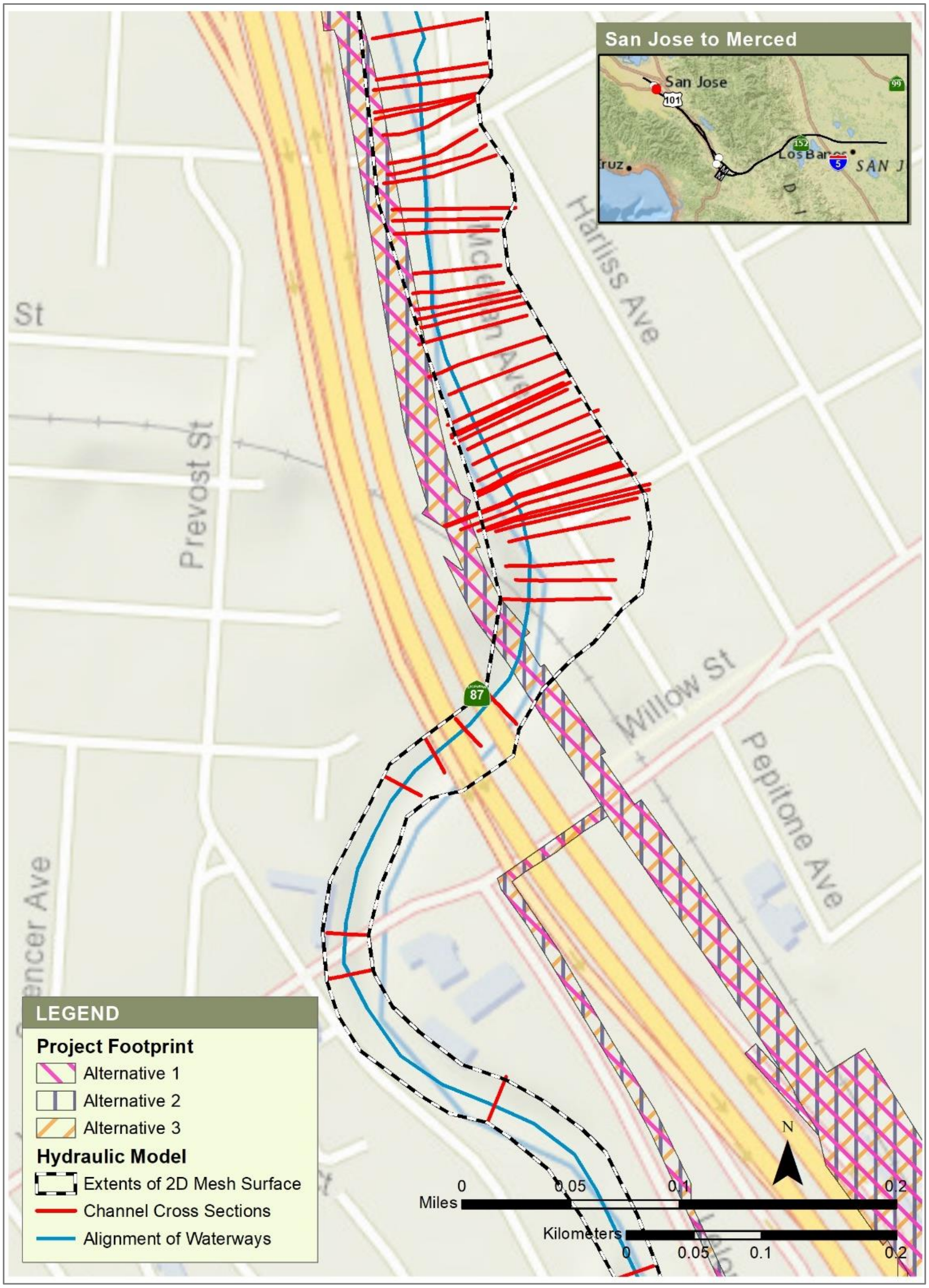
Figure 4-6 Guadalupe River, FEMA FIRM Overlay at Guadalupe River Bridge with Project Footprints for Alternatives 1, 2, 3, and 4



Sources: FEMA 2009; Authority 2019

JANUARY 2019

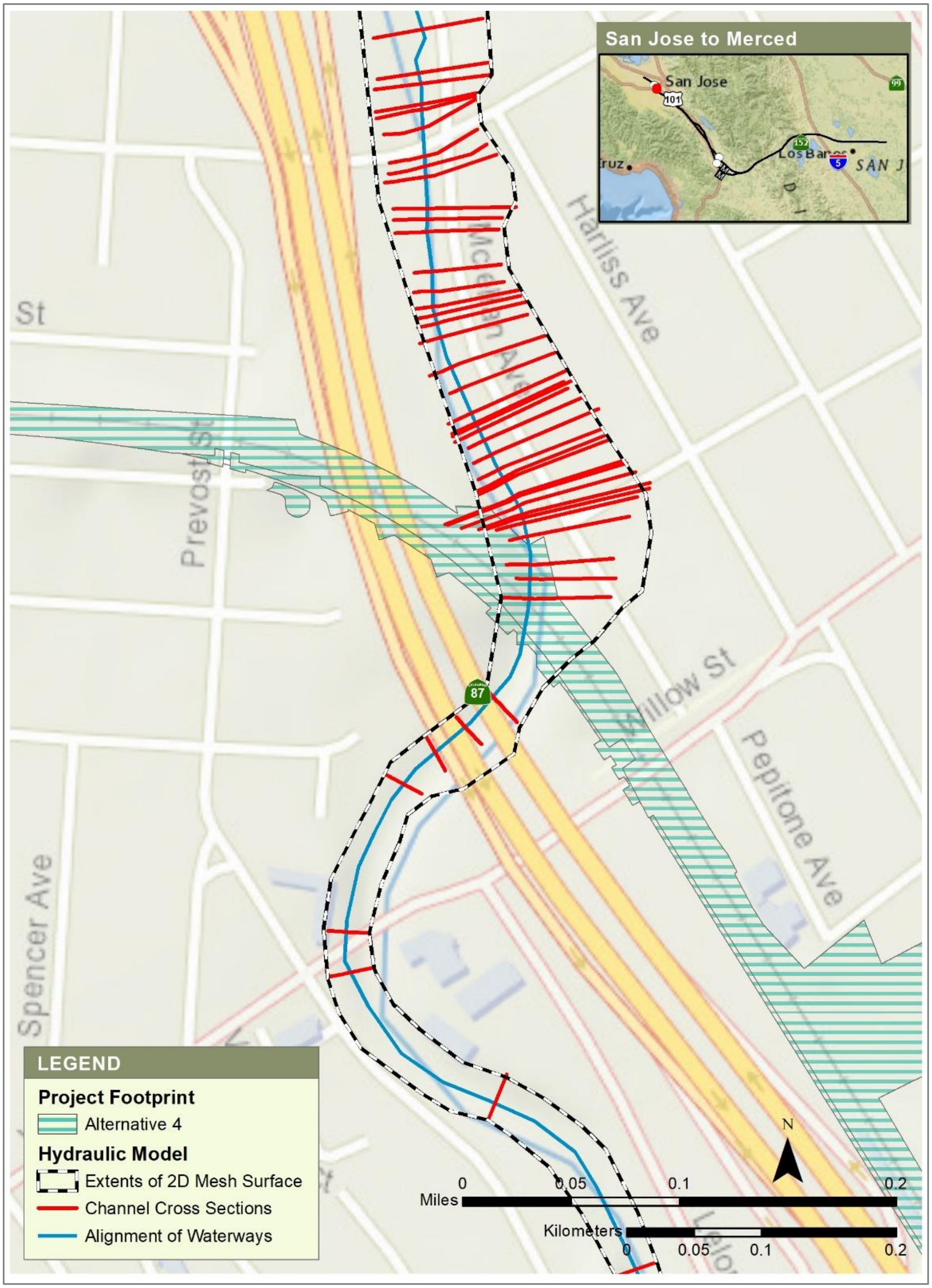
Figure 4-7 Guadalupe River, FEMA FIRM Overlay at Almaden-Curtner Area with Project Footprints for Alternatives 1, 2, 3, and 4



Sources: SCVWD 2018a; Authority 2019

JANUARY 2019

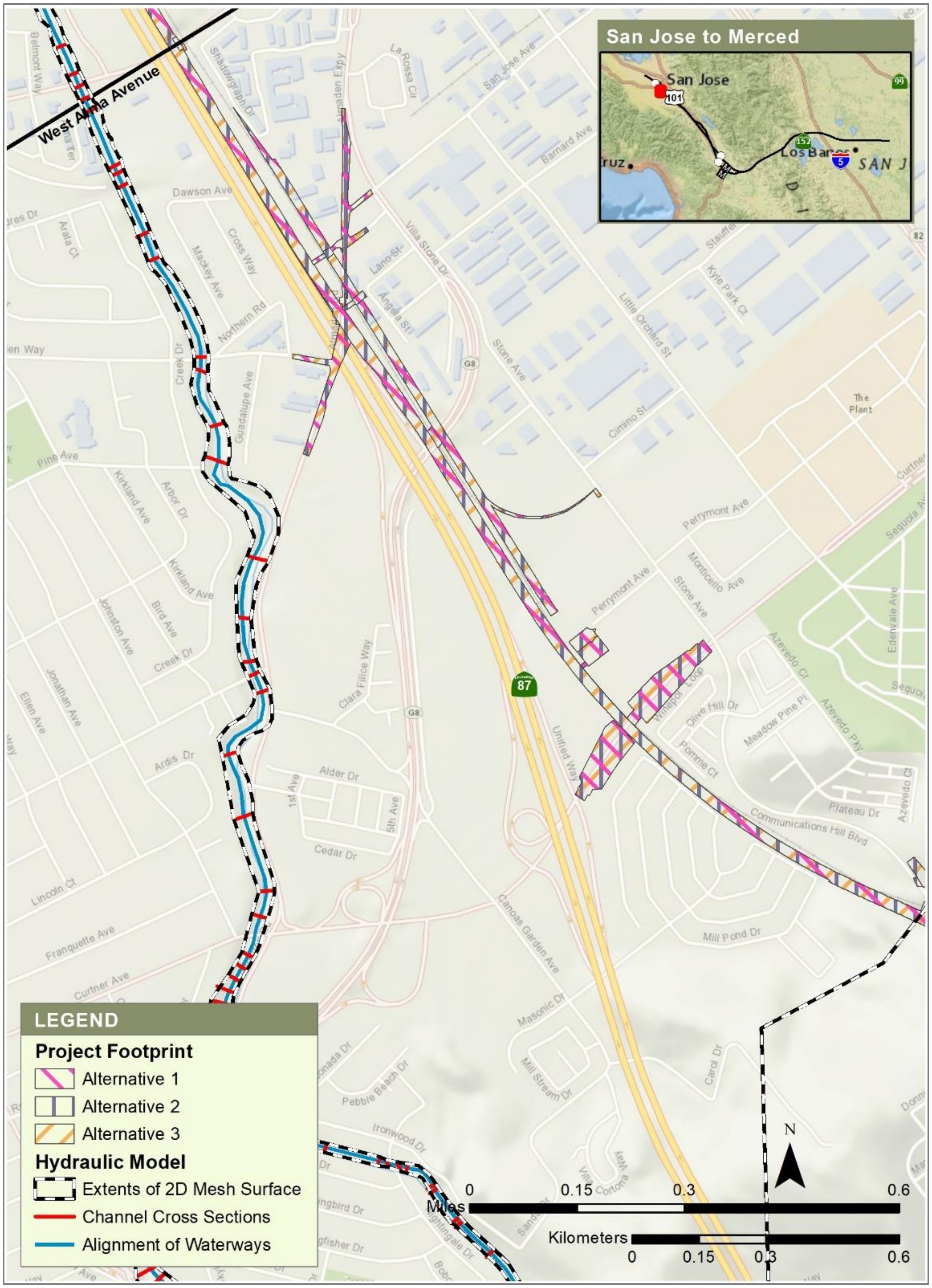
Figure 4-8 Guadalupe River, Plan View of SCVWD Hydraulic Model at Guadalupe River mainline with Project Footprints for Alternatives 1, 2, and 3



Sources: SCVWD 2018a; Authority 2019

JANUARY 2019

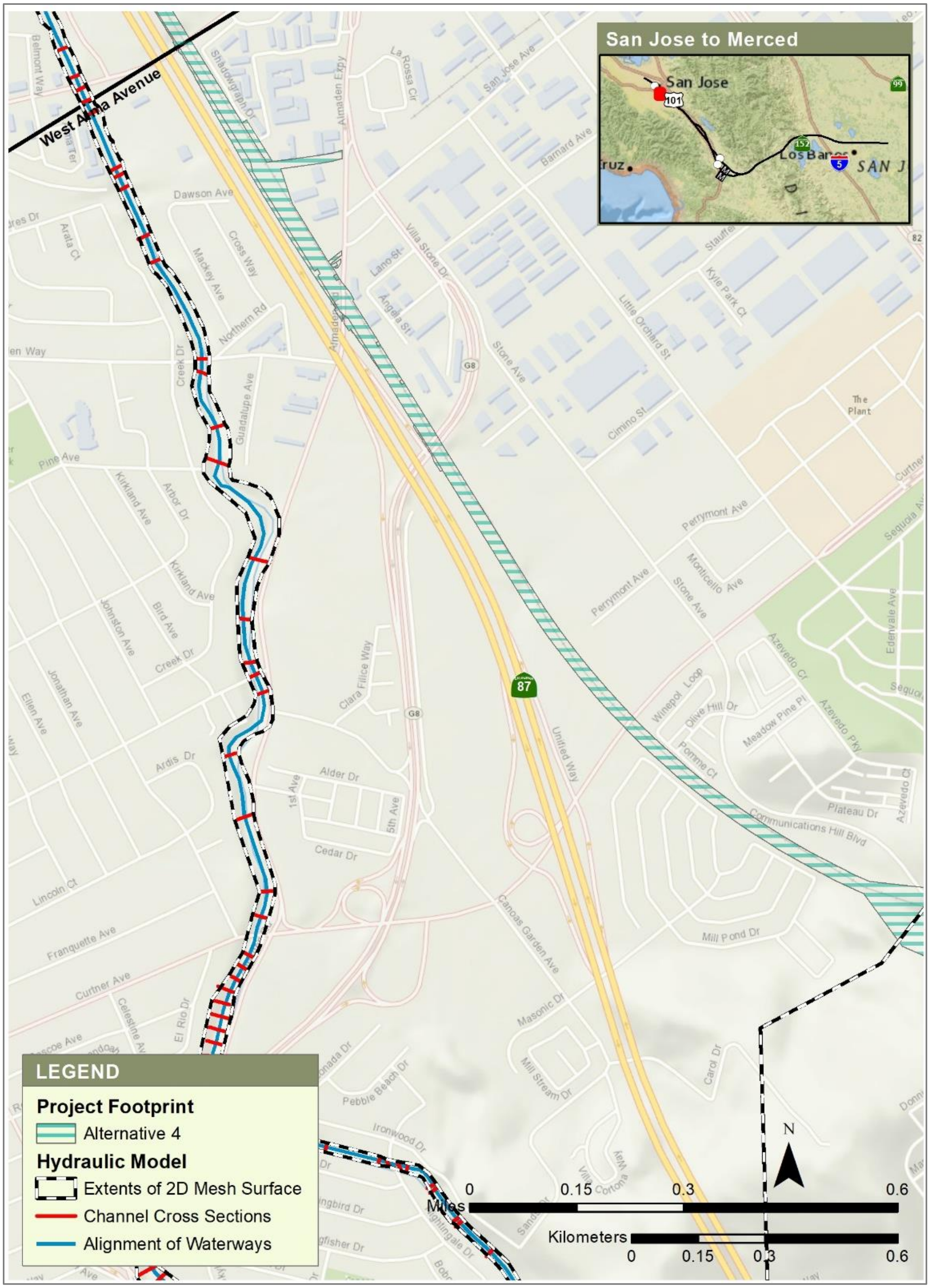
Figure 4-9 Guadalupe River, Plan View of SCVWD Hydraulic Model at Guadalupe River Mainline with Project Footprint for Alternative 4



Sources: SCVWD 2018a; Authority 2019

JANUARY 2019

Figure 4-10 Guadalupe River, Plan View of SCVWD Hydraulic Model at Almaden-Curtner Area with Project Footprint for Alternatives 1, 2, and 3



Sources: SCVWD 2018a; Authority 2019

JANUARY 2019

Figure 4-11 Guadalupe River, Plan View of SCVWD Hydraulic Model at Almaden-Curtner Area with Project Footprint for Alternative 4

4.4.2 SCVWD Hydraulic Model

4.4.2.1 Overview of Hydraulic Model

The combined one- and two-dimensional hydraulic model of Guadalupe River and its tributaries provided by SCVWD was developed using the USACE HEC-RAS. The tributaries of Guadalupe River included in the hydraulic model are Canoas Creek and Ross Creek. The length and upstream/downstream limits of the floodplains included in the hydraulic model are summarized in Table 4-3.

Table 4-3 Floodplains included in Guadalupe River Hydraulic Model

Name of Floodplain	Reach Length (feet)	Location of Upstream Limit	Location of Downstream Limit
Guadalupe River	32,630	Approximately 500 feet downstream (north) of Coleman Road	Immediately upstream of I-280/SR 87 Interchange
Canoas Creek	39,000	At Cottle Road	Confluence with Guadalupe River
Ross Creek	25,920	At Blossom Hill Road	Confluence with Guadalupe River

Source: SCVWD 2018a
I = Interstate
SR = State Route

There were no changes to the setup of the SCVWD hydraulic model to perform the hydraulic analysis of existing condition.

The pier columns supporting the proposed viaduct segments along the Guadalupe River and at the Guadalupe River crossings for Alternatives 1, 2, and 3 were represented in the HEC-RAS model of the proposed condition. The proposed railroad bridge over Guadalupe River crossing for Alternatives 4 was represented in the HEC-RAS model of the by widening the existing railroad bridge over Guadalupe River located immediately downstream of the proposed railroad bridge.

The HEC-RAS model for Alternatives 1, 2, and 3 and Alternative 4 did not make adjustments to the model inputs in the two-dimensional mesh. This setup of the hydraulic model will be revised during the design phase of this project.

Floodwalls and equalizer culverts have been incorporated into Alternatives 1, 2, 3, and 4 to prevent the 100-year flood flow associated with the Canoas Creek/Guadalupe River overflow floodplain from overtopping the proposed HSR corridor near the overcrossings of Almaden Expressway and Curtner Avenue. Hydraulic analysis of the proposed condition with floodwalls and equalizers were also performed for Alternatives 1, 2, and 3 and Alternative 4.

4.4.2.2 Inflow Hydrograph for Hydraulic Analysis

There were 36 locations in the hydraulic model with assigned inflows. The peak 100-year flows at each inflow location are summarized in Table 4-4. The inflow locations in the hydraulic model are shown in Figure 4-12.

Table 4-4 Peak 100-Year Inflows into Guadalupe River and Tributaries Hydraulic Model

Floodplain Name	River Station in Hydraulic Model	Distance from Existing Railroad Bridge[1]	Peak Inflow (cfs)
Guadalupe River	104500	30,300 feet upstream	11,165
Guadalupe River	101450	27,250 feet upstream	137

Floodplain Name	River Station in Hydraulic Model	Distance from Existing Railroad Bridge[1]	Peak Inflow (cfs)
Guadalupe River	98800	24,600 feet upstream	68
Guadalupe River	95900	21,700 feet upstream	68
Guadalupe River	94200	20,000 feet upstream	138
Guadalupe River	88000	13,800 feet upstream	275
Guadalupe River	87000	12,800 feet upstream	46
Guadalupe River	84005	9,800 feet upstream	45
Guadalupe River	82343	8,100 feet upstream	81
Guadalupe River	81773	7,570 feet upstream	45
Guadalupe River	78690	4,490 feet upstream	59
Guadalupe River	77944	3,740 feet upstream	81
Guadalupe River	75490	1,290 feet upstream	53
Guadalupe River	73691.23	500 feet downstream	105
Guadalupe River	72705.37	1,500 feet downstream	26
Canoas Creek	39008.19	46,800 feet upstream	475
Canoas Creek	38981.17	46,700 feet upstream	238
Canoas Creek	24395.26	32,220 feet upstream	93
Canoas Creek	22565.98	30,390 feet upstream	31
Canoas Creek	21618.92	29,440 feet upstream	196
Canoas Creek	21011.59	28,830 feet upstream	177
Canoas Creek	15301.56	23,120 feet upstream	177
Canoas Creek	13527.74	21,350 feet upstream	56
Canoas Creek	11053.71	18,880 feet upstream	56
Canoas Creek	8395.165	16,220 feet upstream	29
Canoas Creek	6665.77	14,490 feet upstream	36
Canoas Creek	6192.517	14,010 feet upstream	106
Ross Creek	25994.8	53010 feet upstream	1,067
Ross Creek	25951.9	52970 feet upstream	161
Ross Creek	18158.9	45180 feet upstream	80
Ross Creek	17695	44710 feet upstream	201
Ross Creek	13572.8	40590 feet upstream	187
Ross Creek	12213	39230 feet upstream	120
Ross Creek	11906.9	38920 feet upstream	67
Ross Creek	10211.4	37230 feet upstream	67
Ross Creek	8544.6	35560 feet upstream	174
Ross Creek	7397.7	34420 feet upstream	107

Sources: SCVWD 2018a
cfs = cubic feet per second
[1] Distance from existing railroad bridge is rounded to the nearest 10 feet.

Sources: SCVWD 2018a; Authority 2019

JANUARY 2019

Figure 4-12 Inflow Locations in the Guadalupe River and Tributaries Hydraulic Model

4.4.2.3 Water Surface Elevations – Main Channel

The modeling results are shown in Table 4-5 for Alternatives 1, 2, and 3 and Table 4-6 for Alternative 4. The outputs from the hydraulic analysis for Alternatives 1, 2, and 3 showed that proposed pier columns supporting the viaduct near the Guadalupe River crossing would raise the 100-year flood profile inside the Guadalupe River main channel by approximately 0.1 foot or less. The outputs from the hydraulic analysis for Alternative 4 showed that the proposed HSR bridge immediately upstream of the existing railroad bridge would raise the 100-year flood profile by approximately 0.24 foot immediately upstream of the proposed railroad bridge.

Project features would be required in Alternative 4 to lower the 100-year flood profile back to the level of existing condition.

Table 4-5 Hydraulic Modeling Results, Guadalupe River, Alternatives 1, 2, and 3

Location	Flow Rate (cfs)	Channel Bank Elevation (feet NAVD 88)	WSE—Existing Condition (feet NAVD 88)	WSE—Proposed Condition (feet NAVD 88)	Change in WSE (feet)
At West Virginia Street	8,020	99.0	93.2	93.2	0.0
At downstream of existing railroad bridge	6,910	104.0	100.2	100.3	0.1
At upstream end of proposed HSR bridge	6,920	107.0	106.34	106.36	0.02
At Willow Street	7,430	109.0	109.13	109.16	0.03

Elevations are rounded to the nearest 0.1 foot, unless otherwise noted.
cfs = cubic feet per second
NAVD 88 = North American Vertical Datum of 1988
WSE = water surface elevation
HSR = high-speed rail

Table 4-6 Hydraulic Modeling Results, Guadalupe River, Alternative 4

Location	Flow Rate (cfs)	Channel Bank Elevation (feet NAVD 88)	WSE—Existing Condition (feet NAVD 88)	WSE—Proposed Condition (feet NAVD 88)	Change in WSE (feet)
At West Virginia Street	8,020	99.0	93.2	93.1	(0.1)
At downstream of existing railroad bridge	6,910	104.0	100.2	100.1	(0.1)
At upstream end of proposed HSR bridge	6,920	107.0	106.34	106.58	0.24
At Willow Street	7,430	109.0	109.13	109.17	0.04

(Parentheses) indicate negative values
Elevations are rounded to the nearest 0.1 foot, unless otherwise noted.
cfs = cubic feet per second
NAVD 88 = North American Vertical Datum of 1988
WSE = water surface elevation

4.4.2.4 Overbank Flood Flow at Almaden-Curtner Area

The modeling results for the two-dimensional floodplain analysis near the Almaden Expressway overcrossing and Curtner Avenue overcrossing over existing railroad track are shown in Figure 4-13 for existing condition, Figure 4-14 for Alternatives 1, 2, and 3 and Figure 4-15 for Alternative 4. The proposed condition with floodwalls and equalizers for Alternatives 1, 2, and 3 and Alternative 4 are shown in Figure 4-16 and Figure 4-17, respectively.

The outputs from the existing condition hydraulic analysis showed the maximum 100-year WSE elevation on the west (upstream) of existing railroad track to be approximately 132.4 to 132.5 ft NAVD 88 between Almaden Expressway overcrossing and Curtner Avenue overcrossing. The existing top of rail elevation in this area is approximately 133 ft NAVD 88 and is lower than the maximum 100-year WSE. Therefore, overbank flood flow overtopped existing railroad track and flow northwest, showing the flooding footprint similar to the FEMA FIRM (Figure 4-7 and 4-13).

The outputs from the proposed condition hydraulic analysis for Alternatives 1, 2, and 3 showed the maximum 100-year WSE elevation on the west (upstream) of existing railroad track to be approximately 132.4 ft to 132.5 ft NAVD 88 between Almaden Expressway overcrossing and Curtner Avenue overcrossing. The changes to the maximum 100-year WSE and extents of the flooded area were minimal at this location for Alternatives 1, 2, and 3 (Figure 4-14). The proposed top of rail elevation for Alternatives 1, 2, and 3 between Almaden Expressway overcrossing and Curtner Avenue overcrossing varies from approximately 125.1 ft at the local low point to approximately 134.7 ft at Curtner Avenue overcrossing. Because elevation of the local low point is lower than the maximum 100-year WSE, the overbank flood flow would overtop the proposed HSR track during the 100-year storm event.

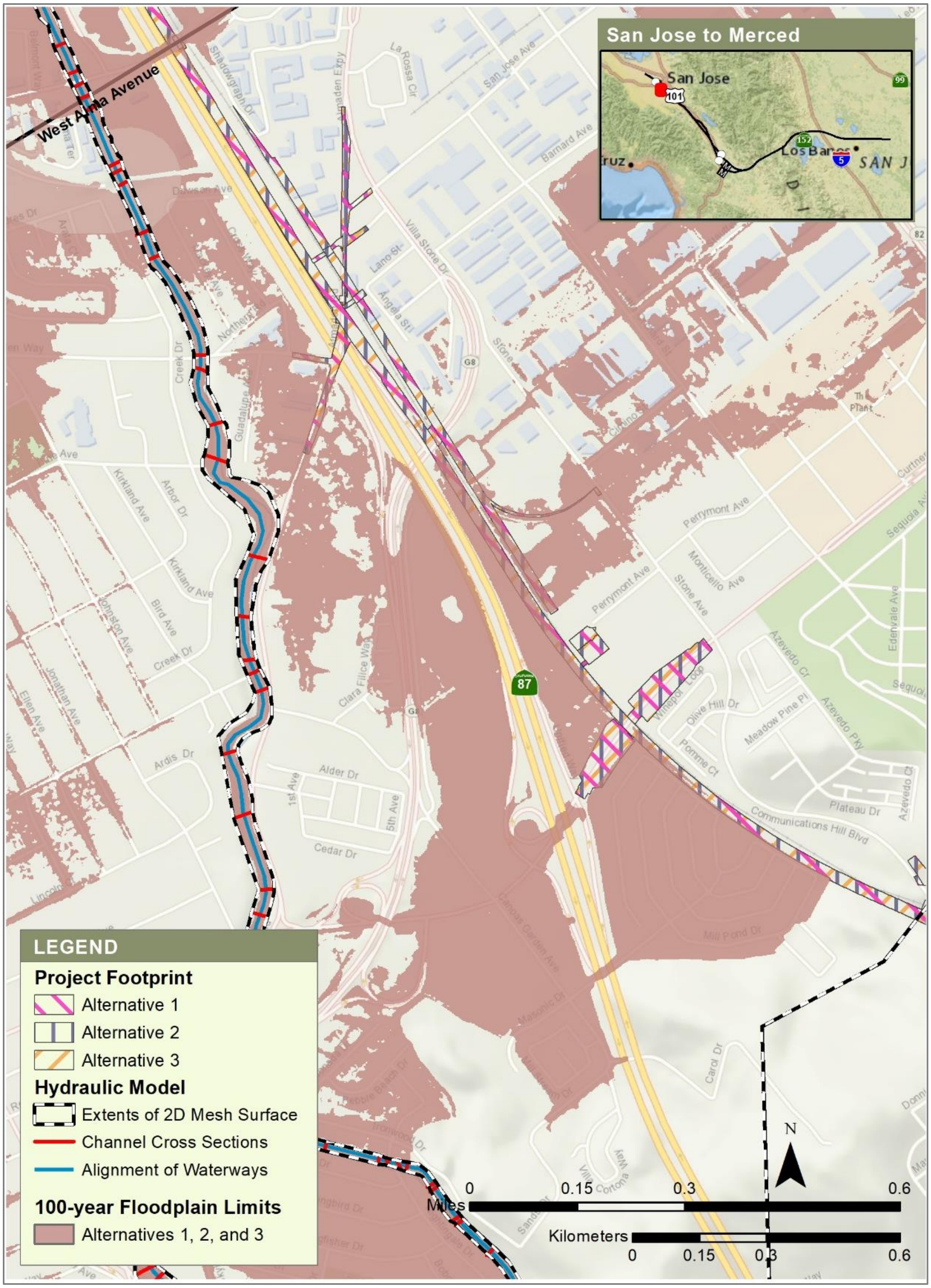
The outputs from the proposed condition hydraulic analysis for Alternative 4 showed the maximum 100-year WSE elevation on the west (upstream) of existing railroad track to be approximately 132.4 ft to 132.5 ft NAVD 88 between Almaden Expressway overcrossing and Curtner Avenue overcrossing. The changes to the maximum 100-year WSE and extents of the flooded area were minimal at this location for Alternative 4 (Figure 4-15). The proposed top of rail elevation for Alternative 4 between Almaden Expressway overcrossing and Curtner Avenue overcrossing would remain unchanged from the existing condition. Because elevation of the local low point is lower than the maximum 100-year WSE, the overbank flood flow would overtop the proposed HSR track during the 100-year storm event.

The outputs from the proposed condition hydraulic analysis with floodwalls and equalizers culverts along proposed HSR track showed that seventeen 36-in. equalizer culverts would replicate the extents and elevation of the existing 100-year floodplain from the existing condition hydraulic model. The hydraulic analysis for Alternatives 1, 2, and 3 and Alternative 4 with floodwall and equalizer culvert showed no substantial changes to the WSE and extents of the 100-year floodplain.

Sources: SCVWD 2018a; Authority 2019

JANUARY 2019

Figure 4-13 100-Year Floodplain at Almaden-Curtner Area from Hydraulic Analysis, Existing Condition



Sources: SCVWD 2018a; Authority 2019

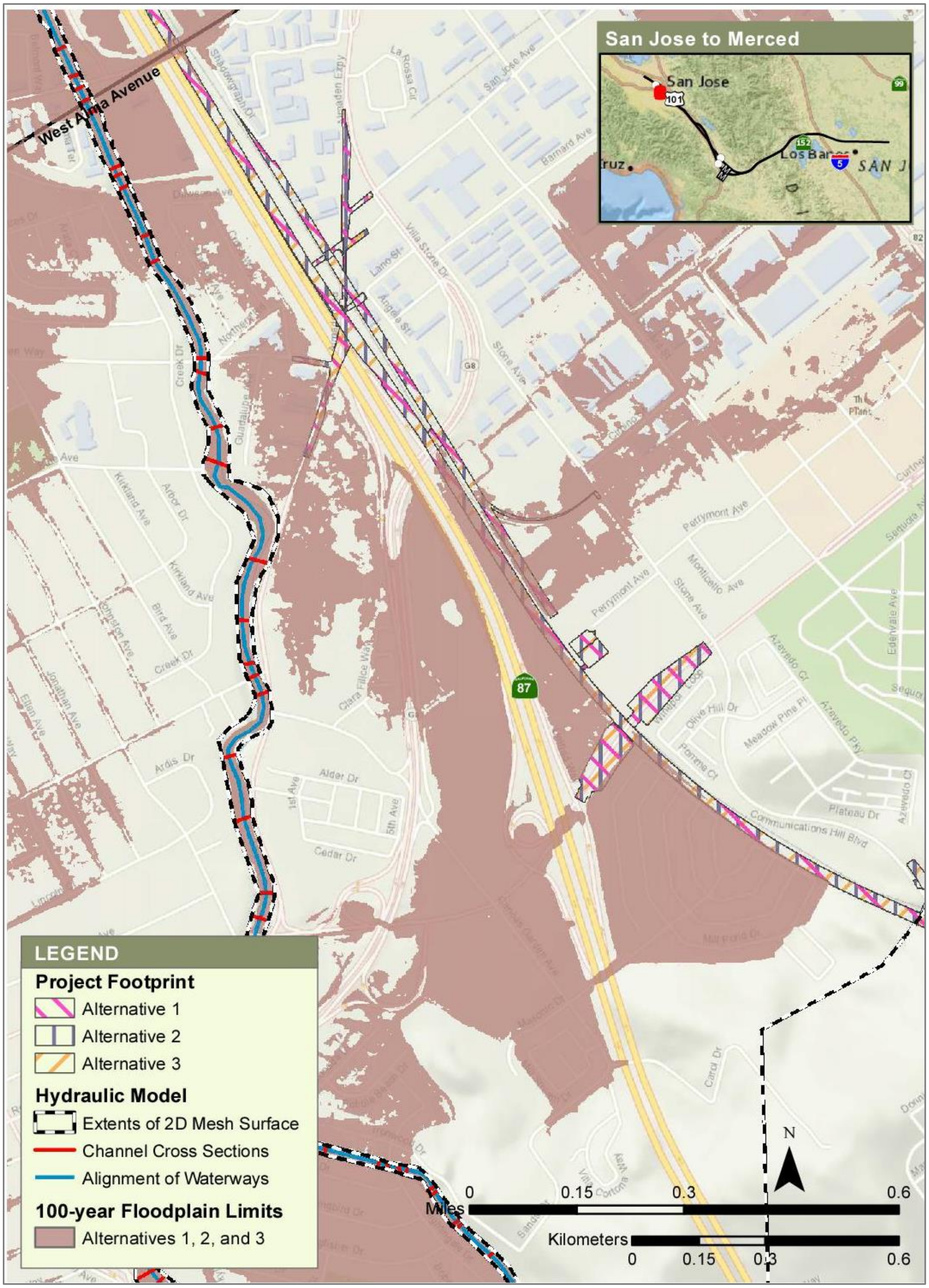
JANUARY 2019

Figure 4-14 100-Year Floodplain at Almaden-Curtner Area from Hydraulic Analysis, Alternatives 1, 2, and 3

Sources: SCVWD 2018a; Authority 2019

JANUARY 2019

Figure 4-15 100-Year Floodplain at Almaden-Curtner Area from Hydraulic Analysis, Alternative 4



Sources: SCVWD 2018a; Authority 2019

JANUARY 2019

Figure 4-16 100-Year Floodplain at Almaden-Curtner Area from Hydraulic Analysis, Alternatives 1, 2, and 3 with Floodwall and Equalizer Culverts

Sources: SCVWD 2018a; Authority 2019

JANUARY 2019

Figure 4-17 100-Year Floodplain at Almaden-Curtner Area from Hydraulic Analysis, Alternative 4 with Floodwall and Equalizer Culverts

4.5 Fisher Creek

4.5.1 Background Information

4.5.1.1 Floodplain Location

Fisher Creek is a tributary of Coyote Creek that flow northwest along western Coyote Valley and to the west of Coyote Creek. The creek changes flow direction from northwest to northeast approximately 1,000 feet upstream of the outfall to Coyote Creek.

4.5.1.2 FEMA Floodplain

According to the FEMA FIRM Panel No. 60685C0426H (FEMA 2009), the main channel of Fisher Creek in the project footprint is identified as Zone AE with a floodway (Figure 4-18). The width of the floodway measured along existing railroad bridge over Fisher Creek is approximately 120 feet.

4.5.1.3 Project Alternatives in the FEMA Floodplain

The project footprints for all project alternatives are in the existing 100-year floodplain for Fisher Creek.

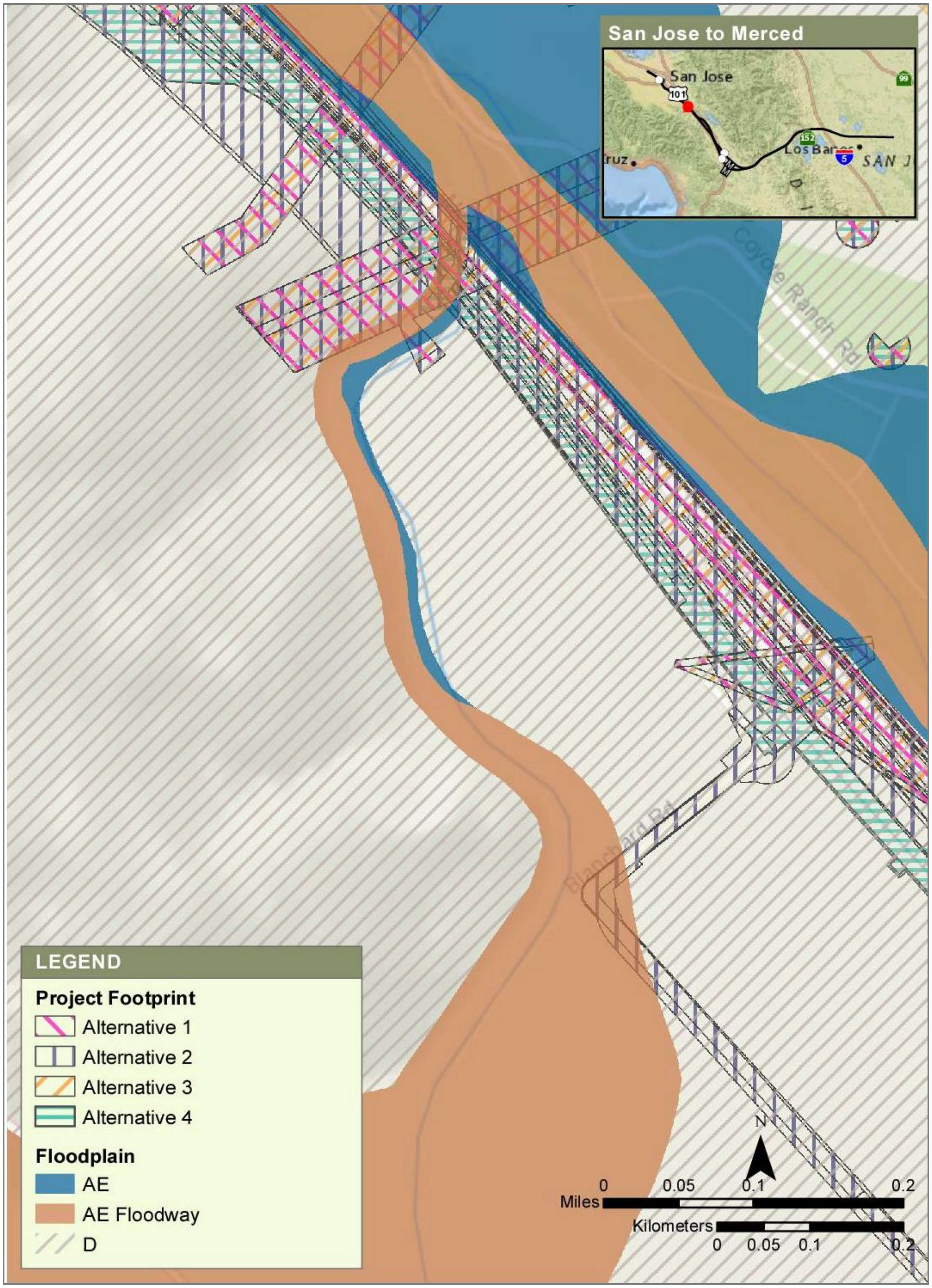
Near the Fisher Creek crossing, Alternatives 1 and 3 would entail a viaduct section supported by pier columns placed in the median of Monterey Road. The viaduct section would cross Fisher Creek at approximately station 665+00. The width of the Zone AE floodplain and floodway measured along the centerline of the proposed track alignment for Alternatives 1 and 3 is approximately 150 feet. This alternative is also proposing to replace the existing Monterey Road bridge/culvert with 40 feet by 9.1 feet (width x height) wildlife crossing. There would be no changes to the existing railroad bridge over Fisher Creek.

Near the Fisher Creek crossing, Alternative 2 would use a new embankment section immediately west of Monterey Road. The existing railroad track paralleling Monterey Road on the west would be relocated farther west to accommodate two new HSR tracks. In addition, the project is proposing to replace the existing bridge/culvert below Monterey Road and existing railroad track with a 40-foot by 11-foot (width by height) wildlife crossing. The embankment section for Alternative 2 would cross Fisher Creek at approximately station 754+50.

Near the Fisher Creek crossing, Alternative 4 would share the existing two railroad tracks with Caltrain and UPRR. There would be no changes to the horizontal/vertical profile of the existing railroad track near Fisher Creek crossing. There would be no changes to the vertical/horizontal alignment of Monterey Highway near the Fisher Creek crossing. The existing bridge/culvert below Monterey Road and the existing railroad track would be replaced by a 40-foot by 11-foot (width × height) wildlife crossing. The wildlife crossing footprint for this alternative would be similar to Alternative 2. The existing railroad track for Alternative 4 would cross Fisher Creek at approximately station 704+00.

4.5.1.4 Available Hydraulic Model

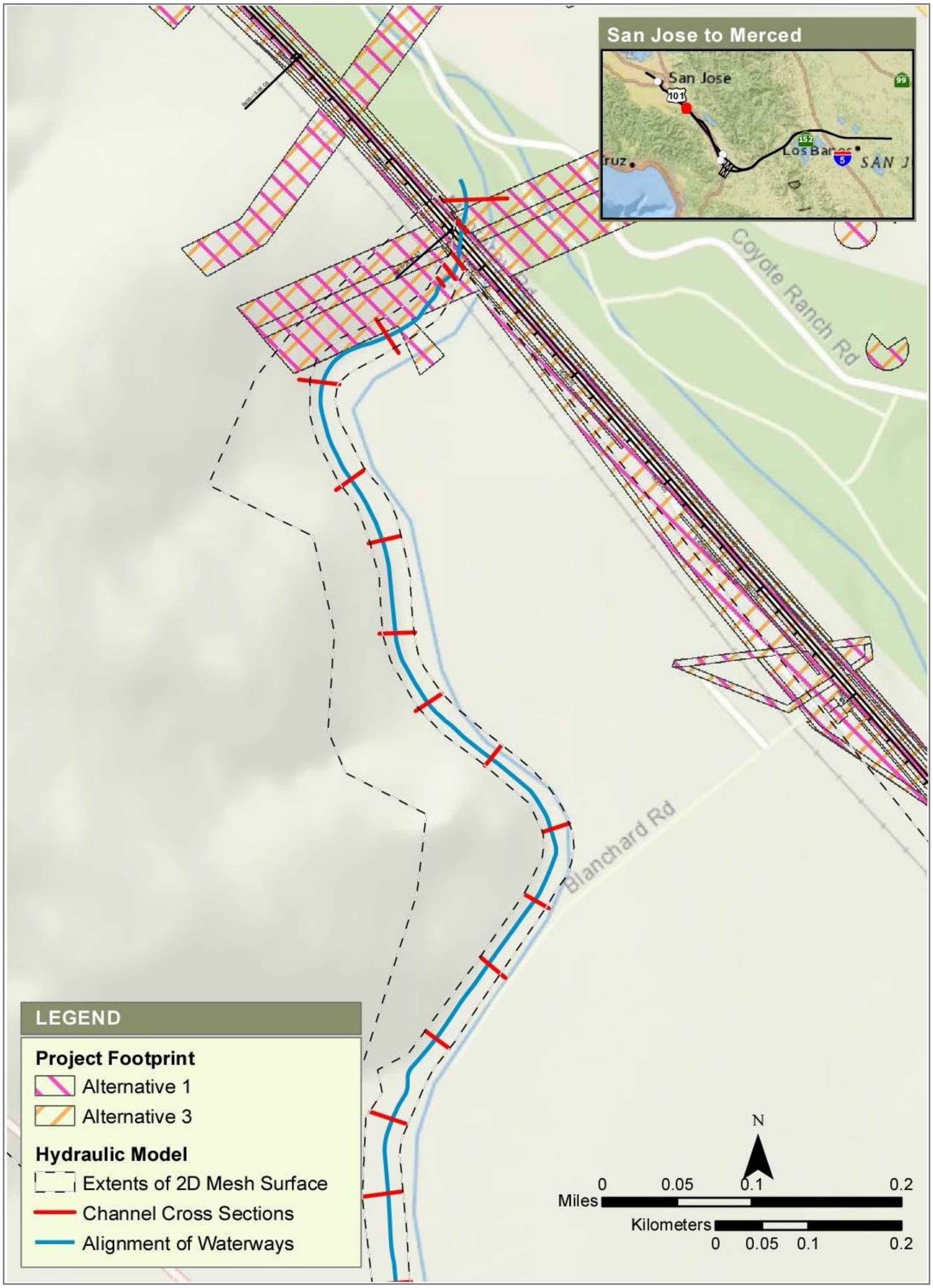
The SCVWD hydraulic model was used to evaluate the potential project impacts on Fisher Creek floodplain, because FEMA did not provide the effective hydraulic model of Fisher Creek to the Authority. Figure 4-19, Figure 4-20, and Figure 4-21 shows the limits of the SCVWD hydraulic model and the project footprint for Alternatives 1 and 3, Alternative 2, and Alternative 4 at Fisher Creek, respectively.



Sources: FEMA 2009; Authority 2019

JANUARY 2019

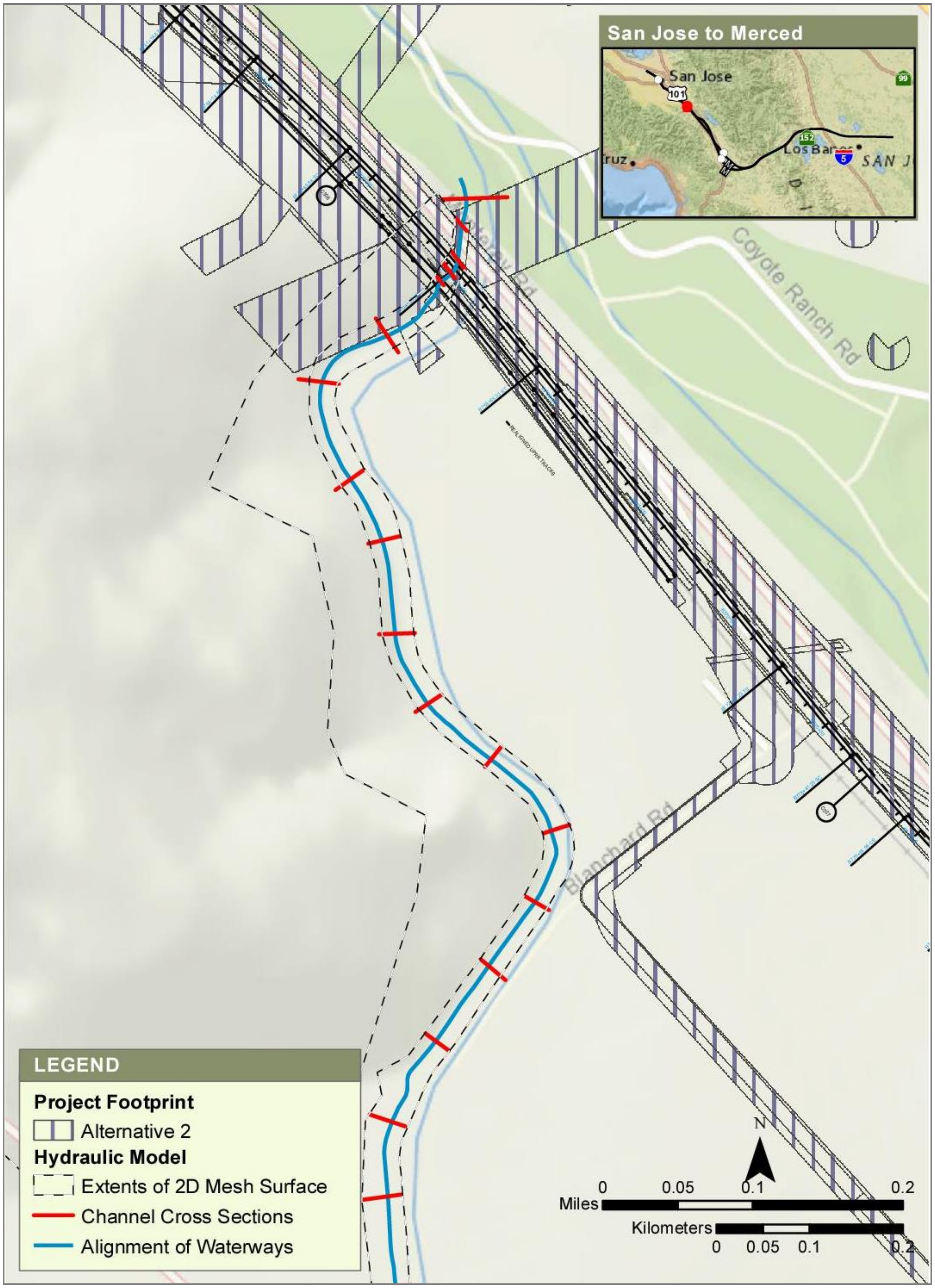
Figure 4-18 FEMA FIRM, Fisher Creek at Project Location



Sources: SCVWD 2015a; Authority 2019

JANUARY 2019

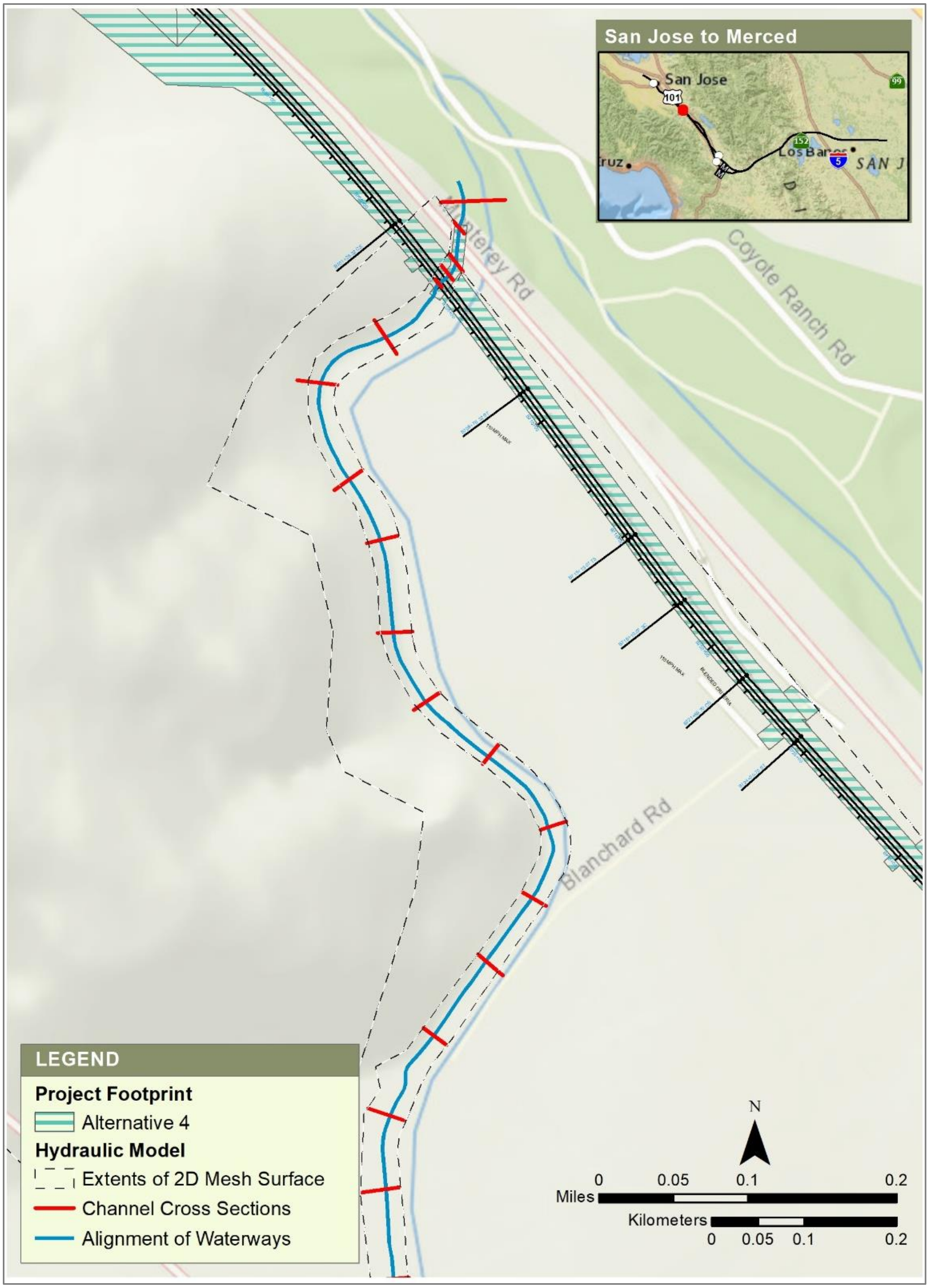
Figure 4-19 Fisher Creek, Plan View of SCVWD Hydraulic Model with Project Footprints for Alternatives 1 and 3



Sources: SCVWD 2015a; Authority 2019

JANUARY 2019

Figure 4-20 Fisher Creek, Plan View of SCVWD Hydraulic Model with Project Footprint for Alternative 2



Sources: SCVWD 2015a; Authority 2019

JANUARY 2019

Figure 4-21 Fisher Creek, Plan View of SCVWD Hydraulic Model with Project Footprint for Alternative 4

4.5.2 SCVWD Hydraulic Model

4.5.2.1 Overview of Hydraulic Model

The upstream and downstream limits of Fisher Creek included in the hydraulic model were immediately downstream of Old Monterey Road in the City of Morgan Hill (approximately 43,880 feet upstream of existing Monterey Road bridge) and confluence with Coyote Creek (approximately 170 feet downstream of existing Monterey Road bridge).

The two-dimensional mesh included in the SCVWD model covered areas west of Monterey Highway. The area of the two-dimensional mesh included in the hydraulic model is approximately 4,926 acres.

The downstream control WSE in the HEC-RAS hydraulic model of Fisher Creek was modified because the input parameters in the SCVWD's hydraulic model were lower than the 100-year WSE shown in the FEMA FIRM for Santa Clara County and Incorporated Areas (FEMA 2014). The downstream control for the hydraulic model was adjusted to 249 feet NAVD 88 to match the FEMA 100-year flood elevation shown in the FEMA FIRM. Because timing of the peak 100-year flood flow relative to the peak 100-year flood flow was not available, the downstream control WSE was set to be 249 feet from beginning to end of the hydraulic analysis.

The extents of the two-dimensional mesh in the base hydraulic model did not cover Monterey Highway. Therefore, the proposed pier columns on median of Monterey Highway were outside of the limits of the hydraulic model and was not included in the proposed condition hydraulic analysis of Alternative 1 and 3. Similarly, detailed grading for Alternatives 2 and 4 were not available. Therefore, the proposed condition hydraulic analysis for Alternatives 2 and 4 did not make adjustments to the ground elevation for the two-dimensional mesh. Because footprint of the wildlife crossing shown in the plans for Alternatives 2 and 4 was identical, the proposed condition hydraulic analysis for these two alternatives were performed using the same hydraulic model. This will be revised in the next phase, when the detailed design is available to differentiate Alternatives 2 and 4.

4.5.2.2 Inflow Hydrograph for Hydraulic Analysis

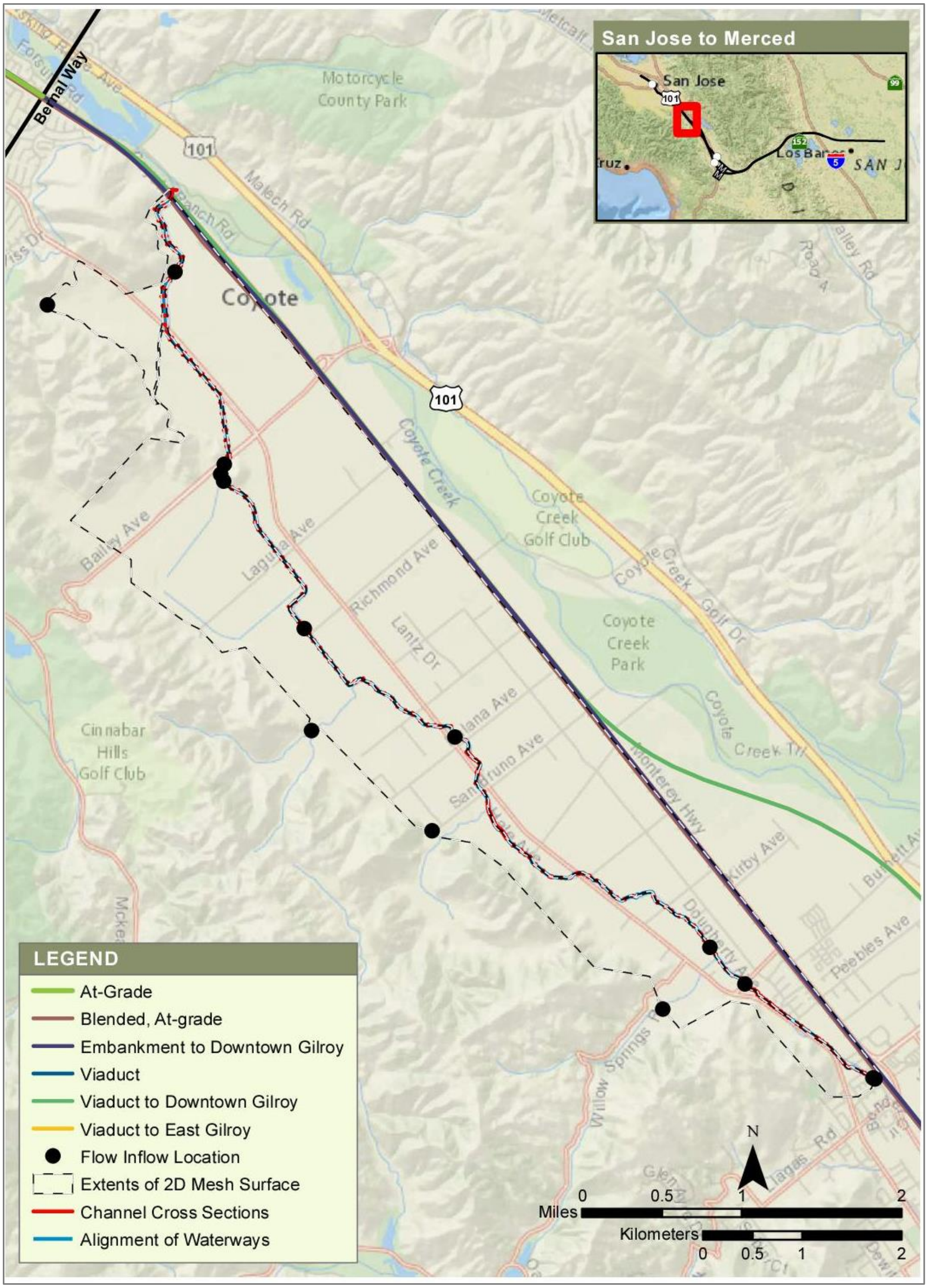
The hydraulic model of Fisher Creek included hydrograph of Fisher Creek and its tributaries during the 100-year storm event. There were 14 locations in the hydraulic model with assigned inflows. Ten inflow locations are assigned as direct inflow into channel cross section, and four remain inflow locations are assigned as surface runoff flowing from the upstream limit of the two-dimensional mesh assigned in the hydraulic model. The peak 100-year flows at each inflow location are summarized in Table 4-7. The inflow locations in the hydraulic model are shown in Figure 4-22.

Table 4-7 Peak 100-Year Inflows into Fisher Creek Hydraulic Model

River Station in Hydraulic Model	Distance from Existing Monterey Highway Bridge[1]	Peak Inflow (cfs)
RS 49999.31	43,780 feet upstream	107
RS 49815.4	43,710 feet upstream	107
RS 38831	38,370 feet upstream	214
RS 37096.59	36,640 feet upstream	294
RS 24250.93	23,990 feet upstream	155
RS 17491.97	17,220 feet upstream	260
RS 11195.68	10,930 feet upstream	326
RS 10944.99	10,670 feet upstream	375

River Station in Hydraulic Model	Distance from Existing Monterey Highway Bridge[1]	Peak Inflow (cfs)
RS 10583.33	10,310 feet upstream	109
RS 3361.912	3,090 feet upstream	159
Overland flow at Palm Avenue	n/a	288
Overland flow at San Bruno Avenue	n/a	294
Overland flow at Willow Springs Road	n/a	231
Overland flow from northwestern tributary	n/a	152

Sources: SCVWD 2015a
RS = River Station
Cfs = cubic feet per second
[1] Note: Distance from existing railroad bridge is rounded to the nearest 10 feet.



Sources: SCVWD 2015a; Authority 2019

JANUARY 2019

Figure 4-22 Inflow Locations in the Fisher Creek Hydraulic Model

4.5.2.3 Water Surface Elevations

The modeling results for Alternatives 1 and 3 and Alternatives 2 and 4 are shown in Table 4-8 and Table 4-9, respectively. The outputs from the hydraulic analysis showed that the proposed wildlife crossing proposed for Monterey Road Bridge (all alternatives) and the railroad bridge (Alternatives 2 and 4) would lower the 100-year flood profile of Fisher Creek main channel upstream of the project location.

Table 4-8 Hydraulic Modeling Results, Fisher Creek, Alternatives 1 and 3

Location	Flow Rate (cfs)	Channel Bank Elevation (feet NAVD 88)	WSE—Existing Condition (feet NAVD 88)	WSE—Proposed Condition (feet NAVD 88)	Change in WSE (feet)
At downstream of Old Monterey Rd	810	247.1	249.0	249.0	0.0
At upstream of Old Monterey Road with proposed wildlife crossing and proposed HSR viaducts on the roadway median	810	247.6	249.4	249.0	(0.4)
At upstream existing railroad crossing	810	254.6	249.4	249.0	(0.4)
At upstream of Santa Teresa Boulevard	880	251.9	251.0	250.9	(0.1)

Elevations are rounded to the nearest 0.1 foot.
cfs = cubic feet per second
NAVD 88 = North American Vertical Datum of 1988
WSE = water surface elevation
HSR = high=speed rail

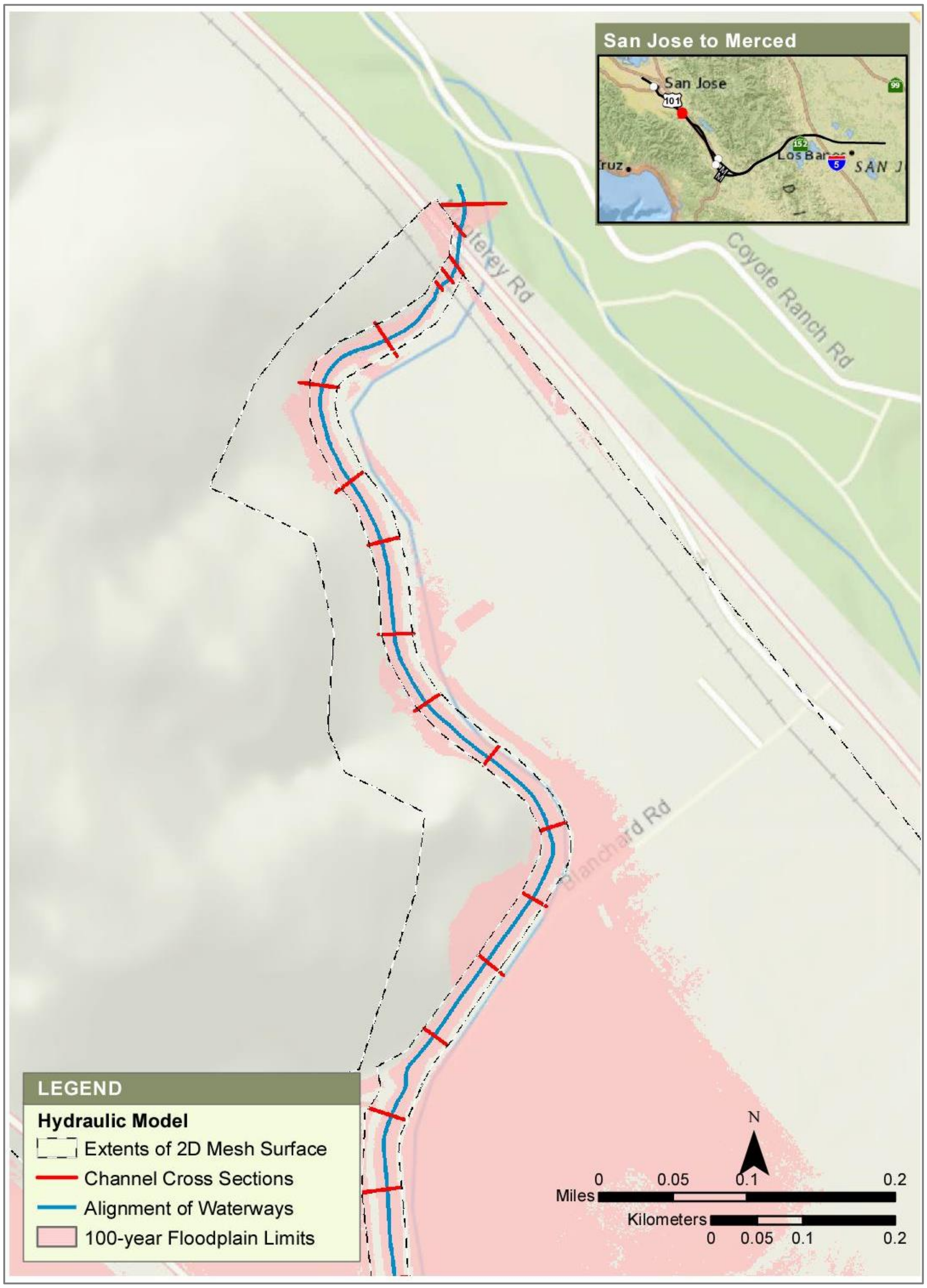
Table 4-9 Hydraulic Modeling Results, Fisher Creek, Alternatives 2 and 4

Location	Flow Rate (cfs)	Channel Bank Elevation (feet NAVD 88)	WSE—Existing Condition (feet NAVD 88)	WSE—Proposed Condition (feet NAVD 88)	Change in WSE (feet)
At downstream of Old Monterey Rd	810	247.1	249.0	249.0	0.0
At upstream of proposed cross culvert/wildlife crossing below railroad tracks	810	254.6	249.4	249.1	(0.3)
At upstream of Santa Teresa Boulevard	880	251.9	251.0	250.8	(0.2)

(Parentheses) indicate negative values
Elevations are rounded to the nearest 0.1 foot.
cfs = cubic feet per second
NAVD 88 = North American Vertical Datum of 1988
WSE = water surface elevation
HSR = high=speed rail

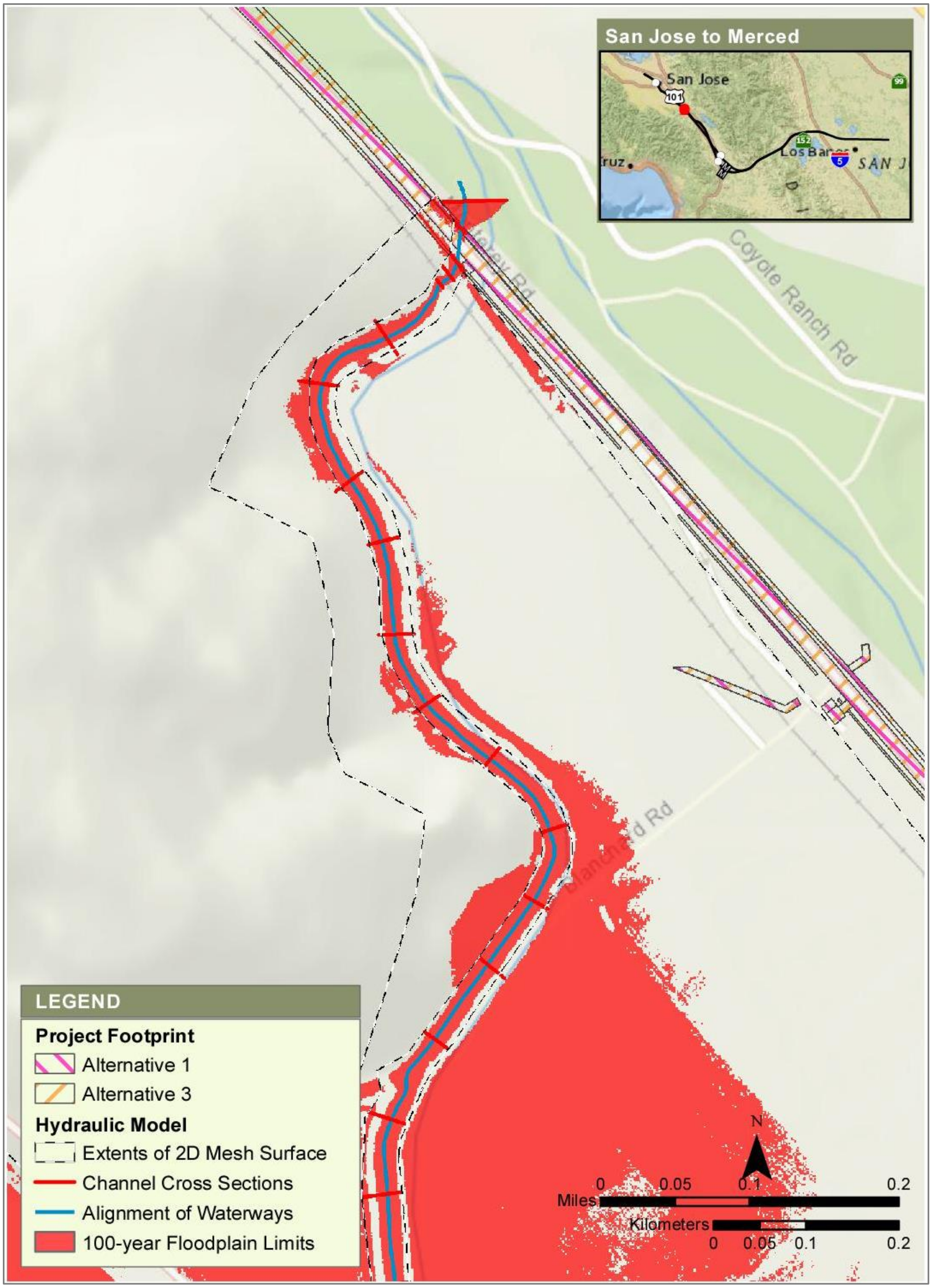
4.5.2.4 Overbank Flood Flow

The modeling results for the two-dimensional floodplain analysis for Fisher Creek in the project vicinity are shown in Figure 4-23 for existing condition, Figure 4-24 for Alternatives 1 and 3, and Figure 4-25 for Alternatives 2 and 4. The outputs from the proposed condition hydraulic analysis showed that the proposed wildlife crossing/cross culvert with a larger flow opening that would lower the 100-year flood profile of mainline Fisher Creek would also reduce the extents of the 100-year floodplain by in the project vicinity.



Sources: SCVWD 2015a; Authority 2019 JANUARY 2019

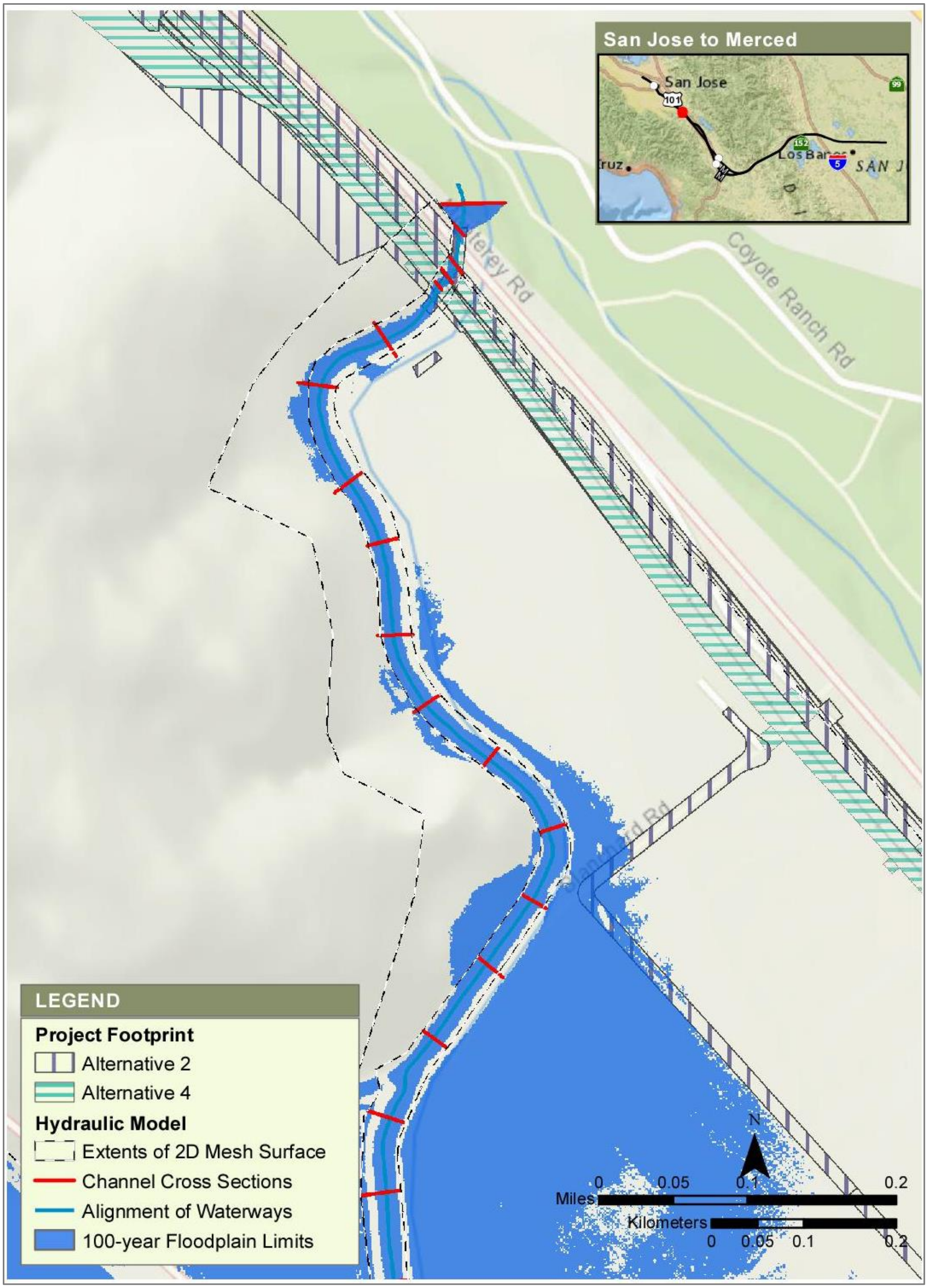
Figure 4-23 Fisher Creek 100-Year Floodplain from Hydraulic Analysis, Existing Condition



Sources: SCVWD 2015a; Authority 2019

JANUARY 2019

Figure 4-24 Fisher Creek 100-Year Floodplain from Hydraulic Analysis, Alternatives 1 and 3



Sources: SCVWD 2015a; Authority 2019

JANUARY 2019

Figure 4-25 Fisher Creek 100-Year Floodplain from Hydraulic Analysis, Alternatives 2 and 4

4.6 Uvas-Carnadero Creek

4.6.1 Background Information

4.6.1.1 Floodplain Location

Uvas-Carnadero Creek originates in the Santa Cruz Mountains, and it has a watershed size of approximately 87 square miles. Uvas Creek drains the southern slope of Loma Prieta, where the Uvas-Carnadero Creek watershed abuts the Los Gatos Creek, Alamitos Creek, and Llagas Creek watersheds. Uvas Creek generally flows in a southeasterly direction through the Santa Cruz Mountains towards Gilroy. Near the US 101, Uvas Creek changes its name to Carnadero Creek; therefore, this system is commonly referred to as Uvas-Carnadero Creek. Carnadero Creek discharges into Pajaro River just upstream of the Pajaro Narrows (SCVWD 2012b).

4.6.1.2 FEMA Floodplain

According to the FEMA FIRM panel numbers 06085C0752H, 06085C0756H, 06085C0760H (FEMA 2009), and FEMA LOMR Case No. 16-09-2429P, the FEMA SFHAs for Uvas-Carnadero Creek and overbank flood flows in the project footprint for are Zones A, AH, AO, and AE. FEMA LOMR Case No. 16-09-2429P became effective in January 8, 2018 revised the 100-year flood profile of mainline Uvas-Carnadero Creek between US 101 and Bloomfield Avenue and at the overbank area bounded by Uvas-Carnadero Creek on north, by Bloomfield Avenue on south and east, and by the railroad track on west. The remaining floodplains are effective since 2009.

There are no designated floodways in the Uvas-Carnadero Creek floodplain in the project footprint. The 100-year WSEs of Uvas-Carnadero Creek and overbank flood flows in the project footprint vary from approximately 195 feet NAVD in the City of Gilroy (Alternatives 1, 2, and 4) to approximately 166 feet NAVD 88 at the Bloomfield Avenue Bridge (Alternatives 1 and 2) and the overbank areas (Alternative 4).

Uvas-Carnadero Creek in the project footprint is recognized as a FEMA 100-year floodplain. Therefore, the project cannot raise the flood profile of Uvas-Carnadero Creek by more than 1.0 foot.

4.6.1.3 Project Alternatives in the FEMA Floodplain

The project footprints for Alternatives 1 and 2 include the Bloomfield Avenue Bridge over Uvas-Carnadero Creek (Figure 4-26). These two alternatives would replace the existing Bloomfield Avenue Bridge with a taller bridge to cross over the proposed maintenance facility. The project footprints for Alternatives 1 and 2 are also within the limits of the 100-year floodplain of the overbank flood flow of Uvas-Carnadero Creek. Alternative 1 is proposing a viaduct segment and maintenance facility in the exiting FEMA 100-year floodplain. Alternative 2 is proposing embankments, a trench section with lid, and a maintenance facility in the exiting FEMA 100-year floodplain.

The project footprint for Alternative 4 does not cross Uvas-Carnadero Creek, but is within the limits of the 100-year floodplain of the overbank flood flow of Uvas-Carnadero Creek (Figure 4-27). Alternative 4 is proposing embankments and a maintenance facility in the exiting FEMA 100-year floodplain.

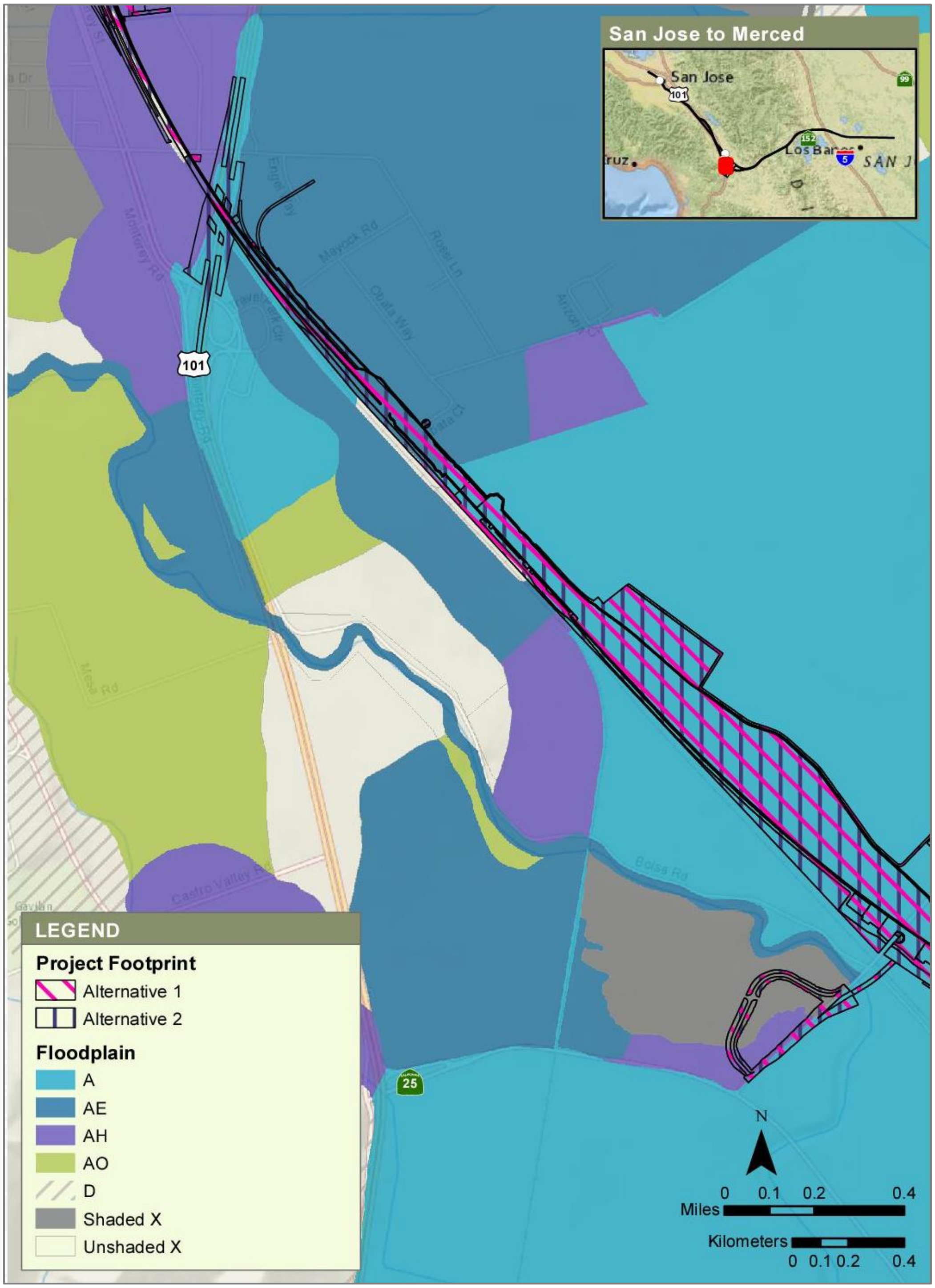
The project footprint for Alternative 3 is outside the limits of the 100-year floodplain of Uvas-Carnadero Creek, excluding the Soap Lake floodplain area.

4.6.1.4 Available Hydraulic Model

The FEMA effective hydraulic model and hydraulic model provided by SCVWD were available for this waterbody.

The SCVWD hydraulic model was used to develop combined one- and two-dimensional hydraulic model of the Soap Lake floodplain, discussed in details in Chapter 5, Combined One- and Two-Dimensional Hydraulic Modeling for Soap Lake floodplain. Therefore, the outputs from this hydraulic model would not be discussed further in this section of this study.

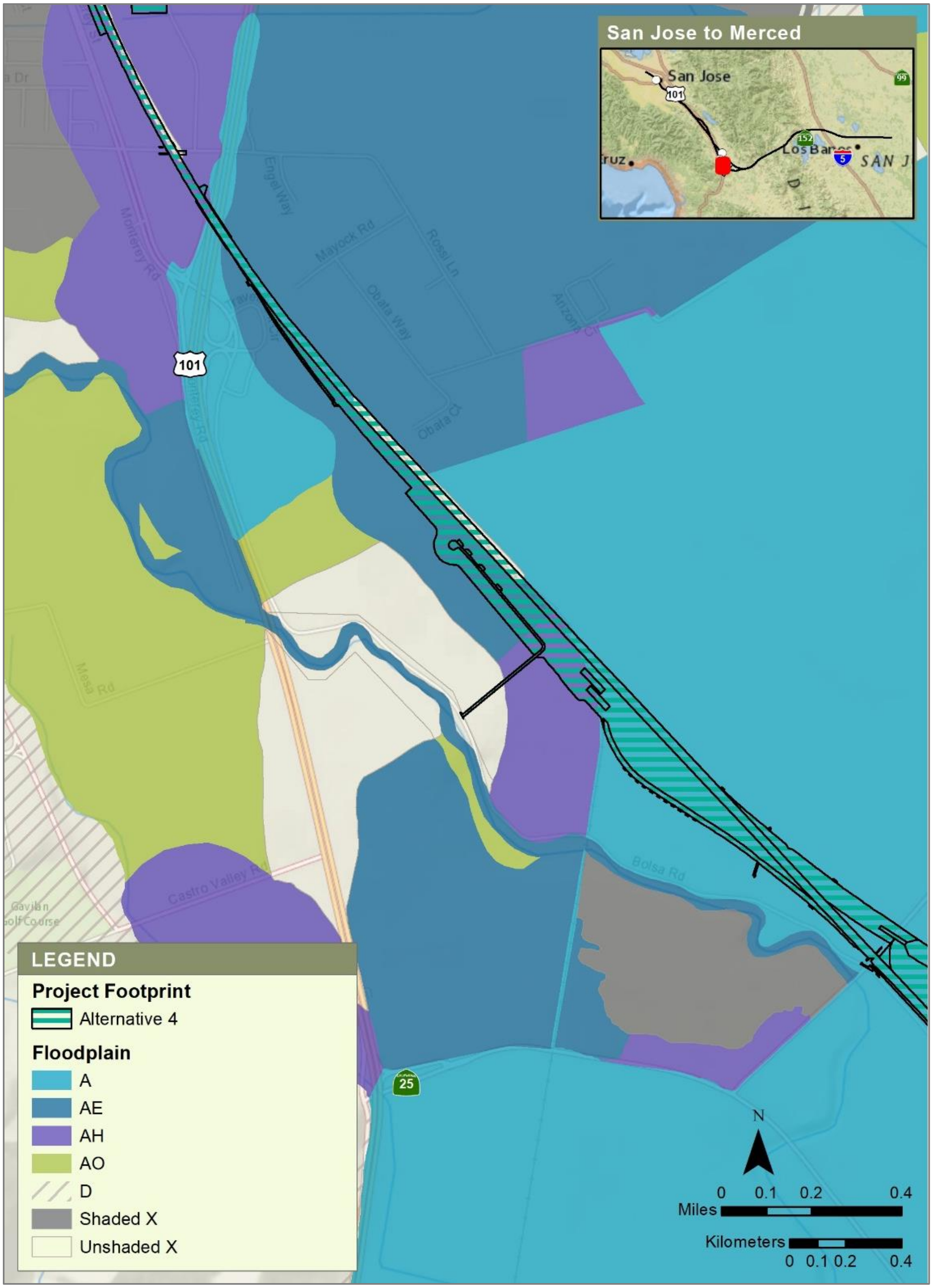
This section addresses the project's potential impacts on the mainline Uvas-Carnadero Creek floodplain using the FEMA effective hydraulic model of Uvas-Carnadero Creek. The project's potential impacts on the overbank flood flows of Uvas-Carnadero Creek in the project footprint are discussed in Chapter 5.



Sources: FEMA 2009; Authority 2019

JANUARY 2019

Figure 4-26 FEMA FIRM, Uvas-Carnadero Creek at Project Location with Project Footprints for Alternatives 1 and 2



Sources: FEMA 2009; Authority 2019

JANUARY 2019

Figure 4-27 FEMA FIRM, Uvas-Carnadero Creek at Project Location with Project Footprint for Alternative 4

4.6.2 FEMA Hydraulic Model

The upstream and downstream limits of Uvas-Carnadero Creek representing the one-dimensional component of the hydraulic model is at Santa Teresa Blvd (approximately 33,100 feet upstream of the existing Bloomfield Avenue Bridge) and approximately 1,700 feet downstream of the existing Bloomfield Avenue Bridge. The two-dimensional surface area is assigned on the overbanks between the downstream limit of the hydraulic model and West Luchessa Avenue bridge (approximately 21,900 feet upstream of Bloomfield Avenue Bridge). The area of the two-dimensional surface included in the hydraulic model is approximately 4,820 acres.

The hydraulic analysis of the existing condition was performed without making any changes to the base hydraulic model. The proposed condition hydraulic model for Alternatives 1 and 2 removed and replaced the existing Bloomfield Avenue Bridge over Uvas-Carnadero Creek. The hydraulic analysis for Alternatives 3 and 4 were not performed because the project footprint for these two alternatives were outside of the main channel of Uvas-Carnadero Creek.

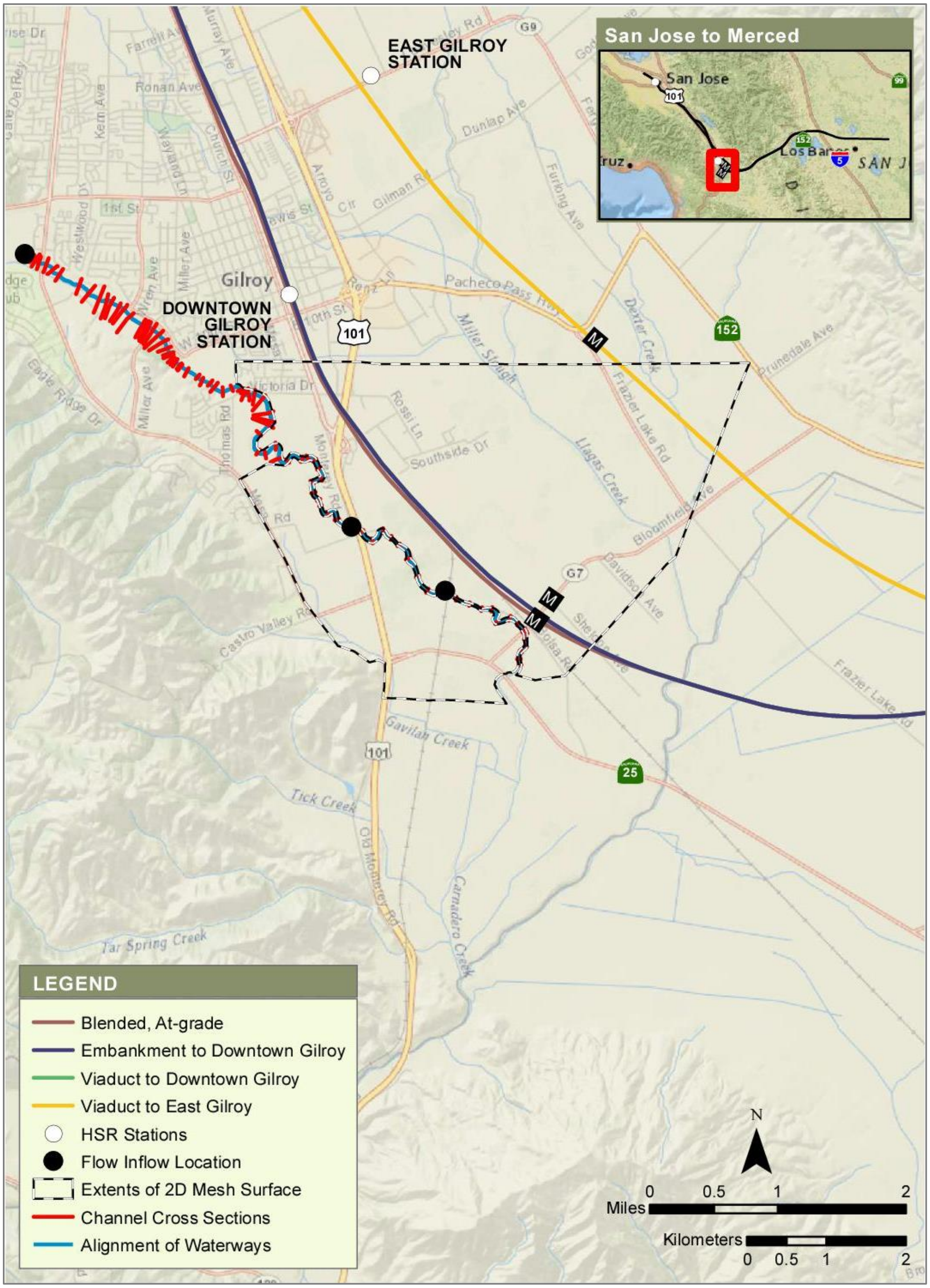
4.6.2.1 Inflow Hydrograph for Hydraulic Analysis

The hydraulic model of Uvas-Carnadero Creek included hydrographs of Uvas-Carnadero Creek during 100-year storm event. There were 3 locations in the hydraulic model with assigned inflows, all assigned as direct inflow into the creek main channel. The peak 100-year flows at each inflow location are summarized in Table 4-10. The inflow locations in the hydraulic model are shown in Figure 4-28.

Table 4-10 Peak 100-Year Inflows into Los Gatos Creek Hydraulic Model

Location	Distance from Existing Bloomfield Avenue Bridge[1]	Peak Inflow (cfs)
RS 32605	33,300 feet upstream	13,480
RS 10720	10,440 feet upstream	1,740
RS 4805.184	4,290 feet upstream	570

Sources FEMA 2018f
RS = River Station
cfs = cubic feet per second
[1] Distance from existing railroad bridge is rounded to the nearest 10 feet.



Sources: FEMA 20018f; Authority 2019

JANUARY 2019

Figure 4-28 Inflow Locations in the Hydraulic Model of Uvas-Carnadero Creek

4.6.2.2 Water Surface Elevations in the main Channel

The modeling results for Alternatives 1 and 2 are shown in Table 4-11. The outputs from hydraulic analysis show the replacement of the existing Bloomfield Avenue Bridge would not raise the 100-year flood profile of Uvas-Carnadero Creek in the project vicinity.

Table 4-11 Hydraulic Modeling Results, Uvas-Carnadero Creek, Alternatives 1 and 2

Location	Flow Rate (cfs)	Channel Bank Elevation (feet NAVD 88)	WSE—Existing Condition (feet NAVD 88)	WSE—Proposed Condition (feet NAVD 88)	Change in WSE (feet)
Downstream limit of hydraulic model, approximately 1,580 feet downstream of existing Bloomfield Avenue Bridge	5,660	161.7	163.9	163.9	0.0
Upstream of proposed Bloomfield Avenue bridge/ Downstream of existing Bloomfield Avenue bridge	6,850	170.1	166.2	166.1	(0.1)
At existing railroad bridge (Approximately 4,220 feet upstream of exist Bloomfield Avenue bridge)	7,080	178.0	174.5	174.5	0.0

(Parentheses) indicate negative values
Elevations are rounded to the nearest 0.1 foot.
cfs = cubic feet per second
NAVD 88 = North American Vertical Datum of 1988
WSE = water surface elevation
HSR = high=speed rail

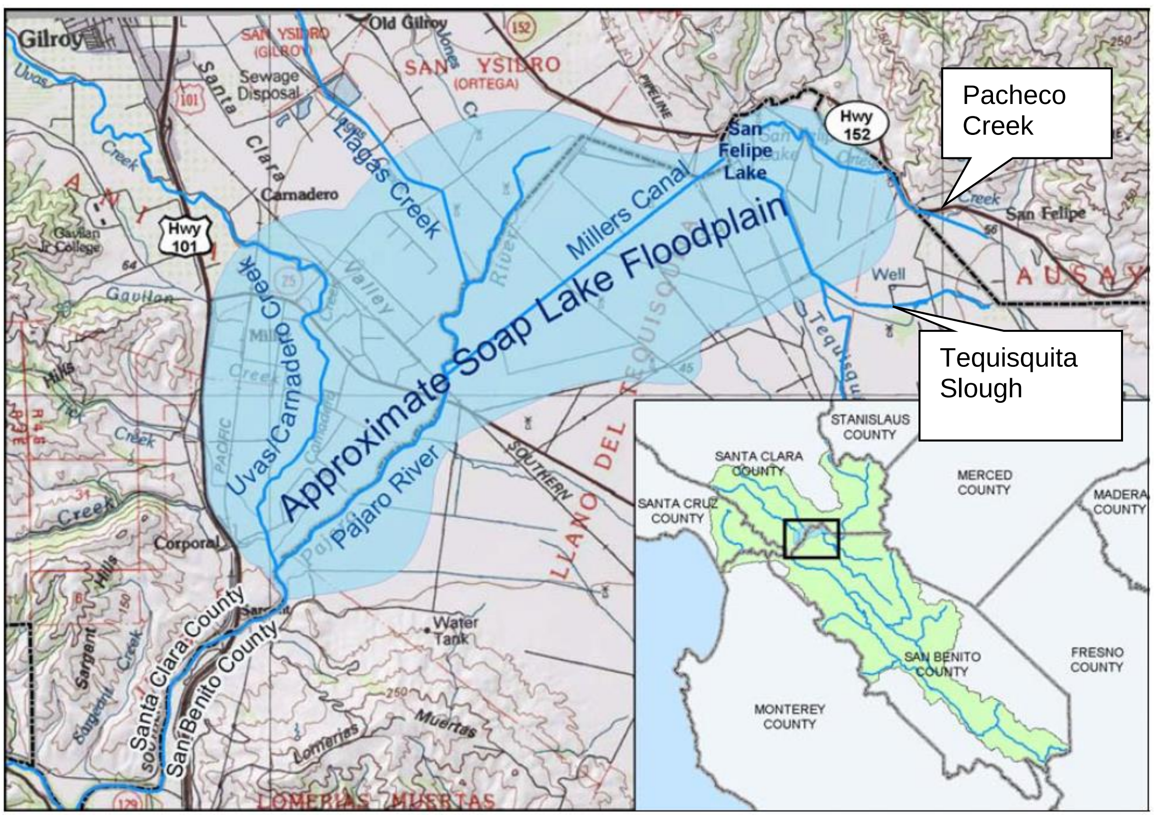
5 COMBINED ONE- AND TWO-DIMENSIONAL HYDRAULIC MODELING FOR SOAP LAKE FLOODPLAIN

5.1 General Information

The Soap Lake floodplain lies along the Pajaro River in San Benito and Santa Clara Counties between SR 152 and US 101. The approximate footprint of the Soap Lake floodplain is illustrated on Figure 5-1. Soap Lake is a natural detention basin storing water and reducing peak flows that would otherwise increase flooding in the lower Pajaro River in San Benito, Santa Cruz, and Monterey Counties. The major waterbodies contributing to the Soap Lake floodplain are Uvas-Carnadero Creek, Llagas Creek, Tequisquita Slough, and Pacheco Creek.

Soap Lake is a very important flood management feature for downstream areas because flood storage and attenuation in Soap Lake leads to a substantial decrease in peak flows downstream. According to the PRWFPA's *Pajaro River Watershed Study Final Phase 3 and 4a Report*, the outputs from the HEC-1 hydrologic model for Pajaro River watershed with and without Soap Lake showed substantial decreases in the peak flood flows at Chittenden stream gage, approximately 5 miles downstream of the Soap Lake outlet (PRWFPA 2005) (Table 5-1 and Figure 5-2).

The preliminary findings from the combined one- and two-dimensional hydraulic analysis were presented to the PRWFPA on December 21, 2016. The approach of the HSR to crossing the Soap Lake floodplain is to minimize potential changes to the WSEs, horizontal extent, and peak flows for the 100-year storm event.



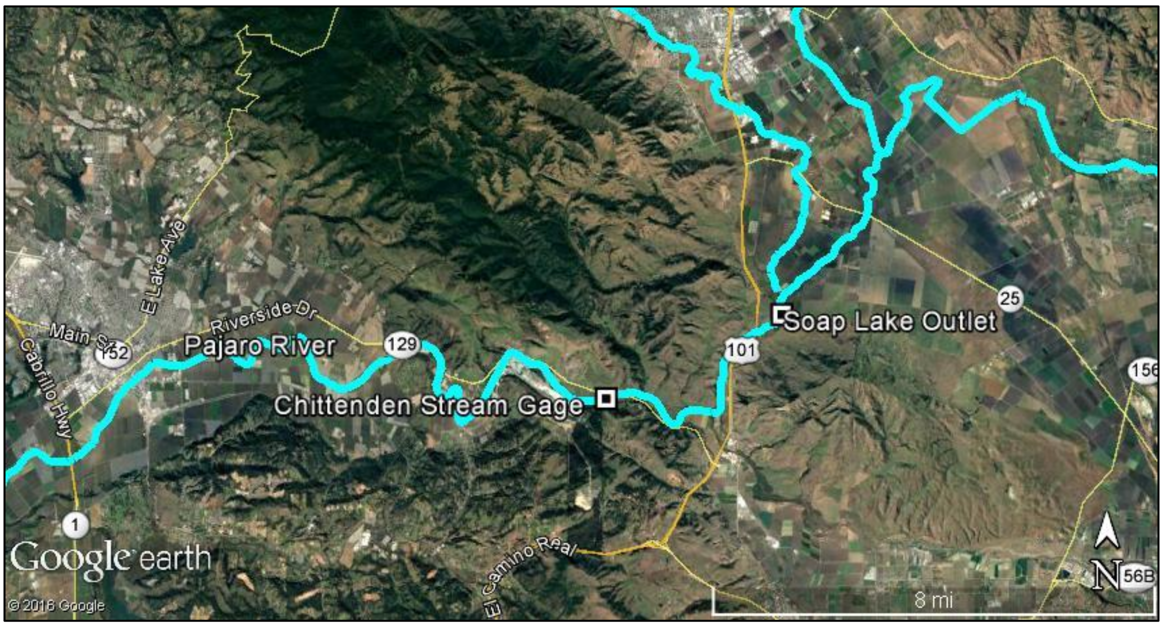
Source: PRWFPA 2005 APRIL 2017

Figure 5-1 Soap Lake Approximate Floodplain Area

Table 5-1 Peak Flows at Chittenden Stream Gage with and without Soap Lake Attenuation

Recurrence Interval (year)	Peak Flow with Soap Lake (cfs)	Peak Flow without Soap Lake (cfs)	Peak Difference (cfs)
2	3,600	3,600	0
10	16,900	19,500	2,600
25	28,700	35,300	6,600
50	38,600	50,300	11,700
100	45,200	60,500	15,300
200	60,500	82,400	21,900

Source: PRWFPA 2005
cfs = cubic feet per second



Source: PRWFPA 2005

APRIL 2017

Figure 5-2 Location of Chittenden Stream Gage

5.2 Existing Floodplain Mapping in Soap Lake Floodplain

The Soap Lake floodplain is located in the FEMA FIRMs 06085C0756H, 06085C0757H, 06085C0760H, 06085C0770H, and 06085C0780H in Santa Clara County and the FEMA FIRMs 06069C0045D, 06069C0050D, and 06069C0075D in San Benito County.

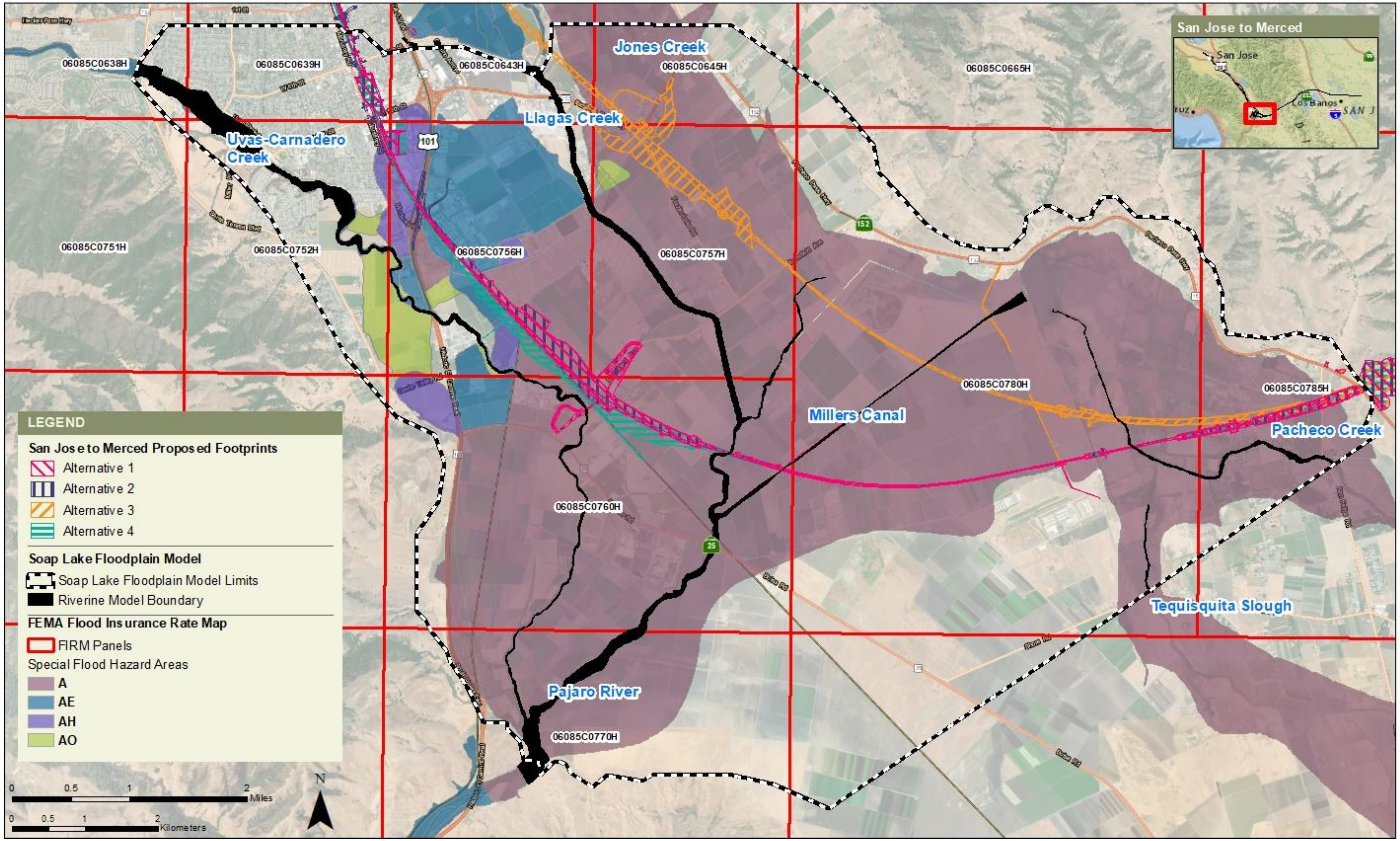
The FEMA FIRMs in Santa Clara County classify the Soap Lake floodplain and its vicinity as Special Flood Hazard Area Zones A, AE, AH, and AO. The FEMA FIRMs in San Benito County indicate that the Soap Lake floodplain and its vicinity are classified as Special Flood Hazard Area Zone A. The FEMA Special Flood Hazard Area Zones near the Soap Lake floodplain are illustrated on Figure 5-3.

Zone A represents areas subject to flooding by the 100-year flood event determined by approximate methods where BFEs are not shown. Because detailed analyses are not performed for such areas, BFEs and flood depths have not been determined by FEMA for the floodplains in the Soap Lake floodplain and vicinity. A majority of the Soap Lake floodplain is designated as Zone A.

Zone AE represents areas subject to flooding by the 100-year flood event determined by detailed methods. The FIRM shows BFEs in this 100-year flood zone. The mainline of Uvas-Carnadero Creek, Llagas Creek, Llagas Overbank Flow, and overbank spill flows from Uvas-Carnadero Creek, and Pajaro River at the Soap Lake outlet are designated as Zone AE near the Soap Lake floodplain.

Zone AH represents areas subject to flooding by the 100-year flood event where average depths are between 1 and 3 feet. Zone AH typically represents areas of shallow ponding during the 100-year flood event. The FIRM shows BFEs derived from detailed hydraulic analyses in this 100-year flood zone. The portions of the overbank spill flows from Uvas-Carnadero Creek are designated as Zone AH near the Soap Lake floodplain.

Zone AO represents areas subject to flooding by the 100-year flood event where average depths are between 1 and 3 feet. Zone AO typically represents areas with shallow sheet flow on sloping terrain during the 100-year flood event. The average flood depths from detailed hydraulic analyses are shown in this 100-year flood zone. The portions of the overbank spill flows from Uvas-Carnadero Creek and portions of the overbank spill flows from Jones Creek are designated as Zone AO near the Soap Lake floodplain.



Source: FEMA 2009; Authority 2019

JANUARY 2019

Figure 5-3 FEMA 100-Year Floodplain in the Vicinity of Soap Lake Floodplain

5.3 Background Information

The hydrologic and hydraulic analyses of the Soap Lake floodplain were performed by combining the information available from the previous studies performed in its vicinity. Table 5-2 shows the list of resources obtained for the hydrologic and hydraulic analyses.

Table 5-2 Resources Obtained for Hydrologic and Hydraulic Analysis

Agency	Obtained Resource	Date
Federal Emergency Management Agency	Flood Insurance Study for Santa Clara County and Incorporated Areas	Published February 14, 2014
Pajaro River Watershed Flood Prevention Authority	One-dimensional hydraulic model of Soap Lake floodplain This model was used in the *Pajaro River Watershed Study, Final Phase 3 and 4a Report*, published February 2005	Received June 26, 2016
Santa Clara Valley Water District	Combined one- and two-dimensional hydraulic model of Uvas-Carnadero Creek One-dimensional hydraulic model of Llagas Creek and West Branch Llagas Creek	Received June 3, 2016
	One-dimensional hydraulic model of Llagas Creek and Tributaries and Hydrologic Analysis of Llagas Creek Watershed	Received January 5, 2018
Schaaf & Wheeler	Hydrologic model of Pajaro River Watershed This model was used in *Technical Memorandum No. 1.2.7* for the PRWFPA's *Pajaro River Watershed Study* (2001)	Received June 30, 2016
Towill, Inc.	One- and three-feet grid LiDAR digital elevation map of Soap Lake floodplain	Received January 6, 2017

PRWFPA = Pajaro River Watershed Flood Prevention Authority

5.4 Hydrologic Data Sources

This section describes the hydrologic data sources that were used to develop the inflow hydrographs into the Soap Lake floodplain model. Analysts reviewed the available hydrologic data from the FEMA FIS, hydraulic models provided by the SCVWD and PRWFPA, and the hydrologic model provided by Schaaf and Wheeler on behalf of PRWFPA.

5.4.1 Available 100-Year Flows

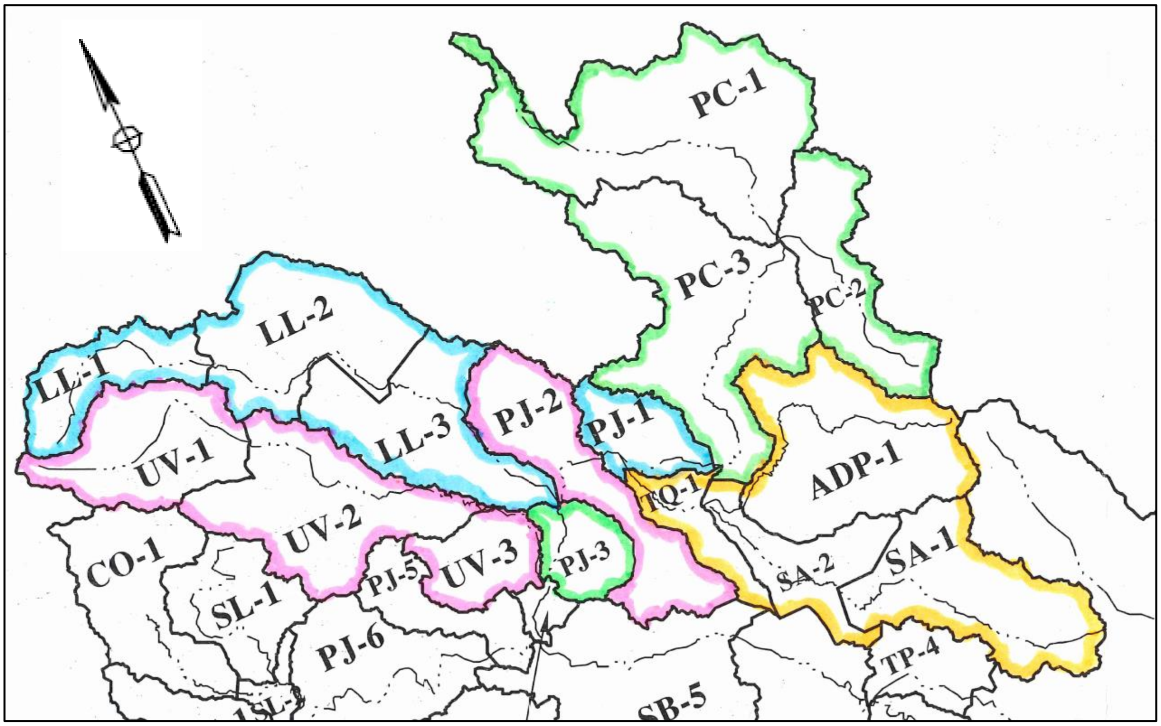
The FEMA FIS for Santa Clara County and Incorporated Areas, last revised on February 14, 2014, provided the peak 100-year flow of Uvas-Carnadero Creek, Llagas Creek, and the Pajaro River. The FEMA FIS for San Benito County and Incorporated Areas, last revised on April 16, 2009, did not provide peak flows of waterbodies near the Soap Lake floodplain.

The hydraulic model for Uvas-Carnadero Creek provided by the SCVWD included the 100-year, 60-hour hydrograph used in the unsteady-state hydraulic analysis. The hydraulic model for Llagas Creek provided by the SCVWD included the peak 100-year flows used in the steady-state hydraulic analysis. SCVWD also provided hydrologic analysis of Llagas Creek, which included peak flow of Llagas Creek with no overbank flood flows in upstream of Soap Lake (SCVWD 2018g).

The one-dimensional hydraulic model of Soap Lake floodplain provided by PRWFPA included the peak 100-year flows of Uvas-Carnadero Creek, Llagas Creek, and Uvas Creek.

On behalf of PRWFPA, Schaaf & Wheeler provided the outputs of the HEC-1 hydrologic model used in *Technical Memorandum No. 1.2.7* for the PRWFPA's *Pajaro River Watershed Study* (2001). The memorandum provided the layout of the subwatersheds in the HEC-1 hydrologic model (Figure 5-4 and Table 5-3). The outputs from HEC-1 hydrologic model included peak flows at each subwatershed in the hydrologic model.

The obtained peak flows of the waterbodies entering the Soap Lake floodplain from FEMA, SCVWD, and Schaaf and Wheeler are shown in Table 5-4.



Source: Schaaf and Wheeler 2001 APRIL 2017

Figure 5-4 Subwatershed Layout for the Pajaro River Watershed Study

Table 5-3 Waterbodies Entering Soap Lake Floodplain

Waterbody Name	Subwatersheds in Figure 5-4	Subwatershed Area (square miles)
Uvas-Carnadero Creek	UV-1, UV-2, and UV-3	86.5
Llagas Creek	LL-1, LL-2, and LL-3	90.2
Tequisquita Slough	ADP-1, SA-1, SA-2, and TQ-1	115.3
Pacheco Creek	PC-1, PC-2, and PC-3	153.2
Unnamed waterbodies outfalling to San Felipe Lake	PJ-1	13.7
Jones Creek and unnamed tributaries outfalling to Pajaro River	PJ-2	34.0
Unnamed waterbodies outfalling to Pajaro River	PJ-3	12.0

Source: Schaaf and Wheeler 2001

Table 5-4 Soap Lake Peak Flows from Available Studies

Waterbody Name	FEMA FIS (cfs)	SCVWD Hydraulic Models (cfs)	PRWFPA Soap Lake Hydraulic Model (cfs)	HEC-1 Hydrologic Model (cfs)
Uvas-Carnadero Creek (upstream of confluence with Pajaro River)	14,000	17,000	12,927	13,041
West Branch Llagas Creek (upstream of confluence with Llagas Creek)	N/A	6,160	N/A	N/A
Llagas Creek (upstream of confluence with West Branch Llagas Creek)	5,200	8,848	N/A	N/A
Llagas Creek (downstream of confluence with West Branch Llagas Creek)	N/A	15,237 (17,800 from Watershed Study)	N/A	N/A
Llagas Creek (upstream of confluence with Pajaro River)	18,800	(18,800 from watershed study)	8,597	10,764
Tequisquita Slough (Upstream of confluence with Pacheco Creek)	N/A	N/A	N/A	10,409
Pacheco Creek (upstream of Soap Lake floodplain outfall)	N/A	N/A	N/A	13,408
Subwatershed PJ-1 (unnamed streams outfalling into Frazier Lake)	N/A	N/A	N/A	2,125
Subwatershed PJ-2 (Jones Creek and unnamed tributaries outfalling into Soap Lake between Frazier Lake and Llagas Creek/Pajaro River confluence)	N/A	N/A	N/A	6,243
Subwatershed PJ-3 (unnamed tributaries outfalling into Soap Lake downstream of Llagas Creek/Pajaro River confluence)	N/A	N/A	N/A	2,856
Pajaro River (at Soap Lake outlet)	30,500	N/A	26,087	26,594

Sources: Schaaf and Wheeler 2001; PRWFPA 2005a, 2005b; SCVWD 2012, 2013b, 2016 2018g; FEMA 2014
cfs = cubic feet per second

5.4.2 Inflow Hydrographs for Hydraulic Analysis

The peak 100-year flow of Uvas-Carnadero Creek from the SCVWD model was the most conservative among the four data sources and was used for the hydraulic analysis of the Soap Lake floodplain. The timing of the peak 100-year flow (17,000 cfs, Table 5-4) was assumed same as the timing of the peak 100-year flow of Uvas-Carnadero Creek from HEC-1 hydrologic model (Figure 5-5). Figure 5-6 shows comparison of the 100-year flow hydrograph of Uvas-Carnadero Creek from SCVWD and HEC-1 hydrologic model.

The peak 100-year flows of Llagas Creek from the HEC-1 hydrologic model is from a study performed in 2001. According to SCVWD, the peak 100-year flow of Llagas Creek included in the SCVWD was based on the USACE's *Upper Llagas Creek Flood Control Project Existing Conditions Floodplains Study* dated September 2006. The FEMA FIS for Santa Clara County dated February 14, 2014, provided the peak 100-year flow of Llagas Creek just upstream of the Soap Lake floodplain. The peak flow rates for Llagas Creek have not been revised from the FEMA FIS for Santa Clara County dated August 17, 1998.

The peak 100-year flows from the FEMA FIS were most conservative among the available 100-year peak flows (Table 5-4). However, the FEMA FIS flows are oldest among the three types of available data, and the FEMA FIS did not provide peak flows of Llagas Creek immediately downstream of confluence with West Branch Llagas Creek. Because sufficient data were not available from the FEMA FIS for the tributary of Llagas Creek, the peak flow of 17,800 cfs from the SCVWD's watershed assessment (SCVWD 2018g) of Llagas Creek was selected as the inflow for the hydraulic analysis of the Soap Lake floodplain. Because SCVWD watershed assessment only provided the peak flow, the hydrograph of Llagas Creek downstream of the confluence with West Little Llagas Creek were assumed to be following the same flooding pattern as the hydrograph of Llagas Creek from the HEC-1 hydrologic model. The hydrograph Llagas Creek were determined by multiplying the hydrograph by the ratio of peak flows between HEC-1 hydrologic model and the SCVWD design flood flows. The timing of the peak flood flow was assumed to remain unchanged from the HEC-1 hydrologic model. Figure 5-7 shows comparison of the 100-year flow hydrographs of Llagas Creek from SCVWD and 100-year flow hydrograph of Llagas Creek from HEC-1 hydrologic model.

For the remaining waterbodies (Jones Creek, unnamed waterbodies, Tequisquita Slough, and Pacheco Creek), the output from the HEC-1 hydrologic model was the only source of the peak flows and was used for the hydraulic analysis of the Soap Lake floodplain.

Subwatershed PJ-2 from the HEC-1 hydrologic model represents the unnamed waterbodies outfalling to Soap Lake, downstream of the confluence of PJ-1 and Pacheco Creek. In addition, PJ-2 represents the storm runoff entering the Soap Lake floodplain flowing from the north and south of this reach, as illustrated on Figure 5-4. Therefore, the hydrograph for PJ-2 in the Soap Lake floodplain model was evenly divided into PJ-2 north and PJ-2 south, based on the watershed area north and south of the Soap Lake to separate out the incoming flows from north and south of the Soap Lake floodplain.

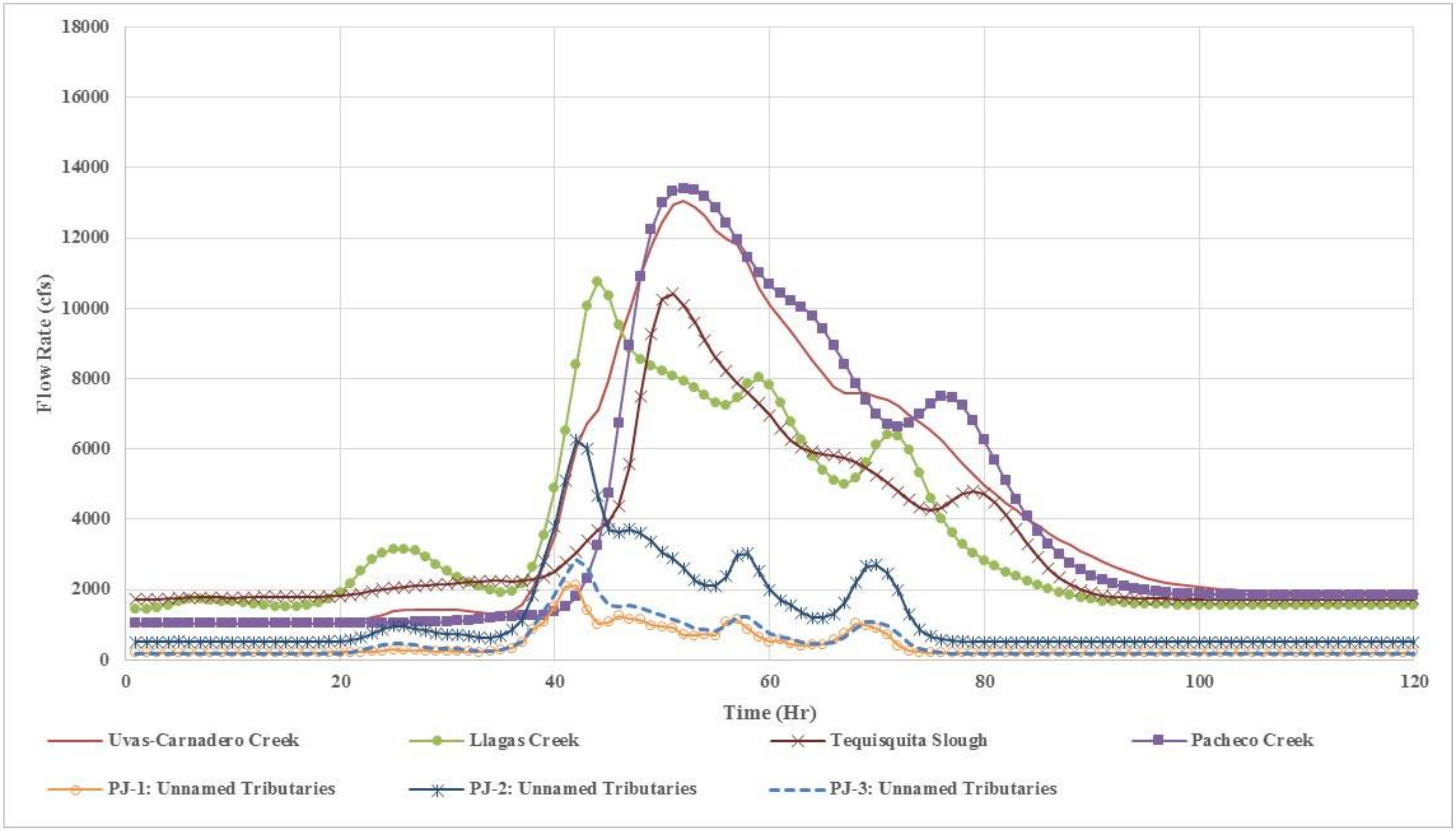
The inflow hydrographs used in the hydraulic analyses are illustrated on Figure 5-8. The begin and end times of the simulation were set to match with the duration of the 60-hr hydrograph of Uvas-Carnadero Creek from SCVWD, adjusted to match with the peak flood of Uvas-Carnadero Creek from the HEC-1 hydrologic model as illustrated on Figure 5-6. To provide stability in the hydraulic model simulation, the inflows at the beginning of the simulations were assumed to be 1 cfs for all of the subwatersheds of the Soap Lake floodplain included in the Soap Lake floodplain model, and was set to match with the inflows from selected hydrographs at hour 2. In addition, the inflow of 5 cfs was assumed to flow into Millers Canal in the first 10 hours of the model simulation to avoid the dry channel before receiving the inflows from Tequisquita Slough, Pacheco Creek, Subwatershed PJ-1, and Subwatershed PJ-2 (south).

The inflow hydrograph for the hydraulic analysis of Soap Lake floodplain are illustrated on Figure 5-8. The peak 100-year flows from the hydrographs assigned to the Soap Lake floodplain model are summarized in Table 5-5.

Table 5-5 Peak 100-Year Flows from the Hydrographs for Soap Lake Floodplain Model

Waterbody Name	Peak 100-year Flow (cfs)	Source
Uvas-Carnadero Creek	17,000	SCVWD 2016
Llagas Creek (downstream of confluence with West Branch Llagas Creek)	17,800	SCVWD 2018
Tequisquita Slough	10,409	*Schaaf and Wheeler 2001*
Pacheco Creek	13,408	*Schaaf and Wheeler 2001*
Subwatershed PJ-1	2,125	*Schaaf and Wheeler 2001*
Subwatershed PJ-2 (north)	3,122	*Schaaf and Wheeler 2001*
Subwatershed PJ-2 (south)	3,122	*Schaaf and Wheeler 2001*
Subwatershed PJ-3	2,856	*Schaaf and Wheeler 2001*

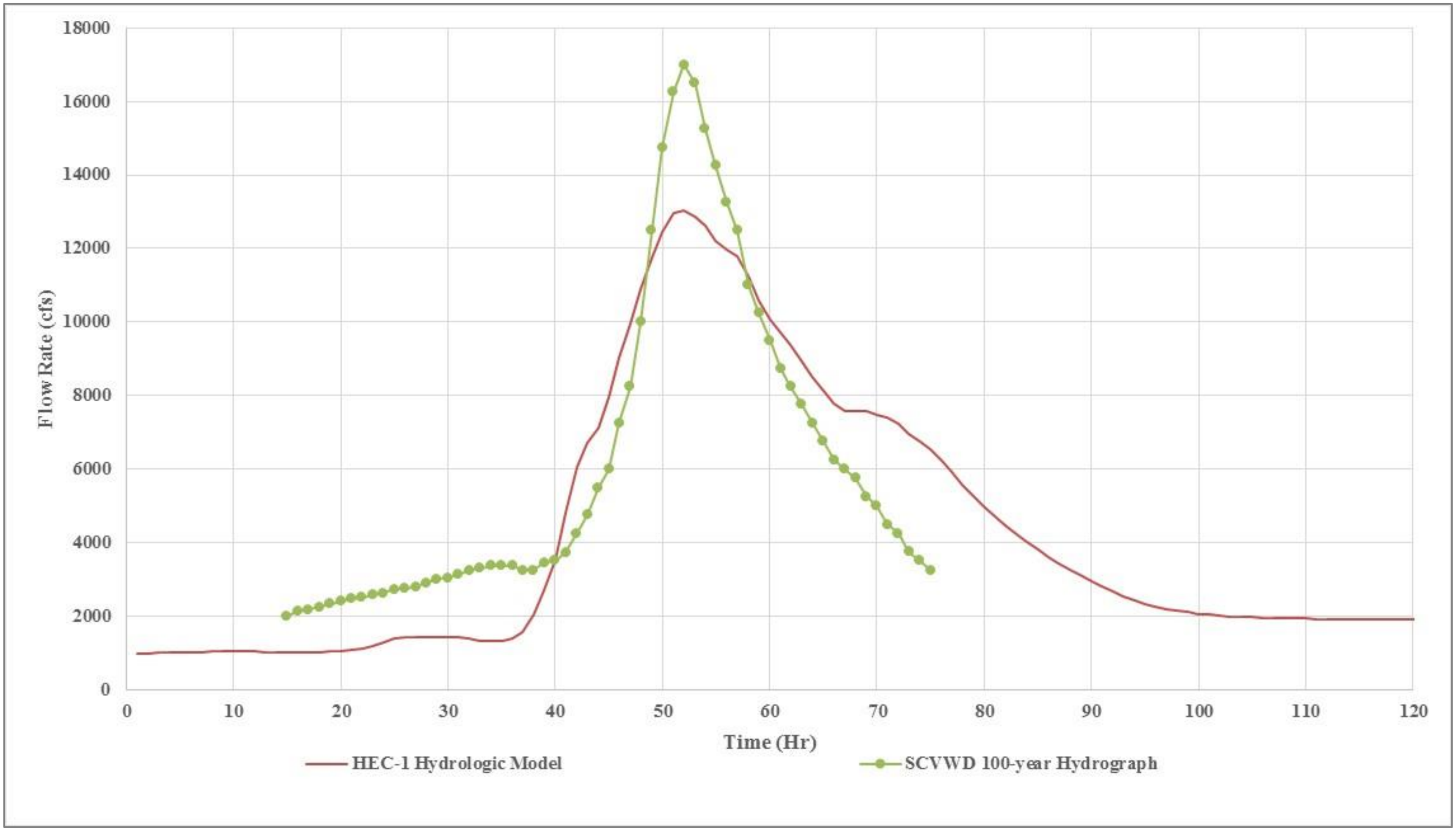
Sources: Schaaf and Wheeler 2001; SCVWD 2016, 2018g
cfs = cubic feet per second



Source: Schaaf and Wheeler 2001

JANUARY 2019

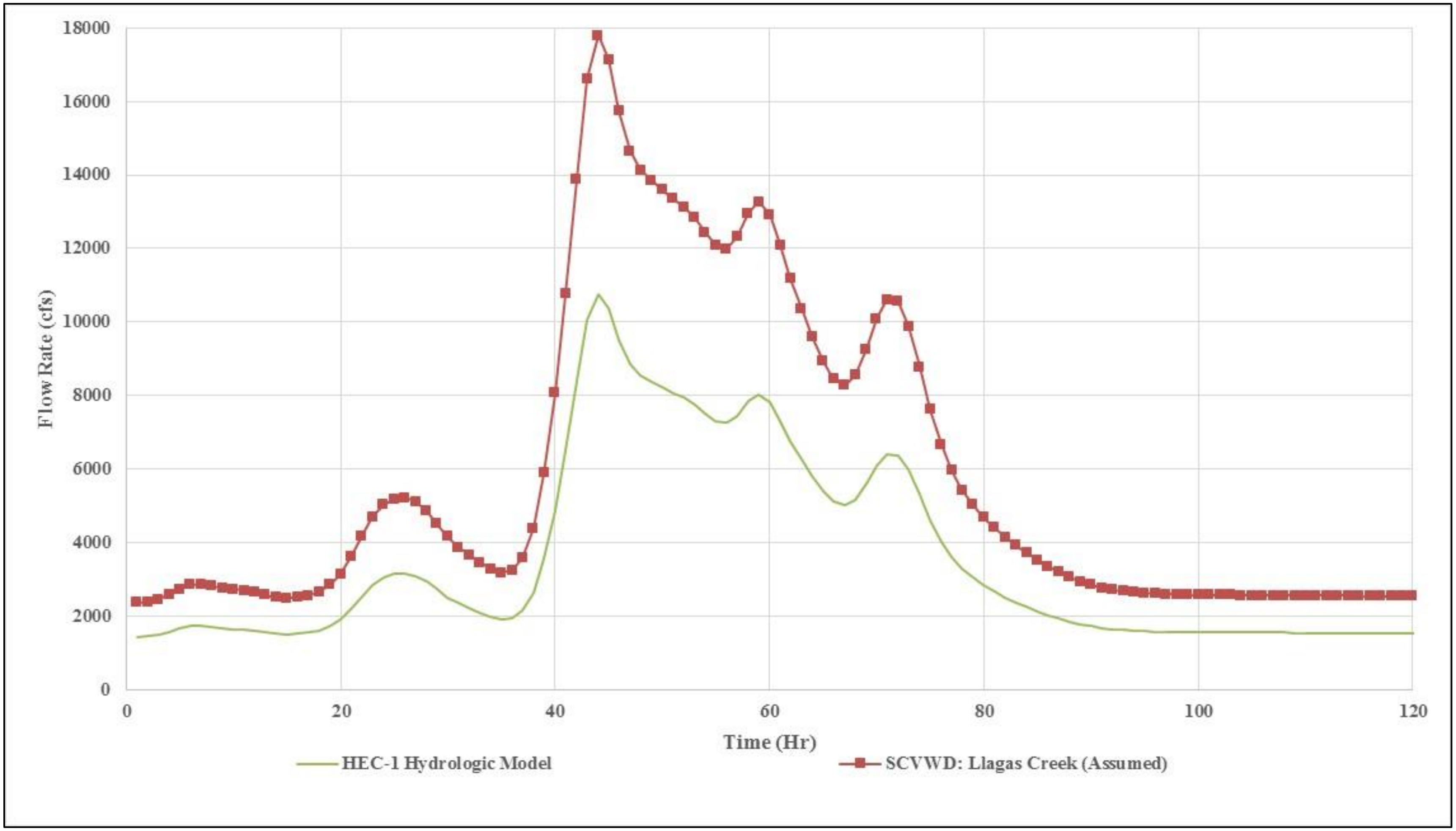
Figure 5-5 100-Year Flow Hydrographs from HEC-1 Hydrologic Model



Sources: Schaaf and Wheeler 2001; SCVWD 2016

JANUARY 2019

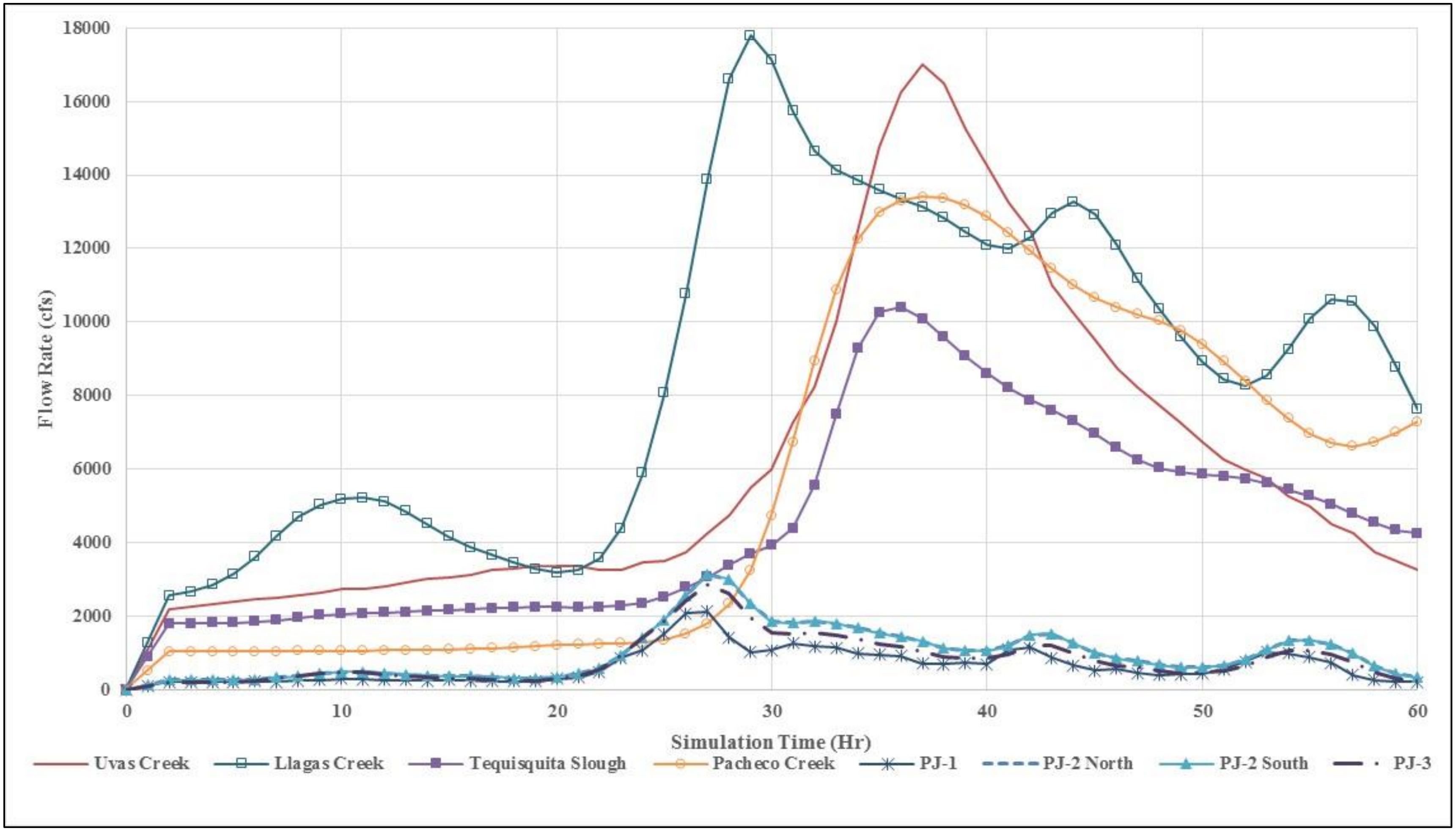
Figure 5-6 Comparison of 100-Year Flow Hydrographs for Uvas-Carnadero Creek



Sources: Schaaf and Wheeler 2001; SCVWD 2016

JANUARY 2019

Figure 5-7 Comparison of the 100-Year Flow Hydrographs for Llagas Creek



Sources: Schaaf and Wheeler 2001; SCVWD 2016, 2018g

JANUARY 2019

Figure 5-8 100-Year Flow Hydrographs for Soap Lake Floodplain Subwatersheds for Hydraulic Analysis

5.5 Hydraulic Analysis

5.5.1 Overview of Hydraulic Analysis

Innovyze's Infoworks ICM software was used to perform the combined one- and two-dimensional hydraulic analysis of the Soap Lake floodplain. ICM is an integrated one-dimensional and two-dimensional hydrodynamic simulation, incorporating both above- and below-ground elements of catchments. This software was chosen because of its ability to combine one-dimensional open channel flows and a full two-dimensional mesh solution for the floodplain flows.

The ICM hydraulic model for the Soap Lake floodplain is composed of a one-dimensional riverine model, two-dimensional floodplain model, inflow hydrographs assigned into the one- and two-dimensional components of the hydraulic model, and geometric features assigned in the model to represent the proposed HSR structures. The following sections describe each of the components in the ICM hydraulic model for the Soap Lake floodplain.

5.5.2 One-Dimensional Riverine Model

The ICM hydraulic model for the Soap Lake floodplain included one-dimensional riverine models of Uvas-Carnadero Creek, Llagas Creek, Pajaro River, Millers Canal, Tequisquita Slough, and Pacheco Creek. Figure 5-6 illustrates the location, alignment, and limits of the one-dimensional riverine models included in the ICM hydraulic model.

The hydraulic model of Uvas-Carnadero Creek, Llagas Creek, and Lower Llagas Creek provided by the SCVWD and the hydraulic model of the Soap Lake floodplain provided by PRWFPA were imported into the ICM hydraulic model to use as the one-dimensional riverine component of the model.

The channel cross sections for Uvas-Carnadero Creek and Llagas Creek overlapped between the SCVWD model and the PRWFPA' Soap Lake floodplain model. Because the hydraulic model prepared by SCVWD was more recent than the Soap Lake floodplain model provided by PRWFPA, the channel cross sections included in the SCVWD hydraulic model were used in the combined one- and two-dimensional hydraulic model for locations with overlap. The input parameters in the SCVWD's hydraulic model, such as channel cross sections, distance between cross sections, Manning's roughness coefficients assigned to each cross section, and bridge dimensions, remained unchanged from the original model in general.

The Soap Lake floodplain used in the *Pajaro River Watershed Study, Final Phase 3 and 4a Report* published in February 2005 included Uvas-Carnadero Creek, Llagas Creek, Pajaro River, and Millers Canal. Because the footprint of this one-dimensional hydraulic model included the overbank areas that would be represented using the two-dimensional mesh in the ICM hydraulic model, the limits of the one-dimensional model were trimmed to include only the main channel of the riverine model. The remaining model attributes from the one-dimensional riverine model were unchanged when they were imported to the ICM hydraulic model.

Within the limits of the Soap Lake Hydraulic Model, there are three confluences of the one-dimensional riverine components: Llagas Creek and Pajaro River, Pajaro River and Millers Canal, and Pajaro River and Uvas-Carnadero Creek. The channel cross sections cut from the terrain files were added to the river reaches at the junctions to improve the accuracy of the hydraulic model.

There were no hydraulic models available for Tequisquita Slough and Pacheco Creek near the Soap Lake floodplain. The riverine models for these two creeks were added into the ICM model using the digital elevation model (DEM) file of Soap Lake floodplain provided by Towill on January 6, 2017.

Tequisquita Slough in the Soap Lake floodplain model is set to outfall into the two-dimensional floodplain model, instead of outfalling into the river reach of Pacheco Creek. Similarly, the upstream limit of Pacheco Creek in the Soap Lake floodplain is set to receive the overland spill flow from the two-dimensional floodplain, instead of assigning the inflow hydrographs at the upstream limit of the one-dimensional riverine model. The one-dimensional and two-dimensional model connections at the upstream or downstream limits of the riverine model for Tequisquita Slough and Pacheco Creek in the Soap Lake floodplain model were assigned, because the terrain file used in the Soap Lake floodplain model does not show a defined floodplain channel beyond the limits of the riverine model. Therefore, based on the current available info, terminating the one-dimensional riverine model in the middle of the two-dimensional floodplain would best represent the flood flows in Pacheco Creek and Tequisquita Slough in the Soap Lake floodplain model. When a detailed survey is available during the design phase of this project, the riverine model limits may be revised if the new survey shows a defined channel.

The riverine models that correspond to Subwatersheds PJ-1, PJ-2, and PJ-3 from the HEC-1 model were not included in the ICM hydraulic model because there was not sufficient information available to determine the geometry of the floodplains corresponding to the Subwatersheds PJ-1, PJ-2, and PJ-3 (except for Jones Creek which is part of the PJ-2 watershed coming from north). The inflow for Subwatershed PJ-3 was represented as inflows into the Pajaro River between the confluences with Llagas Creek and Millers Canal. The inflows for Subwatersheds PJ-1 and PJ-2 were represented as floodplain sheet flows in the two-dimensional floodplain model. The setup of the inflows entering the Soap Lake Floodplain may be revised during the design phase of this project if the revised watershed study becomes available.

The other floodplains, including the irrigation canals and unnamed streams were not represented using the one-dimensional riverine model, because unlike Tequisquita Slough and Pacheco Creek, these floodplains did not have available hydrologic information. In addition, a detailed drainage design to cover the small systems in the project footprint was not available to incorporate into the Soap Lake floodplain model. Therefore, potential flood flows inside the unnamed floodplains and irrigation canals were represented as floodplain sheet flow in the two-dimensional hydraulic component of the Soap Lake floodplain model, discussed in detail in the following section. The setup of the other floodplains in the limits of the Soap Lake Floodplain may be revised during the design phase of this project if the revised watershed study and hydrologic analysis become available.

5.5.3 Two-Dimensional Floodplain Model

The two-dimensional floodplain component of the ICM hydraulic model was created by combining the terrain files of Santa Clara County included in the SCVWD's combined one- and two-dimensional hydraulic model of Uvas-Carnadero Creek and the DEM file of Soap Lake floodplain provided by Towill on January 6, 2017. Figure 5-9 illustrates the limits of the combined terrain file. At the locations covered by both terrain files, the terrain data from Towill was selected because it was taken more recently and had higher resolution. The two DEM files were merged using ESRI ArcMAP software, and the Focal Statistics Tool in ESRI ArcMAP was used to fill in the data gaps that were found in the combined terrain file. Figure 5-10 illustrates the limits of the ICM model and the extents of the two terrain files combined into the single terrain file. In general, areas around the Santa Clara/San Benito County line and in San Benito County reference the Towill terrain file. The areas farther north reference the SCVWD terrain file.

The ground elevation in the limits of the ICM model varies from approximately 120 feet NAVD 88 at the Soap Lake outlet to approximately 200 feet NAVD 88 at the northern and northeastern model limits. The total area in the hydraulic model is approximately 26,300 acres.

The two-dimensional floodplain components of the ICM hydraulic model are represented by meshes with elevations based on the terrain file. The range of the mesh size selected for the hydraulic model is summarized in Table 5-6. The mesh size for a flat, uniform floodplain surface was represented in a larger mesh size. The locations with a rapid change in ground elevation, such as irrigation ditches and unnamed waterbodies and embankments for roadways, are represented using a finer mesh size. Equalizers on the proposed embankment section were 10 feet wide in the Soap Lake floodplain model and were represented using finer mesh close to the size of the grid size of the terrain file.

Table 5-6 Mesh Sizes Selected for Soap Lake Floodplain Model

Terrain Type	Range of Mesh Size (square feet)
General floodplain area	100 to 7,500
City of Gilroy, upstream/downstream of equalizers, proposed diches along embankment, and misc. floodplain areas requiring finer mesh size	100 to 500
Equalizers (for proposed condition only)	25 to 150

The two-dimensional floodplain model and one-dimensional riverine model for the Soap Lake Floodplain are connected using the bank flow connections, which enable overbank flood flow to leave and re-enter between the two modeling components.

The SCVWD's combined one- and two-dimensional hydraulic model of Uvas-Carnadero Creek used Manning's roughness coefficient of 0.060 to represent the floodplain areas in Santa Clara County. The Soap Lake floodplain model also used the same Manning's roughness coefficient for the entire two-dimensional floodplain component of the ICM hydraulic model, except at the equalizers below the proposed embankment for the project alternatives and relocated channel for Jones Creek for Alternative 3. The Manning's roughness coefficients for the two-dimensional floodplain model would be revised during the design phase of this project to account for the land uses within the limits of the hydraulic model.

5.5.4 Inflow Hydrograph

The inflow hydrographs selected for the hydraulic analysis of the Soap Lake Floodplain are discussed in Section 5.4, Hydrologic Data Sources.

The locations of the inflow hydrographs in the ICM hydraulic model are illustrated on Figure 5-11. The inflow hydrographs for Uvas-Carnadero Creek, Llagas Creek, Tequisquita Slough, and Pacheco Creek were assigned at the upstream limit of the riverine 1-D model.

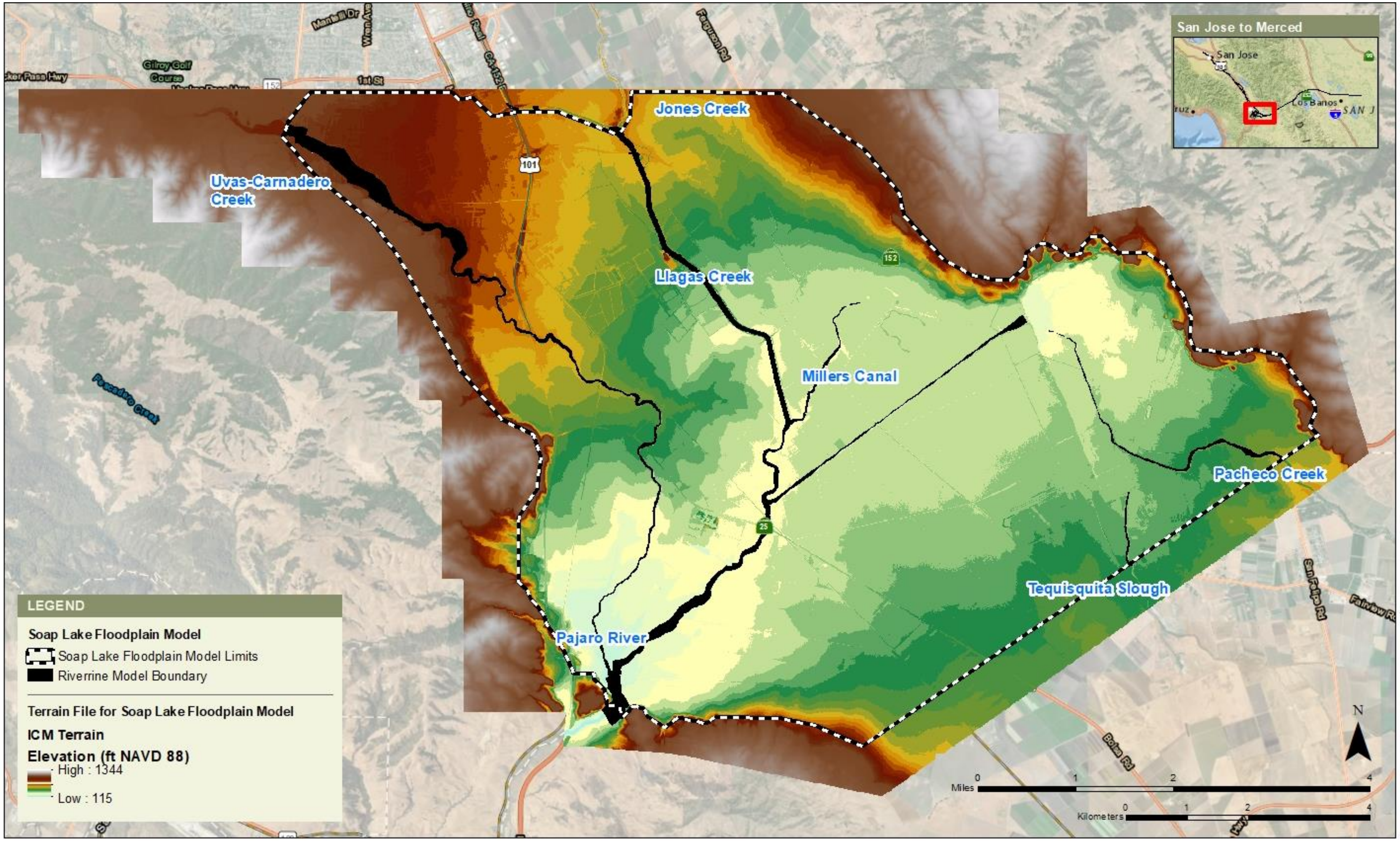
Because inflows from Subwatersheds PJ-1, PJ-2 north, PJ-2 south, and PJ-3 are for unnamed streams, and there are no riverine models associated with those flows, the inflow hydrographs were treated as the floodplain sheet flow entering the limits of the ICM floodplain model.

Subwatershed PJ-1 represents the unnamed waterbodies outfalling to Pacheco Creek between the confluence of Tequisquita Slough and San Felipe Lake in the HEC-1 hydrologic model. PJ-1 was represented in the Soap Lake floodplain model as a floodplain sheet flow entering the limits of the model on upstream of San Felipe Lake to best represent the location of this subwatershed in the HEC-1 hydrologic model.

Subwatershed PJ-2 north was assigned to replicate the FEMA 100-year floodplain sheet flowing incoming from north on east of Llagas Creek, which also included Jones Creek. The extents of the floodplain sheet flow inflow for PJ-2 north at the model boundary was assigned to match with the extents of the FEMA 100-year floodplain.

Subwatershed PJ-2 south was assigned to represent the unnamed waterbodies flowing from the south of the Soap Lake. The extents of the floodplain sheet flow for PJ-2 south was selected at the location at the local low point east of Frazier Lake Road to match with the watershed delineation illustrated on Figure 5-4.

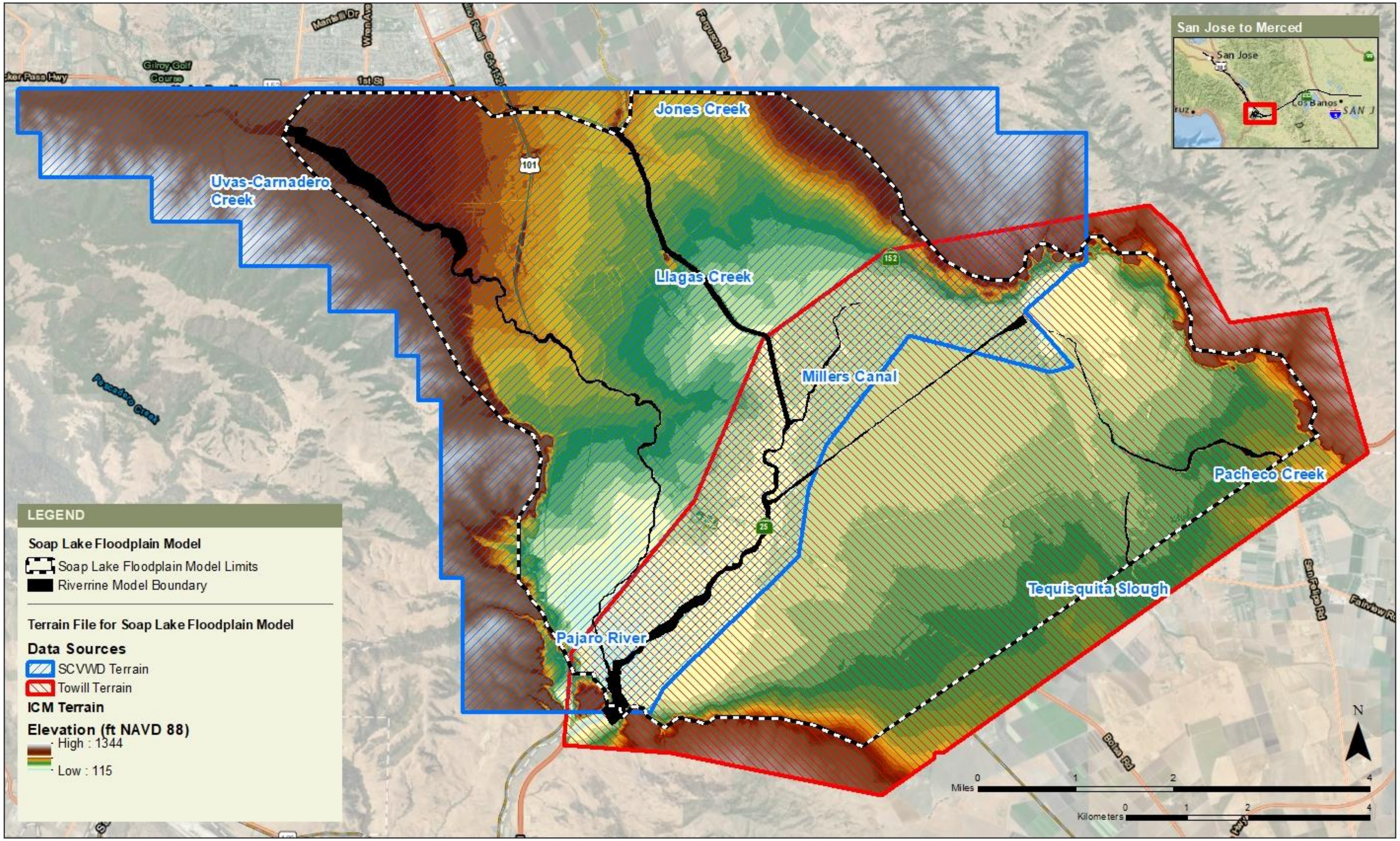
Subwatershed PJ-3 represents the unnamed waterbodies outfalling Soap Lake between San Felipe Lake and the confluence of Uvas-Carnadero Creek and Pajaro River in the HEC-1 hydrologic model. The inflow hydrograph for PJ-3 in the Soap Lake Floodplain was assigned at the confluence of Pajaro River and Llagas Creek to best represent the location of PJ-3 in the HEC-1 hydrologic model.



Sources: SCVWD 2016; Towill 2017

JANUARY 2019

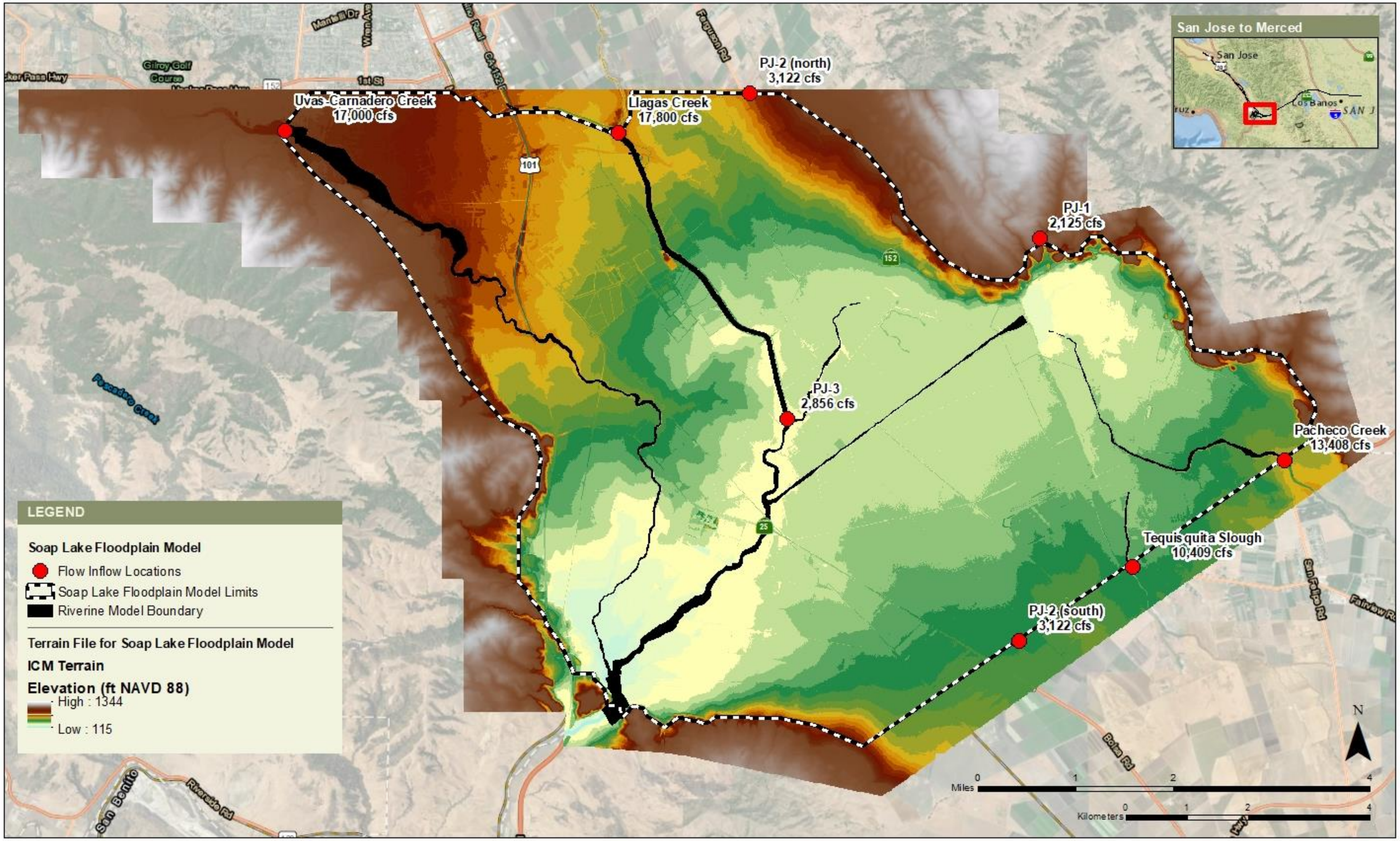
Figure 5-9 Limits and Location of the One-Dimensional Riverine Model Component in the ICM Hydraulic Model



Sources: SCVWD 2016; Towill 2017

JANUARY 2019

Figure 5-10 Limits of the Terrain Files Referenced in the ICM Hydraulic Model



Sources: Schaaf and Wheeler 2001; SCVWD 2016, 2018; Towill 2017

JANUARY 2019

Figure 5-11 Inflow Locations in the ICM Hydraulic Model

5.5.5 HSR Structures and Assumptions in the Hydraulic Model

5.5.5.1 Model Setup

Within the limits of the Soap Lake floodplain model, there are existing storm drain systems and existing cross-drainage structures that are not represented in the one-dimensional riverine model. Because information related to these underground systems and cross drainage information was not readily available, this information was not included in the Soap Lake floodplain model to compare the existing and proposed conditions.

Infoworks ICM can assign rainfall and groundwater infiltration directly to the two-dimensional floodplain. The groundwater infiltration was not assigned in the hydraulic model, because it was assumed that the areas within the limits of the Soap Lake floodplain model are fully saturated during the design 100-year storm event. The direct rainfall onto the two-dimensional floodplain was not included in the hydraulic analysis, because it would double-count the flood flow for the Subwatershed PJ-3, which includes limits of the Soap Lake floodplain model.

The inflow for the first two hours of the simulation was set lower than the values from the hydrograph, and an additional inflow of 5 cfs was assigned to Millers Canal at the first 10 hours of the simulation to provide model stability. Because assigned flow rates of 1 cfs and 5 cfs are small in comparison to the peak 100-year flows of the inflows into the Soap Lake Floodplain and are only assigned at the timesteps before the peak 100-year flood, flows from incoming watersheds enter into the Soap Lake floodplain model. Therefore, it was assumed that the inflows assigned to Millers Canal would not have an influence to the extents and depth of the 100-year floodplain within the limits of the Soap Lake Floodplain model.

A void area is assigned in the two-dimensional mesh at the river reach junctions in the ICM model to prevent the double-counting of the floodplain storage volume in the one-dimensional riverine model and the surface file in the two-dimensional floodplain model.

5.5.5.2 Proposed HSR Structures

The HSR structure types proposed near the Soap Lake floodplain are trench, embankment, and viaducts/bridges for Alternative 2, while the types for Alternatives 1, 3, and 4 consist of embankment and viaduct/bridges. The floodplain minimization measures proposed in the Soap Lake floodplain are equalizers, maximizing the length of the viaduct segment in the footprint of the Soap Lake floodplain, installing lids over the trench segment, and flood basins.

The trench segment proposed in the downtown Gilroy area under Alternative 2 would have floodwalls around the footprint of the trench segment to prevent the overland flood flow from entering the proposed HSR track. The floodwalls are represented in the ICM hydraulic model by assigning a void polygon in the footprint of the trench section with a floodwall, which would act as a wall in the hydraulic model. When undercrossing US 101 in the City of Gilroy, the proposed trench segment would be covered by lids, which would prevent the overland flood flow from entering the proposed HSR track. Within the limits of the segments covered by lids, it was assumed that the project would not modify the existing terrain and would maintain the existing flooding pattern and roughness of the overbank spill flow from Uvas-Carnadero Creek. This assumption is represented in the ICM hydraulic model by not changing the setup of the hydraulic model from the existing conditions within the limits of the trench section with lid.

The embankment portions under Alternatives 1, 2, and 4, as well as the segments under Alternative 3 within the limits of the Soap Lake floodplain model, were assumed elevated above the 100-year floodplain. This assumption was represented in the ICM hydraulic model by assigning void polygons in the footprint of the proposed embankment, which would remove the footprint of the embankment from the potential flooded areas within the limits of the ICM hydraulic model. The ditches along the embankment portion — that would be used for stormwater treatment — would convey runoff from low-intensity storm events and dissipate the energy from the flows concentrated inside the equalizers. These ditches were assumed to be approximately 15 feet wide in the hydraulic model. As discussed in Section 5.5.3, Two-Dimensional Floodplain Model, ditches along the HSR right-of-way were represented in the Soap Lake floodplain model using a finer resolution than the general floodplain area within the limits of the Soap Lake floodplain model.

The viaduct/bridge portions were represented in the ICM hydraulic model by placing 15-foot-wide square piers every 100–120 feet, as shown in the draft plans. The span widths were modified at the bridge crossings where pier locations were included in the CADD file for the proposed alignment. The location and size of the piers included in the Soap Lake floodplain model would be revised during the design phase of this project when the design of the span length and pier type selections are finalized.

The maintenance facilities proposed under the downtown Gilroy (Alternatives 1, 2, and 4) and east Gilroy (Alternative 4) scenarios were modeled the same way as the embankments, but with a wider footprint. The footprint of the proposed maintenance facility was represented as a void space in the Soap Lake floodplain model.

The equalizers for these three project alternatives were assumed to have an opening width of 10 feet for every 100 feet in the hydraulic model. The equalizers in the hydraulic model were represented as openings below the embankment section to help maintain the existing shallow overland floodplain flow within the limits of the Soap Lake floodplain model. Because a detailed design of the equalizers is not available at this phase of the project, they were represented using narrow overland flow with Manning's n value of 0.015 below the embankment section. Sluice gate with opening height of 3 feet was assigned at the upstream and downstream ends of the 10-foot-wide opening area to control the inflows/outflows into the areas assigned as equalizers. The Manning's n value was set lower than the 0.060 used as the general value for the entire floodplain, because equalizers would have a smoother surface than the overall landscape within the limits of the Soap Lake floodplain model. The flowline elevations of the equalizers were assumed to be generally at grade. The flowline elevations of the equalizers were set below-grade at the locations when additional discharge capacity was required to prevent substantial increases to the 100-year floodplain elevation local to the upstream face of the equalizers.

The flood basins located near the footprint of the proposed maintenance facilities were assumed to have depths of 3–4 feet below the original grade. The drainage features, such as culverts with flap gates to release the flood flow from the proposed basins, were not included in the hydraulic model.

Alternative 3 is proposing realignment of Jones Creek. Because a detailed design of the creek realignment was not provided, a realigned Jones Creek in the Soap Lake floodplain model for Alternative 3 is represented by lowering the terrain by approximately 3 feet, and the width of the realigned channel with lowered terrain was set to convey the peak 100-year flow from Subwatershed PJ-2 north when combined with the equalizers assigned below the footprint of the maintenance facility. The design of the realigned Jones Creek in the Soap Lake floodplain model will be refined in the design phase of this project.

5.5.6 Modeled Alternatives

The hydraulic analyses of the Soap Lake floodplain were performed for the following five conditions:

- Existing Condition
- Alternative 1 —With minimization measures and impact avoidance and minimization features (IAMF)
- Alternative 2 — With minimization measures and IAMFs
- Alternative 3 — With minimization measures and IAMFs
- Alternative 4 — With minimization measures and IAMFs

The area of the embankments in the FEMA 100-year floodplain, lengths of viaduct, number of equalizers, and area of the flood basins for each alternative are shown in Table 5-7.

Table 5-7 HSR Structures in the Soap Lake Floodplain Model

HSR Proposed Alignment	Area of Embankments and Viaducts within the FEMA 100-Year Floodplain (acres)	Total Length of Viaduct Segment (feet)	Number of Equalizers	Area of Flood Basins and Ditches (acres)
Existing Condition	N/A	N/A	N/A	N/A
Alternative 1 (through downtown Gilroy by viaduct)	179	26,120	111	28
Alternative 2 (through downtown Gilroy by embankment)	194	23,540	111	28
Alternative 3 (through east Gilroy)	194	22,420	93	41
Alternative 4 (through downtown Gilroy, shared corridor with existing railroad)	157	23,550	105	17

Sources: FEMA 2009; Authority 2019
HSR = high-speed rail
FEMA = Federal Emergency Management Agency

5.5.7 Hydraulic Analysis Outputs

The maximum extents of the 100-year floodplain for the existing condition hydraulic analysis compared with the existing FEMA floodplain limits are illustrated on Figure 5-12. The maximum 100-year WSEs for the existing condition hydraulic analysis are illustrated on Figure 5-13. The maximum floodplain depth for the existing condition hydraulic analysis is illustrated on Figure 5-14. All three figures depict the flooded areas with a maximum 100-year flood depth greater than 0.1 foot in the existing condition's hydraulic analysis. Figure 5-15 through Figure 5-18

illustrate the change in the maximum 100-year flood elevation between the existing and four proposed conditions.

The maximum 100-year floodplain elevation in the Soap Lake floodplain area varies from approximately 150 feet to 155 feet NAVD 88. The flood elevation in the City of Gilroy varies from approximately 185 feet to 200 feet NAVD 88 (Figure 5-13). The footprint of the 100-year floodplain of the existing condition model is similar to the extents of the FEMA 100-year floodplain near the Soap Lake outlet in the toe of the foothills on the eastern side of the floodplain and the south side downstream of the existing railroad crossing. The extents of the 100-year floodplain are larger on the south side on the upstream side of the existing railroad crossing because of the concentrated flood flow for unnamed streams (PJ-2 south) entering the Soap Lake floodplain from south on east of Frazier Lake Road, which is not shown in the FEMA FIRM.

Figure 5-12 also indicates that the some of the areas along the railroad track between Uvas-Carnadero Creek to the west and the Pajaro River to the east that are inside the FEMA 100-year floodplain are outside the 100-year floodplain in the ICM hydraulic model. The outputs from the existing condition hydraulic analysis also showed the Jones Creek floodplain width of approximately 2,000 feet, which is substantially narrower than the floodplain width of approximately 5,000 feet from the FEMA FIRM. The extents of floodplain are narrower in the hydraulic model, most likely because the FEMA FIRM floodplain limits were delineated using an approximate method.

The embankments, viaducts, and maintenance facilities proposed for the alternatives would block the flood flow during the 100-year storm event and would cause backwater upstream of the HSR alignment.

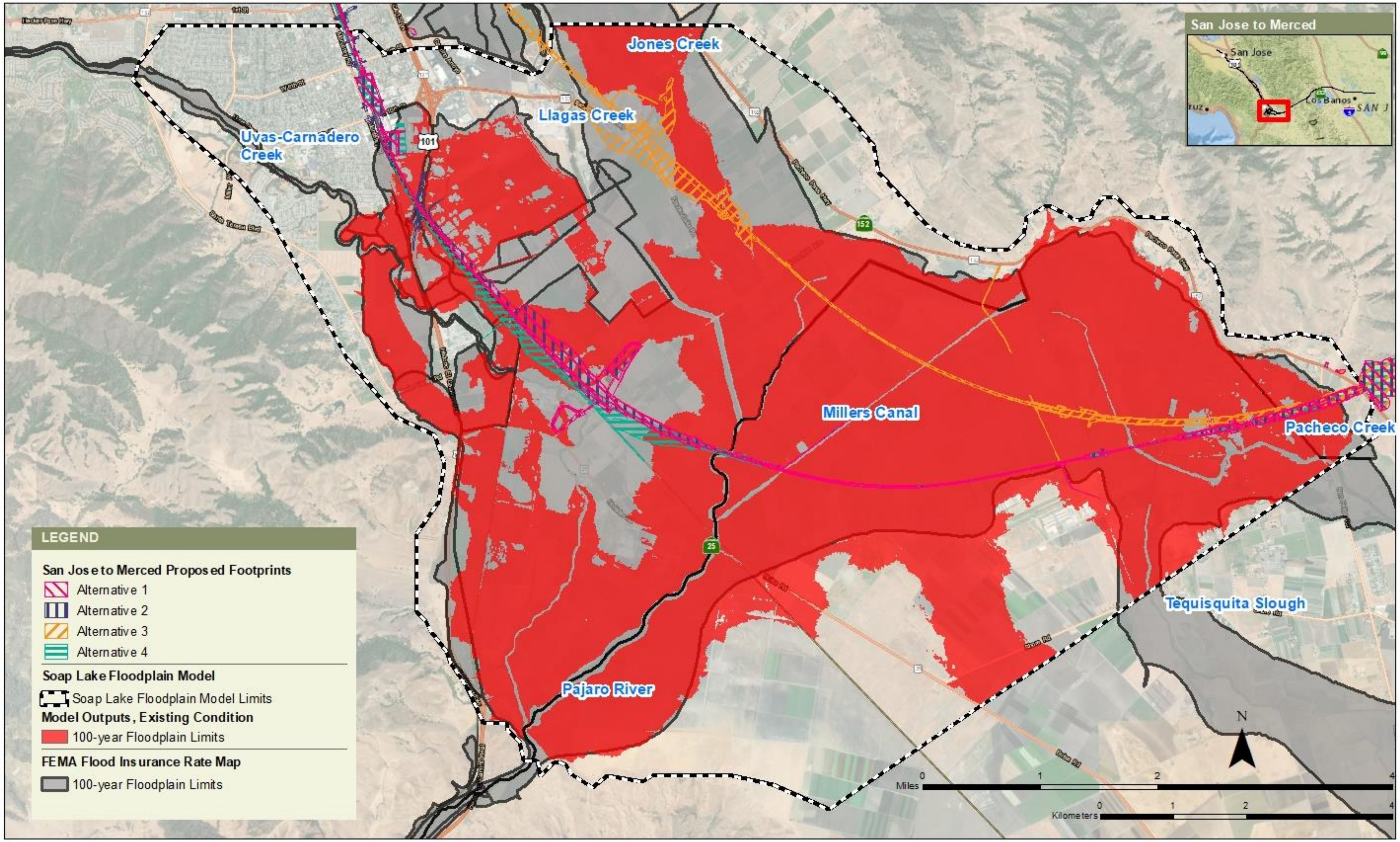
Figure 5-15 illustrates the change in the maximum 100-year flood elevation between the existing condition and Alternative 1 with design measures and project features (HYD-IAMF#: Flood

Protection) that minimize effects on floodplains. The proposed design measures for Alternative 1 (1) extending the viaduct segment inside the soap lake floodplain, (2) providing equalizer culverts in the embankment section, and (4) providing flood basins near the proposed maintenance facility. The total length of viaduct section in the Soap Lake floodplain is approximately 26,120 feet. The area of basins and ditches included in the hydraulic mode for Alternative 1 was approximately 28 acres, and the number of equalizer culverts was 111. With implementation of IAMFs and proposed design features, the outputs from the hydraulic analysis for Alternative 1 showed that the proposed maintenance facility and embankment/viaduct portions of the HSR alignment would have minimal effects on the vertical profile and horizontal extent of the Soap Lake floodplain during the 100-year storm event.

Figure 5-16 illustrates the change in the maximum 100-year flood elevation between the existing condition and Alternative 2 with design measures and project features (HYD-IAMF#: Flood Protection) that minimize effects on floodplains. The proposed design measures for Alternative 1 are (1) extending the viaduct segment inside the soap lake floodplain, (2) providing equalizer culverts in the embankment section, (3) placing a lid on the trench section in Gilroy, and (4) providing flood basins near the proposed maintenance facility. The total length of viaduct section in the Soap Lake floodplain is approximately 23,540 feet. The area of basins and ditches included in the hydraulic mode for Alternative 1 was approximately 28 acres, and the number of equalizer culverts was 111. With implementation of these IAMFs and proposed design features, the outputs from the hydraulic analysis for Alternative 2 showed that the proposed maintenance facility and embankment, viaduct, and trench portions of the HSR alignment would have minimal effects on the vertical profile and horizontal extent of the Soap Lake floodplain during the 100-year storm event.

Figure 5-17 illustrates the change in the maximum 100-year flood elevation between the existing condition and Alternative 3 with design measures and project features (HYD-IAMF#: Flood Protection) that minimize effects on floodplains. The proposed design measures for Alternative 3 are (1) extending the viaduct segment inside the soap lake floodplain, (2) providing equalizer culverts in the embankment section, (3) realigning Jones Creek, and (4) providing flood basins near the proposed maintenance facility. The total length of viaduct section in the Soap Lake floodplain is approximately 22,420 feet. The area of basins and ditches included in the hydraulic mode for Alternative 1 was approximately 41 acres, and the number of equalizer culverts included in the hydraulic model was 96. With implementation of these IAMFs and proposed design features, the outputs from the hydraulic analysis for Alternative 3 showed that the proposed maintenance facility and the embankment and viaduct portions of the HSR alignment would have minimal effects on the vertical profile and horizontal extent of the Soap Lake floodplain during the 100-year storm event.

Figure 5-18 illustrates the change in the maximum 100-year flood elevation between the existing condition and Alternative 4 with design measures and project features (HYD-IAMF#: Flood Protection) that minimize effects on floodplains. The proposed design measures for Alternative 4 are (1) extending the viaduct segment inside the soap lake floodplain, (2) providing equalizer culverts in the embankment section, and (4) providing flood basins near the proposed maintenance facility. The total length of viaduct section in the Soap Lake floodplain is approximately 23,550 feet. The area of basins and ditches included in the hydraulic mode for Alternative 1l was approximately 17 acres, and the number of equalizer culverts included in the hydraulic model was 105. With implementation of IAMFs and proposed design features, the outputs from the hydraulic analysis for Alternative 1 showed that the proposed maintenance facility and embankment/viaduct portions of the HSR alignment would have minimal effects on the vertical profile and horizontal extent of the Soap Lake floodplain during the 100-year storm event.



Source: FEMA 2009

JANUARY 2019

Figure 5-12 Comparison of the FEMA 100-Year Floodplain and Existing Condition 100-Year Floodplain from Hydraulic Analysis

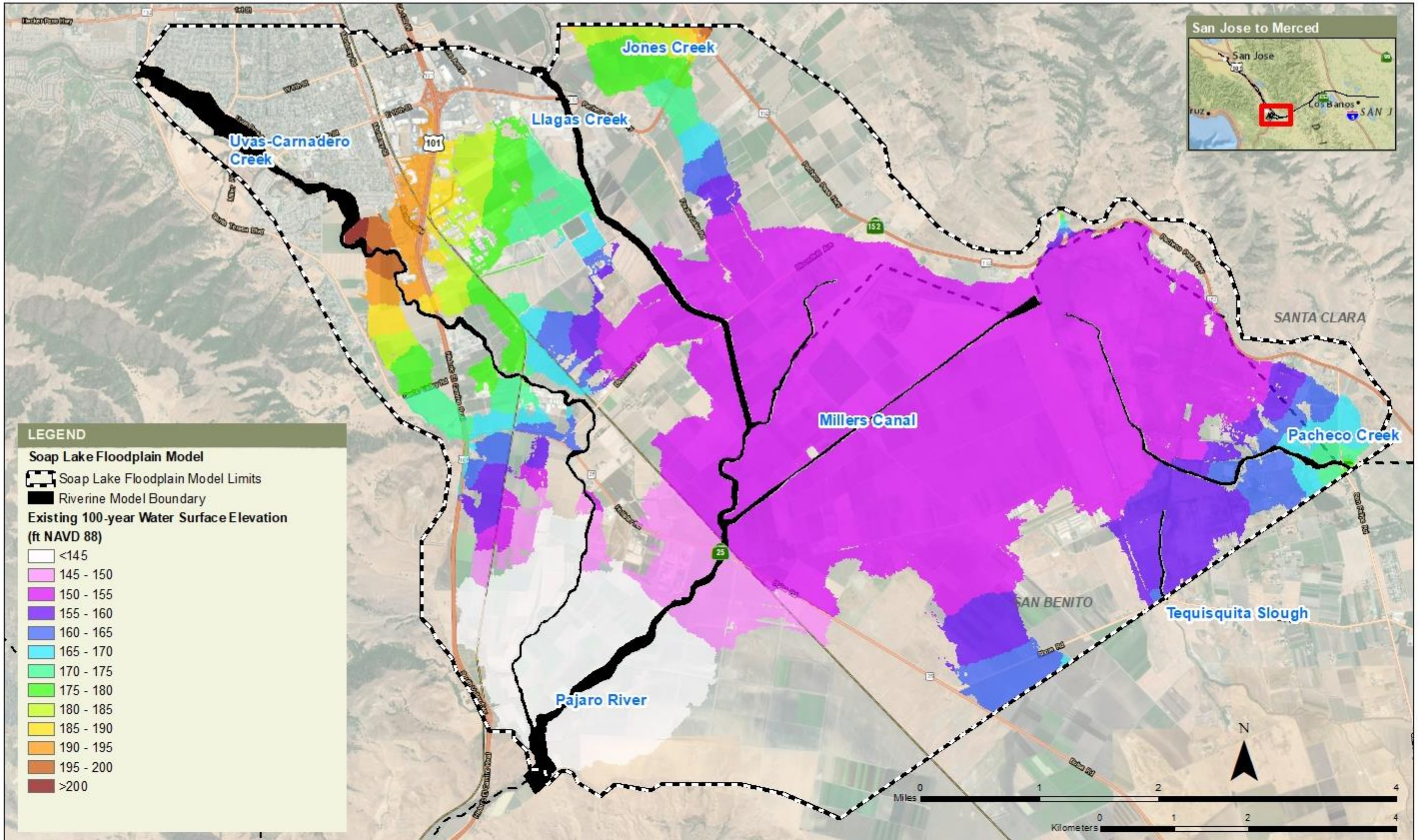


Figure 5-13 100-Year Water Surface Elevations from Existing Condition Hydraulic Analysis

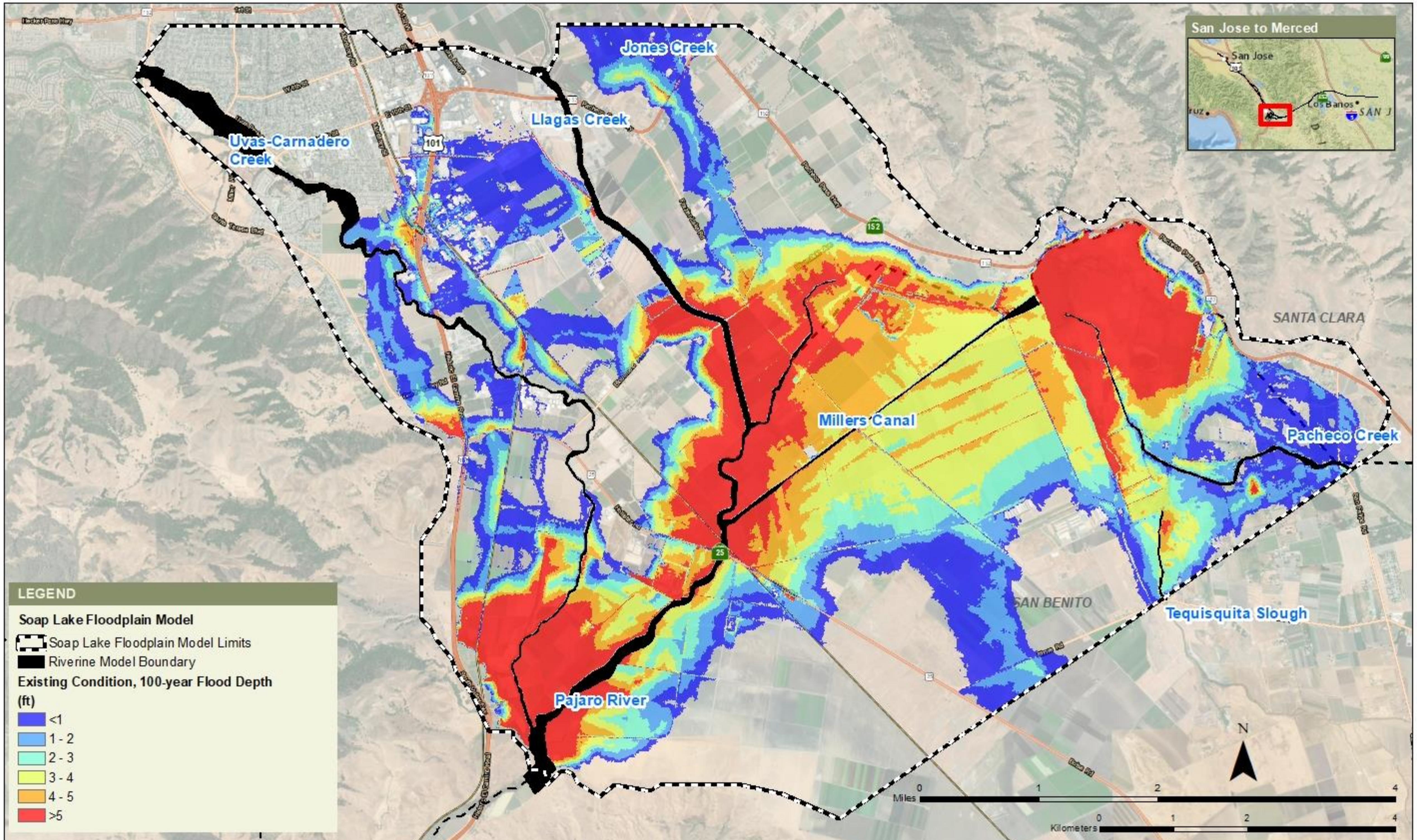


Figure 5-14 100-Year Floodplain Depth from Existing Condition Hydraulic Analysis

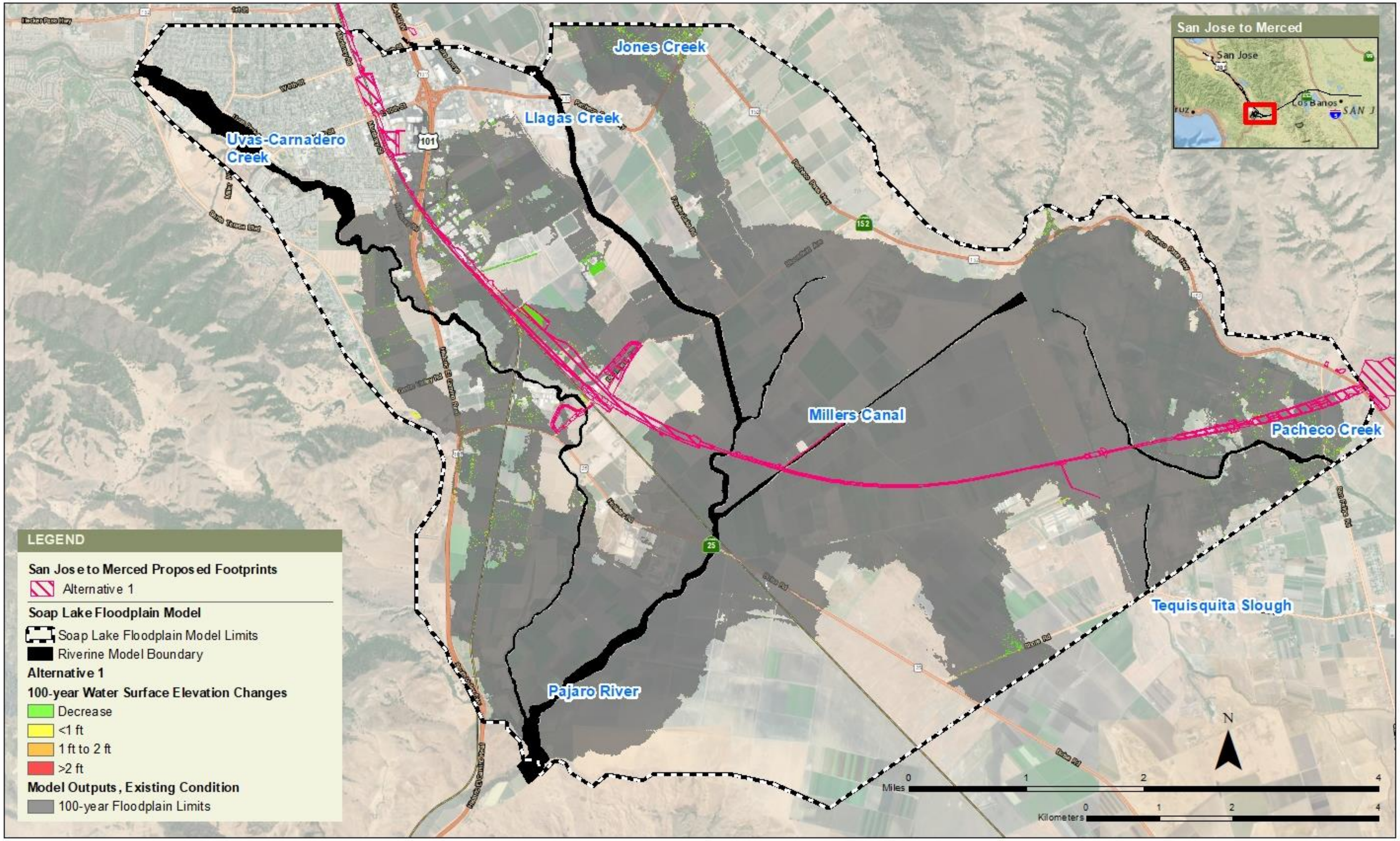


Figure 5-15 Alternative 1: Changes to the Maximum 100-Year Floodplain Elevation

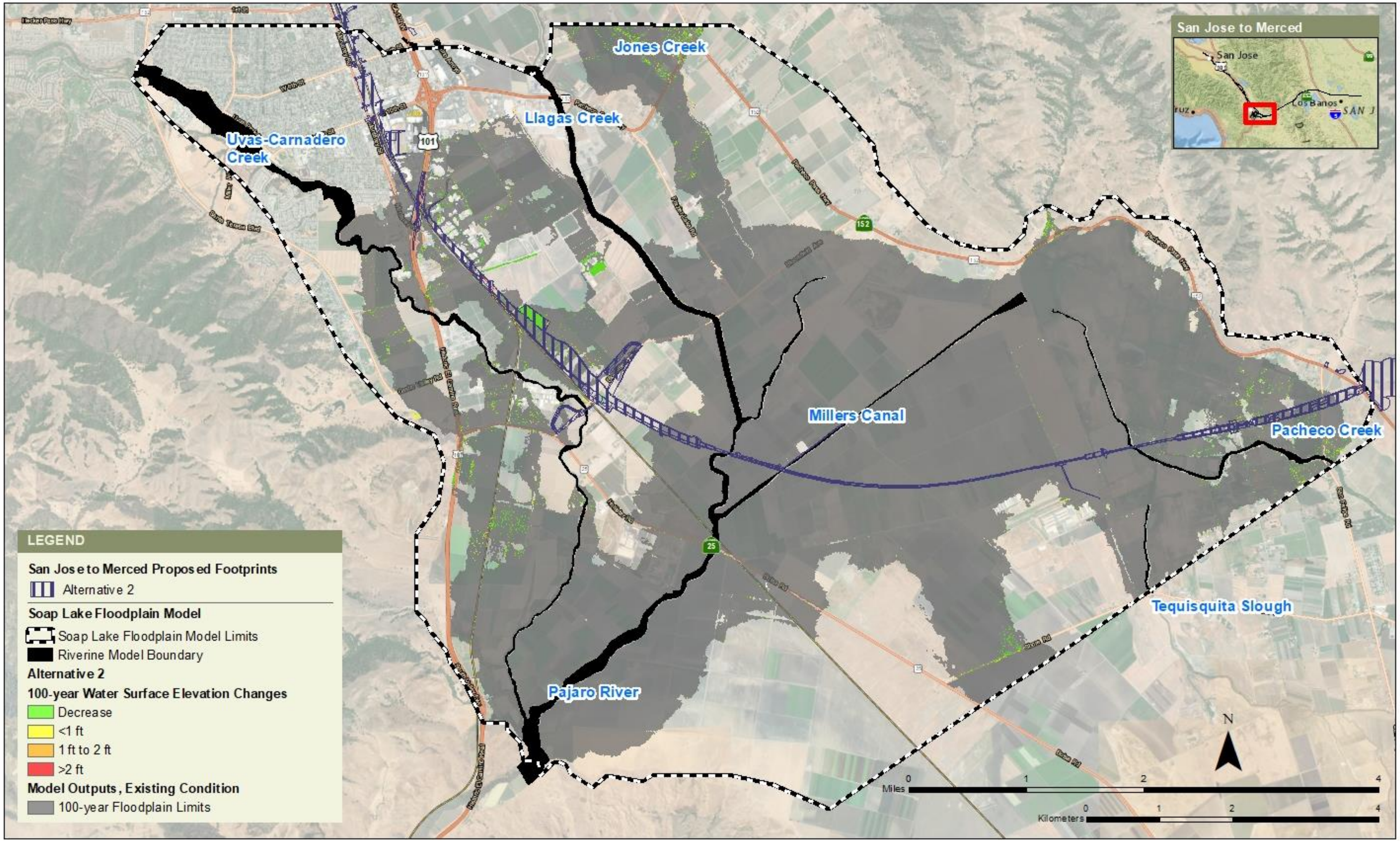


Figure 5-16 Alternative 2: Changes to the Maximum 100-Year Floodplain Elevation

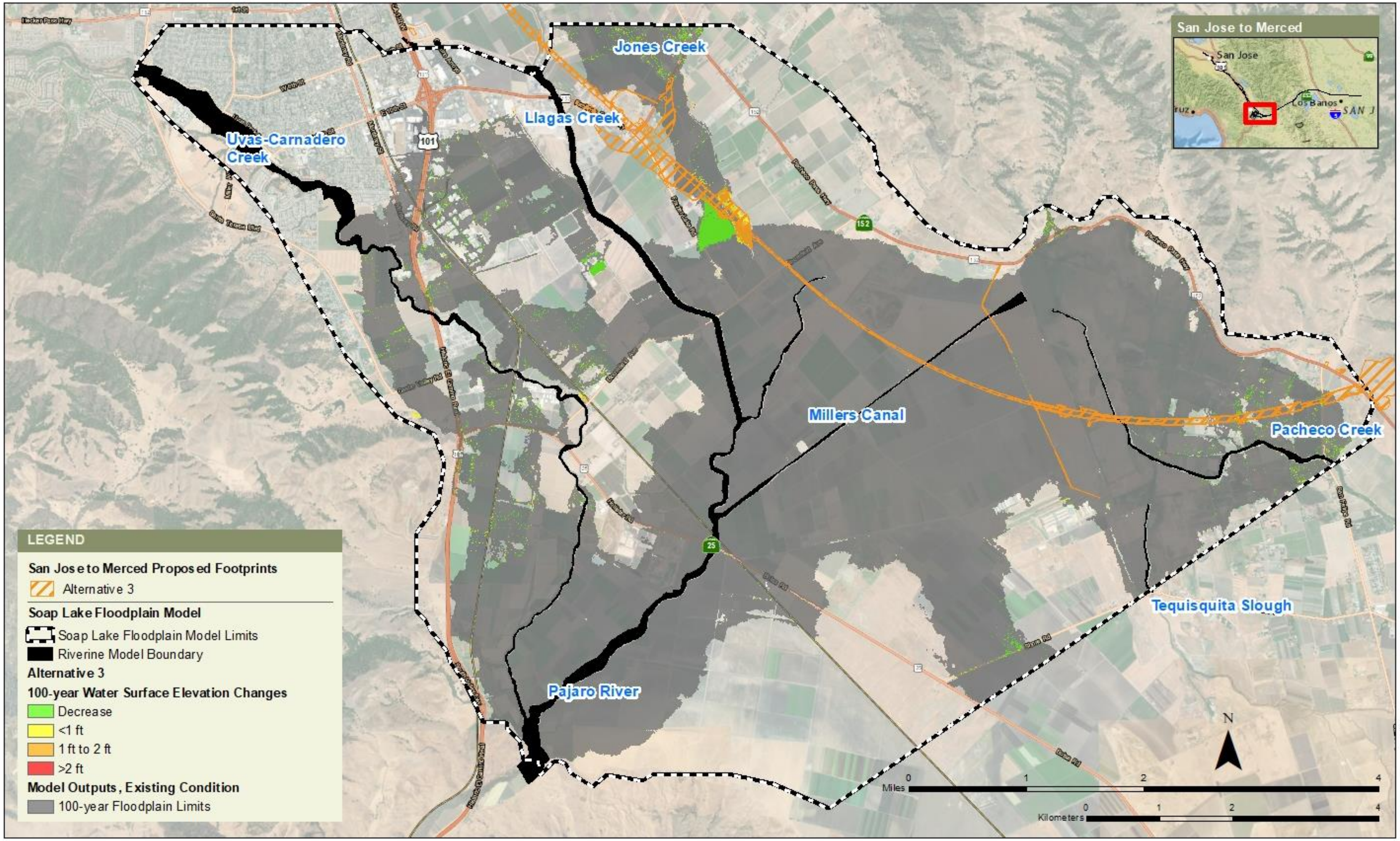


Figure 5-17 Alternative 3: Changes to the Maximum 100-Year Floodplain Elevation

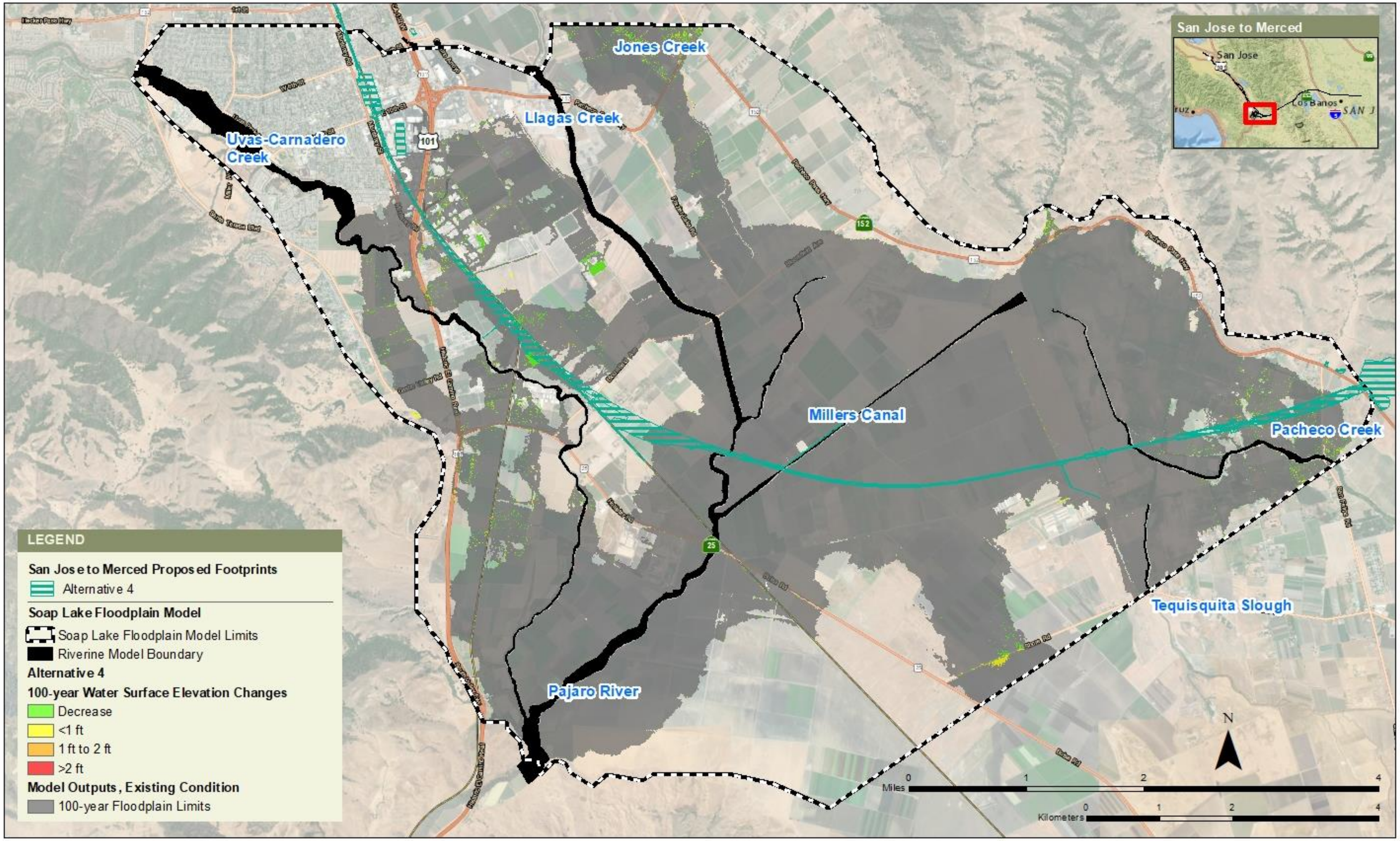


Figure 5-18 Alternative 4: Changes to the Maximum 100-Year Floodplain Elevation

APPENDIX 3.8-B: REFERENCES

California High-Speed Rail Authority (Authority). 2011a. *California High-Speed Train Engineering Report. Draft San Jose to Merced Floodplain Impacts Assessment Report.*

California High-Speed Rail Authority (Authority). 2011b. *California High Speed Train Project Technical Memorandum. Hydraulics and Hydrology Design Guidelines.*

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

FEMA. 1998. *Managing Floodplain Development Through The National Flood Insurance Program.* Developed March 1998, Updated March 2007. www.fema.gov/media-library/assets/documents/6029.

Federal Emergency Management Agency (FEMA). 2008. Flood Insurance Rate Map, Merced County, California, and Incorporated Areas. Panel No 06047C0825G.

Federal Emergency Management Agency (FEMA). 2008. Flood Insurance Rate Map, Merced County, California, and Incorporated Areas. Panel No 06047C0850G.

Federal Emergency Management Agency (FEMA). 2008. Flood Insurance Rate Map, Merced County, California, and Incorporated Areas. Panel No 06047C0875G.

Federal Emergency Management Agency (FEMA). 2009. Flood Insurance Rate Map, Santa Clara County, California, and Incorporated Areas. Panel No 06085C0234H.

Federal Emergency Management Agency (FEMA). 2009. Flood Insurance Rate Map, Santa Clara County, California, and Incorporated Areas. Panel No 06085C0407H.

Federal Emergency Management Agency (FEMA). 2009. Flood Insurance Rate Map, Santa Clara County, California, and Incorporated Areas. Panel No 06085C0426H.

Federal Emergency Management Agency (FEMA). 2009. Flood Insurance Rate Map, Santa Clara County, California, and Incorporated Areas. Panel No 06085C0428H.

Federal Emergency Management Agency (FEMA). 2009. Flood Insurance Rate Map, Santa Clara County, California, and Incorporated Areas. Panel No 06085C0429H.

Federal Emergency Management Agency (FEMA). 2009. Flood Insurance Rate Map, Santa Clara County, California, and Incorporated Areas. Panel No 06085C0436H.

Federal Emergency Management Agency (FEMA). 2009. Flood Insurance Rate Map, Santa Clara County, California, and Incorporated Areas. Panel No 06085C0437H.

Federal Emergency Management Agency (FEMA). 2009. Flood Insurance Rate Map, Santa Clara County, California, and Incorporated Areas. Panel No 06085C0441H.

Federal Emergency Management Agency (FEMA). 2009. Flood Insurance Rate Map, Santa Clara County, California, and Incorporated Areas. Panel No 06085C0607H.

Federal Emergency Management Agency (FEMA). 2009. Flood Insurance Rate Map, Santa Clara County, California, and Incorporated Areas. Panel No 06085C0626H.

Federal Emergency Management Agency (FEMA). 2009. Flood Insurance Rate Map, Santa Clara County, California, and Incorporated Areas. Panel No 06085C0641H.

Federal Emergency Management Agency (FEMA). 2009. Flood Insurance Rate Map, Santa Clara County, California, and Incorporated Areas. Panel No 06085C0643H.

Federal Emergency Management Agency (FEMA). 2009. Flood Insurance Rate Map, Santa Clara County, California, and Incorporated Areas. Panel No 06085C0752H.

Federal Emergency Management Agency (FEMA). 2009. Flood Insurance Rate Map, Santa Clara County, California, and Incorporated Areas. Panel No 06085C0756H.

Federal Emergency Management Agency (FEMA). 2009. Flood Insurance Rate Map, Santa Clara County, California, and Incorporated Areas. Panel No 06085C0760H.

Federal Emergency Management Agency (FEMA). 2009. Flood Insurance Rate Map, Santa Clara County, California, and Incorporated Areas. Panel No 06085C0770H.

Federal Emergency Management Agency (FEMA). 2009. Flood Insurance Rate Map, Santa Clara County, California, and Incorporated Areas. Panel No 06085C0780H.

Federal Emergency Management Agency (FEMA). 2009. Flood Insurance Rate Map, San Benito County, California, and Incorporated Areas. Panel No 06069C0045D.

Federal Emergency Management Agency (FEMA). 2009. Flood Insurance Rate Map, San Benito County, California, and Incorporated Areas. Panel No 06069C0050D.

Federal Emergency Management Agency (FEMA). 2009. Flood Insurance Rate Map, San Benito County, California, and Incorporated Areas. Panel No 06069C0075D.

Federal Emergency Management Agency (FEMA). 2009. *Flood Insurance Study, San Benito County, California, and Incorporated Areas.*

Federal Emergency Management Agency (FEMA). 2010. *Flood Insurance Study, Merced County, California, and Incorporated Areas. (Preliminary).*

Federal Emergency Management Agency (FEMA). 2014. *Flood Insurance Study, Santa Clara County, California, and Incorporated Areas.*

Federal Emergency Management Agency (FEMA). 2018a. Coyote Creek HEC-2 Hydraulic Model Input/output print files. Received on March 28, 2018.

Federal Emergency Management Agency (FEMA). 2018b. West Little Llagas Creek HEC-2 Hydraulic Model. Received on March 28, 2018.

Federal Emergency Management Agency (FEMA). 2018c. Llagas Creek HEC-2 Hydraulic Model Input/output print files. Received on March 28, 2018.

Federal Emergency Management Agency (FEMA). 2018d. West Branch Llagas Creek HEC-2 Hydraulic Model. Received on March 28, 2018.

Federal Emergency Management Agency (FEMA). 2018e. Llagas Overbank HEC-2 Hydraulic Model Input/output print files. Received on March 28, 2018.

Federal Emergency Management Agency (FEMA). 2018f. Uvas-Carnadero Creek HEC-RAS Hydraulic Model. Received on May 16, 2018.

Pajaro River Watershed Flood Prevention Authority (PRWFPA). 2011. *Pajaro River Watershed Study.*

Pajaro River Watershed Flood Prevention Authority (PRWFPA). (2005). *Pajaro River Watershed Study Final Phase 3 and 4a Report*.

Pajaro River Watershed Flood Prevention Authority's (PRWFPA). (2005). Pajaro River HEC-RAS Hydraulic Model at Soap Lake Floodplain. Received on June 26, 2016.

Santa Clara Valley Water District (SCVWD). 2012a. Llagas Creek HEC-RAS Hydraulic Model, Pajaro River to Buena Vista Road. Received on June 3, 2016.

Santa Clara Valley Water District (SCVWD). 2012b. Watching Our Watersheds Interactive Map Layers, Central Santa Clara County. www.valleywater.org/WOW.aspx (accessed May 11, 2016).

Santa Clara Valley Water District (SCVWD). 2014. Coyote Creek HEC-RAS Hydraulic Model. Received June 3, 2016.

Santa Clara Valley Water District (SCVWD). 2015a. Fisher Creek HEC-RAS Hydraulic Model. Received June 3, 2016.

Santa Clara Valley Water District (SCVWD). 2015b. Llagas Creek HEC-RAS Hydraulic Model for Upper Llagas Flood Protection Project. Received January 5, 2018.

Santa Clara Valley Water District (SCVWD). 2016. Uvas Creek HEC-RAS Hydraulic Model. Received June 3, 2016.

Santa Clara Valley Water District (SCVWD). 2017a. Phase 1 Drawings Vol 1 of 2 - 100% Submittal Not For Construction. Received December 20, 2017.

Santa Clara Valley Water District (SCVWD). 2017b. Phase 2 Drawings Vol 1 of 2 - 100% Submittal Not For Construction. Received December 20, 2017.

Santa Clara Valley Water District (SCVWD). 2018a. Guadalupe River and Tributaries HEC-RAS Hydraulic Model. Received July 24, 2018.

Santa Clara Valley Water District (SCVWD). 2018b. West Little Llagas Creek, Middle Avenue Overflow HEC-2 Hydraulic Model. Received October 29, 2018.

Santa Clara Valley Water District (SCVWD). 2018c. Los Gatos Creek HEC-RAS Hydraulic Model. Received December 13, 2018.

Santa Clara Valley Water District (SCVWD). 2018d. Technical Memorandum, Los Gatos Creek Modeling and Mapping, 2D Hydraulic Model Details & Results Analysis. Received December 13, 2018.

Santa Clara Valley Water District (SCVWD). 2018e. *E6: Upper Llagas Flood Protection Project.* www.valleywater.org/project-updates/creek-river-projects/upper-llagas-creek-flood-protection> (accessed January 16, 2019).

Santa Clara Valley Water District (SCVWD). 2018f. *Technical Support Data Notebook for Llagas Creek Flood Protection Project.* Received January 5 2018.

Santa Clara Valley Water District (SCVWD). 2018g. Llagas Flow. Received January 5 2018.

Schaaf & Wheeler Consulting Civil Engineers. 2001. *Pajaro River Watershed Study.* Technical Memorandum No. 1.2.7- Hydrologic Model.

Towill, Inc. 2016. 1- and 3-ft grid LIDAR digital elevation map of Soap Lake Floodplain. Received January 6, 2017.