7. NORTHEASTERN SACRAMENTO VALLEY VERNAL POOL REGION

All three shrimp species occur within the Northeastern Sacramento Valley Vernal Pool Region.

7.1. Vernal Pool Habitat

Approximately 134,478 acres of vernal pool grassland existed within, or immediately adjacent to, this region when the Recovery Plan was published in 2005 (see **Figure 7.1**, **Table 7.1**; Witham et al. 2013). Approximately 133,478 acres remained as of 2012, with 1,107 acres (0.8% of 2005 total) lost between 2005 and 2012 (Witham et al. 2014). However, 107 acres of new vernal pool grassland were created over that same period on vernal pool mitigation banks and other managed wetlands. Of the habitat lost, 62 acres (5.6%) were to urbanization and 1,045 acres (94.4%) were to agricultural conversion (54.4% to bare plowed agricultural land, 30.2% to rice or row crops, 6.9% to orchards, and 2.8% to other agricultural conversions) (Witham et al. 2014).

By 2018, approximately 131,461 acres of vernal pool grassland remained, with a total of 3,126 acres (2.3% of 2005 total) lost between 2005 and 2018 (see **Table 7.1**; Witham 2021). Just 0.6 acres of new vernal pool grassland were identified in the 2018 aerial imagery that were either not present or not visible on both the 2005 and 2012 aerial imagery. Of the habitat lost since 2005, 280 acres (9.0%) were to urbanization and 2,803 acres (89.7%) were to agricultural conversion (36.0% to bare plowed agricultural land, 20.3% to rice or row crops, 27.6% to orchards, and 5.9% to other agricultural conversions) (see **Table 7.2**; Witham 2021). There were also conversions of 43 acres of vernal pool grasslands to managed wetlands with hydrology that no longer supported vernal pool species. Note that some patches of vernal pool grassland that had been converted to bare plowed land in 2012 had been fully converted to agricultural use for either orchards, rice, or row crops by 2018, although some were never developed and actually returned to being vernal pool grassland.

This vernal pool region has exhibited the least amount of total vernal pool losses of all the vernal pool regions that are entirely within the Central Valley (Witham, 2021). It has the least amount of loss due to urban development within the Central Valley (i.e., not including the portions of the Central Coast and Livermore Vernal Pool Regions within Witham's [2021] study area) and the second lowest amount of losses to agricultural conversions within the Central Valley after the Solano-Colusa Vernal Pool Region. The vast majority of vernal pool losses within this region have been to agricultural conversions (89.7%), which is unsurprising given that the region is composed primarily of agricultural lands and very few cities or towns. Many of these losses are likely due to land conversions to orchards and rice or row crops that should be regulated by the Clean Water Act but that are proceeding illegally without the necessary 404 permit from the Corps (Witham et al. 2014; Witham 2021). The largest urban center is the City of Chico, and unlike the rest of the region, the Chico and Doe Mill Core Areas have experienced significant losses of vernal pool habitat to urban development (**Table 7.2**).

As of 2018, roughly 43,718 acres of vernal pool grassland was estimated to be protected in this region, or immediately adjacent to it, typically under a conservation easement (see **Figure 7.1**, **Figure 7.2**, **Table 7.1**; Witham 2021; Vollmar et al. 2017). This represents approximately 33.2% of the currently remaining vernal pool grassland in the region and 32.5% of the vernal pool

grassland that existed in the region in 2005, the Recovery Plan's baseline. However, Vollmar et al.'s (2017) did not include the 4,273-acre easement on the Lowe property that protects an additional 2,836 acres of vernal pool grassland. Thus, a total of 46,554 acres of vernal pool grassland is protected, representing 35.4% of the currently remaining vernal pool grassland and 34.6% of the 2005 baseline.

7.2. Species Occurrences

7.2.1. Vernal Pool Fairy Shrimp

There are 59 occurrence records of the vernal pool fairy shrimp documented within, or immediately adjacent to, the Northeastern Sacramento Valley Vernal Pool Region in the Diversity Database (see **Figure 7.3**; Diversity Database 2022). These occurrences are found on land owned by a variety of private or public entities. Of these 59 occurrences, 1 is listed by the Diversity Database as extirpated; all other occurrences are listed as presumed extant and either occur within extant vernal pool habitat based on Witham's (2021) mapping efforts (52 occurrences) or outside of mapped vernal pool habitat (6 occurrences). It is likely that some of these occurrences are no longer extant, but have not been surveyed recently.

The protected areas contain, at least partially, 29 of the 59 Diversity Database records (49%) for the vernal pool fairy shrimp in this region. However, this does not mean that 49% of all occurrences of the vernal pool fairy shrimp, as the Diversity Database is not an appropriate source for determining all known occurrences (individual Diversity Database records are not necessarily equivalent to occurrences, and some known occurrences may not be documented in the Diversity Database). Only 12 of the 59 Diversity Database polygons (20%) are entirely within the protected areas, although the true number is likely closer to 25. The difference between the number of records partially and entirely within the mapped protected areas is likely a reflection of the irregular size and shape of polygons in the Diversity Database, as well as slight discrepancies in the overlap between the two databases.

7.2.2. Vernal Pool Tadpole Shrimp

There are 61 occurrence records of the vernal pool tadpole shrimp documented within, or immediately adjacent to, the Northeastern Sacramento Valley Vernal Pool Region in the Diversity Database (see **Figure 7.4**; Diversity Database 2022). These occurrences are found on land owned by a variety of private or public entities. All occurrences are presumed extant by the Diversity Database; 51 occur within extant vernal pool grassland, 1 within extirpated vernal pool grassland, and 9 outside of mapped vernal pool grassland (Witham 2021). It is likely that some of these occurrences are no longer extant, but have not been surveyed recently.

The protected areas contain, at least partially, 38 of the 61 Diversity Database records (62%) for the vernal pool tadpole shrimp in this region. Only 16 of the 61 Diversity Database polygons (26%) are entirely within the protected areas; the difference between the number of records partially and entirely within the mapped protected areas is likely a reflection of the irregular size and shape of polygons in the Diversity Database, as well as slight discrepancies in the overlap between the two databases.

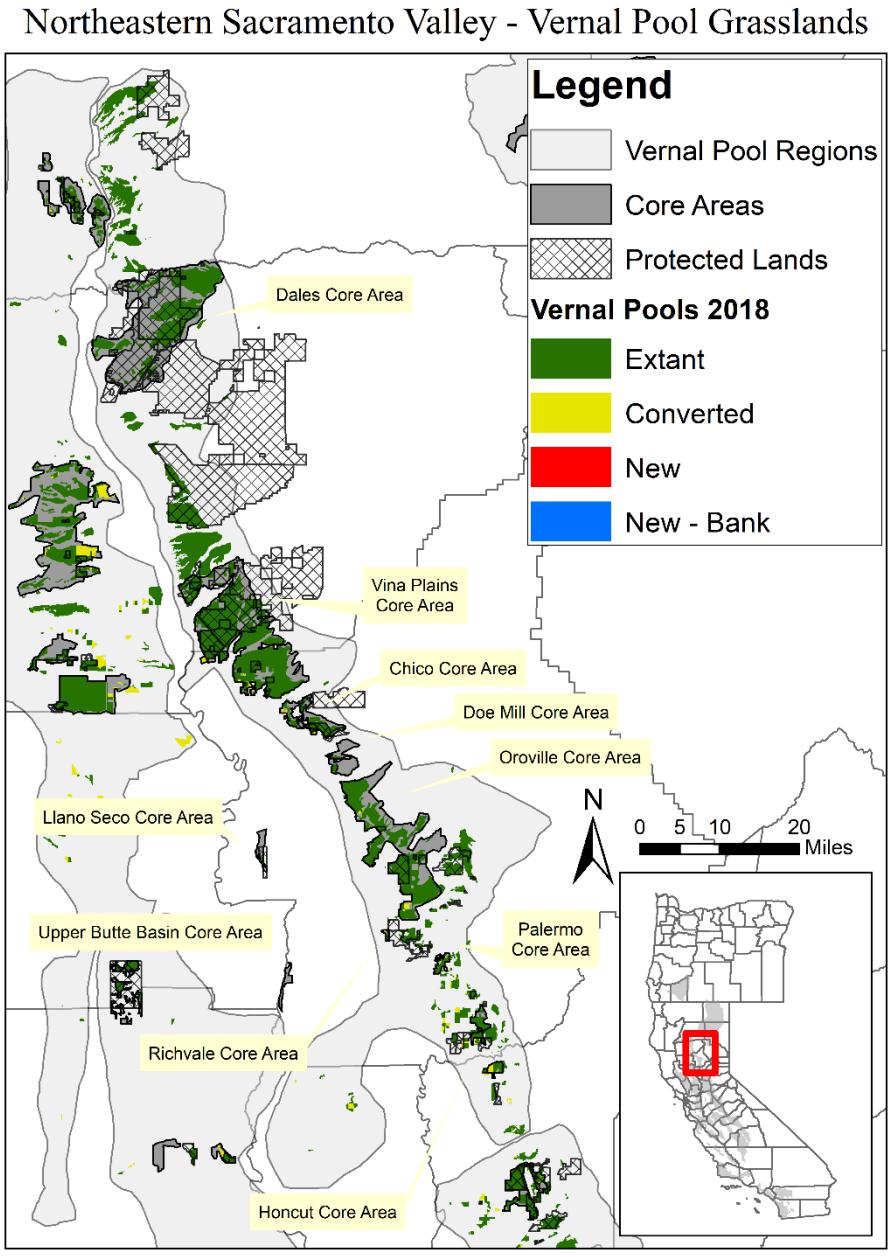

Figure 7.1. Map of vernal pool habitat within the Northeastern Sacramento Valley Vernal Pool Region mapped by Witham (2021) created using aerial imagery from 2018 compared to 2005 and 2012. "New" vernal pool habitat refers to areas not seen in the 2005 or 2012 aerial imagery (either missed or restored). "New - bank" refers to newly created vernal pool habitat on mitigation lands. Converted habitat refers to vernal pool habitat that was seen in 2005 or 2012 aerial imagery and by 2018 was converted to other land uses. Modified habitat as described by Witham (2021) was altered but still provides suitable vernal pool habitat (e.g., mitigation banks, lands managed for waterfowl), and so is mapped as extant. Zoom in for finer resolution.

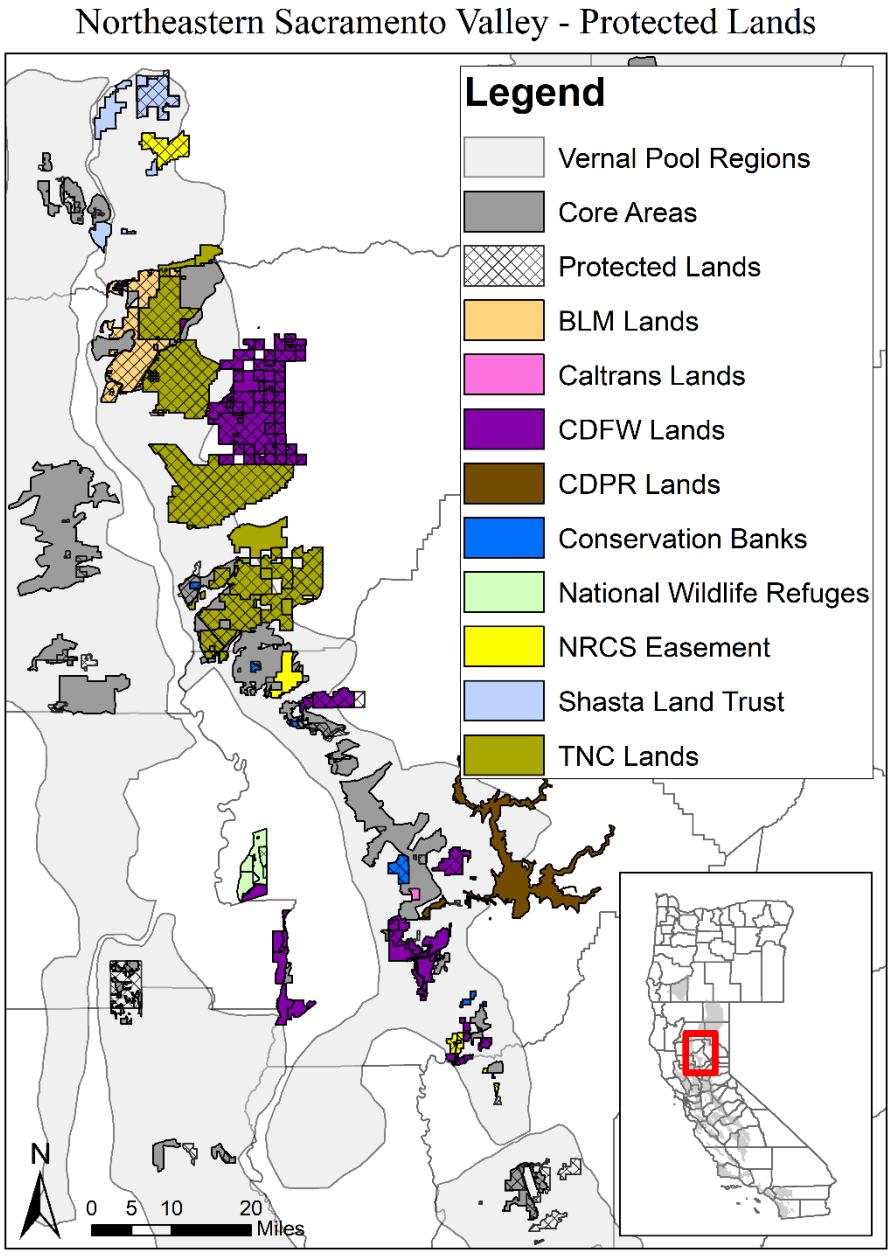

Figure 7.2. Map of protected areas that contain vernal pool grassland habitat and/or the three shrimp species within the Northeastern Sacramento Valley Vernal Pool Region**.** Protected lands are based on Vollmar et al. (2017) and include various preserves. The suspended Shauna Downs Mitigation Bank is not pictured. Zoom in for finer resolution. BLM = Bureau of Land Management, CDFW = California Department of Fish and Wildlife, CDPR = California Department of Parks and Recreation, NRCS = Natural Resources Conservation Service, TNC = The Nature Conservancy.

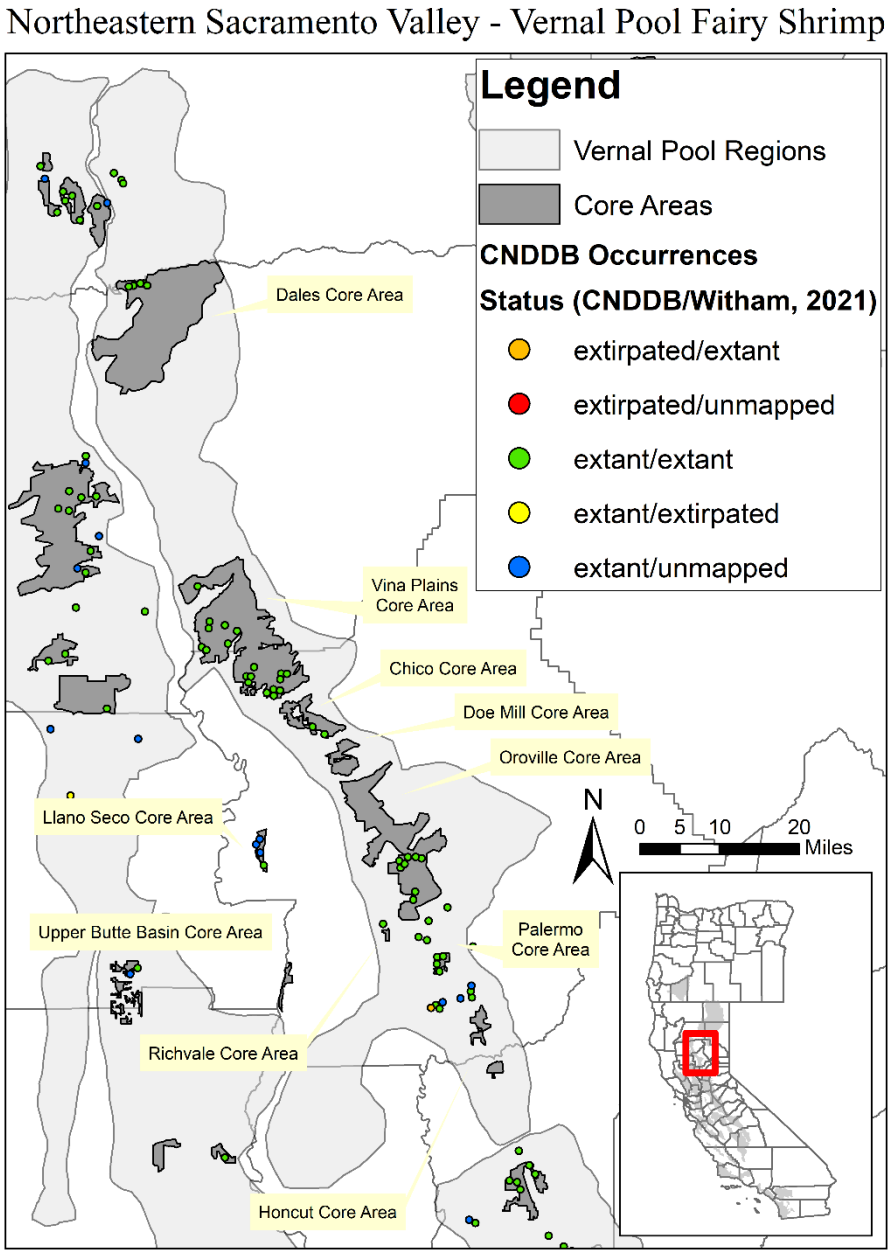

Figure 7.3. Map of known occurrences of vernal pool fairy shrimp recorded in the Diversity Database (2022) in the Northeastern Sacramento Valley Vernal Pool Region. Points may represent individual pools, multiple pools, whole properties, or entire vernal pool grassland complexes. Occurrences are color coded as extant or extirpated based on both Diversity Database occurrence records and Witham's (2021) map of vernal pool habitat. All 10 core areas in the region are displayed, though not all core areas are designated for the vernal pool fairy shrimp.

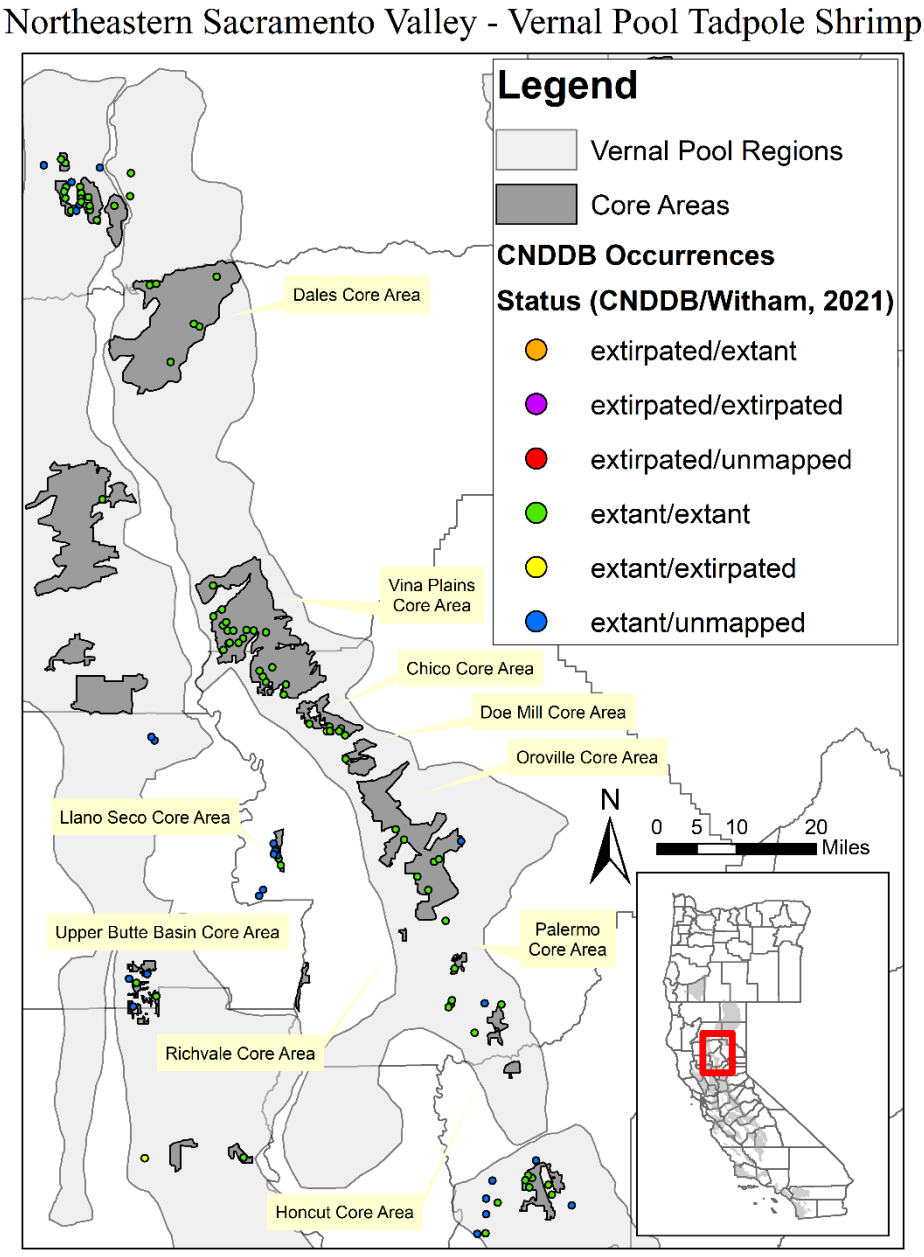

Figure 7.4. Map of known occurrences of vernal pool tadpole shrimp recorded in the Diversity Database (2022) in the Northeastern Sacramento Valley Vernal Pool Region. Points may represent individual pools, multiple pools, whole properties, or entire vernal pool grassland complexes. Occurrences are color coded as extant or extirpated based on both Diversity Database occurrence records and Witham's (2021) map of vernal pool habitat. All 10 core areas in the region are displayed, though not all core areas are designated for the vernal pool tadpole shrimp.

Table 7.1. Acreage of vernal pool habitat and habitat converted within the Northeastern Sacramento Valley Vernal Pool Region mapped by Witham (2021). All habitat labeled as not converted, altered, or new was considered extant. Protected acreage is based on Vollmar et al. (2017).

Core Area	2005 Acres	2018 Acres Total	2018 Acres Extant (% of Total)	2018 Acres Converted – Agriculture (% of Total)	2018 Acres Converted – Urban Development (% of Total)	2018 Acres Protected (% of Total)
Chico	3,153.8	3,153.8	2,933.3 (93.0%)	47.7 (1.5%)	172.9 (5.5%)	1,498.5 (47.5%)
Dales	19,161.2	19,161.2	19,161.2 (100.0%)	0.0 (0.0%)	0.0 (0.0%)	10,718.0 (55.9%)
Doe Mill	444.6	444.6	444.6 (100.0%)	0.0 (0.0%)	0.0 (0.0%)	35.5 (8.0%)
Llano Seco	0.0	107.2	107.2 (100.0%)	0.0 (0.0%)	0.0 (0.0%)	107.2 (100.0%)
Oroville	19,576.0	19,576.0	19,209.8 (98.1%)	334.7 (1.7%)	31.5 (0.2%)	2,799.3 (14.3%)
Palermo	841.1	841.1	648.6 (77.1%)	192.5 (22.9%)	0.0 (0.0%)	0.0 (0.0%)
Richvale	151.2	151.2	113.9 (75.4%)	37.3 (24.6%)	0.0 (0.0%)	18.5 (12.2%)
Vina Plains	34,594.1	34,594.1	34,134.9 (98.7%)	451.1 (1.3%)	8.0 (<0.1%)	16,196.5 (46.8%)
Northeastern Sacramento Valley Vernal Pool Region Total	**134,478.2**	**134,586.1**	**131,460.5 (97.7%)**	**2,802.9 (2.1%)**	**280.0 (0.2%)**	**43,717.5 (32.5%)**

Table 7.2. Acreage of vernal pool habitat losses within the Northeastern Sacramento Valley Vernal Pool Region between 2005 and 2018 mapped by Witham (2021), broken down by what the land use was converted to. All categories besides urban development and managed wetlands are considered agricultural conversions.

Core Area	Urban, Commercial, & Industrial	Orchards, Vineyards, Eucalyptus	Alfalfa and Irrigated Pasture	Bare Plowed Agricultural Lands	Other Ag (Rice, Row Crops, Dairy,	Agricultural Residential	Managed Wetlands	Total Losses	% Losses Urban Development	% Losses Agricultural Conversions
Chico	172.9	47.7	0.0	0.0	0.0	0.0	0.0	220.5	78.4%	21.6%
Dales	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	N/A	N/A
Doe Mill	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	N/A	N/A
Llano Seco	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	N/A	N/A
Oroville	31.5	194.1	0.0	0.0	121.0	19.7	0.0	366.2	8.6%	91.4%
Palermo	0.0	164.4	0.0	4.7	12.6	10.8	0.0	192.5	0.0%	100.0%
Richvale	0.0	0.0	0.0	37.3	0.0	0.0	0.0	37.3	0.0%	100.0%
Vina Plains	8.0	196.8	2.9	201.3	0.0	50.2	0.0	459.1	1.7%	98.3%
Northeastern Sacramento Valley Vernal Pool Region Total	**280.0**	**861.3**	**3.3**	**1124.3**	**634.0**	**180.0**	**42.6**	**3,125.6**	**9.0%**	**89.7%**

7.2.3. Conservancy Fairy Shrimp

There are 13 occurrence records of the Conservancy fairy shrimp documented within the Northeastern Sacramento Valley Vernal Pool Region in the Diversity Database (Diversity Database 2022). These occurrences are all considered part of the Vina Plains population and are within the Vina Plains Core Area. All are presumed extant by the Diversity Database and are within extant vernal pool grasslands (Witham 2021). See the Vina Plains Core Area section for more details.

7.3. Federal Lands

7.3.1. National Wildlife Refuges

Within the Northeastern Sacramento Valley Vernal Pool Region, the vernal pool fairy shrimp and vernal pool tadpole shrimp are known to occur on the North Central Valley Wildlife Management Area, which is part of the Sacramento National Wildlife Refuge Complex (**Figure 7.2**). There are no National Wildlife Refuges with known occurrences of the Conservancy fairy shrimp within this region.

The primary purpose of the Refuge Complex is to maintain managed wetlands that support habitat for birds on the Pacific Flyway, but there are also many other habitats such as vernal pool grasslands throughout the complex given that they are some of the last large areas of undeveloped lands in an otherwise agricultural landscape. A Comprehensive Conservation Plan was prepared for the North Central Valley Wildlife Management Area, and two other wildlife management areas, in 2019 that included the vernal pool fairy shrimp and vernal pool tadpole shrimp (Service 2020c).

There are approximately 404 acres of vernal pool grassland, including 13 acres of vernal pools, on the Service-owned Llano Seco Unit of the Wildlife Management Area (not to be confused with the surrounding CDFW-owned “Llano Seco Unit” of the Upper Butte Basin Wildlife Area or the privately-owned “Llano Seco Ranch” which has a Service-held conservation easement on it) (Service 2020c). The vernal pools occur primarily within Sanctuary II (the eastern unit of the Llano Seco Unit); the western half of Sanctuary II has grasslands with vernal pools, while the eastern half contains seasonal wetlands that are managed for migratory birds. The Comprehensive Conservation Plan includes a variety of goals and management strategies related to enhancing and managing the vernal pool grasslands, including vegetation management, population monitoring, and research (Service 2020c). Information about the vernal pools from past survey efforts, in conjunction with basic soil inventory data, was used to restore vernal pool topography and hydrology at Llano Seco Unit, Sanctuary II, Tract 17 (Service 2020c). Vernal pools also occur on the Llano Seco Ranch conservation easement. Sanctuary II of the Llano Seco Unit is mostly within the Llano Seco Core Area, and the adjacent Llano Seco Ranch conservation easement is also partly within the Llano Seco Core Area.

Based on 11 years of survey data collected between 1993 and 2017, the vernal pool fairy shrimp was observed once in 1 of the 15 vernal pools within Sanctuary II of the Llano Seco Unit in 1994 and once in a restored vernal pool within Tract 17 in 2017 (Helm Biological Consulting 2017; M. D’Errico, Service, *in litt*. 2022). Based on that same survey data, the vernal pool tadpole

shrimp was observed once in 1 of the 15 vernal pools within Sanctuary II of the Llano Seco Unit in 1994, once in a restored vernal pool within Tract 17 in 2015, and three times in a different restored vernal pool within Tract 17 in 2013, 2015, and 2017 (Helm Biological Consulting 2017; M. D'Errico, Service, *in litt*. 2022). There are also two vernal pool fairy shrimp Diversity Database records on the adjacent North Slough Pasture of the Llano Seco Ranch conservation easement area, one from 1994 and one from 2004 .There are also four vernal pool tadpole shrimp Diversity Database records on the adjacent North Slough Pasture of the Llano Seco Ranch conservation easement area and two records on the southwestern portion of the Llano Seco Rancho conservation easement area that have all been observed multiple times between 1993 and 2010 (Diversity Database 2022). The Llano Seco Ranch conservation easement has not been surveyed for the three shrimp species since 2004 (D'Errico, *in litt*. 2022).

7.3.2. Military Lands

There are no military lands with known occurrences of the three shrimp species within the Northeastern Sacramento Valley Vernal Pool Region.

7.3.3. Bureau of Land Management

The Bureau of Land Management's (BLM) Sacramento River Bend area is located on the east side of the Sacramento River north of the City of Red Bluff within the Dales Core Area (**Figure 7.2**). BLM recently completed a multi-year effort to survey and map all vernal pools within the Sacramento River Bend area. There were 149 pools throughout the Sacramento River Bend area, 9 of which were occupied by the vernal pool fairy shrimp (BLM 2017b; BLM 2018; BLM 2019b). All nine of these pools were near the Spring Branch Road target shooting area adjacent to Battle Creek, and seven of the nine pools were classified as artificially created stock ponds and not natural vernal pools. Within the same 149 pools, 8 were occupied by the vernal pool tadpole shrimp (BLM 2017b; BLM 2018; BLM 2019b). Six of the eight pools were near the Spring Branch Road target shooting area adjacent to Battle Creek and were classified as artificially created stock ponds and not natural vernal pools. The other two were in the Hog Lake and Nordic Quarry areas to the southeast and were classified as modified ponds/vernal pools. There is no vernal pool management plan for the Sacramento River Bend area, though the BLM's Redding Field Office, which covers Butte, Tehama, Shasta, Trinity, and Siskiyou Counties, is currently revising its Resource Management Plan, which mentions vernal pools as an important resource that needs protection (S. Laymon, BLM, *in litt*. 2022).

There are several other small parcels of BLM land, likely grazing allotments, throughout this Vernal Pool Region that have vernal pool grasslands mapped within them (Witham 2021), but there are no known occurrences of the vernal pool fairy shrimp or the vernal pool tadpole shrimp within them (Diversity Database 2022).

There are no BLM lands with known occurrences of the Conservancy fairy shrimp within the Northeastern Sacramento Valley Vernal Pool Region.

7.3.4. Other Federal Lands

There are no other federal lands with known occurrences of the three shrimp species within the Northeastern Sacramento Valley Vernal Pool Region.

7.4. Conservation Banks

There are five conservation or mitigation banks within the Northeastern Sacramento Valley Vernal Pool Region that provide credits for preserved and/or created vernal pools that support the vernal pool fairy shrimp and vernal pool tadpole shrimp: Daley Ranch Vernal Pool Conservation Bank, Dove Ridge, Hamilton Ranch, Meridian Ranch, and Shauna Downs (see **Figure 7.2**; RIBITS 2021), though Shauna Downs has been suspended. These banks protect a total of 4,204 acres of land, including 434.9 acres and 424.9 acres of preserved vernal pools for the vernal pool fairy shrimp and vernal pool tadpole shrimp, respectively, and 31.3 acres of created vernal pools for both shrimp species (Table 6 shows 639.2 and 329.2 preservation credits for the vernal pool fairy shrimp and vernal pool tadpole shrimp, respectively, because Dove Ridge Conservation Bank received 2 credits for every 1 acre of preserved habitat). This region has the third largest number of preservation credits and total acreage of banks, and it is one of only three regions that has creation credits for the vernal pool fairy shrimp and vernal pool tadpole shrimp, though other regions may have artificial vernal pools created outside of banks. The five banks have sold a total of 209.39 preservation credits (33% and 49%, respectively), representing 130.18 acres, and 23.96 acres (76% and 76%, respectively) of creation credits for the vernal pool fairy shrimp and vernal pool tadpole shrimp (RIBITS 2021). None of the 31.03 preservation credits for the vernal pool fairy shrimp or the 20.98 preservation credits for the vernal pool tadpole shrimp were sold at the suspended Shauna Downs Mitigation Bank. There is also one proposed bank within this region, the Sycamore Creek Conservation Bank, which may be approved within the next year (**Figure 7.2**).

One of these conservation banks also provides credits for preserved vernal pools that support the Conservancy fairy shrimp: Hamilton Ranch (RIBITS 2021). This bank protects a total of 394 acres of land, including 20.37 acres of preserved vernal pools for the Conservancy fairy shrimp. The Conservancy fairy shrimp was observed on the site in three large vernal pools, known as the Laniger Lakes, in 2003 (Diversity Database 2022) and was most recently observed during regular bank monitoring in 2020 within 2 of the 22 pools that ponded water (Gallaway Enterprises 2020).

The Meridian Ranch Mitigation Bank also supports the Conservancy fairy shrimp, though it does not sell any preservation or creation credits for the species. This bank is 530 acres and contains 55.51 acres of preserved vernal pools and 31.34 acres of created/restored vernal pools for the vernal pool fairy shrimp and vernal pool tadpole shrimp (RIBITS 2021). The Conservancy fairy shrimp has been found in three restored pools on the bank and was observed during surveys in 2012, 2015, and 2016, but not in 2018 (Westervelt Ecological Services 2019a). It was also observed on the adjacent Meridian Preserve mitigation site (a.k.a., Palermo Vernal Pool Restoration Project) in 2009, 2011, 2013, and 2016, but not in 2018 (Westervelt Ecological Services 2019a).

7.5. Habitat Conservation Plans

There is one regional Habitat Conservation Plan (HCP) within the Northeastern Sacramento Valley Vernal Pool Region that includes all three shrimp species as Covered Species.

7.5.1. PG&E Multiple Region Operations and Maintenance HCP

See section 2.5.1 for a description of this HCP.

7.6. Other Preserves

The California Department of Water Resources (DWR) operates the Oroville and Thermalito Dams along the Feather River and owns much of the surrounding lands. The Service issued a biological opinion on the proposed issuance of a Federal Energy Regulatory Commission (FERC) license to DWR for the Oroville facilities on April 9, 2007 (Service 2007b). This biological opinion documented the environmental baseline within the FERC boundary as 72.3 wetted acres of vernal pools and swales, and it stated that take would not exceed 9.5 acres of vernal pools prior to the end of the 50-year FERC license term. CDFW manages the Oroville Wildlife Area, which consists of the Thermalito Afterbay and adjacent portions of the Feather River, and the Thermalito Forebay is within the Lake Oroville State Recreation Area managed by California Department of Parks and Recreation (CDPR). The Oroville Wildlife Area is immediately adjacent to the Oroville, Richvale, and Palermo Core Areas. Most of the vernal pools within the FERC boundary are within Oroville Wildlife Area, but there are some vernal pools outside of the Wildlife Area around Thermalito Forebay as well (R. Carter-Ervin, DWR, *in litt*. 2022). DWR monitors all vernal pools within the FERC boundary to ensure compliance with the biological opinion, but they do not survey for shrimp species; however, pools are occasionally inspected visually, and DWR staff recall seeing vernal pool tadpole shrimp in some pools within the past 10 years (R. Carter-Ervin and K. Moncrief, DWR, pers. comm. 2022). There are nine Diversity Database occurrences of the vernal pool fairy shrimp and two Diversity Database occurrences of the vernal pool tadpole shrimp immediately outside of the FERC boundary. Recent management activities included controlled burns for invasive grasses, but no grazing or other weed management is currently being implemented (Carter-Ervin and Moncrief, pers. comm. 2022).

In addition to the Lake Oroville State Recreation Area, the vernal pool fairy shrimp is also known to occur on CDPR land within the Clay Pit State Vehicular Recreation Area. CDPR is currently preparing a Wildlife Habitat Protection Plan for this area, which includes monitoring for vernal pool fairy shrimp (CDPR 2022a). There are approximately 26 acres of vernal pools within Clay Pit, and despite the disturbance to the pools from off-road vehicles the vernal pool fairy shrimp has consistently been documented within the pools (CDPR 2022a). Potential habitat for the vernal pool tadpole shrimp is also known to occur within the Clay Pit State Vehicular Recreation Area, with the nearest known occurrence of the vernal pool tadpole shrimp is 1.5 miles north.

In addition to the Oroville Wildlife Area, CDFW owns five other preserved areas within this Vernal Pool Region with vernal pool habitat: Dales Lake Ecological Reserve, North Table Mountain Ecological Reserve, Stone Ridge Ecological Reserve, Battle Creek Wildlife Area, Tehama Wildlife Area, and Upper Butte Basin Wildlife Area. CDFW also holds conservation easements on properties around Musty Buck Ridge, Honcut Creek, and Wyandott Creek. The vernal pool fairy shrimp is not known to occur on any of these properties, though it has a high potential to occur on the Dales Lake Ecological Reserve and the Upper Butte Basin Wildlife

Area. The vernal pool tadpole shrimp is only known to occur on the Dales Lake Ecological Reserve, though it has a high potential to occur on the Upper Butte Basin Wildlife Area as well.

The Dales Lake Ecological Reserve is 367 acres located east of BLM's Sacramento River Bend Area and the Inks Creek Ranch. The Ecological Reserve consists of the 17-acre Dales Lake, three sets of constructed vernal pools, and an artificial "pool" which is an old borrow pit (R. Lis, CDFW, *in litt*. 2023). The entire Reserve was mapped as vernal pool grassland habitat by Witham's (2021) mapping efforts. The vernal pool fairy shrimp has never been documented within the Ecological Reserve; however, the vernal pool tadpole shrimp has been observed in all five of these aquatic features in the past, as well as the California fairy shrimp (*Linderiella occidentalis*) (Diversity Database 2022; Lis, *in litt*. 2023). More recently, Dales Lake and the borrow pit consistently fill with water for long enough to support the vernal pool tadpole shrimp's lifecycle, but only a few of the created pools do. However, vernal pool tadpole shrimp carapaces were observed along the edge of one created pool in 2021 and 2022, so some of the created pools may still support the species (Lis, *in litt*. 2023). The nearest known occurrence of the vernal pool fairy shrimp is 6 miles to the northwest in BLM's Sacramento River Bend area (Diversity Database 2022). There is no management plan for the Ecological Reserve (Lis, *in litt*. 2023).

The Upper Butte Basin Wildlife Area totals 9,597 acres along Upper Butte Creek east of the Sacramento River in Butte and Glenn Counties and is divided into three management units: Llano Seco, Howard Slough, and Little Dry Creek (ESA Associates 2013). Vernal pools only occur in field 312 of the Llano Seco Unit (ESA Associates 2013), which is immediately south of the Service's Llano Seco Unit of the North Central Valley Wildlife Management Area, though this habitat was not captured by Witham's (2021) mapping efforts. Surveys for the vernal pool fairy shrimp and vernal pool tadpole shrimp have not been conducted, but both species are known from the adjacent pools on the Service's Llano Seco Unit. The management plan for Upper Butte Basin Wildlife Area includes maintaining, enhancing, and/or restoring vernal pools, using appropriate management techniques for vernal pools such as grazing or controlled burns, and surveying for vernal pool shrimp species (ESA Associates 2013). The Little Dry Creek Unit is the only unit that is actually within the boundaries of the Northeastern Sacramento Valley Vernal Pool Region delineated by the Recovery Plan, as well as the Upper Butte Basin Core Area, but neither the management plan nor Witham's (2021) mapping efforts identified any vernal pool habitat within the Little Dry Creek Unit.

The North Table Mountain Ecological Reserve is 3,315 acres located north of the city of Oroville and has a management plan with the primary purpose of preserving the Northern Basalt Flow Vernal Pool habitat type and sensitive species (ESA Associates 2007). Witham (2021) mapped 2,188 acres of vernal pool grasslands within the Ecological Reserve, though the management plan states that vernal pools are restricted to the Cherotable-Kramn soil complex that covers 407 acres on the top of North Table Mountain (ESA 2007).

The Stone Ridge Ecological Reserve is 754 acres located east of the Chico Airport. About half of the Ecological Reserve is mapped as vernal pool grassland by Witham (2021) and a total of 6.6 acres of vernal pools and swales occur on the property (M. Stanfield, CDFW, *in litt*. 2022), though some do occur on the eastern half of the property that Witham (2021) did not map vernal pool grassland. A draft management plan states that there is potential for the vernal pool fairy

shrimp and the vernal pool tadpole shrimp to occur on the Ecological Reserve (Stanfield, *in litt*. 2022). However, surveys in January 2023 did not find the vernal pool fairy shrimp or the vernal pool tadpole shrimp; despite a large amount of rain, there were only five features onsite that had ponded, leading the CDFW biologist to speculate that the Ecological Reserve may be too steeply sloped to support appropriate hydrology for the vernal pool fairy shrimp or the vernal pool tadpole shrimp (M. Stanfield, CDFW, *in litt*. 2023). The Ecological Reserve is adjacent to the 3,885-acre Musty Buck Ridge property which has a conservation easement held by CDFW (Stanfield, *in litt*. 2022), though only a very small amount of the western edge of this property is estimated to contain vernal pool habitat (Witham 2021).

The Battle Creek Wildlife Area is 582 acres located adjacent to the north side of BLM's Sacramento River Bend Area. Only a small amount of vernal pool habitat is estimated to occur there (Witham 2021), but it is adjacent to the vernal pools occupied by the vernal pool fairy shrimp and the vernal pool tadpole shrimp in the Sacramento River Bend Area. The vernal pools occur on the bluff overlooking Battle Creek, but these pools are quite shallow, barely support vernal pool flora, and have not contained the vernal pool fairy shrimp or vernal pool tadpole shrimp when surveyed by CDFW in the past (Lis, *in litt*. 2023).

The Tehama Wildlife Area is 44,500 acres located between the Sacramento River Bend Area and Lassen National Forest. Again, only a small area is estimated to contain vernal pool habitat (Witham 2021). The Honcut Creek and Wyandott Creek conservation easements are both made up of multiple parcels, with one parcel each that contains vernal pool grassland based on Witham's (2021) mapping efforts. The Honcut Creek easement protects 275 acres of extant vernal pool grassland, about half of which is within the Honcut Core Area, and the Wyandott Creek easement protects 80 acres of extant vernal pool grassland (Witham 2021).

The Nature Conservancy (TNC) owns the Vina Plains Preserve, manages the Dye Creek Preserve, and holds easements on Inks Creek Ranch, Battle Creek, Deer Creek, Mill Creek, and Vina Plains. The Vina Plains Preserve is 4,591 acres located on either side of Highway 99 at the Butte-Tehama County border within the Vina Plains Core Area. Almost the entirety of the preserve is mapped as vernal pool grassland by Witham (2021). There are two Diversity Database occurrences of the vernal pool fairy shrimp within the Preserve and four more which are on the border of the Preserve and may or may not extend into the Preserve (Diversity Database 2022). There are nine Diversity Database occurrences of the vernal pool tadpole shrimp partially or entirely within the Preserve (Diversity Database 2022). There are four Diversity Database occurrences of the Conservancy fairy shrimp within the Preserve and one more which is on the border of the Preserve and may or may not extend into the Preserve (Diversity Database 2022). The management plan for the site identifies grazing as the main management tool, and vernal pool shrimp surveys are planned to occur every five years (TNC 2020).

Northeast of the Vina Plains Preserve are two large conservation easements held by TNC: the 21,015-acre Vina Plains easement and the 25,629 Deer Creek easement. About half of the Vina Plains easement is vernal pool grassland and only a small part of the Deer Creek easement contains vernal pool grasslands (Witham 2021). There is one Diversity Database occurrence of the vernal pool fairy shrimp within the Vina Plains easement and two that border it, Six Diversity Database occurrences of the vernal pool tadpole shrimp partially or entirely within the Vina Plains easement, and one Diversity Database occurrence of the Conservancy fairy shrimp along

the border of the Vina Plains easement and the Vina Plains Preserve (Diversity Database 2022). There are no occurrences of the three shrimp species within the Deer Creek easement (Diversity Database 2022).

The Dye Creek Preserve is 37,540 acres located east of Highway 99 and south of CDFW's Tehama Wildlife Area. It is owned in trust by Exchange Bank, managed by TNC, and TNC reports to the State Controllers Office (A. Craig, TNC, pers. comm. 2022). Witham (2021) mapped an extensive area of presumed vernal pool grassland on the western side of the Preserve. The Preserve's management plan estimated only 10 wetted acres of vernal pools and swales, with much of the other mapped areas being only annual grassland (H.T. Harvey and Associates 2019b), but a focused survey effort in 2020-2021 found vernal pools throughout the entirety of the western side of the preserve (Kramer Botanical 2021), as predicted by Witham (2021). A total of 134 vernal pools were identified, 39 of which were natural and 95 of which were altered, primarily associated with canal levees and road berms (Kramer Botanical 2021). The vernal pool fairy shrimp is known to occur in the southern plains near Mill Creek and is presumed to occur in the vernal pool habitat throughout the western plains (H.T. Harvey and Associates 2019b; S. Wingo, Service, *in litt*. 2022). The vernal pool tadpole shrimp is not known to occur on the preserve, though it is possible as suitable habitat is present (H.T. Harvey and Associates 2019b). Grazing is used to manage the vernal pool grasslands, as well as occasional prescribed fires, and there is the potential for vernal pool restoration to occur on the southern plains (H.T. Harvey and Associates 2019b). The Mill Creek conservation easement borders the Dye Creek Preserve to the south, which is adjacent to the known vernal pool fairy shrimp occurrences on Dye Creek Preserve.

The 36,085-acre Inks Creek Ranch conservation easement is located east of BLM's Sacramento River Bend Area. Witham's (2021) mapping efforts estimated 6,951 acres of vernal pool grassland within the Inks Creek Ranch easement area. There are no known occurrences of the vernal pool fairy shrimp within this area, but the vernal pool tadpole shrimp is known from one pool near the border with the Dales Lake Ecological Reserve, and another occurrence is located just east of Hog Lake on BLM land, though it is unclear if this occurrence is on BLM land or on Inks Creek Ranch (Diversity Database 2022).

A 3,002-acre portion of the Battle Creek conservation easement is located northeast of the Sacramento River Bend Area (other portions are located further west, outside of the Vernal Pool Region). Witham's (2021) mapping efforts estimated 149 acres of vernal pool grassland within the Battle Creek easement area. There are no known occurrences of the three shrimp species within this area (Diversity Database 2022).

The California Department of Transportation (Caltrans) acquired and preserved the Cottonwood Creek Conservation Area north of the City of Oroville in 2008 as advanced mitigation to mitigate for future Caltrans projects with adverse effects to vernal pool species. The Butte County Resource Conservation District holds the conservation easement on the preserve. The preserve is 574 acres of vernal pool grassland complex, with 91.08 acres authorized as vernal pool preservation credits for the vernal pool fairy shrimp and vernal pool tadpole shrimp; to date, 34.86 acres of the preservation credits have been used by local Caltrans projects (Butte County Resource Conservation District 2020). The vernal pool fairy shrimp is known to occur

throughout the preserve and the vernal pool tadpole shrimp is known to occur in the northwest corner of the preserve (Diversity Database 2022).

The Shasta Land Trust holds conservation easements over five properties in this region that have vernal pool grasslands mapped by Witham (2021): Fenwood Ranch, Bear Creek Nature Preserve (a.k.a., Blue Oak Ranch), Rickert Brothers Ranch, Triple B Ranch, and Hathaway Ranch. The former three properties are verified by Shasta Land Trust to have vernal pool habitat onsite, while the latter two properties have wetland features, but not distinctively vernal pool habitat (T. Blevins, Shasta Land Trust, *in litt*. 2022). There are no specific management plans for these properties, and species monitoring is not typically conducted (Blevins, *in litt*. 2022). However, surveys were conducted at the Bear Creek Nature Preserve in 2018; the California fairy shrimp (*Linderiella occidentalis*) was identified within the four vernal pools onsite, but the vernal pool fairy shrimp and vernal pool tadpole shrimp were not (Blevins, *in litt*. 2022). These five properties total 14,637 acres in size, though most of the Fenwood Ranch property is within the Northwestern Sacramento Valley Vernal Pool Region. Only the Hathaway Ranch was included in Vollmar et al.'s (2017) database of protected lands; thus, an additional 1,864 acres of vernal pool habitat mapped by Witham (2021) is estimated to be protected in the Northeastern Sacramento Valley Vernal Pool Region within the other four properties.

In addition to the many protected areas described here, Vollmar et al. (2017) identified 16 other protected properties within the Northeastern Sacramento Valley Vernal Pool Region. The majority of these sites are private preserves that were protected as mitigation by landowners, likely as part of proposed conservation measures during Section 7 interagency consultations. There are also six properties that have a conservation easement held by the Natural Resources Conservation Service (NRCS) including the 4,273-acre Lowe property, one property owned by the California State University system, and one additional area that Vollmar et al. (2017) identify as having a TNC-held conservation easement despite not being included in TNC's GIS layer. All 16 of these protected properties may contain suitable habitat for the vernal pool fairy shrimp and vernal pool tadpole shrimp. Seven of these protected properties are within the Vina Plains Core Area and therefore may also contain suitable habitat for the Conservancy fairy shrimp.

7.7. Vernal Pool Core Areas

There are five Core Areas within the Northeastern Sacramento Valley Vernal Pool Region that are designated in the Recovery Plan for the vernal pool fairy shrimp: Chico, Doe Mill, Llano Seco, Oroville, Vina Plains. There are also three additional Core Areas that were not designated for the vernal pool fairy shrimp in the Recovery Plan, but that have known occurrences of the species in the Diversity Database: Dales, Palermo, and Richvale (Diversity Database 2022). For the Palermo Core Area, the vernal pool fairy shrimp was not identified until 2007, which is why this core area was not designated for the vernal pool fairy shrimp in the Recovery Plan. For the Dales and Richvale Core Areas, there was one Diversity Database occurrence per core area that was known prior to 2005, so the two core areas likely should have been designated for the vernal pool fairy shrimp in the Recovery Plan. One of the eight core areas has met the target of 85% of vernal pool habitat protected and two have lost more than 15% of the amount of vernal pool habitat that remained in 2005, making the 85% target unattainable without habitat creation or restoration (see **Table 7.1**; Vollmar et al. 2017; Witham 2021).

There are six Core Areas within the Northeastern Sacramento Valley Vernal Pool Region that are designated in the Recovery Plan for the vernal pool tadpole shrimp: Chico, Dales, Doe Mill, Llano Seco, Oroville, and Vina Plains. There is also one additional Core Area that was not designated for the vernal pool tadpole shrimp in the Recovery Plan, but that has known occurrences of the species in the Diversity Database: Palermo (Diversity Database 2022). For the Palermo Core Area, the vernal pool tadpole shrimp was not identified until 2008, which is why this core area was not designated for the vernal pool tadpole shrimp in the Recovery Plan. One of the eight core areas has met the target of vernal pool habitat protected (95% for zone 1) and one has lost more than 15% of the amount of vernal pool habitat that remained in 2005, making the target (85% for zone 2) unattainable without habitat creation or restoration (see **Table 7.1**; Vollmar et al. 2017; Witham 2021).

There is one Core Area within the Northeastern Sacramento Valley Vernal Pool Region that is designated in the Recovery Plan for the Conservancy fairy shrimp: Vina Plains. This core area has not yet met the target of 95% of vernal pool habitat protected, but as of 2018 it had only lost 1.3% of the baseline level of habitat that was present in 2005 (see **Table 7.1**; Vollmar et al. 2017; Witham 2021).

7.7.1. Chico

This is a zone 1 core area with a goal of protecting 85% of vernal pool habitat for the vernal pool fairy shrimp and 95% of vernal pool habitat for the vernal pool tadpole shrimp. The core area is located around the northeastern edge of the City of Chico in Butte County.

There were approximately 3,154 acres of vernal pool grassland within this core area when the Recovery Plan was published in 2005 (Witham et al. 2013). As of 2018, there were 2,933 acres of vernal pool grassland remaining, with 221 acres lost since 2005 (see **Figure 7.5**, **Table 7.1**; Witham 2021). Unlike most other habitat losses, the majority of habitat losses within this core area were due to urban development (172.9 acres, 78.4%), which makes sense given the urban setting of the core area (see **Table 7.2**; Witham 2021). All agricultural habitat losses (47.7 acres, 21.6%) were caused by conversion to orchards. Roughly 1,499 acres of vernal pool grassland were protected within this core area as of 2017 (Vollmar et al. 2017), representing 47.5% of the 2005 baseline.

The human population of Chico was 101,475 in 2020, growing 17.7% from 2010 to 2020 after having already grown by over 40% per decade for the three decades prior (U.S. Census Bureau 2022). Due to the Camp Fire wildfire from the nearby town of Paradise in 2018, Chico's population increased by 18,040 people (19.5%) from 2018 to 2019 alone (City of Chico 2022). Residential housing continues to be a need in Chico (City of Chico 2022), and therefore urbanization will likely continue to be a significant cause of habitat loss within this core area.

Protected areas within this core area include CDFW's Stone Ridge Ecological Reserve and several areas owned by the City of Chico, including the Sycamore Glen Wetland Preserve, which was preserved as mitigation for a section 7 consultation (**Figure 7.6**). The proposed Sycamore Creek Conservation Bank is also within this core area.

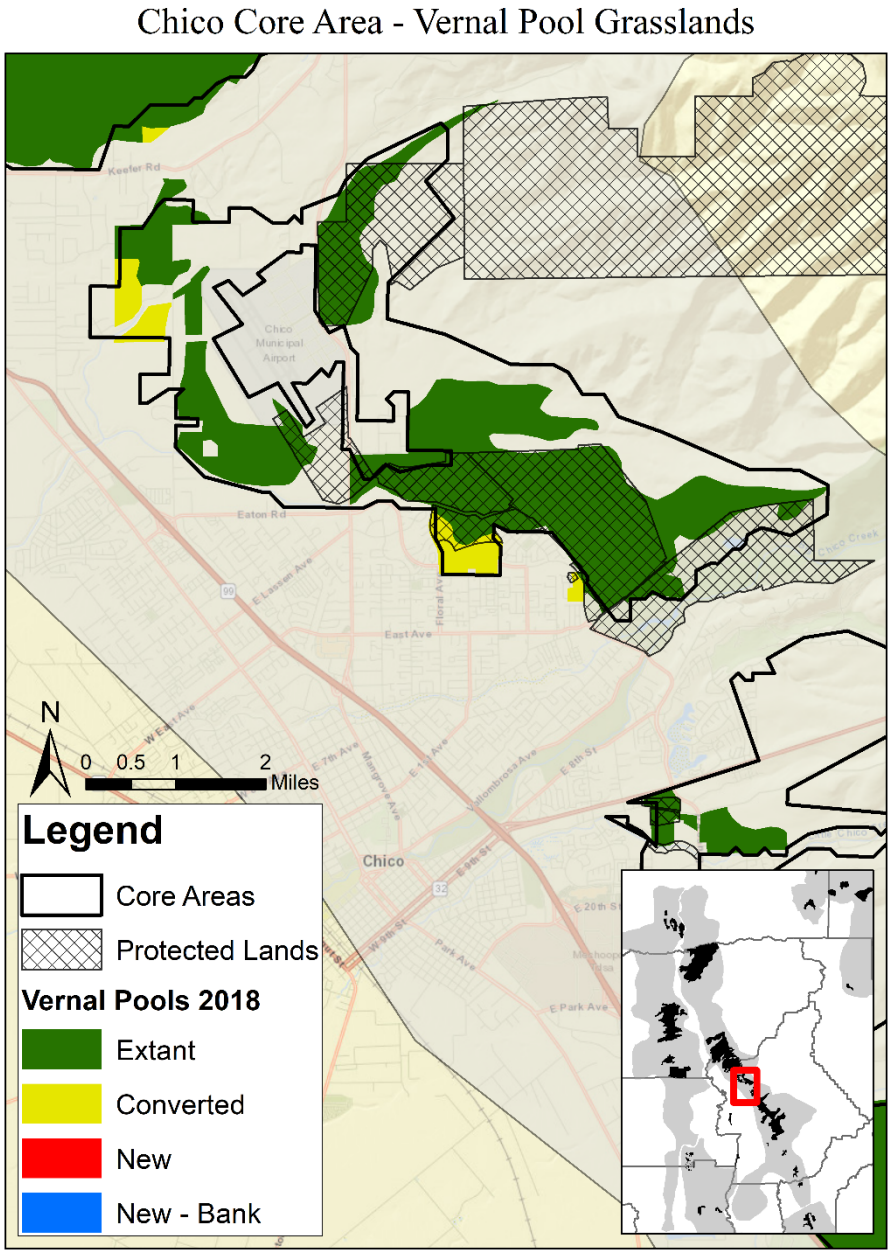

Figure 7.5. Map of vernal pool grassland habitat within the Chico Core Area mapped by Witham (2021) created using aerial imagery from 2018 compared to 2005 and 2012. "New" vernal pool habitat refers to areas not seen in the 2005 or 2012 aerial imagery (either missed or restored). "New - bank" refers to newly created vernal pool habitat on mitigation lands. Converted habitat refers to vernal pool habitat that was seen in 2005 or 2012 aerial imagery and by 2018 was converted to other land uses. Modified habitat as described by Witham (2021) was altered but still provides suitable vernal pool habitat (e.g., mitigation banks, lands managed for waterfowl), and so is mapped as extant. Zoom in for finer resolution.

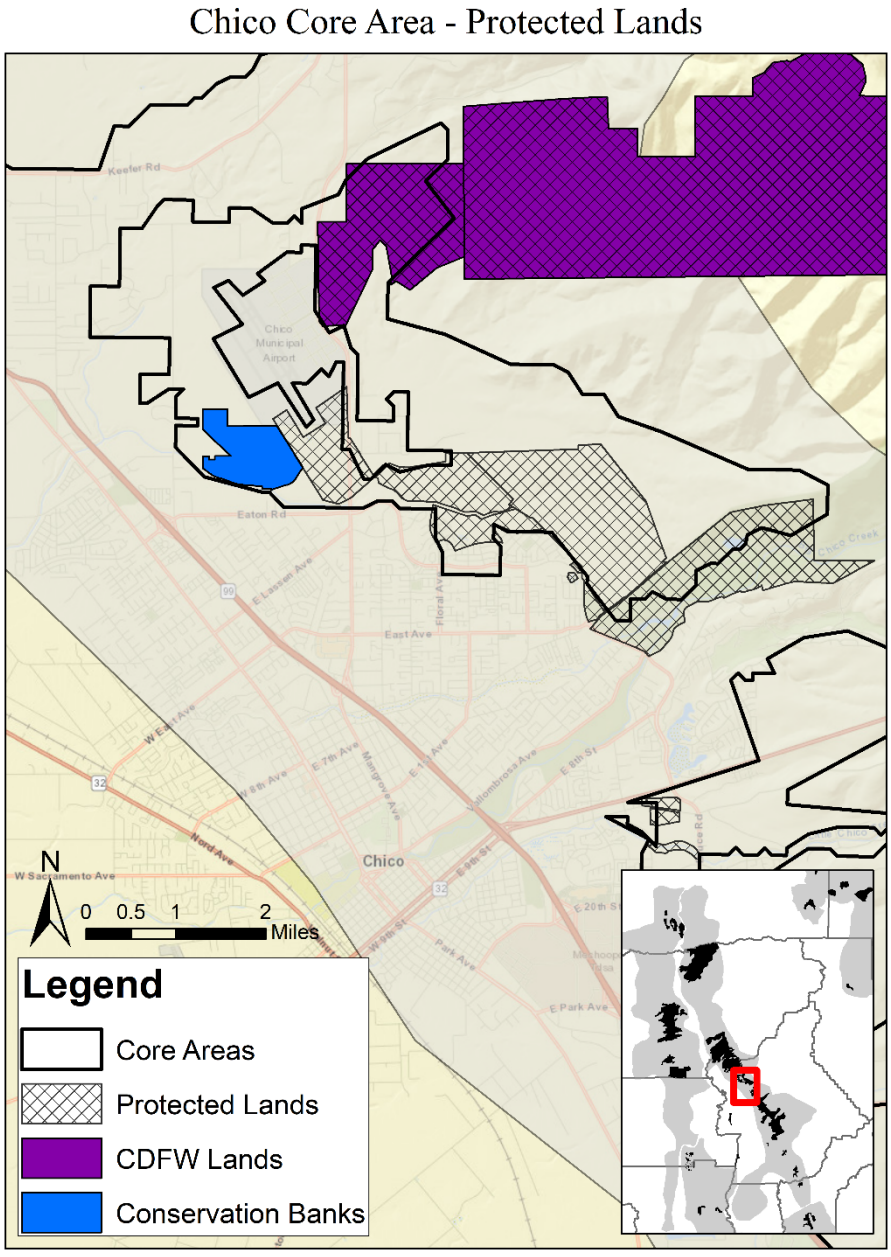

Figure 7.6. Map of protected areas within the Chico Core Area**.** Protected lands are based on Vollmar et al. (2017) and include various preserves. The conservation bank depicted is the proposed Sycamore Creek Conservation Bank, which has not yet been approved by the Service. CDFW = California Department of Fish and Wildlife.

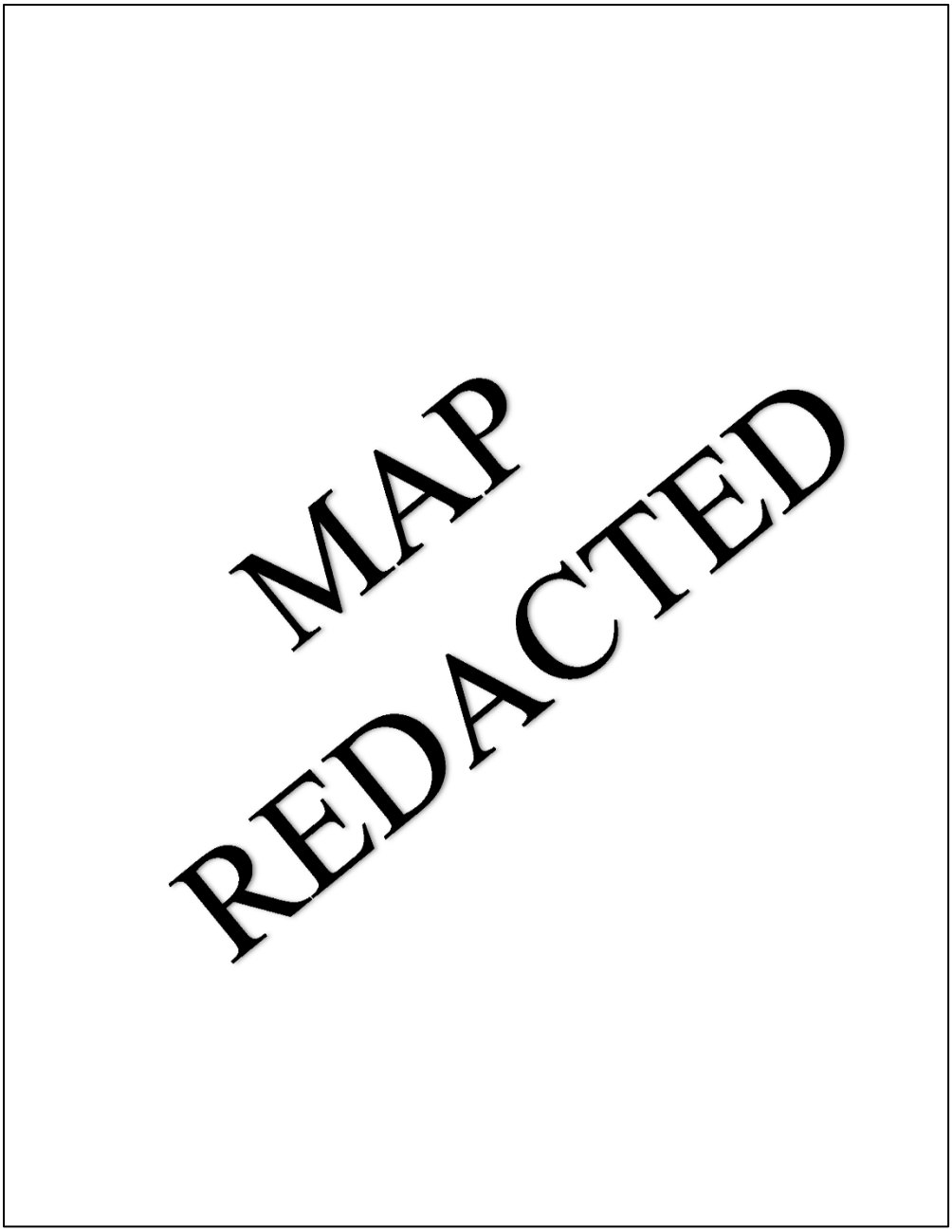

Figure 7.7. Map of known occurrences of vernal pool fairy shrimp recorded in the Diversity Database (2022) within the Chico Core Area. Polygons may represent individual pools, multiple pools, whole properties, or entire vernal pool grassland complexes. Occurrences are color coded as extant or extirpated based on both the Diversity Database and Witham's (2021) map of vernal pool habitat.

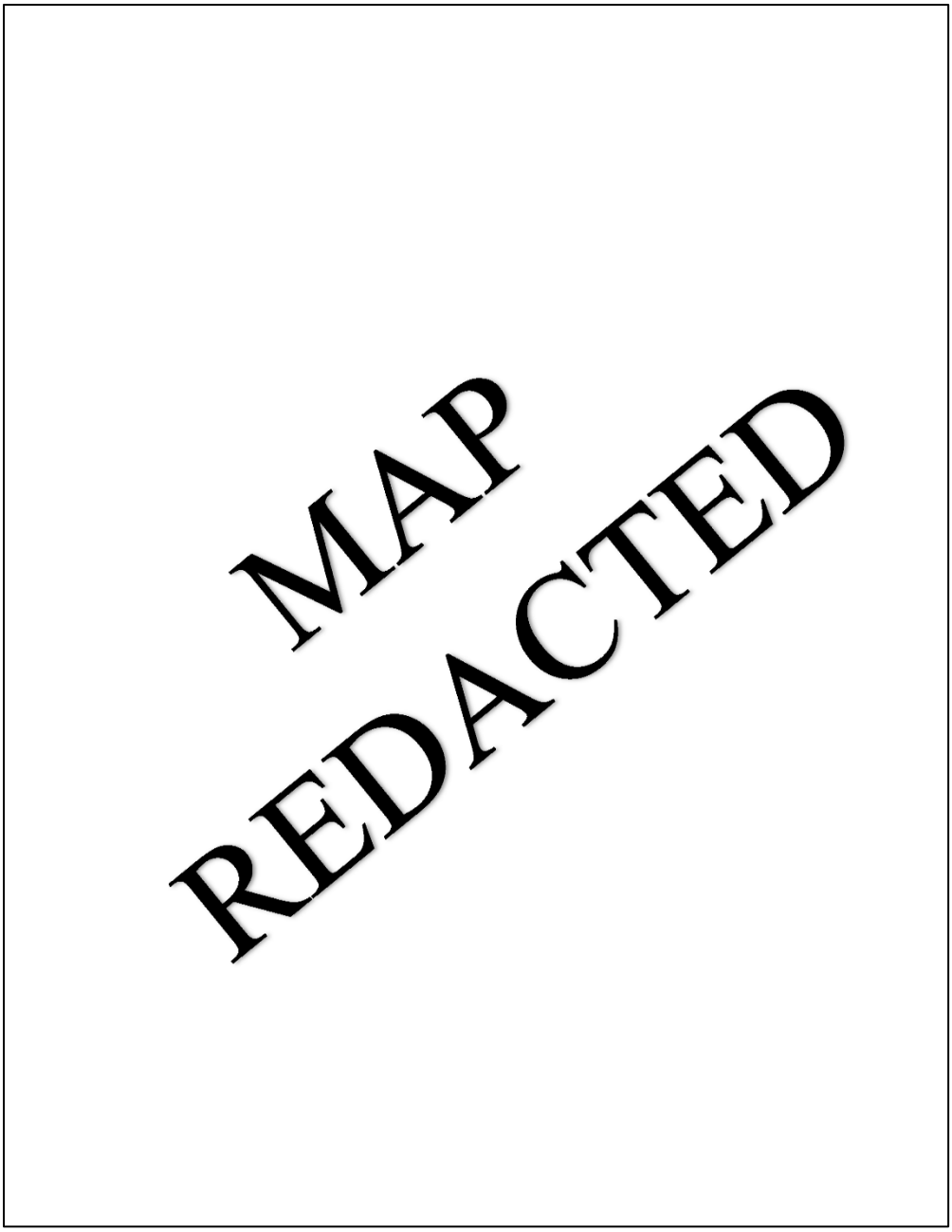

Figure 7.8. Map of known occurrences of vernal pool tadpole shrimp recorded in the Diversity Database (2022) within the Chico Core Area. Polygons may represent individual pools, multiple pools, whole properties, or entire vernal pool grassland complexes. Occurrences are color coded as extant or extirpated based on both the Diversity Database and Witham's (2021) map of vernal pool habitat.

7.7.1.1.Vernal Pool Fairy Shrimp Occurrences

There are two Diversity Database occurrence records for the vernal pool fairy shrimp within this core area (see **Figure 7.7**; Diversity Database 2022). As of 2018, both occurrences were entirely within protected areas (Vollmar et al. 2017); the Service's analysis classified the occurrences as partially protected, but a visual inspection shows that this is simply due to slight discrepancies between the boundaries used by the Diversity Database and Vollmar et al.'s database. Both occurrences are presumed extant by the Diversity Database and are within extant vernal pool grasslands (Witham 2021). The western record was known at the time of listing in 1994 and other record was not recorded until 2009, after the Recovery Plan was published.

7.7.1.2.Vernal Pool Tadpole Shrimp Occurrences

There are seven Diversity Database occurrence records for the vernal pool tadpole shrimp within this core area (see **Figure 7.8**; Diversity Database 2022). As of 2018, six of these occurrences were at least partially within protected areas, and the seventh is within a proposed conservation bank (Vollmar et al. 2017). All occurrences are presumed extant by the Diversity Database; six are within extant vernal pool grasslands and one is within extirpated vernal pool grassland (Witham 2021). None of the occurrences were known at the time of listing in 1994, six were recorded before 2005 when the Recovery Plan was published, and one, which is adjacent to another occurrence, was not recorded until 2009.

7.7.2. Dales

This is a zone 2 core area with a goal of protecting 85% of vernal pool habitat for the vernal pool tadpole shrimp. This core area was not designated for the vernal pool fairy shrimp in the Recovery Plan, but the species is known to occur there. The core area is located in Tehama County northeast of the City of Red Bluff.

There were approximately 19,161 acres of vernal pool grassland within this core area when the Recovery Plan was published in 2005 (Witham et al. 2013). As of 2018, there were still 19,161 acres of vernal pool grassland remaining, with no habitat losses occurring since 2005 (see **Figure 7.9**, **Table 7.1**; Witham 2021). Roughly 10,718 acres of vernal pool grassland were protected within this core area as of 2017 (Vollmar et al. 2017), representing 56% of the 2005 baseline.

Protected areas within this core area include BLM's Sacramento River Bend Area, CDFW's Dales Lake Ecological Reserve and Battle Creek Wildlife Area, and parts of TNC's Inks Creek Ranch and Battle Creek conservation easements (**Figure 7.10**).

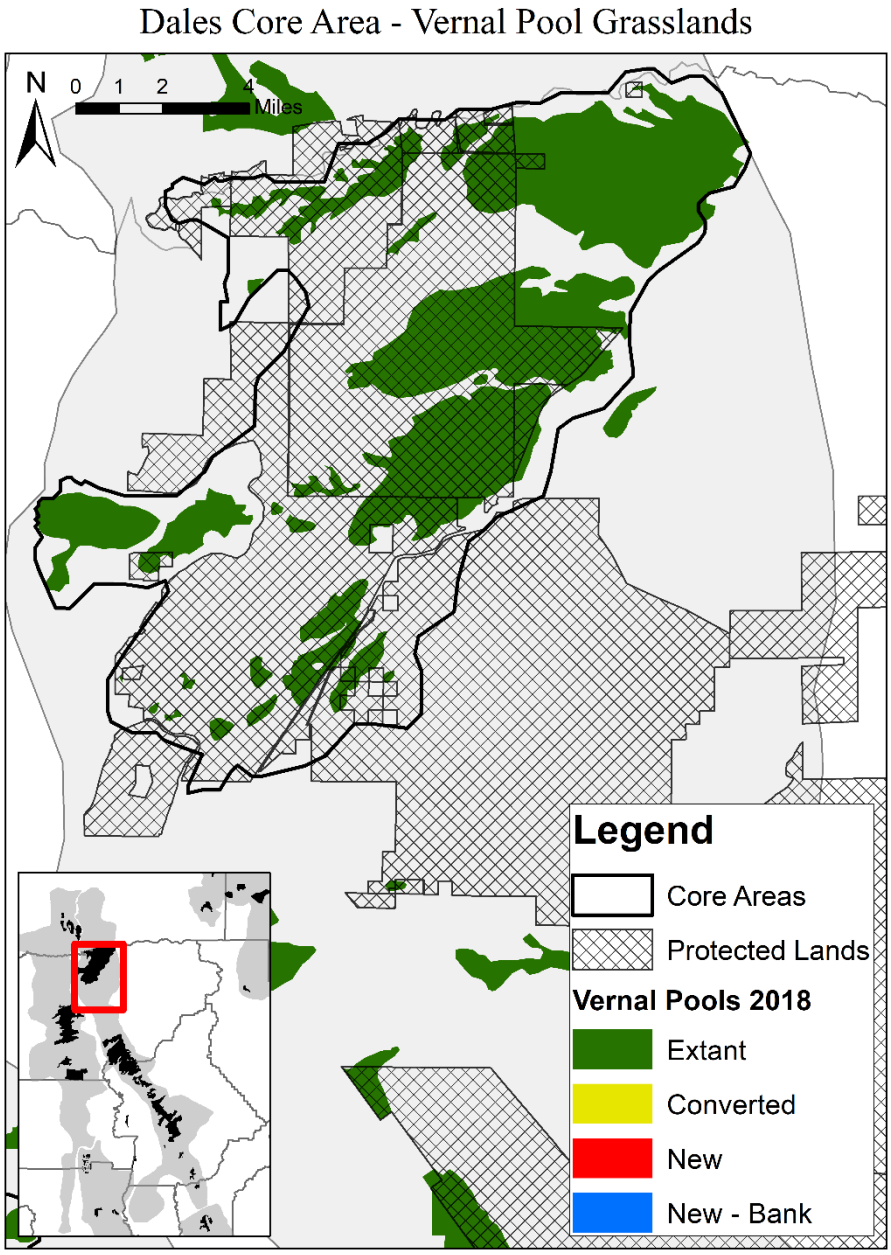

Figure 7.9. Map of vernal pool grassland habitat within the Dales Core Area mapped by Witham (2021) created using aerial imagery from 2018 compared to 2005 and 2012. "New" vernal pool habitat refers to areas not seen in the 2005 or 2012 aerial imagery (either missed or restored). "New - bank" refers to newly created vernal pool habitat on mitigation lands. Converted habitat refers to vernal pool habitat that was seen in 2005 or 2012 aerial imagery and by 2018 was converted to other land uses. Modified habitat as described by Witham (2021) was altered but still provides suitable vernal pool habitat (e.g., mitigation banks, lands managed for waterfowl), and so is mapped as extant. Zoom in for finer resolution.

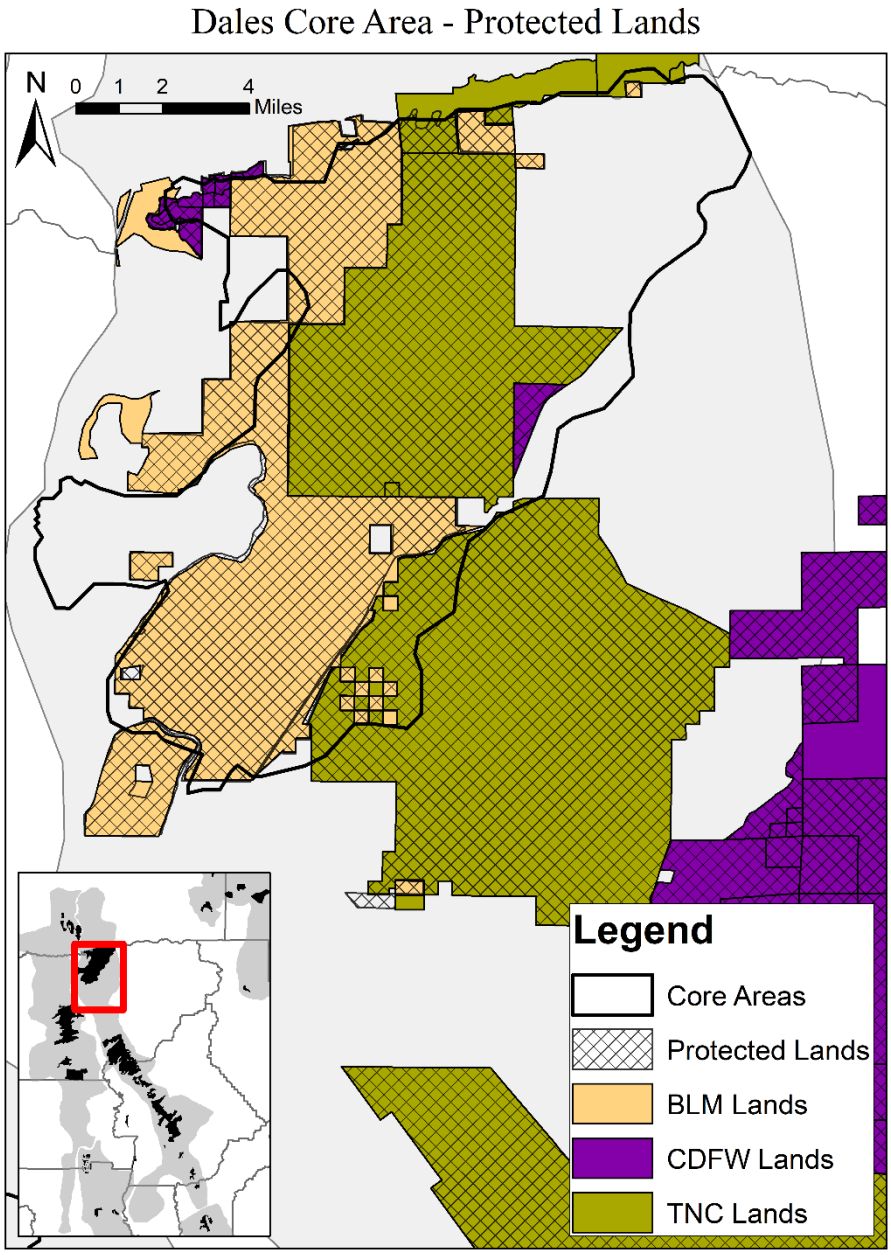

Figure 7.10. Map of protected areas within the Dales Core Area**.** Protected lands are based on Vollmar et al. (2017) and include various preserves. BLM = Bureau of Land Management, CDFW = California Department of Fish and Wildlife, TNC = The Nature Conservancy.

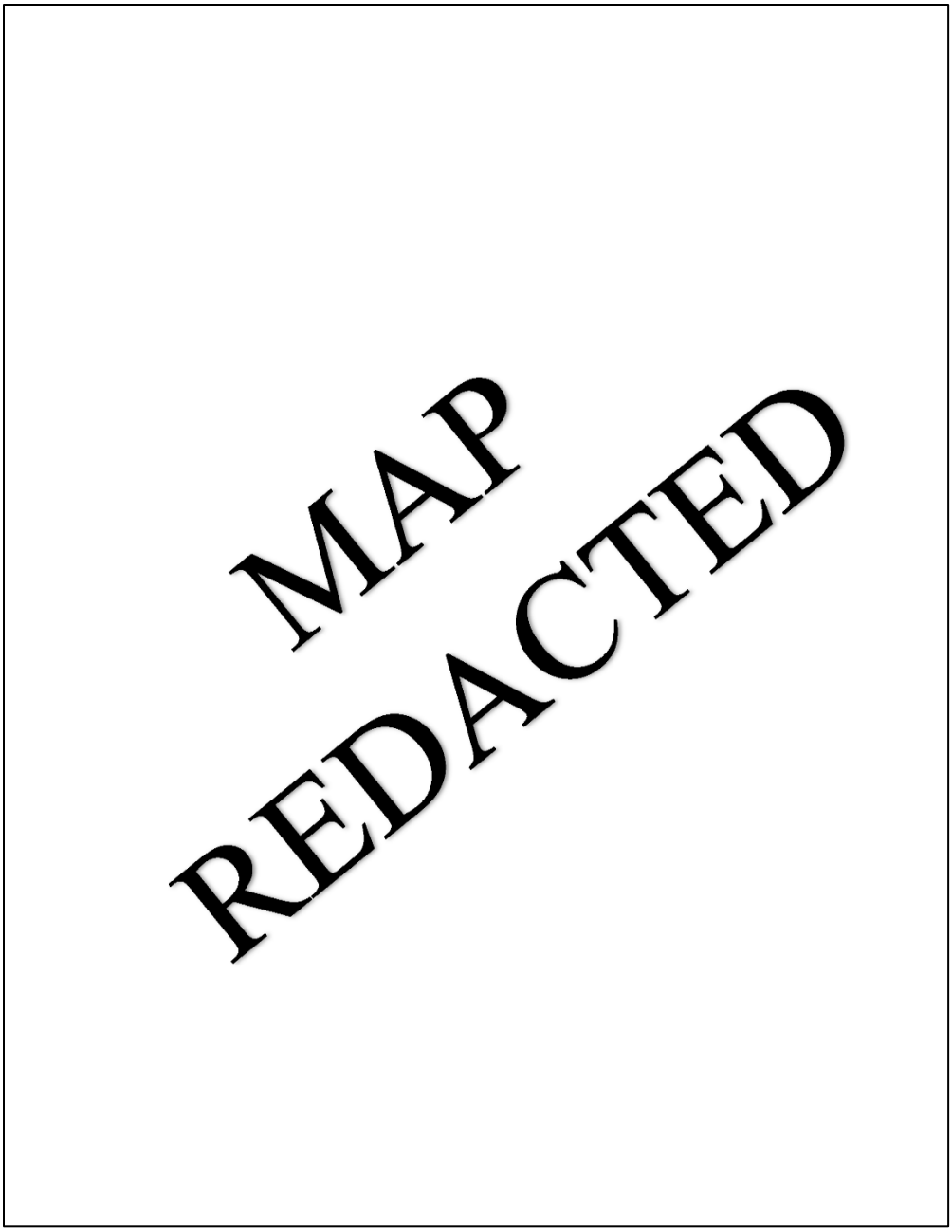

Figure 7.11. Map of known occurrences of vernal pool fairy shrimp recorded in the Diversity Database (2022) within the Dales Core Area. Polygons may represent individual pools, multiple pools, whole properties, or entire vernal pool grassland complexes. Occurrences are color coded as extant or extirpated based on both the Diversity Database and Witham's (2021) map of vernal pool habitat.

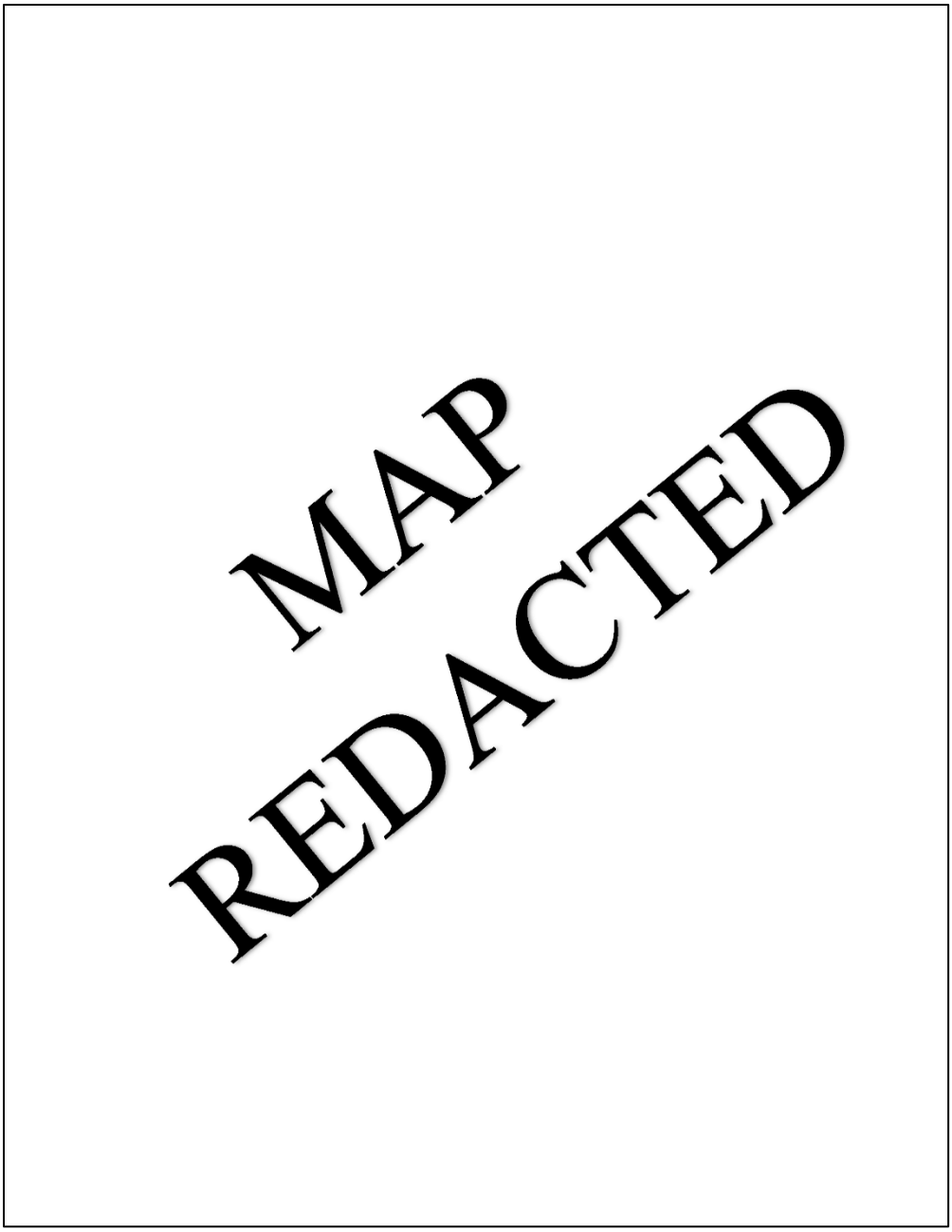

Figure 7.12. Map of known occurrences of vernal pool tadpole shrimp recorded in the Diversity Database (2022) and during Bureau of Land Management (BLM) surveys (BLM 2017b; BLM 2018; BLM 2019b) within the Dales Core Area. Polygons may represent individual pools, multiple pools, whole properties, or entire vernal pool grassland complexes. Occurrences are color coded as extant or extirpated based on both the Diversity Database and Witham's (2021) map of vernal pool habitat.

7.7.2.1.Vernal Pool Fairy Shrimp Occurrences

There are five Diversity Database occurrence records for the vernal pool fairy shrimp within this core area, all in the northwestern corner of the core area along Spring Branch Road near Battle Creek (see **Figure 7.11**; Diversity Database 2022). As of 2018, all of these occurrences were entirely within protected areas (Vollmar et al. 2017). All occurrences are presumed extant by the Diversity Database and are within extant vernal pool grasslands (Witham 2021). Vernal pool fairy shrimp were found most recently in all five locations in 2019 during BLM surveys (BLM 2019b). One of these occurrences, comprised of two pools, mentions collection of vernal pool fairy shrimp occurring in 1993 and 1994. Thus, the Recovery Plan likely should have designated this core area for the vernal pool fairy shrimp. Surveys for vernal pool shrimp species were conducted by BLM in 2017-2019 throughout the Sacramento River Bend Area within the core area and the vernal pool fairy shrimp was never identified in any other part of the core area (BLM 2017b; BLM 2018; BLM 2019b). This indicates that the species is likely restricted to the vernal pool habitat along Spring Branch Road despite the large amount of vernal pool grassland habitat available in the core area and the presence of other vernal pool shrimp species in other parts of the core area.

7.7.2.2.Vernal Pool Tadpole Shrimp Occurrences

There are six Diversity Database occurrence records for the vernal pool tadpole shrimp within this core area (see **Figure 7.12**; Diversity Database 2022). There are also eight occurrence records from recent BLM surveys (BLM 2017b; BLM 2018; BLM 2019b); most of these are within or adjacent to the Diversity Database records, though the is one in the Nordic Quarry area about halfway between the Hog Lake occurrence in the south and the Dales Lake occurrences in the east. As of 2018, five of the Diversity Database occurrences and all of the BLM occurrences were entirely within protected areas (Vollmar et al. 2017). All occurrences are presumed extant by the Diversity Database and are within extant vernal pool grasslands (Witham 2021). Four of the Diversity Database occurrences were known at the time of listing in 1994 and all six were known in 2005 when the Recovery Plan was published.

7.7.3. Doe Mill

This is a zone 1 core area with a goal of protecting 85% of vernal pool habitat for the vernal pool fairy shrimp. The core area is located in the southeastern portion of the City of Chico and adjacent areas of unincorporated Butte County.

Witham et al.'s (2013) mapping effort estimated that there were 445 acres of vernal pool grassland within this core area when the Recovery Plan was published in 2005, and as of 2018 no habitat losses were estimated to have occurred (see **Figure 7.13**, **Table 7.1**; Witham 2021). However, in the biological opinion for the Stonegate Subdivision Project (Service 2020a), the Service estimated that there were approximately 908 acres of extant vernal pool grassland within the Doe Mill Core Area based on habitat mapping conducted for the Butte County Habitat Conservation Plan conducted in 2008, NAIP aerial imagery from 2016, and Witham et al.'s updated 2012 habitat map (see **Figure 7.14**; Witham et al. 2014; C. Hickam, Service, *in litt*. 2019). Thus, an appropriate 2005 baseline for this core area is at least 908 acres of vernal pool grassland. The biological opinion also identified 8 other projects within the Doe Mill Core Area

that had been authorized since 2005 that would result in the loss of 76 acres of vernal pool grassland, but it was not known if any of those losses had occurred yet or if the projects had not yet begun construction (Service 2020a). If the Stonegate Subdivision Project proceeds with construction, it will result in the loss of an additional 170 acres of vernal pool grassland; this is a loss of more than 15% of the amount of vernal pool habitat that remained in 2005, making the 85% target unattainable without habitat creation or restoration. All of these losses are attributable to urbanization.

The human population of Chico was 101,475 in 2020, growing 17.7% from 2010 to 2020 after having already grown by over 40% per decade for the three decades prior (U.S. Census Bureau 2022). Due to the Camp Fire wildfire from the nearby town of Paradise in 2018, Chico's population increased by 18,040 people (19.5%) from 2018 to 2019 alone (City of Chico 2022). Residential housing continues to be a need in Chico (City of Chico 2022), and therefore urbanization will likely continue to be a significant cause of habitat loss for the vernal pool fairy shrimp and vernal pool tadpole shrimp within this core area.

Vollmar et al. (2017) estimated that 35.5 acres of vernal pool grassland were protected within this core area as of 2017; based on Witham et al.'s (2013) estimate of a baseline of 445 acres this is 8% of habitat protected, but based on the Service's estimate of a baseline of 908 acres this is only 4% of habitat protected. The 35.5 acres includes the Meriam Park Preserve and a protected section of Little Chico Creek south of the Preserve (note that the Meriam Park Preserve management plan actually states that the preserve is 42.5 acres; Gallaway Consulting 2009). It does not include the 14.76-acre Doe Mill Schmidbauer Meadowfoam Preserve, which is owned by the City of Chico but has no source of funding (Service 2020a). Part of the Stonegate Subdivision Project includes establishing a 132-acre preserve, which would include the Doe Mill Schmidbauer Meadowfoam Preserve, protected by a conservation easement and with a long-term management plan and endowment fund (Service 2020a). This would result in a total of approximately 168 acres of habitat protected within the core area (18.5% of the Service's 908-acre baseline).

7.7.3.1. Vernal Pool Fairy Shrimp Occurrences

There are no Diversity Database occurrence records for the vernal pool fairy shrimp within this core area; the nearest occurrence is approximately 2 miles northwest within the Chico Core Area (Diversity Database 2022). However, the vernal pool fairy shrimp is presumed to be present within the Doe Mill Core Area due to the presence of suitable habitat and the proximity to nearby occurrences. Biological opinions for section 7 consultations within the core area presume presence and analyze effects to the species, such as the Stonegate Subdivision Project (Service 2020a), and preserves within the core do as well, such as the Meriam Park Preserve (Gallaway Consulting 2009).

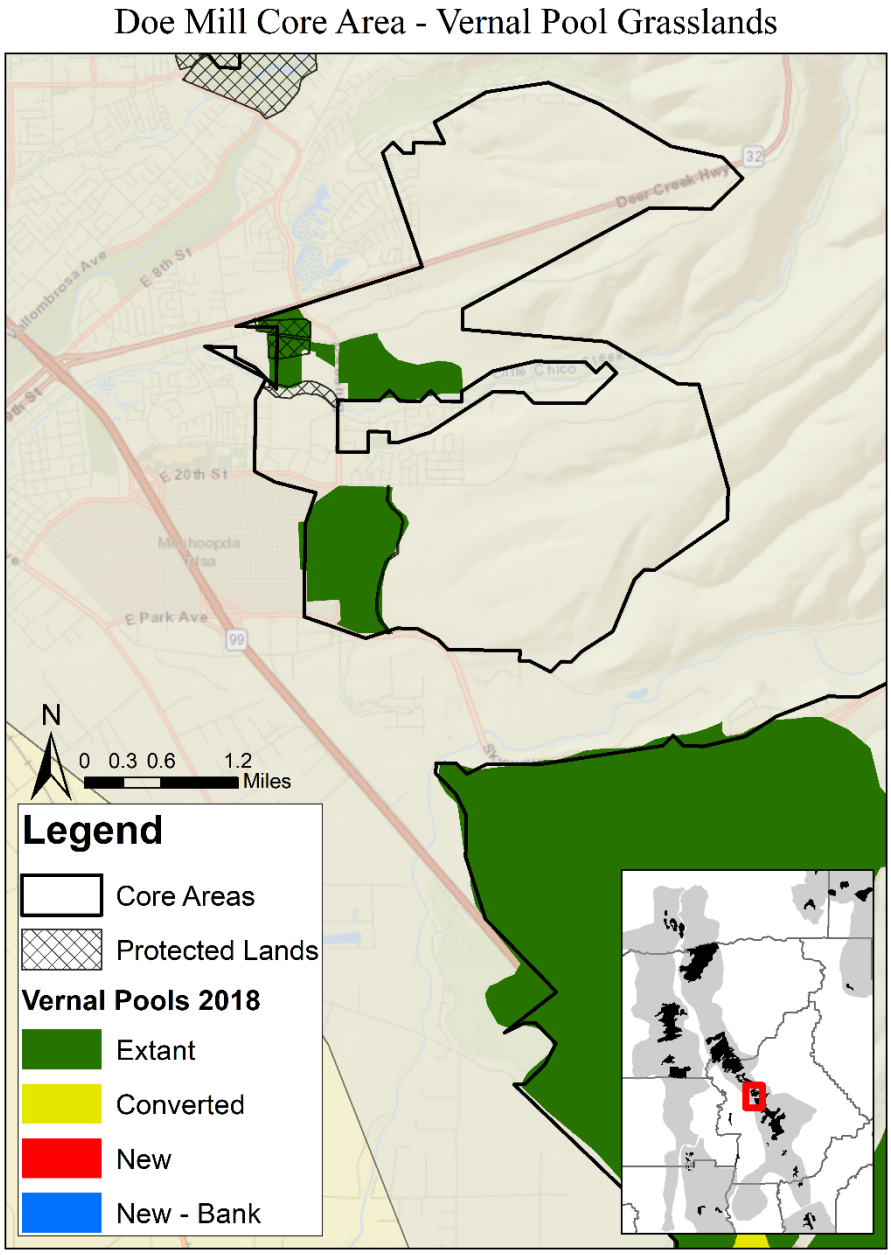

Figure 7.13. Map of vernal pool grassland habitat within the Doe Mill Core Area mapped by Witham (2021) created using aerial imagery from 2018 compared to 2005 and 2012. "New" vernal pool habitat refers to areas not seen in the 2005 or 2012 aerial imagery (either missed or restored). "New - bank" refers to newly created vernal pool habitat on mitigation lands. Converted habitat refers to vernal pool habitat that was seen in 2005 or 2012 aerial imagery and by 2018 was converted to other land uses. Modified habitat as described by Witham (2021) was altered but still provides suitable vernal pool habitat (e.g., mitigation banks, lands managed for waterfowl), and so is mapped as extant. Zoom in for finer resolution.

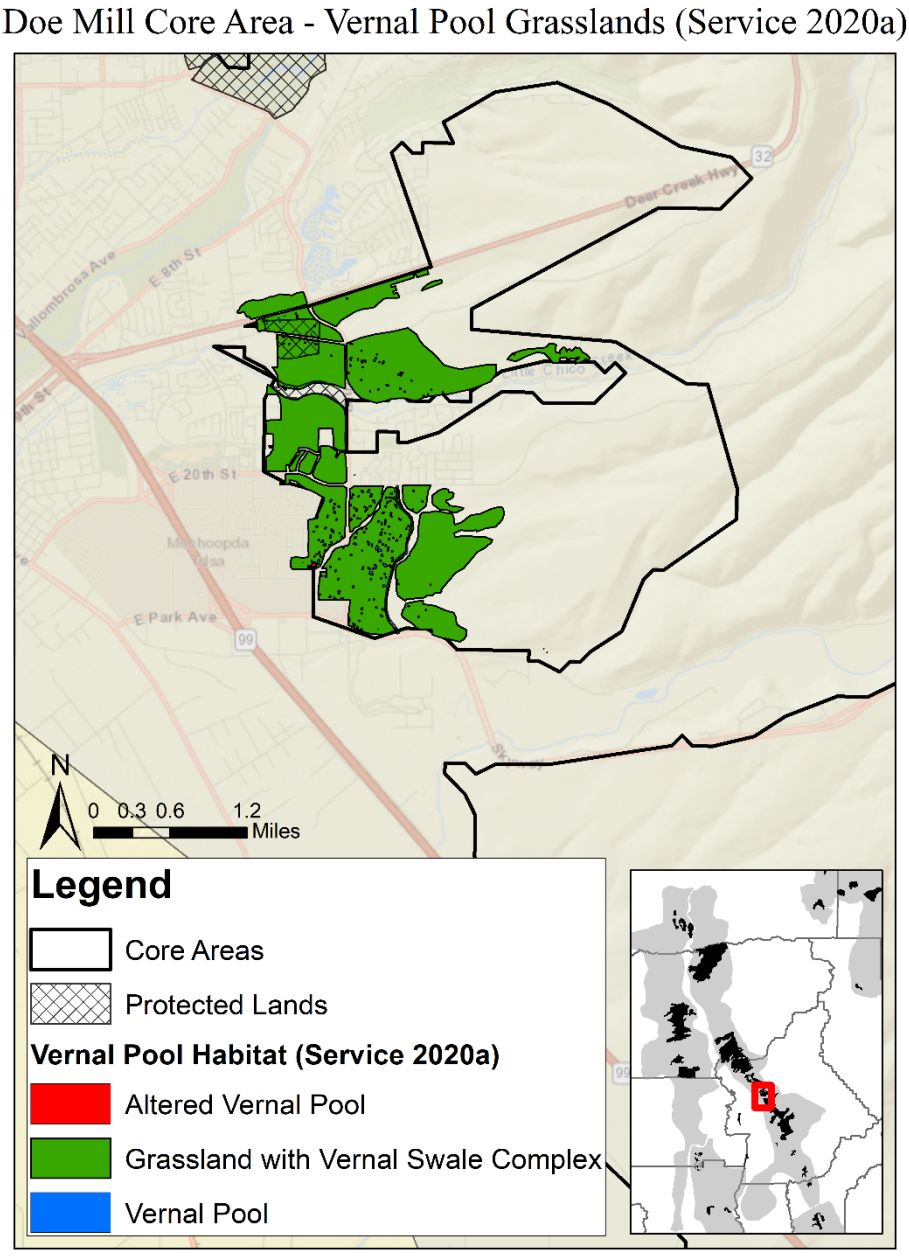

Figure 7.14. Map of vernal pool grassland habitat within the Doe Mill Core Area created by the Service for the section 7 consultation on the Stonegate Subdivision Project. Data sources included habitat mapping conducted for the Butte County Habitat Conservation Plan in 2008, NAIP aerial imagery from 2016, and Witham et al.'s updated 2012 habitat map (Witham et al. 2014; Hickam, *in litt*. 2019).

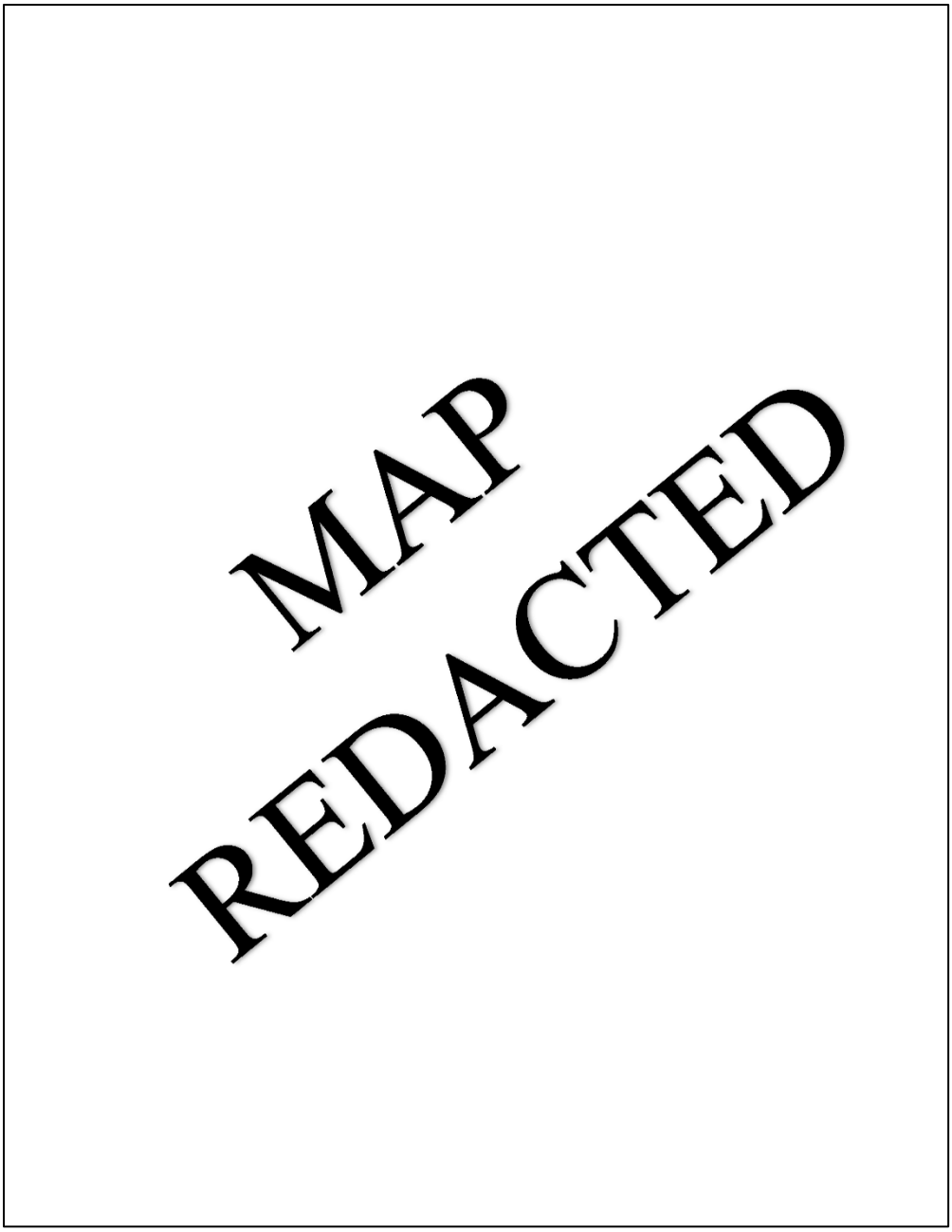

Figure 7.15. Map of known occurrences of vernal pool tadpole shrimp recorded in the Diversity Database (2022) within the Doe Mill Core Area. Polygons may represent individual pools, multiple pools, whole properties, or entire vernal pool grassland complexes. Occurrences are color coded as extant or extirpated based on both the Diversity Database and Witham's (2021) map of vernal pool habitat.

7.7.3.1.Vernal Pool Tadpole Shrimp Occurrences

There is one Diversity Database occurrence record for the vernal pool tadpole shrimp within this core area (see **Figure 7.15**; Diversity Database 2022). Although this occurrence was only ever recorded in 1993 and the spatial precision is low, the location is described as east of Highway 99 and south of Highway 32, which does describe the location of the core area. Biological opinions for section 7 consultations within the core area presume presence and analyze effects to the species, such as the Stonegate Subdivision Project (Service 2020a), and preserves within the core do as well, such as the Meriam Park Preserve (Gallaway Consulting 2009), even when the species has not been confirmed to be present.

7.7.4. Llano Seco

This is a zone 1 core area with a goal of protecting 85% of vernal pool habitat for the vernal pool fairy shrimp and 95% of vernal pool habitat for the vernal pool tadpole shrimp. The core area is geographically disjunct from the rest of the Northeastern Sacramento Valley Vernal Pool Region, located within the North Central Valley Wildlife Management Area of the Sacramento National Wildlife Refuge Complex in Butte County.

Witham (2021) identified 107 acres of vernal pool grassland within this core area, though it was not visible on 2005 aerial imagery (**Figure 7.16**); this habitat is within the Sanctuary II subunit (eastern subunit) of the Service-owned Llano Seco Unit (**Figure 7.17**). The Comprehensive Conservation Plan for the North Central Valley Wildlife Management Area identified 404 acres of vernal pool grassland within the Llano Seco Unit, mostly within the Sanctuary II subunit (Service 2020c). Some amount of these 404 acres is outside of the core area in the Sanctuary I subunit, but there is likely also more vernal pool grassland within the surrounding Service-held conservation easements, which are not considered part of the Llano Seco Unit, given the Diversity Database records of the vernal pool fairy shrimp and vernal pool tadpole shrimp present. The Service-held easements are part of the North Central Valley Wildlife Management Area and include the northern half of the Llano Seco Core Area as well as surrounding lands. Vernal pool grasslands are also present in Field 312 of the nearby CDFW Llano Seco Unit of the Upper Butte Basin Wildlife Area, though the acreage is not quantified in the land management plan (ESA Associates 2013). Although only parts of the areas described here are within the boundaries of the core area, it is likely appropriate to consider this block of federal- and state-owned land a connected vernal pool ecosystem. Regardless of which estimate or boundaries are used, all of the vernal pool grassland complex within and around this core area are protected within the National Wildlife Refuge and CDFW Wildlife Area.

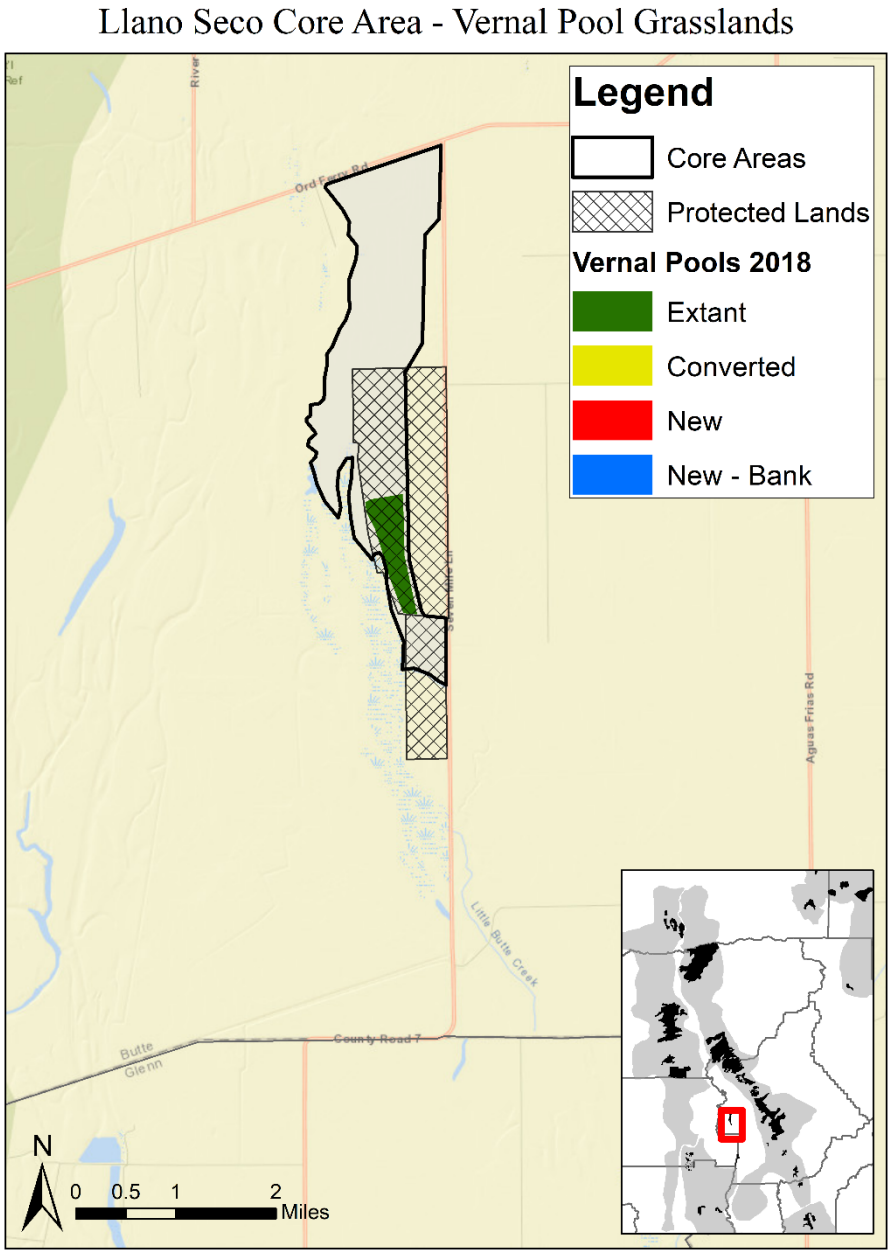

Figure 7.16. Map of vernal pool grassland habitat within the Llano Seco Core Area mapped by Witham (2021) created using aerial imagery from 2018 compared to 2005 and 2012. "New" vernal pool habitat refers to areas not seen in the 2005 or 2012 aerial imagery (either missed or restored). "New - bank" refers to newly created vernal pool habitat on mitigation lands. Converted habitat refers to vernal pool habitat that was seen in 2005 or 2012 aerial imagery and by 2018 was converted to other land uses. Modified habitat as described by Witham (2021) was altered but still provides suitable vernal pool habitat (e.g., mitigation banks, lands managed for waterfowl), and so is mapped as extant. Zoom in for finer resolution.

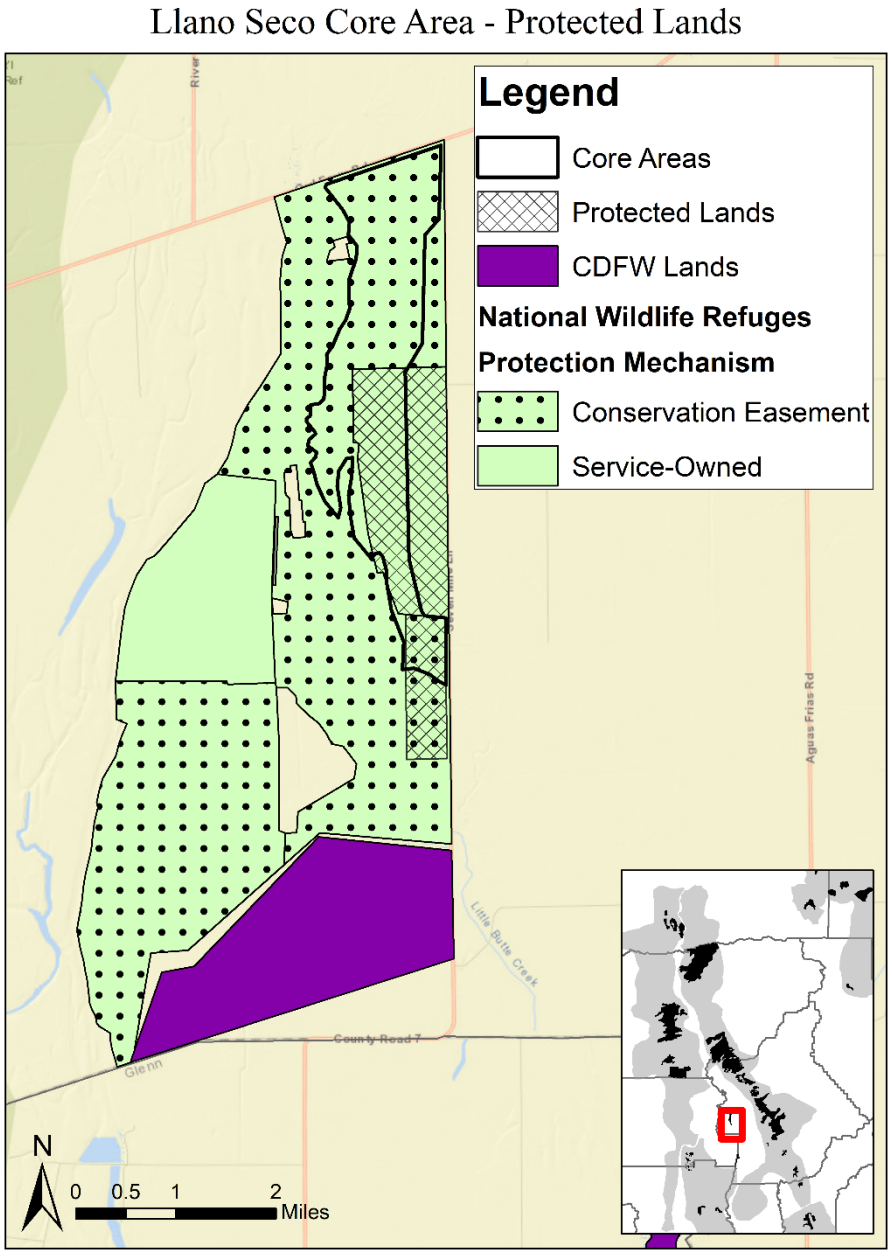

Figure 7.17. Map of protected areas within the Llano Seco Core Area**.** Protected lands are based on Vollmar et al. (2017) and include various preserves. CDFW = California Department of Fish and Wildlife.

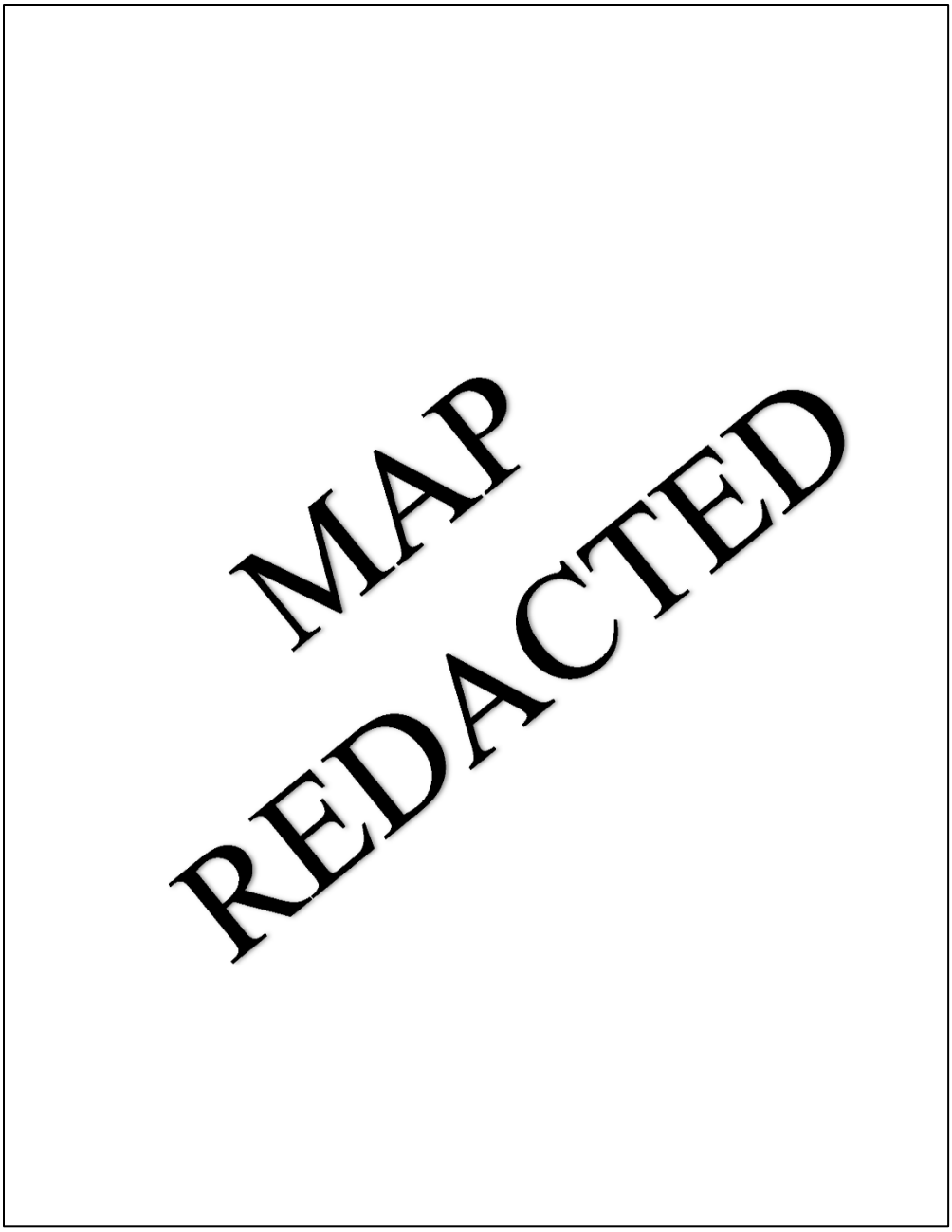

Figure 7.18. Map of known occurrences of vernal pool fairy shrimp recorded in the Diversity Database (2022) within the Llano Seco Core Area. Polygons may represent individual pools, multiple pools, whole properties, or entire vernal pool grassland complexes. Occurrences are color coded as extant or extirpated based on both the Diversity Database and Witham's (2021) map of vernal pool habitat.

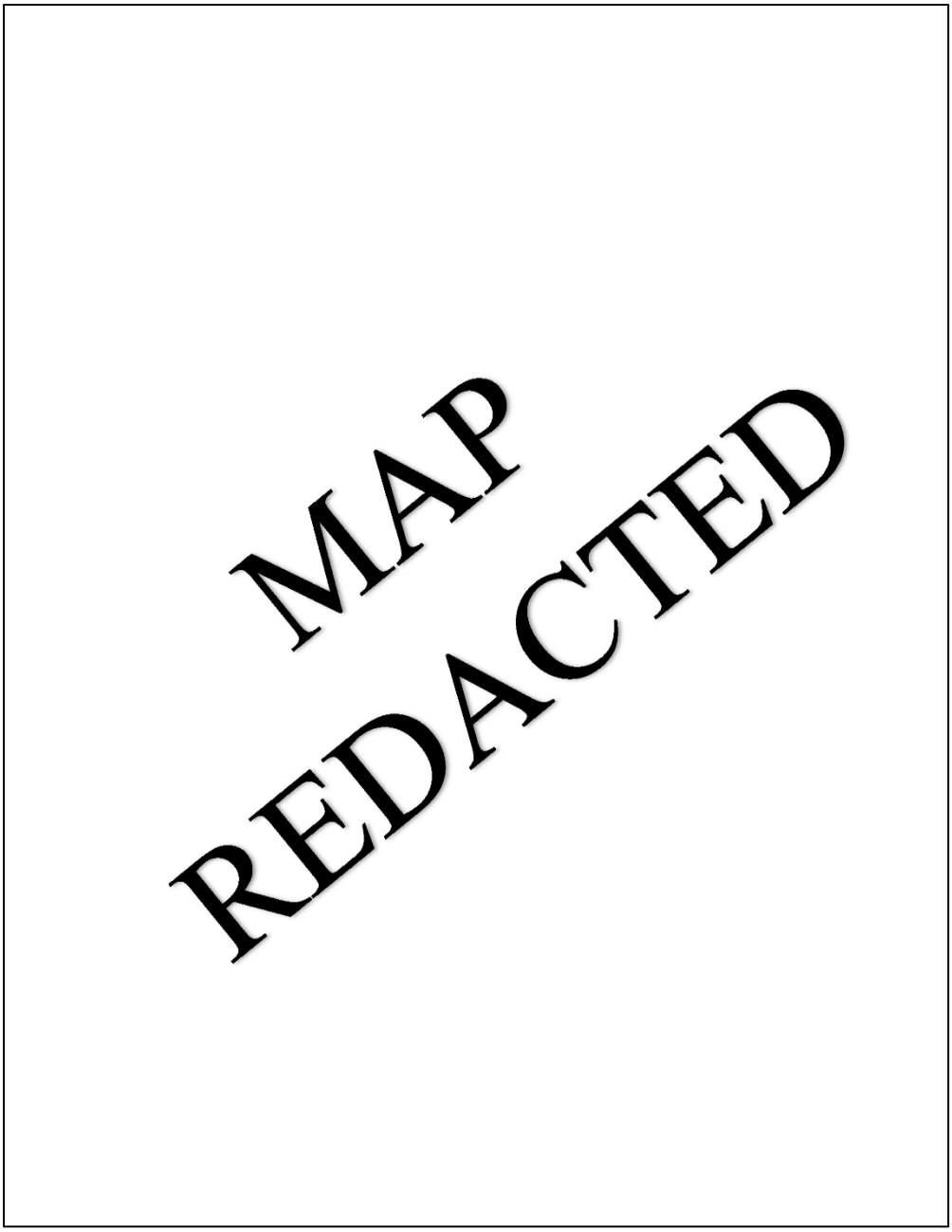

Figure 7.19. Map of known occurrences of vernal pool tadpole shrimp recorded in the Diversity Database (2022) within the Llano Seco Core Area. Polygons may represent individual pools, multiple pools, whole properties, or entire vernal pool grassland complexes. Occurrences are color coded as extant or extirpated based on both the Diversity Database and Witham's (2021) map of vernal pool habitat.

7.7.4.1.Vernal Pool Fairy Shrimp Occurrences

There are three Diversity Database occurrence records for the vernal pool fairy shrimp within this core area and one immediately outside the core area (see **Figure 7.18**; Diversity Database 2022). All of these occurrences are presumed extant by the Diversity Database and are entirely protected within the Sacramento National Wildlife Refuge Complex. Of the four records, two were known at the time of listing in 1994 and three were known at the time the Recovery Plan was published in 2005. The one newer record was from 2017 on the southern border of the Service's Llano Seco Unit, Sanctuary II subunit. The nearby Llano Seco Unit of CDFW's Upper Butte Basin Wildlife Area also contains suitable vernal pool habitat, but it has not been surveyed for the vernal pool fairy shrimp (ESA Associates 2013).

7.7.4.1.Vernal Pool Tadpole Shrimp Occurrences

There are six Diversity Database occurrence records for the vernal pool tadpole shrimp within this core area, one immediately outside the core area, and two 4 miles to the southwest (see **Figure 7.19**; Diversity Database 2022). All of these occurrences are presumed extant by the Diversity Database and are entirely protected within the Sacramento National Wildlife Refuge Complex. Of these nine records, three were known at the time of listing in 1994 and seven were known at the time the Recovery Plan was published in 2005. The two newer records were from 2013 and 2015 on the borders of the Service's Llano Seco Unit, Sanctuary II subunit. The nearby Llano Seco Unit of CDFW's Upper Butte Basin Wildlife Area also contains suitable vernal pool habitat, but it has not been surveyed for the vernal pool tadpole shrimp (ESA Associates 2013).

7.7.5. Oroville

This is a zone 1 core area with a goal of protecting 85% of vernal pool habitat for the vernal pool fairy shrimp and 95% of vernal pool habitat for the vernal pool tadpole shrimp. The core area is located along Highways 99 and 149 between the cities of Oroville and Chico in Butte County.

There were approximately 19,576 acres of vernal pool grassland within this core area when the Recovery Plan was published in 2005 (Witham et al. 2013). As of 2018, there were 19,210 acres of vernal pool grassland remaining, with 366 acres lost since 2005 (see **Figure 7.20**, **Table 7.1**; Witham 2021). The majority of losses were due to agricultural conversion to either orchards (194 acres, 53%) or rice, row crops, dairies, or nurseries (121 acres, 33%), with the remaining losses due to urbanization or agricultural residences (see **Table 7.2**; Witham 2021). Roughly 2,799 acres of vernal pool grassland were protected within this core area as of 2017 (Vollmar et al. 2017), representing 14.3% of the 2005 baseline. However, this number includes the now suspended 212-acre Shauna Downs Mitigation Bank, but also misses the 574-acre Caltrans Cottonwood Creek Conservation Area. Thus, a net total of 3,161 acres of vernal pool grassland are protected, representing 16.1% of the 2005 baseline.

Protected areas within this core area include the Dove Ridge Conservation Bank, Caltrans Cottonwood Creek Conservation Area, and two other mitigation sites identified by Vollmar et al. (2017) (**Figure 7.21**). The Oroville Wildlife Area and CDPR lands around the Thermalito Forebay are also adjacent to the core area to the south.

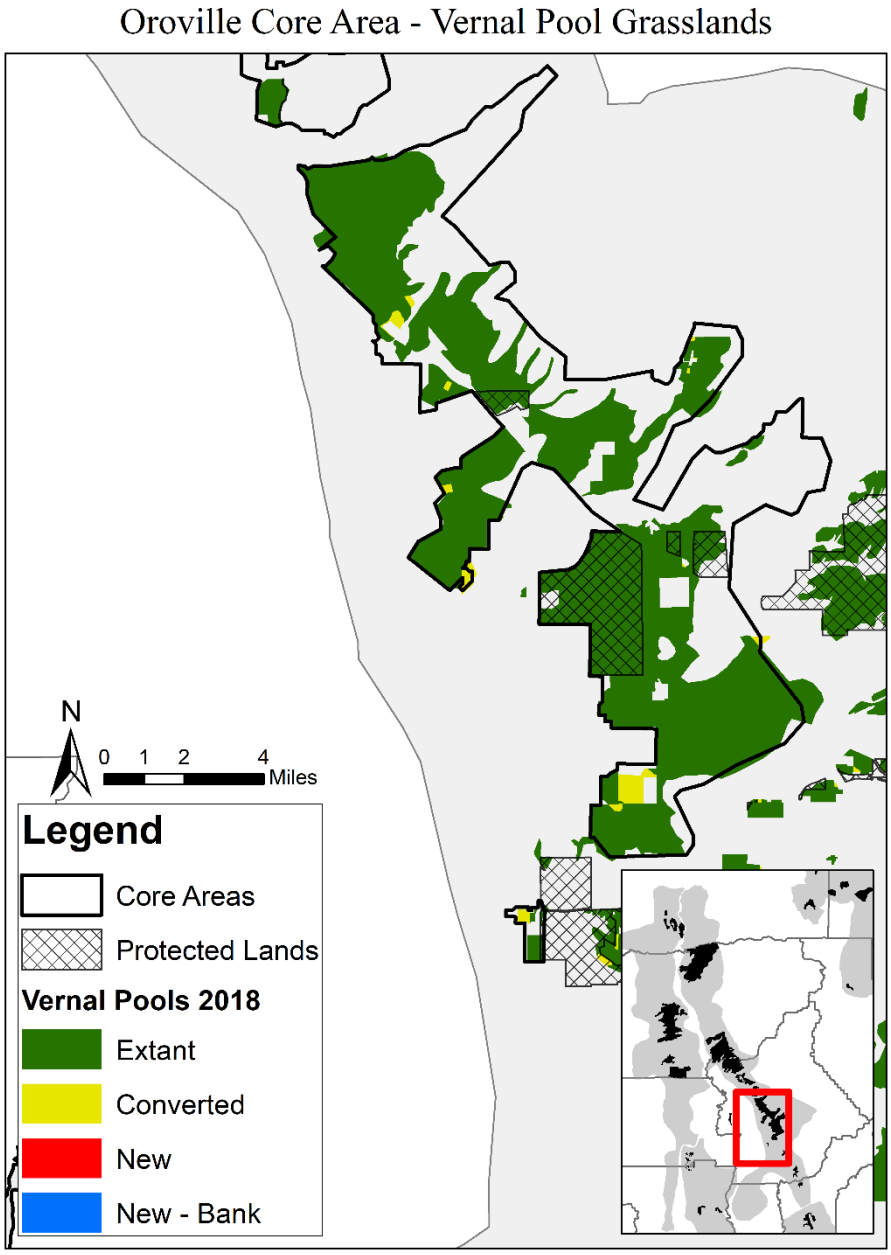

Figure 7.20. Map of vernal pool grassland habitat within the Oroville Core Area mapped by Witham (2021) created using aerial imagery from 2018 compared to 2005 and 2012. "New" vernal pool habitat refers to areas not seen in the 2005 or 2012 aerial imagery (either missed or restored). "New - bank" refers to newly created vernal pool habitat on mitigation lands. Converted habitat refers to vernal pool habitat that was seen in 2005 or 2012 aerial imagery and by 2018 was converted to other land uses. Modified habitat as described by Witham (2021) was altered but still provides suitable vernal pool habitat (e.g., mitigation banks, lands managed for waterfowl), and so is mapped as extant. Zoom in for finer resolution.

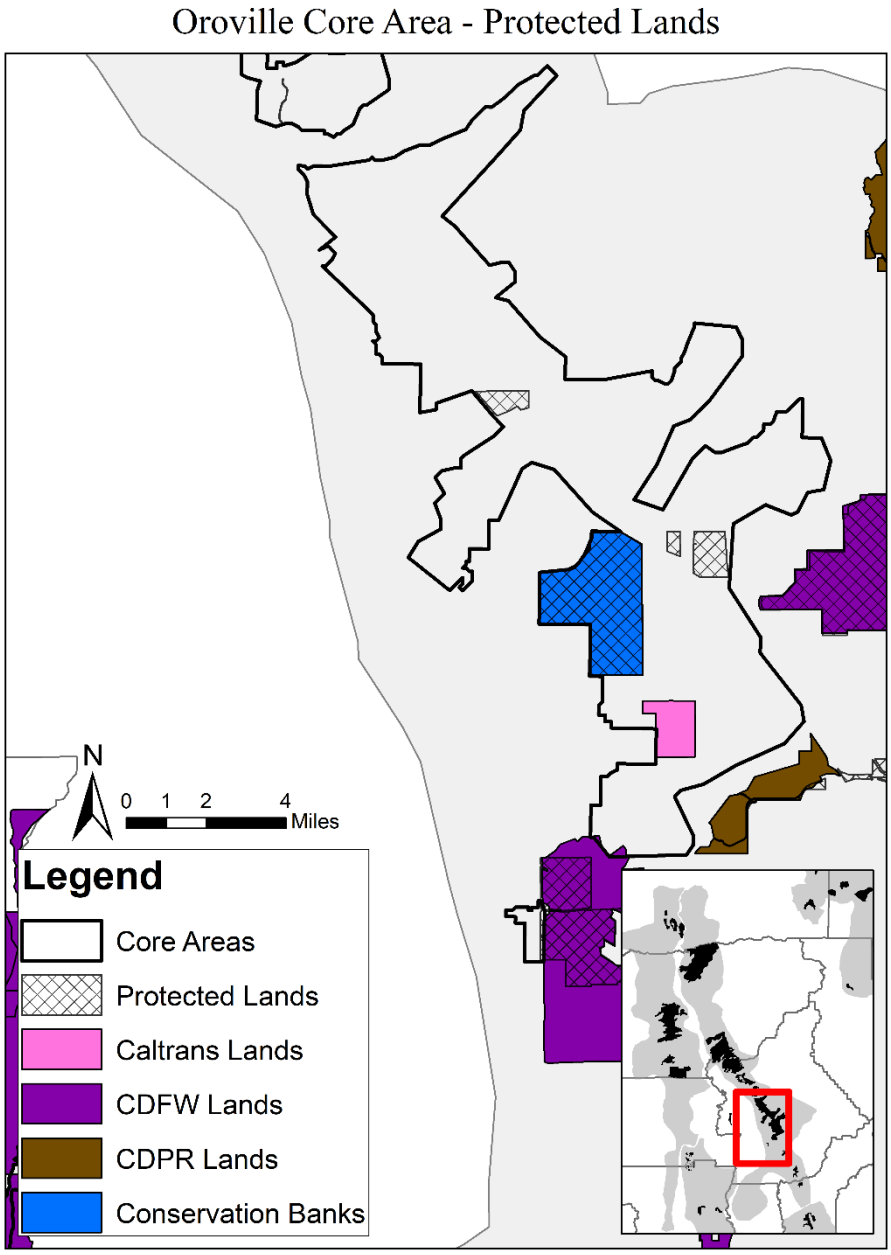

Figure 7.21. Map of protected areas within the Oroville Core Area**.** Protected lands are based on Vollmar et al. (2017) and include various preserves. The northernmost protected area depicted within the core area is the Shauna Downs Mitigation Bank, which is currently suspended and no longer considered protected. CDFW = California Department of Fish and Wildlife, CDPR = California Department of Parks and Recreation.

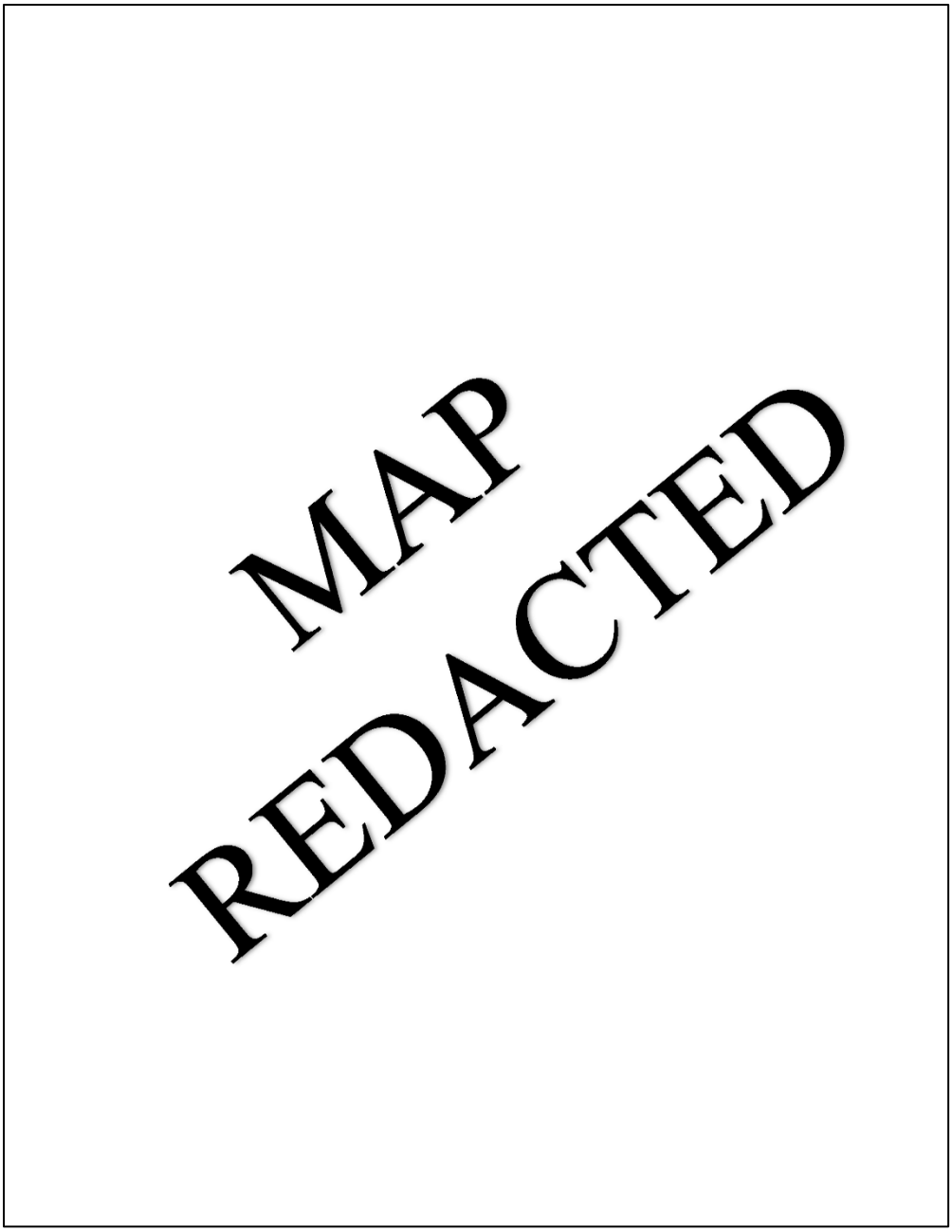

Figure 7.22. Map of known occurrences of vernal pool fairy shrimp recorded in the Diversity Database (2022) within the Oroville Core Area. Polygons may represent individual pools, multiple pools, whole properties, or entire vernal pool grassland complexes. Occurrences are color coded as extant or extirpated based on both the Diversity Database and Witham's (2021) map of vernal pool habitat.

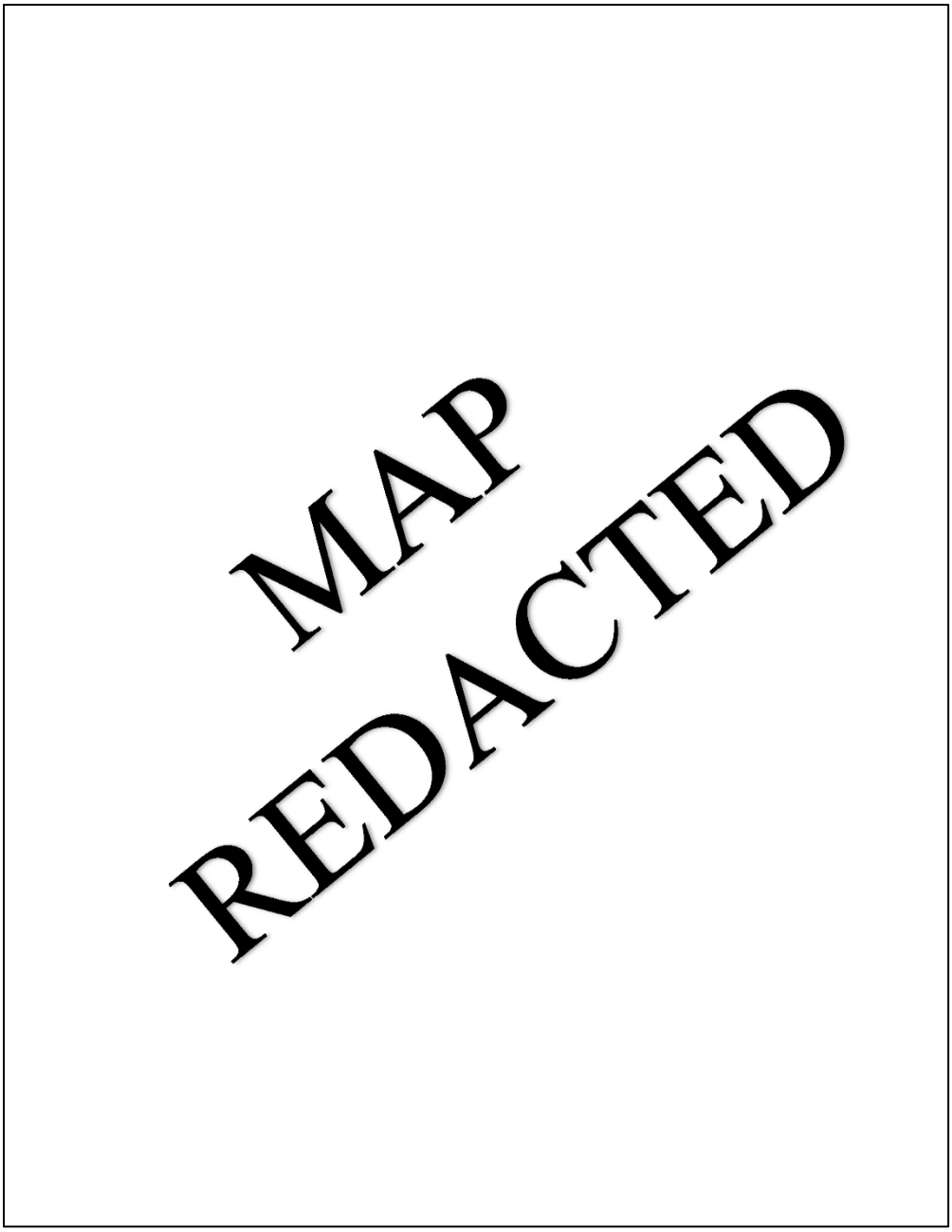

Figure 7.23. Map of known occurrences of vernal pool tadpole shrimp recorded in the Diversity Database (2022) within the Oroville Core Area. Polygons may represent individual pools, multiple pools, whole properties, or entire vernal pool grassland complexes. Occurrences are color coded as extant or extirpated based on both the Diversity Database and Witham's (2021) map of vernal pool habitat.

7.7.5.1.Vernal Pool Fairy Shrimp Occurrences

There are eight Diversity Database occurrence records for the vernal pool fairy shrimp within this core area (see **Figure 7.22**; Diversity Database 2022). As of 2018, all of these occurrences were at least partially within protected areas (Vollmar et al. 2017); seven occurrences are entirely within protected areas and one occurrence is almost entirely within the Caltrans Cottonwood Creek Conservation Area except for one vernal pool (Diversity Database 2022). All occurrences are presumed extant by the Diversity Database and are within extant vernal pool grasslands (Witham 2021). Of the eight records, none were known at the time of listing in 1994 and four were known at the time the Recovery Plan was published in 2005; these records are all within the Dove Ridge Conservation Bank. The four newer records are located within the Caltrans Cottonwood Creek Conservation Area and two other mitigation properties, expanding the distribution of the vernal pool fairy shrimp within this core area from what was known at the time the Recovery Plan was published.

7.7.5.1.Vernal Pool Tadpole Shrimp Occurrences

There are seven Diversity Database occurrence records for the vernal pool tadpole shrimp within this core area (see **Figure 7.23**; Diversity Database 2022). As of 2018, four of these occurrences were at least partially within protected areas (Vollmar et al. 2017) (Diversity Database 2022). All occurrences are presumed extant by the Diversity Database; six are within extant vernal pool grasslands and one is outside of mapped vernal pool grasslands (Witham 2021). Of the seven records, four were known at the time of listing in 1994 and five were known at the time the Recovery Plan was published in 2005; these records are spread across the central and eastern portions of the core area. The two newer records are clusters of vernal pools, one within the Caltrans Cottonwood Creek Conservation Area to the south and the other within a protected mitigation site to the east.

7.7.6. Palermo

This is a zone 2 core area, but it was not designated for the vernal pool fairy shrimp or vernal pool tadpole shrimp in the Recovery Plan. It was designated for slender Orcutt grass (*Orcuttia tenuis*), with a goal of protecting 85% of vernal pool habitat. The core area is located east of the Oroville Wildlife Area and south of the City of Oroville in Butte County.

There were approximately 841 acres of vernal pool grassland within this core area when the Recovery Plan was published in 2005 (Witham et al. 2013). As of 2018, there were 649 acres of vernal pool grassland remaining, with 192 acres lost since 2005 (see **Figure 7.24**, **Table 7.1**; Witham 2021). This represents a loss of more than 15% of the amount of vernal pool habitat that remained in 2005, making the 85% target unattainable without habitat creation or restoration. The majority of losses were due to conversion to orchards (164 acres, 85%), with the remaining losses due to other types of agricultural conversions (see **Table 7.2**; Witham 2021). The Service is not aware of any protected vernal pool habitat within this core area (see **Figure 7.25**; Vollmar et al. 2017). CDFW's Oroville Wildlife Area is immediately west of this core area.

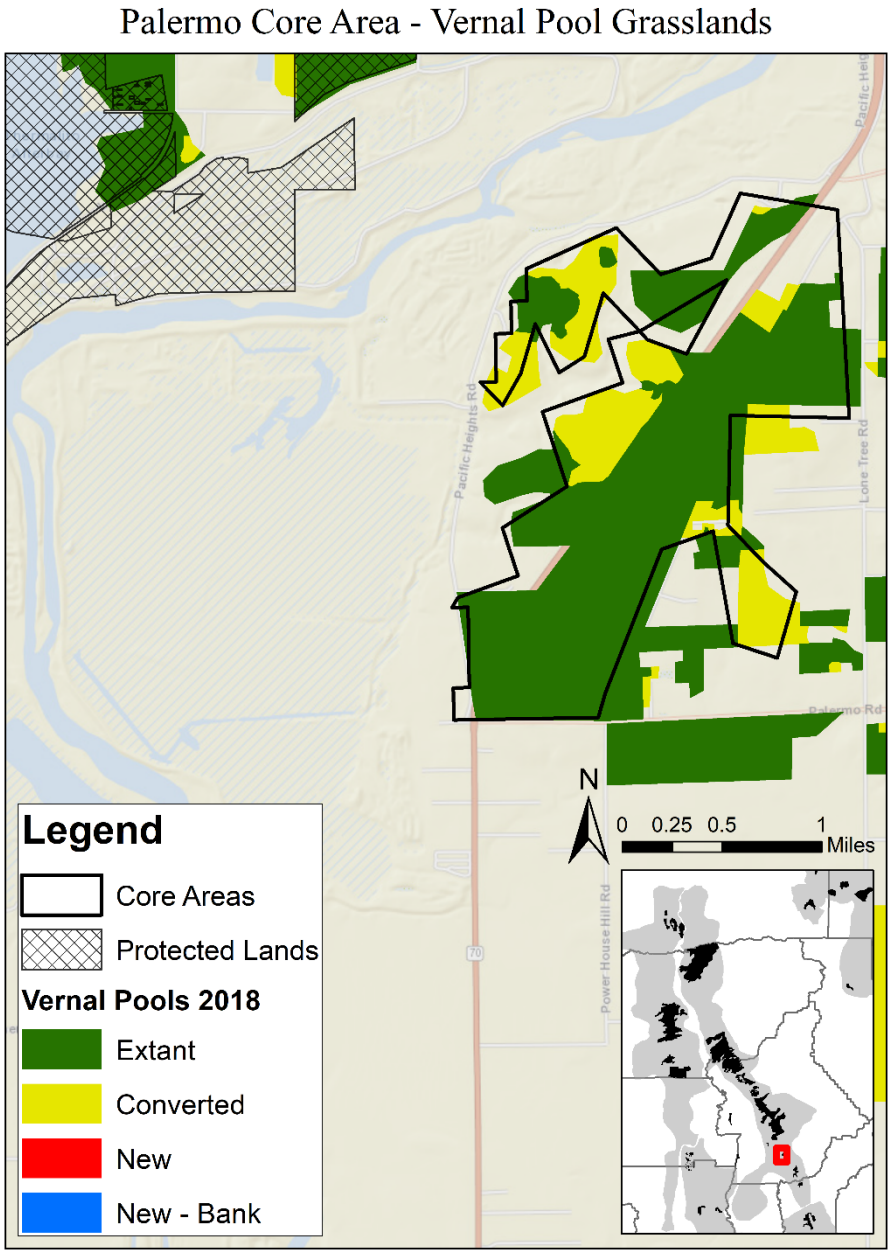

Figure 7.24. Map of vernal pool grassland habitat within the Palermo Core Area mapped by Witham (2021) created using aerial imagery from 2018 compared to 2005 and 2012. "New" vernal pool habitat refers to areas not seen in the 2005 or 2012 aerial imagery (either missed or restored). "New - bank" refers to newly created vernal pool habitat on mitigation lands. Converted habitat refers to vernal pool habitat that was seen in 2005 or 2012 aerial imagery and by 2018 was converted to other land uses. Modified habitat as described by Witham (2021) was altered but still provides suitable vernal pool habitat (e.g., mitigation banks, lands managed for waterfowl), and so is mapped as extant. Zoom in for finer resolution.

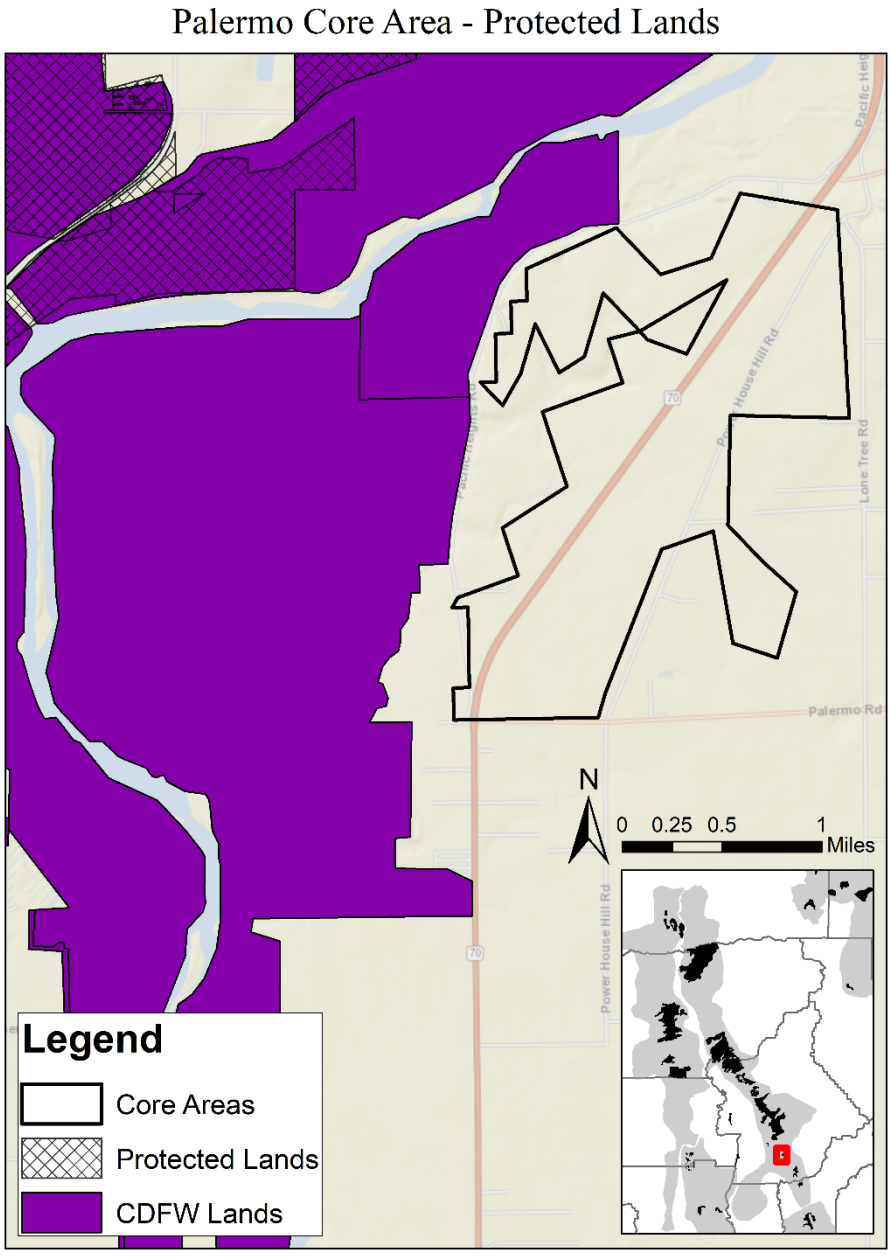

Figure 7.25. Map of protected areas within the Palermo Core Area**.** Protected lands are based on Vollmar et al. (2017) and include various preserves. CDFW = California Department of Fish and Wildlife.

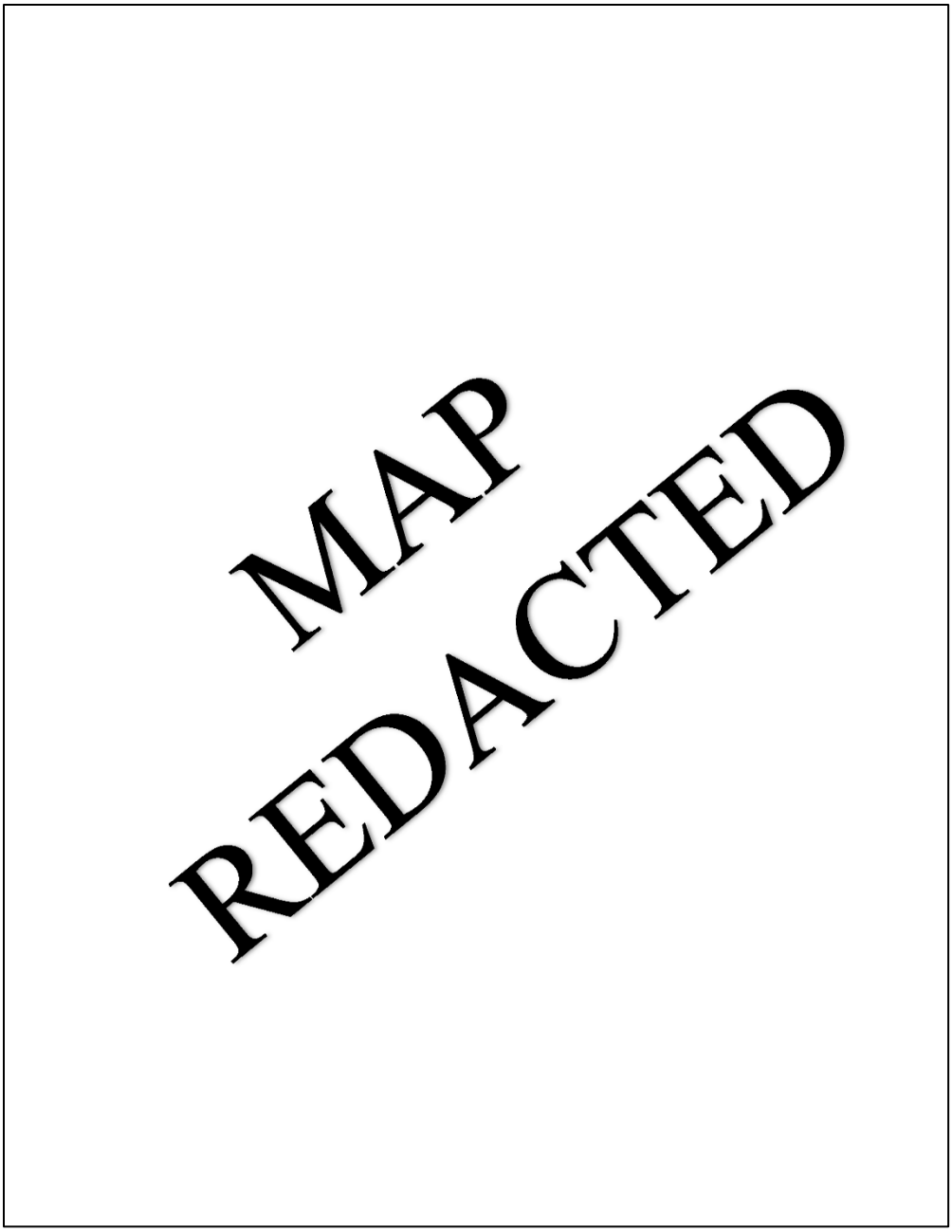

Figure 7.26. Map of known occurrences of vernal pool fairy shrimp recorded in the Diversity Database (2022) within the Palermo Core Area. Polygons may represent individual pools, multiple pools, whole properties, or entire vernal pool grassland complexes. Occurrences are color coded as extant or extirpated based on both the Diversity Database and Witham's (2021) map of vernal pool habitat.

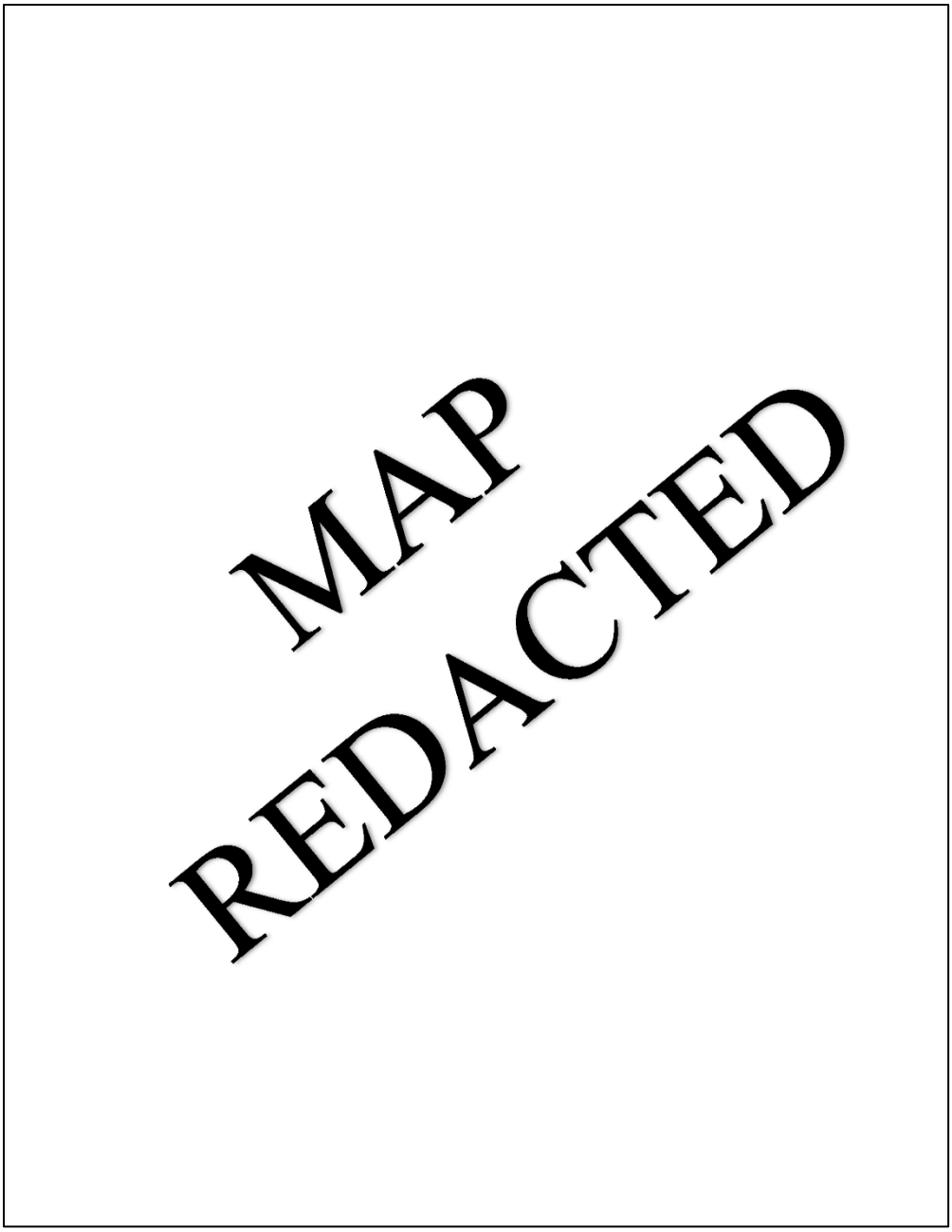

Figure 7.27. Map of known occurrences of vernal pool tadpole shrimp recorded in the Diversity Database (2022) within the Palermo Core Area. Polygons may represent individual pools, multiple pools, whole properties, or entire vernal pool grassland complexes. Occurrences are color coded as extant or extirpated based on both the Diversity Database and Witham's (2021) map of vernal pool habitat.

7.7.6.1.Vernal Pool Fairy Shrimp Occurrences

There are four Diversity Database occurrence records for the vernal pool fairy shrimp within this core area, one of which extends outside of the core area to the west (see **Figure 7.26**; Diversity Database 2022). As of 2018, none of these occurrences were protected (Vollmar et al. 2017). All occurrences are presumed extant by the Diversity Database and are within extant vernal pool grasslands (Witham 2021). None of these occurrences were known at the time of listing or when the Recovery Plan was published. All four occurrences were recorded during the 2007-2008 and 2008-2009 wet seasons on the Rio D'Oro property (Diversity Database 2022).

7.7.6.1.Vernal Pool Tadpole Shrimp Occurrences

There is one Diversity Database occurrence record for the vernal pool tadpole shrimp within this core area (see **Figure 7.27**; Diversity Database 2022). As of 2018, this occurrence was not protected (Vollmar et al. 2017). The occurrence is presumed extant by the Diversity Database and within extant vernal pool grasslands (Witham 2021). The occurrence was not known at the time of listing or when the Recovery Plan was published; it was first detected in 2008 on the Rio D'Oro property (Diversity Database 2022).

7.7.7. Richvale

This is a zone 2 core area, but it was not designated for the vernal pool fairy shrimp in the Recovery Plan. It was designated for Greene's tuctoria (*Tuctoria greenei*), with a goal of protecting 85% of vernal pool habitat. The core area is located west of the Thermalito Afterbay near the City of Oroville in Butte County.

There were approximately 151 acres of vernal pool grassland within this core area when the Recovery Plan was published in 2005 (Witham et al. 2013). As of 2018, there were 114 acres of vernal pool grassland remaining, with 37 acres lost since 2005 (see **Figure 7.28**, **Table 7.1**; Witham 2021). All losses were due to conversion to bare plowed agricultural land (see **Table 7.2**; Witham 2021). This represents a loss of more than 15% of the amount of vernal poolhabitat that remained in 2005, making the 85% target unattainable without habitat creation or restoration.

There is a slight disagreement in the GIS layers regarding whether CDFW's Oroville Wildlife Area extends into the Richvale Core Area or not. Both Vollmar et al.'s (2017) database and DWR's vernal pool survey data (Carter-Ervin, *in litt*. 2022) suggest that the Oroville Wildlife Area does extend into the core area (**Figure 7.29**); if this is correct, then roughly 18.5 acres of vernal pool grassland were protected within this core area as of 2017 (Vollmar et al. 2017), representing 12.2% of the 2005 baseline. However, given the exact border between the core area and the GIS layers obtained from CDFW, it may have been the intent of the Recovery Plan to not include the Oroville Wildlife Area within the Richvale Core Area.

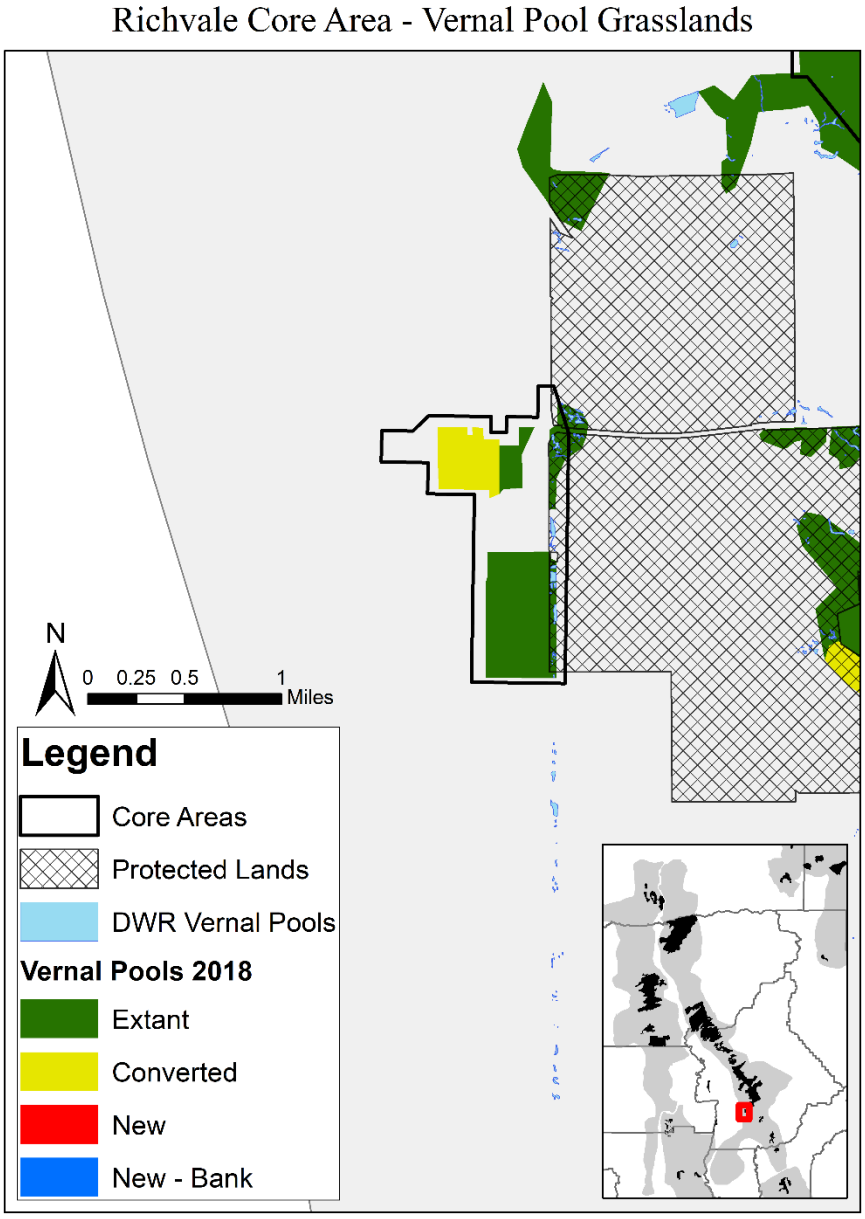

Figure 7.28. Map of vernal pool grassland habitat within the Richvale Core Area mapped by Witham (2021) created using aerial imagery from 2018 compared to 2005 and 2012. "New" vernal pool habitat refers to areas not seen in the 2005 or 2012 aerial imagery (either missed or restored). "New - bank" refers to newly created vernal pool habitat on mitigation lands. Converted habitat refers to vernal pool habitat that was seen in 2005 or 2012 aerial imagery and by 2018 was converted to other land uses. Modified habitat as described by Witham (2021) was altered but still provides suitable vernal pool habitat (e.g., mitigation banks, lands managed for waterfowl), and so is mapped as extant. Vernal pools were mapped by the California Department of Water Resources (DWR) (Carter-Ervin, *in litt*. 2022). Zoom in for finer resolution.

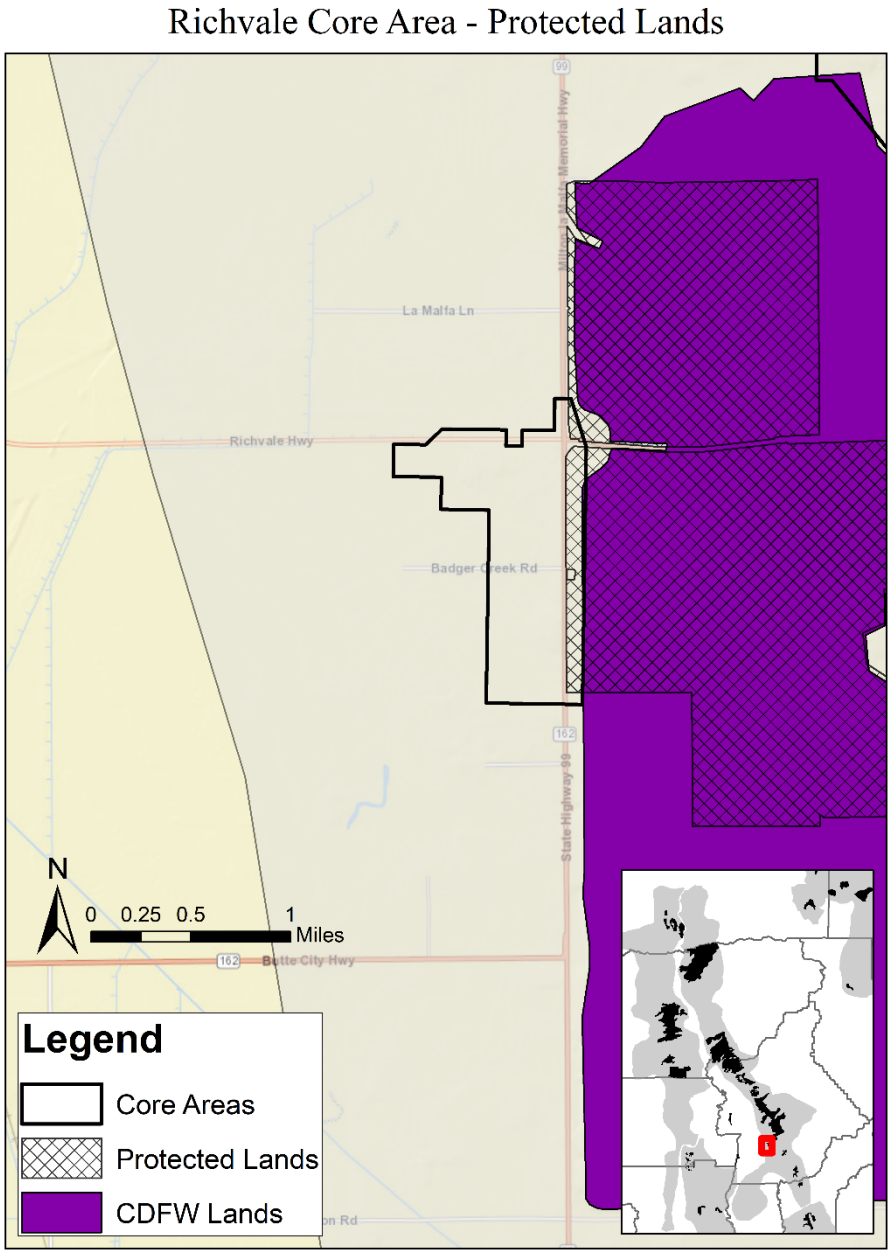

Figure 7.29. Map of protected areas within the Richvale Core Area**.** Protected lands are based on Vollmar et al. (2017) and include various preserves. CDFW = California Department of Fish and Wildlife.

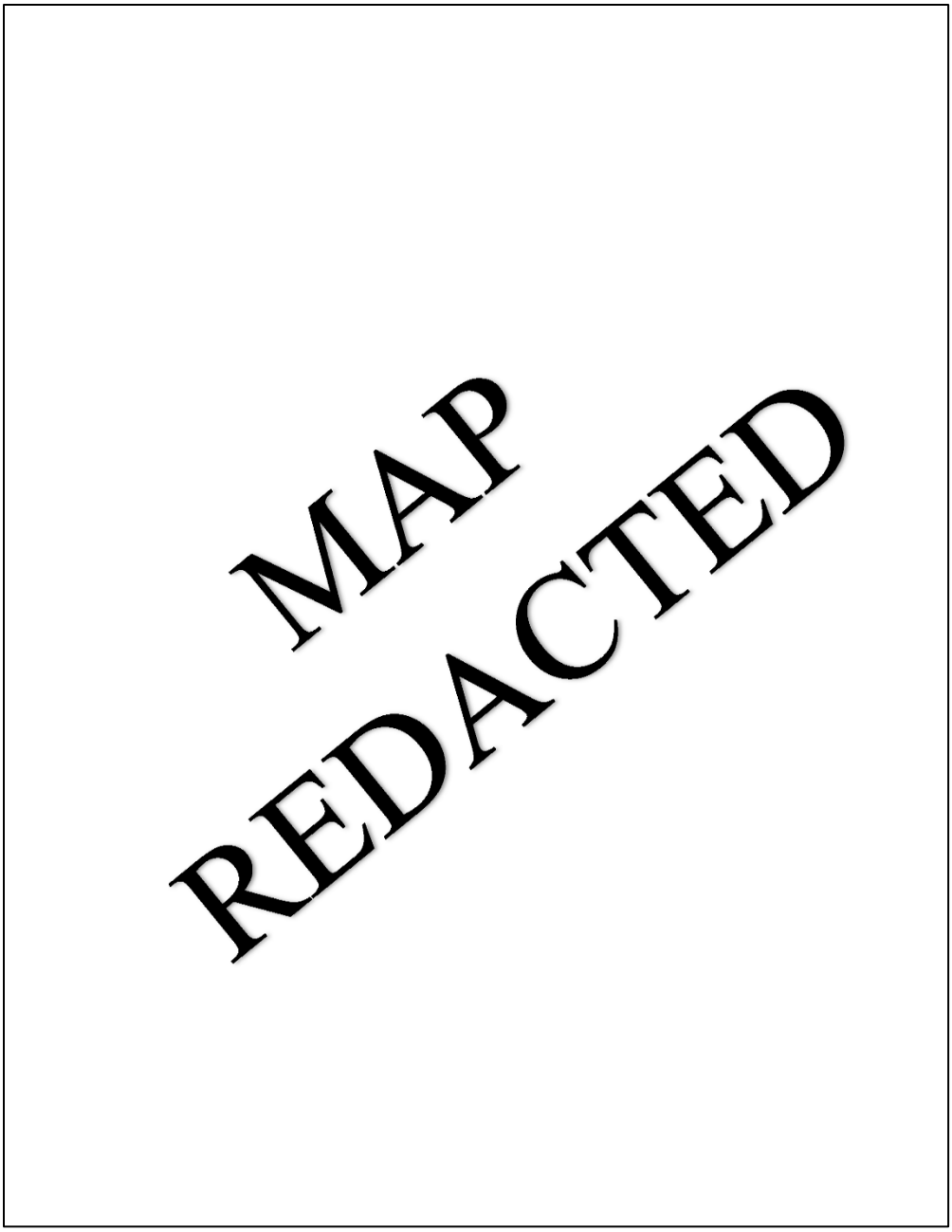

Figure 7.30. Map of known occurrences of vernal pool fairy shrimp recorded in the Diversity Database (2022) within the Richvale Core Area. Polygons may represent individual pools, multiple pools, whole properties, or entire vernal pool grassland complexes. Occurrences are color coded as extant or extirpated based on both the Diversity Database and Witham's (2021) map of vernal pool habitat.

7.7.7.1.Vernal Pool Fairy Shrimp Occurrences

There is one Diversity Database occurrence record for the vernal pool fairy shrimp that partially overlaps this core area (see **Figure 7.30**; Diversity Database 2022). This occurrence was observed in 1993 and was described as northwest of the intersection of Highway 99 and Richvale East Road, likely putting the true location just outside of the core area. As of 2018, this occurrence was not protected (Vollmar et al. 2017), but it is presumed extant by the Diversity Database. This occurrence was classified as partly within extant vernal pool grasslands given the overlap of the polygon with grassland mapped to the northeast (Witham 2021), but the likely true location of the occurrence is outside of vernal pool grasslands mapped by Witham (2021).

7.7.8. Vina Plains

This is a zone 1 core area with a goal of protecting 85% of vernal pool habitat for the vernal pool fairy shrimp and 95% of vernal pool habitat for the vernal pool tadpole shrimp and Conservancy fairy shrimp. The core area is located in northern Butte County and southern Tehama County.

There were approximately 34,594 acres of vernal pool grassland within this core area when the Recovery Plan was published in 2005 (Witham et al. 2013). As of 2018, there were 34,135 acres of vernal pool grassland remaining, with 459 acres lost since 2005 (see **Figure 7.31**, **Table 7.1**; Witham 2021). Almost all losses were due to agricultural conversion (451 acres, 98.3%), mainly to orchards (197 acres, 42.9%) or bare plowed agricultural land (201 acres, 43.8%), and a small amount were due to urbanization (8 acres, 1.7%) (see **Table 7.2**; Witham 2021). Vollmar et al. (2017) estimated that roughly 16,197 acres of vernal pool grassland were protected within this core area as of 2017, representing 46.8% of the 2005 baseline. However, this does not include a 160-acre parcel that is part of TNC's Vina Plains Preserve (**Figure 7.32**) or the 4,273-acre easement on the Lowe property that protects an additional 2,836 acres of vernal pool grassland, so there is actually a total of 19,193 acres of vernal pool grassland protected, representing 55.5% of the 2005 baseline.

Protected areas within this core area include TNC's Vina Plains Preserve, most of the Vina Plains conservation easement, and a small part of the Deer Creek conservation easement; the Hamilton Ranch Conservation Bank, the Meridian Ranch Mitigation Bank and adjacent Meridian Preserve, the Wurlitzer Ranch/Tuscan Preserve (which may or may not still exist; see Service 2020a), and one other mitigation site identified by Vollmar et al. (2017); three ranches with conservation easements, one of which is held by the Natural Resources Conservation Service (NRCS) and another that Vollmar et al. (2017) says is held by TNC; the Lowe property with a conservation easement held by NRCS; and a property owned by Chico State Enterprises (formerly the CSU Chico Research Foundation) (**Figure 7.32**).

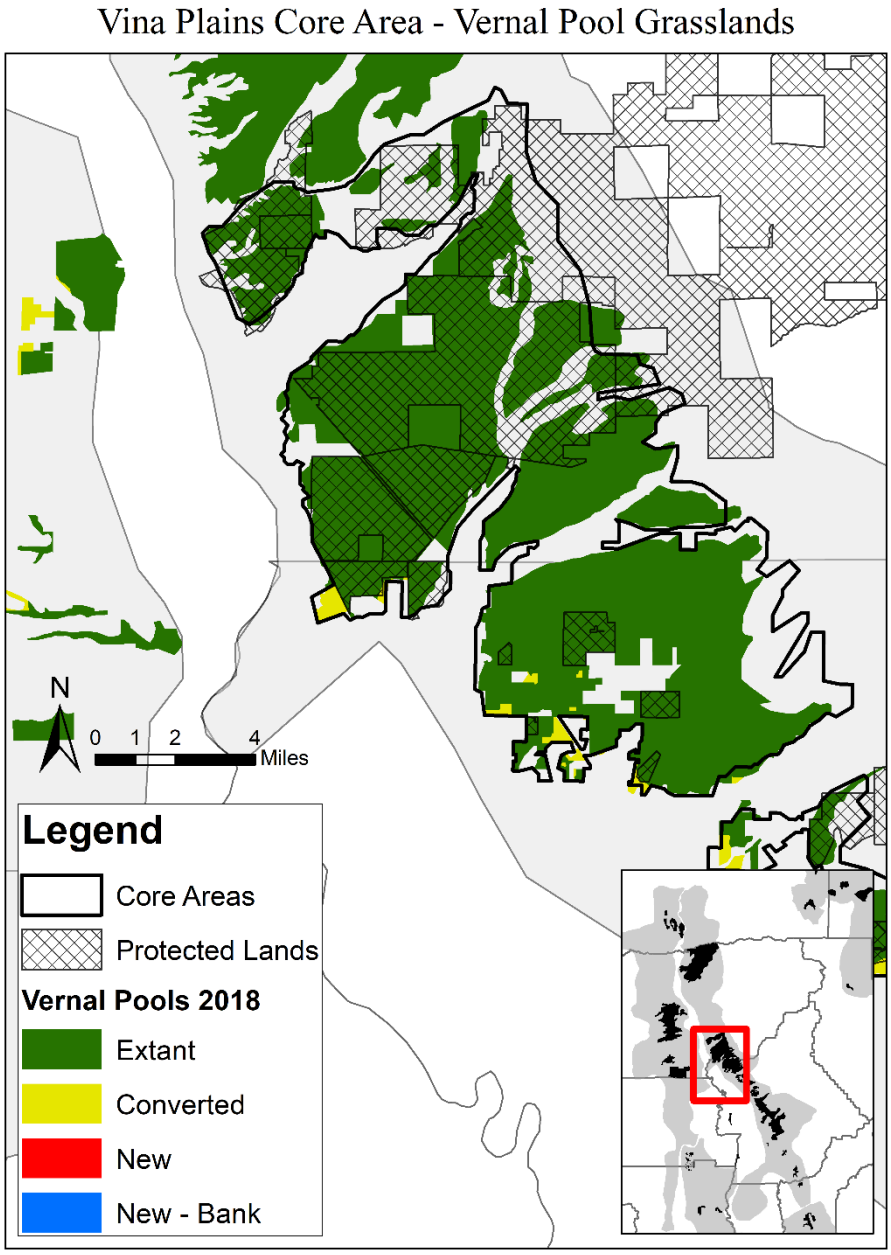

Figure 7.31. Map of vernal pool grassland habitat within the Vina Plains Core Area mapped by Witham (2021) created using aerial imagery from 2018 compared to 2005 and 2012. "New" vernal pool habitat refers to areas not seen in the 2005 or 2012 aerial imagery (either missed or restored). "New - bank" refers to newly created vernal pool habitat on mitigation lands. Converted habitat refers to vernal pool habitat that was seen in 2005 or 2012 aerial imagery and by 2018 was converted to other land uses. Modified habitat as described by Witham (2021) was altered but still provides suitable vernal pool habitat (e.g., mitigation banks, lands managed for waterfowl), and so is mapped as extant. Zoom in for finer resolution.

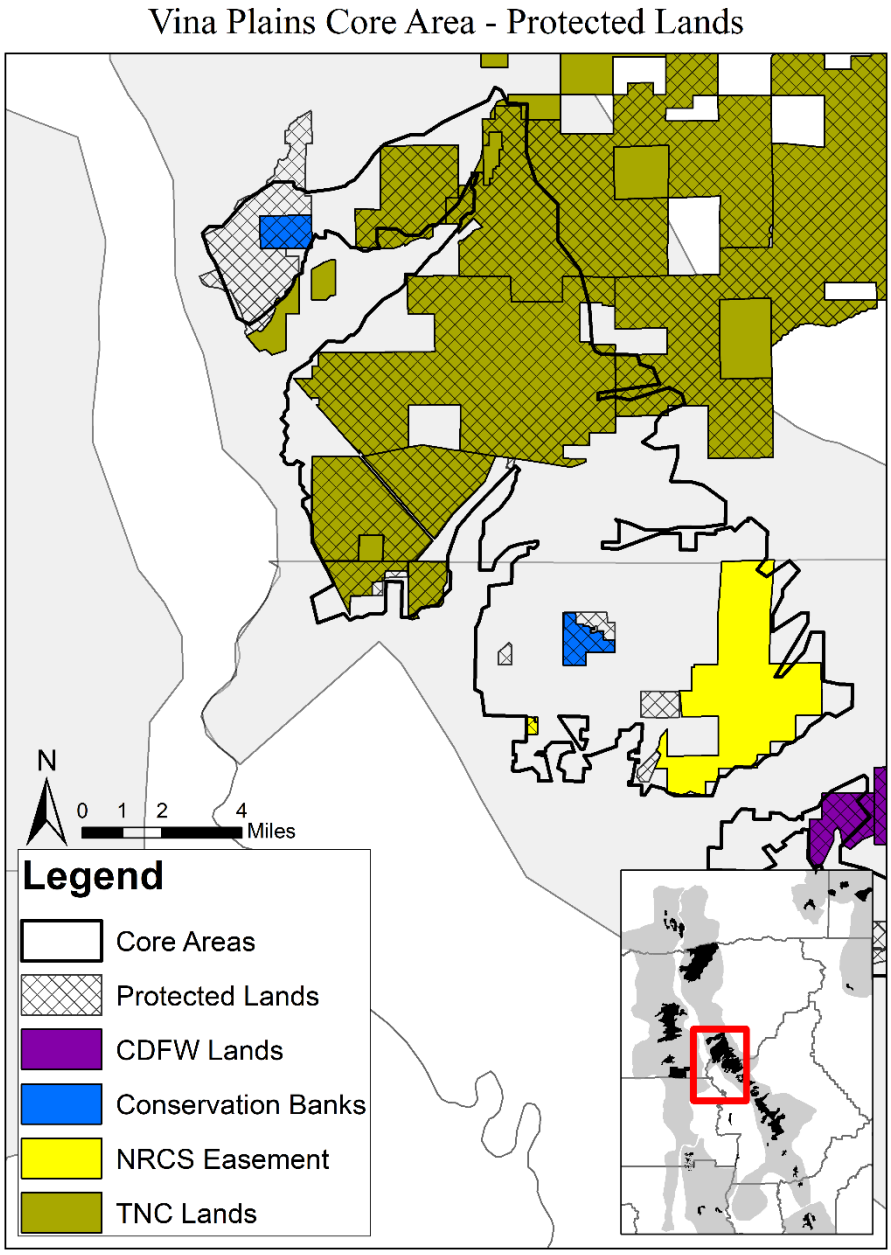

Figure 7.32. Map of protected areas within the Vina Plains Core Area**.** Protected lands are based on Vollmar et al. (2017) and include various preserves. NRCS = Natural Resources Conservation Service, TNC = The Nature Conservancy.

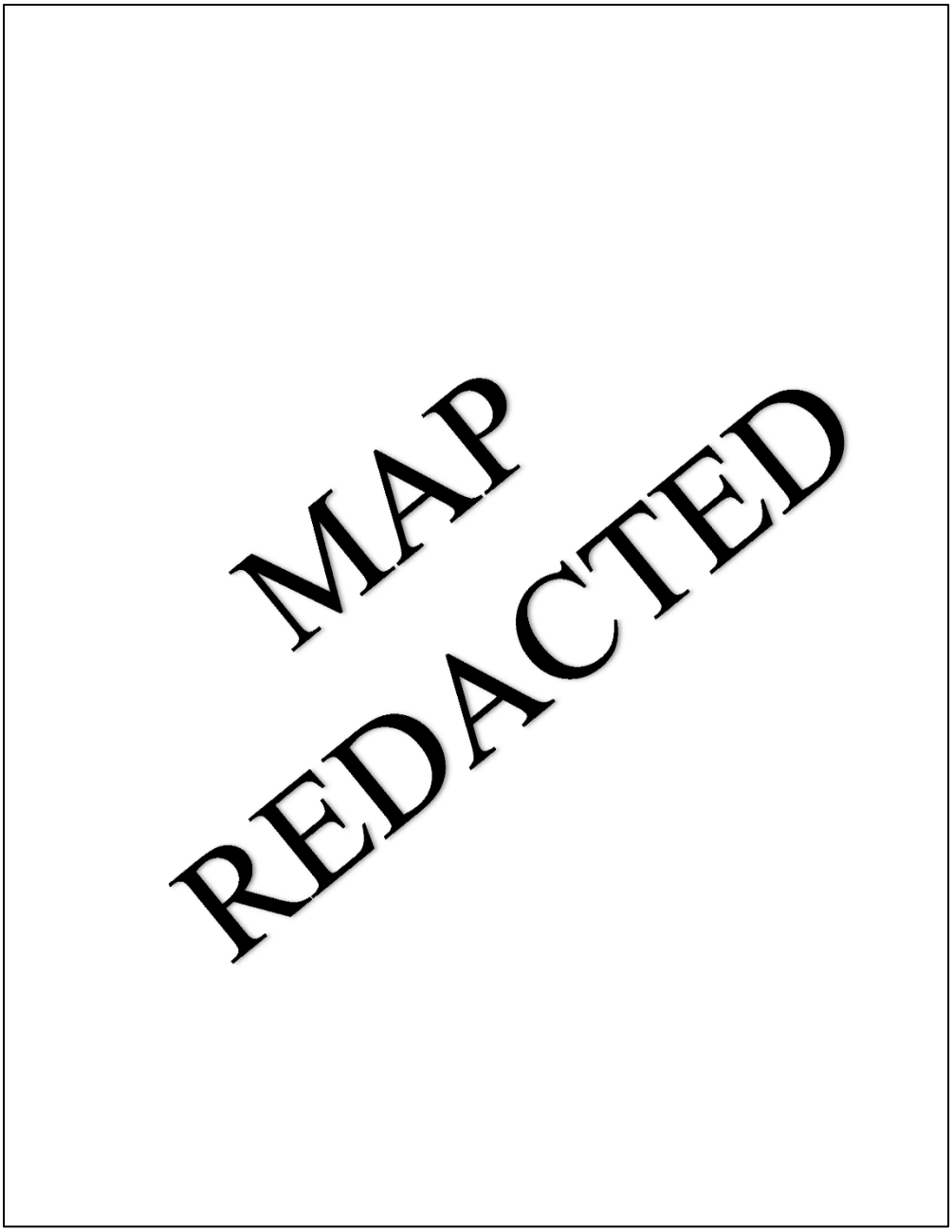

Figure 7.33. Map of known occurrences of vernal pool fairy shrimp recorded in the Diversity Database (2022) within the Vina Plains Core Area. Polygons may represent individual pools, multiple pools, whole properties, or entire vernal pool grassland complexes. Occurrences are color coded as extant or extirpated based on both the Diversity Database and Witham's (2021) map of vernal pool habitat.

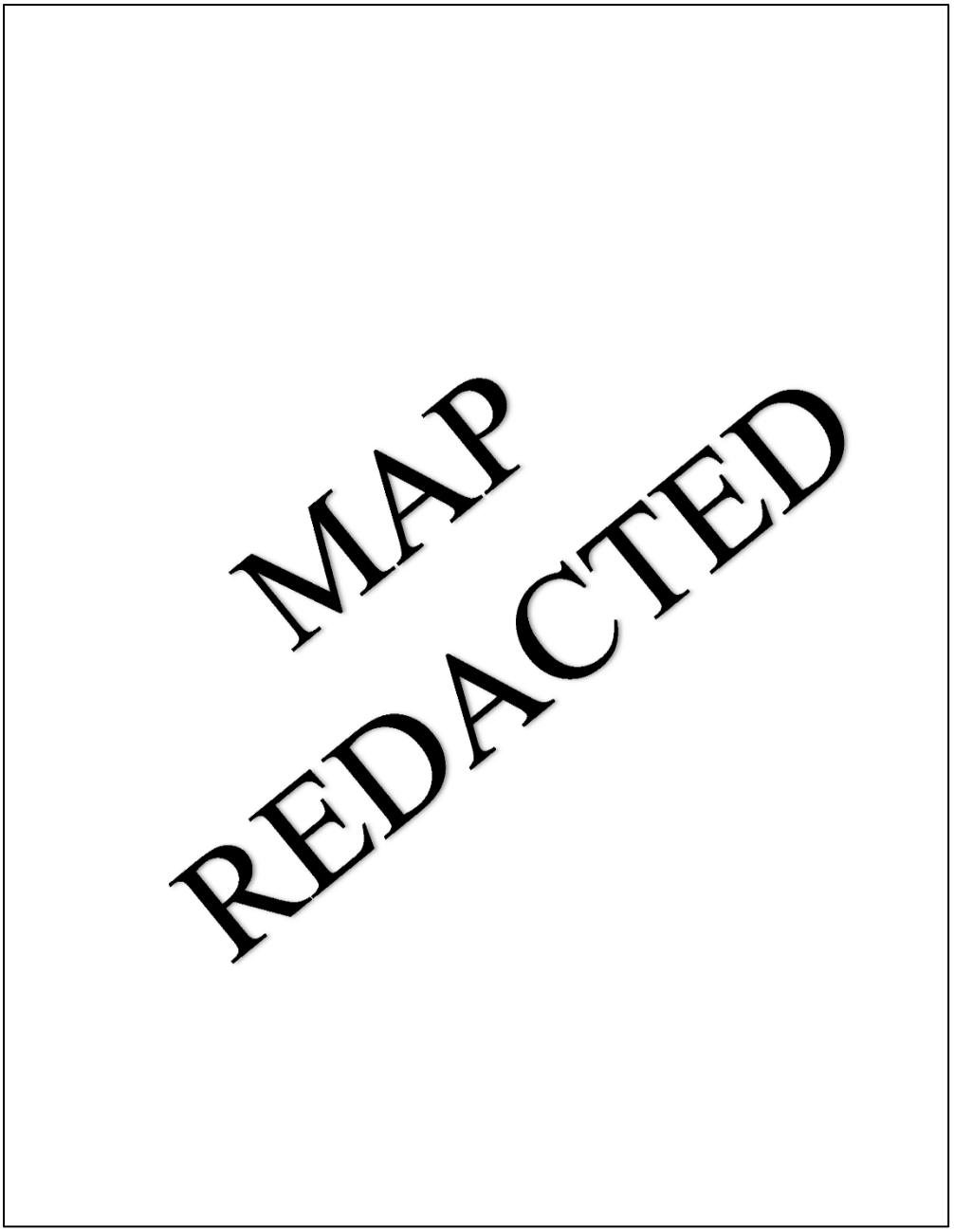

Figure 7.34. Map of known occurrences of vernal pool tadpole shrimp recorded in the Diversity Database (2022) within the Vina Plains Core Area. Polygons may represent individual pools, multiple pools, whole properties, or entire vernal pool grassland complexes. Occurrences are color coded as extant or extirpated based on both the Diversity Database and Witham's (2021) map of vernal pool habitat.

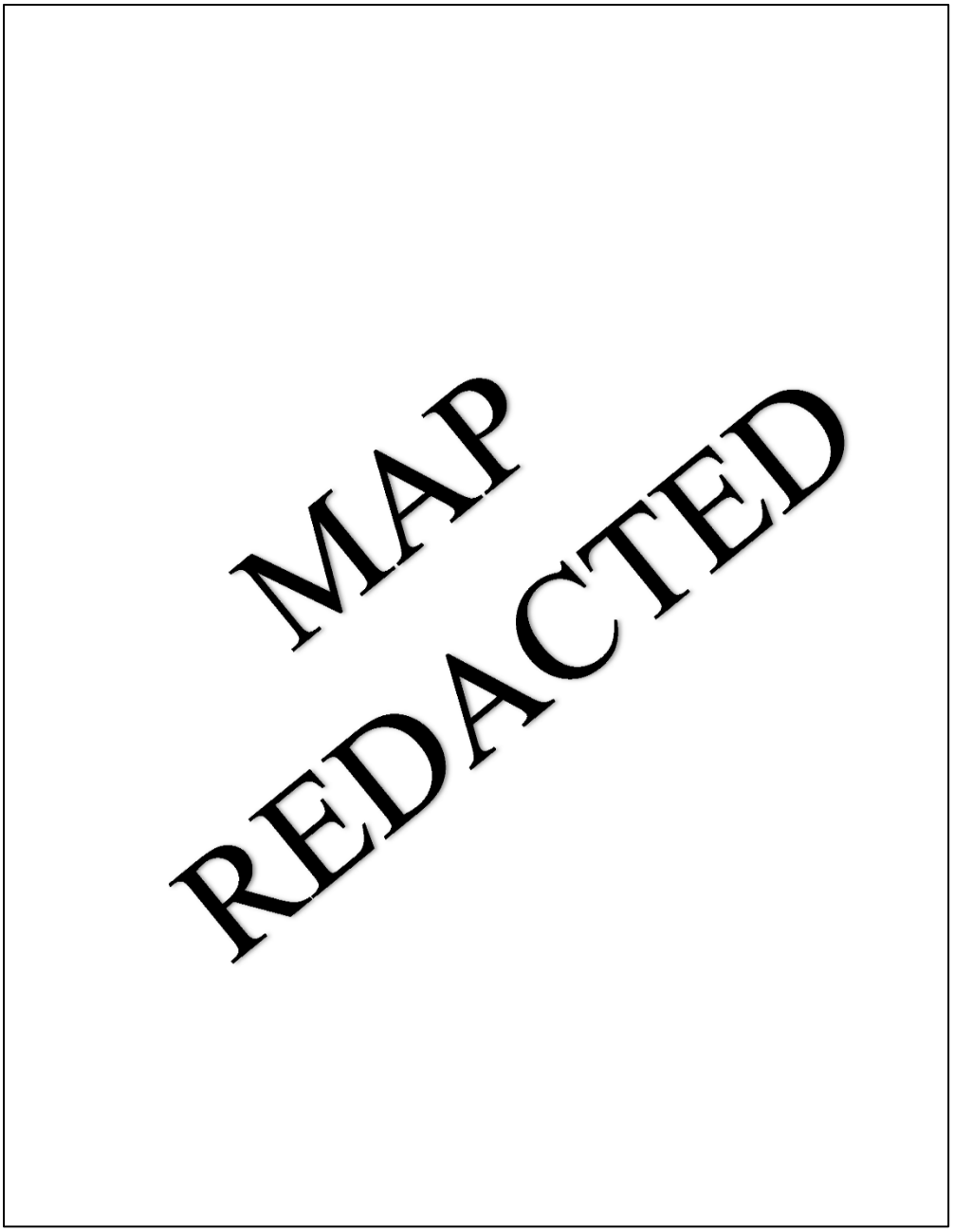

Figure 7.35. Map of known occurrences of Conservancy fairy shrimp recorded in the Diversity Database (2022) within the Vina Plains Core Area. Polygons may represent individual pools, multiple pools, whole properties, or entire vernal pool grassland complexes. Occurrences are color coded as extant or extirpated based on both the Diversity Database and Witham's (2021) map of vernal pool habitat.

7.7.8.1.Vernal Pool Fairy Shrimp Occurrences

There are 19 Diversity Database occurrence records for the vernal pool fairy shrimp within this core area (see **Figure 7.33**; Diversity Database 2022). As of 2018, 10 of these occurrences were at least partially within protected areas (Vollmar et al. 2017). All occurrences are presumed extant by the Diversity Database and are within extant vernal pool grasslands (Witham 2021). Of the 19 records, 5 were known at the time of listing in 1994 and 15 were known at the time the Recovery Plan was published in 2005; these records are located throughout the core area, confirming that the majority of vernal pool grasslands in this core area are occupied by the vernal pool fairy shrimp. The four newer records are located very close to the older records.

7.7.8.1.Vernal Pool Tadpole Shrimp Occurrences

There are 21 Diversity Database occurrence records for the vernal pool tadpole shrimp within this core area (see **Figure 7.34**; Diversity Database 2022). As of 2018, 17 of these occurrences were at least partially within protected areas (Vollmar et al. 2017). All occurrences are presumed extant by the Diversity Database and are within extant vernal pool grasslands (Witham 2021). Of the 21 records, 11 were known at the time of listing in 1994 and 18 were known at the time the Recovery Plan was published in 2005; these records are located throughout the core area. The three newer records are located in the southern portion of the core area, one within the Meridian Ranch Mitigation Bank and adjacent Meridian Preserve, one within another mitigation site to the south, and one just south of the Chico State University research site.

7.7.8.1.Conservancy Fairy Shrimp Occurrences

There are 13 Diversity Database occurrence records for the Conservancy fairy shrimp within this core area (see **Figure 7.35**; Diversity Database 2022). As of 2018, 10 of these occurrences were at least partially within protected areas (Vollmar et al. 2017). All occurrences are presumed extant by the Diversity Database and are within extant vernal pool grasslands (Witham 2021). Of the 13 records, 5 were known at the time of listing in 1994 and 11 were known at the time the Recovery Plan was published in 2005; these records are located throughout the core area. The two newer records are both located on Meridian Ranch in the southern portion of the core area. One occurrence was first observed in 2008 on the northern portion of the property (the Meridian Preserve mitigation site) and the other occurrence was first observed in 2012 on the southern portion of the property (the Meridian Ranch Mitigation Bank). Only 6 of the 13 Diversity Database occurrences include observations from more than one year (Diversity Database 2022), though the two occurrences on Hamilton Ranch Conservation Bank have been observed during more recent regular monitoring (Gallaway Enterprises 2020). Seven of the occurrences have been observed somewhat recently (*i.e.*, 2008 or later) and the other six have not been observed since 2003, either because the species was not present during survey efforts or because the sites have not been surveyed recently.