VEGETATION MANAGEMENT PLAN
FOR THE
HELLHOLE CANYON PRESERVE AND ADDITIONS
COUNTY OF SAN DIEGO
DEPARTMENT OF PARKS AND RECREATION

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ACRONYMS AND ABBREVIATIONS

Acronym	Definition
Additions	Hellhole Canyon Preserve Addition 1, Addition 2, Addition 3, Chabad, Sierra Verde (most recent acquisition of 671 acres)
BLM	Bureau of Land Management
BMP	best management practice
CAL FIRE	California Department of Forestry and Fire Protection
Cal-IPC	California Invasive Plant Council
County	County of San Diego
CRHR	California Register of Historical Resources
DPR	County Department of Parks and Recreation
EDRR	Early Detection Rapid Response
FMZ	Fuel Modification Zone
FRMP	Framework Resource Management Plan
MOU	Memorandum of Understanding
MSCP	Draft North San Diego County Multiple Species Conservation Program
NCCP	Natural Community Conservation Program
Original Preserve	Hellhole Canyon Preserve (original 1,851 acres)
Preserve	Hellhole Canyon Preserve (Original Preserve and Additions, 2,522 acres)
RMP	Resource Management Plan
VCM	Vegetation Classification Manual for Western San Diego County
VMP	Vegetation Management Plan
VMU	Vegetation Management Unit

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1.0 INTRODUCTION

The Hellhole Canyon Preserve consists of an approximately 2,522-acre open space preserve (hereafter referred to as the Preserve) located within an unincorporated area of San Diego County (County). The Preserve falls under the planning boundaries of the Draft North San Diego County Multiple Species Conservation Program (MSCP) Subarea Plan and is owned by the County Department of Parks and Recreation (DPR) as a result of multiple acquisitions between 1973 and 2019. A baseline biodiversity report and a Resource Management Plan (RMP) was prepared in 2008 and 2009, respectively, for preserve acquisitions that occurred prior to that time (TAIC 2008; County of San Diego 2009b). In 2019, a baseline biodiversity report was prepared for more recent Preserve acquisitions, occurring between 2010 and 2019 (ESA 2019a). The results will be integrated into the existing RMP, which will be used to guide the management and preservation of resources within the Preserve in its entirety.

The majority of the Preserve consists of moderate to very-high-quality habitat. Some areas of the Additions are considered lower quality due to habitat disturbance from past agricultural use, unauthorized human activities (e.g., unauthorized trails), and/or development of recreational facilities (e.g., camping areas, restrooms, vehicle staging areas). Vegetation management within the Preserve is necessary to protect species diversity and enhance habitat for special-status plant and wildlife species, as well as to reduce the risk of catastrophic fire.

1.1 PURPOSE AND NEED

The purpose of this Vegetation Management Plan (VMP) is to describe current conditions related to vegetation and fuels and provide guidance and recommendations for vegetation management within the Preserve. The three main components of vegetation management addressed by the VMP for the Preserve include: (1) invasive species removal, (2) habitat restoration and enhancement, and (3) fire management. The VMP provides detailed implementation measures to ensure that conserved vegetation on the Preserve is managed in order to continue to provide habitat for special-status plant and wildlife species and protect species diversity, as well as reduce the risk of catastrophic fire. Although this VMP is intended to be a stand-alone document, the information and recommendations presented will be used by DPR to incorporate into the existing RMP for the Preserve.

The Invasive Plant Species Management section (Section 3) of this VMP lists the invasive non-native plant species observed on the Preserve, identifies and prioritizes target invasive species for removal, and outlines standard removal methods. The Habitat Restoration section (Section 4) of this VMP identifies potential restoration opportunities within the Preserve and outlines standard restoration methods. The Fire Management section (Section 5) of this VMP outlines a framework to address wildfire risk and includes a discussion of fuel management activities that can be

implemented as preventative measures within and adjacent to the Preserve. In addition, this section provides fire response personnel with site information for emergency fire response within and immediately adjacent to the Preserve boundaries.

The goals and objectives as well as the recommendations in this VMP are consistent with the draft Framework Resource Management Plan (FRMP) prepared for the draft North County MSCP Plan (County of San Diego 2018), which includes management directives and stewardship guidelines related to habitat restoration, invasive plant species control, and fire and vegetation management within the MSCP Preserve, as well as the County of San Diego Vegetation Management Report (County of San Diego 2009a), which addresses vegetation management criteria for wildland and urban areas of unincorporated San Diego County. It is anticipated that this VMP will be revised once every 5 years, as needed, in conjunction with anticipated Preserve RMP updates. The VMP may be revised on a shorter timescale if there is a change in circumstance, such as acquisition of additional Preserve land, or a wildfire event on-site.

1.2 SITE LOCATION AND DESCRIPTION

The Preserve is located approximately 6 miles northeast of Escondido in Valley Center, east of Valley Center Road, in an unincorporated area of San Diego County (**Figure 1**). The Original Preserve is mapped within the U.S. Geological Survey 7.5' Oceanside/Borrego Valley Quadrangle, Township 11 South, Range 1 West, Sections 11–15 and Township 11 South, Range 1 East, Section 7. The Additions are located in the Boucher Hill and Rodriguez Mountain Quadrangles and within Township 11 South, Range 1 West in section 14 and Township 11 South, Range 1 East in Sections 7, 8, and 19 (**Figure 2**). To the south, the Preserve is bounded by the community of Valley Center and the San Pasqual Indian Reservation, and to the north by Bureau of Land Management (BLM) land and the Rincon Indian Reservation. The Preserve can currently be accessed from eight locations, including Santee Lane, Canal Road, Sierra Verde Road, and Hell Creek Road.

For the purposes of this report, the Preserve is divided into six preserve areas for discussion and management purposes. Areas acquired prior to 2010, totaling approximately 1,851 acres composed of ten parcels, are referred to as the Original Preserve (**Figure 3**). Areas acquired between 2010 and 2018 totaling approximately 671 acres spanning an additional ten parcels, are collectively referred to as the Additions. The Additions are divided into five distinct sub-areas: Addition 1, Addition 2, Addition 3, Chabad, and Sierra Verde (**Figure 3**). A list of Assessor's Parcel Numbers is included in **Table 1** by preserve area (**Figure 3**).

Table 1. Assessor's Parcel Numbers

Preserve Areas	Assessor's Parcel Numbers
Original Preserve	188-100-39, 189-080-57, 189-080-58, 189-052-31, 188-310-02, 189-080-02, 189-080-25, 189-080-26, 191-069-19, 189-081-24
Addition 1	189-080-11; 189-080-10
Addition 2	189-080-01
Addition 3	191-060-21
Chabad	191-060-06; 191-060-02; 191-060-01
Sierra Verde	191-180-08; 191-180-07; 191-180-05

The Preserve is located in northeastern San Diego County in the Peninsular Geomorphic Range (Fuller et al. 2015) and consists of two main mountains, Rodriguez Mountain and an unnamed mountain, as well as Hell Creek and several drainages and unnamed streams with oak woodland habitat, rocky hills, and valleys north and east of Paradise Mountain. Elevations within the Preserve range from 996 feet to 3,882 feet above mean sea level. The western face of Rodriguez Mountain is located within the Chabad Addition and the second unnamed mountain occurs within the Original Preserve. The Preserve is primarily surrounded by preserved open space areas and Rancho Guejito, as well as scattered rural residential development.

The Preserve is located within the planning boundaries of the County's draft MSCP Plan (**Figure 3**). The draft North County MSCP Plan would extend the boundaries of the County's MSCP into unincorporated areas in northwestern San Diego County. Upon approval, the draft North County MSCP Plan would assemble a preserve system to protect species and habitats covered by the plan. The draft North County MSCP Plan includes a draft FRMP to guide the preparation of RMPs for lands conserved under the MSCP (County of San Diego 2017a; County of San Diego 2018). The Preserve provides habitat for plant and wildlife species covered by the draft North County MSCP Subarea Plan, including Engelmann oak (*Quercus engelmannii*) and pallid bat (*Antrozous pallidus*).

1.3 VEGETATION MANAGEMENT GOALS AND OBJECTIVES

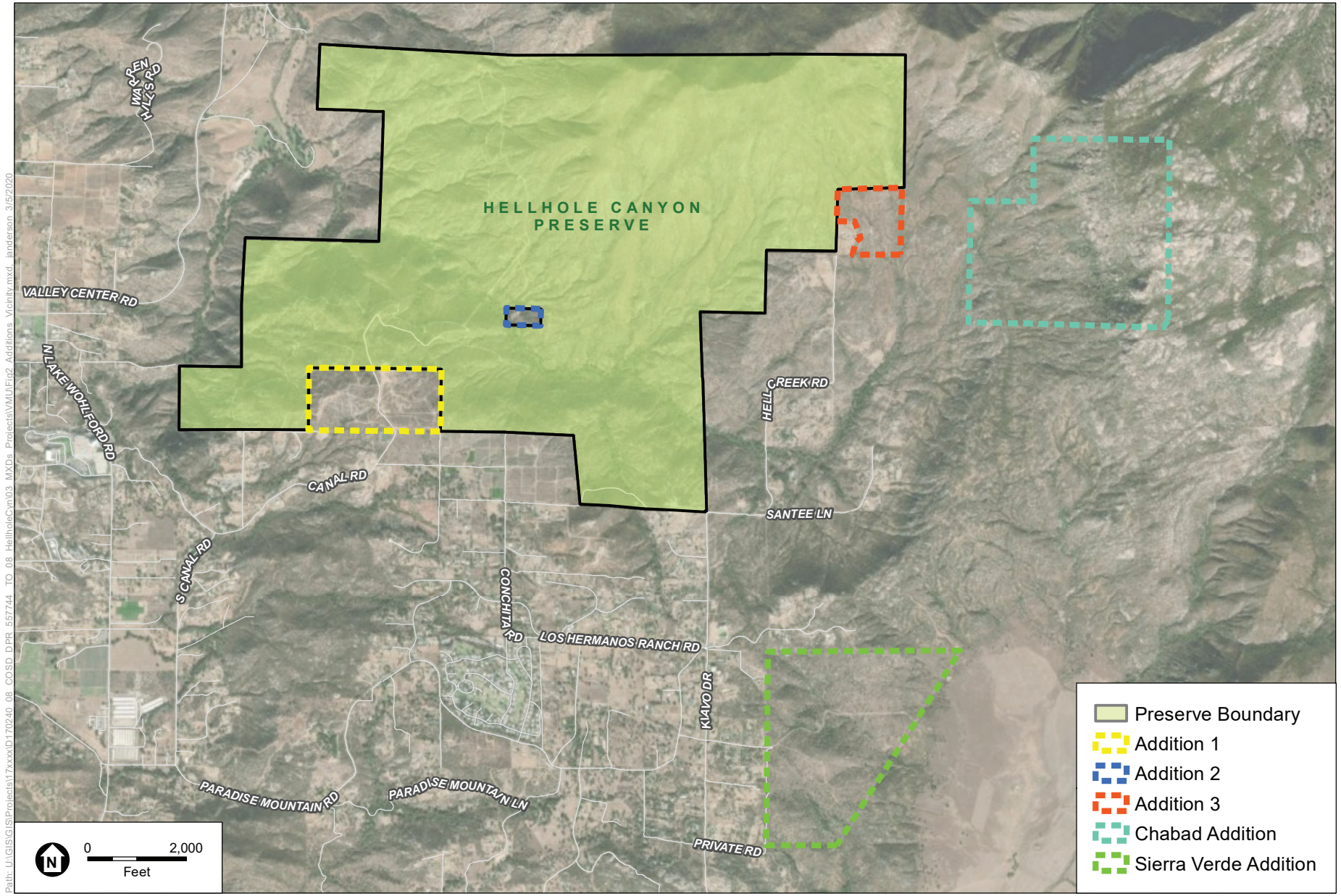
This VMP aims to develop management strategies consistent with the County of San Diego Vegetation Management Report (County of San Diego 2009a), which addresses vegetation management criteria for wildland and urban areas of unincorporated San Diego County. The overall goal of the VMP is to ensure the long-term viability and sustainability of natural ecosystem function and processes through invasive plant management, habitat restoration, and fire management. Specific goals and objectives of this VMP are as follows:

- Goal 1: Manage invasive non-native plant species to ensure preservation of native vegetation communities and resources.
  - Objective 1.1: Identify target high-priority invasive non-native plant species as well as appropriate removal methods.

  - Objective 1.2: Implement an Early Detection Rapid Response (EDRR) program to facilitate early detection and management of invasive non-native plant species occurrences before becoming significant management issues.
- Goal 2: Restore and/or enhance the quality of degraded vegetation communities in a manner consistent with overall species and habitat preservation goals.
  - Objective 2.1: Restore unauthorized trails using passive restoration methods, where feasible. Utilize active restoration methods where passive methods are unsuccessful.
  - Objective 2.2: Implement active restoration projects that encourage the preservation of sensitive species such as the Engelmann oak population.
- Goal 3: Implement fire management methods that are consistent with overall management goals for the Preserve.
  - Objective 3.1: Reduce fuel loads through management of non-native plant species and maintenance of Fuel Modification Zones (FMZs).
  - Objective 3.2: Properly maintain access roads and established roads.

SOURCE: SanGIS

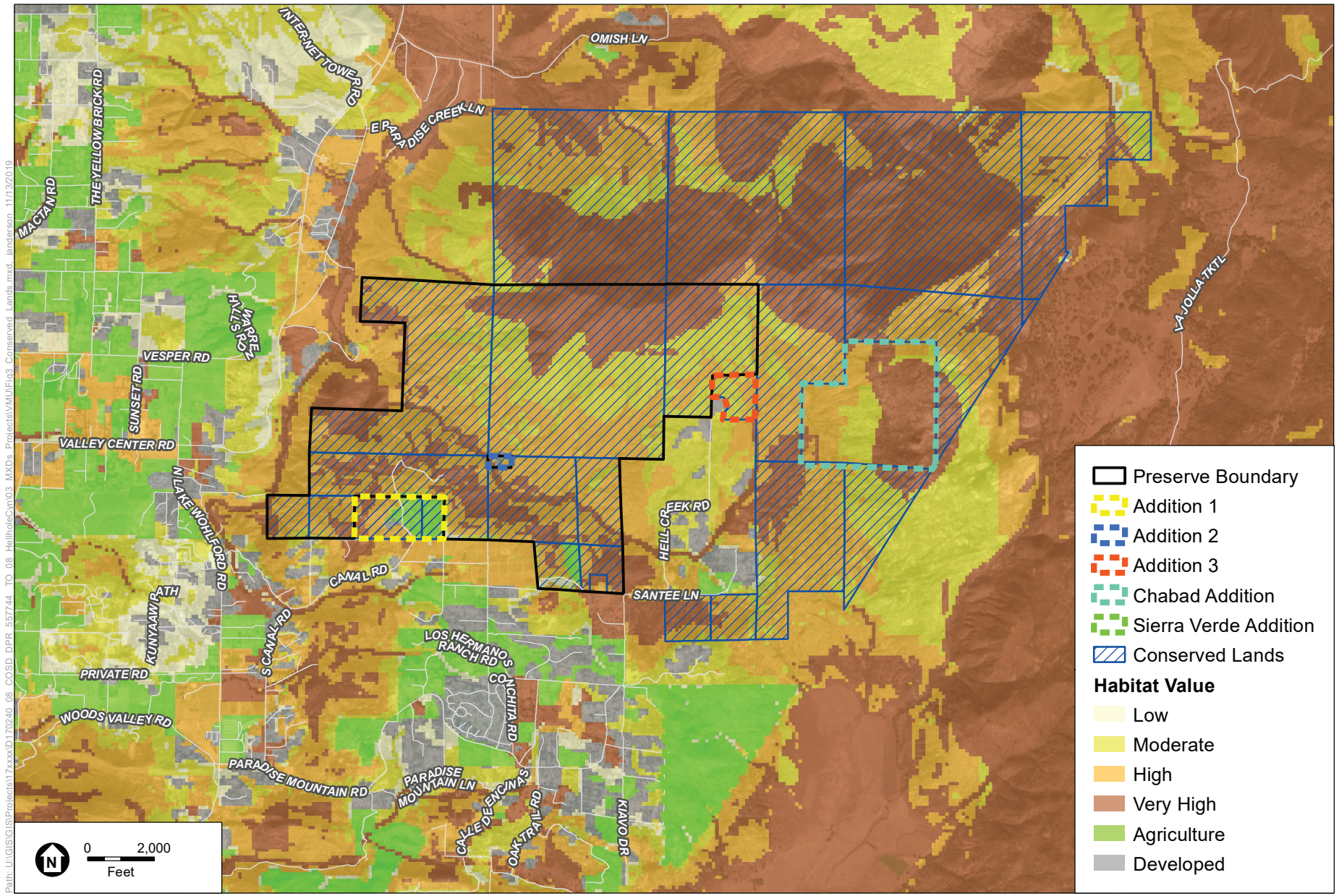
Figure 1
Regional Location



SOURCE: ESRI, 2019; SanGIS, 2019.

Figure 2
Preserve Vicinity Map

ESA



SOURCE: ESRI, 2019; SanGIS, 2019.

Figure 3
Multiple Species Conservation Plan and Conserved Lands

ESA

2.0 ENVIRONMENTAL RESOURCES

Baseline biological surveys were initially conducted by Technology Associates and the San Diego Natural History Museum within the Original Preserve in the winter, spring, and summer of 2008. Additional baseline biological surveys of the Additions were conducted by ESA from spring 2019 through fall 2019. Surveys conducted in 2019 included: vegetation mapping, invasive non-native plant species mapping, rare plant surveys, butterfly surveys, small-mammal trapping, an aquatic survey, herpetological drift fence surveys, diurnal and nocturnal avian surveys, passive and active acoustical bat surveys, focused arroyo toad surveys, pitfall trapping to sample amphibians, reptiles, and small mammals, and medium- and large-mammal remote camera surveys. Brief descriptions of the existing vegetation communities, sensitive biological and cultural resources documented within the Preserve during the baseline surveys are provided below.

2.1 BIOLOGICAL RESOURCES

2.1.1 Vegetation Communities

Vegetation community classification for the Original Preserve follows the Oberbauer (2006) modified Holland (1986) Vegetation Classification System. For the Additions, vegetation community classification was based on two separate systems: The Vegetation Classification Manual for Western San Diego County (VCM) (Sproul et al. 2011) and the Holland (1986) (as modified by Oberbauer et al. 2008) classification system. Field mapping of vegetation communities and land cover for the Additions was conducted in spring 2018 according to the VCM and then cross-walked to the Holland/Oberbauer classification system. Acreages of the vegetation communities for the Original Preserve and the Additions are presented in separate tables as the Original Preserve vegetation classification does not specify the VCM classification or the acreage within the 100-foot buffer (**Table 2a** and **Table 2b** and shown in **Figures 4a** through **4g**).

Vegetation on the Preserve consists of 18 vegetation communities, as classified by Holland/Oberbauer, including mafic southern mixed chaparral and eucalyptus woodland found only within the Original Preserve; non-native grassland, Diegan coastal sage scrub, southern mixed chaparral, coast live oak woodland, and southern coast live oak riparian forest occurring within the Original Preserve and the Additions; and coastal scrub, disturbed Diegan coastal sage scrub, disturbed flat-topped buckwheat, flat-topped buckwheat, chamise chaparral, *Ceanothus crassifolius* chaparral, scrub oak chaparral, southern willow scrub, disturbed open coast live oak woodland, non-native woodland, and mulefat scrub occurring within the Additions.

The predominant vegetation community within the Preserve is southern mixed chaparral, which makes up approximately 1,571.94 acres or 62 percent of the Preserve. Other major vegetation communities include southern coast live oak riparian forest (184.37 acres or 7.3 percent), scrub oak chaparral (105.66 acres or 4.2 percent), open coast live oak woodland (97.23 acres or 3.9 percent), and flat-topped buckwheat (44.85 acres or 1.8 percent).

Table 2a. Vegetation Communities/Land Cover Type Acreages for Hellhole Canyon Original Preserve

Holland/Oberbauer	Acreage[1]
Herbaceous	
42200 Non-Native Grassland	0.9
Scrub	
32500 Diegan Coastal Sage Scrub	5.0
37120 Southern Mixed Chaparral	1,438.0
37122 Mafic Southern Mixed Chaparral	274.7
Woodland	
71160 Coast Live Oak Woodland	43.6
11100 Eucalyptus Woodland	0.5
Riparian	
61310 Southern Coast Live Oak Riparian Forest	50.7
Other	
11300 Disturbed Habitat	25.4
12000 Urban/Developed	12.2
Total	**1,850.9**

[1] Acres within the Original Preserve boundaries. Acreages do not include vegetation within the 100 ft. mapped buffer around the Preserve.
[2] Vegetation acreage may not sum precisely due to rounding.
SOURCE: TAIC 2008

Table 2b. Vegetation Communities/Land Cover Type Acreages for Hellhole Canyon Additions

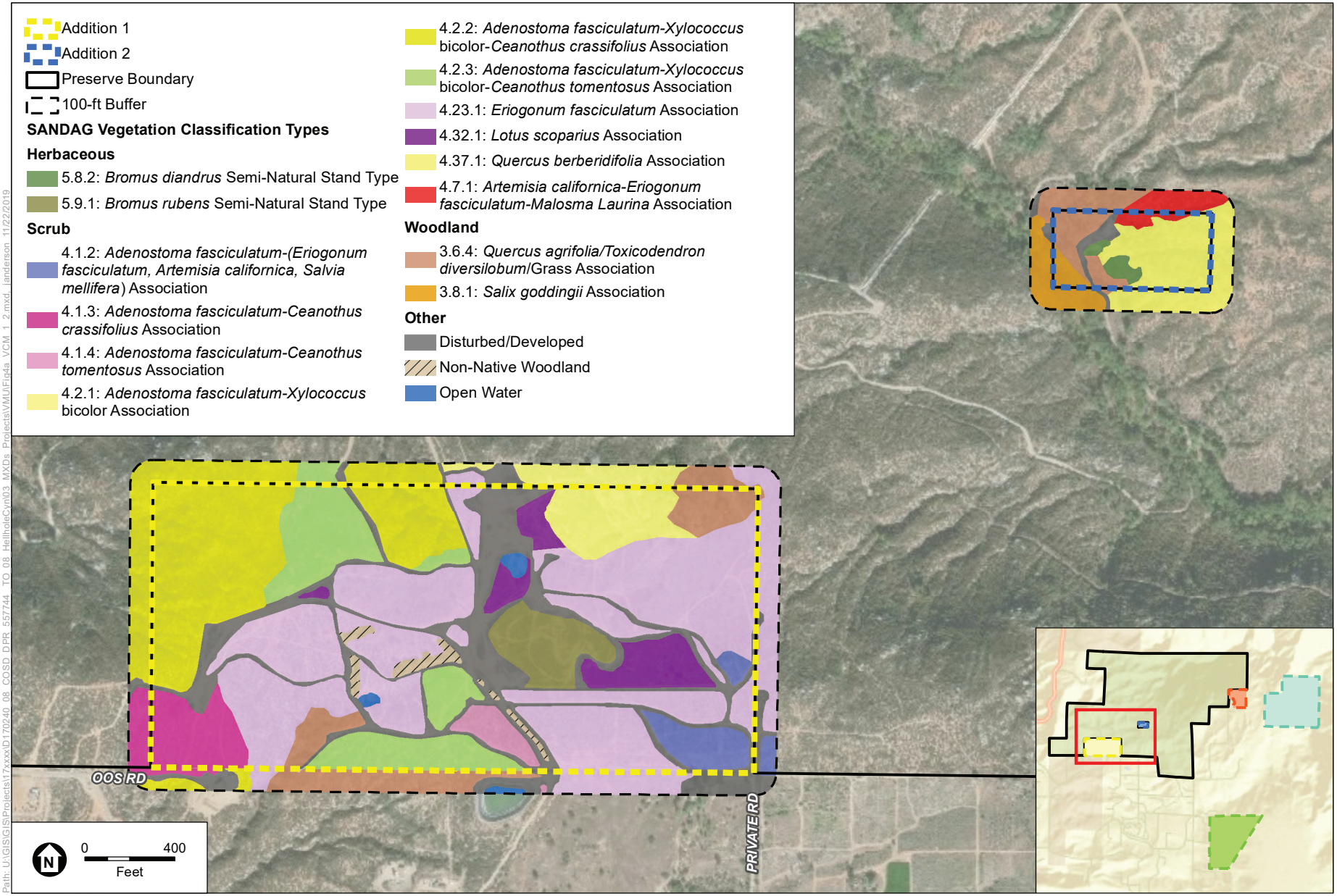
San Diego Vegetation Classification Manual		Holland/ Oberbauer	Additions Acreage	100-foot Buffer Acreage
Alliance Level	**Association Level**			
Herbaceous				
Bromus (*diandrus, hordeaceus)-Brachypodium distachyon* Semi-Natural Stands	5.8.2 *Bromus diandrus* Semi-Natural Stand Type; Ripgut Brome Semi-Natural Stand Type	42200 Non-Native Grassland	0.44	—
	5.9.1 *Bromus rubens* Semi-Natural Stand Type; Red Brome Semi-Natural Stand Type		2.95	—
Bromus rubens Alliance	5.21 Mediterranean California Naturalized Annual and Perennial Grassland Semi-Natural Stands		5.80	1.73
Scrub				
Malosma laurina Alliance	4.35 *Malosma laurina* Alliance; Laurel Sumac Alliance	32000 Coastal Scrub	11.11	—
Acmispon glaber Alliance	4.32.1 *Acmispon glaber* (=Lotus scoparius) Association; Coastal Deerweed Association[1]	32500 Disturbed Diegan Coastal Sage Scrub	0.12	—
Artemisia californica Alliance	4.7.1 *Artemisia californica – Eriogonum fasciculatum – Malosma laurina* Association; California Sage Brush – California Buckwheat – Laurel Sumac Association	32500 Diegan Coastal Sage Scrub	0.33	0.84
Adenostoma fasciculatum Alliance	4.2.2 *Adenostoma fasciculatum – Xylococcus bicolor – Ceanothus crassifolius* Association; Chamise – Mission Manzanita – Hoaryleaf Ceanothus Association	32800 Disturbed Flat-Topped Buckwheat	2.84	0.97
Eriogonum fasciculatum Alliance	4.23.1 *Eriogonum fasciculatum* Association; California Buckwheat Association		23.65	3.89
Acmispon glaber Alliance	4.32.1 *Acmispon glaber* (=Lotus scoparius) Association; Coastal Deerweed Association[1]		1.29	—
Eriogonum fasciculatum Alliance	4.23.1 *Eriogonum fasciculatum* Association; California Buckwheat Association	32800 Flat-Topped Buckwheat	42.66	4.16
Acmispon glaber Alliance	4.32.1 *Acmispon glaber* (=Lotus scoparius) Association; Coastal Deerweed Association[1]		2.19	—

San Diego Vegetation Classification Manual		Holland/ Oberbauer	Additions Acreage	100-foot Buffer Acreage
Alliance Level	**Association Level**			
Adenostoma fasciculatum Alliance	4.1.2 *Adenostoma fasciculatum – (Eriogonum fasciculatum, Artemisia californica, Salvia mellifera)* Association; Chamise – (California Buckwheat, California Sage Brush, Black Sage) Association	37120 Southern Mixed Chaparral	2.07	0.31
	4.1.4 *Adenostoma fasciculatum – Ceanothus tomentosus* Association; Chamise – Woollyleaf Ceanothus Association		1.04	0.03
	4.2.2 *Adenostoma fasciculatum – Xylococcus bicolor – Ceanothus crassifolius* Association; Chamise – Mission Manzanita – Hoaryleaf Ceanothus Association		11.55	3.76
	4.2.3 *Adenostoma fasciculatum – Xylococcus bicolor – Ceanothus tomentosus* Association; Chamise – Mission Manzanita – Woollyleaf Ceanothus Association		7.81	0.42
Ceanothus leucodermis Alliance	4.16.1 *Ceanothus leucodermis* Association; Chaparral Whitethorn Association		16.95	2.37
Malosma laurina Alliance	4.35 *Malosma laurina* Alliance; Laurel Sumac Alliance		80.97	9.36
Quercus berberidifolia Alliance	4.37.1 *Quercus berberidifolia* Association; Inland Scrub Oak Association		2.83	2.10
Quercus (*berberidifolia, Xacutidens*) Alliance	4.38.1 *Quercus* (*berberidifolia,* x*acutidens*) – *Adenostoma fasciculatum* Association; Scrub Oak – Chamise Association		1.45	2.77
Quercus agrifolia Alliance	3.6 *Quercus agrifolia* Alliance; Coast Live Oak Alliance		9.27	—

San Diego Vegetation Classification Manual		Holland/ Oberbauer	Additions Acreage	100-foot Buffer Acreage
Alliance Level	**Association Level**			
Adenostoma fasciculatum Alliance	4.1.2 *Adenostoma fasciculatum – (Eriogonum fasciculatum, Artemisia californica, Saliva mellifera)* Association; Chamise – (California Buckwheat, California Sage Brush, Black Sage) Association	37200 Chamise Chaparral	18.14	1.88
	4.1.3 *Adenostoma fasciculatum – Ceanothus crassifolius*; Chamise – Hoaryleaf Ceanothus Association		2.81	1.10
	4.2.1 *Adenostoma fasciculatum – Xylococcus bicolor*; Chamise – Mission Manzanita Association		8.32	3.85
	4.2.2 *Adenostoma fasciculatum – Xylococcus bicolor – Ceanothus crassifolius* Association; Chamise – Mission Manzanita – Hoaryleaf Ceanothus Association		30.27	9.52
	4.2.6 *Adenostoma fasciculatum – Xylococcus bicolor – Quercus* (*berberidifolia, xacutidens*); Chamise – Mission Manzanita – Scrub Oak Association		4.85	—
Adenostoma fasciculatum Alliance	4.1.3 *Adenostoma fasciculatum – Ceanothus crassifolius* Association; Chamise – Hoaryleaf Ceanothus Association	37820 *Ceanothus crassifolius* Chaparral	1.37	—
Quercus (*berberidifolia, Xacutidens*) Alliance	4.37.3 *Quercus* (*berberidifolia,* x*acutidens*) – *Ceanothus leucodermis* Association; Scrub Oak – Chaparral Whitethorn Association	37900 Scrub Oak Chaparral	104.79	12.71
	4.38.1 *Quercus* (*berberidifolia, xacutidens*) – *Adenostoma fasciculatum* Association; Scrub Oak – Chamise Association		0.87	0.42
Salix gooddingii Alliance	3.8.1 *Salix gooddingii* Association; Goodding's Black Willow Association	63320 Southern Willow Scrub	0.39	1.32
Woodland				
Quercus agrifolia Alliance	3.6 *Quercus agrifolia*; Coast Live Oak Association	61310 Southern Coast Live Oak Riparian Forest	0.30	1.44
	3.6.2 *Quercus agrifolia/Quercus (berberidifolia,* x*acutidens)* Association; Coast Live Oak/Scrub Oak Association		133.37	11.62
Quercus agrifolia Alliance	3.6 *Quercus agrifolia*; Coast Live Oak Association	71161 Disturbed Open Coast Live Oak Woodland	23.21	0.41

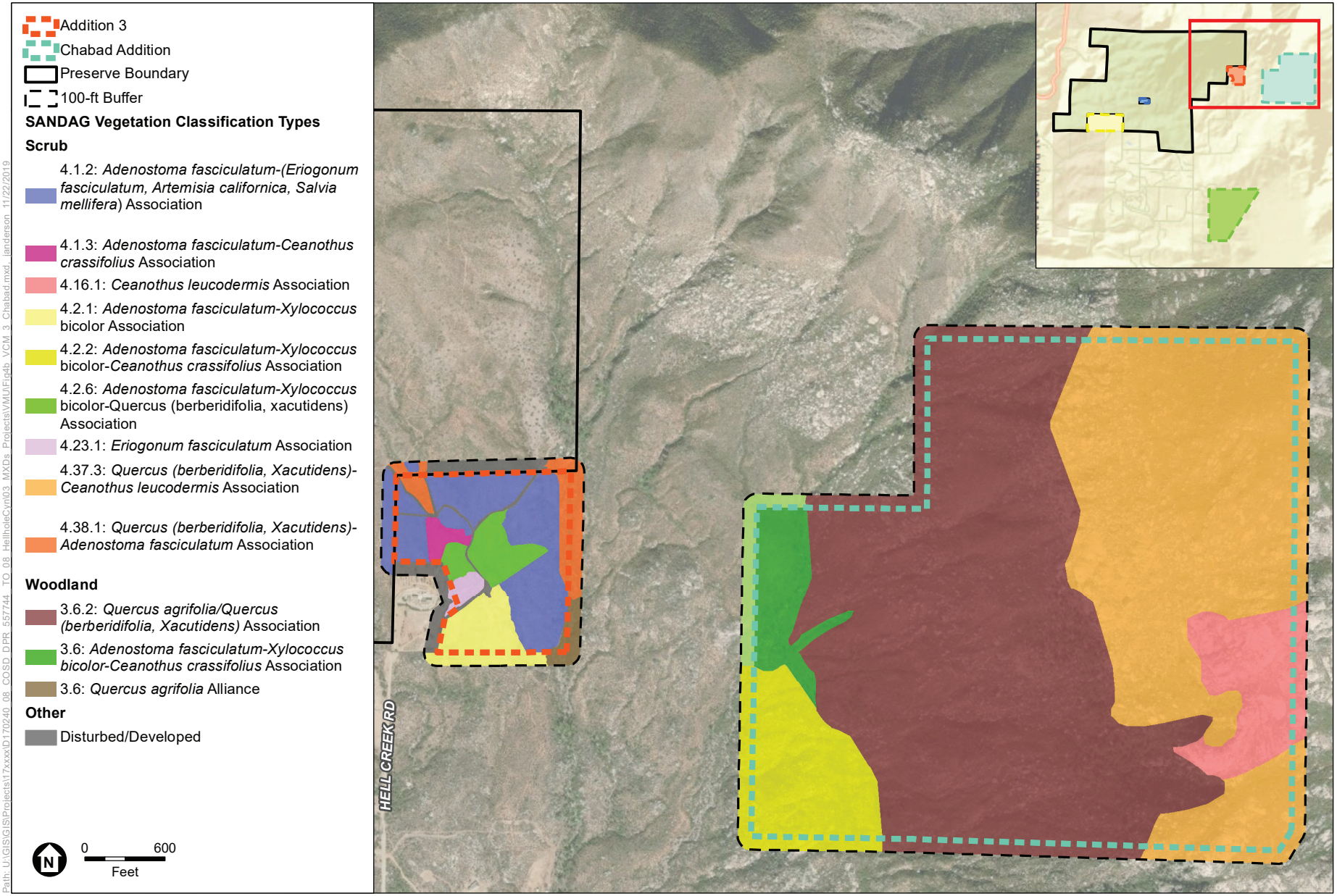
San Diego Vegetation Classification Manual		Holland/ Oberbauer	Additions Acreage	100-foot Buffer Acreage
Alliance Level	**Association Level**			
Quercus agrifolia Alliance	3.6 *Quercus agrifolia*; Coast Live Oak Association	71161 Open Coast Live Oak Woodland	68.61	12.26
	3.6.2 *Quercus agrifolia/Quercus (berberidifolia,* x*acutidens)* Association; Coast Live Oak/Scrub Oak Association		24.11	0.59
	3.6.4 *Quercus agrifolia – Toxicodendron diversilobum* – Grass Association; Coast Live Oak – Poison Oak – Grass Association		3.61	4.01
NA	NA	79000 Non-Native Woodland	0.90	—
Riparian				
Baccharis salicifolia Alliance	4.11.1 *Baccharis salicifolia* Association	63310 Mulefat Scrub	0.20	0.51
Other				
NA	NA	11300 Disturbed/ Developed	15.37	12.13
NA	NA	64100 Open Water	1.70	0.12
Total			**670.51**	**106.60**

[1] The scientific names for a species in the Vegetation Classification Manual and the Holland/Oberbauer vegetation classification have been updated according to the Jepson Manual of Flowering Plants available online at http://ucjeps.berkeley.edu/eflora/ (Jepson Flora Project eds. 2020) and the Checklist of the Vascular Plants of San Diego County, 5th edition by J.P. Rebman and M. G. Simpson 2014 (Rebman, J. P., and M. G. Simpson. 2014) from the San Diego Natural History Museum. Lotus scoparius is now *Acmispon glaber*.



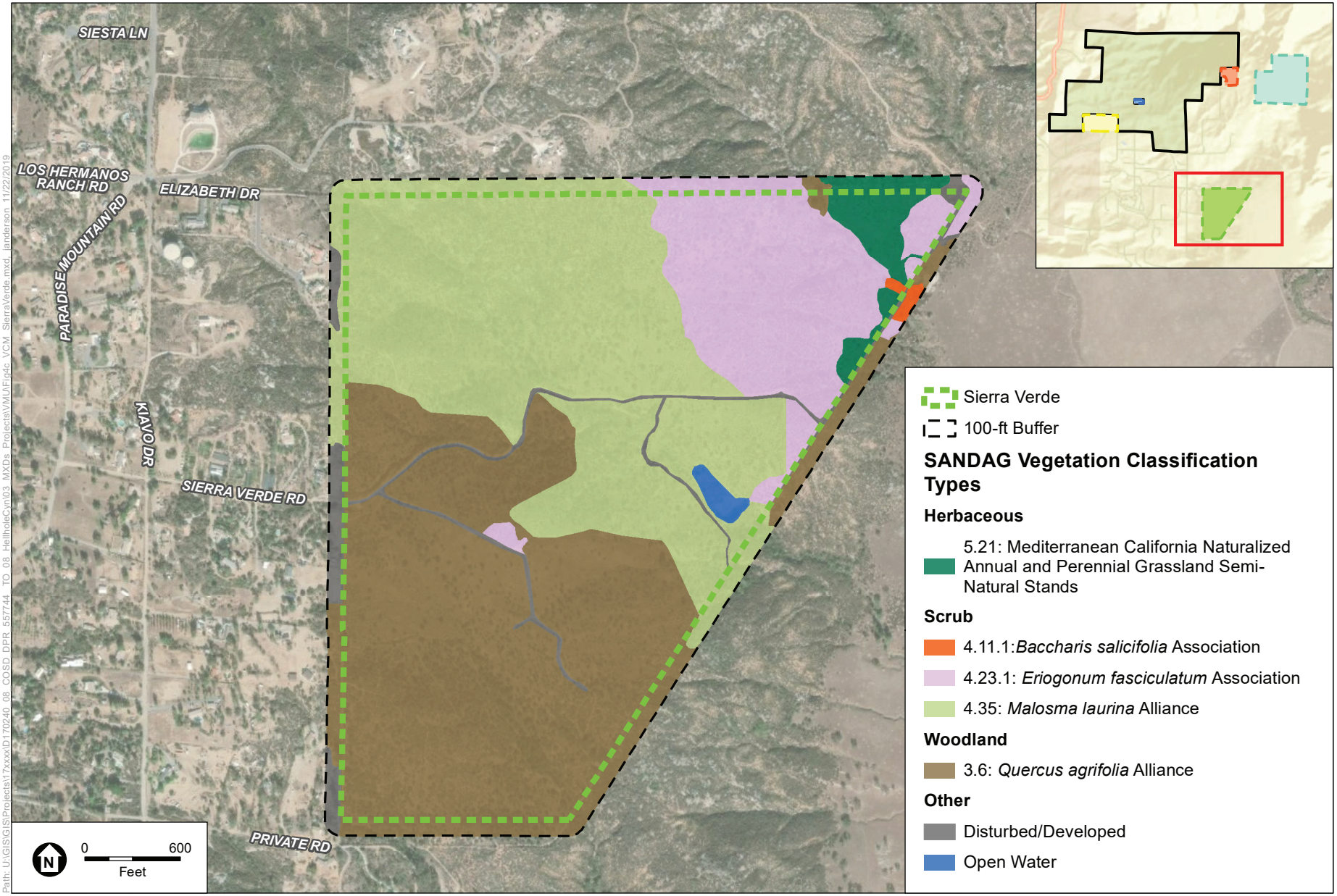
SOURCE: ESRI, 2019; SanGIS, 2019; ESA, 2019.

Figure 4a
Vegetation Communities/Habitats (VCM Classification)
Addition 1 and Addition 2



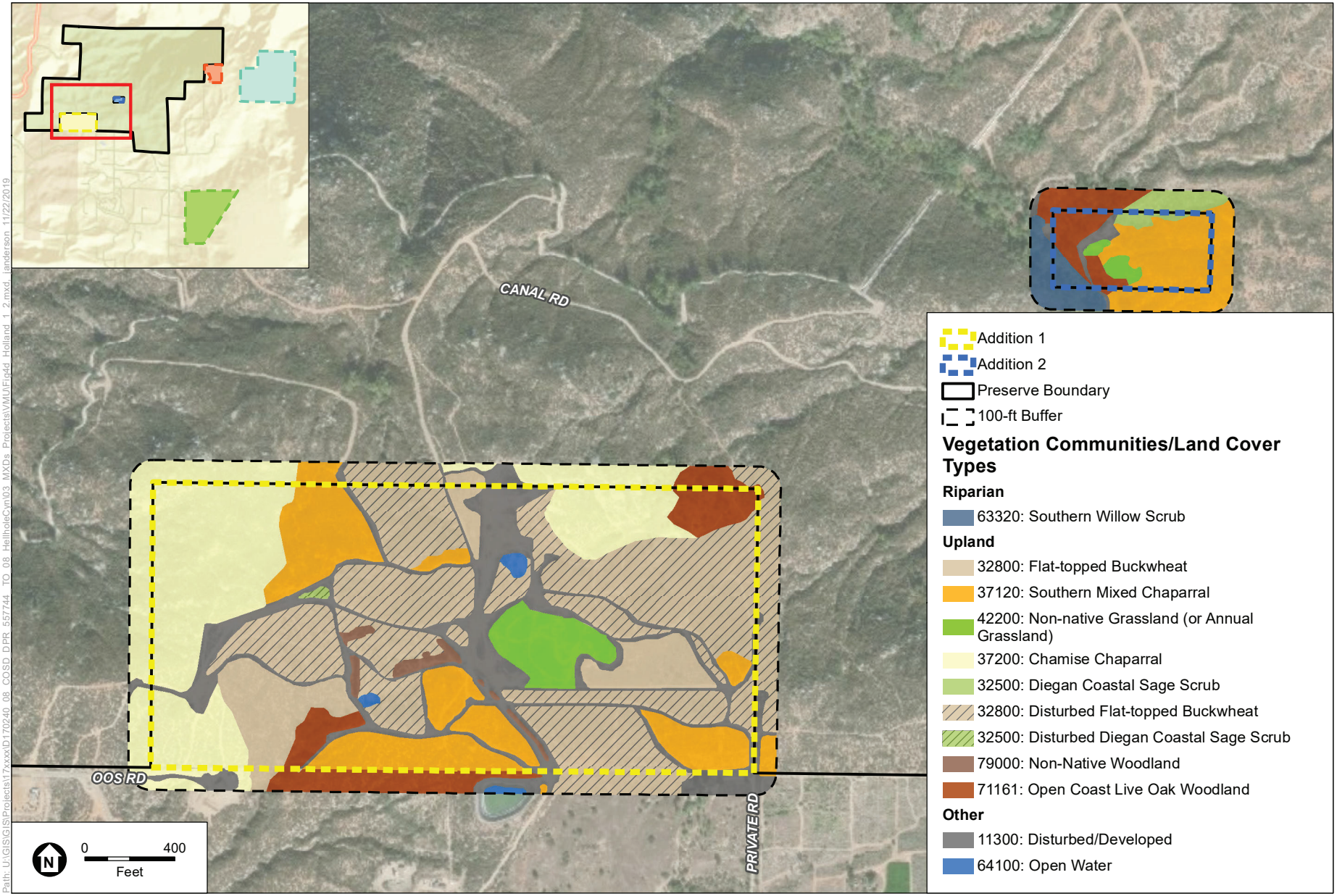
SOURCE: ESRI, 2019; SanGIS, 2019; ESA, 2019.

Figure 4b
Vegetation Communities/Habitats (VCM Classification)
Addition 3 and Chabad Addition



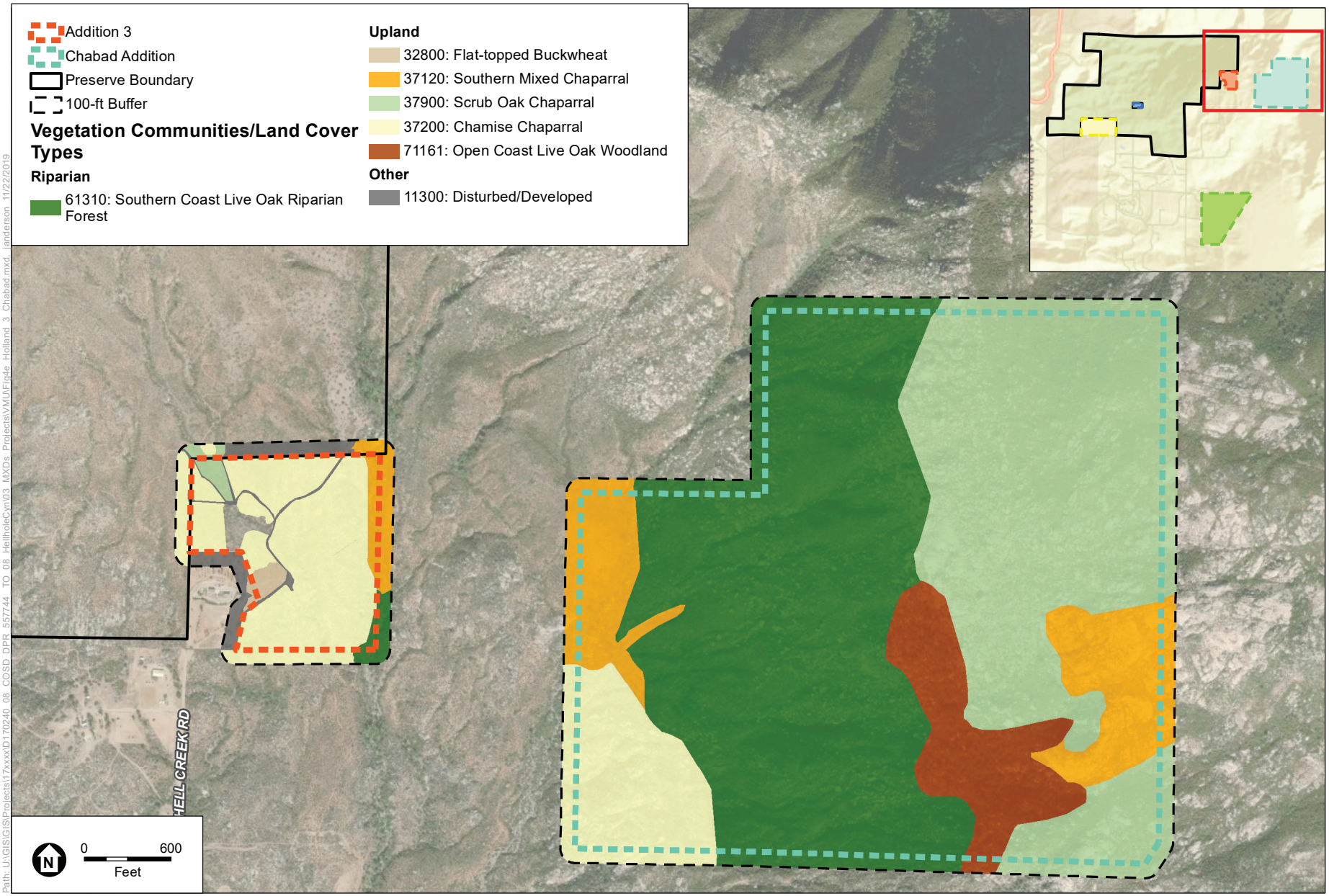
SOURCE: ESRI, 2019; SanGIS, 2019; ESA, 2019.

Figure 4c
Vegetation Communities/Habitats (VCM Classification)
Sierra Verde Addition



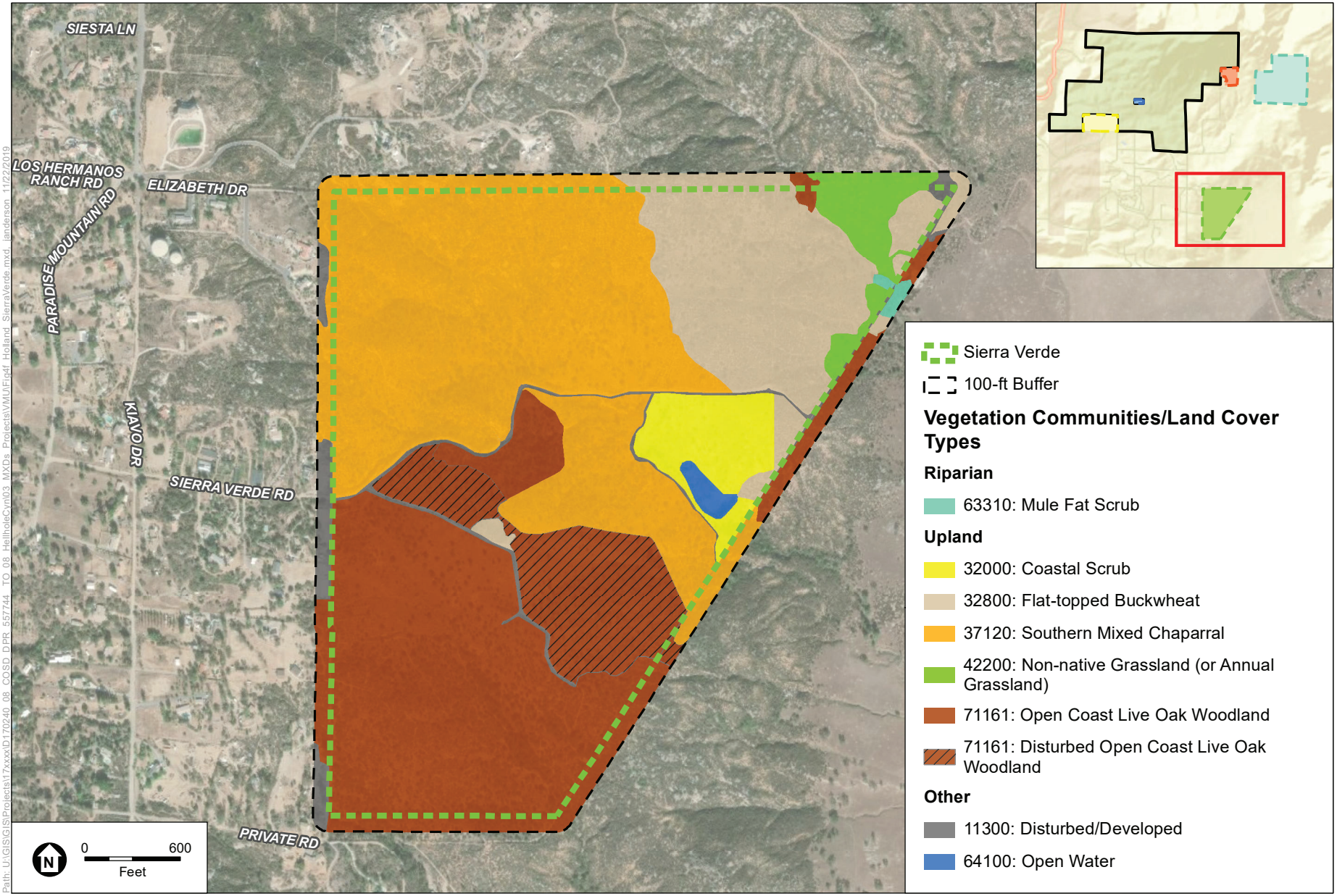
SOURCE: ESRI, 2019; SanGIS, 2019; ESA, 2019.

Figure 4d
Vegetation Communities/Habitats (Holland/Oberbauer Classification)
Addition 1 and Addition 2



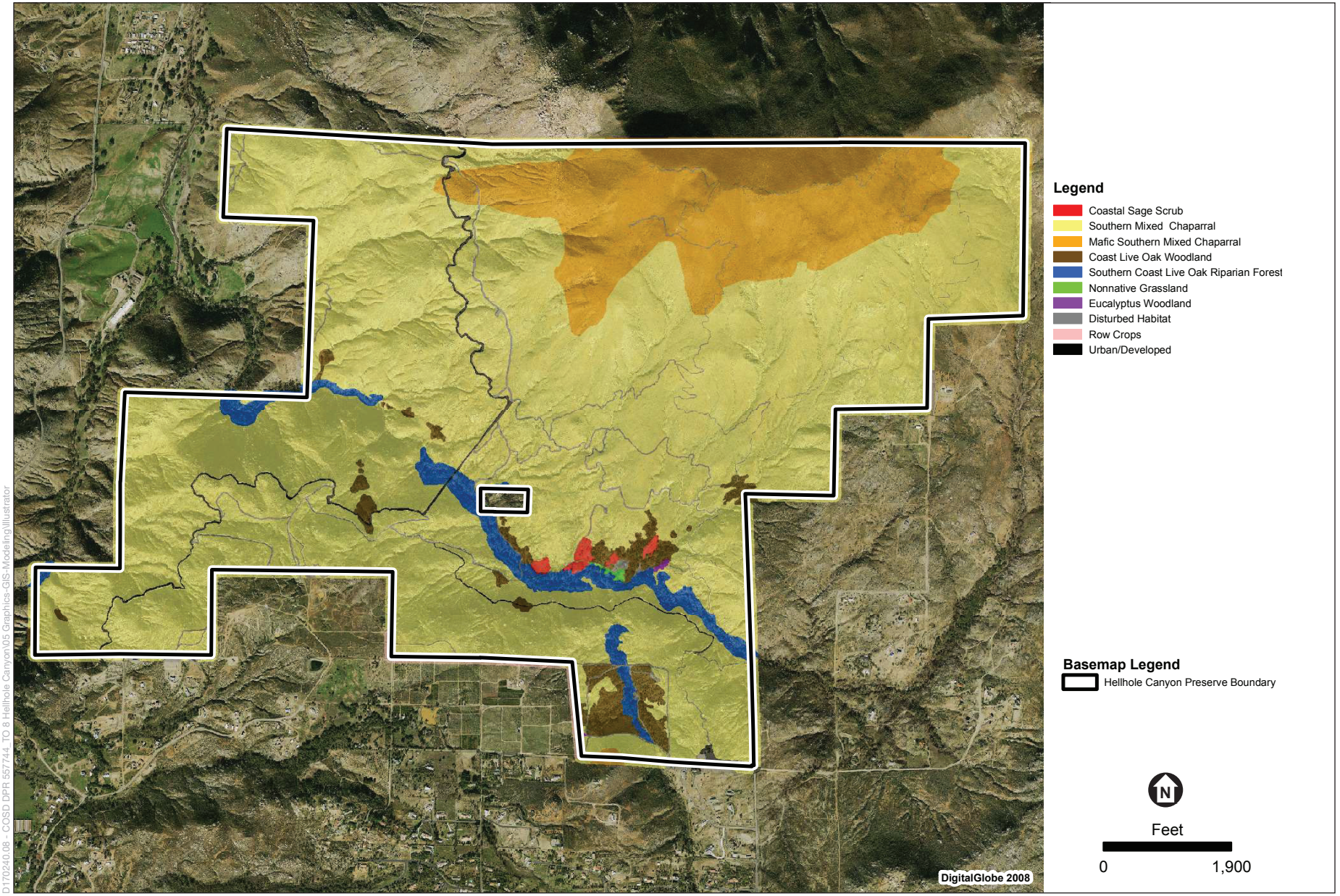
SOURCE: ESRI, 2019; SanGIS, 2019; ESA, 2019.

Figure 4e
Vegetation Communities/Habitats (Holland/Oberbauer Classification)
Addition 3 and Chabad Addition



SOURCE: ESRI, 2019; SanGIS, 2019; ESA, 2019.

Figure 4f
Vegetation Communities/Habitats (Holland/Oberbauer Classification)
Sierra Verde Addition



SOURCE: TAIC 2009

Figure 4g
Vegetation Communities/Habitats (Holland/Oberbauer Classification)
Original Preserve, 2008 Baseline Surveys

ESA

2.1.2 Special-Status Plant Species

Ten special-status rare plant species were documented within the Preserve during 2008 and 2019 rare plant surveys (**Figure 5a** through **5d)**. Of these species, one species is also covered under the Draft North County MSCP Subarea Plan, Engelmann oak (*Quercus engelmannii*). The sensitivity classifications for these plant species are shown in **Table 3**. Further discussions of special-status plant species evaluation for potential to occur within the Preserve are included in the Baseline Biodiversity Survey Report for Hellhole Canyon Preserve (TAIC 2008) and the Baseline Biodiversity Survey Report for the Hellhole Canyon Preserve Additions (ESA 2019a).

Table 3. Special-Status Plant Species Observed on the Hellhole Canyon Preserve

Common Name	Scientific Name	Status (Federal/State/CRPR/MSCP Designation, Local)[1]	Occurrence[2]
Yucaipa onion	*Allium marvinii*	None/None/1B.2/None	A
Brewer's calandrinia	*Calandrinia breweri*	None/None/4.2/ County List D	OP
Palmer's grapplinghook	*Harpagonella palmeri*	None/None/4.2/County List D	A
Robinson's pepper-grass	*Lepidium virginicum* var. *robinsonii*	None/None/4.3/ County List A	OP
Humboldt lily	*Lilium humboldtii ssp. ocellatum*	None/None/4.2/County List D	A, OP
Cleveland's bush monkey flower	*Diplacus clevelandii (=Mimulus clevelandii)*	None/None/4.2/County List D	OP
felt-leaved monardella	*Monardella hypoleuca* ssp. *lanata*	None/None/1B.2/County List A	OP
Fish's milkwort	*Polygala cornuta* var. *fishiae*	None/None/4.3/County List D	A, OP
Engelmann oak	*Quercus engelmannii*	None/None/4.2/MSCP; County List D	A, OP
rush-like bristleweed	*Xanthisma junceum*	None/None/4.3/County List D	A

[1] Status

State/Federal Designations:

FE = Federally Endangered

FT = Federally Threatened

SE = State Endangered

CRPR (California Rare Plant Rank):

CRPR 1B.2 = Plants rare, threatened, or endangered in California and elsewhere; moderately threatened in California.

CRPR 4.2 = *Watch List: Plants of limited distribution; moderately threatened in California.*

CRPR 4.3 = *Watch List: Plants of limited distribution; not very threatened in California.*

County Designations:

MSCP = *MSCP Covered Species*

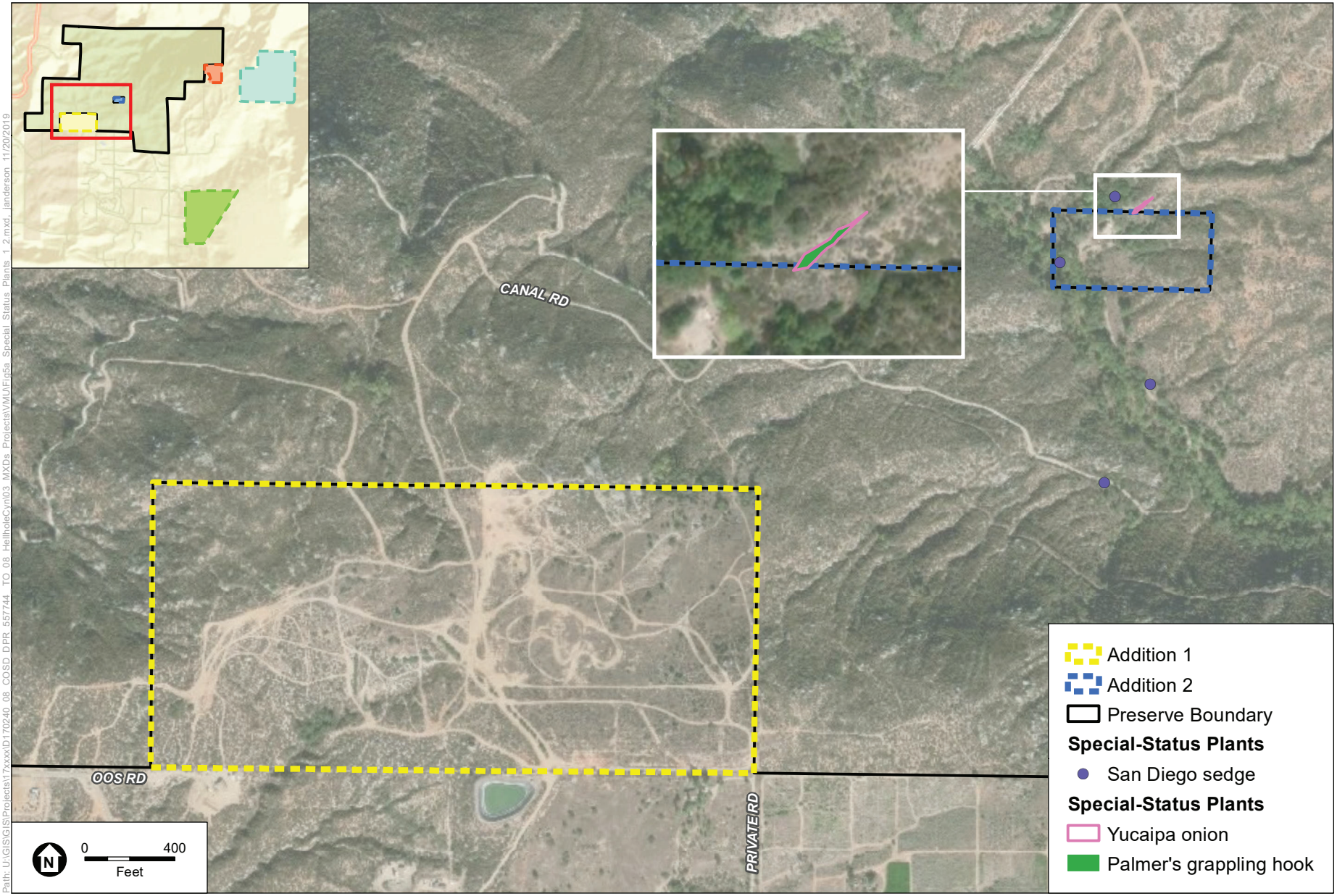
NE = *MSCP Narrow Endemic Species*

County List D = *Plants of limited distribution and are uncommon, but not presently rare or endangered.*

[2] Occurrence:

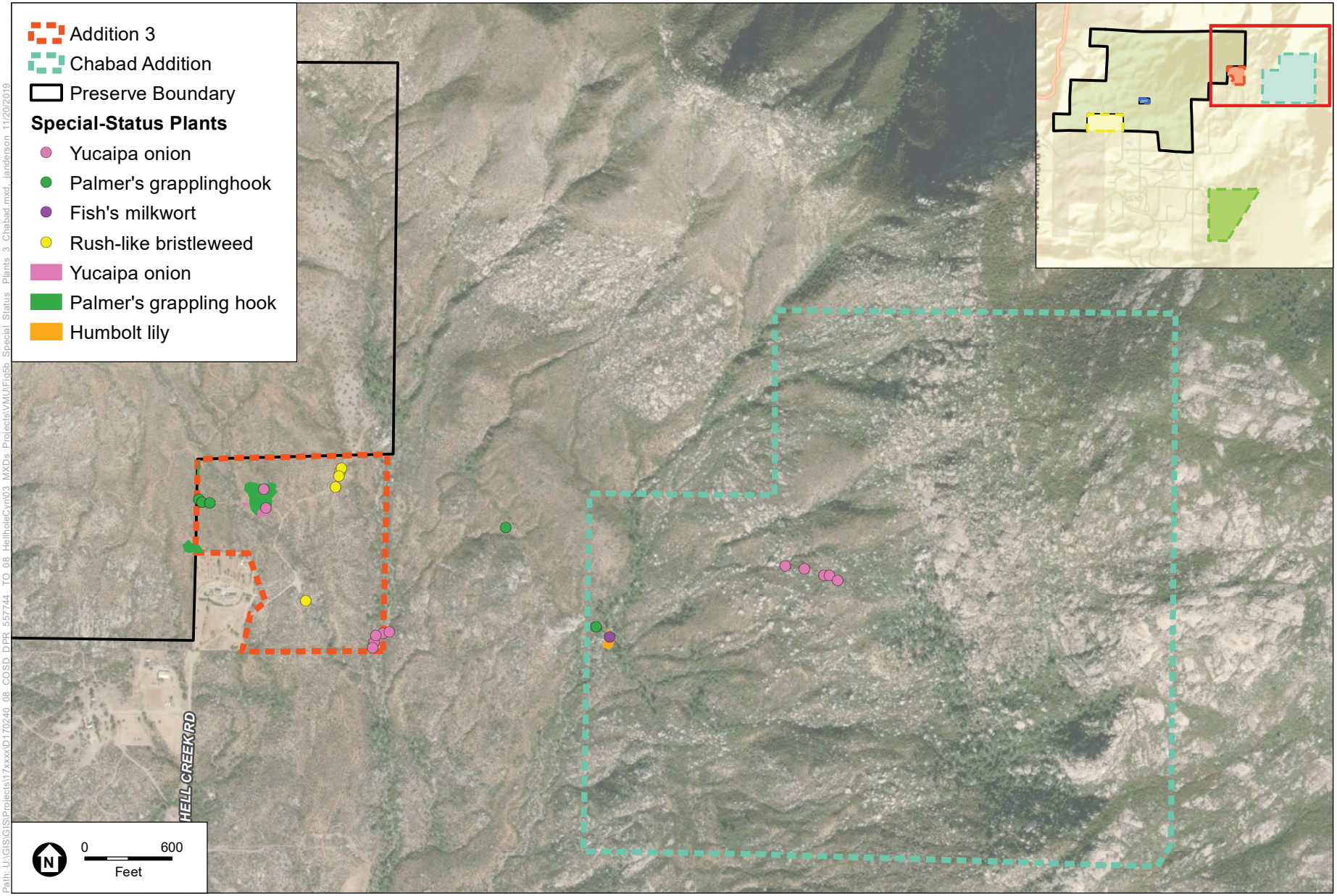
A = Additions

OP = Original Preserve



SOURCE: ESRI, 2019; SanGIS, 2019; ESA, 2019.

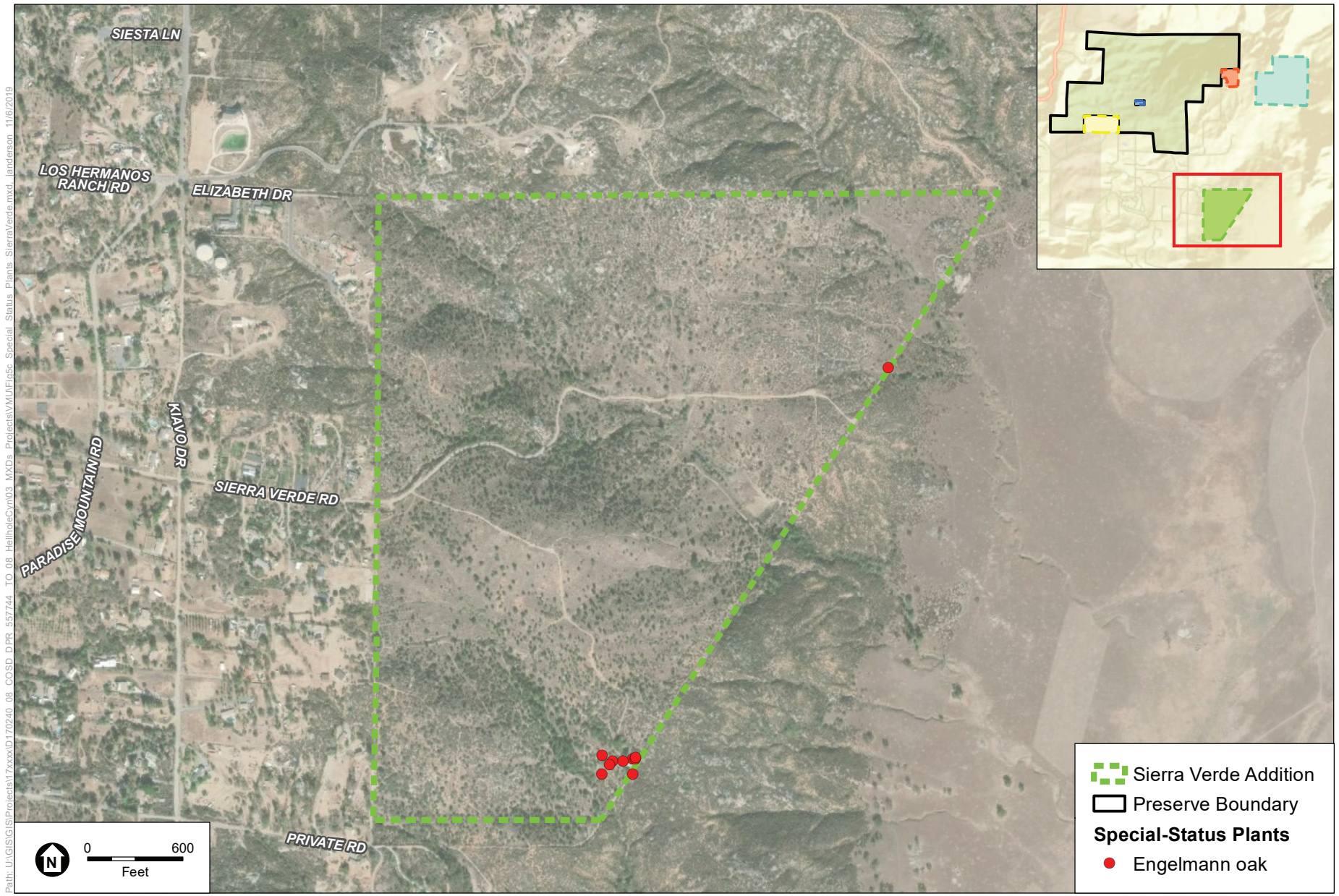
Figure 5a
Special-Status Plant Species
Addition 1 and Addition 2



SOURCE: ESRI, 2019; SanGIS, 2019; ESA, 2019.

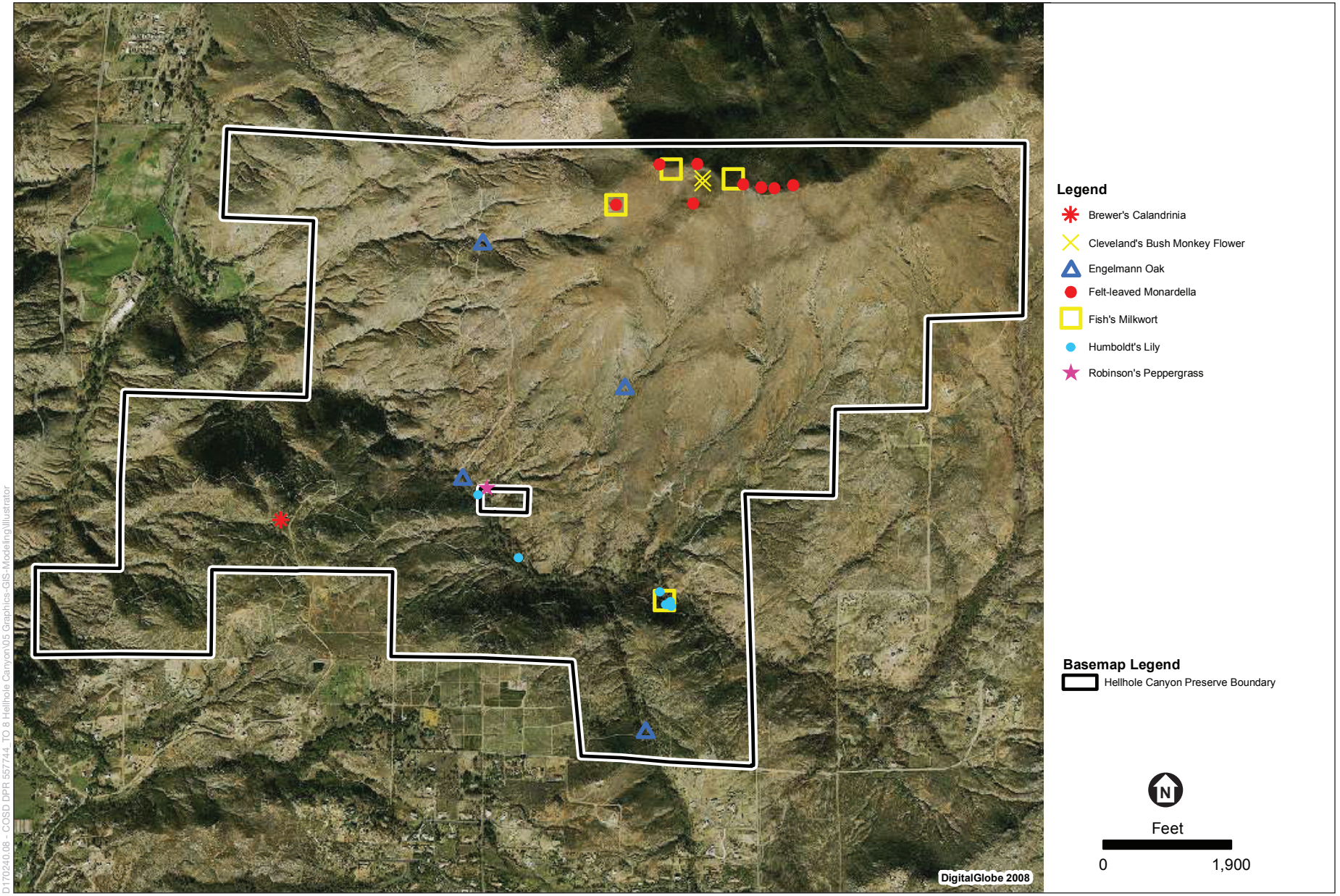
ESA

Figure 5b
Special-Status Plant Species
Addition 3 and Chabad Addition



SOURCE: ESRI, 2019; SanGIS, 2019; ESA, 2019.

Figure 5c
Special-Status Plant Species
Sierra Verde Addition



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SOURCE: TAIC 2009

Figure 5d
Special-Status Plant Species; Original Preserve, 2008 Baseline Surveys

ESA

2.1.3 Special-Status Wildlife Species

A total of 34 special-status wildlife species were observed or detected within the Preserve (**Figures 6a** through **6g**). Of these species, six species are also covered under the Draft North County MSCP Subarea Plan. The sensitivity classifications of these species are listed in **Table 4**. Further discussions of special-status wildlife species evaluation for potential to occur within the Preserve are included in the Baseline Biodiversity Survey Report for Hellhole Canyon Preserve (TAIC 2008) and the Baseline Biodiversity Survey Report for the Hellhole Canyon Preserve Additions (ESA 2019a).

Table 4. Special-Status Wildlife Species Known to Occur in the Hellhole Canyon Preserve

Common Name	Scientific Name	Status (Federal/State/MSCP Designation, Local)[1]	Occurrence[2]
Birds			
white-faced ibis	*Plegadis chihi*	None/WL/Group 1	A
yellow warbler	*Setophaga petechia*	None/SSC/None	A, OP
red-shouldered hawk	*Buteo lineatus*	None/None/Group 1	A
barn owl	*Tyto alba*	None/None/Group 2	A
Bell's sparrow	*Artemisiospiza belli belli*	None/WL/Group 1	A, OP
merlin	*Falco columbarius*	None/None/Group 2	A
western bluebird	*Sialia mexicana*	None/None/Group 1	A, OP
southern California rufous-crowned sparrow	*Aimophila ruficeps canescens*	None/WL/Group 1	A, OP
turkey vulture	*Cathartes aura*	None/None/Group 1	A
Cooper's hawk	*Accipiter cooperii*	None/WL/MSCP, Group 1	OP
burrowing owl	*Athene cunicularia*	None/SSC/MSCP, Group 1	OP
Bats			
pocketed free-tailed bat	*Nyctinomops femorosaccus*	None/SSC/Group 2	A, OP
pallid bat	*Antrozous pallidus*	None/SSC/MSCP, Group 2	A, OP
Townsend's big-eared bat	*Corynorhinus townsendii*	None/SSC/MSCP, Group 2	A, OP
greater western mastiff bat	*Eumops perotis californicus*	None/SSC/Group 2	A
western red bat	*Lasiurus blossevillii*	None/SSC/Group 2	A, OP
western yellow bat	*Lasiurus xanthinus*	None/SSC/None	A
western small-footed myotis	*Myotis ciliolabrum*	None/None/Group 2	A
long-eared myotis	*Myotis evotis*	None/None/Group 2	A
Yuma myotis	*Myotis yumanensis*	None/None/Group 2	A

Common Name	Scientific Name	Status (Federal/State/MSCP Designation, Local)[1]	Occurrence[2]
Reptiles			
Coronado skink	*Plestiodon skiltonianus interparietalis*	None/WL/Group 2	A
Belding's orange-throated whiptail	*Aspidoscelis hyperythra beldingi*	None/WL/Group 2	A
western spadefoot toad	*Spea hammondii*	None/SSC/MSCP, Group 2	A
coastal western whiptail	*Aspidoscelis tigris stejnegeri*	None/SSC/Group 2	A
coast horned lizard	*Phrynosoma blainvillii*	None/SSC/MSCP, Group 2	OP[3]
coast patch-nosed snake	*Salvadora hexalepis virgultea*	None/SSC/Group 2	OP
two-striped garter snake	*Thamnophis hammondii*	None/SSC/Group 1	OP
Mammal			
Dulzura pocket mouse	*Chaetodipus californicus femorali*	None/SSC/Group 2	A, OP[4]
San Diego pocket mouse	*Chaetodipus fallax*	None/SSC/Group 2	OP
San Diego desert woodrat	*Neotoma lepida intermedia*	None/SSC/Group 2	OP
San Diego black-tailed jackrabbit	*Lepus californicus bennettii*	None/SSC/Group 2	A
mountain lion	*Puma concolor*	None/None/Group 2	A, OP[5]
southern mule deer	*Odocoileus hemionus*	None/None/Group 2	A, OP[5]

[1] Status

State/Federal Designations:

FE = Federally Endangered

FT = Federally Threatened

SE = State Endangered

State Designations:

WL = California Department of Fish and Wildlife Watch List

SSC = California Department of Fish and Wildlife Species of Special Concern

County Designations:

MSCP = Covered under the draft North County MSCP Subarea Plan

NE = MSCP Narrow Endemic Species

Group 1 = Animals of high sensitivity (listed or specific natural history requirements) (County)

Group 2 = Animals declining but not in immediate threat of extinction or extirpation (County)

[2] Occurrence:

A = Additions

OP = Original Preserve

[3] Species was listed as *Phrynosoma coronatum* in the Original Preserve, which is assumed to be referring to *Phrynosoma blainvillii*, since that is the only species occurring in San Diego (California Herps, n.d.).

[4] Species was identified as *Chaetodipus californicus* and referred to as sensitive, therefore it is assumed to have been referring *to Chaetodipus californicus femoralis*, which is the sensitive subspecies (TAIC 2008).

[5] Species was not directly observed during 2008 surveys; presence is assumed based on personal accounts, track, and scat (TAIC 2008).

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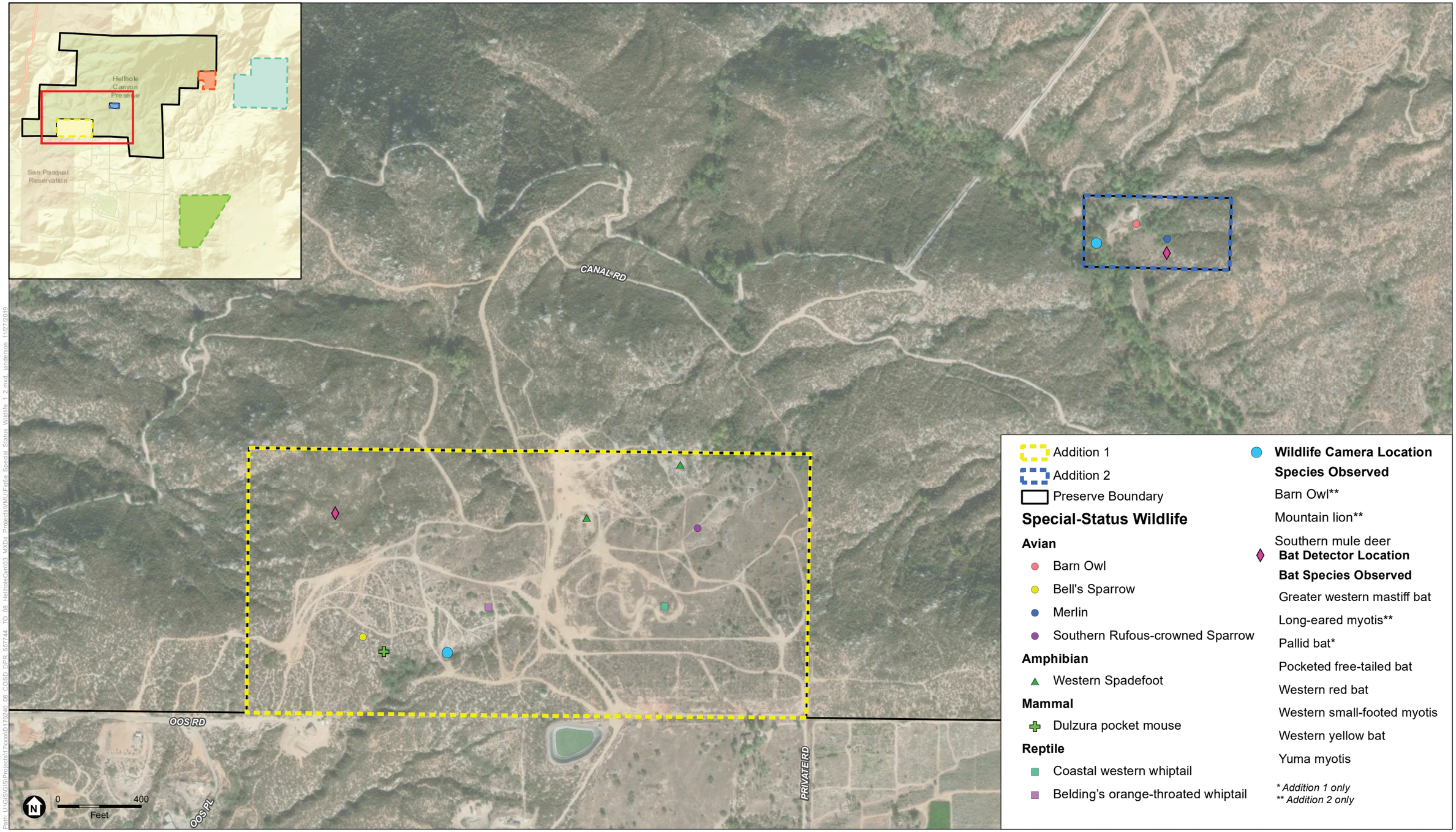

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SOURCE: ESRI, 2019; SanGIS, 2019; ESA, 2019.

ESA

Figure 6a
Special-Status Wildlife Species
Addition 1 and Addition 2

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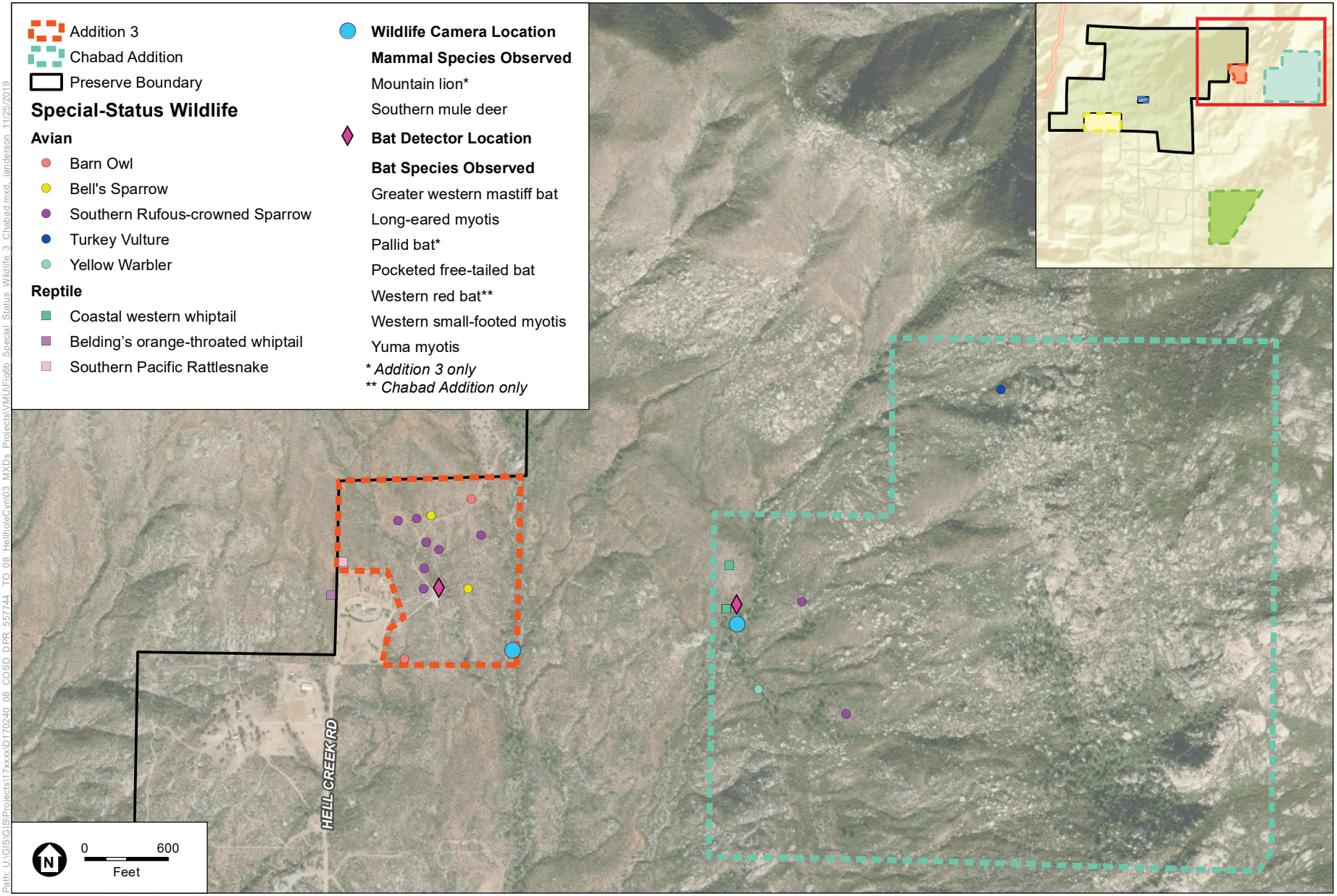
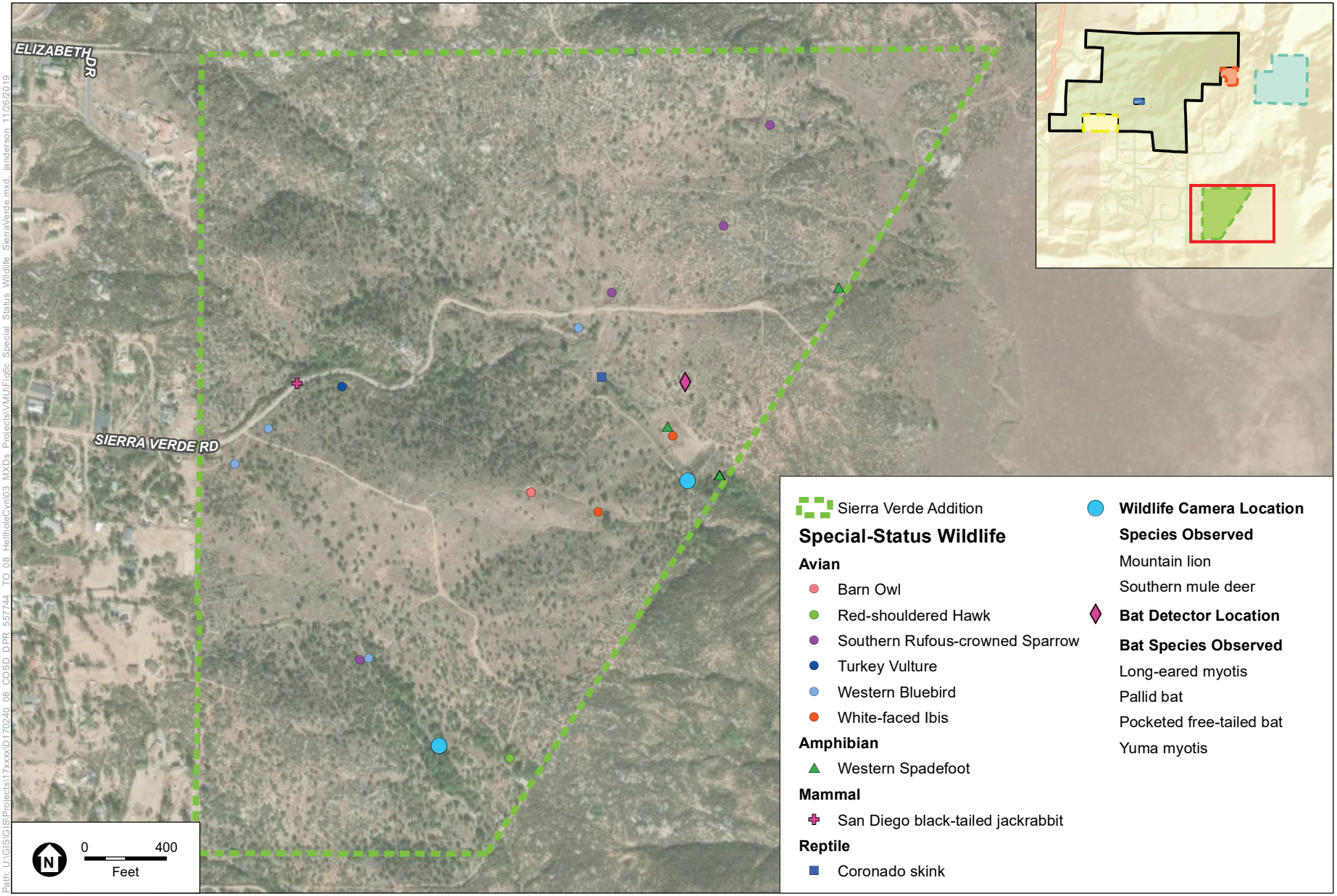


SOURCE: ESRI, 2019; SanGIS, 2019; ESA, 2019.

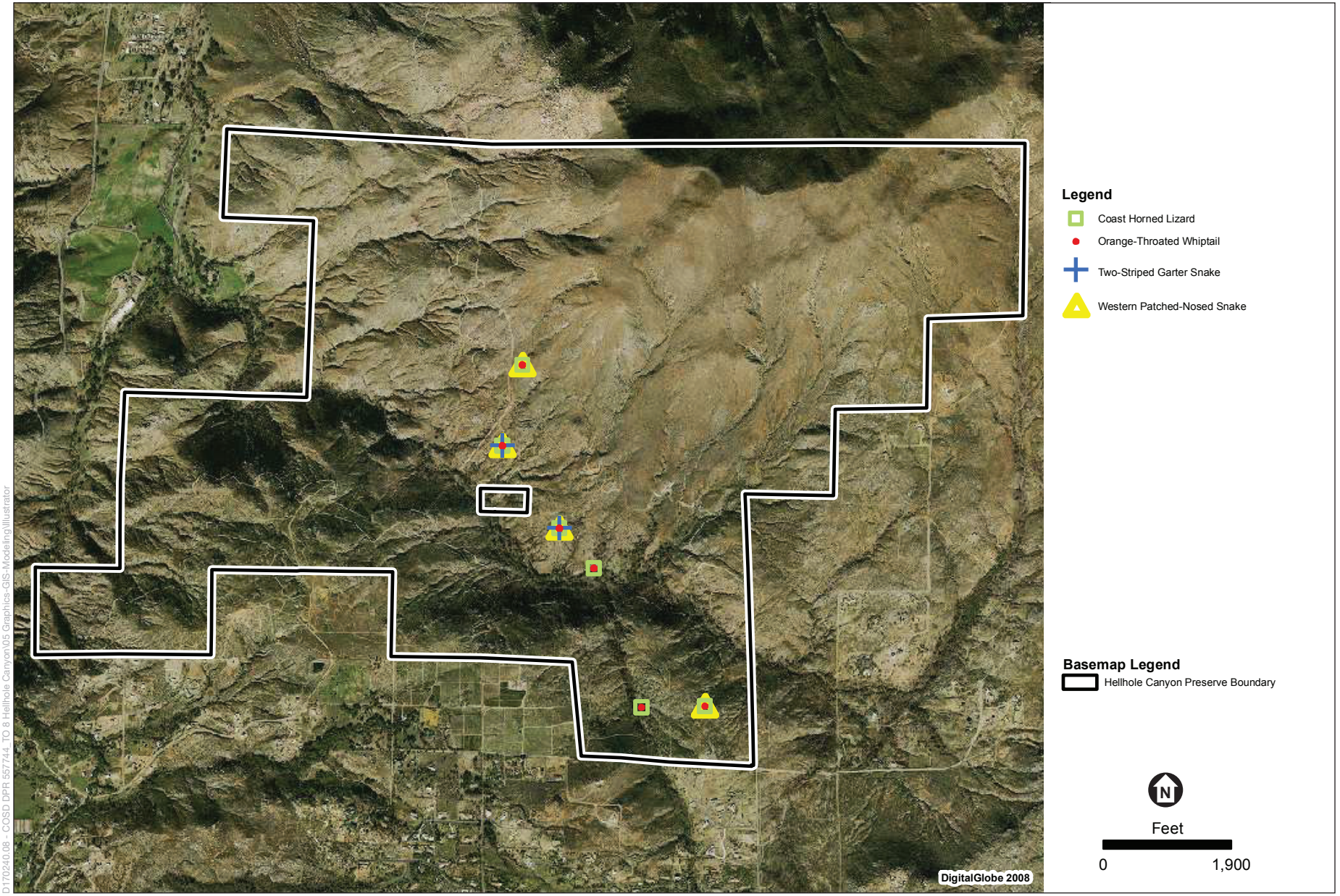
ESA

Figure 6b
Special-Status Wildlife Species
Addition 3 and Chabad Addition



SOURCE: ESRI, 2019; SanGIS, 2019; ESA, 2019.

Figure 6c
Special-Status Wildlife Species
Sierra Verde Addition



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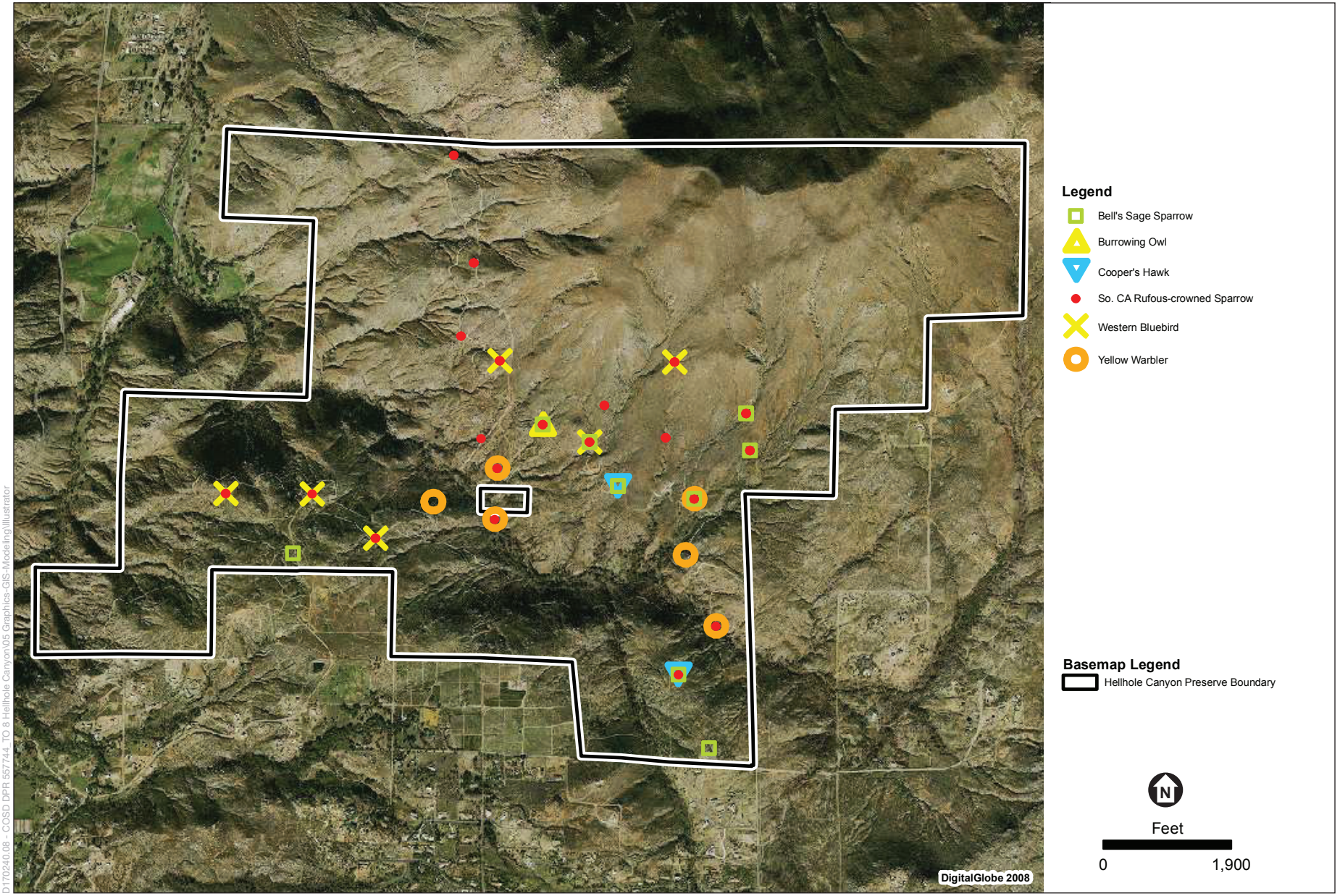
SOURCE: TAIC 2009

Figure 6d
Special-Status Reptile Species; Original Preserve, 2008 Baseline Surveys

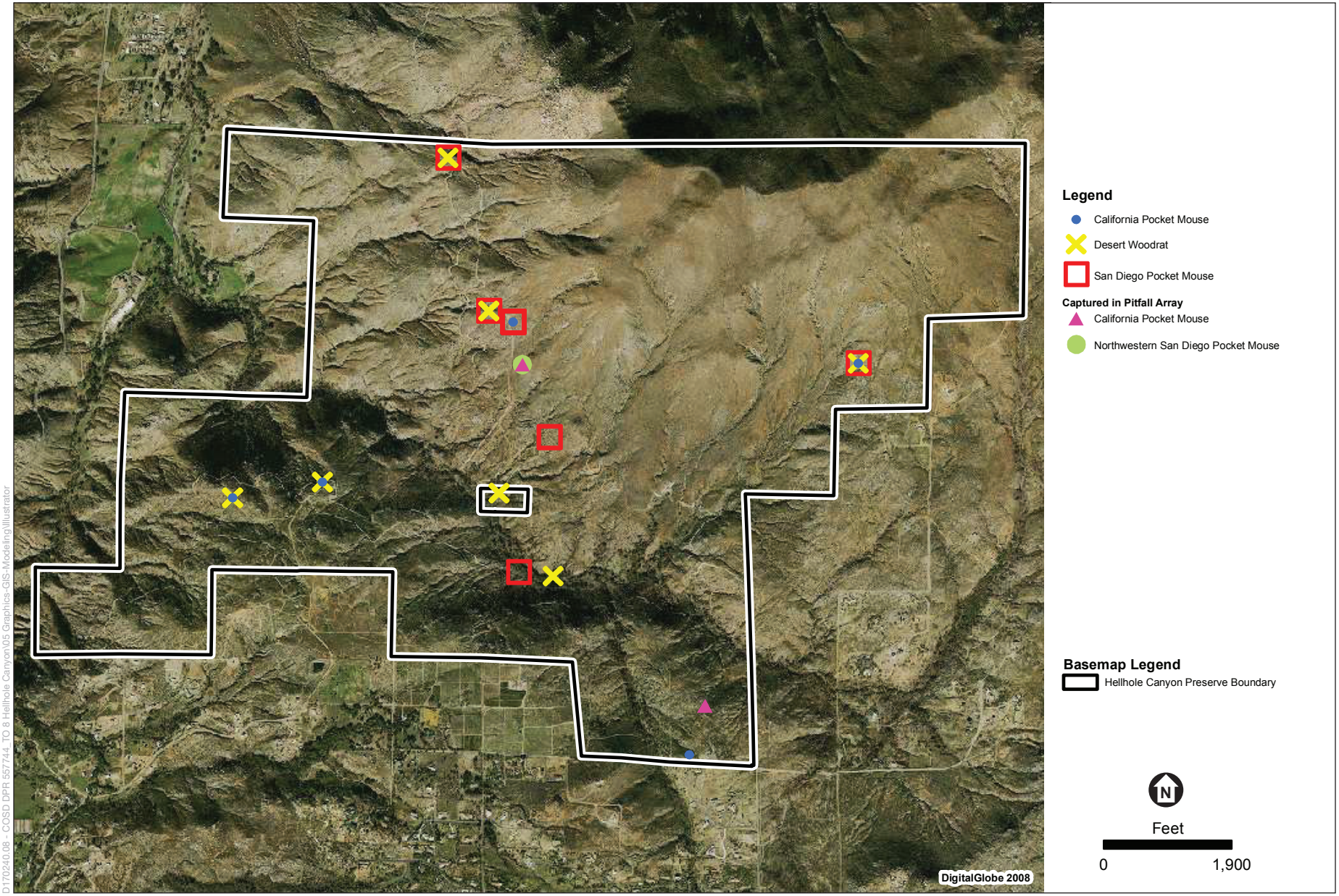
ESA



SOURCE: TAIC 2009

Figure 6e
Special-Status Bird Species; Original Preserve, 2008 Baseline Surveys

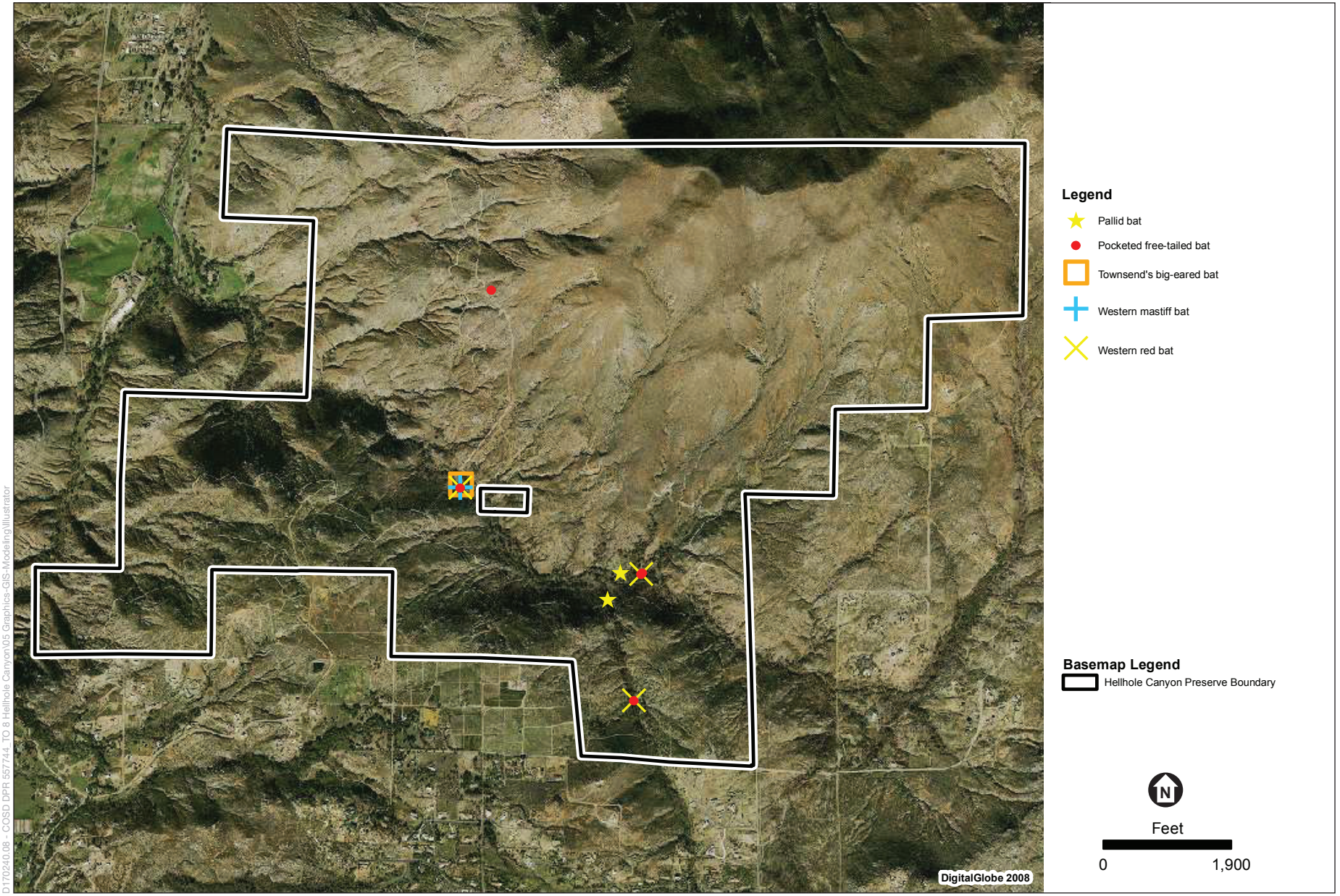
ESA



SOURCE: TAIC 2009

Figure 6f
Special-Status Mammal Species; Original Preserve, 2008 Baseline Surveys

ESA



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SOURCE: TAIC 2009

Figure 6g
Special-Status Bat Species; Original Preserve, 2008 Baseline Surveys

ESA

2.2 CULTURAL RESOURCES

A Phase I archaeological survey and cultural resources inventory was performed for the Original Preserve in 2008 and for the Additions in 2019, in compliance with the California Environmental Quality Act and County of San Diego environmental guidelines. The Phase I inventory involved a records search, historical research, outreach to the Native American Heritage Commission, and field survey. Surveys for the Original Preserve revealed prehistoric and historic cultural resources within the Preserve including bedrock-milling complexes, a lithic scatter, a ceramic scatter, the location of the former Escondido Canal/San Luis Rey Flume, and a homestead. Surveys for the Additions revealed one prehistoric and one historic-period archaeological site in Addition 1, one historic period archaeological site in Addition 2, and 19 prehistoric archaeological sites and three historic-period built resources in the Sierra Verde Addition. No resources were identified within Addition 3 or the Chabad Addition.

While three resources have been previously recommended not eligible for listing in the California Register of Historical Resources (CRHR), none of the other resources have been evaluated for listing, although preliminary assessments have been provided. In the absence of formal evaluations, these resources must be considered significant. Therefore, they either should be avoided or, prior to any impacts resulting from unavoidable maintenance activities and/or future projects, should be evaluated according to the CRHR and County Resource Protection Ordinance. Evaluation may require test excavation in the case of archaeological resources.

In addition, due to the rugged topography and dense vegetation throughout much of the Preserve, large areas could not be accessed for cultural resources survey. As such, there is potential for the discovery of undocumented cultural resources, particularly prehistoric bedrock milling features. If future project implementation or management activities result in an unanticipated discovery of archaeological materials or human remains, all work should cease in the area (e.g. within approximately 100 feet of the discovery) until the discovery can be evaluated by a qualified archaeologist or the San Diego County Coroner, respectively. Further discussion of the cultural resource survey results, including confidential locations of documented cultural resources as well as detailed avoidance measures for the Original Preserve, are included in the report titled *Management Plan for Archaeological Resources within the Hellhole Canyon Preserve, San Diego* County (ASM Affiliates, Inc. 2008), and for the Additions in the report titled *Cultural Resources Survey and Inventory for the Hellhole Canyon Preserve Additions, County of San Diego, California* (ESA 2019b). Cultural resources identified within the Preserve are listed in **Table 5**.

Table 5. Sensitive Cultural Sites in the Hellhole Canyon Preserve

Primary or Trinomial Site Number (P-37-)	Permanent Trinomial (CA-SDI-)	Other Designation	Description	Date Recorded	Eligibility
Original Preserve					
009685	9685	CE-329	Prehistoric archaeological site: seven bedrock milling features on two boulders, and a single green volcanic flake.	1983; Updated in 2008	Should be considered significant
009686	9686	CE-330	Prehistoric archaeological site: five milling slicks on a single boulder. *Could not be relocated.*	1983	Should be considered significant
011134	11134	--	Prehistoric archaeological site: one bedrock milling slick on a large bedrock outcrop. *Could not be relocated.*	1989	Not eligible for CRHR[1]
025798	19058	HH-3	Prehistoric archaeological site: eight bedrock milling features and a cupule.	2008	Appears to meet Criterion 1 of the County RPO[2], Criteria 1,2,4,5 of the County LRHR[3], Criteria 1,4 of the CRHR, and Criteria A,D of the NRHP[4]
025799	19059	HH-2 May represent Sorenson/ Brown/ Pulver Property (APN 189-081-24)	Historic-period archaeological site: house foundations, rock wall, retaining rock/corrugated metal wall, outbuilding foundations, and refuse (historic and modern).	2008	Appears to meet Criterion 1 of the County RPO, Criteria 1,2,4,5 of County LRHR, Criteria 1,4 of CA RHP
025800	19060	HH-1	Prehistoric archaeological site: bedrock milling site with one slick, and lithic and ceramic scatter.	2008	Appears to meet Criterion 1 of the County RPO, Criteria 1,2,4,5 of County LRHR, Criteria 1,4 of CA RHP, Criteria A,D of NRHP
029026	18592	--	Prehistoric archaeological site: lithic scatter. *Could not be relocated.*	2004	Should be considered significant
029803	--	Pecked Cobble	Prehistoric isolate: pecked cobble.	2008	Not significant
029804	--	Quartz Point	Prehistoric isolate: a quartz Cottonwood projectile point.	2008	Not significant

Primary or Trinomial Site Number (P-37-)	Permanent Trinomial (CA-SDI-)	Other Designation	Description	Date Recorded	Eligibility
029802	--	Escondido Canal/Flume – San Luis Rey Flume	Historic-period built resource: canal/flume, stone shoring, a siphon, and associated roads.	2008	Appears to meet Criterion 1 of the County RPO, Criteria 1,2,4,5 of County LRHR, Criteria 1,4 of CA RHP
Addition 1					
038737	22811	ESA-Hellhole-001P	Prehistoric archaeological site: bedrock milling feature	2019	Low Potential Significance
038739	22813	ESA-Hellhole-003-H	Historic-period archaeological site: concrete foundations, earthen basins, and olive trees	2019	Very Low Potential Significance
Addition 2					
038738	22812	ESA-Hellhole-002H	Historic-period archaeological site: remnants of residence, including foundations, walls, and driveway.	2019	Very Low Potential Significance
Addition 3					
None	--	--	--	--	--
Chabad					
None	--	--	--	--	--
Sierra Verde					
011900	11900	SDM-W-4.685, G-S-18	Prehistoric archaeological site: bedrock milling features, flaked stone tools, lithic and groundstone scatter, pottery, pottery figurine fragments, fire-affected rock, and possible human remains.	1990/1993; updated in 2019	High Potential Significance, could be potential contributor to a district
011902	11902	G-S-DB1	Prehistoric archaeological site: bedrock milling features, flaked stone tools, lithic and groundstone scatter, fire-affected rock, and faunal remains	1990/1993; updated in 2019	Moderate Potential Significance, could be potential contributor to a district
011903	11903	--	Prehistoric archaeological site: light lithic scatter – *could not be relocated.*	1990; updated in 2019	Low Potential Significance, could be potential contributor to a district
011904	11904	--	Prehistoric archaeological site: bedrock milling features – *could not be relocated.*	1990; updated in 2019	Moderate Potential Significance, could be potential contributor to a district

Primary or Trinomial Site Number (P-37-)	Permanent Trinomial (CA-SDI-)	Other Designation	Description	Date Recorded	Eligibility
011905	11905	--	Prehistoric archaeological site: single bedrock mortar – *could not be relocated.*	1990; updated in 2019	Low Potential Significance, could be potential contributor to a district
011906	11906	--	Prehistoric archaeological site: light lithic scatter – *could not be relocated.*	1990; updated in 2019	Low Potential Significance, could be potential contributor to a district
011907	11907	--	Prehistoric archaeological site: light lithic scatter – *could not be relocated.*	1990; updated in 2019	Low Potential Significance, could be potential contributor to a district
013341	13341	G-S-15	Prehistoric archaeological site: bedrock milling features, flaked stone artifacts, lithic and groundstone scatter, fire-affected rock, pottery, rock feature, midden, rock art, and faunal remains – *portions outside project area.*	1993; updated in 2019	High Potential Significance, could be potential contributor to a district
013393	13393	G-S-B9	Prehistoric archaeological site: bedrock milling features, flaked stone tools, lithic and groundstone artifact scatter, pottery, fire-affected rock, and midden.	1993; updated in 2019	High Potential Significance, could be potential contributor to a district
013397	13397	G-S-DB2	Prehistoric archaeological site: lithic and groundstone artifact scatter with fire-affected rock.	1993; updated in 2019	Low Potential Significance, could be potential contributor to a district
026394	17332	Phillips Valley Temp 1	Prehistoric archaeological site: bedrock milling features, lithic and groundstone artifact scatter, and pottery.	2005; updated in 2019	Moderate Potential Significance, could be potential contributor to a district
026395	17333	Phillips Valley Temp 2	Prehistoric archaeological site: bedrock milling features and a single flake.	2005; updated in 2019	Previously recommended not eligible, but could be potential contributor to a district
026396	17334	Phillips Valley Temp 3	Prehistoric archaeological site: a single bedrock milling feature.	2005; updated in 2019	Previously recommended not eligible, but could be potential contributor to a district
026397	17335	Phillips Valley Temp 4	Prehistoric archaeological site: a single bedrock milling feature – *could not be relocated.*	2005; updated in 2019	Low Potential Significance, could be potential contributor to a district

Primary or Trinomial Site Number (P-37-)	Permanent Trinomial (CA-SDI-)	Other Designation	Description	Date Recorded	Eligibility
026398	17336	Phillips Valley Temp 5	Prehistoric archaeological site: lithic and groundstone artifact scatter – *could not be relocated.*	2005; updated in 2019	Low Potential Significance, could be potential contributor to a district
038740	--	ESA-Hellhole-004H	Historic-period built resource: concrete, cobble, and mortar culvert.	2019	Very Low Potential Significance
038741	--	ESA-Hellhole-005H	Historic-period built resource: cobble wall.	2019	Very Low Potential Significance
038742	22814	ESA-Hellhole-006P	Prehistoric archaeological site: bedrock milling feature.	2019	Low Potential Significance, but could be potential contributor to a district
038743	22815	ESA-Hellhole-007P	Prehistoric archaeological site: bedrock milling features.	2019	Low Potential Significance, but could be potential contributor to a district
038744	22816	ESA-Hellhole-008P	Prehistoric archaeological site: bedrock milling features.	2019	Low Potential Significance, but could be potential contributor to a district
038745	22817	ESA-Hellhole-009P	Prehistoric archaeological site: bedrock milling features.	2019	Low Potential Significance, but could be potential contributor to a district
038746	--	ESA-Hellhole-0010H	Historic-period built resource: water basins and concrete/cinder block inlets and outlets.	2019	Very Low Potential Significance

[1] California Register of Historical Resources
[2] County of San Diego Resource Protection Ordinance
[3] County of San Diego Local Register of Historical Resources
[4] National Register of Historic Places

3.0 INVASIVE PLANT SPECIES MANAGEMENT

Non-native plant species are defined by California Invasive Plant Council (Cal-IPC) as species that were introduced to California after European contact and as a direct or indirect result of human activity. Invasive plants are also not native but, once introduced, can establish, quickly reproduce and spread, and cause harm to the environment, economy, and/or human health. Once invasive non-native plant species spread into wildland ecosystems, they can hybridize with native plant species, displace native plant and wildlife species, alter biological communities, and/or alter ecosystem processes (Cal-IPC n.d.). These species often germinate and grow faster than native species, which provides an advantage to outcompete native plant species for limited resources such as water, soil nutrients, sunlight, and space. This can result in dense stands of non-native invasive species within wildland areas, which could cause a decline in native species diversity as well as a decline in the presence of associated native wildlife species that depend on those native plants. Therefore, elimination or control of non-native invasive species is an important management activity that not only protects but also enhances biodiversity and habitat quality.

Non-native plants are present throughout the Preserve, particularly along dirt roads, trails, and around grassy areas. A total of 89 non-native plant species[1] were observed in the Original Preserve during the 2008 botanical surveys (TAIC 2008); A total of 62 non-native plant species were detected in the Additions during botanical surveys performed in the spring of 2019 (ESA 2019a). Of the non-native plant species identified during the botanical surveys, 16 invasive non-native plant species were mapped within the Preserve and targeted for control, including both perennial and annual species. **Table 6** lists the mapped invasive non-native plant species and their associated Management Priority Level (Conservation Biology Institute 2012) and Cal-IPC Inventory Ranking (Cal-IPC 2019a). These target invasive non-native plant species' locations are shown in **Figures 7a** through **7d**.

[1] Non-native plant species includes invasive plants species.

Table 6. Non-Native Invasive Plant Species Mapped at the Hellhole Canyon Preserve[1]

Common Name	Scientific Name	CBI Management Priority for Invasive Non-native Plants[2]	Cal-IPC Rating[3]	Occurrence[4,5]
Giant reed	*Arundo donax*	Management Level 3	High	OP
Pampas Grass[5]	*Cortaderia selloana*	Management Level 3	High	A, OP
Artichoke Thistle[5]	*Cynara cardunculus*	Management Level 3	Moderate	A, OP
Sweet Fennel	*Foeniculum vulgare*	Management Level 4	High	A
Iceplant	*Carpobrotus edulis*	NA	High	A
Tamarisk[5]	*Tamarix ramosissima*	NA	High	A, OP
Treasure Flower	*Gazania linearis*	NA	Moderate — Alert	A, OP
Tree Tobacco	*Nicotiana glauca*	NA	Moderate	A, OP
Crimson Fountain Grass	*Pennisetum setaceum*	NA	Moderate	A, OP
Brazilian pepper tree[4]	*Schinus terebinthifolius*	NA	Moderate	OP
Mexican Fan Palm	*Washingtonia robusta*	NA	Moderate	A
Eucalyptus (River red gum)[5]	*Eucalyptus camaldulensis*	NA	Limited	A, OP
Eucalyptus (Southern blue gum)	*Eucalyptus globulus*	NA	Limited	A
Olive tree	*Olea europea*	NA	Limited	A
Peruvian Pepper Tree	*Schinus molle*	NA	Limited	A
Golden wattle	*Acacia pycnantha*	NA	Watch	A

[1] Species are included in this table due to their potential for being invasive and the feasibility of removal from the Preserve since they currently remain in low enough numbers for removal and eradication.

[2] **Source**: San Diego Environmental Mitigation Program Working Group in their Management Priorities for Invasive Nonnative Plants. Conservation Biology Institute (CBI) 2012.

Management Levels for San Diego County's Natural Community Conservation Programs (NCCP):

Level 3 – Containment: Eradication with coordinated programs by management unit or watershed.

Level 4 – Directed Management: Control within reserve or sub-management unit to benefit NCCP resources.

[3] **Source**: Cal-IPC Invasive Plant Inventory Database, 2019a. Overall rating listed for southwest region, factoring impact, invasiveness, distribution, and documentation level.

Cal-IPC Inventory Categories:

Alert: Species with High or Moderate impacts that have limited distribution in California, but may have the potential to spread much further.

High: Species have severe ecological impacts, are conducive to moderate to high rates of dispersal/establishment, and most are widely spread.

Moderate: Species have substantial and apparent, but generally not severe, ecological impacts; are conducive to moderate to high rates of dispersal, though establishment is generally dependent on ecological disturbance; and distribution may range from limited to widespread.

Limited: Species are invasive, but their ecological impacts are minor on a statewide level, or there was not enough information to justify a higher score; have low to moderate rates of invasiveness; and are generally limited but may be locally persistent and problematic.

Watch: Species have been assessed as posing a high risk of becoming invasive in the future in California.

[4] Occurrence:

A = Additions

OP = Original Preserve

[5] Species occurrences within the Original Preserve should be verified. **Source**:TAIC 2008.

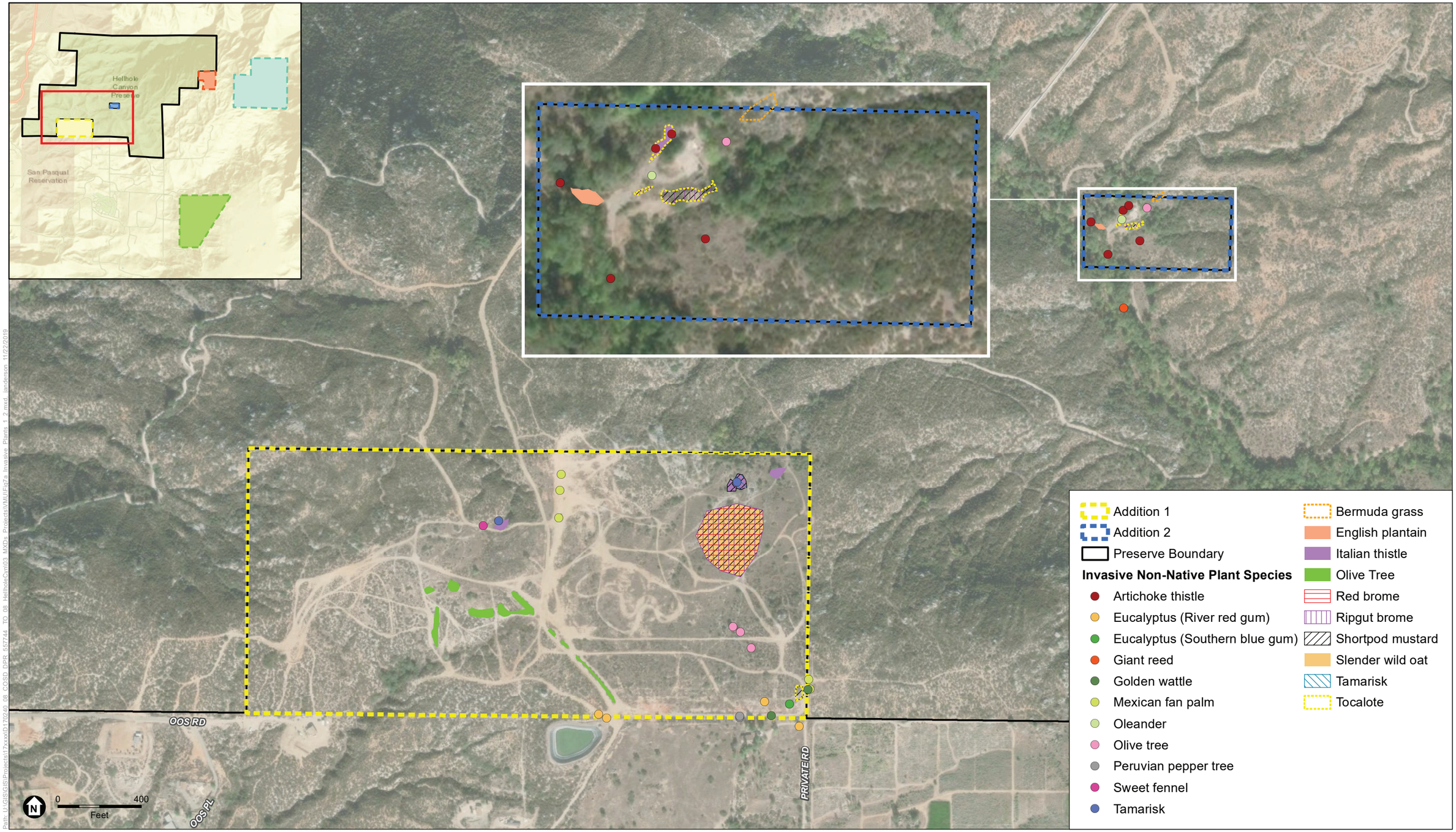
3.1 TARGET INVASIVE SPECIES

A total of 16 non-native invasive plant species observed within the Preserve have been prioritized for removal (**Table 7**). Target invasive non-native plant species were ranked based on their invasive potential, prevalence throughout the Preserve, and priority and ability to be controlled under management. Target plant species designated as high priority are recommended for immediate removal while target plant species designated as moderate priority should be removed after high-priority species are under control or when in close proximity to occupied habitat for special-status species.

Table 7. Removal Priority of Target Invasive Non-Native Plant Species

Common Name	Scientific Name	Removal Priority
Giant reed	*Arundo donax*	High
Pampas Grass	*Cortaderia selloana*	High
Artichoke Thistle	*Cynara cardunculus*	High
Iceplant	*Carpobrotus edulis*	High
Sweet Fennel	*Foeniculum vulgare*	High
Treasure Flower	*Gazania linearis*	High
Crimson Fountain Grass	*Pennisetum setaceum*	High
Peruvian Pepper Tree	*Schinus molle*	High
Brazilian pepper tree	*Schinus terebinthifolius*	Moderate
Tamarisk	*Tamarix ramosissima*	High
Mexican Fan Palm	*Washingtonia robusta*	High
Golden wattle	*Acacia pycnantha*	Moderate
Eucalyptus (River red gum)	*Eucalyptus camaldulensis*	Moderate
Eucalyptus (Southern blue gum)	*Eucalyptus globulus*	Moderate
Tree Tobacco	*Nicotiana glauca*	Moderate
Olive tree	*Olea europea*	Moderate

Within the Original Preserve, dominant plant species observed within the disturbed areas included short-pod mustard, pigweed (*Amaranthus albus*), common lambsquarters (*Chenopodium album*), Russian thistle (*Salsola tragus*), tocalote, and wild radish (*Raphanus sativus*). Within the Additions, additional invasive non-native species, include brome grasses (*Bromus* sp.), short-pod mustard (*Hirschfeldia incana*), tocalote (*Centaurea melitensis*), rattail fescue (*Festuca myuros*), smilo grass (*Stipa miliacea*), and wild oat (*Avena fatua*). Management for these species would most likely not be cost-effective or successful; therefore, these species are not prioritized for removal, but should be included as species to monitor and control as components of general habitat management.



Path: U:\GIS\GIS\Projects\17xxxx\D170240_08_COSD_DPR_557744_TO_08_HellholeCyn\03_MXDs_Projects\VMU\Fig7a_Invasive_Plants_1_2.mxd, landerson 11/22/2019

SOURCE: ESRI, 2019; SanGIS, 2019; ESA, 2019.

Figure 7a
Invasive Non-Native Plant Species
Addition 1 and Addition 2

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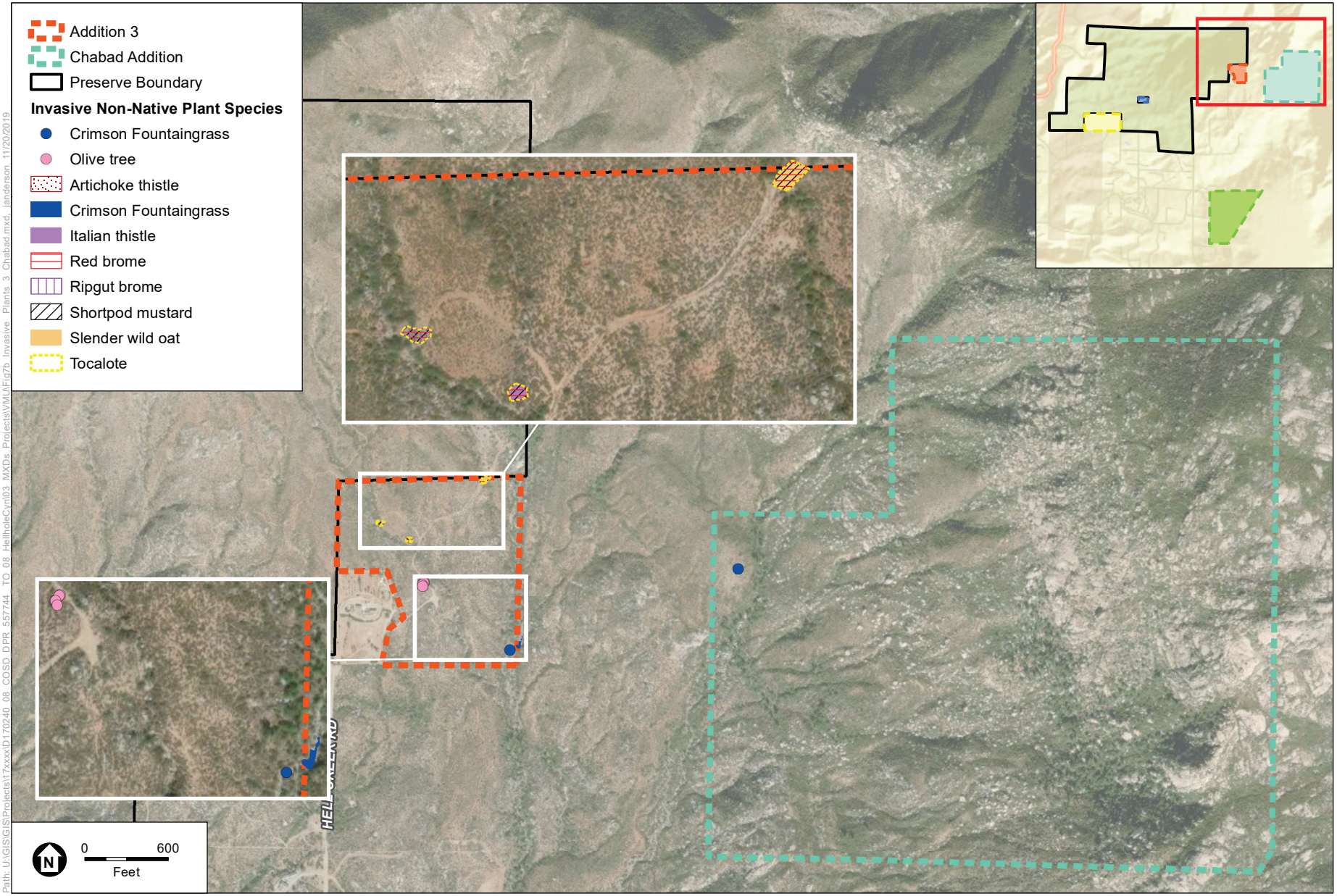
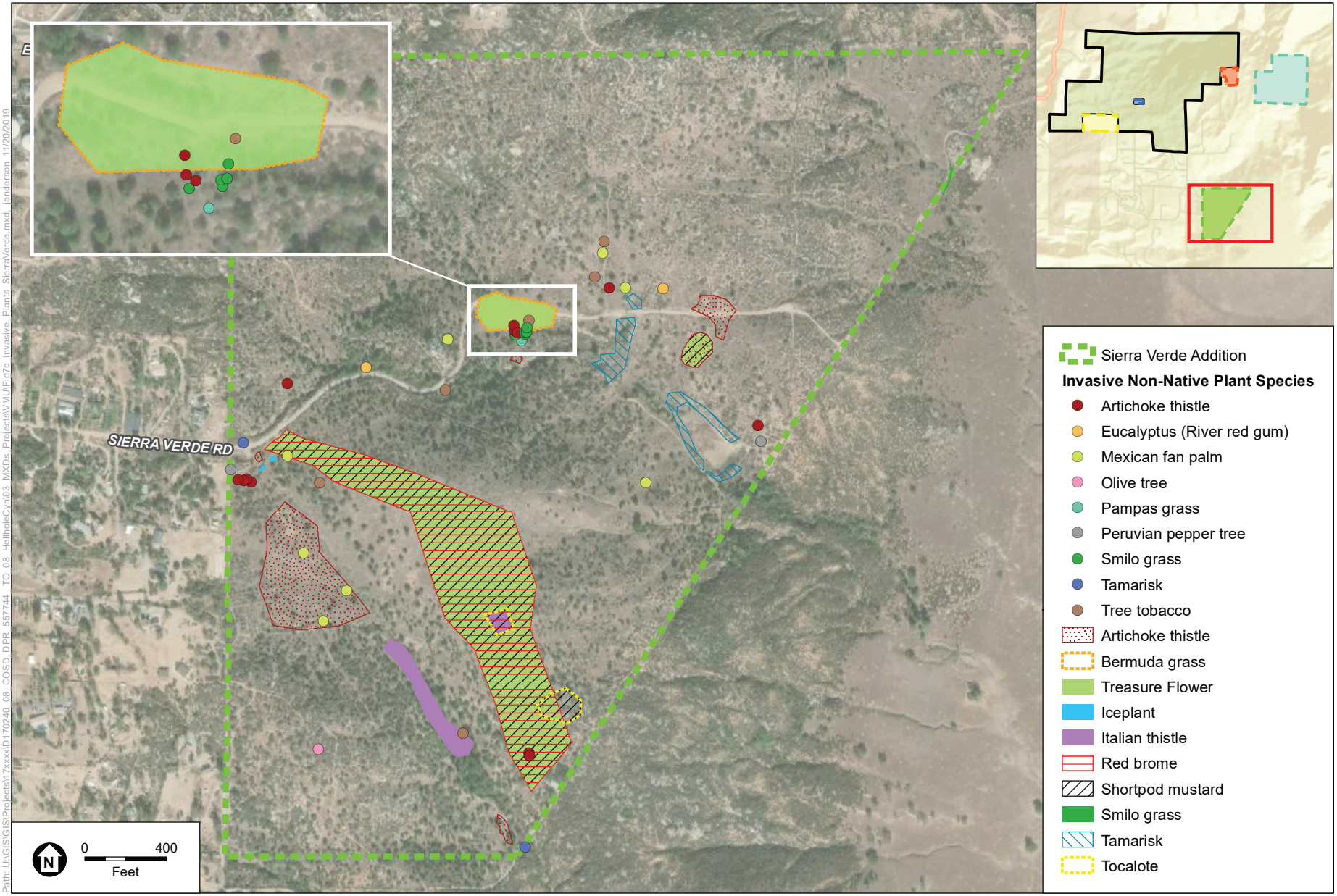


SOURCE: ESRI, 2019; SanGIS, 2019; ESA, 2019.

ESA

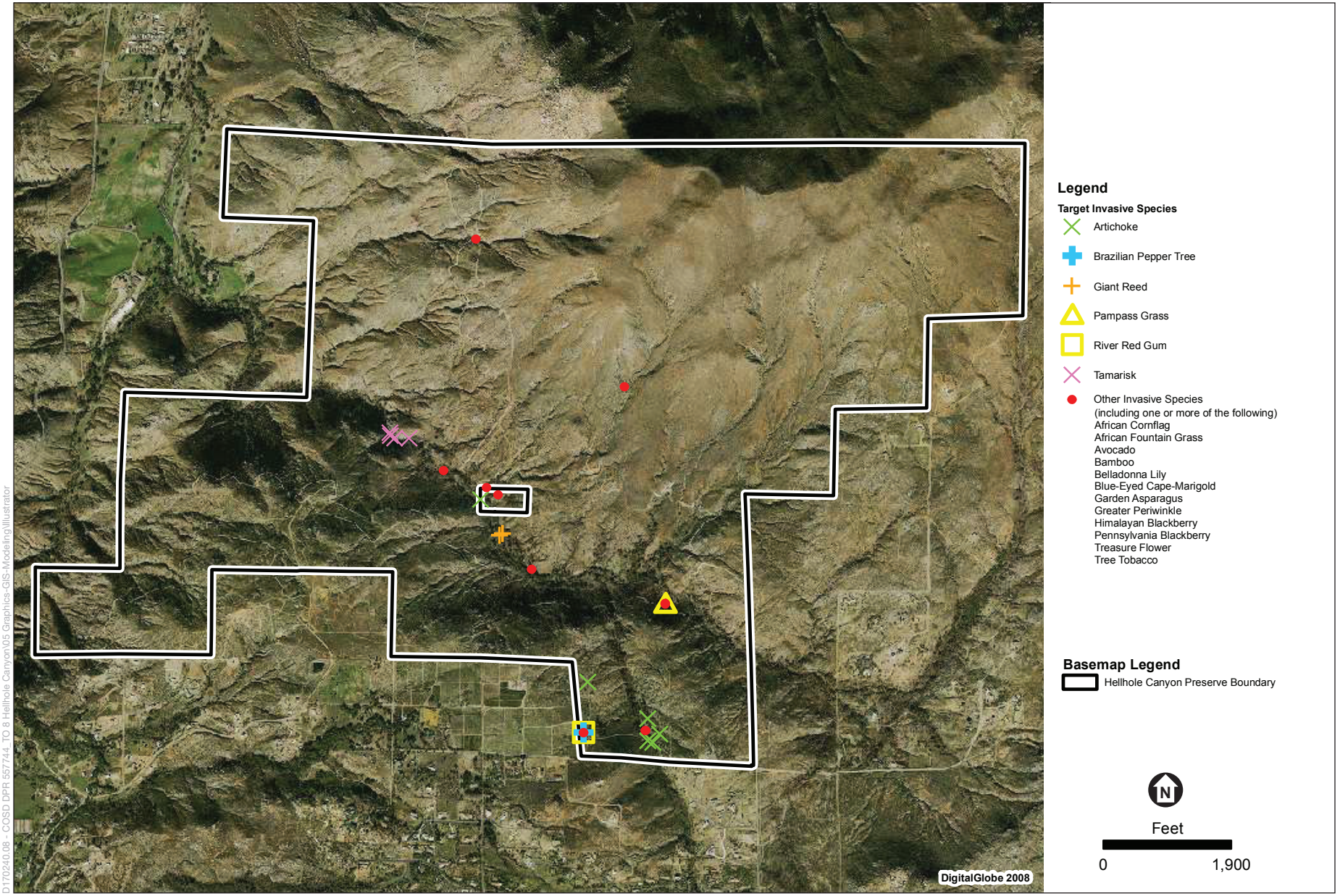
Figure 7b
Invasive Non-Native Plant Species
Addition 3 and Chabad Addition



SOURCE: ESRI, 2019; SanGIS, 2019; ESA, 2019.

ESA

Figure 7c
Invasive Non-Native Plant Species
Sierra Verde Addition



SOURCE: TAIC 2009

Figure 7d
Invasive Non-Native Plant Species; Original Preserve, 2008 Baseline Surveys

ESA

The 16 target invasive non-native plant species listed in **Table 7** are recommended for removal consistent with EDRR practices. The EDRR system is a management approach recommended by Cal-IPC to effectively eradicate invasive plant populations before they have a chance to spread and develop a large seed bank. One of the management directives from the FRMP is to develop and implement an early detection program for invasive plant species to ensure that emerging individuals are detected in a timely fashion and eradicated before they become a long-term problem. Regular monitoring for these species should occur during general stewardship and recorded during biological monitoring activities. Removal methodologies may include manual removal, mechanical removal, herbicides, and cut and daub. However, the appropriate removal methodology will ultimately be determined with consideration of many variables, including time of year, severity of infestation, presence of special-status species, the degree of intermixing of invasive species with sensitive native habitats, access, and proximity to surface water. Continued surveillance is also necessary to ensure these species or other highly invasive species do not spread into other areas of the Preserve. In addition, each occurrence would likely require follow-up treatments and continued monitoring to prevent potential resprouting and re-establishment.

3.1.1 High-Priority Species for Removal

Giant Reed (*Arundo donax*)

Giant reed is a tall perennial grass that typically forms dense stands on disturbed sites, sand dunes, riparian areas, and wetlands. In North America, individuals reproduce only vegetatively from rhizomes and/or stem fragments, which generally disperse with water, mud, and human activities. Individuals produce inflorescences in the spring between March and September; however, the resulting seeds are not viable. This species is threatening California's riparian ecosystems by outcompeting native species, such as willows, for water (Cal-IPC 2019a).

An isolated population of giant reed (*Arundo donax*) was detected within a drainage in southern coast live oak riparian forest habitat (**Figures 7a** and **7d**) during biological surveys conducted within the Original Preserve in 2008, which was confirmed to still be present during biological surveys conducted in 2019. This species is considered high priority for removal to prevent spread into the Harbison's dun skipper (*Euphyes vestris harbisoni*) habitat in Addition 2. Treatment should occur immediately in order to prevent an infestation downstream of the occurrences. Mechanical methods are particularly effective for small infestations, especially in loose soil and after rain when individuals are easier to hand-pull, chop, cut, or mow. For larger infestations, heavy equipment may be needed; however, these methods generally cause more soil disturbance and are nonselective. Mechanical removal methods should be performed when individuals begin to flower, which is when the rhizomes' reserve energy supply would be lowest. In addition, the entire rhizome root mass should be removed, since any small portion of the rhizome has the potential to resprout. All cut plant material must therefore be removed from the Preserve. If the root mass

cannot be completely removed, a non-selective herbicide such as Glyphosate should be applied to any remaining stumps following mechanical removal to prevent resprouting. Glyphosate can also be used in lieu of mechanical methods, though requires 2 to 3 years of treatment (DiTomaso et al. 2013).

Pampas Grass (Cortaderia selloana)

Pampas grass is an invasive perennial grass species that has spread along the coast of California, in the Coast Ranges, Central Valley, western Transverse Ranges, and Mojave Desert due to ornamental planting and as an erosion control species. The bloom period ranges from September to March. Individual plants are functionally male or female, therefore this species develops seed only when male and female plants are within pollination range of one another. Individuals can only reproduce by seed. Plants develop large plumes containing up to 100,000 seeds that are widely dispersed by wind. This species can be found within dunes, bluffs, coastal shrublands, marshes, inland riparian areas, and disturbed areas, where it can quickly colonize bare ground (Cal-IPC 2019a).

Within the Original Preserve, pampas grass was detected on the southeast corner of the boundary within the southern coast live oak riparian forest habitat (**Figure 7d**). Within the Additions, this species was detected in a single location on the Sierra Verde Addition (**Figure 7c**). Mechanical removal can be an effective method for control. By removing the entire crown and top section of the roots and either leaving the plant upside down to dry out the roots or removing the plant from the site, the chances of resprouting are significantly reduced. A chain saw or weedeater can be used to cut down the blades of grass and expose the base of the plant to make removal easier. If manual removal is not feasible, treatment via herbicide application can be used. Glyphosate, a systemic and non-selective herbicide, provides the most consistent treatment for all plant sizes of this species and is most effective when used via foliar application during late summer or fall, after flowering. Whether manual or chemical methods are used, it is important to carefully remove and bag any seed heads prior to treatment in order to prevent further spread (DiTomaso et al. 2013).

Artichoke Thistle (*Cynara cardunculus*)

Artichoke thistle is a large, perennial thistle that can grow to 8 feet tall with grayish-colored spiny leaves and large purple flowerheads. This species is likely a wild biotype of the commercial globe artichoke. Seedlings develop a deep taproot during the first year, but do not flower until typically their second year between April and June. Individuals reproduce by seed and sometimes by resprouting from root fragments (Cal-IPC 2019).

Within the Original Preserve, artichoke thistle was detected in several locations including in the south central area and near the southeast boundary mainly within the southern coast live oak

riparian forest habitat found in the southeastern portion of the boundaries (**Figure 7d**). This species was also detected in various locations on Addition 2, Addition 3, and the Sierra Verde Addition (**Figures 7a** through **7c**). Mechanical removal can be effective for controlling this species. Cultivation or manual removal can be used at the seedling stage; if removing established individuals, most of the taproot must be removed to prevent resprouting. For individuals that have flowers, reduction of seed production can be achieved by cutting flower stems before maturity. For dense patches, mechanical methods followed by herbicide application on resprouts can help control spread. Triclopyr, a broadleaf-selective herbicide, is most effective on smaller plants, can be an option for treating artichoke thistle. 2,4-D, a broadleaf-selective herbicide with no soil activity, is not the most effective treatment, but is widely used due to low cost. Goat grazing may also help reduce seed production (DiTomaso et al. 2013).

Iceplant (*Carpobrotus edulis*)

Iceplant is a perennial invasive succulent shrub found throughout coastal California and the Channel Islands due to ornamental planting. Individuals can grow and bloom yearlong. This species propagates by seed and vegetatively, where even small stem fragments can regenerate into a new plant. It can grow into dense mats within coastal scrub, grasslands, chaparral, bluffs, dunes, and beaches, where it increases soil organic matter over time, allowing new non-native species to invade (Cal-IPC 2019a).

This species was detected in two locations on the Sierra Verde Addition (**Figure 7c**). Manual removal is an effective method for control year-round. However, since iceplant can readily regenerate with soil contact, the biomass (including stem fragments and even the underlying debris which could contain seeds) would need to be completely removed from the site. The entire plant could be hand-pulled and torn by the roots, and rolled up like a carpet for easier transport. If manual removal is not feasible, placing a tarp over the mat to block light can eventually help kill the plant. This would require frequent monitoring to ensure the tarp stays in place and doesn't create a litter issue. Chemical methods of control can also be used to control iceplant. Glyphosate, a non-selective herbicide, is the only chemical option registered in California that has been shown to effectively kill this and other iceplant species. Since it is a succulent, adding surfactant can increase the effectiveness (DiTomaso et al. 2013).

Sweet Fennel (Foeniculum vulgare)

Sweet fennel is an invasive perennial species that has a high ability to spread. Individuals can reproduce by seed and even vegetatively from root or crown fragments. It has established dense local populations throughout California, such as in the Marine Corps Base Camp Pendleton, where it has drastically altered the composition and structure of the landscape and prevented the recovery of native vegetation from disturbance. It is an upright, branching species with a deep thick taproot

that produces aromatic yellow-green leaves and small yellow flowers. The bloom period ranges from May to September. This species can be found within grasslands, coastal scrub, riparian, and wetland communities (Cal-IPC 2019a).

This species was detected in a single location on Addition 1 (**Figure 7a**). Mechanical methods of control can be effective. Slashing the plant stem prior to flowering may kill the plant, but repeat cutting is likely to be needed. However, even if the plant recovers, this slashing will prevent seed set. Digging out the entire plant and root or using a mattock or small cutting tool to remove the plant can also be successful, but is labor intensive. If manual removal is not feasible, treatment via herbicide application can be used. Triclopyr is the standard herbicide for fennel control. It is a broadleaf herbicide that can be used via broadcast foliar treatment. The best time for application is during the wet season from late February to early March, before flowering (DiTomaso et al. 2013).

Treasure Flower (*Gazania linearis*)

Treasure flower is an herbaceous perennial native to South Africa that produces showy, daisy-like flowers. It is widely used in ornamental cultivation in Southern California as a mat-forming or clumping ornamental. Treasure flowers bloom all year and produce an abundance of wind-spread seed. They have taproots that sometimes spread by sending out rhizomes. It has been reported escaping into creek-side vegetation and into native grassland from plantings in San Francisco, Monterey, and Ventura Counties, where it can form a dense groundcover and outcompete other species (Cal-IPC 2019a).

This species appears to have occurred at least once within the Original Preserve and was detected in multiple locations on the Sierra Verde Addition (**Figures 7d** and **7c**). Limited information is available regarding effective management methods. Manual removal of this species appears to be challenging due to the taproot and rhizomes needing to be completely removed to prevent resprouting. If the entire root system is not able to be removed properly, repeated treatments may be needed to deplete the roots of nutrients. The flower heads can also be manually removed and disposed of in order to prevent additional seeds from entering the seed bank. However, for large or widespread populations such as that at the Sierra Verde Addition, glyphosate can be used for foliar treatment. Glyphosate is most effective if applied when individuals are actively growing (HerbiGuide n.d.).

Crimson Fountaingrass (*Pennisetum setaceum*)

Crimson fountaingrass is a coarse-tufted perennial grass species that grows primarily along the Southern California coast. Crimson fountaingrass is well adapted to fire and can increase in density following a burn (Cal-IPC 2019a). Individuals reproduce by seed and blooming period can range

between March and December. It is commonly found within chaparral, grassland, and coastal dune and scrub habitats.

This species appears to have occurred at least once within the Original Preserve and was detected in one location on Addition 3 and one location on the Chabad Addition (**Figures 7d** and **7b**). Manual removal can be an effective method of control for this species. Small infestations can be uprooted using heavy tools (such as picks or shovels) or cut with line-trimmers. Inflorescences should be cut, bagged, and removed to prevent further spread. If manual removal is not feasible, chemical methods may be used, particularly for larger populations, such as along the southern boundary of the Preserve. Glyphosate can be applied to large individuals using a wiper applicator to provide higher selectivity. Herbicide should be applied to rapidly growing plants between mid-summer and fall; best mortality of rhizomes can be achieved at the flowering stage. Fusilade is another chemical control option that can be applied to rapidly growing individuals, but not on water-stressed plants. It is only effective on annual and perennial grass species and therefore, special care should be taken to avoid any native grasses in close proximity to treatment areas (DiTomaso et al. 2013).

Peruvian and Brazilian Pepper Tree (*Schinus molle* and *S. terebinthifolius*)

Peruvian and Brazilian pepper trees are evergreen shrubs or trees. Brazilian pepper tree commonly occurs within riparian areas, canyons, fields, and roadsides, typically where some water is available throughout the year. Peruvian pepper trees more often occur in upland habitats. Peruvian and Brazilian pepper trees reproduce by seed and sometimes vegetatively from root sprouts. Peruvian pepper trees flower between June and August, while Brazilian pepper trees flower from May to September. Both species are dioecious and can be prolific, producing fruits that get eaten and dispersed by wildlife, and root shoots that can result in dense monotypic growth within the tree canopy (Cal-IPC 2019a).

Brazilian pepper tree was detected in the southeast area of the Original Preserve, adjacent to an agricultural field and the boundary line (**Figure 7d**). Peruvian pepper tree was detected in various locations on both Addition 1 and the Sierra Verde Addition (**Figures 7a** and **7c**). If treating small individuals, hand-pulling of entire saplings along with their root systems can be a successful technique. For larger, more established individuals, control is more difficult since they can resprout from the base. Heavy equipment can be used in these cases; however, root pieces as small as 0.25 inch in diameter can resprout, therefore the entire root system must be removed. Mechanical methods followed by chemical treatment, such as the cut and daub method, can effectively control these species. The trunk should be cut as close to the ground as possible before applying herbicide such as Triclopyr, a broadleaf-selective herbicide, to the stump. Drill and kill methods can also be a successful method of control, however, due to the close proximity of many of these individuals to trails and utility lines, this method is not recommended. Individuals should be treated before

they begin to fruit in the late summer or autumn, when plants are actively growing and translocating nutrients to the roots (DiTomaso et al. 2013).

Tamarisk (*Tamarix ramosissima*)

Tamarisk is a tree or shrub that can grow to 20 feet. This species is widely spread throughout California, often in riparian areas such as rivers, lake and pond margins, roadsides, and ditches, where it can significantly impact underground water tables and surface water availability (Cal-IPC 2019). It produces tiny scale- or awl-like leaves and flowers ranging in color from white to dark pink. Its roots extract salt from deep soil layers and excrete it through its leaves. Leaf litter increases the salinity of the upper soil profile, inhibiting the growth, survival, and recruitment of native vegetation. This species blooms between April and August and can reproduce by seed, and sometimes vegetatively from root sprouts and stem fragments, which can take root when buried in moist substrates. Mature trees can produce substantial amounts of seed that disperse by wind and water (DiTomaso et al. 2013).

Within the Original Preserve, several individuals were documented in the central area of the western boundary within southern mixed chaparral habitat (**Figure 7d**). This species was also detected in a single location on Addition 1 and in multiple locations on the Sierra Verde Addition (**Figures 7a** and **7c**). Seedlings can be effectively controlled via hand pulling. Small infestations can be controlled by mechanical methods such as mowing or chopping; however, this species can resprout vigorously after treatments. Cut and daub methods can be very effective. Triclopyr, a broadleaf-selective herbicide, can effectively kill young to mature trees. This herbicide is best used when applied in the summer or fall when plants are still growing and not water stressed (DiTomaso et al. 2013).

Mexican Fan Palm (*Washingtonia robusta*)

Mexican fan palm is a single-trunked perennial palm tree found in the San Francisco Bay area, in southern Sacramento Valley, and along the Southern California coast. This species can only reproduce by seed. Blooming period ranges from April to June. It was introduced as a common landscape ornamental that escaped and became invasive in riparian areas, orchards, and landscaped areas. It can create monospecific stands in riparian areas where the dead fronds can become a fire hazard (Cal-IPC 2019a).

This species was detected in various locations on Addition 1, Addition 2, and the Sierra Verde Addition (**Figures 7a** and **7c**). Manual removal can be a very effective control method. Young individuals can be hand-pulled, while older individuals can be cut at the base with a chainsaw. Manual removal is typically preferred when herbicide application to foliage is out of reach and there is a higher chance of significant herbicide drift. For young individuals, Triclopyr can be

applied into the apical buds or centers, which will also reduce damage to adjacent species. For larger individuals, Glyphosate can be used for the cut and daub treatment as well as for drill and kill methods where herbicide is inserted into drilled holes (DiTomaso et al. 2013). However, using the "drill and kill" method (e.g., inserting herbicide into drilled holes) to allow palms to die in place is not recommended due the proximity of the Mexican fan palms to access roads and social trails.

Golden Wattle (*Acacia pycnantha*)

Golden wattle is a tree native to southeastern Australia. It can grow to a height of 30 feet with profuse, fragrant, golden flowers. This species is an escaped ornamental plant that is commonly found growing along roadsides and in woodlands. Individuals bloom in February and reproduce only by seed, which are long-lived and germinate readily after wildfires (Cal-IPC 2019a).

This species was detected in two locations on Addition 2 (**Figure 7a**). Manual removal can be effective at the seedling stage; once mature, manual removal should be followed by treatment with herbicide. Garlon and Glyphosate can be used for foliar application or for the cut and daub method. Seeds readily germinate in the season after fire or treatment of the adult trees. Follow up visits are important to ensure seedlings are treated or manually removed prior to seed-setting (HerbiGuide n.d.).

Eucalyptus – Red River Gum and Southern Blue Gum (*Eucalyptus camaldulensis* and *Eucalyptus globulus*)

Eucalyptus (river red gum and southern blue gum) are fast-growing trees that can reach heights of 180 feet tall. These species are widely spread throughout the coastal regions of California, often in disturbed, riparian, coastal grasslands, and forest areas. Groves can expand into intact adjacent scrub, woodland, or grassland habitats. The long, glossy leaves have flammable plant compounds and decompose very slowly, increasing leaf litter and the risk of fire. Red river gum trees bloom between April and July and southern blue gum trees bloom between October and January. Seeds are mostly released from capsules while still attached to the tree and can germinate a few weeks after release from capsules. Mature southern blue gum trees drop limbs and leaf litter which decompose slowly and have flammable plant compounds. Dense groves are highly combustible and increase the risk of fire. River red gum trees increase risk of catastrophic wildland fires and over-crowd native plants and trees (Cal-IPC 2019).

Within the Original Preserve, river red gum tree was detected in the southeast area adjacent to the boundary line and agricultural fields within coast live oak woodland habitat (**Figure 7d**). Both river red gum and southern blue gum trees were detected in various locations on both Addition 1 and the Sierra Verde Addition and a single location on Addition 2 (**Figures 7a** and **7c**). Hand

pulling can be used on seedlings, taking care to remove the entire root system to prevent stump sprouting. Mechanical methods such as cutting the tree at ground level before it flowers can reduce seed production and deplete reserves; however, resprouting is common following mechanical removal. Glyphosate, a nonselective systemic herbicide, is considered the most effective herbicide for controlling eucalyptus and is best used in the cut and daub method during late summer to early fall. Foliar treatment should only be used on small trees or seedlings.

Tree Tobacco (*Nicotiana glauca*)

Tree tobacco is a short-lived shrub or tree that can grow up to 20 feet tall. It is a prolific seed producer that can only reproduce by seed. Blooming time ranges between April and August. It was introduced to California approximately 100 years ago and can be found in disturbed areas, in vacant lots, along roadsides and streamsides, and in other riparian areas (Cal-IPC 2019a).

This species appears to have occurred at least once within the Original Preserve and was detected within the Sierra Verde Addition (**Figures 7d** and **7c**). Manual removal can be very effective if performed in the early stages of development. Seedlings and small saplings can be hand pulled, taking special care to extract the entire root to prevent resprouting. Larger established individuals can be extracted with a weed wench or extractor or cut off prior to flowering. Herbicide application should be performed immediately after cutting. Triclopyr can be used for cut stump treatments. Glyphosate is another option that can be used for foliar application when plants are growing rapidly. However, individuals should not be cut for at least 4 months following foliar treatment (DiTomaso et al. 2013).

Olive Tree (*Olea europea*)

Olive is an evergreen tree that is native to the Mediterranean region. This species was likely planted historically but is no longer actively maintained. It can grow to 30 feet tall with very small, fragrant, white flowers, and lance-shaped leaves. It can produce hundreds of seeds that are spread by birds and mammals and has been known to invade open space areas in southern California.

This species was detected in various locations on both Addition 1 and the Sierra Verde Addition and a single location on Addition 2 (**Figures 7a** and **7c).** Seedlings can be hand-pulled. Mechanical removal can be followed by herbicide treatment. Glyphosate and Triclopyr can both provide excellent control when used in cut and daub methods. Triclopyr can also be used for foliar application on seedlings, saplings, and small trees (DiTomaso et al. 2013).

3.2 REMOVAL METHODS

Appropriate removal and control methods shall be determined on a case-by-case basis and should take into consideration several variables, including proximity to surface water, time of year,

severity of infestation, degree of intermixing of invasive species with sensitive native habitats, proximity to sensitive plants and wildlife, and access. Maintenance activities that involve tree trimming, removal of exotic trees, and vegetation thinning/clearance should implement avian and/or bat mitigation measures to avoid potential impacts to nesting birds and roosting bats, as needed. General recommendations for the treatment of invasive non-native plant species within the Preserve are provided below.

3.2.1 Manual Removal

Manual removal such as hand-pulling, grubbing, and hoeing, is labor intensive but can be an effective method for small infestations of annual species as well as young perennial species, where removal of the root system is still possible. Helpful hand tools that can be used include shovels, hoes, loppers, or just hands. Despite the labor-intensive nature of the manual removal method, it can still be used for medium-sized to large infestations and include potential assistance from volunteer groups. Some of the benefits of this approach are that there are no permits or licenses required and it can provide a very immediate solution for cases where ideal herbicide application windows have passed. It also provides a good opportunity for volunteers to learn from these types of experiences and gain a sense of stewardship, awareness, and ownership of the Preserve.

This method should be used particularly for new occurrences where it is crucial to control individuals at early stages before they have a chance to set seed and spread, as well as for cases where target weeds are in close proximity to sensitive or native plant species. In addition, invasive species that have developed fruit or seed on-site should be carefully cut, bagged, and removed from the Preserve in order to prevent future spread. All cut biomass should be removed from the Preserve where feasible to prevent future spread or regeneration from cut material, particularly for iceplant, tamarisk, and giant reed. If material cannot be left on-site to decompose without risk of regeneration, is too large to stay on-site or would be a fall hazard, or if the removed biomass is substantial enough to pose a fire hazard, materials shall be disposed of outside of the Preserve at a green waste facility or landfill.

Manual removal methods such as cultivation or tillage, the process of aerating or turning over the soil, can be used in restoration sites where soils are badly disturbed. Tillage can be effective against non-native annual plants and shallow-rooted perennials, but there is also a chance of resprouting, especially for perennials with rhizomes. Tilling should be performed prior to seed development and when the soil remains dry so that any surviving weed fragments dry out (Tu et al. 2001). However, this practice should be avoided in sensitive habitat areas containing soil crusts or special-status plants and wildlife susceptible to soil disturbance.

3.2.2 Herbicides

Herbicides are widely used as a way to control non-native invasive weed species. Glyphosate is the most-used, most-studied, herbicide in the world. Recent court cases have risen which claim that excessive use of glyphosate over decades has led to cancer. Cal-IPC, an organization focused on the protection of California's environment and economy from invasive plants, produced a Position Statement which stated that the strategic use of herbicides for the purpose of controlling infestations of invasive plants in a wildland setting, which typically involves small scale and limited duration application, to prevent future spread of target weed species and protect biodiversity is an important and appropriate tool in the Integrated Pest Management toolbox. According to the best-available information at the time Cal-IPC wrote this Position Statement, the active ingredient in Glyphosate, when used for invasive plant management projects in accordance with its label and use of appropriate personal protective equipment and best practices, is low-risk for wildlife, applicators, and the public. When taking into consideration the negative impacts that invasive plants have on wildlife habitat, fire and flood patterns, and water use, the risk of using approved herbicides is significantly lower (Cal-IPC 2019b).

Appropriate concentrations and application methods should be determined on a case-by-case basis, taking into consideration all applicable variables which may affect the effectiveness of treatment and surrounding habitat, such as seasonality, current life stage of the individual plant, phenology, and proximity to sensitive biological resources. Herbicide formulations intended for use in aquatic systems shall be used near waterways particularly along the creeks, streams, and tributaries within the Preserve. All herbicide application shall be performed under the supervision of an individual possessing a California Qualified Applicator License and in accordance with all herbicide labels (e.g., Material Safety Data Sheet, US Environmental Protection Agency pesticide labels), which provide first aid guidelines, hazard statements, storage and disposal methods, detailed instructions for various application techniques and equipment, mixing procedures, concentration and dilution rates, Personal Protective Equipment, safety guidelines, scenarios that are appropriate for the individual herbicide, and a table of weed species with recommended application rates and instructions. Special care must be taken to minimize risk of accidental contact to the applicator, the general public that may be nearby, and sensitive environmental and biological resources. During high wind conditions, foliar spray application should be avoided to reduce the potential of overspray and drift. Other methods that can be used in these situations include wick, or wipe-on, applicators, which use a sponge or wick on a long handle to wipe herbicide onto foliage and stems, "paint sticks," which have a reservoir in the handle to hold herbicide and is used to soak a brush or roll, and the "glove of death," which is a technique developed by The Nature Conservancy land stewards where a heavy cotton glove is worn over a thick rubber/latex (or nitrile) glove and soaked in herbicide to provide the glove-wearer complete control of application (Tu et al. 2001). Sensitive plant species occurring in close proximity to target weed species should be flagged by a qualified

biologist prior to herbicide application. Flagged areas should be given a buffer to avoid accidental damage to sensitive species.

3.2.3 Mechanical Removal

Mechanical removal with equipment is typically more effective when used in combination with herbicides. Using a line-trimmer can be a quick way of controlling large stands of soft (non-woody) annual weeds; however, there is also a risk of damaging or killing non-target species. Mowers can quickly remove vegetation; however, in addition to an increased likelihood of damaging or killing non-target species, it can also cause soil disturbance, and risk creating sparks caused by mowing blades hitting rock. Therefore, this method should be a last resort for extreme cases of large infestations of target weeds in flat unobstructed areas with little risk of sparks. Using chainsaws or drills may be necessary for the removal or treatment of woody species; however, cutting and drilling should be followed up by treatment with herbicides to effectively kill the target species, as described in the cut and daub method (Section 3.2.4). All mechanical equipment should be used with extreme caution, particularly around dry vegetation and during windy, hot, dry weather. Bird nesting surveys should be conducted by a qualified biologist prior to maintenance activities to avoid potential impacts.

3.2.4 Cut and Daub

The cut and daub method, also known as the cut stump method, involves both mechanical methods and herbicide application. First, vegetation must be cut close to the base using a chainsaw, then any sawdust or plant debris must be removed from the stump. Herbicide must be applied immediately afterwards, before the cut surface begins to dry and callus. For tree stumps greater than 3 inches in diameter, the entire living inner bark, i.e., cambium layer, must be thoroughly wet with herbicide using special care to avoid herbicide runoff. Surfaces of smaller stumps can be covered entirely with herbicide. Application can be via backpack sprayer, squirt bottle, or paint brush with a tracer dye to ensure treatment of all cut individuals (Ferrell et al. 2018). Aboveground material should be removed from the site, where feasible. Dead stumps may be left in place to decompose; however, they should be monitored to detect the need for retreatment. Special care must be taken to avoid potential impacts to nests during the bird nesting season (January 15 to August 31). During the nesting season, bird nesting surveys should be conducted by a qualified biologist prior to maintenance activities. In addition, a pre-maintenance roosting bat survey of the palm trees should also be completed for maintenance activities occurring during the bat maternity roosting season (between June and August).

4.0 HABITAT RESTORATION

Restoration is an important tool for land management and is used in degraded areas to create or enhance habitat quality and maximize the ecological value of an existing open space. One of the management objectives in the County of San Diego draft Framework Management Plan under the draft North County MSCP Subarea Plan, is to restore degraded habitats to protect and enhance populations of covered species through stabilization of eroded lands and strategic revegetation (County of San Diego 2018). Restoration activities can include working with existing soil conditions and grades, or landform modification (e.g., recontouring) and potential improvement to soil conditions. Selection of the appropriate restoration method(s) should take into consideration the purpose and goal of restoration (such as increasing habitat connectivity, enhancing sensitive species habitat, or removal of invasive non-native plant species), the scale of area to be restored, and the effort and funding/resources required to achieve the desired results. In general, whenever native plant material is being introduced for restoration purposes, efforts should be made to obtain materials from local sources that are adapted to local conditions and have a better chance of survival. In addition, any materials brought into the site (e.g., fiber rolls for erosion control) should be biodegradable where possible to avoid creation of debris/litter problems. Certified weed-free materials should also be used to avoid the introduction of additional invasive non-native plant species.

4.1 PROPOSED RESTORATION AREAS

The Preserve is primarily composed of high-quality native vegetation, including chaparral, woodland, and sage scrub variants. However, there are several opportunities for restoration within the Preserve, primarily in the disturbed habitat and disturbed open coast live oak woodland on-site. The disturbed habitat is mainly associated with unauthorized trails and old access roads, presumably associated with past ranching activities. In addition, the Preserve currently supports a small Engelmann oak population, primarily in the southeastern corner of Sierra Verde immediately adjacent to disturbed open coast live oak woodland (**Figures 5c** and **5d**). Restoration of these areas would serve to increase habitat connectivity, control erosion, and protect the integrity of surrounding vegetation communities, as well as expand habitat for special-status species.

The Original Preserve currently has an established trail system that is maintained according to the Preserve's Public Access Plan. However, unauthorized trails and old access roads traverse portions of the Preserve outside of the approved trail system, and are most prevalent within the Original Preserve, Addition 1, and Sierra Verde. These areas generally are composed of bare ground with scattered invasive plant species, and lack native vegetation. Continued use of unauthorized trails can lead to additional unauthorized trails, continued spread of non-native invasive species, increased potential for accidental damage of sensitive resources, and can create or exacerbate erosion issues that often remain undetected if they are not regularly monitored and maintained. In

addition, erosion issues adjacent to drainages and waterways could potentially contribute to sediment build-up over time. Restoration of disturbed areas and unauthorized trails would help address these issues. Prioritization of trail restoration areas should be based on monitoring results, and be prioritized accordingly.

Per the draft North County MSCP's Framework Management Plan, the primary management goal for Engelmann oak is to ensure its persistence by protecting, maintaining, and enhancing existing populations within conserved lands (County of San Diego 2018). Habitat restoration management objectives identified by the Framework Management Plan for this species include removing invasive non-native plant species and augmenting seedling reproduction. The Engelmann oak population within the preserve is currently limited to a small area in the southeastern corner of the Sierra Verde Addition, and four individuals scattered within the central area of the Original Preserve (**Figures 5c** and **5d**). The Sierra Verde population is bordered by disturbed open coast live oak woodland habitat which includes non-native trees such as avocado and high priority invasive non-native plant species including treasure flower and artichoke thistle, which could be restored to expand the Engelmann oak population on-site, as well as the amount of suitable nesting and roosting habitat for western bluebird and pallid bat.

The restoration of disturbed habitat and Engelmann oak habitat could be successfully implemented within the Preserve and are discussed further below along with a general description of restoration methods.

4.2 RESTORATION METHODS

Passive restoration can typically be achieved by implementing one or all of the invasive non-native plant species removal methods described in Section 3.2, blocking off access to the area, and/or otherwise removing the stressors that are negatively affecting an area. The idea is that once stressors are removed, it will partially improve conditions for native plant species to re-establish naturally. Passive restoration is typically less aggressive/active and costly, and results often occur over a slower and longer timeframe. Although this method does not require as many resources, there is typically a need for a good source of on-site native plant material, such as a good native seed bank in the soil and/or mature native plants nearby (sufficient for adequate native plant recruitment). Weeds tend to thrive from disturbance or in open spaces, so when one invasive species is removed from an area, other invasive non-native plant species can quickly fill in those spaces and outcompete native seedlings. Without sufficient on-site native plant material to support adequate native plant recruitment and revegetation, achieving positive results can take more time. Therefore, regular monitoring of native plant recruitment and follow-up weed treatments are important for ensuring the success of passive restoration projects.

Active restoration typically involves more effort and is costlier, but it can also be a more effective and faster approach than passive restoration. This method not only involves the removal of non-native weed species, but it also involves the installation of native plant materials as well as continued maintenance activities through plant establishment. Active restoration can involve all of the methods described in passive restoration, in addition to the introduction of native plant material such as container plants and/or seed, along with regular follow-up maintenance activities such as weed control and watering until plants are established. If active restoration is used, restoration should take into consideration funding, appropriate access to transport materials (to avoid damage to the Preserve) and water for temporary irrigation, plant palettes appropriate for a site's ecological conditions and on-site wildlife species, and feasibility of performing regular maintenance activities. Depending on the resources and funding available, plant palette(s) may consist of native plant seed and/or native container plants. Seed application is often less costly and does not require as much time, labor, or maintenance as container plant installation but the results, which can be effective, are typically less predictable. Hydroseed application can also be used to help retain seed in contact with the soil in bare open-spaces or on slopes. To be most effective, seeding should occur prior to or shortly after the start of fall-winter rains. Native container plant installation is more labor intensive and requires more follow up maintenance to ensure sufficient survival; however, the advantage to container plant installation is that they immediately take up space that may otherwise be occupied by quick-growing invasive species.

Examples of how and where these restoration methods could be implemented within the Preserve are described below.

4.2.1 Trails (Disturbed Habitat)

Passive restoration could be a feasible option for restoring the selected unauthorized trails. This can be achieved by first closing off access to the unauthorized trails via installation of signs, fencing, and other barriers as appropriate, followed by regular target weed removal to help support naturally recruiting native seedlings. Monitoring should occur regularly in order to track progress.

If passive restoration methods are insufficient, additional active restoration methods can be implemented. Best management practices (BMPs), such as fiber rolls, earthen water bars, and/or deflectors can be installed particularly on trails that are on slopes and/or adjacent to waterways which are susceptible to erosion. This can help reduce the distance of flow acceleration and associated sheet flow velocities within these sensitive areas. BMPs not only help protect a site from further erosion, but they can also help to capture surrounding native seed and sediment that might otherwise wash off the surface, and can also serve as an additional barrier to deter unauthorized trail use. In heavily eroded areas, some minor recontouring may be used to help stabilize the soil. Additionally, if compaction is an issue preventing native plant establishment, soil preparation may be necessary. Decompaction can be accomplished by ripping the soil with a

backhoe, bobcat, or tractor followed by application of organic mulch or other materials for stabilization. In sites where access is restricted or where existing vegetation prevents physical decompaction, spreading a thick organic mulch layer will help partially decompact the underlying soil (SNP n.d.). In heavy traffic areas, container plant installation can also serve as a natural barrier, but depending on the location of the trail, follow-up watering visits may not always be feasible. Supplemental seed application could be very helpful in these cases; hand-seeding is typically sufficient when raked into the soil properly, but hydroseed application may be more effective on slopes and can also aid in soil stabilization.

Since most of the Preserve consists of southern mixed chaparral, container plants and seed species that can be used include but are not limited to, chamise (*Adenostoma fasciculatum*), mission manzanita (*Xylococcus bicolor*), laurel sumac (*Malosma laurina*), and woollyleaf ceanothus (*Ceanothus tomentosus*). California buckwheat (*Eriogonum fasciculatum*) is an example of a shrub that is a good early colonizer which produces large amounts of viable seed that can support natural recruitment and revegetation of areas with low plant cover. Cactus species such as mission cactus (*Opuntia ficus-indica*) are also good access control species that once planted require little maintenance. In addition, nitrogen fixers such as native perennial grasses and legumes can be helpful such as purple needlegrass (*Stipa pulchra*), nodding needlegrass (*Stipa cernua*), and coastal deerweed (*Acmispon glaber*). Where appropriate, plant palettes can also include Engelmann oak to expand the existing population on-site. More specific plant palettes can be developed once specific trails are selected for closure, which can be tailored to blend with the surrounding vegetation to meet individual and site specific needs.

4.2.2 Engelmann Oak Habitat (Disturbed Open Coast Live Oak Woodland)

Engelmann oak (*Quercus engelmannii*) is a wind-pollenated, perennial deciduous tree that grows 16 to 26 feet high in oak woodlands or grassland habitats. Engelmann oak is predominantly found in the foothills of San Diego County, but scattered observations extend up into Los Angeles and southwestern San Bernardino Counties, and down into Baja California, Mexico. This species often occurs with coast live oak (*Quercus agrifolia*), in savannah-like habitats with annual grasses, or in areas where white sage occurs, and is also known to hybridize with scrub oak (*Quercus berberidifolia*) (Baldwin et al. 2012). It is drought-tolerant and will regrow new leaves following rain after going dormant. Reiser (2001) indicates that Engelmann oak populations are relatively stable in Southern California, but reproduction has been limited as a result of cattle grazing and herbivory by small mammals and deer. The introduction of feral pig (*Sus scrofa*) in the county in recent years and wild turkey (*Meleagris gallopavo*) in the early 1990s further exacerbates problems with oak reproduction, as both species consume acorns. Engelmann oaks are masting species on a 3-year cycle, meaning that acorns are produced in abundance every 3 years with limited numbers produced during the other 2 years (Henrich 2014). In addition, this population faces threats from

direct habitat loss, population fragmentation, and the increased potential for exposure to wildfires as a consequence of its proximity to large human population centers (Principe 2015).

Four Engelmann oaks were detected within the Original Preserve in four different locations; an Engelmann oak was also detected in the Sierra Verde Addition along the eastern boundary in the north and a small population of nine Engelmann oaks was detected along the eastern boundary in the south, which is surrounded by disturbed open coast live oak woodland (**Figures 5c** and **5d**). Since the southern location is the only population within the Preserve, restoration efforts should first concentrate on expanding this Engelmann oak woodland population. One opportunity would be to restore the disturbed coast live oak woodland through removal of non-native and invasive species, while expanding the Engelmann oak population in this area.

Active restoration would be the best method of approach for habitat enhancement. This could be achieved through planting of acorns found within the Preserve or propagating acorns in a separate facility. Acorns should be collected on-site in mid-September to December, preferably directly from the parent tree (acorns on the ground are more likely to be predated) and during mast years. Viable acorns can be distinguished by performing a float test (immature or predated acorns contain air spaces which make them buoyant). Acorns can be planted directly onsite or sowed in a separate facility in November to early December, an inch deep in soil. Saplings should be planted on-site soon after germination, preferably during the rainfall season (December through February and continuing through March or April, if necessary). Holes should be dug in moist soil to a depth that will accommodate the taproot, soil around the sapling should be compacted and watered thoroughly. Acorns and saplings can be planted in the vicinity of the female parent tree to simulate natural acorn dispersal or along the drip line (i.e., the point on the ground where water will drip off of the widest-reaching branch) of mature trees, which is where natural recruits have been recorded to be most successful, likely due to greater amounts of moisture and protection from full sun (Henrich 2014); however, saplings can also be planted in more exposed areas to expand Engelmann oak habitat. Milk cartons with the top and bottom cut out can be used to protect and mark planted acorns and chicken wire cages or cones may be installed to protect planted acorns, saplings, and/or naturally recruiting saplings from damage or predation.

Individuals perform best with a minimum of 38.1 cm (15 inches) of annual precipitation, and limited exposure to frost and extreme summer heat. Precipitation and sapling drought stress should be monitored within the restoration area. Supplemental watering should be performed between December and May, if needed; an additional watering in mid-August in the absence of monsoonal rains should also be performed. Saplings planted in exposed areas should be watered monthly through the first two summer dormant seasons (Henrich 2014).

An additional component to this restoration opportunity could be to introduce sympatric native trees/shrubs, grasses, and or forbs to restore the habitat to a natural ecosystem. Hand-seeding of

other compatible native species can be performed underneath the established population canopy and/or where the new individuals are installed so that they can be maintained concurrently. Native container planting should be avoided under established tree canopy to avoid root damage, as well as in close proximity to recently planted acorns or saplings to prevent early competition, overcrowding, and/or mortality of either individual. Engelmann oaks are often found with understory plants including sages (*Salvia* spp.), native grasses and perennial or annual wildflowers (Calscape n.d.); however, the selected plant palette should take into consideration the native species found in close proximity to the restoration area so that the site blends with the existing habitat.

Competition from invasive non-native plant species such as treasure flower, artichoke thistle, and non-native grasses should continue to be controlled as part of the follow-up maintenance in order to support oak establishment. Hand-weeding should be performed within a 2-foot diameter around each new sapling. Between saplings and under mature tree canopies, line trimmers may be used to reduce weed growth to about 6 inches to avoid potential damage to any naturally recruiting saplings (Henrich 2014). Grasses can be trimmed at least 6 inches from the ground just as flowers start to develop, but have not started producing fruit or seeds; any resulting biomass should be removed from the site. Herbicide may be used to control difficult non-native invasive species such as perennials and forbs. Prior to implementing mechanical or chemical maintenance treatments, Engelmann oak saplings should be flagged or protected to avoid potential damage. Within the disturbed open coast live oak woodland, non-native avocado trees may also be removed to allow room in the canopy for the new Engelmann oak population.

This Engelmann oak restoration area can be delineated once the County assesses the amount of effort that can be allocated for this project. Activities such as acorn collection and planting could make use of local volunteer groups (e.g., Boy Scouts, Girl Scouts), which would reduce overall project costs while providing opportunities for public outreach and education.

5.0 FIRE MANAGEMENT

A primary component of fire management is fuel management, which includes keeping an area clear of flammable man-made materials and managing the vegetation to reduce its flammability. Vegetation management is an important management tool used by the County to assist in the reduction of loss of lives and property from wildfires. Vegetation management alone will not prevent fires from occurring; however, by managing plant biomass in strategic locations, the threat of damage from wildfires can be reduced by allowing for defensible space (such as thinning or replacing vegetation adjacent to homes), firefighting access, and or limiting fire spread. In wildland areas, this may include the removal of dead or dying vegetation and highly flammable vegetation such as invasive non-native plants not only to reduce the fuel loads and the risk of accidental wildfires within open-space preserves, but also to enhance habitat quality and associated sensitive biological resources.

5.1 CURRENT FIRE MANAGEMENT PRACTICES

Currently, the Preserve, with the exception of Sierra Verde, falls under an unincorporated State or Federal Responsibility Area which is designated as a Very High Fire Hazard Severity Zone. Sierra Verde falls under an unincorporated State or Federal Responsibility Area that is designated as a Non-Very High Fire Hazard Severity Zone, meaning it is located outside of the very high fire hazard zone (CAL FIRE 2009). The Fire Hazard Severity Zones were created by the California Department of Forestry and Fire Protection (CAL FIRE) Fire and Range Assessment program per the State of California Public Resources Code, Sections 4201-4204, and are designated from moderate to very high based on a combination of relevant factors including fuel/vegetation, terrain, and climate, pursuant to California Government Code sections 51175-51189. Due to the Preserve's location within a State or Federal Responsibility Area, this means that the state or federal government are responsible for responding to fire emergencies. The two small southernmost portions of the Original Preserve, Addition 1, Addition 3, Sierra Verde, and the western side of Chabad are located in the Valley Center Fire Protection District; the rest of the Original Preserve, Addition 2, and the eastern portion of Chabad, are located in the jurisdiction of County Service Area No. 135, which covers the entire unincorporated area of the County as well as several incorporated cities. An agreement with CAL FIRE allows CAL FIRE to provide fire protection services on behalf of the County (San Diego County Fire Authority n.d.).

Under the draft FRMP, habitat restoration and enhancement activities, including the removal of invasive species, which are a component of fuel management, are allowed as part of the habitat management necessary to protect rare and endangered species and unique or sensitive vegetation (County of San Diego 2018). On February 26, 1997, the Wildlife Agencies, California Department of Forestry and local fire agencies entered a Memorandum of Understanding (MOU) to allow property owners, lessees, fire districts and local jurisdictions to implement fire safety standards

related to defensible space and fuel breaks. The MOU also requires that vegetation removal activities avoid recognizable riparian areas and vernal pools, unless permitted (MOU 1997).

California law requires 100 feet of defensible space around homes and habitable structures (State of California 2020a). Defensible space reduces fire speed, intensity, and flame lengths, and limits the spread of a wildfire. This area is known as a FMZ, which is a protective buffer that occurs between structures and wildland areas (including biological open space). The FMZ creates a separation zone between wildlands and structures, a space where fuel is managed or modified to minimize the spread of fire to the structure and providing space for defending structures from burring vegetation (County of San Diego 2010a). Proper clearance to 100 feet dramatically increases the chance of homes surviving a wildfire (State of California 2020a). Under the draft FRMP, fire management activities are permitted within conserved lands, but will need to be conducted according to a fire management plan prepared by the County or private developers (approved by County) and reviewed by appropriate fire districts as part of management directives (County of San Diego 2018). This may be applicable for cases such as is described in the Valley Center Fire Protection District's Ordinance Number 2016-50, Section 4907.2b, which states that when a building or structure in a hazardous fire area is setback less than 100 feet from the property line, the building or structure owner shall meet the maintenance requirements of the FMZ to the extent possible between the building or structure and the owner's property line (Valley Center Fire Protection District 2016).

The majority of the Preserve is adjacent to undeveloped open space area, with a mosaic of rural development with agricultural fields and scattered homes in close proximity. **Figure 10** provides a general view of FMZs within the Preserve, measured as 100 feet from structures (including residential structures and the amphitheater) and 30 feet from the existing staging area and associated access road (County of San Diego 2009). Total mapped FMZs within the Preserve make up approximately 3.44 acres. Complete fire codes, management practices, and guidelines can be found at the Valley Center Fire Protection District website (Valley Center Fire Protection District 2007–2019) as well as the County of San Diego 2017 Consolidated Fire Code (County of San Diego 2017b).

Utility power lines are present within the Preserve and includes (but is not limited to) a utility line that bisects Addition 1 diagonally and a utility line that bisects Sierra Verde horizontally and vertically. Several utility lines also run adjacent to the southern boundary of the Original Preserve as well as the western boundary of Sierra Verde. Investor-owned electric utilities must take practicable measures to reduce the likelihood of fires associated with their facilities, which includes removing vegetation from access roads and around poles and power lines (Public Utilities Commission of the State of California 2014). Additionally, brush clearance around the canal/flume is currently maintained by the City of Escondido (County of San Diego 2009).

5.2 FIRE ENVIRONMENT

The major components that control the fire environment are climate or specific weather conditions, topography, and vegetation/fuels. The status of these components at any time and their relationship with each other affect the behavior of fire over the Preserve. A discussion of the existing conditions on the Preserve provides an understanding of the potential of fire occurring and its level of intensity.

Wildfires occurred naturally in Southern California prior to European contact, either ignited by natural causes such as lightning or the result of indigenous human inhabitants. In the past two decades, large human-caused fires have burned throughout the region. Long-term drought combined with control of fires over the past several decades may have aided in the accumulation of fuels in natural vegetation communities (Minnich 1983; Minnich and Chou 1997; Minnich 2006). Each fall, following a long summer with little or no precipitation, the vegetation reaches highly flammable conditions. Extreme weather with single-digit humidity and strong east winds and high temperatures associated with Santa Ana wind events enhance the hazardous fire conditions. Human-caused fire ignitions occur with regularity and when such ignitions take place during extreme weather conditions, rapidly moving fires are inevitable in wildland areas.

5.2.1 Climate

The climate of the Preserve is considered Mediterranean, with hot, dry summers and cool, wet winters (George 2019). The closest weather station to the Preserve is located at the Palomar Observatory approximately 27 miles northeast of the Preserve (WRCC 2019). Average annual precipitation at the Palomar Observatory is 28.32 inches of rain, with the greatest amount, 5.59 inches, falling in February (**Table 8**). June is the driest month, with an average of 0.11 inch of rain. July and August are the hottest months, with an average high temperature of 83.9 and 83.6 degrees Fahrenheit, respectively. Given the Preserve's distance to the Palomar Observatory weather station and range in elevations within the Preserve, temperature and precipitation values may vary slightly.

Prevailing wind directions were determined by the Western Regional Climate Center based on hourly data from 1992 through 2002 and refers to the direction with the highest percent of frequency. Based on the Marine Corps Air Station Camp Pendleton weather station, which is northwest of the Preserve, the average annual prevailing wind blows from south-southwest (WRCC 2002). Additionally, due to its location in Southern California, the Preserve is subject to Santa Ana winds, which are hot, dry winds that blow from the Great Basin Desert typically from September to May. These winds can increase and enhance fire danger (Fovell 2007).

Table 8. Temperature and Precipitation Data for Palomar Mountain Observatory Weather Station (046657)

Period of Record: January 5, 1901, through June 9, 2016													
	Jan	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**	**Annual**
Average Maximum Temperature (°F)	51.3	52.2	55.3	61.4	68.8	77.4	83.9	83.6	79.6	69.3	58.9	52.4	66.2
Average Minimum Temperature (°F)	34.4	34.3	36.0	40.0	46.3	54.4	61.7	62.1	57.3	48.5	40.0	35.2	45.9
Average Total Precipitation (inches)	5.35	5.59	4.86	2.05	0.58	0.11	0.35	0.64	0.63	1.05	2.67	4.44	28.32

SOURCE: WRCC 2019.

While California is prone to natural drought periods, California recently experienced an acute drought period lasting about 5.5 years, from December of 2011 through April 2017. By the winter of 2013–2014, California had experienced three below-normal rainfall seasons, causing lower groundwater levels and abnormally dry vegetation that raised wildfire risk. Although a heavy rain event occurred toward the beginning of 2016, drought conditions resumed by February of 2016 and continued until April 2017 (NOAA 2019). Anomalous moisture transport into the southwestern United States during December of 2019 resulted in above average precipitation and drought amelioration in California; however, January 2020 was drier than normal across the Southwest, resulting in a statewide precipitation rank of "below average." Snowpack conditions deteriorated by the end of January 2020 with the snowpack at 70 percent of normal statewide (NOAA NCEI 2020a, NOAA NCEI 2020b). As of February 2020, San Diego County is no longer considered to be in drought, though the majority of California is considered to be abnormally dry or in moderate drought (NDMC 2020).

5.2.2 Topography

Elevations within the Preserve range from 996 feet to 3,882 feet above mean sea level, with the lowest elevation occurring within Hell Creek, which runs roughly diagonally along the southern boundary of the Preserve, and the highest elevation occurring on Rodriguez Mountain within the Chabad Addition. The western face of Rodriguez Mountain is located within the Chabad Addition, and a second unnamed mountain occurs within the Original Preserve, east-northeast of Rodriguez Mountain. Unnamed streams and Hell Creek run throughout the Preserve and is primarily surrounded by preserved open space areas and Rancho Guejito, as well as scattered rural residential development.

5.2.3 Watershed Description

The Preserve is located within the San Luis Rey and San Dieguito Watersheds or Hydrologic Units (County of San Diego 2014). The Original Preserve, Addition 1, Addition 2, Addition 3, and the majority of the Chabad Addition fall in the San Luis Rey Watershed within the Monserate hydrologic area and the Pauma hydrologic sub-area. This watershed has two major water bodies:

San Luis Rey River and Lake Henshaw. The Preserve contains an unnamed stream and Hell Creek, which ultimately drain into Paradise Creek offsite before it converges with the San Luis Rey River.

The Sierra Verde Addition and the eastern boundary of the Chabad Addition fall within the San Dieguito Watershed in the Guejito sub-area of the the San Pasqual hydrological area. The San Dieguito Watershed has four major water bodies: the San Dieguito River, Santa Ysabel Creek, Lake Hodges, and Sutherland Reservoir. The Sierra Verde Addition is intersected by unnamed stream that drains southwest of the Preserve into Guejito Creek, a tributary of the Santa Ysabel Creek.

5.2.4 Fire History

The Preserve is located within an area of high wildland fire potential (County of San Diego 2019). Based on historical fire data from the California Department of Forestry and Fire Protection (CAL FIRE 2019), the Preserve has been affected by seven different wildfires (**Table 9** and **Figure 9**) according to records beginning in 1878 (CAL FIRE 2019). The most recent fire was the Poomacha Fire of October 2007, which burned approximately 92 percent of the Original Preserve, 81 percent of Chabad, and 49 percent of Additions 1, 2, and 3, which totals approximately 2,012 acres. The Paradise fire in 2003 burned the entire Preserve. Since 1913, the majority of the Preserve has been burned twice and only 12 acres have been burned four times (**Table 10** and **Figure 9**).

Table 9. Fire Interval Data for the Hellhole Canyon Preserve

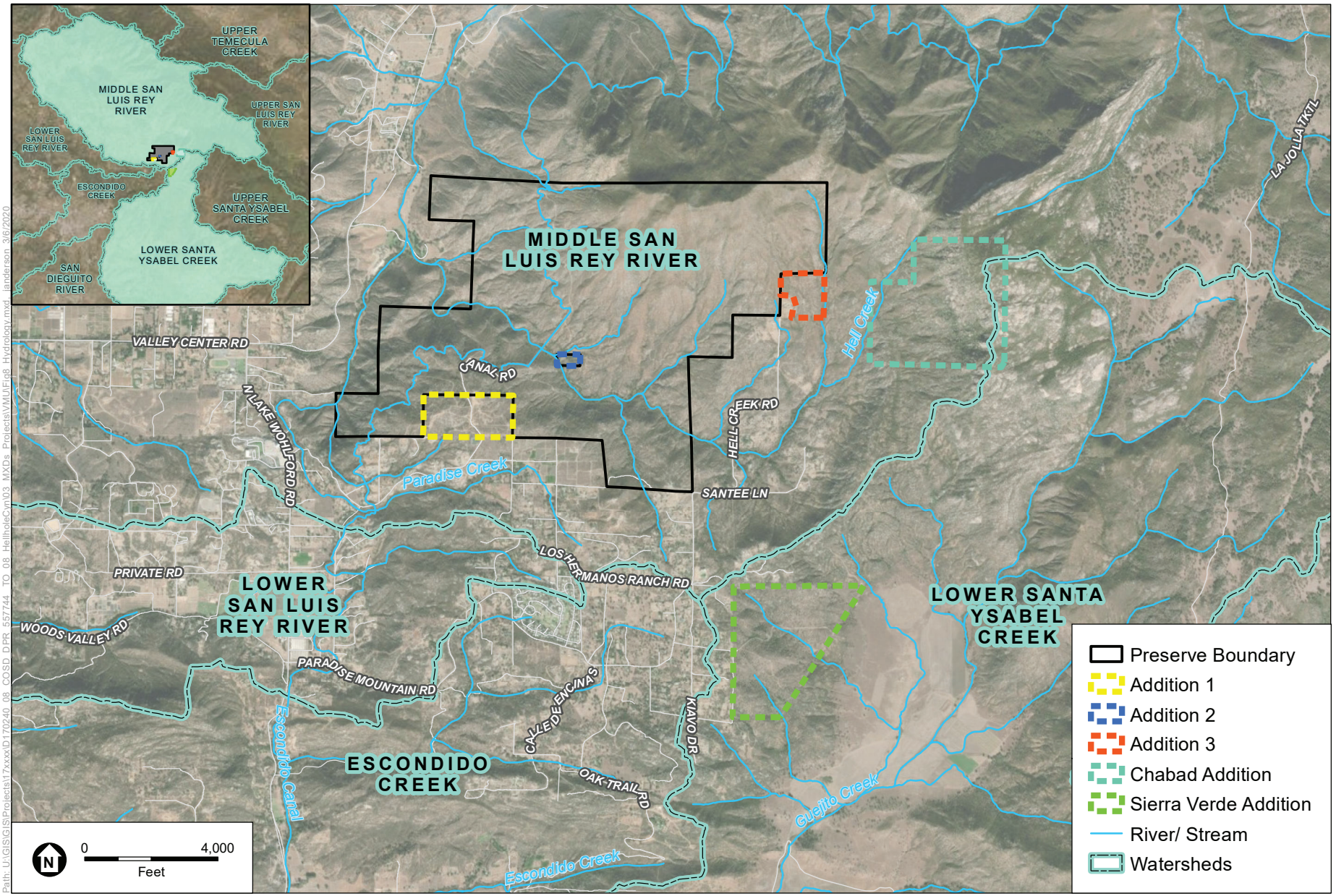
Fire Year	Fire Name	Interval (years)	Acreage/% Burned Original Preserve	Acreage/% Burned Chabad	Acreage/% Burned Sierra Verde	Acreage/% Burned Addition 1,2,3
1926	Unnamed	-	18.6 / 1%	-	-	17.3 / 14.7%
1946	Unnamed	20	192.4 / 10.4%	-	-	-
1950	Guejito	4	-	203.6 / 65.2%	140.1 / 58.1%	-
1987	Rodriguez	37	12.3 / 1%	-	-	-
1999	Canal	12	73.1 / 4%	-	-	9.21 / 7.8%
2003	Paradise	4	1,858.3 /100%	311.9 / 100%	241.4 / 100%	117.6 / 100%
2007	Poomacha	4	1,700.6 / 91.5%	253.5 / 81.3%	-	57.6 / 49%

SOURCE: CAL FIRE 2019

Table 10. Quantity of Times Burned for the Hellhole Canyon Preserve

Quantity of Times Burned	Acreage Burned on Preserve	Percent of Preserve Burned
1	305	12.06%
2	1,783	70.50%
3	429	16.96%
4	12	0.47%

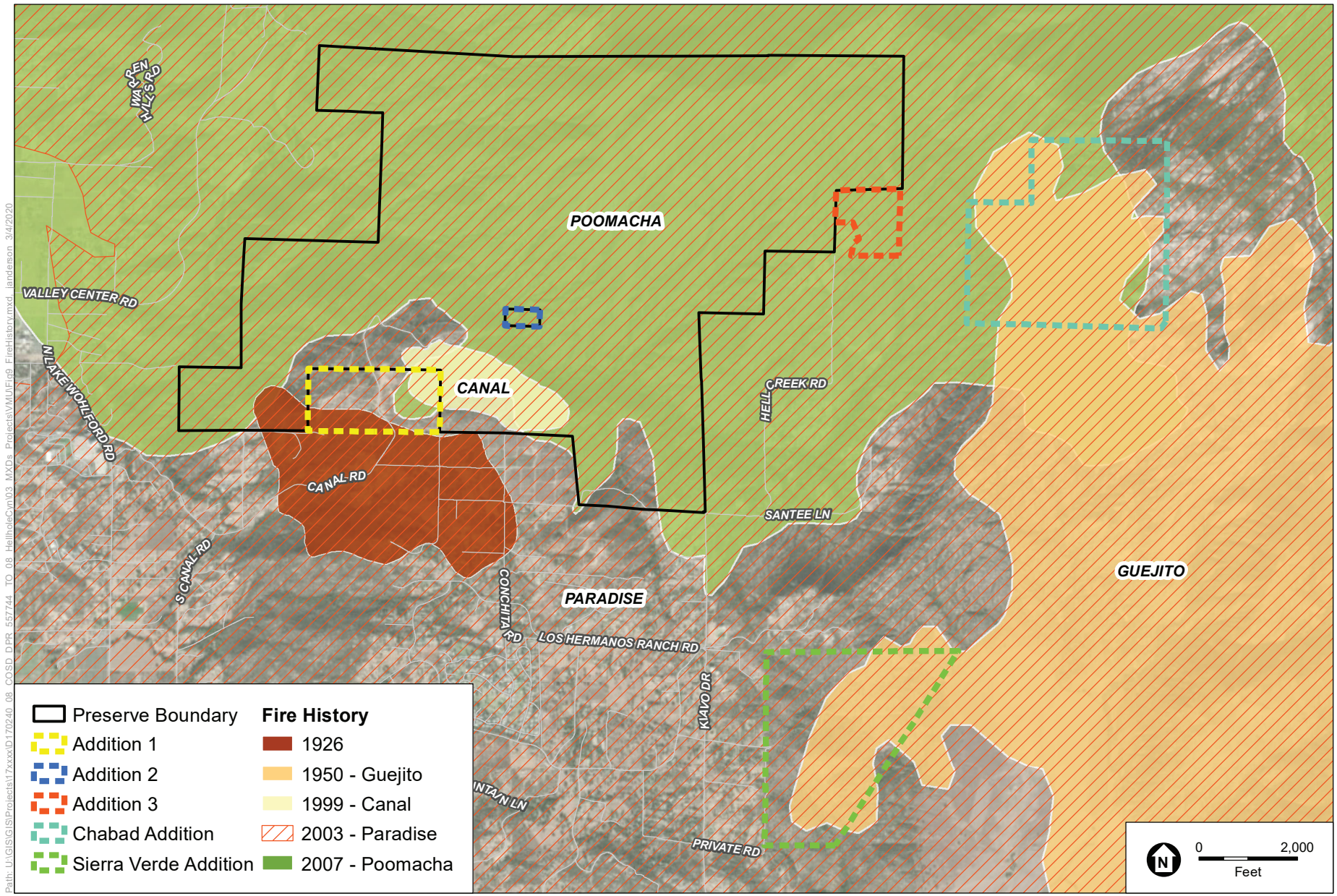
SOURCE: CAL FIRE 2019.



SOURCE: ESRI, 2019; SanGIS, 2019.

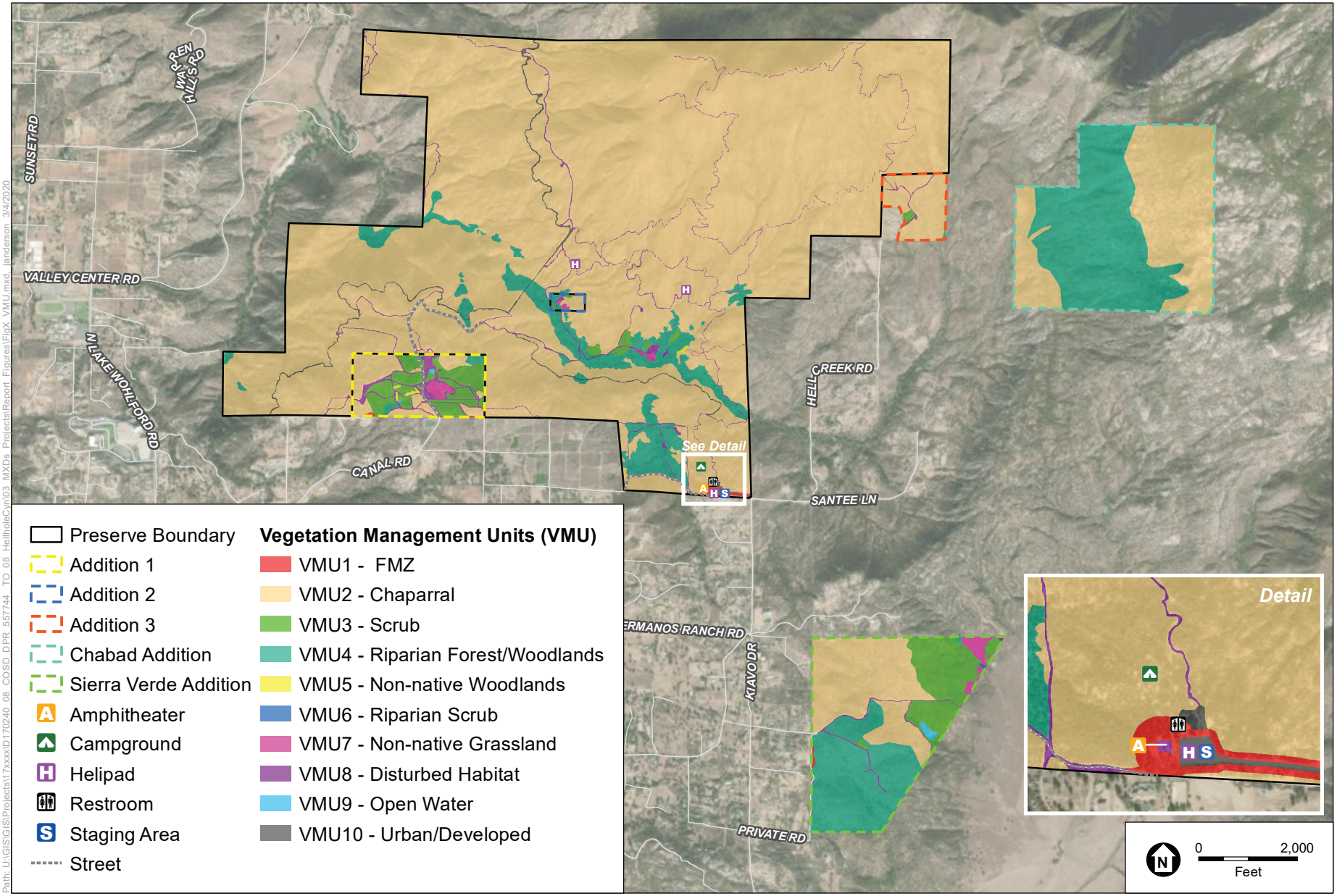
Figure 8
Hydrology

ESA



SOURCE: ESRI, 2019; SanGIS, 2019.

Figure 9
Fire History



SOURCE: ESRI, 2018; SanGIS, 2019;TAIC, 2009.

Figure 10
Vegetation Management Units (VMU)

The Preserve is dominated by southern mixed chaparral vegetation communities. Many of the species within these chaparral communities are well adapted to survive fire events by producing seeds that require a fire-related cue to stimulate germination and/or by stump sprouting after being burned which can become dominant within about 10 years (CNPS 2020). Upland areas are susceptible to burns, particularly as the vegetation ages and drought conditions continue. The most recent wildfire burned most of the Preserve in 2007, indicating that most of the vegetation on the Preserve could be at least 13 years old. In general, old vegetation is more likely to contain large amounts of standing dead material, which can be more susceptible to new fires, especially during extreme weather conditions of heat, wind, and low humidity. The presence and spread of non-native species within the Preserve is an additional source of fuel loads that contribute to the Preserve's susceptibility to fires.

5.2.5 Vegetation Dynamics and Fuel Loads

Various models have been created to assess the behavior of fire in vegetation. Fuel models have been designed to address the variables associated with the vegetation communities that occur on the Preserve. A number of studies have evaluated these and several were reviewed in order to place the vegetation types into fuel models (Dicus and Zimmerman 2007; Scott and Burgan 2005). Fuel model categories often utilized in the BehavePlus model are indicated in **Table 11**. These vegetation classifications follow the Holland/Oberbauer categories from **Table 1**, **Table 2**, and **Figure 4d** through **Figure 4g**. The model categories are included here for information purposes since the County standard model was used for the analysis in this plan as described in **Appendix A**.

Certain vegetation types and species such as eucalyptus increase fire hazard based on plant physiology (resin content), biological function (flowering, retention of dead plant material), and/or physical structure (leaf size, branching patterns). However, during extreme weather conditions of low humidity, high heat, and wind, the National Weather Service declares a Red Flag Warning indicating severe weather hazard for fires. During those conditions, fires may occur in most vegetation and will even burn younger-age vegetation, particularly if it has a high level of annual weed growth, though it might burn with lower intensity than if it was older. If invasive non-native plant species become established, the frequency of fires in the overall area can also be affected because high levels of dried annual fuels can become easily ignited (Brooks et al. 2004).

Table 11. Vegetation Communities and Associated Fuel Models for the Hellhole Canyon Preserve

Vegetation Community Land Cover[1]	Fuel Model[2]	Original Preserve		Additions 1-3		Sierra Verde		Chabad		Total Preserve Acreage	Total Preserve %
		Acres	%	Acres	%	Acres	%	Acres	%		
Coastal Scrub	SCAL18	0.0	0.00	0.0	0.00	11.1	0.44	0.0	0.00	11.1	0.44
Disturbed Diegan Coastal Sage Scrub	SCAL18	0.0	0.00	0.1	0.00	0.0	0.00	0.0	0.00	0.1	0.00
Diegan Coastal Sage Scrub	SCAL18	5.0	0.20	0.3	0.01	0.0	0.00	0.0	0.00	5.3	0.21
Disturbed Flat-topped Buckwheat	SCAL18	0.0	0.00	27.8	1.10	0.0	0.00	0.0	0.00	27.8	1.10
Flat-topped Buckwheat	SCAL18	0.0	0.00	7.2	0.29	37.7	1.49	0.0	0.00	44.9	1.78
Scrub Oak Chaparral	SCAL4	0.0	0.00	0.9	0.03	0.0	0.00	104.8	4.16	105.7	4.19
Southern Mixed Chaparral	SCAL16	1438.0	57.03	15.2	0.60	90.3	3.58	28.5	1.13	1572.0	62.34
Mafic Southern Mixed Chaparral	SCAL16	274.7	10.89	0.0	0.00	0.0	0.00	0.0	0.00	274.7	10.89
Chamise Chaparral	SCAL15	0.0	0.00	43.4	1.72	0.0	0.00	21.0	0.83	64.4	2.55
Ceanothus crassifolius Chaparral	SCAL15[3]	0.0	0.00	1.4	0.05	0.0	0.00	0.0	0.00	1.4	0.05
Southern Willow Scrub	SCAL9[4]	0.0	0.00	0.4	0.02	0.0	0.00	0.0	0.00	0.4	0.02
Southern Coast Live Oak Riparian Forest	SCAL9	50.7	2.01	0.3	0.01	0.0	0.00	133.4	5.29	184.4	7.31
Disturbed Open Coast Live Oak Woodland	SCAL9	0.0	0.00	0.0	0.00	23.2	0.92	0.0	0.00	23.2	0.92
Open Coast Live Oak Woodland	SCAL9	0.0	0.00	3.6	0.14	68.6	2.72	24.1	0.96	96.3	3.82
Coast Live Oak Woodland	SCAL9	43.6	1.73	0.0	0.00	0.0	0.00	0.0	0.00	43.6	1.73
Eucalyptus Woodland	TU1[5]	0.5	0.02	0.0	0.00	0.0	0.00	0.0	0.00	0.5	0.02

Vegetation Community Land Cover[1]	Fuel Model[2]	Original Preserve		Additions 1-3		Sierra Verde		Chabad		Total Preserve Acreage	Total Preserve %
		Acres	%	Acres	%	Acres	%	Acres	%		
Non-Native Woodland	TU1[5]	0.0	0.00	0.9	0.04	0.0	0.00	0.0	0.00	0.9	0.04
Mulefat Scrub	SCAL18[6]	0.0	0.00	0.0	0.00	0.2	0.01	0.0	0.00	0.2	0.01
Non-Native Grassland	SCAL3[7]	0.9	0.04	3.4	0.13	5.8	0.23	0.0	0.00	10.1	0.40
Disturbed/ Developed	NB9	25.4	1.01	12.3	0.49	3.1	0.12	0.0	0.00	40.8	1.62
Urban/Developed	NB1	12.2	0.48	0.0	0.00	0.0	0.00	0.0	0.00	12.2	0.48
Open Water	NB8	0.0	0.00	0.3	0.01	1.4	0.05	0.0	0.00	1.7	0.07
Total		**1851.0**	73.41	**117.5**	4.66	**241.3**	9.57	**311.8**	12.36	**2521.5**	100.00

1 Holland Code is basis for models

2 Fuel Models are classified according to USDA terminology that is based on the volume of biomass in the vegetation.

3 Chamise is a codominant plant within this vegetation community and is not as densely packed as the southern mixed chaparral vegetation community. This vegetation community is also found on more disturbed plots (Addition 1 and 3), hence, this fuel model should be an adequate representation.

4 This vegetation community onsite was fairly uniform and is adjacent to oak woodland habitat, which has similar understory species.

5 While this model most accurately represents the eucalyptus woodland vegetation community, eucalyptus is known to have volatile oil in the leaves, which can cause very high-intensity fires (CNPS 2020). In addition, avocado trees are known to be flammable especially when not receiving a water source, which can also cause very high-intensity fires (Goodall 1965).

6 This model best fits this vegetation type, given the density and presence of non-native grasses and surrounding scrub vegetation community.

7 This model was designed for non-native grassland vegetation types in Southern California, and takes into account Santa Ana winds.

SCAL3 is a custom fuel model for non-native grassland habitat, SCAL4 is a custom fuel model for scrub oak chaparral habitat, SCAL 9 is a custom fuel model for coast live oak woodland, SCAL15 is a custom fuel model for chamise chaparral habitat, SCAL16 is a custom fuel model for southern mixed-chaparral habitat, and SCAL18 is a custom fuel model for Diegan coastal sage scrub habitat for the Behave Fuel Model (Dicus and Zimmerman 2007). TU1 is a model based on Timber-Understory classification with a low load fuelbed of grass and/or shrub with litter. NB8 is open water with insufficient wildland fuel and NB9 is bare ground with insufficient wildland fuel (Scott and Burgan 2005). NB1 is Urban or suburban development, with insufficient wildland fuel to carry wildland fire, NB8 is a model for open water, and NB9 is a model for bare ground (Scott and Burgan 2005).

Vegetation Dynamics

Vegetation is the primary component and variable for fire behavior and modeling. Vegetation is dynamic in terms of varying over time. Succession of vegetation as it regrows following previous fires or other disturbance, and drought are major factors that affect vegetation at any given time. The biomass on the Preserve will continue to increase over time as the shrubs grow larger following the 1947 Unnamed fire. Fires with short intervals may affect regrowth of shrub vegetation, particularly in areas with fine soils.

The southern boundary of the Original Preserve and the western boundary of Sierra Verde are adjacent to low-density rural development; the remaining boundaries are surrounded by large expanses of undeveloped habitat intersected by scattered foot trails. Fuel treatments may be necessary to prevent fire from entering the Preserve from the surrounding undeveloped habitat as well as being carried through the Preserve into the surrounding areas.

Utilizing the County's standard model (County of San Diego 2010b) in which the Preserve is considered both a transitional and an interior area, the County ran three scenarios for the Behave Plus model: Fuel Model 1, Fuel Model 4, and Fuel Model 10. a Model 4 represents more of an extreme condition than Model 1. Under Model 4, the maximum rate of spread of fire during extreme fire conditions in transitional zones may reach 1,600 feet per minute with 87-foot flame lengths and for interior zones may reach 2,400 feet per minute with 105-foot flame length. However, under the more moderate Model 1, the maximum rate of spread is 730 feet per minute with flame lengths of 13 feet for both transitional and interior areas. For surface fires within interior zones of the Preserve, the rate of spread can reach 100 feet per minute with 17-foot flame length (see **Appendix A**).

Southern Mixed Chaparral covers about 1,571.94 acres or 62.34 percent of the Preserve and is the dominant vegetation type. Mafic Southern Mixed Chaparral covers 274.7 acres or 10.89 percent of the Preserve. Southern Coast Live Oak Riparian Forest makes up 184.37 acres or 7.31 percent of the Preserve. Scrub Oak Chaparral covers 105.66 acres or 4.19 percent of the Preserve. Open Coast Live Oak Woodland covers 96.33 acres or 3.82 percent of the Preserve. Chamise Chaparral covers 64.39 acres or 2.55 percent of the Preserve. Flat-topped Buckwheat covers 44.85 acres or 1.78 percent of the Preserve. Coast Live Oak Woodland covers 43.6 acres or 1.73 percent of the Preserve. Disturbed/Developed habitat covers 40.77 acres or 1.62 percent of the Preserve. Disturbed Flat-topped Buckwheat covers 27.78 acres or 1.10 percent of the Preserve. The remaining vegetation communities each cover less than 1 percent of the Preserve and are: Coastal Scrub, Disturbed Diegan Coastal Sage Scrub, Diegan Coastal Sage Scrub, *Ceanothus crassifolius* Chaparral, Southern Willow Scrub, Disturbed Open Coast Live Oak Woodland, Eucalyptus Woodland, Non-native Woodland, Mulefat Scrub, Non-native Grassland, Urban/Developed land, and Open Water which collectively make up 67.12 acres or 2.66 percent of the Preserve.

Lack of disturbance such as fire and grazing will, over time, allow shrub cover to re-establish in recently burned areas. Shrub cover, although less likely to burn in the first 20 years during typical weather conditions, will burn under extreme fire events (Moritz 2003). Once established, the shrub cover will increase in volume, and following approximately 20 years, the hazard will increase corresponding with fuel age (Keeley 2005; Moritz et al. 2004). The vegetation, particularly the shrubs, will continue to build biomass as they grow and, in many cases, retain dead material that may have become damaged (e.g., broken branches) or been killed by disease or drought. Additionally, encroachment of non-native plant species into open space, such as Peruvian and Brazilian pepper trees, in many cases increases the fuel load and likelihood for higher intensity fire.

Provided below is a review of the vegetation communities on the Preserve and information regarding their response to fire. This discussion is based on the mapping conducted at the Additions based on the San Diego Vegetation Classification Manual, but generally can be applied to the Original Preserve, which was mapped using Holland.

Chaparral Communities

Chamise–California Buckwheat–California Sage Brush–Black Sage Association (4.1.2); Chamise – Hoaryleaf Ceanothus Association (4.1.3); Chamise – Woolyleaf Ceanothus Association (4.1.4)

Chamise/California Buckwheat/California Sage Brush/Black Sage Association (*Adenostoma fasciculatum/Eriogonum fasciculatum/Artemisia californica/Salvia mellifera* association) consists of a continuous but more often open canopy dominated by chamise with a combination of the three other species as subdominant. Herb cover is generally diverse and can include both native and non-native grasses. This association is a mix of chaparral and coastal sage scrub as it occurs both as a mature, stable shrub community or an early transitional stage of other shrublands in response to fire or other disturbance (Sproul et al. 2011). This vegetation community occurs on approximately 2.07 acres in the southeast corner of Addition 1, and approximately 18.14 acres throughout Addition 3. The dominant shrub within this community is chamise with California buckwheat, California sage brush, black sage, and coastal deerweed as subdominant shrubs. Chamise/Hoaryleaf Ceanothus Association (*Adenostoma fasciculatum/Ceanothus crassifolius* association) consists of a mostly continuous shrub canopy codominated by chamise and hoaryleaf ceanothus. Additional shrub species can occur as subdominants. Herb diversity and cover are generally low except after fires. This association typically occupies xeric interior sites in cismontane areas (Sproul et al. 2011).

This vegetation community occurs on approximately 2.81 acres in the southwest corner of Addition 1 and 1.10 acres within the 100-foot buffer, and approximately 1.37 acres in the west-central portion of Addition 3. The dominant shrubs within this community include chamise and

hoaryleaf ceanothus. Additional subdominant shrubs detected include laurel sumac, hairyleaf redberry (*Rhamnus pilosa*), sugar bush, Alderson's rush-rose (*Crocanthemum aldersonii*), sticky monkeyflower, and black sage. Chamise/Woollyleaf Ceanothus Association (*Adenostoma fasciculatum/Ceanothus tomentosus* association) consists of a mostly continuous canopy cover dominated by chamise and woollyleaf ceanothus. Additional shrub species can occur as codominants. Herb cover and diversity is generally low, but can increase following fire (Sproul et al. 2011). This vegetation community occurs on approximately 1.04 acres in the south-central portion of Addition 1. The dominant shrubs within this community include chamise and woollyleaf ceanothus. Subdominant shrubs detected include laurel sumac, sugar bush, California buckwheat, and black sage.

Chamise is a facultative sprouter, which can vigorously sprout after fires via lignotubers, and become dominant in 10 years, but its seeds are also stimulated to germinate with heat and charate from fires. Seedlings can have low to moderate recruitment during the first rainy season after a fire. Chamise is adapted to moderately intense, fast spreading, potentially large fires. High fire intensity can increase mortality in chamise. Fire return intervals range between 20-100 years and exhibit high intensity fires that are high in severity (CNPS 2020). California buckwheat can sprout after fires, but grows mainly from buried seed. Therefore, frequent fires can deplete the seed bank. California sage brush may sprout well after fire; however, high-intensity fires or short fire return intervals (high frequency) can deplete the species seed bank and make the population vulnerable to local extinction since most regeneration is from the seed/seed bank. Fire return intervals are typically 20–100+ years and exhibit moderate- to high-intensity fires that are high to very high in severity (CNPS 2020). Black sage is sensitive to fire, with recruitment primarily from seed after fires as well as during intervals between fires. Seeds have low germination rates when not exposed to light and fire heat reduces germination rates. Individuals can sprout at root crowns following fires; however, younger plants have higher sprouting success than older plants. This vegetation community has a medium fire return interval which ranges from 30 to 60 years and exhibits high to very high intensity fires that are high to very high in severity (CNPS 2020). Hoary leaf ceanothus is an obligate seeder. Seed germination is stimulated by heat from moderate to high intensity fire, and can form dense stands within 10 to 20 years after a fire. Accumulation of dead branches in older stands can increase the possibility of high-intensity fires. Fire return intervals range between 10 and 100 years, which can be high to very high in severity (CNPS 2020).

Chamise – Mission Manzanita Association (4.2.1); Chamise–Mission Manzanita–Hoaryleaf Ceanothus Association (4.2.2); Chamise – Mission Manzanita – Woollyleaf Ceanothus ssociation (4.2.3); Chamise – Mission Manzanita – Scrub Oak Association (4.2.6)

Chamise/Mission Manzanita Association (*Adenostoma fasciculatum/Xylococcus bicolor* association) consists of a continuous shrub canopy codominated by chamise and Mission manzanita. Additional subdominant shrubs and herbs occur primarily in openings. Herb diversity

and cover are generally low except after fires. This association occurs in the cismontane foothills south of the Tranverse Range (Sproul et al. 2011). This vegetation community occurs on approximately 3.4 acres in the northeast portion of Addition 1 and 1.78 acres within the 100-foot buffer, and approximately 4.92 acres in the southern portion of Addition 3 and 2.07 acres within the 100-foot buffer. The dominant shrubs within this community include chamise and Mission manzanita. Additional shrubs detected include laurel sumac, California buckwheat, hoaryleaf ceanothus, and lemonade berry (*Rhus integrifolia*). Chamise/Mission Manzanita/Hoaryleaf Ceanothus Association (*Adenostoma fasciculatum/ Xylococcus bicolor/Ceanothus crassifolius* association) consists of the three plant species occurring as codominants in an open or continuous canopy. Additional subdominant shrub species are often present as well. Herb cover in openings and following fire can be diverse (Sproul et al. 2011). This vegetation community occurs on approximately 12.13 acres in the northwest and north-central portions of Addition 1 and approximately 32.53 acres in the southwest portion of the Chabad Addition. The dominant shrubs within this community include chamise, Mission manzanita, woollyleaf ceanothus, and hoaryleaf ceanothus. Additional shrubs detected include laurel sumac, sugar bush (*Rhus ovata*), California buckwheat, and black sage. Chamise/Mission Manzanita/Woollyleaf Ceanothus Association (*Adenostoma fasciculatum/Xylococcus bicolor/Ceanothus tomentosus* association) consists of the three plant species occurring as codominants in an open or continuous canopy. Additional shrub species can occur as codominants. Diverse herb cover often occurs in openings and can increase following fire (Sproul et al. 2011). This vegetation community occurs on approximately 7.81 acres in the north and south of Addition1 and 0.42 acres within the 100-foot buffer. The dominant shrubs within this community include chamise, Mission manzanita, woollyleaf ceanothus, and hoaryleaf ceanothus. Additional shrubs detected include laurel sumac, sugar bush, California buckwheat, and black sage. Chamise/Mission Manzanita/Scrub Oak Association (*Adenostoma fasciculatum/Xylococcus bicolor/Quercus [berberdifolia,* x*acutidens*] association) often occurs as an open canopy codominated by the three shrub species. Additional shrub species can occur as subdominants. Herb diversity and cover are generally low except after fires (Sproul et al. 2011). This vegetation community occurs on approximately 4.85 acres in the center of Addition 3. The dominant shrubs within this community include chamise, Mission manzanita, and scrub oak. Additional shrubs detected include black sage, hairyleaf redberry, sawtooth goldenbush, California matchweed (*Gutierrezia californica*), hoaryleaf ceanothus, and woollyleaf ceanothus.

Mission manzanita are adapted to low- to moderate-intensity fire. Individuals can resprout from the lignotuber after the aboveground portions are damaged by fire and seeds are able to germinate, but rarely establish. Some of the obligate seeding wild lilac and other *Ceanothus* may decline after long periods of time without fire, which favors crown sprouting species, though their seed bank can persist for very long times (League 2005). This vegetation community has an average fire return interval between 30 to 100 or more years and exhibits high intensity fires that are high in severity (CNPS 2020). Woollyleaf ceanothus is an obligate seeder. Seed germination is stimulated

by heat from fires and can form dense, monotypic stands and self-thin within 40 years after fires. Average fire return intervals range from 25 to 50 years and can have very high severity (CNPS 2020). While scrub oak is well adapted to survive fires, it can persist without fire. As an obligate sprouter, scrub oak relies on resprouting to regenerate after fire, and does so vigorously; its seeds are killed by fires. Following a fire, it can resprout and become dominant in 30–40 years. This species has little dead wood and may be less flammable than many other chaparral species. On the other hand, chamise, a facultative sprouter, can vigorously sprout after fires, via lignotubers, and become dominant in 10 years, but its seeds are also stimulated to germinate with heat and charate from fires. Seedlings can have low to moderate recruitment during the first rainy season after a fire. Both species are adapted to moderately intense, fast spreading, potentially large fires. High fire intensity can increase mortality in chamise, where scrub oak is less impacted, and can therefore shift dominance in favor of scrub oaks. Fire return intervals range between 20 and 100 years and exhibit high intensity fires that are high in severity (CNPS 2020).

Chaparral Whitethorn Association (4.16.1); Inland Scrub Oak Association (4.37.1); Scrub Oak – Chaparral Whitethorn Association Scrub (4.37.3); Scrub Oak–Chamise Association (4.38.1)

Chaparral Whitethorn Association (*Ceanothus leucodermis* association) consists of a shrub canopy dominated by chaparral whitethorn and low cover of other subdominant shrubs. Diverse herb cover often occurs in openings and can increase following fire (Sproul et al. 2011). This vegetation community occurs on approximately 16.95 acres in the southeast corner of the Chabad Addition. This community predominantly consists of chaparral whitethorn, with chamise, California buckwheat, and white sage (*Salvia apiana*) occurring in some areas at very low densities. Inland Scrub Oak Association (*Quercus [berberidifolia,* x*acutidens]* association) consists of a continuous shrub canopy dominated by scrub oak. *Quercus berberidifolia* and *Quercus* x*acutidens* are two of the most widespread scrub oaks and due to taxonomic uncertainty, both scrub oak species are included within this association. Herbaceous diversity and cover are relatively low, mostly occurring in openings and increasing in response to fire (Sproul et al. 2011). This vegetation community occurs on approximately 2.83 acres in the eastern half of Addition 2. The dominant shrub detected in this vegetation community is scrub oak, with hoaryleaf ceanothus and chamise as subdominant shrubs. Scrub Oak/Chaparral Whitethorn Association (*Quercus [berberidifolia,* x*acutidens]/Ceanothus leucodermis* association) consists of a continuous shrub canopy codominated by scrub oak and chaparral whitethorn. Due to taxonomic uncertainty, both scrub oak species are included within this association. Additional shrub species can occur as subdominants. Herb diversity and cover are relatively low, mostly occurring in openings, but can increase in response to fire (Sproul et al. 2011). This vegetation community occurs on approximately 104.79 acres on the rocky slopes associated with Rodriguez Mountain in the eastern half of the Chabad Addition. The dominant shrubs within this community include scrub oak and chaparral whitethorn. Additional shrub species detected include chamise and California buckwheat occurring in some

areas at very low densities. Few herbaceous plants occur in the openings of this association. Scrub Oak/Chamise Association (*Quercus [berberdifolia,* x*acutidens]*/*Adenostoma fasciculatum* association) consists of a continuous shrub canopy codominated by scrub oak and chamise. Due to taxonomic uncertainty, both scrub oak species are included within this association. Additional shrub species can occur as subdominants. Herbaceous diversity and cover are relatively low, mostly occurring in openings and increasing in response to fire (Sproul et al. 2011). This vegetation community occurs on approximately 2.32 acres in the northwest corner and along the eastern border of Addition 3 and 3.19 acres within the 100-foot buffer. The dominant shrubs within this community include scrub oak and chamise. Additional shrub species detected include woollyleaf ceanothus, hoaryleaf ceanothus, sticky monkeyflower (*Diplacus aurantiacus*), black sage, California sage brush, California buckwheat, and poison oak.

Chaparral whitethorn rapidly sprouts from root crowns when branches are removed (by fire or other disturbance) in areas south of Tulare County. Seed germination is stimulated by heat from fire, and stands develop quickly, but self-thin for the first 30 years. Most plants die within 70 years. Fire return intervals range between 25 and 65 years and can be very high in severity (CNPS 2020).

Scrub Community

Goodding's Black Willow Association (3.8.1)

Goodding's Black Willow Association (*Salix gooddingii* association) is dominated by Goodding's black willow in an open to closed tree canopy with other riparian tree species, subdominant shrubs, and wetland-affiliated herbaceous plants (Sproul et al. 2011). This vegetation community occurs in the southwest corner of Addition 2, where it covers approximately 0.39 acres. Goodding's black willow is the dominant tree species within this community. Additional riparian tree species detected include coast live oak and western sycamore. Subdominant shrubs and wetland-affiliated herbaceous plants within this community include poison oak, southern honeysuckle (*Lonicera subspicata*), desert wild grape (*Vitis girdiana*), and coyote brush (*Baccharis pilularis*).

Goodding's black willow are top-killed by low- and moderate-intensity fires. Individuals sprout vigorously, but are often disturbed by fluvial processes. Fire frequency and character are generally associated with neighboring upland alliances (CNPS 2020).

California Sage Brush – California Buckwheat – Laurel Sumac Association (4.7.1)

California Sage Brush/California Buckwheat/Laurel Sumac Association (*Artemisia californica/ Eriogonum fasciculatum/Malosma laurina* association) consists of the three plant species occurring as codominants, often occurring with subdominant shrub species. Herb cover is usually open and with high species diversity. This association can occur both as a mature stable shrub community or as an early transitional stage of other shrublands in response to fire or other

disturbance (Sproul et al. 2011). This vegetation community occurs on approximately 0.33 acres in the north-central portion of Addition 2. California sage brush and California buckwheat are codominant within this community with laurel sumac occurring in scattered locations.

Laurel sumac has several adaptation responses after fires; it can sprout prodigiously via its lignotubers when individual plants are top-killed by fire. Seeds also germinate after being scarified by heat, which germinate moderately after fires, in addition to re-sprouting of their crowns. Natural fire return intervals are unclear; however, shorter fire return intervals in the past 50 years in Southern California may account for laurel sumac dominance in the shrub canopy. Data on natural fire return intervals are not conclusive. Accounting for current factors and human influences, fire return intervals for this habitat association are typically 10 to 60 years and exhibit low- to high-intensity fires that are low to high in severity (CNPS 2020).

California Buckwheat Association (4.23.1)

California Buckwheat Association (*Eriogonum fasciculatum* association) consists of an open shrub canopy dominated or co-dominated by California buckwheat. Subdominant shrubs are common and a diverse herb cover occurs predominantly in openings. This association may represent an early transitional phase of other shrub associations or occur as a relatively stable association in ecotonal areas (Sproul et al. 2011). This vegetation community occurs on approximately 27.72 acres throughout Addition 1, approximately 0.94 acres in the west-central portion of Addition 3, and approximately 37.65 acres in the northeast portion of the Sierra Verde Addition. California buckwheat is the dominant shrub within this community. Subdominant shrubs of this association include coastal deerweed, sawtooth goldenbush, black sage, white sage (*Salvia apiana*), and chaparral yucca (*Hesperoyucca whipplei*). Herbaceous plants occurring in the openings of this association include red brome, slender oat, rattail fescue (*Festuca myuros*), and Musky stork's bill (*Erodium moschatum*).

Coastal Deerweed Association (4.32.1)

Coastal Deerweed Association (*Acmispon glaber* [=*Lotus scoparius*] association) consists of dominant coastal deerweed open shrub canopy, often occurring with subdominant shrubs. This association is considered early transitional, resulting from natural post-fire regeneration (Sproul et al. 2011). This vegetation community occurs generally in the eastern portion of Addition 1 where it covers approximately 3.60 acres. Coastal deerweed is the dominant shrub and subdominant shrubs detected within this community include California sage brush, California buckwheat, and sawtooth goldenbush (*Hazardia squarrosa*).

Coastal deerweed is an obligate seeder, that does not spout after fire. However, scarification from fire stimulates germination of seeds. Seedlings can grow larger than other shrub seedlings in the

second season after fire, and can form dense stands within 2 to 3 years after fire. These stands are considered seral communities in that they are a stage of ecological succession, which relinquishes dominance to longer-lived shrubs about 5 to 10 years after fire (CNPS 2020).

Laurel Sumac Alliance (4.35)

Laurel Sumac Alliance (*Malosma laurina* alliance) consists of a shrub canopy dominated or co-dominated by laurel sumac. Additional shrub species occur as subdominants and emergent trees such as southern black walnut (*Juglans californica*), coast live oak (*Quercus agrifolia*), or western sycamore (*Platanus racemosa*) may also be present. Shrubs are usually less than 5 meters and can exist as an open to continuous canopy, with a generally sparse herbaceous layer below (Sproul et al. 2011). This vegetation community occurs from the northwest corner to the east-central portion of the Sierra Verde Addition where it covers approximately 92.08 acres. The dominant shrub within this community is laurel sumac, with California buckwheat and coastal deerweed as subdominant shrubs in many areas. Herbaceous plants occurring in the openings of this association include longbeak stork's bill, wild oat (*Avena* sp.), and red brome.

Herbaceous Community

Ripgut Brome Semi-Natural Stand Type (5.8.2); Red Brome Semi-Natural Stand Type (5.9.1); Mediterranean California Naturalized Annual and Perennial Grassland Semi-Natural Stands (5.21)

Ripgut brome semi-natural stand type (*Bromus diandrus* semi-natural stand type) is dominated by ripgut brome in the herbaceous canopy, particularly in disturbed areas. This brome is most prominent at dominating native grasslands, the understory of oak woodlands, and other vegetation types (Sproul et al. 2011). It invades low areas with deeper soils creating dense cover and biomass that create dense perpetual thatch. Other brome species, such as soft-chess brome (*Bromus hordeaceus*), are often subdominant with other weedy plant species. This vegetation community occurs in the west-central portion of Addition 2 where it covers approximately 0.44 acres. The dominant grasses and herbs within this community include ripgut brome, red brome (*Bromus madritensis* ssp. *rubens*), slender oat (*Avena barbata*), annual yellow sweetclover (*Melilotus indicus*), and shortpod mustard (*Hirschfeldia incana*). Red brome semi-natural stand type (*Bromus rubens* semi-natural stand type) is dominated by red brome in an open herbaceous canopy. Non-native herb species are often subdominant to codominant; however, native herb species can also be subdominant. This vegetation type occurs in areas with drier site conditions and poorer soils than areas that support ripgut brome, purple false brome (*Brachypodium distachyon*), and black mustard (*Brassica nigra*) (Sproul et al. 2011). This vegetation community occurs in the east-central portion of Addition 1 where it covers approximately 2.95 acres. The dominant grasses and herbs within this community include red brome, longbeak stork's bill (*Erodium botrys*), common

sandaster (*Corethrogyne filaginifolia*), and clustered tarweed (*Deinandra fasciculata*). Mediterranean California naturalized annual and perennial grassland semi-natural stands consists of dominant non-native grasses and forbs that have replaced native types through repeated soil disturbance and introduction of non-native plant species (Sproul et al. 2011). This vegetation community type occurs in the northeast corner of the Sierra Verde Addition on approximately 5.8 acres and 1.73 acres. These areas are dominated by weedy non-native species, including ripgut brome, slender oat, longbeak stork's bill, annual yellow sweetclover, and hairy vetch (*Vicia villosa*). However, a few native species, including poison oak (*Toxicodendron diversilobum*), California buckwheat (*Eriogonum fasciculatum*), and Menzie's fiddleneck (*Amsinckia menziesii*) were detected within this community as well.

Annual grassland response to fire depends on the season in which the fire occurs; the height of the vegetation depending on the rainfall of the previous season; and the variables of wind speed, temperature, and humidity. In some cases, burning annual grassland may enhance the reproduction of native annuals; however, it also may stimulate the spread of non-native plant species (DiTomaso and Johnson 2006; DiTomaso et al. 2013). Summer and fall fires appear to have little direct effect on grasses, and fast-burning and relatively cool fires do not kill seed. Wild oats have awns and bristles that help the seeds burry into the soil as the seeds dry, which keeps them insulated from fire (CNPS 2020). Red brome can produce abundant and continuous cover of long-lasting fine fuels, which creates shorter fire return intervals in warm and dry portions of the state. Tall mustards can increase fire fuel loads and intensity, particularly in areas within the Preserve that have areas altered by non-native grasses, and can reproduce and spread rapidly following fires.

Woodland Communities

Coast Live Oak Association (3.6); Coast Live Oak/Scrub Oak Association (3.6.2

Coast Live Oak Alliance (*Quercus agrifolia* alliance) consists of coast live oak stands in either mesic uplands or riparian or semi-riparian settings. Trees are generally less than 30 meters tall with an open to continuous canopy. Additional tree species can occur, and shrub and herbaceous canopies are variable (Sproul et al. 2011). This vegetation community occurs on approximately 0.3 acres in the southeast corner of Addition 3 and approximately 91.82 acres in the southern half of the Sierra Verde Addition. Coast live oak is the dominant tree species within this community. Additional tree, shrub, and herbaceous species detected include western sycamore, scrub oak, poison oak, California blackberry (*Rubus ursinus*), Pacific sweet pea (*Lathyrus vestitus*), and California mugwort (*Artemisia douglasiana*). Coast Live Oak/Scrub Oak Association (*Quercus agrifolia/Quercus [berberidifolia,* x*acutidens]* association) consists of an open tree canopy dominated by coast live oak and scrub oak diagnostically present in the shrub canopy. Additional shrub species can occur as subdominants in the shrub canopy. Herb cover occurs in openings. This association is typical of mesic slopes where coast live oak is not associated with riparian vegetation

types (Sproul et al. 2011). This vegetation community occurs on approximately 157.48 acres in the central portion of the Chabad Addition. Coast live oak is the dominant tree species within this community. Additional shrub and herbaceous species detected include scrub oak and chaparral whitethorn.

Coast live oak individuals have the thickest bark of any California oak. Large individuals are exceptionally fire resistant and recover well from fires, with stands known to be able to attain 80 to 100 percent of their pre-fire densities within 10 years following a fire. However, severely burned crowns, trunks, and root crowns may require several years to sprout and seedlings and saplings can often be killed by low to moderately severe fires. Fire is the main natural process affecting upland stands but both fire and fluvial processes, such as erosion, can impact regeneration of riparian or semi-riparian stands (Sproul et al. 2011). Stands of coast live oak can be eliminated by repeated fires at short intervals. This vegetation community has medium fire return intervals that partly depend on neighboring alliances and range between 30 and 100 years. Fires are typically low to high in intensity and low to high in severity (CNPS 2020). While scrub oak is well adapted to survive periodic fires, but it can persist without fire. As an obligate sprouter, scrub oak relies on resprouting to regenerate after fire, and does so vigorously; its seeds are killed by fires. Following a fire, it can resprout and become dominant in 30–40 years. This species has little dead wood and may be less flammable than many other chaparral species. It is also adapted to moderately intense, fast spreading, potentially large fires. Scrub oak is less impacted by high fire intensity, and can therefore shift dominance in favor of scrub oaks. Fires are typically high in intensity and high in severity, with fire return intervals ranging between 30 and 100 years (CNPS 2020).

Coast Live Oak – Poison Oak – Grass Association (3.6.4)

The Coast Live Oak/Poison Oak/Grass Association (*Quercus agrifolia/Toxicodendron diversilobum/Grass* association) consists of a tree canopy dominated by coast live oak, a shrub canopy with poison oak present, and an herbaceous understory of native and non-native species. Herb diversity is high and cover is generally intermittent to continuous, including many ruderal species. This association typically occurs higher on the hydrologic profile where many upland shrubs and ruderal plants are prevalent above the fluvial regime (Sproul et al. 2011). This vegetation community occurs on approximately 2.42 acres in the northeast corner and southern border of Addition 1 and approximately 1.19 acres in the northwest portion of Addition 2. Coast live oak represents 50 percent of the relative tree cover in this vegetation community. Subdominant shrubs detected include blue elderberry (*Sambucas nigra* ssp. *caerulea*) and coyote brush (*Baccharis pilularis*). Ripgut brome is the dominant grass species in the herbaceous understory.

After a fire or mechanical disturbance, poison oak can sprout vigorously from the root crown and rhizomes. A significant increase in seed germination was observed when seeds are exposed to charate. Dense thickets can develop in areas exposed to frequent fires. Coast live oak fire return

intervals range between 30-100 or more years with low to high intensity fires that are low to high in severity (CNPS 2020).

Non-native woodland (79000)

Land designated as non-native woodland not dominated by eucalyptus (*Eucalyptus* spp.) or tamarisk (*Tamarix* spp.) is not addressed by the VCM; therefore, this description follows Oberbauer et al. (2008). Non-native woodland consists of exotic trees, usually intentionally planted, but not maintained or artificially irrigated. This vegetation community occurs on approximately 0.9 acres in the center of Addition 1. Exotic trees detected within this community include avocado (*Persea americana*) and olive (*Olea europaea*).

Avocado trees can burn easily particularly when stands are grown adjacent to susceptible brushlands. Mortality of individuals can vary depending on the fuel loads present in the understory of trees. Unmaintained trees with high fuel loads from fallen avocado trees, twigs, broken branches, and low limbs may be more susceptible to death. Another source of fuel can be adjacent brush, trees, and other vegetation, which can also cause high fuel load conditions that may contribute to tree death (Goodall 1965). Avocado trees have a great ability to recover after fire damage, particularly when aided by human care (Regents of the University of California n.d.). Olive trees can form dense stands that shade out native species and increase the fire hazard of dry woodland environments. It is also an inflammable species with a high oil content (IUCN ISSG and ARC 2010). Older olive trees can resprout after fire, but younger individuals may be killed (DiTomaso et al. 2013).

Eucalyptus woodland (11100)

Eucalyptus (Eucalyptus globulus/camaldulensis) semi-natural stands are composed of eucalyptus tree species that form self-perpetuating stands (Sproul et al. 2011). Approximately 0.5 acre of eucalyptus woodland composed of *Eucalyptus camaldulensis* occurs within the Original Preserve along the southern central edge of the boundary. Scattered individuals were also documented within disturbed habitat and urban/developed habitat.

Eucalyptus species have evolved in fire-prone environments in Australia. Mature trees develop thick bark and are able to survive most fires. With leaves that have high content of volatile oils, the fire intensity in stands is very high. Seeds are fire resistant, annual seed production is typically high, and germination rates after fires are high. Eucalyptus groves are a major cause of concern near urban/wildland interfaces because the trees and the debris buildup below are extremely flammable (CNPS 2020).

Riparian Community

Baccharis salicifolia Association (4.11.1)

Mulefat Association (*Baccharis salicifolia* association) consists of a shrub canopy dominated by mulefat. Additional shrub species can occur as subdominants and emergent wetland trees can also be present. The herbaceous understory is generally diverse. This association is an open riparian scrub that is most often transitional to more fully developed riparian woodlands (Sproul et al. 2011). This vegetation community occurs on approximately 0.2 acre along the eastern border of the Sierra Verde Addition. The dominant shrub within this community is mulefat, with Goodding's black willow as an emergent wetland tree species, with non-native grasses in the understory.

Mulefat individuals are able to resprout following disturbances such as fire; fluvial processes are the primary cause for disturbance for mulefat stands (CNPS 2020).

Other Habitat and Land Cover Types

Disturbed/Developed (11300)

Land designated as disturbed habitat is not addressed by the VCM; therefore, this description follows Oberbauer et al. (2008). Disturbed habitat consists of areas that have been physically disturbed and are no longer recognizable as a native vegetation community but continue to retain a soil substrate. Vegetation is nearly exclusively composed of non-native species, including ornamentals or ruderal exotic species (Oberbauer et al. 2008). Approximately 25.4 acres in the Original Preserve, 10.91 acres in Addition 1, 0.33 acre in Addition 2, 1.06 acres in Addition 3, and 3.07 acres in the Sierra Verde Addition were mapped as disturbed/developed habitat. The disturbed/developed habitat within the Preserve consists primarily of access roads, unauthorized trails, and areas disturbed by off-highway vehicles and/or erosion. These areas generally consist of bare ground but contain scattered non-native plant species, including short-pod mustard, sweet fennel, pigweed (*Amaranthus albus*), common labsquarters (*Chenopodium album*), Russian thistle (*Salsola tragus*), tree tobacco, crimson fountaingrass, tocalote (*Centaurea melitensis*), wild radish (*Raphanus sativus*), slender oat, ripgut brome, longbeak stork's bill, treasure flower (*Gazania linearis*), and artichoke thistle (*Cynara cardunculus*).

Mustards can increase fire fuel loads and fire intensity, and can reproduce and spread rapidly following fires. Fire also generally has a moderate impact on tocalote seeds within the seed bank, and may actually stimulate some of the seeds to germinate in the next growing season. However, after three consecutive years of exposure to fires, these seed banks may be significantly reduced. Artichoke thistle has a perennial taproot which helps prevent the plant from dying due to fire alone, and the seedbank may flush or germinate following a fire (CNPS 2020).

Urban/Developed (12000)

Land designated as urban/developed are not addressed by the VCM; therefore, this description follows Oberbauer et al. (2008). Urban/Developed areas are found where habitat has been altered by human activities to a state beyond the potential for recovery to a natural state. In general, free standing structures and surrounding areas that are paved, armored, or landscaped are considered developed. Within the Preserve, developed areas include the foundations of two burnt homes and their associated outbuildings, paved and unpaved maintenance roads, driveways, parking and staging areas, restrooms, and concrete-lined aqueducts and pipelines. Developed areas within the Preserve include discrete areas of ornamental landscaping around the burnt homes and homesteads. These areas include lawns, gardens, and non-native shade trees and ornamental shrubs planted by previous inhabitants including assorted eucalyptus trees, acacia (*Acacia* spp.), oleander (*Nerium oleander*), Peruvian pepper tree, and jade plant (*Crassula ovata*). Approximately 12.2 acres of Urban/Developed areas cover the Preserve.

Wildfires in San Diego County can occur naturally or be caused by humans. These wildfires can threaten communities. While there is no way to predict when and how fires will ignite, home owners can take precautions to help reduce risks to their properties starting with diligently maintaining 100 feet of defensible space around their homes, which is required by law (State of California 2020a).

Open Water (64100)

Land designated as open water habitat are not addressed by the VCM; therefore, this description follows Oberbauer et al. (2008). Open water habitat consists of areas that were inundated with water during vegetation mapping surveys. Open water within the Additions consist of stock ponds with standing water for most of the year due to above-average winter and spring rainfall. Approximately 0.32 acres in Addition 1 and 1.38 acres in the Sierra Verde Addition were mapped as open water habitat. These areas were generally devoid of vegetation, but non-native plant species, such as shortpod mustard, were observed bordering the ponds.

Fire Behavior

The fire behavior modeling for this report uses analysis of typical fire season weather conditions divided by climate zones and includes temperature, relative humidity, wind, fuel (vegetation), and moisture. These parameters are all used to calculate the burning index, which represents the relative difficulty of controlling a wildfire. This model provides reasonably accurate representations of how wildfire would move through available fuels (County of San Diego 2010b). This fire behavior model is a tool for fire authorities to estimate the behavior of fire that is moving across the vegetated landscape given certain assumptions. The behavior model is only an estimate

and is not designed to replace eye-witness accounts or the experience of the local fire authority that is familiar with wildland fire behavior. Additional information on the fire behavior assessment for the Preserve is included in **Appendix A**.

5.3 FUEL MANAGEMENT METHODS

Successful fire management requires pre-planning and utilization of fire prevention techniques and strategies. The Preserve has been fire-free for about 13 years. Management of fuels is an important component of overall management of the Preserve. The Original Preserve is bounded by rural residential properties to the south, scattered residential properties to the west and east, and open space land to the north. Addition 1 and Addition 3 abut scattered rural residential properties. Sierra Verde Addition is bounded by rural residential properties to the west and north and open space land (Guejito Ranch) to the south and east. Addition 2 and the Chabad Addition are surrounded by open space land. However, within Addition 2 is the foundations of a historic house and associated structures; therefore, this Addition is within 250 feet of a structure. The Preserve has been divided into nine Vegetation Management Units (VMUs) based on the vegetation types and existing fuel management zones (**Figure 10**). VMU-specific fuel reduction recommendations are provided in the Fire Management section of this report (Section 6.3). General fuel management methods and their suitability for use in the Preserve is discussed below.

5.3.1 Grazing

Animal grazing is a tool that can be used to manage vegetation on the Preserve, depending somewhat on whether it is intended that low-level vegetation, lower than 3 feet tall, is desired to be maintained on the Preserve. Grazing by cattle is not recommended for the Preserve due to site topography and the small amount of sparsely vegetated habitat types, but goat grazing could be an option particularly for Addition 1 and the Sierra Verde Addition, which both have flatter terrain and have more non-native plant cover and disturbed habitat. However, in all cases, monitoring would be needed to ensure that the grazing animals are not dispersing non-native plant species onto the Preserve and type-converting areas of vegetation to a weed-based community. Furthermore, animal grazing is only a temporary control and needs to be used on a regular basis to be effective. Due to the lack of sparsely vegetated habitats and the thick and dense vegetation types (which prevent visibility for monitoring animals) found throughout the majority of the Preserve and the Additions, as well as the lack of fencing or other property boundaries to ensure animals stay within the desired area, grazing is not recommended at this time.

5.3.2 Mowing

Controlled mowing can be a successful method for reducing fuel loads and can be compatible with Preserve management goals. Its usefulness, however, would be generally limited to areas within

roads and established trails. Mowing should be conducted in late spring after weedy annuals have stopped growing but have not yet produced viable seed to ensure efficacy (Bell 2009). Mowing activities performed after seed setting would only cause further spread of non-native invasive species if the biomass is not removed from the Preserve. Mowing is generally not recommended within the Preserve; however, if this method is used, it would need to be monitored to prevent it from causing a permanent conversion of vegetation into a grass-dominant or weedy habitat.

5.3.3 Herbicides

Chemical means to control non-native plants may be an effective method for reducing fire hazard, but might be more appropriate for controlling specific outbreaks of invasive non-native plant species to prevent large infestations. Herbicide use for vegetation management to reduce fuel loads may be more problematic due to the scale needed to be effective in addressing flammability of vegetation, since treatment would leave behind the remaining dead and dry biomass (unless dead biomass is gathered and disposed of offsite). Herbicides could be used in specific treatments for difficult issue areas. Care should be taken such that only aquatic-safe herbicides are used in aquatic areas within the Preserve given the presence of unnamed streams, Hell Creek, and Paradise Creek onsite.

5.3.4 Prescribed Fire

Prescribed fires are intentionally ignited by management actions under specific, predetermined conditions in order to meet specific objectives related to reducing fuels for public safety or habitat improvement, and are regulated by applicable laws. Prescribed fire on the Preserve is generally not recommended due to proximity of surrounding rural residential properties. Where prescribed fire is feasible within the region, it shall be conducted under permit from CAL FIRE, or under contract with CAL FIRE under the statewide Vegetation Management Program. Prescribed fire can only be implemented by CAL FIRE, or a similar fire authority with experience and certifications to conduct burns.

5.3.5 Hand Tool or Mechanical Equipment Thinning

Thinning can reduce fuel continuity and loading by selective removal of dead and dying vegetation. This can be achieved through removal of non-native plant species biomass, brush management within FMZs, and maintenance along trails and roads. Hand tool or mechanical equipment thinning is most useful in the interface and intermix areas around high-value resources. Non-native plant species pose high fire risks, therefore, removal of non-native plant species biomass is particularly important when adjacent to structures, residential properties, and around special-status plant populations that may be put at an increased fire risk due to the presence of these non-native plant species.

Fuel management is required within FMZs up to 100 feet around buildings and facilities. The County is responsible for maintaining FMZs within the Preserve, with adjacent property owners responsible for FMZ maintenance within their respective property boundary. FMZ maintenance is recommended to occur on an annual basis in June prior to the fire season. Special care must be taken to avoid potential impacts to nests during the bird nesting season (January 15 to August 31). Pre-maintenance bird nesting surveys should be conducted by a qualified biologist prior to maintenance activities to determine if some temporary work buffers should be established. In addition, a pre-maintenance roosting bat survey of the palm trees should also be completed for maintenance activities occurring during the bat maternity roosting season (between June and August). Thinning is also appropriate anywhere in the Preserve where insect or disease outbreaks, frost, or drought result in dense, dead vegetation.

The County may also use hand tools or mechanical equipment to maintain the established trail network to meet horizontal and vertical clearance requirements for public trail use within the Preserve. Guidelines on vegetation clearance requirements are provided in the County's Public Access Plan.

5.3.6 Fuel Breaks

Fuel breaks provide areas of removed fuels that may play an important role in helping contain wildfires. The local fire departments and CAL FIRE attempt to minimize impacts to sensitive resources when fighting fires in wildlands. When feasible, fires are usually allowed to run to preexisting breaks, including trails and roads. These locations then serve as a defensive position for fighting the fire. The authorized trail network, staging area, and existing FMZs along the boundary of the Preserve generally meet the anticipated fuel break requirements. Though limited in width, the existing trail network throughout the Additions and existing FMZs along the boundaries generally provide a type of fuel break.

5.4 FIRE RESPONSE PLAN

The southern portions of the Preserve are located under the Valley Center Fire Protection District and the northern portions are in the jurisdiction of the California Department of Forestry and Fire Protection (CAL FIRE). The closest station is the Valley Center Fire Protection District Station #2 located at 28205 North Lake Wohlford Road, Valley Center, CA 92082. This fire station is staffed year-around with five personnel (one fire captain, one fire engineer, two firefighter paramedics, and one firefighter emergency medical technician) on duty every 24 hours and is equipped with a Type-1 fire engine, a Type-6 squad, and an Office of Emergency Services Water Tender. It is located 5.7 miles to the west of the Preserve's staging area at 19324 Santee Lane, Valley Center, CA 92082. Additional fire stations near the Preserve include the CAL FIRE Valley Center Station

#71 approximately 8.3 miles to the west of the Preserve's staging area at 19324 Santee Lane, Valley Center, CA 92082.

Valley Center Fire Protection District would be the primary responders to the Preserve; however, CAL FIRE has a Cooperative Fire Protection Agreement with the County (State of California 2020a). It is expected that Valley Center Fire Protection District and CAL FIRE would work jointly in wildland fire suppression on the Preserve. Both Valley Center Fire Protection District and CAL FIRE are able to provide response in the area of the Preserve to structural fires, wildfires, and medical and associated emergencies. Additionally, CAL FIRE has firefighting personnel and resources available throughout San Diego County that can be called upon to respond to wildfires within or in the vicinity of the Preserve, including the CAL FIRE Valley Center Station approximately 2 miles east of the Preserve. CAL FIRE is currently equipped with Grumman S-2T 1,200-gallon air tankers, UH-1H Super Huey helicopters, and OV-10A airtactical aircraft (State of California 2020b).

CAL FIRE uses three levels of dispatch and response based upon weather conditions and time of year. The three levels are:

- Low – includes two engines with three personnel each.
- Medium – includes three engines (Type-3) with three personnel each, one Battalion Chief, one mid-sized bulldozer, one helicopter (Type-3), and one 16-person hand crew.
- High – includes five engines with three personnel each, one Battalion Chief, two medium-sized bulldozers, one airtactical aircraft, two air tankers, and one helicopter (Type-3).

Low dispatch occurs during the winter months from November through May. Medium and high dispatch occur during the normally declared fire season, which is June through October. There is some variation in the timing of the dispatch levels, based on weather.

Fire-suppression air support with fire retardant drops may be a component of response within the vicinity of the Preserve, especially under conditions that would accelerate wildfire spread and encroach on neighboring residential properties. Under extreme conditions, or at night, air support may not be available; in these situations, response categories may be modified based on public safety.

In some cases, a fire passing through the Preserve may move into adjacent urban areas. Response to a fire within the Preserve may include the use of existing access roads for firefighting personnel, Type-1 engines (limited to off-site paved roadways), Type-3 engines, fire crews, air attack and fire retardant, helicopters, and air tankers. Sierra Verde is bisected by Sierra Verde Road, which varies between 10 to 20 feet in width, but has some erosion issues. Addition 1 is bisected by several trails and roads that vary in width, the main vehicular access being Canal Road, which bisects the

Addition 1 boundaries and continues north and ends at the northern boundary of the Original Preserve. Addition 2 has a road that connects from the Escondido pipeline, which varies between 10 and 20 feet. Addition 3 has a narrow trail that is about 10 feet wide and has erosion issues as well as vegetation throughout. Chabad has no roads that bisect its boundaries. The majority of on-site existing dirt roadways do not seem suitable for fire suppression actions and established roads only provide access to limited areas of the Preserve. Three emergency helicopter landing zones were previously identified within the Original Preserve (County of San Diego 2009b). However, the current condition of these landing zones should be assessed and regularly maintained. Emergency action will likely require direct responses with engines, fire crews, helicopters, and firing operations (i.e., controlling wildland fires by backfiring or burning out to consume fuel between a control line and the main body of a fire). Line construction activities (i.e., constructing fire lines that cut off the supply of fuels by reducing flammable materials such as vegetation) within the Preserve would be best carried out by hand crews. Dozers/road grazers may be activated but should not be put into operation on the Preserve unless necessary for improving existing roads for engine access or constructing line or secondary line for preservation of high-value resources, including plant and animal species, habitats, people, or property. Following fires, vegetation rehabilitation should take place to remediate any physical disturbance that occurs due to fire suppression activities.

5.4.1 Fire Hazard Evaluation

Based on specific data analysis, the Preserve includes an ongoing fire hazard that can result in significant fire intensity and spread during extreme weather events. This section presents a discussion of fire hazard situations for the Preserve. This information was collected during initial analysis of the Preserve and review of project data, fire behavior modeling information, and high-resolution aerial imagery, and was integrated into the preparation of this document and associated recommendations.

1. Based on topography, vegetation, and fire history of the region, a large conflagration (i.e., extensive fire) would likely enter the Preserve from the north/northeast during Santa Ana wind conditions. Fires during typical onshore wind patterns would be likely to enter the Preserve from the nearby Cleveland National Forest to the east.
2. The area of the Preserve consists primarily of wildlands with undeveloped and often inaccessible lands to the east, though is bordered by scattered rural residential development. The staging area at Santee Road is the only public, direct access to the Preserve. The Additions are not open to the public; however, Addition 1 can be accessed from Canal Road; Addition 2 can be accessed from Santee Lane; and Addition 3 can be accessed from Hell Creek Road; the Sierra Verde Addition can be accessed from Sierra Verde Road; the Chabad Addition is not accessible from a road but requires hiking from Hell Creek Road through land owned by private land owners and the BLM for access.

Besides the public access staging area, no other direct, public access is available as the remainder of the Preserve and Additions are bordered by private properties.

3. Potential ignitions include a variety of residential-related sources including structural fires and yard machines in all adjacent residential properties, but there are maintained FMZ's along some of these borders. Additional potential ignitions include vehicular-associated ignitions from on-site illegal activity, such as motorbikes, hunting, a transmission distribution line that bisects the Preserve, accidental fires from transient inhabitants of the area (though there was little evidence of that on the Preserve), and arson.
4. Wildfires fueled by Santa Ana winds may move rapidly across the Preserve. Southern mixed chaparral and other densely vegetated shrub community fuels will be the predominant carriers of fire across the Preserve. Fires in chaparral fuels will move slowly, but will produce flame lengths greater than 20 feet and associated heat output in excess of 5,000 British thermal units.
5. A fire originating in a structure within approximately a 1-mile radius of the Preserve could result in burning embers landing within the Preserve, potentially resulting in vegetation ignition if there is a receptive fuel bed.
6. In general, fires that burn through the Preserve are more likely to be the result of human-caused ignition sources that occur within or adjacent to the Preserve.

The existing staging area and the established authorized trails at the Preserve could be used as a base from which to fight fires; however, general firefighting access for the Original Preserve, Addition 1, and Addition 2 will likely be along the southern boundary and trails of the Original Preserve via Canal Road. Access to Addition 3 and Chabad will likely be limited to Hell Creek Road since the trail dissecting Addition 3 is eroded and narrow and Chabad lacks trails and has steep terrain. Firefighting access for Sierra Verde will likely be along the western boundary via Marin and Scharnau Lane and Sierra Verde Road; however, within the Preserve, Sierra Verde Road may be narrow and eroded. Air attack and support will be an important component for firefighting for a majority of the Preserve area but may not be available or usable depending on the extent of the fire event and/or the time of day and weather conditions.

The catastrophic wildfire threat for the Preserve is extreme when severe fire weather occurs, which will coincide with Red Flag Warning periods. Red Flag Warnings are declared by the National Weather Service and are issued in southern California west of the mountains either when: (1) relative humidity is 15 percent or lower with sustained winds greater than 25 miles per hour (mph) (and/or with frequent gusts greater than or equal to 35 mph) for a duration of 6 hours or more or (2) when relative humidity is less than or equal to 10 percent for a duration of 10 hours or more, regardless of wind (National GACC 2020).

Beyond these provisions, fire management practices are restricted to response and tactical suppression efforts associated with wildfires originating on or burning onto the Preserve. No active

fire or fuel management plans are currently employed on the Preserve and Additions, though active maintenance of the FMZs is occurring.

5.4.2 Primary Actions and Contacts for Wildfire Emergency

The following persons/agencies should be contacted in the event of a wildfire adjacent or on the Preserve and Additions or for information regarding fire management activities.

Valley Center Fire Protection District Station #2
28205 North Lake Wohlford Road
Valley Center, CA 92082
Emergency: 911
Non-Emergency: (760) 751-7605
Website: http://vcfpd.org/

CAL FIRE
San Diego Unit – Valley Center Station #71
14946 Vesper Rd
Valley Center, CA 92082
Emergency: 911
Non-Emergency (760) 749-1702
Website: https://www.fire.ca.gov/

5.4.3 Roads/Access

Road access into the Preserve is predominantly from the staging area at 19324 Santee Road. The partial dirt and gravel road only continues 0.1 miles from the Santee Lane and Kiavo Drive intersection into the staging area for the Preserve and is locked by a gate just west of the intersection when the Preserve is closed. There is no other direct, public access to the Preserve as the entire Preserve is bordered by private properties. The 0.1 mile of existing partial dirt and gravel road do meet the minimum 20-foot requirement for fire access vehicles, and the staging area provides a turn-around location, but past the staging area, the road becomes a foot trail only. Adequate emergency access roads are also found within the Preserve: Canal Road, which provides access to the western and central portion of the Preserve and ends at the northern border of the Preserve boundary; and Santee Lane, which provides access to the staging area. The northeastern area of the Original Preserve is only accessible via the multi-use trails (County of San Diego 2009b). Additional maintenance road access to the Additions are not open to the public; however, Addition 1 can be accessed from Canal Road; Addition 2 can be accessed from Santee Lane; and Addition 3 can be accessed from Hell Creek Road; the Sierra Verde Addition can be accessed from Sierra Verde Road; the Chabad Addition cannot be accessed from the road. Several gates have

been previously identified along the southern boundary of the original preserve; however, the current existence and conditions of these gates should be assessed in order to provide adequate access information to emergency responders.

5.4.4 Fuel Breaks

The Preserve has limited fuel breaks; however, the surrounding area where the Preserve is located has existing dirt roads along the western, eastern, and southern boundaries, which provides breaks in fuel continuity. A 100-foot defensible space buffer is required in areas of the Preserve directly adjacent to private residents, such as those along the southern border. Therefore, creation of additional fuel breaks at this time is not recommended.

However, the need for fuel breaks is dependent on the specific conditions of a fire. If new fire breaks are required, the locations should be coordinated with the Incident Command Team, which includes the County District Park Manager and fire agency staff with access to location information on sensitive biological and cultural resources that should be avoided, if possible. Temporary fuel breaks created during fire episodes should be rehabilitated after a fire is extinguished.

5.4.5 Emergency Staging Areas

Staging areas are important for incident command to organize, plan, and implement firefighting strategies. These areas typically occur on areas that are protected from fire and large enough to temporarily stage and store vehicles. Staging often causes higher ground disturbance from personnel, vehicles, and equipment in confined areas. The Preserve's staging area is large enough to store vehicles in transition. Additionally, three emergency helicopter landing zones were identified in 2009 within the Preserve: (1) the staging area, (2) approximately 1.5 miles north of the staging area off of the trail, and (3) north of the in-holding and Addition 2. However, the use of these areas as suitable landing zones should be confirmed and regularly maintained. Additional staging areas for fires that affect the Preserve will likely occur off-site in well-defended lower hazard areas.

5.4.6 Fire Hydrants

Fire hydrants are scattered within the neighboring rural residential development areas off-site from the Preserve. The closest fire hydrant is at the intersection of Santee Lane and Kiavo Drive, before the gated entrance to the Preserve's staging area. Additional fire hydrants along the Preserve's southern border are located at 18979 Santee Lane under a telephone pole and along Oos Road approximately 0.23 miles north of the intersection of Oos Road and East Canal Road. The closest fire hydrant to Addition 3 and the Chabad Addition is located at 28033 Hell Creek Road. The

closest fire hydrant to the Sierra Verde Addition is located approximately 0.13 miles east of the intersection of Sierra Verde Road and Kiavo Drive.

5.4.7 Other Water Sources

Other water sources that may be available during a wildfire event within the Preserve include:

- The Escondido Canal pipeline that runs through the western half of the Preserve.
- Lake Wohlford, approximately 7.6 miles to the southwest of the staging area of the Preserve, may also be available for helicopter dipping access.

Lake Henshaw, approximately 8 miles to the east of the Preserve, may also be available for helicopter dipping access.

6.0 MANAGEMENT DIRECTIVES

This section provides recommendations for vegetation management within the Preserve, including management directives specifically related to invasive plant species management, habitat restoration, and fire management.

6.1 INVASIVE SPECIES REMOVAL

The short-term management directives below address high-priority invasive plant species removal while long-term management directives consider invasive plant species for their risk of reducing vegetation community quality over time.

Management Directive Invasive 1 – **Remove and Control High-Priority Invasive Non-Native Plant Species.** Remove aggressive, invasive non-native plant species, starting with the high-priority species for removal listed in **Table 7**. New occurrences of invasive plant species should be documented and removed immediately consistent with Early Detection Rapid Response Practices in order to prevent infestations.

Management Directive Invasive 2 – Identify and Pursue Funding for Long-Term Invasive Nonnative Plant Control. Coordinate with other agencies, nonprofit organizations, and/or volunteer groups such as the Friends of Hellhole Canyon and Valley Center Trails Association to seek funding and/or volunteer support for implementing invasive non-native plant removal projects for moderate- and low-priority non-native species within the Preserve.

Management Directive Invasive 3 – Conduct Invasive Non-Native Plant Species Monitoring. Continue to monitor invasive non-native plant species within the Preserve to determine whether removal efforts are warranted in order to maintain and/or improve the quality of the existing native vegetation communities. Monitor for any new invasive plant species that may inhabit the Preserve and document occurrences consistent with the Early Detection Rapid Response practices.

Management Directive Invasive 4 – Educational Outreach. Prepare and implement an invasive non-native plant species educational outreach program and/or materials for visitors and adjacent property owners in order to prevent additional sources of invasive weeds and discourage the use of these species in adjacent landscaping. These handouts can be used by County Park Rangers who lead nature hikes within the Preserve and can also be used to solicit volunteers.

6.2 RESTORATION

The primary management directives for habitat restoration include:

Management Directive Restoration 1 – Restore Native Vegetation Community Quality and Function. Restore degraded areas to reestablish and/or enhance the biological functions and values of native vegetation communities in these areas.

> **1A – Passive Restoration (Trails)**. Perform non-native plant species treatment and removal methods as-needed in disturbed areas where natural recruitment of native plant species is actively occurring. Passive restoration should be used in conjunction with access control measures to restore unauthorized trails to natural habitat conditions where feasible.
>
> **1B.1 – Active Restoration (Trails)**. Conduct soil preparation, erosion control, and native planting within disturbed and/or degraded areas where native vegetation recruitment is not actively occurring within unauthorized trails that have been successfully closed.
>
> **1B.2 – Active Restoration (Engelmann Oak habitat)**. Implement restoration focused on sensitive species habitat enhancement, such as for the Engelmann oak population.

Management Directive Restoration 2 – Monitor the Efficacy of Restoration Activities and Re-strategize as-needed. Monitor invasive plant species removal sites to ensure that passive natural recruitment is successfully occurring in these areas. Monitor active restoration sites to ensure natural recruitment and establishment of seeded/planted individuals. Continue to monitor for additional maintenance needs such as re-treatment of non-native plant species and BMP installation.

Management Directive Restoration 3 – Address Future Restoration Needs. Restoration activities should occur following landscape changing disturbances that remove, damage, degrade, or alter the existing native vegetation communities. Restoration methods will be customized to the Preserve based on the type of disturbance and may include both passive and active restoration methodologies including (but not limited to):

- Supplemental container plantings and seeding of disturbed areas
- Invasive weed removal using mechanical and chemical controls
- Installation of erosion control measures
- Native vegetation community establishment, creation, and enhancement

Management Directive Restoration 4 – Identify and Pursue Funding for Long-term Restoration Goals. Coordinate with other agencies, nonprofit organizations, and/or volunteer groups such as the Friends of Hellhole Canyon and Valley Center Trails Association to seek funding and/or volunteer support for implementing restoration activities, such as the Engelmann oak habitat enhancement, within the Preserve.

6.3 FIRE MANAGEMENT

The long-term strategic fire management directives include strategic fuel reduction activities, fire prevention activities, and management guidelines. The long-term strategic fire management directives for the Preserve must prioritize public safety while meeting Preserve management goals. Management directives are as follows.

Management Directive Fire 1 – Maintain Fuel Modification Zones. FMZs of 100 feet around buildings and facilities are required. Within the Preserve, FMZs have also been established around the amphitheater and staging area/associated road; these zones collectively make up approximately 3.44 acres. **Figure 10** provides a view of fuel modification areas, measured 100 horizontal feet from the edge of structures and the amphitheater, and 30 feet from the existing staging area and associated access road. FMZs should be maintained annually according to the appropriate local and state guidelines. Special care must be taken to avoid potential impacts to nests during the bird nesting season (January 15 to August 31). Pre-maintenance bird nesting surveys should be conducted by a qualified biologist prior to maintenance activities. In addition, a pre-maintenance roosting bat survey of the palm trees should also be completed for maintenance activities occurring during the bat maternity roosting season (between June and August).

Management Directive Fire 2 – Create and Maintain Suitable Emergency Fire Access. The Additions are currently not accessible to any public vehicles; however, the Original Preserve and Additions 1 and 2 have adequate emergency access roads: Canal Road, which provides access to the western and central portion of the Preserve and ends at the northern border of the Preserve boundary; and Santee Lane, which provides access to the staging area. The northeastern area of the Original Preserve is only accessible via the multi-use trails. Addition 3 can be accessed from Hell Creek Road; the Sierra Verde Addition can be accessed from Sierra Verde Road; the Chabad Addition cannot be accessed from the road. Several gates have been previously identified along the southern boundary of the Original Preserve; however, the current existence and conditions of these gates should be assessed in order to provide adequate details to emergency responders.

Management Directive Fire 3 – Access Data Sharing. Maintain local fire agency gate locks and report any notice of removed or missing locks to the appropriate fire agency. Signs should be installed indicating access limitations and extents (map form) and provide road quality to local fire responders. This information will be included in the responder's wildland pre-response plans, resulting in more efficient responses. Information readily accessible by responders not familiar with the area, such as out-of-County or out-of-state responders, will improve fire fighter safety.

Management Directive Fire 4 – Control Illegal Access. Continue to restrict access to off-highway vehicles as well as shooting and firework activities within the Preserve. These are potential ignition sources that must be managed through restricting access (e.g., continued use of

gates, existing sign maintenance, and new gate and sign installation near any potential un-restricted access points) as well as by establishing a high-profile presence of park ranger staff. Conduct monitoring in order to prioritize where these deterrents should be installed. The legality of inhabitants within and adjacent to the area needs to be evaluated and addressed if any reports occur. While there is no evidence of inhabitants at the present, if trespassers appear on the Preserve, they should be removed to prevent any potential fire sources. Routine monitoring should be performed.

Management Directive Fire 5 – Educational Outreach. Private property owners located along the boundaries of the Preserve should be encouraged to play an active role in reducing the potential fire hazard. It will also be beneficial if the public understands the management actions occurring on the Preserve, such as grazing, mowing, and herbicides, as applicable. As such, this VMP recommends a concerted effort to reach property owners who are situated in locations that may be affected by wildfire on the Preserve or whose properties and actions may serve as ignition sources for the Preserve. Educational material can be customized for these homeowners to include discussion of the importance of the Preserve. Standard measures for implementing a 100-foot fuel modification/defensible space zone around the individual homes can be provided from materials available from CAL FIRE and from the County of San Diego Department of Planning and Development Services as well as in Valley Center Fire Protection District website (Valley Center Fire Protection District 2007–2019). As part of the public education program, adjacent private property owners should be encouraged to participate to help curb illegal access and report potential problems.

Management Directive Fire 6 – Reduce Ignition Sources: Potential ignition sources within the Preserve include unauthorized off-highway vehicle use and the high-voltage electrical utility transmission lines that bisect several areas of the Preserve. Adjacent ignition sources include (but are not limited to) roadways with vehicular travel, adjacent and nearby residences, recreational users, and hunting/shooting authorized on the adjacent BLM lands. Implement a litter and trash removal program and maintain existing signage prohibiting littering and illegal dumping, which are also potential sources of fire ignition. Trash receptacles associated with the staging area and designated trails will need to be maintained regularly. Illegal dumping will be regulated and regular monitoring will be performed in order to remove flammable items as soon as possible. It is not possible to remove all sources of ignition. Rather, reducing the potential spread of wildfire onto or throughout the Preserve is recommended. Fuel reduction along access roads will reduce the likelihood of ignitions from maintenance vehicles.

Management Directive Fire 7 – Conduct Recommended Fuels Management. Conduct fuels management using the identified VMUs. VMUs are shown in **Figure 10** and listed in **Table 12** along with a summary of the high-value resources within the Preserve and appropriate fire prevention strategies recommended for achieving long-term management goals. Fuels

management will generally consist of invasive plant removal to reduce their spread and remove some of the fuel loads, as well as required maintenance of FMZs.

Management Directive Fire 8 – Post-fire Management and Erosion Control. Provide controls following fire events to stabilize soils in the burn area and minimize potential for erosion. Erosion control BMP's, such as mechanical rehabilitation treatments including straw mulch, hay bales, and jute rolls, should be in place as soon as possible after a fire and prior to the onset of the winter rainy season. Certified weed-free materials should also be used to avoid the introduction of additional invasive non-native plant species.

Table 12. Fuel Management Activities by Vegetation Management Unit

VMU	Sensitive Resources	Fuel Reduction Practice
1 Fuel Modification Zones Area: 3.44 acres	<u>Sensitive Plant Species:</u> None detected <u>Sensitive Wildlife Species:</u> None detected <u>Cultural Resources</u> None detected <u>Residences</u>	VMU 1 is made up of FMZs that run along the western boundary of Sierra Verde, the southern boundary of the Original Preserve, and around the staging area and its associated access road at the end of Santee Lane and Kiavo Drive. These areas are generally composed of chaparral communities and woodlands. FMZs consist of 100 feet around buildings, structures, and the amphitheater; and 30 feet around the perimeter of the staging area as well as on either side of its associated access road, as shown on **Figure 10**. Fuel reduction in VMU 1 may include manual thinning of native vegetation and/or manual thinning, mowing, and/or herbicide application of non-native species within the FMZs and should be conducted routinely to minimize fire spread and ignition potential from residential development and vehicle use. No primary target invasive non-native plant species occur within this area; however, fuel reduction in this VMU may include removal of other present invasive non-native plant species, such as mustards, in order to reduce further spread into the Preserve as well as to remove the associated fuel loads. Avoidance measures to avoid potential impacts to nests during the bird nesting season (January 15 to August 31) includes pre-maintenance bird nesting surveys to be conducted by a qualified biologist prior to maintenance activities. If any sensitive plant species are encountered, they should be flagged and avoided during vegetation maintenance to the maximum extent possible. Appropriate buffers from sensitive plants should be incorporated during herbicide application at the discretion of a qualified biologist. Access within this VMU is mainly possible via the staging area and associated access road, as well as the existing trail network.

VMU	Sensitive Resources	Fuel Reduction Practice
2 Chaparral Area: 2,021.41 acres	Sensitive Plant Species: Brewer's calandrinia Cleveland's bush monkey flower Engelmann oak Felt-leaved monardella Fish's milkwort Robinson's peppergrass Yucaipa onion Palmer's grapplinghook Rush-like bristleweed Sensitive Wildlife Species Coast horned lizard Belding's orange-throated whiptail Two-striped garter snake Coast patched-nosed snake Western spadefoot toad Coastal western whiptail Bell's sparrow Burrowing owl Cooper's hawk Southern California rufous-crowned sparrow Western bluebird Yellow warbler Barn owl Merlin Dulzura pocket mouse San Diego desert woodrat San Diego pocket mouse San Diego black-tailed jackrabbit Southern mule deer Pallid bat Pocketed free-tailed bat Greater western mastiff bat Western red bat Western yellow bat Western small-footed myotis Long-eared myotis Yuma myotis Cultural Resources See confidential resources map for location details (ASM Affiliates, Inc. 2008 and ESA 2019b)	VMU 2 makes up the majority of the Preserve and is composed of chaparral vegetation communities. Multiple high priority invasive species occur within this VMU. Target invasive species are listed in **Table 7** and include Pampas grass, artichoke thistle, treasure flower, crimson fountain grass, Brazilian pepper tree, tamarisk, Mexican fan palm, golden wattle, eucalyptus, and tree tobacco. Invasive species removal may be performed in order to reduce their spread as well as remove some of the associated fuel loads, particularly due to potential ignition sources from adjacent roads, unauthorized off-highway vehicle use, and pedestrian use. Avoidance measures to avoid potential impacts to nests during the bird nesting season (January 15 to August 31) includes pre-maintenance bird nesting surveys to be conducted by a qualified biologist prior to maintenance activities. A pre-maintenance roosting bat survey of the palm trees should also be completed for maintenance activities occurring during the bat maternity roosting season (between June and August). Special care must be taken to prevent impacts to sensitive plant species occurring within this VMU. All sensitive species should be flagged and avoided during vegetation maintenance. Appropriate buffers from sensitive plants should be incorporated during herbicide application at the discretion of a qualified biologist. Any cultural resource sites in close proximity to invasive non-native plant species treatment or maintenance activities should be flagged to avoid potential impacts during the work activity [See confidential resources map for location details (ASM Affiliates, Inc. 2008 and ESA 2019b)]. Access within this VMU is mainly possible through Canal Road, and is otherwise limited to foot access via the existing trail network.

VMU	Sensitive Resources	Fuel Reduction Practice
3 Scrub Area: 89.48 acres	Sensitive Plant Species: None detected Sensitive Wildlife Species Belding's orange-throated whiptail Western spadefoot toad Coronado skink Bell's sparrow Southern California rufous-crowned sparrow Dulzura pocket mouse Mountain lion Southern mule deer Pallid bat Pocketed free-tailed bat Townsend's big-eared bat Long-eared myotis Yuma myotis Cultural Resources See confidential resources map (ASM Affiliates, Inc. 2008 and ESA 2019b) for location details	VMU 3 makes up the third largest area of the Preserve and is composed primarily of scrub habitat. Multiple high priority invasive species occur within this VMU. Target invasive species are listed in **Table 7** and include artichoke thistle, sweet fennel, Peruvian pepper tree, tamarisk, and olive tree. Invasive species removal may be performed in order to reduce their spread as well as remove some of the associated fuel loads. Avoidance measures to avoid potential impacts to nests during the bird nesting season (January 15 to August 31) includes pre-maintenance bird nesting surveys to be conducted by a qualified biologist prior to maintenance activities. No known sensitive plant species occur within this VMU; however, if any are detected, their locations should be flagged and avoided during vegetation maintenance. Appropriate buffers from sensitive plants should be incorporated during herbicide application at the discretion of a qualified biologist. Any cultural resource sites in close proximity to invasive non-native plant species treatment or maintenance activities should be flagged to avoid potential impacts during the work activity [See confidential resources map for location details (ASM Affiliates, Inc. 2008 and ESA 2019b)]. Access within this VMU is limited but may be possible on foot in certain areas via the existing trail network.
4 Riparian Forest/Woodlands Area: 346.59 acres	Sensitive Plant Species: Engelmann oak Fish's milkwort Humboldt's lily Yucaipa onion Sensitive Wildlife Species Coast horned lizard Belding's orange-throated whiptail Southern California rufous-crowned sparrow Yellow warbler Southern California rufous-crowned sparrow Western bluebird White faced ibis Turkey vulture Red-shouldered hawk Barn owl San Diego desert woodrat San Diego pocket mouse Southern mule deer Pallid bat Pocketed free-tailed bat	VMU 4 is the second largest unit within the Preserve. It is primarily composed of riparian forest and woodland vegetation communities that diagonally bisect the Preserve and includes two large areas within Chabad and Sierra Verde. Multiple high priority invasive species occur within this VMU. Target invasive species are listed in **Table 7** and include giant reed, pampas grass, artichoke thistle, iceplant, crimson fountain grass, Peruvian pepper tree, tamarisk Mexican fan palm, tree tobacco, and olive tree. Invasive species removal may be performed in order to reduce their spread as well as remove some of the associated fuel loads. Avoidance measures to avoid potential impacts to nests during the bird nesting season (January 15 to August 31) includes pre-maintenance bird nesting surveys to be conducted by a qualified biologist prior to maintenance activities. A pre-maintenance roosting bat survey of the palm trees should also be completed for maintenance activities occurring during the bat maternity roosting season (between June and August). Special care must be taken to prevent impacts to sensitive plant species occurring within this VMU. All sensitive species should be flagged and avoided during vegetation maintenance. Appropriate buffers from sensitive plants

VMU	Sensitive Resources	Fuel Reduction Practice
	Townsend's big-eared bat Greater western mastiff bat Western red bat <u>Cultural Resources</u> See confidential resources map (ASM Affiliates, Inc. 2008 and ESA 2019b) for location details	should be incorporated during herbicide application at the discretion of a qualified biologist. Any cultural resource sites in close proximity to invasive non-native plant species treatment or maintenance activities should be flagged to avoid potential impacts during the work activity [See confidential resources map for location details (ASM Affiliates, Inc. 2008 and ESA 2019b)]. Access to the majority of this VMU may be possible through the existing trail network.
5 Non-Native Woodland Area: 1.45 acres	<u>Sensitive Plant Species</u>: None detected <u>Sensitive Wildlife Species</u> None detected <u>Cultural Resources</u> See confidential resources map (ASM Affiliates, Inc. 2008 and ESA 2019b) for location details	VMU 5 is made up of several small patches, two within the Original Preserve near the southeast corner and three within Addition 1, in the center. This VMU primarily consists of non-native trees such as Eucalyptus, Olive, and Avocado trees. Eucalyptus and Olive trees are both target high priority species which are listed in **Table 7**. Both of these tree species are known to be flammable as well as invasive. Their associated fuel loads have the potential to increase with further spread of these species. Therefore, treatment within this VMU should follow the recommendations in Section 3.1.1 (High Priority Species for Removal). Removal of other non-native species occurring within this VMU such as non-native grasses and mustards as well as removing any accumulated dead biomass under the canopy of these trees can also help reduce potential ignition sources and fire intensity. Avoidance measures to avoid potential impacts to nests during the bird nesting season (January 15 to August 31) includes pre-maintenance bird nesting surveys to be conducted by a qualified biologist prior to maintenance activities. No known sensitive plant species occur within this VMU; however, if any are detected, their locations should be flagged and avoided during vegetation maintenance. Appropriate buffers from sensitive plants should be incorporated during herbicide application at the discretion of a qualified biologist. Any cultural resource sites in close proximity to invasive non-native plant species treatment or maintenance activities should be flagged to avoid potential impacts during the work activity [See confidential resources map for location details (ASM Affiliates, Inc. 2008 and ESA 2019b)]. Access to this VMU is possible through the existing trail network.

VMU	Sensitive Resources	Fuel Reduction Practice
6 Riparian Area: 0.20 acre	<u>Sensitive Plant Species</u>: None detected <u>Sensitive Wildlife Species</u> None detected <u>Cultural Resources</u> None detected	VMU 6 consists of a small patch of mulefat scrub within Sierra Verde. No primary target invasive non-native plant species occur within this area; however, fuel reduction in this VMU may include removal of any other present invasive non-native plant species, such as non-native grasses, in order to reduce further spread into the Preserve as well as to remove the associated fuel loads. Treatment methods should avoid ground disturbance activities (e.g., root grubbing) as well as impacts to native wetland vegetation. Avoidance measures to avoid potential impacts to nests during the bird nesting season (January 15 to August 31) includes pre-maintenance bird nesting surveys to be conducted by a qualified biologist prior to maintenance activities. No known sensitive plant species occur within this VMU; however, if any are detected, their locations should be flagged and avoided during vegetation maintenance. Appropriate buffers from sensitive plants should be incorporated during herbicide application at the discretion of a qualified biologist. Access to this VMU is possible through the existing trail network.
7 Non-Native Grassland Area: 10.12 acres	<u>Sensitive Plant Species</u>: Engelmann oak <u>Sensitive Wildlife Species</u> Western spadefoot toad Coastal western whiptail <u>Cultural Resources</u> See confidential resources map (ASM Affiliates, Inc. 2008 and ESA 2019b) for location details	VMU 7 consists of non-native grasslands and which are located in three different areas: one within Addition 1 in the center, one within Sierra Verde in the northeast corner, and one within the Original Preserve in the southeast corner. Target invasive species are listed in **Table 7** and include artichoke thistle. Fuel reduction in VMU 7 may also include removal of other present invasive non-native plant species, such as non-native grasses, in order to reduce further spread into the Preserve as well as to remove the associated fuel loads. Avoidance measures to avoid potential impacts to nests during the bird nesting season (January 15 to August 31) includes pre-maintenance bird nesting surveys to be conducted by a qualified biologist prior to maintenance activities. Special care must be taken to prevent impacts to nearby sensitive plant species (such as any Engelmann oak saplings). All sensitive species should be flagged and avoided during vegetation maintenance. Appropriate buffers from sensitive plants should be incorporated during herbicide application at the discretion of a qualified biologist. Any cultural resource sites in close proximity to invasive non-native plant species treatment or maintenance activities should be flagged to avoid potential impacts during the work activity [See confidential resources map for location details (ASM Affiliates, Inc. 2008 and ESA 2019b)]. Access to these patches appears possible through the existing trail networks.

VMU	Sensitive Resources	Fuel Reduction Practice
8 Disturbed Habitat Area: 40.70 acres	<u>Sensitive Plant Species</u>: Humboldt lily <u>Sensitive Wildlife Species</u> Bell's sparrow Cooper's hawk Southern California rufous-crowned sparrow Western bluebird Barn owl Dulzura pocket mouse San Diego desert woodrat San Diego pocket mouse Palmer's grapplinghook Rush-like bristleweed <u>Cultural Resources</u> See confidential resources map (ASM Affiliates, Inc. 2008 and ESA 2019b) for location details	VMU8 consists of disturbed areas such as access roads and foot trails, an amphitheater, and includes some small pockets of open/disturbed vegetation communities. Multiple high priority invasive species occur within this VMU. Target invasive species are listed in **Table 7** and include artichoke thistle, tamarisk, Mexican fan palm, golden wattle, eucalyptus, and olive tree. Removal of other non-native plant species occurring along trails such as non-native grasses, and mustards can also help reduce potential ignition sources. Invasive species removal may be performed in order to reduce their spread as well as remove some of the associated fuel loads. Sensitive plant species locations such as Humboldt lily should be flagged and avoided during vegetation maintenance. Appropriate buffers from sensitive plants should be incorporated during herbicide application at the discretion of a qualified biologist. Avoidance measures to avoid potential impacts to nests during the bird nesting season (January 15 to August 31) includes pre-maintenance bird nesting surveys to be conducted by a qualified biologist prior to maintenance activities. A pre-maintenance roosting bat survey of the palm trees should also be completed for maintenance activities occurring during the bat maternity roosting season (between June and August). Any cultural resource sites in close proximity to invasive non-native plant species treatment or maintenance activities should be flagged to avoid potential impacts during the work activity [See confidential resources map for location details (ASM Affiliates, Inc. 2008 and ESA 2019b)]. Since this VMU primarily consists of authorized and unauthorized trails and disturbed habitat, access to this VMU is feasible.

VMU	Sensitive Resources	Fuel Reduction Practice
9 Open Water Area: 1.70 acres	<u>Sensitive Plant Species:</u> None detected <u>Sensitive Wildlife Species</u> Western spadefoot toad White faced ibis Southern mule deer <u>Cultural Resources</u> None detected	This VMU is composed of open water. It occurs in a small area within the Sierra Verde Addition. No primary target invasive non-native plant species occur within this area; however, fuel reduction in VMU9 may include removal of other present invasive non-native plant species, such as the mustards that surrounded the water, in order to reduce further spread into the Preserve as well as to remove the associated fuel loads. Treatment methods should avoid ground disturbance activities (e.g., root grubbing) as well as impacts to any native wetland vegetation. Avoidance measures to avoid potential impacts to nests during the bird nesting season (January 15 to August 31) includes pre-maintenance bird nesting surveys to be conducted by a qualified biologist prior to maintenance activities. No known sensitive plant species occur within this VMU; however, if any are detected, their locations should be flagged and avoided during vegetation maintenance. Appropriate buffers from sensitive plants and open water should be incorporated during herbicide application at the discretion of a qualified biologist. Access to this area is possible through the existing road/trail network that horizontally bisects the Sierra Verde Addition.
10 Urban/Developed Area: 11.91 acres	<u>Sensitive Plant Species</u>: None detected <u>Sensitive Wildlife Species</u> Bell's sparrow Southern California rufous-crowned sparrow Yellow warbler <u>Cultural Resources</u> See confidential resources map (ASM Affiliates, Inc. 2008 and ESA 2019b) for location details	This VMU consists of Urban/Developed areas such as the access roads, canal/flume, staging area, restroom, and existing structures within the Preserve. Management for vegetation occurring adjacent to these urban/developed areas is included in VMU1. Any vegetation growing within roads meant for vehicular access (e.g., through cracks in pavement) should be regularly removed and maintained to provide sufficient vehicle clearance and reduce potential ignition sources. Brush clearance around the canal/flume is currently maintained by the City of Escondido (County of San Diego 2009). Any cultural resource sites in close proximity to invasive non-native plant species treatment or maintenance activities should be flagged to avoid potential impacts during the work activity [See confidential resources map for location details (ASM Affiliates, Inc. 2008 and ESA 2019b)]. Access to this VMU is feasible due to the roads and trail networks.

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APPENDIX A

FIRE BEHAVIOR MODELING RESULTS

APPENDIX A
Fire Behavior Modeling Results

The fire effects on the Hellhole Canyon Preserve and the behavior of fire in relation to the vegetation that exists on the Preserve is an important consideration for a VMP for the Preserve. Information for the behavior of fire on the Preserve was generated utilizing the standardized model results information in the *County of San Diego Report Format and Content Requirements, Wildland Fire and Fire Protection* (2010). The following are excerpts from these report format and content requirements.

Analysis of 44 years of weather data (1961–2005) from the USDA Forest Service's Weather Information Management System (WIMS) provides a sampling of weather patterns across San Diego County. San Diego County is divided into five climate zones from the coast to the desert: Climates of San Diego County, Agricultural Relationships, University of California, Agricultural Extension Service, and U.S. Weather Bureau. Daily afternoon weather observations were manually taken at selected fire stations across the county between 1961 and the early 1990s. Remote Automated Weather Stations (RAWS) replaced manual observations beginning in 1992. (http://famweb.nwcg.gov/weatherfirecd/).

Fire Family Plus software (USDA Forest Service) was used to summarize and analyze historical daily fire weather observations and to compute fire danger indices based on the National Fire Danger Rating System (NFDRS).

Weather data from April 15 through December 31 were chosen to represent the general limits of the fire season. Fires have occurred between January 1 and April 14; while dangerous fire weather conditions occur during this period, they typically are not as severe as September and October weather conditions. Including winter weather records would dilute the data and add numerous winter storms that require manual interpretation. Summer fire conditions were derived from records beginning June 15 and ending September 15.

Maximum wind speed data were checked for reasonableness by comparing speed with surrounding stations. Winds associated with winter storms were identified by cross checking with precipitation and relative humidity observations and then excluded. The Santa Ana wind season is assumed to start on September 15. Wind speed is measured at 20 feet above the ground and averaged for at least 10 minutes.

Maximum wind speed was calculated by taking the difference between the maximum recorded wind speed and the 99th percentile wind speed, adding this difference to the 99th percentile wind, adding 10% for a safety margin, and rounding the answer up. This had the effect of throwing out the outliers while including the highest reasonable winds. A table showing days with winds over

the 99th percentile is included for each zone. Peak wind for each zone is the highest recorded wind by a RAWS during the Cedar fire (October 26, 2003).

The program for calculating fire behavior and spread requires temperature and relative humidity ranges as inputs. Temperature ranges of 90°–109°F and relative humidities of 5%–9% are reasonable for most areas of the county under Santa Ana conditions. The Burning Index represents the relative difficulty of controlling a wildfire and is calculated from temperature, wind, relative humidity, fuel (vegetation), moisture, and wind.

Utilizing the information described above, the County of San Diego prepared zone level analysis of the behavior of fire utilizing the BEHAVE Plus fire behavior model. The Hellhole Canyon Preserve is located within both the transitional zone as well as the interior zone as shown in the following Tables 1 through 4.

TABLE 1
BEHAVE PLUS 5.0.1
WORST-CASE SUSTAINED WINDS (10-MINUTE AVERAGE AND PEAK) FUEL MODEL 1 AT 50% SLOPE

Zone	Period	Temperature	Relative Humidity	Sustained Wind Speed	Burning Index (99%)	Rate of Spread Feet/min	Flame Length
Transitional	Summer	90-109°F	10-14%	19 mph	119	430	9
	Santa Ana	90-109°F	5-9%	28 mph	145	730	13
	Peak	90-109°F	5-9%	41 mph	-	730	13
Interior	Summer	90-109°F	5-9%	18 mph	153	470	10
	Santa Ana	90-109°F	5-9%	24 mph	168	730	13
	Peak	90-109°F	5-9%	56 mph	-	730	13

TABLE 3
BEHAVE PLUS 5.0.1
WORST-CASE SUSTAINED WINDS (10-MINUTE AVERAGE AND PEAK) FUEL MODEL 4 AT 50% SLOPE

Zone	Period	Temperature	Relative Humidity	Sustained Wind Speed	Burning Index (99%)	Rate of Spread Feet/min	Flame Length
Transitional	Summer	90-109°F	10-14%	19 mph	119	615	54
	Santa Ana	90-109°F	5-9%	28 mph	145	1100	73
	Peak	90-109°F	5-9%	41 mph	-	1600	87
Interior	Summer	90-109°F	5-9%	18 mph	153	620	56
	Santa Ana	90-109°F	5-9%	24 mph	168	870	66
	Peak	90-109°F	5-9%	56 mph	-	2400	105

TABLE 5
BEHAVE PLUS 5.0.1
WORST-CASE SUSTAINED WINDS (10-MINUTE AVERAGE AND PEAK) FUEL MODEL 10* AT 50% SLOPE

Zone	Period	Temperature	Relative Humidity	Sustained Wind Speed	Burning Index (99%)	Rate of Spread Feet/min	Flame Length
	Summer	90-109°F	5-9%	18 mph	153	30	10
Interior	Santa Ana	90-109°F	5-9%	24 mph	168	40	11
	Peak	90-109°F	5-9%	56 mph	-	100	17

* Surface Fire Only. Behave does not model crown fires in timber fuel types.

Under extreme fire conditions, worst-case scenario modeled using BEHAVE Plus 5.0.1 indicates that the rate of spread of a fire through a transitional zone location such as the western portions of the Hellhole Canyon Preserve will reach 1600 feet per minute with 87-foot flame length. However, under more normal conditions, the spread rate would be 730 feet per minute with flame lengths of 13 feet. The rate of spread of a fire through interior zones such as the eastern portions of the Hellhole Canyon Preserve will reach 2400 feet per minute with 105-foot flame length under extreme fire conditions and 730 feet per minute with flame lengths of 13 feet under more normal conditions. For surface fires within interior zones of the Hellhole Canyon Preserve, the rate of spread can reach 100 feet per minute with 17-foot flame length.

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