# FINAL
# 2017 FONR IMPACT ASSESSMENT AND HABITAT AND RARE PLANT SPECIES SURVEY RESULTS OPERABLE UNIT 1 FORMER FORT ORD, CALIFORNIA

**Prepared for:**

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

**Contract No. W912DY-10-D-0023**
**Delivery Orders CM10 and CM11**

**Prepared by:**

**HydroGeoLogic, Inc.**
**14142 Denver West Parkway, Suite 225**
**Lakewood, Colorado 80401-3127**

**January 2018**

HGL
HydroGeoLogic, Inc

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Approved: Roy Evans Date: 1/23/18
Prepared by: Roy Evans, P.E.
Project Manager

Approved: Date: 1-23-18
Reviewed by: Ryan Sullivan
Project Scientist

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## LIST OF ACRONYMS, ABBREVIATIONS, AND SYMBOLS

| | |
|---|---|
| ACL | aquifer cleanup level |
| COC | chemicals of concern |
| DD&A | Denise Duffy and Associates, Inc. |
| FDA | Fire Drill Area |
| FE | federally endangered |
| FONR | Fort Ord Natural Reserve |
| FT | federally threatened |
| GIS | geographic information system |
| GPS | global positioning system |
| GWETS | groundwater extraction and treatment system |
| HGL | HydroGeoLogic, Inc. |
| HLA | Harding Lawson Associates |
| HMP | Habitat Management Plan |
| NWTS | Northwest Treatment System |
| OU | operable unit |
| ROD | Record of Decision |
| RTE | rare, threatened, or endangered |
| ST | state threatened |
| TCE | trichloroethene |
| UCNRS | University of California Natural Reserve System |
| UCSC | University of California at Santa Cruz |
| USACE | U.S. Army Corps of Engineers |
| USFWS | U.S. Fish and Wildlife Service |

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# 2017 FONR IMPACT ASSESSMENT AND HABITAT AND RARE PLANT SPECIES SURVEY RESULTS OPERABLE UNIT 1 FORMER FORT ORD, CALIFORNIA

## 1.0 INTRODUCTION

HydroGeoLogic, Inc. (HGL) was contracted by the U.S. Army Corps of Engineers (USACE), Sacramento District, to conduct a Fixed-Price Remediation with Insurance scope of work for Operable Unit (OU)-1 at the former U.S. Army Base Fort Ord located in Monterey County, California. The ongoing work was contracted by the USACE, Omaha District, under Contract Number W912DY-10-D-0023 Delivery Orders CM10and CM11, and was administered through the USACE, Sacramento District. The overall goal of this effort is to achieve the primary remediation objectives specified in the Record of Decision (ROD) signed in July of 1995 by the U.S. Army, U.S. Environmental Protection Agency, and the California Environmental Protection Agency (U.S. Army, 1995). Those remediation goals are as follows:

- Establish hydraulic control and contain contaminated groundwater.
- Extract and treat groundwater exceeding aquifer cleanup levels (ACLs).

A groundwater extraction and treatment system (GWETS) was constructed in 1988 to remediate trichloroethene (TCE) and other groundwater contaminants.

A key factor affecting the design and implementation of the groundwater cleanup is that the area including and surrounding the OU-1 contaminant plume is part of the University of California Natural Reserve System (UCNRS), which is designated as the Fort Ord Natural Reserve (FONR). The FONR area potentially affected by the construction of OU-1 remediation facilities and activities is approximately 130 acres. Therefore, the project has the additional constraint that activities undertaken to achieve the OU-1 cleanup adequately protect and maintain the critical habitat and protected species found within the FONR. The FONR is managed by staff at the University of California at Santa Cruz (UCSC).

Figure 1.1 illustrates the location of Former Fort Ord and the OU-1 source area. The source area was the former Fort Ord Fritzsche Army Airfield Fire Drill Area (FDA). Activities conducted at the FDA between 1962 and 1985 resulted in contaminants being released to soils and groundwater. Although 10 volatile organic compounds have been identified as chemicals of concern (COCs) in groundwater underlying the FDA, TCE is the contaminant detected at the highest concentrations and across the greatest extent of the affected aquifer. Sampling results from September 2014 onward showed that all COC concentrations were less than the cleanup targets specified in the ROD.

The Installation-Wide Multispecies Habitat Management Plan (HMP) (U.S. Army, 1997) established the guidelines for conservation and management of the plant species and wildlife that largely depend on the land within the former Fort Ord for survival. The overall goal of the HMP is to provide for, at a minimum, no net loss of populations or important habitat for any of the subject species. The U.S. Army consulted with the U.S. Fish and Wildlife Service (USFWS) in

1998 to assess potential impacts to the sand gilia (*Gilia tenuiflora ssp. arenaria*) and Monterey spineflower (*Chorizanthe pungens var. pungens*) populations resulting from groundwater investigation and remediation activities within the FONR. On 30 March 1999, USFWS issued a Biological and Conference Opinion which described minimization measures to guide remediation and other activities conducted in habitat areas, including OU-1. That opinion is consistent with the HMP. The Army consulted the USFWS again in 2002 and 2007 to address impacts to Monterey spineflower critical habitat and the California tiger salamander (*Ambystoma californiense*) (USFWS, 2002 and 2007). In 2015, USFWS issued a Programmatic Biological Opinion that supersedes all previous biological opinions in which various mitigation measures were identified and are implemented before, during, and after work within the FONR (USFWS, 2015). The Army re-initiated the Programmatic Biological Opinion in 2017 (USFWS, 2017).

Annual biological surveys were conducted within the OU-1 area by others from 1998 through 2003. Since 2004, HGL conducted annual biological surveys focusing on mapping the extent and population of federally protected rare, threatened, or endangered (RTE) plant species within the FONR. The 2006 through 2016, Denise Duffy and Associates (DD&A) conducted rare plant surveys under subcontract to HGL. These surveys included mapping the federally endangered (FE) and state threatened (ST) sand gilia and the federally threatened (FT) Monterey spineflower. The findings of these surveys were submitted in the following reports:

- Appendix A of the *Draft Remedial System Modification Plan, Operable Unit 1, Fritzsche Army Airfield Fire Drill Area, Former Fort Ord, California* (HGL, 2004a)
- *Results of 2004 Monterey Spineflower and Sand Gilia Surveys, OU-1, Former Ft. Ord, California* (HGL, 2004b)
- *Results of 2005 Monterey Spineflower and Sand Gilia Surveys, OU-1, Former Ft. Ord, California* (HGL, 2005)
- *Final 2006 FONR Impact Assessment and Habitat and Rare Plant Species Survey Results* (HGL, 2007a)
- *2007 FONR Impact Assessment and Habitat and Rare Plant Survey Results* (HGL, 2008a)
- *2008 FONR Impact Assessment and Habitat and Rare Plant Species Survey Results* (HGL, 2009a)
- *2009 FONR Impact Assessment and Habitat and Rare Plant Species Survey Results* (HGL, 2009b)
- *2010 FONR Impact Assessment and Habitat and Rare Plant Species Survey Results* (HGL, 2011a)
- *2011 FONR Impact Assessment and Habitat and Rare Plant Species Survey Results* (HGL, 2012)
- *2012 FONR Impact Assessment and Habitat and Rare Plant Species Survey Results* (HGL, 2013a)
- *2013 FONR Impact Assessment and Habitat and Rare Plant Species Survey Results* (HGL, 2013b)

- *2014 FONR Impact Assessment and Habitat and Rare Plant Species Survey Results* (HGL, 2014b)
- *2015 FONR Impact Assessment and Habitat and Rare Plant Species Survey Results* (HGL, 2015)
- *2016 FONR Impact Assessment and Habitat and Rare Plant Species Survey Results* (HGL, 2016)

From 2007 through 2013, HGL engaged the UCSC to perform weed control activities in selected areas of the FONR. The overall objective of the weed control activities was to prevent or reduce potential negative impacts to the Monterey spineflower and sand gilia populations from expansion of non-native plants within that portion of the FONR affected by OU-1 remediation activities. During 2015, UCSC surveyed selected areas that were included in the 2007 through 2013 weed control activities and evaluated the effectiveness of those activities. Based on the results of the 2015 survey, no UCSC surveys or weed control activities were performed in 2016 or 2017.

This document presents the results of two separate 2017 rare plant surveys and discusses the potential impact on those plants from OU-1 remediation activities conducted since 2004. The two separate surveys are further described in Section 1.3. The following information also is included in this report:

- A description of the FONR site and overview of past activities
- Descriptions of the actions taken and site management protocols implemented to minimize adverse impacts to the FONR habitat
- A summary of the site activities conducted by HGL during 2017 and planned future activities
- Results of the 2017 rare plant surveys and interim impact assessments
- Results from previous rare plant surveys for locations surveyed in 2017
- Recommendations for future work

## 1.1 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 downsizing/closure of the base. In August 1994, portions of the property were transferred to UCSC, and the FONR was established in June 1996.

The former Fort Ord is located near Monterey Bay, approximately 80 miles south of San Francisco. The base consists of approximately 28,000 acres near the cities of Seaside, Sand City, Monterey, Del Rey Oaks, and Marina. Monterey Bay marks the western boundary of the former Fort Ord. Toro Regional Park borders the base to the southeast and land use to the east is primarily agricultural.

OU-1 occupies approximately 590 acres of the FONR in the southwestern corner of the former Fritzsche Army Airfield, west of Imjin Road and north of Reservation Road. The dominant habitats within the OU-1 portion of the FONR are coast live oak woodland, coastal scrub, maritime

chaparral and annual grassland. The maritime chaparral is considered a rare habitat by the California Department of Fish and Wildlife. The overall former Fort Ord area contains large areas of maritime chaparral habitat.

Several federally and state protected RTE species are known or suspected to be present within the FONR. These include the sand gilia (FE) (ST), the Monterey spineflower (FT), and the California tiger salamander (FE) (ST). Several plant and animal HMP species are also present in the FONR. Other plant HMP species include the following:

- Coast wallflower (*Erysimum ammophilum*)
- Eastwood's ericameria (*Ericameria fasciculata*)
- Monterey ceanothus (*Ceanothus cuneatus var. rigidus*)
- Sandmat manzanita (*Arctostaphylos pumila*)
- Toro manzanita (*Arctostaphylos montereyensis*)
- Yadon's piperia (*Piperia yadonii) (FE)*

The California black legless lizard (*Anniella pulchra nigra*), and the Monterey ornate shrew (*Sorex ornatus salarius*) are animal HMP species.

The northern and northeastern boundaries of OU-1 are adjacent to a large expanse of privately or municipally owned, non-native grassland. Transmission of non-native grass species into OU-1 is accelerated by the prevailing southern winds, which blow the seeds into the OU-1 area (Fusari, 2004). Non-native grasses and weedy forbs are already present throughout much of the OU-1 area. The significant expansion of these non-native grasses could potentially cause federally and state listed plant populations to decline.

Sand gilia appears to be less tolerant of competing plant cover than the Monterey spineflower. This hypothesis is based on the observation that numerous small Monterey spineflower populations were identified within the dense grassland habitat bordering the main FONR habitat to the east and north or on the roadways bordering this grassland in the initial 1998 survey. Subsequent rare plant surveys conducted between 2004 and 2007 also observed Monterey spineflower in this region.

Although sand gilia was not detected in this region during the 1998 through 2007 surveys, sand gilia population patches were observed in 2007 in open areas within 30 feet of wells EW-OU1-18-A, MW-OU1-SVA-11, and MW-OU1-03-A (HGL, 2008a). These wells (destroyed in 2011) are shown on Figure 1.2. The small open area in which the sand gilia population was observed is approximately 300 feet north and northeast of the OU-1 plume source area and is bordered by grasses that are surrounded by oak woodland and understory habitat. Several Monterey spineflower populations also were observed thriving within dense patches of non-native grasses in the same area.

## 1.2 OVERVIEW OF OU-1 REMEDIATION ACTIVITIES WITHIN THE FONR

Numerous wells and soil borings were constructed within the FONR as part of the investigative effort to define the extent of environmental contamination and remediate contamination. Table 1.1

lists the wells that were installed within the OU-1 portion of the FONR. Table 1.2 lists the soil borings that were drilled without constructing a well since 2004 within the FONR portion of OU-1. Figure 1.2 illustrates the OU-1 well and soil boring locations. No new OU-1 wells or soil borings have been constructed within the FONR since 2006. In September 2011, 55 wells were destroyed within the FONR. In June 2014, 18 wells were destroyed within the FONR. In July 2017, the remaining 33 wells within the FONR were destroyed as part of the closeout effort. There are no longer any OU-1 wells in existence. Figure 1.3 illustrates the layout and components of the former OU-1 groundwater remediation system within the FONR as of June 2015. Buried pipelines were left in place, but all above-ground components shown in Figure 1.3 were removed in July 2017 or earlier.

Note that typical well identification formats—"MW-" prefix for monitoring wells, "EW-" prefix for extraction wells, and "IW-" prefix for injection wells—do not correspond to well function in all cases. The boundaries of the contaminated groundwater zone in OU-1 were refined as the remedial design progressed. The initial system performance pilot test and other field tests provided data that described potential pumping rates for several wells. This data was used during design of the FONR component. Formulating and evaluating design alternatives showed that the most effective OU-1 remedy required that some wells be used for different purposes than originally intended. Consequently, some wells that were intended and named as monitoring wells (MW-OU1-46-AD, MW-OU1-85-A, and MW-OU1-87-A) became extraction wells. Conversely, numerous wells with the EW- prefix have been used only for monitoring groundwater quality. Only the following EW- prefix wells have been used for groundwater extraction:

| | | |
|---|---|---|
| EW-OU1-60-A | EW-OU1-63-A | EW-OU1-71-A |
| EW-OU1-62-A | EW-OU1-66-A | |

Several wells were named as potential injection well sites but only two (IW-OU1-73-A and IW-OU1-74-A) were connected to the Northwest Treatment System (NWTS) for this purpose. The rest of the "IW-" prefix wells have been used only for monitoring groundwater quality, with one exception: well IW-OU1-10-A was converted to an extraction well in October 2010.

## 1.3 SUMMARY OF SITE ACTIVITIES

In 1987, about 4,000 cubic yards of contaminated soils were excavated and replaced with clean fill. The OU-1 ROD (U.S. Army, 1995) indicated that remediation of the contaminated soils at the FDA was complete. The ROD also defined groundwater extraction and treatment as the selected remedy for OU-1 groundwater. A GWETS was constructed in 1988 to remediate TCE and other related groundwater contaminants. The 1988 GWETS consisted of extraction wells EW-OU1-17-A and EW-OU1-18-A and was located a short distance downgradient (north) of the FDA. Extracted groundwater was piped to a treatment facility located at the former FDA, where dissolved organic compounds were removed using granular activated carbon vessels. The treated effluent was spray-irrigated in the southern portion of the FDA.

Despite a steady overall decline in contaminant levels within the groundwater capture zone of the 1988 GWETS, COCs were subsequently detected at concentrations above ACLs in groundwater downgradient from the capture zone. Additional wells installed between 1997 and 2001 (MW-OU1-21-A through MW-OU1-46-A) revealed that TCE exceeded the ACL as far as 2,100

feet downgradient from the existing capture zone. Groundwater modeling showed that contaminated groundwater north and west of extraction well EW-OU1-17A was not captured by the extraction system (AHTNA, 2003).

HGL began performing remediation activities in December 2003. A draft design to expand the original GWETS was presented in the *Draft Remedial System Modification Plan* (HGL, 2004a). New wells were installed and aquifer testing began in 2004 and continued through 2007. The draft GWETS expansion design was adjusted as data from the newly installed wells and aquifer testing was processed. The final design was issued in the three-volume Final Engineering Design Report in 2006 (HGL, 2006a; 2006b; and 2006c).

In 2006, the first component of the GWETS expansion, the Hydraulic Control Pilot Project, was constructed (HGL, 2006d). Four additional extraction wells (the FONR system) were constructed from July through September 2007 to further expand the GWETS. These construction activities are described in detail in the *Final Hydraulic Control Pilot Project Construction Report* (HGL, 2007b) and the *Draft FONR System Construction Report* (HGL, 2008b). Additional details concerning the GWETS expansion and a summary of OU-1 site activities conducted during 2007 relating to habitat monitoring and impacts were provided in the *2007 FONR Impact Assessment and Habitat and Rare Plant Survey Results* (HGL, 2008a).

During 2010, HGL conducted sampling activities and constructed an underground pipeline and underground power line within the FONR habitat area. The underground pipeline and power line connected IW-OU1-10-A to the terminus of the existing remediation system (at extraction well MW-OU1-87-A). The underground piping was laid within the existing roadway to minimize environmental impacts to the surrounding habitat. Converting IW-OU1-10-A to an extraction well accelerated the overall groundwater cleanup. The design parameters for this expansion are described in the Remediation System Expansion Design Technical Memorandum (HGL, 2010). The 2010 construction activities and associated environmental monitoring are described in the *IW-OU1-10-A System Expansion Construction Report* (HGL, 2011b).

Previous results from the groundwater quality monitoring program showed that cleanup targets within the capture zone of the original GWETS extraction wells (Figure 1.3) were achieved during 2005. Groundwater pumping and treatment from the existing GWETS area was suspended in February 2006 as part of the rebound evaluation. A rebound evaluation to assess whether the improved groundwater quality could be sustained without additional remediation was completed during 2007. The *Draft Rebound Evaluation Report* (HGL, 2007c) was submitted for regulatory review and it was agreed that the groundwater sampling frequency in this region can be greatly reduced.

Sampling from selected groundwater monitoring wells in this region continued for some wells at a reduced frequency into 2011. Sampling results confirmed that groundwater quality meets the ACLs and all wells within this area were destroyed in September and October 2011. In total, HGL destroyed 55 OU-1 monitoring wells, 53 of which were located within the FONR, in 2011. These well destruction activities are described in the Well Destruction Report (HGL, 2011c). COC concentrations in groundwater have continued to improve. In 2014, HGL destroyed another 18 monitoring wells that were located within the FONR and no longer needed to support remediation

efforts. The 2014 well destruction activities are described in the *Well Destruction and Former OU-1 Treatment Plant Decommissioning Completion Report* (HGL, 2014a).

HGL typically conducts the following activities annually within the FONR habitat area. Only light-duty vehicles (pickup trucks or sedans) are used for sampling activities and travel routes are limited to established roadways.

- Collect performance monitoring samples from selected extraction wells and from the NWTS. However, no sampling was performed in 2017 because pumping and treatment operations were suspended in October 2014 after the cleanup targets were met.
- Collect samples from the wells composing the OU-1 groundwater long term monitoring network. No sampling was performed in 2017 because the attainment monitoring samples from May, July, October, and December 2015 showed that the remediation effort is complete.
- Survey rare plants at locations where well construction or destruction has occurred within the previous 3 years.

In addition to the activities listed above, HGL also completed a rare plant and habitat survey (Year 0) in April through June 2017 at 33 OU-1 well sites. These 33 wells were destroyed in July 2017 as part of the OU-1 "remediation complete" closeout activities. The well destruction activities are detailed in Appendix B of the OU-1 Site Closure Report (HGL, 2017). This 2017 rare plant and habitat survey (Year 0) will supplement the existing historical records when potential remediation impacts are evaluated after completing the annual post well destruction surveys to be conducted during the flowering season in 2018 through 2020.

The following sections describe the 2017 rare plant and habitat survey for wells destroyed in 2014 (Year 3) and the 2017 rare plant and habitat survey (Year 0).

### 1.3.1 2017 Rare Plant and Habitat Survey for Wells Destroyed in 2014 (Year 3)

Survey dates for the 2017 rare plant and habitat survey for wells destroyed in 2014 (Year 3) were determined through communications with UCSC natural resource staff and by observing Monterey spineflower and sand gilia populations in the reference area near the FONR. Surveys for sand gilia and Monterey spineflower were performed separately, approximately four weeks apart. DD&A conducted surveys for sand gilia on 21 April and 26 May 2017, and Monterey spineflower on 26 May and 1 June 2017. The timing of the surveys corresponded with the observed peak blooming period for each species.

As in 2016, the 2017 surveys included Yadon's piperia in addition to Monterey spineflower and sand gilia. Piperia species can be identified by their flowers and the genus can be identified by their basal leaves prior to bloom. However, the Yadon's piperia peak blooming period typically occurs well after that of Monterey spineflower and sand gilia. Initial surveys were conducted to look for presence of vegetative structures of potential piperia plants, but none were found so follow-up blooming period surveys were not conducted.

The 2017 rare plant and habitat survey (Year 3) for wells destroyed in 2014 covered the reference area near the intersection of Reservation Road and Imjin Parkway, the former fence line around the original OU-1 groundwater treatment facility, and the seven well sites within the FONR habitat area where wells were destroyed in 2014, as noted below and shown on Appendix A, Figures A3.1 through A3.6:

- MW-OU1-22-A
- MW-OU1-24-AR
- MW-OU1-40-A
- PZ-OU1-46-AD2
- MW-OU1-23-A
- MW-OU1-25-A
- MW-OU1-51-A

PZ-OU1-46-AD2 is adjacent to MW-OU1-46-A and near MW-OU1-46-A. These three wells are considered to be a single location when evaluating rare plant survey results. As described in Section 1.3.2, monitoring wells MW-OU1-46-A and MW-OU1-46-A were destroyed as part of the July 2017 well destruction activities.

The wells listed below were also destroyed in 2014 but were not included in the rare plant survey because they are located in grassland areas or along roadway bordering grassland area outside of the FONR habitat:

- EW-OU1-43-A
- EW-OU1-47-A
- MW-B-10-A
- MW-OU1-29-A
- MW-OU1-41-A
- MW-OU1-45-A
- MW-OU1-56-A
- MW-OU1-64-A1
- MW-OU1-64-A2
- MW-OU1-65-A
- MW-OU1-ERD-08-A

The fence surrounding the GWETS location was removed in 2014 after the rare plant survey had been completed for that year. The fence surrounded the original contaminant source area in which contaminated native soils had been removed in 1987 and replaced with clean, non-native soils. No intrusive activities had been conducted along or near the fence line since 2004 or earlier and this area was not explicitly included in rare plant surveys after 1998. Because some wells were constructed in the vicinity in 2004 and 2005, the 2004 baseline and subsequent post-construction rare plant surveys triggered by those activities extended over the northern half of the fence perimeter. In 2014, the GWETS treatment facility and the fence were destroyed and the entire fence line was within the boundary of the post-destruction rare plant survey.

The methodology used for the 2017 rare plant and habitat survey for wells destroyed in 2014 (Year 3) is summarized in Section 2.0 and the associated survey results are presented in Section 3.0. The complete survey report is presented in Appendix A.

### 1.3.2 2017 Rare Plant and Habitat Survey (Year 0)

A 2017 rare plant and habitat survey (Year 0) was completed at 33 monitoring well locations before starting well destruction activities in July 2017. Similar to the approach described in Section

1.3.1, survey dates were determined through communications with UCSC natural resource staff and by observing Monterey spineflower and sand gilia populations in the reference area near the FONR. DD&A conducted surveys for sand gilia on 21 April and 26 May 2017, and Monterey spineflower on 23 May, 26 May, and 1 June 2017. The timing of the surveys corresponded with the observed peak blooming period for each species.

As noted in the previous section, a subsequent survey for Yadon's piperia was not necessary because that species was not observed in the initial surveys.

The 2017 rare plant and habitat survey (Year 0) covered the reference area near the intersection of Reservation Road and Imjin Parkway and the 33 well sites within the FONR habitat area where wells were destroyed in July 2017 as shown on Figure 1.2 and on Appendix B, Figure B1.3. Two wells, MW-OU1-27-A and MW-B-02-A, were also destroyed in July 2017, but were not included in the rare plant survey because they are located in grassland areas or along roadway bordering grassland area outside of the FONR habitat. The grassland area is within the FONR but is considered low quality habitat for Monterey spineflower and sand gilia at this location, and thus is not surveyed for HMP annual species as described in the 2017 Programmatic Biological Opinion (USFWS, 2017).

The methodology used for the 2017 rare plant and habitat survey (Year 0) is summarized in Section 2.0 and the associated survey results are presented in Section 4.0. The complete survey report is presented in Appendix B.

## 1.4 IMPACT PREVENTION AND MITIGATION MEASURES

Activities conducted within the FONR are limited to those essential to achieving the remediation goals for the project. The remedial actions and OU-1 closure activities were performed in accordance with the HMP and biological opinion(s). Compliance with these measures reduces or avoids impacts to RTE species of concern on the project site. In May 2015, the USFWS issued a programmatic biological opinion to address anticipated effects to federally protected species on the former Fort Ord and associated critical habitat as a result of the Army's activities. The Army re-initiated the Programmatic Biological Opinion in 2017 and the 2017 Programmatic Biological Opinion supersedes all previous biological opinions regarding former Fort Ord (USFWS, 2017). Consequently, guidance for the OU-1 remedial action(s) is as follows:

- Installation-Wide Multispecies Habitat Management Plan (U.S. Army, 1997)
- The 7 June 2017 Re-initiated Programmatic Biological Opinion for Cleanup and Property Transfer Actions Conducted at the Former Fort Ord, Monterey County, California
- Site-specific guidance and direction from UCNRS staff for locations within the FONR

The Army avoids OU-1 construction activities within the FONR between November 1 and June 1 to allow Monterey spineflower and sand gilia to set seed and to minimize impact to the FONR during ecologically sensitive periods. All construction or demolition activities are sequenced to avoid this time frame as much as possible within the overall project constraints. For example, the final FONR system construction began in July 2007 and was completed in September 2007 before

the seasonal rains began. Likewise, well destruction and road repair activities have been initiated and completed before the rainy season began.

In addition to complying with the guidance listed above, beginning in 2007, HGL subcontracted with UCSC to implement manual and mechanical weed control measures at selected locations within the OU-1 portion of the FONR. The weed control program was renewed annually and implemented by UCSC through 2013. The areas where weed control activities were performed in 2013 and earlier are shown on Figure 1.4. Each area included in the weed control program received between one and three treatments (using a weed-eater and/or hand pulling) depending on site-specific phenology, observed response to past treatments, and species composition. UCSC staff also surveyed well sites to identify the composition of the plant population in the immediate vicinity of the wells. The effectiveness of the 2007 through 2013 weed control activities was evaluated by UCSC and HGL based on UCSC surveys conducted in 2007 and 2015 (HGL, 2015). Based on the evaluation results, weed control activities were not performed in 2016 and future weed control activities are not planned.

# TABLE(S)

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# Table 1.1
# Wells Within the Fort Ord Natural Reserve

| Wells Installed/Sampled Before 2004 | | | | Wells Installed for Enhanced Reductive Dechlorination Pilot Study | | Wells Installed 2004 through 2006 | | | |
|---|---|---|---|---|---|---|---|---|---|
| **Identification** | **Year Installed** | **Identification** | **Year Installed** | **Identification** | **Year Installed** | **Identification** | **Year Installed** | **Identification** | **Year Installed** |
| MW-B-10-A | 1976 | *MW-OU1-24-A* | 1997 | *IW-OU1-ERD-01-A* | 2002 | *IW-OU1-01-A* | 2004 | PZ-OU1-10-A1 | 2005 |
| *MW-OU1-01-A* | 1986 | MW-OU1-24-AR | 2003 | *MW-OU1-ERD-01-A* | 2002 | IW-OU1-02-A | 2004 | PZ-OU1-46-AD2 | 2005 |
| *MW-OU1-02-A* | 1986 | MW-OU1-25-A | 1998 | *IW-OU1-ERD-02-A* | 2002 | PZ-OU1-02-A1 | 2004 | | |
| *MW-OU1-03-A* | 1986 | MW-OU1-26-A | 1998 | *MW-OU1-ERD-02-A* | 2002 | *IW-OU1-05-A* | 2004 | | |
| *MW-OU1-04-A* | 1986 | MW-OU1-27-A | 1998 | *IW-OU1-ERD-03-A* | 2002 | IW-OU1-10-A | 2004 | EW-OU1-60-A | 2006 |
| *MW-OU1-05-A* | 1986 | *MW-OU1-28-A* | 1998 | *MW-OU1-ERD-03-A* | 2002 | *IW-OU1-13-A* | 2004 | MW-OU1-61-A | 2006 |
| *MW-OU1-06-A* | 1986 | MW-OU1-29-A | 1998 | *IW-OU1-ERD-04-A* | 2002 | *IW-OU1-24-A* | 2004 | EW-OU1-62-A | 2006 |
| *MW-OU1-07-A* | 1986 | *MW-OU1-30-A* | 1998 | *MW-OU1-ERD-04-A* | 2002 | *IW-OU1-25-A* | 2004 | EW-OU1-63-A | 2006 |
| *MW-OU1-08-A* | 1986 | *MW-OU1-32-A* | 1998 | *MW-OU1-ERD-05-A* | 2002 | MW-OU1-46-AD | 2004 | MW-OU1-64-A1 | 2006 |
| *MW-OU1-09-A* | 1986 | *MW-OU1-33-A* | 1998 | *MW-OU1-ERD-06-A* | 2002 | EW-OU1-47-A | 2004 | MW-OU1-64-A2 | 2006 |
| *MW-OU1-10-A* | 1987 | *MW-OU1-34-A* | 1998 | *MW-OU1-ERD-07-A* | 2002 | *EW-OU1-48-A* * | 2004 | MW-OU1-65-A | 2006 |
| *MW-OU1-11-SVA* | 1986 | *PZ-OU1-35-A* | 1998 | MW-OU1-ERD-08-A | 2002 | EW-OU1-49-A | 2004 | EW-OU1-66-A | 2006 |
| *MW-OU1-12-A* | 1988 | *MW-OU1-36-A* | 1999 | | | PZ-OU1-49-A1 | 2004 | MW-OU1-67-A | 2006 |
| *PZ-OU1-13-A* | 1988 | *MW-OU1-37-A* | 1999 | | | MW-OU1-50-A | 2004 | MW-OU1-68-A | 2006 |
| *PZ-OU1-14-A* | 1988 | *MW-OU1-38-A* | 1999 | | | MW-OU1-51-A | 2004 | EW-OU1-71-A | 2006 |
| *PZ-OU1-15-A* | 1988 | *MW-OU1-39-A* | 1999 | | | EW-OU1-52-A | 2004 | EW-OU1-72-A | 2006 |
| *PZ-OU1-16-A* | 1988 | MW-OU1-40-A | 1999 | | | EW-OU1-53-A | 2004 | IW-OU1-73-A | 2006 |
| *EW-OU1-17-A* | 1987 | MW-OU1-41-A | 2001 | | | *EW-OU1-54-A* | 2004 | IW-OU1-74-A | 2006 |
| *EW-OU1-18-A* | 1987 | MW-OU1-43-A | 2001 | | | *EW-OU1-55-A* | 2004 | MW-OU1-82-A | 2006 |
| *MW-OU1-19-A* | 1993 | *MW-OU1-44-A* | 2001 | | | MW-OU1-56-A | 2004 | MW-OU1-83-A | 2006 |
| *MW-OU1-20-A* | 1993 | MW-OU1-45-A | 2001 | | | MW-OU1-57-A | 2004 | MW-OU1-84-A | 2006 |
| *MW-BW-10-A* | 1997 | MW-OU1-46-A | 2001 | | | MW-OU1-58-A | 2004 | MW-OU1-85-A | 2006 |
| *MW-OU1-21-A* | 1997 | *MW-OU1-01-180* | 2000 | | | MW-OU1-59-A | 2004 | MW-OU1-86-A | 2006 |
| MW-OU1-22-A | 1997 | *MW-OU1-02-180* | 2000 | | | | | MW-OU1-87-A | 2006 |
| MW-OU1-23-A | 1997 | *MW-OU1-03-180* | 2000 | | | | | MW-OU1-88-A | 2006 |

**Notes:**

Well name in *italics* indicates that well has been destroyed.
ERD - enhanced reduction dechlorination
EW - extraction well
IW - injection well
MW - monitoring well
OU1 - Operable Unit 1
PZ - piezometer
SVA - Salinas Valley Acquiclude

# Table 1.2
# Soil Borings and Wells Destroyed Within the Fort Ord Natural Reserve

| Identification | Year Boring Abandoned or Well Destroyed | Identification | Year Boring Abandoned or Well Destroyed | Identification | Year Boring Abandoned or Well Destroyed |
|---|---|---|---|---|---|
| **Soil Borings and Wells Destroyed 2004 - 2013. Post Destruction Rare Plant Monitoring Complete.** | | | | | |
| SB-OU1-2004-I | 2004 | MW-OU1-01-180 | 2011 | MW-OU1-32-A | 2011 |
| SB-OU1-2004-J | 2004 | MW-OU1-01-A | 2011 | MW-OU1-33-A | 2011 |
| SB-OU1-2004-K | 2004 | MW-OU1-02-180 | 2011 | MW-OU1-34-A | 2011 |
| SB-OU1-2004-L | 2004 | MW-OU1-02-A | 2011 | MW-OU1-36-A | 2011 |
| SB-OU1-2004-M | 2004 | MW-OU1-03-180 | 2011 | MW-OU1-37-A | 2011 |
| SB-OU1-46-AD1 | 2005 | MW-OU1-03-A | 2011 | MW-OU1-38-A | 2011 |
| SB-OU1-60-A | 2005 | MW-OU1-04-A | 2011 | MW-OU1-39-A | 2011 |
| EW-OU1-48-A | 2006 | MW-OU1-05-A | 2011 | MW-OU1-42-A | 2011 |
| EW-OU1-17-A | 2011 | MW-OU1-06-A | 2011 | MW-OU1-44-A | 2011 |
| EW-OU1-18-A | 2011 | MW-OU1-07-A | 2011 | MW-OU1-ERD-01-A | 2011 |
| EW-OU1-54-A | 2011 | MW-OU1-08-A | 2011 | MW-OU1-ERD-02-A | 2011 |
| EW-OU1-55-A | 2011 | MW-OU1-09-A | 2011 | MW-OU1-ERD-03-A | 2011 |
| IW-OU1-01-A | 2011 | MW-OU1-10-A | 2011 | MW-OU1-ERD-04-A | 2011 |
| IW-OU1-05-A | 2011 | MW-OU1-11-SVA | 2011 | MW-OU1-ERD-05-A | 2011 |
| IW-OU1-13-A | 2011 | MW-OU1-12-A | before 2003 | MW-OU1-ERD-06-A | 2011 |
| IW-OU1-24-A | 2011 | MW-OU1-19-A | 2011 | MW-OU1-ERD-07-A | 2011 |
| IW-OU1-25-A | 2011 | MW-OU1-20-A | 2011 | PZ-OU1-13-A | 2011 |
| IW-OU1-ERD-01-A | 2011 | MW-OU1-21-A | 2011 | PZ-OU1-14-A | 2011 |
| IW-OU1-ERD-02-A | 2011 | MW-OU1-24-A | 2003 | PZ-OU1-15-A | 2011 |
| IW-OU1-ERD-03-A | 2011 | MW-OU1-28-A | 2011 | PZ-OU1-16-A | 2011 |
| IW-OU1-ERD-04-A | 2011 | MW-OU1-30-A | 2011 | PZ-OU1-35-A | 2011 |
| MW-BW-10-A | 2011 | MW-OU1-31-A | 2011 | | |
| **Wells Destroyed in 2014** | | | | | |
| EW-OU1-43-A | 2014 | MW-OU1-25-A | 2014 | MW-OU1-56-A | 2014 |
| EW-OU1-47-A | 2014 | MW-OU1-29-A | 2014 | MW-OU1-64-A1 | 2014 |
| MW-B-10-A | 2014 | MW-OU1-40-A | 2014 | MW-OU1-64-A2 | 2014 |
| MW-OU1-22-A | 2014 | MW-OU1-41-A | 2014 | MW-OU1-65-A | 2014 |
| MW-OU1-23-A | 2014 | MW-OU1-45-A | 2014 | MW-OU1-ERD-08-A | 2014 |
| MW-OU1-24-AR | 2014 | MW-OU1-51-A | 2014 | PZ-OU1-46-AD2 | 2014 |

# Table 1.2
# Soil Borings and Wells Destroyed Within the Fort Ord Natural Reserve

| Identification | Year Boring Abandoned or Well Destroyed | Identification | Year Boring Abandoned or Well Destroyed | Identification | Year Boring Abandoned or Well Destroyed |
|---|---|---|---|---|---|
| **Wells Destroyed in 2017** | | | | | |
| MW-OU1-67-A | 2017 | IW-OU1-10-A | 2017 | MW-OU1-27-A | 2017 |
| MW-OU1-57-A | 2017 | MW-OU1-85-A | 2017 | EW-OU1-72-A | 2017 |
| MW-OU1-58-A | 2017 | MW-OU1-87-A | 2017 | MW-OU1-84-A | 2017 |
| MW-OU1-61-A | 2017 | EW-OU1-53-A | 2017 | MW-OU1-83-A | 2017 |
| MW-OU1-68-A | 2017 | EW-OU1-52-A | 2017 | MW-OU1-82-A | 2017 |
| MW-B-02-A | 2017 | PZ-OU1-10-A1 | 2017 | MW-OU1-50-A | 2017 |
| EW-OU1-60-A | 2017 | IW-OU1-02-A | 2017 | PZ-OU1-02-A1 | 2017 |
| EW-OU1-62-A | 2017 | MW-OU1-26-A | 2017 | MW-OU1-46-A | 2017 |
| EW-OU1-63-A | 2017 | MW-OU1-88-A | 2017 | MW-OU1-59-A | 2017 |
| EW-OU1-66-A | 2017 | EW-OU1-49-A | 2017 | IW-OU1-73-A | 2017 |
| MW-OU1-46-AD | 2017 | PZ-OU1-49-A1 | 2017 | IW-OU1-74-A | 2017 |
| EW-OU1-71-A | 2017 | MW-OU1-86-A | 2017 | | |

**Notes:**

A - A-Aquifer
EW - extraction well
MW- monitoring well
PZ- piezometer
SVA - Salinas Valley Aquiclude
ERD - enhanced reductive dechlorination
IW- injection well
OU1- Operable Unit 1
SB - soil boring

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# FIGURE(S)

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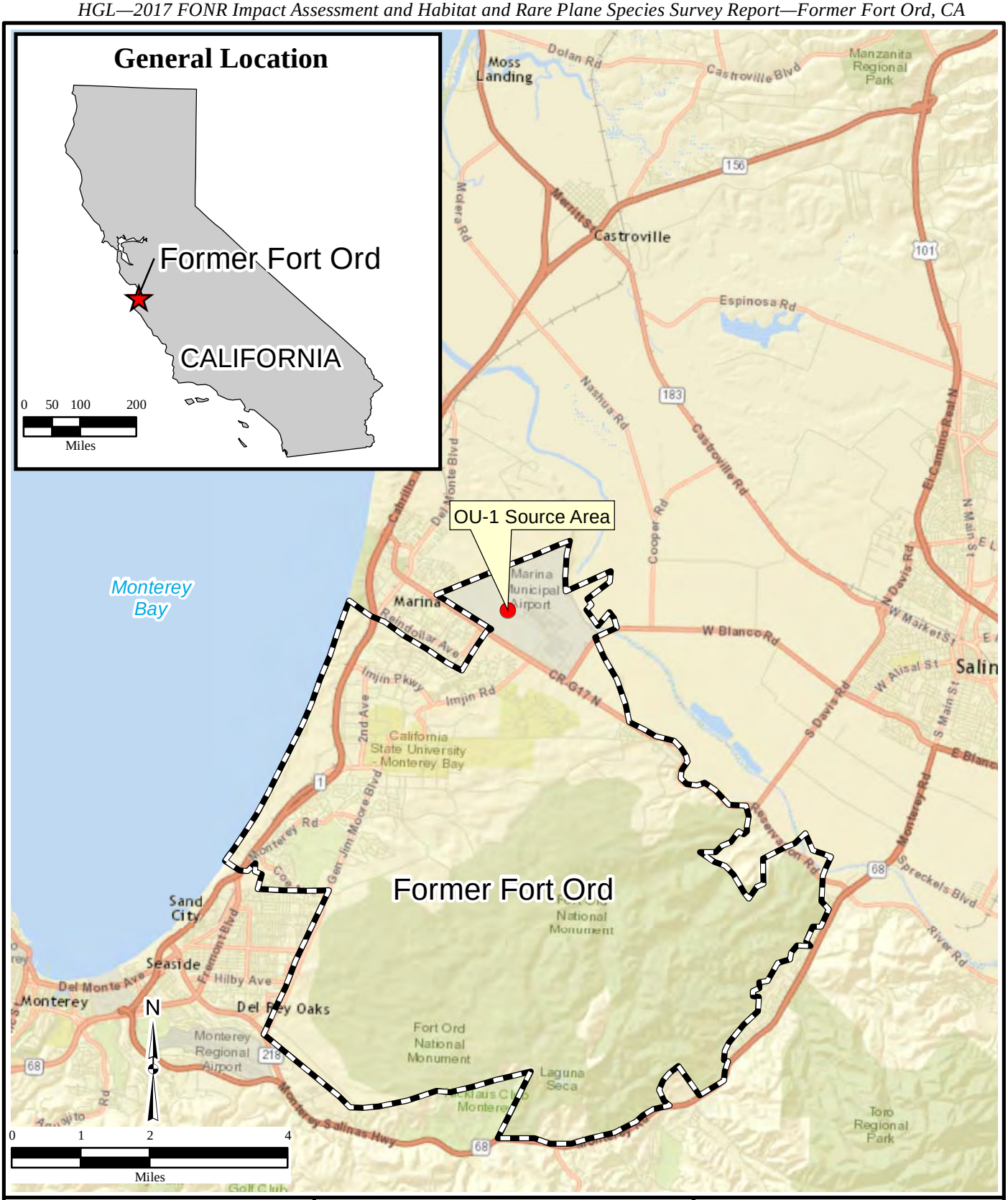



*\\gst-srv-01\hglgis\Ft-Ord_MSIW\ IA_HRPSS_Report_2016\ (1-01)Location_Map.mxd*
*8/30/2017 TB*
*Source: HGL*
*ArcGIS Online Streets Map*

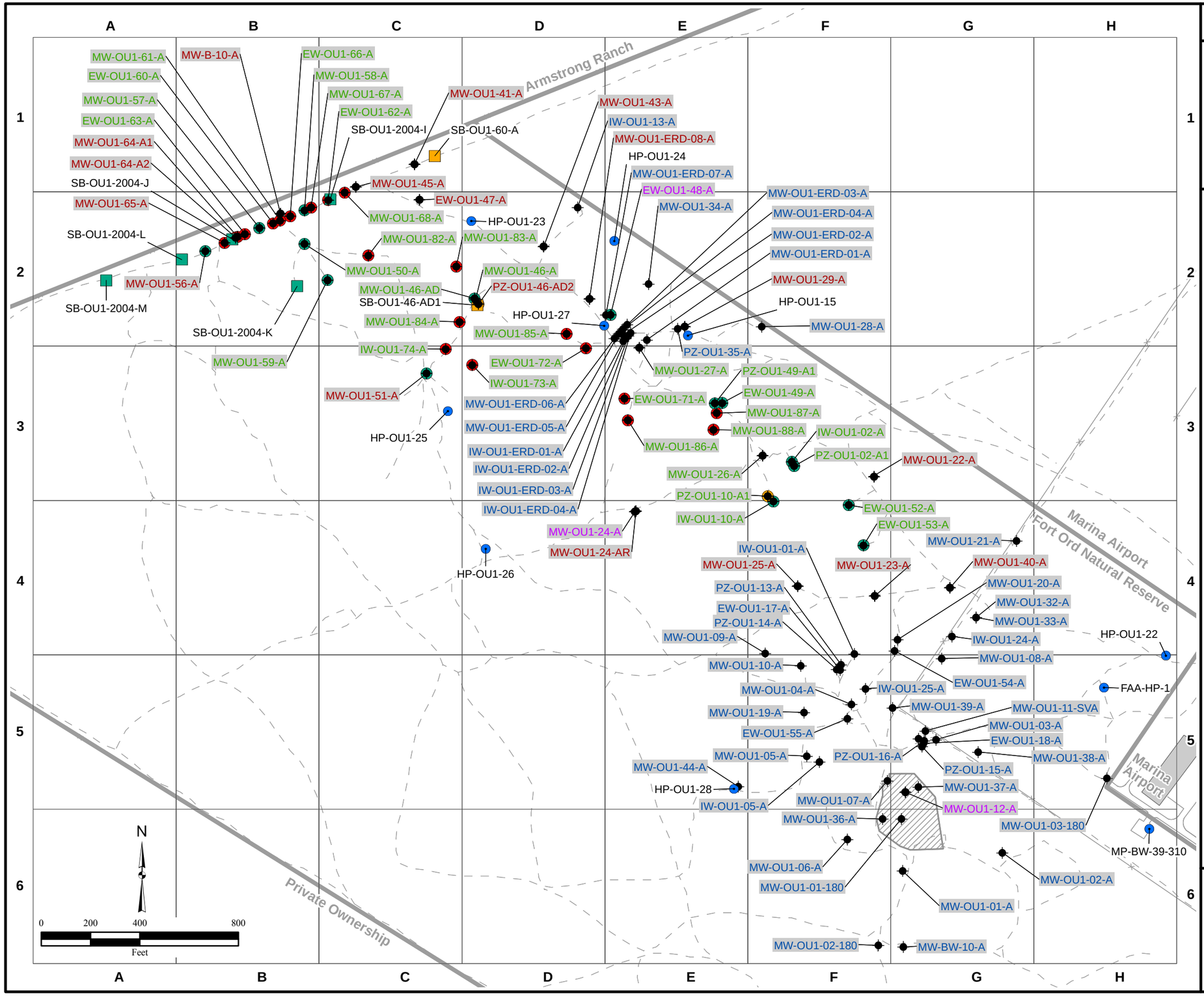
Legend

OU-1 Source Area

Former Fort Ord

**Figure 1.1**
**Former Fort Ord**

# Figure 1.2
# OU-1 Soil Borings, Wells, and Piezometers Constructed Within the FONR




## Legend

- Well/Piezometer Drilled Before 2004
- Soil Boring Drilled Before 2004
- Well Destroyed
- 2004 Well/Piezometer
- 2004 Soil Boring
- 2005 Well/Piezometer
- 2005 Soil Boring
- 2006 Well/Piezometer
- MW-OU1-26-A — Well or Boring ID
- MW-OU1-12-A — Well Destroyed Before 2006
- MW-OU1-21-A — Well Destroyed September 2011
- MW-OU1-40-A — Well Destroyed 2014
- MW-OU1-26-A — Well Destroyed 2017
- Trail/Unimproved Road
- Fence
- Property Boundary
- Building
- Former Fire Drill Area

Notes:
FONR=Fort Ord Natural Reserve
OU-1=Operable Unit 1

*\\gst-srv-01\HGLGIS\Ft_Ord_MSIW\IA_HRPSS_Report_2017\(1-02)FONR_Sampling.mxd*
*8/30/2017 TB*
*Source: HGL*

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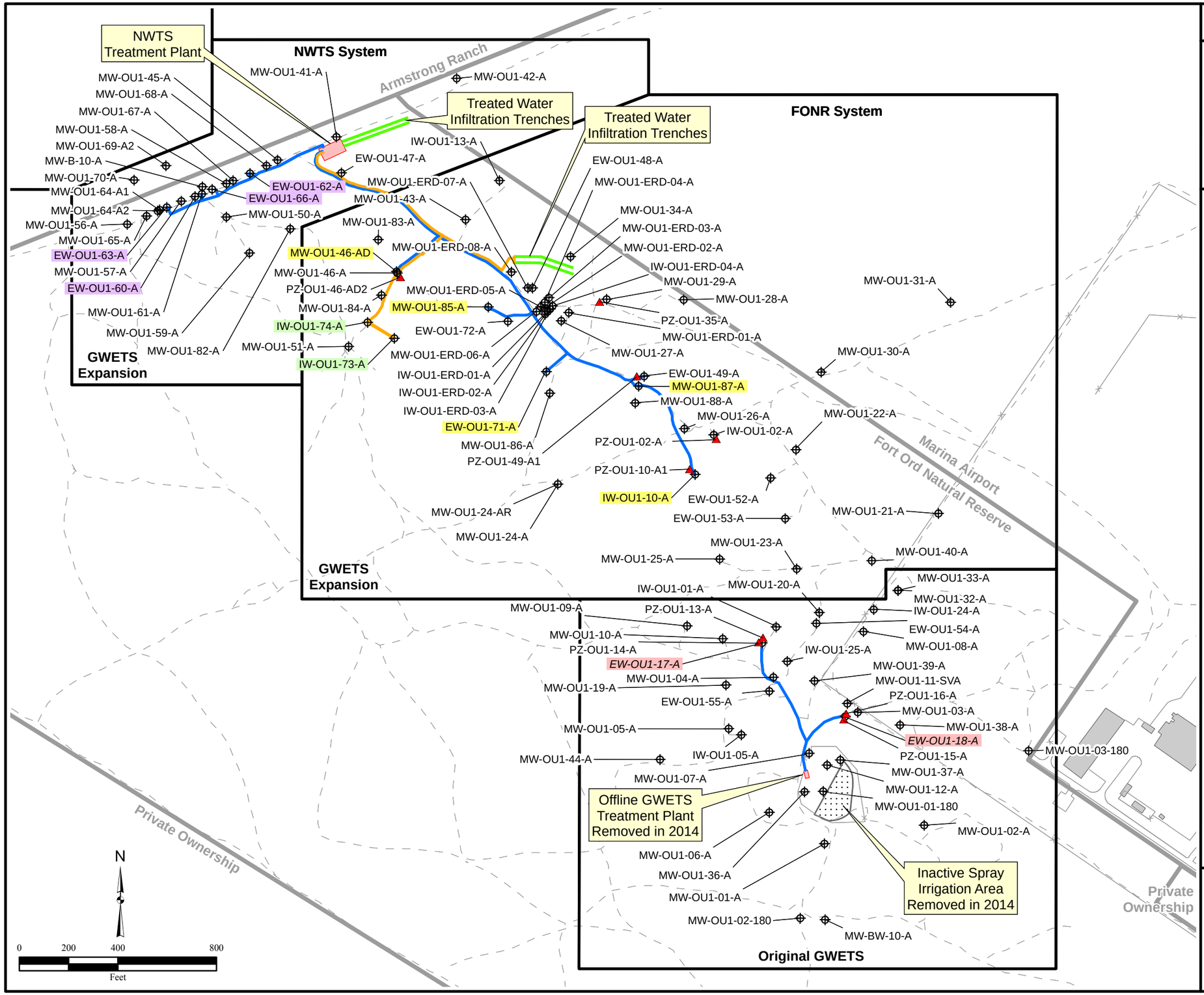
# Figure 1.3
# Former OU-1 Remediation System Areas Within the FONR All Wells Destroyed as of 2017




## Legend

- Well
- Piezometer
- MW-OU1-27-A — Well Identification
- EW-OU1-18-A — Original GWETS Extraction Well (Destroyed September 2011)
- IW-OU1-74-A — FONR Injection Well
- MW-OU1-46-AD — FONR Extraction Well
- EW-OU1-63-A — NWTS Extraction Well
- Trail/Unimproved Road
- Fence
- Extraction Pipeline
- Treated Water Pipeline
- Treated Water Infiltration Trench
- Property Boundary
- Treatment Plant
- Inactive Spray Irrigation Area
- Building

Notes:
The treated water and extraction water pipelines are located in separate trenches within or near the existing roadway. The separation shown in this figure is exaggerated for clarity.

FONR=Fort Ord Natural Reserve
GWETS=Groundwater Extraction and Treatment System
NWTS=Northwest Treatment System
OU-1=Operable Unit 1

*\\gst-srv-01\HGLGIS\Ft_Ord_MSIW\IA_HRPSS_Report_2017\(1-03)GW_Remediation _Sys.mxd*
*9/7/2017 TB*
*Source: HGL*

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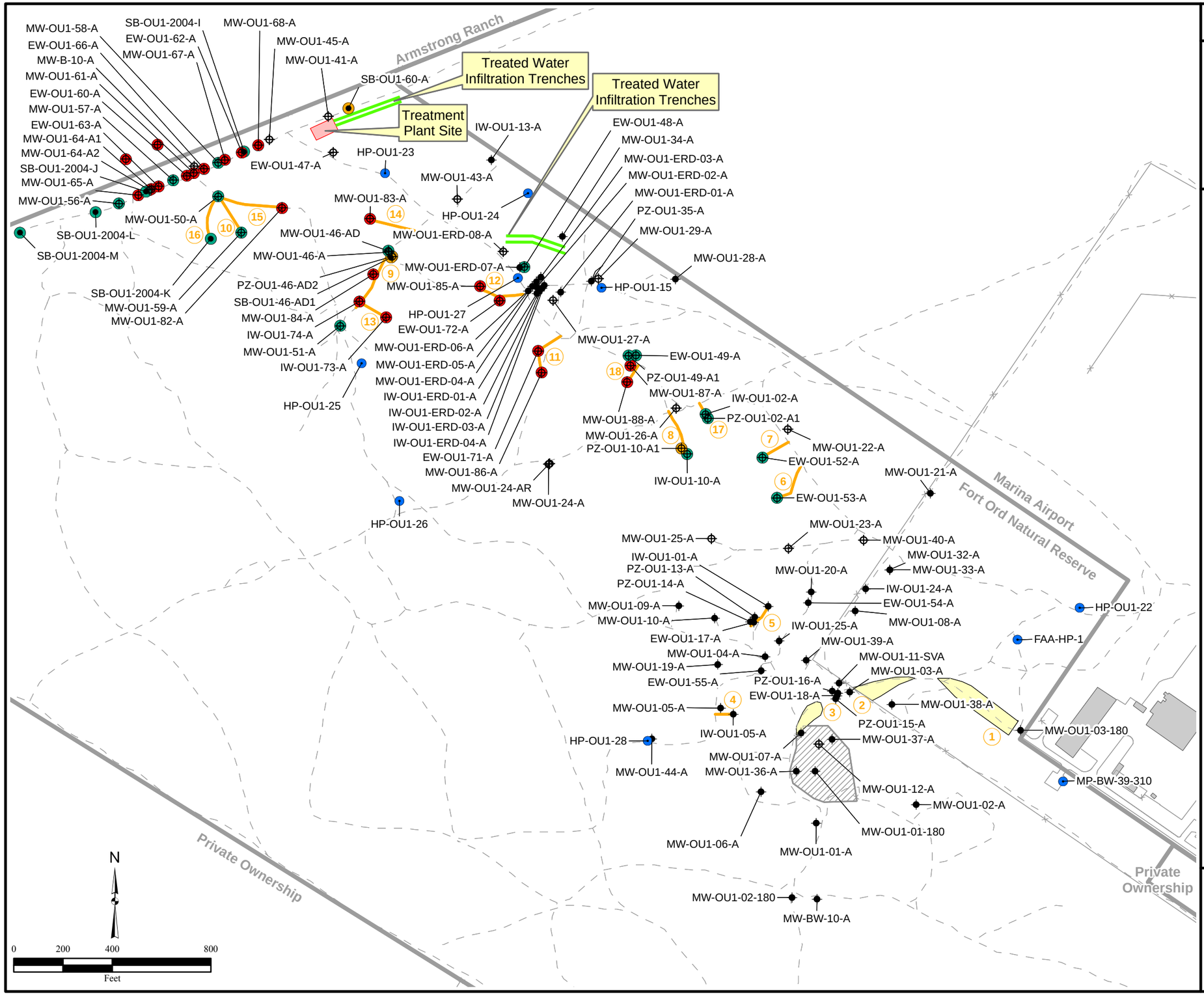
# Figure 1.4
# OU-1 Weed Control Segment Locations




## Legend

- Well/Piezometer Drilled Before 2004
- Soil Boring Drilled Before 2004
- Abandoned Soil Boring
- Well Destroyed September 2011
- 2004 Well/Piezometer
- 2004 Soil Boring (abandoned)
- 2005 Well/Piezometer
- 2005 Soil Boring (abandoned)
- 2006 Well/Piezometer
- MW-OU1-21-A — Well or Boring ID
- Weed Control Segment
- 1 — Weed Control Segment Identification Number 2007-2013
- Trail/Unimproved Road
- Fence
- Treated Water Infiltration Trench
- Property Boundary
- Southern Staging Area in 2004
- Treatment Plant
- Building
- Former Fire Drill Area

Note:
OU-1=Operable Unit 1

*\\gst-srv-01\HGLGIS\Ft_Ord_MSIW\IA_HRPSS_Report_2017\(1-04)Weed_Control_2015.mxd*
*8/30/2017 TB*
*Source: HGL*

HydroGeoLogic, Inc

# 2.0 RARE PLANT SURVEY OBJECTIVES AND METHODS

The objectives of the 2017 rare plant surveys and habitat inventories were to accomplish the following:

1. Identify locations and estimate populations of selected rare plant species at the OU-1 reference site, seven 2014 well destruction sites, and near the GWETS fence line, as described in Section 1.3.1.
2. Identify locations and estimate populations of selected rare plant species at the OU-1 reference site and thirty-three 2017 well destruction sites, as described in Section 1.3.2.
3. Map Monterey spineflower, sand gilia, and Yadon's piperia populations for comparison to past surveys and/or to facilitate planning if future construction, destruction, or maintenance activities are needed.

The reference site encompasses approximately 0.5 acre located approximately 3,000 feet southeast of the former OU-1 source area (Appendix A, Figure A1.2). DD&A biologists have used this site since 2010 to identify the peak of the blooming period for Monterey spineflower and sand gilia. The time to initiate the rare plant surveys at former Fort Ord and other locations has been partly based on observations of plants within the reference area to ensure that such surveys are conducted at appropriate times.

Coast live oak woodland is the dominant habitat in the reference area. Grassland and coast live oak woodland is adjacent to the reference site on the northwestern boundary. All other sides of the reference area are bordered by developed roads (Reservation Road, Mbest Drive, and University Drive). Non-native grasses and weedy forbs were already present throughout much of the reference area when the surveys began in 2010.

## 2.1 RARE PLANT SURVEY METHODS

A DD&A biologist and a DD&A technician conducted surveys for sand gilia and Monterey spineflower using a global positioning system (GPS) on the dates shown below. Piperia was included in all species surveys, but were not found at any location. Consequently, Yadon's piperia is not further discussed in this report. The survey was timed to coincide with the peak blooming period insofar as possible for Monterey spineflower and sand gilia. The peak blooming period was determined through communications with UCSC FONR natural resource management staff and by observing a known occurrence of sand gilia at the Fort Ord reference site near the FONR. The surveys were conducted on the following dates;

### 2017 Rare Plant and Habitat Survey for Wells Destroyed in 2014 (Year 3)

- Monterey Spineflower: 26 May 2017 and 1 June 2017
- Sand Gilia: 21 April 2017 and 26 May 2017

### 2017 Rare Plant and Habitat Survey (Year 0)

- Monterey Spineflower: 23 and 26 May 2017 and 1 June 2017
- Sand Gilia: 21 April 2017 and 26 May 2017

Each rare plant survey was conducted along existing or proposed roadways and access routes. The width of the survey area was approximately 10 feet beyond the edge of the roadway on either side. If a rare plant was identified, the survey in that area was extended to the boundary of the population encountered.

Large areas of Monterey spineflower and sand gilia were mapped as polygons using a Trimble Pathfinder ProXH GPS unit. Smaller plant groups and individuals were mapped as points with attributes to identify the number of individuals at each location. When a rare plant was identified, the survey in that area was extended to the boundary of the population encountered.

Individual counts were made for all sand gilia populations whether they were mapped as points (population less than or equal to five) or polygons (population greater than five). The polygon boundary was drawn to include all plants identified as a distinct population. However, Monterey spineflower was only counted as individuals when groups of less than five were mapped. For larger populations, Monterey spineflower was mapped as polygons and characterized according to the percent of cover, specifically, the percentage of the polygon covered by the Monterey spineflower divided by the total area enclosed 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)
- Very High (greater than 97 percent)

GPS data was exported to shapefile format for use in a geographic information system (GIS) (ESRI ArcGIS) and mapped on high-resolution aerial photography. The maps for the 2017 rare plant and habitat survey for wells destroyed in 2014 (Year 3) are presented in Appendix A (Figures A3.1 through A3.6) and the survey results are summarized in Section 3.0. The maps for the 2017 rare plant and habitat survey (Year 0) are presented in Appendix B (Figures A3.1 through A3.6) and the survey results are summarized in Section 4.0.

## 2.2 PROGRAMMATIC BIOLOGICAL OPINION SUCCESS CRITERIA

As described in Sections 1.0 and 1.4, the 2017 Re-initiated Programmatic Biological Opinion (USFWS, 2017) supersedes all previous biological opinions. The 2017 Re-initiated Programmatic Biological Opinion established success criteria to be used upon the completion of post-disturbance surveys to evaluate whether protected species have been impacted. The success criteria associated with groundwater remediation listed in the 2017 Re-initiated Programmatic Biological Opinion are shown below.

1. Densities and acreage of HMP annual species are within a 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.

These criteria are discussed further in Section 5.0 and 6.0.

# 3.0 DISCUSSION OF 2017 RARE PLANT AND HABITAT SURVEY RESULTS FOR WELLS DESTROYED IN 2014 (YEAR 3)

This section presents the results of the 2017 rare plant and habitat survey (Year 3) for wells destroyed in 2014. The annual reference plot rare plant survey was initiated in 2010. Table 3.1 summarizes the survey results at the reference plot. Tables 3.2A and B summarize the results for the well locations included in the 2017 rare plant and habitat survey for the wells destroyed in 2014 (Year 3). The 2017 rare plant and habitat survey for wells destroyed in 2014 is the third annual survey following the 2014 well destruction activities. An assessment as to whether the success criteria listed in the 2017 Re-initiated Programmatic Biological Opinion have been met at the end of the 3rd year of monitoring is presented in Section 6.1. Tables 3.3A and B summarize the results since 1998 for all 2017 rare plant surveys conducted at the 33 well site sites.

During well construction or destruction activities, the work area and drill rig footprint is approximately 30 feet in diameter and centered on the well borehole. Discussions comparing survey results in this report assume that a plant population or polygon is attributed to a given well site if any part of the population or polygon is within the potentially disturbed area. In some cases, observation wells were constructed within approximately 30 feet of an existing well. For the purpose of this impact assessment, these paired well locations are considered and counted as a single location and data point.

Numerous environmental factors affect the growth of the rare plants monitored in this survey. Precipitation is an important factor, particularly during the rainy season that typically occurs from late October through May. The annual rare plant surveys are timed to coincide with the peak blooming season and are typically performed in April or May (Fort Ord weather station, http://met.nps.edu/~ldm/renard_wx/). The total precipitation for the October 2016 through March 2017 period (24.96 inches) preceding the annual rare plant survey is provided in Table 3.4 for reference in subsequent discussions. The total precipitation of 24.96 inches during the October 2016 through March 2017 period was the largest amount for that period since 2005, exceeding last year's total by nearly 6 inches. Variations in the total area of observed Monterey spineflower in comparison to the total amount of precipitation in the preceding rainy season are illustrated in Table 3.5.

Precipitation is an important factor that affects the growth of both sand gilia and Monterey spineflower (Fox et al., 2006). In previous annual reports, the precipitation between October and March was used to represent antecedent conditions (rare plant surveys were performed as early as April). This period is again presented for consistency with past reports but additional antecedent periods were evaluated in this annual report. Linear correlations between areal coverage of plant populations in the reference area and ten different periods of precipitation (from Fort Ord weather station, http://met.nps.edu/~ldm/renard_wx/) were evaluated and the results are shown in Table 3.6.

As shown in Table 3.6, the total precipitation between April and March showed the highest correlation with the plant's areal coverage. The calculated correlation coefficient between areal coverage and precipitation between April and March is 0.73 and 0.76 (both highly positive) for sand gilia and Monterey spineflower, respectively. The total precipitation from April to March,

October to May, and October to March is provided in Table 3.4. The precipitation from April to March along with the sand gilia and Monterey spineflower areal coverage is shown in Figure 3.1. While there appears to be a general trend between precipitation and the areal coverage of both Monterey spineflower and sand gilia, there is an apparent discrepancy in that relationship in Year 2013. It is likely that other variables influence the populations of these species. In experimental studies, Monterey spineflower's survival and seed set were directly affected by rainfall, whereas sand gilia's vital rates were mainly affected by herbivory (Fox, 2007).

This section compares the results of the 2017 rare plant survey within the DD&A reference area, the 7 well locations on the OU1 FONR property, and the former GWETS fence line with the results of previous surveys.

## 3.1 SAND GILIA

Sand gilia was observed and mapped at 8 locations within the DD&A reference site and at 5 locations within or along the former GWETS fence line. Although sand gilia was present along a secondary access route, it was not observed at any of the seven well locations surveyed. A total of 14 populations (9 points and 5 polygons) of sand gilia were mapped within the 2017 survey area (see Appendix A, Attachment A-1). A total of 610 individual plants were mapped at the 14 populations. The survey results for each area are further detailed in the subsections below.

### 3.1.1 Reference Area

The reference area is located on property that is relatively undisturbed by anthropogenic activities. As seen in Table 3.1, sand gilia populations in the reference area have varied tremendously from one year to the next. Population counts ranged from a low of 70 individuals in 2012 to a maximum of 1,086 individuals in 2010. The rare plant survey results for 2017 (463 individuals) are in the middle of the range of population counts observed between 2010 and 2017. Sand gilia populations fluctuate from year to year because of natural variation in rainfall, temperature, and other factors (e.g., competition between species for limited resources, temperature variations, site-specific soil nutrients, exposure to sunlight, etc.). The interrelationship between these variables is complex, as illustrated by the comparison of total population to the total amount of precipitation in the preceding rainy season:

- The total population of sand gilia dropped from 1,086 in the 2010 survey to 318 in the 2011 survey although total precipitation from October to March—16.85 inches versus 17.29 inches, respectively—was very similar between 2010 and 2011.
- The total population of sand gilia in 2015 was nearly identical to that observed in 2010 (1,078 versus 1,086) although total precipitation from October to March—8.68 inches versus 16.85 inches, respectively—was almost 50 percent lower and was the third consecutive year of below-average annual precipitation.

Similar patterns are shown in the April to March precipitation measurements. The data from the reference area surveys provides a frame of reference for assessing the variability observed at well sites within the FONR where remediation activities have been conducted over the years.

### 3.1.2 FONR Well Locations

In 2017, sand gilia was not detected at any of the 7 well locations (Table 3.2A) surveyed. This is consistent with past survey results. Except at well MW-OU1-40-A (installed in 1999), sand gilia has not been observed at any of these 7 locations in any previous survey. Sand gilia was observed at or near MW-OU1-40-A during the 2001 survey (Harding Lawson Associates [HLA], 2001) but was not seen in the annual surveys from 1998 through 2005 or in the subsequent four surveys that included this well.

### 3.1.3 Former GWETS Fence Line

The 2017 survey results showed 2 sand gilia polygons and 3 points within the fenced area in the southern half of the previously enclosed area—the total number of sand gilia plants observed in 2017 was 37. No wells were located along the fence line, as shown on Appendix A, Figure A3.5. There were no intrusive activities along the fence line since it was installed until the fence was removed in 2014. Consequently, rare plant surveys from 2005 through 2007 and from 2012 through 2014 included only portions of the fence line that were incidental to surveys conducted at nearby newly installed or destroyed well locations. No rare plant surveys were conducted in the vicinity of the GWETS fence line from 2008 through 2011.

Sand gilia was observed in the 1998 and 2004 baseline surveys at locations along the northwest section of the GWETS fence line. Sand gilia was also observed at locations along the fence line in each annual survey from 2000 through 2004. The 2017 observed populations were less extensive than the 1998/ and 2004 baseline surveys and their locations correspond generally to the central part of the western fence line.

The 2017 survey also showed a population of 37 sand gilia plants within the fenced area, a decrease from 2016 (105 plants) and 2015 (295 plants). The 2015 survey was the first survey within the fenced area since 1998. As shown in Table 3.1, the sand gilia population also decreased in the reference area. In total, sand gilia has been observed along or within the fence line in 10 of the 16 rare plant surveys performed in the area since 1998.

## 3.2 MONTEREY SPINEFLOWER

Previous rare plant surveys conducted by DD&A indicate that populations of Monterey spineflower were often observed in areas with sparse to moderately abundant non-native annual grass cover, which suggests that this species may be somewhat more tolerant of annual grass cover variations and environmental factors than sand gilia. As with sand gilia, there are several environmental factors that affect the amount of Monterey spineflower that blooms in a given year and the interrelationship between these variables is complex. For example, variations in the total area of observed Monterey spineflower in comparison to the total amount of precipitation in the preceding rainy season are illustrated in Table 3.5:

- The total population area of Monterey spineflower varied by approximately 1 percent in the reference area in 2010 versus 2013 and in 2011 versus 2013; however, precipitation varied by nearly 50 percent in both comparisons.

- The total population area of Monterey spineflower varied by nearly 25 percent in the reference area in 2013 versus 2015, although precipitation varied only by approximately 1 percent.

Similar patterns are shown in the April to March precipitation measurements. As with sand gilia, these results illustrate the range of variability in plant populations under natural conditions unaffected by remediation activities.

A total of 28 populations (13 points and 15 polygons) of Monterey spineflower were mapped at the reference site, at 4 of the 7 well sites within the FONR, and the area within or along the former GWETS fence line. There were areas within the reference plot and within/along the former GWETS fence line where both Monterey spineflower and sand gilia were observed and in other cases only one or the other was present (see Appendix A, Figures A3.5 and A3.6). Because Monterey spineflower population size estimates are not as easily quantified as the sand gilia populations, individual Monterey spineflower plants were not counted within the GIS polygons. Populations of Monterey spineflower were estimated as a percentage of the overall ground cover using visual estimation (see Section 2.1). Of the 15 populations of Monterey spineflower that were mapped as polygons, three populations were identified as Medium Low (26 to 50 percent cover) and 12 populations were identified as Sparse (3 to 25 percent cover). The survey results for each area are further detailed in the subsections below.

### 3.2.1 Reference Area

Table 3.1 summarizes the reference area survey results for Monterey spineflower. The reference area has shown relatively few populations of Monterey spineflower and the population densities have primarily been Sparse. In 2014, the areal extent was the lowest over the 2010-2017 period, and this coincides with the lowest precipitation from October to March (7.38 inches) and from April to March (8.02 inches). In 2015, the first Monterey spineflower population with Medium density was observed. In 2016, the Medium density population was again observed, and the total area of Monterey spineflower (3,241 square feet) was the largest area observed since reference surveys began in 2010. In 2017, a large polygon population of Monterey spineflower was again observed in the reference area, but the population density was classified as medium-low. The total area of Monterey spineflower observed in the reference area in 2017 decreased by approximately 10 percent to 2,855 square feet. The trend of increasing areal extent of plant populations from 2014 to 2016 and the decrease in the area extent of plant populations from 2016 to 2017 was also observed in the areal extent of plant populations found in surveying the wells destroyed in 2014 and the GWETS area.

### 3.2.2 FONR Well Locations

As shown in Table 3.2B, Monterey spineflower was found at 4 of the 7 well locations (MW-OU1-22-A, MW-OU1-25-A, MW-OU1-40-A and PZ-OU1-46-AD2) in 2017. Well locations PZ-OU1-46-AD2, MW-OU1-46-A, and MW-OU1-46-AD are considered a single location. These three wells have been included in 16 surveys from 1998 through 2017; Monterey spineflower was observed in 8 of the 13 surveys performed since these wells were installed. Monterey spineflower observations during all surveys from 1998 through 2017 at the other 6 well locations surveyed in 2017 are summarized below and presented in detail in Table 3.2B:

- MW-OU1-22-A. Monterey spineflower was observed in 6 of the 7 annual surveys conducted from 1998 through 2004 (absent in 1998), but was not observed during 5 surveys at this location between 2005 and 2016. Monterey spineflower was again observed at this well location in 2017.
- MW-OU1-23-A. Monterey spineflower was observed only in the 1998 rare plant survey, but not in the subsequent 10 surveys conducted between 1999 and 2017.
- MW-OU1-24-AR. Monterey spineflower was observed in 4 (1998 through 2000 and in 2006) of the 13 rare plant surveys conducted between 1998 and 2017.
- MW-OU1-25-A. Monterey spineflower was observed in 3 (1998 through 2000) of the 10 rare plant surveys conducted between 1998 and 2016. Monterey spineflower was again observed at this well location in 2017.
- MW-OU1-40-A. Monterey spineflower was observed in 5 of the 6 surveys conducted from 1998 through 2003, but was not observed during 4 subsequent surveys at this location between 2004 and 2015. Monterey spineflower was observed at this location in both 2016 and 2017.
- MW-OU1-51-A. This location was included in 12 separate surveys, but Monterey spineflower was detected only in the 1999 survey.

The field team also observed Monterey spineflower along access roads at distances greater than 30 feet from a given well. All survey results are summarized in Table 3.2B and presented in detail in Appendix A.

### 3.2.3 Former GWETS Fence Line

The rare plant survey history for the fence removed in 2014 was described in Section 3.1.3. The 2017 survey results showed 4 Monterey spineflower polygons (3 Sparse and 1 Medium Low densities) and a total of 8 individual plants at 5 locations within the fenced area. The survey results are shown on Appendix A, Figure A.5.

Monterey spineflower was observed in the 1998 baseline along part of the eastern fence line and at a small area north of the fence (Figure 4.3). A larger Monterey spineflower population was also found at the northern location in the 2004 baseline survey, but the eastern area was not surveyed. Monterey spineflower populations were observed along portions of the fence line in 13 of the 17 rare plant surveys performed in the area since 1998.

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# TABLE(S)

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# Table 3.1
# Rare Plant Survey Results for Reference Plot - 2010 through 2017

| Sand Gilia | | | | | | |
|---|---|---|---|---|---|---|
| **Year Surveyed** | **Number of Point Populations** | **Number of Individuals at Point Populations** | **Number of Polygon Populations** | **Number of Individuals at Polygon Populations** | **Total Number of Individuals** | **Area of Polygons (square feet)** |
| 2010 | 7 | 18 | 7 | 1,068 | 1086 | 1,715 |
| 2011 | 12 | 40 | 4 | 278 | 318 | 1,410 |
| 2012 | 12 | 21 | 4 | 49 | 70 | 210 |
| 2013 | 7 | 17 | 13 | 719 | 736 | 1,281 |
| 2014 | 2 | 5 | 2 | 92 | 97 | 370 |
| 2015 | 4 | 8 | 7 | 1,070 | 1078 | 1,512 |
| 2016 | 3 | 3 | 3 | 943 | 946 | 1,498 |
| 2017 | 6 | 10 | 2 | 453 | 463 | 1,950 |

| Monterey Spineflower | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| **Year Surveyed** | **Number of Populations with < 5 Individual Plants** | **Total Number of Individual Plants** | **Number of Populations with > 5 Individual Plants** | **Plant Cover Density Summary for Areas With > 5 Individual Plants** | | | | | **Area of Polygons (square feet)** |
| | | | | **Sparse** | **Medium-Low** | **Medium** | **Medium-High** | **Very High** | |
| 2010 | 0 | 0 | 2 | 1 | 1 | 0 | 0 | 0 | 2,846 |
| 2011 | 1 | 4 | 1 | 0 | 1 | 0 | 0 | 0 | 2,865 |
| 2012 | 1 | 4 | 2 | 2 | 0 | 0 | 0 | 0 | 1,494 |
| 2013 | 0 | 0 | 7 | 6 | 1 | 0 | 0 | 0 | 2,813 |
| 2014 | 1 | 4 | 6 | 6 | 0 | 0 | 0 | 0 | 1,119 |
| 2015 | 1 | 3 | 3 | 1 | 1 | 1 | 0 | 0 | 2,114 |
| 2016 | 0 | 0 | 2 | 0 | 1 | 1 | 0 | 0 | 3,241 |
| 2017 | 0 | 0 | 4 | 3 | 1 | 0 | 0 | 0 | 2,855 |

Monterey Spineflower Plant Cover Density Categories Based on Percentage of Plant Cover of Total Ground Area

Very Sparse (less than 3 percent)
Sparse (3 to 25 percent)
Medium Low (26 to 50 percent)
Medium (51 to 76 percent)
Medium High (76 to 97 percent)
Very High (greater than 97 percent)

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**Table 3.2A**
**Sand Gilia Survey Results Relative to OU-1 Well Locations - 2014 Well Destruction Locations**

| Well Identification | Year Installed | Appendix A Figure # | 1998 | Harding Lawson Associates Surveys | | | | | HydroGeoLogic, Inc. Surveys | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | 1999 | 2000 | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 |
| **Wells Installed Before 1998** | | | | | | | | | | | | | | | | | | | | | | |
| MW-OU1-22-A** | 1997 | A3.4 | N | N | N | N | N | N | N | N | N | N | -- | -- | -- | -- | -- | -- | -- | N | N | N |
| MW-OU1-23-A** | 1997 | A3.4 | N | N | N | N | N | N | N | -- | -- | -- | -- | -- | -- | -- | N | -- | -- | N | N | N |
| MW-OU1-24-AR[(2)]** | 2003 | A3.3 | N | N | N | N | N | N | N | N | N | N | -- | -- | -- | -- | -- | -- | -- | N | N | N |
| **Wells Installed from 1998 - 2001** | | | | | | | | | | | | | | | | | | | | | | |
| MW-OU1-25-A** | 1998 | A3.3 | N | N | N | N | N | N | N | -- | -- | -- | -- | -- | -- | -- | N | -- | -- | N | N | N |
| MW-OU1-40-A** | 1999 | A3.4 | N | N | N | SG | N | N | N | N | -- | -- | -- | -- | -- | -- | N | -- | -- | N | N | N |
| **Wells Installed in 2004 After the Rare Plant Survey** | | | | | | | | | | | | | | | | | | | | | | |
| MW-OU1-51-A** | 2004 | A3.2 | N | N | N | -- | -- | -- | N | N | N | N | N | -- | -- | -- | -- | -- | -- | N | N | N |
| **Wells Installed in 2005 After the Rare Plant Survey** | | | | | | | | | | | | | | | | | | | | | | |
| PZ-OU1-46-AD2[(1)]** | 2005 | A3.2 | N | N | N | N | N | N | N | N | N | N | N | N | N | -- | -- | -- | -- | N | N | N |
| **Fence Installed Around Original Groundwater Extraction and Treatment System (GWETS)** | | | | | | | | | | | | | | | | | | | | | | |
| GWETS Fence[(3)] | 1988 | A3.5 | SG | N | SG | SG | SG | SG | SG#82[100]; SG#259[50]; SG#80[80]; | N | N | SG#23[50] | -- | -- | -- | -- | N | N | N | SG#1[2]; SG#2[1]; SG#7[18]; SG#8[295] | SG#1[3]; SG#2[2]; SG#3[4]; SG#20[105]; SG#21[20]; SG#22[10] | SG#8[1]; SG#9[4]; SG#10[5]; SG#26[13]; SG#27[14] |

(1) MW-OU1-46-A, MW-OU1-46-AD, and PZ-OU1-46-AD2 considered to be one location; the results shown are for detections at any or all of these three wells
(2) MW-OU1-24AR replaced MW-OU1-24-A, so they're considered to be one location
(3) Survey included approximately only the northern half of the fence perimeter in 2004 through 2014

**Notes:**
No new wells have been installed since 2006.
**This well was abandoned in 2014.
-- not surveyed
FONR - Fort Ord Natural Reserve
GWETS - Groundwater Extraction and Treatment System
ID - identification
OU1 - operable unit 1
PZ - piezometer
MW - monitoring well
SG - Sand gilia (population ID and number of plants is not available for surveys conducted prior to 2004)
SG#26[13] - population ID # [number of plants]
N - area was surveyed; but no rare plants were detected.

**Table 3.2B**
**Monterey Spineflower Survey Results Relative to OU-1 Well Locations - 2014 Well Destruction Locations**

| Well Identification | Year Installed | Appendix A Figure # | 1998 | Harding Lawson Associates Surveys | | | | | HydroGeoLogic, Inc. Surveys | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | 1999 | 2000 | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 |
| **Wells Installed Before 1998** | | | | | | | | | | | | | | | | | | | | | | |
| MW-OU1-22-A** | 1997 | A3.4 | N | MS | MS | MS | MS | MS | MS#90[1000]; extends far beyond well | N | N | N | -- | -- | -- | -- | -- | -- | -- | N | N | MS#11[2], MS#35[ML] |
| MW-OU1-23-A** | 1997 | A3.4 | MS | N | N | N | N | N | N | -- | -- | -- | -- | -- | -- | -- | N | -- | -- | N | N | N |
| MW-OU1-24-AR[2]** | 2003 | A3.3 | MS | MS | MS | N | N | N | N | N | MS#59[VS] | N | -- | -- | -- | -- | -- | -- | -- | N | N | N |
| **Wells Installed from 1998 - 2001** | | | | | | | | | | | | | | | | | | | | | | |
| MW-OU1-25-A** | 1998 | A3.3 | MS | MS | MS | N | N | N | N | -- | -- | -- | -- | -- | -- | -- | N | -- | -- | N | N | MS#37[S] |
| MW-OU1-40-A** | 1999 | A3.4 | MS | MS | MS | N | MS | MS | N | N | -- | -- | -- | -- | -- | -- | N | -- | -- | N | MS#11[1]; MS#12[2] | MS#12[4], MS#36[S] |
| **Wells Installed in 2004 After the Rare Plant Survey** | | | | | | | | | | | | | | | | | | | | | | |
| MW-OU1-51-A** | 2004 | A3.2 | N | MS | N | -- | -- | -- | N | N | N | N | N | N | -- | -- | -- | -- | -- | N | N | N |
| **Wells Installed in 2005 After the Rare Plant Survey** | | | | | | | | | | | | | | | | | | | | | | |
| PZ-OU1-46-AD2[1]** | 2005 | A3.2 | MS | MS | N | N | MS | MS | N | N | N | N | MS#4[1] | -- | -- | -- | -- | -- | -- | MS#36[S] | MS#32[ML] | MS#42[S] |
| **Fence Installed Around Original Groundwater Extraction and Treatment System (GWETS)** | | | | | | | | | | | | | | | | | | | | | | |
| GWETS Fence[3] | 1988 | A3.5 | MS | MS | MS | N | N | MS | MS#006[100] | MS#213[VS] | N | MS#45[VS] | -- | -- | -- | -- | MS#84[S]; MS#103[ML]; MS#43[3] | MS#123[S] | MS#48[2]; MS#49[3] | MS#19[4]; MS#20[1]; MS#21[4]; MS#32[S]; MS#33[S]; MS#34[ML]; MS#35[ML] | MS#15[1]; MS#16[1]; MS#19[3]; MS#27[S]; MS#30[S]; MS#35[ML] | MS#19[1]; MS#20[1]; MS#21[3]; MS#22[1]; MS#23[2]; MS#38[S]; MS#39[S]; MS#40[S]; MS#41[ML] |

(1) MW-OU1-46-A, MW-OU1-46-AD, and PZ-OU1-46-AD2 considered to be one location; the results shown are for detections at any or all of these three wells
(2) MW-OU1-24AR replaced MW-OU1-24-A, so they're considered to be one location
(3) Survey included approximately only the northern half of the fence perimeter in 2004 through 2014

**Notes:**
No new wells have been installed since 2006.
**This well was abandoned in 2014.
-- not surveyed
FONR - Fort Ord Natural Reserve
GWETS - Groundwater Extraction and Treatment System
ID - identification
MS - Monterey spineflower (population ID and number of plants is not available for surveys conducted prior to 2004)
MS#49[VS] - population ID # [density category or number of plants]
MW - monitoring well
N - area was surveyed; but no rare plants were detected.
OU1 - operable unit 1
PZ - piezometer
MD - medium high
ML - medium low
S - sparse
VS - very sparse

**Table 3.3A**
**Sand Gilia Survey Results Relative to OU-1 Well Locations - 2017 Well Destruction Locations**

| Well Identification | Year Installed | Appendix A Figure # | 1998 | Harding Lawson Associates Surveys | | | | | HydroGeoLogic, Inc. Surveys | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | 1999 | 2000 | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 |
| **Wells Installed from 1998 - 2001** | | | | | | | | | | | | | | | | | | | | | | |
| MW-OU1-26-A | 1998 | NA | N | -- | -- | -- | -- | -- | N | -- | N | N | -- | -- | -- | -- | -- | -- | -- | -- | -- | N |
| MW-OU1-46-A[1] | 2001 | A3.2 | N | N | N | N | N | N | N | N | N | N | N | N | N | -- | -- | -- | -- | N | N | N |
| **Wells Installed in 2004 After the Rare Plant Survey** | | | | | | | | | | | | | | | | | | | | | | |
| MW-OU1-46-AD[1] | 2004 | A3.2 | N | N | N | N | N | N | N | N | N | N | N | N | -- | -- | -- | -- | -- | N | N | N |
| EW-OU1-49-A[2] | 2004 | NA | N | -- | -- | -- | -- | -- | N | N | N | N | -- | -- | -- | -- | -- | -- | -- | -- | -- | N |
| PZ-OU1-49-A1[2] | 2004 | NA | N | -- | -- | -- | -- | -- | N | N | N | N | -- | -- | -- | -- | -- | -- | -- | -- | -- | N |
| EW-OU1-52-A | 2004 | NA | N | -- | -- | -- | -- | -- | N | N | N | N | -- | -- | -- | -- | -- | -- | -- | -- | -- | N |
| EW-OU1-53-A | 2004 | NA | N | -- | -- | -- | -- | -- | N | N | SG#21-#25 & 30 | SG#24[16] | -- | -- | -- | -- | -- | -- | -- | -- | -- | N |
| IW-OU1-02-A | 2004 | NA | N | -- | -- | -- | -- | -- | N | -- | N | N | -- | -- | -- | -- | -- | -- | -- | -- | -- | N |
| PZ-OU1-02-A1 | 2004 | NA | N | -- | -- | -- | -- | -- | N | -- | N | N | -- | -- | -- | -- | -- | -- | -- | -- | -- | N |
| IW-OU1-10-A[3] | 2004 | NA | N | -- | -- | -- | -- | -- | N | -- | N | N | -- | -- | -- | -- | N | -- | -- | -- | -- | N |
| **Wells Installed in 2004 in Area Not Surveyed** | | | | | | | | | | | | | | | | | | | | | | |
| MW-OU1-50-A | 2004 | NA | N | -- | -- | -- | -- | -- | -- | N | N | N | N | N | -- | -- | -- | -- | -- | -- | -- | N |
| MW-OU1-57-A | 2004 | NA | N | -- | -- | -- | -- | -- | -- | N | N | N | -- | -- | -- | -- | -- | -- | -- | -- | -- | N |
| MW-OU1-58-A | 2004 | NA | N | -- | -- | -- | -- | -- | -- | N | N | N | -- | -- | -- | -- | -- | -- | -- | -- | -- | N |
| MW-OU1-59-A | 2004 | NA | N | -- | -- | -- | -- | -- | -- | N | SG#26[13] | N | -- | -- | -- | -- | -- | -- | -- | -- | -- | N |
| **Wells Installed in 2005 After the Rare Plant Survey** | | | | | | | | | | | | | | | | | | | | | | |
| PZ-OU1-10-A1[3] | 2006 | NA | N | -- | -- | -- | -- | -- | N | -- | N | N | -- | -- | -- | -- | -- | -- | -- | -- | -- | N |
| **HCPP Wells Installed Along Northwest Boundary Road in 2006 Before the Rare Plant Survey** | | | | | | | | | | | | | | | | | | | | | | |
| EW-OU1-60-A | 2006 | NA | N | -- | -- | -- | -- | -- | -- | N | N | N | N | -- | -- | -- | -- | -- | -- | -- | -- | N |
| EW-OU1-62-A | 2006 | NA | N | -- | -- | -- | -- | -- | -- | N | N | N | -- | -- | -- | -- | -- | -- | -- | -- | -- | N |
| EW-OU1-63-A | 2006 | NA | N | -- | -- | -- | -- | -- | -- | N | N | N | -- | -- | -- | -- | -- | -- | -- | -- | -- | N |
| EW-OU1-66-A | 2006 | NA | N | -- | -- | -- | -- | -- | -- | N | N | N | -- | -- | -- | -- | -- | -- | -- | -- | -- | N |
| MW-OU1-61-A | 2006 | NA | N | -- | -- | -- | -- | -- | -- | N | N | N | N | -- | -- | -- | -- | -- | -- | -- | -- | N |
| MW-OU1-67-A | 2006 | NA | N | -- | -- | -- | -- | -- | -- | N | N | N | -- | -- | -- | -- | -- | -- | -- | -- | -- | N |
| MW-OU1-68-A | 2006 | NA | N | -- | -- | -- | -- | -- | -- | N | N | N | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| **Wells Installed in 2006 After the Rare Plant Survey** | | | | | | | | | | | | | | | | | | | | | | |
| EW-OU1-71-A | 2006 | NA | N | -- | -- | -- | -- | -- | N | -- | N | N | N | N | -- | -- | -- | -- | -- | -- | -- | N |
| EW-OU1-72-A | 2006 | NA | N | -- | -- | -- | -- | -- | N | N | N | N | N | N | -- | -- | -- | -- | -- | -- | -- | N |
| IW-OU1-73-A | 2006 | NA | N | -- | -- | -- | -- | -- | -- | N | N | N | N | N | -- | -- | -- | -- | -- | -- | -- | N |
| IW-OU1-74-A | 2006 | NA | N | -- | -- | -- | -- | -- | -- | N | N | N | N | N | -- | -- | -- | -- | -- | -- | -- | N |
| MW-OU1-82-A | 2006 | NA | N | -- | -- | -- | -- | -- | -- | N | N | N | N | N | -- | -- | -- | -- | -- | -- | -- | N |
| MW-OU1-83-A | 2006 | NA | N | -- | -- | -- | -- | -- | N | N | N | N | N | N | -- | -- | -- | -- | -- | -- | -- | N |
| MW-OU1-84-A | 2006 | A3.2 | N | N | N | N | N | N | -- | N | N | N | N | N | -- | -- | -- | -- | -- | -- | N | N |
| MW-OU1-85-A | 2006 | NA | N | -- | -- | -- | -- | -- | N | N | N | N | N | N | -- | -- | -- | -- | -- | -- | -- | N |
| MW-OU1-86-A | 2006 | NA | N | -- | -- | -- | -- | -- | N | -- | N | N | N | N | -- | -- | -- | -- | -- | -- | -- | N |
| MW-OU1-87-A | 2006 | NA | N | -- | -- | -- | -- | -- | N | N | N | N | N | N | -- | -- | -- | -- | -- | -- | -- | N |
| MW-OU1-88-A | 2006 | NA | N | -- | -- | -- | -- | -- | N | -- | N | N | N | N | -- | -- | -- | -- | -- | -- | -- | N |

(1) MW-OU1-46-A, MW-OU1-46-AD, and PZ-OU1-46-AD2 considered to be one location
(2) EW-OU1-49-A and PZ-OU1-49-A1 considered to be one location
(3) IW-OU1-10-A and PZ-OU1-10-A1 considered to be one location

**Notes:**
No new wells have been installed since 2006.
-- not surveyed
EW - extraction well
FONR - Fort Ord Natural Reserve
HCCP - Hydraulic Control Pilot Project
ID - identification
IW - injection well
MW - monitoring well
N - area was surveyed; but no rare plants were detected.
OU1 - operable unit 1
PZ - piezometer
SG - Sand gilia (population ID and number of plants is not available for surveys conducted prior to 2004)
SG#26[13] - population ID # [number of plants]

**Table 3.3B**
**Monterey Spineflower Survey Results Relative to OU-1 Well Locations - 2017 Well Destruction Locations**

| Well Identification | Year Installed | Appendix A Figure # | 1998 | Harding Lawson Associates Surveys | | | | | Remarks Regarding Results for Given Year | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | 1999 | 2000 | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 |
| **Wells Installed from 1998 - 2001** | | | | | | | | | | | | | | | | | | | | | | |
| MW-OU1-26-A | 1998 | NA | N | -- | -- | -- | -- | -- | N | -- | N | N | -- | -- | -- | -- | -- | -- | -- | -- | -- | N |
| MW-OU1-46-A[(1)] | 2001 | A3.2 | MS | MS | N | N | MS | MS | N | N | N | N | MS#34[VS] | MS#27[M] | -- | -- | -- | -- | -- | MS#36[S] | MS#32[ML] | MS#30[S] |
| **Wells Installed in 2004 After the Rare Plant Survey** | | | | | | | | | | | | | | | | | | | | | | |
| MW-OU1-46-AD[(1)] | 2004 | A3.2 | MS | MS | N | N | MS | MS | N | N | N | N | MS#34[VS] | MS#27[M] | -- | -- | -- | -- | -- | MS#36[S] | MS#32[ML] | MS#30[S] |
| EW-OU1-49-A[(2)] | 2004 | NA | MS | -- | -- | -- | -- | -- | N | N | N | N | -- | -- | -- | -- | -- | -- | -- | -- | -- | N |
| PZ-OU1-49-A1[(2)] | 2004 | NA | MS | -- | -- | -- | -- | -- | N | N | N | N | -- | -- | -- | -- | -- | -- | -- | -- | -- | N |
| EW-OU1-52-A | 2004 | NA | N | -- | -- | -- | -- | -- | N | N | N | N | -- | -- | -- | -- | -- | -- | -- | -- | -- | N |
| EW-OU1-53-A | 2004 | NA | MS | -- | -- | -- | -- | -- | N | N | MS#92[S] | MS#52[VS]; MS#53 [VS] | -- | -- | -- | -- | -- | -- | -- | -- | -- | MS#20[ML] |
| IW-OU1-02-A | 2004 | NA | N | -- | -- | -- | -- | -- | N | -- | N | N | -- | -- | -- | -- | -- | -- | -- | -- | -- | N |
| PZ-OU1-02-A1 | 2004 | NA | N | -- | -- | -- | -- | -- | N | -- | N | N | -- | -- | -- | -- | -- | -- | -- | -- | -- | N |
| IW-OU1-10-A[(3)] | 2004 | NA | N | -- | -- | -- | -- | -- | N | -- | N | N | -- | -- | -- | -- | -- | -- | -- | -- | -- | N |
| **Wells Installed in 2004 in Area Not Surveyed** | | | | | | | | | | | | | | | | | | | | | | |
| MW-OU1-50-A | 2004 | NA | MS | -- | -- | -- | -- | -- | -- | MS#21[MD] | N | MS#61[ML] | MS#49[ML]; and MS#50[S] | MS#36[S]; MS#4[2]; MS#5[2] | -- | -- | -- | -- | -- | -- | -- | MS#21[ML] |
| MW-OU1-57-A | 2004 | NA | MS | -- | -- | -- | -- | -- | -- | N | N | N | -- | -- | -- | -- | -- | -- | -- | -- | -- | MS#21[ML] |
| MW-OU1-58-A | 2004 | NA | N | -- | -- | -- | -- | -- | -- | N | N | N | -- | -- | -- | -- | -- | -- | -- | -- | -- | MS#21[ML], MS#27[S] |
| MW-OU1-59-A | 2004 | NA | N | -- | -- | -- | -- | -- | -- | MS#153[2] | N | N | -- | -- | -- | -- | -- | -- | -- | -- | -- | MS#22[ML] |
| **Wells Installed in 2005 After the Rare Plant Survey** | | | | | | | | | | | | | | | | | | | | | | |
| PZ-OU1-10-A1[(3)] | 2005 | NA | N | -- | -- | -- | -- | -- | N | -- | N | N | -- | -- | -- | -- | -- | -- | -- | -- | -- | N |
| **HCPP Wells Installed Along Northwest Boundary Road in 2006 Before the Rare Plant Survey** | | | | | | | | | | | | | | | | | | | | | | |
| EW-OU1-60-A | 2006 | NA | MS | -- | -- | -- | -- | -- | -- | N | N | N | N | -- | -- | -- | -- | -- | -- | -- | -- | MS#10[2], MS#11[3], MS#21[ML] |
| EW-OU1-62-A | 2006 | NA | N | -- | -- | -- | -- | -- | -- | N | N | N | -- | -- | -- | -- | -- | -- | -- | -- | -- | N |
| EW-OU1-63-A | 2006 | NA | N | -- | -- | -- | -- | -- | -- | N | N | N | -- | -- | -- | -- | -- | -- | -- | -- | -- | MS#21[ML] |
| EW-OU1-66-A | 2006 | NA | MS | -- | -- | -- | -- | -- | -- | N | N | N | -- | -- | -- | -- | -- | -- | -- | -- | -- | MS#21[ML], MS#27[S], MS#28[S], MS#29[S] |
| MW-OU1-61-A | 2006 | NA | MS | -- | -- | -- | -- | -- | -- | N | N | N | N | -- | -- | -- | -- | -- | -- | -- | -- | MS#10[2], MS#11[3], MS#21[ML], MS#29[S] |
| MW-OU1-67-A | 2006 | NA | N | -- | -- | -- | -- | -- | -- | N | N | N | -- | -- | -- | -- | -- | -- | -- | -- | -- | MS#27[S] |
| MW-OU1-68-A | 2006 | NA | N | -- | -- | -- | -- | -- | -- | N | N | N | -- | -- | -- | -- | -- | -- | -- | -- | -- | N |

**Table 3.3B**
**Monterey Spineflower Survey Results Relative to OU-1 Well Locations - 2017 Well Destruction Locations**

| Well Identification | Year Installed | Appendix A Figure # | 1998 | Harding Lawson Associates Surveys | | | | | Remarks Regarding Results for Given Year | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | 1999 | 2000 | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 |
| **Wells Installed in 2006 After the Rare Plant Survey** | | | | | | | | | | | | | | | | | | | | | | |
| EW-OU1-71-A | 2006 | NA | N | -- | -- | -- | -- | -- | N | -- | N | N | MS#42[S] | N | -- | -- | -- | -- | -- | -- | -- | N |
| EW-OU1-72-A | 2006 | NA | N | -- | -- | -- | -- | -- | N | N | N | N | N | N | -- | -- | -- | -- | -- | -- | -- | N |
| IW-OU1-73-A | 2006 | NA | N | -- | -- | -- | -- | -- | -- | N | N | N | N | N | -- | -- | -- | -- | -- | -- | -- | N |
| IW-OU1-74-A | 2006 | NA | N | -- | -- | -- | -- | -- | -- | N | N | MS#60[VS] | MS#39[S] | MS#41[S]; MS#33[ML] | -- | -- | -- | -- | -- | -- | -- | MS#19[S] |
| MW-OU1-82-A | 2006 | NA | N | -- | -- | -- | -- | -- | -- | N | N | N | MS#51[ML] | MS#10[2] | -- | -- | -- | -- | -- | -- | -- | MS#12[1], MS#24[S], MS#25[S], MS#26[ML] |
| MW-OU1-83-A | 2006 | NA | N | -- | -- | -- | -- | -- | N | N | N | N | MS#26[1]; and MS#46[S] adjacent | MS#23[2]; MS#24[2]; MS#25[1] | -- | -- | -- | -- | -- | -- | -- | MS#31[M] |
| MW-OU1-84-A | 2006 | A3.2 | N | MS | N | N | N | N | -- | N | N | MS#58 across the road | MS#37[ML]; and MS#36[ML] across road | MS#28[M]; MS#15[3] | -- | -- | -- | -- | -- | -- | MS#37[ML]; MS#38[S] | N |
| MW-OU1-85-A | 2006 | NA | N | -- | -- | -- | -- | -- | N | N | N | N | N | N | -- | -- | -- | -- | -- | -- | -- | MS#7[1], MS#8[1] |
| MW-OU1-86-A | 2006 | NA | N | -- | -- | -- | -- | -- | N | -- | N | N | N | N | -- | -- | -- | -- | -- | -- | -- | N |
| MW-OU1-87-A | 2006 | NA | N | -- | -- | -- | -- | -- | N | N | N | N | N | N | -- | -- | -- | -- | -- | -- | -- | N |
| MW-OU1-88-A | 2006 | NA | N | -- | -- | -- | -- | -- | N | -- | N | N | N | N | -- | -- | -- | -- | -- | -- | -- | MS#9[2] |

(1) MW-OU1-46-A, MW-OU1-46-AD, and PZ-OU1-46-AD2 considered to be one location
(2) EW-OU1-49-A and PZ-OU1-49-A1 considered to be one location
(3) IW-OU1-10-A and PZ-OU1-10-A1 considered to be one location

**Notes:**
No new wells have been installed since 2006.
-- not surveyed
EW - extraction well
FONR - Fort Ord Natural Reserve
HCCP - Hydraulic Control Pilot Project
ID - identification
IW - injection well
MD - medium high
ML - medium low
MS - Monterey spineflower (population ID and number of plants is not available for surveys conducted prior to 2004)
MS#49[VS] - population ID # [density category or number of plants]
MW - monitoring well
N - area was surveyed; but no rare plants were detected.
OU1 - operable unit 1
PZ - piezometer
VS - very sparse

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# Table 3.4
# Fort Ord Precipitation Data - 1998-2017

| Year | Precipitation (inches) | | |
|---|---|---|---|
| | **October - March** | **October - May** | **April - March** |
| 1998 | 28.36 | 31.20 | 28.69 |
| 1999 | 11.28 | 12.55 | 14.26 |
| 2000 | 13.07 | 13.67 | 14.53 |
| 2001 | 9.05 | 10.23 | 9.75 |
| 2002 | 6.52 | 6.96 | 7.79 |
| 2003 | 5.88 | 7.44 | 6.36 |
| 2004 | 10.32 | 10.42 | 11.90 |
| 2005 | 21.73 | 23.81 | 21.90 |
| 2006 | 13.89 | 17.27 | 16.34 |
| 2007 | 7.88 | 9.05 | 11.28 |
| 2008 | 9.71 | 9.91 | 11.35 |
| 2009 | 11.89 | 12.32 | 12.16 |
| 2010 | 16.85 | 19.78 | 17.70 |
| 2011 | 17.29 | 18.43 | 20.39 |
| 2012 | 8.44 | 10.70 | 10.25 |
| 2013 | 8.78 | 9.01 | 11.12 |
| 2014 | 7.38 | 8.42 | 8.02 |
| 2015 | 8.68 | 9.69 | 9.92 |
| 2016 | 18.98 | 19.67 | 20.23 |
| 2017 | 24.96 | 26.75 | 25.81 |
| **Average** | **13.05** | **14.36** | **14.49** |

**Notes:**
Precipitation information obtained from
http://met.nps.edu/~ldm/renard_wx/
(Fort Ord Weather Station)
The precipitation range ends on the year listed in the corresponding row; for example: 1998 April - March value of 28.69 includes preciptation from April 1997 through March 1998

## Table 3.5
## Monterey Spineflower Populations for Reference Plot versus Precipitation

| Year Surveyed | Monterey Spineflower | | October - March | | April - March | |
|---|---|---|---|---|---|---|
| | Area of Polygons (square feet) | Variation Between Years (%) | Precipitation (inches) | Variation Between Years (%) | Precipitation (inches) | Variation Between Years (%) |
| 2010 | 2,846 | 1.2% | 16.85 | 47.9% | 17.7 | 37.2% |
| 2013 | 2,813 | | 8.78 | | 11.12 | |
| 2011 | 2,865 | 1.8% | 17.29 | 49.2% | 20.39 | 45.5% |
| 2013 | 2,813 | | 8.78 | | 11.12 | |
| 2013 | 2,813 | 24.8% | 8.78 | 1.1% | 11.12 | 10.8% |
| 2015 | 2,114 | | 8.68 | | 9.92 | |

**Table 3.6**
**Linear Correlations of Precipitation and Plant Population Areal Extent**

| Antecedent Period | Linear Correlation Coefficient | |
|---|---|---|
| | Sand Gilia Areal Extent | Monterey Spineflower Areal Extent |
| April - March | 0.73 | 0.76 |
| October - March | 0.74 | 0.72 |
| October - May | 0.71 | 0.68 |
| July - June | 0.70 | 0.68 |
| June - May | 0.69 | 0.66 |
| January - May | 0.47 | 0.45 |
| January - April | 0.46 | 0.43 |
| February - June | 0.25 | 0.19 |
| February - May | 0.25 | 0.18 |
| February - April | 0.23 | 0.16 |

**Notes:**
Red cells indicate a weaker correlation between precipitation and plant population
Green cells indicate the time period used in past reports

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# FIGURE(S)

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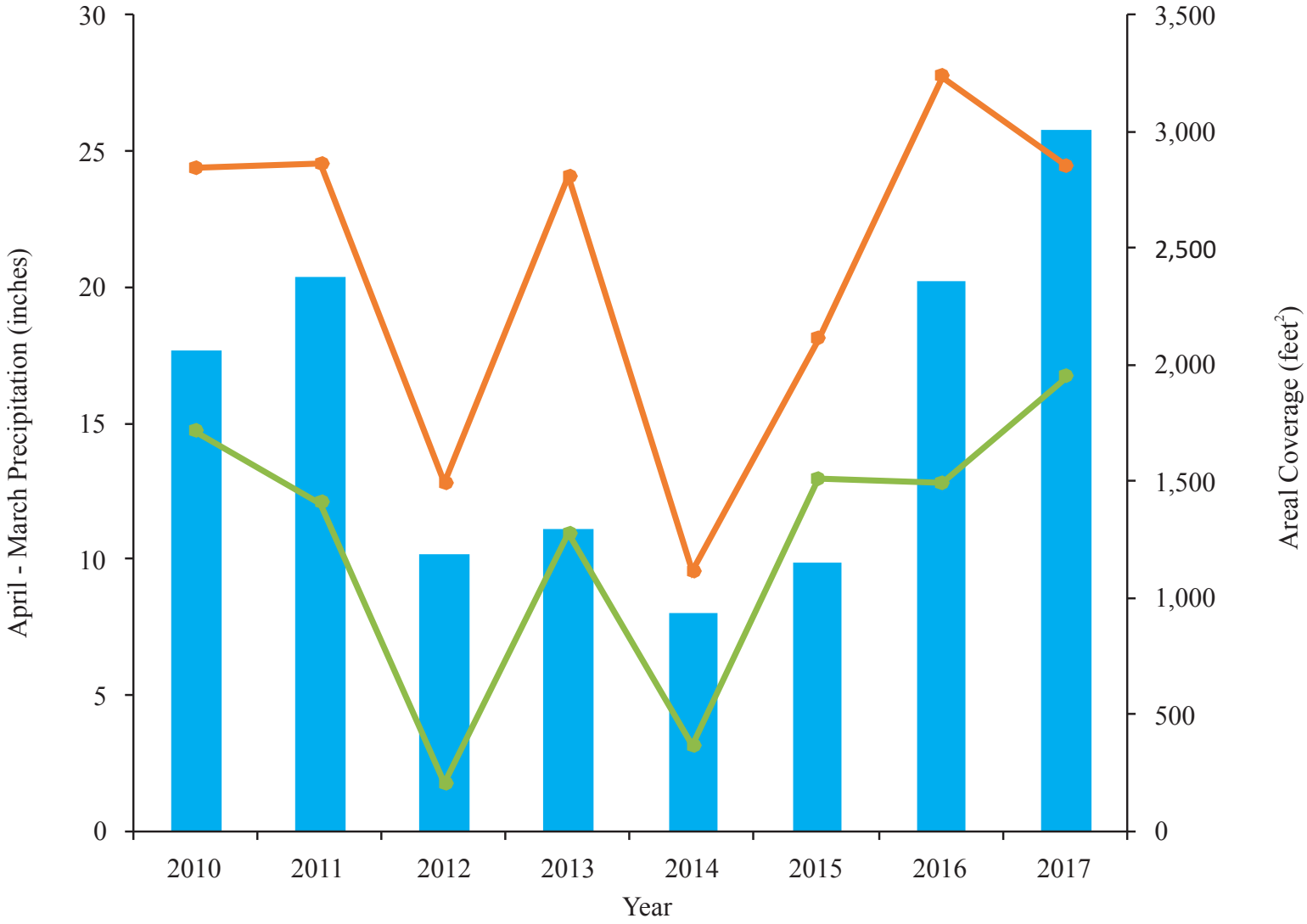


Gst-srv-01\HGLGIS\Ft_Ord_MSIW\IA_HRPSS_Report_2017\
(3-01)Areal_Coverage_Precip.cdr
12/22/17 JG
Source: HGL

**Legend**

- Sand Gilia Areal Coverage-Reference Area
- Monterey Spineflower Areal Coverage-Reference Area
- Precipitation (April - March)

**Figure 3.1**
**Reference Area Plant Population Areal Coverage vs. Precipitation Data**

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# 4.0 DISCUSSION OF 2017 RARE PLANT AND HABITAT SURVEY (YEAR 0)

This section presents the results of the 2017 rare plant and habitat survey (Year 0). Table 3.1 summarizes the survey results at the reference plot; these are the same reference plot survey results described in Section 3.0. Tables 3.3A and B summarizes the results since 1998 for all 2017 rare plant surveys conducted at the 33 well site sites. The 2017 rare plant and habitat survey (Year 0) will supplement the existing baseline surveys that will be used to evaluate the results of the three years of post-well destruction monitoring (to be performed from 2018 through 2020) at the 33 wells that were destroyed in July 2017.

Similar to Section 3.0, discussions comparing survey results assume that a plant population or polygon is attributed to a given well site if any part of the population or polygon is within the potentially disturbed area (30 feet from the well).

## 4.1 SAND GILIA

Sand gilia was observed and mapped at 8 locations (six points and two polygons, 463 total plants) within the DD&A reference site, as described in Section 3.1.1. Sand gilia was not observed along secondary access routes or at any one of the 33 well sites. The survey results for each area are further detailed in the subsections below. The full survey report is presented in Appendix B.

### 4.1.1 Reference Area

Refer to Section 3.1.1 for a detailed discussion of the reference area and the associated results. The results of the reference area survey are presented in Table 3.1.

### 4.1.2 FONR Well Locations

Sand gilia was not detected at any of the 33 well locations surveyed as part of the 2017 rare plant and habitat survey (Year 0). As shown in Table 3.3A, sand gilia has been observed at only 2 of the 33 well locations (EW-OU1-53-A in 2006 and 2007, and MW-OU1-59-A in 2006) during past surveys.

## 4.2 MONTEREY SPINEFLOWER

A total of 23 populations (6 points and 17 polygons) of Monterey spineflower were mapped at the reference site and at 17 of the 33 well sites within the FONR survey area. Because Monterey spineflower population size estimates are not as easily quantified as the sand gilia populations, individual Monterey spineflower plants were not counted within the GIS polygons. Populations of Monterey spineflower were estimated as a percentage of the overall ground cover using visual estimation (see Section 2.1). Of the 17 populations of Monterey spineflower that were mapped as polygons, one population was identified as Medium (51 to 76 percent cover), six populations were identified as Medium Low (26 to 50 percent cover) and ten populations were identified as Sparse (3 to 25 percent cover). The survey results for each area are further detailed in the subsections below. The full survey report is presented in Appendix B.

### 4.2.1 Reference Area

Refer to Section 3.2.1 for a detailed discussion of the reference area and the associated results. The results of the reference area survey are presented in Table 3.1.

### 4.2.2 FONR Well Locations

Monterey spineflower was found at 17 of the 33 well locations included in the 2017 rare plant and habitat survey (Year 0). Monterey spineflower observations during all surveys from 1998 through 2017 presented in detail in Table 3.3B. The 2017 rare plant and habitat survey (Year 0) results are presented in detail in Appendix B. As shown in Table 3.3B, of the 33 well locations:

- Monterey spineflower was not observed at 14 well locations at which Monterey spineflower has never been observed in historical surveys.
- Monterey spineflower was not observed at 2 well locations at which Monterey spineflower has been observed in historical surveys.
- Monterey spineflower was observed at 10 well locations at which Monterey spineflower has been observed in historical surveys.
- Monterey spineflower was observed at 7 well locations at which Monterey spineflower has not been observed in any historical OU-1 survey.

The field team also observed Monterey spineflower along access roads at distances greater than 30 feet from a given well.

# FIGURE(S)

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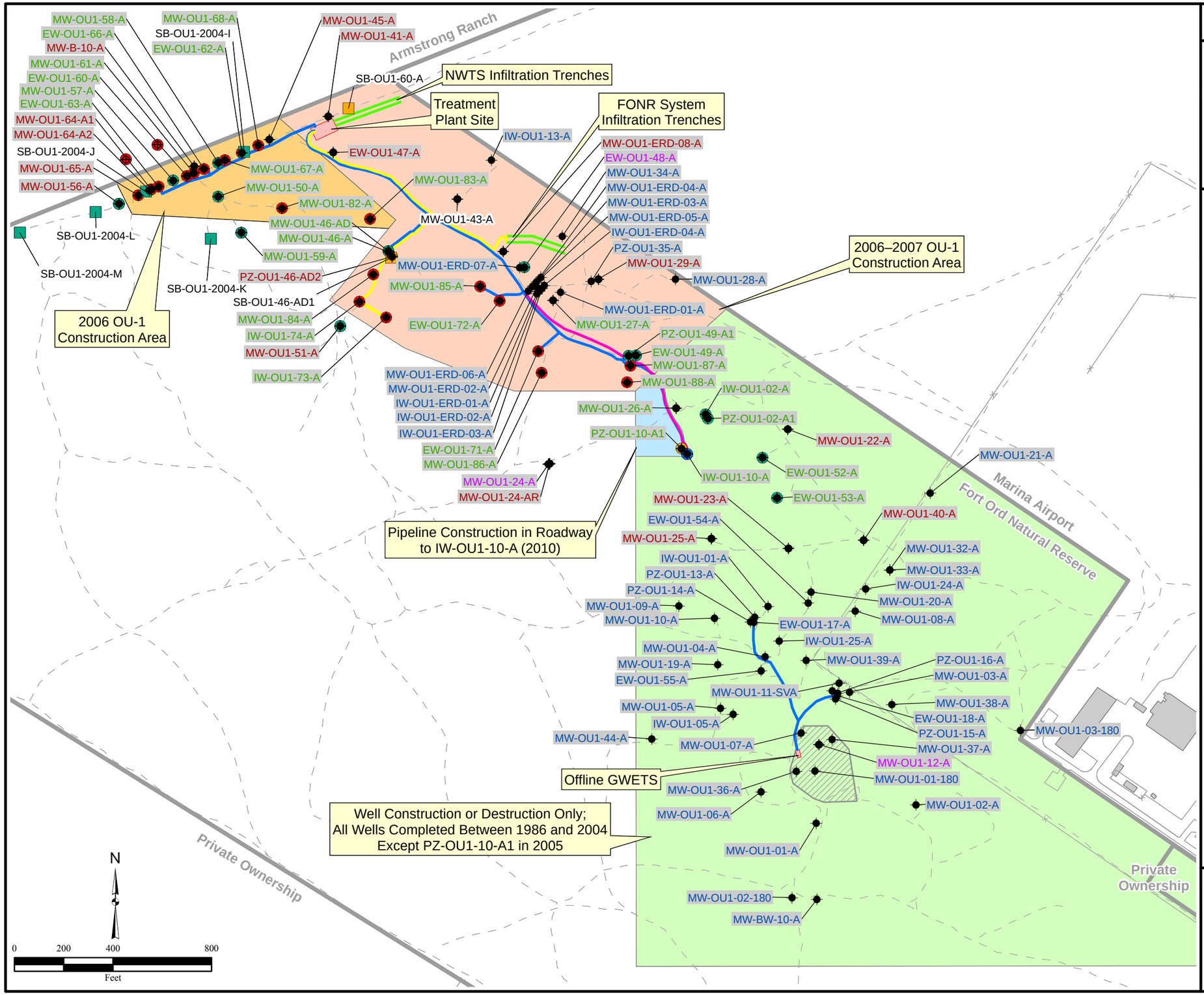
# Figure 4.1
# OU-1 Construction Activities
# 2004–2017




## Legend

- Well/Piezometer Drilled Before 2004
- Well Destroyed
- 2004 Well/Piezometer
- 2004 Soil Boring
- 2005 Well/Piezometer
- 2005 Soil Boring
- 2006 Well/Piezometer
- Existing Well Modified in 2010
- MW-OU1-86-A — Well or Boring ID
- MW-OU1-12-A — Well Destroyed Before 2006
- MW-OU1-21-A — Well Destroyed September 2011
- MW-OU1-40-A — Well Destroyed 2014
- MW-OU1-40-A — Well Destroyed 2017
- IW-OU1-10-A Pipeline Route
- Extraction Pipeline
- Infiltration Trench
- Treated Water Pipeline
- Trail/Unimproved Road
- Fence
- Property Boundary
- Treatment Plant
- Building
- Former Fire Drill Area

Notes:
The treated water and extraction water pipelines are located in separate trenches within or near the existing roadway. The separation shown in this figure is exaggerated for clarity.

FONR=Fort Ord Natural Reserve
GWETS=Groundwater Extraction and Treatment System
NWTS=Northwest Treatment System
OU-1=Operable Unit 1

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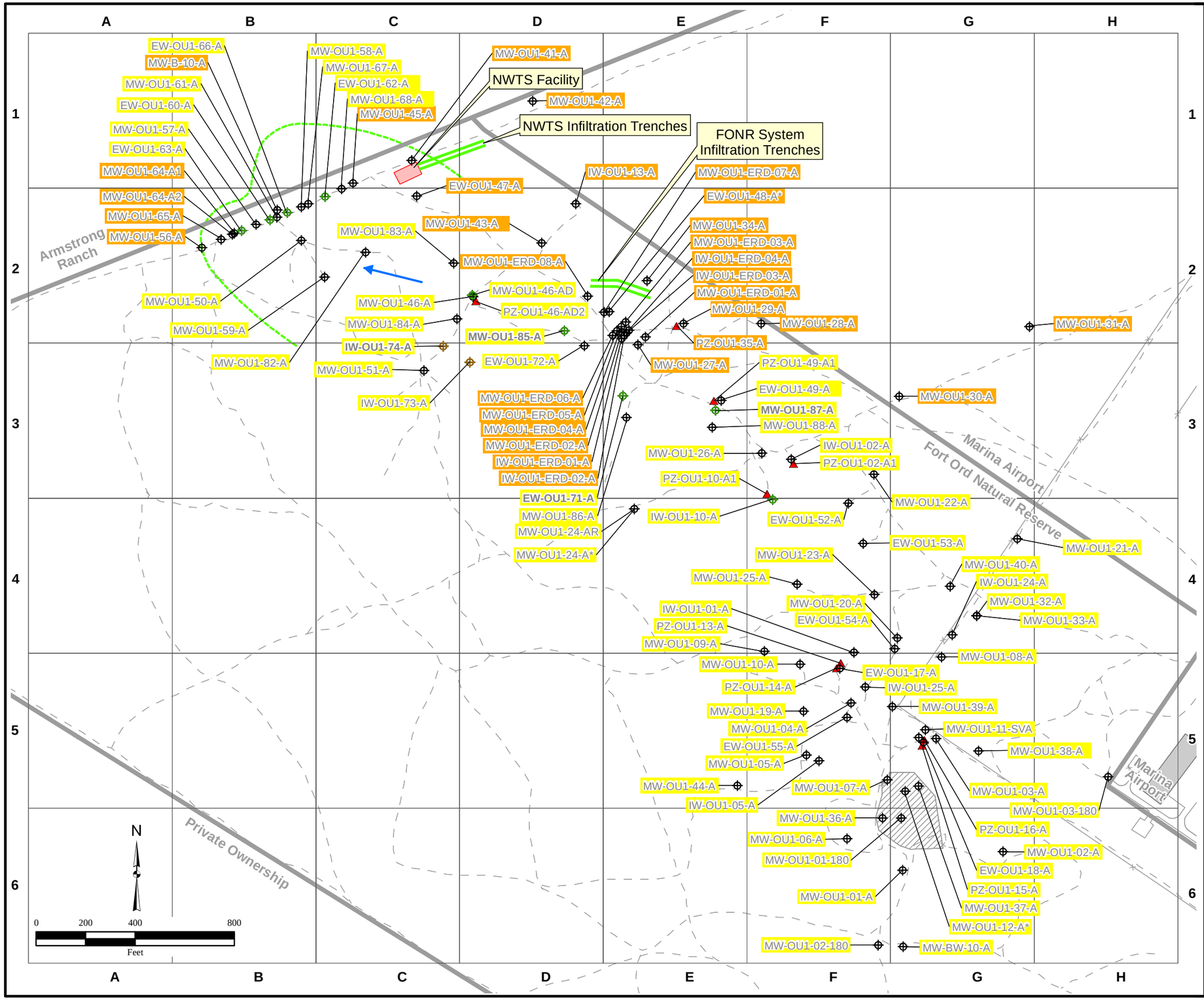
*8/30/2017 TB*
*Source: HGL*

HydroGeoLogic, Inc

# Figure 4.2
# OU-1 Wells Destroyed 2011, 2014, and 2017



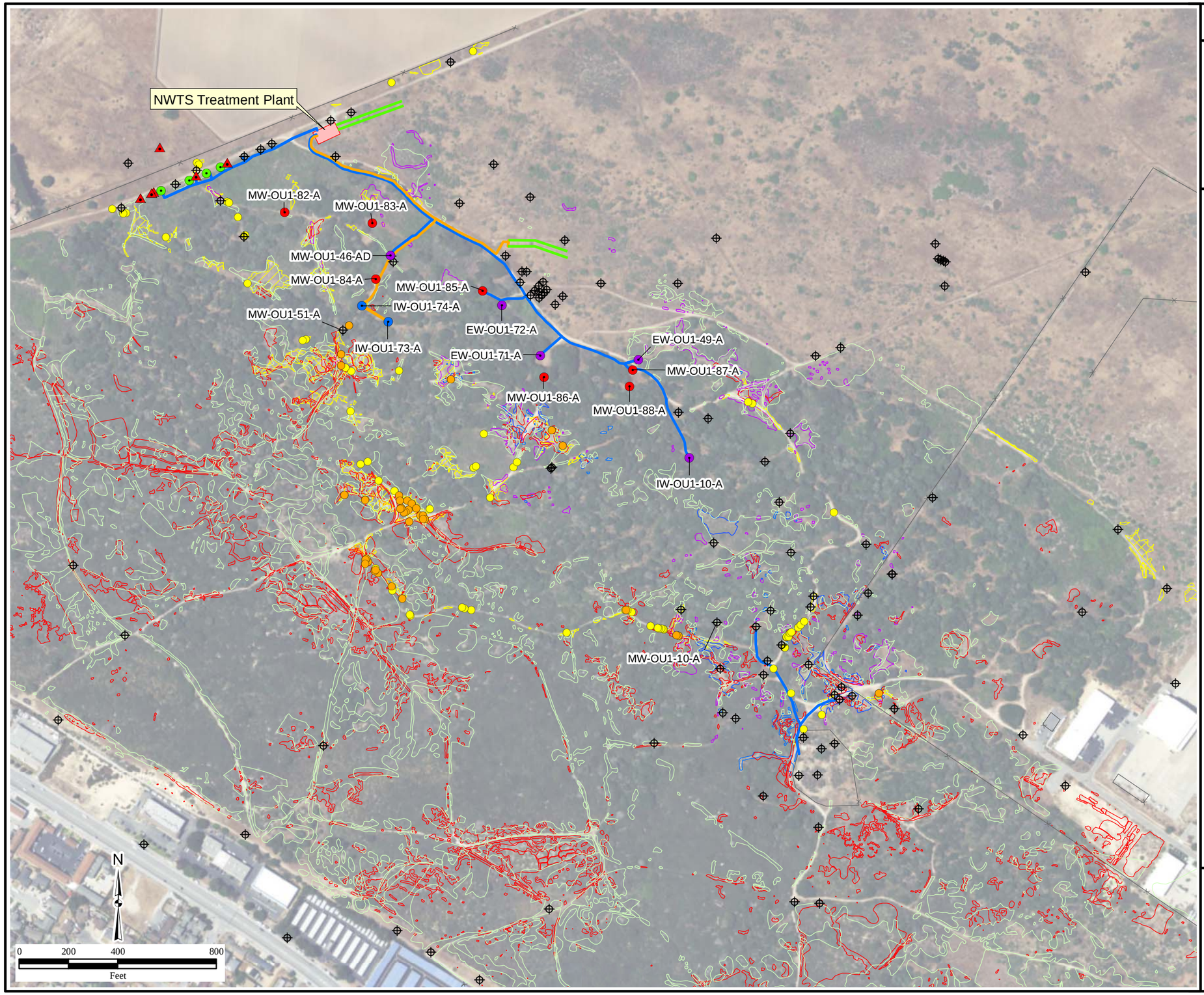

## Legend

- Monitoring Well
- Extraction Well
- Injection Well
- Piezometer
- MW-OU1-88-A — Well ID
- MW-OU1-30-A — Well Destroyed in Grassland or Northwest Boundary Road
- MW-OU1-02-A — Well Destroyed Within FONR Habitat Area
- Trail/Unimproved Road
- Fence
- Treated Water Infiltration Trench
- Estimated Northwest Treatment System Capture Zone
- Groundwater Flow Direction
- Property Boundary
- Treatment Plant
- Building
- Former Fire Drill Area

Notes:
*=Well destroyed before 2006
FONR=Fort Ord Natural Reserve
NWTS=Northwest Treatment System
OU-1=Operable Unit 1

*\\gst-srv-01\hglgis\Ft_Ord_MSIW\IA_HRPSS_Report_2017\(4-02)wells_destroyed_2011.mxd*
*1/24/2018 TH*
*Source: HGL*

# Figure 4.3
# Summary of 1998, 2004, and 2005 Rare Plant Surveys Results




## Legend

- Monitoring Well
- Northwest Treatment System Extraction Well
- Northwest Treatment System Performance Monitoring Well
- FONR OU-1 Monitoring Well
- FONR OU-1 Extraction Well
- FONR OU-1 Injection Well
- Extraction Pipeline Route
- Infiltration Trench
- Treated Water Pipeline Route
- Fence

1998 Rare Plant Survey (UC Santa Cruz):

- Sand Gilia
- Monterey Spineflower

2004 Rare Plant Survey (CH2MHill):

- Sand Gilia
- Monterey Spineflower

2005 Rare Plant Survey (CH2MHill):

- Sand Gilia
- Monterey Spineflower
- Sand Gilia
- Monterey Spineflower–High Density
- Monterey Spineflower–Medium Density
- Monterey Spineflower–Sparse Density
- Monterey Spineflower–Very Sparse Density

Notes:
FONR=Fort Ord Natural Reserve
NWTS=Northwest Treatment System
OU-1=Operable Unit 1

*\\gst-srv-01\HGLGIS\Ft_Ord_MSIW\IA_HRPSS_Report_2017\(4-03)98-05_Plant_Survey.mxd*
*8/30/2017 TB*
*Source: HGL, CH2MHill, UC Santa Cruz*
*ArcGIS Online Imagery*

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# 5.0 IMPACT ASSESSMENT

HGL conducted both construction and groundwater monitoring efforts during 2004 through 2015 to remediate contaminated groundwater within the OU-1 portion of the FONR. Construction activities included the following:

- Drilling soil borings
- Constructing extraction, injection, and monitoring wells
- Installing water conveyance pipelines
- Installing infiltration trenches
- Constructing a groundwater treatment facility
- Converting IW-OU1-10-A from a monitoring well to an extraction well
- Destroying a total of 108 wells within the OU-1 area during 2011, 2014, and 2017
- Repairing road segments to address ruts created by heavy equipment traffic and erosion

Figure 4.1 illustrates the areas in which construction occurred during 2004 through 2015. The locations of OU-1 wells destroyed in 2011, 2014, and 2017 are shown on Figure 4.2.

A critical concern throughout the project has been the protection of the rare plant species within the FONR. To that end, direct impacts of construction activities within the footprint of known populations of Monterey spineflower or sand gilia were minimized by using the results of the 1998 rare plant survey (HLA, 1998). The results of the 1998 rare plant survey are provided on Figure 4.3. In addition, a pre-construction survey was conducted in the spring of 2004 (HGL, 2004b) to delineate population locations. The survey results were used to adjust the location of remediation facilities to avoid previously identified rare plant locations wherever possible. As discussed below, this strategy enabled the construction activity to mostly avoid overlapping known rare plant populations. The few exceptions to this approach are described later in this section.

UCSC staff responsible for managing the FONR expressed a significant concern that construction activities would cause indirect impacts to the rare plant species by altering the habitat in the work areas. They were concerned that the practice of clearing existing native vegetation to enable equipment access for well or pipeline construction may provide a pathway for non-native, invasive plant species from the surrounding areas to encroach farther into the FONR. The UCSC concern is that such encroachment may result in declining rare plant populations as the non-native newcomers outcompete the existing plants and come to dominate the overall species distribution. To address this concern, HGL contributed funds to support manual and mechanical weed control efforts by UCSC from 2007 through 2013. The weed abatement efforts removed large portions of the invasive weed seed source for the growing seasons (HGL, 2008a; 2009a; 2009b; 2011a; 2012; 2013a; 2013b). UCSC, HGL, and the Army evaluated the effectiveness of the previous weed control efforts based on field surveys conducted during the first half of 2015. The Army suspended weed control activities based on those evaluation results.

HGL has conducted annual rare plant surveys from 2004 through 2017 (through subcontractors) to satisfy the requirements of the Biological Opinions (USFWS, 2002; 2007; 2015; 2017). The data resulting from these surveys is evaluated annually and has not shown evidence of overall

negative impact to rare plant populations. Tables 3.2A and 3.2B summarize the rare plant populations observed at the 2017 rare plant survey (Year 3) locations for wells destroyed in 2014. Tables 3.3A and B summarize the rare plant populations observed at the 2017 rare plant and habitat survey (Year 0) locations. Survey data for the 2017 Rare Plant and Habitat Survey for Wells Destroyed in 2014 (Year 3) are evaluated relative to the 2017 Re-initiated Programmatic Biological Opinion success criteria in Section 5.1. Survey data for the 2017 Rare Plant and Habitat Survey (Year 0) are presented in Section 5.2.

## 5.1 2017 RARE PLANT POPULATIONS AT THE WELLS DESTROYED IN 2014 (YEAR 3)

This section summarizes the 2017 survey (Year 3) results for the seven well sites and GWETS fence line within the FONR habitat area that were destroyed in 2014. Sand gilia was not observed at any of seven well sites in 2017 or in any previous survey, except for a single occurrence at well MW-OU1-40-A in 2001 (see Table 3.1). Not surprisingly, the 2017 survey results show no new sand gilia colonization of the surveyed areas.

The 2017 Rare Plant and Habitat Survey for Wells Destroyed in 2014 (Year 3) is the final annual survey following well destruction activities. Accordingly, the data were evaluated with respect to the success criteria to determine if additional monitoring is necessary. This evaluation is presented below.

### 5.1.1 Success Criteria 1

Success Criteria 1 listed in the 2017 Re-initiated Programmatic Biological Opinion is defined as "Densities and acreage of HMP annual species are within a normal range compared with information from reference sites." The survey data are evaluated with respect to success Criteria 1 in the following subsections.

#### 5.1.1.1 Monterey Spineflower

To evaluate Success Criteria 1, Monterey spineflower survey data (e.g., density classes, plant counts, areal coverage, etc.) for the seven well sites destroyed in 2014 and the GWETS were tabulated and compared against the reference area, as shown in Table 5.1. Significant correlations or trends are not apparent when comparing the 2014 well sites and the GWETS against the reference area. This lack of correlation may be a result of several factors besides potential impacts from remediation activities, including:

- the relatively small number of samples may result in greater variability,
- smaller populations may be more susceptible than larger populations to changes in environmental factors (herbivory, temperature, precipitation, etc.) and thereby experience relatively large population fluctuations, and
- natural spatial and temporal variability.

Furthermore, lack of significant correlation between the well sites and the reference area is likely impacted by the characteristics of the reference site relative to the well sites. The reference site

was intentionally established in an area with known sand gilia and Monterey spineflower populations. The wells sites and GWETS were established based on the location of the contaminated groundwater plume and may or may not have been situated in areas where the subject plant populations would be present or would thrive under undisturbed conditions. For example, Monterey spineflower was not observed in the 1998 survey at wells MW-OU1-51-A and MW-OU1-22-A even though 1998 was recognized as a very favorable year for plant populations.

Precipitation from October to March in 1998 was 28.36 inches, more than double the average precipitation from 1998 to 2017 for that same monthly range (October to March, 13.05 inches). Precipitation and plant populations have a strong direct correlation (Table 3.6, also discussed below) so the 1998 survey would be expected to show greater plant populations because of this above-average precipitation season. These examples illustrate the difficulty in evaluating direct comparisons of survey results between the reference site and the small number of well sites destroyed in 2014. Instead, indirect comparisons are made that include general population trends at both locations.

The correlation between precipitation over varying antecedent periods was examined as discussed in Section 3.0. The strongest correlation was observed between the April to March precipitation total and areal coverage for both sand gilia and Monterey spineflower population statistics. The correlation coefficient was 0.73 and 0.76 for sand gilia and Monterey spineflower, respectively. This suggests that variability in precipitation may be a major factor behind annual variability in Monterey spineflower populations. Other factors undoubtedly play a role and the relative importance of each may vary from year to year. Such factors may include at a minimum:

- Competition from other plant species
- Temperature fluctuations and magnitude
- Site-specific soil nutrients
- Availability of sunlight (affected by cloud cover and/or canopy)

The following observations can be made in comparing the 2015 to 2017 survey results (these are the only years in which the reference area, all seven well sites, and the GWETS were surveyed):

1. Monterey spineflower populations of similar densities were observed across the three areas during the three years (Table 5.2).
2. Relative abundance from 2015 to 2017 appears to be consistent between the three areas, as the most (i.e., most individual plants and total polygon area) Monterey spineflower were observed during 2016 and the fewest were observed during 2015 when precipitation was lowest during this three-year period.
3. Areal coverage of Monterey spineflower polygons varied significantly at the 2014 well sites and the GWETS (3,468 to 9,523 square feet) but also varied significantly at the reference area (2,114 to 3,241 square feet). The relative changes over time were also similar at both locations:
    a. Least areal coverage occurred in 2015
    b. Largest areas observed in 2016
    c. Both sites showed decrease in 2017 that was not as large as increase from 2015 to 2016

In summary, the survey data do not include a discernable correlation or trend suggesting that well destruction activities negatively impacted Monterey spineflower populations. Based on the information presented above, the densities of Monterey spineflower populations observed during the three years of monitoring (2015 to 2017) appear to be within a normal range when compared to the reference area, suggesting well destruction activities did not impact Monterey spineflower populations.

#### 5.1.1.2 Sand Gilia

Sand gilia was consistently observed in the reference area during the 2015 to 2017 survey period (as well as historically), but was not observed at any of the seven well sites destroyed in 2014 during the survey years of 2015 through 2017. It has only been observed at these well locations once in over 13 years of surveys (MW- OU1-40-A in 2001).

Therefore, it is not possible to draw conclusions about population trends over time at the 2014 destroyed well sites versus populations trends in the reference area. There is no reason to suspect that the contrast indicates a negative impact from remediation activities to sand gilia at the 2014 well sites. Given the consistent absence of sand gilia at the well sites in all years surveyed – including during the high population 1998 season – the contrast in observed populations is believed to be the result of intentionally establishing the reference site in an area that contained a known sand gilia population.

As shown in Table 5.2, sand gilia was observed at the GWETS and the reference area during the 2015 to 2017 survey period and the following observations are based on that data:

1. Relative abundance appears to be consistent, as the most (i.e., total number of plants) sand gilia were observed in 2015 and decreases were observed in 2016 and 2017.
2. Areal coverage of sand gilia polygons varied significantly at the GWETS (81 to 466 square feet) but was more consistent at the reference area (1,498 to 1,950 square feet). In terms of actual population counts, the range is similar: 385 plants in the GWETS area versus 452 in the Reference Area.

Based on the information presented above and in Table 5.1, the survey data do not indicate that well destruction activities negatively impacted sand gilia populations. As with Monterey spineflower, sand gilia population statistics (primarily areal coverage) are highly correlated with precipitation. This correlation may be the primary factor behind annual variability in sand gilia populations at the GWETS. Additional observed variation in areal coverage at the GWETS, relative to the reference area, may be a result of smaller populations being more susceptible to relatively large population fluctuations.

Based on the information presented above, the densities of sand gilia populations observed at the GWETS during the three years of monitoring (2015 to 2017) appear to be within a normal range when compared to the reference area.

### 5.1.2 Success Criteria 2

Success Criteria 2 listed in the 2017 Re-initiated Programmatic Biological Opinion is defined as "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". The survey data are evaluated with respect to Success Criteria 2 in the following subsections.

#### 5.1.2.1 Monitoring Wells

As shown in Table 3.2B, Monterey spineflower was detected at wells MW-OU1-22-A, MW-OU1-25-A, MW-OU1-40-A, and PZ-OU1-46-AD2 in the Year 3 survey. Monterey spineflower had not been detected since 2004 at MW-OU1-22-A and was last detected at MW-OU1-25-A in 2000 but not in any of the seven OU-1 surveys conducted between 2001 and 2016. Monterey spineflower has been observed in two of the three post-well destruction surveys (in 2016 and 2017) at MW-OU1-40-A and was observed in all three post-well destruction surveys at PZ-OU1-46-AD2 (considered to be same location as MW-OU1-46-A and MW-OU1-46-AD).

Monterey spineflower was not observed at wells MW-OU1-23-A, MW-OU1-24-AR, and MW-OU1-51-A in 2017.

#### 5.1.2.2 Original GWETS Fence Line

The native soils within the GWETS fence line were removed in 1987 as part of the source area remediation effort and the area was used to treat extracted OU-1 groundwater (U.S. Army, 1995). The treated water was returned to the A-Aquifer through a spray irrigation system. The GWETS fence line was not explicitly surveyed in any of the annual efforts conducted from 2004 through 2014 and only partially covered in the 2004 through 2007 surveys because the remediation activities in that time period were limited to sampling existing wells and did not disturb the habitat.

Monterey spineflower was observed within 30 feet of the fence line in at least one location in 1998 and in every subsequent rare plant survey except the 2001, 2002, and 2006 efforts. As shown in Table 3.2B, Monterey spineflower was observed in 13 of the 16 surveys conducted in this area since 1998. Because the fence was constructed before the earliest rare plant survey in 1998, it is not possible to make "before and after" comparisons.

Sand gilia was observed in both the 1998 and 2004 baseline surveys within 30 feet of the fence line and in 10 of the 16 surveys overall. As with Monterey spineflower, it is not possible to make "before and after" comparisons because the fence was constructed before the earliest rare plant survey (in 1998).

#### 5.1.2.3 Summary

The 2017 rare plant and habitat survey for wells destroyed in 2014 (Year 3) results were included with all previous rare plant surveys (conducted between 1998 and 2016) to assess construction impacts on the FONR rare plant populations. Five impact categories have been defined in previous Annual Rare Plant Survey and Habitat Impact Reports as follows:

1. Rare plant species not detected in any survey

2. Rare plant species detected before but not after well construction
3. Rare plant species detected before and after well construction
4. Rare plant species detected only after well construction
5. Well was constructed before earliest rare plant survey in 1998

Well sites included in categories 1 and 5 do not provide data that can be used to compare rare plant populations before and after construction.

As noted earlier, sand gilia was not detected in 2017 or in any previous OU-1 survey at 6 of the 7 well sites monitored in 2017. At well MW-OU1-40-A, sand gilia was detected just once (in 2001) in the 10 post construction surveys that included this location. This well falls into category 4 with respect to sand gilia. Well sites MW-OU1-22-A, MW-OU1-23-A, and the GWETS fence line were constructed before the earliest survey in 1998 and fall into category 5 as defined above. Well locations MW-OU1-25-A, PZ-OU1-46-AD2, and MW-OU1-51-A fall into category 1.

The survey results for Monterey spineflower at four of the five well sites that were constructed after the initial survey in 1998 (MW-OU1-24-AR, MW-OU1-25-A, PZ-OU1-46-AD2, and MW-OU1-40-A) fell into category 3—the population has been observed before and after well construction. Category 2 well MW-OU1-51-A was constructed in 2004 and Monterey spineflower was observed at this site only in 1999. Monterey spineflower was not observed in 1998 at this location although exceptionally favorable conditions for Monterey spineflower were present that year (Fusari, 2004). Also, Monterey spineflower was not seen at MW-OU1-51-A in the 2000 and 2004 surveys performed before well construction or in the 2005 through 2009 annual surveys performed after well construction. These results are consistent with the findings presented in the 2015 and 2016 OU1 habitat impact and rare plant survey reports (HGL, 2015; 2016).

Based on the information presented above, well destruction activities completed in 2014 at the seven FONR well locations and GWETS fence line removal activities do not show evidence of adverse impact on Monterey spineflower populations. Because sand gilia has not been detected in either of the follow up-surveys at the seven well locations, nor in the pre-destruction surveys (with the sole exception of single occurrence at MW-OU1-40-A in 2001), it is difficult to assess the impact of remediation activities on this species at these wells. While sand gilia has not colonized these well locations, there is no evidence that the remediation activities had an adverse impact.

## 5.2 2017 RARE PLANT AND HABITAT SURVEY (YEAR 0)

As shown in Table 3.3B and as discussed in Section 4.0, Monterey spineflower was found at 17 of the 33 well locations included in the 2017 rare plant and habitat survey (Year 0); sand gilia were not found at any of the 33 locations. The results of this survey will be included with the existing baseline when three years of post-well destruction survey results (2018 through 2020) are evaluated to assess potential impacts of the well destruction activities. Accordingly, an impact assessment of the 2017 rare plant and habitat survey (Year 0) data is not applicable at this time and the survey data were not evaluated relative to the success criteria listed in USFWS (2017).

It should be noted, however, that Monterey spineflower was observed in 2017 at five well locations previously defined as Category 1 wells (Rare plant species not detected in any survey), thus

moving them into Category 4 (Rare plant species detected only after well construction). The five wells and the figures on which they are shown are listed below.

- MW-OU1-58-A (Appendix A, Figure A3.2)
- EW-OU1-63-A (Appendix A, Figure A3.2)
- MW-OU1-67-A (Appendix A, Figure A3.2)
- MW-OU1-85-A (Appendix A, Figure A3.3)
- MW-OU1-88-A (Appendix A, Figure A3.4)

The 33 well locations provide 29 total data points because some of the wells are within 30 feet of one another. There is only 1 well location of the 29 where Monterey spineflower was observed before well construction but not after (Category 2). That location is the EW-OU1-49-A / PZ-OU1-49-A1 well pair and Monterey spineflower has been observed only in the 1998 baseline. The 1998 survey showed that it was an exceptionally good year for rare plant populations (Fusari, 2004). The rare plant population survey data from 1998 through 2017 for these 29 wells shows that Monterey spineflower typically recurs after well construction:

1. Rare plant species not detected in any survey – 10 locations
2. Rare plant species detected before but not after well construction – 1 location
3. Rare plant species detected before and after well construction – 8 locations
4. Rare plant species detected only after well construction – 10 locations
5. Well was constructed before earliest rare plant survey in 1998 - none

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# TABLE(S)

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**Table 5.1**

**Summary of Monterey Spineflower Observations at the 2014 Well Sites, GWETS, and Reference Area**

| Survey Year | October - March Precipitation (inches) | April - March Precipitation (inches) | Well Sites Destroyed in 2014 and GWETS | | | | | | | Reference Area | | | Monterey Spineflower Density Classes | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Well Sites Surveyed (7 Total Wells) | Well Sites Where MS Observed | GWETS Surveyed? | MS Observed at GWETS? | Individual Plants Observed | Polygons Observed | Polygon Total Area GWETS and Well Sites (square feet) | Individual Plants Observed | Polygons Observed | Polygon Total Area (square feet) | Very Sparse [VS] | | | Sparse [S] | | | Medium Low [ML] | | | Medium [M] | | | Medium High [MD] | | | Very High [VH] | | |
| | | | | | | | | | | | | | Number of Populations Observed | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | Well Sites | GWETS | Reference Area | Well Sites | GWETS | Reference Area | Well Sites | GWETS | Reference Area | Well Sites | GWETS | Reference Area | Well Sites | GWETS | Reference Area | Well Sites | GWETS | Reference Area |
| 2010 | 16.85 | 17.70 | 0 | -- | No | -- | -- | -- | -- | 0 | 2 | 2,846 | 0 | 0 | 0 | 0 | | 1 | 0 | | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2011 | 17.29 | 20.39 | 0 | -- | No | -- | -- | -- | -- | 4 | 1 | 2,865 | -- | -- | 0 | -- | | 0 | -- | | 1 | -- | -- | 0 | -- | -- | 0 | -- | -- | 0 |
| 2012 | 8.44 | 10.25 | 3 | 0 | Yes | Yes | 3 | 2 | NA | 4 | 2 | 1,494 | 0 | 0 | 0 | 0 | 1 | 2 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2013 | 8.78 | 11.12 | 0 | -- | Yes | Yes | 0 | 1 | NA | 0 | 7 | 2,813 | -- | -- | 0 | -- | 1 | 6 | -- | | 1 | -- | -- | 0 | -- | -- | 0 | -- | -- | 0 |
| 2014 | 7.38 | 8.02 | 0 | -- | Yes | Yes | 5 | 0 | 0 | 4 | 6 | 1,119 | -- | -- | 0 | -- | | 6 | -- | | 0 | -- | -- | 0 | -- | -- | 0 | -- | -- | 0 |
| 2015 | 8.68 | 9.92 | 7 | 1 | Yes | Yes | 21 | 9 | 3,468 | 3 | 4 | 2,114 | 0 | 0 | 0 | 4 | 2 | 1 | 1 | 2 | 1 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2016 | 18.98 | 20.23 | 7 | 2 | Yes | Yes | 19 | 11 | 9,523 | 0 | 2 | 3,241 | 0 | 0 | 0 | 3 | 3 | 0 | 4 | 1 | 1 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2017 | 24.96 | 25.81 | 7 | 4 | Yes | Yes | 23 | 11 | 6,055 | 0 | 4 | 2,855 | 0 | 0 | 0 | 6 | 3 | 3 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

= blue shaded cells indicate the data is for the reference area
= green shaded cells indicate the data is for the 2014 well sites and/or GWETS

GWETS = groundwater extraction and treatment system
MS = Monterey Spineflower
-- = not applicable
NA = not available

Monterey Spineflower Plant Cover Density Categories Based on Percentage of Plant Cover of Total Ground Area
Very Sparse (less than 3 percent)
Sparse (3 to 25 percent)
Medium Low (26 to 50 percent)
Medium (51 to 76 percent)
Medium High (76 to 97 percent)
Very High (greater than 97 percent)

**Table 5.2**

**Summary of Sand Gilia Observations at the GWETS and Reference Area**

| Survey Year | October - March Precipitation (inches) | April - March Precipitation (inches) | Well Sites Surveyed (7 Total Wells) | Individual Plants Observed | GWETS Surveyed? | SG Observed at GWETS? | Number of Point Populations | Number of Point Populations | Number of Individuals at Point Populations | Number of Individuals at Point Populations | Number of Polygon Populations | Number of Polygon Populations | Number of Individuals at Polygon Populations | Number of Individuals at Polygon Populations | Total Number of Individuals | Total Number of Individuals | Area of Polygons (square feet) | Area of Polygons (square feet) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 2010 | 16.85 | 17.70 | 0 | 0 | No | -- | -- | 7 | -- | 18 | -- | 7 | -- | 1,068 | -- | 1,086 | -- | 1,715 |
| 2011 | 17.29 | 20.39 | 0 | 0 | No | -- | -- | 12 | -- | 40 | -- | 4 | -- | 278 | -- | 318 | -- | 1,410 |
| 2012 | 8.44 | 10.25 | 3 | 0 | Yes | No | 0 | 12 | 0 | 21 | 0 | 4 | 0 | 49 | 0 | 70 | -- | 210 |
| 2013 | 8.78 | 11.12 | 0 | 0 | Yes | No | 0 | 7 | 0 | 17 | 0 | 13 | 0 | 719 | 0 | 736 | -- | 1,281 |
| 2014 | 7.38 | 8.02 | 0 | 0 | Yes | No | 0 | 2 | 0 | 5 | 0 | 2 | 0 | 92 | 0 | 97 | -- | 370 |
| 2015 | 8.68 | 9.92 | 7 | 0 | Yes | Yes | 2 | 4 | 3 | 8 | 3 | 7 | 328 | 1,070 | 331 | 1,078 | 81 | 1,512 |
| 2016 | 18.98 | 20.23 | 7 | 0 | Yes | Yes | 3 | 3 | 9 | 3 | 3 | 3 | 135 | 943 | 144 | 946 | 466 | 1,498 |
| 2017 | 24.96 | 25.81 | 7 | 0 | Yes | Yes | 3 | 6 | 10 | 10 | 3 | 2 | 37 | 453 | 47 | 463 | 147 | 1,950 |

= blue shaded cells indicate the data is for the reference area
= green shaded cells indicate the data is for the 2014 well sites and/or GWETS
-- = not applicable
NA = not available
SG = sand gilia
GWETS = groundwater extraction and treatment system

# 6.0 RECOMMENDATIONS AND FUTURE WORK

Recommendations are presented separately below for the two 2017 surveys. OU-1 remediation impacts on the FONR will be assessed after the third year of rare plant surveys for the wells destroyed in 2017 is completed. This assessment will use the results from the 2017 rare plant survey (Year 0) and the 2017 rare plant survey (Year 3) as well as annual survey results from 1998 through 2016.

## 6.1 2017 RARE PLANT AND HABITAT SURVEY FOR WELLS DESTROYED IN 2014 (YEAR 3)

In 2014, the following seven wells were destroyed within the FONR:

| | | | |
|---|---|---|---|
| MW-OU1-22-A | MW-OU1-23-A | MW-OU1-24-AR | MW-OU1-25-A |
| MW-OU1-40-A | PZ-OU1-46-AD2 | MW-OU1-51-A | |

The third year of the three-year monitoring requirement specified in the 2017 Re-initiated Biological Opinion (USFWS, 2017) was performed in 2017 for these wells. The conservation measures specified in the 2017 Re-initiated Programmatic Biological Opinion (USFWS, 2017) states, "Following groundwater remediation, monitoring of HMP annuals and/or their habitat will be conducted where HMP annuals were present prior to remediation and will be monitored for 3 years following the completion to assess the reestablishment of the HMP annual plant populations (Monterey gilia and Monterey spineflower) unless otherwise coordinated with the Service. The exception for this 3-year monitoring schedule will be in the University of California Natural Reserve, where monitoring will be suspended at sites where HMP annuals have not been documented during baseline surveys nor in the first year of follow-up surveys. Additionally, surveys for HMP annuals will not be conducted in areas considered low quality habitat for these species".

As noted earlier, wells MW-OU1-22-A and MW-OU1-23-A are category 5 wells and cannot be used as comparative sites. Monterey spineflower was observed before and after well construction activities in 4 of the 5 wells constructed after the 1998 survey (MW-OU1-51-A is the exception) and in 3 of the 5 wells in one or more of the 3 post-destruction surveys (excluding MW-OU1-24-AR and MW-OU1-51-A). Monterey spineflower historical survey results for these 5 wells exhibit significant variability.

As detailed in Section 3.0 and Section 5.1.2, sand gilia has not been observed at any of the seven well sites before or after well destruction activities (excluding a single occurrence at well MW-OU1-40-A in 2001).

Based on this information, the survey data collected during the three years of monitoring following 2014 well destruction activities do not show evidence that well destruction activities negatively impacted sand gilia or Monterey spineflower populations. The success criteria associated with groundwater remediation listed in the 2017 Re-initiated Programmatic Biological Opinion are shown below.

1. Densities and acreage of HMP annual species are within a 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.

As Described in Section 5.1.1, the densities of Monterey spineflower populations observed during the three years of monitoring (2015 to 2017) appear to be within a normal range when compared to the reference area, suggesting well destruction activities did not impact Monterey spineflower populations and Success Criteria 1 has been achieved.

As described in Section 5.1.2, the survey results show that plant population occurrences have varied within the normal range observed at the reference site and overall have been found in approximately the same number of locations as were observed in the 1998 and 2004 baseline studies, meeting Success Criteria 2. Specifically, plant populations were observed after well construction activities at 6 of the 7 well locations. At one well location, MW-OU1-51-A, Monterey spineflower was only observed in 1 of 3 surveys (1998 through 2000) completed prior to well construction and in none of the 9 total surveys conducted after the well was constructed and subsequently destroyed. Given the low detection frequency in the pre-construction surveys and the fact that Monterey spineflower was not detected in the exceptionally good blooming year 1998 (Fusari, 2004), the absence of Monterey spineflower observations since 1999 is believed to represent overall variability in plant populations.

Based on the information presented above and in Section 5.0, the Success Criteria have been achieved and no further surveys are recommended to document potential impacts at these 7 well locations.

## 6.2 2017 RARE PLANT AND HABITAT SURVEY (YEAR 0)

The 2017 activities included completing a rare plant and habitat survey (Year 0) at 33 wells that were subsequently destroyed in July 2017 and were located within the FONR habitat area. The results of this survey will be used in conjunction the existing baseline data and three years of post-well destruction survey results (2018 through 2020) to evaluate potential impacts of the well destruction activities.

The 2017 Re-initiated Programmatic Biological Opinion lists general conservation measures "to minimize disturbance to natural resources, in particular, HMP species". These include conducting employee environmental awareness training programs, developing Habitat Checklists prior to all activities within non-development parcels, minimizing footprint of work areas, utilizing existing roads, and mapping and flagging HMP plant species to avoid unnecessary disturbances. The Army will continue to employ the above measures to limit disturbance to HMP species. With the completion of the well destruction effort in July 2017, the OU-1 remediation effort is complete. Hereafter, the only planned Army activities within OU-1 are conducting the required 3-year follow up monitoring of HMP annuals at the 2017 destroyed well sites.

The Army will assess whether the success criteria listed in the 2017 Re-initiated Programmatic Biological Opinion have been met at the end of the 3rd year of monitoring of the well sites that were destroyed in 2017. The proposed recommendation for 2018 through 2020 habitat related activities are as follows:

- Continue to implement the conservation measures specified in the 2017 Re-initiated Programmatic Biological Opinion.
- Continue the 3-year rare plant monitoring program at the 33 well sites located within the FONR that were destroyed in July 2017.

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# APPENDIX A

# RESULTS OF 2017 MONTEREY SPINEFLOWER AND SAND GILIA SURVEYS (YEAR 3)

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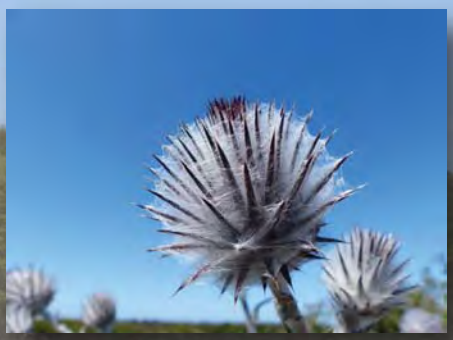
# Results of 2017 Monterey Spineflower and Sand Gilia Surveys (Year 3)

## OU-1, Fort Ord Natural Reserve, California

*Prepared for HydroGeoLogic Inc.*

*Prepared By Denise Duffy & Associates, Inc.*



**Denise Duffy & Associates, Inc.**
**947 Cass St. Suite 5**
**Monterey, CA 93940**
**(831) 373-4341**
**facsimile (831) 373-1417**

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**Acronym List**

| | |
|---|---|
| CDFW | California Department of Fish and Wildlife |
| CNDDB | California Natural Diversity Database |
| DD&A | Denise Duffy & Associates, Inc. |
| FE | federally endangered |
| FDA | Fire Drill Area |
| FONR | Fort Ord Natural Reserve |
| FT | federally threatened |
| GIS | geographic information system |
| GPS | global positioning system |
| GWETS | groundwater extraction and treatment system |
| HGL | HydroGeoLogic, Inc. |
| HMP | Habitat Management Plan |
| OU | operable unit |
| ST | state threatened |
| TCE | trichloroethene |
| UCNRS | University of California Natural Reserve System |
| USACE | U.S. Army Corps of Engineers |
| USGS | United States Geological Survey |
| USFWS | United States Fish and Wildlife Service |
| VOC | volatile organic compound |

# A1.0 Introduction

HydroGeoLogic, Inc. (HGL) is executing a groundwater remediation project at Operable Unit (OU1) at the former Fort Ord U.S. Army Base located in Monterey County, California (Figure A1.1). The U.S. Army Corps of Engineers (USACE)-Sacramento District, under Contract Number W912DY-10-D-0023, awarded this work to HGL. Denise Duffy & Associates (DD&A) performed biological survey work described herein under subcontract to HGL.

Fort Ord was established in 1917 as a military training base for infantry troops. In January 1991, the Secretary of Defense announced the downsizing/closure of the base. In August 1994, portions of the property were transferred to the University of California and the Fort Ord Natural Reserve (FONR) was established in June 1996. The former Fort Ord is located near Monterey Bay approximately 80 miles south of San Francisco. The base consists of approximately 28,000 acres near the cities of Seaside, Sand City, Monterey, Del Rey Oaks, and Marina. Monterey Bay marks the western boundary, Toro Regional Park borders the base to the southeast, and land use to the east is primarily agricultural.

Activities conducted at the former Fort Ord Fritzsche Army Airfield Fire Drill Area (FDA) (the source area for OU1 contaminants) between 1962 and 1985 resulted in the release of contaminants to soils and groundwater. Although 10 volatile organic compounds (VOCs) were identified as contaminants of concern in groundwater underlying OU1, trichloroethene (TCE) is the contaminant that was detected at the highest concentrations and across the greatest extent of the affected aquifer. A groundwater extraction and treatment system (GWETS) began operation in 1988 to remediate TCE and other groundwater contaminants. In 2004 HGL assumed control of the remediation efforts, which included the construction of a new GWETS in 2006. The 1988 facility is referred to as the original GWETS and the new facility is referred to as the Northwest Treatment System (NWTS).

A key factor that affected the design and implementation of the groundwater cleanup is the fact that the groundwater plume lies beneath a part of the University of California Natural Reserve System (UCNRS) designated as the FONR. The FONR area potentially impacted by the construction of OU1 remediation facilities is approximately 130 acres. Rare plant surveys are required by the Habitat Management Plan (USACE, 1997) (HMP) and the 2015 Programmatic Biological Opinion (United States Fish and Wildlife Service, 2015), in areas that are disturbed during construction activities associated with remediation efforts. Project activities undertaken to achieve the OU1 cleanup must protect and maintain the special-status species found within the FONR, specifically two federally listed plant species: federally threatened (FT) Monterey spineflower (*Chorizanthe pungens* var. *pungens*), and federally endangered (FE) and state threatened (ST) sand gilia (*Gilia tenuiflora* ssp. *arenaria*). DD&A also surveyed the disturbed areas for FE Yadon's piperia (*Piperia yadonii*). Yadon's piperia was included in the 2017 survey at the request of the Base Realignment and Closure (BRAC) office and in accordance with the 2017 Programmatic Biological Opinion. As part of the current remediation project, seven wells were destroyed in 2014, and the fencing around the original GWETS was removed. Rare plant surveys

were conducted in 2017 in the OU1 FONR area disturbed by the destruction of wells and the removal of the fence line in 2014. The well survey areas included the secondary access routes to the well locations, but did not include the main thoroughfares on the FONR property. Rare plant surveys are conducted as part of the overall objective of protecting the two special-status plant species in areas affected by construction activities. This report details the surveys completed in April, May, and June 2017.

## *A1.1 Survey Objectives*

The objectives of the 2017 rare plant surveys were to:

1. Map Monterey spineflower and sand gilia at a DD&A reference site southeast of the FONR property (Figure A1.2);
2. Map Monterey spineflower, sand gilia, and Yadon's piperia at well locations destroyed in 2014 within the sensitive habitat portions of the FONR, secondary access routes associated with the destroyed well locations, and where the fencing around the original GWETS was removed (OU1 FONR survey area—Figures A1.3 & A1.4)

## *A1.2 Site Location and Description*

The dominant habitats in the OU1 FONR survey area include coast live oak woodland, maritime chaparral, coastal scrub, disturbed/developed land, and annual grassland. Several special-status plant and wildlife species occur within the FONR, federally Threatened Monterey spineflower and federally Endangered and state Threatened sand gilia. The northern and eastern boundaries of OU1 are adjacent to a large expanse of non-native grassland. Transmission of non-native grass species into OU1 is accelerated by the prevailing southern winds, which blow seeds into the OU1 area (Fusari, 2004). Non-native grasses and weedy forbs are already present throughout much of the OU1 area. The spread of non-native, invasive species into newly disturbed areas may result in population declines of Monterey spineflower and sand gilia. Sand gilia is especially vulnerable to the encroachment of invasive species as it is less tolerant of competing plant cover than Monterey spineflower.

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.

### A1.2.1 Sand Gilia

Sand gilia is a small annual in the phlox family (*Polemoniaceae*). Plants range in height from two to six inches with a small, basal rosette of leaves. The lower branches of the stem are generally densely glandular. Plants typically bloom from April through June and have funnel-shaped flowers with narrow, purple to pinkish petal lobes and a purple throat. This species occurs in open sandy soils in dune scrub, coastal sage scrub, and maritime chaparral habitats. Sand gilia is endemic to Monterey Bay and the peninsular dune complexes. According to the California Natural Diversity Database (CNDDB) there are 31 occurrences

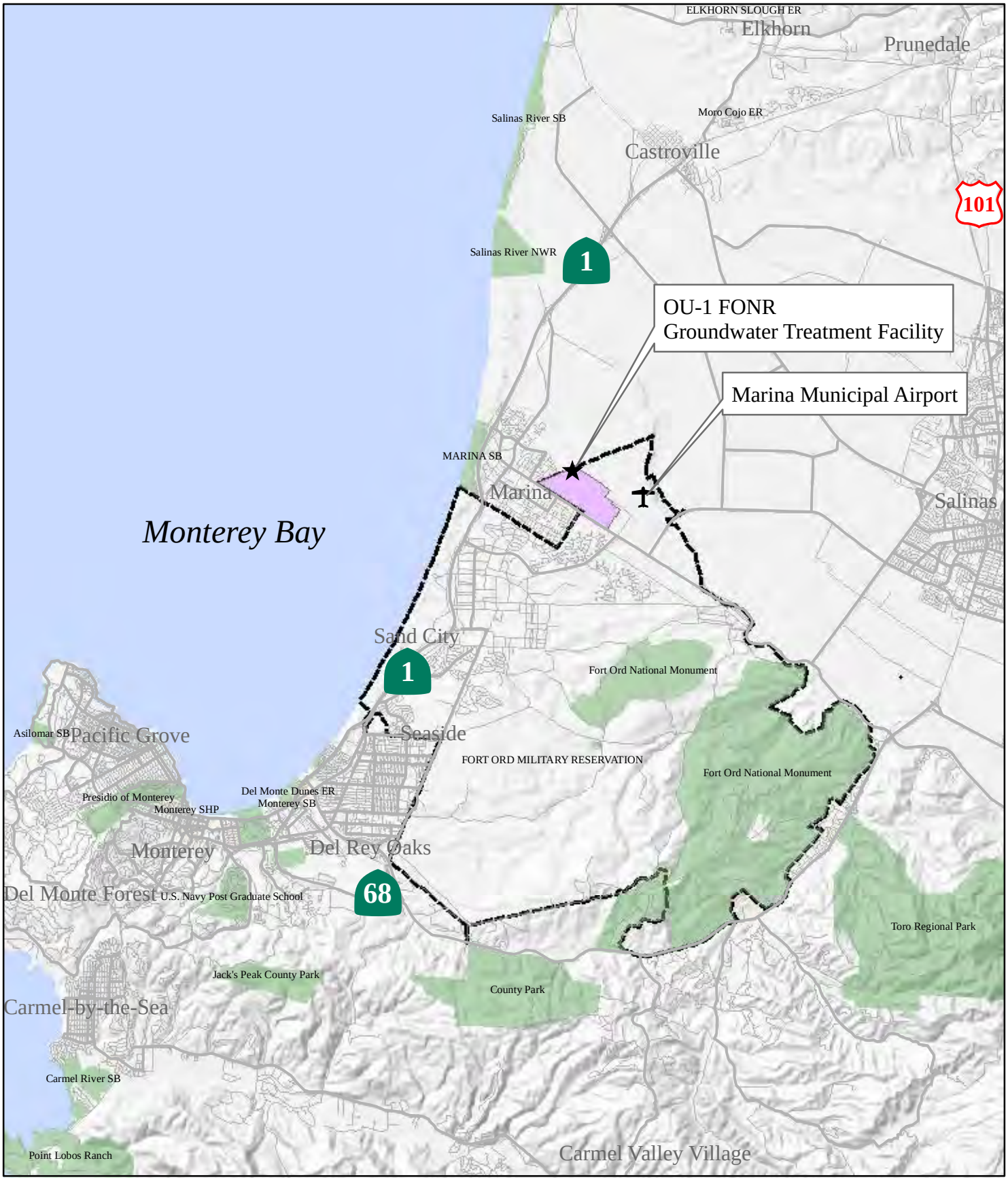
within Monterey County, including the occurrences at Fort Ord (CDFW, 2017). It is likely that some of these occurrences are no longer present and the exact number of extant (still in existence) occurrences are unknown.

### A1.2.2 Monterey Spineflower

Monterey spineflower is a small, prostrate annual in the buckwheat family (*Polygonaceae*) that blooms from April to June. The white to rose floral tube of Monterey spineflower distinguishes it from the more common, but closely related diffuse spineflower (*Chorizanthe diffusa*), which has a lemon-yellow floral tube. This species typically occurs on open sandy or gravelly soils in coastal dune, coastal scrub, and maritime chaparral habitats. There are 47 records of Monterey spineflower within Monterey County in the CNDDB (CDFW, 2017); however, it is not known how many of these are extant.

### A1.2.3 Yadon's Piperia

Yadon's piperia is a perennial herb in the orchid family (*Orchidaceae*) that blooms from May to August. The elongated spur of Yadon's piperia distinguishes it from the more common species of piperia that are found in the same habitat and range. This species typically occurs in coastal scrub, closed-cone pine forests, and maritime chaparral habitats. There are 29 records of Yadon's piperia within Monterey County in the CNDDB (CDFW, 2017); however, it is not known how many of these are extant.



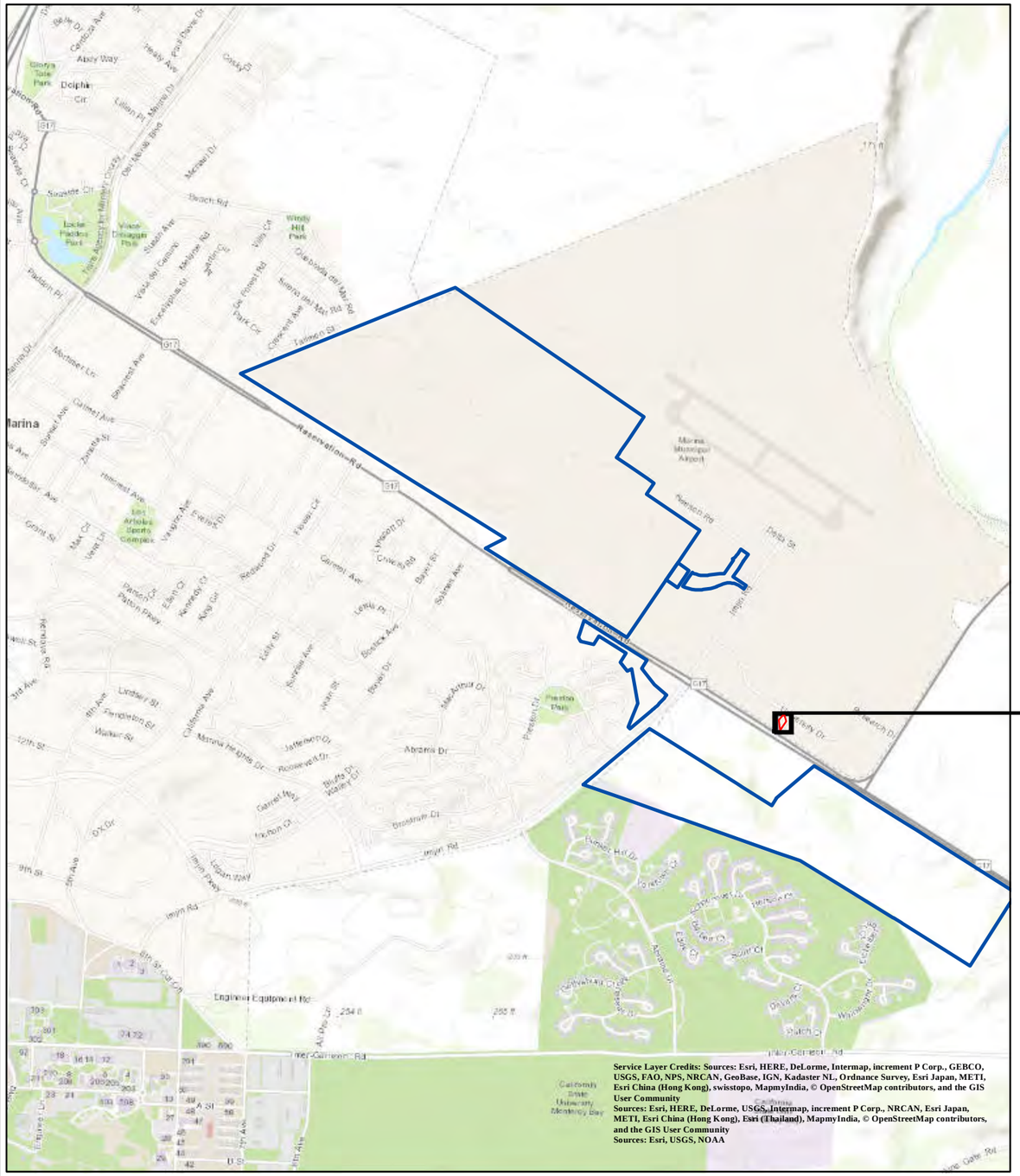

N

0 1.25 2.5 5 Miles

0 2.5 5 10 Kilometers

# Figure A1.1

## Project Vicinity Map





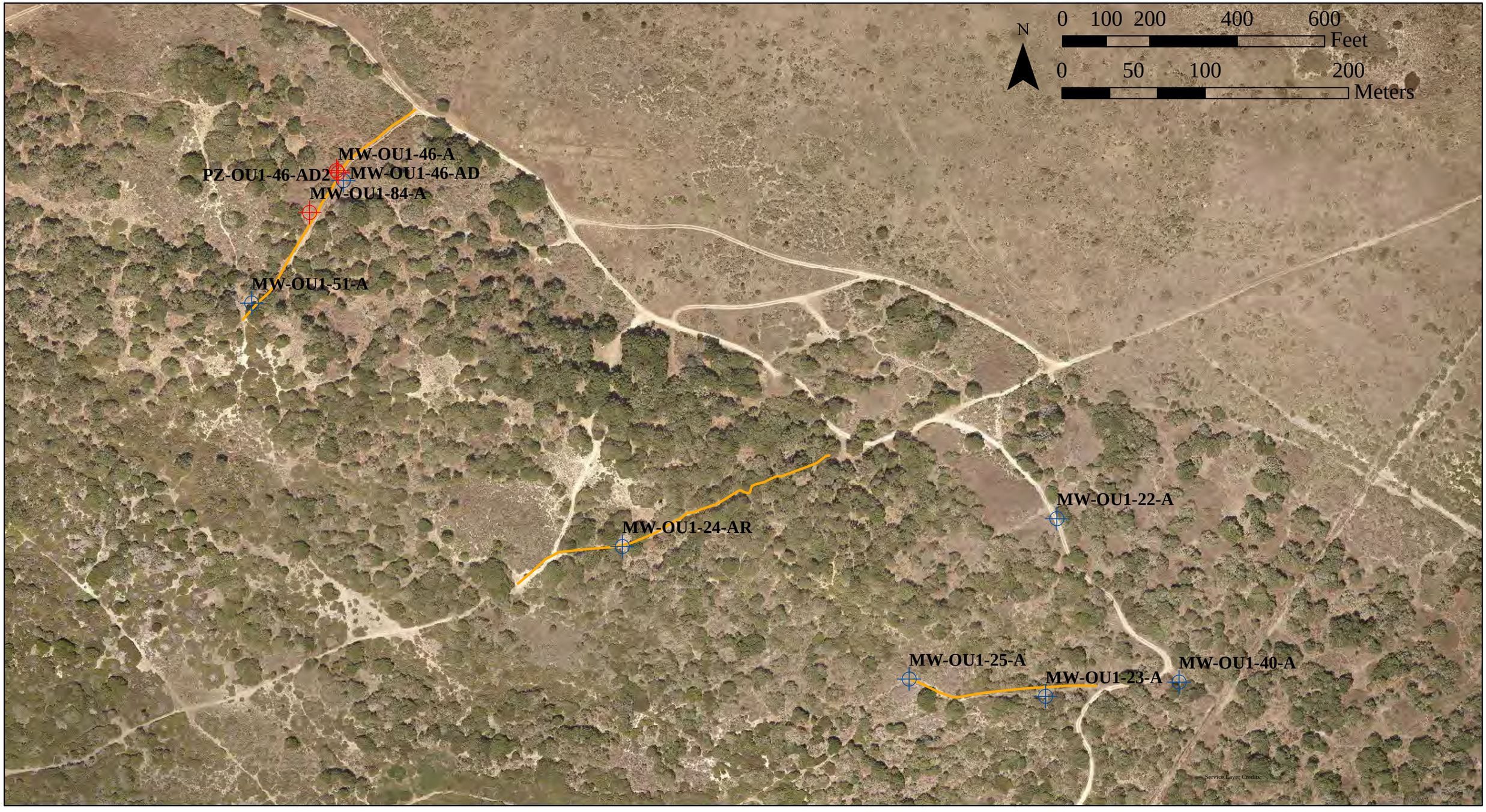
Survey Area

UC FONR Boundary

Figure A1.2

**Date: 10/23/2017**

2017 Survey Area DD&A Reference Site




Wells Surveyed in 2017 (Year 3, Destroyed in 2014)

Wells Surveyed in 2017 (Year 3, Not Destroyed)

Secondary Access Routes Surveyed in 2017

Date: 10/23/2017

# Figure A1.3

OU1 FONR 2017 Rare Plant Survey Area (Year 3)


Original GWETS Fence Line

# Figure A1.4

OU1 FONR Original Groundwater Extraction and Treatment System (GWETS) Fence Line

Date: 10/23/2017

# A2.0 Rare Plant Survey Methods

Rare plant surveys were conducted at a DD&A reference site (Figure A1.2) and the OU1 FONR survey area (Figures A1.3 & A1.4). These areas were surveyed for the three rare plants (i.e., Monterey spineflower, Yadon's piperia, and sand gilia) during four survey efforts. Due to atypical weather, surveys for sand gilia and Monterey spineflower were split into two survey efforts, approximately four weeks apart. Surveys for sand gilia were conducted on April 21, and May 26, 2017 and surveys for Monterey spineflower were conducted on May 26, and June 1, 2017. Surveys were not conducted within the appropriate blooming period for Yadon's piperia. DD&A was tasked with surveying for all piperia within the disturbed areas and reporting the findings to the BRAC office, if any plants were found. BRAC biologists planned to follow-up during the appropriate blooming period and identify the piperia species.

Mapping of the rare plant species was accomplished using a Trimble® Geo 7 Series global positioning system (GPS) with an external Zephyr Model 2 antenna. When Monterey spineflower, Yadon's piperia, or sand gilia was identified, the survey in that area was extended to the boundary of the population encountered. Large areas of Monterey spineflower and sand gilia were mapped as polygons, with attributes to identify number of individuals for sand gilia or percent 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 sand gilia 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 categories used were:

- Very Sparse (corresponding to an absolute cover of less than 3 percent),
- 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).

Locations were mapped using GPS units and data defining the population boundaries and/or point location(s) were exported to shapefile format. Shapefiles were imported for use in the Geographic Information System (GIS) ESRI® ArcGIS 10.4 and overlaid on high-resolution aerial photography/satellite imagery. An overview of the FONR survey area results, the populations identified for each species within FONR, and the populations identified for each species within the reference site are discussed below.

# A3.0 Rare Plant Survey Results

## *A3.1 Sand Gilia*

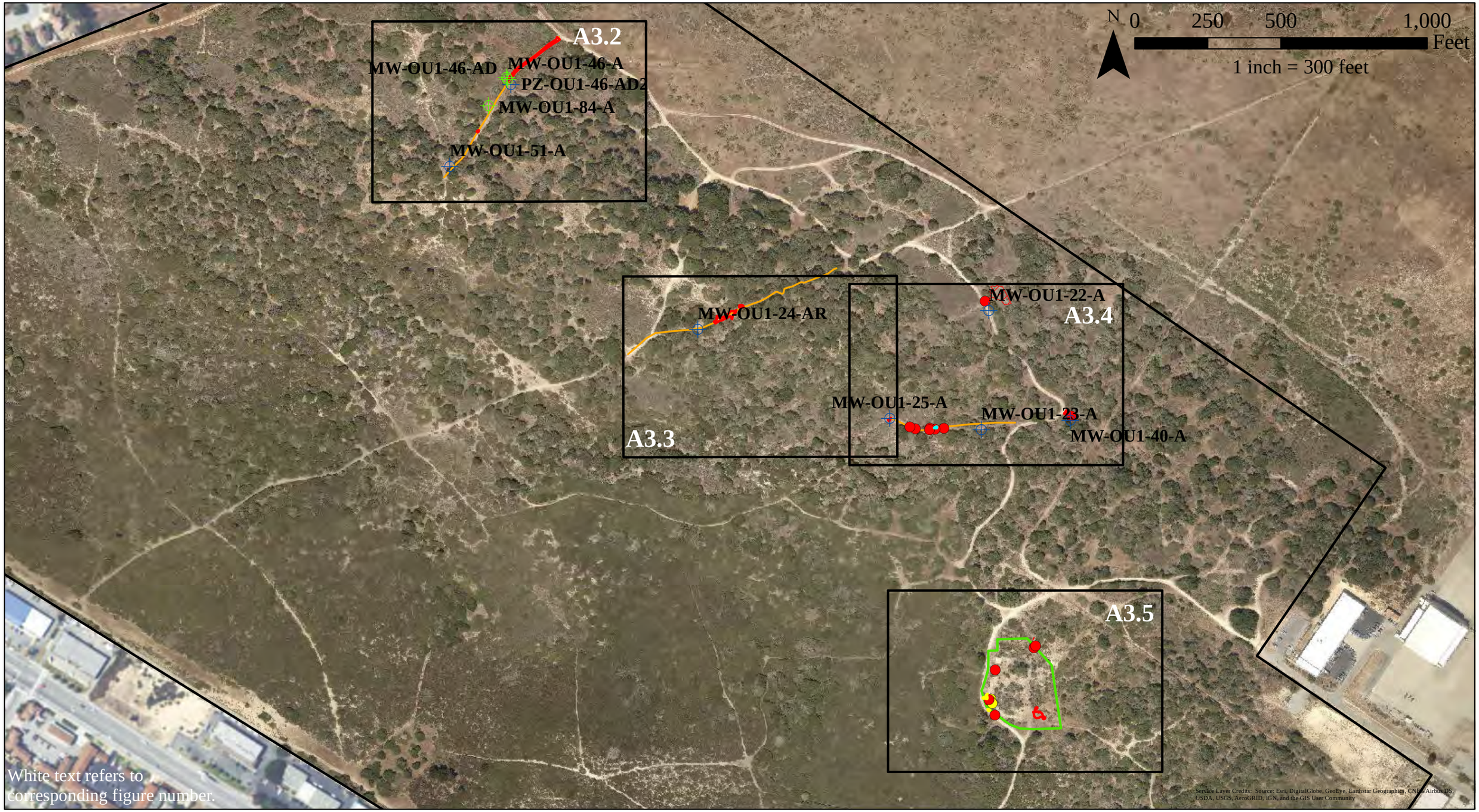
Sand gilia was observed and mapped at the DD&A reference site and OU1 FONR survey area (Figure A3.1 through Figure A3.6; Attachment A-1). Within the OU1 FONR survey area, sand gilia was present along secondary access routes and along the original GWETS fence line. In all, fourteen populations (nine points and five polygons) of sand gilia, totaling 510 individual plants were mapped within the DD&A reference site and OU1 FONR survey area.

## *A3.2 Monterey Spineflower*

Monterey spineflower was observed and mapped at the DD&A reference site and OU1 FONR survey area (Figure A3.1 through Figure A3.6; Attachment A-1). Within the OU1 FONR survey area, Monterey spineflower was present at three of the seven destroyed well locations and two of the three existing well locations, along the secondary access routes, and along the original GWETS fence line. In all, 28 populations (thirteen points and fifteen polygons) of Monterey spineflower were mapped within the DD&A reference site and OU1 FONR survey area. Population size estimates for Monterey spineflower were not easily quantifiable; therefore, individual Monterey spineflower plants were not recorded within the GIS polygons. Populations of Monterey spineflower were categorized by percent cover based on visual estimation. Of the fifteen populations of Monterey spineflower that were mapped as polygons, twelve populations were Sparse (3-25 percent cover), and three populations were Medium Low (26-50 percent cover).

## *A3.3 Yadon's Piperia*

No piperia was observed or mapped within any of the survey areas during the 2017 survey effort. Due to the lack of observations, discussion of piperia, including Yadon's, will not be included in the remainder of this report.




Wells Surveyed in 2017 (Year 3, Destroyed in 2014)

Wells Surveyed in 2017 (Year 3, Not Destroyed)

Secondary Access Routes Surveyed in 2017

Original GWETS Fence Line

Sand Gilia Points

Monterey Spineflower Points

Sand Gilia Polygons

**Monterey Spineflower Polygons**

Sparse

Medium Low

Date: 10/23/2017

# Figure A3.1

## 2017 Survey Area Rare Plant Population Locations Overview Map (Year 3)

N 0 50 100 200 Feet

1 inch = 70 feet

42

MW-OU1-46-AD

MW-OU1-46-A

PZ-OU1-46-AD2

MW-OU1-84-A

34

MW-OU1-51-A

White labels correspond with special-status plant populations IDs from Appendices A-1 & A-2



Wells Surveyed in 2017 (Year 3, Destroyed in 2014)

Wells Surveyed in 2017 (Year 3, Not Destroyed)

Secondary Access Routes Surveyed in 2017

Sand Gilia Points

Monterey Spineflower Points

Sand Gilia Polygons

**Monterey Spineflower Polygons**

Sparse

Medium Low

Date: 10/23/2017

# Figure A3.2

## 2017 OU1 FONR Rare Plant Survey (Year 3)
## Rare Plant Locations

N 0 50 100 200 Feet

1 inch = 70 feet

28

29

MW-OU1-24-AR

MW-OU1-25-A

37

18

17

White labels correspond with special-status plant populations IDs from Appendices A-1 & A-2



Wells Surveyed in 2017 (Year 3, Destroyed in 2014)

Wells Surveyed in 2017 (Year 3, Not Destroyed)

Secondary Access Routes Surveyed in 2017

Sand Gilia Points

Monterey Spineflower Points

Sand Gilia Polygons

**Monterey Spineflower Polygons**

Sparse

Medium Low

Date: 10/23/2017

# Figure A3.3

## 2017 OU1 FONR Rare Plant Survey (Year 3)
## Rare Plant Locations


Wells Surveyed in 2017 (Year 3, Destroyed in 2014)

Wells Surveyed in 2017 (Year 3, Not Destroyed)

Secondary Access Routes Surveyed in 2017

Sand Gilia Points

Monterey Spineflower Points

Sand Gilia Polygons

**Monterey Spineflower Polygons**

Sparse

Medium Low

Date: 10/23/2017

# Figure A3.4

## 2017 OU1 FONR Rare Plant Survey (Year 3)
## Rare Plant Locations


Original GWETS Fence Line

Sand Gilia Points

Monterey Spineflower Points

Sand Gilia Polygons

**Monterey Spineflower Polygons**

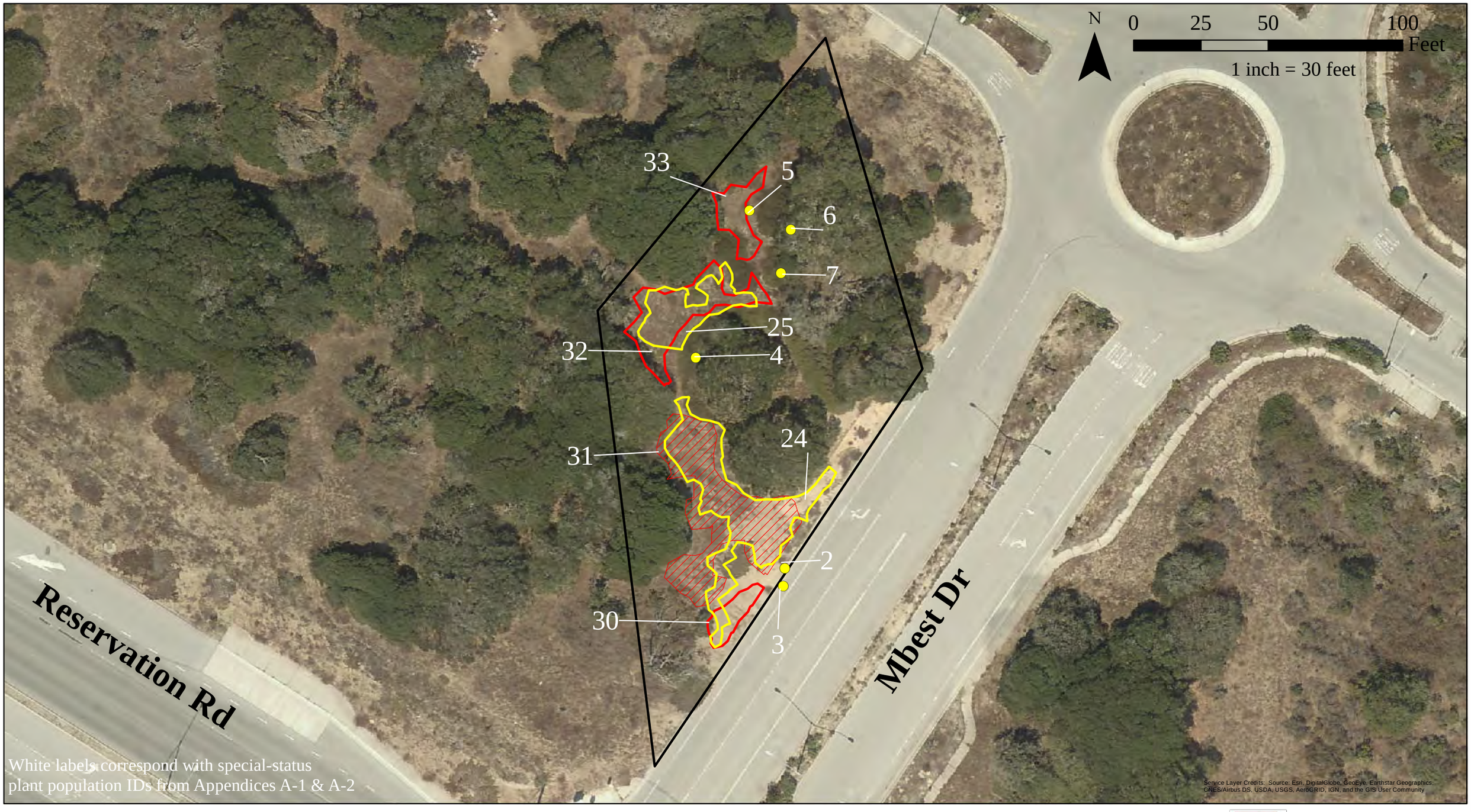
Sparse

Medium Low

# Figure A3.5

## 2017 OU1 FONR Original Groundwater Extraction and Treatment System Fence Line Survey - Rare Plant Locations

Date: 10/23/2017




Reference Area

Sand Gilia Points

Monterey Spineflower Points

Sand Gilia Polygons

**Monterey Spineflower Polygons**

Sparse

Medium Low

# Figure A3.6

Date: 10/23/2017

## 2017 DD&A Reference Site Survey - Rare Plant Locations

# A4.0 Conclusions

## *A4.1 Rare Plant Populations*

As required by the HMP and the 2017 Programmatic Biological Opinion, surveys are conducted for three years after the disturbance occurs in any area that is disturbed during the remediation effort. The 2017 survey is the third and final survey conducted following the disturbance associated with the removal of the original GWETS fence line and the destruction of wells in 2014. Rare plants observed within thirty feet of a well were determined to occur within the area impacted by the destruction of the well.

### A4.1.1 DD&A Reference Site Sand Gilia Populations

The reference site is located in an area relatively undisturbed by anthropogenic activities. Several environmental variables can influence the distribution and abundance of Monterey gilia in a particular year (USFWS, 2008). In 2017, a total of 463 individual sand gilia plants were observed at the reference site (Table A4.1). In 2017, the largest individual population of sand gilia plants was observed at the reference site (283 individuals).

**Table A4.1 Sand Gilia Population at DD&A Reference Site in 2017**

| Year | # of Populations | Individual Plants | # of Points | # of Polygons | Area of Polygons (sq. ft.) |
|---|---|---|---|---|---|
| 2017 | 8 | 463 | 6 | 2 | 1,950 |

### A4.1.2 DD&A Reference Site Monterey Spineflower Populations

Several environmental variables can influence the distribution and abundance of Monterey spineflower in a particular year (USFWS, 2002). In 2017, Monterey spineflower occupied approximately 2,855 square feet at the reference site (Table A4.2).

**Table A4.2 Monterey Spineflower Population at the DD&A Reference Site in 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 (sq. ft.) |
|---|---|---|---|---|---|
| | | | Sparse | Medium-Low | |
| 2017 | 4 | 0 | 3 | 1 | 2,855 |

### A4.1.3 OU1 FONR Survey Area Sand Gilia Populations 2017

In 2017, DD&A surveyed for sand gilia along the original GWETS fence line, along secondary access routes, and at seven destroyed well locations in the OU1 FONR. Sand gilia was not present, within thirty feet of, any of the well locations surveyed. Five populations (3 points and 2 polygons), consisting of 37 individuals were found along the original GWETS fence line (Figure A3.5 and Attachment A-1). The total sand gilia population observed in the 2017 in the OU1 FONR survey area was 47 plants (Table A4.3).

**Table A4.3 Sand Gilia Population in OU1 FONR Survey Area in 2017**

| Year | # of Populations | Individual Plants | # of Points | # of Polygons | Area of Polygons (sq. ft.) | # of Wells Where Present | Well Location Where Present |
|---|---|---|---|---|---|---|---|
| 2017 | 6 | 47 | 3 | 3 | 147 | 0 | - |

## A4.1.4 OU1 FONR Survey Area Monterey Spineflower Populations 2017

In 2017, DD&A surveyed for Monterey spineflower along the original GWETS fence line, along secondary access routes, and at seven destroyed well locations in the OU1 FONR survey area. Monterey spineflower was found along the original GWETS fence line, along secondary access routes, and within 30 feet of three destroyed well locations (MW-OU1-40-A, MW-OU1-25A, and PZ-OU1-46-AD2) (Table A4.4) and two existing well locations (MW-OU1-46-AD, MW-OU1-46-A) (Table A4.4).

**Table A4.4 Monterey Spineflower Population at OU1 FONR Survey Area in 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 (sq. ft.) |
|---|---|---|---|---|---|
| | | | Sparse | Medium-Low | |
| 2017 | 24 | 13 | 9 | 2 | 6,055 |

# A5.0 References

[CDFW] California Department of Fish and Wildlife California Natural Diversity Database. 2017. Biogeographic Data Branch, Monterey County RareFind Report. Department of Fish and Wildlife.

Fusari, Margret, Ph.D. 2004. Director, University of California Santa Cruz Natural Reserves. Telephone conversations and e-mail correspondence with Amy Hiss, Gary Santolo, and Roy Evans regarding the federally listed species and noxious weeds. June, 2004.

[USACE] U.S. Army Corps of Engineers, Sacramento District. 1997. Installation-Wide Multispecies Habitat Management Plan for Former Fort Ord, California. April 1997. Sacramento, CA.

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2008. Monterey Gilia (*Gilia tenuiflora ssp. arenaria*) 5-Year Review: Summary and Evaluation U.S. Fish and Wildlife Service Ventura Fish and Wildlife Office Ventura, California. March 2008.

2017. Re-initiated Programmatic Biological Opinion for Cleanup and Property Transfer Actions Conducted at the Former Fort Ord, Monterey County, California (8-8-09-F-74) (2015 Biological Opinion). May 28. AR# BW-2747.

Appendix A-1. Sand Gilia Populations Identified During 2017 Survey (Year 3)

| **Population #** | **Number of Individuals** | **GIS Feature Type** | **Survey Date** | **Figure Number** |
|---|---|---|---|---|
| 1 | 10 | Polygon | 5/26/2017 | **A3.4** |
| 2 | 3 | Point | 4/21/2017 | **A3.6** |
| 3 | 1 | Point | 4/21/2017 | **A3.6** |
| 4 | 1 | Point | 4/21/2017 | **A3.6** |
| 5 | 1 | Point | 4/21/2017 | **A3.6** |
| 6 | 2 | Point | 4/21/2017 | **A3.6** |
| 7 | 2 | Point | 4/21/2017 | **A3.6** |
| 8 | 1 | Point | 4/21/2017 | **A3.5** |
| 9 | 4 | Point | 4/21/2017 | **A3.5** |
| 10 | 5 | Point | 4/21/2017 | **A3.5** |
| 24 | 283 | Polygon | 4/21/2017 | **A3.6** |
| 25 | 170 | Polygon | 4/21/2017 | **A3.6** |
| 26 | 13 | Polygon | 4/21/2017 | **A3.5** |
| 27 | 14 | Polygon | 4/21/2017 | **A3.5** |

Appendix A-2. Monterey Spineflower Populations Identified During 2017 Survey (Year 3) Number of individual is provided for point features, and percent cover is provided for polygon features.

| Population # | Number of Individuals or Percent Cover | Cover Class | GIS Feature Type | Survey Date | Figure Number |
|---|---|---|---|---|---|
| 11 | 2 | N/A | Point | 5/26/2017 | **A3.4** |
| 12 | 4 | N/A | Point | 5/26/2017 | **A3.4** |
| 13 | 1 | N/A | Point | 5/26/2017 | **A3.4** |
| 14 | 1 | N/A | Point | 5/26/2017 | **A3.4** |
| 15 | 1 | N/A | Point | 5/26/2017 | **A3.4** |
| 16 | 1 | N/A | Point | 5/26/2017 | **A3.4** |
| 17 | 2 | N/A | Point | 5/26/2017 | **A3.3, A3.4** |
| 18 | 4 | N/A | Point | 5/26/2017 | **A3.3, A3.4** |
| 19 | 1 | N/A | Point | 5/26/2017 | **A3.5** |
| 20 | 1 | N/A | Point | 5/26/2017 | **A3.5** |
| 21 | 3 | N/A | Point | 5/26/2017 | **A3.5** |
| 22 | 1 | N/A | Point | 5/26/2017 | **A3.5** |
| 23 | 2 | N/A | Point | 5/26/2017 | **A3.5** |
| 28 | 5 | Sparse | Polygon | 6/1/2017 | **A3.3** |
| 29 | 5 | Sparse | Polygon | 6/1/2017 | **A3.3** |
| 30 | 5 | Sparse | Polygon | 6/1/2017 | **A3.6** |
| 31 | 35 | Medium Low | Polygon | 6/1/2017 | **A3.6** |
| 32 | 20 | Sparse | Polygon | 6/1/2017 | **A3.6** |
| 33 | 10 | Sparse | Polygon | 6/1/2017 | **A3.6** |
| 34 | 10 | Sparse | Polygon | 5/26/2017 | **A3.2** |
| 35 | 30 | Medium Low | Polygon | 5/26/2017 | **A3.4** |
| 36 | 5 | Sparse | Polygon | 5/26/2017 | **A3.4** |
| 37 | 5 | Sparse | Polygon | 5/26/2017 | **A3.3, A3.4** |
| 38 | 10 | Sparse | Polygon | 5/26/2017 | **A3.5** |
| 39 | 10 | Sparse | Polygon | 5/26/2017 | **A3.5** |
| 40 | 10 | Sparse | Polygon | 5/26/2017 | **A3.5** |
| 41 | 50 | Medium Low | Polygon | 5/26/2017 | **A3.5** |
| 42 | 5 | Sparse | Polygon | 5/23/2017 | **A3.2** |

# APPENDIX B

## RESULTS OF 2017 RARE PLANT AND HABITAT SURVEY (YEAR 0)
## MONTEREY SPINEFLOWER AND SAND GILIA SURVEYS

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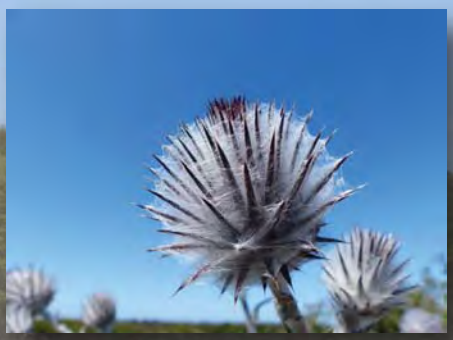
# Results of 2017 Rare Plant and Habitat Survey (Year 0) Monterey Spineflower and Sand Gilia Surveys

## OU-1, Fort Ord Natural Reserve, California

*Prepared for HydroGeoLogic Inc.*

*Prepared By Denise Duffy & Associates, Inc.*



**Denise Duffy & Associates, Inc.**
**947 Cass St. Suite 5**
**Monterey, CA 93940**
**(831) 373-4341**
**facsimile (831) 373-1417**

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## Appendix

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**Acronym List**

| | |
|---|---|
| CDFW | California Department of Fish and Wildlife |
| CNDDB | California Natural Diversity Database |
| DD&A | Denise Duffy & Associates, Inc. |
| FDA | Fire Drill Area |
| FE | federally endangered |
| FONR | Fort Ord Natural Reserve |
| FT | federally threatened |
| GIS | geographic information system |
| GPS | global positioning system |
| GWETS | groundwater extraction and treatment system |
| HGL | HydroGeoLogic, Inc. |
| HMP | Habitat Management Plan |
| OU | operable unit |
| ST | state threatened |
| TCE | trichloroethene |
| UCNRS | University of California Natural Reserve System |
| USACE | U.S. Army Corps of Engineers |
| USGS | United States Geological Survey |
| USFWS | United States Fish and Wildlife Service |
| VOC | volatile organic compound |

# B1.0 Introduction

HydroGeoLogic, Inc. (HGL) was contracted to destroy wells and decommission the associated groundwater treatment facility located within Operable Unit (OU1) at the former Fort Ord U.S. Army Base located in Monterey County, California (Figure A1.1). Biological surveys were required in support of these activities. The U.S. Army Corps of Engineers (USACE)-Sacramento District, under Contract Number W912DY-10-D-0023, awarded this work to HGL. Denise Duffy & Associates (DD&A) performed the biological survey work described herein under subcontract to HGL.

Fort Ord was established in 1917 as a military training base for infantry troops. In January 1991, the Secretary of Defense announced the downsizing/closure of the base. In August 1994, portions of the property were transferred to the University of California and the Fort Ord Natural Reserve (FONR) was established in June 1996. The former Fort Ord is located near Monterey Bay approximately 80 miles south of San Francisco. The base consists of approximately 28,000 acres near the cities of Seaside, Sand City, Monterey, Del Rey Oaks, and Marina. Monterey Bay marks the western boundary, Toro Regional Park borders the base to the southeast, and land use to the east is primarily agricultural.

Activities conducted at the former Fort Ord Fritzsche Army Airfield Fire Drill Area (FDA) (the source area for OU1 contaminants) between 1962 and 1985 resulted in the release of contaminants to soils and groundwater. Although 10 volatile organic compounds (VOCs) were identified as contaminants of concern in groundwater underlying OU1, trichloroethene (TCE) is the contaminant that was detected at the highest concentrations and across the greatest extent of the affected aquifer. A groundwater extraction and treatment system (GWETS) began operation in 1988 to remediate TCE and other groundwater contaminants. In 2004 HGL assumed control of the remediation efforts, which included the construction of a new GWETS in 2006. The 1988 facility is referred to as the original GWETS and the new facility is referred to as the Northwest Treatment System (NWTS).

A key factor that affected the design and implementation of the groundwater cleanup is the fact that the groundwater plume lies beneath a part of the University of California Natural Reserve System (UCNRS) designated as the FONR. The FONR area potentially impacted by the destruction and decommissioning of OU1 remediation facilities includes each well site (including a 30-foot radius from the well location), the NWTS, and the associated secondary access routes (including a 10-foot buffer beyond the edge of the roadway). 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 (PBO) for Cleanup and Property Transfer Actions Conducted at the Former Fort Ord, Monterey County, California (USFWS, 2015 and USFWS, 2017). Project activities undertaken to achieve the OU1 cleanup must protect and maintain the special-status species found within the FONR, specifically: federally threatened (FT) Monterey spineflower (*Chorizanthe pungens* var. *pungens*) and federally endangered (FE) and state threatened (ST) sand gilia (*Gilia tenuiflora* ssp. *arenaria*). DD&A also surveyed for FE Yadon's piperia (*Piperia yadonii*). Yadon's piperia was

included in the 2017 survey at the request of the Base Realignment and Closure (BRAC) office and in accordance with the 2017 PBO.

As part of the destruction and decommissioning project, DD&A was contracted by HGL to conduct baseline surveys at thirty-three well sites and the NWTS. The well survey areas included the secondary access routes to the well locations, but did not include the main thoroughfares on the FONR property. Baseline rare plant surveys were conducted in 2017 in the OU1 FONR area prior to the destruction of wells. Rare plant surveys are conducted as part of the overall objective of protecting the three special-status plant species in areas affected by construction activities. This report details the surveys completed in April, May, and June 2017.

## *B1.1 Survey Objectives*

The objectives of the 2017 rare plant survey (Year 0) were to:

1. Map Monterey spineflower and sand gilia at a DD&A reference site southeast of the FONR property (Figure A1.2);
2. Map Monterey spineflower, sand gilia, and Yadon's piperia at well locations to be destroyed in 2017 within the sensitive habitat portions of the FONR, the NWTS, and secondary access routes. (OU1 FONR survey area—Figures A1.3)

## *B1.2 Site Location and Description*

The dominant habitats in the OU1 FONR survey area include coast live oak woodland, maritime chaparral, coastal scrub, disturbed/developed land, and annual grassland. Several special-status plant and wildlife species occur within the FONR, including sand gilia and Monterey spineflower. The northern and eastern boundaries of OU1 are adjacent to a large expanse of non-native grassland. Transmission of non-native grass species into OU1 is accelerated by the prevailing southern winds, which blow seeds into the OU1 area (Fusari, 2004). Non-native grasses and weedy forbs are already present throughout much of the OU1 area. The spread of non-native, invasive species into newly disturbed areas may result in population declines of Monterey spineflower and sand gilia. Sand gilia is especially vulnerable to the encroachment of invasive species as it is less tolerant of competing plant cover than Monterey spineflower.

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.

### B1.2.1 Sand Gilia

Sand gilia is a small annual in the phlox family (*Polemoniaceae*). Plants range in height from two to six inches with a small, basal rosette of leaves. The lower branches of the stem are generally densely glandular. Plants typically bloom from April through June and have funnel-shaped flowers with narrow, purple to pinkish petal lobes and a purple

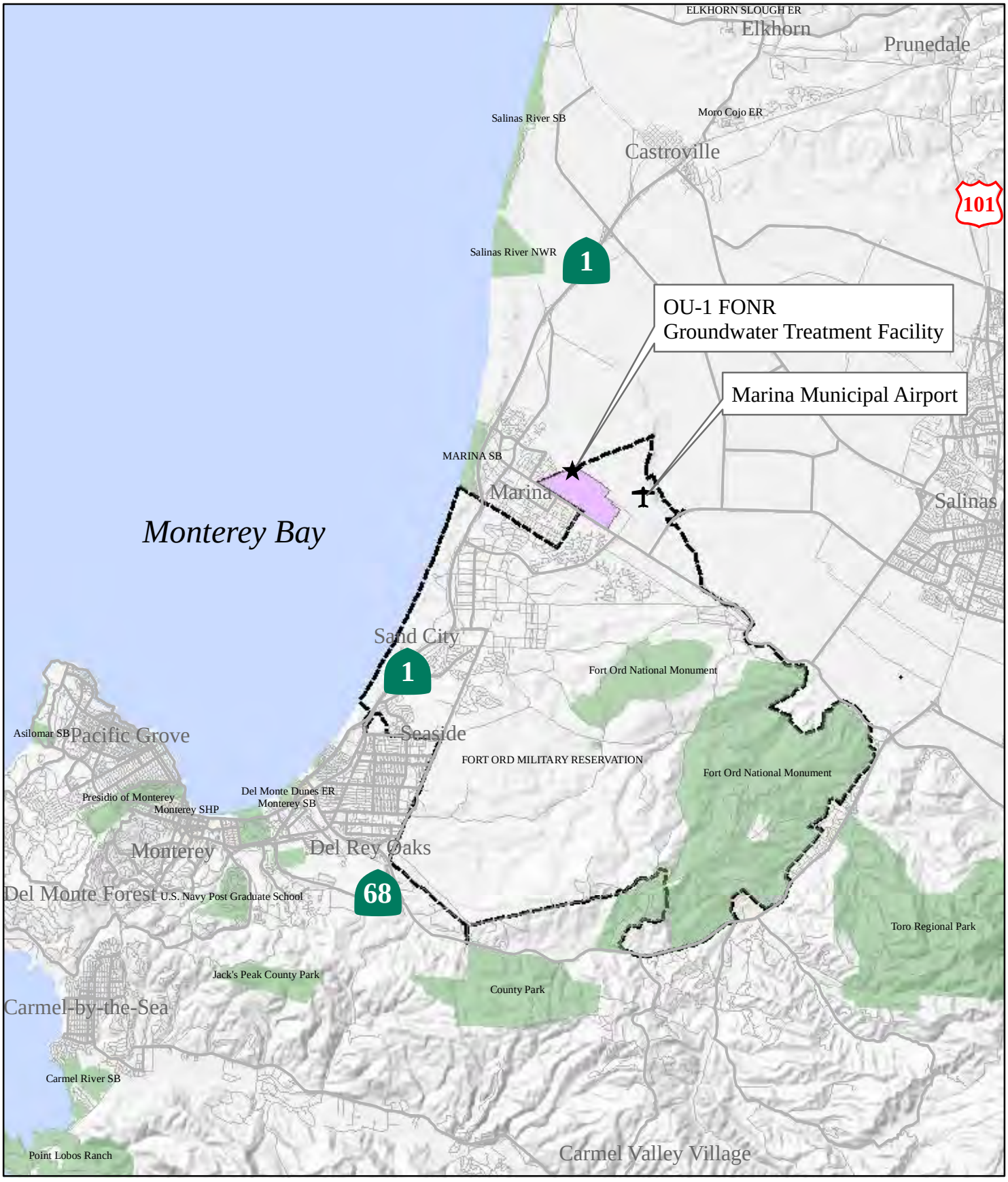
throat. This species occurs in open sandy soils in dune scrub, coastal sage scrub, and maritime chaparral habitats. Sand gilia is endemic to Monterey Bay and the peninsular dune complexes. According to the California Natural Diversity Database (CNDDB) there are 31 occurrences within Monterey County, including the occurrences at Fort Ord (CDFW, 2017). It is likely that some of these occurrences are no longer present and the exact number of extant (still in existence) occurrences are unknown.

### B1.2.2 Monterey Spineflower

Monterey spineflower is a small, prostrate annual in the buckwheat family (*Polygonaceae*) that blooms from April to June. The white to rose floral tube of Monterey spineflower distinguishes it from the more common, but closely related diffuse spineflower (*Chorizanthe diffusa*), which has a lemon-yellow floral tube. This species typically occurs on open sandy or gravelly soils in coastal dune, coastal scrub, and maritime chaparral habitats. There are 47 records of Monterey spineflower within Monterey County in the CNDDB (CDFW, 2017); however, it is not known how many of these are extant.

### B1.2.3 Yadon's Piperia

Yadon's piperia is a perennial herb in the orchid family (*Orchidaceae*) that blooms from May to August. The elongated spur of Yadon's piperia distinguishes it from the more common species of piperia that are found in the same habitat and range. This species typically occurs in coastal scrub, closed-cone pine forests, and maritime chaparral habitats. There are 29 records of Yadon's piperia within Monterey County in the CNDDB (CDFW, 2017); however, it is not known how many of these are extant.



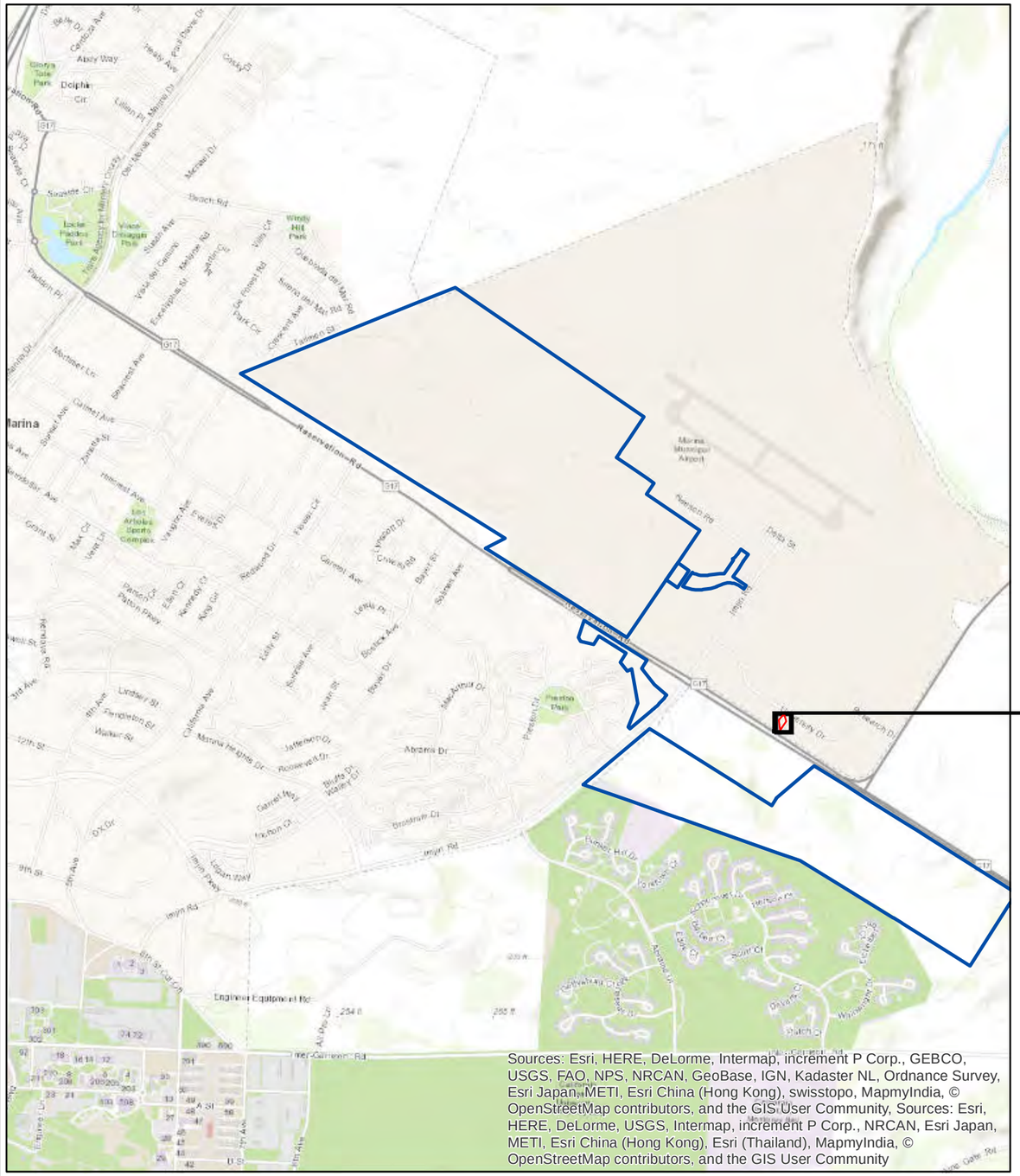

N

0 1.25 2.5 5 Miles

0 2.5 5 10 Kilometers

# Figure B1.1

## Project Vicinity Map





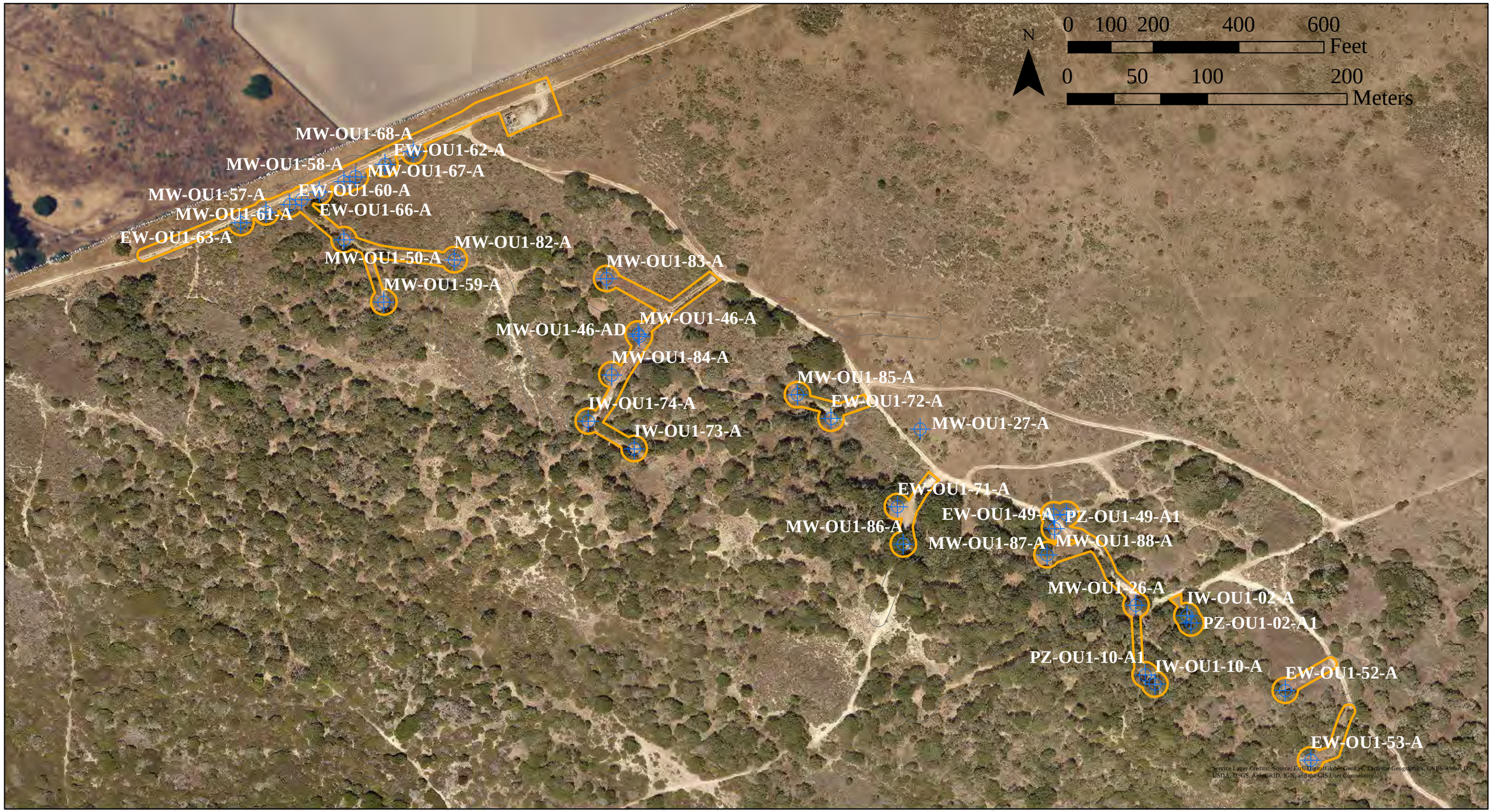
Survey Area

UC FONR Boundary

Figure B1.2

**Date: 10/23/2017**

2017 Survey Area DD&A Reference Site




Wells Surveyed in 2017 (Year 0)

2017 Rare Plant Survey Area (Year 0)

DD&A

# Figure B1.3

Date: 10/23/2017

OU1 FONR 2017 Rare Plant Survey Area (Year 0)

# B2.0 Rare Plant Survey Methods

Rare plant surveys were conducted at a DD&A reference site (Figure A1.2) and the OU1 FONR survey area (Figures A1.3). These areas were surveyed for the three rare plants (i.e., Monterey spineflower, Yadon's piperia, and sand gilia) during four survey efforts. Surveys for sand gilia and Monterey spineflower were split into three survey efforts. Surveys for sand gilia were conducted on April 21, and May 26, 2017 and surveys for Monterey spineflower were conducted on May 23, May 26, and June 1, 2017. Surveys were not conducted within the appropriate blooming period for Yadon's piperia. DD&A was tasked with surveying for all piperia within the disturbed areas and reporting the findings to the BRAC office. If any piperia plants were found, BRAC biologists planned to follow-up during the appropriate blooming period and identify the piperia species.

Mapping of the rare plant species was accomplished using a Trimble® Geo 7 Series global positioning system (GPS) with an external Zephyr Model 2 antenna. When Monterey spineflower, Yadon's piperia, or sand gilia was identified, the survey in that area was extended to the boundary of the population encountered[1]. Large areas of Monterey spineflower and sand gilia were mapped as polygons, with attributes to identify number of individuals for sand gilia or percent 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 sand gilia 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 categories used were:

- Very Sparse (corresponding to an absolute cover of less than 3 percent),
- 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).

Locations were mapped using GPS units and data defining the population boundaries and/or point location(s) were exported to shapefile format. Shapefiles were imported for use in the Geographic Information System (GIS) ESRI® ArcGIS 10.4 and overlaid on high-resolution aerial photography/satellite imagery. An overview of the FONR survey

[1] One exception to this methodology was implemented in the area adjacent to wells MW-OU1-57-A, EW-OU1-63-A, and the associated secondary access route. Monterey spineflower identified at this location extended approximately 500 feet beyond the 2017 Baseline Survey Area, in some instances outside of FONR boundaries. Mapping these polygons to their extents would have greatly overestimated the baseline conditions of area proposed for impact. Therefore, the polygon associated with the well locations referenced above were mapped to the extent of the predetermined survey boundaries (10 feet beyond road edge and 30-feet around the well location).

area results, the populations identified for each species within FONR, and the populations identified for each species within the reference site are discussed below.

# B3.0 Rare Plant Survey Results

## *B3.1 Sand Gilia*

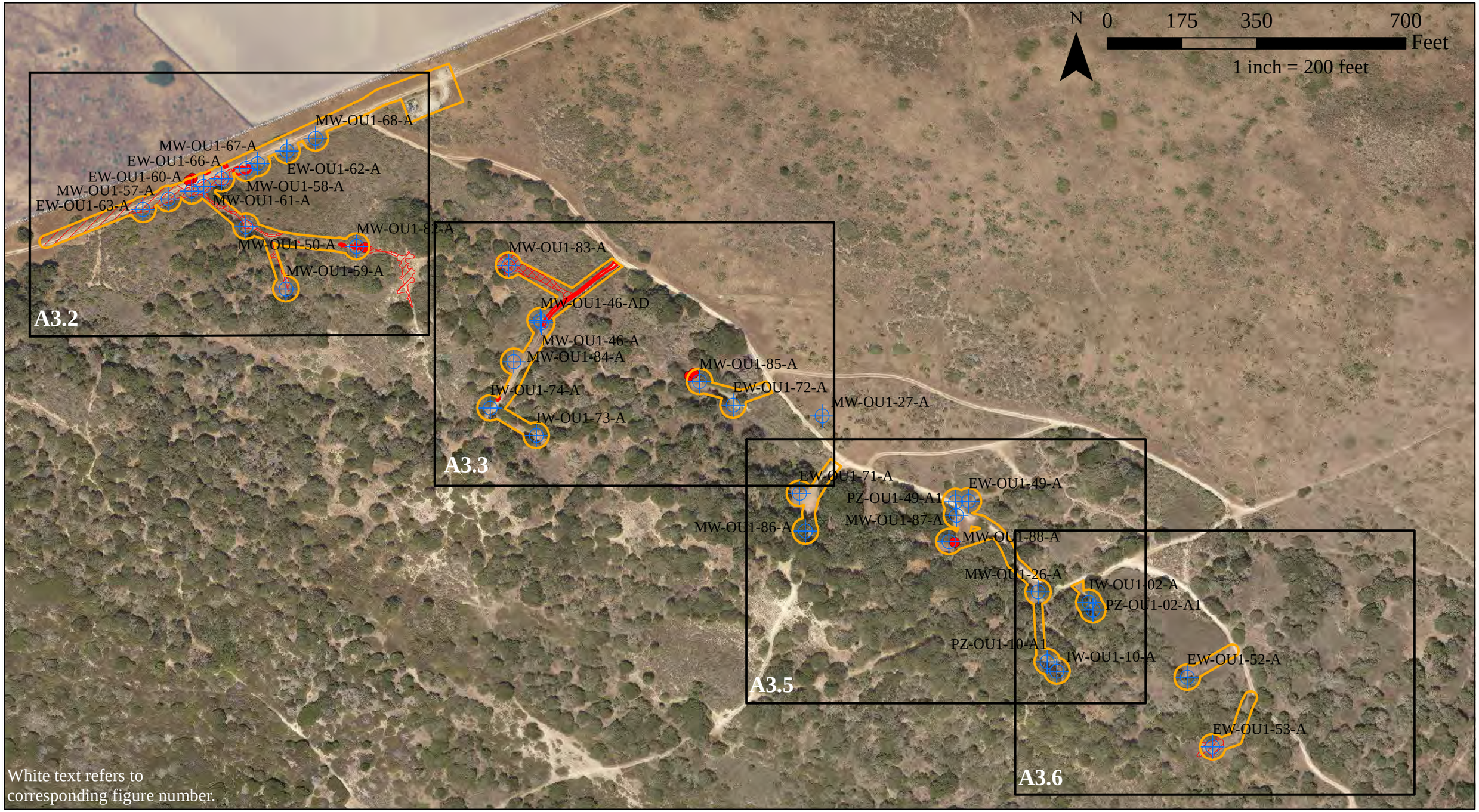
Sand gilia was observed and mapped at the DD&A reference site, however sand gilia was not observed at the OU1 FONR survey area (Figure A3.6; Attachment A-1). Within the OU1 FONR survey area, sand gilia was not present along secondary access routes, the treatment plant, or at any one of the 33 wells. In all, eight populations (six points and two polygons) of sand gilia, totaling 463 individual plants were mapped within the DD&A reference site.

## *B3.2 Monterey Spineflower*

Monterey spineflower was observed and mapped at the DD&A reference site and OU1 FONR survey area (Figure A3.1 through Figure A3.6; Attachment A-1). Within the OU1 FONR survey area, Monterey spineflower was present at 17 of the 33 well locations. In all, 23 populations (six points and 17 polygons) of Monterey spineflower were mapped within the DD&A reference site and OU1 FONR survey area. As referenced above in the methodology section; populations of Monterey spineflower were categorized by percent cover based on visual estimation. Of the 17 populations of Monterey spineflower that were mapped as polygons, 10 populations were Sparse (3-25 percent cover), six populations were Medium Low (26-50 percent cover), and one population was Medium (51-75 percent cover).

## *B3.3 Yadon's Piperia*

No piperia was observed or mapped within any of the survey areas during the 2017 survey effort. Due to the lack of observations, discussion of piperia species, including Yadon's, will not be included in the remainder of this report.




Wells Surveyed in 2017 (Year 0, Destroyed in 2017)

2017 Rare Plant Survey Area (Year 0)

Sand Gilia Points

Monterey Spineflower Points

Sand Gilia Polygons

**Monterey Spineflower Polygons**

Sparse

Medium Low

Medium

# Figure B3.1

## 2017 Survey Area Rare Plant Population Locations Overview Map (Year 0)

Date: 10/23/2017

0 62.5 125 250 Feet

1 inch = 80 feet

N

MW-OU1-68-A
EW-OU1-62-A
27
28
29
MW-OU1-58-A
10
MW-OU1-67-A
11
MW-OU1-61-A
EW-OU1-66-A
21
MW-OU1-57-A
EW-OU1-63-A
EW-OU1-60-A
MW-OU1-50-A
23
24
25
12
MW-OU1-82-A
MW-OU1-83-A
22
26
MW-OU1-59-A
MW-OU1-84-A

White labels correspond with special-status plant populations IDs from Appendices A-1 & A-2



Wells Surveyed in 2017 ( Year 0, Not Destroyed)

2017 Rare Plant Survey Area (Year 0)

Sand Gilia Points

Monterey Spineflower Points

Sand Gilia Polygons

**Monterey Spineflower Polygons**

Sparse

Medium Low

Date: 10/23/2017

# Figure B3.2

## 2017 OU1 FONR Rare Plant Survey (Year 0)
## Rare Plant Locations

N

0 50 100 200 Feet

1 inch = 70 feet

MW-OU1-83-A

31

30

MW-OU1-46-AD

MW-OU1-46-A

MW-OU1-84-A

8

7

MW-OU1-85-A

19

IW-OU1-74-A

EW-OU1-72-A

MW-OU1-27-A

IW-OU1-73-A

EW-OU1-71-A

Service Layer Credits:

White labels correspond with special-status plant populations IDs from Appendices A-1 & A-2

Wells Surveyed in 2017 (Year 0, Destroyed in 2017)

2017 Rare Plant Survey Area (Year 0)

Sand Gilia Points

Monterey Spineflower Points

Sand Gilia Polygons

**Monterey Spineflower Polygons**

Sparse

Medium Low

Medium

Date: 10/23/2017

DD&A

# Figure B3.3

## 2017 OU1 FONR Rare Plant Survey (Year 0) Rare Plant Locations

N 0 50 100 200 Feet

1 inch = 70 feet

EW-OU1-71-A

MW-OU1-86-A

PZ-OU1-49-A1 EW-OU1-49-A

MW-OU1-87-A

MW-OU1-88-A

9

MW-OU1-26-A

IW-OU1-02-A

PZ-OU1-02-A1

PZ-OU1-10-A1

IW-OU1-10-A

White labels correspond with special-status plant populations IDs from Appendices A-1 & A-2

Service Layer Credits:

Wells Surveyed in 2017 (Year 0, Destroyed in 2017)

2017 Rare Plant Survey Area (Year 0)

Sand Gilia Points

Monterey Spineflower Points

Sand Gilia Polygons

**Monterey Spineflower Polygons**

Sparse

Medium Low

DD&A

# Figure B3.4

## 2017 OU1 FONR Rare Plant Survey (Year 0)
## Rare Plant Locations

Date: 10/23/2017


Wells Surveyed in 2017 (Year 0, Destroyed in 2017)

2017 Rare Plant Survey Area (Year 0)

Sand Gilia Points

Monterey Spineflower Points

Sand Gilia Polygons

**Monterey Spineflower Polygons**

Sparse

Medium Low

Date: 10/23/2017

# Figure B3.5

## 2017 OU1 FONR Rare Plant Survey (Year 0)
## Rare Plant Locations

N

0 25 50 100 Feet

1 inch = 30 feet

18 4 5 6 14 3 17 13 16 1 2 15

Reservation Rd

Mbest Dr

White labels correspond with special-status plant population IDs from Appendices A-1 & A-2

Service Layer Credits:

Reference Area

Sand Gilia Points

Sand Gilia Polygons

**Monterey Spineflower Polygons**

Sparse

Medium Low

# Figure B3.6

Date: 10/23/2017

2017 DD&A Reference Site Survey - Rare Plant Locations

# B4.0 Conclusions

## *B4.1 Rare Plant Populations*

As required by the HMP and the 2017 Programmatic Biological Opinion, surveys are conducted for three years after the disturbance occurs in any area that is disturbed during the remediation effort. The 2017 survey is the baseline survey conducted before disturbance associated with the removal of the thirty-three wells, NWTS, and secondary access routes. Rare plants observed within thirty feet of a well were determined to occur within the area to be impacted by the destruction of the well.

### B4.1.1 DD&A Reference Site Sand Gilia Populations

The reference site is located in an area relatively undisturbed by anthropogenic activities. Several environmental variables can influence the distribution and abundance of Monterey gilia in a particular year (USFWS, 2008). In 2017, a total of 463 individual sand gilia plants were observed at the reference site (Table A4.1).

**Table B4.1 Sand Gilia Population at DD&A Reference Site in 2017**

| Year | # of Populations | Individual Plants | # of Points | # of Polygons | Area of Polygons (sq. ft.) |
|---|---|---|---|---|---|
| 2017 | 8 | 463 | 6 | 2 | 1,950 |

### B4.1.2 DD&A Reference Site Monterey Spineflower Populations

Several environmental variables can influence the distribution and abundance of Monterey spineflower in a particular year (USFWS, 2002). In 2017, Monterey spineflower occupied approximately 2,855 square feet at the reference site (Table A4.2).

**Table B4.2 Monterey Spineflower Population at the DD&A Reference Site in 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 (sq. ft.) |
|---|---|---|---|---|---|
| | | | Sparse | Medium-Low | |
| 2017 | 4 | 0 | 3 | 1 | 2,855 |

### B4.1.3 OU1 FONR Survey Area Sand Gilia Populations 2017 (Year 0)

In 2017, DD&A surveyed for sand gilia along secondary access routes, the treatment plant, and at 33 well locations in the OU1 FONR. Sand gilia was not present, within thirty feet of, any well locations surveyed, at the treatment plant, or along secondary access routes.

### B4.1.4 OU1 FONR Survey Area Monterey Spineflower Populations 2017 (Year 0)

In 2017, DD&A surveyed for Monterey spineflower at the treatment plant, at 33 wells proposed for destruction, and along secondary access routes, in the OU1 FONR survey area. Monterey spineflower was found along secondary access routes and within 30 feet of 17 well locations (EW-OU-163-A, MW-OU1-57-A, EW-OU1-60-A, MW-OU1-61-A, EW-OU1-66A, MW-OU1-58-A, MW-OU1-67-A, MW-OU1-50-A, MW-OU1-59-A, MW-OU1-82-A, MW-OU1-83-A, MW-OU1-46-AD, MW-OU1-46-A, IW-OU1-74-A, MW-OU1-85-A, MW-OU1-88-1, EW-OU1-53-A) (Table A4.4).

**Table B4.3 Monterey Spineflower Population at OU1 FONR Survey Area in 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 (sq. ft.) |
|---|---|---|---|---|---|---|
| | | | Sparse | Medium-Low | Medium | |
| 2017 | 19 | 6 | 7 | 5 | 1 | 26,939 |

# B5.0 References

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2008. Monterey Gilia (*Gilia tenuiflora ssp. arenaria*) 5-Year Review: Summary and Evaluation U.S. Fish and Wildlife Service Ventura Fish and Wildlife Office Ventura, California. March 2008.

2017. Re-Initiated Programmatic Biological Opinion for Cleanup and Property Transfer Actions Conducted at the Former Fort Ord, Monterey County, California (8-8-09-F-74) (2015 Biological Opinion). May 28. AR# BW-2747.

Appendix A-1. Sand Gilia Populations Identified During 2017 Survey (Year 0)

| Population # | Number of Individuals | GIS Feature Type | Survey Date | Figure Number |
|---|---|---|---|---|
| 1 | 3 | Point | 4/21/2017 | A3.6 |
| 2 | 1 | Point | 4/21/2017 | A3.6 |
| 3 | 1 | Point | 4/21/2017 | A3.6 |
| 4 | 1 | Point | 4/21/2017 | A3.6 |
| 5 | 2 | Point | 4/21/2017 | A3.6 |
| 6 | 2 | Point | 4/21/2017 | A3.6 |
| 13 | 283 | Polygon | 4/21/2017 | A3.6 |
| 14 | 170 | Polygon | 4/21/2017 | A3.6 |

Appendix A-2. Monterey Spineflower Populations Identified During 2017 Survey (Year 0) Number of individual is provided for point features, and percent cover is provided for polygon features.

| Population # | Number of Individuals or Percent Cover | Cover Class | GIS Feature Type | Survey Date | Figure Number |
|---|---|---|---|---|---|
| 7 | 1 | N/A | Point | 5/26/2017 | A3.3 |
| 8 | 1 | N/A | Point | 5/26/2017 | A3.3 |
| 9 | 2 | N/A | Point | 5/26/2017 | A3.4, A3.5 |
| 10 | 2 | N/A | Point | 5/23/2017 | A3.2 |
| 11 | 3 | N/A | Point | 5/23/2017 | A3.2 |
| 12 | 1 | N/A | Point | 5/23/2017 | A3.2 |
| 15 | 5 | Sparse | Polygon | 6/1/2017 | A3.6 |
| 16 | 35 | Medium Low | Polygon | 6/1/2017 | A3.6 |
| 17 | 20 | Sparse | Polygon | 6/1/2017 | A3.6 |
| 18 | 10 | Sparse | Polygon | 6/1/2017 | A3.6 |
| 19 | 10 | Sparse | Polygon | 5/26/2017 | A3.3 |
| 20 | 50 | Medium Low | Polygon | 5/26/2017 | A3.5 |
| 21 | 40 | Medium Low | Polygon | 5/23/2017 | A3.2 |
| 22 | 35 | Medium Low | Polygon | 5/23/2017 | A3.2 |
| 23 | 25 | Medium Low | Polygon | 5/23/2017 | A3.2 |
| 24 | 10 | Sparse | Polygon | 5/23/2017 | A3.2 |
| 25 | 15 | Sparse | Polygon | 5/23/2017 | A3.2 |
| 26 | 35 | Medium Low | Polygon | 5/23/2017 | A3.2 |
| 27 | 15 | Sparse | Polygon | 5/23/2017 | A3.2 |
| 28 | 5 | Sparse | Polygon | 5/23/2017 | A3.2 |
| 29 | 10 | Sparse | Polygon | 5/23/2017 | A3.2 |
| 30 | 5 | Sparse | Polygon | 5/23/2017 | A3.3 |
| 31 | 60 | Medium | Polygon | 5/23/2017 | A3.3 |