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2023 ANNUAL REPORT
WETLAND VEGETATION AND WILDLIFE MONITORING

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Prepared by:

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DRAFT 2023 ANNUAL REPORT
WETLAND VEGETATION AND WILDLIFE MONITORING

SUBMITTED TO:

US ARMY CORPS OF ENGINEERS
SACRAMENTO DISTRICT
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CONTENTS

Section **Page**

FIGURES

TABLES

APPENDICES

ACRONYMS AND ABBREVIATIONS

Burleson	Burleson Consulting Inc., A Terracon Company
CCG	Contra Costa goldfields
Chenega	Chenega Tri Services, LLC
cm	centimeter(s)
CTS	California Tiger Salamander
DQO	Data Quality Objective
FAC	Facultative Plant
FACU	Facultative Upland Plant
FACW	Facultative Wetland Plant
fairy shrimp	California Fairy Shrimp
HLA	Harding Lawson and Associates
HMP	Habitat Management Plan
m	meter(s)
MEC	Munitions and Explosives of Concern
NCEI	National Centers for Environmental Information
NL	Not Listed
NOAA	National Oceanic and Atmospheric Administration
NPSDM	Naval Postgraduate School Department of Meteorology
NWSFO	National Weather Service Forecast Office
OBL	Obligate Wetland Plant
PBO	Programmatic Biological Opinion
RACs	rank abundance curves
sp.	species
UPL	Obligate Upland Plant
USACE	United States Army Corps of Engineers
USFWS	United States Fish and Wildlife Service
UXO	Unexploded Ordnance
Wetland Plan	Wetland Monitoring and Restoration Plan for Munitions and Contaminated Soil Remediation
%	Percent

1 INTRODUCTION

United States Army Corps of Engineers (USACE) contracted Harris Environmental Group, Inc. (Harris) and Terracon Consultants (Terracon) to conduct wetland monitoring at former Fort Ord, Monterey County, California (see Figure 1-1). However, due to a late award of the biological monitoring contract, USACE, UCLA staff, and Chenega Tri-Services, LLC (Chenega) conducted all wetland monitoring and the Harris-Terracon team analyzed the field data for this report. Wetland monitoring includes three types of monitoring: hydrology, vegetation, and wildlife. Chenega and USACE staff completed wildlife monitoring in 2023, with assistance from Dr. Robert Copper with UCLA who collected CTS tissue samples for research purposes. Wetland vegetation surveys were completed by USACE staff. Hydrology monitoring was completed by Chenega and is reported separately (Chenega, 2023). These monitoring activities are centered around historical vernal pools on former Fort Ord.

The USACE team monitored wetland vegetation including federally endangered Contra Costa goldfields (*Lasthenia conjugens;* CCG) as well as wildlife in the vernal pools. These monitoring requirements were documented in the *Installation-wide Multispecies Habitat Management Plan* (HMP), the *Programmatic Biological Opinion for Cleanup and Property Transfer Actions Conducted at the Former Fort Ord, Monterey County, California* (PBO); and the *Wetland Monitoring and Restoration Plan for Munitions and Contaminated Soil Remedial Activities at Former Fort Ord* (Wetland Plan) (USACE, 1997; USFWS, 2017; Burleson, 2006).

This report presents the results of monitoring within a number of vernal pools on former Fort Ord. Vernal pools assessed in 2023 included reference vernal pools 5, 101 East (East), 997; and remediated vernal pools 21, 76, 3 North, 3 South, 35, 43, 44, 54, 60, 73, 16, 39, 40 South, 41, 42, and 61 (see Figure 1-2 and Figure 1-3). The populations of CCG were mapped and evaluated at Ponds 997, 3 North, 3 South and 61. Invertebrate and protocol-level California tiger salamander (*Ambystoma califoriense*; CTS) aquatic sampling surveys were completed for Ponds 5, 101 East (East), 3 North, 3 South, 16, 21, 39, 41, 42, 54, 60, 73, and 76 during the 2022-2023 water-year. No wildlife surveys were completed at Ponds 997, 35, 40 South, 43, 44, and 61 East, as they were dry by the time wildlife surveys occurred. In order to prioritize California tiger salamander (CTS) surveys due to time and logistical constraints, fairy shrimp and invertebrate surveys were not conducted at Ponds 61 West, 73, and 76.

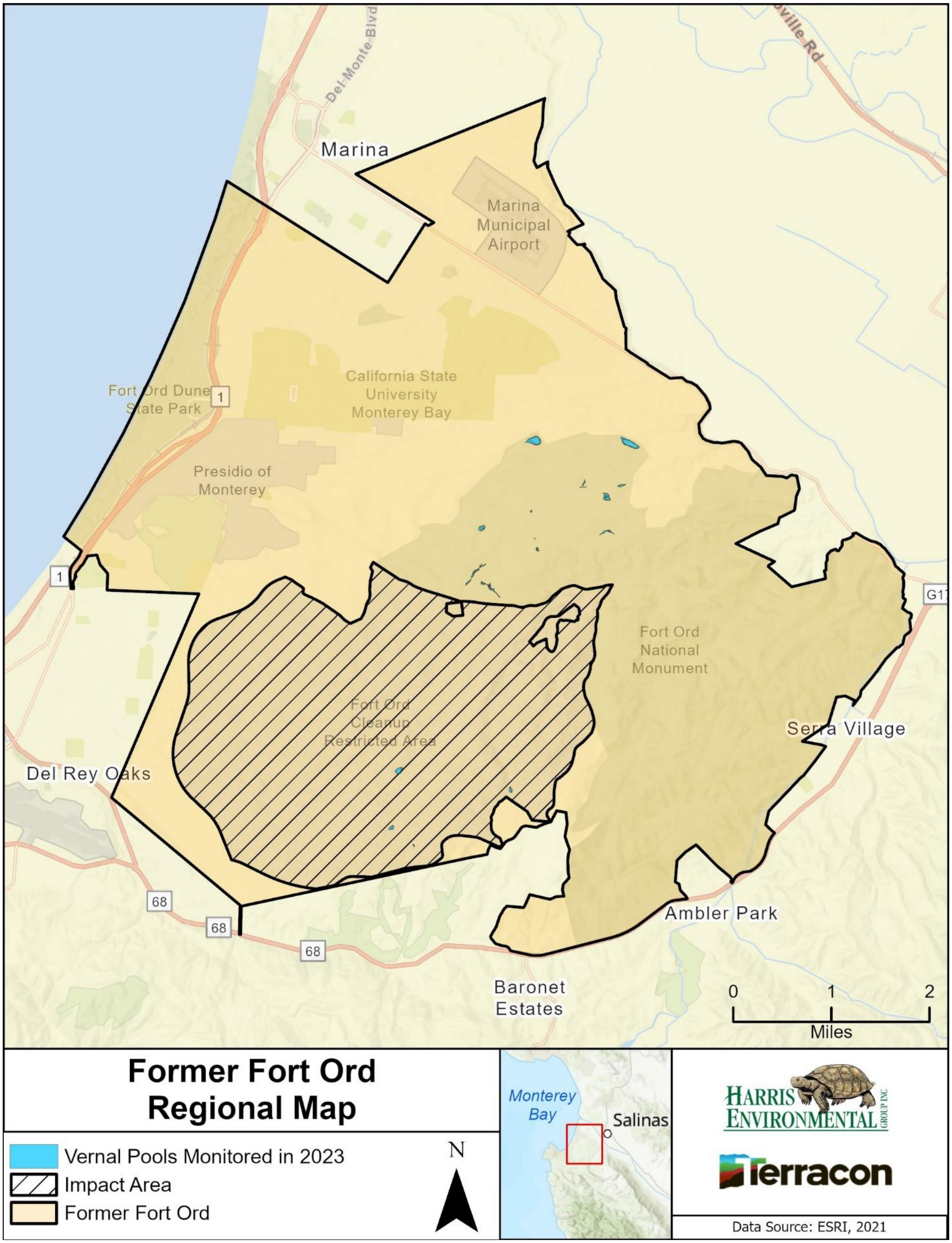

Figure 1-1. Location Map of Vernal Pools on Former Fort Ord Monitored in 2023

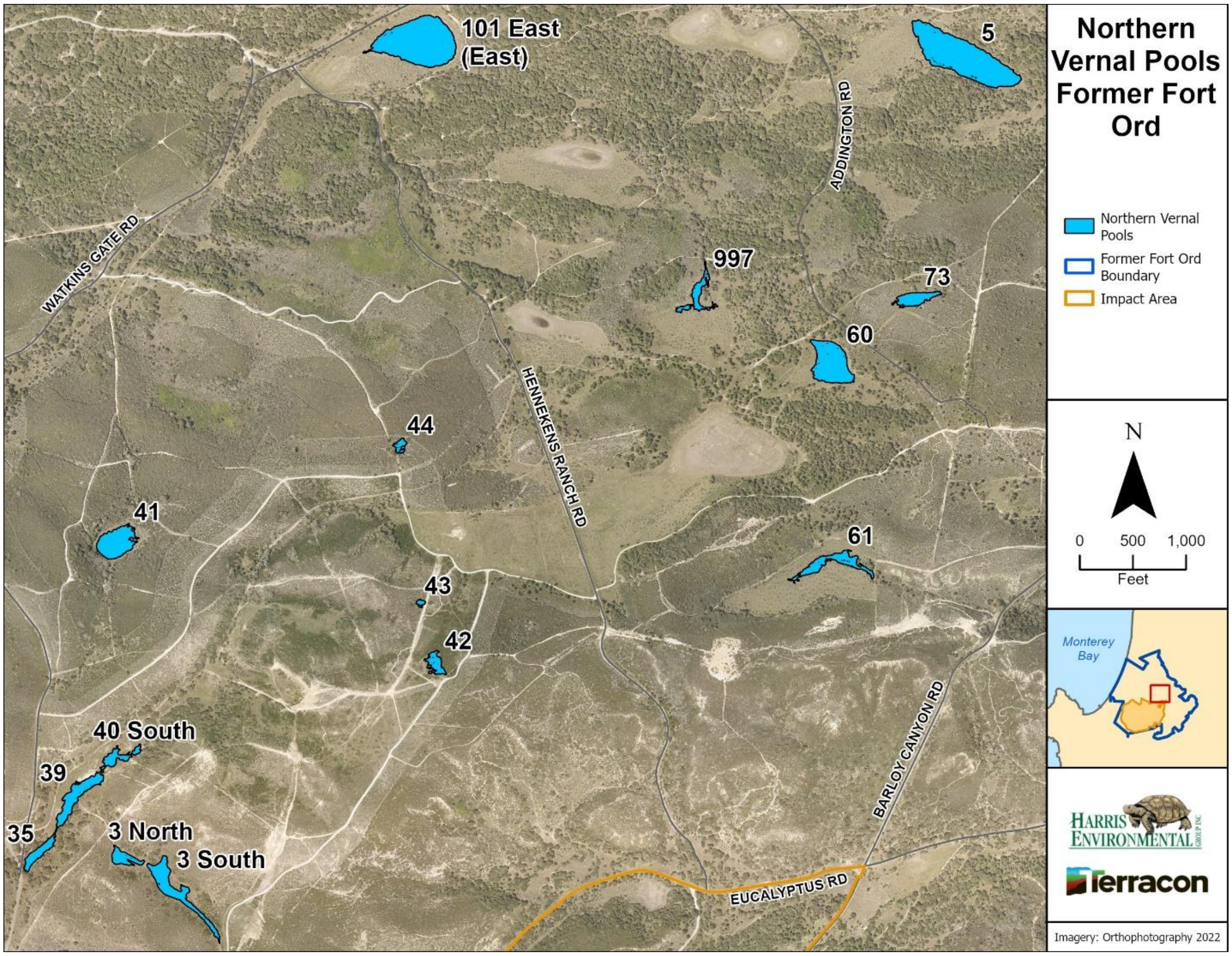

Figure 1-2. Location Map of Ponds 5, 101 East (East), 997, 3 North, 3 South, 35, 39, 40 South, 41, 42, 43, 44, 60, 61, and 73

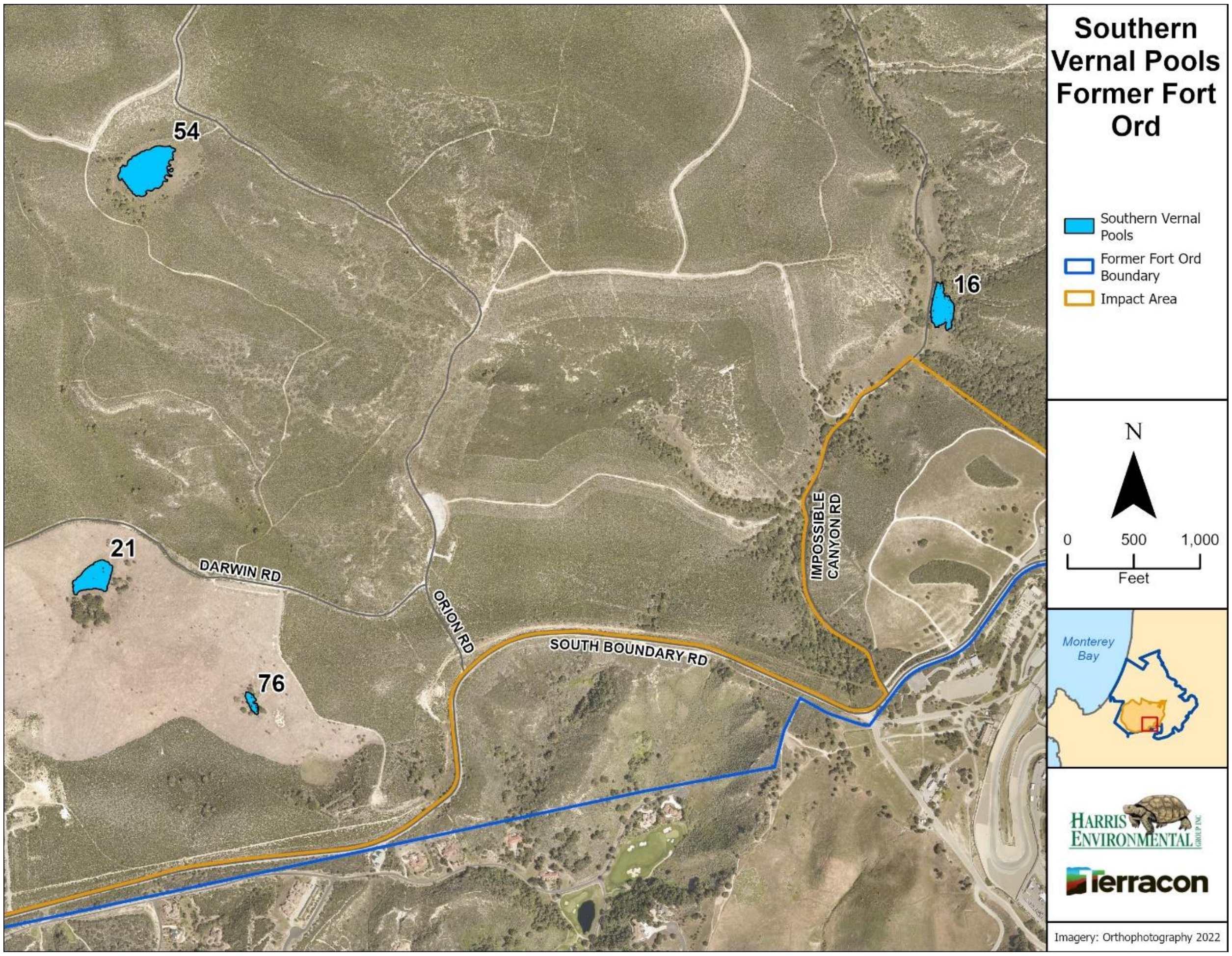

Figure 1-3. Location Map of Ponds 16, 21, 54 and 76

In the 2022-2023 water-year, the Monterey Peninsula Regional Airport meteorological tower recorded precipitation that was approximately 17 centimeters (cm) higher than normal cumulative precipitation, effectively breaking the pattern of drought that spanned the 2020-2021 and 2021-2022 water-years. It was the fifth-highest recorded cumulative precipitation in 32 years of data collection (NPSDM, 2023; see Figure 1-4). There was unusually heavy rainfall from December 2022 through January 2023, with a large spike in March which brought regional flooding through much of the winter and early spring. Many vernal pools on Fort Ord remained inundated with water through the remainder of the water-year even after precipitation fell back to a normal pattern in April (see Figure 1-5). The total cumulative precipitation was approximately 140 percent (%) higher than normal.

The Monterey Peninsula Regional Airport meteorological tower is located approximately two miles southwest of Site 39 on former Fort Ord. The Monterey Peninsula Regional Airport tower replaced the National Weather Service Forecast Office (NWSFO) tower on April 1, 2019; the new tower is located within one kilometer of the NWSFO tower. All 2022-2023 values in this report are from the new Monterey Peninsula Regional Airport tower.

The NWSFO determines normal rainfall based on a 30-year average that is moved forward 10 years at the end of each decade. Prior to 2021, the dataset was from 1981-2010. In this report and the previous two annual reports, normal rainfall was updated resulting in some water-years to be recategorized based on their relationship to normal. The normal dataset used for comparison in this report is from the NWSFO tower and is defined as the mean precipitation from years 1991-2020. Water-years are categorized as normal if cumulative precipitation was within one inch of the NWSFO normal. The two water-years that were recategorized were 1998-1999 and 1999-2000, which changed from below-normal to normal.

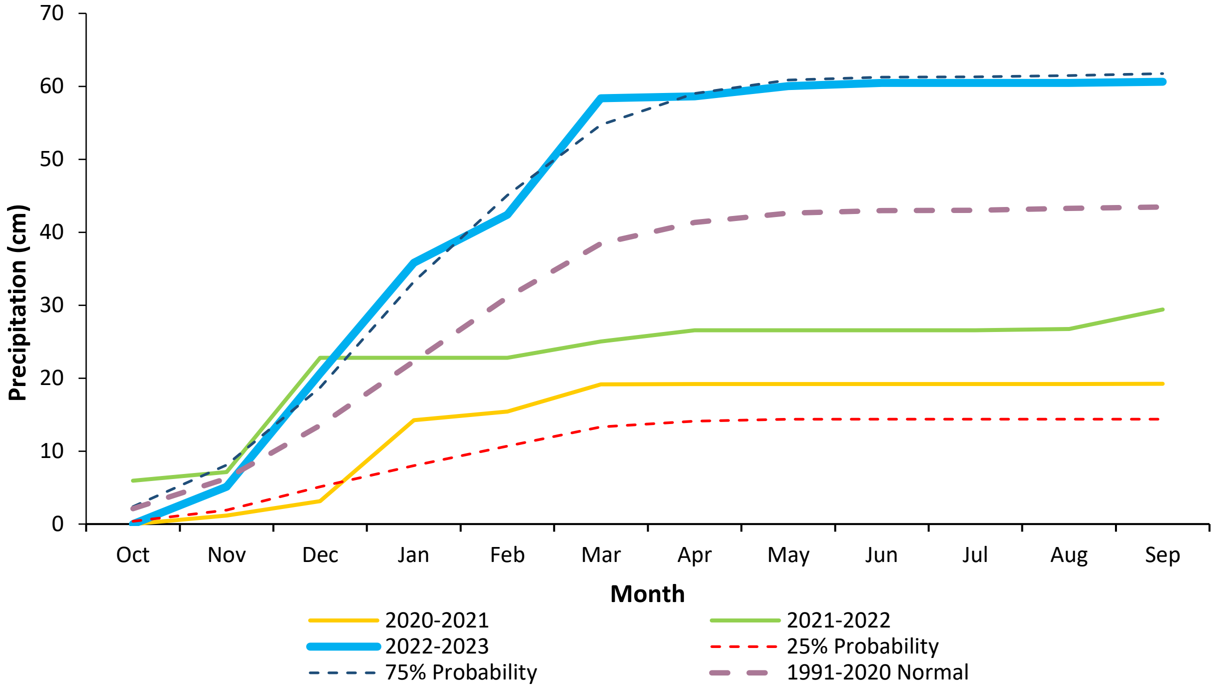

Figure 1-4. Cumulative Monthly Precipitation for the 2022-2023 Water-Year compared to the 30-Year Normal (mean 1991-2020), the 2021-2022 Water-Year, the 2020-2021 Water-Year, and the 25% and 75% Probabilities (NPS, 2022; National Centers for Environmental Information [NCEI] and National Oceanic and Atmospheric Administration [NOAA], 2023)

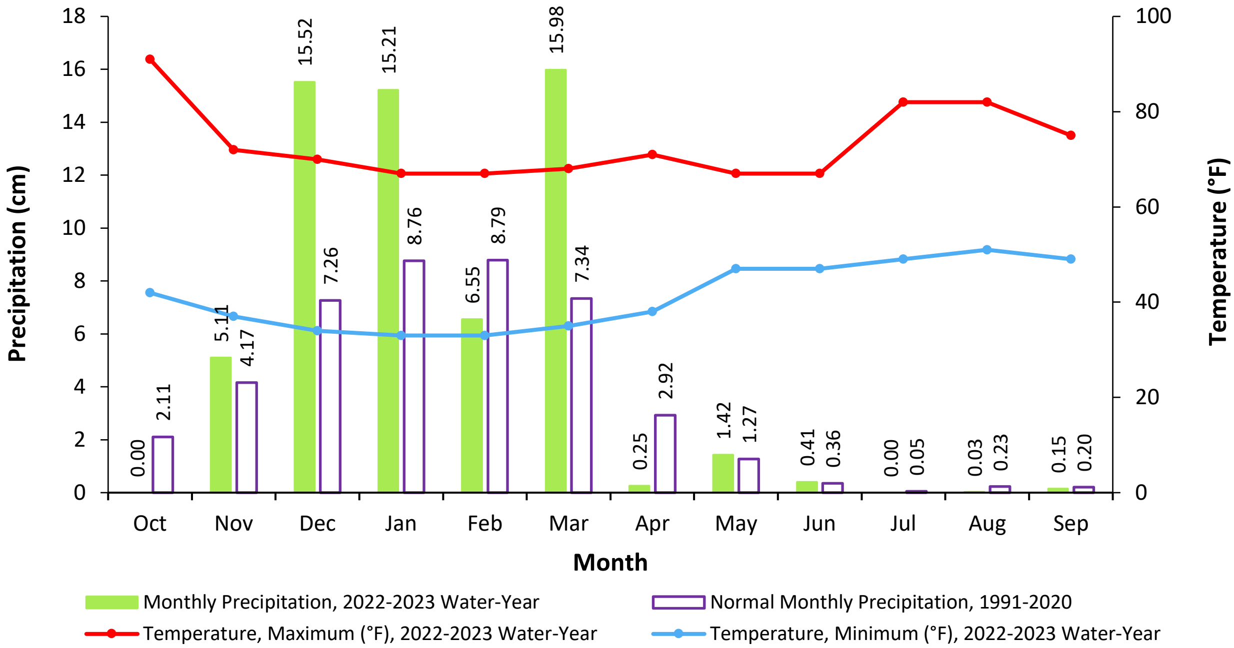

Figure 1-5. Monthly Precipitation, Maximum and Minimum Temperatures for the 2022-2023 Water-Year and Normal Monthly Precipitation (NPS, 2023).

The goal of hydrology, wetland vegetation, and wildlife monitoring efforts is to evaluate vernal pools potentially affected by remediation activities against success criteria identified in the HMP, PBO, and Wetland Plan (USACE, 1997; USFWS, 2017; Burleson, 2006). The Wetland Plan outlines the Data Quality Objectives (DQO) used to evaluate success criteria for this report. The DQOs focus on vernal pool depth, inundation, vegetation, water quality, and wildlife. The PBO outlines success criteria specifically for CTS and CCG. Reestablishment of these species will be considered successful if, at the end of monitoring, wetland function, wildlife usage, wetland plant cover, diversity and dominance, and CCG abundance are directly comparable to the conditions before remediation. Monitoring results guide decision-making to evaluate if and when corrective actions are necessary and to provide insight for potential mitigation or evaluation of monitoring methodologies. The objectives of monitoring were to document the ability of vernal pools to support CTS and California fairy shrimp (*Linderiella occidentalis*; fairy shrimp), understand hydrologic function and water quality conditions, document baseline conditions, and provide data for follow-up comparison. Table 1-1 presents the status of vernal pools monitored in 2023 at former Fort Ord. This report presents Year 5 post-remediation monitoring data for 14 of the 16 remediated vernal pools, which is the final required monitoring year as required by the Wetland Plan and PBO.

Table 1-1. 2023 Monitoring Status of Vernal Pools on Former Fort Ord

Vernal Pool	Monitoring Status
Pond 21	Year 1 Post-Mastication and Post-Subsurface Munitions Remediation
Pond 76	Year 1 Post Mastication
Pond 3 North	Year 5 Post-Subsurface Munitions Remediation (<10 ft^2)
Pond 3 South	Year 5 Post-Subsurface Munitions Remediation (<10 ft^2)
Pond 35	Year 5 Post-Subsurface Munitions Remediation (<10 ft^2)
Pond 43	Year 5 Post-Subsurface Munitions Remediation (<10 ft^2)
Pond 44	Year 5 Post-Subsurface Munitions Remediation (<10 ft^2)
Pond 54	Year 5 Post-Subsurface Munitions Remediation (<10 ft^2)
Pond 60	Year 5 Post-Subsurface Munitions Remediation (<10 ft^2)
Pond 73	Year 5 Post-Subsurface Munitions Remediation (<10 ft^2)
Pond 16	Year 5 Post-Subsurface Munitions Remediation (> 10 ft^2)
Pond 39	Year 5 Post-Subsurface Munitions Remediation (> 10 ft^2)
Pond 40 South	Year 5 Post-Subsurface Munitions Remediation (> 10 ft^2)
Pond 41	Year 5 Post-Subsurface Munitions Remediation (> 10 ft^2)
Pond 42	Year 5 Post-Subsurface Munitions Remediation (> 10 ft^2)
Pond 61	Year 5 Post-Subsurface Munitions Remediation (> 10 ft^2)
Pond 5	Reference
Pond 101 East (East)	Reference
Pond 997	Reference

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2 METHODS

Sampling methods for wetland vegetation monitoring and aquatic surveys were consistent with the PBO and Wetland Plan (USFWS, 2017; Burleson, 2006). Due to a late award of the biological monitoring contract, wetland vegetation and wildlife monitoring surveys were conducted by biologists from USACE, Chenega, and UCLA.

Vernal pools must be monitored for baseline conditions prior to any remedial activities such as prescribed burns, mastication, excavation, or artificial draining (USFWS, 2017). As described in the PBO, the Army will conduct two years of pre-activity larval CTS sampling, to the extent possible, in the vernal pools where more than 50% of the watershed is affected by prescribed burns; thus, vernal pools may be monitored over multiple years for baseline (USFWS, 2017).

Vernal pools are then monitored following any remedial activity for 3 to 5 years depending on the type of disturbance. Post-burn monitoring occurs in vernal pools if more than 50% of the watershed of a vernal pool is affected and is conducted annually for the first three years following a burn (USFWS, 2017). Although not specifically indicated in the PBO, the Army applies the same standard to vernal pools where more than 50% of the watershed was masticated, but no mastication of vegetation occurred within the inundation area. If vegetation is mowed within the inundation area, the vernal pool is monitored for vegetation in the first, third, and fifth years, following mastication (Burleson, 2006). Vernal pools where subsurface munitions remediation activities disturbed less than 10 square feet and were shallower than four feet deep are monitored in the first, third, and fifth years, following remediation, whereas vernal pools with greater and/or deeper disturbances are monitored annually for five years following remediation (Burleson 2006). In cases of vernal pools where more than one type of remedial activity occurred, the most stringent monitoring frequency is followed. Three reference vernal pools that were not remediated are also monitored for comparison on an annual basis.

In 2018, Ponds 3 North, 3 South, 16, 35, 39, 40 South, 41, 42, 43, 44, 54, 60, 61, and 73 were investigated for geophysical anomalies that potentially represented munitions and explosives of concern (MEC) items, and all had subsurface munitions remediation (KEMRON, 2020). They were in their final year of monitoring in 2023 for year 5 post-subsurface munitions remediation. Ponds 5, 101 East (East), and 997 were monitored as reference vernal pools. In 2019, Pond 21 was monitored for baseline. Pond 76 was monitored for Year 1 post-mastication.

For the sake of clarity, all vernal pools in their final year of monitoring (Yr 5) were only analyzed for post-subsurface munitions remediation monitoring from 2019-2023, as monitoring for post-mastication and/or post-burn was completed in year 3 monitoring in either 2019 or 2020. Therefore, results from 2019-2023 were only compared to baseline, and not to the preceeding monitoring years in 2017 or 2018.

2.1 Vegetation Monitoring

Vegetation data were collected at vernal pools after wildlife surveys were completed in late May. Typically, vernal pools are visited more than once prior to collection of quadrat data to identify species presence, evaluate vegetative strata, and determine the ideal time to collect data. However, the late award of the biological monitoring contract, in addition to prolonged inundation, compressed data collection into one to two visits. Vegetation quadrat data were collected between May 30 and September 30, 2023. Data were collected as the vernal pools dried and the vegetation was sufficiently identifiable (see Appendices A, B, C, D, and E). Biologists visually assessed the historical vernal pool basins for each resource and identified homogeneous vegetative strata.

Vernal pool basins are defined by the hydrogeomorphic basin feature and the distinctly different vegetative community compared to the surrounding upland area. Because the basins vary from year to year and from wet to dry weather cycles over decades, the center portions of the basins typically support wetland vegetation associations, whereas outer portions at the highest elevations may not. The basin may vary from year to year from a combination of factors that include the amount of precipitation and timing, the duration of inundation, decaying vegetation from the previous season, sediment load, soil chemistry, and other stochastic processes. For some vernal pools, these variables only minimally impact the vernal pool basin and for others, they can expand, contract, and change dramatically. The basin boundary is identifiable in the field because the hydrologic regime often precludes the presence of mature stands of upland tree and shrub communities within the basin boundaries. For vernal pools located within grasslands, basin boundaries are typically defined by a change from mesic grasses to monotypic stands of upland grasses.

For this report, vegetative strata refer to the different homogenous vegetative communities that are distributed around the vernal pools in a zonate pattern. These are characteristically concentric circles similar to a bullseye. Open water typically recedes towards the center through the dry season. Differing depths and duration of inundation result in suites of plant species which are organized into discernable zones. These can be readily differentiated and mapped. During the visual assessment, biologists recorded the percent of submergent, emergent, and floating vegetative cover within the inundated areas when present. Inundated areas were characterized by the presence of standing water with wetland vegetation, whereas open water areas were characterized by standing water without vegetation. An upland stratum is characterized by upland species but is only mapped when it is within the vernal pool and therefore surrounded by wetland species, such as mima mounds. The upland transition on the periphery of the vernal pool was not mapped.

Strata were differentiated based on dominant species and overall species composition. The team used a stratified random quadrat method to collect data within each accessible stratum (Barbour *et al.*, 1980). When strata were inundated, vegetation was too dense or tall to enter, or in areas with safety concern due to potential MEC presence, visual cover data were estimated to define strata. In vernal pools that have been monitored using the same methodology in previous years, the transect locations were repeated when the strata were defined by the same dominant species and the transect locations were representative of the species composition for that strata. Otherwise, biologists placed a new transect in the most homogenous representative area for each accessible stratum. These were mapped using a Trimble® GeoExplorer® 6000 Global Positioning System (GPS). Transects were 5-meters (m) or 10-m in length depending on stratum size. Biologists used a random number table to determine placement of a 0.25 m^2 quadrat along each transect. The quadrat was placed a minimum of three times for every 5 m of transect. Biologists recorded the absolute percent cover by plant species, thatch, and bare ground (see Appendix A). Species percent cover was averaged for each stratum of the sampled vernal pools (see Appendix B). Biologists mapped strata the same day as quadrat and calculated absolute percent cover of the strata using ArcGIS Pro (Esri, 2024). In addition, photo points were taken to show the extent of each vernal pool for comparison with previous years (See Appendix C).

In addition to quadrat species identification, all plant species observed in the basin for each vernal pool were recorded. Most species were identified in the field using *The Plants of Monterey County, an Illustrated Field Key; Second Edition* (Matthews and Mitchell, 2015), *Monterey County Wildflowers, a*

Field Guide, First Edition (Matthews and Mitchell, 2015), *Plants of San Francisco Bay Region, Mendocino to Monterey, Third Edition* (Beidleman and Kozloff, 2003) and *The Jepson Manual: Vascular Plants of California, Second Edition* (Baldwin *et al.*, 2012). Plants were categorized as native, non-native, or unidentified (see Appendix D Tables D-1 – D-20). Additional categorization of the plants occurred to identify them as one of the following: obligate wetland (OBL), facultative wetland (FACW), facultative (FAC), facultative upland (FACU), obligate upland (UPL), or not listed (NL) (see Appendix D Tables D-21 – D-40) (Lichvar *et al.*, 2016). When species could not be identified in the field, samples were collected from the vernal pool (not from the quadrats) and identified in the office.

Contra Costa goldfields (*Lasthenia conjugens*) were mapped using a Trimble® GeoExplorer® 6000 Global Positioning System (GPS). CCG populations were mapped by creating polygons and absolute cover was visually estimated.

2.2 Wildlife Monitoring

Following the HMP, PBO, and Wetland Plan, biologists typically conduct aquatic surveys for CTS and fairy shrimp in March, April, and May (USACE, 1997; USFWS, 2017; Burleson, 2006). Due to a late award of the biological monitoring contract and logistical constraints, the initial surveys were conducted in April and were focused on detecting CTS in vernal pools with known CTS populations. This decision was made with input from USFWS and CDFW representatives following the Annual Habitat Restoration and Monitoring Meeting on April 19th. Some vernal pools with known CTS populations were not monitored until May (Ponds 16 and 60). Surveys for fairy shrimp and macroinvertebrates were conducted in May along with CTS surveys. The criterion used to identify suitable fairy shrimp habitat requires that a vernal pool retain an average of 10 cm of water for at least 18 consecutive days. The criterion used to identify suitable CTS breeding habitat requires that a vernal pool retain an average depth of at least 25 cm from the first rain event through March (Burleson, 2006). Both criteria were met at all the vernal pools where aquatic surveys were conducted. Although Pond 61 West met both criteria at the end of April, aquatic surveys were not conducted at that vernal pool due to logistical constraints.

Nets, boots, and other equipment were scrubbed with 10% diluted bleach solution and completely dried between monitoring different vernal pools to reduce the possibility of spreading disease. Additionally, nets, boots, and equipment were treated with 10% diluted bleach solution and dried at the end of each day. Cleaning solutions were applied to equipment in areas away from aquatic resources, on disturbed or developed roads to reduce contamination.

2.2.1 California Tiger Salamander

Survey methods for CTS followed the *Interim Guidance on Site Assessment and Field Surveys for Determining Presence or a Negative Finding of the California Tiger Salamander* (USFWS and California Department of Fish and Game, 2003) with modifications to maintain consistency of the data as described in the Wetland Plan. Some exceptions were made as needed: where time and logistics allowed, aquatic sampling continued after initial detection, and dip nets were used exclusively. Additional aquatic sampling was completed to provide additional insight into vernal pool function. USACE Safety deemed the following vernal pools safe to enter: Ponds 5, 101 East (East), 997, 101 (West), 3 North, 3 South, 16, 21, 35, 39, 40 South, 41, 42, 43, 44, 60, 61 West, 61 East, and 73. Ponds 54 and 76 were surveyed from the vernal pool's edge due to potential presence of MEC.

CTS larvae were collected using long-handled, fine-meshed, D-shaped dipnets to allow biologists to record individual metrics and derive an approximate CTS count for each vernal pool where time and logistics allowed. All sites were sampled using dipnets to minimize aquatic habitat disturbance as well as to maintain safety due to potential presence of unexploded ordnance (UXO). This methodology was chosen to allow direct comparison to past results. Depending on the extent of aquatic habitat, two to three biologists sampled each site. Biologists collected samples from each vernal pool until the habitat was adequately represented.

Biologists measured and recorded the length of a subset of 30 individual CTS larvae collected. When the total number of CTS collected was less than 30, all individuals were measured*. Additional amphibian species were identified recorded for presence/absence where applicable.

*One exception to this was at Pond 101 East (East). 29 CTS larvae were observed but only 26 were measured due to field error.

2.2.2 California Fairy Shrimp

Aquatic sampling for fairy shrimp and other aquatic invertebrates was conducted where possible due to time constraints and a limited crew. A fine-meshed dip net was used, and protocols followed the *Interim Survey Guidelines to Permittees for Recovery Permits Under Section 10(a)(1)(A) of the Endangered Species Act for the Listed Vernal Pool Branchiopods* (USFWS and California Department of Fish and Game, 1996). Representative portions of the bottom, edges, and vertical water column of each vernal pool were sampled. When fairy shrimp were present, the abundance was estimated by collecting 5-20 swipes throughout the vernal pool. The number of swipes relates to the size and complexity of the vernal pool and was consistent with the range of frequencies outlined in protocols from previous reports. More swipes occur at larger and/or more complex vernal pools than at small vernal pools. Following dip netting, the number of collected fairy shrimp were totaled and the abundance was reported as follows (see Appendix G Tables G-2 – G-3):

- Low abundance: 1 to 10 individuals;
- Moderate abundance: 11 to 100 individuals;
- High abundance: 101 to 300 individuals; and
- Very high abundance: greater than 300 individuals.

2.3 Evaluation for Data Quality Objectives and Success Criteria

Data quality objectives (DQO) and performance standards outlined in the Wetland Plan were used to measure successful wetland function following MEC and soil remediation activities (Burleson, 2006). DQOs can be summarized as:

- DQO 1: depth – average of 25 cm through March for CTS and average of at least 10 cm through May for fairy shrimp
- DQO 2: inundation – consistent with baseline and similar to reference vernal pool trends
- DQO 3: vegetation – similar hydrophytic vegetation as reference control wetlands
- DQO 4: water quality – adequate for the presence of CTS and/or fairy shrimp
- DQO 5: wildlife – consistent with baseline and similar to reference control wetland trends

Hydrological conditions, inundation areas, and water quality were assessed by Chenega using DQO 1, DQO 2, and DQO 4 and are not included in this report (Chenega, 2023).

Plant cover and species diversity were assessed using DQO 3. Species diversity was assessed by examining species richness and species abundance. Wetland vegetation monitoring results were analyzed to identify whether the vernal pool was similar to baseline and reference vernal pools and if wetland function was consistent through time. The disturbed vernal pool should have the following characteristics by the end of the last year of monitoring:

- A number of native wetland species present in the vernal pool comparable to the number present in the vernal pool before MEC and contaminated soils removal or in control wetlands, and
- A relative dominance of native wetland species in the vernal pool comparable to the relative dominance in the vernal pool before MEC and contaminated soil removal or in control wetlands.

Wildlife usage was assessed using DQO 5. DQOs 1 and 4 apply to depths and the relationship between water quality and wildlife presence and were assessed as part of the Hydrology Monitoring Annual Report (Chenega, 2023). For DQO 5, the vernal pool was considered successful if the post-remediation wildlife usage was similar to pre-disturbance usage. The Wetland Plan indicates that a vernal pool that supported CTS and fairy shrimp prior to remediation activities should continue to support those species following such activities (Burleson, 2006).

In addition to the Wetland Plan, the PBO outlines the following success criteria specifically for CTS and CCG (USFWS, 2017). Species reestablishment will be considered successful if, at the end of monitoring, each of the following is directly comparable to the conditions before the start of work:

1. Wetland function, as measured by the parameters of hydrologic conditions (inundation area and depth, pH, temperature, dissolved oxygen levels);
2. Wildlife usage, specifically CTS larval presence;
3. Plant cover and wetland plant species diversity and dominance; and
4. CCG abundance.

These four conditions were assessed in conjunction with the DQOs. Wetland function was assessed with DQO 1, DQO 2, and DQO 4 and was discussed in the Hydrology Monitoring Annual Report (Chenega, 2023). Wildlife usage is assessed with DQO 5. Plant cover and wetland plant species diversity and dominance were assessed with DQO 3. Contra Costa goldfield abundance was assessed with DQO 3.

Historical data for cumulative precipitation, wetland vegetation, and wildlife presence or absence for all reference and post-remediation vernal pools were summarized by vernal pool. Wetland vegetation was compared across years and to reference vernal pools based on the stratum, absolute percent vegetative cover, species richness, native plant species richness, relative percent native species cover, wetland plant species richness, relative percent wetland plant cover, and species composition (see Appendices A, B, D, and E). Wildlife was evaluated using the presence or non-detection of CTS and fairy shrimp (see Appendix G).

Rank-abundance curves (RACs) were generated to illustrate species composition and relative species abundance at the vernal pools. The species rank was plotted on the x-axis and the proportional abundance on the y-axis, with species identified using their species code. The RACs show the distribution of the species, relative abundance, species evenness, and species richness. They can characterize the species composition further than the community metrics such as the Shannon-Wiener diversity index or the species evenness index (Calow, 1999). We created rank abundance curves using the rankabundance function in the BiodiversityR package (Kindt, 2019). For RACs with species codes and individual years, the y-axis was put into log-10 scale and for the RACs with all years on one plot, the x-axis and y-axis were both in log-10 scale (see Appendix F).

3 RESULTS

Vegetation monitoring was conducted at Ponds 5, 101 East (East), 997, 3 North, 3 South, 16, 21, 35, 39, 40 South, 41, 42, 43, 44, 54, 60, 61, 73, and 76. Across all monitored vernal pools, the mean number of native plant species was 16 and non-native species was 11 (see Table 3-1). Of these species, a mean of 15 were wetland species, either obligate (OBL) wetland, facultative wetland (FACW), or facultative (FAC) (see Table 3-2). In addition to vegetative strata mapping and transect surveys, populations of Contra Costa goldfields (CCG) were surveyed at Ponds 3 North, 3 South, 61, and 997.

Table 3-1. Vegetation Species Richness of Native and Non-Native Species Observed on Transects at Vernal Pools Monitored in 2023

Vernal Pool	Monitoring Status	Native	Non-Native
Pond 5	Reference	12	12
Pond 101 East (East)	Reference	9	7
Pond 997	Reference	13	14
Mean (Reference)	-	**11**	**11**
21	Year 1 Post-Mastication and Post-Subsurface Munitions Remediation	13	6
76	Year 1 Post-Mastication	16	8
3 North	Year 5 Post-Subsurface Munitions Remediation	10	8
3 South	Year 5 Post-Subsurface Munitions Remediation	21	14
35	Year 5 Post-Subsurface Munitions Remediation	7	9
43	Year 5 Post-Subsurface Munitions Remediation	19	6
44	Year 5 Post-Subsurface Munitions Remediation	21	14
54	Year 5 Post-Subsurface Munitions Remediation	19	5
60	Year 5 Post-Subsurface Munitions Remediation	7	6
73	Year 5 Post-Subsurface Munitions Remediation	22	11
16	Year 5 Post-Subsurface Munitions Remediation	11	6
39	Year 5 Post-Subsurface Munitions Remediation	23	17
40 South	Year 5 Post-Subsurface Munitions Remediation	18	18
41	Year 5 Post-Subsurface Munitions Remediation	22	8
42	Year 5 Post-Subsurface Munitions Remediation	14	14
61	Year 5 Post-Subsurface Munitions Remediation	27	17
Mean (Remediated)	-	**17**	**10**
Mean (All)	-	**16**	**11**

Table 3-2. Vegetation Species Richness of Obligate and Facultative Wetland Species Observed on Transects at Vernal Pools Monitored in 2023

Vernal Pool	Monitoring Status	OBL	FACW	FAC	Wetland Species
Pond 5	Reference	6	7	3	16
Pond 101 East (East)	Reference	4	6	1	11
Pond 997	Reference	4	6	4	14
Mean (Reference)	-	**5**	**6**	**3**	**15**
21	Year 1 Post-Mastication and Post-Subsurface Munitions Remediation	3	5	5	13
76	Year 1 Post-Mastication	6	7	3	16
3 North	Year 5 Post-Subsurface Munitions Remediation	3	5	3	11
3 South	Year 5 Post-Subsurface Munitions Remediation	5	10	5	20
35	Year 5 Post-Subsurface Munitions Remediation	5	2	2	9
43	Year 5 Post-Subsurface Munitions Remediation	5	11	3	19
44	Year 5 Post-Subsurface Munitions Remediation	3	10	4	17
54	Year 5 Post-Subsurface Munitions Remediation	7	7	2	16
60	Year 5 Post-Subsurface Munitions Remediation	5	4	1	10
73	Year 5 Post-Subsurface Munitions Remediation	8	7	3	18
16	Year 5 Post-Subsurface Munitions Remediation	2	5	3	10
39	Year 5 Post-Subsurface Munitions Remediation	5	9	6	20
40 South	Year 5 Post-Subsurface Munitions Remediation	3	7	3	13
41	Year 5 Post-Subsurface Munitions Remediation	8	9	3	20
42	Year 5 Post-Subsurface Munitions Remediation	6	6	4	16
61	Year 5 Post-Subsurface Munitions Remediation	4	13	6	23
Mean (Remediated)	-	**5**	**7**	**4**	**16**
Mean (All)	-	**5**	**7**	**3**	**15**

Aquatic wildlife monitoring was conducted at Ponds 5, 101 East (East), 3 North, 3 South, 16, 21, 39, 41, 42, 54, 60, 73, and 76 (see Table 3-3 and Appendix G Tables G-1, G-2, and G-3). No wildlife surveys were completed at Ponds 997, 35, 40 South, 43, 44, and 61 East, as they were dry by the time wildlife surveys occurred. In order to prioritize California tiger salamander (CTS) surveys due to time and logistical constraints, fairy shrimp and invertebrate surveys were not conducted at Ponds 61 West, 73, and 76. Vernal pools were sampled up to two times in April and May. California tiger salamander larvae were present in Ponds 5, 101 East (East), 21, 54, 60, 16, 39, and 41. Fairy shrimp were only present at Pond 16 in 2023 in low abundance.

Table 3-3. California Tiger Salamander and Fairy Shrimp Detections at Vernal Pools in 2023

Vernal Pool	Monitoring Status	CTS Detected	Fairy Shrimp Detected
Pond 5	Reference	Yes	No
Pond 101 East (East)	Reference	Yes	No
Pond 21	Year 1 Post-Mastication and Post-Subsurface Munitions Remediation	Yes	No
Pond 76	Year 1 Post Mastication	No	No
Pond 3 North	Year 5 Post-Subsurface Munitions Remediation	No	No
Pond 3 South	Year 5 Post-Subsurface Munitions Remediation	No	No
Pond 54	Year 5 Post-Subsurface Munitions Remediation	Yes	No
Pond 60	Year 5 Post-Subsurface Munitions Remediation	Yes	No
Pond 73	Year 5 Post-Subsurface Munitions Remediation	No	No
Pond 16	Year 5 Post-Subsurface Munitions Remediation	Yes	Yes (Low)
Pond 39	Year 5 Post-Subsurface Munitions Remediation	No	No
Pond 41	Year 5 Post-Subsurface Munitions Remediation	Yes	No
Pond 42	Year 5 Post-Subsurface Munitions Remediation	No	No

3.1 Pond 5

Pond 5 is a reference vernal pool that was monitored as a control for comparison to the remediated vernal pools. In 2023, Pond 5 was monitored for hydrology, vegetation, and wildlife. Hydrology results are reported separately in the Hydrology Monitoring Annual Report (Chenega, 2023).

3.1.1 Vegetation Monitoring

Vegetation monitoring was completed at Pond 5 on August 30 and September 19, 2023. These monitoring data represent reference conditions. Pond 5 held water from December 2022 through the remainder of the 2022-2023 water-year (Chenega, 2023). Biologists identified three vegetative strata at the vernal pool (see Table 3-4 and Figure 3-1). Strata 2 and 3 were repeated from 2016-2022. Stratum 9 and the associated transect were established in 2023. Transects 2 and 3 were relocated because the previous locations were no longer within the correct strata.

Table 3-4. Pond 5 (Reference) Vegetative Strata Percentage within the Vernal Pool Basin Boundary

Stratum	Percentage
1 (Inundated)	62%
2	18%
3	18%
9	2%

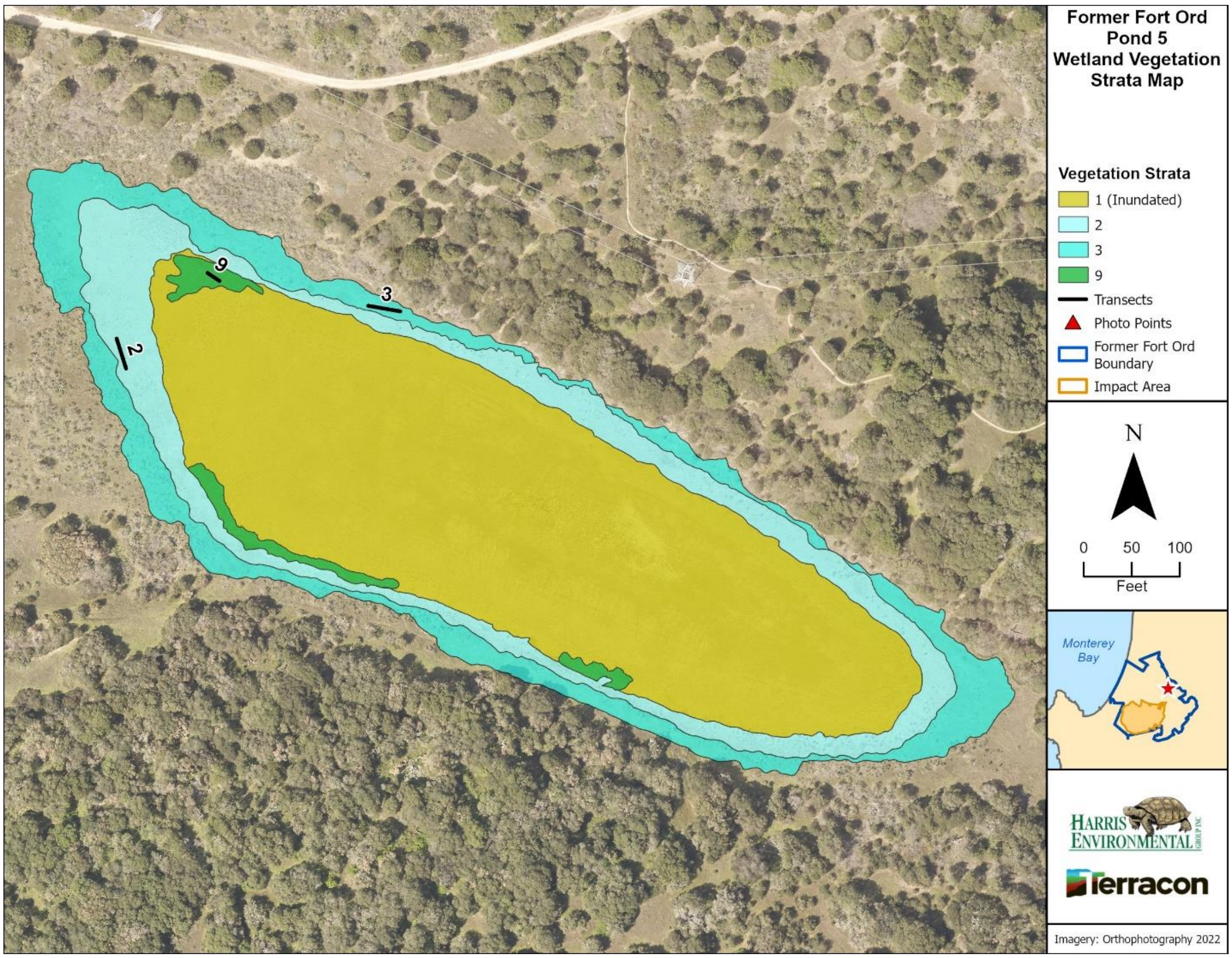

Figure 3-1. Pond 5 (Reference) Vegetation Strata and Transects on Former Fort Ord, 2023

Sixty-eight plant species were observed within the vernal pool basin boundary. Of these species, 41 were native, 23 were non-native, and four were unidentified. Ten species were OBL wetland plants, 23 were FACW or FAC, 11 were FACU or UPL, and 24 were not listed. Appendix B provides the species cover results for each stratum. Appendix D identifies the number of native, non-native, and unidentified species within each stratum as well as the number of species within each wetland indicator category for each stratum. Table 3-5 provides a summary of the dominant species cover results for each stratum.

Table 3-5. Pond 5 (Reference) Dominant Species by Stratum Results

Stratum	Transect Length (m)	Dominant Species	
		Common Name	Absolute Cover on Transect (%)
2	10	pale spikerush	64.3
3	10	grass poly	19.0
		salt grass	13.3
		Lemmon's canary grass	12.8
9	5	Howell's quillwort	43.3

3.1.2 Wildlife Monitoring

Pond 5 was surveyed for CTS on April 27, then the vernal pool was surveyed for both fairy shrimp and CTS on May 11, 2023. California tiger salamanders were present at the April and May surveys, while fairy shrimp were not present in May. Table 3-6 and Table 3-7 provide results of the CTS and fairy shrimp surveys in 2023. Invertebrate results for 2023 are provided in Appendix G (see Table G-2).

Table 3-6. Pond 5 (Reference) CTS Aquatic Monitoring Results

Vernal Pool	Sampling Date	# of Larvae Obs.	# of Larvae Measured	Total Length of Larvae (mm)			Snout-Vent Length of Larvae (mm)			Survey Hours
				Mean*	Range	Mode	Mean*	Range	Mode	
5	4/27/2023	1		-	-	-	-	-	-	20min†
	5/11/2023	44	30	85	43-105	95	46	25-56	54	5 hr 55 min

*The mean was rounded to the nearest whole number
†Surveyed until first detection

Table 3-7. Pond 5 (Reference) Fairy Shrimp Monitoring Results

Sampling Date	Abundance (# Individuals)
5/11/2023	Not Detected

3.2 Pond 101 East (East)

Pond 101 East (East) is a reference vernal pool that was monitored as a control for comparison to the remediated vernal pools. In 2023, Pond 101 East (East) was monitored for hydrology, vegetation, and wildlife. Hydrology results are reported separately in the Hydrology Monitoring Annual Report (Chenega, 2023).

3.2.1 Vegetation Monitoring

Vegetation monitoring was completed at Pond 101 East (East) on August 29, 2023. These monitoring data represent reference conditions. Pond 101 East (East) held water in December through the remainder of the 2022-2023 water-year (Chenega, 2023). Biologists identified three strata at the vernal pool (see Table 3-8 and Figure 3-2). The vernal pool remained indundated late into the season, limiting strata development. Stratum 2 was repeated from 2016 and 2018-2020. Stratum 4 was repeated from 2016 and 2020-2022, whereas Stratum 5 was repeated from 2017-2022. Transect 4 was relocated to a more representative location. Transect 5 was repeated from 2017-2019. There was no transect for

Stratum 2 because it was inundated at the time of survey activities; a visual cover estimate was completed.

Table 3-8. Pond 101 East (East) (Reference) Vegetative Strata Percentage within the Vernal Pool Basin Boundary

Stratum	Percentage
2 (Inundated)	53%
4	21%
5	26%

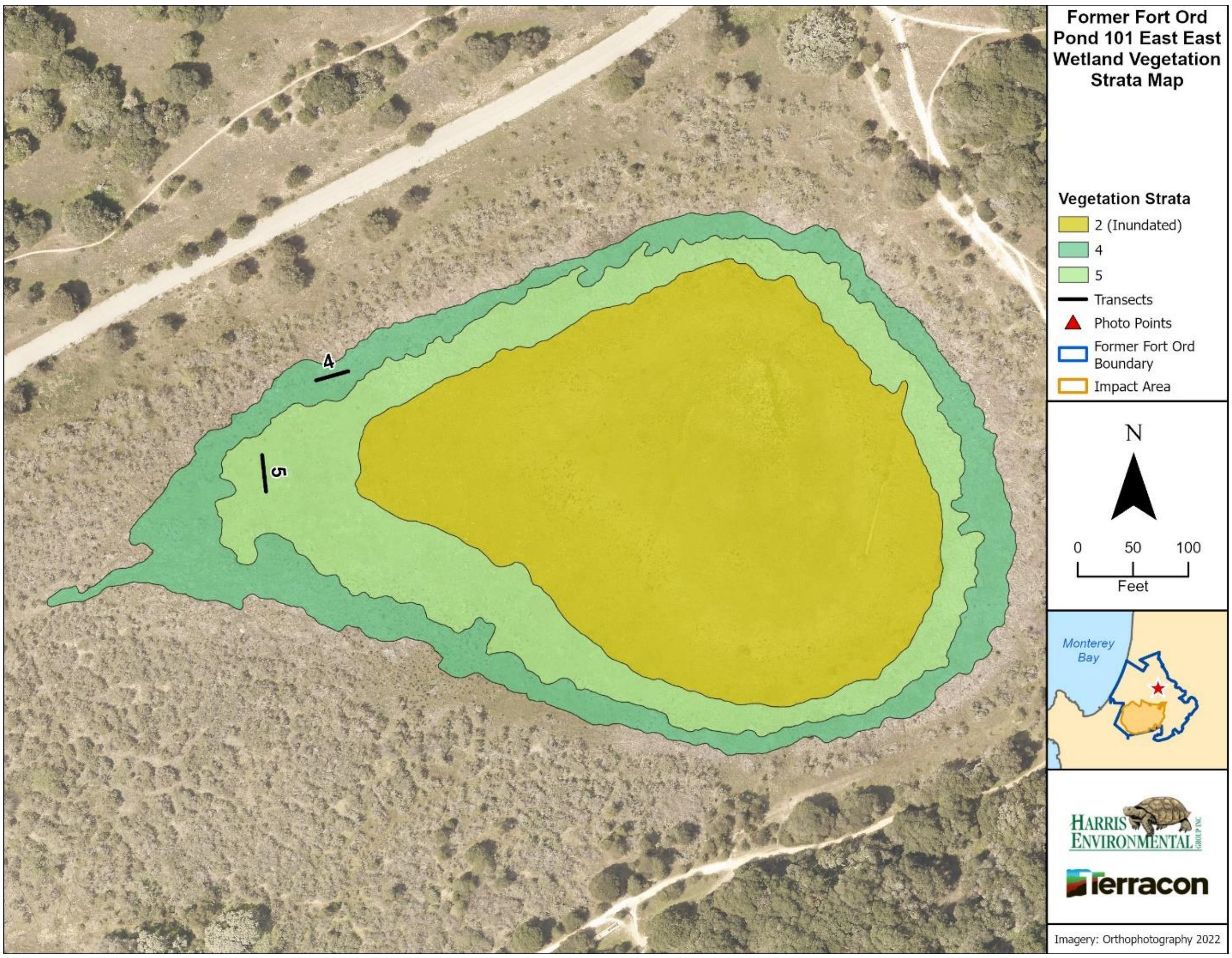

Figure 3-2. Pond 101 East (East) (Reference) Vegetation Strata and Transects on Former Fort Ord, 2023

Fifty-six plant species were observed within the vernal pool basin boundary. Of these species, 27 were native, 27 were non-native, and two were unidentified. Five species were OBL wetland plants, 19 were FACW or FAC, 14 were FACU or UPL, and 18 were not listed. Appendix B provides the species cover results for each stratum. Appendix D identifies the number of native, non-native, and unidentified

species within each stratum as well as the number of species within each wetland indicator category for each stratum. Table 3-9 provides a summary of the dominant species cover results for each stratum.

Table 3-9. Pond 101 East (East) (Reference) Dominant Species by Stratum Results

Stratum	Transect Length (m)	Dominant Species	
		Common Name	Absolute Cover on Transect (%)
4	10	Pacific bent grass Baltic rush	34.2 25.8
5	10	lowland cudweed needle spikerush tall cyperus	34.2 14.2 13.3

3.2.2 Wildlife Monitoring

Pond 101 East (East) was surveyed for CTS on April 27 and May 11, 2023, whereas surveys for fairy shrimp only occurred on the May sampling date. California tiger salamanders were present at the April and May surveys, while fairy shrimp were not present during the May survey. Table 3-10 and Table 3-11 provide results of the CTS and fairy shrimp surveys in 2023. Invertebrate results for 2023 are provided in Appendix G (see Table G-2).

Table 3-10. Pond 101 East (East) (Reference) CTS Aquatic Monitoring Results

Vernal Pool	Sampling Date	# of Larvae Obs.	# of Larvae Measured	Total Length of Larvae (mm)			Snout-Vent Length of Larvae (mm)			Survey Hours
				Mean*	Range	Mode	Mean*	Range	Mode	
101 East (East)	4/27/2023	1		-	-	-	-	-	-	10min†
	5/11/2023	29	26	90	57-115	85	48	30-63	45	3 hr 29 min

*The mean was rounded to the nearest whole number
†Surveyed until first detection

Table 3-11. Pond 101 East (East) (Reference) Fairy Shrimp Monitoring Results

Sampling Date	Abundance (# Individuals)
5/11/2023	Not Detected

3.3 Pond 997

Pond 997 is a reference vernal pool that was monitored as a control for comparison to the remediated vernal pools. In 2022, Pond 997 was monitored for hydrology and vegetation. Hydrology results are reported separately in the Hydrology Monitoring Annual Report (Chenega, 2023).

3.3.1 Vegetation Monitoring

Vegetation monitoring was completed at Pond 997 on June 6, 2023. These monitoring data represent reference conditions. Pond 997 exhibited peripheral ponding in December and held water from January through April (Chenega, 2023). Biologists identified four wetland strata at the vernal pool (see Table 3-12 and Figure 3-3). Strata 1, 2, and 3 were repeated from 2017-2022. Stratum 5 was repeated from 2018-2020. Transect 1 was repeated from 2017-2022, while Transects 3 and 5 were relocated to more representative locations within the corresponding strata. Stratum 2 consisted of CCG and no transects were placed in this stratum. Figure 3-4 illustrates the extent and density of the CCG population at Pond 997.

Table 3-12. Pond 997 (Reference) Vegetative Strata Percentage within the Vernal Pool Basin Boundary

Stratum	Percentage
1	8%
2 (CCG)	2%
3	58%
5	32%

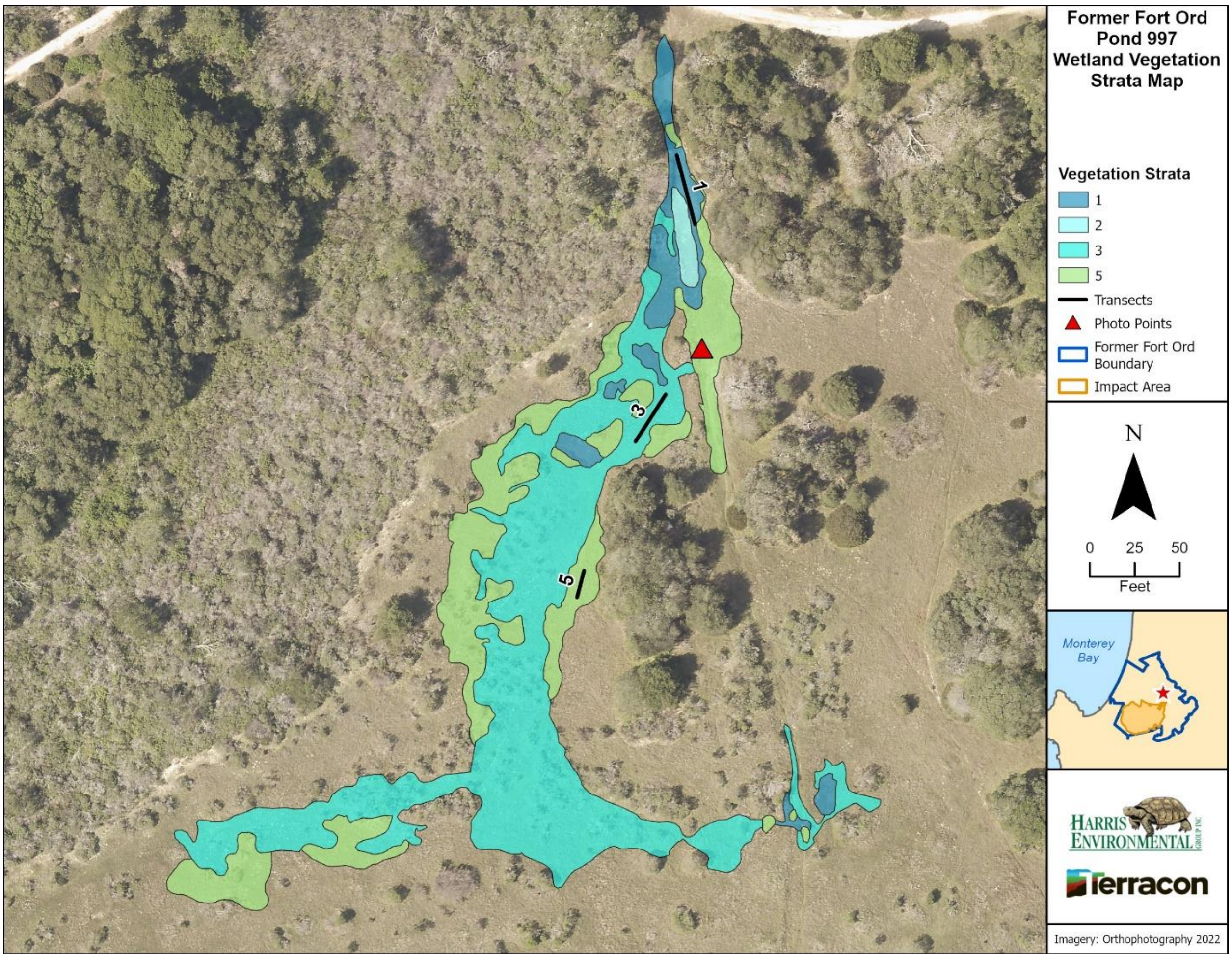

Figure 3-3. Pond 997 (Reference) Vegetation Strata and Transects on Former Fort Ord, 2023

Forty-nine plant species were observed within the vernal pool basin boundary. Of these species, 27 were native, 21 were non-native, and one was unidentified. Five species were OBL wetland plants, 17 were FACW or FAC, eight were FACU or UPL, and 19 were not listed. Appendix B provides the species cover results for each stratum. Appendix D identifies the number of native, non-native, and unidentified species within each stratum as well as the number of species within each wetland indicator category for each stratum. Table 3-13 provides a summary of the dominant species cover results for each stratum.

Table 3-13. Pond 997 (Reference) Dominant Species by Stratum Results

Stratum	Transect Length (m)	Dominant Species	
		Common Name	Absolute Cover on Transect (%)
1	5	Howell's quillwort	21.3
		Hickman's popcornflower	16.7
		round woolly-marbles	16.7
		coyote thistle	13.3
2	N/A	Contra Costa goldfields	N/A
3	10	grass poly	14.7
		rattlesnake grass	10.2
5	5	rattlesnake grass	23.7
		brown-headed rush	11.7
		grass poly	11.7

3.3.1.1 *Contra Costa Goldfields*

Contra Costa goldfields at Pond 997 were mapped on June 6, 2023; they occupied 0.011 acre, with a density of 30% cover. No transects were placed in Stratum 2 to avoid disturbing the population. Figure 3-4 illustrates the extent of the CCG population at Pond 997.

Figure 3-4. Contra Costa Goldfields Populations at Pond 997 (Reference), 2023

3.3.2 Wildlife Monitoring

Wildlife surveys were not conducted at Pond 997 because the vernal pool was dry by the time wildlife surveys began in late April.

3.4 Pond 21

Pond 21 was in year 1 of monitoring for post-mastication in 2023. Pond 21 was monitored for hydrology, vegetation, and wildlife. Hydrology results are reported separately in the Hydrology Monitoring Annual Report (Chenega, 2023).

3.4.1 Vegetation Monitoring

Vegetation monitoring was completed at Pond 21 on July 17 and September 30, 2023. These monitoring data represent year 1 post-mastication and post-subsurface munitions remediation conditions. Pond 21 held water from January to June, 2023 (Chenega, 2023). Biologists identified three strata at the vernal pool (see Table 3-14 and Figure 3-5). Strata 1 and 2 and the corresponding transects were repeated from 2019. Stratum 3 was identified, and the corresponding transect was established in 2023.

Table 3-14. Pond 21 (Year 1 Post-Mastication and Post-Subsurface Munitions Remediation) Vegetative Strata Percentage within the Vernal Pool Basin Boundary

Stratum	Percentage
1	39%
2	57%
3	3%
Upland	1%

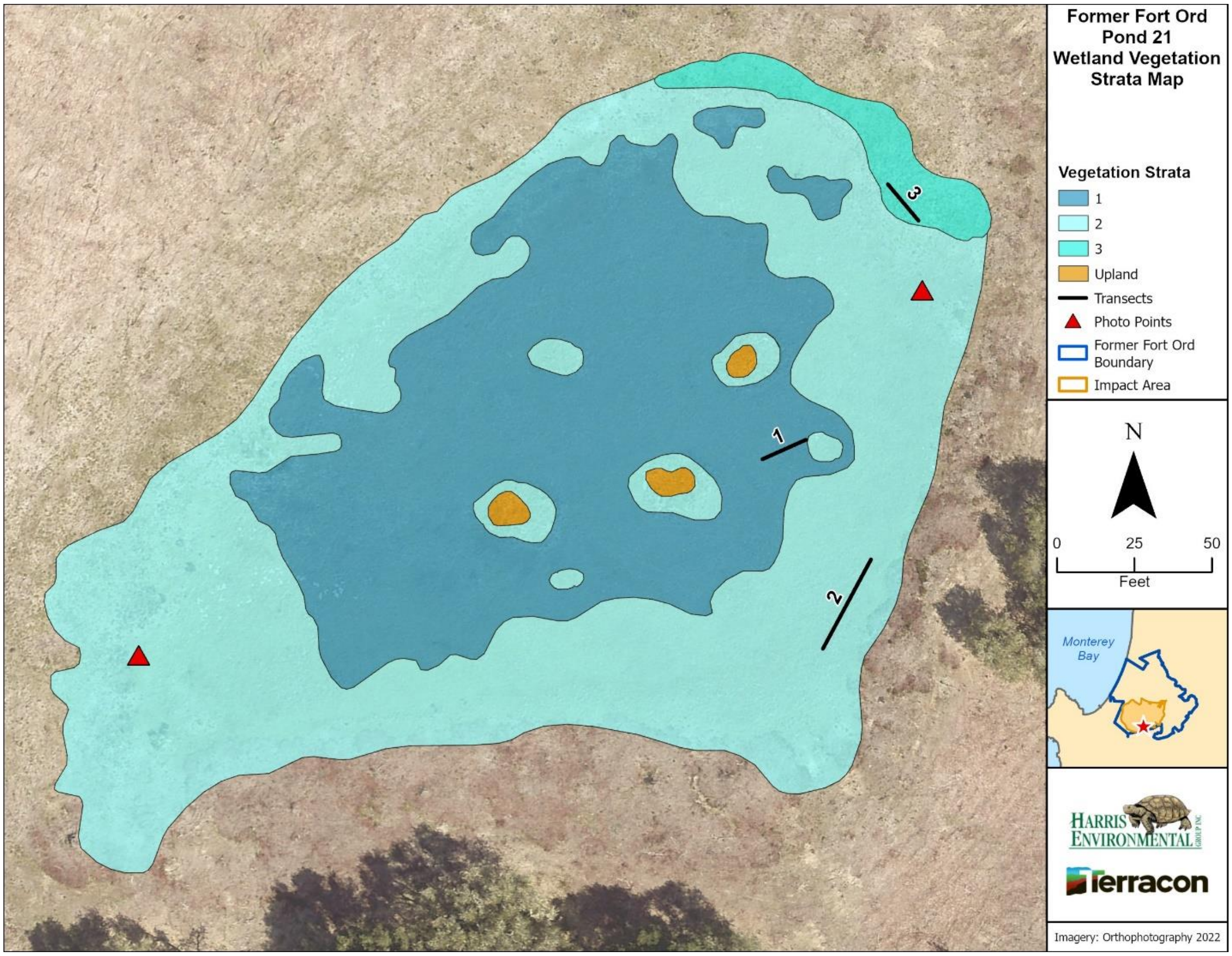

Figure 3-5. Pond 21 (Year 1 Post-Mastication and Post-Subsurface Munitions Remediation) Vegetation Strata and Transects on Former Fort Ord, 2023

Forty-seven species were observed within the vernal pool basin boundary. Of these species, 33 were native and 14 were non-native. Seven species were OBL wetland plants, 16 were FACW or FAC, eight were FACU or UPL, and 16 were not listed. Appendix B provides the species cover results for each stratum. Appendix D identifies the number of native, non-native, and unidentified species within each stratum, as well as the number of species within each wetland indicator category for each stratum. Table 3-15 provides a summary of the dominant species cover results for each stratum.

Table 3-15. Pond 21 (Year 1 Post-Mastication and Post-Subsurface Munitions Remediation) Dominant Species by Stratum Results

Stratum	Transect Length (m)	Dominant Species	
		Common Name	Absolute Cover on Transect (%)
1	5	coyote thistle rabbitfoot grass brown-headed rush	48.3 21.3 14.0
2	10	brown-headed rush coyote thistle pale spikerush	56.7 15.8 10.2
3	5	whiteroot coastal tarweed	32.3 15.3

3.4.2 Wildlife Monitoring

Pond 21 was surveyed for CTS on April 28, 2023, with a subsequent CTS and fairy shrimp survey on May 12, 2023. California tiger salamanders were present in April and May while fairy shrimp were not detected during the May survey. Table 3-16 and Table 3-17 provide results of the CTS and fairy shrimp surveys conducted in 2023. Invertebrate results for 2023 are provided in Appendix G (see Table G-2).

Table 3-16. Pond 21 CTS Aquatic Monitoring Results

Vernal Pool	Sampling Date	# of Larvae Obs.	# of Larvae Measured	Total Length of Larvae (mm)			Snout-Vent Length of Larvae (mm)			Survey Hours
				Mean*	Range	Mode	Mean*	Range	Mode	
21	4/28/2023	1		-	-	-	-	-	-	4 min†
	5/12/2023	8	8	103	68-113	113	52	52-62	61	2 hr 34 min

*The mean was rounded to the nearest whole number
†Surveyed until first detection

Table 3-17. Pond 21 Fairy Shrimp Monitoring Results

Sampling Date	Abundance (# Individuals)
5/12/2023	Not Detected

3.5 Pond 76

Pond 76 was in year 1 of monitoring for post-mastication in 2023. Pond 76 was monitored for hydrology, vegetation, and wildlife. Hydrology results are reported separately in the Hydrology Monitoring Annual Report (Chenega, 2023).

3.5.1 Vegetation Monitoring

Vegetation monitoring was completed at Pond 76 on June 9, 2023. These monitoring data represent year 1 post-mastication conditions. Pond 76 held water from January to April, 2023 (Chenega, 2023). Biologists identified three strata at the vernal pool (see Table 3-18 and Figure 3-6). Strata 1, 2, 3, and the corresponding transects were newly established in 2023.

Table 3-18. Pond 76 (Year 1 Post-Mastication) Vegetative Strata Percentage within the Vernal Pool Basin Boundary

Stratum	Percentage
1	34%
2	32%
3	34%

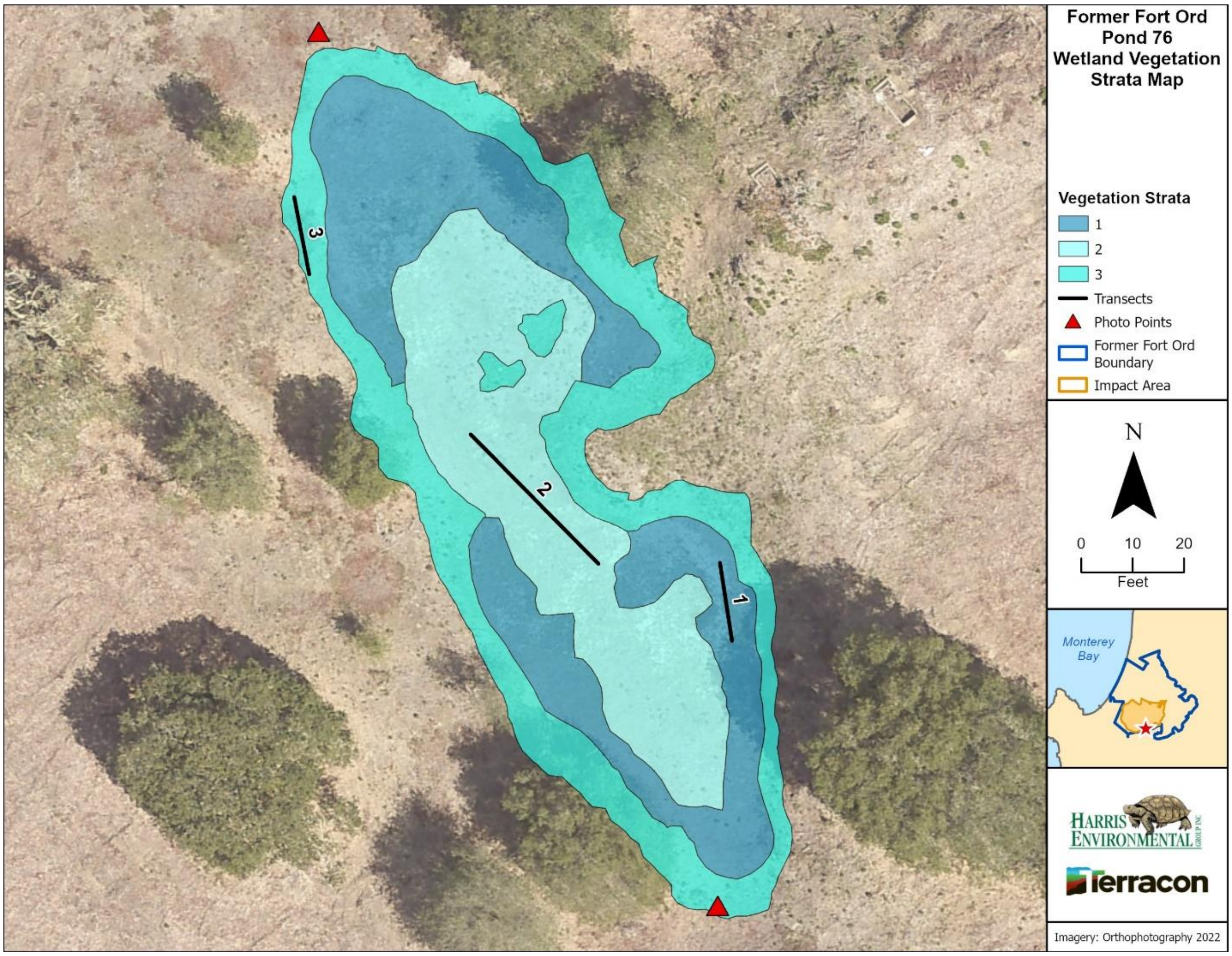

Figure 3-6. Pond 76 (Year 1 Post-Mastication) Vegetation Strata and Transects on Former Fort Ord, 2023

Thirty-three species were observed within the vernal pool basin boundary. Of these species, 23 were native and 10 were non-native. Six species were OBL wetland plants, 12 were FACW or FAC, five were FACU or UPL, and 10 were not listed. Appendix B provides the species cover results for each stratum. Appendix D identifies the number of native, non-native, and unidentified species within each stratum, as well as the number of species within each wetland indicator category for each stratum. Table 3-19 provides a summary of the dominant species cover results for each stratum.

Table 3-19. Pond 76 (Year 1 Post-Mastication) Dominant Species by Stratum Results

Stratum	Transect Length (m)	Dominant Species	
		Common Name	Absolute Cover on Transect (%)
1	5	brown-headed rush	20.0
		needle spikerush	19.3
		Hickman's popcornflower	13.8
2	10	brown-headed rush	30.5
		coyote thistle	14.2
3	5	rabbitfoot grass	18.3

3.5.2 Wildlife Monitoring

Pond 76 was surveyed from the edge for CTS on April 28, 2023, but none were detected. In order to prioritize CTS surveys due to time and logistical constraints, neither fairy shrimp nor invertebrate studies were conducted. Table 3-20 provides results of the CTS survey conducted in 2023.

Table 3-20. Pond 76 CTS Aquatic Monitoring Results

Vernal Pool	Sampling Date	# of Larvae Obs.	# of Larvae Measured	Total Length of Larvae (mm)			Snout-Vent Length of Larvae (mm)			Survey Hours
				Mean	Range	Mode	Mean	Range	Mode	
76	4/28/2023	0		-	-	-	-	-	-	21 min

3.6 Pond 3 North

Pond 3 North was in year 5 of monitoring for post-subsurface munitions remediation in 2023. Pond 3 North was monitored for hydrology, vegetation, and wildlife. Hydrology results are reported separately in the Hydrology Monitoring Annual Report (Chenega, 2023).

3.6.1 Vegetation Monitoring

Vegetation monitoring was completed at Pond 3 North on June 26 and July 21, 2023. These monitoring data represent year 5 post-subsurface munitions remediation conditions. Pond 3 North was hydrologically connected to Pond 3 South in March and remained inundated until June, 2023 (Chenega, 2023). Biologists identified four strata at the vernal pool (Table 3-21 and Figure 3-7). Stratum 1 was repeated from 2015, 2018, and 2020. Strata 2 and 3 were repeated from 2015 and 2018-2021. Stratum 4 was repeated from 2018-2021. Transects 1, 2, and 3 were all relocated because the previous locations were no longer within the corresponding strata. Stratum 4 consisted of CCG so no transects were placed in this stratum. Figure 3-8 illustrates the extent and density of the CCG population at Pond 3 North.

Table 3-21. Pond 3 North (Year 5 Post-Subsurface Munitions Remediation) Vegetative Strata Percentage within the Vernal Pool Basin Boundary

Stratum	Percentage
1	12%
2	7%
3	44%
4 (CCG)	36%
Upland	1%

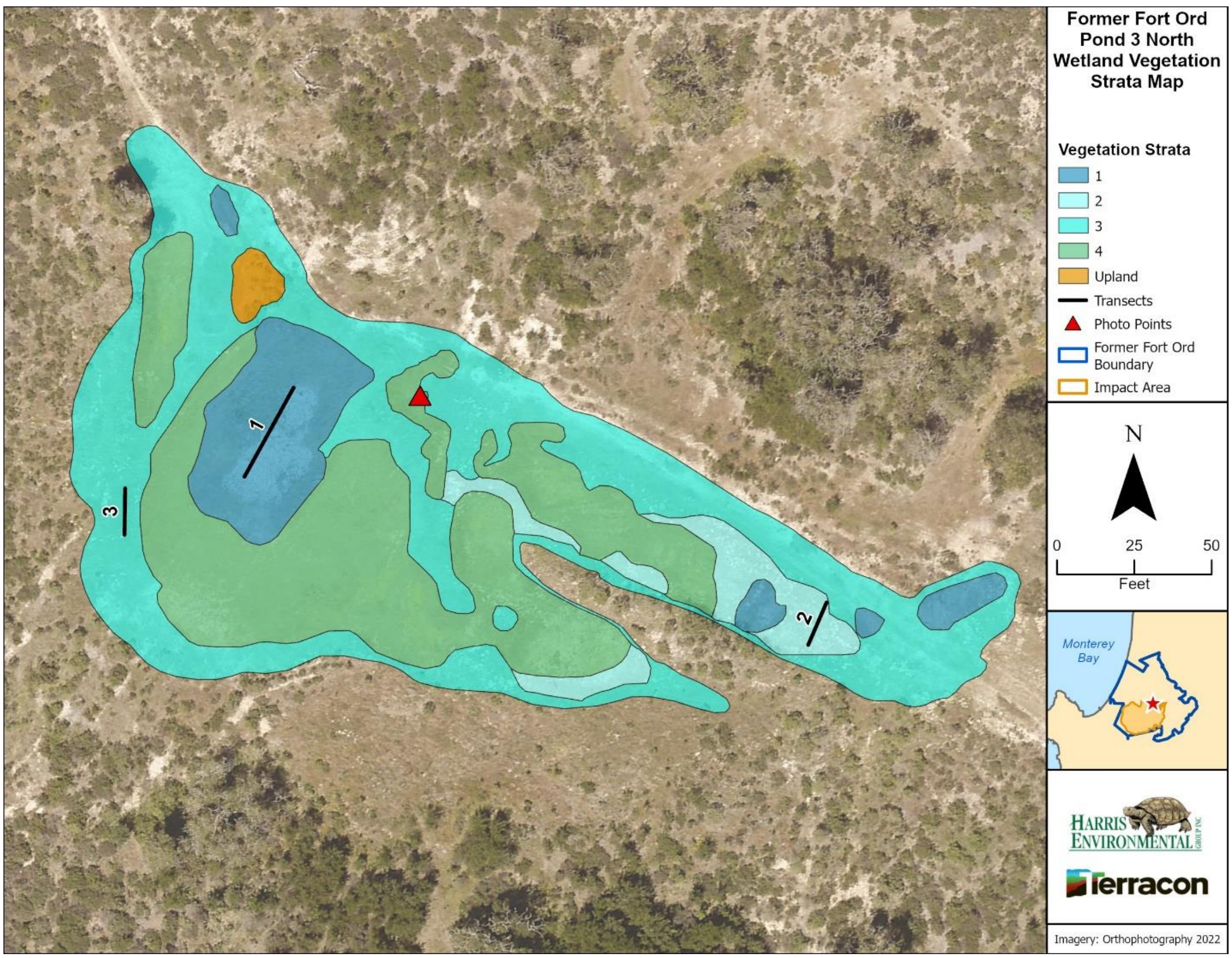

Figure 3-7. Pond 3 North (Year 5 Post-Subsurface Munitions Remediation) Vegetation Strata and Transects on Former Fort Ord, 2023

Forty-two plant species were observed within the vernal pool basin boundary. Of these species, 24 were native and 18 were non-native. Six species were OBL wetland plants, 18 were FACW or FAC, six were FACU or UPL, and 12 were not listed. Appendix B provides the species cover results within each stratum. Appendix D identifies the number of native, non-native, and unidentified species within each stratum as well as the number of species within each wetland indicator category for each stratum. Table 3-22 provides a summary of the dominant species cover results for each stratum.

Table 3-22. Pond 3 North (Year 5 Post-Subsurface Munitions Remediation) Dominant Species by Stratum Results

Stratum	Transect Length (m)	Dominant Species	
		Common Name	Absolute Cover on Transect (%)
1	10	pale spikerush	95.0
2	5	cut-leaved plantain	18.3
		grass poly	15.7
		common toad rush	15.0
		coastal tarweed	10.0
3	5	coastal tarweed	36.7
		narrow-leaved clover	23.3
4	N/A	Contra Costa goldfields	N/A

3.6.1.1 *Contra Costa Goldfields*

Contra Costa goldfields at Pond 3 North were mapped on June 26; they occupied 0.22 acre, with a density range of 1-40% cover. No transects were placed in Stratum 4 to avoid disturbing the population. Figure 3-8 illustrates the extent of the CCG population at Pond 3 North.

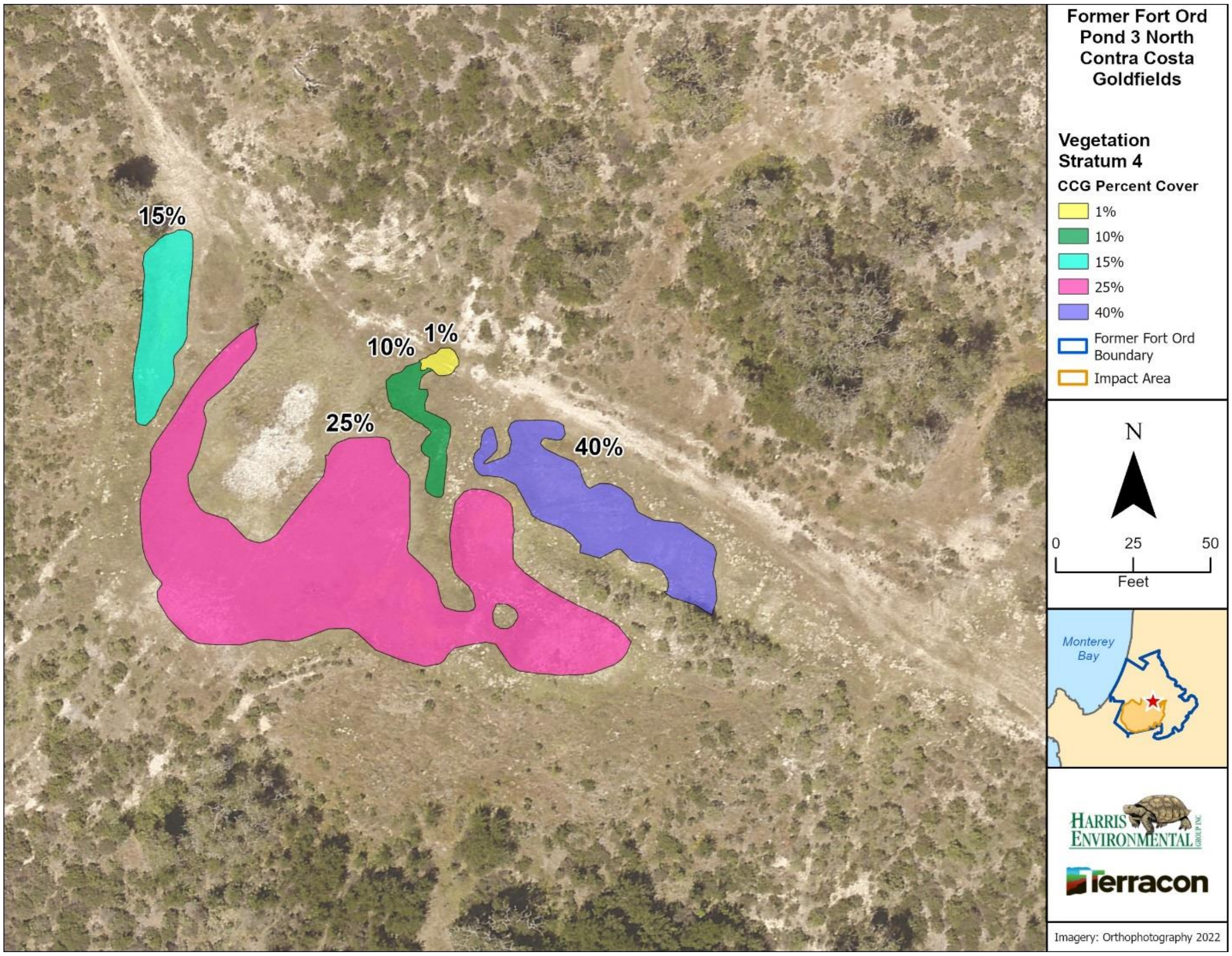

Figure 3-8. Contra Costa Goldfields Populations at Pond 3 North (Year 5 Post-Subsurface Munitions Remediation), 2023

3.6.2 Wildlife Monitoring

Pond 3 North was surveyed for CTS on April 26, 2023, and for both fairy shrimp and CTS on May 9. Neither species was found on either survey date. Table 3-23 and Table 3-24 provide results of the CTS and fairy shrimp surveys conducted in 2023. Invertebrate results for 2023 are provided in Appendix G (see Table G-2).

Table 3-23. Pond 3 North CTS Aquatic Monitoring Results

Vernal Pool	Sampling Date	# of Larvae Obs.	# of Larvae Measured	Total Length of Larvae (mm)			Snout-Vent Length of Larvae (mm)			Survey Hours
				Mean	Range	Mode	Mean	Range	Mode	
3 North	4/26/2023	0		-	-	-	-	-	-	7 min
	5/9/2023	0		-	-	-	-	-	-	50 min

Table 3-24. Pond 3 North Fairy Shrimp Monitoring Results

Sampling Date	Abundance (# Individuals)
5/9/2023	Not Detected

3.7 Pond 3 South

Pond 3 South was in year 5 of monitoring for post-subsurface munitions remediation in 2023. Pond 3 South was monitored for hydrology, vegetation, and wildlife. Hydrology results are reported separately in the Hydrology Monitoring Annual Report (Chenega, 2023).

3.7.1 Vegetation Monitoring

Vegetation monitoring was completed at Pond 3 South on June 26, 2023. These monitoring data represent year 5 post-subsurface munitions remediation conditions. Pond 3 South was inundated from December through May in 2022-2023 water-year. Pond 3 South was hydrologically connected to Pond 3 North in March and remained inundated until May, 2023 (Chenega, 2023). Biologists identified four strata at the vernal pool (see Table 3-25 and Figure 3-9). Strata 1, 2, and 3 were repeated from 2016 and 2018-2021. Stratum 5 was repeated from 2020 and 2021. Transect 1 and 2 were relocated to more representative locations. Transect 3 was moved because the previous location was no longer within the stratum. Stratum 5 consisted of CCG so no transects were placed in this stratum. Figure 3-10 illustrates the extent and density of the CCG population at Pond 3 South.

Table 3-25. Pond 3 South (Year 5 Post-Subsurface Munitions Remediation) Vegetative Strata Percentage within the Vernal Pool Basin Boundary

Stratum	Percentage
1	17%
2	26%
3	50.6%
5 (CCG)	0.4%
Upland	6%

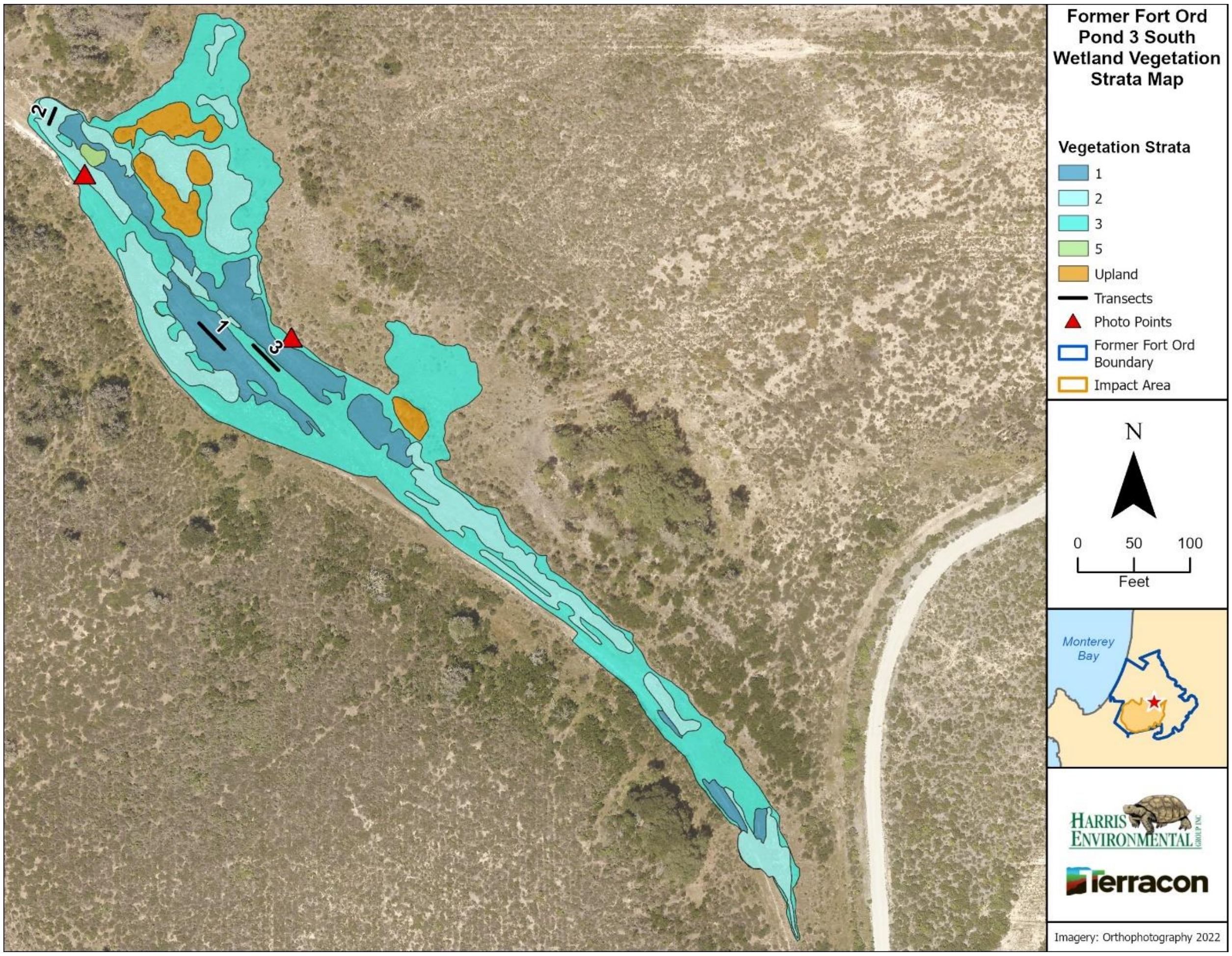

Figure 3-9. Pond 3 South (Year 5 Post-Subsurface Munitions Remediation) Vegetation Strata and Transects on Former Fort Ord, 2023

Sixty-seven plant species were observed within the vernal pool basin boundary. Of these species, 43 were native and 24 were non-native. Six species were OBL wetland plants, 25 were FACW or FAC, 10 were FACU or UPL, and 26 were not listed. Appendix B provides the species cover results within each stratum. Appendix D identifies the number of native, non-native, and unidentified species within each stratum as well as the number of species within each wetland indicator category for each stratum. Table 3-26 provides a summary of the dominant species cover results for each stratum.

Table 3-26. Pond 3 South (Year 5 Post-Subsurface Munitions Remediation) Dominant Species by Stratum Results

Stratum	Transect Length (m)	Dominant Species	
		Common Name	Absolute Cover on Transect (%)
1	10	coyote thistle pale spikerush annual hair grass Hickman's popcornflower	25.8 21.7 11.7 10.0
2	5	brown-headed rush	13.3
3	10	Italian rye grass annual quaking grass grass poly	16.0 11.0 10.0
5	N/A	Contra Costa goldfields	N/A

3.7.1.1 *Contra Costa Goldfields*

Contra Costa goldfields at Pond 3 South were mapped on June 26, 2023; they occupied 0.01 acre, with a density of 5% cover. No transects were placed in Stratum 5 to avoid disturbing the population. Figure 3-10 illustrates the extent of the CCG population at Pond 3 South.

Figure 3-10. Contra Costa Goldfields Population at Pond 3 South (Year 5 Post-Subsurface Munitions Remediation), 2023

3.7.2 Wildlife Monitoring

Pond 3 South was surveyed for CTS on April 26, 2023, and for both fairy shrimp and CTS on May 9. Neither species was found on either survey date. Table 3-27 and Table 3-28 provide results of the CTS and fairy shrimp surveys completed in 2023. Invertebrate results for 2023 are provided in Appendix G (see Table G-2).

Table 3-27. Pond 3 South CTS Aquatic Monitoring Results

Vernal Pool	Sampling Date	# of Larvae Obs.	# of Larvae Measured	Total Length of Larvae (mm)			Snout-Vent Length of Larvae (mm)			Survey Hours
				Mean	Range	Mode	Mean	Range	Mode	
3 South	4/26/2023	0		-	-	-	-	-	-	4 min
	5/9/2023	0		-	-	-	-	-	-	59 min

Table 3-28. Pond 3 South Fairy Shrimp Monitoring Results

Sampling Date	Abundance (# Individuals)
5/9/2023	Not Detected

3.8 Pond 35

Pond 35 was in year 5 of monitoring for post-subsurface munitions remediation in 2023. Pond 35 was monitored for hydrology and vegetation. Hydrology results are reported separately in the Hydrology Monitoring Annual Report (Chenega, 2023).

3.8.1 Vegetation Monitoring

Vegetation monitoring was completed at Pond 35 on May 30 and May 31, 2023. These data represent year 5 post-subsurface munitions remediation conditions. Pond 35 was inundated for a short time in January, dried out, and became inundated again from March to April (Chenega, 2023). Biologists identified four strata at the vernal pool (see Table 3-29 and Figure 3-11). Strata 1 and 2, and the corresponding transects were repeated from 2016 and 2018-2021. Stratum 3 was repeated from 2016, 2018, 2019, and 2021. Stratum 4 was repeated from 2018-2021. Transects 3 and 4 were relocated because the previous locations were no longer within the stratum.

Table 3-29. Pond 35 (Year 5 Post-Subsurface Munitions Remediation) Vegetative Strata Percentage within the Vernal Pool Basin Boundary

Stratum	Percentage
1	19%
2	44%
3	22%
4	15%

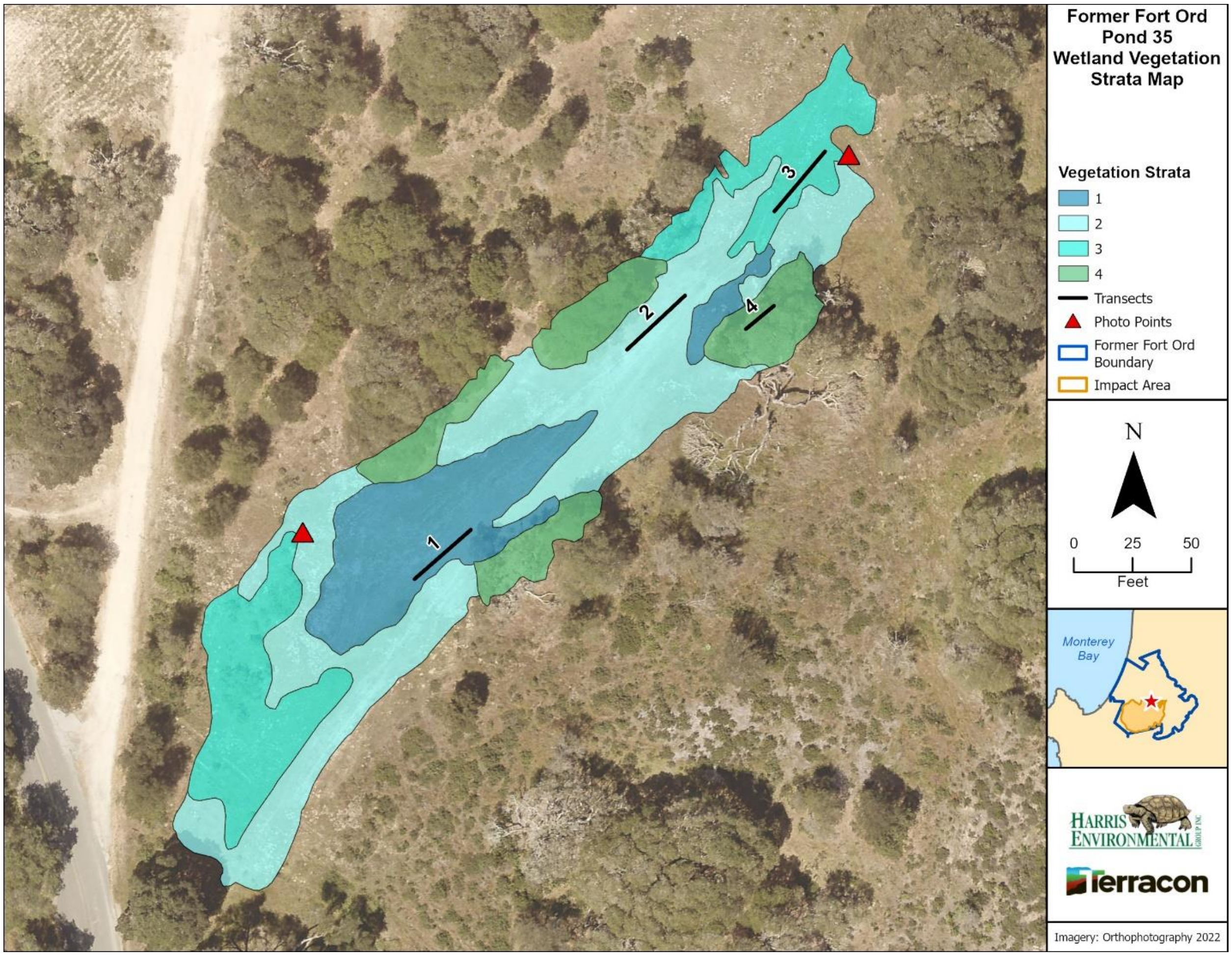

Figure 3-11. Pond 35 (Year 5 Post-Subsurface Munitions Remediation) Vegetation Strata and Transects on Former Fort Ord, 2023

Thirty-seven plant species were observed within the vernal pool basin boundary. Of these species, 15 were native, 21 were non-native, and one was unidentified. Five species were OBL wetland plants, 11 were FACW or FAC, nine were FACU or UPL, and 12 were not listed. Appendix B provides the species cover results for each stratum. Appendix D identifies the number of native, non-native, and unidentified species within each stratum as well as the number of species within each wetland indicator category for each stratum. Table 3-30 provides a summary of the dominant species cover results for each stratum.

Table 3-30. Pond 35 (Year 5 Post-Subsurface Munitions Remediation) Dominant Species by Stratum Results

Stratum	Transect Length (m)	Dominant Species	
		Common Name	Absolute Cover on Transect (%)
1	10	cut-leaved plantain	67.5
2	10	cut-leaved plantain	55.2
3	10	Italian rye grass meadow barley	42.2 30.5
4	5	blue wild-rye	5.0

3.8.2 Wildlife Monitoring

Wildlife surveys were not conducted at Pond 35 because the vernal pool was dry by the time wildlife surveys began.

3.9 Pond 43

Pond 43 was in year 5 of monitoring for post-subsurface munitions remediation in 2023. Pond 43 was monitored for hydrology and vegetation. Hydrology results are reported separately in the Hydrology Monitoring Annual Report (Chenega, 2023).

3.9.1 Vegetation Monitoring

Vegetation monitoring was completed at Pond 43 on June 5, 2023. These monitoring data represent year 5 post-subsurface munitions remediation conditions. Pond 43 held water from January through March, 2023 (Chenega, 2023). Biologists identified three strata at the vernal pool (see Table Table 3-31 and Figure 3-12). Strata 1, 2, and 3 were repeated from 2016 and 2018-2021. Transect 1 was relocated to a more representative location. Transects 2 and 3 were moved because the previous locations were no longer within the respective strata.

Table 3-31. Pond 43 (Year 5 Post-Subsurface Munitions Remediation) Vegetative Strata Percentage within the Vernal Pool Basin Boundary

Stratum	Percentage
1	48%
2	6%
3	45%
Upland	1%

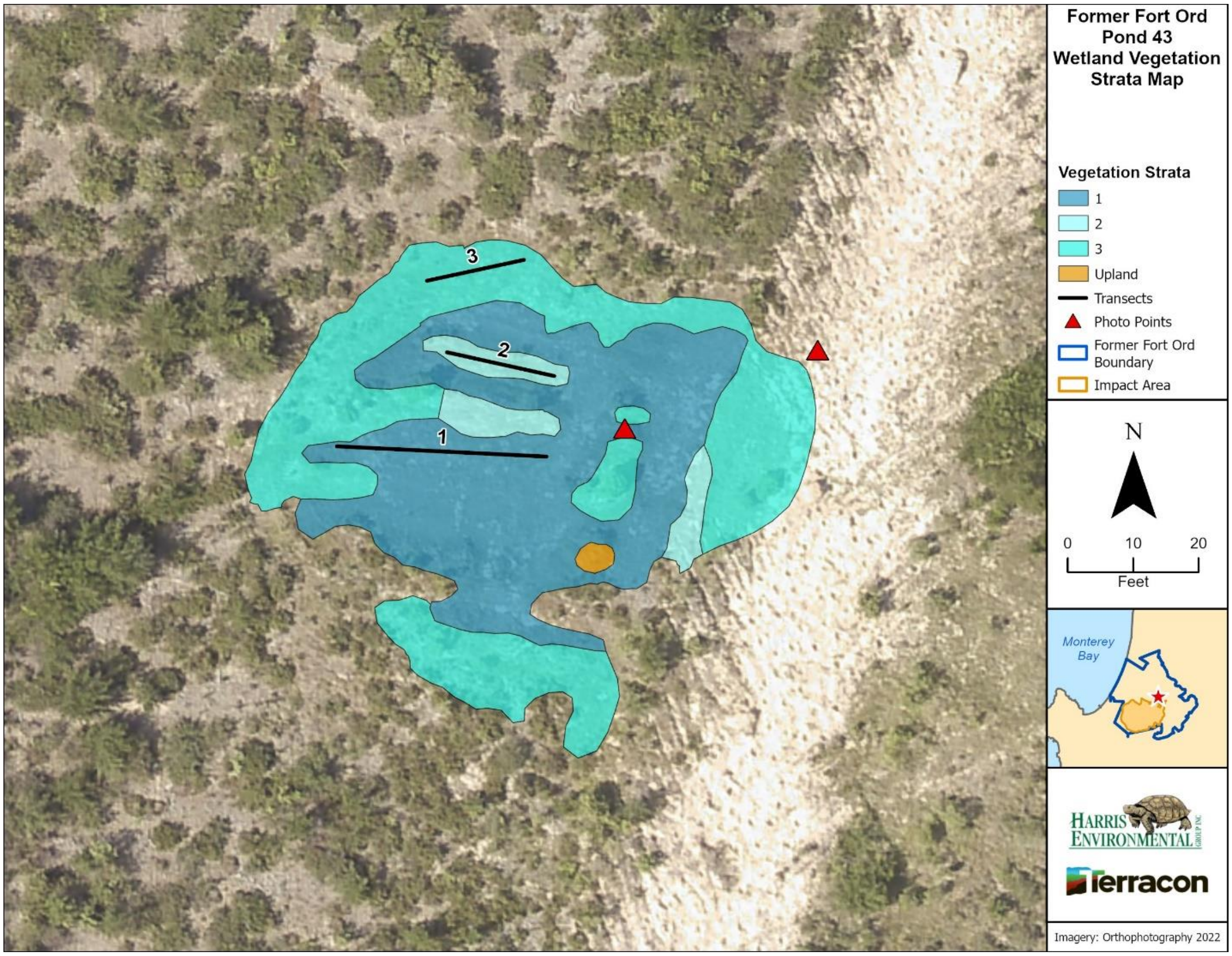

Figure 3-12. Pond 43 (Year 5 Post-Subsurface Munitions Remediation) Vegetation Strata and Transects on Former Fort Ord, 2023

Forty-one plant species were observed within the vernal pool basin boundary. Of these species, 30 were native and 11 were non-native. Five species were OBL wetland plants, 17 were FACW or FAC, four were FACU or UPL, and 15 were not listed. Appendix B provides the species cover results within each stratum. Appendix D identifies the number of native, non-native, and unidentified species within each stratum as well as the number of species within each wetland indicator category for each stratum. Table 3-32 provides a summary of the dominant species cover results for each stratum.

Table 3-32. Pond 43 (Year 5 Post-Subsurface Munitions Remediation) Dominant Species by Stratum Results

Stratum	Transect Length (m)	Dominant Species	
		Common Name	Absolute Cover on Transect (%)
1	10	Hickman's popcornflower	34.2
2	5	grass poly rabbitfoot grass brown-headed rush	21.7 16.3 10.0
3	5	smooth cat's-ear cut-leaved plantain	27.3 12.0

3.9.2 Wildlife Monitoring

Wildlife surveys were not conducted at Pond 43 because the vernal pool was dry by the time wildlife surveys began.

3.10 Pond 44

Pond 44 was in year 5 of monitoring for post-subsurface munitions remediation in 2023. Pond 44 was monitored for hydrology and vegetation. Hydrology results are reported separately in the Hydrology Monitoring Annual Report (Chenega, 2023).

3.10.1 Vegetation Monitoring

Vegetation monitoring was completed at Pond 44 on June 5, 2023. These monitoring data represent year 5 post-subsurface munitions remediation conditions. Pond 44 held water from from December through March, and was dry by April, 2023 (Chenega, 2023). Biologists identified three strata at the vernal pool (see Table 3-33 and Figure 3-13). Strata 1, 2, and 3 were repeated from 2016 and 2018-2021 and the associated transects were all relocated to more representative locations.

Table 3-33. Pond 44 (Year 5 Post-Subsurface Munitions Remediation) Vegetative Strata Percentage within the Vernal Pool Basin Boundary

Stratum	Percentage
1	46%
2	25%
3	24%
Upland	5%

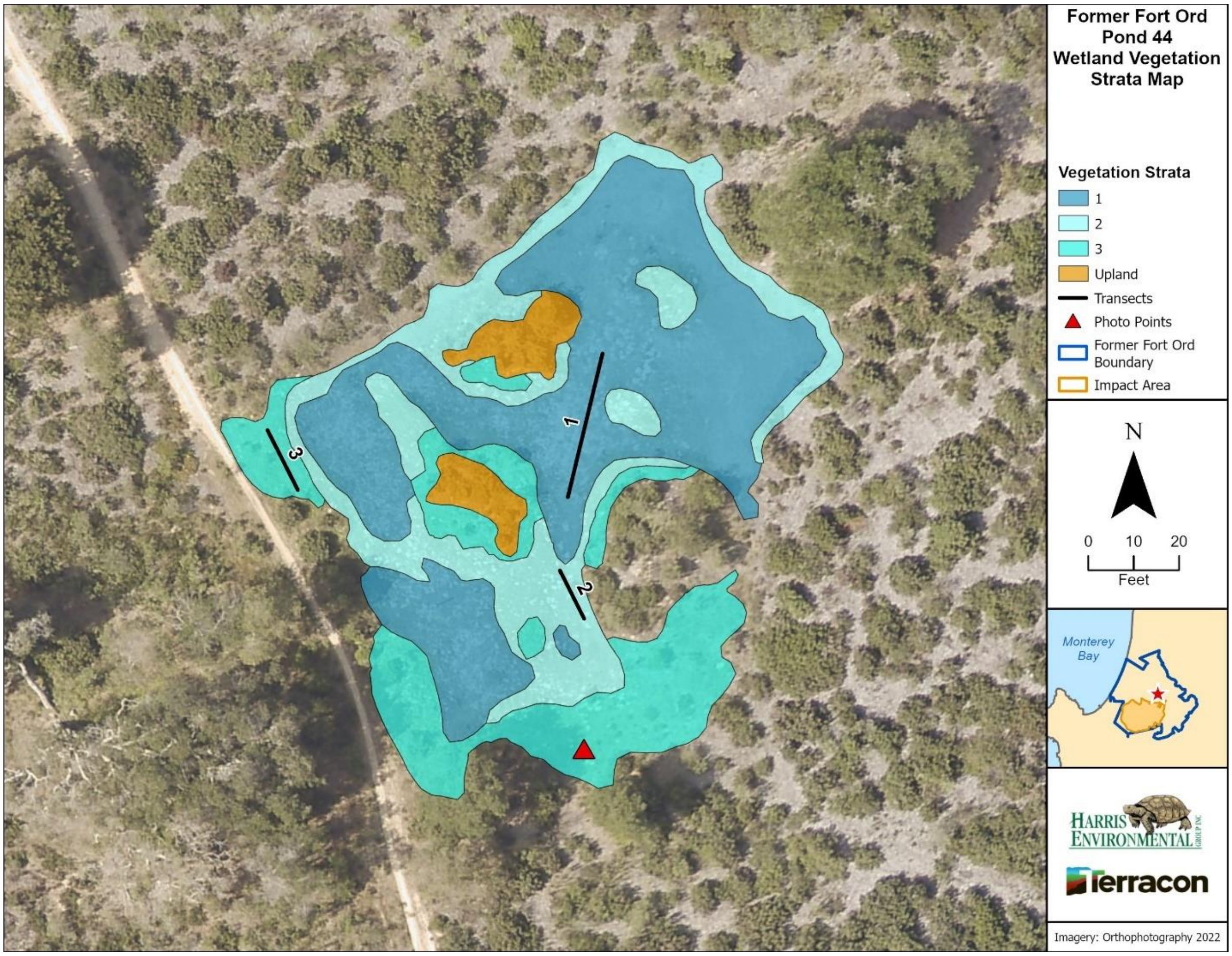

Figure 3-13. Pond 44 (Year 5 Post-Subsurface Munitions Remediation) Vegetation Strata and Transects on Former Fort Ord, 2023

Fifty-eight plant species were observed within the vernal pool basin boundary. Of these species, 34 were native, 21 were non-native, and three were unidentifed. Four species were OBL wetland plants, 18 were FACW or FAC, eight were FACU or UPL, and 28 were not listed. Appendix B provides the species cover results within each stratum. Appendix D identifies the number of native, non-native, and unidentified species within each stratum as well as the number of species within each wetland indicator category for each stratum. Table 3-34 provides a summary of the dominant species cover results for each stratum.

Table 3-34. Pond 44 (Year 5 Post-Subsurface Munitions Remediation) Dominant Species by Stratum Results

Stratum	Transect Length (m)	Dominant Species	
		Common Name	Absolute Cover on Transect (%)
1	10	Hickman's popcornflower grass poly	28.3 13.7
2	5	common toad rush grass poly	18.3 15.0
3	5	little hop clover	15.7

3.10.2 Wildlife Monitoring

Wildlife surveys were not conducted at Pond 44 because the vernal pool was dry by the time wildlife surveys began.

3.11 Pond 54

Pond 54 was in year 5 of monitoring for post-subsurface munitions remediation in 2023. Pond 54 was monitored for hydrology, vegetation, and wildlife. Hydrology results are reported separately in the Hydrology Monitoring Annual Report (Chenega, 2023).

3.11.1 Vegetation Monitoring

Vegetation monitoring was completed at Pond 54 on July 18 and September 20, 2023. These monitoring data represent year 5 post-subsurface munitions remediation conditions. Pond 54 held water from December to June (Chenega, 2023). Biologists identified four strata at the vernal pool (see Table 3-35 and Figure 3-14). Stratum 1 was repeated from 2019 and 2021 whereas Strata 2, 3, 4, and their corresponding transects were repeated from 2019. Transect 1 was relocated to a more representative location.

Table 3-35. Pond 54 (Year 5 Post-Subsurface Munitions Remediation) Vegetative Strata Percentage within the Vernal Pool Basin Boundary

Stratum	Percentage
1	59%
2	13%
3	24%
4	3%
Upland	1%

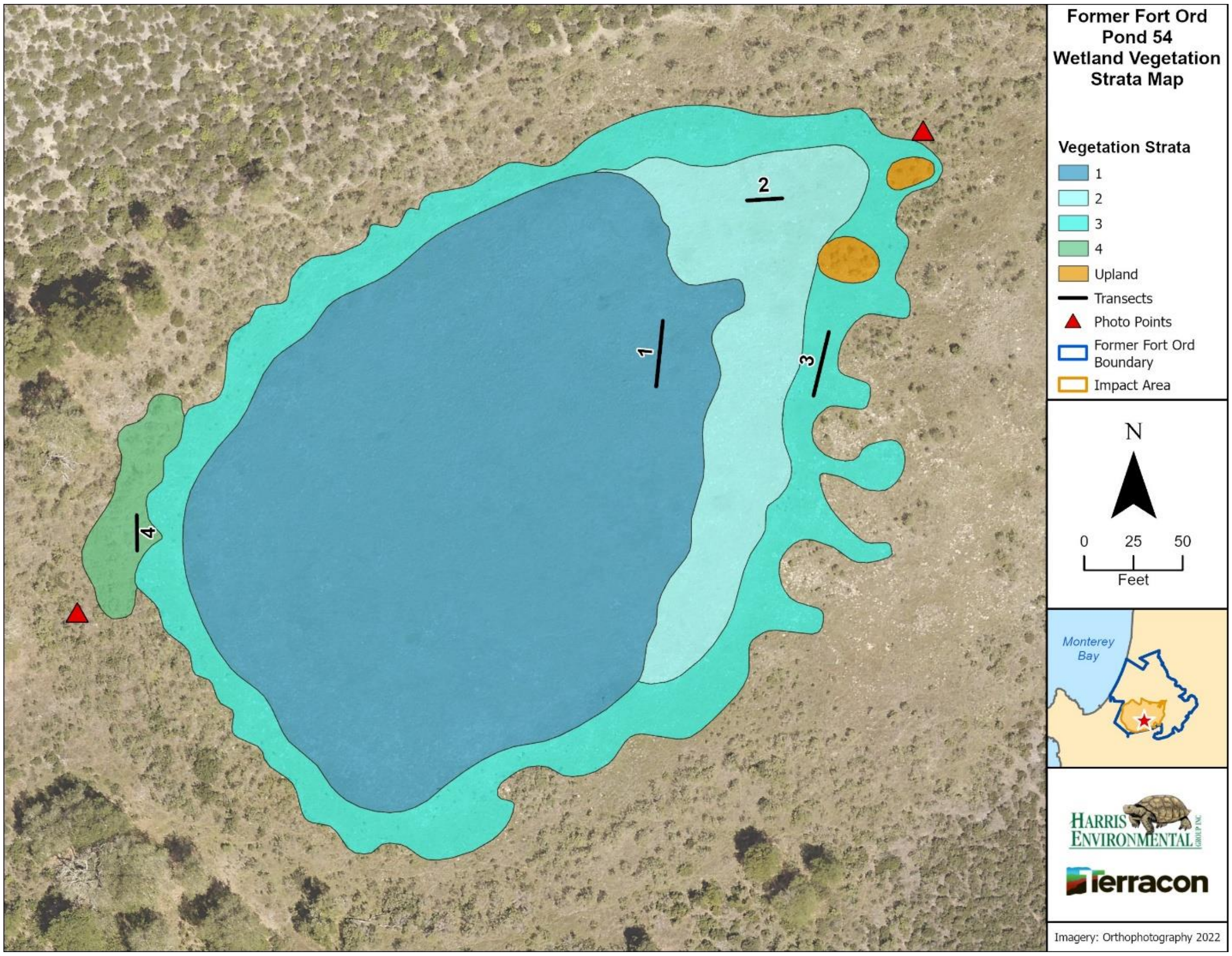

Figure 3-14. Pond 54 (Year 5 Post-Subsurface Munitions Remediation) Vegetation Strata and Transects on Former Fort Ord, 2023

Fifty-four plant species were observed within the vernal pool basin boundary. Of these species, 36 were native, 16 were non-native, and two were unidentified. Seven species were OBL wetland plants, 21 were FACW or FAC, 11 were FACU or UPL, and 15 were not-listed. Appendix B provides the species cover results within each stratum. Appendix D identifies the number of native, non-native, and unidentified species within each stratum as well as the number of species within each wetland indicator category for each stratum. Table 3-36 provides a summary of the dominant species cover results for each stratum.

Table 3-36. Pond 54 (Year 5 Post-Subsurface Munitions Remediation) Dominant Species by Stratum Results

Stratum	Transect Length (m)	Dominant Species	
		Common Name	Absolute Cover on Transect (%)
1	10	pale spikerush	68.5
2	10	needle spikerush rabbitfoot grass	32.3 20.0
3	10	needle spikerush	25.7
4	5	whiteroot western vervain	46.7 11.7

3.11.2 Wildlife Monitoring

Pond 54 was surveyed for CTS on April 28, and for both fairy shrimp and CTS on May 12, 2023. California tiger salamanders were present in April and May, while fairy shrimp were not detected. Table 3-37 and Table 3-38 provide results of the CTS and fairy shrimp surveys completed in 2023. Invertebrate results for 2023 are provided in Appendix G (see Table G-2).

Table 3-37. Pond 54 CTS Aquatic Monitoring Results

Vernal Pool	Sampling Date	# of Larvae Obs.	# of Larvae Measured	Total Length of Larvae (mm)			Snout-Vent Length of Larvae (mm)			Survey Hours
				Mean*	Range	Mode	Mean*	Range	Mode	
54	4/28/2023	1	0	-	-	-	-	-	-	17 min†
	5/12/2023	5	5	92	83-96	-	50	47-53	50	52 min

*The mean was rounded to the nearest whole number
†Surveyed until first detection

Table 3-38. Pond 54 Fairy Shrimp Monitoring Results

Sampling Date	Abundance (# Individuals)
5/12/2023	Not Detected

3.12 Pond 60

Pond 60 was in year 5 of monitoring for post-subsurface munitions remediation in 2023. Pond 60 was monitored for hydrology, vegetation, and wildlife. Hydrology results are reported separately in the Hydrology Monitoring Annual Report (Chenega, 2023).

3.12.1 Vegetation Monitoring

Vegetation monitoring was completed at Pond 60 on August 28 and September 19, 2023. These monitoring data represent year 5 post-subsurface munitions remediation. Pond 60 was inundated from December through June (Chenega, 2023). Biologists identified four strata at the vernal pool (see Table 3-39 and Figure 3-15). Strata 1, 2, 3, and 4 were repeated from 2015 and 2018-2021. Transects 1, 2, and 4 were relocated to more representative locations, while Transect 3 was repeated from 2019. Stratum 1 also included an inundated section that was visually estimated.

Table 3-39. Pond 60 (Year 5 Post-Subsurface Munitions Remediation) Vegetative Strata Percentage within the Vernal Pool Basin Boundary

Stratum	Percentage
1 (Inundated)	6%
1	4%
2	44%
3	23%
4	22%
Upland	1%

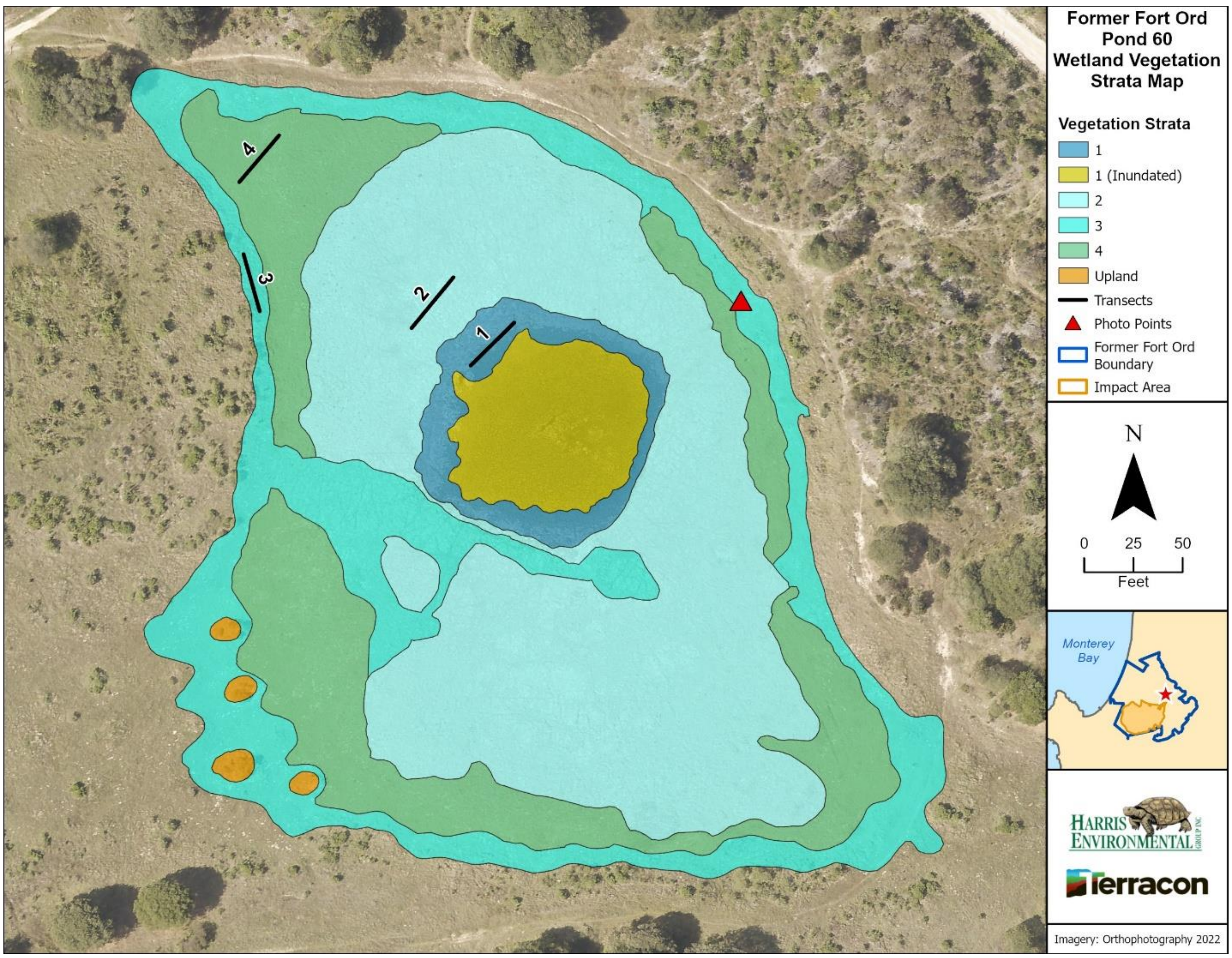

Figure 3-15**.** Pond 60 (Year 5 Post-Subsurface Munitions Remediation) Vegetation Strata and Transects on Former Fort Ord, 2023

Forty plant species were observed within the vernal pool basin boundary. Of these species, 22 were native and 18 were non-native. Seven species were OBL wetland plants, 15 were FACW or FAC, five were FACU or UPL, and 13 were not listed. Appendix B provides the species cover results within each stratum. Appendix D identifies the number of native, non-native, and unidentified species within each stratum as well as the number of species within each wetland indicator category for each stratum. Table 3-40 provides a summary of the dominant species cover results for each stratum.

Table 3-40. Pond 60 (Year 5 Post-Subsurface Munitions Remediation) Dominant Species by Stratum Results

Stratum	Transect Length (m)	Dominant Species	
		Common Name	Absolute Cover on Transect (%)
1	10	pale spikerush	82.7
2	10	pale spikerush salt grass	73.8 19.7
3	10	brown-headed rush	80.0
4	10	pale spikerush	26.5

3.12.2 Wildlife Monitoring

Pond 60 was surveyed for CTS and fairy shrimp on May 11, 2023. California tiger salamanders were detected but fairy shrimp were not. Table 3-41 and Table 3-42 provide results of the CTS and fairy shrimp surveys completed in 2023. Invertebrate results for 2023 are provided in Appendix G (see Table G-2).

Table 3-41. Pond 60 CTS Aquatic Monitoring Results

Vernal Pool	Sampling Date	# of Larvae Obs.	# of Larvae Measured	Total Length of Larvae (mm)			Snout-Vent Length of Larvae (mm)			Survey Hours
				Mean*	Range	Mode	Mean*	Range	Mode	
60	5/11/2023	41	30	88	60-136	82	48	34-70	50	3 hrs[†]

*The mean was rounded to the nearest whole number

Table 3-42. Pond 60 Fairy Shrimp Monitoring Results

Sampling Date	Abundance (# Individuals)
5/11/2023	Not Detected

3.13 Pond 73

Pond 73 was in year 5 of monitoring for post-subsurface munitions remediation in 2023. Pond 73 was monitored for hydrology and vegetation. Hydrology results are reported separately in the Hydrology Monitoring Annual Report (Chenega, 2023).

3.13.1 Vegetation Monitoring

Vegetation monitoring was completed at Pond 73 on June 9, 2023. These monitoring data represent year 5 post-subsurface munitions remediation conditions. Pond 73 exhibited peripheral ponding in December, followed by inundation between January and April of the 2022-2023 water-year (Chenega, 2023). Biologists identified three strata at the vernal pool (see Table 3-43 and Figure 3-16). Strata 1 and 2 were repeated from 2017-2021 and Stratum 3 was repeated from 2017 and 2019. Transect 1 was relocated to a more representative location, while Transects 2 and 3 were moved because the previous locations were no longer within the corresponding strata.

Table 3-43. Pond 73 (Year 5 Post-Subsurface Munitions Remediation) Vegetative Strata Percentage within the Vernal Pool Basin Boundary

Stratum	Percentage
1	55%
2	35%
3	2%
Upland	3%

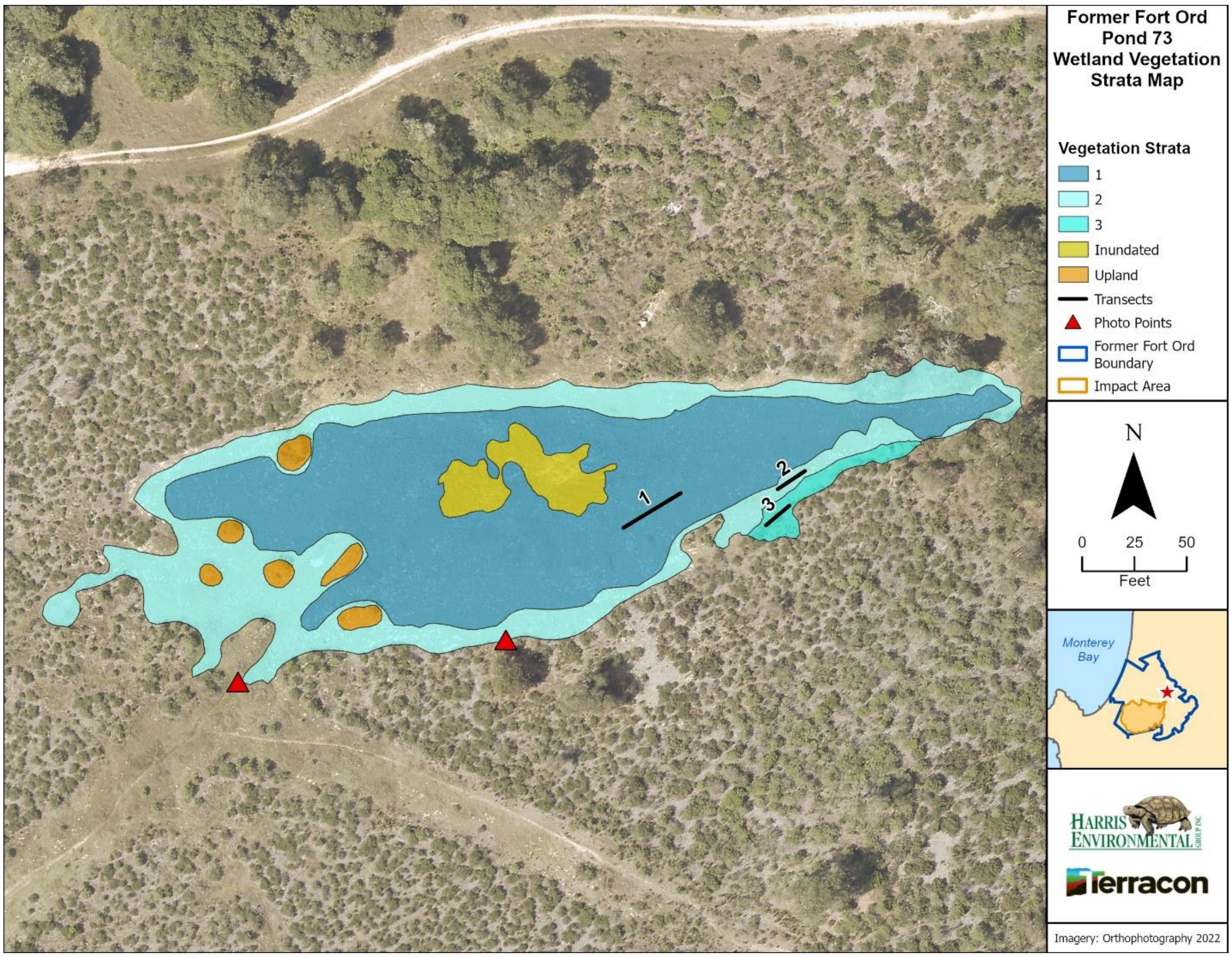

Figure 3-16. Pond 73 (Year 5 Post-Subsurface Munitions Remediation) Vegetation Strata and Transects on Former Fort Ord, 2023

Forty-seven plant species were observed within the vernal pool basin boundary. Of these species, 29 were native, 16 were non-native, and two were unidentified. Eight species were OBL wetland plants, 16 were FACW or FAC, six were FACU or UPL, and 17 were not listed. Appendix B provides the species cover results within each stratum. Appendix D identifies the number of native, non-native, and unidentified species within each stratum as well as the number of species within each wetland indicator category for each stratum. Table 3-44 provides a summary of the dominant species cover results for each stratum.

Table 3-44. Pond 73 (Year 5 Post-Subsurface Munitions Remediation) Dominant Species by Stratum Results

Stratum	Transect Length (m)	Dominant Species	
		Common Name	Absolute Cover on Transect (%)
1	10	pale spikerush smooth goldfields Hickman's popcornflower	19.2 18.2 16.7
2	5	grass poly brown-headed rush coyote thistle rabbitfoot grass	26.7 20.0 12.7 10.0
3	5	scarlet pimpernel	10.3

3.13.2 Wildlife Monitoring

Pond 73 was surveyed for CTS on April 26, 2023. California tiger salamanders were not detected. In order to prioritize CTS surveys due to time and logistical constraints, neither fairy shrimp nor invertebrate studies were conducted. Table 3-45 provides results of the CTS survey completed in 2023.

Table 3-45. Pond 73 CTS Aquatic Monitoring Results

Vernal Pool	Sampling Date	# of Larvae Obs.	# of Larvae Measured	Total Length of Larvae (mm)			Snout-Vent Length of Larvae (mm)			Survey Hours
				Mean	Range	Mode	Mean	Range	Mode	
73	4/26/2023	0	0	-	-	-	-	-	-	27 min

3.14 Pond 16

Pond 16 was in year 5 of monitoring for post-subsurface munitions remediation in 2023. Pond 16 was monitored for hydrology, vegetation, and wildlife. Hydrology results are reported separately in the Hydrology Monitoring Annual Report (Chenega, 2023).

3.14.1 Vegetation Monitoring

Vegetation monitoring was completed at Pond 16 on August 30 and September 20, 2023. These monitoring data represent year 5 post-subsurface munitions remediation conditions. Pond 16 exhibited peripheral ponding in December, then held water from January through June of the 2022-2023 water-year (Chenega, 2023). Biologists identified six strata at the vernal pool (see Table 3-46 and Figure 3-17). Stratum 1 was repeated from 2017, 2019, and 2021-2023. Strata 3 and 5, and their corresponding transects, were repeated from 2015, 2017, and 2019-2022. Strata 4 and 6, and their corresponding transects, were repeated from 2017 and 2019-2022. Stratum 7 was repeated from 2017 and 2019 while Transect 7 was relocated to a more representative location within the stratum. No transect was placed in Stratum 1 because it was inundated at the time of vegetation surveys, so visual cover was estimated.

Table 3-46. Pond 16 (Year 5 Post-Subsurface Munitions Remediation) Vegetative Strata Percentage within the Vernal Pool Basin Boundary

Stratum	Percentage
1 (Inundated)	34%
3	23%
4	15%
5	23%
6	2%
7	3%

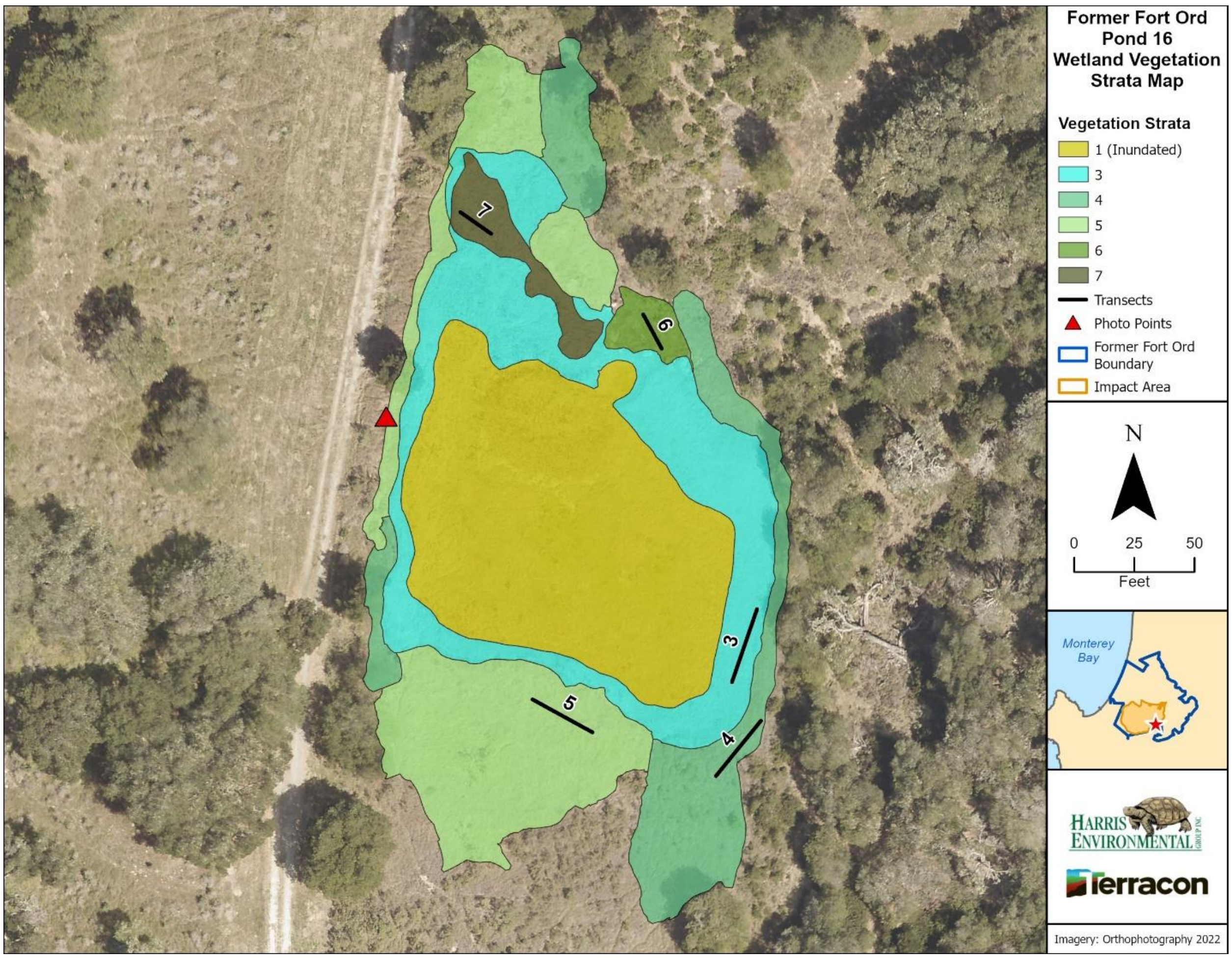

Figure 3-17. Pond 16 (Year 5 Post-Subsurface Munitions Remediation) Vegetation Strata and Transects on Former Fort Ord, 2023

Fifty-three species were observed within the vernal pool basin boundary. Of these species, 32 were native, 20 were non-native, and one was unidentified. Seven species were OBL wetland plants, 20 were FACW or FAC, 14 were FACU or UPL, and 12 were not listed. Appendix B provides the species cover results for each stratum. Appendix D identifies the number of native, non-native, and unidentified

species within each stratum as well as the number of species within each wetland indicator category for each stratum. Table 3-47 provides a summary of the dominant species cover results for each stratum.

Table 3-47. Pond 16 (Year 5 Post-Subsurface Munitions Remediation) Dominant Species by Stratum Results

Stratum	Transect Length (m)	Dominant Species	
		Common Name	Absolute Cover on Transect (%)
3	10	pale spikerush	84.3
4	10	Baltic rush brown-headed rush California blackberry	39.8 30.2 19.0
5	10	whiteroot	69.7
6	5	Baltic rush	92.7
7	5	barnyard grass swamp pricklegrass pale spikerush	34.0 28.3 26.0

3.14.2 Wildlife Monitoring

Pond 16 was surveyed for CTS and fairy shrimp on May 12, 2023. California tiger salamanders and fairy shrimp were present during the survey. Table 3-48 and Table 3-49 provide results of the CTS and fairy shrimp surveys completed in 2023. Invertebrate results for 2023 are provided in Appendix G (see Table G-2).

Table 3-48. Pond 16 CTS Aquatic Monitoring Results

Vernal Pool	Sampling Date	# of Larvae Obs.	# of Larvae Measured	Total Length of Larvae (mm)			Snout-Vent Length of Larvae (mm)			Survey Hours
				Mean*	Range	Mode	Mean*	Range	Mode	
16	5/12/2023	1	1	39	-	39	18	-	18	1 hr 37 min†

*The mean was rounded to the nearest whole number

Table 3-49. Pond 16 Fairy Shrimp Monitoring Results

Sampling Date	Abundance (# Individuals)
5/12/2023	Low (7)

3.15 Pond 39

Pond 39 was in year 5 of monitoring for post-subsurface munitions remediation in 2023. Pond 39 was monitored for hydrology, vegetation, and wildlife. Hydrology results are reported separately in the Hydrology Monitoring Annual Report (Chenega, 2023).

3.15.1 Vegetation Monitoring

Vegetation monitoring was completed at Pond 39 on May 31, 2023. These monitoring data represent year 5 post-subsurface munitions remediation conditions. Pond 39 held water from December through May with peripheral ponding present the first three months. By January, Pond 39 was hydrologically connected to Pond 40 South, and by March it was hydrologically connected to Pond 35 (Chenega, 2023). Biologists identified four strata at the vernal pool (see Table 3-50 and Figure 3-18). Strata 1 and 3 were repeated from 2016 and 2018-2022. Stratum 2 was repeated from 2016 and 2019, while Stratum 4 was repeated from 2018-2022. Transect 1 was repeated from 2019; Transect 3 was repeated from 2018, 2019, and 2020; and Transect 4 was repeated from 2019 and 2022. Transect 2 was relocated to a more representative location.

Table 3-50. Pond 39 (Year 5 Post-Subsurface Munitions Remediation) Vegetative Strata Percentage within the Vernal Pool Basin Boundary

Stratum	Percentage
1	11%
2	18%
3	35%
4	29%
Upland	7%

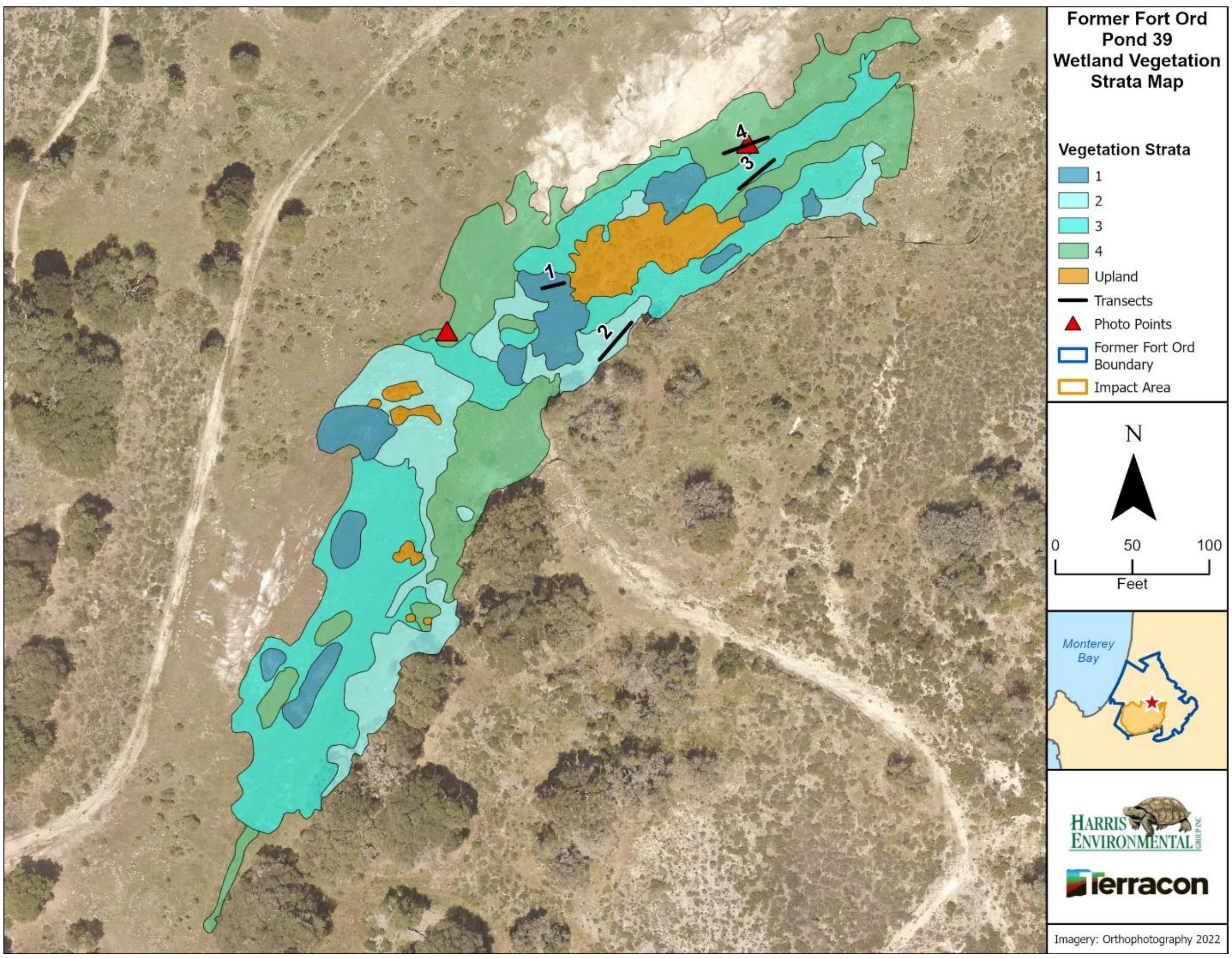

Figure 3-18. Pond 39 (Year 5 Post-Subsurface Munitions Remediation) Vegetation Strata and Transects on Former Fort Ord, 2023

Sixty-nine plant species were observed within the vernal pool basin boundary. Of these species, 39 were native, 28 were non-native, and two were unidentified. Six species were OBL wetland plants, 22 were

FACW or FAC, 13 were FACU or UPL, and 28 were not listed. Appendix B provides the species cover results for each stratum. Appendix D identifies the number of native, non-native, and unidentified species within each stratum as well as the number of species within each wetland indicator category for each stratum. Table 3-51 provides a summary of the dominant species cover results for each stratum.

Table 3-51. Pond 39 (Year 5 Post-Subsurface Munitions Remediation) Dominant Species by Stratum Results

Stratum	Transect Length (m)	Dominant Species	
		Common Name	Absolute Cover on Transect (%)
1	5	pale spikerush cut-leaved plantain Hickman's popcornflower	27.7 15.0 13.3
2	5	toad rush brown-headed rush annual quaking grass	26.7 15.3 11.0
3	10	Italian rye grass common toad rush	21.8 11.0
4	10	narrow-leaved clover purple needle grass	41.8 12.0

3.15.2 Wildlife Monitoring

Pond 39 was surveyed for fairy shrimp and CTS on May 9, 2023. Neither species was present during surveys. Table 3-52 and Table 3-53 provide results of the CTS and fairy shrimp surveys completed in 2023. Invertebrate results for 2023 are provided in Appendix G (see Table G-2).

Table 3-52. Pond 39 CTS Aquatic Monitoring Results

Vernal Pool	Sampling Date	# of Larvae Obs.	# of Larvae Measured	Total Length of Larvae (mm)			Snout-Vent Length of Larvae (mm)			Survey Hours
				Mean	Range	Mode	Mean	Range	Mode	
39	5/9/2023	0		-	-	-	-	-	-	5 min

Table 3-53. Pond 39 Fairy Shrimp Monitoring Results

Sampling Date	Abundance (# Individuals)
5/9/2023	Not Detected

3.16 Pond 40 South

Pond 40 South was in year 5 of monitoring for post-subsurface munitions remediation in 2023. Pond 40 South was monitored for hydrology and vegetation. Hydrology results are reported separately in the Hydrology Monitoring Annual Report (Chenega, 2023).

3.16.1 Vegetation Monitoring

Vegetation monitoring was completed at Pond 40 South on June 2, 2023. These monitoring data represent year 5 post-subsurface munitions remediation conditions. Pond 40 South exhibited peripheral ponding in December and held water from January through April (Chenega, 2023). Biologists identified four strata at the vernal pool (see Table 3-54 and Figure 3-19). Strata 1 and 2 and the corresponding strata were repeated from 2016, 2018-2021, and 2023. Stratum 3 was repeated from 2016 and 2018-2022, while Stratum 4 was repeated from 2022. Transect 3 was repeated from 2019, while Transect 4 was relocated to a more representative location.

Table 3-54. Pond 40 South (Year 5 Post-Subsurface Munitions Remediation) Vegetative Strata Percentage within the Vernal Pool Basin Boundary

Stratum	Percentage
1	11%
2	30%
3	36%
4	20%
Upland	3%

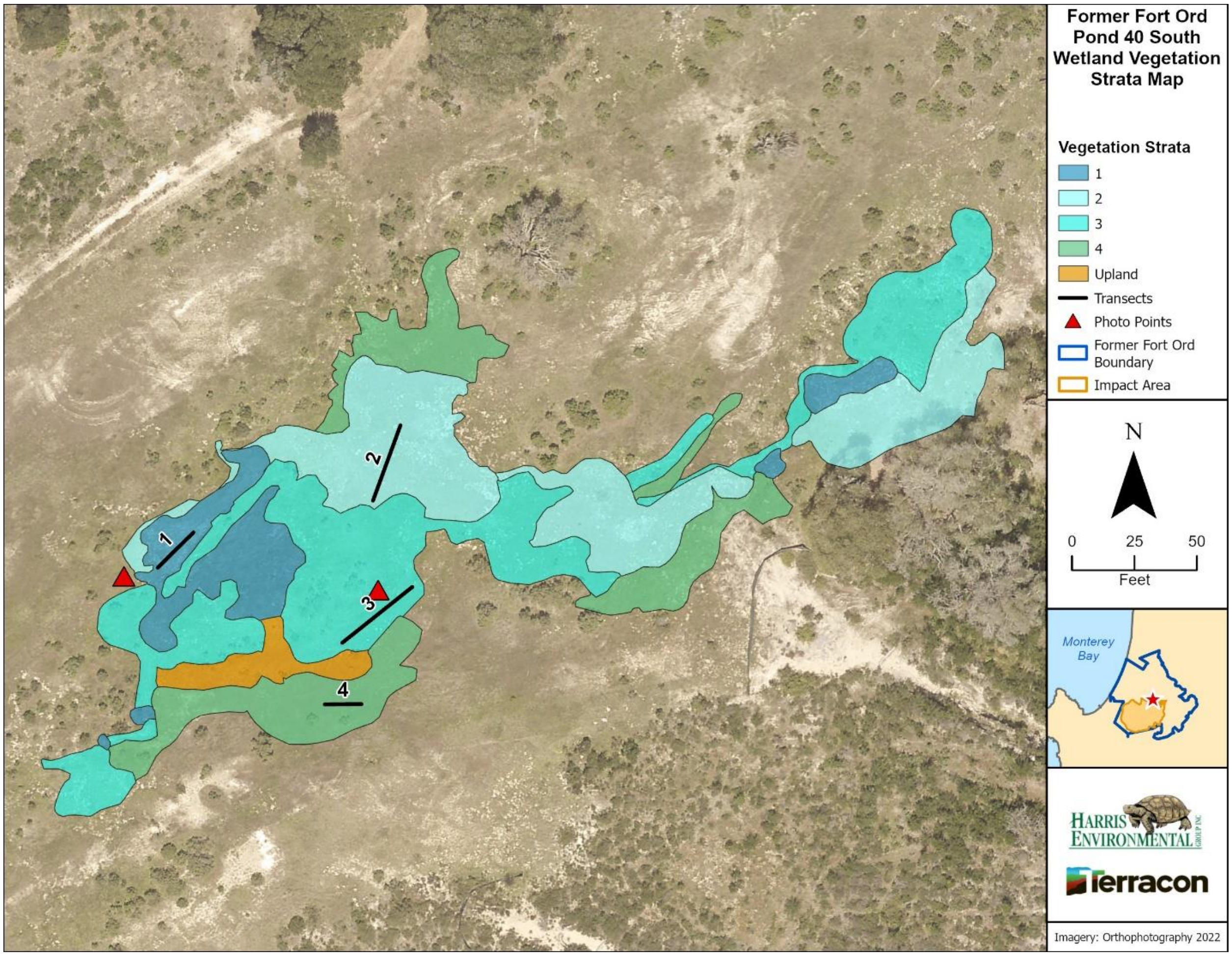

Figure 3-19. Pond 40 South (Year 5 Post-Subsurface Munitions Remediation) Vegetation Strata and Transects on Former Fort Ord, 2023

Sixty plant species were observed within the vernal pool basin boundary. Of these species, 30 were native, 29 were non-native, and one was unidentified. Five species were OBL wetland plants, 17 were FACW or FAC, 15 were FACU or UPL, and 23 were not listed. Appendix B provides the species cover results for each stratum. Appendix D identifies the number of native, non-native, and unidentified species within each stratum, as well as the number of species within each wetland indicator category for each stratum. Table 3-55 provides a summary of the dominant species cover results for each stratum.

Table 3-55. Pond 40 South (Year 5 Post-Subsurface Munitions Remediation) Dominant Species by Stratum Results

Stratum	Transect Length (m)	Dominant Species	
		Common Name	Absolute Cover on Transect (%)
1	5	Hickman's popcornflower	56.3
2	5	brown-headed rush narrow-leaved clover sheep sorrel	25.0 19.0 12.3
3	10	Italian rye grass narrow-leaved clover	28.0 10.3
4	5	gumweed narrow-leaved clover	19.3 16.3

3.16.2 Wildlife Monitoring

Wildlife surveys were not conducted at Pond 40 South because the vernal pool was dry by the time wildlife monitoring began.

3.17 Pond 41

Pond 41 was in year 5 of monitoring for post-subsurface munitions remediation in 2023. Pond 41 was monitored for hydrology, vegetation, and wildlife. Hydrology results are reported separately in the Hydrology Monitoring Annual Report (Chenega, 2023).

3.17.1 Vegetation Monitoring

Vegetation monitoring was completed at Pond 41 on July 19, 2023. These monitoring data represent year 5 post-subsurface munitions remediation conditions. Pond 41 exhibited peripheral ponding in December, then held water from January through June of the 2022-2023 water-year (Chenega, 2023). Biologists identified four strata at the vernal pool (see Table 3-56 and Figure 3-20). Strata 1, 2, and 3 were repeated from 2016 and 2019-2022, while Stratum 4 was repeated from 2019-2022. Transect 1 was repeated from 2016, 2019, and 2020; Transect 2 was repeated from 2016 and 2019-2021; Transect 3 was repeated from 2016 and 2019; and Transect 4 was repeated from 2019-2021.

Table 3-56. Pond 41 (Year 5 Post-Subsurface Munitions Remediation) Vegetative Strata Percentage within the Vernal Pool Basin Boundary

Stratum	Percentage
1	16%
2	57%
3	20%
4	4%
Upland	3%

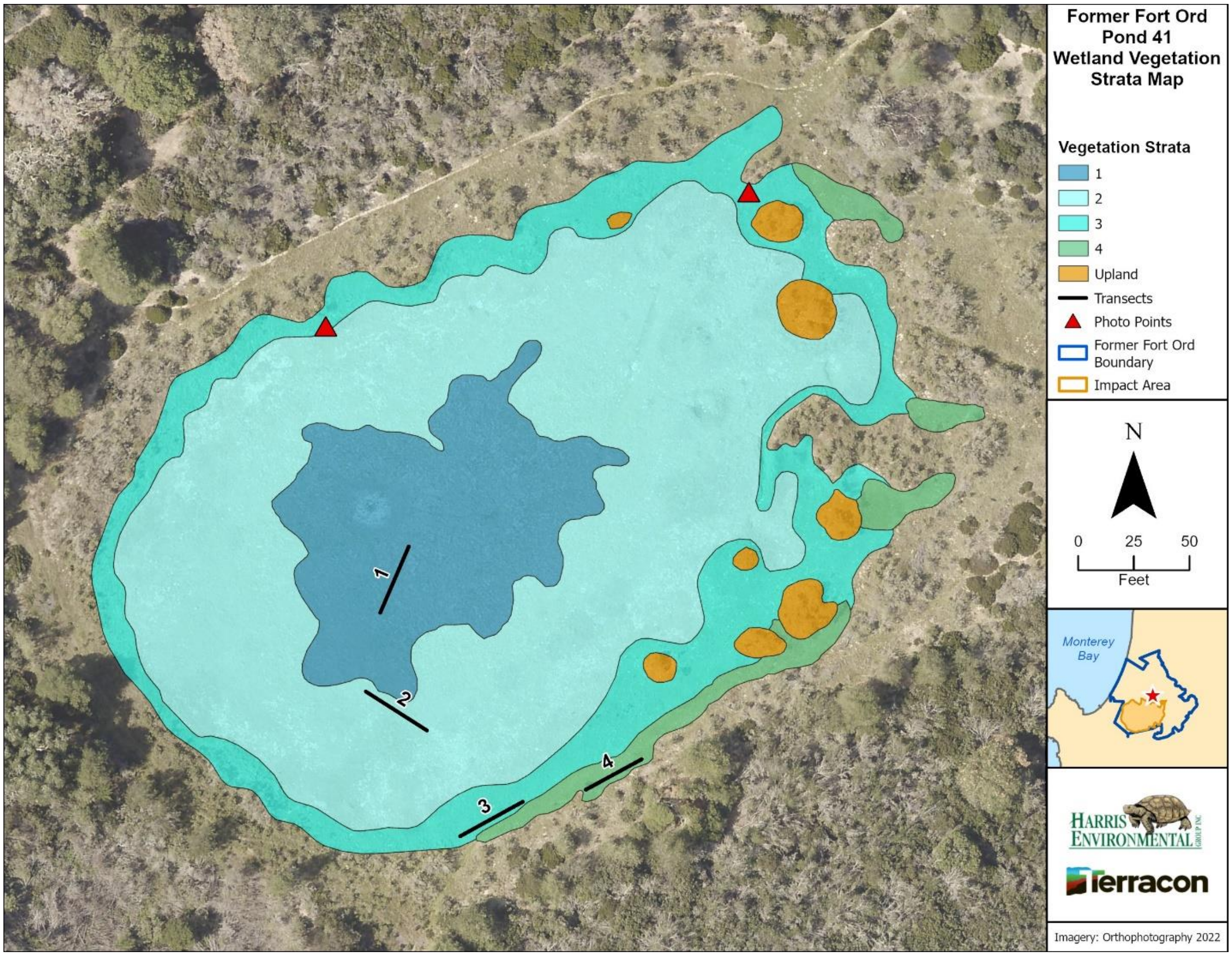

Figure 3-20. Pond 41 (Year 5 Post-Subsurface Munitions Remediation) Vegetation Strata and Transects on Former Fort Ord, 2023

Fifty-two plant species were observed within the vernal pool basin boundary. Of these species, 33 were native and 19 were non-native. Eight species were OBL wetland plants, 18 were FACW or FAC, 11 were FACU or UPL, and 15 were not listed. Appendix B provides the species cover results for each stratum. Appendix D identifies the number of native, non-native, and unidentified species within each stratum as well as the number of species within each wetland indicator category for each stratum. Table 3-57 provides a summary of the dominant species cover results for each stratum.

Table 3-57. Pond 41 (Year 5 Post-Subsurface Munitions Remediation) Dominant Species by Stratum Results

Stratum	Transect Length (m)	Dominant Species	
		Common Name	Absolute Cover on Transect (%)
1	5	pale spikerush	50.3
2	10	needle spikerush Hickman's popcornflower pale spikerush	20.8 14.8 14.3
3	10	brown-headed rush needle spikerush	39.5 11.7
4	5	gumweed	23.0

3.17.2 Wildlife Monitoring

Pond 41 was surveyed for CTS on April 26, and for both fairy shrimp and CTS on May 12, 2023. California tiger salamanders were present at both survey events. Fairy shrimp were not present. Table 3-58 and Table 3-59 provide results of the CTS and fairy shrimp surveys completed in 2023. Invertebrate results for 2023 are provided in Appendix G (see Table G-2).

Table 3-58. Pond 41 CTS Aquatic Monitoring Results

Vernal Pool	Sampling Date	# of Larvae Obs.	# of Larvae Measured	Total Length of Larvae (mm)			Snout-Vent Length of Larvae (mm)			Survey Hours
				Mean*	Range	Mode	Mean*	Range	Mode	
41	4/26/2023	4	4	98	71-116	-	56	42-64	-	31 min
	5/12/2023	7	7	99	84-123	-	54	46-65	-	1 hr 14 min

*The mean was rounded to the nearest whole number

Table 3-59. Pond 41 Fairy Shrimp Monitoring Results

Sampling Date	Abundance (# Individuals)
5/12/2023	Not Detected

3.18 Pond 42

Pond 42 was in year 5 of monitoring for post-subsurface munitions remediation in 2023. Pond 42 was monitored for hydrology, vegetation, and wildlife. Hydrology results are reported separately in the Hydrology Monitoring Annual Report (Chenega, 2023).

3.18.1 Vegetation Monitoring

Vegetation monitoring was completed at Pond 42 on August 3, 2023. These monitoring data represent year 5 post-subsurface munitions remediation conditions. Pond 42 exhibited peripheral ponding in December and then held water from December through April of the 2022-2023 water-year (Chenega, 2023). Biologists identified five strata at the vernal pool (see Table 3-60 and Figure 3-21). Strata 1 through 4 were repeated from 2017-2022. Stratum 5 was repeated from 2019-2022. Transects 1, 3, 4, and 5 were relocated because the previous locations were no longer within the correct strata. Transect 2 was relocated to a more representative location.

Table 3-60. Pond 42 (Year 5 Post-Subsurface Munitions Remediation) Vegetative Strata Percentage within the Vernal Pool Basin Boundary

Stratum	Percentage
1	8%
2	8%
3	36%
4	15%
5	13%
Upland	20%

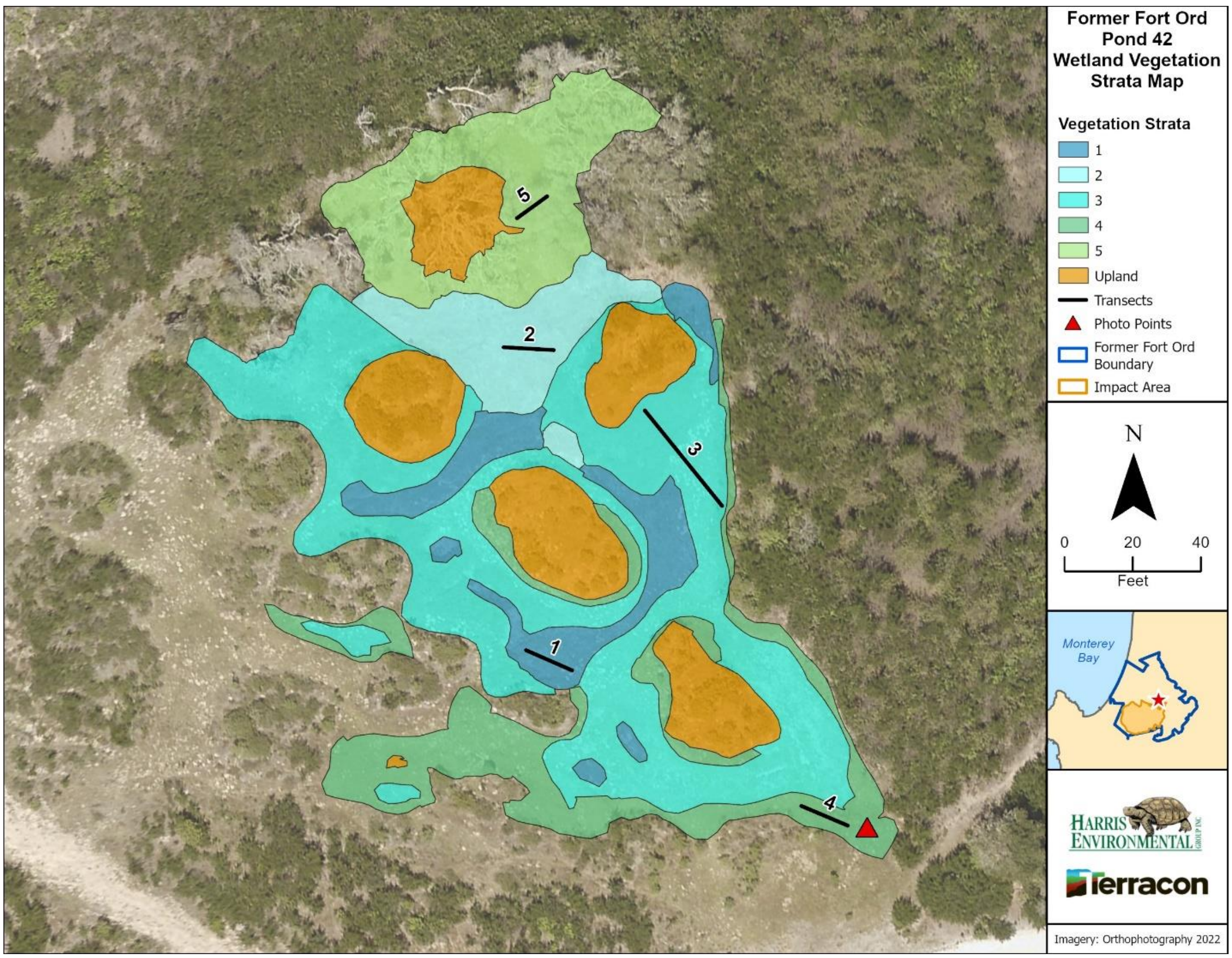

Figure 3-21. Pond 42 (Year 5 Post-Subsurface Munitions Remediation) Vegetation Strata and Transects on Former Fort Ord, 2023

Fifty-five plant species were observed within the vernal pool basin boundary. Of these species, 35 were native, 18 were non-native, and two were unidentified. Seven species were OBL wetland plants, 16 were FACW or FAC, eight were FACU or UPL, and 24 were not listed. Appendix B provides the species cover results for each stratum. Appendix D identifies the number of native, non-native, and unidentified

species within each stratum as well as the number of species within each wetland indicator category for each stratum. Table 3-61 provides a summary of the dominant species cover results for each stratum.

Table 3-61. Pond 42 (Year 5 Post-Subsurface Munitions Remediation) Dominant Species by Stratum Results

Stratum	Transect Length (m)	Dominant Species	
		Common Name	Absolute Cover on Transect (%)
1	5	coyote thistle needle spikerush	25.0 20.7
2	5	pale spikerush rabbitfoot grass	73.3 15.7
3	5	needle spikerush brown-headed rush coyote thistle grass poly	19.0 19.0 15.0 15.0
4	5	coastal tarweed rattlesnake grass	20.0 11.0
5	5	rabbitfoot grass	22.3

3.18.2 Wildlife Monitoring

Pond 42 was partially surveyed for CTS on April 26, 2023, covering 35% of the area. California tiger salamanders were not detected on the survey date. In order to prioritize CTS surveys due to time and logistical constraints, neither fairy shrimp nor invertebrate studies were conducted. Table 3-62 provides results of the CTS survey completed in 2023.

Table 3-62. Pond 42 CTS Aquatic Monitoring Results

Vernal Pool	Sampling Date	# of Larvae Obs.	# of Larvae Measured	Total Length of Larvae (mm)			Snout-Vent Length of Larvae (mm)			Survey Hours
				Mean	Range	Mode	Mean	Range	Mode	
42	4/26/2023	0		-	-	-	-	-	-	22 min

3.19 Pond 61

Pond 61 was in year 5 of monitoring for post-subsurface munitions remediation in 2023. Pond 61 was monitored for hydrology and vegetation. Hydrology results are reported separately in the Hydrology Monitoring Annual Report (Chenega, 2023).

3.19.1 Vegetation Monitoring

Vegetation monitoring was completed at Pond 61 on June 7, 2023. These monitoring data represent year 5 post-subsurface munitions remediation conditions. The eastern section of Pond 61 (hydrologically defined as Pond 61 East) held water from January through April of the 2022-2023 water-year, whereas the western section (hydrologically defined as Pond 61 West) held water in December through April (Chenega, 2023). Biologists identified four strata at the vernal pool (see Table 3-63 and Figure 3-22). Stratum 1 was repeated from 2017-2021, while Strata 2, 3, and 4 were repeated from 2017-2022.

Transects 1, 3, and 4 were relocated because the previous locations were no longer in the correct strata. Stratum 2 consisted of CCG and no transect was placed in this stratum.

Table 3-63. Pond 61 (Year 5 Post-Subsurface Munitions Remediation) Vegetative Strata Percentage within the Vernal Pool Basin Boundary

Stratum	Percentage
1	3%
2 (CCG)	10%
3	52%
4	23%
Upland	12%

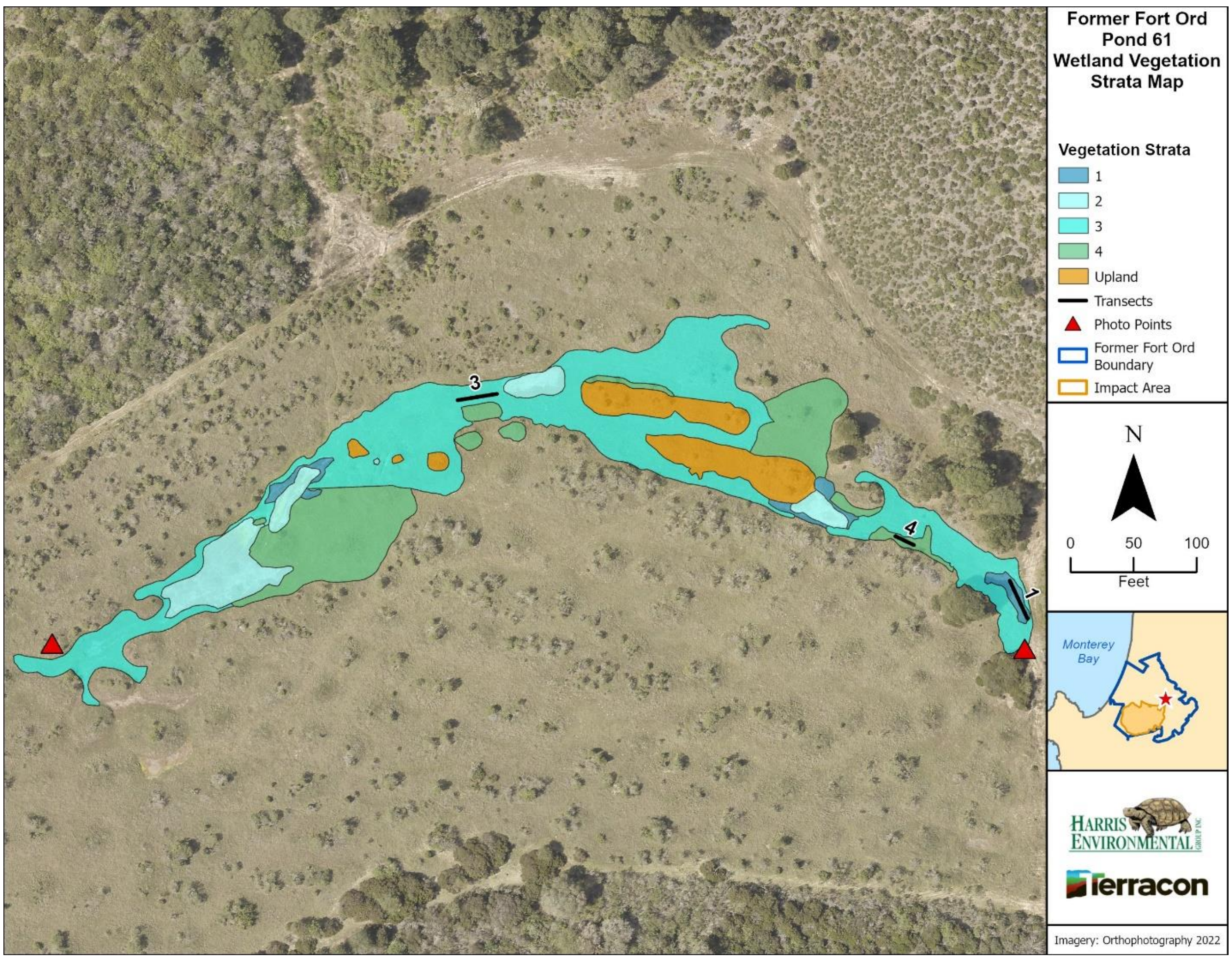

Figure 3-22. Pond 61 (Year 5 Post-Subsurface Munitions Remediation) Vegetation Strata and Transects on Former Fort Ord, 2023

Sixty-four plant species were observed within the vernal pool basin boundary. Of these species, 40 were native and 24 were non-native. Six species were OBL wetland plants, 22 were FACW or FAC, nine were FACU or UPL, and 27 were not listed. Appendix B provides the species cover results for each stratum.

Appendix D identifies the number of native, non-native, and unidentified species within each stratum as well as the number of species within each wetland indicator category for each stratum. Table 3-64 provides a summary of the dominant species cover results for each stratum.

Table 3-64. Pond 61 (Year 5 Post-Subsurface Munitions Remediation) Dominant Species by Stratum Results

Stratum	Transect Length (m)	Dominant Species	
		Common Name	Absolute Cover on Transect (%)
1	10	rabbitfoot grass Hickman's popcornflower grass poly	24.3 12.7 10.0
2	N/A	Contra Costa goldfields	N/A
3	10	grass poly common toad rush	23.0 13.3
4	5	brown-headed rush rattlesnake grass	20.7 20.0

3.19.1.1 *Contra Costa Goldfields*

Contra Costa goldfields at Pond 61 were mapped on June 26, 2023; they occupied 0.13 acre with a density of 15-30% cover. No transects were placed in Stratum 2 to avoid disturbing the population. Figure 3-23 illustrates the extent of the CCG population at Pond 61.

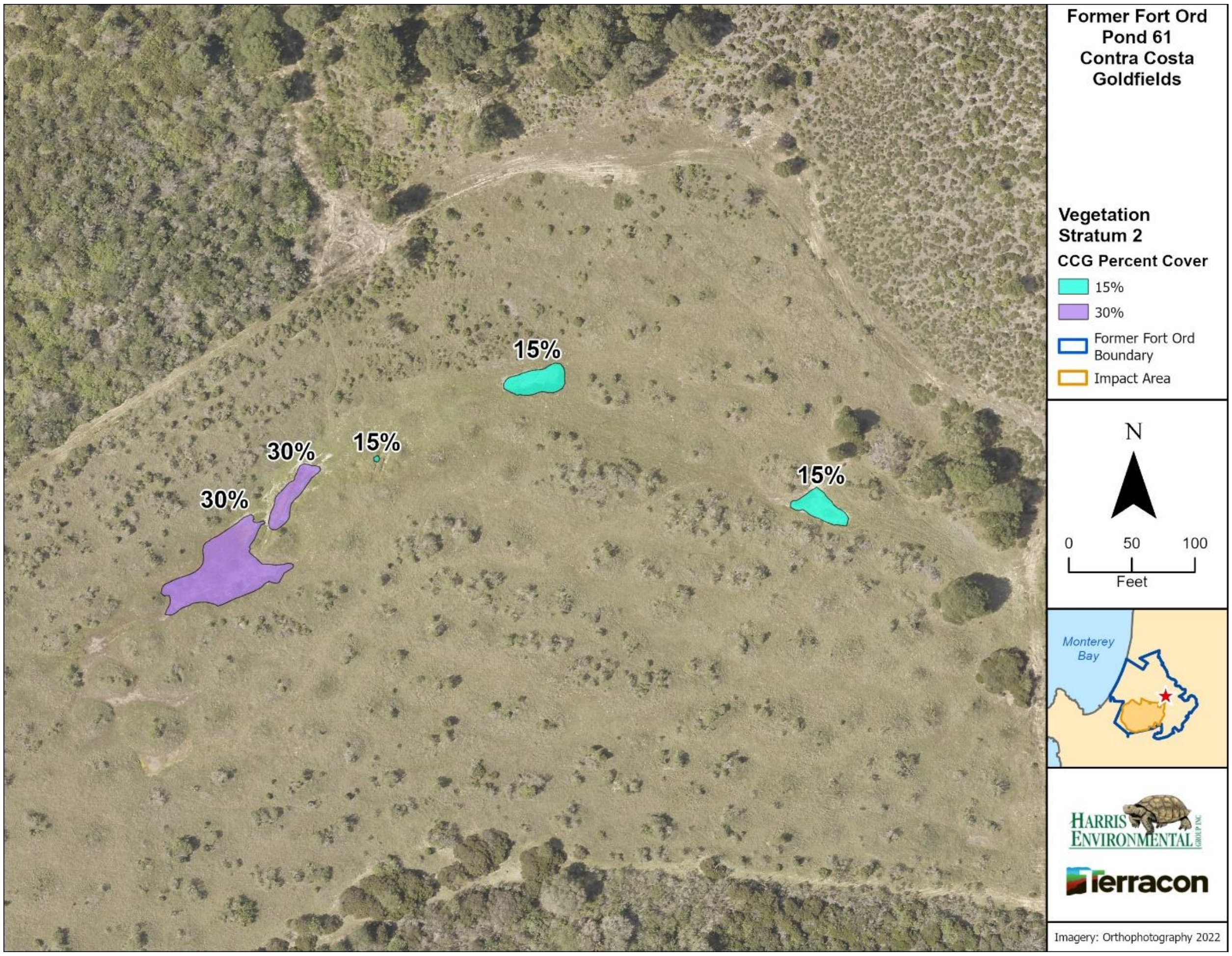

Figure 3-23. Contra Costa Goldfields Populations at Pond 61 (Year 5 Post-Subsurface Munitions Remediation), 2023

3.19.2 Wildlife Monitoring

Wildlife surveys were not conducted at Pond 61. Pond 61 East was dry on the April 27, 2023 survey date when priority was given to survey ponds with known historical CTS presence. Pond 61 West was not surveyed in May due to logistical constraints.

4 DISCUSSION

Data quality objectives (DQO) and performance standards outlined in the Wetland Plan were used to measure successful wetland function following MEC and soil remediation activities (Burleson, 2006). Evaluation for the DQOs was included in the Methods Section 2.4. DQOs for wetland vegetation and wildlife are summarized below:

- DQO 3: vegetation – similar hydrophytic vegetation as reference control wetlands
- DQO 5: wildlife – consistent with baseline and similar to reference control wetland trends

4.1 Pond 5 – Reference

Pond 5 has been monitored for 15 years as a reference vernal pool. Table 4-1 summarizes the years in which monitoring occurred and surveys were conducted. The cumulative precipitation graph shows precipitation for years in which hydrology monitoring was conducted at Pond 5 (see Figure 4-1). Above-normal water-years were 1994-1995, 2015-2016, 2016-2017, 2018-2019 and this year, 2022-2023. All other monitoring was conducted either in a normal or below-normal water-year, drought year, or consecutive drought year.

Table 4-1. Pond 5 (Reference) Summary of Historical Surveys for Hydrology, Vegetation, and Wildlife

Survey	Water-Year														
	1993-1994	1994-1995	1995-1996	2006-2007	2009-2010	2012-2013	2013-2014	2015-2016	2016-2017	2017-2018	2018-2019	2019-2020	2020-2021	2021-2022	2022-2023
Hydrology	●	●	●	●		●	●	●	●	●	●	●	●	●	●
Vegetation	●	●	●	●				●	●	●	●	●	●	●	●
Wildlife	●	●	●	●	●			●	●	●	●	●			●

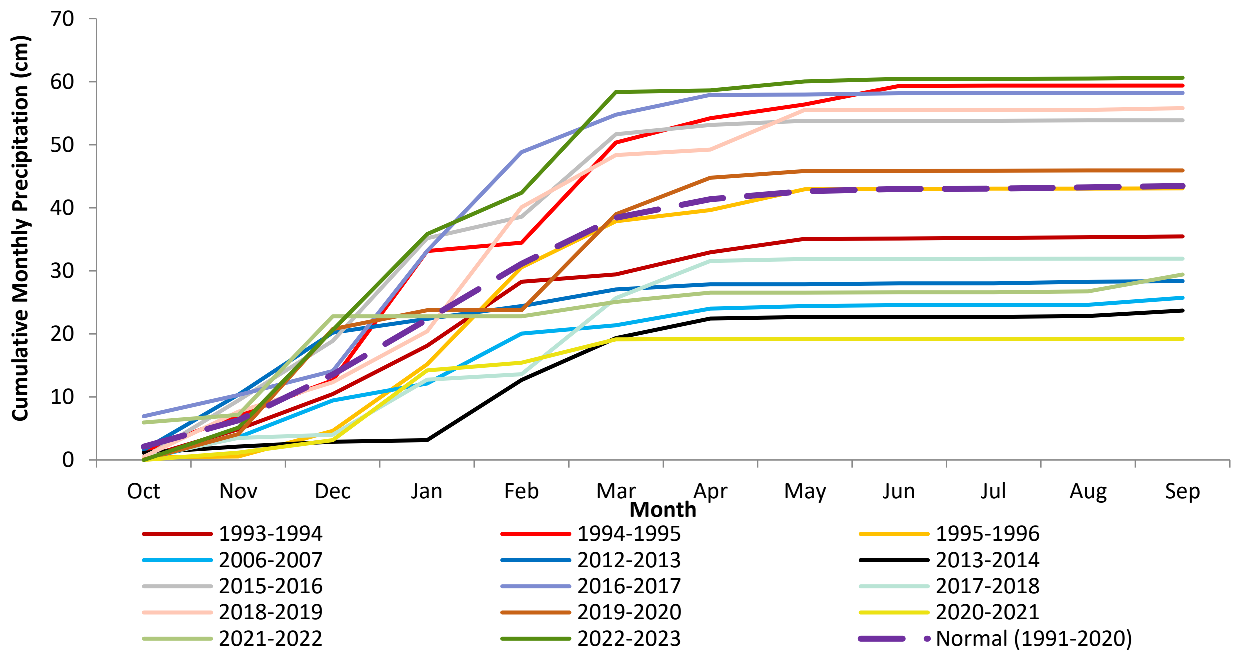

Figure 4-1. Cumulative Monthly Precipitation for Years that Hydrology Monitoring Occurred at Pond 5 (Reference) Compared to the 30-Year Normal (mean 1991-2020) (NPS, 2023; NCEI NOAA, 2023)

4.1.1 Vegetation Monitoring

Vegetation data were collected at Pond 5 in 2007 and 2016-2023 (Shaw, 2008; Burleson, 2017, 2018, 2019, 2020, 2021, 2022, 2023, and 2024). Data from 1994, 1995, and 1996 only represent dominant species and are not included in the following analyses because the data were collected using a different methodology than was used in subsequent years (Jones and Stokes, 1996). In 2007, data were collected in three zones using a 1.0 m^2 quadrat placed at three locations within each zone, and data for all strata were combined for the entire pool to allow for comparison to other years. In years 2016-2023, data were collected using methodologies described in the Methods section of this report. Data from 2016 and 2023 were compared stratum-to-stratum in Table 4-2 as well as visually in Figure 4-2.

Table 4-2. Pond 5 (Reference) Vegetative Strata Percentage within the Vernal Pool Basin Boundary

Stratum	Percentage	
	2016	2023
1	26%	62%
2	32%	18%
3	38%	18%
4	4%	N/A
9	N/A	2%

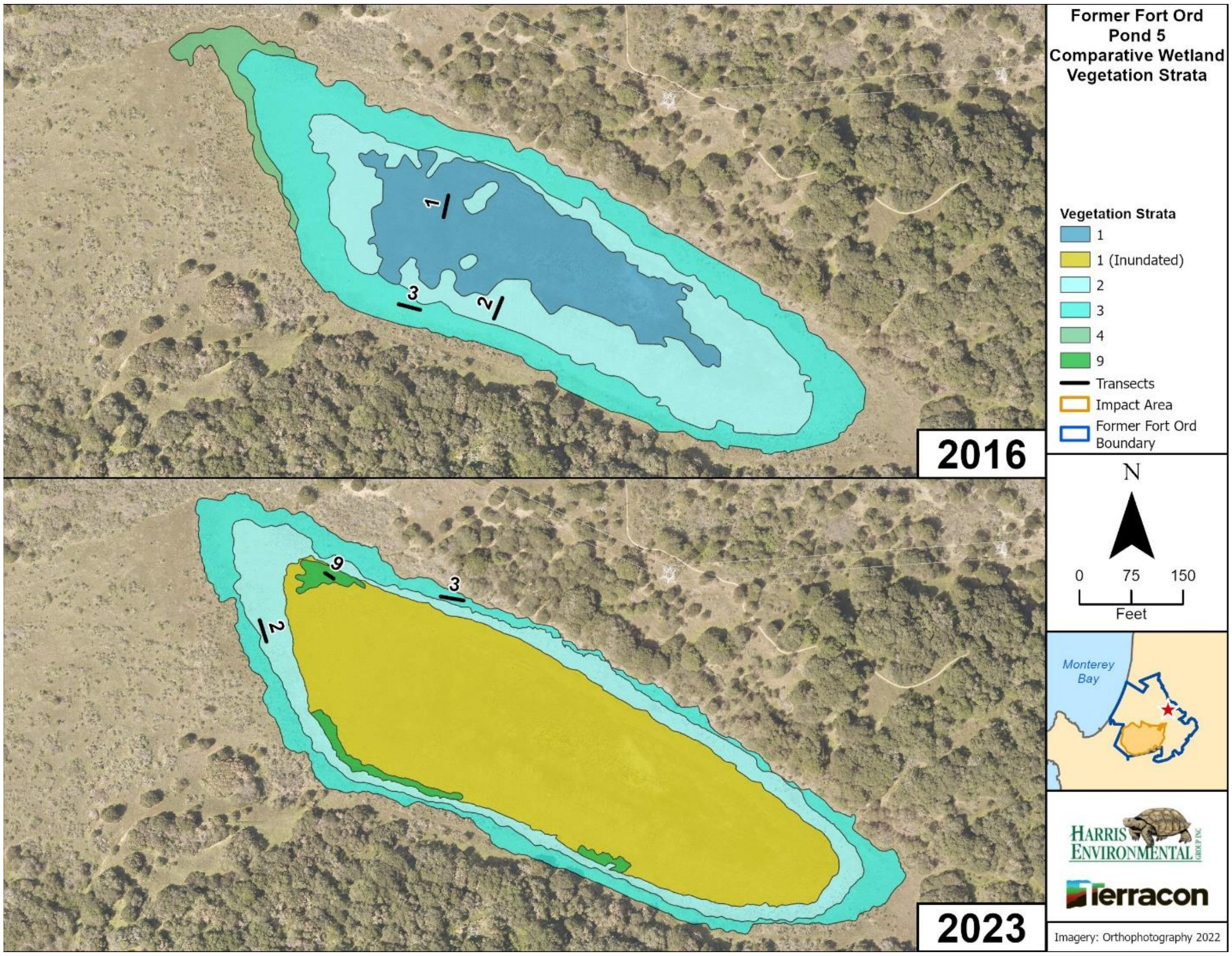

Figure 4-2. Pond 5 (Reference) Vegetation Strata and Transects for 2016 and 2023

The absolute percent vegetative cover observed in 2023 was generally greater than previous years and similar to 2016 (see Table 4-3). Vegetative cover ranged from 36.3% in 2007 to 76.0% in 2019, whereas thatch/bare ground ranged from 24.0% in 2019 to 63.7% in 2007.

Table 4-3. Pond 5 (Reference) Absolute Percent Cover

Year	Vegetative Cover	Thatch/Bare Ground
2007	36.3%	63.7%
2016	75.1%	25.2%
2017	60.5%	40.4%
2018	54.6%	45.5%
2019	76.0%	24.0%
2020	47.6%	52.4%
2021	39.3%	60.7%
2022	41.2%	58.8%
2023	74.5%	25.5%

Species richness on transects and for the overall basin has fluctuated between 2007 and 2023 with the highest richness observed on transects in 2018 and for the overall basin in 2019. Species richness on transects was 4, 7, 29, 41, 35, 23, 31, 29, and 24 species in 2007, 2016, 2017, 2018, 2019, 2020, 2021, 2022, and 2023 respectively, whereas overall basin species richness was 26, 40, 73, 88, 94, 69, 70, 76, and 68 species, respectively (see Table 4-4, and Appendix D Table D-1). The species richness is represented on the RACs as the length of the curve and number of species along the curve (see Figure 4-3 and Figure 4-4).

Species composition at Pond 5 varied between monitoring years. This variability of species composition is illustrated on the RACs as the species codes shift along the curve and losses and gains occur from year to year (see Figure 4-3 and Figure 4-4). Despite overall composition variability, the dominant species in the vernal pool were pale spikerush (*Eleocharis macrostachya*) and salt grass (*Distichlis spicata*) in the majority of monitoring years. Both species are in the top five for all of the RACs. Baltic rush (*Juncus balticus*), cut-leaf geranium (*Geranium dissectum*), smooth cat's-ear (*Hypochaeris glabra*), and bugle hedge nettle (*Stachys ajugoides*) were dominant species in 2021 and 2022. By 2023, Howell's quillwort (*Isöetes howellii*), grass poly (*Lythrum hyssopifolia*), salt grass, and Lemmon's canary grass (*Phalaris lemmonii*) were important species. A complete comparison of species composition observed during the surveys at Pond 5 in 2007 and 2016-2022 can be found in Appendix E. Figure 4-6 shows a subset of this comparison for species observed with a 2% absolute cover or greater.

The evenness from each year is represented by the slope of the RACs. The evenness is fairly similar from year to year with richness uniformly distributed along the entire curve with a slightly higher concentration or plateau of species toward the tail end. This plateau illustrates that there are a high number of species with low abundance. "Structurally complex systems, such as a fen [or vernal pool] system," as explained in Verberk, 2011, "are species rich and have a more even community abundance pattern, possibly owing to a fine partitioning of available niches." When comparing year to year, a more even distribution of the top species occurs in 2017, 2018, 2021, and 2022 at Pond 5 (see Figure 4-4, Figure 4-5, and Appendix F). Whereas, 2016, 2019, 2020, and 2023 have steeper slopes and higher abundance of the dominant species at the top of the curves.

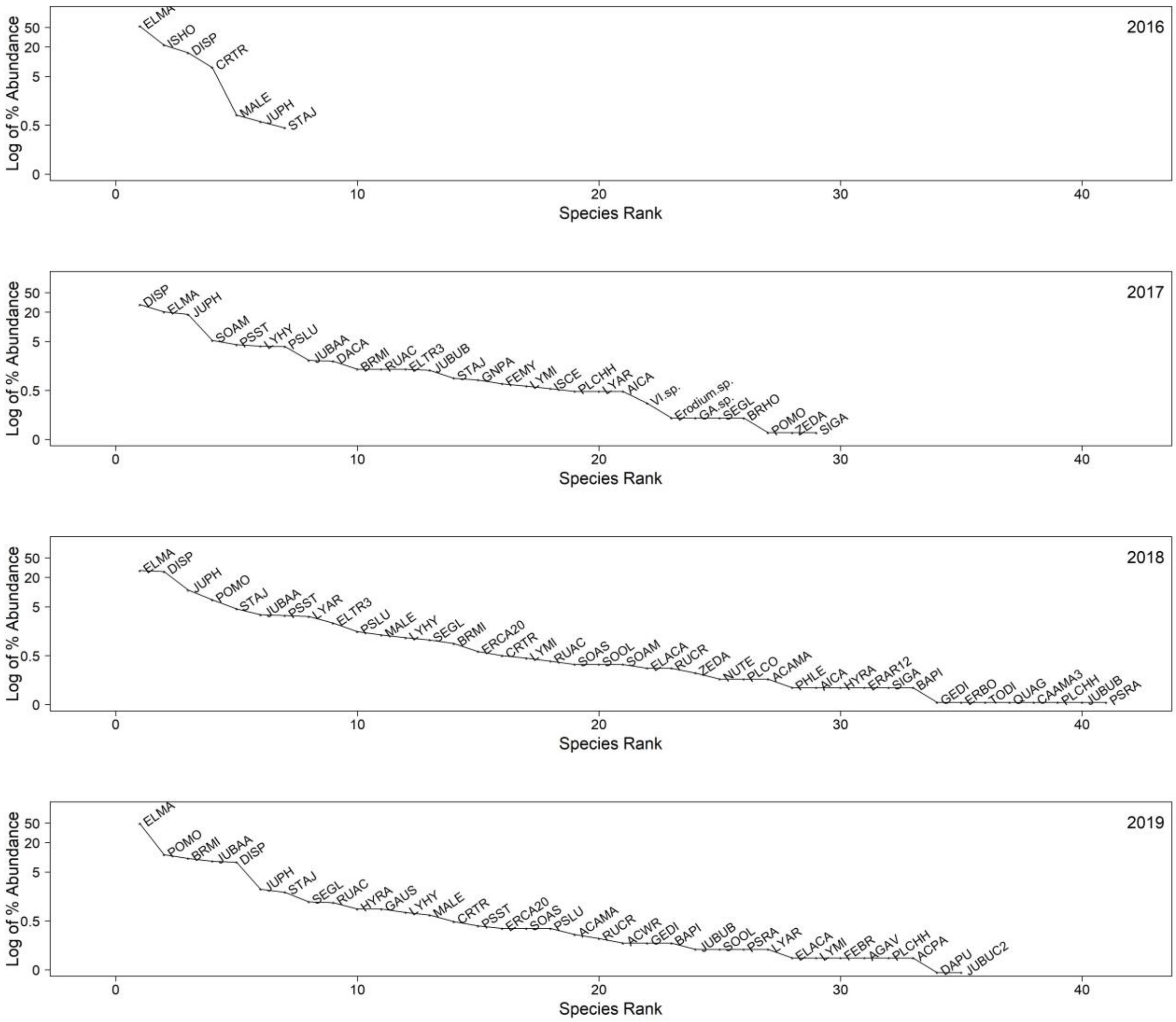

Figure 4-3. Rank Abundance Curves at Pond 5 (Reference) in 2016-2019. Note that the y-axis is in log-10 scale.

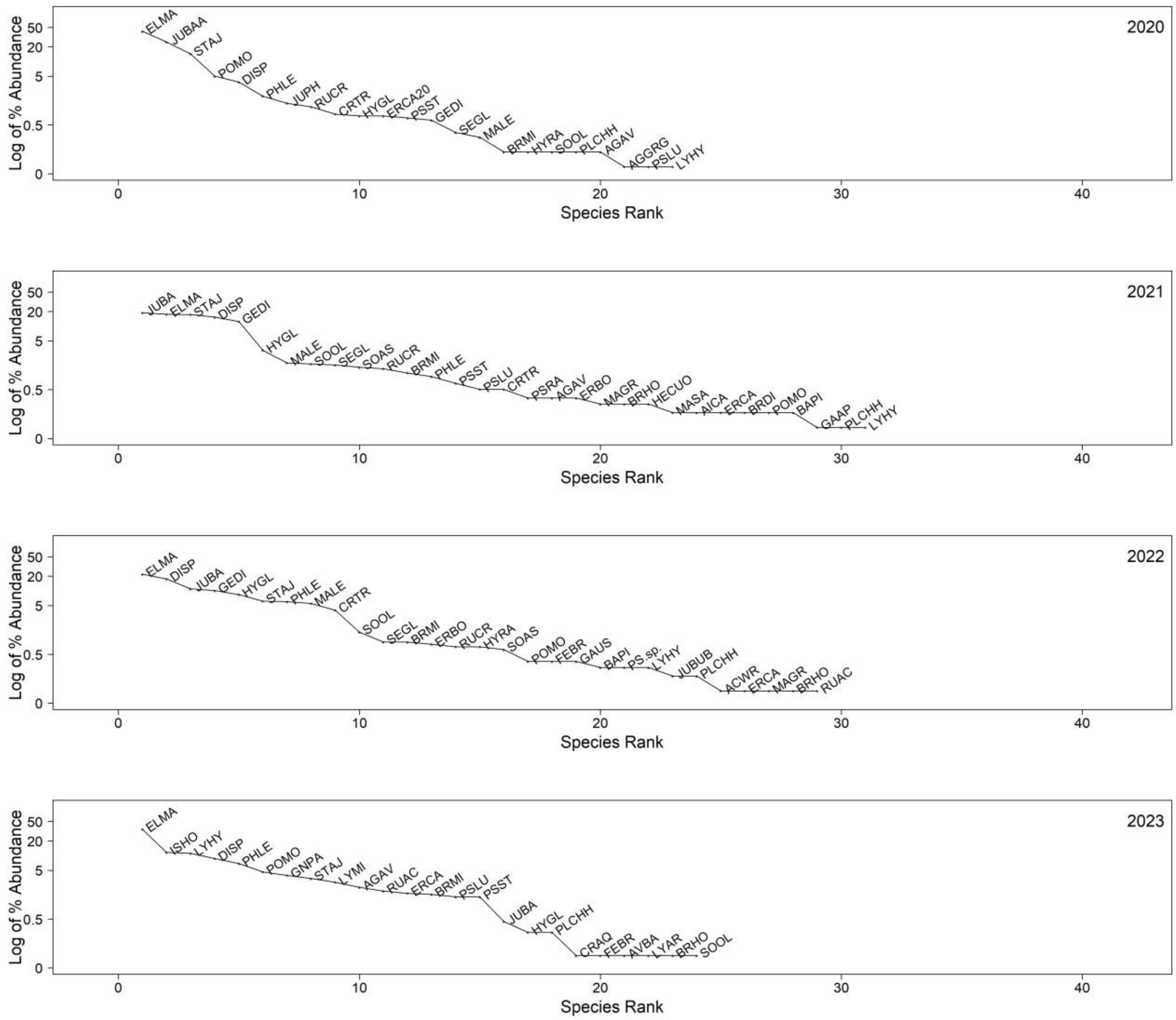

Figure 4-4. Rank Abundance Curves at Pond 5 (Reference) in 2019-2023. Note that the y-axis is in log-10 scale.

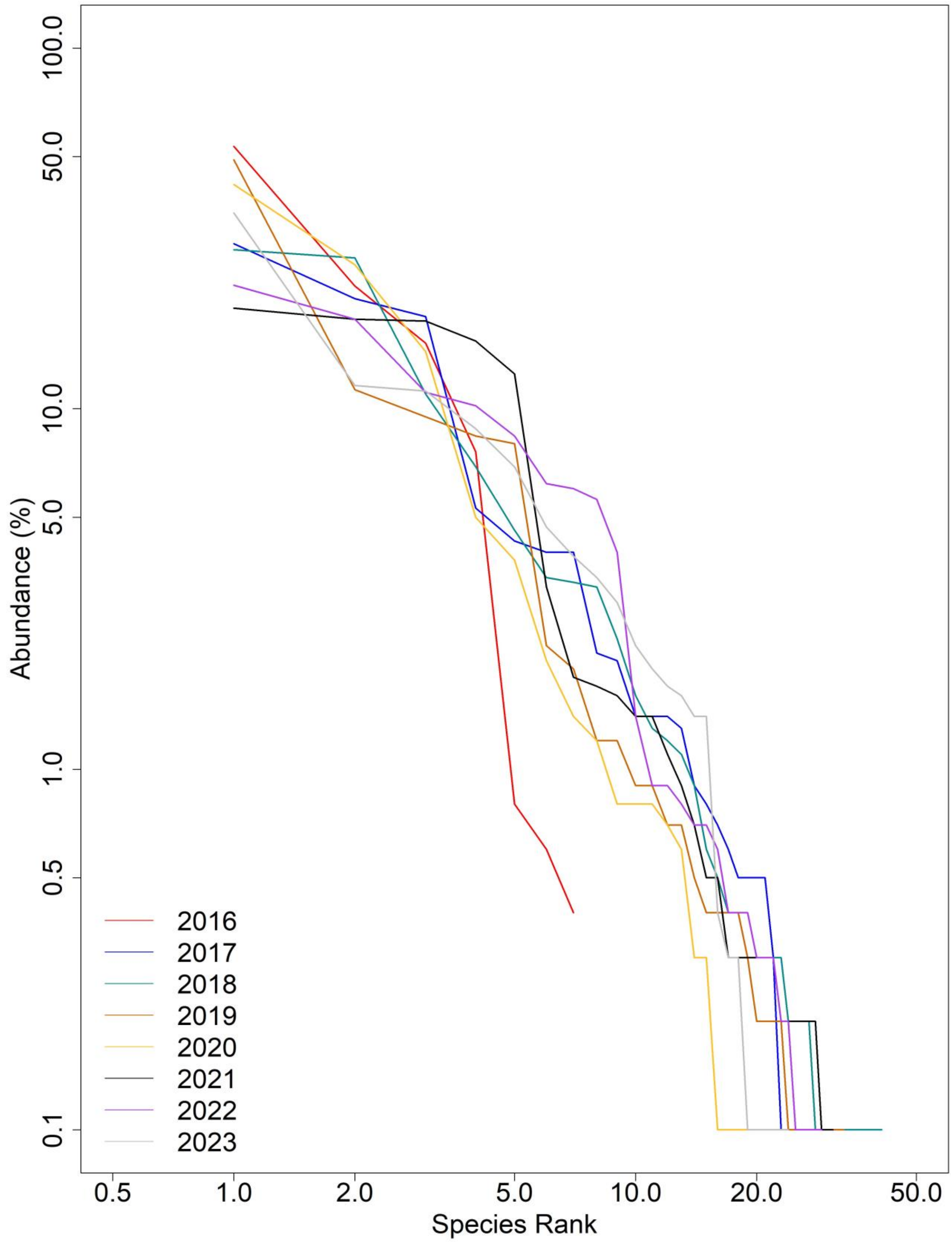

Figure 4-5. Rank Abundance Curves at Pond 5 (Reference) in 2016-2023. Note that both the x-axis and y-axis are in log-10 scale.

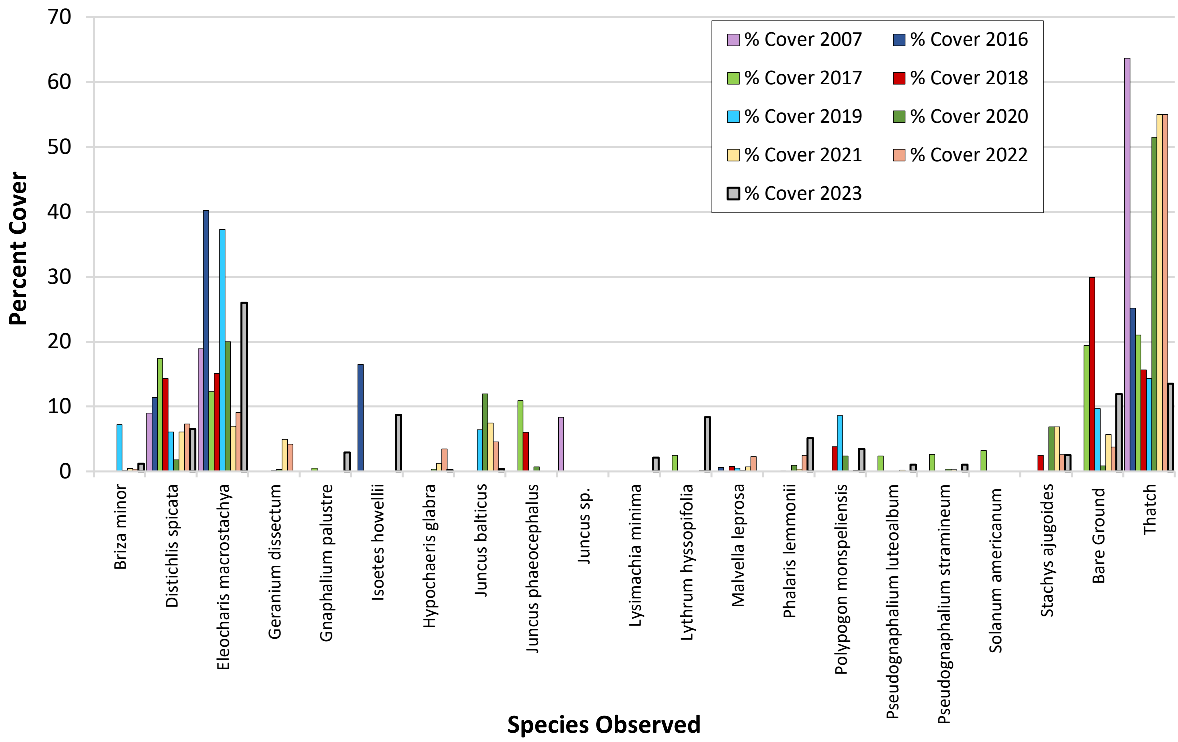

Figure 4-6. Percent Cover of Dominant Species at Pond 5 (Reference)

Native and non-native species richness on Pond 5 transects varied through time, with the highest overall richness recorded in 2018. Richness in 2023 was most similar to 2020 (see Table 4-4). The relative percent cover of native species varied through time, with the highest native cover observed in 2016 at 100.0% and the lowest value observed in 2019 at 73.6%. Values for native relative percent cover in 2023 were very similar to values in 2007 (see Table 4-5).

Table 4-4. Pond 5 (Reference) Native and Non-Native Species Richness

Year	Native	Non-Native	Unidentified
2007	2	1	1
2016	7	0	0
2017	15	11	3
2018	25	16	0
2019	21	14	0
2020	12	11	0
2021	16	15	0
2022	14	14	1
2023	12	12	0

Table 4-5. Pond 5 (Reference) Relative Percent Cover of Native and Non-Native Plants

Year	Native	Non-Native	Unidentified
2007	76.9%	0.3%	22.9%
2016	100.0%	0.0%	0.0%
2017	86.6%	12.9%	0.6%
2018	83.3%	16.7%	0.0%
2019	73.6%	26.4%	0.0%
2020	91.3%	8.7%	0.0%
2021	75.0%	25.0%	0.0%
2022	73.9%	25.9%	0.3%
2023	76.3%	23.7%	0.0%

Wetland species richness on Pond 5 transects increased through time until 2018, decreased in years 2019-2022, then increased again in 2023. The non-wetland species richness was more variable, with the highest value recorded in 2018 (see Table 4-6). The relative percent cover of wetland species in 2023 increased from the low wetland values of the previous two years. Conversely, non-wetland species cover decreased. Wetland cover in 2023 was similar to 2019 and non-wetland cover was similar to 2018 and 2019 (see Table 4-7).

Table 4-6. Pond 5 (Reference) Wetland and Non-Wetland Species Richness

Year	Wetland			Non-Wetland		Not Listed
	OBL	FACW	FAC	FACU	UPL	
2007	1	1	0	1	0	1
2016	3	3	0	1	0	0
2017	5	8	5	5	0	6
2018	5	11	7	8	1	9
2019	5	9	4	5	1	11
2020	4	7	3	3	1	5
2021	4	6	3	7	1	10
2022	4	6	2	7	1	9
2023	6	7	3	3	1	4

Table 4-7. Pond 5 (Reference) Relative Percent Cover of Wetland and Non-Wetland Species

Year	Wetland			Non-Wetland		Not Listed
	OBL	FACW	FAC	FACU	UPL	
2007	52.1%	24.8%	0.0%	0.3%	0.0%	22.9%
2016	75.9%	23.3%	0.0%	0.8%	0.0%	0.0%
2017	26.3%	55.3%	9.6%	8.0%	0.0%	0.8%
2018	33.7%	50.5%	10.2%	3.3%	0.3%	2.0%
2019	51.9%	31.0%	10.3%	3.4%	0.1%	3.3%
2020	56.5%	38.1%	2.0%	1.2%	0.1%	2.0%
2021	35.3%	36.5%	3.1%	4.2%	1.7%	19.1%
2022	28.7%	39.4%	1.6%	8.0%	1.4%	20.9%
2023	61.4%	29.0%	3.1%	3.7%	0.1%	2.7%

4.1.1.1 *Data Quality Objective 3*

Observable changes in hydrophytic vegetation between surveys were largely associated with precipitation fluctuations. This is expected given the dynamic nature of vernal pools and the close relationship between the hydroperiod and wetland vegetation composition. As a reference vernal pool, Pond 5 is used for comparison to remediated vernal pools.

4.1.1.2 *Performance Standard: Plant Cover and Species Diversity*

Pond 5 is a reference vernal pool and not required to meet performance standards. The vernal pool provides a control for comparison to the remediated vernal pools.

4.1.2 Wildlife Monitoring

Wildlife data were collected at Pond 5 in 1994-1996, 2007, 2010, 2016-2020, and 2023 (Jones and Stokes, 1996; Shaw, 2008, 2011; Burleson, 2017, 2018, 2019, 2020, 2021). Fairy shrimp were present in 1995 and 2019. California tiger salamander larvae were observed in 1995, 2010, 2016, 2017, 2019, and 2023. Table 4-8 shows historical wildlife monitoring results.

Table 4-8. Pond 5 (Reference) Historical Wildlife Monitoring Results

Sampling Year	CTS Larvae Abundance (# Individuals)	Fairy Shrimp Abundance (# Individuals)
1994	Not detected	Not detected
1995	Abundant	Very low – moderate
1996	Not detected	Not detected
2007	Not detected	Not detected
2010	Few - Common	Not detected
2016	Common - Abundant (101, 75, 100)	Not detected
2017	Common (12, 18, 16)	Not detected
2018	Not detected	Not detected
2019	Common - Abundant (0, 165, 46)	Low (3)
2020	Not detected	Not detected
2023	Common (1, 44)	Not detected

4.1.2.1 *Data Quality Objective 5*

California tiger salamanders were present in 2023. They were also detected in 1995, 2010, 2016, 2017, and 2019, but were not present in 1994, 1996, 2007, 2018, or 2020. The variation in CTS presence may be associated with rainfall patterns and the resultant vernal pool habitat. Presence was generally observed in above-normal water years, with the exception of 2010, which was a below-normal water-year.

Fairy shrimp were not detected in 2023, but were previously detected in 1995 and 2019. Like CTS, Fairy shrimp detection appears to be associated with above-normal water-years, although timing may have been a factor in 2023 since there was only one fairy shrimp survey completed in May.

4.1.2.2 *Performance Standard: Wildlife Usage*

Pond 5 is a reference vernal pool and was not required to meet the performance standards. The vernal pool is used as a control for comparison to the remediated vernal pools.

4.1.3 Conclusion

Pond 5 is used for comparison to remediated vernal pools (see Table 4-9).

Table 4-9. Success at Pond 5 (Reference) Based on Performance Standards and Applicable Data Quality Objectives

Performance Standard	Applicable DQO	Success
Plant Cover & Species Diversity	DQO 3	Suitable for Comparison
Wildlife Usage	DQO 5	Suitable for Comparison

4.2 Pond 101 East (East) – Reference

Pond 101 East (East) was monitored for fifteen years as a reference vernal pool. Table 4-10 summarizes the years that monitoring occurred and surveys were conducted. The cumulative precipitation graph shows precipitation for years in which hydrology monitoring was conducted at Pond 101 East (East) (see Figure 4-7). Above-normal water-years were 2015-2016, 2016-2017, 2018-2019, and this year, 2022-2023. All other monitoring was conducted either in a normal or below-normal water-year, drought year, or consecutive drought year.

Table 4-10. Pond 101 East (East) (Reference) Summary of Historical Surveys for Hydrology, Vegetation, and Wildlife

Survey	Water-Year														
	1991-1992	2000-2001	2006-2007	2009-2010	2012-2013	2013-2014	2014-2015	2015-2016	2016-2017	2017-2018	2018-2019	2019-2020	2020-2021	2021-2022	2022-2023
Hydrology		•	•		•	•	•	•	•	•	•	•	•	•	•
Vegetation								•	•	•	•	•	•	•	•
Wildlife	•	•	•	•				•	•	•	•	•			•

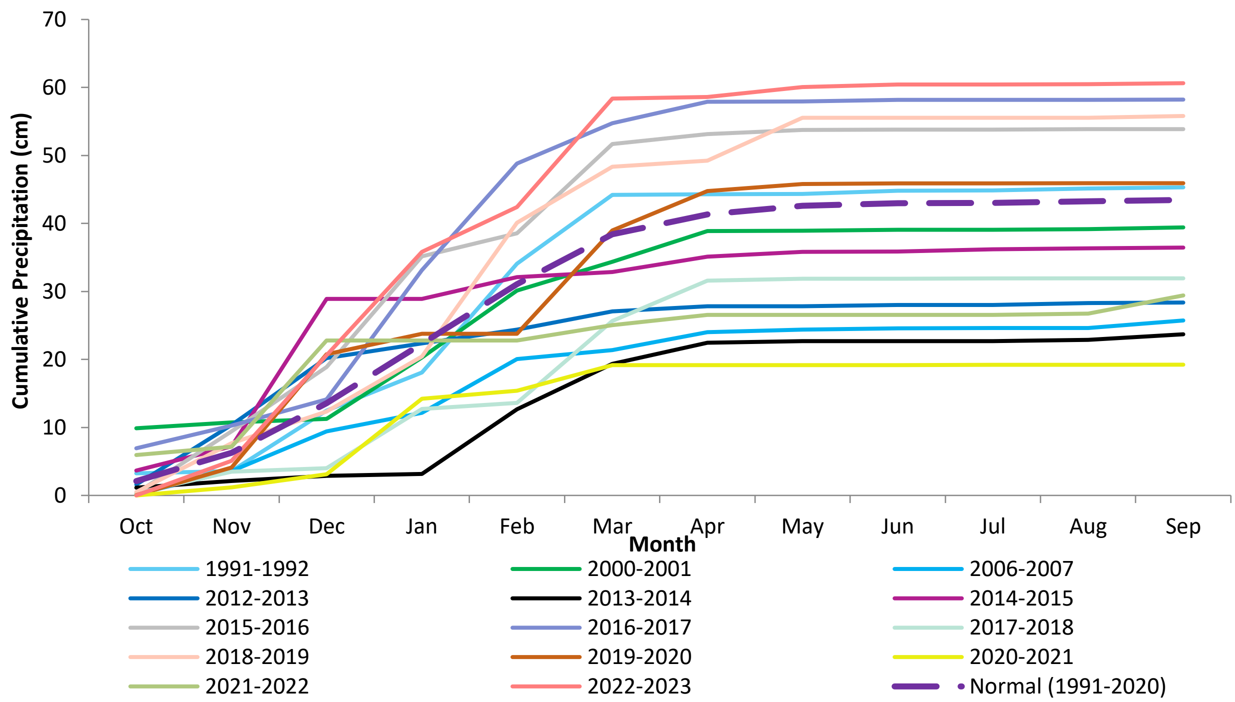

Figure 4-7. Cumulative Monthly Precipitation for Years that Hydrology Monitoring Occurred at Pond 101 East (East) (Reference) Compared to the 30-Year Normal (mean 1991-2020) (NPS, 2023; NCEI NOAA, 2023)

4.2.1 Vegetation Monitoring

Vegetation data were collected at Pond 101 East (East) in 2016-2023 (Burleson, 2017, 2018, 2019, 2020, 2021, 2022, 2023, and 2024). Data were collected using the methodology described in the Methods section of this report. Data from 2016 and 2023 were compared stratum-to-stratum in Table 4-11 as well as visually in Figure 4-8.

Table 4-11. Pond 101 East (East) (Reference) Vegetative Strata Percentage within the Vernal Pool Basin Boundary

Stratum	Percentage	
	2016	2023
1	0.4%	N/A
2	48%	53%
3	44%	N/A
4	8%	N/A
5	N/A	26%
6	N/A	21%

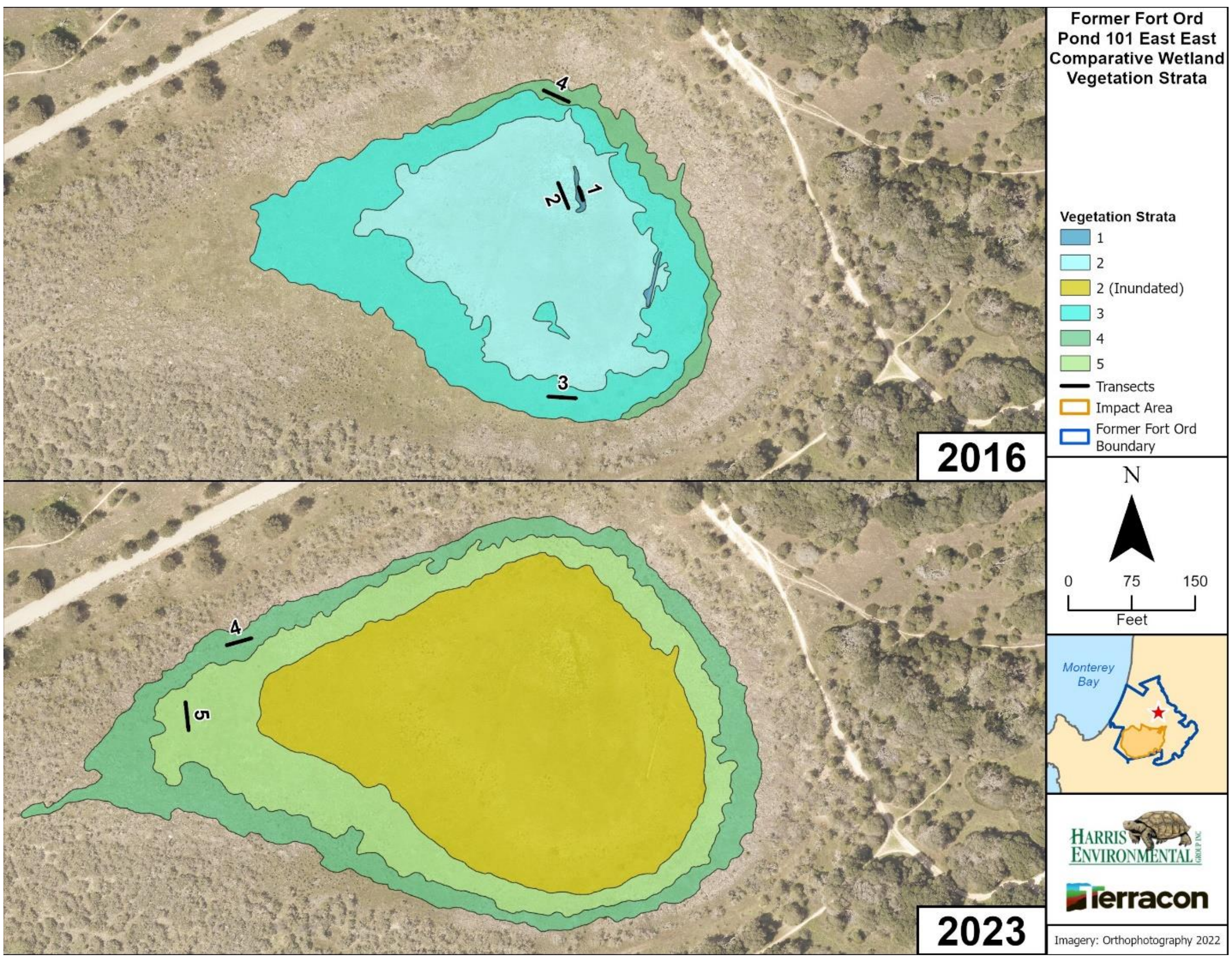

Figure 4-8. Pond 101 East (East) (Reference) Vegetation Strata and Transects for 2016 and 2023

The absolute percent vegetative cover observed at Pond 101 East (East) in 2023 was higher than all other previous years except 2017, to which it was most similar (see Table 4-12). Vegetative cover in previous years ranged from 38.5% in 2021 to 84.6% in 2017, whereas thatch/bare ground ranged from 16.6% in 2017 to 61.6% in 2021. In 2023, vegetative cover values were most similar to 2017.

Table 4-12. Pond 101 East (East) (Reference) Absolute Percent Cover

Year	Vegetative Cover	Thatch/Bare Ground
2016	60.7%	41.0%
2017	84.6%	16.6%
2018	68.7%	32.6%
2019	72.6%	28.6%
2020	63.4%	36.6%
2021	38.5%	61.6%
2022	55.5%	44.5%
2023	82.6%	17.4%

Species richness on transects varied over time with the highest richness observed in 2020 and the lowest richness observed this year, 2023. For the overall basin, the species richness fluctuated between 2016 and 2023 with the highest richness observed in 2018. Species richness on transects was 18, 18, 32, 37, 43, 21, 38, and 16 species in 2016, 2017, 2018, 2019, 2020, 2021, 2022, and 2023, respectively, whereas overall basin species richness was 37, 59, 89, 84, 86, 68, 72, and 56 species, respectively (see Table 4-13 and Appendix D Table D-2). The species richness is represented on the RACs as the length of the curve and number of species along the curve (see Figure 4-9 and Figure 4-10).

Species composition and dominant species at Pond 101 East (East) varied between monitoring years. This variability of species composition is illustrated on the RACs as the species codes shift along the curve and losses and gains occur from year to year (see Figure 4-9 and Figure 4-10). The dominant species shift is shown through the changes in the species at the top of the curve. Pale spikerush (*Eleocharis macrostachya*) and Baltic rush (*Juncus balticus*) were the dominant species in 2016 and 2020; Baltic rush, sheep sorrel (*Rumex acetosella*), and purple cudweed (*Gnaphalium palustre*) were the dominant species in 2017; pale spikerush, common toadrush (*Juncus bufonius* var. *bufonius*) and alkali mallow (*Malvella leprosa*) were dominant in 2018; pale spikerush, sheep sorrel, and Baltic rush were dominant in 2019; and alkali mallow, Baltic rush, and cut-leaved geranium (*Geranium dissectum*) were dominant in 2021. The dominant species in 2022 were similar to the previous year, except pale spikerush, rather than Baltic rush was most dominant. The species composition in 2023 shifted from previous years, with Pacific bentgrass (*Agrostis avenacea*) and purple cudweed as the most dominant species. A complete comparison of species composition observed during the surveys at Pond 101 East (East) from 2016-2023 can be found in Appendix E. Figure 4-12 shows a subset of this comparison for species observed with a 2% cover or greater.

The evenness from each year is represented by the slope of the RACs. The evenness is fairly similar from year to year with richness uniformly distributed along the entire curve and a slightly higher concentration or plateau of species toward the tail end. This plateau illustrates that there are a high number of species with low abundance. “Structurally complex systems, such as a fen [or vernal pool] system,” as explained in Verberk, 2011, “are species rich and have a more even community abundance pattern, possibly owing to a fine partitioning of available niches.” When comparing year to year, a more even distribution of the top species occurs in 2018, 2020, 2021, 2022, and 2023 at Pond 101 East (East) (see Figure 4-11, and Appendix F). Whereas 2016, 2017, and 2019 have a steeper slope and higher abundance of the dominant species at the top of the curve.

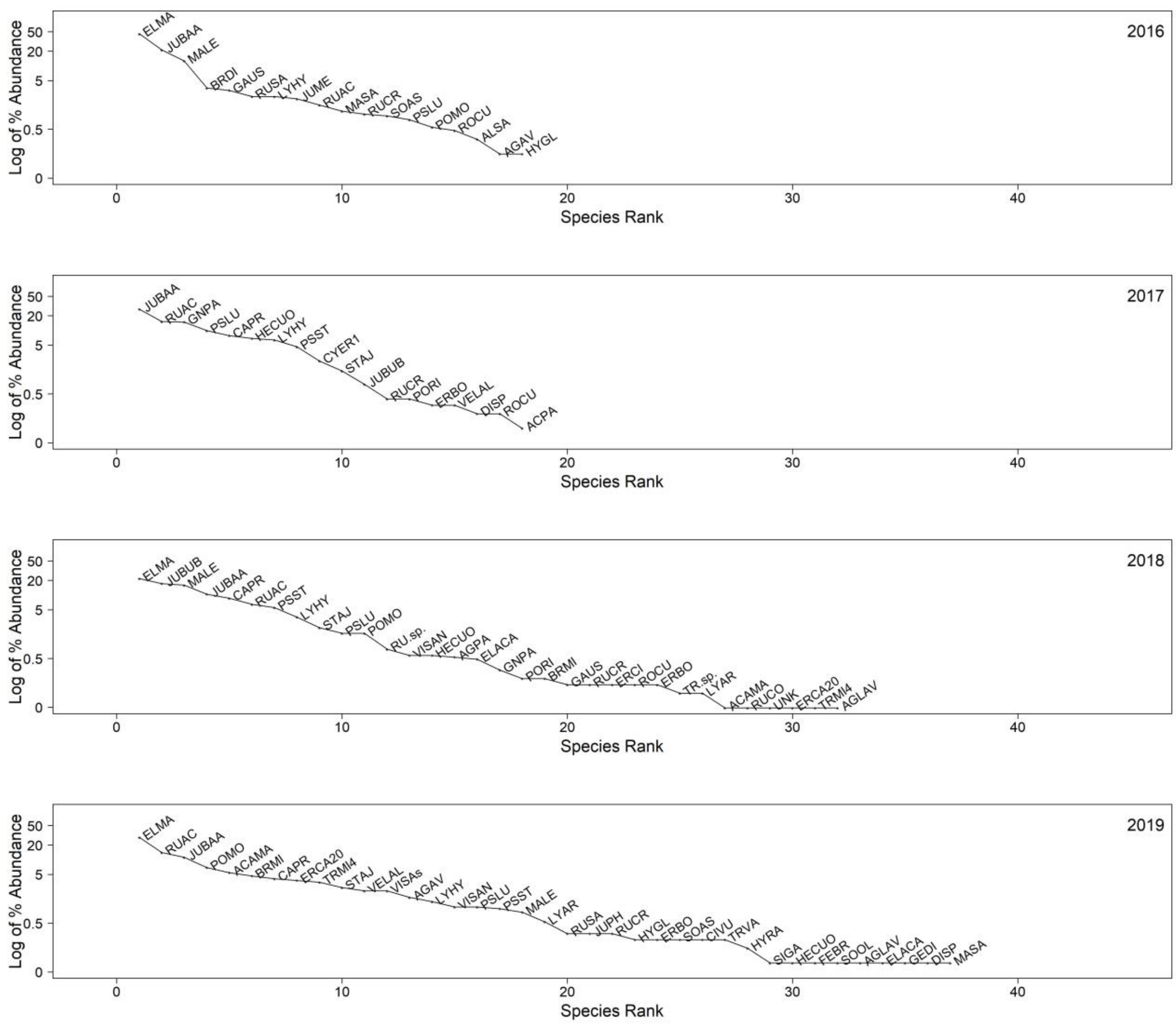

Figure 4-9. Rank Abundance Curves at Pond 101 East (East) (Reference) in 2016-2019. Note that the y-axis is in log-10 scale.

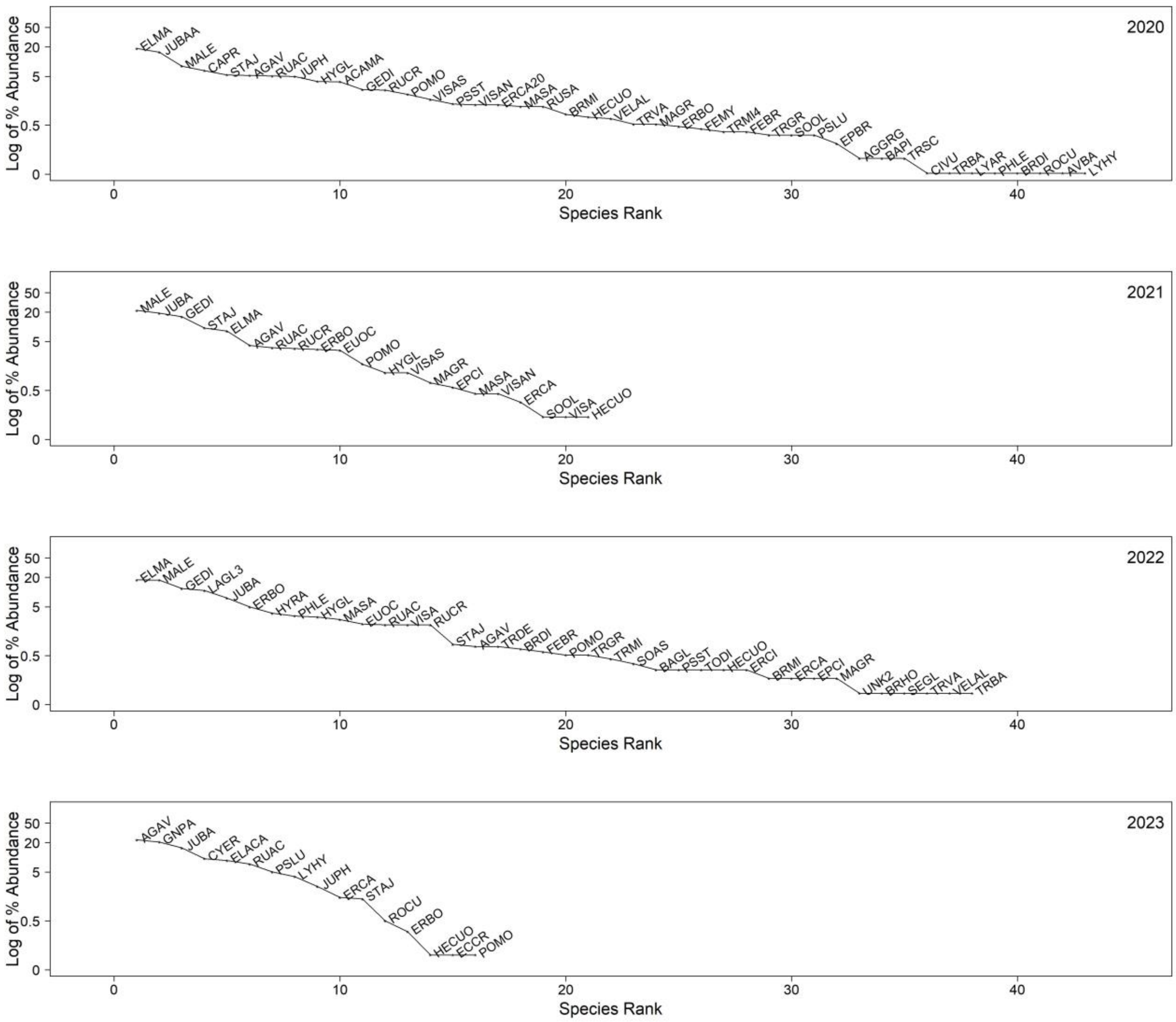

Figure 4-10. Rank Abundance Curves at Pond 101 East (East) (Reference) in 2020-2023. Note that the y-axis is in log-10 scale.

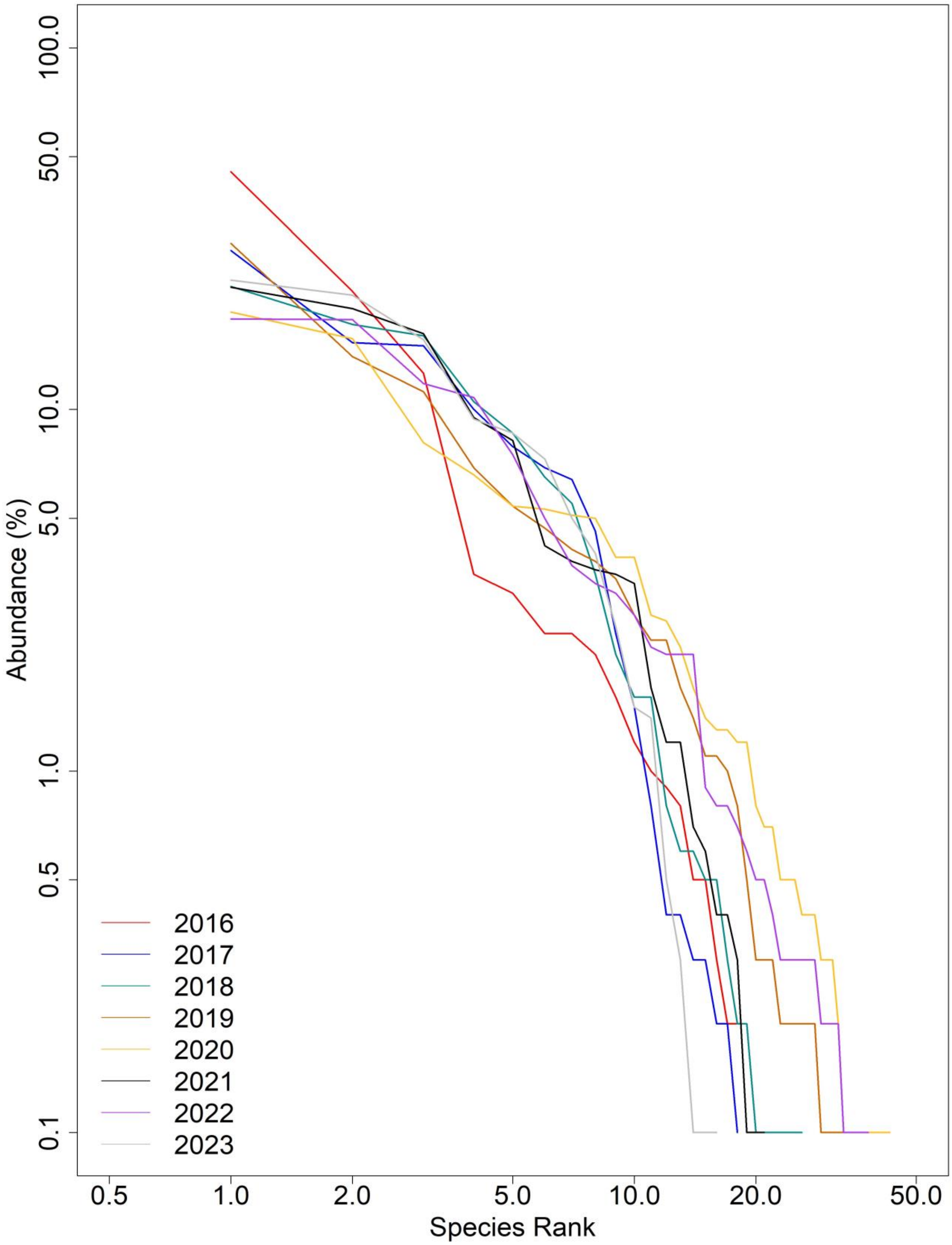

Figure 4-11. Rank Abundance Curves at Pond 101 East (East) (Reference) in 2016-2023. Note that the x-axis and the y-axis are in log-10 scale.

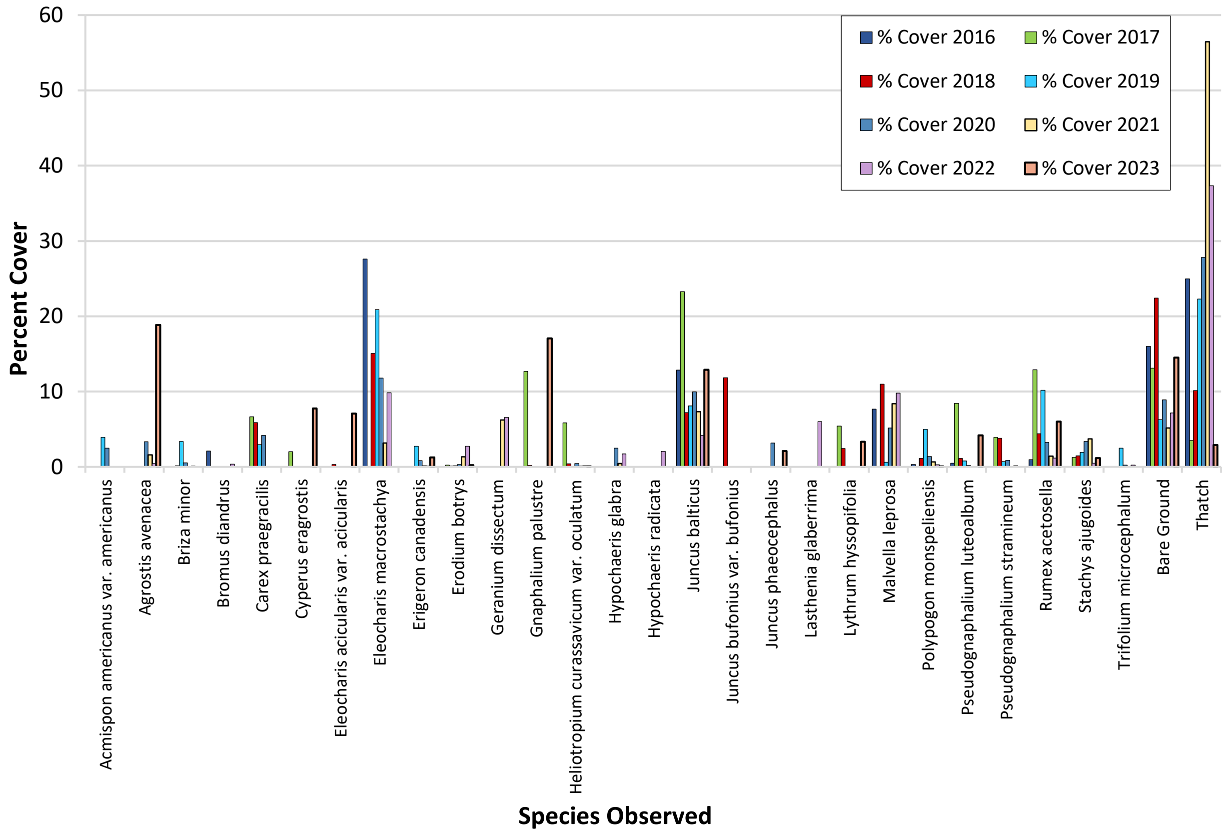

Figure 4-12. Percent Cover of Dominant Species at Pond 101 East (East) (Reference)

Native species richness on Pond 101 East (East) varied through time, with the highest native richness recorded in 2020 and the lowest recorded in 2016 and 2023 (see Table 4-13). Likewise, the relative percent cover of native species varied through time, with the highest native cover observed in 2016 at 88.9% and the lowest value observed in 2023 at 60.3%. Values for relative percent cover in 2023 were most similar to values in 2021 (see Table 4-14).

Table 4-13. Pond 101 East (East) (Reference) Native and Non-Native Species Richness

Year	Native	Non-Native	Unidentified
2016	9	9	0
2017	13	5	0
2018	18	11	3
2019	18	19	0
2020	24	19	0
2021	10	11	0
2022	21	16	1
2023	9	7	0

Table 4-14. Pond 101 East (East) (Reference) Relative Percent Cover of Native and Non-Native Plants

Year	Native	Non-Native	Unidentified
2016	88.9%	11.1%	0.0%
2017	67.7%	32.3%	0.0%
2018	84.4%	14.7%	0.9%
2019	64.7%	35.3%	0.0%
2020	72.2%	27.8%	0.0%
2021	64.1%	35.9%	0.0%
2022	66.4%	33.5%	0.1%
2023	60.3%	39.7%	0.0%

Wetland species richness on Pond 101 East (East) transects increased between 2016 and 2020, decreased to the lowest recorded value in 2021, then fluctuated within the range of previous values in 2022 and 2023 (see Table 4-15). Non-wetland species on transects generally increased from 2016 to 2019, then gradually decreased from 2020 to 2023. Wetland species cover fluctuated, rising initially from 2016 to 2017, decreasing overall from 2018 to 2021, then increasing again from 2022 to 2023 (see Table 4-16). Non-wetland species cover varied between surveys until peaking in 2021 and 2022 to the highest recorded value, then sharply dropping to the lowest recorded value in 2023.

Table 4-15. Pond 101 East (East) (Reference) Wetland and Non-Wetland Species Richness

Year	Wetland			Non-Wetland		Not Listed
	OBL	FACW	FAC	FACU	UPL	
2016	3	6	1	3	0	5
2017	3	8	3	2	0	2
2018	5	9	5	4	2	7
2019	4	8	7	7	3	8
2020	5	8	7	6	3	14
2021	2	4	1	4	4	6
2022	4	6	8	7	1	12
2023	4	6	1	3	0	2

Table 4-16. Pond 101 East (East) (Reference) Relative Percent Cover of Wetland and Non-Wetland Species

Year	Wetland			Non-Wetland		Not Listed
	OBL	FACW	FAC	FACU	UPL	
2016	48.4%	27.3%	1.0%	15.1%	0.0%	8.2%
2017	8.1%	64.0%	5.3%	15.6%	0.0%	7.0%
2018	28.2%	40.2%	6.0%	22.6%	1.1%	1.8%
2019	32.9%	24.0%	12.5%	19.4%	3.4%	7.7%
2020	24.2%	31.1%	6.5%	15.5%	3.3%	19.5%
2021	17.7%	24.7%	3.6%	29.3%	1.9%	22.8%
2022	29.7%	13.8%	4.2%	29.1%	2.1%	21.1%
2023	14.5%	53.4%	0.1%	9.1%	0.0%	22.9%

4.2.1.1 *Data Quality Objective 3*

Observable changes in hydrophytic vegetation between surveys were largely associated with precipitation fluctuations. This is expected given the dynamic nature of vernal pools and the close relationship between the hydroperiod and wetland vegetation composition. As a reference vernal pool, Pond 101 East (East) is used for comparison to remediated vernal pools.

4.2.1.2 *Performance Standard: Plant Cover and Species Diversity*

Pond 101 East (East) is a reference vernal pool and not required to meet performance standards. The vernal pool provides a control for comparison to the remediated vernal pools.

4.2.2 Wildlife Monitoring

Wildlife data were collected at Pond 101 East (East) in 1992, 2001, 2007, 2010, 2016-2020, and 2023 (Jones and Stokes, 1992; Harding ESE, 2002; Shaw, 2008; Shaw, 2011; Burleson, 2017, 2018, 2019, 2020, 2021, and 2024). California tiger salamander larvae were observed in 1992, 2010, 2016-2019, and 2023. Fairy shrimp were present in 2001, 2019, and 2020. Table 4-17 shows historical wildlife monitoring results.

Table 4-17. Pond 101 East (East) (Reference) Historical Wildlife Monitoring Results

Sampling Year	CTS Larvae Abundance (# Individuals)	Fairy Shrimp Abundance (# Individuals)
1992	Present*	Not detected*
2001	Not detected*	Moderate (100, 12)
2007	Not detected	Not detected
2010	Common*	Not detected*
2016	Common – Abundant (>101, 101, 67)	Not detected
2017	Common (36, 70, 5)	Not detected
2018	Few (2)	Not detected
2019	Common – Abundant (38, 212, 225)	Moderate (32)
2020	Not detected	Moderate (15)
2023	Common (1, 29)	Not detected

*Data do not differentiate between 101 East (East), 101 East (West), and 101 West. They are identified collectively as Pond 101.

4.2.2.1 *Data Quality Objective 5*

California Tiger Salamanders were detected in 2023, and were also present in 1992, 2010, and 2016-2019. The lack of CTS in 2001, 2007, and 2020 may have been associated with below-normal or normal precipitation; however, CTS were present in below-normal water-years 2010 and 2018.

Fairy Shrimp were not detected in 2023, which was generally consistent with previous monitoring. Fairy shrimp were also not detected in 1992, 2007, 2010, and 2016-2018, but were detected in 2001, 2019, and 2020. It was possible that survey event timing prevented detections since previous fairy shrimp detections were generally made in February and March, while surveys during years with no detections occurred later between March and May, with the exception of 2020. Detections during the March through May surveys in 2020 suggest that detection is likely associated with the timing of precipitation and resultant ponding, rather than specific months.

4.2.2.2 *Performance Standard: Wildlife Usage*

Pond 101 East (East) is a reference vernal pool and was not required to meet the performance standard. The vernal pool is used as a control for comparison to the remediated vernal pools.

4.2.3 Conclusion

Pond 101 East (East) is used for comparison to remediated vernal pools (see Table 4-18).

Table 4-18. Success at Pond 101 East (East) (Reference) Based on Performance Standards and Applicable Data Quality Objectives

Performance Standard	Applicable DQO	Success
Plant Cover & Species Diversity	DQO 3	Suitable for Comparison
Wildlife Usage	DQO 5	Suitable for Comparison

*Not applicable; wildlife surveys were not conducted due to insufficient depth

4.3 Pond 997 – Reference

Pond 997 was monitored for seven years as a reference vernal pool, although approximately 13% of vegetation within the Pond 997 watershed was masticated in 2017. Table 4-19 summarizes the years that monitoring occurred and surveys were conducted. The cumulative precipitation graph shows precipitation for years in which hydrology monitoring was conducted at Pond 997 (see Figure 4-13). The 2016-2017, 2018-2019, and 2022-2023 water-years were above-normal; whereas the 2019-2020 water-year was similar to the cumulative normal. All other monitoring was conducted either in a below-normal water-year, drought year, or consecutive drought year.

Table 4-19. Pond 997 (Reference) Summary of Historical Surveys for Hydrology, Vegetation, and Wildlife

Survey	Water-Year						
	2016-2017	2017-2018	2018-2019	2019-2020	2020-2021	2021-2022	2022-2023
Hydrology	●	●	●	●	●	●	●
Vegetation	●	●	●	●	●	●	●
Wildlife	●		●				

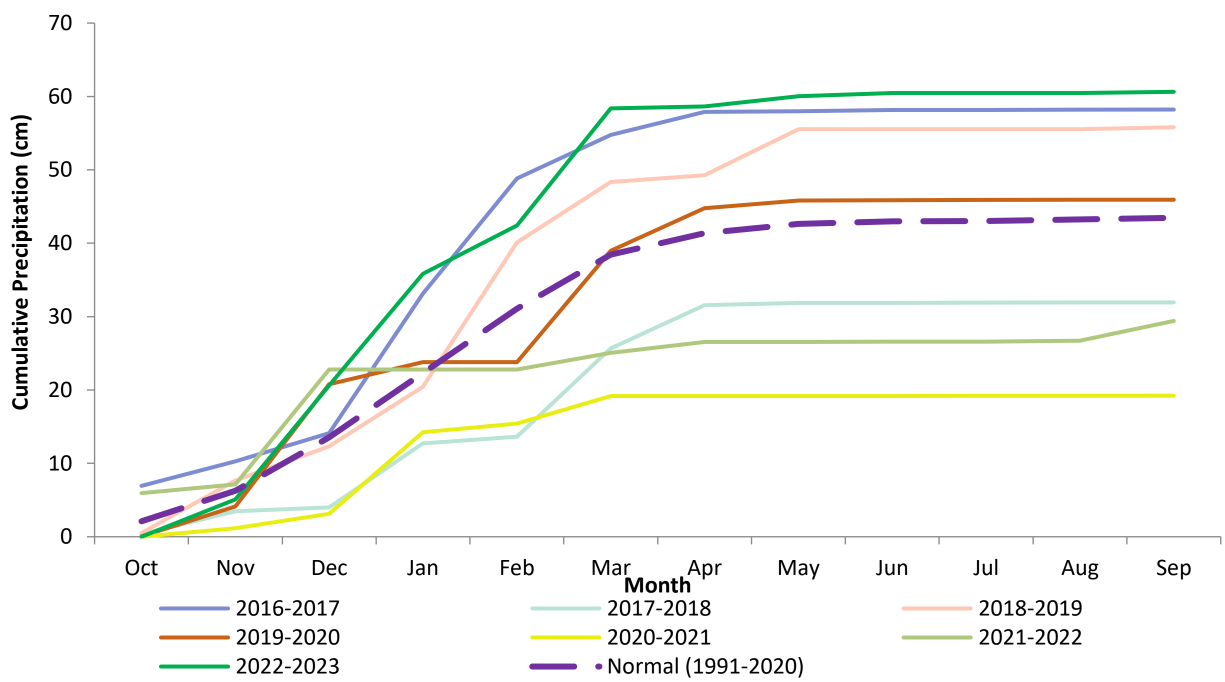

Figure 4-13. Cumulative Monthly Precipitation for Years that Hydrology Monitoring Occurred at Pond 997 (Reference) Compared to the 30-Year Normal (mean 1991-2020) (NPS, 2023; NCEI NOAA, 2023)

4.3.1 Vegetation Monitoring

Vegetation data were collected at Pond 997 from 2017-2023 (Burleson, 2018, 2019, 2020, 2021, 2022, 2023). Data were collected using the methodology described in the Methods section of this report. Data from 2017 and 2023 were compared stratum-to-stratum in Table 4-20 as well as visually in Figure 4-14. Pond 997 also supports a CCG population located in stratum 2. The population was mapped and a visual estimate of percent cover was recorded in 2023 to compare to past years (see Figure 4-19 in Section 4.3.1.1).

Table 4-20. Pond 997 (Reference) Vegetative Strata Percentage within the Vernal Pool Basin Boundary

Stratum	Percentage	
	2017	2023
1	3%	8%
2 (CCG)	2%	2%
3	89%	58%
4	2%	N/A
5	N/A	32%
Upland	4%	N/A

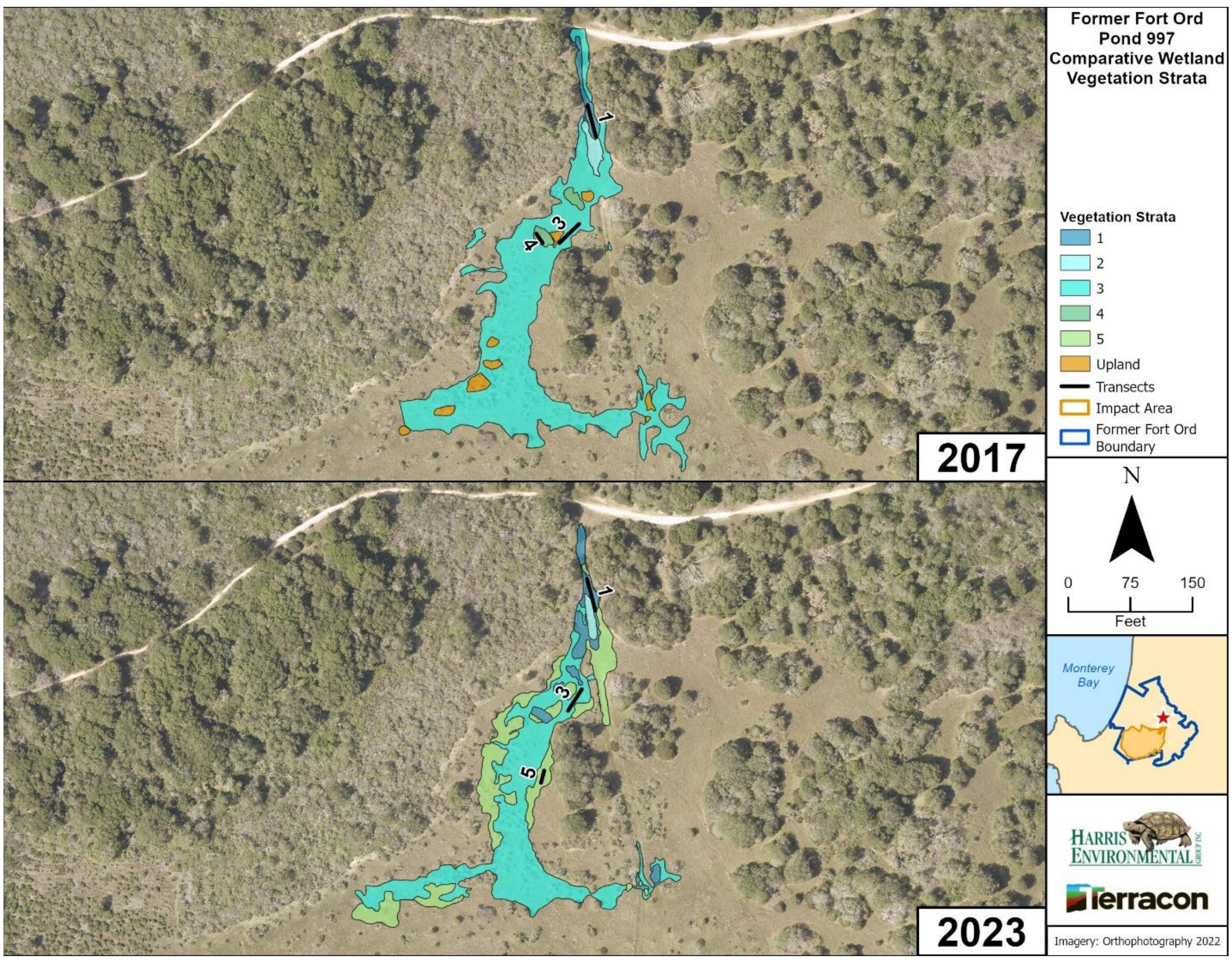

Figure 4-14. Pond 997 (Reference) Vegetation Strata and Transects for 2017 and 2023

The absolute percent vegetative cover observed in 2023 was higher than all previously recorded values for Pond 997 (see Table 4-21). Vegetative cover ranged from 44.7% in 2018 to 83.5% in 2023, whereas thatch/bare ground ranged from 16.7% in 2023 to 55.4% in 2018.

Table 4-21. Pond 997 (Reference) Absolute Percent Cover

Year	Vegetative Cover	Thatch/Bare Ground
2017	57.3%	43.7%
2018	44.7%	55.4%
2019	73.3%	28.6%
2020	70.2%	29.8%
2021	45.1%	55.0%
2022	46.9%	53.1%
2023	83.5%	16.7%

Species richness on transects varied over time, ranging from 27 in 2017 and 2021 to 48 in 2019. Species richness in the overall basin was lower than all previous years, with an decrease of 10 species from the second lowest overall richness in 2021. Species richness on transects was 27, 45, 48, 42, 27, 35, and 28 species in 2017, 2018, 2019, 2020, 2021, 2022, and 2023, respectively, whereas overall basin species richness was 65, 87, 82, 82, 59, 76, and 49 species, respectively (see Table 4-22 and Appendix D Table D-3). The species richness is represented on the RACs as the length of the curve and number of species along the curve (see Figure 4-15 and Figure 4-16).

Species composition at Pond 997 varied between monitoring years. This variability of species composition is illustrated on the RACs as the species codes shift along the curve and losses and gains occur from year to year (see Figure 4-15 and Figure 4-16). Despite overall composition variability, the dominant species in the vernal pool were fairly consistent. Coyote thistle (*Eryngium armatum*) and brown-headed rush (*Juncus phaeocephalus*) were the dominant species from 2018-2020, while coyote thistle and California oatgrass (*Danthonia californica*), were dominant in 2017 and 2021. Rattlesnake grass (*Briza maxima*) was an additional dominant species in 2021. Long-beaked filaree (*Erodium botrys*) and smooth cat's-ear (*Hypochaeris glabra*) became more dominant than coyote thistle in 2022. By 2023, dominant species included more wetland species than in the previous two years with grass poly (*Lythrum hyssopifolia*), and Howell’s quillwort (*Isöetes howellii*) becoming subdominant to rattlesnake grass. A complete comparison of species composition observed during the surveys at Pond 997 in 2017-2023 can be found in Appendix E. Figure 4-18 shows a subset of the observed species with a 2% cover or greater.

The evenness from each year is represented by the slope of the RACs. The evenness is fairly similar from year to year with richness distributed along the entire curve. “Structurally complex systems, such as a fen [or vernal pool] system,” as explained in Verberk, 2011, “are species rich and have a more even community abundance pattern, possibly owing to a fine partitioning of available niches.” When comparing year to year, a more even distribution of the top species occurs in 2017, 2018, 2019, 2020, 2022, and 2023 at Pond 997 (see Figure 4-17, and Appendix F). A steeper distribution of the dominant species however, as shown by a steeper slope, occurs in 2021.

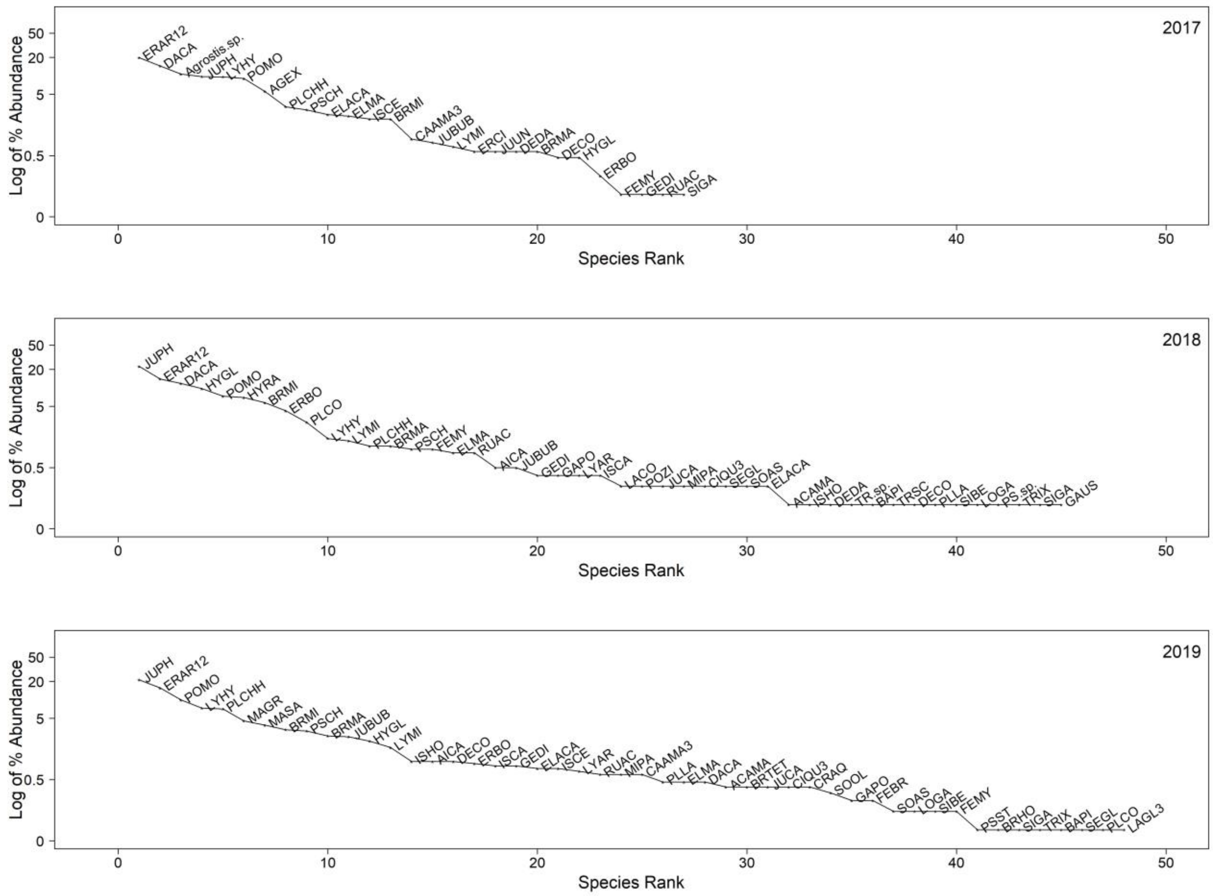

Figure 4-15. Rank Abundance Curves at Pond 997 (Reference) in 2017-2019. Note that the y-axis is in log-10 scale.

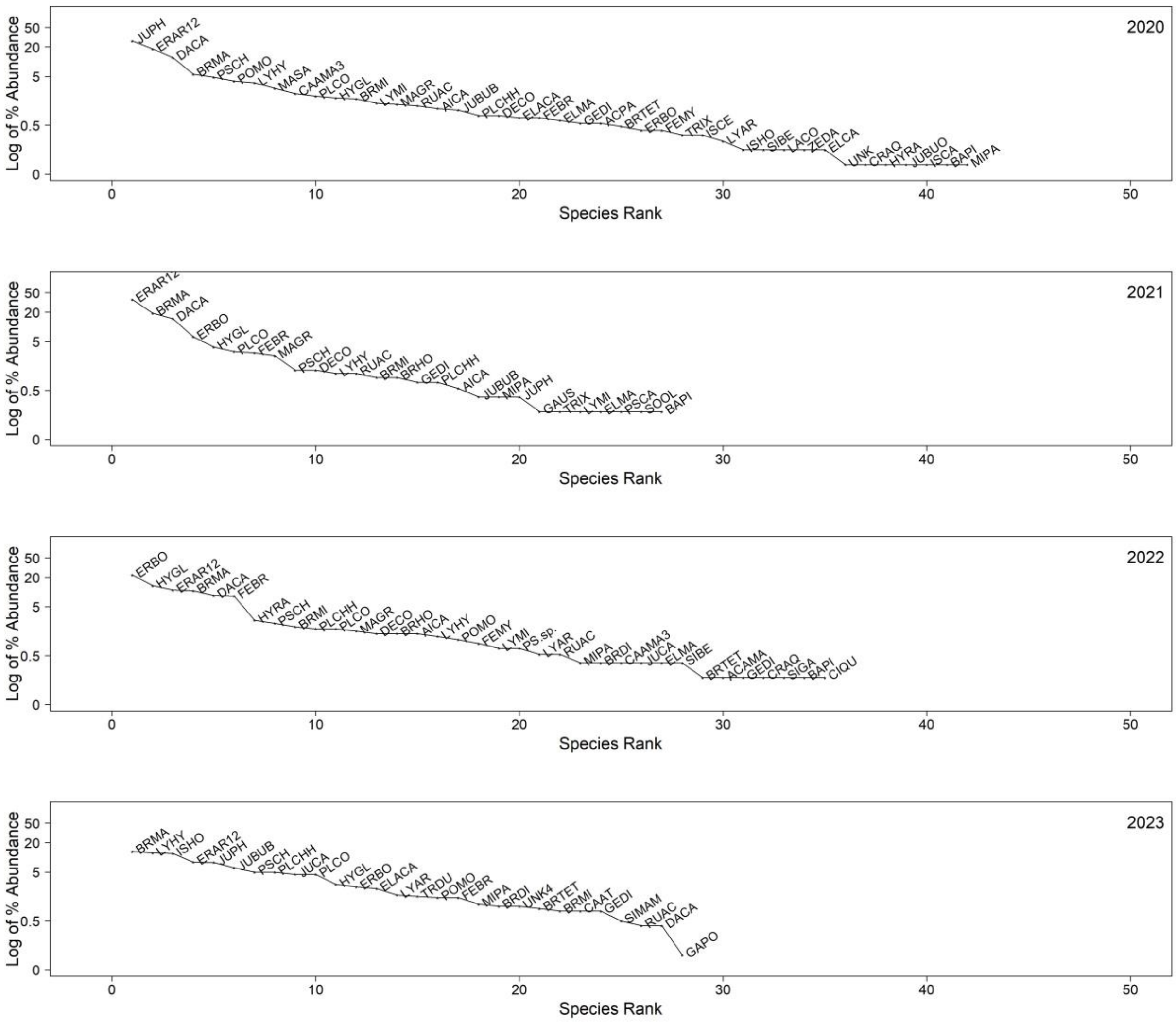

Figure 4-16. Rank Abundance Curves at Pond 997 (Reference) from 2020-2023. Note that the y-axis is in log-10 scale.

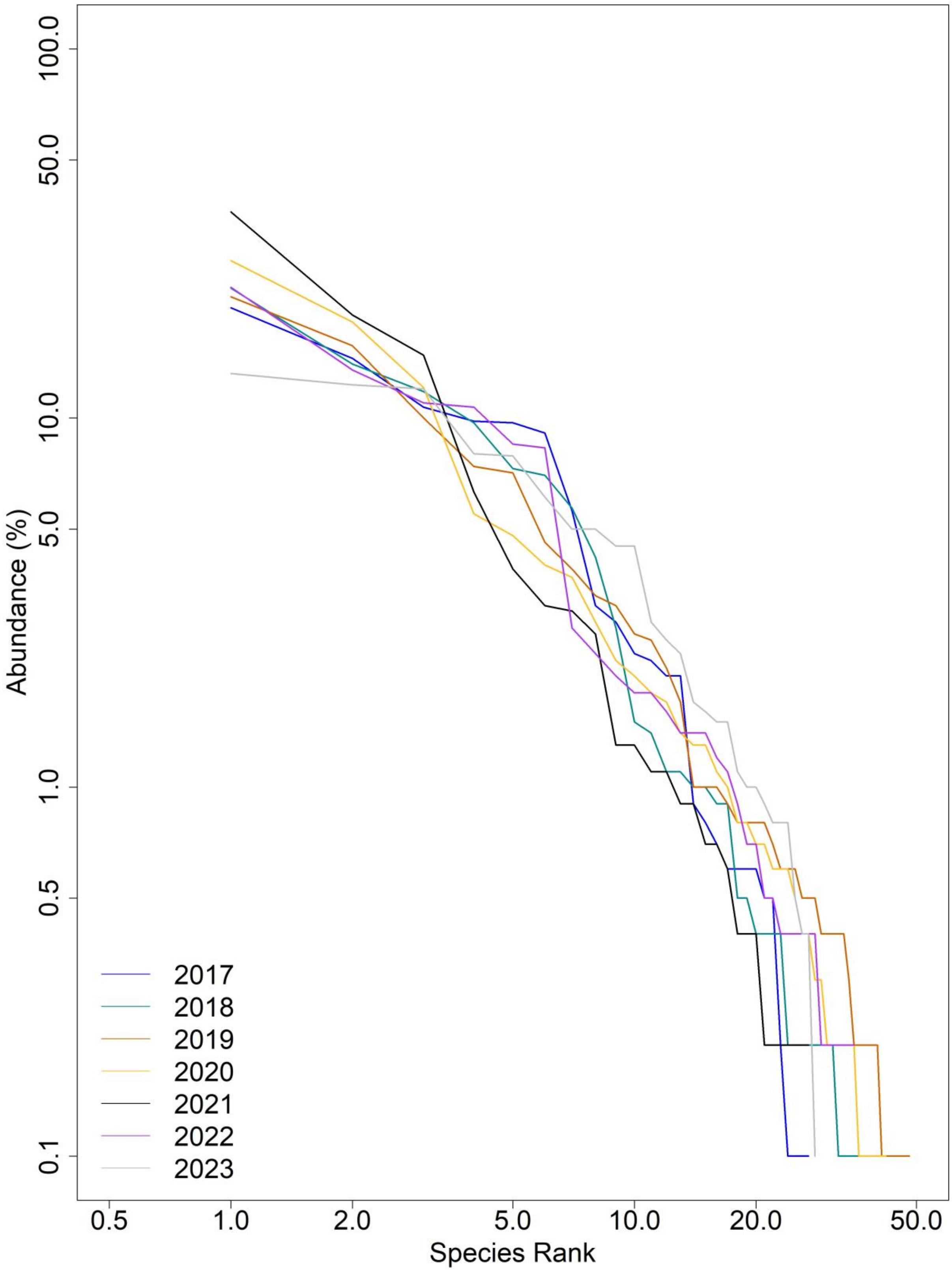

Figure 4-17. Rank Abundance Curves at Pond 997 (Reference) in 2017-2023. Note that the x-axis and y-axis are in log-10 scale.

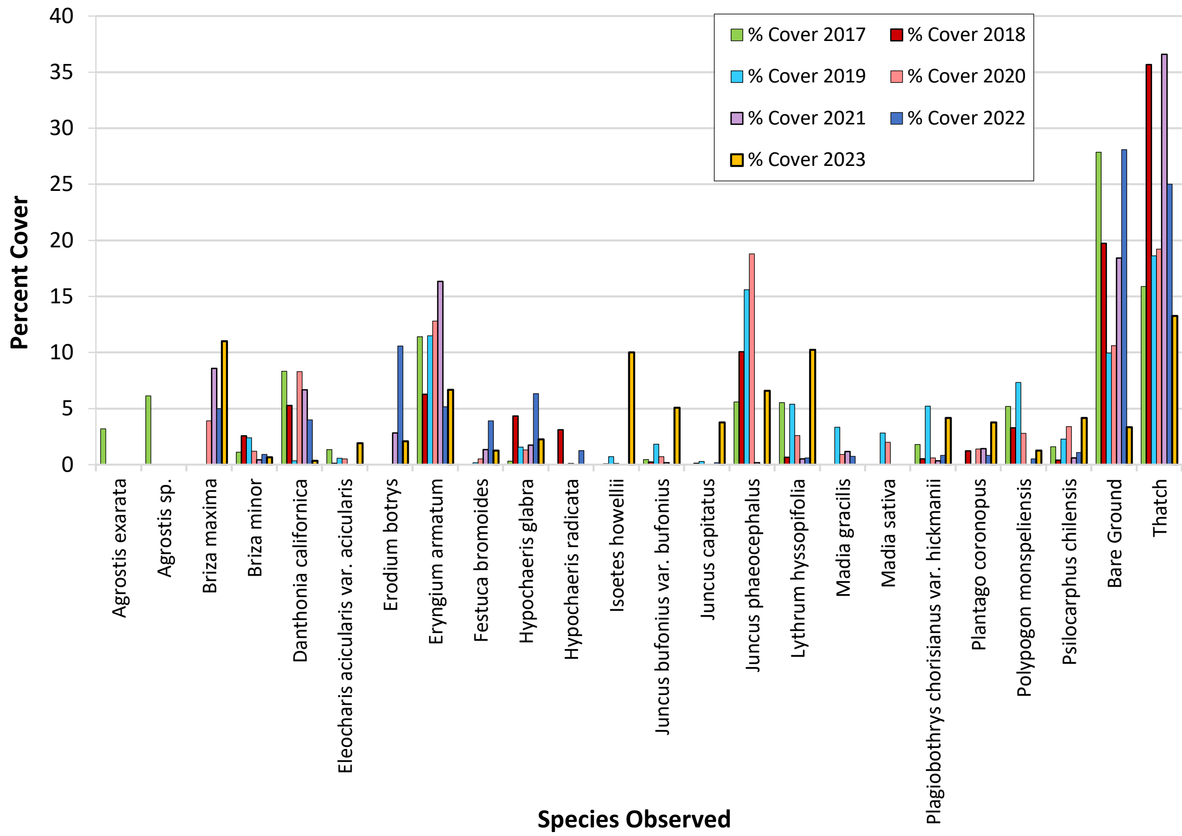

Figure 4-18. Percent Cover of Dominant Species at Pond 997 (Reference)

Native and non-native species richness on Pond 997 transects varied through time, with the highest native richness recorded in 2019 and 2020 and the highest non-native richness in 2019. In 2023, native richness dropped to the lowest value of any previous year, however the non-native richness fell within the range of previous values. The lowest non-native richness values occurred in 2017 (see Table 4-22). Native relative percent cover has fluctuated from year to year. In 2023, native cover increased by over 20% from 2022 values, which were the lowest previously recorded. Conversely non-native cover fell by a similar amount to make both native and non-native cover in 2023 nearly identical, and most like 2018 values (see Table 4-23).

Table 4-22. Pond 997 (Reference) Native and Non-Native Species Richness

Year	Native	Non-Native	Unidentified
2017	15	11	1
2018	24	19	2
2019	27	21	0
2020	27	14	1
2021	15	12	0
2022	16	18	1
2023	13	14	1

Table 4-23. Pond 997 (Reference) Relative Percent Cover of Native and Non-Native Plants

Year	Native	Non-Native	Unidentified
2017	66.3%	23.0%	10.7%
2018	56.3%	43.5%	0.2%
2019	68.5%	31.5%	0.0%
2020	76.3%	23.6%	0.1%
2021	59.1%	40.9%	0.0%
2022	29.7%	69.6%	0.7%
2023	50.0%	49.0%	1.0%

Wetland and non-wetland species richness on Pond 997 transects varied over time with 2023 results falling within the range of previous values (see Table 4-24). Similarly, the relative percent cover of wetland and non-wetland species fluctuated between 2017 and 2023 with the lowest recorded value of wetland cover observed in 2022 and the highest in 2017 (see Table 4-25).

Table 4-24. Pond 997 (Reference) Wetland and Non-Wetland Species Richness

Year	Wetland			Non-Wetland		Not Listed
	OBL	FACW	FAC	FACU	UPL	
2017	5	10	2	3	0	7
2018	8	10	5	8	0	14
2019	9	9	6	8	1	15
2020	9	10	5	5	0	13
2021	3	5	4	4	1	10
2022	4	7	4	7	0	13
2023	4	6	4	4	0	10

Table 4-25. Pond 997 (Reference) Relative Percent Cover of Wetland and Non-Wetland Species

Year	Wetland			Non-Wetland		Not Listed
	OBL	FACW	FAC	FACU	UPL	
2017	19.3%	50.7%	16.5%	0.5%	0.0%	13.0%
2018	4.6%	47.5%	20.7%	14.2%	0.0%	13.0%
2019	18.7%	55.4%	4.6%	3.8%	0.3%	17.1%
2020	6.7%	59.0%	16.1%	3.2%	0.0%	15.0%
2021	2.0%	38.4%	19.0%	8.9%	0.2%	31.4%
2022	3.6%	16.0%	12.8%	29.8%	0.0%	37.8%
2023	31.5%	28.9%	7.4%	9.0%	0.0%	23.2%

4.3.1.1 *Contra Costa Goldfields*

Populations and cover estimates of CCG have been collected from 2017-2023, whereas only its presence was noted in wetland reports from previous years (Burleson, 2018, 2019, 2020, 2021, 2022, 2023). The area of CCG at Pond 997 has varied slightly from 2017 to 2023 (see Table 4-26 and Figure 4-19). The lowest total area recorded was 0.005 acres in 2021 (Yr 3), and the highest was 0.02 acres in 2017, 2020 (Yr 2), and 2022 (Yr 3). The density also fluctuated from 10% cover in 2017, 2020 (Yr 2) and 2021 (Yr 3), to as much as 35% in 2019 (Yr 1). In 2022 (Yr 4), cover was 20%, and in 2023 (Yr 5), cover was 30%. The CCG population was in a similar location in all survey years. Changes in population size can be attributed to natural fluctuation as no remediation has occurred at Pond 997 apart from mastication of a small portion of its watershed in 2017. It is notable that the area of CCG at Pond 997 has fluctuated by an order of magnitude between two consecutive drought years in 2021 and 2022.

Table 4-26. Pond 997 (Reference) Contra Costa Goldfields Estimated Cover

Year	Area (acres)	Density (% cover)
2017	0.02	10%
2018	0.01	25%
2019	0.01	35%
2020	0.02	10%
2021	0.005	10%
2022	0.02	20%
2023	0.01	30%

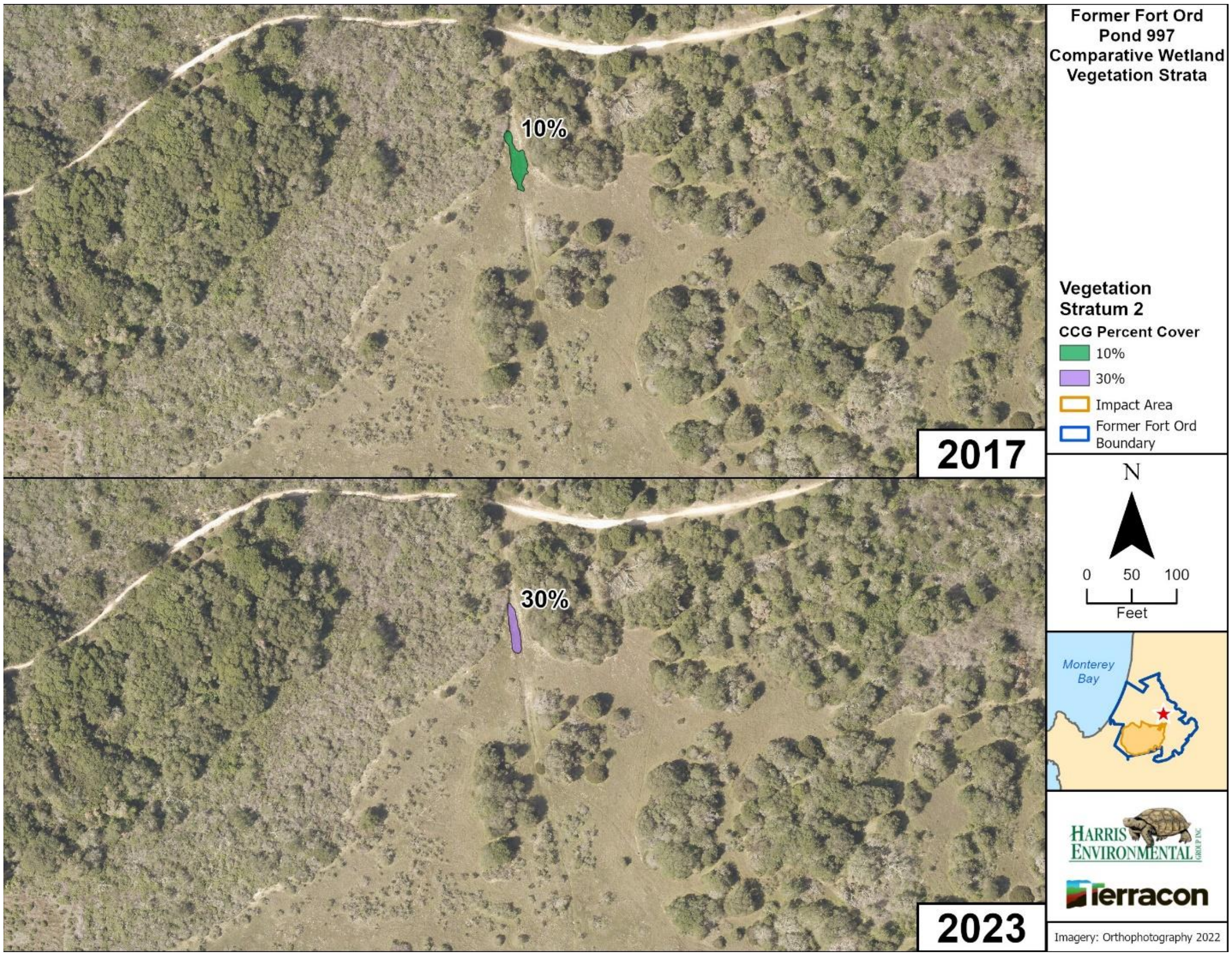

Figure 4-19. Contra Costa Goldfields Populations at Pond 997 (Reference) in 2017 and 2023

4.3.1.2 *Data Quality Objective 3*

Observable changes in hydrophytic vegetation between surveys were largely associated with precipitation fluctuations. This is expected given the dynamic nature of vernal pools and the close relationship between the hydroperiod and wetland vegetation composition. As a reference vernal pool, Pond 997 was used for comparison to remediated vernal pools.

4.3.1.3 *Performance Standard: Plant Cover and Species Diversity*

Pond 997 is a reference vernal pool and not required to meet performance standards. The vernal pool provides a control for comparison to the remediated vernal pools.

4.3.2 Wildlife Monitoring

Wildlife data were collected at Pond 997 in 2017 and 2019 (Burleson, 2018, 2020). California tiger salamanders and fairy shrimp were not detected. The vernal pool did not hold sufficient depth for surveys to be completed in 2018, 2020, 2021, or 2022. In 2023, Pond 997 held water earlier in the season, but was dry by the time wildlife surveys occurred in late April. Therefore, DQO 5 and the applicable wildlife usage performance standard can only be assessed for 2017 and 2019. Table 4-27 shows historical wildlife monitoring results.

Table 4-27. Pond 997 (Reference) Historical Wildlife Monitoring Results

Sampling Year	CTS Larvae Abundance (# Individuals)	Fairy Shrimp Abundance (# Individuals)
2017	Not detected	Not detected
2019	Not detected	Not detected

4.3.2.1 *Data Quality Objective 5*

Pond 997 did not provide suitable depth for CTS and fairy shrimp at the time of the wildlife surveys in either 2017 or 2019, although the reference vernal pool was still surveyed for aquatic invertebrates in both years.

4.3.2.2 *Performance Standard: Wildlife Usage*

Pond 997 is a reference vernal pool and was not required to meet the performance standard but was used as a control for comparison to other small, post-remediated vernal pools of similar size.

4.3.3 Conclusion

Pond 997 is used for comparison to remediated vernal pools (see Table 4-28).

Table 4-28. Success at Pond 997 (Reference) Based on Performance Standards and Applicable Data Quality Objectives

Performance Standard	Applicable DQO	Success
Plant Cover & Species Diversity	DQO 3	Suitable for Comparison
Wildlife Usage	N/A*	N/A*

*Not applicable; wildlife surveys were not conducted due to insufficient depth

4.4 Pond 21 – Year 1

Pond 21 was monitored in 2023 as a year 1 post-mastication and post-subsurface munitions remediation vernal pool. Pond 21 was monitored for baseline conditions in 1992, 1999, 2009, and 2019. Vegetation within Pond 21 and immediately around it was masticated in the summer of 2022. Following mastication and surface MEC removal, subsurface anomaly investigations were completed within Pond 21 basin. Table 4-29 summarizes the years that monitoring occurred and surveys were conducted. The cumulative precipitation graph shows precipitation for years in which hydrology monitoring was conducted at Pond 21 (see Figure 4-20). The 1991-1992 and 1998-1999 water-years were similar to the cumulative normal water-year. Water-year 2008-2009 was below normal, whereas water-year 2018-2019 and this year, 2022-2023 were above-normal.

Table 4-29. Pond 21 (Year 1 Post-Mastication) Summary of Historic Surveys for Hydrology, Vegetation, and Wildlife

Survey	Water-Year				
	1991-1992	1998-1999	2008-2009	2018-2019	2022-2023
Hydrology	●	●		●	●
Vegetation		●		●	●
Wildlife*	●	●	●	●	●

*Water-years 1991-1992 and 1998-1999 have wildlife data. This was not represented in the 2019 Summary of Historic Surveys for Hydrology, Vegetation, and Wildlife table.

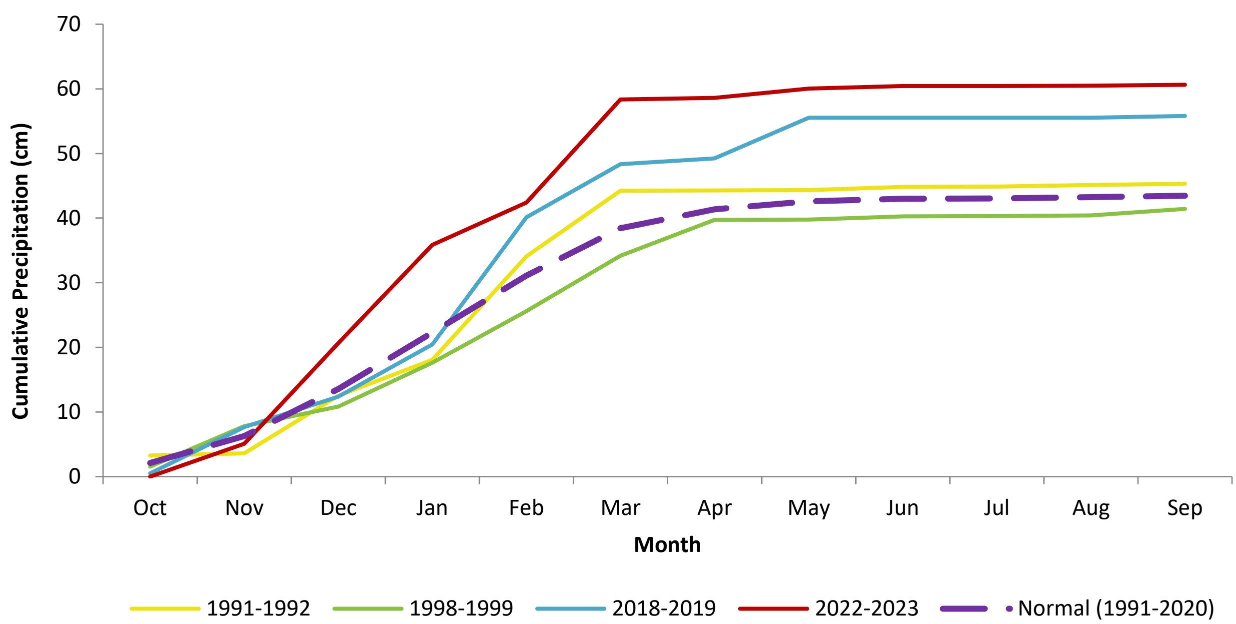

Figure 4-20. Cumulative Monthly Precipitation for Years that Hydrology Monitoring Occurred at Pond 21 (Year 1 Post-Mastication and Post-Subsurface Munitions Remediation) Compared to the 30-Year Normal (mean 1991-2020) (NPS, 2023; NCEI NOAA, 2023)

4.4.1 Vegetation Monitoring

Vegetation data were collected at Pond 21 in 1999, 2019, and 2023. In 1999, data were collected along one transect with a length of 316 feet. Quadrats were placed at 10-foot intervals, alternating from right to left along the transect. Because 1999 data were collected differently than in 2019, strata were combined across the vernal pool to allow for comparison. In 2019 and 2023, data were collected using the methodology described in the Methods section of this report (HLA, 1999; Burleson, 2019, 2023). Data from 2019 and 2023 were compared stratum-to-stratum in Table 4-30 as well as visually in Figure 4-21.

Table 4-30. Pond 21 (Year 1 Post-Mastication and Post-Subsurface Munitions Remediation) Vegetative Strata Percentage within the Vernal Pool Basin Boundary

Stratum	Percentage	
	2019	2023
1	27%	39%
2	71%	57%
3	N/A	3%
upland	2%	1%

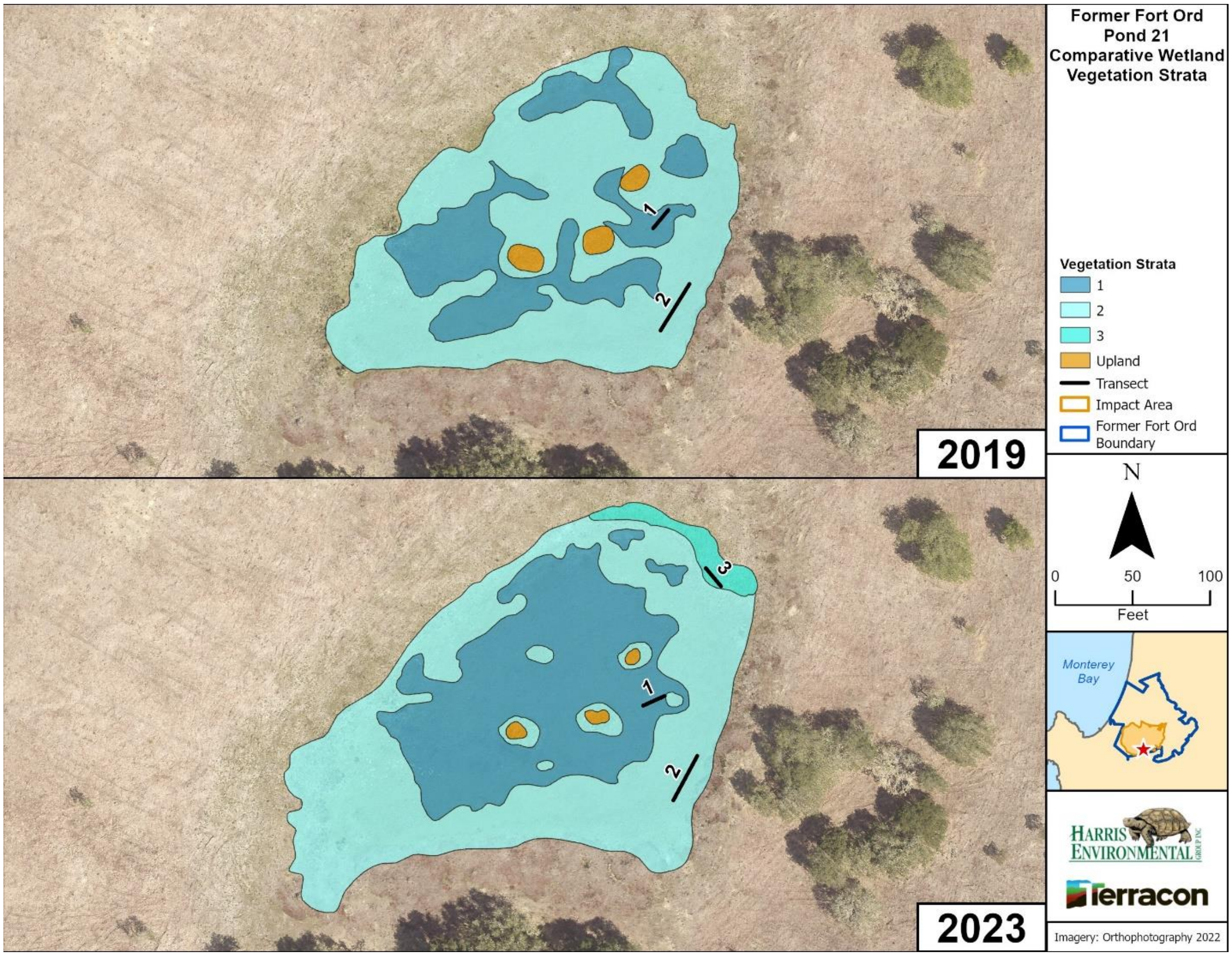

Figure 4-21. Pond 21 (Year 1 Post-Mastication and Post-Subsurface Munitions Remediation) Vegetation Strata and Transects for 2019 and 2023

Absolute percent vegetative cover for Pond 21 was greater than baseline in 1999 and 2019, whereas thatch/bare ground was less than baseline (see Table 4-167). When compared to reference vernal pools the absolute percent vegetative cover and thatch/bare ground cover were within the range of values and most similar to Pond 101 East (East) (see Table 4-168).

Table 4-31. Pond 21 (Year 1 Post-Mastication and Post-Subsurface Munitions Remediation) Absolute Percent Cover

Year	Vegetative Cover	Thatch/Bare Ground
1999*	18.6%	81.6%
2019*	73.6%	26.3%
2023	82.0%	18.0%

*baseline year

Table 4-32. Pond 21 (Year 1 Post-Mastication and Post-Subsurface Munitions Remediation) and Reference Vernal Pool Absolute Percent Cover in 2023

Vernal Pool	Vegetative Cover	Thatch/Bare Ground
5	74.5%	25.5%
101 East (East)	82.6%	17.4%
997	83.5%	16.7%
21	82.0%	18.0%

Species richness in 2023 was less than the baseline year of monitoring. Species richness on transects was 22, 22, and 19 in 1999, 2019, and 2023 respectively; whereas overall basin species richness was 59 and 47 species in 2019 and 2023 respectively, and not recorded in 1999 (see Table 4-33 and Appendix A Table A-4). Pond 21 species richness was less than the values observed for the overall basin at the reference vernal pools, and within the range of reference values for transects (see Table 4-34, and Appendix D Tables D-20 and D-40). The species richness is represented on the RACs as the length of the curve and number of species along the curve (see Figure 4-22 and Figure 4-23).

Species composition and the dominant species at Pond 21 varied somewhat between the monitoring years. This species composition is illustrated on the RACs as the species codes shift along the curve and losses and gains occur from year to year (see Figure 4-22 and Figure 4-23). The most dominant species in the 1999 baseline year was common toad rush (*Juncus bufonius* var. *bufonius*). By the 2019 baseline year, the dominant species were brown-headed rush (*Juncus phaeocephalus*) and coyote thistle (*Eryngium armatum*), both of which where the dominant species in 2023. Other important species in all three years were pale spikerush (*Eleocharis macrostachya*) and Hickman's popcorn flower (*Plagiobothrys chorisianus* var. *hickmanii*), however by 2023 rabbitfoot grass (*Polypogon monspeliensis*) and white root (*Carex barbarae*) became subdominant, marking a shift from the baseline years. A complete comparison of species composition observed at Pond 21 in 1999, 2019, and 2023 can be found in Appendix E. Figure 4-24 shows a subset of this comparison for species observed with a 2% cover or greater.

The evenness from each year is represented by the slope of the RACs. The evenness between the 2019 baseline year and 2023 is similar. In both years there is a steeper slope and higher abundance of the dominant species at the top of the curve, however richness is more evenly distributed along the rest of the curve in 2019 than in 2023 (see Figure 4-23, and Appendix F). When comparing Pond 21 in 2023 to reference vernal pools, it is most similar to Pond 5 which has a similar overall shape, and also has a steeper slope at the beginning. However, the steepness for Pond 5 is much more pronounced than it is for Pond 21.

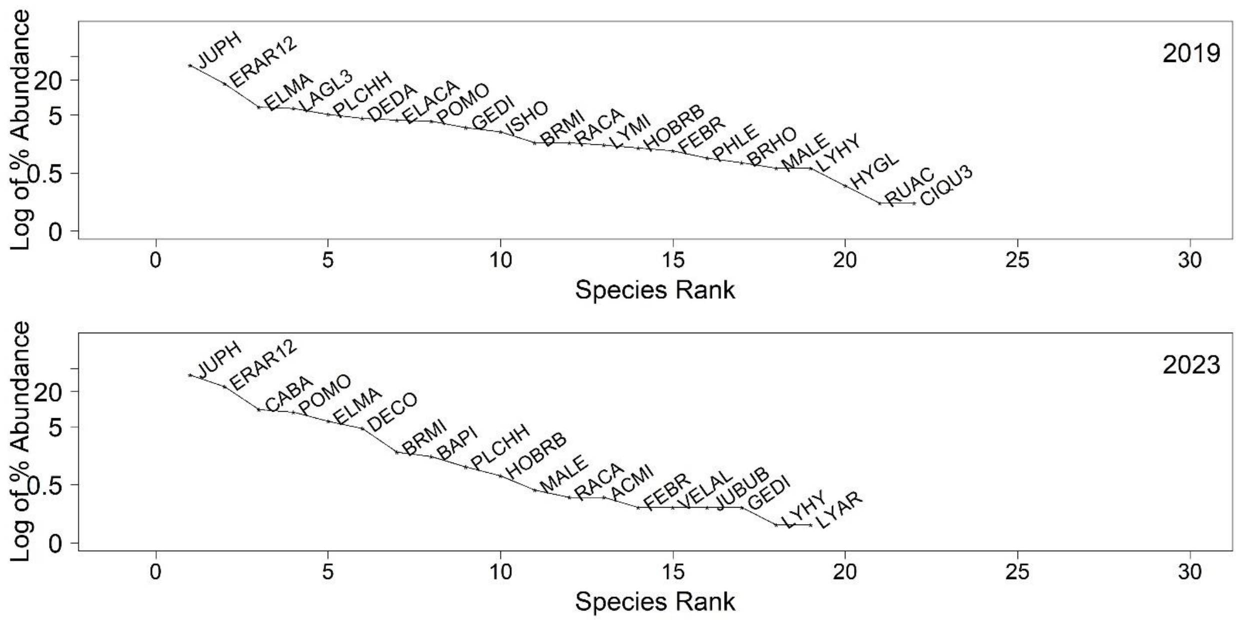

Figure 4-22. Rank Abundance Curves at Pond 21 (Year 1 Post-Mastication) in 2019 and 2023. Note that the y-axis is in log-10 scale.

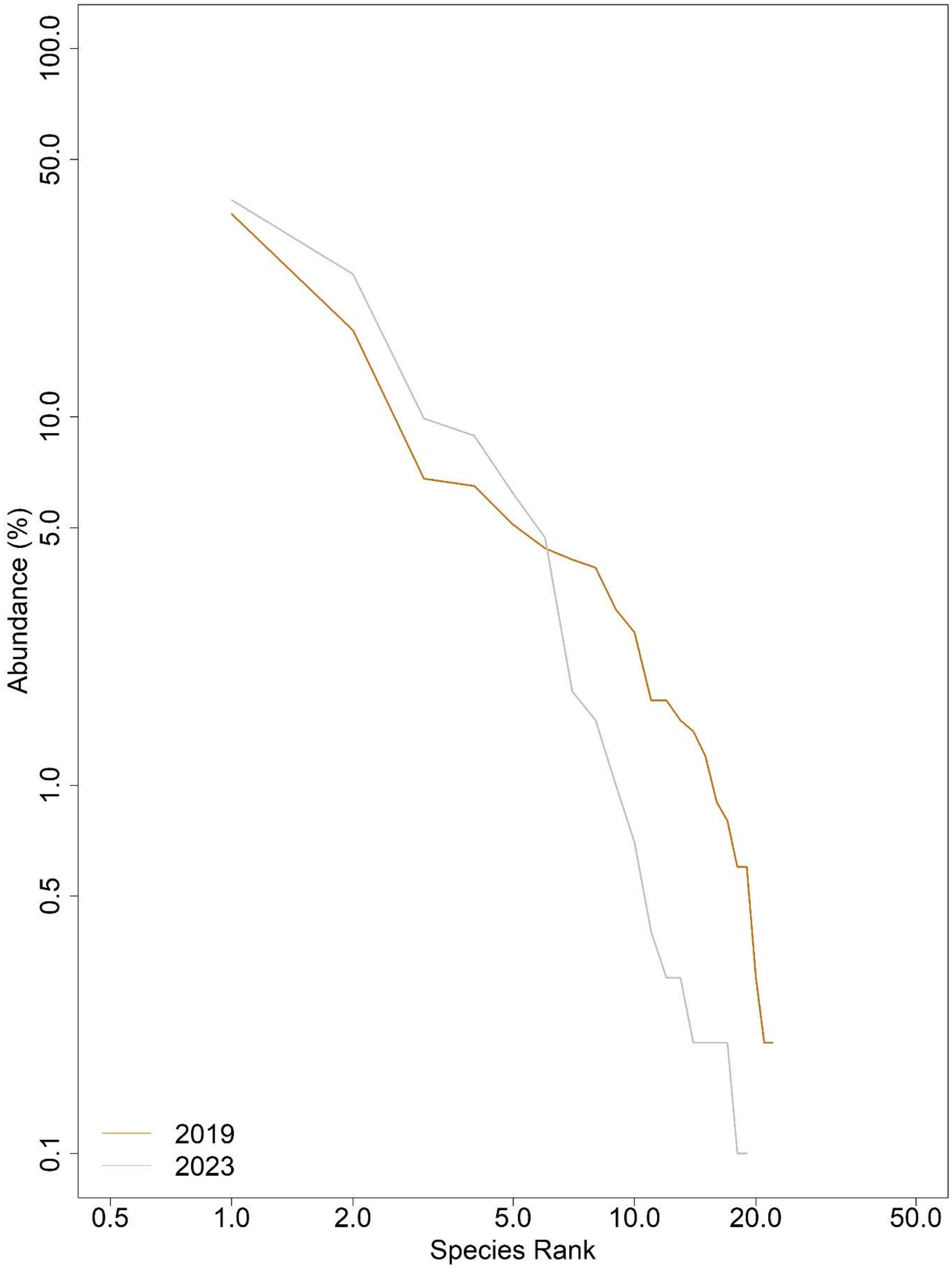

Figure 4-23. Rank Abundance Curves at Pond 21 (Year 1 Post-Mastication) in 2019 and 2023. Note that the x-axis and y-axis are in log-10 scale.

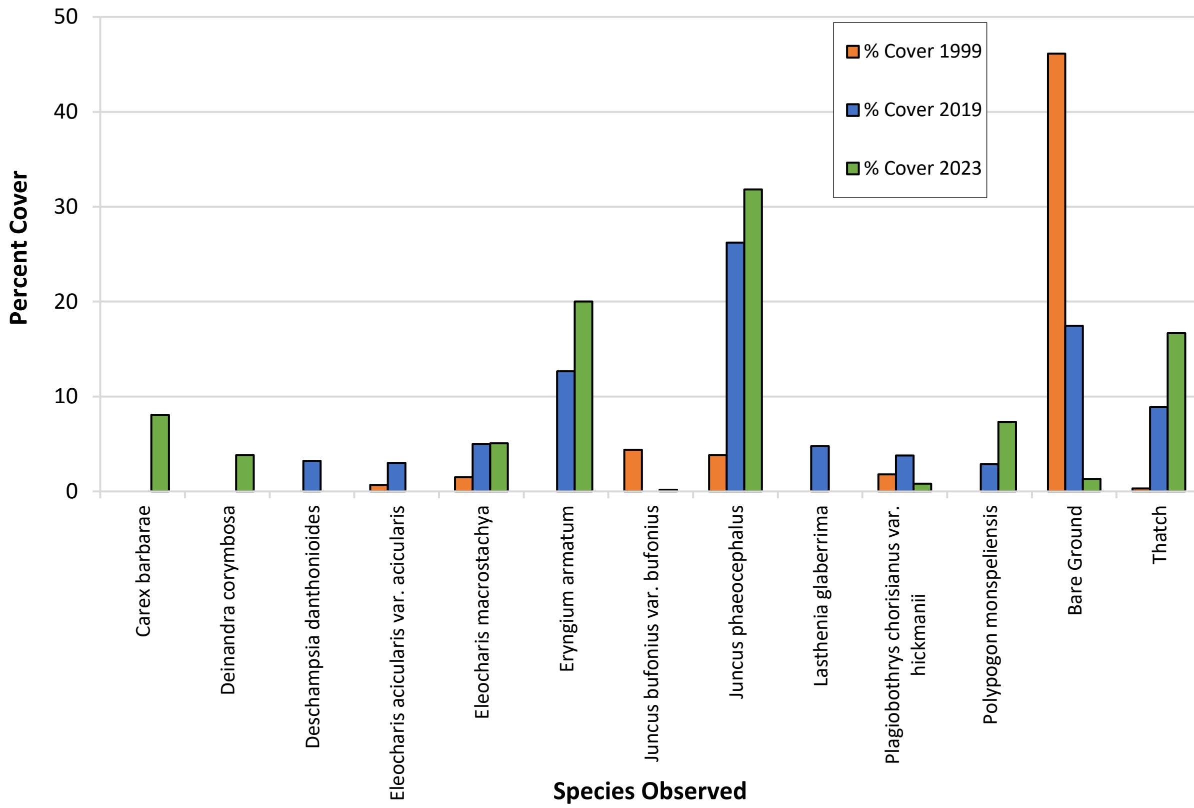

Figure 4-24. Percent Cover of Dominant Species at Pond 21 (Year 1 Post-Mastication and Post-Subsurface Munitions Remediation)

Native species richness on Pond 21 transects was less in 2023 than the baseline years of monitoring, whereas non-native species richness was within the range of baseline values (see Table 4-33). When compared to reference vernal pools, Pond 21 native richness fell within the range of values, whereas non-native species richness was less (see Table 4-34). The relative percent cover of native and non-native species were within the range of baseline values (see Table 4-35). Native relative percent cover was greater than the range of values at reference pools, whereas non-native cover was less (see Table 4-36).

Table 4-33. Pond 21 (Year 1 Post-Mastication and Post-Subsurface Munitions Remediation) Native and Non-Native Species Richness

Year	Native	Non-Native	Unidentified
1999*	17	5	0
2019*	14	8	0
2023	13	6	0

*baseline year

Table 4-34. Pond 21 (Year 1 Post-Mastication and Post-Subsurface Munitions Remediation) and Reference Vernal Pool Native and Non-Native Species Richness in 2023

Vernal Pool	Native	Non-Native	Unidentified
5	12	12	0
101 East (East)	9	7	0
997	13	14	1
21	**13**	**6**	**0**

Table 4-35. Pond 21 (Year 1 Post-Mastication and Post-Subsurface Munitions Remediation) Relative Percent Cover of Native and Non-Native Plants

Year	Native	Non-Native	Unidentified
1999*	95.9%	4.1%	0.0%
2019*	88.4%	11.6%	0.0%
2023	88.6%	11.4%	0.0%

*baseline year

Table 4-36. Pond 21 (Year 1 Post-Mastication and Post-Subsurface Munitions Remediation) and Reference Vernal Pool Relative Percent Cover of Native and Non-Native Plants in 2023

Vernal Pool	Native	Non-Native	Unidentified
5	76.3%	23.7%	0.0%
101 East (East)	60.3%	39.7%	0.0%
997	50.0%	49.0%	1.0%
21	**88.6%**	**11.4%**	**0.0%**

Wetland species richness on Pond 21 transects was less in 2023 than in baseline, whereas non-wetland richness was within the range of baseline values (see Table 4-37). Non-wetland species richness was less than reference vernal pool values while wetland species richness fell within the range of reference (see Table 4-38). The relative percent cover of wetland and non-wetland species was lower than in baseline years (see Table 4-39). When compared to reference vernal pools, the relative percent cover of wetland and non-wetland species fell within the range of values (see Table 4-40).

Table 4-37. Pond 21 (Year 1 Post-Mastication and Post-Subsurface Munitions Remediation) Wetland and Non-Wetland Species Richness

Year	Wetland			Non-Wetland		Not Listed
	OBL	FACW	FAC	FACU	UPL	
1999*	7	5	5	2	0	3
2019*	6	8	2	3	0	3
2023	3	5	5	2	0	4

*baseline year

Table 4-38. Pond 21 (Year 1 Post-Mastication and Post-Subsurface Munitions Remediation) and Reference Vernal Pool Wetland and Non-Wetland Species Richness in 2023

Vernal Pool	Wetland			Non-Wetland		Not Listed
	OBL	FACW	FAC	FACU	UPL	
5	6	7	3	3	1	4
101 East (East)	4	6	1	3	0	2
997	4	6	4	4	0	10
21	**3**	**5**	**5**	**2**	**0**	**4**

Table 4-39. Pond 21 (Year 1 Post-Mastication and Post-Subsurface Munitions Remediation) Relative Percent Cover of Wetland and Non-Wetland Species

Year	Wetland			Non-Wetland		Not Listed
	OBL	FACW	FAC	FACU	UPL	
1999*	38.1%	50.5%	5.0%	4.7%	0.0%	1.6%
2019*	25.6%	65.0%	3.3%	1.5%	0.0%	4.5%
2023	7.3%	73.1%	12.3%	0.7%	0.0%	6.6%

*baseline year

Table 4-40. Pond 21 (Year 1 Post-Mastication and Post-Subsurface Munitions Remediation) and Reference Vernal Pool Relative Percent Cover of Wetland and Non-Wetland Species in 2023

Vernal Pool	Wetland			Non-Wetland		Not Listed
	OBL	FACW	FAC	FACU	UPL	
5	61.4%	29.0%	3.1%	3.7%	0.1%	2.7%
101 East (East)	14.5%	53.4%	0.1%	9.1%	0.0%	22.9%
997	31.5%	28.9%	7.4%	9.0%	0.0%	23.2%
21	**7.3%**	**73.1%**	**12.3%**	**0.7%**	**0.0%**	**6.6%**

4.4.1.1 *Data Quality Objective 3*

Observable changes in hydrophytic vegetation between surveys were largely associated with precipitation fluctuations. This is expected given the dynamic nature of vernal pools and the close relationship between the hydroperiod and wetland vegetation composition (Bauder, 2000). This year had above-normal precipitation following two years of consecutive drought. The wet conditions favored wetland obligate species.

Vegetative cover in Pond 21 was dominated by native and wetland plant species during year 1 post-mastication and post-subsurface munitions remediation monitoring in 2023. Pond 21 wetland vegetation results were generally within range of either baseline and/or reference vernal pools with the exception of non-wetland species relative percent cover, which was less than baseline and reference vernal pool values. These results are not concerning, as low non-wetland cover values support a well-functioning vernal pool ecosystem.

4.4.1.2 *Performance Standard: Plant Cover and Species Diversity*

Pond 21, a post-mastication and post-subsurface munitions remediation vernal pool, is on track to meet the performance standard for year 1. The species composition, richness, and native and wetland species relative abundances were within range of the reference vernal pool conditions or differed in a favorable trajectory for native and wetland species. This vernal pool will be monitored for year 2 post-mastication and post-subsurface munitions remediation in 2024 as specified in the Wetland Plan (Burleson, 2006).

4.4.2 Wildlife Monitoring

Wildlife data were collected at Pond 21 in 1992, 1999, 2009, 2019, and 2023 (USACE, 1992; HLA, 1999; Shaw, 2010; Burleson, 2020). California tiger salamander larvae were observed in 2019 and 2023. Fairy shrimp were not detected at Pond 21 in any monitoring year. Table 4-41 shows historical wildlife monitoring results.

Table 4-41. Pond 21 (Year 1 Post-Mastication and Post-Subsurface Munitions Remediation) Historical Wildlife Monitoring Results

Sampling Year	CTS Larvae Abundance (# Individuals)	Fairy Shrimp Abundance (# Individuals)
1992	Not detected	Not detected
1999	Not detected	Not detected
2009*	Not detected	Not detected
2019*	Few (4)	Not detected
2023	Few (1, 8)	Not detected

*baseline year

4.4.2.1 *Data Quality Objective 5*

California tiger salamanders were present in 2023, which was consistent with 2019 baseline monitoring results. CTS were not present in 1992, 1999, or 2009.

Fairy Shrimp were not detected in 2023, which was consistent with baseline monitoring and all reference pools.

4.4.3 Conclusion

Pond 21, a post-mastication and post-subsurface munitions remediation vernal pool, was in year 1 of monitoring in 2023. The vernal pool is on track to meet the plant cover and species diversity performance standard (see Table 4-42). Pond 21 will continue to be monitored in the future.

Table 4-42. Success at Pond 21 (Year 1 Post-Mastication and Post-Subsurface Munitions Remediation) Based on Performance Standards and Applicable Data Quality Objectives

Performance Standard	Applicable DQO	Success
Plant Cover & Species Diversity	DQO 3	On track
Wildlife Usage	DQO 5	On track

4.5 Pond 76 – Year 1

Pond 76 was monitored in 2023 as a year 1 post-mastication munitions remediation vernal pool. Pond 76 was not monitored for baseline conditions as mastication began in the area prior to its recognition as a vernal pool basin. Subsurface anomaly investigations were completed at the end of 2023, thus the vernal pool will also be monitored for Year 1 post-excavation next year. Table 4-43 summarizes the years that monitoring occurred and surveys were conducted. The cumulative precipitation graph shows precipitation for years in which hydrology monitoring was conducted at Pond 76 (see Figure 4-25). The 2022-2023 water-year was above-normal.

Table 4-43. Pond 76 (Year 1 Post-Mastication) Summary of Historic Surveys for Hydrology, Vegetation, and Wildlife

Survey	Water-Year
	2022-2023
Hydrology	●
Vegetation	●
Wildlife	●

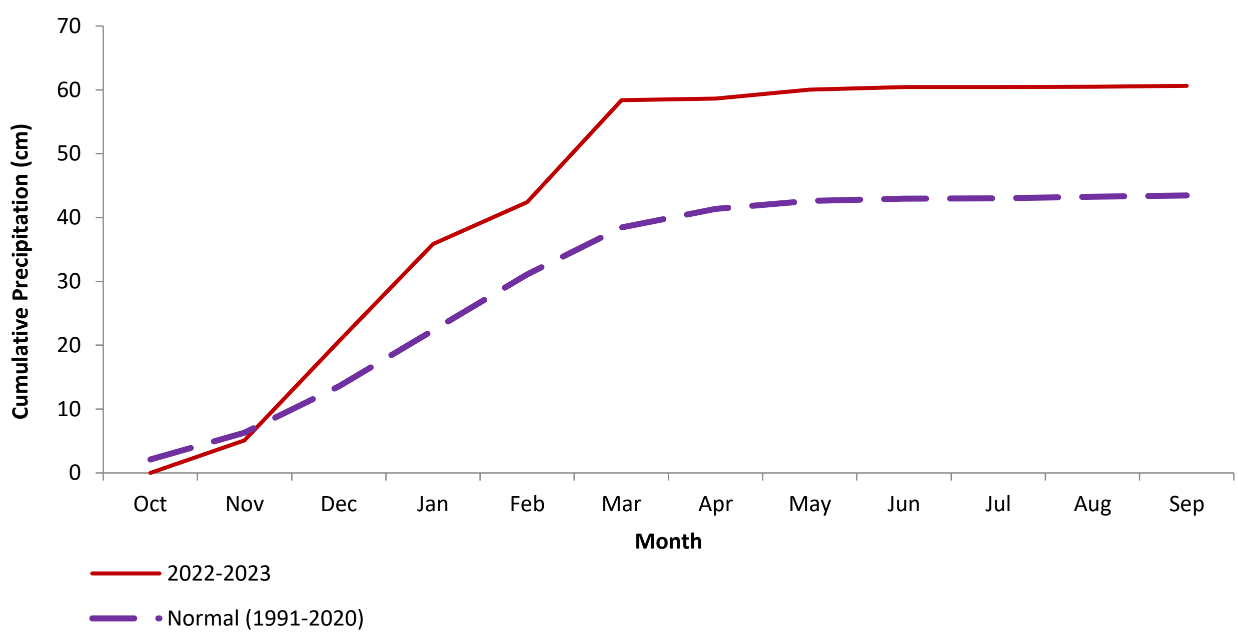

Figure 4-25. Cumulative Monthly Precipitation for Years that Hydrology Monitoring Occurred at Pond 76 (Year 1 Post-Mastication) Compared to the 30-Year Normal (mean 1991-2020) (NPS, 2023; NCEI NOAA, 2023)

4.5.1 Vegetation Monitoring

Vegetation data were collected at Pond 76 in 2023 collected using the methodology described in the Methods section of this report and will be compared to data in future surveys. The absolute percent vegetative cover was 61.2% and 38.8% thatch/bare ground. Pond 76 vegetative cover was less than the values observed at the reference vernal pools (see Table 4-166).

Table 4-44. Pond 76 (Year 1 Post-Mastication) and Reference Vernal Pool Absolute Percent Cover in 2023

Vernal Pool	Vegetative Cover	Thatch/Bare Ground
5	74.5%	25.5%
101 East (East)	82.6%	17.4%
997	83.5%	16.7%
76	61.2%	38.8%

Species richness on transects was 24 species, whereas overall basin species richness was 33 species (see Table 4-45 and Appendix A Table A-5). Pond 76 species richness was within the range of values observed at the reference vernal pools (see Table 4-45 and Appendix D Tables D-20 - E-40). The species richness is represented on the RACs as the length of the curve and number of species along the curve (see Figure 4-26).

Species composition at Pond 76 is illustrated on the RACs as the species codes shift along the curve and losses and gains occur from year to year (see Figure 4-26). The most dominant species were brown-headed rush (*Juncus phaeocephalus*) and needle spikerush *(Eleocharis acicularis* var. *acicularis*), followed by coyote thistle (*Eryngium armatum*), rabbitfoot grass (*Polypogon monspeliensis*), Hickman's popcorn flower (*Plagiobothrys chorisianus* var. *hickmanii*), and flowering quillwort (*Triglochin scilloides*).
The entire species composition observed at Pond 76 can be found in Appendix E. Figure 4-28 shows a subset of this composition for species observed with a 2% cover or greater.

The evenness in 2023 is represented by the slope of the RAC. When comparing vegetation in Pond 76 in 2023 to reference vernal pools, it is most similar to Pond 5 which has a similar overall shape, including a steep slope at the beginning of the curve. A steeper beginning of a RAC conveys less evenness between the dominant species and the rest of the basin flora, however the less dominant species show the vernal pool has high richness and overall evenness (see Figure 4-27 and Appendix F). "Structurally complex systems, such as a fen [or vernal pool] system," as explained in Verberk, 2011, "are species rich and have a more even community abundance pattern, possibly owing to a fine partitioning of available niches."

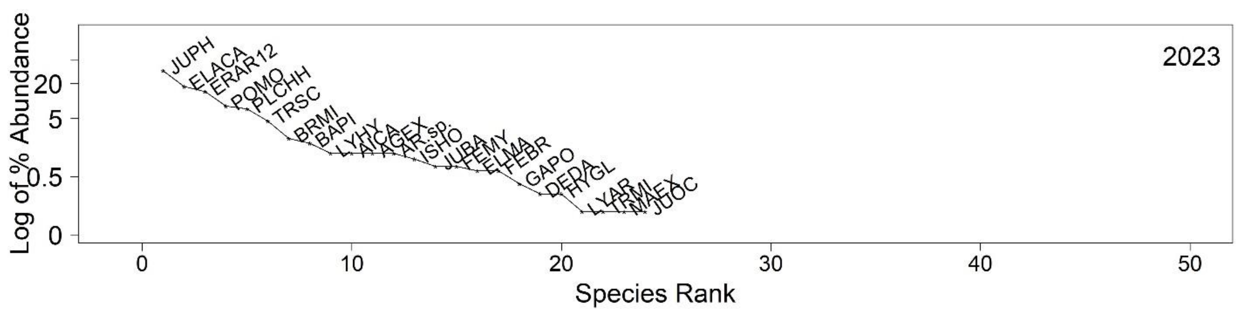

Figure 4-26. Rank Abundance Curves at Pond 76 (Year 1 Post-Mastication) in 2023. Note that the y-axis is in log-10 scale.

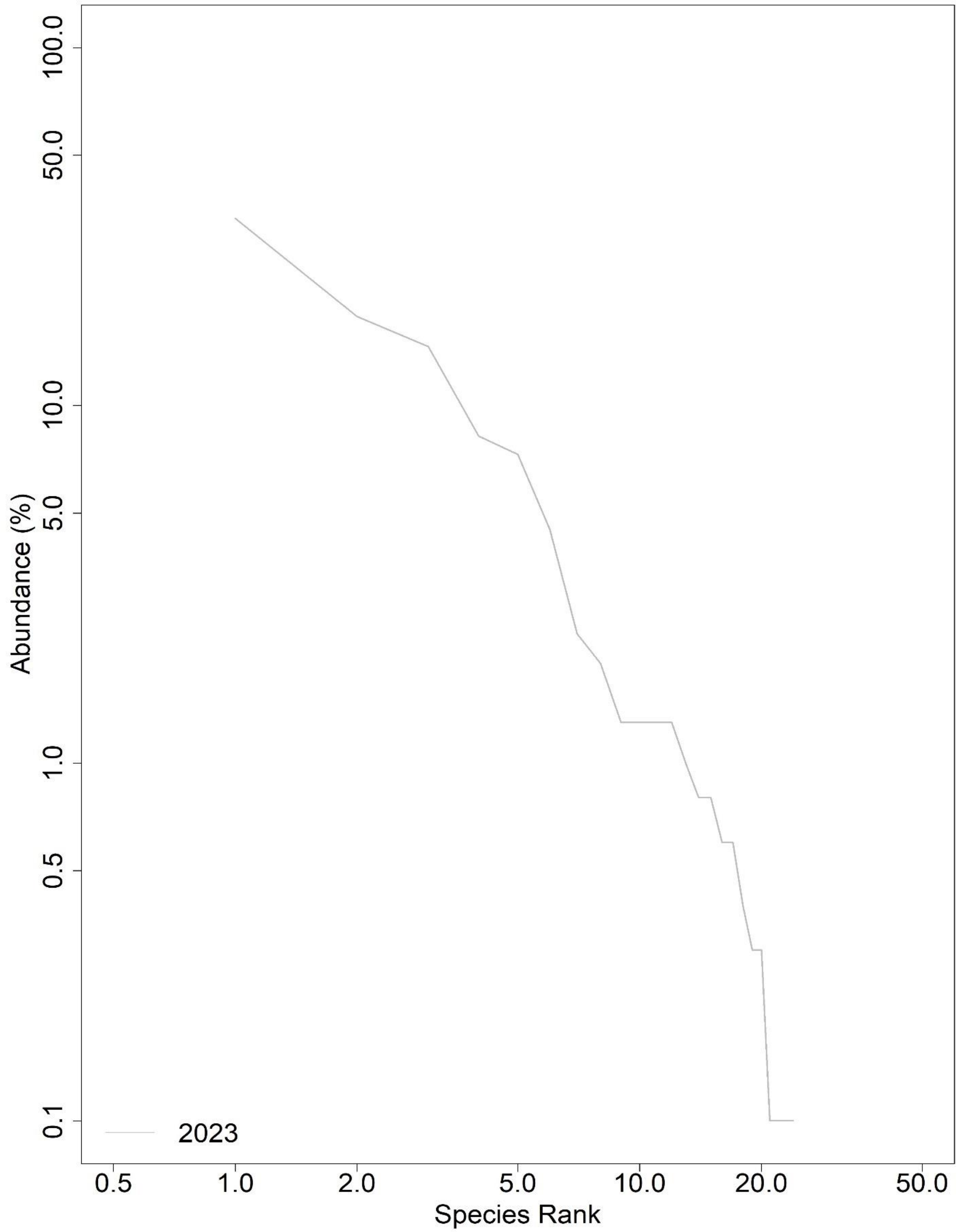

Figure 4-27. Rank Abundance Curves at Pond 76 (Year 1 Post-Mastication) in 2023. Note that the y-axis is in log-10 scale.

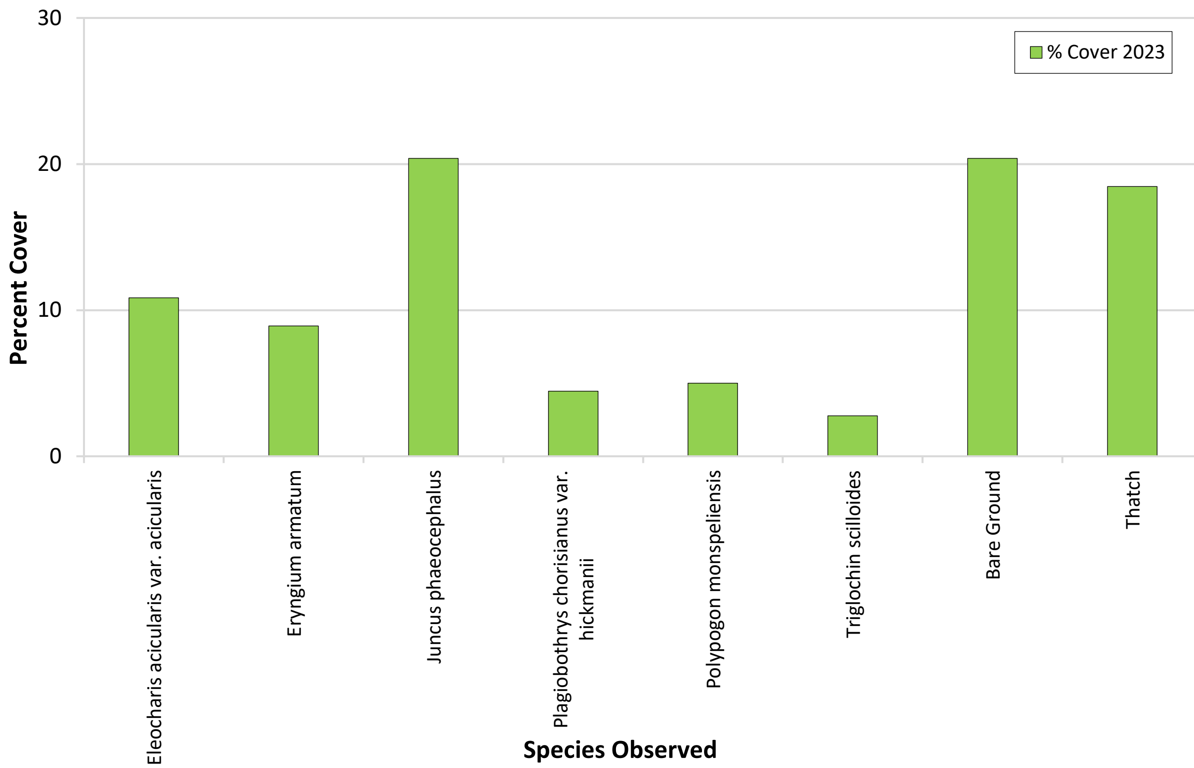

Figure 4-28. Percent Cover of Dominant Species at Pond 76 (Year 1 Post-Mastication)

Pond 76 had a greater number of native species than non-native species in 2023. The native richness was greater than reference vernal pools and non-native richness was the range of values observed at reference (see Table 4-45). The relative percent cover of native species was greater than the relative percent cover of non-native species. Pond 76 had higher native species cover than the reference vernal pools and lower non-native cover (see Table 4-46).

Table 4-45. Pond 76 (Year 1 Post-Mastication) and Reference Vernal Pool Native and Non-Native Species Richness in 2023

Vernal Pool	Native	Non-Native	Unidentified
5	12	12	0
101 East (East)	9	7	0
997	13	14	1
76	**16**	**8**	**0**

Table 4-46. Pond 76 (Year 1 Post-Mastication) and Reference Vernal Pool Relative Percent Cover of Native and Non-Native Plants in 2023

Vernal Pool	Native	Non-Native	Unidentified
5	76.3%	23.7%	0.0%
101 East (East)	60.3%	39.7%	0.0%
997	50.0%	49.0%	1.0%
76	**85.3%**	**14.7%**	**0.0%**

The wetland species in Pond 76 were predominantly facultative and facultative wetland. There were 16 wetland plants and two non-wetland plants observed on transects. Pond 76 was similar to the reference vernal pools with more wetland than non-wetland species, although Pond 76 had fewer non-wetland species than the range of values observed at the reference vernal pools (see Table 4-47). The relative percent cover of wetland species at Pond 76 was within the range of values observed at the reference vernal pools and the non-native cover was less than reference (see Table 4-48).

Table 4-47. Pond 76 (Year 1 Post-Mastication) and Reference Vernal Pool Wetland and Non-Wetland Species Richness in 2023

Vernal Pool	Wetland			Non-Wetland		Not Listed
	OBL	FACW	FAC	FACU	UPL	
5	6	7	3	3	1	4
101 East (East)	4	6	1	3	0	2
997	4	6	4	4	0	10
76	**6**	**7**	**3**	**2**	**0**	**6**

Table 4-48. Pond 76 (Year 1 Post-Mastication) and Reference Vernal Pool Relative Percent Cover of Wetland and Non-Wetland Species in 2023

Vernal Pool	Wetland			Non-Wetland		Not Listed
	OBL	FACW	FAC	FACU	UPL	
5	61.4%	29.0%	3.1%	3.7%	0.1%	2.7%
101 East (East)	14.5%	53.4%	0.1%	9.1%	0.0%	22.9%
997	31.5%	28.9%	7.4%	9.0%	0.0%	23.2%
76	**32.5%**	**58.5%**	**2.5%**	**2.0%**	**0.0%**	**4.5%**

4.5.1.1 *Data Quality Objective 3*

Vegetative cover in Pond 76 was dominated by native and wetland plant species during year 1 post-mastication monitoring in 2023. There are no baseline data available for comparison. Pond 76 wetland species richness and cover fell within the range of reference vernal pools, while non-wetland species were lower. Native species richness and cover were higher than the reference vernal pools. Non-native species were within the range of reference richness results and considerably less than cover results.

4.5.1.2 *Performance Standard: Plant Cover and Species Diversity*

Pond 76, a post-mastication vernal pool, was on track to meet the performance standard for year 1 in 2023. The species composition, although dissimilar from reference vernal pools in 2023, was favorable for wetland and native plant richness and cover.

4.5.2 Wildlife Monitoring

No baseline historical wildlife data were available for comparison. California tiger salamanders were not detected during the survey at the edge of the vernal pool on April 28, 2023, and the invertebrate/fairy shrimp survey was not conducted due to time constraints and logistical issues. Table 4-49 shows historic wildlife monitoring results. Data quality objectives 1 and 4 were analyzed in the Hydrology Monitoring Annual Report (Chenega, 2023).

Table 4-49. Pond 76 (Year 1 Post-Mastication) Historical Wildlife Monitoring Results

Sampling Year	CTS Larvae Abundance (# Individuals)	Fairy Shrimp Abundance (# Individuals)
2023	Not detected	Not surveyed

4.5.2.1 *Data Quality Objective 5*

California tiger salamanders were not detected in 2023. No prior surveys were conducted at Pond 76. This was not consistent with reference vernal pools. Pond 997 had the most similar profile and shorter hydroperiod, so would be the ideal reference vernal pool for comparison, however there were no surveys conducted at this vernal pool due to lack of depth by the time surveys occurred. Reference Ponds 5 and 101 East (East) are not comparable to Pond 76 as they have significantly different size and hydroperiods.

Fairy shrimp were not surveyed at Pond 76 in 2023, as the limited time for wildlife surveys prioritized CTS monitoring.

4.5.2.2 *Performance Standard: Wildlife Usage*

Pond 76, a post-mastication vernal pool, is not on track to meet the performance standard for year 1 since fairy shrimp surveys were not completed and there were no appropriate reference pond data to compare with CTS detections. The vernal pool was only evaluated against the performance standard with consideration to reference vernal pools because there was no baseline wildlife data for Pond 76.

4.5.3 Conclusion

Pond 76, a post-mastication vernal pool, was in year 1 of monitoring in 2023. The vernal pool was on track to meet the plant cover and species diversity performance standard, but was not on track to meet the wildlife usage performance standard (see Table 4-50). Pond 76 will continue to be monitored in the future.

Table 4-50. Success at Pond 76 (Year 1 Post-Mastication) Based on Performance Standards and Applicable Data Quality Objectives

Performance Standard	Applicable DQO	Success
Plant Cover & Species Diversity	DQO 3	On Track
Wildlife Usage	DQO 5	Not On Track

4.6 Pond 3 North –Year 5

Pond 3 North was monitored in 2023 as a year 5 post-subsurface munitions remediation vernal pool. Pond 3 North was monitored for baseline conditions in 1998, 2015, and 2016. Vegetation in Pond 3 North and within its watershed was burned in October 2017 as part of the prescribed burn of BLM Area B Subunit B. Pond 3 North had intrusive anomaly investigations in 2018. Table 4-28 summarizes the years that monitoring occurred and surveys were conducted. The cumulative precipitation graph shows precipitation for years in which hydrology monitoring was conducted at Pond 3 North (see Figure 4-29). The 1997-1998, 2015-2016, 2018-2019 and 2022-2023 water-years were above normal, whereas 2014-2015, 2017- 2018, and 2020-2021 water-years were below normal. Water year 2019-2020 was similar to the cumulative normal water-year.

Table 4-51. Pond 3 North (Year 5 Post-Subsurface Munitions Remediation) Summary of Historical Surveys for Hydrology, Vegetation, and Wildlife

Survey	Water-Year							
	1997-1998	2014-2015	2015-2016	2017-2018	2018-2019	2019-2020	2020-2021	2022-2023
Hydrology	●	●	●	●	●	●	●	●
Vegetation	●	●		●	●	●	●	●
Wildlife	●	●	●	●	●	●		●

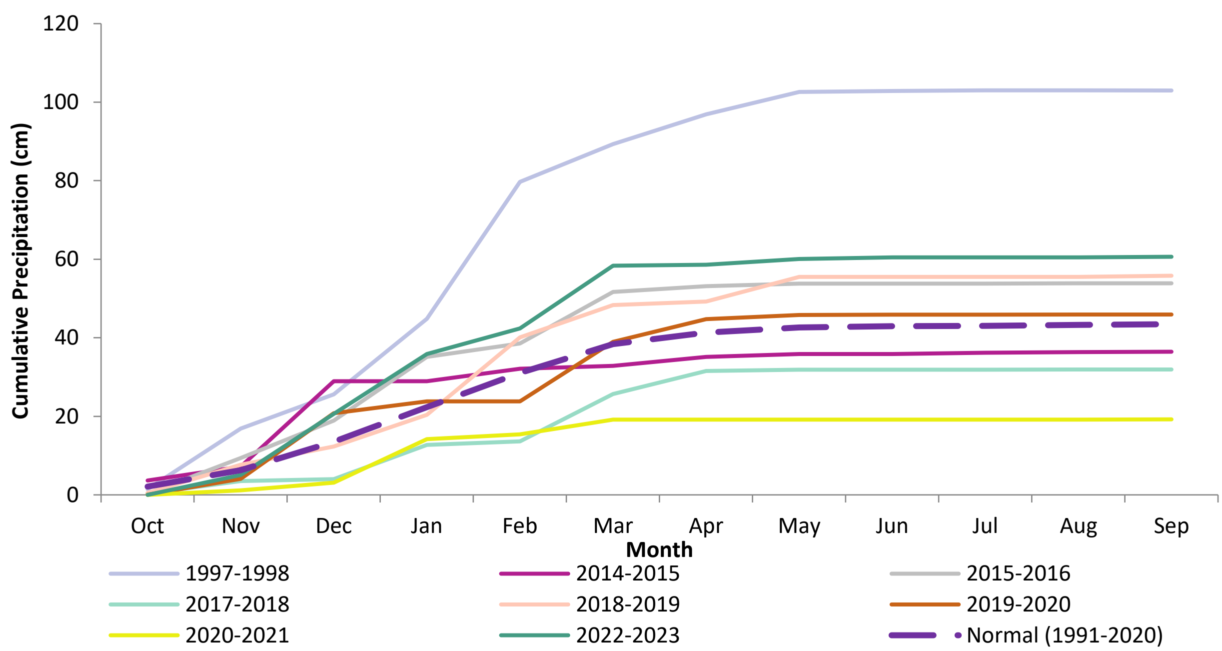

Figure 4-29. Cumulative Monthly Precipitation for Years that Hydrology Monitoring Occurred at Pond 3 North (Year 5 Post-Subsurface Munitions Remediation) Compared to the 30-Year Normal (mean 1991-2020) (NPS, 2023; NCEI NOAA, 2023)

4.6.1 Vegetation Monitoring

Vegetation data were collected at Pond 3 North in 1998, 2015, 2018-2021, and 2023 (HLA, 1998; Burleson, 2016, 2019, 2020, 2021, 2022). In 1998, data were collected along one transect with a length of 116 feet. Quadrats were placed at 10-foot intervals, alternating from right to left along the transect. Because 1998 data were collected differently than in other years, strata were combined across the vernal pool to allow for comparison. In 2015, 2018-2021, and 2023, data were collected using the methodology described in the Methods section of this report. Data from 2015 and 2021 were compared stratum-to-stratum in Table 4-52 as well as visually in Figure 4-30.

Pond 3 North also supports a CCG population located in stratum 4. The population was mapped and a visual estimate of percent cover was recorded in 2023 to compare to 2015, 2016, and 2018-2021 (see Figure 4-35 in Section 4.6.1.1). In 2015, vegetation monitoring was completed on April 22 and CCG monitoring was completed later, on May 19. The CCG was mapped as an overlay on top of the other strata, not as a separate stratum. Therefore, the acreage percentages for the basin did not include CCG.

Table 4-52. Pond 3 North (Year 5 Post-Subsurface Munitions Remediation) Vegetative Strata Percentage within the Vernal Pool Basin Boundary

Stratum	Percentage	
	2015	2023
1	16%	12%
2	14%	7%
3	70%	44%
4 (CCG)	N/A	36%
Upland	N/A	1%

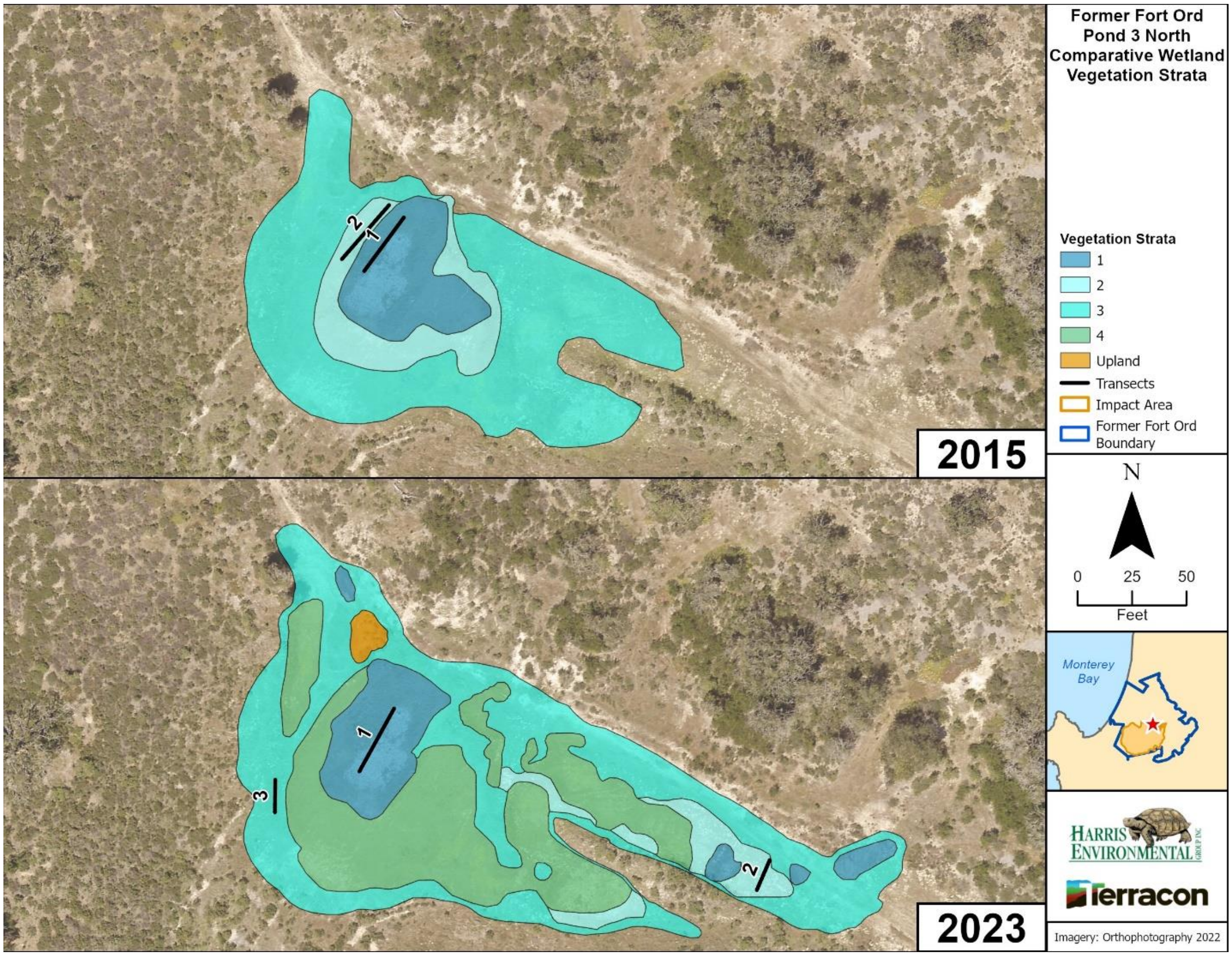

Figure 4-30. Pond 3 North (Year 5 Post-Subsurface Munitions Remediation) Vegetation Strata and Transects for 2015 and 2023

The absolute percent vegetative cover observed in 2023 (Yr 5) was greater than the range of values in baseline years, a shift from previous monitoring years, which were all within the range of baseline (see Table 4-53). Vegetative cover ranged in baseline years from 46.1% in 1998 to 88.7% in 2023. The absolute percent vegetative cover in 2023 was also greater than the reference vernal pool values (see Table 4-54).

Table 4-53. Pond 3 North (Year 5 Post-Subsurface Munitions Remediation) Absolute Percent Cover

Year	Vegetative Cover	Thatch/Bare Ground
1998*	46.1%	54.0%
2015*	80.6%	14.8%
2018	60.2%	40.1%
2019	72.7%	27.3%
2020	57.9%	42.1%
2021	47.8%	52.3%
2023	88.7%	11.3%

*baseline year

Table 4-54. Pond 3 North (Year 5 Post-Subsurface Munitions Remediation) and Reference Vernal Pool Absolute Percent Cover in 2023

Vernal Pool	Vegetative Cover	Thatch/Bare Ground
5	74.5%	25.5%
101 East (East)	82.6%	17.4%
997	83.5%	16.7%
3 North	**88.7%**	**11.3%**

Species richness in 2023 was greater than in baseline years. Species richness on transects was 16, 9, 38, 22, 40, 45, and 18 species in 1998, 2015, 2018, 2019, 2020, 2021, and 2023, respectively, whereas overall basin species richness was 24, 82, 90, 74, 74, and 42 species in 2015, 2018, 2019, 2020, 2021, and 2023, respectively (see Table 4-55 and Appendix A Table A-4). The 1998 survey was limited to species observed on the transect and overall basin species richness was not recorded. Pond 3 North species richness on transects was within the range of values observed at the reference vernal pools (see Table 4-56 and Appendix D Tables D-20 and D-40). The species richness is represented on the RACs as the length of the curve and number of species along the curve (see Figure 4-31 and Figure 4-32).

Species composition at Pond 3 North varied between monitoring years. This variability of species composition is illustrated on the RACs as the species codes shift along the curve and losses and gains occur from year to year (see Figure 4-28 and Figure 4-29). Despite overall composition variability, the dominant species in the vernal pool were fairly consistent. The dominant species every year was pale spikerush (*Eleocharis macrostachya*). Other important species in 2015 (baseline) were brass buttons (*Cotula coronopifolia*) and Hickman's popcornflower (*Plagiobothrys chorisianus* var. *hickmanii*). Coyote thistle (*Eryngium armatum*) was another important species in 2019 (Yr 1), along with rabbitfoot grass (*Polygonum monspeliensis*). In 2020 (Yr 2) and 2021 (Yr 3), coyote thistle, California oatgrass (*Danthonia californica*), and Italian ryegrass (*Festuca perennis*) were other important contributors. By 2023 (Yr 5), coastal tarweed (*Deinandra corymbosa*), narrow-leaved clover (*Trifolium angustifolium*), and cut-leaved plantain (*Plantago coronopus*) were subdominant, marking a shift from previous years. A complete comparison of species composition observed at Pond 3 North in 1998, 2015, 2018-2021, and 2023 can be found in Appendix E. Figure 4-34 shows a subset of this comparison for species observed with a 2% cover or greater.

The evenness from each year for Pond 3 North is represented by the slope of the RACs. The evenness is fairly similar from baseline to 2019 (Yr 1), 2020 (Yr 2), 2021 (Yr 3) and 2023 (Yr 5) with richness distributed along the entire curve. "Structurally complex systems, such as a fen [or vernal pool] system," as explained in Verberk, 2011, "are species rich and have a more even community abundance pattern, possibly owing to a fine partitioning of available niches." The RACs are similar between 2023 (Yr 5) and 2015 (baseline), both of which have an uneven distribution of the dominant species at the top of the curve, whereas, 2020, and 2021 had a higher concentration or plateau of species toward the tail end compared to the other years. Compared to reference vernal pools, vegetation in Pond 3 North is most similar to Pond 5, which also has a steeper distribution of the dominant species, followed by a gradual curve downward (see Figure 4-33, and Appendix F).

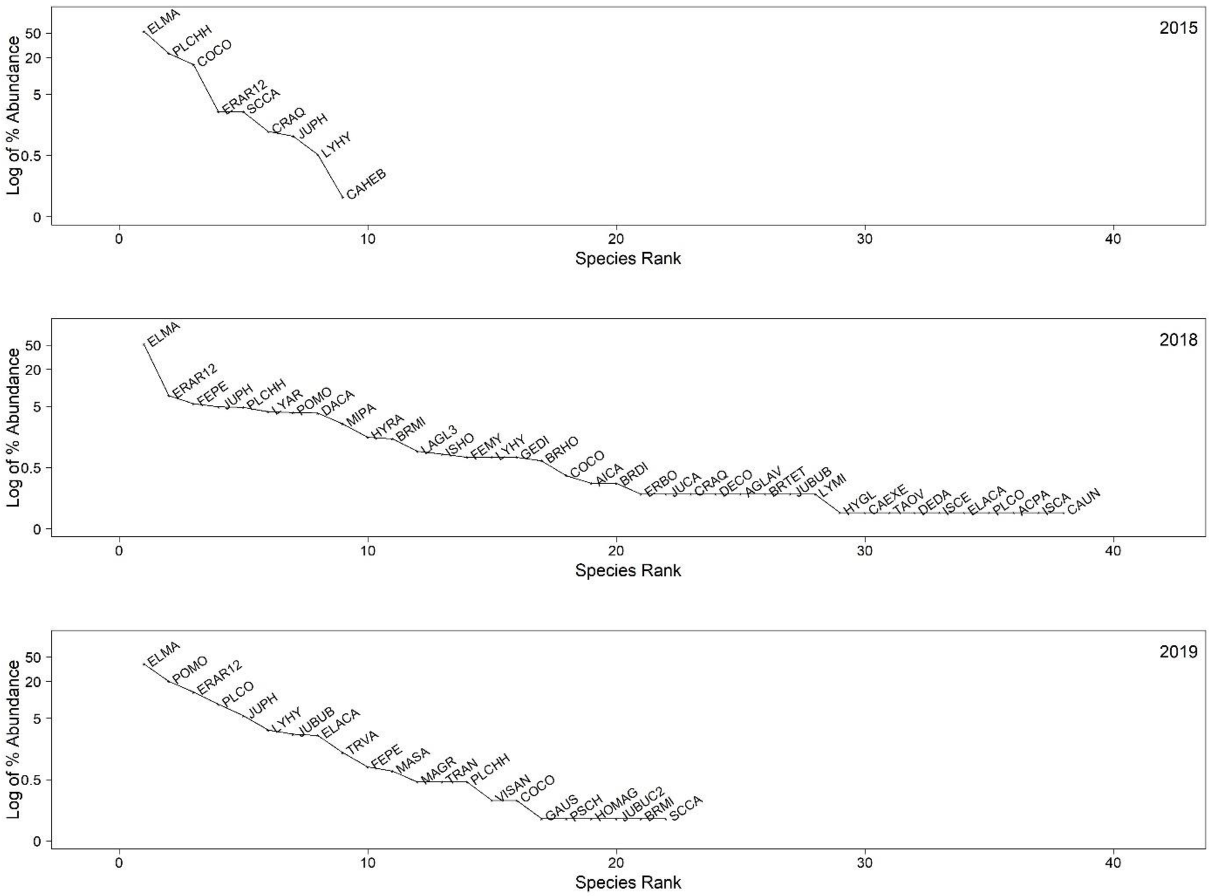

Figure 4-31. Rank Abundance Curves at Pond 3 North (Year 5 Post-Subsurface Munitions Remediation) in 2015, 2018, and 2019. Note that the y-axis is in log-10 scale.

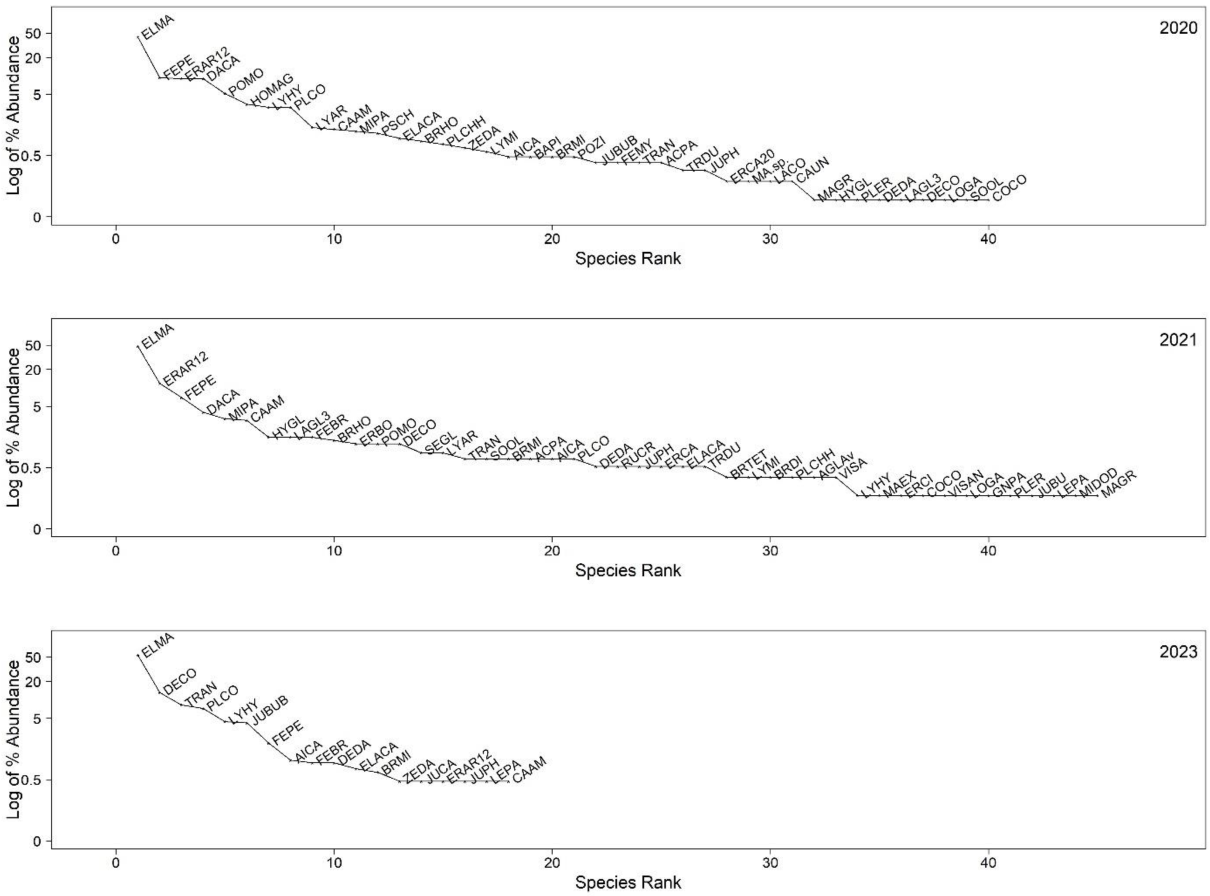

Figure 4-32. Rank Abundance Curves at Pond 3 North (Year 5 Post-Subsurface Munitions Remediation) in 2020, 2021, and 2023. Note that the y-axis is in log-10 scale.

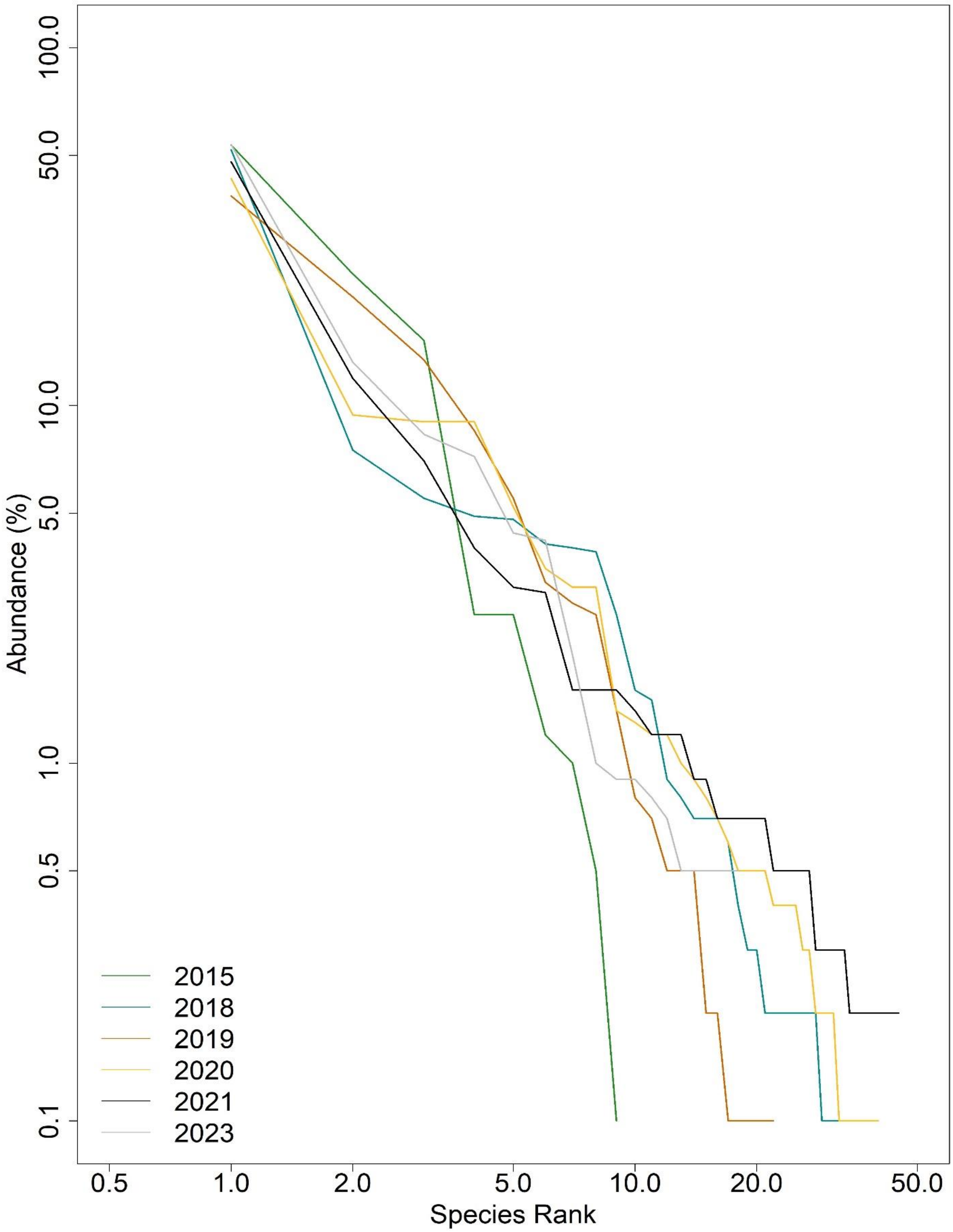

Figure 4-33. Rank Abundance Curves at Pond 3 North (Year 5 Post-Subsurface Munitions Remediation) in 2015-2023. Note that the x-axis and the y-axis are in log-10 scale.

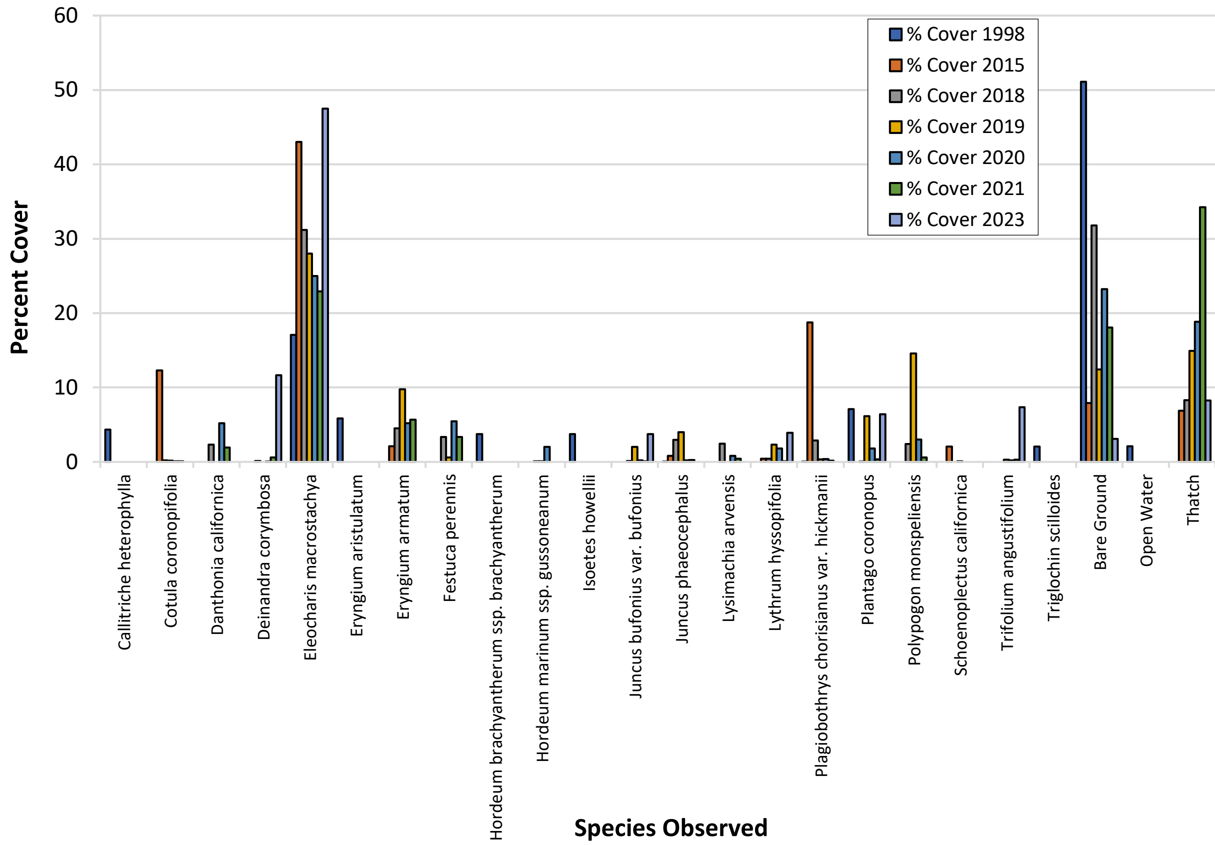

Figure 4-34. Percent Cover of Dominant Species at Pond 3 North (Year 5 Post-Subsurface Munitions Remediation)

Native and non-native species richness were greater than baseline in every monitoring year (see Table 4-55). In 2019 (Yr 1), native richness was greater than reference values while non-native richness was within the range of reference vernal pool values (Burleson, 2020). In 2020 (Yr 2) and 2021 (Yr 3), both native and non-native species richness was greater than the range of reference values (Burleson, 2021, 2022). By 2023 (Yr 5), native and non-native species richness were within the range of reference values (see Table 4-56).

Table 4-55. Pond 3 North (Year 5 Post-Subsurface Munitions Remediation) Native and Non-Native Species Richness

Year	Native	Non-Native	Unidentified
1998*	9	6	1
2015*	7	2	0
2018	22	16	0
2019	13	9	0
2020	23	16	1
2021	23	22	0
2023	10	8	0

*baseline year

Table 4-56. Pond 3 North (Year 5 Post-Subsurface Munitions Remediation) and Reference Vernal Pool Native and Non-Native Species Richness in 2023

Vernal Pool	Native	Non-Native	Unidentified
5	12	12	0
101 East (East)	9	7	0
997	13	14	1
3 North	**10**	**8**	**0**

The relative percent cover of native species was less, and non-native species was greater than the values observed in baseline years during every year of monitoring (see Table 4-57). In 2019 (Yr 1) and 2023 (Yr 5), native and non-native cover values fell within the range of values for reference vernal pools (Burleson, 2020) (see Table 4-58). In 2020 (Yr 2), native cover was less and non-native cover was greater than reference (Burleson, 2021). In 2021 (Yr 3), native cover was greater and non-native cover was less than reference (Burleson, 2022).

Table 4-57. Pond 3 North (Year 5 Post-Subsurface Munitions Remediation) Relative Percent Cover of Native and Non-Native Plants

Year	Native	Non-Native	Unidentified
1998*	81.9%	17.7%	0.4%
2015*	84.2%	15.8%	0.0%
2018	79.0%	21.0%	0.0%
2019	66.3%	33.7%	0.0%
2020	70.9%	28.9%	0.2%
2021	78.2%	21.8%	0.0%
2023	75.0%	25.0%	0.0%

*baseline year

Table 4-58. Pond 3 North (Year 5 Post-Subsurface Munitions Remediation) and Reference Vernal Pool Relative Percent Cover of Native and Non-Native Plants in 2023

Vernal Pool	Native	Non-Native	Unidentified
5	76.3%	23.7%	0.0%
101 East (East)	60.3%	39.7%	0.0%
997	50.0%	49.0%	0.0%
3 North	**75.0%**	**25.0%**	**0.0%**

Wetland and non-wetland species richness on Pond 3 North transects was greater than the baseline years in 2020 (Yr 2), 2021 (Yr 3), and 2023 (Yr 5) (Burleson, 2021, 2022) (see Table 4-59). Whereas 2019 (Yr 1) non-wetland species richness was within the range of baseline values (Burleson, 2020). In 2019 (Yr 1), wetland and non-wetland species values were slightly less than the values observed at reference vernal pools (Burleson, 2020). In 2020 (Yr 3), wetland and non-wetland species richness were within the range of values observed at vernal pools (Burleson, 2019, 2021). In 2021 (Yr 4), wetland and non-wetland richness were both greater than the range of reference vernal pool values (Burleson, 2022). Non-wetland richness in 2023 (Yr 5) at Pond 3 North was less than reference, whereas wetland richness fell within the range of values (see Table 4-60).

Table 4-59. Pond 3 North (Year 5 Post-Subsurface Munitions Remediation) Wetland and Non-Wetland Species Richness

Year	Wetland			Non-Wetland		Not Listed
	OBL	FACW	FAC	FACU	UPL	
1998*	6	2	1	1	0	6
2015*	7	2	0	0	0	0
2018	10	8	5	6	0	9
2019	6	6	5	0	1	4
2020	7	10	6	5	1	11
2021	6	9	6	5	4	15
2023	3	5	3	2	0	5

*baseline year

Table 4-60. Pond 3 North (Year 5 Post-Subsurface Munitions Remediation) and Reference Vernal Pool Wetland and Non-Wetland Species Richness in 2023

Vernal Pool	Wetland			Non-Wetland		Not Listed
	OBL	FACW	FAC	FACU	UPL	
5	6	7	3	3	1	4
101 East (East)	4	6	1	3	0	2
997	4	6	4	4	0	10
3 North	**3**	**5**	**3**	**2**	**0**	**5**

Every monitoring year except for 2019 (Yr 1) had wetland cover values less than the values observed in baseline, and non-wetland cover greater than baseline (see Table 4-61). In 2019 (Yr 1), wetland and non-wetland values fell within the range of baseline values (Burleson, 2020). In 2020 (Yr 2), wetland species cover fell within the range of values observed at reference vernal pools (Burleson, 2021). In 2019 (Yr 1) and 2021 (Yr 3), wetland species cover was greater than the range of values found at reference while non-wetland cover was less (Burleson, 2020, 2022). 2023 (Yr 5) wetland cover values were within the range of values observed at reference vernal pools while non-wetland cover was less than the reference values (see Table 4-62).

Table 4-61. Pond 3 North (Year 5 Post-Subsurface Munitions Remediation) Relative Percent Cover of Wetland and Non-Wetland Species

Year	Wetland			Non-Wetland		Not Listed
	OBL	FACW	FAC	FACU	UPL	
1998*	71.9%	8.2%	15.4%	0.2%	0.0%	4.4%
2015*	96.4%	3.6%	0.0%	0.0%	0.0%	0.0%
2018	59.9%	17.1%	15.1%	3.6%	0.0%	4.3%
2019	45.2%	42.0%	10.9%	0.0%	0.2%	1.7%
2020	48.6%	18.4%	26.8%	2.2%	0.1%	3.8%
2021	50.8%	18.2%	13.8%	4.4%	1.4%	11.5%
2023	58.7%	6.6%	9.9%	1.5%	0.0%	23.3%

*baseline year

Table 4-62. Pond 3 North (Year 5 Post-Subsurface Munitions Remediation) and Reference Vernal Pool Relative Percent Cover of Wetland and Non-Wetland Species in 2023

Vernal Pool	Wetland			Non-Wetland		Not Listed
	OBL	FACW	FAC	FACU	UPL	
5	61.4%	29.0%	3.1%	3.7%	0.1%	2.7%
101 East (East)	14.5%	53.4%	0.1%	9.1%	0.0%	22.9%
997	31.5%	28.9%	7.4%	9.0%	0.0%	23.2%
3 North	**58.7%**	**6.6%**	**9.9%**	**1.5%**	**0.0%**	**23.3%**

4.6.1.1 *Contra Costa Goldfields*

The area of CCG at Pond 3 North increased between 2015 and 2019, then decreased slightly in 2020 and 2021 (Burleson, 2016, 2017, 2019, 2020, 2021, 2022). The population occupied 0.04 acre in 2015, 0.13 acre in 2016, 0.14 acre in 2018, 0.18 acre in 2019 (Yr 1), 0.16 acre in 2020 (Yr 2), 0.14 acre in 2021 (Yr 3), then increased to 0.22 acre in 2023 (Yr 5) (see Table 4-63 and Figure 4-35). The densities ranged between 1-75% cover. In all follow-up monitoring years, the CCG population has been in similar locations to the baseline years. This suggests that post-subsurface munitions remediation in 2018 likely did not affect the population, but rather that changes in population size are attributable to natural fluctuation. It is notable that the population increased by an order of magnitude between 2015 and 2023, with an increase of 0.18 acres. This is a greater increase in CCG than at any other remediated vernal pool.

Table 4-63. Pond 3 North (Year 5 Post-Subsurface Munitions Remediation) Contra Costa Goldfields Estimated Cover

Year	Area (acres)	Density (% cover)
2015*	0.04	10-60%
2016	0.13	5-40%
2018	0.14	10-70%
2019	0.18	5-75%
2020	0.16	5-45%
2021	0.14	10-60%
2023	0.22	1-40%

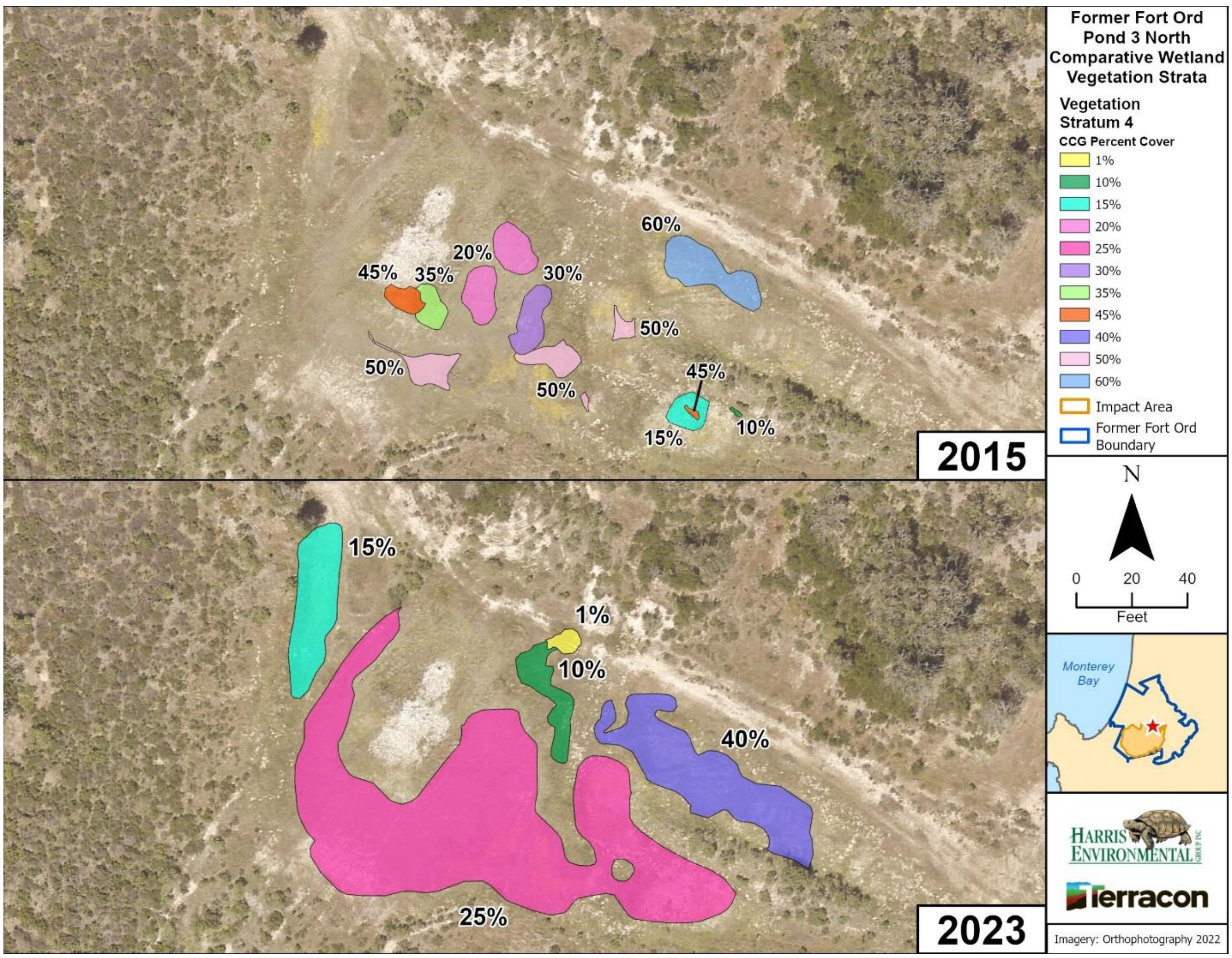

Figure 4-35. Contra Costa Goldfields Populations at Pond 3 North (Year 5 Post-Subsurface Munitions Remediation) in 2015 and 2023

4.6.1.2 *Data Quality Objective 3*

Observable changes in hydrophytic vegetation between surveys were largely associated with precipitation fluctuations. This is expected given the dynamic nature of vernal pools and the close relationship between the hydroperiod and wetland vegetation composition. This year was an above-normal water-year.

Vegetative cover in Pond 3 North was dominated by native and wetland plant species during year 5 post-subsurface munitions remediation monitoring in 2023. In 2019 (Yr 1) and 2020 (Yr 2), values were generally within the range of baseline and reference values and were all considered on track to meet the performance standard. However, In 2021 (Yr 3), native, non-native, wetland, and non-wetland richness were all greater than baseline and reference values and the performance standard was not on track that year. This was thought, however, to be due to the record drought conditions, rather than the effects of remediation. By 2023 (Yr 5), Pond 3 North wetland vegetation results were generally within range of either baseline and/or reference vernal pools, except that non-native richness and cover were greater than baseline values but less than range of values for reference vernal pools. The cover and richness values for native, wetland and non-wetland were variable in relation to baseline and reference, but all were within the range of values for each one of the categories.

4.6.1.3 *Performance Standard: Plant Cover and Species Diversity*

Pond 3 North, a post-subsurface munitions remediation vernal pool, met the performance standard for year 5 in 2023. The species composition and native and wetland species relative abundances were similar to baseline and/or reference vernal pool conditions. The high non-native and non-wetland richness in 2021 (Yr 3) were not seen in any other monitoring year and was thought to have been the result of drought conditions. The evaluation of meeting the vegetation performance standard according to the Wetland Plan, is to “aid in determining whether vegetation in disturbed wetlands is similar enough to that in wetlands before MEC to determine whether wetland function is retained”. The decision for whether a vernal pool has met the performance standard is based on reviewing all years of monitoring data. The results differ slightly between the five years, but the intent of the performance standard has been met based on the consideration of water-years and that the wetland function of Pond 3 North is retained.

4.6.2 Wildlife Monitoring

Wildlife data were collected at Pond 3 North in 1998, 2015, 2016, 2018-2020, and 2023 (HLA, 1998; Burleson, 2016, 2017, 2019, 2020, 2021). California tiger salamander larvae were not detected in any survey year. Fairy shrimp were present in 1998, 2019, and 2020. Table 4-64 shows historical wildlife monitoring results.

Table 4-64. Pond 3 North (Year 5 Post-Subsurface Munitions Remediation) Historical Wildlife Monitoring Results

Sampling Year	CTS Larvae Abundance (# Individuals)	Fairy Shrimp Abundance (# Individuals)
1998*	Not detected	High
2015*	Not detected	Not detected
2016*	Not detected	Not detected
2018	Not detected	Not detected
2019	Not detected	Low – Moderate (36, 72, 3)
2020	Not detected	Low (6)
2023	Not detected	Not detected

*baseline year

4.6.2.1 *Data Quality Objective 5*

California tiger salamanders were not present in any year, which was consistent with baseline monitoring despite having adequate depth in 2019 (Yr 1), 2020 (Yr 2), and 2023 (Yr 5) (Burleson, 2020, Chenega, 2020, 2021, 2023). Compared to reference vernal pools, results in the three monitoring years were partially consistent with the results from the reference vernal pools. California Tiger Salamanders were not detected at reference Ponds 5 or 101 East (East) in 2020, but they were in 2019 and 2023. Reference Pond 997, to which Pond 3 North is most similar in size and depth, also had no CTS detections in 2019.

Fairy shrimp were not detected in 2018 or 2023 (Yr 5), however they were detected in low to moderate numbers in 2019 (Yr 1) and 2020 (Yr 2). Baseline monitoring results were variable for the species. Fairy shrimp were detected in 1998 but not in 2015 or 2016. It was possible survey event timing prevented detection in 2015 and 2016 because surveys occurred later in the year (late March through May). This may also have been the case in 2023 (Yr 5), in which surveys did not begin until even later in the year, at the end of April. When compared to reference vernal pools, fairy shrimp results were mostly similar. The species was found at Pond 5 in 2019, and Pond 101 East (East) in 2019 and 2020. However, Pond 997, to which Pond 3 North is most hydrologically similar, had no fairy shrimp detections in the 2019 monitoring year. No fairy shrimp were found at reference vernal pools in 2023. Data quality objectives 1 and 4 were analyzed in the Hydrology Monitoring Annual Report (Chenega, 2023).

4.6.3 Conclusion

Pond 3 North, a post-subsurface munitions remediation vernal pool, was in the final year (Yr 5) of monitoring in 2023. The vernal pool met the plant cover and species diversity performance standard and met DQO 5 for wildlife useage (see Table 4-65). No further monitoring is recommended for Pond 3 North.

Table 4-65. Success at Pond 3 North (Year 5 Post-Subsurface Munitions Remediation) Based on Performance Standards and Applicable Data Quality Objectives

Performance Standard	Applicable DQO	2019 (Yr 1)	2020 (Yr 2)	2021 (Yr 3)	2023 (Yr 5)	Success
Plant Cover & Species Diversity	DQO 3	On Track	On Track	Not On Track	On Track	Met
Wildlife Usage	DQO 5	On Track	On Track	N/A	On Track	Met

4.7 Pond 3 South –Year 5

Pond 3 South was monitored in 2023 as a year 5 post-subsurface munitions remediation vernal pool. Pond 3 South was monitored for baseline conditions in 1998, 2015, and 2016. Vegetation in Pond 3 South and within its watershed was burned in October 2017 as part of the prescribed burn of BLM Area B Subunit B. Pond 3 South had intrusive anomaly investigations in 2018. Table 4-66 summarizes the years that monitoring occurred and surveys were conducted. The cumulative precipitation graph shows precipitation for years in which hydrology monitoring was conducted at Pond 3 South (see Figure 4-36). The 1997-1998, 2015-2016, 2018-2019, and 2022-2023 water-years were above-normal, whereas the 2014-2015, 2017-2018, and 2020-2021 water-years were below-normal. Water-year 2019-2020 was similar to the cumulative normal water-year.

Table 4-66. Pond 3 South (Year 5 Post-Subsurface Munitions Remediation) Summary of Historical Surveys for Hydrology, Vegetation, and Wildlife

Survey	Water-Year							
	1997-1998	2014-2015	2015-2016	2017-2018	2018-2019	2019-2020	2020-2021	2022-2023
Hydrology	●	●	●	●	●	●	●	●
Vegetation	●		●	●	●	●	●	●
Wildlife	●		●		●	●		●

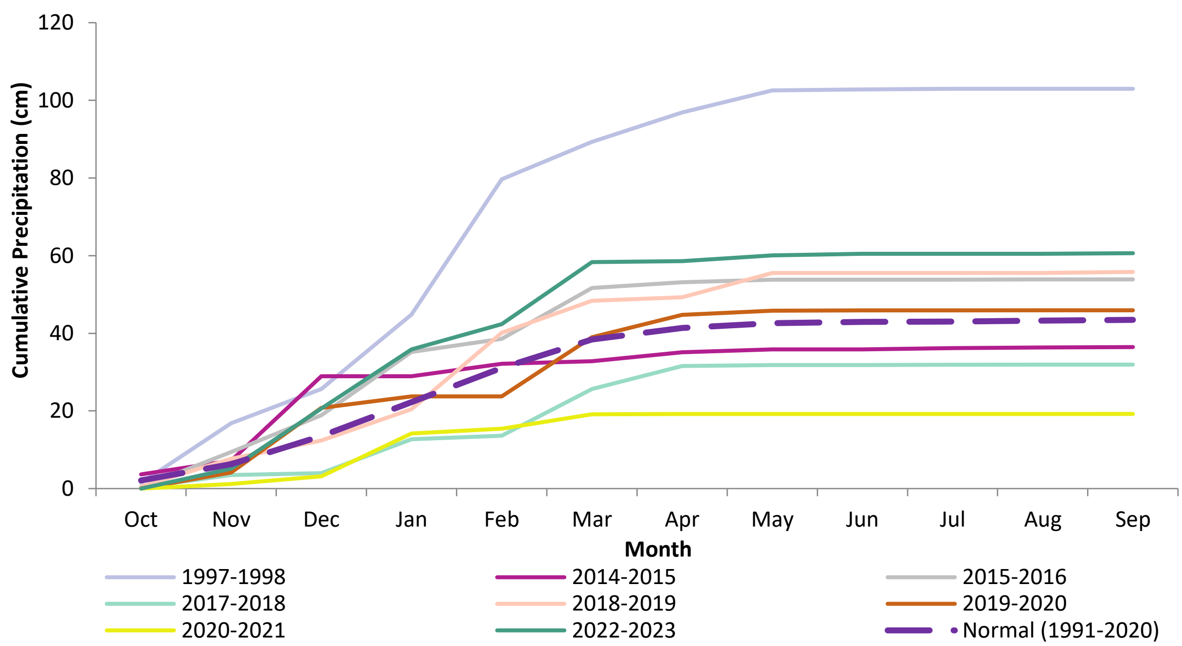

Figure 4-36. Cumulative Monthly Precipitation for Years that Hydrology Monitoring Occurred at Pond 3 South (Year 5 Post-Subsurface Munitions Remediation) Compared to the 30-Year Normal (mean 1991-2020) (NPS, 2023; NCEI NOAA, 2023)

4.7.1 Vegetation Monitoring

Vegetation data were collected at Pond 3 South in 1998, 2016, 2018-2021, and 2023 (HLA, 1998; Burleson, 2017, 2019, 2020, 2021, 2022). In 1998, data were collected along one transect with a length of 116 feet. Quadrats were placed at 10-foot intervals, alternating from right to left along the transect.

Because 1998 data were collected differently than in other years, strata were combined across the vernal pool to allow for comparison. In 2016, 2018-2021, and 2023, data were collected using the methodology described in the Methods section of this report. Data from 2016 and 2023 were compared stratum-to-stratum in Table 4-67 as well as visually in Figure 4-37.

Pond 3 South also supports a CCG population, located in stratum 5. The population was mapped and a visual estimate of percent cover was recorded in 2023 to compare to 2018-2021 (see Figure 4-42 and Table 4-78 in Section 4.7.1.1).

Table 4-67. Pond 3 South (Year 5 Post-Subsurface Munitions Remediation) Vegetative Strata Percentage within the Vernal Pool Basin Boundary

Stratum	Percentage	
	2016	2023
1	20%	17%
2	38%	26%
3	35%	50%
4	5%	N/A
5 (CCG)	N/A	1%
Upland	2%	6%

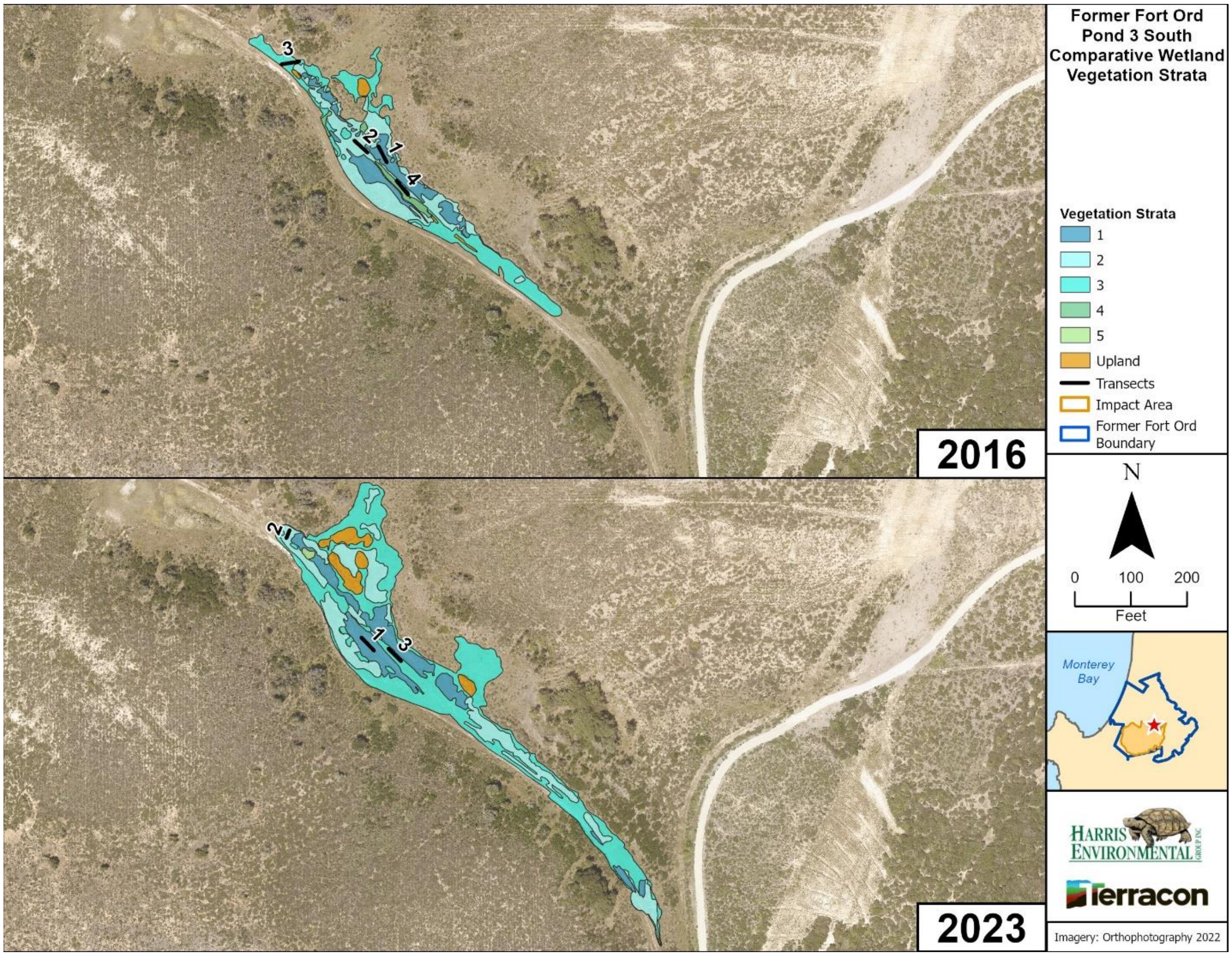

Figure 4-37. Pond 3 South (Year 5 Post-Subsurface Munitions Remediation) Vegetation Strata and Transects for 2016 and 2023

The absolute percent vegetative cover observed in 2023 was within the range of values in baseline years for the first time in all monitoring years (see Table 4-68). Vegetative cover in ponds monitored for post-mitigation ranged from 31.4% in 2021 (Yr 3) to 85.2% in 2023 (Yr 5). Pond 3 South vegetative cover in 2023 was also greater than the range of values observed at the reference vernal pools (Table 4-69).

Table 4-68. Pond 3 South (Year 5 Post-Subsurface Munitions Remediation) Absolute Percent Cover

Year	Vegetative Cover	Thatch/Bare Ground
1998*	90.2%	13.9%
2016*	82.8%	15.1%
2018	59.4%	41.0%
2019	68.9%	31.2%
2020	69.8%	30.6%
2021	31.4%	68.7%
2023	85.2%	14.8%

*baseline year

Table 4-69. Pond 3 South (Year 5 Post-Subsurface Munitions Remediation) and Reference Vernal Pool Absolute Percent Cover in 2023

Vernal Pool	Vegetative Cover	Thatch/Bare Ground
5	74.5%	25.5%
101 East (East)	82.6%	17.4%
997	83.5%	16.7%
3 South	**85.2%**	**14.8%**

Species richness in 2023 was greater than baseline years. Species richness on transects was 38, 30, 49, 55, 54, 45, and 35 species in 1998, 2016, 2018, 2019, 2020, 2021, and 2023, respectively, whereas overall basin species richness was 69, 106, 105, 92, 86, and 67 species in 2016, 2018, 2019, 2020, 2021, and 2023, respectively (see Table 4-70 and Appendix A Table A-7). The 1998 survey was limited to species on the transect and total vernal pool species richness was not recorded. Pond 3 South species richness in 2023 was greater than the values observed at the reference vernal pools (see Table 4-71 and Appendix D Tables D-20 and D-40). The species richness is represented on the RACs as the length of the curve and number of species along the curve (see Figure 4-38 and Figure 4-39).

Species composition at Pond 3 South varied between monitoring years. Brown-headed rush (*Juncus phaeocephalus*) was an abundant species in all years. Pale spikerush (*Eleocharis macrostachya*) was the dominant species in 1998 (baseline), whereas Italian rye grass (*Festuca perennis*) was dominant in 2016 (baseline). Coyote thistle (*Eryngium armatum*) and Italian rye grass were the dominant species in 2018. Italian rye grass, California oatgrass (*Danthonia californica*), and pale spikerush were all important species in 2019 (Yr 1) and 2020 (Yr 2). In 2021 (Yr 3), California oatgrass (*Danthonia californica*) and cut-leaf plantain (*Plantago coronopus*) were most abundant. This year, in 2023 (Yr 5), the most abundant species were coyote thistle and pale spikerush. A complete comparison of species composition observed at Pond 3 South in 1998, 2016, 2018-2021, and 2023 can be found in Appendix E. Figure 4-41 shows a subset of this comparison for species observed with a 2% cover or greater.

The evenness from each year is represented by the slope of the RACs. The evenness between the 2016 baseline year and the monitoring years was mostly similar, with a fairly even distribution of the dominant species, appearing as flat at the top, followed by a gradually sloping curve. However, 2019 (Yr 1) had a much steeper beginning to the curve than the other years (see Figure 4-40, and Appendix F).

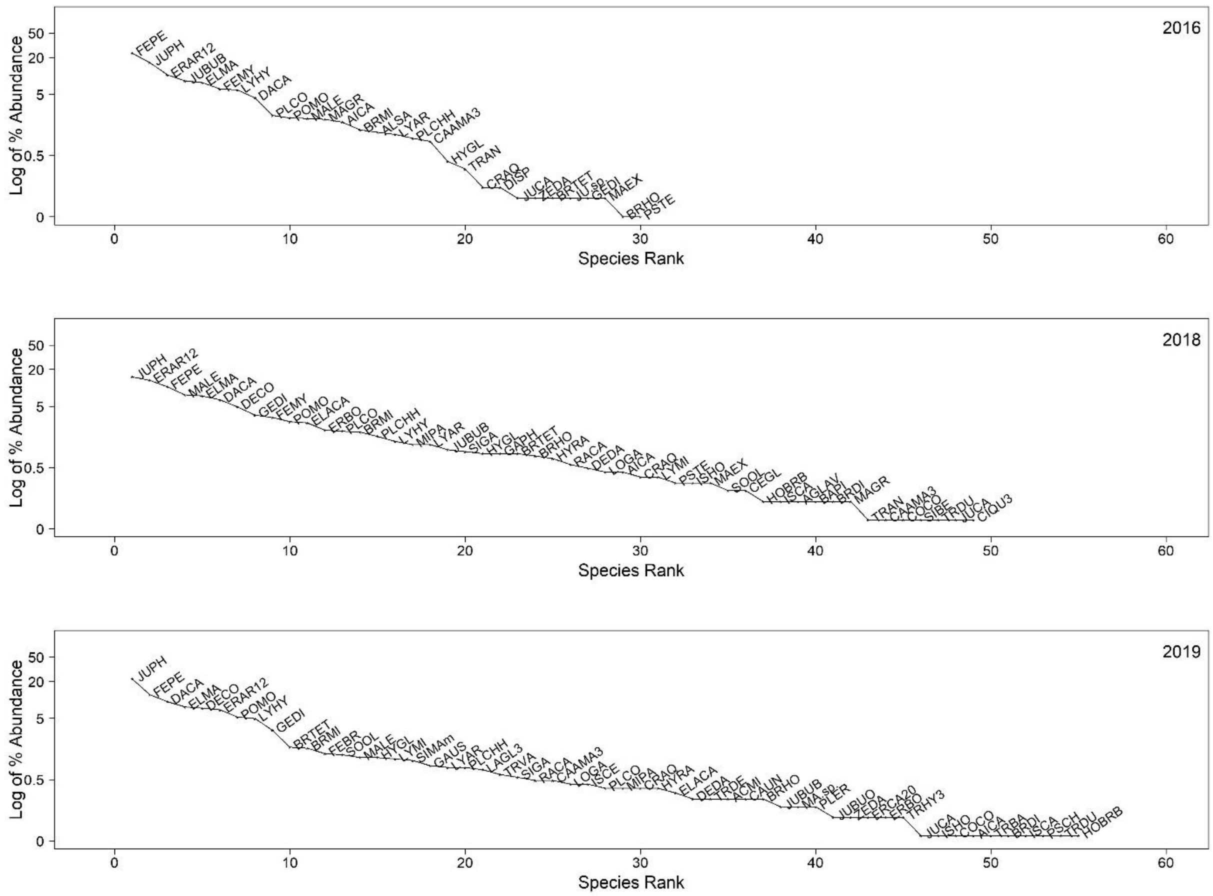

Figure 4-38. Rank Abundance Curves at Pond 3 South (Year 5 Post-Subsurface Munitions Remediation) in 2016, 2018, and 2019. Note that the y-axis is in log-10 scale.

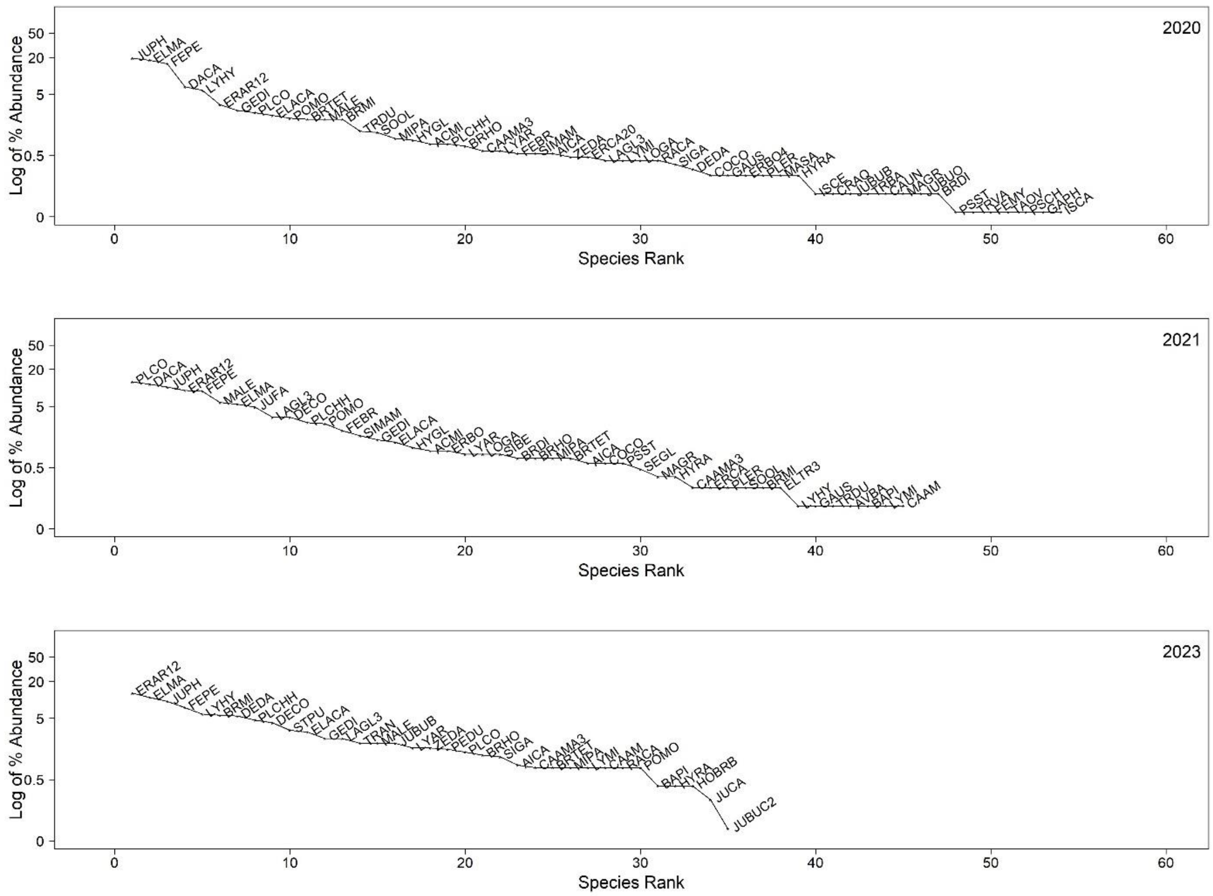

Figure 4-39. Rank Abundance Curves at Pond 3 South (Year 5 Post-Subsurface Munitions Remediation) in 2020, 2021, and 2023. Note that the y-axis is in log-10 scale.

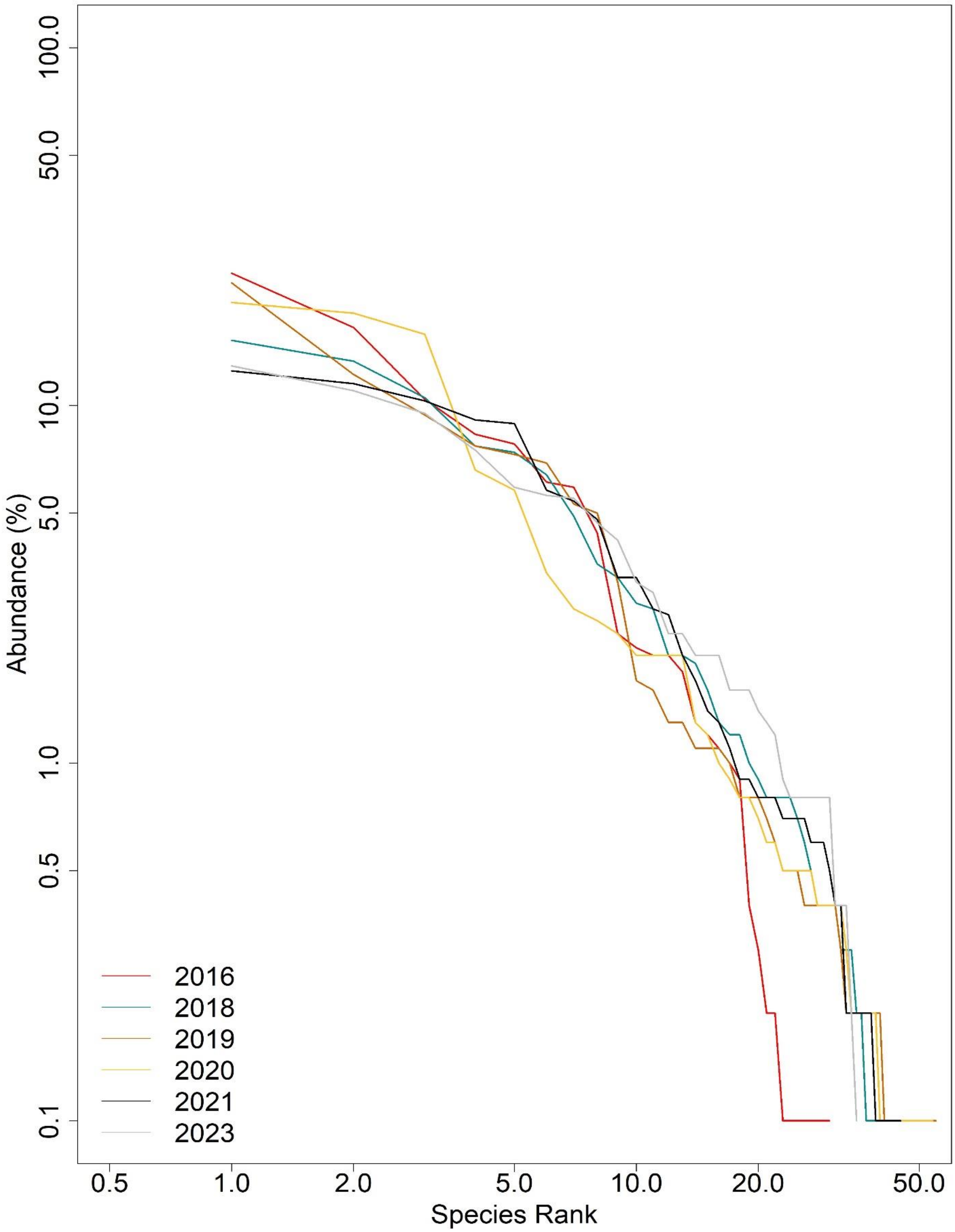

Figure 4-40. Rank Abundance Curves at Pond 3 South (Year 5 Post-Subsurface Munitions Remediation) in 2016, 2018-2021, and 2023. Note that the x-axis and y-axis are in log-10 scale.

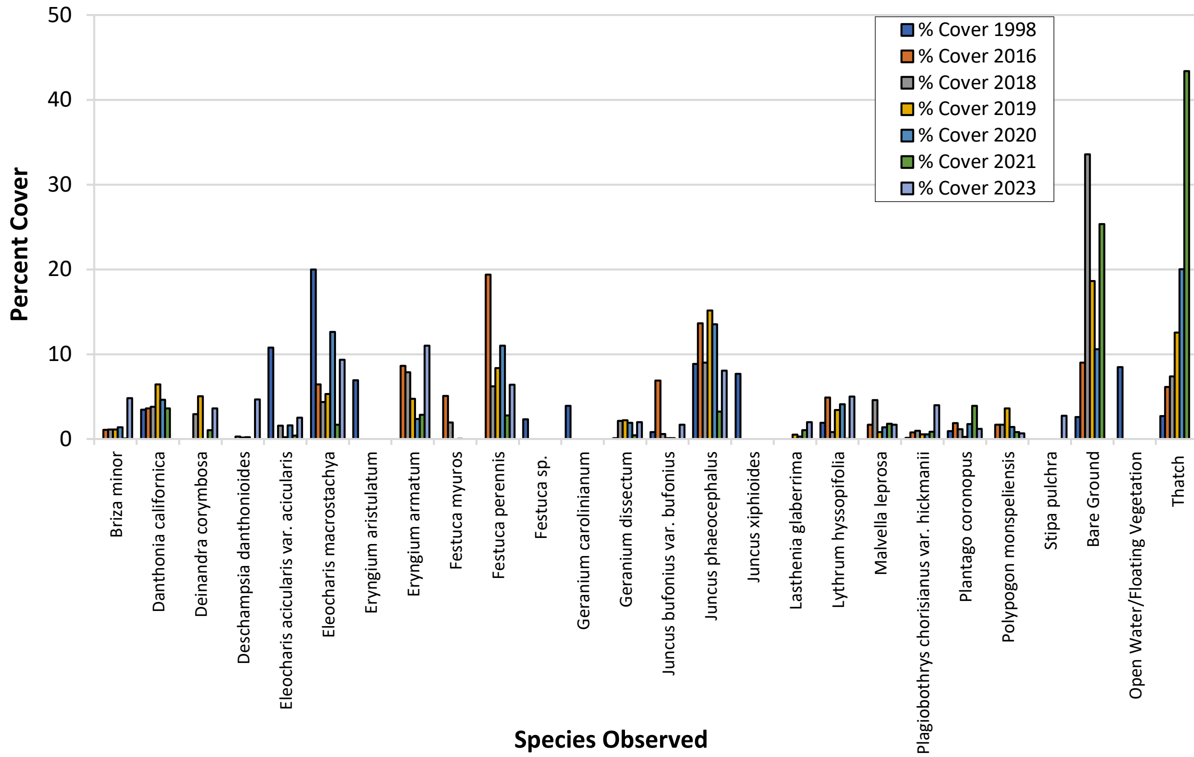

Figure 4-41. Percent Cover of Dominant Species at Pond 3 South (Year 5 Post-Subsurface Munitions Remediation)

Native species richness in 2021 (Yr 3) and 2023 (Yr 5) were within the range of values of baseline years, whereas 2019 (Yr 1) and 2020 (Yr 2) had greater native species richness than baseline. By comparison, non-native species richness was greater than baseline values for every monitoring year (see Table 4-70).

Table 4-70. Pond 3 South (Year 5 Post-Subsurface Munitions Remediation) Native and Non-Native Species Richness

Year	Native	Non-Native	Unidentified
1998*	26	9	3
2016*	16	13	1
2018	26	23	0
2019	34	20	1
2020	33	21	0
2021	25	20	0
2023	21	14	0

*baseline year

In 2019 (Yr 1), non-native species richness was within the range of reference vernal pool values, whereas native species richness was greater than reference (Burleson, 2020). Monitoring years 2020 (Yr 2), 2021 (Yr 3), and 2023 (Yr 5) all had native species richness which was greater than the values observed at the reference vernal pools (Burleson 2021, 2022). Similarly, non-native species richness was greater than reference values for 2020 and 2021, whereas 2023 fell within the range of reference vernal pool values (see Table 4-71).

Table 4-71. Pond 3 South (Year 5 Post-Subsurface Munitions Remediation) and Reference Vernal Pool Native and Non-Native Species Richness in 2023

Vernal Pool	Native	Non-Native	Unidentified
5	12	12	0
101 East (East)	9	7	0
997	13	14	1
3 South	**21**	**14**	**0**

The relative percent cover of native and non-native species fell within the range of values observed in baseline years and reference vernal pools for every year except 2020 (Yr 2), in which native species cover was less, and non-native cover was greater than reference values (see Table 4-72 and Table 4-73).

Table 4-72. Pond 3 South (Year 5 Post-Subsurface Munitions Remediation) Relative Percent Cover of Native and Non-Native Plants

Year	Native	Non-Native	Unidentified
1998*	84.1%	10.4%	5.5%
2016*	55.0%	44.9%	0.1%
2018	65.7%	34.3%	0.0%
2019	65.9%	34.0%	0.2%
2020	61.7%	38.3%	0.0%
2021	64.7%	35.3%	0.0%
2023	67.4%	32.6%	0.0%

*baseline year

Table 4-73. Pond 3 South (Year 5 Post-Subsurface Munitions Remediation) and Reference Vernal Pool Relative Percent Cover of Native and Non-Native Plants in 2023

Vernal Pool	Native	Non-Native	Unidentified
5	76.3%	23.7%	0.0%
101 East (East)	60.3%	39.7%	0.0%
997	50.0%	49.0%	1.0%
3 South	**67.4%**	**32.6%**	**0.0%**

Wetland and non-wetland species richness values in Pond 3 South were greater than baseline every year except for 2023 (Yr 5), which was within the range of baseline (see Table 4-74). Compared to reference vernal pool wetland and non-wetland richness values, every monitoring year was greater (Burleson, 2020, 2021, 2022) (see Table 4-75). The relative percent cover of wetland species was less than baseline in every monitoring year except 2020 (Yr 2), which fell within the range of baseline values. Monitoring years 2020 (Yr 2), 2021 (Yr 3), and 2023 (Yr 5) all fell within the range of baseline values for non-wetland cover, whereas 2019 (Yr 1) had less cover than baseline (see Table 4-76). Every monitoring year fell within the range of reference vernal pool values for wetland cover, however results for non-wetland cover were varied (Burleson, 2020, 2021, 2022) (see Table 4-77). In 2021 (Yr 3), non-wetland cover was greater than reference, whereas 2019 (Yr 1) was slightly less, and 2020 (Yr 2) and 2023 (Yr 5) fell within the range of reference vernal pool values.

Table 4-74. Pond 3 South (Year 5 Post-Subsurface Munitions Remediation) Wetland and Non-Wetland Species Richness

Year	Wetland			Non-Wetland		Not Listed
	OBL	FACW	FAC	FACU	UPL	
1998*	9	6	5	4	0	14
2016*	5	7	5	5	0	8
2018	9	11	6	10	1	12
2019	10	13	9	9	1	13
2020	9	12	8	10	1	14
2021	6	9	7	8	1	14
2023	5	10	5	5	0	10

*baseline year

Table 4-75. Pond 3 South (Year 5 Post-Subsurface Munitions Remediation) and Reference Vernal Pool Wetland and Non-Wetland Species Richness in 2023

Vernal Pool	Wetland			Non-Wetland		Not Listed
	OBL	FACW	FAC	FACU	UPL	
5	6	7	3	3	1	4
101 East (East)	4	6	1	3	0	2
997	4	6	4	4	0	10
3 South	**5**	**10**	**5**	**5**	**0**	**10**

Table 4-76. Pond 3 South (Year 5 Post-Subsurface Munitions Remediation) Relative Percent Cover of Wetland and Non-Wetland Species

Year	Wetland			Non-Wetland		Not Listed
	OBL	FACW	FAC	FACU	UPL	
1998*†	55.8%	14.6%	10.0%	3.8%	0.0%	15.9%
2016*	14.8%	39.5%	32.4%	10.1%	0.0%	3.2%
2018	14.1%	33.6%	22.5%	16.1%	0.2%	13.5%
2019	15.4%	37.9%	25.8%	2.4%	1.3%	17.2%
2020	27.9%	27.2%	28.0%	6.3%	1.2%	9.4%
2021	13.5%	29.8%	34.7%	9.7%	0.2%	12.2%
2023	26.8%	33.4%	17.0%	4.7%	0.0%	18.1%

*baseline year
†Values in this table changed from past reports, HOBR was incorrectly recorded as 0.7 instead of 0.8, which increased the FACW value from 14.5% to 14.6%. The edit has been reflected in the 2023 report and deliverable.

Table 4-77. Pond 3 South (Year 5 Post-Subsurface Munitions Remediation) and Reference Vernal Pool Relative Percent Cover of Wetland and Non-Wetland Species in 2023

Vernal Pool	Wetland			Non-Wetland		Not Listed
	OBL	FACW	FAC	FACU	UPL	
5	61.4%	29.0%	3.1%	3.7%	0.1%	2.7%
101 East (East)	14.5%	53.4%	0.1%	9.1%	0.0%	22.9%
997	31.5%	28.9%	7.4%	9.0%	0.0%	23.2%
3 South	**26.8%**	**33.4%**	**17.0%**	**4.7%**	**0.0%**	**18.1%**

4.7.1.1 *Contra Costa Goldfields*

The area of CCG at Pond 3 South was variable. The acreage increased between 2018 and 2019 (Yr 1) then decreased in 2020 (Yr 2) and 2021 (Yr 3), before finally increasing to the largest acreage in 2023 (Yr 5) (Burleson, 2019, 2020, 2021, 2022). A single CCG plant was documented at Pond 3 South for the first time in 2018. The population occupied 0.003 acre in 2019 (Yr 1), 0.002 acre in 2020 (Yr 2), 0.001 acre in 2021 (Yr 3), and 0.007 acre in 2023 (Yr 5). The densities ranged between 5-15% (see Table 4-78 and Figure 4-42). In 2023, the CCG population was in a similar location to previous years indicating that post-subsurface munitions remediation likely did not affect the population. Minor changes in population size can be attributed to natural fluctuation.

Table 4-78. Pond 3 South (Year 5 Post-Subsurface Munitions Remediation) Contra Costa Goldfields Estimated Cover

Year	Area (acres)	Density (% cover)
1998*	No Detections	N/A
2016*	No Detections	N/A
2018	Individual plant	N/A
2019	0.003	10%
2020	0.002	5%
2021	0.001	15%
2023	0.007	5%

*baseline year

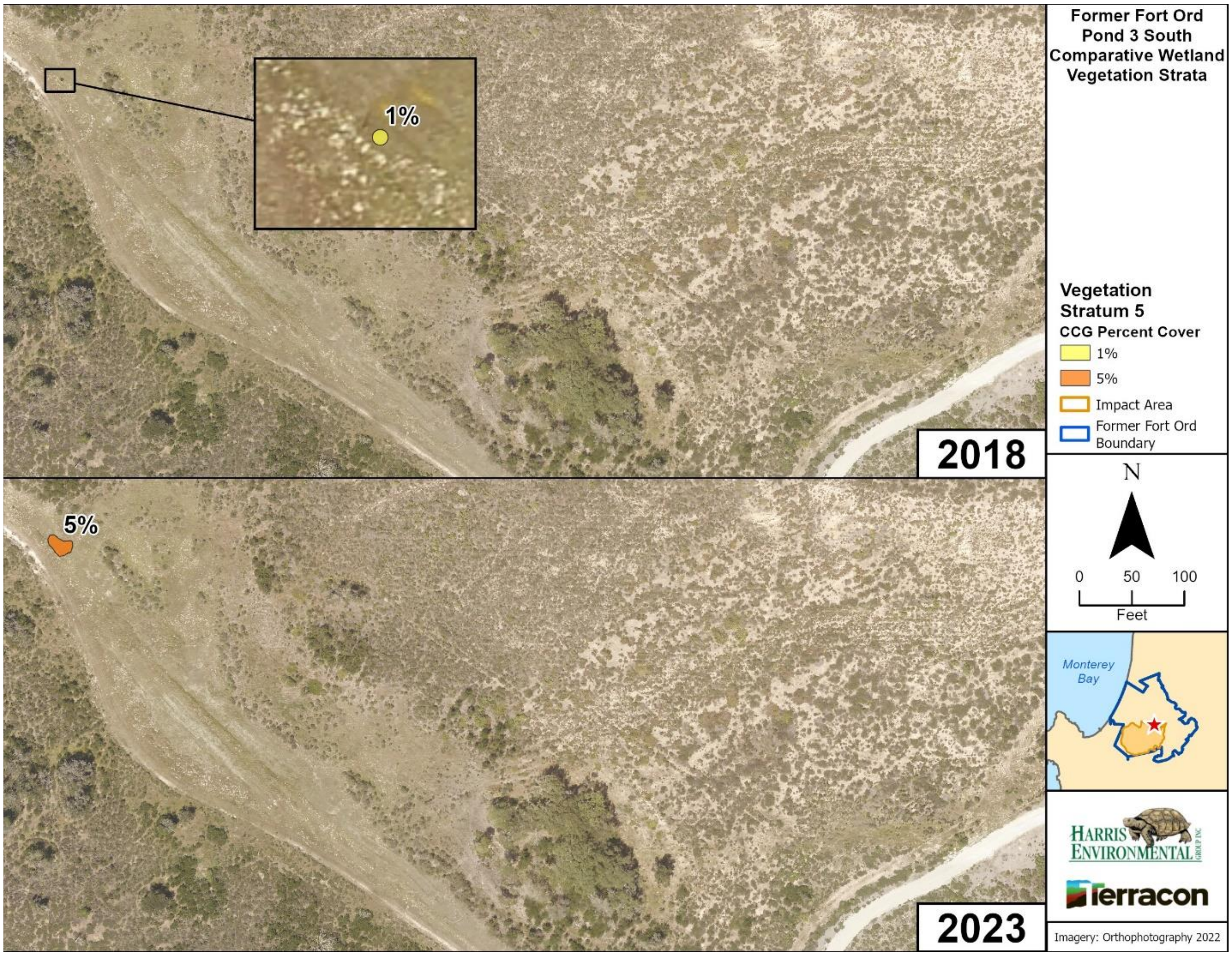

Figure 4-42. Contra Costa Goldfields Populations at Pond 3 South (Year 5 Post-Subsurface Munitions Remediation) in 2018 and 2023

4.7.1.2 *Data Quality Objective 3*

Observable changes in hydrophytic vegetation between surveys were largely associated with precipitation fluctuations. This is expected given the dynamic nature of vernal pools and the close relationship between the hydroperiod and wetland vegetation composition. Vegetative cover in Pond 3 South was dominated by native and wetland plant species during year 5 post-subsurface munitions remediation monitoring in 2023. Pond 3 South wetland vegetation results fell within the range of baseline and/or reference vernal pools in the majority of the monitoring years, including 2023 (Yr 5). In 2021 (Yr 3) however, the non-native richness and non-wetland richness values were all greater than the baseline years and greater than the range of values observed at reference vernal pools. As this was the only year that Pond 3 South was not on track, it was thought to be likely related to the record drought conditions in the 2020-2021 water-year rather than remediation.

4.7.1.3 *Performance Standard: Plant Cover and Species Diversity*

Pond 3 South, a post-subsurface munitions remediation vernal pool, met the performance standard for year 5 in 2023. The species composition, and native and wetland species relative abundances were similar to baseline and/or reference vernal pool conditions. Pond 3 South provided suitable wetland habitat in 2023.

4.7.2 Wildlife Monitoring

Wildlife data were collected at Pond 3 South in 1998, 2016, 2019, 2020, and 2023 (HLA, 1998; Burleson, 2017, 2020, 2021). California tiger salamander larvae were not detected in any survey year. Fairy shrimp were present in 1998, 2019, and 2020; whereas there was no detection in 2016 or 2023. It is possible that fairy shrimp were not detected in either year due to the timing of surveys, which were not completed until later in the season, as opposed to typical monitoring events that would have begun in March. The vernal pool did not hold sufficient depth for surveys to be completed in 2021, thus DQO 5 was not assessed that year. Table 4-79 shows historical wildlife monitoring results.

Table 4-79. Pond 3 South (Year 5 Post-Subsurface Munitions Remediation) Historical Wildlife Monitoring Results

Sampling Year	CTS Larvae Abundance (# Individuals)	Fairy Shrimp Abundance (# Individuals)
1998*	Not detected	Moderate
2016*	Not detected	Not detected
2019	Not detected	Low – Moderate (21, 44, 5)
2020	Not detected	Moderate (13)
2023	Not detected	Not detected

*baseline year

4.7.2.1 *Data Quality Objective 5*

California tiger salamanders were not detected in any year at Pond 3 South, which was consistent with baseline monitoring. Results were partially consistent with reference vernal pools. There were no CTS found at Pond 5 or Pond 101 East (East) in 2020 (Yr 2), however there were detections in both vernal pools in 2019 and 2023. Reference Pond 997, to which Pond 3 South is most hydrologically similar also had no CTS detections in 2019, which was the last time there was a survey conducted at the vernal pool.

Fairy shrimp were not detected in 2023 (Yr 5), but were present in low to moderate abundance in 2019 (Yr 1) and 2020 (Yr 2), which was consistent with baseline. Fairy shrimp were found in moderate numbers in 1998, whereas none were found in 2016. The results for all three years monitored were consistent with reference ponds. Pond 5 had fairy shrimp in 2019, but not in 2020 or 2023, whereas there were fairy shrimp detected in Pond 101 East (East) in 2019 and 2020. Fairy shrimp were not detected at any of the reference vernal pools in 2023.

4.7.2.2 *Performance Standard: Wildlife Usage*

Pond 3 South, a post-subsurface muntions remediation vernal pool, was in the final year of monitoring and met DQO 5. California tiger salamanders were not present in any year, which was consistent with baseline and reference results. Fairy shrimp were detected in 2019 (Yr 1) and 2020 (Yr 2), but were not detected in 2023 (Yr 5). In baseline surveys, fairy shrimp were detected in 1998, but not 2016. Therefore, the 2019 (Yr 1) and 2020 (Yr 2) results were similar to baseline data. Data quality objectives 1 and 4 were analyzed in the Hydrology Monitoring Annual Report (Chenega, 2023).

4.7.3 Conclusion

Pond 3 South, a post-subsurface munitions remediation vernal pool, was in the final year (Yr 5) of monitoring in 2023. The vernal pool met the plant cover and species diversity performance standard and met DQO 5 for wildlife usage (see Table 4-80). No further monitoring is recommended for Pond 3 South.

Table 4-80. Success at Pond 3 South (Year 5 Post-Subsurface Munitions Remediation) Based on Performance Standards and Applicable Data Quality Objectives

Performance Standard	Applicable DQO	2019 (Yr 1)	2020 (Yr 2)	2021 (Yr 3)	2023 (Yr 5)	Success
Plant Cover & Species Diversity	DQO 3	On Track	On Track	Not On Track	On Track	Met
Wildlife Usage	DQO 5	On Track	On Track	N/A	Partially On Track	Met

4.8 Pond 35 – Year 5

Pond 35 was monitored in 2023 as a year 5 post-subsurface munitions remediation vernal pool. Pond 35 was monitored for baseline conditions in 1992, 1994, 1995, 1996, 2015, and 2016. Vegetation within the Pond 35 watershed was masticated in summer of 2017 in preparation for a prescribed burn of BLM Area B Subunit B. Vegetation within and immediately around Pond 35 was not burned, although parts of the Pond 35 watershed were burned in October 2017. Pond 35 had intrusive anomaly investigations in 2018. Table 4-81 summarizes the years that monitoring occurred and surveys were conducted. The cumulative precipitation graph indicates precipitation for the years that monitoring was conducted at Pond 35 (see Figure 4-43). The 1991-1992, 1994-1995, 1995-1996, 2015-2016, 2018-2019, 2019-2020, and 2022-2023 water-years were either normal or above-normal, whereas all other monitoring was conducted during a below-normal water-year, drought year, or consecutive drought year.

Table 4-81. Pond 35 (Year 5 Post-Subsurface Munitions Remediation) Summary of Historical Surveys for Hydrology, Vegetation, and Wildlife

Survey	Water-Year										
	1991-1992	1993-1994	1994-1995	1995-1996	2014-2015	2015-2016	2017-2018	2018-2019	2019-2020	2020-2021	2022-2023
Hydrology	•	•	•	•	•	•	•	•	•	•	•
Vegetation		•	•	•		•	•	•	•	•	•
Wildlife		•	•	•				•	•		

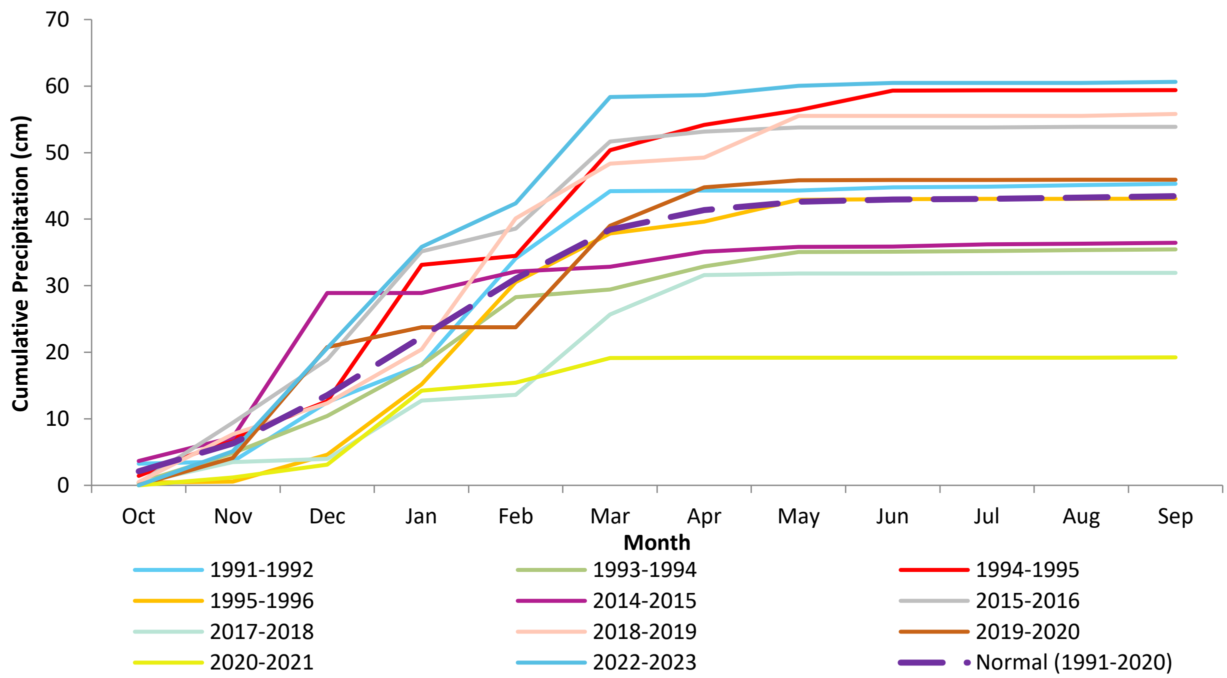

Figure 4-43. Cumulative Monthly Precipitation for Years that Hydrology Monitoring Occurred at Pond 35 (Year 5 Post-Subsurface Munitions Remediation) Compared to the 30-Year Normal (mean 1991-2020) (NPS, 2023; NCEI NOAA, 2023)

4.8.1 Vegetation Monitoring

Vegetation data were collected at Pond 35 in 2016, 2018-2021, and 2023 (Burleson, 2017, 2019, 2020, 2021, 2022). Data from 1994, 1995, and 1996 only represent dominant species and are not included in the following analyses because the data were collected using a different methodology than was used in more recent years (Jones and Stokes, 1996). In 2016, 2018-2021, and 2023, data were collected using the methodology described in the Methods section of this report. Data from 2016 and 2023 were compared stratum-to-stratum in Table 4-82 as well as visually in Figure 4-44.

Table 4-82. Pond 35 (Year 5 Post-Subsurface Munitions Remediation) Vegetative Strata Percentage within the Vernal Pool Basin Boundary

Stratum	Percentage	
	2016	2023
1	28%	19%
2	39%	44%
3	33%	22%
4	N/A	15%

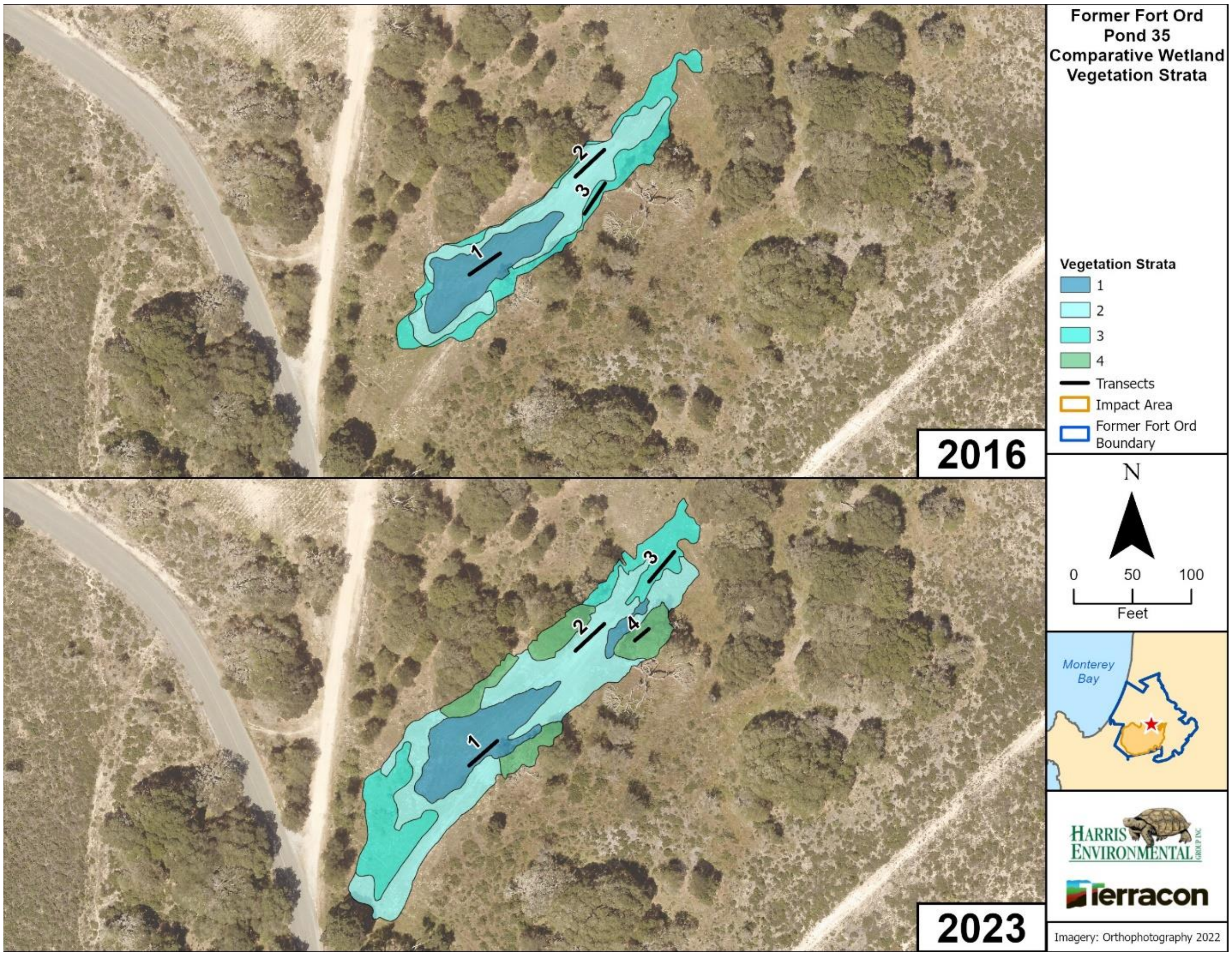

Figure 4-44. Pond 35 (Year 5 Post-Subsurface Munitions Remediation) Vegetation Strata and Transects for 2016 and 2023

Absolute percent vegetative cover observed in 2019 (Yr 1) and 2023 (Yr 5) was greater than the baseline year and less than the range of values observed at the reference vernal pools (see Table 4-83 and Table 4-84). Whereas, 2020 (Yr 2) vegetative cover results were also greater than baseline, but within the range of values observed at reference pools, and 2021 (Yr 3) was less than baseline as well as the range of values at reference vernal pools.

Table 4-83. Pond 35 (Year 5 Post-Subsurface Munitions Remediation) Absolute Percent Cover

Year	Vegetative Cover	Thatch/Bare Ground
2016*	52.1%	48.9%
2018	74.3%	27.7%
2019	59.5%	39.8%
2020	66.3%	33.7%
2021	38.7%	61.3%
2023	64.8%	35.2%

*baseline year

Table 4-84. Pond 35 (Year 5 Post-Subsurface Munitions Remediation) and Reference Vernal Pool Absolute Percent Cover in 2023

Vernal Pool	Vegetative Cover	Thatch/Bare Ground
5	74.5%	25.5%
101 East (East)	82.6%	17.4%
997	83.5%	16.7%
35	**64.8%**	**35.2%**

Species richness in 2023 was greater than the baseline year of monitoring. Species richness on transects was 12, 38, 25, 26, 29, and 17 species in 2016, 2018, 2019, 2020, 2021, and 2023, respectively, whereas overall basin species richness was 35, 64, 79, 60, 63, and 37 species, respectively (see Table 4-85 and Appendix A Table A-8). Pond 35 species richness was within the range observed at the reference vernal pools (see Table 4-86 and Appendix D Tables E-20 and E-40).

Species composition and the dominant species at Pond 35 remained similar between the monitoring years. This species composition is illustrated on the RACs as the species codes shift along the curve and losses and gains occur from year to year (see Figure 4-45 and Figure 4-46). The two dominant species at Pond 35 were either cut-leaved plantain (*Plantago coronopus*) or Hickman's popcornflower (*Plagiobothrys chorisianus* var. *hickmanii*) with fluctuations between years. Other dominant species included meadow barley (*Hordeum brachyantherum*) in 2016 (baseline) and Italian rye grass (*Festuca perennis*) in 2020 (Yr 2). Both meadow barley (*Hordeum brachyantherum*) and Italian rye grass (*Festuca perennis*) were prevalent in 2021 (Yr 3) and 2023 (Yr 5). A complete comparison of species composition observed at Pond 35 in 2016, 2018-2021, and 2023 can be found in Appendix E. Figure 4-48 shows a subset of this comparison for species observed with a 2% cover or greater.

The evenness from each year is represented by the slope of the RACs. All years had a steep start to the curve, indicating less evenness between dominant species and the rest of the vernal pool vegetation (see Figure 4-47 and Appendix F). However, all of the monitoring years exhibited a gradual slope, and therefore greater evenness, over the rest of the curve, with richness distributed along the entire length. 2016 (baseline), 2019 (Yr 1), 2020 (Yr 2), 2021 (Yr 3), and 2023 (Yr 5) were all similar to Ponds 101 East (East) and 997 across the same years, with a more even distribution of species along the curves.

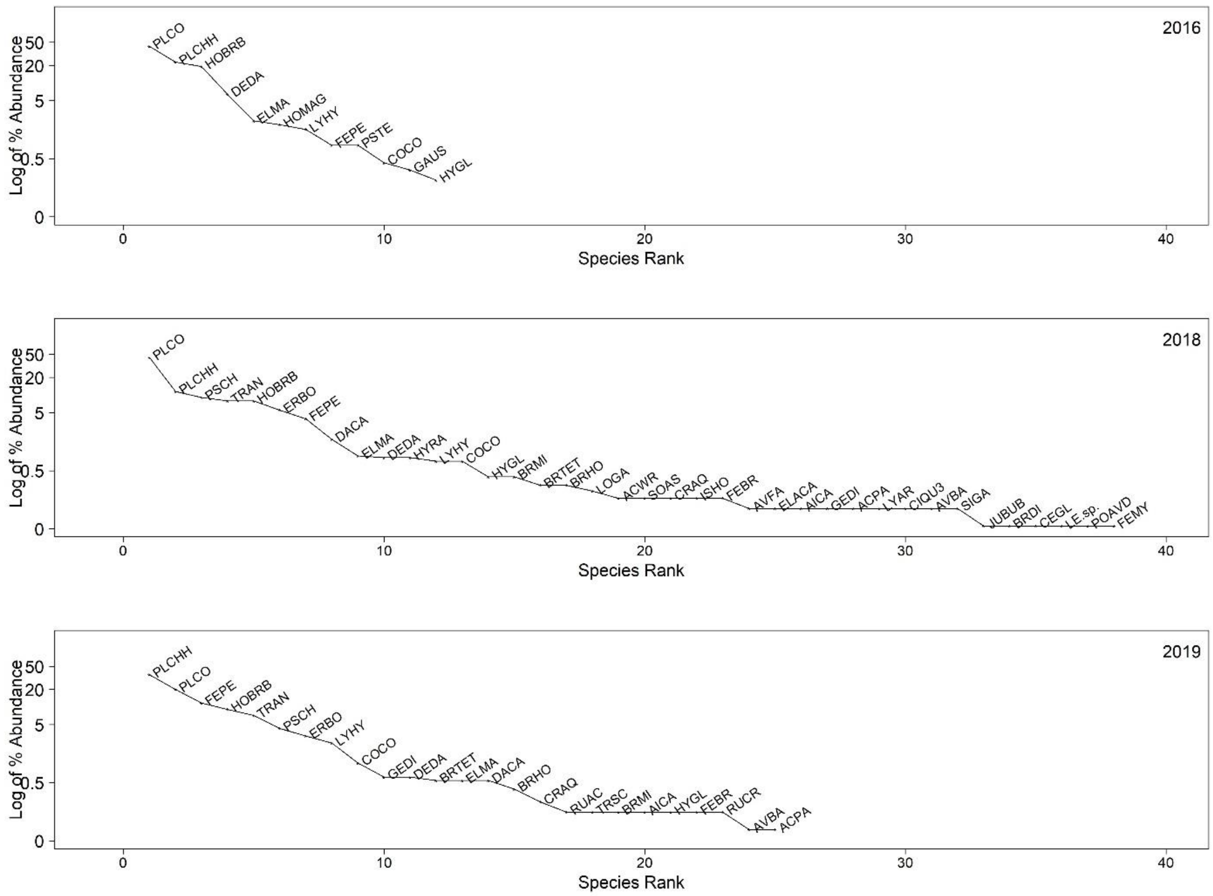

Figure 4-45. Rank Abundance Curves at Pond 35 (Year 5 Post-Subsurface Munitions Remediation) in 2016, 2018 and 2019. Note that the y-axis is in log-10 scale.

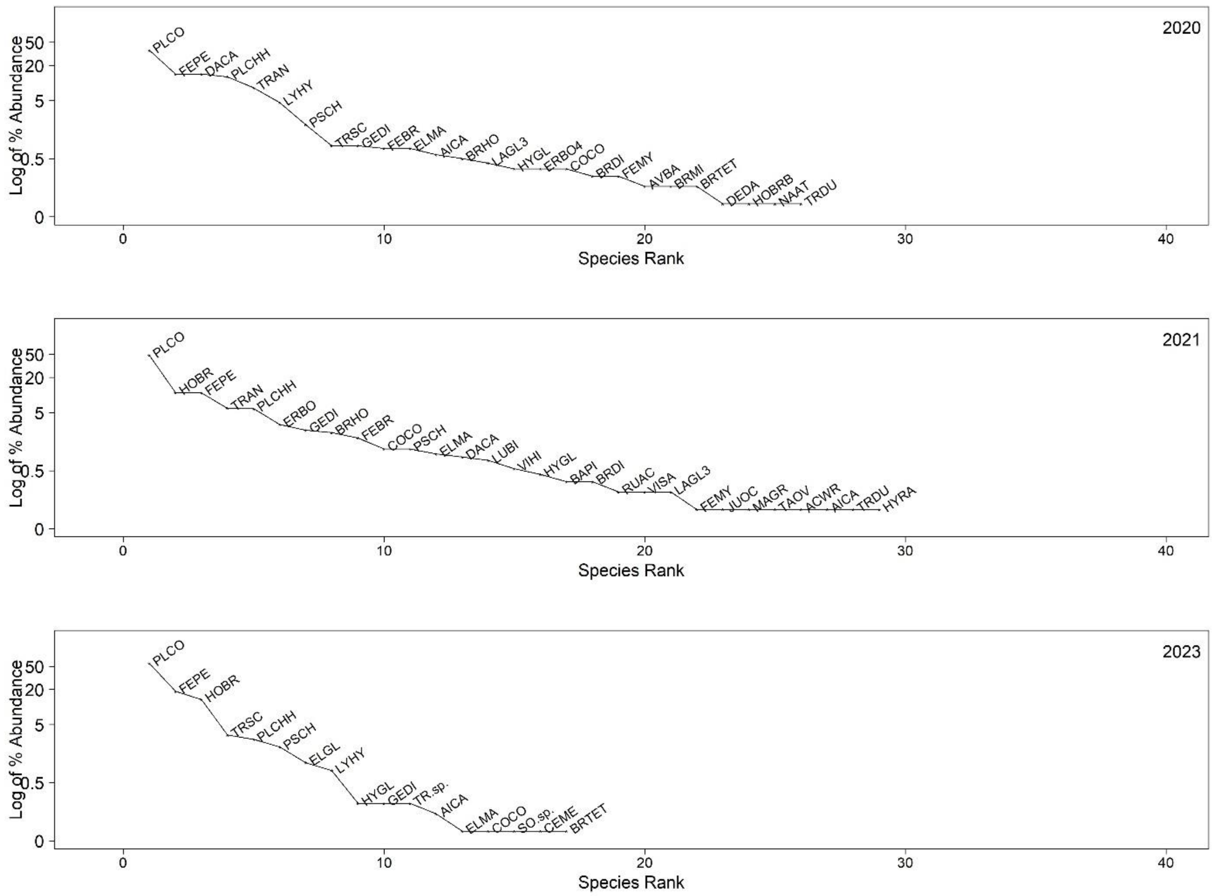

Figure 4-46. Rank Abundance Curves at Pond 35 (Year 5 Post-Subsurface Munitions Remediation) in 2020, 2021, and 2023. Note that the y-axis is in log-10 scale.

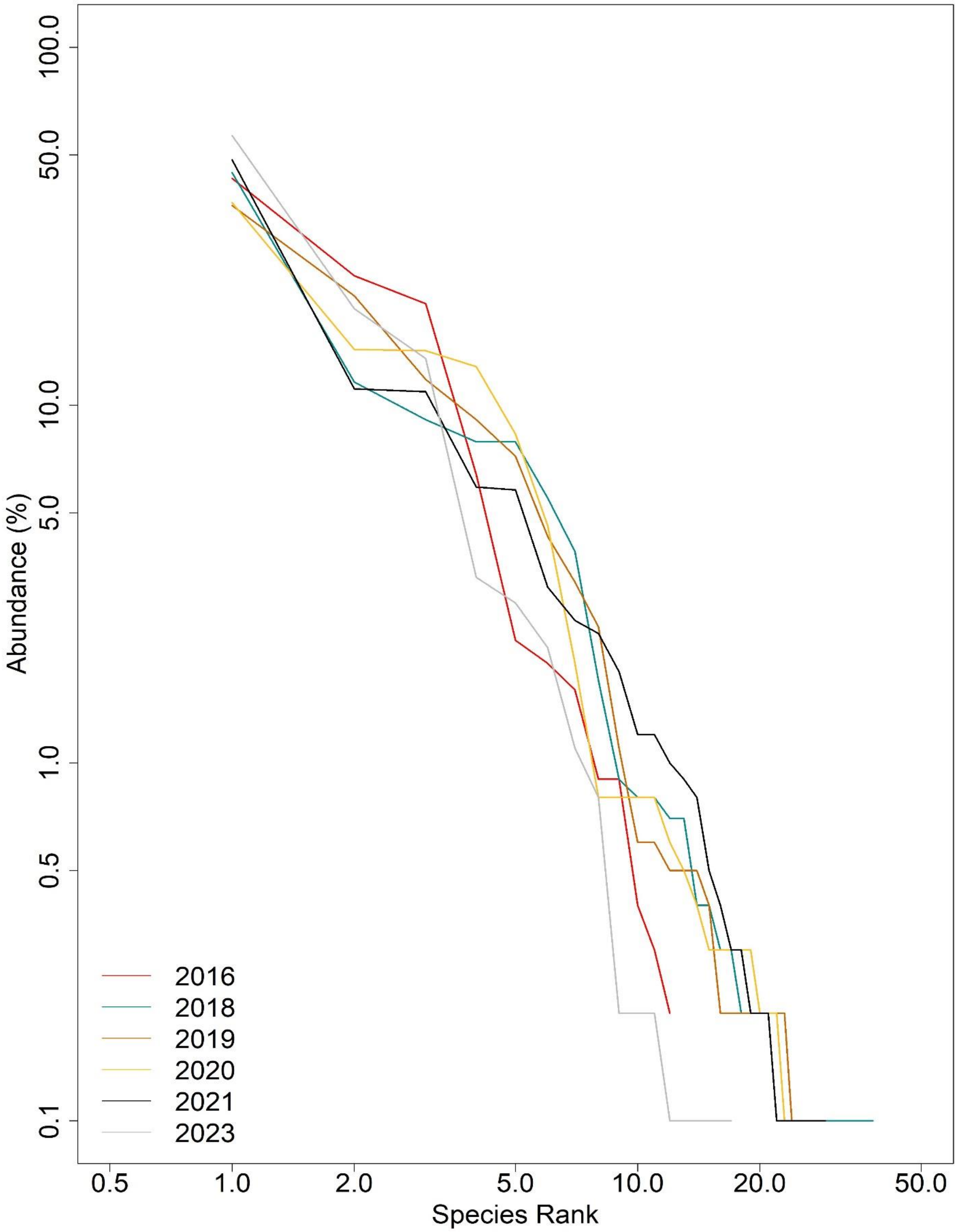

Figure 4-47. Rank Abundance Curves at Pond 35 (Year 5 Post-Subsurface Munitions Remediation) in 2016, 2018-2021, and 2023. Note that the x-axis and y-axis are in log-10 scale.

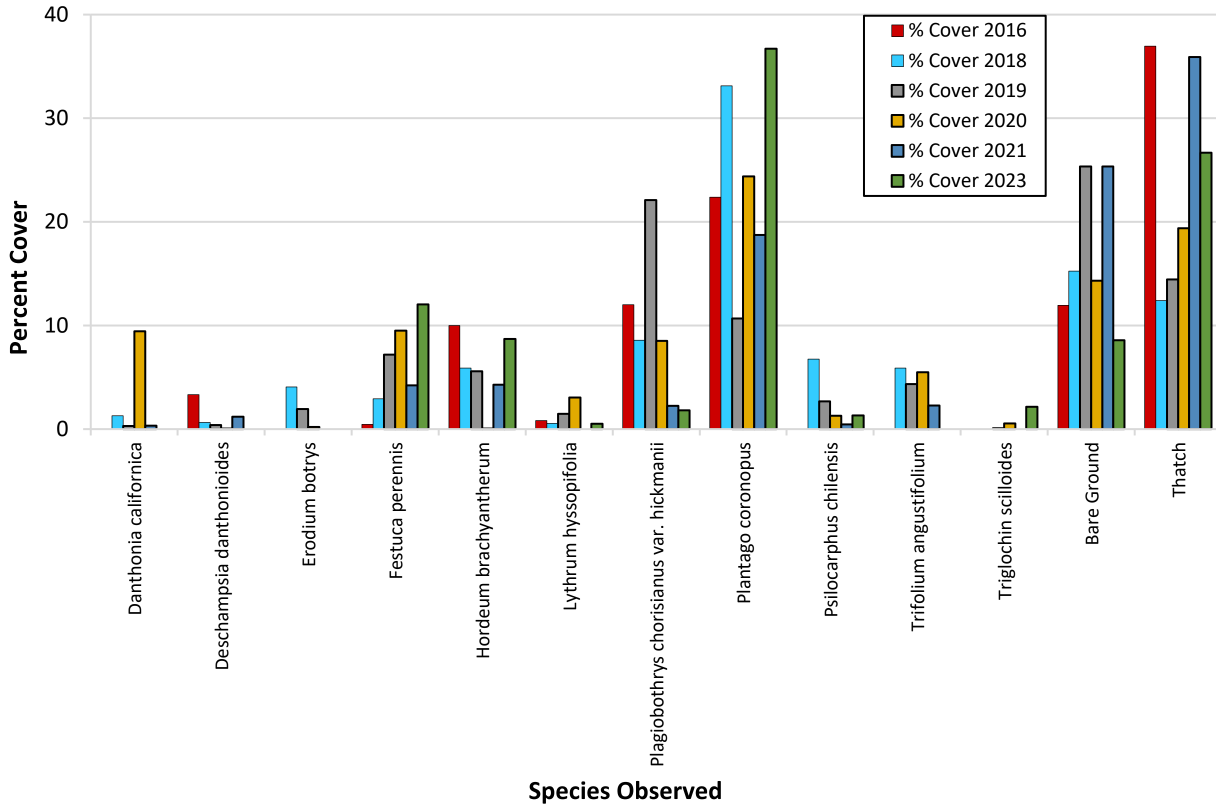

Figure 4-48. Percent Cover of Dominant Species at Pond 35 (Year 5 Post-Subsurface Munitions Remediation)

Native and non-native species richness on Pond 35 transects were greater than baseline in every year (see Table 4-85). In 2019 (Yr 1), 2020 (Yr 2), and 2023 (Yr 5), native species richness was less than reference vernal pool values, while non-native species richness was within the range of values for reference (see Table 4-86). In 2021 (Yr 3), native species richness was within the range of reference vernal pool values, while non-native species richness was greater than reference vernal pools.

Table 4-85. Pond 35 (Year 5 Post-Subsurface Munitions Remediation) Native and Non-Native Species Richness

Year	Native	Non-Native	Unidentified
2016*	6	6	0
2018	14	23	1
2019	10	15	0
2020	10	16	0
2021	12	17	0
2023	7	9	1

*baseline year

Table 4-86. Pond 35 (Year 5 Post-Subsurface Munitions Remediation) and Reference Vernal Pool Native and Non-Native Species Richness in 2023

Vernal Pool	Native	Non-Native	Unidentified
5	12	12	0
101 East (East)	9	7	0
997	13	14	1
35	**7**	**9**	**1**

In 2020 (Yr 2), 2021 (Yr 3), and 2023 (Yr 5), the relative percent cover of native species was less than baseline and reference vernal pool values, and non-native cover was greater (Burleson, 2021, 2022) (see Table 4-87 and Table 4-88). Conversely, native richness in 2019 (Yr 1) was within the baseline values and less than the reference vernal pool values, while non-native cover was within baseline as well as reference pool values (Burleson, 2020).

Table 4-87. Pond 35 (Year 5 Post-Subsurface Munitions Remediation) Relative Percent Cover of Native and Non-Native Plants

Year	Native	Non-Native	Unidentified
2016*	52.0%	48.0%	0.0%
2018	33.2%	66.7%	0.1%
2019	53.8%	46.2%	0.0%
2020	31.4%	68.6%	0.0%
2021	21.7%	78.3%	0.0%
2023	22.9%	76.9%	0.2%

*baseline year

Table 4-88. Pond 35 (Year 5 Post-Subsurface Munitions Remediation) and Reference Vernal Pool Relative Percent Cover of Native and Non-Native Plants in 2023

Vernal Pool	Native	Non-Native	Unidentified
5	76.3%	23.7%	0.0%
101 East (East)	60.3%	39.7%	0.0%
997	50.0%	49.0%	1.0%
35	**22.9%**	**76.9%**	**0.2%**

In 2019 (Yr 1) and 2020 (Yr 2), both wetland and non-wetland species richness were greater than baseline (see Table 4-89). Whereas, wetland species richness on Pond 35 transects in 2021 (Yr 3) was the same as species richness in baseline, and non-wetland species richness was greater than baseline. In 2023 (Yr 5), wetland species richess was less than baseline while non-wetland species richness was greater, though less so than all previous monitoring years.

Table 4-89. Pond 35 (Year 5 Post-Subsurface Munitions Remediation) Wetland and Non-Wetland Species Richness

Year	Wetland			Non-Wetland		Not Listed
	OBL	FACW	FAC	FACU	UPL	
2016*	5	2	3	0	0	2
2018	7	5	6	7	0	13
2019	6	3	5	4	0	7
2020	6	3	4	5	0	8
2021	4	3	3	7	1	11
2023	5	2	2	2	0	6

*baseline year

In 2020 (Yr 2), wetland species richness was slightly less than reference vernal pool values, while non-wetland species richness fell within the range of reference (Burleson, 2021) (see Table 4-90). In 2019 (Yr 1) and 2023 (Yr 5) wetland and non-wetland richness values were less than those at reference vernal pools (Burleson, 2020). Whereas, in 2021 (Yr 3), wetland and non-wetland species richness were both within the range of values observed at reference vernal pools (Burleson, 2022).

Table 4-90. Pond 35 (Year 5 Post-Subsurface Munitions Remediation) and Reference Vernal Pool Wetland and Non-Wetland Species Richness in 2023

Vernal Pool	Wetland			Non-Wetland		Not Listed
	OBL	FACW	FAC	FACU	UPL	
5	6	7	3	3	1	4
101 East (East)	4	6	1	3	0	2
997	4	6	4	4	0	10
35	**5**	**2**	**2**	**2**	**0**	**6**

The relative percent cover of wetland species for every monitoring year was lower, and the non-wetland cover was greater, than the baseline values (see Table 4-91). However, in 2023 (Yr 5) wetland values were only 1.5% less than baseline and non-wetland values were 1.3% greater. In 2019 (Yr 1) and 2020 (Yr 2), both wetland and non-wetland cover were within the range of values for reference vernal pools. In 2021 (Yr 3), wetland cover was greater than reference vernal pool values, while non-native cover was within the range of reference values. In 2023 (Yr 5), wetland cover values were greater than reference, while non-wetland cover was less (see Table 4-92).

Table 4-91. Pond 35 (Year 5 Post-Subsurface Munitions Remediation) Relative Percent Cover of Wetland and Non-Wetland Species

Year	Wetland			Non-Wetland		Not Listed
	OBL	FACW	FAC	FACU	UPL	
2016*	28.1%	25.6%	45.7%	0.0%	0.0%	0.5%
2018	14.4%	18.0%	50.8%	7.0%	0.0%	9.8%
2019	41.7%	14.5%	30.9%	4.0%	0.0%	9.0%
2020	19.8%	2.1%	65.5%	1.8%	0.0%	10.9%
2021	8.2%	12.4%	60.2%	6.0%	0.2%	12.9%
2023	7.1%	15.5%	75.3%	1.3%	0.0%	0.9%

*baseline year

Table 4-92. Pond 35 (Year 5 Post-Subsurface Munitions Remediation) and Reference Vernal Pool Relative Percent Cover of Wetland and Non-Wetland Species in 2023

Vernal Pool	Wetland			Non-Wetland		Not Listed
	OBL	FACW	FAC	FACU	UPL	
5	61.4%	29.0%	3.1%	3.7%	0.1%	2.7%
101 East (East)	14.5%	53.4%	0.1%	9.1%	0.0%	22.9%
997	31.5%	28.9%	7.4%	9.0%	0.0%	23.2%
35	**7.1%**	**15.5%**	**75.3%**	**1.3%**	**0.0%**	**0.9%**

4.8.1.1 *Data Quality Objective 3*

Observable changes in hydrophytic vegetation between surveys were largely associated with precipitation fluctuations and possibly historical disturbance to this area. Some variability is expected given the dynamic nature of vernal pools and the close relationship between the hydroperiod and wetland vegetation composition. Vegetative cover in Pond 35 was dominated by non-native and wetland plant species during year 5 post-subsurface munitions remediation monitoring in 2023. Pond 35 had lower native cover and wetland richness, and conversely higher non-native cover compared to baseline and reference vernal pools. These results were similar to those observed in 2020 (Yr 2) and 2021 (Yr 3).

It is unclear whether subsurface munitions remediation caused these changes. More likely it is related to a prolonged drought prior to baseline monitoring as well as historical disturbance. As mentioned in previous reports, Pond 35 may have high non-native and low native cover due to close proximity to Parker Flats Road and Watkin’s Gate Road. The 1996 Annual Wetland Monitoring Report noted Pond 35 as slightly to moderately disturbed, that it may have silt from erosion of adjacent roads, and that it ponded in old tire depressions (Jones and Stokes, 1996). Pale spikerush, an obligate native species, and English plantain (*Plantago lanceolata*), a facultative non-native species, were noted as the two dominant species in 1994. English plantain is indicative of disturbance (Cal-IPC, 2020).

Another difference was that native richness, non-wetland richness, and both wetland and non-wetland cover were outside the range of baseline and reference vernal pools in the final monitoring year in 2023

(Yr 5). This result is not concerning as it is likely related to the historical disturbance mentioned earlier, rather than remediation.

4.8.1.2 *Performance Standard: Plant Cover and Species Diversity*

Pond 35, a post-mastication and post-subsurface munitions remediation vernal pool, did not meet the performance standard by year 5 in 2023. With the exception of 2019 (Yr 1) results, species composition and wetland species richness differed from baseline and/or reference vernal pools regarding non-native species richness and cover as well as wetland species cover. Wetland species richness, as well as native cover, decreased from 2019 (Yr 1) to 2023 (Yr 5). Conversely, non-native cover increased overall between Year 1 and 5. The valley in Unit B where Pond 35 is located has historically been heavily disturbed which is likely why, in some years, non-native richness and cover were high. Additionally, below-normal water-years in 2021 (Yr 3) and 2022 likely contributed to favorable conditions for non-native species at Pond 35. However, it may also be related to historical disturbance and proximity to roads which was exacerbated by dry conditions.

4.8.2 Wildlife Monitoring

Wildlife data were collected at Pond 35 in 1992, 1994, 1995, 1996, 2019, and 2020 (Jones and Stokes, 1992, 1996; Burleson, 2020, 2021). California tiger salamander larvae were not detected in any previous survey year. Fairy shrimp were present in 1994, 1995, 1996, 2019, and 2020. The vernal pool did not hold sufficient depth for surveys to be completed in 2021 (Yr 3), nor in 2023 (Yr 5) by the time surveys occurred on April 28. Therefore, DQO 5 and the applicable wildlife usage performance standard will only be assessed for 2019 (Yr 1) and 2020 (Yr 2). Table 4-93 shows historical wildlife monitoring results.

Table 4-93. Pond 35 (Year 5 Post-Subsurface Munitions Remediation) Historical Wildlife Monitoring Results

Sampling Year	CTS Larvae Abundance (# Individuals)	Fairy Shrimp Abundance (# Individuals)
1992*	Not detected	Not detected
1994*	Not detected	Low-High
1995*	Not detected	Moderate-High
1996*	Not detected	Low (1)
2019	Not detected	Moderate (74, 50)
2020	Not detected	High (186)

*baseline year

4.8.2.1 *Data Quality Objective 5*

California tiger salamanders were not detected in any monitoring year, which was consistent with baseline monitoring.

Fairy shrimp were present in 2019 (Yr 1) and 2020 (Yr 2). These results were consistent with baseline. The only baseline year where fairy shrimp were not detected was in 1992. 2019 (Yr 1) results were consistent with reference ponds. Pond 5 had fairy shrimp in 2019, but not in 2020, whereas there were fairy shrimp detected in Pond 101 East (East) in both years.

4.8.2.2 *Performance Standard: Wildlife Usage*

Pond 35, a post-subsurface munitions remediation vernal pool, was in the final year of monitoring and met DQO 5. California tiger salamanders were not detected in any year, which was consistent with baseline and reference monitoring. Fairy shrimp were detected in 2019 (Yr 1) and 2020 (Yr 2), the only post-remediation years in which wildlife monitoring occurred. This was consistent with baseline data in every year except 1992, and also with reference vernal pools 5 and 101 East (East). Therefore, the 2019 (Yr 1) and 2020 (Yr 2) results were similar to baseline and reference data. Data quality objectives 1 and 4 were analyzed in the Hydrology Monitoring Annual Report (Chenega, 2023).

4.8.3 Conclusion

Pond 35, a post-subsurface munitions remediation vernal pool, was in the final year (Yr 5) of monitoring in 2023. When examining the results from the five post-subsurface munitions remediation monitoring years, the vernal pool did not meet the plant cover and species diversity performance standard, but did meet DQO 5 for wildlife usage (see Table 4-94). Pond 35 did not meet the plant cover and species diversity performance standard due to low native cover and wetland richness, and conversely higher non-native cover compared to baseline and reference vernal pools. No further monitoring is recommended for Pond 35, as the shifts within the basin flora are not likely to be related to remediation activities.

Table 4-94. Success at Pond 35 (Year 5 Post-Subsurface Munitions Remediation) Based on Performance Standards and Applicable Data Quality Objectives

Performance Standard	Applicable DQO	2019 (Yr 1)	2020 (Yr 2)	2021 (Yr 3)	2023 (Yr 5)	Success
Plant Cover & Species Diversity	DQO 3	On Track	Not On Track	Not On Track	Not On Track	Not Met
Wildlife Usage	DQO 5	On Track	On Track	N/A	N/A	Met

4.9 Pond 43 – Year 5

Pond 43 was monitored in 2023 as a year 5 post-subsurface munitions remediation vernal pool. Pond 43 was monitored for baseline conditions in 1998, 2000, 2015, and 2016. Vegetation in Pond 43 and within its watershed was burned in October 2017 as part of the prescribed burn of BLM Area B Subunit B. Pond 43 had intrusive anomaly investigations in 2018. Table 4-95 summarizes the years that monitoring occurred and surveys were conducted. The cumulative precipitation graph shows precipitation for years in which hydrology monitoring was conducted at Pond 43 (see Figure 4-49). The 1997-1998, 2015-2016, 2018-2019, and 2022-2023 water-years were above normal, whereas 2014-2015, 2017-2018, and 2020-2021 water-years were below normal. Water-years 1999-2000 and 2019-2020 were similar to the cumulative normal.

Table 4-95. Pond 43 (Year 5 Post-Subsurface Munitions Remediation) Summary of Historical Surveys for Hydrology, Vegetation, and Wildlife

Survey	Water-Year								
	1997-1998	1999-2000	2014-2015	2015-2016	2017-2018	2018-2019	2019-2020	2020-2021	2022-2023
Hydrology	●	●	●	●	●	●	●	●	●
Vegetation	●			●	●	●	●	●	●
Wildlife	●	●		●		●	●		

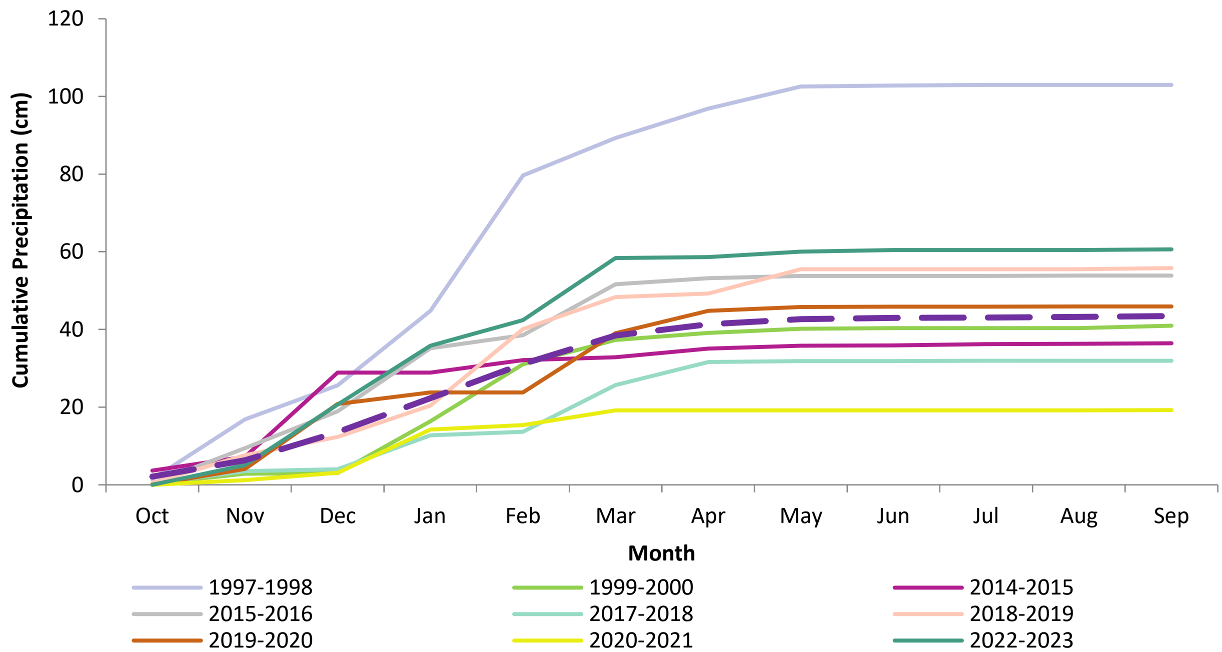

Figure 4-49. Cumulative Monthly Precipitation for Years that Hydrology Monitoring Occurred at Pond 43 (Year 5 Post-Subsurface Munitions Remediation) Compared to the 30-Year Normal (mean 1991-2020) (NPS, 2023; NCEI NOAA, 2023)

4.9.1 Vegetation Monitoring

Vegetation data were collected at Pond 43 in 1998, 2016, 2018-2021, and 2023 (HLA, 1998; Burleson, 2017, 2019, 2020, 2021, 2022). In 1998, data were collected along one transect with a length of 75 feet.

Quadrats were placed at 10-foot intervals, alternating from right to left along the transect. Because 1998 data were collected differently than in other years, strata were combined across the vernal pool to allow for comparison. In 2016, 2018- 2021, and 2023, data were collected using the methodology described in the Methods section of this report. Data from 2016 and 2023 were compared stratum-to-stratum in Table 4-96 as well as visually in Figure 4-50.

Table 4-96. Pond 43 (Year 5 Post-Subsurface Munitions Remediation) Vegetative Strata Percentage within the Vernal Pool Basin Boundary

Stratum	Percentage	
	2016	2023
1	19%	48%
2	50%	6%
3	27%	45.5%
Upland	3%	0.5%

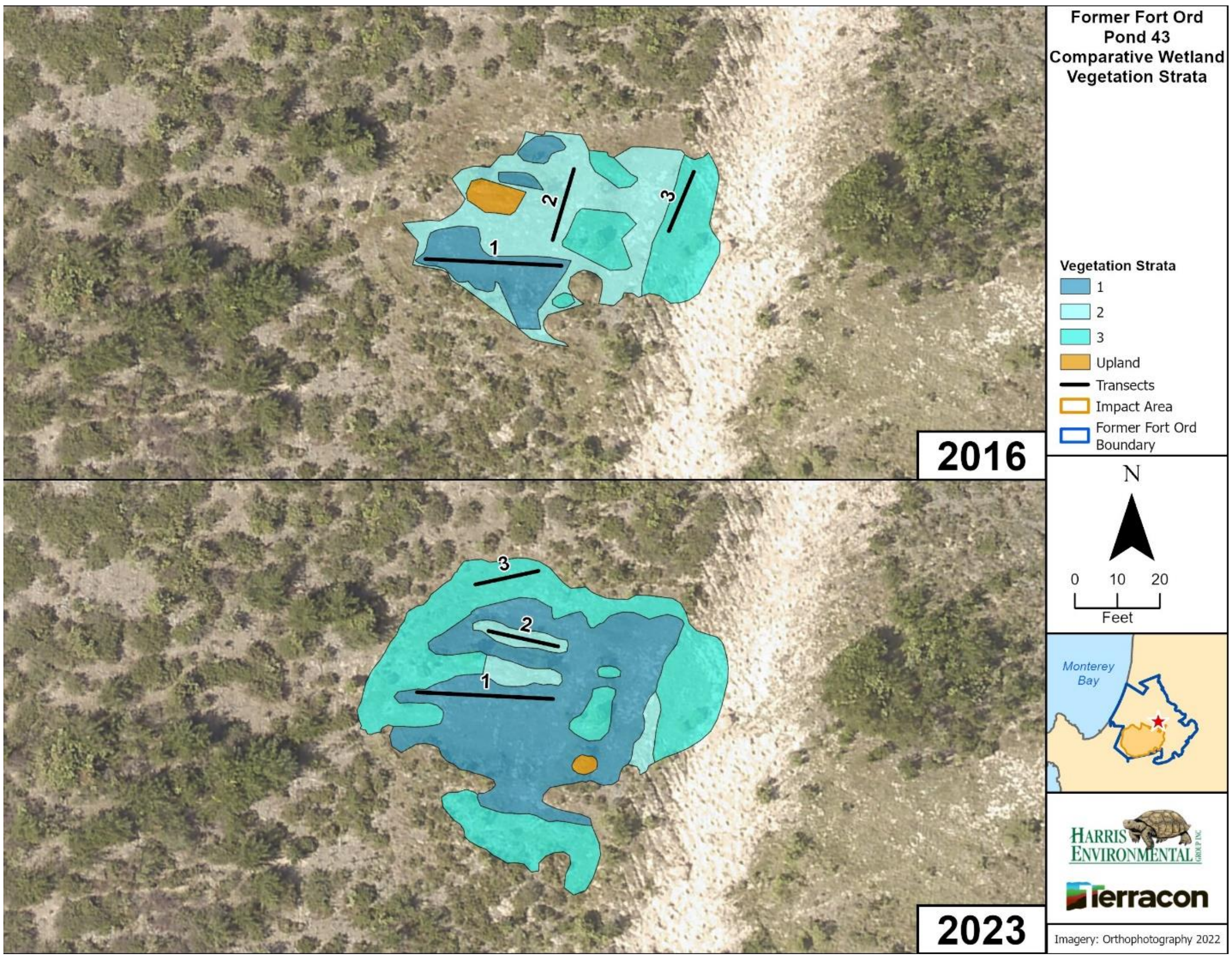

Figure 4-50. Pond 43 (Year 5 Post-Subsurface Munitions Remediation) Vegetation Strata and Transects for 2016 and 2023

Absolute percent vegetative cover in 2023 was higher than all previously recorded values, while thatch was lower (see Table 4-97). Vegetative cover ranged in post-remediation years from 44.8% in 2021 to 72.1% this monitoring year in 2023. The absolute percent vegetative cover of Pond 43 in 2023 was 2.4% less than the range of values observed at the reference vernal pools (see Table 4-98).

Table 4-97. Pond 43 (Year 5 Post-Subsurface Munitions Remediation) Absolute Percent Cover

Year	Vegetative Cover	Thatch/Bare Ground
1998*	55.9%	54.4%
2016*	66.5%	33.3%
2018	56.1%	44.1%
2019	63.9%	37.3%
2020	66.3%	33.8%
2021	44.8%	55.2%
2023	72.1%	27.9%

*baseline year

Table 4-98. Pond 43 (Year 5 Post-Subsurface Munitions Remediation) and Reference Vernal Pool Absolute Percent Cover in 2023

Vernal Pool	Vegetative Cover	Thatch/Bare Ground
5	74.5%	25.5%
101 East (East)	82.6%	17.4%
997	83.5%	16.7%
43	**72.1%**	**27.9%**

Species richness in 2023 was greater than in baseline years. Species richness on transects was 22, 24, 37, 45, 41, 39, and 25 species in 1998, 2016, 2018, 2019, 2020, 2021, and 2023, respectively, whereas overall basin species richness was 35, 51, 103, 86, 61, and 41 species in 2016, 2018, 2019, 2020, 2021, and 2023, respectively (see Table 4-99 and Appendix A Table A-9). The 1998 survey was limited to species on the transect and overall basin species richness was not recorded. Pond 43 species richness was within the range observed on transects at the reference vernal pools but the less than the values observed for the entire basin (see Table 4-100 and Appendix D Tables D-20 and D-40).

Species composition and dominant species at Pond 43 were variable across monitoring years. This is illustrated on the RACs as the species codes shift along the curve and losses and gains occur from year to year (see Figure 4-51 and Figure 4-52). Flowering quillwort (*Triglochin scilloides*) was the dominant species in 1998, Hickman's popcornflower (*Plagiobothrys chorisianus* var. *hickmanii*) was the dominant species in 2016, and brown-headed rush (*Juncus phaeocephalus*) and rabbitfoot grass (*Polypogon monspeliensis*) were the dominant species in 2018 and 2019. In 2020, brown-headed rush and California oatgrass (*Danthonia californica*) were the dominant species. Coyote thistle (*Eryngium armatum*) and brown-headed rush were co-dominant in 2021. In 2023, Hickman's popcornflower was again the dominant species, with brown-headed rush, and smooth cat's-ear (*Hypochaeris glabra*) as important associates. A complete comparison of species composition observed at Pond 43 in 1998, 2016, 2018, 2019, 2020, and 2021 can be found in Appendix E. Figure 4-54 shows a subset of this comparison for species observed with a 2% cover or greater.

The evenness from each year is represented by the slope of the RACs. Most monitoring years had a flat start to the curve, indicating greater evenness between dominant species and the rest of the vernal pool vegetation (see Figure 4-47Figure 4-82 and Appendix F). The exception to this was this year, 2023 (Yr 5), which had a much steeper slope at the beginning. However, every monitoring year exhibited a gradual slope overall, and therefore greater evenness, for the rest of the curve, with richness distributed along the entire length. The curve for 2023 (Yr 5) was most similar to reference Pond 5, both of which had a steep beginning to the curve, followed by a gradual slope to the end. Whereas 2019 (Yr 1), 2020 (Yr 2), and 2021 (Yr 3) were all similar to Ponds 101 East (East) and 997 across the same years, with a more even distribution of species from the beginning to the end of the curves.

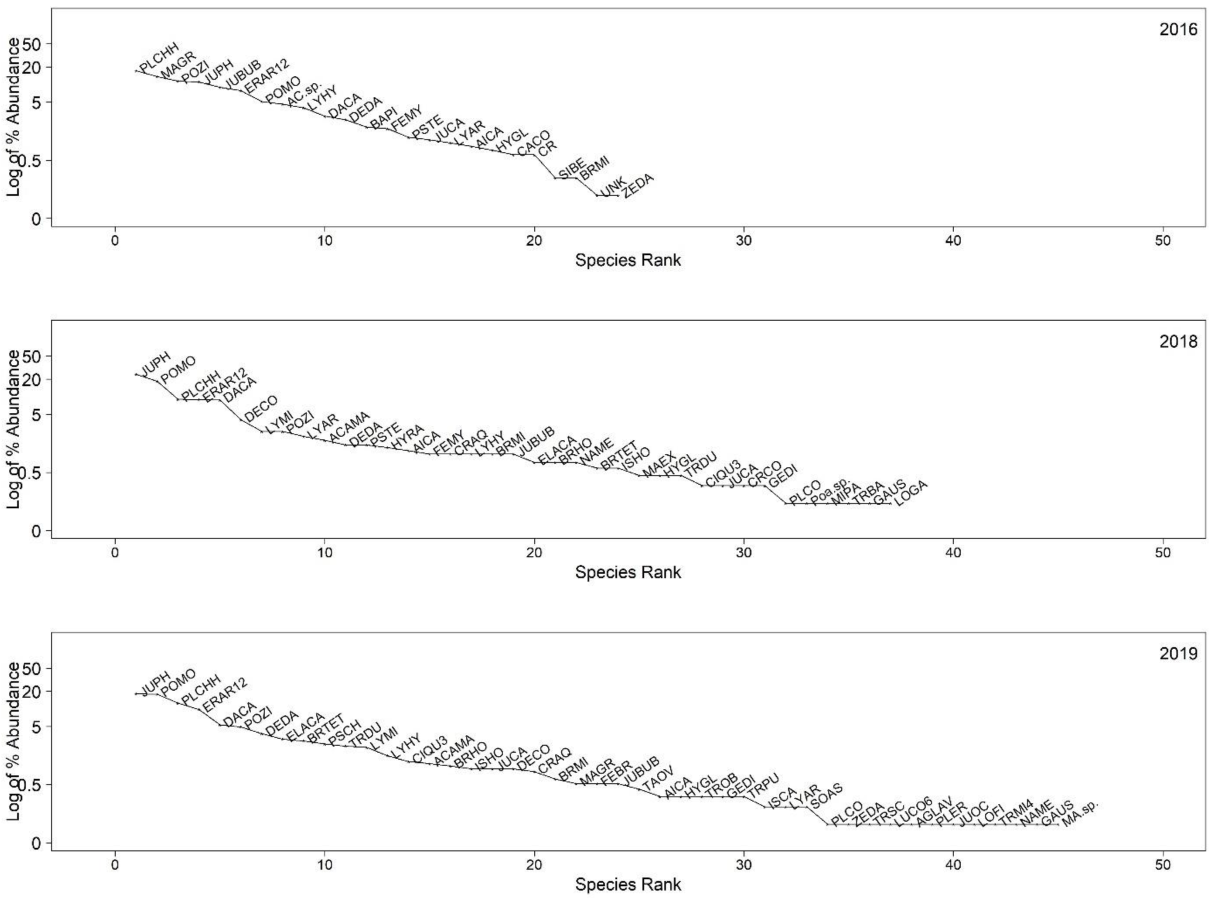

Figure 4-51. Rank Abundance Curves at Pond 43 (Year 5 Post-Subsurface Munitions Remediation) in 2016, 2018, and 2019. Note that the y-axis is in log-10 scale.

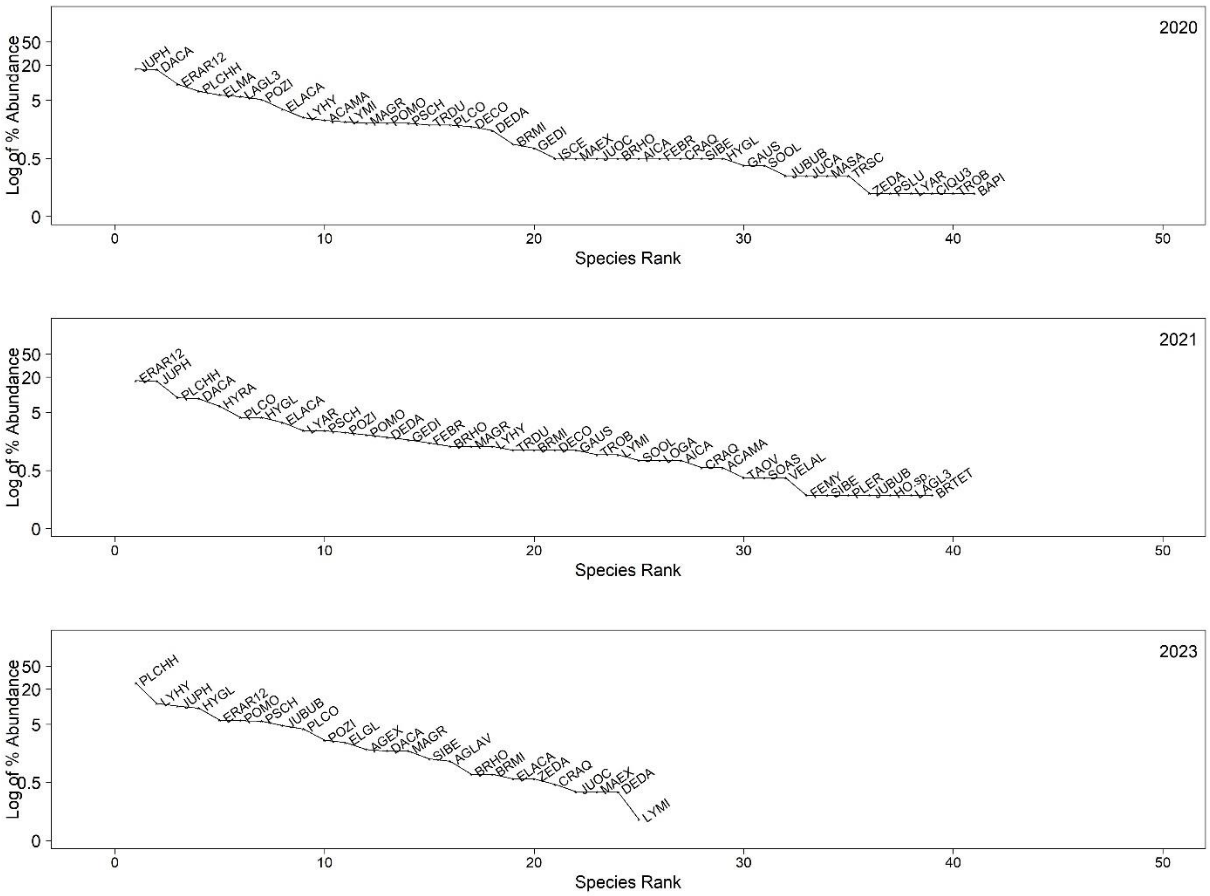

Figure 4-52. Rank Abundance Curves at Pond 43 (Year 5 Post-Subsurface Munitions Remediation) in 2020, 2021, and 2023. Note that the y-axis is in log-10 scale.

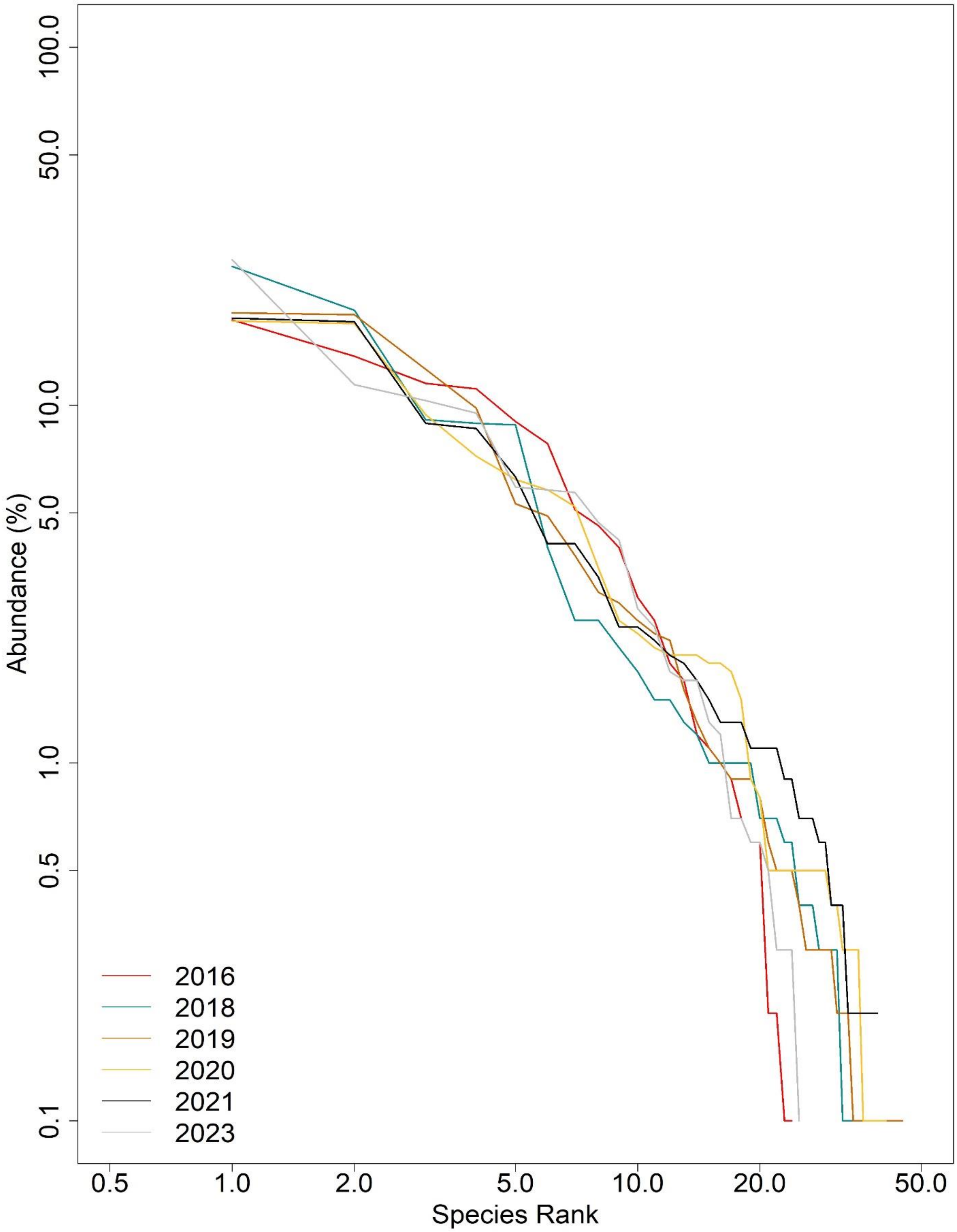

Figure 4-53. Rank Abundance Curves at Pond 43 (Year 5 Post-Subsurface Munitions Remediation) in 2016, 2018-2021, and 2023. Note that the x-axis and y-axis are in log-10 scale.

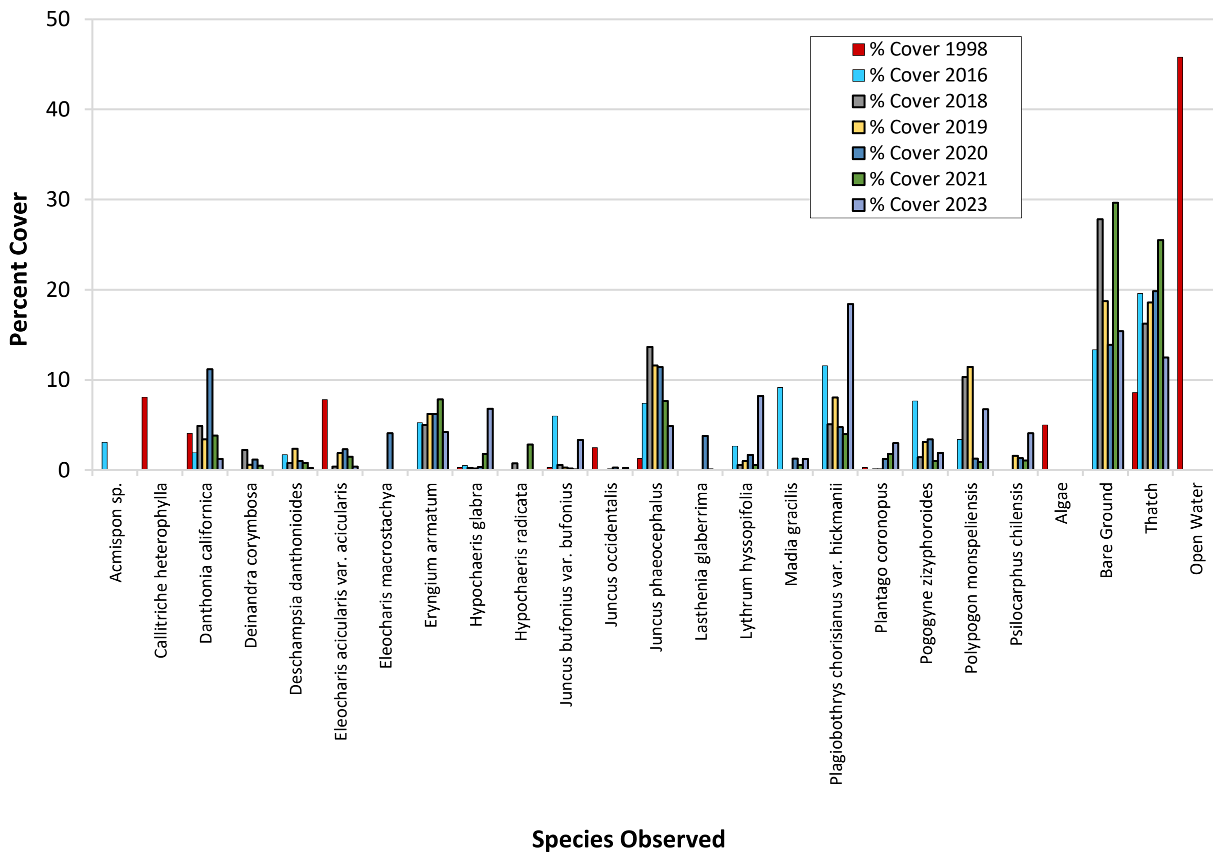

Figure 4-54. Percent Cover of Dominant Species at Pond 43 (Year 5 Post-Subsurface Munitions Remediation)

Whith the exception of 2023, when non-native richness was less than baseline, both native and non-native species richness on transects surpassed the range of baseline every year (see Table 4-99). In 2019 (Yr 1), Native species richness was greater than the values observed at the reference vernal pools, whereas non-native species richness was within the range observed at the reference vernal pools (Burleson, 2020). In 2020 (Yr 2), native and non-native species richness were within the range of values observed at the reference vernal pools (Burleson, 2021). In 2021 (Yr 3), both native and non-native species richness were greater than the range of values observed at reference pools (Burleson, 2022). In 2023 (Yr 5), native species richness was greater than the values observed at the reference vernal pools while non-native species richness was less (see Table 4-100).

Table 4-99. Pond 43 (Year 5 Post-Subsurface Munitions Remediation) Native and Non-Native Species Richness

Year	Native	Non-Native	Unidentified
1998*	13	7	2
2016*	13	8	2
2018	22	14	1
2019	30	14	1
2020	26	15	0
2021**	21	18	0
2023	19	6	0

*baseline year
**This data has changed from previous reports. HO sp. (sterile barley) was previously listed as Unidentified and is now listed as Non-Native.

Table 4-100. Pond 43 (Year 5 Post-Subsurface Munitions Remediation) and Reference Vernal Pool Native and Non-Native Species Richness in 2023

Vernal Pool	Native	Non-Native	Unidentified
5	12	12	0
101 East (East)	9	7	0
997	13	14	1
43	**19**	**6**	**0**

The relative percent cover of native species was less than the baseline values, whereas the relative percent cover of non-native species was greater than baseline in every monitoring year except 2020 (Yr 2) (see Table 4-101). In 2020 (Yr 2), native cover was greater than baseline values and non-native cover was within the range of baseline values. Pond 43 was within the range of native and non-native relative percent cover values observed at the reference vernal pools in every monitoring year (Burleson, 2020, 2021, 2022) (see Table 4-102).

Table 4-101. Pond 43 (Year 5 Post-Subsurface Munitions Remediation) Relative Percent Cover of Native and Non-Native Plants

Year	Native	Non-Native	Unidentified
1998*	83.7%	4.5%	11.8%
2016*	80.3%	14.9%	4.8%
2018	71.2%	28.7%	0.1%
2019	73.2%	26.7%	0.1%
2020	87.0%	13.0%	0.0%
2021**	69.1%	30.9%	0.0%
2023	67.7%	32.3%	0.0%

*baseline year
**This data has changed from previous reports. HO sp. (sterile barley) was previously listed as Unidentified and is now listed as Non-Native.

Table 4-102. Pond 43 (Year 5 Post-Subsurface Munitions Remediation) and Reference Vernal Pool Relative Percent Cover of Native and Non-Native Plants in 2023

Vernal Pool	Native	Non-Native	Unidentified
5	76.3%	23.7%	0.0%
101 East (East)	60.3%	39.7%	0.0%
997	50.0%	49.0%	1.0%
43	**67.7%**	**32.3%**	**0.0%**

Wetland and non-wetland species richness on Pond 43 transects were greater than in baseline years in every monitoring year, except 2023 (Yr 5) (see Table 4-103). In 2023 (Yr 5), wetland species richness was greater than baseline values, whereas non-wetland species richness was within the range of baseline values. In 2019 (Yr 1) and 2023 (Yr 5), wetland species richness was greater than reference vernal pool values, while non-wetland species richness was less (Burleson, 2020). In 2020 (Yr 2), wetland and non-wetland species richness fell within the range of reference vernal pools (Burleson, 2021). Whereas, in 2021 (Yr 3), wetland species richness was greater than reference pools, while non-wetland species richness was within the range of values observed at reference pools (Burleson, 2022) (see Table 4-104).

Table 4-103. Pond 43 (Year 5 Post-Subsurface Munitions Remediation) Wetland and Non-Wetland Species Richness

Year	Wetland			Non-Wetland		Not Listed
	OBL	FACW	FAC	FACU	UPL	
1998*	6	5	4	1	0	6
2016*	4	6	3	3	0	7
2018	7	8	6	6	0	10
2019	8	10	7	5	0	15
2020	9	11	4	4	1	12
2021	6	8	4	6	1	14
2023	5	11	3	2	0	4

*baseline year

Table 4-104. Pond 43 (Year 5 Post-Subsurface Munitions Remediation) and Reference Vernal Pool Wetland and Non-Wetland Species Richness in 2023

Vernal Pool	Wetland			Non-Wetland		Not Listed
	OBL	FACW	FAC	FACU	UPL	
5	6	7	3	3	1	4
101 East (East)	4	6	1	3	0	2
997	4	6	4	4	0	10
43	**5**	**11**	**3**	**2**	**0**	**4**

In 2019 (Yr 1), 2020 (Yr 2), and 2023 (Yr 5), the relative percent cover of wetland species was greater than baseline values (see Table 4-105). Whereas, in 2021 (Yr 3) wetland cover was within the range of values observed in baseline years. Non-wetland relative percent cover was greater than baseline non-wetland cover in 2019 (Yr 1) and 2021 (Yr 3), whereas non-wetland cover was within the range of baseline values in 2020 (Yr 2) and 2023 (Yr 5).

Table 4-105. Pond 43 (Year 5 Post-Subsurface Munitions Remediation) Relative Percent Cover of Wetland and Non-Wetland Species

Year	Wetland			Non-Wetland		Not Listed
	OBL	FACW	FAC	FACU	UPL	
1998*	64.6%	8.6%	8.6%	0.2%	0.0%	18.1%
2016*	34.2%	36.0%	4.1%	3.8%	0.0%	21.9%
2018	16.5%	57.2%	13.1%	5.1%	0.0%	8.2%
2019	24.2%	56.3%	6.6%	4.8%	0.0%	8.1%
2020	31.6%	35.8%	19.7%	3.1%	0.4%	9.3%
2021	16.5%	42.2%	16.2%	10.0%	0.7%	14.3%
2023	40.7%	37.5%	6.6%	3.1%	0.0%	12.1%

*baseline year

Wetland and non-wetland relative percent cover values were within the ranges observed at the reference vernal pools in 2019 (Yr 1), 2020 (Yr 2) and 2021 (Yr 3) (Burleson, 2020, 2021, 2022). Whereas, in 2023 (Yr 5), wetland cover was within the range of values observed at reference vernal pools, while non-wetland cover was less (see Table 4-106).

Table 4-106. Pond 43 (Year 5 Post-Subsurface Munitions Remediation) and Reference Vernal Pool Relative Percent Cover of Wetland and Non-Wetland Species in 2023

Vernal Pool	Wetland			Non-Wetland		Not Listed
	OBL	FACW	FAC	FACU	UPL	
5	61.4%	29.0%	3.1%	3.7%	0.1%	2.7%
101 East (East)	14.5%	53.4%	0.1%	9.1%	0.0%	22.9%
997	31.5%	28.9%	7.4%	9.0%	0.0%	23.2%
43	**40.7%**	**37.5%**	**6.6%**	**3.1%**	**0.0%**	**12.1%**

4.9.1.1 *Data Quality Objective 3*

Observable changes in hydrophytic vegetation between surveys were largely associated with precipitation fluctuations. This is expected given the dynamic nature of vernal pools and the close relationship between the hydroperiod and wetland vegetation composition. Vegetative cover in Pond 43 was dominated by native and wetland plant species during year 5 post-subsurface munitions remediation monitoring in 2023.

By 2023 (Yr 5), Pond 43 wetland vegetation results were generally within range of either baseline and/or reference vernal pools with a few exceptions. The native and wetland richness values were greater, and non-native richness was less, than the baseline years and the range of values observed at reference vernal pools. The increase in native and wetland richness, and decrease in non-native richness are not concerning. All support a well-functioning vernal pool ecosystem.

4.9.1.2 *Performance Standard: Plant Cover and Species Diversity*

Pond 43, a post-subsurface munitions remediation vernal pool, met the performance standard for year 5 in 2023. The species composition, and native and wetland species relative abundances were similar to baseline and/or reference vernal pool conditions. This vernal pool provided suitable wetland habitat in 2023.

4.9.2 Wildlife Monitoring

Wildlife data were collected at Pond 43 in 1998, 2000, 2016, 2019, and 2020 (HLA, 1998, 2000; Burleson, 2017, 2020). California tiger salamander larvae were not detected in any survey year. Fairy shrimp were present in 1998, 2019, and 2020. The vernal pool was dry by the April 26 survey date, so no wildlife sampling was completed in 2023. Therefore, DQO 5 and the applicable wildlife usage performance standard can only be assessed for 2019 (Yr 1) and 2020 (Yr 2). Table 4-107 shows historical wildlife monitoring results.

Table 4-107. Pond 43 (Year 5 Post-Subsurface Munitions Remediation) Historical Wildlife Monitoring Results

Sampling Year	CTS Larvae Abundance (# Individuals)	Fairy Shrimp Abundance (# Individuals)
1998*	Not detected	Moderate
2000*	Not detected	Not detected
2016*	Not detected	Not detected
2019	Not detected	High (135, 210)
2020	Not detected	Moderate (40)

*baseline year

4.9.2.1 *Data Quality Objective 5*

California tiger salamanders were not detected in any monitoring year, which was consistent with baseline monitoring. Results were consistent with reference vernal pools; CTS were not detected at Pond 997 in 2019, nor Pond 5 or 101 East (East) in 2020.

Fairy shrimp were detected in 2019 (Yr 1) and 2020 (Yr 2), which was consistent with baseline in 1998. Results in 2019 (Yr 1) and 2020 (Yr 2) were consistent with reference vernal pools; fairy shrimp were detected at Pond 101 East (East) in 2019 and 2020, and Pond 5 in 2020.

4.9.2.2 *Performance Standard: Wildlife Usage*

Pond 43, a post-subsurface munitions remediation vernal pool, was in year 5 of monitoring and met DQO 5. California tiger salamanders were not present in any year, which was consistent with baseline and reference Pond 997 in 2019 and Ponds 5 and 101 East (East) in 2020. Fairy shrimp were detected in 2019 (Yr 1) and 2020 (Yr 2), which was consistent with baseline in 1998. Similarly, fairy shrimp were detected at Pond 101 East (East) in 2019 and 2020, and Pond 5 in 2020. Data quality objectives 1 and 4 were analyzed in the Hydrology Monitoring Annual Report (Chenega, 2023).

4.9.3 Conclusion

Pond 43, a post-subsurface munitions remediation vernal pool, was in the final year of monitoring in 2023. The vernal pool met the plant cover and species diversity performance standard and met DQO 5 for wildlife usage (see Table 4-108). No further monitoring is recommended for Pond 43.

Table 4-108. Success at Pond 43 (Year 5 Post-Subsurface Munitions Remediation) Based on Performance Standards and Applicable Data Quality Objectives

Performance Standard	Applicable DQO	2019 (Yr 1)	2020 (Yr 2)	2021 (Yr 3)	2023 (Yr 5)	Success
Plant Cover & Species Diversity	DQO 3	On Track	On Track	Not On Track	On Track	Met
Wildlife Usage	DQO 5	On Track	On Track	N/A	On Track	Met

4.10 Pond 44 –Year 5

Pond 44 was monitored in 2023 as a year 5 post-subsurface munitions remediation vernal pool. Pond 44 was monitored for baseline conditions in 1998, 2015, and 2016. Vegetation in Pond 44 and within its watershed was masticated in the summer of 2017 in preparation for a prescribed burn of BLM Area B Subunit B. Pond 44 had intrusive anomaly investigations in 2018. Table 4-109 summarizes the years that monitoring occurred and surveys were conducted. The cumulative precipitation graph indicates precipitation for the years that monitoring was conducted at Pond 44 (see Figure 4-55). The 1997-1998, 2015-2016, 2018-2019 and 2022-2023 water-years were above normal, whereas 2019-2020, was similar to the cumulative normal water-year. The 2014-2015, 2017-2018, and 2020-2021 water-years were below normal.

Table 4-109. Pond 44 (Year 5 Post-Subsurface Munitions Remediation) Summary of Historical Surveys for Hydrology, Vegetation, and Wildlife

Survey	Water-Year							
	1997-1998	2014-2015	2015-2016	2017-2018	2018-2019	2019-2020	2020-2021	2022-2023
Hydrology	●	●	●	●	●	●	●	●
Vegetation	●		●	●	●	●	●	●
Wildlife	●				●	●		

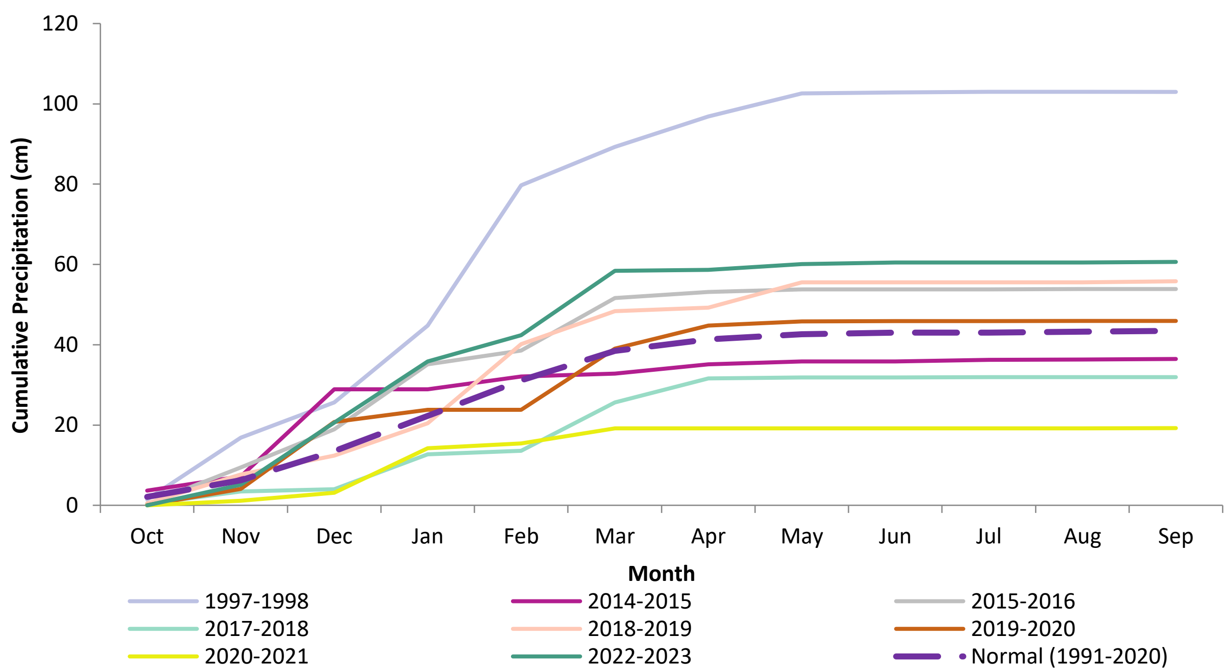

Figure 4-55. Cumulative Monthly Precipitation for Years that Hydrology Monitoring Occurred at Pond 44 (Year 5 Post-Subsurface Munitions Remediation) Compared to the 30-Year Normal (mean 1991-2020) (NPS, 2023; NCEI NOAA, 2023)

4.10.1 Vegetation Monitoring

Vegetation data were collected at Pond 44 in 1998, 2016, 2018- 2021, and 2023 (HLA, 1998; Burleson, 2017, 2019, 2020, 2021, 2022). In 1998, data were collected along two transects close to 50 feet in length. Quadrats were placed at 10-foot intervals, alternating from right to left along the transect. Because 1998 data were collected differently than in other years, strata were combined across the vernal pool to allow for comparison. In 2016, 2018-2021, and 2023, data were collected using the methodology described in the Methods section of this report. Data from 2016 and 2023 were compared stratum-to-stratum in Table 4-110 as well as visually in Figure 4-56**.**

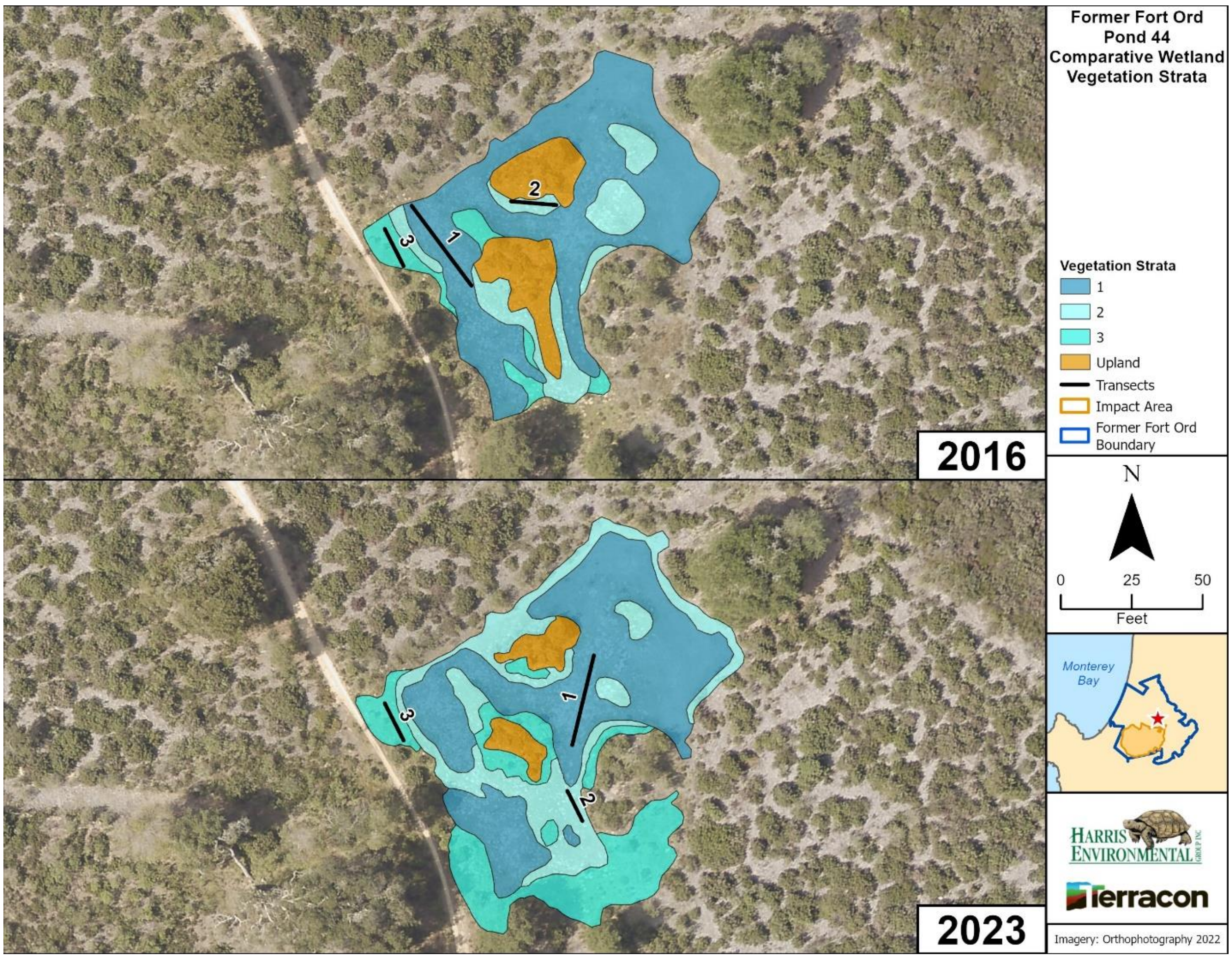

Figure 4-56. Pond 44 (Year 5 Post-Subsurface Munitions Remediation) Vegetation Strata and Transects for 2016 and 2023

Table 4-110. Pond 44 (Year 5 Post-Subsurface Munitions Remediation) Vegetative Strata Percentage within the Vernal Pool Basin Boundary

Stratum	Percentage	
	2016	2023
1	60%	46%
2	17%	25%
3	7%	24%
Upland	16%	5%

The absolute percent vegetative cover of Pond 44 was less than baseline cover in every monitoring year, except in 2020 (Yr 2), in which vegetative cover was within the range of baseline values (see Table 4-111). The absolute percent vegetative cover of Pond 44 in 2020 (Yr 2) and 2021 (Yr 3) was greater than the values observed at the reference vernal pools, while in 2019 (Yr 1) and 2023 (Yr 5), cover was less than reference vernal pools (Burleson, 2020, 2021, 2022) (see Table 4-112).

Table 4-111. Pond 44 (Year 5 Post-Subsurface Munitions Remediation) Absolute Percent Cover

Year	Vegetative Cover	Thatch/Bare Ground
1998*	72.8%	26.0%
2016*	78.6%	22.9%
2018	70.9%	30.0%
2019	67.7%	32.2%
2020	74.4%	25.8%
2021	46.3%	53.8%
2023	71.5%	28.5%

*baseline year

Table 4-112. Pond 44 (Year 5 Post-Subsurface Munitions Remediation) and Reference Vernal Pool Absolute Percent Cover in 2023

Vernal Pool	Vegetative Cover	Thatch/Bare Ground
5	74.5%	25.5%
101 East (East)	82.6%	17.4%
997	83.5%	16.7%
44	**71.5%**	**28.5%**

Species richness was greater than baseline in every monitoring year. Species richness on transects was 26, 36, 44, 44, 39, 48, and 38 species in 1998, 2016, 2018, 2019, 2020, 2021, and 2023 respectively, whereas overall basin species richness was 47, 71, 74, 67, 70, and 58 species in 2016, 2018, 2019, 2020, 2021, and 2023 respectively (see Table 4-113 and Appendix A Table A-10). Pond 44 species richness on transects was greater than the reference vernal pools but was within the range of values observed for the entire basin (see Table 4-114 and Appendix D Tables D-20 and D-40).

Species composition at Pond 44 differed among the monitoring years, however, the dominant species were fairly similar. This species composition is illustrated on the RACs as the species codes shift along the curve and losses and gains occur from year to year (see Figure 4-57 and Figure 4-58). The dominant species in 1998 (baseline) was needle spikerush. In 2016 (baseline), 2018, and 2019 (Yr 1), the dominant species was coyote thistle (*Eryngium armatum*). In 2020 (Yr 2), California oatgrass (*Danthonia californica*) and brown-headed rush (*Juncus phaeocephalus*) were the dominant species. Cut-leaved plantain (*Plantago coronopus*) was the dominant species in 2021 (Yr 3) with moderate cover from coyote thistle and brown-headed rush. By 2023 (Yr 5), the dominant species shifted to Hickman's popcornflower (*Plagiobothrys chorisianus* var. *hickmanii*), and grass poly (*Lythrum hyssopifolia*). A complete comparison of species composition observed at Pond 44 in 1998, 2016, 2018-2021, and 2023 can be found in Appendix E. Figure 4-60 shows a subset of this comparison for species observed with a 2% cover or greater.

The evenness from each year is represented by the slope of the RACs. Most years had a flat start to the curve, indicating greater evenness between dominant species and the rest of the vernal pool vegetation (see Figure 4-59 and Appendix F). However, the curve for 2021 (Yr 3) exhibited a steeper slope, and therefore less evenness, at the beginning of the curve. Every year exhibited a gradual slope after the beginning, with richness distributed along the entire length, making the RAC for Pond 44 most similar to reference Pond 997.

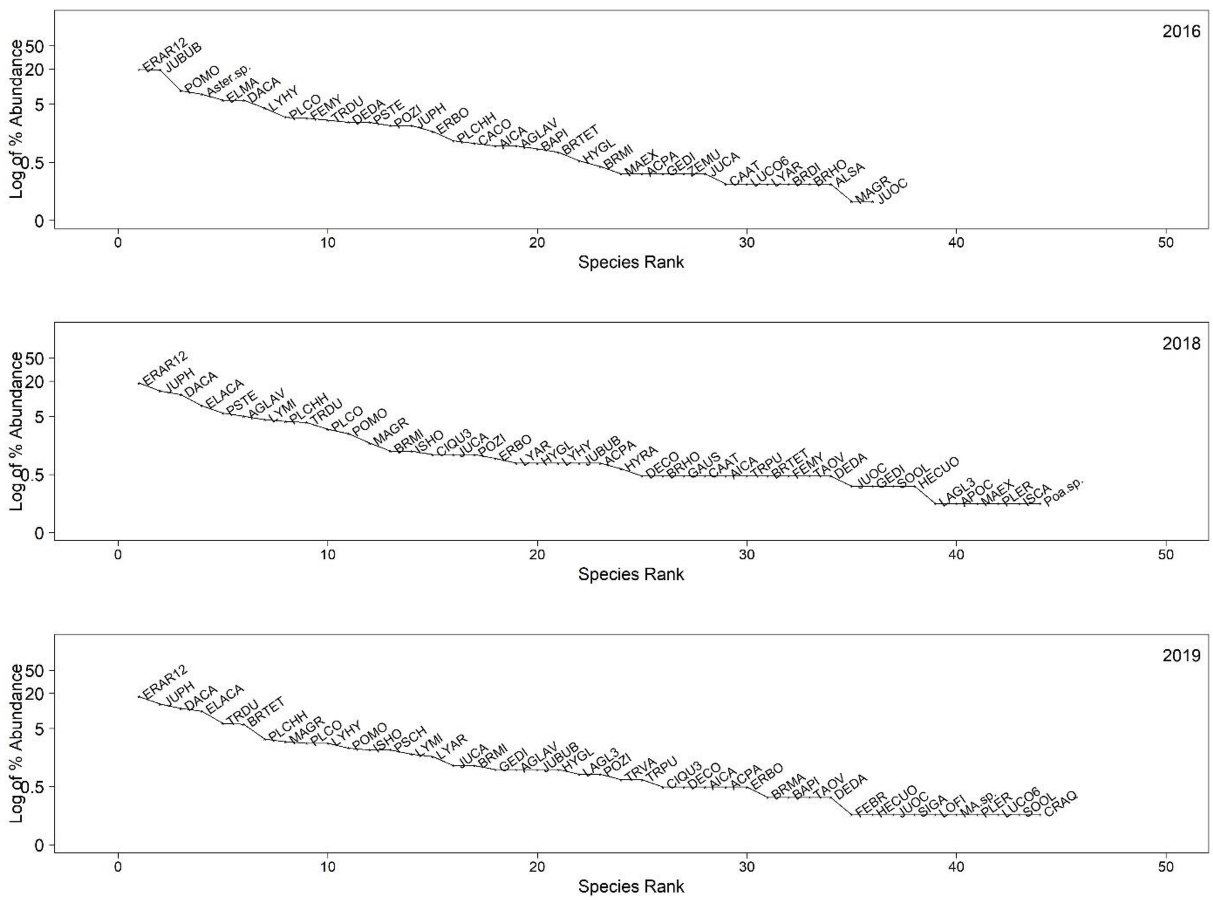

Figure 4-57. Rank Abundance Curves at Pond 44 (Year 5 Post-Subsurface Munitions Remediation) in 2016, 2018 and 2019. Note that the y-axis is in log-10 scale.

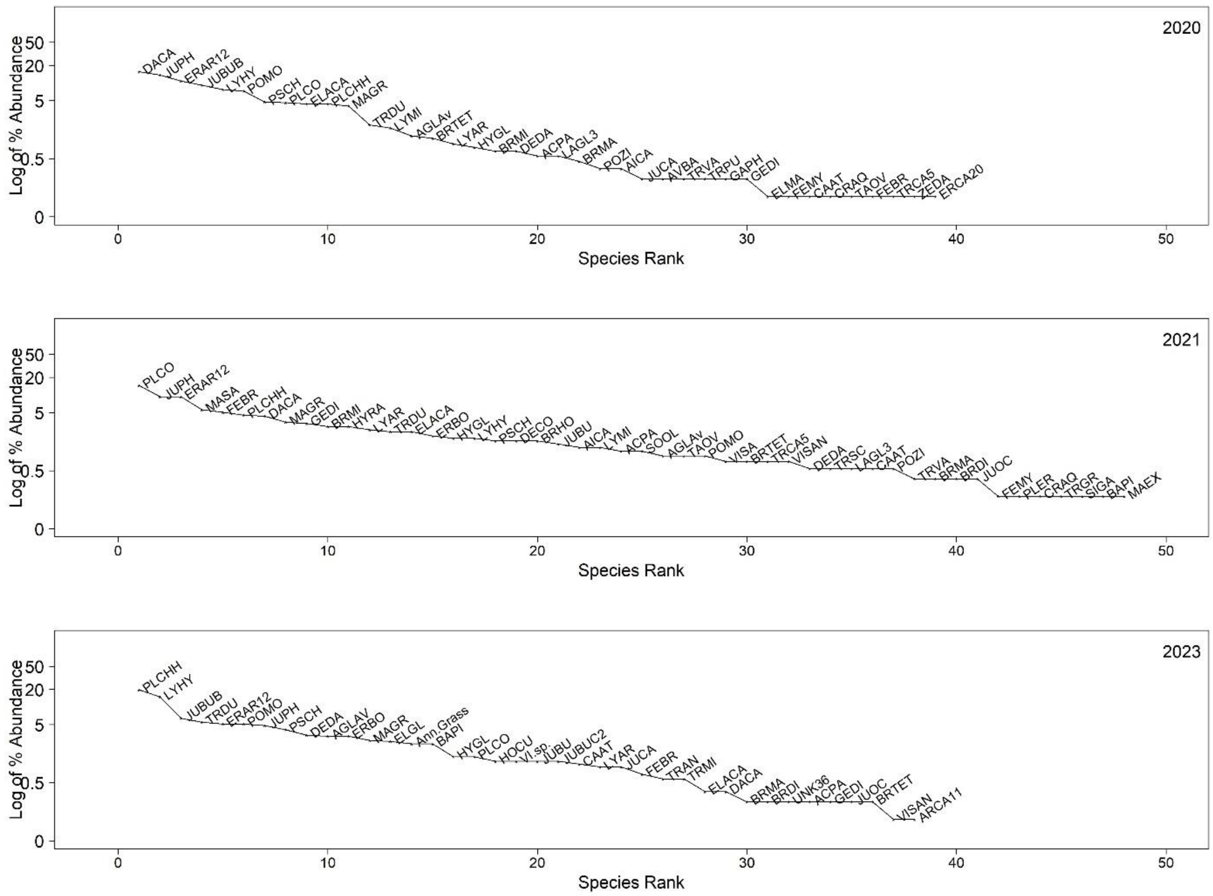

Figure 4-58. Rank Abundance Curves at Pond 44 (Year 5 Post-Subsurface Munitions Remediation) in 2020, 2021 and 2023. Note that the y-axis is in log-10 scale.

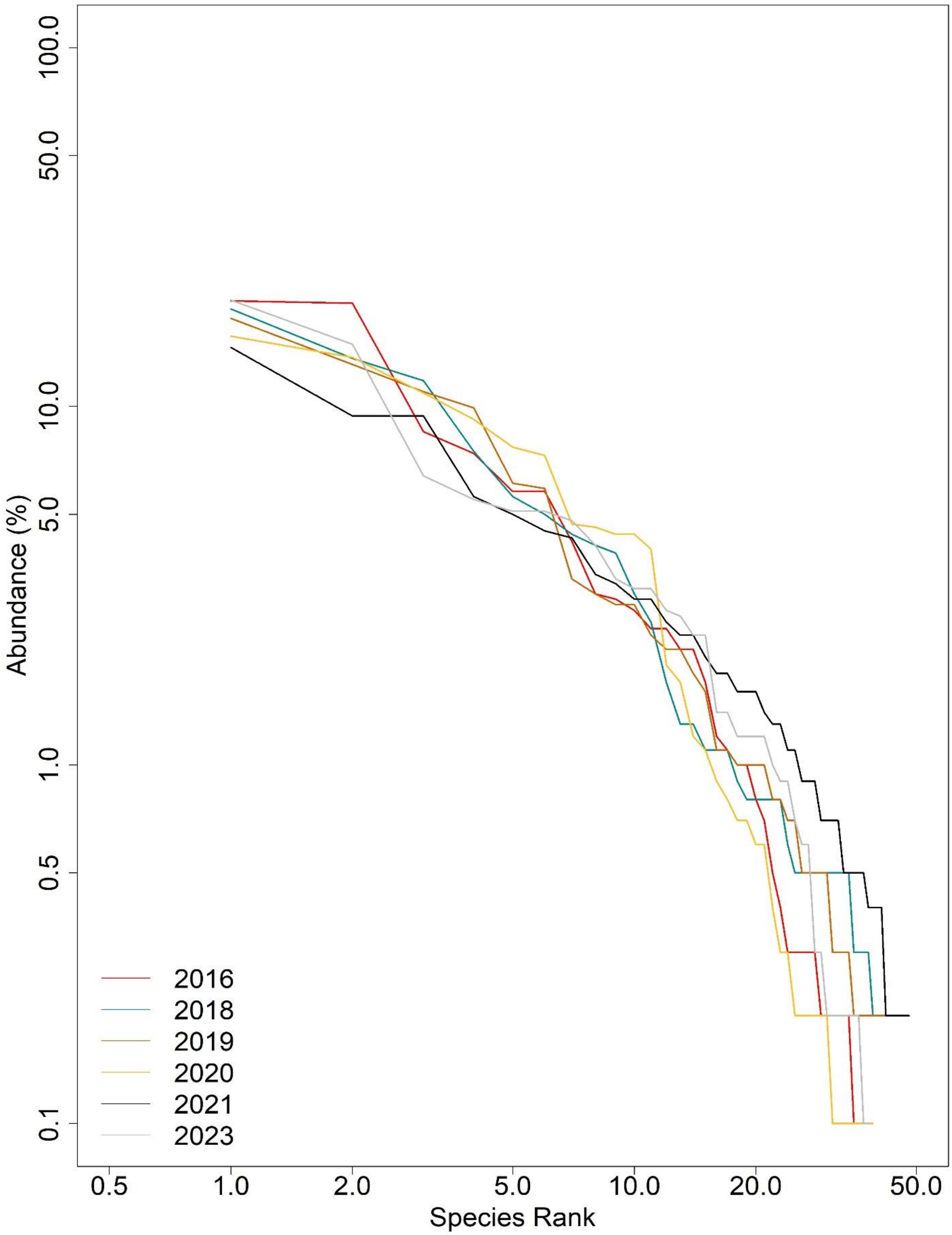

Figure 4-59. Rank Abundance Curves at Pond 44 (Year 5 Post-Subsurface Munitions Remediation) in 2016, 2018-2021, and 2023. Note that the x-axis and y-axis are in log-10 scale

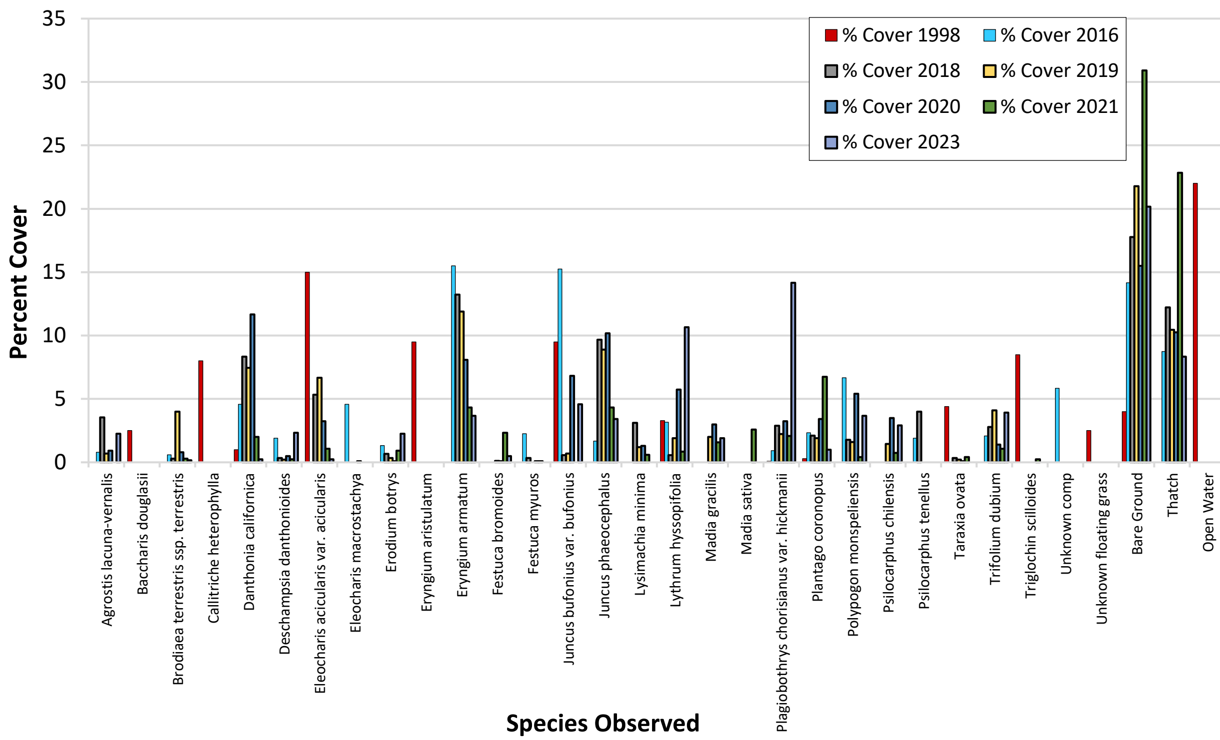

Figure 4-60. Percent Cover of Dominant Species at Pond 44 (Year 5 Post-Subsurface Munitions Remediation)

Native and non-native species richness on Pond 44 transects were greater in 2019 (Yr 1), 2020 (Yr 2), and 2021 (Yr 3) than in baseline years (see Table 4-113). Whereas, in 2023 (Yr 5), native and non-native species richness were within the range of baseline values. In 2019 (Yr 1) and 2023 (Yr 5), native species richness was higher than the range observed at the reference vernal pools, whereas non-native species richness was within the range observed at the reference vernal pools (Burleson, 2020) (see Table 4-114). In 2020 (Yr 2), native and non-native species richness fell within the range of reference vernal pool values (Burleson, 2021). Whereas, in 2021 (Yr 3), native and non-native richness were both higher than the range of values at reference vernal pools (Burleson, 2022).

Table 4-113. Pond 44 (Year 5 Post-Subsurface Munitions Remediation) Native and Non-Native Species Richness

Year	Native	Non-Native	Unidentified
1998*†	17	8	2
2016*	21	14	1
2018	28	15	1
2019	28	15	1
2020	22	17	0
2021	27	21	0
2023	21	14	3

*baseline year
†These values have changed from previous years due to a formula error. The unidentified category in 1998 was 1, but now captures Polytrichum juniperinum, which was previously omitted.

Table 4-114. Pond 44 (Year 5 Post-Subsurface Munitions Remediation) and Reference Vernal Pool Native and Non-Native Species Richness in 2023

Vernal Pool	Native	Non-Native	Unidentified
5	12	12	0
101 East (East)	9	7	0
997	13	14	1
44	**21**	**14**	**3**

The relative percent cover of native and non-native species in 2019 (Yr 1) and 2020 (Yr 2), were within the range of baseline values. Whereas, the relative percent cover of native species was lower, and non-native species cover was greater than, the range of values observed in the baseline years in 2021 (Yr 3) and 2023 (Yr 5) (see Table 4-115).

Table 4-115. Pond 44 (Year 5 Post-Subsurface Munitions Remediation) Relative Percent Cover of Native and Non-Native Plants

Year	Native	Non-Native	Unidentified
1998*†	87.6%	8.8%	3.6%
2016*	66.5%	26.1%	7.4%
2018	82.1%	17.7%	0.2%
2019	78.2%	21.7%	0.2%
2020	74.0%	26.0%	0.0%
2021	52.8%	47.2%	0.0%
2023	60.8%	35.4%	3.7%

*baseline year

† This value has changed from previous years due to a formula error. The unidentified category in 1998 was recorded as 3.4%, but is 0.2% higher due to including Polytrichum juniperinum, which was previously omitted.

The relative percent cover of native and non-native species was withinthe range of values observed at reference vernal pools in 2019 (Yr 1) (Burleson, 2020). Conversely, in 2021 (Yr 3), the relative percent cover of native species was lower, and non-native species cover was greater than, the range of values observed at reference vernal pools (Burleson, 2022). In 2020 (Yr 2), and 2023 (Yr 5), native and non-native relative percent cover were within the range of vaues for reference vernal pools (Burleson, 2021) (see Table 4-116).

Table 4-116. Pond 44 (Year 5 Post-Subsurface Munitions Remediation) and Reference Vernal Pool Relative Percent Cover of Native and Non-Native Plants in 2023

Vernal Pool	Native	Non-Native	Unidentified
5	76.3%	23.7%	0.0%
101 East (East)	60.3%	39.7%	0.0%
997	50.0%	49.0%	1.0%
44	**60.8%**	**35.4%**	**3.7%**

Wetland richness on Pond 44 transects was greater in 2019 (Yr 1) and 2020 (Yr 2) than baseline, while non-wetland richness fell within the range of baseline values (see Table 4-117). Whereas, both wetland

and non-wetland species richness were greater in 2021 (Yr 3) than in baseline years. In 2023 (Yr 5), wetland and non-wetland richness were within the range of baseline results.

Table 4-117. Pond 44 (Year 5 Post-Subsurface Munitions Remediation) Wetland and Non-Wetland Species Richness

Year	Wetland			Non-Wetland		Not Listed
	OBL	FACW	FAC	FACU	UPL	
1998*	7	4	5	1	0	10
2016*	5	9	5	6	0	11
2018	8	9	4	7	1	15
2019	7	10	6	4	1	16
2020	7	8	5	6	0	13
2021**	7	9	5	6	3	18
2023	3	10	4	4	1	16

*baseline year
**These values have changed from previous reports. Due to a formula error in 2021, two species were incorrectly listed as NL instead of UPL. These changes will be reflected in the data deliverable and all future reports. UPL increased from 1 to 3, and NL decreased from 20 to 18.

Wetland species richness at Pond 44 fell within the range of values at reference vernal pools in 2019 (Yr 1) and 2020 (Yr 2) (Burleson, 2020, 2021). Non-wetland species richness was also within the range of values in 2020 (Yr 2), however in 2019 (Yr 1) non-wetland species richness was less than reference. In 2021 (Yr 3) and 2023 (Yr 5), wetland species richness was greater than the range of values observed at reference vernal pools while non-wetland species were within the range of reference (Burleson, 2022) (see Table 4-118).

Table 4-118. Pond 44 (Year 5 Post-Subsurface Munitions Remediation) and Reference Vernal Pool Wetland and Non-Wetland Species Richness in 2023

Vernal Pool	Wetland			Non-Wetland		Not Listed
	OBL	FACW	FAC	FACU	UPL	
5	6	7	3	3	1	4
101 East (East)	4	6	1	3	0	2
997	4	6	4	4	0	10
44	**3**	**10**	**4**	**4**	**0**	**17**

Wetland species relative percent cover was less than the range observed in baseline in 2019 (Yr 1), whereas, in 2020 (Yr 2), wetland cover was greater than baseline; non-wetland species cover was within the range of baseline values in both years (see Table 4-119). In 2021 (Yr 3) and 2023 (Yr 5), the relative percent cover of wetland species was less than, and non-wetland species was greater than, the range of values observed in baseline years.

Table 4-119. Pond 44 (Year 5 Post-Subsurface Munitions Remediation) Relative Percent Cover of Wetland and Non-Wetland Species

Year	Wetland			Non-Wetland		Not Listed
	OBL	FACW	FAC	FACU	UPL	
1998*	63.5%	15.2%	3.3%	0.4%	0.0%	17.6%
2016*	15.8%	53.8%	9.7%	8.7%	0.0%	12.1%
2018	20.7%	46.9%	16.8%	8.0%	0.3%	7.4%
2019	19.9%	39.9%	17.4%	8.2%	0.2%	14.4%
2020	17.6%	49.3%	22.1%	2.9%	0.0%	8.2%
2021**	10.5%	25.8%	24.7%	10.3%	2.5%	26.3%
2023	35.1%	34.5%	3.3%	12.1%	0.1%	14.9%

*baseline year
** These values have changed from previous reports. Due to a formula error in 2021, two species were incorrectly listed as NL instead of UPL. These changes will be reflected in the data deliverable and all future reports. UPL increased from 1.1% to 2.5%, and NL decreased from 27.7% to 26.3%.

Wetland and non-wetland relative percent cover were within the range of values for reference vernal pools in 2019 (Yr 1), 2020 (Yr 2), and 2021 (Yr 3) (Burleson, 2020, 2021, 2022). In 2023 (Yr 5), wetland cover was within the range of reference vernal pool cover values while non-wetland cover was greater (see Table 4-120).

Table 4-120. Pond 44 (Year 5 Post-Subsurface Munitions Remediation) and Reference Vernal Pool Relative Percent Cover of Wetland and Non-Wetland Species in 2023

Vernal Pool	Wetland			Non-Wetland		Not Listed
	OBL	FACW	FAC	FACU	UPL	
5	61.4%	29.0%	3.1%	3.7%	0.1%	2.7%
101 East (East)	14.5%	53.4%	0.1%	9.1%	0.0%	22.9%
997	31.5%	28.9%	7.4%	9.0%	0.0%	23.2%
44	**35.1%**	**34.5%**	**3.3%**	**12.1%**	**0.1%**	**14.9%**

4.10.1.1 *Data Quality Objective 3*

Observable changes in hydrophytic vegetation between surveys were largely associated with precipitation fluctuations. This is expected given the dynamic nature of vernal pools and the close relationship between the hydroperiod and wetland vegetation composition. Vegetative cover in Pond 44 was dominated by native and wetland plant species during year 5 post-subsurface munitions remediation monitoring in 2023. Pond 44 was on track to meet Data Quality Objective 3 in monitoring years 2019 (Yr 1) and 2020 (Yr 2), but not in 2021 (Yr 3), when the vernal pool was in a record drought. Due to the dry conditions, non-native richness and cover were greater in 2021 (Yr 3) than both baseline and reference vernal pool values. Below-normal water-years can result in upland and non-native herbs and grasses exploiting a greater portion of a vernal pool and distributing more evenly (Bauder, 2000).

By 2023 (Yr 5), non-native richness and cover were within the range of reference or baseline again, however non-wetland cover values were greater than the baseline years and the range of values observed at reference vernal pools. Although non-wetland cover increased in 2023 (Yr 5), it was also greater than baseline in every monitoring year, and additionally, the final monitoring year was the first time that non-wetland cover exceeded the range of reference values. The non-wetland cover in 2021 (Yr 3) was distinctly higher than previous monitoring years due to dry conditions, so it is possible that non-wetland communities remained prevalent in the drier strata of the vernal pool. Regardless, it is unlikely that this shift in the amount non-wetland cover is related to remediation activities. Rather, it is more likely due to previous drought conditions that altered the entire watershed.

4.10.1.2 *Performance Standard: Plant Cover and Species Diversity*

Pond 44, a post-subsurface munitions remediation vernal pool met the performance standard by year 5 in 2023. Species composition and native and wetland species relative abundances were similar to baseline and/or reference vernal pool conditions, except that non-wetland cover was greater than baseline and the range of reference vernal pool values. This is likely related to the historic below-normal water-year in 2021, in which non-native and non-wetland species increased substantially in the vernal pool basin. The evaluation of meeting the vegetation performance standard according to the Wetland Plan, is to “aid in determining whether vegetation is disturbed wetlands is similar enough to that in wetlands before MEC to determine whether wetland function is retained”. The decision for whether a vernal pool has met the performance standard is based on reviewing all years of monitoring data. The results differ between the five years, but the intent of the performance standard has been met based on the consideration of water-years and that the wetland function of Pond 44 is retained.

4.10.2 Wildlife Monitoring

Wildlife data were collected at Pond 44 in 1998, 2019, and 2020 (HLA, 1998; Burleson, 2020, 2021). California tiger salamanders were not detected in any year, whereas fairy shrimp were present in all years. Wildlife data were not collected in 2016 or 2021 (Yr 3) because there was not enough depth to trigger a survey. Additionally, in 2023 (Yr 5), the vernal pool was dry by the April 26 survey date, so no wildlife data were collected. Therefore, DQO 5 and the applicable wildlife usage performance standard can only be assessed for 2019 (Yr 1) and 2020 (Yr 2). Table 4-121 shows historical wildlife monitoring results.

Table 4-121. Pond 44 (Year 5 Post-Subsurface Munitions Remediation) Historical Wildlife Monitoring Results

Sampling Year	CTS Larvae Abundance (# Individuals)	Fairy Shrimp Abundance (# Individuals)
1998*	Not detected	Moderate
2019	Not detected	Very High (650, 370)
2020	Not detected	High (258)

*baseline year

4.10.2.1 *Data Quality Objective 5*

California tiger salamanders were not detected in any monitoring year, which was consistent with baseline monitoring. Results were consistent with reference vernal pools; CTS were not detected at Pond 997 in 2019, nor Pond 5 or 101 East (East) in 2020.

Fairy shrimp were detected in 2019 (Yr 1) and 2020 (Yr 2), which was consistent with baseline in 1998. Results in 2019 (Yr 1) and 2020 (Yr 2) were consistent with reference vernal pools; fairy shrimp were detected at Pond 101 East (East) in 2019 and 2020, and Pond 5 in 2020.

4.10.2.2 *Performance Standard: Wildlife Usage*

Pond 44, a post-subsurface munitions remediation vernal pool, was in the final year of monitoring in 2023 and met DQO 5. California tiger salamanders were not present in any year, which was consistent with baseline and reference Pond 997 in 2019 and Ponds 5 and 101 East (East) in 2020. Fairy shrimp were detected in 2019 (Yr 1) and 2020 (Yr 2), which was consistent with baseline in 1998. Similarly, fairy shrimp were detected at Pond 101 East (East) in 2019 and 2020, and Pond 5 in 2020. Data quality objectives 1 and 4 were analyzed in the Hydrology Monitoring Annual Report (Chenega, 2023).

4.10.3 Conclusion

Pond 44, a post-subsurface munitions remediation vernal pool, was in the final year (Yr 5) of monitoring in 2023. The vernal pool met the plant cover and species diversity performance standard and met DQO 5 for wildlife usage (see Table 4-122). No further monitoring is recommended for Pond 44.

Table 4-122. Success at Pond 44 (Year 5 Post-Subsurface Munitions Remediation) Based on Performance Standards and Applicable Data Quality Objectives

Performance Standard	Applicable DQO	2019 (Yr 1)	2020 (Yr 2)	2021 (Yr 3)	2023 (Yr 5)	Success
Plant Cover & Species Diversity	DQO 3	On Track	On Track	Not On Track	Not On Track	Met
Wildlife Usage	DQO 5	On Track	On Track	N/A	N/A	Met

*Not applicable; wildlife surveys were not conducted due to insufficient depth

4.11 Pond 54 – Year 5

Pond 54 was monitored in 2023 as a year 5 post-subsurface munitions remediation vernal pool. Vegetation within the Pond 54 watershed was masticated in the summer of 2015 in support of MEC remediation in Unit 23. Risk reduction activities in Unit 23 resulted in subsurface munitions remediation in Pond 54 in 2018. All surveys before 2015 are pre-remediation and are considered baseline. Table 4-123 summarizes the years that monitoring was conducted. The cumulative precipitation graph shows the precipitation for monitoring years at Pond 54 (see Figure 4-61). The 2016-2017, 2018-2019, and 2022-2023 water-years were above-normal, whereas water-years 2003-2004, 2008-2009, 2017-2018, and 2020-2021 were below-normal.

Table 4-123. Pond 54 (Year 5 Post-Subsurface Munitions Remediation) Summary of Historic Surveys for Hydrology, Vegetation, and Wildlife

Survey	Water-Year						
	2003-2004	2008-2009	2016-2017	2017-2018	2018-2019	2020-2021	2022-2023
Hydrology	●		●	●	●	●	●
Vegetation	●				●	●	●
Wildlife	●	●	●		●		●

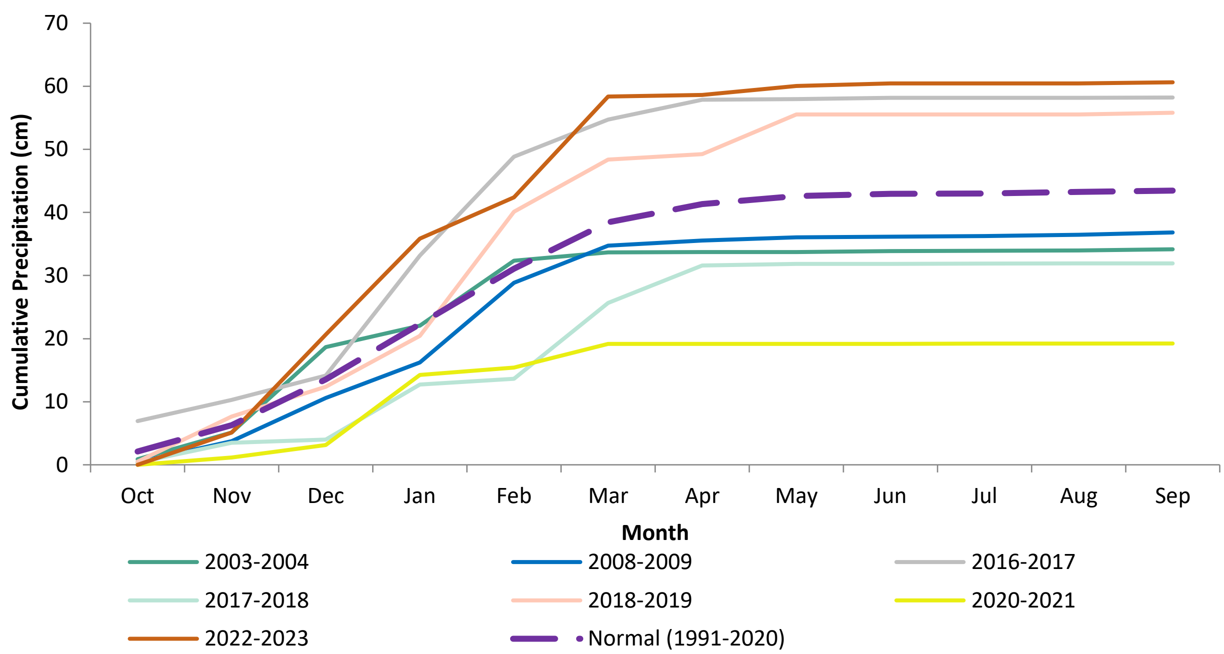

Figure 4-61. Cumulative Monthly Precipitation for Years that Hydrology Monitoring Occurred at Pond 54 (Year 5 Post-Subsurface Munitions Remediation) Compared to the 30-Year Normal (mean 1991-2020) (NPS, 2023; NCEI NOAA, 2023)

4.11.1 Vegetation Monitoring

Vegetation data were collected at Pond 54 in 2004, 2019, 2021, and 2023 (MACTEC, 2005; Burleson 2020, 2022). In 2004, data were collected along two transects close to 50 feet in length. Quadrats were placed at 10-foot intervals, alternating from right to left along the transect. Because 2004 data were collected differently than in other years, strata were combined across the vernal pool to allow for comparison. In 2019 and 2021, data were collected using the methodology described in the Methods section of this report. Data from 2019 (Year 1) and 2023 (Year 5) were compared stratum-to-stratum in Table 4-124 as well as visually in Figure 4-65, however data from 2019 is not the baseline year of monitoring.

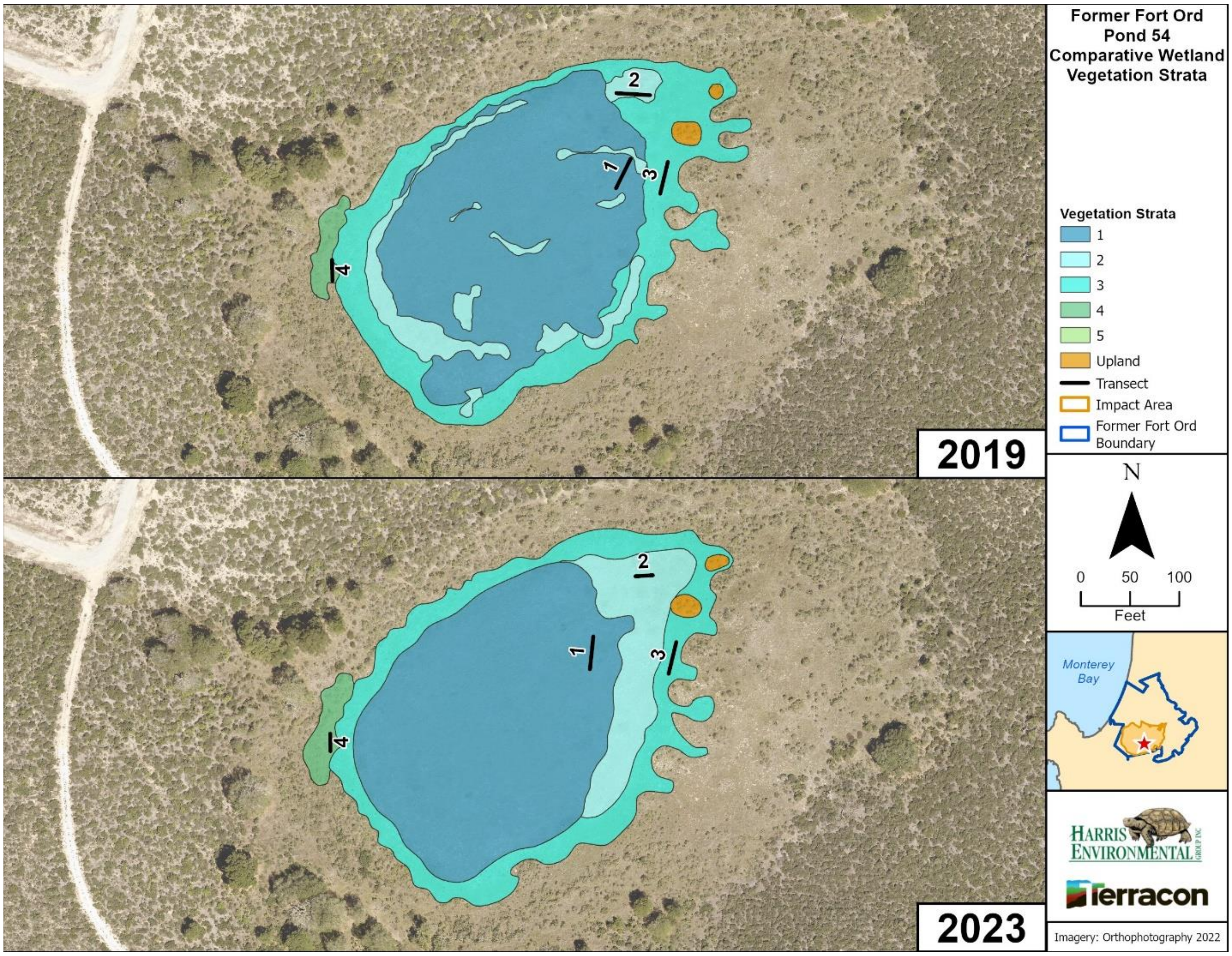

Figure 4-62. Pond 54 (Year 5 Post-Subsurface Munitions Remediation) Vegetation Strata and Transects for 2019 and 2023. This map is not a comparison with baseline; 2019 is Year 1 of monitoring. Baseline data was collected in 2004 using a different methodology.

Table 4-124. Pond 54 (Year 5 Post-Subsurface Munitions Remediation) Vegetative Strata Percentage within the Vernal Pool Basin Boundary

Stratum	Percentage	
	2019*	2023
1	55%	59%
2	11%	13%
3	31%	24.6%
4	2%	2.6%
Upland	1%	0.8%

*2019 is Year 1 of monitoring, baseline data was collected in 2004 using a different methodology.

Absolute percent vegetative cover dramatically decreased between 2004 (baseline) and 2021 (Yr 3), then increased again in 2023 (Yr 5) (see Table 4-125). The absolute percent vegetative cover of Pond 54 in 2023 (Yr 5) was lower than the values observed at the reference vernal pools and thatch/bare ground cover was higher (see Table 4-126).

Table 4-125. Pond 54 (Year 5 Post-Subsurface Munitions Remediation) Absolute Percent Cover

Year	Vegetative Cover	Thatch/Bare Ground
2004*	97.4%	2.5%
2019	85.5%	14.5%
2021	33.8%	66.7%
2023	70.6%	29.4%

*baseline year

Table 4-126. Pond 54 (Year 5 Post-Subsurface Munitions Remediation) and Reference Vernal Pool Absolute Percent Cover in 2023

Vernal Pool	Vegetative Cover	Thatch/Bare Ground
5	74.5%	25.5%
101 East (East)	82.6%	17.4%
997	83.5%	16.7%
54	**70.6%**	**29.4%**

Species richness increased overall between 2004 (baseline) and 2023 (Year 5) at Pond 54. Species richness on transects was 12, 40, 20, and 24 species in 2004, 2019, 2021, and 2023, respectively, whereas overall basin species richness was 79, 53, and 54 species in 2019, 2021, and 2023, respectively (see Table 4-127 and Appendix A Table A-11). The 2004 survey was limited to species on the transects and total vernal pool species richness was not recorded. Pond 54 species richness on transects in 2019 (Yr 1) was within the range observed at the reference vernal pools but was less than the values for the entire basin (Burleson 2020). In 2021 (Yr 3), species richness was less than the range observed at the reference vernal pools for transects and for the entire basin, whereas richness for transects and the entire basin in 2023 (Yr 5) was within the range of reference vernal pool values (Burleson 2022) (See Table 4-128 and Appendix D Tables D-20 and D-40).

Species composition at Pond 54 differed among the monitoring years. This species composition is illustrated on the RACs as the species codes shift along the curve and losses and gains occur from year to year (see Figure 4-63). The dominant species in 2004 (baseline) was rattail sixweeks grass (*Festuca myuros*). In 2019 (Yr 1), the dominant species were brown-headed rush (*Juncus phaeocephalus*), pale spikerush (*Eleocharis macrostachya*), and needle spikerush (*Eleocharis acicularis* var. *acicularis*). Cut-leaved geranium (*Geranium dissectum*) was the dominant species in 2021 (Yr 3), along with moderate cover from pale spikerush and brown-headed rush. Pale spikerush, and needle spikerush were the dominant species in 2023 (Yr 5). A complete comparison of species composition observed at Pond 54 in 2004, 2019, 2021, and 2023 can be found in Appendix E. Figure 4-65 shows a subset of this comparison for species observed with a 2% cover or greater.

The evenness from each year is represented by the slope of the RACs. The evenness between the monitoring years was mostly similar, with a fairly even distribution of the dominant species, appearing as flat at the top, followed by a gradually sloping curve with richness distributed along the entire length. (see Figure 4-64Figure 4-82 and Appendix F). However, in 2023 (Yr 5), there was less evenness between the the most and least dominant species towards the end of the curve. Monitoring years 2019 (Yr 1), 2021 (Yr 3), and 2023 (Yr 5) were all similar to reference Pond 101 East (East) across the same years.

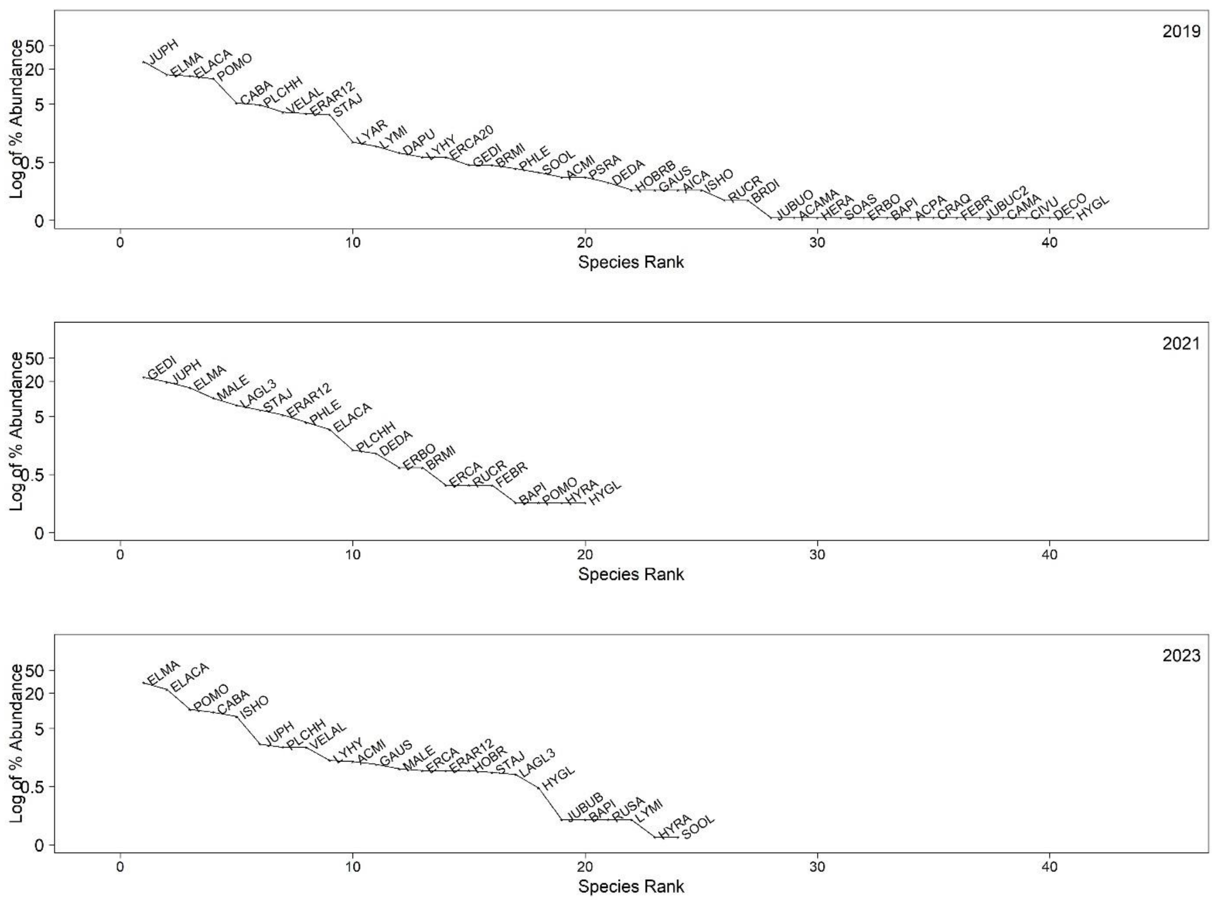

Figure 4-63. Rank Abundance Curves at Pond 54 (Year 5 Post-Subsurface Munitions Remediation) in 2019, 2021 and 2023. Note that the y-axis is in log-10 scale.

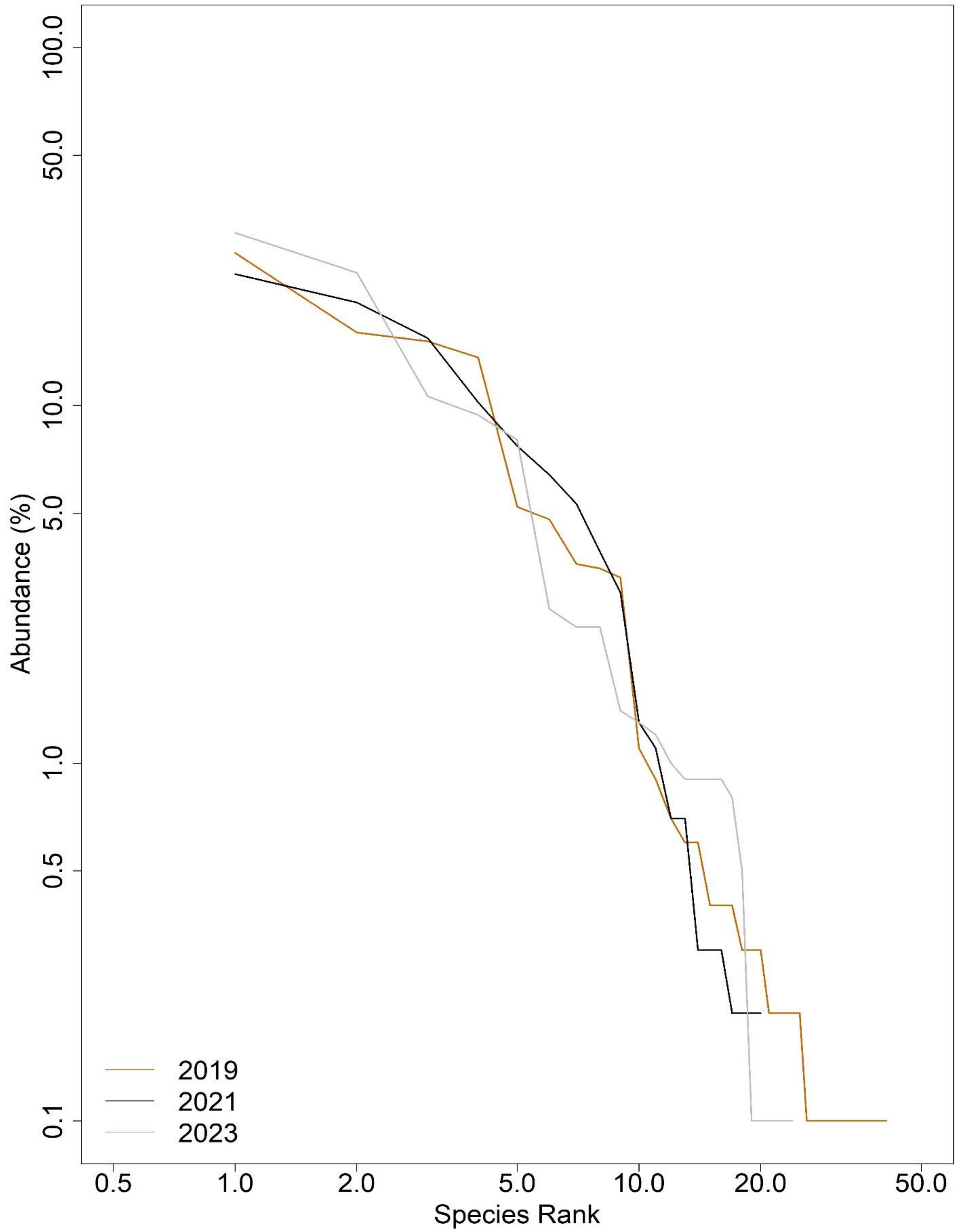

Figure 4-64. Rank Abundance Curves at Pond 54 (Year 5 Post-Subsurface Munitions Remediation) in 2019, 2021, and 2023. Note that the x-axis and y-axis are in log-10 scale

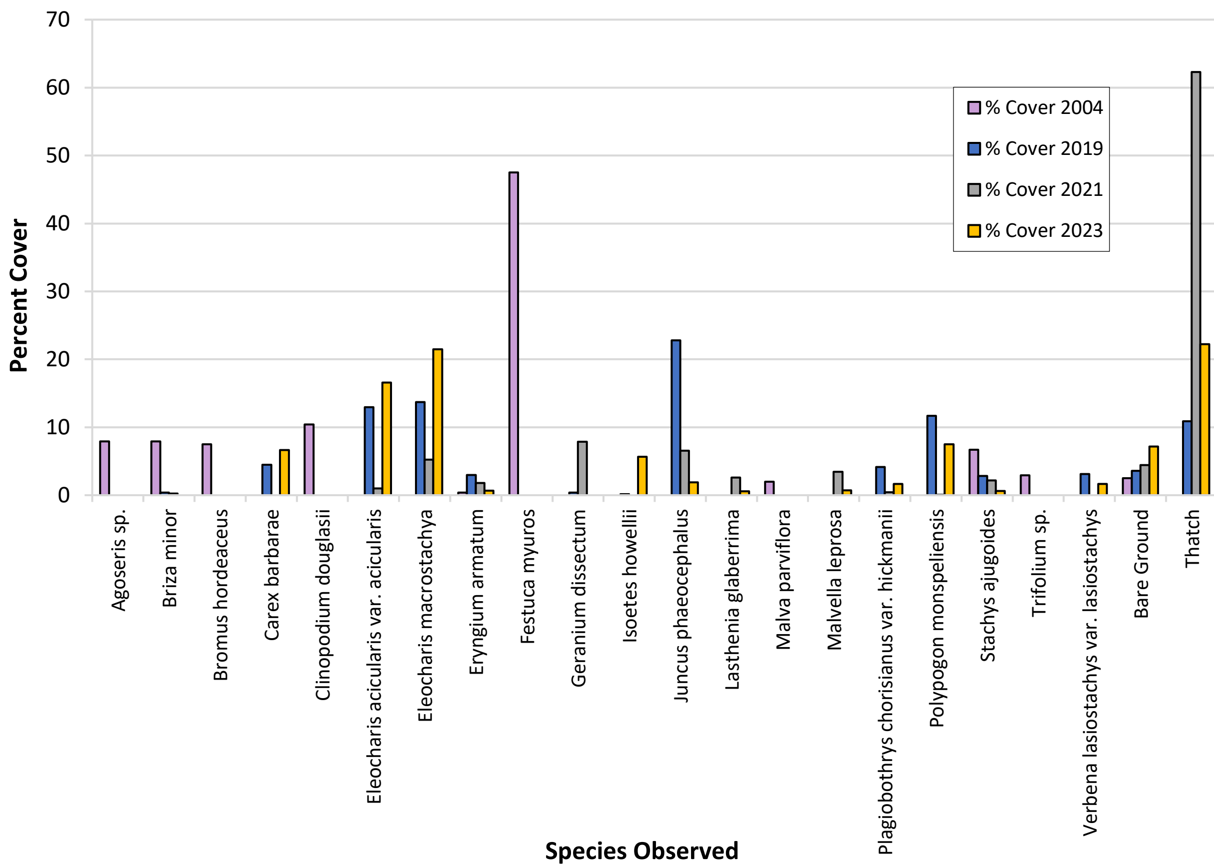

Figure 4-65. Percent Cover of Dominant Species at Pond 54 (Year 5 Post-Subsurface Munitions Remediation)

Native and non-native species richness on Pond 54 were greater than baseline in 2019 (Yr 1) and 2021 (Yr 3) (see Table 4-127). In 2023 (Yr 5), native species richness was also greater than baseline, however, non-native species richness was less. Pond 54 native and non-native species richness were within the range of values observed at the reference vernal pools in 2019 (Yr 1) (Burleson, 2020). Whereas, in 2021 (Yr 3), native species richness was within reference vernal pool values, while non-native species richness was less (Burleson, 2022). By 2023 (Yr 5), native species richness was greater than the range of reference vernal pool values while non-native richness was less (see Table 4-128).

Table 4-127. Pond 54 (Year 5 Post-Subsurface Munitions Remediation) Native and Non-Native Species Richness

Year	Native	Non-Native	Unidentified
2004*	4	6	2
2019	26	14	0
2021	12	8	0
2023	19	5	0

*baseline year

Table 4-128. Pond 54 (Year 5 Post-Subsurface Munitions Remediation) and Reference Vernal Pool Native and Non-Native Species Richness in 2023

Vernal Pool	Native	Non-Native	Unidentified
5	12	12	0
101 East (East)	9	7	0
997	13	14	1
54	**19**	**5**	**0**

The relative percent cover of native species was considerably greater than the baseline year, whereas non-native cover was considerably less than baseline in every year monitored (see Table 4-129). Pond 54 native and non-native cover were within the range of values observed at the reference vernal pools in 2021 (Yr 3), whereas in 2019 (Yr 1) and 2023 (Yr 5) native cover was greater than reference vernal pools, while non-native cover was less (Burleson, 2020, 2022) (see Table 4-130).

Table 4-129. Pond 54 (Year 5 Post-Subsurface Munitions Remediation) Relative Percent Cover of Native and Non-Native Plants

Year	Native	Non-Native	Unidentified
2004*	19.7%	69.2%	11.1%
2019	82.7%	17.3%	0.0%
2021	74.2%	25.8%	0.0%
2023	87.4%	12.6%	0.0%

*baseline year

Table 4-130. Pond 54 (Year 5 Post-Subsurface Munitions Remediation) and Reference Vernal Pool Relative Percent Cover of Native and Non-Native Plants in 2023

Vernal Pool	Native	Non-Native	Unidentified
5	76.3%	23.7%	0.0%
101 East (East)	60.3%	39.7%	0.0%
997	50.0%	49.0%	1.0%
54	**87.4%**	**12.6%**	**0.0%**

Wetland and non-wetland species richness on Pond 54 transects in every monitoring year were greater than baseline values (see Table 4-131). Wetland and non-wetland species richness were within the range of values at the reference vernal pools in 2019 (Yr 1) (Burleson, 2020). Whereas in 2021 (Yr 3), wetland species richness was within the range of reference vernal pool values, while non-wetland species were slightly less (Burleson, 2022). In 2023 (Yr 5), wetland species richness was within the range of reference vernal pool values, while non-wetland species richness was greater (Table 4-132).

Table 4-131. Pond 54 (Year 5 Post-Subsurface Munitions Remediation) Wetland and Non-Wetland Species Richness

Year	Wetland			Non-Wetland		Not Listed
	OBL	FACW	FAC	FACU	UPL	
2004*	2	1	1	3	0	5
2019	8	9	6	6	1	10
2021	5	5	2	4	0	4
2023	7	7	2	4	1	3

*baseline year

Table 4-132. Pond 54 (Year 5 Post-Subsurface Munitions Remediation) and Reference Vernal Pool Wetland and Non-Wetland Species Richness in 2023

Vernal Pool	Wetland			Non-Wetland		Not Listed
	OBL	FACW	FAC	FACU	UPL	
5	6	7	3	3	1	4
101 East (East)	4	6	1	3	0	2
997	4	6	4	4	0	10
54	**7**	**7**	**2**	**4**	**1**	**3**

The relative percent cover of wetland species in every monitoring year was considerably greater than the baseline year, whereas non-wetland cover was considerably less (see Table 4-133). In 2019 (Yr 1) and 2023 (Yr 5), relative percent cover of wetland species was greater than the values observed at reference vernal pools, whereas non-wetland cover was less than reference (Burleson, 2020) (Table 4-134). Whereas, in 2021 (Yr 3), wetland and non-wetland cover were within the range of values of reference vernal pools (Burleson, 2022).

Table 4-133. Pond 54 (Year 5 Post-Subsurface Munitions Remediation) Relative Percent Cover of Wetland and Non-Wetland Species

Year	Wetland			Non-Wetland		Not Listed
	OBL	FACW	FAC	FACU	UPL	
2004*	7.7%	0.4%	8.1%	67.1%	0.0%	16.6%
2019	40.2%	45.6%	10.6%	1.2%	0.3%	2.0%
2021	33.8%	29.9%	1.0%	11.3%	0.0%	24.0%
2023	67.4%	15.6%	11.8%	3.4%	0.1%	1.8%

*baseline year

Table 4-134. Pond 54 (Year 5 Post-Subsurface Munitions Remediation) and Reference Vernal Pool Relative Percent Cover of Wetland and Non-Wetland Species in 2023

Vernal Pool	Wetland			Non-Wetland		Not Listed
	OBL	FACW	FAC	FACU	UPL	
5	61.4%	29.0%	3.1%	3.7%	0.1%	2.7%
101 East (East)	14.5%	53.4%	0.1%	9.1%	0.0%	22.9%
997	31.5%	28.9%	7.4%	9.0%	0.0%	23.2%
54	**67.4%**	**15.6%**	**11.8%**	**3.4%**	**0.1%**	**1.8%**

4.11.1.1 *Data Quality Objective 3*

Observable changes in hydrophytic vegetation between surveys were largely associated with precipitation fluctuations as well as differing methodologies. Changes are expected in relation to precipitation given the dynamic nature of vernal pools and the close relationship between the hydroperiod and wetland vegetation composition. While 2019 (Yr 1) and 2023 (Yr 5) were above-normal water-years, 2021 (Yr 3) was below-normal, and the first of two consecutive droughts. Species composition, richness, and cover between the three monitoring years were thus quite varied.

As mentioned in previous reports, data collection methodologies created some variability when comparing from year to year. In 2004, the transects were placed in “transitional and emergent habitats” and “sampling characterized wetland-influenced vegetation and associated transitional herbaceous species” which differs from the methods in 2019, 2021, and 2023 which focuses on placing transects within the wetland in representative locations in each stratum (MACTEC, 2004).

Vegetative cover in Pond 54 was dominated by native and wetland plant species during year 5 post-subsurface munitions remediation monitoring in 2023. Pond 54 wetland vegetation results varied by year. In 2019 (Yr 1), results were generally within the range of baseline and/or reference vernal pools, except that native cover was greater than both. In 2021 (Yr 3), results were generally within range of baseline and/or reference vernal pools, however non-native and non-wetland richness were greater than baseline but less than reference vernal pools. The increase in non-native and non-wetland richness from baseline was likely related to the below-normal water-year, but also likely related to the different methodology from baseline methodology. In comparison to reference data however, non-native and non-wetland richness were less than reference, which was favorable.

The wetland vegetation conditions shifted by 2023 (Yr 5), where the exceptions to being in the range of baseline and/or reference vernal pools were mostly favorable. Native species richness and cover, and wetland species cover were greater than baseline and reference vernal pool values, while non-native richness and cover and non-wetland cover were less than baseline and reference vernal pool values. The increase in native richness, native cover, and wetland cover is not concerning as native and wetland plants generally support a well-functioning vernal pool ecosystem. However, non-wetland species richness was greater than baseline, and greater than the range of reference vernal pool values, although only by a single species, and was within the range of the previous monitoring years.

4.11.1.2 *Performance Standard: Plant Cover and Species Diversity*

Pond 54, a post-mastication and post-subsurface munitions remediation vernal pool, met the performance standard by year 5 in 2023. The species composition, richness, and native and wetland species relative abundances were similar to baseline and/or reference vernal pool conditions, with a few exceptions that are likely related to the historic below-normal water-year in 2021 and/or differences in sampling methodology from baseline year. Generally, the exceptions seen by 2023 were favorable for wetland function. The increase in non-wetland richness in 2023 (Yr 5) was only one species greater than the previous monitoring year, and one greater than the range of reference vernal pools. The evaluation of meeting the vegetation performance standard according to the Wetland Plan, is to "aid in determining whether vegetation in disturbed wetlands is similar enough to that in wetlands before MEC to determine whether wetland function is retained." The decision for whether a vernal pool has met the performance standard is based on reviewing all years of monitoring data. The results differ between the three years, but the intent of the performance standard has been met based on the consideration of water-years and that the wetland function of Pond 54 is retained.

4.11.2 Wildlife Monitoring

Wildlife data were collected at Pond 54 in 2004, 2009, 2017, 2019, and 2023 (MACTEC, 2005; Shaw, 2010, Burleson, 2018, 2020). California tiger salamander larvae were not detected in 2004 but were present in 2017, 2019, and 2023; CTS eggs were observed in 2009. Fairy shrimp were not detected in any year, although surveys in 2023 (Yr 5) were delayed from normal survey times in February-April, which could have impacted potential detection for year 5. The vernal pool did not hold sufficient depth for surveys to be completed in 2021. Therefore, DQO 5 and the applicable wildlife usage performance standard will only be assessed for 2019 (Yr 1) and 2023 (Yr 5). Table 4-135 shows historic wildlife monitoring results.

Table 4-135. Pond 54 (Year 5 Post-Subsurface Munitions Remediation) Historic Wildlife Monitoring Results

Sampling Year	CTS Larvae Abundance (# Individuals)	Fairy Shrimp Abundance (# Individuals)
2004*	Not detected	Not detected
2009*	CTS eggs present; no larvae	Not detected
2017	Few (1, 4, 2)	Not detected
2019	Common (14, 14)	Not detected
2023	Few (1, 5)	Not detected

*baseline year

4.11.2.1 *Data Quality Objective 5*

California tiger salamanders were detected in 2017, 2019 (Yr 1) and 2023 (Yr 5). This was partially consistent with baseline monitoring, in which there were no CTS detected in 2004, but CTS eggs were found in 2009. These results are not concerning, and indicative of well-functioning wetland conditions. CTS were also detected in Ponds 5 and 101 East (East), thus results for the monitoring years were consistent with reference vernal pools.

Fairy shrimp were not detected in any monitoring year, which was consistent with baseline results and partially consistent with reference vernal pool values. Results in 2019 (Yr 1) were not consistent with Ponds 5 or 101 East (East), however by 2023 (Yr 5), results were consistent with all reference vernal pools.

4.11.2.2 *Performance Standard: Wildlife Usage*

Pond 54, a post-subsurface munitions remediation vernal pool, was in the final year (5) of monitoring in 2023 and met DQO 5. California tiger salamanders were present in 2017, 2019 (Yr 1), and 2023 (Yr 5). CTS were also observed at reference Ponds 5 and 101 East (East), but were not observed in basline surveys at Pond 54. Fairy shrimp were not detected in any monitoring year, which was consistent with baseline data and partially with reference vernal pool data. Data quality objectives 1 and 4 were analyzed in the Hydrology Monitoring Annual Report (Chenega, 2023).

4.11.3 Conclusion

Pond 54, a post-subsurface munitions remediation vernal pool, was in the final year (5) of monitoring in 2023. The vernal pool met the plant cover and species diversity performance standard and met DQO 5 for wildlife usage (see Table 4-136). No further monitoring is recommended for Pond 54.

Table 4-136. Success at Pond 54 (Year 5 Post-Subsurface Munitions Remediation) Based on Performance Standards and Applicable Data Quality Objectives

Performance Standard	Applicable DQO	2019 (Yr 1)	2021 (Yr 3)	2023 (Yr 5)	Success
Plant Cover & Species Diversity	DQO 3	On Track	On Track	On Track	Met
Wildlife Usage	DQO 5	On Track	N/A	On Track	Met

*Not applicable; wildlife surveys were not conducted due to insufficient depth

4.12 Pond 60 – Year 5

Pond 60 was monitored in 2023 as a year 5 post-subsurface munitions remediation vernal pool. Pond 60 was monitored for baseline conditions in 2015 and 2016. Grasses and shrubs in and around Pond 60 were masticated in the summer of 2017 to support MEC remediation activities. Pond 60 had intrusive anomaly investigations in 2018. Table 4-137 summarizes the years that monitoring occurred and surveys were conducted. The cumulative precipitation graph shows precipitation for years in which hydrology monitoring was conducted at Pond 60 (see Figure 4-66). The 2015-2016, 2018-2019, and 2022-2023 water-years were above normal, whereas the 2014-2015, 2017-2018, and 2020-2021 water-years were below normal. Water-year 2019-2020 was similar to the cumulative normal water-year.

Table 4-137. Pond 60 (Year 5 Post-Subsurface Munitions Remediation) Summary of Historical Surveys for Hydrology, Vegetation, and Wildlife

Survey	Water-Year						
	2014-2015	2015-2016	2017-2018	2018-2019	2019-2020	2020-2021	2022-2023
Hydrology	●	●	●	●	●	●	●
Vegetation	●		●	●	●	●	●
Wildlife	●	●	●	●	●	●	●

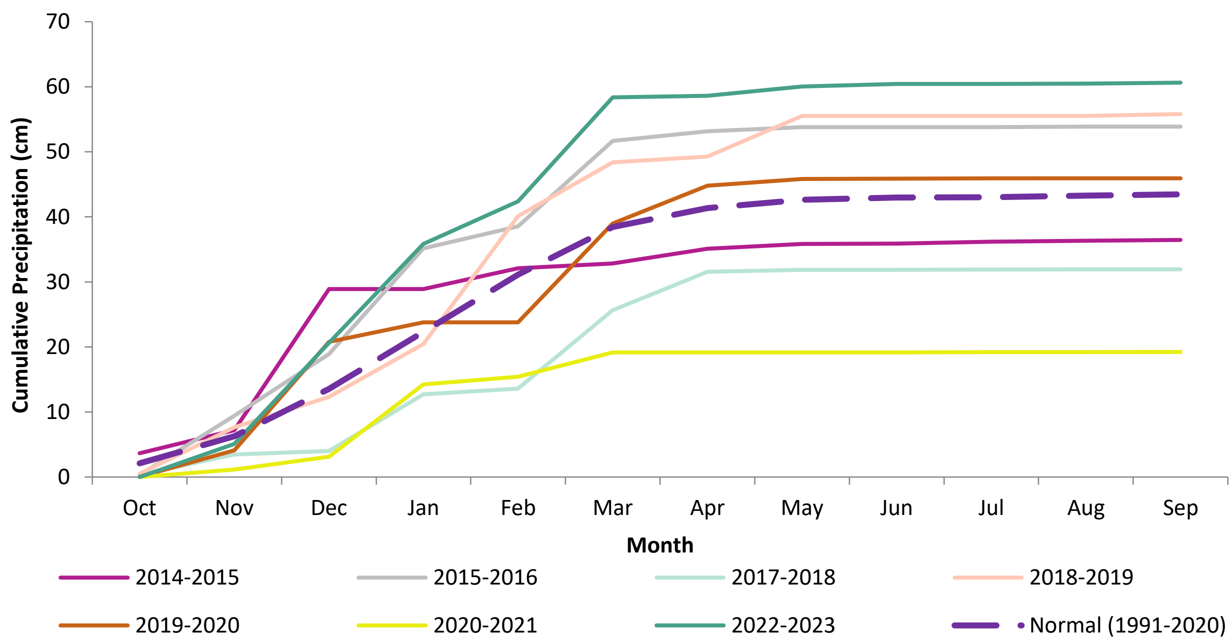

Figure 4-66. Cumulative Monthly Precipitation for Years that Hydrology Monitoring Occurred at Pond 60 (Year 5 Post-Subsurface Munitions Remediation) Compared to the 30-Year Normal (mean 1991-2020) (NPS, 2023; NCEI NOAA, 2023)

4.12.1 Vegetation Monitoring

Vegetation data were collected at Pond 60 in 2015, 2018-2021, and 2023 (Burleson, 2016, 2019, 2020, 2021, 2022). Data were collected using the methodology described in the Methods section of this report. Data from 2015 and 2023 were compared stratum-to-stratum in Table 4-138 as well as visually in Figure 4-67.

Table 4-138. Pond 60 (Year 5 Post-Subsurface Munitions Remediation) Vegetative Strata Percentage within the Vernal Pool Basin Boundary

Stratum	Percentage	
	2015	2023
1	7%	10%
2	35%	44%
3	3%	23%
4	27%	22%
5	2%	N/A
6	26%	N/A
Upland	N/A	1%

Figure 4-67. Pond 60 (Year 5 Post-Subsurface Munitions Remediation) Vegetation Strata and Transects for 2015 and 2023

Absolute percent vegetative cover at Pond 60 was greater than baseline in 2019 (Yr 1) and 2023 (Yr 5), whereas vegetative cover was less than baseline in 2020 (Yr 4) and 2021 (Yr 3) (see Table 4-139). The absolute percent vegetative cover of Pond 60 in 2020 (Yr 2) and 2023 (Yr 5) was within the range of values observed at reference vernal pools (Burleson, 2021) (see Table 4-140). In 2021 (Yr 3), absolute percent vegetative cover was slightly less than the values observed at the reference vernal pools, whereas in 2019 (Yr 1), vegetative cover was slightly greater than reference vernal pool values (Burleson, 2020, 2022).

Table 4-139. Pond 60 (Year 5 Post-Subsurface Munitions Remediation) Absolute Percent Cover

Year	Vegetative Cover	Thatch/Bare Ground
2015*	61.8%	38.4%
2018	40.8%	59.7%
2019	77.5%	22.5%
2020**	54.5%	45.5%
2021†	34.4%	65.6%
2023	80.0%	20.0%

*baseline year
**These values changed from past reports. Due to a formula error, three species values were not counted in the 2020 report. The edits have been reflected in the 2023 report and deliverable. Vegetative cover increased by 0.7%.
†Values in this table changed from past reports. In 2021 report, *Pseudognaphalium* sp. was included but was not counted numerically because the value was so small that the formula showed it as 0.0. The edits have been reflected in the 2023 report and deliverable. Vegetative cover increased by 0.1%.

Table 4-140. Pond 60 (Year 5 Post-Subsurface Munitions Remediation) and Reference Vernal Pool Absolute Percent Cover in 2023

Vernal Pool	Vegetative Cover	Thatch/Bare Ground
5	74.5%	25.5%
101 East (East)	82.6%	17.4%
997	83.5%	16.7%
60	**80.0%**	**20.0%**

Species richness in 2023 (Yr 5) was the same as baseline species richness, whereas all previous monitoring years were greater. Species richness on transects was 13, 19, 14, 16, 22, and 13 species in 2015, 2018, 2019, 2020, 2021, and 2023, respectively, whereas overall basin species richness was 30, 59, 46, 57, 60, and 40 species, respectively (see Table 4-141 and Appendix A Table A-12). Pond 60 species richness in 2019 (Yr 1), 2020 (Yr 2), and 2023 (Yr 5) was lower than the values observed at the reference vernal pools on transects and for the entire basin (Burleson, 2020, 2021) (see Table 4-142 and Appendix D Tables D-20 and D-40). Whereas, in 2021 (Yr 3), species richness was within the range of values observed at the reference vernal pools on transects and for the entire basin (Burleson, 2022).

Species composition at Pond 60 was similar in 2015, 2018-2021, and 2023. This species composition is illustrated on the RACs as the species codes shift along the curve and losses and gains occur from year to year (see Figure 4-68 and Figure 4-69). The dominant species in all years were salt grass (*Distichlis spicata*), brown-headed rush (*Juncus phaeocephalus*), and pale spikerush (*Eleocharis macrostachya*), with rabbitfoot grass (*Polypogon monspeliensis*) as a codominant species in 2019 (Yr 1). A complete comparison of species composition observed at Pond 60 in 2015, 2018-2021, and 2023 can be found in

Appendix E. Figure 4-71 shows a subset of this comparison for species observed with a 2% cover or greater.

The evenness from each year for Pond 60 is represented by the slope of the RACs. The evenness is similar from year to year with a steep slope in which richness is distributed along the entire curve. This implies less evenness among species, as the abundances for each are different between each other. Typically, “structurally complex systems, such as a fen [or vernal pool] system,” as explained in Verberk, 2011, “are species rich and have a more even community abundance pattern, possibly owing to a fine partitioning of available niches.” However, Pond 60 had fewer species than other ponds with less evenness, except for years 2018 and 2021 (Yr 3), which were more species rich. Every year of monitoring at Pond 60 shows a steep curve with species partitioned evenly along the slope, although 2019 (Yr 1), 2020 (Yr 2), and 2023 (Yr 5) had a steeper distribution of the top species, which differed from baseline. Compared to reference vernal pool RACs, Pond 60 was most similar to Pond 5, which also had less even distribution among species, and less richness (see Figure 4-70, and Appendix F).

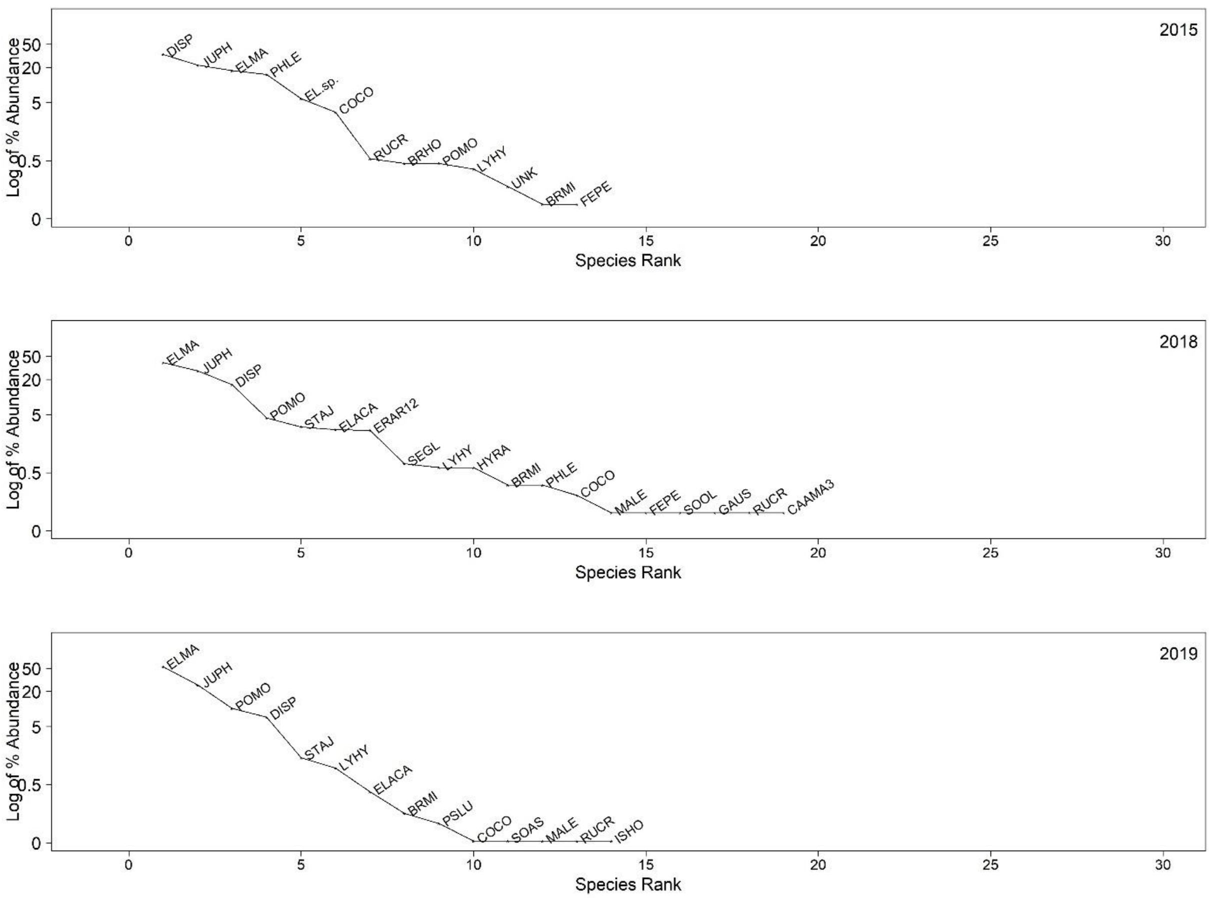

Figure 4-68. Rank Abundance Curves at Pond 60 (Year 5 Post-Subsurface Munitions Remediation) in 2015, 2018 and 2019. Note that the y-axis is in log-10 scale.

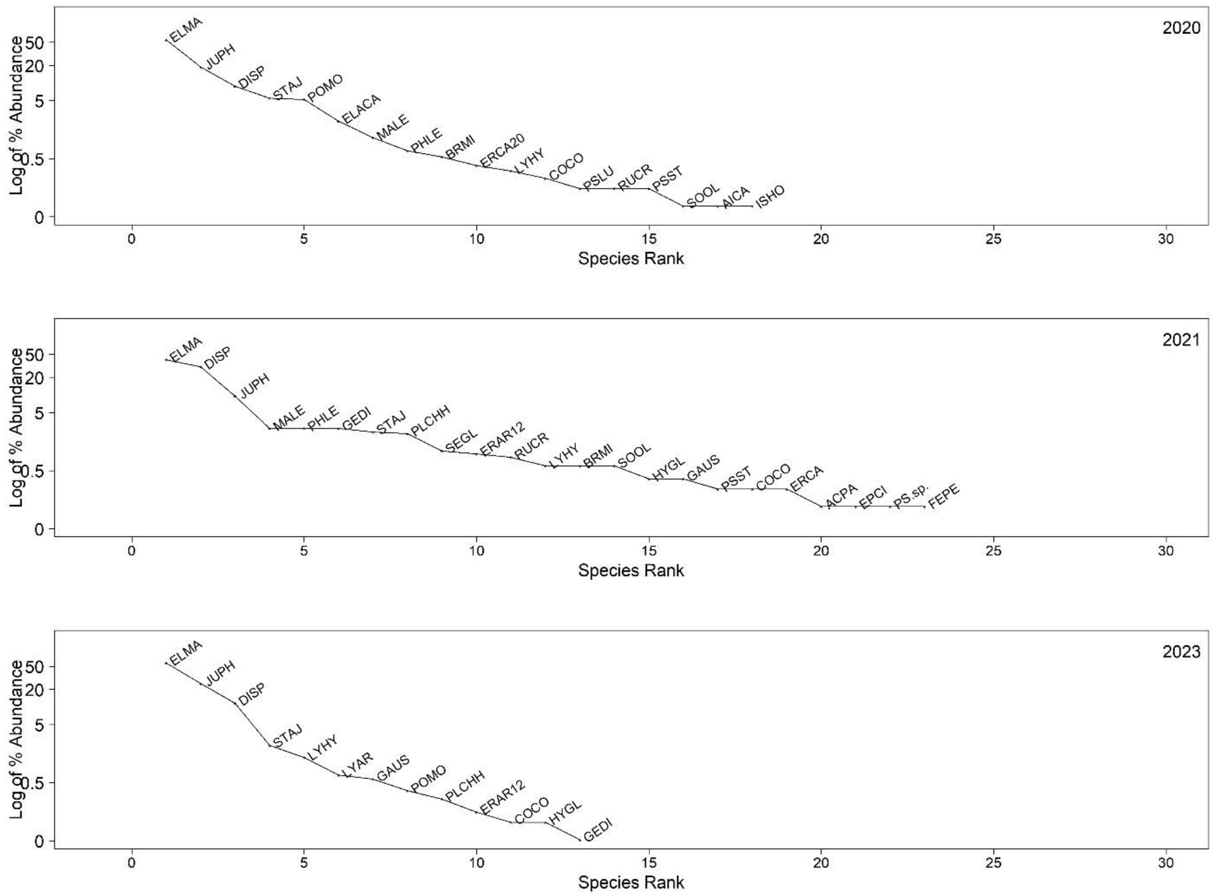

Figure 4-69. Rank Abundance Curves at Pond 60 (Year 5 Post-Subsurface Munitions Remediation) in 2020, 2021 and 2023. Note that the y-axis is in log-10 scale.

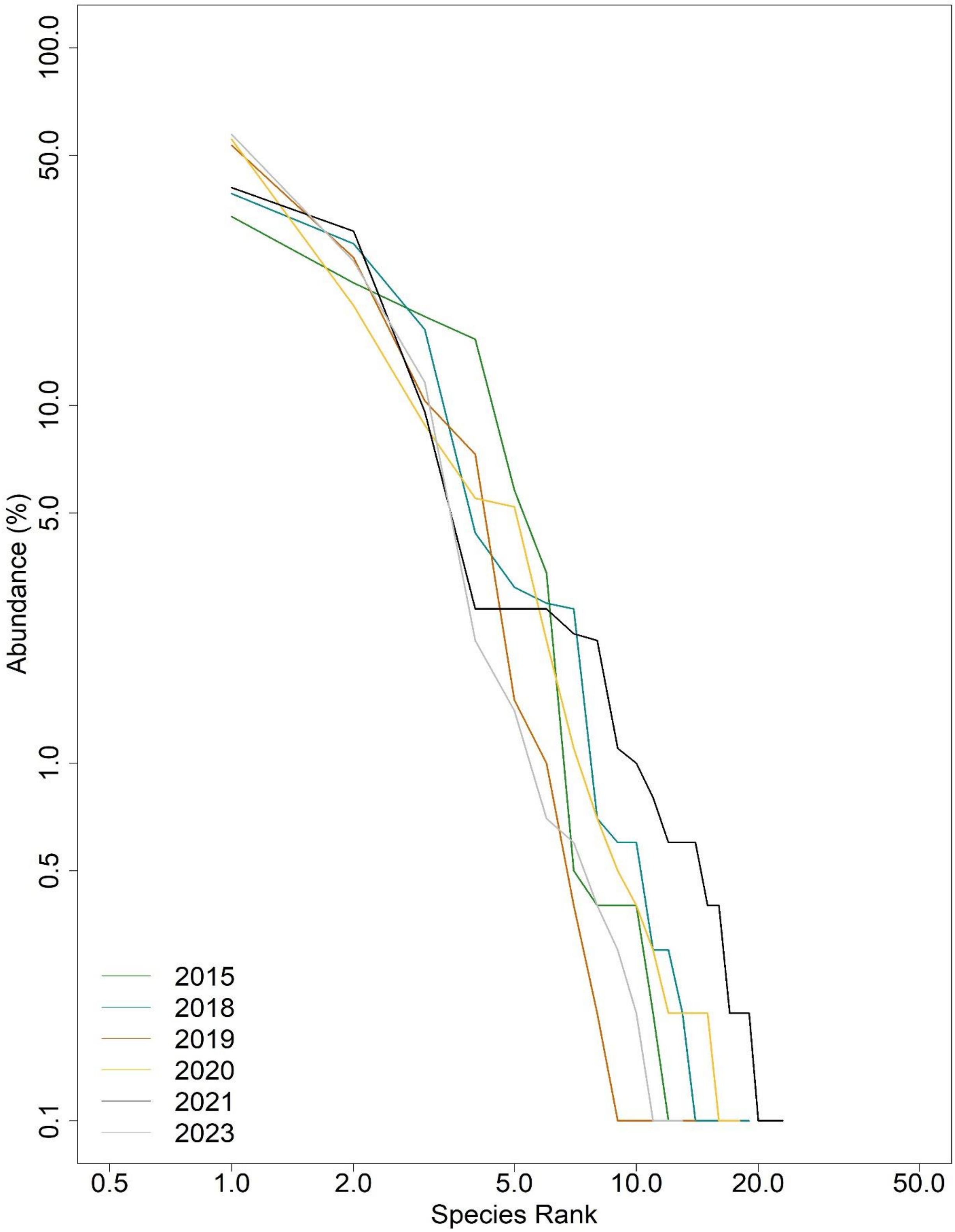

Figure 4-70. Rank Abundance Curves at Pond 60 (Year 5 Post-Subsurface Munitions Remediation) in 2015, 2018-2021, and 2023. Note that the y-axis is in log-10 scale.

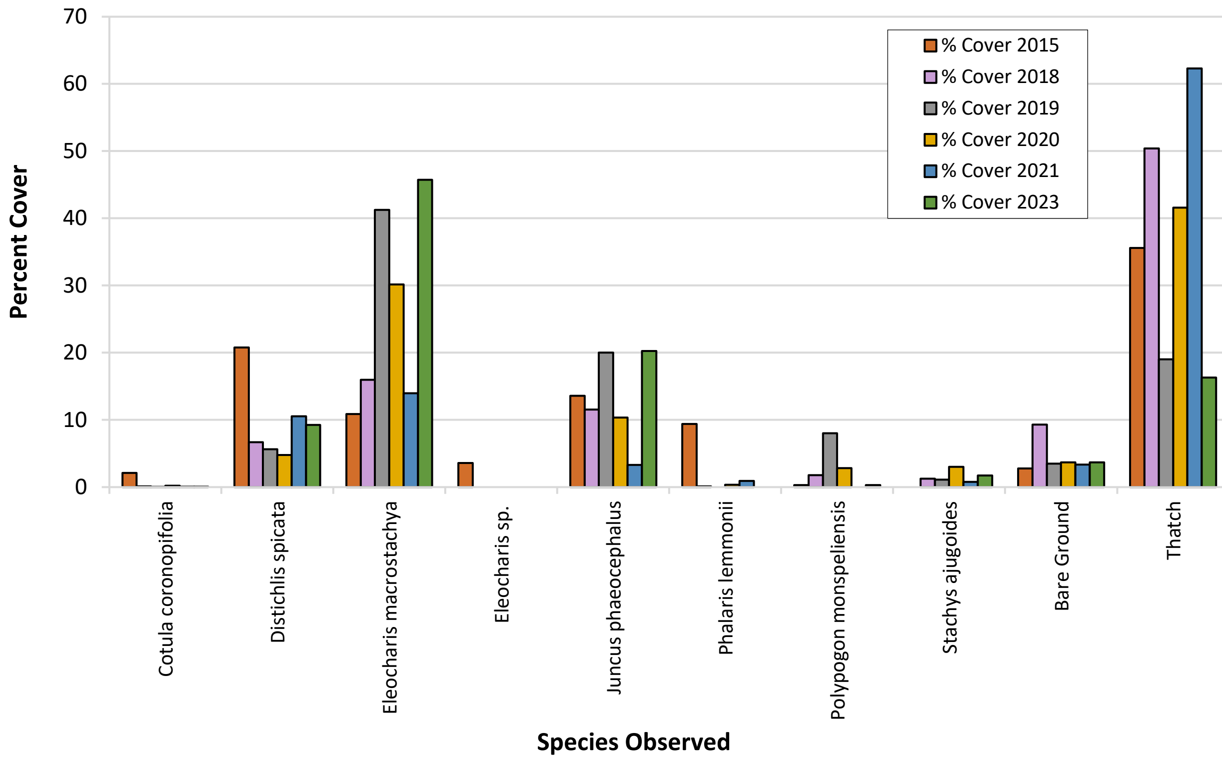

Figure 4-71. Percent Cover of Dominant Species at Pond 60 (Year 5 Post-Subsurface Munitions Remediation)

Native and non-native species richness on Pond 60 transects were greater than in the baseline year in 2020 (Yr 2) and 2021 (Yr 3) (see Table 4-141). Whereas, in 2019 (Yr 1) and 2023 (Yr 5), native species richness was greater than baseline, while non-native species richness was the same as baseline richness in 2019, and less than baseline species richness in 2023. Pond 60 native and non-native species richness in 2019 (Yr 1), 2020 (Yr 2), and 2023 (Yr 3) were less than the values observed in reference vernal pools (Burleson, 2020, 2021) (see Table 4-142). In 2021 (Yr 3), native species richness was within the range of values observed at reference vernal pools, while non-native species richness was less than reference (Burleson, 2022).

Table 4-141. Pond 60 (Year 5 Post-Subsurface Munitions Remediation) Native and Non-Native Species Richness

Year	Native	Non-Native	Unidentified
2015*	4	7	2
2018	10	9	0
2019	7	7	0
2020**	10	8	0
2021†	13	9	1
2023	7	6	0

*baseline year
**These values changed from past reports. Due to a formula error, two species values were not counted. The edits have been reflected in the 2023 report and deliverable. Native cover and non-native cover increased by 1 species each.
†Values in this table changed from past reports. In 2021 report, *Pseudognaphalium* sp. was included but was not counted numerically because the value was so small that the formula showed it as 0.0. The edits have been reflected in the 2023 report and deliverable. Unidentified richness increased by 1 species.

Table 4-142. Pond 60 (Year 5 Post-Subsurface Munitions Remediation) and Reference Vernal Pool Native and Non-Native Species Richness in 2023

Vernal Pool	Native	Non-Native	Unidentified
5	12	12	0
101 East (East)	9	7	0
997	13	14	1
60	**7**	**6**	**0**

Pond 60 relative percent cover of native species was higher than baseline in every monitoring year, except 2019 (Yr 1), which was slightly less than baseline (see Table 4-143). Similarly, non-native cover was higher than baseline in every monitoring year, except 2023 (Yr 5), which was less than baseline. In every monitoring year, relative percent cover of native species was greater than reference vernal pools, whereas the non-native species cover was less than reference (Burleson, 2020, 2021, 2022) (see Table 4-144).

Table 4-143. Pond 60 (Year 5 Post-Subsurface Munitions Remediation) Relative Percent Cover of Native and Non-Native Plants

Year	Native	Non-Native	Unidentified
2015*	88.5%	5.5%	6.0%
2018	92.8%	7.2%	0.0%
2019	88.3%	11.7%	0.0%
2020	93.3%	6.7%	0.0%
2021**	92.7%	7.2%	0.1%
2023	97.3%	2.7%	0.0%

*baseline year
**Values in this table changed from past reports. In 2021 report, *Pseudognaphalium* sp. was included but was not counted numerically because the value was so small that the formula showed it as 0.0. The edits have been reflected in the 2023 report and deliverable. Native relative percent decreased by 0.1%, whereas unidentified relative percent cover increased by 0.1%.

Table 4-144. Pond 60 (Year 5 Post-Subsurface Munitions Remediation) and Reference Vernal Pool Relative Percent Cover of Native and Non-Native Plants in 2023

Vernal Pool	Native	Non-Native	Unidentified
5	76.3%	23.7%	0.0%
101 East (East)	60.3%	39.7%	0.0%
997	50.0%	49.0%	1.0%
60	**97.3%**	**2.7%**	**0.0%**

Wetland and non-wetland species richness on Pond 60 transects were greater than in the baseline year in 2019 (Yr 1), 2020 (Yr 2), and 2021 (Yr 3) (see Table 4-145). Whereas, in 2023 (Yr 5), wetland richness was the same as baseline while non-wetland richness was less than baseline. In 2020 (Yr 2) and 2021 (Yr 3), wetland species richness was within the range observed at reference vernal pools, whereas in 2019 (Yr 1) and 2023 (Yr 5), wetland species richness was less than reference (Burleson, 2020, 2021, 2022) (see Table 4-146). Non-wetland richness was less than the reference vernal pool values in every monitoring year (Burleson, 2020, 2021, 2022).

Table 4-145. Pond 60 (Year 5 Post-Subsurface Munitions Remediation) Wetland and Non-Wetland Species Richness

Year	Wetland			Non-Wetland		Not Listed
	OBL	FACW	FAC	FACU	UPL	
2015*	3	4	3	1	0	2
2018	5	6	3	2	1	2
2019	6	4	2	2	0	0
2020**	6	5	3	3	1	0
2021†	5	5	4	2	1	6
2023	5	4	1	0	0	3

*baseline year
**These values changed from past reports. Due to a formula error, two species values were not counted. The edits have been reflected in the 2023 report and deliverable. FACU richness increased from 1 to 3.
†Values in this table changed from past reports. Due to a formula error, the wetland indicator status was not updated for one species. The edits have been reflected in the 2023 report and deliverable. FACW richness increased from 4 to 5.

Table 4-146. Pond 60 (Year 5 Post-Subsurface Munitions Remediation) and Reference Vernal Pool Wetland and Non-Wetland Species Richness in 2023

Vernal Pool	Wetland			Non-Wetland		Not Listed
	OBL	FACW	FAC	FACU	UPL	
5	6	7	3	3	1	4
101 East (East)	4	6	1	3	0	2
997	4	6	4	4	0	10
60	**5**	**4**	**1**	**0**	**0**	**3**

Relative percent cover of wetland species was greater than baseline in 2019 (Yr 1), 2020 (Yr 2), and 2023 (Yr 3), whereas in 2021 (Yr 3), wetland cover was less. In 2019 (Yr 1) and 2023 (Yr 5), non-wetland relative percent cover was less than baseline, while in 2020 (Yr 2) and 2021 (Yr 3), non-wetland cover was greater than baseline. The relative percent cover of wetland species for every year monitored was greater than the values observed at the reference vernal pools while non-wetland species cover was less than reference (Burleson, 2020, 2021, 2022) (see Table 4-148).

Table 4-147. Pond 60 (Year 5 Post-Subsurface Munitions Remediation) Relative Percent Cover of Wetland and Non-Wetland Species

Year	Wetland			Non-Wetland		Not Listed
	OBL	FACW	FAC	FACU	UPL	
2015*	21.4%	71.4%	0.8%	0.4%	0.0%	6.0%
2018	45.8%	52.1%	0.5%	0.7%	0.1%	0.8%
2019	56.2%	43.5%	0.2%	0.1%	0.0%	0.0%
2020**	63.7%	33.8%	0.8%	1.6%	0.1%	0.0%
2021†	45.9%	44.0%	1.8%	2.9%	0.6%	4.7%
2023	61.1%	37.4%	0.7%	0.0%	0.0%	0.7%

*baseline year

**These values changed from past reports. Due to a formula error, two species values were not counted. The edits have been reflected in the 2023 report and deliverable. OBL relative percent cover decreased by 0.8%, FACW decreased by 0.4%, FAC decreased by 0.1%, and FACU increased by 1.1%.

†Values in this table changed from past reports. Due to a formula error, the wetland indicator status was not updated for one species. The edits have been reflected in the 2023 report and deliverable. OBL relative percent cover decreased by 0.1%, whereas FACW increased by 0.1%.

Table 4-148. Pond 60 (Year 5 Post-Subsurface Munitions Remediation) and Reference Vernal Pool Relative Percent Cover of Wetland and Non-Wetland Species in 2023

Vernal Pool	Wetland			Non-Wetland		Not Listed
	OBL	FACW	FAC	FACU	UPL	
5	61.4%	29.0%	3.1%	3.7%	0.1%	2.7%
101 East (East)	14.5%	53.4%	0.1%	9.1%	0.0%	22.9%
997	31.5%	28.9%	7.4%	9.0%	0.0%	23.2%
60	**61.1%**	**37.4%**	**0.7%**	**0.0%**	**0.0%**	**0.7%**

4.12.1.1 *Data Quality Objective 3*

Observable changes in hydrophytic vegetation between surveys were largely associated with precipitation fluctuations. This is expected given the dynamic nature of vernal pools and the close relationship between the hydroperiod and wetland vegetation composition. Vegetative cover in Pond 60 was dominated by native and wetland plant species during year 5 post-subsurface munitions remediation monitoring in 2023, as well as all previous monitoring years.

Pond 60 wetland vegetation results generally similar to baseline and reference results in 2019 (Yr 1), 2020 (Yr 2), and 2021 (Yr 3), however in 2023 (Yr 5), results generally differed from baseline and/or reference in beneficial ways. By the year 5 monitoring year, non-native and non-wetland species richness and cover were less than baseline and the observed range of values at reference vernal pools. In addition, native and wetland species cover were greater than baseline and reference vernal pool values, as was the case in 2020 (Yr 2) monitoring. The increase in native and wetland cover, as well as the decrease in non-native and non-wetland richness and cover is not concerning as it supports a well-functioning vernal pool ecosystem.

Two exceptions, were that in 2023 (Yr 5), native and wetland species richness were less than the range of reference vernal pool values. A possible explanation for this could be that species richness was low for the entirety of Pond 60, especially as compared to other monitored vernal pools. Higher precipitation years can reduce species richness, especially that of non-native species, but also native species richness if inundation remains high throughout the season, as many ponds did this year. Javornik & Collinge, 2016 referred to high precipitation years in vernal pool environments, as an “ecological filter”, which impairs the establishment of non-native species. However, native species richness was greater than baseline and wetland richness was the same as baseline, thus neither was beyond the range of both. An additional exception was in 2021 (Yr 3), when non-native and non-wetland cover were greater than baseline, but were less than reference values. Rather than remediation, this variability is thought to have been due to low precipitation that water-year, which increased non-native and non-wetland cover throughout the study area that year.

4.12.1.2 *Performance Standard: Plant Cover and Species Diversity*

Pond 60, a post-subsurface munitions remediation vernal pool, met the performance standard in 2023 (Yr 5). The species composition and native and wetland species relative abundances were greater than baseline and/or reference vernal pool conditions with some variability with species richness. In addition, non-native and non-wetland values were less than both baseline and reference vernal pool values in Year 5. Pond 60 provided suitable wetland habitat in 2023.

4.12.2 Wildlife Monitoring

Wildlife data were collected at Pond 60 in 2015, 2016, 2018-2021, and 2023 (Burleson, 2016, 2017, 2019, 2020, 2021, 2022). California tiger salamander larvae were observed in 2015, 2016, 2019, 2020, and 2023. Fairy shrimp were present in 2019. Table 4-149 shows historical wildlife monitoring results.

Table 4-149. Pond 60 (Year 5 Post-Subsurface Munitions Remediation) Historical Wildlife Monitoring Results

Sampling Year	CTS Larvae Abundance (# Individuals)	Fairy Shrimp Abundance (# Individuals)
2015*	Common (23, 19, 28)	Not detected
2016*	Few – Common (3, 11, 7)	Not detected
2018	Not detected	Not detected
2019	Few – Common (5, 53, 18)	Low (6)
2020	Few (1, 5, 7)	Not detected
2021	Not detected	Not detected
2023	Common (41)	Not detected

*baseline year

4.12.2.1 *Data Quality Objective 5*

California tiger salamanders were detected in every monitoring year except 2018 and 2021 (Yr 3), which was likely related to the low water-years rather than remediation. The results for 2018 and 2021 (Yr 3) were not consistent with baseline results, but were consistent with the reference vernal pools in both years, none of which held enough water to trigger a wildlife survey. Ponds 60 and 61 were the only vernal pools monitored in 2021 (Yr 3). CTS were detected in 2019 (Yr 1) and 2023 (Yr 5), both above-normal water-years; this was consistent with reference vernal pools in the same years. CTS were also detected at Pond 60 in 2020 (Yr 2), which differed from reference vernal pool results, though in a favorable tragectory.

Fairy shrimp were not detected in any of the baseline surveys, nor in any post-remediation monitoring except in 2019 (Yr 1). This is a positive change since it demonstrates that Pond 60 can support this species. Compared to reference vernal pools, results were consistent. Fairy shrimp were detected at reference Ponds 5 and 101 East (East) in 2019, but were not detected in any reference vernal pool in 2020. Similarly with CTS surveys, 2021 (Yr 3) fairy shrimp data could not be compared to reference vernal pools, as none of them had enough depth to trigger wildlife surveys that year. Results were also consistent in 2023 (Yr 5), as fairy shrimp were not detected in any reference pond. It is possible this may have had to do with wildlife survey timing however, as fairy shrimp were not surveyed until May of 2023 (Yr 5), which is much later than normal survey timing earlier in the season.

4.12.2.2 *Performance Standard: Wildlife Usage*

Pond 60, a post-mastication and post-subsurface munitions remediation vernal pool, met DQO 5 by 2023 (Yr 5). Baseline results were similar for fairy shrimp and/or CTS in every year. Data quality objectives 1 and 4 were analyzed in the Hydrology Monitoring Annual Report (Chenega, 2023).

4.12.3 Conclusion

Pond 60, a post-mastication and post-subsurface munitions remediation vernal pool, was in the final year (Yr 5) of monitoring in 2023. The vernal pool met the plant cover and species diversity performance standard and met DQO 5 for wildlife usage (see Table 4-150). No further monitoring is recommended for Pond 60.

Table 4-150. Success at Pond 60 (Year 5 Post-Subsurface Munitions Remediation) Based on Performance Standards and Applicable Data Quality Objectives

Performance Standard	Applicable DQO	2019 (Yr 1)	2020 (Yr 2)	2021 (Yr 3)	2023 (Yr 5)	Success
Plant Cover & Species Diversity	DQO 3	On Track	On Track	On Track	On Track	Met
Wildlife Usage	DQO 5	On Track	On Track	Partially On Track	On Track	Met

4.13 Pond 73 – Year 5

Pond 73 was monitored in 2023 as a year 5 post-subsurface munitions remediation vernal pool. Vegetation within the Pond 73 watershed was masticated in the summer of 2017 to support MEC remediation in BLM Area B Subunit B-3 East. Pond 73 had intrusive anomaly investigations in 2018. Baseline inundation and vegetation surveys were recorded in 2017 but no baseline depth, water quality, or wildlife monitoring had been conducted. Table 4-151 summarizes the years that monitoring occurred and surveys were conducted. The cumulative precipitation graph shows precipitation for years in which hydrology monitoring was conducted at Pond 73 (see Figure 4-72). The 2016-2017, 2018-2019, and 2022-2023 water-years were above-normal, whereas the 2017-2018 and 2020-2021 water-years were below normal. Water-year 2019-2020 was similar to the cumulative normal water-year.

Table 4-151. Pond 73 (Year 5 Post-Subsurface Munitions Remediation) Summary of Historical Surveys for Hydrology, Vegetation, and Wildlife

Survey	Water-Year					
	2016-2017	2017-2018	2018-2019	2019-2020	2020-2021	2022-2023
Hydrology	●	●	●	●	●	●
Vegetation	●	●	●	●	●	●
Wildlife		●	●	●		

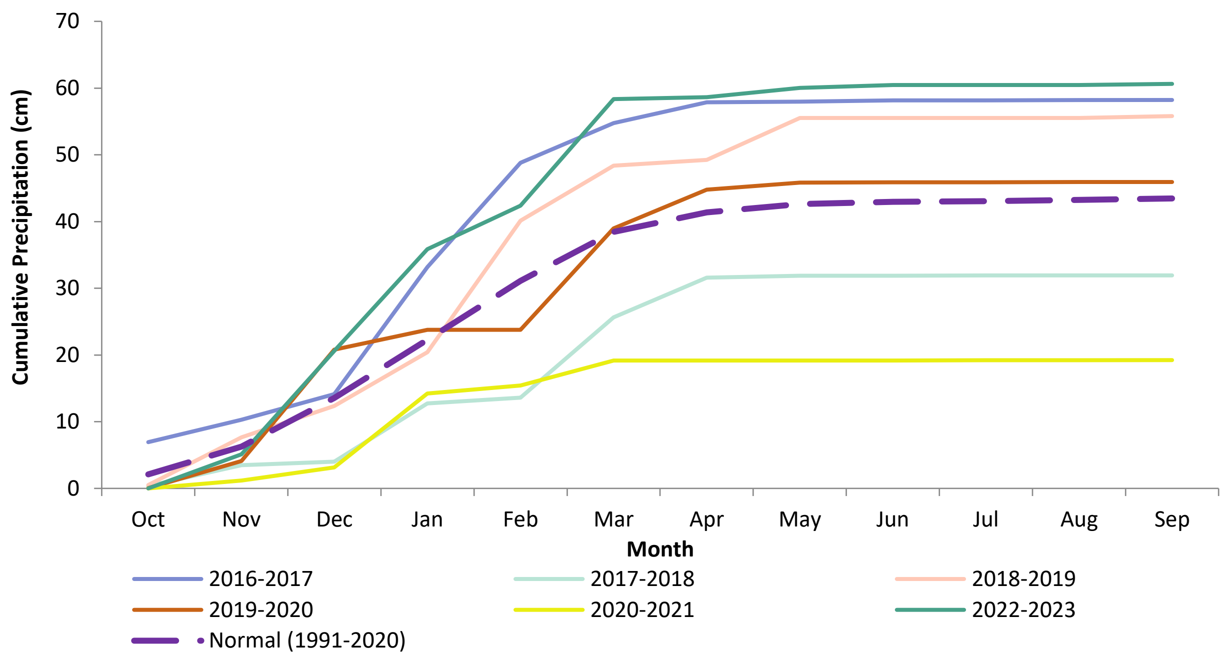

Figure 4-72. Cumulative Monthly Precipitation for Years that Hydrology Monitoring Occurred at Pond 73 (Year 5 Post-Subsurface Munitions Remediation) Compared to the 30-Year Normal (mean 1991-2020) (NPS, 2023; NCEI NOAA, 2023)

4.13.1 Vegetation Monitoring

Vegetation data were collected at Pond 73 in 2017-2021 and 2023 (Burleson, 2018, 2019, 2020, 2021, 2022). Baseline vegetation data were collected at Pond 73 in 2017 by DD&A and provided by the Army in 2018. Data were collected using the methodology described in the Methods section of this report. Data from 2017 and 2021 were compared stratum-to-stratum in Table 4-152 as well as visually in Figure 4-73.

Table 4-152. Pond 73 (Year 5 Post-Subsurface Munitions Remediation) Vegetative Strata Percentage within the Vernal Pool Basin Boundary

Stratum	Percentage	
	2017	2023
1	9%	60%
2	71%	35%
3	17%	2%
Upland	3%	3%

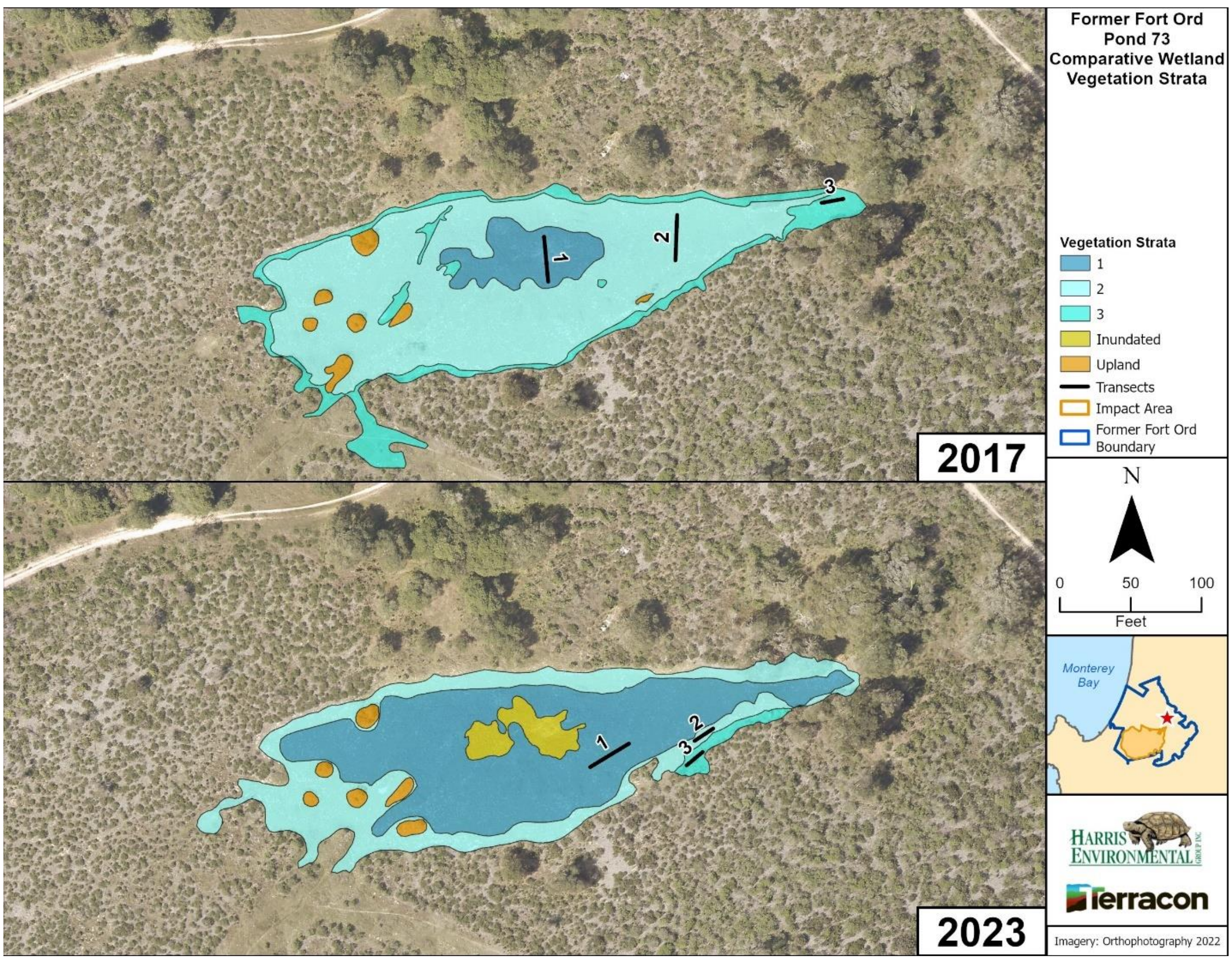

Figure 4-73. Pond 73 (Year 5 Post-Subsurface Munitions Remediation) Vegetation Strata and Transects for 2017 and 2023

The absolute percent vegetative cover decreased dramatically between baseline and 2021 (Yr 3), then increased to the range of previous surveys in 2023 (Yr 5) (see Table 4-153). Pond 73 vegetative cover was less than baseline in every monitoring year, while thatch/bare ground cover was greater than baseline in every monitoring year. In 2020 (Yr 2), vegetative cover was greater than the range observed at reference vernal pools (Burleson, 2021). In 2023 (Yr 5), vegetative cover was within the range of reference vernal pool values, whereas in 2019 (Yr 1) and 2021 (Yr 3), vegetative cover was less (Burleson, 2020, 2022) (see Table 4-154).

Table 4-153. Pond 73 (Year 5 Post-Subsurface Munitions Remediation) Absolute Percent Cover

Year	Vegetative Cover	Thatch/Bare Ground
2017*	82.6%	16.9%
2018	61.8%	39.7%
2019	65.9%	34.1%
2020	78.9%	21.2%
2021	36.3%	63.7%
2023	79.1%	20.9%

*baseline year

Table 4-154. Pond 73 (Year 5 Post-Subsurface Munitions Remediation) and Reference Vernal Pool Absolute Percent Cover in 2023

Vernal Pool	Vegetative Cover	Thatch/Bare Ground
5	74.5%	25.5%
101 East (East)	82.6%	17.4%
997	83.5%	16.7%
73	**79.1%**	**20.9%**

Species richness in 2023 (Yr 5) was greater than baseline on transects, but less than baseline for the whole basin. Species richness on transects was 6, 21, 17, 23, 30, and 34 species in 2017, 2018, 2019, 2020, 2021, and 2023 respectively, whereas overall basin species richness was 49, 68, 62, 68, 66, and 47 species, respectively (see Table 4-155 and Appendix A Table A-13). Pond 73 species richness was within the ranges observed at reference vernal pools for transects and for the whole basin in 2020 (Yr 2) and 2021 (Yr 3), whereas in 2019 (Yr 1), richness was less (Burleson, 2020, 2021, 2022) (see Table 4-156 and Appendix D Tables D-20 and D-40). By contrast, 2023 (Yr 5) had greater species richness than reference vernal pools on transects, but less for the whole basin.

Species composition at Pond 73 was similar between 2017-2021 and 2023. The dominant species in most years were brown-headed rush (*Juncus phaeocephalus*) and coyote thistle (*Eryngium armatum*). Pale spikerush (*Eleocharis macrostachya*) was a subdominant species in all monitoring years except 2023 (Yr 5), in which it was the most dominant species. A complete comparison of species composition observed at Pond 73 in 2017-2021 and 2023 can be found in Appendix F. Figure 4-77 shows a subset of this comparison for species observed with a 2% cover or greater.

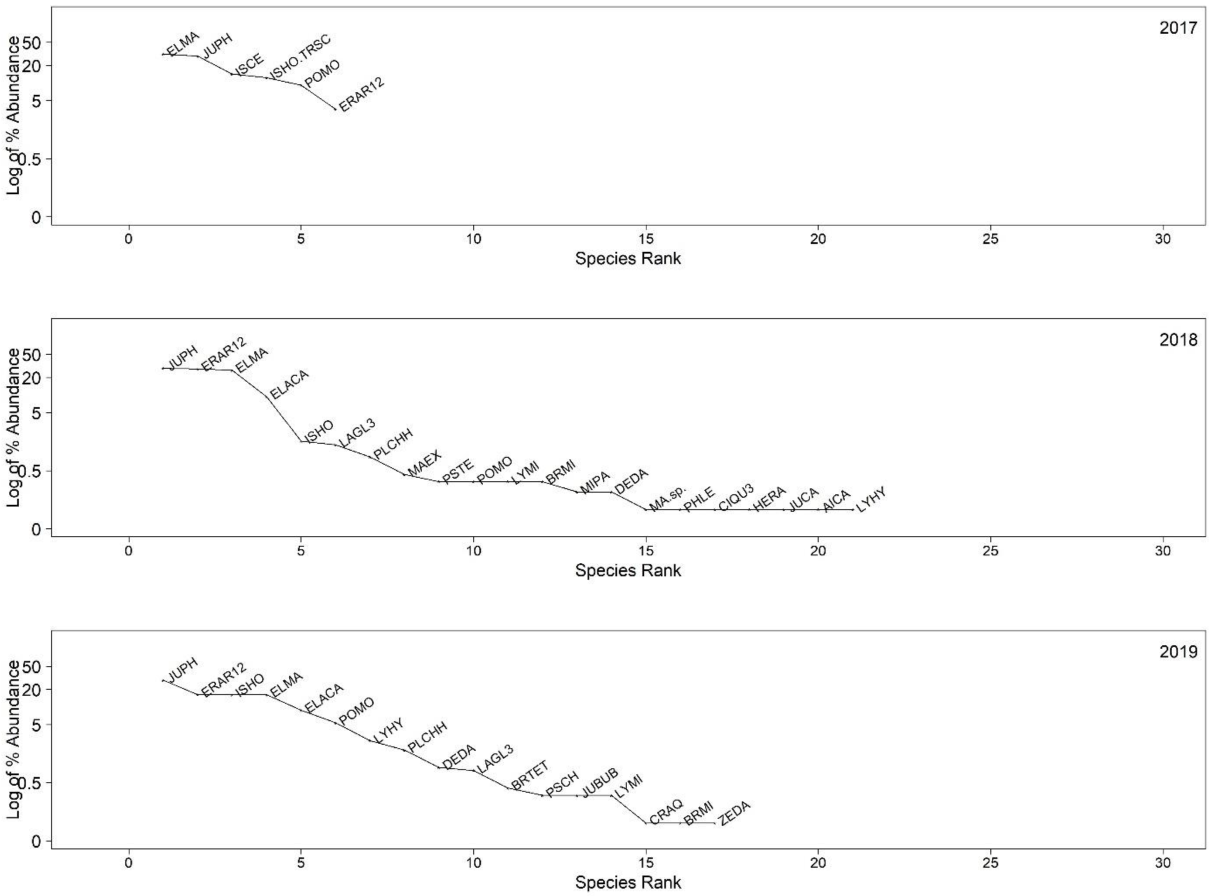

Figure 4-74. Rank Abundance Curves at Pond 73 (Year 5 Post-Subsurface Munitions Remediation) in 2017, 2018, and 2019. Note that the y-axis is in log-10 scale.

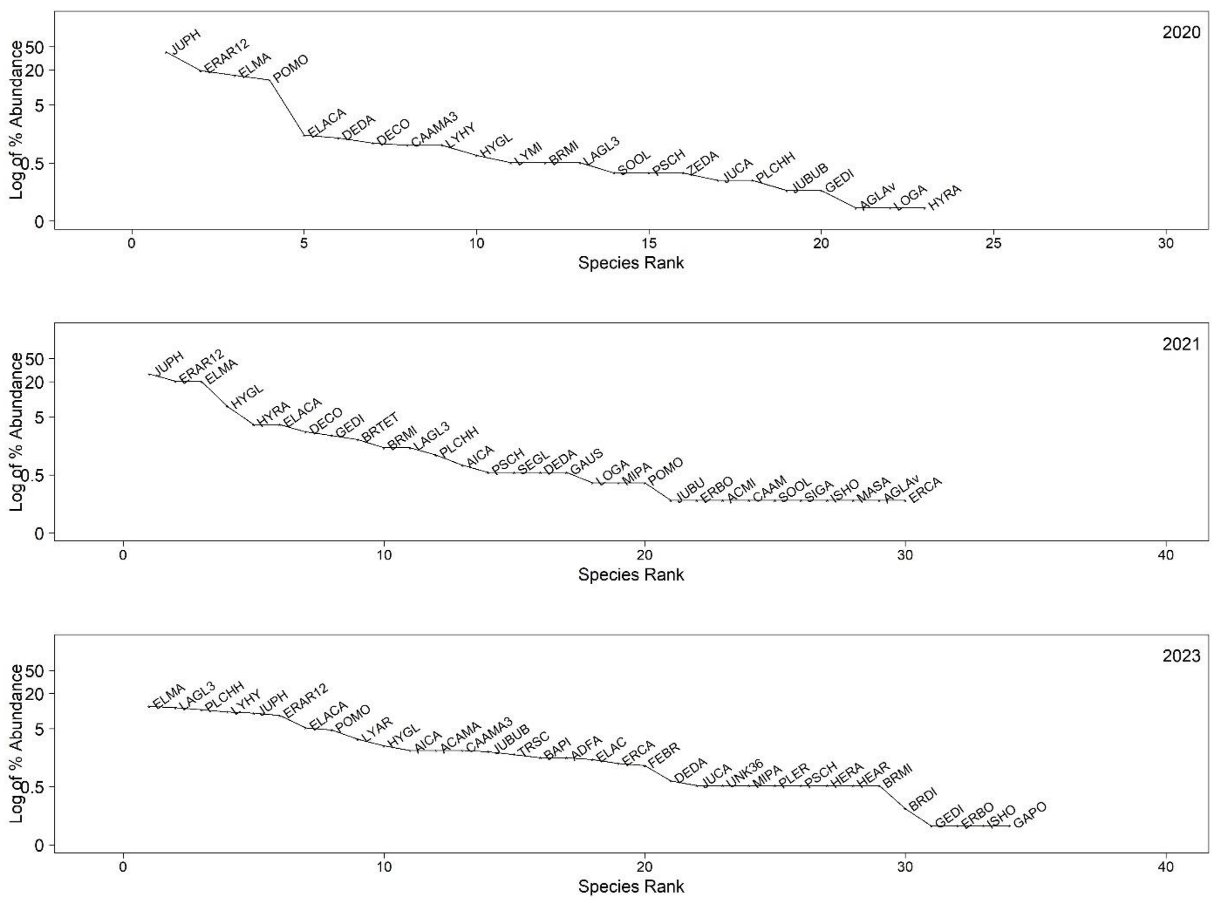

Figure 4-75. Rank Abundance Curves at Pond 73 (Year 5 Post-Subsurface Munitions Remediation) in 2021 and 2023. Note that the y-axis is in log-10 scale.

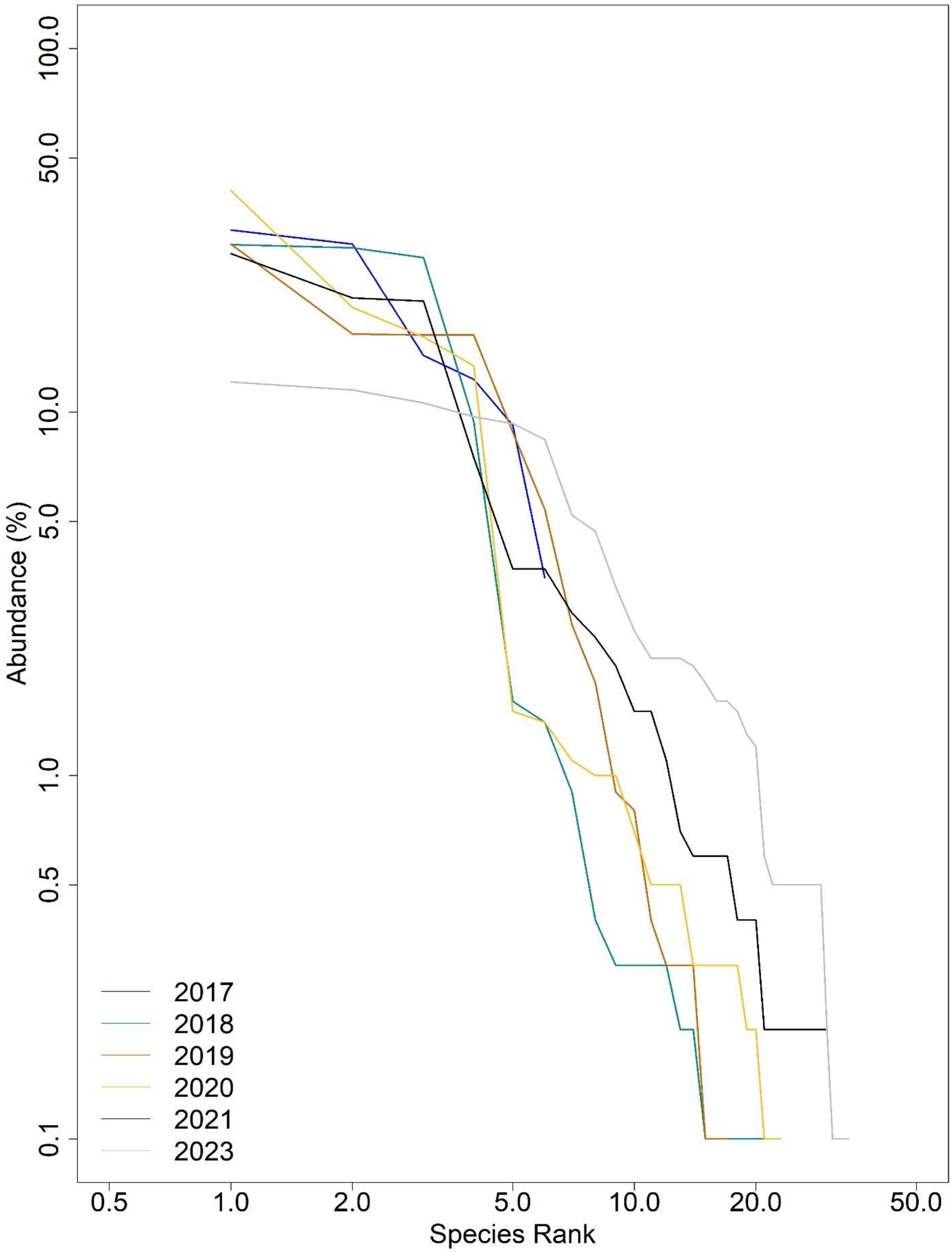

Figure 4-76. Rank Abundance Curves at Pond 73 (Year 5 Post-Subsurface Munitions Remediation) in 2021 and 2023. Note that the y-axis is in log-10 scale.

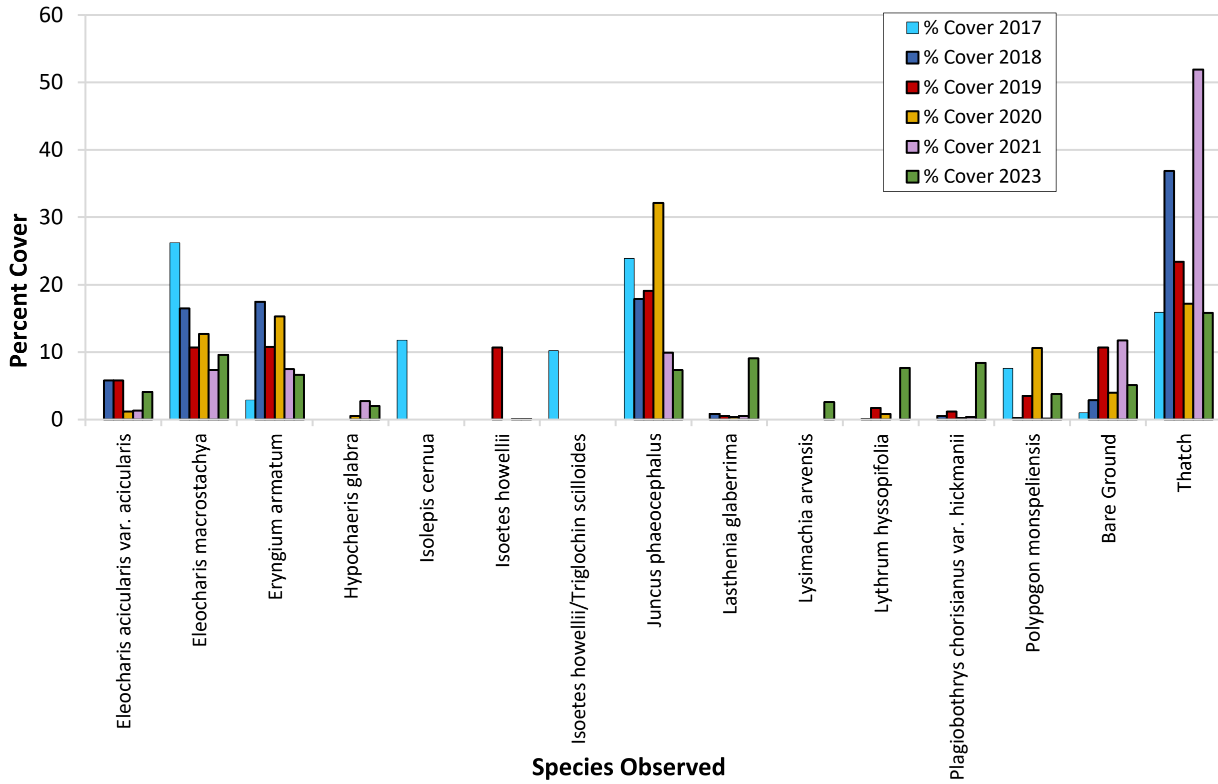

Figure 4-77. Percent Cover of Dominant Species at Pond 73 (Year 5 Post-Subsurface Munitions Remediation)

Native and non-native species richness on Pond 73 transects was greater in all monitoring years than baseline (see Table 4-155). Native and non-native species richness in 2019 (Yr 1) were less than the values observed at reference vernal pools, whereas, in 2020 (Yr 2) native species richness was within the range of values observed at reference vernal pools, while non-native species richness was less than reference (Burleson, 2020, 2021). In 2021 (Yr 3) and 2023 (Yr 5) native richness was greater than the values observed at reference vernal pools, whereas non-native species richness was within the range of values observed at reference (Burleson, 2022) (see Table 4-156).

Table 4-155. Pond 73 (Year 5 Post-Subsurface Munitions Remediation) Native and Non-Native Species Richness

Year	Native	Non-Native	Unidentified
2017*	5	1	0
2018	15	5	1
2019	14	3	0
2020	14	9	0
2021	19	11	0
2023	22	11	1

*baseline year

Table 4-156. Pond 73 (Year 5 Post-Subsurface Munitions Remediation) and Reference Vernal Pool Native and Non-Native Species Richness in 2023

Vernal Pool	Native	Non-Native	Unidentified
5	12	12	0
101 East (East)	9	7	0
997	13	14	1
73	**22**	**11**	**1**

The relative percent cover of native species at Pond 73 was less than baseline and the non-native species cover was greater than baseline in 2020 (Yr 2), 2021 (Yr 3), and 2023 (Yr 5) (see Table 4-157). Whereas, in 2019 (Yr 1), native cover was greater than baseline while non-native cover was less than baseline. Similarly, the relative percent cover of native species in 2019 (Yr 1) and 2021 (Yr 3) was greater than reference vernal pools values and non-native cover was less (Burleson, 2020, 2022). Native and non-native species cover were within the range of values observed at reference vernal pools in 2020 (Yr 2) and 2023 (Yr 5) (Burleson, 2021) (see Table 4-158).

Table 4-157. Pond 73 (Year 5 Post-Subsurface Munitions Remediation) Relative Percent Cover of Native and Non-Native Plants

Year	Native	Non-Native	Unidentified
2017*	90.8%	9.2%	0.0%
2018	98.9%	1.0%	0.1%
2019	91.9%	8.1%	0.0%
2020	83.4%	16.6%	0.0%
2021	82.4%	17.6%	0.0%
2023	74.5%	25.0%	0.5%

*baseline year

Table 4-158. Pond 73 (Year 5 Post-Subsurface Munitions Remediation) and Reference Vernal Pool Relative Percent Cover of Native and Non-Native Plants in 2023

Vernal Pool	Native	Non-Native	Unidentified
5	76.3%	23.7%	0.0%
101 East (East)	60.3%	39.7%	0.0%
997	50.0%	49.0%	1.0%
73	**74.5%**	**25.0%**	**0.5%**

Wetland and non-wetland species richness on Pond 73 transects in every monitoring year were greater than baseline, except for 2019 (Yr 1), in which non-wetland richness was the same as baseline (see Table 4-159). Pond 73 wetland species richness in 2021 (Yr 3) and 2023 (Yr 5) were greater than the reference vernal pools, while non-wetland species richness was within the range of values observed at reference (Burleson, 2022) (see Table 4-160). In 2019 (Yr 1) and 2020 (Yr 2), non-wetland species richness was less than reference values (Burleson, 2020, 2021). However, in 2019 (Yr 1), wetland richness was less than reference, while in 2020 (Yr 2), wetland richness was in the range of values observed at reference vernal pools.

Table 4-159. Pond 73 (Year 5 Post-Subsurface Munitions Remediation) Wetland and Non-Wetland Species Richness

Year	Wetland			Non-Wetland		Not Listed
	OBL	FACW	FAC	FACU	UPL	
2017*	3	3	0	0	0	0
2018	7	7	2	2	0	3
2019	7	7	1	0	0	2
2020	5	9	1	2	1	5
2021	5	8	1	5	1	10
2023	8	7	3	4	0	12

*baseline year

Table 4-160. Pond 73 (Year 5 Post-Subsurface Munitions Remediation) and Reference Vernal Pool Wetland and Non-Wetland Species Richness in 2023

Vernal Pool	Wetland			Non-Wetland		Not Listed
	OBL	FACW	FAC	FACU	UPL	
5	6	7	3	3	1	4
101 East (East)	4	6	1	3	0	2
997	4	6	4	4	0	10
73	**8**	**7**	**3**	**4**	**0**	**12**

The relative percent cover of wetland species in 2020 (Yr 2), 2021 (Yr 3), and 2023 (Yr 5) was less than the baseline year of monitoring and the non-wetland species cover was greater than baseline (see Table 4-161). In 2019 (Yr 1), the relative percent cover of wetand and non-wetland species were the approximately the same as baseline. Conversely, Pond 73 wetland species relative percent cover for 2019 (Yr 1), 2020 (Yr 2), and 2021 (Yr 3), were greater than the values at reference vernal pools, whereas non-wetland cover was less (Burleson, 2020, 2021, 2022). In 2023 (Yr 5), both wetland and non-wetland relative cover values were within the range of values observed at reference vernal pools (see Table 4-162).

Table 4-161. Pond 73 (Year 5 Post-Subsurface Munitions Remediation) Relative Percent Cover of Wetland and Non-Wetland Species

Year	Wetland			Non-Wetland		Not Listed
	OBL	FACW	FAC	FACU	UPL	
2017*†	58.4%	41.6%	0.0%	0.0%	0.0%	0.0%
2018	40.3%	58.3%	0.4%	0.2%	0.0%	0.8%
2019	46.8%	52.6%	0.1%	0.0%	0.0%	0.5%
2020	19.4%	77.0%	0.5%	0.3%	0.3%	2.4%
2021	26.6%	49.9%	1.5%	5.0%	0.2%	16.9%
2023	52.5%	27.7%	4.3%	4.0%	0.0%	11.5%

*baseline year
†These values have changed from previous reports. TRSC/ISHO was incorrectly called NL instead of OBL in the 2020 and 2021 reports. OBL increased by 12.3% and NL decreased by the same amount. Changes are reflected in this report and data deliverable.

Table 4-162. Pond 73 (Year 5 Post-Subsurface Munitions Remediation) and Reference Vernal Pool Relative Percent Cover of Wetland and Non-Wetland Species in 2023

Vernal Pool	Wetland			Non-Wetland		Not Listed
	OBL	FACW	FAC	FACU	UPL	
5	61.4%	29.0%	3.1%	3.7%	0.1%	2.7%
101 East (East)	14.5%	53.4%	0.1%	9.1%	0.0%	22.9%
997	31.5%	28.9%	7.4%	9.0%	0.0%	23.2%
73	**52.5%**	**27.7%**	**4.3%**	**4.0%**	**0.0%**	**11.5%**

4.13.1.1 *Data Quality Objective 3*

Observable changes in hydrophytic vegetation between surveys were largely associated with precipitation fluctuations. This is expected given the dynamic nature of vernal pools and the close relationship between the hydroperiod and wetland vegetation composition. Vegetative cover in Pond 73 was dominated by native and wetland plant species during year 5 post-subsurface munitions remediation monitoring in 2023. Pond 73 wetland vegetation results were generally within range of baseline and/or reference vernal pools in every monitoring year; however, in 2020 (Yr 2) native relative percent cover was greater than baseline and reference values, and in 2021 (Yr 3) and 2023 (Yr 5), native and wetland richness were greater than baseline and reference vernal pools (Burleson, 2021, 2022). The increase in native and wetland richness, as well as native cover, is not concerning. All support a well-functioning vernal pool ecosystem.

While the cover at Pond 73 overall favors native species, native relative percent cover has decreased, and non-native cover has increased every monitoring year since 2019 (Yr 1). Record drought in 2021, followed by an additional year of drought in 2022 had an impact on native species abundance across the entire watershed, and may have caused the overall decline in native cover and increase in non-native cover. Below-normal water-years can result in upland and non-native herbs and grasses exploiting a greater portion of a vernal pool and distributing more evenly (Bauder, 2000). Likewise, there has been a slight decrease in wetland cover, and increase in non-wetland cover compared to baseline, however there has also been an increase in wetland species richness from baseline. Additionally, while there was also an increase in non-native species richness from baseline, there was an even greater increase in native species richness.

4.13.1.2 *Performance Standard: Plant Cover and Species Diversity*

Pond 73, a post-subsurface munitions remediation vernal pool, met the performance standard for year 5. The species composition, richness, and native and wetland species relative abundances were similar to baseline and/or reference vernal pool conditions, with some variability. Pond 73 provided suitable wetland habitat in 2023.

4.13.2 Wildlife Monitoring

Wildlife data were collected at Pond 73 in 2018-2020. California tiger salamander larvae were not observed in any year. Fairy shrimp were present in 2019 and 2020. No baseline historical wildlife data were available for comparison. The vernal pool did not hold sufficient depth for surveys to be completed in 2021 (Yr 3). In 2023 (Yr 5), a brief CTS survey was done but no fairy shrimp or other invertebrate data were collected due to time and logistical constraints. Table 4-163 shows historical wildlife monitoring results.

Table 4-163. Pond 73 (Year 5 Post-Subsurface Munitions Remediation) Historical Wildlife Monitoring Results

Sampling Year	CTS Larvae Abundance (# Individuals)	Fairy Shrimp Abundance (# Individuals)
2018	Not detected	Not detected
2019	Not detected	Present*
2020	Not detected	Low (1)
2023	Not detected	Not surveyed

*Fairy shrimp present during CTS survey, not during the fairy shrimp survey.

4.13.2.1 *Data Quality Objective 5*

California tiger salamanders were not detected in any monitoring year. No baseline data was available for comparison. Results in 2019 (Yr 1), 2020 (Yr 2), and 2023 (Yr 5) were partially consistent with reference vernal pool monitoring. There were no CTS detected at Pond 997 in 2019, nor at Pond 101 East (East) in 2020. However, there were CTS detections in 2023 at Pond 101 East (East), while Pond 997 did not have adequate depth to conduct surveys by the time monitoring began.

Fairy shrimp were detected in 2019 (Yr 1) and 2020 (Yr 2), but not in 2023 (Yr 5). These results are consistent with reference Pond 101 East (East), which had detections in 2019 and 2020, but not in 2023.

4.13.2.2 *Performance Standard: Wildlife Usage*

Pond 73, a post-subsurface munitions remediation vernal pool, was in the final year of monitoring and met DQO 5. California tiger salamanders were not present in any year, which was partially consistent with reference pool monitoring. Pond 997 had no CTS detections in 2019, and Pond 101 East (East) had no CTS detections in 2020 (Yr 2). However Pond 101 East (East) did have detections in 2023, while Pond 997 was too dry to survey by the time monitoring began. Fairy shrimp were found in low numbers in 2019 (Yr 1) and 2020 (Yr 2), but not in 2023 (Yr 5). These results were also consistent with reference vernal pool surveys. Fairy shrimp were detected at Pond 101 East (East) in 2019 (Yr 1) and 2020 (Yr 2), whereas none were detected at reference vernal pools in 2023 (Yr 5). Data quality objectives 1 and 4 were analyzed in the Hydrology Monitoring Annual Report (Chenega, 2023).

4.13.3 Conclusion

Pond 73, a post-subsurface munitions remediation vernal pool, was in its final year of monitoring in 2023 (Yr 5). The vernal pool met the plant cover and species diversity performance standard and met DQO 5 for wildlife usage (see Table 4-164). No further monitoring is recommended for Pond 73.

Table 4-164. Success at Pond 73 (Year 5 Post-Subsurface Munitions Remediation) Based on Performance Standards and Applicable Data Quality Objectives

Performance Standard	Applicable DQO	2019 (Yr 1)	2020 (Yr 2)	2021 (Yr 3)	2023 (Yr 5)	Success
Plant Cover & Species Diversity	DQO 3	On Track	On Track	On Track	On Track	Met
Wildlife Usage	DQO 5	On Track	On Track	N/A	Partially On Track	Met

4.14 Pond 16 – Year 5

Pond 16 was monitored in 2023 as a year 5 post-subsurface munitions remediation vernal pool. Pond 16 was monitored for baseline conditions in 1992, 1994-1996, 2009, and 2015. Vegetation within Pond 16 and immediately around it was masticated in the summer of 2016 in preparation for a prescribed burn in Unit 31. Less than 50 percent of the Pond 16 watershed was masticated, and limited vegetation mastication occurred within the inundation area. Pond 16 had intrusive anomaly investigations in 2018. Table 4-165 summarizes the years that monitoring occurred and surveys were conducted. The cumulative precipitation graph shows precipitation for years in which hydrology monitoring was conducted at Pond 16 (see Figure 4-78). The 1994-1995, 2016-2017, 2018-2019, and 2022-2023 water-years were above normal. Water-year 2019-2020, as well as 1991-1992 and 1995-1996, were similar to the cumulative normal water-year. Below-normal and drought water years occurred in 1993-1994, 2014-2015, 2020-2021, and 2021-2022.

Table 4-165. Pond 16 (Year 5 Post-Subsurface Munitions Remediation) Summary of Historical Surveys for Hydrology, Vegetation, and Wildlife

Survey	Water-Year												
	1991-1992	1993-1994	1994-1995	1995-1996	2008-2009	2014-2015	2016-2017	2017-2018	2018-2019	2019-2020	2020-2021	2021-2022	2022-2023
Hydrology	•	•	•	•		•	•	•	•	•	•	•	•
Vegetation		•	•	•		•	•		•	•	•	•	•
Wildlife	•	•	•	•	•	•			•	•			•

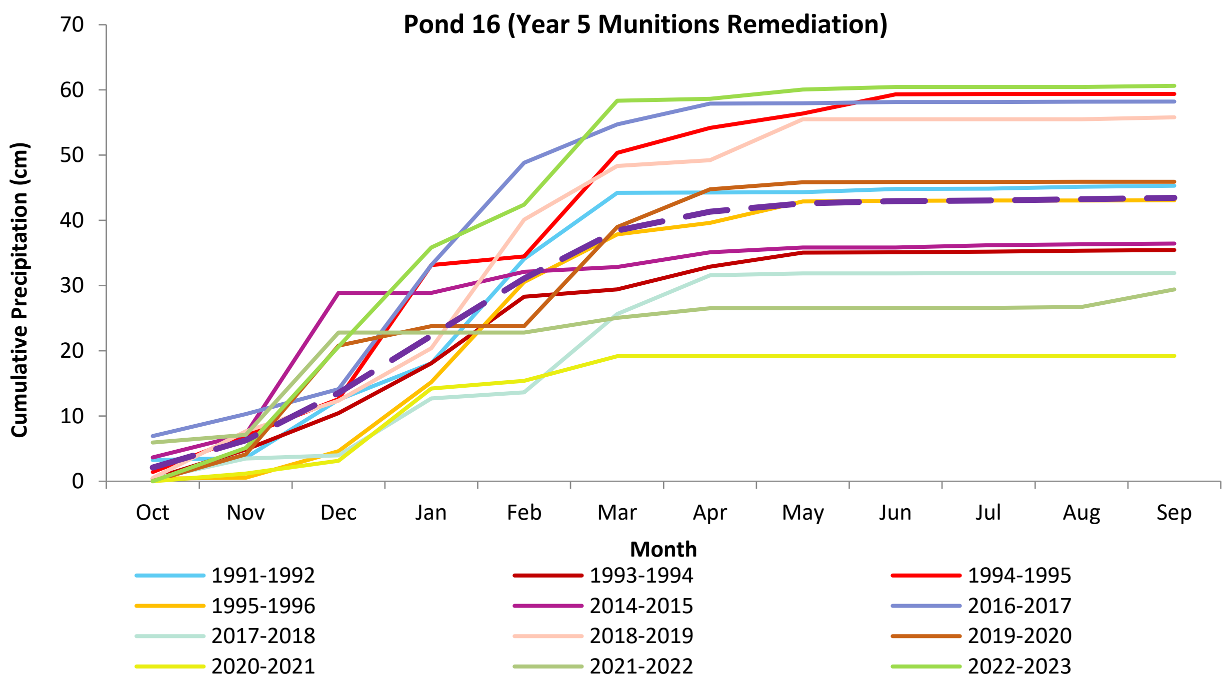

Figure 4-78. Cumulative Monthly Precipitation for Years that Hydrology Monitoring Occurred at Pond 16 (Year 5 Post-Subsurface Munitions Remediation) Compared to the 30-Year Normal (mean 1991-2020) (NPS, 2023; NCEI NOAA, 2023)

4.14.1 Vegetation Monitoring

Vegetation data were collected at Pond 16 in 2015, 2017, and 2019-2023 (Burleson, 2016, 2018, 2020, 2021, 2022, 2023). Data from 1994, 1995, and 1996 only represent dominant species and are not included in the following analyses because the data were collected using a different methodology than was used in later years (Jones and Stokes, 1996). In 2015, 2017, and 2019-2023, data were collected using the methodology described in the Methods section of this report. Data from 2015 and 2023 were compared stratum-to-stratum in Table 4-166 as well as visually in Figure 4-79.

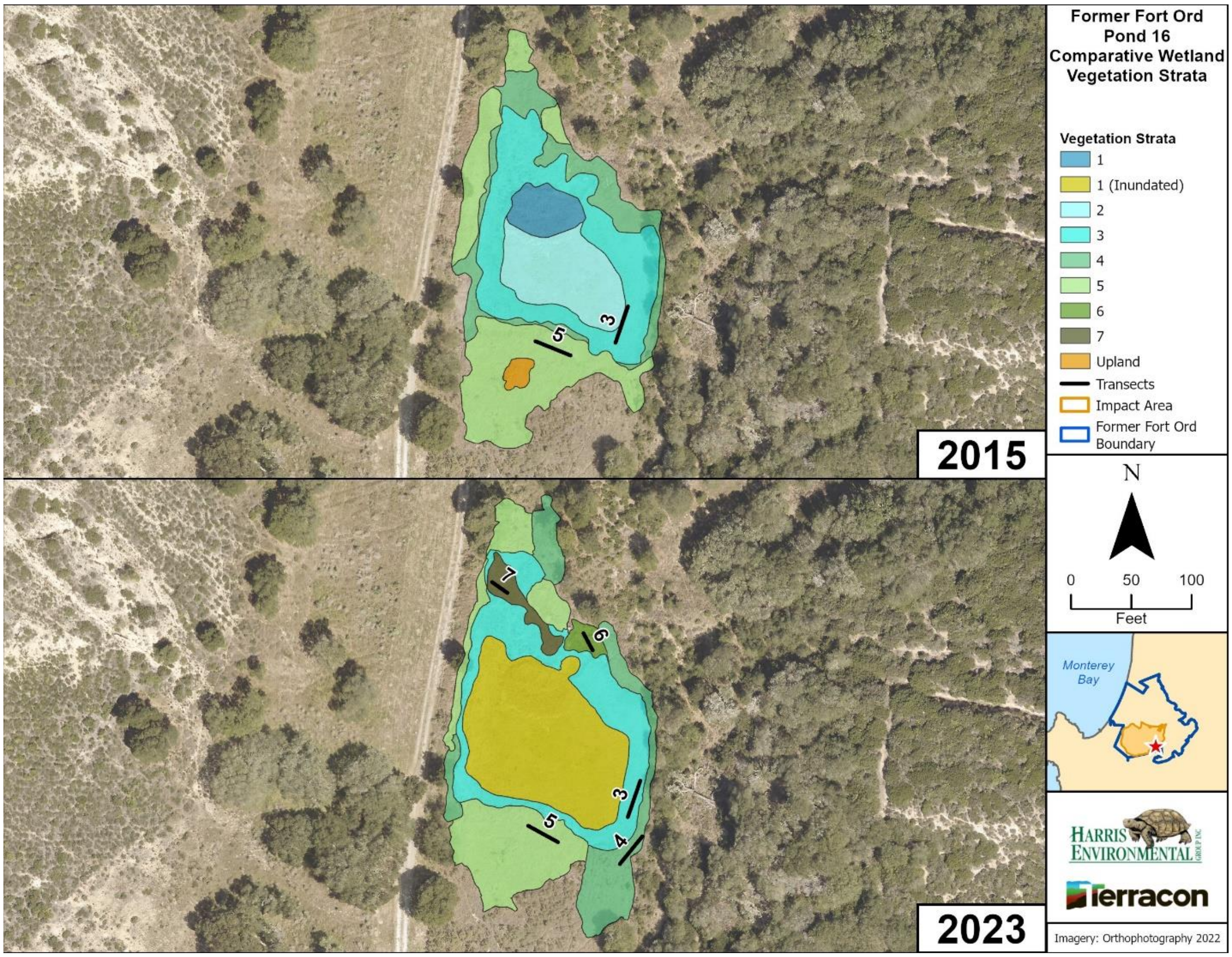

Figure 4-79. Pond 16 (Year 5 Post-Subsurface Munitions Remediation) Vegetation Strata and Transects for 2015 and 2023

Table 4-166. Pond 16 (Year 5 Post-Subsurface Munitions Remediation) Vegetative Strata Percentage within the Vernal Pool Basin Boundary

Stratum	Percentage	
	2015	2023
1	8%	34%
2	24%	N/A
3	44%	23%
4	24%	15%
5*	N/A	23%
6	N/A	2%
7	N/A	3%
Upland*	N/A	N/A

*Stratum 5 and the upland stratum were considered part of an adjacent wetland in 2015, so the area was not calculated for either polygon.

Absolute percent vegetative cover for Pond 16 was greater than baseline in 2019 (Yr 1), 2020 (Yr 2), and 2023 (Yr 5), whereas in 2021 (Yr 3) and 2022 (Yr 4), vegetative cover was less than baseline (see Table 4-167). When compared to reference vernal pools, the absolute percent vegetative cover was less than the range of values in 2019 (Yr 1), within the range of values in 2022 (Yr 4), and greater than the range of values in 2020 (Yr 2), 2021 (Yr 3), and 2023 (Yr 5) (Burleson, 2020, 2021, 2022, 2023) (see Table 4-168).

Table 4-167. Pond 16 (Year 5 Post-Subsurface Munitions Remediation) Absolute Percent Cover

Year	Vegetative Cover	Thatch/Bare Ground
2015*	59.1%	38.8%
2017	77.8%	21.8%
2019	70.6%	29.5%
2020	72.1%	27.8%
2021	56.5%	43.6%
2022	46.4%	53.6%
2023	96.3%	3.8%

*baseline year

Table 4-168. Pond 16 (Year 5 Post-Subsurface Munitions Remediation) and Reference Vernal Pool Absolute Percent Cover in 2023

Vernal Pool	Vegetative Cover	Thatch/Bare Ground
5	74.5%	25.5%
101 East (East)	82.6%	17.4%
997	83.5%	16.7%
16	**96.3%**	**3.8%**

Species richness was greater than baseline in every monitoring year. Species richness on transects was 8, 24, 29, 17, 23, 21, and 17 species in 2015, 2017, 2019, 2020, 2021, 2022, and 2023 respectively, whereas overall basin species richness was 49, 86, 83, 81, 82, 87, and 53, respectively (see Table 4-169 and Appendix A Table A-14). Pond 16 species richness in 2019 (Yr 1), 2020 (Yr 2), and 2021 (Yr 3) were less than the values observed on transects at the reference vernal pools, whereas overall basin species richness was within ranges observed for reference (Burleson, 2020, 2021, 2022) (Appendix D Tables D-20 and D-40). Whereas, in 2022 (Yr 4), species richness at Pond 16 was less than the transect values observed at reference vernal pools, while overall basin richness was greater than the ranges observed for reference (Burleson, 2023). This year, 2023 (Yr 5), species richness values observed on transects and the entire basin were within the ranges of reference vernal pool values (see Table 4-170). The species richness is represented on the RACs as the length of the curve and number of species along the curve (see Figure 4-80 and Figure 4-81).

Species composition and the dominant species at Pond 16 remained similar between the monitoring years. This species composition is illustrated on the RACs as the species codes shift along the curve and losses and gains occur from year to year (see and Figure 4-80 and Figure 4-81). The most dominant species in the 2015 baseline year was whiteroot (*Carex barbarae*), and was an important species every year. Pale spike rush (*Eleocharis macrostachya*) was among the top four dominant species every year from 2015-2023, and was the most dominant species in 2017, 2019, 2021, and 2023 (Yr 5). In 2019 (Yr 1) and 2020 (Yr 2) pale spike rush was codominant with clustered field sedge (*Carex praegracilis*), which was another important species in 2017, 2021, and 2022. In 2021 (Yr 3), non-native rabbitfoot grass (*Polypogon monspeliensis*) was the third most dominant species, and in 2022 (Yr 4) it became the most dominant species, marking a shift from previous years. However, by 2023 (Yr 5), rabbitfoot grass had vanished from Pond 16 and the three dominant species were similar to previous monitoring years, with pale spikerush, whiteroot, and Baltic rush (*Juncus balticus*) as codominants. A complete comparison of species composition observed at Pond 16 in 2015, 2017, and 2019-2023 can be found in Appendix E. Figure 4-83 shows a subset of this comparison for species observed with a 2% cover or greater.

The evenness from each year is represented by the slope of the RACs. The evenness between the 2015 baseline year and 2023 is dissimilar. In 2015, there is a steeper slope and higher abundance of the dominant species at the top of the curve, whereas the RACs from all subsequent monitoring years show a more even distribution of the top species, with richness distributed along the entire curve (see Figure 4-82, and Appendix F). When comparing the Pond 16 RACs to reference vernal pools, they are most similar to Pond 101 East (East), in which most years have a slightly sloping beginning of the curve and similar overall shape that show richness evenly distributed along the its length.

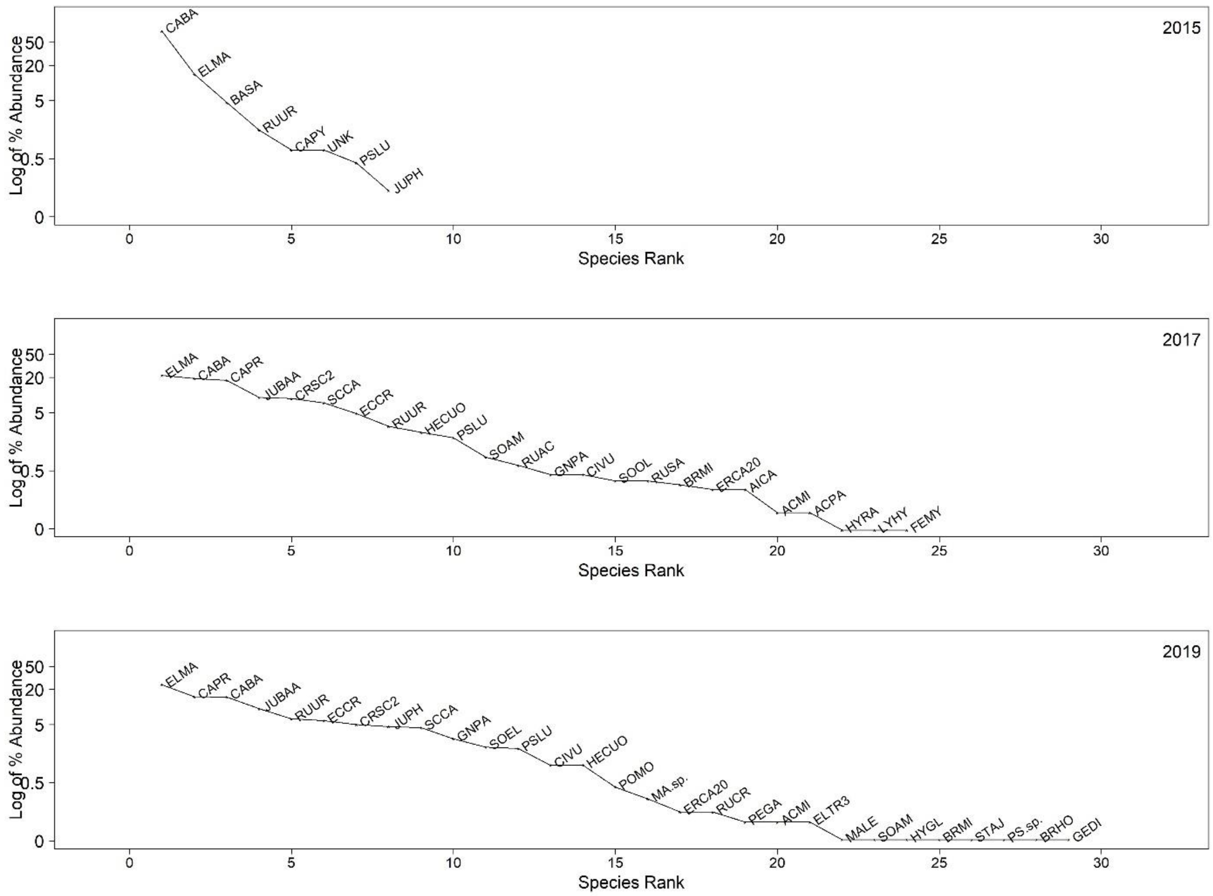

Figure 4-80. Rank Abundance Curves at Pond 16 (Year 5 Post-Subsurface Munitions Remediation) in 2015, 2017, and 2019. Note that the y-axis is in log-10 scale.

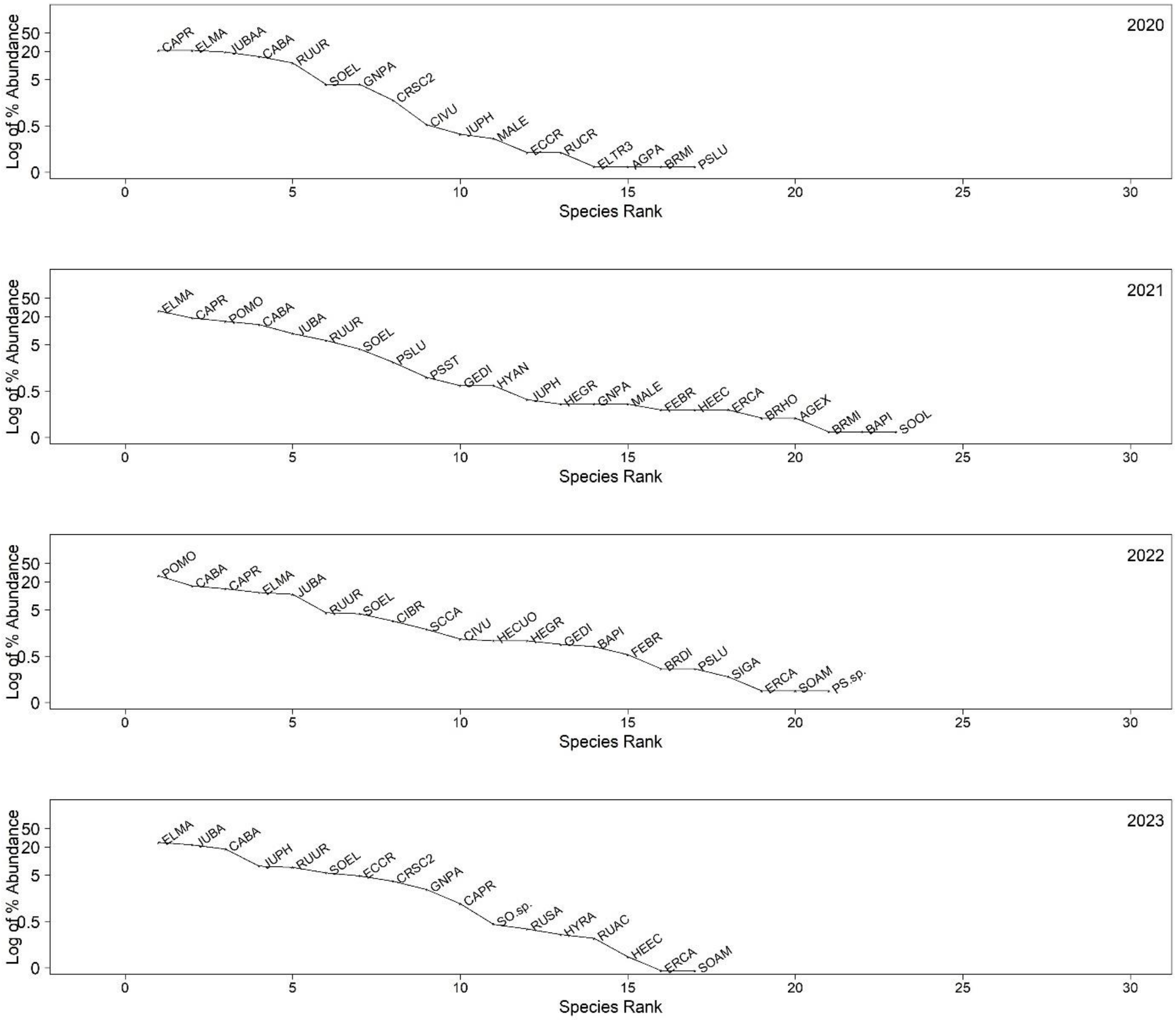

Figure 4-81. Rank Abundance Curves at Pond 16 (Year 5 Post-Subsurface Munitions Remediation) from 2020-2023. Note that the y-axis is in log-10 scale.

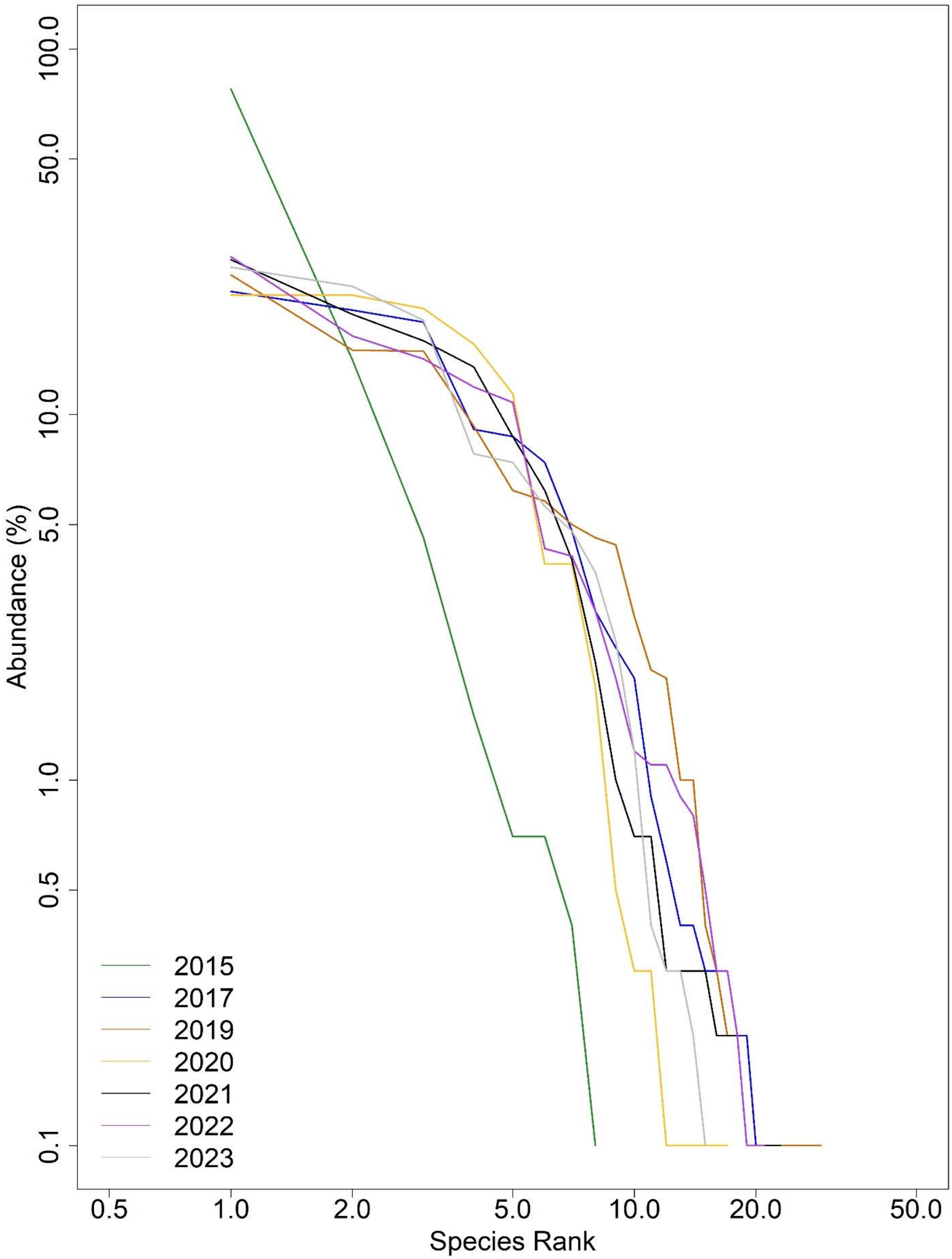

Figure 4-82. Rank Abundance Curves at Pond 16 (Year 5 Post-Subsurface Munitions Remediation) in 2015, 2017, and 2019-2023. Note that the x-axis and y-axis are in log-10 scale.

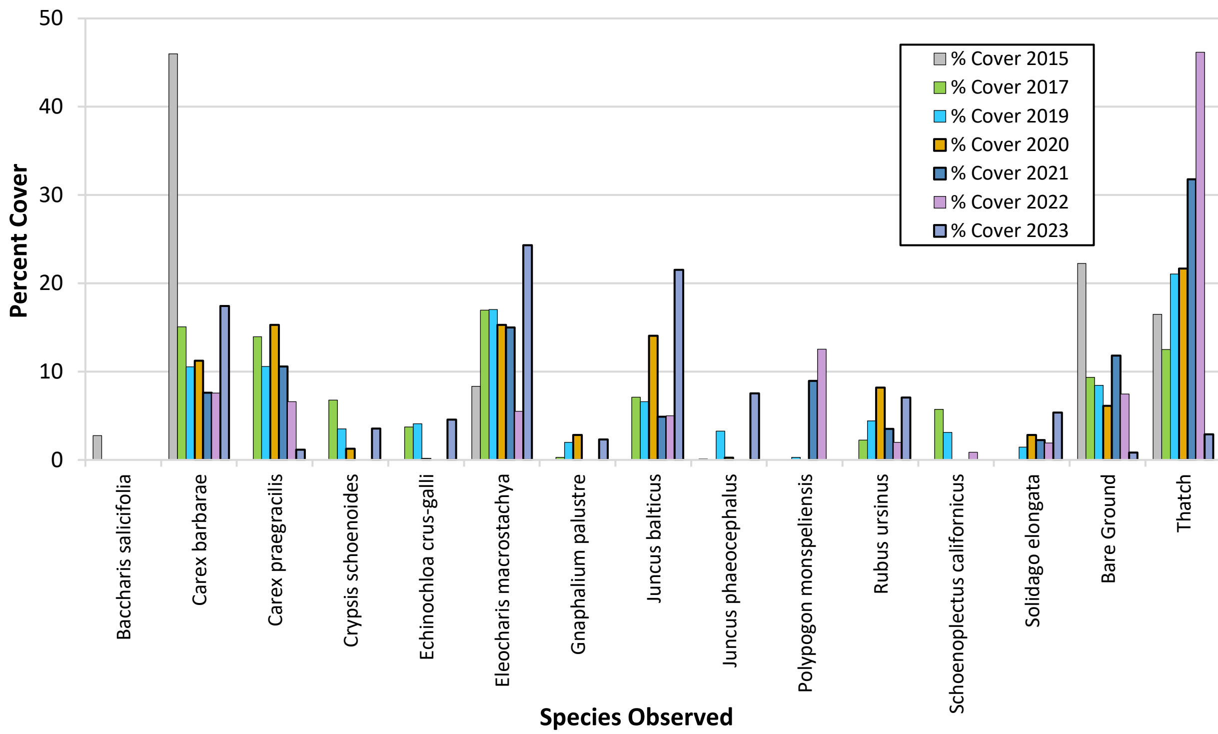

Figure 4-83. Percent Cover of Dominant Species at Pond 16 (Year 5 Post-Subsurface Munitions Remediation)

Native and non-native species richness on Pond 16 transects were greater than baseline in every monitoring year (see Table 4-169). Pond 16 native and non-native species richness were less than the range observed at the reference vernal pools in 2019 (Yr 1), 2020 (yr 2), and 2022 (Yr 3) (Burleson, 2020, 2021, 2023). Whereas, in 2021 (Yr 3) and 2023 (Yr 5), native species richness was within the range of reference vernal pool values while non-native species richness was less (Burleson, 2022) (see Table 4-170).

Table 4-169. Pond 16 (Year 5 Post-Subsurface Munitions Remediation) Native and Non-Native Species Richness

Year	Native	Non-Native	Unidentified
2015*	5	2	1
2017	13	11	0
2019	17	10	2
2020	11	6	0
2021	14	9	0
2022	13	7	1
2023	11	6	0

*baseline year

Table 4-170. Pond 16 (Year 5 Post-Subsurface Munitions Remediation) and Reference Vernal Pool Native and Non-Native Species Richness in 2023

Vernal Pool	Native	Non-Native	Unidentified
5	12	12	0
101 East (East)	9	7	0
997	13	14	1
16	**11**	**6**	**0**

The relative percent cover of native species was less than baseline in every monitoring year, while the relative percent cover of non-native species was greater (see Table 4-171). Pond 16 native relative percent cover was greater than reference vernal pool values in 2019 (Yr 1), 2020 (Yr 2), 2021 (Yr 3), and 2023 (Yr 5) (Burleson, 2020, 2021, 2022) (see Table 4-172). Whereas, in 2022 (Yr 4), native and non-native relative percent cover were within the ranges observed at reference vernal pools.

Table 4-171. Pond 16 (Year 5 Post-Subsurface Munitions Remediation) Relative Percent Cover of Native and Non-Native Plants

Year	Native	Non-Native	Unidentified
2015*	98.2%	1.1%	0.7%
2017	82.9%	17.1%	0.0%
2019	85.2%	14.5%	0.3%
2020	97.3%	2.7%	0.0%
2021	80.1%	19.9%	0.0%
2022	69.5%	30.4%	0.1%
2023	90.6%	9.4%	0.0%

*baseline year

Table 4-172. Pond 16 (Year 5 Post-Subsurface Munitions Remediation) and Reference Vernal Pool Relative Percent Cover of Native and Non-Native Plants in 2023

Vernal Pool	Native	Non-Native	Unidentified
5	76.3%	23.7%	0.0%
101 East (East)	60.3%	39.7%	0.0%
997	50.0%	49.0%	1.0%
16	**90.6%**	**9.4%**	**0.0%**

Wetland and non-wetland species richness on Pond 16 transects were greater than baseline in every monitoring year (see Table 4-173). Wetland species richness was less than reference vernal pool values in 2019 (Yr 1), 2020 (Yr 2), 2022 (Yr 4), and 2023 (Yr 5), whereas in 2021 (Yr 3), both wetland and non-wetland species values were within the range of values observed at reference vernal pools (Burleson, 2020, 2021, 2022, 2023) (see Table 4-174). Compared to reference vernal pools, non-wetland richness was variable between the monitoring years. In 2019 (Yr 1), 2020 (Yr 2), and 2021 (Yr 3), non-wetland richness was within the range of values (Burleson, 2020, 2021, 2022). Whereas, in 2022 (Yr 4), non-wetland richness was less than reference values, and in 2023 (Yr 5), non-wetland richness was greater (Burleson, 2023) (see Table 4-174).

Table 4-173. Pond 16 (Year 5 Post-Subsurface Munitions Remediation) Wetland and Non-Wetland Species Richness

Year	Wetland			Non-Wetland		Not Listed
	OBL	FACW	FAC	FACU	UPL	
2015*	1	3	1	1	0	2
2017	4	5	3	9	1	2
2019	4	6	6	9	1	4
2020	2	5	5	4	1	0
2021	2	7	4	5	1	4
2022	2	4	1	5	0	9
2023	2	5	3	6	0	1

*baseline year

Table 4-174. Pond 16 (Year 5 Post-Subsurface Munitions Remediation) and Reference Vernal Pool Wetland and Non-Wetland Species Richness in 2023

Vernal Pool	Wetland			Non-Wetland		Not Listed
	OBL	FACW	FAC	FACU	UPL	
5	6	7	3	3	1	4
101 East (East)	4	6	1	3	0	2
997	4	6	4	4	0	10
16	**2**	**5**	**3**	**6**	**0**	**1**

The relative percent cover of wetland species in every monitoring year was lower than the baseline year whereas non-wetland species cover was greater (see Table 4-175). The relative percent cover of wetland species was within the range of values observed at the reference pools in 2019 (Yr 1), 2020 (Yr 2), and 2023 (Yr 5), while wetland cover was greater than the ranges observed at reference vernal pools in 2021 (Yr 3) and 2022 (Yr 4) (Burleson, 2020, 2021, 2022, 2023) (see Table 4-176). Non-wetland cover was within the range of reference vernal pool values in 2019-2022, while in 2023 (Yr 5) non-wetland cover was greater (Burleson, 2022, 2021, 2022, 2023).

Table 4-175. Pond 16 (Year 5 Post-Subsurface Munitions Remediation) Relative Percent Cover of Wetland and Non-Wetland Species

Year	Wetland			Non-Wetland		Not Listed
	OBL	FACW	FAC	FACU	UPL	
2015*	14.1%	5.2%	77.9%	1.4%	0.0%	1.4%
2017	37.9%	29.4%	24.5%	5.5%	0.4%	2.4%
2019	33.6%	34.1%	21.2%	9.8%	0.0%	1.4%
2020	23.0%	45.0%	16.0%	16.0%	0.1%	0.0%
2021	27.1%	46.1%	14.7%	10.7%	0.1%	1.2%
2022	13.7%	52.3%	16.4%	9.8%	0.0%	7.8%
2023	28.9%	34.2%	22.9%	13.5%	0.0%	0.4%

*baseline year

Table 4-176. Pond 16 (Year 5 Post-Subsurface Munitions Remediation) and Reference Vernal Pool Relative Percent Cover of Wetland and Non-Wetland Species in 2023

Vernal Pool	Wetland			Non-Wetland		Not Listed
	OBL	FACW	FAC	FACU	UPL	
5	61.4%	29.0%	3.1%	3.7%	0.1%	2.7%
101 East (East)	14.5%	53.4%	0.1%	9.1%	0.0%	22.9%
997	31.5%	28.9%	7.4%	9.0%	0.0%	23.2%
16	**28.9%**	**34.2%**	**22.9%**	**13.5%**	**0.0%**	**0.4%**

4.14.1.1 *Data Quality Objective 3*

Observable changes in hydrophytic vegetation between surveys were largely associated with precipitation fluctuations. This is expected given the dynamic nature of vernal pools and the close relationship between the hydroperiod and wetland vegetation composition. Vegetative cover in Pond 16 was dominated by native and wetland plant species by the year 5 post-subsurface munitions remediation monitoring in 2023 (Yr 5).

Pond 16 wetland vegetation results were dissimilar from the range of either baseline and/or reference vernal pools. Non-native richness and cover were greater than baseline values but less than reference values. Conversely, native cover was less than baseline but greater than reference. Wetland richness was greater than baseline but less than reference values, whereas non-wetland species richness and cover were greater than baseline and reference values. Previous monitoring years largely had results that were similar to baseline and/or reference with some minor outliers that were representative of a well-functioning wetland ecosystem. 2023 (Yr 5) is the first year where non-wetland richness and cover were greater than baseline and reference. These results however, appear to be an outlier across the other monitoring years. Pond 16 retains high vegetative richness every year, which is generally dominated by native wetland species. It is unlikely that the shift to greater non-wetland richness in the final monitoring year is related to remediation activities, although is may be possible that results significantly differed in the final year because so much of the pond was inundated at the time vegetation surveys occurred, thus limiting species richness results. Stratum 1, which represented over a third of the entire pond, was completely inundated in 2023 (Yr 5).

4.14.1.2 *Performance Standard: Plant Cover and Species Diversity*

Pond 16, a post-subsurface munitions remediation vernal pool, met the performance standard for year 5. The species composition, richness, and native and wetland species relative abundances were within range of the reference vernal pool conditions or differed in a favorable trajectory for native and wetland species in most monitoring years.

4.14.2 Wildlife Monitoring

Wildlife data were collected at Pond 16 in 1992, 1994-1996, 2009, 2015, 2019, 2020, and 2023 (USACE 1992, Jones & Stokes 1996; Shaw, 2010; Burleson, 2016, 2020, 2021). California tiger salamander larvae were observed in 2009, 2015, 2019, and 2023. Fairy shrimp were present at Pond 16 in every monitoring year except 2015. The vernal pool did not hold sufficient depth for surveys to be completed in 2021 or 2022. Therefore, DQO 5 and the applicable wildlife usage performance standard can only be assessed for 2019 (Yr 1), 2020 (Yr 2), and 2023 (Yr 5). Table 4-177 shows historical wildlife monitoring results.

Table 4-177. Pond 16 (Year 5 Post-Subsurface Munitions Remediation) Historical Wildlife Monitoring Results

Sampling Year	CTS Larvae Abundance (# Individuals)	Fairy Shrimp Abundance (# Individuals)
1992†	Not detected	Present
1994†	Not detected	Very Low - High
1995†	Not detected	Low - High
1996†	Not detected	Present
2009†	Common	Moderate - High (32, 105)
2015†	Few – Common (13, 1)	Not detected
2019	Few – Common (5, 87, 46)	Present*
2020	Not detected	High (267)
2023	Few (1)	Low (7)

*Fairy shrimp detected during CTS survey, no fairy shrimp survey was conducted in March due to the presence of CTS eggs.
†baseline year

4.14.2.1 *Data Quality Objective 5*

California tiger salamanders were not detected in 2020 (Yr 2) but were present in 2019 (Yr 1) and 2023 (Yr 5), which was partially consistent with baseline monitoring. California tiger salamanders were present in 2009 and 2015. Results in 2023 (Yr 5), 2020 (Yr 2), and 2019 (Yr 1) were consistent with reference vernal pools; CTS were not detected at Pond 5 or 101 East (East) in 2020 but were present in 2019 and 2023.

Fairy shrimp were detected in every year monitored for wildlife, which was mostly consistent with baseline values, except for the 2015 baseline year, in which no fairy shrimp were detected. Fairy shrimp were present at Pond 5 in 2019, and Pond 101 East (East) in 2019 and 2020. Pond 16 was the only vernal pool in 2023 (Yr 5) in which fairy shrimp were detected, so differed from reference vernal pools in a favorable direction.

4.14.2.2 *Performance Standard: Wildlife Usage*

Pond 16, a post-subsurface munitions remediation vernal pool, was in the final year of monitoring and met DQO 5. California tiger salamanders were not detected in 2020 (Yr 2) but were present in 2019 (Yr 1) and 2023 (Yr 5). This trend was also observed at reference vernal pools Pond 5 and 101 East (East). California tiger salamanders were present during the 2009 and 2015 baseline surveys. Fairy shrimp were detected in every monitoring year, whereas, in the 2015 baseline survey, no fairy shrimp were detected. Fairy shrimp were present at Pond 5 in 2019, and Pond 101 East (East) in 2019 and 2020. Data quality objectives 1 and 4 were analyzed in the Hydrology Monitoring Annual Report (Chenega, 2023).

4.14.3 Conclusion

Pond 16, a post-subsurface munitions remediation vernal pool, was in the final year of monitoring in 2023. The vernal pool met the plant cover and species diversity performance standard and met DQO 5 for wildlife usage (see Table 4-178). No further monitoring is recommended for Pond 16.

Table 4-178. Success at Pond 16 (Year 5 Post-Subsurface Munitions Remediation) Based on Performance Standards and Applicable Data Quality Objectives

Performance Standard	Applicable DQO	2019 (Yr 1)	2020 (Yr 2)	2021 (Yr 3)	2022 (Yr 4)	2023 (Yr 5)	Success
Plant Cover & Species Diversity	DQO 3	On Track	On Track	On Track	On Track	Not On Track	Met
Wildlife Usage	DQO 5	On Track	On Track	N/A	N/A	On Track	Met

4.15 Pond 39 – Year 5

Pond 39 was monitored in 2023 as a year 5 post-subsurface munitions remediation vernal pool. Pond 39 was monitored for baseline conditions in 1998, 2015, and 2016. Vegetation in Pond 39 and within its watershed was burned in October 2017 as part of the prescribed burn of BLM Area B Subunit B. Pond 39 had intrusive anomaly investigations in 2018. Table 4-179 summarizes the years that monitoring occurred and surveys were conducted. The cumulative precipitation graph shows precipitation for years in which hydrology monitoring was conducted at Pond 39 (see Figure 4-84). The 1997-1998, 2015-2016, 2018-2019, and 2022-2023 water-years were above normal, whereas the 2014-2015, 2017-2018, 2020-2021, and 2021-2022 water-years were below normal. Water-year 2019-2020 was similar to the cumulative normal water-year.

Table 4-179. Pond 39 (Year 5 Post-Subsurface Munitions Remediation) Summary of Historical Surveys for Hydrology, Vegetation, and Wildlife

Survey	Water-Year								
	1997-1998	2014-2015	2015-2016	2017-2018	2018-2019	2019-2020	2020-2021	2021-2022	2022-2023
Hydrology	●	●	●	●	●	●	●	●	●
Vegetation	●		●	●	●	●	●	●	●
Wildlife	●		●	●	●	●			●

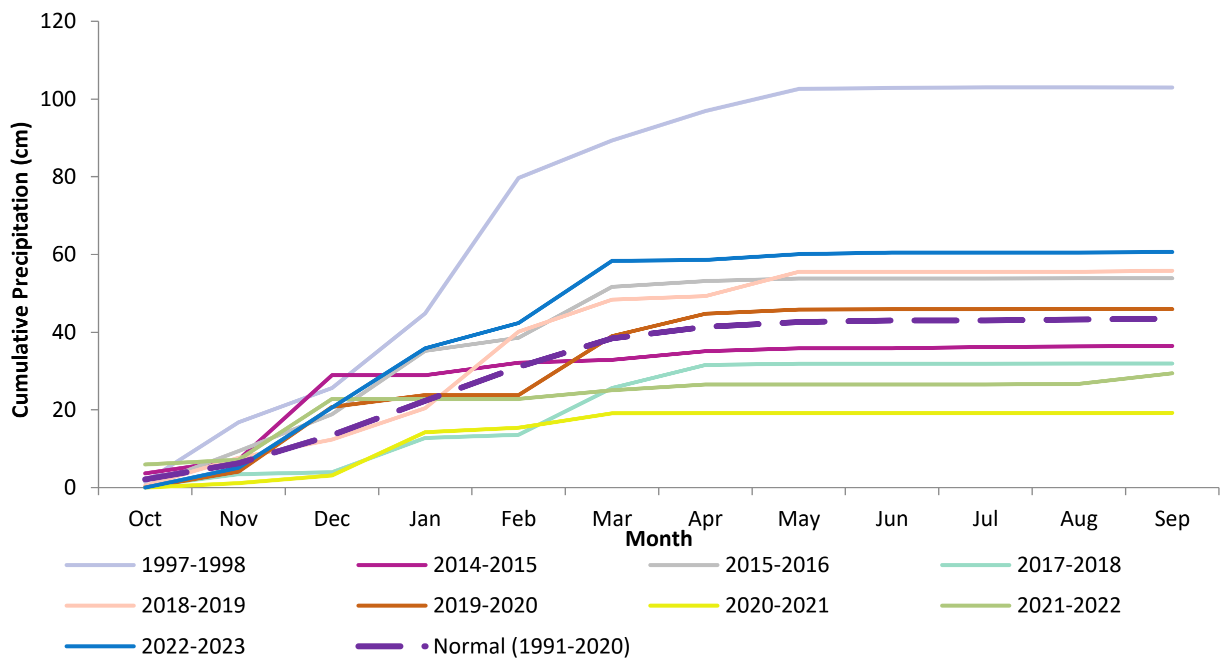

Figure 4-84. Cumulative Monthly Precipitation for Years that Hydrology Monitoring Occurred at Pond 39 (Year 5 Post-Subsurface Munitions Remediation) Compared to the 30-Year Normal (mean 1991-2020) (NPS, 2023; NCEI NOAA, 2023)

4.15.1 Vegetation Monitoring

Vegetation data were collected at Pond 39 in 1998, 2016, and 2018-2023 (HLA, 1998; Burleson, 2017, 2019, 2020, 2021, 2022, 2023). In 1998, data were collected along one transect with a length of 239 feet. Quadrats were placed at 10-foot intervals, alternating from right to left along the transect. Since 1998 data were collected differently than in other years, strata were combined across the vernal pool to allow for comparison. In 2016 and 2018-2023, data were collected using the methodology described in the Methods section of this report. Data from 2016 and 2023 were compared stratum-to-stratum in Table 4-180 as well as visually in Figure 4-85.

Table 4-180. Pond 39 (Year 5 Post-Subsurface Munitions Remediation) Vegetative Strata Percentage within the Vernal Pool Basin Boundary

Stratum	Percentage	
	2016	2023
1	5%	11%
2	8%	18%
3	87%	35%
4	N/A	29%
Upland	N/A	7%

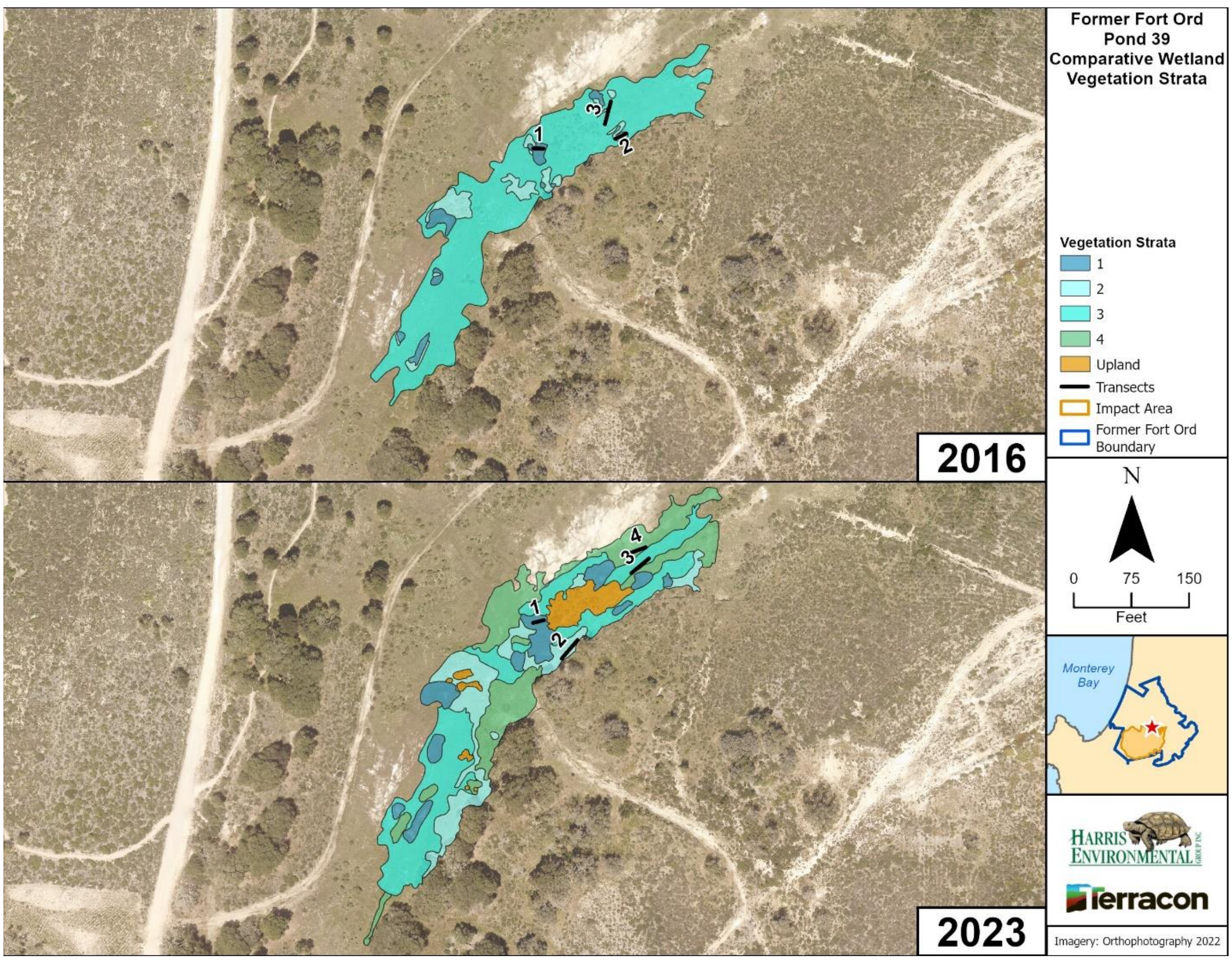

Figure 4-85. Pond 39 (Year 5 Post-Subsurface Munitions Remediation) Vegetation Strata and Transects for 2016 and 2023

The absolute percent vegetative cover for Pond 39 in all monitoring years except 2022 (Yr 4)—which was within the range of values from baseline years—was greater than the range of baseline values (see Table 4-181). The absolute percent vegetative cover of Pond 39 in 2020 (Yr 2), 2021 (Yr 3), and 2022 (Yr 4) was greater than values observed at the reference vernal pools; whereas the vegetative cover in 2019 (Yr 1) and 2023 (Yr 5) was within the range of reference vernal pool values (Burleson, 2020, 2021, 2022, 2023) (see Table 4-182).

Table 4-181. Pond 39 (Year 5 Post-Subsurface Munitions Remediation) Absolute Percent Cover

Year	Vegetative Cover	Thatch/Bare Ground
1998*	48.7%	51.8%
2016*	61.9%	37.4%
2018	59.1%	41.3%
2019	75.2%	25.3%
2020	73.4%	26.6%
2021	64.3%	35.8%
2022	58.7%	41.3%
2023	75.6%	24.4%

*baseline year

Table 4-182. Pond 39 (Year 5 Post-Subsurface Munitions Remediation) and Reference Vernal Pool Absolute Percent Cover in 2023

Vernal Pool	Vegetative Cover	Thatch/Bare Ground
5	74.5%	25.5%
101 East (East)	82.6%	17.4%
997	83.5%	16.7%
39	**75.6%**	**24.4%**

Species richness in 2019 (Yr 1), 2020 (Yr 2), 2022 (Yr 4), and 2023 (Yr 5) was greater than the values observed on transects and in the overall basin in baseline years, whereas in 2021 (Yr 3), species richness was within the range of baseline years, and the overall basin was greater than baseline. Species richness on transects was 22, 30, 35, 46, 32, 29, 37, and 42 species in 1998, 2016, 2018, 2019, 2020, 2021, 2022, and 2023, respectively, whereas overall basin species richness was 61, 90, 98, 85, 73, 76, and 69 species in 2016, 2018, 2019, 2020, 2021, 2022, and 2023, respectively (see Table 4-183 and Appendix A Table A-15). The 1998 survey was limited to species on the transect and overall basin species richness was not recorded. Pond 39 species richness on transects was within the ranges of values at reference vernal pools in 2019 (Yr 1) and 2021 (Yr 3), whereas the species richness for the entire basin was greater (Burleson, 2020, 2022) (see Appendix D Tables D-20 and D-40). Species richness for transects and the overall basin were within the ranges of values at reference vernal pools in 2020 (Yr 2) and 2022 (Yr 4), whereas in 2023 (Yr 5), basin and transect richness was greater (Burleson, 2021, 2023) (see Table 4-184). The species richness is represented on the RACs as the length of the curve and number of species along the curve (see Figure 4-86 and Figure 4-87).

Species composition at Pond 39 varied between monitoring years. This variability of species composition is illustrated on the RACs as the species codes shift along the curve and losses and gains occur from year to year (see Figure 4-86 and Figure 4-87). Despite overall composition variability, the dominant species in the vernal pool were fairly consistent. Two of the top four dominant species in all monitoring years except 2023 (Yr 5), were pale spikerush (*Eleocharis macrostachya*) and Italian rye grass (*Festuca perennis*). Cut-leaved plantain (*Plantago coronopus*) was dominant in 1998 and remained an important species in all other monitoring years. California oat grass (*Danthonia californica*) was dominant from 2018-2021, although in 2019 narrow-leaved clover (*Trifolium angustifolium*) was slightly more dominant. In 2022, long-beaked filaree (*Erodium botrys*) emerged as the second-most dominant species next to Italian rye grass, with Hickman's popcornflower (*Plagiobothrys chorisianus* var. *hickmanii*) as an important sub-dominant. 2023 (Yr 5) results were similar to 2019 (Yr 1), with narrow-leaved clover and Italian rye grass as the dominant species. Unlike the previous monitoring years, pale spikerush was not in the top four dominant species in 2023. A complete comparison of species composition observed at Pond 39 in 1998, 2016, and 2018-2023 can be found in Appendix E. Figure 4-89 shows a subset of this comparison for species observed with a 2% cover or greater.

The evenness from each year for Pond 39 is represented by the slope of the RACs. The evenness is fairly similar from year to year with richness distributed along the entire curve. "Structurally complex systems, such as a fen [or vernal pool] system," as explained in Verberk, 2011, "are species rich and have a more even community abundance pattern, possibly owing to a fine partitioning of available niches." A more even distribution of the top species occurs in the 2016 baseline year, as well as 2019 (Yr 1), 2020 (Yr 2), and 2022 (Yr 4), whereas the RACs for 2021 (Yr 3) and 2023 (Yr 5) have a steeper slope and higher abundance of the dominant species at the top of the curve (see Figure 4-88 and Appendix F). When comparing Pond 39 to reference vernal pools, 2023 (Yr 5) is most similar to Pond 5, whereas 2021 (Yr 3) is similar to 997, both of which have a steep slope at the beginning of the curve and similar shape to the entire RAC. The remaining monitoring years more closely resemble the gradually sloping curve of the 101 East (East) RAC.

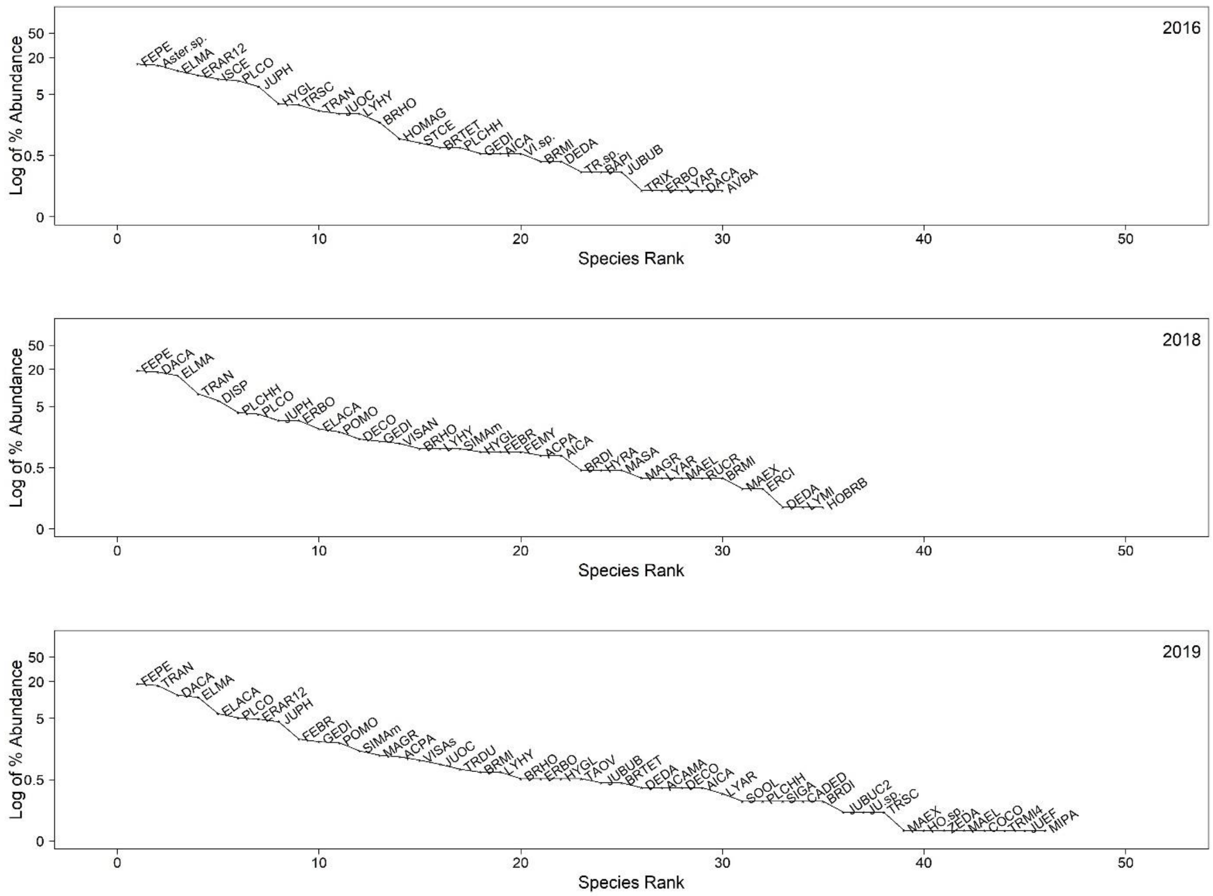

Figure 4-86. Rank Abundance Curves at Pond 39 (Year 5 Post-Subsurface Munitions Remediation) in 2016, 2018, and 2019. Note that the y-axis is in log-10 scale.

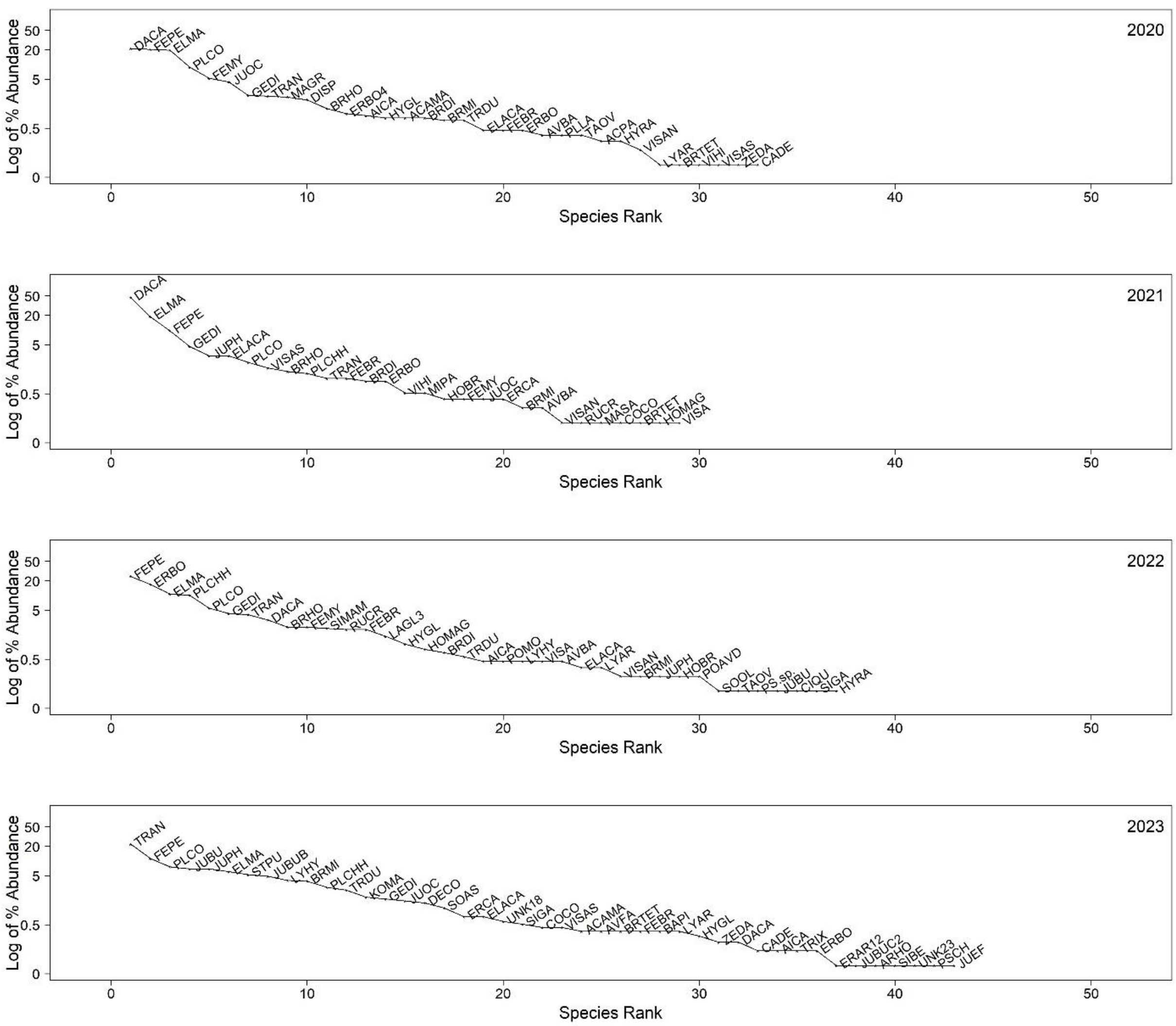

Figure 4-87. Rank Abundance Curves at Pond 39 (Year 4 Post-Subsurface Munitions Remediation) from 2020-2023. Note that the y-axis is in log-10 scale.

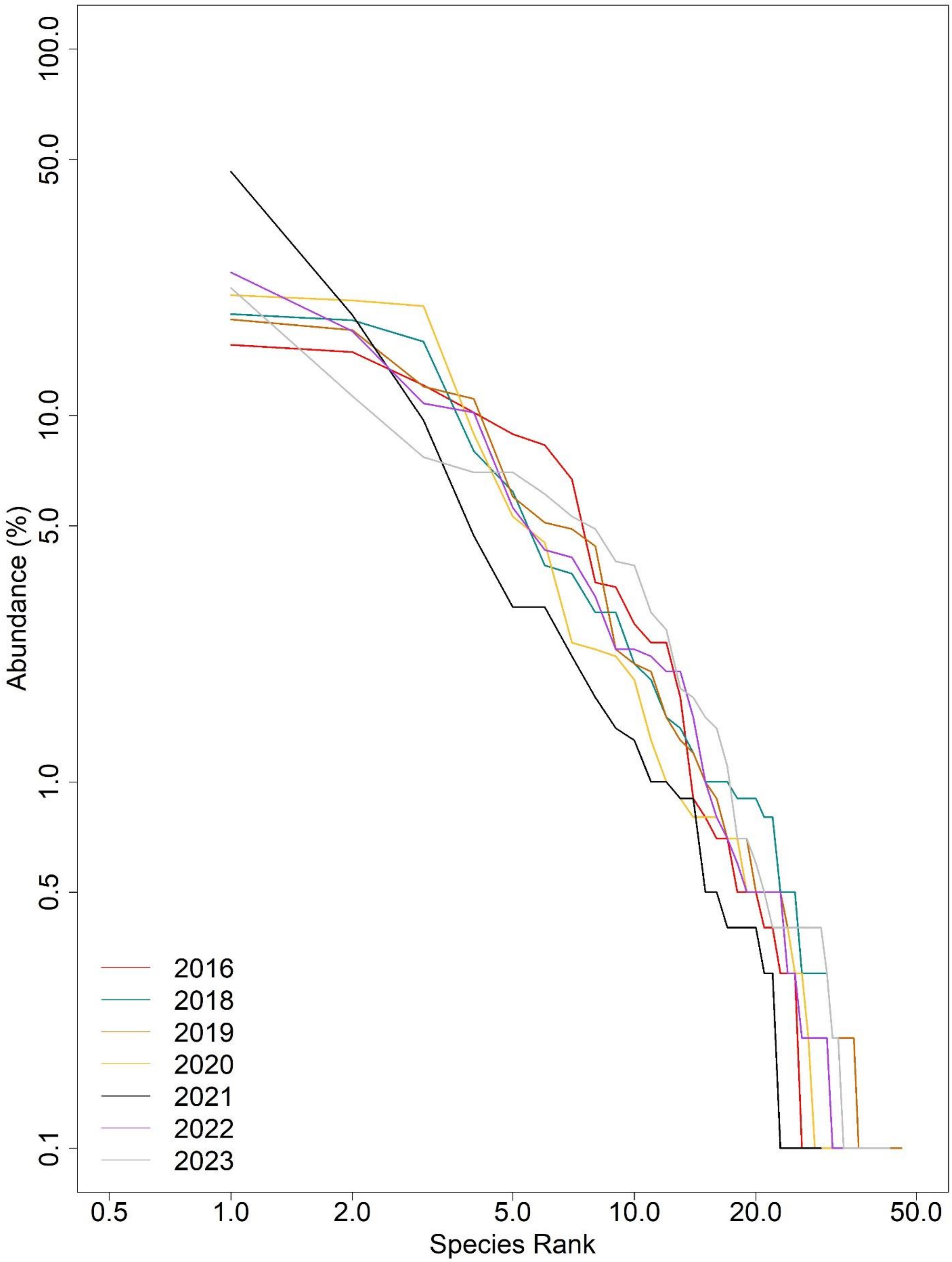

Figure 4-88. Rank Abundance Curves at Pond 39 (Year 5 Post-Subsurface Munitions Remediation) in 2016-2023. Note that the x-axis and the y-axis are in log-10 scale.

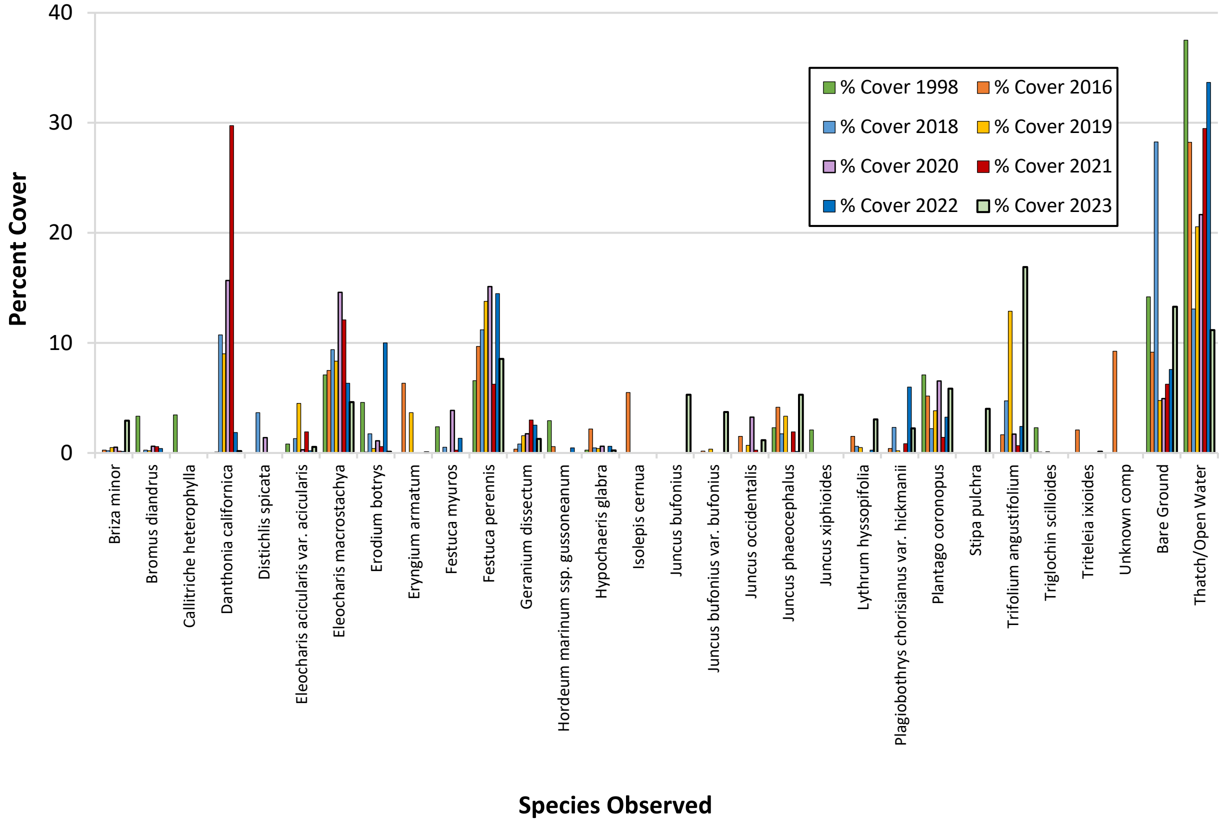

Figure 4-89. Percent Cover of Dominant Species at Pond 39 (Year 5 Post-Subsurface Munitions Remediation)

Native species richness on Pond 39 transects in 2020 (Yr 2), 2021 (Yr 3), and 2022 (Yr 4) were within the range of values observed in baseline years, whereas native richness in 2019 (Yr 1) and 2023 (Yr 5) was greater (see Table 4-183). Non-native species richness was greater than baseline richness in every monitoring year. When comparing to reference vernal pools, results were variable between monitoring years. In 2019 (Yr 1), 2020 (Yr 2), and 2021 (Yr 3), native species richness was in the range of reference vernal pool values (Burleson, 2020, 2021, 2022). In 2023 (Yr 5), native species richness was greater than reference values, whereas in 2022 (Yr 4), native species richness was less than reference values (Burleson, 2023) (see Table 4-184). In every monitoring year except 2019 (Yr 1), non-native species richness was greater than the range of values at reference vernal pools (Burleson, 2020, 2021, 2022, 2023). In 2019 (Yr 1), non-native species richness was within the reference vernal pool ranges.

Table 4-183. Pond 39 (Year 5 Post-Subsurface Munitions Remediation) Native and Non-Native Species Richness

Year	Native	Non-Native	Unidentified
1998*	10	12	0
2016*	14	13	3
2018	16	19	0
2019	25	19	2
2020	12	20	0
2021	11	18	0
2022	11	25	1
2023	23	17	2

*baseline years

Table 4-184. Pond 39 (Year 5 Post-Subsurface Munitions Remediation) and Reference Vernal Pool Native and Non-Native Species Richness in 2023

Vernal Pool	Native	Non-Native	Unidentified
5	12	12	0
101 East (East)	9	7	0
997	13	14	1
39	**23**	**17**	**2**

The relative percent cover of native species in 2019 (Yr 1) and 2023 (Yr 5) was within the values observed in baseline vernal pools, whereas in 2022 (Yr 4), native cover was less, and in 2020 (Yr 2) and 2021 (Yr 3), native cover was greater (see Table 4-185). Non-native cover was within baseline vernal pool values in 2019 (Yr 1), 2020 (Yr 2), and 2023 (Yr 5), whereas non-native cover was less than baseline in 2021 (Yr 3), and greater than baseline in 2022 (Yr 4).

Table 4-185. Pond 39 (Year 5 Post-Subsurface Munitions Remediation) Relative Percent Cover of Native and Non-Native Plants

Year	Native	Non-Native	Unidentified
1998*	39.8%	60.2%	0.0%
2016*	47.1%	37.1%	15.7%
2018	54.3%	45.7%	0.0%
2019	46.8%	53.0%	0.2%
2020	52.0%	48.0%	0.0%
2021	74.3%	25.7%	0.0%
2022	28.9%	70.9%	0.1%
2023	41.5%	57.8%	0.7%

*baseline year

When compared to reference vernal pools, native species relative percent cover values were less in all monitoring years except 2021 (Yr 3), while non-native cover was greater (Burleson, 2020, 2021, 2022, 2023) (see Table 4-186). In 2021 (Yr 3), native and non-native relative percent cover were within the values observed at reference vernal pools (Burleson, 2022).

Table 4-186. Pond 39 (Year 5 Post-Subsurface Munitions Remediation) and Reference Vernal Pool Relative Percent Cover of Native and Non-Native Plants in 2023

Vernal Pool	Native	Non-Native	Unidentified
5	76.3%	23.7%	0.0%
101 East (East)	60.3%	39.7%	0.0%
997	50.0%	49.0%	1.0%
39	**41.5%**	**57.8%**	**0.7%**

Wetland and non-wetland species richness on Pond 39 transects were greater than baseline values in 2019 (Yr 1), 2022 (Yr 4) and 2023 (Yr 5) (see Table 4-187). Whereas, in 2020 (Yr 2) and 2021 (Yr 3), wetland species richness values were less than baseline, while non-wetland species richness was greater than baseline. When compared to reference vernal pools, wetland and non-wetland species richness in 2019 (Yr 1) and 2021 (Yr 3) were within the range of values (Burleson, 2020, 2022). In 2020 (Yr 2), wetland species richness was less than reference vernal pool values and non-wetland species richness was within the range of reference vernal pool values (Burleson, 2021). In contrast, both wetland and non-wetland species richness were greater in 2022 (Yr 4) and 2023 (Yr 5) than the range of reference vernal pool values (Burleson, 2023) (Table 4-188).

Table 4-187. Pond 39 (Year 5 Post-Subsurface Munitions Remediation) Wetland and Non-Wetland Species Richness

Year	Wetland			Non-Wetland		Not Listed
	OBL	FACW	FAC	FACU	UPL	
1998*	7	2	6	3	0	4
2016*	5	5	7	3	0	10
2018	4	7	6	5	1	12
2019	6	9	6	4	2	19
2020	2	2	5	7	2	14
2021	4	3	6	4	3	9
2022	5	6	8	6	3	9
2023	5	9	6	5	1	16

*baseline year

Table 4-188. Pond 39 (Year 5 Post-Subsurface Munitions Remediation) and Reference Vernal Pool Wetland and Non-Wetland Species Richness in 2023

Vernal Pool	Wetland			Non-Wetland		Not Listed
	OBL	FACW	FAC	FACU	UPL	
5	6	7	3	3	1	4
101 East (East)	4	6	1	3	0	2
997	4	6	4	4	0	10
39	**5**	**9**	**6**	**5**	**1**	**16**

The relative percent cover of wetland species at Pond 39 was less than baseline years in 2019 (Yr 1), 2022 (Yr 4), and 2023 (Yr 5), whereas in 2020 (Yr 2) and 2021 (Yr 3) cover was greater than baseline (see Table 4-189). Non-wetland species cover was within the range of baseline values in every monitoring year except for 2022 (Yr 4), in which non-wetland cover was greater. Compared to reference vernal pools, the relative percent cover of wetland and non-wetland species were variable between monitoring years. Wetland cover was less than reference values in 2019 (Yr 1) and 2023 (Yr 5), whereas in 2021 (Yr 3), wetland cover was greater (Burleson, 2020, 2022) (Table 4-190). In 2020 (Yr 2) and 2022 (Yr 4), wetland cover was within the range of values at the reference vernal pools (Burleson, 2021, 2023). Non-wetland cover was within the range of values observed at the reference vernal pools in 2020 (Yr 2), 2022 (Yr 4), and 2023 (Yr 5) (Burleson, 2021, 2023). Whereas, in 2019 (Yr 1) and 2021 (Yr 3), non-wetland cover values were less than reference vernal pool values (Burleson, 2020, 2022).

Table 4-189. Pond 39 (Year 5 Post-Subsurface Munitions Remediation) Relative Percent Cover of Wetland and Non-Wetland Species

Year	Wetland			Non-Wetland		Not Listed
	OBL	FACW	FAC	FACU	UPL	
1998*	32.8%	5.8%	38.9%	14.5%	0.0%	7.9%
2016*	24.2%	20.1%	28.9%	2.4%	0.0%	24.4%
2018	23.0%	12.4%	41.9%	6.1%	1.2%	15.3%
2019	18.2%	14.7%	36.4%	2.1%	1.3%	27.3%
2020	20.3%	6.4%	51.7%	10.3%	0.3%	11.1%
2021	23.2%	3.8%	58.8%	3.1%	1.9%	9.2%
2022	23.3%	3.3%	37.0%	22.7%	0.8%	12.9%
2023	14.3%	20.8%	23.7%	4.7%	0.4%	36.1%

*baseline year

Table 4-190. Pond 39 (Year 5 Post-Subsurface Munitions Remediation) and Reference Vernal Pool Relative Percent Cover of Wetland and Non-Wetland Species in 2023

Vernal Pool	Wetland			Non-Wetland		Not Listed
	OBL	FACW	FAC	FACU	UPL	
5	61.4%	29.0%	3.1%	3.7%	0.1%	2.7%
101 East (East)	14.5%	53.4%	0.1%	9.1%	0.0%	22.9%
997	31.5%	28.9%	7.4%	9.0%	0.0%	23.2%
39	**14.3%**	**20.8%**	**23.7%**	**4.7%**	**0.4%**	**36.1%**

4.15.1.1 *Data Quality Objective 3*

Observable changes in hydrophytic vegetation between surveys were largely associated with precipitation fluctuations and possibly historical disturbance to this area. Some variability is expected given the dynamic nature of vernal pools and the close relationship between the hydroperiod and wetland vegetation composition. Vegetative cover in Pond 39 was dominated by non-native and wetland plant species during year 5 post-subsurface munitions remediation monitoring in 2023. 2019 (Yr 1) was the only monitoring year in which wetland vegetation results were all within range of baseline and/or reference vernal pools. Every proceeding monitoring year was out of range for non-native and/or non-wetland species.

Non-native richness was greater than the values observed in baseline years of monitoring and reference vernal pools in 2023 (Yr 5), which was the same as the results for the 2020-2022 monitoring years.

However, native richness also exceeded the values of baseline and reference. Wetland and non-wetland richness were greater in 2023 than baseline and the range of values at reference, which was similar to 2022 (Yr 4) results. Additionally, wetland cover was less than baseline and the range of reference vernal pool values. The increases in native richness and wetland richness are not concerning. Both are indicators of a well-functioning wetland ecosystem. However, the increase in non-native richness over the last four monitoring years, in addition to the increase in non-wetland richness and decrease in wetland cover, are not favorable trends.

4.15.1.2 *Performance Standard: Plant Cover and Species Diversity*

Pond 39, a post-subsurface munitions remediation vernal pool, did not meet the performance standard by year 5 in 2023. The species composition was dissimilar from baseline and/or reference vernal pool conditions. There was an increase in non-native species richness and non-wetland richness that exceeded the ranges for both baseline and reference. In addition, wetland relative percent cover decreased from baseline and reference vernal pool values.

The valley in Unit B where Pond 39 is located has historically been heavily disturbed which is likely why, in some years, non-native and non-wetland richness is high. The two consecutive low water-years in 2021 and 2022 likely contributed to favorable conditions for non-native species at Pond 39, rather than any effects from remediation. Fortunately, wetland and native species richness were also greater than baseline and reference values, although non-wetland species richness was higher than both sets of values as well. Additionally, non-native cover in 2019 (Yr 1), 2022 (Yr 4), and 2023 (Yr 5) was greater than native cover in all three surveys.

4.15.2 Wildlife Monitoring

Wildlife data were collected at Pond 39 in 1998, 2016, 2018-2020, and 2023 (HLA, 1998; Burleson, 2017, 2019, 2020, 2021). California tiger salamander larvae were not detected in any survey year. Fairy shrimp were present in 1998 and 2018-2020. The vernal pool did not hold sufficient depth for surveys to be completed in 2021 (Yr 3) or 2022 (Yr 4). Fairy shrimp were not detected in 2023 (Yr 5). This may have had to do with the timing of wildlife surveys, as fairy shrimp surveys ideally take place earlier in the season, in February-April, while surveys in 2023 (Yr 5) did not begin until the end of April through May. Table 4-191 shows historical wildlife monitoring results.

Table 4-191. Pond 39 (Year 5 Post-Subsurface Munitions Remediation) Historical Wildlife Monitoring Results

Sampling Year	CTS Larvae Abundance (# Individuals)	Fairy Shrimp Abundance (# Individuals)
1998*	Not detected	Moderate
2016*	Not detected	Not detected
2018	Not detected	Low (8)
2019	Not detected	Low – Moderate (71, 37, 7)
2020	Not detected	Low (5)
2023	Not detected	Not detected

*baseline year

4.15.2.1 *Data Quality Objective 5*

California tiger salamanders were not detected in any monitoring year, which was consistent with baseline. Results in 2019 (Yr 1), 2020 (Yr 2), and 2023 (Yr 5) were partially consistent with reference vernal pool monitoring. Reference Pond 997, to which Pond 39 is most hydrologically similar, did not have CTS detections in 2019. However, while there were no CTS detected at Pond 5 or 101 East (East) in 2020 (Yr 2), the species was detected at both reference vernal pools in 2019 and 2023.

Fairy shrimp were detected in 2019 (Yr 1) and 2020 (Yr 2), but not 2023 (Yr 5). Fairy shrimp results were consistent with baseline results. In 1998, fairy shrimp were detected in moderate numbers, whereas in 2016, no fairy shrimp were detected. Similarly to the 2016 fairy shrimp surveys, 2023 surveys were conducted much later in the season than is ideal for detection. Pond 39 was consistent with reference vernal pools; fairy shrimp were detected at Pond 101 East (East) in 2019 and 2020, and also at Pond 5 in 2019. Fairy shrimp were not detected at any reference vernal pool in 2023.

4.15.2.2 *Performance Standard: Wildlife Usage*

Pond 39 is a post-subsurface munitions remediation vernal pool in the final year (5) of monitoring and met DQO 5. California tiger salamanders were not detected in any monitoring year. This was consistent with baseline and reference vernal pools. Fairy shrimp were present in 2019 (Yr 1) and 2020 (Yr 2), but not in 2023 (Yr 5). This was consistent with baseline results; in 1998, a moderate number of fairy shrimp were detected, while in 2016, none were detected. Additionally, these results were consistent with reference values for the same years. Data quality objectives 1 and 4 were analyzed in the Hydrology Monitoring Annual Report (Chenega, 2023).

4.15.3 Conclusion

Pond 39, a post-subsurface munitions remediation vernal pool, was in year 5 of monitoring in 2023. The vernal pool did not meet the plant cover and species diversity performance standard due to high non-native richness and relative percent cover, as well has high non-wetland richness (see Table 4-192). Wildlife Usage DQO 5 however, was met. CTS and fairy shrimp results were within the ranges of baseline and/or reference vernal pool values. No further monitoring is recommended for Pond 39.

Table 4-192. Success at Pond 39 (Year 5 Post-Subsurface Munitions Remediation) Based on Performance Standards and Applicable Data Quality Objectives

Performance Standard	Applicable DQO	2019 (Yr 1)	2020 (Yr 2)	2021 (Yr 3)	2022 (Yr 4)	2023 (Yr 5)	Success
Plant Cover & Species Diversity	DQO 3	On Track	Not On Track	Not On Track	Not On Track	Not On Track	Not Met
Wildlife Usage	DQO 5	On Track	On Track	N/A	N/A	Partially On Track	Met

*Not applicable; wildlife surveys were not conducted due to insufficient depth

4.16 Pond 40 South – Year 5

Pond 40 South was monitored in 2023 as a year 5 post-subsurface munitions remediation vernal pool. Pond 40 South was monitored for baseline conditions in 1998 and 2015-2017. Vegetation in Pond 40 South and within its watershed was burned in October 2017 as part of the prescribed burn of BLM Area B Subunit B. Pond 40 South had intrusive anomaly investigations in 2018. Table 4-193 summarizes the years that monitoring occurred and surveys were conducted. The cumulative precipitation graph shows precipitation for years in which hydrology monitoring was conducted at Pond 40 South (see Figure 4-90). The 1997-1998, 2015-2016, 2016-2017, 2018-2019, and 2022-2023 water-years were above normal, whereas 2014-2015, 2017-2018, 2020-2021, and 2021-2022 water-years were below normal. Water-year 2019-2020 was similar to the cumulative normal water-year.

Table 4-193. Pond 40 South (Year 5 Post-Subsurface Munitions Remediation) Summary of Historical Surveys for Hydrology, Vegetation, and Wildlife

Survey	Water-Year									
	1997-1998	2014-2015	2015-2016	2016-2017	2017-2018	2018-2019	2019-2020	2020-2021	2021-2022	2022-2023
Hydrology	●	●	●	●	●	●	●	●	●	●
Vegetation	●		●		●	●	●	●	●	●
Wildlife	●		●			●	●			

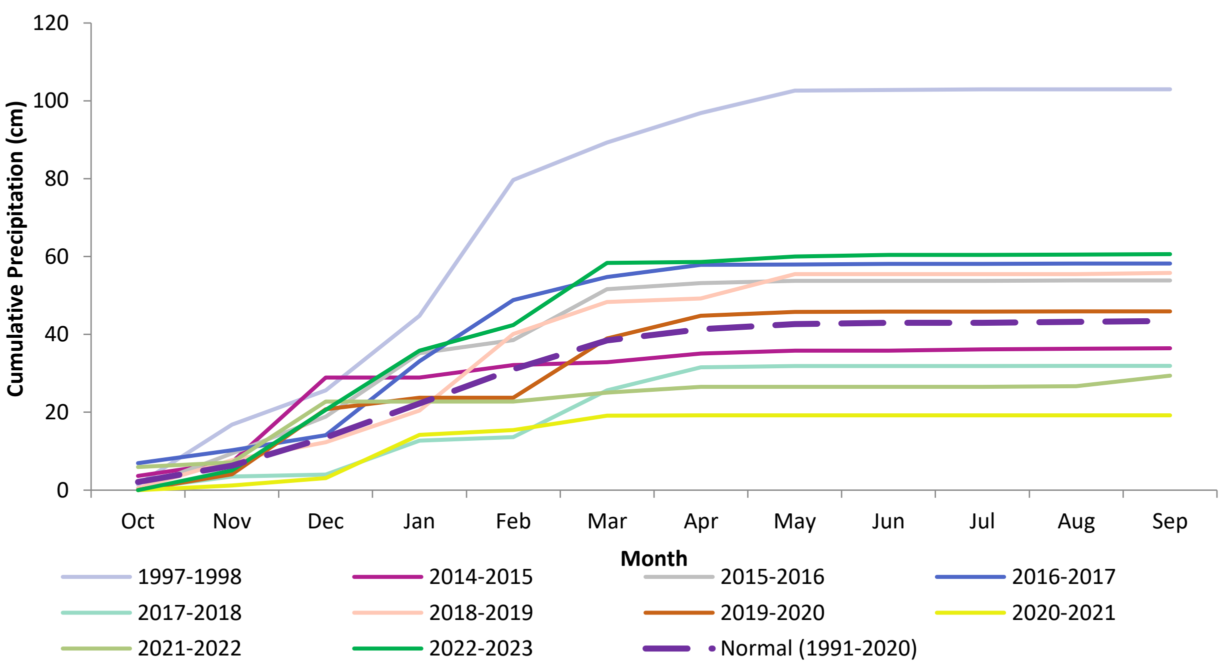

Figure 4-90. Cumulative Monthly Precipitation for Years that Hydrology Monitoring Occurred at Pond 40 South (Year 5 Post-Subsurface Munitions Remediation) Compared to the 30-Year Normal (mean 1991-2020) (NPS, 2023; NCEI NOAA, 2023)

4.16.1 Vegetation Monitoring

Vegetation data were collected at Pond 40 South in 1998, 2016, and 2018-2023 (HLA, 1998; Burleson, 2017, 2019, 2020, 2021, 2022, 2023). In 1998, data were collected along one transect with a length of 135 feet. Quadrats were placed at 10-foot intervals, alternating from right to left along the transect. Because 1998 data were collected differently than in other years, strata were combined across the vernal pool to allow for comparison. In 2016 and 2018-2023 data were collected using the methodology described in the Methods section of this report. Data from 2016 and 2023 were compared stratum-to-stratum in Table 4-194 as well as visually in Figure 4-91.

Table 4-194. Pond 40 South (Year 5 Post-Subsurface Munitions Remediation) Vegetative Strata Percentage within the Vernal Pool Basin Boundary

Stratum	Percentage	
	2016	2023
1	9%	11%
2	26%	30%
3	65%	36%
4	N/A	20%
Upland	N/A	3%

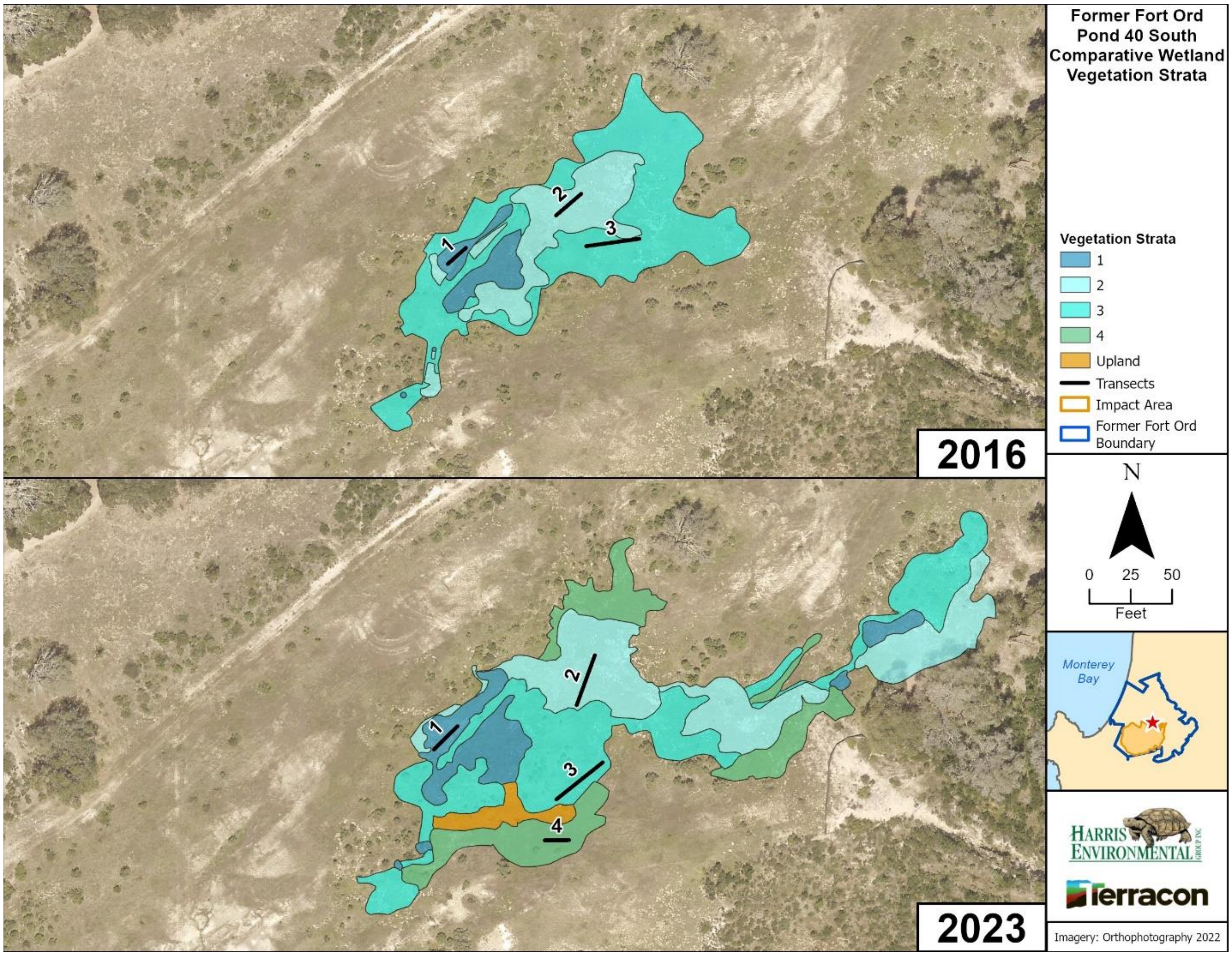

Figure 4-91. Pond 40 South (Year 5 Post-Subsurface Munitions Remediation) Vegetation Strata and Transects for 2016 and 2023

Compared to baseline and reference values, absolute percent vegetative cover was variable between the monitoring years (see Table 4-195). Vegetative cover was greater than baseline in 2019 (Yr 1) and 2023 (Yr 5), whereas in 2020 (Yr 2) and 2021 (Yr 3), cover was less. In 2022 (Yr 4), vegetative cover was within the range of baseline values. In 2019 (Yr 1), 2021 (Yr 3), and 2022 (Yr 4), absolute percent vegetative cover was greater than the range of values observed at reference vernal pools, whereas in 2023 (Yr 5), cover was less (Burleson, 2020, 2022, 2023) (see Table 4-196). In 2020 (Yr 2) cover was within the range of reference vernal pools (Burleson, 2021).

Table 4-195. Pond 40 South (Year 5 Post-Subsurface Munitions Remediation) Absolute Percent Cover

Year	Vegetative Cover	Thatch/Bare Ground
1998*	72.7%	27.1%
2016*	66.7%	33.9%
2018	51.9%	50.3%
2019	78.6%	22.6%
2020	61.2%	38.8%
2021	48.9%	51.1%
2022	67.2%	32.8%
2023	74.3%	25.6%

*baseline year

Table 4-196. Pond 40 South (Year 5 Post-Subsurface Munitions Remediation) and Reference Vernal Pool Absolute Percent Cover in 2023

Vernal Pool	Vegetative Cover	Thatch/Bare Ground
5	74.5%	25.5%
101 East (East)	82.6%	17.4%
997	83.5%	16.7%
40 South	**74.3%**	**25.6%**

Overall basin species richness and species richness on transects in every monitoring year were greater than the baseline years of monitoring, except for 2021 (Yr 3), in which species richness on transects was greater than baseline, but overall basin species richness was within the range of baseline values. Species richness on transects was 21, 20, 32, 41, 26, 25, 33, and 37 species in 1998, 2016, 2018, 2019, 2020, 2021, 2022, and 2023, respectively, whereas overall basin species richness was 27, 55, 75, 66, 53, 60, and 60 species in 2016, 2018, 2019, 2020, 2021, 2022, and 2023, respectively (see Table 4-197 and Appendix A Table A-16). The 1998 survey was limited to species on the transect and overall basin species richness was not recorded. Pond 40 South species richness was within the range observed on transects at the reference vernal pools but below the ranges observed for the entire basin in every monitoring year, except for 2023 (Yr 5), in which species richness on transects was greater than reference values while overall basin species richness was within the range of reference values (Burleson, 2020, 2021, 2022, 2023) (see Table 4-198 and Appendix D Tables D-20 and D-40). The species richness is represented on the RACs as the length of the curve and number of species along the curve (see Figure 4-92 and Figure 4-93).

Species composition and dominant species at Pond 40 South was similar between monitoring years. The changes in species composition is illustrated on the RACs as the species codes shift along the curve and losses and gains occur from year to year (see Figure 4-92 and Figure 4-93). The dominant species was iris-leaved rush (*Juncus xiphioides*) in 1998 (baseline). In the 2016 baseline year and every proceeding monitoring year, Italian rye grass (*Festuca perennis*) was the dominant species, except for 2018, in which it was sub-dominant to cut-leaved plantain *(Plantago coronopus*). In 2019 (Yr 1), 2020 (Yr 2), and 2023 (Yr 5), Italian rye grass and Hickman's popcornflower (*Plagiobothrys chorisianus* var. *hickmanii*) were codominant species. Pale spikerush (*Eleocharis macrostachya*) was present at moderate cover from 1998 to 2019, while cut-leaved plantain was prevalent in every year except 2023 (Yr 5), in which it was less abundant. In 2022, two non-native species became co-dominant with Italian rye grass, including long-beaked filaree (*Erodium botrys)* and narrow-leaved clover (*Trifolium angustifolium*). In 2023 (Yr 5), narrow-leaf clover was the third most dominant species. A complete comparison of species composition observed at Pond 40 South in 1998, 2016, and 2018-2023 can be found in Appendix E. Figure 4-95 shows a subset of this comparison for species observed with a 2% cover or greater.

The evenness from each year is represented by the slope of the RACs. The evenness is fairly similar from year to year with richness distributed along the entire curve. “Structurally complex systems, such as a fen [or vernal pool] system,” as explained in Verberk, 2011, “are species rich and have a more even community abundance pattern, possibly owing to a fine partitioning of available niches.” A more even distribution of the top species occurs in most monitoring years at Pond 40 South compared to the 2016 baseline, which has a steeper slope and higher abundance of the dominant species at the top of the curve; 2021 (Yr 3) was most similar to the 2016 baseline RAC (see Figure 4-94, and Appendix F). When compared to the RACs for reference vernal pools, 2019 (Yr 1), 2021 (Yr 3), and 2023 (Yr 5) were similar to Pond 997 in equivalent years, whereas 2020 (Yr 2) was similar to 101 East (East), and 2022 (Yr 4) had a similar slope as the tail end of Pond 5.

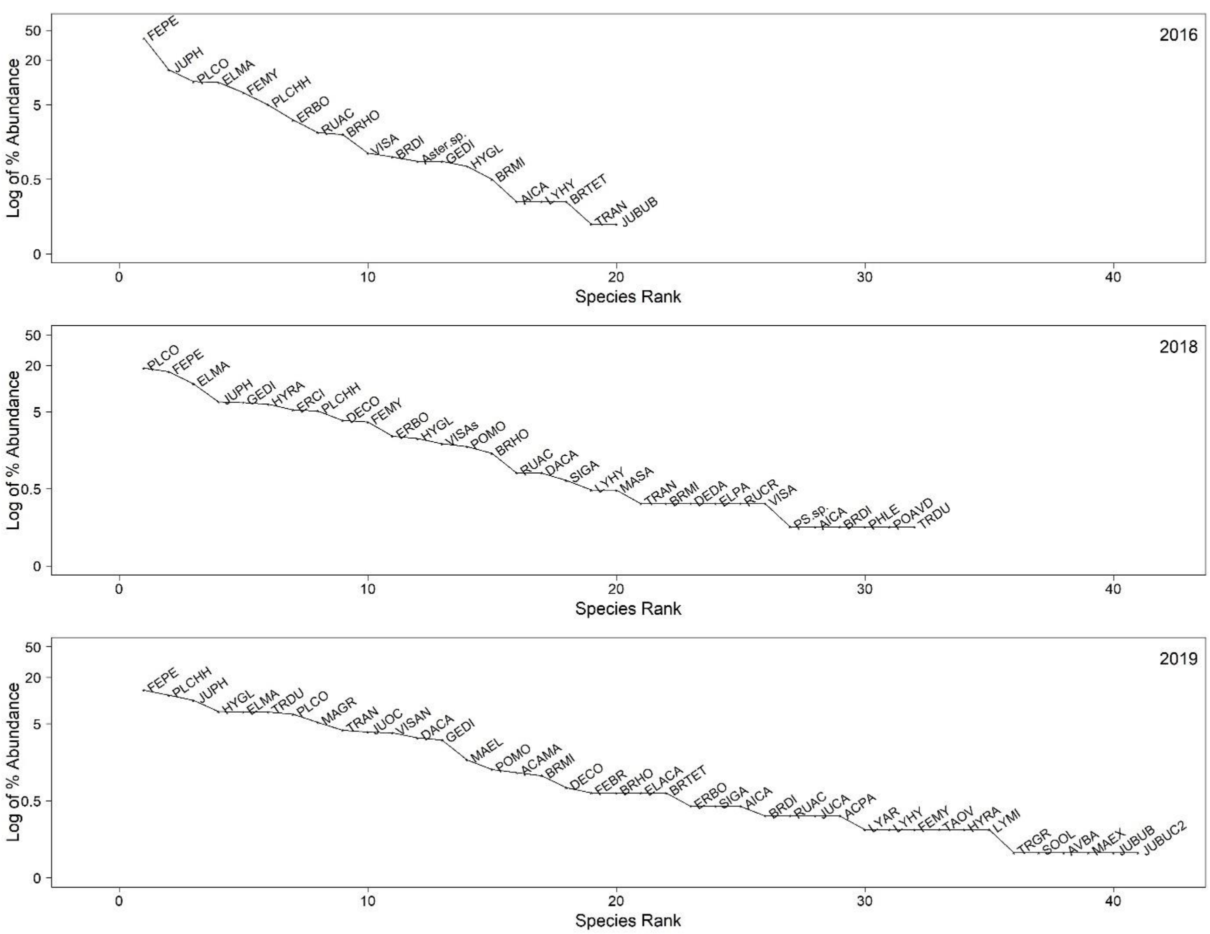

Figure 4-92. Rank Abundance Curves at Pond 40 South (Year 5 Post-Subsurface Munitions Remediation) in 2016, 2018, and 2019. Note that the y-axis is in log-10 scale.

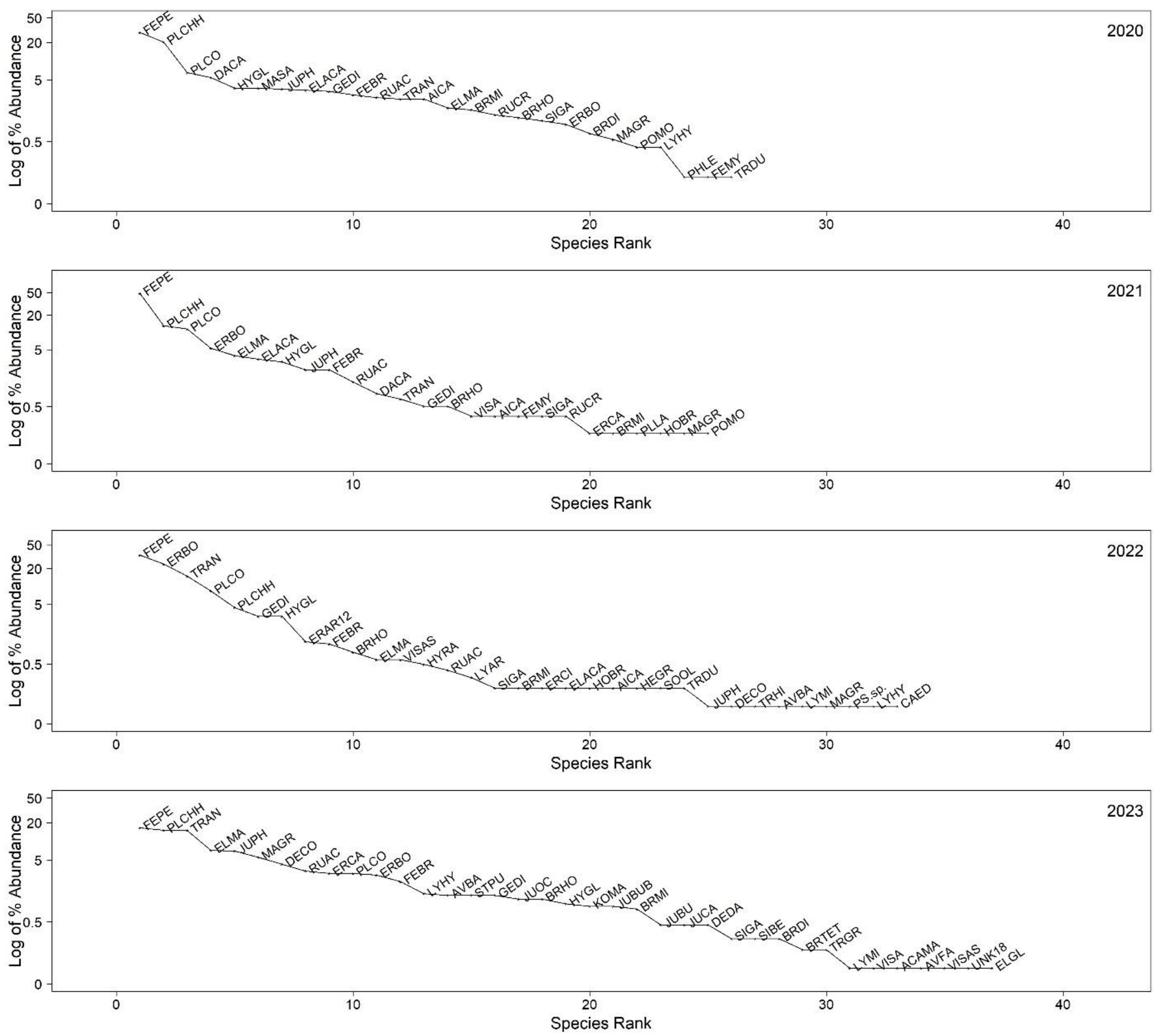

Figure 4-93. Rank Abundance Curves at Pond 40 South (Year 5 Post-Subsurface Munitions Remediation) from 2020-2023. Note that the y-axis is in log-10 scale.

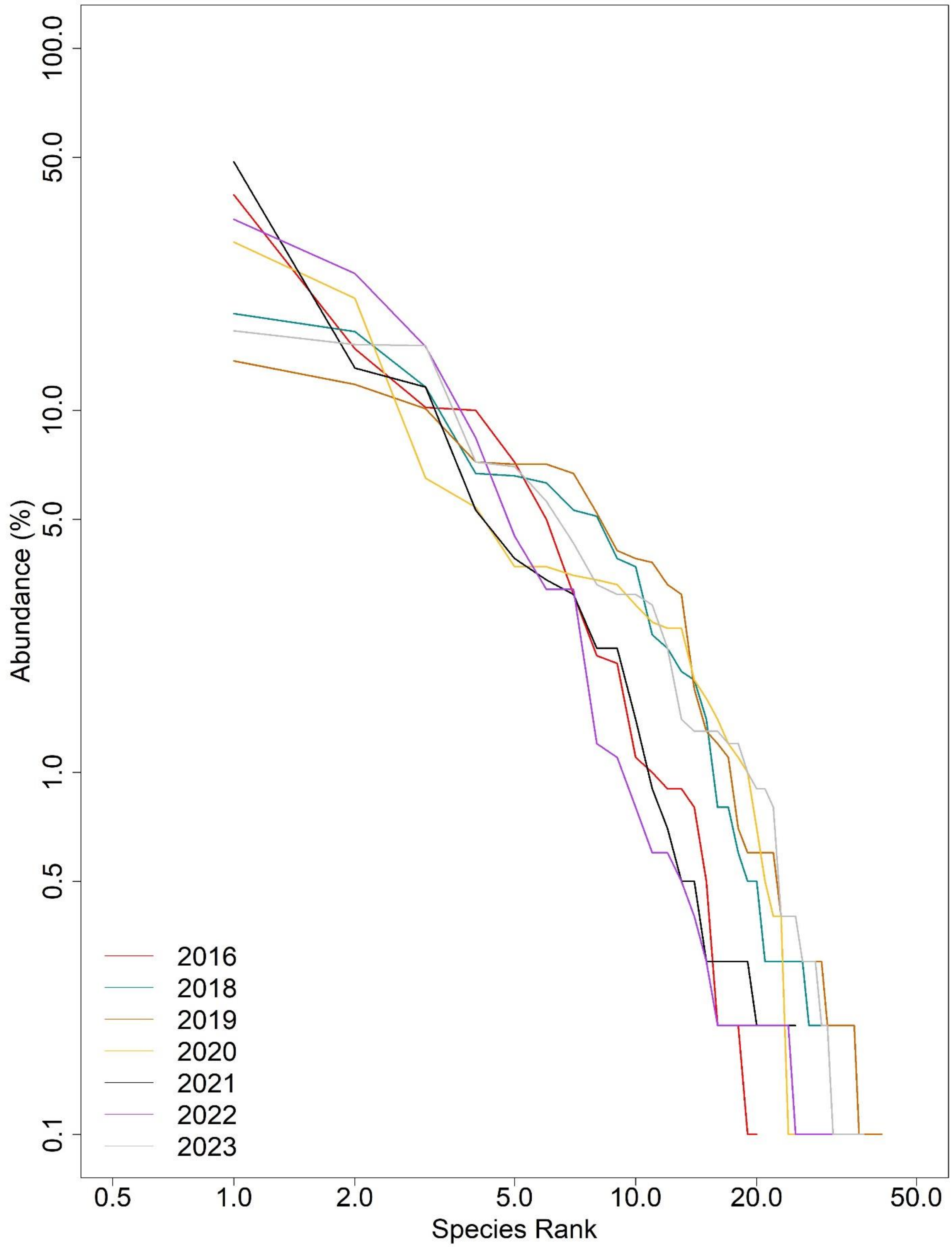

Figure 4-94. Rank Abundance Curves at Pond 40 South (Year 5 Post-Subsurface Munitions Remediation) in 2016-2023. Note that the x-axis and the y-axis are in log-10 scale.

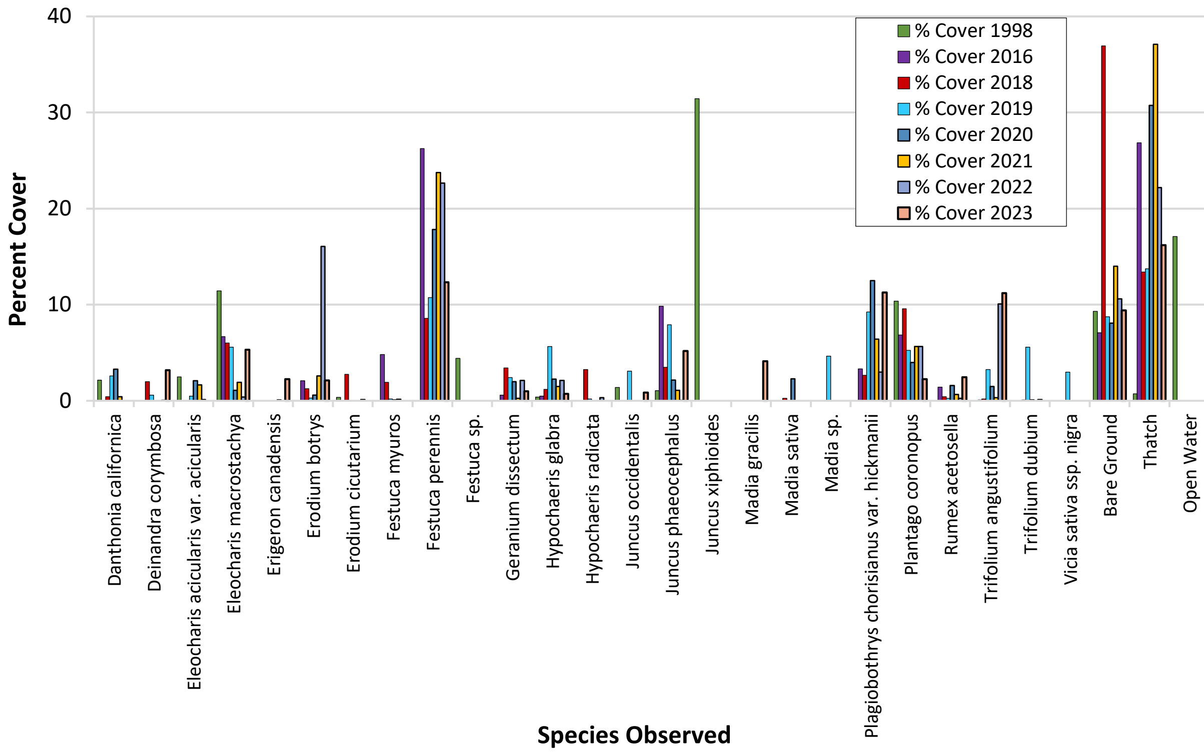

Figure 4-95. Percent Cover of Dominant Species at Pond 40 South (Year 5 Post-Subsurface Munitions Remediation)

Native species richness on Pond 40 South transects was within the range of values observed in baseline years, while non-native species richness was greater than baseline in 2020 (Yr 2), 2021 (Yr 3), and 2022 (Yr 4) (see Table 4-197). In 2019 (Yr 1) and 2023 (Yr 5), native and non-native species richness were greater than baseline. Pond 40 South native species richness was less than reference pools in every monitoring year, except for 2023 (Yr 5), in which native richness was greater than reference (Burleson, 2020, 2021, 2022, 2023) (see Table 4-198). Conversely, non-native species richness was greater than the range of values observed at reference vernal pools in every monitoring year, except 2020 (Yr 2), in which non-native richness was within the range of reference.

Table 4-197. Pond 40 South (Year 5 Post-Subsurface Munitions Remediation) Native and Non-Native Species Richness

Year	Native	Non-Native	Unidentified
1998*	12	6	3
2016*	5	14	1
2018	9	22	1
2019	17	23	1
2020	8	18	0
2021	8	17	0
2022	10	22	1
2023	18	18	1

*baseline year

Table 4-198. Pond 40 South (Year 5 Post-Subsurface Munitions Remediation) and Reference Vernal Pool Native and Non-Native Species Richness in 2023

Vernal Pool	Native	Non-Native	Unidentified
5	12	12	0
101 East (East)	9	7	0
997	13	14	1
40 South	**18**	**18**	**1**

The relative percent cover of native and non-native species was within the range of baseline values in 2019 (Yr 1), 2020 (Yr 2), and 2023 (Yr 5), whereas in 2021 (Yr 3) and 2022 (Yr 4), native cover was less than baseline, while non-native cover was greater (see Table 4-199). Native relative percent cover compared to reference vernal pools was less than the range of values in every monitoring year, whereas non-native cover was greater than the range reference vernal pool values (Burleson, 2020, 2021, 2022, 2023) (see Table 4-200).

Table 4-199. Pond 40 South (Year 5 Post-Subsurface Munitions Remediation) Relative Percent Cover of Native and Non-Native Plants

Year	Native	Non-Native	Unidentified
1998*	75.7%	15.7%	8.5%
2016*	30.1%	69.0%	0.9%
2018	29.4%	70.5%	0.2%
2019	41.5%	52.6%	5.9%
2020	39.0%	61.0%	0.0%
2021	24.0%	76.0%	0.0%
2022	7.2%	92.7%	0.1%
2023	48.4%	51.5%	0.1%

*baseline year

Table 4-200. Pond 40 South (Year 5 Post-Subsurface Munitions Remediation) and Reference Vernal Pool Relative Percent Cover of Native and Non-Native Plants in 2023

Vernal Pool	Native	Non-Native	Unidentified
5	76.3%	23.7%	0.0%
101 East (East)	60.3%	39.7%	0.0%
997	50.0%	49.0%	1.0%
40 South	**48.4%**	**51.5%**	**0.1%**

Wetland richness on Pond 40 South transects was greater than the range of baseline in every year except in 2021 (Yr 3), in which wetland richness was within the range of baseline values (see Table 4-201). Similarly, non-wetland richness was greater than baseline values in every year except 2020 (Yr 2), in which non-wetland richness was within the range of baseline values. Compared to reference vernal pools, wetland richness was less than the range of values in 2019 (Yr 1), 2020 (Yr 2), and 2021 (Yr 3), whereas wetland richness was within the range of values in 2022 (Yr 4), and 2023 (Yr 5) (Burleson, 2020, 2021, 2022, 2023) (see Table 4-202). Non-wetland richness was within the range of values observed at reference vernal pools in every year, except 2023 (Yr 5), in which non-wetland richness was greater.

Table 4-201. Pond 40 South (Year 5 Post-Subsurface Munitions Remediation) Wetland and Non-Wetland Species Richness

Year	Wetland			Non-Wetland		Not Listed
	OBL	FACW	FAC	FACU	UPL	
1998*	4	4	3	1	0	9
2016*	3	2	3	5	1	6
2018	3	5	6	7	2	9
2019	4	6	5	8	2	16
2020	4	3	5	6	0	8
2021	3	3	5	7	1	6
2022	4	4	4	6	2	13
2023	3	7	3	6	2	16

*baseline year

Table 4-202. Pond 40 South (Year 5 Post-Subsurface Munitions Remediation) and Reference Vernal Pool Wetland and Non-Wetland Species Richness in 2023

Vernal Pool	Wetland			Non-Wetland		Not Listed
	OBL	FACW	FAC	FACU	UPL	
5	6	7	3	3	1	4
101 East (East)	4	6	1	3	0	2
997	4	6	4	4	0	10
40 South	**3**	**7**	**3**	**6**	**2**	**16**

The relative percent cover of wetland species was less than the range of values observed in baseline years in every monitoring year, except 2021 (Yr 3), in which wetland cover was within the range of baseline values (see Table 4-203). The relative percent cover of non-wetland species was greater than baseline in 2022 (Yr 4), whereas non-wetland cover was within the range of baseline values in 2019 (Yr 1), 2020 (Yr 2), 2021 (Yr 3), and 2023 (Yr 5). The relative percent cover of wetland species was less than the range of values observed at reference vernal pools in 2019 (Yr 1) and 2023 (Yr 5), whereas in 2020 (Yr 2) and 2022 (Yr 4), cover was within the range of reference pools (Burleson, 2020, 2021, 2023) (see Table 4-204). In 2021 (Yr 3), wetland species relative percent cover was greater than the range of values observed at reference vernal pools (Burleson, 2022). Non-wetland cover was within the range of reference vernal pool values in every year, except in 2023 (Yr 5), in which it was greater (Burleson, 2020, 2021, 2022, 2023).

Table 4-203. Pond 40 South (Year 5 Post-Subsurface Munitions Remediation) Relative Percent Cover of Wetland and Non-Wetland Species

Year	Wetland			Non-Wetland		Not Listed
	OBL	FACW	FAC	FACU	UPL	
1998*	62.6%	4.9%	18.6%	0.2%	0.0%	13.8%
2016*	15.3%	14.9%	50.1%	14.8%	1.1%	3.9%
2018	17.2%	9.3%	36.6%	14.9%	2.2%	19.7%
2019	19.7%	15.7%	24.9%	9.7%	3.9%	26.1%
2020	26.0%	4.1%	44.1%	7.5%	0.0%	18.3%
2021	20.4%	2.6%	61.5%	8.2%	0.3%	7.0%
2022	5.4%	1.6%	42.7%	26.0%	0.8%	23.6%
2023	23.8%	10.3%	20.5%	11.0%	0.2%	34.3%

*baseline year

Table 4-204. Pond 40 South (Year 5 Post-Subsurface Munitions Remediation) and Reference Vernal Pool Relative Percent Cover of Wetland and Non-Wetland Species in 2023

Vernal Pool	Wetland			Non-Wetland		Not Listed
	OBL	FACW	FAC	FACU	UPL	
5	61.4%	29.0%	3.1%	3.7%	0.1%	2.7%
101 East (East)	14.5%	53.4%	0.1%	9.1%	0.0%	22.9%
997	31.5%	28.9%	7.4%	9.0%	0.0%	23.2%
40 South	**23.8%**	**10.3%**	**20.5%**	**11.0%**	**0.2%**	**34.3%**

4.16.1.1 *Data Quality Objective 3*

Observable changes in hydrophytic vegetation between surveys were largely associated with precipitation fluctuations and the resulting inundation and hydroperiod. This is expected given the dynamic nature of vernal pools and the close relationship between the hydroperiod and wetland vegetation composition. Vegetative cover in Pond 40 South has been dominated by non-native and wetland plant species during every year of monitoring. Pond 40 South typically has high non-native richness and cover, even in the baseline year of monitoring. However, Pond 40 South vegetation results differed from baseline in that the non-native species richness was greater than baseline values as well as native species richness in nearly every monitoring year. In 2023 (Yr 5), native and non-native species richness were the same. In addition, native species richness was greater than both baseline and reference vernal pool values, which was a positive shift from previous years.

Wetland species composition varied between the monitoring years. Most years however, had greater non-wetland richness than the baseline values, and most years had less wetland cover than baseline. Generally high non-native richness and cover and high non-wetland richness, have been a concern every year. Monitoring results in 2021 (Yr 3), 2022 (Yr 4) and 2023 (Yr 5) have all had non-native and non-wetland values that have exceeded the ranges of baseline and reference vernal pools. While 2019 (Yr 1) and 2023 (Yr 5) both had above-normal precipitation, species composition in 2023 (Yr 5) was likely impacted by the previous two consecutive drought years, one of which had the lowest recorded precipition for all survey years. Below-normal water-years can result in upland and non-native herbs and grasses exploiting a greater portion of a vernal pool and distributing more evenly (Bauder, 2000). Although non-native upland plants were not prevalent in the final year of monitoring, more facultative and opportunistic non-native species still remained after spreading further in the wetland in previous years. It is thus unlikely that these trends were caused by remediation activities, but rather by natural precipitation fluctuations.

4.16.1.2 *Performance Standard: Plant Cover and Species Diversity*

Pond 40 South, a post-subsurface munitions remediation vernal pool, did not meet the performance standard for year 5 in 2023. The species composition, native species richness, wetland species richness and relative abundances were similar to baseline and/or the reference vernal pools in most monitoring years. However, non-native and non-wetland species richness were greater than both baseline and the range of reference values while wetland cover was less than baseline and reference values. The valley in Unit B where Pond 40 South is located has historically been heavily disturbed which is likely why non-native richness and/or cover has been high, rather than any effects from remediation. Additionally, the low precipitation in 2021 (Yr 3) and 2022 (Yr 4) likely contributed to favorable conditions for non-native species at Pond 40 South.

4.16.2 Wildlife Monitoring

Wildlife data were collected at Pond 40 South in 1998, 2016, 2019, and 2020 (HLA, 1998; Burleson, 2017, 2020, 2021). California tiger salamander larvae were not detected in any survey year. Fairy shrimp were present in 2019 and 2020. The vernal pool did not hold sufficient depth for surveys to be completed in 2021 (Yr 3) or 2022 (Yr 4). While there was adequate depth for wildlife surveys in March and early April, 2023 (Yr 5), depth was too low by the time vernal pools were surveyed in late April through May (Chenega, 2023). Therefore, DQO 5 and the applicable wildlife usage performance standard is only assessed for 2019 (Yr 1) and 2020 (Yr 2). Table 4-205 shows historical wildlife monitoring results.

Table 4-205. Pond 40 South (Year 5 Post-Subsurface Munitions Remediation) Historical Wildlife Monitoring Results

Sampling Year	CTS Larvae Abundance (# Individuals)	Fairy Shrimp Abundance (# Individuals)
1998*	Not detected	Not detected
2016*	Not detected	Not detected
2019	Not detected	Moderate (13, 12)
2020	Not detected	Low (1)

*baseline year

4.16.2.1 *Data Quality Objective 5*

California tiger salamanders were not detected in any year, which was consistent with baseline monitoring. Results were consistent with reference values, as there were no CTS detected at Pond 997 in 2019, nor were any detected at Pond 5 or Pond 101 East (East) in 2020.

Fairy shrimp were present in 2019 (Yr 1) and 2020 (Yr 2), which was not consistent with baseline monitoring, though favorably. Fairy shrimp were not detected in 1998 or 2016. It was possible that survey timing prevented detection in 2016 because surveys occurred later in the year (April and May) (Burleson, 2017). However, in 2020 (Yr 2), a very dry February followed by above-normal March and April rain events may have been favorable for later fairy shrimp detection. Results in 2019 (Yr 1) were consistent with reference Ponds 5 and 101 East (East), while 2020 (Yr 2) results were consistent with reference Pond 101 East (East). Fairy shrimp were present at Pond 101 East (East) but were not detected at Pond 5 in 2020 (Yr 2).

4.16.2.2 *Performance Standard: Wildlife Usage*

Pond 40 South, a post-subsurface munitions remediation vernal pool, was the final year of monitoring and met DQO 5. California tiger salamanders were not detected in any year. This trend was also observed at reference Ponds 5 and 101 East (East) in 2020, and at Pond 997 in 2019. California tiger salamanders were not detected in either year of baseline. Fairy shrimp were present in 2019 (Yr 1) and 2020 (Yr 2), which was not consistent with baseline results, although in a favorable trajectory. Results were consistent with reference Ponds 5 and Pond 101 East (East). Data quality objectives 1 and 4 were analyzed in the Hydrology Monitoring Annual Report (Chenega, 2023).

4.16.3 Conclusion

Pond 40 South, a post-subsurface munitions remediation vernal pool, was in the final year (Yr 5) of monitoring in 2023. The vernal pool did not meet the plant cover and species diversity performance standard due to high non-native and non-wetland richness, as well as low wetland cover (see Table 4-206). The vernal pool did, however meet DQO 5 for wildlife usage. No further monitoring is recommended for Pond 40 South.

Table 4-206. Success at Pond 40 South (Year 5 Post-Subsurface Munitions Remediation) Based on Performance Standards and Applicable Data Quality Objectives

Performance Standard	Applicable DQO	2019 (Yr 1)	2020 (Yr 2)	2021 (Yr 3)	2022 (Yr 4)	2023 (Yr 5)	Success
Plant Cover & Species Diversity	DQO 3	On Track	On Track	Not On Track	Not On Track	Not On Track	Not Met
Wildlife Usage	DQO 5	On Track	On Track	N/A	N/A	N/A	Met

*Not applicable; wildlife surveys were not conducted due to insufficient depth

4.17 Pond 41 – Year 5

Pond 41 was monitored in 2023 as a year 5 post-subsurface munitions remediation vernal pool. Pond 41 was monitored for baseline conditions in 1998, 2015, and 2016 and cleared of subsurface anomalies in 2018. Table 4-207 summarizes the years that monitoring occurred and surveys were conducted. The cumulative precipitation graph shows precipitation for years in which hydrology monitoring was conducted at Pond 41 (see Figure 4-96). The normal or above-normal water-years were 1997-1998, 2015-2016, 2018-2019, 2019-2020, and 2022-2023. Monitoring in 2014-2015, 2020-2021, and 2021-2022 was conducted in below-normal water-years.

Table 4-207. Pond 41 (Year 5 Post-Subsurface Munitions Remediation) Summary of Historical Surveys for Hydrology, Vegetation, and Wildlife

Survey	Water-Year							
	1997-1998	2014-2015	2015-2016	2018-2019	2019-2020	2020-2021	2021-2022	2022-2023
Hydrology	●	●	●	●	●	●	●	●
Vegetation			●	●	●	●	●	●
Wildlife	●		●	●	●			●

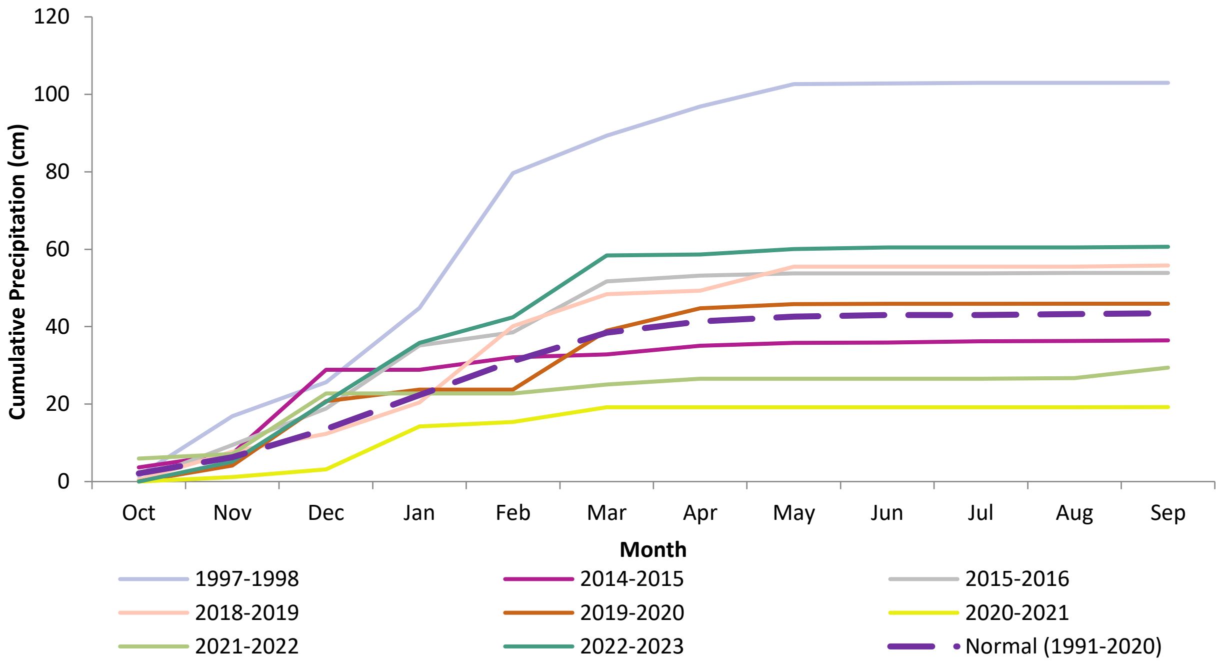

Figure 4-96. Cumulative Monthly Precipitation for Years that Hydrology Monitoring Occurred at Pond 41 (Year 5 Post-Subsurface Munitions Remediation) Compared to the 30-Year Normal (mean 1991-2020) (NPS, 2023; NCEI NOAA, 2023)

4.17.1 Vegetation Monitoring

Vegetation data were collected at Pond 41 in 2016 and 2019-2023 (Burleson, 2017, 2020, 2021, and 2022). Data were collected using the methodology described in the Methods section of this report. Data from 2016 and 2023 were compared stratum-to-stratum in Table 4-208 as well as visually in Figure 4-97.

Table 4-208. Pond 41 (Year 5 Post-Subsurface Munitions Remediation) Vegetative Strata Percentage within the Vernal Pool Basin Boundary

Stratum	Percentage	
	2016	2023
1	29%	16%
2	52%	57%
3	27%	20%
4	N/A	4%
Upland	3%	3%

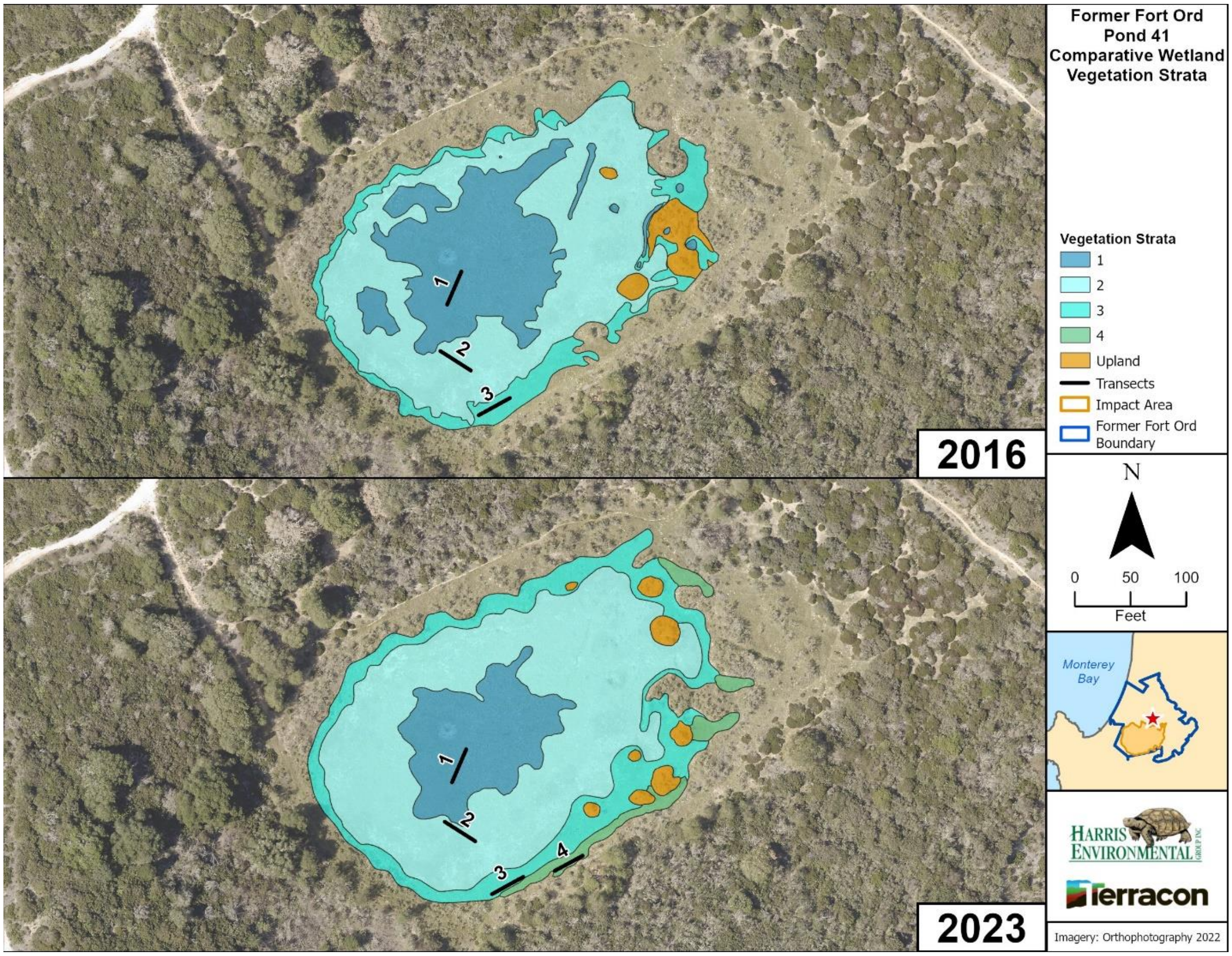

Figure 4-97. Pond 41 (Year 5 Post-Subsurface Munitions Remediation) Vegetation Strata and Transects for 2016 and 2023

The absolute percent vegetative cover was less than baseline in every monitoring year, although by 2023 (Yr 5), cover was only 1.2% less (see Table 4-209). When compared to reference vernal pools, 2019 (Yr 1) and 2023 (Yr 5) were less than the range of reference vernal pool values, whereas monitoring years 2020-2022 (Yrs 2, 3, and 4) were within of values observed at reference vernal pools (Burleson, 2020, 2021, 2022, 2023) (see Table 4-210).

Table 4-209. Pond 41 (Year 5 Post-Subsurface Munitions Remediation) Absolute Percent Cover

Year	Vegetative Cover	Thatch/Bare Ground
2016*	71.7%	28.3%
2019	69.7%	30.3%
2020	68.9%	31.2%
2021	44.1%	55.9%
2022	45.3%	54.7%
2023	70.5%	29.5%

*baseline year

Table 4-210. Pond 41 (Year 5 Post-Subsurface Munitions Remediation) and Reference Vernal Pool Absolute Percent Cover in 2023

Vernal Pool	Vegetative Cover	Thatch/Bare Ground
5	74.5%	25.5%
101 East (East)	82.6%	17.4%
997	83.5%	16.7%
41	**70.5%**	**29.5%**

Species richness was greater than baseline in every monitoring year. Species richness on transects was 16, 33, 35, 32, 28, and 30 species in 2016, 2019, 2020, 2021, 2022, and 2023, respectively. Basin species richness was 28, 75, 60, 63, 58, and 52 species in 2016, 2019, 2020, 2021, 2022, and 2023, respectively (see Table 4-211 and Appendix A Table A-17). Pond 41 overall species richness and transect species richness were less than the range of values observed at the reference vernal pools in 2019 (Yr 1) and 2022 (Yr 4) (Burleson, 2020, 2023) (see Appendix D Tables D-20 and D-40). In 2021 (Yr 3) and 2023 (Yr 5), species richness on transects was greater than reference vernal pool values, while richness for the entire basin was within the range of values observed at reference vernal pools (Burleson, 2022) (see Table 4-212). Conversely, transect richness was within the range of reference pool values in 2020 (Yr 2), while basin richness was less (Burleson, 2021). The species richness is represented on the RACs as the length of the curve and number of species along the curve (see Figure 4-98 and Figure 4-99).

Species composition at Pond 41 varied over the monitoring years, although there were similarities in the dominant species. This variation in species composition is illustrated on the RACs as the species codes shift along the curve and losses and gains occur from year to year (see Figure 4-98 and Figure 4-99). In every monitoring year, brown-headed rush (*Juncus phaeocephalus*) was among the three dominant species and was the most dominant in 2020 (Yr 2) and 2021 (Yr 3), as well as in the baseline year in 2016. Pale spikerush (*Eleocharis macrostachya*) was the most dominant species in 2019 (Yr 1) and 2023 (Yr 5), was co-dominant with brown-headed rush in 2020 (Yr 2), and was the third most dominant species in 2016. Monitoring years 2021 (Yr 3) and 2022 (Yr 4) had shifts in species composition. In 2021 (Yr 3), non-native cut-leaved geranium (*Geranium dissectum*) was the second-most dominant source of cover, and by 2022 it became the most dominant species. Other important species in 2016 were hedge nettle (*Stachys ajugoides*), alkali mallow (*Malvella leprosa*), smooth goldfields (*Lasthenia glaberrima*), and Hickman's popcornflower (*Plagiobothrys chorisianus* var. *hickmanii*). California oatgrass (*Danthonia californica*) and rabbitfoot grass (*Polygonum monspeliensis*) were prevalent in 2019 and 2020. Brown-headed rush, Lemmon's canarygrass (*Phalaris lemmonii*), and alkali mallow were important subdominants in 2022. In 2023 (Yr 5), needle spikerush (*Eleocharis acicularis* var. *acicularis*) became the third most dominant species, followed by gumweed (*Madia gracilis*) and Hickman's popcornflower. A complete comparison of species composition observed at Pond 41 in 2016 and 2019-2022 can be found in Appendix E. Figure 4-101 shows a subset of this comparison for species observed with a 2% cover or greater.

The evenness from each year for Pond 41 is represented by the slope of the RACs. The evenness is fairly similar from year to year with richness distributed along the entire curve. "Structurally complex systems, such as a fen [or vernal pool] system," as explained in Verberk, 2011, "are species rich and have a more even community abundance pattern, possibly owing to a fine partitioning of available niches." Every monitoring year had a similar shape to the curve as baseline, with a fairly even distribution of dominant species at the top (see Figure 4-100, and Appendix F). However, 2016 (baseline) had a much steeper decline in the latter half of the RAC, indicating less evenness between the most and least dominant species. When compared to reference vernal pools, Pond 41 RACs varied among the monitoring years. In 2022 (Yr 4), the most similar reference vernal pool was Pond 5 in the overall slope of the RAC and high concentration of species towards the tail end. 2019 (Yr 1) and 2020 (Yr 2) were most similar to the equivalent years for Pond 997. Whereas, 2021 (Yr 3) and 2023 (Yr 5) were similar to Pond 101 East (East) in the overall shape of the curve.

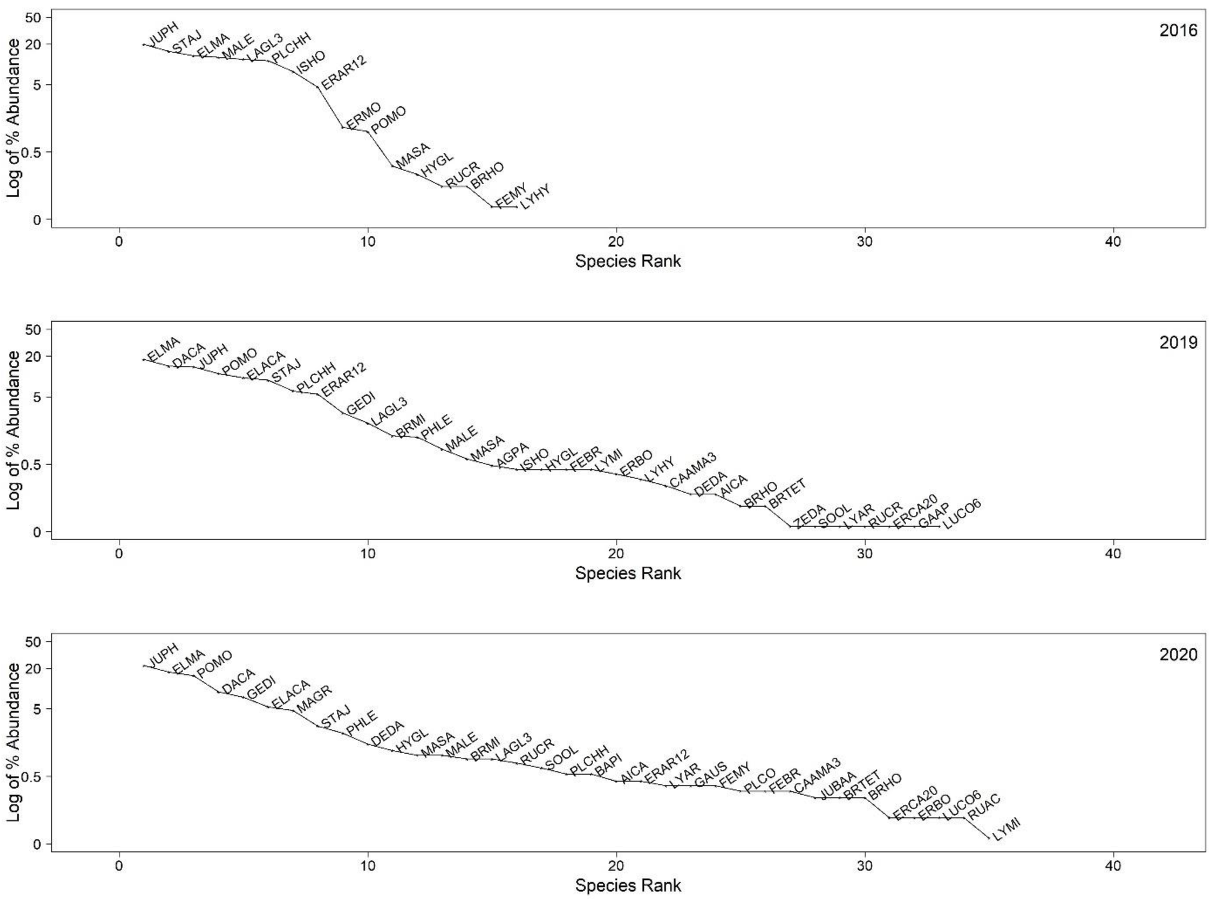

Figure 4-98. Rank Abundance Curves at Pond 41 (Year 5 Post-Subsurface Munitions Remediation) in 2016, 2019, and 2020. Note that the y-axis is in log-10 scale.

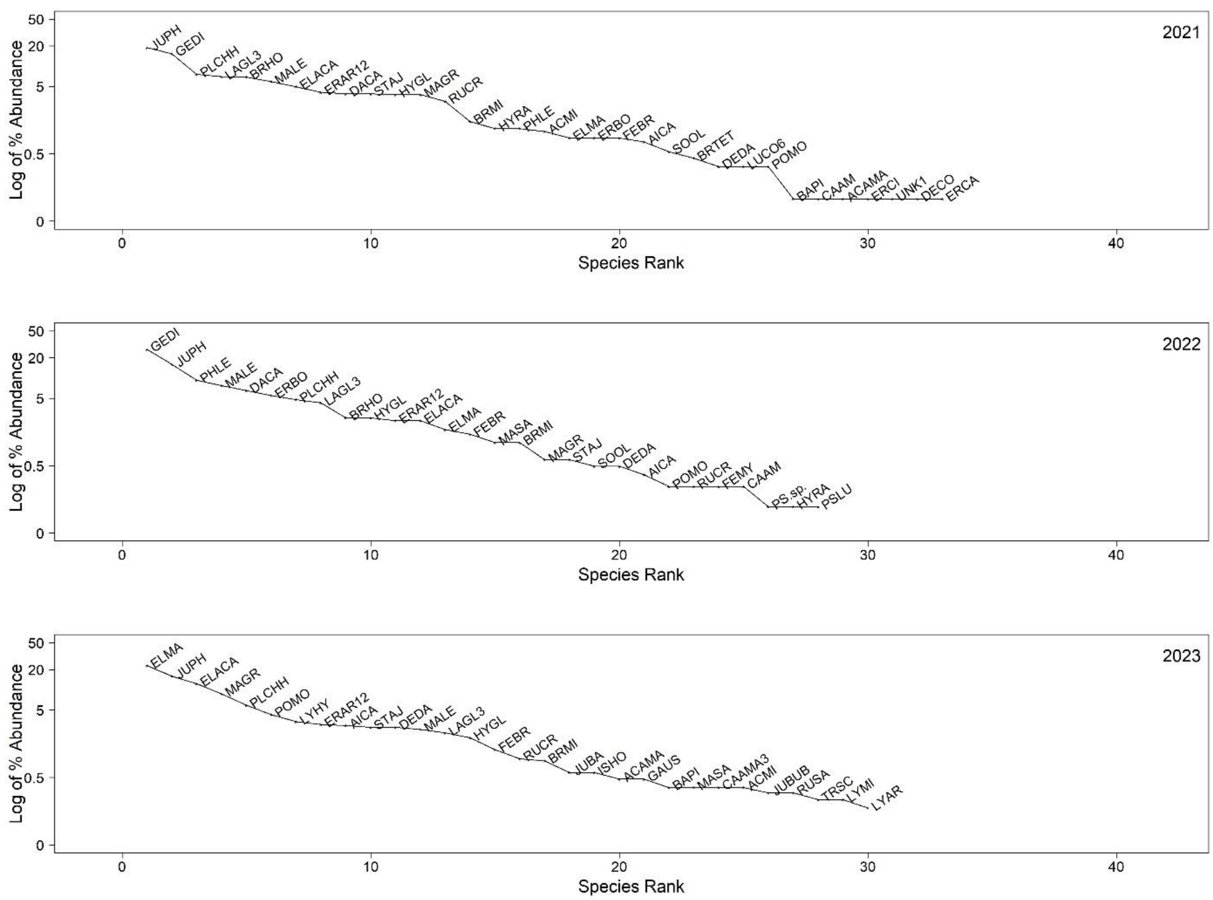

Figure 4-99. Rank Abundance Curves at Pond 41 (Year 5 Post-Subsurface Munitions Remediation) in 2021, 2022, and 2023. Note that the y-axis is in log-10 scale.

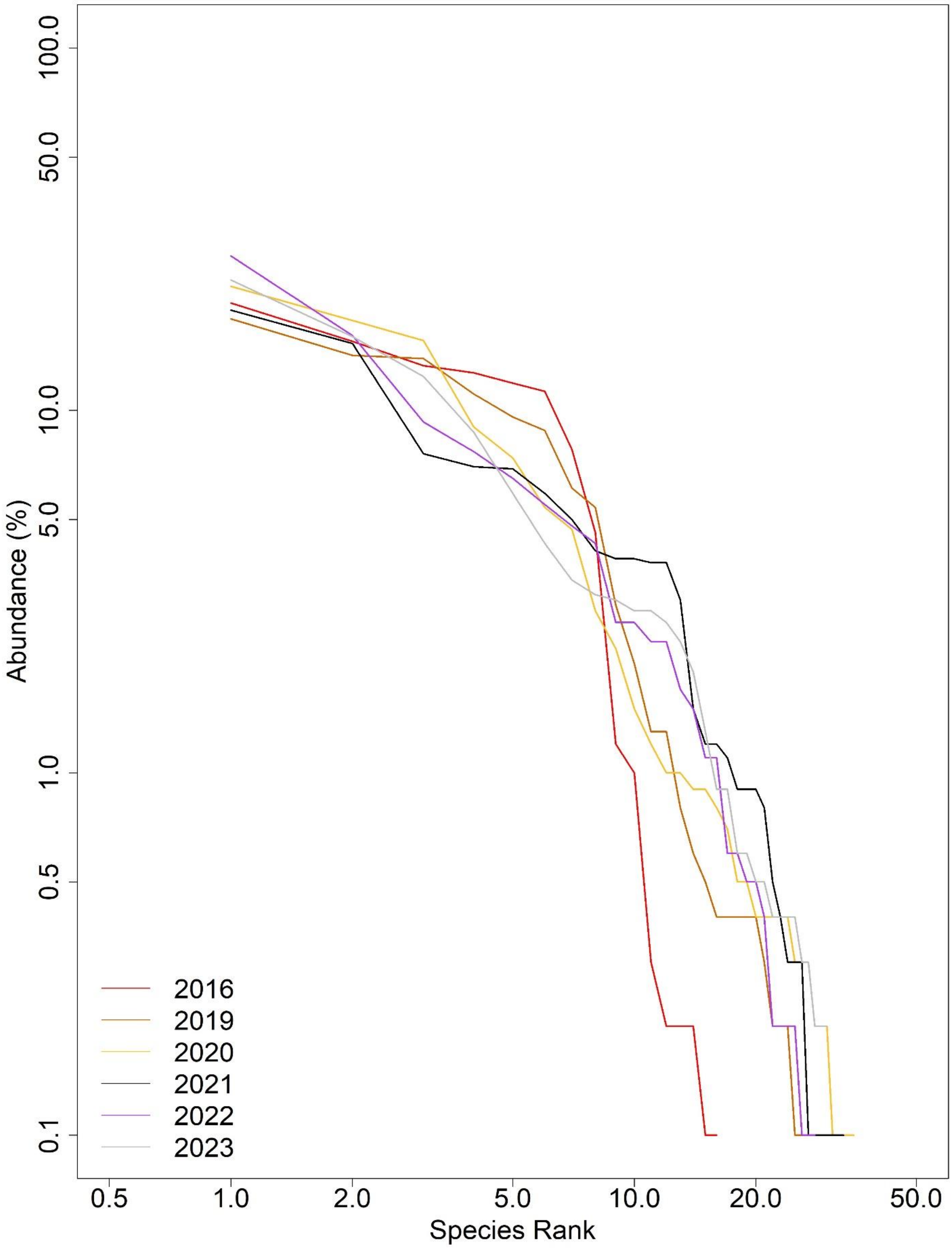

Figure 4-100. Rank Abundance Curves at Pond 41 (Year 5 Post-Subsurface Munitions Remediation) in 2016 and 2019-2023. Note that the x-axis and the y-axis are in log-10 scale

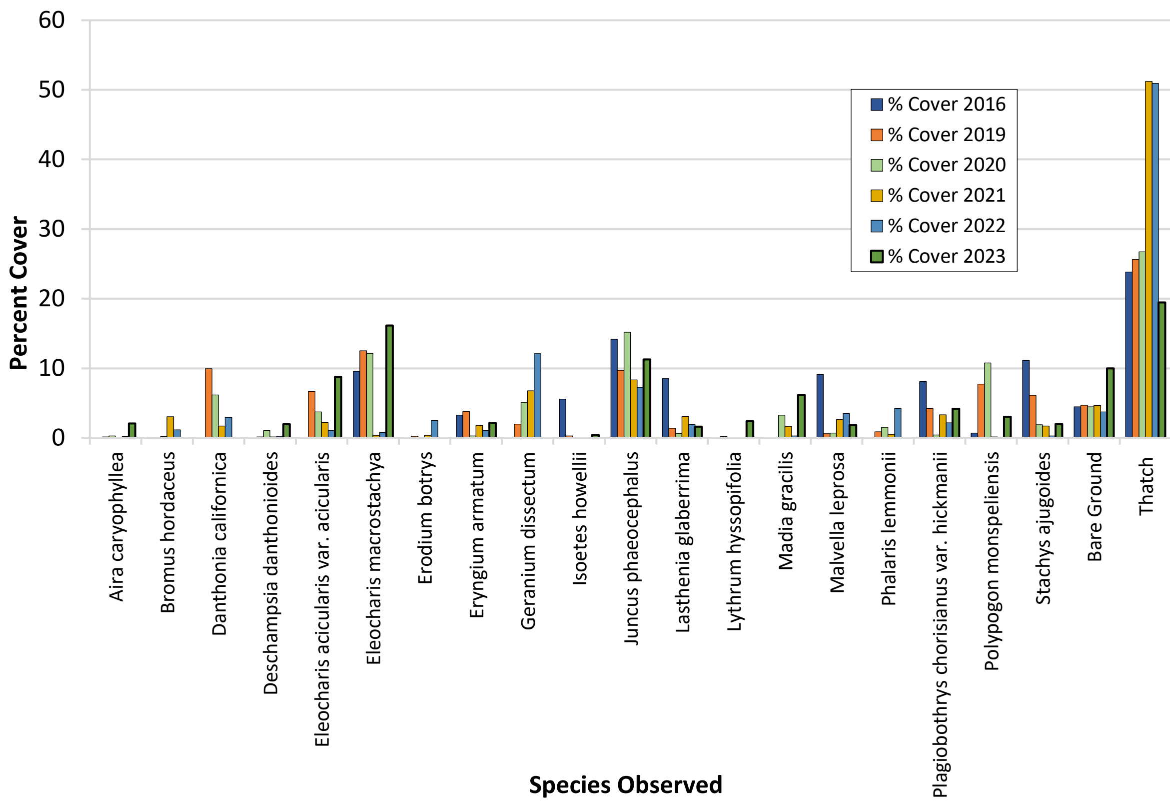

Figure 4-101. Percent Cover of Dominant Species at Pond 41 (Year 5 Post-Subsurface Munitions Remediation)

Native and non-native species richness on Pond 41 transects in every monitoring year were greater than baseline (see Table 4-211). Native species richness was within the range of the reference vernal pools and non-native species richness was less than the range of values observed at reference in 2019 (Yr 1) and 2022 (Yr 4) (Burleson, 2020, 2023) (see Table 4-212). Conversely, native richness was greater than reference values, and non-native richness was in the range of reference vernal pool values in 2021 (Yr 3) and 2023 (Yr 5) (Burleson, 2022). In 2020, both native and non-native species richness were within the range observed at reference vernal pools (Burleson, 2021).

Table 4-211. Pond 41 (Year 5 Post-Subsurface Munitions Remediation) Native and Non-Native Species Richness

Year	Native	Non-Native	Unidentified
2016*	9	7	0
2019	21	12	0
2020	21	14	0
2021**	20	12	1
2022	14	13	1
2023	22	8	0

*baseline year
** This value has changed from previous years. In 2021, *Castilleja ambigua* was not differentiated from *Castilleja ambigua* ssp. *ambigua*, so the data sheet was missing a species. Changes will be reflected in future reports and the data deliverable. The Native value increased from 19 Native species to 20.

Table 4-212. Pond 41 (Year 5 Post-Subsurface Munitions Remediation) and Reference Vernal Pool Native and Non-Native Species Richness in 2023

Vernal Pool	Native	Non-Native	Unidentified
5	12	12	0
101 East (East)	9	7	0
997	13	14	1
41	**22**	**8**	**0**

The relative percent cover of native species decreased, and non-native species increased each year between 2016 (baseline) and 2023 (Yr 5) (see Table 4-213). (see Table 4-214). In 2019 (Yr 1) and 2023 (Yr 5), native species relative percent cover was greater than reference values, whereas non-native cover was less (Burleson, 2020) (see Table 4-214). Native and non-native species cover at Pond 41 were within the range of values observed in reference vernal pools in 2020-2022 (Yrs 2, 3, and 4) (Burleson, 2021, 2022, 2023).

Table 4-213. Pond 41 (Year 5 Post-Subsurface Munitions Remediation) Relative Percent Cover of Native and Non-Native Plants

Year	Native	Non-Native	Unidentified
2016*	97.1%	2.9%	0.0%
2019	82.8%	17.2%	0.0%
2020	71.1%	28.9%	0.0%
2021	64.7%	35.2%	0.1%
2022	58.1%	41.8%	0.1%
2023	84.1%	15.9%	0.0%

*baseline year

Table 4-214. Pond 41 (Year 5 Post-Subsurface Munitions Remediation) and Reference Vernal Pool Relative Percent Cover of Native and Non-Native Plants in 2023

Vernal Pool	Native	Non-Native	Unidentified
5	76.3%	23.7%	0.0%
101 East (East)	60.3%	39.7%	0.0%
997	50.0%	49.0%	1.0%
41	**84.1%**	**15.9%**	**0.0%**

Wetland and non-wetland species richness on Pond 41 transects were greater than baseline in every monitoring year, except for non-wetland richness in 2023 (Yr 5), which was the same value as baseline (see Table 4-215). Wetland and non-wetland species richness were within the range of values observed at the reference vernal pools in 2019 (Yr 1), 2020 (Yr 2), and 2022 (Yr 4), whereas 2021 (Yr 3) and 2023 (Yr 5) had wetland richness values greater than reference values, and non-wetland richness values within the range of values observed at reference (Burleson, 2020, 2021, 2022, 2023) (see Table 4-216).

Table 4-215. Pond 41 (Year 5 Post-Subsurface Munitions Remediation) Wetland and Non-Wetland Species Richness

Year	Wetland			Non-Wetland		Not Listed
	OBL	FACW	FAC	FACU	UPL	
2016*	6	3	1	3	0	3
2019	7	7	5	6	2	6
2020	5	8	6	7	1	8
2021**	5	6	4	7	1	10
2022	5	7	3	6	1	6
2023	8	9	3	3	0	7

*baseline year
**This value has changed from previous years. In 2021, *Castilleja ambigua* was not differentiated from *Castilleja ambigua* ssp. *ambigua*, so the data sheet was missing a species. Changes will be reflected in future reports and the data deliverable. The FACW value increased from 5 to 6.

Table 4-216. Pond 41 (Year 5 Post-Subsurface Munitions Remediation) and Reference Vernal Pool Wetland and Non-Wetland Species Richness in 2023

Vernal Pool	Wetland			Non-Wetland		Not Listed
	OBL	FACW	FAC	FACU	UPL	
5	6	7	3	3	1	4
101 East (East)	4	6	1	3	0	2
997	4	6	4	4	0	10
41	**8**	**9**	**3**	**3**	**0**	**7**

The relative percent cover of wetland species was less than baseline values in 2020-2023, whereas in 2019 (Yr 1), wetland cover was greater (see Table 4-217). Non-wetland cover was less than baseline in 2019 (Yr 1), 2020 (Yr 2), and 2023 (Yr 5), while non-wetland cover was greater than baseline in 2021 (Yr 3) and 2022 (Yr 4). The wetland and non-wetland species relative percent cover values were within the ranges observed at the reference vernal pools for every monitoring year, except in 2019 (Yr 1), in which wetland cover was greater than reference values, while non-wetland cover was less (Burleson, 2020, 2021, 2022, 2023) (see Table 4-218).

Table 4-217. Pond 41 (Year 5 Post-Subsurface Munitions Remediation) Relative Percent Cover of Wetland and Non-Wetland Species

Year	Wetland			Non-Wetland		Not Listed
	OBL	FACW	FAC	FACU	UPL	
2016*	59.8%	25.4%	0.2%	12.9%	0.0%	1.7%
2019	45.1%	32.5%	15.7%	1.6%	0.5%	4.5%
2020	27.3%	42.3%	11.4%	2.4%	0.7%	15.8%
2021**	24.3%	24.9%	8.7%	16.8%	0.5%	24.7%
2022	13.7%	28.8%	7.8%	16.5%	0.5%	32.6%
2023	50.5%	27.9%	2.0%	5.9%	0.0%	13.6%

*baseline year
**This value has changed from previous years. In 2021, *Castilleja ambigua* was not differentiated from *Castilleja ambigua* ssp. *ambigua*, so the data sheet was missing a species. Changes will be reflected in future reports and the data deliverable. The FACW value increased from 24.8% to 24.9%.

Table 4-218. Pond 41 (Year 5 Post-Subsurface Munitions Remediation) and Reference Vernal Pool Relative Percent Cover of Wetland and Non-Wetland Species in 2023

Vernal Pool	Wetland			Non-Wetland		Not Listed
	OBL	FACW	FAC	FACU	UPL	
5	61.4%	29.0%	3.1%	3.7%	0.1%	2.7%
101 East (East)	14.5%	53.4%	0.1%	9.1%	0.0%	22.9%
997	31.5%	28.9%	7.4%	9.0%	0.0%	23.2%
41	**50.5%**	**27.9%**	**2.0%**	**5.9%**	**0.0%**	**13.6%**

4.17.1.1 *Data Quality Objective 3*

Observable changes in hydrophytic vegetation between surveys were largely associated with precipitation fluctuations. This is expected given the dynamic nature of vernal pools and the close relationship between the hydroperiod and wetland vegetation composition. Vegetative cover in Pond 41 was dominated by native and wetland plant species during year 5 post-subsurface munitions remediation monitoring in 2023. Pond 41 wetland vegetation results generally differed from baseline and/or reference values. By the fifth year of monitoring, both native and non-native relative percent cover deviated from baseline and reference: native cover was less than baseline but above reference values, while non-native cover was greater than baseline but below reference. Additionally, native and wetland species richness were greater than baseline and reference values, which also occurred in 2021 (Yr 3). The increase in native and wetland richness is not concerning. Both support a well-functioning vernal pool ecosystem.

4.17.1.2 *Performance Standard: Plant Cover and Species Diversity*

Pond 41, a post-subsurface munitions remediation vernal pool, met the performance standard by the final year of monitoring in 2023 (Yr 5). The species composition, as well as native and wetland species richness and relative abundances were not similar to baseline and/or reference vernal pool conditions, but differed in a neutral to positive way. Although non-native species cover increased from baseline, it was less than the range of values at reference. Additionally, native and wetland species richness values were greater than both baseline and reference vernal pool values, which was a positive shift that has happened twice during the monitoring years. Pond 41 provided suitable wetland habitat in 2023.

4.17.2 Wildlife Monitoring

Wildlife data were collected at Pond 41 in 1998, 2016, 2019, 2020, and 2023 (HLA, 1998; Burleson, 2017, 2020, 2021). California tiger salamander larvae were observed in 2016 (baseline), 2019 (Yr 1), and 2023 (Yr 5). Fairy shrimp were detected in 1998, 2019, and 2020. The vernal pool did not hold sufficient depth for surveys to be completed in 2021 (Yr 3) or 2022 (Yr 4). Therefore, DQO 5 and the applicable wildlife usage performance standard will only be assessed for 2019 (Yr 1), 2020 (Yr 2), and 2023 (Yr 5). Table 4-219 shows historical wildlife monitoring results.

Table 4-219. Pond 41 (Year 5 Post-Subsurface Munitions Remediation) Historical Wildlife Monitoring Results

Sampling Year	CTS Larvae Abundance (# Individuals)	Fairy Shrimp Abundance (# Individuals)
1998*	Not detected	Low
2016*	Few (3)	Not detected
2019	Few – Common (2, 13, 9)	Low – High (122, 6)
2020	Not detected	Moderate (15)
2023	Few (4, 7)	Not detected

*baseline year

4.17.2.1 *Data Quality Objective 5*

California tiger salamanders were not detected in 2020 (Yr 2), but were detected in 2019 (Yr 1) and 2023 (Yr 5), which was consistent the baseline monitoring years. California tiger salamanders were present in 2016 but were not detected in 1998. Results were consistent with reference vernal pools in all three monitoring years; CTS were observed at 5 and 101 East (East) in 2019 (Yr 1) and 2023 (Yr 5), but not in 2020 (Yr 2).

Fairy shrimp were present in 2019 (Yr 1) and 2020 (Yr 2), but not in 2023 (Yr 5), which was consistent with baseline monitoring years. Fairy shrimp were present in 1998 but were not detected in 2016. It is possible that survey event timing prevented detection in 2016 (baseline) and 2023 (Yr 5) because surveys in both years occurred later in the monitoring season (April and May). However, in 2020 (Yr 2), a very dry February followed by above-normal March and April rain events may have been favorable for later fairy shrimp detection. These results were partially consistent with reference vernal pools; while fairy shrimp were detected at Pond 41 in 2020, they were not detected at Ponds 5 or 101 East (East) in 2020 (Yr 2), a favorable difference. 2019 (Yr 1) and 2023 (Yr 5) results were consistent with reference vernal pool values. Fairy shrimp were present at Pond 5 and Pond 101 East (East) in 2019 (Yr 1), however were not detected at Ponds 5 and 101 East (East) in 2023 (Yr 5).

4.17.2.2 *Performance Standard: Wildlife Usage*

Pond 41, a post-subsurface munitions remediation vernal pool, was in the final year of monitoring and met DQO 5. California tiger salamanders were present in 2019 (Yr 1) and 2023 (Yr 5), but were not detected in 2020 (Yr 2). California tiger salamanders were present in the 2016 baseline survey, but not the 1998 baseline survey. These results were also observed at the reference Ponds 5 and 101 East (East) in the respective monitoring years. Fairy shrimp were detected in 2019 (Yr 1) and 2020 (Yr 2), but not 2023 (Yr 5). In contrast to the CTS baseline surveys, fairy shrimp were present in 1998, but not in 2016. Additionally, fairy shrimp were not detected at Ponds 5 or 101 East (East) in 2020 (Yr 2), or 2023 (Yr 5), but they were present at both vernal pools in 2019 (Yr 1). Therefore, the 2019 (Yr 1), 2020 (Yr 2), and 2023 (Yr 5) results were similar to baseline and reference vernal pool data. Data quality objectives 1 and 4 were analyzed in the Hydrology Monitoring Annual Report (Chenega, 2023).

4.17.3 Conclusion

Pond 41, a post-subsurface munitions remediation vernal pool, was in the final year of monitoring. The vernal pool met the plant cover and species diversity performance standard and met DQO 5 for wildlife usage (see Table 4-220). No further monitoring is recommended for Pond 41.

Table 4-220. Success at Pond 41 (Year 5 Post-Subsurface Munitions Remediation) Based on Performance Standards and Applicable Data Quality Objectives

Performance Standard	Applicable DQO	2019 (Yr 1)	2020 (Yr 2)	2021 (Yr 3)	2022 (Yr 4)	2023 (Yr 5)	Success
Plant Cover & Species Diversity	DQO 3	On Track	On Track	On Track	On Track	On Track	Met
Wildlife Usage	DQO 5	On Track	On Track	N/A	N/A	On Track	Met

4.18 Pond 42 – Year 5

Pond 42 was monitored in 2023 as a year 5 post-subsurface munitions remediation vernal pool. Vegetation in Pond 42 and within its watershed was masticated in the summer of 2017 and burned in October 2017 as part of the prescribed burn of BLM Area B Subunit B. Pond 42 had intrusive anomaly investigations in 2018. Pond 42 was first monitored for baseline in 1998. Following MEC remediation activities, Pond 42 was monitored annually from 2000 to 2003. Additional baseline surveys occurred in 2015 and 2017. Table 4-221 summarizes the years that monitoring occurred and surveys were conducted. The cumulative precipitation graph indicates precipitation for the years that monitoring was conducted at Pond 42 (see Figure 4-102). The above-normal water-years were 1997-1998, 2016-2017, 2018-2019, and 2022-2023. Water-years 1999-2000 and 2019-2020 were similar to the cumulative normal water-year. All other monitoring years were a below-normal water-year, drought year, or consecutive drought year.

Table 4-221. Pond 42 (Year 5 Post-Subsurface Munitions Remediation) Summary of Historical Surveys for Hydrology, Vegetation, and Wildlife

Survey	Water-Year												
	1997-1998	1999-2000	2000-2001	2001-2002	2002-2003	2014-2015	2016-2017	2017-2018	2018-2019	2019-2020	2020-2021	2021-2022	2022-2023
Hydrology	•	•	•	•	•	•	•	•	•	•	•	•	•
Vegetation	•	•	•	•	•		•	•	•	•	•	•	•
Wildlife	•	•	•	•	•			•	•	•			•

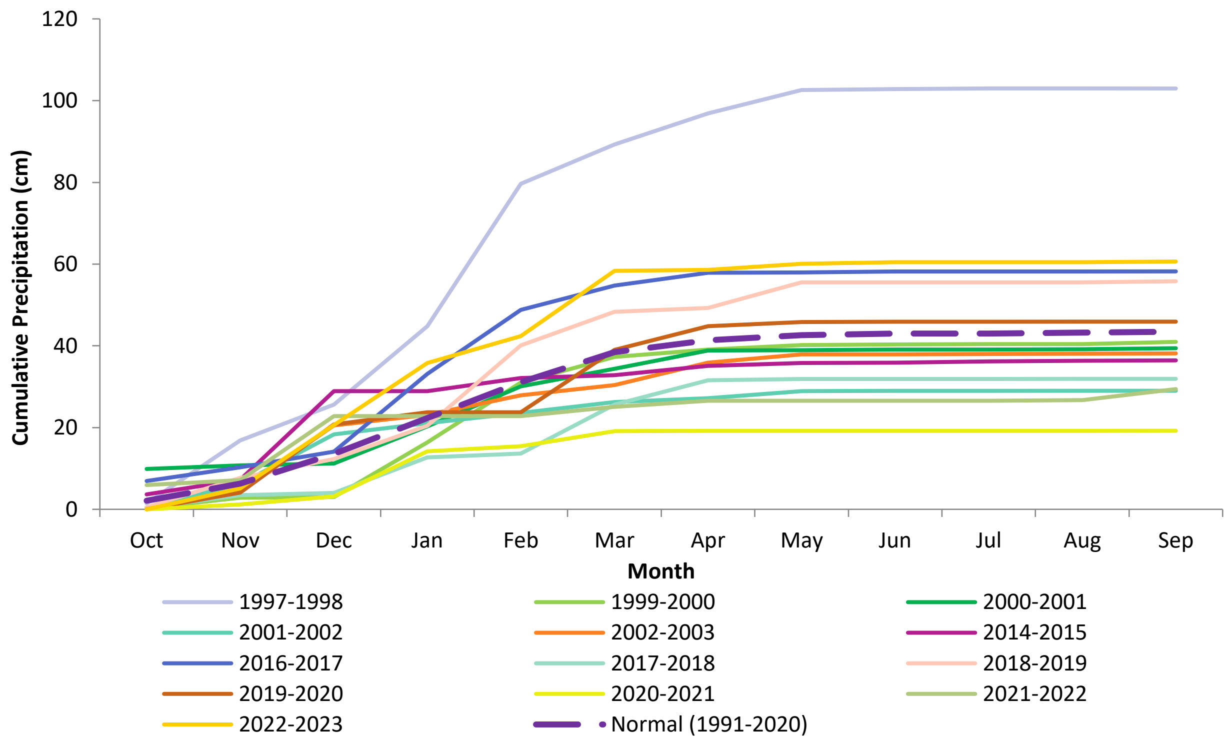

Figure 4-102. Cumulative Monthly Precipitation for Years that Hydrology Monitoring Occurred at Pond 42 (Year 5 Post-Subsurface Munitions Remediation) Compared to the 30-Year Normal (mean 1991-2020) (NPS, 2023; NCEI NOAA, 2023)

4.18.1 Vegetation Monitoring

Vegetation data were collected at Pond 42 in 1998, 2000-2003, and 2017-2023 (HLA, 1998, 2001; Harding ESE, 2002; MACTEC, 2003, 2004; Burleson, 2018, 2019, 2020, 2021, 2022, 2023). In 1998 and 2000-2003 data were collected along transects in lengths varying from 50 to 241 feet. In 2000, 0.25 m^2 quadrats were placed at intervals ranging from 10 to 20 feet, whereas in 1998, 2001, 2002, and 2003, quadrats were placed at 10-foot intervals. Quadrats were placed at the given intervals, alternating from right to left along the transect. In 1998 and 2000-2003, transects of varying lengths were in areas of representative transitional and emergent habitats. Due to differing methodologies, data for all strata in each respective year before 2017 were combined to compare to 2017 through 2023. From 2017-2023, data were collected using the methodology described in the Methods section of this report. Data from 2017 and 2023 were compared stratum-to-stratum in Table 4-222 as well as visually in Figure 4-103.

Table 4-222. Pond 42 (Year 5 Post-Subsurface Munitions Remediation) Vegetative Strata Percentage within the Vernal Pool Basin Boundary

Stratum	Percentage	
	2017	2023
Open Water	4%	N/A
1	8%	8%
2	9%	8%
3	52%	36%
4	10%	15%
5	N/A	13%
Upland	17%	20%

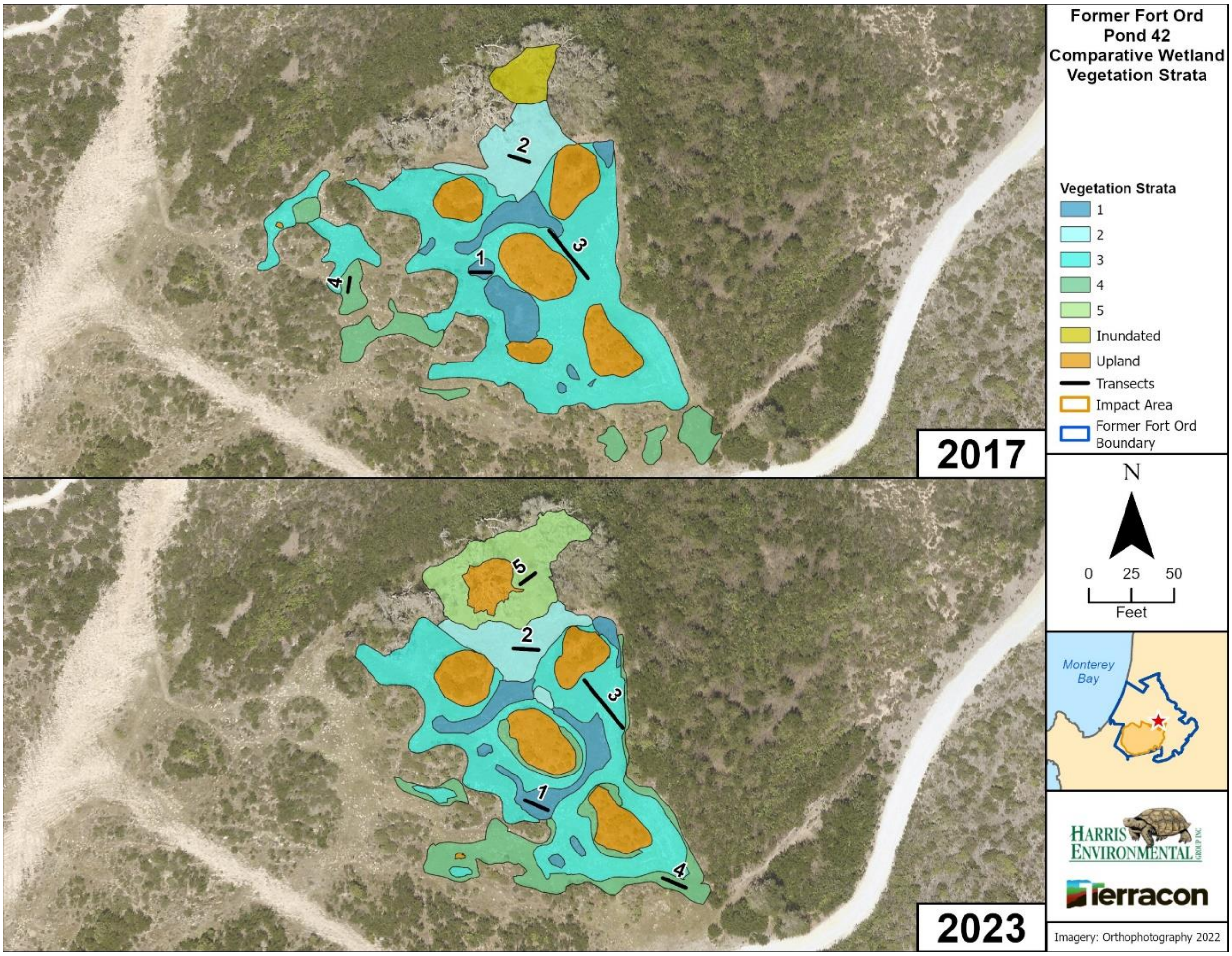

Figure 4-103. Pond 42 (Year 5 Post-Subsurface Munitions Remediation) Vegetation Strata and Transects for 2017 and 2023

Absolute percent vegetative cover in 2021 (Yr 3) and 2022 (Yr 4) was lower than the 1998 and 2017 baseline years of monitoring (see Table 4-223). Conversely, vegetative cover was greater than baseline in 2019 (Yr 1) and 2023 (Yr 5), whereas in 2020 (Yr 2), vegetative cover fell within the range of baseline. The absolute percent vegetative cover of Pond 42 was within the range of values observed at the reference vernal pools in every monitoring year except 2019 (Yr 1), in which it was less than reference vernal pool values (Burleson, 2020, 2021, 2022, 2023) (see Table 4-224).

Table 4-223. Pond 42 (Year 5 Post-Subsurface Munitions Remediation) Absolute Percent Cover

Year	Vegetative Cover	Thatch/Bare Ground
1998*	69.6%	33.1%
2000	101.5%	10.3%
2001	77.5%	24.5%
2002	83.5%	21.2%
2003	88.2%	16.1%
2017*	61.9%	38.7%
2018	55.8%	44.3%
2019	70.2%	29.8%
2020	65.7%	34.4%
2021	43.7%	56.6%
2022	45.9%	54.1%
2023	77.0%	23.0%

*baseline year

Table 4-224. Pond 42 (Year 5 Post-Subsurface Munitions Remediation) and Reference Vernal Pool Absolute Percent Cover in 2023

Vernal Pool	Vegetative Cover	Thatch/Bare Ground
5	74.5%	25.5%
101 East (East)	82.6%	17.4%
997	83.5%	16.7%
42	**77.0%**	**23.0%**

Species richness on transects and for the entire basin was greater than the range of values observed in the baseline years of monitoring for every monitoring year, except for 2019 (Yr 1) and 2023 (Yr 5), in which basin richness was less than the range of baseline values. Species richness on transects was 20, 32, 28, 24, 34, 14, 40, 27, 33, 37, 41, and 28 in 1998, 2000, 2001, 2002, 2003, 2017, 2018, 2019, 2020, 2021, 2022, and 2023, respectively. Overall basin species richness values were only recorded in 2017-2023 and were 78, 126, 77, 93, 82, 85, and 55 species, respectively (see Table 4-225 and Appendix A Table A-18). When compared to reference vernal pools, Pond 42 species richness was variable across the monitoring years. Species richness in 2019 (Yr 1) was less than reference vernal pool values on transects and for the whole basin (Burleson, 2020) (see Appendix D Tables D-20 and D-40). Whereas, in 2020 (Yr 2), richness on transects was within the range of reference values, while basin species richness was greater (Burleson, 2021). In 2021 (Yr 3) and 2022 (Yr 4), species richness was greater than the range of values observed at the reference vernal pools for transects and the species richness for the entire basin. By 2023 (Yr 5), species richness was within the range of reference vernal pools on transects and the entire basin (see Table 4-226). The species richness is represented on the RACs as the length of the curve and number of species along the curve (see Figure 4-104 and Figure 4-105).

Species composition and dominant species at Pond 42 were variable across monitoring years. This variability of species composition is illustrated on the RACs as the species codes shift along the curve and losses and gains occur from year to year (see Figure 4-104 and Figure 4-105). Brown-headed rush

(*Juncus phaeocephalus*) and pale spikerush (*Eleocharis macrostachya*) were the two dominant species in 2017 (baseline), whereas needle spikerush (*Eleocharis acicularis* var. *acicularis*) and coyote thistle (*Eryngium armatum*) were the dominant species in 2018 and 2019 (Yr 1). Rabbitfoot grass (*Polypogon monspeliensis*) was another important species in 2019. In 2020 (Yr 2), the dominant species were brown-headed rush, needle spike rush, and brass buttons (*Cotula coronopifolia*). Needle spike rush was the dominant species in 2021 (Yr 3), with moderate cover from brown-headed rush, rabbitfoot grass, pale spikerush, and coyote thistle. Brown-headed rush and rabbitfoot grass were the primary dominant species of 2022 (Yr 4) with moderate cover from needle spikerush, pale spikerush, and coyote thistle. By 2023 (Yr 5), pale spikerush and rabbitfoot grass were the dominant species, with coyote thistle and needle spikerush as important subdominants. A complete comparison of species composition observed during the surveys at Pond 42 in 1998, 2000-2003, and 2017-2023, can be found in Appendix E. Figure 4-107 shows a subset of this comparison for species observed with a 2% cover or greater.

The evenness from each year for Pond 42 is represented by the slope of the RACs. The evenness is fairly similar from year to year with richness distributed along the entire curve. "Structurally complex systems, such as a fen [or vernal pool] system," as explained in Verberk, 2011, "are species rich and have a more even community abundance pattern, possibly owing to a fine partitioning of available niches." A more even distribution of the top species occurs in most monitoring years, which is similar to baseline (see Figure 4-106, and Appendix F). The exception was in 2021 (Yr 3), when the top species were less even, represented by a steep slope that was similar to reference Pond 997 during the same monitoring year.

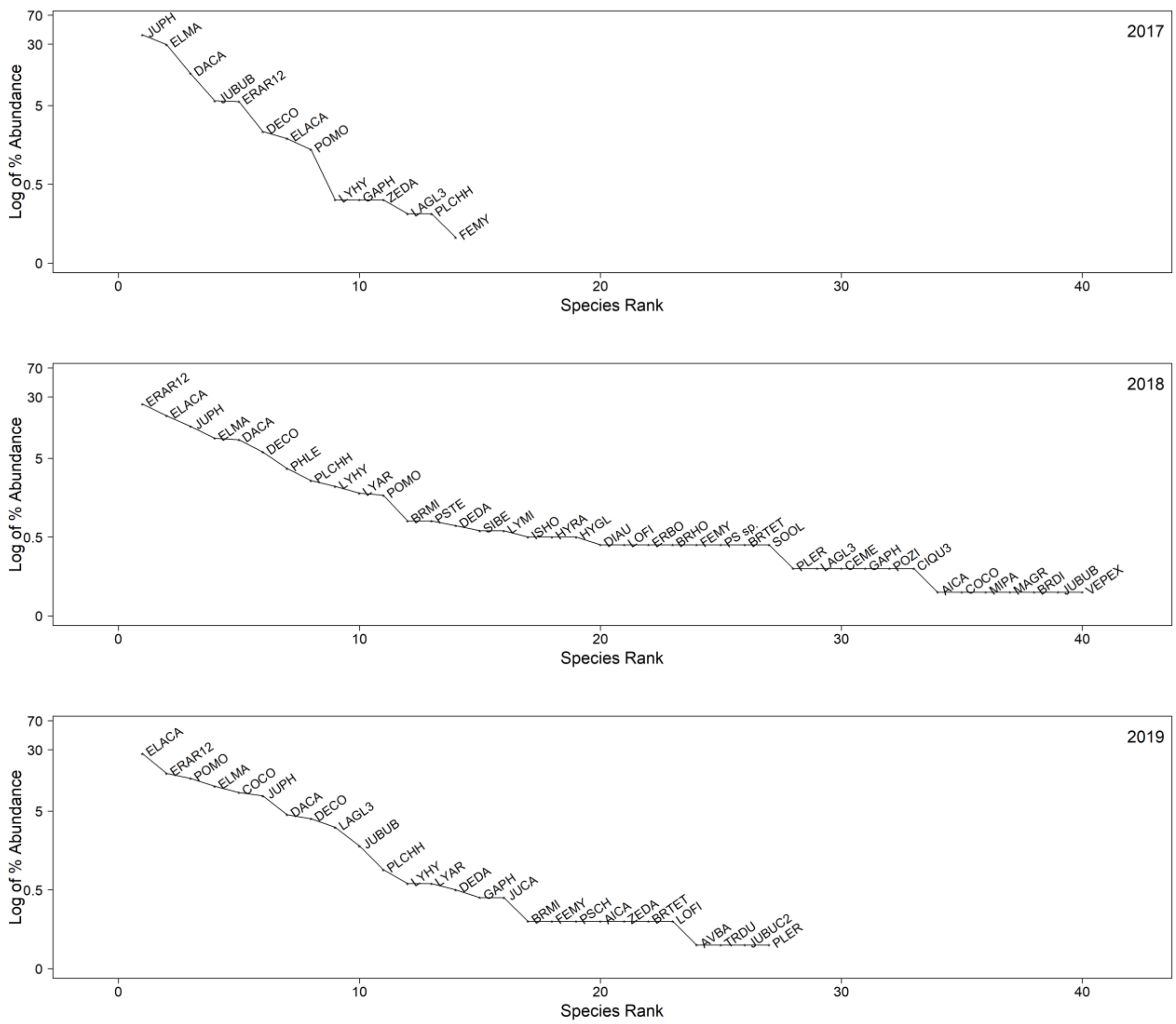

Figure 4-104. Rank Abundance Curves at Pond 42 (Year 5 Post-Subsurface Munitions Remediation) from 2017-2019. Note that the y-axis is in log-10 scale.

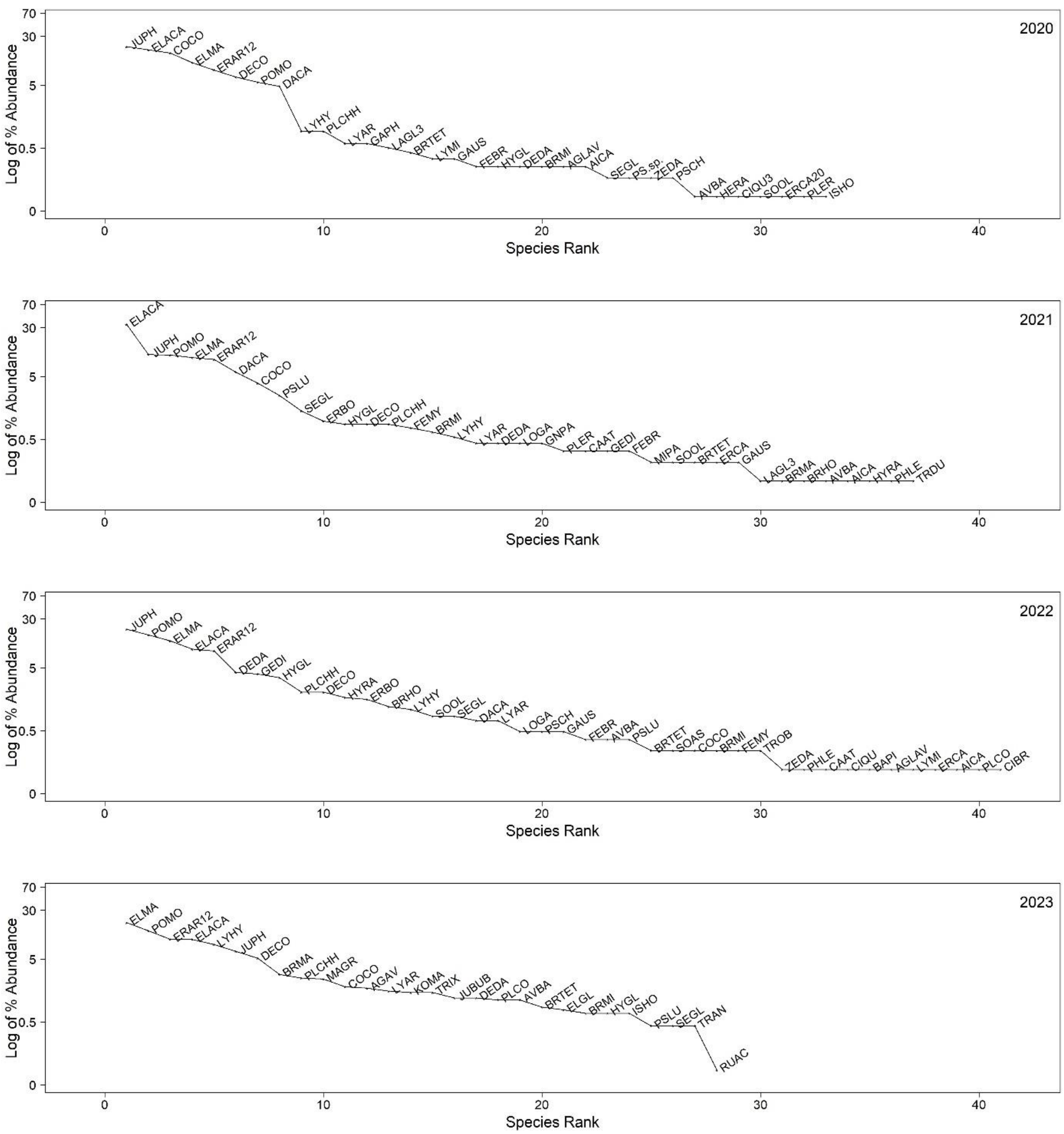

Figure 4-105. Rank Abundance Curves at Pond 42 (Year 5 Post-Subsurface Munitions Remediation) from 2020-2023. Note that the y-axis is in log-10 scale.

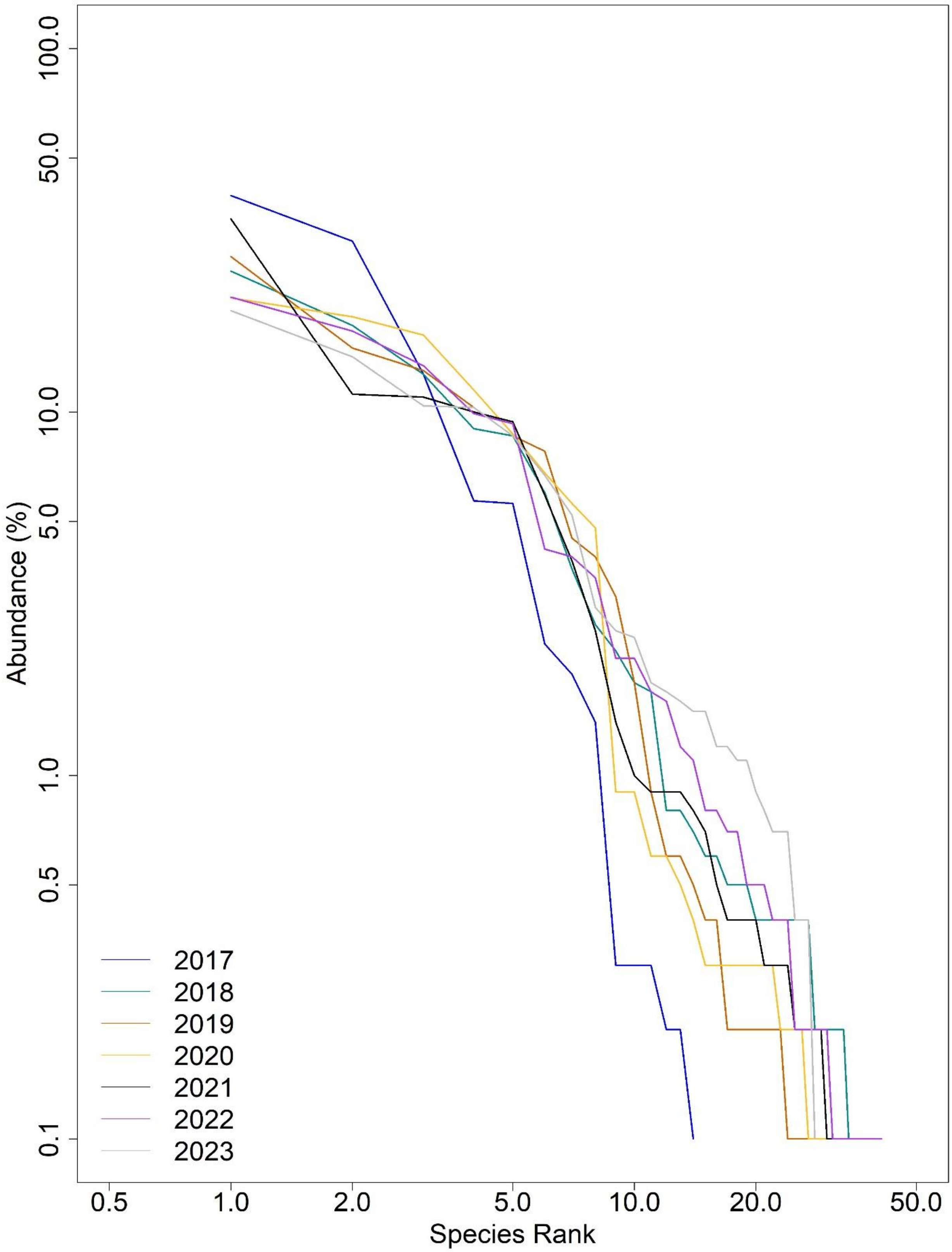

Figure 4-106. Rank Abundance Curves at Pond 42 (Year 5 Post-Subsurface Munitions Remediation) from 2017-2023. Note that the x-axis and the y-axis are in log-10 scale

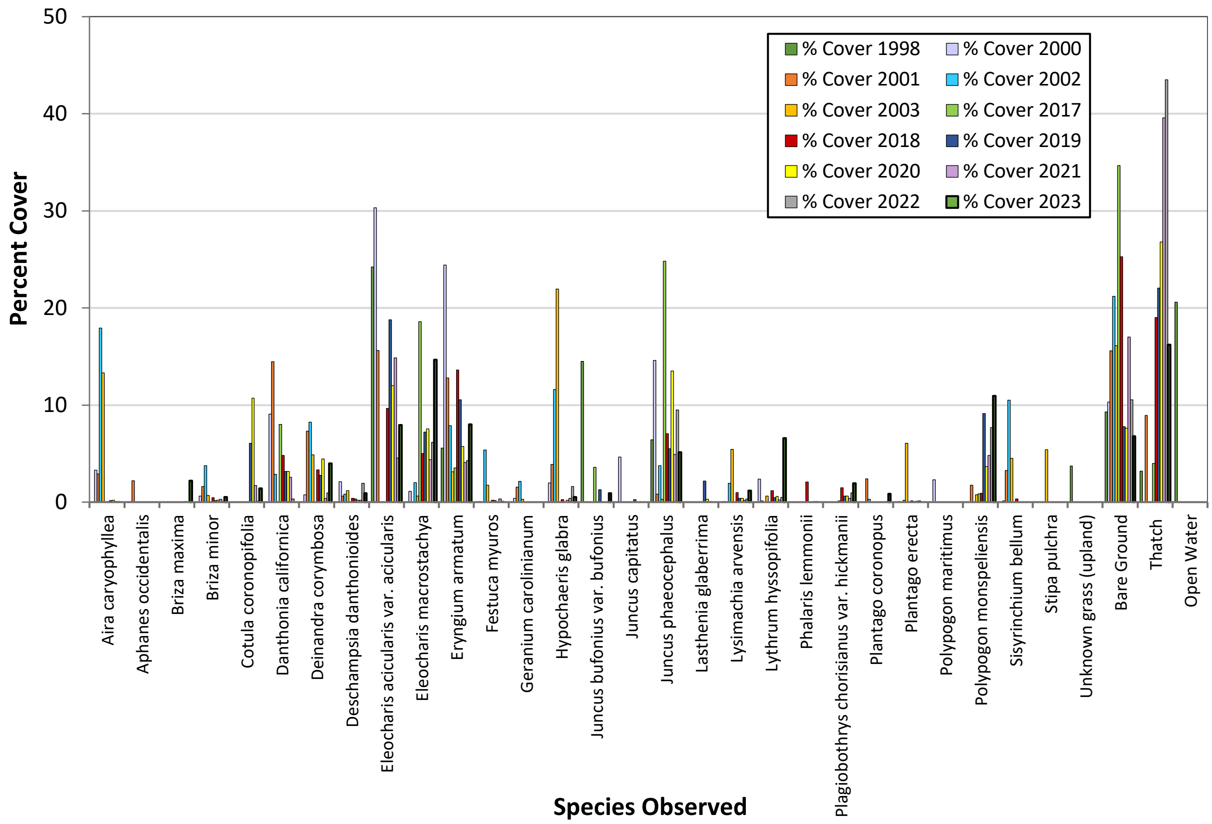

Figure 4-107. Percent Cover of Dominant Species at Pond 42 (Year 5 Post-Subsurface Munitions Remediation)

Native and non-native species richness on Pond 42 transects was greater than baseline in every monitoring year, whereas species richness was variable compared to the range of reference vernal pools (see Table 4-225). Native species richness was less than reference values in 2019 (Yr 1), within the range of reference in 2020 (Yr 2) and 2022 (Yr 4), and greater than reference in 2021 (Yr 3) and 2023 (Yr 5) (Burleson, 2020, 2021, 2022, 2023) (see Table 4-226).

Table 4-225. Pond 42 (Year 5 Post-Subsurface Munitions Remediation) Native and Non-Native Species Richness

Year	Native	Non-Native	Unidentified
1998*	12	5	3
2000	20	11	1
2001	14	13	1
2002	16	8	0
2003	20	13	1
2017*	10	4	0
2018	24	15	1
2019	16	11	0
2020	20	12	1
2021	17	20	0
2022	20	21	0
2023	14	14	0

*baseline year

Table 4-226. Pond 42 (Year 5 Post-Subsurface Munitions Remediation) and Reference Vernal Pool Native and Non-Native Species Richness in 2023

Vernal Pool	Native	Non-Native	Unidentified
5	12	12	0
101 East (East)	9	7	0
997	13	14	1
42	**14**	**14**	**0**

The relative percent cover of native species was less than baseline years and the non-native cover was greater than baseline in every monitoring year (see Table 4-227). In 2019 (Yr 1), native cover was greater than reference vernal pool values, while non-native cover was less (Burleson, 2020) (see Table 4-228). Conversely, in 2020 (Yr 2), native cover was less than reference vernal pools while non-native cover was within the range of reference vernal pools (Burleson, 2021). Native and non-native vegetation percent cover were within the range of values observed at reference vernal pools in 2021-2023 (Burleson, 2022, 2023).

Table 4-227. Pond 42 (Year 5 Post-Subsurface Munitions Remediation) Relative Percent Cover of Native and Non-Native Plants

Year	Native	Non-Native	Unidentified
1998*	87.7%	4.4%	7.9%
2000	84.4%	15.6%	0.0%
2001	77.4%	22.4%	0.3%
2002	49.0%	51.0%	0.0%
2003	41.8%	57.3%	0.9%
2017*	97.8%	2.2%	0.0%
2018	90.0%	9.7%	0.4%
2019	75.5%	24.5%	0.0%
2020	74.5%	25.4%	0.2%
2021	74.9%	25.1%	0.0%
2022	64.8%	35.2%	0.0%
2023	64.2%	35.8%	0.0%

*baseline year

Table 4-228. Pond 42 (Year 5 Post-Subsurface Munitions Remediation) and Reference Vernal Pool Relative Percent Cover of Native and Non-Native Plants in 2023

Vernal Pool	Native	Non-Native	Unidentified
5	76.3%	23.7%	0.0%
101 East (East)	60.3%	39.7%	0.0%
997	50.0%	49.0%	1.0%
42	**64.2%**	**35.8%**	**0.0%**

Wetland and non-wetland species richness on Pond 42 transects were greater than baseline in every monitoring year except for non-wetland richness in 2023 (Yr 5), which was within the range of baseline values (see Table 4-229). Wetland and non-wetland species richness were less than reference vernal pool values in 2019 (Yr 1) (Burleson, 2020). Whereas, in 2021 (Yr 3) and 2022 (Yr 4), wetland species richness was greater than reference vernal pool values and non-wetland species richness was within the range of values observed at the reference vernal pools (Burleson, 2022, 2023). In 2020 (Yr 2) and 2023 (Yr 5), wetland richness was within the range of values observed at the reference vernal pools, while non-wetland richness was less than reference (Burleson, 2021) (see Table 4-230).

Table 4-229. Pond 42 (Year 5 Post-Subsurface Munitions Remediation) Wetland and Non-Wetland Species Richness

Year	Wetland			Non-Wetland		Not Listed
	OBL	FACW	FAC	FACU	UPL	
1998*	6	4	4	1	0	5
2000	5	5	4	6	0	11
2001	3	5	4	6	0	10
2002	3	4	4	2	1	10
2003	5	6	3	4	0	16
2017*	5	4	1	2	0	2
2018	9	10	3	7	1	10
2019	6	7	3	5	0	6
2020	7	8	4	3	1	10
2021	6	7	3	7	1	13
2022	5	10	4	7	1	14
2023	6	6	4	2	0	10

*baseline year

Table 4-230. Pond 42 (Year 5 Post-Subsurface Munitions Remediation) and Reference Vernal Pool Wetland and Non-Wetland Species Richness in 2023

Vernal Pool	Wetland			Non-Wetland		Not Listed
	OBL	FACW	FAC	FACU	UPL	
5	6	7	3	3	1	4
101 East (East)	4	6	1	3	0	2
997	4	6	4	4	0	10
42	**6**	**6**	**4**	**2**	**0**	**10**

The relative percent cover of wetland species was within the range of baseline values in 2019 (Yr 1), 2020 (Yr 2), and 2021 (Yr 3), whereas in 2022 (Yr 4) and 2023 (Yr 5), wetland cover was less than baseline values (see Table 4-231). Non-wetland relative percent cover exceeded baseline in every monitoring year, although 2019 (Yr 1), 2020 (Yr 2), and 2023 (Yr 5) only slightly above baseline values by less than 1%. Relative percent cover of wetland species was greater than the range of values in reference vernal pools, while non-wetland species cover was less than the values observed at reference vernal pools in 2019 (Yr 1), 2021 (Yr 3), and 2022 (Yr 4) (Burleson 2020, 2022, 2023). Whereas, in 2023 (Yr 5) and 2020 (Yr 2), wetland cover was in the range of reference vernal pools, but non-wetland cover was less than reference values (Burleson, 2021) (see Table 4-232).

Table 4-231. Pond 42 (Year 5 Post-Subsurface Munitions Remediation) Relative Percent Cover of Wetland and Non-Wetland Species

Year	Wetland			Non-Wetland		Not Listed
	OBL	FACW	FAC	FACU	UPL	
1998*	42.2%	38.6%	8.7%	0.5%	0.0%	10.0%
2000	35.7%	40.9%	10.3%	8.4%	0.0%	4.7%
2001	20.7%	24.8%	24.0%	7.2%	0.0%	23.3%
2002	3.1%	27.4%	10.6%	27.9%	0.2%	30.7%
2003	5.5%	11.7%	7.2%	18.7%	0.0%	56.9%
2017*	30.9%	53.0%	12.9%	0.4%	0.0%	2.7%
2018	33.0%	44.8%	11.2%	2.3%	0.4%	8.4%
2019	50.3%	38.5%	5.3%	1.3%	0.0%	4.6%
2020	48.6%	36.0%	5.8%	0.9%	0.1%	8.7%
2021	49.5%	35.1%	7.0%	2.4%	0.2%	5.8%
2022	26.8%	52.3%	1.8%	5.2%	0.8%	13.1%
2023	42.9%	34.1%	4.8%	0.9%	0.0%	17.2%

*baseline year

Table 4-232. Pond 42 (Year 5 Post-Subsurface Munitions Remediation) and Reference Vernal Pool Relative Percent Cover of Wetland and Non-Wetland Species in 2023

Vernal Pool	Wetland			Non-Wetland		Not Listed
	OBL	FACW	FAC	FACU	UPL	
5	61.4%	29.0%	3.1%	3.7%	0.1%	2.7%
101 East (East)	14.5%	53.4%	0.1%	9.1%	0.0%	22.9%
997	31.5%	28.9%	7.4%	9.0%	0.0%	23.2%
42	**42.9%**	**34.1%**	**4.8%**	**0.9%**	**0.0%**	**17.2%**

4.18.1.1 *Data Quality Objective 3*

Observable changes in hydrophytic vegetation between surveys were largely associated with precipitation fluctuations. This is expected given the dynamic nature of vernal pools and the close relationship between the hydroperiod and wetland vegetation composition. Vegetative cover in Pond 42 was dominated by native and wetland plant species during year 5 post-subsurface munitions remediation monitoring. By 2023 (Yr 5), Pond 42 species richness and cover values were generally within the range of baseline and/or reference vernal pools with a few exceptions. Native species richness was greater than the ranges of baseline and reference vernal pool values. Additionally, wetland species abundance was greater than baseline but less than the range of reference vernal pools. An increase in richness of native and wetland species is not concerning. Native and wetland species support a well-functioning vernal pool ecosystem. The relatively high numbers of non-native richness has decreased from the high non-native richness observed in 2021 (Yr 3) and 2022 (Yr 4) due to the above-normal water-year in 2023 (Yr 5). The two previous monitoring years were consecutive drought years, which likely led to the pulse of non-native richness.

4.18.1.2 *Performance Standard: Plant Cover and Species Diversity*

Pond 42, a post-subsurface munitions remediation vernal pool, met the performance standard by year 5 in 2023. The species composition, richness, and native and wetland species relative abundances were similar to baseline and/or reference vernal pool conditions. Pond 42 provided suitable wetland habitat in 2023.

4.18.2 Wildlife Monitoring

Wildlife data were collected at Pond 42 in 1998, 2000-2003, 2018-2020, and 2023 (HLA, 1998, 2001, 2002; MACTEC, 2003, 2004, Burleson, 2019, 2020, 2021). California tiger salamander larvae were observed in 2000. Fairy shrimp were present in all years, except for 2023 (Yr 5), in which surveys did not include fairy shrimp or other aquatic invertebrates. In 2023 (Yr 5), biologists completed a partial survey in ~35% of the pond area, and the survey was limited to CTS presence/absence. The vernal pool did not hold sufficient depth for surveys to be completed in 2021 (Yr 3) or 2022 (Yr 4). Therefore, DQO 5 and the applicable wildlife usage performance standard can only be assessed for 2019 (Yr 1), 2020 (Yr 2), and 2023 (Yr 5). Table 4-233 shows historical wildlife monitoring results.

Table 4-233. Pond 42 (Year 5 Post-Subsurface Munitions Remediation) Historical Wildlife Monitoring Results

Sampling Year	CTS Larvae Abundance (# Individuals)	Fairy Shrimp Abundance (# Individuals)
1998*	Not detected	Low-Moderate
2000*	Common (13)	High – Very High (318, 123)
2001*	Not detected	Low (2)
2002*	Not detected	High-Very High (250, 1000s)
2003*	Not detected	High (low 100s)
2018	Not detected	Low
2019	Not detected	High (217)
2020	Not detected	High (125)
2023	Not detected	Not Surveyed

*baseline year

4.18.2.1 *Data Quality Objective 5*

California tiger salamanders were not detected in any monitoring year, which was consistent with baseline monitoring. California tiger salamanders were detected in 2000 but not in 1998, 2001-2003 baseline surveys. Results were partially consistent with reference vernal pools; CTS were not detected at Ponds 5 or 101 East (East) in 2020, however they were detected at both reference vernal pools in 2019 and 2023.

Fairy shrimp were not surveyed in 2023 (Yr 5); therefore, the performance standard for this species can only be assessed for 2019 (Yr 1) and 2020 (Yr 2). Fairy shrimp were detected in high numbers in both monitoring years, which was consistent with baseline. When compared to reference vernal pools, these results were consistent with Pond 5 in 2019, and Pond 101 East (East) in 2019 and 2020.

4.18.2.2 *Performance Standard: Wildlife Usage*

Pond 42, a post-subsurface munitions remediation vernal pool, was in the final year of monitoring and met DQO 5. California tiger salamanders were not detected in any monitoring year, which was consistent with baseline monitoring and partially consistent with reference Ponds 5 and 101 East (East) in 2020. Fairy shrimp were detected in 2019 (Yr 1) and 2020 (Yr 2), which was consistent with baseline results. Additionally, reference Ponds 5 and 101 East (East) had similar trends during the same monitoring years. Data quality objectives 1 and 4 were analyzed in the Hydrology Monitoring Annual Report (Chenega, 2023).

4.18.3 Conclusion

Pond 42, a post-subsurface munitions remediation vernal pool, was in the final year of monitoring in 2023. The vernal pool met the plant cover and species diversity performance standard and DQO 5 for wildlife usage (see Table 4-234).

Table 4-234. Success at Pond 42 (Year 5 Post-Subsurface Munitions Remediation) Based on Performance Standards and Applicable Data Quality Objectives

Performance Standard	Applicable DQO	2019 (Yr 1)	2020 (Yr 2)	2021 (Yr 3)	2022 (Yr 4)	2023 (Yr 5)	Success
Plant Cover & Species Diversity	DQO 3	On Track	On Track	Not On Track	Not On Track	On Track	Met
Wildlife Usage	DQO 5	Partially On Track	On Track	N/A	N/A	Partially On Track	Met

4.19 Pond 61 – Year 5

Pond 61 was monitored in 2023 as a year 5 post-subsurface munitions remediation vernal pool. Although limited subsurface remediation occurred at this vernal pool in 1999, the Army did not conduct monitoring prior to 2017 and it is assumed that 2017 represents baseline conditions. Less than 50 percent of the watershed of Pond 61 was masticated in the summer of 2017 to support MEC remediation in BLM Area B Subunits B-3 East and B2-A. Pond 61 had intrusive anomaly investigations in 2018. Table 4-235 summarizes the years that monitoring occurred and surveys were conducted. The cumulative precipitation graph shows precipitation for years in which hydrology monitoring was conducted at Pond 61 (see Figure 4-108). The 2016-2017, 2018-2019, and 2022-2023 water-years were above normal, whereas the 2017-2018, 2020-2021, and 2021-2022 water-years were below normal. Water-year 2019-2020 was similar to the cumulative normal water-year.

Table 4-235. Pond 61 (Year 5 Post-Subsurface Munitions Remediation) Summary of Historical Surveys for Hydrology, Vegetation, and Wildlife

Survey	Water-Year						
	2016-2017	2017-2018	2018-2019	2019-2020	2020-2021	2021-2022	2022-2023
Hydrology	●	●	●	●	●	●	●
Vegetation	●	●	●	●	●	●	●
Wildlife	●		●	●	●		

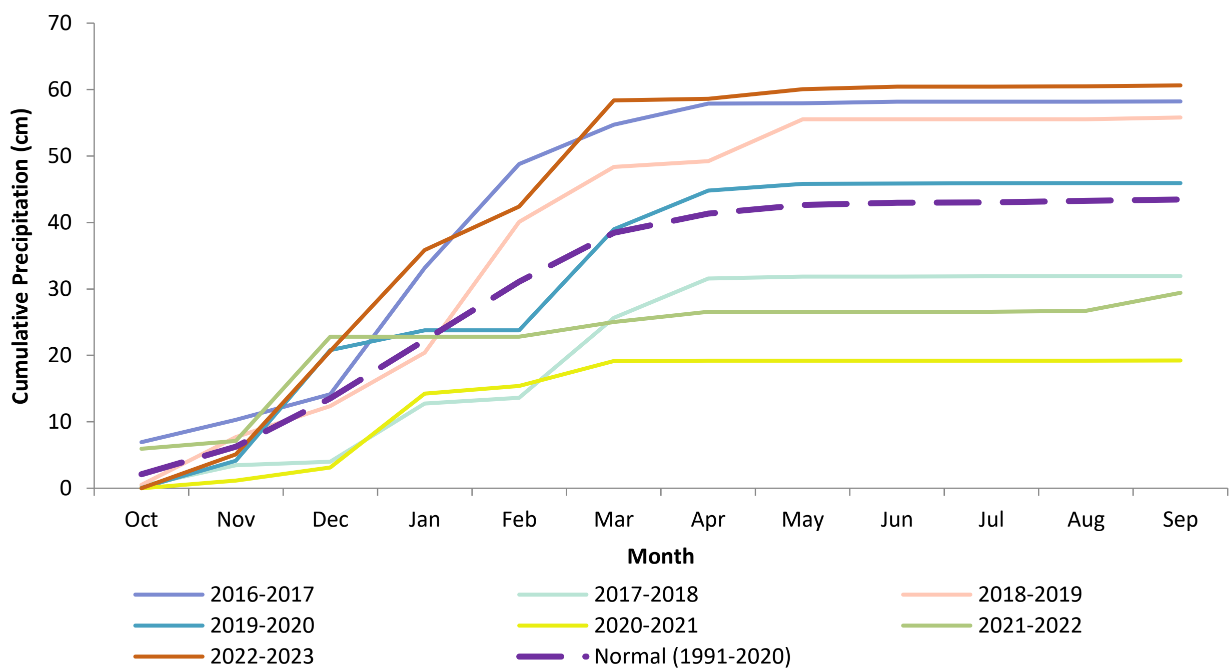

Figure 4-108. Cumulative Monthly Precipitation for Years that Hydrology Monitoring Occurred at Pond 61 (Year 5 Post-Subsurface Munitions Remediation) Compared to the 30-Year Normal (mean 1991-2020) (NPS, 2023; NCEI NOAA, 2023)

4.19.1 Vegetation Monitoring

Vegetation data were collected at Pond 61 from 2017-2023 (Burleson*,* 2018, 2019, 2020, 2021, 2022). Baseline vegetation data were collected at Pond 61 in 2017. Data were collected using the methodology described in the Methods section of this report. Data from 2017 and 2023 were compared stratum-to-stratum in Table 4-236 as well as visually in Figure 4-109**.**

Pond 61 also supports a CCG population, which is represented by stratum 2. The population was mapped and a visual estimate of percent cover was recorded in 2023 to compare to 2017-2021 (see Figure 3-23 in Section 3.19.1.1).

Table 4-236. Pond 61 (Year 5 Post-Subsurface Munitions Remediation) Vegetative Strata Percentage within the Vernal Pool Basin Boundary

Stratum	Percentage	
	2017	2023
1	1%	3%
2 (CCG)	5%	10%
3	7%	52%
4	54%	23%
Upland	33%	12%

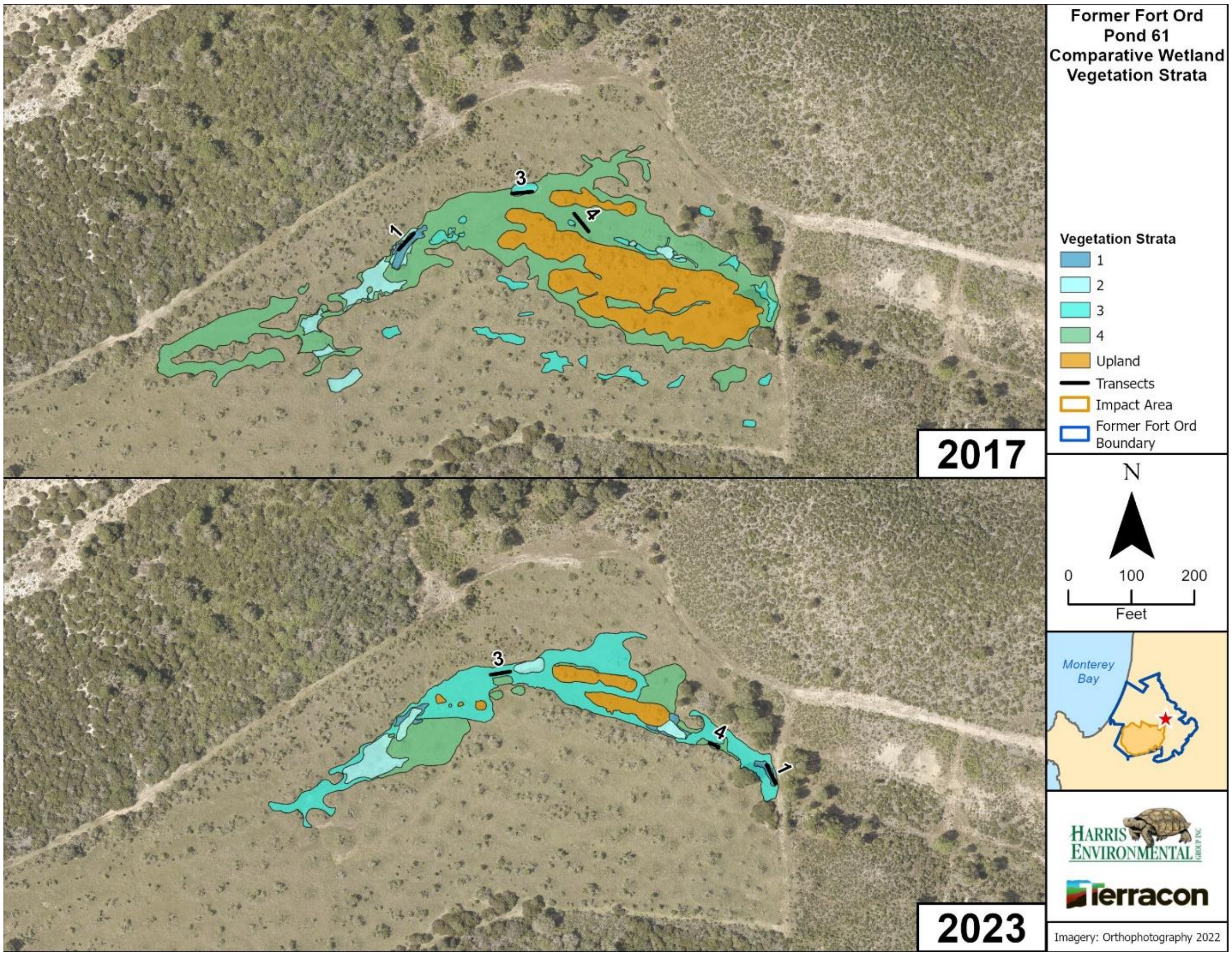

Figure 4-109. Pond 61 (Year 5 Post-Subsurface Munitions Remediation) Vegetation Strata and Transects for 2017 and 2023

The absolute percent vegetative cover was less than baseline in every monitoring year except 2023 (Yr 5), in which cover was greater (see Table 4-237). Pond 61 vegetative cover was within the range of values observed at the reference vernal pools in 2020 (Yr 2), 2021 (Yr 3), and 2023 (Yr 5), but was less in 2019 (Yr 1), and greater in 2022 (Yr 4) (Burleson, 2020, 2021, 2022, 2023) (see Table 4-238).

Table 4-237. Pond 61 (Year 5 Post-Subsurface Munitions Remediation) Absolute Percent Cover

Year	Vegetative Cover	Thatch/Bare Ground
2017*	69.4%	32.1%
2018	60.6%	40.8%
2019	64.9%	35.7%
2020	66.1%	34.0%
2021	42.7%	57.6%
2022	64.8%	35.3%
2023	77.3%	22.7%

*baseline year

Table 4-238. Pond 61 (Year 5 Post-Subsurface Munitions Remediation) and Reference Vernal Pool Absolute Percent Cover in 2023

Vernal Pool	Vegetative Cover	Thatch/Bare Ground
5	74.5%	25.5%
101 East (East)	82.6%	17.4%
997	83.5%	16.7%
61	**77.3%**	**22.7%**

Species richness on transects was greater than baseline in every monitoring year; whereas, the overall basin species richness was less than baseline in every year, except 2019 (Yr 1), in which species richness was greater than baseline. Species richness on transects was 23, 41, 46, 36, 34, 32, and 44 species in 2017, 2018, 2019, 2020, 2021, 2022, and 2023, respectively, whereas overall basin species richness was 100, 100, 119, 98, 97, 94, and 64 species, respectively (see Table 4-239 and Appendix A Table A-19). Pond 61 species richness on transects was within the range of values observed at the reference vernal pools in 2019 (Yr 1), 2020 (Yr 2), and 2022 (Yr 4), whereas in 2021 (Yr 3) and 2023 (Yr 5), transect richness was greater than reference (Burleson, 2020, 2021, 2022, 2023) (see Table 4-240 and Appendix D Tables D-20 and D-40). Richness for the entire basin was greater than reference in every monitoring year, except for 2023 (Yr 5), in which richness was within the range of values observed at reference vernal pools. The species richness is represented on the RACs as the length of the curve and number of species along the curve (see Figure 4-110 and Figure 4-111).

Species composition at Pond 61 varied between monitoring years. This variability of species composition is illustrated on the RACs as the species codes shift along the curve and losses and gains occur from year to year (see Figure 4-110 and Figure 4-111). The dominant species in 2017 (baseline) and 2018 were brown-headed rush (*Juncus phaeocephalus*) and pale spikerush (*Eleocharis macrostachya*), and Hickman's popcornflower (*Plagiobothrys chorisianus* var. *hickmanii*), respectively. In 2019 (Yr 1), the dominant species was again brown-headed rush. By 2020 (Yr 2) the dominant species began to shift from the first three monitoring years. California oatgrass (*Danthonia californica*) became the dominant species in 2020, with moderate cover from pale spikerush, coyote thistle (*Eryngium armatum*), and brown-headed rush. Non-native rattlesnake grass (*Briza maxima*) was the dominant species in 2021 (Yr 3). Rattlesnake grass remained a dominant species in 2022 (Yr 4), along with the largest recorded cover of Hickman's popcornflower. By 2023 (Yr 5), the dominant species was grass poly (*Lythrum hyssopifolia*), with moderate cover from rabbitfoot grass (*Polypogon monspeliensis*), brown-headed rush, rattlesnake grass, common toad rush (*Juncus bufonius* var. *bufonius*), Hickman's popcornflower, and coyote thistle. A complete comparison of species composition observed during the surveys at Pond 61 from 2017-2023 can be found in Appendix E. Figure 4-113 shows a subset of this comparison for species observed with a 2% cover or greater.

The evenness from each year for Pond 61 is represented by the slope of the RACs. The evenness is fairly similar from year to year with richness distributed along the entire curve. "Structurally complex systems, such as a fen [or vernal pool] system," as explained in Verberk, 2011, "are species rich and have a more even community abundance pattern, possibly owing to a fine partitioning of available niches." Every monitoring year had a more even distribution of the top species and gradual curve, which is similar to baseline and reference Pond 997 (see Figure 4-112, and Appendix F).

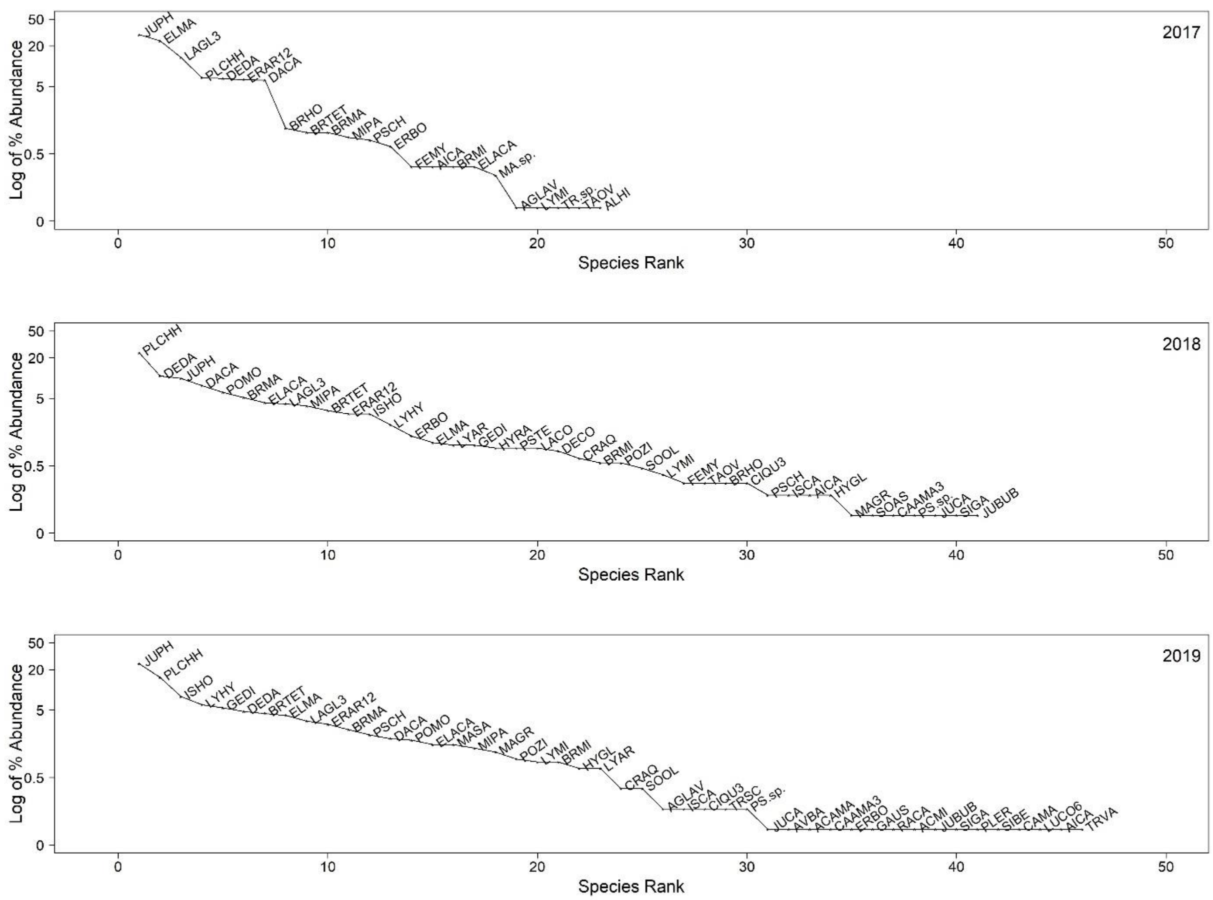

Figure 4-110. Rank Abundance Curves at Pond 61 (Year 5 Post-Subsurface Munitions Remediation) from 2017-2019. Note that the y-axis is in log-10 scale.

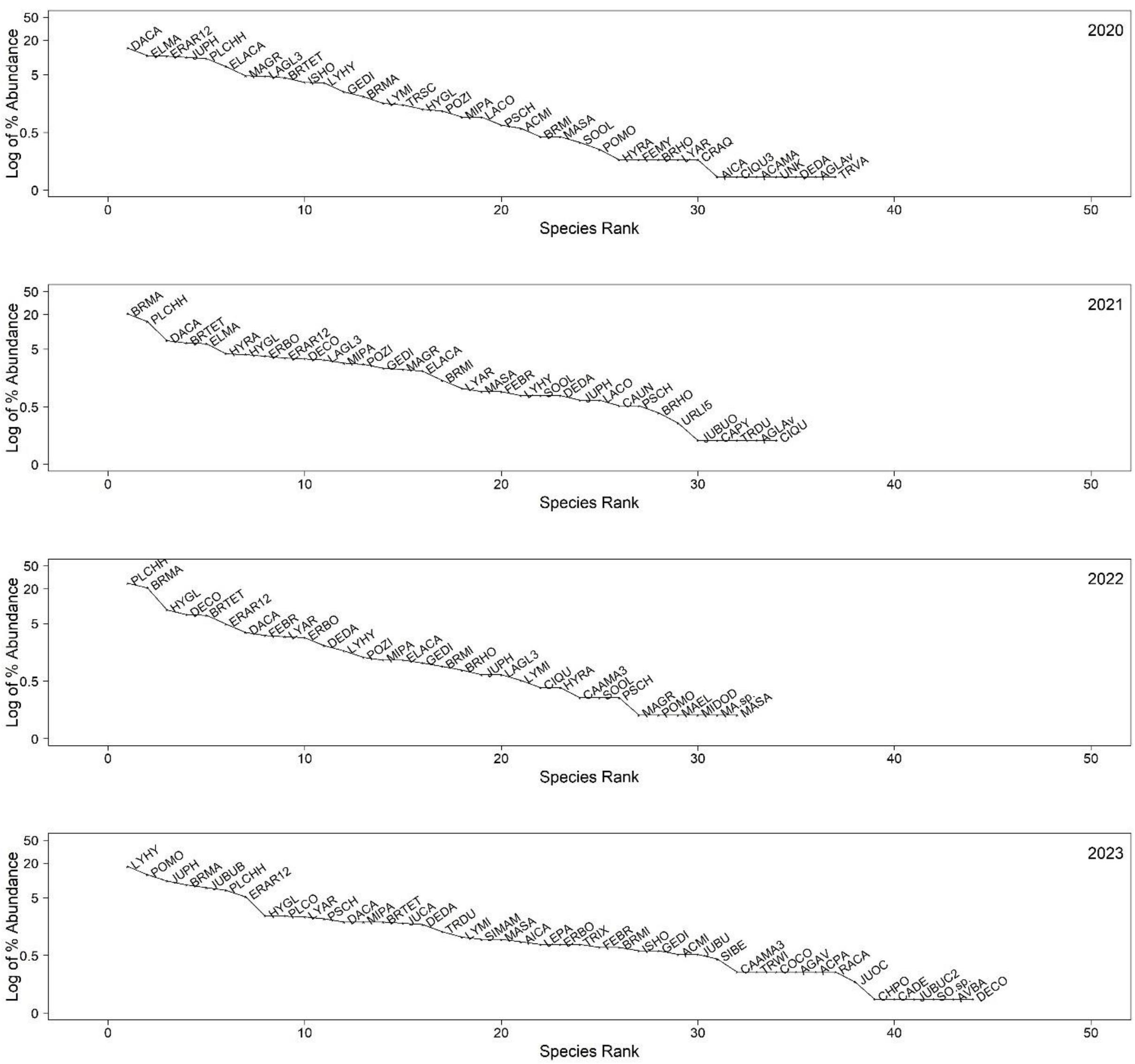

Figure 4-111. Rank Abundance Curves at Pond 61 (Year 5 Post-Subsurface Munitions Remediation) from 2020-2023. Note that the y-axis is in log-10 scale.

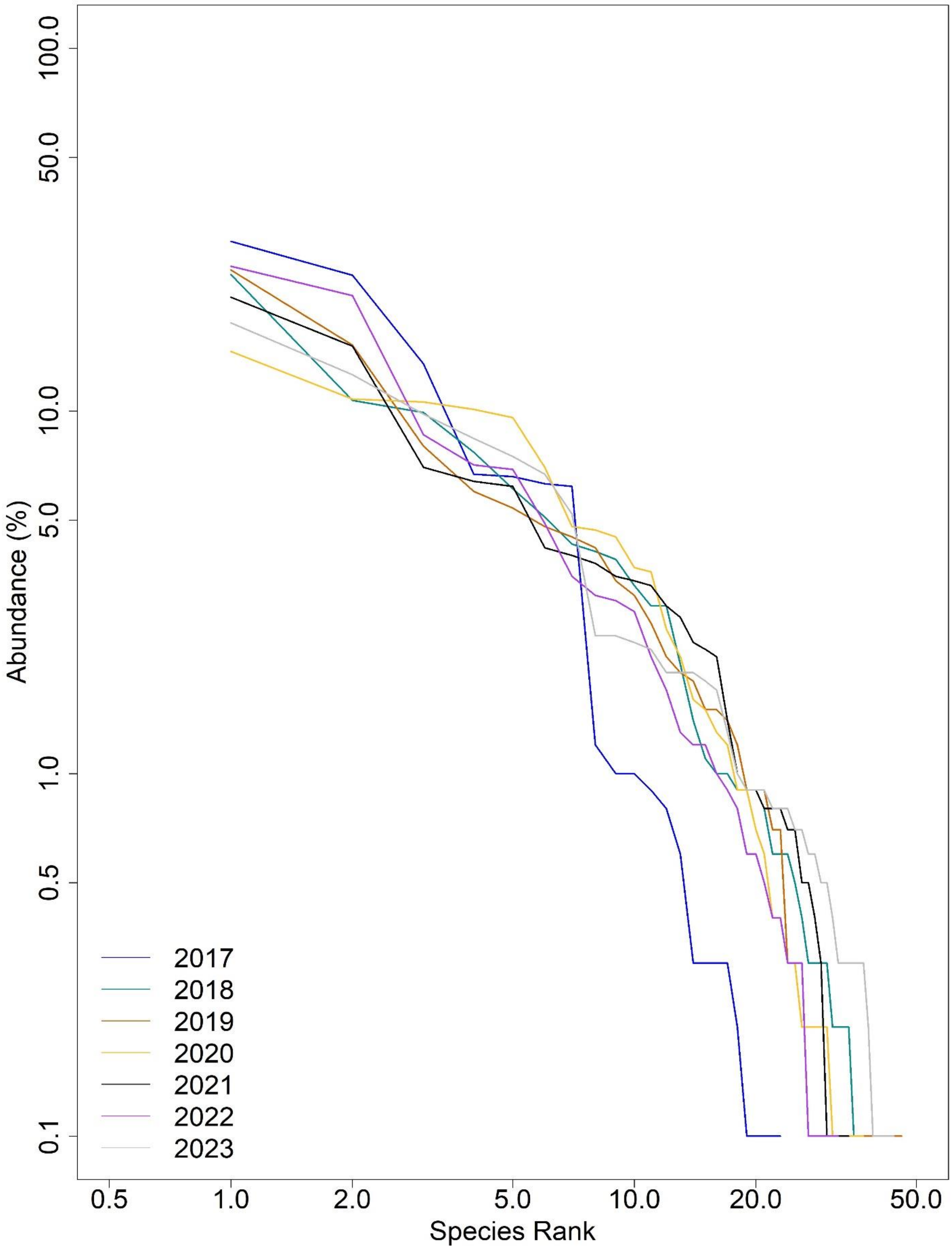

Figure 4-112. Rank Abundance Curves at Pond 61 (Year 5 Post-Subsurface Munitions Remediation) from 2017-2023. Note that the x-axis and the y-axis are in log-10 scale.

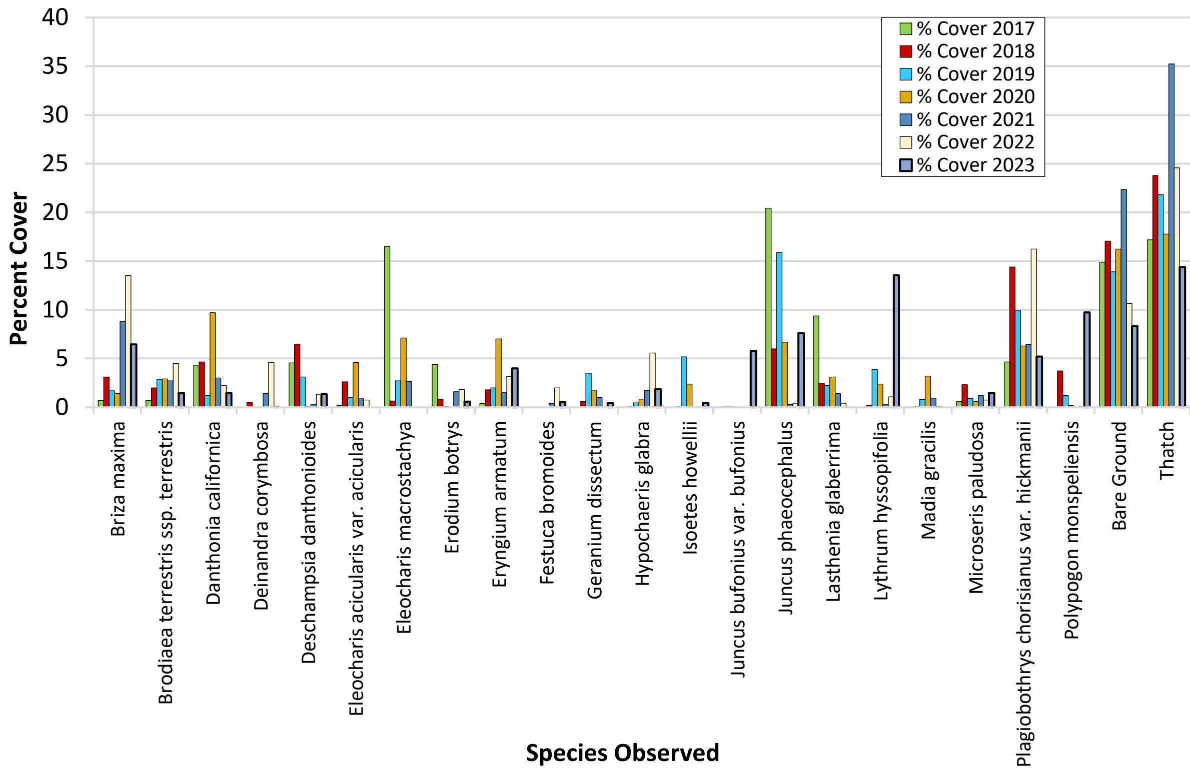

Figure 4-113. Percent Cover of Dominant Species at Pond 61 (Year 5 Post-Subsurface Munitions Remediation)

Native and non-native species richness on Pond 61 transects was greater than baseline in every monitoring year (see Table 4-239). When compared to reference vernal pool values, monitoring results were variable. Native species richness was greater than the range of values observed at reference vernal pools in 2019 (Yr 1), 2021 (Yr 3), and 2023 (Yr 5), whereas native species richness was within the range of reference vernal pool values in 2020 (Yr 2) and 2022 (Yr 4) (Burleson, 2020, 2021, 2022, 2023) (see Table 4-240). Non-native species richness was less than the range of values observed at reference vernal pools in 2019 (Yr 1) and 2022 (Yr 4), whereas non-native species richness was greater than reference values in 2023 (Yr 5), and within the range of reference values in 2020 (Yr 2) and 2021 (Yr 3) (Burleson, 2020, 2021, 2022, 2023) (Burleson, 2020, 2021, 2022, 2023).

Table 4-239. Pond 61 (Year 5 Post-Subsurface Munitions Remediation) Native and Non-Native Species Richness

Year	Native	Non-Native	Unidentified
2017*	15	6	2
2018	24	16	1
2019	32	13	1
2020	24	12	0
2021	21	13	0
2022	19	12	1
2023	27	17	0

*baseline year

Table 4-240. Pond 61 (Year 5 Post-Subsurface Munitions Remediation) and Reference Vernal Pool Native and Non-Native Species Richness in 2023

Vernal Pool	Native	Non-Native	Unidentified
5	12	12	0
101 East (East)	9	7	0
997	13	14	1
61	**27**	**17**	**0**

The relative percent cover of native species was less, and non-native species cover was greater than the baseline values in every monitoring year (see Table 4-241). Pond 61 native and non-native relative percent cover were within the range of values observed at the reference vernal pools in 2020-2022 (Burleson, 2021, 2022, 2023). In 2019 (Yr 1), native cover was greater, and non-native cover was less, than the range of reference vernal pools, whereas in 2023 (Yr 5), native cover was less, while non-native cover was greater than the range of reference (Burleson, 2020) (see Table 4-242).

Table 4-241. Pond 61 (Year 5 Post-Subsurface Munitions Remediation) Relative Percent Cover of Native and Non-Native Plants

Year	Native	Non-Native	Unidentified
2017*	90.3%	9.4%	0.3%
2018	80.1%	19.8%	0.1%
2019	81.1%	18.8%	0.2%
2020	88.7%	11.3%	0.0%
2021	59.5%	40.5%	0.0%
2022	56.4%	43.5%	0.1%
2023	46.9%	53.1%	0.0%

*baseline year

Table 4-242. Pond 61 (Year 5 Post-Subsurface Munitions Remediation) and Reference Vernal Pool Relative Percent Cover of Native and Non-Native Plants in 2023

Vernal Pool	Native	Non-Native	Unidentified
5	76.3%	23.7%	0.0%
101 East (East)	60.3%	39.7%	0.0%
997	50.0%	49.0%	1.0%
61	**46.9%**	**53.1%**	**0.0%**

Wetland species richness on Pond 61 transects was greater than baseline in every monitoring year (see Table 4-243). Non-wetland species richness was the same as baseline in 2019 (Yr 1), 2021 (Yr 3), and 2022 (Yr 4), whereas non-wetland species richness was greater than baseline in 2020 (Yr 2) and 2023 (Yr 5). When compared to reference vernal pool values, monitoring results were variable (see Table 4-244). Wetland richness was greater than the range of values observed at the reference vernal pools in 2019 (Yr 1), 2021 (Yr 3), and 2023 (Yr 5) (Burleson, 2020, 2022). Whereas, in 2020 (Yr 2) and 2022 (Yr 4), wetland richness was within the range of reference values (Burleson, 2021, 2023). Non-wetland richness was less than the range of reference vernal pool values in 2019 (Yr 1), 2021 (Yr 3), and 2022 (Yr 4), whereas in 2020 (Yr 2), non-wetland richness was within the range of reference values, and in 2023 (Yr 5), non-wetland richness was greater.

Table 4-243. Pond 61 (Year 5 Post-Subsurface Munitions Remediation) Wetland and Non-Wetland Species Richness

Year	Wetland			Non-Wetland		Not Listed
	OBL	FACW	FAC	FACU	UPL	
2017*	4	6	2	5	0	6
2018	10	10	3	7	1	10
2019	11	11	6	4	1	13
2020	9	9	4	5	1	8
2021**	6	9	3	4	1	11
2022†	5	8	3	3	2	11
2023	4	13	6	6	0	15

*baseline year
**These values have changed from previous years. In 2021, TRDU was incorrectly labled as NL instead of FACU. This change will be reflected in data deliverables and all future reports. FACU increased by 1 and NL decreased by 1.
†These values have changed from previous years. Due to a formula error, *Microseris douglasii* ssp. *douglasii* was incorrectly labled as NL. This change will be reflected in data deliverables and all future reports. UPL increased from 1 to 2, and NL decreased from 12 to 11.

Table 4-244. Pond 61 (Year 5 Post-Subsurface Munitions Remediation) and Reference Vernal Pool Wetland and Non-Wetland Species Richness in 2023

Vernal Pool	Wetland			Non-Wetland		Not Listed
	OBL	FACW	FAC	FACU	UPL	
5	6	7	3	3	1	4
101 East (East)	4	6	1	3	0	2
997	4	6	4	4	0	10
61	**4**	**13**	**6**	**6**	**0**	**15**

The relative percent cover of wetland and non-wetland species was lower than baseline in every monitoring year except for 2021 (Yr 3), in which non-wetland cover was greater (see Table 4-245). Wetland relative percent cover was within the range of values observed at reference vernal pools in every monitoring year (Burleson, 2020, 2021, 2022, 2023) (see Table 4-246). Non-wetland relative percent cover was less than reference pool values in 2019 (Yr 1) and 2022 (Yr 4), whereas in 2020 (Yr 2), 2021 (Yr 3), and 2023 (Yr 5), non-wetland cover was within the range of reference vernal pool values.

Table 4-245. Pond 61 (Year 5 Post-Subsurface Munitions Remediation) Relative Percent Cover of Wetland and Non-Wetland Species

Year	Wetland			Non-Wetland		Not Listed
	OBL	FACW	FAC	FACU	UPL	
2017*	44.3%	37.6%	6.5%	8.2%	0.0%	3.3%
2018	40.6%	31.7%	9.3%	3.2%	0.5%	14.9%
2019	40.1%	37.8%	3.7%	0.3%	0.3%	17.8%
2020	42.2%	24.4%	15.3%	1.2%	0.3%	16.6%
2021**	30.2%	7.0%	9.5%	8.5%	0.8%	44.0%
2022†	29.9%	9.1%	7.3%	4.0%	0.4%	49.3%
2023	25.1%	42.5%	8.4%	5.5%	0.0%	18.6%

*baseline year

**These values have changed from previous years. In 2021, TRDU was incorrectly labled as NL instead of FACU. This change will be reflected in data deliverables and all future reports. FACU increased by 0.2% and NL decreased by 0.1%.

†These values have changed from previous years. Due to a formula error, *Microseris douglasii* ssp. *douglasii* was incorrectly labled as NL. This change will be reflected in data deliverables all future reports. UPL increased from 0.3% to 0.4%, and NL decreased from 49.4% to 49.3%.

Table 4-246. Pond 61 (Year 5 Post-Subsurface Munitions Remediation) and Reference Vernal Pool Relative Percent Cover of Wetland and Non-Wetland Species in 2023

Vernal Pool	Wetland			Non-Wetland		Not Listed
	OBL	FACW	FAC	FACU	UPL	
5	61.4%	29.0%	3.1%	3.7%	0.1%	2.7%
101 East (East)	14.5%	53.4%	0.1%	9.1%	0.0%	22.9%
997	31.5%	28.9%	7.4%	9.0%	0.0%	23.2%
61	**25.1%**	**42.5%**	**8.4%**	**5.5%**	**0.0%**	**18.6%**

4.19.1.1 *Contra Costa Goldfields*

The area of CCG at Pond 61 has fluctuated from year to year, ranging from 0.11 acres in 2019 (Yr 1) to 0.15 acres in 2020 (Yr 2). In 2023 (Yr 5), the total area was 0.13 acres, which was the same as 2021 (Yr 3), and slightly less than baseline (Burleson, 2018, 2019, 2020, 2021, 2022, 2023) (see Table 4-247 and Figure 4-114). The density also varied from year to year, from 10-65% at baseline to 35-80% in 2022 (Yr 4). By 2023 (Yr 5), density was the lowest overall, with 15-30% cover, however the timing for CCG surveys was past the peak bloom period, and may have been considerably higher. In 1999, 2000, 2002, and 2017-2021 the CCG population was in similar locations as 2023 (Yr 5) and within the range of 0.09-0.15 acre (HLA, 2000, 2001; MACTEC, 2003; Burleson, 2018, 2019, 2020, 2021, 2022, 2023). Results suggest that mastication activities in 2017 and post-subsurface munitions remediation in 2019 (Yr 1) did not affect the population. Minor changes in population size can be attributed to natural fluctuation.

Table 4-247. Pond 61 (Year 5 Post-Subsurface Munitions Remediation) Contra Costa Goldfields Estimated Cover

Year	Area (acres)	Density (% cover)
2017*	0.14	10-65%
2018	0.12	5-65%
2019	0.11	5-85%
2020	0.15	15-65%
2021	0.13	5-70%
2022	0.14	35-80%
2023	0.13	15-30%

*baseline year

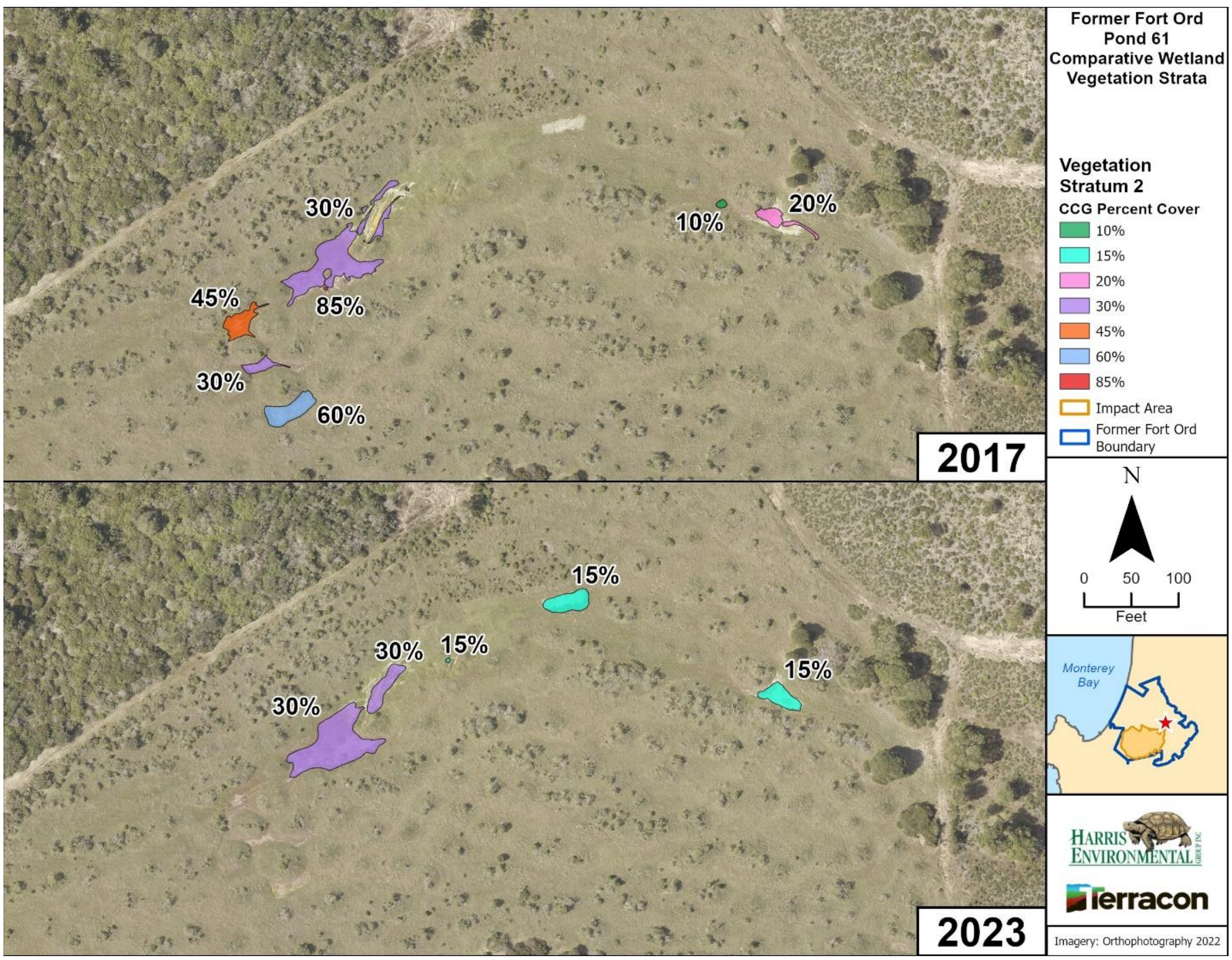

Figure 4-114. Contra Costa Goldfields Populations at Pond 61 (Year 5 Post-Subsurface Munitions Remediation) in 2017 and 2023

4.19.1.2 *Data Quality Objective 3*

Observable changes in hydrophytic vegetation between surveys were largely associated with precipitation fluctuations. This is expected given the dynamic nature of vernal pools and the close relationship between the hydroperiod and wetland vegetation composition. Vegetative cover in Pond 61 was dominated by non-native and wetland plant species during year 5 post-subsurface munitions remediation monitoring in 2023. Pond 61 wetland vegetation results were generally outside the range of baseline and/or reference vernal pools. Non-native richness and relative percent cover were greater than baseline and reference values; whereas native cover was less than both. Additionally, non-wetland richness was greater than reference values and baseline. Conversely, native and wetland species richness were greater than baseline and reference values. The increase in native and wetland richness is not concerning. These results generally support a well-functioning vernal pool ecosystem. However, the increase in non-native richness and cover, decrease in native cover, and increase in non-wetland richness are not favorable.

This year is the first above-normal precipitation year after two consecutive drought years. Below-normal water-years can result in upland and non-native herbs and grasses exploiting a greater portion of a vernal pool and distributing more evenly (Bauder, 2000). It is possible that the influx of non-native species in 2021 (Yr 3) and 2022 (Yr 4) increased the overall footprint of non-native species, the most hydrophytic of which have become dominant in this year of high precipitation. In 2023 (Yr 5), the two most dominant species on transects were non-native wetland species, grass poly and rabbitfoot grass. The increase in non-native wetland species has been a trend across several other vernal pools this year and is likely not a result of remediation activities, but rather the strong precipitation swings over the past five years. This is also the first year that richness and cover were mostly out of range of baseline and reference results, as all previous years were considered on track. This further supports the conclusion that remediation was not the cause of these fluctuations.

4.19.1.3 *Performance Standard: Plant Cover and Species Diversity*

Pond 61, a post-subsurface munitions remediation vernal pool, met the performance standard by year 5 in 2023. The species composition, and native and wetland species richness were similar to baseline and/or reference vernal pool conditions in all but the last year of monitoring. The results in 2023 (Yr 5) that were outside the range of baseline and reference are likely due to fluctuations in precipitation rather than remediation activities. Pond 61 provided suitable wetland habitat in 2023.

4.19.2 Wildlife Monitoring

Wildlife data were collected at Pond 61 in 2017, 2019, 2020, and 2021 (Burleson, 2018, 2020, 2021, 2022). California tiger salamander larvae were not observed in any year. Fairy shrimp were present in 2019 and 2020. The vernal pool did not hold sufficient depth for surveys to be completed in 2022. Pond 61 East was dry on April 27, 2023. In April, priority was given to survey ponds with known historical CTS presence. Pond 61 West was not surveyed in May, 2023 due to logistical constraints. Therefore, DQO 5 and the applicable wildlife usage performance standard is only assessed for 2019-2021. Table 4-248 shows historical wildlife monitoring results.

Table 4-248. Pond 61 (Year 5 Post-Subsurface Munitions Remediation) Historical Wildlife Monitoring Results

Sampling Year	CTS Larvae Abundance (# Individuals)	Fairy Shrimp Abundance (# Individuals)
2017*	Not detected	Not detected
2019	Not detected	High (162)
2020	Not detected	High (172)
2021	Not detected	Not detected

*baseline year

4.19.2.1 *Data Quality Objective 5*

California tiger salamanders were not detected in any monitoring year, which was consistent with baseline and reference monitoring. CTS were not detected at Pond 997 in 2019-2021, nor were they detected at Pond 5 and 101 East (East) in 2020 (Yr 2). Ponds 60 and 61 were the only pond surveyed for wildlife in 2021 (Yr 3) due to drought conditions, so Pond 61 was not compared to reference vernal pools.

Fairy shrimp were detected in 2019 (Yr 1) and 2020 (Yr 2), which was not consistent with baseline, but was a favorable difference. They were not detected however, in 2021 (Yr 3), which was consistent with baseline. Results in 2019 (Yr 1) and 2020 (Yr 2) were consistent with reference vernal pools; fairy shrimp were detected at Pond 5 and Pond 101 East (East) in 2019 (Yr 1), and Pond 101 East (East) in 2020 (Yr 2). Similarly to CTS monitoring, fairy shrimp were not compared to vernal pools in 2021 (Yr 3) because all three reference pools remained dry, so could not be surveyed for wildlife.

4.19.2.2 *Performance Standard: Wildlife Usage*

Pond 61, a post-subsurface munitions remediation vernal pool, was in the final year of monitoring in 2023 and met DQO 5. California tiger salamanders were not detected in any monitoring year, which was consistent with baseline and reference Ponds 997 in 2019-2021 (Yrs 1, 2, and 3) and Pond 5 and 101 East (East) in 2020 (Yr 2). Fairy shrimp were detected in high numbers in 2019 (Yr 1) and 2020 (Yr 2), which was not consistent with baseline, but was consistent with reference Ponds 5 and Pond 101 East (East) in 2019 and 101 East (East) in 2020 (Yr 2). Data quality objectives 1 and 4 were analyzed in the Hydrology Monitoring Annual Report (Chenega, 2023).

4.19.3 Conclusion

Pond 61, a post-subsurface munitions remediation vernal pool, was in the final year of monitoring in 2023. The vernal pool met the plant cover and species diversity performance standard and met DQO 5 for wildlife usage (see Table 4-249). No further monitoring is recommended for Pond 61.

Table 4-249. Success at Pond 61 (Year 5 Post-Subsurface Munitions Remediation) Based on Performance Standards and Applicable Data Quality Objectives

Performance Standard	Applicable DQO	2019 (Yr 1)	2020 (Yr 2)	2021 (Yr 3)	2022 (Yr 4)	2023 (Yr 5)	Success
Plant Cover & Species Diversity	DQO 3	On Track	On Track	On Track	On Track	On Track	Met
Wildlife Usage	DQO 5	On Track	On Track	On Track	N/A	N/A	Met

5 CONCLUSION

Above-normal precipitation in the 2022-2023 water-year allowed generally favorable hydrological, wetland vegetation, and wildlife conditions to occur in the vernal pools following two consecutive years of drought. All of the vernal pools held water for at least part of the season and several exhibited the highest recorded results for inundation and depth (Chenega, 2023). Ponds 3 North, 3 South, 16, 35, 39, 40 South, 41, 42, 43, 44, 54, 60, 61, and 73 were in their fifth and final year of required monitoring following subsurface munitions remediation, which occurred in 2018. Wetland vegetation results shifted significantly between 2019-2023 due to the significantly different water-years. During the five years of monitoring, the first and last monitoring years 2019 (Yr 1) and 2023 (Yr 5) had above-normal precipitation, while 2021 (Yr 3) and 2022 (Yr 4) had below normal precipitation. 2020 (Yr 2) was similar to the cumulative normal water-year. The performance standards used to measure success as outlined in the Wetland Plan were assessed across the required five year monitoring period.

Due to the late contract reward, wildlife monitoring did not begin until late April and was truncated to prioritize California tiger salamander monitoring, rather than the invertebrate and fairy shrimp monitoring conducted at ten of the nineteen ponds this year. The late monitoring period may have missed the window for fairy shrimp detection for many of the ponds, especially those with prior detections of the species. In addition, several of the ponds had adequate depth for wildlife surveys earlier in the season, but were either too shallow or dry by the time surveys began, including reference Pond 997, which has not commonly had adequate depth for surveys in the past.

Vegetative variability is expected in vernal pools that have dynamic conditions in response to the amount of precipitation and the resulting hydroperiod (Bauder, 2000, 2005; Mulhouse et al., 2005; Witham et al., 1998). Above-normal rainfall dramatically shifted the wetland vegetation across all vernal pools, especially the relative percent cover of wetland and native species, which increased from the two previous survey years. In regards to vegetation monitoring, the unusually late vernal pool strata surveys may have also had an effect on plant community results, as vegetative surveys are normally conducted earlier in the year and the plants that were growing in the strata may have shifted. There was generally less species richness than in past years. This may have more to do with prolonged inundation rather than a difference in survey timing however, as inundation limits the number of species to the most hydrophytic.

There were sixteen remediated vernal pools monitored this year, fourteen of which were in Year 5. Despite the abbreviated wildlife surveys, every pond met or was on track to meet DQO 5 for wildlife except for Pond 76, which could not be compared to reference Pond 997 due to lack of wildlife surveys in 2023.

Three vernal pools did not meet DQO 3 for vegetation, which included Ponds 35, 39, and 40 South (see Table 5-1). These three vernal pools have not historically been on track to meet DQO 3, thus their failure to meet the performance standard for vegetation is not surprising. It is unlikely that any of these three ponds, all of which have high non-native and non-wetland species richness and/or cover, and low native and wetland species richness and/or cover, failed due to remediation activities. As mentioned in the discussion sections for all three ponds, the valley in Unit B where Ponds 35, 39, and 40 South are located has historically been heavily disturbed which is likely why, in some years, non-native richness and cover were high. Additionally, below-normal water-years in 2021 (Yr 3) and 2022 (Yr 4) likely contributed to favorable conditions for non-native and non-wetland species at the three ponds. However, it may also be related to historical disturbance and proximity to roads which was exacerbated by dry conditions.

These attributes show that it is not likely that remediation activities played a role in the failure of these ponds to meet vegetative success criteria, but rather environmental conditions that were unique to that basin.

This is the third year in a row that Rank Abundance Curves (RACs) have been utilized to understand distribution of the species, relative abundance, species evenness, and species richness. Rank abundance curves were created for all vernal pools this year. Comparison plots were also produced for each vernal pool with all monitoring years from 2015-2023 (see Appendix F). Notable differences from year to year are species richness, the change in species composition through gains and losses of differing species, and the distribution and relative abundance of species as they shift in position along the curves. For many vernal pools the dominant species are similar from year to year but for others they change every year.

Remarkably, the evenness is relatively low and fairly similar across years. This may be in part because of generally high species richness at the vernal pools and our sampling methodology. This is supported by a study of subalpine meadow communities with the same sampling scale as data collected at Ford Ord vernal pools. The researchers found a consistent negative correlation between S (species richness) and J (evenness) in these communities along the successional gradient at the sampling scale of 0.5 m x 0.5 m quadrats along transect lines (Hui Zhang, 2012). In addition to low evenness, richness was uniformly distributed along the entire curve with a slightly higher concentration or plateau of species toward the tail end. This plateau represents the species that are likely contributing around 1% and only found once along the transect.

Ponds 21 and 76 were in their first year of monitoring and will continue to be monitored for wetland vegetation and wildlife usage in the future.

Table 5-1. 2023 Remediated Vernal Pools and Performance Standards Status

Vernal Pool	Monitoring Status	Wetland Vegetation	Wildlife
		DQO 3 (richness and cover)	DQO 5 (wildlife presence)
21	Year 1 Post-Mastication and Post-Subsurface Munitions Remediation	On track	On track
76	Year 1 Post-Mastication	On track	Not on track
3 North	Year 5 Post-Subsurface Munitions Remediation	Met	Met
3 South	Year 5 Post-Subsurface Munitions Remediation	Met	Met
35	Year 5 Post-Subsurface Munitions Remediation	Not Met	Met
43	Year 5 Post-Subsurface Munitions Remediation	Met	Met
44	Year 5 Post-Subsurface Munitions Remediation	Met	Met
54	Year 5 Post-Subsurface Munitions Remediation	Met	Met
60	Year 5 Post-Subsurface Munitions Remediation	Met	Met
73	Year 5 Post-Subsurface Munitions Remediation	Met	Met
16	Year 5 Post-Subsurface Munitions Remediation	Met	Met
39	Year 5 Post-Subsurface Munitions Remediation	Not Met	Met
40 South	Year 5 Post-Subsurface Munitions Remediation	Not Met	Met
41	Year 5 Post-Subsurface Munitions Remediation	Met	Met
42	Year 5 Post-Subsurface Munitions Remediation	Met	Met
61	Year 5 Post-Subsurface Munitions Remediation	Met	Met

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APPENDIX A

Vegetation Transect Data

Table A-1. Pond 5 (Reference) Wetland Vegetation Transect Data by Stratum

POND 5			
Date	9/19/2023, 8/30/2023		
Surveying Personnel	USACE		
Vegetation Type	**% Cover**	**Species**	**Notes**
Emergent Vegetation	65	ELMA	dominant
Floating Vegetation	5	PONDWEED, LIVERWORT-LIKE	EVIDENT AT EDGES, DIFFICULT TO EST THROUGHOUT
Submerged Vegetation	10	BOTH QUILLWORTS	EVIDENT AT EDGES, DIFFICULT TO EST THROUGHOUT
Open Water	20		SMALL POOLS AND THROUGHOUT; DEPTH GAUGE INACCESSIBLE, EST 20CM
Notes			
Pond 5 held water from January 2023 through the end of the 2023 water-year, with shallow peripheral ponding observed in December (Chenega, 2024). Stratum 1 was repeated from 2016-2022. Strata 2 and 3 were repeated from 2016-2022. Stratum 9 and the associated transect were established in 2023. There was no transect placed in Stratum 1 because it was inundated at the time of vegetation surveys, so a visual cover estimate was completed. Transects 2 and 3 were relocated because the previous locations were no longer within the correct strata.			

Transect #	Transect Length	Relative % Cover of Wetland	Quadrat #1		Quadrat #2		Quadrat #3		Quadrat #4		Quadrat #5		Quadrat #6	
			Species	% Cover	Species	% Cover	Species	% Cover	Species	% Cover	Species	% Cover	Species	% Cover
2	10 m		DISP	2	DISP	3	DISP	5	DISP	5	DISP	3	ELMA	90
			ELMA	52	ELMA	75	ELMA	80	ELMA	59	ELMA	30	LYHY	5
			LYHY	1	RUAC	1	LYHY	2	GNPA	2	LYHY	2	TH	5
			RUAC	10	STAJ	1	POMO	3	LYHY	1	PLCHH	3		
			STAJ	15	TH	5	RUAC	5	POMO	2	STAJ	10		
			TH	10	BG	15	TH	5	RUAC	1	TH	2		
			BG	10					TH	10	BG	50		
									BG	20				
			TOTAL	**100**	**TOTAL**	**100**	**TOTAL**	**100**	**TOTAL**	**100**	**TOTAL**	**100**	**TOTAL**	**100**

Transect #	Transect Length	Relative % Cover of Wetland	Quadrat #1		Quadrat #2		Quadrat #3		Quadrat #4		Quadrat #5		Quadrat #6	
			Species	% Cover	Species	% Cover	Species	% Cover	Species	% Cover	Species	% Cover	Species	% Cover
3	10 m		AGAV	20	DISP	5	DISP	5	AVBA	1	AGAV	5	BRHO	1
			DISP	25	GNPA	3	ERCA	15	BRMI	3	DISP	15	BRMI	15
			ERCA	3	LYHY	30	GNPA	10	DISP	20	ERCA	1	DISP	10
			GNPA	20	LYMI	1	LYHY	10	FEBR	1	GNPA	3	GNPA	1
			LYHY	5	PHLE	35	PHLE	35	GNPA	5	LYHY	30	LYHY	10
			POMO	20	POMO	1	POMO	15	HYGL	3	LYMI	2	LYMI	24
			STAJ	5	PSST	10	PSST	1	JUBA	5	PHLE	3	PHLE	3
			TH	1	TH	13	RUAC	3	LYAR	1	POMO	10	POMO	1
			BG	1	BG	2	SOOL	1	LYHY	29	PSLU	6	PSLU	10
							TH	2	LYMI	5	TH	15	TH	15
							BG	3	PHLE	1	BG	10	BG	10
									PSST	5				
									RUAC	1				
									TH	10				
									BG	10				
			TOTAL	**100**	**TOTAL**	**100**	**TOTAL**	**100**	**TOTAL**	**100**	**TOTAL**	**100**	**TOTAL**	**100**

Transect #	Transect Length	Relative % Cover of Wetland	Quadrat #1		Quadrat #2		Quadrat #3	
			Species	% Cover	Species	% Cover	Species	% Cover
9	5 m		CRAQ	1	ISHO	50	ELMA	4
			ISHO	30	STAJ	5	ISHO	50
			STAJ	1	TH	30	STAJ	1
			TH	40	BG	15	TH	40
			BG	28			BG	5
			TOTAL	**100**	**TOTAL**	**100**	**TOTAL**	**100**

Pond 5 2023 Species List

Species Name	Common Name	Species Code	Species Name	Common Name	Species Code
Achillea millefolium	common yarrow	ACMI	*Madia gracilis*	gumweed	MAGR
Agrostis avenacea	Pacific bent grass	AGAV	*Madia sativa*	coast tarweed	MASA
Agrostis pallens	seashore bent grass	AGPA	*Malvella leprosa*	alkali mallow	MALE
Avena barbata	slender wild oat	AVBA	*Nuttallanthus texanus*	blue toadflax	NUTE
Baccharis pilularis	coyote brush	BAPI	*Persicaria lapathifolia*	willoweed	PELA
Briza maxima	rattlesnake grass	BRMA	*Phalaris lemmonii*	Lemmon's canary grass	PHLE
Briza minor	annual quaking grass	BRMI	*Plagiobothrys chorisianus* var. hickmanii	Hickman's popcornflower	PLCHH
Bromus hordeaceus	soft chess	BRHO	*Plantago coronopus*	cut-leaved plantain	PLCO
Carpobrotus edulis	ice plant	CAED	*Polypogon monspeliensis*	rabbitfoot grass	POMO
Castilleja ambigua ssp. ambigua	Johnny-Nip	CAAMA3	*Potamogeton sp.*	pondweed	POSP
Clarkia purpurea ssp. quadrivulnera	winecup clarkia	CLPUQ	*Pseudognaphalium luteoalbum*	weedy cudweed	PSLU
Cotula coronopifolia	brass buttons	COCO	*Pseudognaphalium stramineum*	cottonbatting plant	PSST
Crassula aquatica	aquatic pygmy-weed	CRAQ	*Quercus agrifolia*	coast live oak	QUAG
Cyperus eragrostis	tall cyperus	CYER	*Rumex acetosella*	sheep sorrel	RUAC
Danthonia californica	California oat grass	DACA	*Rumex crispus*	curly dock	RUCR
Diplacus aurantiacus	sticky monkey flower	DIAU	*Rumex salicifolius*	willow dock	RUSA
Distichlis spicata	salt grass	DISP	*Schoenoplectus californicus*	California bulrush	SCCA
Eleocharis acicularis var. acicularis	needle spikerush	ELACA	*Senecio glomeratus*	cutleaf burnweed	SEGL
Eleocharis macrostachya	pale spikerush	ELMA	*Solanum americanum*	small-flowered nightshade	SOAM
Erigeron canadensis	horseweed	ERCA	*Sonchus asper*	prickly sow thistle	SOAS
Eryngium armatum	coyote thistle	ERAR12	*Sonchus oleraceus*	common sow thistle	SOOL
Euthamia occidentalis	western goldenrod	EUOC	*Spergula arvensis*	corn spurry	SPAR
Festuca bromoides	brome fescue	FEBR	*Stachys ajugoides*	bugle hedge nettle	STAJ
Geranium dissectum	cut-leaved geranium	GEDI	*Stipa pulchra*	purple needle grass	STPU
Gnaphalium palustre	lowland cudweed	GNPA	*Toxicodendron diversilobum*	poison oak	TODI
Heliotropium curassavicum var. oculatum	Chinese pusley	HECUO	*Trifolium angustifolium*	narrow-leaved clover	TRAN
Hypochaeris glabra	smooth cat's-ear	HYGL	*Triglochin scilloides*	flowering quillwort	TRSC
Hypochaeris radicata	rough cat's-ear	HYRA	*Typha sp.*	cattail	TY sp.
Isoetes howellii	Howell's quillwort	ISHO	Unknown 62		UNK62
Juncus balticus	Baltic rush	JUBA	Unknown 63		UNK63
Juncus bufonius var. bufonius	common toad rush	JUBUB	*Verbena lasiostachys* var. lasiostachys	western vervain	VELAL
Juncus phaeocephalus	brown-headed rush	JUPH	*Zeltnera davyi*	Davy's centuary	ZEDA
Lysimachia arvensis	scarlet pimpernel	LYAR	**Groundcover Codes**		
Lysimachia minima	chaffweed	LYMI	BG	Bare Ground	
Lythrum hyssopifolia	grass poly	LYHY	TH	Thatch/Duff/Algae	
Madia elegans	common madia	MAEL	AL	Algae	

Table A-2. Pond 101 East (East) (Reference) Wetland Vegetation Transect Data by Stratum

POND 101 East (East)			
Date	8/29/2023		
Surveying Personnel	USACE		
Vegetation Type	**% Cover**	**Species**	**Notes**
Emergent Vegetation	10	ELMA	SPARSE, EVENLY DISTRIBUTED
Floating Vegetation	1		AZOLLA SP.
Submerged Vegetation	0		WATER IS HIGHLY TURBID
Open Water	89		.45M ON DEPTH GAUGE

Notes

Pond 101 East (East) held water in January through the remainder of the 2022-2023 water-year. Peripheral ponding was present in December 2022 (Chenega, 2024). The vernal pool remained indundated late into the season, limiting strata development. Stratum 2 was repeated from 2016 and 2018-2020. Stratum 4 was repeated from 2016 and 2020-2022, whereas Stratum 5 was repeated from 2017-2022. Transect 4 was relocated to a more representative location. Transect 5 was repeated from 2017-2019. There was no transect for Stratum 2 because it was inundated at the time of survey activities; a visual cover estimate was completed.

Transect #	Transect Length	Relative % Cover of Wetland	Quadrat #1		Quadrat #2		Quadrat #3		Quadrat #4		Quadrat #5		Quadrat #6	
			Species	% Cover	Species	% Cover	Species	% Cover	Species	% Cover	Species	% Cover	Species	% Cover
4	10 m		AGAV	75	AGAV	15	AGAV	30	AGAV	70	AGAV	5	AGAV	10
			RUAC	5	JUBA	60	CYER	5	JUBA	20	JUBA	50	CYER	8
			BG	20	RUAC	10	JUBA	15	TH	3	RUAC	15	JUBA	10
					TH	5	LYHY	15	BG	7	BG	30	POMO	1
					BG	10	RUAC	15					RUAC	1
							BG	20					BG	70
			TOTAL	**100**	**TOTAL**	**100**	**TOTAL**	**100**	**TOTAL**	**100**	**TOTAL**	**100**	**TOTAL**	**100**

Transect #	Transect Length	Relative % Cover of Wetland	Quadrat #1		Quadrat #2		Quadrat #3		Quadrat #4		Quadrat #5		Quadrat #6	
			Species	% Cover	Species	% Cover	Species	% Cover	Species	% Cover	Species	% Cover	Species	% Cover
5	10 m		AGAV	3	AGAV	5	AGAV	5	CYER	10	CYER	45	AGAV	8
			CYER	25	ERCA	5	ELACA	10	ECCR	1	ERBO	3	GNPA	55
			ELACA	25	GNPA	50	GNPA	50	ELACA	50	ERCA	5	JUPH	5
			ERCA	5	JUPH	10	JUPH	10	GNPA	10	GNPA	15	LYHY	5
			GNPA	25	LYHY	3	LYHY	5	HECUO	1	LYHY	5	PSLU	5
			LYHY	2	PSLU	5	PSLU	10	LYHY	5	PSLU	5	RUAC	10
			PSLU	5	RUAC	10	ROCU	5	PSLU	20	STAJ	2	STAJ	10
			TH	10	TH	2	RUAC	5	RUAC	1	TH	15	BG	2
					BG	10			STAJ	2	BG	5		
			TOTAL	**100**	**TOTAL**	**100**	**TOTAL**	**100**	**TOTAL**	**100**	**TOTAL**	**100**	**TOTAL**	**100**

Pond 101 East (East) 2023 Species List

Species Name	Common Name	Species Code	Species Name	Common Name	Species Code
Acmispon americanus var. americanus	Spanish lotus	ACAMA	*Lysimachia arvensis*	scarlet pimpernel	LYAR
Agrostis avenacea	Pacific bent grass	AGAV	*Lysimachia minima*	chaffweed	LYMI
Aira caryophyllea	silvery hair-grass	AICA	*Lythrum hyssopifolia*	grass poly	LYHY
Avena barbata	slender wild oat	AVBA	*Madia sativa*	coast tarweed	MASA
Baccharis pilularis	coyote brush	BAPI	*Malvella leprosa*	alkali mallow	MALE
Briza maxima	rattlesnake grass	BRMA	*Persicaria lapathifolia*	willoweed	PELA
Briza minor	annual quaking grass	BRMI	*Phalaris lemmonii*	Lemmon's canary grass	PHLE
Bromus diandrus	ripgut grass	BRDI	*Plantago lanceolata*	English plantain	PLLA
Bromus hordeaceus	soft chess	BRHO	*Polypogon monspeliensis*	rabbitfoot grass	POMO
Carex praegracilis	clustered field sedge	CAPR	*Potentilla rivalis*	brook cinquefoil	PORI
Cirsium brevistylum	Indian thistle	CIBR	*Pseudognaphalium luteoalbum*	weedy cudweed	PSLU
Cirsium vulgare	bull thistle	CIVU	*Pseudognaphalium ramosissimum*	pink everlasting	PSRA
Cyperus eragrostis	tall cyperus	CYER	*Pseudognaphalium stramineum*	cottonbatting plant	PSST
Echinochloa crus-galli	barnyard grass	ECCR	*Rorippa curvisiliqua*	western yellowcress	ROCU
Eleocharis acicularis var. acicularis	needle spikerush	ELACA	*Rubus ursinus*	California blackberry	RUUR
Eleocharis macrostachya	pale spikerush	ELMA	*Rumex acetosella*	sheep sorrel	RUAC
Elymus glaucus	blue wild-rye	ELGL	*Rumex crispus*	curly dock	RUCR
Erigeron canadensis	horseweed	ERCA	*Senecio glomeratus*	cutleaf burnweed	SEGL
Erodium botrys	long-beaked filaree	ERBO	*Solanum americanum*	small-flowered nightshade	SOAM
Erodium cicutarium	redstem filaree	ERCI	*Sonchus asper*	prickly sow thistle	SOAS
Festuca bromoides	brome fescue	FEBR	*Sonchus oleraceus*	common sow thistle	SOOL
Festuca perennis	Italian rye grass	FEPE	*Stachys ajugoides*	bugle hedge nettle	STAJ
Geranium dissectum	cut-leaved geranium	GEDI	*Trifolium angustifolium*	narrow-leaved clover	TRAN
Gnaphalium palustre	lowland cudweed	GNPA	*Verbena lasiostachys* var. lasiostachys	western vervain	VELAL
Heliotropium curassavicum var. oculatum	Chinese pusley	HECUO	*Vicia sativa* ssp. nigra	common vetch	VISAN
Hypochaeris glabra	smooth cat's-ear	HYGL	*Vicia sativa* ssp. sativa	spring vetch	VISAS
Hypochaeris radicata	rough cat's-ear	HYRA	**Groundcover Codes**		
Juncus balticus	Baltic rush	JUBA	BG	Bare Ground	
Juncus phaeocephalus	brown-headed rush	JUPH	TH	Thatch/Duff	
Luzula comosa	Pacific woodrush	LUCO6	AL	Algae	

Table A-3. Pond 997 (Reference) Wetland Vegetation Transect Data by Stratum

POND 997			
Date	6/6/2023		
Surveying Personnel	USACE		
Vegetation Type	**% Cover**	**Species**	**Notes**
Emergent Vegetation			
Floating Vegetation			
Submerged Vegetation			
Open Water			

Pond 997 exhibited peripheral ponding in December and held water from January through April (Chenega, 2024). Strata 1, 2, and 3 were repeated from 2017-2022. Stratum 5 was repeated from 2018-2020, whereas the corresponding transect was relocated to a more representative location. Transect 1 was repeated from 2017-2022, while Transects 3 and 5 were relocated to more representative locations within the corresponding strata. Stratum 2 consisted of CCG and no transects were placed in this stratum.

Transect #	Transect Length	Relative % Cover of Wetland	Quadrat #1		Quadrat #2		Quadrat #3	
			Species	% Cover	Species	% Cover	Species	% Cover
1	5 m		ERAR12	5	ERAR12	10	ERAR12	25
			ISHO	29	ISHO	15	ISHO	20
			JUPH	5	JUPH	5	JUPH	5
			PLCHH	20	PLCHH	15	PLCHH	15
			POMO	10	POMO	5	PSCH	5
			PSCH	20	PSCH	25	TH	15
			TH	10	TH	20	BG	15
			BG	1	BG	5		
			TOTAL	**100**	**TOTAL**	**100**	**TOTAL**	**100**

Transect #	Transect Length	Relative % Cover of Wetland	Quadrat #1		Quadrat #2		Quadrat #3		Quadrat #4		Quadrat #5		Quadrat #6	
			Species	% Cover	Species	% Cover	Species	% Cover	Species	% Cover	Species	% Cover	Species	% Cover
3	10 m		BRMA	15	BRMA	5	BRMA	10	BRDI	5	BRDI	5	BRMA	5
			ERAR12	5	CAAT	5	ERAR12	20	BRMA	11	BRMA	15	BRMI	3
			FEBR	10	ERAR12	5	ERBO	3	BRTET	3	DACA	1	BRTET	5
			GEDI	2	ERBO	5	FEBR	5	DACA	3	ERAR12	5	CAAT	2
			ISHO	15	GEDI	3	GEDI	2	ELACA	23	ERBO	1	ERBO	10
			JUBUB	10	HYGL	11	ISHO	15	ERAR12	5	ISHO	15	JUBUB	15
			JUPH	3	ISHO	11	JUBUB	5	ERBO	5	JUBUB	5	JUCA	25
			LYHY	20	JUBUB	5	LYHY	25	JUBUB	5	JUCA	20	JUPH	15
			PLCO	10	JUPH	11	RUAC	3	LYHY	11	LYHY	10	LYHY	5
			TH	10	LYHY	17	TH	10	MIPA	5	PLCO	3	MIPA	5
					PLCO	11	BG	2	UNK4	10	TH	20	PLCO	5
					RUAC	1			TH	11			TH	3
					TH	5			BG	5			BG	2
					BG	5								
			TOTAL	**100**	**TOTAL**	**100**	**TOTAL**	**100**	**TOTAL**	**102**	**TOTAL**	**100**	**TOTAL**	**100**

Transect #	Transect Length	Relative % Cover of Wetland	Quadrat #1		Quadrat #2		Quadrat #3	
			Species	% Cover	Species	% Cover	Species	% Cover
5	5 m		BRMA	16	BRMA	15	BRMA	40
			BRMI	5	GEDI	1	ERBO	1
			BRTET	1	HYGL	2	HYGL	4
			CAAT	1	JUPH	15	JUPH	15
			GAPO	1	LYAR	2	LYAR	10
			HYGL	11	LYHY	25	LYHY	5
			JUBUB	16	TRDU	15	SIMAM	5
			JUPH	5	TH	25	TH	20
			LYAR	5				
			LYHY	5				
			MIPA	1				
			PLCO	16				
			TRDU	1				
			TH	11				
			BG	5				
			TOTAL	**100**	**TOTAL**	**100**	**TOTAL**	**100**

Pond 997 2023 Species List

Species Name	Common Name	Species Code	Species Name	Common Name	Species Code
Achillea millefolium	common yarrow	ACMI	*Lasthenia conjugens*	Contra Costa goldfields	LACO
Aira caryophyllea	silvery hair-grass	AICA	*Leptosiphon parviflorus*	variable linanthus	LEPA
Avena barbata	slender wild oat	AVBA	*Lupinus nanus*	sky lupine	LUNA
Baccharis pilularis	coyote brush	BAPI	*Lysimachia arvensis*	scarlet pimpernel	LYAR
Briza maxima	rattlesnake grass	BRMA	*Lythrum hyssopifolia*	grass poly	LYHY
Briza minor	annual quaking grass	BRMI	*Microseris paludosa*	marsh microseris	MIPA
Brodiaea terrestris ssp. terrestris	dwarf brodiaea	BRTET	*Plagiobothrys chorisianus* var. hickmanii	Hickman's popcornflower	PLCHH
Bromus diandrus	ripgut grass	BRDI	*Plantago coronopus*	cut-leaved plantain	PLCO
Castilleja ambigua ssp. ambigua	Johnny-Nip	CAAMA3	*Polypogon monspeliensis*	rabbitfoot grass	POMO
Castilleja attenuata	valley tassels	CAAT	*Pseudognaphalium luteoalbum*	weedy cudweed	PSLU
Cotula coronopifolia	brass buttons	COCO	*Psilocarphus chilensis*	round woolly-marbles	PSCH
Danthonia californica	California oat grass	DACA	*Quercus agrifolia*	coast live oak	QUAG
Deinandra corymbosa	coastal tarweed	DECO	*Rumex acetosella*	sheep sorrel	RUAC
Diplacus aurantiacus	sticky monkey flower	DIAU	*Sidalcea malviflora* ssp. malviflora	checkerbloom	SIMAM
Eleocharis acicularis var. acicularis	needle spikerush	ELACA	*Silene gallica*	small-flower catchfly	SIGA
Erodium botrys	long-beaked filaree	ERBO	*Sisyrinchium bellum*	western blue-eyed grass	SIBE
Eryngium armatum	coyote thistle	ERAR12	*Toxicodendron diversilobum*	poison oak	TODI
Eschscholzia californica	California poppy	ESCA	*Triphysaria pusilla*	little owl's clover	TRPU
Festuca bromoides	brome fescue	FEBR	*Triteleia ixioides*	coast pretty face	TRIX
Festuca perennis	Italian rye grass	FEPE	Unknown 4		UNK4
Galium porrigens	climbing bedstraw	GAPO	*Vicia sativa* ssp. nigra	common vetch	VISAN
Geranium dissectum	cut-leaved geranium	GEDI	*Vicia sativa* ssp. sativa	spring vetch	VISAS
Hypochaeris glabra	smooth cat's-ear	HYGL	**Groundcover Codes**		
Isoetes howellii	Howell's quillwort	ISHO	BG	Bare Ground	
Juncus bufonius var. bufonius	common toad rush	JUBUB	TH	Thatch/Duff	
Juncus capitatus	dwarf rush	JUCA	AL	Algae	
Juncus phaeocephalus	brown-headed rush	JUPH			

Table A-4. Pond 21 (Year 1 Post-Mastification and Post-Subsurface Munitions Remediation) Wetland Vegetation Transect Data by Stratum

POND 21			
Date	7/17/2023, 9/30/2023		
Surveying Personnel	USACE		
Vegetation Type	**% Cover**	**Species**	**Notes**
Emergent Vegetation			
Floating Vegetation			
Submerged Vegetation			
Open Water			
Pond 21 held water from January to June 2023 (Chenega, 2024). Strata 1 and 2 and the corresponding transects were repeated from 2019. Stratum 3 was identified, and the corresponding transect was established in 2023.			

Transect #	Transect Length	Relative % Cover of Wetland	Quadrat #1		Quadrat #2		Quadrat #3	
			Species	% Cover	Species	% Cover	Species	% Cover
1	5 m		ERAR12	60	ERAR12	30	ERAR12	55
			JUPH	3	JUPH	24	JUPH	15
			PLCHH	1	PLCHH	1	PLCHH	1
			POMO	30	POMO	25	POMO	9
			RACA	1	TH	20	TH	20
			TH	5				
			TOTAL	**100**	**TOTAL**	**100**	**TOTAL**	**100**

Transect #	Transect Length	Relative % Cover of Wetland	Quadrat #1		Quadrat #2		Quadrat #3		Quadrat #4		Quadrat #5		Quadrat #6	
			Species	% Cover	Species	% Cover	Species	% Cover	Species	% Cover	Species	% Cover	Species	% Cover
2	10 m		ELMA	5	JUPH	60	ELMA	5	JUPH	70	ELMA	5	ELMA	46
			ERAR12	25	ERAR12	30	GEDI	2	LYHY	1	ERAR12	40	JUPH	45
			HOBRB	5	POMO	1	HOBRB	1	MALE	1	JUPH	45	MALE	1
			JUPH	55	HOBRB	1	JUPH	65	POMO	2	MALE	2	PLCHH	2
			PLCHH	2	TH	8	POMO	15	TH	26	PLCHH	3	POMO	2
			POMO	3			RACA	2			TH	5	TH	1
			TH	5			TH	7					BG	3
							BG	3						
			TOTAL	**100**	**TOTAL**	**100**	**TOTAL**	**100**	**TOTAL**	**100**	**TOTAL**	**100**	**TOTAL**	**100**

Transect #	Transect Length	Relative % Cover of Wetland	Quadrat #1		Quadrat #2		Quadrat #3	
			Species	% Cover	Species	% Cover	Species	% Cover
3	5 m		ACMI	3	BAPI	10	BAPI	4
			BAPI	1	BRMI	1	BRMI	5
			BRMI	12	CABA	42	CABA	40
			CABA	15	DECO	2	POMO	1
			DECO	44	FEBR	2	TH	50
			VELAL	2	JUBUB	2		
			TH	23	LYAR	1		
					TH	30		
					BG	10		
			TOTAL	**100**	**TOTAL**	**100**	**TOTAL**	**100**

Pond 21 2023 Species List

Species Name	Common Name	Species Code	Species Name	Common Name	Species Code
Achillea millefolium	common yarrow	ACMI	*Juncus phaeocephalus*	brown-headed rush	JUPH
Acmispon americanus var. americanus	Spanish lotus	ACAMA	*Lasthenia glaberrima*	smooth goldfields	LAGL3
Aira caryophyllea	silvery hair-grass	AICA	*Lysimachia arvensis*	scarlet pimpernel	LYAR
Arctostaphylos hookeri	Hooker's manzanita	ARHO	*Lythrum hyssopifolia*	grass poly	LYHY
Avena barbata	slender wild oat	AVBA	*Madia gracilis*	gumweed	MAGR
Baccharis pilularis	coyote brush	BAPI	*Madia sativa*	coast tarweed	MASA
Briza minor	annual quaking grass	BRMI	*Malvella leprosa*	alkali mallow	MALE
Bromus hordeaceus	soft chess	BRHO	*Phalaris lemmonii*	Lemmon's canary grass	PHLE
Carex barbarae	whiteroot	CABA	*Plagiobothrys chorisianus* var. hickmanii	Hickman's popcornflower	PLCHH
Clinopodium douglasii	yerba buena	CLDO	*Pogogyne zizyphoroides*	Sacramento mesa mint	POZI
Crassula aquatica	aquatic pygmy-weed	CRAQ	*Polypogon monspeliensis*	rabbitfoot grass	POMO
Deinandra corymbosa	coastal tarweed	DECO	*Quercus agrifolia*	coast live oak	QUAG
Eleocharis acicularis var. acicularis	needle spikerush	ELACA	*Ranunculus californicus*	California buttercup	RACA
Eleocharis macrostachya	pale spikerush	ELMA	*Rumex acetosella*	sheep sorrel	RUAC
Eryngium armatum	coyote thistle	ERAR12	*Rumex salicifolius*	willow dock	RUSA
Festuca bromoides	brome fescue	FEBR	*Senecio glomeratus*	cutleaf burnweed	SEGL
Geranium dissectum	cut-leaved geranium	GEDI	*Sisyrinchium bellum*	western blue-eyed grass	SIBE
Heliotropium curassavicum var. oculatum	Chinese pusley	HECUO	*Sonchus asper*	prickly sow thistle	SOAS
Heteromeles arbutifolia	toyon	HEAR	*Toxicodendron diversilobum*	poison oak	TODI
Hordeum brachyantherum	meadow barley	HOBR	*Triodanis biflora*	Venus' looking glass	TRBI2
Horkelia cuneata var. cuneata	wedge-leaved horkelia	HOCUC	*Verbena lasiostachys* var. lasiostachys	western vervain	VELAL
Hypochaeris glabra	smooth cat's-ear	HYGL	**Groundcover Codes**		
Hypochaeris radicata	rough cat's-ear	HYRA	BG	Bare Ground	
Juncus bufonius var. bufonius	common toad rush	JUBUB	TH	Thatch/Duff	
Juncus occidentalis	western rush	JUOC	AL	Algae	
Juncus patens	spreading rush	JUPA			

Table A-5. Pond 76 (Year 1 Post-Mastification) Wetland Vegetation Transect Data by Stratum

POND 76			
Date	6/9/2023		
Surveying Personnel	USACE		
Vegetation Type	**% Cover**	**Species**	**Notes**
Emergent Vegetation			
Floating Vegetation			
Submerged Vegetation			
Open Water			
Notes			
Pond 76 held water from January to June 2023 (Chenega, 2024). Strata 1, 2, and 3 and the corresponding transects were established in 2023.			

Transect #	Transect Length	Relative % Cover of Wetland	Quadrat #1		Quadrat #2		Quadrat #3		Quadrat #4	
			Species	% Cover	Species	% Cover	Species	% Cover	Species	% Cover
1	5 m		ELACA	20	ELACA	30	DEDA	1	ELACA	5
			ELMA	5	ERAR12	5	ELACA	22	JUPH	40
			ERAR12	10	JUPH	20	ERAR12	10	PLCHH	5
			PLCHH	15	PLCHH	20	JUPH	20	TH	10
			POMO	10	TRSC	5	LYHY	1	BG	40
			TRSC	10	TH	10	PLCHH	15		
			TH	10	BG	10	TRSC	1		
			BG	20			TH	20		
							BG	10		
			TOTAL	**100**	**TOTAL**	**100**	**TOTAL**	**100**	**TOTAL**	**100**

Transect #	Transect Length	Relative % Cover of Wetland	Quadrat #1		Quadrat #2		Quadrat #3		Quadrat #4		Quadrat #5		Quadrat #6	
			Species	% Cover	Species	% Cover	Species	% Cover	Species	% Cover	Species	% Cover	Species	% Cover
2	10 m		DEDA	1	ELACA	15	ERAR12	25	BAPI	1	BAPI	3	ELACA	17
			ELACA	2	ERAR12	25	JUPH	30	ELACA	10	ELACA	10	ERAR12	15
			ERAR12	5	JUPH	15	TH	15	ERAR12	10	ERAR12	5	JUPH	25
			ISHO	2	TH	15	BG	30	ISHO	5	ISHO	1	LYHY	2
			JUPH	45	BG	30			JUPH	23	JUPH	45	PLCHH	1
			TH	5					PLCHH	1	PLCHH	1	TRSC	15
			BG	40					TH	30	TRSC	5	TH	15
									BG	20	TH	25	BG	10
											BG	5		
			TOTAL	**100**	**TOTAL**	**100**	**TOTAL**	**100**	**TOTAL**	**100**	**TOTAL**	**100**	**TOTAL**	**100**

Transect #	Transect Length	Relative % Cover of Wetland	Quadrat #1		Quadrat #2		Quadrat #3	
			Species	% Cover	Species	% Cover	Species	% Cover
3	5 m		AGEX	5	AGEX	5	AICA	7
			AICA	3	BAPI	5	AR sp.	10
			BAPI	1	BRMI	10	BAPI	5
			ERAR12	1	ELACA	10	BRMI	8
			FEMY	1	ERAR12	5	FEBR	5
			GAPO	3	FEMY	3	FEMY	2
			HYGL	2	JUBA	5	JUBA	1
			LYHY	2	JUPH	2	JUOC	1
			MAEX	1	LYHY	5	LYAR	1
			TRMI	1	POMO	10	POMO	45
			TH	50	TH	25	TH	10
			BG	30	BG	15	BG	5
			TOTAL	**100**	**TOTAL**	**100**	**TOTAL**	**100**

Pond 76 2023 Species List

Species Name	Common Name	Species Code	Species Name	Common Name	Species Code
Acmispon americanus var. americanus	Spanish lotus	ACAMA	*Juncus balticus*	Baltic rush	JUBA
Acmispon parviflorus	hill lotus	ACPA	*Juncus occidentalis*	western rush	JUOC
Agrostis exarata	spike bent grass	AGEX	*Juncus phaeocephalus*	brown-headed rush	JUPH
Aira caryophyllea	silvery hair-grass	AICA	*Lysimachia arvensis*	scarlet pimpernel	LYAR
Arctostaphylos sp.	manzanita	AR sp.	*Lythrum hyssopifolia*	grass poly	LYHY
Baccharis pilularis	coyote brush	BAPI	*Madia exigua*	small tarweed	MAEX
Briza minor	annual quaking grass	BRMI	*Plagiobothrys chorisianus* var. hickmanii	Hickman's popcornflower	PLCHH
Deschampsia danthonioides	annual hair grass	DEDA	*Polypogon monspeliensis*	rabbitfoot grass	POMO
Diplacus aurantiacus	sticky monkey flower	DIAU	*Quercus agrifolia*	coast live oak	QUAG
Drymocallis glandulosa var. wrangelliana	sticky cinquefoil	DRGLW	*Sisyrinchium bellum*	western blue-eyed grass	SIBE
Eleocharis acicularis var. acicularis	needle spikerush	ELACA	*Sonchus oleraceus*	common sow thistle	SOOL
Eleocharis macrostachya	pale spikerush	ELMA	*Trifolium microcephalum*	small head clover	TRMI
Eryngium armatum	coyote thistle	ERAR12	*Triglochin scilloides*	flowering quillwort	TRSC
Festuca bromoides	brome fescue	FEBR	*Zeltnera davyi*	Davy's centuary	ZEDA
Festuca myuros	rattail sixweeks grass	FEMY	**Groundcover Codes**		
Galium porrigens	climbing bedstraw	GAPO	BG	Bare Ground	
Hypochaeris glabra	smooth cat's-ear	HYGL	TH	Thatch/Duff	
Hypochaeris radicata	rough cat's-ear	HYRA	AL	Algae	
Isoetes howellii	Howell's quillwort	ISHO			

Table A-6. Pond 3 North (Year 5 Post-Subsurface Munitions Remediation) Wetland Vegetation Transect Data by Stratum

POND 3 North			
Date	6/26/2023, 7/21/2023		
Surveying Personnel	USACE		
Vegetation Type	**% Cover**	**Species**	**Notes**
Emergent Vegetation			
Floating Vegetation			
Submerged Vegetation			
Open Water			
Notes			
Pond 3 North had peripheral ponding in December through February of the 2022-2023 water-year. Pond 3 North was hydrologically connected to Pond 3 South by March and remained inundated until June 2023 (Chenega, 2024). Stratum 1 was repeated from 2015, 2018, and 2020. Strata 2 and 3 were repeated from 2015 and 2018-2021. Stratum 4 was repeated from 2018-2021. Transects 1, 2, and 3 were all relocated because the previous locations were no longer within the corresponding strata. Stratum 4 consisted of CCG so no transects were placed in this stratum.			

Transect #	Transect Length	Relative % Cover of Wetland	Quadrat #1		Quadrat #2		Quadrat #3		Quadrat #4		Quadrat #5		Quadrat #6	
			Species	% Cover	Species	% Cover	Species	% Cover	Species	% Cover	Species	% Cover	Species	% Cover
1	10 m		ELACA	5	ELACA	1	ELMA	99	ELMA	95	ELMA	95	ELACA	2
			ELMA	95	ELMA	93	TH	1	TH	5	TH	5	ELMA	93
					BG	1							TH	5
					TH	5								
			TOTAL	**100**	**TOTAL**	**100**	**TOTAL**	**100**	**TOTAL**	**100**	**TOTAL**	**100**	**TOTAL**	**100**

Transect #	Transect Length	Relative % Cover of Wetland	Quadrat #1		Quadrat #2		Quadrat #3	
			Species	% Cover	Species	% Cover	Species	% Cover
2	5 m		BRMI	1	AICA	1	AICA	3
			DECO	25	BRMI	1	BRMI	5
			FEBR	1	CAAM	5	DECO	5
			JUBUB	15	FEBR	5	DEDA	10
			LYHY	25	FEPE	1	ERAR12	5
			PLCO	15	JUBUB	15	FEBR	4
			TRAN	10	LEPA	2	JUBUB	15
			TH	8	LYHY	15	JUCA	5
					PLCO	20	JUPH	5
					TRAN	5	LEPA	3
					ZEDA	5	LYHY	7
					TH	10	PLCO	20
					BG	15	TRAN	3
							BG	7
							TH	3
			TOTAL	**100**	**TOTAL**	**100**	**TOTAL**	**100**

Transect #	Transect Length	Relative % Cover of Wetland	Quadrat #1		Quadrat #2		Quadrat #3	
			Species	% Cover	Species	% Cover	Species	% Cover
3	5 m		AICA	1	AICA	3	AICA	3
			DECO	50	DECO	35	DECO	25
			FEPE	5	FEPE	5	FEPE	10
			TRAN	20	PLCO	15	PLCO	7
			TH	20	TRAN	25	TRAN	25
			BG	4	TH	12	TH	25
					BG	5	BG	5
			TOTAL	**100**	**TOTAL**	**100**	**TOTAL**	**100**

Pond 3 North 2023 Species List

Species Name	Common Name	Species Code	Species Name	Common Name	Species Code
Achillea millefolium	common yarrow	ACMI	*Lysimachia arvensis*	scarlet pimpernel	LYAR
Aira caryophyllea	silvery hair-grass	AICA	*Lythrum hyssopifolia*	grass poly	LYHY
Avena barbata	slender wild oat	AVBA	*Madia sativa*	coast tarweed	MASA
Baccharis pilularis	coyote brush	BAPI	*Microseris paludosa*	marsh microseris	MIPA
Briza minor	annual quaking grass	BRMI	*Plagiobothrys chorisianus* var. hickmanii	Hickman's popcornflower	PLCHH
Brodiaea terrestris ssp. terrestris	dwarf brodiaea	BRTET	*Plantago coronopus*	cut-leaved plantain	PLCO
Castilleja ambigua ssp. ambigua	Johnny-Nip	CAAMA3	*Polypogon monspeliensis*	rabbitfoot grass	POMO
Centaurea melitensis	Maltese star-thistle	CEME	*Rumex crispus*	curly dock	RUCR
Cotula coronopifolia	brass buttons	COCO	*Schoenoplectus californicus*	California bulrush	SCCA
Danthonia californica	California oat grass	DACA	*Sidalcea malviflora* ssp. malviflora	checkerbloom	SIMAM
Deinandra corymbosa	coastal tarweed	DECO	*Silene gallica*	small-flower catchfly	SIGA
Deschampsia danthonioides	annual hair grass	DEDA	*Sisyrinchium bellum*	western blue-eyed grass	SIBE
Eleocharis acicularis var. acicularis	needle spikerush	ELACA	*Trifolium angustifolium*	narrow-leaved clover	TRAN
Eleocharis macrostachya	pale spikerush	ELMA	*Trifolium dubium*	little hop clover	TRDU
Eryngium armatum	coyote thistle	ERAR12	*Trifolium variegatum*	variegated clover	TRVA
Festuca bromoides	brome fescue	FEBR	*Triteleia hyacinthina*	white brodiaea	TRHY3
Festuca perennis	Italian rye grass	FEPE	*Vicia sativa* ssp. nigra	common vetch	VISAN
Juncus bufonius var. bufonius	common toad rush	JUBUB	*Vicia sativa* ssp. sativa	spring vetch	VISAS
Juncus capitatus	dwarf rush	JUCA	*Zeltnera davyi*	Davy's centuary	ZEDA
Juncus occidentalis	western rush	JUOC	**Groundcover Codes**		
Juncus phaeocephalus	brown-headed rush	JUPH	BG	Bare Ground	
Lasthenia conjugens	Contra Costa goldfields	LACO	TH	Thatch/Duff	
Leptosiphon parviflorus	variable linanthus	LEPA	AL	Algae	

Table A-7. Pond 3 South (Year 5 Post-Subsurface Munitions Remediation) Wetland Vegetation Transect Data by Stratum

POND 3 South			
Date	6/26/2023		
Surveying Personnel	USACE		
Vegetation Type	**% Cover**	**Species**	**Notes**
Emergent Vegetation			
Floating Vegetation			
Submerged Vegetation			
Open Water			
Notes			
Pond 3 South had peripheral ponding in December through February of the 2022-2023 water-year. Pond 3 South was hydrologically connected to Pond 3 North by March and remained inundated until June 2023 (Chenega, 2024). Strata 1, 2, and 3 were repeated from 2016 and 2018-2021. Stratum 5 was repeated from 2020 and 2021. Transect 1 and 2 were relocated to more representative locations. Transect 3 was moved because the previous location was no longer within the stratum. Stratum 5 consisted of CCG so no transects were placed in this stratum.			

Transect #	Transect Length	Relative % Cover of Wetland	Quadrat #1		Quadrat #2		Quadrat #3		Quadrat #4		Quadrat #5		Quadrat #6	
			Species	% Cover	Species	% Cover	Species	% Cover	Species	% Cover	Species	% Cover	Species	% Cover
1	10 m		ELMA	25	ERAR12	25	JUPH	5	DEDA	15	DEDA	15	DEDA	25
			ERAR12	40	ELMA	40	DEDA	15	ELACA	15	ELMA	20	ELMA	15
			LAGL3	5	JUPH	5	ELMA	20	ELMA	10	ERAR12	20	ERAR12	20
			PLCHH	15	LAGL3	5	ERAR12	30	ERAR12	20	JUPH	10	JUPH	10
			TH	5	PLCHH	5	LAGL3	5	JUPH	5	LAGL3	5	LAGL3	5
			BG	10	TH	5	PLCHH	10	LAGL3	5	LYAR	5	PLCHH	10
					BG	15	TH	10	PLCHH	10	PLCHH	10	TH	10
							BG	5	POMO	5	TH	10	BG	5
									TH	10	BG	5		
									BG	5				
			TOTAL	**100**	**TOTAL**	**100**	**TOTAL**	**100**	**TOTAL**	**100**	**TOTAL**	**100**	**TOTAL**	**100**

Transect #	Transect Length	Relative % Cover of Wetland	Quadrat #1		Quadrat #2		Quadrat #3	
			Species	% Cover	Species	% Cover	Species	% Cover
2	5 m		BRMI	3	AICA	1	AICA	10
			ELACA	22	BRMI	1	BRMI	2
			ERAR12	10	CAAM	10	CAAMA3	10
			JUBUB	10	DECO	1	DECO	3
			JUPH	10	ELACA	1	JUBUB	5
			LYHY	10	JUBUB	10	JUPH	20
			PLCO	8	JUBUC2	1	LYAR	5
			POMO	5	JUCA	3	LYMI	10
			ZEDA	10	JUPH	10	PLCO	5
			TH	2	LYAR	1	TRAN	20
			BG	10	LYHY	5	ZEDA	5
					PLCO	5	BG	5
					ZEDA	1		
					TH	5		
					BG	45		
			TOTAL	**100**	**TOTAL**	**100**	**TOTAL**	**100**

Transect #	Transect Length	Relative % Cover of Wetland	Quadrat #1		Quadrat #2		Quadrat #3		Quadrat #4		Quadrat #5		Quadrat #6	
			Species	% Cover	Species	% Cover	Species	% Cover	Species	% Cover	Species	% Cover	Species	% Cover
			BRMI	15	BAPI	5	BRMI	10	BRHO	5	BRMI	10	BRHO	11
			DECO	10	BRMI	10	BRTET	5	BRMI	10	BRTET	5	BRMI	11
			FEPE	25	DECO	10	DECO	5	DECO	10	DECO	10	DECO	5
			GEDI	5	FEPE	10	FEPE	15	ELMA	10	FEPE	15	FEPE	21
			JUPH	5	GEDI	5	GEDI	5	FEPE	10	GEDI	5	GEDI	5
			LYAR	5	JUPH	5	JUPH	15	GEDI	5	HOBRB	5	HYRA	5
			LYHY	5	LYHY	10	LYHY	20	JUPH	5	JUPH	5	JUPH	11
3	10 m		MALE	5	MALE	5	MALE	5	LYAR	5	LYHY	10	LYHY	5
			PEDU	5	MIPA	5	PEDU	5	LYHY	10	MALE	5	MALE	5
			STPU	10	PEDU	5	RACA	5	MIPA	5	PEDU	5	STPU	11
			TH	5	RACA	5	TRAN	5	SIGA	10	SIGA	5	TH	5
			BG	5	STPU	10	BG	5	STPU	10	TH	5	BG	5
					ZEDA	5			BG	5	BG	15		
					TH	5								
					BG	5								
			TOTAL	**100**	**TOTAL**	**100**	**TOTAL**	**100**	**TOTAL**	**100**	**TOTAL**	**100**	**TOTAL**	**100**

Pond 3 South 2023 Species List

Species Name	Common Name	Species Code
Achillea millefolium	common yarrow	ACMI
Acmispon americanus var. americanus	Spanish lotus	ACAMA
Acmispon parviflorus	hill lotus	ACPA
Adenostoma fasciculatum	chamise	ADFA
Agrostis exarata	spike bent grass	AGEX
Aira caryophyllea	silvery hair-grass	AICA
Arctostaphylos hookeri	Hooker's manzanita	ARHO
Avena barbata	slender wild oat	AVBA
Baccharis pilularis	coyote brush	BAPI
Briza maxima	rattlesnake grass	BRMA
Briza minor	annual quaking grass	BRMI
Brodiaea terrestris ssp. terrestris	dwarf brodiaea	BRTET
Bromus diandrus	ripgut grass	BRDI
Bromus hordeaceus	soft chess	BRHO
Carpobrotus edulis	ice plant	CAED
Castilleja ambigua ssp. ambigua	Johnny-Nip	CAAMA3
Cotula coronopifolia	brass buttons	COCO
Danthonia californica	California oat grass	DACA
Deinandra corymbosa	coastal tarweed	DECO
Deschampsia danthonioides	annual hair grass	DEDA
Diplacus aurantiacus	sticky monkey flower	DIAU
Eleocharis acicularis var. acicularis	needle spikerush	ELACA
Eleocharis macrostachya	pale spikerush	ELMA
Eryngium armatum	coyote thistle	ERAR12
Festuca perennis	Italian rye grass	FEPE
Geranium dissectum	cut-leaved geranium	GEDI
Heteromeles arbutifolia	toyon	HEAR
Hordeum brachyantherum ssp. brachyantherum	meadow barley	HOBRB
Horkelia cuneata	wedge-leaved horkelia	HOCU
Hypochaeris glabra	smooth cat's-ear	HYGL
Hypochaeris radicata	rough cat's-ear	HYRA
Juncus bufonius var. bufonius	common toad rush	JUBUB
Juncus bufonius var. congestus	clustered toad rush	JUBUC2
Juncus bufonius var. occidentalis	round-fruited toad rush	JUBUO
Juncus capitatus	dwarf rush	JUCA
Juncus occidentalis	western rush	JUOC
Juncus phaeocephalus	brown-headed rush	JUPH
Lasthenia conjugens	Contra Costa goldfields	LACO
Lasthenia glaberrima	smooth goldfields	LAGL3
Lupinus nanus	sky lupine	LUNA
Lysimachia arvensis	scarlet pimpernel	LYAR
Lythrum hyssopifolia	grass poly	LYHY
Lysimachia minima	chaffweed	LYMI
Madia sativa	coast tarweed	MASA
Malvella leprosa	alkali mallow	MALE
Microseris paludosa	marsh microseris	MIPA
Petrorhagia dubia	hairypink	PEDU
Plagiobothrys chorisianus var. hickmanii	Hickman's popcornflower	PLCHH
Plantago coronopus	cut-leaved plantain	PLCO
Plantago lanceolata	English plantain	PLLA
Polypogon monspeliensis	rabbitfoot grass	POMO
Ranunculus californicus	California buttercup	RACA
Rubus ursinus	California blackberry	RUUR
Rumex crispus	curly dock	RUCR
Senecio glomeratus	cutleaf burnweed	SEGL
Sidalcea malviflora ssp. malviflora	checkerbloom	SIMAM
Silene gallica	small-flower catchfly	SIGA
Sisyrinchium bellum	western blue-eyed grass	SIBE
Stipa pulchra	purple needle grass	STPU
Taraxia ovata	sun cups	TAOV
Toxicodendron diversilobum	poison oak	TODI
Trifolium angustifolium	narrow-leaved clover	TRAN
Trifolium campestre	hop clover	TRCA5
Trifolium willdenovii	tomcat clover	TRWI
Triteleia hyacinthina	white brodiaea	TRHY3
Triteleia ixioides	coast pretty face	TRIX
Zeltnera davyi	Davy's centuary	ZEDA
Groundcover Codes		
BG	Bare Ground	
TH	Thatch/Duff	
AL	Algae	

Table A-8. Pond 35 (Year 5 Post-Subsurface Munitions Remediation) Wetland Vegetation Transect Data by Stratum

POND 35			
Date	5/30/2023, 5/31/2023		
Surveying Personnel	USACE		
Vegetation Type	**% Cover**	**Species**	**Notes**
Emergent Vegetation			
Floating Vegetation			
Submerged Vegetation			
Open Water			
Notes			
Pond 35 held water from January through April 2023 (Chenega, 2024). Strata 1 and 2 and the corresponding transects were repeated from 2016 and 2018-2021. Stratum 3 was repeated from 2016, 2018, 2019, and 2021, and Stratum 4 was repeated from 2018-2021. Transect 3 was relocated because the previous location was no longer within the stratum. Transect 4 was repeated from 2019.			

Transect #	Transect Length	Relative % Cover of Wetland	Quadrat #1		Quadrat #2		Quadrat #3		Quadrat #4		Quadrat #5		Quadrat #6	
			Species	% Cover	Species	% Cover	Species	% Cover	Species	% Cover	Species	% Cover	Species	% Cover
1	10 m		LYHY	1	PLCHH	1	PLCHH	1	LYHY	1	PLCHH	2	COCO	1
			PLCHH	1	PLCO	74	PLCO	50	PLCHH	3	PLCO	75	PLCHH	5
			PLCO	83	PSCH	1	PSCH	5	PLCO	49	PSCH	3	PLCO	74
			PSCH	1	TRSC	8	TRSC	2	PSCH	5	TRSC	5	PSCH	5
			TRSC	10	TH	1	TH	5	TRSC	10	TH	10	TRSC	5
			TH	3	BG	15	BG	37	TH	2	BG	5	TH	5
			BG	1					BG	30			BG	5
			TOTAL	**100**	**TOTAL**	**100**	**TOTAL**	**100**	**TOTAL**	**100**	**TOTAL**	**100**	**TOTAL**	**100**

Transect #	Transect Length	Relative % Cover of Wetland	Quadrat #1		Quadrat #2		Quadrat #3		Quadrat #4		Quadrat #5		Quadrat #6	
			Species	% Cover	Species	% Cover	Species	% Cover	Species	% Cover	Species	% Cover	Species	% Cover
2	10 m		PLCO	44	PLCO	58	PLCO	43	PLCO	45	LYHY	1	PLCO	72
			PSCH	1	PSCH	1	PSCH	1	PSCH	1	PLCO	69	PSCH	1
			TH	30	TH	40	TR sp.	1	SO sp.	1	PSCH	1	TR sp.	1
			BG	25	BG	1	TH	15	TR sp.	1	TH	25	TH	25
							BG	40	TH	47	BG	4	BG	1
									BG	5				
			TOTAL	**100**	**TOTAL**	**100**	**TOTAL**	**100**	**TOTAL**	**100**	**TOTAL**	**100**	**TOTAL**	**100**

Transect #	Transect Length	Relative % Cover of Wetland	Quadrat #1		Quadrat #2		Quadrat #3		Quadrat #4		Quadrat #5		Quadrat #6	
			Species	% Cover	Species	% Cover	Species	% Cover	Species	% Cover	Species	% Cover	Species	% Cover
3	10 m		CEME	1	HOBR	84	AICA	1	ELMA	1	PLCO	1	AICA	1
			HOBR	57	LYHY	1	FEPE	84	FEPE	67	FEPE	39	BRTET	1
			HOBR	1	PLCO	5	LYHY	3	GEDI	1	GEDI	1	FEPE	63
			PLCHH	5	TH	5	PLCO	3	HOBR	1	HOBR	40	GEDI	1
			PLCO	15	BG	5	PSCH	1	PLCHH	20	HYGL	3	LYHY	3
			TH	20			TH	5	TH	8	LYHY	1	PLCO	10
			BG	1			BG	3	BG	2	TH	15	PSCH	1
													TH	20
			TOTAL	**100**	**TOTAL**	**100**	**TOTAL**	**100**	**TOTAL**	**100**	**TOTAL**	**100**	**TOTAL**	**100**

Transect #	Transect Length	Relative % Cover of Wetland	Quadrat #1		Quadrat #2		Quadrat #3	
			Species	% Cover	Species	% Cover	Species	% Cover
4	5 m		ELGL	5	ELGL	5	ELGL	5
			TRSC	5	PLCO	1	TH	95
			TH	90	TH	94		
			TOTAL	**100**	**TOTAL**	**100**	**TOTAL**	**100**

Pond 35 2023 Species List

Species Name	Common Name	Species Code	Species Name	Common Name	Species Code
Achillea millefolium	common yarrow	ACMI	*Plantago coronopus*	cut-leaved plantain	PLCO
Aira caryophyllea	silvery hair-grass	AICA	*Psilocarphus chilensis*	round woolly-marbles	PSCH
Briza minor	annual quaking grass	BRMI	*Quercus agrifolia*	coast live oak	QUAG
Brodiaea terrestris ssp. terrestris	dwarf brodiaea	BRTET	*Rumex acetosella*	sheep sorrel	RUAC
Carpobrotus edulis	ice plant	CAED	*Rumex crispus*	curly dock	RUCR
Centaurea melitensis	Maltese star-thistle	CEME	*Sidalcea malviflora* ssp. malviflora	checkerbloom	SIMAM
Cotula coronopifolia	brass buttons	COCO	*Sonchus sp.*	sow thistle	SO sp.
Cyperus eragrostis	tall cyperus	CYER	*Sonchus asper*	prickly sow thistle	SOAS
Eleocharis macrostachya	pale spikerush	ELMA	*Sonchus oleraceus*	common sow thistle	SOOL
Elymus glaucus	blue wild-rye	ELGL	*Taraxacum officinale*	dandelion	TAOF
Erodium botrys	long-beaked filaree	ERBO	*Toxicodendron diversilobum*	poison oak	TODI
Eryngium armatum	coyote thistle	ERAR12	*Trifolium sp.*	clover	TR sp.
Eschscholzia californica	California poppy	ESCA	*Trifolium angustifolium*	narrow-leaved clover	TRAN
Festuca perennis	Italian rye grass	FEPE	*Triglochin scilloides*	flowering quillwort	TRSC
Geranium dissectum	cut-leaved geranium	GEDI	*Vicia sativa* ssp. nigra	common vetch	VISAN
Heliotropium curassavicum var. oculatum	Chinese pusley	HECUO	*Vicia sativa* ssp. sativa	spring vetch	VISAS
Hordeum brachyantherum	meadow barley	HOBR	**Groundcover Codes**		
Hypochaeris glabra	smooth cat's-ear	HYGL	BG	Bare Ground	
Lysimachia arvensis	scarlet pimpernel	LYAR	TH	Thatch/Duff	
Lythrum hyssopifolia	grass poly	LYHY	AL	Algae	
Plagiobothrys chorisianus var. hickmanii	Hickman's popcornflower	PLCHH			

Table A-9. Pond 43 (Year 5 Post-Subsurface Munitions Remediation) Wetland Vegetation Transect Data by Stratum

POND 43			
Date	6/5/2023		
Surveying Personnel	USACE		
Vegetation Type	**% Cover**	**Species**	**Notes**
Emergent Vegetation			
Floating Vegetation			
Submerged Vegetation			
Open Water			
Notes			
Pond 43 held water from January through March 2023 (Chenega, 2024). Strata 1, 2, and 3 were repeated from 2016 and 2018-2021. Transect 1 was relocated to a more representative location. Transect 2 and 3 were moved because the previous locations were no longer within the respective strata.			

Transect #	Transect Length	Relative % Cover of Wetland	Quadrat #1		Quadrat #2		Quadrat #3		Quadrat #4		Quadrat #5		Quadrat #6	
			Species	% Cover	Species	% Cover	Species	% Cover	Species	% Cover	Species	% Cover	Species	% Cover
1	10 m		ERAR12	10	CRAQ	1	CRAQ	1	CRAQ	1	CRAQ	1	ELACA	1
			LYHY	2	ELACA	1	ERAR12	1	ELACA	2	ERAR12	3	JUPH	10
			PLCHH	35	ERAR12	15	LYHY	10	ERAR12	2	LYHY	4	LYHY	10
			POMO	3	JUPH	15	PLCHH	20	JUPH	2	PLCHH	75	LYMI	1
			PSCH	5	LYHY	2	POMO	10	LYHY	5	POMO	5	PLCHH	25
			TH	15	PLCHH	25	POZI	8	PLCHH	25	POZI	2	POMO	3
			BG	30	POMO	1	PSCH	10	POMO	2	TH	5	POZI	5
					POZI	1	TH	10	POZI	1	BG	5	PSCH	5
					PSCH	9	BG	30	PSCH	5			TH	10
					BG	15			TH	30			BG	30
					TH	15			BG	25				
			TOTAL	**100**	**TOTAL**	**100**	**TOTAL**	**100**	**TOTAL**	**100**	**TOTAL**	**100**	**TOTAL**	**100**

Transect #	Transect Length	Relative % Cover of Wetland	Quadrat #1		Quadrat #2		Quadrat #3	
			Species	% Cover	Species	% Cover	Species	% Cover
2	5 m		DEDA	3	DACA	1	BRMI	4
			ERAR12	5	ELACA	1	DACA	4
			JUBUB	2	ERAR12	5	ERAR12	10
			JUPH	30	JUBUB	1	JUBUB	10
			LYHY	40	JUOC	1	JUOC	2
			PLCHH	2	JUPH	10	JUPH	20
			POMO	3	LYHY	20	LYHY	5
			SIBE	5	PLCHH	9	PLCHH	5
			BG	10	POMO	10	POMO	5
					POZI	1	PSCH	10
					PSCH	5	SIBE	5
					SIBE	1	TH	15
					TH	20	BG	5
					BG	15		
			TOTAL	**100**	**TOTAL**	**100**	**TOTAL**	**100**

Transect #	Transect Length	Relative % Cover of Wetland	Quadrat #1		Quadrat #2		Quadrat #3	
			Species	% Cover	Species	% Cover	Species	% Cover
3	5 m		PLCO	35	AGEX	1	AGEX	5
			HYGL	30	AGLAV	10	BRHO	5
			ZEDA	5	BRHO	1	BRMI	2
			AGEX	10	DACA	5	ELGL	15
			ELGL	5	ELGL	1	HYGL	25
			DACA	5	HYGL	27	MAEX	3
			BG	10	JUBUB	28	MAGR	15
					JUPH	2	POMO	5
					LYHY	1	POZI	5
					PLCO	1	TH	15
					POMO	3	BG	5
					TH	15		
					BG	5		
			TOTAL	**100**	**TOTAL**	**100**	**TOTAL**	**100**

Pond 43 2023 Species List

Species Name	Common Name	Species Code
Adenostoma fasciculatum	chamise	ADFA
Agrostis exarata	spike bent grass	AGEX
Agrostis lacuna-vernalis	vernal pool bent grass	AGLAV
Aira caryophyllea	silvery hair-grass	AICA
Arctostaphylos hookeri	Hooker's manzanita	ARHO
Baccharis pilularis	coyote brush	BAPI
Briza minor	annual quaking grass	BRMI
Brodiaea terrestris ssp. terrestris	dwarf brodiaea	BRTET
Bromus hordeaceus	soft chess	BRHO
Ceanothus rigidus	Monterey ceanothus	CERI
Crassula aquatica	aquatic pygmy-weed	CRAQ
Danthonia californica	California oat grass	DACA
Deinandra corymbosa	coastal tarweed	DECO
Deschampsia danthonioides	annual hair grass	DEDA
Diplacus aurantiacus	sticky monkey flower	DIAU
Eleocharis acicularis var. acicularis	needle spikerush	ELACA
Elymus glaucus	blue wild-rye	ELGL
Eryngium armatum	coyote thistle	ERAR12
Festuca bromoides	brome fescue	FEBR
Geranium dissectum	cut-leaved geranium	GEDI
Horkelia cuneata var. cuneata	wedge-leaved horkelia	HOCUC
Hypochaeris glabra	smooth cat's-ear	HYGL
Juncus bufonius var. bufonius	common toad rush	JUBUB
Juncus bufonius var. congestus	clustered toad rush	JUBUC2
Juncus occidentalis	western rush	JUOC
Juncus phaeocephalus	brown-headed rush	JUPH
Lepechinia calycina	pitcher sage	LECA
Lysimachia arvensis	scarlet pimpernel	LYAR
Lysimachia minima	chaffweed	LYMI
Lythrum hyssopifolia	grass poly	LYHY
Madia exigua	small tarweed	MAEX
Madia gracilis	gumweed	MAGR
Plagiobothrys chorisianus var. hickmanii	Hickman's popcornflower	PLCHH
Plantago coronopus	cut-leaved plantain	PLCO
Pogogyne zizyphoroides	Sacramento mesa mint	POZI
Polypogon monspeliensis	rabbitfoot grass	POMO
Psilocarphus chilensis	round woolly-marbles	PSCH
Senecio glomeratus	cutleaf burnweed	SEGL
Sisyrinchium bellum	western blue-eyed grass	SIBE
Toxicodendron diversilobum	poison oak	TODI
Zeltnera davyi	Davy's centuary	ZEDA
Groundcover Codes		
BG	Bare Ground	
TH	Thatch/Duff	
AL	Algae	

Table A-10. Pond 44 (Year 5 Post-Subsurface Munitions Remediation) Wetland Vegetation Transect Data by Stratum

POND 44			
Date	6/5/2023		
Surveying Personnel	USACE		
Vegetation Type	**% Cover**	**Species**	**Notes**
Emergent Vegetation			
Floating Vegetation			
Submerged Vegetation			
Open Water			
Notes			
Pond 44 had peripheral ponding in December, held water from January through March, and was dry by April 2023. Strata 1, 2, and 3 were repeated from 2016 and 2018-2021. Transects 1-3 were all relocated to more representative locations.			

Transect #	Transect Length	Relative % Cover of Wetland	Quadrat #1		Quadrat #2		Quadrat #3		Quadrat #4		Quadrat #5		Quadrat #6	
			Species	% Cover	Species	% Cover	Species	% Cover	Species	% Cover	Species	% Cover	Species	% Cover
1	10 m		AGLAV	10	AGLAV	10	AGLAV	4	ERAR12	15	AGLAV	3	DEDA	3
			LYHY	10	ERAR12	5	ERAR12	2	JUPH	25	DACA	2	ERAR12	5
			PLCHH	15	LYHY	35	JUPH	1	PLCHH	20	ERAR12	10	LYHY	2
			POMO	10	PLCHH	15	LYHY	35	POMO	5	JUPH	10	PLCHH	70
			PSCH	5	POMO	5	PLCHH	15	PSCH	5	PLCHH	35	POMO	3
			TH	5	PSCH	10	POMO	3	TH	5	POMO	5	PSCH	5
			BG	45	BG	20	PSCH	5	BG	25	PSCH	5	TH	10
							TH	5			TH	5	BG	2
							BG	30			BG	25		
			TOTAL	**100**	**TOTAL**	**100**	**TOTAL**	**100**	**TOTAL**	**100**	**TOTAL**	**100**	**TOTAL**	**100**

Transect #	Transect Length	Relative % Cover of Wetland	Quadrat #1		Quadrat #2		Quadrat #3	
			Species	% Cover	Species	% Cover	Species	% Cover
2	5 m		POMO	10	BRTET	2	CAAT	5
			LYHY	10	ELACA	3	ERBO	15
			JUPH	5	ERBO	10	FEBR	3
			JUBUB	30	GEDI	1	HYGL	5
			TH	10	HYGL	3	JUBU	10
			BG	35	JUBUB	20	JUBUB	5
					JUBUC2	10	JUCA	5
					JUCA	3	LYHY	15
					LYHY	20	MAGR	5
					MAGR	2	POMO	2
					POMO	1	TRMI	5
					UNK36	1	TH	10
					TH	20	BG	15
					BG	4		
			TOTAL	**100**	**TOTAL**	**100**	**TOTAL**	**100**

Transect #	Transect Length	Relative % Cover of Wetland	Quadrat #1		Quadrat #2		Quadrat #3	
			Species	% Cover	Species	% Cover	Species	% Cover
3	5 m		BRMA	1	ACPA	2	ARCA11	1
			BRDI	1	BAPI	20	BRDI	1
			DACA	1	BRMA	1	CAAT	4
			ELGL	22	ERAR12	4	DEDA	25
			ERAR12	3	ERBO	1	ERBO	1
			GEDI	1	FEBR	1	FEBR	2
			HOCU	10	HYGL	2	HYGL	2
			JUOC	1	JUOC	1	LYAR	5
			LYAR	1	LYAR	2	MAGR	15
			PLCO	6	LYHY	1	PLCO	2
			TRDU	1	MAGR	1	TRAN	5
			UNK36	1	PLCO	4	TRDU	15
			Unknown Annual Grass	20	TRDU	4	TRDU	2
			VI sp.	10	TRDU	25	TH	5
			TH	20	VISAN	1	BG	15
			BG	1	TH	5		
					BG	25		
			TOTAL	**100**	**TOTAL**	**100**	**TOTAL**	**100**

Pond 44 2023 Species List

Species Name	Common Name	Species Code	Species Name	Common Name	Species Code
Acmispon parviflorus	hill lotus	ACPA	*Juncus bufonius* var. congestus	clustered toad rush	JUBUC2
Adenostoma fasciculatum	chamise	ADFA	*Juncus capitatus*	dwarf rush	JUCA
Agrostis lacuna-vernalis	vernal pool bent grass	AGLAV	*Juncus occidentalis*	western rush	JUOC
Aira caryophyllea	silvery hair-grass	AICA	*Juncus phaeocephalus*	brown-headed rush	JUPH
Arctostaphylos hookeri	Hooker's manzanita	ARHO	*Lysimachia arvensis*	scarlet pimpernel	LYAR
Arctostaphylos tomentosa	woolly leaf manzanita	ARTO	*Lythrum hyssopifolia*	grass poly	LYHY
Artemisia californica	California sagebrush	ARCA11	*Madia gracilis*	gumweed	MAGR
Avena barbata	slender wild oat	AVBA	*Madia sativa*	coast tarweed	MASA
Baccharis pilularis	coyote brush	BAPI	*Plagiobothrys chorisianus* var. hickmanii	Hickman's popcornflower	PLCHH
Briza maxima	rattlesnake grass	BRMA	*Plantago coronopus*	cut-leaved plantain	PLCO
Briza minor	annual quaking grass	BRMI	*Polypogon monspeliensis*	rabbitfoot grass	POMO
Brodiaea terrestris ssp. terrestris	dwarf brodiaea	BRTET	*Psilocarphus chilensis*	round woolly-marbles	PSCH
Bromus diandrus	ripgut grass	BRDI	*Quercus agrifolia*	coast live oak	QUAG
Bromus hordeaceus	soft chess	BRHO	*Silene gallica*	small-flower catchfly	SIGA
Calochortus albus	white globe lily	CAAL	*Sisyrinchium bellum*	western blue-eyed grass	SIBE
Castilleja attenuata	valley tassels	CAAT	*Toxicodendron diversilobum*	poison oak	TODI
Danthonia californica	California oat grass	DACA	*Tribolium obliterum*	Capetown grass	TROB
Deinandra corymbosa	coastal tarweed	DECO	*Trifolium angustifolium*	narrow-leaved clover	TRAN
Deschampsia danthonioides	annual hair grass	DEDA	*Trifolium campestre*	hop clover	TRCA5
Diplacus aurantiacus	sticky monkey flower	DIAU	*Trifolium dubium*	little hop clover	TRDU
Eleocharis acicularis var. acicularis	needle spikerush	ELACA	*Trifolium microcephalum*	small head clover	TRMI
Elymus glaucus	blue wild-rye	ELGL	*Triteleia ixioides*	coast pretty face	TRIX
Erodium botrys	long-beaked filaree	ERBO	Unknown Annual Grass		UNK Ann. Grass
Eryngium armatum	coyote thistle	ERAR12	Unknown 36		UNK36
Festuca bromoides	brome fescue	FEBR	*Vicia sp.*		VI sp.
Geranium dissectum	cut-leaved geranium	GEDI	*Vicia sativa* ssp. nigra	common vetch	VISAN
Horkelia cuneata	wedge-leaved horkelia	HOCU	*Zeltnera davyi*	Davy's centuary	ZEDA
Hypochaeris glabra	smooth cat's-ear	HYGL	**Groundcover Codes**		
Isoetes howellii	Howell's quillwort	ISHO	BG	Bare Ground	
Juncus bufonius	toad rush	JUBU	TH	Thatch/Duff	
Juncus bufonius var. bufonius	common toad rush	JUBUB	AL	Algae	

Table A-11. Pond 54 (Year 5 Post-Subsurface Munitions Remediation) Wetland Vegetation Transect Data by Stratum

POND 54			
Date	7/18/2023, 9/20/2023		
Surveying Personnel	USACE		
Vegetation Type	**% Cover**	**Species**	**Notes**
Emergent Vegetation			
Floating Vegetation			
Submerged Vegetation			
Open Water			
Notes			
Pond 54 exhibited peripheral ponding in December of the 2022-2023 water-year, after which it held water from January to June (Chenega, 2024). Stratum 1 was repeated from 2019 and 2021 whereas Strata 2, 3 and 4 and their corresponding transects were repeated from 2019. Transect 1 was relocated to a more representative location.			

Transect #	Transect Length	Relative % Cover of Wetland	Quadrat #1		Quadrat #2		Quadrat #3		Quadrat #4		Quadrat #5		Quadrat #6	
			Species	% Cover	Species	% Cover	Species	% Cover	Species	% Cover	Species	% Cover	Species	% Cover
1	10 m		ELMA	92	ELMA	90	ELMA	85	ELMA	93	ELMA	41	ELMA	10
			PLCHH	1	LAGL3	2	LAGL3	5	MALE	5	ISHO	6	ISHO	10
			POMO	1	LYHY	1	PLCHH	2	PLCHH	1	JUPH	1	JUPH	1
			TH	5	MALE	1	POMO	2	TH	1	LAGL3	5	MALE	1
			BG	1	PLCHH	1	TH	5			PLCHH	2	PLCHH	1
					POMO	2	BG	1			POMO	2	POMO	2
					STAJ	2					TH	2	STAJ	3
					TH	1					BG	41	TH	57
													BG	15
			TOTAL	**100**	**TOTAL**	**100**	**TOTAL**	**100**	**TOTAL**	**100**	**TOTAL**	**100**	**TOTAL**	**100**

Transect #	Transect Length	Relative % Cover of Wetland	Quadrat #1		Quadrat #2		Quadrat #3		Quadrat #4		Quadrat #5		Quadrat #6	
			Species	% Cover	Species	% Cover	Species	% Cover	Species	% Cover	Species	% Cover	Species	% Cover
2	10 m		HOBR	1	ELACA	47	ELMA	30	ELACA	53	ELMA	10	ELACA	44
			MALE	2	HOBR	2	HOBR	5	HOBR	5	ISHO	25	HOBR	1
			PLCHH	7	ISHO	10	MALE	5	ISHO	10	JUPH	5	HYRA	1
			ELACA	50	MALE	1	PLCHH	15	LYHY	1	PLCHH	5	ISHO	10
			POMO	10	POMO	5	POMO	30	POMO	20	POMO	35	JUPH	3
			TH	30	TH	30	TH	15	TH	10	TH	20	POMO	20
					BG	5			BG	1			STAJ	2
													TH	18
													BG	1
			TOTAL	**100**	**TOTAL**	**100**	**TOTAL**	**100**	**TOTAL**	**100**	**TOTAL**	**100**	**TOTAL**	**100**

Transect #	Transect Length	Relative % Cover of Wetland	Quadrat #1		Quadrat #2		Quadrat #3		Quadrat #4		Quadrat #5		Quadrat #6	
			Species	% Cover	Species	% Cover	Species	% Cover	Species	% Cover	Species	% Cover	Species	% Cover
3	10 m		ACMI	1	ACMI	2	ACMI	5	ELACA	30	ACMI	3	ACMI	2
			ELACA	71	ELACA	3	ELACA	30	ACMI	5	ELACA	15	ELACA	5
			GAUS	2	ERCA	5	ERAR12	4	ERAR12	5	ERAR12	4	ERAR12	1
			ISHO	1	GAUS	3	ERCA	3	GAUS	5	ERCA	1	ERCA	5
			JUBUB	2	HYGL	7	GAUS	5	ISHO	10	GAUS	1	GAUS	2
			JUPH	2	ISHO	23	ISHO	10	JUPH	10	ISHO	4	STAJ	3
			LYHY	5	JUPH	3	JUPH	10	LYHY	2	JUPH	5	TH	72
			POMO	1	LYHY	5	LYHY	5	LYMI	2	LYHY	2	BG	10
			TH	5	POMO	2	POMO	5	POMO	10	POMO	10		
			BG	10	BG	24	STAJ	3	BG	6	TH	25		
					TH	23	TH	15	TH	15	BG	30		
							BG	5						
			TOTAL	**100**	**TOTAL**	**100**	**TOTAL**	**100**	**TOTAL**	**100**	**TOTAL**	**100**	**TOTAL**	**100**

Transect #	Transect Length	Relative % Cover of Wetland	Quadrat #1		Quadrat #2		Quadrat #3	
			Species	% Cover	Species	% Cover	Species	% Cover
4	5 m		ACMI	2	BAPI	1	BAPI	1
			CABA	60	CABA	40	CABA	40
			RUSA	2	TH	59	VELAL	30
			SOOL	1			TH	29
			VELAL	5				
			TH	30				
			TOTAL	**100**	**TOTAL**	**100**	**TOTAL**	**100**

Pond 54 2023 Species List

Species Name	Common Name	Species Code	Species Name	Common Name	Species Code
Achillea millefolium	common yarrow	ACMI	*Lysimachia arvensis*	scarlet pimpernel	LYAR
Acmispon americanus var. americanus	Spanish lotus	ACAMA	*Lysimachia minima*	chaffweed	LYMI
Aira caryophyllea	silvery hair-grass	AICA	*Lythrum hyssopifolia*	grass poly	LYHY
Baccharis pilularis	coyote brush	BAPI	*Madia sativa*	coast tarweed	MASA
Briza minor	annual quaking grass	BRMI	*Malvella leprosa*	alkali mallow	MALE
Bromus diandrus	ripgut grass	BRDI	*Phalaris lemmonii*	Lemmon's canary grass	PHLE
Bromus hordeaceus	soft chess	BRHO	*Plagiobothrys chorisianus* var. hickmanii	Hickman's popcornflower	PLCHH
Carex barbarae	whiteroot	CABA	*Polypogon monspeliensis*	rabbitfoot grass	POMO
Castilleja ambigua ssp. ambigua	Johnny-Nip	CAAMA3	*Pseudognaphalium luteoalbum*	weedy cudweed	PSLU
Castilleja densiflora	dense flower owl's clover	CADE	*Pseudognaphalium ramosissimum*	pink everlasting	PSRA
Cirsium vulgare	bull thistle	CIVU	*Ranunculus californicus*	California buttercup	RACA
Clinopodium douglasii	yerba buena	CLDO	*Rumex acetosella*	sheep sorrel	RUAC
Danthonia californica	California oat grass	DACA	*Rumex crispus*	curly dock	RUCR
Deschampsia danthonioides	annual hair grass	DEDA	*Rumex salicifolius*	willow dock	RUSA
Eleocharis acicularis var. acicularis	needle spikerush	ELACA	*Sidalcea malviflora* ssp. malviflora	checkerbloom	SIMAM
Eleocharis macrostachya	pale spikerush	ELMA	*Sisyrinchium bellum*	western blue-eyed grass	SIBE
Erigeron canadensis	horseweed	ERCA	*Sonchus asper*	prickly sow thistle	SOAS
Eryngium armatum	coyote thistle	ERAR12	*Sonchus oleraceus*	common sow thistle	SOOL
Gamochaeta ustulata	purple cudweed	GAUS	*Stachys ajugoides*	bugle hedge nettle	STAJ
Geranium dissectum	cut-leaved geranium	GEDI	*Trifolium microcephalum*	small head clover	TRMI
Heliotropium curassavicum var. oculatum	Chinese pusley	HECUO	*Triodanis biflora*	Venus' looking glass	TRBI2
Hordeum brachyantherum	meadow barley	HOBR	Unknown 48		UNK48
Horkelia cuneata var. cuneata	wedge-leaved horkelia	HOCUC	Unknown 49		UNK49
Hypochaeris glabra	smooth cat's-ear	HYGL	*Verbena lasiostachys* var. lasiostachys	western vervain	VELAL
Hypochaeris radicata	rough cat's-ear	HYRA	*Zeltnera davyi*	Davy's centuary	ZEDA
Isoetes howellii	Howell's quillwort	ISHO	**Groundcover Codes**		
Juncus bufonius var. bufonius	common toad rush	JUBUB	BG	Bare Ground	
Juncus phaeocephalus	brown-headed rush	JUPH	TH	Thatch/Duff	
Lasthenia glaberrima	smooth goldfields	LAGL3	AL	Algae	

Table A-12. Pond 60 (Year 5 Post-Subsurface Munitions Remediation) Wetland Vegetation Transect Data by Stratum

POND 60			
Date	8/28/2023, 9/19/2023		
Surveying Personnel	USACE		
Vegetation Type	**% Cover**	**Species**	**Notes**
Emergent Vegetation	80	ELMA, DISP	Dominant
Floating Vegetation	0		
Submerged Vegetation	0		
Open Water	20		SMALL POOLS THROUGHOUT; DEPTH GAUGE INACCESSIBLE, EST 10CM
Notes			
Pond 60 had peripheral ponding present in December and January of the 2022-2023 water-year, followed by inundation from February through June (Chenega, 2024). Strata 1, 2, 3, and 4 were repeated from 2015 and 2018-2021. Transects 1, 2, and 4 were relocated to more representative locations, while Transect 3 was repeated from 2019. Stratum 1 also included an inundated section that was visually estimated.			

Transect #	Transect Length	Relative % Cover of Wetland	Quadrat #1		Quadrat #2		Quadrat #3		Quadrat #4		Quadrat #5		Quadrat #6	
			Species	% Cover	Species	% Cover	Species	% Cover	Species	% Cover	Species	% Cover	Species	% Cover
1	**10 m**		ELMA	90	DISP	2	DISP	1	DISP	1	DISP	1	DISP	5
			TH	1	ELMA	90	ELMA	79	ELMA	80	ELMA	79	ELMA	78
			BG	9	TH	3	TH	5	TH	9	TH	10	TH	12
					BG	5	BG	15	BG	10	BG	10	BG	5
			TOTAL	**100**	**TOTAL**	**100**	**TOTAL**	**100**	**TOTAL**	**100**	**TOTAL**	**100**	**TOTAL**	**100**

Transect #	Transect Length	Relative % Cover of Wetland	Quadrat #1		Quadrat #2		Quadrat #3		Quadrat #4		Quadrat #5		Quadrat #6	
			Species	% Cover	Species	% Cover	Species	% Cover	Species	% Cover	Species	% Cover	Species	% Cover
2	**10 m**		DISP	15	DISP	10	DISP	5	DISP	5	DISP	8	DISP	75
			ELMA	80	ELMA	80	ELMA	93	ELMA	95	ELMA	80	ELMA	15
			TH	5	TH	10	TH	2			TH	10	TH	10
											BG	2		
			TOTAL	**100**	**TOTAL**	**100**	**TOTAL**	**100**	**TOTAL**	**100**	**TOTAL**	**100**	**TOTAL**	**100**

Transect #	Transect Length	Relative % Cover of Wetland	Quadrat #1		Quadrat #2		Quadrat #3		Quadrat #4		Quadrat #5		Quadrat #6	
			Species	% Cover	Species	% Cover	Species	% Cover	Species	% Cover	Species	% Cover	Species	% Cover
3	**10 m**		DISP	4	DISP	5	DISP	3	DISP	5	DISP	30	DISP	5
			ERAR12	2	JUPH	90	GAUS	2	GAUS	5	GAUS	3	JUPH	90
			JUPH	85	LYHY	5	JUPH	85	JUPH	90	HYGL	2	POMO	1
			LYHY	3			LYHY	5			JUPH	40	STAJ	4
			TH	5			TH	4			LYHY	11		
			BG	1			BG	1			TH	10		
											BG	4		
			TOTAL	**100**	**TOTAL**	**100**	**TOTAL**	**100**	**TOTAL**	**100**	**TOTAL**	**100**	**TOTAL**	**100**

Transect #	Transect Length	Relative % Cover of Wetland	Quadrat #1		Quadrat #2		Quadrat #3		Quadrat #4		Quadrat #5		Quadrat #6	
			Species	% Cover	Species	% Cover	Species	% Cover	Species	% Cover	Species	% Cover	Species	% Cover
4	10 m		DISP	10	DISP	6	COCO	1	DISP	10	DISP	10	COCO	1
			ELMA	40	ELMA	73	DISP	4	ELMA	2	ELMA	10	DISP	3
			LYAR	5	STAJ	11	ELMA	25	GAUS	1	LYAR	5	ELMA	9
			STAJ	10	TH	8	JUPH	1	JUPH	5	PLCHH	5	ERAR12	1
			TH	35	BG	2	POMO	4	LYAR	2	TH	60	GEDI	1
							STAJ	15	LYHY	2	BG	10	LYAR	1
							TH	40	STAJ	3			POMO	2
							BG	10	TH	72			TH	80
									BG	3			BG	2
			TOTAL	**100**	**TOTAL**	**100**	**TOTAL**	**100**	**TOTAL**	**100**	**TOTAL**	**100**	**TOTAL**	**100**

Pond 60 2023 Species List

Species Name	Common Name	Species Code	Species Name	Common Name	Species Code
Agrostis avenacea	Pacific bent grass	AGAV	*Lysimachia arvensis*	scarlet pimpernel	LYAR
Avena barbata	slender wild oat	AVBA	*Lysimachia minima*	chaffweed	LYMI
Baccharis pilularis	coyote brush	BAPI	*Lythrum hyssopifolia*	grass poly	LYHY
Briza maxima	rattlesnake grass	BRMA	*Madia sativa*	coast tarweed	MASA
Briza minor	annual quaking grass	BRMI	*Phalaris lemmonii*	Lemmon's canary grass	PHLE
Brodiaea terrestris ssp. terrestris	dwarf brodiaea	BRTET	*Plagiobothrys chorisianus* var. hickmanii	Hickman's popcornflower	PLCHH
Cotula coronopifolia	brass buttons	COCO	*Plantago coronopus*	cut-leaved plantain	PLCO
Deinandra corymbosa	coastal tarweed	DECO	*Polypogon monspeliensis*	rabbitfoot grass	POMO
Diplacus aurantiacus	sticky monkey flower	DIAU	*Pseudognaphalium luteoalbum*	weedy cudweed	PSLU
Distichlis spicata	salt grass	DISP	*Pseudognaphalium ramosissimum*	pink everlasting	PSRA
Eleocharis acicularis var. acicularis	needle spikerush	ELACA	*Pseudognaphalium stramineum*	cottonbatting plant	PSST
Eleocharis macrostachya	pale spikerush	ELMA	*Rumex acetosella*	sheep sorrel	RUAC
Elymus triticoides	beardless wild rye	ELTR3	*Rumex crispus*	curly dock	RUCR
Erigeron canadensis	horseweed	ERCA	*Senecio glomeratus*	cutleaf burnweed	SEGL
Eryngium armatum	coyote thistle	ERAR12	*Sonchus asper*	prickly sow thistle	SOAS
Festuca perennis	Italian rye grass	FEPE	*Sonchus oleraceus*	common sow thistle	SOOL
Gamochaeta ustulata	purple cudweed	GAUS	*Stachys ajugoides*	bugle hedge nettle	STAJ
Geranium dissectum	cut-leaved geranium	GEDI	*Toxicodendron diversilobum*	poison oak	TODI
Heliotropium curassavicum var. oculatum	Chinese pusley	HECUO	**Groundcover Codes**		
Hypochaeris glabra	smooth cat's-ear	HYGL	BG	Bare Ground	
Isoetes howellii	Howell's quillwort	ISHO	TH	Thatch/Duff	
Juncus phaeocephalus	brown-headed rush	JUPH	AL	Algae	

Table A-13. Pond 73 (Year 5 Post-Subsurface Munitions Remediation) Wetland Vegetation Transect Data by Stratum

POND 73			
Date	6/9/2023		
Surveying Personnel	USACE		
Vegetation Type	**% Cover**	**Species**	**Notes**
Emergent Vegetation			
Floating Vegetation			
Submerged Vegetation			
Open Water			
Notes			
Pond 73 exhibited peripheral ponding in December, followed by inundation between January and April of the 2022-2023 water-year (Chenega 2024). Strata 1 and 2 were repeated from 2017-2021 and Stratum 3 was repeated from 2017 and 2019. Transect 1 was relocated to a more representative location, while Transects 2 and 3 were moved because the previous locations were no longer within the corresponding strata.			

Transect #	Transect Length	Relative % Cover of Wetland	Quadrat #1		Quadrat #2		Quadrat #3		Quadrat #4		Quadrat #5		Quadrat #6	
			Species	% Cover	Species	% Cover	Species	% Cover	Species	% Cover	Species	% Cover	Species	% Cover
1	10 m		ELACA	3	ELACA	15	ELMA	20	ELACA	10	ELACA	7	DEDA	5
			ELMA	30	ELMA	25	ERAR12	10	ELMA	20	ELMA	20	ELACA	10
			JUPH	1	JUPH	5	JUPH	5	LAGL3	25	ISHO	1	ERAR12	15
			LAGL3	15	LAGL3	10	LAGL3	20	PLCHH	20	JUPH	2	JUPH	10
			PLCHH	15	PLCHH	20	PLCHH	10	TRSC	5	LAGL3	14	LAGL3	25
			POMO	1	POMO	5	TH	30	TH	15	LYHY	2	PLCHH	10
			TH	35	TH	20	BG	5	BG	5	PLCHH	25	TRSC	10
											POMO	2	TH	10
											TRSC	2	BG	5
											TH	20		
											BG	5		
			TOTAL	**100**	**TOTAL**	**100**	**TOTAL**	**100**	**TOTAL**	**100**	**TOTAL**	**100**	**TOTAL**	**100**

Transect #	Transect Length	Relative % Cover of Wetland	Quadrat #1		Quadrat #2		Quadrat #3	
			Species	% Cover	Species	% Cover	Species	% Cover
2	5 m		ELAC	10	DEDA	1	ELAC	4
			ERAR12	15	ELACA	4	ERAR12	20
			JUBUB	5	ERAR12	3	JUBUB	1
			JUPH	10	JUBUB	6	JUPH	30
			LYHY	15	JUPH	20	LYHY	25
			POMO	20	LYHY	40	POMO	5
			PSCH	5	PLCHH	1	TH	10
			TH	10	POMO	5	BG	5
			BG	10	TH	5		
					BG	15		
			TOTAL	**100**	**TOTAL**	**100**	**TOTAL**	**100**

Transect #	Transect Length	Relative % Cover of Wetland	Quadrat #1		Quadrat #2		Quadrat #3	
			Species	% Cover	Species	% Cover	Species	% Cover
3	5 m		ACAMA	15	AICA	5	ACAMA	5
			ADFA	5	BAPI	15	ADFA	10
			AICA	10	BRDI	1	AICA	5
			BRDI	1	BRMI	2	CAAMA3	5
			BRMI	3	CAAMA3	15	ERCA	10
			ERAR12	2	ERAR12	15	FEBR	5
			ERCA	2	ERBO	1	HERA	5
			FEBR	1	FEBR	5	HYGL	5
			GAPO	1	HEAR	5	JUBUB	5
			GEDI	1	HYGL	2	LYAR	15
			HYGL	17	JUBUB	1	LYHY	5
			JUBUB	1	JUCA	5	MIPA	5
			LYAR	1	JUPH	5	PLER	5
			UNK36	5	LYAR	15	POMO	5
			TH	30	LYHY	5	TH	5
			BG	5	POMO	2	BG	5
					BG	1		
			TOTAL	**100**	**TOTAL**	**100**	**TOTAL**	**100**

Pond 73 2023 Species List

Species Name	Common Name	Species Code	Species Name	Common Name	Species Code
Achillea millefolium	common yarrow	ACMI	*Juncus bufonius* var. bufonius	common toad rush	JUBUB
Acmispon americanus var. americanus	Spanish lotus	ACAMA	*Juncus capitatus*	dwarf rush	JUCA
Adenostoma fasciculatum	chamise	ADFA	*Juncus phaeocephalus*	brown-headed rush	JUPH
Aira caryophyllea	silvery hair-grass	AICA	*Lasthenia glaberrima*	smooth goldfields	LAGL3
Avena barbata	slender wild oat	AVBA	*Lysimachia arvensis*	scarlet pimpernel	LYAR
Baccharis pilularis	coyote brush	BAPI	*Lythrum hyssopifolia*	grass poly	LYHY
Briza maxima	rattlesnake grass	BRMA	*Microseris paludosa*	marsh microseris	MIPA
Briza minor	annual quaking grass	BRMI	*Plagiobothrys chorisianus* var. hickmanii	Hickman's popcornflower	PLCHH
Brodiaea terrestris ssp. terrestris	dwarf brodiaea	BRTET	*Plantago erecta*	California plantain	PLER
Bromus diandrus	ripgut grass	BRDI	*Polypogon monspeliensis*	rabbitfoot grass	POMO
Castilleja ambigua ssp. ambigua	Johnny-Nip	CAAMA3	*Psilocarphus chilensis*	round woolly-marbles	PSCH
Cotula coronopifolia	brass buttons	COCO	*Rumex crispus*	curly dock	RUCR
Danthonia californica	California oat grass	DACA	*Sonchus asper*	prickly sow thistle	SOAS
Deschampsia danthonioides	annual hair grass	DEDA	*Spiranthes romanzoffiana*	hooded lady's tresses	SPRO
Eleocharis acicularis var. acicularis	needle spikerush	ELACA	*Toxicodendron diversilobum*	poison oak	TODI
Eleocharis macrostachya	pale spikerush	ELMA	*Trifolium variegatum*	variegated clover	TRVA
Erigeron canadensis	horseweed	ERCA	*Triglochin scilloides*	flowering quillwort	TRSC
Erodium botrys	long-beaked filaree	ERBO	*Triteleia ixioides*	coast pretty face	TRIX
Eryngium armatum	coyote thistle	ERAR12	Unknown 18		UNK18
Festuca bromoides	brome fescue	FEBR	Unknown 36		UNK36
Galium porrigens	climbing bedstraw	GAPO	*Zeltnera davyi*	Davy's centuary	ZEDA
Geranium dissectum	cut-leaved geranium	GEDI	**Groundcover Codes**		
Heteromeles arbutifolia	toyon	HEAR	BG	Bare Ground	
Heterocodon rariflorum	western pearlflower	HERA	TH	Thatch/Duff	
Hypochaeris glabra	smooth cat's-ear	HYGL	AL	Algae	
Isoetes howellii	Howell's quillwort	ISHO			

Table A-14. Pond 16 (Year 5 Post-Subsurface Munitions Remediation)
Wetland Vegetation Transect Data by Stratum

POND 16

Date	8/30/2023, 9/20/2023		
Surveying Personnel	USACE		
Vegetation Type	**% Cover**	**Species**	**Notes**
Emergant Vegetation	15	SCCA	
Floating Vegetation	0		
Submerged Vegetation	0		Not counting algae
Open Water	85		

Notes

Pond 16 exhibited peripheral ponding in December, then held water from January through May of the 2022-2023 water-year (Chenega, 2024). Stratum 1 was repeated from 2017, 2019, 2021, and 2022. Strata 3 and 5 and their corresponding transects were repeated from 2015, 2017, and 2019-2022. Strata 4 and 6 and their corresponding transects were repeated from 2017 and 2019-2022. Stratum 7 was repeated from 2017 and 2019 while Transect 7 was relocated to a more representative location within the stratum. No transect was placed in Stratum 1 because it was inundated at the time of vegetation surveys, so visual cover was estimated.

Transect #	Transect Length	Relative % Cover of Wetland	Quadrat #1		Quadrat #2		Quadrat #3		Quadrat #4		Quadrat #5		Quadrat #6	
			Species	% Cover	Species	% Cover	Species	% Cover	Species	% Cover	Species	% Cover	Species	% Cover
3	10 m		ELMA	80	ELMA	94	ECCR	5	ECCR	1	ECCR	2	ELMA	85
			GNPA	10	GNPA	5	ELMA	75	ELMA	87	ELMA	85	GNPA	10
			TH	5	SO sp.	1	GNPA	10	GNPA	10	GNPA	10	HYRA	5
			BG	5			RUSA	3	HYRA	1	BG	3		
							SO sp.	2	BG	1				
							TH	2						
							BG	3						
			TOTAL	**100**	**TOTAL**	**100**	**TOTAL**	**100**	**TOTAL**	**100**	**TOTAL**	**100**	**TOTAL**	**100**

Transect #	Transect Length	Relative % Cover of Wetland	Quadrat #1		Quadrat #2		Quadrat #3		Quadrat #4		Quadrat #5		Quadrat #6	
			Species	% Cover	Species	% Cover	Species	% Cover	Species	% Cover	Species	% Cover	Species	% Cover
4	10 m		CAPR	10	CAPR	10	CAPR	5	JUBA	10	JUBA	55	CAPR	3
			JUBA	50	JUBA	29	JUBA	80	JUPH	80	JUPH	15	JUBA	15
			RUUR	30	JUPH	1	JUPH	5	RUUR	9	RUAC	5	JUPH	80
			TH	10	RUUR	60	RUUR	10	SO sp.	1	RUSA	5	SO sp.	1
											RUUR	5	BG	1
											SO sp.	5		
											TH	5		
											BG	5		
			TOTAL	**100**	**TOTAL**	**100**	**TOTAL**	**100**	**TOTAL**	**100**	**TOTAL**	**100**	**TOTAL**	**100**

Transect #	Transect Length	Relative % Cover of Wetland	Quadrat #1		Quadrat #2		Quadrat #3		Quadrat #4		Quadrat #5		Quadrat #6	
			Species	% Cover	Species	% Cover	Species	% Cover	Species	% Cover	Species	% Cover	Species	% Cover
5	10 m		CABA	2	CABA	50	CABA	98	CABA	80	CABA	98	CABA	90
			RUUR	3	RUUR	25	RUUR	1	RUUR	10	RUUR	2	RUUR	10
			SOEL	93	SOEL	25	SOEL	1	SOEL	10				
			TH	2										
			BG	1										
			TOTAL	**101**	**TOTAL**	**100**	**TOTAL**	**100**	**TOTAL**	**100**	**TOTAL**	**100**	**TOTAL**	**100**

Transect #	Transect Length	Relative % Cover of Wetland	Quadrat #1		Quadrat #2		Quadrat #3	
			Species	% Cover	Species	% Cover	Species	% Cover
6	5 m		TH	10	JUBA	98	JUBA	95
			JUBA	85	BG	1	GNPA	1
			RUUR	5	TH	1	SOAM	1
							ERCA	1
							TH	2
			TOTAL	**100**	**TOTAL**	**100**	**TOTAL**	**100**

Transect #	Transect Length	Relative % Cover of Wetland	Quadrat #1		Quadrat #2		Quadrat #3	
			Species	% Cover	Species	% Cover	Species	% Cover
7	5 m		CRSC2	55	CRSC2	10	CRSC2	20
			ECCR	12	ECCR	40	ECCR	50
			ELMA	23	ELMA	30	ELMA	25
			TH	10	HEEC	2	TH	5
					TH	18		
			TOTAL	**100**	**TOTAL**	**100**	**TOTAL**	**100**

Pond 16 2023 Species List

Species Name	Common Name	Species Code	Species Name	Common Name	Species Code
Achillea millefolium	common yarrow	ACMI	*Lupinus arboreus*	yellow bush lupine	LUAR
Agrostis exarata	spike bent grass	AGEX	*Luzula comosa*	Pacific woodrush	LUCO6
Aira caryophyllea	silvery hair-grass	AICA	*Lythrum hyssopifolia*	grass poly	LYHY
Avena barbata	slender wild oat	AVBA	*Madia sativa*	coast tarweed	MASA
Baccharis pilularis	coyote brush	BAPI	*Polypogon monspeliensis*	rabbitfoot grass	POMO
Briza maxima	rattlesnake grass	BRMA	*Pseudognaphalium luteoalbum*	weedy cudweed	PSLU
Briza minor	annual quaking grass	BRMI	*Pseudognaphalium stramineum*	cottonbatting plant	PSST
Bromus hordeaceus	soft chess	BRHO	*Pteridium aquilinum* var. pubescens	western bracken fern	PTAQP
Carex barbarae	whiteroot	CABA	*Quercus agrifolia*	coast live oak	QUAG
Carex harfordii	Harford's sedge	CAHA4	*Rosa californica*	California wild rose	ROCA
Carex praegracilis	clustered field sedge	CAPR	*Rubus ursinus*	California blackberry	RUUR
Cirsium vulgare	bull thistle	CIVU	*Rumex acetosella*	sheep sorrel	RUAC
Conium maculatum	poison hemlock	COMA	*Rumex crispus*	curly dock	RUCR
Crypsis schoenoides	swamp pricklegrass	CRSC2	*Rumex salicifolius*	willow dock	RUSA
Echinochloa crus-galli	barnyard grass	ECCR	*Schoenoplectus californicus*	California bulrush	SCCA
Eleocharis acicularis var. acicularis	needle spikerush	ELACA	*Solanum americanum*	small-flowered nightshade	SOAM
Eleocharis macrostachya	pale spikerush	ELMA	*Solidago elongata*	West Coast Canada goldenrod	SOEL
Elymus glaucus	blue wild-rye	ELGL	*Solidago velutina* ssp. californica	California goldenrod	SOVEC
Elymus triticoides	beardless wild rye	ELTR3	*Sonchus sp.*	sow thistle	SO sp.
Erigeron canadensis	horseweed	ERCA	*Sonchus asper*	prickly sow thistle	SOAS
Geranium dissectum	cut-leaved geranium	GEDI	*Sonchus oleraceus*	common sow thistle	SOOL
Gnaphalium palustre	lowland cudweed	GNPA	*Stachys ajugoides*	bugle hedge nettle	STAJ
Heliotropium curassavicum var. oculatum	Chinese pusley	HECUO	*Toxicodendron diversilobum*	poison oak	TODI
Helminthotheca echioides	bristly oxtongue	HEEC	Unknown 43		UNK43
Heterotheca grandiflora	telegraph weed	HEGR	**Groundcover Codes**		
Hypochaeris radicata	rough cat's-ear	HYRA	BG	Bare Ground	
Juncus balticus	Baltic rush	JUBA	TH	Thatch/Duff	
Juncus effusus	common rush	JUEF	AL	Algae	
Juncus phaeocephalus	brown-headed rush	JUPH			

**Table A-15. Pond 39 (Year 5 Post-Subsurface Munitions Remediation)
Wetland Vegetation Transect Data by Stratum**

POND 39			
Date	5/31/2023		
Surveying Personnel	USACE		
Vegetation Type	**% Cover**	**Species**	**Notes**
Emergent Vegetation			
Floating Vegetation			
Submerged Vegetation			
Open Water			
Notes			
Pond 39 held water from December through May with peripheral ponding present the first three months. By January, Pond 39 was hydrologically connected to Pond 40 South, and by March it was hydrologically connected to Pond 35 (Chenega, 2024). Strata 1 and 3 were repeated from 2016 and 2018-2022. Stratum 2 was repeated from 2016 and 2019, while Stratum 4 was repeated from 2018-2022. Transect 1 was repeated from 2019; Transect 3 was repeated from 2018, 2019, and 2020; and Transect 4 was repeated from 2019 and 2022. Transect 2 was relocated to a more representative location.			

Transect #	Transect Length	Relative % Cover of Wetland	Quadrat #1		Quadrat #2		Quadrat #3	
			Species	% Cover	Species	% Cover	Species	% Cover
1	5 m		JUPH	23	COCO	1	COCO	5
			LYHY	1	ELMA	39	ELMA	44
			PLCHH	5	PLCHH	25	LYHY	1
			PLCO	20	PLCO	5	PLCHH	10
			PSCH	1	TH	25	PLCO	20
			TH	20	BG	5	TH	10
			BG	30			BG	10
			TOTAL	**100**	**TOTAL**	**100**	**TOTAL**	**100**

Transect #	Transect Length	Relative % Cover of Wetland	Quadrat #1		Quadrat #2		Quadrat #3	
			Species	% Cover	Species	% Cover	Species	% Cover
2	5 m		JUPH	23	JUOC	1	BRMI	3
			PLCO	18	JUPH	20	DACA	1
			ACAMA	3	TRAN	5	ELACA	10
			SIGA	2	TRDU	25	FEPE	5
			JUBU	29	ARHO	1	GEDI	1
			DACA	1	BAPI	5	HYGL	1
			BRMI	4	ACAMA	1	JUBU	46
			LYHY	1	PLCO	1	JUEF	1
			FEBR	1	JUBU	5	JUPH	3
			AICA	1	BRMI	26	LYAR	1
			HYGL	1	ERAR12	1	LYHY	5
			LYAR	1	GEDI	1	PLCO	8
			JUBUC2	1	LYHY	1	SIGA	1
			TH	5	TH	2	TRAN	1
			BG	10	BG	5	TRDU	5
							TH	3
							BG	5
			TOTAL	**101**	**TOTAL**	**100**	**TOTAL**	**100**

Transect #	Transect Length	Relative % Cover of Wetland	Quadrat #1		Quadrat #2		Quadrat #3		Quadrat #4		Quadrat #5		Quadrat #6	
			Species	% Cover	Species	% Cover	Species	% Cover	Species	% Cover	Species	% Cover	Species	% Cover
3	10 m		BRTET	5	ERBO	1	FEPE	12	ACAMA	1	AICA	1	AVFA	5
			FEPE	35	FEPE	20	GEDI	1	FEPE	30	BRMI	1	FEPE	29
			GEDI	15	GEDI	1	JUBUB	50	GEDI	3	DACA	1	JUBUB	1
			JUBUB	7	JUBU	5	JUBUB	1	JUBUB	1	FEPE	5	JUPH	5
			LYHY	3	JUBUB	1	LYHY	20	JUPH	1	JUBUB	5	LYHY	1
			SOAS	15	KOMA	25	TRAN	1	LYHY	1	JUPH	20	TRAN	10
			UNK18	5	LYHY	10	TH	12	PLCO	2	LYHY	10	TH	29
			TH	10	PLCO	5	BG	3	TH	30	TRAN	10	BG	20
			BG	5	TRAN	1			TRAN	25	UNK18	1		
					UNK18	1			UNK18	1	TH	15		
					BG	20			BG	5	BG	31		
					TH	10								
			TOTAL	**100**	**TOTAL**	**100**	**TOTAL**	**100**	**TOTAL**	**100**	**TOTAL**	**100**	**TOTAL**	**100**

Transect #	Transect Length	Relative % Cover of Wetland	Quadrat #1		Quadrat #2		Quadrat #3		Quadrat #4		Quadrat #5		Quadrat #6	
			Species	% Cover	Species	% Cover	Species	% Cover	Species	% Cover	Species	% Cover	Species	% Cover
4	10 m		CADE	1	BRMI	1	BRMI	5	BRMI	3	BRMI	5	BRMI	5
			FEBR	1	DECO	4	PLCO	2	FEPE	1	ERCA	10	CADE	1
			HYGL	1	FEBR	3	SIGA	1	HYGL	1	FEPE	6	DECO	15
			JUOC	5	PLCO	2	STPU	20	LYAR	1	GEDI	1	ERBO	1
			LYAR	1	STPU	15	TRAN	30	PLCO	10	JUBU	10	FEPE	10
			PLCO	2	TRAN	64	VISAS	1	STPU	15	JUBUB	1	FEPE	1
			STPU	20	TRIX	1	ZEDA	1	TRAN	59	JUOC	10	JUOC	5
			TRAN	29	VISAS	1	TH	5	TH	10	LYAR	1	PLCO	5
			TRIX	1	ZEDA	1	BG	35			LYHY	1	SIGA	1
			UNK23	1	TH	3					PLCO	5	STPU	2
			VISAS	3	BG	5					SIBE	1	TRAN	49
			ZEDA	1							SIGA	2	VISAS	1
			TH	5							TRAN	20	TH	3
			BG	29							TRDU	5	BG	1
											TH	4		
											BG	20		
			TOTAL	**100**	**TOTAL**	**100**	**TOTAL**	**100**	**TOTAL**	**100**	**TOTAL**	**102**	**TOTAL**	**100**

Pond 39 2023 Species List

Species Name	Common Name	Species Code	Species Name	Common Name	Species Code
Achillea millefolium	common yarrow	ACMI	*Lysimachia arvensis*	scarlet pimpernel	LYAR
Acmispon americanus var. americanus	Spanish lotus	ACAMA	*Lythrum hyssopifolia*	grass poly	LYHY
Adenostoma fasciculatum	chamise	ADFA	*Madia sativa*	coast tarweed	MASA
Aira caryophyllea	silvery hair-grass	AICA	*Microseris paludosa*	marsh microseris	MIPA
Arctostaphylos hookeri	Hooker's manzanita	ARHO	*Plagiobothrys chorisianus* var. hickmanii	Hickman's popcornflower	PLCHH
Avena fatua	wild oat	AVFA	*Plantago coronopus*	cut-leaved plantain	PLCO
Baccharis pilularis	coyote brush	BAPI	*Plantago erecta*	California plantain	PLER
Briza minor	annual quaking grass	BRMI	*Plantago lanceolata*	English plantain	PLLA
Brodiaea terrestris ssp. terrestris	dwarf brodiaea	BRTET	*Polypogon monspeliensis*	rabbitfoot grass	POMO
Bromus diandrus	ripgut grass	BRDI	*Psilocarphus chilensis*	round woolly-marbles	PSCH
Bromus hordeaceus	soft chess	BRHO	*Quercus agrifolia*	coast live oak	QUAG
Carpobrotus edulis	ice plant	CAED	*Ranunculus californicus*	California buttercup	RACA
Castilleja attenuata	valley tassels	CAAT	*Rumex acetosella*	sheep sorrel	RUAC
Cotula coronopifolia	brass buttons	COCO	*Rumex crispus*	curly dock	RUCR
Danthonia californica	California oat grass	DACA	*Rumex salicifolius*	willow dock	RUSA
Deinandra corymbosa	coastal tarweed	DECO	*Sidalcea malviflora* ssp. malviflora	checkerbloom	SIMAM
Eleocharis acicularis var. acicularis	needle spikerush	ELACA	*Silene gallica*	small-flower catchfly	SIGA
Eleocharis macrostachya	pale spikerush	ELMA	*Sisyrinchium bellum*	western blue-eyed grass	SIBE
Erigeron canadensis	horseweed	ERCA	*Sonchus asper*	prickly sow thistle	SOAS
Erodium botrys	long-beaked filaree	ERBO	*Sonchus oleraceus*	common sow thistle	SOOL
Eryngium armatum	coyote thistle	ERAR12	*Stipa pulchra*	purple needle grass	STPU
Eschscholzia californica	California poppy	ESCA	*Toxicodendron diversilobum*	poison oak	TODI
Festuca bromoides	brome fescue	FEBR	*Trifolium angustifolium*	narrow-leaved clover	TRAN
Festuca perennis	Italian rye grass	FEPE	*Trifolium dubium*	little hop clover	TRDU
Geranium dissectum	cut-leaved geranium	GEDI	*Triodanis biflora*	Venus' looking glass	TRBI2
Horkelia cuneata var. cuneata	wedge-leaved horkelia	HOCUC	*Triteleia hyacinthina*	white brodiaea	TRHY3
Hypochaeris glabra	smooth cat's-ear	HYGL	*Triteleia ixioides*	coast pretty face	TRIX
Isoetes howellii	Howell's quillwort	ISHO	Unknown 18		UNK18
Juncus bufonius	toad rush	JUBU	Unknown 23		UNK23
Juncus bufonius var. bufonius	common toad rush	JUBUB	*Vicia sativa* ssp. nigra	common vetch	VISAN
Juncus bufonius var. congestus	clustered toad rush	JUBUC2	*Vicia sativa* ssp. sativa	spring vetch	VISAS
Juncus capitatus	dwarf rush	JUCA	*Zeltnera davyi*	Davy's centuary	ZEDA
Juncus effusus	common rush	JUEF	**Groundcover Codes**		
Juncus occidentalis	western rush	JUOC	BG	Bare Ground	
Juncus phaeocephalus	brown-headed rush	JUPH	TH	Thatch/Duff	
Koeleria macrantha	June grass	KOMA	AL	Algae	
Logfia gallica	narrowleaf cottonrose	LOGA			

Table A-16. Pond 40 South (Year 5 Post-Subsurface Munitions Remediation) Wetland Vegetation Transect Data by Stratum

POND 40 South			
Date	6/2/2023		
Surveying Personnel	USACE		
Vegetation Type	**% Cover**	**Species**	**Notes**
Emergent Vegetation			
Floating Vegetation			
Submerged Vegetation			
Open Water			
Notes			
Pond 40 South exhibited peripheral ponding in December and held water from January through April (Chenega, 2024). Strata 1 and 2 and the corresponding strata were repeated from 2016, 2018-2021, and 2023. Stratum 3 was repeated from 2016 and 2018-2022, while Stratum 4 was repeated from 2022. Transect 3 was repeated from 2019, while Transect 4 was relocated to a more representative location.			

Transect #	Transect Length	Relative % Cover of Wetland	Quadrat #1		Quadrat #2		Quadrat #3	
			Species	% Cover	Species	% Cover	Species	% Cover
1	5 m		JUPH	3	ELMA	40	ELMA	40
			LYHY	2	PLCHH	45	LYMI	1
			PLCHH	75	TH	10	PLCHH	49
			PLCO	5	BG	5	TH	8
			TH	5			BG	2
			BG	10				
			TOTAL	**100**	**TOTAL**	**100**	**TOTAL**	**100**

Transect #	Transect Length	Relative % Cover of Wetland	Quadrat #1		Quadrat #2		Quadrat #3	
			Species	% Cover	Species	% Cover	Species	% Cover
2	5 m		ACAMA	1	BRMI	1	BRMI	5
			AVFA	1	ERBO	1	ERBO	1
			ERBO	1	JUCA	5	JUPH	26
			FEBR	3	JUPH	39	LYHY	3
			FEPE	1	LYHY	1	PlCO	3
			GEDI	1	PLCO	15	RUAC	20
			HYGL	4	RUAC	2	SIGA	1
			JUBU	5	SIGA	2	TRAN	26
			JUBUB	10	TRAN	19	TH	10
			JUPH	10	TH	10	BG	5
			LYHY	10	BG	5		
			PLCO	5				
			RUAC	15				
			TRAN	12				
			UNK18	1				
			TH	5				
			BG	15				
			TOTAL	**100**	**TOTAL**	**100**	**TOTAL**	**100**

Transect #	Transect Length	Relative % Cover of Wetland	Quadrat #1		Quadrat #2		Quadrat #3		Quadrat #4		Quadrat #5		Quadrat #6	
			Species	% Cover	Species	% Cover	Species	% Cover	Species	% Cover	Species	% Cover	Species	% Cover
3	10 m		AVBA	8	AVBA	1	AVBA	1	AVBA	1	AVBA	1	AVBA	2
			BRDI	1	BRDI	1	BRHO	4	BRHO	1	BRDI	1	BRHO	1
			BRHO	4	BRHO	1	BRMI	2	ERCA	19	BRHO	2	ELGL	1
			BRMI	1	DECO	8	DECO	12	FEBR	3	BRTET	1	FEBR	3
			BRTET	1	ERCA	2	ERCA	10	FEPE	40	FEBR	12	FEPE	30
			DECO	3	FEPE	41	FEPE	20	GEDI	9	FEPE	29	GEDI	1
			ERBO	2	GEDI	2	KOMA	2	MAGR	2	SIBE	2	SIBE	1
			ERCA	3	JUOC	13	MAGR	1	TRAN	2	TRAN	5	STPU	10
			FEBR	1	KOMA	2	PLCO	2	TH	20	TRGR	1	TH	41
			FEPE	8	MAGR	1	TRAN	20	BG	3	TH	25	BG	10
			GEDI	2	PLCO	4	TH	15			BG	20		
			HYGL	1	TRAN	10	BG	10						
			KOMA	5	TRGR	1								
			TRAN	25	VISAS	1								
			TH	25	TH	10								
			BG	10	BG	2								
			TOTAL	**100**	**TOTAL**	**100**	**TOTAL**	**99**	**TOTAL**	**100**	**TOTAL**	**99**	**TOTAL**	**100**

Transect #	Transect Length	Relative % Cover of Wetland	Quadrat #1		Quadrat #2		Quadrat #3	
			Species	% Cover	Species	% Cover	Species	% Cover
4	5 m		AVBA	1	ERBO	10	ERBO	10
			DECO	25	FEBR	1	FEBR	2
			DEDA	5	FEPE	10	FEPE	3
			ERBO	7	HYGL	1	HYGL	5
			FEPE	3	MAGR	24	KOMA	1
			TRAN	29	STPU	5	MAGR	34
			TH	25	TRAN	20	VISA	1
			BG	5	TH	14	TH	20
					BG	15	BG	24
			TOTAL	**100**	**TOTAL**	**100**	**TOTAL**	**100**

Pond 40 South 2023 Species List					
Species Name	**Common Name**	**Species Code**	**Species Name**	**Common Name**	**Species Code**
Achillea millefolium	common yarrow	ACMI	*Lysimachia arvensis*	scarlet pimpernel	LYAR
Acmispon americanus var. americanus	Spanish lotus	ACAMA	*Lysimachia minima*	chaffweed	LYMI
Aira caryophyllea	silvery hair-grass	AICA	*Lythrum hyssopifolia*	grass poly	LYHY
Avena barbata	slender wild oat	AVBA	*Madia gracilis*	gumweed	MAGR
Avena fatua	wild oat	AVFA	*Madia sativa*	coast tarweed	MASA
Baccharis pilularis	coyote brush	BAPI	*Microseris paludosa*	marsh microseris	MIPA
Briza minor	annual quaking grass	BRMI	*Plagiobothrys chorisianus* var. hickmanii	Hickman's popcornflower	PLCHH
Brodiaea terrestris ssp. terrestris	dwarf brodiaea	BRTET	*Plantago erecta*	California plantain	PLER
Bromus diandrus	ripgut grass	BRDI	*Plantago lanceolata*	English plantain	PLLA
Bromus hordeaceus	soft chess	BRHO	*Polypogon monspeliensis*	rabbitfoot grass	POMO
Cotula coronopifolia	brass buttons	COCO	*Ranunculus californicus*	California buttercup	RACA
Cynosurus echinatus	bristly dogtail grass	CYEC	*Rumex acetosella*	sheep sorrel	RUAC
Danthonia californica	California oat grass	DACA	*Rumex crispus*	curly dock	RUCR
Deinandra corymbosa	coastal tarweed	DECO	*Sidalcea malviflora* ssp. malviflora	checkerbloom	SIMAM
Deschampsia danthonioides	annual hair grass	DEDA	*Silene gallica*	small-flower catchfly	SIGA
Eleocharis macrostachya	pale spikerush	ELMA	*Sisyrinchium bellum*	western blue-eyed grass	SIBE
Elymus glaucus	blue wild-rye	ELGL	*Sonchus asper*	prickly sow thistle	SOAS
Erigeron canadensis	horseweed	ERCA	*Sonchus oleraceus*	common sow thistle	SOOL
Erodium botrys	long-beaked filaree	ERBO	*Stipa pulchra*	purple needle grass	STPU
Eschscholzia californica	California poppy	ESCA	*Toxicodendron diversilobum*	poison oak	TODI
Festuca bromoides	brome fescue	FEBR	*Trifolium angustifolium*	narrow-leaved clover	TRAN
Festuca perennis	Italian rye grass	FEPE	*Trifolium dubium*	little hop clover	TRDU
Geranium dissectum	cut-leaved geranium	GEDI	*Trifolium gracilentum*	pin point clover	TRGR
Hypochaeris glabra	smooth cat's-ear	HYGL	*Triteleia ixioides*	coast pretty face	TRIX
Isoetes howellii	Howell's quillwort	ISHO	Unknown 18		UNK18
Juncus bufonius	toad rush	JUBU	*Vicia sativa*	spring vetch	VISA
Juncus bufonius var. bufonius	common toad rush	JUBUB	*Vicia sativa* ssp. nigra	common vetch	VISAN
Juncus capitatus	dwarf rush	JUCA	*Vicia sativa* ssp. sativa	spring vetch	VISAS
Juncus occidentalis	western rush	JUOC	**Groundcover Codes**		
Juncus phaeocephalus	brown-headed rush	JUPH	BG	Bare Ground	
Koeleria macrantha	June grass	KOMA	TH	Thatch/Duff	
Logfia gallica	narrowleaf cottonrose	LOGA	AL	Algae	

Table A-17. Pond 41 (Year 5 Post-Subsurface Munitions Remediation) Wetland Vegetation Transect Data by Stratum

POND 41			
Date	7/19/2023		
Surveying Personnel	USACE		
Vegetation Type	**% Cover**	**Species**	**Notes**
Emergent Vegetation			
Floating Vegetation			
Submerged Vegetation			
Open Water			
Notes			
Pond 41 exhibited peripheral ponding in December, then held water from January through June of the 2022-2023 water-year (Chenega, 2024). Strata 1, 2, and 3 were repeated from 2016 and 2019-2022 while Stratum 4 was repeated from 2019-2022. Transect 1 was repeated from 2016, 2019, and 2020; Transect 2 was repeated from 2016 and 2019-2021; Transect 3 was repeated from 2016 and 2019; and Transect 4 was repeated from 2019-2021.			

Transect #	Transect Length	Relative % Cover of Wetland	Quadrat #1		Quadrat #2		Quadrat #3		Quadrat #4		Quadrat #5		Quadrat #6	
			Species	% Cover	Species	% Cover	Species	% Cover	Species	% Cover	Species	% Cover	Species	% Cover
1	10 m		ELACA	5	ELMA	50	ELACA	5	ELMA	70	ELMA	55	ELACA	5
			ELMA	37	ISHO	10	ELMA	30	TH	20	TH	30	ELMA	60
			PLCHH	1	PLCHH	5	LAGL3	5	BG	10	BG	15	TH	25
			TRSC	2	POMO	5	PLCHH	5					BG	10
			TH	40	TH	20	POMO	5						
			BG	15	BG	10	TH	40						
							BG	10						
			TOTAL	**100**	**TOTAL**	**100**	**TOTAL**	**100**	**TOTAL**	**100**	**TOTAL**	**100**	**TOTAL**	**100**

Transect #	Transect Length	Relative % Cover of Wetland	Quadrat #1		Quadrat #2		Quadrat #3		Quadrat #4		Quadrat #5		Quadrat #6	
			Species	% Cover	Species	% Cover	Species	% Cover	Species	% Cover	Species	% Cover	Species	% Cover
2	10 m		ELACA	30	ELACA	5	ELACA	50	ELACA	12	ELACA	13	ELACA	15
			ELMA	10	ELMA	5	ELMA	5	ELMA	16	ELMA	40	ELMA	10
			LAGL3	10	LAGL3	5	JUPH	5	LAGL3	2	LAGL3	10	LAGL3	5
			MALE	5	MALE	5	LAGL3	2	LYMI	1	PLCHH	10	PLCHH	10
			PLCHH	30	PLCHH	20	MALE	1	MALE	9	POMO	1	STAJ	20
			STAJ	5	POMO	20	PLCHH	3	PLCHH	16	STAJ	2	TH	5
			TH	5	STAJ	5	POMO	1	POMO	16	TRSC	2	BG	35
			BG	5	TH	35	STAJ	5	RUCR	16	TH	20		
							TH	25	STAJ	2	BG	2		
							BG	3	TH	5				
									BG	5				
			TOTAL	**100**	**TOTAL**	**100**	**TOTAL**	**100**	**TOTAL**	**100**	**TOTAL**	**100**	**TOTAL**	**100**

Transect #	Transect Length	Relative % Cover of Wetland	Quadrat #1		Quadrat #2		Quadrat #3		Quadrat #4		Quadrat #5		Quadrat #6	
			Species	% Cover	Species	% Cover	Species	% Cover	Species	% Cover	Species	% Cover	Species	% Cover
3	10 m		ELACA	15	JUPH	70	ELACA	5	ELACA	15	BAPI	5	ELACA	35
			JUPH	50	LYAR	1	GAUS	2	ERAR12	1	ERAR12	20	ERAR12	10
			LYHY	5	LYHY	4	JUPH	42	JUPH	25	JUPH	40	JUBUB	3
			MALE	10	LYMI	1	LYHY	5	LYHY	10	LYHY	5	JUPH	10
			POMO	10	MALE	3	MAGR	10	MALE	5	MALE	5	LYHY	25
			RUSA	5	POMO	1	MALE	1	POMO	3	POMO	5	LYMI	1
			TH	5	TH	10	POMO	5	STAJ	1	STAJ	5	POMO	1
					BG	10	TH	10	TH	15	TH	10	TH	10
							BG	20	BG	25	BG	5	BG	5
			TOTAL	**100**	**TOTAL**	**100**	**TOTAL**	**100**	**TOTAL**	**100**	**TOTAL**	**100**	**TOTAL**	**100**

Transect #	Transect Length	Relative % Cover of Wetland	Quadrat #1		Quadrat #2		Quadrat #3		Quadrat #4		Quadrat #5		Quadrat #6	
			Species	% Cover	Species	% Cover	Species	% Cover	Species	% Cover	Species	% Cover	Species	% Cover
4	10 m		ACAMA	1	ACAMA	1	ACAMA	3	ACAMA	3	ACMI	1	ACMI	5
			AICA	5	AICA	25	DEDA	15	CAAMA3	5	AICA	10	AICA	10
			CAAMA3	1	BRMI	5	JUBA	10	DEDA	32	BAPI	1	ERAR12	6
			ERAR12	15	FEBR	7	JUPH	5	GAUS	3	BRMI	10	GAUS	2
			FEBR	5	HYGL	3	MAGR	35	JUPH	10	FEBR	10	JUPH	2
			HYGL	15	JUBUB	1	STAJ	2	LYAR	2	GAUS	1	MAGR	20
			JUPH	10	JUPH	2	TH	15	LYHY	2	HYGL	15	MASA	5
			LYHY	1	LYMI	1	BG	15	MAGR	33	JUBUB	1	TH	40
			MAGR	10	MAGR	25			TH	10	MAGR	15	BG	10
			TH	32	TH	20					MASA	1		
			BG	5	BG	10					TH	20		
											BG	15		
			TOTAL	**100**	**TOTAL**	**100**	**TOTAL**	**100**	**TOTAL**	**100**	**TOTAL**	**100**	**TOTAL**	**100**

Pond 41 2023 Species List					
Species Name	**Common Name**	**Species Code**	**Species Name**	**Common Name**	**Species Code**
Achillea millefolium	common yarrow	ACMI	*Lasthenia glaberrima*	smooth goldfields	LAGL3
Acmispon americanus var. americanus	Spanish lotus	ACAMA	*Lysimachia arvensis*	scarlet pimpernel	LYAR
Agrostis pallens	seashore bent grass	AGPA	*Lysimachia minima*	chaffweed	LYMI
Aira caryophyllea	silvery hair-grass	AICA	*Lythrum hyssopifolia*	grass poly	LYHY
Avena barbata	slender wild oat	AVBA	*Madia elegans*	common madia	MAEL
Baccharis pilularis	coyote brush	BAPI	*Madia gracilis*	gumweed	MAGR
Briza maxima	rattlesnake grass	BRMA	*Madia sativa*	coast tarweed	MASA
Briza minor	annual quaking grass	BRMI	*Malvella leprosa*	alkali mallow	MALE
Bromus hordeaceus	soft chess	BRHO	*Plagiobothrys chorisianus* var. hickmanii	Hickman's popcornflower	PLCHH
Castilleja ambigua ssp. ambigua	Johnny-Nip	CAAMA3	*Plantago coronopus*	cut-leaved plantain	PLCO
Daucus pusillus	rattlesnake weed	DAPU	*Polypogon monspeliensis*	rabbitfoot grass	POMO
Deschampsia danthonioides	annual hair grass	DEDA	*Pseudognaphalium luteoalbum*	weedy cudweed	PSLU
Eleocharis acicularis var. acicularis	needle spikerush	ELACA	*Pseudognaphalium stramineum*	cottonbatting plant	PSST
Eleocharis macrostachya	pale spikerush	ELMA	*Quercus agrifolia*	coast live oak	QUAG
Elymus glaucus	blue wild-rye	ELGL	*Rumex acetosella*	sheep sorrel	RUAC
Elymus triticoides	beardless wild rye	ELTR3	*Rumex crispus*	curly dock	RUCR
Erodium botrys	long-beaked filaree	ERBO	*Rumex salicifolius*	willow dock	RUSA
Eryngium armatum	coyote thistle	ERAR12	*Sonchus asper*	prickly sow thistle	SOAS
Festuca bromoides	brome fescue	FEBR	*Sonchus oleraceus*	common sow thistle	SOOL
Gamochaeta ustulata	purple cudweed	GAUS	*Stachys ajugoides*	bugle hedge nettle	STAJ
Geranium dissectum	cut-leaved geranium	GEDI	*Toxicodendron diversilobum*	poison oak	TODI
Heteromeles arbutifolia	toyon	HEAR	*Triglochin scilloides*	flowering quillwort	TRSC
Hypochaeris glabra	smooth cat's-ear	HYGL	*Verbena lasiostachys* var. lasiostachys	western vervain	VELAL
Hypochaeris radicata	rough cat's-ear	HYRA	*Zeltnera davyi*	Davy's centuary	ZEDA
Isoetes howellii	Howell's quillwort	ISHO	**Groundcover Codes**		
Juncus balticus	Baltic rush	JUBA	BG	Bare Ground	
Juncus bufonius var. bufonius	common toad rush	JUBUB	TH	Thatch/Duff	
Juncus phaeocephalus	brown-headed rush	JUPH	AL	Algae	

**Table A-18. Pond 42 (Year 5 Post-Subsurface Munitions Remediation)
Wetland Vegetation Transect Data by Stratum**

POND 42			
Date	8/3/2023		
Surveying Personnel	USACE		
Vegetation Type	**% Cover**	**Species**	**Notes**
Emergent Vegetation			
Floating Vegetation			
Submerged Vegetation			
Open Water			
Notes			
Pond 42 exhibited peripheral ponding in December and then held water from January through April of the 2022-2023 water-year (Chenega, 2024). Strata 1 through 4 were repeated from 2017-2022. Stratum 5 was repeated from 2019-2022. Transects 1, 3, 4, and 5 were relocated because the previous locations were no longer within the correct strata. Transect 2 was relocated to a more representative location.			

Transect #	Transect Length	Relative % Cover of Wetland	Quadrat #1		Quadrat #2		Quadrat #3	
			Species	% Cover	Species	% Cover	Species	% Cover
1	5 m		ERAR12	30	ELACA	18	DEDA	8
			BRTET	10	ERAR12	20	ELACA	24
			DEDA	1	LYHY	10	ERAR12	25
			ELACA	20	PLCHH	12	LYHY	5
			JUPH	20	POMO	15	PLCHH	12
			LYHY	10	TH	16	POMO	6
			PLCHH	5	BG	9	TH	15
			TH	4			BG	5
			TOTAL	**100**	**TOTAL**	**100**	**TOTAL**	**100**

Transect #	Transect Length	Relative % Cover of Wetland	Quadrat #1		Quadrat #2		Quadrat #3	
			Species	% Cover	Species	% Cover	Species	% Cover
2	5 m		ELMA	48	ELMA	90	ELMA	82
			LYHY	20	KOMA	1	KOMA	3
			POMO	30	POMO	9	LYHY	2
			TH	1			POMO	8
			BG	1			TH	3
							BG	2
			TOTAL	**100**	**TOTAL**	**100**	**TOTAL**	**100**

Transect #	Transect Length	Relative % Cover of Wetland	Quadrat #1		Quadrat #2		Quadrat #3	
			Species	% Cover	Species	% Cover	Species	% Cover
3	5 m		ELACA	15	DEDA	2	DEDA	2
			ERAR12	10	ELACA	17	ELACA	25
			JUPH	40	ERAR12	20	ERAR12	15
			LYHY	25	JUPH	4	JUPH	13
			POMO	5	LYAR	1	LYAR	7
			TH	1	LYHY	10	LYHY	10
			BG	4	POMO	6	POMO	18
					BG	40	TH	1
							BG	9
			TOTAL	**100**	**TOTAL**	**100**	**TOTAL**	**100**

Transect #	Transect Length	Relative % Cover of Wetland	Quadrat #1		Quadrat #2		Quadrat #3	
			Species	% Cover	Species	% Cover	Species	% Cover
4	5 m		AVBA	3	AVBA	5	AGAV	10
			BRMA	30	BRMA	3	AVBA	5
			BRMI	3	LYAR	10	DECO	30
			DECO	20	MAGR	8	HYGL	5
			DEDA	1	HYGL	2	ISHO	8
			ELGL	1	AGAV	10	JUBUB	12
			HYGL	1	LYHY	1	KOMA	3
			JUBUB	2	ELGL	8	LYHY	2
			LYHY	4	TRIX	8	MAGR	5
			MAGR	15	TRAN	5	PLCO	8
			PLCO	5	BRMI	5	TRIX	8
			RUAC	1	KOMA	10	TH	2
			TRIX	1	DECO	10	BG	2
			BG	10	BG	10		
			TH	3	TH	5		
			TOTAL	**100**	**TOTAL**	**100**	**TOTAL**	**100**

Transect #	Transect Length	Relative % Cover of Wetland	Quadrat #1		Quadrat #2		Quadrat #3	
			Species	% Cover	Species	% Cover	Species	% Cover
5	5 m		COCO	14	COCO	5	COCO	2
			POMO	20	POMO	7	POMO	40
			PSLU	1	PSLU	2	PSLU	2
			TH	65	SEGL	1	SEGL	4
					TH	83	TH	44
					BG	2	BG	8
			TOTAL	**100**	**TOTAL**	**100**	**TOTAL**	**100**

Pond 42 2023 Species List

Species Name	Common Name	Species Code
Achillea millefolium	common yarrow	ACMI
Adenostoma fasciculatum	chamise	ADFA
Agrostis avenacea	Pacific bent grass	AGAV
Arctostaphylos hookeri	Hooker's manzanita	ARHO
Avena barbata	slender wild oat	AVBA
Baccharis pilularis	coyote brush	BAPI
Briza maxima	rattlesnake grass	BRMA
Briza minor	annual quaking grass	BRMI
Brodiaea terrestris ssp. terrestris	dwarf brodiaea	BRTET
Bromus hordeaceus	soft chess	BRHO
Carpobrotus edulis	ice plant	CAED
Castilleja ambigua ssp. ambigua	Johnny-Nip	CAAMA3
Cotula coronopifolia	brass buttons	COCO
Deinandra corymbosa	coastal tarweed	DECO
Deschampsia danthonioides	annual hair grass	DEDA
Diplacus aurantiacus	sticky monkey flower	DIAU
Eleocharis acicularis var. acicularis	needle spikerush	ELACA
Eleocharis macrostachya	pale spikerush	ELMA
Elymus glaucus	blue wild-rye	ELGL
Eriodictyon californicum	yerba santa	ERCA6
Eryngium armatum	coyote thistle	ERAR12
Heteromeles arbutifolia	toyon	HEAR
Horkelia cuneata var. cuneata	wedge-leaved horkelia	HOCUC
Hypochaeris glabra	smooth cat's-ear	HYGL
Iris douglasiana	Douglas iris	IRDO
Isoetes howellii	Howell's quillwort	ISHO
Juncus bufonius var. bufonius	common toad rush	JUBUB
Juncus occidentalis	western rush	JUOC
Juncus phaeocephalus	brown-headed rush	JUPH
Koeleria macrantha	June grass	KOMA
Lasthenia glaberrima	smooth goldfields	LAGL3
Lysimachia arvensis	scarlet pimpernel	LYAR
Lythrum hyssopifolia	grass poly	LYHY
Madia gracilis	gumweed	MAGR
Madia sativa	coast tarweed	MASA
Phalaris lemmonii	Lemmon's canary grass	PHLE
Plagiobothrys chorisianus var. hickmanii	Hickman's popcornflower	PLCHH
Plantago coronopus	cut-leaved plantain	PLCO
Plantago erecta	California plantain	PLER
Polypogon monspeliensis	rabbitfoot grass	POMO
Pseudognaphalium luteoalbum	weedy cudweed	PSLU
Quercus agrifolia	coast live oak	QUAG
Rubus ursinus	California blackberry	RUUR
Rumex acetosella	sheep sorrel	RUAC
Rumex salicifolius	willow dock	RUSA
Salix sp.	willow	SA sp.
Salvia mellifera	black sage	SAME
Senecio glomeratus	cutleaf burnweed	SEGL
Sisyrinchium bellum	western blue-eyed grass	SIBE
Sonchus asper	prickly sow thistle	SOAS
Sonchus oleraceus	common sow thistle	SOOL
Toxicodendron diversilobum	poison oak	TODI
Trifolium angustifolium	narrow-leaved clover	TRAN
Triteleia ixioides	coast pretty face	TRIX
Typha sp.	cattail	TY sp.

Groundcover Codes		
BG	Bare Ground	
TH	Thatch/Duff	
AL	Algae	

**Table A-19. Pond 61 (Year 5 Post-Subsurface Munitions Remediation)
Wetland Vegetation Transect Data by Stratum**

POND 61			
Date	6/7/2023		
Surveying Personnel	USACE		
Vegetation Type	**% Cover**	**Species**	**Notes**
Emergent Vegetation			
Floating Vegetation			
Submerged Vegetation			
Open Water			
Notes			
Pond 61 exhibited peripheral ponding from December through February and held water from January through April of the 2022-2023 water-year (Chenega, 2024). Stratum 1 was repeated from 2017-2021 while Strata 2, 3 and 4 were repeated from 2017-2022. Stratum 2 consisted of CCG and no transect was placed in this stratum. Transects 1, 3 and 4 were relocated because the previous locations were no longer in the correct strata.			

Transect #	Transect Length	Relative % Cover of Wetland	Quadrat #1		Quadrat #2		Quadrat #3		Quadrat #4		Quadrat #5		Quadrat #6	
			Species	% Cover	Species	% Cover	Species	% Cover	Species	% Cover	Species	% Cover	Species	% Cover
1	10 m		COCO	1	COCO	2	ERAR12	15	BRTET	1	DEDA	5	ERAR12	4
			DEDA	15	ERAR12	10	HYGL	2	ERAR12	2	ERAR12	10	JUBUB	1
			ERAR12	10	JUPH	5	ISHO	7	HYGL	1	JUBUB	5	LYHY	20
			JUPH	5	LYHY	5	LYHY	10	JUPH	1	LYHY	10	PLCHH	25
			LYHY	10	LYMI	5	LYMI	5	LYHY	5	MIPA	5	PLCO	5
			PLCHH	30	PLCHH	5	PLCHH	1	LYMI	2	PLCHH	10	POMO	30
			POMO	15	PLCO	3	PLCO	5	PLCHH	5	PLCO	10	TH	5
			PSCH	5	POMO	40	POMO	20	PLCO	5	POMO	10	BG	10
			TH	4	PSCH	5	TH	15	POMO	31	PSCH	5		
			BG	5	TH	10	BG	20	PSCH	10	TH	5		
					BG	10			SO sp.	1	BG	25		
									TH	31				
									BG	5				
			TOTAL	**100**	**TOTAL**	**100**	**TOTAL**	**100**	**TOTAL**	**100**	**TOTAL**	**100**	**TOTAL**	**100**

Transect #	Transect Length	Relative % Cover of Wetland	Quadrat #1		Quadrat #2		Quadrat #3		Quadrat #4		Quadrat #5		Quadrat #6	
			Species	% Cover	Species	% Cover	Species	% Cover	Species	% Cover	Species	% Cover	Species	% Cover
3	10 m		BRMA	10	AGAV	2	BRMA	5	AGAV	1	BRMA	2	AICA	2
			BRTET	5	BRMA	5	DACA	10	BRMA	5	BRTET	4	AVBA	1
			FEBR	5	BRMI	5	HYGL	10	BRMI	1	CAAMA3	2	BRMA	10
			GEDI	1	BRTET	1	JUBU	5	BRTET	1	DACA	2	BRTET	10
			HYGL	5	CHPO	1	JUBUB	15	CAAMA3	1	ERAR12	5	HYGL	2
			JUBUB	5	DECO	1	LEPA	3	CADE	1	JUBUB	20	JUBUB	10
			JUPH	15	ERBO	1	LYAR	2	JUBU	1	JUCA	5	JUCA	10
			LYHY	20	HYGL	1	LYHY	30	JUBUB	25	LYAR	2	JUPH	15
			MIPA	2	JUBUB	5	TH	15	JUCA	5	LYHY	20	LEPA	5
			TRDU	10	JUBUC2	1	BG	5	JUPH	10	MASA	1	LYAR	5
			TRWI	2	JUCA	1			LEPA	1	TRDU	5	LYHY	15
			TH	15	JUPH	1			LYAR	1	TRIX	2	MASA	3
			BG	5	LYHY	28			LYHY	25	TH	25	TRIX	2
					MIPA	11			MIPA	1	BG	5	BG	10
					PLCHH	2			TRWI	1				
					RACA	1			TH	15				
					TH	28			BG	5				
					BG	5								
			TOTAL	**100**	**TOTAL**	**100**	**TOTAL**	**100**	**TOTAL**	**100**	**TOTAL**	**100**	**TOTAL**	**100**

Transect #	Transect Length	Relative % Cover of Wetland	Quadrat #1		Quadrat #2		Quadrat #3	
			Species	% Cover	Species	% Cover	Species	% Cover
4	5 m		ACPA	1	ACMI	6	ACPA	2
			AICA	5	BRMA	15	AICA	3
			BRMA	22	DACA	5	BRMA	23
			BRMI	1	ERBO	5	BRMI	1
			DACA	5	GEDI	5	ERBO	1
			ERAR12	4	JUPH	15	GEDI	1
			ERBO	2	LYAR	10	HYGL	2
			FEBR	3	MASA	5	JUPH	24
			HYGL	5	MIPA	1	LYAR	5
			JUBUB	1	RACA	2	LYHY	3
			JUOC	2	SIBE	5	MASA	1
			JUPH	23	SIMAM	5	MIPA	1
			LYAR	2	TRIX	5	SIMAM	1
			LYHY	2	TH	15	TH	23
			MASA	1	BG	1	BG	9
			MIPA	1				
			SIMAM	5				
			TH	10				
			BG	5				
			TOTAL	**100**	**TOTAL**	**100**	**TOTAL**	**100**

Pond 61 2023 Species List					
Species Name	**Common Name**	**Species Code**	**Species Name**	**Common Name**	**Species Code**
Achillea millefolium	common yarrow	ACMI	*Juncus capitatus*	dwarf rush	JUCA
Acmispon parviflorus	hill lotus	ACPA	*Juncus occidentalis*	western rush	JUOC
Agrostis avenacea	Pacific bent grass	AGAV	*Juncus phaeocephalus*	brown-headed rush	JUPH
Agrostis pallens	seashore bent grass	AGPA	*Lasthenia conjugens*	Contra Costa goldfields	LACO
Aira caryophyllea	silvery hair-grass	AICA	*Leptosiphon parviflorus*	variable linanthus	LEPA
Arctostaphylos tomentosa	woolly leaf manzanita	ARTO	*Logfia gallica*	narrowleaf cottonrose	LOGA
Avena barbata	slender wild oat	AVBA	*Lupinus nanus*	sky lupine	LUNA
Avena fatua	wild oat	AVFA	*Lysimachia arvensis*	scarlet pimpernel	LYAR
Baccharis pilularis	coyote brush	BAPI	*Lysimachia minima*	chaffweed	LYMI
Briza maxima	rattlesnake grass	BRMA	*Lythrum hyssopifolia*	grass poly	LYHY
Briza minor	annual quaking grass	BRMI	*Madia sativa*	coast tarweed	MASA
Brodiaea terrestris ssp. terrestris	dwarf brodiaea	BRTET	*Microseris paludosa*	marsh microseris	MIPA
Bromus diandrus	ripgut grass	BRDI	*Plagiobothrys chorisianus* var. hickmanii	Hickman's popcornflower	PLCHH
Bromus hordeaceus	soft chess	BRHO	*Plantago coronopus*	cut-leaved plantain	PLCO
Castilleja ambigua ssp. ambigua	Johnny-Nip	CAAMA3	*Polypogon monspeliensis*	rabbitfoot grass	POMO
Castilleja densiflora	dense flower owl's clover	CADE	*Psilocarphus chilensis*	round woolly-marbles	PSCH
Chlorogalum pomeridianum	wavyleaf soap plant	CHPO	*Quercus agrifolia*	coast live oak	QUAG
Cotula coronopifolia	brass buttons	COCO	*Ranunculus californicus*	California buttercup	RACA
Danthonia californica	California oat grass	DACA	*Senecio glomeratus*	cutleaf burnweed	SEGL
Deinandra corymbosa	coastal tarweed	DECO	*Sidalcea malviflora* ssp. malviflora	checkerbloom	SIMAM
Deschampsia danthonioides	annual hair grass	DEDA	*Silene gallica*	small-flower catchfly	SIGA
Dichelostemma capitatum ssp. capitatum	bluedicks	DICAC	*Sisyrinchium bellum*	western blue-eyed grass	SIBE
Eleocharis acicularis var. acicularis	needle spikerush	ELACA	*Sonchus* sp.	sow thistle	SO sp.
Eleocharis macrostachya	pale spikerush	ELMA	*Sonchus asper*	prickly sow thistle	SOAS
Erodium botrys	long-beaked filaree	ERBO	*Toxicodendron diversilobum*	poison oak	TODI
Eryngium armatum	coyote thistle	ERAR12	*Trifolium dubium*	little hop clover	TRDU
Festuca bromoides	brome fescue	FEBR	*Trifolium willdenovii*	tomcat clover	TRWI
Gamochaeta ustulata	purple cudweed	GAUS	*Triteleia hyacinthina*	white brodiaea	TRHY3
Geranium dissectum	cut-leaved geranium	GEDI	*Triteleia ixioides*	coast pretty face	TRIX
Hypochaeris glabra	smooth cat's-ear	HYGL	*Zeltnera davyi*	Davy's centuary	ZEDA
Isoetes howellii	Howell's quillwort	ISHO	**Groundcover Codes**		
Juncus bufonius	toad rush	JUBU	BG	Bare Ground	
Juncus bufonius var. bufonius	common toad rush	JUBUB	TH	Thatch/Duff	
Juncus bufonius var. congestus	clustered toad rush	JUBUC2	AL	Algae	

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APPENDIX B

Stratum Cover by Vernal Pool

Table B-1. Pond 5 (Reference) Wetland Vegetation Cover by Stratum

POND 5				
Stratum	**Relative % Cover of Wetland**	**Species Code**	**Species Common Name**	**% Cover**
1 (inundated)	**62%**	-	-	-
2	**18%**	DISP	salt grass	3.0
		ELMA	pale spikerush	64.3
		GNPA	lowland cudweed	0.3
		LYHY	grass poly	1.8
		PLCHH	Hickman's popcornflower	0.5
		POMO	rabbitfoot grass	0.8
		RUAC	sheep sorrel	2.8
		STAJ	bugle hedge nettle	4.3
		TH	Thatch	6.2
		BG	Bare Ground	15.8
		TOTAL		**100.0**
3	**18%**	AGAV	Pacific bent grass	4.2
		AVBA	slender wild oat	0.2
		BRHO	soft chess	0.2
		BRMI	annual quaking grass	3.0
		DISP	salt grass	13.3
		ERCA	horseweed	3.2
		FEBR	brome fescue	0.2
		GNPA	lowland cudweed	7.0
		HYGL	smooth cat's-ear	0.5
		JUBA	Baltic rush	0.8
		LYAR	scarlet pimpernel	0.2
		LYHY	grass poly	19.0
		LYMI	chaffweed	5.3
		PHLE	Lemmon's canary grass	12.8
		POMO	rabbitfoot grass	7.8
		PSLU	weedy cudweed	2.7
		PSST	cottonbatting plant	2.7
		RUAC	sheep sorrel	0.7
		SOOL	common sow thistle	0.2
		STAJ	bugle hedge nettle	0.8
		TH	Thatch	9.3
		BG	Bare Ground	6.0
		TOTAL		**100.0**

Table B-1 (continued). Pond 5 (Reference) Wetland Vegetation Cover by Stratum

POND 5				
Stratum	**Relative % Cover of Wetland**	**Species Code**	**Species Common Name**	**% Cover**
9	**2%**	CRAQ	aquatic pygmy-weed	0.3
		ELMA	pale spikerush	1.3
		ISHO	Howell's quillwort	43.3
		STAJ	bugle hedge nettle	2.3
		TH	Thatch	36.7
		BG	Bare Ground	16.0
		TOTAL		**100.0**

Table B-2. Pond 101 East (East) (Reference) Wetland Vegetation Cover by Stratum

POND 101 East (East)				
Stratum	**Relative % Cover of Wetland**	**Species Code**	**Species Common Name**	**% Cover**
2 (Inundated)	**53%**	-	-	-
4	**21%**	AGAV	Pacific bent grass	3.5
		CYER	tall cyperus	13.3
		ECCR	barnyard grass	0.2
		ELACA	needle spikerush	14.2
		ERBO	long-beaked filaree	0.5
		ERCA	horseweed	2.5
		GNPA	lowland cudweed	34.2
		HECUO	Chinese pusley	0.2
		JUPH	brown-headed rush	4.2
		LYHY	grass poly	4.2
		PSLU	weedy cudweed	8.3
		ROCU	western yellowcress	0.8
		RUAC	sheep sorrel	4.3
		STAJ	bugle hedge nettle	2.3
		TH	Thatch	4.5
		BG	Bare Ground	2.8
		TOTAL		**100.0**
5	**26%**	AGAV	Pacific bent grass	34.2
		CYER	tall cyperus	2.2
		JUBA	Baltic rush	25.8
		LYHY	grass poly	2.5
		POMO	rabbitfoot grass	0.2
		RUAC	sheep sorrel	7.7
		TH	Thatch	1.3
		BG	Bare Ground	26.2
		TOTAL		**100.0**

Table B-3. Pond 997 (Reference) Wetland Vegetation Cover by Stratum

POND 997				
Stratum	**Relative % Cover of Wetland**	**Species Code**	**Species Common Name**	**% Cover**
1	**8%**	ERAR12	coyote thistle	13.3
		ISHO	Howell's quillwort	21.3
		JUPH	brown-headed rush	5.0
		PLCHH	Hickman's popcornflower	16.7
		POMO	rabbitfoot grass	5.0
		PSCH	round woolly-marbles	16.7
		TH	Thatch	15.0
		BG	Bare Ground	7.0
		TOTAL		**100.0**
2 (CCG)	**2%**	-	-	-
3	**58%**	BRDI	ripgut grass	1.7
		BRMA	rattlesnake grass	10.2
		BRMI	annual quaking grass	0.5
		BRTET	dwarf brodiaea	1.3
		CAAT	valley tassels	1.2
		DACA	California oat grass	0.7
		ELACA	needle spikerush	3.8
		ERAR12	coyote thistle	6.7
		ERBO	long-beaked filaree	4.0
		FEBR	brome fescue	2.5
		GEDI	cut-leaved geranium	1.2
		HYGL	smooth cat's-ear	1.8
		ISHO	Howell's quillwort	9.3
		JUBUB	common toad rush	7.5
		JUCA	dwarf rush	7.5
		JUPH	brown-headed rush	4.8
		LYHY	grass poly	14.7
		MIPA	marsh microseris	1.7
		PLCO	cut-leaved plantain	4.8
		RUAC	sheep sorrel	0.7
		UNK4	Unknown	1.7
		TH	Thatch	9.8
		BG	Bare Ground	2.3
		TOTAL		**100.3**

Table B-3 (continued). Pond 997 (Reference) Wetland Vegetation Cover by Stratum

POND 997				
Stratum	**Relative % Cover of Wetland**	**Species Code**	**Species Common Name**	**% Cover**
5	**32%**	BRMA	rattlesnake grass	23.7
		BRMI	annual quaking grass	1.7
		BRTET	dwarf brodiaea	0.3
		CAAT	valley tassels	0.3
		ERBO	long-beaked filaree	0.3
		GAPO	climbing bedstraw	0.3
		GEDI	cut-leaved geranium	0.3
		HYGL	smooth cat's-ear	5.7
		JUBUB	common toad rush	5.3
		JUPH	brown-headed rush	11.7
		LYAR	scarlet pimpernel	5.7
		LYHY	grass poly	11.7
		MIPA	marsh microseris	0.3
		PLCO	cut-leaved plantain	5.3
		SIMAM	checkerbloom	1.7
		TRDU	little hop clover	5.3
		TH	Thatch	18.7
		BG	Bare Ground	1.7
		TOTAL		**100.0**

Table B-4. Pond 21 (Year 1 Post-Mastication and Post-Subsurface Munitions Remediation) Wetland Vegetation Cover by Stratum

POND 21				
Stratum	**Relative % Cover of Wetland**	**Species Code**	**Species Common Name**	**% Cover**
1	**39%**	ERAR12	coyote thistle	48.3
		JUPH	brown-headed rush	14.0
		PLCHH	Hickman's popcornflower	1.0
		POMO	rabbitfoot grass	21.3
		RACA	California buttercup	0.3
		TH	Thatch	15.0
		TOTAL		**100.0**
2	**57%**	ELMA	pale spikerush	10.2
		ERAR12	coyote thistle	15.8
		GEDI	cut-leaved geranium	0.3
		HOBRB	meadow barley	1.2
		JUPH	brown-headed rush	56.7
		LYHY	grass poly	0.2
		MALE	alkali mallow	0.7
		PLCHH	Hickman's popcornflower	1.2
		POMO	rabbitfoot grass	3.8
		RACA	California buttercup	0.3
		TH	Thatch	8.7
		BG	Bare Ground	1.0
		TOTAL		**100.0**
3	**3%**	ACMI	common yarrow	1.0
		BAPI	coyote brush	5.0
		BRMI	annual quaking grass	6.0
		CABA	whiteroot	32.3
		DECO	coastal tarweed	15.3
		FEBR	brome fescue	0.7
		JUBUB	common toad rush	0.7
		LYAR	scarlet pimpernel	0.3
		POMO	rabbitfoot grass	0.3
		VELAL	western vervain	0.7
		TH	Thatch	34.3
		BG	Bare Ground	3.3
		TOTAL		**100.0**
Upland	**1%**	**-**	**-**	**-**

Table B-5. Pond 76 (Year 1 Post-Mastication) Wetland Vegetation Cover by Stratum

POND 76				
Stratum	**Relative % Cover of Wetland**	**Species Code**	**Species Common Name**	**% Cover**
1	**34%**	DEDA	annual hair grass	0.3
		ELACA	needle spikerush	19.3
		ELMA	pale spikerush	1.3
		ERAR12	coyote thistle	6.3
		JUPH	brown-headed rush	20.0
		LYHY	grass poly	0.3
		PLCHH	Hickman's popcornflower	13.8
		POMO	rabbitfoot grass	2.5
		TRSC	flowering quillwort	4.0
		TH	Thatch	12.5
		BG	Bare Ground	20.0
		TOTAL		**100.0**
2	**32%**	BAPI	coyote brush	0.7
		DEDA	annual hair grass	0.2
		ELACA	needle spikerush	9.0
		ERAR12	coyote thistle	14.2
		ISHO	Howell's quillwort	1.3
		JUPH	brown-headed rush	30.5
		LYHY	grass poly	0.3
		PLCHH	Hickman's popcornflower	0.5
		TRSC	flowering quillwort	3.3
		TH	Thatch	17.5
		BG	Bare Ground	22.5
		TOTAL		**100.0**

Table B-5 (continued). Pond 76 (Year 1 Post-Mastication)
Wetland Vegetation Cover by Stratum

POND 76				
Stratum	**Relative % Cover of Wetland**	**Species Code**	**Species Common Name**	**% Cover**
3	**34%**	AGEX	spike bent grass	3.3
		AICA	silvery hair-grass	3.3
		AR sp.	manzanita	3.3
		BAPI	coyote brush	3.7
		BRMI	annual quaking grass	6.0
		ELACA	needle spikerush	3.3
		ERAR12	coyote thistle	2.0
		FEBR	brome fescue	1.7
		FEMY	rattail sixweeks grass	2.0
		GAPO	climbing bedstraw	1.0
		HYGL	smooth cat’s-ear	0.7
		JUBA	Baltic rush	2.0
		JUOC	western rush	0.3
		JUPH	brown-headed rush	0.7
		LYAR	scarlet pimpernel	0.3
		LYHY	grass poly	2.3
		MAEX	small tarweed	0.3
		POMO	rabbitfoot grass	18.3
		TRMI	small head clover	0.3
		TH	Thatch	28.3
		BG	Bare Ground	16.7
		TOTAL		**100.0**

Table B-6. Pond 3 North (Year 5 Post-Subsurface Munitions Remediation) Wetland Vegetation Cover by Stratum

POND 3 NORTH				
Stratum	**Relative % Cover of Wetland**	**Species Code**	**Species Common Name**	**% Cover**
1	**12%**	ELACA	needle spikerush	1.3
		ELMA	pale spikerush	95.0
		TH	Thatch	3.5
		BG	Bare Ground	0.2
		TOTAL		**100.0**
2	**7%**	AICA	silvery hair-grass	1.3
		BRMI	annual quaking grass	2.3
		CAAM	Johnny-Nip	1.7
		DECO	coastal tarweed	10.0
		DEDA	annual hair grass	3.3
		ERAR12	coyote thistle	1.7
		FEBR	brome fescue	3.3
		FEPE	Italian rye grass	0.3
		JUBUB	common toad rush	15.0
		JUCA	dwarf rush	1.7
		JUPH	brown-headed rush	1.7
		LEPA	variable linanthus	1.7
		LYHY	grass poly	15.7
		PLCO	cut-leaved plantain	18.3
		TRAN	narrow-leaved clover	6.0
		ZEDA	Davy's centuary	1.7
		TH	Thatch	7.0
		BG	Bare Ground	7.3
		TOTAL		**100.0**
3	**44%**	AICA	silvery hair-grass	2.3
		DECO	coastal tarweed	36.7
		FEPE	Italian rye grass	6.7
		PLCO	cut-leaved plantain	7.3
		TRAN	narrow-leaved clover	23.3
		TH	Thatch	19.0
		BG	Bare Ground	4.7
		TOTAL		**100.0**
4 (CCG)	**36%**	-	-	-
Upland	**1%**	-	-	-

Table B-7. Pond 3 South (Year 5 Post-Subsurface Munitions Remediation) Wetland Vegetation Cover by Stratum

POND 3 SOUTH				
Stratum	**Relative % Cover of Wetland**	**Species Code**	**Species Common Name**	**% Cover**
1	**17%**	DEDA	annual hair grass	11.7
		ELACA	needle spikerush	2.5
		ELMA	pale spikerush	21.7
		ERAR12	coyote thistle	25.8
		JUPH	brown-headed rush	5.8
		LAGL3	smooth goldfields	5.0
		LYAR	scarlet pimpernel	0.8
		PLCHH	Hickman's popcornflower	10.0
		POMO	rabbitfoot grass	0.8
		TH	Thatch	8.3
		BG	Bare Ground	7.5
		TOTAL		**100.0**
2	**26%**	AICA	silvery hair-grass	3.7
		BRMI	annual quaking grass	2.0
		CAAM	Johnny-Nip	3.3
		CAAMA3	Johnny-Nip	3.3
		DECO	coastal tarweed	1.3
		ELACA	needle spikerush	7.7
		ERAR12	coyote thistle	3.3
		JUBUB	common toad rush	8.3
		JUBUC2	clustered toad rush	0.3
		JUCA	dwarf rush	1.0
		JUPH	brown-headed rush	13.3
		LYAR	scarlet pimpernel	2.0
		LYHY	grass poly	5.0
		LYMI	chaffweed	3.3
		PLCO	cut-leaved plantain	6.0
		POMO	rabbitfoot grass	1.7
		TRAN	narrow-leaved clover	6.7
		ZEDA	Davy's centuary	5.3
		TH	Thatch	2.3
		BG	Bare Ground	20.0
		TOTAL		**100.0**

Table B-7 (continued). Pond 3 South (Year 5 Post-Subsurface Munitions Remediation) Wetland Vegetation Cover by Stratum

POND 3 SOUTH				
Stratum	**Relative % Cover of Wetland**	**Species Code**	**Species Common Name**	**% Cover**
3	**50.6%**	BAPI	coyote brush	0.8
		BRHO	soft chess	2.7
		BRMI	annual quaking grass	11.0
		BRTET	dwarf brodiaea	1.7
		DECO	coastal tarweed	8.3
		ELMA	pale spikerush	1.7
		FEPE	Italian rye grass	16.0
		GEDI	cut-leaved geranium	5.0
		HOBRB	meadow barley	0.8
		HYRA	rough cat's-ear	0.8
		JUPH	brown-headed rush	7.7
		LYAR	scarlet pimpernel	1.7
		LYHY	grass poly	10.0
		MALE	alkali mallow	4.2
		MIPA	marsh microseris	1.7
		PEDU	hairypink	3.3
		RACA	California buttercup	1.7
		SIGA	small-flower catchfly	2.5
		STPU	purple needle grass	6.8
		TRAN	narrow-leaved clover	0.8
		ZEDA	Davy's centuary	0.8
		TH	Thatch	3.3
		BG	Bare Ground	6.7
		TOTAL		**100.0**
5 (CCG)	**0.4%**	**-**	**-**	**-**
Upland	**6%**	**-**	**-**	**-**

Table B-8. Pond 35 (Year 5 Post-Subsurface Munitions Remediation) Wetland Vegetation Cover by Stratum

POND 35				
Stratum	**Relative % Cover of Wetland**	**Species Code**	**Species Common Name**	**% Cover**
1	**19%**	COCO	brass buttons	0.2
		LYHY	grass poly	0.3
		PLCHH	Hickman's popcornflower	2.2
		PLCO	cut-leaved plantain	67.5
		PSCH	round woolly-marbles	3.3
		TRSC	flowering quillwort	6.7
		TH	Thatch	4.3
		BG	Bare Ground	15.5
		TOTAL		**100.0**
2	**44%**	LYHY	grass poly	0.2
		PLCO	cut-leaved plantain	55.2
		PSCH	round woolly-marbles	1.0
		SO sp.	sowthistle	0.2
		TR sp.	clover	0.5
		TH	Thatch	30.3
		BG	Bare Ground	12.7
		TOTAL		**100.0**
3	**22%**	AICA	silvery hair-grass	0.3
		BRTET	dwarf brodiaea	0.2
		CEME	Maltese star-thistle	0.2
		ELMA	pale spikerush	0.2
		FEPE	Italian rye grass	42.2
		GEDI	cut-leaved geranium	0.5
		HOBR	meadow barley	30.5
		HYGL	smooth cat's-ear	0.5
		LYHY	grass poly	1.3
		PLCHH	Hickman's popcornflower	4.2
		PLCO	cut-leaved plantain	5.7
		PSCH	round woolly-marbles	0.3
		TH	Thatch	12.2
		BG	Bare Ground	1.8
		TOTAL		**100.0**
4	**15%**	TRSC	flowering quillwort	1.7
		ELGL	blue wild-rye	5.0
		PLCO	cut-leaved plantain	0.3
		TH	Thatch	93.0
		TOTAL		**100.0**

Table B-9. Pond 43 (Year 5 Post-Subsurface Munitions Remediation) Wetland Vegetation Cover by Stratum

POND 43				
Stratum	**Relative % Cover of Wetland**	**Species Code**	**Species Common Name**	**% Cover**
1	**48%**	CRAQ	aquatic pygmy-weed	0.7
		ELACA	needle spikerush	0.7
		ERAR12	coyote thistle	5.2
		JUPH	brown-headed rush	4.5
		LYHY	grass poly	5.5
		LYMI	chaffweed	0.2
		PLCHH	Hickman's popcornflower	34.2
		POMO	rabbitfoot grass	4.0
		POZI	Sacramento mesa mint	2.8
		PSCH	round woolly-marbles	5.7
		TH	Thatch	14.2
		BG	Bare Ground	22.5
		TOTAL		**100.0**
2	**6%**	BRMI	annual quaking grass	1.3
		DACA	California oat grass	1.7
		DEDA	annual hair grass	1.0
		ELACA	needle spikerush	0.3
		ERAR12	coyote thistle	6.7
		JUBUB	common toad rush	4.0
		JUOC	western rush	1.0
		JUPH	brown-headed rush	10.0
		LYHY	grass poly	21.7
		PLCHH	Hickman's popcornflower	5.3
		POMO	rabbitfoot grass	16.3
		POZI	Sacramento mesa mint	0.3
		PSCH	round woolly-marbles	5.0
		SIBE	western blue-eyed grass	3.7
		TH	Thatch	11.7
		BG	Bare Ground	10.0
		TOTAL		**100.0**

Table B-9 (continued). Pond 43 (Year 5 Post-Subsurface Munitions Remediation)
Wetland Vegetation Cover by Stratum

POND 43				
Stratum	**Relative % Cover of Wetland**	**Species Code**	**Species Common Name**	**% Cover**
3	**45%**	AGEX	spike bent grass	5.3
		AGLAV	vernal pool bent grass	3.3
		BRHO	soft chess	2.0
		BRMI	annual quaking grass	0.7
		DACA	California oat grass	3.3
		ELGL	blue wild-rye	7.0
		HYGL	smooth cat's-ear	27.3
		JUBUB	common toad rush	9.3
		JUPH	brown-headed rush	0.7
		LYHY	grass poly	0.3
		MAEX	small tarweed	1.0
		MAGR	gumweed	5.0
		PLCO	cut-leaved plantain	12.0
		POMO	rabbitfoot grass	2.7
		POZI	Sacramento mesa mint	1.7
		ZEDA	Davy's centuary	1.7
		TH	Thatch	10.0
		BG	Bare Ground	6.7
		TOTAL		**100.0**
Upland	**1%**	**-**	**-**	**-**

Table B-10. Pond 44 (Year 5 Post-Subsurface Munitions Remediation) Wetland Vegetation Cover by Stratum

POND 44				
Stratum	**Relative % Cover of Wetland**	**Species Code**	**Species Common Name**	**% Cover**
1	**46%**	AGLAV	vernal pool bent grass	4.5
		DACA	California oat grass	0.3
		DEDA	annual hair grass	0.5
		ERAR12	coyote thistle	6.2
		JUPH	brown-headed rush	6.0
		LYHY	grass poly	13.7
		PLCHH	Hickman's popcornflower	28.3
		POMO	rabbitfoot grass	5.2
		PSCH	round woolly-marbles	5.8
		TH	Thatch	5.0
		BG	Bare Ground	24.5
		TOTAL		**100.0**
2	**25%**	BRTET	dwarf brodiaea	0.7
		CAAT	valley tassels	1.7
		ELACA	needle spikerush	1.0
		ERBO	long-beaked filaree	8.3
		FEBR	brome fescue	1.0
		GEDI	cut-leaved geranium	0.3
		HYGL	smooth cat's-ear	2.7
		JUBU	toad rush	3.3
		JUBUB	common toad rush	18.3
		JUBUC2	clustered toad rush	3.3
		JUCA	dwarf rush	2.7
		JUPH	brown-headed rush	1.7
		LYHY	grass poly	15.0
		MAGR	gumweed	2.3
		POMO	rabbitfoot grass	4.3
		TRMI	small head clover	1.7
		UNK36	Unknown	0.3
		TH	Thatch	13.3
		BG	Bare Ground	18.0
		TOTAL		**100.0**

Table B-10 (continued). Pond 44 (Year 5 Post-Subsurface Munitions Remediation) Wetland Vegetation Cover by Stratum

POND 44				
Stratum	**Relative % Cover of Wetland**	**Species Code**	**Species Common Name**	**% Cover**
3	**24%**	ACPA	hill lotus	0.7
		Unknown Annual Grass	Unknown Annual Grass	6.7
		ARCA11	California sagebrush	0.3
		BAPI	coyote brush	6.7
		BRDI	ripgut grass	0.7
		BRMA	rattlesnake grass	0.7
		CAAT	valley tassels	1.3
		DACA	California oat grass	0.3
		DEDA	annual hair grass	8.3
		ELGL	blue wild-rye	7.3
		ERAR12	coyote thistle	2.3
		ERBO	long-beaked filaree	0.7
		FEBR	brome fescue	1.0
		GEDI	cut-leaved geranium	0.3
		HOCU	wedge-leaved horkelia	3.3
		HYGL	smooth cat's-ear	1.3
		JUOC	western rush	0.7
		LYAR	scarlet pimpernel	2.7
		LYHY	grass poly	0.3
		MAGR	gumweed	5.3
		PLCO	cut-leaved plantain	4.0
		TRAN	narrow-leaved clover	1.7
		TRDU	little hop clover	15.7
		UNK36	Unknown	0.3
		VISAN	common vetch	0.3
		VI sp.	vetch	3.3
		TH	Thatch	10.0
		BG	Bare Ground	13.7
		TOTAL		**100.0**
Upland	**5%**	**-**	**-**	**-**

Table B-11. Pond 54 (Year 5 Post-Subsurface Munitions Remediation) Wetland Vegetation Cover by Stratum

POND 54				
Stratum	**Relative % Cover of Wetland**	**Species Code**	**Species Common Name**	**% Cover**
1	**59%**	ELMA	pale spikerush	68.5
		ISHO	Howell's quillwort	2.7
		JUPH	brown-headed rush	0.3
		LAGL3	smooth goldfields	2.0
		LYHY	grass poly	0.2
		MALE	alkali mallow	1.2
		PLCHH	Hickman's popcornflower	1.3
		POMO	rabbitfoot grass	1.5
		STAJ	bugle hedge nettle	0.8
		TH	Thatch	11.8
		BG	Bare Ground	9.7
		TOTAL		**100.0**
2	**13%**	ELACA	needle spikerush	32.3
		ELMA	pale spikerush	6.7
		HOBR	meadow barley	2.3
		HYRA	rough cat's-ear	0.2
		ISHO	Howell's quillwort	9.2
		JUPH	brown-headed rush	1.3
		LYHY	grass poly	0.2
		MALE	alkali mallow	1.3
		PLCHH	Hickman's popcornflower	4.5
		POMO	rabbitfoot grass	20.0
		STAJ	bugle hedge nettle	0.3
		TH	Thatch	20.5
		BG	Bare Ground	1.2
		TOTAL		**100.0**

Table B-11 (continued). Pond 54 (Year 5 Post-Subsurface Munitions Remediation)
Wetland Vegetation Cover by Stratum

POND 54				
Stratum	**Relative % Cover of Wetland**	**Species Code**	**Species Common Name**	**% Cover**
3	**24%**	ACMI	common yarrow	3.0
		ELACA	needle spikerush	25.7
		ERAR12	coyote thistle	2.3
		ERCA	horseweed	2.3
		GAUS	purple cudweed	3.0
		HYGL	smooth cat's-ear	1.2
		ISHO	Howell's quillwort	8.0
		JUBUB	common toad rush	0.3
		JUPH	brown-headed rush	5.0
		LYHY	grass poly	3.2
		LYMI	chaffweed	0.3
		POMO	rabbitfoot grass	4.7
		STAJ	bugle hedge nettle	1.0
		BG	Bare Ground	14.2
		TH	Thatch	25.8
		TOTAL		**100.0**
4	**3%**	ACMI	common yarrow	0.7
		BAPI	coyote brush	0.7
		CABA	whiteroot	46.7
		RUSA	willow dock	0.7
		SOOL	common sow thistle	0.3
		VELAL	western vervain	11.7
		TH	Thatch	39.3
		TOTAL		**100.0**
Upland	**1%**	-	-	-

Table B-12. Pond 60 (Year 5 Post-Subsurface Munitions Remediation) Wetland Vegetation Cover by Stratum

POND 60				
Stratum	**Relative % Cover of Wetland**	**Species Code**	**Species Common Name**	**% Cover**
1 (Inundated)	**6%**	-	-	-
1	**4%**	DISP	salt grass	1.7
		ELMA	pale spikerush	82.7
		TH	Thatch	6.7
		BG	Bare Ground	9.0
		TOTAL		**100.0**
2	**44%**	DISP	salt grass	19.7
		ELMA	pale spikerush	73.8
		TH	Thatch	6.2
		BG	Bare Ground	0.3
		TOTAL		**100.0**
3	**23%**	DISP	salt grass	8.7
		ERAR12	coyote thistle	0.3
		GAUS	purple cudweed	1.7
		HYGL	smooth cat's-ear	0.3
		JUPH	brown-headed rush	80.0
		LYHY	grass poly	4.0
		POMO	rabbitfoot grass	0.2
		STAJ	bugle hedge nettle	0.7
		BG	Bare Ground	1.0
		TH	Thatch	3.2
		TOTAL		**100.0**

Table B-12 (continued). Pond 60 (Year 5 Post-Subsurface Munitions Remediation) Wetland Vegetation Cover by Stratum

POND 60				
Stratum	**Relative % Cover of Wetland**	**Species Code**	**Species Common Name**	**% Cover**
4	**22%**	COCO	brass buttons	0.3
		DISP	salt grass	7.2
		ELMA	pale spikerush	26.5
		ERAR12	coyote thistle	0.2
		GAUS	purple cudweed	0.2
		GEDI	cut-leaved geranium	0.2
		JUPH	brown-headed rush	1.0
		LYAR	scarlet pimpernel	2.2
		LYHY	grass poly	0.3
		PLCHH	Hickman's popcornflower	0.8
		POMO	rabbitfoot grass	1.0
		STAJ	bugle hedge nettle	6.5
		TH	Thatch	49.2
		BG	Bare Ground	4.5
		TOTAL		**100.0**
Upland	**1%**	**-**	**-**	**-**

Table B-13. Pond 73 (Year 5 Post-Subsurface Munitions Remediation) Wetland Vegetation Cover by Stratum

POND 73				
Stratum	**Relative % Cover of Wetland**	**Species Code**	**Species Common Name**	**% Cover**
1	**55%**	DEDA	annual hair grass	0.8
		ELACA	needle spikerush	7.5
		ELMA	pale spikerush	19.2
		ERAR12	coyote thistle	4.2
		ISHO	Howell's quillwort	0.2
		JUPH	brown-headed rush	3.8
		LAGL3	smooth goldfields	18.2
		LYHY	grass poly	0.3
		PLCHH	Hickman's popcornflower	16.7
		POMO	rabbitfoot grass	1.3
		TRSC	flowering quillwort	2.8
		TH	Thatch	21.7
		BG	Bare Ground	3.3
		TOTAL		**100.0**
2	**35%**	DEDA	annual hair grass	0.3
		ELAC	needle spikerush	4.7
		ELACA	needle spikerush	1.3
		ERAR12	coyote thistle	12.7
		JUBUB	common toad rush	4.0
		JUPH	brown-headed rush	20.0
		LYHY	grass poly	26.7
		PLCHH	Hickman's popcornflower	0.3
		POMO	rabbitfoot grass	10.0
		PSCH	round woolly-marbles	1.7
		TH	Thatch	8.3
		BG	Bare Ground	10.0
		TOTAL		**100.0**

Table B-13 (continued). Pond 73 (Year 5 Post-Subsurface Munitions Remediation) Wetland Vegetation Cover by Stratum

POND 73				
Stratum	**Relative % Cover of Wetland**	**Species Code**	**Species Common Name**	**% Cover**
3	2%	ACAMA	Spanish lotus	6.7
		ADFA	chamise	5.0
		AICA	silvery hair-grass	6.7
		BAPI	coyote brush	5.0
		BRDI	ripgut grass	0.7
		BRMI	annual quaking grass	1.7
		CAAMA3	Johnny-Nip	6.7
		ERAR12	coyote thistle	5.7
		ERBO	long-beaked filaree	0.3
		ERCA	horseweed	4.0
		FEBR	brome fescue	3.7
		GAPO	climbing bedstraw	0.3
		GEDI	cut-leaved geranium	0.3
		HEAR	toyon	1.7
		HERA	western pearlflower	1.7
		HYGL	smooth cat's-ear	8.0
		JUBUB	common toad rush	2.3
		JUCA	dwarf rush	1.7
		JUPH	brown-headed rush	1.7
		LYAR	scarlet pimpernel	10.3
		LYHY	grass poly	3.3
		MIPA	marsh microseris	1.7
		PLER	California plantain	1.7
		POMO	rabbitfoot grass	2.3
		UNK36	Unknown	1.7
		TH	Thatch	11.7
		BG	Bare Ground	3.7
		TOTAL		**100.0**
Upland	**3%**	**-**	**-**	**-**

Table B-14. Pond 16 (Year 5 Post-Subsurface Munitions Remediation) Wetland Vegetation Cover by Stratum

POND 16				
Stratum	**Relative % Cover of Wetland**	**Species Code**	**Species Common Name**	**% Cover**
1 (Inundated)	**34%**	-	-	-
3	**23%**	ECCR	barnyard grass	1.3
		ELMA	pale spikerush	84.3
		GNPA	lowland cudweed	9.2
		HYRA	rough cat's-ear	1.0
		RUSA	willow dock	0.5
		SO sp.	sowthistle	0.5
		TH	Thatch	1.2
		BG	Bare Ground	2.0
		TOTAL		**100.0**
4	**15%**	CAPR	clustered field sedge	4.7
		JUBA	Baltic rush	39.8
		JUPH	brown-headed rush	30.2
		RUAC	sheep sorrel	0.8
		RUSA	willow dock	0.8
		RUUR	California blackberry	19.0
		SO sp.	sowthistle	1.2
		TH	Thatch	2.5
		BG	Bare Ground	1.0
		TOTAL		**100.0**
5	**23%**	CABA	whiteroot	69.7
		RUUR	California blackberry	8.5
		SOEL	West Coast Canada goldenrod	21.5
		TH	Thatch	0.3
		BG	Bare Ground	0.2
		TOTAL		**100.2**
6	**2%**	ERCA	horseweed	0.3
		GNPA	lowland cudweed	0.3
		JUBA	Baltic rush	92.7
		RUUR	California blackberry	1.7
		SOAM	small-flowered nightshade	0.3
		TH	Thatch	4.3
		BG	Bare Ground	0.3
		TOTAL		**100.0**

**Table B-14 (continued). Pond 16 (Year 5 Post-Subsurface Munitions Remediation)
Wetland Vegetation Cover by Stratum**

POND 16				
Stratum	**Relative % Cover of Wetland**	**Species**	**Species Common Name**	**% Cover**
7	**3%**	ECCR	barnyard grass	34.0
		CRSC2	swamp pricklegrass	28.3
		ELMA	pale spikerush	26.0
		HEEC	bristly oxtongue	0.7
		TH	Thatch	11.0
		TOTAL		**100.0**

Table B-15. Pond 39 (Year 5 Post-Subsurface Munitions Remediation) Wetland Vegetation Cover by Stratum

POND 39				
Stratum	**Relative % Cover of Wetland**	**Species Code**	**Species Common Name**	**% Cover**
1	**11%**	COCO	brass buttons	2.0
		ELMA	pale spikerush	27.7
		JUPH	brown-headed rush	7.7
		LYHY	grass poly	0.7
		PLCHH	Hickman's popcornflower	13.3
		PLCO	cut-leaved plantain	15.0
		PSCH	round woolly-marbles	0.3
		TH	Thatch	18.3
		BG	Bare Ground	15.0
		TOTAL		**100.0**
2	**18%**	ACAMA	Spanish lotus	1.3
		AICA	silvery hair-grass	0.3
		ARHO	Hooker's manzanita	0.3
		BAPI	coyote brush	1.7
		BRMI	annual quaking grass	11.0
		DACA	California oat grass	0.7
		ELACA	needle spikerush	3.3
		ERAR12	coyote thistle	0.3
		FEBR	brome fescue	0.3
		FEPE	Italian rye grass	1.7
		GEDI	cut-leaved geranium	0.7
		HYGL	smooth cat's-ear	0.7
		JUBU	toad rush	26.7
		JUBUC2	clustered toad rush	0.3
		JUEF	common rush	0.3
		JUOC	western rush	0.3
		JUPH	brown-headed rush	15.3
		LYAR	scarlet pimpernel	0.7
		LYHY	grass poly	2.3
		PLCO	cut-leaved plantain	9.0
		SIGA	small-flower catchfly	1.0
		TRAN	narrow-leaved clover	2.0
		TRDU	little hop clover	10.0
		TH	Thatch	3.3
		BG	Bare Ground	6.7
		TOTAL		**100.3**

**Table B-15 (continued). Pond 39 (Year 5 Post-Subsurface Munitions Remediation)
Wetland Vegetation Cover by Stratum**

POND 39				
Stratum	**Relative % Cover of Wetland**	**Species Code**	**Species Common Name**	**% Cover**
3	**35%**	ACAMA	Spanish lotus	0.2
		AICA	silvery hair-grass	0.2
		AVFA	wild oat	0.8
		BRMI	annual quaking grass	0.2
		BRTET	dwarf brodiaea	0.8
		DACA	California oat grass	0.2
		ERBO	long-beaked filaree	0.2
		FEPE	Italian rye grass	21.8
		GEDI	cut-leaved geranium	3.3
		JUBU	toad rush	0.8
		JUBUB	common toad rush	11.0
		JUPH	brown-headed rush	4.3
		KOMA	June grass	4.2
		LYHY	grass poly	7.5
		PLCO	cut-leaved plantain	1.2
		SOAS	prickly sow thistle	2.5
		TRAN	narrow-leaved clover	7.8
		UNK18	Unknown	1.3
		TH	Thatch	17.7
		BG	Bare Ground	14.0
		TOTAL		**100.0**

Table B-15 (continued). Pond 39 (Year 5 Post-Subsurface Munitions Remediation) Wetland Vegetation Cover by Stratum

POND 39				
Stratum	**Relative % Cover of Wetland**	**Species Code**	**Species Common Name**	**% Cover**
4	**29%**	BRMI	annual quaking grass	3.2
		CADE	dense flower owl's clover	0.3
		DECO	coastal tarweed	3.2
		ERBO	long-beaked filaree	0.2
		ERCA	horseweed	1.7
		FEBR	brome fescue	0.7
		FEPE	Italian rye grass	3.0
		GEDI	cut-leaved geranium	0.2
		HYGL	smooth cat's-ear	0.3
		JUBU	toad rush	1.7
		JUBUB	common toad rush	0.2
		JUOC	western rush	3.3
		LYAR	scarlet pimpernel	0.5
		LYHY	grass poly	0.2
		PLCO	cut-leaved plantain	4.3
		SIBE	western blue-eyed grass	0.2
		SIGA	small-flower catchfly	0.7
		STPU	purple needle grass	12.0
		TRAN	narrow-leaved clover	41.8
		TRDU	little hop clover	0.8
		TRIX	coast pretty face	0.3
		UNK23	Unknown	0.2
		VISAS	spring vetch	1.0
		ZEDA	Davy's centuary	0.5
		TH	Thatch	5.0
		BG	Bare Ground	15.0
		TOTAL		**100.3**
Upland	**7%**	**-**	**-**	**-**

Table B-16. Pond 40 South (Year 5 Post-Subsurface Munitions Remediation) Wetland Vegetation Cover by Stratum

POND 40 SOUTH				
Stratum	**Relative % Cover of Wetland**	**Species Code**	**Species Common Name**	**% Cover**
1	11%	ELMA	pale spikerush	26.7
		JUPH	brown-headed rush	1.0
		LYHY	grass poly	0.7
		LYMI	chaffweed	0.3
		PLCHH	Hickman's popcornflower	56.3
		PLCO	cut-leaved plantain	1.7
		TH	Thatch	7.7
		BG	Bare Ground	5.7
		TOTAL		**100.0**
2	30%	ACAMA	Spanish lotus	0.3
		AVFA	wild oat	0.3
		BRMI	annual quaking grass	2.0
		ERBO	long-beaked filaree	1.0
		FEBR	brome fescue	1.0
		FEPE	Italian rye grass	0.3
		GEDI	cut-leaved geranium	0.3
		HYGL	smooth cat's-ear	1.3
		JUBU	toad rush	1.7
		JUBUB	common toad rush	3.3
		JUCA	dwarf rush	1.7
		JUPH	brown-headed rush	25.0
		LYHY	grass poly	4.7
		PLCO	cut-leaved plantain	7.7
		RUAC	sheep sorrel	12.3
		SIGA	small-flower catchfly	1.0
		TRAN	narrow-leaved clover	19.0
		UNK18	Unknown	0.3
		TH	Thatch	8.3
		BG	Bare Ground	8.3
		TOTAL		**100.0**

Table B-16 (continued). Pond 40 South (Year 5 Post-Subsurface Munitions Remediation) Wetland Vegetation Cover by Stratum

POND 40 SOUTH				
Stratum	**Relative % Cover of Wetland**	**Species Code**	**Species Common Name**	**% Cover**
3	**36%**	AVBA	slender wild oat	2.3
		BRDI	ripgut grass	0.5
		BRHO	soft chess	2.2
		BRMI	annual quaking grass	0.5
		BRTET	dwarf brodiaea	0.3
		DECO	coastal tarweed	3.8
		ELGL	blue wild-rye	0.2
		ERBO	long-beaked filaree	0.3
		ERCA	horseweed	5.7
		FEBR	brome fescue	3.2
		FEPE	Italian rye grass	28.0
		GEDI	cut-leaved geranium	2.3
		HYGL	smooth cat's-ear	0.2
		JUOC	western rush	2.2
		KOMA	June grass	1.5
		MAGR	gumweed	0.7
		PLCO	cut-leaved plantain	1.0
		SIBE	western blue-eyed grass	0.5
		STPU	purple needle grass	1.7
		TRAN	narrow-leaved clover	10.3
		TRGR	pin point clover	0.3
		VISAS	spring vetch	0.2
		TH	Thatch	22.7
		BG	Bare Ground	9.2
		TOTAL		**99.7**

**Table B-16 (continued). Pond 40 South (Year 5 Post-Subsurface Munitions Remediation)
Wetland Vegetation Cover by Stratum**

POND 40 SOUTH				
Stratum	**Relative % Cover of Wetland**	**Species Code**	**Species Common Name**	**% Cover**
4	**20%**	AVBA	slender wild oat	0.3
		DECO	coastal tarweed	8.3
		DEDA	annual hair grass	1.7
		ERBO	long-beaked filaree	9.0
		FEBR	brome fescue	1.0
		FEPE	Italian rye grass	5.3
		HYGL	smooth cat's-ear	2.0
		KOMA	June grass	0.3
		MAGR	gumweed	19.3
		STPU	purple needle grass	1.7
		TRAN	narrow-leaved clover	16.3
		VISA	spring vetch	0.3
		TH	Thatch	19.7
		BG	Bare Ground	14.7
		TOTAL		**100.0**
Upland	**3%**	**-**	-	**-**

Table B-17. Pond 41 (Year 5 Post-Subsurface Munitions Remediation) Wetland Vegetation Cover by Stratum

POND 41				
Stratum	**Relative % Cover of Wetland**	**Species Code**	**Species Common Name**	**% Cover**
1	**16%**	ELACA	needle spikerush	2.5
		ELMA	pale spikerush	50.3
		ISHO	Howell's quillwort	1.7
		LAGL3	smooth goldfields	0.8
		PLCHH	Hickman's popcornflower	1.8
		POMO	rabbitfoot grass	1.7
		TRSC	flowering quillwort	0.3
		TH	Thatch	29.2
		BG	Bare Ground	11.7
		TOTAL		**100.0**
2	**57%**	ELACA	needle spikerush	20.8
		ELMA	pale spikerush	14.3
		JUPH	brown-headed rush	0.8
		LAGL3	smooth goldfields	5.7
		LYMI	chaffweed	0.2
		MALE	alkali mallow	3.3
		PLCHH	Hickman's popcornflower	14.8
		POMO	rabbitfoot grass	6.3
		RUCR	curly dock	2.7
		STAJ	bugle hedge nettle	6.5
		TRSC	flowering quillwort	0.3
		TH	Thatch	15.8
		BG	Bare Ground	8.3
		TOTAL		**100.0**

Table B-17 (continued). Pond 41 (Year 5 Post-Subsurface Munitions Remediation) Wetland Vegetation Cover by Stratum

POND 41				
Stratum	**Relative % Cover of Wetland**	**Species Code**	**Species Common Name**	**% Cover**
3	**20%**	BAPI	coyote brush	0.8
		ELACA	needle spikerush	11.7
		ERAR12	coyote thistle	5.2
		GAUS	purple cudweed	0.3
		JUBUB	common toad rush	0.5
		JUPH	brown-headed rush	39.5
		LYAR	scarlet pimpernel	0.2
		LYHY	grass poly	9.0
		LYMI	chaffweed	0.3
		MAGR	gumweed	1.7
		MALE	alkali mallow	4.0
		POMO	rabbitfoot grass	4.2
		RUSA	willow dock	0.8
		STAJ	bugle hedge nettle	1.0
		TH	Thatch	10.0
		BG	Bare Ground	10.8
		TOTAL		**100.0**

Table B-17 (continued). Pond 41 (Year 5 Post-Subsurface Munitions Remediation) Wetland Vegetation Cover by Stratum

POND 41				
Stratum	**Relative % Cover of Wetland**	**Species Code**	**Species Common Name**	**% Cover**
4	**4%**	ACAMA	Spanish lotus	1.3
		ACMI	common yarrow	1.0
		AICA	silvery hair-grass	8.3
		BAPI	coyote brush	0.2
		BRMI	annual quaking grass	2.5
		CAAMA3	Johnny-Nip	1.0
		DEDA	annual hair grass	7.8
		ERAR12	coyote thistle	3.5
		FEBR	brome fescue	3.7
		GAUS	purple cudweed	1.0
		HYGL	smooth cat's-ear	5.5
		JUBA	Baltic rush	1.7
		JUBUB	common toad rush	0.3
		JUPH	brown-headed rush	4.8
		LYAR	scarlet pimpernel	0.3
		LYHY	grass poly	0.5
		LYMI	chaffweed	0.2
		MAGR	gumweed	23.0
		MASA	coast tarweed	1.0
		STAJ	bugle hedge nettle	0.3
		TH	Thatch	22.8
		BG	Bare Ground	9.2
		TOTAL		**100.0**
Upland	**3%**	**-**	**-**	**-**

**Table B-18. Pond 42 (Year 5 Post-Subsurface Munitions Remediation)
Wetland Vegetation Cover by Stratum**

POND 42				
Stratum	**Relative % Cover of Wetland**	**Species Code**	**Species Common Name**	**% Cover**
1	**8%**	BRTET	dwarf brodiaea	3.3
		DEDA	annual hair grass	3.0
		ELACA	needle spikerush	20.7
		ERAR12	coyote thistle	25.0
		JUPH	brown-headed rush	6.7
		LYHY	grass poly	8.3
		PLCHH	Hickman's popcornflower	9.7
		POMO	rabbitfoot grass	7.0
		TH	Thatch	11.7
		BG	Bare Ground	4.7
		TOTAL		**100.0**
2	**8%**	ELMA	pale spikerush	73.3
		KOMA	June grass	1.3
		LYHY	grass poly	7.3
		POMO	rabbitfoot grass	15.7
		TH	Thatch	1.3
		BG	Bare Ground	1.0
		TOTAL		**100.0**
3	**36%**	DEDA	annual hair grass	1.3
		ELACA	needle spikerush	19.0
		ERAR12	coyote thistle	15.0
		JUPH	brown-headed rush	19.0
		LYAR	scarlet pimpernel	2.7
		LYHY	grass poly	15.0
		POMO	rabbitfoot grass	9.7
		TH	Thatch	0.7
		BG	Bare Ground	17.7
		TOTAL		**100.0**

Table B-18 (continued). Pond 42 (Year 5 Post-Subsurface Munitions Remediation) Wetland Vegetation Cover by Stratum

POND 42				
Stratum	**Relative % Cover of Wetland**	**Species Code**	**Species Common Name**	**% Cover**
4	**15%**	AGAV	Pacific bent grass	6.7
		AVBA	slender wild oat	4.3
		BRMA	rattlesnake grass	11.0
		BRMI	annual quaking grass	2.7
		DECO	coastal tarweed	20.0
		DEDA	annual hair grass	0.3
		ELGL	blue wild-rye	3.0
		HYGL	smooth cat's-ear	2.7
		ISHO	Howell's quillwort	2.7
		JUBUB	common toad rush	4.7
		KOMA	June grass	4.3
		LYAR	scarlet pimpernel	3.3
		LYHY	grass poly	2.3
		MAGR	gumweed	9.3
		PLCO	cut-leaved plantain	4.3
		RUAC	sheep sorrel	0.3
		TRAN	narrow-leaved clover	1.7
		TRIX	coast pretty face	5.7
		TH	Thatch	3.3
		BG	Bare Ground	7.3
		TOTAL		**100.0**
5	**13%**	COCO	brass buttons	7.0
		POMO	rabbitfoot grass	22.3
		PSLU	weedy cudweed	1.7
		SEGL	cutleaf burnweed	1.7
		TH	Thatch	64.0
		BG	Bare Ground	3.3
		TOTAL		**100.0**
Upland	**20%**	-	-	-

**Table B-19. Pond 61 (Year 5 Post-Subsurface Munitions Remediation)
Wetland Vegetation Cover by Stratum**

POND 61				
Stratum	**Relative % Cover of Wetland**	**Species Code**	**Species Common Name**	**% Cover**
1	**3%**	BRTET	dwarf brodiaea	0.2
		COCO	brass buttons	0.5
		DEDA	annual hair grass	3.3
		ERAR12	coyote thistle	8.5
		HYGL	smooth cat's-ear	0.5
		ISHO	Howell's quillwort	1.2
		JUBUB	common toad rush	1.0
		JUPH	brown-headed rush	1.8
		LYHY	grass poly	10.0
		LYMI	chaffweed	2.0
		MIPA	marsh microseris	0.8
		PLCHH	Hickman's popcornflower	12.7
		PLCO	cut-leaved plantain	4.7
		POMO	rabbitfoot grass	24.3
		PSCH	round woolly-marbles	4.2
		SO sp.	sowthistle	0.2
		TH	Thatch	11.7
		BG	Bare Ground	12.5
		TOTAL		**100.0**
2 (CCG)	**10%**	**-**	**-**	**-**

Table B-19 (continued). Pond 61 (Year 5 Post-Subsurface Munitions Remediation) Wetland Vegetation Cover by Stratum

POND 61				
Stratum	**Relative % Cover of Wetland**	**Species Code**	**Species Common Name**	**% Cover**
3	**52%**	AGAV	Pacific bent grass	0.5
		AICA	silvery hair-grass	0.3
		AVBA	slender wild oat	0.2
		BRMA	rattlesnake grass	6.2
		BRMI	annual quaking grass	1.0
		BRTET	dwarf brodiaea	3.5
		CAAMA3	Johnny-Nip	0.5
		CADE	dense flower owl's clover	0.2
		CHPO	wavyleaf soap plant	0.2
		DACA	California oat grass	2.0
		DECO	coastal tarweed	0.2
		ERAR12	coyote thistle	0.8
		ERBO	long-beaked filaree	0.2
		FEBR	brome fescue	0.8
		GEDI	cut-leaved geranium	0.2
		HYGL	smooth cat's-ear	3.0
		JUBU	toad rush	1.0
		JUBUB	common toad rush	13.3
		JUBUC2	clustered toad rush	0.2
		JUCA	dwarf rush	3.5
		JUPH	brown-headed rush	6.8
		LEPA	variable linanthus	1.5
		LYAR	scarlet pimpernel	1.7
		LYHY	grass poly	23.0
		MASA	coast tarweed	0.7
		MIPA	marsh microseris	2.3
		PLCHH	Hickman's popcornflower	0.3
		RACA	California buttercup	0.2
		TRDU	little hop clover	2.5
		TRIX	coast pretty face	0.7
		TRWI	tomcat clover	0.5
		TH	Thatch	16.3
		BG	Bare Ground	5.8
		TOTAL		**100.0**

Table B-19 (continued). Pond 61 (Year 5 Post-Subsurface Munitions Remediation)
Wetland Vegetation Cover by Stratum

POND 61				
Stratum	**Relative % Cover of Wetland**	**Species Code**	**Species Common Name**	**% Cover**
4	**23%**	ACMI	common yarrow	2.0
		ACPA	hill lotus	1.0
		AICA	silvery hair-grass	2.7
		BRMA	rattlesnake grass	20.0
		BRMI	annual quaking grass	0.7
		DACA	California oat grass	3.3
		ERAR12	coyote thistle	1.3
		ERBO	long-beaked filaree	2.7
		FEBR	brome fescue	1.0
		GEDI	cut-leaved geranium	2.0
		HYGL	smooth cat's-ear	2.3
		JUBUB	common toad rush	0.3
		JUOC	western rush	0.7
		JUPH	brown-headed rush	20.7
		LYAR	scarlet pimpernel	5.7
		LYHY	grass poly	1.7
		MASA	coast tarweed	2.3
		MIPA	marsh microseris	1.0
		RACA	California buttercup	0.7
		SIBE	western blue-eyed grass	1.7
		SIMAM	checkerbloom	3.7
		TRIX	coast pretty face	1.7
		TH	Thatch	16.0
		BG	Bare Ground	5.0
		TOTAL		**100.0**
Upland	**12%**	**-**	**-**	**-**

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APPENDIX C

Site Photos

Figure C-1. Pond 5 (Reference): Vegetation Photo Point (S) on 8/31/2023

Figure C-2. Pond 5 (Reference): Vegetation Photo Point (W) on 8/31/2023

Figure C-3. Pond 101 East (East) (Reference): Vegetation Photo Point on 8/29/2023

Figure C-4. Pond 997 (Reference): Vegetation Photo Point on 6/6/2023

Figure C-5. Pond 21 (Year 1 Post-Mastication): Vegetation Photo Point (NE) on 7/17/2023

Figure C-6. Pond 21 (Year 1 Post-Mastication): Vegetation Photo Point (SW) on 7/17/2023

Figure C-7. Pond 21 (Year 1 Post-Mastication): Vegetation Photo Point (B?) on 7/17/2023

Figure C-8. Pond 3 North (Year 5 Post-Subsurface Munitions Remediation): Vegetation Photo Point on 6/26/2023

Figure C-9. Pond 3 North (Year 5 Post-Subsurface Munitions Remediation): Vegetation Photo Point (NW) on 6/26/2023

Figure C-9 Pond 3 North (Year 5 Post-Subsurface Munitions Remediation): Vegetation Photo Point (SE) on 6/26/2023

Figure C-10 Pond 3 North (Year 5 Post-Subsurface Munitions Remediation): Vegetation Photo Point (SW) on 6/26/2023

Figure C-11. Pond 3 South (Year 5 Post-Subsurface Munitions Remediation): Vegetation Photo Point (NE) on 6/26/2023

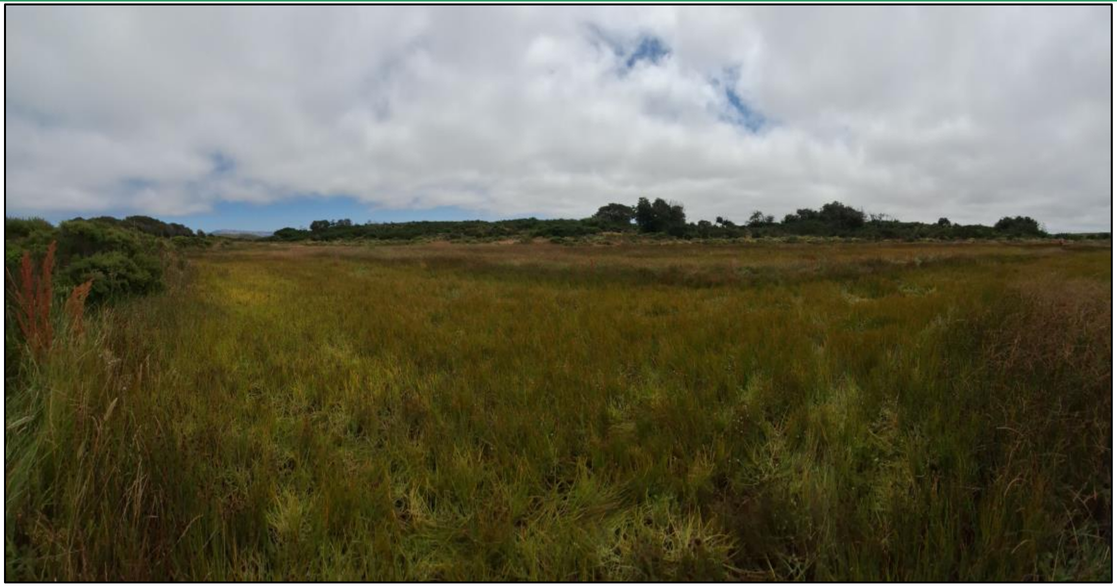

Figure C-12. Pond 3 South (Year 5 Post-Subsurface Munitions Remediation): Vegetation Photo Point (SW) on 6/26/2023

Figure C-13. Pond 35 (Year 5 Post-Subsurface Munitions Remediation): Vegetation Photo Point on 5/30/2023

Figure C-14. Pond 43 (Year 5 Post-Subsurface Munitions Remediation): Vegetation Photo Point (W) on 6/2/2023

Figure C-15. Pond 44 (Year 5 Post-Subsurface Munitions Remediation): Vegetation Photo Point on 6/5/2023


Figure C-16. Pond 54 (Year 5 Post-Subsurface Munitions Remediation): Vegetation Photo Point (NE) on 7/18/2023

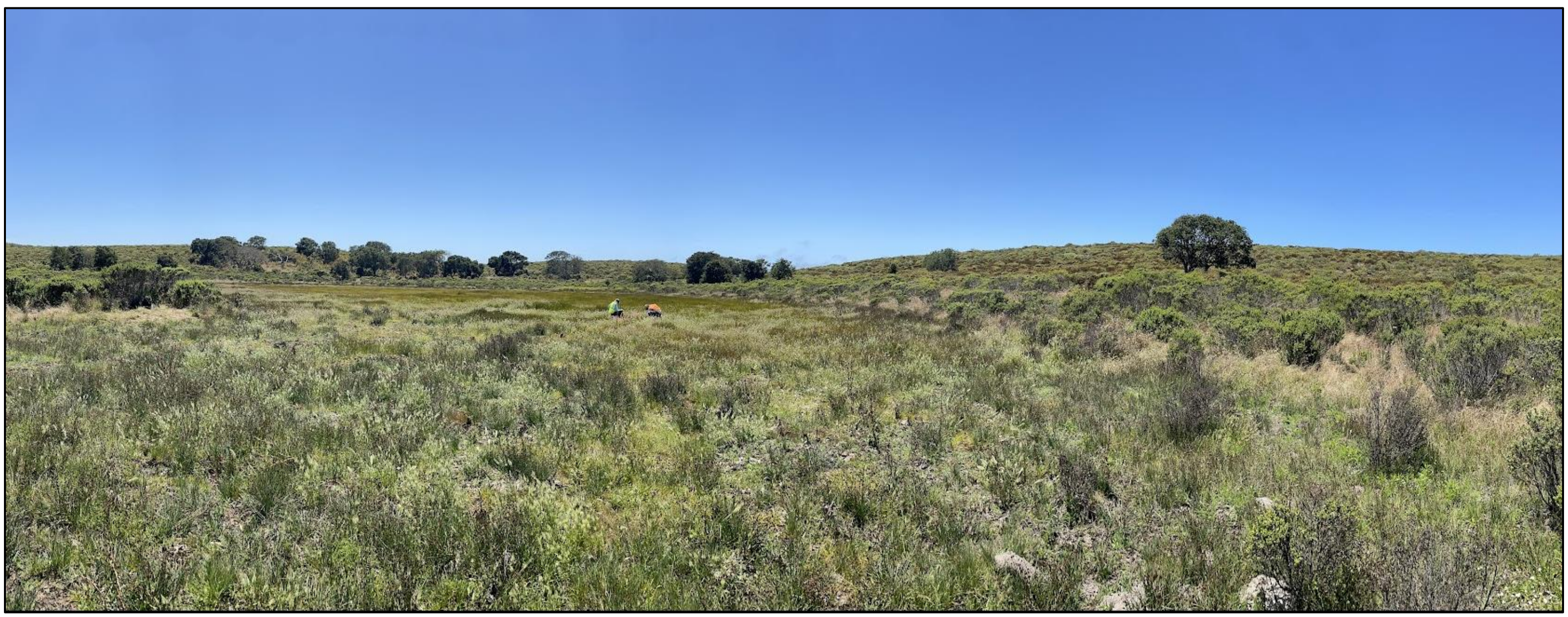
Figure C-17. Pond 54 (Year 5 Post-Subsurface Munitions Remediation): Vegetation Photo Point (SW) on 7/18/2023

Figure C-18. Pond 60 (Year 5 Post-Subsurface Munitions Remediation): Vegetation Photo Point on 8/28/2023

Figure C-19. Pond 73 (Year 5 Post-Subsurface Munitions Remediation): Vegetation Photo Point 1 on 6/9/2023

Figure C-20. Pond 73 (Year 5 Post-Subsurface Munitions Remediation): Vegetation Photo Point 2 on 6/9/2023

Figure C-21. Pond 73 (Year 5 Post-Subsurface Munitions Remediation): Vegetation Photo Point 3 on 6/9/2023

Figure C-22. Pond 16 (Year 5 Post-Subsurface Munitions Remediation): Vegetation Photo Point on 9/14/2023

Figure C-23. Pond 39 (Year 5 Post-Subsurface Munitions Remediation): Vegetation Photo Point (S) on 5/31/2023

Figure C-24. Pond 39 (Year 5 Post-Subsurface Munitions Remediation): Vegetation Photo Point (SE) on 5/31/2023

Figure C-25. Pond 40 South (Year 5 Post-Subsurface Munitions Remediation): Vegetation Photo Point (N) on 6/1/2023

Figure C-26. Pond 40 South (Year 5 Post-Subsurface Munitions Remediation): View to the south from northern-most point of the pond on 6/1/2023

Figure C-27. Pond 41 (Year 5 Post-Subsurface Munitions Remediation): Vegetation Photo Point (SE) on 7/19/2023

Figure C-28. Pond 41 (Year 5 Post-Subsurface Munitions Remediation): Vegetation Photo Point (SW) on 7/19/2023

Figure C-29. Pond 42 (Year 5 Post-Subsurface Munitions Remediation): Vegetation Photo Point on 8/3/2023

Figure C-30. Pond 61 (Year 5 Post-Subsurface Munitions Remediation): Vegetation Photo Point (W) on 6/7/2023

Figure C-31. Pond 61 (Year 5 Post-Subsurface Munitions Remediation): Vegetation Photo Point (E) on 6/7/2023

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APPENDIX D

Vegetation Species Richness of Native and Non-Native Species and Wetland Indicator Category by Vernal Pool

Table D-1. Pond 5 (Reference) Vegetation Species Richness of Native and Non-Native Species by Stratum

Pond 5			
Stratum	Native	Non-Native	Unidentified
2	5	3	0
3	8	12	0
9	4	0	0
Basin Total	**41**	**23**	**4**

Table D-2. Pond 101 East (East) (Reference) Vegetation Species Richness of Native and Non-Native Species by Stratum

Pond 101 East (East)			
Stratum	Native	Non-Native	Unidentified
5	8	6	0
6	2	4	0
Basin Total	**27**	**27**	**2**

Table D-3. Pond 997 (Reference) Vegetation Species Richness of Native and Non-Native Species by Stratum

Pond 997			
Stratum	Native	Non-Native	Unidentified
1	5	1	0
2	9	10	2
3	7	9	0
Basin Total	**27**	**21**	**1**

Table D-4. Pond 21 (Year 1 Post Mastication) Vegetation Species Richness of Native and Non-Native Species by Stratum

Pond 21			
Stratum	Native	Non-Native	Unidentified
1	4	1	0
2	7	3	0
4	6	4	0
Basin Total	**33**	**14**	**0**

Table D-5. Pond 76 (Year 1 Post Mastication) Vegetation Species Richness of Native and Non-Native Species by Stratum

Pond 76			
Stratum	Native	Non-Native	Unidentified
1	7	2	0
2	8	1	0
3	11	8	0
Basin Total	**23**	**10**	**0**

Table D-6. Pond 3 North (Year 5 Post-Subsurface Munitions Remediation) Vegetation Species Richness of Native and Non-Native Species by Stratum

Pond 3 North			
Stratum	Native	Non-Native	Unidentified
1	2	0	0
2	8	8	0
3	1	4	0
Basin Total	**24**	**18**	**0**

Table D-7. Pond 3 South (Year 5 Post-Subsurface Munitions Remediation) Vegetation Species Richness of Native and Non-Native Species by Stratum

Pond 3 South			
Stratum	Native	Non-Native	Unidentified
1	7	2	0
2	10	8	0
3	11	10	0
Basin Total	**43**	**24**	**0**

Table D-8. Pond 35 (Year 5 Post-Subsurface Munitions Remediation) Vegetation Species Richness of Native and Non-Native Species by Stratum

Pond 35			
Stratum	Native	Non-Native	Unidentified
1	3	3	0
2	2	6	1
3	2	9	0
4	7	12	0
Basin Total	**15**	**21**	**1**

Table D-9. Pond 43 (Year 5 Post-Subsurface Munitions Remediation) Vegetation Species Richness of Native and Non-Native Species by Stratum

Pond 43			
Stratum	Native	Non-Native	Unidentified
1	8	2	0
2	11	3	0
3	10	6	0
Basin Total	**30**	**11**	**0**

Table D-10. Pond 44 (Year 5 Post-Subsurface Munitions Remediation) Vegetation Species Richness of Native and Non-Native Species by Stratum

Pond 44			
Stratum	Native	Non-Native	Unidentified
1	7	2	0
2	9	7	1
3	11	12	3
Basin Total	**34**	**21**	**2**

Table D-11. Pond 54 (Year 5 Post-Subsurface Munitions Remediation) Vegetation Species Richness of Native and Non-Native Species by Stratum

Pond 54			
Stratum	Native	Non-Native	Unidentified
1	7	2	0
2	8	3	0
3	10	3	0
4	5	1	0
Basin Total	**36**	**16**	**2**

Table D-12. Pond 60 (Year 5 Post-Subsurface Munitions Remediation) Vegetation Species Richness of Native and Non-Native Species by Stratum

Pond 60			
Stratum	Native	Non-Native	Unidentified
1	2	0	0
2	2	0	0
3	5	3	0
4	7	5	0
Basin Total	**22**	**18**	**0**

Table D-13. Pond 73 (Year 5 Post-Subsurface Munitions Remediation) Vegetation Species Richness of Native and Non-Native Species by Stratum

Pond 73			
Stratum	Native	Non-Native	Unidentified
1	9	2	0
2	8	2	0
3	13	11	1
Basin Total	**29**	**16**	**2**

Table D-14. Pond 16 (Year 5 Post-Subsurface Munitions Remediation) Vegetation Species Richness of Native and Non-Native Species by Stratum

Pond 16			
Stratum	Native	Non-Native	Unidentified
3	3	3	0
4	5	2	0
5	3	0	0
6	5	0	0
7	1	3	0
Basin Total	**32**	**20**	**1**

Table D-15. Pond 39 (Year 5 Post-Subsurface Munitions Remediation) Vegetation Species Richness of Native and Non-Native Species by Stratum

Pond 39			
Stratum	Native	Non-Native	Unidentified
1	4	3	0
2	11	12	0
3	7	10	1
4	7	9	0
Basin Total	**39**	**28**	**2**

Table D-16. Pond 40 South (Year 5 Post-Subsurface Munitions Remediation) Vegetation Species Richness of Native and Non-Native Species by Stratum

Pond 40 South			
Stratum	Native	Non-Native	Unidentified
1	4	2	0
2	4	13	1
3	10	12	0
4	2	4	0
Basin Total	**30**	**29**	**1**

Table D-17. Pond 41 (Year 5 Post-Subsurface Munitions Remediation) Vegetation Species Richness of Native and Non-Native Species by Stratum

Pond 41			
Stratum	Native	Non-Native	Unidentified
1	6	1	0
2	9	2	0
3	11	3	0
4	14	6	0
Basin Total	**33**	**19**	**0**

Table D-18. Pond 42 (Year 5 Post-Subsurface Munitions Remediation) Vegetation Species Richness of Native and Non-Native Species by Stratum

Pond 42			
Stratum	Native	Non-Native	Unidentified
1	6	2	0
2	2	2	0
3	4	3	0
4	8	10	0
5	0	4	0
Basin Total	**35**	**18**	**2**

Table D-19. Pond 61 (Year 5 Post-Subsurface Munitions Remediation) Vegetation Species Richness of Native and Non-Native Species by Stratum

Pond 61			
Stratum	Native	Non-Native	Unidentified
1	10	6	0
2	18	13	0
3	13	9	0
Basin Total	**40**	**24**	**0**

Table D-20. Vegetation Species Richness of Native and Non-Native Species within Entire Vernal Pool Basin at Vernal Pools Monitored in 2023

Vernal Pool	Native	Non-Native	Unidentified	Total
5	41	23	4	68
101 East (East)	27	27	2	56
997	27	21	1	49
3 North	24	18	0	42
3 South	43	24	0	67
16	32	20	1	53
21	33	14	0	47
35	15	21	1	37
39	39	28	2	69
40 South	30	29	1	60
41	33	19	0	52
42	35	18	2	55
43	30	11	0	41
44	34	21	3	58
54	36	16	2	54
60	22	18	0	40
61	40	24	0	64
73	29	16	2	47
76	23	10	0	33

Table D-21. Pond 5 (Reference) Number of Wetland Plants by Indicator Category by Stratum

Pond 5						
Stratum	**OBL**	**FACW**	**FAC**	**FACU**	**UPL**	**NL**
2	4	3	0	1	0	0
3	2	7	3	3	1	4
9	4	0	0	0	0	0
Basin Total	**10**	**15**	**8**	**9**	**2**	**24**

Table D-22. Pond 101 East (East) (Reference) Number of Wetland Plants by Indicator Category by Stratum

Pond 101 East (East)						
Stratum	**OBL**	**FACW**	**FAC**	**FACU**	**UPL**	**NL**
5	4	4	1	3	0	2
6	1	3	0	1	0	1
Basin Total	**5**	**11**	**8**	**11**	**3**	**18**

Table D-23. Pond 997 (Reference) Number of Wetland Plants by Indicator Category by Stratum

Pond 997						
Stratum	**OBL**	**FACW**	**FAC**	**FACU**	**UPL**	**NL**
1	2	4	0	0	0	0
2	3	3	3	2	0	10
3	1	3	3	2	0	7
Basin Total	**5**	**10**	**7**	**6**	**2**	**19**

Table D-24. Pond 21 (Year 1 Post-Mastication) Number of Wetland Plants by Indicator Category by Stratum

Pond 21						
Stratum	**OBL**	**FACW**	**FAC**	**FACU**	**UPL**	**NL**
1	1	3	1	0	0	0
2	3	4	1	1	0	1
4	0	2	4	1	0	3
Basin Total	**7**	**10**	**6**	**8**	**0**	**16**

Table D-25. Pond 76 (Year 1 Post-Mastication) Number of Wetland Plants by Indicator Category by Stratum

Pond 76						
Stratum	**OBL**	**FACW**	**FAC**	**FACU**	**UPL**	**NL**
1	5	4	0	0	0	0
2	5	3	0	0	0	1
3	2	6	3	2	0	6
Basin Total	**6**	**8**	**4**	**4**	**1**	**10**

Table D-26. Pond 3 North (Year 5 Post-Subsurface Munitions Remediation) Number of Wetland Plants by Indicator Category by Stratum

Pond 3 North						
Stratum	**OBL**	**FACW**	**FAC**	**FACU**	**UPL**	**NL**
1	2	0	0	0	0	0
2	1	5	3	2	0	5
3	0	0	2	1	0	2
Basin Total	**6**	**10**	**8**	**4**	**2**	**12**

Table D-27. Pond 3 South (Year 5 Post-Subsurface Munitions Remediation) Number of Wetland Plants by Indicator Category by Stratum

Pond 3 South						
Stratum	OBL	FACW	FAC	FACU	UPL	NL
1	4	4	1	0	0	0
2	2	8	3	2	0	3
3	2	2	4	3	0	10
Basin Total	**6**	**15**	**10**	**10**	**0**	**26**

Table D-28. Pond 35 (Year 5 Post-Subsurface Munitions Remediation) Number of Wetland Plants by Indicator Category by Stratum

Pond 35						
Stratum	OBL	FACW	FAC	FACU	UPL	NL
1	4	1	1	0	0	0
2	1	2	2	0	0	4
3	0	1	2	2	1	5
4	0	2	3	5	0	9
Basin Total	**5**	**5**	**6**	**6**	**3**	**12**

Table D-29. Pond 43 (Year 5 Post-Subsurface Munitions Remediation) Number of Wetland Plants by Indicator Category by Stratum

Pond 43						
Stratum	OBL	FACW	FAC	FACU	UPL	NL
1	5	5	0	0	0	0
2	4	8	2	0	0	0
3	2	5	3	2	0	4
Basin Total	**5**	**12**	**5**	**4**	**0**	**15**

Table D-30. Pond 44 (Year 5 Post-Subsurface Munitions Remediation) Number of Wetland Plants by Indicator Category by Stratum

Pond 44						
Stratum	OBL	FACW	FAC	FACU	UPL	NL
1	2	6	1	0	0	0
2	2	5	1	2	0	7
3	1	3	3	3	1	15
Basin Total	**4**	**11**	**7**	**7**	**1**	**28**

Table D-31. Pond 54 (Year 5 Post-Subsurface Munitions Remediation) Number of Wetland Plants by Indicator Category by Stratum

Pond 54						
Stratum	OBL	FACW	FAC	FACU	UPL	NL
1	6	2	0	1	0	0
2	6	3	0	2	0	0
3	4	5	0	2	0	2
4	0	1	2	1	1	1
Basin Total	**7**	**13**	**8**	**10**	**1**	**15**

Table D-32. Pond 60 (Year 5 Post-Subsurface Munitions Remediation) Number of Wetland Plants by Indicator Category by Stratum

Pond 60						
Stratum	OBL	FACW	FAC	FACU	UPL	NL
1	1	1	0	0	0	0
2	1	1	0	0	0	0
3	2	4	0	0	0	2
4	5	4	1	0	0	2
Basin Total	**7**	**7**	**8**	**4**	**1**	**13**

Table D-33. Pond 73 (Year 5 Post-Subsurface Munitions Remediation) Number of Wetland Plants by Indicator Category by Stratum

Pond 73						
Stratum	OBL	FACW	FAC	FACU	UPL	NL
1	7	4	0	0	0	0
2	4	6	0	0	0	0
3	1	5	3	4	0	12
5	4	2	0	0	0	1
Basin Total	**8**	**8**	**8**	**6**	**0**	**17**

Table D-34. Pond 16 (Year 5 Post-Subsurface Munitions Remediation) Number of Wetland Plants by Indicator Category by Stratum

Pond 16						
Stratum	OBL	FACW	FAC	FACU	UPL	NL
3	1	2	1	1	0	1
4	0	4	0	2	0	1
5	0	0	1	2	0	0
6	0	2	0	3	0	0
7	2	0	2	0	0	0
Basin Total	**7**	**9**	**11**	**13**	**1**	**12**

Table D-35. Pond 39 (Year 5 Post-Subsurface Munitions Remediation) Number of Wetland Plants by Indicator Category by Stratum

Pond 39						
Stratum	OBL	FACW	FAC	FACU	UPL	NL
1	4	2	1	0	0	0
2	2	6	5	2	0	8
3	1	3	4	3	0	7
4	1	3	4	2	0	5
Basin Total	**6**	**12**	**10**	**10**	**3**	**28**

Table D-36. Pond 40 South (Year 5 Post-Subsurface Munitions Remediation) Number of Wetland Plants by Indicator Category by Stratum

Pond 40 South						
Stratum	OBL	FACW	FAC	FACU	UPL	NL
1	3	2	1	0	0	0
2	1	3	3	3	0	8
3	0	2	3	4	1	12
4	0	1	1	1	1	8
Basin Total	**5**	**9**	**8**	**11**	**4**	**23**

Table D-37. Pond 41 (Year 5 Post-Subsurface Munitions Remediation) Number of Wetland Plants by Indicator Category by Stratum

Pond 41						
Stratum	OBL	FACW	FAC	FACU	UPL	NL
1	6	1	0	0	0	0
2	6	3	1	1	0	0
3	3	6	1	1	0	3
4	2	7	2	2	0	7
Basin Total	**8**	**10**	**8**	**9**	**2**	**15**

Table D-38. Pond 42 (Year 5 Post-Subsurface Munitions Remediation) Number of Wetland Plants by Indicator Category by Stratum

Pond 42						
Stratum	OBL	FACW	FAC	FACU	UPL	NL
1	3	4	0	0	0	1
2	2	1	0	0	0	1
3	2	4	1	0	0	0
4	2	2	4	2	0	8
5	1	2	0	0	0	1
Basin Total	**7**	**11**	**5**	**7**	**1**	**24**

Table D-39. Pond 61 (Year 5 Post-Subsurface Munitions Remediation) Number of Wetland Plants by Indicator Category by Stratum

Pond 61						
Stratum	**OBL**	**FACW**	**FAC**	**FACU**	**UPL**	**NL**
1	4	7	1	0	0	4
2	2	6	5	5	0	13
3	1	6	5	3	0	7
Basin Total	**6**	**14**	**8**	**8**	**1**	**27**

Table D-40. Wetland Plants by Indicator Category within Entire Vernal Pool Basin at Vernal Pools Monitored in 2023

Vernal Pool	OBL	FACW	FAC	FACU	UPL	NL	Total
5	10	15	8	9	2	24	68
101 East (East)	5	11	8	11	3	18	56
997	5	10	7	6	2	19	49
3 North	6	10	8	4	2	12	42
3 South	6	15	10	10	0	26	67
16	7	9	11	13	1	12	53
21	7	10	6	8	0	16	47
35	5	5	6	6	3	12	37
39	6	12	10	10	3	28	69
40 South	5	9	8	11	4	23	60
41	8	10	8	9	2	15	52
42	7	11	5	7	1	24	55
43	5	12	5	4	0	15	41
44	4	11	7	7	1	28	58
54	7	13	8	10	1	15	54
60	7	7	8	4	1	13	40
61	6	14	8	8	1	27	64
73	8	8	8	6	0	17	47
76	6	8	4	4	1	10	33

APPENDIX E

Species Composition of Follow-Up Wetland Vegetation Monitoring by Vernal Pool

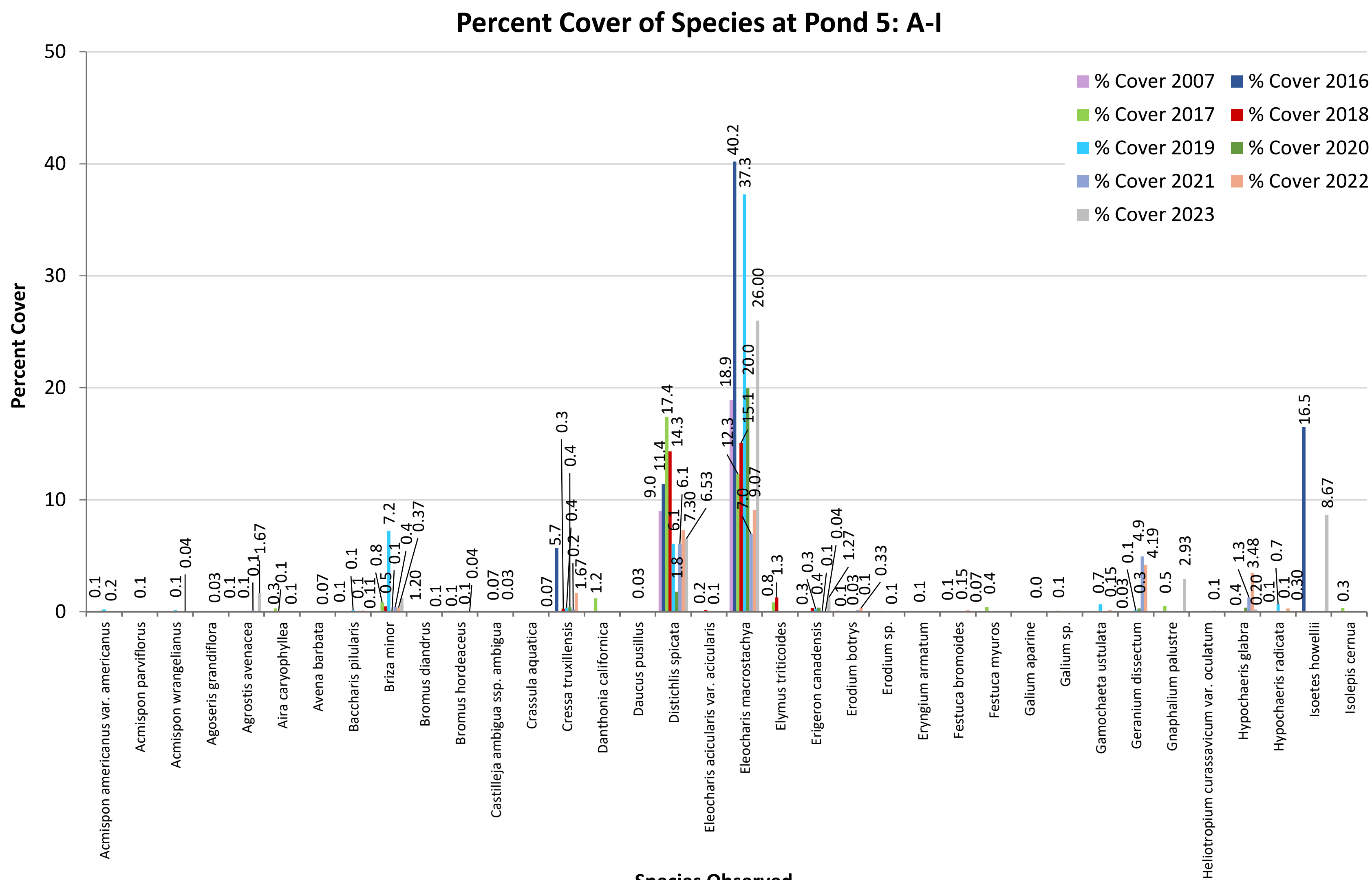

Figure E-1. Comparison Graph of Percent Cover by Wetland Plant Species for 2007, 2016, 2017, 2018, 2019, 2020, 2021, 2022, and 2023 at Pond 5 (Reference)

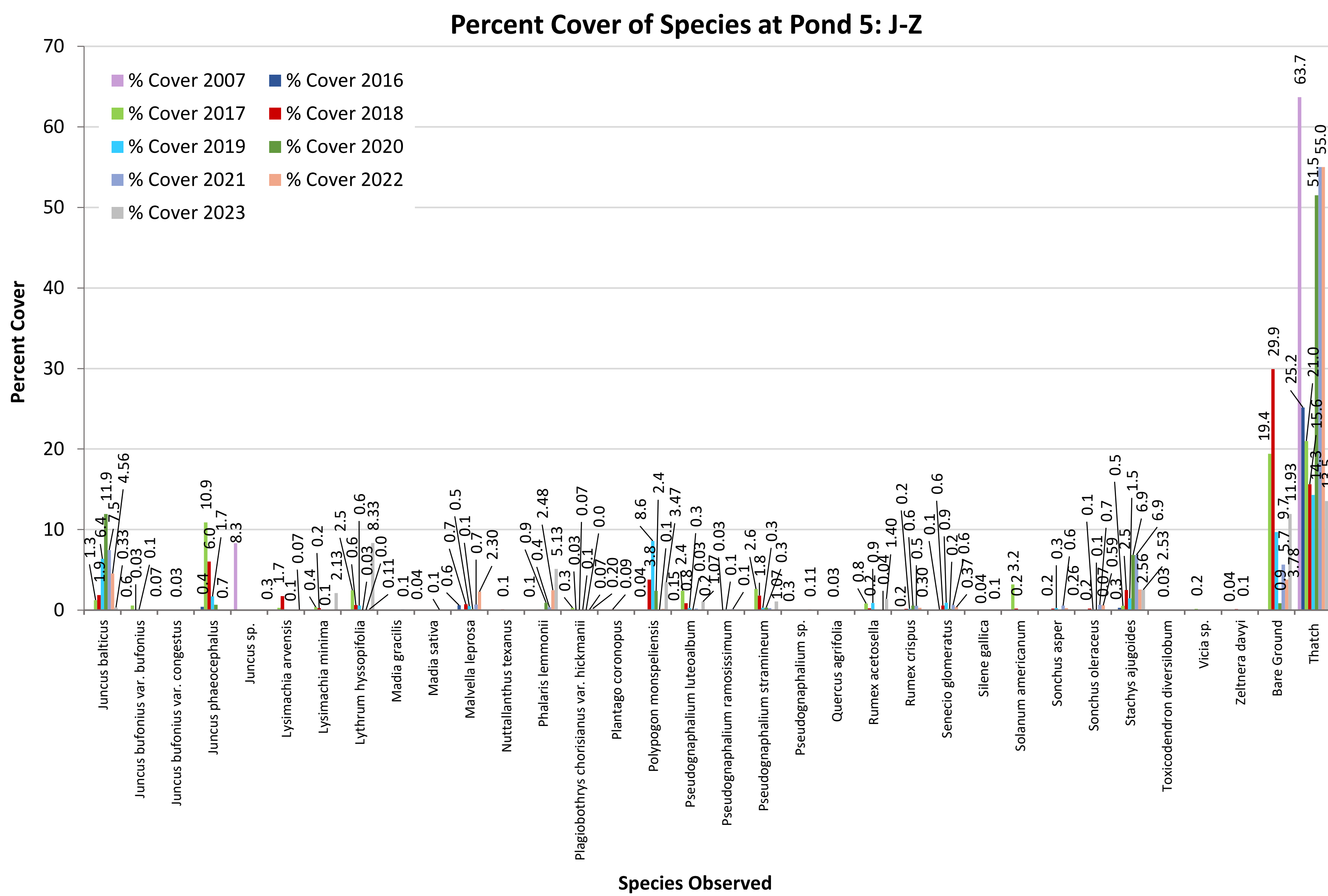

Figure E-1. (continued). Comparison Graph of Percent Cover by Wetland Plant Species for 2007, 2016, 2017, 2018, 2019, 2020, 2021, and 2022 at Pond 5 (Reference)

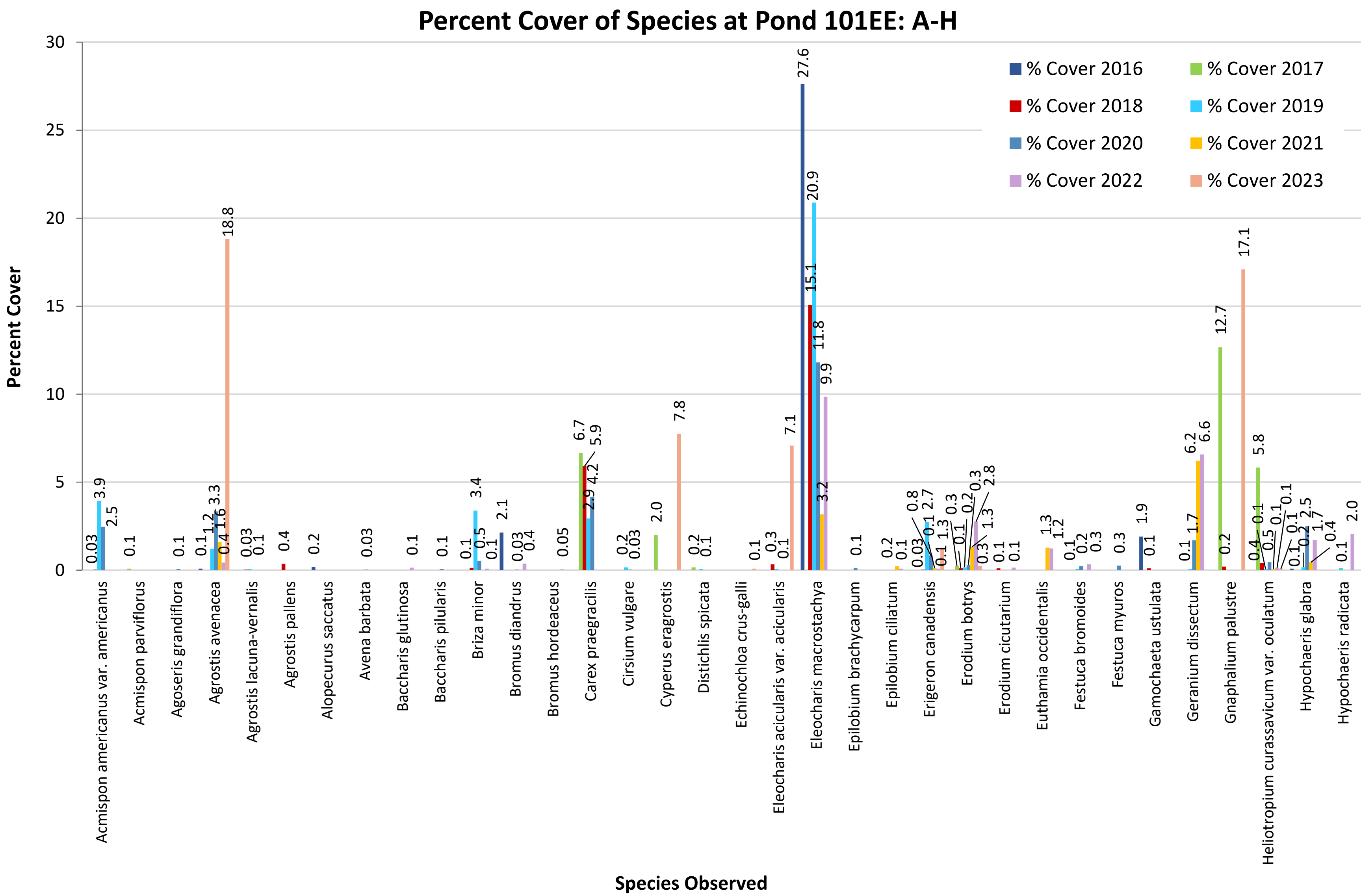

Figure E-2. Comparison Graph of Percent Cover by Wetland Plant Species for 2016, 2017, 2018, 2019, 2020, 2021, 2022, and 2023 at Pond 101 East (East)(Reference)

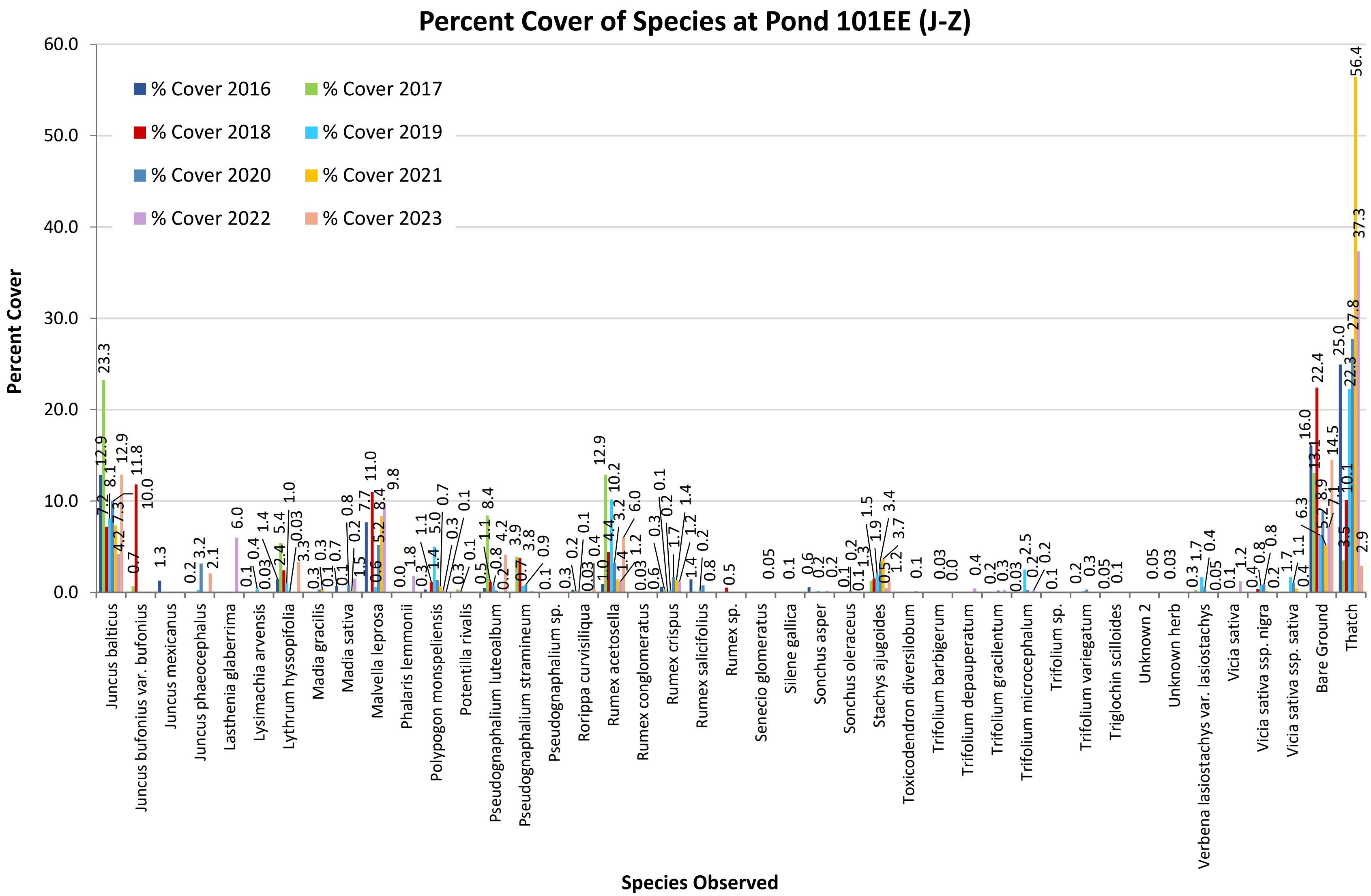

Figure E-2 (continued). Comparison Graph of Percent Cover by Wetland Plant Species for 2016, 2017, 2018, 2019, 2020, 2021, 2022, and 2023 at Pond 101 East (East) (Reference)

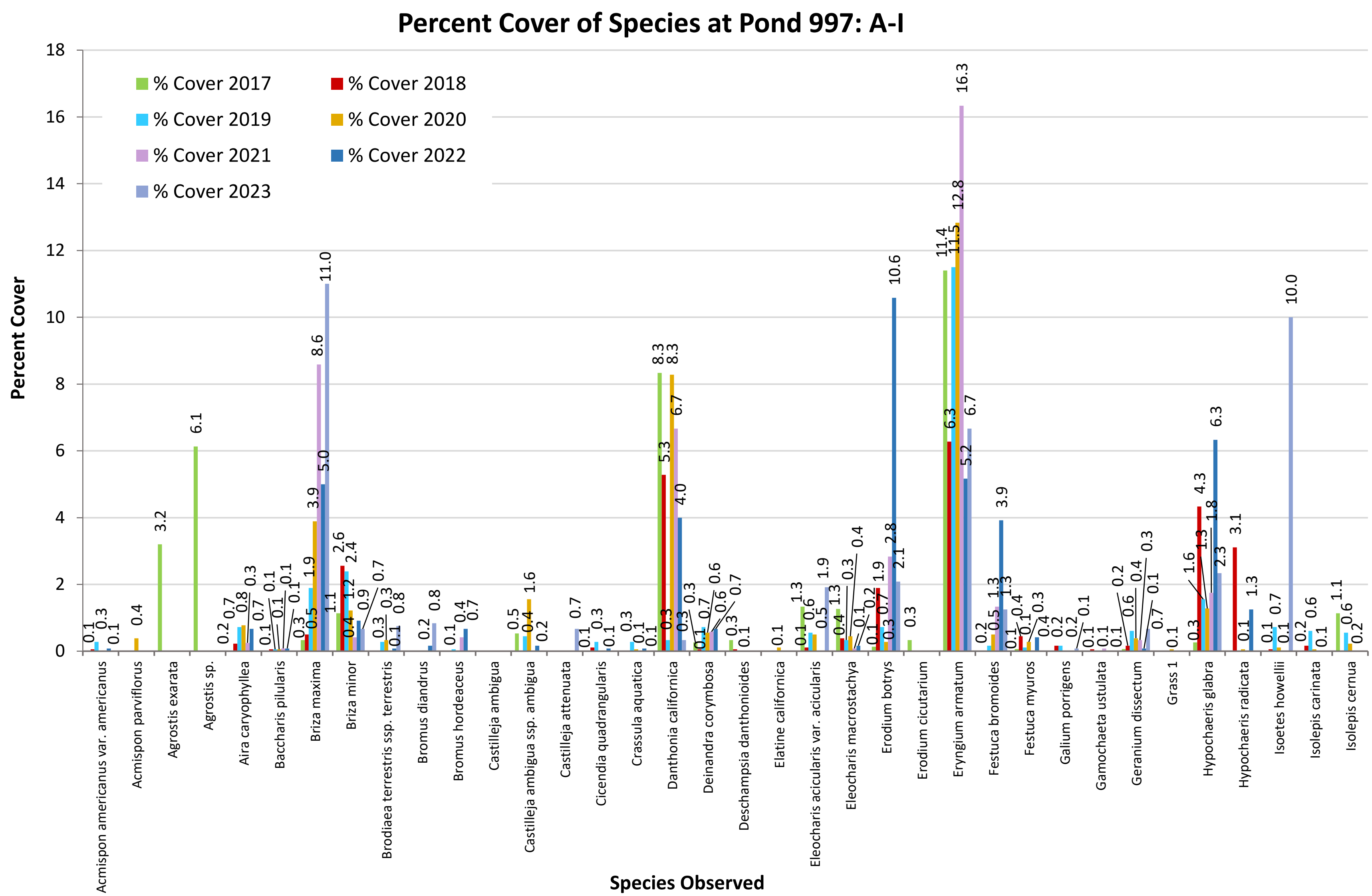

Figure E-3. Comparison Graph of Percent Cover by Wetland Plant Species for 2017, 2018, 2019, 2020, 2021, 2022, and 2023 at Pond 997 (Reference)

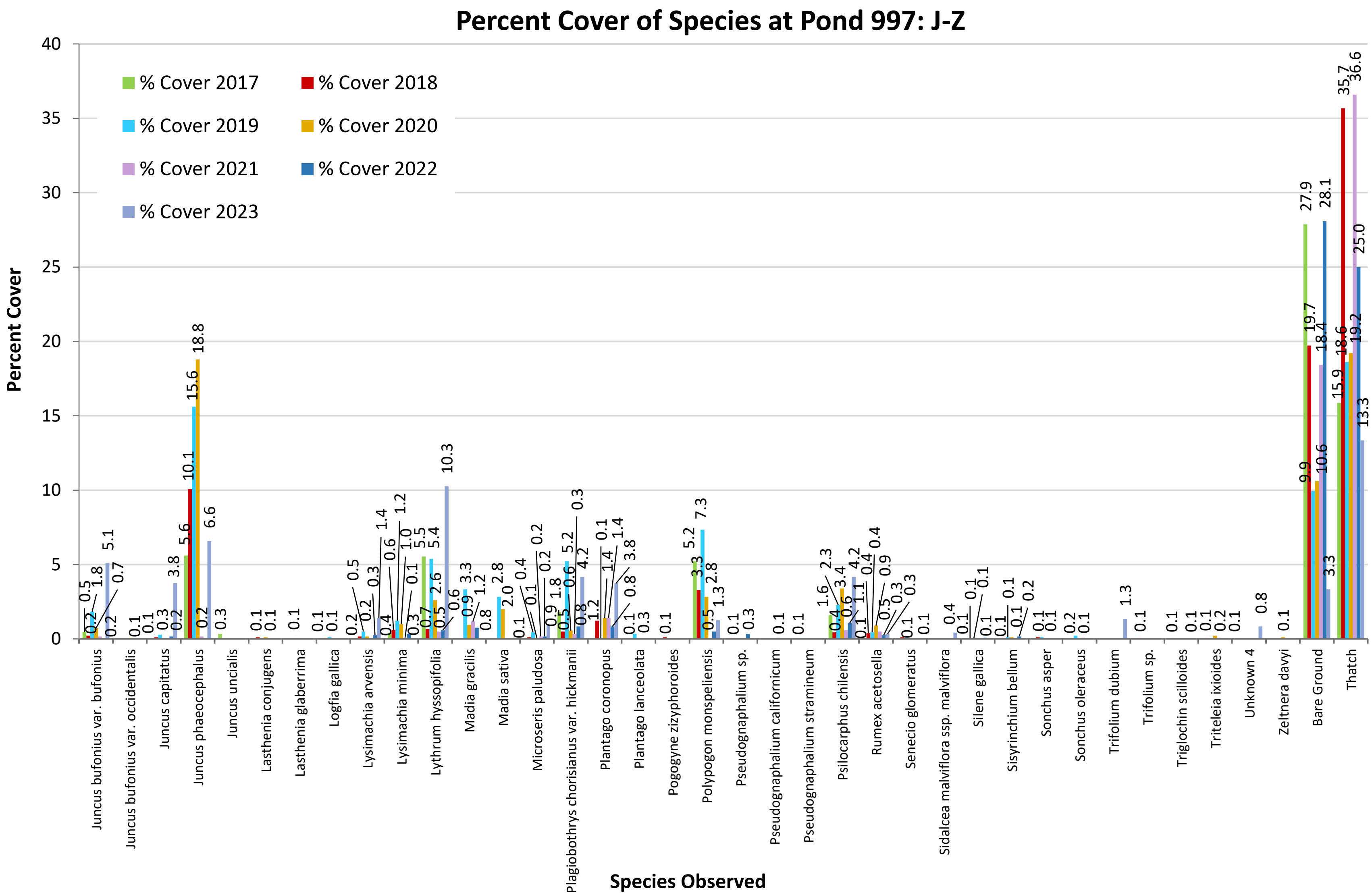

Figure E-4 (Continued)**.** Comparison Graph of Percent Cover by Wetland Plant Species for 2017, 2018, 2019, 2020, 2021, 2022, and 2023 at Pond 997 (Reference)

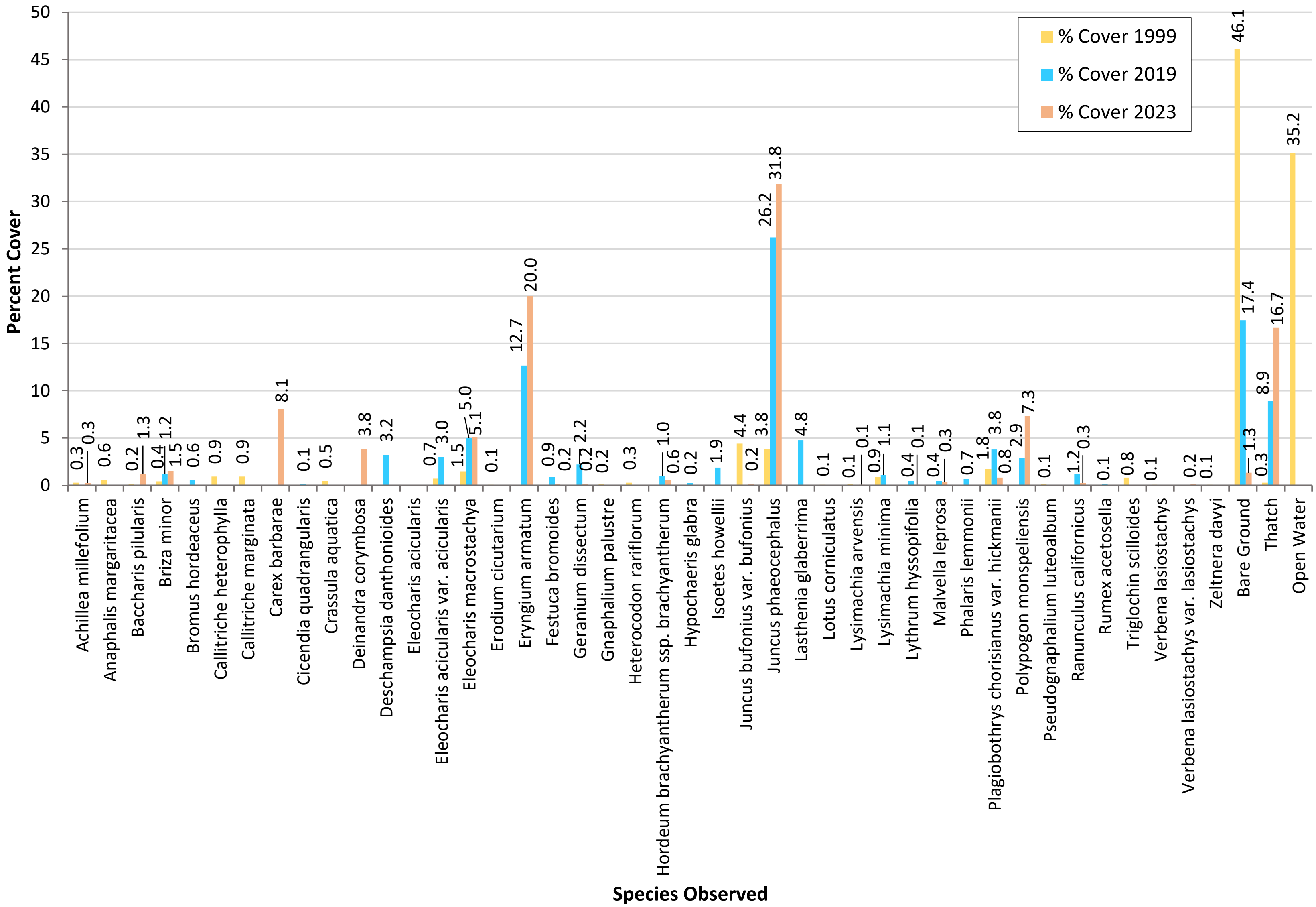

Figure E-5. Comparison Graph of Percent Cover by Wetland Plant Species for 1999, 2019, and 2023 at Pond 21 (Year 1 Post Mastication).

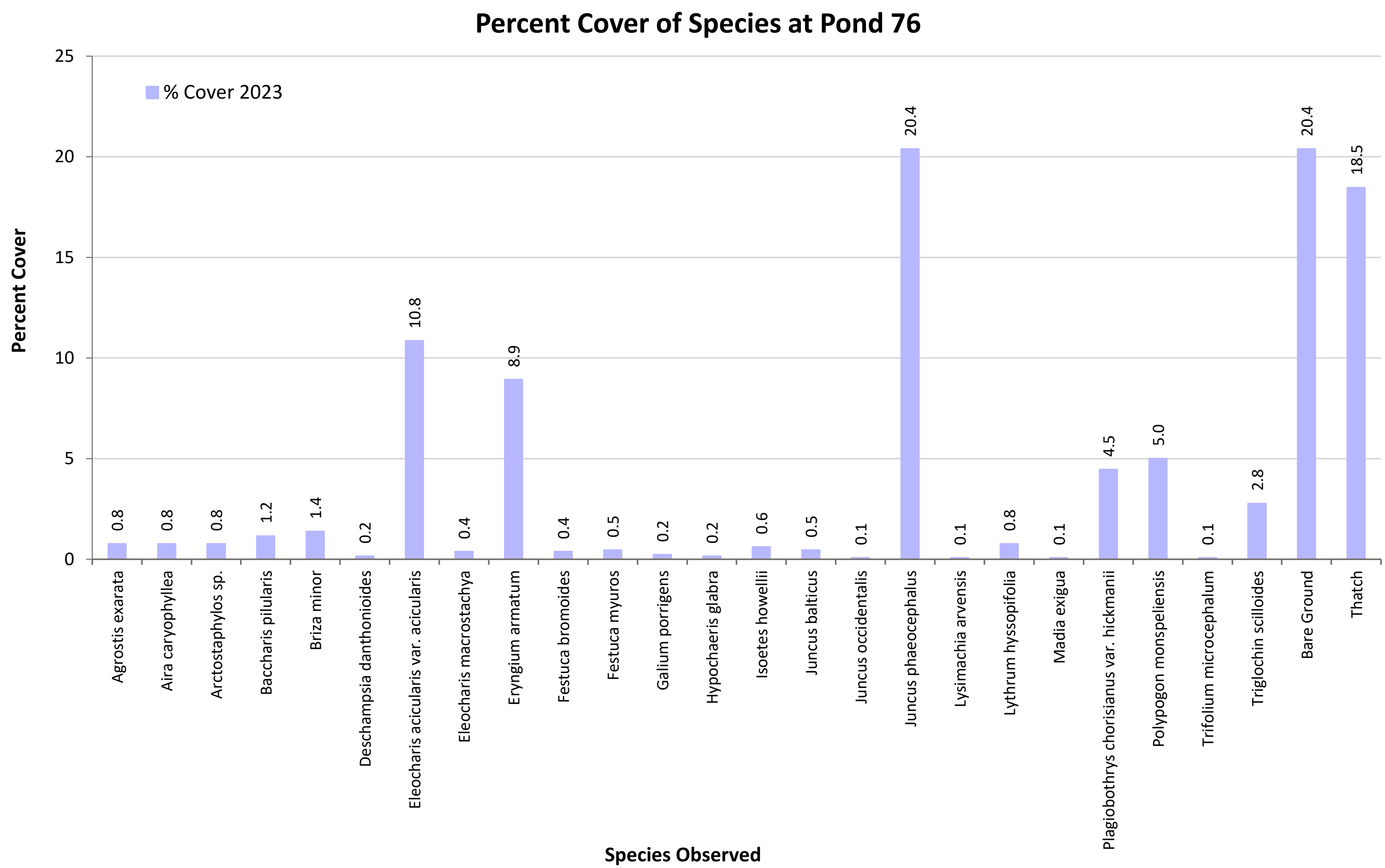

Figure E-5. Comparison Graph of Percent Cover by Wetland Plant Species for 2023 at Pond 76 (Year 1 Post Mastication).

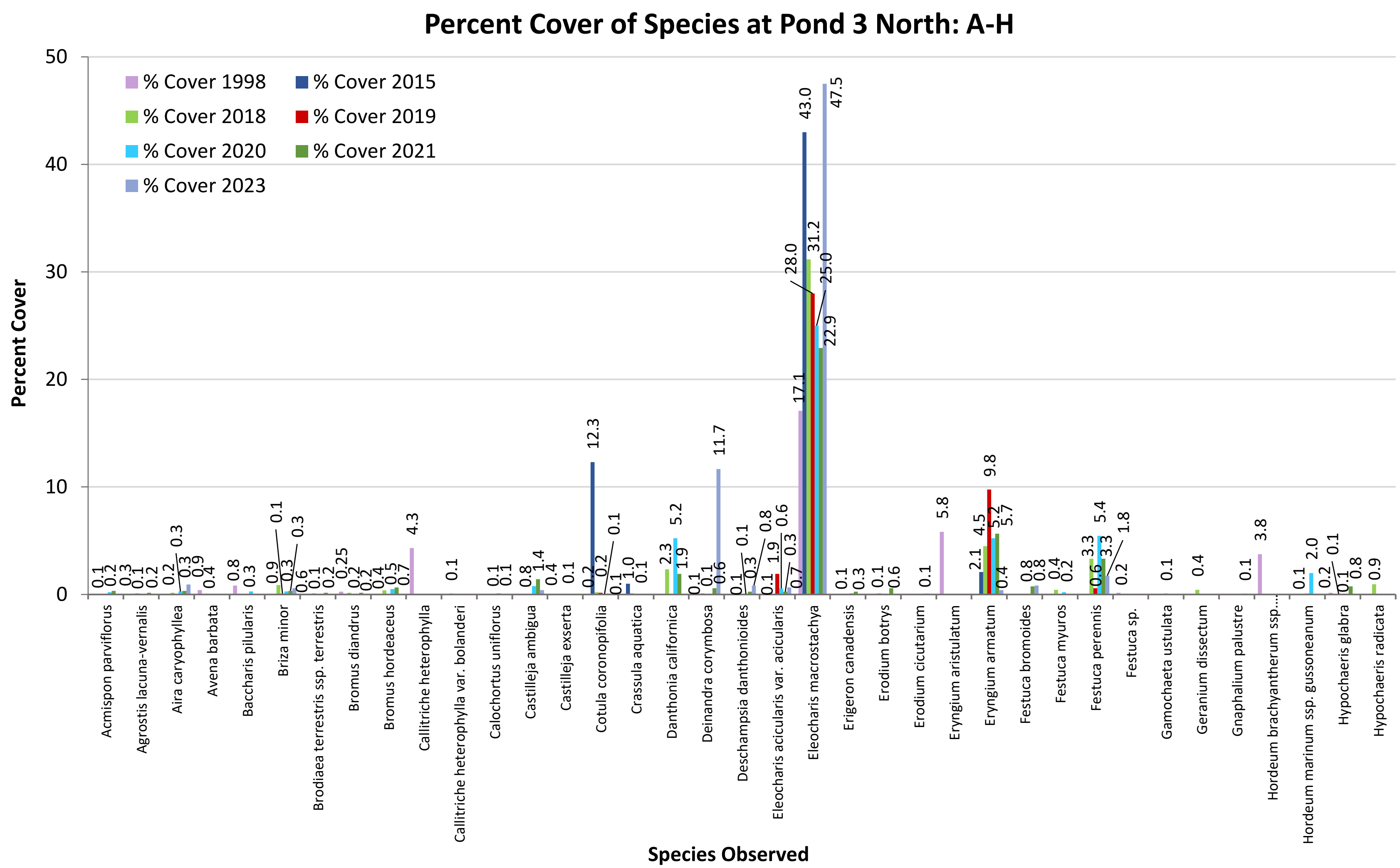

Figure E-6. Comparison Graph of Percent Cover by Wetland Plant Species for 1998, 2015, 2018, 2019, 2020, 2021, and 2023 at Pond 3 North (Year 5 Post-Subsurface Munitions Remediation).

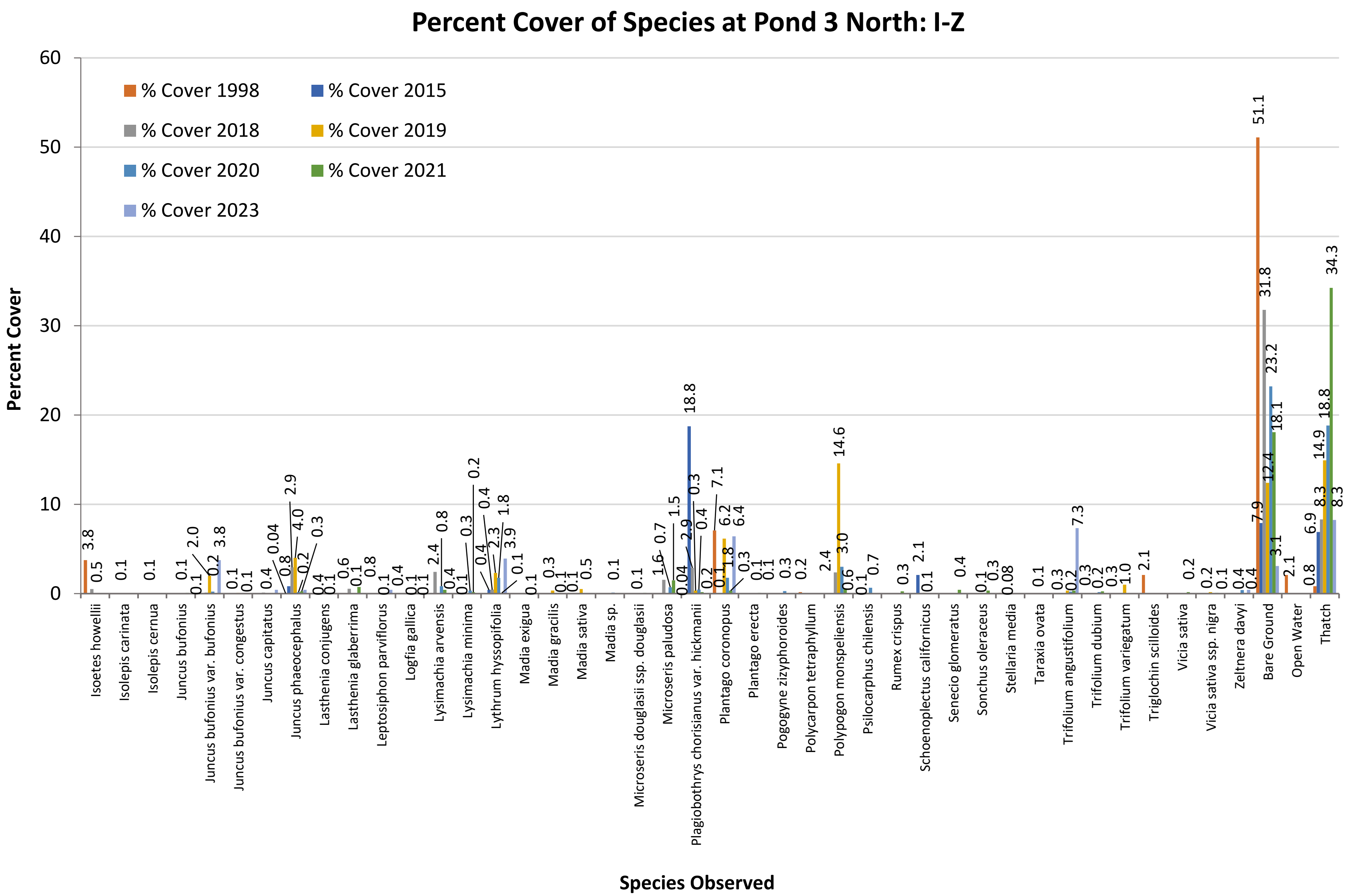

Figure E-6 (Continued). Comparison Graph of Percent Cover by Wetland Plant Species for 1998, 2015, 2018, 2019, 2020, 2021, and 2023 at Pond 3 North (Year 5 Post-Subsurface Munitions Remediation).

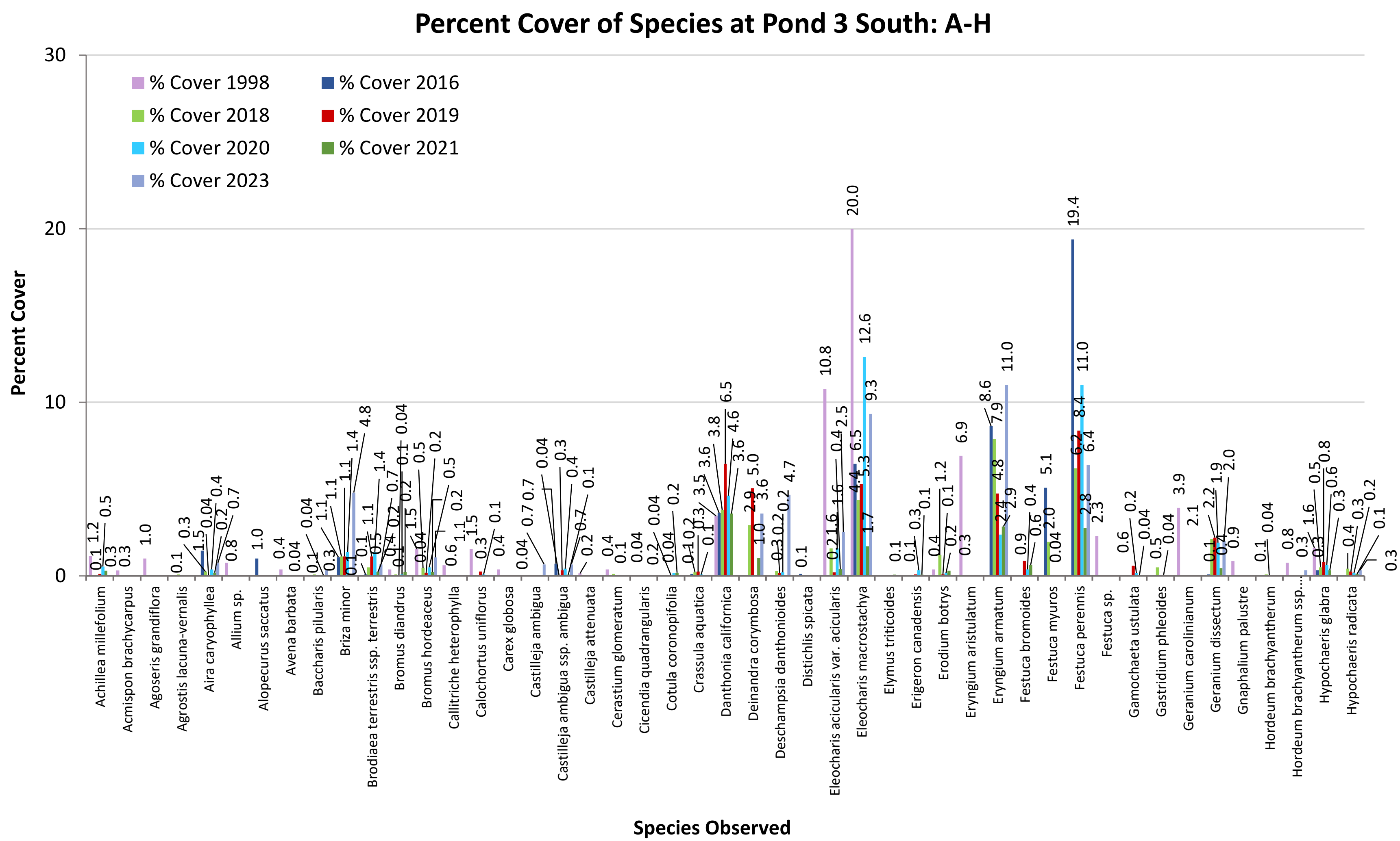

Figure E-7. Comparison Graph of Percent Cover by Wetland Plant Species for 1998, 2016, 2018, 2019, 2020, 2021, and 2023 at Pond 3 South (Year 5 Post-Subsurface Munitions Remediation).

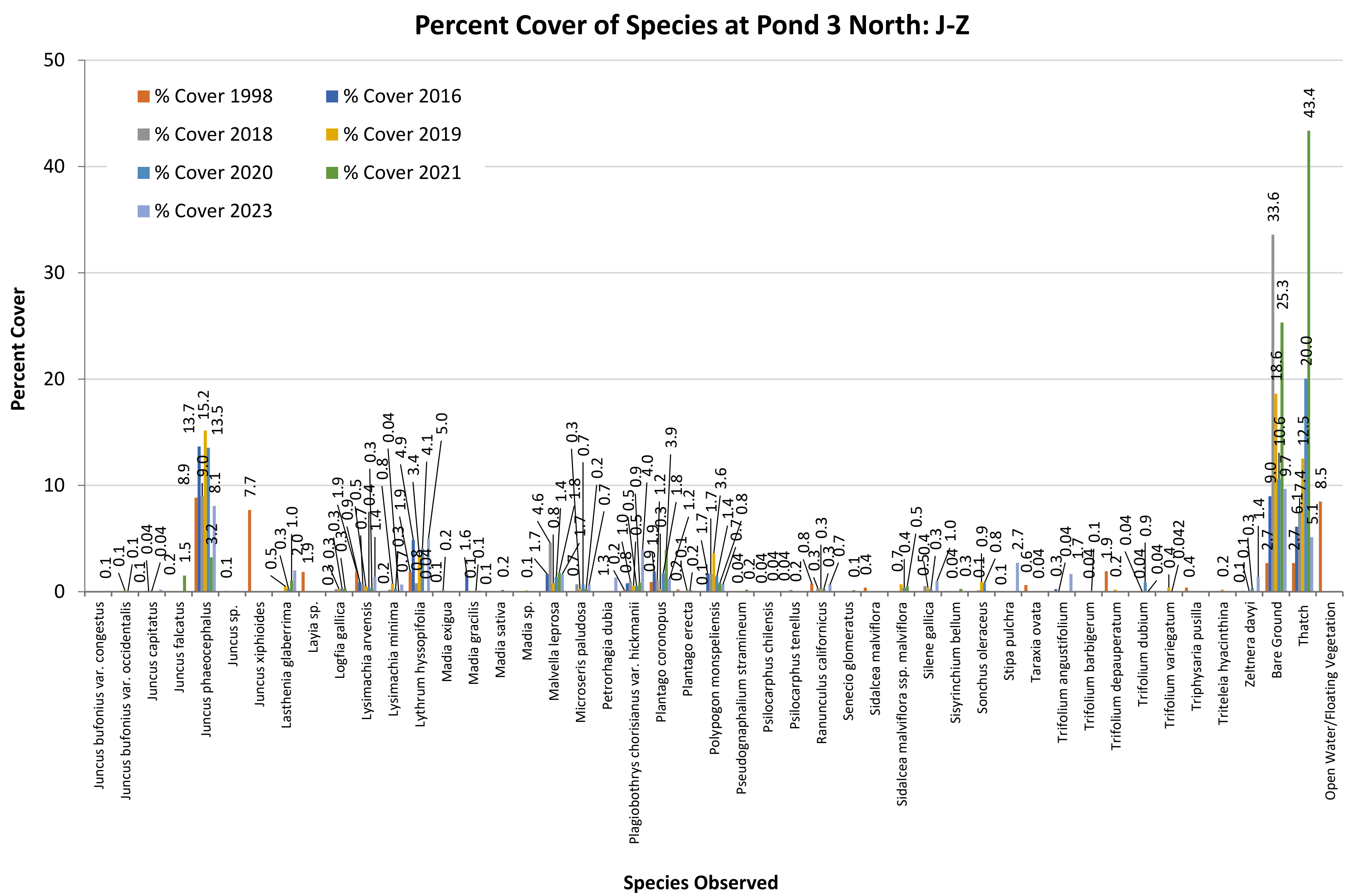

Figure E-7 (continued). Comparison Graph of Percent Cover by Wetland Plant Species for 1998, 2016, 2018, 2019, 2020, 2021, and 2023 at Pond 3 South (Year 5 Post-Subsurface Munitions Remediation).

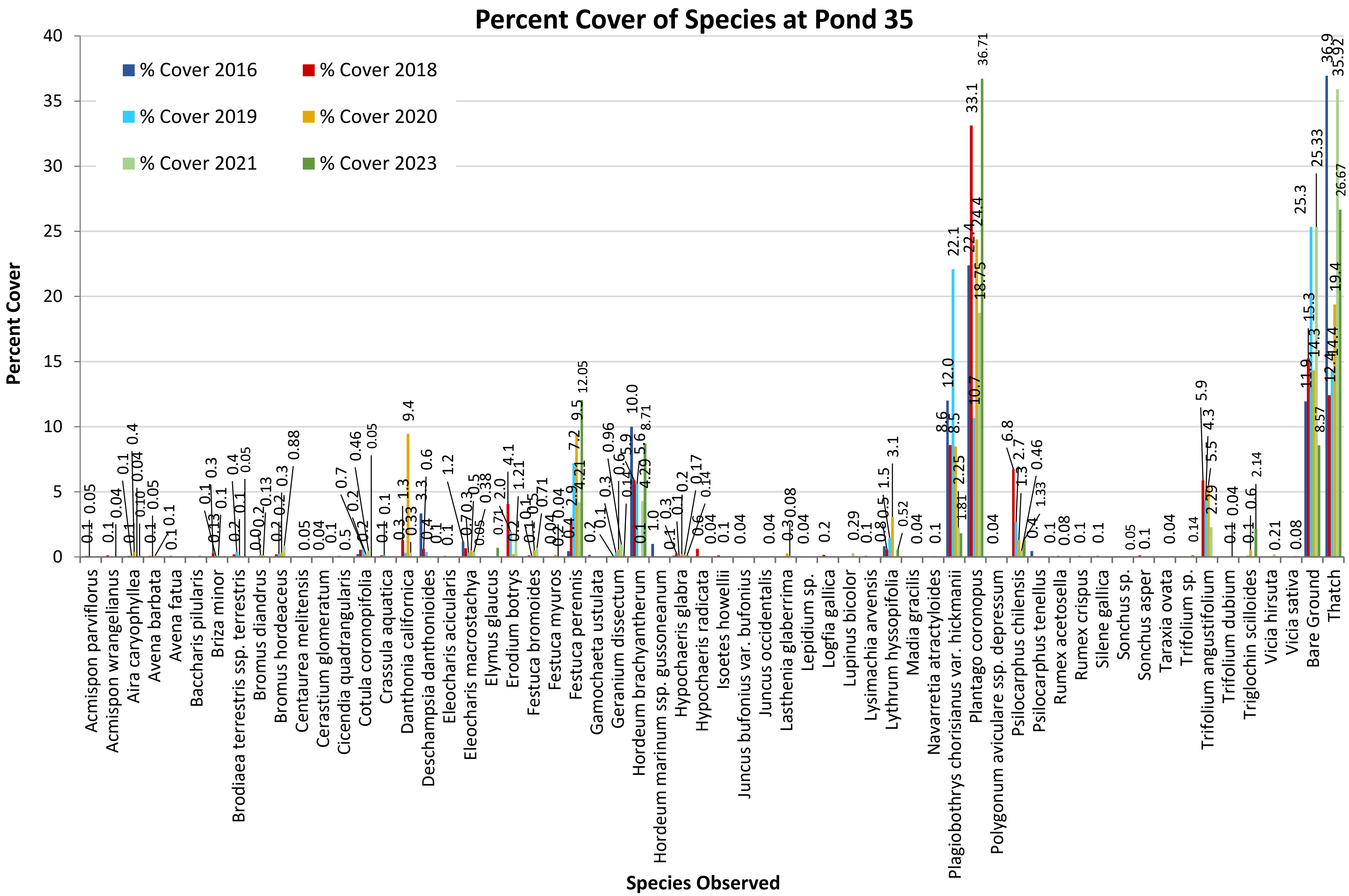

Figure E-8. Comparison Graph of Percent Cover by Wetland Plant Species for 2016, 2018, 2019, 2020, 2021, and 2023 at Pond 35 (Year 5 Post-Subsurface Munitions Remediation).

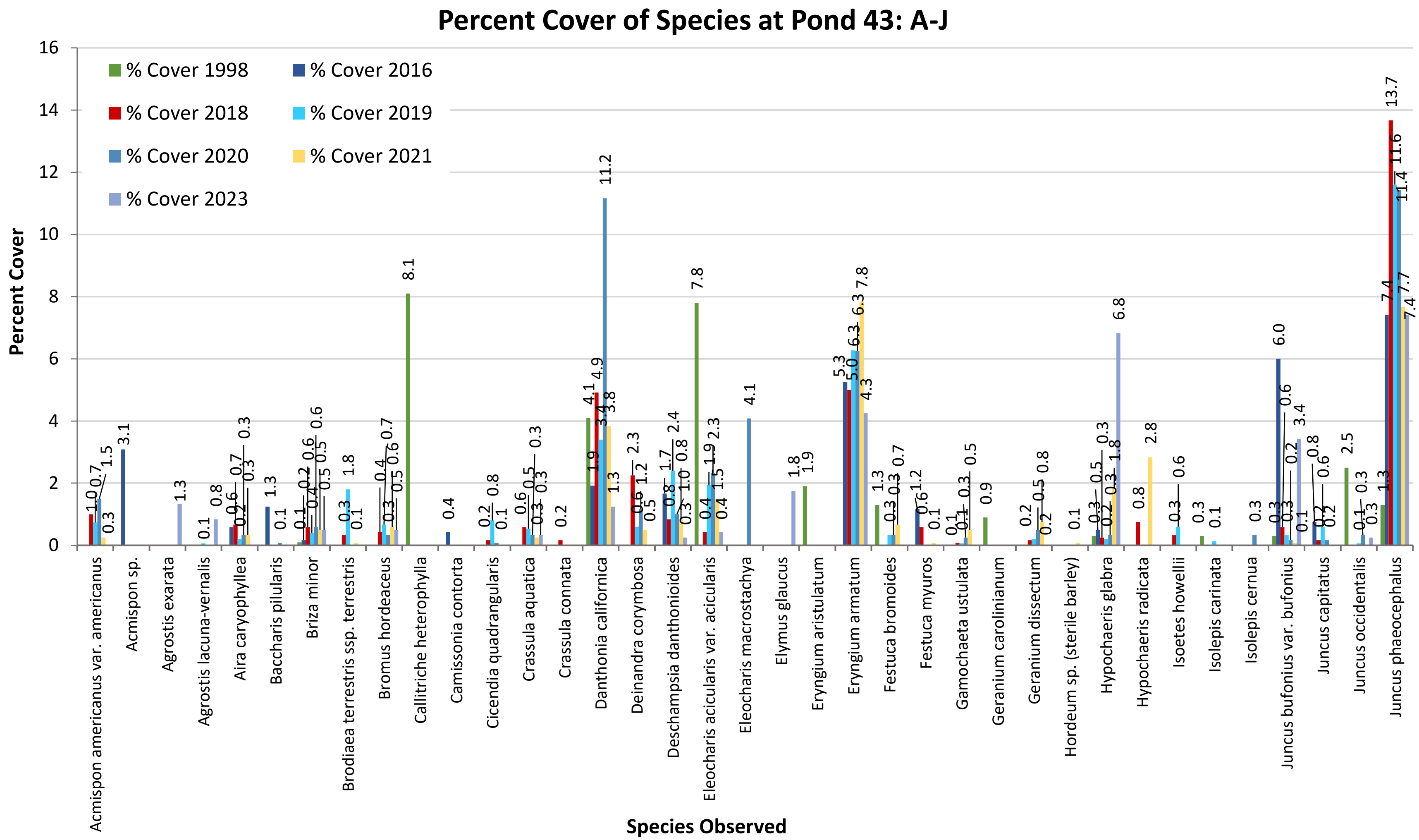

Figure E-9. Comparison Graph of Percent Cover by Wetland Plant Species for 1998, 2016, 2018, 2019, 2020, 2021, and 2023 at Pond 43 (Year 5 Post-Subsurface Munitions Remediation).

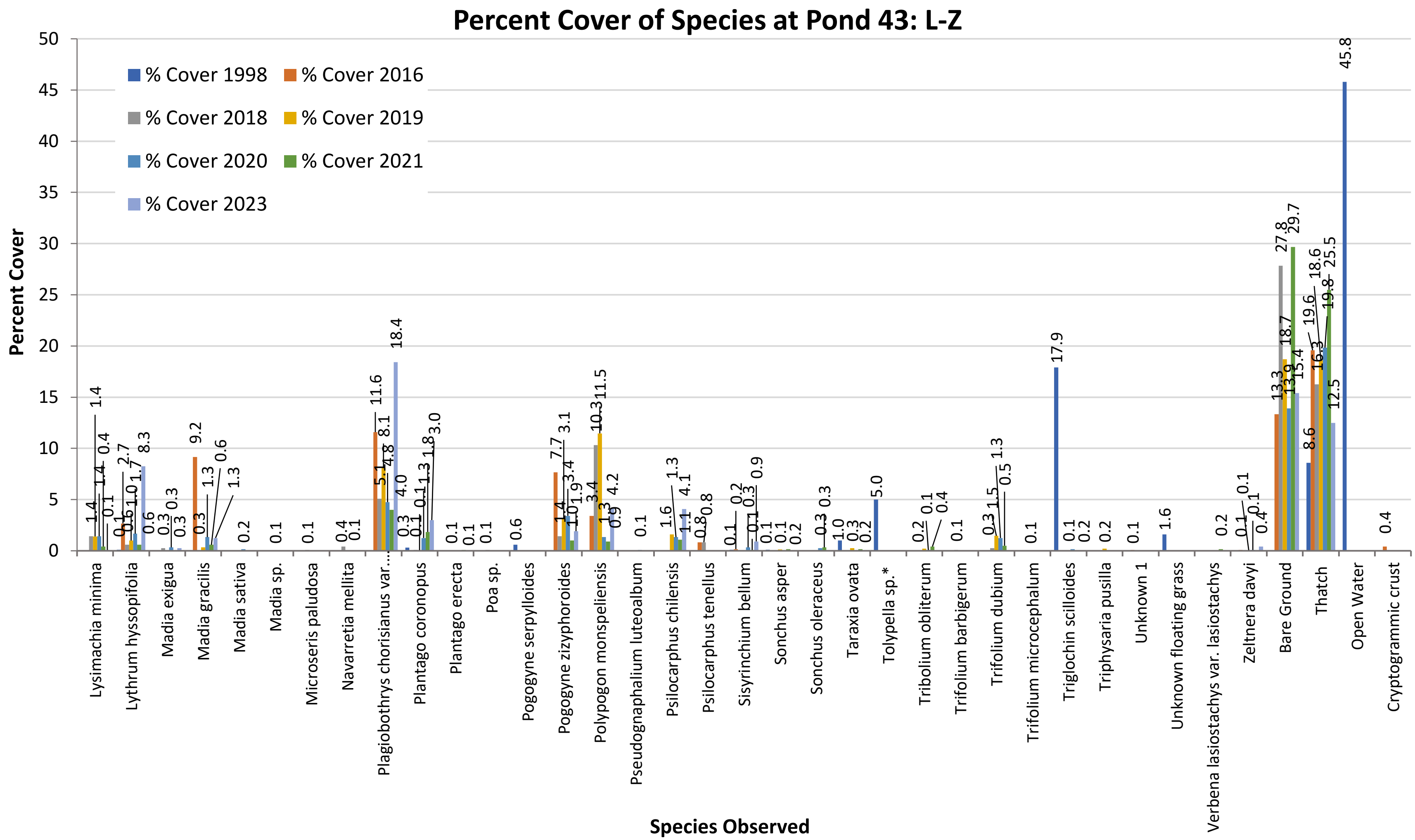

Figure E-9 (continued). Comparison Graph of Percent Cover by Wetland Plant Species for 1998, 2016, 2018, 2019, 2020, 2021, and 2023 at Pond 43 (Year 5 Post-Subsurface Munitions Remediation).

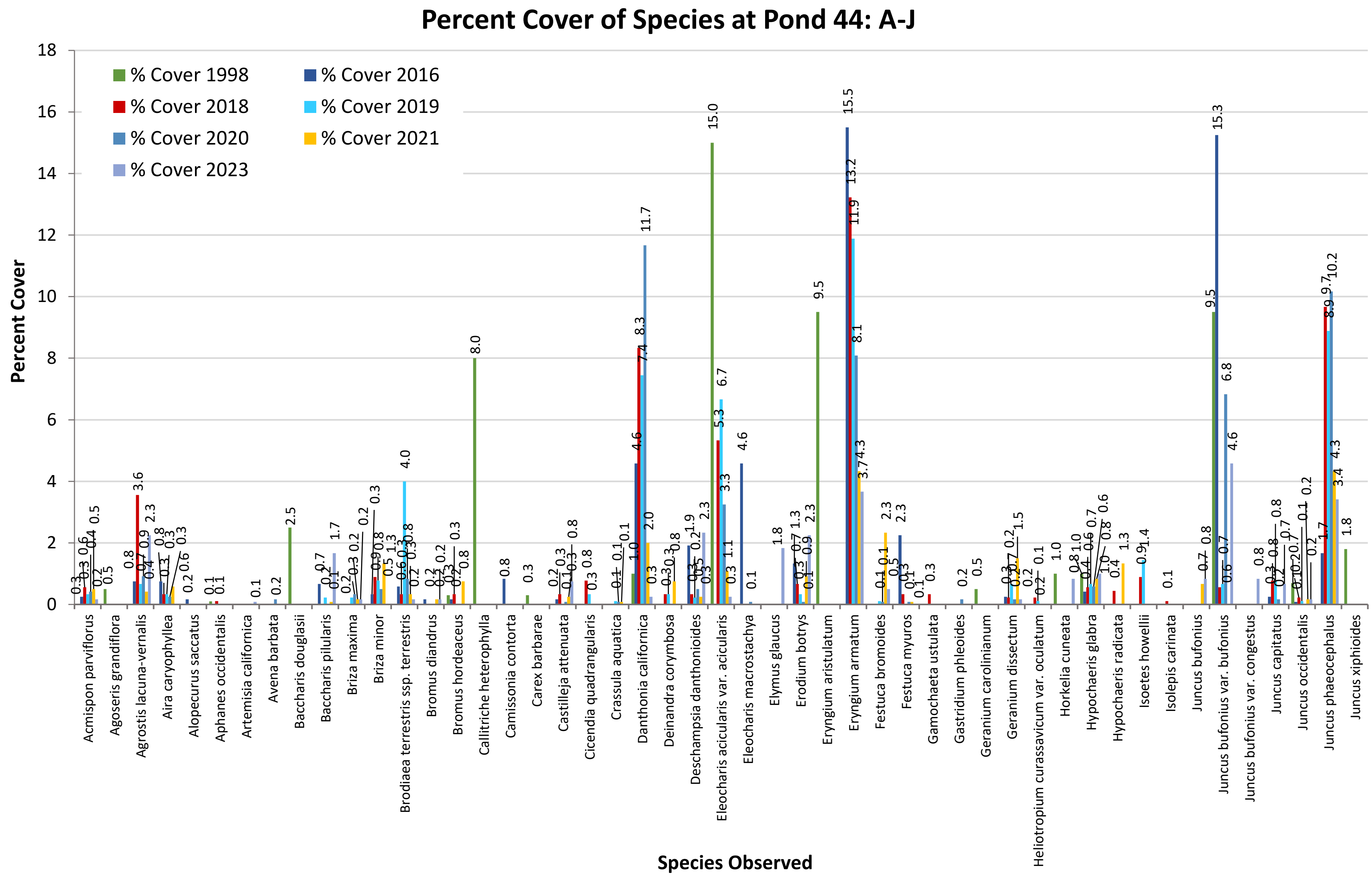

Figure E-10. Comparison Graph of Percent Cover by Wetland Plant Species for 1998, 2016, 2018, 2019, 2020, 2021, and 2023 at Pond 44 (Year 5 Post-Subsurface Munitions Remediation).

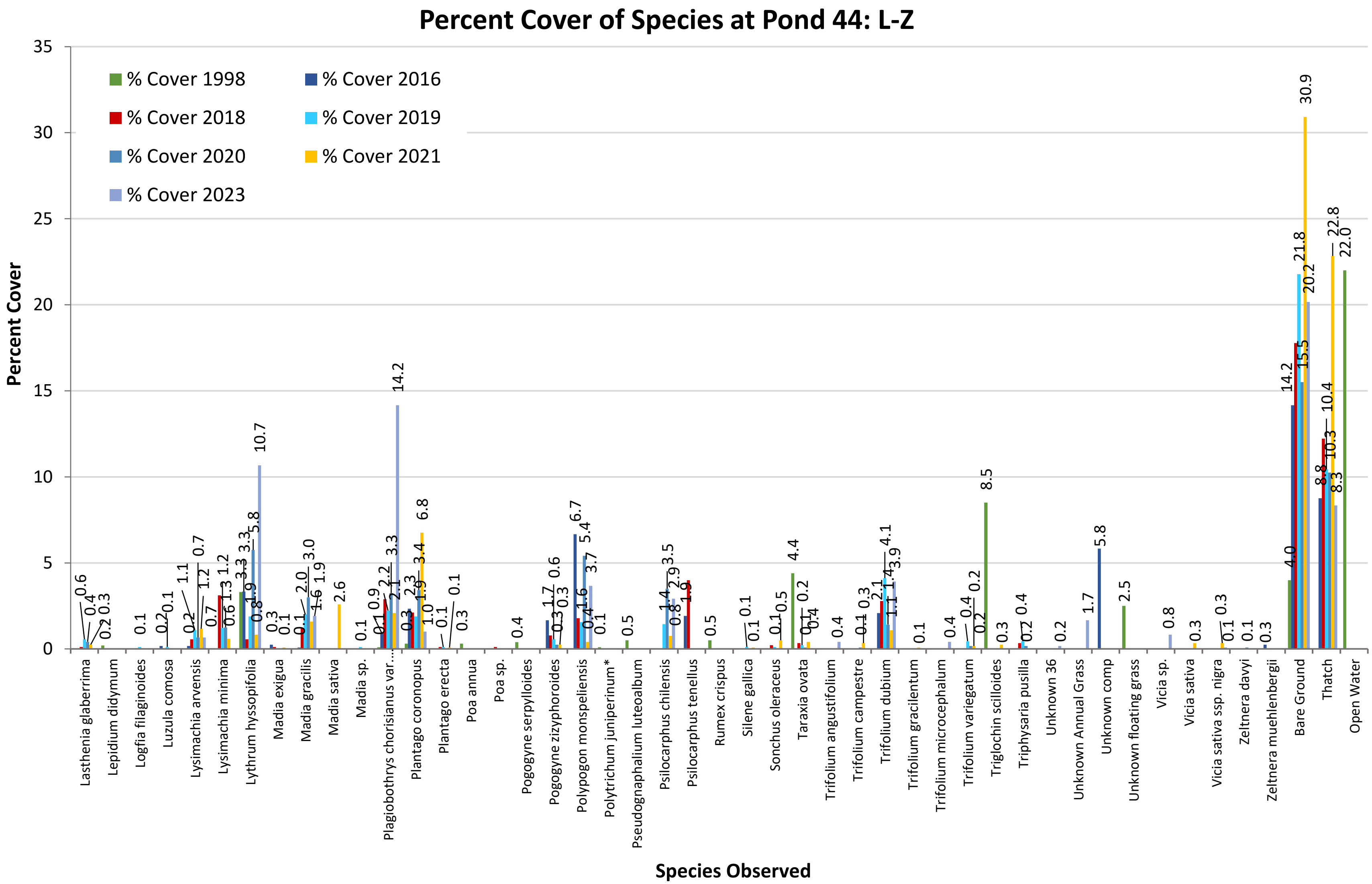

Figure E-10 (continued). Comparison Graph of Percent Cover by Wetland Plant Species for 1998, 2016, 2018, 2019, 2020, 2021, and 2023 at Pond 44 (Year 5 Post-Subsurface Munitions Remediation).

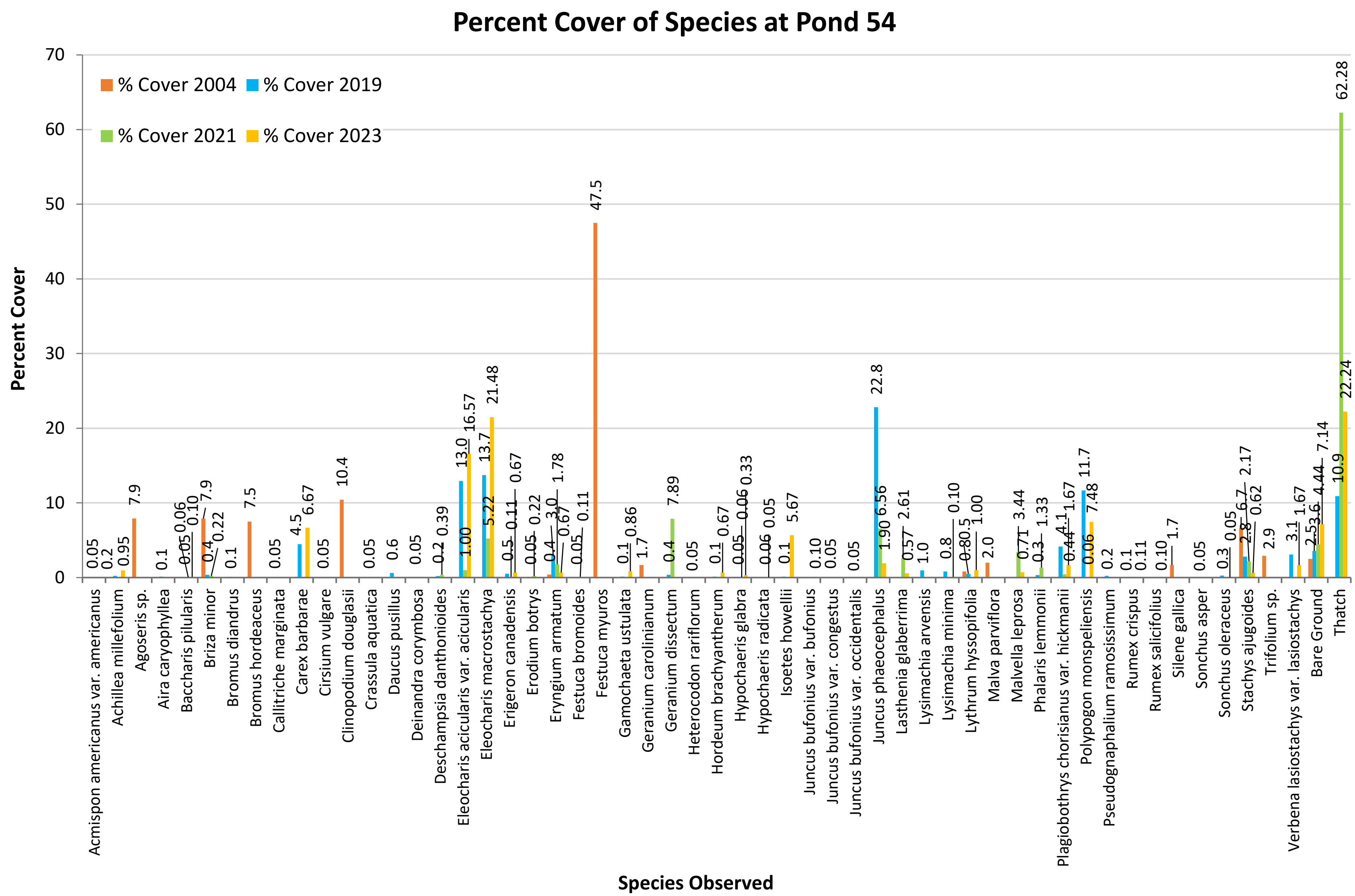

Figure E-11. Comparison Graph of Percent Cover by Wetland Plant Species for 2004, 2019, 2021, and 2023 at Pond 54 (Year 5 Post-Subsurface Munitions Remediation).

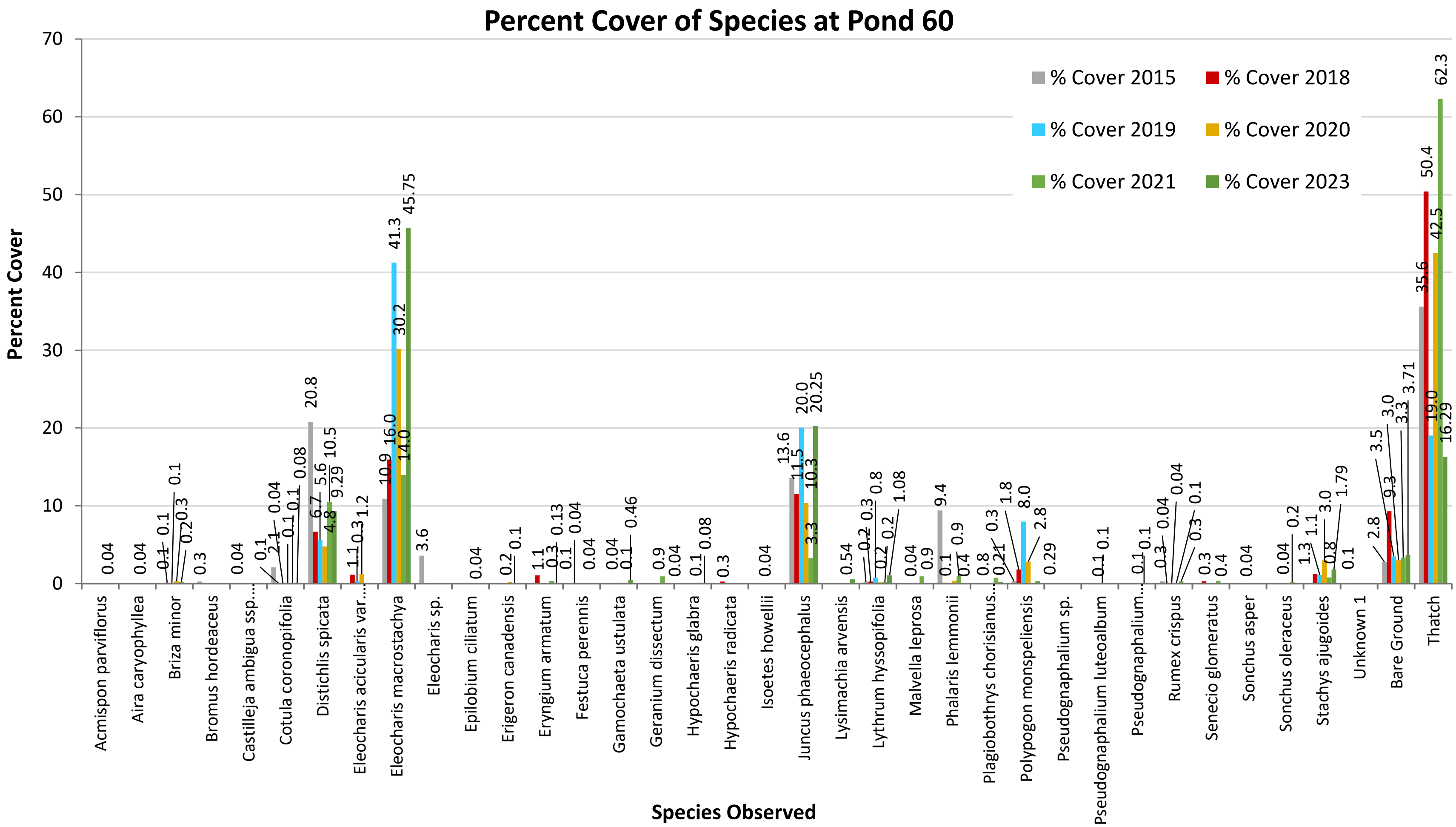

Figure E-12. Comparison Graph of Percent Cover by Wetland Plant Species for 2015, 2018, 2019, 2020, 2021, and 2023 at Pond 60 (Year 5 Post-Subsurface Munitions Remediation).

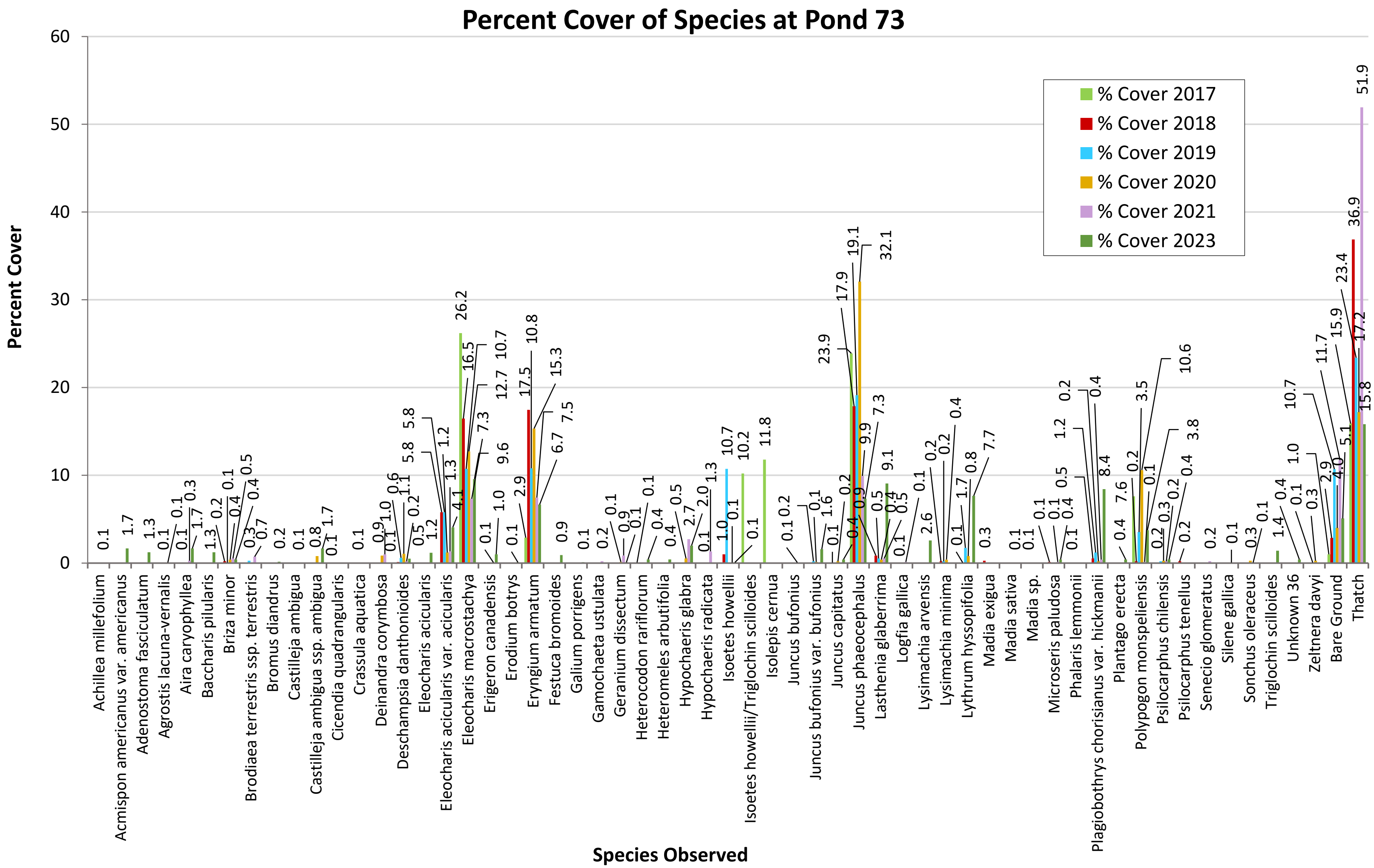

Figure E-13. Comparison Graph of Percent Cover by Wetland Plant Species for 2017, 2018, 2019, 2020, 2021, and 2023 at Pond 73 (Year 5 Post-Subsurface Munitions Remediation).

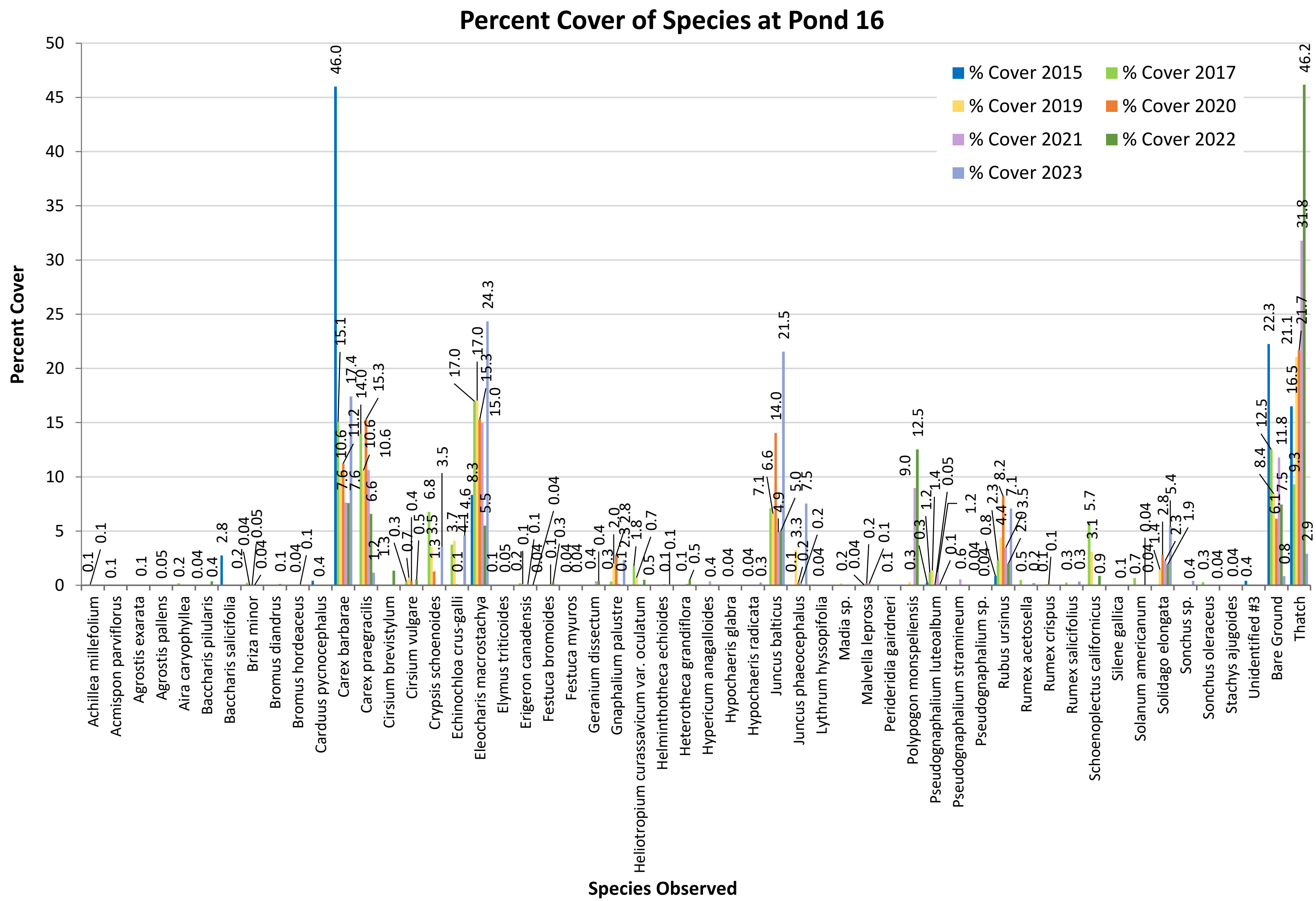

Figure E-14. Comparison Graph of Percent Cover by Wetland Plant Species for 2017, 2018, 2019, 2020, 2021, and 2023 at Pond 16 (Year 5 Post-Subsurface Munitions Remediation).

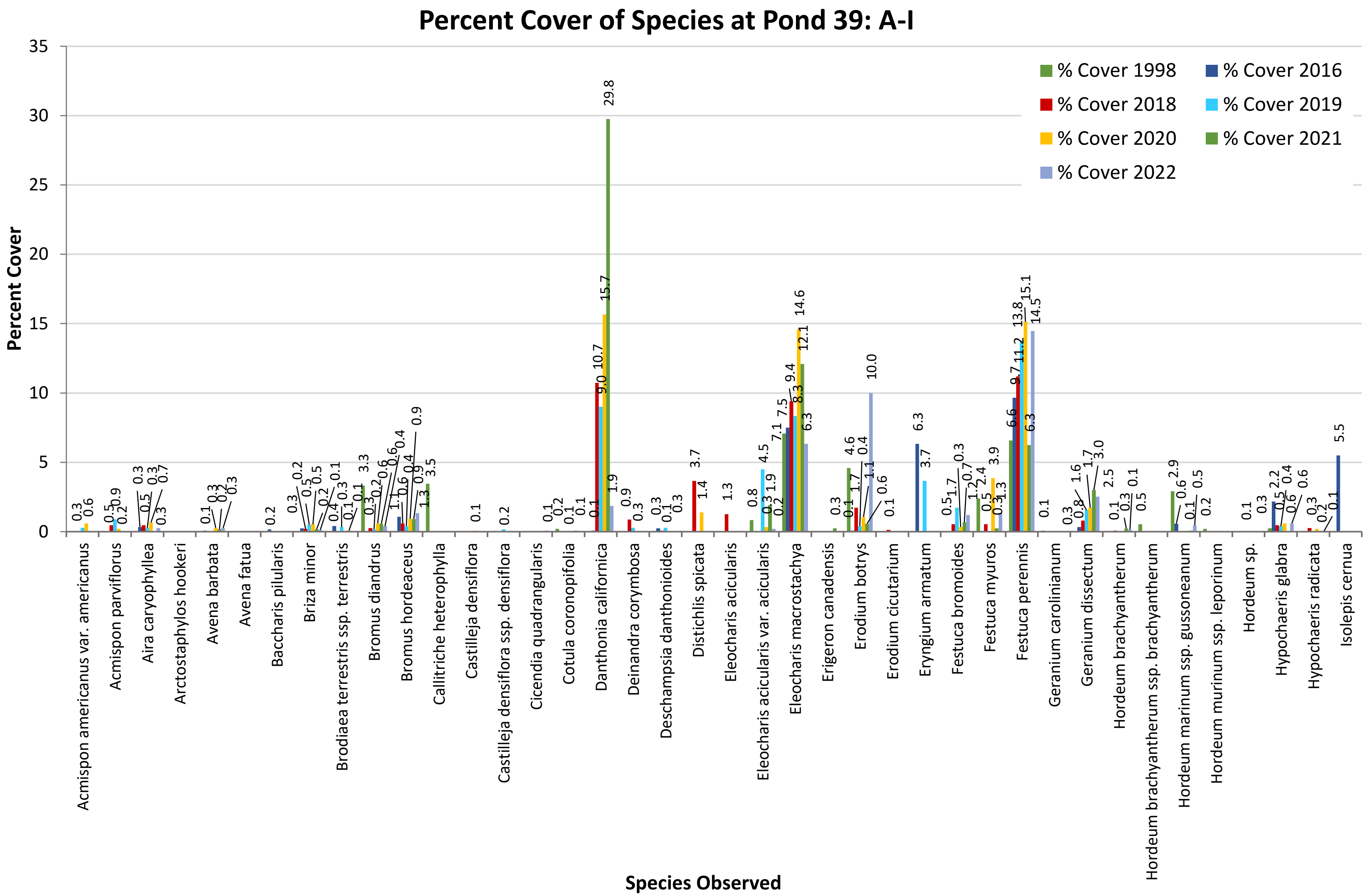

Figure E-15. Comparison Graph of Percent Cover by Wetland Plant Species for 2017, 2018, 2019, 2020, 2021, and 2023 at Pond 39 (Year 5 Post-Subsurface Munitions Remediation).

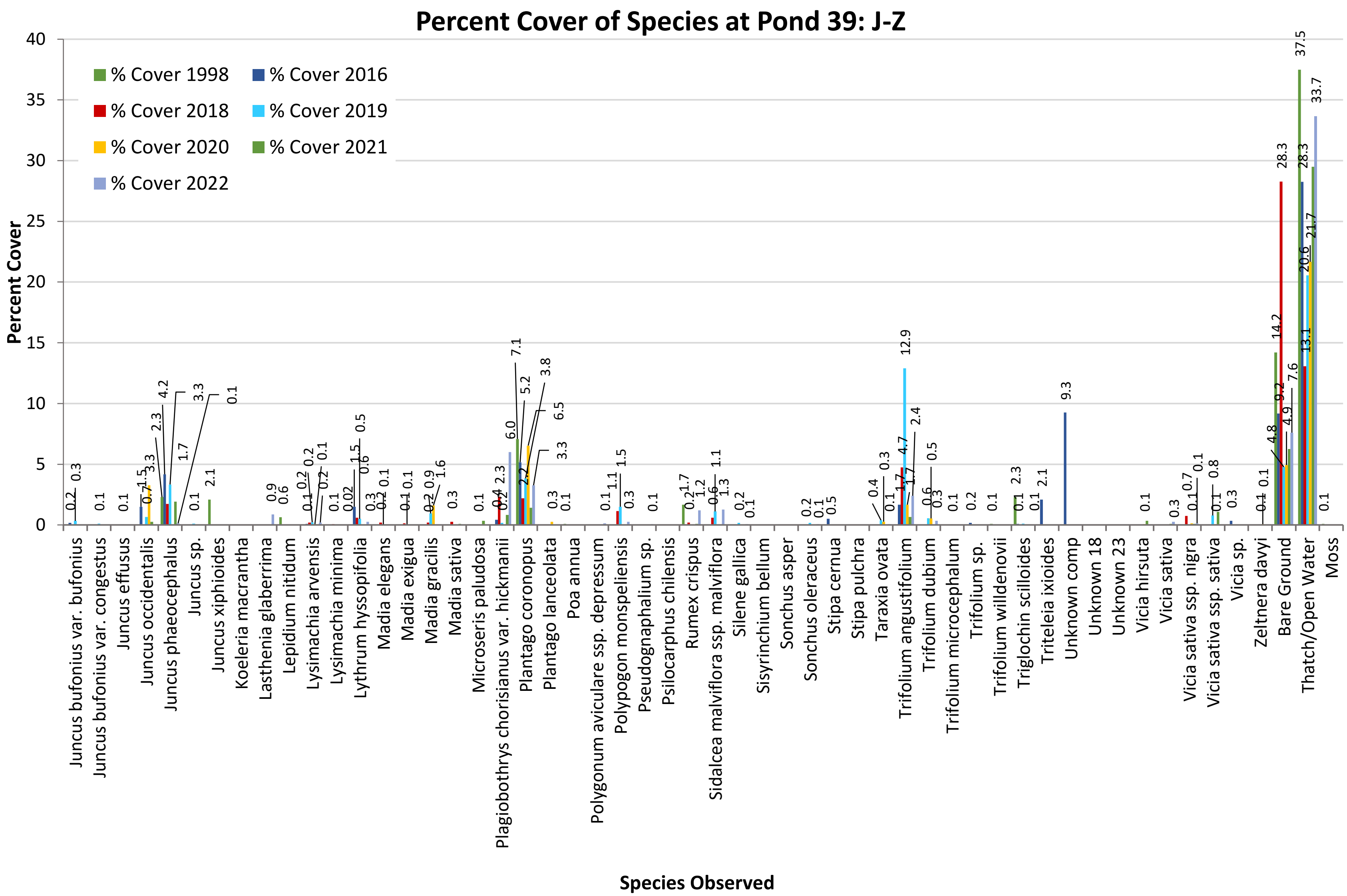

Figure E-15 (continued). Comparison Graph of Percent Cover by Wetland Plant Species for 2017, 2018, 2019, 2020, 2021, and 2023 at Pond 39 (Year 5 Post-Subsurface Munitions Remediation).

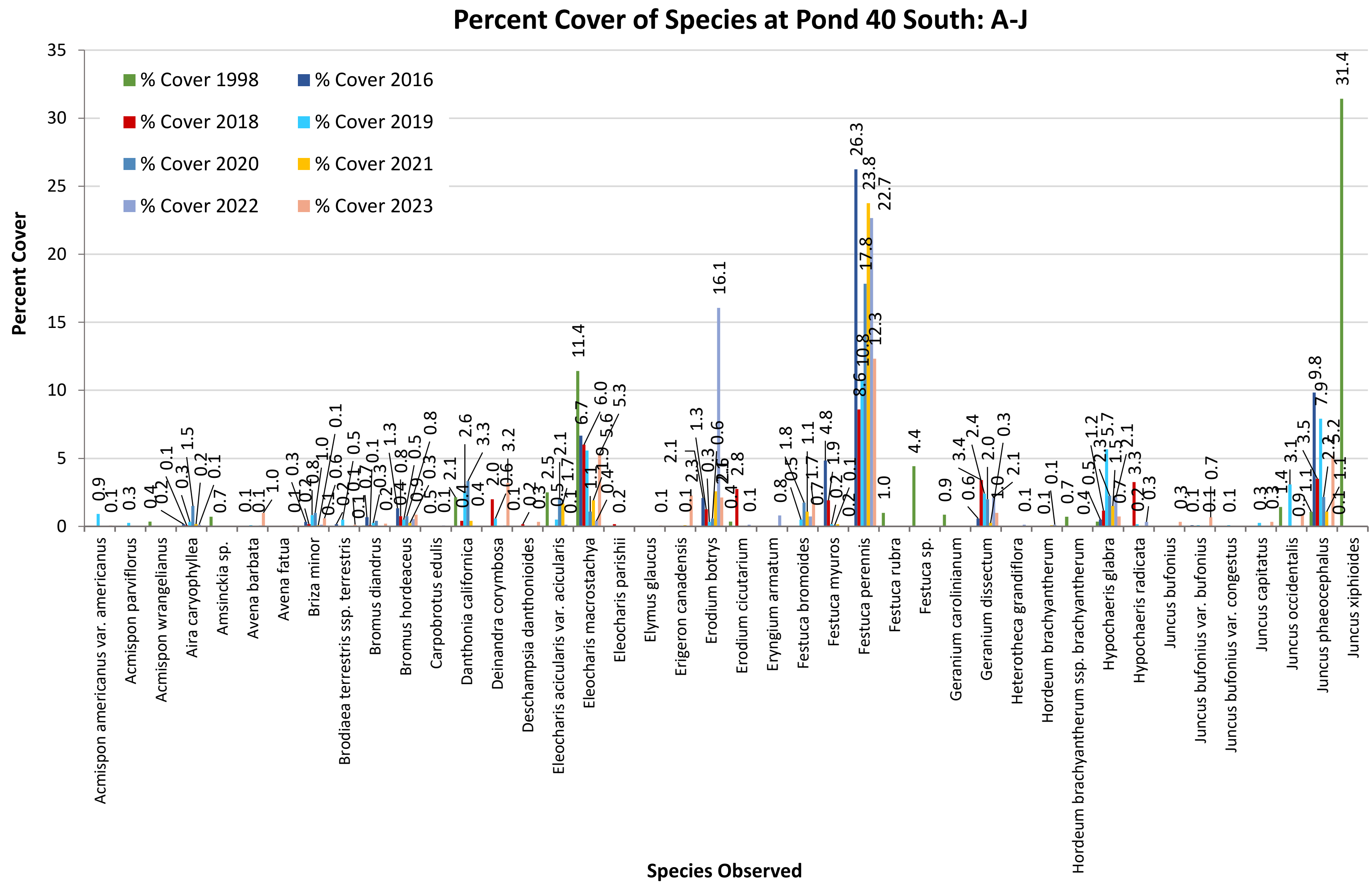

Figure E-16. Comparison Graph of Percent Cover by Wetland Plant Species for 1998, 2016, 2018, 2019, 2020, 2021, 2022 and 2023 Pond 40 South (Year 5 Post-Subsurface Munitions Remediation).

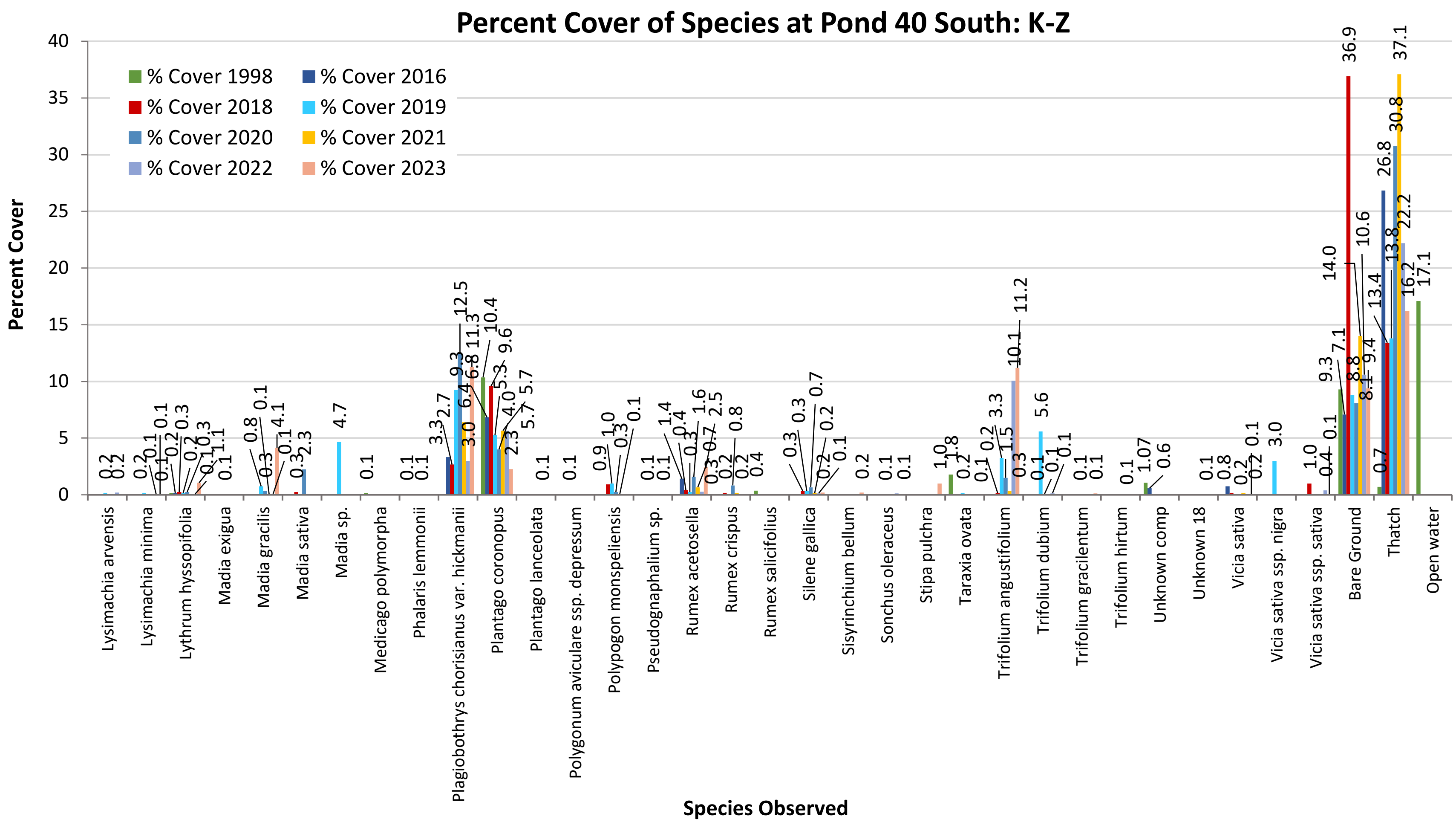

Figure E-16 (continued). Comparison Graph of Percent Cover by Wetland Plant Species for 1998, 2016, 2018, 2019, 2020, 2021, 2022 and 2023 Pond 40 South (Year 5 Post-Subsurface Munitions Remediation).

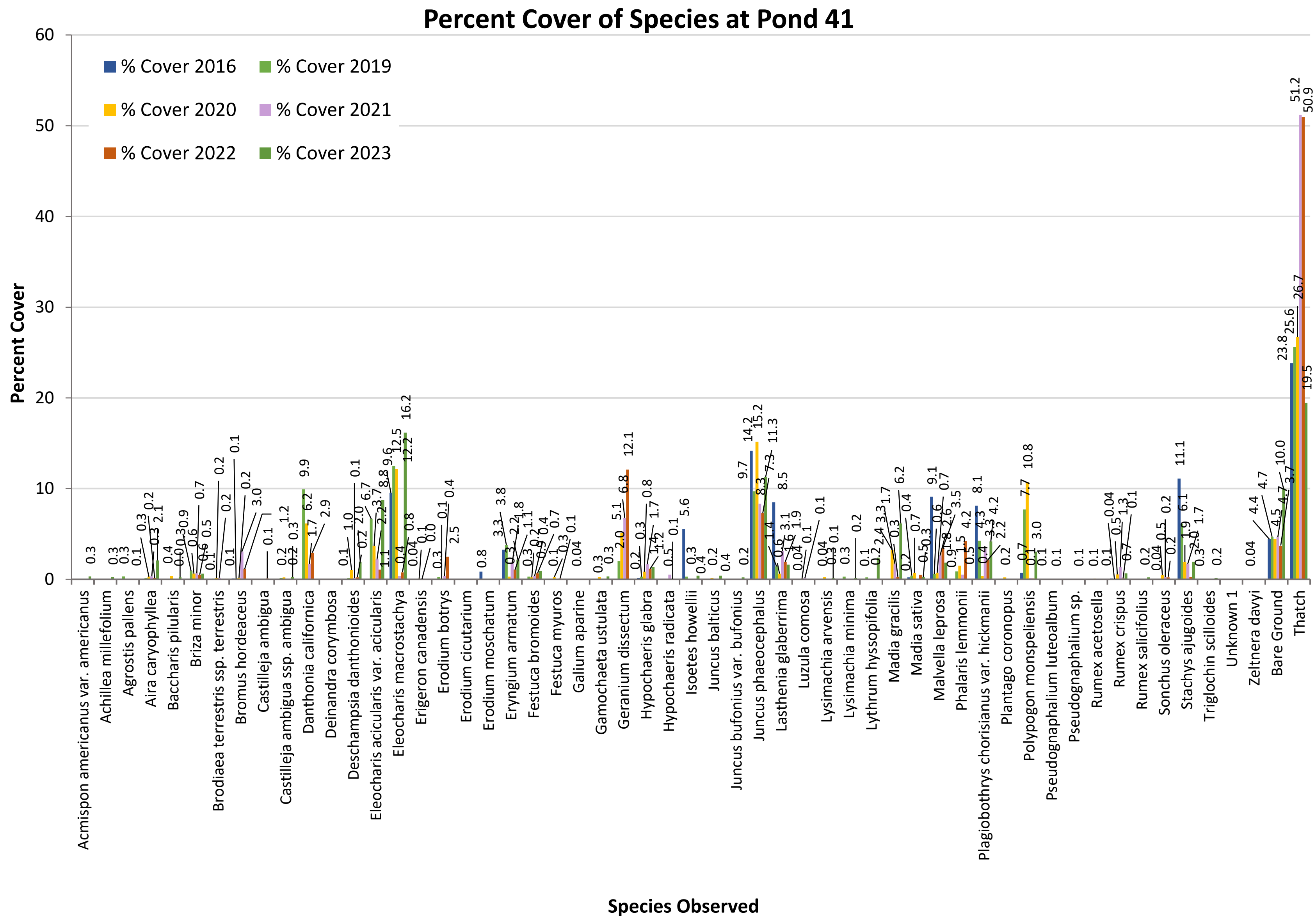

Figure E-17. Comparison Graph of Percent Cover by Wetland Plant Species for 2016, 2019, 2020, 2021, 2022 and 2023 at Pond 41 (Year 5 Post-Subsurface Munitions Remediation).

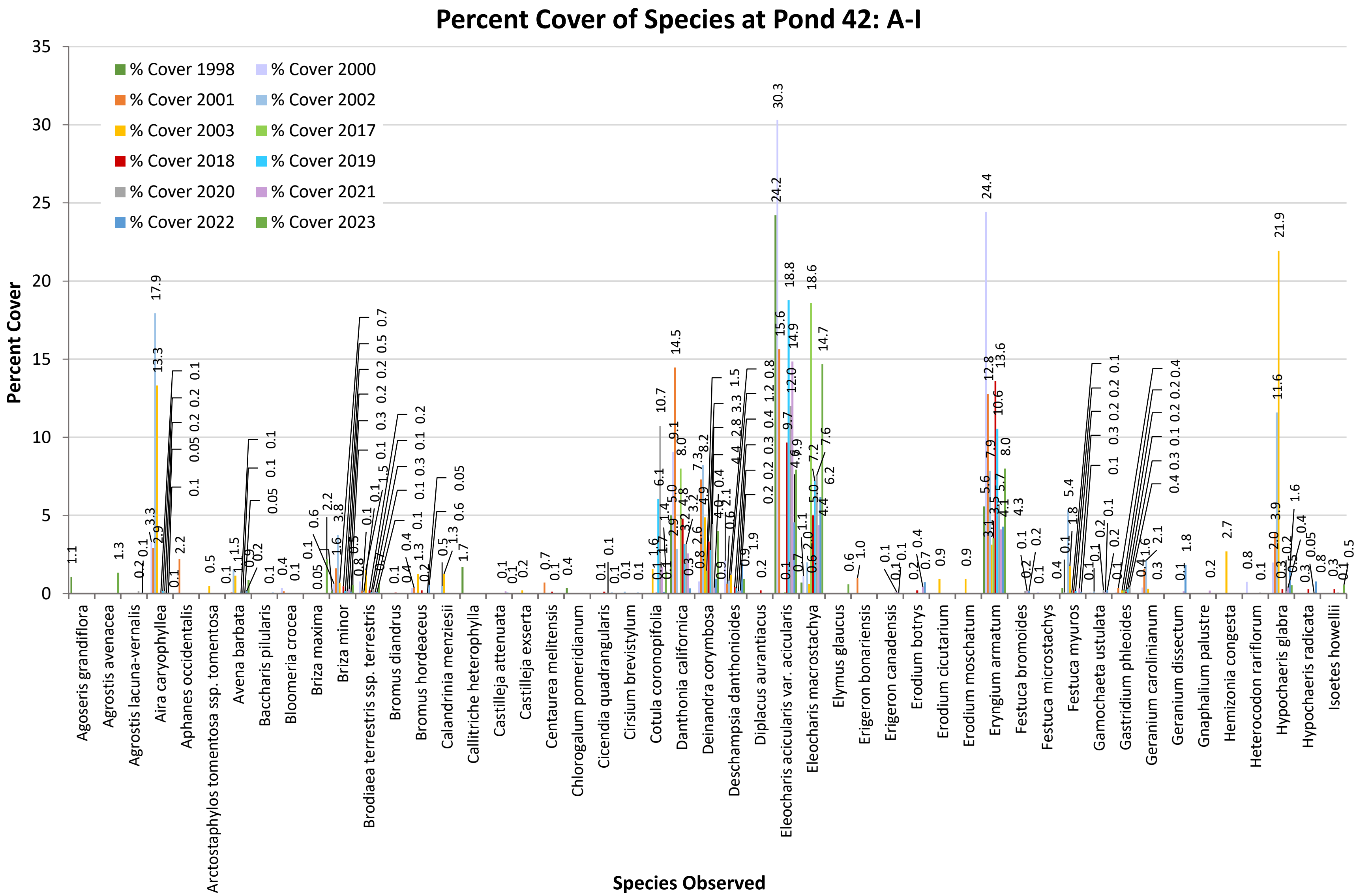

Figure E-18. Comparison Graph of Percent Cover by Wetland Plant Species for 1998, 2000, 2001, 2003, 2017, 2018, 2019, 2020, 2021, 2022 and 2023 at Pond 42 (Year 5 Post-Subsurface Munitions Remediation).

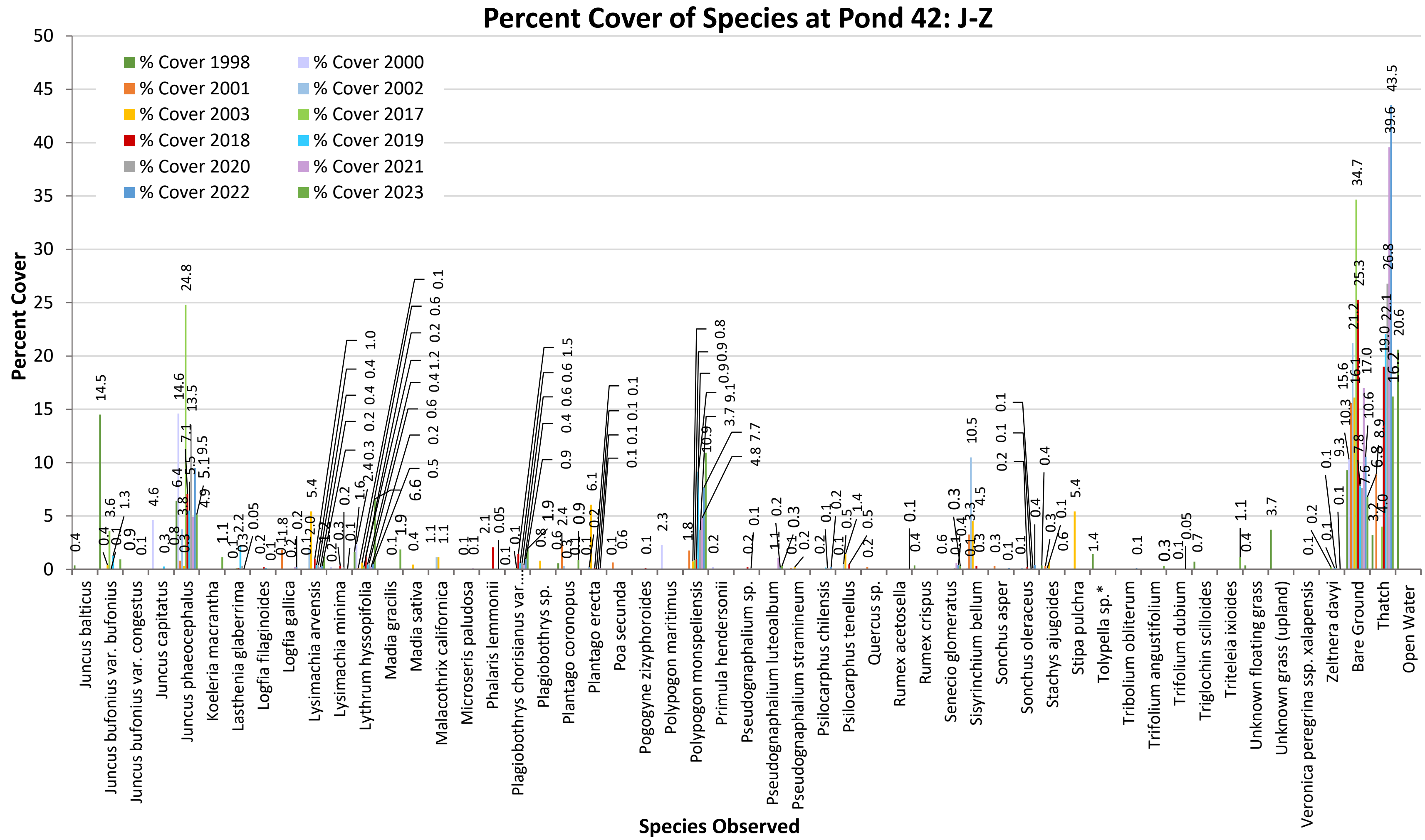

Figure E-18 (continued). Comparison Graph of Percent Cover by Wetland Plant Species for 1998, 2000, 2001, 2003, 2017, 2018, 2019, 2020, 2021, 2022 and 2023 at Pond 42 (Year 5 Post-Subsurface Munitions Remediation).

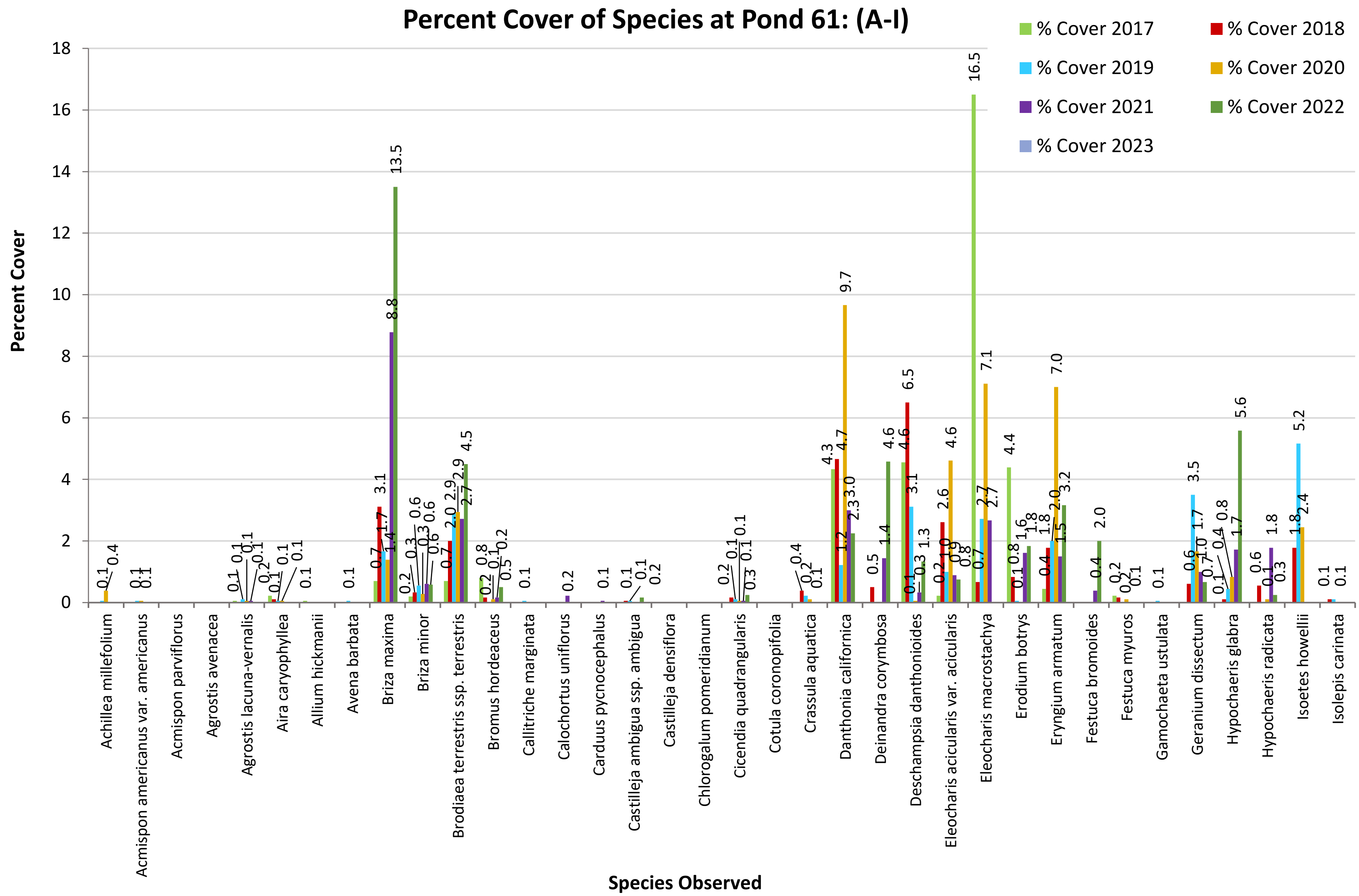

Figure E-19. Comparison Graph of Percent Cover by Wetland Plant Species for 2017, 2018, 2019, 2020, 2021, 2022 and 2023 at Pond 61 (Year 5 Post-Subsurface Munitions Remediation).

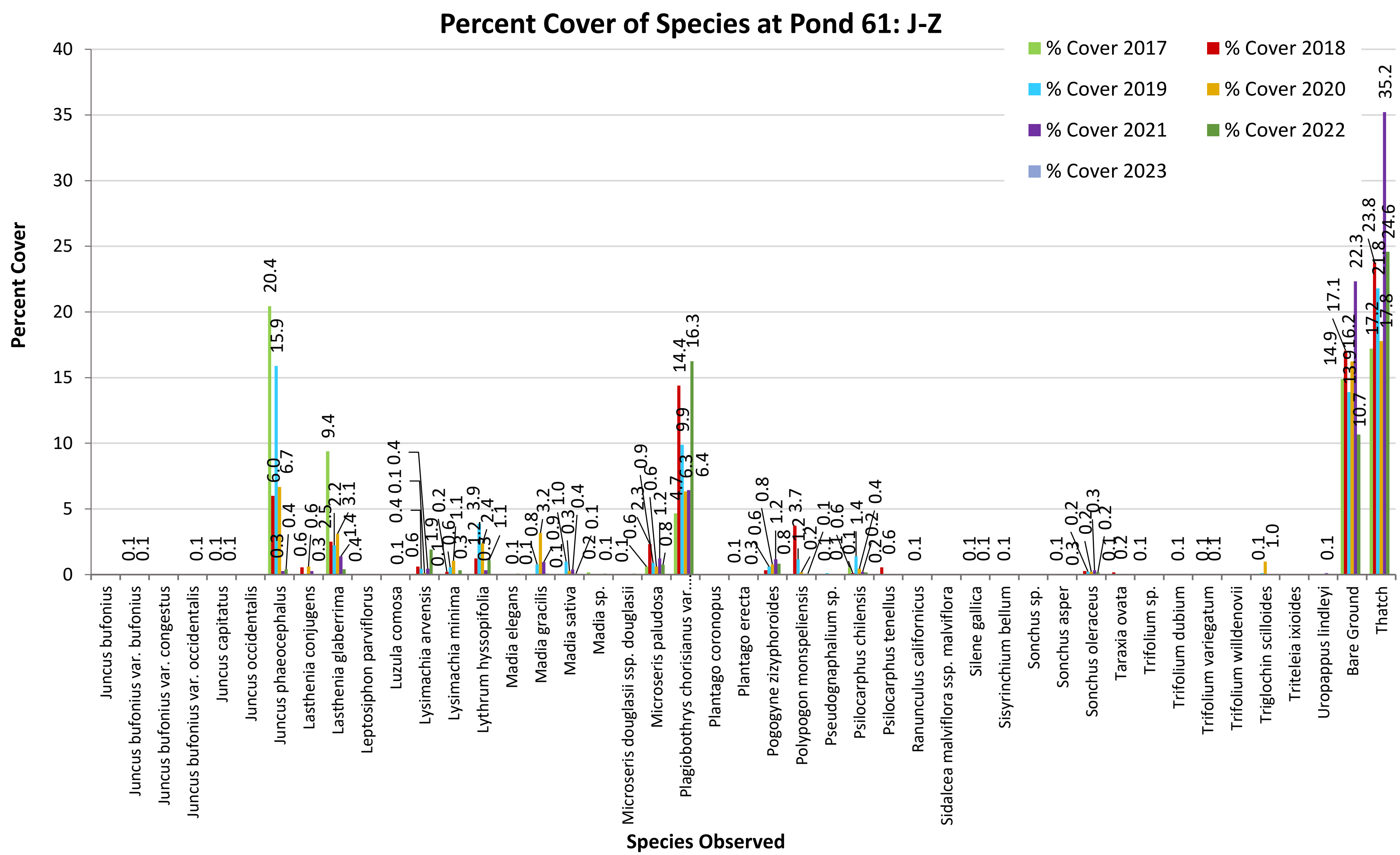

Figure E-19 (continued). Comparison Graph of Percent Cover by Wetland Plant Species for 2017, 2018, 2019, 2020, 2021, 2022 and 2023 at Pond 61 (Year 5 Post-Subsurface Munitions Remediation).

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APPENDIX F

Rank Abundance Curves

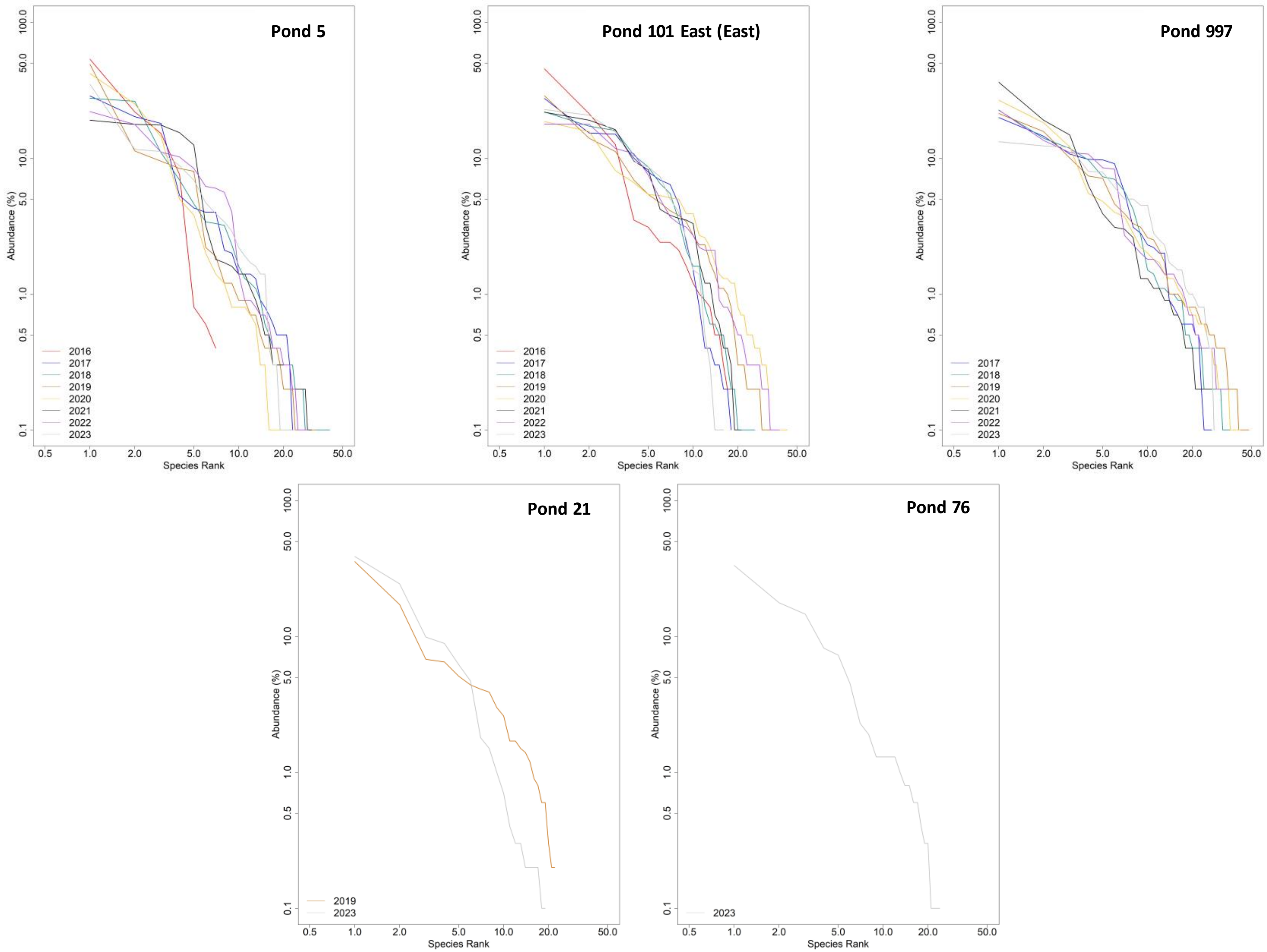

Figure F-1. Comparison Plots for RACs by Pond for all years. The top three plots are reference vernal pools. The bottom two plots are vernal pools in their first year of monitoring. Both the x-axis and y-axis are in log-10 scale.

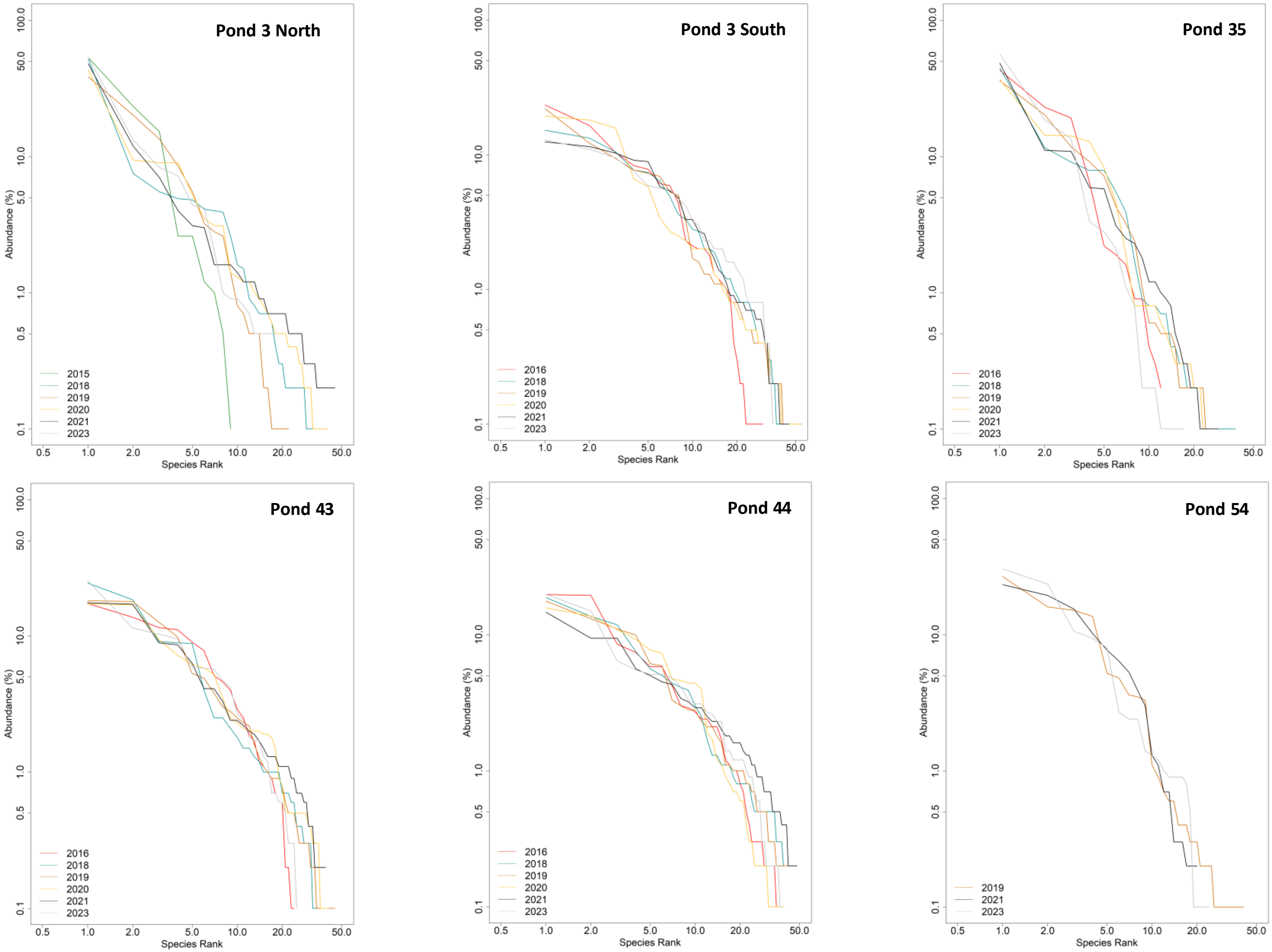

Figure F-2. Comparison Plots for RACs by Pond for all years. All plots are vernal pools in their fifth year of monitoring. Both the x-axis and y-axis are in log-10 scale.

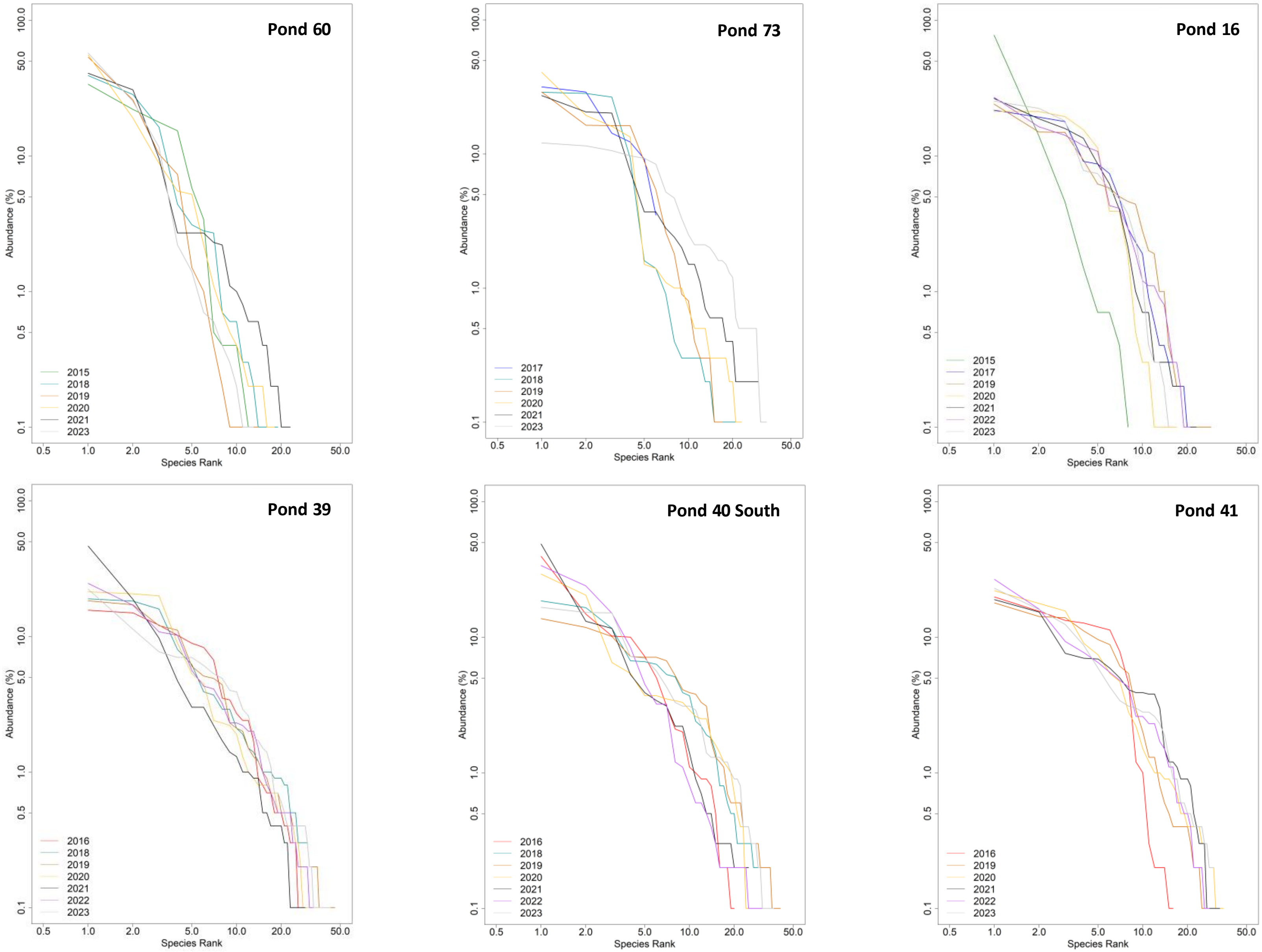

Figure F-3, continued. Comparison Plots for RACs by Pond for all years. All plots are vernal pools in their fifth year of monitoring. Both the x-axis and y-axis are in log-10 scale.

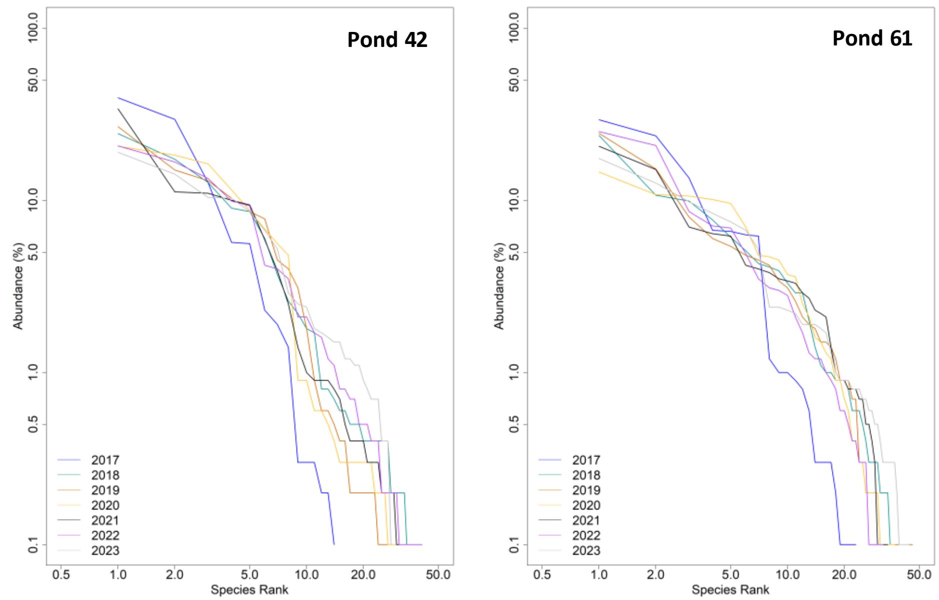

Figure F-4, continued. Comparison Plots for RACs by Pond for all years. All plots are vernal pools in their fifth year of monitoring. Both the x-axis and y-axis are in log-10 scale.

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APPENDIX G

CTS and Aquatic Invertebrate Data from Aquatic Surveys at Vernal Pools Monitored in 2023

Table G-1. CTS Aquatic Survey Results for Vernal Pools Monitored in 2023 at Former Fort Ord

Vernal Pool	Sampling Date	# of Larvae Observed	# of Larvae Measured	Total Length of Larvae (mm)			Snout-Vent Length of Larvae (mm)			Survey Hours
				Mean*	Range	Mode	Mean*	Range	Mode	
5	4/27/2023	1	0	-	-	-	-	-	-	20min
	5/11/2023	44	30	85	43-105	95	46	25-56	54	5 hr 55 min
101 East (East)	4/27/2023	1	0	-	-	-	-	-	-	10 min
	5/11/2023	29	26	90	57-115	85	48	30-63	45	3 hrs 29 min
21	4/28/2023	1	0	-	-	-	-	-	-	4 min
	5/12/2023	8	8	103	68-113	113	52	52-62	61	2 hrs 34 min
76	4/28/2023	0	0	-	-	-	-	-	-	21 min
3 North	4/26/2023	0	0	-	-	-	-	-	-	7 min
	5/9/2023	0	0	-	-	-	-	-	-	50 min
3 South	4/26/2023	0	0	-	-	-	-	-	-	4 min
	5/9/2023	0	0	-	-	-	-	-	-	59 min
54	4/28/2023	1	0	-	-	-	-	-	-	17 min
	5/12/2023	5	5	92	83-96	N/A	50	47-53	50	52 min
60	5/11/2023	41	30	88	60-136	82	48	34-70	50	3 hrs
73	4/26/2023	0	0	-	-	-	-	-	-	27 min
16	5/12/2023	1	1	39	39-39	39	18	18-18	18	1 hr 37 min
39	5/9/2023	0	0	-	-	-	-	-	-	5 min
41	4/26/2023	4	4	98	71-116	N/A	56	42-64	N/A	31 min
	5/12/2023	7	7	99.43	84-123	N/A	53.57	46-65	N/A	1 hr 14 min
42	4/26/2023	0	0	-	-	-	-	-	-	22 min

*The mean was rounded to the nearest whole number

Table G-2. Aquatic Invertebrates Observed During Aquatic Surveys at Vernal Pools Monitored in 2023

Vernal Pool	Aquatic Invertebrate																	
	CA Fairy Shrimp (Order Anostraca)	Clam Shrimp (Order Conchostraca)	Water Flea (Order Cladocera)	Seed Shrimp (Order Ostracoda)	Copepods (Order Eucopepoda)	Scuds (Order Amphipoda)	Mayfly Larvae (Order Ephemeroptera)	Dragonfly Larvae (Sub-order Anisoptera)	Damselfly Larvae (Sub-order Zygoptera)	Backswimmer (Family Notonectidae)	Waterboatmen (Family Corixidae)	Predaceous Diving Beetle (Family Dytiscidae)	Giant Water Bug (Family Belostomatidae)	Water Scorpion (Family Nepidae)	Mosquito Larvae (Family Culicidae)	Water Scavenger Beetle (Family Hydrophilidae)	Dipteran Larvae (Order Diptera)	Snail (Class Gastropoda)
5	-	●	●	-	●	-	-	●	-	●	●	-	-	-	●	-	●	●
101 East (East)	-	●	●	●	●	-	●	●	-	-	●	-	-	-	●	●	●	-
21	-	●	●	●	●	-	●	●	-	●	●	●	-	-	●	-	●	-
3 North	-	●	●	●	-	-	●	-	●	-	●	-	-	-	●	-	-	●
3 South	-	-	●	●	-	-	●	-	●	-	●	-	-	-	-	●	-	-
54	-	-	-	●	●	-	-	●	-	-	-	●	-	-	●	●	-	-
60	-	●	●	●	●	-	-	●	-	●	●	●	-	-	-	●	-	●
16	●	●	●	●	●	-	-	-	●	●	●	-	-	-	-	-	-	●
39	-	●	●	●	-	-	●	-	-	-	●	-	-	-	-	-	-	●
41	-	●	-	-	-	-	-	●	-	●	●	-	-	-	-	-	-	-

Table G-2. Fairy Shrimp Aquatic Survey Results for Vernal Pools Monitored in 2023 at Former Fort Ord

Vernal Pool	Sampling Date	Abundance (# of Individuals)
5	5/11/2023	Not detected
101 East (East)	5/11/2023	Not detected
21	5/12/2023	Not detected
41	5/12/2023	Not detected
3 North	5/9/2023	Not detected
3 South	5/9/2023	Not detected
39	5/9/2023	Not detected
60	5/11/2023	Not detected
16	5/12/2023	Low (7)
54	5/12/2023	Not detected