January 6, 2009

Fort Ord Base Realignment and Closure Office
ATTN: Gail Youngblood, BEC
Building 4463 Gigling Road
Monterey, CA 93944-5008

Subject: 2008 FONR Impact Assessment and Rare Plant Species Survey Results
Operable Unit 1, Fritzsche Army Airfield Fire Drill Area
Former Fort Ord, California
Contract No. DACA45-03-D-0029, Delivery Order CM01

Dear Ms. Youngblood:

Enclosed are seven hard copies and two CDs of the *2008 FONR Impact Assessment and Rare Plant Species Survey Results, Operable Unit 1, Fritzsche Army Airfield Fire Drill Area, Former Fort Ord, California* dated January 2008. The enclosed document provides the results of the rare plant surveys conducted at Operable Unit 1 (OU-1) and an assessment of the environmental impacts of construction and operation of the OU-1 groundwater remediation system. There were no construction activities within the Fort Ord Natural Reserve (FONR) during 2008. The impact assessment is related to OU-1 construction activities during the 2004 through 2007 period.

We appreciate the opportunity to support the U.S. Army on this project. If you have any questions, please contact me at (916) 614-8770.

Sincerely,

HYDROGEOLOGIC, INC.

/Roy Evans/

Roy Evans, P.E.
Project Manager

/Dennis McCrumb/

Dennis McCrumb, P.G. PMP

Enclosures (7) and two CD's

2008 FONR IMPACT ASSESSMENT AND HABITAT AND RARE PLANT SPECIES SURVEY RESULTS FRITZSCHE ARMY AIRFIELD FIRE DRILL AREA FORMER FORT ORD, CALIFORNIA

Prepared for

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

Contract No. DACA45-03-D-0029
Delivery Order CM01

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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
GAC	granular activated carbon
GIS	geographic information system
GPS	global positioning system
GWETS	groundwater extraction and treatment system
HGL	HydroGeoLogic, Inc.
NWTS	Northwest Treatment System
OU	operable unit
ROD	Record of Decision
RTE	rare, threatened, or endangered
SOC	species of concern
TCE	trichloroethene
UCNRS	University of California Natural Reserve System
UCSC	University of California at Santa Cruz
USACE	U.S. Army Corps of Engineers
USEPA	U.S. Environmental Protection Agency
USFWS	U.S. Fish and Wildlife Service
VOC	volatile organic compound

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2008 FONR IMPACT ASSESSMENT AND RARE PLANT SPECIES SURVEY RESULTS FRITZSCHE ARMY AIRFIELD FIRE DRILL AREA 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 DACA45-03-D-0029, and was administered through the USACE-Sacramento District. The objectives of this effort are the same as those of the Record of Decision (ROD) signed in July of 1995 by the U.S. Army, U.S. Environmental Protection Agency (USEPA), and the California Environmental Protection Agency (U.S. Army, 1995).

The primary remediation objectives specified in the ROD are as follows:

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

Activities undertaken to achieve the OU-1 cleanup must adequately protect and maintain the critical habitat and protected species found within the Fort Ord Natural Reserve (FONR).

Figure 1.1 illustrates the location of Former Fort Ord and the OU-1 source area. Activities conducted at the former Fort Ord Fritzsche Army Airfield Fire Drill Area (FDA) (i.e., OU-1) between 1962 and 1985 resulted in contaminants being released to soils and groundwater. Although 10 volatile organic compounds (VOC) have been identified as contaminants of concern (COC) in groundwater underlying the FDA, trichloroethene (TCE) is the contaminant that is detected at the highest concentrations and across the greatest extent of the affected aquifer. Thus far, data show that the TCE plume "footprint" encompasses that of the other nine COCs. Figure 1.2 shows the estimated extent of the TCE plume in September 2008. The area surrounding the OU-1 contaminant plume is part of the University of California Natural Reserve System (UCNRS) designated as the FONR. The FONR is managed by staff at the University of California Santa Cruz (UCSC).

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 March 30, 1999. The Army consulted again in 2002 and 2007 to address impacts to Monterey spineflower Critical Habitat and the California tiger salamander (*Ambystoma californiense*). 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 within the OU-1 area have been undertaken by others since 1998 (Harding Lawson Associates, 1998) and annual biological surveys were conducted by HGL, using subcontractor CH2M Hill, in 2004 and 2005 (HGL, 2004a Appendix A; CH2M Hill, 2005) and subcontractor Denise Duffy and Associates, Inc (DD&A) in 2006 and 2007 (HGL, 2007a, 2008a). These surveys have focused 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.

This document presents the results of the 2008 rare plant survey and discusses the potential impact to date on those plants associated with the OU-1 remediation activities conducted since 2004. The 2008 rare plant survey was conducted by DD&A under subcontract to HGL. The following are also 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 2008 and planned future activities, and
- Results of the 2008 rare plant survey and interim impact assessment.

These topics are addressed in the following sections.

1.1 SITE DESCRIPTION

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 UCSC and the FONR was established in June 1996. Additional information regarding past land use at this site is presented in the Final Operable Unit 1 Project Management Plan, Fritzsche Army Airfield Fire Drill Area, Former Fort Ord, California (HGL, 2004b).

The former Fort Ord is located near Monterey Bay, which is located 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 found in OU-1 include coast live oak woodland, maritime chaparral, and annual grassland. Maritime chaparral is considered a rare habitat by the California Department of Fish and Game. The 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 (SOC) are also present in the FONR. Other plant SOC include coast wallflower (*Erysimum ammophilum*),

Eastwood's ericameria (*Ericameria fasciculata*), Monterey ceanothus (*Ceanothus cuneatus* var. *rigidus*), Sandmat manzanita (*Arctostaphylos pumila*), and Toro manzanita (*A. montereyensis*). The California black legless lizard (*Anniella pulchra nigra*), California coast horned lizard (*Phrynosoma coronatum*), and the Monterey ornate shrew (*Sorex ornatus salarius*) are animal SOC.

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 winds, which blow the seeds south and into the OU-1 area (Fusari, 2004). Non-native grasses and weedy forbs are already present throughout much of the OU-1 area. Significant expansion of the non-native grasses could result in population declines of federally listed plants.

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 – 2007 surveys, one sand gilia population was observed in 2007 within a small "island" of grassland species within the more extensive oak woodland habitat near the OU-1 plume source area (i.e., the former FDA; see Figure A3.4 in Appendix A). The small open area in which the sand gilia population was observed is bordered by grasses that are surrounded by oak woodland and understory habitat. Several Monterey spineflower populations were also observed thriving within dense patches of non-native grasses in the same vicinity. This region was not surveyed in 2008 because it has been more than three years since construction activities were completed.

1.2 OVERVIEW OF OPERABLE UNIT-1 REMEDIATION ACTIVITIES WITHIN THE FORT ORD NATURAL RESERVE

Numerous wells and soil borings were constructed within the FONR as part of the investigative effort to define the extent of environmental contamination or to remediate that contamination. Table 1.1 lists the wells that have been installed within the OU-1 portion of the FONR. Table 1.2 lists the abandoned wells and the soil borings that were drilled within the FONR portion of OU-1 between 2004 and 2006 and left without constructing a well. Figure 1.3 illustrates the OU-1 well and soil boring locations. No new wells or soil borings were constructed by HGL within the FONR portion since 2006.

1.3 SITE ACTIVITY SUMMARY

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 remedial action for OU-1 groundwater. A groundwater extraction and treatment system (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 of the FDA. Extracted groundwater was transported through pipelines to a treatment unit located at the former FDA and

passed through vessels containing granular activated carbon (GAC). 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 extraction 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 is not captured by the extraction system (AHTNA, 2003).

The HGL remediation contract was awarded in December 2003 and 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 new data from the well installation and aquifer testing were processed; the final design was issued in the three-volume Final Engineering Design Report in 2006 (HGL, 2006a, 2006b, and 2006c). Figure 1.4 illustrates the layout and components of the completed OU-1 groundwater remediation project within the FONR. Construction of the first component of the GWETS expansion, the Hydraulic Control Pilot Project (HGL, 2006d), was initiated and completed in 2006. The remainder of the GWETS expansion (the FONR system) was constructed from July through September 2007. These construction activities were 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 2008, the only activities conducted by HGL within the FONR habitat area were the bi-monthly collection of samples from the eight extraction wells and groundwater treatment system and the quarterly collection of samples from the wells comprising the OU-1 groundwater long-term monitoring network. These activities used only light vehicles (pick-up trucks or sedans) that traveled only on established roadways. A description of the 2008 sampling activities and the 2008 rare plant survey is presented in the following sections.

1.3.1 2008 Rare Plant and Habitat Surveys

Surveys for sand gilia and Monterey spineflower were conducted by DD&A on May 5, 2008. The timing of the survey was intended to correspond with the peak blooming period (late April to early May) and was determined through communications with UCSC natural resource staff and by observing a known occurrence of sand gilia in the vicinity of FONR. A survey was conducted along the five roadways and access routes where construction occurred within the last three years and included 13 well sites. The areas surveyed are shown in Figure 1.5. An overview of the biological survey results is presented in Section 2.0 of this report and a detailed description is included in Appendix A.

1.3.2 2008 Sampling Activities

No drilling or aquifer testing activity was conducted by HGL within OU-1 during 2008. Groundwater samples were collected during 2008 from many of the existing wells within the FONR as part of the OU-1 groundwater long-term monitoring program. As the remediation effort progresses, the number of wells included in the network decreases and the monitoring frequency is reduced at others. Wells are typically sampled quarterly, semiannually, or annually. The quarterly sampling usually occurs in March, June, September, and December of each year. Samples were collected from the northwest treatment system (NWTS) and operating extraction wells at approximately two-month intervals (during the odd-numbered months). Table 1.3 summarizes the 2008 sampling events conducted at each of the OU-1 wells.

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 if 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 will continue for some wells, though at a reduced frequency.

Groundwater levels are measured quarterly at most wells within the OU-1 long-term monitoring network.

1.4 IMPACT PREVENTION AND MITIGATION MEASURES

Activities conducted within the FONR are strictly limited to those that are essential to achieving the remediation goals for the project. The remedial design and construction as well as the ongoing operation of the remedial system have been and will continue to be consistent with the various biological opinions and guidance regarding mitigation measures to reduce and avoid impacts to RTE SOC on the project site. Guidance for the remedial design and action(s) includes the following:

- The March 30, 1999, 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 October 22, 2002, Biological Opinion on the Closure and Reuse of Fort Ord, Monterey County, California, as it affects Monterey spineflower Critical Habitat, (1-8-01-F-70R) (USFWS, 2002)
- The March 14, 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 (1-8-04-F-25R) (USFWS, 2005)
- The June 1, 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 (1-8-04-F-25R) (USFWS, 2007)

- Guidance and direction from UCNRS staff
- Former Fort Ord Habitat Management Plan (U.S. Army, 1997)

To avoid or minimize impact to the FONR during ecologically sensitive periods (i.e., the rainy season, typically ranging between November and April), construction was scheduled at other times insofar as possible within the overall project constraints. The final FONR system construction, for example, began in July 2007 and was completed in September 2007 before the seasonal rains began.

In addition to compliance with the above guidance, HGL subcontracted with UCSC to implement weed control measures at selected locations within the OU-1 portion of the FONR during 2007. This subcontract was renewed in 2008 and the weed control program was continued. UCSC staff began weed control treatments on May 21, 2008, and continued through August 21, 2008. 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 is included as Appendix B. The objectives of the weed control activities are:

- Cut down or remove undesirable vegetation from areas disturbed by OU-1 construction activities 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 during the 2004 through 2006 period.
- 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 1.6 illustrates the locations where weed control measures were performed. Weed control consisted of cutting the weeds using manual methods only during 2008 (Appendix B). During 2007, hand tools (such as powered string trimmers or similar, easily portable equipment) were also used. Herbicides or similar poisons were not used in either year. Disposal of cut weeds was dependent 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.

1.5 FUTURE ACTIVITIES

Currently planned and potential activities for 2009 include the following:

- Continue operating the NWTS and FONR systems.
- Continue to sample groundwater quality at selected existing wells.
- Monitor rare plants and habitat at those locations where construction occurred in 2006.

- Continue weed control treatments through UCSC.

No new wells or other construction within OU-1 at FONR are planned at this time. As the remediation progresses, the number of wells that are included in the sampling program and/or the number of samples collected will be reduced. To date, sampling has been suspended at 45 OU-1 wells. The eight extraction wells and the NWTS facility will be sampled approximately every other month. Of the remaining 47 monitoring wells, 21 wells will be sampled quarterly, 19 wells semiannually, and seven wells annually. Groundwater levels are measured at most wells on a quarterly basis.

Upon attainment and verification of the groundwater cleanup targets established in the ROD, the monitoring wells and treatment facilities will be abandoned. The timetable for this milestone is not yet established.

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2.0 OVERVIEW OF 2008 RARE PLANT SURVEY RESULTS

The objectives of the 2008 rare plant survey and habitat inventory were to accomplish the following:

- Identify locations and estimate rare plant populations for Monterey spineflower and sand gilia at each site where construction for the remediation system (including well installation) took place since 2005.
- Map Monterey spineflower and sand gilia populations for comparison to past surveys and to facilitate planning if future construction or maintenance activities are needed (no such activities are currently planned).

The rare plant survey was conducted along the five roadways and access routes where construction occurred within the last three years and included 15 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.

Surveys for sand gilia and Monterey spineflower were conducted by a DD&A biologist and a DD&A global positioning system (GPS) technician on May 05, 2008. 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 in the vicinity of FONR.

Each of the rare plant surveys was conducted along existing or proposed roadways and access routes. In the absence of rare plants, 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.

Individual counts were made for all sand gilia populations whether they were mapped using points (population less than 10) or polygons (population greater than 10). However, Monterey spineflower were only counted as individuals when groups of less than five were mapped. Monterey spineflower mapped as polygons were characterized according to the percent of cover. The categories ranged from 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 76 percent), and Medium High (76 to 97 percent) to Very High (greater than 97 to 100 percent). GPS data were 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 and A3.2).

2.2 SAND GILIA SURVEY RESULTS

Sand gilia was not observed or mapped in any of the locations within the five survey areas and 15 well sites surveyed for rare plants. Sand gilia was not detected at these survey locations in either the 1998 or the 2004 pre-construction surveys. Consequently, the absence of sand gilia in the 2008 rare plant survey is believed to be due to natural variation in rainfall and climate factors. Sand gilia occurrences are discussed in more detail in Section 3.1 and Sections 4.2 through 4.4.

2.3 MONTEREY SPINEFLOWER SURVEY RESULTS

A total of 52 populations (19 polygons and 33 points) of Monterey spineflower were mapped along the five rare plant survey areas and 15 well sites within the FONR (Table A3.1 and Figures A3.1 through A3.2 in Appendix A). The occurrences of Monterey spineflower in the 2008 and previous post-construction rare plant surveys suggest a possible temporary or long-term beneficial impact of ground disturbance associated with construction activity relative to the Monterey spineflower population. This issue is discussed in more detail in Sections 3.2 and Sections 4.1, 4.3 and 4.4.

A total of 56 individual plants were identified at the 33 mapped GIS points. 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 19 populations of Monterey spineflower that were mapped as polygons, two populations had a Medium cover class (51 to 76 percent cover), five populations had a Medium Low cover class (26 to 50 percent), 11 populations had a Sparse cover class (3 to 25 percent), and one population had a Very Sparse cover class (less than 3 percent). None of the Monterey spineflower populations observed and mapped exceeded the Medium cover class.

Plant density estimates in the polygon areas were typically Very Sparse or Sparse. Approximately 63 percent (12 of the 19 populations) fell into these two categories. Sparse populations out-numbered Very Sparse populations by 11 to 1 (58 percent of the total versus 5 percent).

Monterey spineflower was observed in each of the habitat types at the site and was usually restricted to open sandy areas with sparse vegetative cover. In the live oak woodland and maritime chaparral habitats, this species was often observed along access roads and other disturbed areas such as existing well locations, and in naturally occurring sandy or grassy open areas.

In the annual grassland habitat, Monterey spineflower was most often restricted to relatively open areas around the perimeter of shrubs, small areas of disturbance, and along existing access roads. Common associated species include stork's bill geranium (*Erodium botrys*), sand mat (*Cardionema ramosissimum*), fescue (*Vulpia* sp.), rip-gut brome, and catchfly (*Silene gallica*). Monterey spineflower populations were often observed in areas with sparse to moderately abundant non-native annual grass cover, suggesting that this species may be somewhat more tolerant of annual grass cover than sand gilia.

3.0 IMPACT ASSESSMENT

Data collected during the 2008 rare plant survey were evaluated in conjunction with other observations to identify impacts to the FONR habitat resulting from OU-1 activities. This annual impact assessment represents current conditions only and will be considered along with future data in the overall impact assessment to be conducted upon completion of the OU-1 remedial action.

3.1 SAND GILIA

No sand gilia populations were observed during the 2008 survey versus 12 locations where sand gilia was evident in 2007. The difference is attributed to the combined effect of several potential factors:

- The amount of surveyed locations decreased from 15 sites in 2007 compared to five sites in 2008.
- Spring rainfall totals have declined dramatically over the last three years. According to the National Weather Service Climatological Station for Monterey, the spring (March, April, and May) rainfall total for 2006 was 12.63 inches, while the rainfall total for spring of 2007 was only 2.31 inches. In 2008, the spring rainfall total was only 0.79 inches.
- Sand gilia populations at DD&A reference sites were also relatively low indicating that the conditions during the 2008 sand gilia growing season were not optimal.

Sand gilia previously had been observed (in 2006) at two of the five sites surveyed in 2008 - at Site 6 (at the western extreme of a potential route to well MW-OU1-86-A) and Site 9 (around the well site at MW-OU1-59-A). Sand gilia had also been observed earlier at 2008 Site 4 (in the vicinity of well MW-OU1-51-A in 2005).

The proposed well location for MW-OU1-86-A (within the Site 6 survey area) was relocated more than 140 feet to the east of the sand gilia population observed in 2006 – consequently, no construction or monitoring activities (other than foot traffic during the plant surveys) have been conducted in the sand gilia population area during the 2004 – 2008 period. At Site 4, the sand gilia population in 2005 was observed the year after the roadway and well MW-OU1-51-A were constructed and there have been no other construction activities in that area since 2004. Well MW-OU1-59-A was also constructed in 2004 and there has been only light vehicle traffic (for quarterly groundwater monitoring) since then.

In summary, sand gilia has been previously detected during the post-construction period at Sites 4 and 9 and the potential well location/access road at Site 6 was re-routed to avoid the rare plant populations observed in the pre-construction survey. Consequently, the absence of sand gilia in the 2008 rare plant survey is believed to be due to natural variation in rainfall and climate factors.

3.2 MONTEREY SPINEFLOWER

Overlap between the OU-1 construction zones and populations of Monterey spineflower observed in the 2008 and previous surveys were limited, as described below:

- IW-OU1-74-A was constructed to the west of small, very sparse populations that were observed in 2005 and 2006 (absent in 2004). The 1998 survey also showed the presence of Monterey spineflower in this area. The 2007 survey showed that the boundary of the very sparse population area had expanded to include the well site. The pipeline constructed to that well passed adjacent to or along the edge of the population. In 2008, Monterey spineflower was again observed in approximately the same area but the population density improved to sparse.
- An access road leads from the main northwest–southeast roadway bordering the FONR habitat (segment 3 in Figure 1.5) to the closely spaced wells MW-OU1-46-A (constructed in 2001), MW-OU1-46-AD (constructed in 2004), and PZ-OU1-46-AD2 (constructed in 2005). Monterey spineflower populations (very sparse) were observed in the central segment of this road (Site 4 on Figure 1.5) in 2004 and 2006. The 2006 survey showed the boundary of the very sparse population extended along the full distance from the junction with the northwest–southeast road. The 2007 survey showed a very sparse Monterey spineflower population along a much smaller segment of this roadway to the east of the MW-OU1-46-AD well cluster and a slightly larger population to the west. The pipelines to extraction well MW-OU1-46-AD and injection wells IW-OU1-73-A and IW-OU1-74-A were constructed down the approximate center of this road to minimize impact to the spineflower population. In 2008, Monterey spineflower showed dramatically increased numbers as populations and/or individual plants were observed along approximately one-half of the roadway between the eastern grasslands and well site IW-OU1-74-A (Figure A3.2). In addition, the observed population densities increased to sparse (populations #34, #35, #38 and #39 on Figure A3.2 in Appendix A) and medium-low (populations #36 and #37 on Figure A3.2 in Appendix A). Finally, 20 individual plant clusters ranging from one to three plants each were observed in the same segment (Site 4).
- Two small, populations (one very sparse and one sparse) were observed in the 2007 survey in the vicinity of monitoring well MW-OU1-83-A (constructed in 2006). One population was nearby to the northwest and the other population was more distant to the southeast. The 2004 and 2005 surveys also showed a similar presence of the southeast population. The northeast population observed in 2007 was not found in the previous surveys although two other populations of very limited extent were noted in the general vicinity in the 2004 survey. These populations were also present in 2008 and the population density for the very sparse population increased to sparse. No disturbance was made to this area in 2007 – 2008 other than light vehicle (pick-up truck or sport utility vehicle) or foot traffic as part of groundwater sample collection.
- A small, medium density population was observed along the north access road to well site EW-OU1-71-A (constructed in 2006; Figure A3.2 in Appendix A) during the 2007 survey. Monterey spineflower had not been observed at this location in previous surveys. In 2008 the location of this population (#42) shifted to the southwest and encompassed the well site although the density decreased by one category to sparse.

- The extraction well pipeline along the northwest–southeast roadway passed through the edge of, or adjacent to, seven Monterey spineflower populations located along this roadway in the segment between the NWTS facility and the intersection with the access road to MW-OU1-46-AD. These populations were identified as very sparse, sparse, or limited to a single plant and confined to narrow bands along the edge of the roadway (Figures A3.1 through A3.4 in Appendix A). These populations are observed at the edge of the grassland habitat and the UCSC FONR natural resource management staff indicated that these populations are of marginal value to the overall FONR population (HGL, 2006b). This segment was not surveyed in 2008 because of the proximity to the eastern grassland and the marginal value of the habitat.

Maximum plant population densities increased significantly in 2008 in comparison to 2007, despite a decrease of approximately 65 percent in total spring rainfall. Even though a smaller area was surveyed and there were overall slightly fewer populations, the number of medium cover populations increased from one to two and the number of medium low populations from one to five.

Relatively abundant Monterey spineflower populations do not seem as equally affected by the same constraints as sand gilia. Previous rare plant surveys conducted by DD&A also indicate that populations of Monterey spineflower were often observed in areas with sparse to moderately abundant non-native annual grass cover, suggesting that this species may be somewhat more tolerant of annual grass cover than sand gilia.

In summary, the potential conflicts with rare plants in the FONR System project area are minimal—less than 600 feet out of a total pipeline distance of approximately 3,300 feet. Approximately 0.5-foot of that 600-foot total represents marginal value populations located at the edge of roadways adjacent to the grassland habitat that borders the FONR to the east and north.

3.3 EROSION

HGL staff conducted visual reconnaissance surveys to detect erosion resulting from construction activity along the roadways used to access the construction areas and the monitoring well network. These erosion surveys are conducted routinely during the quarterly groundwater monitoring events and on occasion during routine system maintenance. Significant erosion was not observed on the FONR roadways during 2008.

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4.0 CONCLUSIONS

Construction efforts were undertaken by HGL during the 2004 through 2007 time period to remediate contaminated groundwater within the OU-1 portion of the FONR. Construction included:

- Drilling soil borings;
- Constructing extraction, injection, and monitoring wells;
- Installing water conveyance pipelines;
- Installing infiltration trenches; and
- Constructing a groundwater treatment facility.

Figure 4.1 illustrates the areas in which construction occurred during 2004 through 2007. No additional construction efforts within the FONR are anticipated at this time.

A critical concern throughout the project has been the protection of the rare plant species within the FONR. To that end, direct impacts (i.e., construction activity within the footprint of known populations of Monterey spineflower or sand gilia) have been minimized through the use of pre-construction surveys to delineate population locations. The results of the surveys were used to adjust the location of remediation facilities to avoid previously identified locations wherever possible. As discussed below, this strategy enabled the construction activity to avoid direct impact except in a handful of cases described below.

UCSC staff responsible for the management of the FONR indicated significant concern regarding indirect impacts to the rare plant species through alteration of the habitat associated with the construction activity. Clearing existing, native vegetation to enable equipment access for well or pipeline construction may have provided 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 out-compete 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 2008 (through subcontractors) and conducted habitat surveys in 2006 and 2007. In addition, HGL has contributed funding to support weed control efforts by UCSC in 2007 and 2008.

To date, the above efforts and the proactive construction management techniques employed throughout the construction effort to mitigate impacts appear to have been successful in minimizing the impact to rare plant populations. Table 4.1 summarizes the rare plant populations observed at the well sites for those wells constructed during 2004 and thereafter. The data from Table 4.1 are discussed in detail below.

4.1 OPERABLE UNIT 1 GROUNDWATER EXTRACTION AND TREATMENT SUMMARY EXPANSION IMPACTS ON MONTEREY SPINEFLOWER

Forty-six new OU-1 wells were constructed within the FONR between 2004 and 2006. Previously existing Monterey spineflower populations were identified at only 12 of these locations. At eight of these 12 locations, however, the wells were constructed along the

roadways bordering the adjacent grasslands to the north and east, and the habitat/rare plant populations are considered of marginal value (HGL, 2006b). HGL discussed the proposed well locations with UCSC management staff before well construction began to confirm that the potential disruption of these plant populations was an acceptable approach and would not present a significant impact. These eight well locations were:

EW-OU1-49-A	PZ-OU1-49-A1	MW-OU1-56-A	MW-OU1-57-A
EW-OU1-60-A	MW-OU1-61-A	MW-OU1-65-A	EW-OU1-66-A

As shown in Table 4.1, these wells were not surveyed in 2008. Monterey spineflower was not detected at these locations in the 2005, 2006, or 2007 surveys. Monterey spineflower also was not detected at these locations in the pre-construction survey of 2004. Consequently, it is not possible to conclude that the absence of these marginal populations since their detection in 1998 is the result of the construction activity. Natural variables, including precipitation factors, may be responsible for the lack of detected populations in recent years. In either case, these populations are of marginal value given that they are present within the edge of the grassland habitat.

The remaining four wells with a construction footprint that overlapped the population boundary were as follows:

- MW-OU1-46-AD and PZ-OU1-46-AD2. These wells were located within the boundary of a narrow, north-south oriented Monterey spineflower population identified in 1998 (Figure 4.2). Monterey spineflower was not observed at the well site in the 2005 – 2007 surveys. The plant population also was not observed at this location during the 2004 pre-construction survey. The 2006 survey did show the presence of a very sparse Monterey spineflower population (#70 in the 2006 survey) that extended approximately 200 feet along the access road to these wells and terminated approximately 20 feet to the east of the well sites. Given the scale of the maps available, it is possible that one or both of the wells are located outside the plant population boundary observed in 1998. In 2008, however, this population boundary (#34 in this 2008 survey; Figure A3.1 in Appendix A) shifted to the west and overlapped the MW-OU1-46-AD well site and a single plant was observed at PZ-OU1-46-AD2. In addition, the population density in 2008 improved to sparse. These occurrences, in both wet (2006) and dry (2008) spring rainfall patterns, support the assertion that there have not been any significant negative impacts to the rare plant population at this location.
- EW-OU1-53-A and IW-OU1-01-A. Neither of these wells were surveyed in 2008 because they were constructed in 2004 and 2007 was the end of the three-year survey window. In both cases, the results of the rare plant surveys from 2004 – 2007 were the same. Monterey spineflower was detected in 1998 but not in 2004. Although absent in 2005, Monterey spineflower was present in both locations in the 2006 and 2007 rare plant surveys. The data suggest that the well construction activity did not significantly impact the rare plant population.

At five well locations, Monterey spineflower was identified in one or more post-construction surveys between 2005 and 2007, although that species was not detected in either the 1998 or

2004 surveys. These wells were EW-OU1-54-A, IW-OU1-05-A, IW-OU1-24-A, MW-OU1-59-A, and IW-OU1-74-A. Only the latter well was included in the 2008 survey area and Monterey spineflower was again present. In addition, the population density improved to sparse as compared to the very sparse classification in 2007. These occurrences suggest a possible temporary or long-term beneficial impact of ground disturbance associated with construction activity relative to the Monterey spineflower population.

4.2 OPERABLE UNIT 1 GROUNDWATER EXTRACTION AND TREATMENT EXPANSION IMPACTS ON SAND GILIA

Sand gilia was not detected at any of the well sites shown in Table 4.1 during the 1998 or 2004 rare plant surveys. In the absence of any previously known populations, it is concluded that the construction activity did not adversely affect the sand gilia population. Further support for this conclusion is found in the 2006 survey results at well MW-OU1-59-A, constructed in 2004. Although absent in previous surveys, the 2006 survey team encountered a population of 13 sand gilia plants surrounding the well site. The decrease in spring rainfall in 2007 (less than 25 percent of that which occurred in 2006) may have negatively impacted sand gilia in 2007. This area was not surveyed in 2008 because three years have passed since the well was constructed.

4.3 PREVIOUS OPERABLE UNIT 1 CONSTRUCTION VERSUS RARE PLANT OCCURRENCES

Twenty OU-1 wells (counting MW-OU1-24-A and replacement well MW-OU1-24-AR as one well) were installed by previous investigators between 1985 and 1997, and one well was installed along the northwest boundary of the FONR in 1976. As these wells pre-date the earliest available survey results in 1998, it is unknown whether rare plants were present before the wells were constructed. These 21 wells have each been included in at least one of the rare plant surveys from 1998 through 2007. As shown in Table 4.2, Monterey spineflower has been detected in 15 of these 21 wells in one or more of those surveys. Except for MW-OU1-46-A, the wells shown in Table 4.2 are located outside the areas included in the 2008 rare plant survey. Monterey spineflower was observed at the MW-OU1-46-A well site as part of the sparse population stretching along much of the access road to the well site (population #34 as discussed previously in Section 4.1). The following paragraphs summarize the results of previous surveys.

If wells MW-B-10-A, MW-OU1-07-A, and MW-OU1-12-A are discounted as not representative, then Monterey spineflower has been detected at 15 of 18 well sites at least once since construction was completed. These wells can be deemed unrepresentative because well MW-B-10-A is located in the grassland at the northern edge of the FONR, and wells MW-OU1-07-A and MW-OU1-12-A are located within the footprint of the former FDA and subject to far more disturbance than simple well construction. Even with the most conservative possible assumption that Monterey spineflower was present at all 18 sites before construction, this high percentage (83 percent) of post-construction occurrences suggests that well construction does not significantly affect the population's sustainability.

An additional 17 wells were constructed between 1998 and 2001. Monterey spineflower was present at nine of these sites in the 1998 rare plant survey. This suggests that the assumption in the preceding paragraph that this species was present at all 18 sites is too high and therefore the 83 percent figure calculated for the recurrence of Monterey spineflower may be low. At six of

the nine sites, Monterey spineflower was present in one or more of the surveys conducted between 2004 and 2007. Of the remaining three sites, MW-OU1-44-A was not surveyed after 1998 and is thus not useful for this assessment. The other two were sampled only once (MW-OU1-25-A in 2004) or twice (MW-OU1-40-A in 2004 and 2005). Thus, Monterey spineflower was detected at least once in six of the eight sites (75 percent) even with limited post-construction surveys. In addition, Monterey spineflower was detected in the 2006 and 2007 surveys at MW-OU1-30-A even though it was absent in both the 1998 and 2004 surveys.

For sand gilia, the results are similar (Table 4.2) to those described above. Of the 21 wells installed before the initial 1998 plant survey, sand gilia was detected at nine locations in one or more of the rare plant surveys. During the 2004 rare plant survey, which covered a larger area than the more focused surveys that followed, sand gilia was observed at 90 locations in comparison to 209 locations for Monterey spineflower. This equals a 43 percent sand gilia to spineflower ratio. The 2005 survey covered somewhat less area overall but included areas in the northwest part of the OU-1 plume that were not included in the 2004 effort. Nonetheless, the results were quite similar to the 2004 survey—102 occurrences of sand gilia in comparison to 215 instances of Monterey spineflower (47 percent ratio). For the 18 relevant well sites installed before 1998, the nine subsequent sand gilia occurrences compare to 15 subsequent Monterey spineflower occurrences (a ratio of 66 percent). Thus the presence of sand gilia at nine of the 18 relevant locations for the pre-1998 wells is quite reasonable and does not show any adverse impact related to well construction.

Sand gilia was present at five of the 17 additional well sites constructed after 1998. Wells MW-OU1-36-A and MW-OU1-37-A are located within the footprint of the former FDA and MW-OU1-45-A is located at the edge of the grassland on the northern edge of the FONR. Excluding these non-representative sites, sand gilia was detected in the 1998 survey at five of the 14 well locations; this frequency of occurrence is similar to that observed for the group of wells constructed before 1998 (nine detections at 18 locations). The ratio of sand gilia detections to Monterey spineflower detections for these 14 well locations is also similar to that for the pre-1998 group—5:9 (56 percent) in comparison to 9:15 (66 percent). In two of these five locations, sand gilia was subsequently detected in at least one of the 2004 – 2007 surveys. One location (MW-OU1-44-A) was not included in any subsequent survey. Sand gilia was not detected in subsequent surveys at the other two wells (the 2004 survey at MW-OU1-38-A and the 2004, 2006 and 2007 surveys at PZ-OU1-14-A).

4.4 SUMMARY

Data from the annual post-construction rare plant surveys for the expansion of the OU-1 groundwater remediation system was compared with the 1998 and 2004 pre-construction rare plant survey data to assess construction impacts on the FONR rare plant populations (Monterey spineflower and sand gilia). The results of that comparison indicate that the construction activity has not had significant adverse effects on those populations. The supporting observations for this conclusion were described in the preceding paragraphs and are summarized below:

- Neither Monterey spineflower nor sand gilia was detected in the 2004 pre-construction rare plant survey at any of the locations where wells were subsequently constructed. The

absence of these plants before construction began is taken as one indication of the lack of construction impact.

- During planning discussions before well construction began, the UCSC FONR management staff characterized the 1998 rare plant survey as representing a "great year" for Monterey spineflower and sand gilia (UCSC, 2006). Nonetheless, sand gilia was not detected in 1998 at any of the well sites where construction occurred during the 2004 – 2007 period. Monterey spineflower was detected in 1998 at only 12 of the 46 locations where wells were subsequently constructed between 2004 and 2007:
  - At eight of these 12 locations, the well sites were located at the edge of the grassland in areas already impacted by invasive species and outside the critical FONR habitat; potential construction impacts to these areas are not considered significant.
  - Two wells (MW-OU1-46-AD and PZ-OU1-46-AD2) were located within approximately 25 feet of one another and possibly overlapped with a Monterey spineflower population. Although that plant was not detected in subsequent surveys at the well sites in 2005 through 2007, the 2008 survey showed that a sparse Monterey spineflower population (#34; see Section 4.1) overlapped the MW-OU1-46-AD well site and a single plant was observed at PZ-OU1-46-AD2. While not conclusive, this occurrence combined with the uncertainty regarding the boundary of the plant population in 1998 relative to the well locations suggests there have not been any long-term negative impacts to the rare plant population.
  - At the other two well sites (EW-OU1-53-A and IW-OU1-01-A); Monterey spineflower was detected in both the 2005 and 2006 surveys.
- The wells and access roads constructed as part of the expansion of the OU-1 groundwater remediation were constructed between 2004 and 2006. At five of the 2004 – 2006 well locations, Monterey spineflower was identified in one or more post-construction surveys between 2005 and 2007 although that species was not detected in either the 1998 or 2004 pre-construction surveys. These wells are EW-OU1-54-A, IW-OU1-05-A, IW-OU1-24-A, MW-OU1-59-A and IW-OU1-74-A (Table 4.1). Only well IW-OU1-74-A is located within the 2008 survey area and Monterey spineflower was detected with an increased population density relative to 2007 (Section 4.1). These occurrences suggest a possible temporary and/or long-term beneficial impact from ground disturbance associated with construction activity relative to the rare plant population.
- For 15 of the 18 wells constructed before 1998 in relevant FONR locations, Monterey spineflower was detected in one or more subsequent rare plant surveys. This represents a minimum recurrence rate of 83 percent under the most conservative possible assumption that this species was present at all 18 sites before construction began. Similarly, sand gilia was detected at nine of the 18 wells sites detected in one or more subsequent rare plant surveys. The frequency of occurrence for sand gilia relative to Monterey spineflower in subsequent surveys suggests that well construction activities resulted in no adverse impact to the sand gilia population.
- For those wells constructed between 1998 and 2001, Monterey spineflower was detected in 1998 at eight sites included in subsequent surveys and recurred at least once in six of those sites during the 2004 – 2007 surveys. In addition, this species was detected in 2006 and 2007 at well MW-OU1-30-A although it was not identified in 1998. Only one of

these wells was located within the 2008 survey area and Monterey spineflower was detected (MW-OU1-46-A, Table 4.2) for the first time subsequent to 1998.

- Sand gilia in this group of wells was observed at four locations included in subsequent surveys and recurred at two locations in previous surveys.

Weed control efforts were initiated through the UCSC in 2007 and continued in 2008 as a preventive measure (Section 1.4 and Appendix B). Visual observations of the extent of the weed populations were made by UCSC field staff in regard to the effectiveness of the weed control program during 2008. These observations indicated that the weed control program reduced the number of invasive plants and, importantly, removed a large portion of the invasive weed seed source for 2009 (Appendix B). This positive preliminary assessment of the effectiveness of the weed control program will be re-examined in 2009 in light of the weed population data collected during implementation of the 2009 weed control program.

5.0 RECOMMENDATIONS

Five years of annual rare plant monitoring have shown that the 2004 – 2007 construction activities associated with the expansion of the OU-1 groundwater remediation program have not significantly impacted rare plant populations within the FONR. The status of the OU-1 rare plant survey program and recommendations concerning 2009 rare plant monitoring are presented in this section.

As shown in Figure 4.1, there has been no construction activity over the last three years in the southern part of OU-1 within the FONR. Consequently, the HGL rare plant sampling program was suspended in this region in 2007. Selected areas in the northern half of the FONR were suspended for the same reason.

As noted previously, the well sites and roadways that border the adjacent grasslands to the north and east of the FONR represent marginal habitat for Monterey spineflower and sand gilia. Although isolated patches of the Monterey spineflower are sometimes encountered in this area (sand gilia has not been detected), the predominant pre-construction population is non-native invasive grasses. Consequently, the potential impact due to the construction activities is not significant and the HGL rare plant sampling program will remain suspended in this region.

At three well locations in the northern portion of the FONR, rare plants were not detected in any of the surveys conducted before construction began. These wells are:

- PZ-OU1-10-A1 – Area surveyed in 1998 and 2004; well constructed in 2005,
- MW-OU1-87-A – Area surveyed in 1998, 2004, 2005 and 2006; well constructed after the rare plant survey in 2006, and
- MW-OU1-88-A – Area surveyed in 1998, 2004, and 2006; well constructed after the rare plant survey in 2006.

Given the absence of rare plants before well construction in the above cases, these well sites will be omitted from the HGL 2009 rare plant survey program.

The HGL rare plant monitoring program for 2009 will include the following areas:

- Rare Plant Survey Site 3 (Figure 1.5), including well sites MW-OU1-86-A and EW-OU1-71-A;
- Rare Plant Survey Site 4 (Figure 1.5), including well sites MW-OU1-46-AD, PZ-OU1-46-AD1, MW-OU1-51-A, IW-OU1-73-A, IW-OU1-74-A, and MW-OU1-84-A;
- Rare Plant Survey Site 7 (Figure 1.5), including well sites MW-OU1-85-A and EW-OU1-72-A;
- Rare Plant Survey Site 8A (Figure 1.5), including well site MW-OU1-83-A; and
- Rare Plant Survey Site 9 (Figure 1.5), including well sites MW-OU1-50-A and MW-OU1-82-A.

The weed control program will also be continued in 2009. The areas in which weed control will be implemented and the methodology used will be the same as in 2008 (Figure 1.6). In addition, the following actions will be taken to minimize impacts:

- Minimize roadway traffic during quarterly groundwater sampling activities to the extent practical.
- If approved by regulatory stakeholders, reduce the sampling frequency from the groundwater monitoring well network to minimize road traffic wherever such reductions can be made consistent with remediation and performance monitoring objectives for the OU-1 cleanup.

The results of the recommended 2009 rare plant and habitat inventory surveys will be described in the 2009 Annual FONR Impact and Habitat and Rare Plant Survey Results.

6.0 REFERENCES

AHTNA Government Services Corporation, 2003. Draft Enhanced Reductive Dechlorination Pilot Study Report Operable Unit 1 Groundwater Remedy Former Fort Ord, Monterey County, California. Prepared for U.S. Department of the Army Sacramento District Corps of Engineers dated December 9, 2003.

CH2M Hill, 2005. 2005 Monterey spineflower and Sand Gilia Survey Results Fort Ord Operable Unit 1, Former Fort Ord, California. Prepared for HydroGeoLogic, Inc. December, 2005.

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

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.

HydroGeoLogic, Inc., 2004a. Draft Remedial System Modification Plan, Operable Unit 1, Fritzsche Army Airfield Fire Drill Area, Former Fort Ord, California. July 2004.

HydroGeoLogic, Inc. 2004b. Final Operable Unit 1 Project Management Plan, Fritzsche Army Airfield Fire Drill Area, Former Fort Ord, California. Prepared for the U.S. Army Corps of Engineers. February, 2004.

HydroGeoLogic, Inc., 2006a. Final 100% Engineering Design Report, Volume 1, Geology and Conceptual Site Model, Operable Unit 1, Fritzsche Army Airfield Fire Drill Area, Former Fort Ord, California. September 2006.

HydroGeoLogic, Inc., 2006b. Final 100% Engineering Design Report, Volume 2 of 3, Groundwater Modeling and Design Analysis, Operable Unit 1, Fritzsche Army Airfield Fire Drill Area, Former Fort Ord, California. July 2006.

HydroGeoLogic, Inc., 2006c. Final 100% Engineering Design Report, Volume 3 of 3, Engineering Calculations, Operable Unit 1, Fritzsche Army Airfield Fire Drill Area, Former Fort Ord, California. October, 2006.

HydroGeoLogic, Inc. 2006d. Final Work Plan Hydraulic Control Pilot Project Operable Unit 1, Fritzsche Army Airfield Fire Drill Area, Former Fort Ord, California. April 2006.

HydroGeoLogic, Inc., 2007a. Final 2006 FONR Impact Assessment and Habitat and Rare Plant Survey Results, Fritzsche Army Airfield Fire Drill Area, Former Fort Ord, California. September 2006.

HydroGeoLogic, Inc., 2007b. Final Hydraulic Control Pilot Project Construction Report, Operable Unit 1, Fritzsche Army Airfield Fire Drill Area, Former Fort Ord, California. January 2007.

HydroGeoLogic, Inc., 2007c. Draft Rebound Evaluation Report Operable Unit 1, Fritzsche Army Airfield Fire Drill Area, Former Fort Ord, California. November 2007.

HydroGeoLogic, Inc., 2008a. 2007 FONR Impact Assessment and Habitat and Rare Plant Survey Results, Fritzsche Army Airfield Fire Drill Area, Former Fort Ord, California. February 2008.

HydroGeoLogic, Inc., 2008b. Draft FONR System Construction Report, Operable Unit 1, Fritzsche Army Airfield Fire Drill Area, Former Fort Ord, California. January 2008.

University of California Santa Cruz, 2006. Meeting with Dr. Margaret Fusari (UCSC), Sean McStay (UCSC), Gary Santolo (CH2MHill), Amy Hiss (CH2MHill), Michael Bombard (HGL) and Roy Evans (HGL) at University of California Santa Cruz campus. 10 January, 2006.

U.S. Army, 1995. Record of Decision, Operable Unit I, Fritzsche Army Airfield Fire Drill Area. Fort Ord, California. July 25, 1995.

U.S. Army, 1997. Installation-Wide Multispecies Habitat Management Plan for Former Fort Ord, California. April 1997.

U.S. Fish and Wildlife Service, 1999. Biological and Conference Opinion on the Closure and Reuse of Fort Ord, Monterey County, California (1-8-99-F/C-39R). March 30, 1999

U.S. Fish and Wildlife Service, 2002. Biological Opinion on the Closure and Reuse of Fort Ord, Monterey County, California, as it affects Monterey spineflower Critical Habitat, (1-8-01-F-70R). October 22, 2002

U.S. Fish and Wildlife Service, 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 (1-8-04-F-25R). March 14, 2005

U.S. Fish and Wildlife Service, 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 (1-8-04-F-25R). June 6, 2007