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WETLAND VEGETATION AND WILDLIFE MONITORING
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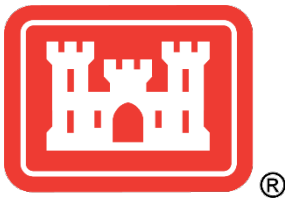

Prepared for:
US Army Corps of Engineers
Sacramento District
1325 J Street
Sacramento, CA 95814-2922

Prepared by:
Burleson Consulting Inc., A Terracon Company
1900 Garden Road, Suite 210
Monterey, CA 93940

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F RANK ABUNDANCE CURVES

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

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1 INTRODUCTION

The United States Army Corps of Engineers (USACE) contracted Burleson Consulting Inc., A Terracon Company (Burleson) to conduct wetland monitoring at former Fort Ord, Monterey County, California (see Figure 1-1). Wetland monitoring includes three types of monitoring: hydrology, vegetation, and wildlife. Burleson was contracted to complete vegetation and wildlife monitoring in 2022. Hydrology monitoring was completed by Chenega Tri-Services, LLC (Chenega) and is reported separately (Chenega, 2023). These monitoring activities are centered around historical vernal pools on former Fort Ord.

The Burleson team monitored wetland vegetation including federally endangered Contra Costa goldfields (*Lasthenia conjugens;* CCG) however wildlife surveys were not completed as the vernal pools did not hold sufficient depth. 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 2022 included reference vernal pools 5, 101 East (East), 997; and remediated vernal pools 16, 39, 40 South, 41, 42, 61, and 75 (see Figure 1-2 and Figure 1-3). The populations of CCG were mapped and evaluated at Ponds 997 and 61. A new occurrence of vernal pool bent grass was mapped at Pond 16. Invertebrate and protocol-level California tiger salamander (*Ambystoma californiense*; CTS) aquatic sampling surveys were not completed for the 2021-2022 water-year because none of the vernal pools held water long enough to trigger the wildlife surveys.

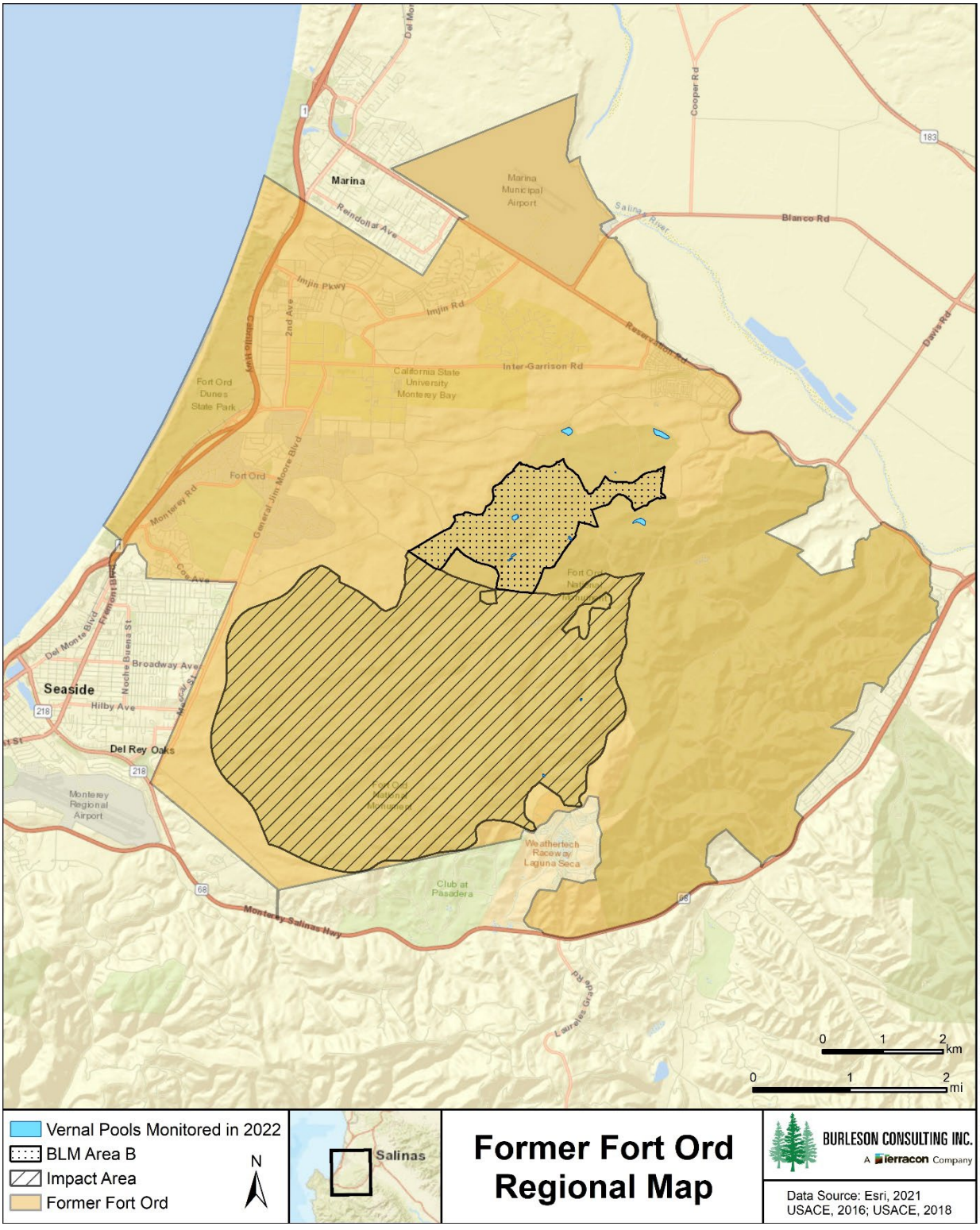

Figure 1-1. Location Map of Vernal Pools on Former Fort Ord Monitored in 2022

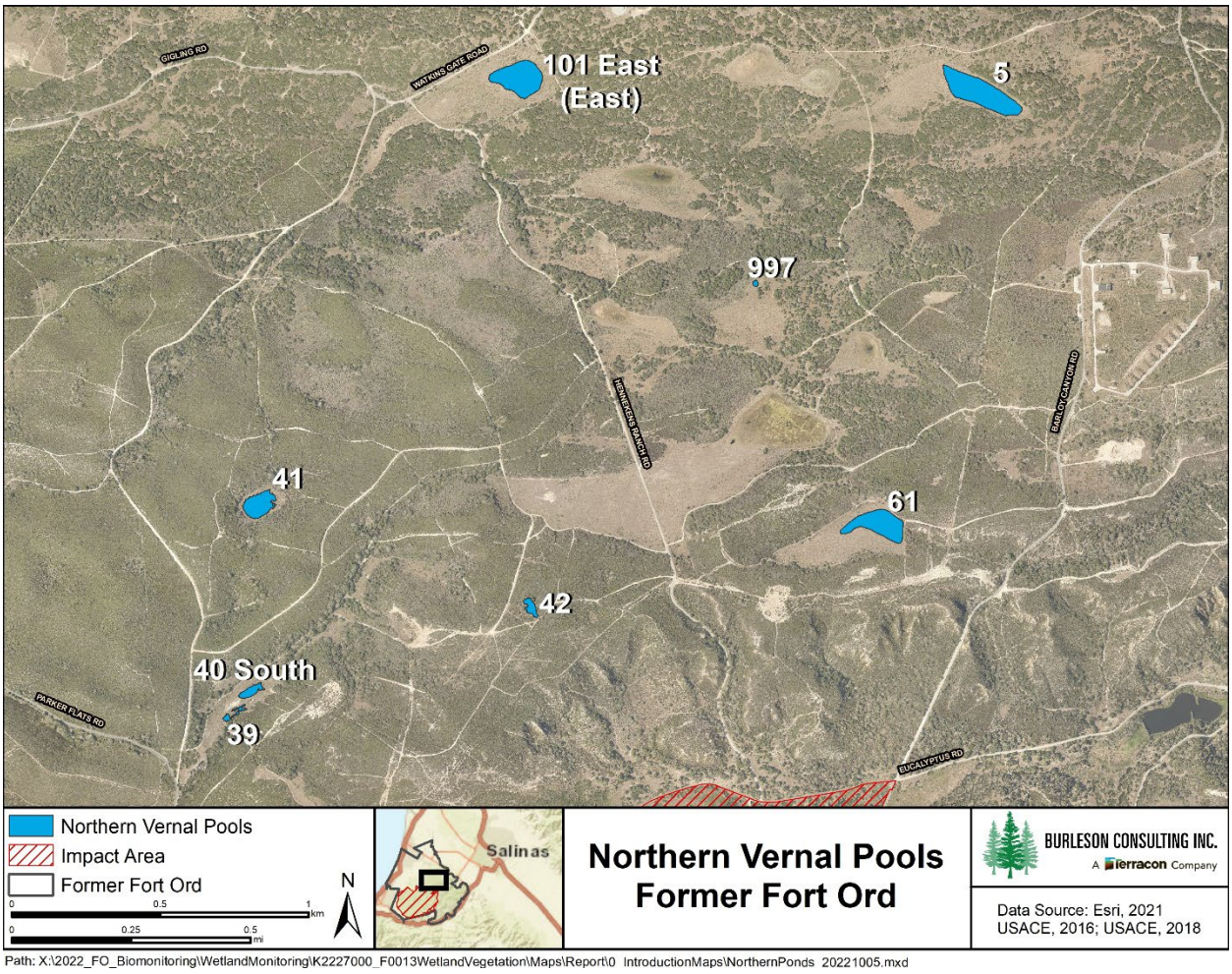

Figure 1-2. Location Map of Ponds 5, 101 East (East), 997, 39, 40 South, 41, 42, and 61

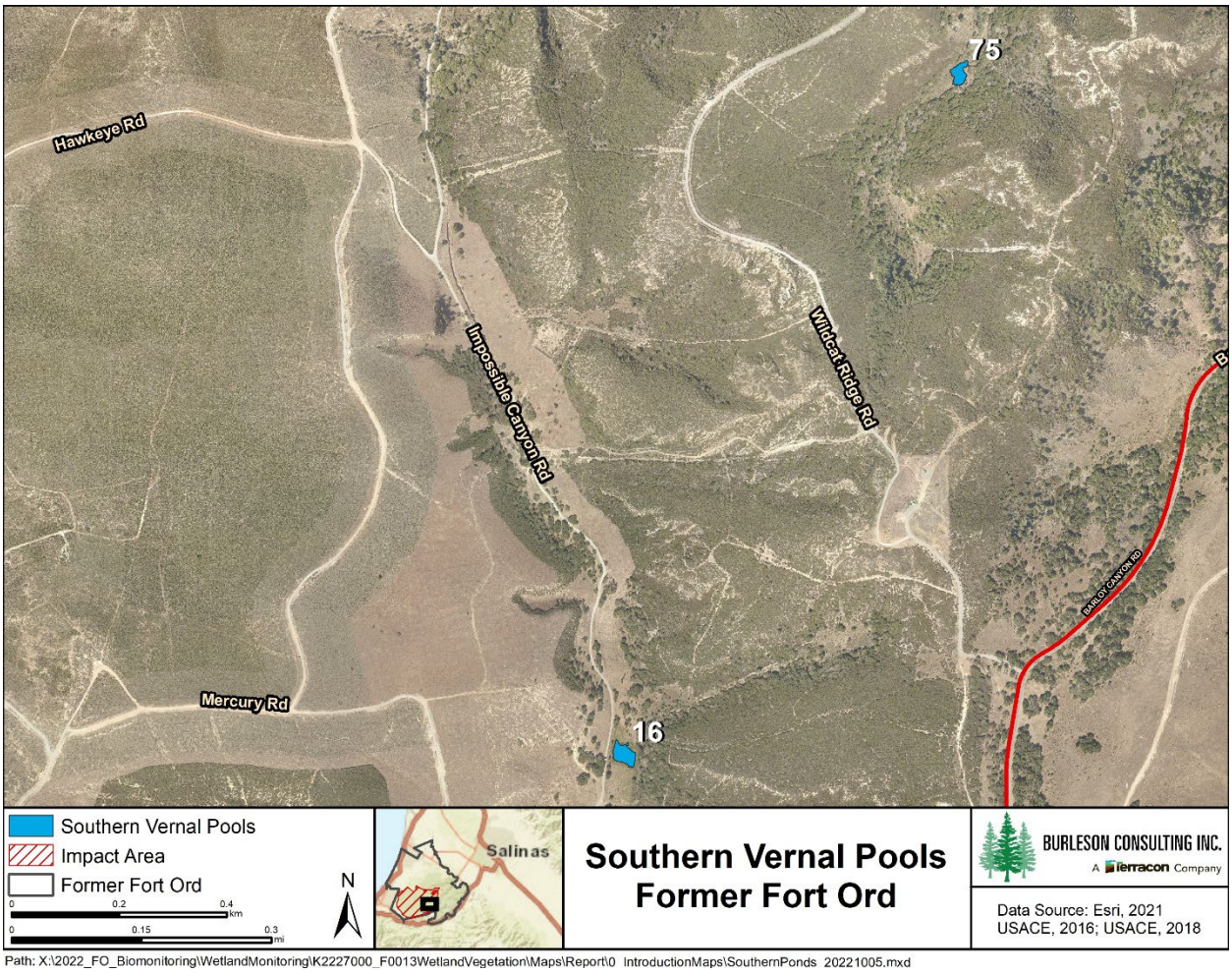

Figure 1-3. Location Map of Ponds 16 and 75

In the 2021-2022 water-year, the Monterey Peninsula Regional Airport meteorological tower recorded precipitation that was approximately 14 centimeters (cm) less than normal cumulative precipitation, making it the second of two consecutive drought years. It was the sixth-lowest recorded cumulative precipitation in 31 years of data collection (NPSDM, 2022; see Figure 1-4). There was unusually heavy rainfall from October through December which constituted the bulk of precipitation for the water-year. January and February were completely dry. The rain events that occurred in March and April brought some moisture to the area but were still below-normal, yielding 3.76 cm of precipitation. Only 0.03 cm of additional precipitation occurred in June (see Figure 1-5). The total cumulative precipitation was approximately 67 percent (%) of 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 and is located within one kilometer of the NWSFO tower. All 2021-2022 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 at the end of each decade is moved forward another 10 years. Prior to 2021, the dataset was from 1981-2010. In this report and the 2021 annual report, 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.

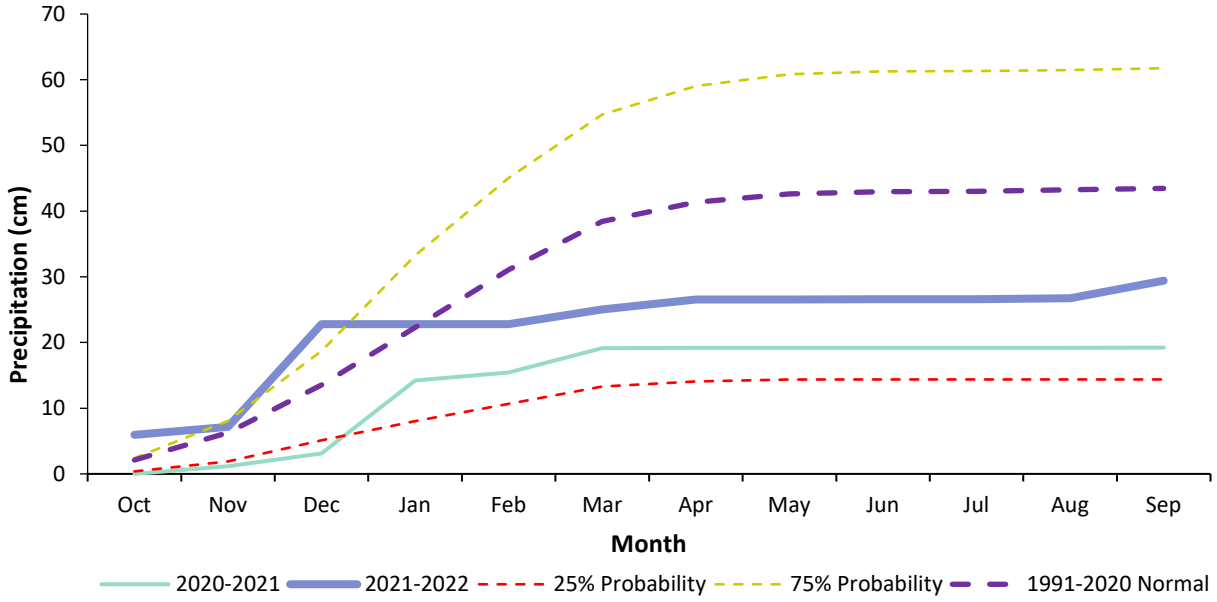

Figure 1-4. Cumulative Monthly Precipitation for the 2021-2022 Water-Year compared to the 30-Year Normal (mean 1991-2020), the 2020-2021 Water-Year, and the 25% and 75% Probabilities (NPS, 2022; National Centers for Environmental Information [NCEI] and National Oceanic and Atmospheric Administration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

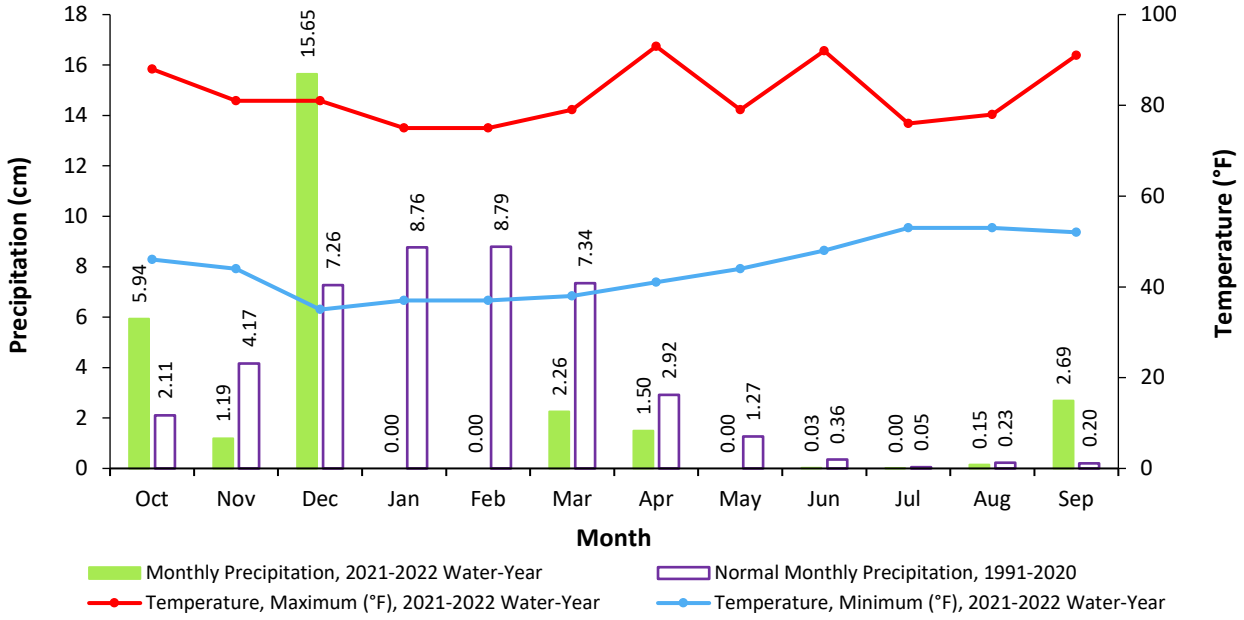

Figure 1-5. Monthly Precipitation, Maximum and Minimum Temperatures for the 2021-2022 Water-Year and Normal Monthly Precipitation (NPS, 2022).

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 2022 at former Fort Ord.

Table 1-1. 2022 Monitoring Status of Vernal Pools on Former Fort Ord

Vernal Pool	Monitoring Status
Pond 5	Reference
Pond 16	Year 4 Post-Subsurface Munitions Remediation (> 10 ft^2)
Pond 39	Year 4 Post-Subsurface Munitions Remediation (> 10 ft^2)
Pond 40 South	Year 4 Post-Subsurface Munitions Remediation (> 10 ft^2)
Pond 41	Year 4 Post-Subsurface Munitions Remediation (> 10 ft^2)
Pond 42	Year 4 Post-Subsurface Munitions Remediation (> 10 ft^2)
Pond 61	Year 4 Post-Subsurface Munitions Remediation (> 10 ft^2)
Pond 75	Baseline
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).

Vernal pools must be monitored for baseline condition 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 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 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 first, third, and fifth years, following remediation, whereas vernal pools with greater and/or deeper disturbance 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 16, 39, 40 South, 41, 42, and 61 were investigated for geophysical anomalies that potentially represented munitions and explosives of concern (MEC) items, and all had subsurface munitions remediation that exceeded the ten square foot threshold (KEMRON, 2020). They were monitored in 2022 for year 4 post-subsurface munitions remediation. Ponds 5, 101 East (East), and 997 were monitored as reference vernal pools and Pond 75 was monitored for an additional year of baseline conditions.

2.1 Vegetation Monitoring

Prior to collecting transect data, vernal pools were visited in early spring to assess the condition and initiate a list of plant species present. Vernal pools were visited more than once prior to collection of quadrat data to identify species present, evaluate vegetative strata, and determine the ideal time to collect data. Vegetation quadrat data were collected between April 28 and May 10, 2022. 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, it 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 is 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® Juno ® T41 Series GPS unit. 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 sampling using a Trimble® Juno ® T41 Series GPS unit and calculated absolute percent cover of the strata using ArcGIS (Esri, 2022). In addition, photo points were taken to show the extent of each vernal pool for comparison with previous years (See Appendix C).

Plant species observed at 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, 2016), *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-11. 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-12 – D-22) (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*) and vernal pool bent grass (*Agrostis lacuna-vernalis)* were mapped using a Trimble® Juno ® T41 Series GPS unit. CCG populations were mapped by creating polygons and bsolute cover was visually estimated. Vernal pool bent grass occurrences were mapped to document the extent of the species across former Fort Ord. Vernal pool bent grass is a recently described Fort Ord endemic 1B.1 ranked species by CNPS but is currently not federally listed (Peterson *et al.,* 2011).

2.2 Wildlife Monitoring

Following the HMP, PBO, and Wetland Plan, biologists typically conduct aquatic surveys for CTS and fairy shrimp (USACE, 1997; USFWS, 2017; Burleson, 2006). Wildlife surveys are scheduled in March, April, and May for CTS and fairy shrimp. 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). Surveys would have begun for fairy shrimp and CTS if the vernal pools maintained a minimum depth of 10 cm during the March hydrology events, however none of the scheduled vernal pools met that criterion and wildlife surveys were not conducted.

When surveys do occur, nets, boots, and other equipment would be 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 would be treated with 10% diluted bleach solution and dried at the end of each day. Cleaning solutions would be applied to equipment in areas away from aquatic resources, on disturbed or developed roads to reduce contamination.

2.2.1 California Tiger Salamander

Although no surveys were completed this year, survey methods for CTS follow 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 are typically made as needed: aquatic sampling continued after initial detection and dip nets were used exclusively. Additional aquatic sampling may be completed to provide additional insight into vernal pool function.

When surveys do occur, CTS larvae are 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. All sites are 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 six biologists sample each site. Biologists collect samples from each vernal pool until the habitat was adequately represented.

Biologists measure and record the length of a subset of 30 individual CTS larvae collected. When the total number of CTS collected is less than 30, all individuals are measured. California tiger salamander and other amphibian species encountered are identified and the total numbers recorded.

2.2.2 California Fairy Shrimp

Normally, aquatic sampling for fairy shrimp and other aquatic invertebrates is conducted using a fine-meshed dip net and 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 are then sampled. When fairy shrimp are present, the abundance is 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 is 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 are totaled and the abundance as reported as follows:

- 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 would typically be assessed using DQO 5, however because wildlife surveys were not completed the DQO was not accessed in this report. 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). In years when wildlife surveys are completed for DQO 5, the vernal pool is considered successful if the post-remediation wildlife usage is 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).

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).

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3 RESULTS

Vegetation monitoring was conducted at Ponds 5, 101 East (East), 997, 16, 39, 40 South, 41, 42, 61, and 75. Across all monitored vernal pools, the mean number of native plant species was 15 and non-native species was 15 (see Table 3-1). Of these species, a mean of 15 were wetland species, either obligate (OBL), facultative wetland (FACW), or facultative (FAC) (see Table 3-2). In addition to vegetative strata mapping and transect surveys, populations of CCG were surveyed at Ponds 61 and 997, and vernal pool bent grass was mapped at one new location at Pond 16.

Table 3-1. Vegetation Species Richness of Native and Non-Native Species Observed on Transects at Vernal Pools Monitored in 2022

Vernal Pool	Monitoring Status	Native	Non-Native
Pond 5	Reference	14	14
Pond 101 East (East)	Reference	21	16
Pond 997	Reference	16	18
Mean (Reference)	-	**17**	**16**
16	Year 4 Post-Subsurface Munitions Remediation	13	7
39	Year 4 Post-Subsurface Munitions Remediation	11	25
40 South	Year 4 Post-Subsurface Munitions Remediation	10	22
41	Year 4 Post-Subsurface Munitions Remediation	14	13
42	Year 4 Post-Subsurface Munitions Remediation	20	21
61	Year 4 Post-Subsurface Munitions Remediation	19	12
75	Baseline	10	5
Mean (Remediated)	-	**14**	**15**
Mean (All)	-	**15**	**15**

Table 3-2. Vegetation Species Richness of Obligate and Facultative Wetland Species Observed on Transects at Vernal Pools Monitored in 2022

Vernal Pool	Monitoring Status	OBL	FACW	FAC	Wetland Species
Pond 5	Reference	4	6	2	12
Pond 101 East (East)	Reference	4	6	8	18
Pond 997	Reference	4	7	4	15
Mean (Reference)	-	**4**	**6**	**5**	**15**
16	Year 4 Post-Subsurface Munitions Remediation	2	4	1	7
39	Year 4 Post-Subsurface Munitions Remediation	5	6	8	19
40 South	Year 4 Post-Subsurface Munitions Remediation	4	4	4	12
41	Year 4 Post-Subsurface Munitions Remediation	5	7	3	15
42	Year 4 Post-Subsurface Munitions Remediation	5	10	4	19
61	Year 4 Post-Subsurface Munitions Remediation	5	8	3	16
75	Baseline	1	5	3	9
Mean (Remediated)	-	**4**	**6**	**4**	**14**
Mean (All)	-	**4**	**6**	**4**	**14**

Aquatic wildlife monitoring was not conducted because vernal pools did not hold sufficient depth to trigger the wildlife surveys in 2022. Ponds 5, 39, 41, 42, 61, and 101 East (East) held some water for part of the season. Pond 61 held water from December 2021 through February 2022 and was dry by March (Chenega, 2023). Likewise, Pond 5 held water in December 2021 through February 2022, however there were still peripheral inundations in early March. Pond 42 held water from December 2021 to January 2022, Pond 101 East (East) held water from January through February, and Pond 41 held water briefly in January. Pond 39 held water the longest, from October 2021 to February 2022. Ponds 16, 40 South, 75 and Reference Pool 997 never held water for any part of the water-year.

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 2022, Pond 5 was monitored for hydrology and vegetation. 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 May 6 and May 10, 2022. These monitoring data represent reference conditions. Pond 5 held water from January through February during the 2021-2022 water-year, with shallow peripheral ponding observed in December and March (Chenega, 2023). Biologists identified five vegetative strata at the vernal pool (see Table 3-3 and Figure 3-1). Stratum 1 and the associated transect were repeated from 2016 and 2018-2021. Strata 2 and 3 were repeated from 2016-2021. Stratum 7 was repeated from 2019-2021. Stratum 8 was repeated from 2021. Transects 2 and 8 were relocated because the previous locations were no longer within the correct strata. Transect 3 was repeated from 2020 and 2021. Transect 7 was relocated to a more representative location and reduced from 10 m to 5 m.

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

Stratum	Percentage
1	35%
2	21%
3	8%
7	1%
8	35%

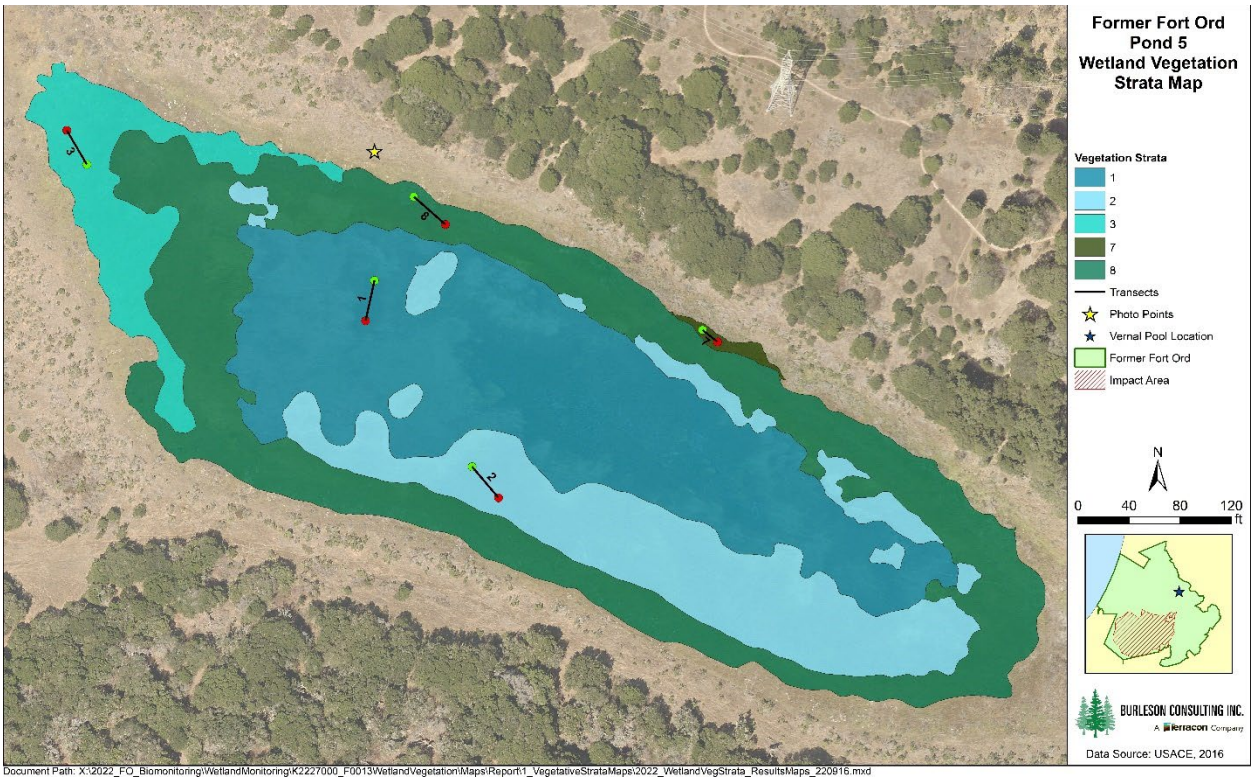

Figure 3-1. Pond 5 (Reference) Vegetation Strata and Transects on Former Fort Ord, 2022

Seventy-six plant species were observed within the vernal pool basin boundary. Of these species, 42 were native, 31 were non-native, and three were unidentified. Seven species were OBL wetland plants, 23 were FACW or FAC, 16 were FACU or UPL, and 30 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 3-4 provides a summary of the dominant species cover results for each stratum.

Table 3-4. Pond 5 (Reference) Dominant Species by Stratum Results

Stratum	Transect Length (m)	Dominant Species	
		Common Name	Absolute Cover on Transect (%)
1	10	pale spikerush alkali mallow	35.2 9.0
2	10	salt grass	24.2
3	10	bugle hedge nettle smooth cat's-ear salt grass	11.3 9.5 8.2
7	5	Baltic rush	41.0
8	10	cut-leaved geranium Lemmon's canary grass	12.2 9.5

3.1.2 Wildlife Monitoring

Wildlife surveys were not conducted at Pond 5 because the vernal pool did not have sufficient depth to trigger surveys.

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 2022, Pond 101 East (East) was monitored for hydrology and vegetation. 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 May 5, 2022. These monitoring data represent reference conditions. Pond 101 East (East) held water briefly in January and early February but was completely dry by the February 17 hydrology monitoring event (Chenega, 2023). Biologists identified four strata at the vernal pool (see Table 3-5 and Figure 3-2). Stratum 3 was repeated from 2016 and 2021. Stratum 4 was repeated from 2016, 2020, and 2021 whereas stratum 5 was repeated from 2017-2021. Stratum 9 and the corresponding transect were newly established in 2022. Transects 3 and 5 were repeated from 2021, whereas Transect 4 was relocated because the previous location was no longer within the correct stratum.

Table 3-5. Pond 101 East (East) (Reference) Vegetative Strata Percentage within the Vernal Pool Basin Boundary

Stratum	Percentage
3	33%
4	10%
5	55%
9	2%

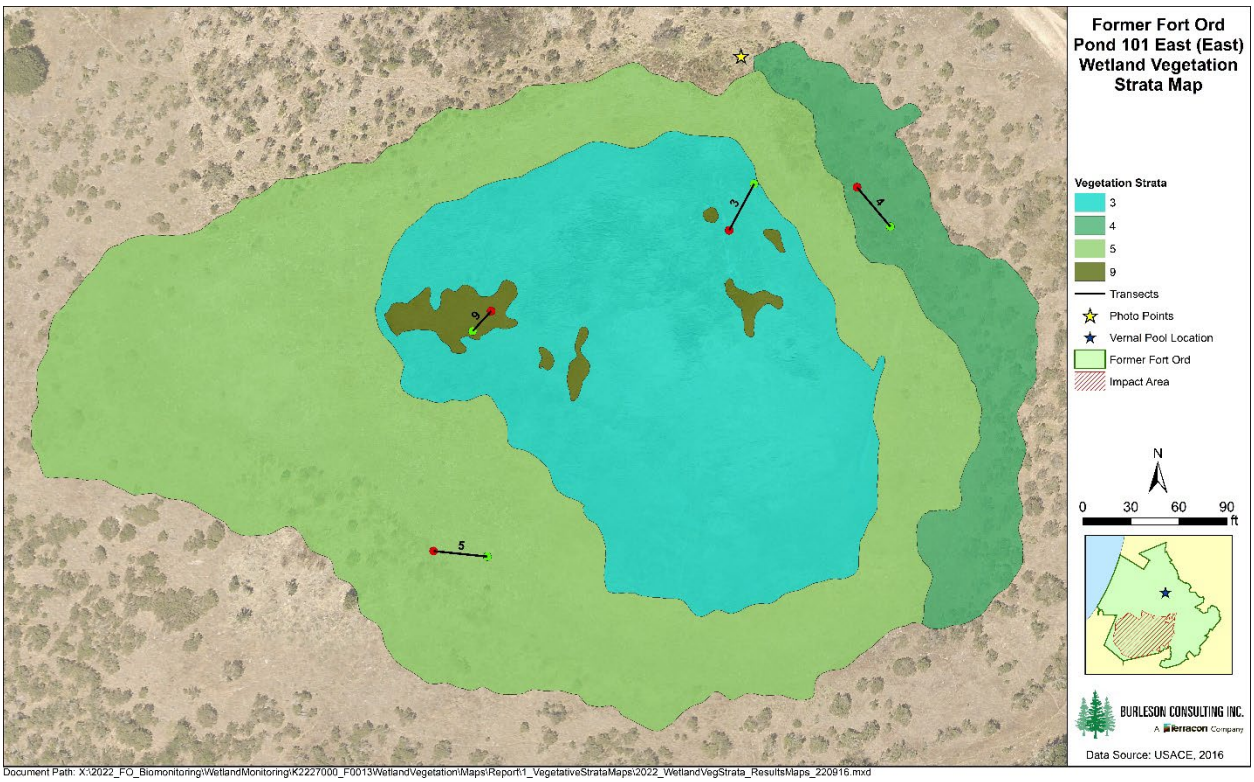

Figure 3-2. Pond 101 East (East) (Reference) Vegetation Strata and Transects on Former Fort Ord, 2022

Seventy-two plant species were observed within the vernal pool basin boundary. Of these species, 40 were native, 29 were non-native, and three were unidentified. Six species were OBL wetland plants, 26 were FACW or FAC, 14 were FACU or UPL, and 26 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 3-6 provides a summary of the dominant species cover results for each stratum.

Table 3-6. Pond 101 East (East) (Reference) Dominant Species by Stratum Results

Stratum	Transect Length (m)	Dominant Species	
		Common Name	Absolute Cover on Transect (%)
3	10	pale spikerush alkali mallow	30.0 29.3
4	10	Baltic rush cut-leaved geranium	14.7 6.8
5	10	cut-leaved geranium long-beaked filaree rough cat's-ear	14.5 9.7 6.7
9	5	smooth goldfields	42.0

3.2.2 Wildlife Monitoring

Wildlife surveys were not conducted at Pond 101 East (East) because the vernal pool did not have sufficient depth to trigger surveys.

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 May 2 and 3, 2022. These monitoring data represent reference conditions. Pond 997 remained dry throughout the 2021-2022 water-year (Chenega, 2023). Biologists identified three wetland strata at the vernal pool (see Table 3-7 and Figure 3-3). Strata and Transects 1 and 3 were repeated from 2017-2021. Stratum 2 was repeated from the same range of years but 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 3-7. Pond 997 (Reference) Vegetative Strata Percentage within the Vernal Pool Basin Boundary

Stratum	Percentage
1	5%
2 (CCG)	6%
3	89%

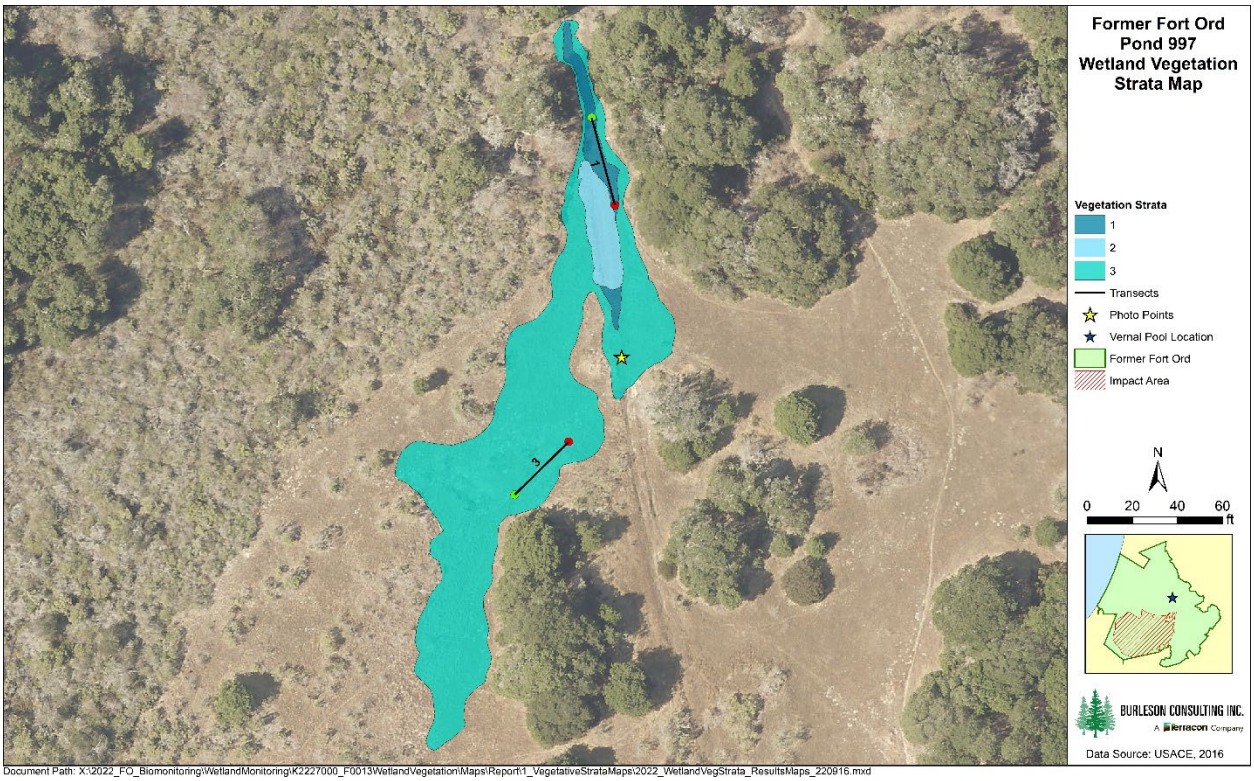

Figure 3-3. Pond 997 (Reference) Vegetation Strata and Transects on Former Fort Ord, 2022

Sixty-four plant species were observed within the vernal pool basin boundary. Of these species, 40 were native, 23 were non-native, and one was unidentified. Five species were OBL wetland plants, 22 were FACW or FAC, nine 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 3-8 provides a summary of the dominant species cover results for each stratum.

Table 3-8. Pond 997 (Reference) Dominant Species by Stratum Results

Stratum	Transect Length (m)	Dominant Species	
		Common Name	Absolute Cover on Transect (%)
1	10	coyote thistle long-beaked filaree brome fescue	8.3 6.0 6.0
2	N/A	Contra Costa goldfields	N/A
3	10	long-beaked filaree smooth cat's-ear rattlesnake grass California oat grass	15.2 11.2 10.0 8.0

3.3.1.1 *Contra Costa Goldfields*

Contra Costa goldfields at Pond 997 were mapped on March 30, 2022; they occupied 0.015 acre, with a density of 20% 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), 2022

3.3.2 Wildlife Monitoring

Wildlife surveys were not conducted at Pond 997 because the vernal pool did not have sufficient depth to trigger surveys.

3.4 Pond 16

Pond 16 was in year 4 of monitoring for post-subsurface munitions remediation in 2022. Pond 16 was monitored for hydrology and vegetation. Hydrology results are reported separately in the Hydrology Monitoring Annual Report (Chenega, 2023).

3.4.1 Vegetation Monitoring

Vegetation monitoring was completed at Pond 16 on May 9 and May 10, 2022. These monitoring data represent year 4 post-subsurface munitions remediation conditions. Pond 16 remained dry throughout the 2021-2022 water-year (Chenega, 2023). Biologists identified six strata at the vernal pool (see Table 3-9 and Figure 3-5). Strata 3 and 5 were repeated from 2015, 2017, and 2019-2021. Strata 1, 4, and 6 were repeated from 2017 and 2019-2021. Stratum 8 and the associated transect were repeated from 2021. Transect 1 was repeated from 2017 and 2019. Transects 3 and 4 were relocated because the previous locations were no longer within the correct strata. Transect 3 was also reduced from 10 m to 5 m to better represent the extent of vegetation across the vernal pool. Transect 5 was repeated from 2015, 2017, and 2019-2021. Transect 6 was repeated from 2017 and 2019-2021.

Table 3-9. Pond 16 (Year 4 Post-Subsurface Munitions Remediation) Vegetative Strata Percentage within the Vernal Pool Basin Boundary

Stratum	Percentage
1	5%
3	34%
4	10%
5	32%
6	12%
8	7%

Figure 3-5. Pond 16 (Year 4 Post-Subsurface Munitions Remediation) Vegetation Strata and Transects on Former Fort Ord, 2022

Eighty-seven species were observed within the vernal pool basin boundary. Of these species, 53 were native, 32 were non-native, and two were unidentified. Four species were OBL wetland plants, 31 were FACW or FAC, 19 were FACU or UPL, and 33 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 3-10 provides a summary of the dominant species cover results for each stratum.

Table 3-10. Pond 16 (Year 4) Dominant Species by Stratum Results

Stratum	Transect Length (m)	Dominant Species	
		Common Name	Absolute Cover on Transect (%)
1	5	California bulrush	7.0
3	5	pale spikerush	44.0
4	5	clustered field sedge	52.7
5	10	whiteroot	30.3
6	5	Baltic rush	38.7
8	10	rabbitfoot grass	49.2

3.4.1.1 *Vernal Pool Bent Grass*

Vernal pool bent grass was observed and mapped at Pond 16 on June 28, 2022 (see Figure 3-6). This was the first time that the species has been documented at Pond 16, expanding the current known range farther south than has been previously recorded. Vernal pool bent grass has been documented at Ponds 3 North, 3 South, 16, 42, 43, 44, 61, 73, 101 East (East), 997, and outer transition zones of Machine Gun Flats.

Figure 3-6. Vernal Pool Bent Grass Occurrence at Pond 16 (Year 4 Post-Subsurface Munitions Remediation), 2022

3.4.2 Wildlife Monitoring

Wildlife surveys were not conducted at Pond 16 because the vernal pool did not have sufficient depth to trigger surveys.

3.5 Pond 39

Pond 39 was in year 4 of monitoring for post-subsurface munitions remediation in 2022. Pond 39 was monitored for hydrology and vegetation. Hydrology results are reported separately in the Hydrology Monitoring Annual Report (Chenega, 2023).

3.5.1 Vegetation Monitoring

Vegetation monitoring was completed at Pond 39 on April 29 and May 2, 2022. These monitoring data represent year 4 post-subsurface munitions remediation conditions. Pond 39 was dry by the February 17 hydrology monitoring event (Chenega, 2023). Biologists identified three strata at the vernal pool (see Table 3-11 and Figure 3-7). Strata 1 and 3 were repeated from 2016 and 2018-2021. Stratum 4 was repeated from 2018-2021. Transect 1 was relocated to a more representative location and reduced from 10 m to 5 m. Transect 3 was relocated because the previous location was no longer within the correct stratum, whereas Transect 4 was repeated from 2019.

Table 3-11. Pond 39 (Year 4 Post-Subsurface Munitions Remediation) Vegetative Strata Percentage within the Vernal Pool Basin Boundary

Stratum	Percentage
1	3%
3	9%
4	67%
Upland	21%

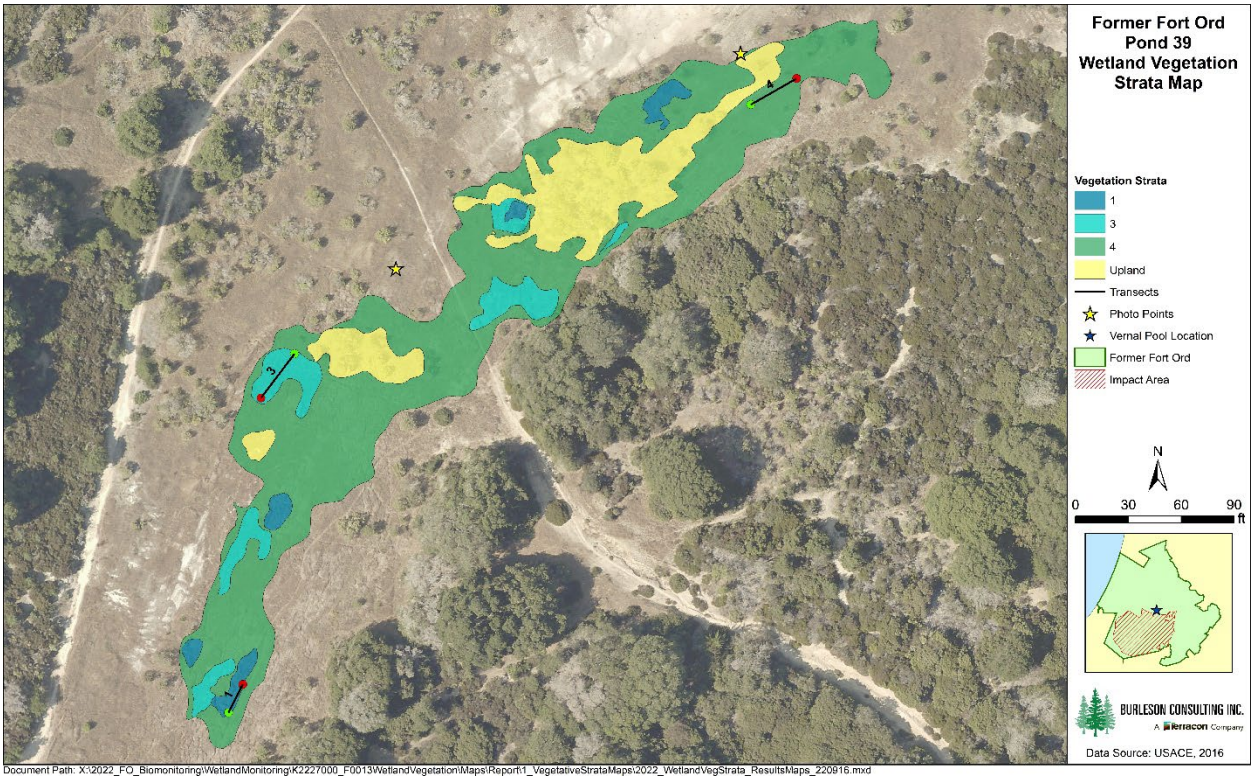

Figure 3-7. Pond 39 (Year 4 Post-Subsurface Munitions Remediation) Vegetation Strata and Transects on Former Fort Ord, 2022

Seventy-six plant species were observed within the vernal pool basin boundary. Of these species, 42 were native, 33 were non-native, and one was unidentified. Seven species were OBL wetland plants, 25 were FACW or FAC, 12 were FACU or UPL, and 32 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 3-12 provides a summary of the dominant species cover results for each stratum.

Table 3-12. Pond 39 (Year 4) Dominant Species by Stratum Results

Stratum	Transect Length (m)	Dominant Species	
		Common Name	Absolute Cover on Transect (%)
1	5	Hickman's popcornflower pale spikerush	30.0 22.7
3	10	Italian rye grass	35.7
4	10	long-beaked filaree	25.0

3.5.2 Wildlife Monitoring

Wildlife surveys were not conducted at Pond 39 because the vernal pool did not have sufficient depth to trigger surveys.

3.6 Pond 40 South

Pond 40 South was in year 4 of monitoring for post-subsurface munitions remediation in 2022. Pond 40 South was monitored for hydrology and vegetation. Hydrology results are reported separately in the Hydrology Monitoring Annual Report (Chenega, 2023).

3.6.1 Vegetation Monitoring

Vegetation monitoring was completed at Pond 40 South on April 29, 2022. These monitoring data represent year 4 post-subsurface munitions remediation conditions. Pond 40 South remained dry throughout the 2021-2022 water-year (Chenega, 2023). Biologists identified three strata at the vernal pool (see Table 3-13 and Figure 3-8). Stratum 3 was repeated from 2016 and 2018-2021. Strata 4 and 5 and the corresponding transects were identified and established in 2022. Transect 3 was relocated because the previous location was no longer within the correct stratum.

Table 3-13. Pond 40 South (Year 4 Post-Subsurface Munitions Remediation) Vegetative Strata Percentage within the Vernal Pool Basin Boundary

Stratum	Percentage
3	37%
4	56%
5	7%

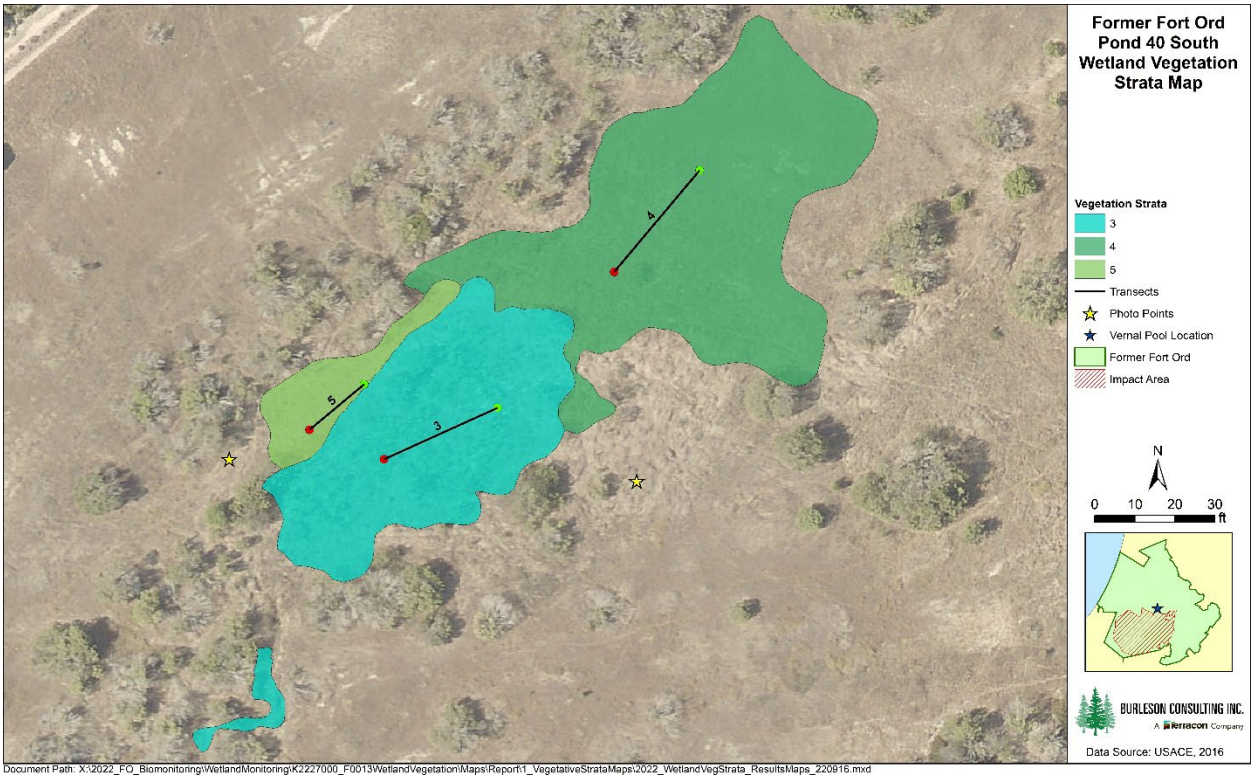

Figure 3-8. Pond 40 South (Year 4 Post-Subsurface Munitions Remediation) Vegetation Strata and Transects on Former Fort Ord, 2022

Sixty plant species were observed within the vernal pool basin boundary. Of these species, 27 were native, 32 were non-native, and one was unidentified. Four species were OBL wetland plants, 14 were FACW or FAC, 13 were FACU or UPL, and 29 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 3-14 provides a summary of the dominant species cover results for each stratum.

Table 3-14. Pond 40 South (Year 4) Dominant Species by Stratum Results

Stratum	Transect Length (m)	Dominant Species	
		Common Name	Absolute Cover on Transect (%)
3	10	Italian rye grass	54.5
4	10	long-beaked filaree narrow-leaved clover	39.8 25.0
5	5	cut-leaved plantain Hickman's popcornflower	20.3 14.3

3.6.2 Wildlife Monitoring

Wildlife surveys were not conducted at Pond 40 South because the vernal pool did not have sufficient depth to trigger surveys.

3.7 Pond 41

Pond 41 was in year 4 of monitoring for post-subsurface munitions remediation in 2022. Pond 41 was monitored for hydrology and vegetation. Hydrology results are reported separately in the Hydrology Monitoring Annual Report (Chenega, 2023).

3.7.1 Vegetation Monitoring

Vegetation monitoring was completed at Pond 41 on May 3, 2022. These monitoring data represent year 4 post-subsurface munitions remediation conditions. Pond 41 briefly held water in January with some peripheral ponding present but was otherwise dry throughout the 2021-2022 water-year (Chenega, 2023). Biologists identified four strata at the vernal pool (see Table 3-15 and Figure 3-9). Strata 1, 2, and 3 were repeated from 2016 and 2019-2021. Stratum 4 was repeated from 2019-2021. Transects 1, 3, and 4 were relocated because the previous locations were no longer within the correct strata. Transect 2 was relocated to an area with more representative vegetative composition.

Table 3-15. Pond 41 (Year 4 Post-Subsurface Munitions Remediation) Vegetative Strata Percentage within the Vernal Pool Basin Boundary

Stratum	Percentage
1	3%
2	91%
3	5%
4	1%

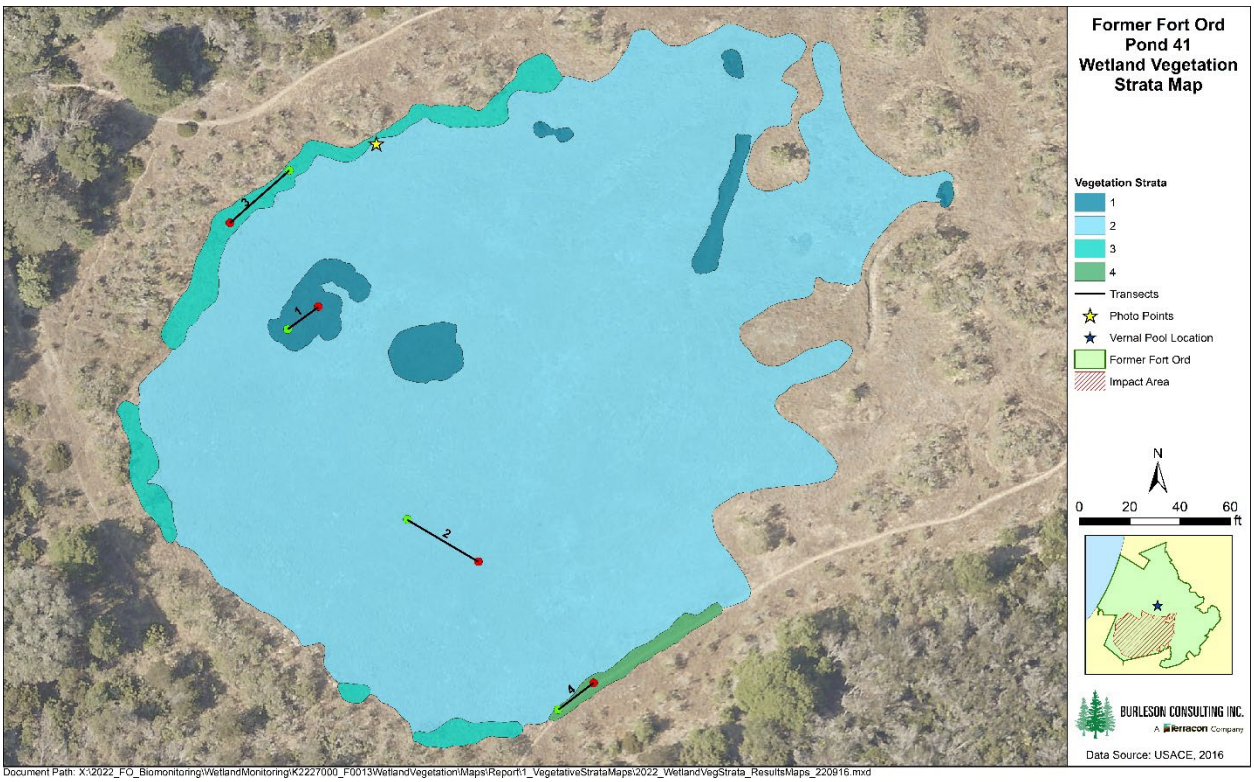

Figure 3-9. Pond 41 (Year 4 Post-Subsurface Munitions Remediation) Vegetation Strata and Transects on Former Fort Ord, 2022

Fifty-eight plant species were observed within the vernal pool basin boundary. Of these species, 35 were native, 22 were non-native, and one was unidentified. Six species were OBL wetland plants, 21 were FACW or FAC, 13 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 3-16 provides a summary of the dominant species cover results for each stratum.

Table 3-16. Pond 41 (Year 4) Dominant Species by Stratum Results

Stratum	Transect Length (m)	Dominant Species	
		Common Name	Absolute Cover on Transect (%)
1	5	smooth goldfields alkali mallow cut-leaved geranium	10.7 8.0 7.3
2	10	cut-leaved geranium Lemmon's canary grass	24.0 10.5
3	10	brown-headed rush	21.7
4	5	California oat grass long-beaked filaree	17.7 13.3

3.7.2 Wildlife Monitoring

Wildlife surveys were not conducted at Pond 41 because the vernal pool did not have sufficient depth to trigger surveys.

3.8 Pond 42

Pond 42 was in year 4 of monitoring for post-subsurface munitions remediation in 2022. Pond 42 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 42 on May 4, 2022. These monitoring data represent year 4 post-subsurface munitions remediation conditions. Pond 42 was completely dry by the February 1 hydrology monitoring event (Chenega, 2023). Biologists identified five strata at the vernal pool (see Table 3-17 and Figure 3-10). Strata 1 through 4 were repeated from 2017-2021. Stratum 5 was repeated from 2019-2021. Transects 1, 3, and 4 were relocated because the previous locations were no longer within the correct strata. Transect 2 was repeated from 2018-2021. Transect 5 was repeated from 2020 and 2021.

Table 3-17. Pond 42 (Year 4 Post-Subsurface Munitions Remediation) Vegetative Strata Percentage within the Vernal Pool Basin Boundary

Stratum	Percentage
1	18%
2	7%
3	22%
4	25%
5	12%
Upland	16%

Figure 3-10. Pond 42 (Year 4 Post-Subsurface Munitions Remediation) Vegetation Strata and Transects on Former Fort Ord, 2022

Eighty-five plant species were observed within the vernal pool basin boundary. Of these species, 51 were native, 33 were non-native, and one was unidentified. Eight species were OBL wetland plants, 21 were FACW or FAC, 19 were FACU or UPL, and 37 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 3-18 provides a summary of the dominant species cover results for each stratum.

Table 3-18. Pond 42 (Year 4) Dominant Species by Stratum Results

Stratum	Transect Length (m)	Dominant Species	
		Common Name	Absolute Cover on Transect (%)
1	5	needle spikerush annual hair grass coyote thistle	17.0 10.7 10.7
2	5	pale spikerush	37.0
3	10	brown-headed rush	28.2
4	5	smooth cat's-ear coastal tarweed coyote thistle long-beaked filaree	7.7 5.7 4.3 4.3
5	5	rabbitfoot grass	41.7

3.8.2 Wildlife Monitoring

Wildlife surveys were not conducted at Pond 42 because the vernal pool did not have sufficient depth to trigger surveys.

3.9 Pond 61

Pond 61 was in year 4 of monitoring for post-subsurface munitions remediation in 2022. Pond 61 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 61 on April 28, 2022. These monitoring data represent year 4 post-subsurface munitions remediation conditions. Pond 61 was dry by the March 2 hydrology monitoring event (Chenega, 2023). Biologists identified three strata at the vernal pool (see Table 3-19 and Figure 3-11). Strata 2 through 4 were repeated from 2017-2021. Transect 3 was relocated to an area with more representative vegetative composition, whereas Transect 4 was repeated from 2017-2021. Stratum 2 consisted of CCG and no transect was placed in this stratum. Figure 3-12 illustrates the extent and density of the CCG populations at Pond 61.

Table 3-19. Pond 61 (Year 4 Post-Subsurface Munitions Remediation) Vegetative Strata Percentage within the Vernal Pool Basin Boundary

Stratum	Percentage
2 (CCG)	6%
3	4%
4	57%
Upland	33%

Figure 3-11. Pond 61 (Year 4 Post-Subsurface Munitions Remediation) Vegetation Strata and Transects on Former Fort Ord, 2022

Ninety-four plant species were observed within the vernal pool basin boundary. Of these species, 66 were native, 26 were non-native, and two were unidentified. Nine species were OBL wetland plants, 31 were FACW or FAC, 13 were FACU or UPL, and 41 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 3-20 provides a summary of the dominant species cover results for each stratum.

Table 3-20. Pond 61 (Year 4) Dominant Species by Stratum Results

Stratum	Transect Length (m)	Dominant Species	
		Common Name	Absolute Cover on Transect (%)
2	N/A	Contra Costa goldfields	N/A
3	10	Hickman's popcornflower	32.5
4	10	rattlesnake grass	26.7

3.9.1.1 *Contra Costa Goldfields*

Contra Costa goldfields at Pond 61 were mapped on March 30, 2022; they occupied 0.14 acre with a density of 5-80% cover. No transects were placed in stratum 2 to avoid disturbing the population. Figure 3-12 illustrates the extent of the CCG population at Pond 61.

Figure 3-12. Contra Costa Goldfields Populations at Pond 61 (Year 4 Post-Subsurface Munitions Remediation), 2022

3.9.2 Wildlife Monitoring

Wildlife surveys were not conducted at Pond 61 because the vernal pool did not have sufficient depth to trigger surveys.

3.10 Pond 75

Pond 75 was in the second year of baseline monitoring in 2022. Pond 75 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 75 on May 9, 2022. These monitoring data represent baseline conditions. Pond 75 remained dry throughout the 2020-2021 water-year (Chenega, 2023). Biologists identified four strata at the vernal pool (see Table 3-21 and Figure 3-13). Strata 1 through 4 were repeated from 2021. Transects 1, 2, and 4 were repeated from 2021; whereas Transect 3 was relocated to an area with more representative vegetative composition.

Table 3-21. Pond 75 (Baseline) Vegetative Strata Percentage within the Vernal Pool Basin Boundary

Stratum	Percentage
1	16%
2	67%
3	5%
4	12%

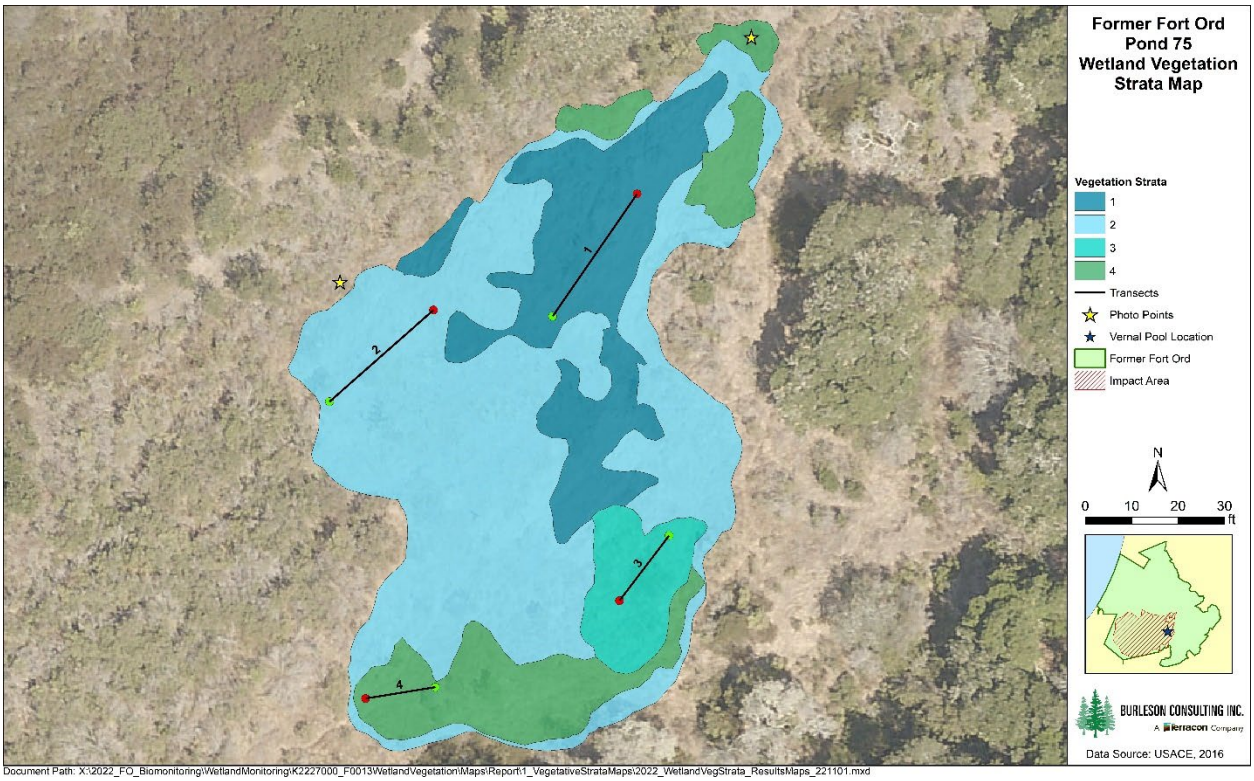

Figure 3-13. Pond 75 (Baseline) Vegetation Strata and Transects on Former Fort Ord, 2022

Forty-three species were observed within the vernal pool basin boundary. Of these species, 28 were native and 15 were non-native. One species was an OBL wetland plant, 16 were FACW or FAC, 8 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 3-22 provides a summary of the dominant species cover results for each stratum.

Table 3-22. Pond 75 (Baseline) Dominant Species by Stratum Results

Stratum	Transect Length (m)	Dominant Species	
		Common Name	Absolute Cover on Transect (%)
1	10	pale spikerush milk thistle cut-leaved geranium	14.5 12.7 11.3
2	10	beardless wild rye	51.8
3	5	western goldenrod	26.3
4	5	brown-headed rush	36.3

3.10.2 Wildlife Monitoring

Wildlife surveys were not conducted at Pond 75 because the vernal pool did not have sufficient depth to trigger surveys.

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 14 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, and 2018-2019. All other monitoring, including this year, 2021-2022, 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
Hydrology	●	●	●	●		●	●	●	●	●	●	●	●	●
Vegetation	●	●	●	●				●	●	●	●	●	●	●
Wildlife	●	●	●	●	●			●	●	●	●	●		

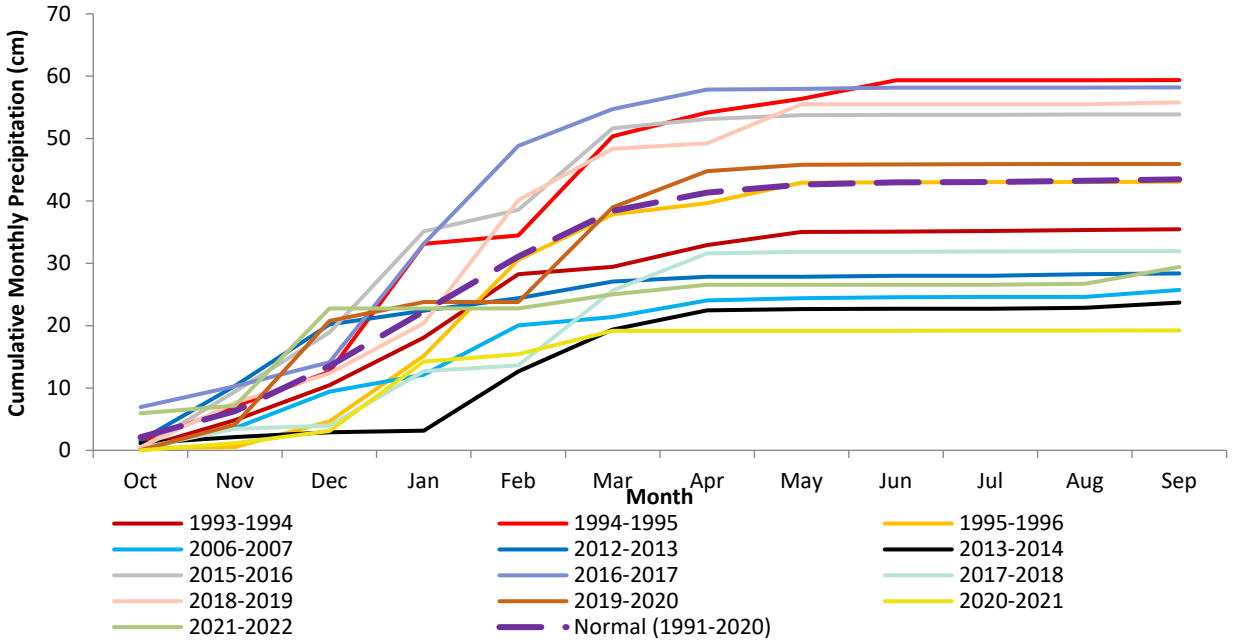

Figure 4-1. Cumulative Monthly Precipitation for Years that Hydrology Monitoring Occurred at Pond 5 (Reference) Compared to the 30-Year Normal (mean 1991-2020) (NPS, 2022; NCEI NOAA, 2022)

4.1.1 Vegetation Monitoring

Vegetation data were collected at Pond 5 in 2007 and 2016-2022 (Shaw, 2008; Burleson, 2017, 2018, 2019, 2020, 2021, 2022, and 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 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 2016-2022, data were collected using methodologies described in the Methods section of this report. Data from 2016 and 2022 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	2022
1	26%	35%
2	32%	21%
3	38%	8%
4	4%	N/A
7	N/A	1%
8	N/A	35%

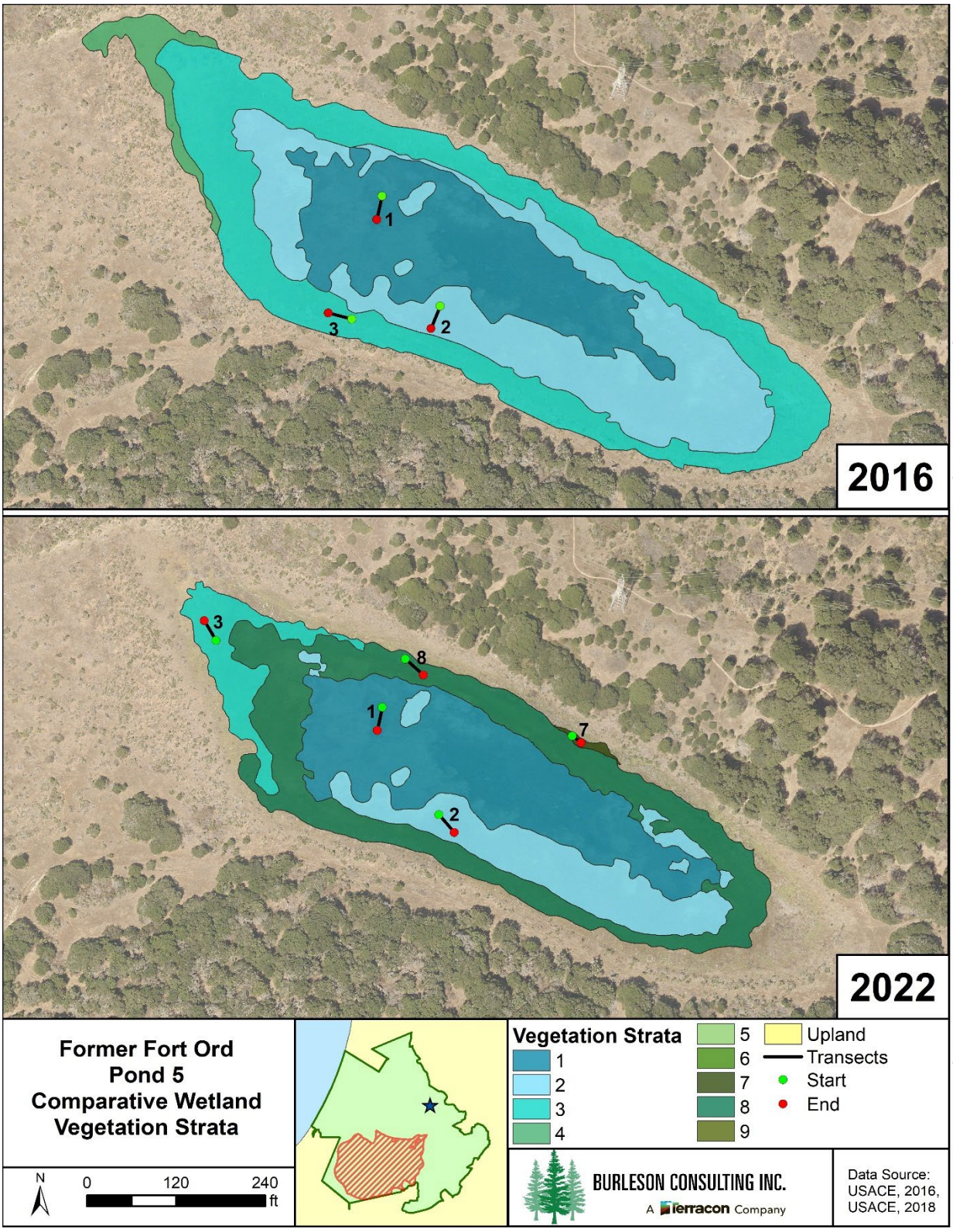

Figure 4-2. Pond 5 (Reference) Vegetation Strata and Transects for 2016 and 2022

The absolute percent vegetative cover observed in 2022 was generally less than previous years and similar to 2021 (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%

Species richness on transects and for the overall basin has fluctuated between 2007 and 2022 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, and 29 species in 2007, 2016, 2017, 2018, 2019, 2020, 2021, and 2022 respectively, whereas overall basin species richness was 26, 40, 73, 88, 94, 69, 70, and 76 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). 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 (Figure 4-4). 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 4-5, and Appendix F). Whereas, 2016, 2019, and 2020 have less even slopes and higher abundance of the dominant species at the top of the curves.

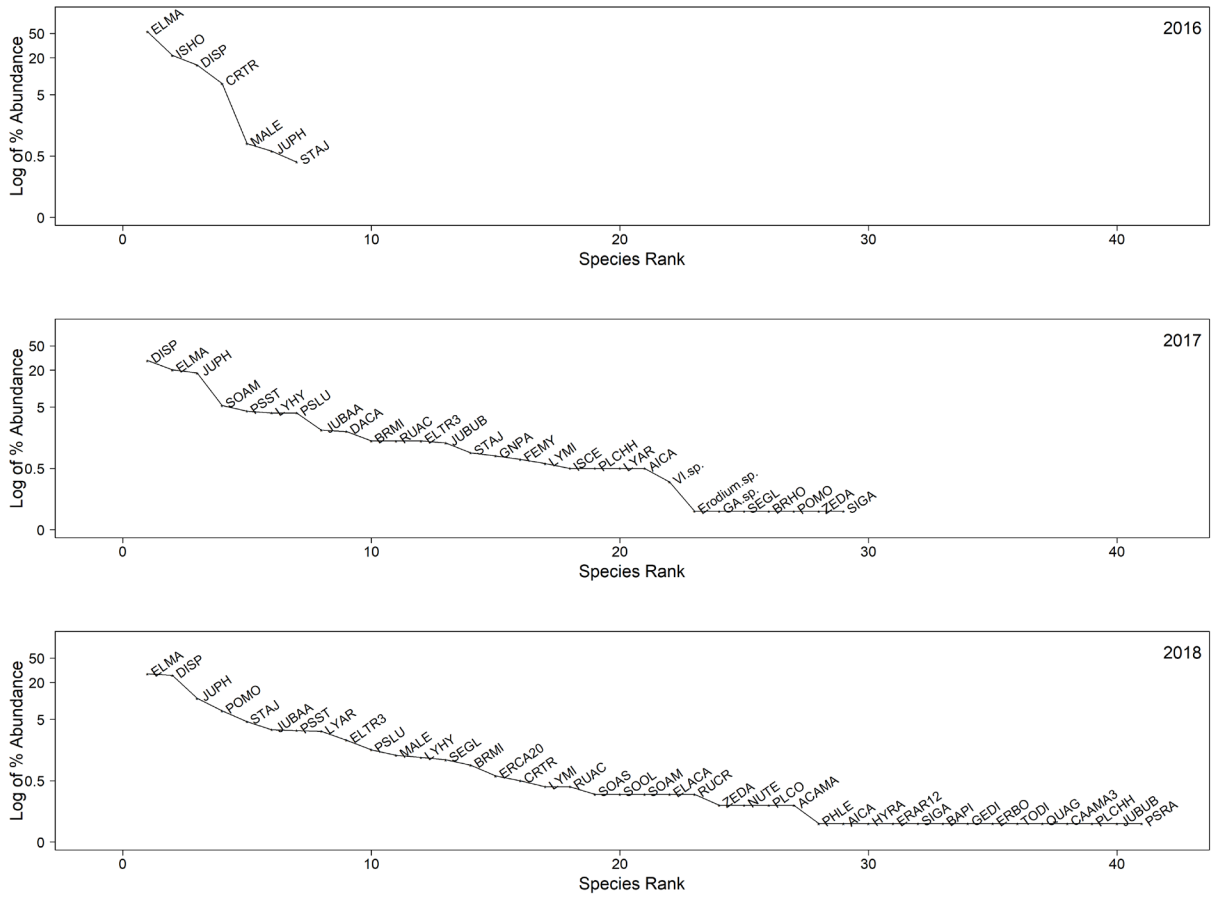

Figure 4-3. Rank Abundance Curves at Pond 5 (Reference) in 2016-2018. Note that the y-axis is in log-10 scale.

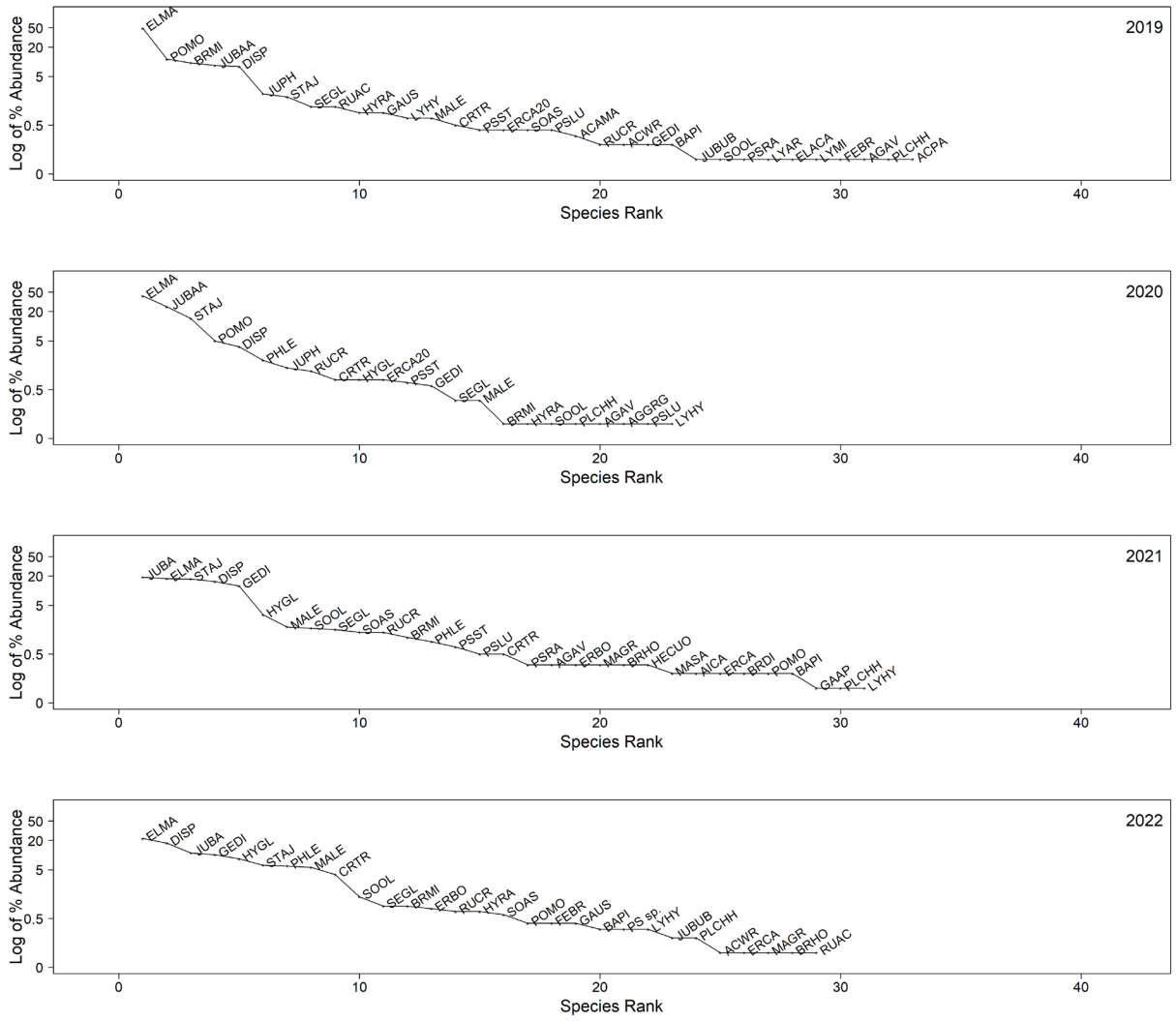

Figure 4-4. Rank Abundance Curves at Pond 5 (Reference) in 2019-2022. Note that the y-axis is in log-10 scale.

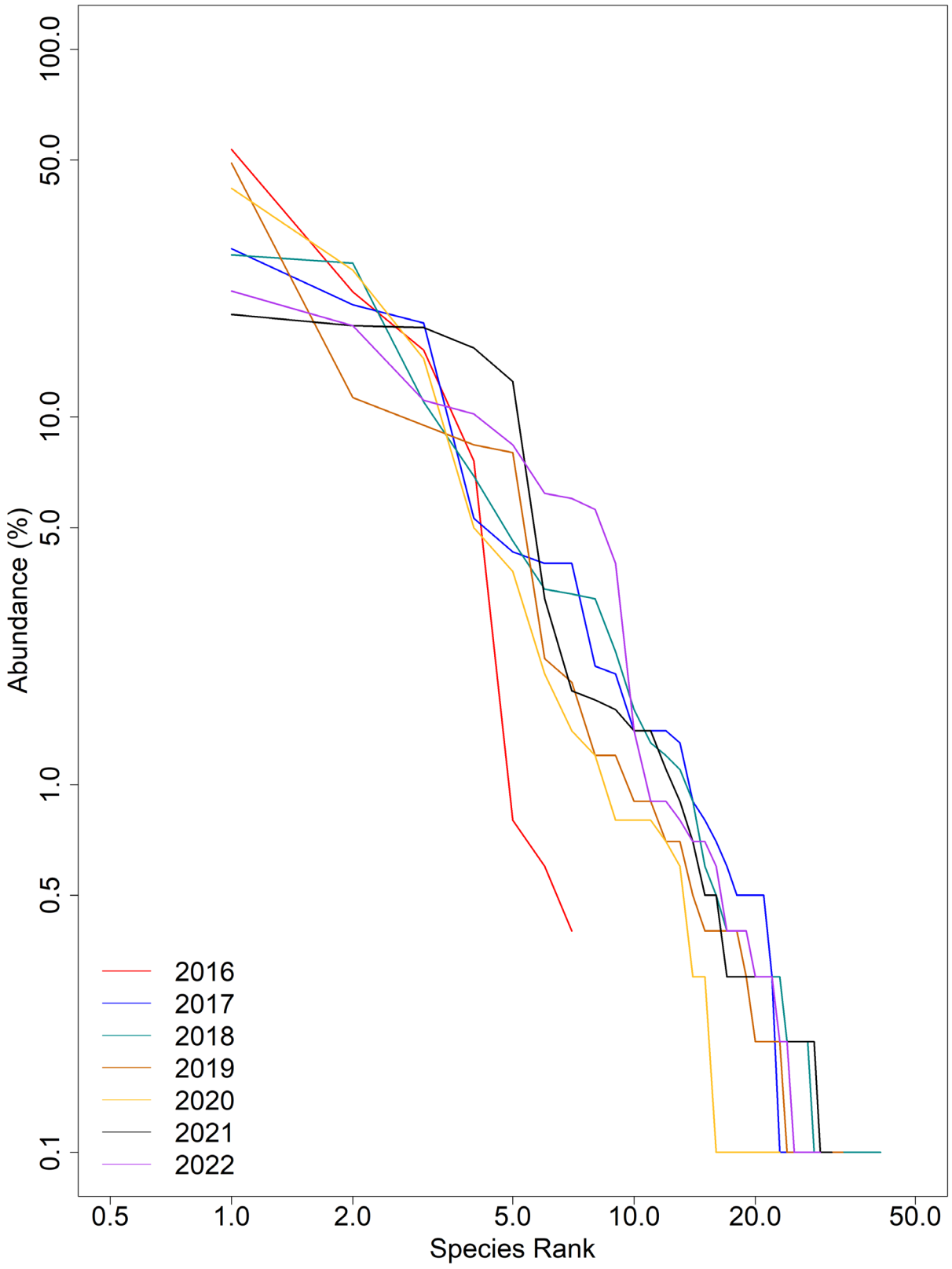

Figure 4-5. Rank Abundance Curves at Pond 5 (Reference) in 2016-2022. Note that both the x-axis and y-axis are in log-10 scale.

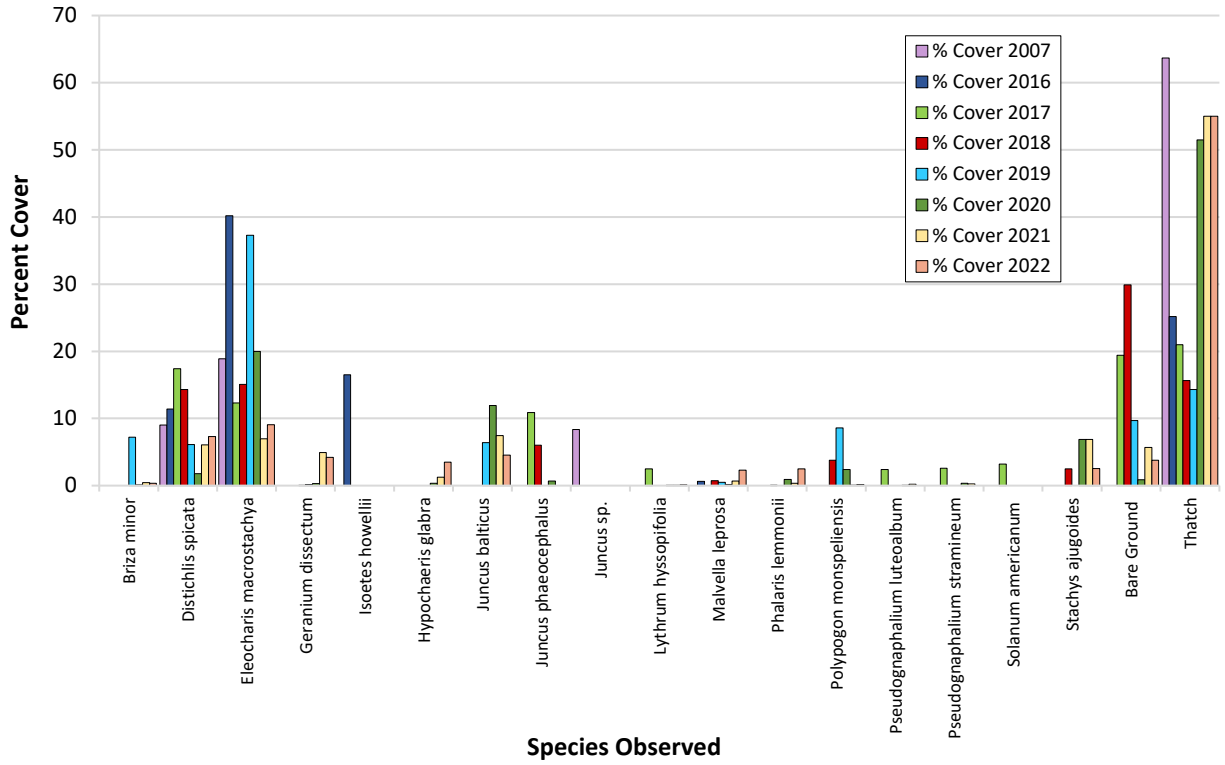

Figure 4-6. Percent Cover of Dominant Species at Pond 5 (Reference)

Native and non-native species richness on Pond 5 transects varied through time, with the highest overall richness recorded in 2018. Richness in 2022 was most similar to 2021 (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 relative percent cover in 2022 were very similar to values in 2019 (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

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%

Wetland species richness on Pond 5 transects increased through time until 2018, then decreased in years 2019-2022. 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 2022 was the lowest recorded, while non-wetland species cover was the highest recorded of any previous year. Wetland cover in 2022 was similar to 2021 and non-wetland cover was similar to 2017 (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

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%

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, and 2016-2020 (Jones and Stokes, 1996; Shaw, 2008, 2011; Burleson, 2017, 2018, 2019, 2020, and 2021). Fairy shrimp were present in 1995 and 2019. California tiger salamander larvae were observed in 1995, 2010, 2016, 2017, and 2019. The vernal pool did not hold sufficient depth for surveys to be completed in 2022. Therefore, DQO 5 and the applicable wildlife usage performance standard cannot be assessed. 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

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	N/A*	N/A*

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

4.2 Pond 101 East (East) – Reference

Pond 101 East (East) was monitored for fourteen 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, and 2018-2019. All other monitoring, including this year, 2021-2022, 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
Hydrology		●	●		●	●	●	●	●	●	●	●	●	●
Vegetation								●	●	●	●	●	●	●
Wildlife	●	●	●	●				●	●	●	●	●		

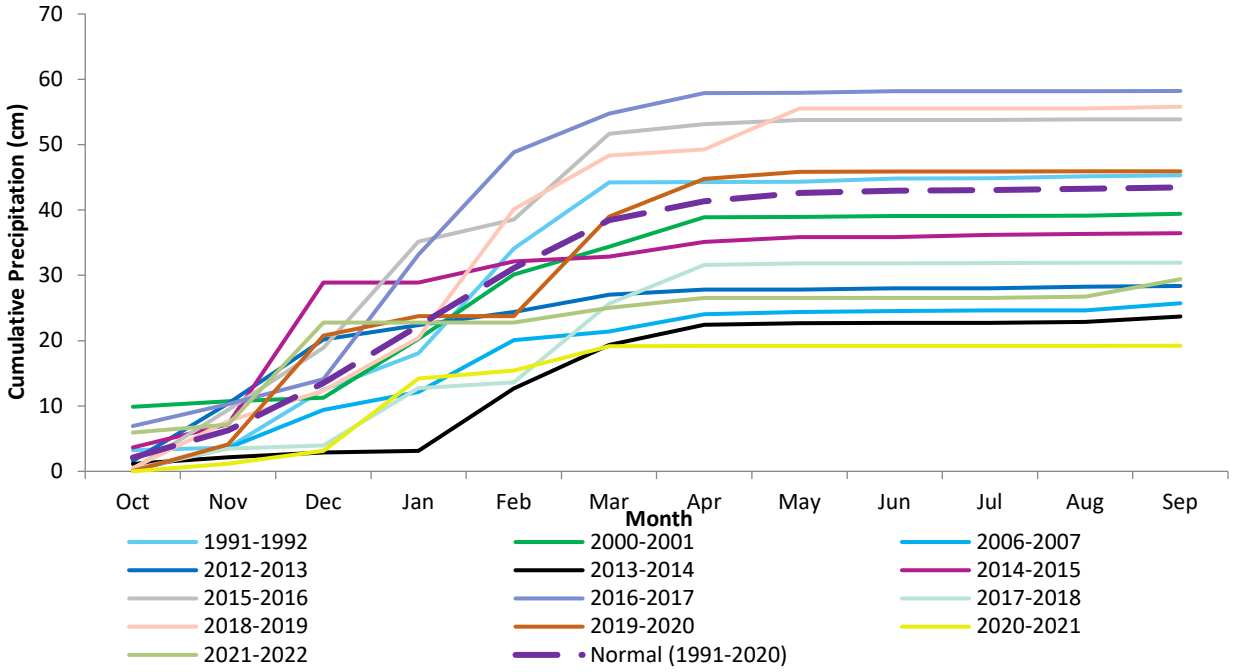

Figure 4-7. Cumulative Monthly Precipitation for Years that Hydrology Monitoring Occurred at Pond 101 East (East) (Reference) Compared to the 30-Year Normal (mean 1991-2020) (NPS, 2022; NCEI NOAA, 2022)

4.2.1 Vegetation Monitoring

Vegetation data were collected at Pond 101 East (East) in 2016-2022 (Burleson, 2017, 2018, 2019, 2020, 2021, and 2022). Data were collected using the methodology described in the Methods section of this report. Data from 2016 and 2022 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	2022
1	0.4%	N/A
2	48%	N/A
3	44%	33%
4	8%	10%
5	N/A	55%
9	N/A	2%

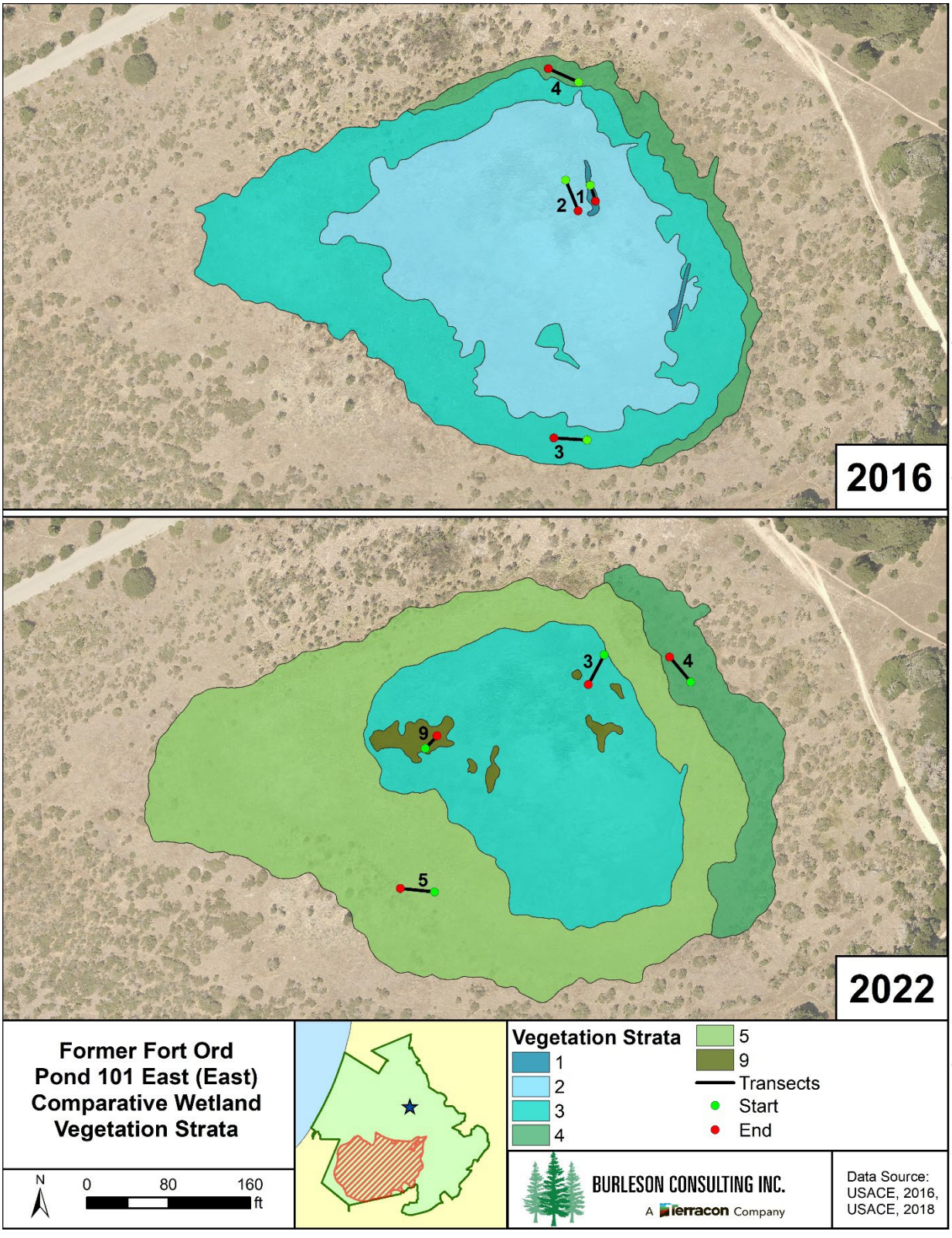

Figure 4-8. Pond 101 East (East) (Reference) Vegetation Strata and Transects for 2016 and 2022

The absolute percent vegetative cover observed at Pond 101 East (East) in 2022 increased 17% from the lowest recorded value in 2021 and was most similar to 2016 (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 2022, vegetative cover was 55.5% and thatch/bare ground was 44.5%.

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%

Species richness on transects increased between 2016 and 2020, decreased in 2021, then increased again in 2022. For the overall basin, the species richness fluctuated between 2016 and 2022 with the highest richness observed in 2018. Species richness on transects was 18, 18, 32, 37, 43, 21, and 38 species in 2016, 2017, 2018, 2019, 2020, 2021, and 2022, respectively, whereas overall basin species richness was 37, 59, 89, 84, 86, 68, and 72 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. A complete comparison of species composition observed during the surveys at Pond 101 East (East) from 2016-2022 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, and 2022 at Pond 101 East (East) (see Figure 4-11, and Appendix F). Whereas 2016, 2017, and 2019 have a less even slope and higher abundance of the dominant species at the top of the curve.

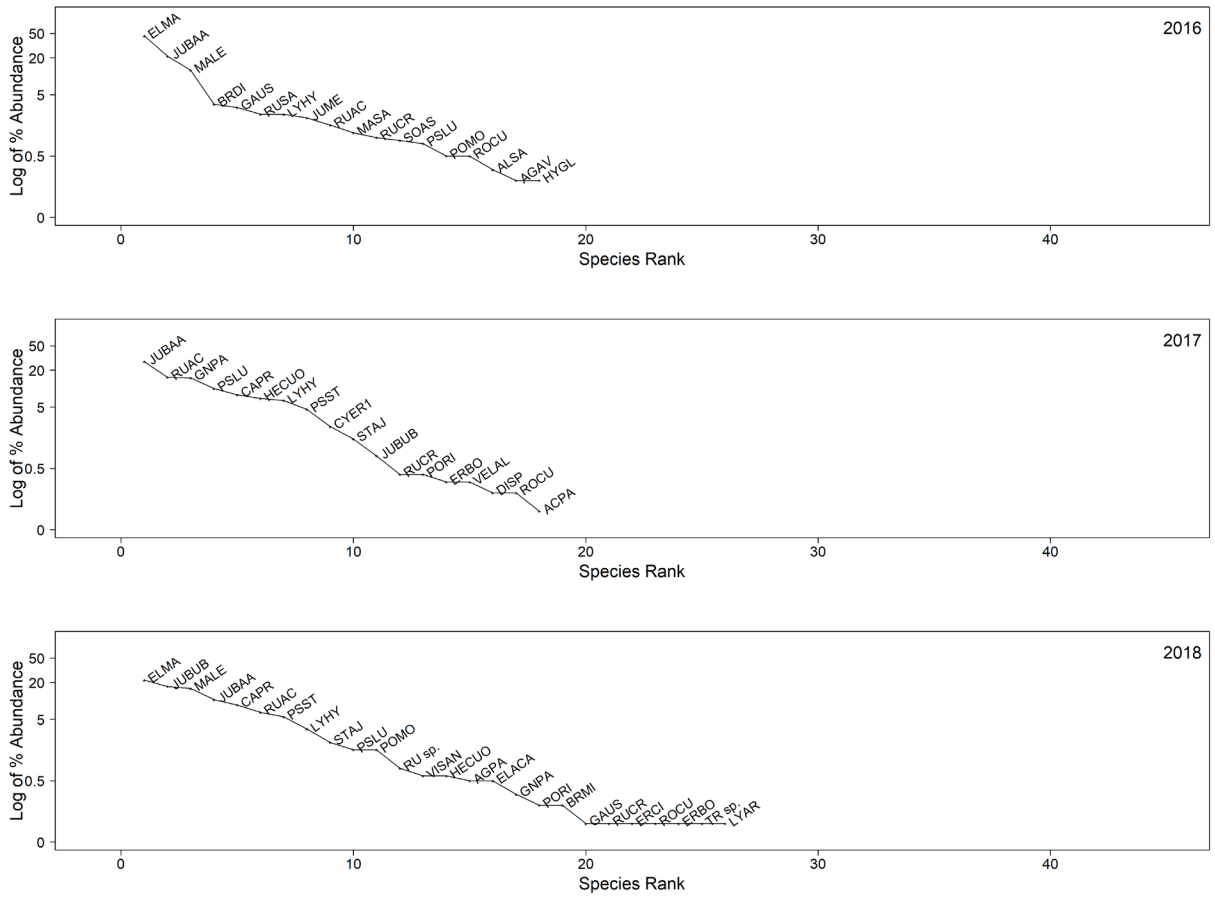

Figure 4-9. Rank Abundance Curves at Pond 101 East (East) (Reference) in 2016-2018. Note that the y-axis is in log-10 scale.

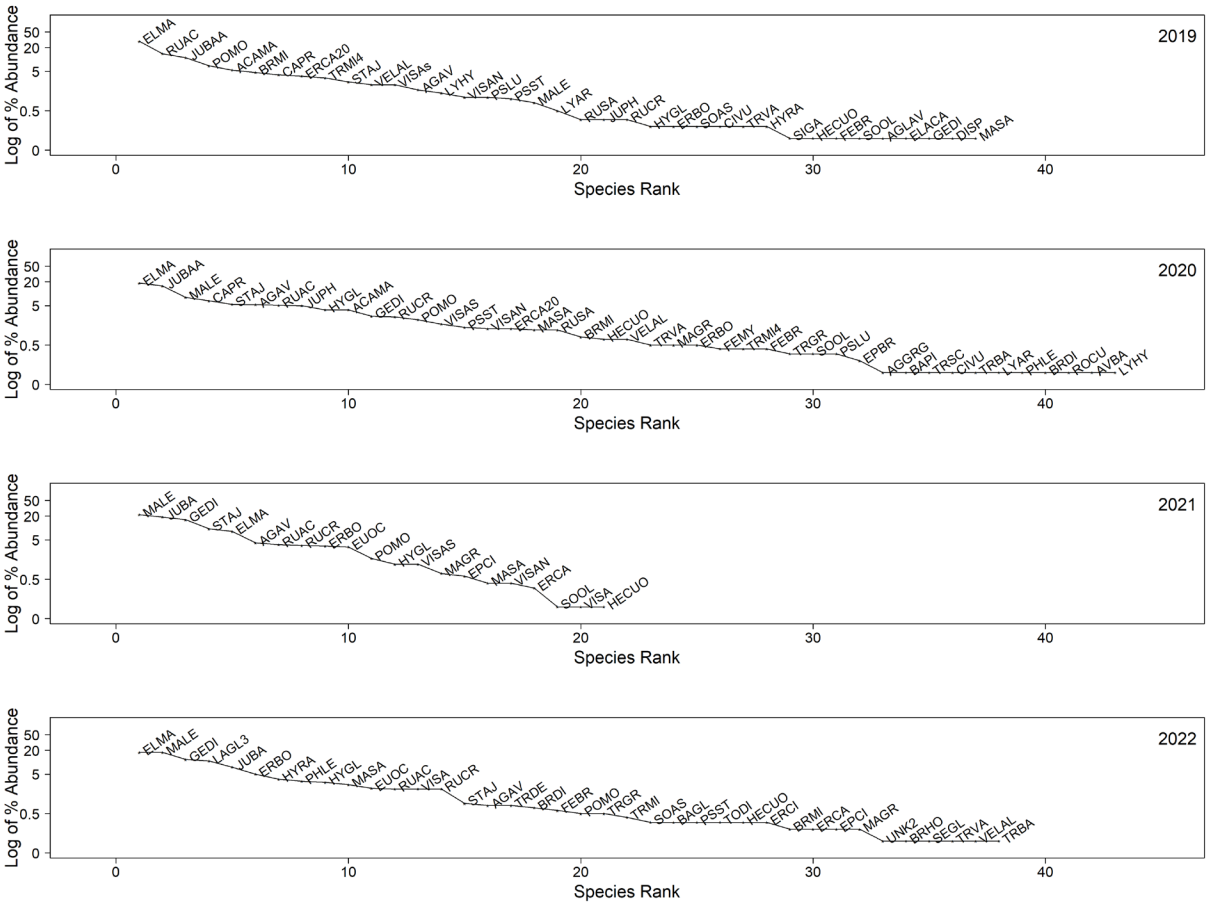

Figure 4-10. Rank Abundance Curves at Pond 101 East (East) (Reference) in 2019-2022. Note that the y-axis is in log-10 scale.

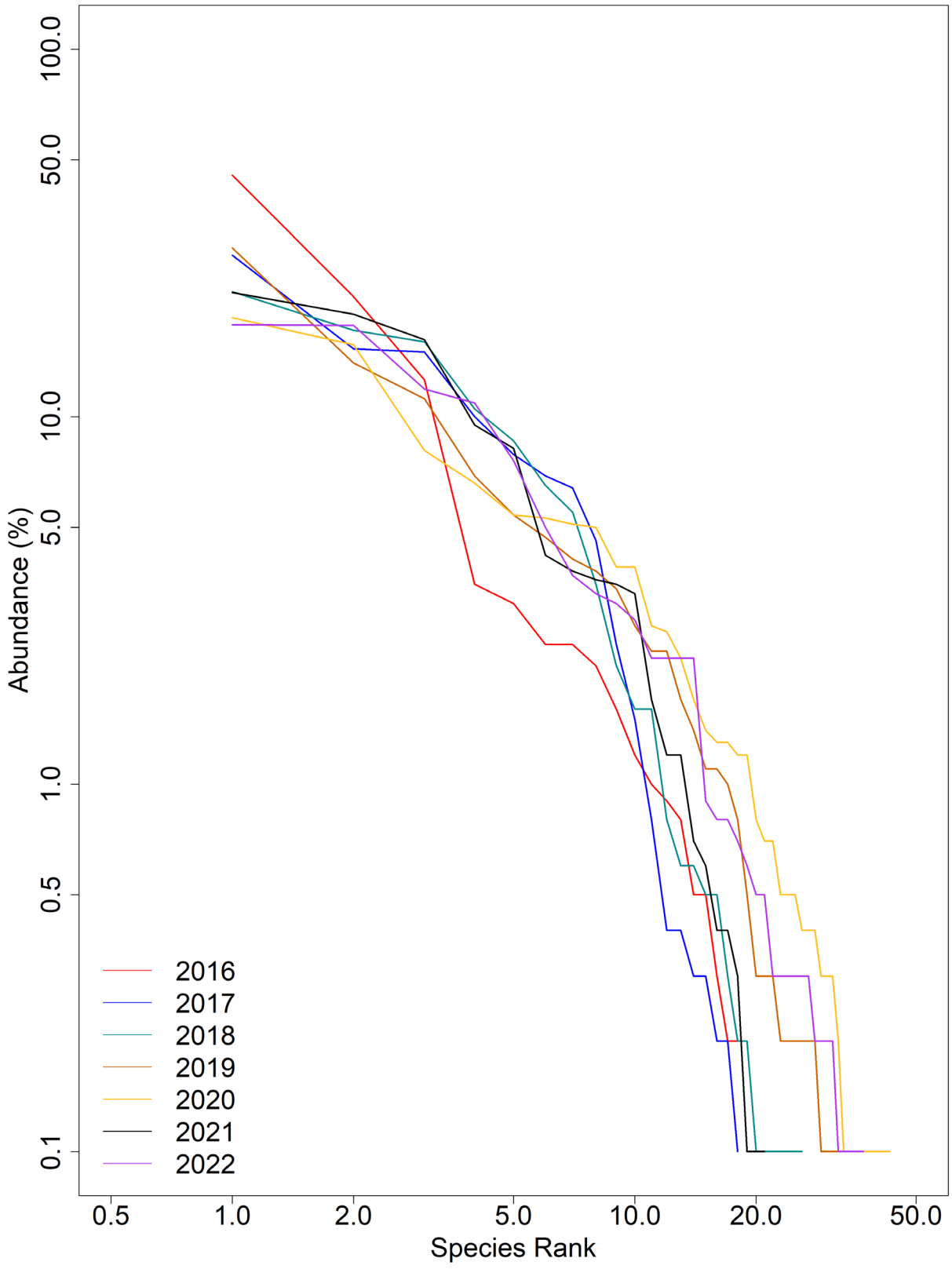

Figure 4-11. Rank Abundance Curves at Pond 101 East (East) (Reference) in 2016-2022. Note that the x-axis and the y-axis are in log-10 scale.

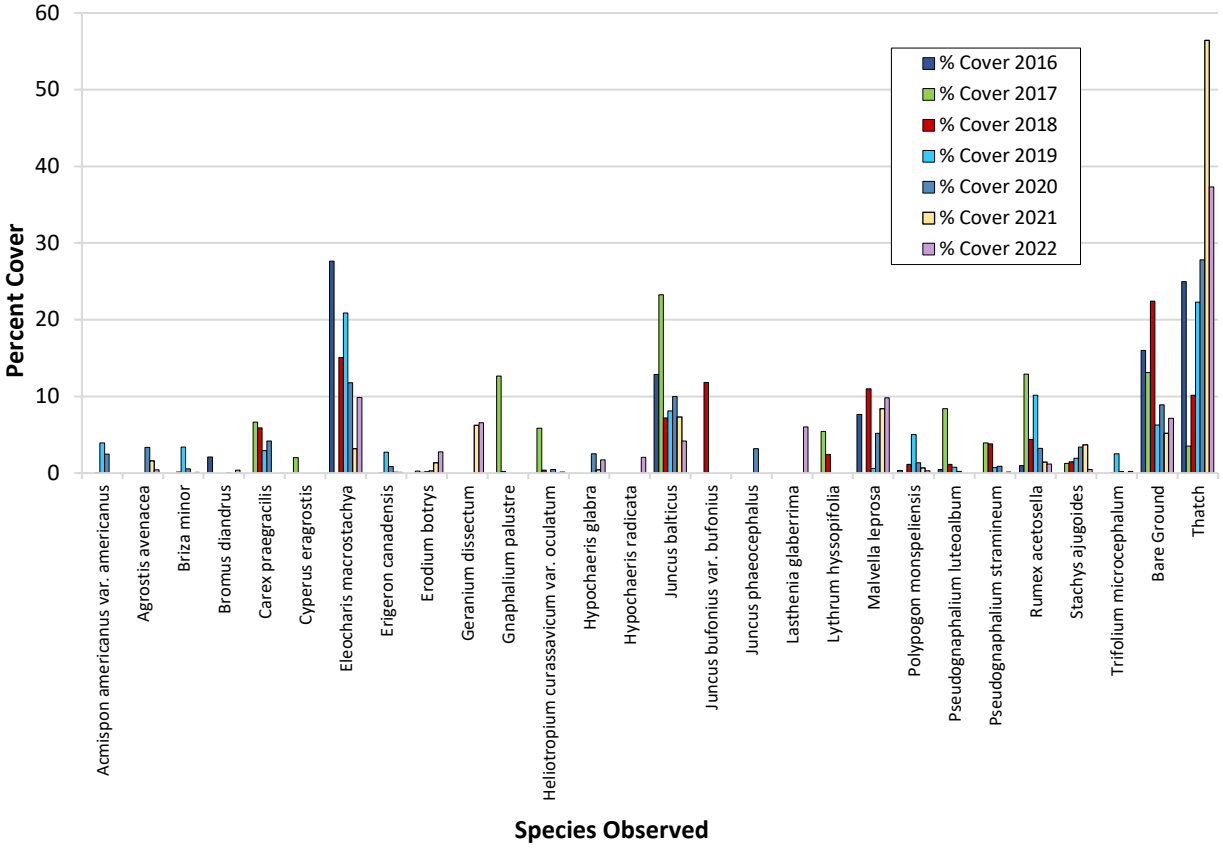

Figure 4-12. Percent Cover of Dominant Species at Pond 101 East (East) (Reference)

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 (see Table 4-13). Likewise, non-native species richness varied, with the highest richness recorded in 2019 and 2020, and the lowest value recorded in 2017 (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

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%

Wetland species richness on Pond 101 East (East) transects increased between 2016 and 2020, decreased to the lowest recorded value in 2021, then increased in 2022 to the range of previous years (see Table 4-15). Non-wetland species on transects generally increased from 2016 to 2019, then remained similar from 2020-2022. The relative percent cover of wetland species was variable between surveys with a decrease from 2019 to 2021, then a slight increase in 2022 (see Table 4-16). The relative percent cover of non-wetland species was variable between surveys until 2021, when the percentage cover increased to its highest recorded value, then remained the same in 2022. The non-wetland species cover values have ranged from 15.1% in 2016 to 31.2% in 2021 and 2022.

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

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%

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, and 2016-2020 (Jones and Stokes, 1992; Harding ESE, 2002; Shaw, 2008; Shaw, 2011; Burleson, 2017, 2018, 2019, 2020, and 2021). California tiger salamander larvae were observed in 1992, 2010, and 2016-2019. Fairy shrimp were present in 2001, 2019, and 2020. The vernal pool did not hold sufficient depth for surveys to be completed in 2022. Therefore, DQO 5 and the applicable wildlife usage performance standard cannot be assessed. 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)

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

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	N/A*	N/A*

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

4.3 Pond 997 – Reference

Pond 997 was monitored for six 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 and 2018-2019 water-years were above-normal; whereas the 2019-2020 water-year was similar to the cumulative normal. All other monitoring, including this year, 2021-2022, 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
Hydrology	●	●	●	●	●	●
Vegetation	●	●	●	●	●	●
Wildlife	●		●			

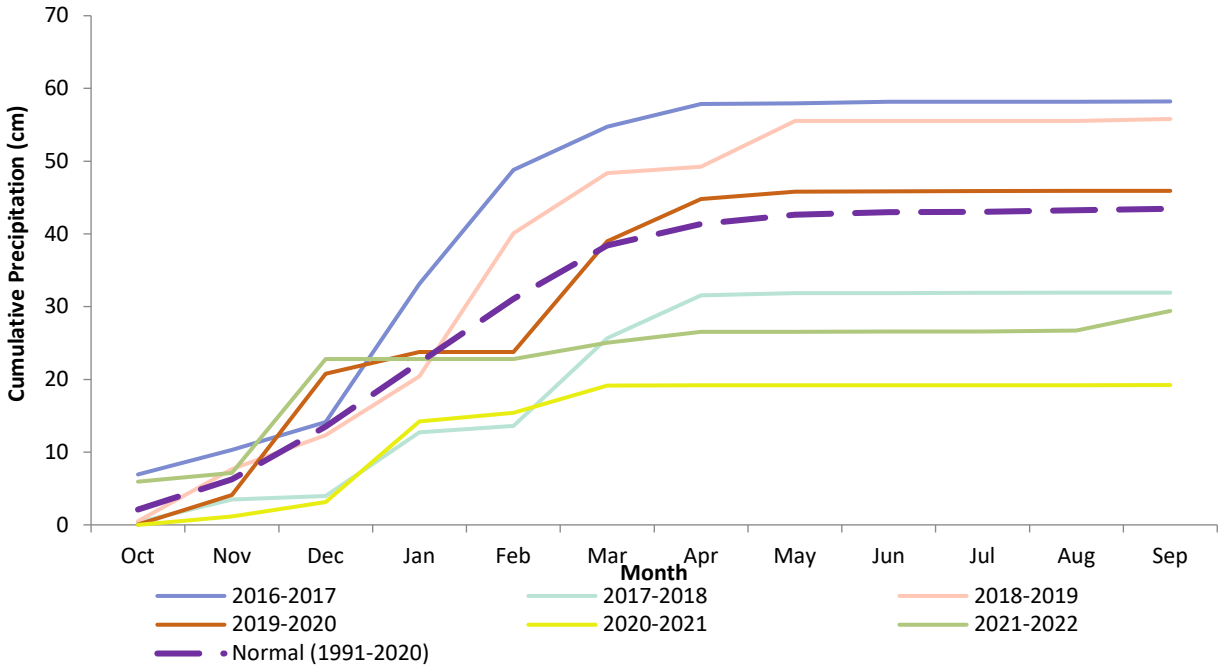

Figure 4-13. Cumulative Monthly Precipitation for Years that Hydrology Monitoring Occurred at Pond 997 (Reference) Compared to the 30-Year Normal (mean 1991-2020) (NPS, 2022; NCEI NOAA, 2022)

4.3.1 Vegetation Monitoring

Vegetation data were collected at Pond 997 from 2017-2022 (Burleson, 2018, 2019, 2020, 2021, and 2022). Data were collected using the methodology described in the Methods section of this report. Data from 2017 and 2022 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 2022 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	2022
1	3%	5%
2 (CCG)	2%	6%
3	89%	89%
4	2%	N/A
Upland	4%	N/A

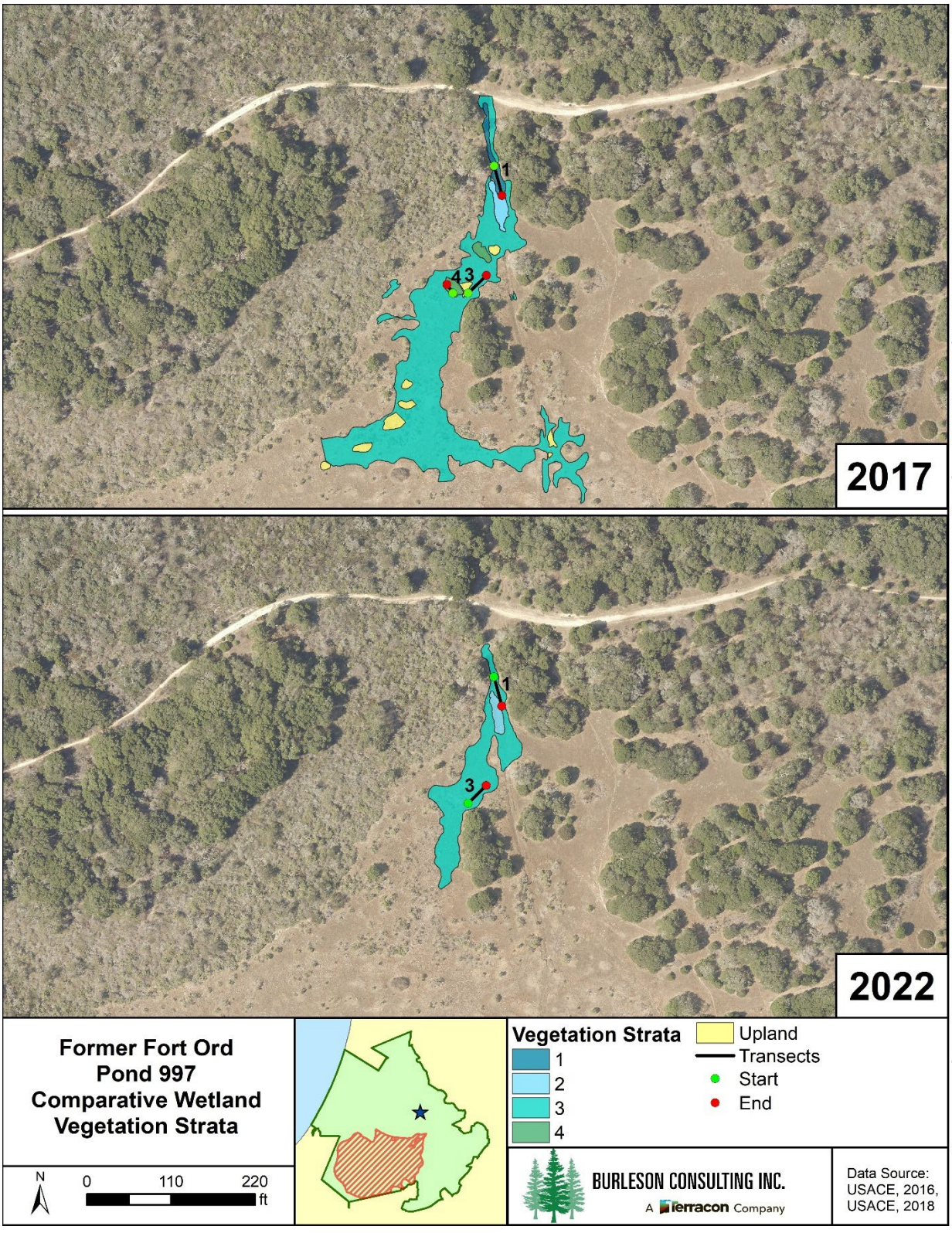

Figure 4-14. Pond 997 (Reference) Vegetation Strata and Transects for 2017 and 2022

The absolute percent vegetative cover observed in 2022 was comparable to previous years and most similar to 2018 (see Table 4-21). Vegetative cover ranged from 44.7% in 2018 to 73.3% in 2019, whereas thatch/bare ground ranged from 28.6% in 2019 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%

Species richness on transects increased between 2017 and 2019, decreased in 2020 and 2021, and then increased again in 2022. Species richness in the overall basin was within the range of previous years, with an increase by 8 species from 2021. Species richness on transects was 27, 45, 48, 42, 27, and 35 species in 2017, 2018, 2019, 2020, 2021, and 2022, respectively, whereas overall basin species richness was 65, 87, 82, 82, 59, and 76 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, marking a shift towards non-native annual species composition. A complete comparison of species composition observed during the surveys at Pond 997 in 2017-2022 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, 2019, 2020, and 2022 at Pond 997 (see Figure 4-17, and Appendix F). A less even distribution of the dominant species however, as shown by a steeper slope occurs in 2018 and 2021.

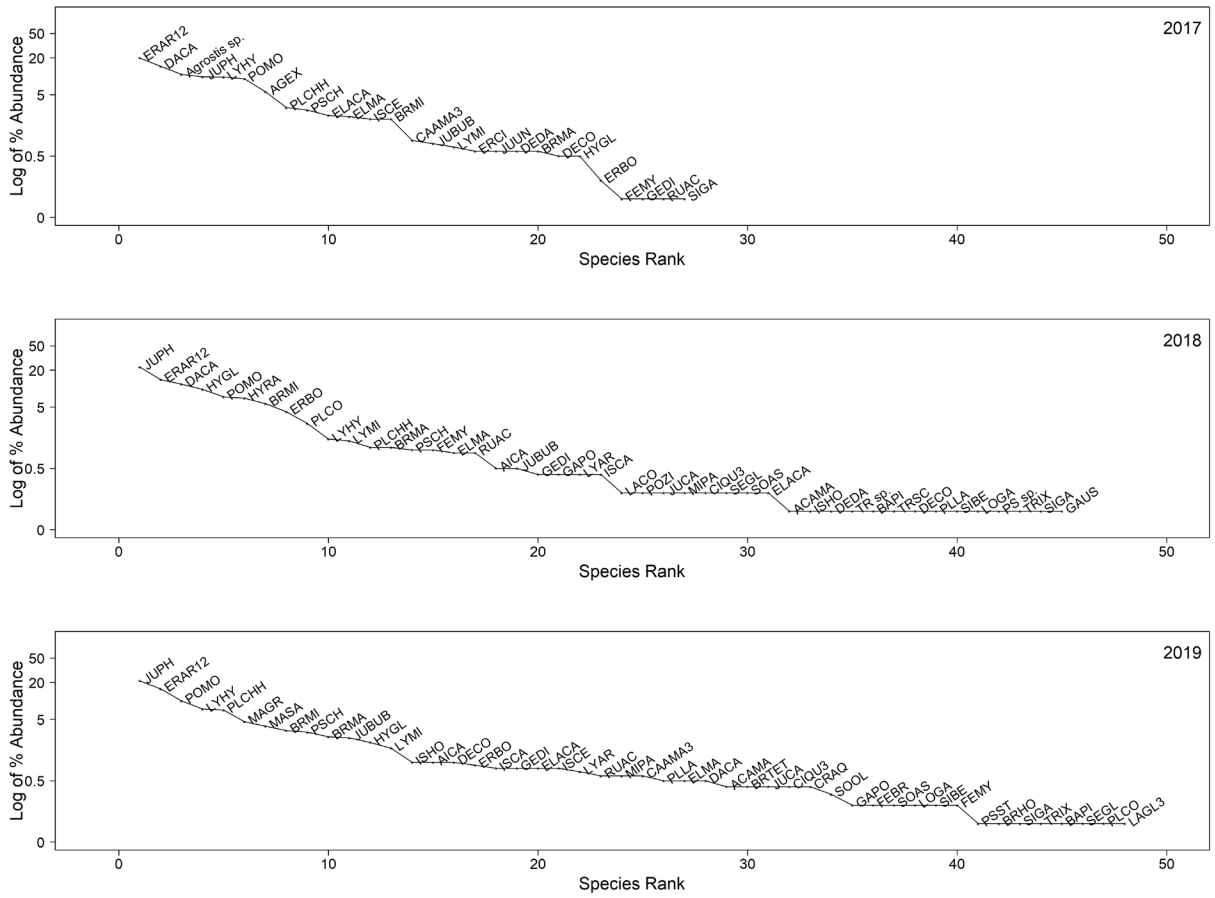

Figure 4-15. Rank Abundance Curves at Pond 997 (Reference) in 2017-2019. Note that the y-axis is in log-10 scale.

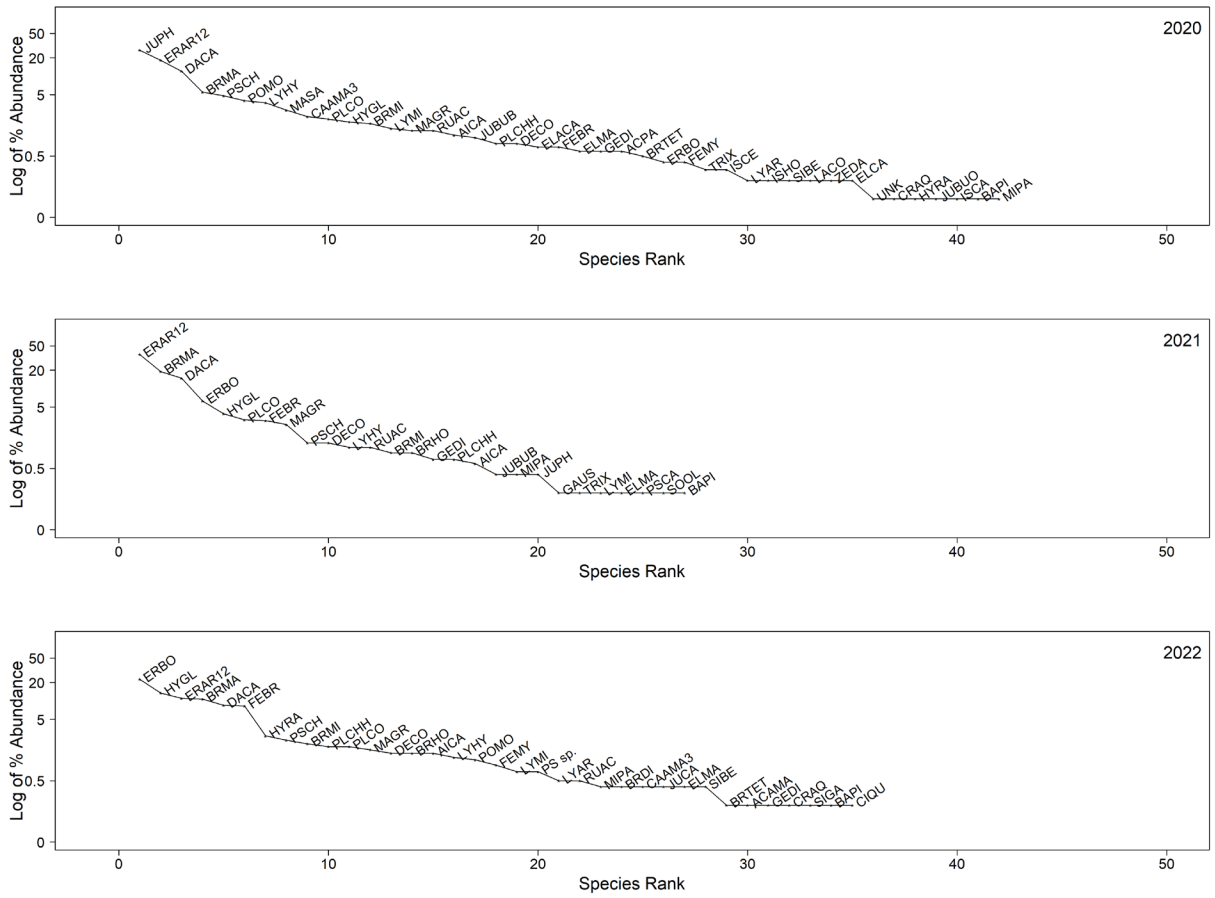

Figure 4-16. Rank Abundance Curves at Pond 997 (Reference) from 2020-2022. Note that the y-axis is in log-10 scale.

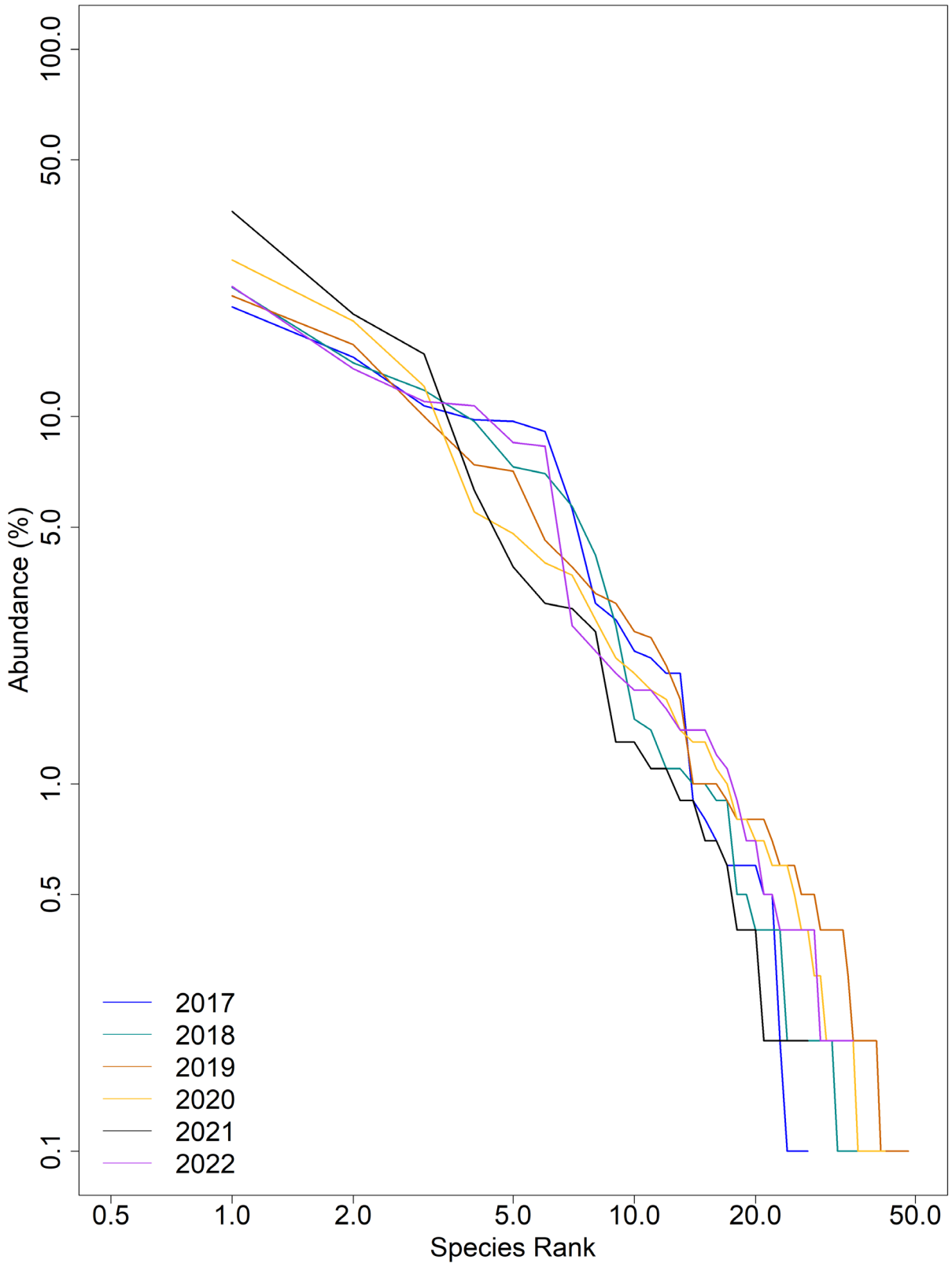

Figure 4-17. Rank Abundance Curves at Pond 997 (Reference) in 2017-2022. Note that the x-axis and y-axis are in log-10 scale.

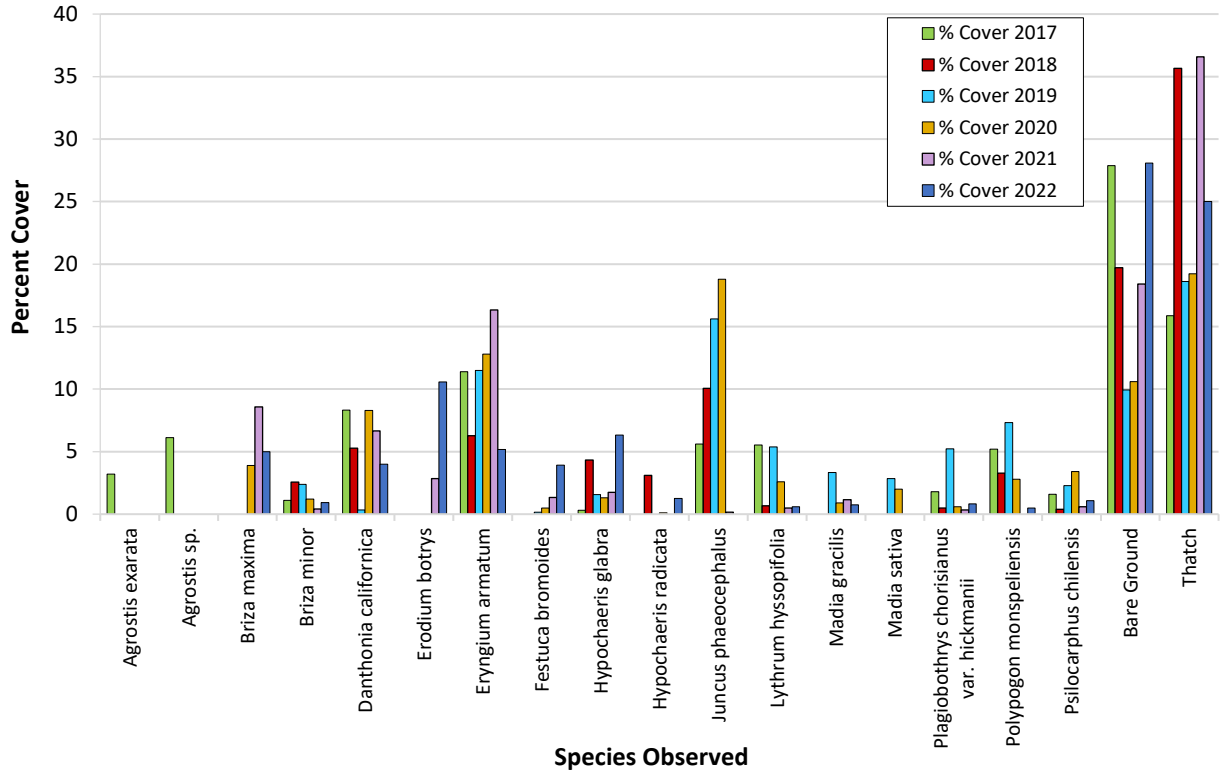

Figure 4-18. Percent Cover of Dominant Species at Pond 997 (Reference)

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 also occurring in 2019. The lowest recorded native and non-native richness values occurred in 2017 and 2021. Native species richness in 2022 was similar to 2017 and 2021, whereas non-native species richness was similar to 2018 (see Table 4-22). Native relative percent cover has fluctuated from year to year. In 2022, native cover dipped to the lowest percentage ever recorded, and conversely non-native cover was dramatically higher than any previous year (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

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%

Wetland species richness on Pond 997 transects increased from 2017 to 2020, decreased in 2021, then increased in 2022 (see Table 4-24). Non-wetland species richness varied through time, with the highest richness recorded in 2019 and the lowest recorded in 2017. Non-wetland richness in 2022 was most similar to 2018. The relative percent cover of wetland species fluctuated between 2017 and 2022 with the lowest recorded value of wetland cover observed in 2022. Non-wetland cover also varied through time, but then increased in 2022 to the highest recorded value (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

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%

4.3.1.1 *Contra Costa Goldfields*

Populations and cover estimates of CCG have been collected from 2017-2022, whereas in previous years only its presence was noted (Burleson, 2018, 2019, 2020, 2021, 2022, and 2023). The area of CCG at Pond 997 has varied slightly from 2017 to 2022 (see Table 4-26 and Figure 4-19). The lowest total area recorded was 0.005 acres in 2021, and the highest was 0.02 acres in 2017, 2020, and 2022. The density

also fluctuated from 10% cover in 2017, 2020 and 2021, to as much as 35% in 2019. In 2022, cover was 20%. The CCG population was in a similar location in all survey years. Minor 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.

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%

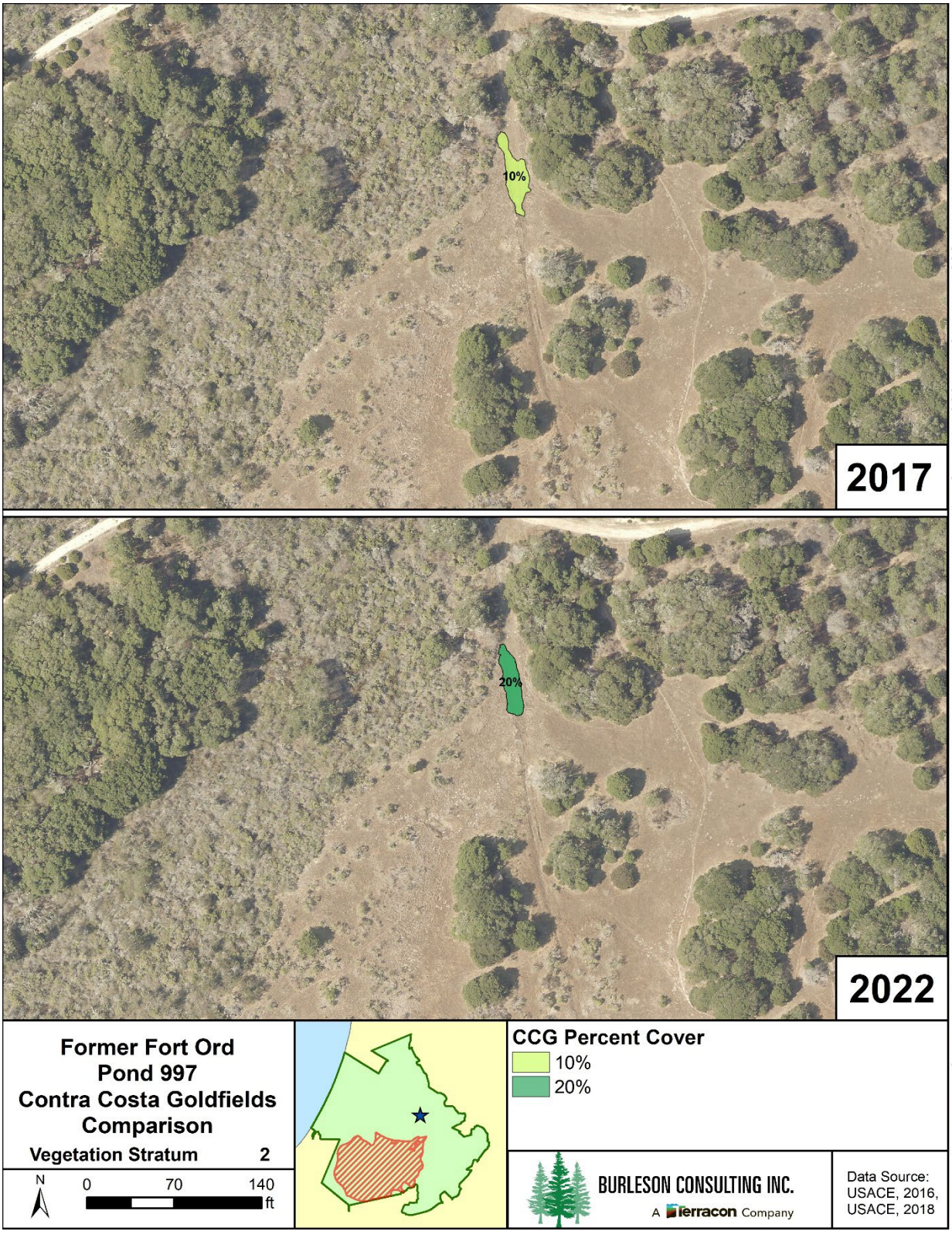

Figure 4-19. Contra Costa Goldfields Populations at Pond 997 (Reference) in 2017 and 2022

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 salamander 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. Therefore, DQO 5 and the applicable wildlife usage performance standard cannot be assessed. 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

4.3.3 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 16 – Year 4

Pond 16 was monitored in 2022 as a year 4 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 4-29 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 16 (see Figure 4-20). The 1994-1995, 2016-2017, and 2018-2019 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 4-29. Pond 16 (Year 4 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
Hydrology	●	●	●	●		●	●	●	●	●	●	●
Vegetation		●	●	●		●	●		●	●	●	●
Wildlife	●	●	●	●	●	●			●	●		

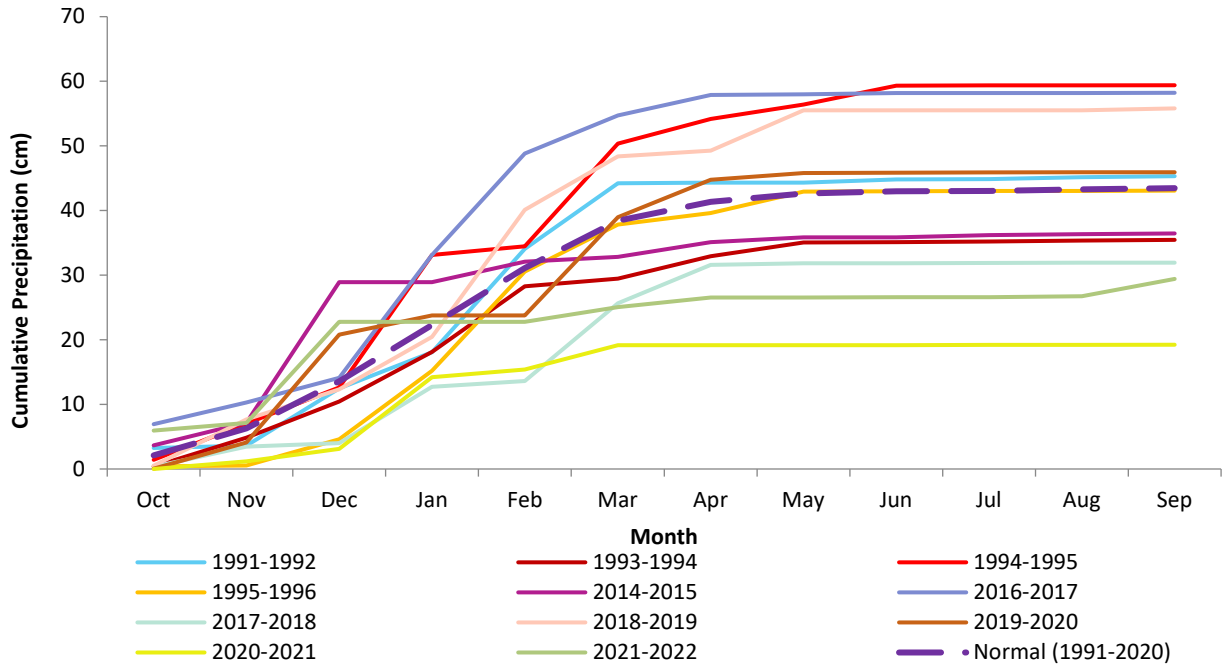

Figure 4-20. Cumulative Monthly Precipitation for Years that Hydrology Monitoring Occurred at Pond 16 (Year 4 Post-Subsurface Munitions Remediation) Compared to the 30-Year Normal (mean 1991-2020) (NPS, 2022; NCEI NOAA, 2022)

4.4.1 Vegetation Monitoring

Vegetation data were collected at Pond 16 in 2015, 2017, and 2019-2022 (Burleson, 2016, 2018, 2020, 2021, 2022, and 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 2019-2022, data were collected using the methodology described in the Methods section of this report. Data from 2015 and 2022 were compared stratum-to-stratum in Table 4-30 as well as visually in Figure 4-21.

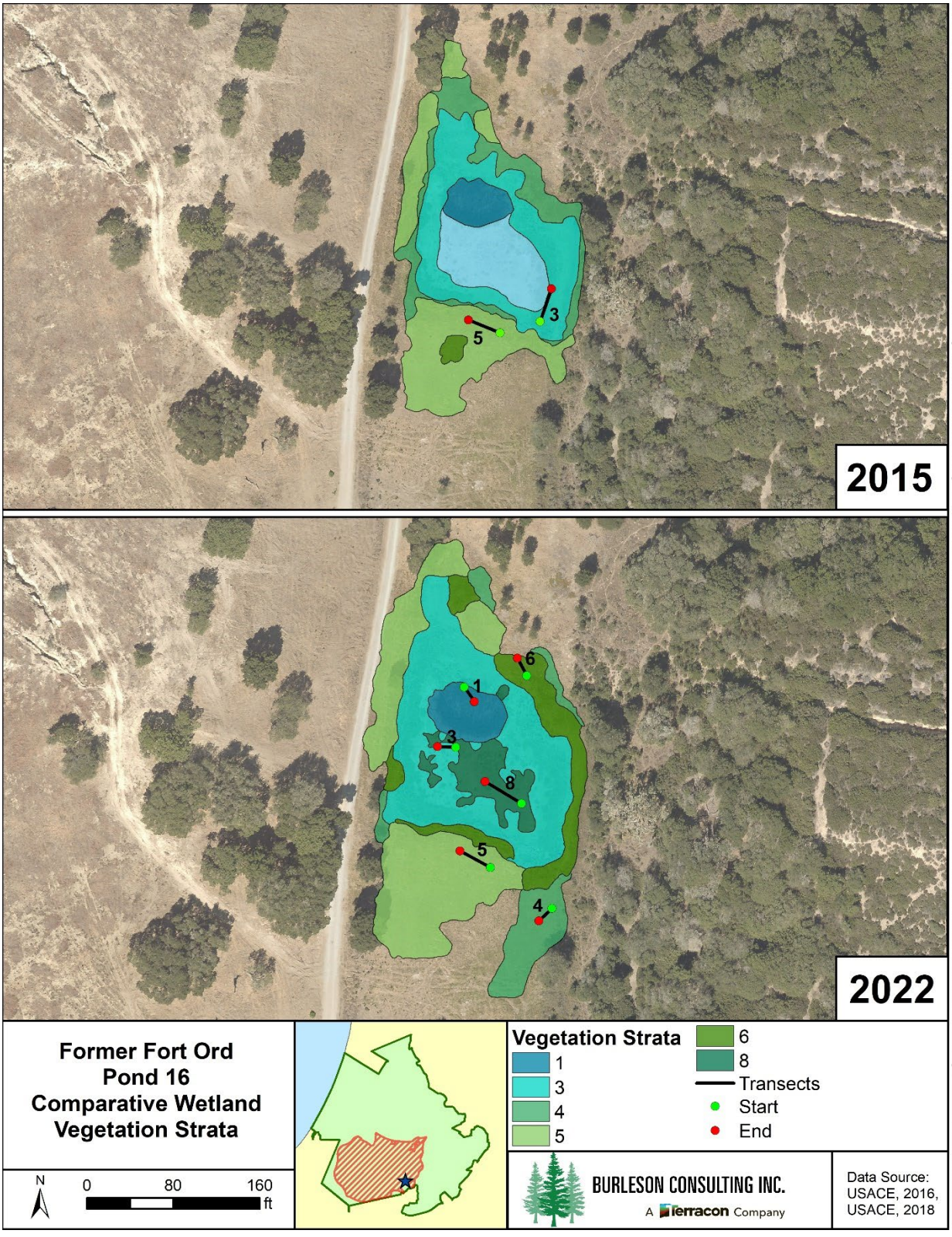

Figure 4-21. Pond 16 (Year 4 Post-Subsurface Munitions Remediation) Vegetation Strata and Transects for 2015 and 2022

Table 4-30. Pond 16 (Year 4 Post-Subsurface Munitions Remediation) Vegetative Strata Percentage within the Vernal Pool Basin Boundary

Stratum	Percentage	
	2015	2022
1	8%	5%
2	24%	N/A
3	44%	34%
4	24%	10%
5	N/A	32%
6	N/A	12%
8	N/A	7%

Absolute percent vegetative cover for Pond 16 was less than baseline in 2022, whereas thatch/bare ground was higher than baseline (see Table 4-31). 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 997 (see Table 4-32).

Table 4-31. Pond 16 (Year 4 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%

*baseline year

Table 4-32. Pond 16 (Year 4 Post-Subsurface Munitions Remediation) and Reference Vernal Pool Absolute Percent Cover in 2022

Vernal Pool	Vegetative Cover	Thatch/Bare Ground
5	41.2%	58.8%
101 East (East)	55.5%	44.5%
997	46.9%	53.1%
16	**46.4%**	**53.6%**

Species richness in 2022 was greater than the baseline year of monitoring. Species richness on transects was 8, 24, 29, 17, 23, and 21 species in 2015, 2017, 2019, 2020, 2021, and 2022 respectively, whereas overall basin species richness was 49, 86, 83, 81, 82, and 87, respectively (see Table 4-33 and Appendix D Table D-4). Pond 16 species richness was less than the values observed on transects at the reference vernal pools, whereas overall basin species richness was greater than ranges observed for reference (see Table 4-34 and Appendix D Tables D-11 and D-22). 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 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 4-22 and Figure 4-23). The most dominant species in the 2015 baseline year was whiteroot (*Carex barbarae*), and was an important species every other year. Pale spike rush (*Eleocharis macrostachya*) was among the top four dominant species every year from 2015-2022, and was the most dominant species in 2017, 2019, 2020 and 2021. In 2020 pale spike rush was codominant with clustered field sedge (*Carex praegracilis*), which was another important species from 2017-2022. In 2021, non-native rabbitfoot grass (*Polypogon monspeliensis*) was the third most dominant species, and by 2022 it became the most dominant species, marking a shift from previous years. A complete comparison of species composition observed at Pond 16 in 2015, 2017, and 2019-2022 can be found in Appendix E. Figure 4-25 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 2022 is dissimilar. In 2015, there is a less even slope and higher abundance of the dominant species at the top of the curve, whereas the 2022 RAC shows a more even distribution of the top species, with richness distributed along the entire curve (see Figure 4-24, and Appendix F). When comparing Pond 16 in 2022 to reference vernal pools, it is most similar to Ponds 5 and 997, which both have a slightly sloping beginning of the curve and similar shape to the entire curve. However, Pond 16 and Pond 5 have a higher concentration or plateau of species toward the end of the tail. In contrast, the tail end of Pond 997 drops off earlier.

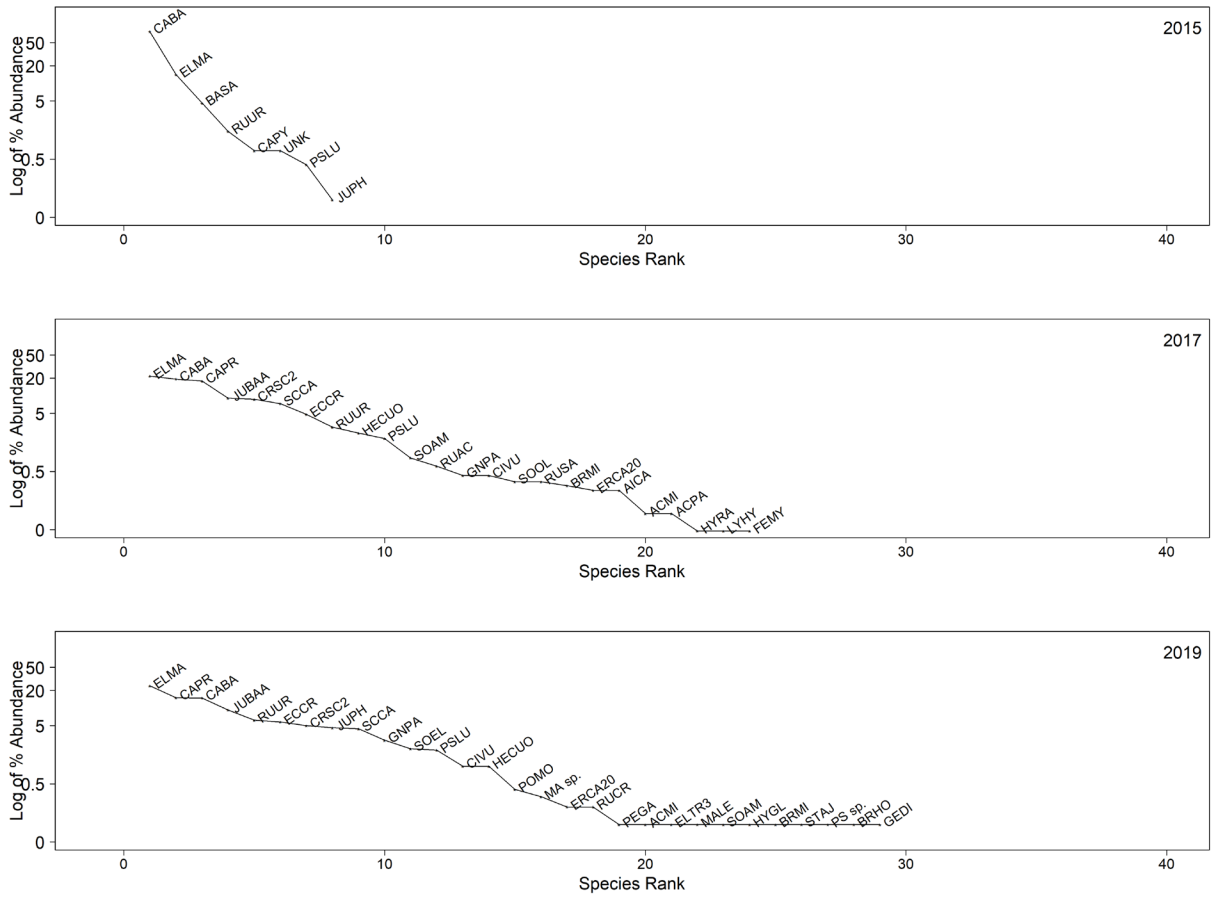

Figure 4-22. Rank Abundance Curves at Pond 16 (Year 4 Post-Subsurface Munitions Remediation) in 2015, 2017, and 2019. Note that the y-axis is in log-10 scale.

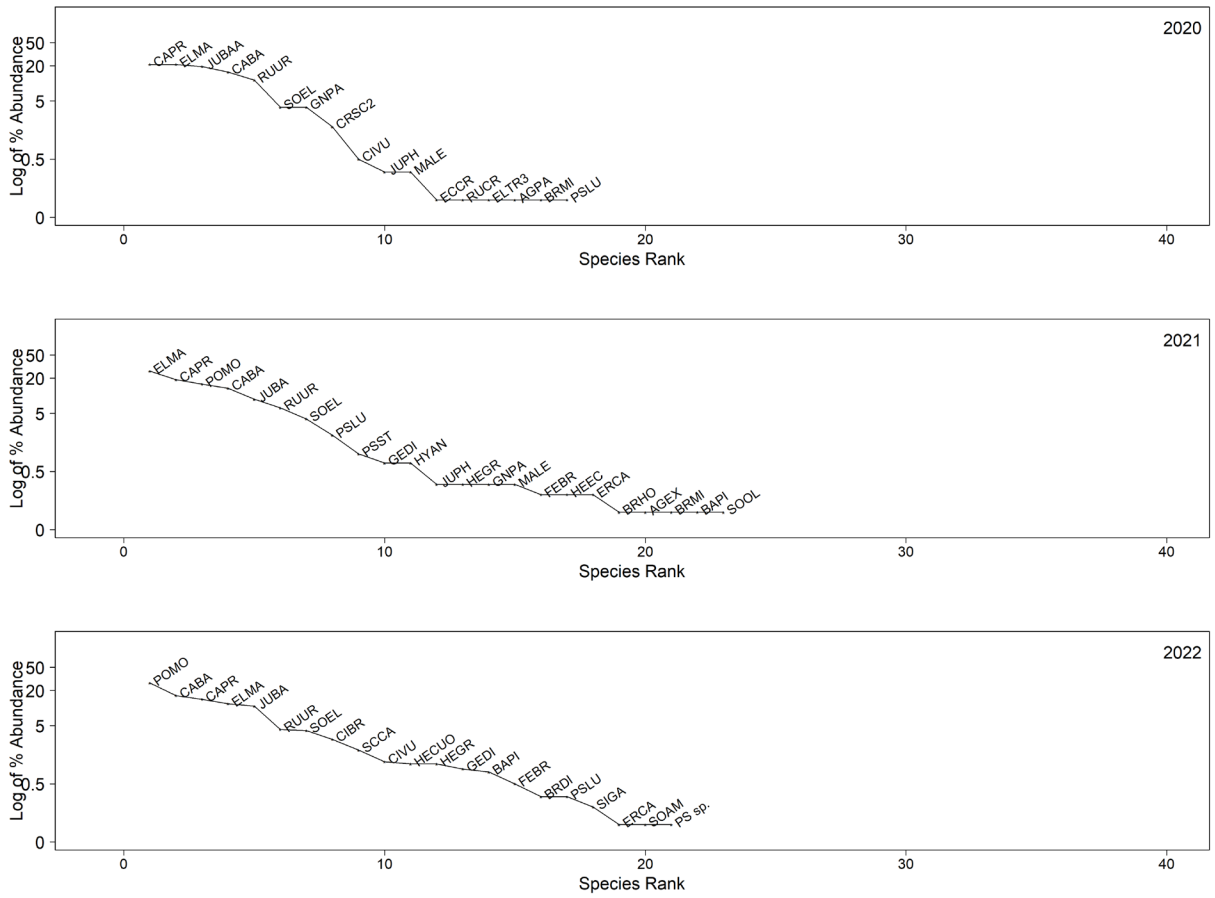

Figure 4-23. Rank Abundance Curves at Pond 16 (Year 4 Post-Subsurface Munitions Remediation) from 2020-2022. Note that the y-axis is in log-10 scale.

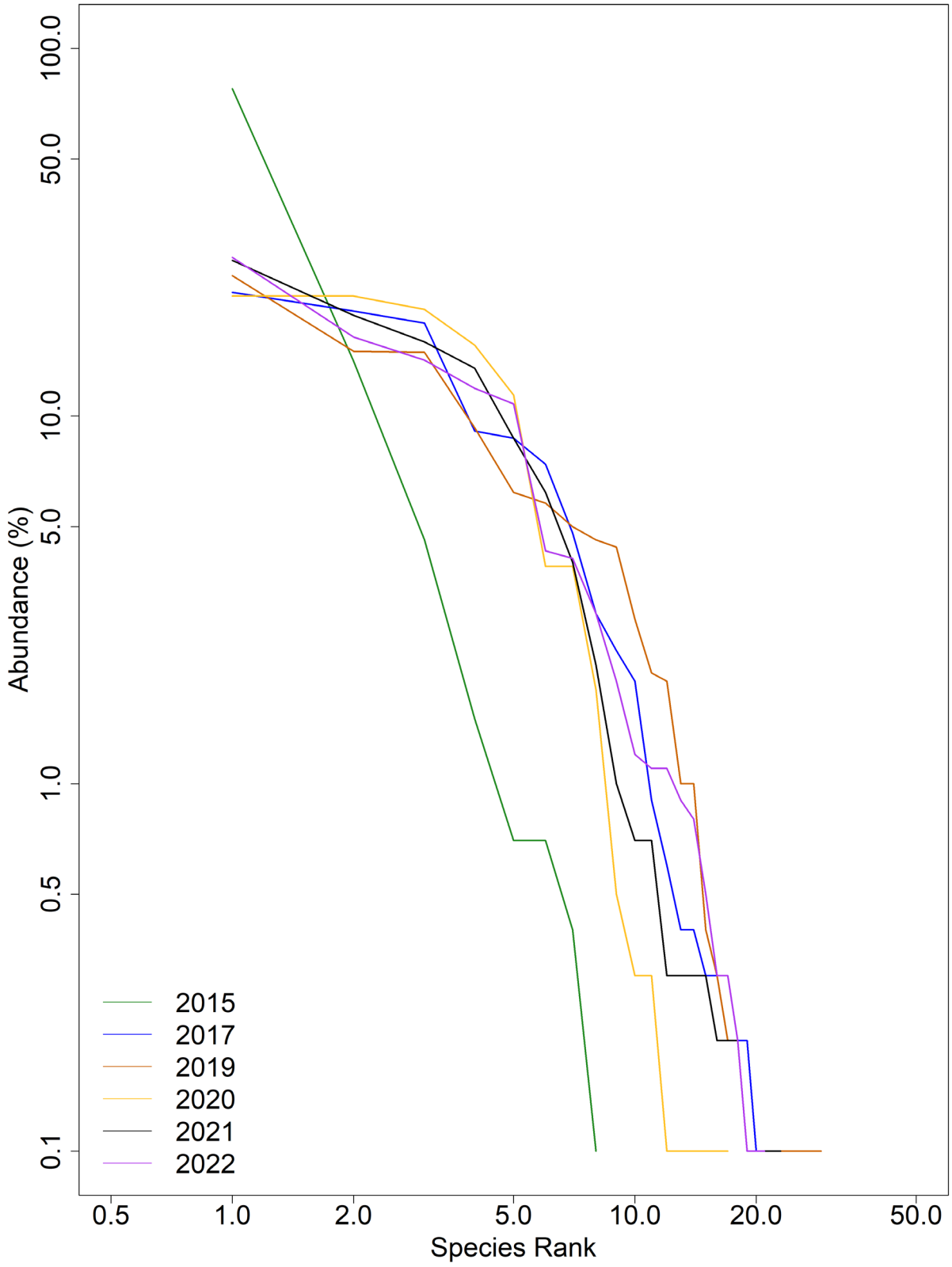

Figure 4-24. Rank Abundance Curves at Pond 16 (Year 4 Post-Subsurface Munitions Remediation) in 2015, 2017, and 2019-2022. Note that the x-axis and y-axis are in log-10 scale.

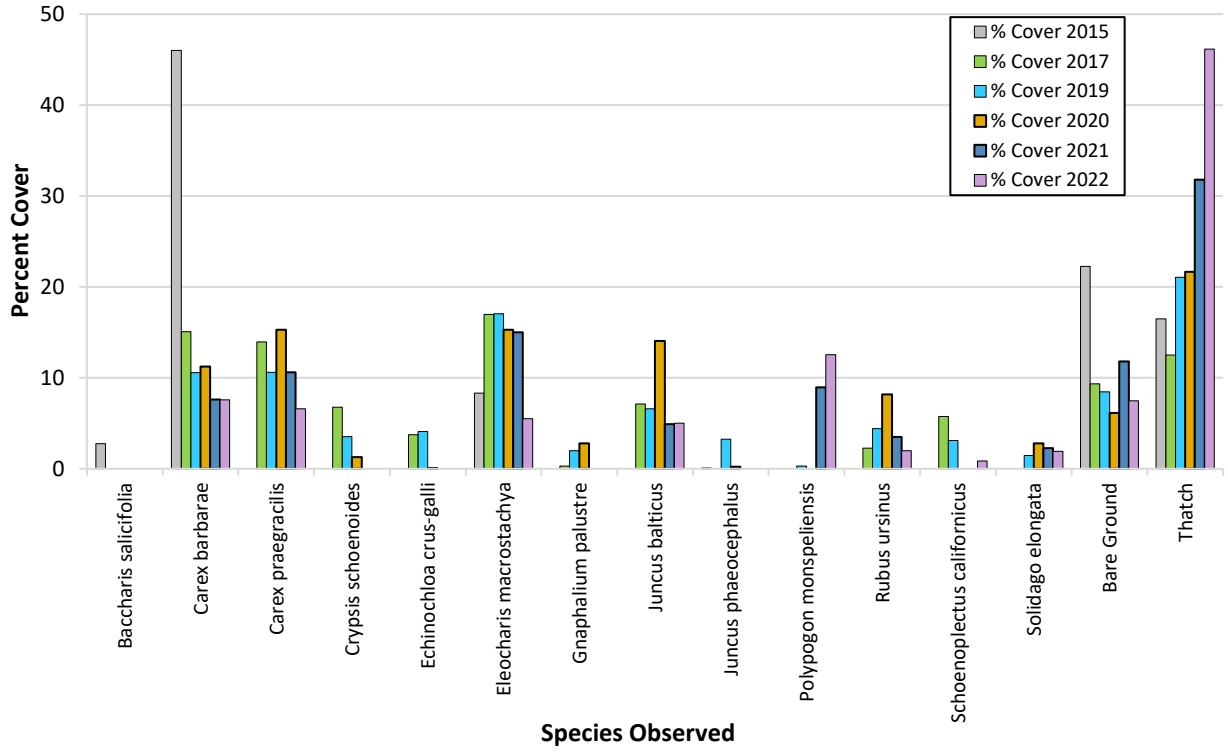

Figure 4-25. Percent Cover of Dominant Species at Pond 16 (Year 4 Post-Subsurface Munitions Remediation)

Native and non-native species richness on Pond 16 transects were greater in 2022 than the baseline year of monitoring (see Table 4-33). Pond 16 native and non-native species richness in 2022 were less than the range observed at the reference vernal pools (see Table 4-34). The relative percent cover of native species was less than baseline, while the relative percent cover of non-native species was greater (see Table 4-35). Pond 16 native and non-native relative percent cover were within the ranges observed at reference vernal pools (see Table 4-36).

Table 4-33. Pond 16 (Year 4 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

*baseline year

**Values in this table changed from past reports, PEGA was incorrectly coded in 2019 as Unidentified instead of Native. The edits have been reflected in the 2022 report and deliverable.

Table 4-34. Pond 16 (Year 4 Post-Subsurface Munitions Remediation) and Reference Vernal Pool Native and Non-Native Species Richness in 2022

Vernal Pool	Native	Non-Native	Unidentified
5	14	14	1
101 East (East)	21	16	1
997	16	18	1
16	**13**	**7**	**1**

Table 4-35. Pond 16 (Year 4 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%

*baseline year

**Values in this table changed from past reports, PEGA was incorrectly coded in 2019 as Unidentified instead of Native. The edits have been reflected in the 2022 report and deliverable.

Table 4-36. Pond 16 (Year 4 Post-Subsurface Munitions Remediation) and Reference Vernal Pool Relative Percent Cover of Native and Non-Native Plants in 2022

Vernal Pool	Native	Non-Native	Unidentified
5	73.9%	25.9%	0.3%
101 East (East)	66.4%	33.5%	0.1%
997	29.7%	69.6%	0.7%
16	**69.5%**	**30.4%**	**0.1%**

Wetland and non-wetland species richness on Pond 16 transects were greater in 2022 than in baseline (see Table 4-37). Conversely, wetland and non-wetland species richness were less than reference vernal pool values (see Table 4-38). The relative percent cover of wetland species was lower than the baseline year whereas non-wetland species cover was greater (see Table 4-39). Relative percent cover of wetland species was greater than the range of values observed at the reference pools, while non-wetland species were within the range of values observed at the reference vernal pools (see Table 4-40).

Table 4-37. Pond 16 (Year 4 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

*baseline year
**Values in this table changed from past reports, PEGA was incorrectly coded in 2019 as Not Listed instead of Native. The edits have been reflected in the 2022 report and deliverable.

Table 4-38. Pond 16 (Year 4 Post-Subsurface Munitions Remediation) and Reference Vernal Pool Wetland and Non-Wetland Species Richness in 2022

Vernal Pool	Wetland			Non-Wetland		Not Listed
	OBL	FACW	FAC	FACU	UPL	
5	4	6	2	7	1	9
101 East (East)	4	6	8	7	1	12
997	4	7	4	7	0	13
16	**2**	**4**	**1**	**5**	**0**	**9**

Table 4-39. Pond 16 (Year 4 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%

*baseline year
**Values in this table changed from past reports, PEGA was incorrectly coded in 2019 as Not Listed instead of Native. The edits have been reflected in the 2022 report and deliverable.

Table 4-40. Pond 16 (Year 4 Post-Subsurface Munitions Remediation) and Reference Vernal Pool Relative Percent Cover of Wetland and Non-Wetland Species in 2022

Vernal Pool	Wetland			Non-Wetland		Not Listed
	OBL	FACW	FAC	FACU	UPL	
5	28.7%	39.4%	1.6%	8.0%	1.4%	20.9%
101 East (East)	29.7%	13.8%	4.2%	29.1%	2.1%	21.1%
997	3.6%	16.0%	12.8%	29.8%	0.0%	37.8%
16	**13.7%**	**52.3%**	**16.4%**	**9.8%**	**0.0%**	**7.8%**

4.4.1.1 *Vernal Pool Bent Grass*

Vernal pool bent grass was identified at Pond 16 for the first time in 2022 (see Figure 3-6 in Section 3.4.1.1). This species is listed as a 1B.1 seriously threatened plant in California (CNPS, 2022). Vernal pool bent grass was first identified and described as a new species in 2011 and only occurs at vernal pools in Monterey County (Peterson *et al*., 2011). Vernal pool bent grass has been documented at Ponds 3 North, 3 South, 42, 44, 61, 73, 997, 101 East (East), and Machine Gun Flats on former Fort Ord. The Pond 16 documentation of vernal pool bent grass further expanded the current known range to the south.

4.4.1.2 *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 the second of 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).

Vegetative cover in Pond 16 was dominated by native and wetland plant species during year 4 post-subsurface munitions remediation monitoring in 2022. Pond 16 wetland vegetation results were generally within range of either baseline and/or reference vernal pools with a few exceptions. Native, non-native, wetland, and non-wetland species richness were greater than baseline but less than reference. Additionally, wetland cover was less than baseline but greater than the range of reference pools. None of the exceptions are concerning and are likely related to a below-normal water-year rather than remediation and will be observed closely in the future.

4.4.1.3 *Performance Standard: Plant Cover and Species Diversity*

Pond 16, a post-subsurface munitions remediation vernal pool, is on track to meet the performance standard for year 4. 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 5 post-subsurface munitions remediation as specified in the Wetland Plan (Burleson, 2006).

4.4.2 Wildlife Monitoring

Wildlife data were collected at Pond 16 in 1992, 1994-1996, 2009, 2015, 2019, and 2020 (USACE 1992, Jones & Stokes 1996; Shaw, 2010; Burleson, 2016, 2020, and 2021). California tiger salamander larvae were observed in 2009, 2015, and 2019. 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 cannot be assessed. Table 4-41 shows historical wildlife monitoring results.

Table 4-41. Pond 16 (Year 4 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)

*Fairy shrimp detected during CTS survey, no fairy shrimp survey was conducted in March due to the presence of CTS eggs.
†baseline year

4.4.3 Conclusion

Pond 16, a post-subsurface munitions remediation vernal pool, was in year 4 of monitoring in 2022. The vernal pool is on track to meet the plant cover and species diversity performance standard (see Table 4-42). Pond 16 will continue to be monitored in the future.

Table 4-42. Success at Pond 16 (Year 4 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	N/A*	N/A*

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

4.5 Pond 39 – Year 4

Pond 39 was monitored in 2022 as a year 4 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 4-43 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 39 (see Figure 4-26). The 1997-1998, 2015-2016, and 2018-2019 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 4-43. Pond 39 (Year 4 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
Hydrology	●	●	●	●	●	●	●	●
Vegetation	●		●	●	●	●	●	●
Wildlife	●		●	●	●	●		

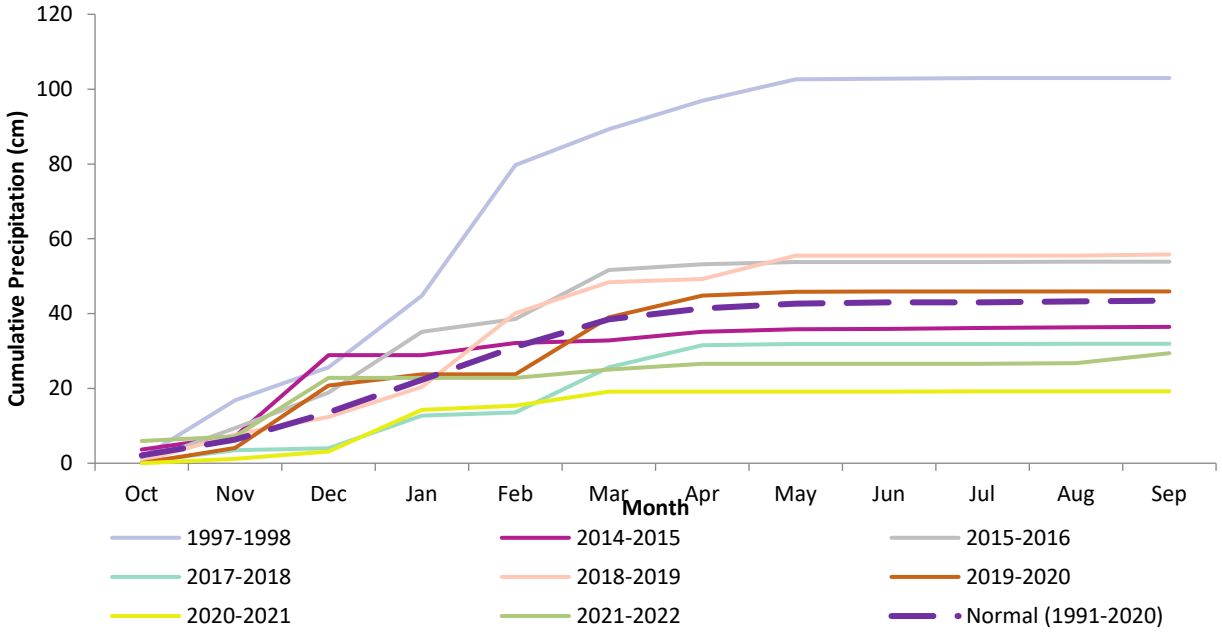

Figure 4-26. Cumulative Monthly Precipitation for Years that Hydrology Monitoring Occurred at Pond 39 (Year 4 Post-Subsurface Munitions Remediation) Compared to the 30-Year Normal (mean 1991-2020) (NPS, 2022; NCEI NOAA, 2022)

4.5.1 Vegetation Monitoring

Vegetation data were collected at Pond 39 in 1998, 2016, and 2018-2022 (HLA, 1998; Burleson, 2017, 2019, 2020, 2021, and 2022). 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 2018-2022, data were collected using the methodology described in the Methods section of this report. Data from 2016 and 2022 were compared stratum-to-stratum in Table 4-44 as well as visually in Figure 4-27.

Table 4-44. Pond 39 (Year 4 Post-Subsurface Munitions Remediation) Vegetative Strata Percentage within the Vernal Pool Basin Boundary

Stratum	Percentage	
	2016	2022
1	5%	3%
2	8%	N/A
3	87%	9%
4	N/A	67%
Upland	N/A	21%

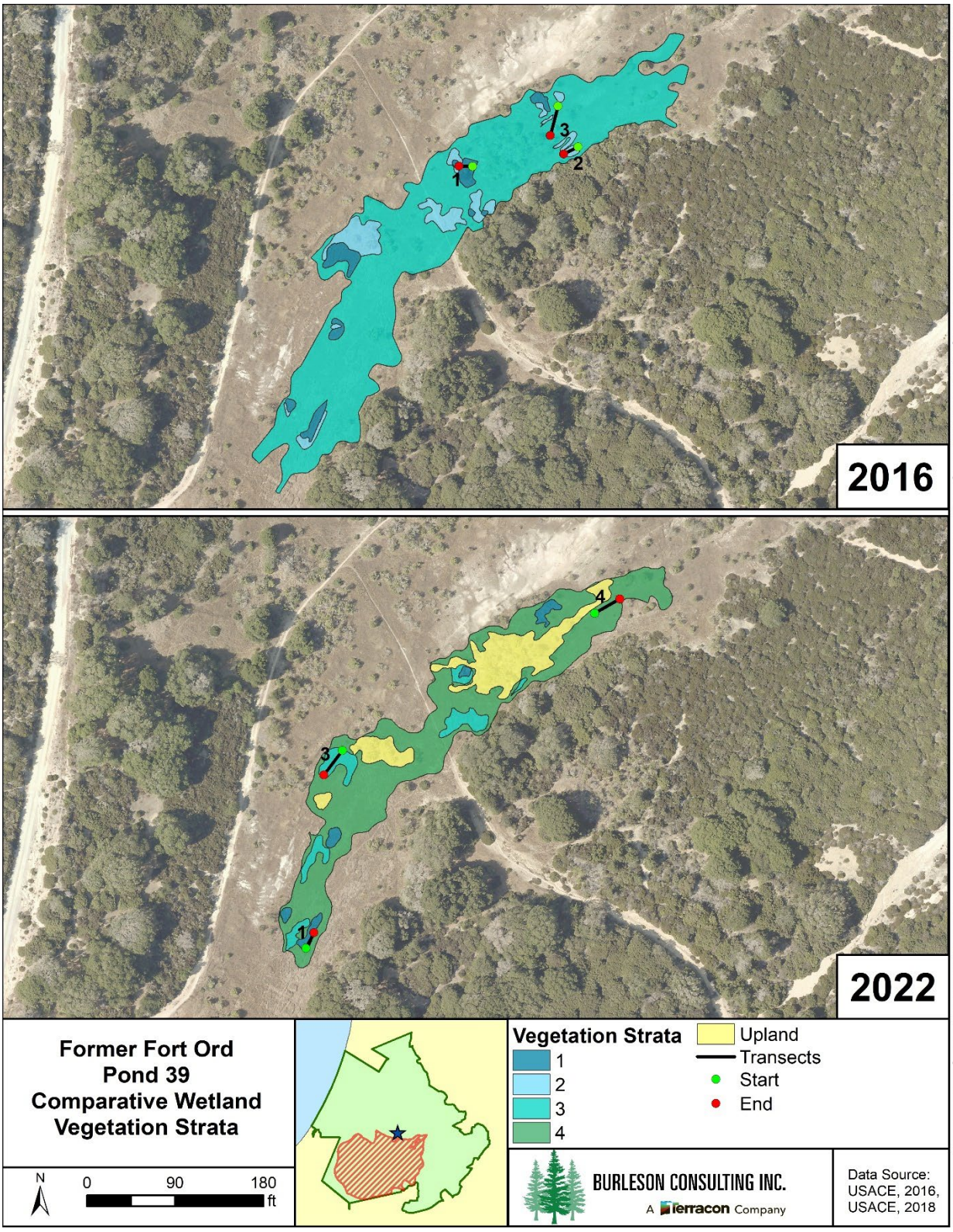

Figure 4-27. Pond 39 (Year 4 Post-Subsurface Munitions Remediation) Vegetation Strata and Transects for 2016 and 2022

Absolute percent vegetative cover in 2022 for Pond 39 was within the range of values from baseline years (see Table 4-45). Vegetative cover ranged in baseline years from 48.7% in 1998 to 61.9% in 2016, whereas thatch/bare ground ranged from 37.4% in 2016 to 51.8% in 1998. The absolute percent vegetative cover of Pond 39 in 2022 was greater than values observed at the reference vernal pools (see Table 4-46).

Table 4-45. Pond 39 (Year 4 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%

*baseline year

Table 4-46. Pond 39 (Year 4 Post-Subsurface Munitions Remediation) and Reference Vernal Pool Absolute Percent Cover in 2022

Vernal Pool	Vegetative Cover	Thatch/Bare Ground
5	41.2%	58.8%
101 East (East)	55.5%	44.5%
997	46.9%	53.1%
39	**58.7%**	**41.3%**

Species richness in 2022 was greater than the values observed on transects and in the overall basin in baseline years. Species richness on transects was 22, 30, 35, 46, 32, 29, and 37 species in 1998, 2016, 2018, 2019, 2020, 2021, and 2022, respectively, whereas overall basin species richness was 61, 90, 98, 85, 73, and 76 species in 2016, 2018, 2019, 2020, 2021, and 2022, respectively (see Table 4-47 and Appendix D Table D-5). The 1998 survey was limited to species on the transect and overall basin species richness was not recorded. Pond 39 species richness on transects and for the overall basin were within the ranges of values at reference vernal pools (see Table 4-48 and Appendix D Tables D-11 and D-22). The species richness is represented on the RACs as the length of the curve and number of species along the curve (see Figure 4-28 and Figure 4-29).

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 4-28 and Figure 4-29). 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 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.

A complete comparison of species composition observed at Pond 39 in 1998, 2016, and 2018-2022 can be found in Appendix E. Figure 4-31 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, whereas the RAC for 2022 has a less even slope and higher abundance of the dominant species at the top of the curve. When comparing Pond 39 in 2022 to reference vernal pools, it is most similar to Ponds 5 and 997, which both have a slightly sloping beginning of the curve and similar shape to the entire RAC. However, Pond 39 and Pond 5 have a higher concentration or plateau of species toward the end of the tail, whereas the tail end of Pond 997 drops off earlier, indicating fewer species with low abundance.

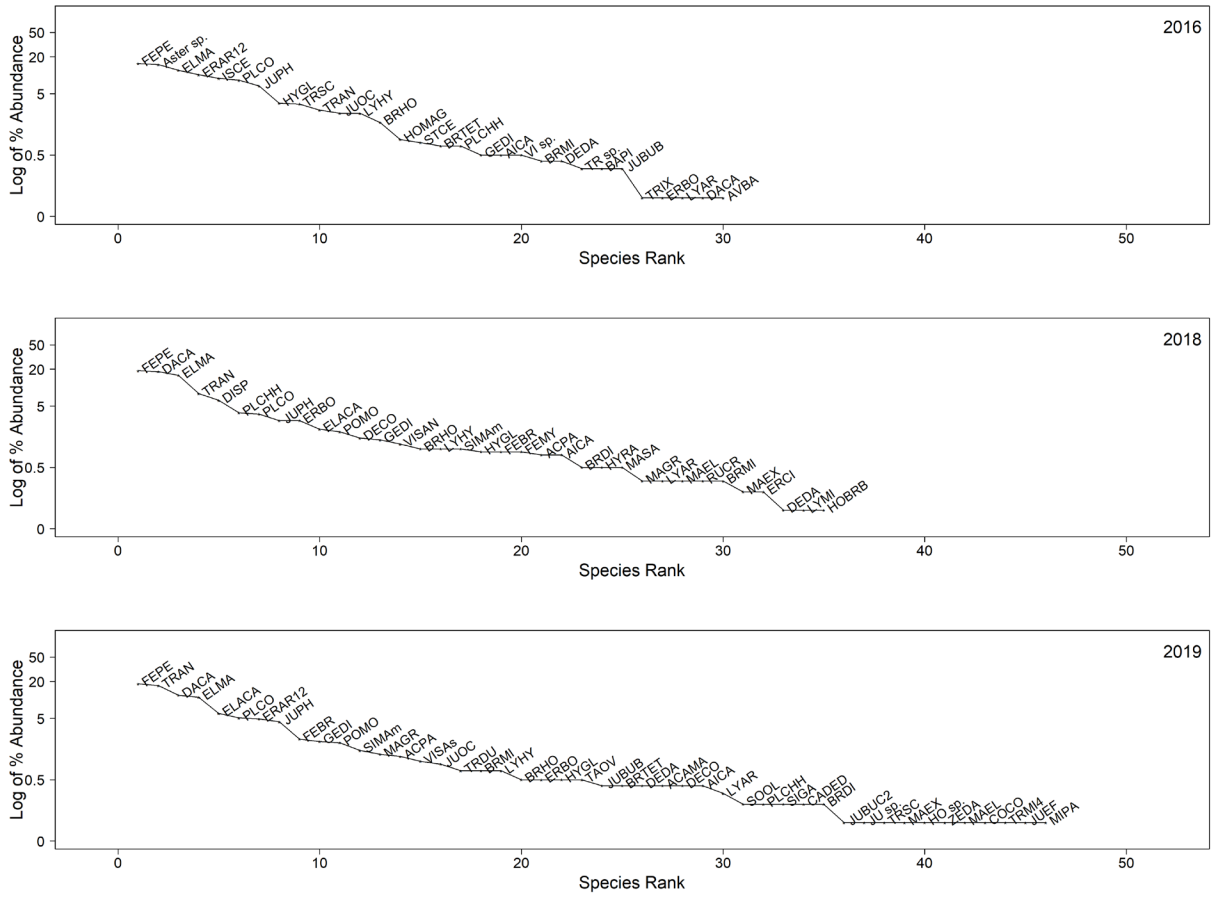

Figure 4-28. Rank Abundance Curves at Pond 39 (Year 4 Post-Subsurface Munitions Remediation) in 2016, 2018, and 2019. Note that the y-axis is in log-10 scale.

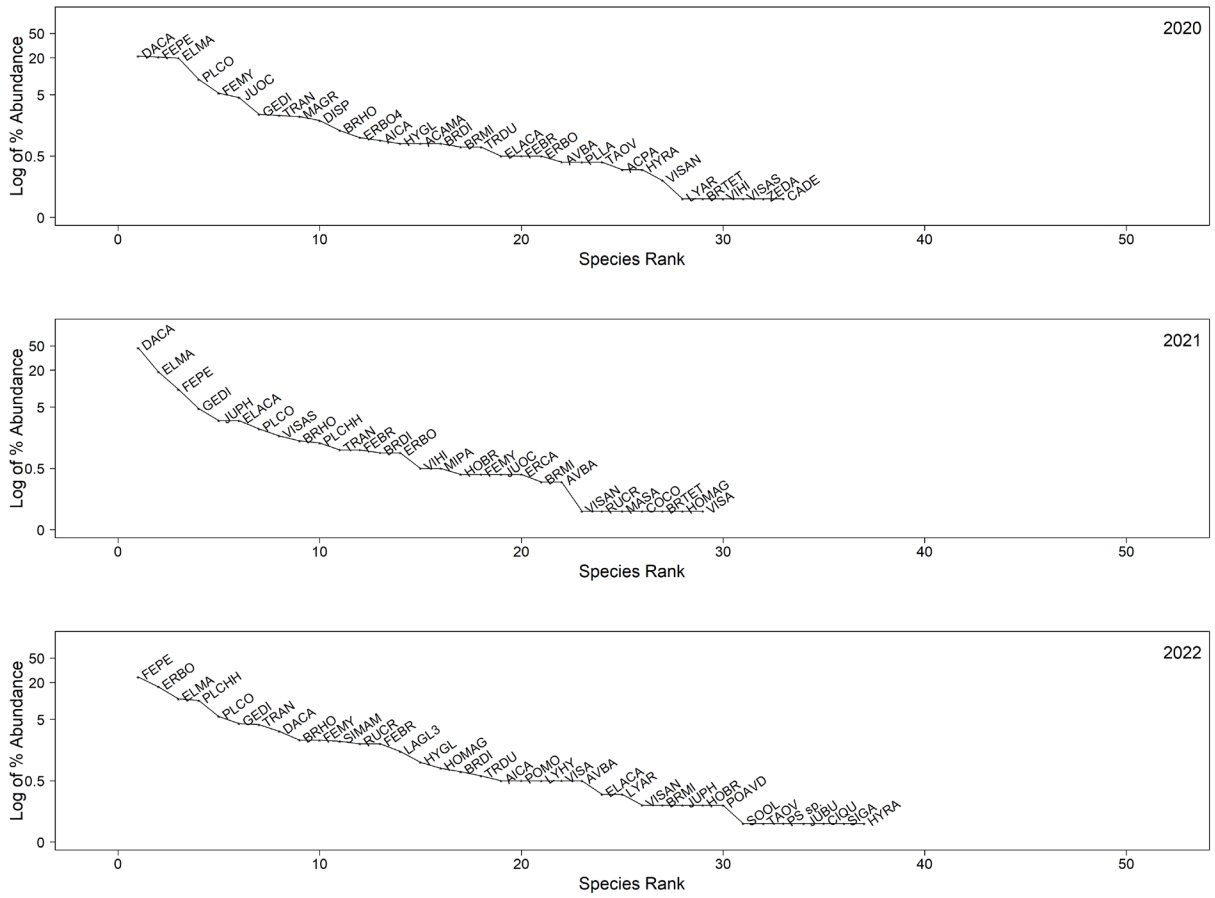

Figure 4-29. Rank Abundance Curves at Pond 39 (Year 4 Post-Subsurface Munitions Remediation) from 2020-2022. Note that the y-axis is in log-10 scale.

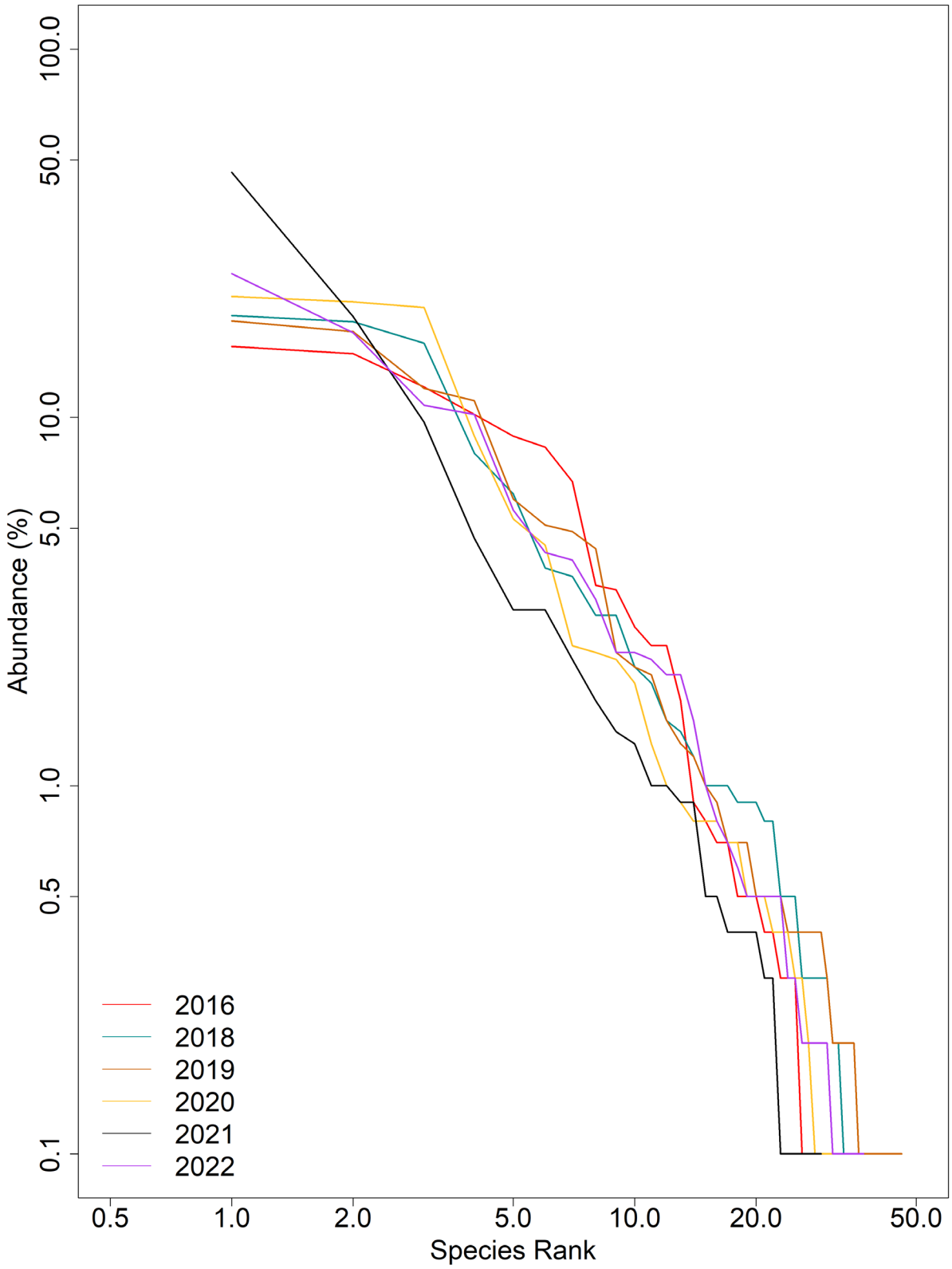

Figure 4-30. Rank Abundance Curves at Pond 39 (Year 4 Post-Subsurface Munitions Remediation) in 2016-2022. Note that the x-axis and the y-axis are in log-10 scale.

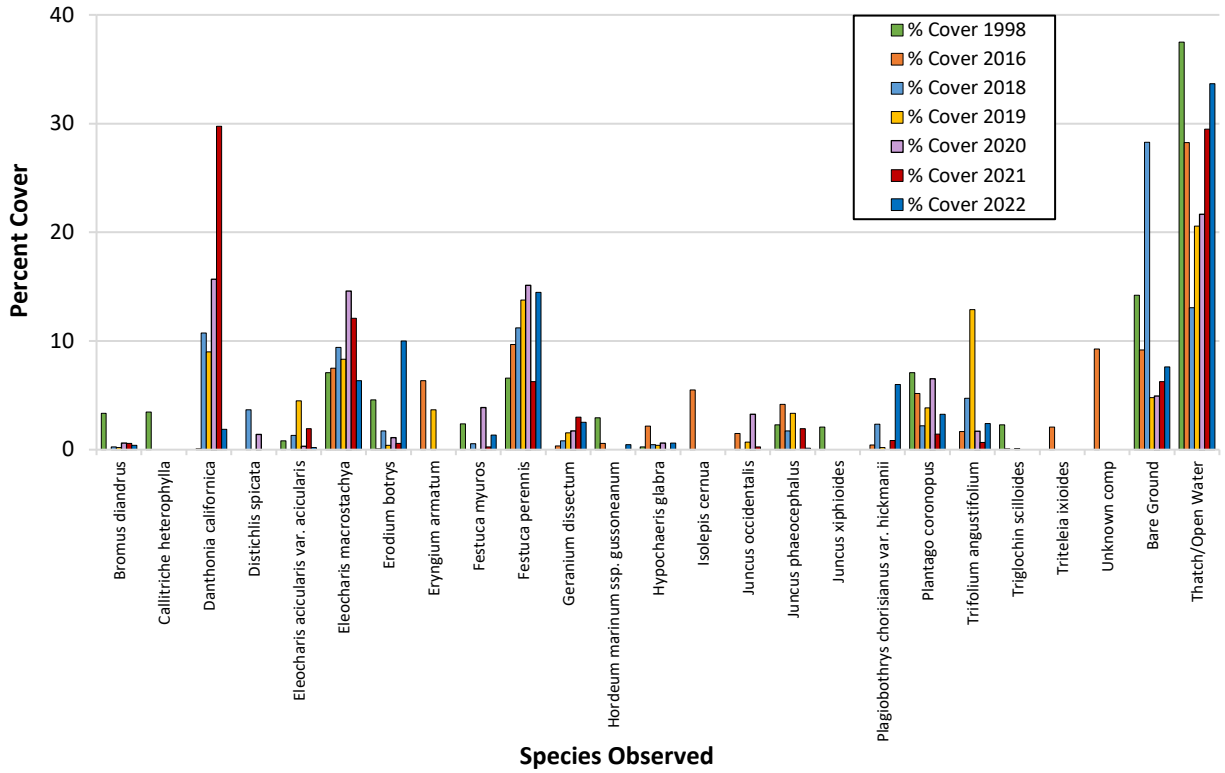

Figure 4-31. Percent Cover of Dominant Species at Pond 39 (Year 4 Post-Subsurface Munitions Remediation)

Native species richness on Pond 39 transects in 2022 was within the range of values observed in baseline years but less than the values at reference vernal pools. Non-native species richness was greater than baseline and reference richness (see Table 4-47 and see Table 4-48). The relative percent cover of native species in 2022 was less than the values observed in baseline and reference vernal pools, while non-native cover was greater than baseline and reference vernal pools (see Table 4-49 and Table 4-50).

Table 4-47. Pond 39 (Year 4 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

*baseline years

†Values in this table changed from past reports, FEMY was incorrectly coded in past reports as Unidentified instead of Non-Native. This is because the name changed from VUMY to FEMY between 1998 and 2016 and was entered in our database as *Festuca* sp. instead of FEMY. Edits have been reflected in the 2022 report and deliverable.

Table 4-48. Pond 39 (Year 4 Post-Subsurface Munitions Remediation) and Reference Vernal Pool Native and Non-Native Species Richness in 2022

Vernal Pool	Native	Non-Native	Unidentified
5	14	14	1
101 East (East)	21	16	1
997	16	18	1
39	**11**	**25**	**1**

Table 4-49. Pond 39 (Year 4 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%

*baseline year

Table 4-50. Pond 39 (Year 4 Post-Subsurface Munitions Remediation) and Reference Vernal Pool Relative Percent Cover of Native and Non-Native Plants in 2022

Vernal Pool	Native	Non-Native	Unidentified
5	73.9%	25.9%	0.3%
101 East (East)	66.4%	33.5%	0.1%
997	29.7%	69.6%	0.7%
39	**28.9%**	**70.9%**	**0.1%**

Wetland and non-wetland species richness on Pond 39 transects were greater than baseline and the range of values observed at reference vernal pools in 2022 (see Table 4-51 and Table 4-52). The relative percent cover of wetland species was less than baseline years and non-wetland cover was greater than baseline (see Table 4-53). The relative percent cover of wetland and non-wetland species were within the range of values at the reference vernal pools in 2022 (Table 4-54).

Table 4-51. Pond 39 (Year 4 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

*baseline year

Table 4-52. Pond 39 (Year 4 Post-Subsurface Munitions Remediation) and Reference Vernal Pool Wetland and Non-Wetland Species Richness in 2022

Vernal Pool	Wetland			Non-Wetland		Not Listed
	OBL	FACW	FAC	FACU	UPL	
5	4	6	2	7	1	9
101 East (East)	4	6	8	7	1	12
997	4	7	4	7	0	13
39	**5**	**6**	**8**	**6**	**3**	**9**

Table 4-53. Pond 39 (Year 4 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%

*baseline year

Table 4-54. Pond 39 (Year 4 Post-Subsurface Munitions Remediation) and Reference Vernal Pool Relative Percent Cover of Wetland and Non-Wetland Species in 2022

Vernal Pool	Wetland			Non-Wetland		Not Listed
	OBL	FACW	FAC	FACU	UPL	
5	28.7%	39.4%	1.6%	8.0%	1.4%	20.9%
101 East (East)	29.7%	13.8%	4.2%	29.1%	2.1%	21.1%
997	3.6%	16.0%	12.8%	29.8%	0.0%	37.8%
39	**23.3%**	**3.3%**	**37.0%**	**22.7%**	**0.8%**	**12.9%**

4.5.1.1 *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. This year was the second of 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).

Vegetative cover in Pond 39 was dominated by non-native and wetland plant species during year 4 post-subsurface munitions remediation monitoring in 2022. Non-native richness was much greater than the values observed in baseline years of monitoring and reference vernal pools. Additionally, the relative percent cover of non-native species far exceeded the cover of native species on Pond 39 and was greater than both baseline cover values and reference cover values. It is noteable however, that reference pond 997 had nearly the same non-native cover value as Pond 39, with a difference of less than 1%. Native cover in 2022, conversely, was less than baseline and reference values. Both wetland and non-wetland richness were greater in 2022 than baseline and the range of values at reference. The relatively high numbers of non-native richness and abundance was likely related to a consecutive below-normal water-year rather than remediation, but it should be observed closely in the future.

4.5.1.2 *Performance Standard: Plant Cover and Species Diversity*

Pond 39, a post-subsurface munitions remediation vernal pool, was not on track to meet the performance standard for year 4 in 2022. The species composition was dissimilar from baseline and/or reference vernal pool conditions. There was an increase in non-native species richness and the relative percent cover of non-native species far exceeded the percent cover of native species this year for both baseline and reference. 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. A low water-year likely contributed to favorable conditions for non-native species at Pond 39. Fortunately, wetland species richness was greater than baseline and reference values, although non-wetland species richness was higher than both sets of values as well. Increases in both wetland and non-wetland species richness was a trend across many of the ponds monitored this year. This vernal pool will be monitored for year 5 post-subsurface munitions remediation as specified in the Wetland Plan (Burleson, 2006).

4.5.2 Wildlife Monitoring

Wildlife data were collected at Pond 39 in 1998, 2016, 2018, 2019, and 2020 (HLA, 1998; Burleson, 2017, 2019, 2020, and 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 2022. Therefore, DQO 5 and the applicable wildlife usage performance standard cannot be assessed. Table 4-55 shows historical wildlife monitoring results.

Table 4-55. Pond 39 (Year 4 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)

*baseline year

4.5.3 Conclusion

Pond 39, a post-subsurface munitions remediation vernal pool, was in year 4 of monitoring in 2022. The vernal pool was not on track to 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 4-56). Pond 39 will continue to be monitored in the future.

Table 4-56. Success at Pond 39 (Year 4 Post-Subsurface Munitions Remediation) Based on Performance Standards and Applicable Data Quality Objectives

Performance Standard	Applicable DQO	Success
Plant Cover & Species Diversity	DQO 3	Not on track
Wildlife Usage	N/A*	N/A*

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

4.6 Pond 40 South – Year 4

Pond 40 South was monitored in 2022 as a year 4 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 4-57 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 4-32). The 1997-1998, 2015-2016, 2016-2017, and 2018-2019 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 4-57. Pond 40 South (Year 4 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
Hydrology	●	●	●	●	●	●	●	●	●
Vegetation	●		●		●	●	●	●	●
Wildlife	●		●			●	●		

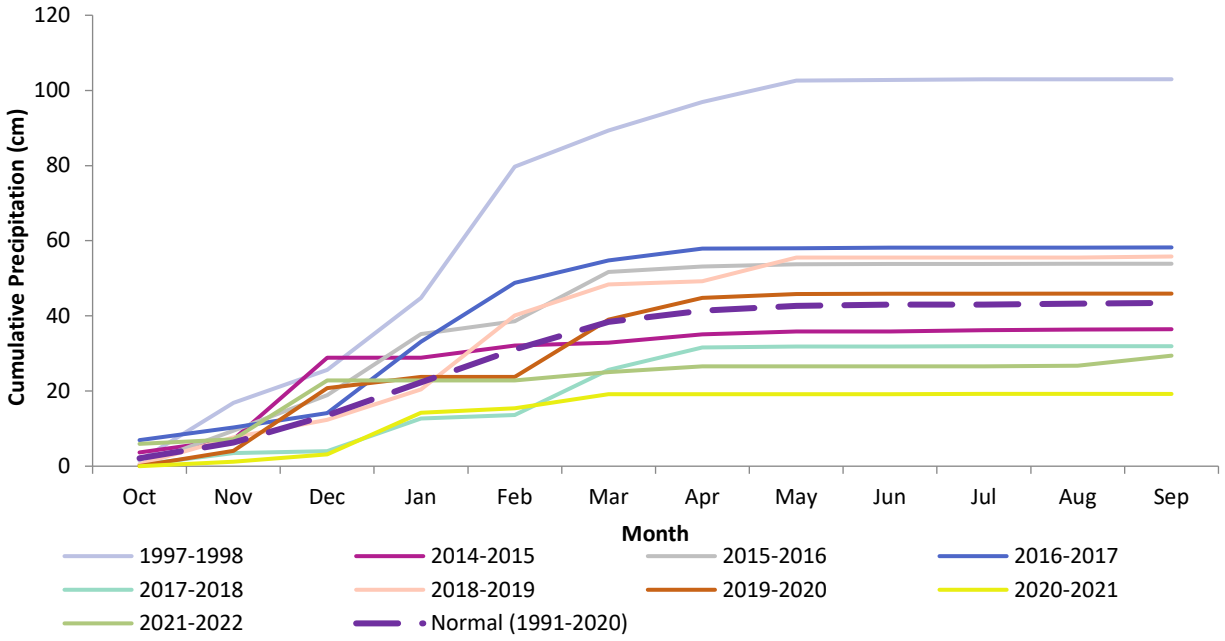

Figure 4-32. Cumulative Monthly Precipitation for Years that Hydrology Monitoring Occurred at Pond 40 South (Year 4 Post-Subsurface Munitions Remediation) Compared to the 30-Year Normal (mean 1991-2020) (NPS, 2022; NCEI NOAA, 2022)

4.6.1 Vegetation Monitoring

Vegetation data were collected at Pond 40 South in 1998, 2016, and 2018-2022 (HLA, 1998; Burleson, 2017, 2019, 2020, 2021, and 2022). 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 2018-2022 data were collected using the methodology described in the Methods section of this report. Data from 2016 and 2022 were compared stratum-to-stratum in Table 4-58 as well as visually in Figure 4-33.

Table 4-58. Pond 40 South (Year 4 Post-Subsurface Munitions Remediation) Vegetative Strata Percentage within the Vernal Pool Basin Boundary

Stratum	Percentage	
	2016	2022
1	9%	N/A
2	26%	N/A
3	65%	37%
4	N/A	56%
5	N/A	7%

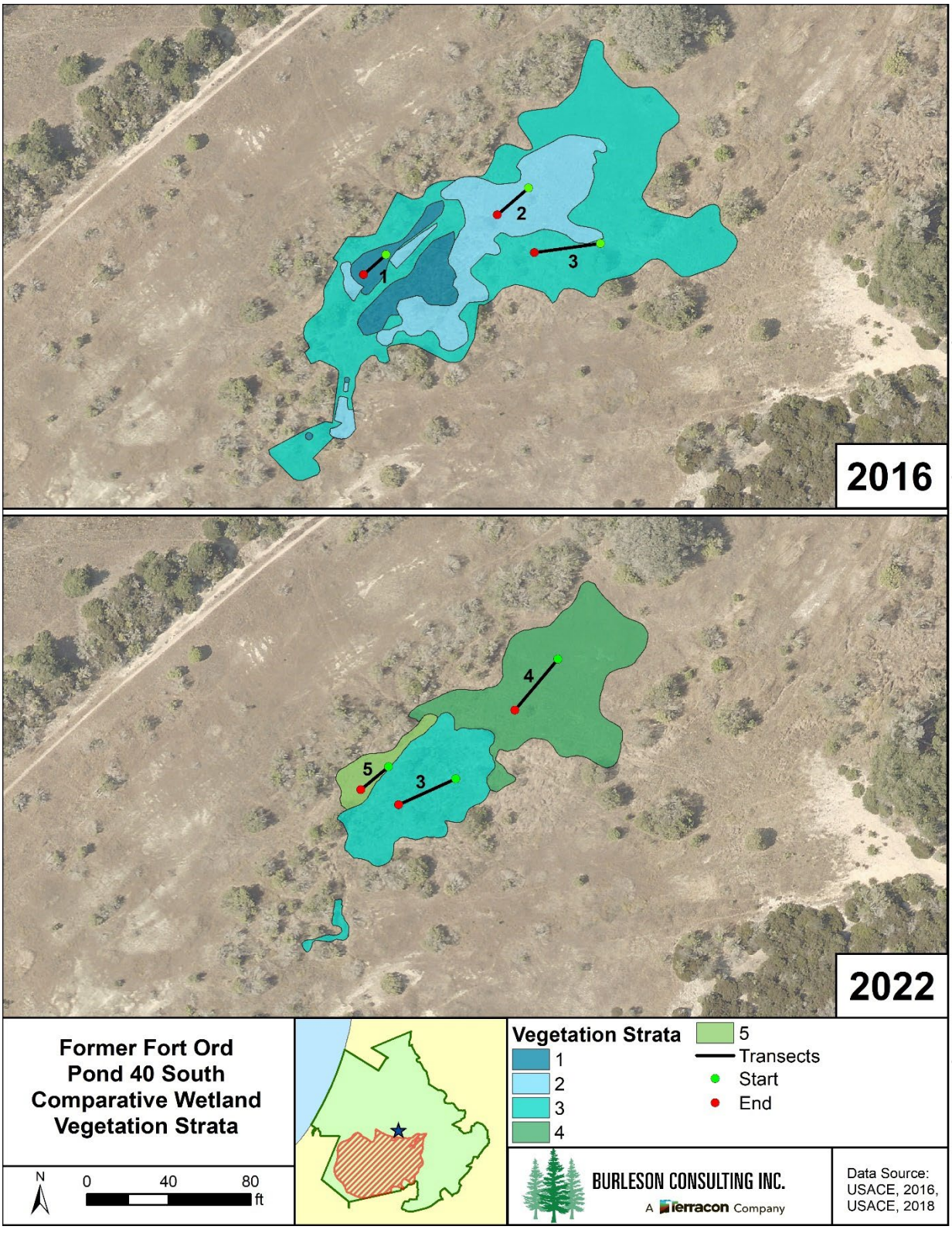

Figure 4-33. Pond 40 South (Year 4 Post-Subsurface Munitions Remediation) Vegetation Strata and Transects for 2016 and 2022

Absolute percent vegetative cover observed in 2022 was within the range of values observed in the baseline years of monitoring (see Table 4-59). Vegetative cover ranged in baseline years from 66.7% in 2016 to 72.7% in 1998, whereas thatch/bare ground ranged from 27.1% in 1998 to 33.9% in 2016. The 2022 Pond 40 South vegetative cover value was greater than reference vernal pools and bare ground was less than reference values (see Table 4-60).

Table 4-59. Pond 40 South (Year 4 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%

*baseline year

Table 4-60. Pond 40 South (Year 4 Post-Subsurface Munitions Remediation) and Reference Vernal Pool Absolute Percent Cover in 2022

Vernal Pool	Vegetative Cover	Thatch/Bare Ground
5	41.2%	58.8%
101 East (East)	55.5%	44.5%
997	46.9%	53.1%
40 South	**67.2%**	**32.8%**

Overall basin species richness and species richness on transects in 2022 was greater than the baseline years of monitoring. Species richness on transects was 21, 20, 32, 41, 26, 25, and 33 species in 1998, 2016, 2018, 2019, 2020, 2021, and 2022, respectively, whereas overall basin species richness was 27, 55, 75, 66, 53, and 60 species in 2016, 2018, 2019, 2020, 2021, and 2022, respectively (see Table 4-61 and Appendix D Table D-6). 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 (see Table 4-62 and Appendix D Tables D-11 and D-22). The species richness is represented on the RACs as the length of the curve and number of species along the curve (see Figure 4-34 and Figure 4-35).

Species composition and dominant species at Pond 40 South varied 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 4-34 and Figure 4-35). The dominant species included iris-leaved rush (*Juncus xiphioides*) in 1998; Italian rye grass (*Festuca perennis*) in 2016, 2021, and 2022; and cut-leaved plantain *(Plantago coronopus*) and Italian rye grass co-dominance in 2018. In 2019 and 2020, 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 all seven years. 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*). Figure 4-37 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 2022 at Pond 40 South compared to the 2016 baseline, which has a less even slope and higher abundance of the dominant species at the top of the curve (see Figure 4-36, and Appendix F). The slope of the tail end of the RAC at Pond 40 South in 2022 is most similar to Reference Pond 5, where both vernal pools show a high concentration of species towards the bottom of the curve.

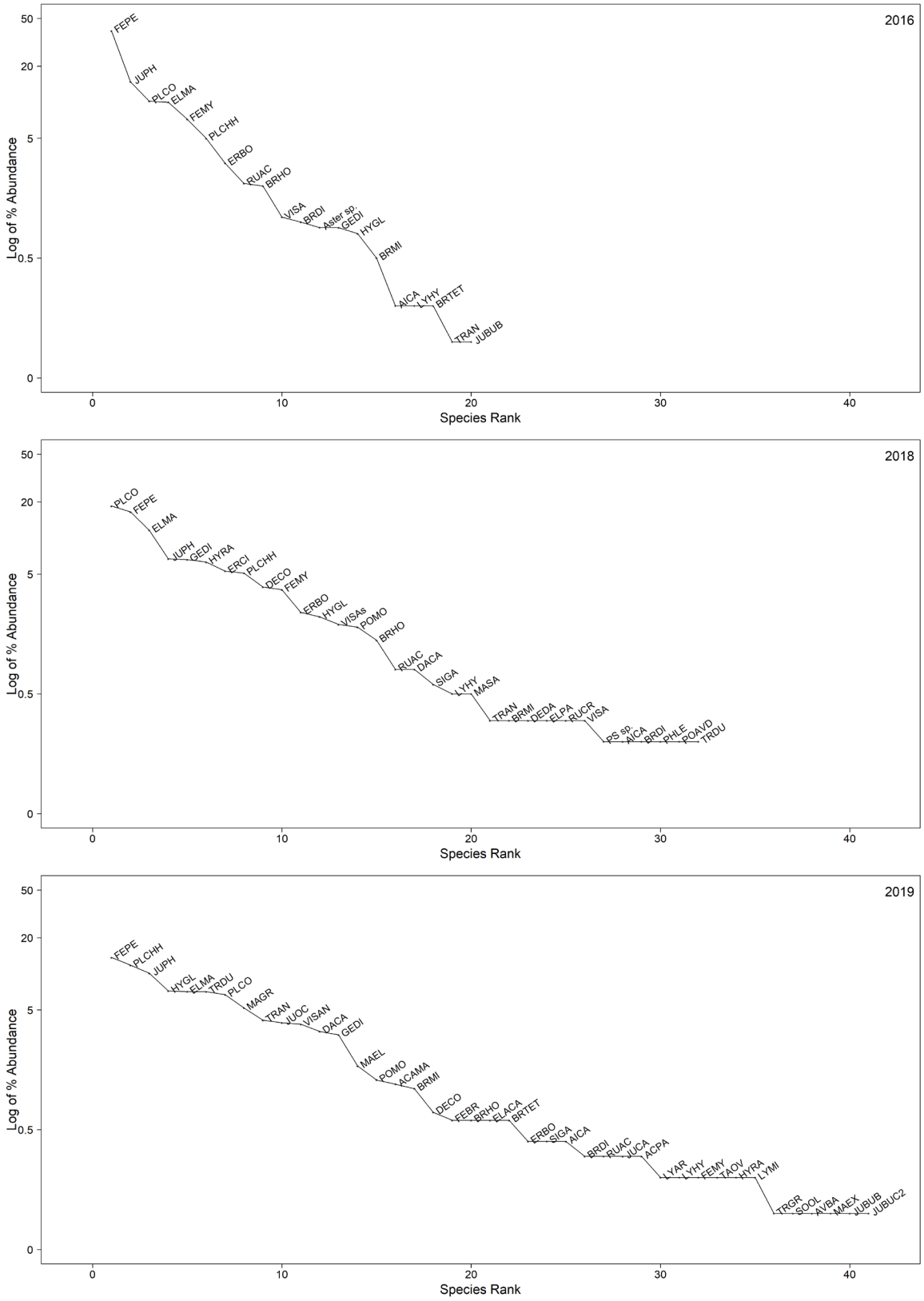

Figure 4-34. Rank Abundance Curves at Pond 40 South (Year 4 Post-Subsurface Munitions Remediation) in 2016, 2018, and 2019. Note that the y-axis is in log-10 scale.

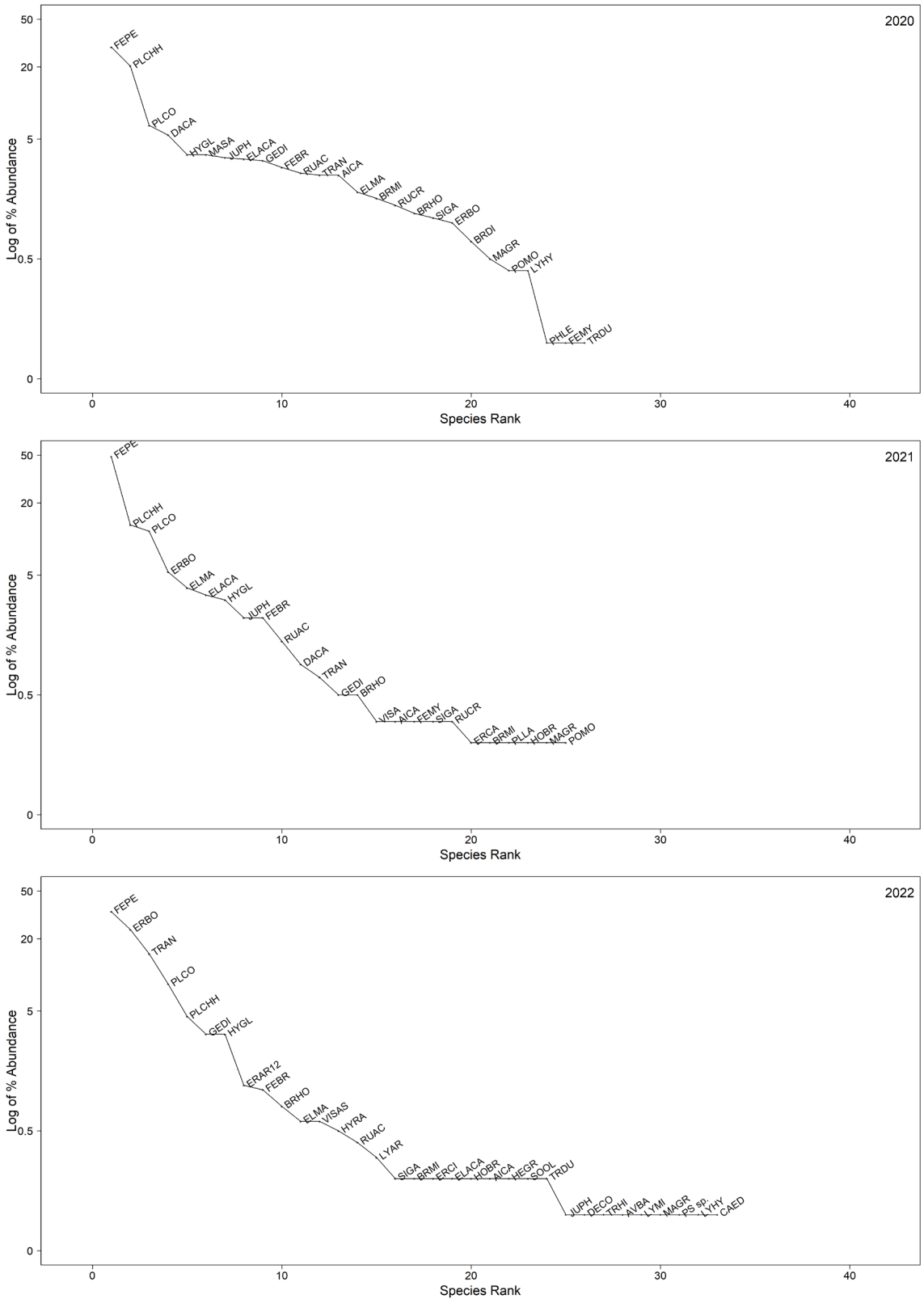

Figure 4-35. Rank Abundance Curves at Pond 40 South (Year 4 Post-Subsurface Munitions Remediation) from 2020-2022. Note that the y-axis is in log-10 scale.

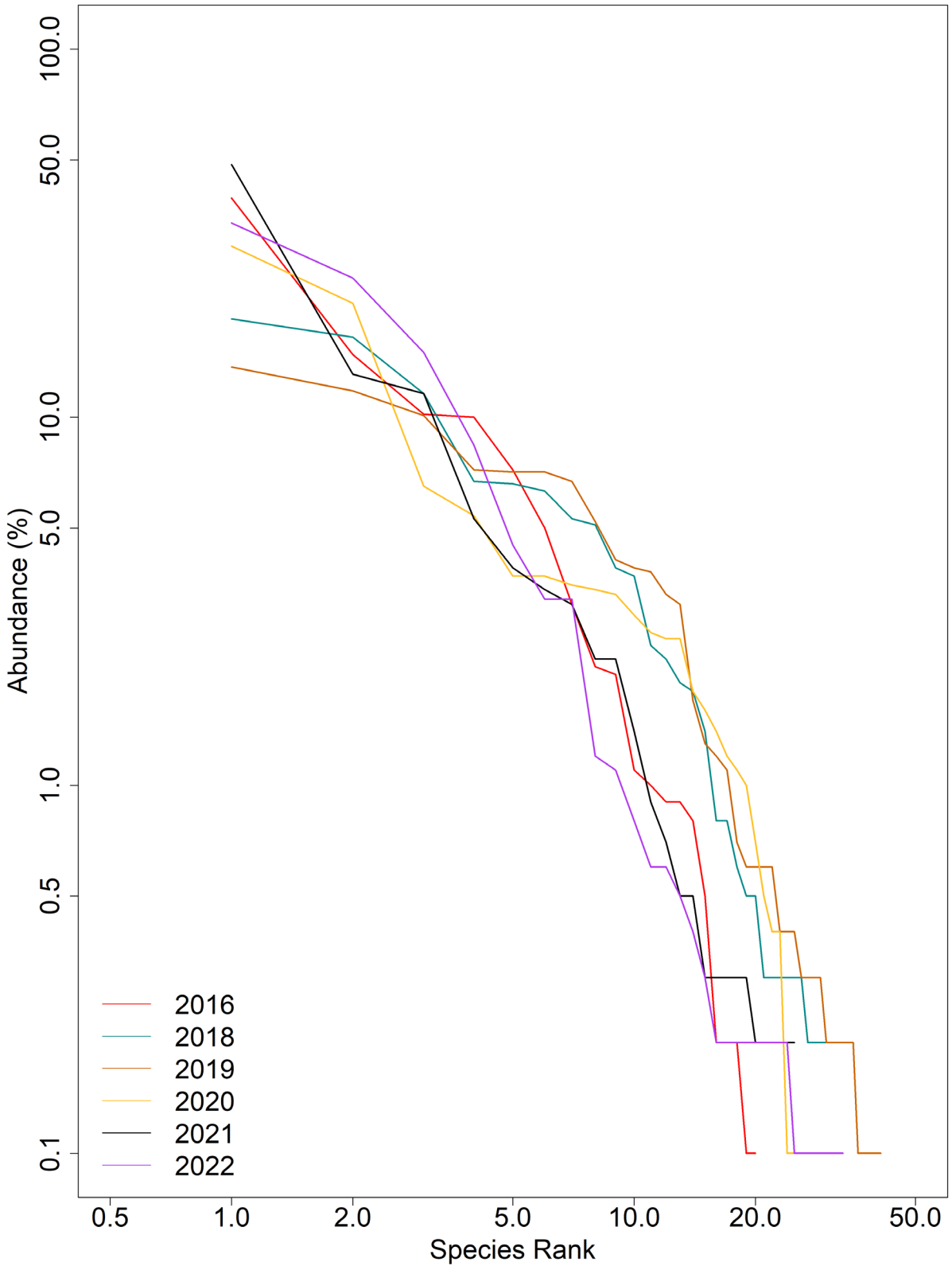

Figure 4-36. Rank Abundance Curves at Pond 40 South (Year 4 Post-Subsurface Munitions Remediation) in 2016-2022. Note that the x-axis and the y-axis are in log-10 scale.

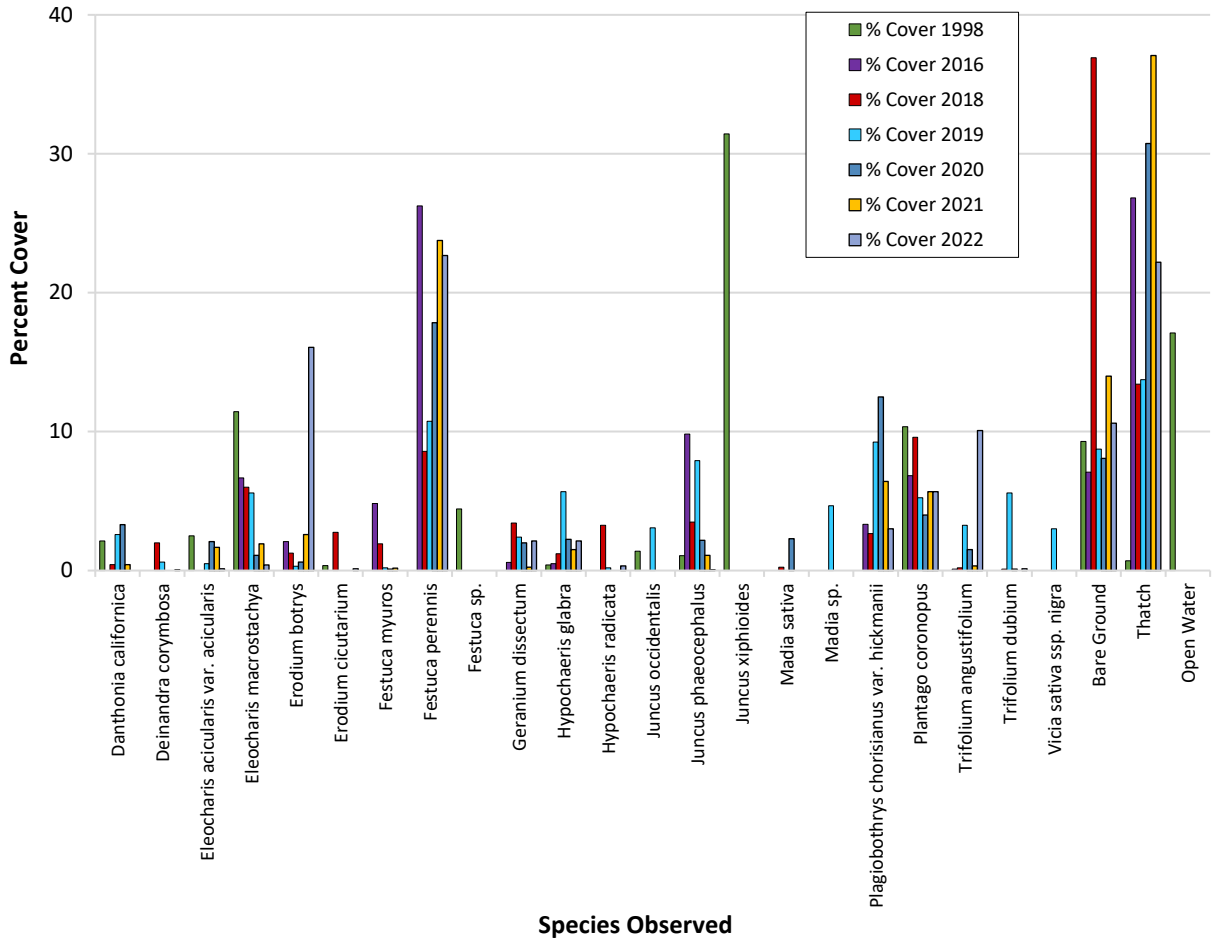

Figure 4-37. Percent Cover of Dominant Species at Pond 40 South (Year 4 Post-Subsurface Munitions Remediation)

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 (see Table 4-61). Pond 40 South native species richness in 2022 was less than reference pools, whereas non-native species richness was greater than reference (see Table 4-62). The relative percent cover of native species was the lowest value observed, compared to all previous monitoring years and less than the range of values observed in baseline years and reference. Conversely, non-native species cover was higher than all previous monitoring years, and greater than both baseline and reference (see Table 4-63 and Table 4-64).

Table 4-61. Pond 40 South (Year 4 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

*baseline year

Table 4-62. Pond 40 South (Year 4 Post-Subsurface Munitions Remediation) and Reference Vernal Pool Native and Non-Native Species Richness in 2022

Vernal Pool	Native	Non-Native	Unidentified
5	14	14	1
101 East (East)	21	16	1
997	16	18	1
40 South	**10**	**22**	**1**

Table 4-63. Pond 40 South (Year 4 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%

*baseline year

Table 4-64. Pond 40 South (Year 4 Post-Subsurface Munitions Remediation) and Reference Vernal Pool Relative Percent Cover of Native and Non-Native Plants in 2022

Vernal Pool	Native	Non-Native	Unidentified
5	73.9%	25.9%	0.3%
101 East (East)	66.4%	33.5%	0.1%
997	29.7%	69.6%	0.7%
40 South	**7.2%**	**92.7%**	**0.1%**

Wetland and non-wetland species richness on Pond 40 South transects in 2022 were greater than the range of values in baseline years (see Table 4-65). The wetland and non-wetland species richness at Pond 40 South were within the range observed at reference vernal pools (see Table 4-66). The relative percent cover of wetland species in 2022 was less than the range of values observed in baseline years, whereas the relative percent cover of non-wetland species was greater than baseline (see Table 4-67). The relative percent cover of wetland and non-wetland species in 2022 were within the range of values observed at reference vernal pool (see Table 4-68).

Table 4-65. Pond 40 South (Year 4 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

*baseline year

Table 4-66. Pond 40 South (Year 4 Post-Subsurface Munitions Remediation) and Reference Vernal Pool Wetland and Non-Wetland Species Richness in 2022

Vernal Pool	Wetland			Non-Wetland		Not Listed
	OBL	FACW	FAC	FACU	UPL	
5	4	6	2	7	1	9
101 East (East)	4	6	8	7	1	12
997	4	7	4	7	0	13
40 South	**4**	**4**	**4**	**6**	**2**	**13**

Table 4-67. Pond 40 South (Year 4 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%

*baseline year

Table 4-68. Pond 40 South (Year 4 Post-Subsurface Munitions Remediation) and Reference Vernal Pool Relative Percent Cover of Wetland and Non-Wetland Species in 2022

Vernal Pool	Wetland			Non-Wetland		Not Listed
	OBL	FACW	FAC	FACU	UPL	
5	28.7%	39.4%	1.6%	8.0%	1.4%	20.9%
101 East (East)	29.7%	13.8%	4.2%	29.1%	2.1%	21.1%
997	3.6%	16.0%	12.8%	29.8%	0.0%	37.8%
40 South	**5.4%**	**1.6%**	**42.7%**	**26.0%**	**0.8%**	**23.6%**

4.6.1.1 *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. This year was the second of two consecutive drought years. Pond 40 South remained dry throughout the water year for the second year in a row. 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).

Vegetative cover in Pond 40 South was dominated by non-native and wetland plant species during year 4 post-subsurface munitions remediation monitoring in 2022. Pond 40 South typically has high non-native richness and cover, even in the baseline year of monitoring. However, Pond 40 South wetland vegetation results differed from baseline and reference vernal pools, in that the non-native species richness was greater than baseline and reference. Additionally, the relative percent cover of native species was dramatically less than the range of values observed in baseline years and reference, while non-native species cover was far greater than baseline and reference. Of particular concern was that non-native and non-wetland species, long-beaked fillaree and narrow leaved clover, along with Italian rye grass became the most dominant species. The relatively high numbers of non-native richness was a trend observed across many vernal pools this year, however it was particularly high at this vernal pool. Non-native cover and richness at Pond 40 South was likely exacerbated by a consecutive below-normal water-year rather than remediation, but it should be observed closely in the future.

4.6.1.2 *Performance Standard: Plant Cover and Species Diversity*

Pond 40 South, a post-subsurface munitions remediation vernal pool, was not on track to meet the performance standard for year 4 in 2022. The species composition, native species richness, wetland species richness and relative abundances were similar to baseline and/or the reference vernal pools. However, non-native species richness and cover were greater than both baseline and the range reference while native 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 cover is high. Additionally, a low water-year likely contributed to favorable conditions for non-native species at Pond 40 South. This vernal pool will be monitored for year 5 post-subsurface munitions remediation as specified in the Wetland Plan (Burleson, 2006).

4.6.2 Wildlife Monitoring

Wildlife data were collected at Pond 40 South in 1998, 2016, 2019, and 2020 (HLA, 1998; Burleson, 2017, 2020, and 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 or 2022. Therefore, DQO 5 and the applicable wildlife usage performance standard cannot be assessed. Table 4-69 shows historical wildlife monitoring results.

Table 4-69. Pond 40 South (Year 4 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

4.6.3 Conclusion

Pond 40 South, a post-subsurface munitions remediation vernal pool, was in year 4 of monitoring in 2022. The vernal pool was not on track to meet the plant cover and species diversity performance standard due to high non-native richness and cover and low native cover (see Table 4-70). Pond 40 South will continue to be monitored in the future.

Table 4-70. Success at Pond 40 South (Year 4 Post-Subsurface Munitions Remediation) Based on Performance Standards and Applicable Data Quality Objectives

Performance Standard	Applicable DQO	Success
Plant Cover & Species Diversity	DQO 3	Not on track
Wildlife Usage	N/A*	N/A*

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

4.7 Pond 41 – Year 4

Pond 41 was monitored in 2022 as a year 4 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 4-71 summarizes surveys conducted. The cumulative precipitation graph shows precipitation for years in which hydrology monitoring was conducted at Pond 41 (see Figure 4-38). The normal or above-normal water-years were 1997-1998, 2015-2016, 2018-2019, and 2019-2020. Monitoring in 2014-2015, 2020-2021, and 2021-2022 was conducted in below-normal water-years.

Table 4-71. Pond 41 (Year 4 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
Hydrology	●	●	●	●	●	●	●
Vegetation			●	●	●	●	●
Wildlife	●		●	●	●		

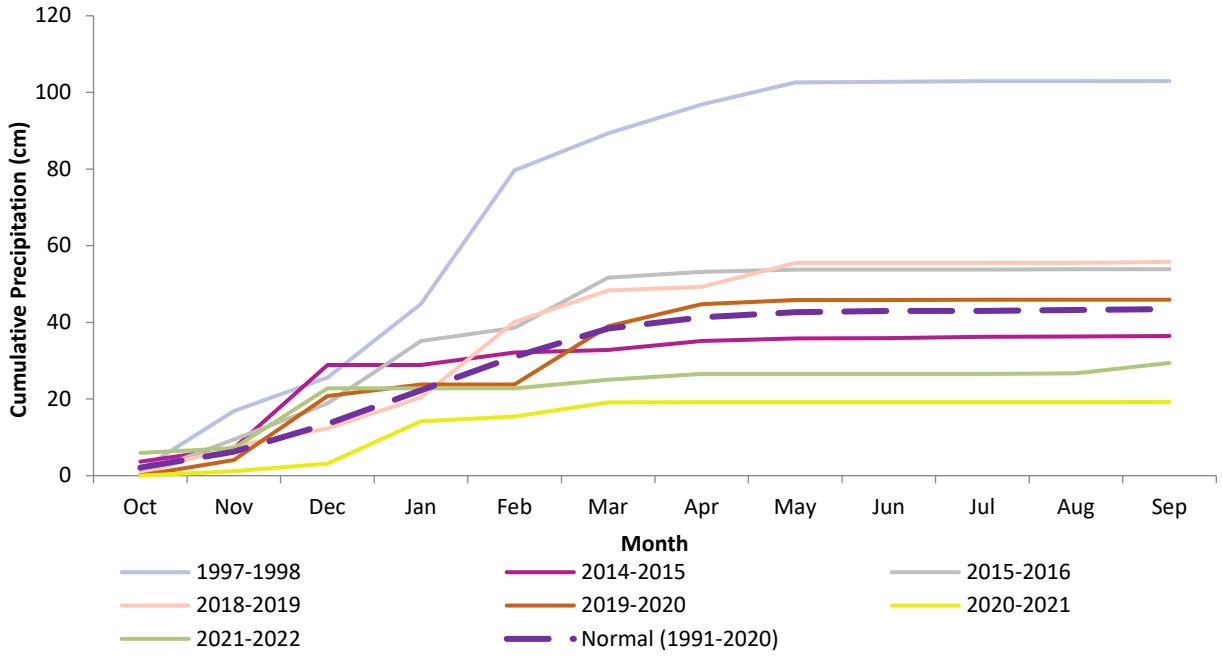

Figure 4-38. Cumulative Monthly Precipitation for Years that Hydrology Monitoring Occurred at Pond 41 (Year 4 Post-Subsurface Munitions Remediation) Compared to the 30-Year Normal (mean 1991-2020) (NPS, 2022; NCEI NOAA, 2022)

4.7.1 Vegetation Monitoring

Vegetation data were collected at Pond 41 in 2016 and 2019-2022 (Burleson, 2017, 2020, 2021, and 2022). Data were collected using the methodology described in the Methods section of this report. Data from 2016 and 2022 were compared stratum-to-stratum in Table 4-72 as well as visually in Figure 4-39.

Table 4-72. Pond 41 (Year 4 Post-Subsurface Munitions Remediation) Vegetative Strata Percentage within the Vernal Pool Basin Boundary

Stratum	Percentage	
	2016	2022
1	29%	3%
2	52%	91%
3	27%	5%
4	N/A	1%
Upland	3%	N/A

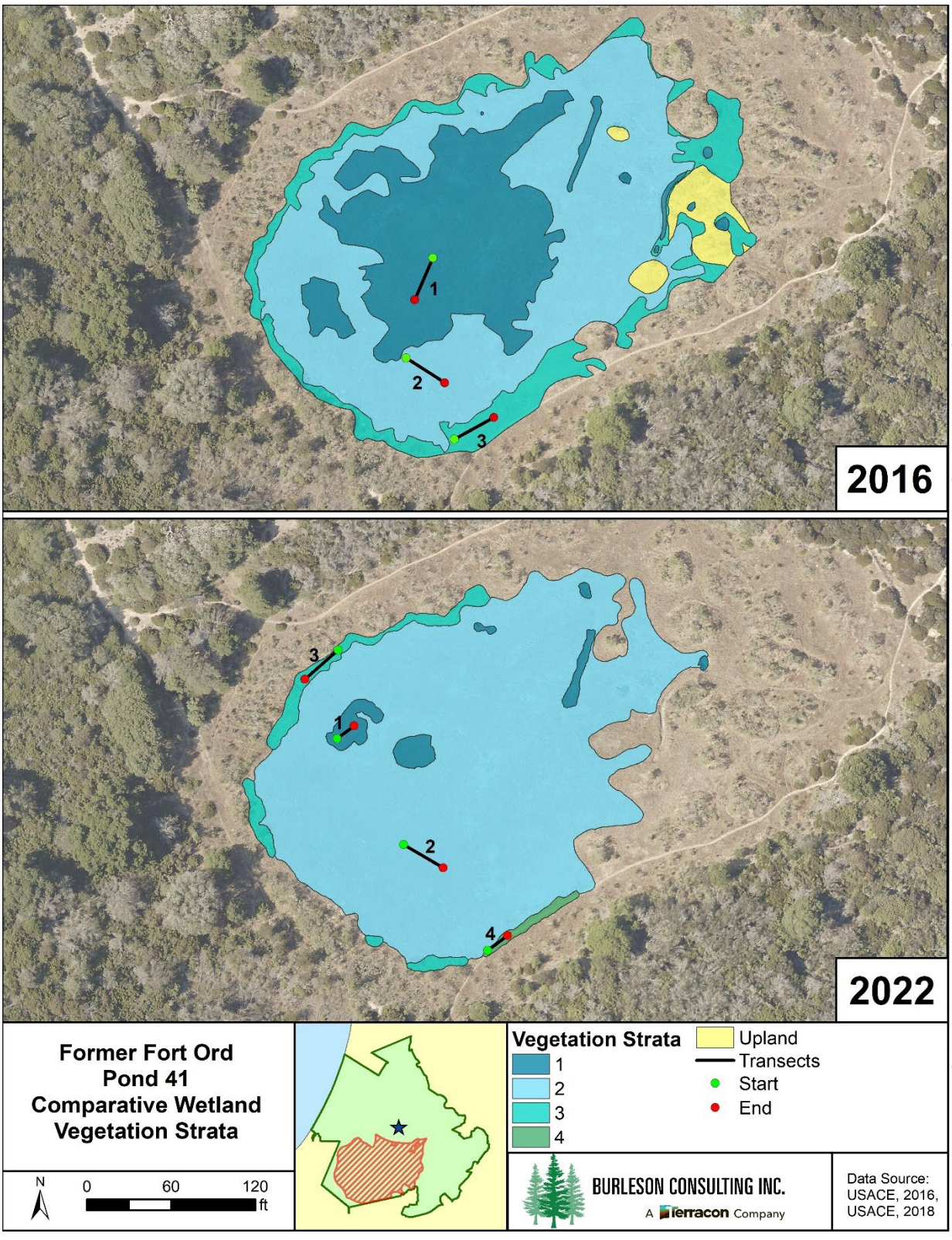

Figure 4-39. Pond 41 (Year 4 Post-Subsurface Munitions Remediation) Vegetation Strata and Transects for 2016 and 2022

The absolute percent vegetative cover observed in 2022 was less than baseline but was within the range of values observed at the reference vernal pools (see Table 4-73). Pond 41 was most similar to reference vernal pool 997 (see Table 4-74).

Table 4-73. Pond 41 (Year 4 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%

*baseline year

Table 4-74. Pond 41 (Year 4 Post-Subsurface Munitions Remediation) and Reference Vernal Pool Absolute Percent Cover in 2022

Vernal Pool	Vegetative Cover	Thatch/Bare Ground
5	41.2%	58.8%
101 East (East)	55.5%	44.5%
997	46.9%	53.1%
41	**45.3%**	**54.7%**

Species richness in 2022 was greater than the baseline year of monitoring. Species richness on transects was 16, 33, 35, 32, and 28 species in 2016, 2019, 2020, 2021, and 2022, respectively. Basin species richness was 28, 75, 60, 63, and 58 species in 2016, 2019, 2020, 2021, and 2022, respectively (see Table 4-75 and Appendix D Table D-7). Pond 41 overall species richness and transect species richness were less than the range of values observed at the reference vernal pools (see Table 4-76 and Appendix D Tables D-11 and D-22). The species richness is represented on the RACs as the length of the curve and number of species along the curve (see Figure 4-40 and Figure 4-41).

Species composition at Pond 41 was similar for the first three monitoring years, then began to vary over the last two drought years. 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 4-40 and Figure 4-41). From 2016-2021 the dominant species was either pale spikerush (*Eleocharis macrostachya*) or brown-headed rush (*Juncus phaeocephalus*). 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. By 2021, non-native cut-leaved geranium (*Geranium dissectum*) was the second-most dominant source of cover, and by 2022 it became the most dominant species. Brown-headed rush, Lemmon's canarygrass (*Phalaris lemmonii*), and alkali mallow were important subdominants in 2022. A complete comparison of species composition observed at Pond 41 in 2016 and 2019-2022 can be found in Appendix E. Figure 4-43 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." When comparing to baseline, a more even distribution of the top species occurs in baseline than 2022 (see Figure 4-42, and Appendix F). This year, 2022 has a less even slope and higher abundance of the dominant species at the top of the curve when compared to both baseline and reference vernal pools. Pond 41 in 2022 is most similar to Reference Pond 5 in the overall slope of the RAC and high concentration of species towards the tail end.

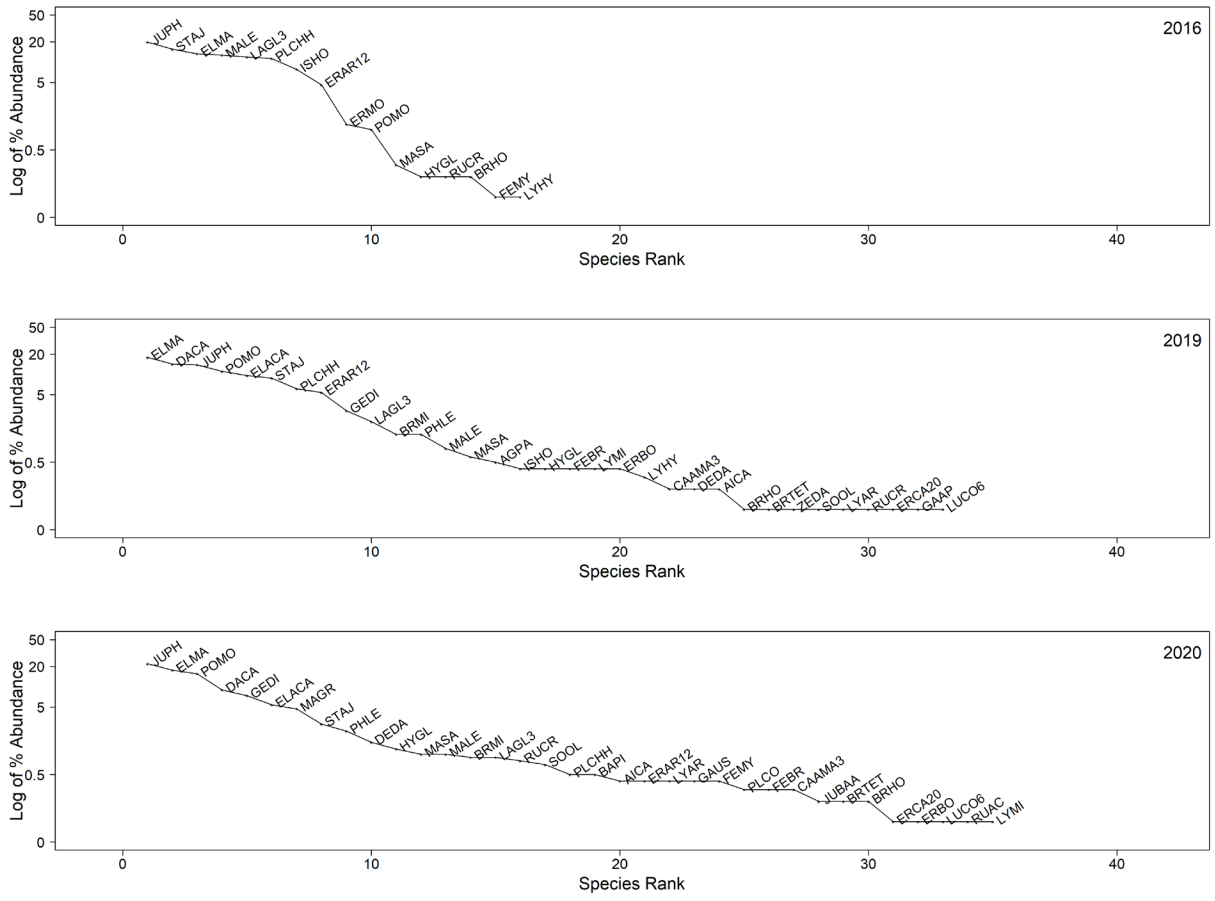

Figure 4-40. Rank Abundance Curves at Pond 41 (Year 4 Post-Subsurface Munitions Remediation) in 2016, 2019, and 2020. Note that the y-axis is in log-10 scale.

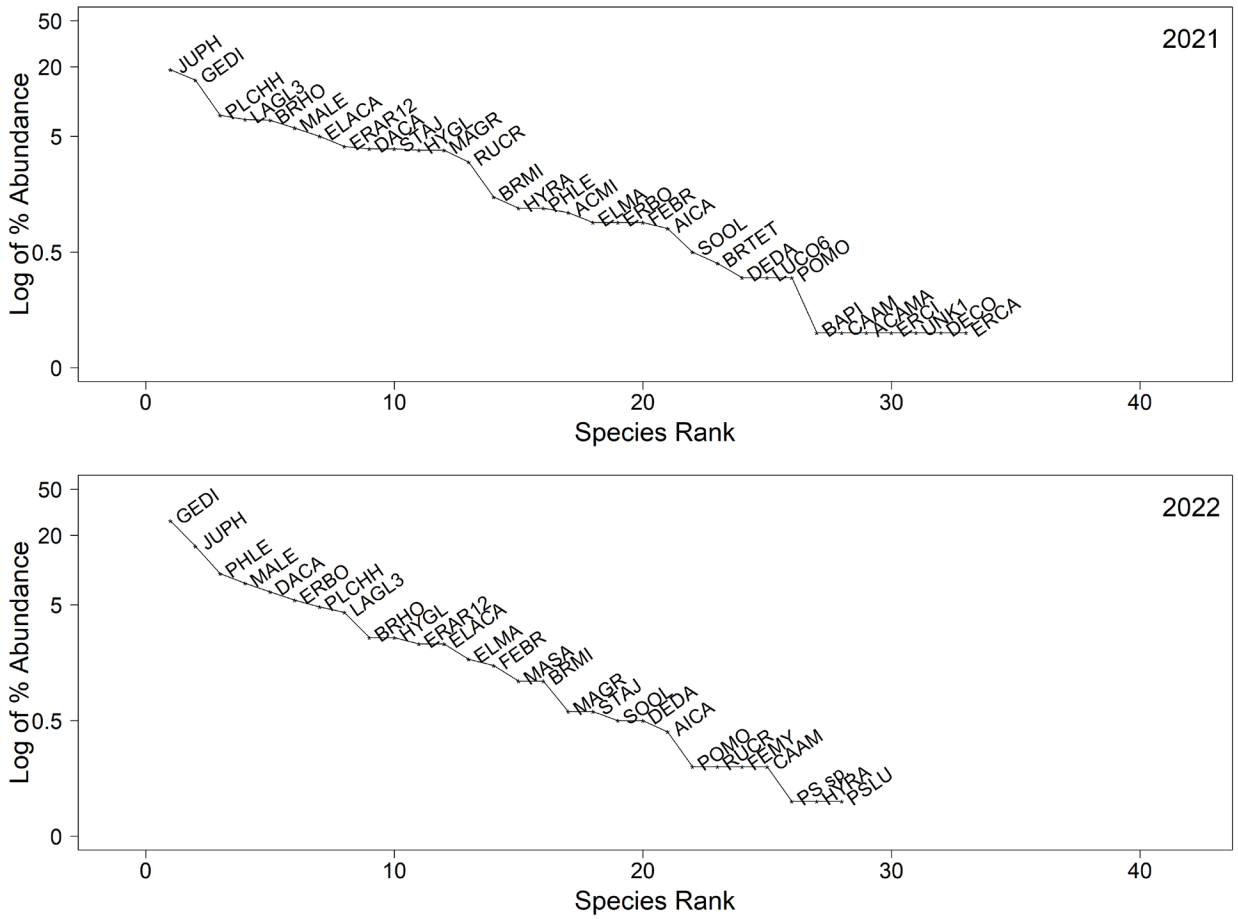

Figure 4-41. Rank Abundance Curves at Pond 41 (Year 4 Post-Subsurface Munitions Remediation) in 2021 and 2022. Note that the y-axis is in log-10 scale.

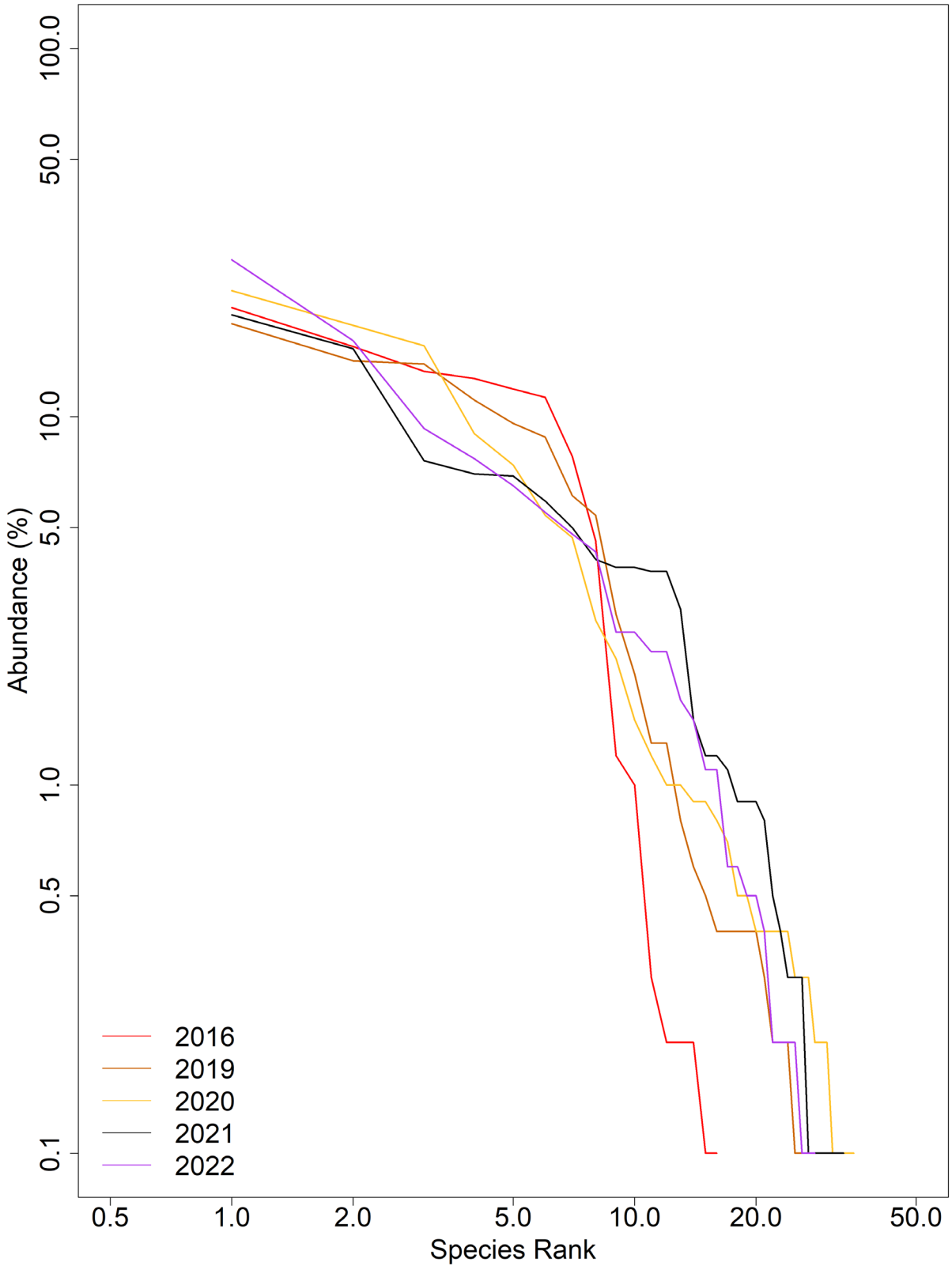

Figure 4-42. Rank Abundance Curves at Pond 41 (Year 4 Post-Subsurface Munitions Remediation) in 2016 and 2018-2022. Note that the x-axis and the y-axis are in log-10 scale

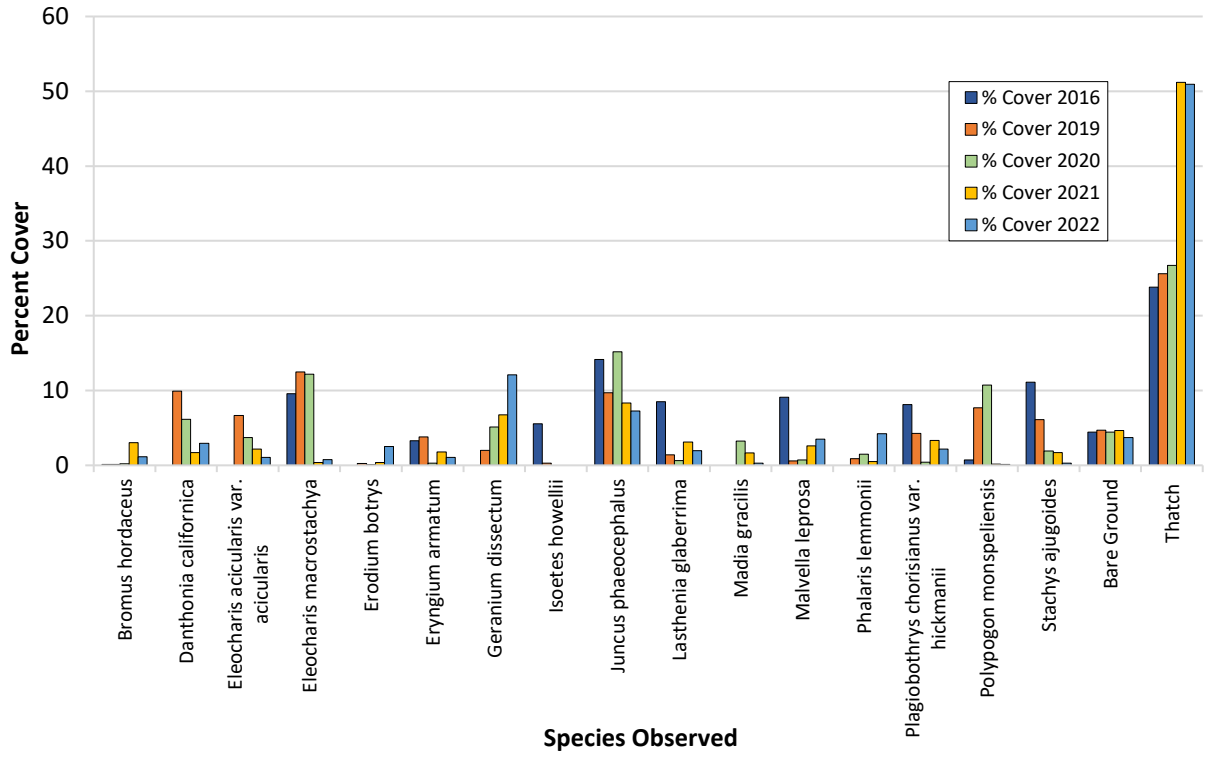

Figure 4-43. Percent Cover of Dominant Species at Pond 41 (Year 4 Post-Subsurface Munitions Remediation)

Native and non-native species richness on Pond 41 transects in 2022 were greater than baseline (see Table 4-75). 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 (see Table 4-76). The relative percent cover of native species decreased, and non-native species increased each year between 2016 and 2022 (see Table 4-77). The relative percent cover values of native and non-native species in Pond 41 were within the range of values observed in reference vernal pools and most similar to Pond 101 East (East) (see Table 4-78).

Table 4-75. Pond 41 (Year 4 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	19	12	1
2022	14	13	1

*baseline year

Table 4-76. Pond 41 (Year 4 Post-Subsurface Munitions Remediation) and Reference Vernal Pool Native and Non-Native Species Richness in 2022

Vernal Pool	Native	Non-Native	Unidentified
5	14	14	1
101 East (East)	21	16	1
997	16	18	1
41	**14**	**13**	**1**

Table 4-77. Pond 41 (Year 4 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%

*baseline year

Table 4-78. Pond 41 (Year 4 Post-Subsurface Munitions Remediation) and Reference Vernal Pool Relative Percent Cover of Native and Non-Native Plants in 2022

Vernal Pool	Native	Non-Native	Unidentified
5	73.9%	25.9%	0.3%
101 East (East)	66.4%	33.5%	0.1%
997	29.7%	69.6%	0.7%
41	**58.1%**	**41.8%**	**0.1%**

Wetland and non-wetland species richness on Pond 41 transects were greater in 2022 than baseline (see Table 4-79). Wetland and non-wetland species richness were within the range of values observed at the reference vernal pools (see Table 4-80). The relative percent cover of wetland species was less than baseline values, while non-wetland cover was greater than baseline (see Table 4-81). The wetland and non-wetland species relative percent cover values were within the ranges observed at the reference vernal pools (see Table 4-82).

Table 4-79. Pond 41 (Year 4 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	5	4	7	1	10
2022	5	7	3	6	1	6

*baseline year

Table 4-80. Pond 41 (Year 4 Post-Subsurface Munitions Remediation) and Reference Vernal Pool Wetland and Non-Wetland Species Richness in 2022

Vernal Pool	Wetland			Non-Wetland		Not Listed
	OBL	FACW	FAC	FACU	UPL	
5	4	6	2	7	1	9
101 East (East)	4	6	8	7	1	12
997	4	7	4	7	0	13
41	**5**	**7**	**3**	**6**	**1**	**6**

Table 4-81. Pond 41 (Year 4 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%	24.8%	8.7%	16.8%	0.5%	24.7%
2022	13.7%	28.8%	7.8%	16.5%	0.5%	32.6%

*baseline year

Table 4-82. Pond 41 (Year 4 Post-Subsurface Munitions Remediation) and Reference Vernal Pool Relative Percent Cover of Wetland and Non-Wetland Species in 2022

Vernal Pool	Wetland			Non-Wetland		Not Listed
	OBL	FACW	FAC	FACU	UPL	
5	28.7%	39.4%	1.6%	8.0%	1.4%	20.9%
101 East (East)	29.7%	13.8%	4.2%	29.1%	2.1%	21.1%
997	3.6%	16.0%	12.8%	29.8%	0.0%	37.8%
41	**13.7%**	**28.8%**	**7.8%**	**16.5%**	**0.5%**	**32.6%**

4.7.1.1 *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. This year was the second of 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).

Vegetative cover in Pond 41 was dominated by native and wetland plant species during year 4 post-subsurface munitions remediation monitoring in 2022. Pond 41 wetland vegetation results were generally within range of reference vernal pools, except that non-native species richness was less than reference. When compared with baseline, both native and non-native species richness had increased, as well as wetland and non-wetland species richness. The increase in native and wetland richness is not concerning. Both support a healthy vernal pool ecosystem.

4.7.1.2 *Performance Standard: Plant Cover and Species Diversity*

Pond 41, a post-subsurface munitions remediation vernal pool, was on track to meet the performance standard for year 4 in 2022. The species composition, as well as native and wetland species richness and relative abundances were similar to baseline and/or reference vernal pool conditions. Although non-native species richness increased from baseline, it was less than the range of values at reference. This vernal pool will be monitored for year 5 post-subsurface munitions remediation as specified in the Wetland Plan (Burleson, 2006).

4.7.2 Wildlife Monitoring

Wildlife data were collected at Pond 41 in 1998, 2016, 2019, and 2020 (HLA, 1998; Burleson, 2017, 2020, and 2021). California tiger salamander larvae were observed in 2016 and 2019. Fairy shrimp were detected in 1998, 2019, and 2020. 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 cannot be assessed. Table 4-83 shows historical wildlife monitoring results.

Table 4-83. Pond 41 (Year 4 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)

*baseline year

4.7.3 Conclusion

Pond 41, a post-subsurface munitions remediation vernal pool, was in year 4 of monitoring in 2022. The vernal pool was on track to meet the plant cover and species diversity performance standard (see Table 4-84). Pond 41 will continue to be monitored in the future.

Table 4-84. Success at Pond 41 (Year 4 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	N/A*	N/A*

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

4.8 Pond 42 – Year 4

Pond 42 was monitored in 2022 as a year 4 post-subsurface munitions remediation vernal pool. Vegetation in Pond 42 and within its watershed was masticated in the summer of 2018 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 4-85 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 4-44). The above-normal water-years were 1997-1998, 2016-2017, and 2018-2019. Water-years 1999-2000 and 2019-2020 were similar to the cumulative normal water-year. All other monitoring years, including this year, 2021-2022, were a below-normal water-year, drought year, or consecutive drought year.

Table 4-85. Pond 42 (Year 4 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
Hydrology	●	●	●	●	●	●	●	●	●	●	●	●
Vegetation	●	●	●	●	●		●	●	●	●	●	●
Wildlife	●	●	●	●	●			●	●	●		

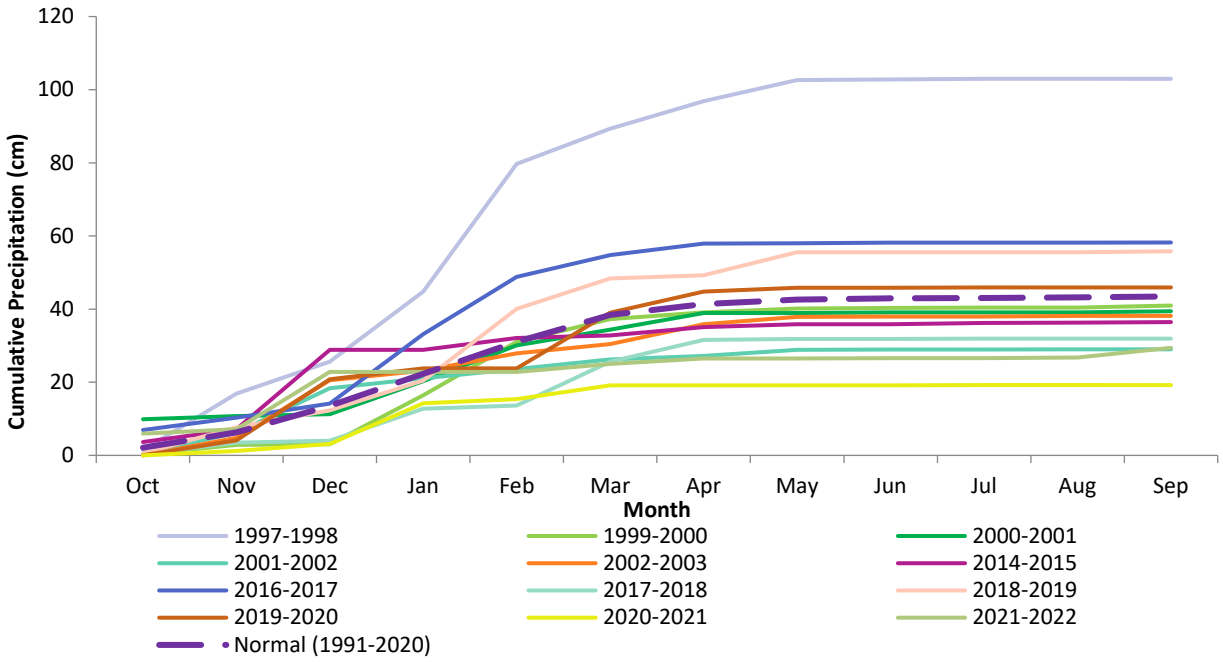

Figure 4-44. Cumulative Monthly Precipitation for Years that Hydrology Monitoring Occurred at Pond 42 (Year 4 Post-Subsurface Munitions Remediation) Compared to the 30-Year Normal (mean 1991-2020) (NPS, 2022; NCEI NOAA, 2022)

4.8.1 Vegetation Monitoring

Vegetation data were collected at Pond 42 in 1998, 2000-2003, and 2017-2022 (HLA, 1998, 2001; Harding ESE, 2002; MACTEC, 2003, 2004; Burleson, 2018, 2019, 2020, 2021, and 2022). 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 2021. From 2017-2022, data were collected using the methodology described in the Methods section of this report. Data from 2017 and 2022 were compared stratum-to-stratum in Table 4-86 as well as visually in Figure 4-45.

Table 4-86. Pond 42 (Year 4 Post-Subsurface Munitions Remediation) Vegetative Strata Percentage within the Vernal Pool Basin Boundary

Stratum	Percentage	
	2017	2022
Open Water	4%	N/A
1	8%	18%
2	9%	7%
3	52%	22%
4	10%	25%
5	N/A	12%
Upland	17%	16%

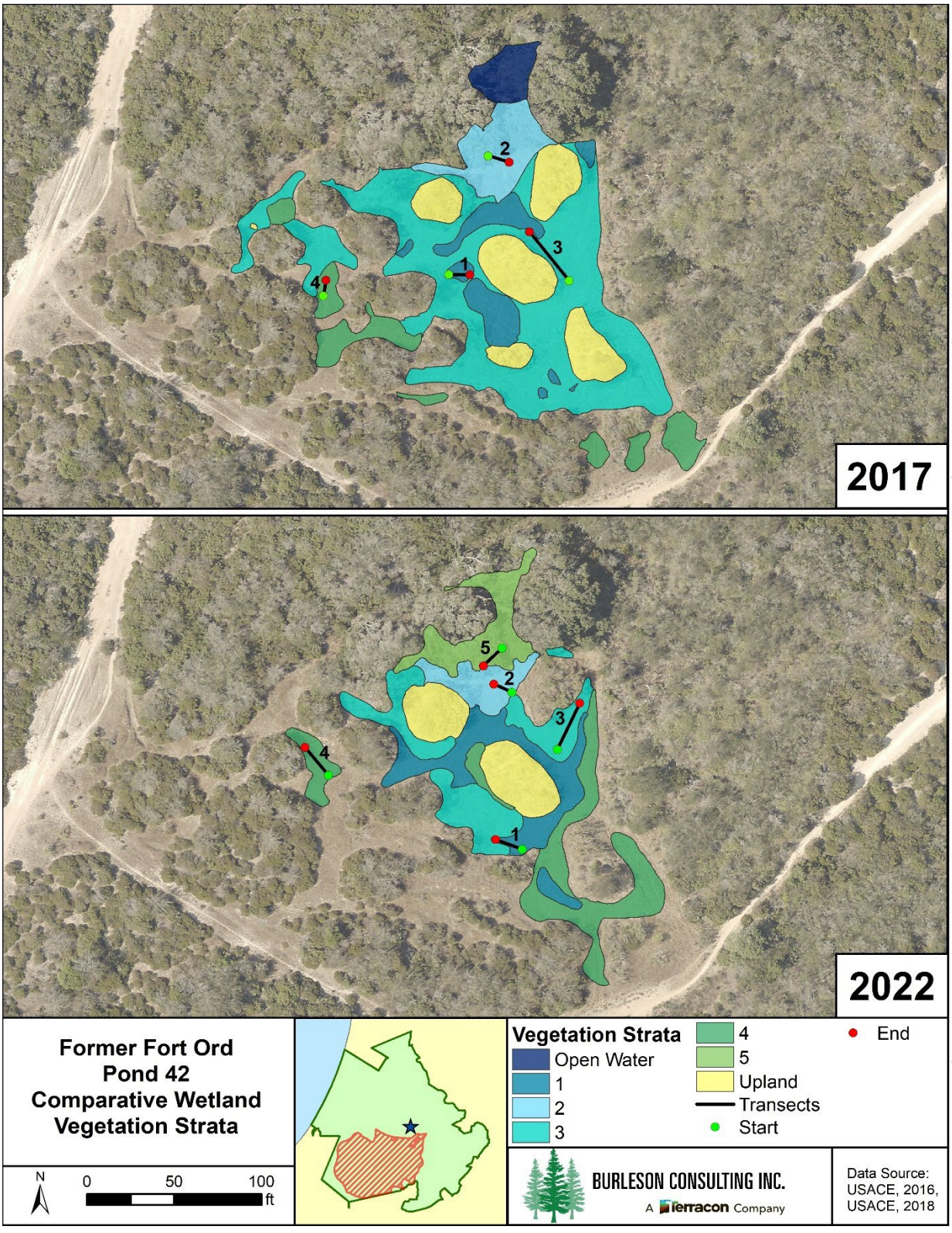

Figure 4-45. Pond 42 (Year 4 Post-Subsurface Munitions Remediation) Vegetation Strata and Transects for 2017 and 2022

Absolute percent vegetative cover in 2022 was lower and thatch/bare ground cover was higher than the 1998 and 2017 baseline years of monitoring (see Table 4-87). Vegetative cover ranged in baseline years from 61.9% in 2017 to 69.6% in 1998, whereas thatch/bare ground ranged from 33.1% in 1998 to 38.7% in 2017. The absolute percent vegetative cover of Pond 42 in 2022 was within the range of values observed at the reference vernal pools and most similar to Pond 997 (see Table 4-88).

Table 4-87. Pond 42 (Year 4 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%

*baseline year
**Values in this table changed from past reports. Two species were omitted from data during transcription of 2003 values. The edits have been reflected in the 2022 report and deliverable. Vegetative cover increased by 3.6%
†Values in this table changed from past reports. Five species were not initially entered because they were new species found in 2020 and the formulas were not added to the new species rows. The edits have been reflected in the 2022 report and deliverable. Vegetative cover increased by 0.6%

Table 4-88. Pond 42 (Year 4 Post-Subsurface Munitions Remediation) and Reference Vernal Pool Absolute Percent Cover in 2022

Vernal Pool	Vegetative Cover	Thatch/Bare Ground
5	41.2%	58.8%
101 East (East)	55.5%	44.5%
997	46.9%	53.1%
42	**45.9%**	**54.1%**

Species richness in 2022 was greater than the range of values observed in the baseline years of monitoring. Species richness on transects was 20, 32, 28, 24, 34, 14, 40, 27, 33, 37, and 41 in 1998, 2000, 2001, 2002, 2003, 2017, 2018, 2019, 2020, 2021, and 2022, respectively. Overall basin species richness values were only recorded in 2017-2022 and were 78, 126, 77, 93, 82, and 85 species, respectively (see Table 4-89 and Appendix D Table D-8). Pond 42 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 (see Table 4-90 and Appendix D Tables D-11 and D-22). The species richness is represented on the RACs as the length of the curve and number of species along the curve (see Figure 4-46 and Figure 4-47). 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 4-46 and Figure 4-47). Brown-headed rush

(*Juncus phaeocephalus*) and pale spikerush (*Eleocharis macrostachya*) were the two dominant species in 2017, whereas needle spikerush (*Eleocharis acicularis* var. *acicularis*) and coyote thistle (*Eryngium armatum*) were the dominant species in 2018 and 2019. Rabbitfoot grass (*Polypogon monspeliensis*) was another important species in 2019. In 2020, the dominant species were brown-headed rush, needle spike rush, and brass buttons (*Cotula coronopifolia*). Needle spike rush was the dominant species in 2021, 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 with moderate cover from needle spikerush, pale spikerush, and coyote thistle. A complete comparison of species composition observed during the surveys at Pond 42 in 1998, 2000-2003, and 2017-2022, can be found in Appendix E. Figure 4-49 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 2022, which is similar to baseline and most like Reference Pond 101 East (East) (see Figure 4-48, and Appendix F).

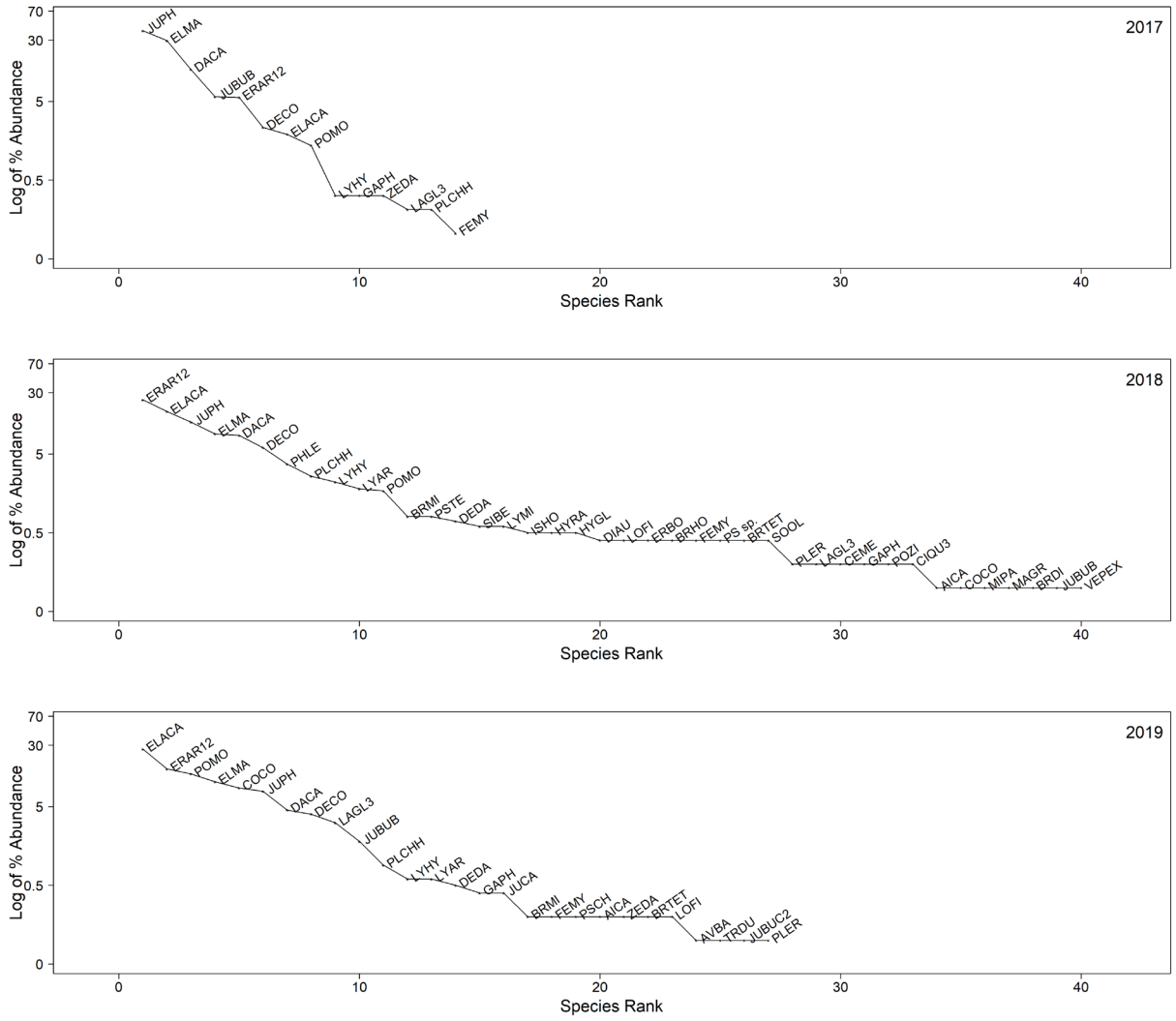

Figure 4-46. Rank Abundance Curves at Pond 42 (Year 4 Post-Subsurface Munitions Remediation) from 2017-2019. Note that the y-axis is in log-10 scale.

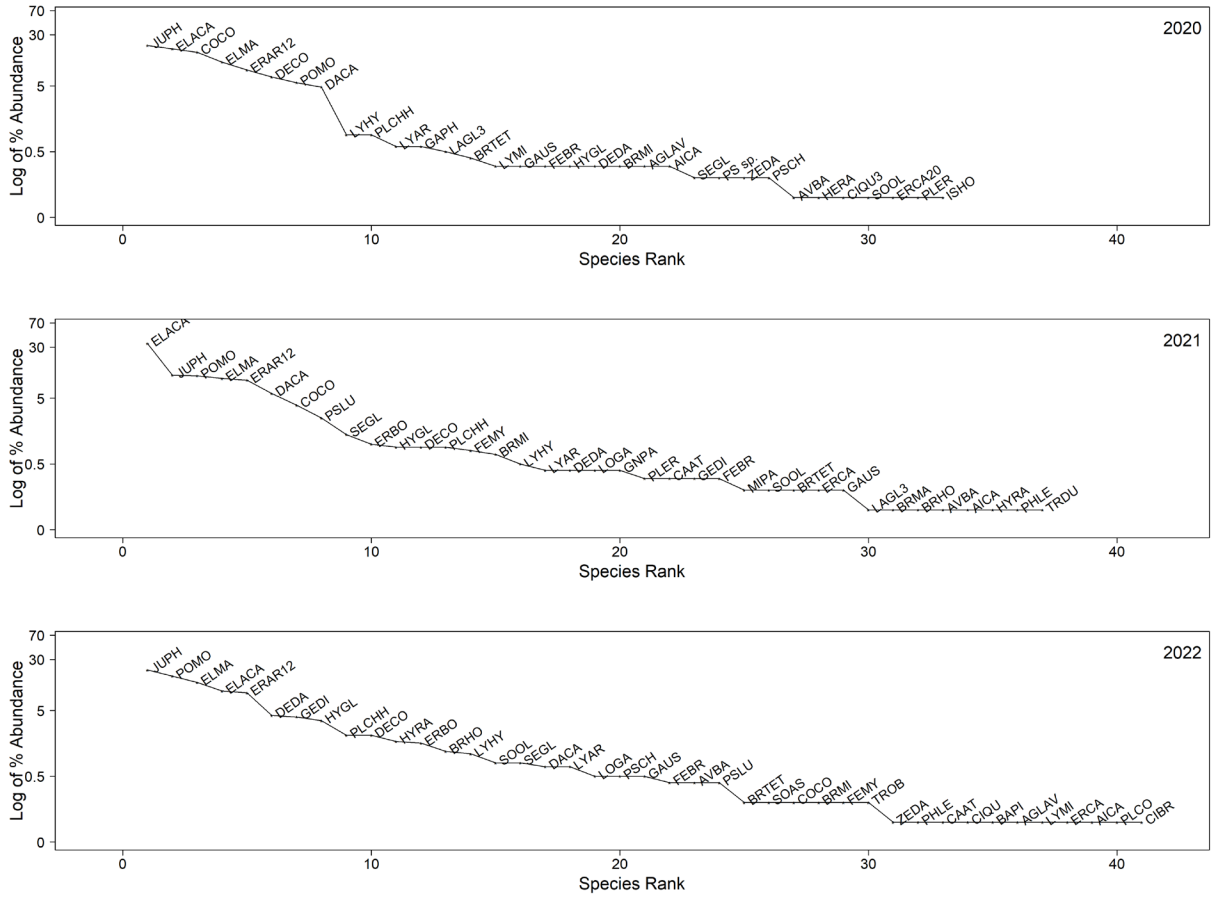

Figure 4-47. Rank Abundance Curves at Pond 42 (Year 4 Post-Subsurface Munitions Remediation) from 2020-2022. Note that the y-axis is in log-10 scale.

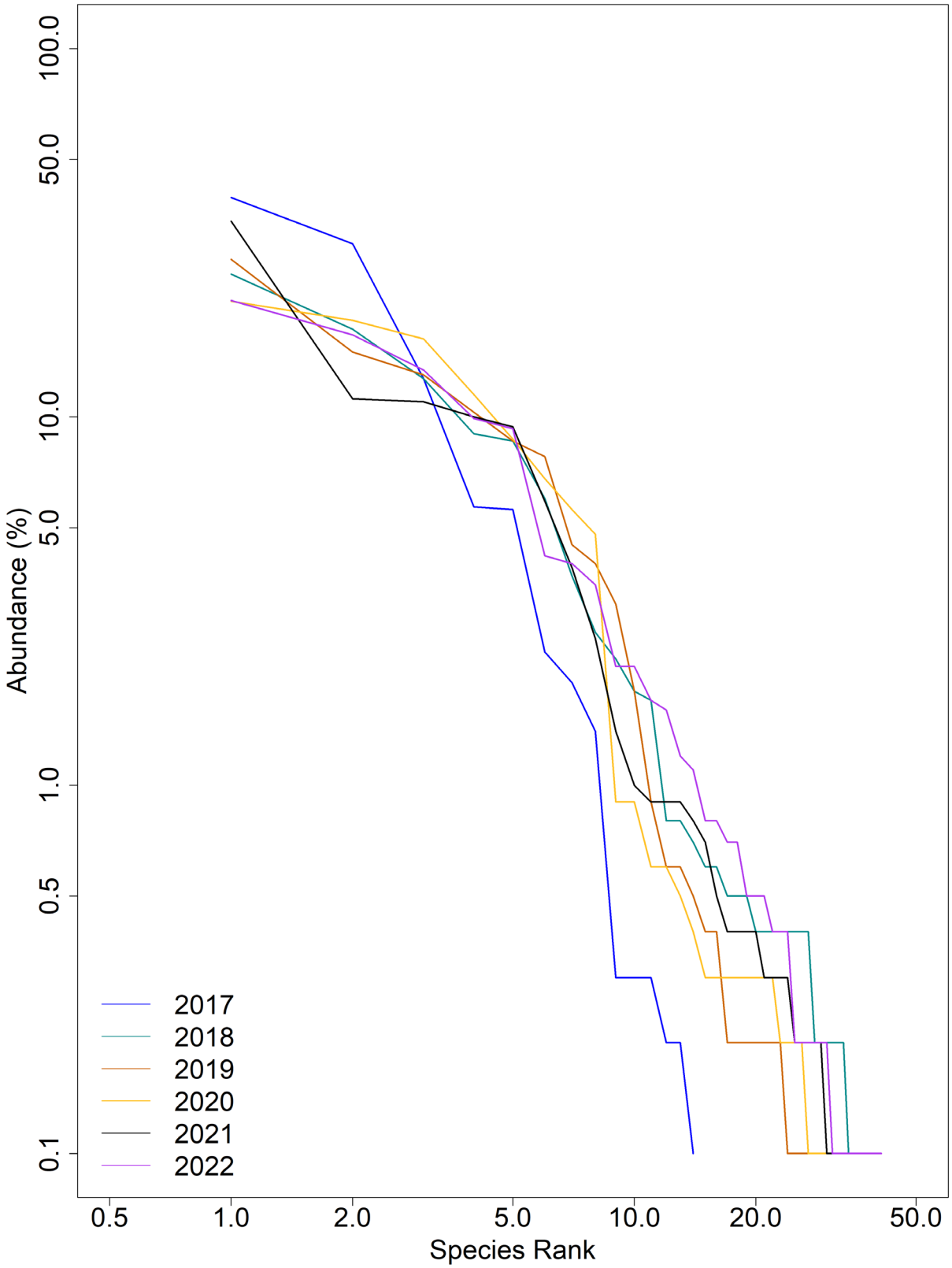

Figure 4-48. Rank Abundance Curves at Pond 42 (Year 4 Post-Subsurface Munitions Remediation) from 2017-2022. Note that the x-axis and the y-axis are in log-10 scale

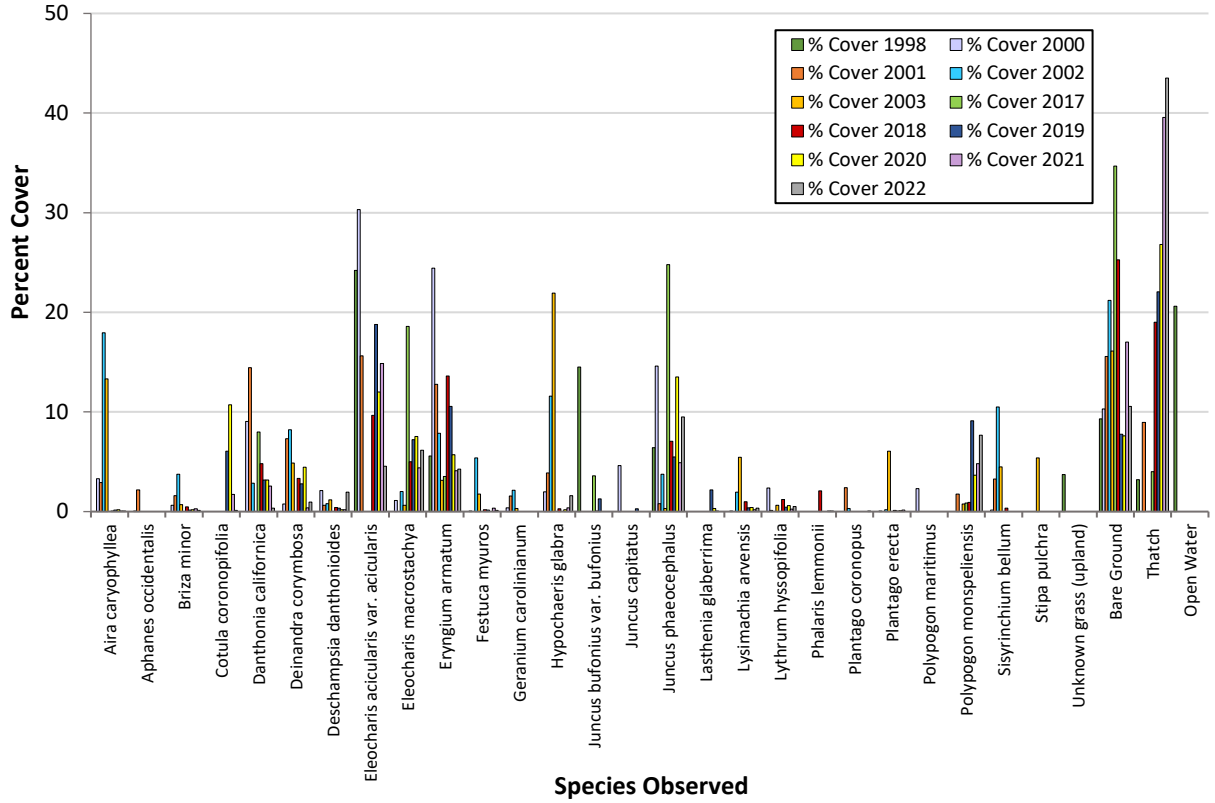

Figure 4-49. Percent Cover of Dominant Species at Pond 42 (Year 4 Post-Subsurface Munitions Remediation)

Native and non-native species richness on Pond 42 transects was greater in 2022 than baseline, whereas native species richness was within the range of values observed at the reference vernal pools and non-native species richness was greater (see Table 4-89 and Table 4-90). The relative percent cover of native species was less than baseline years and the non-native cover was greater than baseline (see Table 4-91). Pond 42 native and non-native vegetation percent cover were within the range of values observed at reference vernal pools (see Table 4-92).

Table 4-89. Pond 42 (Year 4 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

*baseline year

**Values in this table changed from past reports. Two species were omitted from data during transcription of 2003 values. The edits have been reflected in the 2022 report and deliverable. The species richness increased by 1 for native and 1 for non-native.

†Values in this table changed from past reports. Five species were not initially entered because they were new species found in 2020 and the formulas were not added to the new species rows. The edits have been reflected in the 2022 report and deliverable. The species richness increased by 2 for native, 2 for non-native, and 1 for unidentified.

Table 4-90. Pond 42 (Year 4 Post-Subsurface Munitions Remediation) and Reference Vernal Pool Native and Non-Native Species Richness in 2022

Vernal Pool	Native	Non-Native	Unidentified
5	14	14	1
101 East (East)	21	16	1
997	16	18	1
42	**20**	**21**	**0**

Table 4-91. Pond 42 (Year 4 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%

*baseline year

**Values in this table changed from past reports. Two species were omitted from data during transcription of 2003 values. The edits have been reflected in the 2022 report and deliverable. The native cover increased by 1.4% and non-native cover decreased by 1.4%

†Values in this table changed from past reports. Five species were not initially entered because they were new species found in 2020 and the formulas were not added to the new species rows. The edits have been reflected in the 2022 report and deliverable. Native cover decreased by 0.3%, non-native cover increased by 0.2%, and unidentified cover increased by 0.2%

Table 4-92. Pond 42 (Year 4 Post-Subsurface Munitions Remediation) and Reference Vernal Pool Relative Percent Cover of Native and Non-Native Plants in 2022

Vernal Pool	Native	Non-Native	Unidentified
5	73.9%	25.9%	0.3%
101 East (East)	66.4%	33.5%	0.1%
997	29.7%	69.6%	0.7%
42	**64.8%**	**35.2%**	**0.0%**

Wetland and non-wetland species richness on Pond 42 transects were greater in 2022 than the baseline years of monitoring (see Table 4-93). Wetland species richness was greater than reference vernal pools, while non-wetland species richness was within the range of values observed at the reference vernal pools (see Table 4-94). The relative percent cover of wetland species was less than the range of values observed in previous baseline years, whereas non-wetland cover was greater than baseline (see Table 4-95). 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 (see Table 4-96).

Table 4-93. Pond 42 (Year 4 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

*baseline year

**Values in this table changed from past reports. Two species were omitted from data during transcription of 2003 values. The edits have been reflected in the 2022 report and deliverable. Not listed species increased by 2.

†Values in this table changed from past reports. Five species were not initially entered because they were new species found in 2020 and the formulas were not added to the new species rows. The edits have been reflected in the 2022 report and deliverable. FACW increased by 1, FACU increased by 1 and not-listed increased by 3.

Table 4-94. Pond 42 (Year 4 Post-Subsurface Munitions Remediation) and Reference Vernal Pool Wetland and Non-Wetland Species Richness in 2022

Vernal Pool	Wetland			Non-Wetland		Not Listed
	OBL	FACW	FAC	FACU	UPL	
5	4	6	2	7	1	9
101 East (East)	4	6	8	7	1	12
997	4	7	4	7	0	13
42	**5**	**10**	**4**	**7**	**1**	**14**

Table 4-95. Pond 42 (Year 4 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%

*baseline year

**Values in this table changed from past reports. Two species were omitted from data during transcription of 2003 values. The edits have been reflected in the 2022 report and deliverable. All values except UPL changed slightly by less than 2%.

†Values in this table changed from past reports. Five species were not initially entered because they were new species found in 2020 and the formulas were not added to the new species rows. The edits have been reflected in the 2022 report and deliverable. OBL decreased by 0.5% and not-listed increased by 0.3%.

Table 4-96. Pond 42 (Year 4 Post-Subsurface Munitions Remediation) and Reference Vernal Pool Relative Percent Cover of Wetland and Non-Wetland Species in 2022

Vernal Pool	Wetland			Non-Wetland		Not Listed
	OBL	FACW	FAC	FACU	UPL	
5	28.7%	39.4%	1.6%	8.0%	1.4%	20.9%
101 East (East)	29.7%	13.8%	4.2%	29.1%	2.1%	21.1%
997	3.6%	16.0%	12.8%	29.8%	0.0%	37.8%
42	**26.8%**	**52.3%**	**1.8%**	**5.2%**	**0.8%**	**13.1%**

4.8.1.1 *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. This year was the second of 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).

Vegetative cover in Pond 42 was dominated by native and wetland plant species during year 4 post-subsurface munitions remediation monitoring. However, more non-native species than native were observed on transects. Non-native and wetland species richness on Pond 42 transects were greater in 2022 than baseline and reference. Wetland species abundance was less than baseline but greater than the range of reference vernal pools, while non-wetland abundance was greater than baseline and less than reference pools. An increase in richness of wetland species is not concerning since wetland species generally support a healthy vernal pool ecosystem. The relatively high numbers of non-native richness

was a trend observed across many vernal pools this year. This is likely related to a below-normal water-year rather than remediation, but it should be observed closely in future monitoring years.

4.8.1.2 *Performance Standard: Plant Cover and Species Diversity*

Pond 42, a post-subsurface munitions remediation vernal pool, was not on track to meet the performance standard for year 4 in 2022. The species composition, native and non-wetland richness, and native and non-native species relative abundances were similar to baseline and/or reference vernal pool conditions. However, non-native species richness was greater than the range of values observed in baseline years and the reference vernal pools. This vernal pool will be monitored for year 5 post-subsurface munitions remediation as specified in the Wetland Plan (Burleson, 2006).

4.8.2 Wildlife Monitoring

Wildlife data were collected at Pond 42 in 1998, 2000-2003, and 2018-2020 (HLA, 1998, 2001, 2002; MACTEC, 2003, 2004, Burleson, 2019, 2020, and 2021). California tiger salamander larvae were observed in 2000. Fairy shrimp were present in all years. 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 cannot be assessed. Table 4-97 shows historical wildlife monitoring results.

Table 4-97. Pond 42 (Year 4 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)

*baseline year

4.8.3 Conclusion

Pond 42, a post-subsurface munitions remediation vernal pool, was in year 4 of monitoring in 2022. The vernal pool was not on track to meet the plant cover and species diversity performance standard due to high non-native richness (see Table 4-98). Pond 42 will continue to be monitored in the future.

Table 4-98. Success at Pond 42 (Year 4 Post-Subsurface Munitions Remediation) Based on Performance Standards and Applicable Data Quality Objectives

Performance Standard	Applicable DQO	Success
Plant Cover & Species Diversity	DQO 3	Not on track
Wildlife Usage	N/A*	N/A*

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

4.9 Pond 61 – Year 4

Pond 61 was monitored in 2022 as a year 4 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 4-99 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 4-50). The 2016-2017 and 2018-2019 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 4-99. Pond 61 (Year 4 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
Hydrology	●	●	●	●	●	●
Vegetation	●	●	●	●	●	●
Wildlife	●		●	●	●	

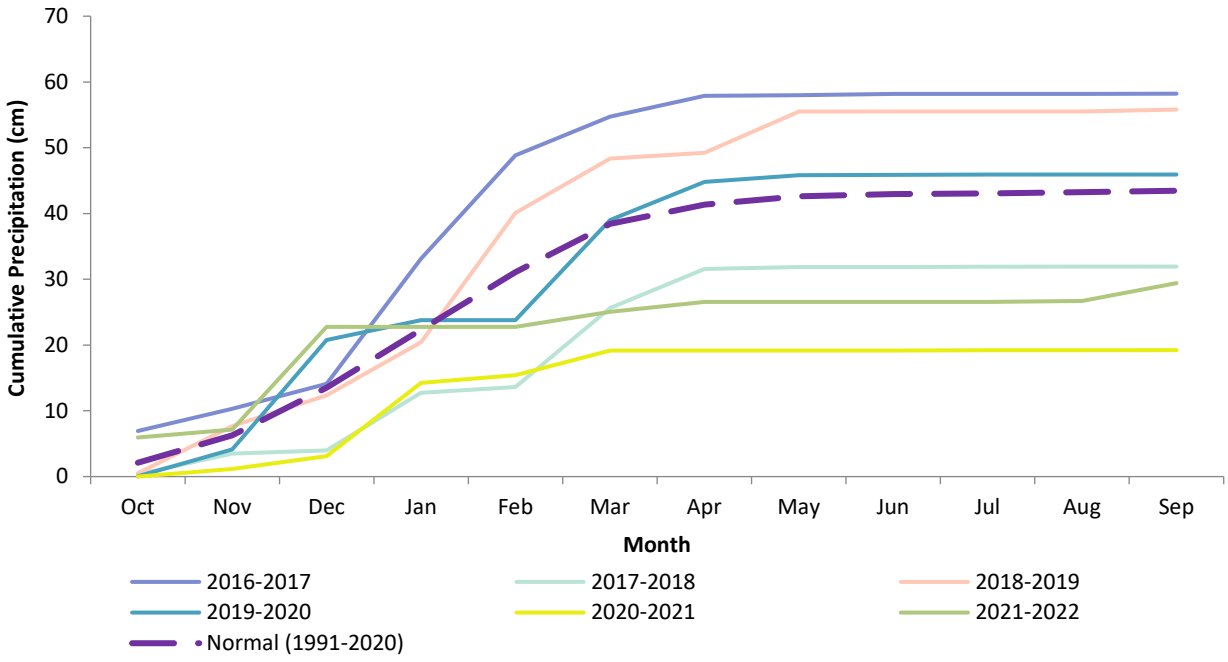

Figure 4-50. Cumulative Monthly Precipitation for Years that Hydrology Monitoring Occurred at Pond 61 (Year 4 Post-Subsurface Munitions Remediation) Compared to the 30-Year Normal (mean 1991-2020) (NPS, 2022; NCEI NOAA, 2022)

4.9.1 Vegetation Monitoring

Vegetation data were collected at Pond 61 from 2017-2022 (Burleson, 2018, 2019, 2020, 2021, and 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 2022 were compared stratum-to-stratum in Table 4-100 as well as visually in Figure 4-51**.**

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 2022 to compare to 2017-2021 (see Figure 3-12 in Section 3.9.1.1).

Table 4-100. Pond 61 (Year 4 Post-Subsurface Munitions Remediation) Vegetative Strata Percentage within the Vernal Pool Basin Boundary

Stratum	Percentage	
	2017	2022
1	1%	N/A
2 (CCG)	5%	6%
3	7%	4%
4	54%	57%
Upland	33%	33%

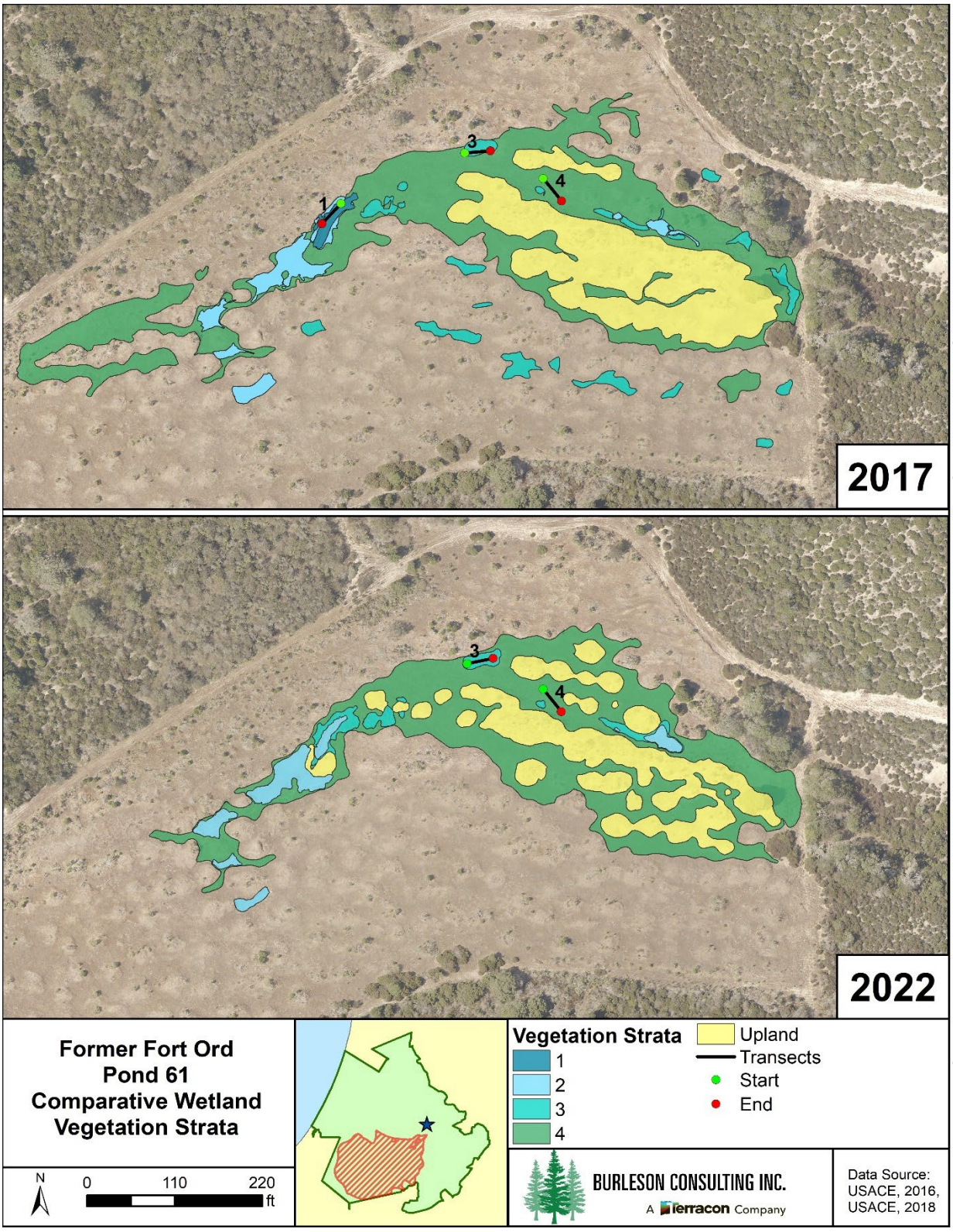

Figure 4-51. Pond 61 (Year 4 Post-Subsurface Munitions Remediation) Vegetation Strata and Transects for 2017 and 2022

The absolute percent vegetative cover observed in 2022 was less than baseline (see Table 4-101). Pond 61 vegetative cover was greater than the range of values observed at the reference vernal pools and was most similar to Pond 101 East (East) (see Table 4-102).

Table 4-101. Pond 61 (Year 4 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%

*baseline year

**Values in this table changed from past reports. In 2019, *Madia sp*. was split into two species after identification was confirmed later in the season; however. *Madia sp*. was not removed from the data after the identification occurred. The edits have been reflected in the 2022 report and deliverable. Vegetative cover decreased by 1.7%

Table 4-102. Pond 61 (Year 4 Post-Subsurface Munitions Remediation) and Reference Vernal Pool Absolute Percent Cover in 2022

Vernal Pool	Vegetative Cover	Thatch/Bare Ground
5	41.2%	58.8%
101 East (East)	55.5%	44.5%
997	46.9%	53.1%
61	**64.8%**	**35.3%**

Species richness on transects in 2022 was greater than the baseline year; however, the overall basin species richness was less than baseline. Species richness on transects was 23, 41, 46, 36, 34, and 32 species in 2017, 2018, 2019, 2020, 2021, and 2022, respectively, whereas overall basin species richness was 100, 100, 119, 98, 97, and 94 species, respectively (see Table 4-103 and Appendix D Table D-9). Pond 61 species richness on transects was within the range of values observed at the reference vernal pools, whereas richness for the entire basin was greater than reference (see Table 4-104 and Appendix D Tables D-11 and D-22). The species richness is represented on the RACs as the length of the curve and number of species along the curve (see Figure 4-52 and Figure 4-53).

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 4-52 and Figure 4-53). The dominant species in 2017 and 2018 were brown-headed rush (*Juncus phaeocephalus*) and pale spikerush (*Eleocharis macrostachya*), and Hickman's popcornflower (*Plagiobothrys chorisianus* var. *hickmanii*), respectively. In 2019, the dominant species was again brown-headed rush. By 2020 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. Rattlesnake grass remained a dominant species in 2022, along with the largest recorded cover of Hickman's popcornflower. A complete comparison of species composition observed during the surveys at Pond 61 from 2017-2022 can be found in Appendix E. Figure 4-55 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.” A more even distribution of the top species occurs in 2022, which is similar to baseline and most like Reference Pond 101 East (East) (see Figure 4-54, and Appendix F).

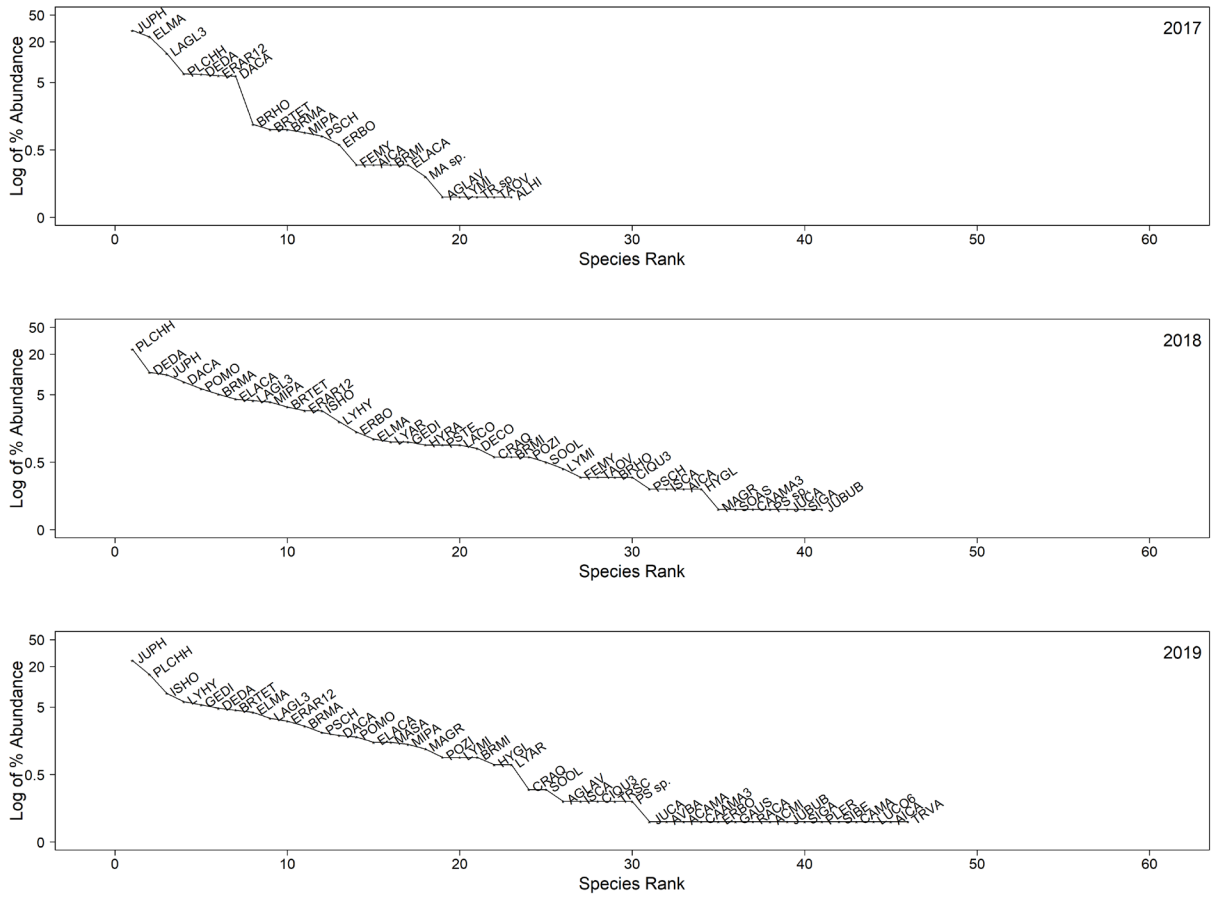

Figure 4-52. Rank Abundance Curves at Pond 61 (Year 4 Post-Subsurface Munitions Remediation) from 2017-2019. Note that the y-axis is in log-10 scale.

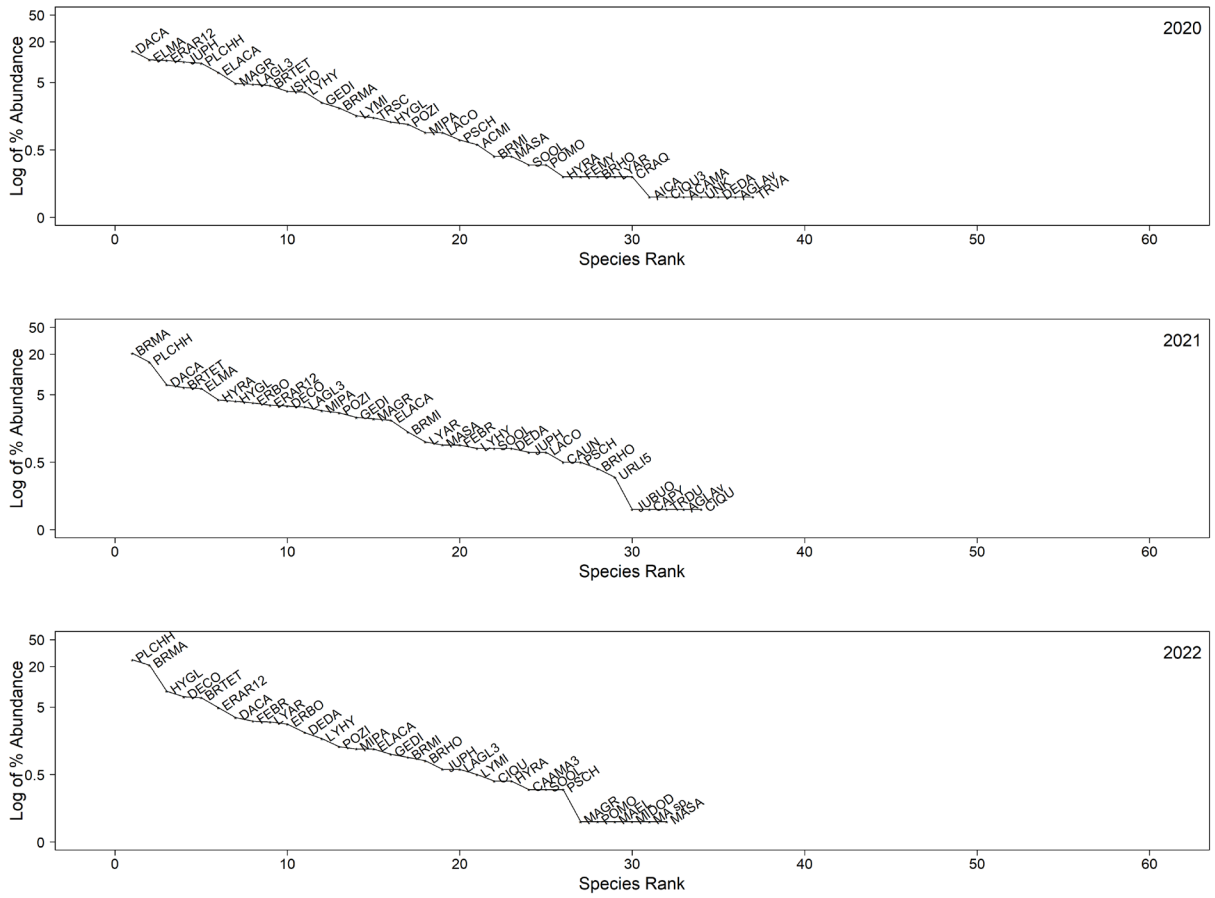

Figure 4-53. Rank Abundance Curves at Pond 61 (Year 4 Post-Subsurface Munitions Remediation) from 2020-2022. Note that the y-axis is in log-10 scale.

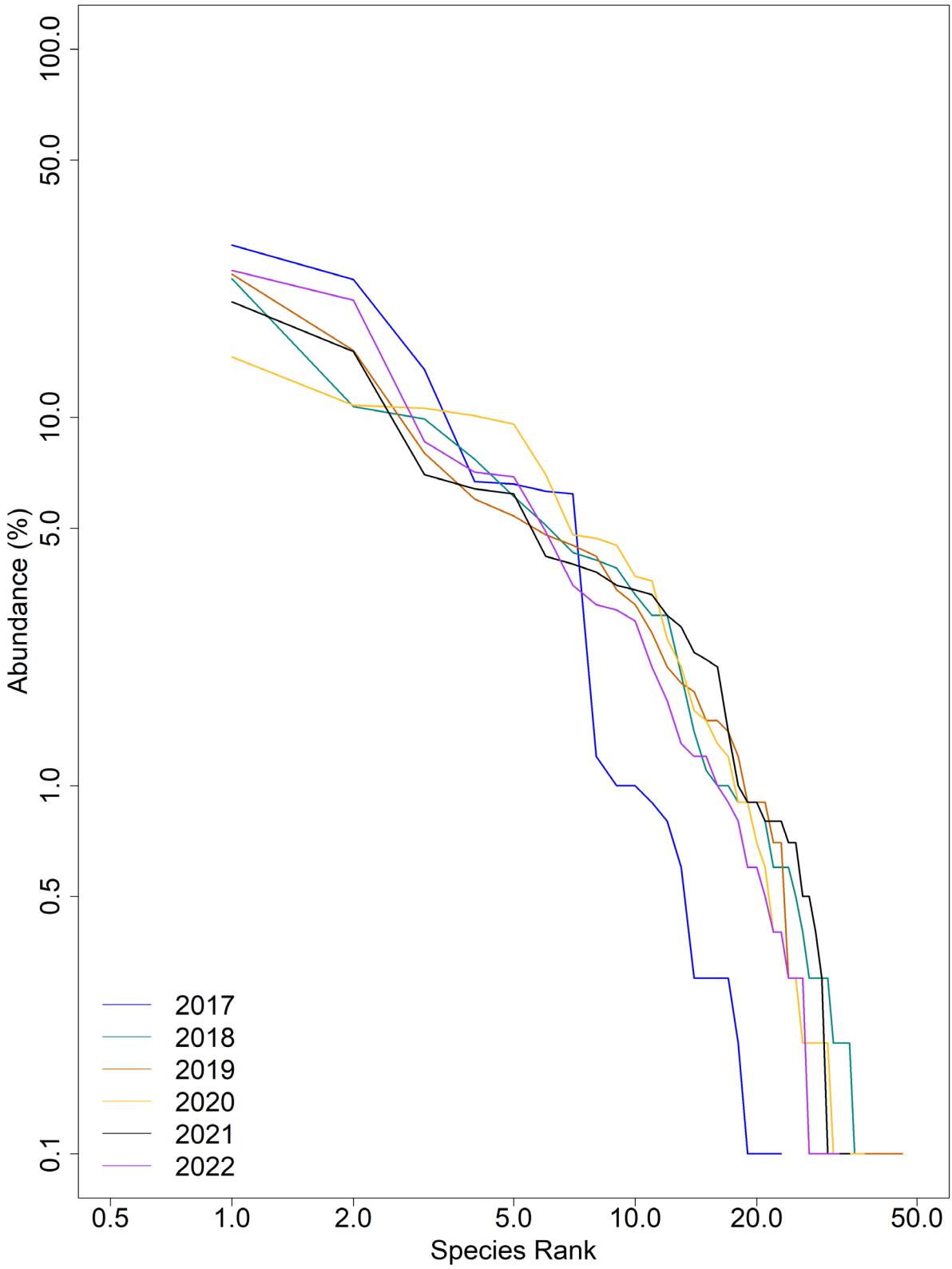

Figure 4-54. Rank Abundance Curves at Pond 61 (Year 4 Post-Subsurface Munitions Remediation) from 2017-2022. Note that the x-axis and the y-axis are in log-10 scale.

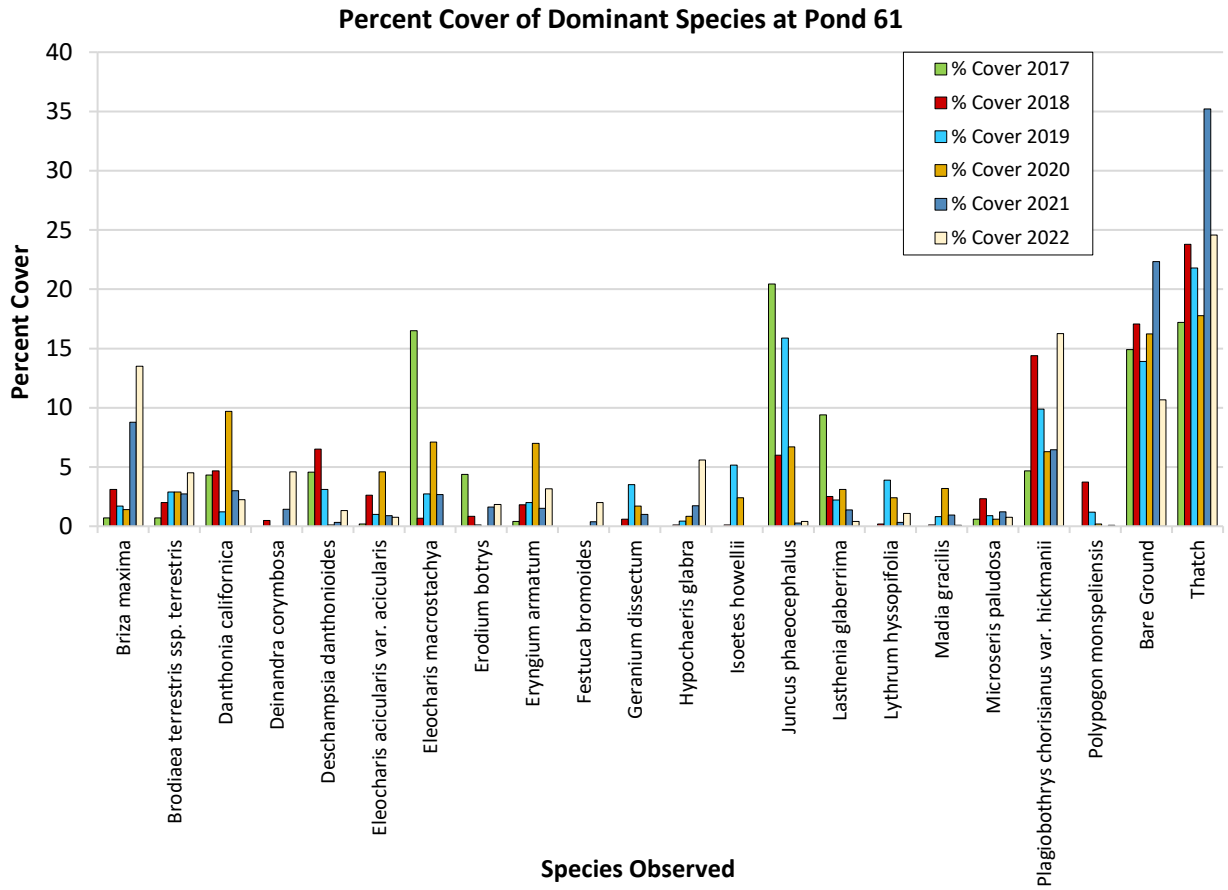

Figure 4-55. Percent Cover of Dominant Species at Pond 61 (Year 4 Post-Subsurface Munitions Remediation)

Native and non-native species richness on Pond 61 transects was greater in 2022 than baseline (see Table 4-103). Native species richness was within the range of values observed at reference vernal pools, whereas non-native species richness was less than reference values (see Table 4-104). The relative percent cover of native species was less, and non-native species cover was greater than the baseline values (see Table 4-105). Pond 61 native and non-native relative percent cover were within the range of values observed at the reference vernal pools (Table 4-106).

Table 4-103. Pond 61 (Year 4 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

*baseline year

**Values in this table changed from past reports. In 2019, *Madia sp*. was split into two species after identification was confirmed later in the season, however *Madia sp*. was not removed from the data after the identification occurred. The edits have been reflected in the 2022 report and deliverable. Unidentified species decreased by 1.

Table 4-104. Pond 61 (Year 4 Post-Subsurface Munitions Remediation) and Reference Vernal Pool Native and Non-Native Species Richness in 2022

Vernal Pool	Native	Non-Native	Unidentified
5	14	14	1
101 East (East)	21	16	1
997	16	18	1
61	**19**	**12**	**1**

Table 4-105. Pond 61 (Year 4 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%

*baseline year

**Values in this table changed from past reports. In 2019, *Madia sp*. was split into two species after identification was confirmed later in the season, however *Madia sp*. was not removed from the data after the identification occurred. The edits have been reflected in the 2022 report and deliverable. Native species cover increased by 2.1%, non-native cover increased by 0.5%, unidentified cover decreased by 0.2%.

Table 4-106. Pond 61 (Year 4 Post-Subsurface Munitions Remediation) and Reference Vernal Pool Relative Percent Cover of Native and Non-Native Plants in 2022

Vernal Pool	Native	Non-Native	Unidentified
5	73.9%	25.9%	0.3%
101 East (East)	66.4%	33.5%	0.1%
997	29.7%	69.6%	0.7%
61	**56.4%**	**43.5%**	**0.1%**

Wetland species richness on Pond 61 transects was greater in 2022 than the baseline year and within the range of values at reference vernal pools, whereas non-wetland species richness was less than both (see Table 4-107 and Table 4-108). The relative percent cover of wetland species, however, was dramatically lower than in the baseline year while non-wetland cover was only slightly less (see Table 4-109). Wetland relative percent cover was within the range of values observed at reference vernal pools, while non-wetland relative percent cover was less than reference pool values (see Table 4-110).

Table 4-107. Pond 61 (Year 4 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	3	1	12
2022	5	8	3	3	1	12

*baseline year

**Values in this table changed from past reports. In 2019, *Madia sp*. was split into two species after identification was completed later in the season, however *Madia sp*. was not removed from the data after the identification occurred. The edits have been reflected in the 2022 report and deliverable. Not listed species decreased by 1.

Table 4-108. Pond 61 (Year 4 Post-Subsurface Munitions Remediation) and Reference Vernal Pool Wetland and Non-Wetland Species Richness in 2022

Vernal Pool	Wetland			Non-Wetland		Not Listed
	OBL	FACW	FAC	FACU	UPL	
5	4	6	2	7	1	9
101 East (East)	4	6	8	7	1	12
997	4	7	4	7	0	13
61	**5**	**8**	**3**	**3**	**1**	**12**

Table 4-109. Pond 61 (Year 4 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%	8.3%	0.8%	44.1%
2022	29.9%	9.1%	7.3%	4.0%	0.3%	49.4%

*baseline year

**Values in this table changed from past reports. In 2019, *Madia sp*. was split into two species after identification was completed later in the season, however *Madia sp*. was not removed from the data after the identification occurred. The edits have been reflected in the 2022 report and deliverable. All values changed slightly by less than 2.1%.

Table 4-110. Pond 61 (Year 4 Post-Subsurface Munitions Remediation) and Reference Vernal Pool Relative Percent Cover of Wetland and Non-Wetland Species in 2022

Vernal Pool	Wetland			Non-Wetland		Not Listed
	OBL	FACW	FAC	FACU	UPL	
5	28.7%	39.4%	1.6%	8.0%	1.4%	20.9%
101 East (East)	29.7%	13.8%	4.2%	29.1%	2.1%	21.1%
997	3.6%	16.0%	12.8%	29.8%	0.0%	37.8%
61	**29.9%**	**9.1%**	**7.3%**	**4.0%**	**0.3%**	**49.4%**

4.9.1.1 *Contra Costa Goldfields*

The area of CCG at Pond 61 has fluctuated from year to year but by 2022, the total CCG area was the same as baseline at 0.14 acres (Burleson, 2018, 2019, 2020, 2021, 2022, and 2023) (see Table 4-111 and Figure 4-56). The density also varied, from 10-65% in baseline to the highest overall density, 35-80%, in 2022. In 1999, 2000, 2002, and 2017-2021 the CCG population was in similar locations as 2022 and within the range of 0.09-0.15 acre (HLA, 2000, 2001; MACTEC, 2003; Burleson, 2018, 2019, 2020, 2021, 2022, and 2023). Results suggest that mastication activities in 2017 and post-subsurface munitions remediation in 2019 did not affect the population. Minor changes in population size can be attributed to natural fluctuation.

Table 4-111. Pond 61 (Year 4 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%

*baseline year

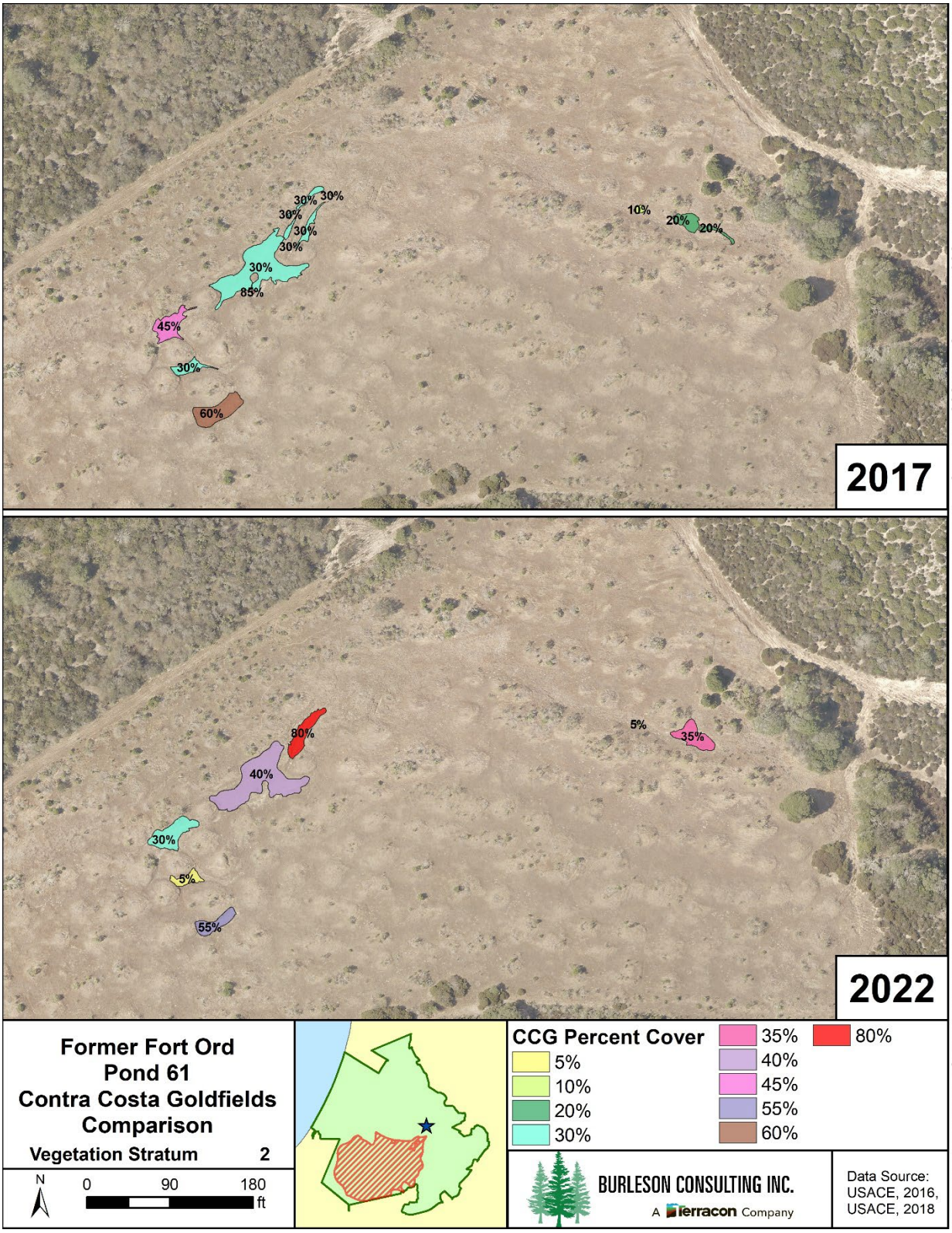

Figure 4-56. Contra Costa Goldfields Populations at Pond 61 (Year 4 Post-Subsurface Munitions Remediation) in 2017 and 2022

4.9.1.2 *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 the second of 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).

Vegetative cover in Pond 61 was dominated by native and wetland plant species during year 4 post-subsurface munitions remediation monitoring in 2022. Pond 61 wetland vegetation results were generally within the range of baseline and/or reference vernal pools with a few favorable exceptions. Non-wetland richness and relative percent cover were less than baseline and reference values. Additionally, non-native richness was less than reference values, although greater than baseline. The relative low values for non-wetland richness and abundance are not concerning. These results generally support a healthy vernal pool ecosystem.

4.9.1.3 *Performance Standard: Plant Cover and Species Diversity*

Pond 61, a post-subsurface munitions remediation vernal pool, was on track to meet the performance standard for year 4. The species composition, and native and wetland species richness were similar to baseline and/or reference vernal pool conditions. This vernal pool will be monitored for year 5 post-subsurface munitions remediation as specified in the Wetland Plan (Burleson, 2006).

4.9.2 Wildlife Monitoring

Wildlife data were collected at Pond 61 in 2017, 2019, 2020, and 2021 (Burleson, 2018, 2020, and 2021). 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. Therefore, DQO 5 and the applicable wildlife usage performance standard cannot be assessed. Table 4-112 shows historical wildlife monitoring results.

Table 4-112. Pond 61 (Year 4 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

4.9.3 Conclusion

Pond 61, a post-subsurface munitions remediation vernal pool, was in year 4 of monitoring in 2022. The vernal pool was on track to meet the plant cover and species diversity performance standard (see Table 4-113). Pond 61 will continue to be monitored in the future.

Table 4-113. Success at Pond 61 (Year 4 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	N/A*	N/A*

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

4.10 Pond 75 – Baseline

Pond 75 was surveyed for an additional year of baseline data in 2022. Table 4-114 summarizes the years that monitoring occurred and surveys conducted. The cumulative precipitation graph shows below-normal precipitation for the 2020-2021 and 2021-2022 water-years compared to the 30-year normal (see Figure 4-57).

Table 4-114. Pond 75 (Baseline) Summary of Historic Surveys for Hydrology, Vegetation, and Wildlife

Survey	Water-Year	
	2020-2021	2021-2022
Hydrology	●	●
Vegetation	●	●
Wildlife		

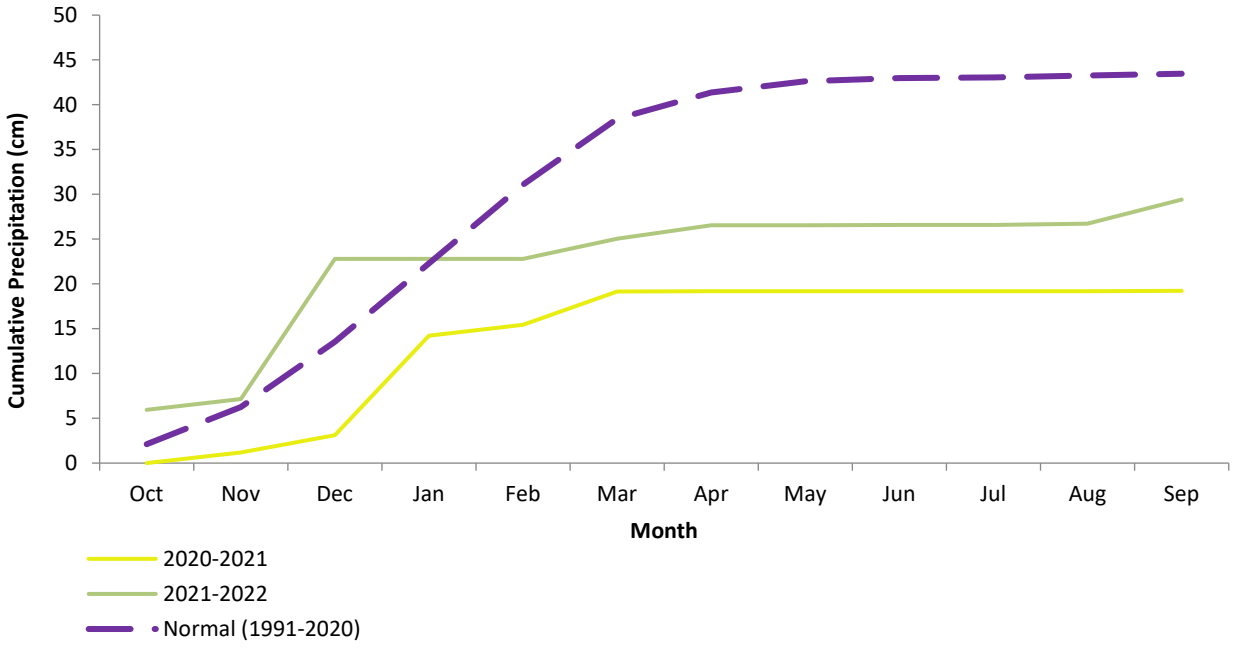

Figure 4-57. Cumulative Monthly Precipitation for Years that Hydrology Monitoring Occurred at Pond 75 (Baseline) Compared to the 30-Year Normal (mean 1991-2020) (NPS, 2021; NCEI NOAA, 2022)

4.10.1 Vegetation Monitoring

Baseline vegetation data were collected at Pond 75 in 2021 and 2022 (Burleson 2022). Data were collected using the methodology described in the Methods section of the report. Data from 2021 and 2022 were compared stratum-to-stratum in Table 4-115 as well as visually in Figure 4-58.

Table 4-115. Pond 75 (Baseline) Vegetative Strata Percentage within the Vernal Pool Basin Boundary

Stratum	Percentage	
	2021	2022
1	25%	16%
2	65%	67%
3	7%	5%
4	4%	12%

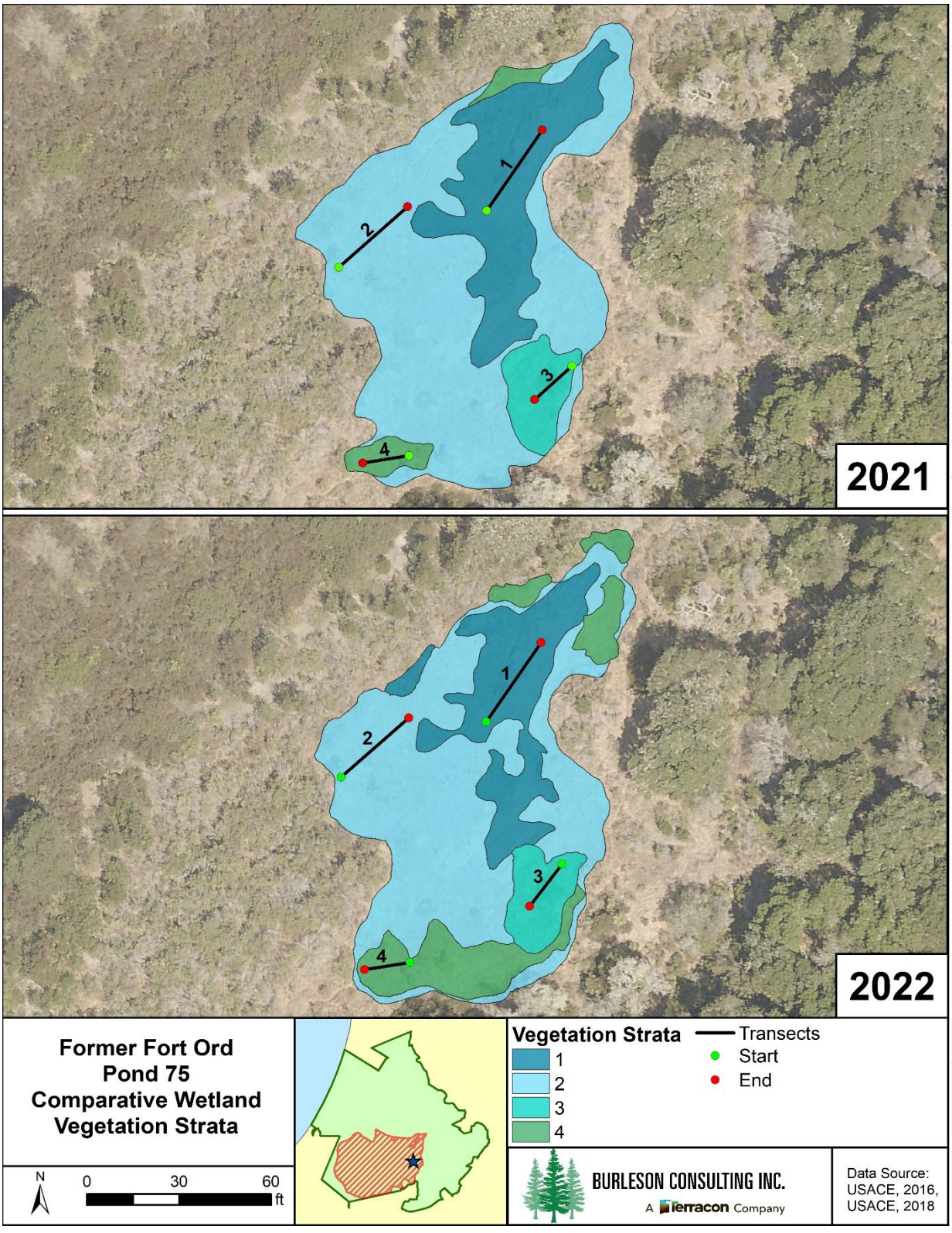

Figure 4-58. Pond 75 (Baseline) Vegetation Strata and Transects for 2021 and 2022

The absolute percent vegetative cover was 48.7% and 47.9% in 2021 and 2022, respectively (see Table 4-116). Pond 75 vegetative cover was within the range of values observed at the reference vernal pools and was similar to reference vernal pool 997, which had 46.9% vegetative cover (see Table 4-117).

Table 4-116. Pond 75 (Baseline) Absolute Percent Cover

Year	Vegetative Cover	Thatch/Bare Ground
2021*	48.7%	51.4%
2022*	47.9%	52.1%

*baseline year

Table 4-117. Pond 75 (Baseline) and Reference Vernal Pool Absolute Percent Cover in 2022

Vernal Pool	Vegetative Cover	Thatch/Bare Ground
5	41.2%	58.8%
101 East (East)	55.5%	44.5%
997	46.9%	53.1%
75	**47.9%**	**52.1%**

Species richness on transects was 16 and 15 species in 2021 and 2022, respectively, whereas overall basin species richness was 35 and 43 species in 2021 and 2022, respectively (see Table 4-118 and Appendix D Table D-10). Pond 75 species richness was less than the values observed at the reference vernal pools (see Table 4-119 and Appendix D Tables D-11 and D-22). The species richness is represented on the RACs as the length of the curve and number of species along the curve (see Figure 4-59).

Species composition at Pond 75 was similar between the two 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 4-59). Beardless wild rye (*Elymus triticoides*) and pale spikerush (*Eleocharis macrostachya*) were the most dominant species both years, although beardless wild rye was more dominant in 2022 than 2021. Brown-headed rush (*Juncus phaeocephalus*), and western goldenrod (*Euthamia occidentalis*) were also important species in both years. Milk thistle (*Silybum marianum*) and cut-leaved geranium (*Geranium dissectum*) were more prominent species in 2022, each comprising approximately 3% more cover than in the previous year of baseline monitoring. A complete comparison of species composition observed at Pond 75 can be found in Appendix E. Figure 4-61 shows a subset of this comparison for species observed with a 2% cover or greater.

The evenness from both years is represented by the slope of the RACs. The evenness is fairly similar from between 2021 and 2022 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 2021 to 2022, a more even distribution of the top species occurs in 2021 at Pond 75 (see Figure 4-60 and Appendix F). Whereas, 2022 has a less even slope and higher abundance of the dominant species at the top of the curve.

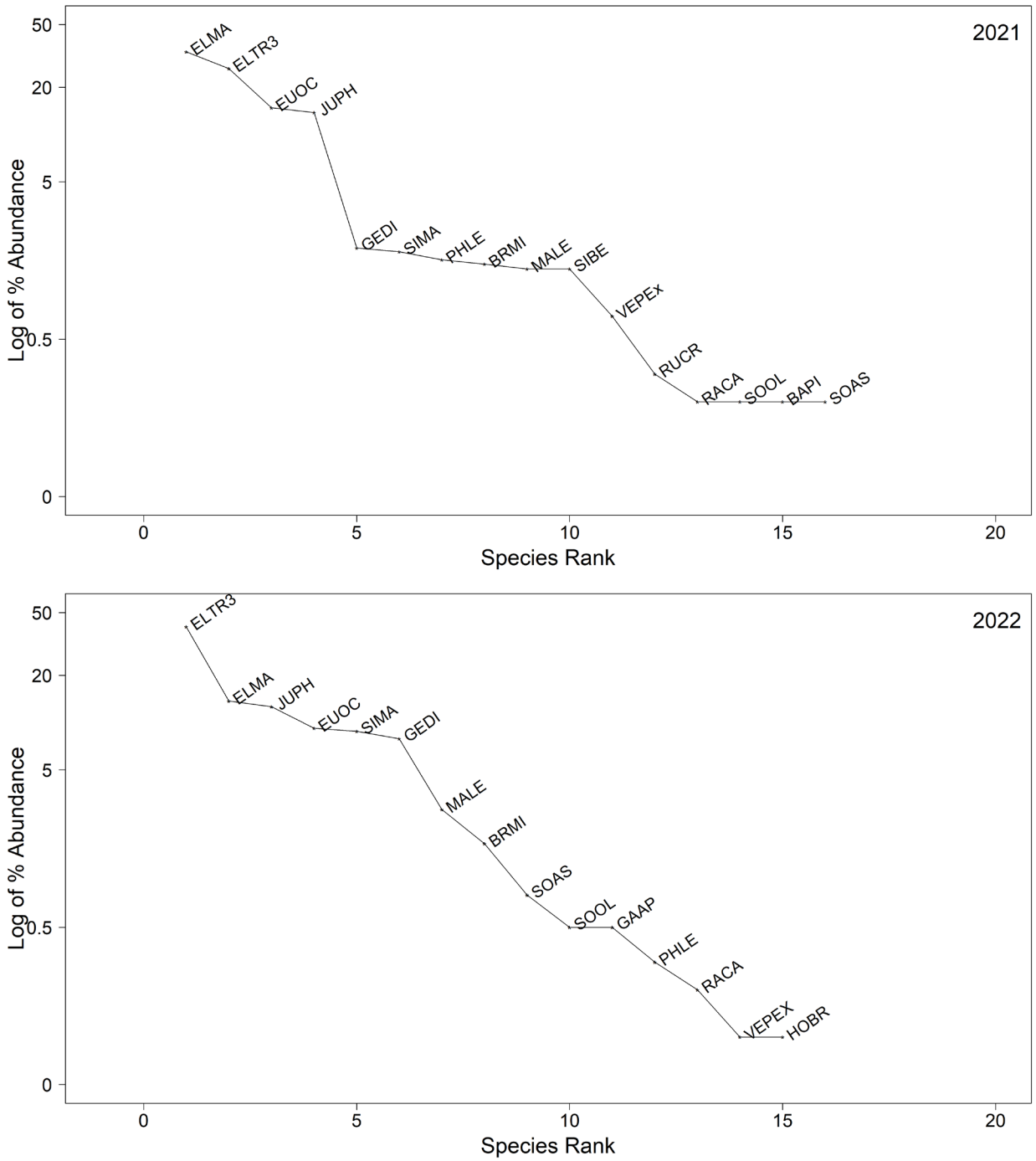

Figure 4-59. Rank Abundance Curves at Pond 75 (Baseline) in 2021 and 2022. Note that the y-axis is in log-10 scale.

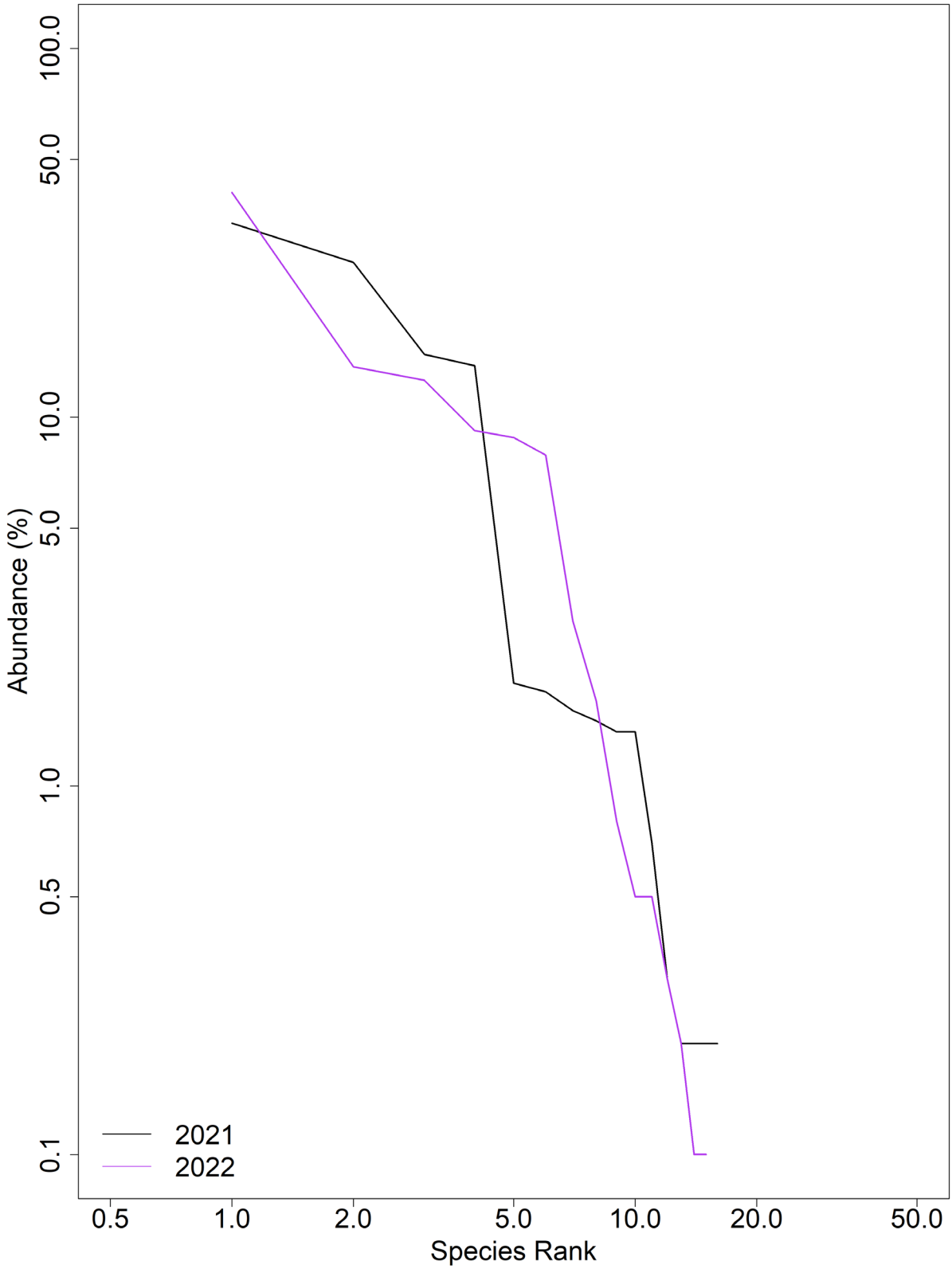

Figure 4-60. Rank Abundance Curves at Pond 75 (Baseline) in 2021 and 2022. Note that the y-axis is in log-10 scale.

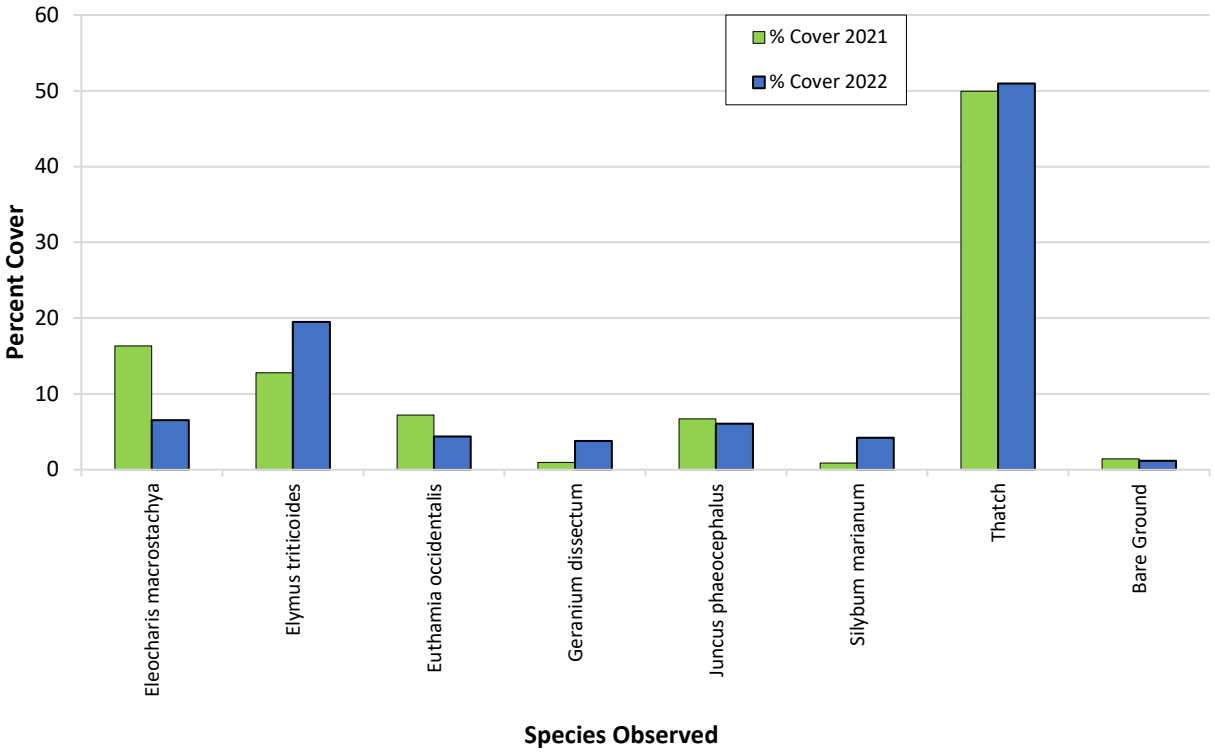

Figure 4-61. Percent Cover of Dominant Species at Pond 75 (Baseline)

Pond 75 native species richness remained the same between monitoring years, while non-native richness decreased by one (see Table 4-118). The native and non-native richness, however, were less than the range of values observed at reference vernal pools (see Table 4-119). The relative percent cover of native species in 2022 was less than the previous baseline year, while the cover of non-native species was higher (see Table 4-120). Pond 75 had higher native species cover than the reference vernal pools however, and lower non-native cover (see Table 4-121).

Table 4-118. Pond 75 (Baseline) Native and Non Native Species Richness

Year	Native	Non-Native	Unidentified
2021*	10	6	0
2022*	10	5	0

*baseline year

Table 4-119. Pond 75 (Baseline) and Reference Vernal Pool Native and Non-Native Species Richness in 2022

Vernal Pool	Native	Non-Native	Unidentified
5	14	14	1
101 East (East)	21	16	1
997	16	18	1
75	**10**	**5**	**0**

Table 4-120. Pond 75 (Baseline) Relative Percent Cover of Native and Non-Native Species

Year	Native	Non-native	#N/A
2021*	93.9%	6.1%	0.0%
2022*	80.3%	19.7%	0.0%

*baseline year

Table 4-121. Pond 75 (Baseline) and Reference Vernal Pool Relative Percent Cover of Native and Non-Native Plants in 2022

Vernal Pool	Native	Non-Native	Unidentified
5	73.9%	25.9%	0.3%
101 East (East)	66.4%	33.5%	0.1%
997	29.7%	69.6%	0.7%
75	**80.3%**	**19.7%**	**0.0%**

Wetland and non-wetland species richness was similar between monitoring years, although the number of wetland species decreased by one, while the number of non-wetland species increased by one (see Table 4-122). Pond 75 followed the same trend as the reference vernal pools with more wetland than non-wetland species, although wetland and non-wetland species richness were both less than the range of values observed at the reference vernal pools in 2022 (see Table 4-123). The relative percent cover of wetland species at Pond 75 was less than the previous monitoring year, while non-wetland species cover was greater (see Table 4-124). When compared to the range of reference pools, the relative percent cover of wetland species was greater and the non-native cover was less than reference. (see Table 4-125).

Table 4-122. Pond 75 (Baseline) Wetland and Non-Wetland Species Richness

Year	Wetland			Non-Wetland		Not Listed
	OBL	FACW	FAC	FACU	UPL	
2021*	1	5	4	2	1	3
2022*	1	5	3	3	1	2

*baseline year

Table 4-123. Pond 75 (Baseline) and Reference Vernal Pool Wetland and Non-Wetland Species Richness in 2022

Vernal Pool	Wetland			Non-Wetland		Not Listed
	OBL	FACW	FAC	FACU	UPL	
5	4	6	2	7	1	9
101 East (East)	4	6	8	7	1	12
997	4	7	4	7	0	13
75	**1**	**5**	**3**	**3**	**1**	**2**

Table 4-124. Pond 75 (Baseline) Relative Percent Cover of Wetland Species

Year	Wetland			Non-Wetland		Not Listed
	OBL	FACW	FAC	FACU	UPL	
2021*	33.6%	32.3%	28.3%	1.6%	0.2%	4.0%
2022*	13.7%	22.4%	42.7%	4.1%	0.5%	16.7%

*baseline year

Table 4-125. Pond 75 (Baseline) and Reference Vernal Pool Relative Percent Cover of Wetland and Non-Wetland Species in 2022

Vernal Pool	Wetland			Non-Wetland		Not Listed
	OBL	FACW	FAC	FACU	UPL	
5	28.7%	39.4%	1.6%	8.0%	1.4%	20.9%
101 East (East)	29.7%	13.8%	4.2%	29.1%	2.1%	21.1%
997	3.6%	16.0%	12.8%	29.8%	0.0%	37.8%
75	**13.7%**	**22.4%**	**42.7%**	**4.1%**	**0.5%**	**16.7%**

4.10.1.1 *Data Quality Objective 3*

Pond 75 was dominated by native and wetland plant species during baseline monitoring in 2022. Pond 75 baseline data will be compared to future surveys.

4.10.1.2 *Performance Standard: Plant Cover and Species Diversity*

Pond 75 was a baseline vernal pool in 2022 and was not required to meet the performance standard. Pond 75 will be monitored after remediation and will be compared to these baseline data in future years as described in the PBO (USFWS, 2017).

4.10.2 Wildlife Monitoring

Baseline wildlife data were not collected at Pond 75 because the vernal pool did not hold sufficient depth for surveys to be completed in 2022.

4.10.3 Conclusion

Pond 75 was not compared to DQOs in 2022 because the vernal pool was in baseline condition. The plant cover and species diversity data were suitable for comparison to future monitoring events (see Table 4-126).

Table 4-126. Success at Pond 75 (Baseline) Based on Performance Standards and Applicable Data Quality Objectives

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

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

5 CONCLUSION

Although rainfall during the 2021-2022 water-year was greater than last year, it still remained well below-normal with a total cumulative precipitation approximately 67% of normal rainfall. This consecutive drought year had measurable impacts to the vernal pools' wetland vegetation and wildlife usage. While two vernal pools held enough water to trigger wildlife surveys in 2020-2021, none held adequate water depths for these surveys to occur during the 2021-2022 water-year, and four of the ten vernal pools surveyed never held water for any period of time (Chenega, 2023).

As mentioned in previous reports, 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). Drought conditions impacted the wetland vegetation across all vernal pools, especially the relative percent cover of wetland and native species.

It is notable that every vernal pool monitored in 2022, both reference and remediated, had results for cover and/or richness that were beyond the range of previous years data (see Table 5-1). Table 5-1 illustrates these values with arrows representing a data value that was less than or greater than any previous year' data. Six out of nine vernal pools had the lowest native and highest non-native relative percent cover of any previous year. Additionally, two of the nine vernal pools had the highest non-native richness of any previous year. There were also extreme wetland cover values compared to previous monitoring results. Seven out of nine vernal pools had the lowest wetland relative percent cover of any previous year, and five out of nine had the highest non-wetland cover. In addition, there was a general increase to both non-wetland and wetland species richness. The following are a list of the extremes for each vernal pool monitored in 2022*:

- Pond 5 (reference) had the lowest recorded relative percent cover of wetland species, and the highest non-wetland cover of any year.

- Pond 101 East (East) (reference) had the highest relative percent cover of non-wetland species in 2021 and 2022, at 31.2% for both years.

- Pond 997 (reference) had the lowest native and wetland relative percent cover and highest non-native and non-wetland relative percent cover of any previous year.

- Pond 16 had the lowest recorded relative percent native cover and conversely the highest non-native relative percent cover. Pond 16 also had the lowest recorded wetland relative percent cover of any previous monitoring year.

- Pond 39 had the highest non-native richness (14 more non-native species than native), and the lowest native cover and highest non-native cover. In addition, Pond 39 had the lowest wetland relative percent cover and highest non-wetland relative percent cover of any year.

- Pond 40 South had the lowest relative percent cover of native and wetland species, and conversely the highest cover of non-native and non-wetland species of any previous year.

- Pond 41 had the lowest native and wetland relative percent cover and highest non-native cover of any previous year.

- Pond 42 had the highest non-native richness of any previous year.

- Pond 61 had the lowest native and wetland relative percent cover and highest non-native cover of any previous year.

*Pond 75 was not included since there were only two years' worth of data, and therefore could not be compared between multiple years.

Table 5-1. Vegetation Result Extremes in 2022 in Comparison to All Previous Years

Vernal Pools	Native		Non-Native		Wetland		Non-Wetland	
	Richness	Relative % Cover	Richness	Relative % Cover	Richness	Relative % Cover	Richness	Relative % Cover
5						↓		↑
101 East (East)								↑
997		↓		↑		↓		↑
16		↓		↑		↓		
39		↓	↑	↑		↓		↑
40 South		↓		↑		↓		↑
41		↓		↑		↓		
42			↑					
61		↓		↑		↓		

The most significant trend was that seven of the nine vernal pools had the lowest wetland cover in 2022 compared to any previous monitoring year. In addition, five of the nine vernal pools, including all three reference vernal pools monitored had the highest non-wetland cover compared to any previous year. This observation is consistent with the literature; most [vernal pool] species will germinate and persist without inundation, but it is likely that inundation plays a large role in keeping upland competitors out of the pools (Bliss and Zedler, 1998). In addition, 2022 saw a significant shift within wetland cover values from previous years (see Table 5-2). Table 5-2 illustrates these values with arrows representing a data value that was less than or greater than any previous year' data. The gradient of blue to yellow in the table signifies wettest (OBL) to driest (UPL) and the gradient of the red arrows gives more (darker) significance to the wettest extreme values and less (lighter) significance to the least wetland obligate (FAC) or upland obligate (FACU) results. Four of the vernal pools surveyed this year had the lowest cover values for OBL and FACW plants of any previous year. Conversely, four of the vernal pools also had the highest FACU cover of any previous year, and Pond 42 had the highest UPL cover ever recorded. These

results show a trend towards drier plant communities across the basin. The following are a list of the extremes of wetland categories for each vernal pool monitored in 2022*:

- Pond 5 (reference) had the highest FACU cover in both 2022 and 2017 at 8%.
- Pond 101 East (East) (reference) had the lowest FACW cover of any previous year.
- Pond 997 (reference) had the lowest FACW cover and the highest FACU cover of any previous year.
- Pond 16 had the highest FACW cover, coupled with the lowest OBL cover of any previous year.
- Pond 39 had the lowest FACW cover and the highest FACU cover of any previous year.
- Pond 40 South had the lowest OBL and FACW cover, as well as the highest FACU cover of any previous year.
- Pond 41 had the lowest OBL cover of any previous year.
- Pond 42 had the lowest FAC cover and highest UPL cover of any previous year.
- Pond 61 had the lowest OBL cover of any previous years

*Pond 75 was not included since there were only two years' worth of data, and therefore could not be compared between multiple years.

Table 5-2. Wetland and Non-Wetland Relative Percent Cover Extremes in 2022 Compared to All Previous Years, by Wetland Type

Vernal Pools	Wetland			Non-Wetland	
	OBL	FACW	FAC	FACU	UPL
5				↑	
101 East (East)		↓			
997		↓		↑	
16	↓	↑			
39		↓		↑	
40 South	↓	↓		↑	
41	↓				
42			↓		↑
61	↓				

This is the second 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 2015-2022 (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 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.

When compared to reference and baseline, there were three out of seven remediated vernal pools that were not on track to meet the performance standard for wetland vegetation due to high non-native richness, low native cover, high non-native cover, high non-wetland richness and/or out of range for wetland cover (see Table 5-3). Despite dry conditions, all vernal pools supported a majority of wetland species and relative percent cover was dominated by wetland species.

The 2021-2022 water-year did not provide favorable conditions for CTS or fairy shrimp. None of the vernal pools held sufficient depth in March to trigger wildlife surveys.

Ponds 16, 39, 40 South, 41, 42, 61, and 75 will continue to be monitored for wetland vegetation and wildlife usage.

Table 5-3. 2022 Remediated Vernal Pools and Performance Standards Status

Vernal Pool	Monitoring Status	Wetland Vegetation	Wildlife
		DQO 3 (richness and cover)	DQO 5 (wildlife presence)
16	Year 4 Post-Subsurface Munitions Remediation	On track	N/A
39	Year 4 Post-Subsurface Munitions Remediation	Not on track	N/A
40 South	Year 4 Post-Subsurface Munitions Remediation	Not on track	N/A
41	Year 4 Post-Subsurface Munitions Remediation	On track	N/A
42	Year 4 Post-Subsurface Munitions Remediation	Not on track	N/A
61	Year 4 Post-Subsurface Munitions Remediation	On track	N/A
75	Baseline	Suitable for Baseline	N/A

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APPENDIX A

Vegetation Transect Data

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Table A-1. Pond 5 (Reference) Wetland Vegetation Transect Data by Stratum

POND 5			
Date	5/6/2022, 5/10/2022		
Surveying Personnel	Kayti Christianson, Emily Poor, and Brett Bell		
Vegetation Type	**% Cover**	**Species**	**Notes**
Emergent Vegetation			
Floating Vegetation			
Submerged Vegetation			
Open Water			
Notes			
Pond 5 held water from January through February during the 2021-2022 water-year, with shallow peripheral ponding observed in December and March (Chenega 2023). Stratum 1 and the associated transect were repeated from 2016 and 2018-2021. Strata 2 and 3 were repeated from 2016-2021. Stratum 7 was repeated from 2019-2021. Stratum 8 was repeated from 2021. Transects 2 and 8 were relocated because the previous locations were no longer within the correct strata. Transect 3 was repeated from 2020 and 2021. Transect 7 was relocated to a more representative location and reduced from 10 m to 5 m.			

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	35%	ELMA	35	ELMA	40	ELMA	33	BAPI	1	CRTR	1	CRTR	5
			MALE	13	MALE	12	MALE	12	ELMA	38	ELMA	33	ELMA	32
			TH	51	SOOL	2	SOOL	1	MALE	7	MALE	10	SOOL	2
			BG	1	TH	45	TH	52	SOOL	2	SOOL	2	TH	59
					BG	1	BG	2	TH	51	TH	53	BG	2
									BG	1	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
2	10 m	21%	DISP	28	DISP	22	DISP	28	DISP	30	CRTR	1	CRTR	1
			ELMA	5	ELMA	6	ELMA	4	ELMA	4	DISP	20	DISP	17
			MALE	1	MALE	1	MALE	1	MALE	1	ELMA	4	ELMA	4
			TH	66	SOOL	1	SOAS	7	SEGL	2	MALE	1	HYGL	1
					TH	69	TH	59	TH	61	RUCR	1	MALE	2
					BG	1	BG	1	BG	2	SEGL	1	RUCR	1
											TH	70	SEGL	1
											BG	2	TH	72
													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	8%	DISP	11	DISP	3	DISP	7	BRMI	1	ACWR	1	BRMI	1
			ELMA	1	ELMA	1	ELMA	1	CRTR	1	BRMI	1	DISP	8
			ERBO	1	GEDI	7	GEDI	6	DISP	6	DISP	14	ELMA	1
			GEDI	3	HYGL	11	HYGL	6	ERBO	2	ELMA	1	ERBO	2
			HYGL	9	MAGR	1	MALE	1	FEBR	1	FEBR	1	FEBR	1
			HYRA	1	PHLE	4	PHLE	1	GEDI	8	GEDI	8	GEDI	4
			PHLE	1	POMO	1	PLCHH	1	HYGL	15	HYGL	10	HYGL	6
			PLCHH	1	RUCR	1	RUCR	1	HYRA	1	PHLE	1	PHLE	1
			POMO	1	SEGL	1	STAJ	14	PHLE	2	RUCR	1	STAJ	11
			RUCR	2	STAJ	11	TH	61	POMO	1	SOOL	1	TH	62
			SEGL	2	TH	57	BG	1	STAJ	6	STAJ	13	BG	3
			STAJ	13	BG	2			TH	53	TH	30		
			TH	51					BG	3	BG	18		
			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
7	5 m	0.4%	BAPI	2	BRHO	1	JUBA	45
			BRMI	1	GEDI	1	GEDI	1
			DISP	1	JUBA	43	SOOL	1
			ERCA	1	PS sp.	1	TH	51
			GEDI	2	TH	53	BG	2
			HYGL	2	BG	1		
			JUBA	35				
			PS sp.	1				
			SEGL	1				
			SOOL	3				
			TH	48				
			BG	3				
			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
8	10 m	36%	BRMI	1	BRMI	1	BRMI	1	BRMI	2	BRMI	1	CRTR	9
			CRTR	5	CRTR	5	CRTR	3	CRTR	8	CRTR	6	FEBR	1
			DISP	1	GEDI	12	DISP	1	ELMA	1	ELMA	1	GAUS	4
			GEDI	10	HYGL	6	ERBO	1	ERBO	3	GEDI	14	GEDI	13
			HYGL	12	HYRA	4	GEDI	9	GEDI	15	HYGL	1	HYGL	8
			PHLE	9	JUBUB	1	HYGL	6	HYGL	1	HYRA	2	PHLE	14
			POMO	1	LYHY	1	PHLE	11	LYHY	1	JUBUb	1	RUAC	1
			TH	60	PHLE	3	SEGL	2	PHLE	7	LYHY	1	STAJ	1
			BG	1	PS sp.	1	TH	63	RUCR	1	PHLE	13	TH	42
					TH	58	BG	3	SOOL	1	TH	32	BG	7
					BG	8			TH	56	BG	28		
									BG	4				
			TOTAL	**100**	**TOTAL**	**100**	**TOTAL**	**100**	**TOTAL**	**100**	**TOTAL**	**100**	**TOTAL**	**100**

Pond 5 2022 Species List					
Species Name	**Common Name**	**Species Code**	**Species Name**	**Common Name**	**Species Code**
Achillea millefolium	common yarrow	ACMI	*Hypochaeris glabra*	smooth cat's-ear	HYGL
Acmispon wrangelianus	Chilean trefoil	ACWR	*Hypochaeris radicata*	rough cat's-ear	HYRA
Agoseris grandiflora	large-flowered agoseris	AGGR	*Isoetes howellii*	Howell's quillwort	ISHO
Agrostis avenacea	Pacific bent grass	AGAV	*Juncus balticus*	Baltic rush	JUBA
Aira caryophyllea	silvery hair-grass	AICA	*Juncus bufonius* var. *bufonius*	common toad rush	JUBUB
Artemisia californica	California sagebrush	ARCA11	*Juncus phaeocephalus*	brown-headed rush	JUPH
Atriplex prostrata	fat-hen	ATPR	*Lactuca serriola*	prickly lettuce	LASE
Avena barbata	slender wild oat	AVBA	*Lasthenia glaberrima*	smooth goldfields	LAGL3
Baccharis glutinosa	marsh baccharis	BAGL	*Lysimachia arvensis*	scarlet pimpernel	LYAR
Baccharis pilularis	coyote brush	BAPI	*Lythrum hyssopifolia*	grass poly	LYHY
Brassica sp.			*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 carinatus	California brome	BRCA	*Nuttallanthus texanus*	blue toadflax	NUTE
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
Calandrinia menziesii	redmaids	CAME	*Plantago coronopus*	cut-leaved plantain	PLCO
Carduus pycnocephalus	Italian thistle	CAPY	*Polypogon monspeliensis*	rabbitfoot grass	POMO
Cirsium brevistylum	Indian thistle	CIBR	*Pseudognaphalium luteoalbum*	weedy cudweed	PSLU
Cirsium vulgare	bull thistle	CIVU	*Pseudognaphalium ramosissimum*	pink everlasting	PSRA
Clinopodium douglasii	yerba buena	CLDO	*Pseudognaphalium stramineum*	cottonbatting plant	PSST
Cressa truxillensis	spreading alkaliweed	CRTR	*Pseudognaphalium* sp.		
Cynosurus echinatus	bristly dogtail grass	CYEC	*Rumex acetosella*	sheep sorrel	RUAC
Daucus pusillus	rattlesnake weed	DAPU	*Rumex crispus*	curly dock	RUCR
Distichlis spicata	salt grass	DISP	*Sanicula crassicaulis*	Pacific sanicle	SACR
Eleocharis macrostachya	pale spikerush	ELMA	*Senecio glomeratus*	cutleaf burnweed	SEGL
Epilobium ciliatum	fringed willowherb	EPCI	*Senecio vulgaris*	common groundsel	SEVU
Erigeron canadensis	horseweed	ERCA	*Silene gallica*	small-flower catchfly	SIGA
Erodium botrys	long-beaked filaree	ERBO	*Sonchus asper*	prickly sow thistle	SOAS
Erodium cicutarium	redstem filaree	ERCI	*Sonchus oleraceus*	common sow thistle	SOOL
Eryngium armatum	coyote thistle	ERAR12	*Stachys ajugoides*	bugle hedge nettle	STAJ
Euphorbia spathulata	warty spurge	EUSP	*Trifolium barbigerum*	bearded clover	TRBA
Euthamia occidentalis	western goldenrod	EUOC	*Trifolium depauperatum* var. *amplectens*	pale sack clover	TRDEA
Festuca bromoides	brome fescue	FEBR	*Trifolium microcephalum*	small head clover	TRMI
Festuca myuros	rattail sixweeks grass	FEMY	Unknown 1		
Frankenia salina	alkali heath	FRSA	*Verbena lasiostachys* var. *lasiostachys*	western vervain	VELAL
Galium aparine	goose grass	GAAP	**Groundcover Codes**		
Gamochaeta ustulata	purple cudweed	GAUS	BG	Bare Ground	
Geranium dissectum	cut-leaved geranium	GEDI	TH	Thatch/Duff/Algae	
Heliotropium curassavicum var. *oculatum*	Chinese pusley	HECUO	AL	Algae	

Table A-2. Pond 101 East (East) (Reference) Wetland Vegetation Transect Data by Stratum

POND 101 East (East)			
Date	5/5/2022		
Surveying Personnel	Kayti Christianson, Emily Poor, and Brett Bell		
Vegetation Type	**% Cover**	**Species**	**Notes**
Emergent Vegetation			
Floating Vegetation			
Submerged Vegetation			
Open Water			
Notes			
Pond 101 East (East) held water briefly in January and early February but was completely dry by the February 17 hydrology monitoring event (Chenega 2023). Stratum 3 was repeated from 2016 and 2021. Stratum 4 was repeated from 2016, 2020, and 2021 whereas stratum 5 was repeated from 2017-2021. Stratum 9 and the corresponding transect were newly established in 2022. Transects 3 and 5 were repeated from 2021, whereas Transect 4 was relocated because the previous location was no longer within the correct 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
3	10 m	33%	BRDI	5	AGAV	6	ELMA	30	ELMA	38	ELMA	30	ELMA	33
			ELMA	25	ELMA	24	MALE	24	MALE	40	MALE	28	MALE	36
			GEDI	10	MALE	18	PHLE	26	TH	22	RUCR	6	RUCR	9
			MALE	30	PHLE	8	RUCR	3			TH	36	TH	22
			RUCR	5	RUCR	1	TH	17						
			VELAL	1	TH	43								
			TH	24										
			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	10%	ERCA	2	BAGL	1	BAGL	1	EUOC	9	BAGL	1	BRDI	3
			EUOC	5	EUOC	7	EUOC	2	GEDI	7	EUOC	3	GEDI	9
			GEDI	3	GEDI	1	JUBA	15	JUBA	22	GEDI	21	HYGL	1
			JUBA	12	JUBA	8	TODI	2	POMO	1	JUBA	7	JUBA	24
			MASA	6	PSST	1	TH	79	PSST	1	MASA	5	RUAC	7
			POMO	1	SEGL	1	BG	1	RUAC	2	TH	62	TH	54
			PSST	1	SOAS	4			UNK2	1	BG	1	BG	2
			TH	40	TODI	1			TH	54				
			BG	30	TH	60			BG	3				
					BG	16								
			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	55%	ERBO	4	AGAV	1	AGAV	1	BRMI	1	ERBO	15	AGAV	1
			GEDI	30	EPCI	1	ERBO	11	EPCI	1	GEDI	10	BRMI	1
			HYGL	6	ERBO	11	GEDI	15	ERBO	9	HYGL	8	ERBO	8
			HYRA	3	GEDI	17	HYGL	3	FEBR	1	HYRA	5	GEDI	5
			MALE	1	HYGL	3	HYRA	14	GEDI	10	MAGR	1	HECUO	3
			RUAC	7	HYRA	8	MASA	4	HYGL	8	MASA	8	HYGL	7
			RUCR	1	MASA	5	PHLE	1	HYRA	1	POMO	1	HYRA	9
			STAJ	3	POMO	1	POMO	1	RUAC	8	STAJ	5	MAGR	1
			VISA	6	RUAC	1	STAJ	1	TRDE	1	TRMI	3	MASA	4
			TH	26	STAJ	1	TRDE	4	TRMI	1	TRVA	1	POMO	1
			BG	13	TRGR	2	TRGR	3	VISA	3	VISA	4	TRBA	1
					VISA	3	TRMI	1	TH	24	TH	31	TRDE	1
					TH	37	VISA	3	BG	32	BG	8	TRGR	1
					BG	9	TH	8					VISA	6
							BG	30					TH	46
													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
9	5 m	2%	ELMA	11	ELMA	10	BRHO	1
			ERCI	3	HYRA	1	ELMA	6
			HYRA	2	LAGL3	40	FEBR	6
			LAGL3	42	MALE	12	LAGL3	44
			MALE	4	PHLE	2	MALE	13
			TRDE	1	TRDE	1	PHLE	1
			TH	37	TH	34	TRDE	1
							TH	28
			TOTAL	**100**	**TOTAL**	**100**	**TOTAL**	**100**

Pond 101 East (East) 2022 Species List					
Species Name	**Common Name**	**Species Code**	**Species Name**	**Common Name**	**Species Code**
Agrostis avenacea	Pacific bent grass	AGAV	*Lasthenia glaberrima*	smooth goldfields	LAGL3
Agrostis pallens	seashore bent grass	AGPA	*Lupinus bicolor*	miniature lupine	LUBI
Aira caryophyllea	silvery hair-grass	AICA	*Lythrum hyssopifolia*	grass poly	LYHY
Alopecurus saccatus	Pacific foxtail	ALSA	*Madia gracilis*	gumweed	MAGR
Atriplex prostrata	fat-hen	ATPR	*Madia sativa*	coast tarweed	MASA
Avena barbata	slender wild oat	AVBA	*Malvella leprosa*	alkali mallow	MALE
Baccharis glutinosa	marsh baccharis	BAGL	*Nuttallanthus texanus*	blue toadflax	NUTE
Baccharis pilularis	coyote brush	BAPI	*Phalaris lemmonii*	Lemmon's canary grass	PHLE
Brassica sp.			*Polygonum aviculare* ssp. *depressum*	prostrate knotweed	POAVD
Briza maxima	rattlesnake grass	BRMA	*Polypogon monspeliensis*	rabbitfoot grass	POMO
Briza minor	annual quaking grass	BRMI	*Pseudognaphalium luteoalbum*	weedy cudweed	PSLU
Bromus carinatus	California brome	BRCA	*Pseudognaphalium* sp.		
Bromus diandrus	ripgut grass	BRDI	*Pseudognaphalium stramineum*	cottonbatting plant	PSST
Bromus hordeaceus	soft chess	BRHO	*Rorippa curvisiliqua*	western yellowcress	ROCU
Carduus pycnocephalus	Italian thistle	CAPY	*Rubus ursinus*	California blackberry	RUUR
Centaurea solstitialis	yellow star-thistle	CESO3	*Rumex acetosella*	sheep sorrel	RUAC
Cirsium brevistylum	Indian thistle	CIBR	*Rumex crispus*	curly dock	RUCR
Cirsium vulgare	bull thistle	CIVU	*Rumex salicifolius*	willow dock	RUSA
Drymocallis glandulosa var. *wrangelliana*	sticky cinquefoil	DRGLW	*Senecio glomeratus*	cutleaf burnweed	SEGL
Eleocharis macrostachya	pale spikerush	ELMA	*Silene gallica*	small-flower catchfly	SIGA
Epilobium ciliatum	fringed willowherb	EPCI	*Sonchus asper*	prickly sow thistle	SOAS
Erigeron canadensis	horseweed	ERCA	*Sonchus oleraceus*	common sow thistle	SOOL
Erodium botrys	long-beaked filaree	ERBO	*Stachys ajugoides*	bugle hedge nettle	STAJ
Erodium cicutarium	redstem filaree	ERCI	*Toxicodendron diversilobum*	poison oak	TODI
Euthamia occidentalis	western goldenrod	EUOC	*Trifolium barbigerum*	bearded clover	TRBA
Festuca bromoides	brome fescue	FEBR	*Trifolium depauperatum*	sack clover	TRDE
Festuca perennis	Italian rye grass	FEPE	*Trifolium depauperatum* var. *amplectens*	pale sack clover	TRDEA
Galium aparine	goose grass	GAAP	*Trifolium gracilentum*	pin point clover	TRGR
Gamochaeta ustulata	purple cudweed	GAUS	*Trifolium microcephalum*	small head clover	TRMI
Geranium dissectum	cut-leaved geranium	GEDI	*Trifolium variegatum*	variegated clover	TRVA
Gnaphalium palustre	lowland cudweed	GNPA	Unknown 2		
Heliotropium curassavicum var. *oculatum*	Chinese pusley	HECUO	*Verbena lasiostachys* var. *lasiostachys*	western vervain	VELAL
Heterotheca grandiflora	telegraph weed	HEGR	*Veronica peregrina* ssp. *xalapensis*	speedwell	VEPEX
Hordeum brachyantherum	meadow barley	HOBR	*Vicia sativa* ssp. *sativa*	spring vetch	VISAS
Hypochaeris glabra	smooth cat's-ear	HYGL	**Groundcover Codes**		
Hypochaeris radicata	rough cat's-ear	HYRA	BG	Bare Ground	
Juncus balticus	Baltic rush	JUBA	TH	Thatch/Duff	
Juncus bufonius var. *bufonius*	common toad rush	JUBUB	AL	Algae	

Table A-3. Pond 997 (Reference) Wetland Vegetation Transect Data by Stratum

POND 997			
Date	5/2/2022, 5/3/2022		
Surveying Personnel	Kayti Christianson, Emily Poor, and Brett Bell		
Vegetation Type	**% Cover**	**Species**	**Notes**
Emergent Vegetation			
Floating Vegetation			
Submerged Vegetation			
Open Water			
Pond 997 remained dry throughout the 2021-2022 water-year (Chenega 2023). Strata and Transects 1 and 3 were repeated from 2017-2021. Stratum 2 was repeated from the same range of years but consisted of CCG and 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	5%	BRHO	3	BRDI	2	AICA	1	BRHO	1	BRMI	1	AICA	1
			BRMI	1	BRHO	2	BAPI	1	ERAR12	18	ERAR12	5	BRHO	1
			ELMA	1	BRMI	1	BRHO	1	ERBO	3	ERBO	18	ERBO	9
			ERAR12	10	BRTET	1	BRMI	1	FEBR	1	FEBR	1	FEBR	2
			ERBO	2	ERAR12	5	CIQU	1	HYGL	1	HYGL	1	HYGL	2
			FEBR	6	ERBO	1	CRAQ	1	HYRA	1	HYRA	4	HYRA	1
			HYGL	2	FEBR	25	ELMA	1	LYHY	3	LYHY	1	LYHY	1
			HYRA	2	HYGL	3	ERAR12	12	LYMI	1	LYMI	1	PLCHH	2
			LYAR	1	HYRA	1	ERBO	3	PLCHH	3	PLCHH	2	PLCO	6
			LYHY	1	LYAR	1	FEBR	1	PLCO	1	PLCO	1	POMO	1
			POMO	1	PLCHH	1	LYHY	1	POMO	1	POMO	1	PSCH	1
			PSCH	1	POMO	1	PLCHH	2	PS sp.	1	PS sp.	1	TH	45
			SIGA	1	PSCH	1	POMO	1	PSCH	5	PSCH	2	BG	28
			TH	13	TH	10	PS sp.	1	TH	10	TH	26		
			BG	55	BG	45	PSCH	3	BG	50	BG	35		
							TH	9						
							BG	60						
			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	89%	AICA	1	AICA	1	AICA	1	AICA	1	AICA	1	ACAMA	1
			BRMA	16	BRMA	25	BRMA	8	BRMA	5	BRMA	3	AICA	1
			BRMI	2	BRMI	2	BRMI	1	BRMI	1	BRMI	1	BRMA	3
			CAAMA3	1	DACA	3	DACA	7	DACA	30	DACA	6	CAAMA3	1
			DECO	3	ERAR12	3	DECO	1	ERAR12	2	DECO	1	DACA	2
			ERAR12	2	ERBO	12	ERAR12	3	ERBO	15	ERAR12	2	DECO	3
			ERBO	6	FEBR	2	ERBO	24	FEBR	2	ERBO	9	ERBO	25
			FEBR	1	HYGL	13	FEBR	3	HYGL	3	FEBR	1	FEBR	2
			GEDI	1	MAGR	3	FEMY	1	MIPA	2	FEMY	2	FEMY	2
			HYGL	22	PLCO	1	HYGL	5	TH	36	HYGL	12	HYGL	12
			JUCA	1	TH	28	MAGR	1	BG	3	HYRA	3	HYRA	3
			LYMI	1	BG	7	TH	42			JUCA	1	LYMI	1
			MAGR	1			BG	3			LYAR	1	MAGR	2
			PS sp.	1							MAGR	2	RUAC	2
			TH	36							PLCO	1	SIBE	2
			BG	5							RUAC	1	TH	27
											TH	18	BG	11
											BG	35		
			TOTAL	**100**	**TOTAL**	**100**	**TOTAL**	**100**	**TOTAL**	**100**	**TOTAL**	**100**	**TOTAL**	**100**

Pond 997 2022 Species List

Species Name	Common Name	Species Code	Species Name	Common Name	Species Code
Acmispon americanus var. *americanus*	Spanish lotus	ACAMA	*Lasthenia conjugens*	Contra Costa goldfields	LACO
Acmispon parviflorus	hill lotus	ACPA	*Logfia gallica*	narrowleaf cottonrose	LOGA
Agrostis lacuna-vernalis	vernal pool bent grass	AGLAV	*Lupinus nanus*	sky lupine	LUNA
Aira caryophyllea	silvery hair-grass	AICA	*Luzula comosa*	Pacific woodrush	LUCO6
Avena barbata	slender wild oat	AVBA	*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 gracilis*	gumweed	MAGR
Brodiaea terrestris ssp. *terrestris*	dwarf brodiaea	BRTET	*Madia sativa*	coast tarweed	MASA
Bromus diandrus	ripgut grass	BRDI	*Microseris paludosa*	marsh microseris	MIPA
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
Cicendia quadrangularis	timwort	CIQU	*Polypogon monspeliensis*	rabbitfoot grass	POMO
Crassula aquatica	aquatic pygmy-weed	CRAQ	*Pseudognaphalium californicum*	California everlasting	PSCA
Danthonia californica	California oat grass	DACA	*Pseudognaphalium ramosissimum*	pink everlasting	PSRA
Deinandra corymbosa	coastal tarweed	DECO	*Pseudognaphalium* sp.		
Eleocharis acicularis var. *acicularis*	needle spikerush	ELACA	*Psilocarphus chilensis*	round woolly-marbles	PSCH
Eleocharis macrostachya	pale spikerush	ELMA	*Quercus agrifolia*	coast live oak	QUAG
Elymus triticoides	beardless wild rye	ELTR3	*Ranunculus californicus*	California buttercup	RACA
Erodium botrys	long-beaked filaree	ERBO	*Rumex acetosella*	sheep sorrel	RUAC
Eryngium armatum	coyote thistle	ERAR12	*Senecio glomeratus*	cutleaf burnweed	SEGL
Festuca bromoides	brome fescue	FEBR	*Sidalcea malviflora* ssp. *malviflora*	checkerbloom	SIMAM
Festuca myuros	rattail sixweeks grass	FEMY	*Silene gallica*	small-flower catchfly	SIGA
Festuca perennis	Italian rye grass	FEPE	*Sisyrinchium bellum*	western blue-eyed grass	SIBE
Galium aparine	goose grass	GAAP	*Sonchus oleraceus*	common sow thistle	SOOL
Galium porrigens	climbing bedstraw	GAPO	*Spiranthes romanzoffiana*	hooded lady's tresses	SPRO
Gamochaeta ustulata	purple cudweed	GAUS	*Stipa pulchra*	purple needle grass	STPU
Geranium dissectum	cut-leaved geranium	GEDI	*Taraxia ovata*	sun cups	TAOV
Horkelia cuneata var. *cuneata*	wedge-leaved horkelia	HOCUC	*Triteleia ixioides*	coast pretty face	TRIX
Hypochaeris glabra	smooth cat's-ear	HYGL	*Zeltnera davyi*	Davy's centuary	ZEDA
Hypochaeris radicata	rough cat's-ear	HYRA	**Groundcover Codes**		
Juncus bufonius var. *bufonius*	common toad rush	JUBUB	BG	Bare Ground	
Juncus capitatus	dwarf rush	JUCA	TH	Thatch/Duff	
Juncus phaeocephalus	brown-headed rush	JUPH	AL	Algae	

Table A-4. Pond 16 (Year 4 Post-Subsurface Munitions Remediation)
Wetland Vegetation Transect Data by Stratum

POND 16			
Date	5/10/2022		
Surveying Personnel	Kayti Christianson, Emily Poor and Brett Bell		
Vegetation Type	**% Cover**	**Species**	**Notes**
Emergant Vegetation			
Floating Vegetation			
Submerged Vegetation			
Open Water			

Notes

Pond 16 remained dry throughout the 2021-2022 water-year (Chenega 2023). Strata 3 and 5 were repeated from 2015, 2017, and 2019-2021. Strata 1, 4, and 6 were repeated from 2017 and 2019-2021. Stratum 8 and the associated transect were repeated from 2021. Transect 1 was repeated from 2017 and 2019. Transects 3 and 4 were relocated because the previous locations were no longer within the correct strata. Transect 3 was also reduced from 10 m to 5 m to better represent the extent of vegetation across the pond. Transect 5 was repeated from 2015, 2017, and 2019-2021. Transect 6 was repeated from 2017 and 2019-2021.

Transect #	Transect Length	Relative % Cover of Wetland	Quadrat #1		Quadrat #2		Quadrat #3	
			Species	% Cover	Species	% Cover	Species	% Cover
1	5 m	5%	HECUO	2	HECUO	3	HECUO	7
			SCCA	5	SCCA	8	SCCA	8
			SOAM	1	TH	77	TH	69
			TH	60	BG	12	BG	16
			BG	32				
			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	34%	ELMA	40	ELMA	47	ELMA	45
			HEGR	1	HEGR	1	ERCA	1
			POMO	1	POMO	2	HEGR	2
			SIGA	1	PSLU	1	POMO	3
			BG	9	BG	7	PSLU	1
			TH	48	TH	42	BG	7
							TH	41
			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	10%	CAPR	58	CAPR	50	CAPR	50
			GEDI	1	GEDI	1	GEDI	2
			JUBA	2	JUBA	1	JUBA	1
			TH	38	RUUR	3	RUUR	2
			BG	1	TH	45	TH	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
5	10 m	32%	CABA	55	CABA	10	CABA	40	CABA	17	CABA	20	CABA	40
			RUUR	5	RUUR	9	RUUR	3	RUUR	10	RUUR	2	RUUR	10
			SOEL	4	SOEL	6	SOEL	7	SOEL	12	SOEL	2	SOEL	15
			TH	33	TH	73	TH	49	TH	60	TH	75	TH	30
			BG	3	BG	2	BG	1	BG	1	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	
			Species	% Cover	Species	% Cover	Species	% Cover
6	5 m	12%	GEDI	1	JUBA	28	JUBA	40
			JUBA	48	TH	67	PSLU	1
			TH	51	BG	5	RUUR	4
							TH	53
							BG	2
			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
8	10 m	7%	BAPI	2	BAPI	3	BRDI	3	CIBR	3	CIBR	8	BAPI	4
			CIBR	11	CIBR	5	CIBR	1	FEBR	1	FEBR	1	CIBR	4
			CIVU	4	CIVU	3	CIVU	2	HEGR	2	HEGR	2	CIVU	4
			GEDI	1	FEBR	2	FEBR	1	POMO	64	POMO	52	FEBR	1
			POMO	52	GEDI	4	HEGR	1	TH	25	TH	33	HEGR	3
			TH	27	POMO	30	POMO	42	BG	5	BG	4	POMO	55
			BG	3	SIGA	1	PS sp.	1					TH	27
					TH	24	TH	16					BG	2
					BG	28	BG	33						
			TOTAL	**100**	**TOTAL**	**100**	**TOTAL**	**100**	**TOTAL**	**100**	**TOTAL**	**100**	**TOTAL**	**100**

Pond 16 2022 Species List

Species Name	Common Name	Species Code
Achillea millefolium	common yarrow	ACMI
Acmispon americanus var. *americanus*	Spanish lotus	ACAMA
Acmispon strigosus	strigose lotus	ACST
Agoseris grandiflora	large-flowered agoseris	AGGR
Agrostis exarata	spike bent grass	AGEX
Agrostis lacuna-vernalis	vernal pool bent grass	AGLAV
Agrostis pallens	seashore bent grass	AGPA
Aira caryophyllea	silvery hair-grass	AICA
Amsinckia menziesii	common fiddleneck	AMME
Artemisia douglasiana	mugwort	ARDO
Avena barbata	slender wild oat	AVBA
Baccharis pilularis	coyote brush	BAPI
Bowlesia incana	hoary bowlesia	BOIN3
Briza maxima	rattlesnake grass	BRMA
Briza minor	annual quaking grass	BRMI
Bromus diandrus	ripgut grass	BRDI
Bromus hordeaceus	soft chess	BRHO
Camissoniopsis micrantha	miniature suncup	CAMI
Carex barbarae	whiteroot	CABA
Carex pachystachya	chamisso sedge	CAPA
Carex praegracilis	clustered field sedge	CAPR
Carpobrotus edulis	ice plant	CAED
Cerastium glomeratum	sticky mouse-ear chickweed	CEGL
Cirsium brevistylum	Indian thistle	CIBR
Cirsium vulgare	bull thistle	CIVU
Clarkia purpurea ssp. *quadrivulnera*	winecup clarkia	CLPUQ
Conium maculatum	poison hemlock	COMA
Cyperus eragrostis	tall cyperus	CYER
Deschampsia cespitosa ssp. *cespitosa*	tufted hair grass	DECEC2
Diplacus aurantiacus	sticky monkey flower	DIAU
Drymocallis glandulosa var. *wrangelliana*	sticky cinquefoil	DRGLW
Eleocharis macrostachya	pale spikerush	ELMA
Erigeron canadensis	horseweed	ERCA
Festuca bromoides	brome fescue	FEBR
Galium aparine	goose grass	GAAP
Geranium dissectum	cut-leaved geranium	GEDI
Gnaphalium palustre	lowland cudweed	GNPA
Heliotropium curassavicum var. *oculatum*	Chinese pusley	HECUO
Helminthotheca echioides	bristly oxtongue	HEEC
Heterotheca grandiflora	telegraph weed	HEGR
Hypericum anagalloides	creeping St. John's wort	HYAN
Hypochaeris glabra	smooth cat's-ear	HYGL
Hypochaeris radicata	rough cat's-ear	HYRA
Iris douglasiana	Douglas iris	IRDO
Juncus balticus	Baltic rush	JUBA
Juncus effusus	common rush	JUEF
Juncus falcatus	falcate rush	JUFA
Juncus phaeocephalus	brown-headed rush	JUPH
Linum bienne	pale flax	LIBI5
Lupinus arboreus	yellow bush lupine	LUAR
Luzula comosa	Pacific woodrush	LUCO6
Lysimachia arvensis	scarlet pimpernel	LYAR
Madia sativa	coast tarweed	MASA
Malvella leprosa	alkali mallow	MALE
Nuttallanthus texanus	blue toadflax	NUTE
Petrorhagia dubia	hairypink	PEDU
Phalaris lemmonii	Lemmon's canary grass	PHLE
Plantago coronopus	cut-leaved plantain	PLCO
Poa sp.		
Polypogon monspeliensis	rabbitfoot grass	POMO
Pseudognaphalium luteoalbum	weedy cudweed	PSLU
Pseudognaphalium ramosissimum	pink everlasting	PSRA
Pseudognaphalium sp.		
Quercus agrifolia	coast live oak	QUAG
Ranunculus californicus	California buttercup	RACA
Rosa californica	California wild rose	ROCA
Rubus ursinus	California blackberry	RUUR
Rumex acetosella	sheep sorrel	RUAC
Rumex crispus	curly dock	RUCR
Rumex salicifolius	willow dock	RUSA
Salix lasiandra var. *lasiandra*	shining willow	SALAL
Schoenoplectus californicus	California bulrush	SCCA
Senecio glomeratus	cutleaf burnweed	SEGL
Senecio vulgaris	common groundsel	SEVU
Silene gallica	small-flower catchfly	SIGA
Silybum marianum	milk thistle	SIMA
Solanum americanum	small-flowered nightshade	SOAM
Solidago elongata	West Coast Canada goldenrod	SOEL
Solidago velutina ssp. *californica*	California goldenrod	SOVEC
Sonchus asper	prickly sow thistle	SOAS
Sonchus oleraceus	common sow thistle	SOOL
Spergularia rubra	red sand-spurrey	SPRU
Stachys ajugoides	bugle hedge nettle	STAJ
Torilis arvensis	tall sock destroyer	TOAR
Toxicodendron diversilobum	poison oak	TODI
Trifolium microcephalum	small head clover	TRMI
Vicia americana ssp. *americana*	American vetch	VIAMA

Groundcover Codes	
BG	Bare Ground
TH	Thatch/Duff
AL	Algae

Table A-5. Pond 39 (Year 4 Post-Subsurface Munitions Remediation)
Wetland Vegetation Transect Data by Stratum

POND 39			
Date	4/29/2022, 5/2/2022		
Surveying Personnel	Kayti Christianson, Emily Poor, and Brett Bell		
Vegetation Type	**% Cover**	**Species**	**Notes**
Emergent Vegetation			
Floating Vegetation			
Submerged Vegetation			
Open Water			
Notes			
Pond 39 was dry by the February 17 hydrology monitoring event (Chenega 2023). Strata 1 and 3 were repeated from 2016 and 2018-2021. Stratum 4 was repeated from 2018-2021. Transect 1 was relocated to a more representative location and reduced from 10 m to 5 m. Transect 3 was relocated because the previous location was no longer within the correct stratum, whereas Transect 4 was repeated from 2019.			

Transect #	Transect Length	Relative % Cover of Wetland	Quadrat #1		Quadrat #2		Quadrat #3	
			Species	% Cover	Species	% Cover	Species	% Cover
1	5 m	3%	BRHO	1	AICA	1	ELACA	1
			BRMI	1	ELACA	2	ELMA	23
			CIQU	1	ELMA	25	GEDI	1
			ELMA	20	FEBR	1	LAGL3	4
			FEBR	1	FEPE	1	PLCHH	40
			FEPE	2	GEDI	1	PLCO	5
			GEDI	2	LAGL3	8	RUCR	9
			HYGL	1	LYHY	1	TH	14
			LAGL3	1	PLCHH	15	BG	3
			LYHY	1	PLCO	10		
			PLCHH	35	POMO	1		
			PLCO	3	TH	19		
			POMO	1	BG	15		
			SOOL	1				
			TRAN	1				
			TRDU	1				
			VISA	1				
			TH	16				
			BG	10				
			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	9%	ELMA	2	ELMA	4	AVBA	1	AVBA	1	BRDI	1	ELMA	4
			FEBR	4	FEBR	1	BRDI	1	BRHO	1	ELMA	4	FEBR	1
			FEPE	25	FEPE	28	BRHO	1	BRMI	1	FEBR	1	FEPE	40
			GEDI	4	GEDI	7	ELMA	5	ELMA	8	FEPE	48	GEDI	4
			HOBR	2	HOMAG	2	FEPE	33	FEBR	5	GEDI	3	HOMAG	1
			HOMAG	2	HYGL	1	GEDI	8	FEPE	40	HOMAG	1	HYGL	2
			JUPH	1	JUBU	1	LYHY	1	GEDI	7	TRAN	1	RUCR	1
			PLCO	13	LYHY	1	POAVD	1	HOMAG	1	VISA	1	TRAN	2
			TRAN	1	POAVD	1	POMO	1	RUCR	4	TH	38	VISA	1
			TRDU	1	POMO	1	RUCR	3	TRAN	1	BG	2	TH	36
			TH	35	PS sp.	1	TH	35	TRDU	1			BG	8
			BG	10	RUCR	1	BG	10	VISA	1				
					TRDU	1			TH	25				
					TH	25			BG	4				
					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		Quadrat #4		Quadrat #5		Quadrat #6	
			Species	% Cover	Species	% Cover	Species	% Cover	Species	% Cover	Species	% Cover	Species	% Cover
4	10 m	67%	BRHO	4	BRHO	1	AICA	1	AICA	1	AVBA	1	AICA	1
			DACA	6	DACA	4	BRHO	8	BRDI	1	BRDI	1	AVBA	1
			ERBO	22	ERBO	12	DACA	7	BRHO	2	BRHO	2	BRDI	2
			FEBR	1	FEBR	1	ERBO	27	DACA	3	DACA	4	DACA	4
			HYGL	1	FEMY	15	FEBR	2	ERBO	35	ERBO	24	ERBO	30
			JUPH	1	PLCO	4	FEMY	4	FEMY	1	SIMAM	17	GEDI	1
			PLCO	2	TH	57	LYAR	1	HYGL	2	TRAN	9	HYGL	2
			SIGA	1	BG	6	PLCO	3	HYRA	1	VISAN	1	LYAR	2
			TRAN	1			TRAN	1	PLCO	6	TH	38	PLCO	3
			TH	56			TH	40	TRAN	11	BG	3	SIMAM	2
			BG	5			BG	6	VISAN	1			TAOV	1
									TH	34			TRAN	8
									BG	2			TRDU	1
													TH	37
													BG	5
			TOTAL	**100**	**TOTAL**	**100**	**TOTAL**	**100**	**TOTAL**	**100**	**TOTAL**	**100**	**TOTAL**	**100**

Pond 39 2022 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	*Lepidium nitidum*	shining pepperweed	LENI
Acmispon parviflorus	hill lotus	ACPA	*Luzula comosa*	Pacific woodrush	LUCO6
Aira caryophyllea	silvery hair-grass	AICA	*Lysimachia arvensis*	scarlet pimpernel	LYAR
Avena barbata	slender wild oat	AVBA	*Lythrum hyssopifolia*	grass poly	LYHY
Baccharis pilularis	coyote brush	BAPI	*Madia gracilis*	gumweed	MAGR
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
Calochortus uniflorus	pink star-tulip	CAUN	*Plantago erecta*	California plantain	PLER
Cicendia quadrangularis	timwort	CIQU	*Plantago lanceolata*	English plantain	PLLA
Clarkia purpurea ssp. *quadrivulnera*	winecup clarkia	CLPUQ	*Pogogyne zizyphoroides*	Sacramento mesa mint	POZI
Cotula coronopifolia	brass buttons	COCO	*Polygonum aviculare* ssp. *depressum*	prostrate knotweed	POAVD
Danthonia californica	California oat grass	DACA	*Polypogon monspeliensis*	rabbitfoot grass	POMO
Daucus pusillus	rattlesnake weed	DAPU	*Pseudognaphalium* sp.		
Deinandra corymbosa	coastal tarweed	DECO	*Psilocarphus chilensis*	round woolly-marbles	PSCH
Deschampsia danthonioides	annual hair grass	DEDA	*Quercus agrifolia*	coast live oak	QUAG
Distichlis spicata	salt grass	DISP	*Rumex acetosella*	sheep sorrel	RUAC
Eleocharis acicularis var. *acicularis*	needle spikerush	ELACA	*Rumex crispus*	curly dock	RUCR
Eleocharis macrostachya	pale spikerush	ELMA	*Rumex salicifolius*	willow dock	RUSA
Erodium botrys	long-beaked filaree	ERBO	*Senecio glomeratus*	cutleaf burnweed	SEGL
Erodium cicutarium	redstem filaree	ERCI	*Sidalcea malviflora* ssp. *malviflora*	checkerbloom	SIMAM
Eryngium armatum	coyote thistle	ERAR12	*Silene gallica*	small-flower catchfly	SIGA
Festuca bromoides	brome fescue	FEBR	*Sisyrinchium bellum*	western blue-eyed grass	SIBE
Festuca myuros	rattail sixweeks grass	FEMY	*Sonchus oleraceus*	common sow thistle	SOOL
Festuca perennis	Italian rye grass	FEPE	*Spergula arvensis*	corn spurry	SPAR
Galium porrigens	climbing bedstraw	GAPO	*Stipa pulchra*	purple needle grass	STPU
Gamochaeta ustulata	purple cudweed	GAUS	*Taraxia ovata*	sun cups	TAOV
Geranium dissectum	cut-leaved geranium	GEDI	*Trifolium angustifolium*	narrow-leaved clover	TRAN
Heterotheca grandiflora	telegraph weed	HEGR	*Trifolium dubium*	little hop clover	TRDU
Hordeum brachyantherum	meadow barley	HOBR	*Trifolium hirtum*	rose clover	TRHI
Hordeum marinum ssp. *gussoneanum*	Mediterranean barley	HOMAG	*Vicia hirsuta*	hairy vetch	VIHI
Horkelia cuneata var. *sericea*	wedge-leaved horkelia	HOCUS	*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	*Zeltnera davyi*	Davy's centuary	ZEDA
Juncus balticus	Baltic rush	JUBA	**Groundcover Codes**		
Juncus bufonius	toad rush	JUBU	BG	Bare Ground	
Juncus occidentalis	western rush	JUOC	TH	Thatch/Duff	
Juncus phaeocephalus	brown-headed rush	JUPH	AL	Algae	

Table A-6. Pond 40 South (Year 4 Post-Subsurface Munitions Remediation)
Wetland Vegetation Transect Data by Stratum

POND 40 South			
Date	4/29/2022		
Surveying Personnel	Kayti Christianson, Emily Poor, and Brett Bell		
Vegetation Type	**% Cover**	**Species**	**Notes**
Emergent Vegetation			
Floating Vegetation			
Submerged Vegetation			
Open Water			
Notes			
Pond 40 South remained dry throughout the 2021-2022 water-year (Chenega, 2023). Stratum 3 was repeated from 2016 and 2018-2021. Strata 4 and 5 and the corresponding transects were identified and established in 2022. Transect 3 was relocated because the previous location was no longer within the correct 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
3	10 m	37%	FEBR	2	BRMI	1	FEPE	48	BRHO	1	FEPE	65	FEPE	44
			FEPE	60	ERCI	2	TH	33	FEPE	55	GEDI	1	GEDI	3
			GEDI	3	FEBR	3	BG	19	GEDI	1	HOBR	1	HOBR	1
			TH	27	FEPE	55			HYGL	2	PLCHH	1	LYAR	1
			BG	8	GEDI	2			TH	40	SOOL	1	MAGR	1
					HYGL	2			BG	1	TH	28	PLCHH	1
					TRAN	1					BG	3	PS sp.	1
					TH	31							SOOL	1
					BG	3							TH	45
													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
4	10 m	56%	ERBO	32	BRHO	1	BRHO	2	AVBA	1	BRHO	1	AICA	1
			HYGL	2	BRMI	1	ERBO	40	BRHO	1	ERBO	71	BRHO	1
			PLCO	8	ERBO	38	FEBR	1	ERBO	38	GEDI	1	ERBO	20
			TRAN	26	FEBR	1	FEPE	1	FEBR	1	HYGL	1	HYGL	2
			TH	8	HYGL	1	GEDI	3	HYGL	3	PLCO	8	JUPH	1
			BG	24	PLCO	2	HYGL	1	HYRA	1	SIGA	1	PLCO	4
					TRAN	40	RUAC	4	PLCO	2	TRAN	2	SIGA	1
					TH	6	TRAN	23	TRAN	35	TH	10	TRAN	24
					BG	10	TRDU	2	TH	4	BG	5	TH	11
							TH	20	BG	14			BG	35
							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
5	5 m	7%	CAED	1	BRHO	1	AICA	1
			ELMA	1	ELACA	1	DECO	1
			ERBO	2	ELMA	3	ELACA	1
			FEBR	1	ERAR12	12	ELMA	2
			FEPE	4	FEBR	1	FEBR	1
			GEDI	4	FEPE	6	FEPE	2
			HEGR	1	GEDI	8	GEDI	6
			HYGL	14	HYGL	3	HEGR	1
			HYRA	1	LYAR	2	HYGL	1
			LYHY	1	PLCHH	12	HYRA	3
			LYMI	1	PLCO	17	PLCHH	18
			PLCHH	13	VISAS	3	PLCO	22
			PLCO	22	TH	19	VISAS	1
			TRHI	1	BG	12	TH	27
			VISAS	2			BG	13
			TH	24				
			BG	7				
			TOTAL	**100**	**TOTAL**	**100**	**TOTAL**	**100**

Pond 40 South 2022 Species List					
Species Name	**Common Name**	**Species Code**	**Species Name**	**Common Name**	**Species Code**
Acaena pinnatifida var. *californica*	California acaena	ACPIC	*Lupinus nanus*	sky lupine	LUNA
Achillea millefolium	common yarrow	ACMI	*Lysimachia arvensis*	scarlet pimpernel	LYAR
Acmispon americanus var. *americanus*	Spanish lotus	ACAMA	*Lysimachia minima*	chaffweed	LYMI
Acmispon parviflorus	hill lotus	ACPA	*Lythrum hyssopifolia*	grass poly	LYHY
Aira caryophyllea	silvery hair-grass	AICA	*Madia exigua*	small tarweed	MAEX
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	*Plagiobothrys chorisianus* var. *hickmanii*	Hickman's popcornflower	PLCHH
Brodiaea terrestris ssp. *terrestris*	dwarf brodiaea	BRTET	*Plantago coronopus*	cut-leaved plantain	PLCO
Bromus diandrus	ripgut grass	BRDI	*Plantago lanceolata*	English plantain	PLLA
Bromus hordeaceus	soft chess	BRHO	*Pseudognaphalium luteoalbum*	weedy cudweed	PSLU
Bromus madritensis ssp. *madritensis*	foxtail chess	BRMAM3	*Pseudognaphalium* sp.		
Carduus pycnocephalus	Italian thistle	CAPY	*Rumex acetosella*	sheep sorrel	RUAC
Carpobrotus edulis	ice plant	CAED	*Rumex salicifolius*	willow dock	RUSA
Castilleja densiflora ssp. *densiflora*	dense flower owl's clover	CADED	*Sidalcea malviflora* ssp. *malviflora*	checkerbloom	SIMAM
Danthonia californica	California oat grass	DACA	*Silene gallica*	small-flower catchfly	SIGA
Deinandra corymbosa	coastal tarweed	DECO	*Sisyrinchium bellum*	western blue-eyed grass	SIBE
Eleocharis acicularis var. *acicularis*	needle spikerush	ELACA	*Sonchus asper*	prickly sow thistle	SOAS
Eleocharis macrostachya	pale spikerush	ELMA	*Sonchus oleraceus*	common sow thistle	SOOL
Erodium botrys	long-beaked filaree	ERBO	*Stipa pulchra*	purple needle grass	STPU
Erodium cicutarium	redstem filaree	ERCI	*Taraxia ovata*	sun cups	TAOV
Eryngium armatum	coyote thistle	ERAR12	*Trifolium angustifolium*	narrow-leaved clover	TRAN
Festuca bromoides	brome fescue	FEBR	*Trifolium campestre*	hop clover	TRCA5
Festuca perennis	Italian rye grass	FEPE	*Trifolium dubium*	little hop clover	TRDU
Geranium dissectum	cut-leaved geranium	GEDI	*Trifolium hirtum*	rose clover	TRHI
Heterotheca grandiflora	telegraph weed	HEGR	*Vicia hirsuta*	hairy vetch	VIHI
Hordeum brachyantherum	meadow barley	HOBR	*Vicia sativa* ssp. *sativa*	spring vetch	VISAS
Hypochaeris glabra	smooth cat's-ear	HYGL	*Vicia sativa* ssp. *nigra*	common vetch	VISAN
Hypochaeris radicata	rough cat's-ear	HYRA	**Groundcover Codes**		
Juncus occidentalis	western rush	JUOC	BG	Bare Ground	
Juncus phaeocephalus	brown-headed rush	JUPH	TH	Thatch/Duff	
Logfia gallica	narrowleaf cottonrose	LOGA	AL	Algae	

Table A-7. Pond 41 (Year 4 Post-Subsurface Munitions Remediation) Wetland Vegetation Transect Data by Stratum

POND 41			
Date	5/3/2022		
Surveying Personnel	Kayti Christianson, Emily Poor, and Brett Bell		
Vegetation Type	**% Cover**	**Species**	**Notes**
Emergent Vegetation			
Floating Vegetation			
Submerged Vegetation			
Open Water			
Notes			
Pond 41 briefly held water in January with some peripheral ponding present but was otherwise dry throughout the 2021-2022 water-year (Chenega, 2023). Strata 1, 2, and 3 were repeated from 2016, 2019, 2020, and 2021. Stratum 4 was repeated from 2019-2021. Transects 1, 3, and 4 were relocated because the previous locations were no longer within the correct strata. Transect 2 was relocated to an area with more representative vegetative composition.			

Transect #	Transect Length	Relative % Cover of Wetland	Quadrat #1		Quadrat #2		Quadrat #3	
			Species	% Cover	Species	% Cover	Species	% Cover
1	5 m	3%	BRHO	2	LAGL3	10	DEDA	1
			DEDA	1	BRHO	2	ELACa	2
			ELACa	1	DEDA	1	ELMA	2
			ELMA	2	ELACa	2	GEDI	17
			GEDI	3	ELMA	1	LAGL3	14
			LAGL3	8	GEDI	2	MALE	10
			MALE	6	HYGL	2	PLCHH	3
			PHLE	3	MALE	8	PS sp.	1
			PLCHH	1	PHLE	3	TH	49
			SOOL	1	PLCHH	3	BG	1
			TH	70	POMO	1		
			BG	2	TH	62		
					BG	3		
			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	91%	ELACa	4	ELACa	1	BRMI	1	ELACa	5	BRHO	8	BRHO	6
			ELMA	2	ELMA	1	ELACa	3	ELMA	2	DEDA	1	ELMA	1
			GEDI	18	GEDI	16	ELMA	2	GEDI	35	ELACa	1	GEDI	25
			MALE	7	LAGL3	1	GEDI	30	LAGL3	1	ELMA	1	MALE	2
			PHLE	25	MALE	4	LAGL3	1	MALE	4	GEDI	20	PHLE	1
			PLCHH	2	PHLE	14	MALE	7	PHLE	6	MALE	2	STAJ	2
			TH	40	PLCHH	7	MASA	2	PLCHH	8	PHLE	6	TH	62
			BG	2	TH	55	PHLE	11	STAJ	1	PLCHH	6	BG	1
					BG	1	PLCHH	9	TH	37	POMO	1		
							RUCR	1	BG	1	TH	50		
							STAJ	1			BG	4		
							TH	26						
							BG	6						
			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	4%	GEDI	7	BRHO	1	BRHO	1	BRMI	1	GEDI	8	BRHO	1
			JUPH	18	BRMI	3	BRMI	3	GEDI	8	HYGL	6	BRMI	1
			MALE	2	ERBO	4	ERBO	1	JUPH	26	HYRA	1	GEDI	7
			RUCR	1	GEDI	3	GEDI	13	MALE	2	JUPH	11	JUPH	5
			SOOL	1	JUPH	20	JUPH	50	PHLE	3	MALE	2	MALE	1
			TH	70	MALE	1	MALE	4	TH	59	PHLE	1	PHLE	3
			BG	1	SOOL	2	TH	26	BG	1	PSLU	1	TH	82
					TH	65	BG	2			STAJ	1		
					BG	1					TH	69		
			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	1%	MASA	4	DACA	30	DACA	12
			CAAM	1	ERBO	16	ERBO	12
			HYGL	8	MAGR	1	HYGL	2
			MAGR	3	MASA	2	MALE	1
			ERBO	12	ERAR12	10	ERAR12	7
			DACA	11	AICA	1	FEBR	8
			AICA	1	HYGL	3	MASA	1
			FEBR	3	FEBR	1	MAGR	1
			FEMY	2	CAAM	1	AICA	1
			ERAR12	2	TH	16	TH	44
			GEDI	6	BG	19	BG	11
			JUPH	1				
			TH	35				
			BG	11				
			TOTAL	**100**	**TOTAL**	**100**	**TOTAL**	**100**

Pond 41 2022 Species List					
Species Name	**Common Name**	**Species Code**	**Species Name**	**Common Name**	**Species Code**
Achillea millefolium	common yarrow	ACMI	*Hypochaeris radicata*	rough cat's-ear	HYRA
Agoseris grandiflora var. *grandiflora*	large-flowered agoseris	AGGRG	*Juncus balticus*	Baltic rush	JUBA
Aira caryophyllea	silvery hair-grass	AICA	*Juncus phaeocephalus*	brown-headed rush	JUPH
Baccharis pilularis	coyote brush	BAPI	*Lasthenia glaberrima*	smooth goldfields	LAGL3
Briza minor	annual quaking grass	BRMI	*Luzula comosa*	Pacific woodrush	LUCO6
Brodiaea terrestris ssp. *terrestris*	dwarf brodiaea	BRTET	*Lysimachia arvensis*	scarlet pimpernel	LYAR
Bromus diandrus	ripgut grass	BRDI	*Lythrum hyssopifolia*	grass poly	LYHY
Bromus hordeaceus	soft chess	BRHO	*Madia gracilis*	gumweed	MAGR
Calandrinia menziesii	redmaids	CAME	*Madia sativa*	coast tarweed	MASA
Carduus pycnocephalus	Italian thistle	CAPY	*Malvella leprosa*	alkali mallow	MALE
Castilleja ambigua	Johnny-Nip	CAAM	*Oxalis corniculata*	creeping woodsorrel	OXCO
Danthonia californica	California oat grass	DACA	*Phalaris lemmonii*	Lemmon's canary grass	PHLE
Deinandra corymbosa	coastal tarweed	DECO	*Plagiobothrys chorisianus* var. *hickmanii*	Hickman's popcornflower	PLCHH
Deschampsia danthonioides	annual hair grass	DEDA	*Plantago coronopus*	cut-leaved plantain	PLCO
Drymocallis glandulosa var. *wrangelliana*	sticky cinquefoil	DRGLW	*Polypogon monspeliensis*	rabbitfoot grass	POMO
Eleocharis acicularis var. *acicularis*	needle spikerush	ELACA	*Pseudognaphalium luteoalbum*	weedy cudweed	PSLU
Eleocharis macrostachya	pale spikerush	ELMA	*Pseudognaphalium* sp.		
Elymus glaucus	blue wild-rye	ELGL	*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
Erodium botrys	long-beaked filaree	ERBO	*Sonchus asper*	prickly sow thistle	SOAS
Erodium cicutarium	redstem filaree	ERCI	*Sonchus oleraceus*	common sow thistle	SOOL
Eryngium armatum	coyote thistle	ERAR12	*Stachys ajugoides*	bugle hedge nettle	STAJ
Festuca bromoides	brome fescue	FEBR	*Trifolium depauperatum*	sack clover	TRDE
Festuca myuros	rattail sixweeks grass	FEMY	*Trifolium microcephalum*	small head clover	TRMI
Gamochaeta ustulata	purple cudweed	GAUS	*Verbena bracteata*	bracted verbena	VEBR
Geranium dissectum	cut-leaved geranium	GEDI	*Verbena lasiostachys* var. *lasiostachys*	western vervain	VELAL
Gnaphalium palustre	lowland cudweed	GNPA	**Groundcover Codes**		
Heliotropium curassavicum var. *oculatum*	Chinese pusley	HECUO	BG	Bare Ground	
Heterotheca grandiflora	telegraph weed	HEGR	TH	Thatch/Duff	
Hypochaeris glabra	smooth cat's-ear	HYGL	AL	Algae	

Table A-8. Pond 42 (Year 4 Post-Subsurface Munitions Remediation)
Wetland Vegetation Transect Data by Stratum

POND 42			
Date	5/4/2022		
Surveying Personnel	Kayti Christianson, Emily Poor, and Brett Bell		
Vegetation Type	**% Cover**	**Species**	**Notes**
Emergent Vegetation			
Floating Vegetation			
Submerged Vegetation			
Open Water			
Notes			
Pond 42 was dry by the February 1 hydrology monitoring event (Chenega, 2023). Strata 1 through 4 were repeated from 2017-2021. Stratum 5 was repeated from 2019-2021. Transects 1, 3, and 4 were relocated because the previous locations were no longer within the correct strata. Transect 2 was repeated from 2018-2021. Transect 5 was repeated from 2020 and 2021.			

Transect #	Transect Length	Relative % Cover of Wetland	Quadrat #1		Quadrat #2		Quadrat #3	
			Species	% Cover	Species	% Cover	Species	% Cover
1	5 m	18%	BRMI	1	AGLAV	1	BRMI	1
			BRTET	1	DEDA	2	DEDA	28
			DEDA	2	ELACA	13	ELACA	8
			ELACA	30	ERAR12	18	GAUS	2
			ERAR12	14	ERCA	1	GEDI	1
			FEBR	1	GAUS	1	HYGL	2
			GAUS	1	GEDI	3	LYHY	2
			GEDI	2	HYGL	3	PLCHH	4
			HYRA	5	HYRA	4	POMO	2
			JUPH	2	LYHY	1	PSCH	1
			LOGA	1	PLCHH	7	SEGL	1
			LYHY	2	PLCO	1	TH	39
			PLCHH	1	POMO	1	BG	9
			POMO	3	PSCH	2		
			SEGL	1	TH	39		
			TH	18	BG	3		
			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
2	5 m	7%	CIBR	1	ELACA	3	ELMA	46
			COCO	1	ELMA	28	TH	54
			ELMA	37	PHLE	1	BG	0
			GEDI	2	PLCHH	1		
			PLCHH	1	PSLU	1		
			PSLU	1	TH	65		
			SOOL	1	BG	1		
			TH	54				
			BG	2				
			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	22%	BRHO	1	BAPI	1	BRHO	1	BRHO	1	BRHO	2	AICA	1
			ELACA	2	BRHO	2	COCO	1	DEDA	1	DEDA	1	BRHO	2
			ERAR12	8	ELACA	6	ELACA	1	ELACA	4	ELACA	10	DEDA	1
			GEDI	1	ERAR12	8	ERAR12	6	GEDI	7	ERAR12	4	ELACA	4
			JUPH	30	GEDI	2	GEDI	1	JUPH	28	GEDI	6	ERAR12	6
			SEGL	1	JUPH	30	HYRA	1	LYHY	1	JUPH	16	GEDI	7
			TH	51	PLCHH	1	JUPH	40	SOOL	1	PLCHH	1	HYGL	1
			BG	6	POMO	1	POMO	1	TH	54	POMO	2	JUPH	25
					PSLU	1	SEGL	1	BG	3	SEGL	1	POMO	1
					SEGL	1	SOOL	1			SOAS	1	SEGL	1
					TH	38	TH	37			SOOL	3	SOAS	1
					BG	9	BG	9			TH	51	SOOL	1
											BG	2	TH	45
													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	
			Species	% Cover	Species	% Cover	Species	% Cover
4	5 m	25%	AVBA	1	AVBA	1	AVBA	1
			CIQU	1	BRTET	1	DECO	4
			DACA	5	CAAT	1	ERAR12	9
			DECO	7	DACA	1	ERBO	3
			ELACA	1	DECO	6	FEBR	1
			ERAR12	2	ERAR12	2	GEDI	1
			ERBO	8	ERBO	2	HYGL	7
			FEMY	1	FEMY	1	HYRA	1
			HYGL	8	HYGL	8	LOGA	1
			HYRA	2	HYRA	1	LYAR	2
			LOGA	1	LOGA	1	PLCHH	1
			LYAR	2	LYAR	2	POMO	1
			LYHY	1	LYHY	1	TROB	1
			ZEDA	1	LYMI	1	TH	30
			TH	30	POMO	1	BG	36
			BG	29	PSCH	1		
					TH	27		
					BG	42		
			TOTAL	**100**	**TOTAL**	**100**	**TOTAL**	**99**

Transect #	Transect Length	Relative % Cover of Wetland	Quadrat #1		Quadrat #2		Quadrat #3	
			Species	% Cover	Species	% Cover	Species	% Cover
5	5 m	12%	POMO	60	FEBR	1	BRHO	1
			LYHY	1	POMO	53	POMO	12
			TH	28	TH	44	TROB	1
			BG	11	BG	2	TH	79
							BG	7
			TOTAL	**100**	**TOTAL**	**100**	**TOTAL**	**100**

Pond 42 2022 Species List

Species Name	Common Name	Species Code
Achillea millefolium	common yarrow	ACMI
Acmispon parviflorus	hill lotus	ACPA
Agrostis avenacea	Pacific bent grass	AGAV
Agrostis lacuna-vernalis	vernal pool bent grass	AGLAV
Aira caryophyllea	silvery hair-grass	AICA
Arctostaphylos hookeri	Hooker's manzanita	ARHO
Arctostaphylos tomentosa	woolly leaf manzanita	ARTO
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 carinatus	California brome	BRCA
Bromus diandrus	ripgut grass	BRDI
Bromus hordeaceus	soft chess	BRHO
Castilleja ambigua ssp. *ambigua*	Johnny-Nip	CAAMA3
Castilleja attenuata	valley tassels	CAAT
Centaurea melitensis	Maltese star-thistle	CEME
Cicendia quadrangularis	timwort	CIQU
Cirsium brevistylum	Indian thistle	CIBR
Cotula coronopifolia	brass buttons	COCO
Crocanthemum scoparium	peak rush-rose	CRSC
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
Elymus glaucus	blue wild-rye	ELGL
Erigeron canadensis	horseweed	ERCA
Eriodictyon californicum	yerba santa	ERCA6
Erodium botrys	long-beaked filaree	ERBO
Eryngium armatum	coyote thistle	ERAR12
Festuca bromoides	brome fescue	FEBR
Festuca myuros	rattail sixweeks grass	FEMY
Galium aparine	goose grass	GAAP
Galium porrigens	climbing bedstraw	GAPO
Gamochaeta ustulata	purple cudweed	GAUS
Geranium dissectum	cut-leaved geranium	GEDI
Hypochaeris glabra	smooth cat's-ear	HYGL
Hypochaeris radicata	rough cat's-ear	HYRA
Juncus phaeocephalus	brown-headed rush	JUPH
Lasthenia glaberrima	smooth goldfields	LAGL3
Logfia gallica	narrowleaf cottonrose	LOGA
Luzula comosa	Pacific woodrush	LUCO6
Lysimachia arvensis	scarlet pimpernel	LYAR
Lysimachia minima	chaffweed	LYMI
Lythrum hyssopifolia	grass poly	LYHY
Madia gracilis	gumweed	MAGR
Madia sativa	coast tarweed	MASA
Melilotus indicus	Indian sweetclover	MEIN
Microseris paludosa	marsh microseris	MIPA
Phalaris lemmonii	Lemmon's canary grass	PHLE
Plagiobothrys chorisianus var. *hickmanii*	Hickman's popcornflower	PLCHH
Plantago coronopus	cut-leaved plantain	PLCO
Plantago elongata	annual coast plantain	PLEL
Plantago erecta	California plantain	PLER
Plantago lanceolata	English plantain	PLLA
Pogogyne zizyphoroides	Sacramento mesa mint	POZI
Polypogon monspeliensis	rabbitfoot grass	POMO
Pseudognaphalium luteoalbum	weedy cudweed	PSLU
Pseudognaphalium ramosissimum	pink everlasting	PSRA
Pseudognaphalium stramineum	cottonbatting plant	PSST
Psilocarphus chilensis	round woolly-marbles	PSCH
Rubus ursinus	California blackberry	RUUR
Rumex acetosella	sheep sorrel	RUAC
Rumex salicifolius	willow dock	RUSA
Senecio glomeratus	cutleaf burnweed	SEGL
Silene gallica	small-flower catchfly	SIGA
Sisyrinchium bellum	western blue-eyed grass	SIBE
Sonchus asper	prickly sow thistle	SOAS
Sonchus oleraceus	common sow thistle	SOOL
Stachys ajugoides	bugle hedge nettle	STAJ
Stachys bullata	California hedge nettle	STBU
Stipa pulchra	purple needle grass	STPU
Toxicodendron diversilobum	poison oak	TODI
Tribolium obliterum	Capetown grass	TROB
Trifolium angustifolium	narrow-leaved clover	TRAN
Trifolium campestre	hop clover	TRCA5
Trifolium dubium	little hop clover	TRDU
Trifolium microdon	thimble clover	TRMI5
Trifolium willdenovii	tomcat clover	TRWI
Typha sp.		
Vicia sativa	spring vetch	VISA
Zeltnera davyi	Davy's centuary	ZEDA
Groundcover Codes		
BG	Bare Ground	
TH	Thatch/Duff	
AL	Algae	

Table A-9. Pond 61 (Year 4 Post-Subsurface Munitions Remediation)
Wetland Vegetation Transect Data by Stratum

POND 61			
Date	4/28/2022		
Surveying Personnel	Kayti Christianson, Emily Poor, and Brett Bell		
Vegetation Type	**% Cover**	**Species**	**Notes**
Emergent Vegetation			
Floating Vegetation			
Submerged Vegetation			
Open Water			
Notes			
Pond 61 was dry by the March 2 hydrology monitoring event (Chenega, 2023). Strata 2 through 4 were repeated from 2017-2021. Transect 3 was was relocated to an area with more representative vegetative composition, whereas Transect 4 was repeated from 2017-2021. Stratum 2 consisted of CCG and no transect was 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
3	10 m	4%	BRMA	1	BRHO	1	BRTET	5	BRTET	6	BRTET	16	BRTET	10
			BRMI	1	BRMA	1	DEDA	5	DEDA	2	CIQU	1	DECO	1
			BRTET	5	BRTET	4	ERAR12	4	ELACA	5	DEDA	1	DEDA	2
			CIQU	1	CIQU	1	HYGL	2	ERAR12	3	ELACA	2	ELACA	2
			DEDA	3	DECO	1	JUPH	2	FEBR	1	ERAR12	9	ERAR12	7
			ERAR12	9	DEDA	3	LYHY	3	GEDI	1	HYGL	2	FEBR	1
			FEBR	4	ERAR12	6	LYMI	1	HYGL	4	LAGL3	1	HYGL	4
			HYGL	1	GEDI	1	PLCHH	30	HYRA	1	LYAR	1	LAGL3	2
			JUPH	2	HYGL	2	POZI	1	JUPH	1	LYHY	1	LYAR	1
			LAGL3	1	LYHY	2	SOOL	1	LAGL3	1	LYMI	1	LYHY	1
			LYHY	2	PLCHH	35	TH	32	LYHY	1	MIPA	1	LYMI	1
			LYMI	1	POMO	1	BG	14	PLCHH	35	PLCHH	30	PLCHH	35
			MIDOD	1	PSCH	1			TH	35	POZI	9	TH	30
			MIPA	1	TH	31			BG	4	TH	23	BG	3
			PLCHH	30	BG	10					BG	2		
			PSCH	1										
			TH	22										
			BG	14										
			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	57%	BRMA	40	BRHO	1	BRHO	1	BRMA	15	BRMA	25	BRHO	3
			BRMI	1	BRMA	35	BRMA	20	BRMI	1	BRMI	1	BRMA	25
			BRTET	5	BRMI	1	BRMI	1	BRTET	1	CAAMA3	1	BRMI	1
			DECO	2	DECO	5	BRTET	1	CAAMA3	1	DACA	5	BRTET	1
			ERBO	3	ERBO	3	DACA	10	DACA	12	DECO	12	DECO	28
			FEBR	1	FEBR	1	DECO	1	DECO	5	ERBO	2	ERBO	7
			GEDI	1	HYGL	12	ERBO	5	ERBO	2	FEBR	10	FEBR	3
			HYGL	4	HYRA	2	FEBR	1	FEBR	2	GEDI	1	GEDI	3
			LYAR	1	LYAR	1	HYGL	10	GEDI	1	HYGL	8	HYGL	6
			MIPA	2	MAGR	1	LYAR	1	HYGL	12	LYAR	5	LYAR	9
			TH	34	MASA	1	LYHY	1	LYAR	4	LYHY	1	LYHY	1
			BG	6	SOOL	1	MA sp.	1	MIPA	1	MAEL	1	TH	10
					TH	24	MIPA	1	TH	8	MIPA	3	BG	3
					BG	12	TH	31	BG	35	TH	15		
							BG	15			BG	10		
			TOTAL	**100**	**TOTAL**	**100**	**TOTAL**	**100**	**TOTAL**	**100**	**TOTAL**	**100**	**TOTAL**	**100**

Pond 61 2022 Species List					
Species Name	**Common Name**	**Species Code**	**Species Name**	**Common Name**	**Species Code**
Acaena pinnatifida var. *californica*	California acaena	ACPIC	*Juncus bufonius* var. *occidentalis*	round-fruited toad rush	JUBUO
Achillea millefolium	common yarrow	ACMI	*Juncus occidentalis*	western rush	JUOC
Adenostoma fasciculatum	chamise	ADFA	*Juncus phaeocephalus*	brown-headed rush	JUPH
Agrostis lacuna-vernalis	vernal pool bent grass	AGLAV	*Koeleria macrantha*	June grass	KOMA
Aira caryophyllea	silvery hair-grass	AICA	*Lasthenia conjugens*	Contra Costa goldfields	LACO
Allium hickmanii	Hickman's onion	ALHI	*Lasthenia glaberrima*	smooth goldfields	LAGL3
Arctostaphylos hookeri	Hooker's manzanita	ARHO	*Leptosiphon parviflorus*	variable linanthus	LEPA
Avena barbata	slender wild oat	AVBA	*Logfia gallica*	narrowleaf cottonrose	LOGA
Baccharis pilularis	coyote brush	BAPI	*Lupinus nanus*	sky lupine	LUNA
Briza maxima	rattlesnake grass	BRMA	*Luzula comosa*	Pacific woodrush	LUCO6
Briza minor	annual quaking grass	BRMI	*Lysimachia arvensis*	scarlet pimpernel	LYAR
Brodiaea terrestris ssp. *terrestris*	dwarf brodiaea	BRTET	*Lysimachia minima*	chaffweed	LYMI
Bromus diandrus	ripgut grass	BRDI	*Lythrum hyssopifolia*	grass poly	LYHY
Bromus hordeaceus	soft chess	BRHO	*Madia elegans*	common madia	MAEL
Calochortus uniflorus	pink star-tulip	CAUN	*Madia gracilis*	gumweed	MAGR
Calystegia subacaulis ssp. *subacaulis*	hill morning glory	CASUS	*Madia sativa*	coast tarweed	MASA
Castilleja ambigua ssp. *ambigua*	Johnny-Nip	CAAMA3	*Madia* sp.		
Castilleja densiflora	dense flower owl's clover	CADE	*Microseris douglasii* ssp. *douglasii*	Douglas' silverpuffs	MIDOD
Centaurea melitensis	Maltese star-thistle	CEME	*Microseris paludosa*	marsh microseris	MIPA
Chlorogalum pomeridianum	wavyleaf soap plant	CHPO	*Phalaris lemmonii*	Lemmon's canary grass	PHLE
Cicendia quadrangularis	timwort	CIQU	*Plagiobothrys chorisianus* var. *hickmanii*	Hickman's popcornflower	PLCHH
Cirsium quercetorum	brownie thistle	CIQU2	*Plantago coronopus*	cut-leaved plantain	PLCO
Corethrogyne filaginifolia	common sandaster	COFI	*Plantago elongata*	annual coast plantain	PLEL
Cotula coronopifolia	brass buttons	COCO	*Plantago erecta*	California plantain	PLER
Crassula aquatica	aquatic pygmy-weed	CRAQ	*Pogogyne zizyphoroides*	Sacramento mesa mint	POZI
Danthonia californica	California oat grass	DACA	*Polypogon monspeliensis*	rabbitfoot grass	POMO
Deinandra corymbosa	coastal tarweed	DECO	*Primula clevelandii* var. *patula*	Padre's shooting star	PRCLP
Deschampsia danthonioides	annual hair grass	DEDA	*Pseudognaphalium californicum*	California everlasting	PSCA
Dichelostemma capitatum ssp. *capitatum*	bluedicks	DICAC	*Psilocarphus chilensis*	round woolly-marbles	PSCH
Eleocharis acicularis var. *acicularis*	needle spikerush	ELACA	*Quercus agrifolia*	coast live oak	QUAG
Eleocharis macrostachya	pale spikerush	ELMA	*Ranunculus californicus*	California buttercup	RACA
Elymus glaucus	blue wild-rye	ELGL	*Rumex acetosella*	sheep sorrel	RUAC
Erodium botrys	long-beaked filaree	ERBO	*Sidalcea malviflora* ssp. *malviflora*	checkerbloom	SIMAM
Erodium cicutarium	redstem filaree	ERCI	*Silene gallica*	small-flower catchfly	SIGA
Eryngium armatum	coyote thistle	ERAR12	*Sisyrinchium bellum*	western blue-eyed grass	SIBE
Eschscholzia californica	California poppy	ESCA	*Sonchus oleraceus*	common sow thistle	SOOL
Festuca bromoides	brome fescue	FEBR	*Spiranthes romanzoffiana*	hooded lady's tresses	SPRO
Festuca myuros	rattail sixweeks grass	FEMY	*Taraxia ovata*	sun cups	TAOV
Festuca perennis	Italian rye grass	FEPE	*Toxicodendron diversilobum*	poison oak	TODI
Galium aparine	goose grass	GAAP	*Trifolium depauperatum*	sack clover	TRDE
Galium porrigens	climbing bedstraw	GAPO	*Trifolium gracilentum*	pin point clover	TRGR
Gamochaeta ustulata	purple cudweed	GAUS	*Trifolium microdon*	thimble clover	TRMI5
Geranium dissectum	cut-leaved geranium	GEDI	*Trifolium polyodon*	Pacific Grove clover	TRPO3
Gnaphalium palustre	lowland cudweed	GNPA	*Triteleia* sp.		
Hordeum marinum ssp. *gussoneanum*	Mediterranean barley	HOMAG	*Vicia sativa* ssp. *sativa*	spring vetch	VISAS
Hypochaeris glabra	smooth cat's-ear	HYGL	**Groundcover Codes**		
Hypochaeris radicata	rough cat's-ear	HYRA	BG	Bare Ground	
Isoetes howellii	Howell's quillwort	ISHO	TH	Thatch/Duff	
Juncus bufonius var. *bufonius*	common toad rush	JUBUB	AL	Algae	

Table A-10. Pond 75 (Baseline) Wetland Vegetation Transect Data by Stratum

POND 75			
Date	5/9/2022		
Surveying Personnel	Kayti Christianson, Emily Poor, and Brett Bell		
Vegetation Type	**% Cover**	**Species**	**Notes**
Emergent Vegetation			
Floating Vegetation			
Submerged Vegetation			
Open Water			
Notes			
Pond 75 remained dry throughout the 2021-2022 water-year (Chenega, 2023). Strata 1 through 4 were repeated from 2021. Transects 1, 2, and 4 were repeated from 2021; whereas Transect 3 was relocated to an area with more representative vegetative composition.			

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	16%	ELMA	3	BRMI	1	BRMI	12	BRMI	1	ELMA	23	ELMA	20
			GAAP	2	ELMA	11	ELMA	12	ELMA	18	GEDI	12	GEDI	7
			GEDI	10	GAAP	1	GEDI	13	GEDI	16	MALE	6	MALE	6
			SIMA	55	GEDI	10	HOBR	1	MALE	7	TH	58	SOOL	1
			SOAS	2	SIMA	7	MALE	5	PHLE	2	BG	1	TH	65
			SOOL	1	SOAS	4	PHLE	1	SIMA	13			BG	1
			TH	25	TH	65	SIMA	1	SOAS	1				
			BG	2	BG	1	SOOL	2	VEPEX	1				
							TH	50	TH	40				
							BG	3	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
2	10 m	67%	ELMA	4	ELMA	5	ELMA	2	ELMA	3	ELMA	1	ELMA	2
			ELTR3	56	ELTR3	62	ELTR3	48	ELTR3	40	ELTR3	50	ELTR3	55
			TH	40	TH	33	TH	50	TH	56	TH	49	TH	42
									BG	1			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	
			Species	% Cover	Species	% Cover	Species	% Cover
3	5 m	5%	ELMA	1	ELMA	3	ELMA	10
			ELTR3	5	ELTR3	19	EUOC	28
			EUOC	19	EUOC	32	TH	62
			TH	73	GAAP	1		
			BG	2	RACA	1		
					TH	44		
			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	12%	BRMI	1	ELTR3	2	ELTR3	2
			ELTR3	12	JUPH	53	JUPH	22
			JUPH	34	RACA	1	TH	75
			TH	50	TH	40	BG	1
			BG	3	BG	4		
			TOTAL	**100**	**TOTAL**	**100**	**TOTAL**	**100**

Pond 75 2022 Species List

Species Name	Common Name	Species Code
Acmispon americanus var. *americanus*	Spanish lotus	ACAMA
Aira caryophyllea	silvery hair-grass	AICA
Baccharis pilularis	coyote brush	BAPI
Briza minor	annual quaking grass	BRMI
Bromus diandrus	ripgut grass	BRDI
Bromus hordeaceus	soft chess	BRHO
Calandrinia menziesii	redmaids	CAME
Carex praegracilis	clustered field sedge	CAPR
Centaurea melitensis	Maltese star-thistle	CEME
Cirsium brevistylum	Indian thistle	CIBR
Eleocharis macrostachya	pale spikerush	ELMA
Elymus triticoides	beardless wild rye	ELTR3
Erigeron canadensis	horseweed	ERCA
Euthamia occidentalis	western goldenrod	EUOC
Festuca bromoides	brome fescue	FEBR
Galium aparine	goose grass	GAAP
Galium porrigens	climbing bedstraw	GAPO
Gamochaeta ustulata	purple cudweed	GAUS
Geranium dissectum	cut-leaved geranium	GEDI
Heliotropium curassavicum var. *oculatum*	Chinese pusley	HECUO
Hordeum brachyantherum	meadow barley	HOBR
Hypochaeris glabra	smooth cat's-ear	HYGL
Juncus falcatus	falcate rush	JUFA
Juncus phaeocephalus	brown-headed rush	JUPH
Lysimachia arvensis	scarlet pimpernel	LYAR
Madia gracilis	gumweed	MAGR
Malvella leprosa	alkali mallow	MALE
Microseris paludosa	marsh microseris	MIPA
Perideridia gairdneri	Gairdner's yampah	PEGA
Phalaris lemmonii	Lemmon's canary grass	PHLE
Pseudognaphalium luteoalbum	weedy cudweed	PSLU
Pseudognaphalium stramineum	cottonbatting plant	PSST
Quercus agrifolia	coast live oak	QUAG
Ranunculus californicus	California buttercup	RACA
Rumex crispus	curly dock	RUCR
Silybum marianum	milk thistle	SIMA
Sisyrinchium bellum	western blue-eyed grass	SIBE
Sonchus asper	prickly sow thistle	SOAS
Sonchus oleraceus	common sow thistle	SOOL
Stachys bullata	California hedge nettle	STBU
Triodanis biflora	Venus' looking glass	TRBI2
Veronica peregrina ssp. *xalapensis*	speedwell	VEPEX
Vicia sativa ssp. *sativa*	spring vetch	VISAS
Groundcover Codes		
BG	Bare Ground	
TH	Thatch/Duff	
AL	Algae	

APPENDIX B

Stratum Cover by Vernal Pool

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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	**35%**	BAPI	coyote brush	0.2
		CRTR	spreading alkaliweed	1.0
		ELMA	pale spikerush	35.2
		MALE	alkali mallow	9.0
		SOOL	common sow thistle	1.5
		TH	Thatch	51.8
		BG	Bare Ground	1.3
		TOTAL		**100.0**
2	**21%**	CRTR	spreading alkaliweed	0.3
		DISP	salt grass	24.2
		ELMA	pale spikerush	4.5
		HYGL	smooth cat's-ear	0.2
		MALE	alkali mallow	1.2
		RUCR	curly dock	0.3
		SEGL	cutleaf burnweed	0.7
		SOAS	prickly sow thistle	1.2
		SOOL	common sow thistle	0.2
		TH	Thatch	66.2
		BG	Bare Ground	1.2
		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**
3	**8%**	ACWR	Chilean trefoil	0.2
		BRMI	annual quaking grass	0.5
		CRTR	spreading alkaliweed	0.2
		DISP	salt grass	8.2
		ELMA	pale spikerush	0.8
		ERBO	long-beaked filaree	0.8
		FEBR	brome fescue	0.5
		GEDI	cut-leaved geranium	6.0
		HYGL	smooth cat's-ear	9.5
		HYRA	rough cat's-ear	0.3
		MAGR	gumweed	0.2
		MALE	alkali mallow	0.2
		PHLE	Lemmon's canary grass	1.7
		PLCHH	Hickman's popcornflower	0.3
		POMO	rabbitfoot grass	0.5
		RUCR	curly dock	0.8
		SEGL	cutleaf burnweed	0.5
		SOOL	common sow thistle	0.2
		STAJ	bugle hedge nettle	11.3
		TH	Thatch	52.3
		BG	Bare Ground	5.0
		TOTAL		**100.0**
7	**1%**	BAPI	coyote brush	0.7
		BRHO	soft chess	0.3
		BRMI	annual quaking grass	0.3
		DISP	salt grass	0.3
		ERCA	horseweed	0.3
		GEDI	cut-leaved geranium	1.3
		HYGL	smooth cat's-ear	0.7
		JUBA	Baltic rush	41.0
		PS sp.	*Pseudognaphalium* sp.	0.7
		SEGL	cutleaf burnweed	0.3
		SOOL	common sow thistle	1.3
		TH	Thatch	50.7
		BG	Bare Ground	2.0
		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**
8	**35%**	BRMI	annual quaking grass	1.0
		CRTR	spreading alkaliweed	6.0
		DISP	salt grass	0.3
		ELMA	pale spikerush	0.3
		ERBO	long-beaked filaree	0.7
		FEBR	brome fescue	0.2
		GAUS	purple cudweed	0.7
		GEDI	cut-leaved geranium	12.2
		HYGL	smooth cat's-ear	5.7
		HYRA	rough cat's-ear	1.0
		JUBUB	common toad rush	0.3
		LYHY	grass poly	0.5
		PHLE	Lemmon's canary grass	9.5
		POMO	rabbitfoot grass	0.2
		PS sp.	*Pseudognaphalium* sp.	0.2
		RUAC	sheep sorrel	0.2
		RUCR	curly dock	0.2
		SEGL	cutleaf burnweed	0.3
		SOOL	common sow thistle	0.2
		STAJ	bugle hedge nettle	0.2
		TH	Thatch	51.8
		BG	Bare Ground	8.5
		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**
3	**33%**	AGAV	Pacific bent grass	1.0
		BRDI	ripgut grass	0.8
		ELMA	pale spikerush	30.0
		GEDI	cut-leaved geranium	1.7
		MALE	alkali mallow	29.3
		PHLE	Lemmon's canary grass	5.7
		RUCR	curly dock	4.0
		VELAL	western vervain	0.2
		TH	Thatch	27.3
		TOTAL		**100.0**
4	**10%**	BAGL	marsh baccharis	0.5
		BRDI	ripgut grass	0.5
		ERCA	horseweed	0.3
		EUOC	western goldenrod	4.3
		GEDI	cut-leaved geranium	6.8
		HYGL	smooth cat's-ear	0.2
		JUBA	Baltic rush	14.7
		MASA	coast tarweed	1.8
		POMO	rabbitfoot grass	0.3
		PSST	cottonbatting plant	0.5
		RUAC	sheep sorrel	1.5
		SEGL	cutleaf burnweed	0.2
		SOAS	prickly sow thistle	0.7
		TODI	poison oak	0.5
		UNK2	Unknown 2	0.2
		TH	Thatch	58.2
		BG	Bare Ground	8.8
		TOTAL		**100.0**

Table B-2 (continued). 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**
5	**55%**	AGAV	Pacific bent grass	0.5
		BRMI	annual quaking grass	0.3
		EPCI	fringed willowherb	0.3
		ERBO	long-beaked filaree	9.7
		FEBR	brome fescue	0.2
		GEDI	cut-leaved geranium	14.5
		HECUO	Chinese pusley	0.5
		HYGL	smooth cat's-ear	5.8
		HYRA	rough cat's-ear	6.7
		MAGR	gumweed	0.3
		MALE	alkali mallow	0.2
		MASA	coast tarweed	3.5
		PHLE	Lemmon's canary grass	0.2
		POMO	rabbitfoot grass	0.7
		RUAC	sheep sorrel	2.7
		RUCR	curly dock	0.2
		STAJ	bugle hedge nettle	1.7
		TRBA	bearded clover	0.2
		TRDE	sack clover	1.0
		TRGR	pin point clover	1.0
		TRMI	small head clover	0.8
		TRVA	variegated clover	0.2
		VISA	spring vetch	4.2
		TH	Thatch	28.7
		BG	Bare Ground	16.2
		TOTAL		**100.0**
9	**2%**	BRHO	soft chess	0.3
		ELMA	pale spikerush	9.0
		ERCI	redstem filaree	1.0
		FEBR	brome fescue	2.0
		HYRA	rough cat's-ear	1.0
		LAGL3	smooth goldfields	42.0
		MALE	alkali mallow	9.7
		PHLE	Lemmon's canary grass	1.0
		TRDE	sack clover	1.0
		TH	Thatch	33.0
		BG	Bare Ground	0.0
		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	**5%**	AICA	silvery hair-grass	0.3
		BAPI	coyote brush	0.2
		BRDI	ripgut grass	0.3
		BRHO	soft chess	1.3
		BRMI	annual quaking grass	0.7
		BRTET	dwarf brodiaea	0.2
		CIQU	timwort	0.2
		CRAQ	aquatic pygmy-weed	0.2
		ELMA	pale spikerush	0.3
		ERAR12	coyote thistle	8.3
		ERBO	long-beaked filaree	6.0
		FEBR	brome fescue	6.0
		HYGL	smooth cat's-ear	1.5
		HYRA	rough cat's-ear	1.5
		LYAR	scarlet pimpernel	0.3
		LYHY	grass poly	1.2
		LYMI	chaffweed	0.3
		PLCHH	Hickman's popcornflower	1.7
		PLCO	cut-leaved plantain	1.3
		POMO	rabbitfoot grass	1.0
		PS sp.	*Pseudognaphalium* sp.	0.5
		PSCH	round woolly-marbles	2.2
		SIGA	small-flower catchfly	0.2
		TH	Thatch	18.8
		BG	Bare Ground	45.5
		TOTAL		**100.0**
2 (CCG)	**6%**	**-**	**-**	**-**

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**
3	**89%**	ACAMA	Spanish lotus	0.2
		AICA	silvery hair-grass	1.0
		BRMA	rattlesnake grass	10.0
		BRMI	annual quaking grass	1.2
		CAAMA3	Johnny-Nip	0.3
		DACA	California oat grass	8.0
		DECO	coastal tarweed	1.3
		ERAR12	coyote thistle	2.0
		ERBO	long-beaked filaree	15.2
		FEBR	brome fescue	1.8
		FEMY	rattail sixweeks grass	0.8
		GEDI	cut-leaved geranium	0.2
		HYGL	smooth cat's-ear	11.2
		HYRA	rough cat's-ear	1.0
		JUCA	dwarf rush	0.3
		LYAR	scarlet pimpernel	0.2
		LYMI	chaffweed	0.3
		MAGR	gumweed	1.5
		MIPA	marsh microseris	0.3
		PLCO	cut-leaved plantain	0.3
		PS sp.	*Pseudognaphalium* sp.	0.2
		RUAC	sheep sorrel	0.5
		SIBE	western blue-eyed grass	0.3
		TH	Thatch	31.2
		BG	Bare Ground	10.7
		TOTAL		**100.0**

Table B-4. Pond 16 (Year 4 Post-Subsurface Munitions Remediation) Wetland Vegetation Cover by Stratum

POND 16				
Stratum	**Relative % Cover of Wetland**	**Species Code**	**Species Common Name**	**% Cover**
1	**5%**	HECUO	Chinese pusley	4.0
		SCCA	California bulrush	7.0
		SOAM	small-flowered nightshade	0.3
		TH	Thatch	68.7
		BG	Bare Ground	20.0
		TOTAL		**100.0**
3	**34%**	ELMA	pale spikerush	44.0
		ERCA	horseweed	0.3
		HEGR	telegraph weed	1.3
		POMO	rabbitfoot grass	2.0
		PSLU	weedy cudweed	0.7
		SIGA	small-flower catchfly	0.3
		TH	Thatch	43.7
		BG	Bare Ground	7.7
		TOTAL		**100.0**
4	**10%**	CAPR	clustered field sedge	52.7
		GEDI	cut-leaved geranium	1.3
		JUBA	Baltic rush	1.3
		RUUR	California blackberry	1.7
		TH	Thatch	42.7
		BG	Bare Ground	0.3
		TOTAL		**100.0**
5	**32%**	CABA	whiteroot	30.3
		RUUR	California blackberry	6.5
		SOEL	West Coast Canada goldenrod	7.7
		TH	Thatch	53.3
		BG	Bare Ground	2.2
		TOTAL		**100.0**

Table B-4 (continued). Pond 16 (Year 4 Post-Subsurface Munitions Remediation)
Wetland Vegetation Cover by Stratum

POND 16				
Stratum	**Relative % Cover of Wetland**	**Species**	**Species Common Name**	**% Cover**
6	**12%**	GEDI	cut-leaved geranium	0.3
		JUBA	Baltic rush	38.7
		PSLU	weedy cudweed	0.3
		RUUR	California blackberry	1.3
		TH	Thatch	57.0
		BG	Bare Ground	2.3
		TOTAL		**100.0**
8	**7%**	BAPI	coyote brush	1.5
		BRDI	ripgut grass	0.5
		CIBR	Indian thistle	5.3
		CIVU	bull thistle	2.2
		FEBR	brome fescue	1.0
		GEDI	cut-leaved geranium	0.8
		HEGR	telegraph weed	1.3
		POMO	rabbitfoot grass	49.2
		PS sp.	*Pseudognaphalium* sp.	0.2
		SIGA	small-flower catchfly	0.2
		TH	Thatch	25.3
		BG	Bare Ground	12.5
		TOTAL		**100.0**

Table B-5. Pond 39 (Year 4 Post-Subsurface Munitions Remediation) Wetland Vegetation Cover by Stratum

POND 39				
Stratum	**Relative % Cover of Wetland**	**Species Code**	**Species Common Name**	**% Cover**
1	**3%**	AICA	silvery hair-grass	0.3
		BRHO	soft chess	0.3
		BRMI	annual quaking grass	0.3
		CIQU	timwort	0.3
		ELACA	needle spikerush	1.0
		ELMA	pale spikerush	22.7
		FEBR	brome fescue	0.7
		FEPE	Italian rye grass	1.0
		GEDI	cut-leaved geranium	1.3
		HYGL	smooth cat's-ear	0.3
		LAGL3	smooth goldfields	4.3
		LYHY	grass poly	0.7
		PLCHH	Hickman's popcornflower	30.0
		PLCO	cut-leaved plantain	6.0
		POMO	rabbitfoot grass	0.7
		RUCR	curly dock	3.0
		SOOL	common sow thistle	0.3
		TRAN	narrow-leaved clover	0.3
		TRDU	little hop clover	0.3
		VISA	spring vetch	0.3
		TH	Thatch	16.3
		BG	Bare Ground	9.3
		TOTAL		**100.0**

Table B-5 (continued). Pond 39 (Year 4 Post-Subsurface Munitions Remediation)
Wetland Vegetation Cover by Stratum

POND 39				
Stratum	**Relative % Cover of Wetland**	**Species Code**	**Species Common Name**	**% Cover**
3	**9%**	AVBA	slender wild oat	0.3
		BRDI	ripgut grass	0.3
		BRHO	soft chess	0.3
		BRMI	annual quaking grass	0.2
		ELMA	pale spikerush	4.5
		FEBR	brome fescue	2.0
		FEPE	Italian rye grass	35.7
		GEDI	cut-leaved geranium	5.5
		HOBR	meadow barley	0.3
		HOMAG	Mediterranean barley	1.2
		HYGL	smooth cat's-ear	0.5
		JUBU	toad rush	0.2
		JUPH	brown-headed rush	0.2
		LYHY	grass poly	0.3
		PLCO	cut-leaved plantain	2.2
		POAVD	prostrate knotweed	0.3
		POMO	rabbitfoot grass	0.3
		PS sp.	*Pseudognaphalium* sp.	0.2
		RUCR	curly dock	1.5
		TRAN	narrow-leaved clover	0.8
		TRDU	little hop clover	0.5
		VISA	spring vetch	0.5
		TH	Thatch	32.3
		BG	Bare Ground	9.8
		TOTAL		**100.0**

Table B-5 (continued). Pond 39 (Year 4 Post-Subsurface Munitions Remediation)
Wetland Vegetation Cover by Stratum

POND 39				
Stratum	**Relative % Cover of Wetland**	**Species Code**	**Species Common Name**	**% Cover**
4	**67%**	AICA	silvery hair-grass	0.5
		AVBA	slender wild oat	0.3
		BRDI	ripgut grass	0.7
		BRHO	soft chess	2.8
		DACA	California oat grass	4.7
		ERBO	long-beaked filaree	25.0
		FEBR	brome fescue	0.7
		FEMY	rattail sixweeks grass	3.3
		GEDI	cut-leaved geranium	0.2
		HYGL	smooth cat's-ear	0.8
		HYRA	rough cat's-ear	0.2
		JUPH	brown-headed rush	0.2
		LYAR	scarlet pimpernel	0.5
		PLCO	cut-leaved plantain	3.0
		SIGA	small-flower catchfly	0.2
		SIMAM	checkerbloom	3.2
		TAOV	sun cups	0.2
		TRAN	narrow-leaved clover	5.0
		TRDU	little hop clover	0.2
		VISAN	common vetch	0.3
		TH	Thatch	43.7
		BG	Bare Ground	4.5
		TOTAL		**100.0**
UPLAND	**21%**	**-**	**-**	**-**

Table B-6. Pond 40 South (Year 4 Post-Subsurface Munitions Remediation) Wetland Vegetation Cover by Stratum

POND 40 SOUTH				
Stratum	**Relative % Cover of Wetland**	**Species Code**	**Species Common Name**	**% Cover**
3	**37%**	BRHO	soft chess	0.2
		BRMI	annual quaking grass	0.2
		ERCI	redstem filaree	0.3
		FEBR	brome fescue	0.8
		FEPE	Italian rye grass	54.5
		GEDI	cut-leaved geranium	1.7
		HOBR	meadow barley	0.3
		HYGL	smooth cat's-ear	0.7
		LYAR	scarlet pimpernel	0.2
		MAGR	gumweed	0.2
		PLCHH	Hickman's popcornflower	0.3
		PS sp.	*Pseudognaphalium* sp.	0.2
		SOOL	common sow thistle	0.3
		TRAN	narrow-leaved clover	0.2
		TH	Thatch	34.0
		BG	Bare Ground	6.0
		TOTAL		**100.0**
4	**56%**	AICA	silvery hair-grass	0.2
		AVBA	slender wild oat	0.2
		BRHO	soft chess	1.0
		BRMI	annual quaking grass	0.2
		ERBO	long-beaked filaree	39.8
		FEBR	brome fescue	0.5
		FEPE	Italian rye grass	0.2
		GEDI	cut-leaved geranium	0.7
		HYGL	smooth cat's-ear	1.7
		HYRA	rough cat's-ear	0.2
		JUPH	brown-headed rush	0.2
		PLCO	cut-leaved plantain	4.0
		RUAC	sheep sorrel	0.7
		SIGA	small-flower catchfly	0.3
		TRAN	narrow-leaved clover	25.0
		TRDU	little hop clover	0.3
		TH	Thatch	9.8
		BG	Bare Ground	15.2
		TOTAL		**100.0**

Table B-6 (continued). Pond 40 South (Year 4 Post-Subsurface Munitions Remediation)
Wetland Vegetation Cover by Stratum

POND 40 SOUTH				
Stratum	**Relative % Cover of Wetland**	**Species Code**	**Species Common Name**	**% Cover**
5	**7%**	AICA	silvery hair-grass	0.3
		BRHO	soft chess	0.3
		CAED	ice plant	0.3
		DECO	coastal tarweed	0.3
		ELACA	needle spikerush	0.7
		ELMA	pale spikerush	2.0
		ERAR12	coyote thistle	4.0
		ERBO	long-beaked filaree	0.7
		FEBR	brome fescue	1.0
		FEPE	Italian rye grass	4.0
		GEDI	cut-leaved geranium	6.0
		HEGR	telegraph weed	0.7
		HYGL	smooth cat's-ear	6.0
		HYRA	rough cat's-ear	1.3
		LYAR	scarlet pimpernel	0.7
		LYHY	grass poly	0.3
		LYMI	chaffweed	0.3
		PLCHH	Hickman's popcornflower	14.3
		PLCO	cut-leaved plantain	20.3
		TRHI	rose clover	0.3
		VISAs	spring vetch	2.0
		TH	Thatch	23.3
		BG	Bare Ground	10.7
		TOTAL		**100.0**

Table B-7. Pond 41 (Year 4 Post-Subsurface Munitions Remediation) Wetland Vegetation Cover by Stratum

POND 41				
Stratum	**Relative % Cover of Wetland**	**Species Code**	**Species Common Name**	**% Cover**
1	**3%**	BRHO	soft chess	1.3
		DEDA	annual hair grass	1.0
		ELACA	needle spikerush	1.7
		ELMA	pale spikerush	1.7
		GEDI	cut-leaved geranium	7.3
		HYGL	smooth cat's-ear	0.7
		LAGL3	smooth goldfields	10.7
		MALE	alkali mallow	8.0
		PHLE	Lemmon's canary grass	2.0
		PLCHH	Hickman's popcornflower	2.3
		POMO	rabbitfoot grass	0.3
		PS sp.	*Pseudognaphalium* sp.	0.3
		SOOL	common sow thistle	0.3
		TH	Thatch	60.3
		BG	Bare Ground	2.0
		TOTAL		**100.0**
2	**91%**	BRHO	soft chess	2.3
		BRMI	annual quaking grass	0.2
		DEDA	annual hair grass	0.2
		ELACA	needle spikerush	2.3
		ELMA	pale spikerush	1.5
		GEDI	cut-leaved geranium	24.0
		LAGL3	smooth goldfields	0.5
		MALE	alkali mallow	4.3
		MASA	coast tarweed	0.3
		PHLE	Lemmon's canary grass	10.5
		PLCHH	Hickman's popcornflower	5.3
		POMO	rabbitfoot grass	0.2
		RUCR	curly dock	0.2
		STAJ	bugle hedge nettle	0.7
		TH	Thatch	45.0
		BG	Bare Ground	2.5
		TOTAL		**100.0**

Table B-7 (continued). Pond 41 (Year 4 Post-Subsurface Munitions Remediation) Wetland Vegetation Cover by Stratum

POND 41				
Stratum	**Relative % Cover of Wetland**	**Species Code**	**Species Common Name**	**% Cover**
3	**5%**	BRHO	soft chess	0.5
		BRMI	annual quaking grass	1.3
		ERBO	long-beaked filaree	0.8
		GEDI	cut-leaved geranium	7.7
		HYGL	smooth cat's-ear	1.0
		HYRA	rough cat's-ear	0.2
		JUPH	brown-headed rush	21.7
		MALE	alkali mallow	2.0
		PHLE	Lemmon's canary grass	1.2
		PSLU	weedy cudweed	0.2
		RUCR	curly dock	0.2
		SOOL	common sow thistle	0.5
		STAJ	bugle hedge nettle	0.2
		TH	Thatch	61.8
		BG	Bare Ground	0.8
		TOTAL		**100.0**
4	**1%**	AICA	silvery hair-grass	1.0
		CAAM	Johnny-Nip	0.7
		DACA	California oat grass	17.7
		ERAR12	coyote thistle	6.3
		ERBO	long-beaked filaree	13.3
		FEBR	brome fescue	4.0
		FEMY	rattail sixweeks grass	0.7
		GEDI	cut-leaved geranium	2.0
		HYGL	smooth cat's-ear	4.3
		JUPH	brown-headed rush	0.3
		MAGR	gumweed	1.7
		MALE	alkali mallow	0.3
		MASA	coast tarweed	2.3
		TH	Thatch	31.7
		BG	Bare Ground	13.7
		TOTAL		**100.0**

Table B-8. Pond 42 (Year 4 Post-Subsurface Munitions Remediation)
Wetland Vegetation Cover by Stratum

POND 42				
Stratum	**Relative % Cover of Wetland**	**Species Code**	**Species Common Name**	**% Cover**
1	**18%**	AGLAV	vernal pool bent grass	0.3
		BRMI	annual quaking grass	0.7
		BRTET	dwarf brodiaea	0.3
		DEDA	annual hair grass	10.7
		ELACA	needle spikerush	17.0
		ERAR12	coyote thistle	10.7
		ERCA	horseweed	0.3
		FEBR	brome fescue	0.3
		GAUS	purple cudweed	1.3
		GEDI	cut-leaved geranium	2.0
		HYGL	smooth cat's-ear	1.7
		HYRA	rough cat's-ear	3.0
		JUPH	brown-headed rush	0.7
		LOGA	narrowleaf cottonrose	0.3
		LYHY	grass poly	1.7
		PLCHH	Hickman's popcornflower	4.0
		PLCO	cut-leaved plantain	0.3
		POMO	rabbitfoot grass	2.0
		PSCH	round woolly-marbles	1.0
		SEGL	cutleaf burnweed	0.7
		TH	Thatch	32.0
		BG	Bare Ground	9.0
		TOTAL		**100.0**
2	**7%**	CIBR	Indian thistle	0.3
		COCO	brass buttons	0.3
		ELACA	needle spikerush	1.0
		ELMA	pale spikerush	37.0
		GEDI	cut-leaved geranium	0.7
		PHLE	Lemmon's canary grass	0.3
		PLCHH	Hickman's popcornflower	0.7
		PSLU	weedy cudweed	0.7
		SOOL	common sow thistle	0.3
		TH	Thatch	57.7
		BG	Bare Ground	1.0
		TOTAL		**100.0**

Table B-8 (continued). Pond 42 (Year 4 Post-Subsurface Munitions Remediation)
Wetland Vegetation Cover by Stratum

POND 42				
Stratum	**Relative % Cover of Wetland**	**Species Code**	**Species Common Name**	**% Cover**
3	**22%**	AICA	silvery hair-grass	0.2
		BAPI	coyote brush	0.2
		BRHO	soft chess	1.5
		COCO	brass buttons	0.2
		DEDA	annual hair grass	0.5
		ELACA	needle spikerush	4.5
		ERAR12	coyote thistle	5.3
		GEDI	cut-leaved geranium	4.0
		HYGL	smooth cat's-ear	0.2
		HYRA	rough cat's-ear	0.2
		JUPH	brown-headed rush	28.2
		LYHY	grass poly	0.2
		PLCHH	Hickman's popcornflower	0.3
		POMO	rabbitfoot grass	0.8
		PSLU	weedy cudweed	0.2
		SEGL	cutleaf burnweed	0.8
		SOAS	prickly sow thistle	0.3
		SOOL	common sow thistle	1.0
		TH	Thatch	46.0
		BG	Bare Ground	5.5
		TOTAL		**100.0**

Table B-8 (continued). Pond 42 (Year 4 Post-Subsurface Munitions Remediation)
Wetland Vegetation Cover by Stratum

POND 42				
Stratum	**Relative % Cover of Wetland**	**Species Code**	**Species Common Name**	**% Cover**
4	**25%**	AVBA	slender wild oat	1.0
		BRTET	dwarf brodiaea	0.3
		CAAT	valley tassels	0.3
		CIQU	timwort	0.3
		DACA	California oat grass	2.0
		DECO	coastal tarweed	5.7
		ELACA	needle spikerush	0.3
		ERAR12	coyote thistle	4.3
		ERBO	long-beaked filaree	4.3
		FEBR	brome fescue	0.3
		FEMY	rattail sixweeks grass	0.7
		GEDI	cut-leaved geranium	0.3
		HYGL	smooth cat's-ear	7.7
		HYRA	rough cat's-ear	1.3
		LOGA	narrowleaf cottonrose	1.0
		LYAR	scarlet pimpernel	2.0
		LYHY	grass poly	0.7
		LYMI	chaffweed	0.3
		PLCHH	Hickman's popcornflower	0.3
		POMO	rabbitfoot grass	0.7
		PSCH	round woolly-marbles	0.3
		TROB	Capetown grass	0.3
		ZEDA	Davy's centuary	0.3
		TH	Thatch	29.0
		BG	Bare Ground	35.7
		TOTAL		**99.7**
5	**12%**	BRHO	soft chess	0.3
		FEBR	brome fescue	0.3
		LYHY	grass poly	0.3
		POMO	rabbitfoot grass	41.7
		TROB	Capetown grass	0.3
		TH	Thatch	50.3
		BG	Bare Ground	6.7
		TOTAL		**100.0**
UPLAND	**16%**	-	-	-

Table B-9. Pond 61 (Year 4 Post-Subsurface Munitions Remediation)
Wetland Vegetation Cover by Stratum

POND 61				
Stratum	**Relative % Cover of Wetland**	**Species Code**	**Species Common Name**	**% Cover**
2 (CCG)	**6%**	-	-	-
3	**4%**	BRHO	soft chess	0.2
		BRMA	rattlesnake grass	0.3
		BRMI	annual quaking grass	0.2
		BRTET	dwarf brodiaea	7.7
		CIQU	timwort	0.5
		DECO	coastal tarweed	0.3
		DEDA	annual hair grass	2.7
		ELACA	needle spikerush	1.5
		ERAR12	coyote thistle	6.3
		FEBR	brome fescue	1.0
		GEDI	cut-leaved geranium	0.3
		HYGL	smooth cat's-ear	2.5
		HYRA	rough cat's-ear	0.2
		JUPH	brown-headed rush	0.8
		LAGL3	smooth goldfields	0.8
		LYAR	scarlet pimpernel	0.3
		LYHY	grass poly	1.7
		LYMI	chaffweed	0.7
		MIDOD	Douglas' silverpuffs	0.2
		MIPA	marsh microseris	0.3
		PLCHH	Hickman's popcornflower	32.5
		POMO	rabbitfoot grass	0.2
		POZI	Sacramento mesa mint	1.7
		PSCH	round woolly-marbles	0.3
		SOOL	common sow thistle	0.2
		TH	Thatch	28.8
		BG	Bare Ground	7.8
		TOTAL		**100.0**

Table B-9 (continued). Pond 61 (Year 4 Post-Subsurface Munitions Remediation)
Wetland Vegetation Cover by Stratum

POND 61				
Stratum	**Relative % Cover of Wetland**	**Species Code**	**Species Common Name**	**% Cover**
4	**57%**	BRMA	rattlesnake grass	26.7
		BRHO	soft chess	0.8
		BRMI	annual quaking grass	1.0
		BRTET	dwarf brodiaea	1.3
		CAAMa3	Johnny-Nip	0.3
		DACA	California oat grass	4.5
		DECO	coastal tarweed	8.8
		ERBO	long-beaked filaree	3.7
		FEBR	brome fescue	3.0
		GEDI	cut-leaved geranium	1.0
		HYGL	smooth cat's-ear	8.7
		HYRA	rough cat's-ear	0.3
		LYAR	scarlet pimpernel	3.5
		LYHY	grass poly	0.5
		MA sp.	*Madia* sp.	0.2
		MAEL	common madia	0.2
		MAGR	gumweed	0.2
		MASA	coast tarweed	0.2
		MIPA	marsh microseris	1.2
		SOOL	common sow thistle	0.2
		TH	Thatch	20.3
		BG	Bare Ground	13.5
		TOTAL		**100.0**
UPLAND	**33%**	**-**	**-**	**-**

Table B-10. Pond 75 (Baseline) Wetland Vegetation Cover by Stratum

POND 75				
Stratum	**Relative % Cover of Wetland**	**Species Code**	**Species Common Name**	**% Cover**
1	**16%**	BRMI	annual quaking grass	2.3
		ELMA	pale spikerush	14.5
		GAAP	goose grass	0.5
		GEDI	cut-leaved geranium	11.3
		HOBR	meadow barley	0.2
		MALE	alkali mallow	4.0
		PHLE	Lemmon's canary grass	0.5
		SIMA	milk thistle	12.7
		SOAS	prickly sow thistle	1.2
		SOOL	common sow thistle	0.7
		VEPEX	speedwell	0.2
		TH	Thatch	50.5
		BG	Bare Ground	1.5
		TOTAL		**100.0**
2	**67%**	ELMA	pale spikerush	2.8
		ELTR3	beardless wild rye	51.8
		TH	Thatch	45.0
		BG	Bare Ground	0.3
		TOTAL		**100.0**
3	**5%**	ELMA	pale spikerush	4.7
		ELTR3	beardless wild rye	8.0
		EUOC	western goldenrod	26.3
		GAAP	goose grass	0.3
		RACA	California buttercup	0.3
		TH	Thatch	59.7
		BG	Bare Ground	0.7
		TOTAL		**100.0**
4	**12%**	BRMI	annual quaking grass	0.3
		ELTR3	beardless wild rye	5.3
		JUPH	brown-headed rush	36.3
		RACA	California buttercup	0.3
		TH	Thatch	55.0
		BG	Bare Ground	2.7
		TOTAL		**100.0**

APPENDIX C

Site Photos

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Figure C-1. Pond 5 (Reference): Vegetation Photo Point 1 on 5/6/2022

Figure C-2. Pond 5 (Reference): Vegetation Photo Point 2 on 5/6/2022

Figure C-3. Pond 101 East (East) (Reference): Vegetation Photo Point on 5/6/2022

Figure C-4. Pond 997 (Reference): Vegetation Photo Point on 5/2/2022

Figure C-5. Photo of Contra Costa goldfields (*Lasthenia conjugens)* at Pond 997 (Reference): Vegetation Photo Point on 5/2/2022

Figure C-6. Pond 16 (Year 4 Post-Subsurface Munitions Remediation): Vegetation Photo Point on 5/10/2022

Figure C-7. Photo 1: New population of vernal pool bent grass (*Agrostis lacuna-vernalis)* at Pond 16 (Year 4 Post-Subsurface Munitions Remediation) on 5/10/2022

Figure C-8. Photo 2: New population of vernal pool bent grass (*Agrostis lacuna-vernalis)* at Pond 16 (Year 4 Post-Subsurface Munitions Remediation) on 5/10/2022

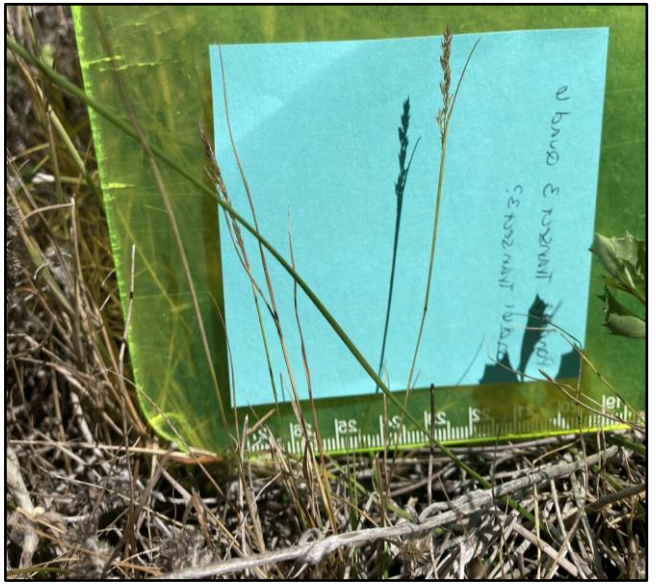

Figure C-9**.** Photo 3: New population of vernal pool bent grass (*Agrostis lacuna-vernalis)* at Pond 16 (Year 4 Post-Subsurface Munitions Remediation) on 5/10/2022

Figure C-10. Pond 39 (Year 4 Post-Subsurface Munitions Remediation): Vegetation Photo Point on 4/29/2022

Figure C-11. Pond 40 South (Year 4 Post-Subsurface Munitions Remediation): Vegetation Photo Point 1 on 4/29/2022

Figure C-12. Pond 40 South (Year 4 Post-Subsurface Munitions Remediation): Vegetation Photo Point 2 on 4/29/2022

Figure C-13. Pond 41 (Year 4 Post-Subsurface Munitions Remediation): Vegetation Photo Point 1 on 5/3/2022

Figure C-14. Pond 41 (Year 4 Post-Subsurface Munitions Remediation): Vegetation Photo Point 2 on 5/3/2022

Figure C-15. Pond 42 (Year 4 Post-Subsurface Munitions Remediation): Vegetation Photo Point on 5/4/2022

Figure C-16. Pond 61 (Year 4 Post-Subsurface Munitions Remediation): Vegetation Photo Point 1 on 4/28/2022

Figure C-17. Pond 61 (Year 4 Post-Subsurface Munitions Remediation): Vegetation Photo Point 2 on 4/28/2022

Figure C-18. Photo 1 of Contra Costa goldfields (*Lasthenia conjugens)* at Pond 61 (Year 4 Post-Subsurface Munitions Remediation) on 3/30/2022

Figure C-19. Photo 2 of Contra Costa goldfields (*Lasthenia conjugens)* at Pond 61 (Year 4 Post-Subsurface Munitions Remediation) on 3/30/2022

Figure C-20. Photo 3 of Contra Costa goldfields (*Lasthenia conjugens)* at Pond 61 (Year 4 Post-Subsurface Munitions Remediation) on 3/30/2022

Figure C-21. Photo 4 of Contra Costa goldfields (*Lasthenia conjugens)* at Pond 61 (Year 4 Post-Subsurface Munitions Remediation) on 3/30/2022

Figure C-22. Pond 75 (Baseline): Vegetation Photo Point 1 on 5/9/2022

Figure C-23. Pond 75 (Baseline): Vegetation Photo Point 2 on 5/9/2022

APPENDIX D

Vegetation Species Richness of Native and Non-Native Species and Wetland Indicator Category by Vernal Pool

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Table D-1. Pond 5 (Reference) Vegetation Species Richness of Native and Non-Native Species by Stratum

Pond 5			
Stratum	**Native**	**Non-Native**	**Unidentified**
1	4	1	0
2	4	5	0
3	9	10	0
7	4	6	1
8	7	12	1
Basin Total	**42**	**31**	**3**

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**
3	4	4	0
4	7	7	1
5	12	11	0
9	5	4	0
Basin Total	**40**	**29**	**3**

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	9	13	1
3	9	13	1
Basin Total	**40**	**23**	**1**

Table D-4. Pond 16 (Year 4 Post-Subsurface Munitions Remediation) Vegetation Species Richness of Native and Non-Native Species by Stratum

Pond 16			
Stratum	**Native**	**Non-Native**	**Unidentified**
1	3	0	0
3	3	3	0
4	3	1	0
5	3	0	0
6	2	2	0
8	3	6	1
Basin Total	**53**	**32**	**2**

Table D-5. Pond 39 (Year 4 Post-Subsurface Munitions Remediation) Vegetation Species Richness of Native and Non-Native Species by Stratum

Pond 39			
Stratum	**Native**	**Non-Native**	**Unidentified**
1	5	15	0
3	4	17	1
4	4	16	0
Basin Total	**42**	**33**	**1**

Table D-6. Pond 40 South (Year 4 Post-Subsurface Munitions Remediation) Vegetation Species Richness of Native and Non-Native Species by Stratum

Pond 40 South			
Stratum	**Native**	**Non-Native**	**Unidentified**
3	3	10	1
4	1	15	0
5	7	14	0
Basin Total	**27**	**32**	**1**

Table D-7. Pond 41 (Year 4 Post-Subsurface Munitions Remediation) Vegetation Species Richness of Native and Non-Native Species by Stratum

Pond 41			
Stratum	**Native**	**Non-Native**	**Unidentified**
1	7	5	1
2	9	5	0
3	4	9	0
4	7	6	0
Basin Total	**35**	**22**	**1**

Table D-8. Pond 42 (Year 4 Post-Subsurface Munitions Remediation) Vegetation Species Richness of Native and Non-Native Species by Stratum

Stratum	**Native**	**Non-Native**	**Unidentified**
1	10	10	0
2	5	4	0
3	6	12	0
4	11	12	0
5	0	5	0
Basin Total	**51**	**33**	**1**

Table D-9. Pond 61 (Year 4 Post-Subsurface Munitions Remediation) Vegetation Species Richness of Native and Non-Native Species by Stratum

Pond 61			
Stratum	**Native**	**Non-Native**	**Unidentified**
3	14	11	0
4	8	11	1
Basin Total	**66**	**26**	**2**

Table D-10. Pond 75 (Baseline) Vegetation Species Richness of Native and Non-Native Species by Stratum

Pond 75			
Stratum	**Native**	**Non-Native**	**Unidentified**
1	6	5	0
2	2	0	0
3	5	0	0
4	3	1	0
Basin Total	**28**	**15**	**0**

Table D-11. Vegetation Species Richness of Native and Non-Native Species within Entire Vernal Pool Basin at Vernal Pools Monitored in 2022

Vernal Pool	Native	Non-Native	Unidentified	Total
5	42	31	3	76
101 East (East)	40	29	3	72
997	40	23	1	64
16	53	32	2	87
39	42	33	1	76
40 South	27	32	1	60
41	35	22	1	58
42	51	33	1	85
61	66	26	2	94
75	28	15	0	43

Table D-12. Pond 5 (Reference) Number of Wetland Plants by Indicator Category by Stratum

Pond 5						
Stratum	**OBL**	**FACW**	**FAC**	**FACU**	**UPL**	**NL**
1	1	1	0	1	1	1
2	1	2	1	2	1	2
3	3	4	2	3	1	6
7	0	2	1	2	1	5
8	3	5	2	3	1	6
Basin Total	**7**	**13**	**10**	**15**	**1**	**30**

Table D-13. 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**
3	1	1	2	1	0	3
4	1	3	2	3	0	6
5	1	4	5	4	1	8
9	2	1	1	3	0	2
Basin Total	**6**	**13**	**13**	**11**	**3**	**26**

Table D-14. Pond 997 (Reference) Number of Wetland Plants by Indicator Category by Stratum

Pond 997						
Stratum	**OBL**	**FACW**	**FAC**	**FACU**	**UPL**	**NL**
1	4	5	3	4	0	7
3	0	4	4	6	0	9
Basin Total	**5**	**13**	**9**	**8**	**1**	**28**

Table D-15. Pond 16 (Year 4 Post-Subsurface Munitions Remediation) Number of Wetland Plants by Indicator Category by Stratum

Pond 16						
Stratum	**OBL**	**FACW**	**FAC**	**FACU**	**UPL**	**NL**
1	1	0	0	1	0	1
3	1	2	0	1	0	2
4	0	2	0	1	0	1
5	0	0	1	2	0	0
6	0	2	0	1	0	1
8	0	1	0	1	0	8
Basin Total	**4**	**15**	**16**	**17**	**2**	**33**

Table D-16. Pond 39 (Year 4 Post-Subsurface Munitions Remediation) Number of Wetland Plants by Indicator Category by Stratum

Pond 40 South						
Stratum	**OBL**	**FACW**	**FAC**	**FACU**	**UPL**	**NL**
1	5	2	4	3	2	4
3	2	4	6	2	1	7
4	0	2	3	6	1	8
Basin Total	**7**	**15**	**10**	**9**	**3**	**32**

Table D-17. Pond 40 South (Year 4 Post-Subsurface Munitions Remediation) Number of Wetland Plants by Indicator Category by Stratum

Pond 40 South						
Stratum	**OBL**	**FACW**	**FAC**	**FACU**	**UPL**	**NL**
3	1	1	3	1	1	7
4	0	1	3	6	0	6
5	4	2	3	4	1	7
Basin Total	**4**	**9**	**5**	**10**	**3**	**29**

Table D-18. Pond 41 (Year 4 Post-Subsurface Munitions Remediation) Number of Wetland Plants by Indicator Category by Stratum

Pond 41						
Stratum	**OBL**	**FACW**	**FAC**	**FACU**	**UPL**	**NL**
1	4	3	0	2	1	3
2	5	3	2	2	0	2
3	1	3	2	4	1	2
4	0	3	1	4	0	5
Basin Total	**6**	**9**	**12**	**12**	**1**	**18**

Table D-19. Pond 42 (Year 4 Post-Subsurface Munitions Remediation) Number of Wetland Plants by Indicator Category by Stratum

Pond 42						
Stratum	**OBL**	**FACW**	**FAC**	**FACU**	**UPL**	**NL**
1	3	6	2	2	0	7
2	4	2	0	0	1	2
3	4	5	0	4	1	4
4	3	5	2	3	0	10
5	1	1	0	1	0	2
Basin Total	8	14	7	17	2	37

Table D-20. Pond 61 (Year 4 Post-Subsurface Munitions Remediation) Number of Wetland Plants by Indicator Category by Stratum

Pond 61						
Stratum	**OBL**	**FACW**	**FAC**	**FACU**	**UPL**	**NL**
3	5	7	2	2	2	7
4	1	1	3	3	1	11
Basin Total	**9**	**21**	**10**	**10**	**3**	**41**

Table D-21. Pond 75 (Baseline) Number of Wetland Plants by Indicator Category by Stratum

Pond 75						
Stratum	**OBL**	**FACW**	**FAC**	**FACU**	**UPL**	**NL**
1	1	3	1	3	1	2
2	1	0	1	0	0	0
3	1	1	2	1	0	0
4	0	1	3	0	0	0
Basin Total	**1**	**9**	**7**	**6**	**2**	**18**

Table D-22. Wetland Plants by Indicator Category within Entire Vernal Pool Basin at Vernal Pools Monitored in 2022

Vernal Pool	OBL	FACW	FAC	FACU	UPL	NL	Total
5	7	13	10	15	1	30	76
101 East (East)	6	13	13	11	3	26	72
997	5	13	9	8	1	28	64
16	4	15	16	17	2	33	87
39	7	15	10	9	3	32	76
40 South	4	9	5	10	3	29	60
41	6	9	12	12	1	18	58
42	8	14	7	17	2	37	85
61	9	21	10	10	3	41	94
75	1	9	7	6	2	18	43

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APPENDIX E

Species Composition of Follow-Up Wetland Vegetation Monitoring by Vernal Pool

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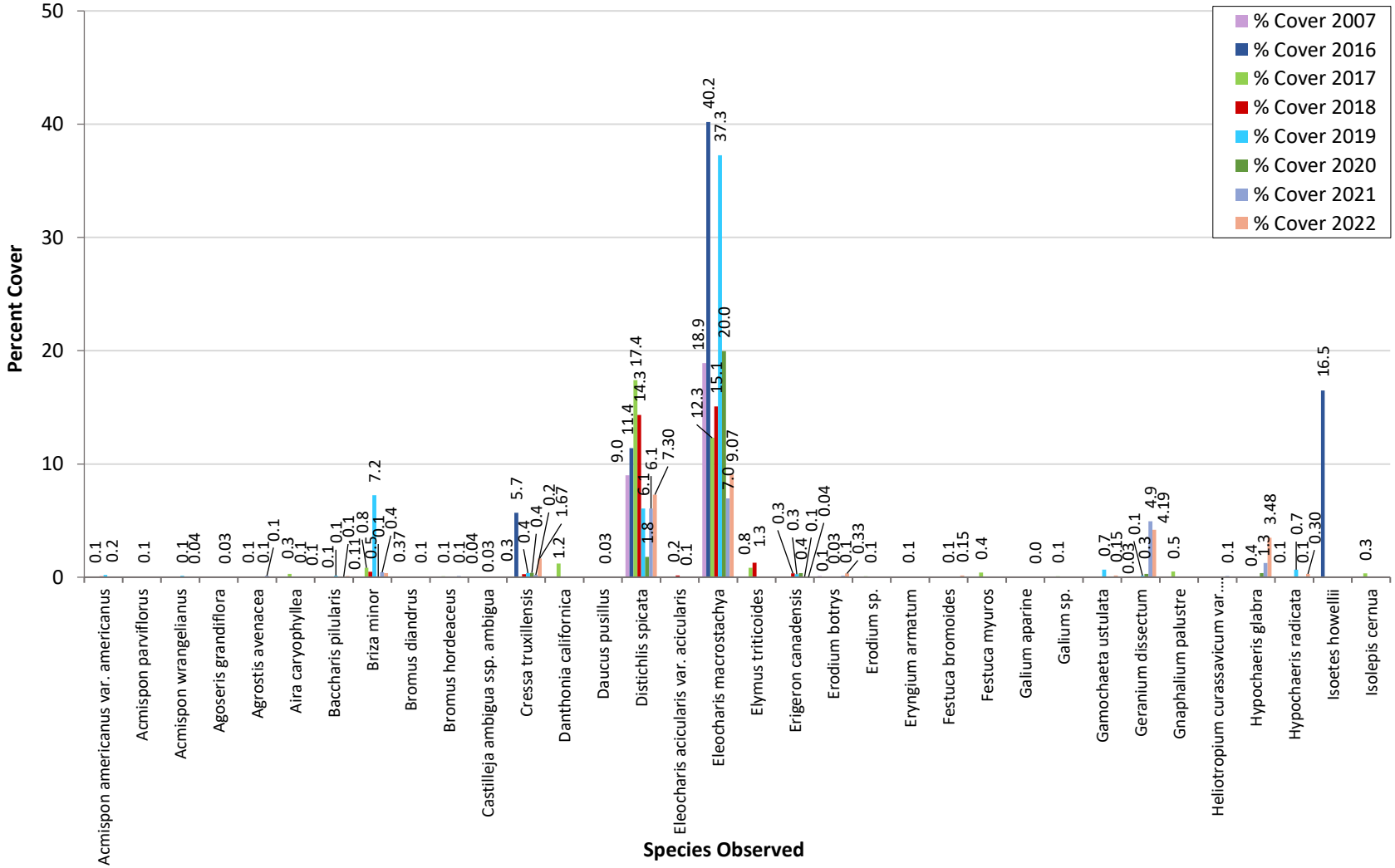

Figure E-1. Comparison Graph of Percent Cover by Wetland Plant Species for 2007, 2016, 2017, 2018, 2019, 2020, 2021, and 2022 at Pond 5 (Reference)

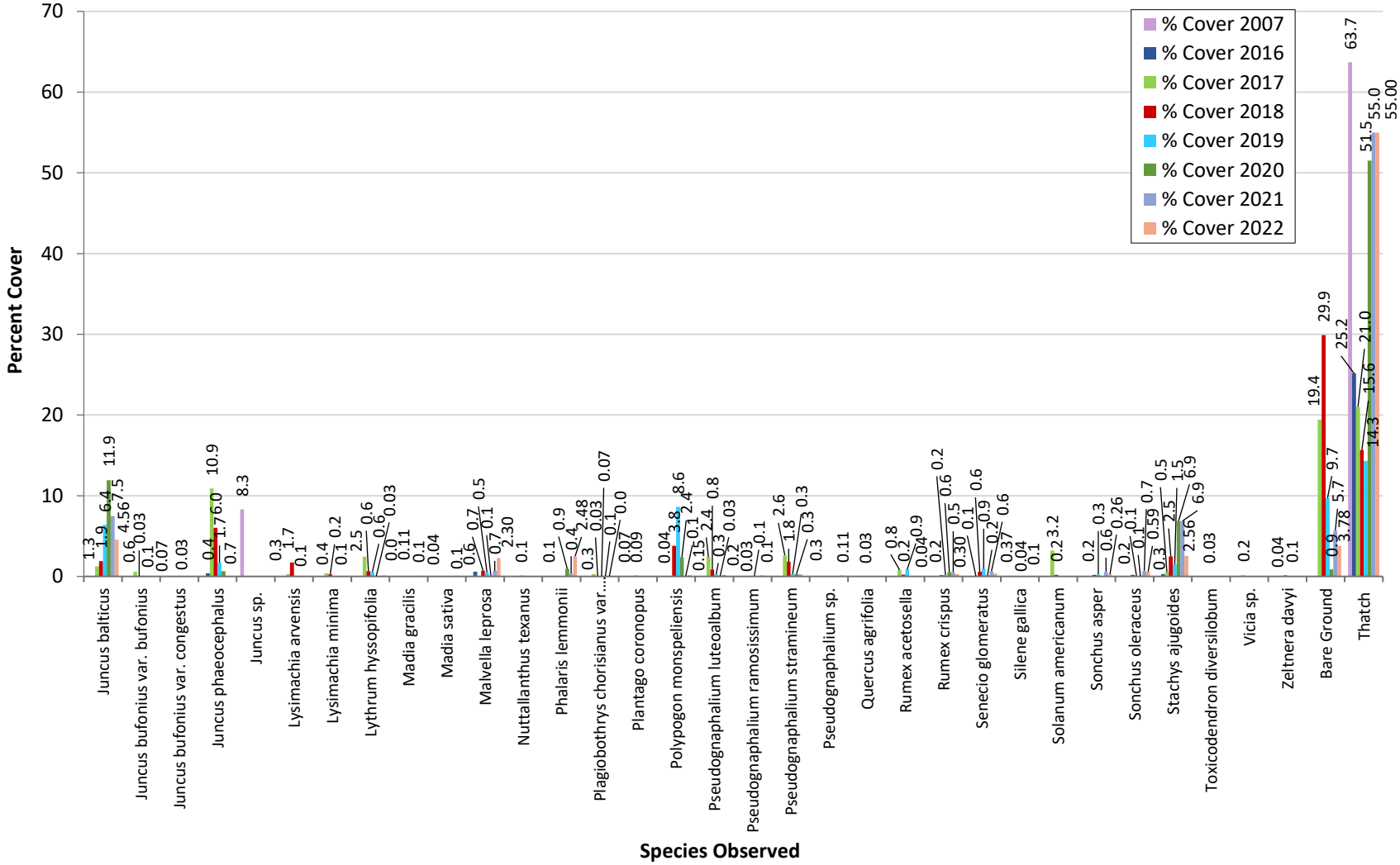

Figure E-1. (continued). Comparison Graph of Percent Cover by Wetland Plant Species for 2007, 2016, 2017, 2018, 2019, 2020, 2021, and 2022 at Pond 5 (Reference)

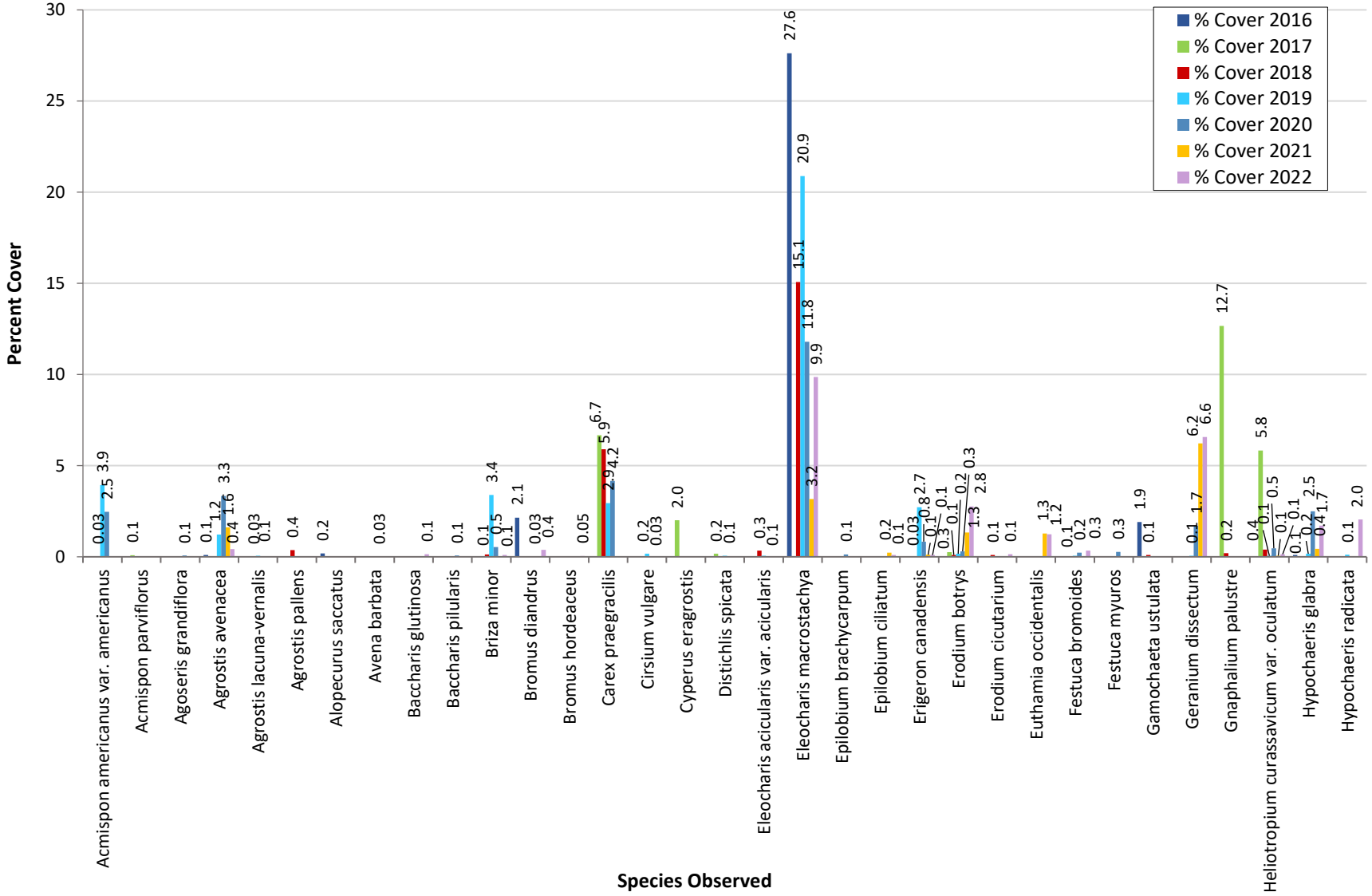

Figure E-2. Comparison Graph of Percent Cover by Wetland Plant Species for 2016, 2017, 2018, 2019, 2020, 2021, and 2022 at Pond 101 East (East)(Reference)

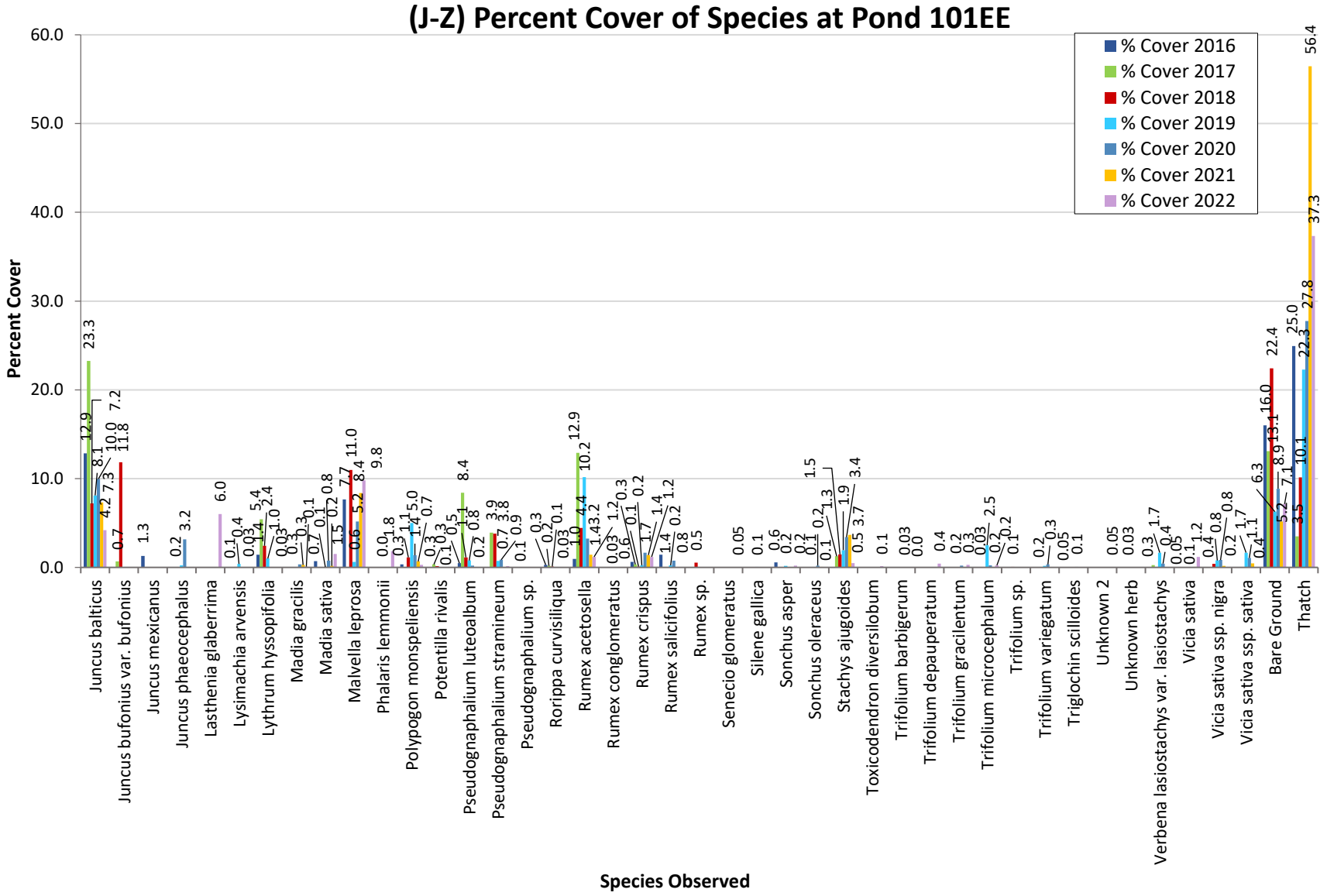

Figure E-2 (continued). Comparison Graph of Percent Cover by Wetland Plant Species for 2016, 2017, 2018, 2019, 2020, 2021, and 2022 at Pond 101 East (East) (Reference)

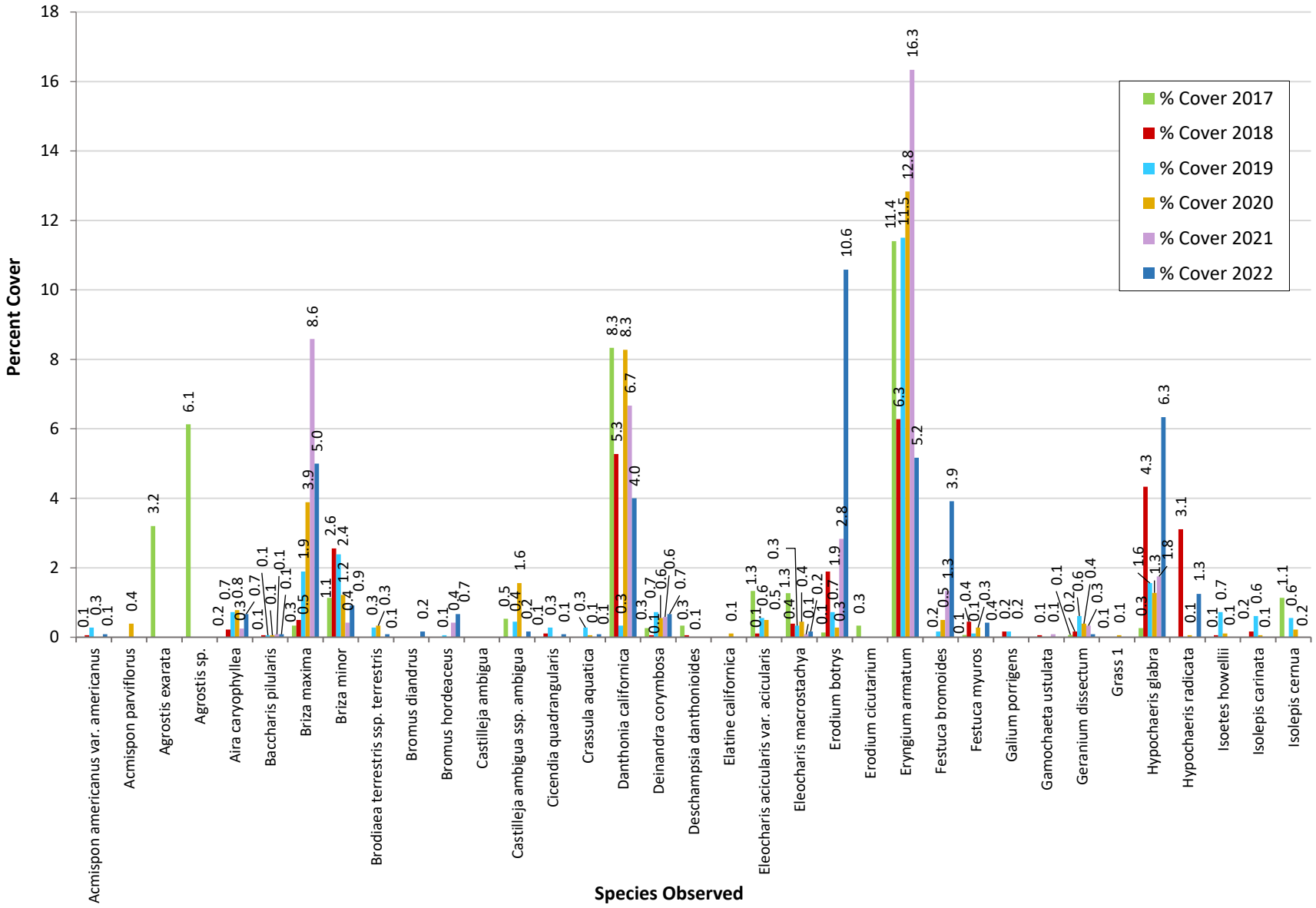

Figure E-3. Comparison Graph of Percent Cover by Wetland Plant Species for 2017, 2018, 2019, 2020, 2021, and 2022 at Pond 997 (Reference)

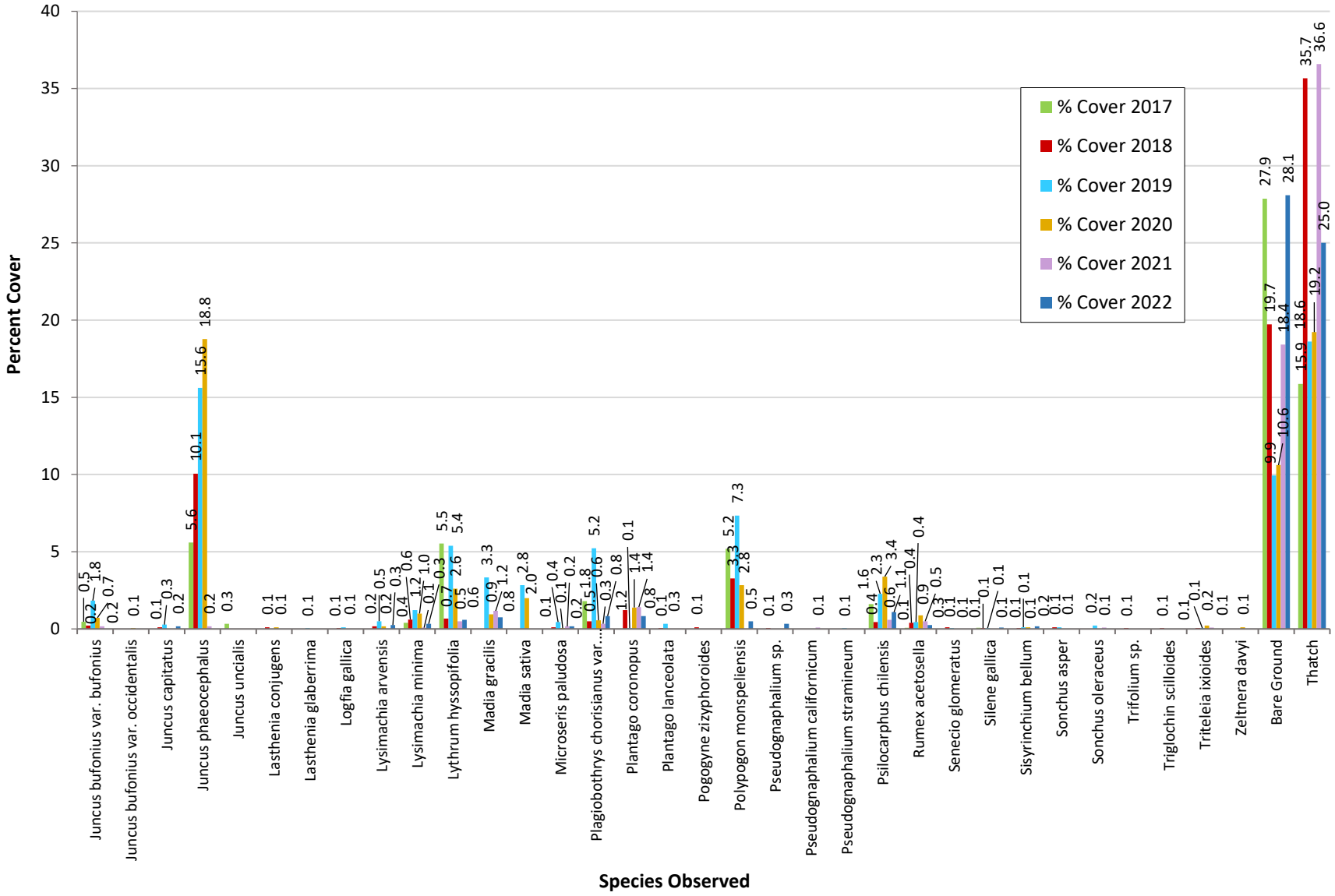

Figure E-3 (continued). Comparison Graph of Percent Cover by Wetland Plant Species for 2017, 2018, 2019, 2020, 2021, and 2022 at Pond 997 (Reference)

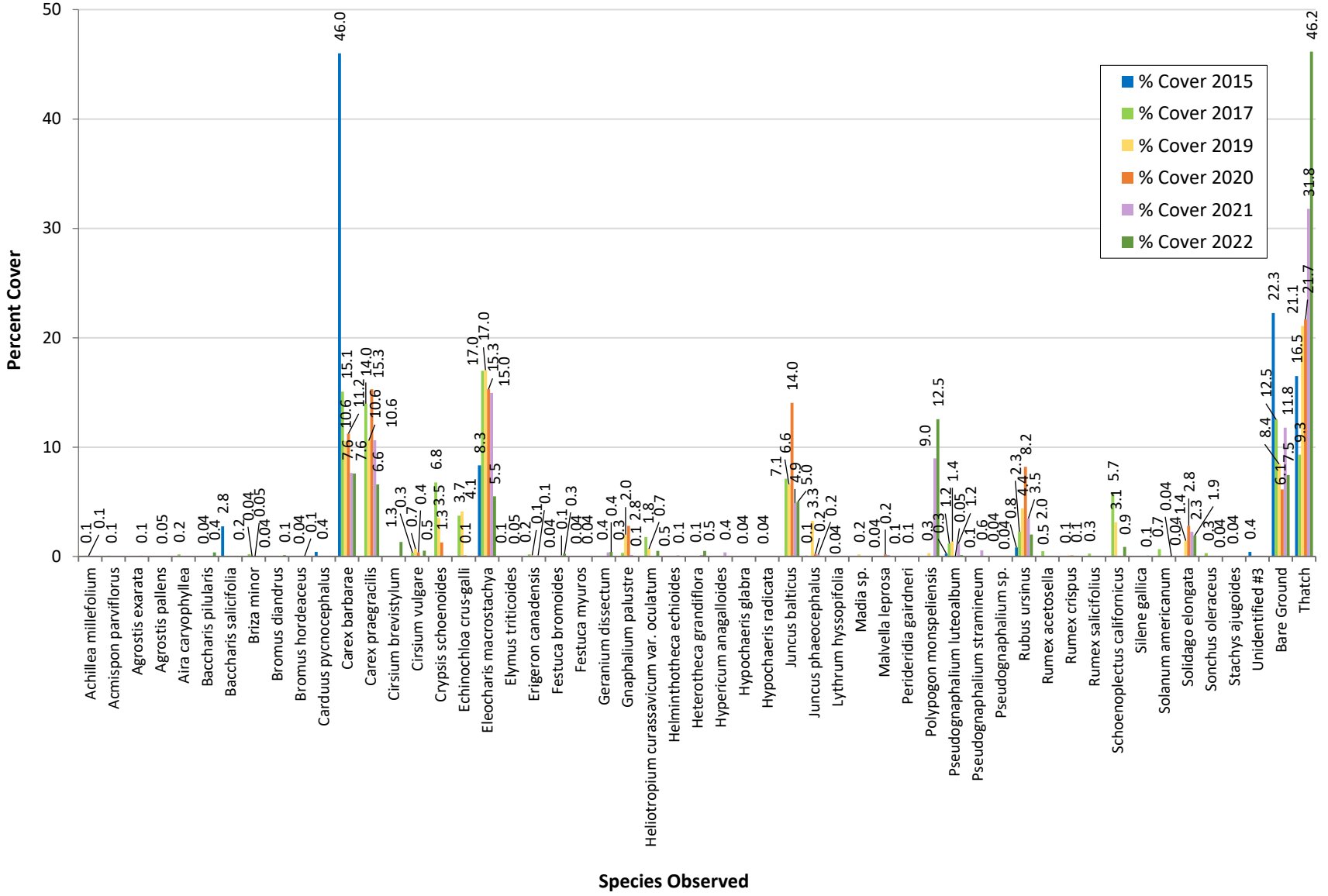

Figure E-4. Comparison Graph of Percent Cover by Wetland Plant Species for 2015, 2017, 2019, 2020, 2021, and 2022 at Pond 16 (Year 4 Post-Subsurface Munitions Remediation)

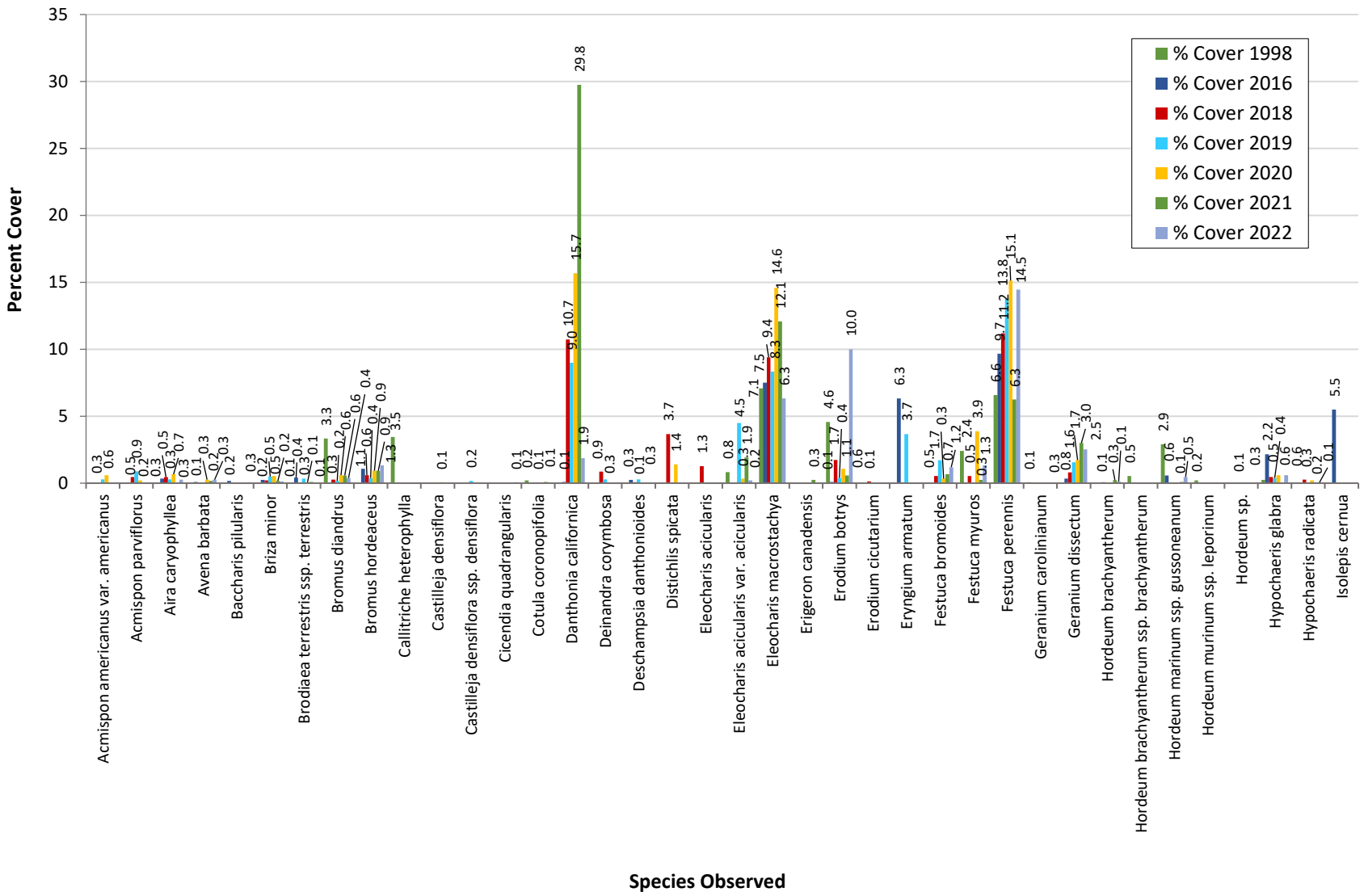

Figure E-5. Comparison Graph of Percent Cover by Wetland Plant Species for 1998, 2016, 2018, 2019, 2020, 2021, and 2022 at Pond 39 (Year 4 Post-Subsurface Munitions Remediation)

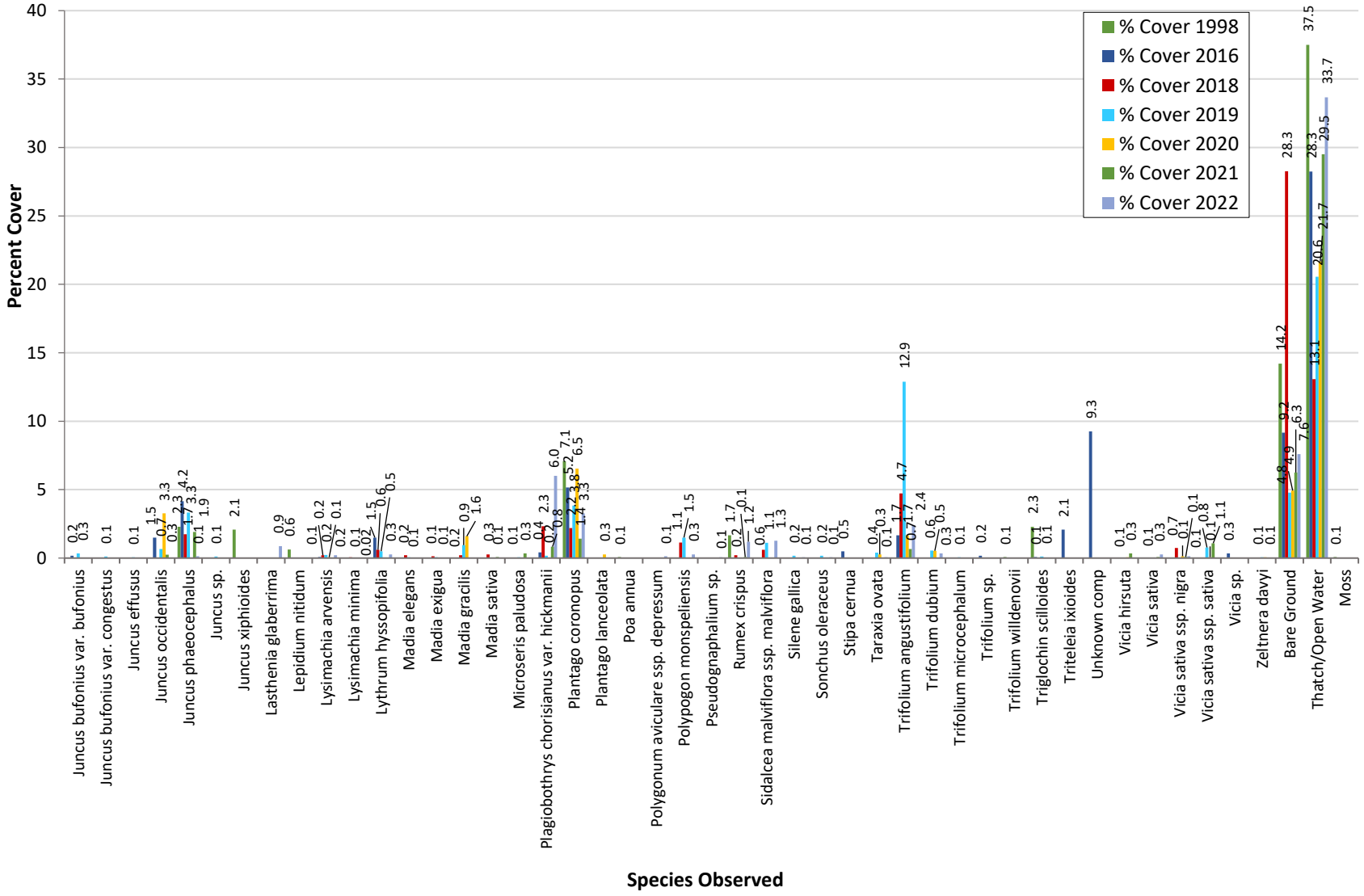

Figure E-5 (Continued). Comparison Graph of Percent Cover by Wetland Plant Species for 1998, 2016, 2018, 2019, 2020, 2021, and 2022 at Pond 39 (Year 4 Post-Subsurface Munitions Remediation)

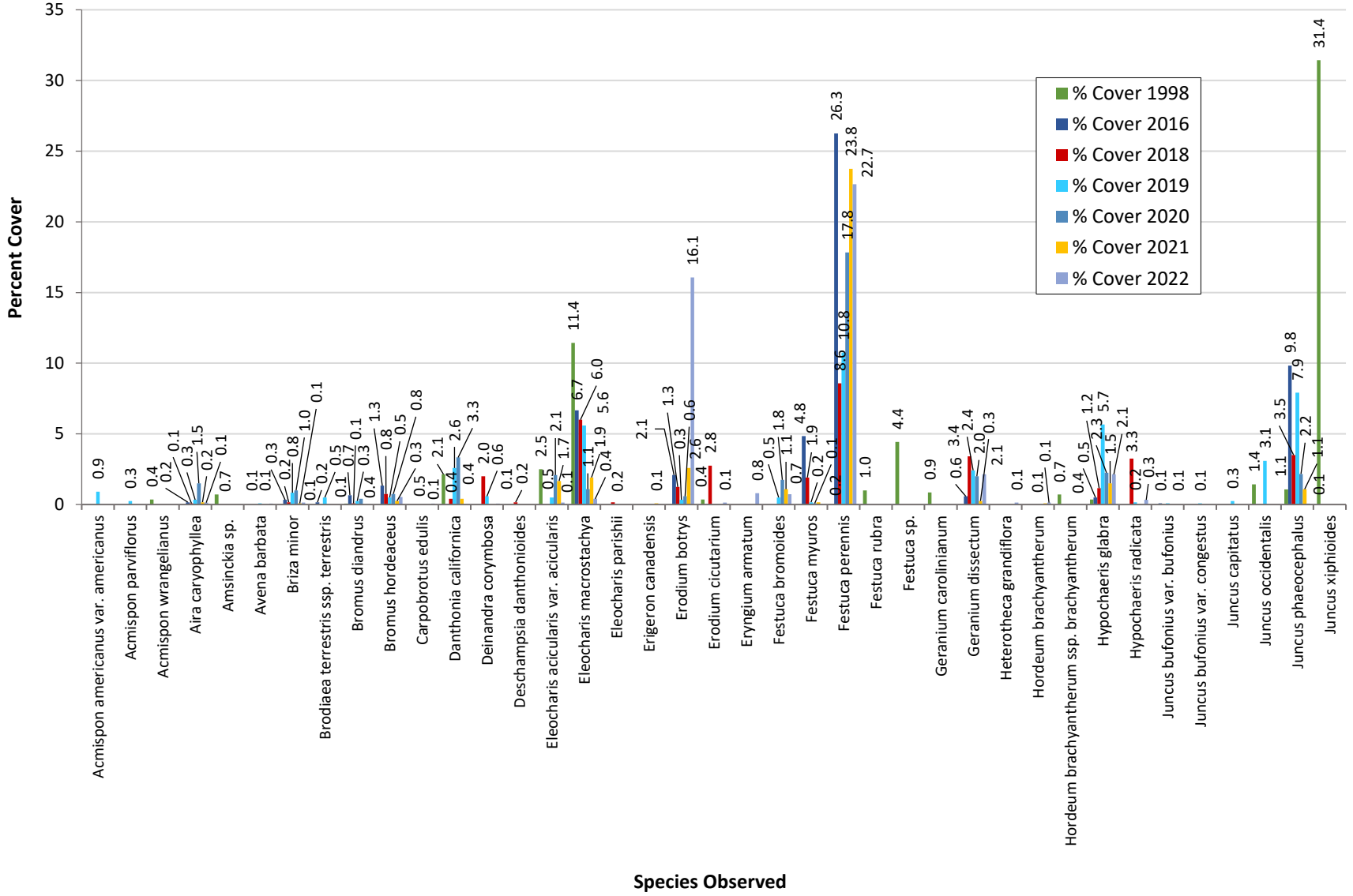

Figure E-6. Comparison Graph of Percent Cover by Wetland Plant Species for 1998, 2016, 2018, 2019, 2020, 2021, and 2022 at Pond 40 South (Year 4 Post-Subsurface Munitions Remediation)

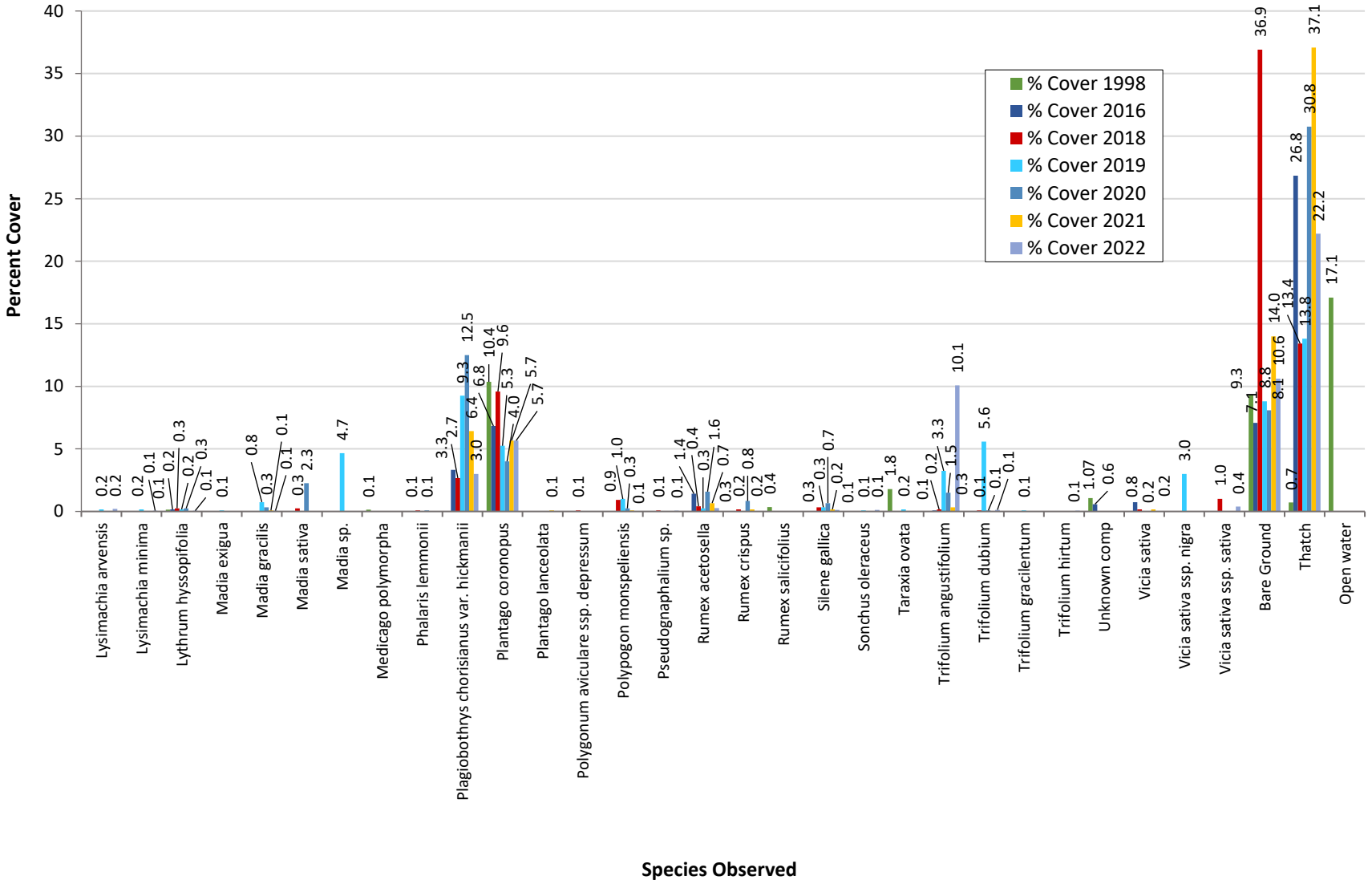

Figure E-6 (continued). Comparison Graph of Percent Cover by Wetland Plant Species for 1998, 2016, 2018, 2019, 2020, 2021, and 2022 at Pond 40 South (Year 4 Post-Subsurface Munitions Remediation)

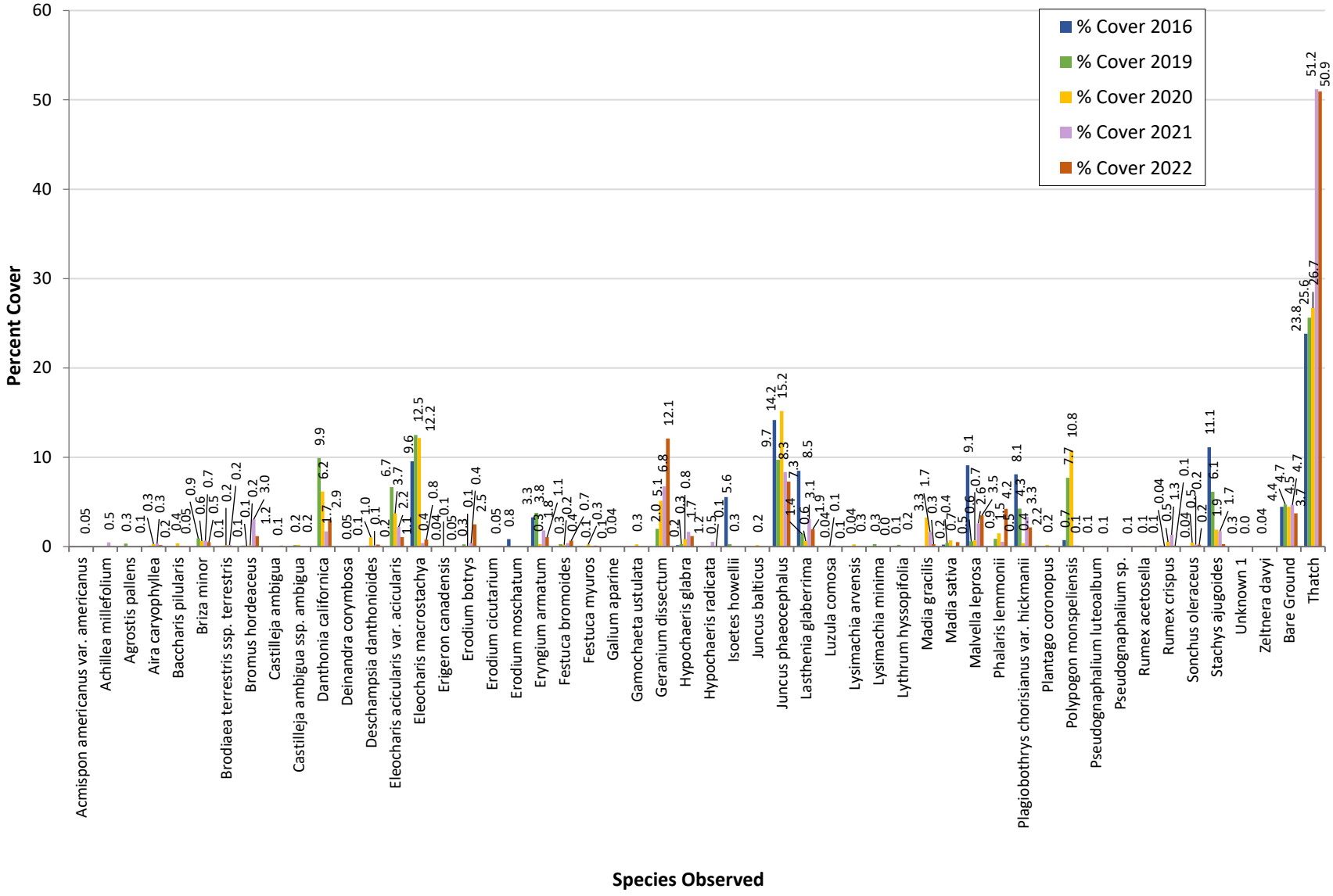

Figure E-7. Comparison Graph of Percent Cover by Wetland Plant Species for 2016, 2019, 2020, 2021, and 2022 at Pond 41 (Year 4 Post-Subsurface Munitions Remediation)

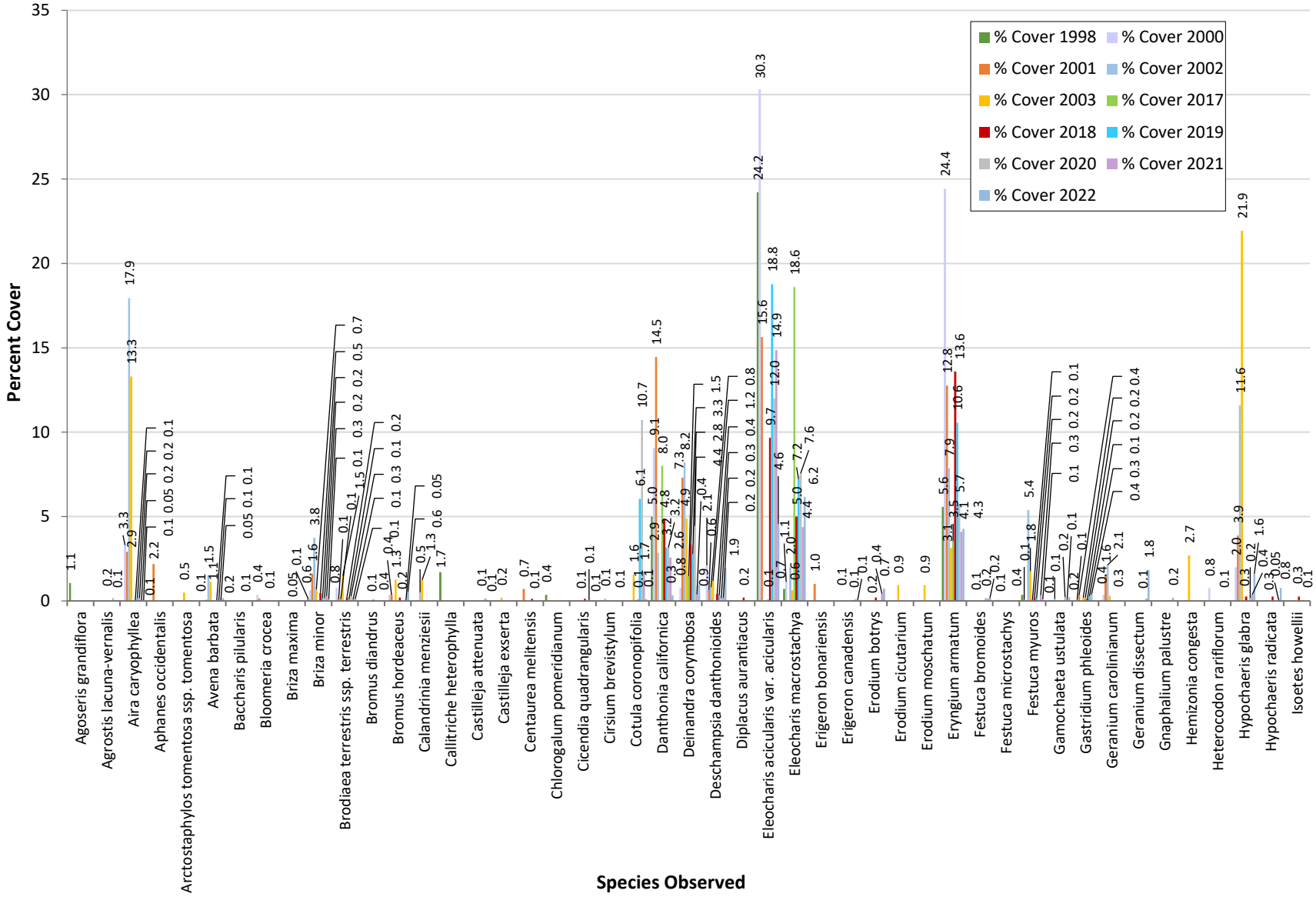

Figure E-8. Comparison Graph of Percent Cover by Wetland Plant Species for 1998, 2000, 2001, 2002, 2003, 2017, 2018, 2019, 2020, 2021, and 2022 at Pond 42 (Year 4 Post-Subsurface Munitions Remediation)

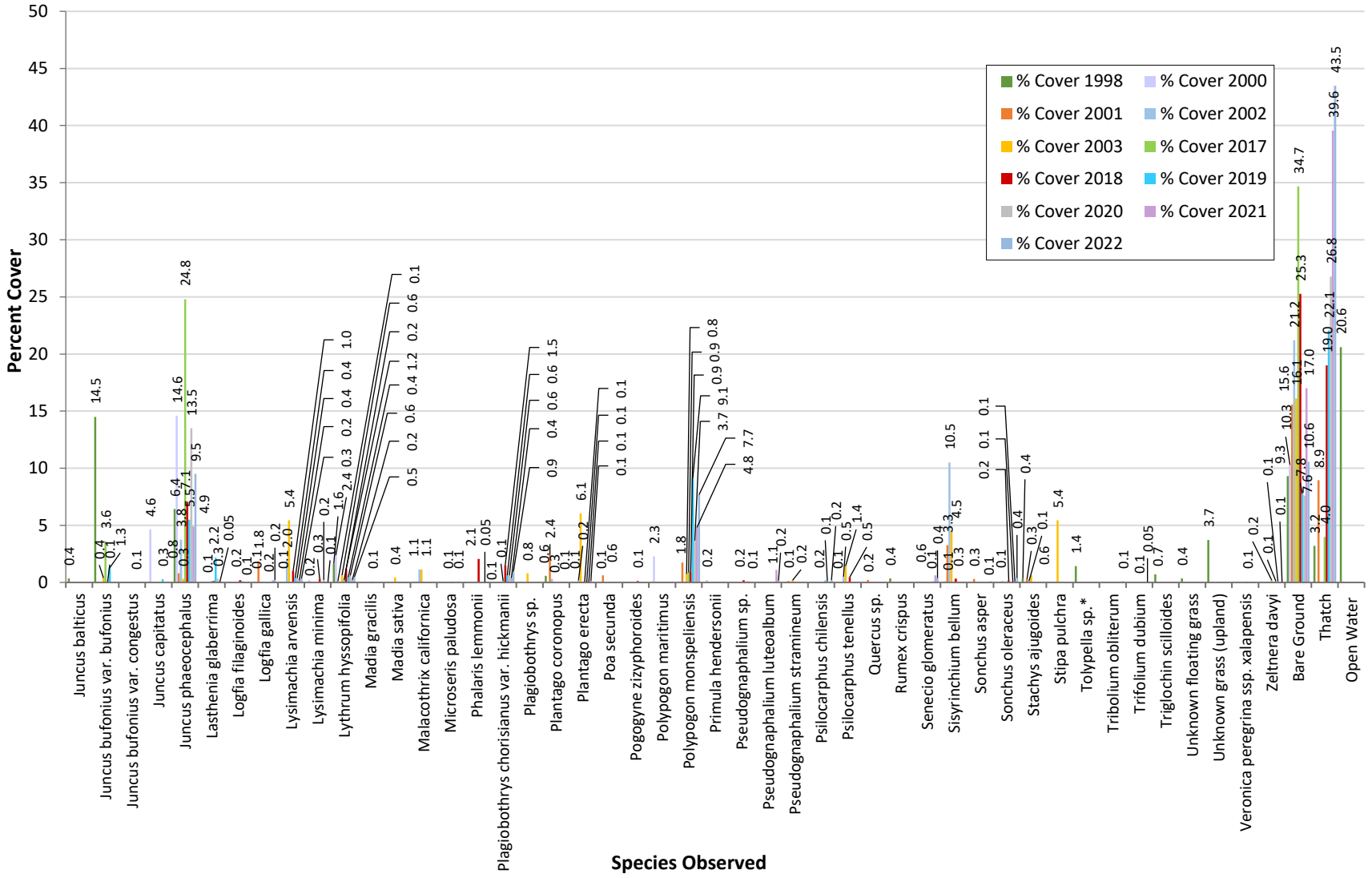

Figure E-8 (continued). Comparison Graph of Percent Cover by Wetland Plant Species for 1998, 2000, 2001, 2002, 2003, 2017, 2018, 2019, 2020, 2021, and 2022 at Pond 42 (Year 4 Post-Subsurface Munitions Remediation)

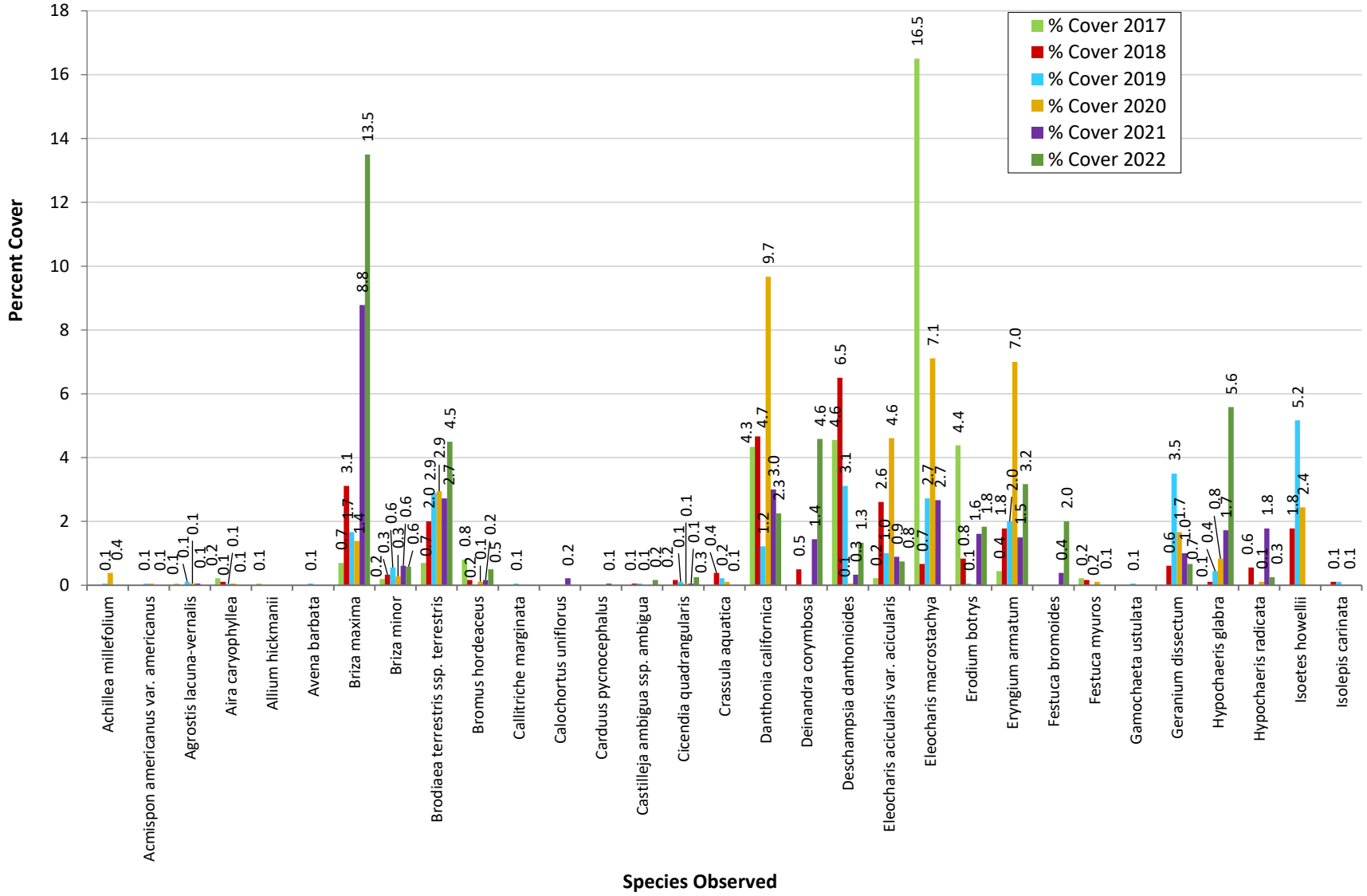

Figure E-9. Comparison Graph of Percent Cover by Wetland Plant Species for 2017, 2018, 2019, 2020, 2021, and 2022 at Pond 61 (Year 4 Post-Subsurface Munitions Remediation)

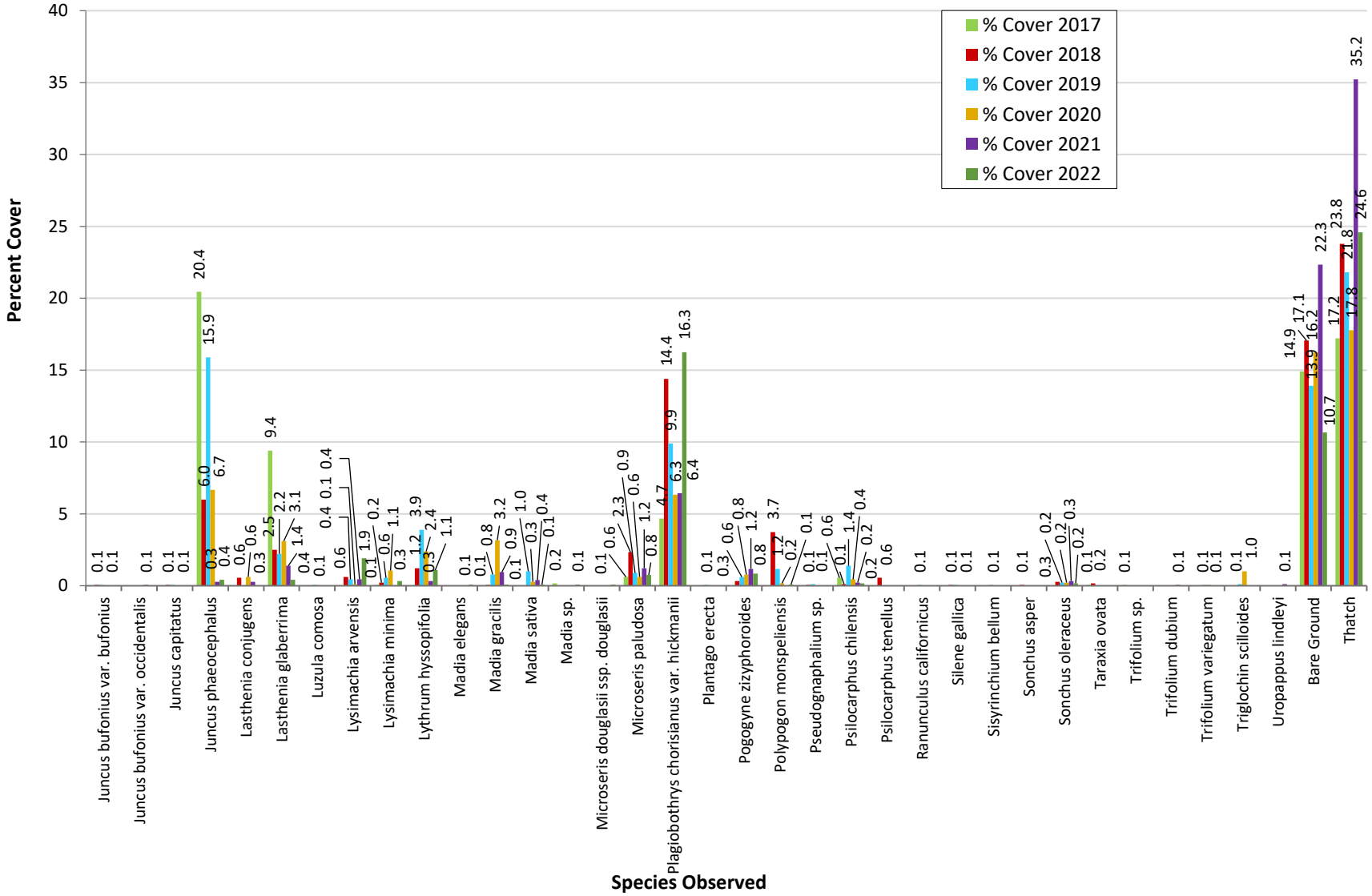

Figure E-9 (continued)**.** Comparison Graph of Percent Cover by Wetland Plant Species for 2017, 2018, 2019, 2020, 2021, and 2022 at Pond 61 (Year 4 Post-Subsurface Munitions Remediation)

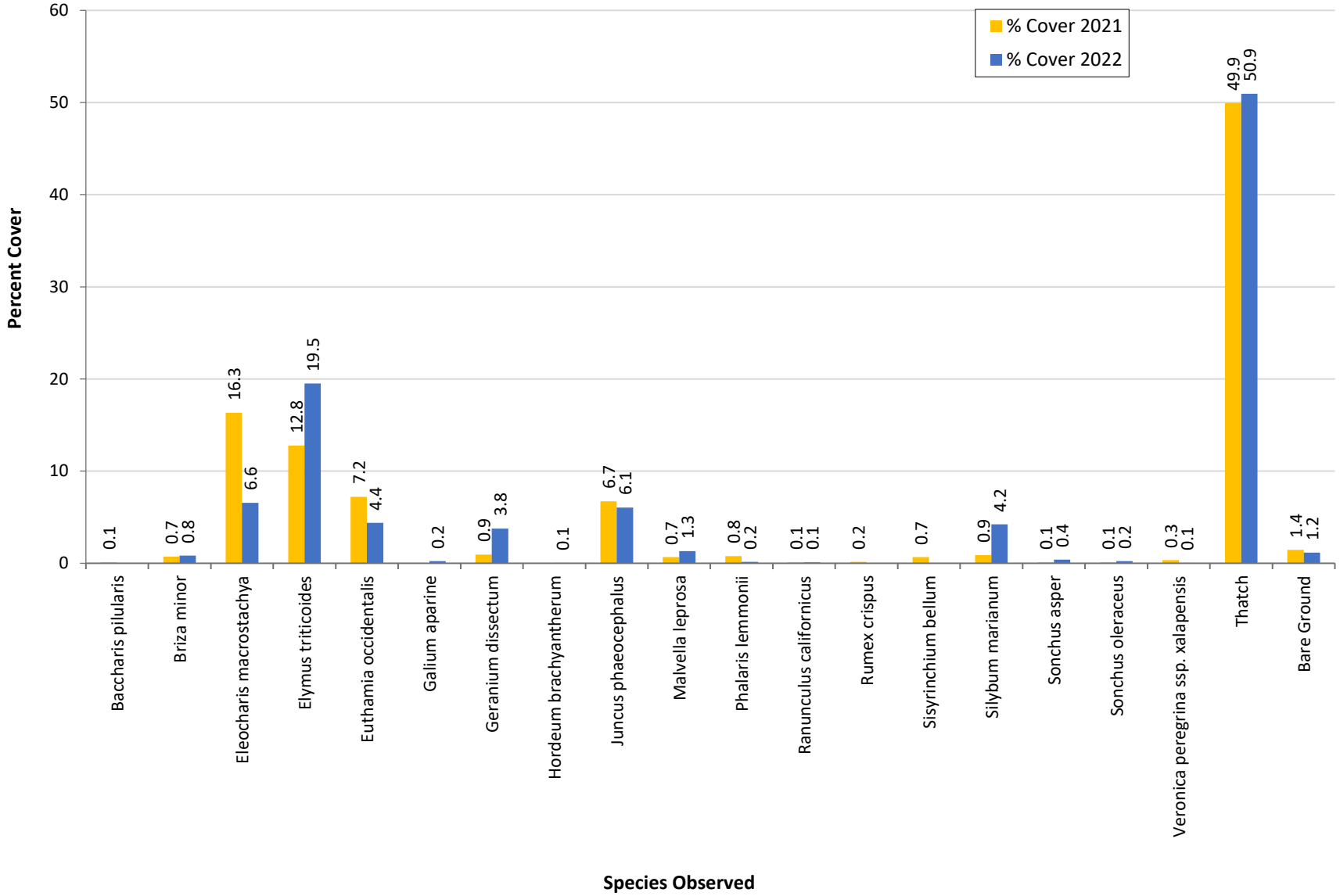

Figure E-10. Comparison Graph of Percent Cover by Wetland Plant Species for 2021 and 2022 at Pond 75 (Baseline)

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APPENDIX F

Rank Abundance Curves

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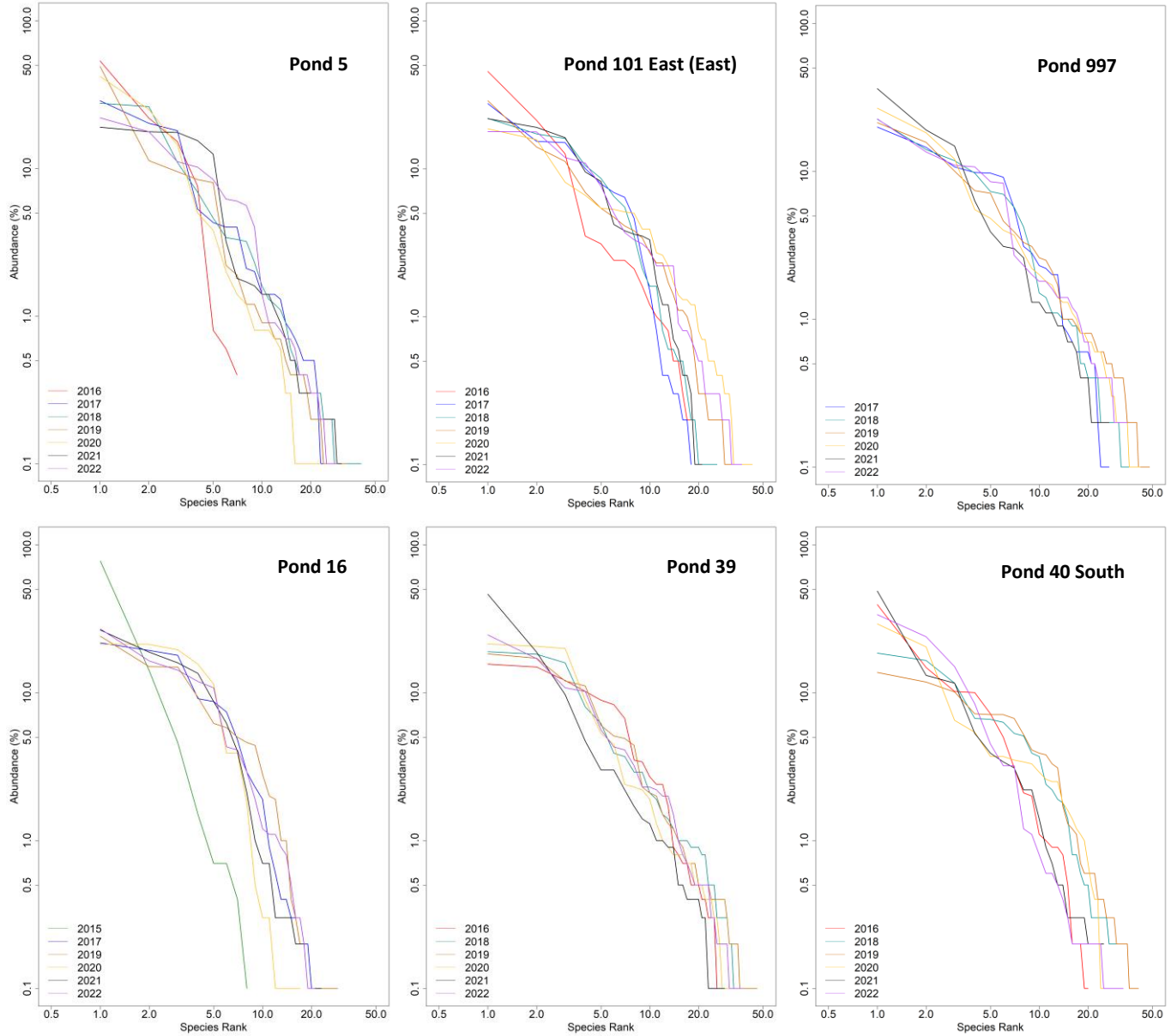

Figure F-1. Comparison Plots for RACs by Pond for all years. Top three plots are reference vernal pools. The bottom three plots are vernal pools in their fourth year of monitoring. Both the x-axis and y-axis are in log-10 scale.

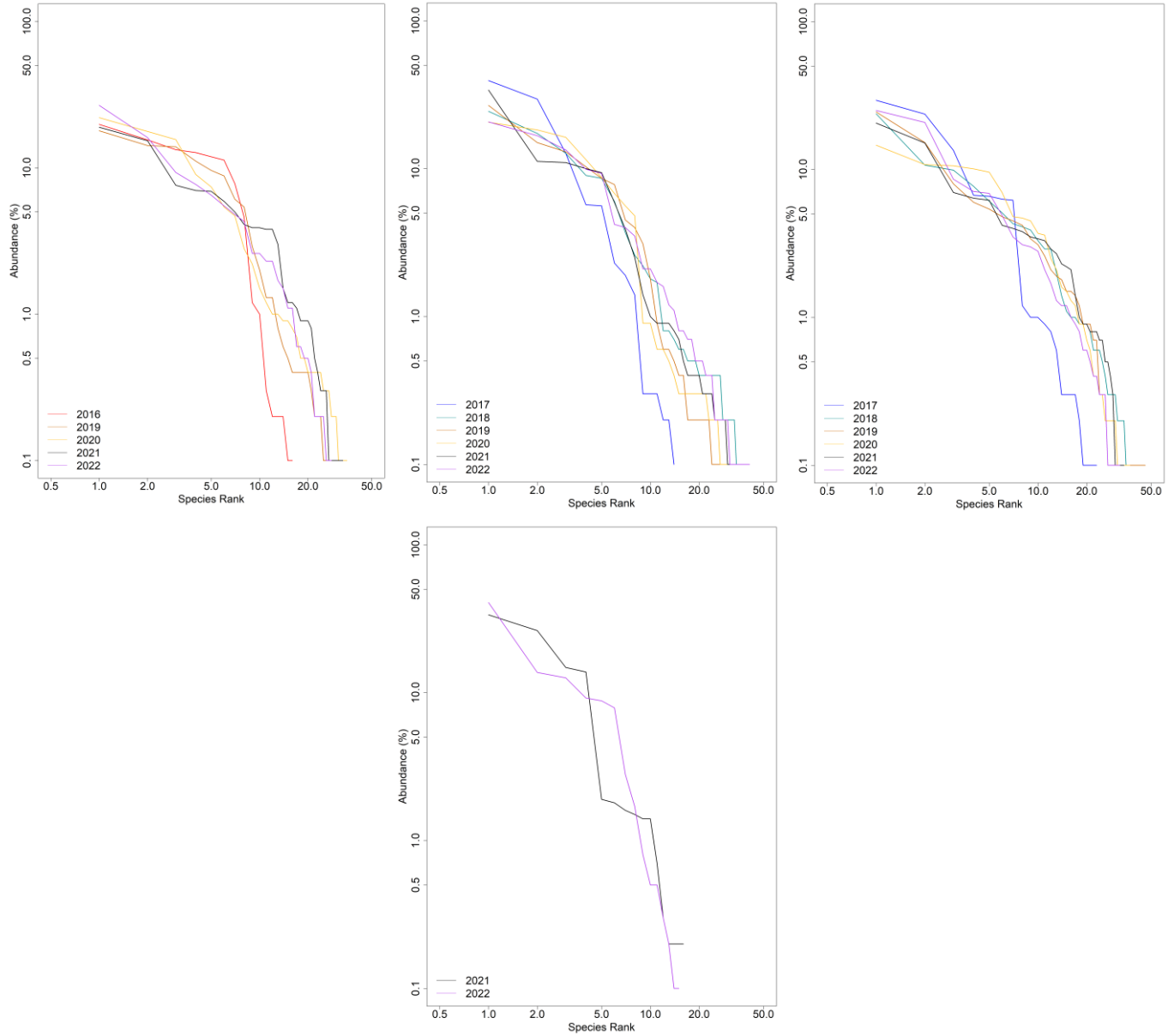

Figure F-2, Continued. Comparison Plots for RACs by Pond for all years. All plots are vernal pools in their fourth year of monitoring. Both the x-axis and y-axis are in log-10 scale.