

Wildlife Infrastructure Plan for State Route 94, San Diego County Post Miles 15.27 to 30.00

Prepared for:

California Department of Fish and Wildlife
Natural Community Conservation Planning
Local Assistance Grant P1382108

Prepared by:

Conservation Biology Institute

in collaboration with

U.S. Geological Survey
U.S. Bureau of Land Management
San Diego National Wildlife Refuge
California Department of Transportation
California Department of Fish and Wildlife
San Diego Management and Monitoring Program

January 2016





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List of Abbreviations

BLM	Bureau of Land Management
CalTrans	California Department of Transportation
CBI	Conservation Biology Institute
CDFW	California Department of Fish and Wildlife
CROS	California Roadkill Observation System
FHWA	Federal Highway Administration
HCWA	Hollenbeck Canyon Wildlife Area
MSCP	Multiple Species Conservation Program
MSP	Management Strategic Plan 08.27.2013
MU	Management Unit
NCCP	Natural Community Conservation Planning
RJER	Rancho Jamul Ecological Reserve
ROW	Right-of-Way
SDMMP	San Diego Management and Monitoring Program
SDNWR	San Diego National Wildlife Refuge
SDSU	San Diego State University
SR	State Route
TEE	Tribal Environmental Evaluation
TNC	The Nature Conservancy
USFWS	US Fish and Wildlife Service
USGS	US Geological Survey



Executive Summary

The California Natural Community Conservation Planning (NCCP) program is an ecosystem-based approach to conserving species and their habitats in a linked network of high quality habitat blocks, with an emphasis on maintaining landscape integrity and ecosystem functions. NCCP-conserved lands in southern San Diego County (South County) support the largest expanse of remaining coastal habitats in southern California—coastal sage scrub, maritime succulent scrub, chaparral, riparian woodlands, vernal pools, and grasslands. Intact landscapes are critical to genetic interchange within plant and animal populations and allow dispersal and recolonization of new areas. Large landscapes that span elevational gradients, such as this core area in South County, also enable populations to shift in response to environmental and land use changes.

State Route 94 (SR-94), among other roads, cuts through the heart of this core area, potentially impeding wildlife movement across otherwise intact landscapes. New residential development and a casino under construction in Jamul will increase traffic and potentially impact the wildlife value and connectivity of adjacent conserved lands. Proposed road improvements associated with these new land uses provide an opportunity to mitigate the potential barrier effects of SR-94 as well as accommodate current hydrologic flow that has increased as a result of development and additional impervious surface not anticipated in the original design of the highway. Scientific literature suggests that strategically-placed wildlife fencing along roads, combined with effective wildlife crossing areas (e.g., undercrossings, overcrossings, bridges) are the most effective means of influencing animal behavior and directing animal movement, thereby reducing roadkill, enhancing connectivity, and improving traffic safety.

The purpose of this document is to (1) identify where improvements to existing infrastructure on SR-94 could improve connectivity across the South County preserves, using Best Management Practices from the scientific literature, (2) recommend wildlife movement monitoring to identify where new crossings are needed, and (3) identify where additional conservation would enhance the integrity of South County linkages. Wildlife movement studies, camera traps, and systematic collection of roadkill data will refine the design and placement of wildlife fencing and crossing structures. Once implemented, post-construction monitoring should be conducted to ensure that the new infrastructure is functional and cost-effective.

This review prioritizes infrastructure improvements of 35 existing undercrossings inspected by wildlife experts in the field along 14.6 miles of SR-94 where the highway bisects conserved lands—particularly between the San Diego National Wildlife Refuge (SDNWR), where a box culvert has been designed specifically for this undercrossing, between Rancho Jamul Ecological Reserve (RJER) and Hollenbeck Canyon Wildlife Area (HCWA), and between Bureau of Land



Management (BLM) lands and the Lawrence and Barbara Daley Preserve (LB Daley). In total, SR-94 crosses >10 miles of conserved lands with only three bridges—at the Sweetwater River, Dulzura Creek, and Campus Grove bridge in Dulzura. Following is a summary of improvements recommended for existing undercrossings and proposed new undercrossings, by segment, presented in this document.

Seg.	Conserved lands	# linear feet (% conserved ¹)	# bridges	# culvert improvements ²	New undercrossings ³
1	SDNWR	6,492 (91%)	Sweetwater	0	0
2	none	5,394 (0%)	0	0	0
3	SDNWR	9,127 (100%)	0	7	1
4	none	9,135 (0%)	0	0	0
5	RJER/HCWA	4,372 (100%)	0	2	1
6	RJER/HCWA	7,232 (100%)	0	3	0
7	RJER/HCWA	9,220 (100%)	Dulzura Crk	2	3
8	BLM/HCWA	6,677 (100%)	0	3	1
9	BLM/LB Daley	9,194 (100%)	0	1	0
10	BLM	10,389 (25%)	Campus Grove	7	0
TOTAL		77,232 (70%)	3		

¹ On at least one side of the highway

² Near-term improvements or replacements proposed for existing undercrossings

³ Longer-term proposed new undercrossings

The majority of the recommendations for infrastructure improvement focus on increasing the diameter, and thus the openness ratio (cross-sectional area divided by length), of the undercrossing itself, removing vegetation and debris blocking the undercrossing, restoring habitat in the approach to the undercrossing, and installing fencing to both (1) keep animals off the highway and (2) funnel wildlife to the undercrossings. These improvements are intended to facilitate connectivity for the community of species, as opposed to a single target species. Monitoring wildlife movement should help inform placement of new undercrossings and evaluate their effectiveness post-construction. Increasing the diameter of existing undercrossings and restoring approaches will also facilitate the current and future volume of hydrologic flow, not anticipated in the original design of the highway.

The appendices summarize the covered species that will benefit from these improvements, along with examples of proposed infrastructure and their costs, and roadkill data over the past 5 years. The cost of not implementing these improvements will be a loss of habitat integrity and ecosystem function in the largest core area in San Diego County.



1 Introduction

The rural, mostly two-lane, portion of SR-94 through Jamul, Dulzura, and Potrero was originally a stagecoach route in the late 1800s. In 1933 the County of San Diego transferred responsibility for the highway to Caltrans. This County-designated Scenic Highway is infamous for its curves, climbs, limited sight distances, narrow shoulders, and boulders, as well as for the beauty of the conserved lands that border it. Proposed residential development, road improvements, and a casino under construction in Jamul will increase traffic on SR-94 that will impact habitat integrity and ecosystem functions of the lands conserved as part of the NCCP. Potential impacts are likely to be species-specific and include animal mortality from increased traffic and decreased survivorship (i.e., create “population sinks”) for animals that do not or cannot avoid the road due to inherent spatial habitat and migratory needs. At the same time, road improvements associated with these new land uses provide an opportunity to mitigate the potential barrier effects of SR-94 to wildlife populations and conservation values, as well as accommodate existing and future hydrologic flow not anticipated in the original highway design.

Western San Diego County supports three NCCP programs that comprise a network of biological core areas and linkages aimed at maintaining and enhancing covered species and their associated vegetation communities. NCCP-conserved lands in South County alone support 22 federally and state-listed species and 53 species covered by the Multiple Species Conservation Program (Appendix A). These lands are fundamental to the integrity of the overall San Diego County NCCP preserve network (Figure 1). As population growth and development increase, management and monitoring programs are being implemented to mitigate threats to conserved lands and ecosystem functions. These programs are coordinated by the San Diego Management and Monitoring Program (SDMMP) and funded by the Environmental Mitigation Program for the regional transportation program (Transnet). The SDMMP identified eight Management Units (MU) as part of the Management Strategic Plan (MSP, SDMMP 2013). The study area for this project is within MU3 (Figure 2).

1.1 Purpose of this Plan

Many conservation actions are necessary to enhance connectivity across the South County preserves that connect the Cleveland National Forest with the Otay Mountain Wilderness Area (Figures 1 and 2). These actions include strategic land conservation, habitat restoration, land use enforcement, adaptive management, and enhanced permeability of major roads, including SR-94, Otay Lakes Road, Proctor Valley Road, and Honey Springs Road, among others.

The purpose of this review is to (1) identify where improvements to existing infrastructure along 14.6 miles of SR-94 could improve connectivity in MU3 and decrease the potential for

Figure 1: Conserved Lands in San Diego County

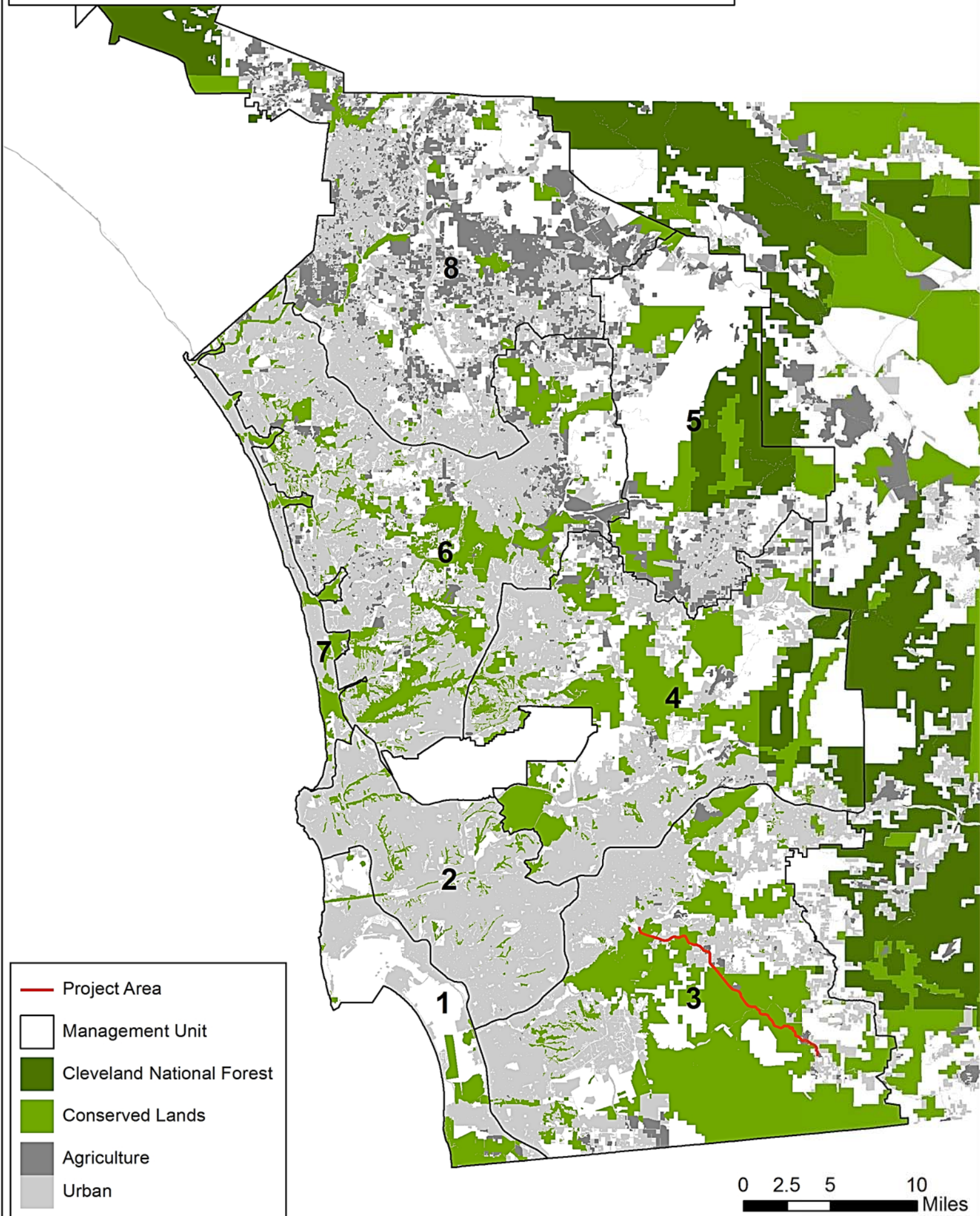
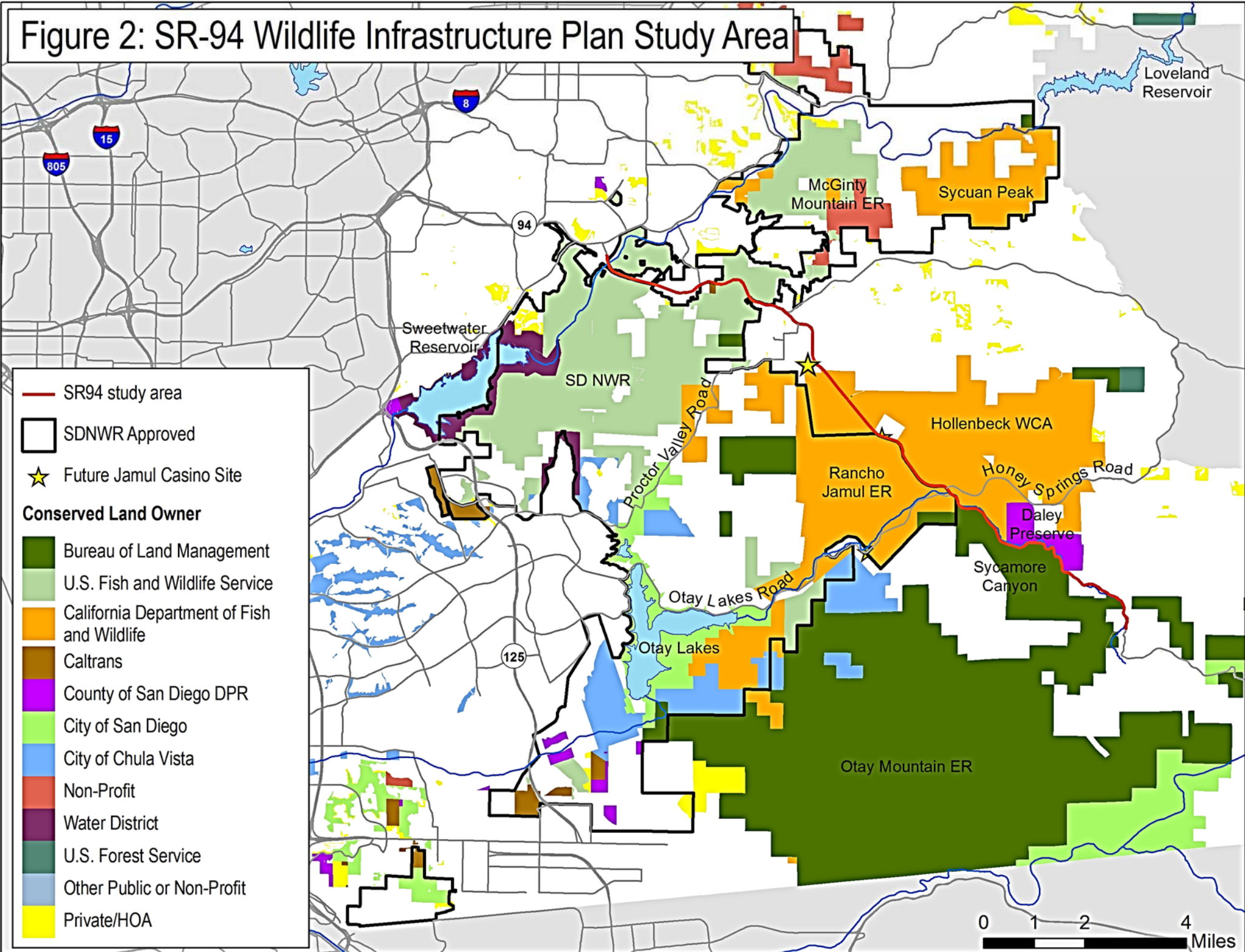
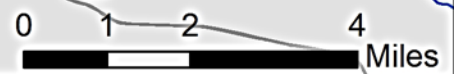


Figure 2: SR-94 Wildlife Infrastructure Plan Study Area



- SR94 study area
- SDNWR Approved
- ★ Future Jamul Casino Site
- Conserved Land Owner**
- Bureau of Land Management
- U.S. Fish and Wildlife Service
- California Department of Fish and Wildlife
- Caltrans
- County of San Diego DPR
- City of San Diego
- City of Chula Vista
- Non-Profit
- Water District
- U.S. Forest Service
- Other Public or Non-Profit
- Private/HOA





wildlife-vehicle collisions, (2) recommend wildlife movement monitoring to identify where new crossings are needed on SR-94 and other roads, and (3) identify where additional conservation would enhance the integrity of South County linkages. Wildlife movement studies, camera traps, and systematic collection of roadkill data will refine the design and placement of wildlife fencing and crossing structures. Once implemented, post-construction monitoring should be conducted to ensure that the new infrastructure is functional and cost-effective. These studies should include landscape modeling, road mortality monitoring that includes daytime and night time surveys and wet-season/dry season surveys by biologists, estimates of wildlife population sizes, territory and range sizes, distance and frequency of movement within or between metapopulations, and frequency of use of various crossing areas by targeted taxa. Once road improvements are implemented, post-construction monitoring should be conducted to ensure that the new infrastructure is functional and cost-effective.

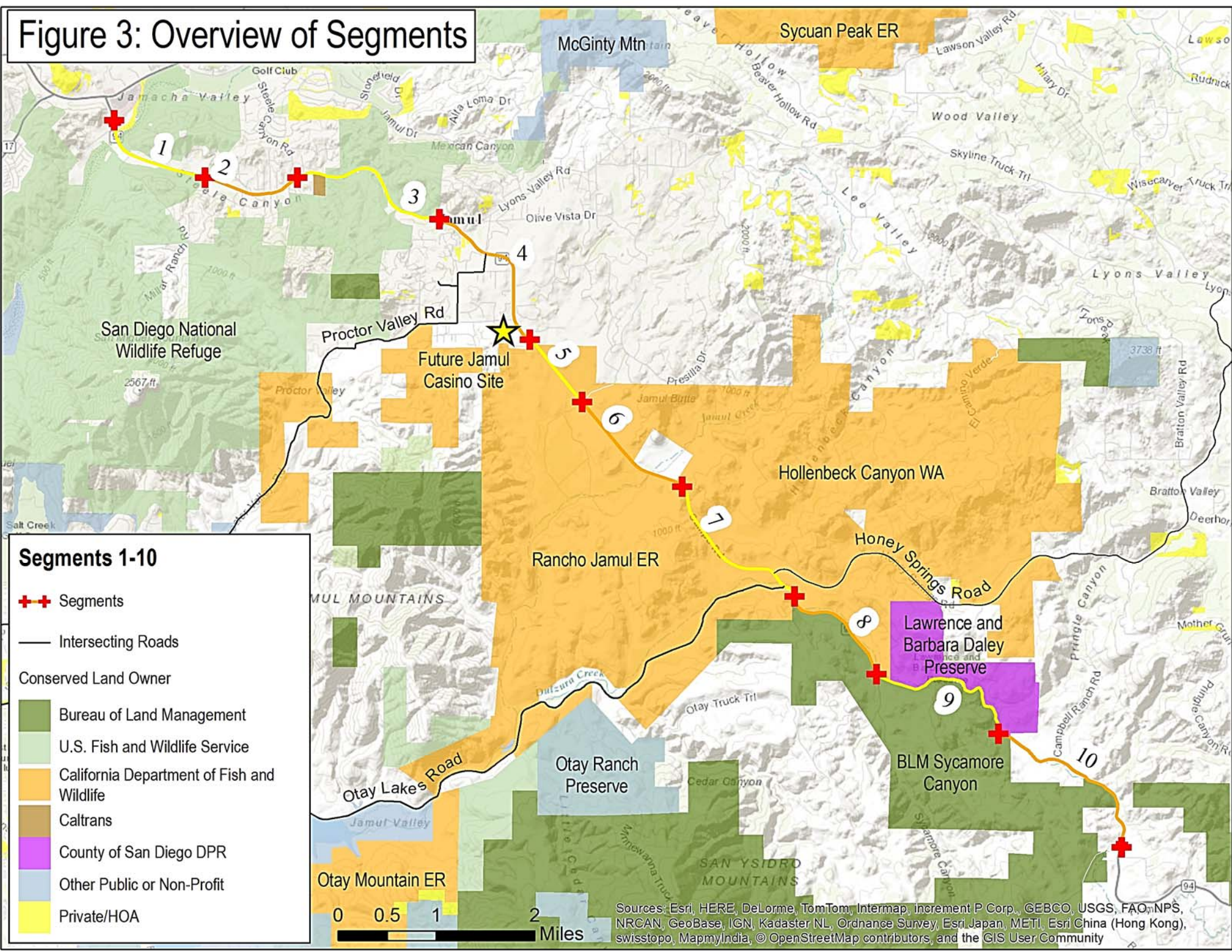
1.2 Process/Methods

This review was informed by SDMMP's Connectivity Monitoring Strategic Plan (SDMMP 2011), previous roadway and tracking studies (USGS unpublished data, W. Vickers unpublished data, Tracey et al. 2014), baseline studies and management plans for RJER and HCWA (EDAW 2008, Hathaway et al. 2002, Madden-Smith et al. 2004, TAIC 2008, 2011; USFWS SDNWR 1999, USGS et al. 2002), roadkill data (Appendix B), SDMMP species data, and on-the-ground field reconnaissance with local wildlife movement experts and land managers in the study area (Dillingham 2015)¹. We divided SR-94 into 10 segments between the Sweetwater River and Marron Valley Road (Figure 3), based on land uses (conserved, commercial, residential, etc.), terrain, and vegetation community (flat, steep, grassland, coastal sage scrub, riparian/oaks). Under a Caltrans encroachment permit (no. 11-14-6SV-0260) authorizing fieldwork within the Caltrans Right-of-Way (ROW), we assessed the following conditions, which are summarized by segment in Section 3.4:

- Land uses, degree of human activity, and landscape condition.
- Locations and sizes of existing infrastructure (e.g., undercrossings, fences, cattle guards, gates) and presumed use, based on observed animal sign, condition, and apparent functionality of infrastructure (e.g., culvert full of sediment or water, undercrossings blocked by overgrown vegetation, broken fence, placement of undercrossings relative to landscape features, spacing of undercrossings).

¹ J. Terp, J. Martin, J. Schlachter, T. Nelson, T. Dillingham, S. Brown, R. Rempel, Y. Moore, C. Rochester, R. Fisher, B. Martin, W. Vickers, J. Vinje, J. Stallcup, SDSU engineering students, various dates 2013-2015.

Figure 3: Overview of Segments



Segments 1-10

++ Segments

— Intersecting Roads

Conserved Land Owner

Bureau of Land Management

U.S. Fish and Wildlife Service

California Department of Fish and Wildlife

Caltrans

County of San Diego DPR

Other Public or Non-Profit

Private/HOA



Sources: Esri, HERE, DeLorme, TomTom, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), swisstopo, MapmyIndia, © OpenStreetMap contributors, and the GIS User Community



- Potential fencing needs along the highway and access roads, considering the needs of various taxa.
- Features that influence visibility of drivers and behavior of wildlife, including topographic contours (e.g., ridgelines or ravines), vegetation communities (riparian, grassland, scrub, woodland), curvature of the highway, and width of ROW.
- Areas where potential mitigation measures can be incorporated to either keep animals off the highway (e.g., fences, cattle guards, barriers) or allow escape for wildlife on the highway (e.g., jump-outs for deer).

Monitoring of wildlife approaches to SR-94 and road-crossing behaviors of target species should inform infrastructure improvements and placement. We reviewed examples of infrastructure in the literature (Appendix C) and potential placements for an undercrossing designed by San Diego State University (SDSU) civil engineering students (Appendix D).



2 Conservation Context

While South County comprises the largest blocks of conserved land in the San Diego NCCP planning area, the MU3 preserve network is not yet completely conserved as proposed by the MSCP Plan. Many private lands needed for connectivity could be developed, and loss of these habitats will not only result in loss of significant natural resources but will fragment existing landscape-scale management initiatives on conserved lands, increase sources of fire ignition, and increase the area of habitat managed for fire (i.e., the Wildland Urban Interface). Moreover, loss of habitat could preclude linkages across elevational gradients to Forest Service lands, a factor important to accommodating adaptations in response to climate change. Continued development in South County will produce more edge effects, greater recreational pressures, and increased traffic, adding to the impacts of roads on South County preserves.

Conserving and managing connectivity between and within these conserved lands is a goal of the MSCP, a directive in the habitat management plans for the San Diego National Wildlife Refuge (SDNWR), Rancho Jamul Ecological Reserve (RJER), Hollenbeck Canyon Wildlife Area (HCWA), and Lawrence and Barbara Daley Preserve (LB Daley Preserve) along SR-94 (County of San Diego 2011, EDAW 2008, TAIC 2008, USFWS SDNWR 2014), and critical to the sustainability of the Otay Mountain Ecological Reserve (OMER), McGinty Mountain Ecological Reserve (MMER), and other lands in MU3 (Table 1).

This section identifies selected examples of important linkages that require conservation and other major roads that should be evaluated for infrastructure improvements. It also identifies the species targeted for connectivity monitoring and their habitats on either side of SR-94.

Table 1—Conservation acreages by land manager/owner in MU3.

Land manager/owner	Major preserves in study area	MU3 (acres)
US Fish and Wildlife Service	SD National Wildlife Refuge (SDNWR)	11,652
California Department of Fish & Wildlife	RJER, HCWA, OMER, MMER	18,250
Bureau of Land Management	Sycamore Canyon	27,496
County of San Diego	LB Daley Preserve	10,044
City of San Diego Public Utilities District	Otay Lakes Cornerstone Lands	8,236
City of Chula Vista	Otay Ranch Preserve	2,614
Otay Water District	San Miguel Habitat Management Area	238
Sweetwater Authority	Sweetwater Reservoir	1,777
The Nature Conservancy	McGinty Mountain	588
Endangered Habitats Conservancy	South Crest	966
TOTAL		81,861



2.1 Linkage Conservation Priorities

National Wildlife Refuge to Sycuan Peak Ecological Reserve. Functional connectivity between the SDNWR (SR-94 Segment 3) and Sycuan Peak Ecological Reserve will require strategic conservation of lands between Jamul, McGinty Mountain, and the Sycuan Peak Ecological Reserve (Figure 4).

CDFW Hollenbeck Canyon. Conservation of some or all of the Hollenbeck Canyon Conceptual Area Protection Plan (CAPP) will complete the linkage identified through SR-94 Segments 5, 6, and 7 (Figure 3) to Forest Service lands to the east (Figure 4). This linkage is a priority for large mammals, including deer and mountain lions (pers. comm. W. Vickers, R. Burg).

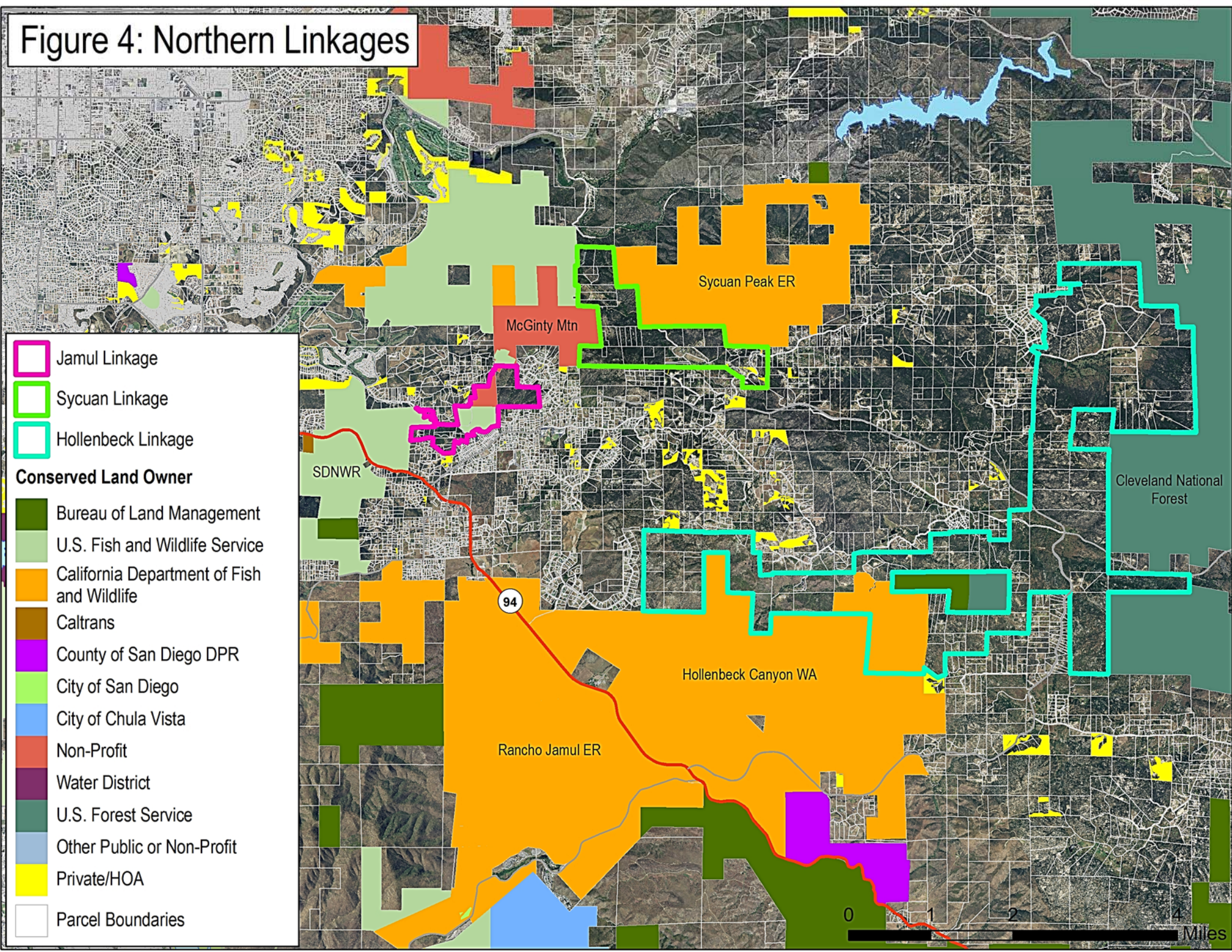
BLM. Strategic acquisition or conservation easements east of SR-94 Segment 10 (Figure 3) will connect BLM, City of San Diego PUD, and Forest Service lands (Figure 5). To improve connectivity in the southern portion of the SR-94 study area, we recommend evaluating lands important to complete the conservation linkage connecting BLM, City of San Diego PUD, and Forest Service lands (Figure 5). This could include acquisition (or conservation easement) of the 31.7-acre parcel to connect BLM property across SR-94 (Arbaban APN 64905009) and to other BLM lands to the east (e.g., Mottola APN 64909006).

Otay Valley Regional Park. The planning area for Otay Valley Regional Park links south San Diego Bay with Otay Mountain, San Miguel Mountain, and the Jamul Mountains. The planning area boundary encompasses 9,195 acres (Figure 6), of which 5,562 acres have been conserved, and another 1,055 acres are pending conservation as part of the Otay Ranch mitigation (County of San Diego, City of Chula Vista, and City of San Diego 2001). The area includes resources critical to the biodiversity of south San Diego County, including maritime succulent scrub, vernal pools, and endemic plant species. The Conservation Implementation Plan for the coastal cactus wren in southern San Diego County targets this area as a conservation priority for the Otay genetic subunit of the species (TNC and SDMMP 2015).

Proctor Valley—Otay Ranch. Proctor Valley lies at the center of the SDNWR planning boundary and supports Quino checkerspot butterfly, vernal pools, and foraging habitat for golden eagles, among other resources. Proctor Valley Road cuts through the middle of conserved lands managed by the SDNWR, CDFW, and City of San Diego PUD (Figure 7). Acquisition of additional lands in Proctor Valley would reduce existing edge effects from privately owned land, facilitate habitat management and restoration among the land managers, and enhance connectivity.

As Proctor Valley Road intersects with SR-94 in Segment 4, traffic associated with the Jamul Casino and Hotel will likely use Proctor Valley Road and thus further increase cumulative levels of traffic (Kimley-Horn 2012) on SR-94. Thus, closing Proctor Valley Road to through-traffic at

Figure 4: Northern Linkages



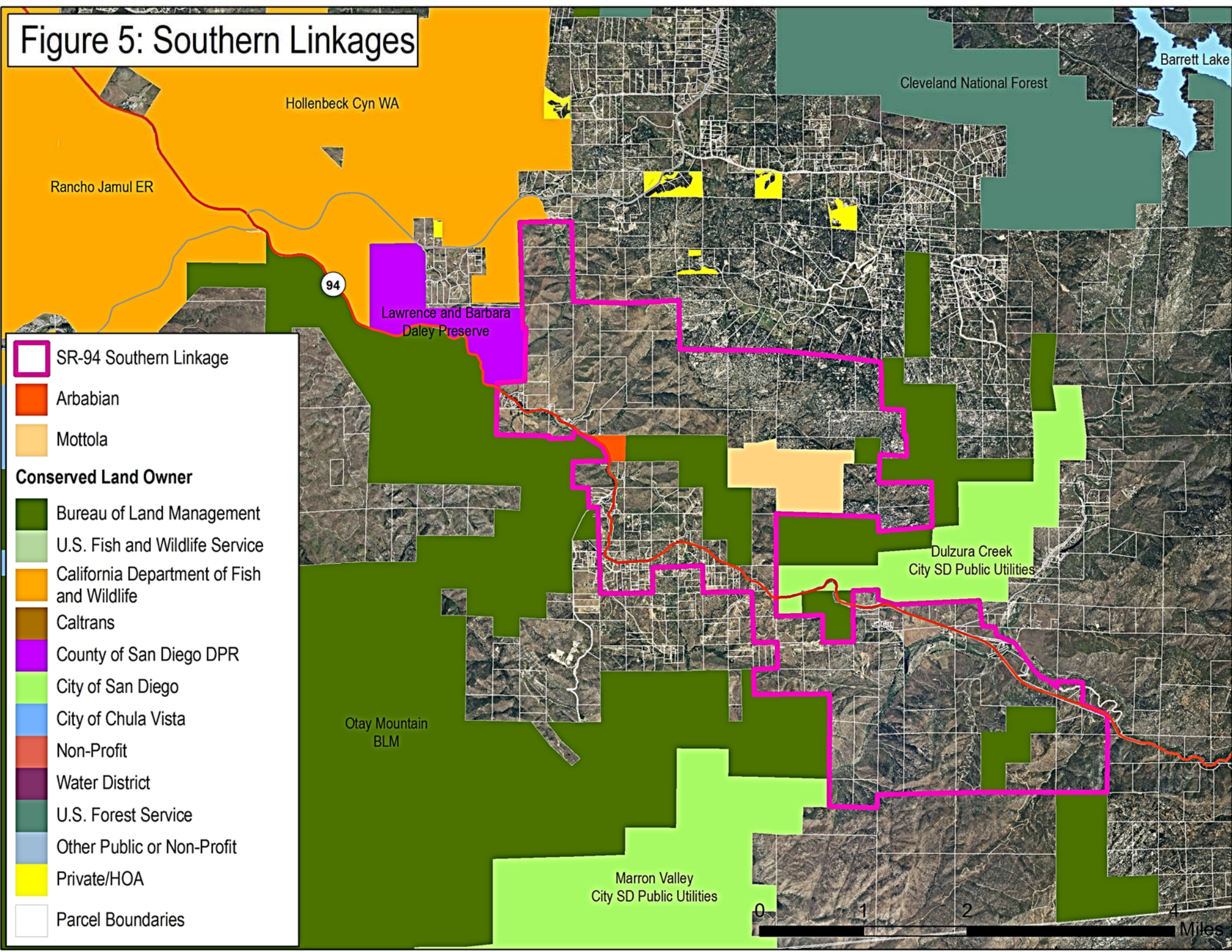
Linkages

- Jamul Linkage
- Sycuan Linkage
- Hollenbeck Linkage

Conserved Land Owner

- Bureau of Land Management
- U.S. Fish and Wildlife Service
- California Department of Fish and Wildlife
- Caltrans
- County of San Diego DPR
- City of San Diego
- City of Chula Vista
- Non-Profit
- Water District
- U.S. Forest Service
- Other Public or Non-Profit
- Private/HOA
- Parcel Boundaries

Figure 5: Southern Linkages



- SR-94 Southern Linkage
- Arbabian
- Mottola

Conserved Land Owner

- Bureau of Land Management
- U.S. Fish and Wildlife Service
- California Department of Fish and Wildlife
- Caltrans
- County of San Diego DPR
- City of San Diego
- City of Chula Vista
- Non-Profit
- Water District
- U.S. Forest Service
- Other Public or Non-Profit
- Private/HOA
- Parcel Boundaries

Figure 6: Otay Valley Regional Park

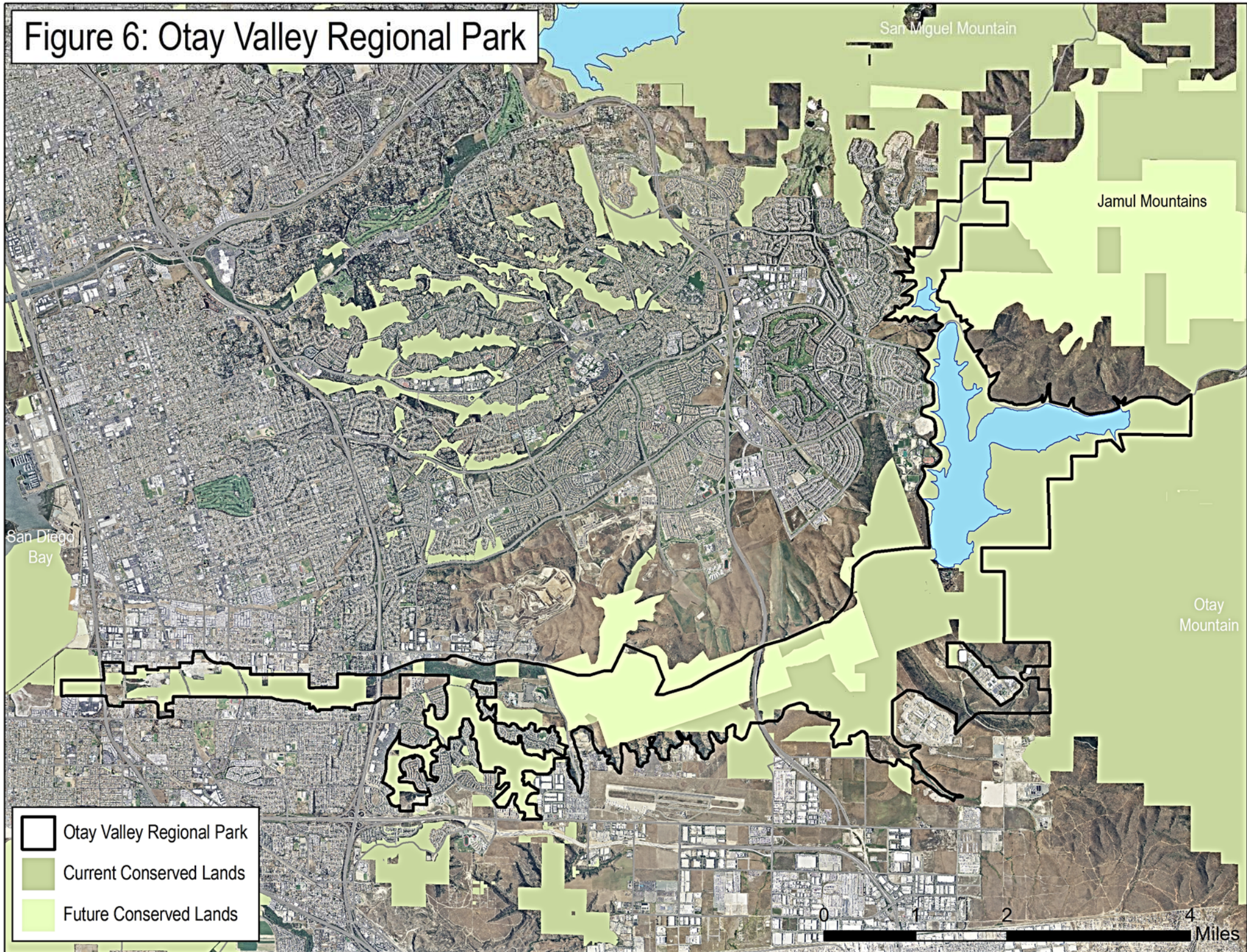
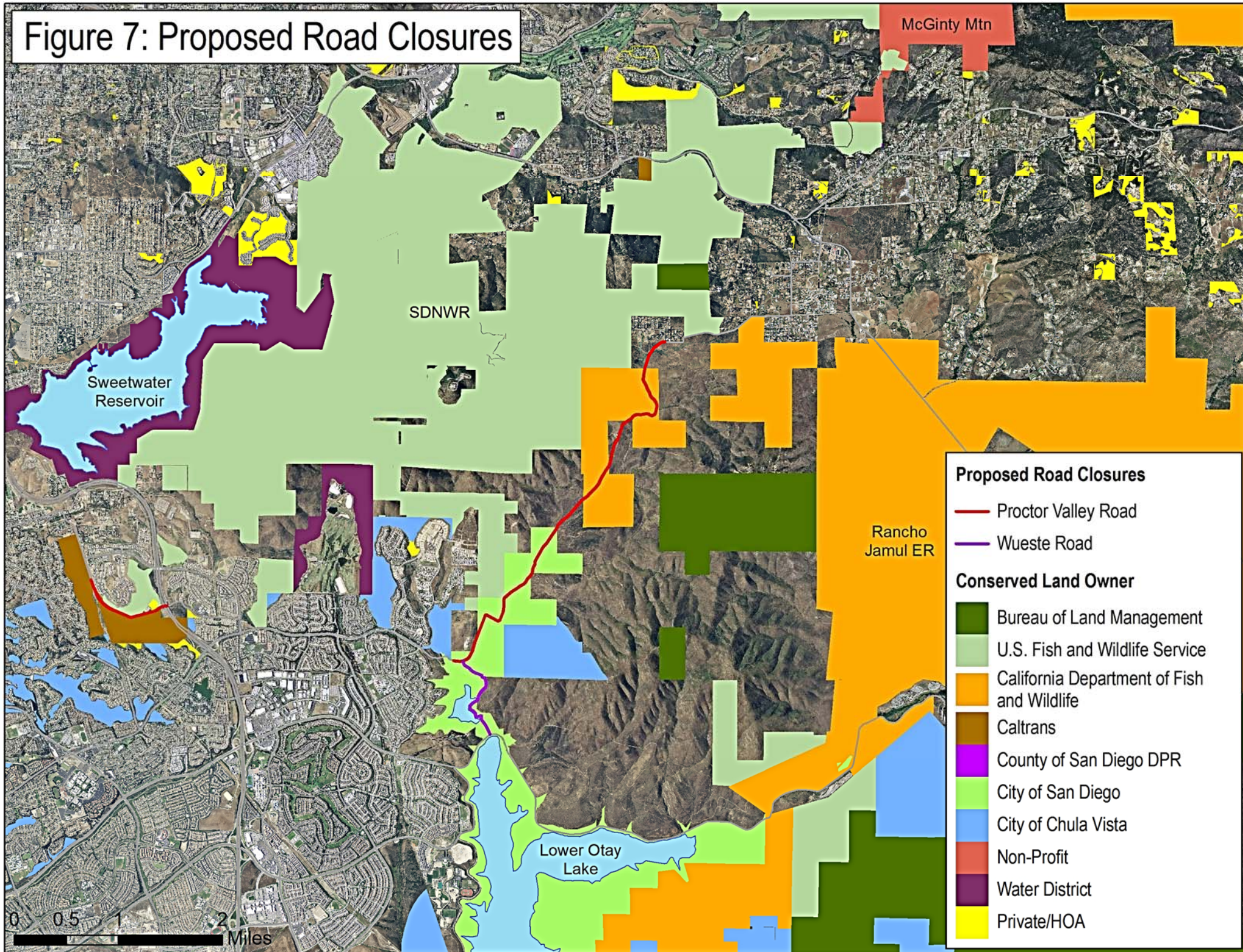


Figure 7: Proposed Road Closures





the north and south ends (between Echo Valley Road on the north and Northwoods Drive on the south, Figure 7) will not only reduce traffic volumes on SR-94, it will also achieve another MSCP objective of improving connectivity between conserved lands in Proctor Valley. Closing the mostly dirt road to through traffic would forego the need for expensive crossing infrastructure and road improvement if it were not closed. We recommend that Proctor Valley Road be maintained as a gated, private dirt road for residents, land managers, and fire safety.

2.2 Other Road Infrastructure Priorities

Many public roads in South County cross through conserved lands and inhibit wildlife movement, including Millar Ranch Road, Jamul Drive (Rochester and Fisher 2013), Rancho Jamul Drive, Daley Ranch Truck Trail, Hollenbeck Road, Sycamore Canyon Road, Marron Valley Road, and Proctor Valley Road, among others. Otay Lakes Road and Honey Springs Road support greater levels of traffic and are priorities for wildlife movement monitoring and infrastructure improvements. As these two roads parallel creeks, they are a large source of mortality for amphibians and many other species (USGS unpublished data).

Otay Lakes Road. An infrastructure enhancement study should be conducted for Otay Lakes Road, where there are conserved lands, or lands to be conserved, on both sides of the road between SR-94 on the east and Otay Lakes on the west (Figure 2). For example, CDFW has recommended that the Dulzura Creek undercrossing by the yellow gate at the entrance to Otay Mountain Ecological Reserve should be replaced with a bridge. Wildlife movement should be monitored in this area prior to developing an infrastructure improvement plan.

Honey Springs Road. San Diego County has proposed straightening Otay Lakes Road to meet Honey Springs Road in direct alignment. This would create a new road crossing over Dulzura Creek and provide opportunities to improve wildlife movement connections across Otay Lakes Road. Wildlife movement should be monitored through the HCWA to enhance permeability across Honey Springs Road (Figure 2).

2.3 Target Species for Monitoring Connectivity

In this document we consider three functional groups of target species categorized by the Connectivity Monitoring Strategic Plan (SDMMP 2011, as amended, Y. Moore, pers. comm.):

- Large animals and bats: mountain lion, American badger, southern mule deer, bobcat, coyote, gray fox, greater roadrunner, pallid bat, Townsend's big-eared bat.
- Small animals: orange-throated whiptail, Blainville's horned lizard, Dulzura kangaroo rat, California ground squirrel, San Diego black-tailed jackrabbit, western spadefoot toad,



coastal whiptail, deer mouse, big-eared wood rat, desert woodrat, cactus mouse, San Diego pocket mouse, southwestern pond turtle, southwestern arroyo toad.

- Birds: California gnatcatcher, southwestern willow flycatcher, least Bells' vireo, northern harrier, burrowing owl, golden eagle, cactus wren.
- Invertebrates: California swollen stinger scorpion, Jerusalem cricket, Quino checkerspot butterfly, Hermes copper butterfly, and Harbison's dun skipper.
- Plants: Encinitas baccharis, Otay tarplant, salt marsh birds-beak, Orcutt's birds-beak, willow monardella.

However, the recommended improvements herein are intended to facilitate connectivity for the community of species, as opposed to a single target species or group of target species. Figure 8 shows distribution of these species and vegetation communities bordering SR-94 in MU3. The majority of the vegetation communities bordering SR-94 are coastal sage scrub and chaparral, with stringers of riparian woodland, oak woodland, and eucalyptus woodland (Table 2). Segments 2 and 4 cross commercial and residential land uses in the community of Jamul, and Segment 10 runs through the rural community of Dulzura. Segments 1, 3, 5, 6, 7, 8, and 9 bisect conserved lands. The primary drainages crossed by SR-94 are the Sweetwater River, Steele Canyon Creek, Jamul Creek, Hollenbeck Creek, Dulzura Creek, Pringle Canyon Creek, and Dutchman Canyon Creek.

Table 3 summarizes roadkill for each segment, and Figure 9 shows roadkill of target species by segment. There have been no regular roadkill observations south of Segment 6. Clearly the invertebrate species and bats have not been recorded as roadkill. The only recorded roadkill for mountain lions and bobcats is in Segment 3, where a new undercrossing is proposed (Appendix D). Coyotes, ground squirrels, desert cottontails, birds, and snakes have been killed in all segments where there has been regular roadkill reporting for the period (Sections 1-6). Section 3.4 recommends infrastructure improvements for targeted species, to be informed further by monitoring techniques using (for example) cameras, track beds, track plates, hair snags, GPS collars, roadkill observations, and fence integrity surveys.

Figure 8: Connectivity Monitoring Target Species in MU 3

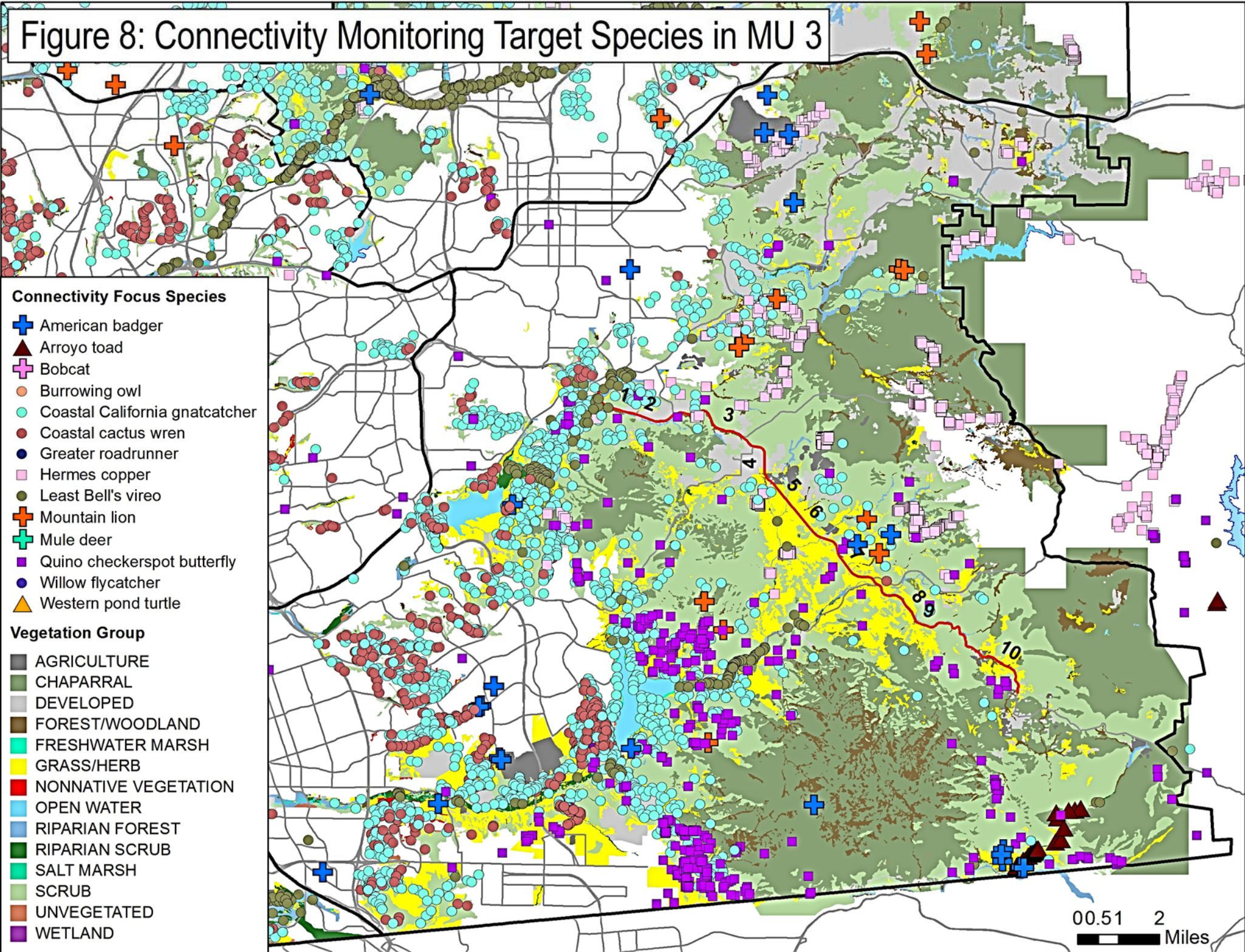




Table 2—Summary of primary land uses and vegetation communities by segment.

Seg.	Land uses	Vegetation communities ¹	Target species ²
1	Conserved—SDNWR; private stables, playing fields	CSS, RW (Sweetwater R., Steele Canyon Crk), GL; patches of CHP, RW, DH	bobcat, coyote, mule deer, California ground squirrel, deer mouse, CAGN, LBV, spadefoot toad, Hermes copper, QCB
2	Private commercial, residential (Jamul)	DEV, CSS, CHP, RW (Steele Canyon Crk); patches of EW and OW	California ground squirrel, CAGN, QCB
3	Conserved—SDNWR	CSS, CHP, RW (Steele Canyon Crk); patches of EW and OW	mountain lion, bobcat, mule deer, California ground squirrel, deer mouse, desert woodrat, DKR, CAGN, Blainville's horned lizard, QCB, Hermes copper
4	Private commercial, residential (Jamul)	DEV, CSS, CHP, RW (Steele Canyon Crk); patches of EW and OW	California ground squirrel, black-tailed jackrabbit, deer mouse, SDPM, desert woodrat, CAGN, QCB
5	Conserved—RJER, HCWA	P, CSS, CHP; patches of EW, GL, RW	mule deer, bobcat, coyote, California ground squirrel, black-tailed jackrabbit, greater roadrunner, deer mouse, cactus mouse, DKR, desert wood rat, SDPM, CAGN, orange-throated whiptail, Blainville's horned lizard, spadefoot toad, Thorne's hair streak, QCB, Hermes copper
6	Conserved—RJER, HCWA	AG, P, CSS, GL, RW (Jamul Crk)	mule deer, bobcat, coyote, California ground squirrel, black-tailed jackrabbit, greater roadrunner, deer mouse, cactus mouse, DKR, desert wood rat, SDPM, CAGN, orange-throated whiptail, Blainville's horned lizard, spadefoot toad, QCB, Hermes copper
7	Conserved—RJER, HCWA	CHP, CSS, GL, P, RW (Hollenbeck Crk, Dulzura Crk)	mountain lion, mule deer, bobcat, coyote, California ground squirrel, black-tailed jackrabbit, greater roadrunner, deer mouse, cactus mouse, DKR, desert wood rat, SDPM, CAGN, orange-throated whiptail, Blainville's horned lizard, spadefoot toad, QCB, Hermes copper
8	Conserved—RJER, HCWA	CHP, CSS, P, CHP, RW (Dulzura Crk)	mule deer, bobcat, coyote, black-tailed jackrabbit, greater roadrunner, deer mouse, cactus mouse, DKR, desert wood rat, SDPM, CAGN, orange-throated whiptail, Blainville's horned lizard, spadefoot toad, QCB, Hermes copper
9	Conserved—BLM, LB Daley preserve	CHP, CSS, GL, RW (Dulzura Crk, Pringle Crk, Honey Springs Crk)	mule deer, bobcat, coyote, California ground squirrel, deer mouse, SDPM, DKR, cactus mouse, desert woodrat, CAGN, orange-throated whiptail, QCB, Thorne's hairstreak
10	Private residential (Dulzura); conserved BLM	AG, CSS, DEV, GL, P, RW (Dulzura Crk, Dutchman Canyon); patches of EW	mule deer, greater roadrunner, CAGN, QCB, Thorne's hairstreak



Table 2—Summary of primary land uses and vegetation communities by segment (continued).

¹Vegetation communities (SANDAG 2012)

AG	agriculture
CHP	chaparral
CSS	coastal sage scrub
DEV	developed
DH	disturbed habitat
EW	eucalyptus woodland
GL	grassland
OW	oak woodland
P	pasture
RS	riparian scrub
RW	riparian woodland

²Target species (Clark 2015, County of San Diego 2011, CROS 2015 database, Famolaro 2015, Hathaway et al. 2002, ICF Jones & Stokes 2008, Madden-Smith 2004, Martin 2015, SDMMP 2015 MOM database, SDNWR 1999, TAIC 2011):

CAGN	California gnatcatcher
DKR	Dulzura kangaroo rat
LBV	Least Bell's vireo
QCB	Quino checkerspot butterfly
SDPM	San Diego pocket mouse

However, the recommended improvements are intended to facilitate connectivity for the community of species, as opposed to a single target species or group of species.



Table 3—Summary of roadkill by segment, October 2010-April 2015 (see Appendix B for full list).

TAXA/NUMBER OF INDIVIDUALS	SEGMENT OF SR-94									
	1	2	3	4	5	6	7	8	9	10
Total number of dates recorded	105	71	125	143	74	71	11	3	1	4
Mountain lion (1994 and 2010)			2							
Mule deer					1	1	1			
Bobcat			2							
Coyote	3	1	5	4	8	21	2	1		
Greater roadrunner		1		1	1	1				1
Long-tailed weasel		1	1	7	10	10				
California ground squirrel	8	2	10	32	11	2	1			
Botta's pocket gopher		1	1		2	1				
Deer mouse	1		1	1						
San Diego pocket mouse				1		1				
Desert woodrat			3	1						
Dulzura kangaroo rat			1							
Desert cottontail	60	43	83	119	26	15	1			
Black-tailed jackrabbit						1				
Raccoon	9	1	3	2			1		1	
Striped skunk	29	15	3			1				
Western spotted skunk	1			1						
Virginia opossum	5	3	1	2						
Snakes ¹	5	1	18	9	9	8		1		1
Western fence lizard/southern alligator lizard				1		2	2			
Western toad	2				1		1			
Passerine birds (native) ²	7	3	20	12	3	2	1			1
Anna's hummingbird			1							
Acorn woodpecker						1			1	
California quail			1							
Barn owl		1	3	3	6	8	1			
Great-horned owl		1	3							
Sharp-shinned hawk			1							
American kestrel					2					
Red-shouldered hawk										1
Water birds ³	1	2		1	1			1		

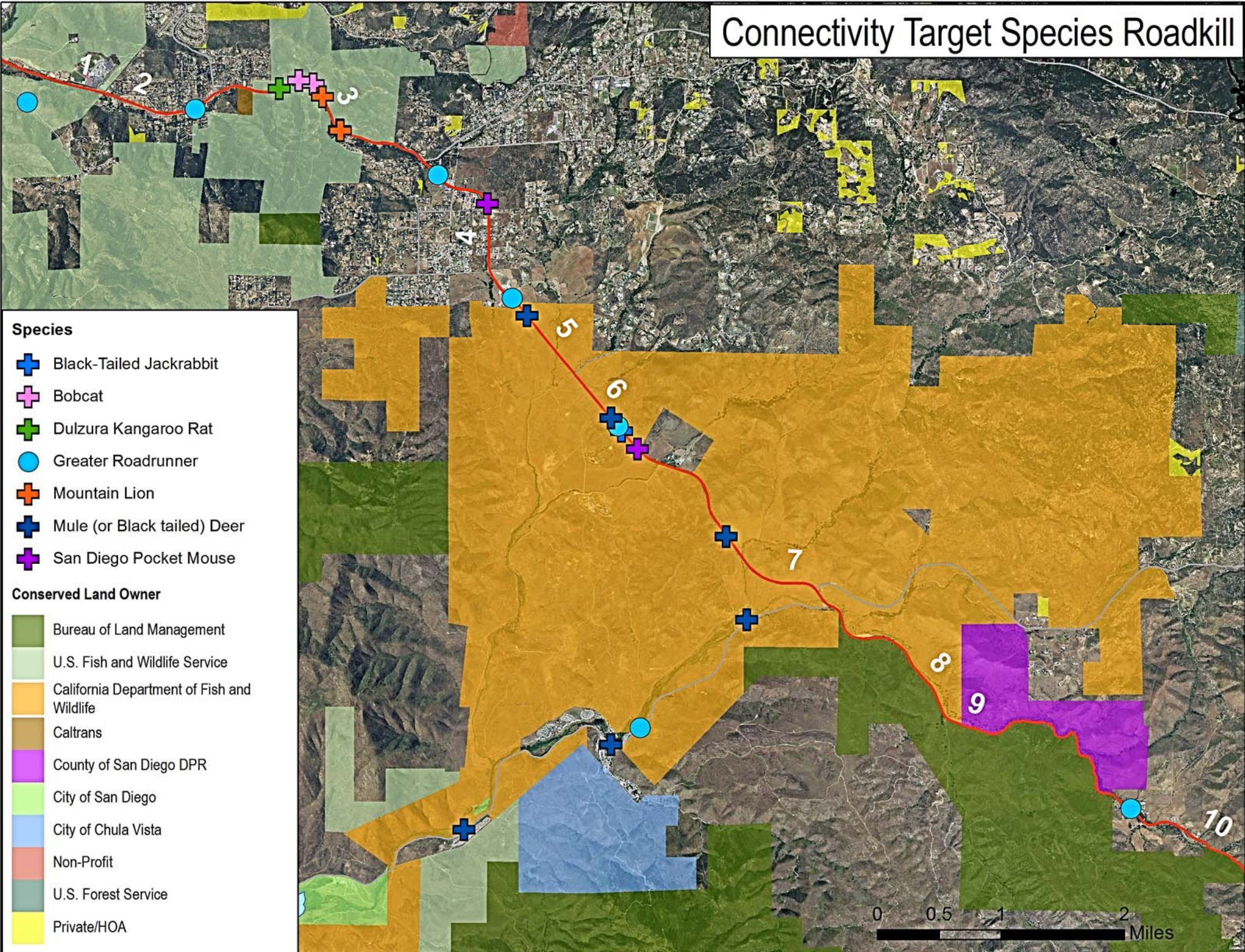
¹ Gopher snake, western rattlesnake, red diamond rattlesnake, common kingsnake, western blind snake, rosy boa, striped racer, Baja California coachwhip

² Spotted towhee, California towhee, western scrub jay, northern rough-winged swallow, common yellowthroat, savannah sparrow, house wren, common raven, white-crowned sparrow, song sparrow, lark sparrow, hooded oriole, American crow, yellow-breasted chat, lesser goldfinch, California thrasher, bushtit, northern mockingbird, Cassin's kingbird, least Bell's vireo

³ American coot, Virginia rail, mallard, western grebe

Source: J. Martin, P. Pum, J. Terp, NWR; T. Dillingham, CDFW; J. Schlachter, BLM.

Connectivity Target Species Roadkill





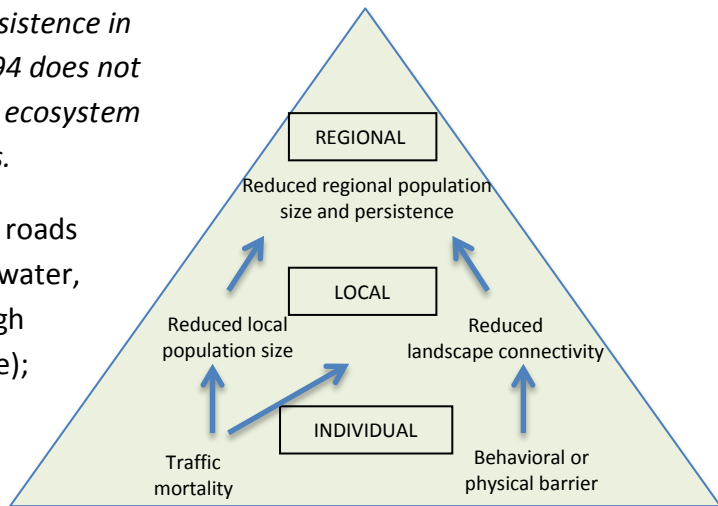
3 Wildlife Infrastructure Needs

3.1 Conservation Goal and Assumptions

Overall Goal for SR-94 Wildlife Infrastructure Plan

Enhance the integrity of and species persistence in the MU3 preserve core area so that SR-94 does not function as a barrier to connectivity and ecosystem functions at regional and preserve levels.

The scientific literature documents how roads affect hydrological regimes; pollute air, water, and soils; degrade habitat quality through edge effects (e.g., invasive species, noise); result in wildlife mortality and indirect effects of this mortality (e.g., lower reproductive rates); change patterns of wildlife movement and communication;



Source: Forman et al. 2003

inhibit seasonal migration; fragment and isolate habitat patches; and reduce the persistence of populations. “Dead zones” or “virtual footprints,” with reduced populations of native rodents, reptiles, amphibians, deer, birds, and other wildlife, can extend hundreds of meters on either side of even moderately traveled roads (Forman et al. 2003). Species respond differently to roads and their infrastructure, depending on traffic volumes, habitat type and patch sizes, topographic patterns, adjacent land uses and disturbance regimes, and population space needs, among others (e.g., Brehme 2003, Brehme et al. 2013, Crooks and Sanjayan 2006, Soulé and Terborgh 1999, Turner et al. 2001).

Road ecology studies in Europe and the United States (see reviews by Forman et al. 2003, Federal Highway Administration—Clevenger and Huijser 2011—and others) have informed various types of mitigation to reduce road mortality and effectively increase connectivity. Measures include wildlife fencing, overpasses and underpasses, habitat restoration or vegetation clearing, mirrors and reflectors, public relations, warning signs, warning whistles, highway lighting, visual barriers, sound barriers, and lower speed limits, among others. Strategically-placed wildlife fencing, combined with effective wildlife crossing structures, are by far the most successful means of directing animal movement, thereby reducing roadkill, enhancing connectivity, and improving traffic safety (e.g., Clevenger 2001, Forman et al. 2003).



Based on the extensive scientific literature, we can assume that SR-94 and other roads in this area fragment habitat and have negative impacts on species movement patterns and species persistence (Brehme 2003). We also assume that removing these roads, or removing or mitigating barriers to connectivity, would enhance species persistence and allow more natural ecological processes.

3.2 Before/After/Control/Impact (BACI) Studies

Baseline surveys should be conducted before construction in the portions of the SDNWR, RJER, HCWA, BLM lands, and County lands bisected by SR-94 to better understand what species are present, their population sizes, vegetation communities, and distribution in the greater project area. In addition, assess occupancy models should be conducted to assess whether they can help predict species occurrences across the greater project area, which could help inform expected use of wildlife crossings.

We recommend that, as part of making any infrastructure improvements, Caltrans conduct Before/After/Control/Impact (BACI) studies that include location and frequency of crossing use by taxon, using camera-based assessments (both at-grade and within crossing structures), tracking (track beds and track plates), radio-telemetry collars, hair snags, systematic roadkill observations, and/or genetic comparisons (e.g., using scat). These types of data can be used to develop movement models and identify barriers to dispersal for selected species. Most BACI studies have found that it takes time, often years, for regular use patterns to develop for certain species (W. Vickers, pers. comm.), including the conserved lands in the area of SR-94. We recommend that at least 3 years of pre-improvement data and 3 years of post-improvement data—followed by monitoring at longer intervals—be collected along the entire stretch of highway proposed for construction. Surveys of fence integrity (before construction) and systematic visits to jump-outs (after construction) can also contribute information on where animals are crossing at-grade. Targeted goals should be a significant reduction in mortality rates and a significant increase in use of crossing structures.

BACI studies, and continued monitoring and research, provide an excellent opportunity to understand ecosystem functions in South County, especially if monitoring is extended to include other roads, such as Otay Lakes Road, Proctor Valley Road, Honey Springs Road, and Jamul Drive. Genetic and demographic monitoring of targeted taxa within the larger reserves, such as the SDNWR, RJER, and HCWA, could identify conservation priorities in these habitats and inform long-term management and monitoring.



3.3 Best Management Practices

This section assimilates best practices from the scientific literature (see References) that apply to all portions of the study area, while Section 3.4 recommends potential infrastructure improvements by segment. Because of the significance of MU3 to the MSCP in general and to wildlife movement in particular, our potential options for mitigating the barrier effect that highways typically have on wildlife may seem more rigorous than those in areas with less conserved open space, lower traffic volumes, and less complex highway geometrics and terrain.

These BMPs and potential infrastructure improvements in Section 3.4 are consistent with those in the scientific literature, previous studies of other roadways (e.g., Orange County toll road SR-241, Vickers and Huber 2012), and the Caltrans (2007, 2009) and Federal Highway Administration (Clevenger and Huijser 2011) wildlife crossings manuals for maintaining, retrofitting, or supplementing existing crossing structures and fencing. As used in this document, “ROW fencing” (also called funnel fencing, exclusion fencing, or species protection fencing) is intended to keep animals off the highway, while “secondary fencing” is intended to be more of a visual barrier (and thus potentially less expensive than ROW fencing) to discourage animals from using private lands adjacent to conserved lands. Depending on the species targeted for each segment, there may be the need for extra reinforcements at the bottoms (for small animals) and tops (for mountain lions and deer) of the ROW fencing. Appendix C provides examples of infrastructure designs that have proven effective in mitigating wildlife-vehicle collisions and barrier effects.

The following BMPs should be incorporated into the specific recommendations for all segments in Section 3.4.

Fencing and Gates

1. Keep wildlife off the highway by installing impermeable Right-of-Way (ROW) fencing at or inside the Caltrans ROW boundary (depending on location and slope) along both sides of the highway where it crosses natural habitat, to reduce roadkill as informed by monitoring. Installing fencing close to the road will reduce the amount of vegetation clearing. Ensure that fence ends are directly across from each other and not offset. Use ≥ 10 ft fencing to prevent deer and mountain lions from crossing, and bury all ROW fencing to prevent coyotes from digging under.
2. Use ROW fencing to funnel wildlife toward culverts and bridges and to block animals attempting to cross the highway at-grade; install ROW fence at the openings of culverts and other undercrossings, on the highway side of openings, and anchor fencing securely



to culvert or bridge abutments rather than anchoring to end-posts installed next to abutments.

3. Discourage wildlife from using natural habitat that is vacant and not protected by installing secondary fencing between conserved lands and natural habitat that is not conserved, to reduce access to the highway across unprotected lands, where determined necessary by condition of habitat and potential for wildlife use. Evaluate whether this may create a trap in the case of fire.
4. Install gates that are of the same height and construction as the surrounding ROW fencing to reduce roadkill; gates must be <3 inches from the ground when closed.
5. Install fencing between drainage ditches and the highway, so that animals can access drainage ditches from the open space, and clear vegetation in the ROW to reduce animal incentives for foraging there.
6. Install one-way escape structures at ≤ 0.5 mi intervals along the highway (W. Vickers pers. com.), or as determined by monitoring, to allow deer and other large animals to exit the highway.
7. Install specialized fencing to exclude smaller animals (see Appendix C for examples).

Placement of Crossing Areas

8. To inform placement of new infrastructure, monitor segments seasonally for at least 3 years prior to construction to determine locations and extent of roadkill and wildlife movement through protected and unprotected lands and at the interface with the highway; monitor wildlife use of existing crossing areas.
9. Place crossings such that they provide connectivity between similar habitats in conserved areas of a size large enough to meet daily habitat requirements for the target species.
10. Take advantage of topography and natural vegetation that funnel animals to crossing points.

Structure and Function of Crossing Areas

11. Remove rip-rap on either end of the crossing area, or if rip-rap is needed for energy dissipation, cover the rip-rap with material or grouted pathways more usable by wildlife; bury rip-rap needed for scour protection below average ground level; use slopes $\leq 5\%$.
12. Use natural substrate in the undercrossing that is similar to that of the surrounding habitat.



13. Incorporate dry ledges in undercrossings and under bridges to accommodate use by small terrestrial wildlife, and incorporate natural structural features such as rocks and logs in large culverts and under bridges.
14. Make undercrossings straight (i.e., without dog-legs) and of limited length such that animals can see natural habitat through the undercrossing from one end of the crossing area to the other (see openness ratio, Caltrans 2007, 2009; Section 3.4). The undercrossing should follow the pathway of hydrologic flow; install sediment catch basins at both ends of the undercrossing.
15. Keep livestock out of crossing areas.

Monitoring and Maintenance

16. Assess effectiveness of new infrastructure by monitoring seasonally for at least 3 years duration post-construction to determine locations and extent of roadkill, wildlife movement through protected and unprotected lands, and wildlife use of new and enhanced crossing areas. Monitoring may include camera-trapping, tracking, and/or other means.
17. Clear or control vegetation and silt at entrances to and within crossing structures and approach routes, and ensure that hydrologic flow is not impeded, especially when there are changes in human development patterns, land uses, and climate.
18. Establish a maintenance budget to regularly monitor infrastructure, replace or repair damaged fencing, remove sediment build-up in the crossing areas, manage vegetation growing in approaches to crossing areas, and remove trash that builds up along the fence line and in crossing areas.

3.4 Recommendations by Segment

This section discusses near-term infrastructure priorities to improve habitat connectivity, wildlife connectivity, and therefore ecosystem function, and longer-term options that could be implemented as part of future road improvements. Targeted goals are to reduce any potential barrier effect of SR-94 as indicated by (1) a significant reduction in mortality rates, and (2) a significant increase in use of crossing structures, compared to existing conditions. These recommendations are consistent with the CDFW Wildlife Crossing and Safety Assessment (Dillingham 2015) as well as the Caltrans (2007, 2009) and Federal Highway Administration (FHWA 2011) wildlife crossings manuals for maintaining, retrofitting, or supplementing existing crossing structures and fencing. Some of the discussion of existing conditions for Segments 5, 6, and 7 is from Dillingham (2015); photos of culverts in these segments are included as part of



Appendix E. Transportation improvement measures included in the Jamul Casino Tribal Environmental Evaluation (TEE) and the SR-94 Operational Improvement Project (Caltrans 2011) described in Section 4 are included at the end of each segment's priorities as potential opportunities to implement the priority infrastructure enhancements. Section 3.5 describes public use considerations identified by the preserve land managers.

Appendix B shows roadkill data, by segment, obtained from the California Roadkill Observation System at UC Davis. Table 3 summarizes these data. There have been no regular roadkill observations south of Segment 6. Table 4 lists existing undercrossings generally >3 ft in diameter, by segment; smaller culverts are included where they may accommodate water flow. These undercrossings are shown in Maps 1-10, along with near-term priority actions, which are summarized in Table 5. Appendix C provides examples of infrastructure designs that have proven effective in mitigating wildlife-vehicle collisions and facilitating connectivity for communities of species.

Table 4—Existing infrastructure.

Post Mile	Type	Subtype	Material ¹	Diameter (ft)	Width (ft)	Height (ft)	Nearest road or feature
SEGMENT 1							
1527	Bridge	Bridge	Concrete	0	13	3	Sweetwater River
1605	Culvert	Circular	Concrete	4	0	0	HS parking lot
1630	Culvert	Circular	Concrete	4	0	0	SDG&E easement
SEGMENT 2							
1646	Culvert	Box	Concrete	0	4	2	SDG&E easement
1718	Culvert	Circular	CSP	2	0	0	riparian
1735	Culvert	Circular	Concrete	4	0	0	Steele Canyon Rd.
SEGMENT 3							
1749	Culvert	Circular	Concrete	3	0	0	edge of NWR
1755	Culvert	Box	Concrete	0	6	4	Filippi's Pizza
1790	Culvert	Circular	CSP	4	0	0	Steele Canyon Creek
1835	Culvert	Circular	CSP	4	0	0	Steele Canyon Creek
1850	Culvert	Circular	CSP	3	0	0	Steele Canyon Creek
1855	Culvert	Circular	CSP	4	0	0	Vista Sage
1885	Culvert	Circular	CSP	4	0	0	Vista Sage
1900	Culvert	Circular	CSP	3	0	0	SE end of NWR
SEGMENT 4							
1925	Culvert	Circular	CSP	2	0	0	Water tank
1948	Culvert	Box	Concrete	0	12	8	Lyons Valley Rd.
2040	Culvert	Box	Concrete	0	4	2	Maxfield Rd.



Post Mile	Type	Subtype	Material ¹	Diameter (ft)	Width (ft)	Height (ft)	Nearest road or feature
SEGMENT 5							
2151	Box	Culvert	Concrete	3	0	0	Daley Dip
2170	Culvert	Circular	Concrete	4	0	0	Rancho Jamul Drive
SEGMENT 6							
2190	Culvert	Circular	Concrete	2	0	0	riparian
2255	Culvert	Circular	CSP	4	0	0	N. end Daley property
2280	Bridge	Bridge	Concrete	0	36	12	Jamul Creek
SEGMENT 7							
2395	Culvert	Box	Concrete	0	5	4	Hollenbeck Cyn Creek
2466	Bridge	Bridge	Concrete	0	10	4	Dulzura Ck @ Otay Lakes Rd.
SEGMENT 8							
2515	Culvert	Elliptical	CSP	0	3	2	Border Patrol Station
2540	Culvert	Circular	CSP	3	0	0	Border Patrol Station
2615	Culvert	Circular	Concrete	3	0	0	Sycamore Canyon (pink gate)
SEGMENT 9							
2795	Culvert	Circular	CSP	2	0	0	BLM brown gate
SEGMENT 10							
2850	Bridge	Bridge	Concrete	0	0	0	Dulzura Creek
2870	Culvert	Circular	CSP	4	0	0	Cal Fire station Dulzura
2890	Culvert	Circular	Concrete	5	0	0	Rancho Las Nubes
2912	Bridge	Bridge	Concrete	0	0	20	Grande Ck @ Dutchman Cyn
2945	Culvert	Elliptical	CSP	0	4	3	Arbabian acquisition
2985	Culvert	Elliptical	CSP	0	3	2	Cañon de Roca
3000	Culvert	Circular	Concrete	5	0	0	Marron Valley Rd.

Note: this table includes only those culverts ≥3 ft diameter, except where there is water flow from riparian habitat.

¹CSP = corrugated steel pipe



Table 5—Summary of recommendations for SR-94 infrastructure improvements to benefit communities of species as opposed to a single target species or groups of target species (see text for further detail and Appendix C for infrastructure examples).

RECOMMENDATIONS ^{1,2}	LAND OWNER
Segment 1—Funnel wildlife to Sweetwater River bridge undercrossing and reduce roadkill.	
Near-term	
1. Install ROW fencing south of SR-94 (5,200 ft).	Caltrans
2. Develop a path along the rip-rap, or cover the rip-rap, to encourage animal movement along the Sweetwater River.	
3. Determine need for replacing SDG&E gate to access utility easement.	Caltrans/SDG&E
4. Assess need for improved fencing northeast of horse facilities to funnel animals to Sweetwater River.	SDNWR
5. Install cattle guards at Singer Lane, Millar Ranch Road, dirt road to the stables, and dirt trail along river (Rochester and Fisher 2013).	Private
6. Monitor wildlife use of Sweetwater River and Steele Canyon Creek.	SDNWR
Longer-term	
Restore the Cottonwood Golf Course to enhance use as a wildlife linkage.	
Traffic signal at Cougar Canyon Road intersection (Kimley-Horn 2012).	Caltrans
Segment 2—Reduce roadkill.	
1. Assess need for secondary fencing around the knoll between NWR and private land, south side of Steele Canyon Creek.	SDNWR
2. Assess need for secondary fencing along Aurora Vista Drive and between Aurora Vista Drive and Florence Terrace along SDNWR.	SDNWR
Segment 3—Enhance integrity across the SDNWR and reduce roadkill.	
Near-term	
1. Maintain culverts at PM 1749 and PM 1855 to allow drainage.	Caltrans
2. Fence (secondary) the non-functional box culvert (PM 1755).	Caltrans
3. Install 8,400 ft ROW fencing both sides of highway, with herp guards along Steele Canyon Creek; install funnel fencing to PM 1790.	Caltrans
4. Install 1,550 ft secondary fencing between Vista Sage Lane and Steele Canyon Creek.	SDNWR
5. At bottom of the curve, install new box culvert with dry ledges for small animals; remove vegetation blocking undercrossing.	Caltrans
6. Install jump-outs on both sides of highway, before and after the curve.	Caltrans
7. Tie-in ROW fencing to new box culvert and existing culverts (PM 1835, 1850, 1855, 1885, 1900; maintain vegetation around culverts).	Caltrans
8. Install secondary fence between nursery and SDNWR and along Vista Sage Lane to Verde Lane.	SDNWR
9. Remove trash, invasive species, and dense understory within Steele Canyon Creek.	SDNWR
Longer-term	
Straighten SR-94 at the curve by re-routing SR-94 onto SDNWR lands; construct undercrossings at east and west ends.	Caltrans



RECOMMENDATIONS ^{1,2}	LAND OWNER
Segment 4—Reduce roadkill.	
1. Assess fencing needs by documenting wildlife movement between the SDNWR and RJER at their junction with Proctor Valley Road, to funnel wildlife to crossings in Segments 3 and 5.	Caltrans
Longer-term	
Traffic controls at intersections for the Jamul Casino (Kimley-Horn 2012).	Caltrans
Segment 5—Facilitate animal movement between RJER and HCWA.	
1. Remove vegetation, sediment, and trash at both culverts.	Caltrans
2. Install ROW fencing both sides of SR-94 and anchor at culvert abutments on both sides.	Caltrans
3. Determine need for secondary fencing perpendicular to highway along private properties.	Caltrans
4. Replace the “Daley Dip” (PM 2151) with a larger undercrossing by leveling the highway.	Caltrans
5. Replace the 2 RJER gates at the Daley Dip and anchor to fencing.	CDFW
6. Contour approaches and remove overgrown vegetation at the entrances to PM 2170.	CDFW
Longer-term	
Investigate feasibility for excavating a “basin undercrossing” north of Daley Dip.	CDFW
Install a traffic signal or stop sign at Rancho Jamul Drive to reduce roadkill through the preserves.	Caltrans
Widen the road and include a passing lane (Caltrans 2011).	Caltrans
Segment 6—Facilitate animal movement between RJER and HCWA.	
1. Install ROW fencing both sides of SR-94 and tie-into undercrossing abutments	Caltrans
2. Determine if the RJER gate and two HCWA gates should be replaced and tied into new ROW fencing.	CDFW
3. Install a stop sign or traffic signal at Rancho Jamul Drive or Daley Ranch Truck Trail so slow traffic through the preserves.	Caltrans
4. Evaluate the need for a cattle guard at Rancho Jamul Drive.	CDFW
5. Install a new undercrossing at PM 2190 and include structural features to provide cover for smaller animals.	Caltrans
6. Recontour the drainage at PM 2190 and restore riparian vegetation along the drainage on both sides SR-94.	CDFW
7. Excavate a basin undercrossing at PM 2255 and recontour the approaches.	Caltrans/CDFW
8. Install jump-outs south of Rancho Jamul Drive and on the west side of the bridge at RJER main entrance road.	Caltrans
9. Install a cattle guard at the Daley Ranch entrance road.	CDFW
10. Remove and maintain vegetation and old fence at the entrances to the PM 2280 culverts.	CDFW
Longer-term	
Widen the road and include a passing lane (Caltrans 2011).	Caltrans



RECOMMENDATIONS ^{1,2}	LAND OWNER
Segment 7—Facilitate animal movement between RJER and HCWA.	
1. Install ROW fencing both sides of SR-94 and tie-into undercrossing abutments.	Caltrans
2. Evaluate need to replace 2 CDFW gates at Hollenbeck Road, both sides of SR-94, and tie into ROW fencing.	CDFW
3. Replace culverts at PM 2395 with a 15-ft arch or bridge; recontour both sides with earthen benches; and remove or cover rip-rap.	Caltrans
4. Install cattle guard on Honey Springs Road and continue ROW fencing.	Caltrans
5. Conduct “hot spots analysis” along Honey Springs Road and Otay Lakes Road.	Caltrans
6. Install secondary fencing around house on HCWA to encourage wildlife movement behind house to Dulzura Creek bridge.	CDFW
7. Determine locations for at least 2 jump-outs.	Caltrans
Longer-term	
Realign curves, widen the road, and include a passing lane (Caltrans 2011).	Caltrans
Install stop controls at Honey Springs Road and Otay Lakes Road (Kimley-Horn 2012).	Caltrans
Evaluate feasibility of a land bridge for large animals.	CDFW
Evaluate feasibility of placing undercrossings both north and south of Hollenbeck Road.	CDFW
Segment 8—Facilitate animal movement between BLM Sycamore Canyon and HCWA and BLM and LB Daley Preserve.	
1. Install ROW fencing north side and secondary fencing south side of SR-94 and tie-into undercrossing abutments.	Caltrans
2. Remove and maintain sediment and vegetation at culverts PM 2515 and PM 2540.	Caltrans
3. Install at least 2 jump-outs in appropriate locations, as informed by wildlife movement monitoring.	Caltrans
4. Install a 15-ft arch at pink BLM gate (PM 2615) and contour approaches.	Caltrans
5. Install fencing to funnel animals to the new undercrossing and tie-in with abutments.	Caltrans
Longer-term	
Realign curves, widen the road, and include a passing lane (Caltrans 2011).	Caltrans
Segment 9—Facilitate animal movement between BLM Sycamore Canyon and HCWA and BLM and LB Daley Preserve.	
1. Install a 15-ft arch at the brown BLM gate (PM 2795) and tie into the fence.	Caltrans
2. Install jump-outs, as informed by wildlife movement monitoring.	Caltrans
3. Install 2 new gates and tie into fencing.	BLM/CDFW
Longer-term	
Eliminate curves by tunneling through all or a portion of this segment (“bypass alignment” alternative, Caltrans 2011).	Caltrans
Install standard 8 ft shoulders (Caltrans 2011).	Caltrans



RECOMMENDATIONS ^{1,2}	LAND OWNER
Segment 10—Enhance connectivity between BLM lands and Forest Service lands.	
1. Monitor seasonally to determine most likely areas for ROW fencing and jump-outs.	Caltrans
2. Install secondary fence to funnel wildlife under Camps Grove bridge (PM 2850); build dry ledges on both sides of the undercrossing.	Caltrans
3. Remove and maintain sediment load and vegetation at culvert PM 2870.	Caltrans
4. Remove invasive species and other vegetation at PM 2890; recontour the drainage, especially upstream.	Caltrans
5. Install a dry ledge under the bridge over Grande Creek (PM 2912); remove invasive species; install fencing to funnel to bridge.	Caltrans
6. Install a jump-out across from driveway southeast of Dutchman Canyon Road.	Caltrans
7. Install a larger culvert at PM 2945.	Caltrans
8. Install directional ROW fencing to PM 2945.	Caltrans
9. Install a pre-formed arch at PM 2985; fence or gate the Canon de Roca driveway; install jump-out on south side SR-94.	Caltrans
10. Remove and maintain sediment load and vegetation at PM 3000).	Caltrans
Longer-term	
Realign curves, widen the road, and include a passing lane (Caltrans 2011).	Caltrans

¹ All measurements are approximate. ROW = right-of-way (impermeable) fence along SR-94. Secondary fence separates conserved lands from private lands.

² Specific placement to be informed by monitoring.



Segment #1 (Map 1)

Existing conditions: The bridge over the Sweetwater River provides the best wildlife crossing opportunity through this segment where SR-94 cuts through the San Diego National Wildlife Refuge (SDNWR), which in this area supports mostly coastal sage scrub and coastal sage scrub species. There are few data on wildlife use of the riparian habitat at this location, except for some herpetofauna surveys (SDNWR 1999) and annual least Bell's vireo surveys (Martin 2015). Farther downstream, Famolaro (2015) has recorded bobcats, mule deer, coyotes, raccoons, striped skunk, opossum, red fox, cottontail, deer mice, dusky-footed woodrats, and ground squirrels on Sweetwater Authority property in the riparian habitat of the Sweetwater River. The riparian habitat along Steele Canyon Creek, which runs parallel to the south side of SR-94, likely supports wildlife that can enter the highway. Based on the SDMMP MOM database (2015), bobcats, mule deer, and other connectivity target species use the SDNWR near this segment (Table 3); Hermes copper and Quino checkerspot butterfly also occupy the SDNWR, but are not likely to successfully cross SR-94 and the other land uses in this segment. The Caltrans culvert data show 18 circular concrete pipes and slotted pipe drains in this ~1.2-mile segment; all but a couple are <3 ft in diameter. Table 4 shows the two largest of these (aside from the bridge)—both draining the Steele Canyon high school parking lot and playing fields. Based on roadkill data, coyotes are the largest animals to cross at-grade, but smaller mammals, birds, snakes, and a western toad were collected in this heavy traffic segment, including a road-killed least Bell's vireo (J. Martin, pers. comm., July 23, 2014). Caltrans is conducting a traffic study in this segment.

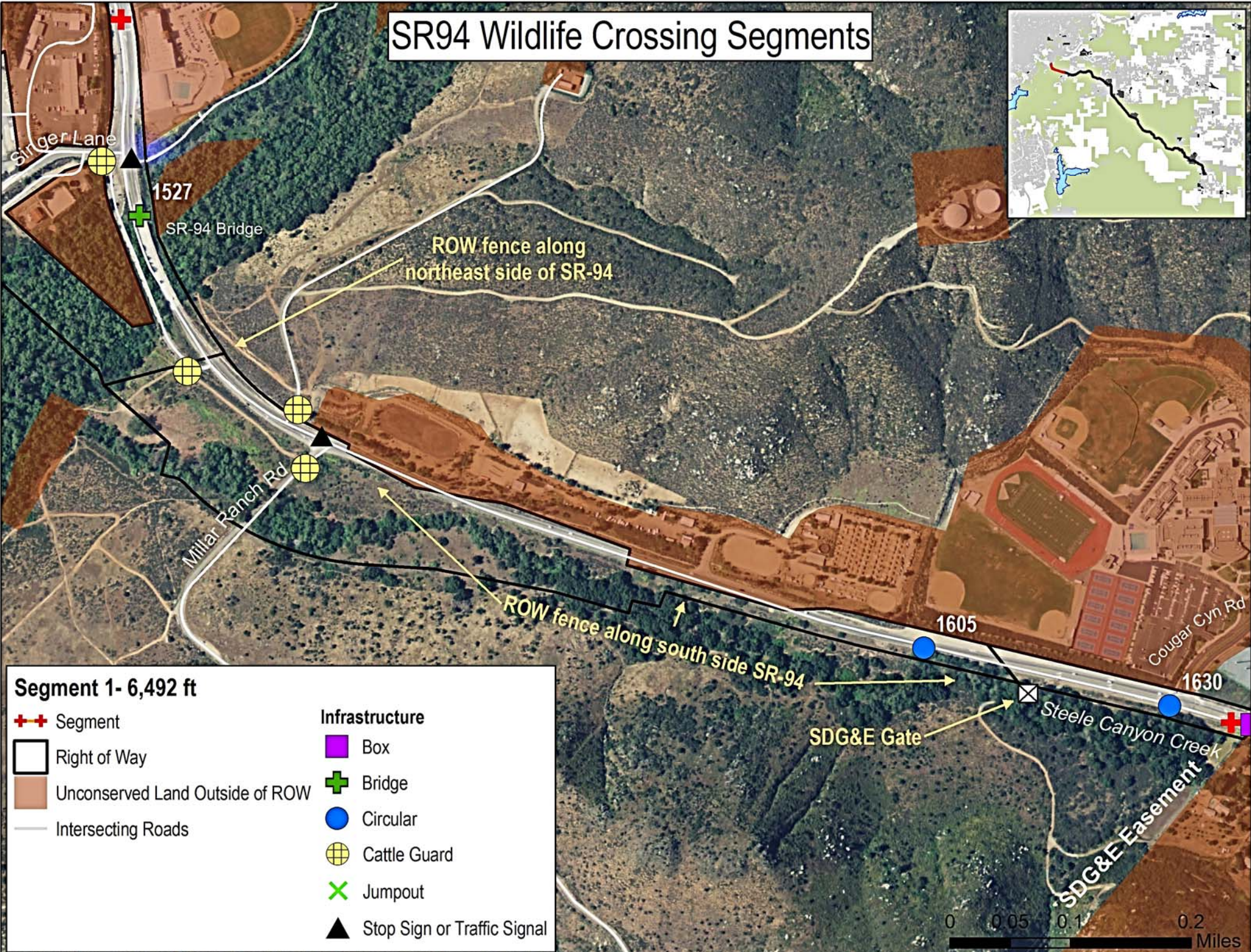
Objectives:

- *Improve habitat integrity on SDNWR land south of SR-94.*
- *Reduce roadkill by keeping the community of species off the highway and funneling them to the riparian habitat and the existing bridge at the Sweetwater River.*
- *Enhance native habitat along the Sweetwater River for wildlife movement.*
- *Protect and enhance wildlife habitat in Steele Canyon Creek.*

Near-term recommendations:

1. Install ROW fencing along the south side of the highway between the Sweetwater River bridge and the SDG&E easement, based on monitoring which species are using these areas ≥ 4 ft high with small mesh size (see Appendix C).

SR94 Wildlife Crossing Segments



Segment 1- 6,492 ft

++ Segment

□ Right of Way

■ Unconserved Land Outside of ROW

— Intersecting Roads

Infrastructure

■ Box

⊕ Bridge

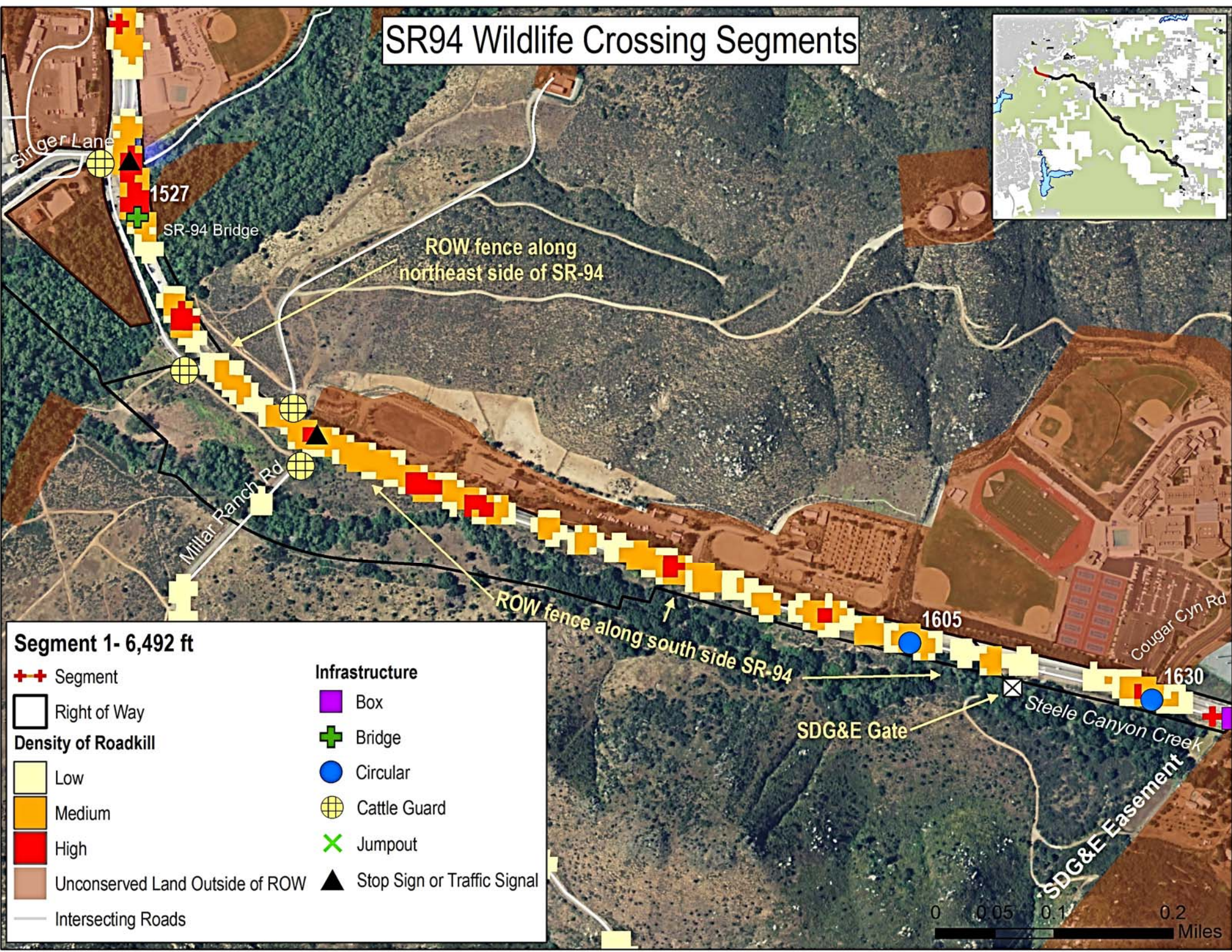
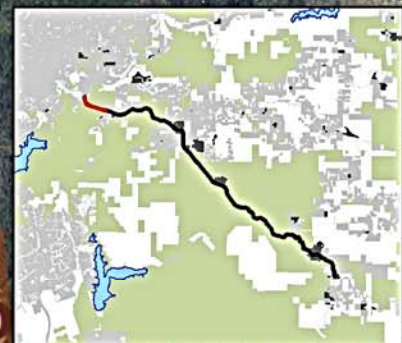
● Circular

⊗ Cattle Guard

⊗ Jumpout

▲ Stop Sign or Traffic Signal

SR94 Wildlife Crossing Segments



Segment 1- 6,492 ft

- | | |
|-----------------------------------|-------------------------------|
| ++ Segment | Infrastructure |
| □ Right of Way | ■ Box |
| Density of Roadkill | ⊕ Bridge |
| □ Low | ● Circular |
| ■ Medium | ⊗ Cattle Guard |
| ■ High | ⊗ Jumpout |
| ■ Unconserved Land Outside of ROW | ▲ Stop Sign or Traffic Signal |
| — Intersecting Roads | |





2. Develop a path along the rip-rap, or cover the rip-rap, to encourage animal movement along the Sweetwater River.
3. Determine the need for replacing the SDG&E gate on the south side of SR-94 to access its utility easement.
4. Check the need to improve secondary fencing along the SDNWR boundary, north of the property leased for horse facilities, to funnel animals to habitat along the Sweetwater River. There already is a secondary fence around the Steele Canyon High School property and along both sides of the SDG&E easement north and south of the highway to discourage animal movement into these areas.
5. Install cattle guards at Singer Lane, Millar Ranch Road, dirt road to the stables, and dirt trail along the river, at the intersection of SR-94 (see also Rochester and Fisher 2013).
6. Document wildlife use through the riparian habitat, and animals killed crossing at-grade, by conducting a wildlife movement study for at least 1 week each season of the year for 2 years using tracking and camera traps (a) along and under the SR-94 bridge at the Sweetwater River, between Willow Glen Drive and the Otay Water District recycled water plant along El Tae Road to the west of the highway, and (b) between the edge of the riparian habitat at the river and Millar Ranch Road. This will help determine what type of fencing is needed.

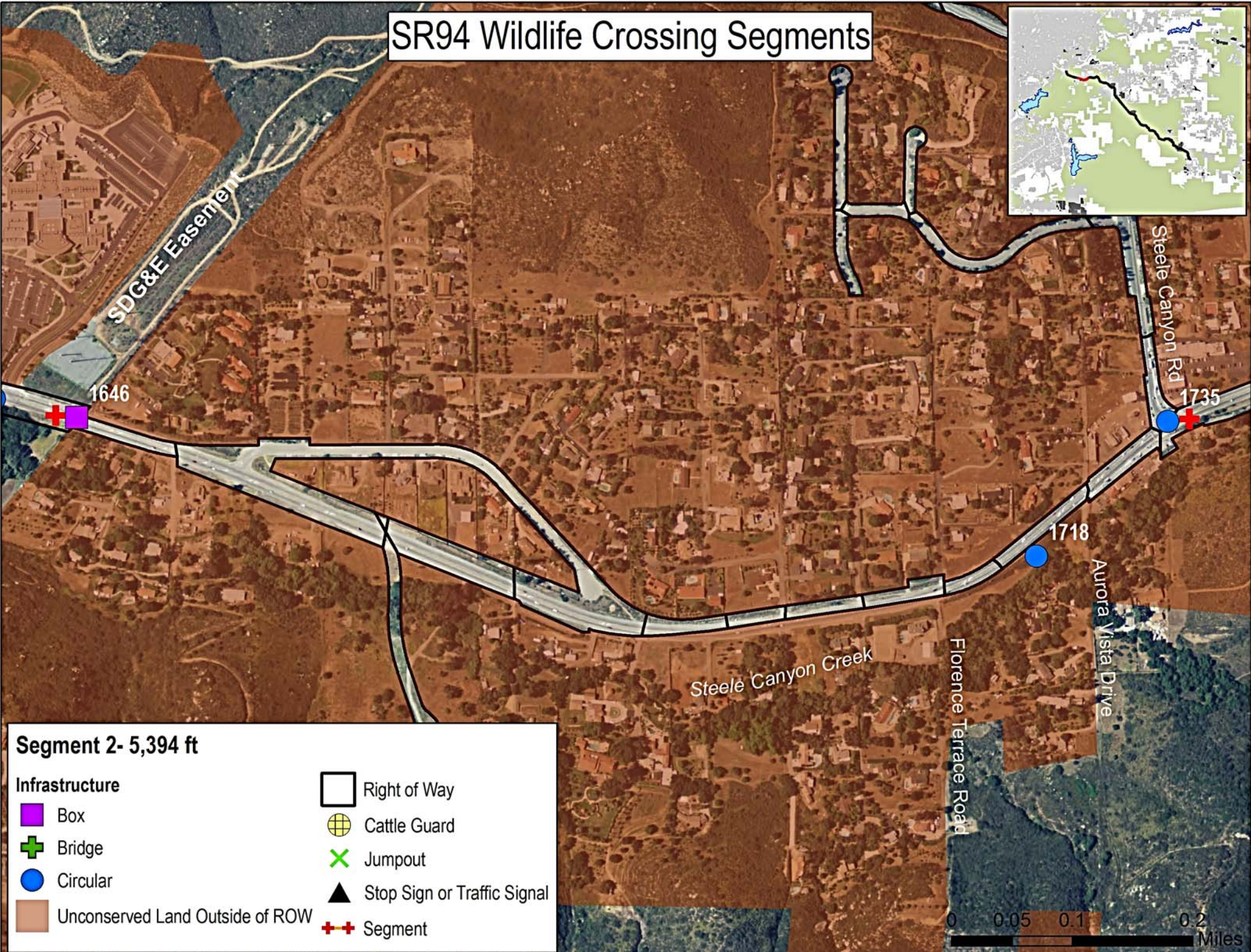
Longer-term recommendations:

- Restore the Cottonwood Golf Course to enhance use as a wildlife linkage (perhaps as a riparian mitigation project).
- The Tribal Environmental Evaluation (TEE) for the Jamul Casino includes a traffic signal at the Cougar Canyon Road intersection, which could help reduce roadkill.

Segment #2 (Map 2)










Existing conditions: Segment 2 of the highway traverses through ~1 mile of residential and commercial land uses. There is no conserved open space in this segment; although coastal sage scrub and chaparral border the developed areas, these habitats may be lost or fragmented by new development. The Caltrans culvert data show 14 circular concrete pipes and slotted pipe drains in this segment; all but the three undercrossings shown on Map 2 are <2 ft in diameter. The majority of animals killed on the road in this segment are desert cottontails and striped skunks, which are species that do well in urban areas. Monitoring could help determine the

SR94 Wildlife Crossing Segments



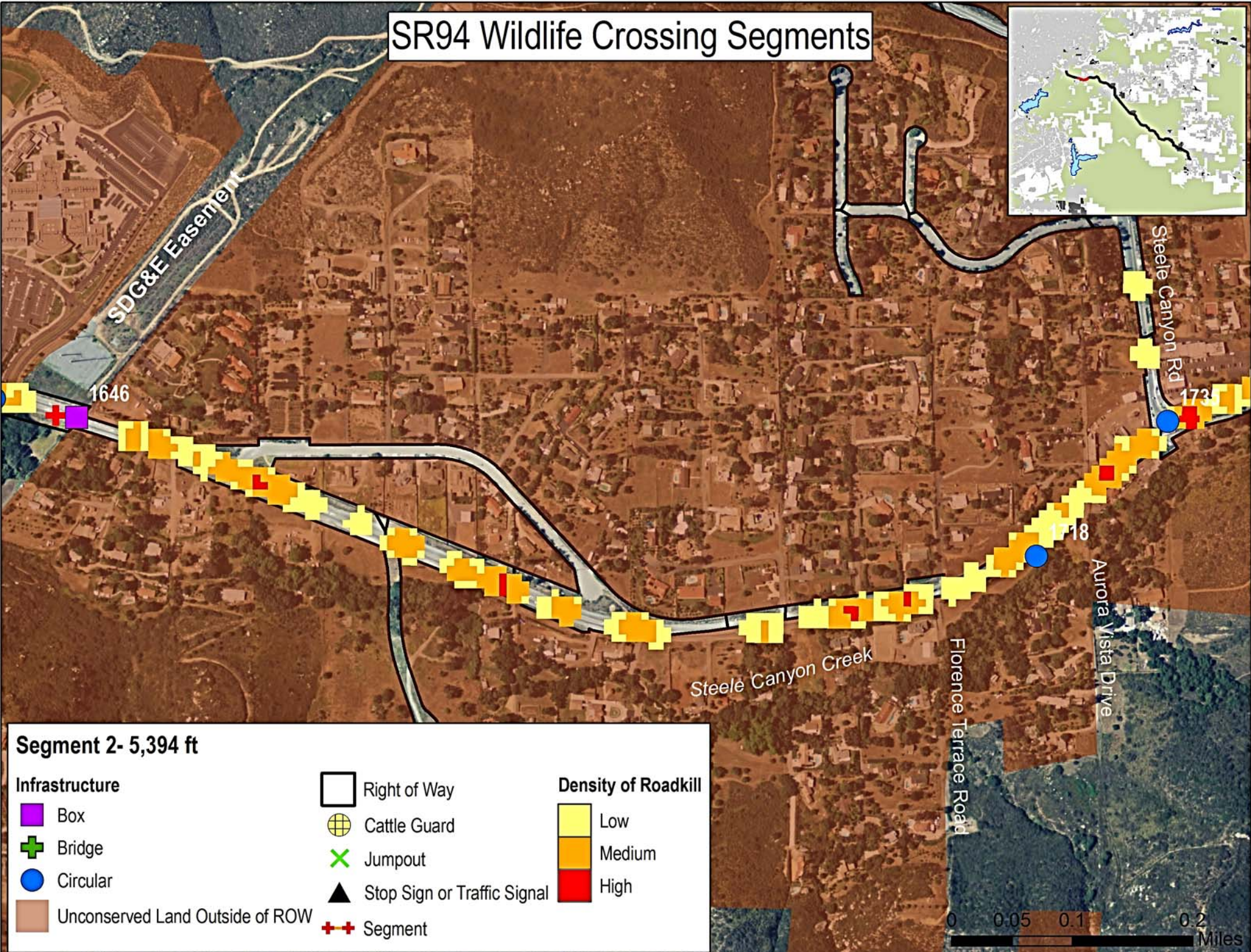
Segment 2- 5,394 ft

Infrastructure

-  Box
-  Bridge
-  Circular
-  Unconserved Land Outside of ROW
-  Segment
-  Right of Way
-  Cattle Guard
-  Jumpout
-  Stop Sign or Traffic Signal



SR94 Wildlife Crossing Segments



Segment 2- 5,394 ft

Infrastructure

- Box
- Bridge
- Circular
- Unconserved Land Outside of ROW

Right of Way

- Cattle Guard
- Jumpout
- Stop Sign or Traffic Signal
- Segment

Density of Roadkill

- Low
- Medium
- High





need for fencing along the highway, but because of the existing and future land uses (i.e., loss of more habitat to development), highway fencing is not a priority.

Objectives:

- *Reduce roadkill by encouraging use of Segments 1 and 3 as crossing areas.*

Near-term recommendations:

1. Assess the need for secondary fencing on the south side of the highway, around the knoll that borders the south side of Steele Canyon Creek, between SDNWR land and private land.
2. Assess the need for secondary fencing along the SDNWR boundary along Aurora Vista Drive, and between Aurora Vista Drive and Florence Terrace along the SDNWR boundary, south of SR-94.

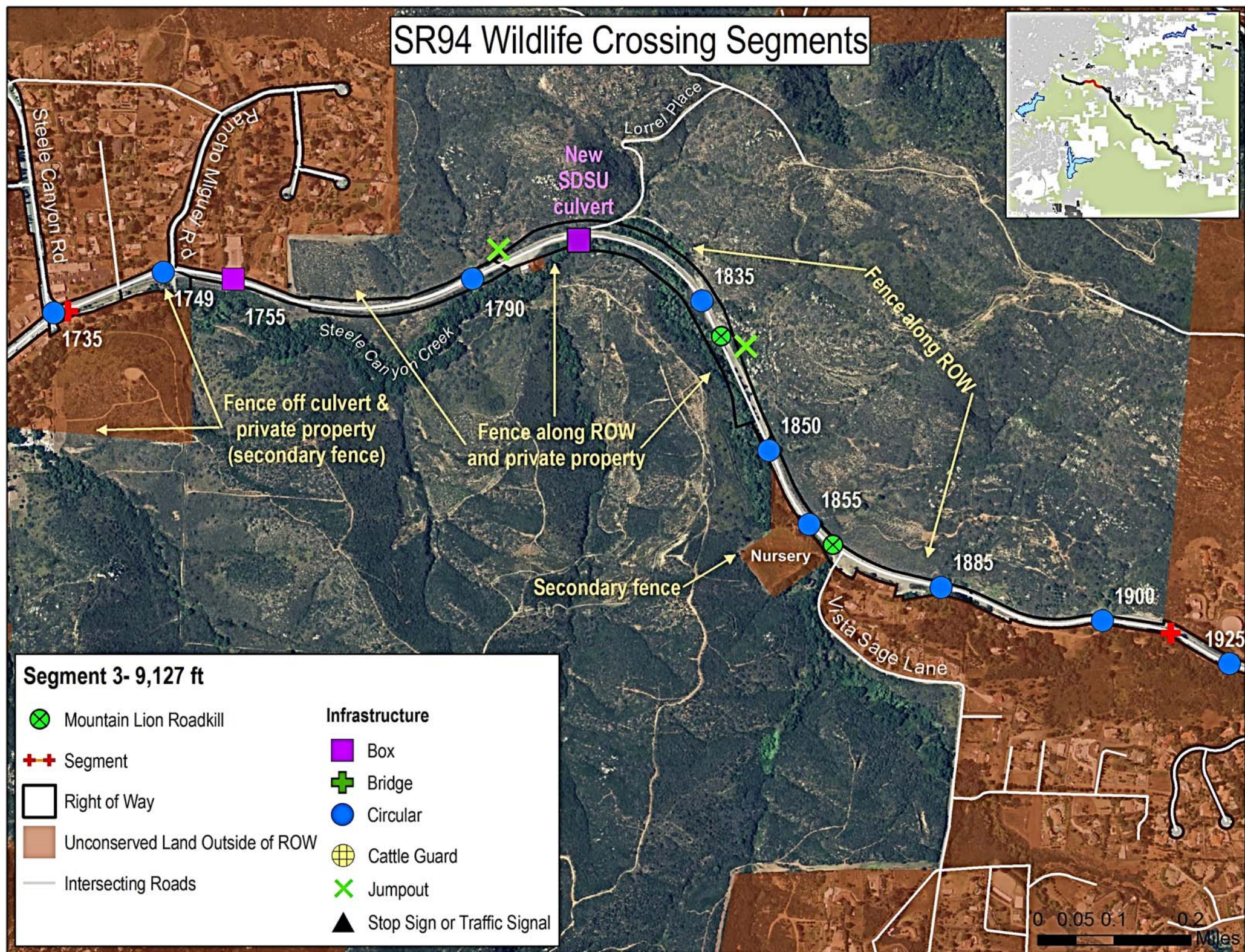
Segment #3 (Map 3)

Existing conditions: This segment of highway crosses 1.7 miles of the SDNWR, where the habitat is mostly coastal sage scrub and chaparral, and scattered oaks in the canyons. Steele Canyon Creek, lined with live oak riparian forest, parallels the south side of SR-94 but crosses under the highway at the large curve, where there is a significant dip in elevation. There are seven circular culverts ≥ 3 ft diameter and one box culvert through this segment. The box culvert (PM 1755) across from the parking lot for Filippi's Pizza (south of SR-94), has a dogleg in it and empties into the parking lot so probably is not functional for wildlife. The culvert at PM 1790 appears to be little used, if at all, by wildlife; it is more likely that wildlife cross at grade in this location (J. Martin, pers. comm.). The existing culvert at the bottom of the curve (not shown in Caltrans culvert data) is blocked by sediment and dense vegetation on the north side of the highway and not currently functional for wildlife movement. The culvert at PM 1835 is about half full of sediment and debris. There are no camera data for these culverts and apparently no regular maintenance by Caltrans. Two mountain lions have been killed on the southern end of this segment; other roadkill data include two bobcats, coyotes, large numbers of desert cottontails, and many birds and snakes that probably use the adjacent riparian habitat.

Objectives:

- *Reduce roadkill by keeping animals off the road and enhancing multiple crossing areas.*
- *Enhance ecological integrity across the SDNWR.*
- *Protect and enhance wildlife habitat in Steele Canyon Creek.*

SR94 Wildlife Crossing Segments

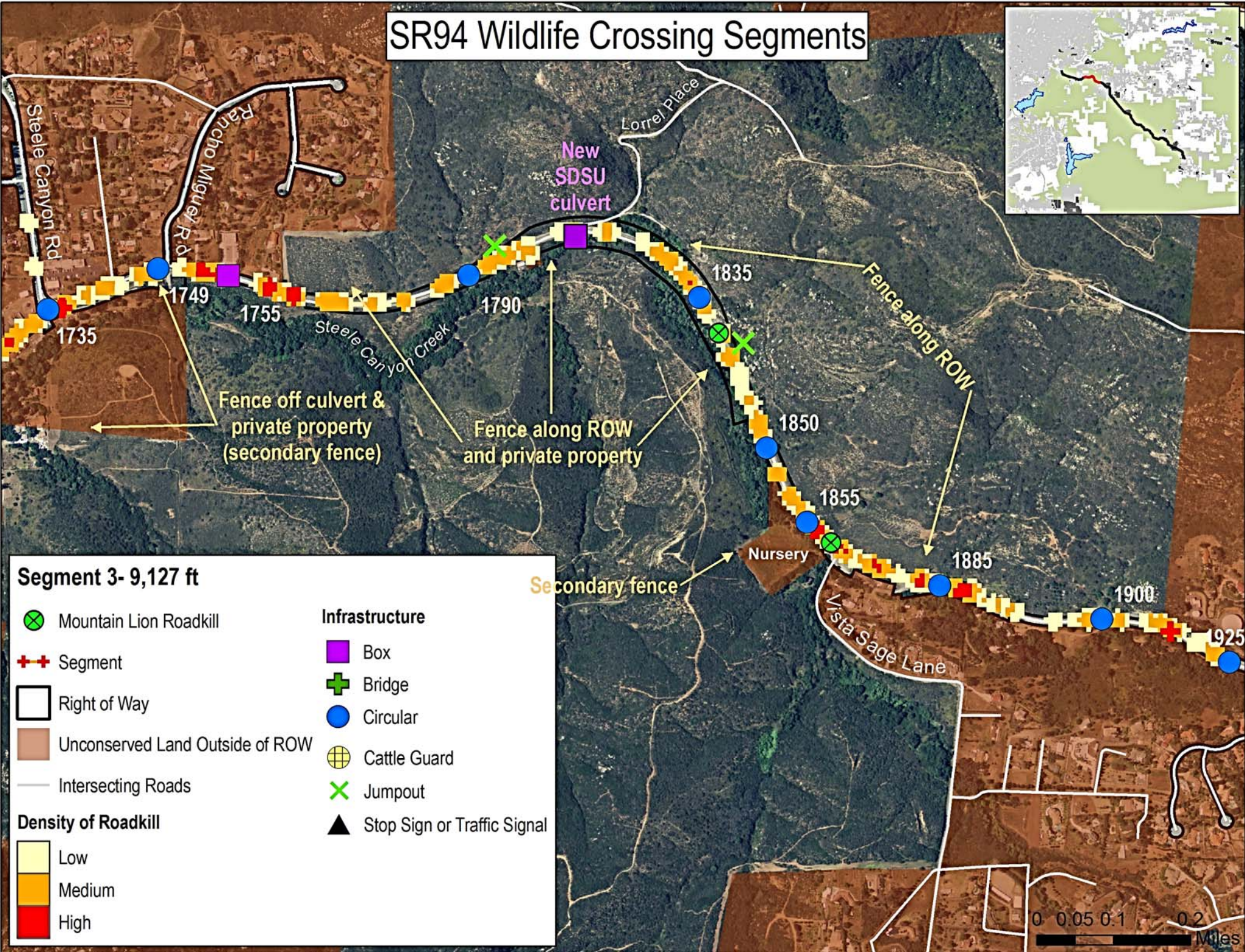


Segment 3- 9,127 ft

- | | | | |
|--|---------------------------------|-----------------------|-----------------------------|
| | Mountain Lion Roadkill | Infrastructure | |
| | Segment | | Box |
| | Right of Way | | Bridge |
| | Unconserved Land Outside of ROW | | Circular |
| | Intersecting Roads | | Cattle Guard |
| | | | Jumpout |
| | | | Stop Sign or Traffic Signal |



SR94 Wildlife Crossing Segments



Segment 3- 9,127 ft

- | | |
|---------------------------------|-----------------------------|
| Mountain Lion Roadkill | Infrastructure |
| Segment | Box |
| Right of Way | Bridge |
| Unconserved Land Outside of ROW | Circular |
| Intersecting Roads | Cattle Guard |
| Density of Roadkill | Jumpout |
| Low | Stop Sign or Traffic Signal |
| Medium | |
| High | |



Near-term recommendations:

1. Maintain culverts at PM 1749 and PM 1855 to allow drainage.
2. Install secondary fencing to enclose the non-functional box culvert (PM 1755).
3. Install ≥ 10 ft ROW fencing on both sides of the highway west from this culvert to Steele Canyon Road and east across the SDNWR to Vista Diego Road (Segment 4), with small mesh size and herp guards at the bottom along Steele Canyon Creek to keep small animals from entering the highway, and funnel fencing to the culvert at PM 1790. Bury fencing to prevent coyotes from digging under.
4. Install secondary fencing between Vista Sage Lane and Steele Canyon Creek.
5. Replace the existing, nonfunctional culvert at the bottom of the curve with the new SDSU undercrossing design (box culvert) at the intersection with Lorrel Place and Steele Canyon Creek. See SDSU engineering design (Appendix D). Install the culvert at an angle following the stream course. Incorporate structural features and dry ledges to provide cover for herpetofauna and smaller wildlife (i.e., a community of wildlife species). Remove or thin existing vegetation blocking the current undercrossing, which has caused water to pool on the north side of the highway; there is now a dense thicket of willows which impedes medium-large animal movement.
6. Install jump-outs (X) on the north and south sides of the highway, before and after the curve where the grade drops off.
7. Tie in ROW fencing to the new SDSU undercrossing and existing culverts (PM 1835, 1850, 1855, 1885, and 1900). Remove vegetation within and around these existing culverts to allow movement for small animals, and direct ROW fencing to funnel animals to these culverts.
8. Install ROW fence along the south side of SR-94 across the private parcel (nursery), install a secondary fence between the nursery and SDNWR and along Vista Sage Lane to Verde Lane.
9. Remove trash, human encampments, invasive species, and dense understory within Steele Canyon Creek to enhance use as a wildlife movement corridor.
10. Fencing and fire breaks line the residential development along Rancho Miguel Road, and there is no vegetation cover in the adjacent habitat, so no additional secondary fencing is recommended there.



Longer-term recommendations:

- Straighten the highway at the curve in the middle of this segment, and construct wildlife crossings at both the east and west ends of this re-route. This would involve re-routing the highway onto SDNWR lands. Include infrastructure for utilities in the new highway bed, thereby reducing fire risk from overhead transmission lines.

Segment #4 (Map 4)

Existing conditions: Segment 4 of the highway traverses through ~1.7 miles of residential and commercial land uses, with some unprotected open space—mostly coastal sage scrub, north and south of Lyons Valley Road on the north side of the highway. The Caltrans culvert data show 14 small (<2 ft in diameter) circular concrete pipes and slotted pipe drains in this segment. In addition, there is one circular culvert #1925 and two box culverts that are shown on Map 4). Large numbers of road-killed desert cottontails and ground squirrels, long-tailed weasels, coyotes, and some herps and birds have been recorded through this segment. Monitoring could help determine the need for fencing along the highway, but because of the existing and future land uses, highway fencing is not a priority.

Objectives:

- *Reduce roadkill by encouraging use of Segments 3 and 5 as crossing areas.*

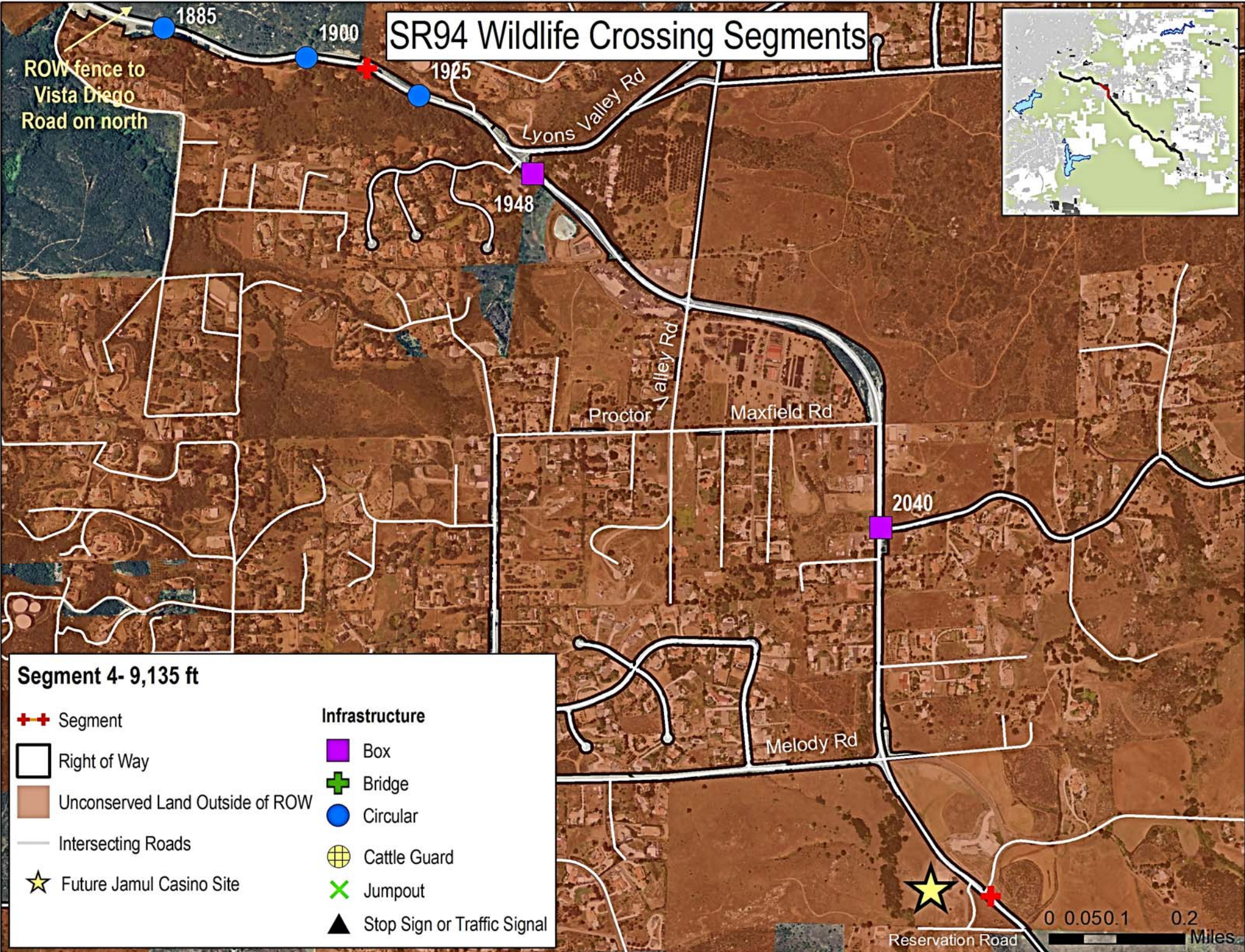
Near-term recommendations:

1. Assess the need for fencing at selected locations, along both sides of the highway, by documenting wildlife movement between the SDNWR and RJER at their junction with Proctor Valley Road, to funnel wildlife to crossings in Segments 3 and 5.
2. Because of the degraded nature of the habitat, and presence of residential development, there is no need for secondary fencing between undeveloped and developed land north of SR-94, between Lyons Valley Road and Melody Road (both sides of SR-94).

Longer-term recommendations:

- The TEE for the Jamul Casino includes two-way stop controls at the Lyons Valley and Melody Road/Peaceful Valley Ranch Road intersections and one-way stop controls at the Maxfield Road and Reservation Road intersections. This would have the effect of slowing eastbound traffic entering RJER.

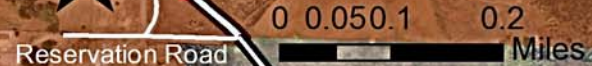
SR94 Wildlife Crossing Segments



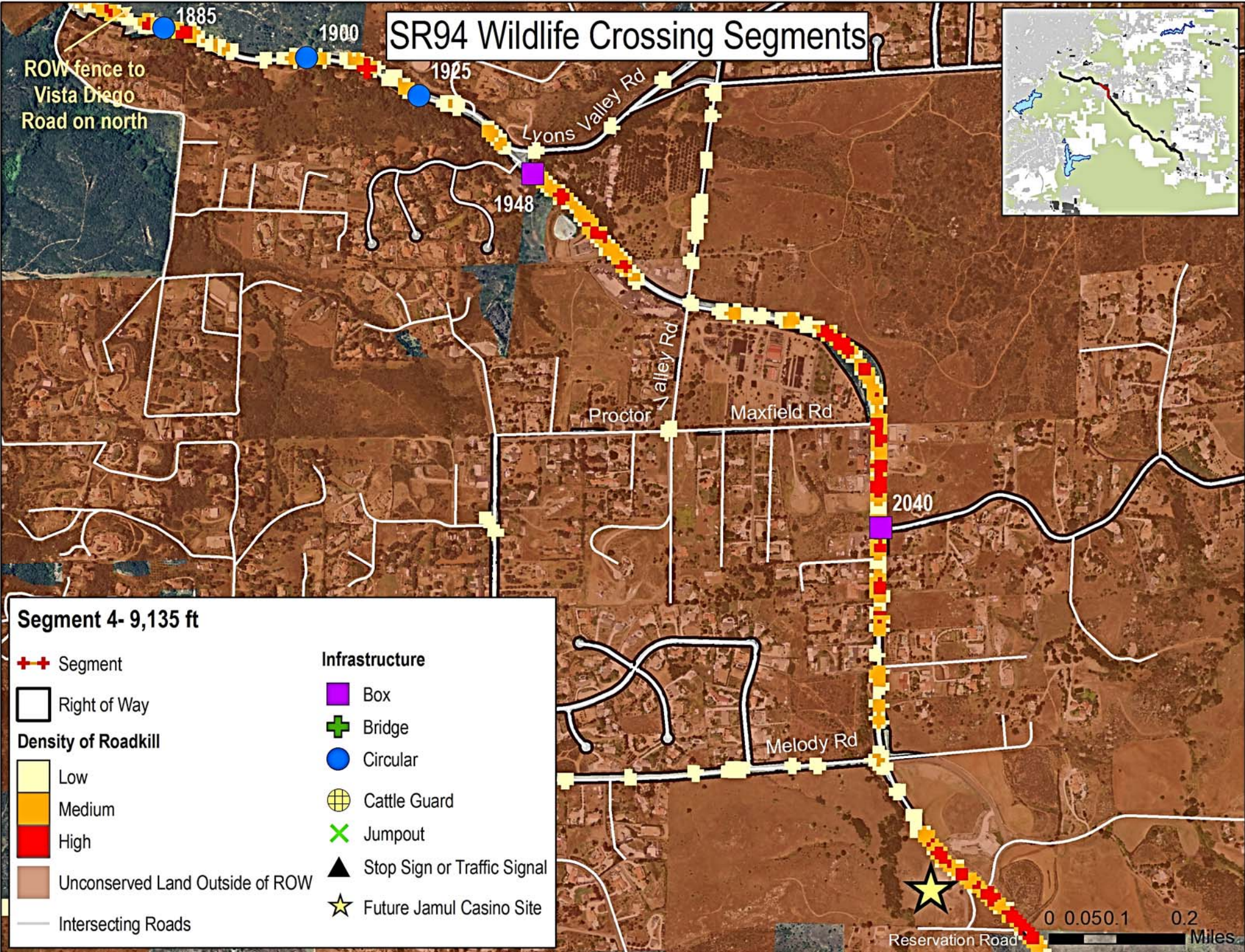
Segment 4- 9,135 ft

- Segment
- Right of Way
- Unconserved Land Outside of ROW
- Intersecting Roads
- Future Jamul Casino Site

- ### Infrastructure
- Box
 - Bridge
 - Circular
 - Cattle Guard
 - Jumpout
 - Stop Sign or Traffic Signal



SR94 Wildlife Crossing Segments



Segment 4- 9,135 ft

++ Segment

□ Right of Way

Density of Roadkill

□ Low

□ Medium

□ High

□ Unconserved Land Outside of ROW

— Intersecting Roads

Infrastructure

■ Box

⊕ Bridge

● Circular

⊗ Cattle Guard

✕ Jumpout

▲ Stop Sign or Traffic Signal

★ Future Jamul Casino Site



Segment #5 (Map 5)

Existing conditions: Segment #5 of the highway separates grassland on HCWA from the northeast part of RJER, also grassland. There are only two undercrossings in this nearly 1 mile stretch—a box culvert at the “Daley Dip,” which is filled with sediment and therefore not functional for wildlife or flow, and three side-by-side circular culverts just north of Rancho Jamul Drive. The approaches to the circular culverts are partially blocked by vegetation. Coyotes are known to cross the highway at grade through this section, and previous camera traps have recorded long-tailed weasels and rabbits using the circular culverts (Dillingham 2015). Because of the lack of vegetative cover adjacent to the highway in this segment, it is unlikely to support significant use by mountain lions, but the HCWA and RJER reserves are used by bobcats, coyotes, mule deer, and many small mammals. Documented roadkill include mule deer, coyotes, ground squirrels, desert cottontails, long-tailed weasels, gopher snakes, western rattlesnakes, and birds. Fencing is three-strand barbed wire which has been damaged by storm flow.

Objectives:

- *Provide for large animal movement between RJER and HCWA.*
- *Provide for small animal movement between CDFW lands.*
- *Reduce roadkill by enhancing two crossing areas.*

Near-term recommendations:

1. Remove vegetation and trash at entrances to existing culverts to allow movement of spadefoot toads and other herpetofauna and small animals under SR-94.
2. Install ≥ 4 ft ROW fencing, with small mesh size, along both sides of SR-94 through this entire segment, beginning at Melody Road in Segment 4. Install fencing between the drainage ditch and the open space on the south side of the highway, not over the drainage ditch or between the drainage ditch and the highway. Anchor fencing at the new culvert abutments on both sides. Bury fencing to prevent coyotes from digging under.
3. Based on wildlife tracking and monitoring, determine if secondary fencing should extend outward from the highway along the private properties where the habitat is degraded, with very little vegetation cover.

SR94 Wildlife Crossing Segments



Private Rd

Excavate basin for undercrossing

ROW fencing both sides of road

Daley Dip

2151

2170

Rancho Jamul Dr

0 0.05 0.1 0.2 Miles

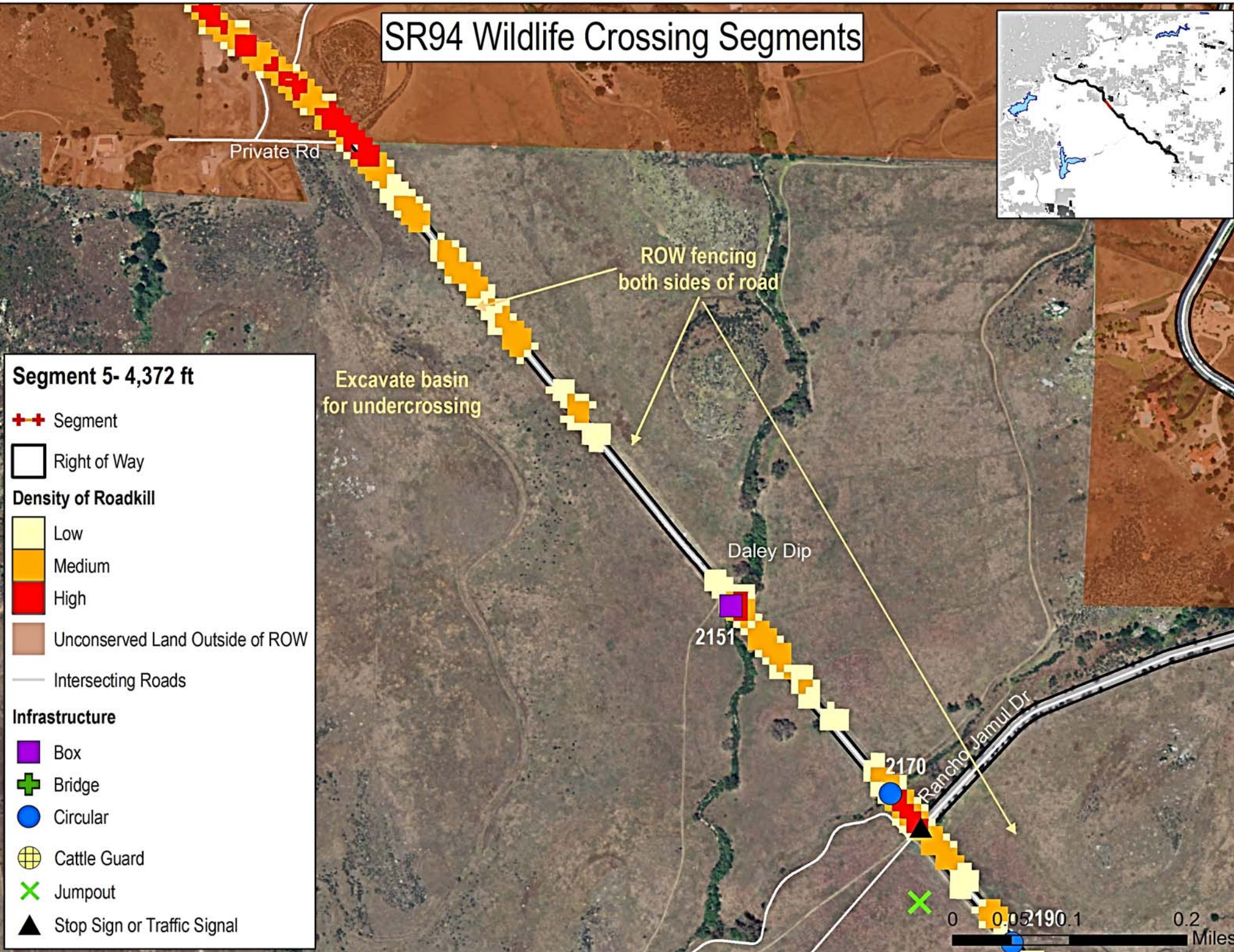
Segment 5- 4,372 ft

- Segment
- Right of Way
- Unconserved Land Outside of ROW
- Intersecting Roads

Infrastructure

- Box
- Bridge
- Circular
- Cattle Guard
- Jumpout
- Stop Sign or Traffic Signal

SR94 Wildlife Crossing Segments



Segment 5- 4,372 ft

++ Segment

□ Right of Way

Density of Roadkill

□ Low

□ Medium

□ High

□ Unconserved Land Outside of ROW

— Intersecting Roads

Infrastructure

□ Box

⊕ Bridge

● Circular

⊗ Cattle Guard

⊗ Jumpout

▲ Stop Sign or Traffic Signal



4. Level the highway at the “Daley Dip” (PM 2151), and replace the existing Arizona-style crossing (three 3 ft diameter pipes buried by sediment) where many amphibians and small mammals have been found on the highway. This habitat does not extend very far off the current RJER boundary to the north and east. However, the buried culvert is a traffic safety issue during a large flood, which could inundate the road. Replace this non-functional undercrossing with larger culverts at a higher elevation (once the highway is leveled to eliminate the dip) to carry runoff and not fill with sediment.
5. Replace the two existing gates on RJER on both sides of SR-94 at the Daley Dip, and anchor to fencing.
6. Contour the approaches and remove overgrown vegetation and trash at the entrances to the three 4 ft culverts just north of Rancho Jamul Drive (PM 2170).
7. Because of the degraded nature of the habitat and the presence of residential development, there is no need for a secondary fence along the north side of Rancho Jamul Drive.

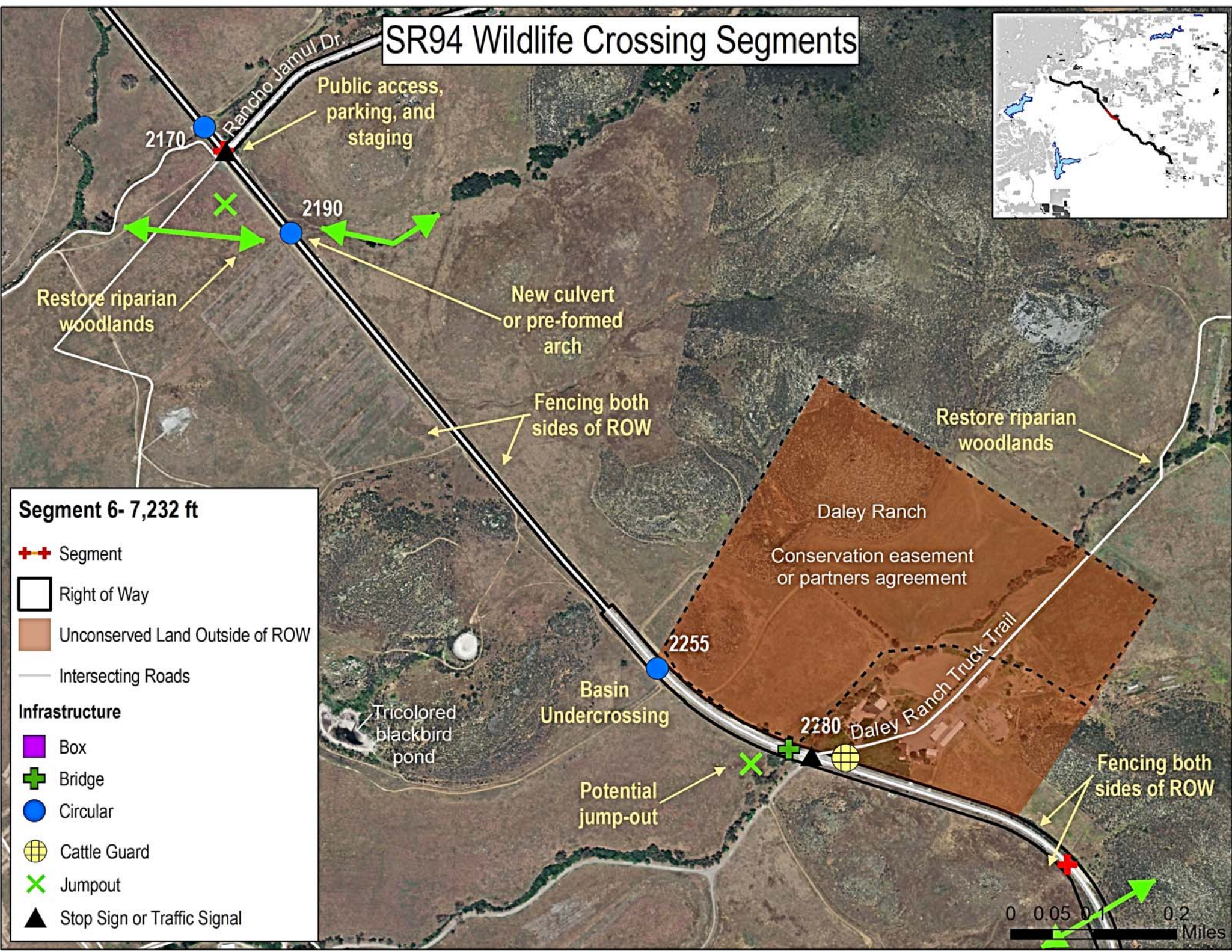
Longer-term recommendations:

- Caltrans (2011) includes widening and a passing lane through this segment, and thus implement the near-term priorities above.
- Consider installing a traffic signal or stop sign at Rancho Jamul Drive to reduce roadkill.
- Investigate the feasibility for an undercrossing north of the Daley Dip. It would require excavating a basin under the road (i.e., a “basin undercrossing” with location to be determined through monitoring).

Segment #6 (Map 6)

Existing conditions: This segment also separates grasslands on both sides of SR-94 through HCWA and RJER. There are three existing undercrossings in this 1.4 mile stretch, only one of which appears to be functional for wildlife. Just south of Rancho Jamul Drive is a very small (2 ft-diameter) culvert (PM 2190) partially blocked with sediment and brush, in a location where there is still a channel that supports riparian habitat upstream and downstream of the highway. However, a chain-link fence blocks the entrance to the culvert on the east side of the road, and the diversion box on the west side is filled with sediment and debris and obscures visibility through the culvert.

SR94 Wildlife Crossing Segments



Segment 6- 7, 232 ft

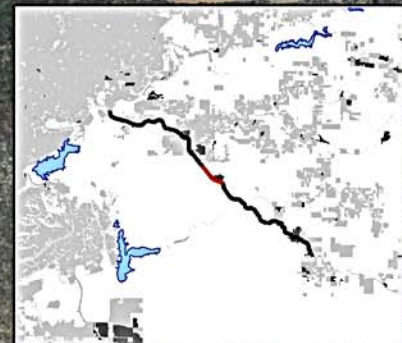
- + Segment
- Right of Way
- Unconserved Land Outside of ROW
- Intersecting Roads

Infrastructure

- Box
- + Bridge
- Circular
- Cattle Guard
- × Jumpout
- ▲ Stop Sign or Traffic Signal



SR94 Wildlife Crossing Segments



Segment 6- 7, 232 ft

- + Segment
- Right of Way
- Unconserved Land Outside of ROW

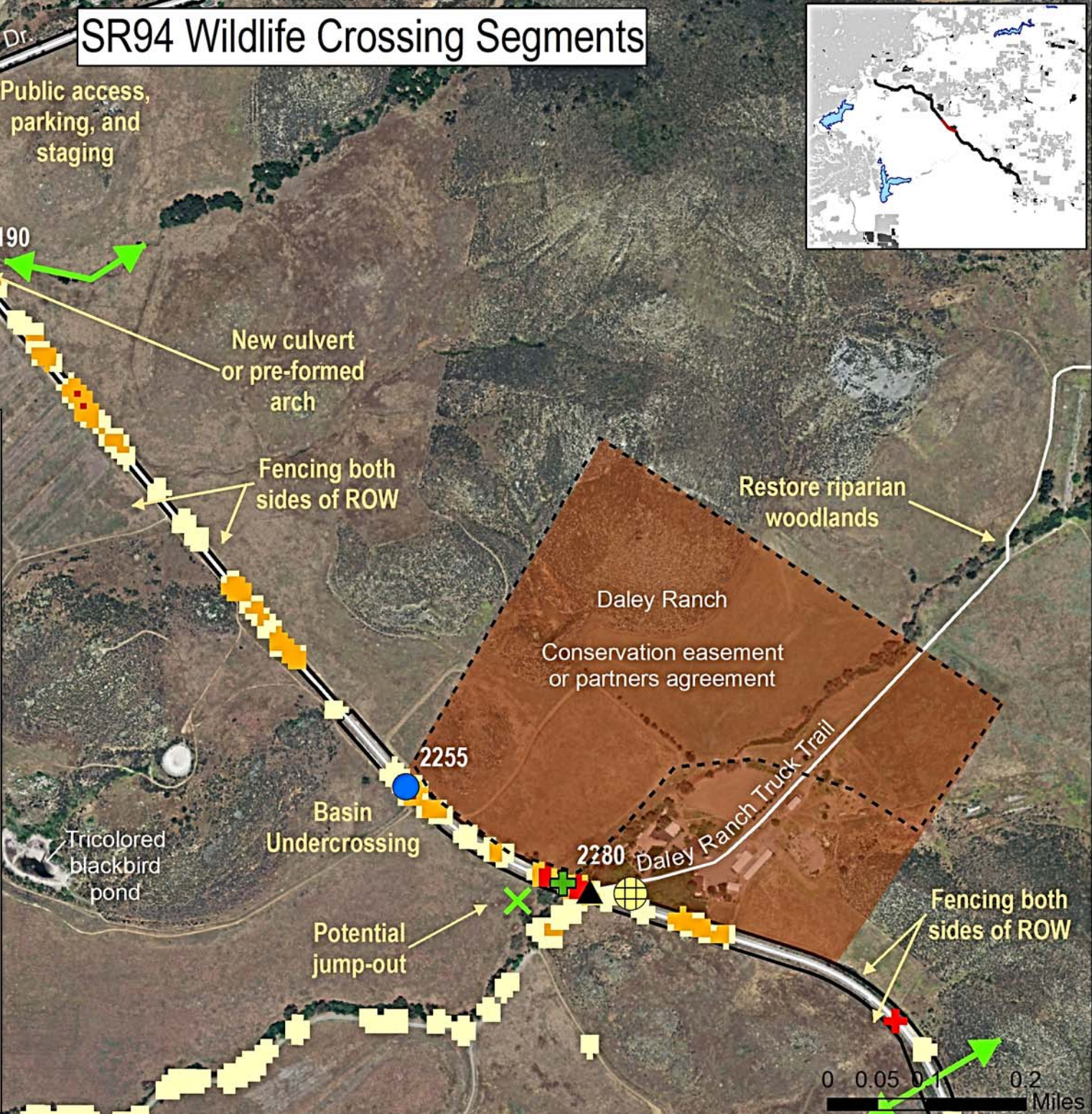
Density of Roadkill

- Low
- Medium
- High

— Intersecting Roads

Infrastructure

- Box
- + Bridge
- Circular
- Cattle Guard
- x Jumpout
- ▲ Stop Sign or Traffic Signal





Just north of PM 2255, Dillingham (2015) describes an at-grade wildlife crossing, currently fenced with no undercrossing, where wildlife may be trying to access the pond on RJER. The 6 ft chain link fabric fence is frequently damaged by vehicle crashes in this area because of the undulating roadway, leaving openings for wildlife.

At the north end of the Daley Ranch property (PM 2255) there is a 4 ft diameter culvert with grated drains, smooth, steeply angled concrete sides, and a bend in the pipe. It is likely not functional for wildlife. The bridge over Jamul Creek at the RJER main gate is actually three side-by-side 12 ft box culverts. It is partially blocked on the east side, allowing only small and medium mammals to pass.

Although there is little vegetative cover adjacent to the highway in this segment, documented roadkill include deer, coyotes, ground squirrels, desert cottontails, long-tailed weasels, gopher snakes, western rattlesnakes, and birds. Bobcats and many other connectivity target species occupy the conserved habitats on both sides of the highway.

Objectives:

- *Provide for large animal movement, including deer and mountain lions, between RJER and HCWA.*
- *Reduce roadkill by enhancing multiple crossing areas.*

Near-term recommendations:

1. Install ≥ 10 ft ROW fencing along both sides of SR-94 through this segment and tie into undercrossing abutments. Include smaller mesh size at the bottom of the fencing to keep smaller animals off the road. Bury fencing to prevent coyotes from digging under.
2. Inspect the existing gate on RJER across from Rancho Jamul Drive and the two gates on both sides of the highway at the northwest end of the Daley Ranch and northwest of the RJER main entrance; determine if they need to be replaced; tie into new ROW fencing.
3. Install a stop sign or traffic signal at Rancho Jamul Drive or at the Daley Ranch Truck Trail, with right and left turn lanes both directions, to slow traffic through RJER and HCWA.
4. Determine the need for a cattle guard at Rancho Jamul Drive.
5. In place of the existing 2-ft diameter culvert (PM 2190), install a new undercrossing (box culvert, basin undercrossing, or 15 ft pre-formed arch) for large animals and to accommodate the drainage that crosses under the highway just south of Rancho Jamul Drive and continues on both sides of the highway, partially lined by oaks (this is a



- tributary to Jamul Creek). Include structural features in the new undercrossing to provide cover for smaller animals.
6. Recontour the drainage at PM 2190 and plant riparian vegetation cover (e.g., sycamores, oaks, shrubs) on both sides of the highway along this drainage. The existing 2 ft culvert is partially blocked with sediment and brush and does not accommodate movement of any but potentially very small wildlife (Dillingham 2015) and is not adequate to accommodate existing hydrologic flow. Wildlands has plans for restoring the drainage that runs along Rancho Jamul Drive; their plans should be expanded to include the drainage south of Rancho Jamul Drive (green arrows, Map 6), which originally connected with the northern drainage. Restoring riparian habitat will encourage use by deer and mountain lions.
 7. At PM 2255, replace the single 4 ft diameter culvert, which has a bend in the middle so that little light passes through. The culvert empties into a drainage ditch within RJER, and the two inlets on either side of SR-94 consist of grated drains with steeply angled concrete sides. Recontour the approaches to both sides of the culvert and excavate a basin undercrossing to accommodate small and large animals which may be trying to access the tricolored blackbird pond on RJER. Raising the elevation of the highway between the two rises just northwest of this location could eliminate the condition that creates vehicle crashes and connect what appears to be a major game trail from HCWA to the RJER pond.
 8. Install jump-outs (**X**) south of Rancho Jamul Drive and on the west side of the bridge at the RJER main entrance road, based on wildlife movement monitoring.
 9. There is already a chain link (secondary) fence along the Daley Property on the north side of SR-94, east of the main entrance to the property, which should be sufficient for discouraging animals into the Daley Ranch property. Install a cattle guard at the Daley Ranch entrance road (Daley Ranch Truck Trail).
 10. Improve the entrance to the bridge over Jamul Creek (three side-by-side 12x12 ft culverts) underneath SR-94 (PM 2280) at the RJER main gate by removing plants and shrubs and by removing the Daley Ranch fence across the north side of the bridge, which restricts wildlife movement and has been used as a human hiding spot (Dillingham 2014). Maintain the vegetation on the RJER side of the bridge to allow for wildlife movement.



Longer-term recommendations:

- Caltrans (2011) includes widening and a passing lane through this segment. This could be accomplished as part of implementing the near-term priorities above.

Segment #7 (Map 7)

Existing conditions: This 1.7-mi segment of the highway separates mostly grassland on conserved lands at HCWA and RJER, with two riparian-lined creek crossings. Wildlife cross the highway at-grade through this segment (T. Dillingham, pers. comm.), both northwest and southeast of Hollenbeck Creek. There is a 2-ft culvert about 0.5 southeast of the RJER main gate, but is not functional and not shown on Map 7 (location of potential wildlife overcrossing). The two existing undercrossings shown on Map 7 are at Hollenbeck Creek (PM 2395) and Dulzura Creek (PM 2466). The Hollenbeck Creek undercrossing comprises two side-by-side 5x4 ft box culverts with poor access by wildlife because of a vertical drop on the west side of the highway and no directional fencing. The Otay Lakes Road bridge over Dulzura Creek is large enough to allow passage of large animals, although there is no directional fencing and no ROW fencing throughout this segment, so that wildlife can freely enter the highway. Documented roadkill include deer, coyote, ground squirrel, western toad, and barn owl. A mountain lion has been recorded at the HCWA.

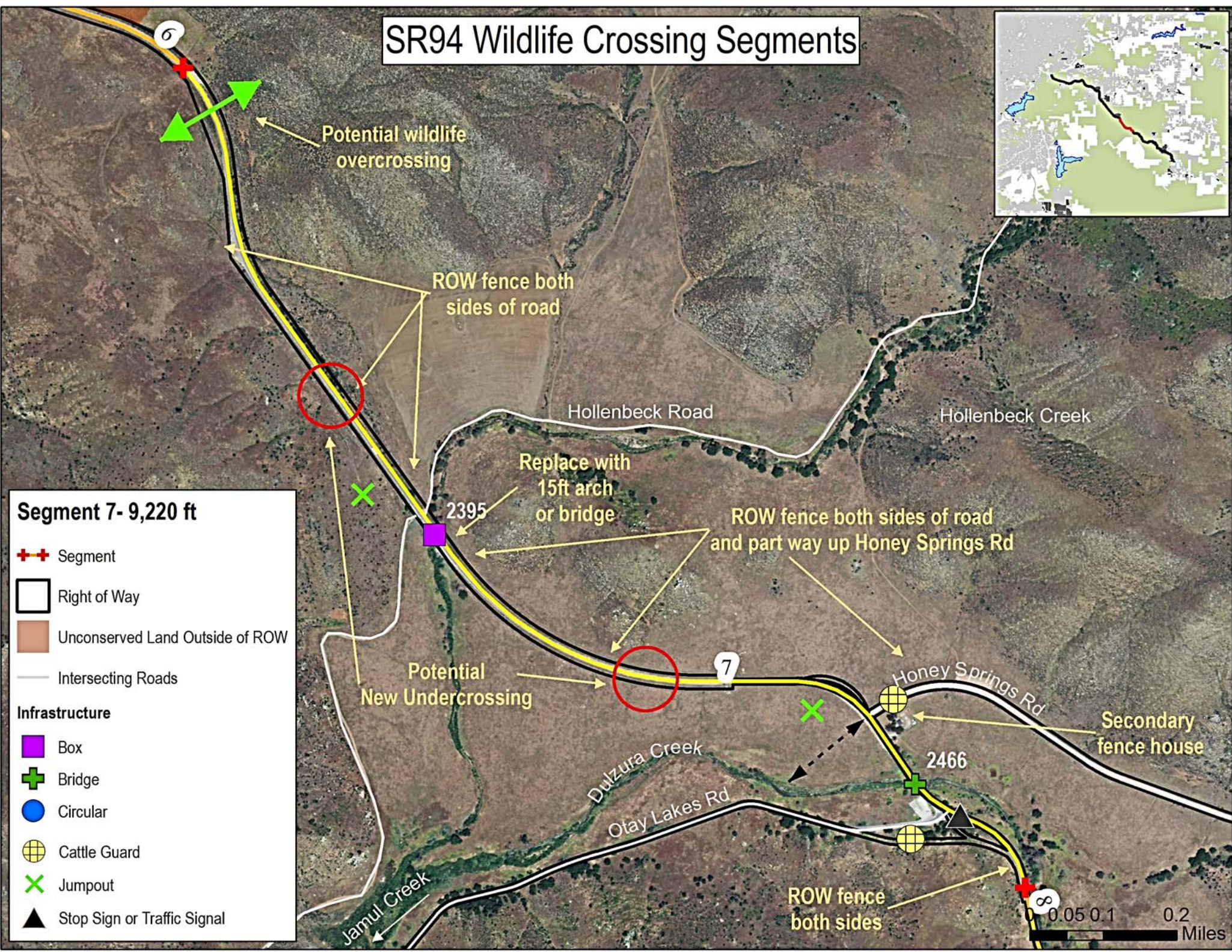
Objectives:

- *Provide for large animal movement, including deer and mountain lions, between RJER and HCWA.*
- *Reduce roadkill by enhancing multiple crossing areas.*

Near-term recommendations:

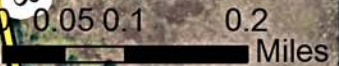
1. Install ≥ 10 ft ROW fencing on both sides of the highway, from the RJER entrance and Daley Ranch property to Hollenbeck Road, Honey Springs Road, and Otay Lakes Road. Use smaller mesh at the bottom of the fence, and bury fencing to prevent coyotes from digging under. Funnel wildlife to the two enhanced undercrossings described below. Tie ROW fencing into the box culvert and bridge abutments.
2. Inspect and, if necessary, replace the two CDFW gates in this segment (Hollenbeck Road, both sides of highway), and tie into the ROW fencing.

SR94 Wildlife Crossing Segments



Segment 7- 9,220 ft

- + + Segment
 - Right of Way
 - Unconserved Land Outside of ROW
 - Intersecting Roads
- Infrastructure**
- Box
 - + Bridge
 - Circular
 - Cattle Guard
 - x Jumpout
 - ▲ Stop Sign or Traffic Signal





3. Replace the two 44-ft long, side-by-side 5x4 ft box culverts (PM 2395) in the middle of this segment with a 15-ft arch or bridge to accommodate deer and mountain lions, re-contour both sides of the bridge with earthen benches, include structural features in the new undercrossing to provide cover for smaller animals, and remove or cover rip-rap to facilitate wildlife use on the approaches to the undercrossing, especially on the downstream side where the drainage is very incised and the topography is lower than on the upstream side of the highway. Maintain trash-pickup in this area.
4. Install a cattle guard on Honey Springs Road, and continue the ROW fencing east on Honey Springs Road to the HCWA Honey Springs parking area on the north side, and past the CDFW residence on the south side. Stagger the end points of the fencing to allow a straight uphill-downhill travel path to the opposite side of the road.
5. Conduct a “Hot Spots Analysis” (Bissonette and Cramer 2008, Wilson 2012) along (a) Honey Springs Road up to Deerhorn Valley and (b) Otay Lakes Road to Otay Lakes to determine where undercrossings should be located for herpetofauna, which are victims of significant roadkill (R. Fisher pers. com.), and identify locations for special herpetofauna fencing to keep small to medium-sized animals off the roads.
6. Install secondary fencing around the house south of Honey Springs Road, beginning at the cattle guard, and tie-in fence to the Dulzura Creek bridge abutments (PM 2466) to encourage wildlife movement around the back of the house to the Dulzura Creek bridge.
7. Determine locations for at least two jump-outs through this segment, based on wildlife movement monitoring.
8. East of Otay Lakes Road, install ROW fence on both sides of SR-94 at the same location as the current barbed-wire fencing, all the way to the Border Patrol checkpoint. The fence on the south side of SR-94 is on top of the slope.

Longer term recommendations:

- Investigate the feasibility of a land bridge over the highway for large animals in the northwest portion of this segment, where topography allows (Map 7). Monitor to determine the most preferred crossing location here. Dodd et al. (2007a) showed that there were significantly more bird flights over vegetated overpasses compared to flights directly over the road.



- Investigate the feasibility of placing undercrossings both north of and south of Hollenbeck Road (red circles on map), as there currently are so few opportunities to cross the road except at-grade.
- The TEE includes one-way stop controls at the Honey Springs Road and Otay Lakes Road intersections.
- Caltrans (2011) includes realignment of deficient curves, highway widening, and a passing lane through this segment, so the near-term priorities listed above could be accommodated during this alignment and widening.

Segment #8 (Map 8)

Existing conditions: Segment 8 of SR-94 is mostly south of the Border Patrol Station, and Dulzura Creek borders the highway on the northeast. BLM administers the lands southwest of the highway, while CDFW (HCWA) and the County (Daley Preserve) administer lands to the north. There are only three 3-ft wide undercrossings through this 1.3-mile segment, and one of them (PM 2515) is right at the Border Patrol Station. Because of the topography through this segment—the coastal sage scrub on the southwest side is steep and higher than the more level grassland and coastal sage scrub in the valley that borders Dulzura Creek—the most likely wildlife movement corridor crosses SR-94 at Sycamore Canyon Road (BLM pink gate), through the oak riparian forest along Dulzura Creek. Although some small animals may use the five 3 ft culverts at this location (PM 2615), which are choked by vegetation, crossing by larger animals is likely at grade. There was evidence of coyote and raccoon in the approach to the culvert, but deer and bobcats are also present in the adjacent habitats, as well as roadrunners and small mammals that are connectivity targets.

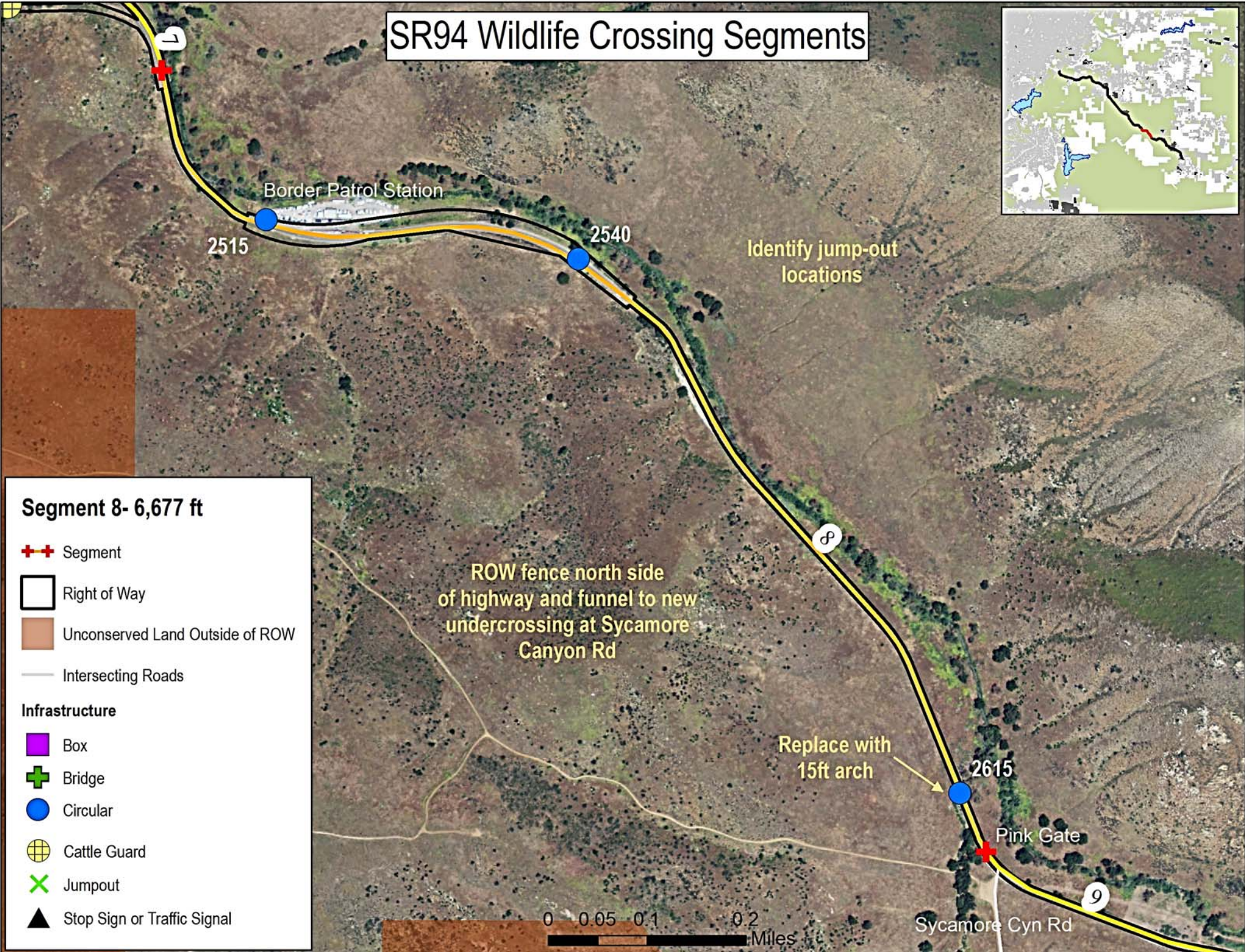
Objectives:

- *Enhance connectivity for large animals, including deer and mountain lions, between BLM Sycamore Canyon and HCWA.*
- *Reduce roadkill by enhancing crossing areas and discouraging animals from crossing the highway at-grade.*

Near-term recommendations:

1. Install ≥ 10 ft ROW fencing along the northeast side of the highway through this segment to discourage wildlife crossings at grade. Bury fencing to prevent coyotes from digging under. Install secondary fencing on the hill on the south side of the highway. Where the fences enter the grasslands at the south end of this segment, reinforce the bottoms

SR94 Wildlife Crossing Segments



Segment 8- 6,677 ft

- ++ Segment
- Right of Way
- Unconserved Land Outside of ROW
- Intersecting Roads
- Infrastructure**
- Box
- ⊕ Bridge
- Circular
- ⊗ Cattle Guard
- ✕ Jumpout
- ▲ Stop Sign or Traffic Signal

ROW fence north side of highway and funnel to new undercrossing at Sycamore Canyon Rd

Replace with 15ft arch



- of the fencing on both sides to prevent smaller animals from getting through. Determine the need for taller ROW fencing through the grassland on the southwest side.
2. Remove and maintain sediment and vegetation at culverts PM 2515 and PM 2540.
 3. Install at least two jump-outs in appropriate locations, based on wildlife movement monitoring.
 4. Replace the five 3 ft culverts (PM 2615) at the pink BLM gate with a 15-ft arch to accommodate large mammals. Contour the approaches as necessary, and clean out the vegetation choking entry into the undercrossing on each side). Include structural features in the new undercrossing to provide cover for smaller animals.
 5. Install fencing to funnel animals to the new undercrossing and tie in with abutments.

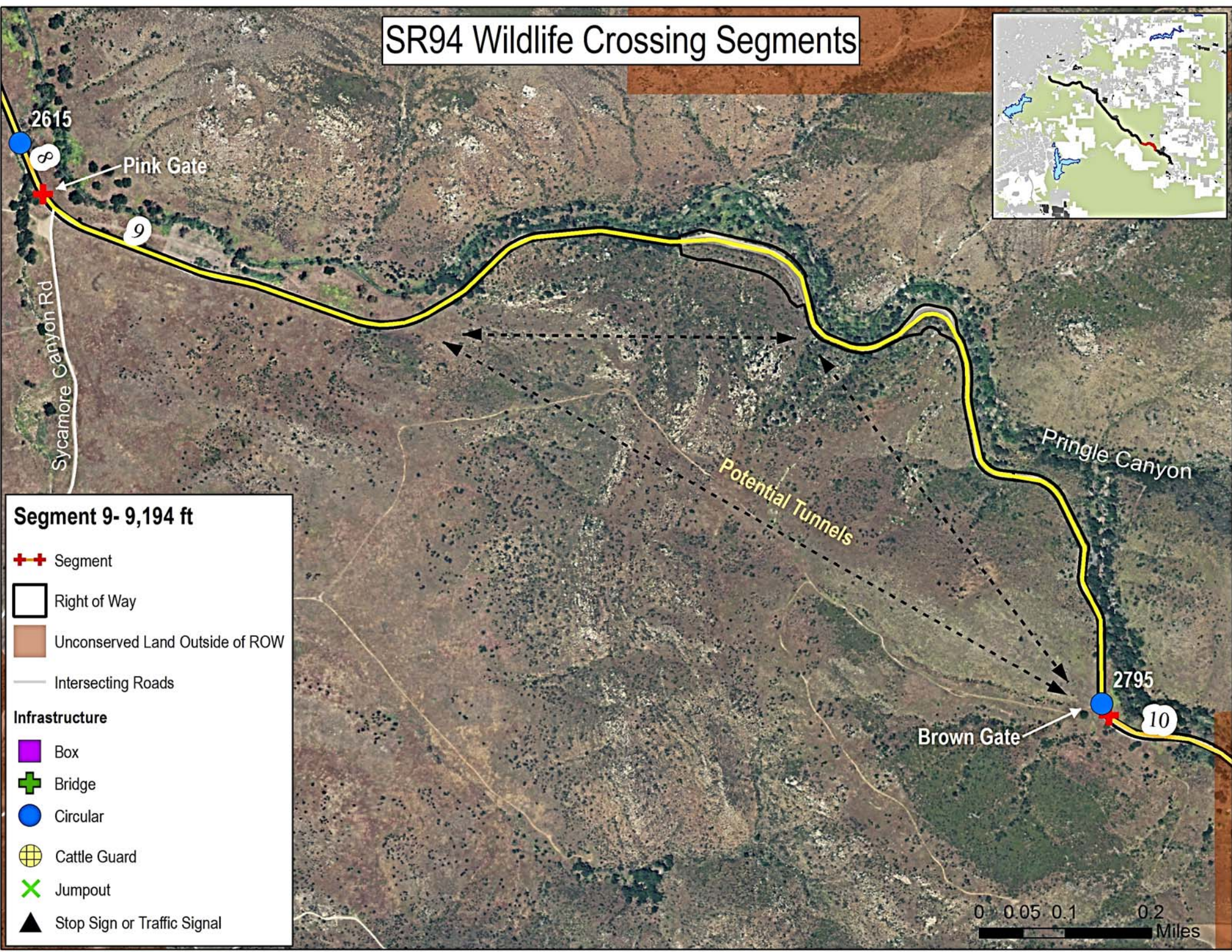
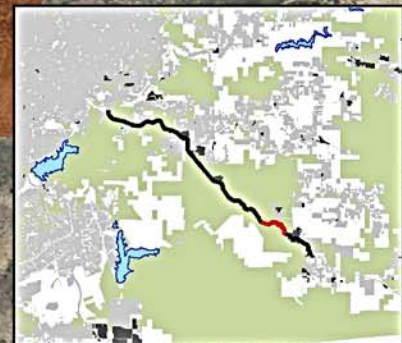
Longer term recommendations:

- Caltrans (2011) includes realignment of deficient curves, road widening, and a passing lane through this segment so could install the new undercrossing concurrently with these improvements.

Segment #9 (Map 9)

Existing conditions: Segment 9 (1.7 mi) runs along the steep, north face of a mountain, with Dulzura Creek ~100 ft below the highway grade, so fencing and jump-outs through this portion are likely not needed. The highway divides BLM land on the south from the County's LB Daley Preserve on the north. Most of the vegetation is coastal sage scrub and chaparral, with oak riparian woodland lining Dulzura Creek and within Pringle Canyon. Because of the difference in elevation, and the steep rock face on the south side of the highway, there are no potential wildlife undercrossings except for the southern end of the segment at the BLM brown gate. There is a wildlife trail from Dulzura Creek to the road at the brown gate, where there is evidence of at-grade crossings by deer, bobcat, and coyote. The 2-ft diameter culvert at this location (PM 2795) is full of sediment and not functional. Coyotes and small mammals were observed in track and camera stations along an unnamed drainage in the middle of this section and in Pringle Canyon on the LB Daley Preserve (TAIC 2011); mule deer, bobcats, and smaller animals have been recorded in the area (Table 2).

SR94 Wildlife Crossing Segments



Segment 9- 9,194 ft

- +++ Segment
 - Right of Way
 - Unconserved Land Outside of ROW
 - Intersecting Roads
- Infrastructure**
- Box
 - ⊕ Bridge
 - Circular
 - ⊗ Cattle Guard
 - ✕ Jumpout
 - ▲ Stop Sign or Traffic Signal





Objectives:

- *Enhance connectivity for large animals between BLM lands and the County's Lawrence and Barbara Daley Preserve.*
- *Identify existing at-grade crossing points, as informed by wildlife movement monitoring.*

Near-term recommendations:

1. Replace the small 2 ft culvert at the brown BLM gate (PM 2795) with a larger undercrossing (e.g., 15 ft arch to accommodate large mammals) that is tied into the fence. Include structural features in the new undercrossing to provide cover for smaller animals.
2. Install jump-outs, as informed by wildlife movement monitoring.
3. Install new gates (replace brown gate on BLM land, south of highway, and gate to restoration area on CDFW land, north of highway); tie into fencing.

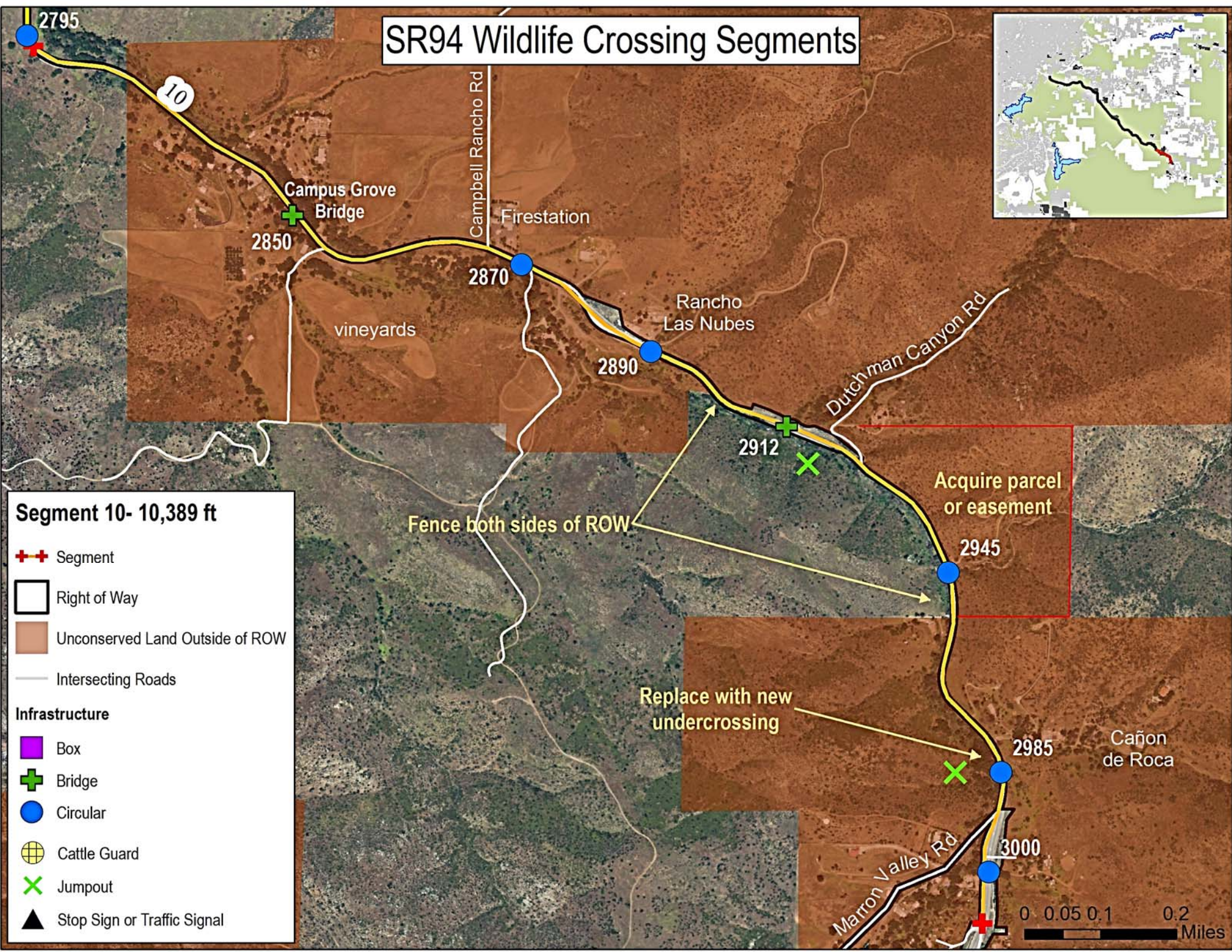
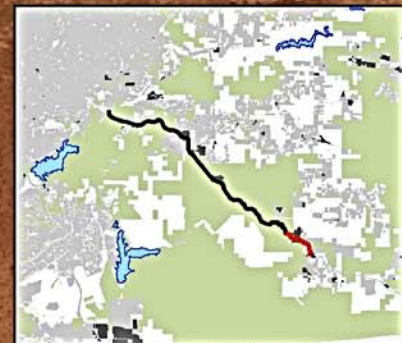
Longer-term recommendations:

- Eliminate the dangerous curves through this segment by tunneling through all or a portion of this segment. This would provide 1.7 miles without a highway, so that animals could move freely across conserved lands.
- Caltrans (2011) includes installation of standard 8 ft shoulders through this segment; it also identifies a "bypass alignment" alternative where there are multiple curves within a short distance, challenging traffic maneuverability.

Segment #10 (Map 10)

Existing conditions: Segment 10 (almost 2 miles) traverses the community of Dulzura, which is mostly private land comprising disturbed habitat, agriculture (vineyards), pasture, and houses, surrounded by coastal sage scrub. The southern end of the segment borders BLM land, with a possible connection across SR-94 to other BLM land. There is a bridge at Camps Grove, with some water flow, that is used by livestock. Oak riparian woodland lines Dulzura Creek, which borders the highway on the north, and Dutchman Canyon also supports oak riparian woodland along with some exotic species along Grande Creek, with a 20 ft high box culvert/bridge at the intersection with SR-94. Because of the narrow ROW and elevation differences between the north and south sides of the highway, there are infrequent places for crossing. In addition to one 1-ft nonfunctional culvert at Dutchman Canyon Road (not shown on Map 10 or Table 4 because of its small size), there are five partially functional culvert undercrossings in this

SR94 Wildlife Crossing Segments



Segment 10- 10,389 ft

- ++ Segment
- Right of Way
- Unconserved Land Outside of ROW
- Intersecting Roads

Infrastructure

- Box
- ⊕ Bridge
- Circular
- ⊘ Cattle Guard
- ✕ Jumpout
- ▲ Stop Sign or Traffic Signal





segment—at the fire station (4 ft diameter culvert) where the steep slope supports a rock wall; at Rancho Las Nubes (5 ft diameter); on the Arbabian parcel (4x3 elliptical culvert) between Dutchman Canyon Road and Canon de Roca; at Canon de Roca (3x2 ft elliptical culvert); and just south of Marron Valley Road. Fencing is not recommended through Dulzura, but the need for fencing should be assessed on BLM property. Mule deer, greater roadrunner, California gnatcatcher, Quino checkerspot butterfly, and Thorne’s hairstreak have been recorded in this area, but roadkill has not been monitored regularly.

Objectives:

- *Enhance connectivity between BLM lands and Forest Service lands.*
- *Encourage wildlife movement under the bridge at Camps Grove in the western portion of the segment.*
- *Facilitate wildlife crossing at-grade in the eastern portion of the segment.*

Near-term recommendations:

1. Monitor this segment seasonally to determine most likely areas for at-grade crossings, best areas to establish jump-outs, and where ROW fencing is needed (e.g., BLM property). Assess where fencing is not needed due to topography or land use relative to the highway (e.g., through the community of Dulzura).
2. Install secondary fence to funnel wildlife under the Camps Grove bridge (PM 2850), and build dry ledges on both sides of the undercrossing. There is evidence of cows and small mammals currently using the bridge undercrossing.
3. Remove and maintain sediment load and vegetation at the culvert (PM 2870) at fire station.
4. Remove the invasive species and other vegetation at the 5 ft concrete culvert (PM 2890) at Rancho Las Nubes (17460 Campo Road). Recontour the drainage, especially upstream, where it is incised. The culvert currently is used by small mammals. Monitor this area to determine wildlife use.
5. Install a dry ledge under the 20 ft bridge over Grande Creek (PM 2912), north of Dutchman Canyon Road, which is being used by raccoons, bobcats, and foxes. Remove invasive species along the openings on each side of the bridge. Based on monitoring, evaluate where directional ROW or secondary fencing is needed to funnel animals to the bridge undercrossing.



6. Install a jump-out (**X**) for deer on the south side of the highway across from the driveway southeast of Dutchman Canyon Road (17771 Campo Road), where there is a 12" culvert that is probably not functional for wildlife movement (not shown on map because of small size). The jump-out should accommodate the 10 ft elevation drop on the south side of the highway and tie into new ROW fencing. Based on monitoring and assessment of the hydrology in this area, evaluate whether a larger culvert is needed.
7. Replace the 4x3 ft elliptical culvert (PM 2945), which does not appear functional for wildlife movement, with a larger culvert to accommodate large animals.
8. Install directional ROW fencing in the area between PM2800 and PM 2945, as informed by monitoring.
9. Elevate the highway at the dirt road intersection at Cañon de Roca (PM 2985, 17764 Campo Road) to eliminate the dip, and install a pre-formed arch or bridge to replace the three small culverts at this location, which appear to be used only by small mammals. Fence or gate the Cañon de Roca driveway. There was sign of coyote crossing at-grade in this area. Place a jump-out on the south side of the highway.
10. Remove and maintain sediment load and vegetation at the culvert (PM 3000) at Marron Valley Road.

Longer term recommendations:

- Caltrans (2011) includes realignment of deficient curves, road widening, and a passing lane through this segment; therefore, these priority enhancements could be accommodated in the high realignment.

3.5 Public Use Recommendations

Improving infrastructure on SR-94 presents an opportunity to also accommodate public uses on conserved lands, such as access points, parking, trails, and other facilities. Public use of wildlife crossings should be evaluated for compatibility with wildlife use as well as compatibility with the county trails master plan.

Segment #1

1. Determine the need to build an all-weather crossing to accommodate equestrians under the SR-94 bridge over the Sweetwater River by placing a hard surface material over the top of the rip-rap. This would replace the existing pedestrian/horse lane on the east side of the bridge (Map 1).



2. The SDNWR would like to build an office, parking lot, and interpretive area in the vacant lot located along the south side of SR-94 east of the Sweetwater River. A trail for pedestrians and horses could be routed from the SDNWR parking lot to the old SR-94 bridge that crosses the Sweetwater River and tie into the existing trail along the south side of the river.
3. Discuss the need for gates with SDG&E; there are no gates now for accessing the easement from SR-94; the dirt road that accesses the easement is across the highway from the baseball fields (Map 1).
4. Improve traffic safety and facilitate traffic entering and exiting at the Millar Ranch Road intersection.
5. Install a traffic signal or stop sign and horse-crossing over SR-94 at Singer Lane. This would allow westward continuation of the trail on the north side of the river.
6. Install a left turn lane to Millar Ranch Road on SR-94 westbound. There already is a left turn lane on SR-94 eastbound.

Segment #2

1. Maintain traffic safety for residential access.

Segment #3

1. Add a parking lot at the pump station for hikers.

Segment #4

1. Maintain traffic safety for residential access.
2. Reduce traffic from Proctor Valley Road.
3. The TEE includes a traffic signal at the Jefferson Road/Proctor Valley Road intersection.
4. The TEE includes two-way stop controls at the Lyons Valley and Melody Road/Peaceful Valley Ranch Road intersections and one-way stop controls at the Maxfield Road and Reservation Road intersections. This would have the effect of slowing east-bound traffic entering RJER.
5. The TEE includes improvements to culverts and the Melody Road bridge to address hydrologic impacts.



Segment #5

1. Consider installing a traffic signal or stop sign at Rancho Jamul Drive. There is already a left-turn lane onto Rancho Jamul Drive eastbound on SR-94 (Map 5).
2. Caltrans (2011) includes widening and a passing lane through this segment. This could be accomplished as part of the near-term priorities above. However, crossings should be improved or created as soon as possible to reduce roadkill regardless of the implementation of a road improvement project.

Segment #6

1. Install a stop sign or traffic signal at Rancho Jamul Drive or at the Daley Ranch Truck Trail, with right and left turn lanes both directions, to slow traffic through RJER and HCWA (Map 6).
2. Investigate the feasibility for having a public entry point, parking, and staging area for RJER across from Rancho Jamul Drive (south side of SR-94).
3. Caltrans (2011) includes widening and a passing lane through this segment.
4. Level the section of highway immediately north of the RJER main gate, where many car accidents occur (T. Dillingham, pers. comm.).

Segment #7

1. Conduct a "Hot Spots Analysis" along (a) Honey Springs Road up to Deerhorn Valley and (b) Otay Lakes Road to Otay Lakes to determine where undercrossings should be located for herpetofauna; identify locations for special herpetofauna fencing to keep small to medium-sized animals off the roads.
2. Re-route Otay Lakes Road to intersect SR-94 at the Honey Springs Road intersection. While this may not improve connectivity, it should improve traffic safety (Map 7). Maintain the left-turn lane from SR-94 westbound to Otay Lakes Road. Install a cattle guard at Otay Lakes Road and a traffic sign or signal at the intersection.
3. The TEE includes one-way stop controls at the Honey Springs Road and Otay Lakes Road intersections.
4. Caltrans (2011) includes realignment of deficient curves through this segment.
5. Caltrans (2011) includes widening and a passing lane through this segment. This could be accomplished as part of implementing the near-term priorities in this segment.



Segment #8

1. Caltrans (2011) includes realignment of deficient curves, road widening, and a passing lane through this segment; a new undercrossing could be accommodated with these improvements.

Segment #9

1. Eliminate the dangerous curves through this segment by tunneling through all or a portion of this segment (Map 9).
2. Caltrans (2011) includes installation of standard 8 ft shoulders through this segment; it also identifies a “bypass alignment” alternative where there are multiple curves within a short distance, challenging traffic maneuverability. These improvements could be accomplished as part of implementing the near-term priorities above and tunneling through all or a portion of this segment.

Segment #10

1. Enhance traffic safety through the community of Dulzura.
2. Caltrans (2011) includes realignment of deficient curves, road widening, and a passing lane through this segment.



4 Opportunities for Infrastructure Improvements

This section summarizes (1) the results of the Jamul Casino environmental evaluation and (2) the improvements that Caltrans has proposed to improve traffic safety and level of service in light of the casino and other development projects. These developments will increase traffic levels on SR-94, Otay Lakes Road, Proctor Valley Road, and other roads in south San Diego County. Proposed improvements to SR-94 provide the opportunity to enhance highway permeability while helping to mitigate regional impacts on wildlife movement and preserve integrity.

4.1 Jamul Indian Village Gaming Development Project

The Tribal Environmental Evaluation (TEE) for the Jamul Casino and Hotel lists the most prominent issues yet to be resolved and areas of controversy as:

- Traffic—potential impacts to level of service for SR-94 and neighboring county roadways
- Community character/visual effects—change in the rural character of the community, impacts to dark skies, and visual effects on the County-designated Scenic Highway
- Fire/emergency service and police service—impacts to the Fire District’s ability to respond to calls in a timely fashion
- Biological resources—operational impacts on the SDNWR and MSCP.

A traffic analysis was conducted that assumes additional traffic controls such as signal lights and one-way and two-way stop signs at various intersections (Kimley-Horn 2012). The County of San Diego has significance criteria that would require additional controls. Kimley-Horn (2012) estimates that almost 80% of the traffic would travel from the direction of Jamacha Road to the casino project site, i.e., through Segments 1-4, regardless of the casino entrance alternative.

The direct and cumulative traffic analyses for the proposed developments do not consider potential impacts of increased traffic to wildlife (i.e., wildlife-vehicle collisions, barrier effects) as part of the significance criteria, but rather evaluate the capacity of the road networks to accommodate projected traffic increases compared to existing traffic. The TEE for the Jamul Casino concludes that, with the recommended intersection improvements, all project-related impacts would be mitigated. The TEE identifies the Willow Creek channel that drains north to south on the reservation property as the only “wildlife corridor” in the project area. The TEE does not consider potential indirect and cumulative impacts of traffic increases to various wildlife species and landscape connectivity and integrity.



Based on the casino traffic analyses and anticipated traffic increases generated by other new developments proposed for Segment 4, Segments 1-4 will receive considerably more daily trips. As traffic volume is a factor in wildlife mortalities and wildlife avoidance, we can infer that these predictions for increased traffic reinforce the need for improvements to address wildlife crossing issues, especially for affected roads (e.g., SR-94, Otay Lakes Road, Proctor Valley Road).

4.2 Caltrans Transportation Concept Summary

Caltrans (2011) developed a Transportation Concept Summary as an analysis tool and conceptual long-range guide to inform future roadway investment decisions. This summary documents existing (2009) and future (2030) Levels of Service (LOS) and Annual Average Daily Traffic (AADT) for different portions of the highway (Table 6). Major development projects proposed for the study area will increase average daily traffic (ADT) levels (Table 7).

Table 6—Levels of service, by segment (Figure 3).

Location	Segments & preserves	2009 AADT	LOS 2009	2030 AADT	LOS 2030
Jamacha Rd to Steele Canyon Rd	1-2, SDNWR	17,700	D	39,700	F
Steele Canyon Rd to Lyons Valley Rd	3-4, SDNWR	18,400	D	35,700	F
Lyons Valley Rd to Honey Springs Rd	4-7, RJER, HCWA	11,400	C	19,800	F
Honey Springs Rd to Otay Lakes Rd	7, RJER, HCWA	6,800	B	12,300	D
Otay Lakes Rd to Dulzura	7-10, RJER, HCWA, BLM, Daley Preserve	7,100	B	15,800	D

Source: Caltrans 2011; only relevant segments included.

Table 7—Major development projects, by segment.

Segment	Project	Description	ADT
4	Jamul Highlands	23 large acre homes	2,400
4	Simpson Farm	97 residential units	7,690
4	Jamul Casino and Hotel	Casino and hotel	9,442
4	Peaceful Valley	Residential units	750
5	Rancho Jamul Estates	120 residential units	1,440

Source: Caltrans 2011; only relevant segments included.

Based on these estimates, District 11 has recommended the following improvements which provide opportunities to address wildlife crossing issues.

- Realignment of deficient curves (Segments 7-10);
- Installation of passing lanes (Segments 5-8, Segment 10);



- Widening of the traveled way (Segments 5-8, Segment 10);
- Installation of standard 8 ft shoulders (Segment 9);
- Adding/improving turn pockets (selected intersections);
- Bridge rails (Segments 6-10); and
- Centerline rumble strip (all segments).

4.3 SR-94 Infrastructure Priorities, Costs, and Schedule

There are immediate actions that could be taken to improve existing undercrossings at minimal cost, as detailed in Section 3.4, for example:

- Remove sediment blocking undercrossings.
- Remove or thin vegetation at the entrances to culverts, remove trash, and install catch basements.
- Improve approaches to undercrossings, such as contouring approaches to decrease elevation differences between sides of the highway.
- Cover rip-rap along Sweetwater River and within undercrossings.
- Install structural cover for small animals under bridges, and create dry ledges for movement.
- Repair or remove existing fencing as described in Section 3.4, and add directional fencing where needed.
- Install cattle guards.

Decisions on priorities and schedule by segment will obviously depend on funding and funding sources. However, prioritization should consider these factors:

1. The presence of conserved lands on both sides of the highway, where the highway is assumed to be a barrier to movement and ecosystem function (i.e., all but segments 2, 4, and 10).
2. Existing and proposed land uses, and thus level of traffic and loss of habitat near the highway. Based on the Jamul Casino traffic analyses and proposed new developments, there will be greater habitat loss to development and increased traffic in Segments 1-4. Sections 3 and 5 bisect conserved lands within and adjacent to these segments. Based on this analysis, the highest priorities for infrastructure improvements to SR-94 are Segments 3 and 5 (Table 5). However, not included in the TEE analysis was the potential traffic from Tecate, by Mexican workers supporting the casino and hotel. There will also



be traffic increases on Otay Lakes Road and Proctor Valley Road, where infrastructure improvements should be addressed (see Section 1.3).

3. Segments 6, 7, 8, and 9 cross the areas most likely to support large animals, i.e., deer and mountain lions, especially where riparian areas cross the highway and there are conserved lands on both sides of the highway. Tunneling through Segment 9 would remove 1.7 miles of highway where large animals could cross freely.

See Appendix C for costs and schedule examples.



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6 Acknowledgements

The following land managers and wildlife experts accompanied CBI in the field to evaluate existing infrastructure on SR-94, reviewed earlier drafts and recommendations of this document, and provided field notes, data, and reports to assist in evaluating wildlife use of the study area:

Barry Martin, Wildlife Tracking Company
Carlton Rochester and Robert Fisher, U.S. Geological Survey
Jill Terp and John Martin, USFWS, San Diego National Wildlife Refuge
Joyce Schlacter, U.S. Bureau of Land Management
Ron Rempel and Yvonne Moore, San Diego Management and Monitoring Program
Sally Brown, U.S. Fish and Wildlife Service
Tim Dillingham and Tracie Nelson, California Department of Fish and Wildlife
Winston Vickers, U.C. Davis Wildlife Health Center

The San Diego Management and Monitoring Program provided in-kind support in the preparation of this document: Emily Perkins provided all report graphics and mapping, and Ron Rempel and Yvonne Moore provided data and comments on earlier drafts.

Scientists from the U.S. Geological Survey and The Nature Conservancy reviewed and commented on recommendations in this report: Cheryl Brehme (USGS) and Trish Smith (TNC).

Staff from the California Department of Transportation—Bruce April, Kim Smith, Robert Shanaberger, Sue Scatolini, Wendy Dandeneau, Nancy Siepel—provided data on existing infrastructure and example costs. Jeffrey Meyer and Molly Dana of San Diego Gas & Electric provided information on the SDG&E easement east of Steele Canyon High School.

Engineering students of John Prince at San Diego State University designed the undercrossing recommended to improve connectivity between portions of the San Diego National Wildlife Refuge. Megan Jennings of San Diego State University shared literature on road ecology and infrastructure recommendations.

Susan Wynn of the U.S. Fish and Wildlife Service provided guidance on the initial proposal. David Mayer, Shannon Lucas, and Heather Pert of the California Department of Fish and Wildlife provided proposal guidance, report review, and contract support.



Appendices

- A MSCP covered species in MU3
- B Roadkill by segment
- C Example infrastructure designs, costs, and schedule
- D SR-94 wildlife crossing and highway expansion (SIMBA 2013)
- E SR-94 wildlife crossing and safety assessment (Dillingham 2015)