2017 ANNUAL RARE PLANT SURVEY & BIOLOGICAL MONITORING REPORT

FOR THE

AHTNA MONITORING WELLS

AND

ENHANCED IN SITU BIOREMEDIATION (EISB) DEPLOYMENT AREA

AT THE

OPERABLE UNIT CARBON TETRACHLORIDE PLUME (OUCTP)

November 2017

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1 INTRODUCTION

Denise Duffy and Associates, Inc. (DD&A) was contracted by Ahtna Environmental, Inc. (Ahtna) to conduct baseline surveys, provide construction phase biological monitoring, and complete annual follow-up surveys within the University of California Fort Ord Natural Reserve (FONR) in support of the 2015 monitoring well installation effort and the 2016 Enhanced In Situ Bioremediation (EISB) Deployment Area construction. This task required part-time and on-call environmental monitoring of construction activities to advise the Ahtna Field Supervisor on avoidance of special-status plant and wildlife species, and provide guidance on minimizing habitat impacts in response to requests from the construction field staff. Following the installation of wells and support facilities, in accordance with the governing documents, DD&A was scheduled to conduct three annual follow-up surveys for three annual special-status plant species: federally Threatened Monterey spineflower (*Chorizanthe pungens* var. *pungens*), federally Endangered and state Threatened Monterey gilia (*Gilia tenuiflora* ssp. *arenaria*), and federally Threatened Yadon's piperia (*Piperia yadonii*). This report details the results of the second annual follow-up survey (annual survey) for the 2015 monitoring well installation. This report will also provide a comparison to the 2015 baseline survey, as well as the 2016 first annual survey.[1] Additionally, this report details the results of the first annual follow up survey conducted in 2017 for the 2016 construction of the EISB Deployment Area and compares the results to the 2016 baseline survey.

1.1 BACKGROUND AND PROJECT INITIATION

FONR is located on the former Fort Ord, Marina, California and is adjacent to the Marina Municipal Airport (the former Fort Ord Fritzsche Army Airfield). A portion of the Operable Unit Carbon Tetrachloride Plume (OUCTP) in the A-Aquifer underlies FONR. The chemicals of concern (COCs) associated with OUCTP in the A-Aquifer are carbon tetrachloride (CT); tetrachloroethene (PCE); chloroform; 1,1-dichloroethene; total-1,2-dichloroethene; methylene chloride; vinyl chloride; and trichloroethene (TCE). The presence and concentration levels of CT are used to define the extent of OUCTP. The remedy for OUCTP in the A-Aquifer is EISB, which has been implemented at three deployment areas in FONR. In 2014 the U.S. Army Corps of Engineers (USACE) contracted with Ahtna to conduct field work to collect additional site information to further characterize groundwater gradients and chemistry in the north and northeastern portions of the OUCTP to support the design and implementation of additional EISB deployment area(s), if necessary.

Rare plant surveys are required by the Installation-Wide Multispecies Habitat Management Plan (HMP) for Former Fort Ord, California (USACE 1997) and the Programmatic Biological Opinion for Cleanup and Property Transfer Actions Conducted at the Former Fort Ord, Monterey County, California (PBO; USFWS, 2015 and USFWS, 2017) in areas that are disturbed during construction activities associated with remediation efforts. A PBO was issued in 2015; however, in 2016 a re-initiation of formal consultation was requested by the Department of the Army. A new PBO was issued for Cleanup and Property Transfer Actions Conducted at the Former Fort Ord, Monterey County, California in 2017 following the re-initiation of formal consultation (USFWS, 2017). Project activities undertaken must protect and maintain the special-

[1] 2015 baseline surveys for the monitoring wells were conducted for only two annual special-status plant species, Monterey spineflower and Monterey gilia. Beginning in 2016 Yadon's piperia was included in the special-status plant species surveys.

status species found within FONR. Efforts are taken to avoid or minimize impacts to all HMP species, with emphasis on three federally listed plant species: Monterey spineflower, Monterey gilia, and Yadon's piperia.

Special-status species listed in the HMP and PBOs that occur or may occur on FONR include:

- Monterey gilia (*Gilia tenuiflora* ssp. *arenaria*) – federally Endangered, state Threatened
- Monterey spineflower (*Chorizanthe pungens* var. *pungens*) – federally Threatened
- Seaside bird's-beak (*Cordylanthus rigidus* ssp. *littoralis*) – state Endangered
- Sandmat manzanita (*Arctostaphylos pumila*)
- Monterey manzanita (*A. montereyensis*)
- Monterey ceanothus (*Ceanothus rigidus*)
- Eastwood's goldenbush (*Ericameria fasciculata*)
- Yadon's piperia (*Piperia yadonii*) – federally Endangered
- Coast wallflower (*Erysimum ammophilum*)
- 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

Monterey gilia, Monterey spineflower, Seaside bird's-beak, and coast wallflower are annual herb species that may occur within maritime chaparral, coastal scrub, grasslands, dune scrub, or disturbed areas. Sandmat manzanita, Monterey manzanita, Monterey ceanothus, and Eastwood's goldenbush are perennial shrub species that typically occur in maritime chaparral, but individuals can also be found mixed with oak woodland or coastal scrub habitats. Yadon's piperia is a perennial herb that is typically found in maritime chaparral and Monterey pine habitats.

The BLL is a rare variety of the California legless lizard (*A. pulchra*) that inhabits areas with sandy soils on the former Fort Ord. The Monterey ornate shrew is a rare variety of the ornate shrew (*S. ornatus*) found in riparian forest and oak woodland habitats. The CTS is typically found in vernal or seasonal ponds on the former Fort Ord. The CTS may also be found aestivating in small mammal burrows or under logs in upland areas within 2.2 kilometers of vernal ponds.

As identified in the 2017 PBO success criteria for the contaminated groundwater remediation are as follows:

> *After the final monitoring period for each of the federally listed species or designated Monterey spineflower critical habitat, species reestablishment will be considered successful when:*
>
> 1. *densities and acreage of HMP annual species are within a normal range compared with information from reference sites, and;*
>
> 2. *the number of wells where HMP annual species are detected in follow up surveys will be the same or greater that the number of wells where these species were found in baseline surveys.*

If the success criteria are not met corrective measures have been identified in the 2017 PBO and are as follows:

> *If populations of HMP annuals or critical habitat are determined to have been adversely affected by remediation activity, based on the evaluation of the monitoring data, corrective measures will be developed and applied on a case-by-case basis in coordination with the Service.*

DD&A met and coordinated with Ahtna, USACE, U.S. Army Base Realignment and Closure (BRAC) Fort Ord Field Office, and FONR staff to finalize the scope and project path, as well as identify project boundaries, project footprint, and site access.

1.2 SITE DESCRIPTION

This report describes activities that have occurred within FONR. FONR is approximately 605 acres in size. The habitats present within FONR include coast live oak woodland, maritime chaparral, coastal scrub, disturbed/developed land, and annual grassland. Areas surveyed as part of the installation of OUCTP monitoring wells (approximately 7 acres) and construction of an EISB Deployment Area (approximately 6 acres)[2] included portions of each habitat type present on FONR.

1.2.1 OUCTP MONITORING WELL INSTALLATION

The OUCTP monitoring well installation included eight monitoring wells and corresponding potential access routes. The following monitoring wells were included in the installation on FONR:[3]

- MW-BW-86-A
- MW-BW-87-A
- MW-BW-88-A
- MW-BW-89-A
- MW-BW-90-A
- MW-BW-91-A[4]
- MW-BW-92-A

As required by the HMP, existing roads were used to the greatest extent feasible for potential access routes. Access roads and monitoring wells were sited to minimize impacts to HMP plant and wildlife species.

1.2.2 OUCTP EISB DEPLOYMENT AREA

The OUCTP EISB Deployment Area included 10 extraction wells, 10 injection wells, pipelines, and corresponding potential access routes. The EISB Deployment Area included the following components:

[2] This acreage is the survey area for the EISB Deployment Area located on FONR. Please see Section 1.3.1.1.2 below for additional information.

[3] Monitoring well MW-BW-85-A was also installed as part of the well installation effort; however, since it is located outside of FONR on a parcel designated as development (S2.1.1) the well location and access route were not included in monitoring efforts.

[4] A portion of the access route to monitoring well MW-BW-91-A is located on a parcel designated as development (S2.1.1) outside of FONR. Only portions of the access route within FONR were included in monitoring efforts.

Extraction wells

- EW-BW-160-A
- EW-BW-161-A
- EW-BW-162-A
- EW-BW-163-A
- EW-BW-164-A
- EW-BW-165-A
- EW-BW-166-A
- EW-BW-167-A
- EW-BW-168-A
- EW-BW-169-A

Injection wells

- IW-BW-159-A
- IW-BW-160-A
- IW-BW-161-A
- IW-BW-162-A
- IW-BW-163-A
- IW-BW-164-A
- IW-BW-165-A
- IW-BW-166-A
- IW-BW-167-A
- IW-BW-168-A

Pipelines

- Injection
- Extraction

As required by the HMP, existing roads were used to the greatest extent feasible for potential access routes. Access roads and other facilities were sited to minimize impacts to HMP plant and wildlife species.

1.3 METHODOLOGY

1.3.1 PLANT SURVEYS

The Scope of Work (SOW) provided by Ahtna to DD&A was intended to comply with the HMP and the PBOs. The SOW required that annual biological surveys be conducted to determine the effects of well installation and other groundwater remediation activities on three federally listed HMP species: Monterey spineflower, Monterey gilia, and Yadon's piperia.[5] Rare plant survey methods were based on methods DD&A used previously for vegetation surveys at FONR on behalf of HydroGeoLogic, Inc. (HGL 2008, 2009a, 2009b, 2011, 2012, 2013a, 2013b, 2014 & 2015). In 2016 Yadon's piperia was added to the species surveyed (DD&A 2016).

Monterey spineflower, Monterey gilia, and Yadon's piperia are annual plant species that must be blooming in order to make a positive identification. DD&A conducts one survey effort per year at each site for the required monitoring period. DD&A used several reference sites and conferred with other local experts to ensure that surveys for Monterey spineflower and Monterey gilia were conducted within the appropriate blooming period. Annual plant surveys did not occur at the appropriate blooming period for Yadon's piperia. Of the three special-status plant species included in the survey efforts, the Yadon's piperia blooming period is later, occurring typically May through August. DD&A biologists documented potential piperia basal rosettes and relayed the location(s) to the BRAC Biologist so that additional surveys may be conducted by the BRAC Biologist during the appropriate blooming period for Yadon's piperia, if necessary.

Where found, the locations of the three rare plant species were mapped using a Trimble® Geo 7 Series global positioning system (GPS) with an external Zephyr Model 2 antenna or delineated on an aerial and digitized in office. Large areas of Monterey spineflower, Monterey gilia, and piperia were mapped as polygons, with attributes to identify the number of individuals for Monterey gilia and piperia or percent

[5] Prior to 2016 Yadon's piperia was not included in the baseline or annual plant surveys.

absolute cover for Monterey spineflower. Smaller groups and individuals were mapped as points with attributes to identify the number of individuals at each location.

Individual counts were made for all Monterey gilia and piperia populations whether they were mapped using points (population ≤5) or polygons (population ≥6). However, Monterey spineflower were only counted as individuals when groups of five or less were mapped. Monterey spineflower populations consisting of greater than five individuals were mapped as polygons and characterized according to the percent of cover. The density classes used for percent cover were:

- Very Sparse (<3 percent absolute cover),
- Sparse (3-25 percent absolute cover),
- Medium-Low (26-50 percent absolute cover),
- Medium (51-75 percent absolute cover),
- Medium-High (76-97 percent absolute cover), and
- Very High (>97-100 percent absolute cover).

GPS data, defining the population boundaries and/or point location(s), were exported to shapefile format. Shapefiles were then imported into the Geographic Information System (GIS) ESRI® ArcGIS 10.4.1 software platform and overlaid on high-resolution aerial photography/satellite imagery.

1.3.1.1 SURVEY AREA

The entire survey area consisted of the OUCTP monitoring well survey area and the survey area for the EISB Deployment Area within FONR as shown in Figure 1.1. There is approximately 2.0 acres of overlap between the OUCTP monitoring well survey area and the survey area for the EISB Deployment Area.

1.3.1.1.1 OUCTP MONITORING WELL SURVEY AREA

The survey area for the OUCTP monitoring wells included all monitoring well locations with a 50-foot buffer area. The survey area also included access routes and a 20-foot buffer area on the access routes. The survey area for the monitoring wells installation is shown in Figure 1.1.[6]

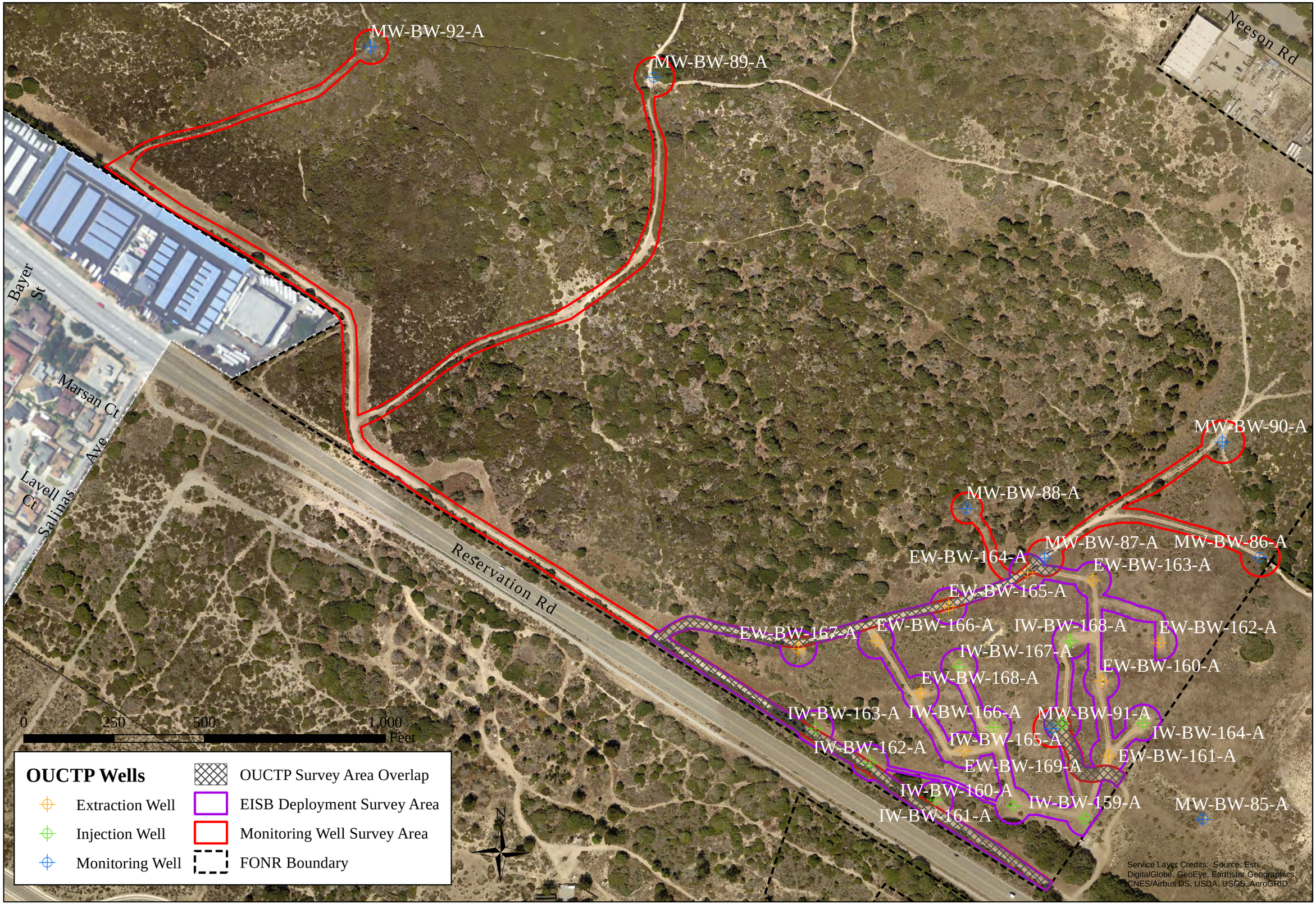
1.3.1.1.2 EISB DEPLOYMENT AREA – SURVEY AREA

The survey area for the EISB Deployment Area is the area of impact defined within the baseline survey area.[7] In general, the survey area was defined using a 50-foot buffer area around the extraction and injection wells and a 20-foot buffer around access routes. The presence of University of California Santa Cruz (UCSC) study plots and transects required that in some instances the typical buffer area around wells and access routes be modified (reduced) to avoid impacts to study areas. Additionally, the buffer along a section of

[6] The location of MW-BW-85-A and the associated access route are outside of FONR in adjacent development property.

[7] The area of impact for the EISB was entirely contained within the area surveyed during the baseline surveys. Please refer to the *2016 Annual Rare Plant Survey & Biological Monitoring Report for the Ahtna Monitoring Well Installation & Development and Enhanced In Situ Bioremediation (EISB) Deployment Area Construction at the Operable Unit Carbon Tetrachloride Plume (OUCTP)* (DD&A, 2017) for additional details.

Figure 1.1 Ahtna FONR OUCTP Monitoring Well and EISB Deployment Survey Areas



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pipeline between wells IW-BW-162-A and IW-BW-160-A was reduced as impacts from installation resulted in less disturbance to ground cover.[8] The survey area for the EISB Deployment Area is shown in Figure 1.1.[9]

1.3.1.1.3 REFERENCE SITE

As part of survey effort, a rare plant survey is conducted in a reference site each year (Figure 1.2). At the DD&A reference site coast live oak woodland is the dominant habitat type. Grassland and coast live oak woodland is adjacent to the DD&A reference site on the northwestern boundary. All other boundaries of the reference site are paved roadways (Reservation Road, MBEST Drive, and University Drive). Non-native grasses and weedy forbs are present throughout much of the reference site.

The reference site is used to ensure that surveys are conducted during the appropriate blooming period in a given year and as a population reference to determine if success criteria are being met. Different variables, such as the level of ground disturbance and available habitat, are not always consistent between the reference site and the survey area(s); therefore, trends observed in the population may differ between the survey area(s) and the reference site.

1.4 PREVIOUS MONITORING

A baseline survey was conducted for the monitoring well installation in 2015 and the first annual survey was conducted in 2016. In 2016, DD&A conducted a baseline survey for the EISB Deployment Area. No monitoring prior to 2016 was conducted for the EISB Deployment Area. A comparison of survey results to previous years is included in Section 4 (Discussion).

1.4.1 2015 BASELINE SURVEY RESULTS & BIOLOGICAL MONITORING – MONITORING WELLS

In 2015, DD&A conducted baseline surveys for Monterey spineflower and Monterey gilia within the designated survey area for the monitoring wells, which included eight monitoring well installation locations and access routes[10]. In 2015, 150 populations of Monterey spineflower [20,563 square feet (ft^2) of polygons and 55 points] were identified. Monterey spineflower was found at (within 50 feet of) four of the eight well locations (MW-BW-86-A, MW-BW-88-A, MW-BW-90-A, and MW-BW-92-A) and along access routes (DD&A 2015). In 2015, 14 populations of Monterey gilia (347 individual plants) were identified. All Monterey gilia populations present in 2015 were located along the access route to monitoring well installation location MW-BW-89-A.

In 2015, DD&A conducted construction phase biological monitoring for the installation and development of the OUCTP monitoring wells. Additionally, the DD&A reference site was also surveyed in 2015 and is surveyed every year rare plant surveys are conducted. Please refer to the *Biological Monitoring Completion*

[8] No mowing occurred along this section of pipeline. With the exception of the access routes and this area of pipeline mowing of herbaceous ground cover occurred prior to installation of the EISB Deployment Area.
[9] The location of treatment plant and the associated access route are outside of FONR in adjacent development property.
[10] Please refer to *Biological Monitoring Completion Report for the Ahtna Well Installation and Development at the Operable Unit Carbon Tetrachloride Plume (OUCTP)* (DD&A, 2015) for additional details.

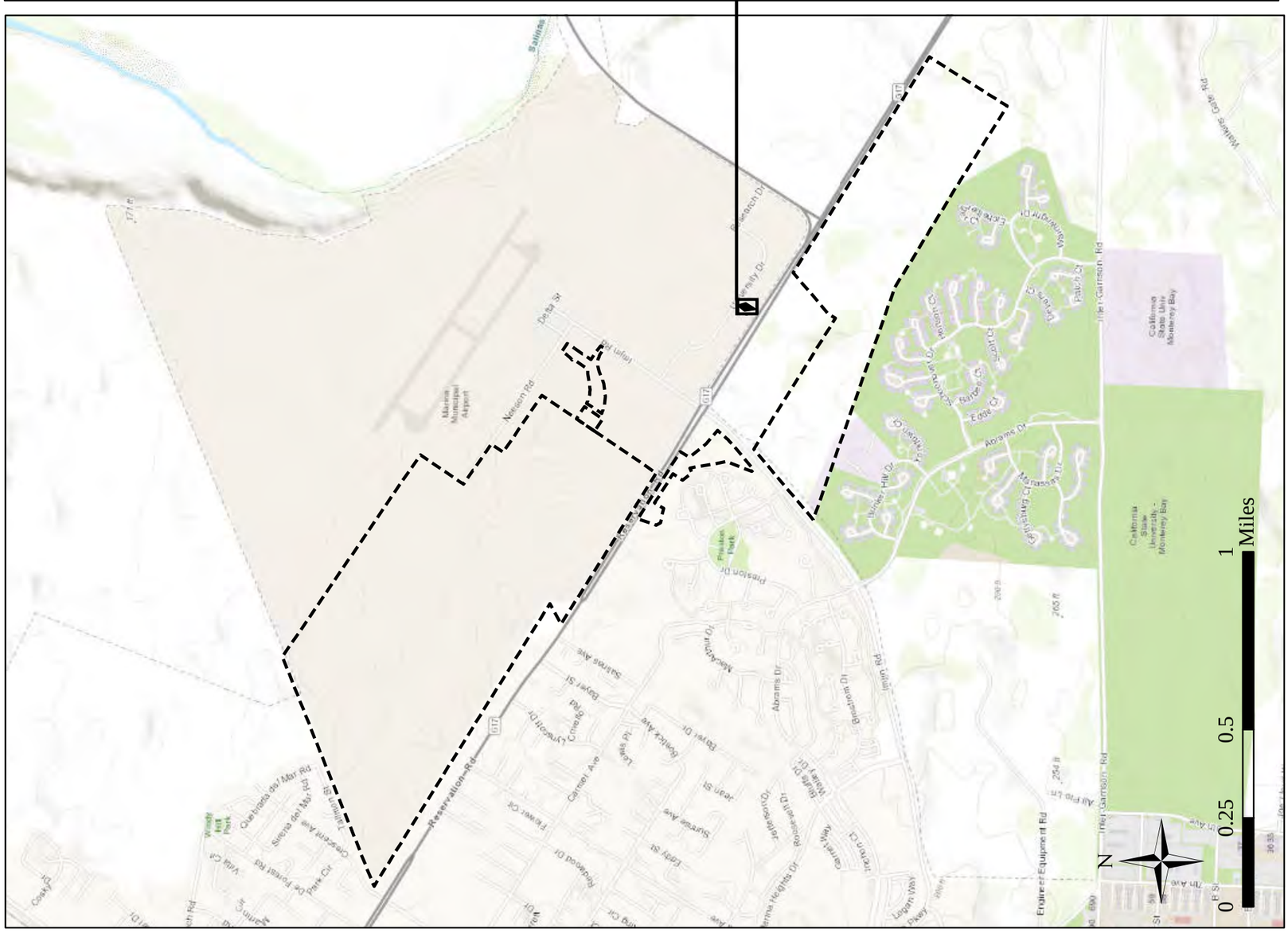

Figure 1.2 DD&A Reference Site Survey Area

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Report for the Ahtna Well Installation and Development at the Operable Unit Carbon Tetrachloride Plume (OUCTP) (DD&A, 2015) for additional details.[11]

1.4.2 2016 First Annual Follow-Up Survey – Monitoring Wells

In 2016 the first annual follow-up survey was conducted for the OUCTP monitoring wells. In 2016, 177 populations (114,818 ft^2 of polygons and 75 points) of Monterey spineflower were identified. Monterey spineflower was found at (within 50 feet of) six of the eight well locations (MW-BW-86-A, MW-BW-87-A, MW-BW-88-A, MW-BW-89-A MW-BW-90-A, and MW-BW-92-A) and along access routes. In 2016, 66 populations of Monterey gilia (1,591 individuals) were identified. Monterey gilia was present at (within 50 feet of) two of the eight well installation locations (MW-BW-92-A and MW-BW-89-A) and along access routes.

The DD&A reference site was also surveyed in 2016 and is surveyed every year rare plant surveys are conducted. Please refer to the *2016 Annual Rare Plant Survey & Biological Monitoring Report for the Ahtna Monitoring Well Installation & Development and Enhanced In Situ Bioremediation (EISB) Deployment Area Construction at the Operable Unit Carbon Tetrachloride Plume (OUCTP)* (DD&A, 2017) for additional details.

1.4.3 2016 Baseline Survey Results & Biological Monitoring – EISB Deployment Area

In 2016, DD&A conducted baseline surveys for Monterey spineflower, Monterey gilia, and Yadon's piperia within the EISB Deployment Area. In 2016, 76 populations of Monterey spineflower (117,397 ft^2 of polygons and 22 points) were identified in the EISB Deployment Area. Monterey spineflower was found at (within 50 feet of) fourteen of the twenty well locations (EW-BW-160-A, EW-BW-161-A, EW-BW-162-A, EW-BW-164-A, EW-BW-165-A, EW-BW-166-A, EW-BW-168-A, EW-BW-169-A, IW-BW-159-A, IW-BW-160-A, IW-BW-161-A, IW-BW-162-A, IW-BW-163-A, and IW-BW-165-A) and along access routes. One population of Monterey gilia (36 individual plants) was identified in 2016 in the EISB Deployment Area. The population of Monterey gilia was located along the access route to well installation location IW-BW-160-A.

In 2016, DD&A conducted construction phase biological monitoring for the EISB Deployment Area. Additionally, the DD&A reference site was also surveyed in 2016 and is surveyed every year rare plant surveys are conducted. Please refer to the *2016 Annual Rare Plant Survey & Biological Monitoring Report for the Ahtna Monitoring Well Installation & Development and Enhanced In Situ Bioremediation (EISB) Deployment Area Construction at the Operable Unit Carbon Tetrachloride Plume (OUCTP)* (DD&A, 2017) for additional details.

[11] Results reported in the 2015 report (DD&A, 2015) included populations that were located outside of FONR, associated with well MW-BW-85-A. For the purposes of this report the area of rare plants reported as identified in 2015 has been modified to include only the populations that were present within FONR.

2 RESULTS

As part of survey effort, a rare plant survey is conducted in a reference site each year. In 2017, the second annual follow-up survey was conducted for the OUCTP monitoring wells. The first annual follow-up survey for the EISB Deployment Area also occurred in 2017.

2.1 REFERENCE SITE SURVEY RESULTS 2017

The DD&A reference site was surveyed for Monterey gilia on April 21, 2017 and Monterey spineflower June 1, 2017.

2.1.1 MONTEREY SPINEFLOWER

In 2017, Monterey spineflower occupied approximately 2,855 ft^2 at the reference site (Table 2.1.1 and Figure 2.1).

Table 2.1.1 Monterey Spineflower at DD&A Reference Site 2017. Polygon Density Class: Sparse (3-25 percent cover). Medium-Low (26-50 percent cover).

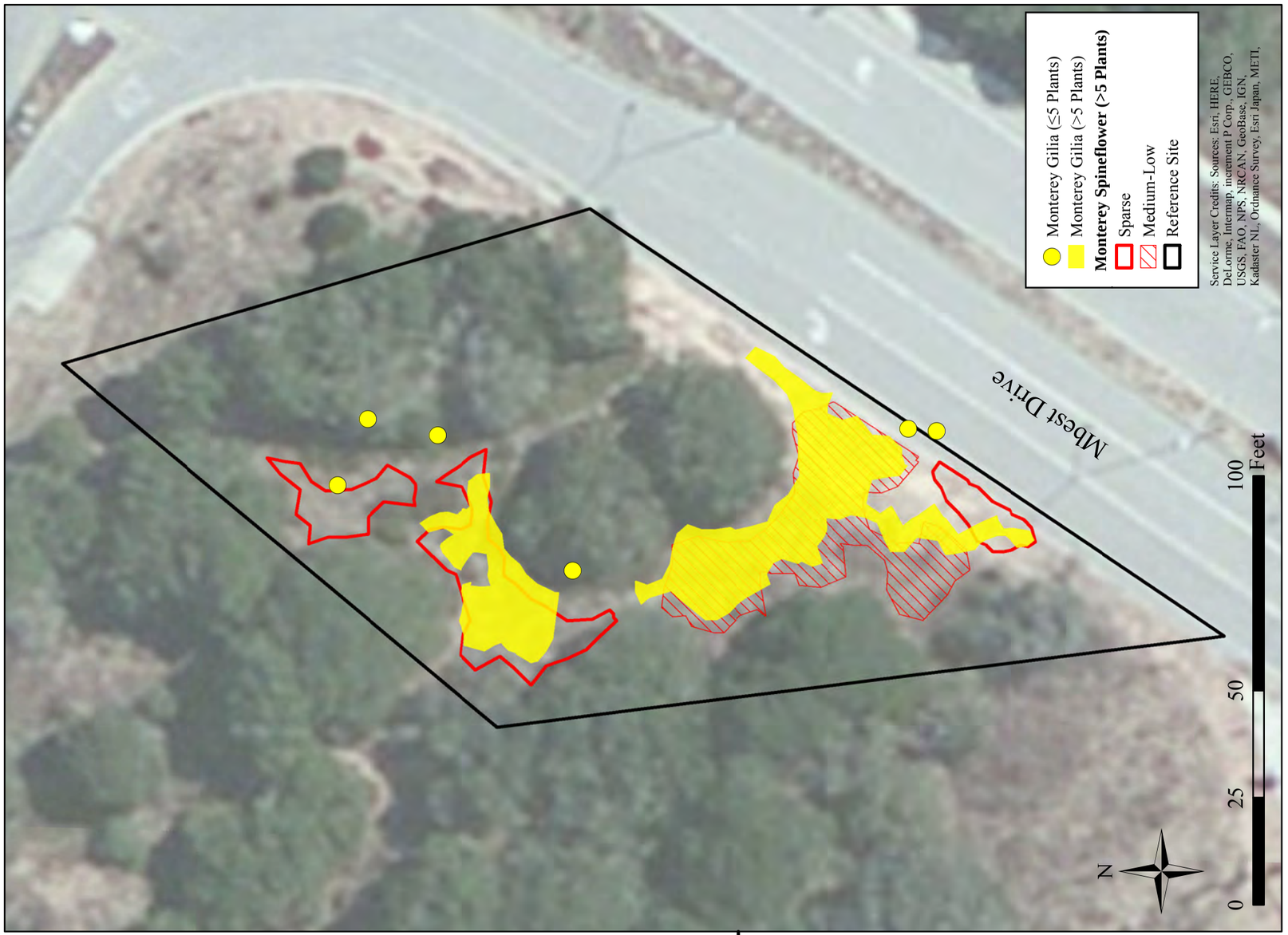
			Polygons per Density Class		
Year	# of Populations	# of Points	Sparse	Medium-Low	Total Area of Polygons (ft²)
2017	4	0	3	1	2,855

2.1.2 MONTEREY GILIA

In 2017, a total of 463 individual Monterey gilia plants were observed at the reference site (Table 2.1.2 and Figure 2.1).

Table 2.1.2 Monterey Gilia at DD&A Reference Site 2017

Year	# of Populations	Individual Plants	# of Points	# of Polygons	Area of Polygons (ft²)
2017	8	463	6	2	1,950



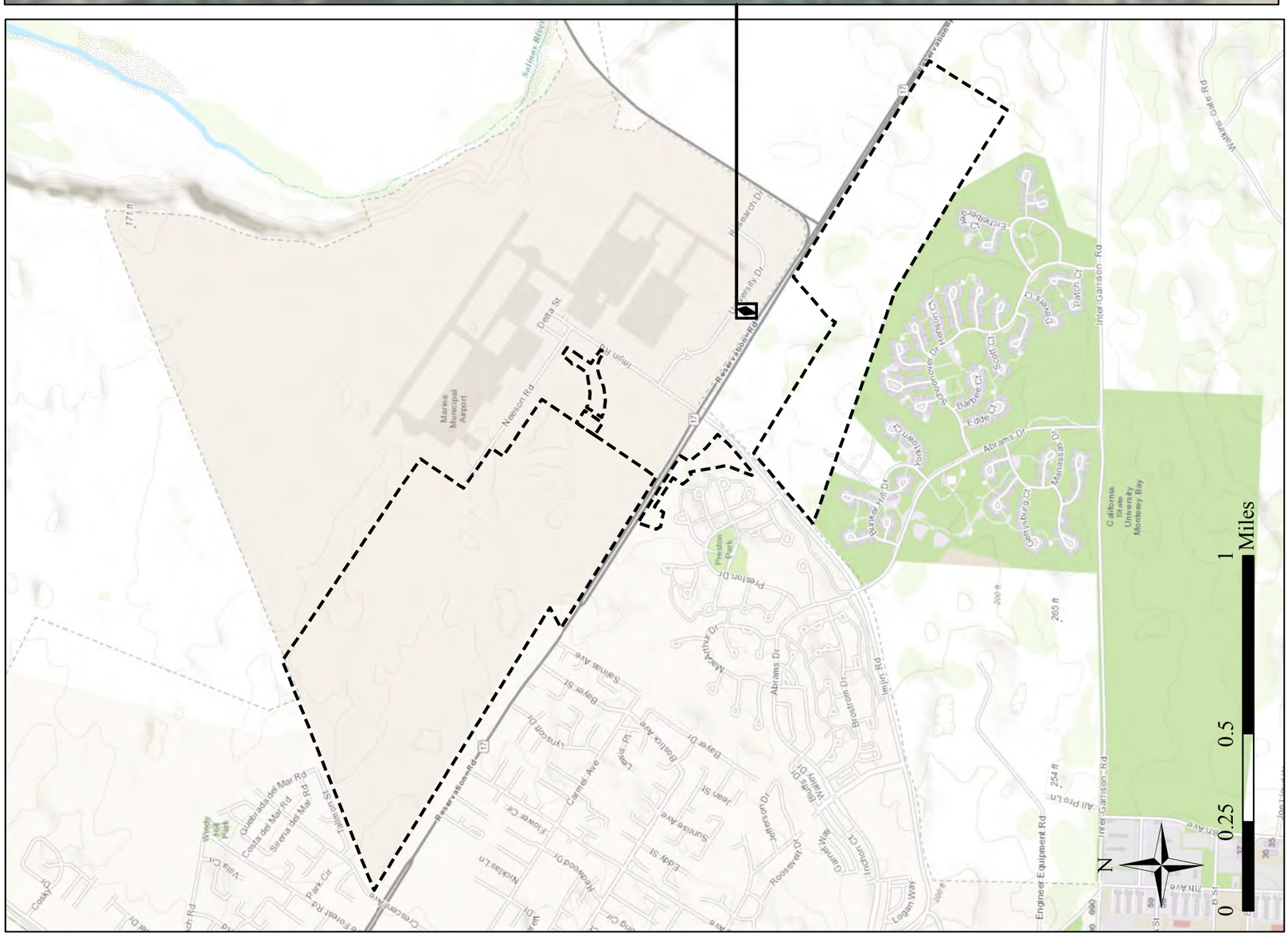


Figure 2.1 2017 DD&A Reference Site Survey Results

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2.2 SURVEY RESULTS 2017

The entire survey site was surveyed for Monterey gilia on April 14 and April 19, 2017. DD&A conducted surveys for Monterey spineflower within the entire survey area on May 18, May 19, and May 23, 2017.

2.2.1 MONTEREY SPINEFLOWER

In 2017, Monterey spineflower occupied approximately 118,750 ft^2 of the entire survey area (Table 2.2.1-1 and Attachment A). DD&A identified 144 populations (63 points and 81 polygons) within the entire survey area. Of the populations of Monterey spineflower mapped in 2017, 50 populations (24 points and 26 polygons) were located in the approximately 2-acres of overlap of the survey area for the EISB Deployment Area and the monitoring wells survey area (Table 2.2.1-2).

Table 2.2.1-1 Monterey Spineflower within the Entire Survey Area. Polygon Density Class: Sparse (3-25 percent cover). Medium-Low (26-50 percent cover).

			Polygons per Density Class		
Year	# of Populations	# of Points	Sparse	Medium-Low	Total Area of Polygons (ft^2)
2017	144	63	69	12	118,750

Table 2.2.1-2 Monterey Spineflower Within the 2-Acre Area of Overlap of the Survey Area for the EISB Deployment Area and the Monitoring Wells Survey Area Identified in 2017. Polygon Density Class: Sparse (3-25 percent cover). Medium-Low (26-50 percent cover).

			Polygons per Density Class		
Year	# of Populations	# of Points	Sparse	Medium-Low	Total Area of Polygons (ft^2)
2017	50	26	22	4	79,302

2.2.2 MONTEREY GILIA

In 2017, a total of 1,546 individual Monterey gilia plants were observed within the entire survey area (Table 2.2.2 and Attachment A). DD&A identified 43 populations of Monterey gilia (28 points and 14 polygons) within the entire survey area. No Monterey gilia were identified in the 2-acre area of overlap of the survey area for the EISB Deployment Area and the monitoring well survey area.

Table 2.2.2 Monterey Gilia within the Entire Survey Area Identified in 2017.

Year	# of Populations	Individual Plants	# of Points	# of Polygons	Area of Polygons (ft^2)
2017	42	1546	28	14	8,523

2.2.3 YADON'S PIPERIA

In 2017, DD&A surveyed for piperia within the entire survey area (Figure 1.1), which included the monitoring well survey area and the EISB Deployment Area. No piperia basal rosettes were found.

2.2.4 SECOND ANNUAL FOLLOW-UP SURVEY RESULTS 2017 – MONITORING WELLS

In 2017, DD&A performed the second annual follow-up survey in the monitoring well survey area (Figure 1.1), which included eight monitoring well installation locations and the associated access routes. Attachment A includes detailed maps of the survey results for the 2017 monitoring wells second annual follow-up survey.

2.2.4.1 MONTEREY SPINEFLOWER – MONITORING WELLS

Monterey spineflower was found at (within 50 feet of) five of the eight well locations (MW-BW-86-A, MW-BW-87-A, MW-BW-88-A, MW-BW-90-A, and MW-BW-92-A) and along access routes (Table 2.2.4.1 and Attachment A). During the 2017 survey, 131 populations (55 points and 76 polygons) of Monterey spineflower were identified.[12] Of the polygons mapped, the majority (65 polygons) were identified as having a density class of sparse (5-25 percent cover of Monterey spineflower) (Table 2.2.4.1).

Table 2.2.4.1 Monterey Spineflower at OUCTP Monitoring Wells – Second Annual Survey Results 2017. Polygon Density Class: Sparse (3-25 percent cover) and Medium-Low (26-50 percent cover).

			Polygons per Density Class		
Year	# of Populations	# of Points	Sparse	Medium-Low	Total Area of Polygons (ft²)
2017	131	55	65	11	108,402

2.2.4.2 MONTEREY GILIA – MONITORING WELLS

Monterey gilia was present at (within 50 feet of) one of the eight well installation locations (MW-BW-92-A) and along access routes (Table 2.2.4.2 and Attachment A). During the 2017 survey, 41 populations (28 points and 13 polygons), consisting of a total of 1,539 individual Monterey gilia plants were found within the monitoring well survey area (Table 2.2.4.2).

Table 2.2.4.2 Monterey Gilia at FONR OUCTP Monitoring Wells – Second Annual Survey Results 2017.

Year	# of Populations	Individual Plants	# of Points	# of Polygons	Area of Polygons (ft²)
2017	41	1,539	28	13	8,494

[12] This assessment includes the 2-acre overlap between the survey area of the EISB Deployment Area and the monitoring well survey area.

2.2.5 FIRST ANNUAL FOLLOW-UP SURVEY RESULTS 2017 – EISB DEPLOYMENT AREA

In 2017, DD&A conducted the first annual survey for Monterey spineflower, Monterey gilia, and Yadon's piperia within the EISB Deployment Area (Figure 1.1). Attachment A includes a map of the survey results within the 2017 ESIB Deployment Area.

2.2.5.1 MONTEREY SPINEFLOWER– EISB DEPLOYMENT AREA

In 2017, 62 populations of Monterey spineflower (89,649 ft^2 of polygons and 31 points) were identified in the EISB Deployment Area[13]. Monterey spineflower was found at (within 50 feet of) seventeen of the twenty well locations (EW-BW-160-A, EW-BW-161-A, EW-BW-164-A, EW-BW-165-A, EW-BW-166-A, EW-BW-168-A, EW-BW-169-A, IW-BW-159-A, IW-BW-160-A, IW-BW-161-A, IW-BW-162-A, IW-BW-163-A, IW-BW-165-A, IW-BW-166-A, and IW-BW-168-A) and along access routes.

Table 2.2.5.1 Monterey Spineflower at EISB Deployment Area – First Annual Survey Results 2017. Polygon Density Class: Sparse (3-25 percent cover) and Medium-Low (26-50 percent cover).

Year	# of Populations	# of Points	Polygons per Density Class		Total Area of Polygons (ft^2)
			Sparse	Medium-Low	
2017	62	31	26	5	89,649

2.2.5.2 MONTEREY GILIA – EISB DEPLOYMENT AREA

In 2017, one population of Monterey gilia (7 individual plants) was identified in the EISB Deployment Area. The population of Monterey gilia was identified and mapped along the access route to well installation location IW-BW-160-A.

Table 2.2.5.2 Monterey Gilia at EISB Deployment Area – First Annual Survey Results 2017.

Year	# of Populations	Individual Plants	# of Points	# of Polygons	Area of Polygons (ft^2)
2017	1	7	0	1	29

[13] This assessment includes the 2-acre overlap between the survey area of the EISB Deployment Area and the monitoring well survey area.

3 DISCUSSION

3.1 RARE PLANT POPULATIONS

As required by the PBO, surveys are conducted for three years after a disturbance occurs as the result of a groundwater remediation effort.

3.1.1 REFERENCE SITE

DD&A conducted surveys at the reference site in 2017 for the third consecutive year. The DD&A reference site was surveyed in 2015 as part of the monitoring well baseline survey. DD&A again surveyed the reference site in 2016 as part of the EISB Deployment Area baseline survey and the first annual survey for the monitoring wells. The reference site is located in an area relatively undisturbed by anthropogenic activities.

3.1.1.1 MONTEREY SPINEFLOWER

Several environmental variables can influence the distribution and abundance of Monterey spineflower in a particular year (USFWS, 2002). Table 3.1.1.1 below shows the survey results for Monterey spineflower at the reference site for surveys conducted from 2015 to 2017. Between 2015 and 2016 the DD&A reference site showed an increase in total area of Monterey spineflower polygons from 2,114 ft^2 to 3,241 ft^2, an increase of approximately 50% (Table 3.1.1.1). While the total area of polygons was in the range of the area observed in previous years the density class of the polygons in 2017 was on average lower than it had been in 2015 and 2016. During the 2017 survey effort it was anecdotally observed, by DD&A, that non-native invasive grasses were colonizing the reference site more aggressively than previous years. The abundance of non-native invasive grass species resulted in a smaller amount of open space. The reduction in open space lowers the quality of habitat for Monterey spineflower and may have been a contributing factor to the reduction in density observed in the data for 2017.

Table 3.1.1.1 Monterey Spineflower Population at the DD&A Reference Site 2015 - 2017. Polygon Density Class: Sparse (3-25 percent cover), Medium-Low (26-50 percent cover), and Medium (51-75 percent cover).

			Polygons per Density Class					
Year	# of Populations	# of Points	Very Sparse	Sparse	Medium-Low	Medium	Medium-High	Total Area of Polygons (ft^2)
2015	4	1	0	1	1	1	0	2,114
2016	2	0	0	0	1	1	0	3,241
2017	4	0	0	3	1	0	0	2,855

3.1.1.2 MONTEREY GILIA

Several environmental variables can influence the distribution and abundance of Monterey gilia in a particular year (USFWS, 2008). Table 3.1.1.2 below shows the survey results for Monterey gilia at the reference site for surveys conducted from 2015 to 2017. Between 2015 and 2016 the DD&A reference site showed a decrease in number of individual Monterey gilia plants, from 1,078 to 946, and a decrease in total

area of Monterey gilia polygons from 1,512 ft^2 to 1,498 ft^2 (Table 3.1.1.2). The decrease in individual Monterey gilia plants (132, approximately 12%) was greater than the decrease in total area of Monterey gilia polygons (14 ft^2, approximately 1%). However, between 2015 and 2016, neither individual plants nor total area decreased by a substantial amount. As with Monterey spineflower there was a reduction in the presence of Monterey gilia at the reference site in 2017. The number of individual plants observed in 2017 was the lowest number observed in the three years of monitoring. Between 2016 and 2017 the number of individual Monterey gilia plants decreased by approximately half (483, approximately 51%); however, the total area of the polygons increased between 2016 and 2017 (452 ft^2, approximately 30%). As discussed above, it was anecdotally observed in 2017 that open space at the reference site was reduced due to an increase in grass cover at the site, which likely contributed to the quality of habitat for this species.

Table 3.1.1.2 Monterey Gilia at DD&A Reference Site 2015-2017.

Year	# of Populations	Individual Plants	# of Points	# of Polygons	Area of Polygons (ft^2)
2015	11	1,078	4	7	1,512
2016	6	946	3	3	1,498
2017	8	463	6	2	1,950

3.1.2 SECOND ANNUAL FOLLOW-UP SURVEY 2017 – MONITORING WELLS

Surveys conducted in 2017 were the second of three annual surveys required following the disturbance associated with the well installation and other groundwater remediation efforts of 2015.

3.1.2.1 MONTEREY SPINEFLOWER

As stated in Section 2.2.4, 131 populations (55 points and 76 polygons) of Monterey spineflower were identified in 2017 within the monitoring well survey area. Of the polygons mapped in 2017, the majority (65 polygons) were identified as having a density class of sparse (5-25 percent cover of Monterey spineflower). The total area of Monterey spineflower polygons decreased from 114,818 ft^2 in 2016 to 108,174 ft^2 in 2017; however; the total area observed in 2017 was considerably larger than the total area observed during baseline surveys in 2015. Within the monitoring well survey area, the total area of Monterey spineflower polygons increased by approximately 442% between 2015 and 2016. During the 2015 baseline surveys, Monterey spineflower was observed within 50 feet of four well locations (MW-BW-86-A, MW-BW-88-A, MW-BW-90-A, and MW-BW-92-A) and along access routes. In 2016, Monterey spineflower was found at (within 50 feet of) six of the eight well locations (MW-BW-86-A, MW-BW-87-A, MW-BW-88-A, MW-BW-89-A MW-BW-90-A, and MW-BW-92-A) and along access routes (Table 3.1.2.1). In 2017, Monterey spineflower was found at (within 50 feet of) five of the eight well locations (MW-BW-86-A, MW-BW-87-A, MW-BW-88-A, MW-BW-90-A, and MW-BW-92-A) and along access routes.

Table 3.1.2.1 Monterey Spineflower within the FONR OUCTP Monitoring Wells Survey Area 2015-2017. Polygon Density Class: Very Sparse (3-25 percent cover), Sparse (5-25 percent cover), Medium-Low (26-50 percent cover), Medium (51-75 percent cover), and Medium-High (76-97 percent cover).

			Polygons per Density Class					
Year	# of Populations	# of Points	Very Sparse	Sparse	Medium-Low	Medium	Medium-High	Total Area of Polygons (ft²)
2015	150	55	3	74	12	5	1	20,563
2016	177	75	0	78	21	3	0	114,818
2017	131	55	0	65	11	0	0	108,402

As mentioned above several environmental variables can influence the distribution and abundance of Monterey spineflower in a particular year. Some combination of the environmental variables are likely responsible for a percentage of the increasing trend in Monterey spineflower populations observed at both the reference site and survey area in 2016. However, while both the survey area and the reference site exhibited an increase in Monterey spineflower in 2016, the percent increase in Monterey spineflower was much greater within the survey area compared to the reference site. In addition to favorable environmental factors, well installation activities within the survey area that required vegetation clearing may have resulted in an increase in suitable habitat for Monterey spineflower (open sandy areas), which may have contributed to the substantial increase of Monterey spineflower observed within the survey area in 2016. The relationship between activities associated with the cleanup of the former Fort Ord and an increase of Monterey spineflower populations has been previously documented (USFWS, 2002). A shift in the density class of polygons (no polygons with a density class above medium-low) and a decrease in total area of polygons was observed in 2017. The decrease was consistent with the trend observed at the reference site in 2017.

3.1.2.2 MONTEREY GILIA

As stated in Section 2.2.4, 41 populations (28 points and 13 polygons), consisting of 1,539 individuals were found within the monitoring well survey area in 2017. Between 2015 and 2016, the monitoring well survey area experienced a substantial increase in number of individual Monterey gilia plants, from 347 observed in 2015 to 1,591 observed in 2016, and an increase in total area of Monterey gilia polygons, from 1,217 ft^2 in 2015 to 4,921 ft^2 in 2016. Within the monitoring well survey area, the number of individual Monterey gilia plants increased in 2016 by approximately 360% and the total area of Monterey gilia polygons increased by approximately 300%. During the 2015 baseline surveys Monterey gilia was not observed within 50 feet any of the well locations. However, during the 2016 follow-up survey, Monterey gilia was observed within 50 feet of two well locations (MW-BW-89-A and MW-BW-92-A). The number of Monterey gilia populations within the monitoring well survey area more than quadrupled in 2016 compared to the 2015 baseline data (Table 3.1.2.2). The detected increase in Monterey gilia between 2015 and 2016 at the monitoring wells is inconsistent with observations at the reference site; however, the comparison of trends between the reference site and the survey area is complicated by variables that may differ between the sites and trends observed at the two areas not required to be consistent. In 2017 Monterey gilia was observed at one well location (MW-BW-92-A). The number of populations and the individual Monterey gilia decreased slightly between 2016 and 2017 (25 fewer populations and 52 fewer plants); however, the total area of Monterey gilia plants increased from 4,921 ft^2 in 2016 to 8,494 ft^2 in 2017.

Table 3.1.2.2 Monterey Gilia within FONR OUCTP Monitoring Well Survey Area 2015-2017.

Year	# of Populations	Individual Plants	# of Points	# of Polygons	Area of Polygons (ft^2)	# of Wells Where Present	Well Location Where Present
2015	14	347	10	4	1,217	0	
2016	66	1591	35	31	4,921	2	MW-BW-89-A MW-BW-92-A
2017	41	1539	28	13	8,494	1	MW-BW-92-A

As mentioned above, several environmental variables can influence the distribution and abundance of Monterey gilia in a particular year. Some combination of factors are likely responsible for the decreasing trend in Monterey gilia populations observed at the reference site and the increasing trend at the monitoring well survey area in 2016. However, the percent variation in Monterey gilia was much greater within the survey area compared to the reference site. In addition to favorable environmental factors, well installation activities within the survey area that required vegetation clearing may have resulted in an increase in suitable habitat for Monterey gilia (open sandy areas). Resource competition is generally understood to refer to the negative effects caused by the presence of neighbors, usually by reducing the availability of resources. Competition is an important factor controlling plant communities. Since all plants require a few basic elements, the resources involved are generally light, water, nitrogen, or phosphorus, depending upon the species and the location. The disturbance/clearing associated with well installation reduces the level of competition for these finite resources by creating voids in otherwise densely competitive communities (grasslands) that are generally dominated by non-native invasive plants. Increased availability of suitable habitat and a reduction in resource competition within the survey area may have contributed to the substantial increase of Monterey gilia observed within this area in 2016. A slight decrease in the number of individual plants was observed in 2017. The decrease was consistent with the trend observed at the reference site in 2017, although the percent decrease in individual plants observed at the reference site was much larger.

3.1.3 FIRST ANNUAL FOLLOW-UP SURVEY 2017 – EISB DEPLOYMENT AREA

Surveys conducted in 2017 were the first of three annual surveys required following the disturbance associated with the EISB Deployment Area where construction activities occurred in 2016.

3.1.3.1 MONTEREY SPINEFLOWER

As stated in Section 2.2.5, 62 populations (31 points and 31 polygons) of Monterey spineflower were identified in 2017 within the survey area of the EISB Deployment Area. Of the polygons mapped in 2017, the majority (26 polygons) were identified as having a density class of sparse (5-25 percent cover of Monterey spineflower). The total area of Monterey spineflower polygons decreased from 117,397 ft^2 in 2016 to 89,649 ft^2 in 2017 (Table 3.1.3.1).

Table 3.1.3.1 Monterey Spineflower within the EISB Deployment Area 2016-2017. Polygon Density Class: Very Sparse (3-25 percent cover), Sparse (5-25 percent cover), Medium-Low (26-50 percent cover), and Medium (51-75 percent cover).

Year	# of Populations	# of Points	Polygons per Density Class			Total Area of
			Sparse	Medium-Low	Medium	
2016	76	22	39	12	3	117,397
2017	62	31	26	5	--	89,649

As mentioned above several environmental variables can influence the distribution and abundance of Monterey spineflower in a particular year. Some combination of the environmental variables are likely responsible for a downward trend in Monterey spineflower populations observed at both the reference site and survey area in 2017. A shift in the density class of polygons (no polygons with a density class above medium-low) and a decrease in total area of polygons was observed in 2017 within the survey area for the EISB Deployment Area. The decrease was consistent with the trend observed at the reference site in 2017.

3.1.3.2 MONTEREY GILIA

As stated in Section 2.2.5, 1 population (1 polygon), consisting of 7 individuals was found within the survey area for the EISB Deployment Area in 2017. Between 2016 and 2017, the number of individual plants observed within the survey area for the EISB Deployment Area decreased from 36 observed in 2016 to 7 observed in 2017, and a decrease in total area of Monterey gilia polygons from 84 ft^2 in 2016 to 29 ft^2 in 2017 (Table 3.1.3.2). During the 2016 baseline surveys and in 2017 Monterey gilia was not observed within 50 feet any of the well locations.

Table 3.1.3.2 Monterey Gilia within EISB Deployment Area 2016-2017.

Year	# of Populations	Individual Plants	# of Points	# of Polygons	Area of Polygons (ft^2)	# of Wells Where Present	Well Location Where Present
2016	1	36	0	1	84	0	--
2017	1	7	0	1	29	0	--

As mentioned above, several environmental variables can influence the distribution and abundance of Monterey gilia in a particular year. Some combination of factors are likely responsible for the decreasing trend in Monterey gilia populations observed at the reference site and the decreasing trend at the survey area for the EISB Deployment Area in 2017. Additionally, there is a small sample size of one population within the EISB Deployment Area.

4 CONCLUSION AND RECOMMENDATION

4.1 FONR OUCTP RARE PLANT SURVEYS

In 2017, Monterey spineflower and Monterey gilia were present within the entire survey area. Within the monitoring well survey area the populations of Monterey gilia and Monterey spineflower were larger in 2017 than those identified in the 2015 baseline survey. No piperia rosettes were identified in 2017. The populations of Monterey gilia and Monterey spineflower observed in 2017 within the EISB Deployment Area were less than those observed in the 2016 baseline survey for that area; however, a downward trend between 2016 and 2017 was observed at the reference site as well. Populations of Monterey spineflower and Monterey gilia at the FONR OUTCP monitoring wells and EISB Deployment are trending toward meeting the success criteria identified in the 2017 PBO. Annual surveys of the monitoring well survey site will be conducted again in 2018, the third and final year following construction and development of the FONR OUCTP monitoring wells in 2015. The second and third annual follow up surveys will also be conducted at the EISB Deployment Area in 2018 and 2019 respectively. DD&A will communicate with all relevant parties prior to conducting annual surveys.

Well monitoring for the OUCTP involves driving or walking to the monitoring well location and collecting a water level measurement and groundwater samples from the well using passive diffusion bags. To reduce the amount of potential impacts to seedbank of rare annual plants or actual individuals of rare annual plants during the blooming period, walking would be the preferred method to access the monitoring well locations from the main thoroughfares whenever possible. Walking to well MW-BW-88-A is highly recommended, due to the slope and substrate of the secondary access road, to reduce excess erosion and potential impacts to rare annual plant species seed banks. To reduce the potential for impacts to rare annual plant species seed banks located along the main access roads it is recommended that vehicle traffic be limited to the minimum necessary to conduct well monitoring and vehicle speeds should remain under 15 miles per hour (mph). Four-wheel or all-wheel drive vehicles should be employed to conduct well monitoring activities to reduce the likelihood of vehicle becoming stuck and causing excess erosion.

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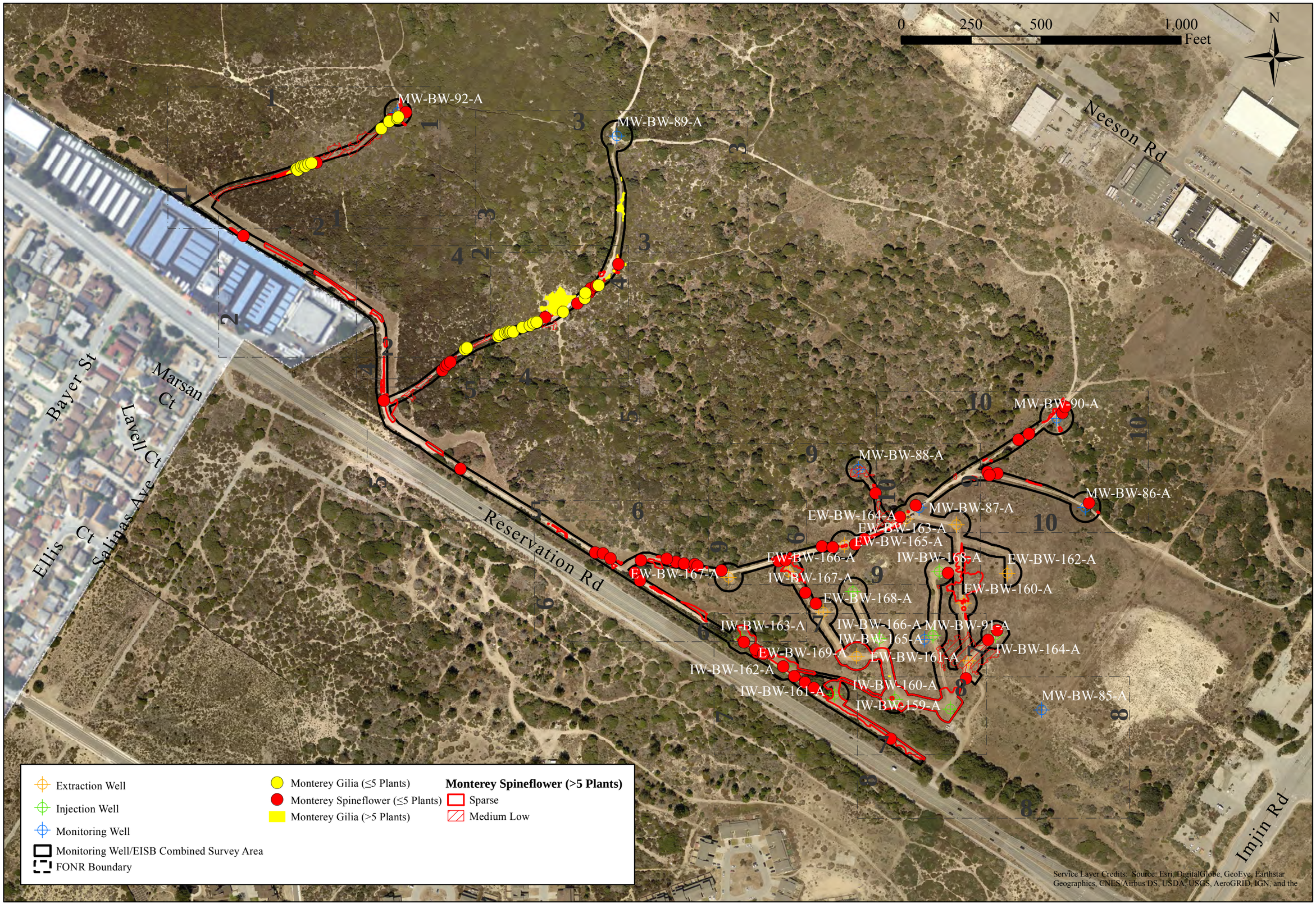
ATTACHMENT A

2017 Annual Rare Plant Survey Results Overview and Detail Maps

Attachment A 2017 Rare Plant Survey Results Overview and Detail Maps



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DD&A

Attachment A 2017 Rare Plant Survey Results Overview and Detail Maps

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Date: 7/5/2017

DD&A

0 50 100 200 Feet

N

MW-BW-92-A

Extraction Well
Injection Well
Monitoring Well
Monitoring Well/EISB Combined Survey Area
FONR Boundary

Monterey Gilia (≤5 Plants)
Monterey Spineflower (≤5 Plants)
Monterey Gilia (>5 Plants)

Monterey Spineflower (>5 Plants)
Sparse
Medium Low

Service Layer Credits: Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

Attachment A 2017 Rare Plant Survey Results Overview and Detail Maps

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Date: 7/5/2017

DD&A

0 50 100 200 Feet

N

Extraction Well
Injection Well
Monitoring Well
Monitoring Well/EISB Combined Survey Area
FONR Boundary

Monterey Gilia (≤5 Plants)
Monterey Spineflower (≤5 Plants)
Monterey Gilia (>5 Plants)

Monterey Spineflower (>5 Plants)
Sparse
Medium Low

Esri, Layer Credits: Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

Attachment A 2017 Rare Plant Survey Results Overview and Detail Maps

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Date: 7/5/2017

DD&A

0 50 100 200 Feet

N

MW-BW-89-A

3 3 3 3 4

Extraction Well
Injection Well
Monitoring Well
Monitoring Well/EISB Combined Survey Area
FONR Boundary

Monterey Gilia (≤5 Plants)
Monterey Spineflower (≤5 Plants)
Monterey Gilia (>5 Plants)

Monterey Spineflower (>5 Plants)
Sparse
Medium Low

Service Layer Credits: Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

Attachment A 2017 Rare Plant Survey Results Overview and Detail Maps

0 50 100 200 Feet

N

Extraction Well
Injection Well
Monitoring Well
Monitoring Well/EISB Combined Survey Area
FONR Boundary

Monterey Gilia (≤5 Plants)
Monterey Spineflower (≤5 Plants)
Monterey Gilia (>5 Plants)

Monterey Spineflower (>5 Plants)
Sparse
Medium Low

Service Layer Credits: Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

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Date: 7/5/2017

DD&A

Attachment A 2017 Rare Plant Survey Results Overview and Detail Maps

0 50 100 200 Feet

N

Reservation Rd

2 4 5 4 6 6 5 6

Extraction Well
Injection Well
Monitoring Well
Monitoring Well/EISB Combined Survey Area
FONR Boundary

Monterey Gilia (≤5 Plants)
Monterey Spineflower (≤5 Plants)
Monterey Gilia (>5 Plants)

Monterey Spineflower (>5 Plants)
Sparse
Medium Low

Service Layer Credits: Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

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Date: 7/5/2017

DD&A

Attachment A 2017 Rare Plant Survey Results Overview and Detail Maps

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Date: 7/5/2017

DD&A

50 100 200 Feet

N

EW-BW-167-A

EW-BW-166-A

IW-BW-163-A

IW-BW-162-A

Reservation Rd

Extraction Well
Injection Well
Monitoring Well
Monitoring Well/EISB Combined Survey Area
FONR Boundary

Monterey Gilia (≤5 Plants)
Monterey Spineflower (≤5 Plants)
Monterey Gilia (>5 Plants)

Monterey Spineflower (>5 Plants)
Sparse
Medium Low

Attachment A 2017 Rare Plant Survey Results Overview and Detail Maps

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Date: 7/5/2017

DD&A

IW-BW-167-A
EW-BW-168-A
EW-BW-160-A
IW-BW-163-A
IW-BW-166-A
IW-BW-165-A
MW-BW-91-A
IW-BW-164-A
EW-BW-169-A
EW-BW-161-A
IW-BW-162-A
IW-BW-161-A
IW-BW-160-A
IW-BW-159-A
Reservation Rd
6
7
8
9

0 50 100 200 Feet

N

Extraction Well
Injection Well
Monitoring Well
Monitoring Well/EISB Combined Survey Area
FONR Boundary

Monterey Gilia (≤5 Plants)
Monterey Spineflower (≤5 Plants)
Monterey Gilia (>5 Plants)

Monterey Spineflower (>5 Plants)
Sparse
Medium Low

Service Layer Credits: Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

Attachment A 2017 Rare Plant Survey Results Overview and Detail Maps

EW-BW-169-A
EW-BW-161-A
IW-BW-160-A
IW-BW-159-A
MW-BW-85-A
8
22
Reservation Rd

0 50 100 200 Feet

N

Extraction Well
Injection Well
Monitoring Well
Monitoring Well/EISB Combined Survey Area
FONR Boundary

Monterey Gilia (≤5 Plants)
Monterey Spineflower (≤5 Plants)
Monterey Gilia (>5 Plants)

Monterey Spineflower (>5 Plants)
Sparse
Medium Low

Service Layer Credits: Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

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Date: 7/5/2017

DD&A

Attachment A 2017 Rare Plant Survey Results Overview and Detail Maps

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Date: 7/5/2017

DD&A

0 50 100 200 Feet

MW-BW-88-A

MW-BW-87-A

EW-BW-164-A

EW-BW-163-A

EW-BW-165-A

EW-BW-166-A

EW-BW-167-A

IW-BW-168-A

IW-BW-167-A

EW-BW-160-A

Extraction Well
Injection Well
Monitoring Well
Monitoring Well/EISB Combined Survey Area
FONR Boundary

Monterey Gilia (≤5 Plants)
Monterey Spineflower (≤5 Plants)
Monterey Gilia (>5 Plants)

Monterey Spineflower (>5 Plants)
Sparse
Medium Low

Service Layer Credits: Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

Attachment A 2017 Rare Plant Survey Results Overview and Detail Maps

Document Path: F:\GIS\GIS_Projects\2015-09 Ahtna FONR\Map Products\2017 Annual Follow Up\Attachment A 2017 Rare Plant Survey Results Detail Maps.mxd

Date: 7/5/2017

DD&A

0 50 100 200 Feet

N

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MW-BW-90-A

MW-BW-87-A

EW-BW-164-A

EW-BW-163-A

MW-BW-86-A

Extraction Well
Injection Well
Monitoring Well
Monitoring Well/EISB Combined Survey Area
FONR Boundary

Monterey Gilia (≤5 Plants)
Monterey Spineflower (≤5 Plants)
Monterey Gilia (>5 Plants)

Monterey Spineflower (>5 Plants)
Sparse
Medium Low

Service Layer Credits: Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community