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SENT VIA EMAIL

February 21, 2014

Teresa M. Rodgers
Technical Lead
USACE-SPK-ED-ED
1325 J Street, 12th Floor, #119
Sacramento, CA 95814

Contract: W912DY-10-D-0023 CM03
Subject: Groundwater Monitoring and Maintenance of Treatment System at Sites OU-1 Former Fort Ord, California
Submittal: 2013 FONR Impact Assessment and Habitat and Rare Plant Species Survey Results

Dear Ms. Rodgers:

The 2013 FONR Impact Assessment report is submitted in accordance with the Performance Work Statement. An electronic copy has been uploaded to the HGL ftp page and can be accessed as described below. Six hard copies are also being sent to the Base Realignment and Closure Office and one copy will be sent to Dr. Gage Dayton at the University of California Santa Cruz. The signed transmittal letter for the deliverable is attached.

The best way to copy files from the FTP page to your computer is to open a Windows Explorer window (please do not use a web browser). Please call David Klataske (303-984-1167) if you have any questions or trouble accessing the site. Type the following address into the address bar of the Windows Explorer window:

ftp.hgl.com

You can log into the FTP page using the following:
User name: User
Password: Sne5b1

Open the Fort Ord folder and you will see the 2013 FONR Impact Report folder. You can open the folder and copy the file from the ftp site to your local computer or network.

I am available at your convenience to discuss these results and any questions or comments you may have. You can reach me at (720) 381-5591.

Sincerely,

Roy Evans

Roy Evans, P.E.
Project Manager

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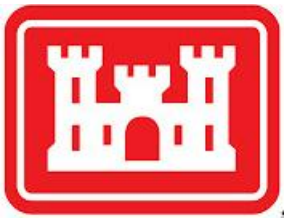
cc: James Specht, (USACE)
William Collins (Fort Ord BRAC Environmental Coordinator)
Bart Kowalski (Chenega representing USACE)
Gage Dayton, Ph.D. (University of California Santa Cruz)
Donald Boyle, P.E. (HGL)
HGL Project Files H10203

2013 FONR IMPACT ASSESSMENT AND HABITAT AND RARE PLANT SPECIES SURVEY RESULTS OPERABLE UNIT 1 FORMER FORT ORD, CALIFORNIA



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Contract No. W912DY-10-D-0023
Delivery Order CM03

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HydroGeoLogic, Inc

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Project Scientist

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TABLE OF CONTENTS

Section **Page**

LIST OF TABLES

LIST OF FIGURES

LIST OF APPENDICES

LIST OF ACRONYMS, ABBREVIATIONS, AND SYMBOLS

ACL	aquifer cleanup level
COC	contaminant of concern
DD&A	Denise Duffy and Associates, Inc.
FDA	Fire Drill Area
FONR	Fort Ord Natural Reserve
ft^2	square feet
GIS	geographic information system
GPS	global positioning system
GWETS	groundwater extraction and treatment system
HMP	Habitat Management Plan
HGL	HydroGeoLogic, Inc.
LTM	long term monitoring
NWTS	Northwest Treatment System
OU	operable unit
ROD	Record of Decision
RTE	rare, threatened, or endangered
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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2013 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. This work was contracted in December 2003 by the USACE, Omaha District, under Contract Number W912DY-10-D-0023, 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 contaminants 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. Data shows that the footprint of the TCE plume encompasses the extent of contamination contributed to by the other nine COCs. Figure 1.2 shows the estimated extent of the TCE plume in March 2013.

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 HMP presents habitat management procedures to guide remediation and other activities conducted in habitat areas, including OU-1. 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. The opinion was issued on 30 March 1999. The 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). Various mitigation measures were identified as a result of these consultations and are implemented before, during, and after work within the FONR.

Intermittent biological surveys were conducted within the OU-1 area by others since 1998 (Harding Lawson Associates, 1998). While delivery order CM01 was being executed, 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, including the endangered sand gilia and the threatened 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, 2012a); and
- *2012 FONR Impact Assessment and Habitat and Rare Plant Species Survey Results* (HGL, 2013a).

This document presents the results of the 2013 rare plant survey and discusses the potential impact to date on those plants associated with the OU-1 remediation activities conducted since 2004. The 2013 rare plant survey was conducted by Denise Duffy and Associates (DD&A) under subcontract to HGL; DD&A completed the 2006 through 2012 surveys as well. 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 2013 and planned future activities,
- Results of the 2013 rare plant survey and interim impact assessment, and
- 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 Game. The overall former Fort Ord area contains large areas of maritime chaparral habitat.

Several federally protected RTE species are known or suspected to be present within the FONR. These include the endangered sand gilia, the threatened Monterey spineflower, and the threatened California tiger salamander. Several plant and animal species of concern are also present in the FONR. Other plant species of concern include the following:

- Coast wallflower (*Erysimum ammophilum*);
- Eastwood's ericameria (*Ericameria fasciculata*);
- Monterey ceanothus (*Ceanothus cuneatus var. rigidus*);
- Sandmat manzanita (*Arctostaphylos pumila*); and
- Toro manzanita (*Arctostaphylos montereyensis*).

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

The northern boundary of OU-1 is adjacent to a large expanse of privately 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 cause federally 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 at open areas within a small zone of grassland species inside the more extensive oak woodland habitat near the OU-1 plume source area (sand gilia patches 20 through 22 appear on Figure A3.4 in Appendix A of the 2007 FONR Impact Report [HGL, 2008a]). The small open area in which the sand gilia population was observed is approximately 300 feet east of the 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 vicinity.

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 within the FONR portion of OU-1 between 2004 and 2013 without constructing a well. Table 1.2 also lists the wells that were destroyed during that period. Figure 1.3 illustrates the OU-1 well and soil boring locations. No new wells or soil borings have been constructed by HGL within the FONR since 2006. In September 2011, 55 wells were destroyed within the FONR. Figure 1.4 illustrates the layout and components of the OU-1 groundwater remediation system within the FONR as of September 2013.

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).

The HGL remediation contract was awarded 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 has 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).

During 2011, activities conducted by HGL within the FONR habitat area included sampling activities, the 2011 rare plant survey, and destroying 55 monitoring wells (53 of which are located within the FONR). The 2011 well destruction activities are described in the Well Destruction Report (HGL, 2011c).

HGL conducted the following activities during 2013 within the FONR habitat area:

- Collected performance monitoring samples from three extraction wells and from the NWTS;
- Collected samples from the wells composing the OU-1 groundwater long term monitoring (LTM) network; and
- Performed the 2013 rare plant survey.

Only light-duty vehicles (pickup trucks or sedans) were used for sampling activities, and travel routes were limited to established roadways.

In addition to the HGL activities listed above, UCSC performed weed control activities in selected areas (see Appendix B). The following sections describe the 2013 activities and the 2013 rare plant survey.

1.3.1 2013 Rare Plant and Habitat Surveys

DD&A conducted surveys for sand gilia and Monterey spineflower on 12, 15, and 16 April 2013. The timing of the survey was intended to correspond with the plants' peak blooming period (late April to early May). 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. The 2013 rare plant survey covered three areas:

- The reference area near the intersection of Reservation Road and Imjin Parkway,
- The roadway and access route leading to well IW-OU1-10-A where construction occurred during 2010, and
- Those well sites within the FONR habitat area where wells were destroyed in September 2011, except as noted below.

The evaluation of survey results from 2004 through 2012 indicate that the construction activity has not had significant adverse effects on the Monterey spineflower and sand gilia plant populations. Furthermore, HGL believes that the extended 10-year monitoring period has adequately characterized the impacts to Monterey spineflower and sand gilia populations from OU-1 remediation activities; therefore HGL recommended that monitoring be discontinued at seven destroyed well locations that were surveyed in 2011 and 2012 (HGL, 2012a and 2013a). The UCSC FONR management staff indicated that these seven well locations were not located in significant habitat area. After discussions between the USFWS, the Army, the UCSC FONR

management staff, and HGL, the USFWS concurred and the following destroyed well locations were deleted from the 2013 rare plant survey (USFWS, 2013):

- MW-OU1-10-A
- MW-OU1-36-A
- MW-OU1-01-180
- MW-OU1-03-180
- MW-OU1-07-A
- MW-OU1-37-A
- MW-OU1-02-180

Section 2.0 of this report presents an overview of the biological survey results, and Appendix A provides a detailed description.

1.3.2 2013 Sampling Activities

During 2013, HGL did not conduct drilling, construction, or aquifer testing activities within OU--1. Groundwater samples were collected during 2013 from many of the existing wells within the FONR as part of the OU-1 groundwater LTM program. As the remediation effort has progressed, the number of wells included in the LTM network decreased and the monitoring frequency was reduced at others. Before 2009, wells included in the LTM network were typically sampled on a quarterly, semiannual, or annual basis. The quarterly sampling usually occurred in March, June, September, and December of each year. In 2009, the LTM sampling program was modified and samples from individual wells are now collected only on a semiannual or annual basis. Performance monitoring samples originally were collected at the NWTS on a bimonthly basis; however, in 2010, the sampling frequency was decreased to quarterly, and in 2012 sampling was reduced to semiannually. The September 2012 LTM results showed significant progress toward meeting the ACL and the overall system pumping increased in the fourth quarter of 2012. Consequently, HGL proposed revisions to the sampling schedule for 2013. After discussion and approval from the regulatory agencies, additional samples from selected wells were collected in January and February of 2013 and the number and locations of the March 2013 samples were reduced. From March 2013 on, samples were collected quarterly.

Previous results from the groundwater quality monitoring program showed that cleanup targets within the capture zone of the original GWETS extraction wells (Figure 1.4) 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.

Based on the cleanup progress, HGL and regulatory agencies agreed to reduce the groundwater pumping and sampling efforts in 2012 within the interior portion of the OU-1 FONR area. Pumping and sampling along the northwest boundary continued at the same rate and schedule. The decreased pumping and sampling in the interior portion of the OU-1 FONR reduced the

number of site visits and vehicle miles traveled on FONR roads, thereby reducing the potential impact to the FONR habitat.

In 2013, LTM samples and NWTS performance samples were collected in January, February, March, and June. Additional samples will be collected in September 2013. Table 1.3 summarizes the 2013 LTM and NWTS sampling events conducted at each of the OU-1 wells. At some wells only water level measurements are taken.

Groundwater elevations are measured semiannually at most wells within the OU-1 LTM network and are taken either concurrently with or within a few days of sample collection. Groundwater measurements collected from wells that are no longer sampled also are listed in Table 1.3.

1.4 IMPACT PREVENTION AND MITIGATION MEASURES

Activities conducted within the FONR are limited to those that are essential to achieving the remediation goals for the project. The remedial actions and ongoing operation of the remedial system have been and will continue to be consistent with the HMP and biological opinions. Compliance with these measures reduces or avoids impacts to RTE species of concern on the project site. Guidance for the remedial design and action(s) are as follows:

- *Installation-Wide Multispecies Habitat Management Plan* (U.S. Army, 1997).
- The 30 March 1999 letter regarding Biological and Conference Opinion on the Closure and Reuse of Fort Ord, Monterey County, California (1-8-99-F/C-39R) and supporting documentation, such as enclosure 2 to the request for consultation (Harding Lawson Associates, 1998);
- The 22 October 2002 *Biological Opinion on the Closure and Reuse of Fort Ord, Monterey County, California, as it affects Monterey Spineflower Critical Habitat,* (USFWS, 2002);
- The 14 March 2005 *Biological Opinion on the Cleanup and Reuse of Former Fort Ord, Monterey County, California, as it affects California Tiger Salamander and Critical Habitat for Contra Costa Goldfields* (USFWS, 2005);
- The 1 June 2007 *Amendment to Biological Opinion 1-8-04-F-25R, Cleanup and Reuse of Former Fort Ord, Monterey County, California, as it affects California Tiger Salamander and Critical Habitat for Contra Costa Goldfields* (USFWS, 2007); and
- Guidance and direction from UCNRS staff.

To avoid or minimize impact to the FONR during ecologically sensitive periods (defined as the rainy season, which typically ranges from November to April), construction is 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, the well destruction and road repair activities were performed in September and October 2012 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 has been renewed annually and implemented by UCSC through 2013. UCSC staff began weed control treatments on 1 April 2013 and continued through 13 September 2013. 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. UCSC prepared a report that describes and summarizes their efforts regarding weed control and plant surveys; the report describing the 2013 weed control program is included as Appendix B.

The objectives of the weed control activities are as follows:

- Cut down or remove undesirable vegetation from areas disturbed by past OU-1 construction activities—particularly those completed during 2004 through 2006—before such vegetation released seeds into the environment.
- Prevent or reduce the expansion of non-native plants into areas disturbed by construction related to OU-1 activities.
- Prevent the occurrence of unacceptable impacts to the Monterey spineflower and sand gilia populations within that portion of the FONR affected by OU-1 remediation activities.

Figure 1.5 illustrates the locations where weed control measures were performed. During 2013, weed control consisted of cutting the weeds using manual methods (hand pulling, clipping) and mechanical devices (such as powered string trimmers or similar, easily portable equipment) as described in Appendix B. Herbicides or similar poisons have not been used as part of this effort in any year. Disposal of cut weeds depended on both the plant species and the timing of the weed cutting episode. Cut weeds were left on the ground if there was no danger that the seeds would germinate and sprout after cutting; otherwise, the cut weeds were bagged and removed from the site for proper disposal. The species subject to weed control included plant species that are listed as a noxious weed by the California Department of Food and Agriculture, included on invasive plant lists maintained by the California Invasive Plant Council, or considered to be a problematic species by the UCSC FONR natural resource staff.

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2.0 OVERVIEW OF 2013 RARE PLANT SURVEY RESULTS

The objectives of the 2013 rare plant survey and habitat inventory were to accomplish the following:

1. Identify locations of and estimate rare plant populations at an identified reference site and at FONR well destruction sites, and at sites where construction for the remediation system took place; and
2. Map Monterey spineflower and sand gilia populations for comparison to past surveys and to facilitate planning if future construction 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 for several years 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 based, in part, 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 are already present throughout much of the reference area.

The 2013 rare plant survey was conducted at the reference site, along the IW-OU1-10-A pipeline route, and at 30 well sites within OU-1. This section presents a summary of the key findings from those surveys. The complete survey report is presented in Appendix A.

A DD&A biologist and a DD&A technician conducted surveys for sand gilia and Monterey spineflower on 12, 15, and 16 April 2013 using a global positioning system (GPS). The survey was timed to coincide with the peak blooming period insofar as possible. 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.

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.

2.1 RARE PLANT SURVEY METHODS

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 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); and
- 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. These maps are presented in Appendix A (Figures A3.1, A3.2, and A3.3).

2.2 SAND GILIA SURVEY RESULTS

Sand gilia was observed and mapped at the DD&A reference site and at 15 of the 30 well sites. A total of 89 populations (44 points and 45 polygons) of sand gilia were mapped within the 2013 survey area (see Appendix A, Table A3.1, and Figures A3.1, A3.2, and A3.3). A total of 1,893 individual plants were mapped at the 89 populations.

2.3 MONTEREY SPINEFLOWER SURVEY RESULTS

A total of 69 populations (26 points and 43 polygons) of Monterey spineflower were mapped at the reference site and at 24 of the 30 well sites within the FONR (Table A3.2 and Figures A3.1, A3.2, and A3.3 in Appendix A). 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. Of the 43 populations of Monterey spineflower that were mapped as polygons, 2 were identified as Medium cover class (51 to 75 percent cover), 7 populations were identified as Medium Low (26 to 50 percent cover), 31 populations were identified as Sparse (3 to 25 percent cover), and 3 populations were identified as Very Sparse (less than 3 percent cover).

3.0 DISCUSSION OF 2013 SURVEY RESULTS

As noted earlier, the 2013 rare plant survey area overlapped the previous surveys with the exception of the number of well sites being reduced to 30 locations. The annual reference plot rare plant survey was initiated in 2010. Table 3.1 summarizes the survey results at the reference plot. Table 3.2 summarizes the results for all rare plant surveys conducted within the OU-1 footprint since 1998.

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 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. The total precipitation for the October through March period preceding the annual rare plant survey is provided in Table 3.3 for reference in subsequent discussions.

Fifty-three wells were destroyed in the FONR in 2011. Thirty-seven of the destroyed wells were located at 32 sites (more than one well was present at some sites) within the FONR habitat area and were included in the 2012 rare plant survey. In addition, the IW-OU1-10-A/PZ-OU1-10-A1 well pair is considered to be one site and was included in the survey as part of the 3-year post-construction monitoring that began after IW-OU1-10-A was converted to an extraction well in 2010. The remaining destroyed wells were located in the grassland portion of the FONR or in grassland outside the FONR property and are therefore not included in any rare plant surveys at OU-1. In 2013, HGL received approval from the USFWS to discontinue monitoring on seven well locations that were previously surveyed in 2011 and 2012. This section compares the results of the 2013 rare plant survey within the DD&A reference area and the 30 well locations on the OU1 FONR property with the results of the 2011 and 2012 surveys. Section 4.0 presents a comprehensive overall review of the 2004 through 2012 rare plant data for all wells within the FONR habitat area.

3.1 SAND GILIA

Within the FONR area surveyed, sand gilia populations were observed in more locations than Monterey spineflower populations for the third consecutive year. In each OU-1 rare plant survey performed from 2004 through 2007, Monterey spineflower populations were observed in more locations (no rare plant surveys were conducted from 2008 through 2010 within the 2013 survey area). Because of the significant differences in rainfall and in the size of the 2007 versus 2013 survey areas, as well as the complexity of environmental factors affecting sand gilia, it is not possible to assess the significance of the greater number of sand gilia locations in comparison to Monterey spineflower locations.

3.1.1 Reference Area

In 2011, 16 populations totaling 318 individual sand gilia (four polygons and 12 points) were mapped within the DD&A reference area. In 2012, 16 populations totaling 70 individual sand gilia (four polygons and 12 points) were mapped within the DD&A reference area. In 2013, 20 populations with a total of 736 individual sand gilia plants (seven points and 13 polygons) were mapped within the DD&A reference area. Table 3.1 summarizes the results for years 2011 through 2013. The sand gilia polygons covered approximately 1,409.5 square feet (ft^2) in 2011, approximately 209.6 ft^2 in 2012, and approximately 1,281.4 ft^2 in 2013. The area decreased approximately 1,199.9 ft^2 from 2011 to 2012, and then increased approximately 1,071.9 ft^2 from 2012 to 2013.

The most significant change in sand gilia cover was located in the middle of the reference area (see Figure A3.1 in Appendix A). Sand gilia observed during the 2012 survey effort was substantially less when compared to the 2011 survey effort. In 2013, sand gilia populations rebounded beyond 2011 levels in terms of number of plants and closely resembled the 2011 spatial distribution. The reference area is located on property that is relatively undisturbed by anthropogenic activities. Sand gilia fluctuate in a given year because of natural variation in rainfall, temperature, and other factors. Comparing 2012 to 2011 and 2013 population numbers supports the statement made in the 2012 plant report that the environmental factors necessary to yield abundant populations of sand gilia were not ideal in 2012.

3.1.2 FONR Well Locations

Sand gilia was found in 2011 at 9 of the 33 sites surveyed before well destruction activities were performed. At eight of these nine sites, sand gilia also was found in the 2012 survey, which indicates no adverse impact to the plant population between 2011 and 2012. In 2013, sand gilia was found at 15 of 30 well locations (Table 3.2).

In 2013, 32 polygons of sand gilia totaling 4,274.8 ft^2 (1,082 individuals) and 37 points of sand gilia totaling 75 individuals were mapped. The total area of sand gilia decreased by 3,188.5 ft^2 when compared to 2011 and by 1,446.1 ft^2 when compared to 2012. While the total number of sand gilia plants mapped in 2013 (1,157) decreased by 105 when compared to 2011 (1,262), the results showed an increase of 175 plants when compared to 2012 (982).

This data shows similar population fluctuations to those observed in the reference area and support the conclusion that the well destruction and maintenance activities did not impact sand gilia populations in the survey area.

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. Although sand gilia populations were observed more often than Monterey spineflower in 2013, both species were widespread in the 2012 and 2013 surveys. There are several environmental factors that affect the amount of

Monterey spineflower that blooms in a given year. Again, these results reinforce the statement that in 2012 the environmental factors necessary to yield abundant populations of Monterey spineflower were not ideal. It also appears that 2011 and 2013 were more productive years for Monterey spineflower.

3.2.1 Reference Area

One population (Sparse polygon) of Monterey spineflower was mapped at the DD&A reference site in 2011. Three Monterey spineflower populations (two Sparse polygons and one point) were mapped within the DD&A reference area in 2012. Seven Monterey spineflower populations (six Sparse and one Medium Low) were mapped within the DD&A reference area in 2013. Table 3.1 summarizes these results. The Monterey spineflower polygons covered approximately 2,865.4 ft^2 in 2011, approximately 1,493.5 ft^2 in 2012 and approximately 2,813.0 ft^2 in 2013. The difference between 2011 and 2012 (1,371.9 ft^2) is substantially more than the difference between 2011 and 2013 (52.4 ft^2). This data illustrates the high variability in Monterey spineflower populations resulting from natural factors.

3.2.2 FONR Well Locations

In 2013, 36 polygons totaling 11,100.4 ft^2 were mapped at the OU1 FONR well locations. The 36 polygon Monterey spineflower populations were as follows: 3 Very Sparse, 25 Sparse, 6 Medium Low and 2 Medium; all survey results are summarized in Table 3.2 and presented in detail in Appendix A. The Monterey spineflower area decreased by 16,839.1 ft^2 when compared with 2011 and by 1,032.4 ft^2 when compared with 2012.

In addition, 27 Monterey spineflower points were mapped in 2013, totaling 49 plants, which was an increase of 37 plants when compared to 2012 and an increase of 16 plants compared to 2011. The Monterey spineflower was found at all 30 well locations surveyed in 2011, 24 of the 30 well locations in 2012, and at 24 of 30 well locations in 2013.

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4.0 IMPACT ASSESSMENT AND CONCLUSIONS

Construction efforts were undertaken by HGL during the 2004 through 2013 time period 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 55 wells within the FONR; and
- Road repair to address ruts created by heavy equipment traffic and erosion.

Figure 4.1 illustrates the areas in which construction occurred during 2004 through 2013. The locations of wells destroyed in 2011 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 (Harding Lawson Associates, 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 has conducted annual rare plant surveys from 2004 through 2013 (through subcontractors) and conducted habitat surveys in 2006 and 2007. The data resulting from these surveys is evaluated annually and has not shown evidence of overall negative impact to rare plant populations. For Monterey spineflower, the survey results indicate the possibility that the remediation activities may have beneficially impacted the plant population.

In addition, HGL has contributed funds to support manual and mechanical weed control efforts by UCSC from 2007 through 2013. The most recent effort is described in detail in Appendix B. UCSC is confident that the weed abatement efforts are having a positive impact on reducing

weed populations on the OU-1 cleanup sites and, very importantly, have removed a large portion of the invasive weed seed source for the 2013 growing season.
Table 3.2 summarizes the rare plant populations observed at the OU-1 well sites located within the FONR. To date, the survey results show that the impact-minimization and abatement efforts and proactive construction management techniques employed throughout the construction effort to mitigate impacts have been successful in minimizing the impact to rare plant populations. The data from Table 3.2 is discussed in the following sections.

Where multiple wells were constructed within approximately 30 feet of one another, the group of wells was considered to be a single site for the purpose of evaluating the rare plant survey results. A total of 45 new OU-1 wells were constructed at 42 locations within the FONR between 2004 and 2006. Several wells constructed between 1986 and 2002 also were co-located. To provide a more consistent basis for assessing the rare plant survey results, the following sets of wells are counted as a single location when tabulating the occurrences of rare plant populations.

- MW-OU1-24AR replaced MW-OU1-24-A;
- MW-OU1-46-AD, MW-OU1-42-AD, and PZ-OU1-46-AD2;
- MW-OU1-64-A1 and MW-OU1-64-A2;
- EW-OU1-49-A and PZ-OU1-49-A1;
- IW-OU1-10-A and PZ-OU1-10-A1;
- IW-OU1-02-A and PZ-OU1-02-A;
- EW-OU1-17-A, PZ-OU1-13-A, and PZ-OU1-14-A;
- EW-OU1-18-A, PZ-OU1-15-A, and PZ-OU1-16-A; and
- MW-OU1-32-A and MW-OU1-33-A.

After aggregating the individual wells as noted above, rare plant population data was evaluated for 74 well locations and at 3 equipment staging areas used during the 2004 construction activities, for a total of 77 total sites. The following sections discuss the results of the rare plant surveys conducted from the initial survey in 1998 through the most recent survey in 2013. A total of 26 wells at 20 evaluation sites (based on the multiwell locations and other factors discussed above) were constructed before the initial rare plant survey was performed in 1998.

4.1 OPERABLE UNIT 1 IMPACTS ON MONTEREY SPINEFLOWER

Evaluation of the data showed that these 77 total locations fall into five categories as defined below. Wells constructed after the initial rare plant survey was completed in 1998 fall within one of the first four categories. Wells constructed before the 1998 rare plant survey are discussed in the fifth category.

1. Monterey spineflower not detected before or after construction (25 locations);
2. Monterey spineflower detected before but not after construction (8 locations);
3. Monterey spineflower detected before and after construction (10 locations);
4. Monterey spineflower not detected before construction but was detected after construction (14 locations); and
5. The well was constructed before the initial rare plant survey in 1998 (20 locations).

The rare plant survey results with respect to Monterey spineflower are discussed in the following subsections.

4.1.1 Monterey Spineflower Not Detected Before or After Construction

Approximately 32 percent of the sites fell within this category (25 of the 77 total). This data cannot be used to assess site-specific impacts.

4.1.2 Monterey Spineflower was Detected Before but Not After Construction

At eight locations where wells were constructed after the 1998 or 2004 baseline rare plant surveys were performed, Monterey spineflower populations were identified in one or both of the baseline surveys but were not observed in subsequent surveys. These locations are:

- MW-OU1-25-A
- MW-OU1-40-A
- EW-OU1-49-A/ PZ-OU1-49-A1
- MW-OU1-57-A
- EW-OU1-60-A
- EW-OU1-66-A
- MW-OU1-61-A
- MW-OU1-65-A

At six of the eight locations above, the wells were constructed along the roadways bordering the adjacent grasslands to the north and/or east. The rare plant populations observed in these areas in 1998 are considered of marginal value because they are adjacent to grassland habitat that is unsuitable for sustaining the rare plant species (HGL, 2006b). HGL discussed these proposed well locations with UCSC management staff before construction began to confirm that the potential disruption of these plant populations was an acceptable approach and would not present a significant impact. These six well locations were as follows:

- EW-OU1-49-A/ PZ-OU1-49-A1
- MW-OU1-57-A
- EW-OU1-60-A
- EW-OU1-66-A
- MW-OU1-61-A
- MW-OU1-65-A

Of the six wells listed above, only wells EW-OU1-49-A/PZ-OU1-49-A1 were surveyed in 2004. The other five wells were surveyed from 2005 through 2007. Plant surveys were not performed at these six well sites after 2007, except at EW-OU1-60A and MW-OU1-61-A, which also were surveyed in 2008. Annual rare plant surveys at these wells ceased after 2008 because 3 years of monitoring had been completed. Monterey spineflower was not detected at these locations during the surveys completed in 2005, 2006, and 2007. It is not possible to conclude that the absence of these populations since their detection in 1998 is the result of the construction activity because their location is adjacent to grassland areas and is susceptible to varying environmental conditions and competition from the grassland species. Natural variables, including precipitation (Table 3.3), may be responsible for the lack of detected populations in post-construction surveys. In any case, these populations are of marginal value given that they are present within the edge of the grassland habitat.

Monterey spineflower was observed in 1998 at the site of two future wells MW-OU1-25-A installed in 1998 and MW-OU1-40-A installed in 1999. There was no activity other than sampling in this area thereafter. Given the population variability observed at the undisturbed

reference plot, the data is inconclusive concerning the impact of construction activity on the Monterey spineflower population. Also, the fact that the 1998 data represented a "great year" for Monterey spineflower and sand gilia (UCSC, 2006) suggests that natural variability rather than construction impacts may be the reason it was not found in subsequent surveys.

4.1.3 Monterey Spineflower was Detected Before and After Construction

There were 10 locations where the 1998 or 2004 rare plant survey identified Monterey spineflower populations that also were observed at least once in subsequent surveys. The data provided below indicates that OU-1 remediation activities did not impact Monterey spineflower populations at these sites.

Location	Number of pre-construction surveys	Number of pre-construction survey detections	Number of post-construction surveys	Number of post-construction survey detections
MW-OU1-39-A	2	2	3	3
MW-OU1-44-A	1	1	3	3
MW-OU1-46-A*	2	1	6	3
MW-OU1-46-AD*	2	1	5	2
EW-OU1-53-A	2	1	3	2
IW-OU1-01-A	2	1	6	5
IW-OU1-25-A	2	1	6	2
MW-OU1-50-A	1	1	5	4
MW-OU1-56-A	1	1	3	1
Staging Area #1	2	1	3	2
Staging Area #2	2	1	3	3

*Indicates co-located wells—considered as a single site in assessing results.

Additional survey results are provided in Table 3.2.

4.1.4 Monterey spineflower was Not Detected Before But was Detected After Construction

The rare plant survey results indicated potentially beneficial impacts on Monterey spineflower populations at 14 sites where this species was not observed before the OU-1 remediation activities beginning in 2004 but was detected in post-construction surveys. The site locations and data are summarized below:

Location	Number of pre-construction surveys (no detections)	Number of post-construction surveys	Number of post-construction Monterey spineflower detections
MW-OU1-30-A	2	2	2
MW-OU1-32-A*	2	3	3
MW-OU1-33-A*	2	3	3
MW-OU1-38-A	2	4	3
EW-OU1-54-A	2	6	2
EW-OU1-55-A	2	6	3
IW-OU1-05-A	2	5	5
IW-OU1-24-A	2	5	3
MW-OU1-59-A	1	3	1
Staging Area #3	2	3	2
EW-OU1-71-A	2	4	1
IW-OU1-74-A	1	5	3
MW-OU1-82-A	1	5	2
MW-OU1-83-A	2	5	2
MW-OU1-84-A	1	5	2

* Indicates co-located wells, which are considered as a single site in assessing results.

This data suggests that the site disturbances from remediation activities had a potentially beneficial effect on Monterey spineflower conditions. Additional survey results details are provided in Table 3.2.

4.1.5 Well Was Constructed Before the Initial Rare Plant Survey

Monterey spineflower was observed in one or more rare plant surveys from 1998 through 2013 at 20 locations where wells were constructed before the 1998 survey was performed. Because these wells pre-date the earliest available survey results from 1998, it is not known whether rare plants were present before the wells were constructed. In total, 26 wells were constructed at 20 locations before the 1998 survey. Monterey spineflower was observed at 19 of these 20 locations in at least one subsequent survey. The only well (MW-OU1-07-A) where Monterey spineflower was not detected was located within the source area where the native soils were excavated and replaced with non-native fill as part of the soil remediation effort.

4.2 OPERABLE UNIT 1 IMPACTS ON SAND GILIA

As above, the 77 total well locations and staging areas fall into five categories:

1. Sand gilia was not detected in any survey (47 locations);
2. Sand gilia was detected before but not after construction (1 location);
3. Sand gilia was detected before and after construction (5 locations);
4. Sand gilia was not detected before construction but was detected after construction (4 locations); and
5. The well was constructed before the initial rare plant survey in 1998 (20 locations).

The rare plant survey results with respect to sand gilia are discussed in the following subsections.

4.2.1 Sand Gilia Not Detected Before or After Construction

Approximately 61 percent of the sites fell within this category (47 of the 77 total). This data cannot be used to assess site-specific impacts but they suggest that sand gilia is not widespread within the OU-1 portion of the FONR.

4.2.2 Sand Gilia was Detected Before but Not After Construction

There was only one location where a well was constructed after 1998 and the 1998 or 2004 rare plant survey identified sand gilia populations that were not observed at least once in subsequent surveys: IW-OU1-25-A.

At well IW-OU1-25-A sand gilia was observed in the 2004 survey but was absent in the 1998 survey. Sand gilia was not observed at this location in post-construction surveys from 2005 through 2007 and from 2011 through 2013. As noted previously, 1998 presented optimum environmental conditions to promote rare plant growth. Given the absence of sand gilia in 1998 and the population variability observed at the undisturbed reference plot, this data is inconclusive concerning the effect of construction activity on the sand gilia populations.

4.2.3 Sand Gilia was Detected Before and After Construction

There were five locations where the 1998 or 2004 rare plant survey identified sand gilia populations that also were observed at least once in subsequent surveys. The data provided below indicate that OU-1 remediation activities did not impact sand gilia populations at these sites.

Location	Number of pre-construction surveys	Number of pre-construction survey detections	Number of post-construction surveys	Number of post-construction survey detections
MW-OU1-38-A	2	1	4	3
MW-OU1-39-A west access road*	2	2	3	3
MW-OU1-44-A	1	1	3	1
Staging Area #2	2	2	3	3
Staging Area #3	2	2	3	1

*Co-located with well MW-OU1-39-A.

Additional survey results are provided in Table 3.2.

4.2.4 Sand Gilia Was Not Detected Before But Was Detected After Construction

The rare plant survey results indicated potentially beneficial impacts on sand gilia populations at four sites where this species was not observed before the OU-1 remediation activities beginning in 2004 but was detected in post-construction surveys. The site locations and data are summarized below:

Location	Number of pre-construction surveys (no detections)	Number of post-construction surveys	Number of post-construction sand gilia detections
EW-OU1-53-A	2	3	2
EW-OU1-54-A	2	6	1
IW-OU1-01-A	2	6	1
MW-OU1-59-A	1	3	1

Additional survey results details are provided in Table 3.2.

4.2.5 Well Was Constructed Before the Initial Rare Plant Survey

Sand gilia was observed in one or more rare plant surveys from 1998 through 2013 at 12 of the 20 locations where wells were constructed before the 1998 survey was performed. Because these wells pre-date the earliest available survey results from 1998, it is not known whether rare plants were present before the wells were constructed. One well (MW-OU1-07-A) was located within the source area and those soils were excavated and replaced with non-native fill. Thus, sand gilia was observed at a detection frequency of 60 percent (12 out of 20 native soil locations) in these wells.

As noted earlier, the 1998 rare plant survey represented exceptionally favorable environmental conditions for Monterey spineflower and sand gilia (UCSC, 2006). Because pre-construction rare plant populations are unknown at these locations, it is not possible to make site-specific comparisons to the post-construction rare plant survey results. However, the fact that sand gilia was found at 60 percent of the well locations in this category indicates that no adverse impact to plant populations occurred as a result of OU-1 remediation activities.

4.3 WEED CONTROL ACTIVITIES

The weed control segments include the 10 well locations shown in Table 4.1. Sand gilia was not detected at any of the 10 locations in the 1998 and 2004 rare plant surveys but was found at 3 locations at least once in subsequent surveys. Monterey spineflower was noted in the 1998 rare plant survey at 4 of the 10 sites but was not detected in the 2004 pre-construction survey at any site. The 2005 through 2013 rare plant surveys showed the following results:

- At the four locations where Monterey spineflower was detected in 1998, it was detected multiple times in subsequent surveys.
- At the five locations where Monterey spineflower was not detected in 1998 or 2004, it was subsequently found once (one location), twice (three locations), and five times (one location).

- At one location, Monterey spineflower was not detected in 1998, 2004, or any subsequent survey.

These results show the success of the weed control program and the lack of impact on rare plant populations from the remediation activities.

The weed control effort was initiated as a proactive effort to mitigate potential impacts of invasive species. The initial effort in 2007 included a detailed survey to identify all species present and corresponding extent in each weed control area. Subsequent weed control efforts have focused on weed removal and detailed surveys of plant populations and extents have not been performed. Consequently, it is uncertain if the observed effectiveness of the weed control program to date provides a long term solution or if periodic future weed control efforts will be needed to sustain the gains made since 2007. To make this determination, it will be necessary to suspend the weed control effort, conduct a detailed survey in significant areas in a manner consistent with the 2007 survey, and evaluate the results of that effort.

4.4 SUMMARY

The post-construction rare plant surveys were compared with the 1998 and 2004 pre-construction rare plant surveys to assess construction impacts on the FONR rare plant populations. The results of that comparison indicate that the construction activity has not had significant adverse effects on the Monterey spineflower and sand gilia plant populations. Overall, the number of post-construction rare plant populations exceeded the number of populations found in pre-construction surveys. This result is partly attributed to the fact that HGL reviewed the 1998 and 2004 rare plant surveys when planning well locations and avoided known population occurrences. A summary of the supporting observations for this conclusion were described in the preceding paragraphs and are summarized in the following paragraphs.

At the 57 well locations constructed after the initial baselines survey in 1998 and/or 2004, Monterey spineflower was detected at 32 of the locations. At 10 of these 32 well sites, Monterey spineflower populations were similar to or greater than those in the pre-construction surveys. At eight well sites Monterey spineflower was detected before but not after well construction. However, at 14 well sites, Monterey spineflower was not detected in the pre-construction surveys but was found at least once in post-construction surveys. These results suggest a potential overall positive impact of remediation activities on Monterey spineflower populations. In addition, the reference area surveys showed wide variations in Monterey spineflower populations in areas not subject to intrusive activities. Together, these findings support the conclusion that remediation activities have not discernibly affected this plant population within the OU-1 area.

Monterey spineflower was found at each of the 19 native soil well locations where remediation activities were performed before the 1998 baseline survey. Although pre-construction rare plant surveys were not performed, the subsequent detection(s) at each location indicate that these sites fall into one of two categories (1) Monterey spineflower was detected both before and after construction, or (2) Monterey spineflower was absent before well construction but appeared afterward. These results clearly demonstrate that well construction and sampling activities have not affected Monterey spineflower populations within the OU-1 area.

At the 57 well locations constructed after the initial baselines survey in 1998 and/or 2004, sand gilia was detected at 10 of the locations. The absence of sand gilia in both pre- and post-construction surveys at 47 locations is consistent with the observation that sand gilia are much less common than Monterey spineflower throughout the OU-1 area. Five of the 10 well sites showed sand gilia populations similar to or greater than those in the pre-construction surveys. At one location, sand gilia was observed in the pre-construction survey but not in the post-construction survey. However, sand gilia was observed at four locations in post-construction surveys where it had not been seen in any pre-construction survey. As with Monterey spineflower, the reference area surveys showed wide variations in sand gilia populations in an area that is not subject to intrusive activities. Together, these findings support the conclusion that remediation activities have not discernibly impacted the sand gilia population within the OU-1 area

Sand gilia was found at 11 of the 57 surveyed locations (approximately 20 percent) where remediation activities were performed after the 1998 baseline survey. Sand gilia was found much more frequently—at 12 of the 19 native soil well locations (approximately 63 percent)—where remediation activities were performed before the 1998 baseline survey. The absence of baseline population data and the less than 100 percent occurrence of sand gilia at the pre-1998 sites prevents a definitive assessment of potential remediation impacts. However, the more frequent occurrence at the pre-1998 FONR sites in comparison to sand gilia occurrences at the post-1998 remediation sites and in contrast to the site as a whole (23 of total 76 sites or thirty percent) do not indicate a potential negative impact on sand gilia populations from remediation activities.

Manual and mechanical (nonchemical) weed control efforts were initiated throughout the UCSC in 2007 and continued through 2013 as a preventive measure (see Section 1.4 and Appendix B). Visual observations of the extent of the weed populations were made by UCSC field staff in 2013 to determine the effectiveness of the weed control program. UCSC stated that the weed control efforts significantly reduced the survivorship, seed production, and abundance of the target species (see Appendix B). Each year the weed control program removes a large portion of the invasive weed seed source for the subsequent year, thus building on the effectiveness of the program. As described in Section 4.3, the recurrence of rare plant populations in the areas where weed control activities have been performed has clearly demonstrated that rare plant populations have been sustained or expanded.

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TABLE(S)

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Table 1.1
Wells Within the Fort Ord Natural Reserve

Wells Installed/Sampled Before 2004				Wells Installed for Enchanced 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 2004 - 2013 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
SB-OU1-2004-I	2004	MW-OU1-01-180	2011	MW-OU1-33-A	2011
SB-OU1-2004-J	2004	MW-OU1-01-A	2011	MW-OU1-34-A	2011
SB-OU1-2004-K	2004	MW-OU1-02-180	2011	MW-OU1-36-A	2011
SB-OU1-2004-L	2004	MW-OU1-02-A	2011	MW-OU1-37-A	2011
SB-OU1-2004-M	2004	MW-OU1-03-180	2011	MW-OU1-38-A	2011
SB-OU1-46-AD1	2005	MW-OU1-03-A	2011	MW-OU1-39-A	2011
SB-OU1-60-A	2005	MW-OU1-04-A	2011	MW-OU1-42-A	2011
EW-OU1-48-A	2006	MW-OU1-05-A	2011	MW-OU1-44-A	2011
EW-OU1-17-A	2011	MW-OU1-06-A	2011	MW-OU1-ERD-01-A	2011
EW-OU1-18-A	2011	MW-OU1-07-A	before 2004	MW-OU1-ERD-02-A	2011
EW-OU1-54-A	2011	MW-OU1-08-A	2011	MW-OU1-ERD-03-A	2011
EW-OU1-55-A	2011	MW-OU1-09-A	2011	MW-OU1-ERD-04-A	2011
IW-OU1-01-A	2011	MW-OU1-10-A	2011	MW-OU1-ERD-05-A	2011
IW-OU1-05-A	2011	MW-OU1-11-SVA	2011	MW-OU1-ERD-06-A	2011
IW-OU1-13-A	2011	MW-OU1-12-A	before 2004	MW-OU1-ERD-07-A	2011
IW-OU1-24-A	2011	MW-OU1-19-A	2011	PZ-OU1-13-A	2011
IW-OU1-25-A	2011	MW-OU1-20-A	2011	PZ-OU1-14-A	2011
IW-OU1-ERD-01-A	2011	MW-OU1-21-A	2011	PZ-OU1-15-A	2011
IW-OU1-ERD-02-A	2011	MW-OU1-28-A	2011	PZ-OU1-16-A	2011
IW-OU1-ERD-03-A	2011	MW-OU1-30-A	2011	PZ-OU1-35-A	2011
IW-OU1-ERD-04-A	2011	MW-OU1-31-A	2011		
MW-BW-10-A	2011	MW-OU1-32-A	2011		

Notes:

OU-1- operable unit 1
EW - extraction well
SB - soil boring
MW- monitoring well
PZ- piezometer
IW- injection well

Table 1.3
Summary of 2013 Groundwater Long Term Monitoring Program

Well Identification	Groundwater Sampling Events*				
	Jan-13	Feb-13	Mar-13	Jun-13	Sep-13
MW-OU1-46-AD	--	--	--	--	--
EW-OU1-60-A	X	--	X	--	X
EW-OU1-62-A	--	--	--	--	--
EW-OU1-63-A	--	--	--	--	--
EW-OU1-66-A	--	--	X	--	X
EW-OU1-71-A	--	--	--	--	X
MW-OU1-85-A	--	--	--	--	--
MW-OU1-87-A	X	--	X	X	X
IW-OU1-10-A	--	--	--	--	--
IW-OU1-02-A	water level only				
PZ-OU1-10-A1	--	--	--	--	X
MW-OU1-22-A	water level only				
MW-OU1-23-A	water level only				
MW-OU1-24-AR	water level only				
MW-OU1-25-A	water level only				
MW-OU1-26-A	X	X	--	--	X
MW-OU1-27-A	water level only				
MW-OU1-29-A	water level only				
MW-OU1-40-A	water level only				
MW-OU1-41-A	water level only				
MW-OU1-43-A	water level only				
MW-OU1-45-A	water level only				
MW-OU1-46-A	water level only				
EW-OU1-47-A	water level only				
EW-OU1-48-A	no longer sampled				
EW-OU1-49-A	water level only				
PZ-OU1-49-A1	water level only				X
MW-OU1-50-A	water level only				X
MW-OU1-51-A	water level only				
EW-OU1-52-A	water level only				X
EW-OU1-53-A	water level only				
MW-OU1-56-A					
MW-OU1-57-A	X	--	--	--	--
MW-OU1-58-A	X	--	--	--	--
MW-OU1-59-A	water level only				
MW-OU1-61-A	X	X	X	--	X
MW-OU1-64-A1	water level only				
MW-OU1-64-A2	water level only				
MW-OU1-65-A	water level only				
MW-OU1-67-A	water level only				
MW-OU1-68-A	water level only				

Table 1.3
Summary of 2013 Groundwater Long Term Monitoring Program

Well Identification	Groundwater Sampling Events*				
	Jan-13	Feb-13	Mar-13	Jun-13	Sep-13
MW-OU1-69-A2	--	--	X	--	X
MW-OU1-70-A	--	--	X	--	X
EW-OU1-72-A	--	--	--	--	X
IW-OU1-73-A	water level only				
IW-OU1-74-A	water level only				
MW-OU1-82-A (MW-G)	water level only				
MW-OU1-83-A (MW-F)	water level only				
MW-OU1-84-A (MW-E)	water level only				
MW-OU1-86-A (MW-C)	water level only				
MW-OU1-88-A (MW-A)	X	X	X	--	X
MW-BW-10-A	water level only				
MW-OU1-ERD-08-A	water level only				

Notes:

* includes sampling of extraction wells

Italicized well name indicates the well is not located within the Fort Ord Natural Reserve.

Identification in parantheses indicates temporary well name used in early planning documents.

X - sample collected

-- no sample collected

ERD - enhanced reductive dechlorination

EW - extraction well

IW - injection well

SVA - Salinas Valley Aquiclude

OU1 - Operable Unit 1

MW - monitoring well

PZ - piezometer

Table 3.1
Rare Plant Survey Results for Reference Plot - 2011 through 2013

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**
2011	12	40	4	278	318
2012	12	21	4	49	70
2013	7	17	13	719	736

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**				
				Sparse	**Medium-Low**	**Medium**	**Medium-High**	**Very High**
2011	1	4	1	0	1	0	0	0
2012	1	4	2	2	0	0	0	0
2013	0	0	7	6	1	0	0	0

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 3.2
Rare Plant Survey Results Relative to OU-1 Well Locations

Well Identification	Year Installed	Appendix A Figure #	1998	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	Remarks Regarding Results for Given Year								
														2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
Wells Installed Before 1998																							
EW-OU1-17-A*[1]	1987	A3.2	MS, SG	N	--	N	N	--	--	--	MS	MS	MS								MS#91[ML]; MS#92[S] nearby	MS#90[S]; MS#74[S]	MS#153[ML]; MS#155[ML]; MS#158[M]
PZ-OU1-13-A*[1]	1988	A3.2	MS	MS	--	MS	N	--	--	--	MS	MS	MS	MS#216[100]		MS#46[S]					MS#91[ML]	MS#90[S]; MW#74[S]	MS#153[ML]; MS#155[ML]; MS#158[M]
PZ-OU1-14-A*[1]	1988	A3.2	MS, SG	N	--	N	MS	--	--	--	MS	MS	MS				MS#49[VS]				MS#91[ML]; MS#92[S] nearby	MS#90[S]; MW#74[S]	MS#153[ML]; MS#155[ML]; MS#158[M]
EW-OU1-18-A*[2]	1987	A3.2	MS, SG	MS, SG	--	N	SG	--	--	--	SG	MS, SG	MS, SG	SG#07[100]; MS#07[1000]			SG#22[75]				SG#35[4]; SG#36[2]	MS#93[S]; SG#48[13]; SG#6[4], SG#52[10]	MS#47[1]; MS#128[S]; SG#9[4]; SG#85[26]; MS#48[1]; MS#49[2]
PZ-OU1-15-A*[2]	1988	A3.2	MS, SG	MS, SG	--	N	N	--	--	--	MS, SG	MS, SG	MS, SG	SG#07[100]; MS#07[1000]							MS#109[S]; SG#[35]; SG#[38]; SG#[37]	MS#93[S]; SG#48[13]; SG#6[4], SG#52[10]	MS#47[1];MS#128[S]; SG#9[4]; SG#85[26]
PZ-OU1-16-A*[2]	1988	A3.2	MS, SG	MS, SG	--	N	SG	--	--	--	SG	MS, SG	MS, SG	SG#07[100]; MS#07[1000]			SG#22[75]				SG#37[9]; SG#38[3]; SG#39[2]	MS#93[S]; SG#48[13]; SG#6[4], SG#52[10]	MS#47[1]; MS#48[1]; MS#49[2]; MS#128[S]; SG#9[4]; SG#85[26]
MW-BW-10-A*	1993	A3.3	N	--	N	N	N	--	--	--	MS	MS, SG	MS, SG	MS#166, 167 & 215 nearby							MS#[78]; MS# [67], MS#[66]	MS#82[S]; SG#9[1]; SG#10[2], SG#11[1]	MS#149[S]; SG#21[2]; SG#22[2]; SG#100[53]; SG#101[11]
MW-OU1-01-A*	1985	A3.3	MS, SG	--	--	--	--	--	--	--	MS	MS, SG	MS, SG								MS#68[1]; MS#79[S]; MS#80[S]; MS#81[S]	MS#42[1]; SG#53[17]	MS#60[1]; SG#98[12]; SG#99[35]; MS#124[S]
MW-OU1-02-A*	1985	A3.3	MS, SG	--	--	--	--	--	--	--	MS, SG	SG	MS, SG								SG#11[2]; SG#7[3]; SG#8[3]; SG#9[1]; SG#10[4]; MS#111[ML]; SG#12, 54, 55, 56, 57, & 58 nearby	SG#55[10]; SG#15[1]; SG#16[4]; SG#17[1]; SG#14[2]; SG#54[10]; SG#13[2]; SG#56[11]	MS#61[1]; MS#62[5]; SG#23[4]; SG#24[1]; SG#25[1]; SG#102[6]
MW-OU1-03-A*	1985	A3.2	MS	MS, SG	N	N	MS, SG	--	--	--	MS, SG	MS, SG	MS, SG	SG#07[100]; MS#07[1000]			SG#21[100]; MS#44[S]				MS#99[S]; SG#34[5]	MS#93[S]; SG#48[13]	MS#47[1]; MS#48[1]; MS#49[2]; SG#85[26]; SG#87[24]; MS#138[S]
MW-OU1-04-A*	1985	A3.2	N	N	--	--	--	--	--	--	MS	N	MS								MS#70[2]; MS#71[5]		MS#131[S]
MW-OU1-05-A*	1985	A3.2	MS	SG	N	N	N	--	--	--	MS	MS	MS	SG#261[25]							MS#69[1]; MS#88[S]	MS#75[S]	MS#50[4]; MS#129[S]; MS#156[ML]
MW-OU1-06-A*	1985	A3.3	SG	--	--	--	--	--	--	--	MS	MS	MS, SG								MS#82[S]; MS#83[M], MS#84 & 85 across street	MS#102[ML]	MS#157[M]; SG#97[6]
MW-OU1-07-A*	1985	NA	N	N	N	--	N	--	--	--	N	N	--										
MW-OU1-08-A*	1986	A3.2	SG	MS	--	--	--	--	--	--	MS	MS	MS	MS#20[100]							MS#103[ML]	MS#40[1]; MS#80[S]	MS#135[S]
MW-OU1-09-A*	1986	A3.2	MS	MS	MS	--	--	--	--	--	MS, SG	MS, SG	MS, SG	MS#20[100]	MS#82[S]						MS#94[ML]; SG#1-6 along access road	MS#73[S]; MS#100[ML]; MS#45[1]; SG#25[1]; SG#26[3]	MS#148[S]; MS#152[ML]; SG#18[4]; SG#19[1]; SG#96[8]
MW-OU1-10-A*	1987	A3.2	MS	N	N	--	--	--	--	--	N	N	--										
MW-OU1-11-SVA*	1986	A3.2	MS	MS	--	--	MS, SG	--	--	--	MS, SG	MS, SG	MS, SG	MS#220[1000]; extends far beyond well			SG#20; MS#42				SG#27[3]; SG#28[1]; SG#29[2]; SG#30[2]; SG#40[1]; SG#61[18]; MS#100[S]	MS#98[S]; MS#71[S]; SG#8[2]; SG#7[1]; SG#52[10], SG#6[4]	MS#45[1]; MS#46[4]; MS#127[S]; SG#86[31]
MW-OU1-12-A*[3]	1984	A3.3	N	--	--	--	--	--	--	--	--	--	--	Well destroyed in 2002									
MW-OU1-19-A*	1993	A3.2	MS, SG	MS	--	MS, SG	--	--	--	--	MS, SG	MS, SG	MS, SG	MS#57[1000]; extends far beyond well		SG#33[375]; MS#45[S]					SG#53[697]; MS#89[S]	MS#76[S]; MS#77[S], MS#95[S]; SG#64[562]	MS#117[VS]; MS#118[VS]; SG#115[603]
MW-OU1-20-A*	1993	A3.2	N	N	MS	--	--	--	--	--	MS	N	N		MS#126[VS]						MS#95[S]		
MW-OU1-21-A*	1997	A3.2	N	--	N	--	--	--	--	--	MS	MS	N								MS#102[S]	MS#88[S]	
MW-OU1-22-A	1997	NA	N	MS	N	N	N	--	--	--	--	--	--	MS#90[1000]; extends far beyond well									
MW-OU1-23-A	1997	A3.2	MS	N	--	--	--	--	--	--	--	N	--										
MW-OU1-24-A[4]	1997	NA	MS	--	--	--	--	--	--	--	--	--	--	Well destroyed in 2003; see replacement well MW-24-AR									
MW-OU1-24-AR[4]	2003	NA	MS	N	N	MS	N	--	--	--	--	--	--			MS#59[VS]							

Table 3.2
Rare Plant Survey Results Relative to OU-1 Well Locations

Well Identification	Year Installed	Appendix A Figure #	1998	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	Remarks Regarding Results for Given Year								
														2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
Wells Installed from 1998 - 2001																							
MW-OU1-25-A	1998	A3.2	MS	N	--	--	--	--	--	--	--	N	--										
MW-OU1-26-A	1998	NA	N	N	--	N	N	--	--	--	--	--	--										
MW-OU1-30-A*	1998	NA	N	N	--	MS	MS	--	--	--	--	--	--			MS#79[S]	MS#26[S]						
MW-OU1-32-A#[5]	1998	A3.2	N	N	--	--	--	--	--	--	MS	MS	MS								MS#76[1]; MS#101[S]	MS#41[3]; MS#97[S]	MS#150[ML]; MS#126[S]
MW-OU1-33-A#[5]	1998	NA	N	N	--	--	--	--	--	--	MS	MS	MS								MS#76[1]; MS#101[S]	MS#41[3]; MS#97[S]	MS#150[ML]; MS#126[S]
MW-OU1-36-A*	1999	A3.3	N	--	--	--	--	--	--	--	N	N	--										
MW-OU1-37-A*	1999	A3.3	N	N	--	--	--	--	--	--	N	N	--										
Wells Installed from 1998 - 2001 (Continued)																							
MW-OU1-38-A*	1999	A3.2	SG	N	--	--	N	--	--	--	MS, SG	MS, SG	MS, SG								MS#105[S]; MS#106, 107, & 108, SG#31, 32, & 33 nearby	MS#96[S]; MS#92[S]; SG#2[1]; SG#47[10], SG#3[1]	MS#136[S]; SG#8[2]; SG#84[10]
MW-OU1-39-A#[9]	1999	A3.2	MS	MS	--	--	--	--	--	--	MS, SG	MS, SG	MS, SG	MS#220[1000]; extends far beyond well							SG#17[5]; SG#18[2]; SG#15[1]; SG#16[4]; MS#98[MD]	MS#98[S]; SG#49[18]	SG#10[3]; SG#11[3]; SG#88[18]; SG#89[6]; MS#137[S]
MW-OU1-39-A west access road[9]	--	A3.2	MS	MS, SG	--	--	--	--	--	--	MS, SG	MS, SG	MS, SG	MS#220 [1000]; SG#003 [50]; MS#002 [100]							MS#98[MH]; SG#59[66]; SG#19[1], SG#20[4]; SG#21[2]; SG#22[1]; SG#23[1]; SG#60[41]	MS#98[S]; SG#50[53]; SG#4[4]; SG#51[13]; SG#5[1]	MS#137[S]; SG#10[3]; SG#11[3]; SG#12[3]; SG#13[2]; SG#14[4]; SG#88[18]; SG#89[6]; SG#90[45]; SG#91[13]; SG#92[15]
MW-OU1-39-A east access road[9]	--	A3.2	MS	MS	--	--	--	--	--	--	MS, SG	MS	MS	MS#220[1000]							MS#98[MH]; SG#24[2]; SG#25[4]; SG#26[1]	MS#98[S]	MS#137[S]
MW-OU1-40-A	1999	A3.2	MS	N	N	--	--	--	--	--	--	N	--										
MW-OU1-44-A*	2000	NA	MS, SG	--	--	--	--	--	--	--	MS	MS	MS, SG								MS#[87]	MS#101[ML]	MS#52[1]; MS#139[S]; MS#151[ML]; SG#15[1]
MW-OU1-45-A	2001	NA	N	--	N	N	N	--	--	--	--	--	--										
MW-OU1-46-A[6]	2001	NA	MS	N	N	N	N	MS	MS	MS	--	--	--					MS#34[VS]	MS#27[M]				
MW-OU1-01-180*	2000	A3.3	N	--	--	--	--	--	--	--	N	N	--										
MW-OU1-02-180*	2000	A3.3	N	--	--	--	--	--	--	--	N	N	--										
MW-OU1-03-180*	2000	A3.2	N	N	N	N	--	--	--	--	N	N	--										
Wells Installed in 2004 After the Rare Plant Survey																							
MW-OU1-46-AD[6]	No	4	MS	N	N	N	N	MS	MS	--	--	--	--					MS#34[VS]	MS#27[M]				
EW-OU1-47-A	No	3	N	N	N	N	N	--	N	--	--	--	--	Located in grassland east of FONR.									
EW-OU1-48-A	No	3	N	N	N	N	N	--	--	--	--	--	--	Located in grassland east of FONR.									
EW-OU1-49-A[7]	No	3	MS	N	N	N	N	--	--	--	--	--	--										
PZ-OU1-49-A1[7]	No	3	MS	N	N	N	N	--	--	--	--	--	--										
EW-OU1-52-A	No	11A	N	N	N	N	N	--	--	--	--	--	--										
EW-OU1-53-A	Yes	11B	MS	N	N	MS, SG	MS,SG	--	--	--	--	--	--			MS#92[S]; SG#21-#25 & 30	SG#24[16]; MS#52[VS]; MS#53 [VS]						
EW-OU1-54-A*	No	Well Site	N	N	MS	N	N	--	--	--	MS, SG	N	N		MS#126[VS]						MS#72[4]; MS#96[S]; MS#97[S]; SG#13 & #14 nearby		
EW-OU1-55-A*	No	Well Site	N	N	N	N	N	--	--	--	MS	MS	MS								MS#90[S]	MS#78[S]	MS#132[S]
IW-OU1-01-A*	No	12	MS	N	N	MS, SG	MS	--	--	--	MS	MS	MS			MS#46[S]; and SG#2-6 nearby	MS#50[S]				MS#91[ML]	MS#90[S]	MS#57[2]; MS#153[ML]
IW-OU1-02-A	Yes	Well Site	N	N	--	N	N	--	--	--	--	--	--										
IW-OU1-05-A*	No	13	N	N	--	MS	MS	--	--	--	MS	MS	MS			MS#49[VS]	MS#46[VS]				MS#86[S]	MS#91[S]	MS#129[S]; MS#130[S]
IW-OU1-10-A[8]	Yes	Well Site	N	N	--	N	N	--	--	--	--	N	--										
IW-OU1-24-A*	No	Well Site	N	N	--	N	MS	--	--	--	MS	MS	N				MS#35[VS]				MS#104[S]	MS#81[S]	
IW-OU1-25-A*	No	Well Site	N	MS, SG	N	N	N	--	--	--	MS	MS	N	MS#135[5];and SG#30 [2]							MS#73[4]; MS#74[4]; MS#75[4]	MS#86[S]	
MW-OU1-51-A	No	4	N	N	N	N	N	N	N	--	--	--	--										

Table 3.2
Rare Plant Survey Results Relative to OU-1 Well Locations

Well Identification	Year Installed	Appendix A Figure #	1998	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	Remarks Regarding Results for Given Year								
														2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
Wells Installed in 2004 in Area Not Surveyed																							
MW-OU1-50-A	Yes	9	MS	--	MS	N	MS	MS	MS	--	--	--	--		MS#21[MD]		MS#61[ML]	MS#49[ML]; and MS#50[S]	MW#36[S]; MW#4[2]; MW#5[2]				
MW-OU1-56-A	No	1	MS	--	N	MS	N	--	--	--	--	--	--		MS#146[1] nearby	MS#76[VS] nearby							
MW-OU1-57-A	No	1	MS	--	N	N	N	--	--	--	--	--	--										
MW-OU1-58-A	No	1	N	--	N	N	N	--	--	--	--	--	--										
MW-OU1-59-A	Yes	Well Site	N	--	MS	SG	N	--	--	--	--	--	--		MS#153[2]	SG#26[13]							
Staging Areas Used in 2004																							
Area # 1	No	Area 1	MS	N	N	MS	MS	--	--	--	--	--	--			MS#39[1]; MS#56[VS]; and MS#57[VS]	MS#9[3]; MS#39[VS]; MS#40[S]						
Area # 2	No	Area 2	MS, SG	SG	MS, SG	MS, SG	MS, SG	--	--	--	--	--	--	SG#011[10]	SG#045[1]; MS#047[S]	SG#35[110]; SG#37[80]; and MS#54[S]	SG#18[36]; MS#8[1]; MS#36[S]; MS#37[S]						
Area # 3	No	Area 3	SG[1]	N	N	MS, SG	MS	--	--	--	--	--	--			SG#7[1]; MS#50[S]; and MS#52[S]	MS#41[S]						
Wells Installed in 2005 After the Rare Plant Survey																							
PZ-OU1-10-A1[8]	No	Well Site	N	N	--	N	N	--	--	--	--	--	--										
PZ-OU1-46-AD2[6]	No	4	MS	N	--	N	N	MS	N	--	--	--	--					MS#4[1]					
HCPP Wells Installed Along Northwest Boundary Road in 2006 Before the Rare Plant Survey																							
EW-OU1-60-A	No	1	MS	--	N	N	N	N	--	--	--	--	--										
EW-OU1-62-A	No	1	N	--	N	N	N	--	--	--	--	--	--										
EW-OU1-63-A	No	1	N	--	N	N	N	--	--	--	--	--	--										
EW-OU1-66-A	No	1	MS	--	N	N	N	--	--	--	--	--	--										
MW-OU1-61-A	No	1	MS	--	N	N	N	N	--	--	--	--	--										
MW-OU1-64-A1	No	1	N	--	N	N	N	--	--	--	--	--	--										
MW-OU1-64-A2	No	1	N	--	N	N	N	--	--	--	--	--	--										
MW-OU1-65-A	No	1	MS	--	N	N	N	--	--	--	--	--	--										
MW-OU1-67-A	No	1	N	--	N	N	N	--	--	--	--	--	--										
MW-OU1-68-A	No	1	N	--	N	N	N	--	--	--	--	--	--										
Wells Installed in 2006 After the Rare Plant Survey																							
EW-OU1-71-A	Yes	6	N	N	--	N	N	MS	N	--	--	--	--					MS#42[S]					
EW-OU1-72-A	Yes	7	N	N	N	N	N	N	N	--	--	--	--										
IW-OU1-73-A	Yes	4	N	--	N	N	N	N	N	--	--	--	--										
IW-OU1-74-A	No	4	N	--	N	N	MS	MS	MS	--	--	--	--				MS#60[VS]	MS#39[S]	MS#41[S]; MS#33[ML]				
MW-OU1-82-A	Yes	9	N	--	N	N	N	MS	MS	--	--	--	--					MS#51[ML]	MS#10[2]				
MW-OU1-83-A	Yes	8	N	N	N	N	N	MS	MS	--	--	--	--					MS#26[1]; and MS#46[S] adjacent	MW#23[2]; MW#24[2]; MW#25[1]				
MW-OU1-84-A	No	4	N	--	N	N	N	MS	MS	--	--	--	--				MS#58 across the road	MS#37[ML]; and MS#36[ML] across road	MS#28[M]; MS#15[3]				
MW-OU1-85-A	Yes	7	N	N	N	N	N	N	N	--	--	--	--										
MW-OU1-86-A	Yes	6	N	N	--	N	N	N	N	--	--	--	--										
MW-OU1-87-A	No	Well Site	N	N	N	N	N	N	N	--	--	--	--										
MW-OU1-88-A	Yes	Well Site	N	N	--	N	N	N	N	--	--	--	--										

[1] EW-OU1-17-A, PZ-OU1-13-A, and PZ-OU1-14-A considered to be one location
[2] EW-OU1-18-A, PZ-OU1-15-A, and PZ-OU1-16-A considered to be one location
[3] MW-OU1-12-A was destroyed before the 2004 survey and is not included in the evaluation
[4] MW-OU1-24AR replaced MW-OU1-24-A, so they're considered to be one location
[5] MW-OU1-32-A and MW-OU1-33-A considered to be one location
[6] MW-OU1-46-A, MW-OU1-46-AD, and PZ-OU1-46-AD2 considered to be one location
[7] EW-OU1-49-A and PZ-OU1-49-A1 considered to be one location
[8] IW-OU1-10-A and PZ-OU1-10-A1 considered to be one location
[9] MW-OU1-39-A, MW-OU1-39-A west access road, and MW-OU1-39-A east access road are considered one location

Notes:

No new wells have been installed since 2006.
*This well has been abandoned.
-- 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
MS#49[VS] - population ID # [density category or number of plants]
SG[1] - Given map scale, it is possible that the observed sand gilia population was just outside the northwest boundary of the staging area.
#49 - indicates population ID number assigned in corresponding annual rare plant survey; [13] indicates number of plants.
SG - Sand gilia
SG#26[13] - population ID # [number of plants]
S - sparse
VS - very sparse
MW - monitoring well
N - area was surveyed; but no rare plants were detected.
OU1 - operable unit 1
PZ - piezometer
RP/HS - rare plant/habitat survey; population ID# & segment identification refers to Figures A3.1 through A3.3 in Appendix A.

Table 3.3
Fort Ord Precipitation Data - 1998-2013

Year	October - March Rainfall (inches)
1998	22.36
2004	10.32
2005	21.73
2006	14.18
2007	7.88
2008	9.71
2009	11.89
2010	16.85
2011	17.29
2012	11.3
2013	8.78
Average	**13.84**

Notes:
Precipitation information obtained from
http://met.nps.edu/~ldm/renard_wx/

Table 4.1
Rare Plant Survey Results Relative to OU-1 Weed Control Segment Well Locations

Well Identification	Year Installed	Appendix A Figure #	1998	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
Wells Installed from 1998 - 2001 (Continued)													
MW-OU1-46-A[1]	2001	NA	MS	N	N	N	N	MS	MS	MS	--	--	--
Wells Installed in 2004 After the Rare Plant Survey													
MW-OU1-46-AD[1]	No	4	MS	N	N	N	N	MS	MS	--	--	--	--
Wells Installed in 2005 After the Rare Plant Survey													
PZ-OU1-46-AD2[1]	No	4	MS	N	--	N	N	MS	N	--	--	--	--
EW-OU1-53-A	Yes	11B	MS	N	N	MS, SG	MS,SG	--	--	--	--	--	--
IW-OU1-01-A*	No	12	MS	N	N	MS, SG	MS	--	--	--	MS	MS	MS
IW-OU1-05-A*	No	13	N	N	--	MS	MS	--	--	--	MS	MS	MS
MW-OU1-51-A	No	4	N	N	N	N	N	N	N	--	--	--	--
MW-OU1-50-A	Yes	9	MS	--	MS	N	MS	MS	MS	--	--	--	--
MW-OU1-59-A	Yes	Well Site	N	--	MS	SG	N	--	--	--	--	--	--
Wells Installed in 2006 After the Rare Plant Survey													
MW-OU1-82-A	Yes	9	N	--	N	N	N	MS	MS	--	--	--	--
MW-OU1-83-A	Yes	8	N	N	N	N	N	MS	MS	--	--	--	--
MW-OU1-84-A	No	4	N	--	N	N	N	MS	MS	--	--	--	--

[1] MW-OU1-46-A, MW-OU1-46-AD, and PZ-OU1-46-AD2 considered to be one location

Notes:

No new wells have been installed since 2006.
*This well has been abandoned.

-- 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

MS#49[VS] - population ID # [density category or number of plants]

SG[1] - Given map scale, it is possible that the observed sand gilia population was just outside the northwest boundary of the staging area.

#49 - indicates population ID number assigned in corresponding annual rare plant survey; [13] indicates number of plants.

SG - Sand gilia

SG#26[13] - population ID # [number of plants]

S - sparse

VS - very sparse

MW - monitoring well

N - area was surveyed; but no rare plants were detected.

OU1 - operable unit 1

PZ - piezometer

RP/HS - rare plant/habitat survey; population ID# & segment identification refers to Figures A3.1 through A3.3 in Appendix A.

Table 5.1
Rare Plant Survey Results Relative to OU-1 Destroyed Well Locations

Well Identification	Year Installed	Appendix A Figure #	1998	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
Wells Installed Before 1998													
EW-OU1-17-A*[1]	1987	A3.2	MS, SG	N	--	N	N	--	--	--	MS	MS	MS
PZ-OU1-13-A*[1]	1988	A3.2	MS	MS	--	MS	N	--	--	--	MS	MS	MS
PZ-OU1-14-A*[1]	1988	A3.2	MS, SG	N	--	N	MS	--	--	--	MS	MS	MS
EW-OU1-18-A*[2]	1987	A3.2	MS, SG	MS, SG	--	N	SG	--	--	--	SG	MS, SG	MS, SG
PZ-OU1-15-A*[2]	1988	A3.2	MS, SG	MS, SG	--	N	N	--	--	--	MS, SG	MS, SG	MS, SG
PZ-OU1-16-A*[2]	1988	A3.2	MS, SG	MS, SG	--	N	SG	--	--	--	SG	MS, SG	MS, SG
MW-BW-10-A*	1993	A3.3	N	--	N	N	N	--	--	--	MS	MS, SG	MS, SG
MW-OU1-01-A*	1985	A3.3	MS, SG	--	--	--	--	--	--	--	MS	MS, SG	MS, SG
MW-OU1-02-A*	1985	A3.3	MS, SG	--	--	--	--	--	--	--	MS, SG	SG	MS, SG
MW-OU1-03-A*	1985	A3.2	MS	MS, SG	N	N	MS, SG	--	--	--	MS, SG	MS, SG	MS, SG
MW-OU1-04-A*	1985	A3.2	N	N	--	--	--	--	--	--	MS	N	MS
MW-OU1-05-A*	1985	A3.2	MS	SG	N	N	N	--	--	--	MS	MS	MS
MW-OU1-06-A*	1985	A3.3	SG	--	--	--	--	--	--	--	MS	MS	MS, SG
MW-OU1-08-A*	1986	A3.2	SG	MS	--	--	--	--	--	--	MS	MS	MS
MW-OU1-09-A*	1986	A3.2	MS	MS	MS	--	--	--	--	--	MS, SG	MS, SG	MS, SG
MW-OU1-10-A*	1987	A3.2	MS	N	N	--	--	--	--	--	N	N	--
MW-OU1-11-SVA*	1986	A3.2	MS	MS	--	--	MS, SG	--	--	--	MS, SG	MS, SG	MS, SG
MW-OU1-19-A*	1993	A3.2	MS, SG	MS	--	MS, SG	--	--	--	--	MS, SG	MS, SG	MS, SG
MW-OU1-20-A*	1993	A3.2	N	N	MS	--	--	--	--	--	MS	N	N
MW-OU1-21-A*	1997	A3.2	N	--	N	--	--	--	--	--	MS	MS	N
Well Identification	**Year Installed**	**Appendix A Figure #**	**1998**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**
Wells Installed from 1998 - 2001													
MW-OU1-30-A*	1998	NA	N	N	--	MS	MS	--	--	--	--	--	--
MW-OU1-32-A*[3]	1998	A3.2	N	N	--	--	--	--	--	--	MS	MS	MS
MW-OU1-33-A*[3]	1998	NA	N	N	--	--	--	--	--	--	MS	MS	MS
MW-OU1-36-A*	1999	A3.3	N	--	--	--	--	--	--	--	N	N	--
MW-OU1-37-A*	1999	A3.3	N	N	--	--	--	--	--	--	N	N	--
MW-OU1-01-180*	2000	A3.3	N	--	--	--	--	--	--	--	N	N	--
MW-OU1-02-180*	2000	A3.3	N	--	--	--	--	--	--	--	N	N	--
MW-OU1-03-180*	2000	A3.2	N	N	N	N	--	--	--	--	N	N	--
MW-OU1-38-A*	1999	A3.2	SG	N	--	--	N	--	--	--	MS, SG	MS, SG	MS, SG
MW-OU1-39-A*[9]	1999	A3.2	MS	MS	--	--	--	--	--	--	MS, SG	MS, SG	MS, SG
MW-OU1-44-A*	2000	NA	MS, SG	--	--	--	--	--	--	--	MS	MS	MS, SG
Well Identification	**New Access Cleared to Install Well**	**2008 RP/HS Segment ID**	**1998**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**
Wells Installed in 2004 After the Rare Plant Survey													
EW-OU1-54-A*	No	Well Site	N	N	MS	N	N	--	--	--	MS, SG	N	N
EW-OU1-55-A*	No	Well Site	N	N	N	N	N	--	--	--	MS	MS	MS
IW-OU1-01-A*	No	12	MS	N	N	MS, SG	MS	--	--	--	MS	MS	MS
IW-OU1-05-A*	No	13	N	N	--	MS	MS	--	--	--	MS	MS	MS
IW-OU1-24-A*	No	Well Site	N	N	--	N	MS	--	--	--	MS	MS	N
IW-OU1-25-A*	No	Well Site	N	MS, SG	N	N	N	--	--	--	MS	MS	N

[1] EW-OU1-17-A, PZ-OU1-13-A, and PZ-OU1-14-A considered to be one location

[2] EW-OU1-18-A, PZ-OU1-15-A, and PZ-OU1-16-A considered to be one location

[3] MW-OU1-32-A and MW-OU1-33-A considered to be one location

Notes:

No new wells have been installed since 2006.

*This well has been abandoned.

OU1 - operable unit 1

PZ - piezometer

N - area was surveyed; but no rare plants were detected.

MS - Monterey spineflower

SG - Sand gilia

-- not surveyed

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FIGURE(S)

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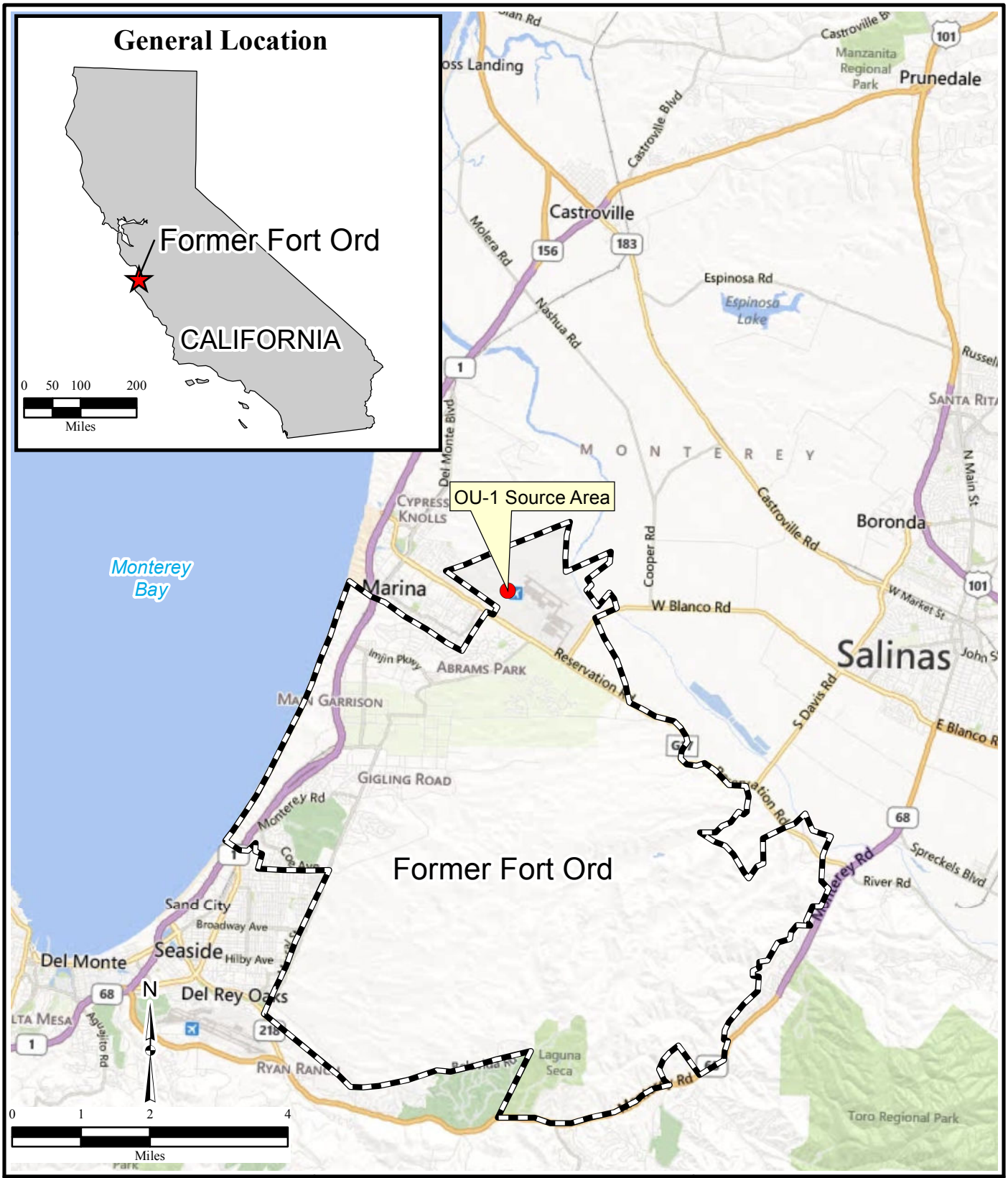

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Source: HGL
ESRI Online Bing Maps Road Map

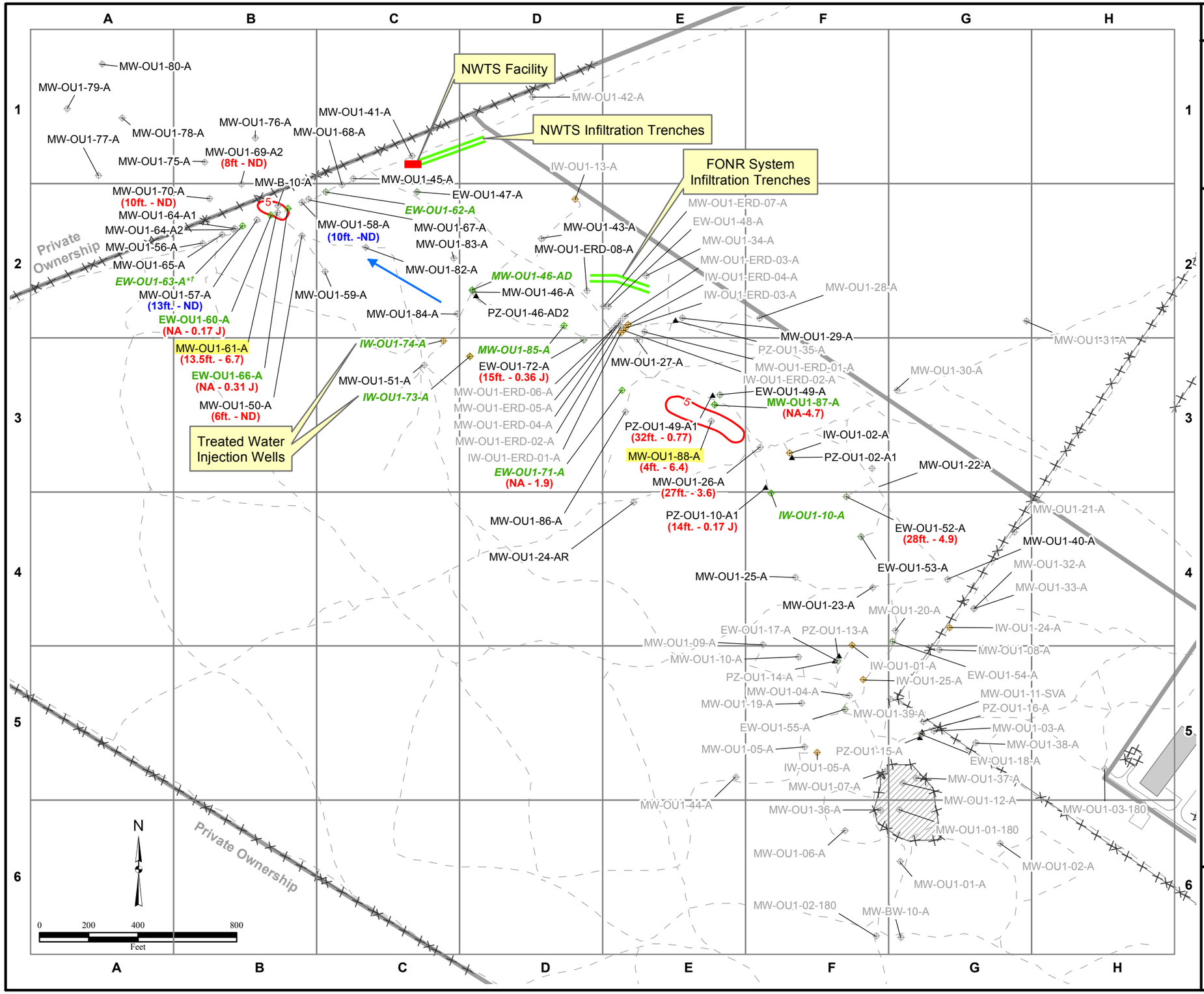
Legend

OU-1 Source Area

Former Fort Ord

Figure 1.1
Former Fort Ord

Figure 1.2
OU-1 FONR A-Aquifer
TCE Concentration in Groundwater
September 2013
Former Fort Ord, CA



Legend

- Well
- Extraction Well
- Injection Well
- Piezometer or 2-Inch Well
- Groundwater Flow Direction
- MW-OU1-21-A — Well Destroyed
- MW-OU1-88-A — Location with March 2013 TCE Concentrations at or above ACL (5 µg/L)
- MW-OU1-57-A — Well ID
- (13.5ft. - 6.7) — September 2013 TCE Result (µg/L) / Sample Elevation (feet above mean sea level)
- (13ft. - ND) — Jan/Feb/March 2013 Latest TCE Result (µg/L) / Sample Elevation (feet above mean sea level)
- 5 — TCE contour based on September 2013 Data
- Trail/Unimproved Road
- Fence
- Treated Water Infiltration Trench
- Property Boundary
- Building
- Former Fire Drill Area

Notes:
Units of TCE concentration are in micrograms per liter.
FONR = Fort Ord Natural Reserve
NWTS = Northwest Treatment System
ACL = Aquifer Cleanup Level
ND = nondetect
NA = Depth is not applicable - sample is from pumping well
µg/L = micrograms per liter
Wells shown with an asterisk were not used to develop contour boundaries.
Wells for which no data are posted were not sampled.
J = Estimated value
Green font indicates extraction or injection well.
Italicized font shows pumping suspended.
† = Disconnected extraction well. No longer operable.

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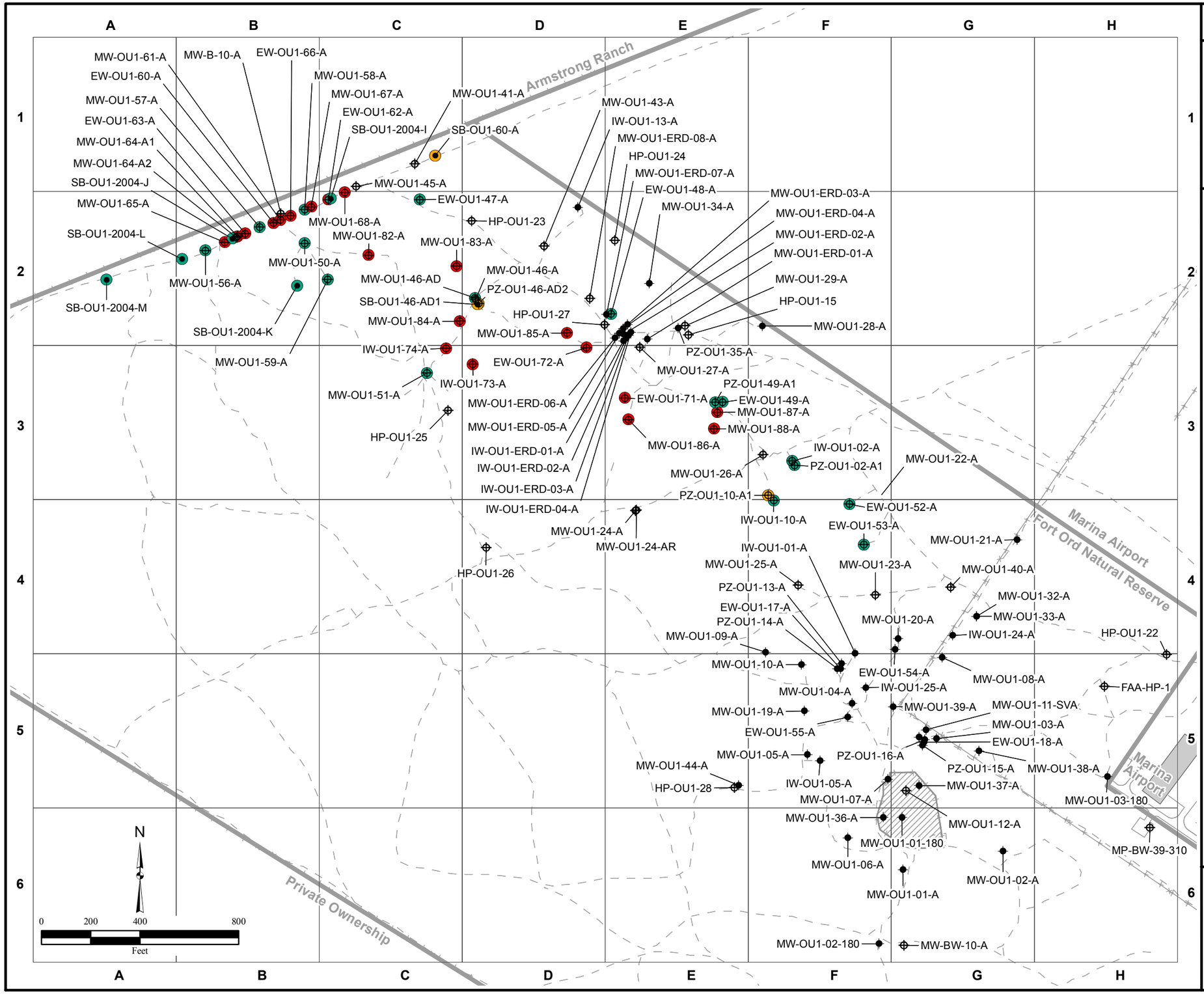
12/27/2013 CNL
Source: HGL

HGL HydroGeoLogic, Inc

Figure 1.3
OU-1 Soil Borings, Wells, and Piezometers Constructed Within the FONR



Legend

- Well/Piezometer 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
- Trail/Unimproved Road
- Fence
- Property Boundary
- Former Fire Drill Area
- Building

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

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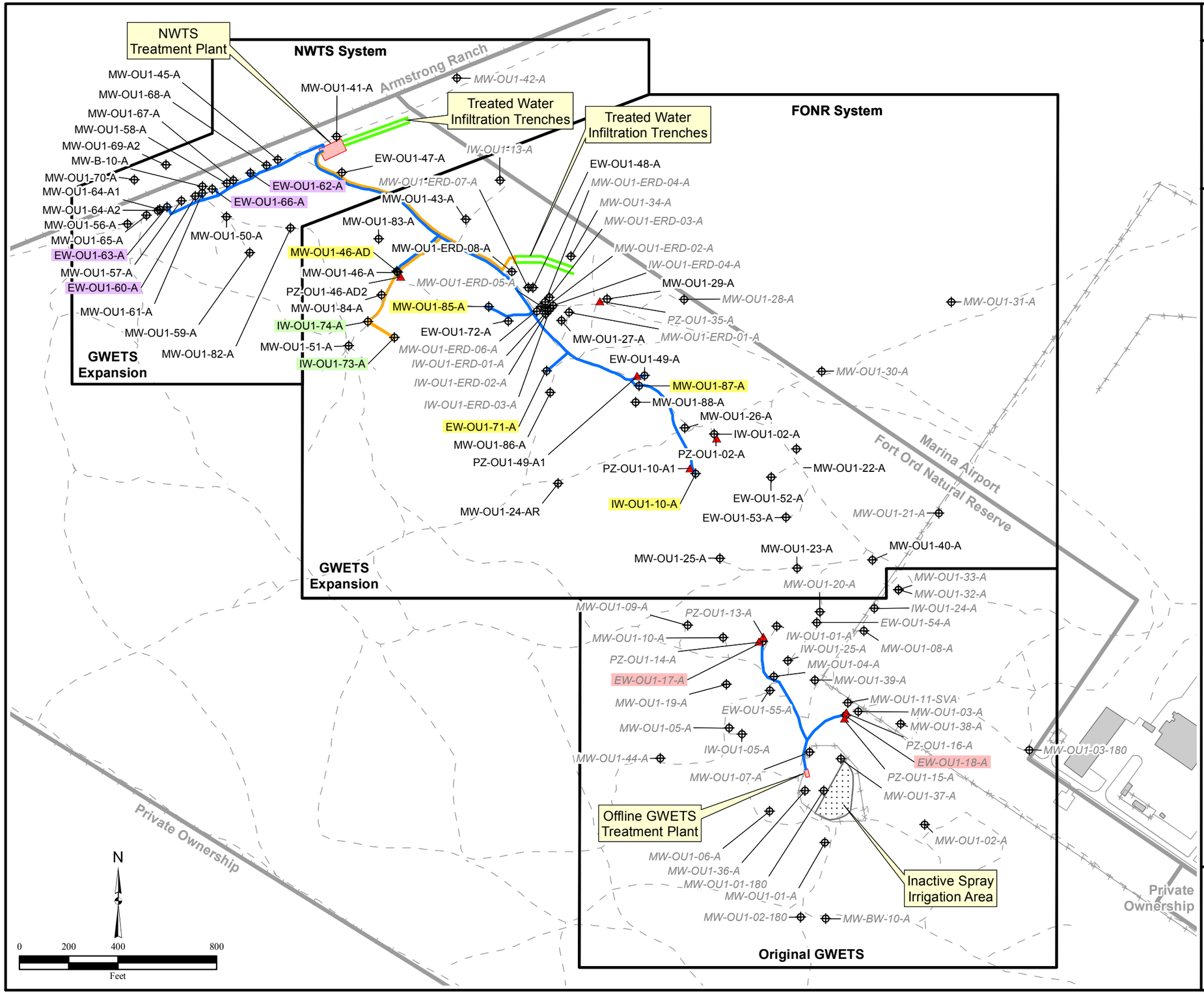
12/27/2013 CNL
Source: HGL

HydroGeoLogic, Inc

Figure 1.4
Fort Ord Natural Reserve (FONR)
OU-1 Remediation System Areas



Legend

- Well
- Piezometer
- EW-OU1-18-A — Original GWETS Extraction Well
- IW-OU1-74-A — FONR Injection Well
- MW-OU1-46-AD — FONR Extraction Well
- EW-OU1-63-A — NWTS Extraction Well
- MW-OU1-31-A — Well Destroyed September 2011
- 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

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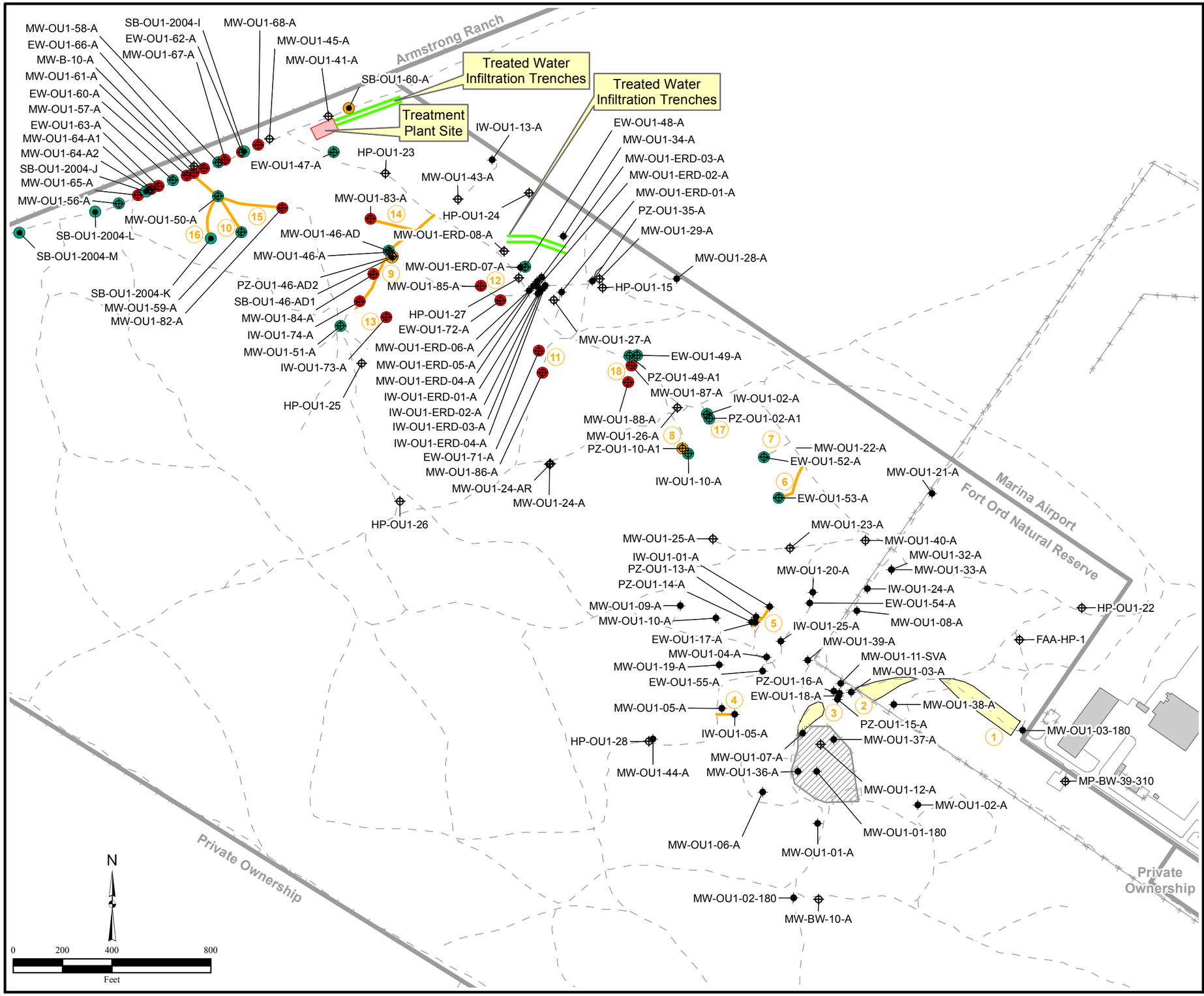
12/27/2013 CNL
Source: HGL

HGL HydroGeoLogic, Inc

Figure 1.5
Year 2013
OU-1 Weed Control Segment Locations



Legend

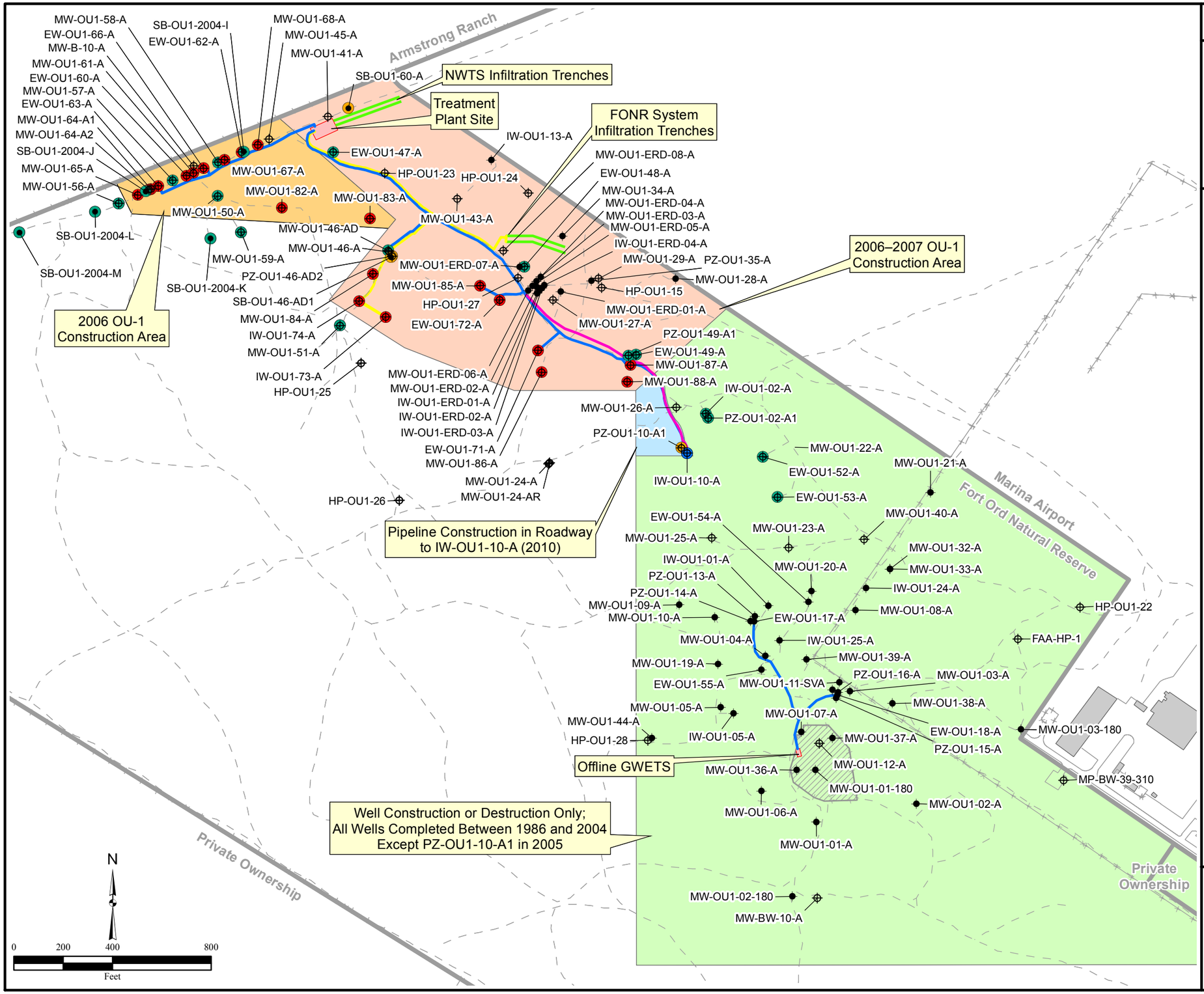
- Well/Piezometer Drilled Before 2004
- Abandoned Soil Boring
- Well Destroyed September 2011
- 2004 Well/Piezometer
- 2004 Soil Boring (abandoned)
- 2005 Well/Piezometer
- 2005 Soil Boring (abandoned)
- 2006 Well/Piezometer
- MW-OU1-21-A — Well or Boring ID
- Active Weed Control Segment
- 1 — Weed Control Segment Identification Number
- 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_Survey_Report_2013\(1-05)Weed_Control_2012.mxd
12/30/2013 CNL
Source: HGL

HGL HydroGeoLogic, Inc

Figure 4.1
OU-1 Construction Activities
2004–2013



Legend

- Well/Piezometer 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
- Existing Well Modified in 2010
- MW-OU1-21-A — Well or Boring ID
- 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

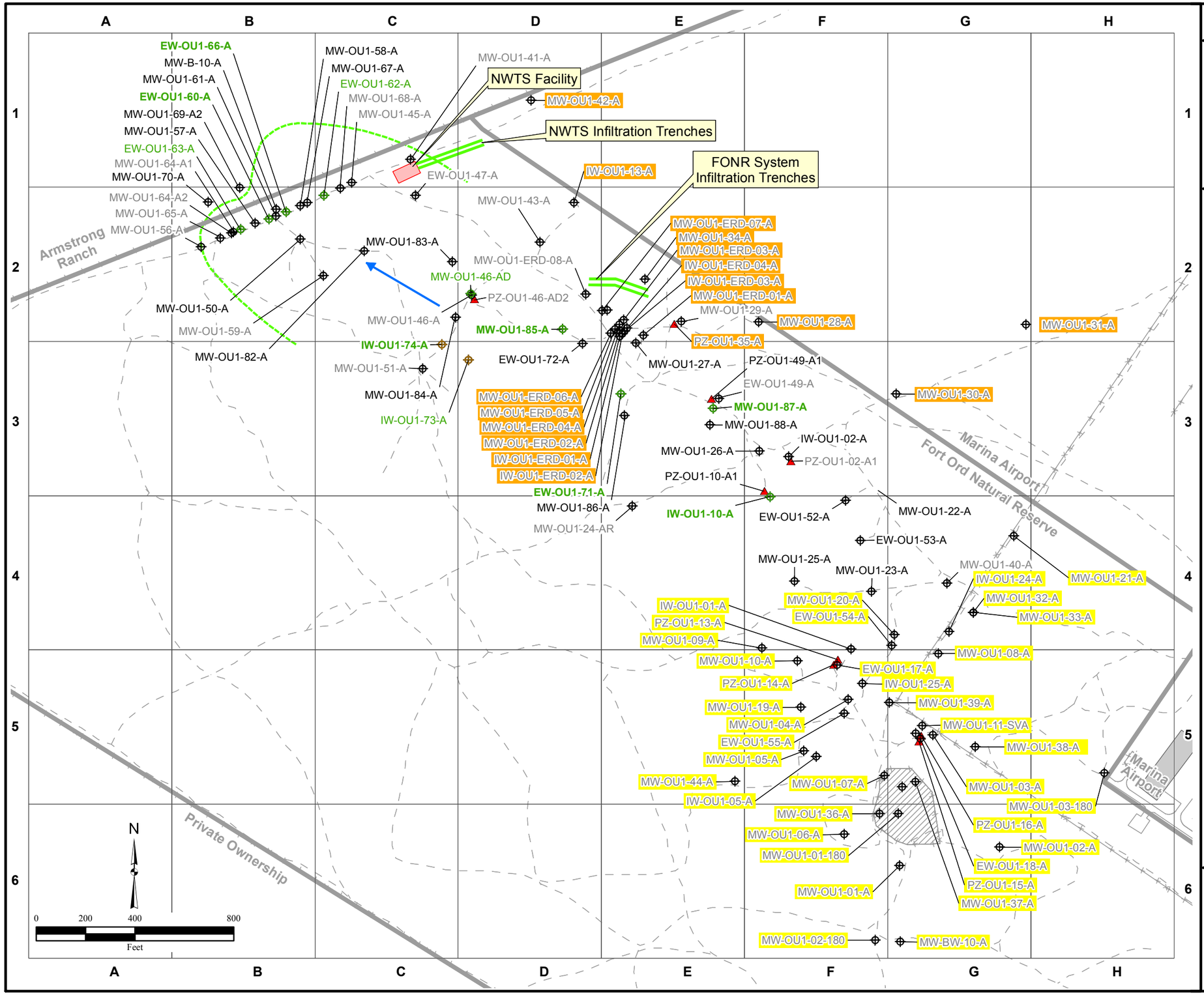
Notes:
The treated water and extraction water pipelines are located in separate trenches within or near the existing roadway. The separation shown in this figure is exaggerated for clarity.

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

\\Gst-srv-01\hglgis\Ft_Ord_MSIW\IA_Survey_Report_2013\(4-01)Constr_Activity.mxd
12/27/2013 CNL
Source: HGL

HydroGeoLogic, Inc

Figure 4.2
Former Fort Ord OU-1
Wells Destroyed in 2011



Legend

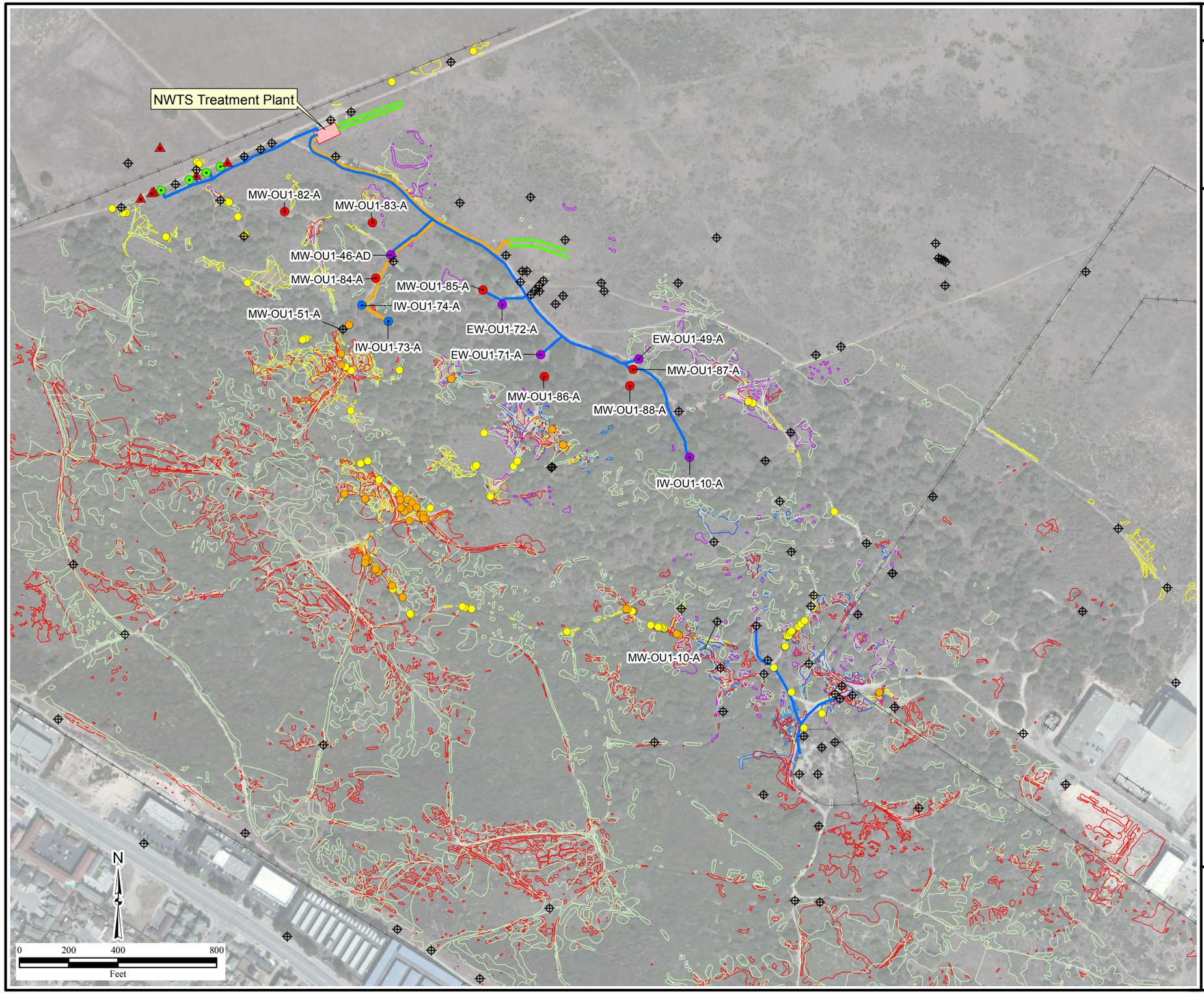
- Monitoring Well
- Extraction Well
- Injection Well
- Piezometer
- MW-OU1-88-A — Well ID
- MW-OU1-87-A — Active Well
- EW-OU1-62-A — Inactive Well
- MW-OU1-30-A — Well Destroyed in Grassland or Northwest Boundary Road
- MW-OU1-02-A — Well Destroyed Within FONR Habitat Area
- Trail/Unimproved Road
- Fence
- Treated Water Infiltration Trench
- Estimated Northwest Treatment System Capture Zone
- Groundwater Flow Direction
- Property Boundary
- Treatment Plant
- Building
- Former Fire Drill Area

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

\\Gst-srv-01\hglgis\Ft_Ord_MSIW\IA_Survey_Report_2013\(4-02)wells_destroyed_2011.mxd
12/27/2013 CNL
Source: HGL

HydroGeoLogic, Inc

Figure 4.3
Summary
of Rare Plant Survey Results
1998–2005



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_Survey_Report_2013\(4-03)98-05_Plant_Survey.mxd
12/27/2013 CNL
Source: HGL, CH2MHill, UC Santa Cruz
ArcGIS Online Bing Maps Aerial

HydroGeoLogic, Inc

APPENDIX A

RESULTS OF 2013 MONTEREY SPINEFLOWER AND SAND GILIA SURVEYS

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TABLE OF CONTENTS

Section **Page**

LIST OF FIGURES

LIST OF TABLES

LIST OF ACRONYMS

CDFW	California Department of Fish and Wildlife
CNDDB	California Natural Diversity Database
DD&A	Denise Duffy & Associates, Inc.
FDA	Fire Drill Area
FONR	Fort Ord Natural Reserve
ft^2	square feet
GIS	geographic information system
GPS	global positioning system
GWETS	groundwater extraction and treatment system
HGL	HydroGeoLogic, Inc.
HMP	Habitat Management Plan
OU	operable unit
TCE	trichloroethene
UCNRS	University of California Natural Reserve System
USACE	U.S. Army Corps of Engineers
USFWS	United States Fish and Wildlife Service
VOC	volatile organic compound

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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 DACA45-03-D-0029 awarded this work to HGL in December 2003. Denise Duffy & Associates (DD&A) performed the 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) was constructed in 1988 to remediate TCE and other groundwater contaminants.

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 (U.S. Army, 1997) (HMP) 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: Monterey spineflower (*Chorizanthe pungens* var. *pungens*) and sand gilia (*Gilia tenuiflora* ssp. *arenaria*). As part of the current remediation project, rare plant surveys were conducted in 2013 to meet the overall objective of protecting these two special-status plant species in areas affected by construction activities. This report details the surveys completed in April 2013.

A1.1 Survey Objectives

The objectives of the 2013 rare plant surveys were to:

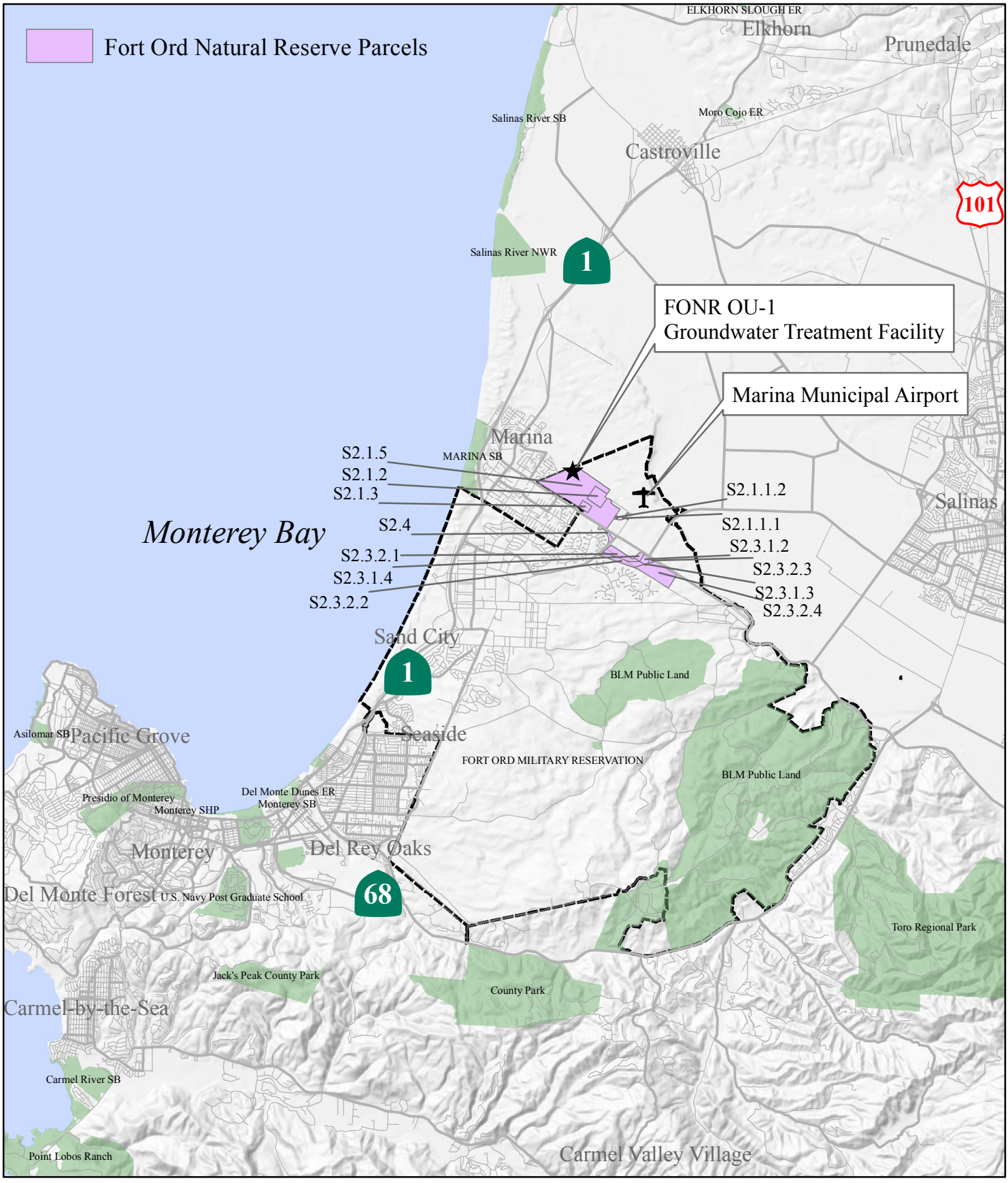


Figure A1.1

Project Vicinty Map

1. Map Monterey spineflower and sand gilia at a DD&A reference site southeast of the FONR property;
2. Map Monterey spineflower and sand gilia at well locations within the sensitive habitat portions of the FONR where existing wells were dismantled and destroyed in late 2011. HGL believes that the extended 10-year monitoring period has adequately characterized the impacts to Monterey spineflower and sand gilia populations from OU-1 remediation activities. Therefore in 2013, HGL recommended that monitoring be discontinued at seven destroyed well locations that were surveyed in 2011 and 2012. The UCSC FONR management staff indicated that these seven well locations were not located in significant habitat area. After discussions between the USFWS, the Army, the UCSC FONR management staff, and HGL, the USFWS concurred and the following destroyed well locations were deleted from the 2013 rare plant survey:

    - MW-OU1-10-A, MW-OU1-07-A, MW-OU1-36-A, MW-OU1-37-A, MW-OU1-01-180, MW-OU1-02-180, and MW-OU1-03-180.

The DD&A reference site location is shown on Figure A1.2. The well locations that were surveyed for Monterey spineflower and sand gilia in 2013 are shown on Figure A1.3.

A1.2 Site Location and Description

The dominant habitats in the area surrounding the well locations 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 boundary of OU1 is 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 might result in population declines of Monterey spineflower and, especially sand gilia, which is less tolerant of competing plant cover than Monterey spineflower.

Coast live oak woodland is the dominant habitat in the reference site. Grassland and coast live oak woodland is adjacent to the reference site on the northwestern boundary. All other sides of the reference site are bordered by paved roadways (Reservation Road, MBEST Drive, and University Drive). Non-native grasses and weedy forbs are present throughout much of the reference site.

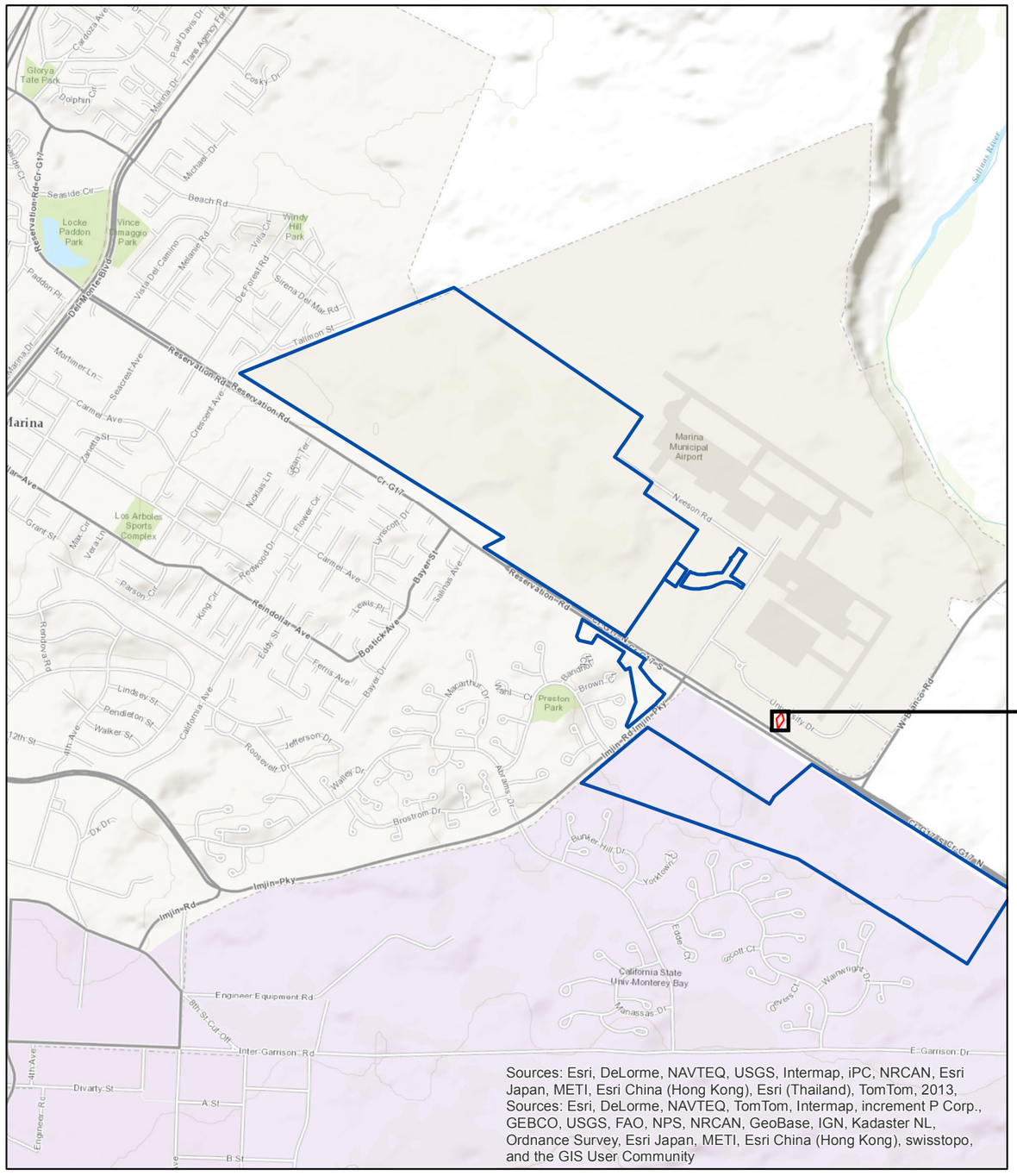
A1.1.1 Sand Gilia

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. A search of the California Natural Diversity Database (CNDDB) revealed that there are 28

occurrences within Monterey County, including the occurrences at Fort Ord (CDFW, 2013). It is likely that some of these occurrences are no longer present and the exact number of extant (still in existence) occurrences are unknown.

A1.1.2 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 24 records of Monterey spineflower within Monterey County in the CNDDB (CDFW, 2013); however, it is not known how many of these are extant.

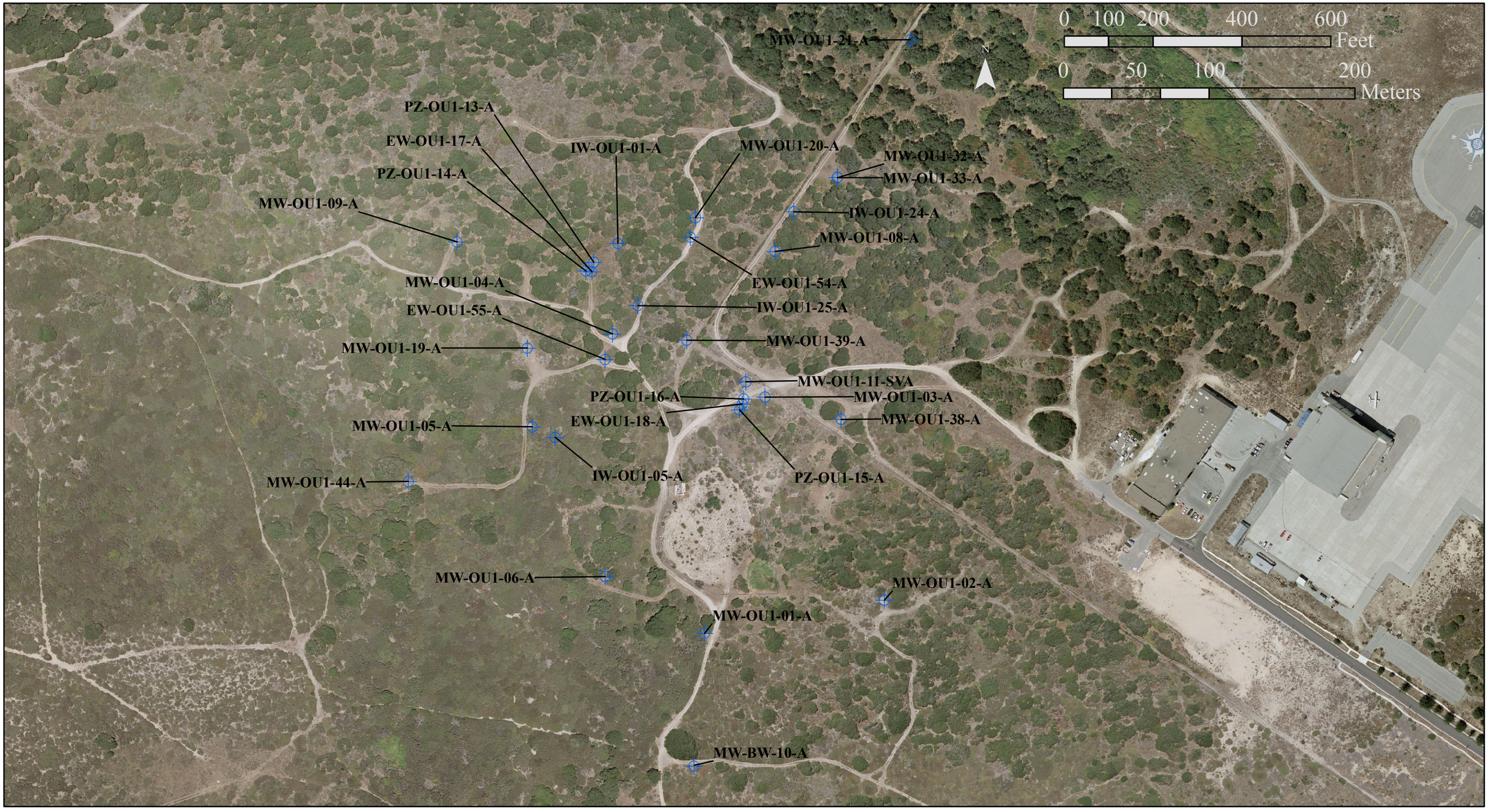


Survey Area

UC FONR Boundary

Figure A1.2

2013 Survey Area
DD&A Reference Site



Wells Surveyed in 2013

Figure A1.3

OU-1 Wells Surveyed in 2013

A2.0 Rare Plant Survey Methods

The survey areas consisted of the DD&A reference site outlined in Figure A1.2 and the OU1 FONR well locations shown on Figure A1.3. These areas were completely surveyed for the rare plants (i.e., Monterey spineflower and sand gilia) during three survey efforts conducted on April 12, 15, and 16, 2013.

Mapping of rare plant species was done using a Trimble Pathfinder ProXH GPS unit. When either 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, with attributes to identify number of individuals or percent absolute cover. 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 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.

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A3.0 Results

A3.1 Rare Plant Survey Results

A3.1.1 Sand Gilia

Sand gilia was observed and mapped at the DD&A reference site and 14 of the OU1 FONR well locations. In all, 89 populations (44 points and 45 polygons) of sand gilia, totaling 1,893 individual plants were mapped within the DD&A reference site and OU1 FONR well locations. The discrete populations are listed in Table A3.1. Figures A3.1 through A3.8 detail the survey results including a complete overview of the OU1 FONR survey area.

A3.1.2 Monterey Spineflower

Monterey spineflower was observed and mapped at the DD&A reference site and 24 of the OU1 FONR well locations. In all, 69 populations (26 points and 43 polygons) of Monterey spineflower were mapped within the DD&A reference site and the OU1 FONR well locations. The discrete populations are listed in Table A3.2 and shown on Figures A3.1 through A3.8. Population size estimates for Monterey spineflower are not as easily quantified as the sand gilia populations, and, therefore, individual Monterey spineflower plants were not recorded within the GIS polygons. As noted previously, populations of Monterey spineflower were categorized as a percentage of cover based on visual estimation. Of the 43 populations of Monterey spineflower that were mapped as polygons, three were Very Sparse (less than three percent cover), 31 populations were Sparse (5-25 percent cover), seven populations were Medium Low (26-50 percent cover) and two populations were identified as Medium (51-75 percent cover).

Table A3.1 Sand Gilia Populations Identified During 2013 Survey

Population #	Number of Individuals	GIS Feature Type	Survey Date	Figure Number
1	1	Point	4/12/2013	**A3.8**
2	2	Point	4/12/2013	**A3.8**
3	1	Point	4/12/2013	**A3.8**
4	3	Point	4/12/2013	**A3.8**
5	4	Point	4/12/2013	**A3.8**
6	4	Point	4/12/2013	**A3.8**
7	2	Point	4/12/2013	**A3.8**
8	2	Point	4/12/2013	**A3.5**
9	4	Point	4/12/2013	**A3.5**
10	3	Point	4/12/2013	**A3.2**
11	3	Point	4/12/2013	**A3.2**
12	3	Point	4/12/2013	**A3.2**
13	2	Point	4/12/2013	**A3.2**
14	4	Point	4/12/2013	**A3.2**
15	1	Point	4/15/2013	**A3.4**
16	4	Point	4/15/2013	**A3.2**
17	1	Point	4/15/2013	**A3.2**
18	4	Point	4/15/2013	**A3.2**
19	1	Point	4/15/2013	**A3.2**
20	1	Point	4/15/2013	**A3.6**
21	2	Point	4/15/2013	**A3.7**
22	2	Point	4/15/2013	**A3.7**
23	4	Point	4/16/2013	**A3.6**
24	1	Point	4/16/2013	**A3.6**
25	1	Point	4/16/2013	**A3.6**
26	1	Point	4/16/2013	**A3.6**
27	1	Point	4/16/2013	**A3.6**
28	2	Point	4/16/2013	**A3.6**
29	4	Point	4/16/2013	**A3.6**
30	2	Point	4/16/2013	**A3.6**
31	1	Point	4/16/2013	**A3.6**
32	1	Point	4/16/2013	**A3.6**
33	3	Point	4/16/2013	**A3.6**
34	1	Point	4/16/2013	**A3.6**
35	2	Point	4/16/2013	**A3.6**
36	1	Point	4/16/2013	**A3.6**
37	1	Point	4/16/2013	**A3.6**
38	4	Point	4/16/2013	**A3.6**

Table A3.1 Sand Gilia Populations Identified During 2013 Survey (continued)

Population #	Number of Individuals	GIS Feature Type	Survey Date	Figure Number
39	1	Point	4/16/2013	**A3.6**
40	2	Point	4/16/2013	**A3.6**
41	1	Point	4/16/2013	**A3.2**
42	1	Point	4/16/2013	**A3.2**
43	2	Point	4/16/2013	**A3.2**
44	1	Point	4/16/2013	**A3.2**
71	12	Polygon	4/12/2013	**A3.8**
72	74	Polygon	4/12/2013	**A3.8**
73	61	Polygon	4/12/2013	**A3.8**
74	31	Polygon	4/12/2013	**A3.8**
75	30	Polygon	4/12/2013	**A3.8**
76	16	Polygon	4/12/2013	**A3.8**
77	6	Polygon	4/12/2013	**A3.8**
78	11	Polygon	4/12/2013	**A3.8**
79	219	Polygon	4/12/2013	**A3.8**
80	17	Polygon	4/12/2013	**A3.8**
81	162	Polygon	4/12/2013	**A3.8**
82	14	Polygon	4/12/2013	**A3.8**
83	66	Polygon	4/12/2013	**A3.8**
84	10	Polygon	4/12/2013	**A3.5**
85	26	Polygon	4/12/2013	**A3.5**
86	31	Polygon	4/12/2013	**A3.5**
87	24	Polygon	4/12/2013	**A3.5**
88	18	Polygon	4/12/2013	**A3.2**
89	6	Polygon	4/12/2013	**A3.2**
90	45	Polygon	4/12/2013	**A3.2**
91	13	Polygon	4/12/2013	**A3.2**
92	15	Polygon	4/12/2013	**A3.2**
93	20	Polygon	4/15/2013	**A3.2**
94	8	Polygon	4/15/2013	**A3.2**
95	7	Polygon	4/15/2013	**A3.2**
96	8	Polygon	4/15/2013	**A3.2**
97	6	Polygon	4/15/2013	**A3.6**
98	12	Polygon	4/15/2013	**A3.6**
99	35	Polygon	4/15/2013	**A3.6**
100	53	Polygon	4/15/2013	**A3.7**
101	11	Polygon	4/15/2013	**A3.7**
102	6	Polygon	4/16/2013	**A3.6**

Table A3.1 Sand Gilia Populations Identified During 2013 Survey (continued)

Population #	Number of Individuals	GIS Feature Type	Survey Date	Figure Number
103	34	Polygon	4/16/2013	**A3.6**
104	16	Polygon	4/16/2013	**A3.6**
105	6	Polygon	4/16/2013	**A3.6**
106	7	Polygon	4/16/2013	**A3.6**
107	6	Polygon	4/16/2013	**A3.6**
108	6	Polygon	4/16/2013	**A3.6**
109	7	Polygon	4/16/2013	**A3.6**
110	10	Polygon	4/16/2013	**A3.6**
111	6	Polygon	4/16/2013	**A3.6**
112	9	Polygon	4/16/2013	**A3.6**
113	8	Polygon	4/16/2013	**A3.6**
114	10	Polygon	4/16/2013	**A3.6**
115	603	Polygon	4/16/2013	**A3.2**

Table A3.2 Monterey Spineflower Populations Identified During 2013 Survey

Population #	Number of Individuals or Percent Cover	Cover Class	GIS Feature Type	Survey Date	Figure Number
45	1	N/A	Point	4/12/2013	**A3.5**
46	4	N/A	Point	4/12/2013	**A3.5**
47	1	N/A	Point	4/12/2013	**A3.5**
48	1	N/A	Point	4/12/2013	**A3.5**
49	2	N/A	Point	4/12/2013	**A3.5**
50	4	N/A	Point	4/15/2013	**A3.4**
51	1	N/A	Point	4/15/2013	**A3.4**
52	1	N/A	Point	4/15/2013	**A3.4**
53	3	N/A	Point	4/15/2013	**A3.2**
54	1	N/A	Point	4/15/2013	**A3.2**
55	2	N/A	Point	4/15/2013	**A3.2**
56	1	N/A	Point	4/15/2013	**A3.2**
57	2	N/A	Point	4/15/2013	**A3.2**
58	4	N/A	Point	4/15/2013	**A3.6**
59	2	N/A	Point	4/15/2013	**A3.6**
60	1	N/A	Point	4/15/2013	**A3.6**
61	1	N/A	Point	4/16/2013	**A3.6**
62	5	N/A	Point	4/16/2013	**A3.6**
63	2	N/A	Point	4/16/2013	**A3.6**
64	1	N/A	Point	4/16/2013	**A3.6**
65	1	N/A	Point	4/16/2013	**A3.6**
66	1	N/A	Point	4/16/2013	**A3.6**
67	2	N/A	Point	4/16/2013	**A3.6**
68	2	N/A	Point	4/16/2013	**A3.2**
69	2	N/A	Point	4/16/2013	**A3.2**
70	1	N/A	Point	4/16/2013	**A3.2**
116	1.00	Very Sparse	Polygon	4/16/2013	**A3.6**
117	2.00	Very Sparse	Polygon	4/16/2013	**A3.2**
118	2.00	Very Sparse	Polygon	4/16/2013	**A3.2**
119	3.00	Sparse	Polygon	4/12/2013	**A3.8**
120	3.00	Sparse	Polygon	4/12/2013	**A3.8**
121	3.00	Sparse	Polygon	4/12/2013	**A3.3**
122	3.00	Sparse	Polygon	4/15/2013	**A3.6**
123	3.00	Sparse	Polygon	4/15/2013	**A3.6**
124	3.00	Sparse	Polygon	4/15/2013	**A3.6**
125	3.00	Sparse	Polygon	4/16/2013	**A3.2**
126	5.00	Sparse	Polygon	4/12/2013	**A3.3**

Table A3.2 Monterey Spineflower Populations Identified During 2013 Survey (continued)

Population #	Number of Individuals or Percent Cover	Cover Class	GIS Feature Type	Survey Date	Figure Number
127	5.00	Sparse	Polygon	4/12/2013	**A3.5**
128	5.00	Sparse	Polygon	4/12/2013	**A3.5**
129	5.00	Sparse	Polygon	4/15/2013	**A3.4**
130	5.00	Sparse	Polygon	4/15/2013	**A3.4**
131	5.00	Sparse	Polygon	4/15/2013	**A3.2**
132	5.00	Sparse	Polygon	4/15/2013	**A3.2**
133	5.00	Sparse	Polygon	4/16/2013	**A3.6**
134	5.00	Sparse	Polygon	4/16/2013	**A3.2**
135	10.00	Sparse	Polygon	4/12/2013	**A3.3**
136	10.00	Sparse	Polygon	4/12/2013	**A3.5**
137	10.00	Sparse	Polygon	4/12/2013	**A3.2, A3.5**
138	10.00	Sparse	Polygon	4/12/2013	**A3.5**
139	10.00	Sparse	Polygon	4/15/2013	**A3.4**
140	10.00	Sparse	Polygon	4/16/2013	**A3.6**
141	10.00	Sparse	Polygon	4/16/2013	**A3.6**
142	10.00	Sparse	Polygon	4/16/2013	**A3.2**
143	15.00	Sparse	Polygon	4/12/2013	**A3.7**
144	15.00	Sparse	Polygon	4/12/2013	**A3.7**
145	15.00	Sparse	Polygon	4/15/2013	**A3.6**
146	20.00	Sparse	Polygon	4/12/2013	**A3.8**
147	20.00	Sparse	Polygon	4/12/2013	**A3.8**
148	20.00	Sparse	Polygon	4/15/2013	**A3.2**
149	25.00	Sparse	Polygon	4/15/2013	**A3.7**
150	30.00	Medium Low	Polygon	4/12/2013	**A3.3**
151	30.00	Medium Low	Polygon	4/15/2013	**A3.4**
152	30.00	Medium Low	Polygon	4/15/2013	**A3.2**
153	30.00	Medium Low	Polygon	4/15/2013	**A3.2**
154	40.00	Medium Low	Polygon	4/12/2013	**A3.8**
155	40.00	Medium Low	Polygon	4/15/2013	**A3.2**
156	50.00	Medium Low	Polygon	4/15/2013	**A3.4**
157	65.00	Medium	Polygon	4/15/2013	**A3.6**
158	75.00	Medium	Polygon	4/15/2013	**A3.2**

N

0 125 250 500 Feet

1 inch = 200 feet

MW-OU1-25-A
MW-OU1-23-A
MW-OU1-40-A
MW-OU1-33-A
A3.3
MW-OU1-20-A
IW-OU1-24-A
EW-OU1-54-A
MW-OU1-08-A
MW-OU1-09-A
IW-OU1-01-A
A3.2
MW-OU1-10-A
PZ-OU1-13-A
PZ-OU1-14-A
EW-OU1-17-A
IW-OU1-25-A
MW-OU1-04-A
MW-OU1-19-A
MW-OU1-39-A
A3.5
MW-OU1-11-SVA
EW-OU1-55-A
MW-OU1-03-A
PZ-OU1-16-A
MW-OU1-38-A
EW-OU1-18-A
PZ-OU1-15-A
MW-OU1-05-A
IW-OU1-05-A
A3.4
MW-OU1-44-A
MW-OU1-07-A
MW-OU1-37-A
A3.6
MW-OU1-36-A
MW-OU1-01-180
MW-OU1-06-A
MW-OU1-02-A
MW-OU1-01-A
A3.7
MW-OU1-02-180
MW-BW-10-A
MW-BW-32-A
MW-40-01-A
MW-OU1-03-180

White text refers to corresponding figure number.

Monterey Spineflower Polygons

- Very Sparse
- Sparse
- Medium Low
- Medium

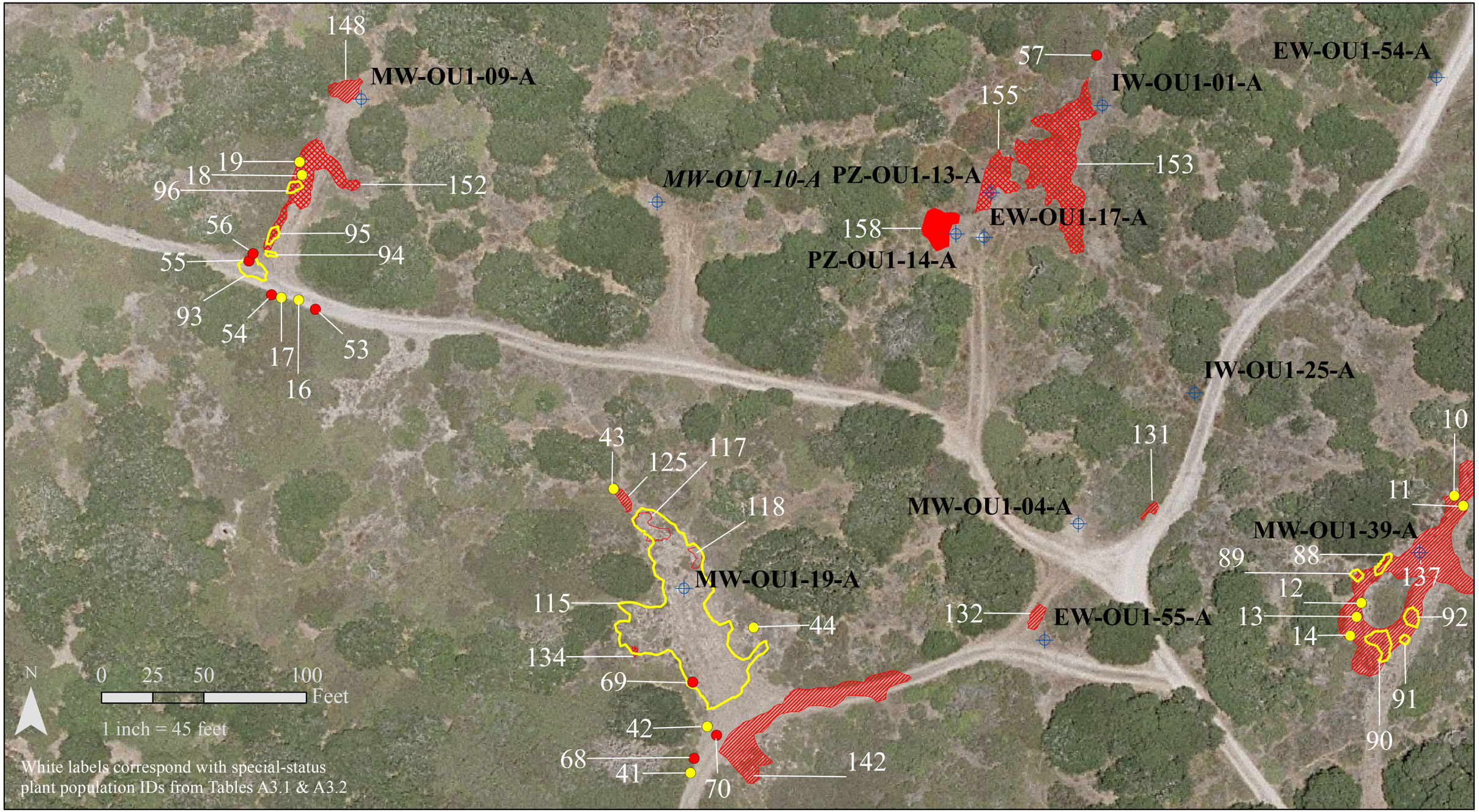
- Sand Gilia Polygons
- Monterey Spineflower Points
- Sand Gilia Points

**Wells labeled in italic font were not surveyed during 2013 survey effort.*

DD&A

Figure A3.1

2013 Survey Area Rare Plant Population Locations Overview Map



Monterey Spineflower Polygons

- Very Sparse
- Sparse
- Medium Low
- Medium

- Sand Gilia Polygons
- Monterey Spineflower Points
- Sand Gilia Points

**Wells labeled in italic font were not surveyed during 2013 survey effort.*

DD&A

Figure A3.2

2013 OU1 FONR Well Survey - Rare Plant Locations

N

0 25 50 100 Feet

1 inch = 45 feet

121

150

MW-OU1-32-A
MW-OU1-33-A

126

IW-OU1-24-A

MW-OU1-20-A

MW-OU1-08-A

135

White labels correspond with special-status plant population IDs from Tables A3.1 & A3.2

Monterey Spineflower Polygons

- Very Sparse
- Sparse
- Medium Low
- Medium

- Sand Gilia Polygons
- Monterey Spineflower Points
- Sand Gilia Points

**Wells labeled in italic font were not surveyed during 2013 survey effort.*

DD&A

Figure A3.3

2013 OU1 FONR Well Survey - Rare Plant Locations

Monterey Spineflower Polygons

- Very Sparse
- Sparse
- Medium Low
- Medium

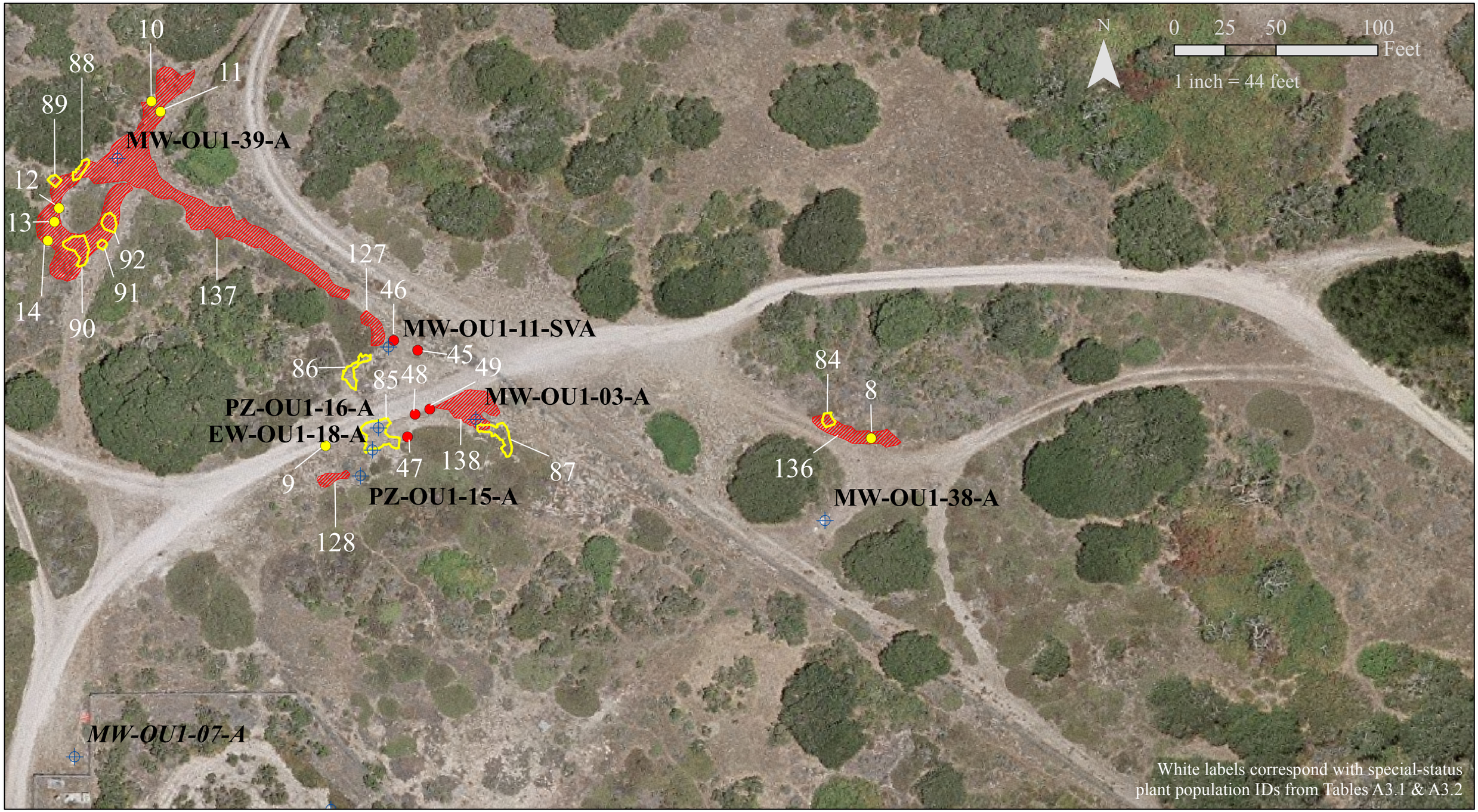
- Sand Gilia Polygons
- Monterey Spineflower Points
- Sand Gilia Points

**Wells labeled in italic font were not surveyed during 2013 survey effort.*

DD&A

Figure A3.4

2013 OU1 FONR Well Survey - Rare Plant Locations



Monterey Spineflower Polygons
- Very Sparse
- Sparse
- Medium Low
- Medium

- Sand Gilia Polygons
- Monterey Spineflower Points
- Sand Gilia Points

DD&A

Figure A3.5

2013 OU1 FONR Well Survey - Rare Plant Locations

Monterey Spineflower Polygons

- Very Sparse
- Sparse
- Medium Low
- Medium

- Sand Gilia Polygons
- Monterey Spineflower Points
- Sand Gilia Points

**Wells labeled in italic font were not surveyed during 2013 survey effort.*

DD&A

Figure A3.6

2013 OU1 FONR Well Survey - Rare Plant Locations

N

0 25 50 100 Feet

1 inch = 44 feet

21

MW-OU1-02-180

MW-BW-10-A

100

101

149

22

White labels correspond with special-status plant population IDs from Tables A3.1 & A3.2

Monterey Spineflower Polygons

- Very Sparse
- Sparse
- Medium Low
- Medium

- Sand Gilia Polygons
- Monterey Spineflower Points
- Sand Gilia Points

**Wells labeled in italic font were not surveyed during 2013 survey effort.*

DD&A

Figure A3.7

2013 OU1 FONR Well Survey - Rare Plant Locations

N

0 25 50 100 Feet

1 inch = 30 feet

1 71 147 75 74 72 4 5 146 6 3 76 73 2 7 154 77 120 78 79 144 80 81 82 143 83

Mbest Dr

Reservation Rd

White labels correspond with special-status plant population IDs from Tables A3.1 & A3.2

Service Layer Credits: Source: Esri, DigitalGlobe, GeoEye, i-cubed, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community

Monterey Spineflower Polygons

- Very Sparse
- Sparse
- Medium Low
- Medium

- Sand Gilia Polygons
- Survey Area
- Monterey Spineflower Points
- Sand Gilia Points

DD&A

Figure A3.8

2013 DD&A Reference Area Survey - Rare Plant Locations

A4.0 Conclusion

A4.1 Comparisons

Surveys are required by the Biological and Conference Opinion on the Closure and Reuse of Fort Ord, Monterey County, California (Harding Lawson, 1998) for three years after the disturbance occurs in areas that are disturbed during the remediation effort. In 2013, after a discussion with the USFWS, the number of well sites surveyed on OU1 FONR was reduced to 30 locations. This section compares the results of the 2013 and previous rare plant surveys within the DD&A reference site. Also, the survey results for 2013 at the 30 well locations on the OU1 FONR property are compared with the results of the 2011 and 2012 surveys at the same locations.

A4.1.1 DD&A Reference Site

In 2010, 14 populations of sand gilia (seven polygons and seven points) were mapped within the DD&A reference site. A total of 1,086 individual plants were mapped at the 14 populations. In 2011, 16 populations of sand gilia (four polygons and 12 points) were mapped within the DD&A reference site. A total of 318 individual plants were mapped at the 16 populations. In 2012, 16 populations with a total of 70 individual sand gilia plants (four polygons and 12 points) were mapped within the DD&A reference site. In 2013, 20 populations with a total of 736 individual sand gilia plants (seven points and 13 polygons) were mapped within the DD&A reference site. The sand gilia polygons covered approximately 1,695.2 square feet (ft^2) in 2010, 1,409.5 (ft^2) in 2011, 209.6 ft^2 in 2012, and 1,281.4 ft^2 in 2013. The area decreased approximately 285.7 ft^2 from 2010 to 2011, decreased again 1199.9 ft^2 from 2011 to 2012, and then increased 1,071.9 ft^2 from 2012 to 2013. These results are detailed below in Table A4.1.

Table A4.1 Sand Gilia Population Comparisons at DD&A Reference Site

Year	# of Populations	Individual Plants	Square Feet
2010	14	1086	1,695.2
2011	16	318	1,409.5
2012	16	70	209.6
2013	20	736	1,281.4

The most significant change in sand gilia cover from 2011 to 2012 was located in the center of the reference site. Sand gilia observed during the 2012 survey effort was substantially less when compared to the 2011 survey effort. In 2013, sand gilia populations rebounded beyond 2011 levels in terms of number of plants and closely resembled the 2011 spatial distribution. The reference site is located on property that is relatively undisturbed by anthropogenic activities. Sand gilia fluctuate in a given year because of natural variation in rainfall, temperature, and other factors. Comparing 2012 to 2010, 2011, and 2013 population numbers supports the statement made in the 2012 plant report that the environmental factors necessary to yield abundant populations of sand gilia were not ideal in 2012.

In 2010, two populations (one Sparse polygon and one Medium-Low polygon) of Monterey spineflower were mapped at the DD&A reference site. One population (Sparse polygon) of Monterey spineflower was mapped at the DD&A reference site in 2011. Three Monterey spineflower populations (two Sparse polygons and one point) were mapped within the DD&A reference site in 2012. Seven Monterey spineflower populations (six Sparse and one Medium Low) were mapped within the DD&A reference site in 2013. The Monterey spineflower polygons covered approximately 2846.1 ft^2 in 2010, approximately 2,865.4 ft^2 in 2011, 1,493.5 ft^2 in 2012 and 2,813.0 ft^2 in 2013. The area increased approximately ft^2 from 2010 to 2011, decreased 1,371.9 ft^2 from2011 to 2012 () and increased 1,319.5 ft^2 from 2012 to 2013. These results are detailed below in Table A4.2.

Table A4.2 Monterey Spineflower Population Comparisons at DD&A Reference Site

Year	# of Populations	Square Feet	GIS Feature Type	Density Classes
2010	2	2846.1	2 Polygon	Sparse Medium-Low
2011	1	2,865.4	1 Polygon	Sparse
2012	3	1,493.5	2 Polygon 1 Point	2 Sparse
2013	7	2,813.0	7 Polygon	6 Sparse 1Medium Low

As mentioned above for sand gilia, there are several environmental factors that are responsible for the amount of Monterey spineflower that blooms in a given year. Again, these results reinforce the statement that in 2012 the environmental factors necessary to yield abundant populations of Monterey spineflower were not ideal. It also appears that 2010, 2011, and 2013 were more productive years for Monterey spineflower.

A4.1.2 OU1 FONR Well Locations

The results for sand gilia for the 30 well locations on the OU1 FONR property surveyed during the 2011, 2012, and 2013 survey efforts showed:

- In 2011, nine polygons of sand gilia totaling 7,463.3 ft^2 (1,140 individuals) were recorded. In addition, 40 points of sand gilia, totaling 122 individual plants were recorded.
- In 2012, 18 polygons of sand gilia totaling 5,720.9 ft^2 (933 individuals) and 26 points of sand gilia totaling 49 individuals were mapped. The total area of sand gilia polygons decreased 1,742.4 ft^2 from 2011 to 2012. Total individual counts of sand gilia decreased from 1,262 in 2011 to 982 in 2012, a difference of 280 sand gilia individuals.
- In 2013, 32 polygons of sand gilia totaling 4,274.8 ft^2 (1,082 individuals) and 37 points of sand gilia totaling 75 individuals were mapped. Again, the total area of sand gilia decreased 3,188.5 ft^2 when compared to 2011 and 1,446.1 ft^2 when compared to 2012. While the total number of sand gilia plants mapped in 2013 (1,157) decreased by 105 when compared to 2011 (1,262), the results showed an increase of 175 plants when compared to 2012 (982).

- Sand gilia was found at 9 of the 30 well locations during the 2011 and 2012 surveys. In 2013, sand gilia was found at 14 of 30 well locations.
- During 2011, 2012, and 2013 sand gilia was found at the following seven well locations:

  EW-OU1-18-A, MW-OU1-02-A, MW-OU1-11-SVA, MW-OU1-19-A, MW-OU1-39-A, PZ-OU1-15-A, and PZ-OU1-16-A
- In 2011, sand gilia was also found at these two well locations:

  EW-OU1-54-Aand MW-OU1-03-A
- In 2012, sand gilia was also found at these two well locations:

  MW-OU1-01-A and MW-BW-10-A
- In 2013, sand gilia was also found at these five well locations:

  MW-BW-10-A, MW-OU1-01-A, MW-OU1-03-A, MW-OU1-06-A, and MW-OU1-44-A

These results are detailed below in Table A4.3.

Table A4.3 Sand Gilia Population Comparisons at OU1 FONR Well Locations

Year	# of Populations	Individual Plants	Square Feet	# of Well Locations	Well Labels
2011	49	1262	7,463.3	9	EW-OU1-18-A MW-OU1-02-A MW-OU1-11-SVA MW-OU1-19-A MW-OU1-39-A PZ-OU1-15-A PZ-OU1-16-A EW-OU1-54-A MW-OU1-03-A
2012	44	982	5,720.9	9	EW-OU1-18-A MW-OU1-02-A MW-OU1-11-SVA MW-OU1-19-A MW-OU1-39-A PZ-OU1-15-A PZ-OU1-16-A MW-OU1-01-A MW-BW-10-A

Table A4.3 Sand Gilia Population Comparisons at OU1 FONR Well Locations (continued)

Year	# of Populations	Individual Plants	Square Feet	# of Well Locations	Well Labels
2013	69	1157	4,274.8	12	EW-OU1-18-A MW-OU1-02-A MW-OU1-11-SVA MW-OU1-19-A MW-OU1-39-A PZ-OU1-15-A PZ-OU1-16-A MW-BW1-10-A MW-OU1-01-A MW-OU1-03-A MW-OU1-06-A MW-OU1-44-A

The results for Monterey spineflower for all well locations on the OU1 FONR property surveyed during the 2011, 2012, and 2013 survey efforts showed:

- In 2011, 30 polygons of Monterey spineflower (24 Sparse, one Medium, four Medium Low and one Medium High cover class) totaling 27,939.5 ft^2 were mapped. In addition, 11 Monterey spineflower points were mapped totaling 33 plants.
- In 2012, 31 polygons of Monterey spineflower were mapped (26 Sparse and five Medium Low cover class) totaling 12,132.8 ft^2—a decrease of 15,806.74 ft^2 when compared to 2011. In addition, seven Monterey spineflower points were mapped, totaling 12 plants.
- In 2013, 36 polygons (three Very Sparse, 25 Sparse, six Medium Low and two Medium) totaling 11,100.4 ft^2 were mapped. Monterey spineflower area decreased 16,839.1 ft^2 when compared with 2011 and 1,032.4 ft^2 when compared with 2012. In addition, 27 Monterey spineflower points were mapped, totaling 49 plants.
- Monterey spineflower was found at all 30 well locations surveyed in 2011, 24 of the 30 well locations in 2012, and at 24 of 30 well locations in 2013.

These results are detailed below in Table A4.4.

Table A4.4 Monterey Spineflower Population Comparisons at DD&A Reference Site

Year	# of Populations	Square Feet	GIS Feature Type	Density Classes
2011	41	27,939.5	30 Polygon 11 Point	24 Sparse 1 Medium 4 Medium Low 1 Medium High
2012	38	12,132.8	31 Polygon 7 Point	26 Sparse 5 Medium Low
2013	63	11,100.4	36 Polygon 27 Point	3 Very Sparse 25 Sparse 6 Medium Low 2 Medium

A4.1.3 Population Sustainability

More sand gilia populations were recorded than Monterey spineflower populations (89 locations compared to 68 locations of Monterey spineflower) during the 2013 survey effort. DD&A conducted rare plant surveys from 2006-2013 within the OU1 FONR area, and the 2013 rare plant survey was the third year in which sand gilia populations outnumbered Monterey spineflower populations.

Sand gilia at the OU1 FONR well locations have historically fluctuated because of natural variation in rainfall, temperature, and other factors. An example of this fluctuation at OU1 FONR was observed during the 2006 survey effort. The 2006 survey found 40 sand gilia plants in five areas at the west end of Survey Site 6; an area north of the well locations surveyed in 2013. Based on their presence in 2006, HGL avoided activity in this area and relocated the well that was originally proposed at this location to approximately 180 feet to the east. However, none of the populations observed in 2006 were found in subsequent years. The annual survey data at this location illustrates population fluctuations in an area that was not impacted by human disturbance.

Monterey spineflower populations are relatively abundant and seem to be less affected by the same environmental factors or constraints as sand gilia. 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. These observations suggest that this species may be somewhat more tolerant of competing annual grass cover than sand gilia.

The survey data shows that both Monterey spineflower and sand gilia occurrences within the surveyed portion of the OU1 FONR continue to exist despite the earlier construction efforts.

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A5.0 References

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Harding Lawson Associates, 1998. Biological information for agency consultation related to groundwater remediation activities and quarterly groundwater sampling at FONR Fort Ord Natural Reserve. Biological and Conference Opinion on the Closure and Reuse of Fort Ord, Monterey County, California (1-8-99-F/C-39R), Enclosure 2. Letter to Jane Holte.

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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APPENDIX B

REPORT ON WEED CONTROL SEGMENT TREATMENTS 2013

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OPERABLE UNIT 1 (OU-1)

2013 WEED CONTROL SEGMENT TREATMENT REPORT

UNIVERSITY OF CALIFORNIA - FORT ORD NATURAL RESERVE

SPRING 2013

Prepared for:

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TABLE OF CONTENTS

TABLES

ATTACHMENTS

Introduction

Weed control efforts continued on HydroGeoLogic, Inc. (HGL) work sites within the Operable Unit 1 (OU-1) portion of the Fort Ord Natural Reserve (FONR) in 2013. Weed control work was similar to the 2010 effort and emphasized control of non-native grasses before they were able to establish in habitat disturbed by groundwater clean-up activities. The 2013 effort was scaled back from previous years because FONR was unable to hire additional staff to perform the weed control treatments. Consequently, the level of treatment documentation was reduced from previous weed control efforts and only a subset of the Weed Control Segments (WCS) was treated. Comprehensive vegetation surveys (e.g. species composition and cover data) of Weed Control Segments (WCS) were not conducted in 2013, which is consistent with the 2008- 2012 weed control efforts. It is our opinion that these comprehensive vegetation surveys are not necessary each year. Rather, vegetation surveys are intended to evaluate success of WCS treatments, which might not be evident within one year. This report summarizes the 2013 weed control efforts, data collection and survey results.

Methods

WCS treatments began 4 April 2013 and continued through 2 August 2013. Each WCS received 1-5 treatments (weedeater and hand pulling) depending on site-specific phenology, response to treatments, and species composition. One WCS (16A) received five treatments, two WCS (5A, 6A) received four treatments, four WCS (9A, 9B, 9C, 14A) received three treatments, four WCS (4A, 9D, 10A, 15A) received two treatments, and one WCS (10B) received only one treatment. Prior to the initial treatment, rare plant surveys were conducted within each WCS. Unlike previous weed control efforts, treatment diagrams and rare plant diagrams were not completed for each WCS. In addition to the rare plant surveys, pre-treatment photos were taken from photo stations within each

WCS. After performing the final treatment of the season, post-treatment photos were taken from appropriate photo stations within each WCS.

Results

The 2013 weed control program significantly reduced the survivorship, abundance, and seed production of target species in areas disturbed by OU-1 cleanup activities. Pre-treatment rare plant surveys identified locations of rare plants prior to treatments. Thus, we were able to avoid areas with protected species and ensure they were not negatively impacted by treatments. The results of the rare plant surveys show that sand gilia (*Gilia tenuiflora ssp. arenaria*) were present in 2 WCS (5A, 6A) and Monterey spineflower (*Chorizanthe pungens var. pungens*) were present in all 12 WCS treated this year. Along with this report, we have included the following documentation as attachments:

- detailed photo log (Attachment 1)
- pre- & post treatment photos (Attachment 2)
    - Powerpoint file with photos formatted for printing
    - Original digital photo files (.jpgs) included on compact disc)

Discussion

Early spring implementation enabled us to effectively utilize mechanical methods to control non-native annual grasses and forbs. Both mechanical and hand control methods were utilized making the weed control efforts more effective, broad scale and sensitive to rare species habitat. Multiple treatments were focused on high priority sites, with prioritization based on habitat type, rare plant presence, and weed species composition. Pre-treatment rare plant surveys identified presence of sand gilia in 2 WCS (5A, 6A) and Monterey spineflower in all 12 WCS that were treated in 2013. These pre-treatment surveys are essential to ensure mechanical weed treatments do not have a negative impact on protected species. Because weed control efforts were initiated at the appropriate

time, we were able reduce seed production of a significant portion of non-native annual grasses in locations where control was critical (i.e. within or adjacent to chaparral and scrub habitat). The continued removal of invasive forbs resulted in a reduction of thousands of invasive weeds from the well sites that may have otherwise expanded their distribution into FONR and increased their seed bank in areas disturbed by OU-1 clean-up activities. It is difficult to determine with measureable certainty if the relatively low weed abundance observed this year is a result of annual variation, climate conditions, or effective weed control. However, we are confident the weed abatement efforts are having a positive impact on reducing weed populations on the OU-1 cleanup sites. As a result, our efforts have reduced the number of invasive plants and, very importantly, removed a large portion of the invasive weed seed source for 2014.

Table 1. Summary of Weed Control Segment (WCS) treatments, spring 2013.

WCS	Well ID	# of Treatments	Treatment Method	Species Treated	Rare Plants Present	WCS of High Concern**
4A	IW-OU1-05-A	2	mechanical	avsp, brdi, brmaru, hysp, ersp, vusp	Y	*
5A	IW-OU1-01-A	4	manual, mechanical	aica, avsp, brdi, brho, brmaru, ceme, ersp, hysp, vusp	Y	*
6A	EW-OU1-53-A	4	manual, mechanical	aica, avsp, brdi, brho, brmaru, coma, ersp, hysp, ruac, vusp	Y	*
9A	MW-OU1-46-A MW-OU1-46-AD PZ-OU1-46-AD2	3	manual, mechanical	aica, anar, brdi, brho, brmaru, coma, ersp, ruac, vusp	Y	
9B	MW-OU1-84-A	3	manual, mechanical	anar, avsp, brca, brdi, brho, brmaru, coma, ceme, ersp, hysp, vusp,	Y	
9C	MW-OU1-50-A	3	manual, mechanical	aica, anar, avsp, brdi, brmaru, coma, ersp, hysp, ruac, vusp	Y	*
9D	MW-OU1-51-A	2	mechanical	avsp, brca, brdi, brho, brmaru, ersp, hysp, ruac	Y	*
10A	MW-OU1-50-A	2	mechanical	aica, avsp, brca, brdi, brho, brmaru, ersp, hysp, vusp,	Y	
10B	MW-OU1-59-A	1	manual, mechanical	anar, avsp, brca, brdi, brho, brmaru, capy, ersp, hysp, ruac, vusp	Y	
14A	MW-OU1-83-A	3	mechanical	anar, avsp, brca, brdi, brho, brmaru, ersp, ruac, vusp	Y	
15A	MW-OU1-82-A	2	mechanical	aica, anar, avsp, brca, brdi, brho, brmaru, hysp, ersp, vusp	Y	*
16A	SB-OU1-2004-K	5	manual, mechanical	aica, anar, avsp, brca, brdi, brho, brmaru, capy, coma, hysp, vusp	Y	*

** **WCS of High Concern**– this classification represents a subjective judgment based on a number of factors, including (among others) the number and frequency of treatments, observed response to treatments, and the species composition of the site.

Table 2. Invasive species treated within the 12 Weed Control Segments (WCS), spring 2013.

Genus	Species	Code	Common Name
Aira	*caryophyllea*	aica	slivery hair-grass
Anaglis	*arvensis*	anar	scarlet pimpernel
Avena	species	avsp	wild oat species (Note: species not identified – avsp includes both *Avena barbata* and *A. fatua*)
Bromus	*catharticus*	brca	prairie grass
Bromus	*diandrus*	brdi	ripgut grass
Bromus	*hordeaceus*	brho	soft chess
Bromus	*madritensis ssp. rubens*	brmaru	red brome
Carduus	*pycnocephalis*	capy	Italian thistle
Centaurea	*melitensis*	ceme	tocalote, Maltese star thistle
Conium	*maculatum*	coma	poison hemlock
Erodium	species	ersp	*Erodium* species (Note: species not identified – ersp includes *Erodium botrys, Erodium brachycarpum, Erodium cicutarium* and *Erodium moschatum*)
Hypochaeris	species	hysp	cats ear species (Note: species not identified – hysp includes both *Hypochaeris glabra* and *H. radicata)*
Rumex	*acetosella*	ruac	sheep sorrel
Vulpia	species	vusp	fescue species (Note: species not identified – vusp includes *Vulpia bromoides, V. myuros var. hirsute,* and *V. myuros var. myuros*)

Attachment 1

'WCS Photo Log 2013'

The attached spreadsheet (HGL_WCS_PhotoLog_2013.xls) contains a detailed log of all photographs (pre- and post-treatment) taken during the 2013 weed control program within the Operable Unit 1 portion of the FONR.

HGL - WCS 2013 - Photo Log

Date= photo treatment date
WCS= Weed Control Segment; HGL defined weed management area with corresponding wells.

Photo filenames:
All filenames given in following format: <fonr_ps_##x_year-mo-date>
where: ps= photo station ; ##= number; x= photo point; year= year four digit format (e.g., 2013);
mo= month (e.g., april=04); date= date (09 instead of 9); Photo dates are not always the same as treatment dates

Date	Photo #	WCS #	Photo Station	Photo Point	Compass Bearing Point	Well/Road #	Notes
4/4/13	1391	04A	2	a	55	IW-OU1-05-A	Pre-Treatment Photos Note: Well demolished
4/4/13	1392	04A	3	a	55	IW-OU1-05-A	Pre-Treatment Photos
4/4/13	1393	04A	3	b	236	IW-OU1-05-A	Pre-Treatment Photos
4/4/13	1394	05A	7	a	197	IW-OU1-01-A	Pre-Treatment Photos
4/4/13	1395	05A	7	b	3	IW-OU1-01-A	Pre-Treatment Photos Note: Well demolished
4/4/13	1396	05A	8	a	11	IW-OU1-01-A	Pre-Treatment Photos
4/4/13	1397	05A	8	b	40	IW-OU1-01-A	Pre-Treatment Photos
4/4/13	1398	05A	8	c	160	IW-OU1-01-A	Pre-Treatment Photos
4/4/13	1399	06A	10	a	177	EW-OU1-53-A	Pre-Treatment Photos
4/4/13	1400	06A	11	a	0	EW-OU1-53-A	Pre-Treatment Photos
4/4/13	1401	06A	11	b	244	EW-OU1-53-A	Pre-Treatment Photos
4/4/13	1402	06A	12	a	268	EW-OU1-53-A	Pre-Treatment Photos
4/4/13	1403	06A	12	b	228	EW-OU1-53-A	Pre-Treatment Photos
4/4/13	1408	09A	22	a	27	MW-OU1-46AD, PZ-OU1-46-AD2, MW-OU1-46-A	Pre-Treatment Photos
4/4/13	1409	09A	22	b	116	MW-OU1-46AD, PZ-OU1-46-AD2, MW-OU1-46-A	Pre-Treatment Photos
4/4/13	1404	09A	25	a	223	MW-OU1-46AD, PZ-OU1-46-AD2, MW-OU1-46-A	Pre-Treatment Photos
4/4/13	1405	09A	49	a	35	MW-OU1-46AD, PZ-OU1-46-AD2, MW-OU1-46-A	Pre-Treatment Photos
4/4/13	1406	09A	49	b	214	MW-OU1-46AD, PZ-OU1-46-AD2, MW-OU1-46-A	Pre-Treatment Photos
4/4/13	1407	09A	49	c	297	MW-OU1-83A	Pre-Treatment Photos
4/4/13	1410	09B	22	c	193	MW-OU1-84A	Pre-Treatment Photos
4/4/13	1411	09B	51	a	283	MW-OU1-84A	Pre-Treatment Photos
4/4/13	1412	09C	52	a	338	IW-OU1-74A	Pre-Treatment Photos
4/4/13	1416	09D	24	a	217	MW-OU1-51A	Pre-Treatment Photos
4/4/13	1413	09D	52	c	214	MW-OU1-51A	Pre-Treatment Photos
4/4/13	1418	10A	28	a	118	MW-OU1-50A	Pre-Treatment Photos
4/4/13	1419	10A	29	a	109	MW-OU1-50A	Pre-Treatment Photos
4/4/13	1420	10A	29	b	288	MW-OU1-50A	Pre-Treatment Photos
4/4/13	1426	10B	30	a	150	MW-OU1-59A	Pre-Treatment Photos
4/4/13	1427	10B	30	b	334	MW-OU1-59A	Pre-Treatment Photos
4/4/13	1417	14A	50	a	111	MW-OU1-83A	Pre-Treatment Photos
4/4/13	1428	15A	54	a	79	MW-OU1-82A	Pre-Treatment Photos
4/4/13	1429	15A	54	b	258	MW-OU1-82A	Pre-Treatment Photos
4/4/13	1430	15A	55	a	269	MW-OU1-82A	Pre-Treatment Photos
4/4/13	1431	15A	55	b	80	MW-OU1-82A	Pre-Treatment Photos

HGL - WCS 2013 - Photo Log

4/4/13	1421	16A	31	a	180	SB-OU1-2004K	Pre-Treatment Photos
4/4/13	1422	16A	32	a	150	SB-OU1-2004K	Pre-Treatment Photos
4/4/13	1423	16A	32	b	357	SB-OU1-2004K	Pre-Treatment Photos
4/4/13	1424	16A	33	a	152	SB-OU1-2004K	Pre-Treatment Photos
4/4/13	1425	16A	33	b	337	SB-OU1-2004K	Pre-Treatment Photos
9/10/13	1563	04A	2	a	55	IW-OU1-05-A	Post-Treatment Photos
9/10/13	1564	04A	3	a	55	IW-OU1-05-A	Post-Treatment Photos
9/10/13	1565	04A	3	b	236	IW-OU1-05-A	Post-Treatment Photos
9/10/13	1566	05A	7	a	197	IW-OU1-01-A	Post-Treatment Photos
9/10/13	1567	05A	7	b	3	IW-OU1-01-A	Post-Treatment Photos
9/10/13	1568	05A	8	a	11	IW-OU1-01-A	Post-Treatment Photos
9/10/13	1569	05A	8	b	40	IW-OU1-01-A	Post-Treatment Photos
9/10/13	1570	05A	8	c	160	IW-OU1-01-A	Post-Treatment Photos
9/10/13	1571	06A	10	a	177	EW-OU1-53-A	Post-Treatment Photos
9/10/13	1572	06A	11	a	0	EW-OU1-53-A	Post-Treatment Photos
9/10/13	1573	06A	11	b	244	EW-OU1-53-A	Post-Treatment Photos
9/10/13	1574	06A	12	a	268	EW-OU1-53-A	Post-Treatment Photos
9/10/13	1575	06A	12	b	228	EW-OU1-53-A	Post-Treatment Photos
9/10/13	1581	09A	22	a	27	MW-OU1-46AD, PZ-OU1-46-AD2, MW-OU1-46-A	Post-Treatment Photos
9/10/13	1582	09A	22	b	116	MW-OU1-46AD, PZ-OU1-46-AD2, MW-OU1-46-A	Post-Treatment Photos
9/10/13	1576	09A	25	a	223	MW-OU1-46AD, PZ-OU1-46-AD2, MW-OU1-46-A	Post-Treatment Photos
9/10/13	1577	09A	49	a	35	MW-OU1-46AD, PZ-OU1-46-AD2, MW-OU1-46-A	Post-Treatment Photos
9/10/13	1578	09A	49	b	214	MW-OU1-46AD, PZ-OU1-46-AD2, MW-OU1-46-A	Post-Treatment Photos
9/10/13	1579	09A	22	c	193	MW-OU1-84A	Post-Treatment Photos
9/10/13	1584	09B	51	a	283	MW-OU1-84A	Post-Treatment Photos
9/10/13	1585	09C	52	a	338	IW-OU1-74A	Post-Treatment Photos
9/10/13	1587	09D	24	a	217	MW-OU1-51A	Post-Treatment Photos
9/10/13	1586	09D	52	c	214	MW-OU1-51A	Post-Treatment Photos
9/10/13	1589	10A	28	a	118	MW-OU1-50A	Post-Treatment Photos
9/10/13	1590	10A	29	a	109	MW-OU1-50A	Post-Treatment Photos
9/10/13	1591	10A	29	b	288	MW-OU1-50A	Post-Treatment Photos
9/10/13	1597	10B	30	a	150	MW-OU1-59A	Post-Treatment Photos
9/10/13	1598	10B	30	b	334	MW-OU1-59A	Post-Treatment Photos
9/10/13	1588	14A	50	a	111	MW-OU1-83A	Post-Treatment Photos
9/10/13	1599	15A	54	a	79	MW-OU1-82A	Post-Treatment Photos
9/10/13	1600	15A	54	b	258	MW-OU1-82A	Post-Treatment Photos
9/10/13	1601	15A	55	a	269	MW-OU1-82A	Post-Treatment Photos
9/10/13	1602	15A	55	b	80	MW-OU1-82A	Post-Treatment Photos
9/10/13	1592	16A	31	a	180	SB-OU1-2004K	Post-Treatment Photos
9/10/13	1593	16A	32	a	150	SB-OU1-2004K	Post-Treatment Photos
9/10/13	1594	16A	32	b	357	SB-OU1-2004K	Post-Treatment Photos
9/10/13	1595	16A	33	a	152	SB-OU1-2004K	Post-Treatment Photos
9/10/13	1596	16A	33	b	337	SB-OU1-2004K	Post-Treatment Photos

Attachment 2

‘HGL_WCS_Photos_2013’

The enclosed compact disc (CD) contains digital photographs taken during the 2013 weed control program performed by FONR staff. Photographs on the CD are organized in the folder 'HGL_WCS_Photos_2013_jpgs'. This folder contains photo files (.jpg format) with the file name designating the reserve (fonr), the photo station number (‘_ps#’), and the date the photo was taken (_year-month-day).

e.g. ‘fonr_ps13a_2013-04-04’
‘fonr_ps13a_2013-09-10’

Each photo station has at least two photos, one pre-treatment and one post-treatment, designated by date of photo. Refer to photo log (HGL_WCS_PhotoLog_2013.xls) for more detailed information.

In addition to the digital photograph files, the enclosed CD also contains an Adobe PDF file 'HGL_WCS_Photos_2013.pdf' with the pre-treatment and post-treatment photos for each WCS labeled and formatted on a standard letter (8.5" x 11") portrait layout.

WCS# 4A ps2a IW-OU1-05-A Pre-Treatment 4 April 2013

WCS# 4A ps2a IW-OU1-05-A Post-Treatment 10 September 2013

WCS# 4A ps3a IW-OU1-05-A Pre-Treatment 4 April 2013

WCS# 4A ps3a IW-OU1-05-A Post-Treatment 10 September 2013

WCS# 4A ps3b IW-OU1-05-A Pre-Treatment 4 April 2013

WCS# 4A ps3b IW-OU1-05-A Post-Treatment 10 September 2013

WCS# 5A ps7a IW-OU1-01-A Pre-Treatment 4 April 2013

WCS# 5A ps7a IW-OU1-01-A Post-Treatment 10 September 2013

WCS# 5A ps7b IW-OU1-01-A Pre-Treatment 4 April 2013

WCS# 5A ps7b IW-OU1-01-A Post-Treatment 10 September 2013

WCS# 5A ps8a IW-OU1-01-A Pre-Treatment 4 April 2013

WCS# 5A ps8a IW-OU1-01-A Post-Treatment 10 September 2013

WCS# 5A ps8b IW-OU1-01-A Pre-Treatment 4 April 2013

WCS# 5A ps8b IW-OU1-01-A Post-Treatment 10 September 2013

WCS# 5A ps8c IW-OU1-01-A Pre-Treatment 4 April 2013

WCS# 5A ps8c IW-OU1-01-A Post-Treatment 10 September 2013

WCS# 6A ps10a EW-OU1-53-A Pre-Treatment 4 April 2013

WCS# 6A ps10a EW-OU1-53-A Post-Treatment 10 September 2013

WCS# 6A ps11a EW-OU1-53-A Pre-Treatment 4 April 2013

WCS# 6A ps11a EW-OU1-53-A Post-Treatment 10 September 2013

WCS# 6A ps11b EW-OU1-53-A Pre-Treatment 4 April 2013

WCS# 6A ps11b EW-OU1-53-A Post-Treatment 10 September 2013

WCS# 6A ps12a EW-OU1-53-A Pre-Treatment 4 April 2013

WCS# 6A ps12a EW-OU1-53-A Post-Treatment 10 September 2013

WCS# 6A ps12b EW-OU1-53-A Pre-Treatment 4 April 2013

WCS# 6A ps12b EW-OU1-53-A Post-Treatment 10 September 2013

WCS# 9A ps22a MW-OU1-46-A Pre-Treatment 4 April 2013

WCS# 9A ps22a MW-OU1-46-A Post-Treatment 10 September 2013

WCS# 9A ps22b MW-OU1-46-A Pre-Treatment 4 April 2013

WCS# 9A ps22b MW-OU1-46-A Post-Treatment 10 September 2013

WCS# 9A ps25a MW-OU1-46-A Pre-Treatment 4 April 2013

WCS# 9A ps25a MW-OU1-46-A Post-Treatment 10 September 2013

WCS# 9A ps49a MW-OU1-46-A Pre-Treatment 4 April 2013

WCS# 9A ps49a MW-OU1-46-A Post-Treatment 10 September 2013

WCS# 9A ps49b MW-OU1-46-A Pre-Treatment 4 April 2013

WCS# 9A ps49b MW-OU1-46-A Post-Treatment 10 September 2013

WCS# 9A ps49c MW-OU1-46-A Pre-Treatment 4 April 2013

WCS# 9A ps49c MW-OU1-46-A Post-Treatment 10 September 2013

WCS# 9B ps22c MW-OU1-84A Pre-Treatment 4 April 2013

WCS# 9B ps22c MW-OU1-84A Post-Treatment 10 September 2013

WCS# 9B ps51a MW-OU1-84A Pre-Treatment 4 April 2013

WCS# 9B ps51a MW-OU1-84A Post-Treatment 10 September 2013

WCS# 9C ps52a IW-OU1-74A Pre-Treatment 4 April 2013

WCS# 9C ps52a IW-OU1-74A Post-Treatment 10 September 2013

WCS# 9D ps24a MW-OU1-51-A Pre-Treatment 4 April 2013

WCS# 9D ps24a MW-OU1-51-A Post-Treatment 10 September 2013

WCS# 9D ps52c MW-OU1-51-A Pre-Treatment 4 April 2013

WCS# 9D ps52c MW-OU1-51-A Post-Treatment 10 September 2013

WCS# 10A ps28a MW-OU1-50-A Pre-Treatment 4 April 2013

WCS# 10A ps28a MW-OU1-50-A Post-Treatment 10 September 2013

WCS# 10A ps29a MW-OU1-50-A Pre-Treatment 4 April 2013

WCS# 10A ps29a MW-OU1-50-A Post-Treatment 10 September 2013

WCS# 10A ps29b MW-OU1-50-A Pre-Treatment 4 April 2013

WCS# 10A ps29b MW-OU1-50-A Post-Treatment 10 September 2013

WCS# 10B ps30a MW-OU1-59-A Pre-Treatment 4 April 2013

WCS# 10B ps30a MW-OU1-59-A Post-Treatment 10 September 2013

WCS# 10B ps30b MW-OU1-59-A Pre-Treatment 4 April 2013

WCS# 10B ps30b MW-OU1-59-A Post-Treatment 10 September 2013

WCS# 14A ps49c MW-OU1-83A Pre-Treatment 4 April 2013

WCS# 14A ps49c MW-OU1-83A Post-Treatment 10 September 2013

WCS# 14A ps50a MW-OU1-83A Pre-Treatment 4 April 2013

WCS# 14A ps50a MW-OU1-83A Post-Treatment 10 September 2013

WCS# 15A ps54a MW-OU1-82A Pre-Treatment 4 April 2013

WCS# 15A ps54a MW-OU1-82A Post-Treatment 10 September 2013

WCS# 15A ps54b MW-OU1-82A Pre-Treatment 4 April 2013

WCS# 15A ps54b MW-OU1-82A Post-Treatment 10 September 2013

WCS# 15A ps55a MW-OU1-82A Pre-Treatment 4 April 2013

WCS# 15A ps55a MW-OU1-82A Post-Treatment 10 September 2013

WCS# 15A ps55b MW-OU1-82A Pre-Treatment 4 April 2013

WCS# 15A ps55b MW-OU1-82A Post-Treatment 10 September 2013

WCS# 16A ps31a SB-OU1-2004K Pre-Treatment 4 April 2013

WCS# 16A ps31a SB-OU1-2004K Post-Treatment 10 September 2013

WCS# 16A ps32a SB-OU1-2004K Pre-Treatment 4 April 2013

WCS# 16A ps32a SB-OU1-2004K Post-Treatment 10 September 2013

WCS# 16A ps32b SB-OU1-2004K Pre-Treatment 4 April 2013

WCS# 16A ps32b SB-OU1-2004K Post-Treatment 10 September 2013

WCS# 16A ps33a SB-OU1-2004K Pre-Treatment 4 April 2013

WCS# 16A ps33a SB-OU1-2004K Post-Treatment 10 September 2013

WCS# 16A ps33b SB-OU1-2004K Pre-Treatment 4 April 2013

WCS# 16A ps33b SB-OU1-2004K Post-Treatment 10 September 2013