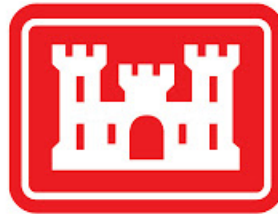


**2023 ANNUAL RARE PLANT SURVEY
FOR THE PER- AND POLYFLUOROALKYL SUBSTANCES (PFAS) SITE
INSPECTION, FORMER FORT ORD, CALIFORNIA**

Prepared for:



**U.S. Army Corps of Engineers
Sacramento District
1325 J Street
Sacramento, CA 95814-2922**

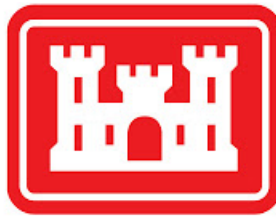
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April 2024

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LIST OF ACRONYMS, ABBREVIATIONS, AND SYMBOLS

AFFF	Aqueous Film-Forming Foam
CSUMB	California State University Monterey Bay
CDFW	California Department of Fish and Wildlife
FAAF	Fritzsche Army Airfield
FONR	Fort Ord Natural Reserve
ft ²	square feet
GIS	geographic information system
GPS	global positioning system
HMP	Habitat Management Plan
OUI	Operable Unit 1
PBO	Programmatic Biological Opinion
PFAS	Per- and Polyfluoroalkyl Substances
SI	Site Inspection
USACE	U.S. Army Corps of Engineers
USFWS	U.S. Fish and Wildlife Service

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2023 ANNUAL RARE PLANT SURVEY FOR THE PER- AND POLYFLUOROALKYL SUBSTANCES (PFAS) SITE INSPECTION, FORMER FORT ORD, CALIFORNIA

1.0 INTRODUCTION

This report describes the methods and results for the 1st year follow up monitoring of rare plants after the installation of two new monitoring wells and one new soil boring location at the former Fritzsche Army Airfield (FAAF) Fire Drill Area at approximately 36.680 degrees latitude and -121.773 degrees longitude. These locations are currently part of FONR North, which is located on the former Fort Ord, Marina, California and is adjacent to the Marina Municipal Airport (what was formerly FAAF) (Figure 1). These activities were part of the Per- and Polyfluoroalkyl Substances (PFAS) Site Inspection (SI) within the Fort Ord Natural Reserve (FONR), on former Fort Ord, California. The specific objective of the SI was to collect data from sites where probable PFAS releases occurred and provide analysis and recommendations. (Ahtna, 2023)

PFAS refers to the entire class of approximately 600 per- and polyfluoroalkyl substances; the current SI includes analysis for 40 of these PFAS compounds. After 1972, the Army began using PFAS-containing aqueous film-forming foams (AFFFs) to extinguish fuel-based fires, deploying them in particular in the vicinity of aviation assets, fuel farms, or aircraft crash sites. From 1962 through 1985, FAAF Fire Drill Area was used as a training area for the Fort Ord Fire Department (Ahtna, 2023).

Rare plant surveys are required by the Installation-Wide Multispecies Habitat Management Plan for Former Fort Ord, California (HMP; USACE, 1997) and the Programmatic Biological Opinion for Cleanup and Property Transfer Actions Conducted at the Former Fort Ord, Monterey County, California (PBO; USFWS, 2017) in areas where ground disturbing or other construction activities occurred. Project activities undertaken must protect and maintain the special-status species found within FONR. Efforts are taken to avoid or minimize impacts to all HMP species, with emphasis on two federally listed plant species: Monterey spineflower (*Chorizanthe p. pungens*) and Monterey gilia (*Gilia tenuiflora ssp. arenaria*).

In accordance with the conservation measures outlined in the Programmatic Biological Opinion (USFWS 2017) DD&A conducted baseline surveys in 2022 prior to Site Inspections for federally listed species Monterey spineflower and Yadon's piperia and federally and state listed sand gilia to provide data by which to assess the potential impacts of the activity. This report covers the methods, results, and discussion of year-1 follow-up surveys.

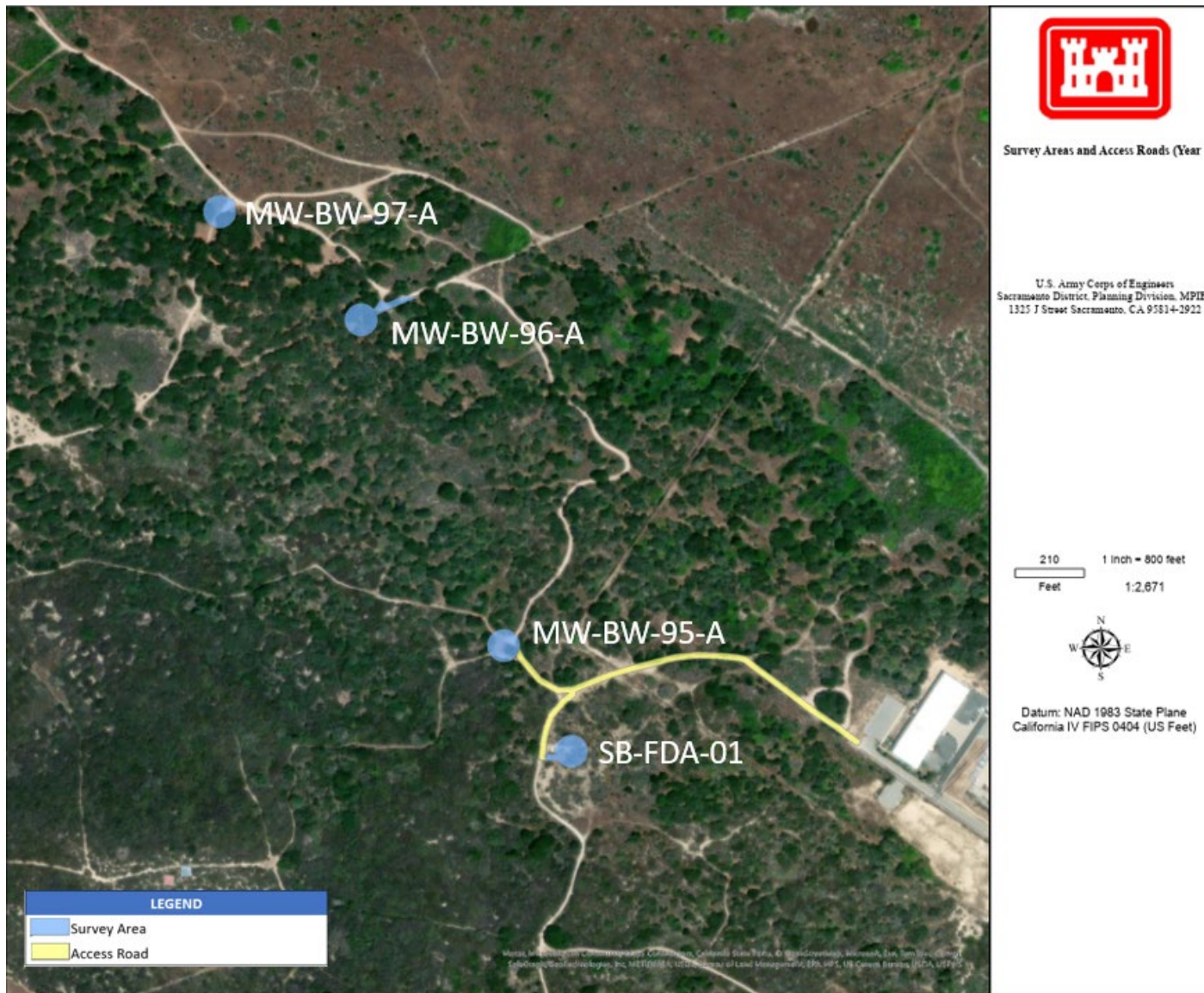


Figure 1. Locations of FAAF Fire Drill Area year-1 follow-up monitoring

2.0 SITE DESCRIPTION

Fort Ord was established in 1917 as a military training base for infantry troops. In January 1991, the U.S. Secretary of Defense announced the closure of the base. In August 1994, portions of the property were transferred to University of California Monterey Bay Education, Science, and Technology Center (UC MBEST), and Fort Ord Natural Reserve (FONR) was established as part of the Natural Reserve System operated by UC Santa Cruz.

Former Fort Ord is located in the northwestern part of Monterey County, California, on the boundary of Monterey Bay, approximately 80 miles south of San Francisco. FONR comprises 605 acres of coast live oak woodland, coastal scrub, maritime chaparral, and annual grassland in the northern portion of the former Fort Ord. The property is divided into two parcels, FONR North and FONR South; FAAF Fire Drill Area is located in the south east part of FONR North. The area's maritime climate is characterized by cool, overcast, foggy summers, and cool rainy winters, with the warmest days generally occurring in late summer and early fall.

FAAF Fire Drill Area is dominated by Coast live oaks (*Quercus agrifolia*) woodland, with associations of poison oak (*Toxicodendron diversilobum*) and both native and non-native grasses, as well as fractions of maritime chaparral, annual grassland, and disturbed/developed land. Herbivorous species such as brush rabbits, mule deer, and California ground squirrels are common, as are carnivorous species such bobcats and coyotes.

Several protected species are known or suspected to be present within the FONR. These include the federally threatened Monterey spineflower, and the federally endangered and state threatened sand gilia. State endangered Seaside bird's beak (*Cordylanthus rigidus ssp. littoralis*) is present in the reserve as well as within FAAF Fire Drill Area (DD&A, 2023). Yadon's piperia was included in rare plant surveys beginning in 2016 per agencies request, but since 1992 the species was never found on the reserve during the annual surveys conducted by the Army, FONR staff, and academic researchers. This species has been found in two primary habitat types: ridges in maritime chaparral, and Monterey pine forest (USFWS 2009a). In maritime chaparral habitat in northern Monterey County, plants grow on sandstone ridges where soils are shallow (USFWS 2009a), features that are not present in FONR. Several other special status plant and animal species listed in the HMP and PBO that are or may be present in the FONR include the following:

- Coast wallflower (*Erysimum ammophilum*)
- Sandmat manzanita (*Arctostaphylos pumila*)
- Monterey manzanita (*A. montereyensis*)
- Monterey ceanothus (*Ceanothus rigidus*)
- Eastwood's goldenbush (*Ericameria fasciculata*)
- California black legless lizard (*Anniella pulchra nigra*; BLL) – state species of concern

- California tiger salamander (*Ambystoma californiense*; CTS) – federally threatened, state threatened
- Monterey ornate shrew (*Sorex ornatus salarius*) – state species of concern

The areas surveyed in 2023 consisted of Reference Site 1, F3 Plots 1-3 (an additional reference site of potential import for future work), and the following locations at FAAF Fire Drill Area:

- MW-BW-96-A (New Monitoring Well)
- MW-BW-97-A (New Monitoring Well)
- MW-BW-95-A (Existing Monitoring Well)
- SB-FDA-01 (Soil Boring)

Additionally, a portion of the associated access roads were also included in the surveys.

3.0 OVERVIEW OF RARE PLANT SURVEY METHODS

The surveys for Monterey spineflower and sand gilia were conducted with the same methods as the baseline surveys (DD&A 2023) and were timed to coincide with the peak blooming period which was determined by observing known occurrences of the species in the nearby areas and within the survey area. Note that this was not the case for Yadon’s piperia, whose peak blooming does not coincide with that of Monterey spineflower or Monterey gilia; instead, surveys were conducted for basal rosettes. No basal rosettes were identified during year-1 surveys, however, any results would have been documented and locations relayed to the BRAC Biologist for follow-up surveys during peak blooming period. Baseline surveys within FAAF Fire Drill Area and its access routes were conducted on April 13-May 12, 2022 (DD&A 2023). Year-1 follow-up monitoring surveys for Monterey spineflower and sand gilia were conducted on May 2-8, 2023.

Within FAAF Fire Drill Area, each rare plant survey was conducted around well locations and along existing access routes. The survey area consisted of approximately 50-foot buffer around the wells and around the soil boring location, and a 20-foot buffer along access routes, from centerline. If a rare plant population was identified, the survey in that area was extended to the boundary of the population encountered. Populations separated by less than three feet were mapped as a single population, with the occasional exception when the populations were separated by clear boundaries, such as between access roads and grassland areas.

All GPS data were collected using a Trimble Geoexplorer 6000 unit, processed using Trimble GPS Pathfinder Office Software v5.80, and mapped using ESRI ArcMap 10.7 GIS software.

3.1 Monterey Spineflower Survey Methods

Monterey spineflower groups of five or less were mapped as points with attributes to identify the number of individuals at each location. Areas of Monterey spineflower with populations greater

than five individual plants were mapped as polygons. When a population of Monterey spineflower was identified, the survey in that area was extended to the boundary of the population encountered. In populations with greater than five individual plants, the quantity of Monterey spineflower was characterized as the percentage of the polygon covered by the Monterey spineflower within the polygon. The cover classes are defined as follows:

- Very Sparse (corresponding to an absolute cover of less than 3 percent);
- Sparse (3 to 25 percent);
- Medium Low (26 to 50 percent);
- Medium (51 to 75 percent);
- Medium High (76 to 97 percent); and
- Very High (greater than 97 percent).

3.2 Sand gilia survey methods

Areas of sand gilia with populations greater than five individual plants were mapped as polygons using a GPS unit. Plant groups of 5 or less were mapped as points, and the number of individuals was recorded at each group location. When a population of sand gilia was identified, the survey in that area was extended to the boundary of the population encountered. All individual plants within each population were counted.

4.0 RESULTS OF 2023 PLANT SURVEYS

4.1 Monterey spineflower results

Reference Area 1 contained 24 populations of Monterey spineflower, generally tracking interstitial grassland patches and clearings within the oak woodland, and in the open ground along its boundaries. The number of polygons (13) and points of less than 5 individuals (6) comprising these populations were both greater than found in the Baseline, and these populations were of overall higher density, including increases over Baseline in populations of both very sparse and sparse density classes, as well as the addition of one population of medium low density class (Table 1; Fig 2. The total area of these polygons increase 1,115% from baseline, from 117 ft² to 1464 ft² (Table 1).

FAAF Fire Drill Area survey areas (well locations) showed decreases in Monterey spineflower extent, as compared to Baseline (Fig 3); the species was only found within 50 feet of the soil boring location, SB-FDA-01, and was solely identified by four point populations, representing a total of 8 individuals, with no measurable area of extent; this compares to the 4 populations identified at Baseline, covering 497 ft² at both the soil boring location, SB-FDA-01, and existing monitoring well location, MW-BW-95-A. In neither Baseline nor 2023 surveys were Monterey

spineflower identified within 50 feet of new monitoring wells MW-BW-96-A and MW-BW-97-A.

The access routes of FAAF Fire Drill Area similarly showed marked decreases in Monterey spineflower extent, as compared to Baseline (Fig 2), with the number of populations reduced from 29 to 14 and both point/polygon populations being less than Baseline. The total area of these populations decreased by 66%, from 395 ft² to 134 ft².

An additional reference area--F3 Plots 1, 2 and 3—was explored and has been included in Table 1, but its data are not currently comparable to previous year.

Figure 2: Monterey spineflower survey results for reference sites, baseline surveys, and year-1 follow-up monitoring (2010-2019 DD&A; 2020 Chenega; 2022 DD&A; 2023 Chenega/USACE)

Year	Location	# of Populations	# of Plants	# of Points	# of Polygons	Polygons per Density Class						Total Area of Polygons (ft ²)	Area % Change
						Very Sparse	Sparse	Medium Low	Medium Medium	Medium High	Very High		
2010	Ref Site 1	2	N/A	0	2	1	0	1	0	0	0	2846	N/A
2011	Ref Site 1	1	N/A	0	1	0	1	0	0	0	0	2865	1
2012	Ref Site 1	3	N/A	1	2	0	2	0	0	0	0	1494	-48
2013	Ref Site 1	7	N/A	0	7	0	6	1	0	0	0	2813	88
2014	Ref Site 1	7	N/A	1	6	0	6	0	0	0	0	1119	-60
2015	Ref Site 1	4	N/A	1	3	0	1	1	1	0	0	2114	89
2016	Ref Site 1	2	N/A	0	2	0	0	1	1	0	0	3241	53
2017	Ref Site 1	4	N/A	0	4	0	3	1	0	0	0	2855	-12
2018	Ref Site 1	5	N/A	2	3	1	2	0	0	0	0	3078	8
2019	Ref Site 1	12	N/A	4	8	1	6	1	0	0	0	2283	-26
2020	Ref Site 1	15	N/A	6	9	7	2	0	0	0	0	2614	14
2022 (Baseline)	Ref Site 1	10	N/A	7	3	2	1	0	0	0	0	117	-96
2023 (Year 1)	Ref Site 1	34	N/A	21	13	6	5	1	0	0	0	1464	1151
2023	Ref Site F3 1	N/A	289	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
2023	Ref Site F3 2	N/A	239	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
2023	Ref Site F3 3	N/A	23	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
2022 (Baseline)	Survey Area	4	N/A	2	2	1	1	0	0	0	0	497	N/A
2023 (Year 1)	Survey Area	4	8	4	0	0	0	0	0	0	0	0	-100
2022 (Baseline)	Access Route	7	N/A	1	6	3	3	0	0	0	0	395	N/A
2023 (Year 1)	Access Route	14	N/A	8	6	5	1	0	0	0	0	134	-66

4.2 Sand Gilia results

Sand Gilia in Reference Area 1 generally co-occurred with Monterey spineflower populations, and was thus similarly constrained to open or grassy areas within and surrounding the oak woodland. The 22 sand gilia populations covered 1243 ft² divided among 11 polygons, with an additional 11 populations of fewer than 5 plants. This represented an 1972% increase in area from Baseline, with the total sand gilia plants within Reference Site 1 being 1985 (Fig 3), representing a 4,863% increase from Baseline.

FAAF Fire Drill Area survey areas did not have any recorded populations of Sand Gilia in Baseline Surveys, but the 2023 surveys found 5 populations with 26 total individuals; only a

single populations comprised more than 5 individuals, covering a total area of 9 ft² (Fig 3, 5); all populations were confined to within 50 feet of the soil boring location, SB-FDA-01.

A comparable increase in Sand Gilia populations was also seen along the FAAF Fire Drill Area access routes, from 1 population in Baseline Surveys to 6 populations in 2023, representing an increase of 17 to 58 individual plants respectively, or 241%. The total area of these populations decreased slightly from 65 ft² to 41 ft² or 37% (Table 2).

As with Monterey spineflower, the additional reference area--F3 Plots 1, 2 and 3—was explored and has been included in Table 2, but its data are not currently comparable to previous years.

Figure 3: Sand gilia survey results for reference sites, baseline surveys, and year-1 follow-up monitoring (2010-2019, DD&A; 2020 Chenega; 2022 DD&A; 2023 Chenega/USACE)

Year	Location	# of Populations	# of Plants	# of Points	# of Polygons	Total Area of Polygons (ft ²)	Area % Change	Plants % Change
2010	Ref Site 1	14	1086	7	7	1715	N/A	N/A
2011	Ref Site 1	16	318	4	12	1410	-18	-71
2012	Ref Site 1	16	70	12	4	210	-85	-78
2013	Ref Site 1	20	736	7	13	1281	511	951
2014	Ref Site 1	4	97	2	2	370	-71	-87
2015	Ref Site 1	11	1078	4	7	1512	309	1011
2016	Ref Site 1	12	1090	6	3	1964	30	1
2017	Ref Site 1	8	463	6	2	1950	-1	-58
2018	Ref Site 1	21	352	8	13	481	-75	-24
2019	Ref Site 1	18	3065	8	10	717	49	771
2020	Ref Site 1	65	614	44	21	256	-64	-80
2022 (Baseline)	Ref Site 1	4	40	0	4	60	-77	-93
2023 (Year 1)	Ref Site 1	22	1985	11	11	1243	1972	4863
2023	Ref Site F3 1	N/A	58	N/A	N/A	N/A	N/A	N/A
2023	Ref Site F3 2	N/A	197	N/A	N/A	N/A	N/A	N/A
2023	Ref Site F3 3	N/A	284	N/A	N/A	N/A	N/A	N/A
2022 (Baseline)	Survey Area	0	0	0	0	0	N/A	N/A
2023 (Year 1)	Survey Area	5	26	4	1	9	N.D.	N.D.
2022 (Baseline)	Access Route	1	17	0	1	65	N/A	N/A
2023 (Year 1)	Access Route	6	58	4	2	41	-37	241

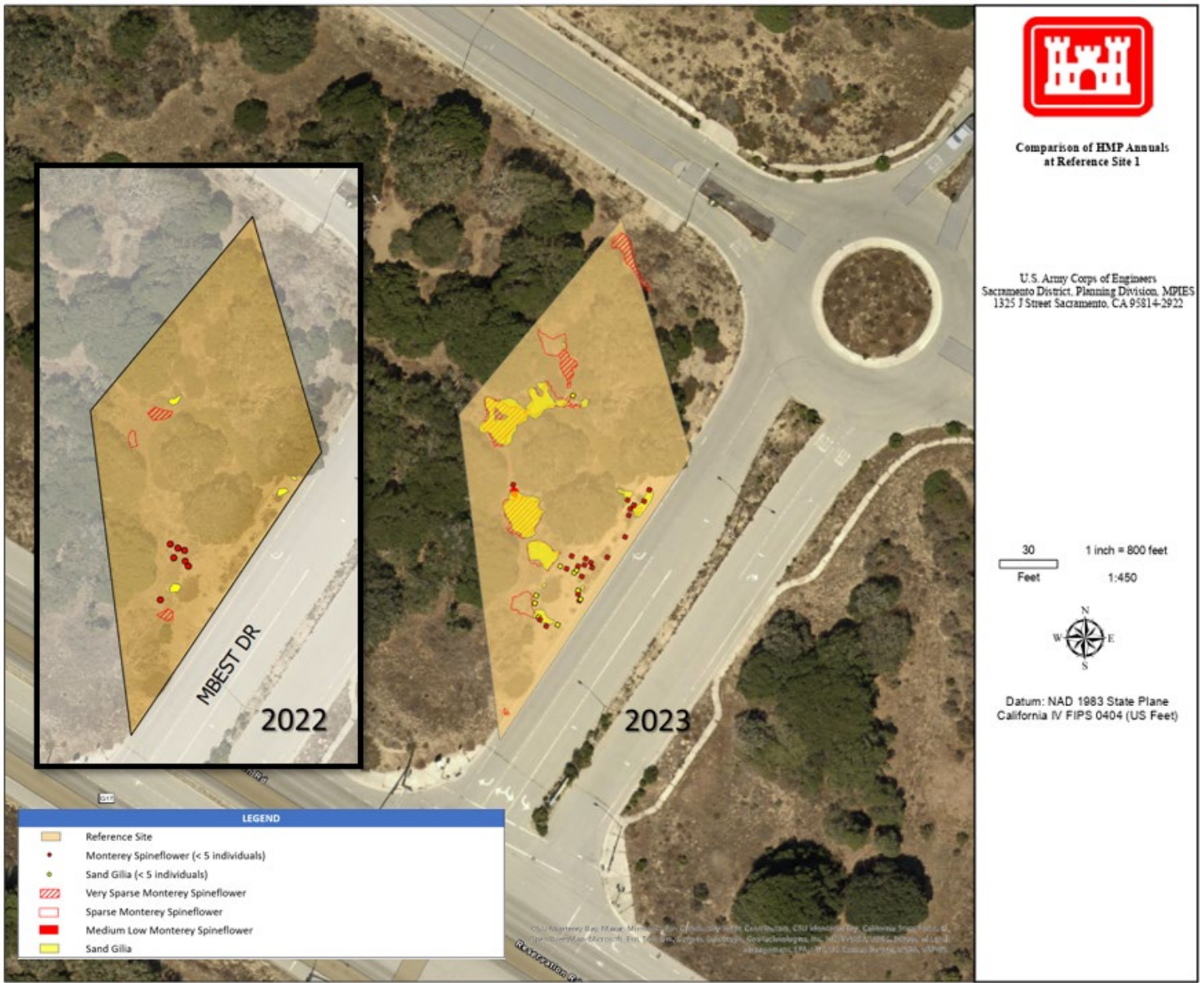


Figure 4. Comparison of Baseline and Year-1 follow-up monitoring for Monterey spinneflower and sand gilia at Reference Site 1.



Figure 5. Comparison of baseline and year-1 follow-up monitoring for Monterey spineflower and sand gilia at FAAF Fire Drill Area survey areas; note that 2023 data displayed defines extent of where the species were found; no HMP species were found within the 50-foot radius of MW-BW-97-A and MW-BW-96-A.



Figure 6. View of oak woodland vegetative cover type where no HMP annuals were discovered; this cover type is typical of the new monitoring wells, MW-BW-96-A and MW-BW-97-A. Note abundant grass and *Toxicodendron* growth in the understory.



Figure 7. Examples of the herbivory pressure on sand gilia populations (see arrows); note that flower stalks rather than foliage seem to be preferred, which would likely be more deleterious on seed production.



Figure 8. Example of disturbed soil subsequently colonized by Monterey spineflower; note that this observation is from BLM Unit A, not from the FONR.

5.0 DISCUSSION

The 2022 PFAS SI monitoring well and soil probe installation work at FAAF Fire Drill Area was completed between October 18th and November 16th by AHTNA, with the biological support of DD&A (DD&A 2023). Conservation measures implemented to minimize impact to listed and HMP species included the following;

- Baseline surveys for special status species
- Completion of a Habitat Checklist before construction work began
- Environmental awareness training for field crews
- Monitoring by a qualified biologist during construction activities
- Selection of established or pre-defined access routes and staging areas to minimize impacts to special status species
- Dry-brushing of equipment entering the FONR from off-site to reduce invasive plant spread

These conservation measures along with follow-up monitoring were implemented to ensure continued existence of HMP annual species within the FAAF Fire Drill Area PFAS SI areas.

5.1 Monterey Spineflower

The dramatic increase in Monterey spineflower cover from Baseline to Year-1 at Reference Site 1 contrasted sharply with a commensurate decrease in cover at the survey areas and along access routes during the same time period. While some variability due to differing site conditions may be expected—and a high degree of annual variability due to differing environmental conditions is evident in observations dating to 2010 at Reference Site 1 (Figure 2)—the inverted relationship between sites suggests that impacts from construction activities are possible, especially given the overall vulnerability of small populations to anthropogenic factors.

However, the baseline density of Monterey spineflower at the survey areas and access routes contrasts with Reference Site 1, and thus could indicate important and as yet unidentified site-specific factors that may interact paradoxically under comparable environmental conditions; one example of this could be topographic or soil features that would, during high precipitation events, assist seed germination at one site and wash seeds off-site at another. Additionally, access routes were established on preexisting roads that are in current use by other entities, such as UCSC, making conclusions about the effects of PFAS investigation work in isolation difficult to establish; it should be noted here that some of the baseline data from the access routes was excluded from Figure 2, as baseline surveys were conducted on access routes past well MW-BW-95A to provide supplemental information, but was not required per USFWS' Revisions of Monitoring Plan for Federally Listed Plants in (USFWS, 2013), and were also excluded from Year-1 Follow-Up Surveys. Lastly, decreases in abundance of comparable magnitude have historically been observed at Reference Site 1, and thus this decrease at FAAF Fire Drill Area may be explicable by the natural variability of the species alone.

As has been found elsewhere in the FONR, Monterey spineflower populations appear more likely to be detected where small herbivorous mammal browsing has created microhabitats with sparse herbaceous cover (USFWS 2009b, Chenega 2020), such as in the transition areas between shrubs and grasslands, which are intensely browsed by brush rabbits due to proximity to predation refugia, i.e. shrubs (Chapman 1974). Furthermore, as Monterey spineflower has not itself been shown to be affected by herbivory in both a two-year field experiment (Fox 2007) and direct observation throughout Fort Ord, this further connotes a commensalistic relationship between herbivores and spineflower via preferential predation of competition. No observations of such microhabitats were recorded in FAAF Fire Drill Area, and thus the relative decline in population may be correlated to external factors such as a localized and/or cyclical declines in herbivore populations and thus such microhabitats; furthermore, observations of spineflower growing singly in the open sandy areas of the F3 Plots—rather than growing in dense, interlocking mats—suggest that this lack of microhabitats can apply to more than just areas overgrown with annual grasses. Subsequent years of monitoring will clarify such dynamics.

5.2 Sand gilia

The increase from baseline of individual sand gilia plants across all survey areas in 2023 was in itself highly variable, ranging from 4862% in Reference Area 1 to 241% along the access routes; the survey areas within 50ft of monitoring wells did not have a defined increase, due to their absence from baseline surveys and presence around the soil boring location in Year-1 follow up monitoring.

There was a commensurate increase of 1972% in total cover of sand gilia from baseline at Reference Site 1; however, the access routes saw a decrease of 37% (the monitoring wells again had an undefined increase, for reasons listed above), indicating a curious shift in distribution rather than abundance, a decoupling of plant and extent metrics not previously observed at the reference site.

As discussed above, Fox (2007) demonstrated under experimental conditions that while herbivory did not affect vital rates of Monterey spineflower, it was a main driver of sand gilia's; thus in areas with small sand gilia populations, herbivory can have an outsized impact on populations. Figure 7 shows some of the clear evidence of herbivory observed during 2023 surveys. Reference Site 1 has historically showed population swings of comparable magnitude and variability to 2023, which may in part be due to unstudied variability in herbivory and its contingency on extrinsic population dynamics. Indeed, given the local decline of Monterey spineflower due to a possible decrease herbivory-driven microhabitat abundance, a commensurate increase in sand gilia abundance may possibly be anticipated. Establishing an inverse correlation between the two HMP annuals could present a possibly useful tool for interpreting future survey results.

5.3 Success criteria

The success criteria for HMP annual species are identified in the 2017 PBO as:

1. Densities and acreage of HMP annual species are within normal range compared with information from reference sites.
2. The number of wells where HMP annual species are detected in follow-up surveys will be the same or greater than the number of wells where these species were found in baseline surveys.

Success criterion 1 for Monterey spineflower has been met in 2023, as its decrease in density and acreage as compared to both Reference and baseline are within the normal range of the species, as evidenced by similar historical decreases at Reference Site 1. The success criterion 1 for sand gilia has been met in 2023.

Success criterion 2 for Monterey spineflower has not been met in 2023, as Monterey spineflower was detected at 1 well, as compared to 2 wells at baseline. Success criterion 2 for sand gilia has been met in 2023, as sand gilia was detected at 1 well, as compared to 0 wells at baseline.

6.0 CONCLUSIONS AND RECOMMENDATIONS

The results presented in this report are for Year 1 follow up surveys for rare plant species in the FAAF FIRE DRILL AREA area in the FONR. Year 2 and 3 years surveys will be conducted for the soil boring location SB-FDA-01, well MW-BW-95A and for the access route leading up to it, to ascertain whether decreasing Monterey spineflower populations in FAAF Fire Drill Area are due to natural variability or are long term trends established following well construction. Year 1 comparison to baseline data does not give sufficient support for either contention, given patterns observed in these populations elsewhere on the FONR and the presence of confounding external factors. Per 2017 PBO, follow-up surveys will be suspended at wells MW-BW-97-A and MW-BW-96-A, since no HMP annual species were detected there during Baseline and Year 1 follow-up surveys.

The increase of sand gilia populations within FAAF Fire Drill Area, however, provides a strong sign that the effects of well and probe installation have not jeopardized the continued occupation of the site by this species. While these small populations may be vulnerable to anthropogenic changes and environmental shifts going forward, a positive population response following ground disturbing work is encouraging, and year 2 and 3 surveys may interrogate whether habitat may have been improved or remained unaffected for this species.

Data from Year 2 and 3 surveys will be utilized to assess the success criteria for locations where PFAS investigation occurred. Given the possible effects of herbivory on the population dynamics of both species (directly or indirectly), any related observations in follow up monitoring would be helpful in defining further research questions on these rare annuals.

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